CITY OF NEWPORT BEACH
SNUG HARBOR

WATER SUPPLY EVALUATION

CITY OF NEWPORT BEACH
ORANGE COUNTY, CALIFORNIA

PREPARED FOR:

Back Bay Barrels, LLC
3857 Birch Street, Suite #521
Newport Beach, CA 92660

PREPARED BY:

FUSCOE ENGINEERING, INC.
15535 Sand Canyon Ave, Unit 100
Irvine, CA 92618
949.474.1960
www.fuscoe.com

DATE PREPARED: DECEMBER 24, 2024

DATE 1ST REVISION: FEBRUARY 26, 2025

DATE 2ND REVISION: APRIL 7, 2025

TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

1. Overview

1.1. BACKGROUND & SCOPE OF WORK

This Water Supply Evaluation (WSE) has been prepared for Back Bay Barrels, LLC by Fuscoe Engineering, Inc. in connection with the proposed Snug Harbor project ("Project"). The Project site is located in Newport Beach and involves redeveloping a portion of an existing golf course and commercial facilities into a wave pool/surf lagoon and associated clubhouse/amenities. This change in land use may increase water demand on the site beyond current levels, and this WSE assesses potential impacts of Project development on the City's water supply. As the water provider for the proposed development site, the City of Newport Beach serves as the lead agency in reviewing and approving the Project's water demands.

Thus, the purpose of this WSE is to analyze the sufficiency of Newport Beach's existing and planned water supplies to meet the projected demands of the Snug Harbor Project. This analysis considers regional and project specific water demand and supply projections under normal, single dry, and multiple dry year conditions, which is consistent with the requirements of the California Environmental Quality Act (CEQA). Findings from this WSE will support the Environmental Impact Report (EIR) for the Project and provide a clear evaluation of how the proposed changes in land use will interact with regional and City water resources.

1.2. SUMMARY OF FINDINGS

As discussed, in the sections below, the City of Newport Beach in collaboration with regional agencies and water purveyors, manages water supplies within the project area and surrounding areas. Provided below is a summary of the projects existing and projected water demands, available supplies, and supply reliability under various drought conditions.

1.2.1. WATER DEMAND

The projected water demand for the Snug Harbor project was estimated using water management data from Wavegarden Cove for the surf lagoon and regional usage factors from the Irvine Ranch Water District's 2019 Water Resources Master Plan (WRMP). The total demand is expected to be approximately 85-acre feet per year (AFY), This demand includes water needs for the surf lagoon, which must use potable water to meet public health standards, ensuring safety for public contact, as well as water needs for associated commercial facilities.

The site's current potable water demand is approximately 1.56 AFY, based on average domestic meter usage from July 2022 to June 2024. The new project is expected to fully replace this existing demand, resulting in a net increase in potable water use of about 87 AFY.

Prior water studies, EIR evaluations, and the City of Newport Beach's 2020 Urban Water Management Plan (UWMP), see Appendix C did not fully account for this new demand, so including the project's demand in the City's upcoming 2025 UWMP update is recommended. Inclusion of the project within the City's upcoming UWMP will ensure that future demand forecasting and water supply planning and reliability assessments are accurate. Additionally, to support sustainable water use, the Snug Harbor project will incorporate water efficient fixtures and implement conservation practices aligned with the City and region's local sustainability goals. This proactive approach will help manage the increased demands associated with the development and contribute to the City's overall water conservation efforts.

1.2.2. WATER SUPPLY

As discussed in Section 5 of this WSE, the City of Newport Beach's water supply is sourced from a combination of local groundwater, imported water, and recycled water. The City purchases imported water through the Municipal Water District of Orange County (MWDOC), which receives its water from the Metropolitan Water District of Southern California (MET). MET sources water from both the Colorado River and the State Water Project (SWP), utilizing extensive infrastructure and storage to ensure reliability across member agencies. Newport Beach relies primarily on groundwater from the Orange County Groundwater Basin, which is managed by the Orange County Water District (OCWD). This basin benefits from replenishment efforts through OCWD's Groundwater Replenishment System (GWRS), which utilizes treated wastewater to support groundwater sustainability. Recycled water, which is a small percentage of the City's overall water supply, is also treated and distributed through OCWD, with applications primarily for non-potable uses like landscape irrigation.

In 2020, the City's water supply portfolio was comprised of approximately 68% groundwater, 28.5% imported water, and 3.5% recycled water. Projections indicate that by 2045, groundwater use will increase to about 82%, with imported water reduced to 14.5%, while recycled water use remains consistent at 3.5% . This diversified supply supports local and regional planning efforts throughout Newport Beach and can meet both current and anticipated future demands, including the proposed Snug Harbor project.

1.2.3. WATER SUPPLY RELIABILITY

As discussed in the City's UWMP and this WSE, Newport Beach has sufficient supply to meet anticipated projected demands from 2020 through 2045 under the normal, single dry-year and multiple dry-year conditions, including the proposed Snug Harbor project. In the event of significant supply shortfalls, the City's Water Shortage Contingency Plan (WSCP) provides a structured response. The WSCP outlines six stages of action, each progressively enforcing conservation and reduction measures based on the severity of the shortage. For instance, Stage 1 encourages voluntary conservation, while Stage 6 mandates emergency measures to address supply reductions exceeding 50%.

2. LEGAL REQUIREMENTS AND DETERMINATIONS

2.1. SB 610, WATER DEMAND THRESHOLD

Among other things, in 2002 California's SB 610 amended the California Water Code to require preparation of a "water supply assessment" (WSA) for proposed development projects meeting one or more specified water demand thresholds. The Water Code's provisions regarding preparation of WSAs have subsequently been amended several times to, among other things, revise the thresholds for WSA preparation and expand WSA analysis requirements related to the use of groundwater to meet project demands.

Pursuant to SB 610, a water supply assessment is required for any project subject to CEQA that is one or more of the following:

1) A proposed residential development of more than 500-dwelling units.
2) A proposed shopping center or business establishment employing over 1,000 persons or having over 500,000 square feet of floor space.
3) A proposed commercial office building employing over 1,000 persons or over 250,000 square feet of floor space.
4) A proposed hotel or motel, or both, having more than 500 rooms.

5) A proposed industrial, manufacturing, or processing plant, or industrial park planned to house over 1,000 persons, occupying over 40 acres of land or over 650,000 square feet of floor area.
6) A mixed-use project that includes one or more of the projects specified in this subdivision.
7) A project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500-dwelling unit project.

(Water Code § 10912(a).) The Project does not require preparation of a WSA under thresholds (1) through (6) above. As described below, the Project also does not meet WSA preparation threshold (7) because it would not demand an amount of water equivalent to or greater than the amount required by a 500-dwelling unit project.

Table 1 –500 Unit Residential Demand - City of Newport Beach, Water Department Calendar Year 2024 Avg. Water Use

Average Residential Water Demand (AFY/PP)[1]	Average Persons Per Residential Unit (PP/DU)[2]	Water Use Factor (AFY/DU)	Water Demand – 500 DUs (AFY)	Proposed Snug Harbor Water Demands (AFY)
0.11	2.13	0.24	120.49	88.54

Sources
1. AFY/PP = Acre-feet Per Person. City of Newport Beach, "Email to Fuscoe Engineering." 11/2024. Calendar Year 2024 Avg. Water Use (101 Gallons Per Day Per Person)
2. PP/DU = Persons Per Dwelling Unit. State of California Department of Finance. 05/2024. E-5 Population and Housing Estimates for Cities, Counties, and the State, 2020-2024

To determine whether the project's demand would be equivalent to or exceed the demand for a 500 dwelling unit development, the Project's demand was compared to the demand of a 500-unit residential project with per-unit demand equal to average residential unit demand in Newport Beach. The table above summarizes expected demand for a 500-unit residential project using 2024 average water use data for residential demand, which includes both single-family and multi-family residential units. This data provided a basis for estimating the threshold demand for a 500-dwelling unit residential project within Newport Beach. The results indicate that the proposed Snug Harbor project's demand, at approximately 88.54 AFY, falls below the threshold of 120.49 AFY for a 500-unit residential project, meaning a WSA is not required for the Project.

To validate the findings, a separate letter was submitted to the City of Newport Beach to confirm the proposed project does not trigger a WSA. Additional residential water usage analysis was provided in the letter for the City to confirm the project does not trigger WSA preparation under SB 610. The City provided a concurrence letter stating the project does not trigger a WSA. Although a WSA is not required, this WSE was prepared to ensure the City's water supplies are adequate to serve the Project.

3. Project Description

3.1. EXISTING LAND USE

The proposed Snug Harbor project is located in the City of Newport Beach at the intersection of Irvine Avenue and Bristol Street. The project site is currently the Newport Beach Golf Course, which includes three holes of the 18-hole course, a driving range, a pro shop, a clubhouse, a restaurant, and a parking lot. The site spans approximately 15.4 acres and is bounded by the Santa Ana Delhi Channel to the north, Irvine Avenue to the northeast, existing commercial property to the southeast, and Mesa Drive to the southwest. Surrounding land uses include commercial properties, office buildings, businesses, and a fire station.

3.2. PROPOSED LAND USE

The development will transform the existing golf course into a facility that includes a 13-foot-deep surf lagoon, three pools, one spa, a three-story 68,478-square-foot clubhouse and accommodations with one subterranean level, a lodging building, and standalone restroom. The project will also feature parking lots with solar panel canopies, a service yard, landscaping, utilities, and retaining walls. This development is designed to introduce new recreational and lodging amenities to Newport Beach while complementing the surrounding area.

The proposed development will convert three holes of the existing golf course and parking lot, to include the following features:

- 5.5-Acre Wave Pool/Surf Lagoon
- 3 Ancillary Pools And 1 Spa
- 68,478 Square Feet of Clubhouse Building and Accommodations[1]
- 20 Athlete Rooms/Lodging Accommodations
- 9 Outdoor Showers for Guests

The following report sections will evaluate the potential water demands and impacts associated with the proposed Snug Harbor project and its amenities. See Appendix A for the proposed projects site plan.

3.3. WATER SYSTEM

3.3.1. REGIONAL WATER SYSTEM, THE CITY OF NEWPORT BEACH

The City of Newport Beach's water service area spans approximately 11 square miles along the Orange County coast of Southern California. This area is bounded by the Pacific Ocean to the west, Huntington Beach and Costa Mesa to the north, Laguna Beach to the south, and Irvine to the east. While most of the City's boundaries are within the service area, some portions are served by Irvine Ranch Water District (IRWD) and Mesa Water District.

The City's water system is managed collaboratively by the Utilities Department and the Public Works Department. The Utilities Department is responsible for the operation and maintenance of the City's water, wastewater, and storm drain systems. Meanwhile, the Public Works Department handles engineering services, including capital project delivery, bay water quality, environmental services, and transportation and development services. Together, these departments ensure the effective planning and improvement of the City's water supply and distribution systems through master planning and capital improvement projects.

Newport Beach's water infrastructure includes a wellfield with a total capacity of 10,900 gallons per minute (GPM), 15 recycled water connections, and six inter-agency emergency interconnections. The City's water distribution network consists of approximately 300 miles of pipelines, serving 26,765 connections. This distribution system is divided into five main pressure zones (Zones 1 through 5) and 16 minor zones. Zones 1 and 2 are the largest and meet the majority of City's demands, while Zones 3, 4, and 5 are smaller pumped zones. Supporting this system are four wells, three storage reservoirs, five pump stations, and 43 pressure-reducing stations (PRS) that manage water pressure across the network.

[1] 69,216 SF includes Clubhouse Building 68,478 SF and the Standalone Restrooms 738 SF.

3.3.2. LOCAL WATER SYSTEM, SNUG HARBOR

The proposed project is located within the City of Newport Beach located east of the intersection of Irvine Avenue and Mesa Drive. The property is bounded by the Santa Ana Delhi Channel to the north, Irvine Avenue to the northeast, existing commercial property to the southeast, and Mesa Drive to the southwest. The site is currently the Newport Beach Golf Course which consists of three holes, a driving range, pro shop, clubhouse, restaurant, and parking lot. Historically, the proposed project site has received water from both IRWD and the City of Newport Beach's Public Works and Utilities Department. However, for this development, the City will provide water for the entire project site. Therefore, this WSE will evaluate the sufficiency of Newport Beach's water supplies to meet Project demands. This WSE also evaluates water pressures in Pressure Zone 2, which serves the project area.

4. WATER DEMANDS

4.1. EXISTING REGIONAL WATER DEMANDS, CITY OF NEWPORT BEACH

Water use within the City of Newport Beach's service area has remained relatively stable over the past decade, with an annual average consumption of approximately 15,413 AF up through 2020. This stability reflects the City's land use growth and implementation of water conservation measures. Of the total water used, potable water, which includes both groundwater and imported water, has accounted for approximately 97% of the City's total consumption, with the remaining 3% being non-potable recycled water used for landscape irrigation.

In Fiscal Year (FY) 2019-20, see Table 2, the City's total water use was 15,005 AF, which included 14,492 AF of potable water and 513 AF of direct recycled water for landscape irrigation. During this time, the potable water use profile consisted of 58.9% residential consumption, 18.2% commercial, institutional, and industrial uses, and 18.1% for large landscape irrigation. Non-revenue water and other uses made up about 4.8% of the total potable water consumption.

In addition to the water use reported in its UWMP, the City also tracks its annual calendar year (CY) water use under varying land use categories and for CY 21 through 23 water use ranged from approximately 13,960 AF in 2021 to 11,830 AF in 2023. This trend demonstrates further reductions in water demand and increased effectiveness of water conservation. These water uses are represented in Table 2, which outlines the City's actual water demand by land use from 2020 to 2023.

Table 2 – City of Newport Beach Actual Water Demands 2020 and CY 21-23 (AF)

Land Use Type	2020
Single Family	6,750
Multi-Family	1,782
Commercial	2,463
Institutional/Governmental	173
Landscape + Other Potable	2,720
Losses	603
Total Potable	**14,492**
Recycled Water	513
Total Potable + Non-Potable	**15,005**

Source: City of Newport Beach, 2020 UWMP, Table 4-1: Retail: Demands for Potable and Non-Potable Water – Actual

Meter Type	CY21	CY22	CY23
Single Family	6,820	6,339	5,732
Multi-Family	1,850	1,735	1,634
Commercial	2,260	2,322	2,231
City Meter	209	213	169
Sprinkler	2,220	2,199	1,617
City Sprinkler	514	476	374
Boat Dock	18	15	12
City Fire Meter	1	1	0
Fire	6	6	5
Pool	61	57	55
Pump Station	1	0	0
Total Potable	**13,960**	**13,363**	**11,830**

Source: City of Newport Beach, "Email to Fuscoe Engineering." 29 August 2024.

As shown above the City's existing total potable water demands have ranged from as low as 11,830 AF in CY 2023 to 14,492 AF in FY 19-20. Thus, the City has experienced a decrease in water use when comparing water usage from the past four years. Between FY 19-20 to CY 23 the sectors had a general average decrease in water use of approximately 7% for single family and 19% for commercial land uses. Significant above average rainfall for 2022/2023 and slightly above average rainfall for 2023/2024 may also be partially responsible for the recent decrease in water usage. See Table 4 for further discussion on how approved and developed projects since 2020 have influenced the City's water usage trends.

4.1.1. SBX7-7 BASELINE AND TARGETS

The Water Conservation Act of 2009, also known as SBx7-7 (Senate Bill 7), was signed into law in 2010 and mandated that the State of California reduce urban water use by 20% by the year 2020, using a 2013 baseline. To comply with SBx7-7, retail water suppliers, such as the City, had to determine their baseline water use and set targets for 2015 and 2020. Compliance for suppliers could be achieved individually or as part of a regional collaboration with other retail water suppliers. The City of Newport Beach achieved their SBx7-7 target both individually and as a member of the Orange County 20x2020 Regional Alliance, which is a coalition of MWDOC and its retail member agencies, as well as the Cities of Anaheim, Fullerton, and Santa Ana.

To determine the regional water, use target of the Orange County 20x2020 Regional Alliance a weighted average (based on population) of individual agency targets was taken. In 2020, the regional water use target for the Orange County 20x2020 Regional Alliance was 158 gallons per capita per day (GPCD), and the actual water use in the region was 109 GPCD, demonstrating that the region successfully met its goal. Similarly, the City of Newport Beach met its water conservation goals, with an actual water use of 160 GPCD in 2020, which was well below its target of 207 GPCD.

4.2. PROPOSED REGIONAL WATER DEMANDS, CITY OF NEWPORT BEACH

Looking ahead, the City's projected water demand values were developed in collaboration with MWDOC as part of the City's Urban Water Management Plan (UWMP). MWDOC, as the regional wholesale supplier for much of Orange County, works closely with its retail agencies, including Newport Beach, and with its wholesaler, MET, to develop accurate demand projections for imported water.

The City's future water demand projections consider several factors, including ongoing water conservation strategies and the expansion of recycled water use within the service area. While single-family and multi-family residential water use is projected to decrease due to increased water use efficiency measures, the demand for non-residential water uses is expected to increase. Projections for non-residential water use from 2025 through 2045 have been separated into commercial, industrial, and institutional/governmental categories based on the proportions reported for each billing sector in FY 2019-20 (See Table 2). Large landscape water demands are anticipated to remain consistent, while non-revenue water, which includes water losses within the system, is projected to increase slightly until 2040, after which it is expected to decrease as a result of infrastructure improvements and enhanced water loss control measures. See Table 3 for the breakdown of the City's proposed water demand by land use.

Table 3 – City of Newport Beach Projected Water Demands 2025-2045 (AF)

Land Use Type	2025	2030	2035	2040	2045
Single Family	6,385	6,294	6,202	6,111	6,077
Multi-Family	1,729	1,691	1,653	1,615	1,614
Commercial	2,762	3,334	3,584	3,853	3,853
Institutional/ Governmental	194	234	251	270	270
Landscape + Other Potable	2,616	2,616	2,616	2,616	2,616
Losses	638	661	667	675	673
TOTAL	**14,324**	**14,829**	**14,975**	**15,140**	**15,103**
Recycled Water	542	542	542	542	542
TOTAL	**14,866**	**15,371**	**15,517**	**15,682**	**15,645**
Source: Table 7-2, 7-3, and 7-4 Retail: Dry Projected, City of Newport Beach 2020 UWMP.					

The City's total water demand is projected to increase by approximately 4% from 2020 to 2045, growing from 15,005 AF to 15,645 AF. The majority of this growth is anticipated to come from commercial and institutional/governmental water use, while residential water demands are expected to decline due to continued water use efficiency measures. As shown in Table 2 from CY21 to CY23 actual water demands ranged from approximately 13,960 AF in 2021 to 11,830 AF in 2023, which is 6-20% below the projected 14,866 AF that the UWMP anticipated for 2025.

The City also tracks future development areas and projects and since 2020 the following six projects have been built and occupied and are described in more detail in Table 4 below.

Table 4 – City of Newport Beach Approved Developments After 2020

Project	Proposed DUs	Proposed SF	Percent Occupied as of 08/2024
Starbucks - Birch	-	-	100%
Uptown Newport Mixed Use Development (PA2011-134)	1,244	11,500	37%
Old Newport GPA Project	-	25,000	100%
Vue Newport (PA2001-210)	27	36,000	30%
Saint Mark Presbyterian Church (PA2003-085)	-	33,867	77%
Harbor Pointe Senior Living (PA2015-210)	121	85,000	100%
Total Units	**1,392 DUs**	**191,367 SF**	**589 DUs / 151,133 SF**
Source: City of Newport Beach, "Email to Fuscoe Engineering." 28 August 2024.			

As shown above there have been 6 developed projects since 2020 ranging from partially to fully occupied as of August 2024. These projects collectively encompass approximately 1,392 dwelling units (DUs) and 191,367 SF of nonresidential space. When summing the total percent of each project that is occupied there are approximately 589 DUs and 151,133 SF that would generate additional water demands, up to 112 AFY, when using the demand factors for High Density Residential – Newport Beach and Community Commercial uses listed in Section 4.4.2.

When using these water demand factors and assuming all cumulative projects in Newport Beach will be built and fully occupied, the estimated increase in water demands is approximately 909 AFY[2] and this does not specifically account for the Snug Harbor project. This estimate slightly exceeds the growth projections outlined in the City's 2020 UWMP, which anticipates growth of 779 AFY in normal years, 826 AFY in single dry years, and 739 to 826 AFY in multiple dry years (See Section 6). This is primarily due to the fact that the 2019 Water System Master Plan, which was used as the basis for future water demand projections in the UWMP, did not account for all a number of current cumulative projects now underway. Therefore, the 909 AFY projected increase slightly exceeds the growth estimates in the current UWMP. Despite this, recent trends in water demands suggest that the City's actual water use may continue to lower than the demand projections.

As discussed in Section 4.1, since 2020, the City of Newport Beach has experienced a reduction in existing water use, dropping from 15,005 AF in 2020 to 11,830 AF in 2023. Despite the approval of the 589 DUs and 151,133 square feet of non-residential space, which should've increased demands by 112 AFY, the City has instead lowered overall water usage. This reduction is due to improvements in water efficiency, conservation efforts, and the diversification of the City's water supplies. As a result, while the 909 AFY projected increase from all the cumulative new developments does not match up directly with the anticipated growth in the UWMP, the City's current actual water use data suggest that the future projects including the proposed project falls within the projected demand and supply of the current UWMP.

When the 2025 UWMP is updated which requires City Council approval by June 30, 2026, it will incorporate additional cumulative projects and provide a more accurate reflection of future water demands and supply impacts. Additionally, the 2020 UWMP matches supply to demands, and should the need arise, the City can purchase more MET water through MWDOC. This flexibility will support the City's capacity to meet growing demands, even as new developments are completed.

[2] The 909 AFY future demand volume assumes all potential projects on the City's tracking excel spreadsheet will be approved, constructed, built and occupied at 100%. A number of projects on the list have been quiet or dormant for years and may not ultimately be built.

4.3. EXISTING LOCAL WATER DEMANDS, SNUG HARBOR

The existing water demand for the project site, which currently operates as a golf course with 18 holes, a driving range, a pro shop, a clubhouse, a restaurant, and a parking lot, includes both landscaping and commercial uses. The demand generated from the project covers both landscaping and commercial water use. The golf course's landscape irrigation is supplied by well water pumped from the Orange County Water District (OCWD), while the buildings utilize domestic water from the City of Newport Beach. Over the past four years (2020-2023), well production for irrigation purposes has averaged approximately 91,796 gallons per day (GPD) or 103 AFY. These totals represent the full water demand for the entire 18-hole golf course of which the proposed project only occupies three. During this same period, potable water uses for commercial activities on the project sites buildings and amenities averaged 1,389 GPD or approximately 1.6 AFY. Combined, the total water demand (irrigation and commercial) for the 18-hole golf course and existing commercial building averages about 93,186 GPD or 104 AFY see Table 5 for a summary of these existing water demands.

Table 5 – Snug Harbor Existing Water Demands

Existing Irrigation Demands (Groundwater Well Production)		
2020	29,750,000	gallons
2021	34,181,764	gallons
2022	36,267,210	gallons
2023	33,823,328	gallons
Average Demand 2020-2023 (18-Hole Course)	**91,796**	**GPD**
	103	**AFY**
Estimated Project Area Demand 2020-2023 (3-Hole Course)	**15,300**	**GPD**
	17.2	**AFY**
Existing Commercial Demands (Potable Water)		
July '22 – June '23	529,584	gallons
July '23 – June '24	484,704	gallons
Average Demand FY 22-23 & 23-24	**1,389**	**GPD**
	1.6	**AFY**
Total Existing Demand (Irrigation + Commercial)		
18-Hole Course + Commercial Demands	93,186	GPD
	104	AFY
Project Area Demand 3-Hole Course + Commercial	16,689	GPD
	18.7	**AFY**
Source: Coyne. 6 August 2024. Development Corporation, Domestic Meter and Well Production Invoices "Email to Fuscoe Engineering."		

Given that the project site only encompasses 3 of the 18-hole course, the average irrigation demand from groundwater wells can be estimated for the 3 holes using a proportional approach. Dividing the total demand by 18 holes and then multiplying it by the 3 holes in the project area results in an estimated irrigation demand of approximately 15,300 GPD or 17.2 AFY for the course. This provides an estimate of 16,689 GPD or 18.7 AFY, conservatively assuming that the groundwater irrigation demand is relatively uniform across all holes. The existing drive range is supported by artificial turf and does not require irrigation.

4.4. PROPOSED LOCAL WATER DEMANDS, SNUG HARBOR

As described previously, the proposed project will transform the existing golf course into a facility that includes a 13-foot-deep surf lagoon, three pools, a spa, a three-story 50,000-square-foot clubhouse with one subterranean level, a lodging building, and standalone restroom. The following tables will present a detailed analysis of the local water use factors, demand analyses, and water studies used to determine the proposed projects anticipated water usage. These factors are necessary to understand how existing water demands will be altered when projecting future potable water needs under the Snug Harbor project.

4.4.1. WAVEGARDEN COVE WATER DEMAND ESTIMATES FOR WAVE POOL

The Wavegarden Cove company designs and manufactures artificial wave-generating technology for surfing and is known as the market leader for the research and design of surf parks that mimic ocean waves. Wavegarden provided specialized consulting services for the proposed wave park/lagoon, providing guidance on necessary water treatment requirements, water demand requirements, water discharges, and water source quality analysis. Due to the proprietary nature of the technical methodologies and operational parameters utilized by Wavegarden, detailed documentation and data are not included within the WSE, as they are subject to confidentiality agreements[3]. A summary of the water demand parameters estimated for the Snug Harbor project are provided below.

WATER DEMAND PARAMETERS

Based on the general water demand parameters it is estimated that the total annual freshwater requirements will largely consist of the following relationship:

Water Evaporation – Rainfall + Other Losses = Total Annual Requirement

Water Evaporation: Water evaporation occurs naturally from the surface of the wave park/lagoon due to surrounding temperature, humidity, pressure, surface area, and wind conditions. In Newport Beach, the annual mean temperature is 66 degrees Fahrenheit, thus evaporation is a major factor in the projects water demand. The rate of evaporation will depend on the surface area of the lagoon, amount of exposure to sunlight, and changing wind patterns.

Rainfall: Rainfall will provide a natural source of water replenishment for the lagoon. The amount of rainfall will help reduce the overall need for additional freshwater.

Other Losses: Other losses in the system can occur from various sources including the following: spillage from wave splash, losses in pipes, basin leakages, users carrying water out, water treatment housekeeping, and filter backwash. Some of these losses are negligible or should not take place regularly (losses in pipes, basin leakages, etc.) and will be resolved once detected.

Using the proprietary calculations estimated by Wavegarden an annual water requirement for the project has been determined to account for all the above factors. See Table 6 below which provides a breakdown of the various general water requirements for the project.

[3] Wavegarden Cove, Water Management Introduction – Newport Beach Cove. 18 October 2024

Table 6 – Snug Harbor Proposed Lagoon Water Demands

WATER REQUIREMENTS – ROUTINE SURF LAGOON MAINTENANCE			
	Gallons/Year	**Gallons/Day**	**AFY**
Draining of the Lagoon – *(Frequency: Annually)*	5,100,000	13,973	15.65
Filter Cleaning of the Lagoon – *(Frequency: 17 times per year)*	45,067	123	0.14
Total Water Requirements – Routine Maintenance	**5,145,067**	**14,096**	**15.79**
WATER REQUIREMENTS – ANNUAL SURF LAGOON OPERATION			
	Gallons/Year	**Gallons/Day**	**AFY**
Average Temperature *(°F)*	66 °F		
Open Water Evaporation Estimate *(gal/year)*	12,966,764	35,525	39.79
Wave Operation Factor	1.45		
Backwash losses *(gal/year)*	192,867	528	0.59
Average Evaporation Water Loss *(gal/year)*	51,512	141	0.16
Operating Water Loss *(gal/year)*	**18,994,674**	**52,040**	**58.29**
Annual Rainfall *(11 inches)*	**1,396,018**	**3,825**	**4.28**
Total Water Requirement – Annual Operation	**17,598,655**	**48,215**	**54.01**
Total Water Requirement – Routine Maintenance + Annual Operation	**22,743,722**	**62,312**	**69.80**

Sources
1. *Wavegarden Cove. 18 October 2024. Water Management Introduction – Newport Beach Cove*
2. *Coyne. 30 September 2024. Water Requirement "Email to Fuscoe Engineering."*

The water demand analysis provided by Wavegarden for the Snug Harbor lagoon demonstrates a total annual freshwater requirement that is projected to be approximately 22.7 million gallons per year or 69.8 AFY. Demands are primarily driven by open water evaporation, which accounts for the largest water demand as a result of the warm climate and the lagoons larger surface area. Additional demands come from routine maintenance wave generation, backwash, and other losses that contribute to the overall demands.

4.4.2. WATER DEMAND ESTIMATES FOR PROJECT CLUBHOUSE AND ACCOMODATIONS

The water uses factors used to estimate the proposed commercial water demands are from IRWD's 2019 Water Resources Master Plan (WRMP). All connections throughout IRWDs service area are metered and IRWD employs water use factors which assigns water demands to various land use types and then aggregates these regional demands. The water use factors are based on average water use and incorporate the effect of IRWD's tiered-rate conservation pricing (budget-based rates)[4]. IRWD's collaborative and thorough approach ensures that the water use factors as shown in Table 7 below represent actual regional usage patterns, support sustainable water management, and inform decision-making for land use planning throughout the multiple jurisdictions within its service area, including portions of the City. See

[4] Irvine Ranch Water District, 2019, Water Resources Master Plan, Table 3-1

Table 7 below for a summary of the IRWD water use factors used to calculate the projects commercial water demands.

Table 7 – Proposed Water Use Factors

IRWD WATER USE FACTORS	
Land Use Designation	**Water Use Factor**
Community Commercial	175 Gallons/KSF/Day
Hotel	160 Gallons/Room/Day
Sources: *IRWD 2019 Water Resources Master Plan - Table 3-1: Land Use and Water Use Factors*	

As shown above the water use factors that the proposed project uses are based on IRWD's community commercial and hotel land use designations. See Table 8 below for an estimate of the proposed water demands based on these factors.

Table 8 – Snug Harbor Proposed Clubhouse & Accommodations Water Demands

Proposed Clubhouse and Accommodations	Amount	Avg. Unit Flow	Avg. Flow (GPD)	Avg. Flow (AFY)
Clubhouse Building & Accommodations[5] (SF)	69,216 SF	0.175 (GPD/SF)[1]	12,113	13.57
Athlete Accommodations (Rms)	20 Keys	160 (GPD/Key)[1]	3,200	3.58
Showers for Pools/Lagoons	9 Showers	54 (GPD/Shower)[2]	486	0.54
Recreational Pools and Spas (SF)	3 Pools 1 Spa	* Proration of the lagoons water usage based on surface areas	931	1.04
		TOTALS	**16,733**	**18.74**

1. Irvine Ranch Water District, 2019, Water Resources Master Plan, Table 3-1
2. 54 GPD/Shower = Assumed 18 gal/shower usage x 3 uses per day per shower facility. Source: Alliance for Water Efficiency. "Showering to Savings." *Home Water Works*, 2016 Residential End Uses of Water Study, The Water Research Foundation, https://home-water-works.org/indoor-use/showers.

As shown in the table above the Snug Harbor's proposed clubhouse and accommodations will increase the volume of commercial uses and has the potential to demand up to 16,733 GPD or 18.74 AFY of water.

4.5. NET CHANGE IN WATER DEMANDS (EXISTING TO PROPOSED)

In evaluating the water demand for the proposed Snug Harbor project, it is important to distinguish between existing and projected water sources. The current golf course is three holes and relies on groundwater for irrigation. However, the redevelopment plan shifts the focus to potable water demand for new commercial amenities, including a surf lagoon, pro shop, clubhouse, and restaurant. These new facilities will require potable water to meet health

[5] 69,216 SF includes Clubhouse Building 68,478 SF and the Standalone Restrooms 738 SF.

and safety standards, particularly for the lagoon, which must maintain high water quality for public use.

While groundwater is part of the overall water supply for the City, it will not be utilized for this specific project site at this time.[6] Thus, the net change in water use calculations for the project will reflect only the demands from the existing potable commercial amenities and exclude the golf course's groundwater usage. This approach provides a clear distinction in water sources and ensures an accurate reflection of the project's new potable water demand that would be met by the City, see Table 9 below for more details.

Table 9 – Snug Harbor Net Change in Water Demands

Proposed Land Uses	Amount	GPD	AFY
Proposed Water Use			
Wave Pool/ Surf Lagoon	• 5.06 Acre Wave Pool	62,312	69.80
Clubhouse & Accommodations	• 69,216 SF • 20 Keys • 9 Showers • 3 Pools and 1 Spa	16,733	18.74
	Total Proposed Water Demands	**79,045**	**88.54**
Existing Water Use			
Golf Course	• 3-holes	15,299	17.14
Commercial Amenities	• Pro Shop, Clubhouse, and Restaurant	1,389	1.56
	Total Existing Water Demands	**16,689**	**18.70**
	Net Change (Proposed – All Existing Uses)	**62,356**	**70**
	Net Change (Proposed – Existing Commercial Amenities)	**77,656**	**87**

As shown above, the transition from the existing golf course and associated commercial building to the proposed Snug Harbor with its lagoon, pools, and associated clubhouse and accommodations is anticipated to result in a net increase in water demand. The total proposed water demand for the Snug Harbor project is estimated at 79,045 GPD or 85 AFY, while the existing water use for the golf course and current commercial amenities are approximately 16,689 GPD or 18.7 AFY. This would result in a net increase in water demand of 62,356 GPD or 70 AFY if the proposed Snug Harbor used the non-potable water for irrigating the golf-course. However, when comparing the net change in potable water demand met by the City, the proposed potable demands of the Snug Harbor project results in an increase of approximately 77,656 GPD or 87 AFY relative to demand of existing commercial facilities on the Project site.

5. Water Supplies

5.1. EXISTING REGIONAL WATER SUPPLIES, CITY OF NEWPORT BEACH

The City of Newport Beach meets its water demands through a combination of imported water, local groundwater, and recycled water. The City collaborates closely with two primary agencies, the Municipal Water District of Orange County (MWDOC) and the OCWD, to ensure a reliable water supply, even during periods of drought and shortage. The City's main source of water is groundwater from the Orange County Basin, which accounted for 68% of the total

[6] The on-site groundwater well may be a future source of water for the proposed project, but it is not being analyzed in this EIR nor is it part of the water demand calculations. Any use of the existing or a future groundwater well for water supply will be adequately evaluated at that time.

water supply in FY 2019-20. Imported water, making up 28.5% of the supply, is from the Colorado River and the State Water Project (SWP), provided by the Metropolitan Water District of Southern California (MET) and delivered through MWDOC. Recycled water accounts for the remaining 3.5% of the City's water supply and is used primarily for non-potable purposes such as landscape irrigation. These sources of supply are summarized below and discussed in more detail in the UWMP, which is included as Attachment B to this WSE.

5.1.1. GROUNDWATER

OC Basin groundwater has historically been the most cost-effective and reliable source of water for the City of Newport Beach. The OC Basin spans approximately 350 square miles and holds around 66 million acre-feet (MAF) of water across three aquifer systems: the Shallow, Principal, and Deep Aquifers. Over 90% of groundwater is extracted from the Principal Aquifer system, located between 200 and 1,300 feet. The OCWD monitors groundwater levels, water quality, and regulates recharge operations to prevent overdraft and seawater intrusion. The basin is not adjudicated, so pumping is managed through financial incentives rather than legal mandates.

The City operates four active wells within the OC Basin and supplied 10,237 AF of groundwater or 68% of its total water supply in FY 2019-20. The City's wellfield is located about five miles north in Fountain Valley with a total capacity of 10,900 GPM. Groundwater from the wellfield is transported via a 30 to 36-inch pipeline to the 16th Street Reservoir and then distributed throughout the City, including to the 600 AF Big Canyon Reservoir. The City's groundwater supply is subject to the Basin Production Percentage (BPP) and the capacity of the four wells the City uses. The City also benefits from OCWD's Groundwater Replenishment System (GWRS), which treats wastewater to replenish the OC Basin and improve the overall sustainability of the groundwater supply by preventing seawater intrusion and supporting non-potable uses. Aside from a decrease in groundwater volume pumped in FY 2017-18, the City has experienced relative stability in groundwater volume pumped as shown in Table 10.

Table 10 – Groundwater Volume Pumped 2017-2020 (AFY)

Type	Basin	2016	2017	2018	2019	2020
Alluvial Basin	Orange County Groundwater Basin	9,616	10,004	8,200	10,877	10,237
	TOTAL	**9,616**	**10,004**	**8,200**	**10,877**	**10,237**
Source: Table 6-4, City of Newport Beach 2020 UWMP.						

As shown above the fluctuations in City's groundwater pumping are likely influenced by a combination of factors, including annual water demand, conservation efforts, and water availability in the OC Basin. The overall trend suggests that the City has maintained stable groundwater use in recent years, with 2020 levels being consistent with those of 2017, highlighting the City's reliance on the OC Basin as a critical water supply source.

SUSTAINABLE GROUNDWATER MANAGEMENT ACT (SGMA)

The SGMA is aimed at ensuring the long-term sustainability of California's groundwater resources. Under SGMA, local agencies are required to form Groundwater Sustainability Agencies (GSAs) and develop Groundwater Sustainability Plans (GSPs) for basins classified as medium or high priority. There are multiple components that go into categorizing a priority level for the basins such as; current population and projected growth overlying the basin, number of public and private wells that draw from the basin, the irrigated acreage overlying the basin, the degree to which individuals rely on the groundwater as their primary source in the basin, and any external impacts on the basin. The OC Basin, where Newport Beach sources a significant portion of its water, is classified as a medium priority basin due to the heavy regional reliance on its groundwater as a primary water supply[7].

Although the OC Basin is not in overdraft, OCWD, which manages the basin, has taken proactive steps to comply with SGMA requirements. In 2017, OCWD and other local agencies within Basin 8-1 collaborated to submit an Alternative to a GSP, known as the "Basin 8-1 Alternative," to meet SGMA compliance, (See Appendix D). This plan outlines the management strategies and measures implemented to ensure the sustainable use of groundwater in the basin. OCWD's management approach under SGMA includes monitoring groundwater levels and quality, regulating annual pumping through the BPP, and maintaining recharge operations using water from the Santa Ana River, recycled water from the GWRS, and other sources[8]. These efforts are designed to prevent issues such as land subsidence and seawater intrusion, ensuring that the OC Basin remains a reliable source of water for Newport Beach and surrounding communities. The Basin 8-1 Alternative is included as Attachment C to this WSE.

In addition to the Basin 8-1 Alternative, OCWD's broader groundwater management plans address various aspects of basin sustainability, including hydrogeology, water supply monitoring, and the operation of recharge facilities. These plans are integral to maintaining the health of the OC Basin and ensuring that it can continue to meet the water demands of the region under SGMA's requirements[9].

5.1.1. PURCHASED OR IMPORTED WATER

The City supplements its local groundwater supply with imported water purchased from MET through MWDOC. In FY 2019-20, the City relied on approximately 4,255 AFY, which was 28.5% of the City's water supply portfolio. MET's principal sources of water are the Colorado River via the CRA and the Lake Oroville watershed in Northern California through the SWP. For Orange County, the water obtained from these sources is treated at the Robert B. Diemer Filtration Plant located in Yorba Linda. Typically, the Diemer Filtration Plant receives a blend of Colorado River water from Lake Mathews through the MET Lower Feeder and SWP water through the Yorba Linda Feeder. The City currently maintains six connections to the MET system along the Orange County Feeder and the East Orange County Feeder No. 2 with a total available capacity of 104 cfs, or 67 MGD.

5.1.2. WASTEWATER AND RECYCLED WATER

The City of Newport Beach does not own or operate its own wastewater treatment facilities but sends all collected wastewater to the Orange County Sanitation District (OC San) for treatment and disposal. OC San then provides treated water to the OCWD. The City plays a role in recycled water production by supplying wastewater for indirect potable reuse (IPR) and collaborates with agencies like OCWD to expand and manage recycled water resources.

The stormwater management system within the City is extensive, with over 3,200 catch basins and more than 95 miles of storm drainpipe that divert stormwater into the wastewater system. A portion of this combined stormwater and wastewater is treated by OCWD's Green Acres Project (GAP) and the GWRS to produce recycled water, which is used for irrigation and other

---

[7] State of California, Department of Water Resources SGMA Basin Prioritization Dashboard. Found here: https://gis.water.ca.gov/app/bp-dashboard/final/#

[8] Orange County Water District, 2015. Groundwater Management Plan. Found here: https://www.ocwd.com/wp-content/uploads/groundwatermanagementplan2015update_20150624.pdf

[9] Orange County Water District. Accessed September 2024. Groundwater Management Plan. Found here: https://www.ocwd.com/what-we-do/groundwater-management/groundwater-management-plan/

non-potable purposes. OCWD's GAP is a water recycling system that provides up to 8,400 AFY of recycled water for irrigation and industrial uses. This recycled water is then distributed to parks, golf courses, greenbelts, cemeteries, and nurseries across Costa Mesa, Fountain Valley, Newport Beach, and Santa Ana. The City purchases GAP water from OCWD and distributes it to its recycled water customers, with approximately 100 sites currently using GAP water.

5.2. PROPOSED REGIONAL WATER SUPPLIES, CITY OF NEWPORT BEACH

Looking ahead, the City's water supply portfolio is projected to shift by 2045, with groundwater expected to provide approximately 82% of the total supply, imported water 14.5%, and recycled water maintaining its 3.5% share. This shift aligns with projected demands, and the City has the capability to purchase additional MET water through MWDOC, if necessary. In addition to its primary water resources, the City has established inter-agency emergency interconnections to ensure water supply during shortages or outages. There are six emergency connections with the IRWD and seven with Mesa Water District, providing additional security for the City's water system. See Table 11 below, which shows projected supply sources for the City of Newport Beach.

Table 11 - Projected Water Supplies 2025 -2045 (AFY)

Water Supply Source	2020	2025	2030	2035	2040	2045
OC Groundwater Basin (not desalinated)	10,237	12,175	12,605	12,729	12,869	12,838
Purchased or Imported Water (MWDOC)	4,255	2,149	2,224	2,246	2,271	2,265
Recycled Water (OCWD)	513	542	542	542	542	542
TOTAL	**15,005**	**14,866**	**15,371**	**15,517**	**15,682**	**15,645**
Source: Table 6-1 and 6-2, City of Newport Beach 2020 UWMP.						

As shown above the City projects that their water supply profile by 2045 will largely consist of 82% not desalinated groundwater, 14% purchased or imported water, and 4% recycled water.

5.2.1. CAPITAL IMPROVEMENT PROJECTS

The capital improvement programs within the City of Newport Beach include those managed by OCWD, Orange County Public Works (OCPW), and the City's Public Works Department. These capital improvement programs are essential to maintaining, improving and expanding the regions water supply and infrastructure. See Table 12 for a list of the most recent capital improvement projects aimed at improving the City's long-term water supply management.

Table 12 – Proposed Capital Improvement Projects (CIP)

Project Name	CIP Fiscal Year	Project Summary
Newport Beach Combined PFAS Treatment System[2]	FY 26-27 through FY 28-29	OCWD will design and construct a PFAS treatment system to remove contaminants from the water, which will enhance the City's groundwater supply reliability.
Water Well Rehabilitation Program[2]	FY 24-25 through FY 29-30	The City currently operates four potable water wells in Fountain Valley. These wells require on-going routine rehabilitation in order to maintain their pumping capacities and to prolong their service lives. This year's project will focus on rehabilitating both the City's deep and shallow wells are located in Fountain Valley.
New Water Wells and Pipeline[2]	FY 24-25 through FY 29-30	This is a multi-year project that involves locating a new well site, drilling new potable water wells and installing a new transmission water main from this new well site to the City's water system to increase the supply of groundwater.
[1] OCWD Budget Report Fiscal Year 2024-2025 https://www.ocwd.com/wp-content/uploads/FY24-25-Budget-Report-Final.pdf [2] City of Newport Beach, Capital Improvement Program Proposed for Fiscal Year 2024-25 through 2029-30. Found here: https://www.newportbeachca.gov/government/departments/public-works/capital-improvement-program		

These projects reflect the City's efforts to ensure water quality and reliable water supply for its service area which includes the proposed project area.

6. Regional Water Supply Reliability

To ensure the proposed project is adequately supported, it is important to understand the City's forecast of water supplies to meet future demands. The City of Newport Beach's 2020 UWMP uses current and projected population data, water supply sources, demand estimates, and factors affecting water demand to forecast supply and demand into the future. This comprehensive approach allows the City to evaluate its ability to meet water needs through 2045 under various conditions, including normal, single dry-year, and multiple dry-year scenarios.

The findings of the 2020 UWMP indicate that Newport Beach has sufficient supply to meet projected demands from 2020 through 2045 under the normal, single dry-year and multiple dry-year conditions. The City's Water Shortage Contingency Plan (WSCP) also outlines specific actions to address droughts and other supply challenges, including conservation measures and demand reduction strategies. The WSCP, along with regional collaborations such as the GWRS, ensures the City has the capacity to manage both normal, single, and multiple dry-year conditions through 2045.

6.1. NORMAL AND SINGLE DRY YEAR WATER RELIABILITY

For both normal and single dry year scenarios the City's UWMP assures that water demands and supplies will be met and for simplicity shows that supply is equal to demand. As noted in previous discussions the City does have access to additional water supplies from MET and MWDOC, should the need arise. Thus, when determining dry year supply and demand reliability the normal year represents the water supplies a supplier considers available during normal conditions. While a single-dry year is defined as a single year of no to minimal rainfall within a period that average precipitation is expected to occur. See Table 13 for a view of the City's water supply and demand projections during normal and single dry years.

Table 13 – Single and Normal Dry Year Supply & Demand Comparison (AFY)

NORMAL-DRY YEAR						
	2025	**2030**	**2035**	**2040**	**2045**	**UWMP Projected Growth**
Supply Totals (AF)	14,866	15,371	15,517	15,682	15,645	**779 AFY**
Demand Totals (AF)	14,866	15,371	15,517	15,682	15,645	
DIFFERENCE (AF)	**0**	**0**	**0**	**0**	**0**	
Snug Harbor Net Water Demand						**87**
SINGLE-DRY YEAR						
	2025	**2030**	**2035**	**2040**	**2045**	**UWMP Projected Growth**
Supply Totals (AF)	15,758	15,758	16,293	16,448	16,623	**826 AFY**
Demand Totals (AF)	15,758	15,758	16,293	16,448	16,623	
DIFFERENCE (AF)	**0**	**0**	**0**	**0**	**0**	
Snug Harbor Net Water Demand						**87**
Source: Table 7-2, 7-3, and 7-4, City of Newport Beach 2020 UWMP.						

As outlined in the table above the City's demands during normal dry year conditions are anticipated to grow from 779 AFY from 2025 to 2045 and up to 826 AFY during a single dry year. During the single dry year demands and supplies are anticipated to increase by an average of 6% because the City conservatively assumed that a single dry year demand is 6% greater than each respective year's normally projected total water demand.

6.2. MULTIPLE DRY YEAR WATER RELIABILITY

The City describes an extended multiple drought year (5 years) as the driest five-year historical sequence, which may be the lowest average water supply available for five years in a row. Although water use may decrease in the later years of a multiple year drought due to implementation of conservation measures and drought messaging, the assessment is based on a 106% increase throughout the 5-year drought to be conservative. See Table 14 for an outline of the City's projected supply and demand during five consecutive dry years.

Table 14 - Multiple Dry Years Supply and Demand Comparison (AFY)

MULTIPLE-DRY YEARS						
FIRST YEAR	**2025**	**2030**	**2035**	**2040**	**2045**	**UWMP Projected Growth**
Supply Totals (AF)	15,876	15,865	16,324	16,483	16,615	**739 AFY**
Demand Totals (AF)	15,876	15,865	16,324	16,483	16,615	
DIFFERENCE (AF)	**0**	**0**	**0**	**0**	**0**	
					Snug Harbor Net Water Demand	**87**
SECOND YEAR	**2025**	**2030**	**2035**	**2040**	**2045**	**UWMP Projected Growth**
Supply Totals (AF)	15,846	15,972	16,355	16,553	16,599	**761 AFY**
Demand Totals (AF)	15,846	15,972	16,355	16,553	16,599	
DIFFERENCE (AF)	**0**	**0**	**0**	**0**	**0**	
					Snug Harbor Net Water Demand	**87**
THIRD YEAR	**2025**	**2030**	**2035**	**2040**	**2045**	**UWMP Projected Growth**
Supply Totals (AF)	15,817	16,079	16,386	16,553	16,599	**782 AFY**
Demand Totals (AF)	15,817	16,079	16,386	16,553	16,599	
DIFFERENCE (AF)	**0**	**0**	**0**	**0**	**0**	
					Snug Harbor Net Water Demand	**87**
FOURTH YEAR	**2025**	**2030**	**2035**	**2040**	**2045**	**UWMP Projected Growth**
Supply Totals (AF)	15,787	16,186	16,417	16,588	16,592	**805 AFY**
Demand Totals (AF)	15,787	16,186	16,417	16,588	16,592	
DIFFERENCE (AF)	**0**	**0**	**0**	**0**	**0**	
					Snug Harbor Net Water Demand	**87**
FIFTH YEAR	**2025**	**2030**	**2035**	**2040**	**2045**	**UWMP Projected Growth**
Supply Totals (AF)	15,758	16,293	16,448	16,623	16,584	**826 AFY**
Demand Totals (AF)	15,758	16,293	16,448	16,623	16,584	
DIFFERENCE (AF)	**0**	**0**	**0**	**0**	**0**	
					Snug Harbor Net Water Demand	**87**
Source: Table 7-2, 7-3, and 7-4, City of Newport Beach 2020 UWMP.						

As shown above the City's demand and supply varies from 2025 to 2045 with demands reaching as low as 15,758 AF (5th year 2025) to 16,615 AF (1st year 2045). Overall, from 2025 to 2045 in each dry year scenario growth in demands and supplies are anticipated to increase in the range of 739 AF (1st multiple dry year) to 826 AF (5th multiple dry year). One factor that affects these projections is the continued drought conditions, which are conservatively anticipated to increase to as much as 106% of normal dry year values.

6.3. THE IMPLICATIONS OF SNUG HARBOR ON FUTURE WATER DEMANDS & SUPPLY RELIABILITY

As shown in the tables above, the City's supplies are expected to remain consistent throughout various dry year scenarios. However, the proposed Snug Harbor project, which was not accounted for in the City's 2019 Water System Master Plans or the most recent 2020 UWMP, introduces an additional demand of approximately 85 AFY.

To address the projects potential effect on the City's projected water demands and supply reliability, the highest water demand scenario where all the City's accounted for developments and the proposed Snug Harbor project was considered. Under this scenario the proposed project alongside all the City's other planned projects and areas of development are assumed to be fully built out and occupied. The City's current water supply and demand analysis would need to account for the projects projected net demand of 87 AFY beyond original 2020 projections, which matches supply projections to demands for simplicity. Therefore, under this scenario, the City can request additional water supplies from MWDOC, should the need arise. Additionally, the planning for the City's 2025 UWMP will be initiated within the next 12 months and provides an opportunity for the City to reevaluate all prior anticipated projects, new projects (such as Snug Harbor), Regional Housing Needs Assessments, and population projections to provide a comprehensive demand assessment out to 2050.

It is important to note that recent trends in existing and proposed water demands from new developments have not resulted in as high a demand as discussed in Sections 4.1 and 4.2. Additionally, while all projects assumed in the UWMP were expected to be fully built and occupied, some projects have been stalled for years (such as Newport Back Bay Landing[10]) or canceled (such as Banning Ranch[11]). Thus, the City's overall demand forecast is reduced and provides a buffer for unanticipated and new developments like Snug Harbor. By comparing actual water demands from 2020 to 2023 with projected demands it is not anticipated that incorporating the proposed Snug Harbor projects water demand will result in exceeding the projected demands and supplies.

6.4. LOCAL WATER CONSERVATION & SUPPLY SHORTAGE PROGRAM

The City of Newport Beach's Water Conservation and Water Supply Shortage Program is designed to manage water demand through both long-term conservation measures and responsive actions during times of water shortages. The program aims to reduce water consumption, prevent waste, and ensure a reliable supply of water for public health and safety. This is achieved by establishing permanent mandatory water conservation requirements, as well as implementing specific restrictions during declared water supply shortages.

---

[10] The Newport Back Bay Landing project initially proposed in 2012, aimed to develop a mixed-use waterfront village. Over the years the project has faced delays and as of 2024 the project has not yet commenced construction, reflecting the complexities and extended timelines of projects. Notice of Preparation, 10/1/2012. Found here: https://www.newportbeachca.gov/pln/CEQA_REVIEW/Back%20Bay%20Landing/Final%20NOP_with_PA_No%20.pdf

[11] The City's 2019 WSMP incorporated the potential water demands of the Banning Ranch project, which at the time was listed as a future development with a maximum buildout of 1,375 residential units, 75,000 square feet of retail commercial space, and 75 hotel rooms. However, in 2022 an agreement was finalized to preserve Banning Ranch as a nature preserve and public park. As a result, the projected water demands associated with this development are no longer anticipated. See description of the agreement here: https://mrca.ca.gov/press/13639/ .

6.4.1. PERMANENT MANDATORY WATER CONSERVATION REQUIREMENTS

To promote efficient water, use at all times, the City enforces several permanent mandatory water conservation measures. These include the following limits[12]:

- **Residential**
    - No watering landscape between the hours of 9:00 a.m. and 5:00 p.m.
    - Limit watering landscape to no more than 10 minutes per station for automated irrigation systems.
    - Repair water leaks or breaks within 3 days
    - Watering outdoor landscapes in a manner that causes runoff.
    - No washing down hard surfaces including sidewalks and driveways.
    - Irrigating lawn, shrubs or ornamental landscape during or 48-hours after rainfall.
    - Operating a fountain or decorative water feature, unless the water is part of a recirculating system.
    - Washing a vehicle (including cars, trucks, boats, trailers and recreational) with a hose, unless the hose is fitted with a self-closing shut-off nozzle.
- **Commercial**
    - No watering of non-functional grass
    - Restaurants and other food service establishments can only serve water to customers on request.
    - Hotels and motels must provide guests with the option of not having towels and linens laundered daily.

In addition to these permanent mandatory water conservation requirements the City has several other plans and procedures to prepare for water supply shortages[13].

6.4.2. WATER SUPPLY SHORTAGE LEVELS

In times of water shortages, the City can declare different levels of water supply shortages, ranging from Level One (up to 10% reduction) to Level Six (over 50% reduction). As the severity of the shortage increases, the restrictions on water use become more stringent. For example, during a Level One shortage, irrigation is limited to four days per week, while in a Level Five severe shortage, the use of potable water for landscape irrigation is prohibited entirely, with limited exceptions for fire protection and public safety. A Level Six catastrophic shortage includes additional prohibitions, such as the suspension of new water connections and restrictions on non-essential water uses.

6.4.3. EMERGENCY INTERCONNECTIONS AND EXEMPTIONS

To ensure water supply reliability during emergencies, the City has established inter-agency emergency interconnections with neighboring water districts, such as IRWD and Mesa Water District. Certain water uses necessary for public health and safety are exempt from restrictions, and customers who face unique hardships can apply for relief from compliance through a water conservation plan, which must demonstrate the maximum feasible reduction in water consumption.

---

[12] City of Newport Beach, Water Quality and Conservation Program. Found here: https://www.newportbeachca.gov/government/departments/public-works/water-quality-and-conservation/water-conservation

[13] City of Newport Beach, Water Conservation And Water Supply Shortage Program. Found here: https://www.codepublishing.com/CA/NewportBeach/#!/html/NewportBeach14/NewportBeach1416.html

6.4.4. ENFORCEMENT AND COMPLIANCE

The City enforces its water conservation regulations through a structured implementation plan, which includes public notifications, fines, and penalties for violations. For willful or continued non-compliance, the City may install water flow restrictors or even terminate water service. The City Council may also adjust the regulations in response to changes in water supply conditions or mandates from state authorities during declared emergencies.

By adopting these comprehensive measures, the City of Newport Beach manages its water demands effectively, and ensures long-term water supply reliability for its residents and businesses.

6.5. REGIONAL WATER SUPPLY RELIABILITY CONCLUSIONS

As discussed, and outlined above in all supply scenarios, whether normal year, single year, or multiple dry-year sequences, the City projects a balanced supply and demand, with no expected shortages. Groundwater storage, coupled with conservation efforts and the use of recycled water, will ensure that Newport Beach's water resources remain sustainable and reliable through 2045.

The City's WSCP assessment also identifies potential limitations on water availability, including the effects of droughts on imported water supplies. However, Newport Beach's access to groundwater allows the City to shift its reliance to groundwater during single dry years and consecutive dry years. The local groundwater basins act as a large reservoir, storing water during wet years and allowing the City to meet its demands during dry periods. The City's proactive management and regional collaboration with the OCWD and MWD will also provide flexibility and security in maintaining adequate water supplies, even in the face of prolonged drought conditions. As a result, with the proposed Snug Harbor Newport Beach's water supplies are not significantly impacted during any of the normal, single or multiple dry year conditions.

7. Conclusion

The following is a summary of the key findings and conclusions that were discussed in further detail throughout the report. This summary focuses on the proposed projects impact on water demand and supplies and highlights some of the regulations and projects that will support the project;

- **Water Demand**: The projected water demand for the Snug Harbor project is estimated to be approximately 85 acre-feet per year (AFY), which encompasses the demands for the projects proposed lagoon, pools, spa, and club house. This estimate is based on established water use factors sourced from the IRWD and Wave Garden engineering, which specializes in the research and design of wave generating systems and lagoons, such as what is proposed for the project. Refer to Section 4 for more details.

- **Water Supply**: The primary water sources available to the project area includes groundwater, imported water, and recycled water. The total available water supply from these sources is projected to be sufficient to meet the demands of the proposed project under normal, single-dry, and multiple- dry year scenarios. Refer to Section 5 for more details.

- **Groundwater Management**: The groundwater basin serving the project area is the Coastal Plain of Orange County groundwater basin also known as Basin 8-1 "OC Basin" or "Basin." The Basin is currently managed by the Orange County Water District (OCWD) and under the Sustainable Groundwater Management Act (SGMA), is classified as a medium priority basin, due to the regional reliance on the Basin's groundwater supplies. The Basin is not currently experiencing overdraft conditions, and the project's groundwater use is expected to be sustainable under the basin's existing management plans. Refer to Section 5.1.1 for more details.

- **Future Water Supply Improvements**: The City of Newport Beach alongside other stakeholders using the regional water supplies has identified future capital improvement program (CIP) projects that will support the regional water supply and reliability. These projects include City and OCWD improvements, which will further enhance the water system. Refer to Section 5.2.1 for more details.

Overall, the analysis in this WSE demonstrates that the proposed Snug Harbor water demands are anticipated to be met by the City under various drought scenarios ranging from normal, single-dry, and multiple dry years. With the incorporation of water sustainability measures and ongoing infrastructure improvements managed by the City's Utility Department, the Project's the City can meet the Project's demand without causing adverse effects on its water supplies or supplies available to its other customers.

8. Appendices

Appendix A Snug Harbor Site Plan
Appendix B Water Volume & Demand Calculations
Appendix C Newport Beach UWMP 2020
Appendix D Basin 8-1 Alternative

APPENDIX A

SNUG HARBOR SITE PLAN

SNUG HARBOR
NEWPORT BEACH, CA 92660

Site Development Review

BACK BAY BARRELS, LLC
3857 BIRCH STREET, SUITE 521
NEWPORT BEACH, CA 92660

FUSCOE ENGINEERING
15535 SAND CANYON AVE, SUITE 100
IRVINE, CA 92618
PHONE: 949.474.1960

C-04
CONCEPTUAL UTILITY

11/13/2024

F:\PROJECTS\4206\001\PLANS\ENTITLEMENTS\SCHEMATIC PLANS\4206-001ET04UT.DWG (11-13-2024 6:26:45PM) Plotted by: GAttord

APPENDIX B

WATER VOLUME & DEMAND CALCULATIONS

Snug Harbor Existing Water Demands

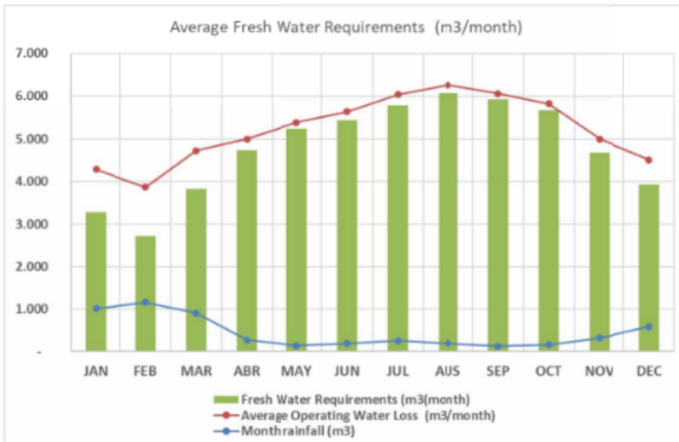
Existing Irrigation Demands (Groundwater Well Production)		
2020	29,750,000	gallons
2021	34,181,764	gallons
2022	36,267,210	gallons
2023	33,823,328	gallons
Average Demand 2020-2023 (18-Hole Course)	**91,796**	**GPD**
	103	**AFY**
Estimated Project Area Demand 2020-2023 (3-Hole Course)	**15,300**	**GPD**
	17.2	**AFY**
Existing Commercial Demands (Potable Water)		
July ’22 – June ’23	529,584	gallons
July ’23 – June ’24	484,704	gallons
Average Demand FY 22-23 & 23-24	**1,389**	**GPD**
	1.6	**AFY**
Total Existing Demand (Irrigation + Commercial)		
18-Hole Course + Commercial Demands	93,186	GPD
	104	AFY
Project Area Demand 3-Hole Course + Commercial	16,689	GPD
	18.7	**AFY**

Source: Coyne. 6 August 2024. Development Corporation, Domestic Meter and Well Production Invoices “Email to Fuscoe Engineering.”

Wavegarden Cove, Water Management Introduction – Newport Beach Cove.

18 October 2024. Proposed Lagoon Water Estimates

In the following graph it can be seen how rainfall compensates water evaporation and final fresh water requirements are much lower than evaporation losses.



In addition, it may is prudent to also consider a possible drain/fill of the whole Cove lagoon for exceptional maintenance issues; this represents some 10.2 Mgal of additional water requirements (although this is unlikely to be required every year).

In addition, we have made a rough estimation considering that the water temperature doesn´t go below 19ºC. This artificial increase of water temperature generates an "extra" evaporation. It is like having summer water temperature the whole year.

Table 2.General water requirements estimation for Newport Beach Cove considering that water temperature is over 19ºC

Surf lagoon water loss calculation	Totals	Gallons
Temperature mean (ºC)	19	
Open water Evaporation Estimate (m3/year) (gal/year)	49.079	12.966.764
Wave operation Factor WG	1,45	
Backwash losses (m3/year) (gal/year)	730	192.867
Average Evaporation Water Loss (m3/day) (gal/year)	195	51.512
Operating Water Loss (m3/year)(gal/year)	71.895	18.994.674
Annual rainfall (mm)(inch)	267	11
Annual rainfall (m3) (gal)	5.284	1.396.018
Total Year Water Requirements (m3/year) (gal/year)	**66.611**	**17.598.655**
Mean total water requirements (m3/day) (gal/day)	**182**	**48.215**
Average total water requirements not considering Annual fill and no rain (m3/day)(gal/day)	**197**	**52.040**
Maximum daily August (max average temp) (m3/day)(gal/day)	**272**	**71.811**

18.994 MILLION GALLONS = ANNUAL OPERATION VOLUMES (OPERATING LOSS) AND DOES NOT INCLUDE INITIAL LAGOON FILL OR DRAW DOWN AND REFILL.

Snug Harbor Proposed Lagoon Water Demands

WATER REQUIREMENTS – ROUTINE SURF LAGOON MAINTENANCE			
	Gallons/Year	**Gallons/Day**	**AFY**
Draining of the Lagoon – *(Frequency: Annually)*	5,100,000	13,973	15.65
Filter Cleaning of the Lagoon – *(Frequency: 17 times per year)*	45,067	123	0.14
Total Water Requirements – Routine Maintenance	**5,145,067**	**14,096**	**15.79**
WATER REQUIREMENTS – ANNUAL SURF LAGOON OPERATION			
	Gallons/Year	**Gallons/Day**	**AFY**
Average Temperature *(°F)*	66 °F		
Open Water Evaporation Estimate *(gal/year)*	12,966,764	35,525	39.79
Wave Operation Factor	1.45		
Backwash losses *(gal/year)*	192,867	528	0.59
Average Evaporation Water Loss *(gal/year)*	51,512	141	0.16
Operating Water Loss *(gal/year)*	**18,994,674**	**52,040**	**58.29**
Annual Rainfall *(11 inches)*	**1,396,018**	**3,825**	**4.28**
Total Water Requirement – Annual Operation	**17,598,655**	**48,215**	**54.01**
Total Water Requirement – Routine Maintenance + Annual Operation	**22,743,722**	**62,312**	**69.80**

Sources
1. *Wavegarden Cove. 18 October 2024. Water Management Introduction – Newport Beach Cove*
2. *Coyne. 30 September 2024. Water Requirement "Email to Fuscoe Engineering."*

Proposed Water Use Factors

IRWD WATER USE FACTORS	
Land Use Designation	**Water Use Factor**
Community Commercial	175 Gallons/KSF/Day
Hotel	160 Gallons/Room/Day

Sources: *IRWD 2019 Water Resources Master Plan - Table 3-1: Land Use and Water Use Factors*

Snug Harbor Proposed Clubhouse & Accommodations Water Demands

Proposed Clubhouse and Accommodations	Amount	Avg. Unit Flow	Avg. Flow (GPD)	Avg. Flow (AFY)
Clubhouse Building & Accommodations[14] (SF)	69,216 SF	0.175 (GPD/SF)[1]	12,113	13.57
Athlete Accommodations (Rms)	20 Keys	160 (GPD/Key)[1]	3,200	3.58
Showers for Pools/Lagoons	9 Showers	54 (GPD/Shower)[2]	486	0.54
Recreational Pools and Spas (SF)	3 Pools 1 Spa	* Proration of the lagoons water usage based on surface areas	931	1.04
		TOTALS	**16,733**	**18.74**

1. Irvine Ranch Water District, 2019, Water Resources Master Plan, Table 3-1
2. 54 GPD/Shower = Assumed 18 gal/shower usage x 3 uses per day per shower facility. Source: Alliance for Water Efficiency. "Showering to Savings." *Home Water Works*, 2016 Residential End Uses of Water Study, The Water Research Foundation, https://home-water-works.org/indoor-use/showers.

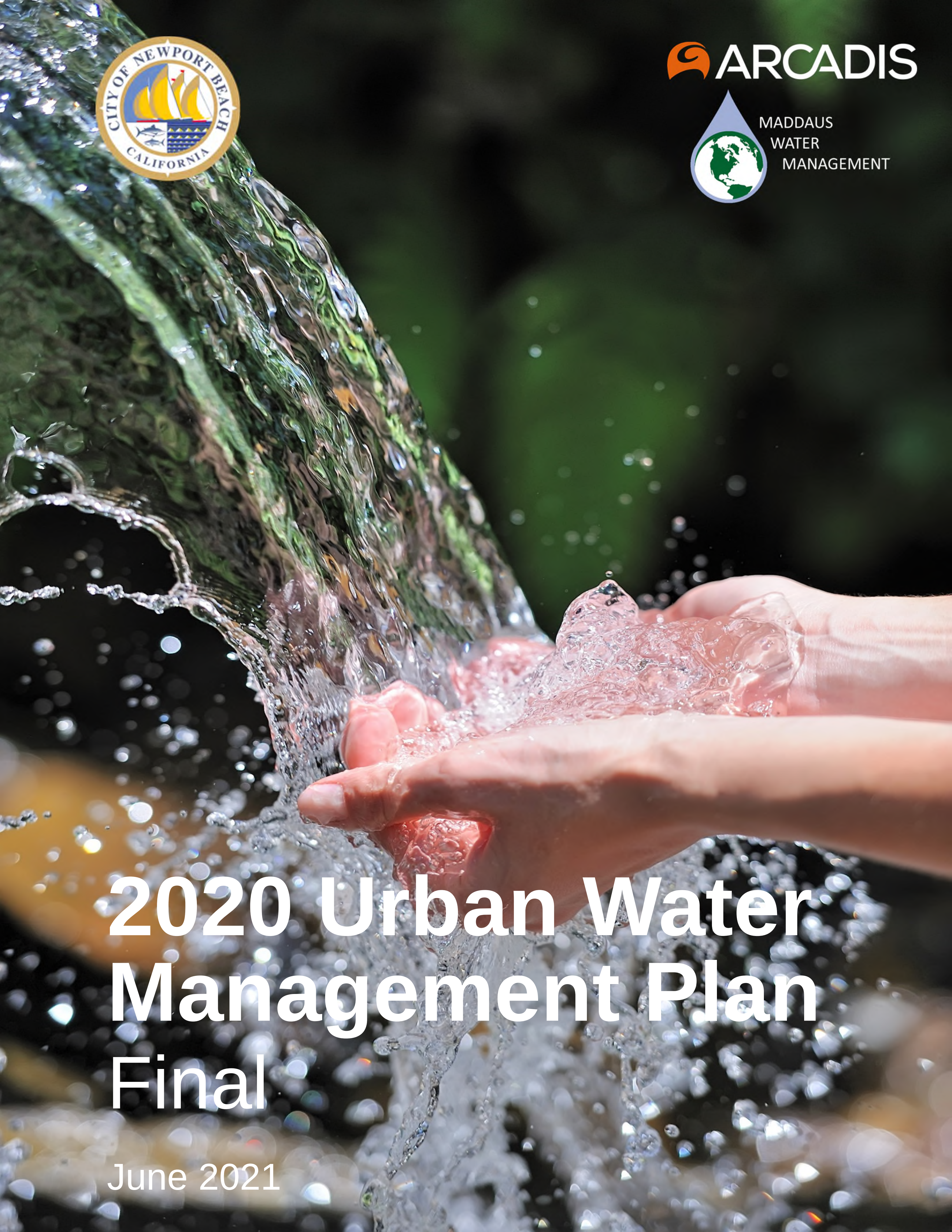
Snug Harbor Net Change in Water Demands

Proposed Land Uses	Amount	GPD	AFY
Proposed Water Use			
Wave Pool/ Surf Lagoon	• 5.5 Acre Wave Pool	62,312	69.80
Clubhouse & Accommodations	• 69,216 SF • 20 Keys • 9 Showers • 3 Pools and 1 Spa	16,733	18.74
	Total Proposed Water Demands	**79,045**	**88.54**
Existing Water Use			
Golf Course	• 3-holes	15,299	17.14
Commercial Amenities	• Pro Shop, Clubhouse, and Restaurant	1,389	1.56
	Total Existing Water Demands	**16,689**	**18.70**
	Net Change (Proposed – All Existing Uses)	**62,356**	**70**
	Net Change (Proposed – Existing Commercial Amenities)	**77,656**	**87**

[14] 69,216 SF includes Clubhouse Building 68,478 SF and the Standalone Restrooms 738 SF.

APPENDIX C

NEWPORT BEACH UWMP 2020



CITY OF NEWPORT BEACH CALIFORNIA

ARCADIS

MADDAUS WATER MANAGEMENT

2020 Urban Water Management Plan

Final

June 2021

2020 URBAN WATER MANAGEMENT PLAN

Prepared for:

City of Newport Beach

949 W. 16th Street

Newport Beach, California 92663

Sarina Sriboonlue, P.E.
Project Manager

Prepared by:

Arcadis U.S., Inc.

320 Commerce

Suite 200

Irvine

California 92602

Tel 714 730 9052

Fax 714 730 9345

Our Ref:

30055240

Date:

June 2021

CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

%	Percent
20x2020	20% water use reduction in GPCD by year 2020
ADU	Accessory Dwelling Unit
Act	Urban Water Management Planning Act of 1983
AF	Acre-Feet
AFY	Acre-Feet per Year
AMI	Advanced Metering Infrastructure
AWWA	American Water Works Association
BEA	Basin Equity Assessment
Biops	Biological Opinions
BMP	Best Management Practice
BPP	Basin Production Percentage
CCC	California Coastal Commission
CDR	Center for Demographic Research at California State Fullerton
CEC	Constituents of Emerging Concern
CEE	Consortium for Energy Efficiency
CFS	Cubic Feet per Second
CII	Commercial/Industrial/Institutional
CIP	Capital Improvement Program
City	City of Newport Beach
CPTP	Coastal Pumping Transfer Program
CRA	Colorado River Aqueduct
CTE	Career Technical Education
CUP	Conjunctive Use Program
CVP	Central Valley Project
CY	Calendar Year
DAC	Disadvantaged Communities
DCP	Delta Conveyance Project
DDW	California State Division of Drinking Water
Delta	Sacramento-San Joaquin River Delta
DRA	Drought Risk Assessment
DMM	Demand Management Measure
DOF	Department of Finance
DVL	Diamond Valley Lake
DWR	Department of Water Resources
FIRO	Forecast Informed Reservoir Operations
FY	Fiscal Year
GAP	Green Acres Project

GHG	Greenhouse Gas
GPCD	Gallons per Capita per Day
gpf	Gallons per Flush
GRP	Groundwater Reliability Plan
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWRS	Groundwater Replenishment System
GWRSFE	Groundwater Replenishment System Final Expansion
H_2O_2	Hydrogen Peroxide
HECW	High Efficiency Clothes Washer
HEN	High Efficiency Nozzle
HET	High Efficiency Toilet
HOA	Home Owners Association
IPR	Indirect Potable Reuse
IRP	Integrated Water Resources Plan
JADU	Junior Accessory Dwelling Unit
kWh	Kilowatt-Hour
LRP	Local Resources Program
LTFP	Long-Term Facilities Plan
MAF	Million Acre-Feet
MCL	Maximum Contaminant Level
MET	Metropolitan Water District of Southern California
MF	Microfiltration
MG	Million Gallon
MGD	Million Gallons per Day
MHI	Median Household Income
MNWD	Moulton Niguel Water District
MTBE	Methyl Tertiary Butyl Ether
MWDOC	Municipal Water District of Orange County
MWELO	Model Water Use Efficiency Landscape Ordinance
NDMA	N-nitrosodimethylamine
NPDES	National Pollutant Discharge Elimination System
NRW	Non-Revenue Water
OC	Orange County
OC Basin	Orange County Groundwater Basin
OC San	Orange County Sanitation District
OCWD	Orange County Water District
ORP	On-Site Retrofit Program
PFAS	Per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid

PFOS	perfluorooctane sulfanate
Poseidon	Poseidon Resources LLC
PPCP	Pharmaceuticals and Personal Care Product
ppt	Parts per trillion
PSA	Public Service Announcement
QWEL	Qualified Water Efficient Landscaper
RA	Replenishment Assessment
RHNA	Regional Housing Needs Assessment
RO	Reverse Osmosis
RUWMP	Regional Urban Water Management Plan
SBx7-7	Senate Bill 7 as part of the Seventh Extraordinary Session
SCAB	South Coast Air Basin
SCAG	Southern California Association of Governments
SCWD	South Coast Water District
SMWD	Santa Margarita Water District
SDP	Seawater Desalination Program
sf	Square Feet
STEAM	Science Technology Engineering Arts and Mathematics
SWP	State Water Project
SWRCB	California State Water Resources Control Board
TAF	Thousand Acre-Feet
TDS	Total Dissolved Solids
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
UV	Ultraviolet
UWMP	Urban Water Management Plan
UWMP Act	Urban Water Management Planning Act of 1983
VOC	Volatile Organic Compound
Water Code	California Water Code
WBIC	Weather-Based Irrigation Controller
WF-21	Water Factory 21
WSAP	Water Supply Allocation Plan
WSCP	Water Shortage Contingency Plan
WSIP	Water Savings Inventory Program
WUO	Water Use Objective

EXECUTIVE SUMMARY

INTRODUCTION AND UWMP OVERVIEW

The City of Newport Beach (City) prepared this 2020 Urban Water Management Plan (UWMP) to submit to the California Department of Water Resources (DWR) to satisfy the UWMP Act of 1983 (UWMP Act or Act) and subsequent California Water Code (Water Code) requirements. The City is a retail water supplier that provides water to its residents and other customers using the imported potable water supply obtained from its regional wholesaler, Municipal Water District of Orange County (MWDOC), local groundwater from the Orange County Groundwater Basin (OC Basin), and recycled water from the Orange County Water District (OCWD).

UWMPs are comprehensive documents that present an evaluation of a water supplier's reliability over a long-term (20-25 year) horizon. This 2020 UWMP provides an assessment of the present and future water supply sources and demands within the City's service area. It presents an update to the 2015 UWMP on the City's water resource needs, water use efficiency programs, water reliability assessment and strategies to mitigate water shortage conditions. It also presents a new 2020 Water Shortage Contingency Plan (WSCP) designed to prepare for and respond to water shortages. This 2020 UWMP contains all elements to meet compliance of the new requirements of the Act as amended since 2015.

UWMP PREPARATION

The City coordinated the preparation of this 2020 UWMP with other key entities, including MWDOC (regional wholesaler of imported water for Orange County), Metropolitan Water District of southern California (MET) (regional wholesaler for Southern California and the direct supplier of imported water to MWDOC), and OCWD (OC Basin manager and provider of recycled water in north Orange County). The City also coordinated with other entities, which provided valuable data for the analyses prepared in this UWMP, such as the Center for Demographic Research (CDR) at California State University Fullerton for population projections, through MWDOC's assistance.

SYSTEM DESCRIPTION

The City was incorporated on September 1, 1906 and is governed by a seven-member City Council which operates under a Council-Manager format of government. The City Utilities Department and the Public Works Department work collaboratively to provide water to the customers.

The City's water service area covers about 11 square miles located along the Orange County coast of Southern California. The water service area covers most of the City's boundaries with the remaining areas served by Irvine Ranch Water District (IRWD) and Mesa Water District (Mesa Water).

The City operates a wellfield with a total capacity of 10,900 gallons per minute (gpm), 15 recycled water connections, 6 inter-agency emergency interconnections and manages about 300-mile water mains system with 26,765 service connections.

Lying in the South Coast Air Basin (SCAB), its climate is characterized by Southern California's "Mediterranean" climate with mild winters, warm summers and moderate rainfall. In terms of land use, the City is almost built out with predominantly single and multi-family residential units. Moving forward, the City will continue planning for its Regional Housing Needs Assessment (RHNA) allocation and future planned developments beyond 2020 will mainly include addition of institutional, commercial and a few residential units. The current population of 61,916 is projected to increase by only 4.8% over the next 25 years.

WATER USE CHARACTERIZATION

Water use within the City's service area has been relatively stable in the past decade with an annual average of 15,413 AF. In this period, potable and non-potable water use accounted for an average of 97% and 3% of total City water use, respectively. In FY2019-20, the City's water use was 14,492 AF of potable water (groundwater and imported) and 513 AF of direct recycled water for landscape irrigation. In FY2019-20, the City's potable water use profile was comprised of 58.9% residential use, 18.2% commercial, institutional, and industrial (CII) and 18.1% large landscape/irrigation, with non-revenue water and other uses comprising about 4.8%.

Water Use Projections: 5-year and 25-year

The City's service area is almost completely built-out and is projected to add minimum land use and small population increase. Water demand is likely to decrease less than 1% over the next 5 years. In the longer term, water demand is projected to increase 5.2% from 2025 through 2045. The projected water use for 2045 is 15,103 AF for potable water and 542 AF for recycled water.

This demand projection considers such factors as current and future demographics, future water use efficiency measures, and long term weather variability.

CONSERVATION TARGET COMPLIANCE

Retail water suppliers are required to comply with the requirements of Water Conservation Act of 2009, also known as SBx7-7 (Senate Bill 7 as part of the Seventh Extraordinary Session), which was signed into law in 2010 and requires the State of California to reduce urban water use by 20% by 2020 from a 2013 baseline.

The retail water suppliers can comply individually or as a region in collaboration with other retail water suppliers, in order to be eligible for water related state grants and loans. The City is part of the Orange County 20x2020 Regional Alliance created in collaboration with MWDOC, its retail member agencies as well as the Cities of Anaheim, Fullerton, and Santa Ana. The Alliance was created to assist OC retail agencies in complying with SBx7-7.

The City met its 2020 water use target and is in compliance with SBx7-7; the actual 2020 consumption was 160 gallons per capita per day (GPCD), which is below its 2020 target of 207 GPCD.

WATER SUPPLY CHARACTERIZATION

The City meets all of its demands with a combination of imported water, local groundwater, and recycled water. The City works together with two primary agencies, MWDOC and OCWD to ensure a safe and reliable water supply that will continue to serve the community in periods of drought and shortage. The sources of imported water supplies include water from the Colorado River and the State Water Project (SWP) provided by MET and delivered through MWDOC.

The City's main source of water supply is groundwater from the OC Basin. Imported water and recycled water supplement the City's water supply portfolio. In FY 2019-20, the City's water supplies consisted of 68% groundwater, 28.5% imported water, and 3.5% recycled water.

It is projected that by 2045, the water supply portfolio will shift to 82% groundwater, 14.5% imported water, and 3.5% recycled water. Note that these representations of supply match the projected demand. The City can purchase more MET water through MWDOC, should the need arise.

The City does not own or operate wastewater treatment facilities but owns and operates the wastewater collection system in its service area that sends all wastewater to OC San for treatment and disposal. The City benefits from its direct and indirect uses of recycled water. OCWD's Green Acres Project (GAP) produces recycled water for direct non-potable reuses such as landscape irrigation. OCWD's Groundwater Replenishment System (GWRS) produces recycled water for indirect potable reuse (IPR) through the replenishment of the OC Basin.

WATER SERVICE RELIABILITY AND DROUGHT RISK ASSESSMENT

Every urban water supplier is required to assess the reliability of their water service to its customers under a normal year, a single dry year, and a drought period lasting five consecutive years. The water service reliability assessment compares projected supply to projected demand for the three hydrological conditions between 2025 and 2045. Factors affecting reliability, such as climate change and regulatory impacts, are accounted for as part of the assessment.

The City depends on a combination of imported and local supplies to meet its water demands and has taken numerous steps to ensure it has adequate supplies. MET's and MWDOC's 2020 UWMPs conclude that they can meet full-service demands of their member agencies through 2045 during normal years, single-dry years, and multiple-dry years. Consequently, the City is projected to meet full-service demands through 2045 for all scenarios, due to diversified supply and conservation measures.

The Drought Risk Assessment (DRA) evaluates the City's near-term ability to supply water assuming the City is experiencing a drought over the next five years. Even under the assumption of a drought over the next five years, MET's 2020 UWMP concludes a surplus of water supplies would be available to all of its Member Agencies, including MWDOC and in effect, the City, should the need for additional supplies arise to close any local supply gap. Additionally, the City partakes in various efforts to reduce its reliance on imported water supplies such as increasing the use of local groundwater and recycled water supplies.

WATER SHORTAGE CONTINGENCY PLANNING

Water shortage contingency planning is a strategic planning process that the City engages to prepare for and respond to water shortages. A water shortage, when water supply available is insufficient to meet the normally expected customer water use at a given point in time, may occur due to a number of reasons, such as water supply quality changes, climate change, drought, and catastrophic events (e.g., earthquake). The City's WSCP provides real-time water supply availability assessment and structured steps designed to respond to actual conditions. This level of detailed planning and preparation will help maintain reliable supplies and reduce the impacts of supply interruptions.

The WSCP serves as the operating manual that the City will use to prevent catastrophic service disruptions through proactive, rather than reactive, mitigation of water shortages. The WSCP contains the processes and procedures that will be deployed when shortage conditions arise so that the City's governing body, its staff, and its retail agencies can easily identify and efficiently implement pre-determined steps to mitigate a water shortage to the level appropriate to the degree of water shortfall anticipated.

DEMAND MANAGEMENT MEASURES

The City, along with other Retail water agencies throughout Orange County, recognizes the need to use existing water supplies efficiently. This ethic of efficient water use has evolved as a result of the development and implementation of water use efficiency programs that make economic sense while reflecting responsible stewardship of the region’s water resources. The City works closely with MWDOC to promote regional efficiency by participating in the regional water savings programs, leveraging MWDOC local program assistance, and applying the findings of MWDOCs research and evaluation efforts. This approach helps minimize confusion to consumers by providing the same programs with the same participation guidelines, maintains a consistent message to the public to use water efficiently, and provides support to retail water agencies with MWDOC serving as program administrator for the region.

PLAN ADOPTION, SUBMITTAL, AND IMPLEMENTATION

The Water Code requires the UWMP to be adopted by the Supplier’s governing body. Before the adoption of the UWMP, the City notified the public and the cities and counties within its service area per the Water Code and held a public hearing to receive input from the public on the UWMP. Post adoption, the City submitted the UWMP to DWR and the other key agencies and will make it available for public review no later than 30 days after filing with DWR.

1 INTRODUCTION AND UWMP OVERVIEW

The City of Newport Beach (City) prepared this 2020 Urban Water Management Plan (UWMP or Plan) to submit to the California Department of Water Resources (DWR) to satisfy the UWMP Act of 1983 (UWMP Act or Act) and subsequent California Water Code (Water Code) requirements. The City is a retail water supplier that provides water to its residents and other customers using the imported potable water supply obtained from its regional wholesaler, Municipal Water District of Orange County (MWDOC), local groundwater from the Orange County Groundwater Basin (OC Basin), and recycled water from the Orange County Water District (OCWD). The City, as one of MWDOC's 28 member agencies, prepared this 2020 UWMP in collaboration with MWDOC, Metropolitan Water District of Southern California (MET), OCWD, and other key agencies.

UWMPs are comprehensive documents that present an evaluation of a water supplier's reliability over a long-term (20-25 year) horizon. In response to the changing climatic conditions and regulatory updates since the 2015 UWMP, the City has been proactively managing its water supply and demand. The water loss audit program, water conservation measures and efforts for increased self-reliance in order to reduce dependency on imported water from the Sacramento-San Joaquin Delta (Delta) are some of the water management efforts that the City is a part of to maintain the reliability of water supply for its service area.

This 2020 UWMP provides an assessment of the present and future water supply sources and demands within the City's service area. It presents an update to the 2015 UWMP on City's water resource needs, water use efficiency programs, water reliability assessment and strategies to mitigate water shortage conditions. It presents a new 2020 Water Shortage Contingency Plan (WSCP) designed to prepare for and respond to water shortages. This 2020 UWMP contains all elements to meet compliance of the new requirements of the Act as amended since 2015.

1.1 Overview of Urban Water Management Plan Requirements

The UWMP Act enacted by California legislature requires every urban water supplier (Supplier) providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet (AF) of water annually to prepare, adopt, and file an UWMP with the California DWR every five years in the years ending in zero and five.

For this 2020 UWMP cycle, DWR placed emphasis on achieving improvements for long term reliability and resilience to drought and climate change in California. Legislation related to water supply planning in California has evolved to address these issues, namely Making Conservation a Way of Life [Assembly Bill (AB) 1668 and Senate Bill (SB) 606] and Water Loss Performance Standard SB555. New UWMP requirements in 2020 are a direct result of these new water regulations. Two complementary components were added to the 2020 UWMP. First is the WSCP to assess the Supplier's near term 5-year drought risk assessment (DRA) and provide a structured guide for the Supplier to deal with water shortages. Second is the Annual Water Supply Demand Assessment (WSDA) to assess the current year plus one dry year i.e., short-term demand/supply outlook. Analyses over near- and long-term horizons together will provide a more complete picture of Supplier's reliability and will serve to inform appropriate actions it needs to take to build up capacity over the long term.

The various key new additions in the 2020 UWMP included as a result of the most recent water regulations are:

- **Water Shortage Contingency Plan (WSCP) –** WSCP helps a Supplier to better prepare for drought conditions and provides the steps and water use efficiency measures to be taken in times of water shortage conditions. WSCP now has more prescriptive elements, including an analysis of water supply reliability; the water use efficiency measures for each of the six standard water shortage levels, that correspond to water shortage percentages ranging from 0 - 10% to greater than 50%; an estimate of potential to close supply gap for each measure; protocols and procedures to communicate identified actions for any current or predicted water shortage conditions; procedures for an annual water supply and demand assessment; monitoring and reporting requirements to determine customer compliance; reevaluation and improvement procedures for evaluating the WSCP.
- **Drought Risk Assessment –** The Suppliers are now required to compare their total water use and supply projections and conduct a reliability assessment of all their sources for a consecutive five-year drought period beginning 2021.
- **Five Consecutive Dry-Year Water Reliability Assessment** - The three-year multiple dry year reliability assessment in previous UWMPs has now been extended from three to five consecutive dry years to include a more comprehensive assessment of the reliability of the water sources to improve preparedness of Suppliers for extended drought conditions.
- **Seismic Risk –** The UWMP now includes a seismic risk assessment of the water supply infrastructure and a plan to mitigate any seismic risks on the water supply assets.
- **Groundwater Supplies Coordination –** The UWMP should be in accordance with the Sustainable Groundwater Management Act of 2014 and consistent with the Groundwater Sustainability Plans, wherever applicable.
- **Lay Description** – To provide a better understanding of the UWMP to the general public, a lay description of the UWMP is included, especially summarizing the Supplier's detailed water service reliability assessment and the planned management steps and actions to mitigate any possible shortage scenarios.

1.2 UWMP Organization

This UWMP is organized into 10 main sections aligned with the DWR Guidebook recommendations. The subsections are customized to tell the City's story of water supply reliability and ways to overcome any water shortages over a planning horizon of the next 25 years.

Section 1 Introduction and UWMP Overview gives an overview of the UWMP fundamentals and briefly describes the new additional requirements passed by the Legislature for 2020 UWMP.

Section 2 UWMP Preparation identifies this UWMP as an individual planning effort of the City, lists the type of year and units of measure used and introduces the coordination and outreach activities conducted by the City to develop this UWMP.

Section 3 System Description gives a background on the City's water system and its climate characteristics, population projection, demographics, socioeconomics and predominant current and projected land uses of its service area.

Section 4 Water Use Characterization provides historical, current, and projected water use by customer category for the next 25 years within the City's service area and the projection methodology used by MWDOC to develop the 25-year projections**.**

Section 5 Conservation Target Compliance reports the SB X7-7 water use conservation target compliance of the City (individually and as a member of the OC 20x2020 Regional Alliance).

Section 6 Water Supply Characterization describes the current water supply portfolio of the City as well as the planned and potential water supply projects and water exchange and transfer opportunities.

Section 7 Water Service Reliability and Drought Risk Assessment assesses the reliability of the City's water supply service to its customers for a normal year, single dry year, and five consecutive dry years scenarios. This section also includes a DRA of all the supply sources for a consecutive five-year drought period beginning 2021.

Section 8 Water Shortage Contingency Planning is a brief summary of the standalone WSCP document (Appendix H) which provides a structured guide for the City to deal with water shortages, incorporating prescriptive information and standardized action levels, lists the appropriate actions and water use efficiency measures to be taken to ensure water supply reliability in times of water shortage conditions, along with implementation actions in the event of a catastrophic supply interruption.

Section 9 Demand Management Measures provides a comprehensive description of the water conservation programs that the City has implemented, is currently implementing, and plans to implement in order to meet its urban water use reduction targets.

Section 10 Plan Adoption, Submittal, and Implementation provides a record of the process the City followed to adopt and implement its UWMP.

2 UWMP PREPARATION

The City's 2020 UWMP is an individual UWMP for the City to meet the Water Code compliance as a retail water supplier. While the City opted to prepare its own UWMP and meet Water Code compliance individually, the development of this UWMP involved close coordination with its whole supplier, MWDOC along with other key entities within the region.

2.1 Individual Planning and Compliance

The City opted to prepare its own UWMP (Table 2-1) and comply with the Water Code individually, while closely coordinating with MWDOC and various key entities as discussed in Section 2.2 to ensure regional integration. The UWMP Checklist was completed to confirm the compliance of this UWMP with the Water Code Appendix A.

One consistency with MWDOC and the majority of its other retail member agencies is that the City selected to report demands and supplies using fiscal year (FY) basis (Table 2-2).

Table 2-1: Plan Identification

DWR Submittal Table 2-2: Plan Identification			
Select Only One	**Type of Plan**		**Name of RUWMP or Regional Alliance** *if applicable*
☑	**Individual UWMP**		
	☐	Water Supplier is also a member of a RUWMP	
	☑	Water Supplier is also a member of a Regional Alliance	Orange County 20x2020 Regional Alliance
☐	**Regional Urban Water Management Plan (RUWMP)**		
NOTES:			

Table 2-2: Supplier Identification

DWR Submittal Table 2-3: Supplier Identification	
Type of Supplier (select one or both)	
☐	Supplier is a wholesaler
☑	Supplier is a retailer
Fiscal or Calendar Year (select one)	
☐	UWMP Tables are in calendar years
☑	UWMP Tables are in fiscal years
If using fiscal years provide month and date that the fiscal year begins (mm/dd)	
7/1	
Units of measure used in UWMP (select from drop down)	
Unit	AF
NOTES: The energy intensity data is reported in calendar year consistent with the Greenhouse Gas Protocol.	

2.2 Coordination and Outreach

2.2.1 Integration with Other Planning Efforts

The City, as a retail water supplier, coordinated this UWMP preparation effort with other key entities, including MWDOC (regional wholesale supplier for OC), MET (regional wholesaler for Southern California and the direct supplier of imported water to MWDOC), and OCWD (OC Basin manager and provider of recycled water in north OC). The City also developed this Plan in conjunction with other MWDOC-led efforts such as population projection from the Center for Demographic Research at California State University Fullerton (CDR).

Some of the key planning and reporting documents that were used to develop this UWMP are:

- **MWDOC's 2020 UWMP** provides the basis for the projections of the imported supply availability over the next 25 years for the City's service area.
- **MWDOC's 2020 WSCP** provides a water supply availability assessment and structured steps designed to respond to actual conditions that will help maintain reliable supplies and reduce the impacts of supply interruptions.

- **2021 OC Water Demand Forecast for MWDOC and OCWD Technical Memorandum (Demand Forecast TM)** provides the basis for water demand projections for MWDOC's member agencies as well as Anaheim, Fullerton, and Santa Ana.
- **MET's 2020 Draft Integrated Water Resources Plan (IRP)** is a long-term planning document to ensure water supply availability in Southern California and provides a basis for water supply reliability in Orange County.
- **MET's 2020 UWMP** was developed as a part of the 2020 IRP planning process and was used by MWDOC as another basis for the projections of supply capability of the imported water received from MET.
- **MET's 2020 WSCP** provides a water supply assessment and guide for MET's intended actions during water shortage conditions.
- **OCWD's Groundwater Reliability Plan** (to be finalized after July 2021) provides the latest information on groundwater management and supply projection for the OC Basin, the primary source of groundwater for 19 retail water suppliers in OC.
- **OCWD's 2019-20 Engineer's Report** provides information on the groundwater conditions and basin utilization of the OC Basin.
- **OCWD's 2017 Basin 8-1 Alternative** is an alternative to the Groundwater Sustainability Plan (GSP) for the OC Basin and provides significant information related to sustainable management of the basin in the past and hydrogeology of the basin, including groundwater quality and basin characteristics.
- **Local Hazard Mitigation Plan** provides the basis for the seismic risk analysis of the water system facilities.
- **Orange County Local Agency Formation Commission's 2020 Municipal Service Review for MWDOC Report** provides comprehensive review of the municipal services provided by MWDOC.
- **Water Master Plan** of the City provides information on water infrastructure planning projects and plans to address any required water system improvements.

Statewide Water Planning

In addition to regional coordination with various agencies described above, the City as a MWDOC member agency is currently a part of MET's statewide planning effort to reduce reliance on the water imported from Sacramento-San Joaquin Delta.

It is the policy of the State of California to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. This policy is codified through the Delta Stewardship Council's Delta Plan Policy WR P1 and is measured through Supplier reporting in each Urban Water Management Planning cycle. WR P1 is relevant to water suppliers that plan to participate in multi-year water transfers, conveyance facilities, or new diversions in the Delta.

Through significant local and regional investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts, the City has demonstrated a reduction in Delta reliance and a subsequent improvement in regional self-reliance. For a detailed description and documentation of the City's consistency with Delta Plan Policy WR P1 see Section 7.4 and Appendix C.

2.2.2 Wholesale and Retail Coordination

The City developed its UWMP in conjunction with MWDOC's 2020 UWMP. The City provided its historical water use and initial water use projections data to MWDOC (Table 2-3). MWDOC facilitated in refining the projections of the City's water demand and the imported supply from MWDOC over the next 25 years.

The City also has been taking part in many regional programs administered by MWDOC to assist retail agencies meet various State compliance, such as the OC Regional Alliance for SBx7-7 compliance, regional water loss program for SB555 compliance, and regional water use efficiency programs. Sections 5 and 9 provide detailed information on these programs.

Table 2-3: Retail: Water Supplier Information Exchange

DWR Submittal Table 2-4 Retail: Water Supplier Information Exchange
The retail Supplier has informed the following wholesale supplier(s) of projected water use in accordance with Water Code Section 10631.
Wholesale Water Supplier Name
MWDOC
NOTES:

2.2.3 Public Participation

For further coordination with other key agencies and to encourage public participation in the review and update of this Plan, the City held a public hearing and notified key entities and the public per the Water Code requirements. Sections 10.2 and 10.3 describe these efforts in detail.

3 SYSTEM DESCRIPTION

The City was incorporated on September 1, 1906 and is governed by a seven-member City Council which operates under a Council-Manager format of government. The City Utilities Department and the Public Works Department work collaboratively to provide water to the customers.

The City's water service area covers about 11 square miles located along the Orange County coast of Southern California, bounded to the West by the Pacific Ocean, to the North by the cities of Huntington Beach and Costa Mesa, to the South by Laguna Beach, and to the East by Irvine. The water service area covers most of the City's boundaries with the remaining areas served by Irvine Ranch Water District (IRWD) and Mesa Water District (Mesa Water). The City operates a wellfield with a total capacity of 10,900 gallons per minute (gpm), 15 recycled water connections, 6 inter-agency emergency interconnections and manages about 300-mile water mains system with 26,765 service connections.

Lying in the South Coast Air Basin (SCAB), its climate is characterized by Southern California's "Mediterranean" climate with mild winters, warm summers and moderate rainfall. In terms of land use, the City is almost built out with predominantly single and multi-family residential units. Moving forward, the City will continue planning for its Regional Housing Needs Assessment (RHNA) allocation and future planned developments beyond 2020 will mainly include addition of institutional, commercial and a few residential units. The current population of 61,916 is projected to increase by only 4.8% over the next 25 years.

3.1 Agency Overview

This section provides information on the formation and history of the City, its organizational structure, roles, objectives, and the relationship to MWDOC.

3.1.1 Formation and Purpose

The City was incorporated on September 1, 1906 and the current City Charter was adopted in 1954. The City is known for its fine residential areas, modern shopping facilities, strong business community and quality school system. It surrounds Newport Bay where approximately 4,300 boats of all types are docked within the 21-square-mile harbor area. The bay area and the City's eight miles of ocean beach offer outstanding fishing, swimming, surfing, and aquatic sports activities.

The City Utilities Department is responsible for the operation and maintenance of the City's water, wastewater, and storm drain systems, as well as and other municipal utilities within the City. The City's Public Works Department is responsible for engineering services including, capital project delivery, bay water quality and environmental services, and transportation and development services. The two departments work collaboratively to plan for the City's water supply and distribution system improvements through master planning and capital improvement program (CIP) efforts.

3.1.2 City Council

The City Council operates under a Council-Manager format of government. Its seven City Council Members are elected by district, but the population as a whole votes for them. The current City Council members are:

- Brad Avery, Mayor
- Kevin Muldoon, Mayor Pro Tem
- Diane B. Dixon
- Duffy Duffield
- Noah Blom
- Joy Brenner
- Will O'Neill

3.1.3 Relationship to MWDOC

The City is one of MWDOC's 28 member agencies purchasing imported water from MWDOC, Orange County's wholesale water supplier and a member agency of MET. The City's location within MWDOC's service is shown on Figure 3-1.

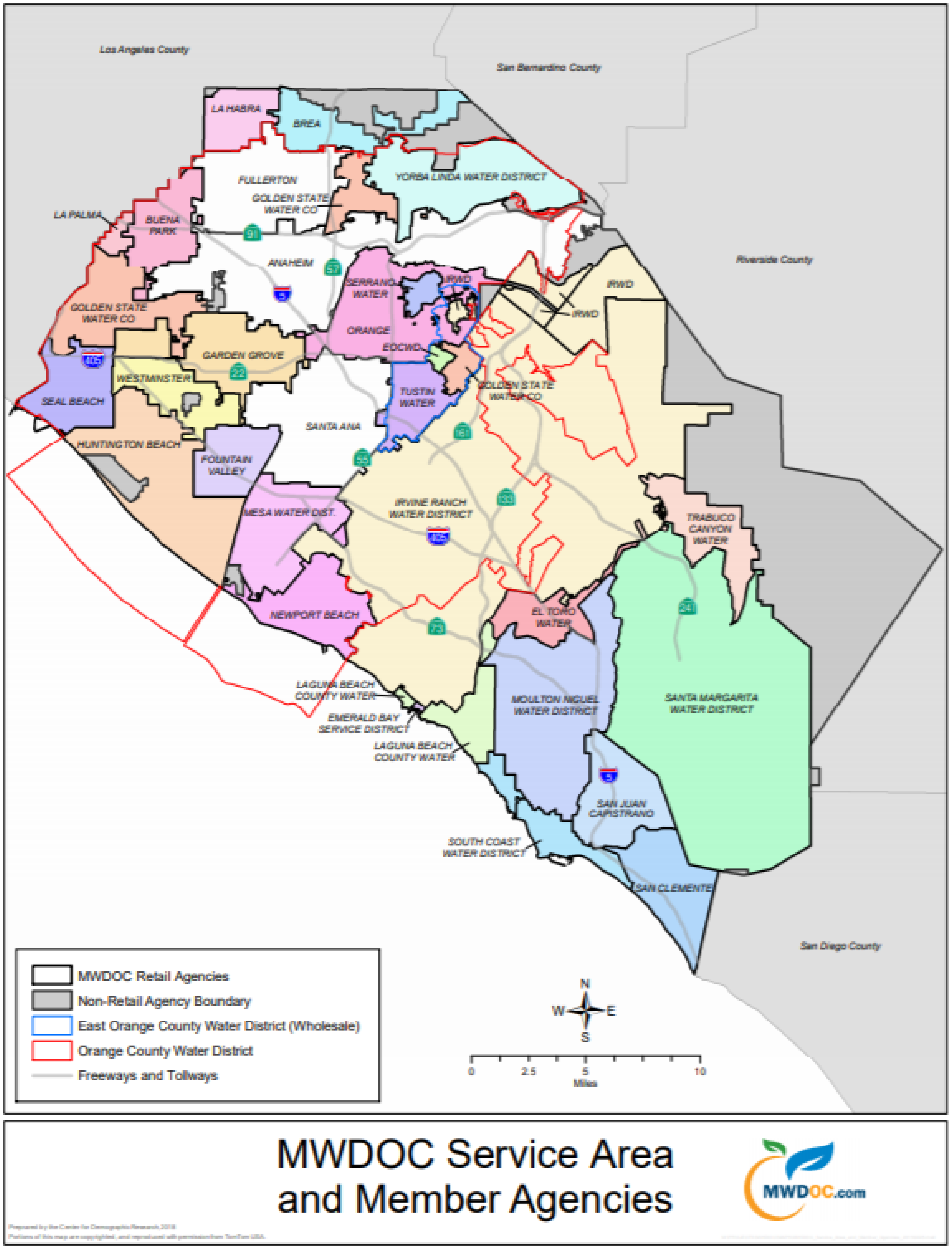


Figure 3-1: Regional Location of City of Newport Beach and Other MWDOC Member Agencies

3.2 Water Service Area and Facilities

3.2.1 Water Service Area

The City provides water to approximately 11 square miles of land area located along the Orange County coast of Southern California. The City is bounded to the West by the Pacific Ocean, to the North by the cities of Huntington Beach and Costa Mesa, to the South by Laguna Beach, and to the East by Irvine. The water service area covers most of the City's boundaries with the remaining areas served by IRWD and Mesa Water as shown on Figure 3-2.

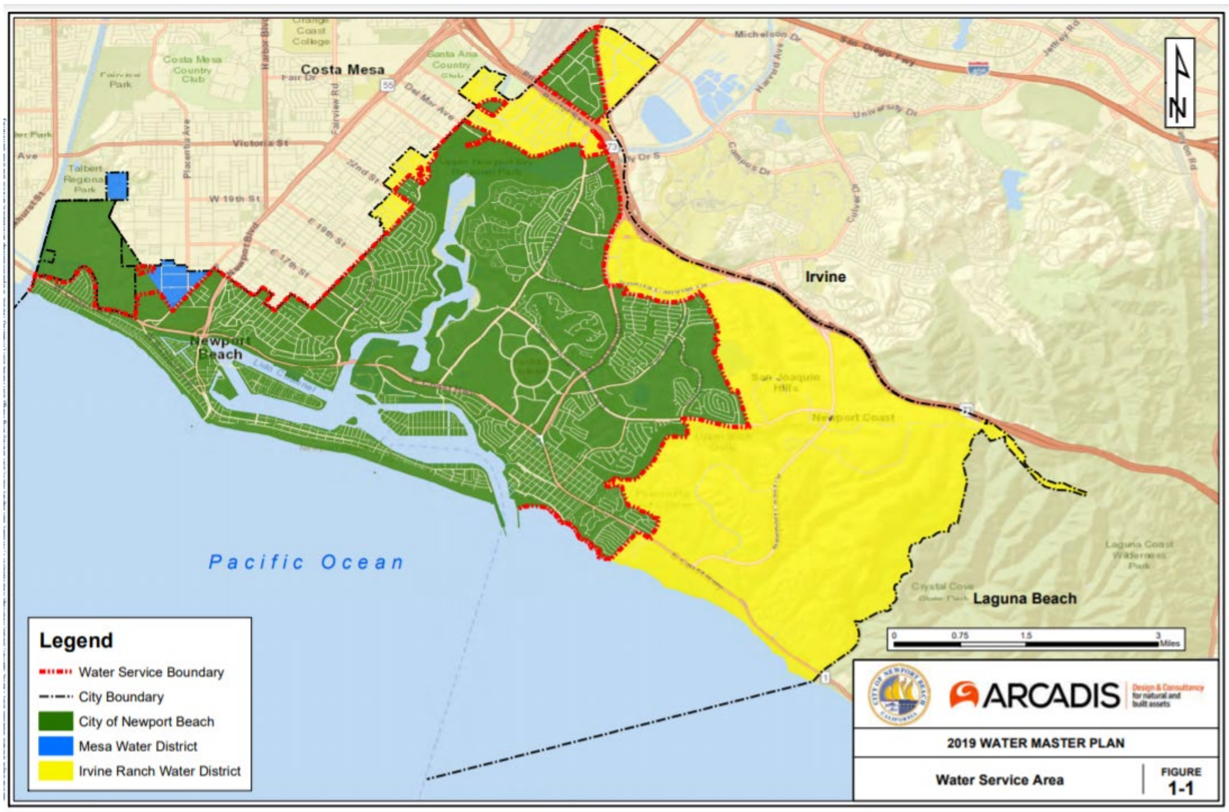


Figure 3-2: City of Newport Beach Water Service Area

3.2.2 Water Facilities

Groundwater Facilities

The City receives a large percentage of its supply from groundwater. The City's wellfield with a total capacity of 10,900 gpm is located in Fountain Valley, approximately five miles north of the City. Groundwater is conveyed from the wellfield to the City via a 30 to 36-inch pipeline that discharges into the 16th Street Reservoir. From the reservoir, the water is pumped into the City's distribution system and into a 600 Acre-foot (AF) storage facility across town called Big Canyon Reservoir.

Reservoirs

The City has three reservoirs - Big Canyon Reservoir has a capacity of 600 AF, 16th Street Reservoir can store up to 3 AF, and Spyglass Reservoir has a capacity of 1.5 AF.

Imported Water Supply Facilities

The City supplements its local groundwater with imported water purchased from MET through MWDOC as a wholesaler. All of the water supplied by the City is sold to its retail customers (residential and commercial). The City maintains its own retail distribution system. The City delivers potable water through its water system which consists of approximately 300 miles of pipelines ranging in size from 1-inch to 48 inches. The City has an extensive distribution system, which includes five pressure zones and six connections along the Orange County Feeder and the East Orange County Feeder No. 2. Maximum turnout capacity equals 67 million gallons per day (MGD). The City has five pump stations that deliver water to the upper zones, and backup generation facilities ensure that the City can still deliver water to all zones during a rolling blackout.

Recycled Water Facilities

The City owns and operates recycled water pump stations for Big Canyon Country Club and the Newport Beach Country Club. Including these two sites, there are currently 15 recycled water connections that supply five different customers. Recycled water is purchased from OCWD and sold to the City's customers.

Water Transmission System

Water is delivered to the City's customers from the Groundwater Transmission Main, and from diversions off the Orange County Feeder and the East Orange County Feeder No. 2. The transmission system consists of pipelines, booster pump stations, and storage reservoirs and tanks. The current capacity of the City's potable water supply is 104 cubic feet per second (cfs).

Emergency Interconnections

For emergency water shortage or outage conditions, the City has six inter-agency emergency interconnections with IRWD and seven with Mesa.

The system connections and water volume supplied are summarized in Table 3-1.

Table 3-1: Retail Only: Public Water Systems

DWR Submittal Table 2-1 Retail Only: Public Water Systems			
Public Water System Number	Public Water System Name	Number of Municipal Connections 2020	Volume of Water Supplied 2020
CA3010023	City of Newport Beach	26,765	15,047
	TOTAL	26,765	15,047
NOTES:			

3.3 Climate

The City is located within the SCAB that encompasses all of OC, and the urban areas of Los Angeles, San Bernardino, and Riverside counties. The SCAB climate is characterized by Southern California's "Mediterranean" climate: a semi-arid environment with mild winters, warm summers and moderate rainfall.

Local rainfall has limited impacts on reducing water demand in the City, except for landscape irrigation demand. Water that infiltrates into the soil may enter groundwater supplies depending on the local geography. However, due to the large extent of impervious cover in Southern California, rainfall runoff quickly flows to a system of concrete storm drains and channels that lead directly to the ocean. OCWD is one agency that has successfully captured stormwater along the Santa Ana River and in recharge basins for years and used it as an additional source of supply for groundwater recharge. Based on the 2017 Basin 8-1 Alternative Plan, OCWD captured an average annual stormwater volume of approximately 44,000 AF over the period of ten years, from Water Year 2006-07 to 2015-16; however, this period's rainfall was 17% below the long term average using San Bernardino precipitation data. Based on a longer period (1989-2015) of rainfall and captured stormwater records, the average year water budget of OCWD assumes a stormwater capture volume of 52,000 AF.

MET's water supplies come from the State Water Project (SWP) and the Colorado River Aqueduct (CRA), influenced by climate conditions in northern California and the Colorado River Basin, respectively. The years 2000-2018 have been the driest 19-year period in the history and both regions have been receiving record low precipitation which directly impact water supplies to Southern California. Due to the prolonged drought conditions since 2000, storage within the Colorado River system has declined to half of its reservoir capacity and has been fluctuating at that level (DWR, January 2020)

3.4 Population, Demographics, and Socioeconomics

3.4.1 Population

Based on CDR and the City's Planning Department's estimates, the City's service area population is projected to increase by about 4.8% over the 25-year period from 2020 to 2045. The growth is slightly higher in the first 15 years until 2035 and tapered off from there. There is limited vacant land left within the service area and most growth is projected to be from densification of existing communities. Table 3-2 shows the population projections in five-year increments out to 2045 within the City's service area.

Table 3-2: Retail: Population - Current and Projected

DWR Submittal Table 3-1 Retail: Population - Current and Projected						
Population Served	2020	2025	2030	2035	2040	2045
	61,916	64,273	65,015	65,397	65,360	64,872
NOTES: Source - Center for Demographic Research at California State University, Fullerton, 2020						

In March of 2021, the Southern California Association of Governments (SCAG), the region's Metropolitan Planning Organization, adopted the 6th cycle of the Regional Housing Needs Assessment (RHNA) spanning the years of 2021 through 2029. RHNA is mandated by State Housing Law as part of the periodic process of updating local housing element of the City's General Plan. Currently, the City is in the process of updating its General Plan housing element, which is due to be completed by October of 2021 followed by an up-to three-year rezoning process to plan for RHNA.

The RHNA allocations may affect future iterations of the population and housing projections after the City updates the General Plan Housing Element, and zoning. If rezoning land to residential uses or rezoning to increase housing densities occurs as a result of the RHNA allocations, this may result in the City providing feedback, to CDR and/or SCAG during future growth forecast update processes, if additional housing units are expected to be built beyond what was forecast in the previous growth forecast iteration. Future City UWMPs will incorporate the best available local planning information for the City's service area.

3.4.2 Demographics and Socioeconomics

As shown in Table 3-3 below, the total number of dwelling units in the City is expected to increase by 4.1% in the next 25 years from 33,146 in 2020 to 34,511 in 2045. Table 3-3 also shows a breakdown of the total dwelling units by type for the 25-year period from 2020 to 2045.

Table 3-3: City of Newport Beach Service Area Dwelling Units by Type

City of Newport Beach Service Area Dwelling Units by Type						
Dwelling Units	2020	2025	2030	2035	2040	2045
Total	**33,146**	**34,279**	**34,280**	**34,496**	**34,499**	**34,511**
Single Family	12,431	12,450	12,451	12,451	12,451	12,453
All Other*	20,715	21,829	21,829	22,045	22,048	22,058

Source: Center for Demographic Research at California State University, Fullerton, 2020

*Includes duplex, triplex, apartment, condo, townhouse, mobile home, etc. Yachts, houseboats, recreational vehicles, vans, etc. are included if is primary place of residence. Does not include group quartered units, cars, railroad box cars, etc.

In addition to the types and proportions of dwelling units, various socio-economic factors such as age distribution, education levels, general health status, income and poverty levels affect City's water management and planning. Based on the U.S. Census Bureau's QuickFacts, the City has about 23.1% of population of 65 years and over, 17.2% under the age of 18 years and 3.9% under the age of 5 years. 97.8% of the City's population with an age of more than 25 years has a minimum of high school graduate and 67% of this age group has at least a bachelor's degree.

3.4.3 CDR Projection Methodology

The City obtains its services area population and dwelling unit data from MWDOC via CDR. MWDOC contracts with CDR to update the historic population estimates for 2010 to the current year and provide an annual estimate of population served by each of its retail water suppliers within its service area. CDR uses GIS and data from the 2000 and 2010 U.S. Decennial Censuses, State Department of Finance (DOF) population estimates, and the CDR annual population estimates. These annual estimates incorporate annual revisions to the DOF annual population estimates, often for every year back to the most recent Decennial Census. As a result, all previous estimates were set aside and replaced with the most current set of annual estimates. Annexations and boundary changes for water suppliers are incorporated into these annual estimates.

In the summer of 2020, projections by water supplier for population and dwelling units by type were estimated using the 2018 Orange County Projections dataset. Growth for each of the five-year increments was allocated using GIS and a review of the traffic analysis zones (TAZ) with a 2019 aerial photo. The growth was added to the 2020 estimates by water supplier.

The City made minor revision to the 2020 population estimated by CDR and used 4.8% as the overall growth in the population by 2045, which is consistent with the CDR's projections.

3.5 Land Uses

3.5.1 Current Land Uses

The City's service area can best be described as a predominantly residential single and multi-family community located along the coast in central Orange County, close to scenic beaches and natural preserves.

Based on the zoning designation collected and aggregated by SCAG around 2018, the current land use within the City's service area can be categorized as follows:

- Single family residential – 36.4%
- Multi-family residential – 12.3%
- Commercial – 11.6%
- Industrial – 0.9%
- Institutional/Governmental – 6.2%
- Open space and parks – 21.2%
- Other – 7.5% (e.g., Undevelopable or Protected Land, Water, and Vacant)
- No land use designations – 3.9%

3.5.2 Projected Land Uses

The City is nearly built out within its water service area. Table 3-4 lists the information on planned future development and redevelopment areas per the 2019 Water Master Plan of the City.

Table 3-4: Future Development Areas per 2019 Water Master Plan

Future Development/Redevelopment	Anticipated Development Type and Size	Future Land Use Category (Existing)	Size (Acres)	Anticipated Development Period
ENC Preschool	Vacant since 2007	Mixed Use (Office)	1.25	2022
Lido Villas (DART)	Church: 8,961 sq.ft. Office Building: 32,469 sq. ft.	Residential Very High (Residential)	1.20	2022
Back Bay Landing	RV, Boat storage, 45 storage units, kayak/paddleboard rentals.	Mixed Use (Mixed Use)	12.74	2024
Plaza Corona del Mar	Vacant	Mixed Use (Mixed Use)	0.35	2022
Hoag Memorial Hospital Presbyterian Master Plan Update Project	Vacant	Commercial (Large Water User)	17.53	Long term plans unknown. No new major development
Ullman Sail Lofts	Commercial: 9,962 sq. ft.	Mixed Use (Mixed Use)	0.13	2021
Newport Crossings	Retail: 22,976 sq. ft. Restaurant: 15,887 sq. ft. Medical Office: 5,467 sq. ft	Mixed Use (Mixed Use)	1.94	2023
Newport Dunes Hotel	None - Vacant area of Newport Dunes Resort	Commercial (Parks and Recreation)	69.41	2025

Future Development/Redevelopment	Anticipated Development Type and Size	Future Land Use Category (Existing)	Size (Acres)	Anticipated Development Period
Newport Village – Mariners Mile	Retail, Service Office: 65,604 sq. ft.	Mixed use (Commercial)	8.23	2023
Westcliff Mixed-Use Project	None	Mixed use (Commercial)	0.99	2023
Banning Ranch (currently on hold due to the lack of the Coastal Development Permit)	To be determined	Residential/Mixed use/Institutional/Open Space	-	Currently unknown

In addition to the above upcoming developments, the following requirements and changes in laws will impact the City's future land use:

- **RHNA** - State law requires jurisdictions to provide their share of the RHNA allocation and SCAG determines the housing growth needs by income for local jurisdictions through RHNA. The City's RHNA allocation for the 2021 - 2029 is 4,845 dwelling units. This includes 1,456 units for very low-income households, 930 units for low-income households, 1,050 units for moderate-income households, and 1,409 units for above moderate-income households.
- **Housing Crisis Act of 2019 (Senate Bill 330)** – This law was signed in 2019 to respond to the California housing crisis. Effective January 1, 2020, the law aims to increase residential unit development, protect existing housing inventory, and expedite permit processing. Under this legislation, municipal and county agencies are restricted in ordinances and polices that can be applied to residential development. The revised definition of "Housing Development" now contains residential projects of two or more units, mixed-use projects (with two-thirds of the floor area designated for residential use), transitional, supportive, and emergency housing projects. The City currently has 5 applications in process under this law.
- **Accessory Dwelling Units (ADUs)** – ADUs are separate small dwellings embedded within residential properties. There has been an increase in the construction of ADUs in California in response to the rise in interest to provide affordable housing supply. The Legislature updated the ADU law effective January 1, 2020 to clarify and improve various provisions to promote the development of ADUs (AB-881, "Accessory dwelling units," and AB-68, "Land use: accessory dwelling units"). These include:
    - allowing ADUs and Junior Accessory Dwelling Units (JADUs) to be built concurrently with a single-family dwelling. JADUs max size is 500 sf.
    - opening areas where ADUs can be created to include all zoning districts that allow single-family and multi-family uses
    - maximum size cannot be less than 850 sf for a one-bedroom ADU or 1,000 sf for more than one bedroom (California Department of Housing and Community Development, 2020)

About 92% of the ADUs in California are being built in the single-family-zoned parcels (University of California Berkeley, 2020). The increase in ADUs implies an increase in number of people per dwelling unit which potentially translates to higher water demand.

4 WATER USE CHARACTERIZATION

4.1 Water Use Overview

Water use within the City's service area has been relatively stable in the past decade with an annual average of 15,413 AF. In this period, potable and non-potable water use accounted for an average of 97% and 3% of total City water use, respectively. In FY2019-20, the City's water use was 14,492 AF of potable water (groundwater and imported) and 513 AF of direct recycled water for landscape irrigation. In FY2019-20, the City's potable water use profile was comprised of 58.9% residential use, 18.2% commercial, institutional, and industrial (CII) and 18.1% large landscape/irrigation, with non-revenue water and other uses comprising about 4.8%. As described in Section 3, the City's service area is almost completely built-out and is projected to add minimum land use and small population increase. Water demand is likely to decrease less than 1% over the next 5 years. In the longer term, water demand is projected to increase 5.2% from 2025 through 2045. The projected water use for 2045 is 15,103 AF for potable water and 542 AF for recycled water. The passive savings are anticipated to continue for the next 25 years and are considered in the water use projections. Permanent water conservation requirements and water conservation strategies are discussed in Section 8 and 9 of this document.

4.2 Past and Current Water Use

The City's service area has exhibited relatively stable water use within the past decade—the annual average being 15,413 AF. A stable trend is expected because the city is essentially built-out and the rate of population growth is small (less than 0.2% per year). Water conservation efforts also kept per capita water use down.

As a result of Governor Jerry Brown's mandatory water conservation order in 2014, the City's water use in the last five years decreased below the 10-year average. Between FY 2015-16 and FY 2019-20, water use within the City's service area ranged from 13,326 to 15,358 acre-feet per year (AFY) (potable and non-potable combined). In the past decade, between FY 2010-11 and FY 2019-20, potable and non-potable water use accounts for an average of 97% and 3% of total City water use, respectively. Potable water uses include demands from residential, CII, and large landscape irrigation. Non-potable use includes the use of recycled water for large landscape and golf course irrigation.

As of FY 2019-20 there are 26,765 active service connections in the City's water distribution system. Of these, 17 are recycled water accounts. Table 4-1 summarizes the City's total water demand for potable and non-potable water for FY 2019-20. The City has a mix of commercial uses (markets, restaurants, etc.), public entities (schools, fire stations and government offices), and office complexes. Single and multi- family residential water demand combined accounts for 58.8% of the total water demand. Commercial and governmental/institutional use account for 16.9%, and 1.2% of total demand, respectively. Large landscape (irrigation) accounts for 18.1% of total demand.

Table 4-1: Retail: Demands for Potable and Non-Potable Water – Actual

DWR Submittal Table 4-1 Retail: Demands for Potable and Non-Potable Water - Actual			
Use Type	2020 Actual		
	Additional Description *(as needed)*	Level of Treatment When Delivered	Volume
Single Family		Drinking Water	6,750
Multi-Family		Drinking Water	1,782
Commercial		Drinking Water	2,463
Institutional/Governmental		Drinking Water	173
Landscape	Represents large landscape (with irrigation meters) served by potable water and not recycled water	Drinking Water	2,629
Losses	Non-Revenue Water	Drinking Water	603
Other Potable		Drinking Water	91
		TOTAL	14,492
NOTES: Volumes reported in AF. This table only represents potable water; recycled water projections are shown in Table 4-4 (DWR Submittal Tables 4-3) and Table 6-8 (DWR Submittal Tables 6-4). 603 AF NRW value is based on the most FY 2019-20 Water Loss Audit.			

4.3 Water Use Projections

A key component of this 2020 UWMP is to provide an insight into the City's future water demand outlook. This section discusses the considerations and methodology used to estimate the 25-year water use projection. Overall, total water demand is projected to increase 4.3% between 2020 and 2045.

While single and multifamily residential use is projected to decrease between 2025 and 2045, usage by CII is projected to increase during the same timeframe. Demands for large landscape applications are projected to remain steady. Non-revenue water loss as a percentage of total demand is also projected to remain steady. The City's AMI system anticipated to be completed at the end of FY2021-22 will help maintain a low water loss rate into the future.

4.3.1 Water Use Projection Methodology

In 2021, MWDOC and OCWD, in collaboration with their member agencies, led the effort to update water demand projections originally done as part of the 2021 OC Water Demand Forecast for MWDOC and OCWD. The updated demand projections, prepared by CDM Smith, were for the Orange County region as a whole, and provided retail agency specific demands. The projections span the years of 2025-2050 and are based upon information surveyed from each Orange County water agency.

The forecast methodology began with a retail water agency survey that asked for FY 2017-18, FY 2018-19 and FY 2019-20 water use by major sector, including number of accounts. If a member agency provided recycled water to customers that information was also requested. Given that FY 2017-18 was a slightly above-normal demand year (warmer/drier than average) and FY 2018-19 was a slightly below-normal demand year (cooler/wetter than average), water use from these two years were averaged to represent an average-year base water demand.

For the residential sectors (single-family and multifamily) the base year water demand was divided by households in order to get a total per unit water use (gallons per home per day). In order to split household water use into indoor and outdoor uses, three sources of information were used, along with CDM Smith's expertise. The sources of information included: (1) *the Residential End Uses of Water* (Water Research Foundation, 2016); (2) California's plumbing codes and landscape ordinances; and (3) CA DWR's Model Water Efficient Landscape Ordinance (MWELO) calculator.

Three different periods of residential end uses of water were analyzed as follows:

- **Pre-2010 efficiency levels** – Has an average indoor water use that is considered to be moderately efficient, also does not include the most recent requirements for MWELO.
- **High-efficiency levels** – Includes the most recent plumbing codes that are considered to be highly efficient, and also includes the most recent requirements for MWELO.
- **Current average efficiency levels** – Represents the weighted average between pre-2010 efficiency and high efficiency levels, based on average age of homes for each retail water agency.

For outdoor residential water use, the indoor per capita total was multiplied by each member agency-specific persons per household in order to get an indoor residential household water use (gallons per day per home), and then was subtracted from the base year total household water use for single-family and multifamily for each agency based on actual water use as reported by the agency surveys.

For existing residential homes, the current average indoor and outdoor water use for each member agency were used for the year 2020. It was assumed that indoor water uses would reach the high efficiency level by 2040. Based on current age of homes, replacement/remodeling rates, and water utility rebate programs it is believed this assumption is very achievable. It was also assumed that current outdoor water use would be reduced by 5% by 2050.

For new homes, the indoor high efficiency level was assumed for the years 2025 through 2050. Outdoor uses for new homes were assumed to be 25% and 30% lower than current household water use for single-family and multifamily homes, respectively. This methodology is illustrated in Figure 4-1 below.

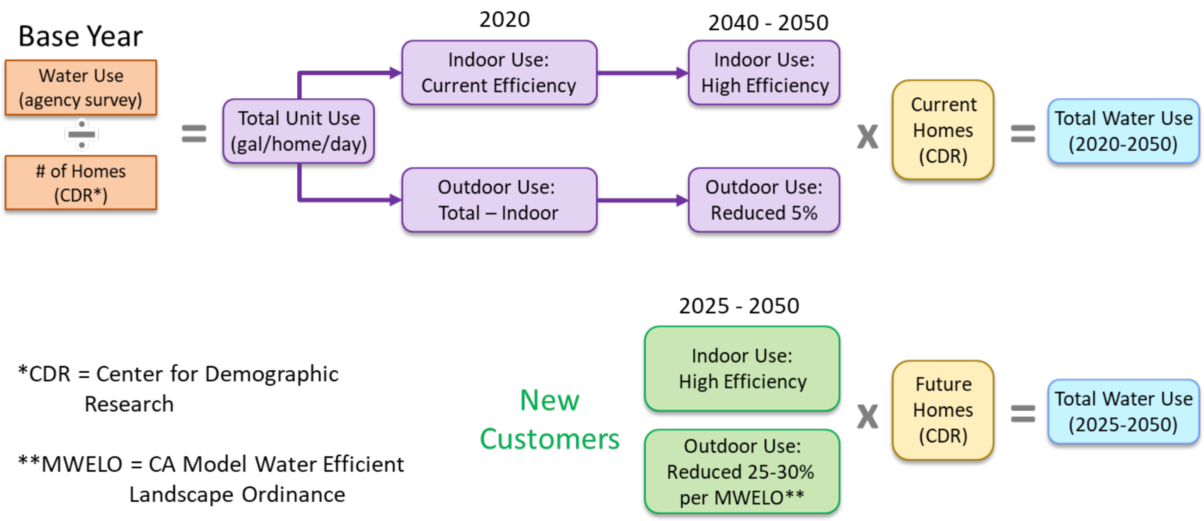


Figure 4-1: Water Use Projection Methodology Diagram

Existing and projected population, single-family and multifamily households for each retail water agency were provided by CDR under contract by MWDOC and OCWD. CDR provides historical and future demographics by census tracts for all of Orange County (Section 3.4). Census tract data is then clipped to retail water agency service boundaries in order to produce historical and projected demographic data by agency.

For the CII water demands, which have been fairly stable from a unit use perspective (gallons/account/day), it was assumed that the unit demand in FY 2019-20 would remain the same from 2020-2025 to represent COVID-19 impacts. Reviewing agency water use data from FY 2017-18 through FY2019-20 revealed that residential water use increased slightly in FY 2019-20 while CII demands decreased slightly as a result of COVID-19. From 2030 to 2050, the average CII unit use from FY 2017-18 and 2018-19 was used. These unit use factors were then multiplied by an assumed growth of CII accounts under three broad scenarios:

- Low Scenario – assuming no growth in CII accounts
- Mid Scenario – assuming 0.5% annual growth in CII accounts
- High Scenario – assuming 1.5% annual growth in CII accounts

For most retail agencies, the Mid Scenario of CII account growth was used, but for those retail agencies that have had faster historical growth the High Scenario was used. For those retail agencies that have had relatively stable CII water demand, the Low Scenario was used. For Newport Beach, the high scenario was used.

For those agencies that supply recycled water for non-potable demands, MWDOC used agency-specified growth assumptions. Most agencies have already maximized their recycled water and thus are not expecting for this category of demand to grow. However, a few agencies in South Orange County do expect moderate growth in recycled water customers.

For large landscape customers served currently by potable water use, MWDOC assumed these demands to be constant through 2050, except for agencies that have growing recycled water demands. For the agencies that have growing recycled water demands, large landscape demands served by potable water reduced accordingly. For non-revenue water, which represents the difference in total water production less all water billed to customers, this percentage was held constant through 2050. Note that 2050 data was not presented in the UWMP.

A member agency's water use demand projection is the summation of their residential water demand, CII demands, large landscape and recycled water demands, and water losses all projected over the 25-year time horizon. These demands were provided to each of the Orange County water agencies for their review, feedback, and revision before being finalized.

The MWDOC regional water demand projection was collaboratively developed between MWDOC and its member agencies. MWDOC's projections were built upon the same model developed by CDM Smith, and took into consideration specific assumptions and projections provided to MWDOC by its member agencies.

4.3.1.1 Weather Variability and Long-Term Climate Change Impacts

In any given year water demands can vary substantially due to weather. In addition, long-term climate change can have an impact on water demands into the future. For the 2014 OC Water Reliability Study, CDM Smith developed a statistical model of total water monthly production from 1990 to 2014 from a sample of retail water agencies. This model removed impacts from population growth, the economy and drought restrictions in order to estimate the impact on water use from temperature and precipitation.

The results of this statistical analysis are:

- Hot/dry weather demands will be 5.5% greater than current average weather demands
- Cooler/wet weather demands will be 6% lower than current average weather demands
- Climate change impacts will increase current average weather demands by:
  - 2% in 2030
  - 4% in 2040
  - 6% in 2050

4.3.2 25-Year Water Use Projection

The projected demand values were provided by MWDOC and reviewed by the City as part of the UWMP effort. As the regional wholesale supplier for much of Orange County, MWDOC works in collaboration with each of its retail agencies as well as MET, its wholesaler, to develop demand projections for imported water. The City has been proactively decreasing its reliance on imported water by pursuing a variety of water conservation strategies and continuing its recycled water use within the service area. Future water savings and low-income water use are included in these projected values.

4.3.2.1 Water Use Projections for 2021-2025

The water use projection for normal year conditions without drought for 2021-2025 is presented in Table 4-2. This table will be adjusted to estimate the five-years' cumulative drought effects as described in the five-year DRA in Section 7. A linear decrease in total water demand is expected between 2021 and 2025.

Table 4-2: Water Use Projections for 2021 to 2025

Retail: Total Water Demand					
FY Ending	2021	2022	2023	2024	2025
Total Water Demand (AF)	14,977	14,949	14,921	14,893	14,866
NOTES:					

4.3.2.2 Water Use Projections for 2025-2045

Table 4-3 is a projection of the City's water demand for the next 25 years. While single-family and multi-family residential use is projected to decrease due to water use efficiency measures, usage by CII is projected to increase. CII projections for 2025 through 2045 were broken down into commercial, industrial, and institutional/governmental using proportions reported for each billing sector in FY 2019-20. Demands for large landscape applications are projected to stay consistent, while non-revenue water is projected to increase until 2040, then decrease slightly.

The demand data presented in this section accounts for passive savings in the future. Passive savings are water savings as a result of codes, standards, ordinances and public outreach on water conservation and higher efficiency fixtures. Passive savings are anticipated to continue for the next 25 years and will result in continued water saving and reduced consumption levels. Permanent water conservation requirements and water conservation strategies are discussed in Section 8 and 9 of this document.

Table 4-3: Retail: Use for Potable and Non-Potable Water - Projected

DWR Submittal Table 4-2 Retail: Use for Potable and Non-Potable Water - Projected						
Use Type	Additional Description *(as needed)*	Projected Water Use				
		2025	2030	2035	2040	2045
Single Family		6,385	6,294	6,202	6,111	6,077
Multi-Family		1,729	1,691	1,653	1,615	1,614
Commercial		2,762	3,334	3,584	3,853	3,853
Institutional/Governmental		194	234	251	270	270
Landscape	Large Landscape Potable	2,616	2,616	2,616	2,616	2,616
Losses	Non-Revenue Water	638	661	667	675	673
	TOTAL	14,324	14,829	14,975	15,140	15,103

NOTES: Volumes reported in AF. This table only represents potable water; recycled water projections are shown in Table 4-4 (DWR Submittal Tables 4-3) and Table 6-8 (DWR Submittal Tables 6-4).

Based on the information provided above, the total demand for potable water is listed below in Table 4-4. The City currently provides recycled water in its service area and is projected to maintain its use.

Table 4-4: Retail: Total Water Use (Potable and Non-Potable)

DWR Submittal Table 4-3 Retail: Total Gross Water Use (Potable and Non-Potable)						
	2020	2025	2030	2035	2040	2045
Potable Water, Raw, Other Non-potable	14,492	14,324	14,829	14,975	15,140	15,103
Recycled Water Demand	513	542	542	542	542	542
TOTAL WATER USE	15,005	14,866	15,371	15,517	15,682	15,645
NOTES: Volumes reported in AF						

Future water savings and low-income water use are included in these projected values (Table 4-5).

Table 4-5: Retail Only: Inclusion in Water Use Projections

DWR Submittal Table 4-5 Retail Only: Inclusion in Water Use Projections	
Are Future Water Savings Included in Projections? (Refer to Appendix K of UWMP Guidebook)	Yes
If "Yes" to above, state the section or page number, in the cell to the right, where citations of the codes, ordinances, or otherwise are utilized in demand projections are found.	Section 8 and 9
Are Lower Income Residential Demands Included In Projections?	Yes
NOTES:	

4.3.2.3 Water Use Projections for Lower Income Households

Since 2010, the UWMP Act has required retail water suppliers to include water use projections for single-family and multi-family residential housing for lower income and affordable households. This will assist the City in complying with the requirement under Government Code Section 65589.7 granting priority for providing water service to lower income households. A lower income household is defined as a household earning below 80% of the MHI.

DWR recommends retail suppliers rely on the housing elements of city or county general plans to quantify planned lower income housing with the City's service area (DWR, 2020). RHNA assists jurisdictions in updating general plan's housing elements section. The RHNA identifies additional housing needs and assesses households by income level for the City through 2010 decennial Census and 2005-2009

American Community Survey data. The sixth cycle of the RHNA covers the planning period of October 2021 to October 2029. The SCAG adopted the RHNA Allocation Plan for this cycle on March 4, 2021. The California Department of Housing and Community Development reviewed the housing elements data submitted by jurisdictions in the SCAG region and concluded the data meets statutory requirements for the assessment of current housing needs.

Under the assumption that the RHNA household allocations adequately represent ratios of the City's overall future income categories (not the exact ratio of all household by income but a conservative one for low-income household estimates), the RHNA low-income percentage can be used to estimate future low income demands. One objective of RHNA is to increase affordable housing, therefore RHNA has been allocating additional low-income households to various regions. Because relying on the RHNA distribution of households by income category is likely to produce an overestimate of low-income water demands, this approach represents a conservative projection of future low-income water use.

Table 4-6 presents the City's RHNA housing allocation. RHNA classifies low income housing into two categories: very low income (<30% - 50% MHI), and low income (51% - 80% MHI). Altogether 49.2% of the City's allocated housing need for the planning period of October 2021 to October 2029 are considered low-income housing (SCAG, 2021).

Table 4-6: SCAG 6th Cycle Household Allocation Based on Median Household Income

Household Category by Income	Number of Households	% of Total Allocated Households
Very Low Income	1,456	30.1%
Low Income	930	19.2%
Moderate Income	1,050	21.7%
Above Moderate Income	1,409	29.1%
Total Future Allocated Households	4,845	100.0%

By applying the percentage of low-income housing from the SCAG report to the total projected SF/MF residential demand calculated in Table 4-3 above, low-income demand can be conservatively estimated for both SF and MF through 2045. For example, the total low-income single family residential demand is projected to be 3,144 AF in 2025 and 2,993 AF in 2045 (Table 4-7).

Table 4-7: Projected Water Use for Low Income Households (AF)

Water Use Sector	FY Ending				
	2025	2030	2035	2040	2045
Total Residential Demand (AF)	8,114	7,984	7,856	7,726	7,691
Single-Family Residential Demand - Low Income Households (AF)	3,144	3,099	3,054	3,009	2,993
Multi-Family Residential Demand - Low Income Households (AF)	851	833	814	795	795
Total Low Income Households Demand (AF)	3,996	3,932	3,869	3,805	3,788

4.4 Water Loss

The City has conducted annual water loss audit since 2015 per the American Water Works Association (AWWA) methodology per SB 555 to understand the relationship between water loss, operating costs and revenue losses. Non-revenue water for CY2015 to FY 2019-20 (Figure 4-2) consists of three components: real losses (e.g., leakage in mains and service lines, and storage tank overflows), apparent losses (unauthorized consumption, customer metering inaccuracies and systematic data handling errors), and unbilled water (e.g., hydrant flushing, firefighting, and blow-off water from well start-ups). The City's real losses ranged from 354 AFY to 881 AFY and apparent losses ranged from 186 AFY to 212 AFY between CY2015 and FY 2019-20. The unbilled water ranged from 32 AFY to 37 AFY in that same timeframe.

In the latest water loss audit (FY2019/20), the City's total water loss was 567 AFY (Table 4-8), compared to the total water use of 15,047 AF in that period. The total water loss consists of real loss of 354 AFY and apparent loss of 212 AFY. The non-revenue water was 603 AFY. The active and inactive service connections were relatively consistent in the last five years with 26,765 connections in FY2019/20. The real loss performance indicator was 12 gals/connection/day in FY2019/20. Figure 4-3 presents the performance indicators of gallons of real and apparent loss per connection per day. The City's recent AMI implementation will likely reduce water loss in future years. Understanding and controlling water loss from a distribution system is an effective way for the City to achieve regulatory standards and manage their existing resources. The California State Water Resources Control Board (SWRCB) is still developing water loss performance standards; these standards have not yet been adopted.

Table 4-8: Retail: 12 Month Water Loss Audit Reporting

DWR Submittal Table 4-4 Retail: Last Five Years of Water Loss Audit Reporting	
Reporting Period Start Date (mm/yyyy)	Volume of Water Loss [1,2] (AF)
01/2015	855
01/2016	805
01/2017	1080
07/2018	891
07/2019	567
[1] *Taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet.* [2] ***Units of measure (AF, CCF, MG)*** *must remain consistent throughout the UWMP as reported in Table 2-3.*	
NOTES: Water audit data collected in both CY 2018 and FY 2018-2019.	

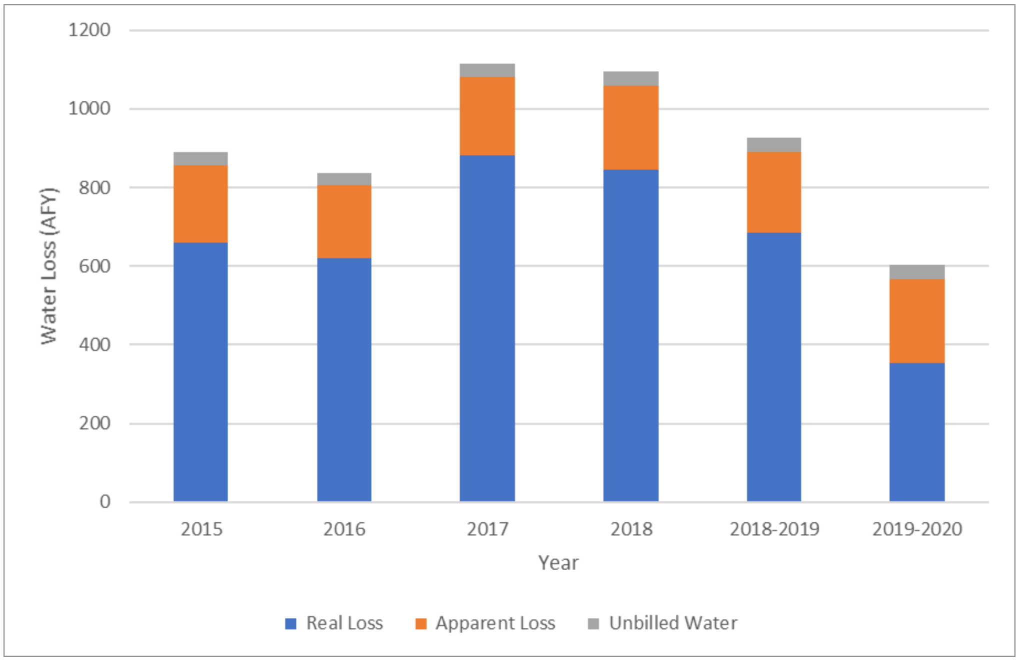


Figure 4-2: Water Loss Audit for CY2015 - FY 2019/20

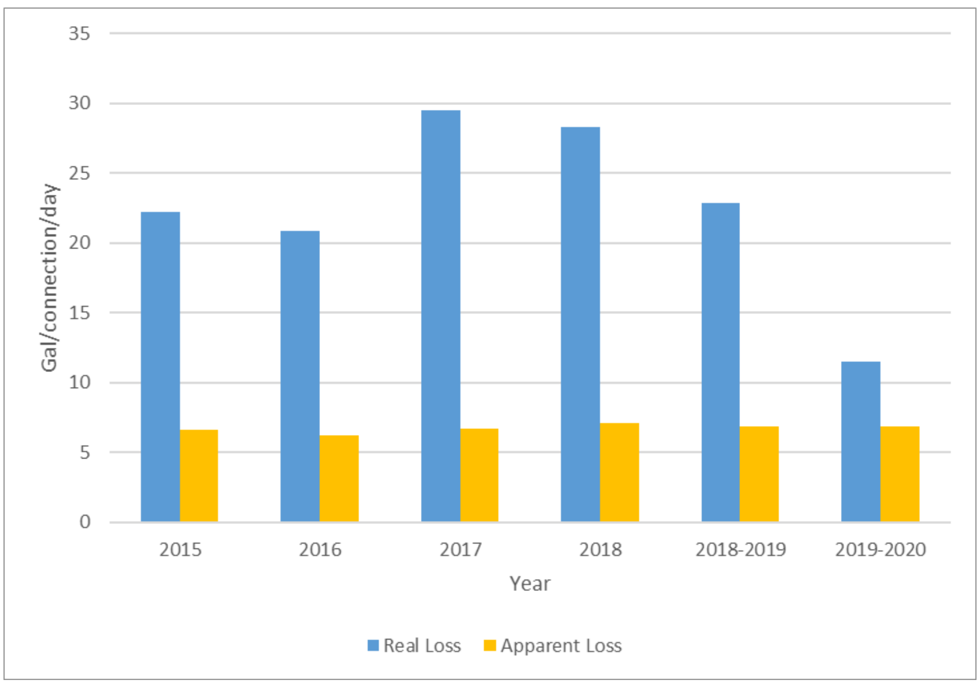


Figure 4-3: Water Loss Performance Indicators for CY2015 - FY 2019/20

5 CONSERVATION TARGET COMPLIANCE

The Water Conservation Act of 2009, also known as SBx7-7 (Senate Bill 7 as part of the Seventh Extraordinary Session), signed into law on February 3, 2010, requires the State of California to reduce urban water use by 20% by the year 2020 (20x2020). To achieve this each retail urban water supplier must determine baseline water use during their baseline period and target water use for the years 2015 and 2020 to meet the state's water reduction goal. Retail water suppliers are required to comply with SBx7-7 individually or as a region in collaboration with other retail water suppliers, or demonstrate they have a plan or have secured funding to be in compliance, in order to be eligible for water related state grants and loans on or after July 16, 2016.

The City's actual 2020 water use is lower than its 2020 water use target, therefore, demonstrating compliance with SBx7-7. In its 2015 UWMP, the City revised its baseline per capita water use calculations using 2010 U.S. Census data. Changes in the baseline calculations resulted in updated per capita water use targets.

The following sections describe the efforts by the City to comply with the requirements of SBx7-7 and efforts by MWDOC to assist retail agencies, including the formation of a Regional Alliance to provide additional flexibility to all water suppliers in Orange County. A discussion of programs implemented to support retail agencies in achieving their per capita water reduction goals is covered in Section 9 – Demand Management Measures of this UWMP.

Complimentary to information presented in this section are SBx7-7 Verification and Compliance Forms, a set of standardized tables required by DWR to demonstrate compliance with the Water Conservation Act in this 2020 UWMP (Appendix D) including calculations of recycled water used for groundwater recharge (indirect reuse) to offset a portion of the agency's potable demand when meeting the regional as well as individual water use targets.

5.1 Baseline Water Use

The baseline water use is the City's gross water use divided by its service area population, reported in GPCD. Gross water use is a measure of water that enters the distribution system of the supplier over a 12-month period with certain allowable exclusions. These exclusions are:

- Recycled water delivered within the service area
- Indirect recycled water
- Water placed in long term storage
- Water conveyed to another urban supplier
- Water delivered for agricultural use
- Process water.

Water suppliers within the OCWD Groundwater Basin, including the City, have the option of choosing to deduct recycled water used for indirect potable reuse (IPR) from their gross water use to account for the recharge of recycled water into the OC Basin by OCWD, historically through Water Factory 21 (WF-21), and now by the Groundwater Replenishment System (GWRS).

Water suppliers must report baseline water use for two baseline periods, the 10- to 15-year baseline (baseline GPCD) and the five-year baseline (target confirmation) as described below.

5.1.1 Ten to 15-Year Baseline Period (Baseline GPCD)

The first step to calculating the City's water use targets is to determine its base daily per capita water use (baseline water use). The baseline water use is calculated as a continuous (rolling) 10-year average during a period, which ends no earlier than December 31, 2004 and no later than December 31, 2010. Water suppliers whose recycled water made up 10% or more of their 2008 retail water delivery can use up to a 15-year average for the calculation. Recycled water use was less than 10% of the City's retail delivery in 2008; therefore, a 10-year baseline period is used.

The City's baseline water use is 258 GPCD, obtained from the 10-year period July 1, 1995 to June 30, 2005.

5.1.2 Five-Year Baseline Period (Target Confirmation)

Water suppliers are required to calculate water use, in GPCD, for a five-year baseline period. This number is used to confirm that the selected 2020 target meets the minimum water use reduction requirements. Regardless of the compliance option adopted by the City, it will need to meet a minimum water use target of 5% reduction from the five-year baseline water use. This five-year baseline water use is calculated as a continuous five-year average during a period, which ends no earlier than December 31, 2007 and no later than December 31, 2010. The City's five-year baseline water use is 256 GPCD, obtained from the five-year period July 1, 2003 to June 30, 2008.

5.1.3 Service Area Population

The City's service area boundaries correspond with the boundaries for a city or census designated place. This allows the City to use service area population estimates prepared by the DOF. CDR is the entity which compiles population data for Orange County based on DOF data. The calculation of the City's baseline water use and water use targets in the 2010 UWMP was based on the 2000 U.S. Census population numbers obtained from CDR. The baseline water use and water use targets in the 2015 UWMP were revised based on the 2010 U.S. Census population obtained from CDR in 2012. The population numbers and baseline water use (both 10- and 5-year baselines) were revised again in this 2020 UWMP per CDR's most recently adjusted population numbers for 2001 onward.

5.2 SBx7-7 Water Use Targets

In the 2020 UWMP, the City may update its 2020 water use target by selecting a different target method than what was used previously. The target methods and determination of the 2015 and 2020 targets are described below. The City selected Option 1 consistent with 2015 but its 2020 target water use was adjusted as a result of the adjusted population and baseline water use values.

5.2.1 SBx7-7 Target Methods

DWR has established four target calculation methods for urban retail water suppliers to choose from. The City is required to adopt one of the four options to comply with SBx7-7 requirements. The four options include:

- *Option 1* requires a simple 20% reduction from the baseline by 2020 and 10% by 2015.
- *Option 2* employs a budget-based approach by requiring an agency to achieve a performance standard based on three metrics
    - Residential indoor water use of 55 GPCD
    - Landscape water use commensurate with the Model Landscape Ordinance
    - 10% reduction in baseline CII water use
- *Option 3* is to achieve 95% of the applicable state hydrologic region target as set forth in the State's 202020 Water Conservation Plan.
- *Option 4* requires the subtraction of Total Savings from the baseline GPCD:
    - Total savings includes indoor residential savings, meter savings, CII savings, and landscape and water loss savings.

With MWDOC's assistance in the calculation of the City's base daily per capita use and water use targets, the City selected to comply with Option 1 consistent with the option selected in 2010 and 2015.

5.2.2 2020 Targets and Compliance

Under Compliance Option 1, the simple 20% reduction, the City's 2020 target is 207 GPCD as summarized in Table 5-1. In addition, the confirmed 2020 target needs to meet a minimum of 5% reduction from the five-year baseline water use.

Table 5-1: Baselines and Targets Summary

DWR Submittal Table 5-1 Baselines and Targets Summary From SB X7-7 Verification Form *Retail Supplier or Regional Alliance Only*				
Baseline Period	Start Year *	End Year *	Average Baseline GPCD*	Confirmed 2020 Target*
10-15 year	*1996*	*2005*	*258*	*207*
5 Year	*2004*	*2008*	*256*	
**All cells in this table should be populated manually from the supplier's SBX7-7 Verification Form and reported in Gallons per Capita per Day (GPCD)*				
NOTES:				

The City's actual 2020 consumption is 160 GPCD which is below its 2020 target of 207 GPCD (Table 5-2). As shown in Table 5-2, the City did not make any adjustments in its actual 2020 consumption using weather normalization, economic adjustment, or extraordinary events. The City met its 2020 water use target and is in compliance with SBx7-7.

Table 5-2: 2020 Compliance

DWR Submittal Table 5-2: 2020 Compliance From SB X7-7 2020 Compliance Form *Retail Supplier or Regional Alliance Only*				
2020 GPCD			2020 Confirmed Target GPCD*	Did Supplier Achieve Targeted Reduction for 2020? Y/N
Actual 2020 GPCD*	2020 TOTAL Adjustments*	Adjusted 2020 GPCD* *(Adjusted if applicable)*		
160	0	160	207	Y
**All cells in this table should be populated manually from the supplier's SBX7-7 2020 Compliance Form and reported in Gallons per Capita per Day (GPCD)*				
NOTES:				

5.3 Orange County 20x2020 Regional Alliance

A retail supplier may choose to meet the SBx7-7 targets on its own or it may form a regional alliance with other retail suppliers to meet the water use target as a region. Within a Regional Alliance, each retail water supplier will have an additional opportunity to achieve compliance under both an individual target and a regional target.

- If the Regional Alliance meets its water use target on a regional basis, all agencies in the alliance are deemed compliant.
- If the Regional Alliance fails to meet its water use target, each individual supplier will have an opportunity to meet their water use targets individually.

The City is a member of the Orange County 20x2020 Regional Alliance formed by MWDOC, its wholesaler. This regional alliance consists of 29 retail agencies in Orange County as described in MWDOC's 2020 UWMP. MWDOC provides assistance in the calculation of each retail agency's baseline water use and water use targets.

In 2020, the regional baseline and targets were revised from 2015 to account for any revisions made by the retail agencies to their individual 2020 targets. The regional water use target is the weighted average of the individual retail agencies' targets (by population). The Orange County 20x2020 Regional Alliance weighted 2020 target is 158 GPCD. The actual 2020 water use in the region is 109 GPCD, i.e., the region met its 2020 GPCD goal.

6 WATER SUPPLY CHARACTERIZATION

As a counterpart to Section 4's Water Use Characterization, this section characterizes the City's water supply. This section includes identification and quantification of water supply sources through 2045, descriptions of each water supply source and their management, opportunities for exchanges and transfers, and discussion regarding any planned future water supply projects. This section also includes the energy intensity of the water service, a new UWMP requirement.

6.1 Water Supply Overview

The City meets all of its demands with a combination of imported water, local groundwater, and recycled water. The City works together with two primary agencies, MWDOC and OCWD, to ensure a safe and reliable water supply that will continue to serve the community in periods of drought and shortage. The sources of imported water supplies include water from the Colorado River and the SWP provided by MET and delivered through MWDOC.

The City's main source of water supply is groundwater from the OC Basin. Imported water and recycled water make up the rest of the City's water supply portfolio. In FY 2019-20, the City relied on 68% groundwater, 28.5% imported water, and 3.5% recycled water (Table 6-1).

It is projected that by 2045, the water supply portfolio will change to approximately 82% groundwater, 14.5% imported water, and 3.5% recycled water (Table 6-2 and Figure 6-1). Note that these representations of supply match the projected demand. However, the City can purchase more MET water through MWDOC, should the need arise. Additionally, GWRS supplies are included as part of groundwater pumping numbers.

The following subsections provide a detailed discussion of the City's water sources as well as the future water supply portfolio for the next 25 years.

Table 6-1: Retail: Water Supplies – Actual

DWR Submittal Table 6-8 Retail: Water Supplies — Actual			
Water Supply	Additional Detail on Water Supply	2020	
		Actual Volume (AF)	Water Quality
Groundwater (not desalinated)	Orange County Groundwater Basin	10,237	Drinking Water
Purchased or Imported Water	MWDOC	4,255	Drinking Water
Recycled Water	OCWD	513	Recycled Water
	Total	15,005	
NOTES: Source - MWDOC, 2020 for groundwater and purchased water data, Newport Beach for recycled water data.			

Table 6-2: Retail: Water Supplies – Projected

DWR Submittal Table 6-9 Retail: Water Supplies — Projected						
Water Supply	Additional Detail on Water Supply	**Projected Water Supply (AF)**				
		2025	**2030**	**2035**	**2040**	**2045**
		Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume
Groundwater (not desalinated)	Orange County Groundwater Basin	12,175	12,605	12,729	12,869	12,838
Purchased or Imported Water	MWDOC	2,149	2,224	2,246	2,271	2,265
Recycled Water	OCWD	542	542	542	542	542
	Total	14,866	15,371	15,517	15,682	15,645

NOTES:
Source - CDM Smith, 2021
Due to OCWD’s plans to increase regional groundwater recharge, the basin production percentage (BPP) is expected to be 85% starting in 2025 (Refer to Section 6.3.4). The BPP is only applied to the City’s potable water supply. Volumes of groundwater and imported water may vary depending on OCWD's actual BPP projections, which are established annually.

This table only considers direct use of recycled water - this does not include indirect potable recharge.

Figure 6-1: City's Projected Water Supply Sources (AF)

6.2 Imported Water

The City supplements its local water supply with imported water purchased from MET through MWDOC. In FY 2019-20, the City relied on approximately 4,255 AFY – approximately 28.5% of the City's water supply portfolio for FY 2019-20 – of imported water from MET / MWDOC. MET's principal sources of water are the Colorado River via the CRA and the Lake Oroville watershed in Northern California through the SWP. For Orange County, the water obtained from these sources is treated at the Robert B. Diemer Filtration Plant located in Yorba Linda. Typically, the Diemer Filtration Plant receives a blend of Colorado River water from Lake Mathews through the MET Lower Feeder and SWP water through the Yorba Linda Feeder. The City currently maintains six connections to the MET system along the Orange County Feeder and the East Orange County Feeder No. 2 with a total available capacity of 104 cfs, or 67 MGD.

6.2.1 Colorado River Supplies

Background

The Colorado River was MET's original source of water after MET's establishment in 1928. The CRA, which is owned and operated by MET, transports water from the Colorado River to its terminus Lake Mathews, in Riverside County. The actual amount of water per year that may be conveyed through the CRA to MET's member agencies is subject to the availability of Colorado River water. Approximately 40 million people rely on the Colorado River and its tributaries for water with 5.5 million acres of land using Colorado River water for irrigation. The CRA includes supplies from the implementation of the Quantification Settlement Agreement and its related agreements to transfer water from agricultural agencies to urban uses. The 2003 Quantification Settlement Agreement enabled California to implement major Colorado River water conservation and transfer programs, in order to stabilize water supplies and reduce the state's demand on the river to its 4.4 million acre-feet (MAF) entitlement. Colorado River transactions are potentially available to supply additional water up to the CRA capacity of 1.25 MAF on an as-needed basis. Water from the Colorado River or its tributaries is available to users in California, Arizona, Colorado, Nevada, New Mexico, Utah, Wyoming, and Mexico. California is apportioned the use of 4.4 MAF of water from the Colorado River each year plus one-half of any surplus that may be available for use collectively in Arizona, California, and Nevada. In addition, California has historically been allowed to use Colorado River water apportioned to, but not used by, Arizona or Nevada. MET has a basic entitlement of 550,000 AFY of Colorado River water, plus surplus water up to an additional 662,000 AFY when the following conditions exists (MET, 2021):

- Water is unused by the California holders of priorities 1 through 3
- Water is saved by the Palo Verde land management, crop rotation, and water supply program
- When the U.S. Secretary of the Interior makes available either one or both of the following:
    - Surplus water
    - Colorado River water that is apportioned to but unused by Arizona and/or Nevada.

Current Conditions and Supply

MET has not received surplus water for a number of years. The Colorado River supply faces current and future imbalances between water supply and demand in the Colorado River Basin due to long-term drought conditions. Analysis of historical records suggests a potential change in the relationship between precipitation and runoff in the Colorado River Basin. The past 21 years (1999-2020) have seen an overall drying trend, even though the period included several wet or average years. The river basin has substantial storage capacity, but the significant reduction in system reservoir storage in the last two decades is great enough to consider the period a drought (DWR, 2020a). At the close of 2020, system storage was at or near its lowest since 2000, so there is very little buffer to avoid a shortage from any future period of reduced precipitation and runoff (MET, 2021). Looking ahead, the long-term imbalance in the Colorado River Basin's future supply and demand is projected to be approximately 3.2 MAF by the year 2060 (USBR, 2012).

Over the years, MET has helped fund and implement various programs to improve Colorado River supply reliability and help resolve the imbalance between supply and demand. Implementation of such programs have contributed to achievements like achieving a record low diversion of the Colorado River in 2019, a level not seen since the 1950s. Colorado River water management programs include:

- **Imperial Irrigation District / MET Conservation Program** – Under agreements executed in 1988 and 1989, this program allows MET to fund water efficiency improvements within Imperial Irrigation District's service area in return for the right to divert the water conserved by those investments. An average of 105,000 AFY of water has been conserved since the program's implementation.
- **Palo Verde Land Management, Crop Rotation, and Water Supply Program** – Authorized in 2004, this 35-year program allows MET to pay participating farmers to reduce their water use, and for MET to receive the saved water. Over the life of the program, an average of 84,500 AFY has been saved and made available to MET.
- **Bard Seasonal Fallowing Program** – Authorized in 2019, this program allows MET to pay participating farmers in Bard to reduce their water use between the late spring and summer months of selected years, which provides up to 6,000 AF of water to be available to MET in certain years.
- **Management of MET-Owned Land in Palo Verde** – Since 2001, MET has acquired approximately 21,000 acres of irrigable farmland that are leased to growers, with incentives to grow low water-using crops and experiment with low water-consumption practices. If long-term water savings are realized, MET may explore ways to formally account them for Colorado River supplies.
- **Southern Nevada Water Authority (SNWA) and MET Storage and Interstate Release Agreement** – Entered in 2004, this agreement allows SNWA to store its unused, conserved water with MET, in exchange for MET to receive additional Colorado River water supply. MET has relied on the additional water during dry years, especially during the 2011-2016 California drought, and SNWA is not expected to call upon MET to return water until after 2026.
- **Lower Colorado Water Supply Projects** – Authorized in 1980s, this project provides up to 10,000 AFY of water to certain entities that do not have or have insufficient rights to use Colorado River water. A contract executed in 2007 allowed MET to receive project water left unused by the project contractors along the River – nearly 10,000 AF was received by MET in 2019 and is estimated for 2020.

- **Exchange Programs** – MET is involved in separate exchange programs with the United States Bureau of Reclamation, which takes place at the Colorado River Intake and with San Diego County Water Authority (SDCWA), which exchanges conserved Colorado River water.
- **Lake Mead Storage Program** – Executed in 2006, this program allows MET to leave excessively conserved water in Lake Mead, for exclusive use by MET in later years.
- **Quagga Mussel Control Program** – Developed in 2007, this program introduced surveillance activities and control measures to combat quagga mussels, an invasive species that impact the Colorado River's water quality.
- **Lower Basin Drought Contingency Plan** – Signed in 2019, this agreement incentivizes storage in Lake Mead through 2026 and overall, it increases MET's flexibility to fill the CRA as needed (MET, 2021).

Future Programs / Plans

The Colorado River faces long-term challenges of water demands exceeding available supply with additional uncertainties due to climate change. Climate change impacts expected in the Colorado River Basin include the following:

- More frequent, more intense, and longer lasting droughts, which will result in water deficits
- Continued dryness in the Colorado River Basin, which will increase the likelihood of triggering a first-ever shortage in the Lower Basin
- Increased temperatures, which will affect the percentage of precipitation that falls as rain or snow, as well as the amount and timing of mountain snowpack (DWR, 2020b)

Acknowledging the various uncertainties regarding reliability, MET plans to continue ongoing programs, such as those listed earlier in this section. Additionally, MET supports increasing water recycling in the Colorado River Basin and is in the process of developing additional transfer programs for the future (MET, 2021).

6.2.2 State Water Project Supplies

Background

The SWP consists of a series of pump stations, reservoirs, aqueducts, tunnels, and power plants operated by DWR and is an integral part of the effort to ensure that business and industry, urban and suburban residents, and farmers throughout much of California have sufficient water. Water from the SWP originates at Lake Oroville, which is located on the Feather River in Northern California. Much of the SWP water supply passes through the Delta. The SWP is the largest state-built, multipurpose, user-financed water project in the United States. Nearly two-thirds of residents in California receive at least part of their water from the SWP, with approximately 70% of SWP's contracted water supply going to urban users and 30% to agricultural users. The primary purpose of the SWP is to divert and store water during wet periods in Northern and Central California and distribute it to areas of need in Northern California, the San Francisco Bay area, the San Joaquin Valley, the Central Coast, and Southern California (MET, 2021).

The Delta is key to the SWP's ability to deliver water to its agricultural and urban contractors. All but five of the 29 SWP contractors receive water deliveries below the Delta (pumped via the Harvey O. Banks or Barker Slough pumping plants). However, the Delta faces many challenges concerning its long-term sustainability such as climate change posing a threat of increased variability in floods and droughts. Sea level rise complicates efforts in managing salinity levels and preserving water quality in the Delta to ensure a suitable water supply for urban and agricultural use. Furthermore, other challenges include continued subsidence of Delta islands, many of which are below sea level, and the related threat of a catastrophic levee failure as the water pressure increases, or as a result of a major seismic event.

Current Conditions and Supply

"Table A" water is the maximum entitlement of SWP water for each water contracting agency. Currently, the combined maximum Table A amount is 4.17 million AFY. Of this amount, 4.13 million AFY is the maximum Table A water available for delivery from the Delta. On average, deliveries are approximately 60% of the maximum Table A amount (DWR, 2020b).

SWP contractors may receive Article 21 water on a short-term basis in addition to Table A water if requested. Article 21 of SWP contracts allows contractors to receive additional water deliveries only under specific conditions, generally during wet months of the year (December through March). Because a SWP contractor must have an immediate use for Article 21 supply or a place to store it outside of the SWP, there are few contractors like MET that can access such supplies.

Carryover water is SWP water allocated to an SWP contractor and approved for delivery to the contractor in a given year, but not used by the end of the year. The unused water is stored in the SWP's share of San Luis Reservoir, when space is available, for the contractor to use in the following year.

Turnback pool water is Table A water that has been allocated to SWP contractors that has exceeded their demands. This water can then be purchased by another contractor depending on its availability.

SWP Delta exports are the water supplies that are transferred directly to SWP contractors or to San Luis Reservoir storage south of the Delta via the Harvey O. Banks pumping plant. Estimated average annual Delta exports and SWP Table A water deliveries have generally decreased since 2005, when Delta export regulations affecting SWP pumping operations became more restrictive due to federal biological opinions (Biops). The Biops protect species listed as threatened or endangered under the federal and state Endangered Species Acts (ESAs) and affect the SWP's water delivery capability because they restrict SWP exports in the Delta and include Delta outflow requirements during certain times of the year, thus reducing the available supply for export or storage.

Before being updated by the 2019 Long-Term Operations Plan, the prior 2008 and 2009 Biops resulted in an estimated reduction in SWP deliveries of 0.3 MAF during critically dry years to 1.3 MAF in above normal water years as compared to the previous baseline. However, the 2019 Long-Term Operations Plan and Biops are expected to increase SWP deliveries by an annual average of 20,000 AF as compared to the previous Biops (MET, 2021). Average Table A deliveries decreased in the 2019 SWP Final Delivery Capability Report compared to 2017, mainly due to the 2018 Coordinated Operation Agreement (COA) Addendum and the increase in the end of September storage target for Lake Oroville. Other factors that also affected deliveries included changes in regulations associated with the Incidental Take Permit (ITP) and the Reinitiation of Consultation for Long-Term Operations (RoC on LTO), a shift in Table A to Article 21 deliveries which occurred due to higher storage in SWP San Luis, and other operational updates to the SWP and federal Central Valley Project (CVP) (DWR, 2020b). Since 2005, there are similar decreasing trends for both the average annual Delta exports and the average annual Table A deliveries (Table 6-3).

Table 6-3: MET SWP Program Capabilities

Year	Average Annual Delta Exports (MAF)	Average Annual Table A Deliveries (MAF)
2005	2.96	2.82
2013	2.61	2.55
2019	2.52	2.41
Percent Change*	-14.8%	-14.3%

*Percent change is between the years 2019 and 2005.

Ongoing regulatory restrictions, such as those imposed by the Biops on the effects of SWP and the CVP operations on certain marine life, also contribute to the challenge of determining the SWP's water delivery reliability. In dry, below-normal conditions, MET has increased the supplies delivered through the California Aqueduct by developing flexible CVP/SWP storage and transfer programs. The goal of the storage/transfer programs is to develop additional dry-year supplies that can be conveyed through the available Harvey O. Banks pumping plant capacity to maximize deliveries through the California Aqueduct during dry hydrologic conditions and regulatory restrictions. In addition, the SWRCB has set water quality objectives that must be met by the SWP including minimum Delta outflows, limits on SWP and CVP Delta exports, and maximum allowable salinity level.

The following factors affect the ability to estimate existing and future water delivery reliability:

- **Water availability at the source:** Availability can be highly variable and depends on the amount and timing of rain and snow that fall in any given year. Generally, during a single-dry year or two, surface and groundwater storage can supply most water deliveries, but multiple-dry years can result in critically low water reserves. Fisheries issues can also restrict the operations of the export pumps even when water supplies are available.
- **Water rights with priority over the SWP:** Water users with prior water rights are assigned higher priority in DWR's modeling of the SWP's water delivery reliability, even ahead of SWP Table A water.
- **Climate change:** Mean temperatures are predicted to vary more significantly than previously expected. This change in climate is anticipated to bring warmer winter storms that result in less snowfall at lower elevations, reducing total snowpack. From historical data, DWR projects that by 2050, the Sierra snowpack will be reduced from its historical average by 25 to 40%. Increased precipitation as rain could result in a larger number of "rain-on-snow" events, causing snow to melt earlier in the year and over fewer days than historically, affecting the availability of water for pumping by the SWP during summer. Furthermore, water quality may be adversely affected due

to the anticipated increase in wildfires. Rising sea levels may result in potential pumping cutbacks on the SWP and CVP.

- **Regulatory restrictions on SWP Delta exports:** The Biops protect special-status species such as delta smelt and spring- and winter-run Chinook salmon and imposed substantial constraints on Delta water supply operations through requirements for Delta inflow and outflow and export pumping restrictions. Restrictions on SWP operations imposed by state and federal agencies contribute substantially to the challenge of accurately determining the SWP's water delivery reliability in any given year (DWR, 2020b).
- **Ongoing environmental and policy planning efforts:** Governor Gavin Newsom ended California WaterFix in May 2019 and announced a new approach to modernize Delta Conveyance through a single tunnel alternative. The EcoRestore Program aims to restore at least 30,000 acres of Delta habitat, with the near-term goal of making significant strides toward that objective by 2020 (DWR, 2020b).
- **Delta levee failure:** The levees are vulnerable to failure because most original levees were simply built with soils dredged from nearby channels and were not engineered. A breach of one or more levees and island flooding could affect Delta water quality and SWP operations for several months. When islands are flooded, DWR may need to drastically decrease or even cease SWP Delta exports to evaluate damage caused by salinity in the Delta.

Operational constraints will likely continue until a long-term solution to the problems in the Bay-Delta is identified and implemented. New Biops for listed species under the Federal ESA or by the California Department of Fish and Game's issuance of incidental take authorizations under the Federal ESA and California ESA might further adversely affect SWP and CVP operations. Additionally, new litigation, listings of additional species or new regulatory requirements could further adversely affect SWP operations in the future by requiring additional export reductions, releases of additional water from storage or other operational changes impacting water supply operations.

Future Programs / Plans

MET's Board approved a Delta Action Plan in June 2007 that provides a framework for staff to pursue actions with other agencies and stakeholders to build a sustainable Delta and reduce conflicts between water supply conveyance and the environment. The Delta Action Plan aims to prioritize immediate short-term actions to stabilize the Delta while an ultimate solution is selected, and mid-term steps to maintain the Delta while a long-term solution is implemented. Currently, MET is working towards addressing four elements: Delta ecosystem restoration, water supply conveyance, flood control protection, and storage development.

In May 2019, Governor Newsom ended California WaterFix, announced a new approach to modernize Delta Conveyance through a single tunnel alternative, and released Executive Order 10-19 that directed state agencies to inventory and assess new planning for the project. DWR then withdrew all project approvals and permit applications for California WaterFix, effectively ending the project. The purpose of the Delta Conveyance Project (DCP) gives rise to several project objectives (MET, 2021). In proposing to make physical improvements to the SWP Delta conveyance system, the project objectives are:

- To address anticipated rising sea levels and other reasonably foreseeable consequences of climate change and extreme weather events.
- To minimize the potential for public health and safety impacts from reduced quantity and quality of SWP water deliveries, and potentially CVP water deliveries, south of the Delta resulting from a major earthquake that causes breaching of Delta levees and the inundation of brackish water into the areas in which existing pumping plants operate.
- To protect the ability of the SWP, and potentially the CVP, to deliver water when hydrologic conditions result in the availability of sufficient amounts, consistent with the requirements of state and federal law.
- To provide operational flexibility to improve aquatic conditions in the Delta and better manage risks of further regulatory constraints on project operations.

6.2.3 Storage

Storage is a major component of MET's dry year resource management strategy. MET's likelihood of having adequate supply capability to meet projected demands, without implementing its Water Supply Allocation Plan (WSAP), is dependent on its storage resources. Due to the pattern of generally drier hydrology, the groundwater basins and local reservoirs have dropped to low operating levels and remain below healthy storage levels. For example, the Colorado River Basin's system storage at the close of 2020, was at or near its lowest since 2000, so there is very little buffer to avoid a shortage from any future period of reduced precipitation and runoff (MET, 2021).

MET stores water in both DWR and MET surface water reservoirs. MET's surface water reservoirs are Lake Mathews, Lake Skinner, and Diamond Valley Lake (DVL), which have a combined storage capacity of over 1 MAF. Approximately 650,000 AF are stored for seasonal, regulatory, and drought use, while approximately 370,000 AF are stored for emergency use.

MET also has contractual rights to DWR surface Reservoirs, such as 65 thousand acre-feet (TAF) of flexible storage at Lake Perris (East Branch terminal reservoir) and 154 TAF of flexible storage at Castaic Lake (West Branch terminal reservoir) that provides MET with additional options for managing SWP deliveries to maximize the yield from the project. This storage can provide MET with up to 44 TAF of additional supply over multiple dry years, or up to 219 TAF to Southern California in a single dry year (MET, 2021).

MET endeavors to increase the reliability of water supplies through the development of flexible storage and transfer programs including groundwater storage (MET, 2021). These include:

- **Lake Mead Storage Program:** Executed in 2006, this program allows MET to leave excessively conserved water in Lake Mead, for exclusive use by MET in later years. MET created "Intentionally Created Surplus" (ICS) water in 2006-2007, 2009-2012, and 2016-2019, and withdrew ICS water in 2008 and 2013-2015. As of January 1, 2021, MET had a total of 1.3 MAF of Extraordinary Conservation ICS water.
- **Semitropic Storage Program:** The maximum storage capacity of the program is 350 TAF, and the minimum and maximum annual yields available to MET are 34.7 TAF and 236.2 TAF, respectively. The specific amount of water MET can expect to store in and subsequently receive from the program depends on hydrologic conditions, any regulatory requirements restricting

MET's ability to export water for storage and demands placed by other program participants. During wet years, MET has the discretion to use the program to store portions of its SWP supplies which are in excess, and during dry years, the Semitropic Water Storage District returns MET's previously stored water to MET by direct groundwater pump-in or by exchange of surface water supplies.

- **Arvin-Edison Storage Program:** The storage program is estimated to deliver 75 TAF, and the specific amount of water MET can expect to store in and subsequently receive from the program depends on hydrologic conditions and any regulatory requirements restricting MET's ability to export water for storage. During wet years, MET has the discretion to use to program to store portions of its SWP supplies which are in excess, and during dry years, the Arvin-Edison Water Storage District returns MET's previously stored water to MET by direct groundwater pump-in or by exchange of surface water supplies.
- **Antelope Valley-East Kern (AVEK) Water Agency Exchange and Storage Program:** Under the exchange program, for every two AF MET receives, MET returns 1 AF back to AVEK, and MET will also be able to store up to 30 TAF in the AVEK's groundwater basin, with a dry-year return capability of 10 TAF.
- **High Desert Water Bank Program:** Under this program, MET will have the ability to store up to 280 TAF of its SWP Table A or other supplies in the Antelope Valley groundwater basin, and in exchange will provide funding for the construction of monitoring and production wells, turnouts from the California Aqueduct, pipelines, recharge basins, water storage, and booster pump facilities. The project is anticipated to be in operation by 2025.
- **Kern-Delta Water District Storage Program:** This groundwater storage program has 250 TAF of storage capacity, and water for storage can either be directly recharged into the groundwater basin or delivered to Kern-Delta Water District farmers in lieu of pumping groundwater. During dry years, the Kern-Delta Water District returns MET's previously stored water to MET by direct groundwater pump-in return or by exchange of surface water supplies.
- **Mojave Storage Program:** MET entered into a groundwater banking and exchange transfer agreement with Mojave Water Agency that allows for the cumulative storage of up to 390 TAF. The agreement allows for MET to store water in an exchange account for later return.

6.2.4 Planned Future Sources

Beyond the programs highlighted in Sections 6.2.1 through 6.2.3, MET continues to invest in efforts to meet its goal of long-term regional water supply reliability, focusing on the following:

- Continuing water conservation
- Developing water supply management programs outside of the region
- Developing storage programs related to the Colorado River and the SWP
- Developing storage and groundwater management programs within the Southern California region
- Increasing water recycling, groundwater recovery, stormwater and seawater desalination
- Pursuing long-term solutions for the ecosystem, regulatory and water supply issues in the California Bay-Delta (MET, 2021).

6.3 Groundwater

Historically, local groundwater has been the cheapest and most reliable source of supply for the City. The City has four active wells that draw water from the OC Basin. In FY 2019-20, the City relied on 10,237 AFY – approximately 68% of the City's water supply portfolio for FY 2019-20 – from the OC Basin to meet its demands.

This section describes the OC Basin and the management measures taken by OCWD, the basin manager to optimize local supply and minimize overdraft. This section also provides information on historical groundwater production as well as a 25-year projection of the City's groundwater supply.

The OCWD was formed in 1933 by a special legislative act of the California State Legislature to protect and manage the County's vast, natural, groundwater supply using the best available technology and defend its water rights to the OC Basin. This legislation is found in the State of California Statutes, Water – Uncodified Acts, Act 5683, as amended. The OC Basin is managed by OCWD under the Act, which functions as a statutorily-imposed physical solution. The OCWD Management Area includes approximately 89% of the land area of the OC Basin, and 98% of all groundwater production occurs within the area. OCWD monitors the basin by collecting groundwater elevation and quality data from wells and manages an electronic database that stores water elevation, water quality, production, recharge, and other data on over 2,000 wells and facilities within and outside OCWD boundaries (City of La Habra et al., 2017).

Groundwater levels are managed within a safe basin operating range to protect the long-term sustainability of the OC Basin and to protect against land subsidence. OCWD regulates groundwater levels in the OC Basin by regulating the annual amount of pumping and setting the basin production percentage (BPP) for the water year. As defined in the District Act, the BPP is the ratio of water produced from groundwater supplies within the district to all water produced within the district from both supplemental sources and groundwater within the district (OCWD, 2020). On a per agency basis including the City, the BPP is the total percentage amount of groundwater allowed to be produced towards that agency's or city's demand. For the City, the remaining percentage of potable water demand is achieved through MET water.

6.3.1 Historical Groundwater Extraction

The City pumps groundwater through its four wells. Pumping limitations set by the BPP and the pumping capacity of the wells are the only constraints affecting the groundwater supply to the City. Aside from a decrease in groundwater volume pumped in FY 2017-18, the City has experienced relative stability in groundwater volume pumped for the last five years (Table 6-4).

Table 6-4: Retail: Groundwater Volume Pumped

DWR Submittal Table 6-1 Retail: Groundwater Volume Pumped						
☐	Supplier does not pump groundwater. The supplier will not complete the table below.					
☐	All or part of the groundwater described below is desalinated.					
Groundwater Type	Location or Basin Name	2016	2017	2018	2019	2020
Alluvial Basin	Orange County Groundwater Basin	9,616	10,004	8,200	10,877	10,237
	TOTAL	9,616	10,004	8,200	10,877	10,237
NOTES: Source - MWDOC, 2020						

6.3.2 Basin Characteristics

The OC Basin underlies the northerly half of Orange County beneath broad lowlands. The OC Basin, managed by OCWD, covers an area of approximately 350 square miles, bordered by the Coyote and Chino Hills to the north, the Santa Ana Mountains to the northeast, and the Pacific Ocean to the southwest. The OC Basin boundary extends to the Orange County-Los Angeles Line to the northwest, where groundwater flows across the county line into the Central Groundwater Basin of Los Angeles County. A map of the OC Basin is shown in Figure 6-2. The total thickness of sedimentary rocks in the OC Basin is over 20,000 feet, with only the upper 2,000 to 4,000 feet containing fresh water. The OC Basin's full volume is approximately 66 MAF.

There are three major aquifer systems that have been subdivided by OCWD, the Shallow Aquifer System, the Principal Aquifer System, and the Deep Aquifer System. These three aquifer systems are hydraulically connected as groundwater is able to flow between each other through intervening aquitards or discontinuities in the aquitards. The Shallow Aquifer system occurs from the surface to approximately 250 feet below ground surface. Most of the groundwater from this aquifer system is pumped by small water systems for industrial and agricultural use. The Principal Aquifer system occurs at depths between 200 and 1,300 feet below ground surface. Over 90% of groundwater production is from wells that are screened within the Principal Aquifer system. Only a minor amount of groundwater is pumped from the Deep Aquifer system, which underlies the Principal Aquifer system and is up to 2,000 feet deep in the center of the OC Basin.

Per- and polyfluoroalkyl substances (PFAS) are a group of thousands of manmade chemicals that includes perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). PFAS compounds were once commonly used in many products including, among many others, stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, and fire-fighting foams.

Beginning in the summer of 2019, the California State Division of Drinking Water (DDW) began requiring testing for PFAS compounds in some groundwater production wells in the OCWD area.

Groundwater production in FY 2019-20 was expected to be approximately 325,000 AF but declined to 286,550 AF primarily due to PFAS impacted wells being turned off around February 2020. OCWD expects groundwater production to be in the area of 245,000 AF in FY 2020-21 due to the currently idled wells and additional wells being impacted by PFAS and turned off. As PFAS treatment systems are constructed, OCWD expects total annual groundwater production to slowly increase back to normal levels (310,000 to 330,000 AF) (OCWD, 2020).

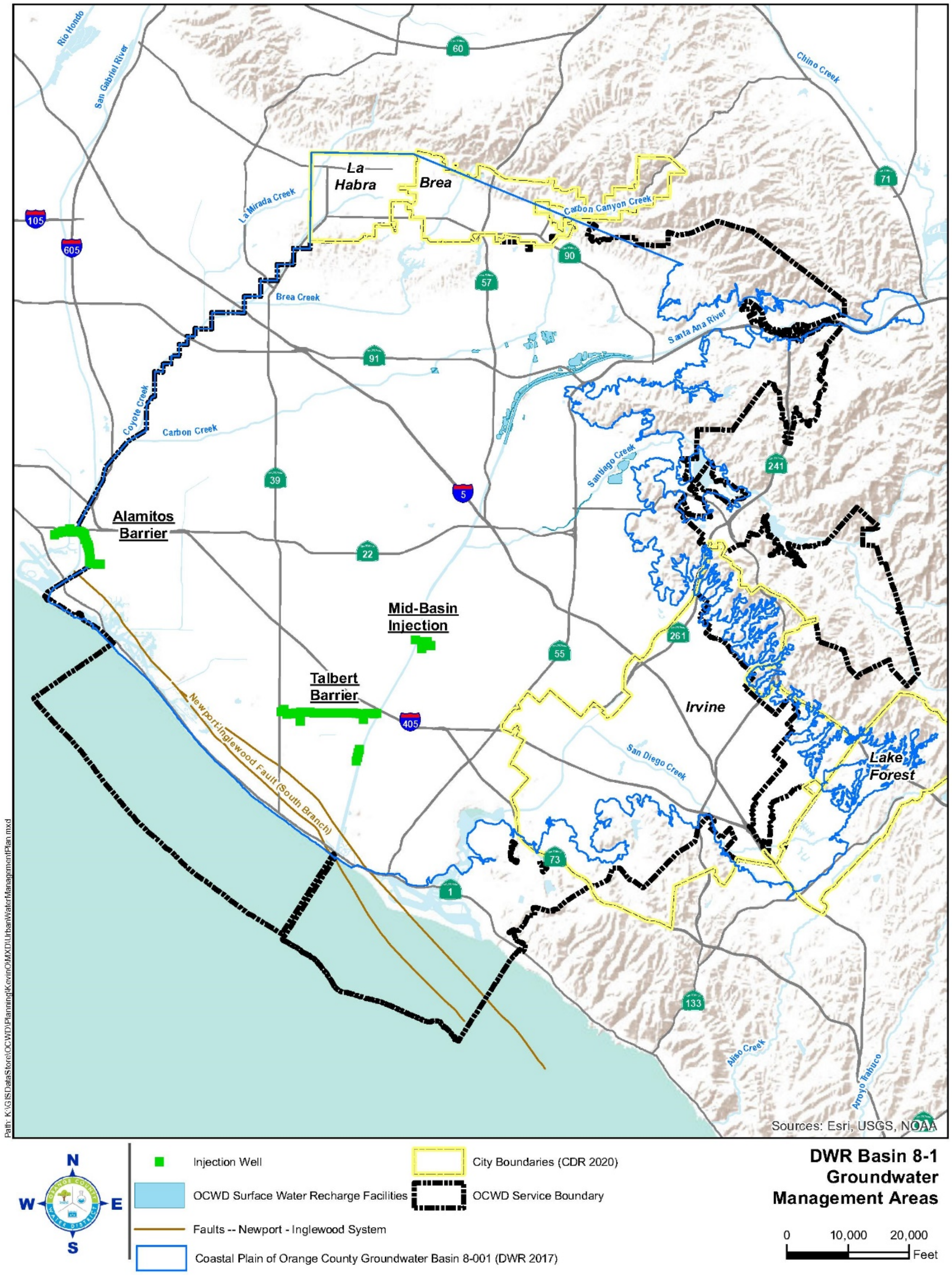


Figure 6-2: Map of the OC Basin

6.3.3 Sustainable Groundwater Management Act

In 2014, the State of California adopted the Sustainable Groundwater Management Act (SGMA) to help manage its groundwater sustainably, and limit adverse effects such as significant groundwater-level declines, land subsidence, and water quality degradation. SGMA requires all high- and medium-priority basins, as designated by DWR, be sustainably managed. DWR designated the non-adjudicated Coastal Plain of OC Basin ("Basin 8-1" or "Basin") as a medium-priority basin, primarily due to heavy reliance on the Basin's groundwater as a source of water supply. Compliance with SGMA can be achieved in one of two ways:

1) A Groundwater Sustainability Agency (GSA) is formed and a GSP is adopted, or
2) Special Act Districts created by statute, such as OCWD, and other agencies may prepare and submit an Alternative to a GSP (City of La Habra et al., 2017).

The agencies within Basin 8-1, led by OCWD collaborated to submit an Alternative to a GSP in 2017, titled the "Basin 8-1 Alternative" to meet SGMA compliance. This document will be updated every five years. The current (2017) version is included in Appendix G.

6.3.4 Basin Production Percentage

Background

The OC Basin is not adjudicated and as such, pumping from the OC Basin is managed through a process that uses financial incentives to encourage groundwater producers to pump a sustainable amount of water. The framework for the financial incentives is based on establishing the BPP, the percentage of each Producer's total water supply that comes from groundwater pumped from the OC Basin. Groundwater production at or below the BPP is assessed the Replenishment Assessment (RA). While there is no legal limit as to how much an agency pumps from the OC Basin, there is a financial disincentive to pump above the BPP. The BPP is set uniformly for all Producers by OCWD on an annual basis. Agencies that pump above the BPP are charged the RA plus the Basin Equity Assessment (BEA). The BEA is presently calculated so that the cost of groundwater production is equivalent to the cost of importing potable water supplies. This approach serves to discourage, but not eliminate, production above the BPP, and the BEA can be increased to discourage production above the BPP if necessary.

The BPP is set based on groundwater conditions, availability of imported water supplies, and Basin management objectives. The supplies available for recharge must be estimated for a given year. The supplies of recharge water that are estimated are: 1) Santa Ana River stormflow, 2) Natural incidental recharge, 3) Santa Ana River baseflow, 4) GWRS supplies, and 5) other supplies such as imported water and recycled water purchased for the Alamitos Barrier. The BPP is a major factor in determining the cost of groundwater production from the OC Basin for that year. The BPP set for Water Year 2021-22 is 77%.

BPP Adjustments for Basin Management

OCWD has established management guidelines that are used to establish future BPPs, as seen in Table 6-5. Raising or lowering the BPP allows OCWD to manage the amount of pumping from the basin. OCWD has a policy to manage the groundwater basin within a sustainable range to avoid adverse impacts to the basin. OCWD seeks to maintain some available storage space in the basin to maximize surface water recharge when such supplies are available, especially in relatively wet years. By keeping the basin relatively full during wet years, and for as long as possible in years with near-normal recharge, the maximum amount of groundwater could be maintained in storage to support pumping in future drought conditions. During dry hydrologic years when less water would be available for recharge, the BPP could be lowered to maintain groundwater storage levels. A component of OCWD's BPP policy is to manage the groundwater basin so that the BPP will not fluctuate more that 5 percent from year to year.

Based on most recent modeling of water supplies available for groundwater recharge and water demand forecasts, OCWD anticipates being able to sustain the BPP at 85% starting in 2025. The primary reasons for the higher BPP are the expected completion of the GWRS Final Expansion (GWRSFE) in 2023 and the relatively low water demands of approximately 400,000 AFY.

Modeling and forecasts generate estimates based on historical averages. Consequently, forecasts use average hydrologic conditions which smooth the dynamic and unpredictable local hydrology. Variations in local hydrology are the most significant impact to supplies of water available to recharge the groundwater basin. The BPP projection of 85% is provided based upon average annual rainfall weather patterns. If the City were to experience a relatively dry period, the BPP could be reduced to maintain water storage levels, by as much as five percent.

Table 6-5: Management Actions Based on Changes in Groundwater Storage

Available Storage Space (amount below full basin condition, AF)	Considered Basin Management Action
Less than 100,000	Raise BPP
100,000 to 300,000	Maintain and / or raise BPP towards 75% goal
300,000 to 350,000	Seek additional supplies to refill basin and / or lower the BPP
Greater than 350,000	Seek additional supplies to refill basin and lower the BPP

BPP Exemptions

In some cases, OCWD encourages pumping and treating groundwater that does not meet drinking water standards in order to protect water quality. This is achieved by using a financial incentive called the BEA Exemption. A BEA Exemption is used to promote beneficial uses of poor-quality groundwater and reduce or prevent the spread of poor-quality groundwater into non-degraded aquifer zones. OCWD uses a partial or total exemption of the BEA to compensate a qualified participating agency or Producer for the costs of treating poor quality groundwater, which typically include capital, interest and operations and maintenance costs for treatment facilities. When OCWD authorizes a BEA exemption for a project, it is obligated to provide the replenishment water for the production above the BPP and forgo the BEA revenue that OCWD would otherwise receive from the producer (City of La Habra et al., 2017). Similarly, for proactive water quality management, OCWD exempts a portion of the BEA for their Coastal Pumping Transfer Program (CPTP). The CPTP encourages inland groundwater producers to increase pumping and coastal producers to decrease pumping in order to reduce the groundwater basin drawdown at the coast and protect against seawater intrusion. Inland pumpers can pump above the BPP without having to pay the full BEA for the amount pumped above the BPP (OCWD, 2015). Coastal pumpers receive BEA revenue from OCWD to assist in offsetting their additional water supply cost from taking less groundwater.

6.3.4.1 2020 OCWD Groundwater Reliability Plan

In order to adapt to the substantial growth in water demands in OCWD's management area, it is paramount to anticipate and understand future water demands and develop projects to increase future water supplies proactively to match demands. The GRP is a continuation of these planning efforts that estimates the OC Basin's sustainable average annual production and extrapolates water needs of the OC Basin by combining recently completed water demand projections and modeling of Santa Ana River flows available for recharge. These data will be used to evaluate future water supply projects and guide management of the OC Basin. OCWD is currently developing the GRP, and the first public draft is expected to be available May 2021.

Current water demand projections show a relatively slow increase over the 25-year planning horizon, which is generally of similar magnitude as the additional production from the GWRSFE in early 2023. Once complete, the GWRSFE will increase capacity from 100,000 to 134,000 AFY of high-quality recycled water. This locally controlled, drought proof supply of water reduces the region's dependance on imported water.

Historically, the Santa Ana River has served as the primary source of water to recharge the OC Basin. To determine the availability of future Santa Ana River flows, OCWD utilized surface water flow modeling of the upper watershed. Modeling was developed to predict the impacts future stormwater capture and wastewater recycling projects in the upper watershed would have on future Santa Ana River flow rates at Prado Dam. Santa Ana River base flows are expected to decrease as more water recycling projects are built in the upper watershed. OCWD continues to work closely with the US Army Corps of Engineers to temporarily impound and slowly release up to approximately 20,000 AF of stormwater in the Prado Dam Conservation Pool. To some extent, the losses in baseflow are partially offset through the capture of additional stormwater held in the Prado Dam Conservation Pool. When available, OCWD will continue to augment groundwater recharge through the purchase of imported water through MET. OCWD will diligently monitor and evaluate future water supply projects to sustainably manage and protect the OC Basin for future generations.

6.3.4.2 OCWD Engineer's Report

The OCWD Engineer's Report reports on the groundwater conditions and investigates information related to water supply and groundwater basin usage within OCWD's service area.

The overall BPP achieved in the 2019 to 2020 water year within OCWD for non-irrigation use was 75.9%. The achieved pumping was less than the BPP established for the 2019 to 2020 water year primarily due to the water quality impacts of PFAS. As indicated in Section 6.3.4, a BPP of 77% was established for water year 2021-22. Analysis of the groundwater basin's projected accumulated overdraft, the available supplies to the OC Basin (assuming average hydrology) and the projected pumping demands indicate that this level of pumping can be sustained for 2021-22 without detriment to the OC Basin (OCWD, 2021).

In FY 2021-22 additional production of approximately 22,000 AF above the BPP will be undertaken by the City of Tustin, City of Garden Grove, City of Huntington Beach, Mesa Water District, and IRWD. These agencies use the additional pumping allowance in order to accommodate groundwater quality improvement projects. As in prior years, production above the BPP from these projects would be partially or fully exempt from the BEA as a result of the benefit provided to the OC Basin by removing poor-quality groundwater and treating it for beneficial use (OCWD, 2021).

6.3.5 Recharge Management

Recharging water into the OC Basin through natural and artificial means is essential to support pumping from the OC Basin. Active recharge of groundwater began in 1949, in response to increasing drawdown of the OC Basin and, consequently, the threat of seawater intrusion. The OC Basin's primary source of recharge is flow from the Santa Ana River, which is diverted into recharge basins and its main Orange County tributary, Santiago Creek. Other sources of recharge water include natural infiltration, recycled water, and imported water. Natural recharge consists of subsurface inflow from local hills and mountains, infiltration of precipitation and irrigation water, recharge in small flood control channels, and groundwater underflow to and from Los Angeles County and the ocean.

Recycled water for the OC Basin recharge is from two sources. The main source of recycled water is from the GWRS, which is injected into the Talbert Seawater Barrier and recharged in the Kraemer, Miller and Miraloma Basins (City of La Habra et al., 2017). The second source of recycled water is water purified at the Water Replenishment District's Leo J. Vander Lans Treatment Facility, which supplies water to the Alamitos Seawater Barrier (owned and operated by the Los Angeles County Department of Public Works). OCWD's share of the Alamitos Barrier injection total for water year 2018-19 was less than half of the total injection, based on barrier wells located within Orange County. The Water Replenishment District of Southern California (WRD) also works closely with OCWD to ensure that the water demands at the Alamitos Barrier are fulfilled through the use of recycled water as opposed to imported water, however the recycled portion was less than 33% for the last six years due to operational issues and wastewater supply interruptions (OCWD, 2020a). Injection of recycled water into these barriers is an effort by OCWD to control seawater intrusion into the OC Basin. Operation of the injection wells forms a hydraulic barrier to seawater intrusion.

OCWD purchases imported water for recharge from MWDOC. Untreated imported water can be used to recharge the OC Basin through the surface water recharge system in multiple locations, such as Anaheim Lake, Santa Ana River, Irvine Lake, and San Antonio Creek. Treated imported water can be used for in-lieu recharge, as was performed extensively from 1977 to 2007 (City of La Habra et al., 2017).
For detailed recharge management efforts from OCWD, refer to OCWD's 2017 "Basin 8-1 Alternative" (Appendix G).

6.3.6 MET Groundwater Replenishment Program

In the past, OCWD, MWDOC, and MET have coordinated water management to increase storage in the OC Basin when imported supplies are available for this purpose. MET's groundwater replenishment program was discontinued on January 1, 2013, and currently MET via MWDOC sells replenishment water to OCWD at the full-service untreated MET rate.

MWDOC's imported water sales to OCWD since FY 1990-91 averages approximately 31,200 AF per year. Recently, due to low Santa Ana River flows as a result of low precipitation and increased use along the river, OCWD has needed to purchase more imported replenishment water per year than the average of 31,200 AFY over the last 25 years (this does not include water amounts from MET's Conjunctive Use Program (CUP) or its Cyclic Storage Account). However, with the emergence of PFAS affecting groundwater production, the need to purchase imported water has been temporary suspended. Until PFAS treatment is in place for most groundwater producers in the region, imported replenishment water will be significantly reduced.

6.3.7 MET Conjunctive Use Program / Cyclic Storage Program with OCWD

Since 2004, OCWD, MWDOC, and certain groundwater producers have participated in MET's CUP. This program allows for the storage of MET water in the OC Basin. The existing MET program provides storage up to 66,000 AF of water in the OC Basin to be pumped by participating producers in place of receiving imported supplies during water shortage events in exchange for MET's contribution to improvements in basin management facilities and an annual administrative fee. These improvements include eight new groundwater production wells, improvements to the seawater intrusion barrier, and construction of the Diemer Bypass Pipeline. The water is accounted for via the CUP program administered by the wholesale agencies and is controlled by MET such that it can be withdrawn over a three-year time period (OCWD, 2020). As of 2021, the CUP has not been in use since 2014. The CUP contract ends in 2028.

The Cyclic Storage account is an alternative storage account with MET. However, unlike the CUP program, OCWD controls when the water is used. The Cyclic Water Storage Program allows MET to store water in a local groundwater basin during surplus conditions, where MET has limited space in its regional storage locations. Once the water is stored via direct delivery or In-lieu the groundwater agency has the ability to purchase this water at a future date or over a 5-year period.

6.3.8 Overdraft Conditions

Annual groundwater basin overdraft, as defined in OCWD's Act, is the quantity by which production of groundwater supplies exceeds natural replenishment of groundwater supplies during a water year. This difference between extraction and replenishment can be estimated by determining the change in volume of groundwater in storage that would have occurred had supplemental water not been used for any groundwater recharge purpose, including seawater intrusion protection, advanced water reclamation, and the in-Lieu Program.

The annual analysis of basin storage change and accumulated overdraft for water year 2019-20 has been completed. Based on the three-layer methodology, an accumulated overdraft of 200,000 AF was calculated for the water year ending June 30, 2020. The accumulated overdraft for the water year ending June 30, 2019 was 236,000 AF, which was also calculated using the three-layer storage method. Therefore, an annual increase of 36,000 AF in stored groundwater was calculated as the difference between the June 2019 and June 2020 accumulated overdrafts (OCWD, 2021).

6.3.9 Planned Future Sources

The City plans to construct new wells in Fountain Valley, including a pipeline transmission to the existing well transmission main to provide redundancy for the wells providing water to the City. This project is further described in Section 6.9.

On a regional scale, OCWD regularly evaluates potential projects and conducts studies to improve the existing facilities and build new facilities to include in their Long-Term Facilities Plans (LTFP). OCWD's 2014 LTFP evaluated 65 potential projects for water supply, basin management, recharge facilities, operational improvements, and operational efficiency. Some of OCWD's planned water projects that would increase supply are listed below. For a more detailed list of projects, refer to the 2014 LTFP (OCWD).

- **GWRSFE –** The Final Expansion of the GWRS is currently underway and is the third and final phase of the project. When the Final Expansion is completed in early 2023, the plant's treatment capacity will increase from 100 to 130 MGD. To produce 130 MGD, additional treated wastewater from Orange County Sanitation District (OC San)'s Treatment Plant 2 is required. This recycled water represents a high quality, drought-proof source of water to protect and enhance the OC Basin. The Final Expansion project will include expanding the existing GWRS treatment facilities, constructing new conveyance facilities at OC San Plant 2, and rehabilitating an existing pipeline between OC San Plant 2 and the GWRS. Once completed, the GWRS plant will recycle 100% of OC San's reclaimable sources and produce enough water to meet the needs of over one million people.
- **Forecast Informed Reservoir Operations (FIRO) at Prado Dam** – Stormwater represents a significant source of water used by OCWD to recharge the OC Basin. Much of this recharge is made possible by the capture of Santa Ana River stormflows behind Prado Dam in the Conservation Pool. FIRO represents the next generation of operating water reservoirs using the best available technology. Advances in weather and stormwater runoff forecasting hold promise to allow USACE to safety impound more stormwater while maintaining equivalent flood risk management capability behind Prado Dam. Preliminary modeling show that by expanding the Conservation Pool from elevation 505 to 512 ft msl, annual recharge to the groundwater basin could increase by as much as 4,500 to 7,000 AFY.

6.4 Surface Water

6.4.1 Existing Sources

There are, currently, no direct surface water uses in the City's service area.

6.4.2 Planned Future Sources

As of 2021, there are no planned direct uses of surface water in the City's service area.

6.5 Stormwater

6.5.1 Existing Sources

The City has over 3,200 catch basins and over 95 miles of storm drain pipe that divert stormwater to the wastewater system (City of Newport Beach, 2021). A portion of the combined stormwater and wastewater are treated at OCWD's Green Acres Project (GAP) and / or GWRS to produce recycled water that is used for irrigation purposes, as further described in Section 6.6.

6.5.2 Planned Future Sources

The City will continue to divert stormwater. Otherwise, there are no planned direct uses of stormwater in the City's service area as of early 2021.

6.6 Wastewater and Recycled Water

The City is directly involved in wastewater services through its ownership and operation of the wastewater collection system in its service area. However, the City does not own or operate wastewater treatment facilities. The City's sewer system includes over 200 miles of sewer lines and 21 wastewater lift stations and serves a population of approximately 66,000 residents.

Recycled water is wastewater that is treated through primary, secondary, and tertiary processes and is acceptable for most non-potable water purposes such as irrigation, and commercial and industrial process water per Title 22 requirements. Recycled water opportunities have continued to grow in Southern California as public acceptance and the need to expand local water resources continues to be a priority. Recycled water also provides a degree of flexibility and added reliability during drought conditions when imported water supplies are restricted. The City is indirectly involved in recycled water production, through its supply of wastewater IPR. The following sections expand on the existing agency collaboration involved in these efforts as well as the City's projected recycled water use over the next 25 years.

6.6.1 Agency Coordination

The City does not own or operate wastewater treatment facilities and sends all collected wastewater to OC San for treatment and disposal. OC San provides treated water to OCWD, the manager of the OC Basin. OCWD strives to maintain and increase the reliability of the OC Basin through replenishment with imported water, stormwater, and advanced treated wastewater. A full description of the OC Basin is available in Section 6.3.2. OCWD and OC San have jointly constructed and expanded two water recycling projects to meet this goal including: 1) OCWD GAP, and 2) OCWD GWRS.

6.6.1.1 OCWD Green Acres Project

OCWD owns and operates the GAP, a water recycling system that provides up to 8,400 AFY of recycled water for irrigation and industrial uses. GAP provides an alternate source of water that is mainly delivered to parks, golf courses, greenbelts, cemeteries, and nurseries in the cities of Costa Mesa, Fountain Valley, Newport Beach, and Santa Ana. OCWD produces and distributes GAP water for purchase by the City, which sells and distributes the water to recycled water customers. Approximately 100 sites use GAP water, current recycled water users include the Newport Beach County Club, the Big Canyon Country Club, median strips, a City-owned park, and the recently added Eastbluff Village.

6.6.1.2 OCWD Groundwater Replenishment System

OCWD's GWRS allows Southern California to decrease its dependency on imported water and creates a local and reliable source of water. OCWD's GWRS purifies secondary treated wastewater from OC San to levels that meet and exceed all state and federal drinking water standards. The GWRS Phase 1 plant has been operational since January 2008 and uses a three-step advanced treatment process consisting of microfiltration (MF), reverse osmosis (RO), and ultraviolet (UV) light with hydrogen peroxide (H_2O_2). A portion of the treated water is injected into the seawater barrier to prevent seawater intrusion into the groundwater basin. The other portion of the water is pumped to ponds where the water percolates into deep aquifers and becomes part of OC's water supply.

The GWRS first began operating in 2008 producing 70 MGD and in 2015, it underwent a 30 MGD expansion. Approximately 39,200 AFY of the highly purified water is pumped into the injection wells and 72,900 AFY is pumped to the percolation ponds in the City of Anaheim where the water is naturally filtered through sand and gravel to deep aquifers of the groundwater basin. The OC Basin provides approximately 72% of the potable water supply for north and central Orange County. The design and construction of the first phase (78,500 AFY) of the GWRS project was jointly funded by OCWD and OC San; Phase 2 expansion (33,600 AFY) was funded solely by OCWD.

The Final Expansion of the GWRS is currently underway and is the third and final phase of the project. When the Final Expansion is completed in 2023, the plant will produce 130 MGD. To produce 130 MGD, additional treated wastewater from OC San is required. This additional water will come from OC San's Treatment Plant 2, which is in the City of Huntington Beach approximately 3.5 miles south of the GWRS. The Final Expansion project will include expanding the existing GWRS treatment facilities, constructing new conveyance facilities at OC San Plant 2 and rehabilitating an existing pipeline between OC San Plant 2 and the GWRS. Once completed, the GWRS plant will recycle 100% of OC San's reclaimable sources and produce enough water to meet the needs of over one million people.

6.6.2 Wastewater Description and Disposal

The City operates and maintains the local sewer collection pipes that feed into the OC San's trunk sewer system to convey wastewater to OC San's treatment plants. The City's sewer system includes 202.4 miles of sewer lines and 21 wastewater lift stations. The wastewater collected in the City's system is conveyed to OC San's extensive system of gravity flow sewers, pump stations, and pressurized sewers. Ultimately, the wastewater is treated at OC San treatment plants in Fountain Valley (Plant No. 1) and Huntington Beach (Plant No. 2). Plant No. 1 has a total rated primary capacity of 108 MGD and a secondary treatment capacity of 80 MGD. Plant No. 2 has a rated primary capacity of 168 MGD and secondary treatment capacity of 90 MGD. Both plants share a common ocean outfall, but Plant No. 1 currently provides all its secondary treated wastewater to OCWD's GWRS for beneficial reuse. The 120-inch diameter ocean outfall extends 4 miles off the coast of Huntington Beach. A 78-inch diameter emergency outfall also extends 1.3 miles off the coast. Table 6-6 summarizes the wastewater collected by the City and transported to OC San's system in 2020.

Table 6-6: Retail: Wastewater Collected Within Service Area in 2020

DWR Submittal Table 6-2 Retail: Wastewater Collected Within Service Area in 2020						
☐	There is no wastewater collection system. The supplier will not complete the table below.					
	Percentage of 2020 service area covered by wastewater collection system *(optional)*					
	Percentage of 2020 service area population covered by wastewater collection system *(optional)*					
Wastewater Collection			**Recipient of Collected Wastewater**			
Name of Wastewater Collection Agency	Wastewater Volume Metered or Estimated?	Volume of Wastewater Collected from UWMP Service Area 2020	Name of Wastewater Treatment Agency Receiving Collected Wastewater	Treatment Plant Name	Is WWTP Located Within UWMP Area?	Is WWTP Operation Contracted to a Third Party? *(optional)*
Add additional rows as needed						
Newport Beach	Estimated	10,015	OC San	Plant No. 1 / Plant No. 2	No	No
Total Wastewater Collected from Service Area in 2020:		10,015				
NOTES: Used a 65% return rate (City of Newport Beach, 2015)						

6.6.3 Current Recycled Water Uses

The City currently uses recycled water from OCWD's GAP for direct non-potable reuse such as landscape irrigation. The City owns approximately ten miles of recycled water distribution pipe that supplies eight sites. The sites served with recycled water for irrigation include the Newport Beach County Club, the Big Canyon Country Club, median strips, a City-owned park, and the recently added Eastbluff Village. In FY 2020, approximately 85 AFY of recycled water was used in the City's service area for landscape irrigation and 428 AFY for golf course irrigation, about 3.5% of the City's annual water demand.

For indirect use, the City also benefits from OCWD's GWRS system that provides IPR through replenishment of OC Basin with water that meets state and federal drinking water standards.

6.6.4 Projected Recycled Water Uses

The City will continue to receive recycled water from GAP and supply it to the various landscape irrigation sites mentioned in Section 6.6.3. The City will continue to supply wastewater to support the region's IPR via GWRS. Current and projected recycled water use through 2045 are shown in Table 6-8 and are expected to increase. Although the 2015 UWMP acknowledged IPR of wastewater, it did not quantify projections. These projections will be prepared moving forward. The projected 2020 recycled water use from the City's 2015 UWMP are compared to the 2020 actual use in Table 6-8, where the actual use is slightly less than the projected.

Table 6-7: Retail: Recycled Water Direct Beneficial Uses Within Service Area

DWR Submittal Table 6-4 Retail: Recycled Water Direct Beneficial Uses Within Service Area										
Name of Supplier Producing (Treating) the Recycled Water:		OCWD								
Name of Supplier Operating the Recycled Water Distribution System:		OCWD								
Beneficial Use Type	Potential Beneficial Uses of Recycled Water (Describe)	Amount of Potential Uses of Recycled Water (Quantity)	General Description of 2020 Uses	Level of Treatment	2020	2025	2030	2035	2040	2045 (opt)
Landscape irrigation (excludes golf courses)	Parks, Country Clubs, medians	See projections	Parks, Country Clubs, medians	Tertiary	85	92	92	92	92	92
Golf course irrigation	Golf course	See projections	Golf course	Tertiary	428	450	450	450	450	450
				Total:	513	542	542	542	542	542
**IPR - Indirect Potable Reuse*										
NOTES: Table does not include groundwater recharge (IPR) numbers as they are not separate from OCWD's supply										

Table 6-8: Retail: 2015 UWMP Recycled Water Use Projection Compared to 2020 Actual

DWR Submittal Table 6-5 Retail: 2015 UWMP Recycled Water Use Projection Compared to 2020 Actual		
☐	Recycled water was not used in 2015 nor projected for use in 2020. The Supplier will not complete the table below.	
Use Type	**2015 Projection for 2020**	**2020 Actual Use**
Landscape irrigation (excludes golf courses)	95	85
Golf course irrigation	450	428
Groundwater recharge (IPR)	N/A	3,411
Total	545	3,924
NOTES: Groundwater recharge (IPR) estimated based on OCWD Groundwater Basin Production and Percent of Total Basin Production for FY 2019-20 (33.3%)		

6.6.5 Potential Recycled Water Uses

Potential recycled water users are locations where recycled water could replace potable water use. These potential users are typically landscape or agricultural systems, or possibly water users. The City does not currently have any potential recycled water uses.

6.6.6 Optimization Plan

Studies of water recycling opportunities within Southern California provide a context for promoting the development of water recycling plans. It is recognized that broad public acceptance of recycled water requires continued education and public involvement. Currently, most of the recycled water available is being directed toward replenishment of the groundwater basin and improvements in groundwater quality. As a user of groundwater, the City supports the efforts of OCWD and OC San to use recycled water as a primary resource for groundwater recharge in Orange County.

Public Education

The City participates in the MWDOC public education and school education programs, which include extensive sections on water recycling. MWDOC's water use efficiency public information programs are a partnership with agencies throughout the county. The City also contracts with Inside the Outdoors Foundation (ITOF) administered by the Orange County Department of Education. Through ITOF the City conducts effective environmental education programs promoting studies of environmental Science, Technology, Engineering and Math (STEM).

Through a variety of public information programs, MWDOC and ITOF reach the public, including those in the City, with information regarding present and future water supplies, the demands for a suitable quantity and quality of water, including recycled water, and the importance of implementing water efficiency rebates, techniques and behaviors. Through ITOF, water education programs have reached thousands of students in the City with grade-specific programs that include information on recycled water.

Financial Incentives

Recycled water users benefit from a lower unit water cost than potable water, the difference depending primarily on the amount of imported water included in the potable supply. The City maintains water rates for each recycled water user that are on average 80% of the City's domestic water rates. Each recycled water user increases their cost savings the more recycled water they use.

The implementation of recycled water projects involves a substantial upfront capital investment for planning studies, Environmental Impact Reports (EIRs), engineering design and construction before there recycled water is available to the market. The establishment of new supplemental funding sources through federal, state and regional programs now provides significant financial incentives for water agencies to develop and make use of recycled water locally. Potential sources of funding include federal, state and local funding opportunities. These funding sources include the United States Bureau of Reclamation (USBR), California Proposition 13 Water Bond, Proposition 84 and MET Local Resources Program (LRP). These funding opportunities may be sought by the City or possibly more appropriately by regional agencies. The City will continue to support seeking funding for regional water recycling projects and programs.

Optimizing Recycled Water Use

In Orange County, recycled water is used for irrigating golf courses, parks, schools, businesses, and communal landscapes, as well as for groundwater recharge. Recycled water users in the City receive their water from OCWD's GAP. Future recycled water use can be increased by requiring dual piping in new developments, retrofitting existing landscaped areas and constructing recycled water pump stations and transmission pipelines to reach areas that are further from treatment plants. Gains in implementing some of these projects have been made throughout the county; however, the additional costs, large energy requirements, and facilities make such projects very expensive to pursue. The City will continue to conduct feasibility studies for recycled water and seek out creative solutions such as funding, regulatory requirements, institutional arrangement, and public acceptance for recycled water use with OCWD, MET, and other cooperative agencies.

6.7 Desalination Opportunities

In 2001, MET developed a Seawater Desalination Program (SDP) to provide incentives for developing new seawater desalination projects in MET's service area. In 2014, MET modified the provisions of their LRP to include incentives for locally produced seawater desalination projects that reduce the need for imported supplies. To qualify for the incentive, proposed projects must replace an existing demand or prevent new demand on MET's imported water supplies. In return, MET offers three incentive formulas under the program:

- Sliding scale incentive up to $340 per AF for a 25-year agreement term, depending on the unit cost of seawater produced compared to the cost of MET supplies.
- Sliding scale incentive up to $475 per AF for a 15-year agreement term, depending on the unit cost of seawater produced compared to the cost of MET supplies.

- Fixed incentive up to $305 per AF for a 25-year agreement term.

Developing local supplies within MET's service area is part of their IRP goal of improving water supply reliability in the region. Creating new local supplies reduce pressure on imported supplies from the SWP and Colorado River.

On May 6th, 2015, the SWRCB approved an amendment to the state's Water Quality Control Plan for the Ocean Waters of California (California Ocean Plan) to address effects associated with the construction and operation of seawater desalination facilities (Desalination Amendment). The amendment supports the use of ocean water as a reliable supplement to traditional water supplies while protecting marine life and water quality. The California Ocean Plan now formally acknowledges seawater desalination as a beneficial use of the Pacific Ocean and the Desalination Amendment provides a uniform, consistent process for permitting seawater desalination facilities statewide.

If the following projects are developed, MET's imported water deliveries to Orange County could be reduced. These projects include the Huntington Beach Seawater Desalination Project and the Doheny Desalination Project.

As for City-led initiatives, the City has not investigated seawater desalination as a result of economic and physical impediments.

Brackish groundwater is groundwater with a salinity higher than freshwater, but lower than seawater. Brackish groundwater typically requires treatment using desalters.

6.7.1 Ocean Water Desalination

Huntington Beach Seawater Desalination Project – Poseidon Resources LLC (Poseidon), a private company, is developing the Huntington Beach Seawater Desalination Project to be co-located at the AES Power Plant in the City of Huntington Beach along Pacific Coast Highway and Newland Street. The proposed project would produce up to 50 MGD (56,000 AFY) of drinking water to provide approximately 10% of Orange County's water supply needs.

Over the past several years, Poseidon has been working with OCWD on the general terms and conditions for selling the water to OCWD. OCWD and MWDOC have proposed a few distribution options to agencies in Orange County. The northern option proposes the water be distributed to the northern agencies closer to the plant within OCWD's service area with the possibility of recharging/injecting a portion of the product water into the OC Basin. The southern option builds on the northern option by delivering a portion of the product water through the existing OC-44 pipeline for conveyance to the South Orange County water agencies. A third option is also being explored, which includes all of the product water to be recharged into the OC Basin. Currently, a combination of these options could be pursued.

The Huntington Beach Seawater Desalination project plant capacity of 56,000 AFY would be the single largest source of new, local drinking water available to the region. In addition to offsetting imported demand, water from this project could provide OCWD with management flexibility in the OC Basin by augmenting supplies into the Talbert Seawater Barrier to prevent seawater intrusion.

In May 2015, OCWD and Poseidon entered into a non-binding Term Sheet that provided the overall partner structure in order to advance the project. Based on the initial Term Sheet, which was updated in 2018, Poseidon would be responsible for permitting, financing, design, construction, and operations of the treatment plant while OCWD would purchase the production volume, assuming the product water quality and quantity meet specific contract parameters and criteria. Furthermore, OCWD would then distribute the water in Orange County using one of the proposed distribution options described above.

Currently, the project is in the regulatory permit approval process with the Regional Water Quality Control Board and the California Coastal Commission. Once all of the required permits are approved, Poseidon will then work with OCWD and interested member agencies in developing a plan to distribute the water. Subsequent to the regulatory permit approval process, and agreement with interested parties, Poseidon estimates that the project could be online as early as 2027.

Under guidance provided by DWR, the Huntington Beach Seawater Desalination Plant's projected water supplies are not included in the supply projections due to its current status within the criteria established by State guidelines (DWR, 2020c).

Doheny Desalination Project – South Coast Water District (SCWD) is proposing to develop an ocean water desalination facility in Dana Point. SCWD intends to construct a facility with an initial capacity of up to 5 million gallons per day (MGD). The initial up to 5 MGD capacity would be available for SCWD and potential partnering water agencies to provide a high quality, locally-controlled, drought-proof water supply. The desalination facility would also provide emergency backup water supplies, should an earthquake, system shutdown, or other event disrupt the delivery of imported water to the area. The Project would consist of a subsurface slant well intake system (constructed within Doheny Beach State Park), raw (sea) water conveyance to the desalination facility site (located on SCWD owned property), a seawater reverse osmosis (SWRO) desalination facility, brine disposal through an existing wastewater ocean outfall, solids handling facilities, storage, and potable water conveyance interties to adjacent local and regional distribution infrastructure.

The Doheny Ocean Desalination Project has been determined as the best water supply option to meet reliability needs of SCWD and south Orange County. SCWD is pursuing the Project to ensure it meets the water use needs of its customers and the region by providing a drought-proof potable water supply, which diversifies SCWD's supply portfolio and protects against long-term imported water emergency outages and supply shortfalls that could have significant impact to our coastal communities, public health, and local economy. Phase I of the Project (aka, the "Local" Project) will provide SCWD and the region with up to 5 MGD of critical potable water supply that, together with recycled water, groundwater, and conservation, will provide the majority of SCWD's water supply through local reliable sources. An up to 15 MGD capacity project has been identified as a potential future "regional" project that could be phased incrementally, depending on regional needs.

On June 27, 2019, SCWD certified the final EIR and approved the Project. The Final EIR included considerable additional information provided at the request of the Coastal Commission and the Regional Board, including an updated coastal hazard analysis, updated brine discharge modeling, and updated groundwater modeling, updated hydrology analysis. The approval of the Project also included a commitment to 100 percent carbon neutrality through a 100 percent offset of emissions through the expansion of Project mitigation and use of renewable energy sources. SCWD is currently in the permitting process and finalizing additional due diligence studies. If implemented, SCWD anticipates an online date of 2025.

Under guidance provided by DWR, the Doheny Seawater Desalination Project's projected water supplies are not included in the supply projections due to its current status within the criteria established by State guidelines (DWR, 2020c).

6.7.2 Groundwater Desalination

There are currently no brackish groundwater opportunities within the City's service area.

6.8 Water Exchanges and Transfers

Interconnections with other agencies result in the ability to share water supplies during short term emergency situations or planned shutdowns of major imported water systems. However, beyond -short term outages, transfers can also be involved with longer term water exchanges to deal with droughts or water allocation situations. The following subsections describe the City's existing and planned exchanges and transfers.

6.8.1 Existing Exchanges and Transfers

The City has multiple inter-agency emergency interconnections with IRWD and Mesa Water. The City does not routinely use these interconnections; however, the interconnections are included as fixed-grade reservoirs for future use if needed.

6.8.2 Planned and Potential Exchanges and Transfers

The City does not currently have plans to introduce new exchanges and transfers. However, MWDOC continues to help its retail agencies develop transfer and exchange opportunities that promote reliability within their systems. Therefore, MWDOC will look to help its retail agencies navigate the operational and administrative issues of transfers within the MET distribution system.

On a regional scale, the Santa Ana River Conservation and Conjunctive Use Project (SARCCUP) is a joint project established by five regional water agencies within the Santa Ana River Watershed (Eastern Municipal Water District, Inland Empire Utilities Agency, Western Municipal Water District, OCWD, and San Bernardino Valley Municipal Water District).

In 2016, SARCCUP was successful in receiving $55 million in grant funds from Proposition 84 through DWR. The overall SARCCUP program awarded by Proposition 84, consists of three main program elements:

- Watershed-Scale Cooperative Water Banking Program
- Water Use Efficiency: Landscape Design and Irrigation Improvements and Water Budget Assistance for Agencies
- Habitat Creation and *Arundo Donax* Removal from the Santa Ana River

The Watershed-Scale Cooperative Water Banking Program is the largest component of SARCCUP and since 2016, Valley, MET, and the four SARCCUP-MWD Member Agencies, with MWDOC representing OCWD, have been discussing terms and conditions for the ability to purchase surplus water from Valley to be stored in the Santa Ana River watershed. With the Valley and MET surplus water purchase agreement due for renewal, it was the desire of Valley to establish a new agreement with MET that allows a portion of its surplus water to be stored within the Santa Ana River watershed.

An agreement between MET and four SARCCUP-MWD Member Agencies was approved earlier this year that gives the SARCCUP agencies the ability to purchase a portion (up to 50%) of the surplus water that San Bernardino Valley Municipal Water District (Valley), a SWP Contractor, sells to MET. Such water will be stored in local groundwater basins throughout the Santa Ana River watershed and extract during dry years to reduce the impacts from multiyear droughts. In Orange County, 36,000 AF can be stored in the OC Basin for use during dry years. More importantly, this stored SARCCUP water can be categorized as “extraordinary supplies”, if used during a MET allocation, and can enhance a participating agencies’ reliability during a drought. Moreover, if excess water is available MWDOC can purchase additional water for its service area.

Further details remain to be developed between OCWD, retail agencies, and MWDOC in how the water will be distributed in Orange County and who participates.

6.9 Summary of Future Water Supply Projects

The City continually reviews practices that will provide its customers with adequate and reliable supplies. Trained staff continue to ensure the water quality is safe and the water supply will meet present and future needs in an environmentally and economically responsible manner.

Although the City has various projects planned to maintain and improve the water system, there are currently no City-specific planned projects that have both a concrete timeline and a quantifiable increase in supply.

6.9.1 City Initiatives

The City anticipates water demand in the City to increase slightly over the next 25 years. Any new water supply sources will be developed primarily to better manage the Basin and to replace or upgrade inefficient wells, rather than to support population growth and new development.

The projects that have been identified by the City to improve the City’s water supply reliability and enhance the operations of the City include facilities projects such as pump station upgrades and rehabilitation, pressure reducing system upgrades, and pipeline replacement and relining projects. Projects identified in the Thirty-year Capital Improvement Program include the below. For the full list of projects, refer to the City’s 2019 Water Master Plan (Arcadis, 2019).

New Wells – Construction of new wells in Fountain Valley, including a pipeline connection to the existing well transmission main, would provide redundancy for the wells providing water to the City.

Facilities Projects – Projects such as facility improvements, well rehabilitation, and distribution system upgrades.

Pressure Reducing Station Projects – Replacement and installation projects throughout the distribution system.

Pipeline Projects – Pipe renewal or replacement projects that ensure reliable water conveyance.

6.9.2 Regional Initiatives

Beyond City-specific projects, the City consistently coordinates its long-term water shortage planning with MWDOC and OCWD. MWDOC has identified the following future regional projects, some of which can indirectly benefit the City to further increase local supplies and offset imported supplies (CDM Smith, 2019):

Poseidon Huntington Beach Ocean Desalination Project – Poseidon proposes to construct and operate the Huntington Beach Ocean Desalination Plant on a 12-acre parcel adjacent to the AES Huntington Beach Generating Station. The facility would have a capacity of 50 MGD and 56,000 AFY, with its main components consisting of a water intake system, a desalination facility, a concentrate disposal system, and a product water storage tank. This project would provide both system and supply reliability benefits to South Orange County (SOC), the OC Basin, and Huntington Beach. The capital cost in the initial year for the plant is $1.22 billion.

Doheny Ocean Desalination Project – SCWD is proposing to construct an ocean water desalination facility in Dana Point at Doheny State Beach. The facility would have an initial up to 5 MGD capacity, with the potential for future expansions up to 15 MGD. The project's main components are a subsurface water intake system, a raw ocean water conveyance pipeline, a desalination facility, a seawater reverse osmosis (SWRO) desalination facility, a brine disposal system, and a product water storage tank.

San Juan Watershed Project – Santa Margarita Water District (SMWD) and other project partners have proposed a multi-phased project within the San Juan Creek Watershed to capture local stormwater and develop, convey, and recharge recycled water into the San Juan Groundwater Basin and treat the water upon pumping it out of the basin. The first phase includes the installation of three rubber dams within San Juan Creek to promote in-stream recharge of the basin, with an anticipated production of 700 AFY on average. The second phase would develop additional surface water and groundwater management practices by using stormwater and introducing recycled water for infiltration into the basin and has an anticipated production of 2,660 to 4,920 AFY. The third phase will introduce recycled water directly into San Juan Creek through live stream recharge, with an anticipated production of up to 2,660 AFY (SMWD, 2021).

Cadiz Water Bank – SMWD and Cadiz, Inc. are developing this project to create a new water supply by conserving groundwater that is currently being lost to evaporation and recovering the conserved water by pumping it out of the Fenner Valley Groundwater Basin to convey to MET's CRA. The project consists of a groundwater pumping component that includes an average of 50 TAFY of groundwater that can be pumped from the basin over a 50-year period, and a water storage component that allows participants to send surplus water supplies to be recharged in spreading basins and held in storage.

South Orange County Emergency Interconnection Expansion – MWDOC has been working with the SOC agencies on improvements for system reliability primarily due to the risk of earthquakes causing outages of the MET imported water system as well as extended grid outages. Existing regional interconnection agreements between IRWD and SOC agencies provides for the delivery of water through the IRWWD system to participating SOC agencies in times of emergency. MWDOC and IRWD are currently studying an expansion of the program, including the potential East Orange County Feeder No. 2 pipeline and an expanded and scalable emergency groundwater program, with a capital cost of $867,451.

SARCCUP – SARCCUP is a joint project established between MET, MWDOC, Eastern MWD, Western MWD, Inland Empire Utilities Agency, and OCWD that can provide significant benefits in the form of additional supplies during dry years for Orange County. Surplus SWP water from San Bernardino Valley Water District (SBVMWD) can be purchased and stored for use during dry years. This water can even be considered an extraordinary supply under MET allocation Plan, if qualified under MET's extraordinary supply guidelines. OCWD has the ability to store 36,000 AF of SARCCUP water and if excess water is available MWDOC has the ability to purchase additional water. Further details remain to be developed between OCWD, retail agencies, and MWDOC in how the water will be distributed in Orange County and who participates.

Moulton Niquel Water District (MNWD) / OCWD Pilot Storage Program - OCWD entered into an agreement with MNWD to develop a pilot program to explore the opportunity to store water in the OC Basin. The purpose of such a storage account would provide MNWD water during emergencies and/or provide additional water during dry periods. As part of the agreement, OCWD hired consultants to evaluate where and how to extract groundwater from the OC Basin with several options to pump the water to MNWD via the East Orange County Feeder No. 2; as well as a review of existing banking/exchange programs in California to determine what compensation methodologies could OCWD assess for a storage/banking program.

6.10 Energy Intensity

A new requirement for this 2020 UWMP is an energy intensity analysis of the Supplier's water, wastewater, and recycled water systems, where applicable for a 12-month period. The City owns and operates a water distribution system and a wastewater collection system. This section reports the energy intensity for each system using data from FY 2019-2020. The recycled water system within the City is owned and operated by OCWD, therefore it is outside of the City's operational control.

Water and energy resources are inextricably connected. Known as the "water-energy nexus", the California Energy Commission estimates the transport and treatment of water, treatment and disposal of wastewater, and the energy used to heat and consume water account for nearly 20% of the total electricity and 30% of non-power plant related natural gas consumed in California. In 2015, California issued new rules requiring 50% of its power to come from renewables, along with a reduction in greenhouse gas (GHG) emissions to 40% below 1990 levels by 2030. Consistent with energy and water conservation, renewable energy production, and GHG mitigation initiatives, the City reports the energy intensity of its water and wastewater operations.

The methodology for calculating water energy intensity outlined in Appendix O of the UWMP Guidebook was adapted from the California Institute for Energy Efficiency exploratory research study titled "Methodology for Analysis of the Energy Intensity of California's Water Systems" (Wilkinson 2000). The study defines water energy intensity as the total amount of energy, calculated on a whole-system basis, required for the use of a given amount of water in a specific location.

UWMP reporting is limited to available energy intensity information associated with water processes occurring within an urban water supplier's direct operational control. Operational control is defined as authority over normal business operations at the operational level. Any energy embedded in water supplies imparted by an upstream water supplier (e.g., water wholesaler) or consequently by a downstream water purveyor (e.g., retail water provider) is not included in the UWMP energy intensity tables. The City's calculations conform to methodologies outlined in the UWMP Guidebook and Wilkinson study.

Although the standard reporting cycle for GHG emissions is calendar years (CYs), the data the follows is for the 12 month period from July 2019 to June 2020 which was the most up-to-date data at the time this report was written.

6.10.1 Water Supply Energy Intensity

In CY2019, the City consumed 817 kilowatt-hour (kWh) per AF for water services (Table 6-9). The basis for calculations is provided in more detail in the following subsections.

Table 6-9: Recommended Energy Intensity – Multiple Water Delivery Products

Urban Water Supplier: *Newport Beach*

Water Delivery Product (If delivering more than one type of product use Table O-1C)

Retail Potable Deliveries

Table O-1A: Recommended Energy Reporting - Water Supply Process Approach

Enter Start Date for Reporting Period: 7/1/2019

End Date: 6/29/2020

☐ Is upstream embedded in the values reported?

		Urban Water Supplier Operational Control							
		Water Management Process						Non-Consequential Hydropower (if applicable)	
	Water Volume Units Used	Extract and Divert	Place into Storage	Conveyance	Treatment	Distribution	Total Utility	Hydropower	Net Utility
Volume of Water Entering Process	AF	*10236.78*	*0*	*0*	*0*	*14492*	*14492*	*0*	*14492*
Energy Consumed (kWh)	*N/A*	*5413351.69*	*0*	*0*	*0*	*6420371.31*	*11833723*	*0*	*11833723*
Energy Intensity (kWh/vol.)	*N/A*	*528.8*	*0.0*	*0.0*	*0.0*	*443.0*	*816.6*	*0.0*	*816.6*

Quantity of Self-Generated Renewable Energy

0 kWh

Data Quality *(Estimate, Metered Data, Combination of Estimates and Metered Data)*

Combination of Estimates and Metered Data

Data Quality Narrative:

All energy information comes from Southern California Edison energy bills. Volume of water extracted and diverted and distributed water is based on MWDOC records for groundwater withdrawals and MET deliveries.

Narrative:

Newport Beach relies on imported water, local groundwater, and recycled water to meet their customers' water needs. Operational control is limited to groundwater wells and potable water booster stations and two recycled water pump stations. This table does not include upstream embedded energy consumed prior to Newport Beach taking control. All numbers were calculated for July 2019-June 2020.

6.10.1.1 Operational Control and Reporting Period

As described throughout the report, the City is a retail agency that relies on groundwater and imported water.

Water supply energy intensity was calculated for the 2019FY. CY reporting is standard for energy and GHG reporting to the Climate Registry, California Air Resources Board and the United States Environmental Protection Agency it provides consistency when assessing direct and indirect energy consumption within a larger geographical context, versus FY starting dates which can vary between utilities and organizations. FY data was used for this report because it was the most recent data available.

6.10.1.2 Volume of Water Entering Processes

According to the MWDOC water audit records, the City extracted 10,237 AF of groundwater from the OC Basin and received 4,255 AF of MET water. This is based on a combination of metered data and estimates.

6.10.1.3 Energy Consumption and Generation

According to Southern California Edison Electricity Bills, groundwater wells consumed 5,413,351 kwH of electricity and pump stations along the distribution system consumed 6,420,371 kWh of electricity. Currently, the City does not generate renewable energy. Energy consumption is based on metered data.

6.10.2 Wastewater and Recycled Water Energy Intensity

In FY2019, the City consumed 30.4 KWh per AF for wastewater services and 2,008 kWh per AF for recycled water services (Table 6-10). The basis for calculations is provided in more detail in the following subsections.

Table 6-10: Recommended Energy Intensity – Wastewater & Recycled Water

Urban Water Supplier: *Newport Beach*

Table O-2: Recommended Energy Reporting - Wastewater & Recycled Water						
Enter Start Date for Reporting Period	7/1/2019	**Urban Water Supplier Operational Control**				
End Date	6/29/2020					
		Water Management Process				
☐ Is upstream embedded in the values reported?		Collection / Conveyance	Treatment	Discharge / Distribution	Total	
Volume of Water Units Used	AF					
Volume of Wastewater Entering Process (volume units selected above)		*10015*	*0*	*0*	*0*	
Wastewater Energy Consumed (kWh)		*304209*	*0*	*0*	*304209*	
Wastewater Energy Intensity (kWh/volume)		*30.4*	*0.0*	*0.0*	*0.0*	
Volume of Recycled Water Entering Process (volume units selected above)		*0*	*0*	*513*	*513*	
Recycled Water Energy Consumed (kWh)		*0*	*0*	*1030045.69*	*1030045.7*	
Recycled Water Energy Intensity (kWh/volume)		*0.0*	*0.0*	*2007.9*	*2007.9*	

Quantity of Self-Generated Renewable Energy related to recycled water and wastewater operations

0 kWh

Data Quality *(Estimate, Metered Data, Combination of Estimates and Metered Data)*

Combination of Estimates and Metered Data

Data Quality Narrative:

Volume of Water Entering Process: Estimated based potable water consumption in the service area
Wastewater Energy Consumed: Based on metered data
513 AF of recycled water was purchased through OCWD's GAP based on metered data.

Narrative:

Newport Beach operates the local wastewater and recycled water collection system but does not operate treatment facilities. Operational control is limited to wastewater and recycled water lift stations in the local collection system. This table does not include downstream energy consumed to treat the wastewater, after Newport Beach's control.

6.10.2.1 Operational Control and Reporting Period

The City's existing sewer system is made up of a network of gravity sewers and twenty booster stations. As explained in Section 6.6, the City owns and operates wastewater lift stations but no treatment facilities.

Similar to the water supply energy intensity, wastewater energy intensity was calculated for the 2019 financial year.

6.10.2.2 Volume of Wastewater Entering Processes

In CY2019, the City collected and conveyed 10,015 AF of wastewater to OC San. Water volumes are based on estimates as a portion of the total potable water delivered in the service area.

513 AF of recycled water was purchased through OC San's GAP for use in irrigation.

6.10.2.3 Energy Consumption and Generation

According to Southern California Edison Electricity Bills, the City's 20 wastewater lift stations consumed 304,209 kWh of electricity. There are no other wastewater facilities that are owned and operated by the City. Two pump stations that are used to deliver 513 AF of recycled water used 1,030,046 kWh. Currently, the City does not generate renewable energy. Energy consumption data was based on metered data from SCE.

6.10.3 Key Findings and Next Steps

Calculating and disclosing direct operationally controlled energy intensities is another step towards understanding the water-energy nexus. However, much work is still needed to better understand upstream and downstream (indirect) water-energy impacts. When assessing water supply energy intensities or comparing intensities between providers, it is important to consider reporting boundaries as they do not convey the upstream embedded energy or impacts energy intensity has on downstream users. Engaging one's upstream and downstream supply chain can guide more informed decisions that holistically benefit the environment and are mutually beneficial to engaged parties. Suggestions for further study include:

- Supply-chain engagement – The City relies on a variety of water sources for their customers. While some studies have used life cycle assessment tools to estimate energy intensities, there is a need to confirm this data. The 2020 UWMP requirement for all agencies to calculate energy intensity will help the City and neighboring agencies make more informed decisions that would benefit the region as a whole regarding the energy and water nexus. A similar analysis could be performed with upstream supply chain energy, for example, with State Project Water.
- Internal benchmarking and goal setting – With a focus on energy conservation and a projected increase in water demand despite energy conservation efforts, the City's energy intensities will likely decrease with time. Conceivably, in a case where water demand decreases, energy intensities may rise as the energy required to pump or treat is not always proportional to water delivered. In the course of exploring the water-energy nexus and pursuing renewable energy goals, there is a need to assess whether energy intensity is a meaningful indicator or if it makes

sense to use a different indicator to reflect the City's commitment to energy and water conservation.

- Regional sustainability – Water and energy efficiency are two components of a sustainable future. Efforts to conserve water and energy, however, may impact the social, environmental, and economic livelihood of the region. In addition to the relationship between water and energy, over time, it may also be important to consider and assess the connection these resources have on other aspects of a sustainable future.
- Consistent reporting – as discussed in this report, GHG's are typically reported on a CY cycle but this report used financial year data. In the future, Huntington Beach should consider evaluating CY energy intensities for better benchmarking and consistency with other agencies.

7 WATER SERVICE RELIABILITY AND DROUGHT RISK ASSESSMENT

Building upon the water supply identified and projected in Section 6, this key section of the UWMP examines the City's projected water supplies, water demand, and the resulting water supply reliability. Water service reliability reflects the City's ability to meet the water needs of its customers under varying conditions. For the UWMP, water supply reliability is evaluated in two assessments: 1) the Water Service Reliability Assessment and 2) the DRA. The Water Service reliability assessment compares projected supply to projected demand in 2025 through 2045 for three hydrological conditions: a normal year, a single dry year, and a drought period lasting five consecutive years. The DRA, a new UWMP requirement, assesses near-term water supply reliability. It compares projected water supply and demand assuming the City experiences a drought period for the next five consecutive years. Factors affecting reliability, such as climate change and regulatory impacts, are accounted for in the assessment.

7.1 Water Service Reliability Overview

Every urban water supplier is required to assess the reliability of their water service to their customers under normal, single-dry, and multiple dry water years. The City depends on a combination of imported and local supplies to meet its water demands and has taken numerous steps to ensure it has adequate supplies. Development of local supplies augments the reliability of the water system. There are various factors that may impact reliability of supplies such as legal, environmental, water quality and climatic which are discussed below. MET and MWDOC's 2020 UWMPs conclude that they can meet full-service demands of their member agencies starting 2025 through 2045 during normal years, single-dry years, and multiple-dry years. Consequently, the City is projected to meet full-service demands through 2045 for the same scenarios.

MET's 2020 IRP update describes the core water resources that will be used to meet full-service demands at the retail level under all foreseeable hydrologic conditions from 2025 through 2045. The foundation of MET's resource strategy for achieving regional water supply reliability has been to develop and implement water resources programs and activities through its IRP preferred resource mix. This preferred resource mix includes conservation, local resources such as water recycling and groundwater recovery, Colorado River supplies and transfers, SWP supplies and transfers, in-region surface reservoir storage, in-region groundwater storage, out-of-region banking, treatment, conveyance, and infrastructure improvements.

Table 7-1 shows the basis of water year data used to predict drought supply availability. The average (normal) hydrologic condition for the MWDOC service area, which the City is a part of, is represented by FY 2017-18 and FY 2018-19 and the single-dry year hydrologic condition by FY 2013-14. The five consecutive years of FY 2011-12 to FY 2015-16 represent the driest five consecutive year historic sequence for MWDOC's service area. Locally, Orange County rainfall for the five-year period totaled 36 inches, the driest on record.

Table 7-1: Retail: Basis of Water Year Data (Reliability Assessment)

DWR Submittal Table 7-1 Retail: Basis of Water Year Data (Reliability Assessment)			
Year Type	**Base Year**	**Available Supplies if Year Type Repeats**	
		☐	Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location ____________________________
		☑	Quantification of available supplies is provided in this table as either volume only, percent only, or both.
		Volume Available	**% of Average Supply**
Average Year	2018-2019	-	100%
Single-Dry Year	2014	-	106%
Consecutive Dry Years 1st Year	2012	-	106%
Consecutive Dry Years 2nd Year	2013	-	106%
Consecutive Dry Years 3rd Year	2014	-	106%
Consecutive Dry Years 4th Year	2015	-	106%
Consecutive Dry Years 5th Year	2016	-	106%

NOTES:
Assumes an increase of 6% above average year demands in dry and multiple dry years based on the Demand Forecast TM (CDM Smith, 2021). 106% represents the percent of average supply needed to meet demands of a single-dry and multiple-dry years. Since the City is able to meet all of its demand with imported water from MWDOC / MET (on top of local supplies), the percent of average supply value reported is equivalent to the percent of average demand under the corresponding hydrologic condition.

The following sections provide a detailed discussion of the City's water source reliability. Additionally, the following sections compare the City's projected supply and demand under various hydrological conditions, to determine the City's supply reliability for the 25-year planning horizon.

7.2 Factors Affecting Reliability

In order to prepare realistic water supply reliability assessments, various factors affecting reliability were considered. These include climate change and environmental requirements, regulatory changes, water quality impacts, and locally applicable criteria.

7.2.1 Climate Change and the Environment

Changing climate patterns are expected to shift precipitation patterns and affect water supply availability. Unpredictable weather patterns will make water supply planning more challenging. Although climate change impacts are associated with exact timing, magnitude, and regional impacts of these temperature and precipitation changes, researchers have identified several areas of concern for California water planners (MET, 2021). These areas include:

- A reduction in Sierra Nevada Mountain snowpack.
- Increased intensity and frequency of extreme weather events.
- Prolonged drought periods.
- Water quality issues associated with increase in wildfires.
- Changes in runoff pattern and amount.
- Rising sea levels resulting in:
  - Impacts to coastal groundwater basins due to seawater intrusion.
  - Increased risk of damage from storms, high-tide events, and the erosion of levees.
  - Potential pumping cutbacks to the SWP and CVP.

Other important issues of concern due to global climate change include:

- Effects on local supplies such as groundwater.
- Changes in urban and agricultural demand levels and patterns.
- Increased evapotranspiration from higher temperatures.
- Impacts to human health from water-borne pathogens and water quality degradation.
- Declines in ecosystem health and function.
- Alterations to power generation and pumping regime.
- Increases in ocean algal blooms affected seawater desalination supplies.

The major impact in California is that without additional surface storage, the earlier and heavier runoff (rather than snowpack retaining water in storage in the mountains), will result in more water being lost to the oceans. A heavy emphasis on storage is needed in California.

In addition, the Colorado River Basin supplies have been inconsistent since about the year 2000, with precipitation near normal while runoff has been less than average in two out of every three years. Climate models are predicting a continuation of this pattern whereby hotter and drier weather conditions will result in continuing lower runoff, pushing the system toward a drying trend that is often characterized as long term drought.

Dramatic swings in annual hydrologic conditions have impacted water supplies available from the SWP over the last decade. The declining ecosystem in the Delta has also led to a reduction in water supply deliveries, and operational constraints, which will likely continue until a long-term solution to these problems is identified and implemented (MET, 2021).

Legal, environmental, and water quality issues may have impacts on MET supplies. It is felt, however, that climatic factors would have more of an impact than legal, water quality, and environmental factors. Climatic conditions have been projected based on historical patterns, but severe pattern changes are still a possibility in the future (MET, 2021).

7.2.2 Regulatory and Legal

Ongoing regulatory restrictions, such as those imposed by the Biops on the effects of SWP and the federal CVP operations on certain marine life, also contributes to the challenge of determining water delivery reliability. Endangered species protection and conveyance needs in the Delta have resulted in operational constraints that are particularly important because pumping restrictions impact many water resources programs – SWP supplies and additional voluntary transfers, Central Valley storage and transfers, and in-region groundwater and surface water storage. Biops protect special-status species listed as threatened or endangered under the ESAs and imposed substantial constraints on Delta water supply operations through requirements for Delta inflow and outflow and export pumping restrictions.

In addition, the SWRCB has set water quality objectives that must be met by the SWP including minimum Delta outflows, limits on SWP and CVP Delta exports, and maximum allowable salinity level. SWRCB plans to fully implement the new Lower San Joaquin River (LSJR) flow objectives from the Phase 1 Delta Plan amendments through adjudicatory (water rights) and regulatory (water quality) processes by 2022. These LSJR flow objectives are estimated to reduce water available for human consumptive use. New litigation, listings of additional species under the ESAs, or regulatory requirements imposed by the SWRCB could further adversely affect SWP operations in the future by requiring additional export reductions, releases of additional water from storage, or other operational changes impacting water supply operations.

The difficulty and implications of environmental review, documentation, and permitting pose challenges for multi-year transfer agreements, recycled water projects, and seawater desalination plants. The timeline and roadmap for getting a permit for recycled water projects are challenging and inconsistently implemented in different regions of the state. IPR projects face regulatory restraints such as treatment, blend water, retention time, and Basin Plan Objectives, which may limit how much recycled water can feasibly be recharged into the groundwater basins. New regulations and permitting uncertainty are also barriers to seawater desalination supplies, including updated Ocean Plan Regulations, Marine Life Protected Areas, and Once-Through Cooling Regulations (MET, 2021).

7.2.3 Water Quality

The following sub-sections include narratives on water quality issues experienced in various water supplies, if any, and the measures being taken to improve the water quality of these sources.

7.2.3.1 Imported Water

MET is responsible for providing high quality potable water throughout its service area. Over 300,000 water quality tests are performed per year on MET's water to test for regulated contaminants and additional contaminants of concern to ensure the safety of its waters. MET's supplies originate primarily from the CRA and from the SWP. A blend of these two sources, proportional to each year's availability of the source, is then delivered throughout MET's service area.

MET's primary water sources face individual water quality issues of concern. The CRA water source contains higher total dissolved solids (TDS) and the SWP contains higher levels of organic matter, lending to the formation of disinfection byproducts. To remediate the CRA's high level of salinity and the SWP's high level of organic matter, MET blends CRA and SWP supplies and has upgraded all of its treatment facilities to include ozone treatment processes. In addition, MET has been engaged in efforts to protect its Colorado River supplies from threats of uranium, perchlorate, and chromium VI while also investigating the potential water quality impact of the following emerging contaminants: N-nitrosodimethylamine (NDMA), pharmaceuticals and personal care products (PPCP), microplastics, PFAS, and 1,4-dioxane (MET, 2021). While unforeseeable water quality issues could alter reliability, MET's current strategies ensure the delivery of high-quality water.

The presence of quagga mussels in water sources is a water quality concern. Quagga mussels are an invasive species that was first discovered in 2007 at Lake Mead, on the Colorado River. This species of mussels forms massive colonies in short periods of time, disrupting ecosystems and blocking water intakes. They can cause significant disruption and damage to water distribution systems. MET has had success in controlling the spread and impacts of the quagga mussels within the CRA, however the future could require more extensive maintenance and reduced operational flexibility than current operations allow. It also resulted in MET eliminating deliveries of CRA water into DVL to keep the reservoir free from quagga mussels (MET, 2021).

7.2.3.2 Groundwater

OCWD is responsible for managing the OC Basin. To maintain groundwater quality, OCWD conducts an extensive monitoring program that serves to manage the OC Basin's groundwater production, control groundwater contamination, and comply with all required laws and regulations. A network of nearly 700 wells provides OCWD a source for samples, which are tested for a variety of purposes. OCWD collects samples each month to monitor Basin water quality. The total number of water samples analyzed varies year-to-year due to regulatory requirements, conditions in the basin, and applied research and/or special study demands. These samples are collected and tested according to approved federal and state procedures as well as industry-recognized quality assurance and control protocols (City of La Habra et al., 2017).

Although PFAS have not been detected in the City's wells, PFAS are of particular concern for groundwater quality, and since the summer of 2019, DDW requires testing for PFAS compounds in some groundwater production wells in the OCWD area. In February 2020, the DDW lowered its Response Levels (RL) for PFOA and PFOS to 10 and 40 parts per trillion (ppt) respectively. The DDW recommends Producers not serve any water exceeding the RL – effectively making the RL an interim Maximum Contaminant Level (MCL) while DDW undertakes administrative action to set a MCL. In response to DDW's issuance of the revised RL, as of December 2020, approximately 45 wells in the OCWD service area have been temporarily turned off until treatment systems can be constructed. As additional wells are tested, OCWD expects this figure may increase to at least 70 to 80 wells. The state has begun the process of establishing MCLs for PFOA and PFOS and anticipates these MCLs to be in effect by the Fall of 2023. OCWD anticipates the MCLs will be set at or below the RLs.

In April 2020, OCWD as the groundwater basin manager, executed an agreement with the impacted Producers to fund and construct the necessary treatment systems for production wells impacted by PFAS compounds. The PFAS treatment projects includes the design, permitting, construction, and operation of PFAS removal systems for impacted Producer production wells. Each well treatment system will be evaluated for use with either granular activated carbon (GAC) or ion exchange (IX) for the removal of PFAS compounds. These treatment systems utilize vessels in a lead-lag configuration to remove PFOA and PFOS to less than 2 ppt (the current non-detect limit). Use of these PFAS treatment systems are designed to ensure the groundwater supplied by Producer wells can be served in compliance with current and future PFAS regulations. With financial assistance from OCWD, the Producers will operate and maintain the new treatment systems once they are constructed.

To minimize expenses and provide maximum protection to the public water supply, OCWD initiated design, permitting, and construction of the PFAS treatment projects on a schedule that allows rapid deployment of treatment systems. Construction contracts were awarded for treatment systems for production wells in the City of Fullerton and Serrano Water District in Year 2020. Additional construction contracts will likely be awarded in the first and second quarters of 2021. OCWD expects the treatment systems to be constructed for most of the initial 45 wells above the RL within the next 2 to 3 years.

As additional data are collected and new wells experience PFAS detections at or near the current RL, and/or above a future MCL, and are turned off, OCWD will continue to partner with the affected Producers and take action to design and construct necessary treatment systems to bring the impacted wells back online as quickly as possible.

Groundwater production in FY 2019-20 was expected to be approximately 325,000 AF but declined to 286,550 AF primarily due to PFAS impacted wells being turned off around February 2020. OCWD expects groundwater production to be in the area of 245,000 AF in FY 2020-21 due to the currently idled wells and additional wells being impacted by PFAS and turned off. As PFAS treatment systems are constructed, OCWD expects total annual groundwater production to slowly increase back to normal levels (310,000 to 330,000 AF) (OCWD, 2020).

Salinity is a significant water quality problem in many parts of Southern California, including Orange County. Salinity is a measure of the dissolved minerals in water including both TDS and nitrates.

OCWD continuously monitors the levels of TDS in wells throughout the OC Basin. TDS currently has a California Secondary MCL of 500 mg/L. The portions of the OC Basin with the highest levels are generally located in the cities of Irvine, Tustin, Yorba Linda, Anaheim, and Fullerton. There is also a broad area in the central portion of the OC Basin where TDS ranges from 500 to 700 mg/L. Sources of TDS include the water supplies used to recharge the OC Basin and from onsite wastewater treatment systems, also known as septic systems. The TDS concentration in the OC Basin is expected to decrease over time as the TDS concentration of GWRS water used to recharge the OC Basin is approximately 50 mg/L (City of La Habra et al., 2017).

Nitrates are one of the most common and widespread contaminants in groundwater supplies, originating from fertilizer use, animal feedlots, wastewater disposal systems, and other sources. The MCL for nitrate in drinking water is set at 10 mg/L. OCWD regularly monitors nitrate levels in groundwater and works with producers to treat wells that have exceeded safe levels of nitrate concentrations. OCWD manages the nitrate concentration of water recharged by its facilities to reduce nitrate concentrations in groundwater. This includes the operation of the Prado Wetlands, which was designed to remove nitrogen and other pollutants from the Santa Ana River before the water is diverted to be percolated into OCWD's surface water recharge system.

Although water from the Deep Aquifer System is of very high quality, it is amber-colored and contains a sulfuric odor due to buried natural organic material. These negative aesthetic qualities require treatment before use as a source of drinking water. The total volume of the amber-colored groundwater is estimated to be approximately 1 MAF.

There are other potential contaminants that are of concern to and are monitored by OCWD. These include:

- **Methyl Tertiary Butyl Ether (MTBE) –** MTBE is an additive to gasoline that increases octane ratings but became a widespread contaminant in groundwater supplies. The greatest source of MTBE contamination comes from underground fuel tank releases. The primary MCL for MTBE in drinking water is 13 µg/L.
- **Volatile Organic Compounds (VOC) –** VOCs come from a variety of sources including industrial degreasers, paint thinners, and dry cleaning solvents. Locations of VOC contamination within the OC Basin include the former El Toro marine Corps Air Station, the Shallow Aquifer System, and portions of the Principal Aquifer System in the Cities of Fullerton and Anaheim.
- **NDMA –** NDMA is a compound that can occur in wastewater that contains its precursors and is disinfected via chlorination and/or chloramination. It is also found in food products such as cured meat, fish, beer, milk, and tobacco smoke. The California Notification Level for NDMA is 10 ng/L and the RL is 300 ng/L. In the past, NDMA has been found in groundwater near the Talbert Barrier, which was traced to industrial wastewater dischargers.
- **1,4-Dioxane –** 1,4-Dioxane is a suspected human carcinogen. It is used as a solvent in various industrial processes such as the manufacture of adhesive products and membranes.
- **Perchlorate –** Perchlorate enters groundwater through application of fertilizer containing perchlorate, water imported from the Colorado River, industrial or military sites that have perchlorate, and natural occurrence. Perchlorate was not detected in 84% of the 219 production wells tested between the years 2010 through 2014.
- **Selenium –** Selenium is a naturally occurring micronutrient found in soils and groundwater in the Newport Bay watershed. The bio-accumulation of selenium in the food chain may result in deformities, stunted growth, reduced hatching success, and suppression of immune systems in fish and wildlife. Management of selenium is difficult as there is no off-the-shelf treatment technology available.
- **Constituents of Emerging Concern (CEC) –** CECs are either synthetic or naturally occurring substances that are not currently regulated in water supplies or wastewater discharged but can be detected using very sensitive analytical techniques. The newest group of CECs include pharmaceuticals, personal care products, and endocrine disruptors. OCWD's laboratory is one of a

few in the state of California that continuously develops capabilities to analyze for new compounds (City of La Habra et al., 2017).

7.2.4 Locally Applicable Criteria

Within Orange County, there are no significant local applicable criteria that directly affect reliability. Through the years, the water agencies in Orange County have made tremendous efforts to integrate their systems to provide flexibility to interchange with different sources of supplies. There are emergency agreements in place to ensure all parts of the County have an adequate supply of water. In the northern part of the County, agencies are able to meet a majority of their demands through groundwater with very little limitation, except for the OCWD BPP. For the agencies in southern Orange County, most of their demands are met with imported water where their limitation is based on the capacity of their system, which is very robust.

However, if a major earthquake on the San Andreas Fault occurs, it will be damaging to all three key regional water aqueducts and disrupt imported supplies for up to six months. The region would likely impose a water use reduction ranging from 10-25% until the system is repaired. However, MET has taken proactive steps to handle such disruption, such as constructing DVL, which mitigates potential impacts. DVL, along with other local reservoirs, can store a six to twelve-month supply of emergency water (MET, 2021).

7.3 Water Service Reliability Assessment

This Section assesses the City's reliability to provide water services to its customers under various hydrological conditions. This is completed by comparing the projected long-term water demand (Section 4) to the projected water supply sources available to the City (Section 6), in five-year increments, for a normal water year, a single dry water year, and a drought lasting five consecutive water years.

7.3.1 Normal Year Reliability

The water demand forecasting model developed for the Demand Forecast TM (described in Section 4.3), to project the 25-year demand for Orange County water agencies, also isolated the impacts that weather and future climate can have on water demand through the use of a statistical model. The explanatory variables of population, temperature, precipitation, unemployment rate, drought restrictions, and conservation measures were used to create the statistical model. The impacts of hot/dry weather condition are reflected as a percentage increase in water demands from the average condition. The average (normal) demand is represented by the average water demand of FY 2017-18 and FY 2018-19 (CDM Smith, 2021).

The City is 100 percent reliable for normal year demands from 2025 through 2045 (Table 7-2) due to diversified supply and conservation measures. For simplicity, the table shows supply to balance demand in the table. However, the City can purchase more MET water through MWDOC, should the need arise. The City has entitlements to receive imported water from MET through MWDOC via connections to MET's regional distribution system. All imported water supplies are assumed available to the City from existing water transmission facilities, as per MET and MWDOC's 2020 UWMPs. The demand and supplies listed in Table 7-2 also include local groundwater supplies that are available to the City through OCWD by an assumed BPP of 85%, per Section 6.3.4.

Table 7-2: Retail: Normal Year Supply and Demand Comparison

DWR Submittal Table 7-2 Retail: Normal Year Supply and Demand Comparison					
	2025	2030	2035	2040	2045
Supply totals (AF)	14,866	15,371	15,517	15,682	15,645
Demand totals (AF)	14,866	15,371	15,517	15,682	15,645
Difference (AF)	0	0	0	0	0
NOTES: This table compares the projected demand and supply volumes determined in Sections 4.3.2 and 6.1, respectively.					

7.3.2 Single Dry Year Reliability

A single dry year is defined as a single year of minimal to no rainfall within a period where average precipitation is expected to occur. The water demand forecasting model developed for the Demand Forecast TM (described in Section 4.3) isolated the impacts that weather and future climate can have on water demand through the use of a statistical model. The impacts of hot/dry weather condition are reflected as a percentage increase in water demands from the normal year condition (average of FY 2017-18 and FY 2018-19). For a single dry year condition (FY 2013-14), the model projects a six percent increase in demand for the OC Basin area where the City's service area is located (CDM Smith, 2021). Detailed information of the model is included in Appendix E.

The City has documented that it is 100 percent reliable for single dry year demands from 2025 through 2045 with a demand increase of 6% from normal demand with significant reserves held by MET, local groundwater supplies, and conservation. A comparison between the supply and the demand in a single dry year is shown in Table 7-3. For simplicity, the table shows supply to balance demand in the table. However, the City can purchase more MET water through MWDOC, should the need arise.

Table 7-3: Retail: Single Dry Year Supply and Demand Comparison

DWR Submittal Table 7-3 Retail: Single Dry Year Supply and Demand Comparison					
	2025	2030	2035	2040	2045
Supply totals (AF)	15,758	16,293	16,448	16,623	16,584
Demand totals (AF)	15,758	16,293	16,448	16,623	16,584
Difference (AF)	0	0	0	0	0
NOTES: It is conservatively assumed that a single dry year demand is 6% greater than each respective year's normally projected total water demand. Groundwater is sustainably managed through the BPP and robust management measures (Section 6.3.4 and Appendix G); direct and indirect recycled water uses provide additional local supply (Section 6.6); and based on MET's and MWDOC's UWMP, imported water is available to close any potable water supply gap that local sources cannot meet (Section 7.5.1).					

7.3.3 Multiple Dry Year Reliability

Assessing the reliability to meet demand for five consecutive dry years is a new requirement for the 2020 UWMP, as compared to the previous requirement of assessing three or more consecutive dry years. Multiple dry years are defined as five or more consecutive dry years with minimal rainfall within a period of average precipitation. The water demand forecasting model developed for the Demand Forecast TM (described in Section 4.3) isolated the impacts that weather and future climate can have on water demand through the use of a statistical model. The impacts of hot/dry weather condition are reflected as a percentage increase in water demands from the normal year condition (average of FY 2017-18 and FY 2018-19). For a single dry year condition (FY 2013-14), the model projects a 6% increase in demand for the OC Basin area where the City's service area is located (CDM Smith, 2021). It is conservatively assumed that a five consecutive dry year scenario is a repeat of the single dry year over five consecutive years.

Even with a conservative demand increase of 6% each year for five consecutive years, the City is capable of meeting all customers' demands from 2025 through 2045 (Table 7-4), with significant reserves held by MET and conservation. For simplicity, the table shows supply to balance demand in the table. However, the City can purchase more MET water through MWDOC, should the need arise.

Table 7-4: Retail: Multiple Dry Years Supply and Demand Comparison

DWR Submittal Table 7-4 Retail: Multiple Dry Years Supply and Demand Comparison (AF)						
		2025	2030	2035	2040	2045
First year	Supply totals	15,876	15,865	16,324	16,483	16,615
	Demand totals	15,876	15,865	16,324	16,483	16,615
	Difference	0	0	0	0	0
Second year	Supply totals	15,846	15,972	16,355	16,518	16,607
	Demand totals	15,846	15,972	16,355	16,518	16,607
	Difference	0	0	0	0	0
Third year	Supply totals	15,817	16,079	16,386	16,553	16,599
	Demand totals	15,817	16,079	16,386	16,553	16,599
	Difference	0	0	0	0	0
Fourth year	Supply totals	15,787	16,186	16,417	16,588	16,592
	Demand totals	15,787	16,186	16,417	16,588	16,592
	Difference	0	0	0	0	0
Fifth year	Supply totals	15,758	16,293	16,448	16,623	16,584
	Demand totals	15,758	16,293	16,448	16,623	16,584
	Difference	0	0	0	0	0

NOTES:
It is conservatively assumed that a five consecutive dry year scenario is a repeat of the single dry year (106% of projected normal year values) over five consecutive years. The 2025 column assesses supply and demand for FY 2020-21 through FY 2024-25; the 2030 column assesses FY 2025-26 through FY 2029-30 and so forth, in order to end the water service reliability assessment in FY 2044-45. Groundwater is sustainably managed through the BPP and robust management measures (Section 6.3.4 and Appendix G); direct and indirect recycled water uses provide additional local supply (Section 6.6); and based on MET and MWDOC's UWMP, imported water is available to close any potable water supply gap that local sources cannot meet (Section 7.5.1).

7.4 Management Tools and Options

Existing and planned water management tools and options for the City and MWDOC's service area that seek to maximize local resources and result in minimizing the need to import water are described below.

- **Reduced Delta Reliance:** MET has demonstrated consistency with Reduced Reliance on the Delta Through Improved Regional Water Self-Reliance (Delta Plan policy WR P1) by reporting the expected outcomes for measurable reductions in supplies from the Delta. MET has improved its self-reliance through methods including water use efficiency, water recycling, stormwater capture and reuse, advanced water technologies, conjunctive use projects, local and regional water supply and storage programs, and other programs and projects. In 2020, MET had a 602,000 AF change in supplies contributing to regional-self-reliance, corresponding to a 15.3% change, and this amount is projected to increase through 2045 (MET, 2021). For detailed information on the Delta Plan Policy WR P1, refer to Appendix C.

- **The continued and planned use of groundwater:** The water supply resources within MWDOC's service area are enhanced by the existence of groundwater basins that account for the majority of local supplies available and are used as reservoirs to store water during wet years and draw from storage during dry years, subsequently minimizing MWDOC's reliance on imported water. Groundwater basins are managed within a safe basin operating range so that groundwater wells are only pumped as needed to meet water use. Although MWDOC does not produce or manage recycled water, MWDOC supports and partners in recycled water efforts, including groundwater recharge. The City is currently planning a water well rehabilitation project and construction of new wells in Fountain Valley (Section 6.9).

- **Groundwater storage and transfer programs:** MWDOC and OCWD's involvement in SARCCUP includes participation in a CUP that improves water supply resiliency and increases available dry-year yield from local groundwater basins. The groundwater bank has 137,000 AF of storage (OCWD, 2020b). Additionally, MET has numerous groundwater storage and transfer programs in which MET endeavors to increase the reliability of water supplies, including the AVEK Waster Agency Exchange and Storage Program and the High Desert Water Bank Program. The IRWD Strand Ranch Water Banking Program has approximately 23,000 AF stored for IRWD's benefit, and by agreement, the water is defined to be an "Extraordinary Supply" by MET and counts essentially 1:1 during a drought/water shortage condition under MET's WSAP In addition, MET has encouraged storage through its cyclic and conjunctive use programs that allow MET to deliver water into a groundwater basin in advance of agency demands, such as the Cyclic Storage Agreements under the Main San Gabriel Basin Judgement.

- **Water Loss Program:** The water loss audit program reduces MWDOC's dependency on imported water from the Delta by implementing water loss control technologies after assessing audit data and leak detection.

- **Increased use of recycled water:** MWDOC partners with local agencies in recycled water efforts, including OCWD to identify opportunities for the use of recycled water for irrigation purposes, groundwater recharge and some non-irrigation applications. OCWD's GWRS and

GAP allow Southern California to decrease its dependency on imported water and create a local and reliable source of water that meet or exceed all federal and state drinking level standards. Expansion of the GWRS is currently underway to increase the plant's production to 130 MGD, and further reduce reliance on imported water.

- **Implementation of demand management measures (DMMs) during dry periods:** During dry periods, water reduction methods to be applied to the public through the retail agencies, will in turn reduce MWDOC's overall demands on MET and reliance on imported water. MWDOC is assisting its retail agencies by leading the coordination of Orange County Regional Alliance for all of the retail agencies in Orange County. MWDOC assists each retail water supplier in Orange County in analyzing the requirements of and establishing their baseline and target water use, as guided by DWR. The City's specific DMMs are further discussed in Section 9.

7.5 Drought Risk Assessment

Water Code Section 10635(b) requires every urban water supplier include, as part of its UWMP, a DRA for its water service as part of information considered in developing its DMMs and water supply projects and programs. The DRA is a specific planning action that assumes the City is experiencing a drought over the next five years and addresses the City's water supply reliability in the context of presumed drought conditions. Together, the water service reliability assessment (Sections 7.1 through 7.3), DRA, and WSCP (Section 8 and Appendix H) allow the City to have a comprehensive picture of its short-term and long-term water service reliability and to identify the tools to address any perceived or actual shortage conditions.

Water Code Section 10612 requires the DRA to be based on the driest five-year historic sequence of the City's water supply. However, Water Code Section 10635 also requires that the analysis consider plausible changes on projected supplies and demands due to climate change, anticipated regulatory changes, and other locally applicable criteria.

The following sections describe the City's methodology and results of its DRA.

7.5.1 DRA Methodology

The water demand forecasting model developed for the Demand Forecast TM (described in Section 4.3 isolated the impacts that weather and future climate can have on water demand through the use of a statistical model. The impacts of hot/dry weather condition are reflected as a percentage increase in water demands from the average condition (average of FY 2017-18 and FY 2018-19). For a single dry year condition (FY 2013-14), the model projects a 6% increase in demand for the region encompassing the City's service area (CDM Smith, 2021).

Locally, the five-consecutive years of FY 2011-12 through FY 2015-16 represent the driest five consecutive year historic sequence for the City's water supply. This period that spanned water years 2012 through 2016 included the driest four-year statewide precipitation on record (2012-2015) and the smallest Sierra Cascades snowpack on record (2015, with 5% of average). It was marked by extraordinary heat: 2014, 2015 and 2016 were California's first, second and third warmest year in terms of statewide average temperatures. Locally, Orange County rainfall for the five-year period totaled 36 inches, the driest on record.

As explained in Section 6, the City currently relies on, and will continue to rely on, three main water sources: local groundwater, local recycled water, and imported water supply from MWDOC / MET. The City maximizes local water supply use before the purchase of imported water. The difference between total forecasted potable demands and local groundwater supply projections is the demand on MWDOC's imported water supplies, which are supplied by MET. Local groundwater supply for the City comes from the OC Basin and is dictated by the BPP set annually by OCWD. Therefore, the City's DRA focuses on the assessment of imported water from MWDOC / MET, which will be used to close any local water supply gap. This assessment aligns with the DRA presented in MWDOC's 2020 UWMP.

Water Demand Characterization

All of MWDOC's water supplies are purchased from MET, regardless of hydrologic conditions. As described in Section 6.2, MET's supplies are from the Colorado River, SWP, and in-region storage. In its 2020 UWMP, MET's DRA concluded that even without activating WSCP actions, MET can reliably provide water to all of their member agencies, including MWDOC, and in effect the City, assuming a five-year drought from FY 2020-21 through FY 2024-25. Beyond this, MET's DRA indicated a surplus of supplies that would be available to all of its member agencies, including MWDOC, should the need arise. Therefore, any increase in demand that is experienced in MWDOC's service area, which includes the City, will be met by MET's water supplies.

Based on the Demand Forecast TM, in a single dry year, demand is expected to increase by 6% above a normal year. Both MWDOC and the City's DRA conservatively assumes a drought from FY 2020-21 through FY 2024-25 is a repeat of the single dry year over five consecutive years.

The City's demand projections were developed as part of the Demand Forecast TM, led by MWDOC. As part of the study, MWDOC first estimated total retail demands for its service area. This was based on estimated future demands using historical water use trends, future expected water use efficiency measures, additional projected land-use development, and changes in population. The City's projected water use, linearly interpolated per the demand forecast, is presented annually for the next five years in in Table 4-2. Next, MWDOC estimated the projections of local supplies derived from current and expected local supply programs from their member agencies. Finally, the demand model calculated the difference between total forecasted demands and local supply projections. The resulting difference between total demands net of savings from conservation and local supplies is the expected regional demands on MWDOC from their member agencies, such as the City.

Water Supply Characterization

MWDOC's assumptions for its supply capabilities are discussed and presented in 5-year increments under its 2020 UWMP water reliability assessment. For MWDOC's DRA, these supply capabilities are further refined and presented annually for the years 2021 to 2025 by assuming a repeat of historic conditions from FY 2011-12 to FY 2015-16. For its DRA, MWDOC assessed the reliability of supplies available to MWDOC through MET using historical supply availability under dry-year conditions. MET's supply sources under the Colorado River, SWP, and in-region supply categories are individually listed and discussed in detail in MET's UWMP. Future supply capabilities for each of these supply sources are also individually tabulated in Appendix 3 of MET's UWMP, with consideration for plausible changes on projected supplies under climate change conditions, anticipated regulatory changes, and other factors. MWDOC's supplies are used to meet consumptive use, surface water and groundwater recharge needs that are in excess of locally available supplies. In addition, MWDOC has access to supply augmentation actions through MET. MET may exercise these actions based on regional need, and in accordance with their WSCP, and may include the use of supplies and storage programs within the Colorado River, SWP, and in-region storage.

7.5.2 Total Water Supply and Use Comparison

The City's DRA reveals that its supply capabilities are expected to balance anticipated total water use and supply, assuming a five-year consecutive drought from FY 2020-21 through FY 2024-25 (Table 7-5). For simplicity, the table shows supply to balance the modeled demand in the table. However, the City can purchase more MET water from MWDOC, should the need arise.

Table 7-5: Five-Year Drought Risk Assessment Tables to Address Water Code Section 10635(b)

DWR Submittal Table 7-5: Five-Year Drought Risk Assessment Tables to address Water Code Section 10635(b)

2021	Total
Total Water Use	15,876
Total Supplies	15,876
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

2022	Total
Total Water Use	15,846
Total Supplies	15,846
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

DWR Submittal Table 7-5: Five-Year Drought Risk Assessment Tables to address Water Code Section 10635(b)

2023	Total
Total Water Use	15,817
Total Supplies	15,817
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

2024	Total
Total Water Use	15,787
Total Supplies	15,787
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

2025	Total
Total Water Use	15,758
Total Supplies	15,758
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

Note: Groundwater is sustainably managed through the BPP and robust management measures (Section 6.3.4 and Appendix G); direct and indirect recycled water uses provide additional local supply (Section 6.6); and based on MET and MWDOC's UWMP, imported water is available to close any potable water supply gap that local sources cannot meet (Section 7.5.1).

7.5.3 Water Source Reliability

Locally, approximately 77% (BPP for Water Year 2021-22) of the City's total water supply can rely on OC Basin groundwater through FY 2024-25. The BPP is projected to increase to 85% starting in FY 2024-25. Based on various storage thresholds and hydrologic conditions, OCWD, who manages the OC Basin, has numerous management measures that can be taken, such as adjusting the BPP or seeking additional supplies to refill the basin, to ensure the reliability of the Basin. For more information on the OC Basin's management efforts, refer to Section 6.3.

Additionally, the City's use of direct (OCWD GAP) and indirect recycled water (OCWD GWRS) should also be considered. The ability to continue producing water locally greatly improves the City's water reliability. More detail on these programs is available in Sections 6.6.3 and 6.6.4.

Moreover, although they would not normally be considered part of the City's water portfolio, the emergency interconnections the City has with IRWD and Mesa Water could help mitigate any water supply shortages, though shortages are not expected. Emergency interconnections are described in Section 6.8.

The City's DRA concludes that its water supplies meet total water demand, assuming a five-year consecutive drought from FY 2020-21 through FY 2024-25 (Table 7-5). For simplicity, the table shows supply to balance the modeled demand in the table. However, the City can purchase more MET water from MWDOC, should the need arise.

As detailed in Section 8, the City has in place a robust WSCP and comprehensive shortage response planning efforts that include demand reduction measures and supply augmentation actions. However, since the City's DRA shows a balance between water supply and demand, no water service reliability concern is anticipated and no shortfall mitigation measures are expected to be exercised over the next five years. The City and its wholesale supplier, MWDOC, will periodically revisit its representation of the supply sources and of the gross water use estimated for each year, and will revise its DRA if needed.

8 WATER SHORTAGE CONTINGENCY PLANNING

8.1 Layperson Description

Water shortage contingency planning is a strategic planning process that the City engages to prepare for and respond to water shortages. A water shortage, when water supply available is insufficient to meet the normally expected customer water use at a given point in time, may occur due to a number of reasons, such as water supply quality changes, climate change, drought, and catastrophic events (e.g., earthquake). The City's WSCP provides real-time water supply availability assessment and structured steps designed to respond to actual conditions. This level of detailed planning and preparation will help maintain reliable supplies and reduce the impacts of supply interruptions.

Water Code Section 10632 requires that every urban water supplier that serves more than 3,000 AFY or have more than 3,000 connections prepare and adopt a standalone WSCP as part of its UWMP. The WSCP is required to plan for a greater than 50% supply shortage. This WSCP due to be updated based on new requirements every five years and will be adopted as a current update for submission to DWR by July 1, 2021.

8.2 Overview of the WSCP

The WSCP serves as the operating manual that the City will use to prevent catastrophic service disruptions through proactive, rather than reactive, mitigation of water shortages. The WSCP contains processes and procedures documented in the WSCP, which are given legal authority through the WSCP Response Ordinance. This way, when shortage conditions arise, the City's governing body, its staff, and the public can easily identify and efficiently implement pre-determined steps to mitigate a water shortage to the level appropriate to the degree of water shortfall anticipated. Figure 8-1 illustrates the interdependent relationship between the three procedural documents related to planning for and responding to water shortages.

Figure 8-1: UWMP Overview

A copy of the City's WSCP is provided in Appendix H and includes the steps to assess if a water shortage is occurring, and what level of shortage drought actions to trigger the best response as appropriate to the water shortage conditions. WSCP has prescriptive elements, including an analysis of water supply reliability; the drought shortage actions for each of the six standard water shortage levels, that correspond to water shortage percentages ranging from 10% to greater than 50%; an estimate of potential to close supply gap for each measure; protocols and procedures to communicate identified actions for any current or predicted water shortage conditions; procedures for an annual water supply and demand assessment; monitoring and reporting requirements to determine customer compliance; reevaluation and improvement procedures for evaluating the WSCP.

8.3 Summary of Water Shortage Response Strategy and Required DWR Tables

This WSCP is organized into three main sections with Section 3 aligned with the Water Code Section 16032 requirements.

Section 1 Introduction and WSCP Overview gives an overview of the WSCP fundamentals.

Section 2 Background provides a background on the City's water service area.

Section 3.1 Water Supply Reliability Analysis provides a summary of the water supply analysis and water reliability findings from the 2020 UWMP.

Section 3.2 Annual Water Supply and Demand Assessment Procedures provide a description of procedures to conduct and approve the Annual Assessment.

Section 3.3 Six Standard Water Shortage Stages explains the WSCP's six standard water shortage levels corresponding to progressive ranges of up to 10, 20, 30, 40, 50, and more than 50% shortages.

Section 3.4 Shortage Response Actions describes the WSCP's shortage response actions that align with the defined shortage levels.

Section 3.5 Communication Protocols addresses communication protocols and procedures to inform customers, the public, interested parties, and local, regional, and state governments, regarding any current or predicted shortages and any resulting shortage response actions.

Section 3.6 Compliance and Enforcement describes customer compliance, enforcement, appeal, and exemption procedures for triggered shortage response actions.

Section 3.7 Legal Authorities is a description of the legal authorities that enable the City to implement and enforce its shortage response actions.

Section 3.8 Financial Consequences of the WSCP provides a description of the financial consequences of and responses for drought conditions.

Section 3.9 Monitoring and Reporting describes monitoring and reporting requirements and procedures that ensure appropriate data is collected, tracked, and analyzed for purposes of monitoring customer compliance and to meet state reporting requirements**.**

Section 3.10 WSCP Refinement Procedures addresses reevaluation and improvement procedures for monitoring and evaluating the functionality of the WSCP.

Section 3.11 Special Water Feature Distinction a required definition for inclusion in a WSCP per the

Water Code.

Section 3.12 Plan Adoption, Submittal, and Implementation provides a record of the process the City followed to adopt and implement its WSCP.

The WSCP is based on adequate details of demand reduction and supply augmentation measures that are structured to match varying degrees of shortage will ensure the relevant stakeholders understand what to expect during a water shortage situation. The City has adopted water shortage levels consistent with the requirements identified in Water Code Section 10632 (a)(3)(A) (Table 8-1). A cross-walk table showing the relationship between the City's Water Shortage Levels and the Mandated Six Shortage Levels are shown on Table 3-2 of the WSCP in Appendix H.

The supply augmentation actions that align with each shortage level are described in DWR Table 8-3 (Appendix B). These augmentations represent short-term management objectives triggered by the WSCP and do not overlap with the long-term new water supply development or supply reliability enhancement projects.

The demand reduction measures that align with each shortage level are described in DWR Table 8-2 (Appendix B). This table also estimates the extent to which that action will reduce the gap between supplies and demands to demonstrate to the that choose suite of shortage response actions can be expected to deliver the expected outcomes necessary to meet the requirements of a given shortage level.

Table 8-1: Water Shortage Contingency Plan Levels

Submittal Table 8-1 Water Shortage Contingency Plan Levels		
Shortage Level	**Percent Shortage Range**	**Shortage Response Actions**
0	**0%**	**Permanent Mandatory Water Conservation Requirements**
1	>10%	A Level 1 Water Shortage applies when the City determines that a water supply shortage or threatened shortage exists and, and it is necessary to impose mandatory conservation requirements to appropriately respond to conditions created by the water supply shortage.
2	10-25%	A Level 2 Water Shortage applies when the City determines that a water supply shortage or threatened shortage exists and, and it is necessary to impose mandatory conservation requirements to appropriately respond to conditions created by the water supply shortage.
3	25-40%	A Level 3 Water Shortage applies when the City determines that a water supply shortage or threatened shortage exists and, and it is necessary to impose mandatory conservation requirements to appropriately respond to conditions created by the water supply shortage.
4	>40%	A Level 4 Water Shortage applies when the City determines that a water supply shortage or threatened shortage exists and, and it is necessary to impose mandatory conservation requirements to appropriately respond to conditions created by the water supply shortage.
NOTES: A cross-walk table to DWR six shortage levels is provided in Table 3-2 of the WSCP in Appendix H.		

Water shortage contingency planning is a strategic planning process to prepare for and respond to water shortages. Detailed planning and preparation can help maintain reliable supplies and reduce the impacts of supply interruptions. This chapter provides a structured plan for dealing with water shortages, incorporating prescriptive information and standardized action levels, along with implementation actions in the event of a catastrophic supply interruption.

A well-structured WSCP allows real-time water supply availability assessment and structured steps designed to respond to actual conditions, to allow for efficient management of any shortage with predictability and accountability. A water shortage, when water supply available is insufficient to meet the normally expected customer water use at a given point in time, may occur due to a number of reasons, such as population growth, climate change, drought, and catastrophic events. The WSCP is the City’s operating manual that is used to prevent catastrophic service disruptions through proactive, rather than reactive, management. This way, when shortage conditions arise, the City’s governing body, its staff, and the public can easily identify and efficiently implement pre-determined steps to manage a water shortage.

9 DEMAND MANAGEMENT MEASURES

The City, along with other Retail water agencies throughout Orange County, recognizes the need to use existing water supplies efficiently. This ethic of efficient use of water has evolved as a result of the development and implementation of water use efficiency programs that make good economic sense and reflect responsible stewardship of the region's water resources. The City works closely with MWDOC to promote regional efficiency by participating in the regional water savings programs, leveraging MWDOC local program assistance, and applying the findings of MWDOCs research and evaluation efforts. This chapter communicates the City's efforts to promote conservation and to reduce demand on water supplies. A detailed description of demand management measures is available in Appendix J.

9.1 Demand Management Measures for Retail Suppliers

The goal of the DMM section is to provide a comprehensive description of the water conservation programs that a supplier has implemented, is currently implementing, and plans to implement in order to meet its urban water use reduction targets. The reporting requirements for DMM has been significantly modified and streamlined in 2014 by Assembly Bill 2067. Additionally, this section of the UWMP will report on the role of MWDOC's programs in meeting new state regulations for complying with the SWRCB's new Conservation Framework. These categories of demand management measures are as follows:

- Water waste prevention ordinances;
- Metering;
- Conservation pricing;
- Public education and outreach;
- Programs to assess and manage distribution system real loss;
- Water conservation program coordination and staffing support;
- Other DMMs that have a significant impact on water use as measured in GPCD, including innovative measures, if implemented;
- Programs to assist retailers with Conservation Framework Compliance.

9.1.1 Water Waste Prevention Ordinances

Ordinance No. 2016-14 adopted in 2015 amended the City's Municipal Code (NBMC 14.16) pertaining to Water Conservation and Supply Level Regulations. The ordinance establishes permanent mandatory water conservation requirements as follows:

- No customer shall use potable water to irrigate any lawn and/or ornamental landscape area using a landscape irrigation system or a watering device that is not continuously attended unless such irrigation is limited to no more than fifteen (15) minutes watering per day per station.
- No person shall use water to irrigate any lawn and/or ornamental landscape area in a manner that causes or allows excessive flow or runoff onto an adjoining sidewalk, driveway, street, alley, gutter or ditch.
- No person shall use water to wash down hard or paved surfaces.

- No person shall permit excessive use, loss or escape of water through breaks, leaks or other malfunctions in the person's plumbing.
- No customer shall use potable water to irrigate lawns, groundcover, shrubbery or other ornamental landscape material during and within 48 hours after measurable rainfall event.
- All landscape irrigation systems connected to dedicated landscape meters shall include rain sensors that automatically shut off.
- No customer shall operate a water fountain or other decorative water feature that does not use a recirculating water system.
- Commercial conveyor car wash systems shall be operational recirculating water systems.
- Restaurants shall not provide drinking water to any person unless expressly requested by the person.
- Commercial lodging establishments shall provide people with the option of not having towels and linen laundered daily.
- Washing machines installed in commercial and/or coin-operated laundries shall be ENERGY STAR® and Consortium for Energy Efficiency (CEE) Tier III qualified.
- No customer shall use water from any fire hydrant for any purpose other than fire suppression or emergency aid with exceptions.
- No person shall water with potable water the landscapes outside of newly constructed homes and buildings in a manner inconsistent with regulations or other requirements established by the California Building Standards Commission.
- Construction Site Requirements.
- Commercial Kitchen Requirements.

The ordinance also establishes four levels of mandatory water supply shortage response actions to be implemented during times of declared water shortage or declared water shortage emergency, with increasing restrictions on water use in response to worsening drought or emergency conditions and decreasing supplies. The provisions and water conservation measures to be implemented in response to each shortage level are described in the WSCP located in Appendix H of this 2020 UWMP. The City's water conservation ordinance is included in Appendix D of the WSCP.

In November 2015, the City published the Water Conservation Implementation Plan to serve as a guideline for the implementation and enforcement of the Water Conservation and Supply Level Regulations during water shortage conditions.

9.1.2 Metering

The City's water connections are fully metered for all customer sectors, including separate meters for single-family and multi-family residential, CII, dedicated landscape, and City-owned meters. In multi-family dwellings with one property owner, a master-meter is often used. However, for multi-family dwellings with more than one owner, separate water meters are installed.

In July 2020, the City initiated an Advanced Metering Infrastructure (AMI) Program. The City is currently replacing all meters under 2" with AMI meters with a target completion date of July 2022. Meters larger than 2" will be retrofitted to AMI capability. The City has an internal webpage real time the progress of the meter replacement. In addition, since the 2015 UWMP, the City has implemented a meter calibration program to calibrate meters every 2 years, including wellhead meters.

9.1.3 Conservation Pricing

The City has a uniform commodity pricing for all of its customer sectors plus a combined fixed charge based on meter size. The current commodity charges for single family, multi-family, and CII customers are $3.08 per HCF. The monthly fixed charges are based on the customer meter size as shown in Table 9-1. The City's uniform commodity pricing is based off of best management practice (BMP) 13 that states 70% of revenue must be obtained from the variable or commodity rate, and 30% from the fixed rate. The commodity rate is in place to recover operational costs, while the fixed fee is in place to fund capital projects identified in the City's Water Master Plan. The City completed a rate study in November 2019 which became effective on January 1, 2020 and will provide the rate structure until 2025. The rate study resulted in a rate increase of 7.4% every year for five years. All increases occur in the fixed charge for 2020 and then the 7.4% is spread across fixed and usage charge.

Table 9-1: Newport Beach Residential Water Usage Rates

Water Services		Effective	Effective	Effective	Effective	Effective
Meter Size (Inch)	Previous Rates	JAN 1, 2020	JAN 1, 2021	JAN 1, 2022	JAN 1, 2023	JAN 1, 2024
5/8th	$17.27	$20.35	$21.86	$23.48	$25.22	$27.09
3/4th	$17.27	$20.35	$21.86	$23.48	$25.22	$27.09
1	$28.79	$31.54	$33.88	$36.39	$39.09	$41.99
1 1/2	$57.58	$59.47	$63.88	$68.61	$73.69	$79.15
2	$92.12	$93.00	$99.89	$107.29	$115.23	$123.76
3	$172.73	$246.68	$264.94	$284.55	$305.61	$328.23
4	$287.88	$422.71	$454.00	$487.60	$523.69	$562.45
6	$575.76	$897.73	$964.17	$1,035.52	$1,112.15	$1,194.45
8	$921.22	$1,568.33	$1,684.39	$1,809.04	$1,942.91	$2,086.69
10	$1,655.90	$2,350.70	$2,524.66	$2,711.49	$2,912.15	$3,127.65
12	$2,663.48	$2,965.44	$3,184.89	$3,420.58	$3,673.71	$3,945.57
Per Dwelling Unit Charge	$1.00	N/A	N/A	N/A	N/A	N/A
Usage Charges Potable Water	$3.08	$3.11	$3.35	$3.60	$3.87	$4.16

The City's current billing system does not support allocation-based rate structures; however, the new billing system will support allocation-based rate structures. Once the new system is in place, the City will investigate the allocation-based rate structures so it can report to the California Urban Water Conservation Council on the efficiency and staffing requirements to convert the new billing system to one that includes allocation-based rate pricing.

9.1.4 Public Education and Outreach

The City's public education and outreach program is administered by the City and MWDOC, its wholesale supplier. MWDOC develops, coordinates, and delivers a substantial number of public information, education, and outreach programs aimed at elevating water agency and consumer awareness and understanding of current water issues as well as efficient water use and water-saving practices, sound policy, and water reliability investments that are in the best interest of the region. These efforts encourage good water stewardship that benefits all City residents, businesses, and industries across all demographics.

The City also contracts with Inside the Outdoors Foundation (ITOF) administered by the Orange County Department of Education. Through ITOF the City conducts effective environmental education programs promoting studies of environmental Science, Technology, Engineering and Math (STEM).

Through a variety of public information programs, MWDOC and ITOF reach the public with information regarding present and future water supplies, the demands for a suitable quantity and quality of water, including recycled water, and the importance of implementing water efficiency rebates, techniques and behaviors. Through ITOF, water education programs have reached thousands of students in the City with grade-specific programs focused on the above mentioned.

Several examples are included below:

Print and Electronic Materials
MWDOC offers a variety of print and electronic materials that are designed to assist City water users of all ages in discovering where their water comes from, what the City and other water industry professionals are doing to address water challenges, how to use water most efficiently, and more. Through MWDOC's robust social media presence, award-winning website, eCurrents newsletter, media tool kits, public service announcements (PSAs), flyers, brochures, and other outreach materials, MWDOC ensures that stakeholders are equipped with sufficient information and subject knowledge to assist them in making good behavioral and civic choices that ultimately affect the quality and quantity of the region's water supply.

Public Events
Each year, MWDOC hosts an array of public events intended to engage a diverse range of water users in targeted discussions and actions that homes in on their specific interests or needs. Some of these public events include:

- **MWDOC Water Policy Forums and Orange County Water Summit** are innovative and interactive symposiums that bring together hundreds of business professionals, elected officials, water industry stakeholders, and community leaders from throughout the state for a discussion on new and ongoing water supply challenges, water policy issues, and other important topics that impact our water supply, economy, and public health.
- **Inspection Trips** of the state's water supply systems are sponsored each year by MWDOC and MET. Orange County elected officials, residents, business owners, and community leaders are invited to tour key water facilities throughout the state and learn more about the critical planning, procurement, and management of Southern California's water supply, as well as the issues surrounding delivery and management of our most precious natural resource – water.
- **Community Events and Events Featuring MWDOC Mascot Ricky the Rambunctious Raindrop** provide opportunities to interact with Orange County water users in a fun and friendly way, offer useful water-related information or education, and engage them in important discussions about the value of water and how their decisions at home, at work, and as tax- or ratepayers may impact Orange County's quality and quantity of water for generations to come.

Education Programs and Initiatives

Over the past several years, MWDOC and ITOF have amplified its efforts in water education programs and activities for Orange County's youngest water users. This is accomplished by continuing to grow professional networks and partnerships that consist of leading education groups, advisors, and teachers, and by leading the way for the City and its 28 member agencies to be key contributors of both Southern California and Orange County water-centric learning. Several key water education programs and initiatives include:

- **Environmental Literacy** is an individual's awareness of the interconnectedness and interdependency between people and natural systems, being able to identify patterns and systems within their communities, while also gathering evidence to argue points and solve problems. By using the environment as the context for learning, K-12 students gain real-world knowledge by asking questions and solving problems that directly affect them, their families, and their communities. This approach to K-12 education builds critical thinking skills and promotes inquiry, and is the foundation for all MWDOC education programs, initiatives, and activities.
- **MWDOC Choice School Programs** have provided Orange County K-12 students water-focused learning experiences for nearly five (5) decades. Interactive, grade-specific lessons invite students to connect with, and learn from, their local ecosystems, guiding them to identify and solve local water-related environmental challenges affecting their communities. Choice School Programs are aligned with state standards, and participation includes a dynamic in-class or virtual presentation, and pre- and post-activities that encourage and support Science Technology Engineering Arts and Mathematics (STEAM)-based learning and good water stewardship.
- **Water Energy Education Alliance (WEEA)** is a coalition of education and water and energy industry professionals led by MWDOC that works together to build and bolster Career Technical Education programs (CTE) for Southern California high school students. These CTEs focus on workforce pathways in the Energy, Environment, and Utility Sectors, and connections established through this powerful Southern California alliance assist stakeholders as they thoughtfully step up their investment in the education and career success of California's future workforce.
- **MWDOC Water Awareness Poster Contest** is an annual activity developed to encourage Orange County's K-12 students to investigate and explore their relationship to water, connect the importance of good water stewardship to their daily lives, and express their conclusions creatively through art. Each year, MWDOC receives hundreds of entries, and 40 winners from across Orange County are invited to attend a special awards ceremony with their parents and teachers, and Ricky the Rambunctious Raindrop.
- **Boy Scouts Soil and Water Conservation Merit Badge and Girl Scouts Water Resources and Conservation Patch Programs** guide Orange County Scouts on a learning adventure of where their water comes from, the importance of Orange County water resources, and how to be water efficient. These STEAM-based clinics are hosted by MWDOC and include interactive learning stations, hands-on activities, and a guided tour of an Orange County water source, water treatment facility, or ecological reserve
- ITOF - MLK Day of Service is an annual event held at the Peter and Mary Muth Center in the Upper Newport Bay - inviting students to perform a land based clean up and be recognized for their efforts throughout the year.

- **Partnerships** are an integral part of achieving water-related goals that impact all Orange County water users. MWDOC's partner list is extensive, and acts as a collective catalyst for all those involved to grow and prosper. Some of the MWDOC's most recognized partners include local, regional, state, and federal legislators, educators, water and energy industry leaders, environmental groups, media, and business associations all focused on the common goals of water education, water use efficiency, and advocacy on behalf of the region.

9.1.5 Programs to Assess and Manage Distribution System Real Loss

The City records daily production and demand data and reads all meters on a bi-monthly basis in order to assess and manage distribution system real loss. All metered sales and other verifiable uses such as backwash, flush water, and operation and maintenance, are recorded.

In 2020, the City completed a leak detection program with MWDOC to detect and repair distribution system leaks. The City is evaluating the possibility of developing a formal leak detection program in the next 2 to 5 years with MWDOC to audit the entire system. Leak detection on the customer-side will be supported through the AMI Program.

Much of the City' steel and ductile iron pipe is protected from early deterioration with a cathodic protection system. This system draws the negative current away from the pipe to a sacrificial anode that erodes instead of the piping. This prevents leakage on the piping and reduces water loss.

Senate Bill 1420 signed into law in September 2014 requires urban water suppliers that submit UWMPs to calculate annual system water losses using the water audit methodology developed by the AWWA. SB 1420 requires the water loss audit be submitted to DWR every five years as part of the urban water supplier's UWMP. Water auditing is the basis for effective water loss control. DWR's UWMP Guidebook include a water audit manual intended to help water utilities complete the AWWA Water Audit on an annual basis. A Water Loss Audit was completed for the City which identified areas for improvement and quantified total loss. Based on the data presented, the three priority areas identified were volume from own sources, billed metered, and customer metering inaccuracies. Multiple criteria are a part of each validity score and a system wide approach will need to be implemented for the City's improvement. Expressing water loss audit results in terms of Real Losses per Service Connection per Day allows for standardized comparison across MWDOC retailer agencies and is a metric consistent with the Water Board's forthcoming economic model. The Real Losses per Service Connection per Day for CY2019 was 22.83 gal/connection/day.

9.1.6 Water Conservation Program Coordination and Staffing Support

The City has designated a Water Conservation Coordinator since November 2007 whose responsibilities include the following tasks:

- Manage, oversee and coordinate the City's water conservation program; implement specific projects to improve water conservation and water quality, and assist in the City's compliance with all storm water quality (National Pollutant Discharge Elimination System (NPDES) requirements.

- Perform professional level duties in the City's residential, commercial and large landscape water conservation programs; develop programs to promote water conservation, conduct field audits and provide consultation on residential and landscape water conservation methods;
- Establish an effective City-wide water conservation program; develop applicable procedures, standards and guidelines;
- Respond to customer inquiries or complaints; make site visits, gather and analyze data, and make written reports to site owners and managers with recommendations for improving water use, irrigation efficiency and runoff reduction; contact property owners and other members of the public to explain code requirements and to answer questions related to code compliance;
- Advise and assist the Water Division of the Utilities Department regarding rate structures and water conservation initiatives;
- Develop and chair a water conservation committee to ensure the City is effectively managing water conservation efforts across departments and citywide;
- Assist with the City's NPDES requirements and provide support in meeting reporting requirements; attend NPDES meetings as requested by the Division Manager;
- Develop and submit applications for grant funding related to water conservation and water quality; administer and maintain grant contract requirements;
- Manage a variety of projects related water conservation, water quality protection, and watershed management;
- Assist, train, and advise Code and Water Quality Enforcement staff and other City personnel in the enforcement of water conservation and water quality rules, regulations, and ordinances;
- Conduct field inspections and surveys to determine compliance with NPDES requirements;
- Serve as liaison and educator to the community, including residents, visitors, and businesses; attend meetings and collaborate with stakeholders; provide public information and outreach on water conservation initiatives; develop public education materials on water conservation and water quality issues; conduct public presentations and classroom visits;
- Provide technical expertise and advice on water conservation and water quality practices to managerial staff, the public, and other interested parties;
- Issue Notices of Violation, Administrative Citations and letters to property owners/tenants and businesses whose properties are not in compliance with current water conservation and water quality regulations;
- Conduct follow-up investigations and develop correspondence.

An annual budget of $420,000 is provided for conservation support and initiatives. This budget does not include the AMI Program but does support the leak detection program and staffing.

9.1.7 Other Demand Management Measures

9.1.7.1 Residential Program

MWDOC assists the City with the implementation of residential DMMs by making available the following programs aimed at increasing landscape and indoor water use efficiency for residential customers.

High Efficiency Clothes Washer Rebate Program

The High Efficiency Clothes Washer (HECW) Rebate Program provides residential customers with rebates for purchasing and installing HECWs that. Approximately 15% of home water use goes towards laundry, and HECWs use 35-50% less water than standard washer models, with savings of approximately 10,500 gallons per year, per device. Devices must meet or exceed the CEE 1 Standard, and a listing of qualified products can be found at ocwatersmart.com. There is a maximum of one rebate per home.

Premium High Efficiency Toilet Rebate Program

The largest amount of water used inside a home, 30%, goes toward flushing the toilet. The Premium High Efficiency Toilet (HET) Rebate Program offers incentives to residential customers for replacing their toilets using 1.6 gallons per flush or more. Premium HETs use just 1.1 gallons of water or less per flush, which is 20% less water than WaterSense standard toilets. In addition, Premium HETs save an average of 9 gallons of water per day while maintaining high performance standards.

9.1.7.2 CII Programs

MWDOC provides a variety of financial incentives to help City businesses, restaurants, institutions, hotels, hospitals, industrial facilities, and public sector sites achieve their efficiency goals. Water users in these sectors have options to choose from a standardized list of water efficient equipment/devices or may complete customized projects through a pay-for-performance where the incentive is proportional to the amount of water saved. Such projects include high efficiency commercial equipment installation and manufacturing process improvements.

Water Savings Incentive Program

The Water Savings Incentive Program (WSIP) is designed for non-residential customers to improve their water efficiency through upgraded equipment or services that do not qualify for standard rebates. WSIP is unique because it provides an incentive based on the amount of water customers actually save. This “pay-for-performance” design lets customers implement custom projects for their sites.

Projects must save at least 10 million gallons (MGs) of water to qualify for the Program and are offered from $195 to $390 per acre foot of water saved. Examples of successfully projects include but are not limited to changing industrial process system water, capturing condensation and using it to supplement cooling tower supply, and replacing water-using equipment with more efficient products.

On-site Retrofit Program

The On-site Retrofit Program provides another pay-for-performance financial incentive to commercial, industrial and institutional property owners, including Homeowner Associations (HOAs), who convert potable water irrigation or industrial water systems to recycled water use.

Projects commonly include the conversion of mixed or dedicated irrigation meters using potable water to irrigate with reclaimed water, or convert industrial processes use to recycled water, such as a cooling towers. Financial incentives of up to $1,300 per AF of potable water saved are available for customer-side on the meter retrofits. Funding is provided by Metropolitan, USBR, and DWR.

Multi-Family Premium High Efficiency Toilet Incentive Program

MWDOC makes an effort to reach all water-users in Orange County. For the Multi-Family Premium HET Rebate Program, MWDOC targets multi-family buildings in both disadvantaged communities (DAC) and non-DAC communities, in addition to targeting all commercial buildings, and single-family residential homes through Premium HET device rebates.

MWDOC offers the DAC Multi-Family HET Program, a special version of the HET Program, to ensure regardless of economic status all water-users in Orange County can benefit from the rebate. This Program targets 3.5 gallon per flush (gpf) or greater toilets to replace them with WaterSense Labeled 1.1 gpf or less. For this purpose, DAC are referenced as communities facing economic hardship. This is defined using criteria established by DWR and the County of Orange, which includes communities where the MHI is less than 85% of the Orange County MHI.

The DAC Multi-Family Program is contractor-driven, where a contractor works with building owners to replace all of the toilets in the building(s). To avoid any cost to tenants, the rebate is $200 per toilet paid to the contractor, essentially covering the contractor’s cost; therefore, there is little to no charge to the building owners that may be passed through to tenants. This process was formed after consulting contractors and multi-family building owners in Orange County. To serve those in multi-family buildings outside of designated DAC locations, MWDOC offers $75 per toilet through the same contractor-driven format. An additional option is available through SoCal Water$mart, which offers up to $250 per toilet to multi-family buildings that were built before 1994, therefore targeting buildings built before legislation required low-flow plumbing fixtures in new construction.

Device Retrofits

MWDOC offers additional financial incentives under the SoCal Water$mart Rebate Program which offers rebates for various water efficient devices to CII customers. Core funding is provided by Metropolitan and supplemental funding is sourced from MWDOC via grant funds and/or retail water agencies.

9.1.7.3 Landscape Programs

One of the most active and exciting water use efficiency sectors MWDOC provides services for are those programs that target the reduction of outdoor water use. With close to 60% of water consumed outdoors, this sector has been and will continue to be a focus for MWDOC and the City.

Turf Removal Program

The Orange County Turf Removal Program offers incentives to remove turf grass from residential, commercial, and public properties throughout the County. This program is a partnership between MWDOC, Metropolitan, and local retail water agencies. The goals of this program are to increase water use efficiency through sustainable landscaping practices that result in multi-benefit projects across Orange County. Participants replace their turf grass with drought-tolerant, CA Friendly, or CA Native landscaping, and retrofit their irrigation systems to high efficiency equipment, such as drip, or remove it entirely, and are encouraged to utilize smart irrigation timers. Furthermore, projects are required to include a stormwater capture feature, such as a rain garden or dry stream bed, and have a minimum of three plants per 100 square feet to increase plant density and promote healthy soils. These projects save water and also reduce dry and wet weather runoff, increase urban biomass, and sequester more carbon than turf landscapes.

Landscape Design and Maintenance Plan Assistance Programs

To maximize the water efficiency and quality of Orange County's Turf Removal Program Projects, MWDOC offers free landscape designs and free landscape maintenance plans to participating residential customers. The Landscape Design Assistance Program is offered at the beginning stages of their turf removal project so that customers may receive a customized, professionally designed landscape to replace their turf. Landscape designs include plant selection, layout, irrigation plans, and a stormwater capture feature. These designs help ensure climate appropriate plants are chosen and planted by hydrozone, that appropriate high efficiency irrigation is properly utilized, that water savings are maximized as a result of the transformation. Landscape maintenance plans are offered after a project is complete to ensure that the new landscape is cared for properly and water savings are maximized.

Smart Timer Rebate Program

Smart Timers are irrigation clocks that are either weather-based irrigation controllers (WBICs) or soil moisture sensor systems. WBICs adjust automatically to reflect changes in local weather and site-specific landscape needs, such as soil type, slopes, and plant material. When WBICs are programmed properly, turf and plants receive the proper amount of water throughout the year. During the fall months, when property owners and landscape professionals often overwater, Smart Timers can save significant amounts of water.

Rotating Nozzles Rebate Program

The Rotating Nozzle Rebate Program provides incentives to residential and commercial properties for the replacement of high-precipitation rate spray nozzles with low-precipitation rate multi-stream, multi-trajectory rotating nozzles. The rebate offered through this Program aims to offset the cost of the device and installation.

Spray-to-Drip Rebate Program

The Spray to Drip Rebate Program offers residential, commercial, and public agency customers rebates for converting areas irrigated by traditional high-precipitation rate spray heads to low-precipitation rate drip irrigation. Drip irrigation systems are extremely water-efficient. Rather than spraying wide areas subject to wind drift, overspray and runoff, drip systems use point emitters to deliver water to specific locations at or near plant root zones. Water drips slowly from the emitters either onto the soil surface or below ground. As a result, less water is lost to wind, evaporation, and overspray, saving water and reducing irrigation runoff and non-point source pollution.

SoCal Water$mart Rebate Program for Landscape

The City through MWDOC also offers financial incentives under the SoCal Water$mart Rebate Program for a variety of water efficient landscape devices, such as Central Computer Irrigation Controllers, large rotary nozzles, and in-stem flow regulators.

Landscape Training Classes

The California Friendly and Native Landscape Training and the Turf Removal and Garden Transformation Workshops provide education to residential homeowners, property managers, and professional landscape contractors on a variety of landscape water efficiency practices that they can employ and use to help design a beautiful garden using California Friendly and native plant landscaping principles. The California Friendly and Native Landscape Class demonstrates how to: implement storm water capture features in the landscape; create a living soil sponge that holds water; treat rainwater by a resource; select and arrange plants to maximize biodiversity and minimize water use; and control irrigation to minimize water waste, runoff and non-point source pollution.

The Turf Removal and Garden Transformation Workshop teaches participants how to transform thirsty turfgrass into a beautiful, climate-appropriate water efficient garden. This class teaches how to: evaluate the landscape's potential; plan for garden transformation; identify the type of turfgrass in the yard; remove grass without chemicals; build healthy, living soils; select climate-appropriate plants that minimize water use and maximize beauty and biodiversity; and implement a maintenance schedule to maintain the garden.

Qualified Water Efficient Landscape Certification (Commercial)

Since 2018, MWDOC along with the City, has offered free Qualified Water Efficient Landscaper (QWEL) certification classes designed for landscape professionals. Classes are open to any city staff, professional landscaper, water district employee, or maintenance personnel that would like to become a Qualified Water Efficient Landscaper. The QWEL certification program provides 20 hours of instruction on water efficient areas of expertise such as local water supply, sustainable landscaping, soil types, irrigation systems and maintenance, as well as irrigation controller scheduling and programing. QWEL has received recognition from EPA WaterSense for continued promotion of water use efficiency. To earn the QWEL certification, class participants must demonstrate their ability to perform an irrigation audit as well as pass the QWEL exam. Successful graduates will be listed as a Certified Professional on the WaterSense website as well as on MWDOC's landscape resources page, to encourage Turf Removal participants or those making any landscape improvements to hire a QWEL certified professional.

Started in December 2020, a hybrid version of QWEL is available in conjunction with the California Landscape Contractors Association's Water Management Certification Program. This joint effort allows landscape industry an opportunity to obtain two nationally recognized EPA WaterSense Professional Certifications with one course and one written test. This option is offered through MET.

OC Water Smart Gardens Resource Page

MWDOC's OC Water Smart Gardens webpage provides a surplus of helpful guides and fact sheets, as well as an interactive photo gallery of water-saving landscape ideas. The purpose of this resource is to help Orange County residents find a broad variety of solutions for their water efficient landscaping needs. This includes a detailed plant database with advanced to search features; photo and/or video-based garden tours; garden gallery with images organized into helpful landscape categories such as back yards, hillsides, full sun, and/or shade with detailed plant information; and the ability to select and store plants in a list that the user can print for use when shopping.

Additional technical resources are available such as a watering calculator calibrated for local evapotranspiration rates, and a garden resources section with fact sheets on sustainable landscape fundamentals, water and soil management, composting, solving run-off, and other appropriate topics. Web page is accessible through mwdoc.com and directly at www.ocwatersmartgardens.com.

9.2 Implementation over the Past Five Years

During the past five years, FY 2015-16 to 2020-21, the City, with the assistance of MWDOC, has continued water use efficiency programs for its residential, CII, and landscape customers as described below. Implementation data is provided in Appendix I. The City will continue to implement all applicable programs in the next five years.

Table 9-2: City of Newport Beach Water Conservation Efficiency Program Participation

Measure	Unit	FY15/16	FY16/17	FY17/18	FY18/19	FY19/20
Central Computer Irrigation Controllers	computer controllers	-	-	-	-	-
Flow Restrictor	restrictors	-	-	-	-	-
HECW	washers	71	61	52	41	28
HETs	toilets	237	3	-	-	-
Rain Barrels	barrels	58	5	5	1	3
Cisterns	cisterns	-	-	-	-	-
Premium HETs	toilets	7	14	7	-	-
Rotating Nozzles	nozzles	1,028	-	45	-	-
CII WBICs	clocks	46	12	-	-	32
Residential WBICs	clocks	32	30	26	25	16
Zero Water Urinals	urinals	-	-	-	-	-
Plumbing Flow Control	valves	-	-	-	-	-
Soil Moisture Sensor	controllers	-	-	-	-	-
Ice-Making Machine	machines	-	-	-	-	-
Turf Removal	sf	20,568	2,924	12,437	90,403	1,294
Spray-to-Drip	sf	-		1600	1495	301
Landscape Design Assistance		-	-	-	-	-
Water Savings Incentive Program		-	-	0	0	0
On Site Retrofit Program	sites	-	1*	-	-	-
*Saved 152 AFY of potable water; irrigated area covers 2090880 sq ft.						

9.3 Water Use Objectives (Future Requirements)

To support Orange County retailers with SB 606 and AB 1668 compliance (Conservation Framework), MWDOC is providing multi-level support to members agencies to ensure they meet the primary goals of the legislation including to Use Water More Wisely and to Eliminate Water Waste. Beginning in 2023, Urban water suppliers are required to calculate and report their annual urban water use objective (WUO), submit validated water audits annually, and to implement and report BMP CII performance measures.

Urban Water Use Objective

An Urban Water Supplier's urban WUO is based on efficient water use of the following:

- Aggregate estimated efficient **indoor residential** water use;
- Aggregate estimated efficient **outdoor residential** water use;
- Aggregate estimated efficient **outdoor** irrigation landscape areas with dedicated irrigation meters or equivalent technology in connection with **CII** water use;
- Aggregate estimated efficient **water losses;**
- Aggregate estimated water use for variances approved the State Water Board;
- Allowable **potable reuse water** bonus incentive adjustments.

MWDOC offers a large suite of programs, described in detail throughout section 1.3.6, that will assist Orange County retailers in meeting and calculating their WUO.

Table 9-3 describes MWDOC's programs that will assist agencies in meeting their WUO through both direct measures: programs/activities that result in directly quantifiable water savings; and indirectly: programs that provide resources promoting water efficiencies to the public that are impactful but not directly measurable.

Table 9-3: MWDOC Programs to Assist in Meeting WUO

WUO Component	Calculation	Program	Impact
Indoor Residential	Population and GPCD standard	**Direct Impact** • HECW • HET • Multi-Family HET (DAC/ non-DAC)	Direct Impact: Increase of indoor residential efficiencies and reductions of GPCD use
Outdoor Residential	Irrigated/irrigable area measurement and a percent factor of local ETo	**Direct Impact** • Turf Removal • Spray-to-Dip • Smart Timer • HEN • Rain Barrels/Cisterns	Direct Impact: Increase outdoor residential efficiencies and reductions of gallons per ft^2 of irrigated/ irrigable area used

WUO Component	Calculation	Program	Impact
		Indirect Impact • Landscape Design and Maintenance Assistance • OC Friendly Gardens Webpage • CA Friendly/Turf Removal Classes • QWEL	Indirect Impact: Provide information, resources, and education to promote efficiencies in the landscape
Outdoor Dedicated Irrigation Meters	Irrigated/irrigable area measurement and a percent factor of local ETo	**Direct Impact** • Turf Removal • Spray-to-Dip • Smart Timer • HEN • Central Computer Irrigation Controllers • Large Rotary Nozzles • In-Stem Flow Regulators **Indirect Impact** • OC Friendly Gardens Webpage • CA Friendly/Turf Removal Classes • QWEL	Direct Impact: Increase outdoor residential efficiencies and reductions of gallons per ft^2 of irrigated/ irrigable area used Indirect Impact: Provide information, resources, and education to promote efficiencies in the landscape
Water Loss	Following the AWWA M36 Water Audits and Water Loss Control Program, Fourth Edition and AWWA	**Direct Impact** • Water Balance Validation • Customer Meter Accuracy Testing • Distribution System Pressure Surveys	Direct Impact: Identify areas of the distribution system that need repair, replacement, or other action

WUO Component	Calculation	Program	Impact
	Water Audit Software V5	• Distribution System Leak Detection • No-Discharge Distribution System Flushing • Water Audit Compilation • Component Analysis	
Bonus Incentives	One of the following: • Volume of potable reuse water from existing facilities, not to exceed 15% of WUO. • Volume of potable reuse water from new facilities, not to exceed 10% of WUO	**Direct Impact** • GWRS	Direct Impact: The GWRS (run by OCWD) significantly increases the availability of potable reuse water

In addition, MWDOC is providing support to agencies to assist with the calculation of WUOs. DWR will provide residential outdoor landscape measurements; however, Urban Water Suppliers are responsible for measuring landscape that is irrigated/irrigable by dedicated irrigation meters. MWDOC is contracting for consultant services to assist agencies in obtaining these measurements. Services may include but are not limited to:

- Accounting/database clean up (e.g., data mining billing software to determine dedicated irrigation customers);
- Geolocation of dedicated irrigation meters;
- In-field measurements;
- GIS/Aerial imagery measurements;
- Transformation of static/paper maps to digital/GIS maps.

These services will help agencies organize and/or update their databases to determine which accounts are dedicated irrigation meters and provide landscape area measurements for those accounts. These data points are integral when calculating the WUO. MWDOC is also exploring funding options to help reduce retail agencies' costs of obtaining landscape area measurements for dedicated irrigation meters.

CII Performance Measures

Urban water supplies are expected to report BMPs and more for CII customers. MWDOC offers a broad variety of programs and incentives to help CII customers implement BMPs and increase their water efficiencies.

Table 9-4: CII BMP Implementation Programs Offered

Component	Program Offered	Impact
CII Performance Measures	• WSIP • On-Site Retrofit Program (ORP) • HETs • HE Urinals • Plumbing Flow Control Valves • Connectionless Food Steamers • Air-cooled Ice Machines • Cooling Tower Conductivity controllers • Cooling Tower pH Controllers • Dry Vacuum Pumps • Laminar Flow Restrictors	WSIP incentivizes customized CII water efficiency projects that utilize BMPS. ORP incentivizes the conversion of potable to recycled water and is applicable to CII dedicated irrigation meters or CII mixed-use meters that may be split to utilize recycled water for irrigation. Additional CII rebates based on BMPS increase the economic feasibility of increasing water efficiencies.

These efforts to assist OC retail agencies are only just beginning. Our plan is to ensure that all agencies are fully ready to begin complying with the new water use efficiency standards framework called for in SB 606 and SB 1668 by the start date of 2023.

10 PLAN ADOPTION, SUBMITTAL, AND IMPLEMENTATION

The Water Code requires the UWMP to be adopted by the Supplier's governing body. Before the adoption of the UWMP, the Supplier has to notify the public and the cities and counties within its service area per the Water Code and hold a public hearing to receive input from the public on the UWMP. Post adoption, the Supplier submits the UWMP to DWR and the other key agencies and makes it available for public review. This section provides a record of the process the City followed to adopt and implement its UWMP.

10.1 Overview

Recognizing that close coordination among other relevant public agencies is key to the success of its UWMP, the City worked closely with many other entities, including representation from diverse social, cultural, and economic elements of the population within the City's service area, to develop and update this planning document. The City also encouraged public involvement through its public hearing process, which provided residents with an opportunity to learn and ask questions about their water supply management and reliability. Through the public hearing, the public has an opportunity to comment and put forward any suggestions for revisions of the Plan.

Table 10-1 summarizes external coordination and outreach activities carried out by the City and their corresponding dates. The UWMP checklist to confirm compliance with the Water Code is provided in Appendix A.

Table 10-1: External Coordination and Outreach

External Coordination and Outreach	Date	Reference
Notified the cities and counties within the Supplier's service area that Supplier is preparing an updated UWMP (at least 60 days prior to public hearing)	3/11/2021	Appendix K
Public Hearing Notice	5/22/2021	Appendix K
Held Public Hearing	5/25/2021	Appendix K
Adopted UWMP	6/22/2021	Appendix L
Submitted UWMP to DWR (no later than 30 days after adoption)	7/1/2021	-
Submitted UWMP to the California State Library (no later than 30 days after adoption)	7/1/2021	-
Submitted UWMP to the cities and counties within the Supplier's service area (no later than 30 days after adoption)	7/1/2021	-
Made UWMP available for public review (no later than 30 days after filing with DWR)	8/1/2021	-

This UWMP was adopted by the City Council on June 22, 2021. A copy of the adopted resolution is provided in Appendix L.

10.2 Agency Coordination

The Water Code requires the Suppliers preparing UWMPs to notify any city or county within their service area at least 60 days prior to the public hearing. As shown in Table 10-2, the City sent a Letter of Notification to the County of Orange on March 11, 2021 to state that it was in the process of preparing an updated UWMP (Appendix K).

Table 10-2: Retail: Notification to Cities and Counties

DWR Submittal Table 10-1 Retail: Notification to Cities and Counties		
County Name	60 Day Notice	Notice of Public Hearing
Orange County	☑	☑

The City's water supply planning relates to the policies, rules, and regulations of its regional and local water providers. The City is dependent on imported water from MET through MWDOC, its regional wholesaler. The City is also dependent on groundwater from OCWD, the agency that manages the OC Basin and provides recycled water in partnership with the OC San. As such, the City involved the relevant agencies in this 2020 UWMP at various levels of contribution as described below.

MWDOC provided assistance to the City's 2020 UWMP development by providing much of the data and analysis such as population projections from the CDR and the information quantifying water availability to meet the City's projected demands for the next 25 years, in five-year increments. Additionally, MWDOC led the effort to develop a Model Water Shortage Ordinance that its retail suppliers can adopt as is or customize and adopt as part of developing their WSCPs. This 2020 UWMP was developed in collaboration with MWDOC's 2020 UWMP to ensure consistency between the two documents.

As a groundwater producer who relies on supplies from the OCWD-managed OC Basin, the City coordinated the preparation of this 2020 UWMP with OCWD. Several OCWD documents, such as the Groundwater Reliability Plan, Engineer's Report, and 2017 Basin 8-1 Alternative were used to retrieve the required relevant information, including the projections of the amount of groundwater the City is allowed to extract in the 25-year planning horizon.

The various planning documents of the key agencies that were used to develop this UWMP are listed in Section 2.2.1.

10.3 Public Participation

The City encouraged community and public interest involvement in the plan update through a public hearing and inspection of the draft document on May 25, 2021. As part of the public hearing, the City discussed adoption of the UWMP, SBx7-7 baseline values, compliance with the water use targets (Section 5), implementation, and economic impacts of the water use targets (Section 9).

Copies of the draft plan were made available for public inspection at the City Clerk's and Utilities Department offices.

Public hearing notifications were published in local newspapers. A copy of the published Notice of Public Hearing is included in Appendix K.

The hearing was conducted during a regularly scheduled meeting of the City Council.

10.4 UWMP Submittal

The City Council reviewed and approved the 2020 UWMP at its June 22, 2021 meeting after public hearing on May 25, 2021. See Appendix L for the resolution approving the Plan.

By July 1, 2021, the City's adopted 2020 UWMP was filed with DWR, California State Library, and the County of Orange. The submission to DWR was done electronically through the online submittal tool - WUE Data Portal. The City will make the Plan available for public review on its website no later than 30 days after filing with DWR.

10.5 Amending the Adopted UWMP or WSCP

Based on DWR's review of the UWMP, the City will make any amendments in its adopted UWMP, as required, and directed by DWR and will follow each of the steps for notification, public hearing, adoption, and submittal for the amending the adopted UWMP.

If the City revises its WSCP after UWMP is approved by DWR, then an electronic copy of the revised WSCP will be submitted to DWR within 30 days of its adoption.

11 REFERENCES

Arcadis. (2019, April). *2019 Water Master Plan*. https://www.newportbeachca.gov/home/showdocument?id=62782. Accessed on March 2, 2021.

California Department of Housing and Community Development. (2020). *Accessory Dwelling Units (ADUs) and Junior Accessory Dwelling Units (JADUs)*. https://www.hcd.ca.gov/policy-research/accessorydwellingunits.shtml

California Department of Water Resources (DWR). (2020a, January). *California's Most Significant Droughts: Comparing Historical and Recent Conditions*. https://water.ca.gov/-/media/DWR-Website/Web-Pages/What-We-Do/Drought-Mitigation/Files/Publications-And-Reports/a6022_CalSigDroughts19_v9_ay11.pdf. Accessed on October 12, 2020.

California Department of Water Resources (DWR). (2020b, August 26). *The Final State Water Project Delivery Capability Report (DCR) 2019*. https://data.cnra.ca.gov/dataset/state-water-project-delivery-capability-report-dcr-2019. Accessed on December 28, 2020.

California Department of Water Resources (DWR). (2020c, August). *Draft Urban Water Management Plan Guidebook 2020.* https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Urban-Water-Management-Plans/Draft-2020-UWMP-Guidebook.pdf?la=en&hash=266FE747760481ACF779F0F2AAEE615314693456. Accessed on December 28, 2020.

CDM Smith. (2021, March 30). *Orange County Water Demand Forecast for MWDOC and OCWD Technical Memorandum.*

City of La Habra, Irvine Ranch Water District, & Orange County Water District. (2017, January 1). *Basin 8-1 Alternative*. https://www.ocwd.com/media/4918/basin-8-1-alternative-final-report-1.pdf. Accessed on December 29, 2020.

City of Newport Beach. (2021). *Storm Drains.* https://www.newportbeachca.gov/government/departments/utilities/storm-drains. Accessed on April 13, 2021.

City of Newport Beach. (2015). *Urban Water Management Plan*. https://www.newportbeachca.gov/government/departments/utilities/administration/reports Accessed on December 31, 2020.

Metropolitan Water District of Southern California (MET). (2021, June). *2020 Urban Water Management Plan.*

Orange County Local Agency Formation Commission (OC LAFCO). (2020, September). *Municipal Service Review for the Municipal Water District of Orange County.*

Orange County Water District. (2021). *2019-2020 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District.*

Orange County Water District. (2020, February). *2018-2019 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District.* https://www.ocwd.com/media/8791/2018-19-engineers-report-final.pdf. Accessed on December 30, 2020.

Santa Margarita Water District (SMWD). (2021). San Juan Watershed Project. *About the Project: Phases.* http://sanjuanwatershed.com/about-the-project/eir/phases/. Accessed on April 20, 2021.

The Metropolitan Water District Act. (1969). http://www.mwdh2o.com/Who%20We%20Are%20%20Fact%20Sheets/1.2_Metropolitan_Act.pdf

United States Bureau of Reclamation (USBR). (2012, December). *Colorado River Basin Water Supply and Demand Study: Study Report.* https://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Study%20Report/CRBS_Study_Report_FINAL.pdf. Accessed on December 29, 2020.

University of California Berkeley. (2020). *About Accessory Dwelling Units.* https://www.aducalifornia.org/. Accessed on December 9, 2020.

APPENDICES

Arcadis U.S., Inc.

320 Commerce

Suite 200

Irvine, California 92602

Tel 714 730 9052

Fax 714 730 9345

www.arcadis.com

Maddaus Water Management, Inc.

105 Zephyr Place

Danville

California 94526

www.maddauswater.com

APPENDIX D

BASIN 8-1 ALTERNATIVE

Basin 8-1 Alternative 2022 Update

Submitted by: Orange County Water District
City of La Habra
Irvine Ranch Water District

Submitted to: California Department of Water Resources

January 1, 2022

Table of Contents

BASIN 8-1 ALTERNATIVE OVERVIEW

The Sustainable Groundwater Management Act (SGMA) requires all high- and medium-priority basins, as designated by the California Department of Water Resources (DWR), be sustainably managed. DWR designated the Coastal Plain of Orange County Groundwater Basin ("Basin 8-1" or "Basin") as a medium-priority basin, primarily due to heavy reliance on the Basin's groundwater as a source of water supply.

The agencies within Basin 8-1 collaborated to prepare and submit an Alternative to a Groundwater Sustainability Plan (GSP) on December 22, 2016. Within this document, this Alternative to a GSP will be referred to herein as the "Basin 8-1 Alternative" or "Alternative". In accordance with Water Code §10733.6(b)(3), the Alternative presented an analysis of basin conditions that demonstrated that Basin 8-1 had operated within its sustainable yield over a period of at least 10 years. On July 17, 2019, DWR determined that the Alternative satisfied SGMA objectives and was therefore approved.

Approved alternatives are required to submit annual reports to DWR on April 1 of each year, and to resubmit the alternative by January 1 every five years. Annual reports were submitted to DWR as follows:

- Water Year 2016-17 – March 29, 2018
- Water Year 2017-18 – March 29, 2019
- Water Year 2018-19 – March 30, 2020
- Water Year 2019-20 – March 30, 2021

This document represents the first five-year update, which is due January 1, 2022.

This update has been jointly prepared by the Orange County Water District (OCWD), Irvine Ranch Water District (IRWD); and the City of La Habra Groundwater Sustainability Agency (collectively the "Submitting Agencies"); pursuant to this Alternative, the Submitting Agencies will ensure the entire Basin 8-1 continues to be sustainably managed and data reported as required by SGMA. Pursuant to Water Code §10733.6(b)(3), the Basin 8-1 Alternative has been prepared by or under the direction of a professional geologist or professional engineer.

For purposes of this report, the Basin 8-1 Alternative approved by DWR on July 17, 2019, is referred to as the 2017 Alternative. The first five-year update will be referred to as the 2022 Update. The 2017 Alternative was a comprehensive document showing that Basin 8-1 had been managed sustainably for more than 10 years. For the 2022 Update, the focus is on documenting that the basin has continued to be operated sustainably during the five years since the 2017 Alternative was submitted and to present any new information. As such, background information, such as Basin Hydrogeology, and other sections with no new information are not repeated in the 2022 Update.

As described in the 2017 Alternative, Basin 8-1 was sub-divided into four management areas: La Habra-Brea, OCWD, South East, and Santa Ana Canyon Management Areas (Figure 1-1). The 2022 Update contains four chapters, one for each management area.

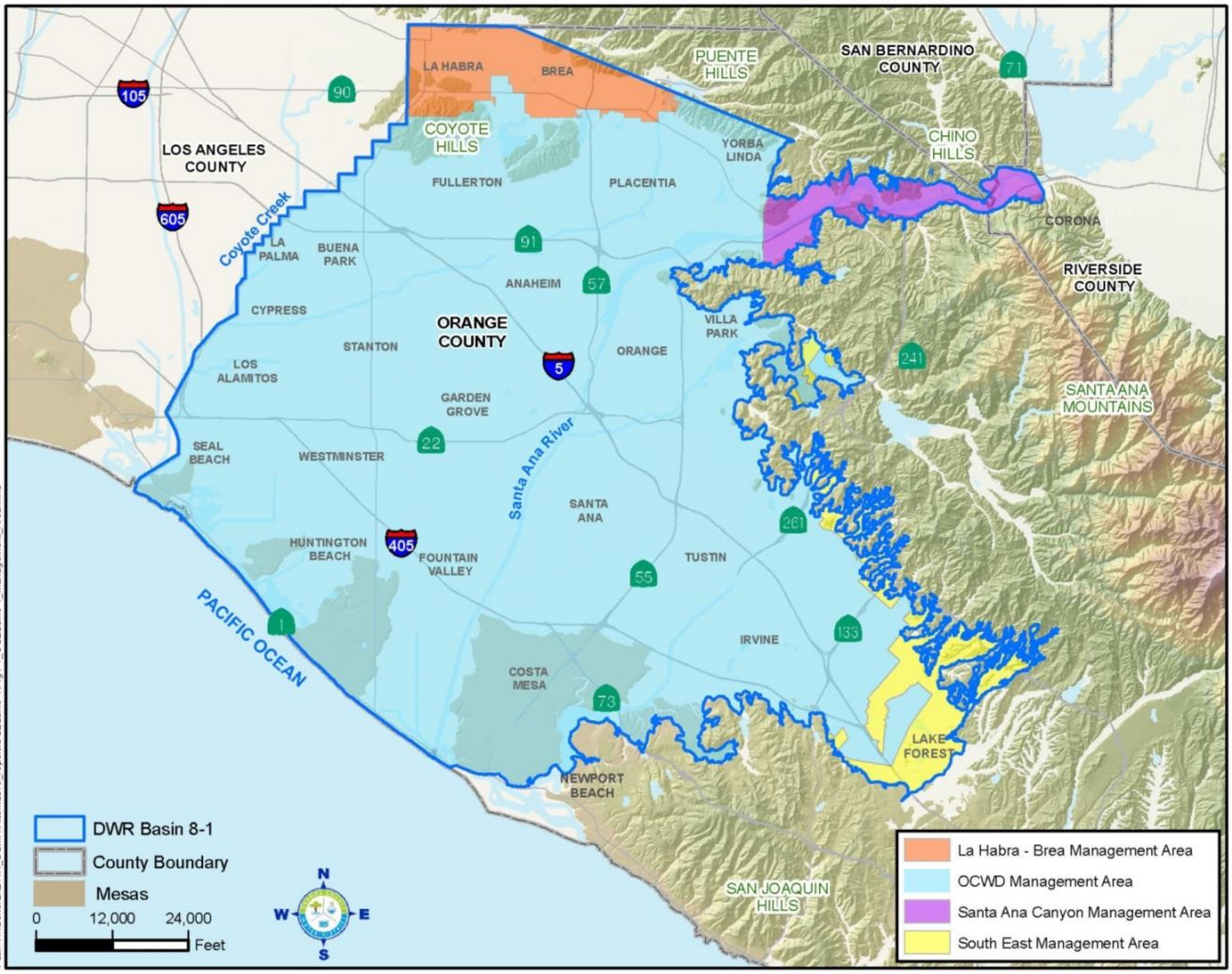


Figure 1-1: Basin 8-1 Management Area Boundaries

In its evaluation of the Basin 8-1 Alternative, DWR provided four recommendations that they encouraged “be given due consideration and suggest incorporating any resulting changes to the Alternative in future updates.” The recommendations and responses to these recommendations are in Attachment 1 and incorporated into the 2022 Update where appropriate.

ABBREVIATIONS AND ACRONYMS

afy	acre-feet per year
AWPF	Advanced Water Purification Facility
basin	Orange County groundwater basin
Basin Model	OCWD groundwater model
BEA	Basin Equity Assessment
BPP	Basin Production Percentage
CDPH	California Department of Public Health
cfs	cubic feet per second
DATS	Deep Aquifer Treatment System
DOC	dissolved organic compound
DWR	Department of Water Resources
DWSAP	Drinking Water Source Assessment and Protection
EDCs	Endocrine Disrupting Compounds
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
FY	fiscal year
GAC	granular activated carbon
GIS	geographic information system
GWRS	Groundwater Replenishment System
IAP	Independent Advisory Panel
IRWD	Irvine Ranch Water District
LACPW	Los Angeles County Public Works
maf	million acre feet
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
MF	microfiltration
MODFLOW	Computer modeling program developed by USGS
mgd	million gallons per day
mg/L	milligrams per liter
MTBE	methyl tertiary-butyl ether
MWD	Metropolitan Water District of Southern California
MWDOC	Municipal Water District of Orange County
NDMA	n-Nitrosodimethylamine
NF	nanofiltration
ng/L	nanograms per liter
NBGPP	North Basin Groundwater Protection Program
NO_2	nitrite
NO_3^-	nitrate
NPDES	National Pollution Discharge Elimination System
NWRI	National Water Research Institute

ABBREVIATIONS AND ACRONYMS

O&M	operations and maintenance
OCHCA	Orange County Health Care Agency
OCSD	Orange County Sanitation District
OC Survey	Orange County Survey
OCWD	Orange County Water District
PCE	perchloroethylene
PFAS	Per- and polyfluoroalkyl substances
PPCPs	pharmaceuticals and personal care products
Producers	Orange County groundwater producers
RA	replenishment assessment
RO	reverse osmosis
Regional Water Board	Regional Water Quality Control Board
SARI	Santa Ana River Interceptor
SARMON	Santa Ana River Monitoring Program
SARWQH	Santa Ana River Water Quality and Health
SAWPA	Santa Ana Watershed Project Authority
SBGPP	South Basin Groundwater Protection Program
SDWA	Safe Drinking Water Act
SOCs	synthetic organic chemicals
SWP	State Water Project
SWRCB	State Water Resources Control Board
TCE	trichloroethylene
TDS	total dissolved solids
TIN	total inorganic nitrogen
µg/L	micrograms per liter
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
UV	ultraviolet light
VOCs	volatile organic compounds
WACO	Water Advisory Committee of Orange County
WEI	Wildermuth Environmental Inc.
WF-21	Water Factory 21
WLAM	Waste Load Allocation Model
WRD	Water Replenishment District of Southern California
WRMS	Water Resources Management System

Basin 8-1 Alternative

La Habra-Brea Management Area

2022 UPDATE

Submitted by: City of La Habra

On behalf of: City of La Habra
City of Brea

January 1, 2022

Basin 8-1 Alternative
La Habra-Brea Management Area

2022 UPDATE

Jeffrey D. Helsley, P.E.

Stetson Engineers, Inc.
861 S. Village Oaks Drive, Suite 100
Covina, CA 91724

Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3)

January 1, 2022

Table of Contents

Section **Page**

Figure

Table

LA HABRA-BREA
MANAGEMENT AREA

SECTION 1. EXECUTIVE SUMMARY

The agencies within Basin 8-1 collaborated to prepare and submit an Alternative to a Groundwater Sustainability Plan (GSP). In accordance with Water Code §10733.6(b)(3), the Alternative presented an analysis of basin conditions that demonstrated that the Basin had operated within its sustainable yield over a period of at least 10 years. The Alternative was submitted to DWR on December 22, 2016. On July 17, 2019, DWR determined that the Alternative satisfied SGMA objectives and was therefore approved.

Approved alternatives are required to submit annual reports to DWR on April 1 of each year. Annual reports for Basin 8-1 were submitted to DWR as follows:

- Water Year 2016-17, Submitted on March 29, 2018
- Water Year 2017-18, Submitted on March 29, 2019
- Water Year 2018-19, Submitted on March 30, 2020
- Water Year 2019-20, Submitted on March 30, 2021

According to Water Code §10733.8, "At least every five years after initial submission of a plan pursuant to Section 10733.4, the department shall review any available groundwater sustainability plan or alternative submitted in accordance with Section 10733.6, and the implementation of the corresponding groundwater sustainability program for consistency with this part, including achieving the sustainability goal. The department shall issue an assessment for each basin for which a plan or alternative has been submitted in accordance with this chapter, with an emphasis on assessing progress in achieving the sustainability goal within the basin. The assessment may include recommended corrective actions to address any deficiencies identified by the department."

The Basin 8-1 Alternative, submitted on December 22, 2016, will be referenced to as the 2017 Alternative. This document represents the first five-year update, herein referenced as the 2022 Update, which is due January 1, 2022. The 2017 Alternative was a comprehensive document showing that Basin 8-1 had been managed sustainably for more than 10 years. For the 2022 Update, the focus is on documenting that the basin has been continued to be sustainably management during the five years since the 2017 Alternative was submitted and to present any new information from the last five years. As such, the 2017 Alternative is considered a key reference document with background information that is not duplicated in the 2022 Update.

The La Habra-Brea Management Area overlies the extents of the La Habra Groundwater Basin, referenced herein. Figure 1-1 shows the extent of the La Habra Groundwater Basin and the cities (La Habra and Brea) with jurisdiction in the La Habra-Brea Management Area.

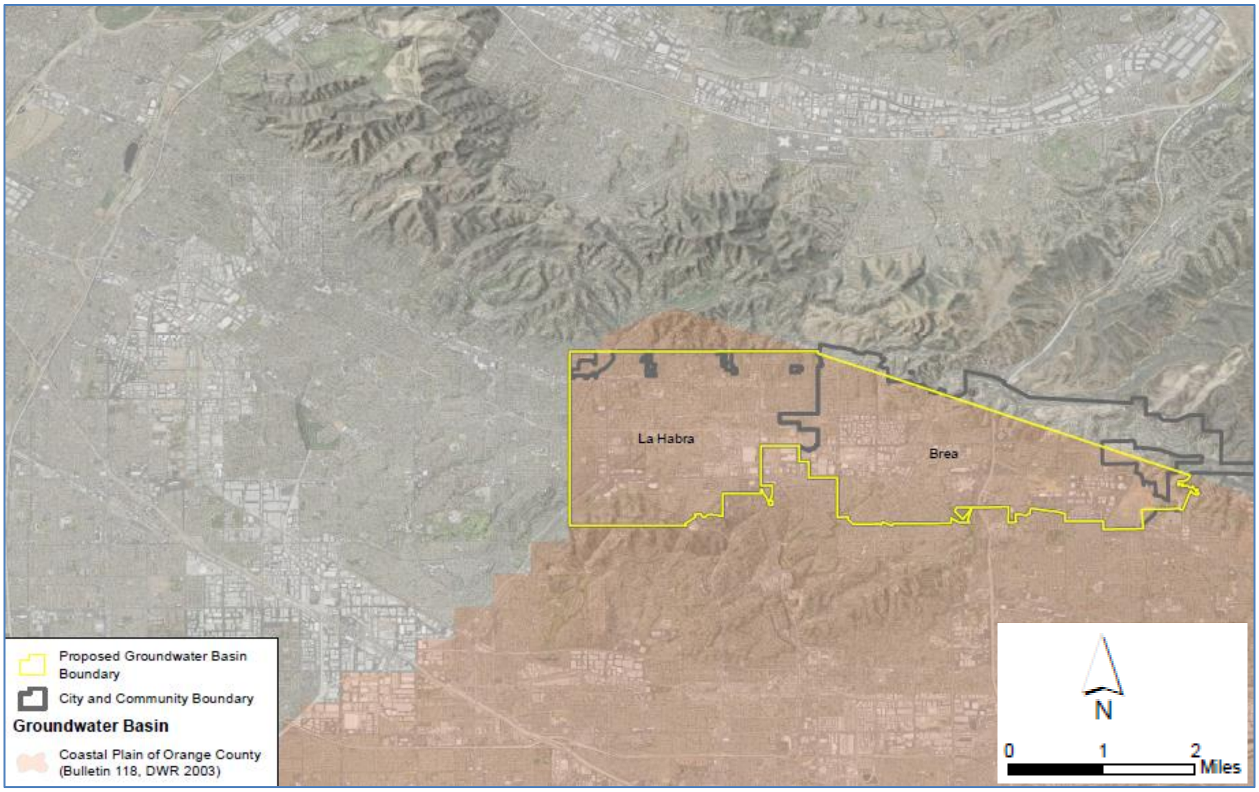


Figure 1-1. La Habra Groundwater Basin.

Groundwater resources protection is considered a critical component for safeguarding the long-term sustainability of the La Habra Groundwater Basin. The La Habra GSA has continued to sustainably manage groundwater resources within the La Habra Groundwater Basin. Groundwater production over the past five years has been within the safe yield of the basin. Accordingly, no undesirable effects have been observed within the La Habra-Brea Management Area.

As the City of La Habra (or City) currently depends on local groundwater to meet approximately 40 percent of its water consumption, preserving the sustainability of the La Habra Groundwater Basin is essential for the well-being of the City. Currently (and historically), the City of La Habra manages (and has managed) the La Habra Groundwater Basin through management plans and programs for groundwater levels, basin storage, and water quality.

SECTION 2. AGENCY INFORMATION

2.1 HISTORY OF AGENCIES IN LA HABRA GROUNDWATER BASIN

Historically, the Cities of La Habra and Brea have managed the groundwater resources in the La Habra Groundwater Basin. The history of the agencies can be found in the 2017 Alternative.

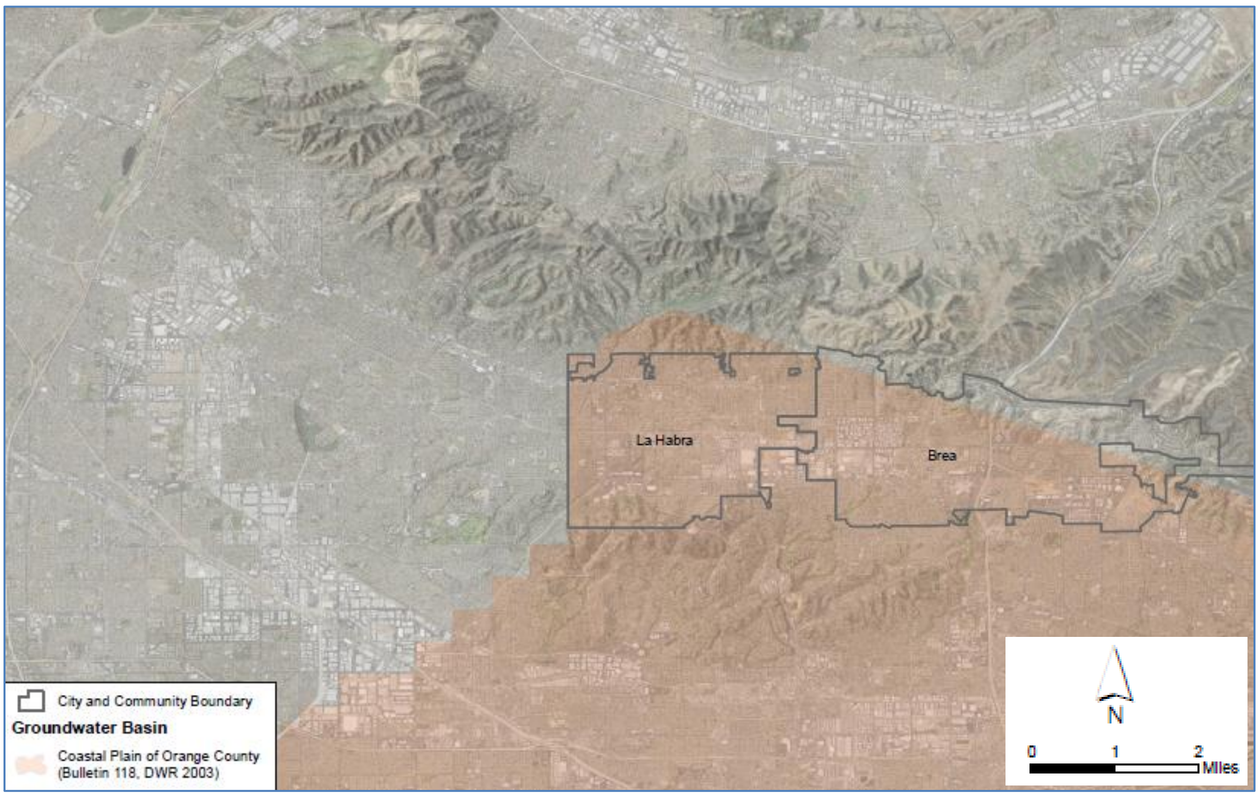


Figure 2-1: Cities of La Habra and Brea within Basin 8-1.

2.2 GOVERNANCE AND MANAGEMENT STRUCTURE

See the 2017 Alternative for a discussion on governance and management structure.

2.3 LEGAL AUTHORITY

See the 2017 Alternative for a discussion on legal authority.

2.4 BUDGET

See the 2017 Alternative for a discussion on the budget.

SECTION 3. MANAGEMENT AREA DESCRIPTION

3.1 LA HABRA GROUNDWATER BASIN SERVICE AREA

The La Habra-Brea Management Area refers to the northwestern portion of Basin 8-1, as defined by DWR Bulletin 118, overlying the La Habra Groundwater Basin. This management area is outside of the jurisdiction of OCWD. As discussed in Section 2.2, the City of La Habra adopted a resolution establishing it as a GSA, under a memorandum of agreement with the City of Brea, for management of the La Habra Groundwater Basin underlying the two cities. The City adopted a second resolution to establish the La Habra Basin as a separate basin from Basin 8-1. OCWD adopted a resolution to support the City's establishment of the La Habra Basin.

3.1.1 Jurisdictional Boundaries

The historical La Habra Groundwater Basin as described in DWR Bulletin 45 (1934) and Bulletin 53 (1947) is located in both Los Angeles (western basin) and Orange Counties (eastern basin) (see Figure 3-1). The majority of the historical La Habra Basin located in Los Angeles County is within Basin 4-11, the Coastal Plain of Los Angeles, as depicted in DWR Bulletin 118 (2003 update); the entirety of the La Habra Basin located in Los Angeles County is within the area subject to the terms of the Central Basin Adjudication. The majority of the historical La Habra Basin located in Orange County is within Basin 8-1, the Coastal Plain of Orange County as depicted in DWR Bulletin 118. Only a small portion of the historical La Habra Basin in Orange County is within the boundaries of the Orange County Water District.

The Cities of La Habra and Brea overlie a portion of the La Habra Groundwater Basin that is not within the area subject to the terms of the Central Basin Adjudication, nor within the boundaries of the Orange County Water District. The La Habra Groundwater Basin, referred to herein, includes all of the City of La Habra and the portion of the City of Brea within Basin 8-1 but not within the jurisdiction of Orange County Water District, overlying the historical La Habra Groundwater Basin (see Figure 3-2).

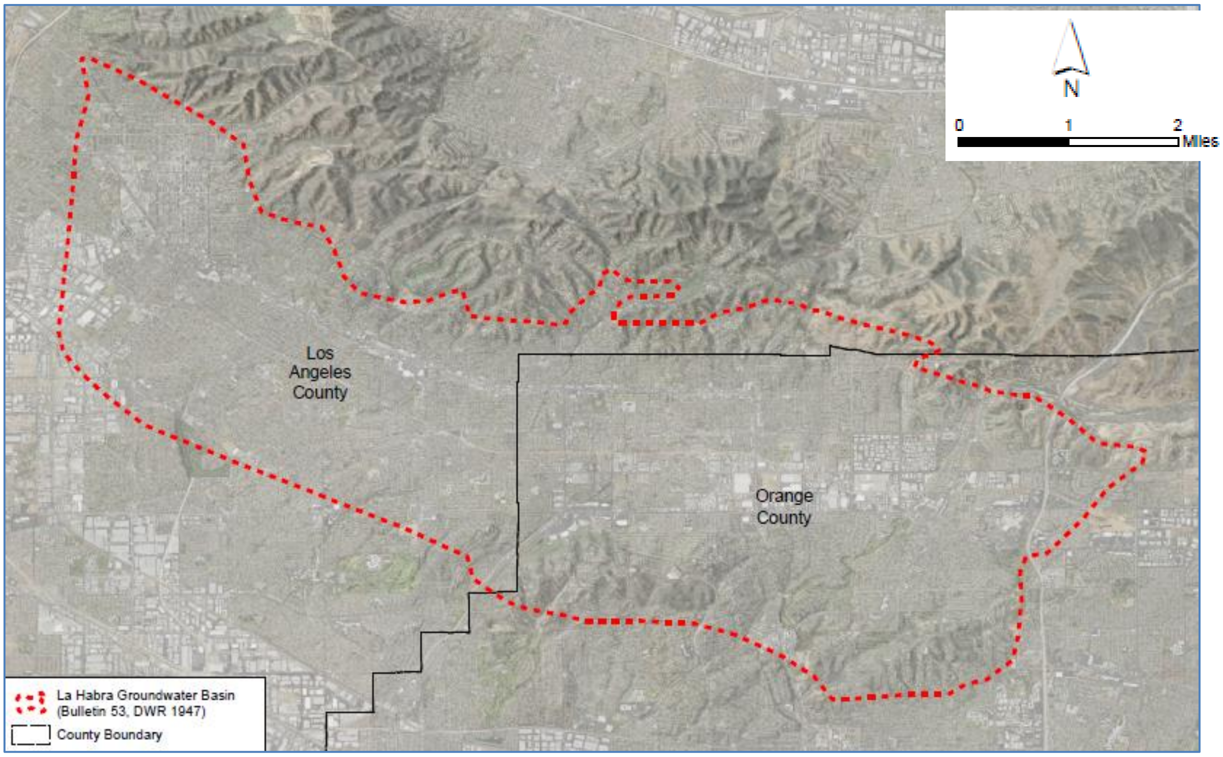


Figure 3-1: Historical La Habra Groundwater Basin (DWR, 1934. DWR, 1937).

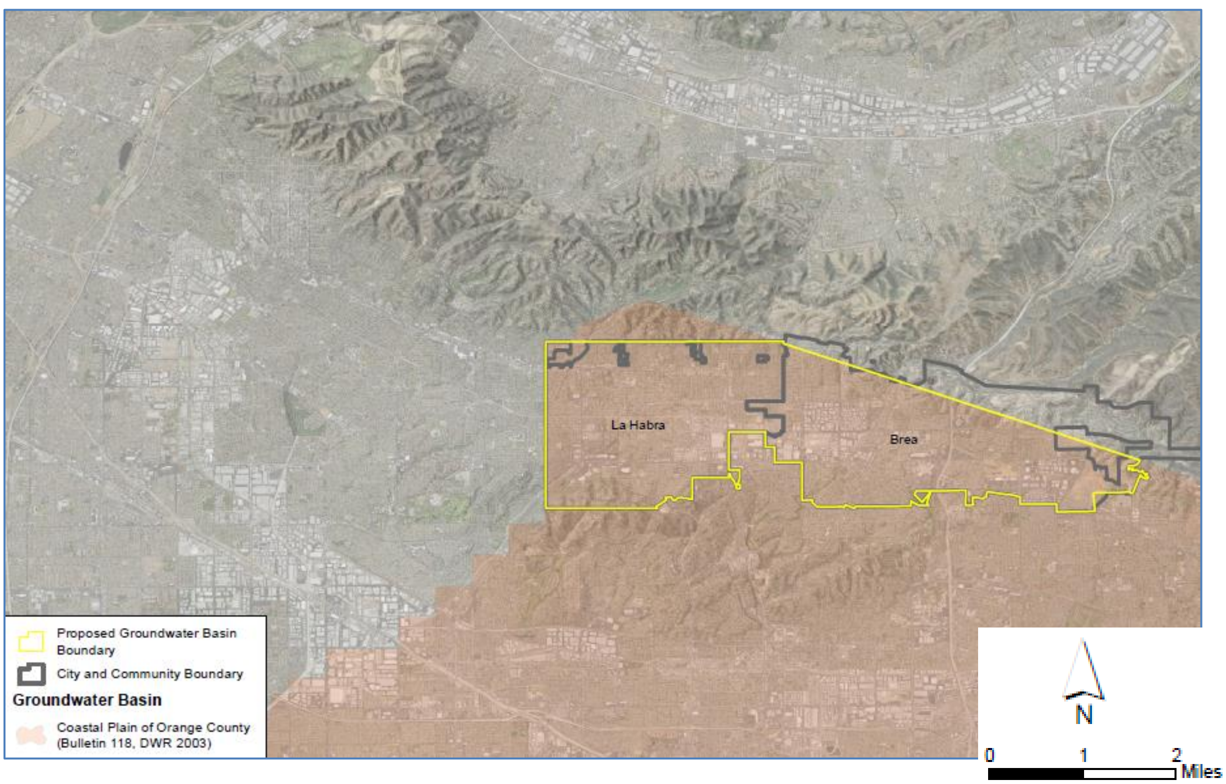


Figure 3-2. La Habra Groundwater Basin.

3.1.2 Existing Land Use Designations

The major land use within the City of La Habra is low-density residential with pockets of medium-density residential areas. Portions of La Habra consist of commercial and light industrial land uses. Likewise, land use within the City of Brea is primarily residential with sections of commercial and industrial facilities.

3.2 GROUNDWATER CONDITIONS

The geologic structure of the La Habra Groundwater Basin is dominated by the La Habra Syncline, a northwest trending, U-shaped down-fold. The syncline is deepest in the Brea area and becomes increasingly shallower to the west and is bounded by the Whittier Fault within the Puente Hills to the north and the Coyote Hills to the south (Montgomery, 1977). The La Habra Syncline produces the La Habra Valley, a naturally-occurring valley, where significant amounts of groundwater have accumulated over the past 150,000 years (Malcolm Pirnie, 2011a).

3.2.1 Groundwater Elevation

Groundwater within the La Habra Groundwater Basin generally flows from the Puente Hills in a south or southwesterly direction. Subsurface flow out of the basin occurs near Coyote and La Mirada Creeks into the Coastal Plain of Los Angeles and at the gap between the East and West Coyote Hills into the Coastal Plain of Orange County (Stetson, 2014).

A groundwater level hydrograph for a well completed in the Alluvium shows water levels declining to their lowest level in the 1950s, and recovering during the 1970s. More recent data from a nearby well shows a leveling off of water levels through the 1990s. Two other wells completed in the alluvium also show relatively flat water levels from the 1970s through the 1990s (Stetson, 2014).

Wells completed in the San Pedro Formation show rising groundwater levels. The lowest groundwater levels in this aquifer were observed during the 1930s and 1940s, with water levels recovering about 60 feet through 1972. This corresponds to DWR Bulletin No. 53 (1947) stating that the La Habra Groundwater Basin was in overdraft. More recent data show an overall rising trend of 50 to 60 feet in groundwater levels from 1970 through 2007 and a slight decline during more recent years. There were no water levels available for the La Habra Formation. See Section 3.2.3 for more information.

3.2.2 Regional Pumping Patterns

The transmissivity of a groundwater basin is the rate at which groundwater flows horizontally through the aquifer. Based on Montgomery (1977), the following are the estimated transmissivities in gallons per day per foot (gpd/ft) for each of the water-bearing zones of the La Habra Groundwater Basin.

- Alluvium: 200 gpd/ft to 10,000 gpd/ft
- La Habra Formation: 25,000 gpd/ft
- San Pedro Formation: 60,000 gpd/ft

Historically, all three water-bearing zones of the La Habra Groundwater Basin were developed for domestic and irrigation purposes, with most wells drilled between 1916 and 1940. The City of La Habra originally drilled three production wells in the deeper aquifers. Groundwater production in these wells ceased in 1968 (Montgomery, 1977). Based on Montgomery (1979), the Alluvium and La Habra Formations are not considered to have groundwater development potential for the following reasons: the Alluvium is limited in thickness and extent, has low permeability characteristics, and is of poor water quality while the La Habra Formation's permeable sand and gravel zones are thin and discontinuous. Groundwater production in the San Pedro Formation continues to this day. Based on Montgomery (1977), the following are expected well yields for each of the water-bearing zones of the La Habra Groundwater Basin.

- Alluvium: 200 gpm
- La Habra Formation: 100 gpm to 400 gpm
- San Pedro Formation: 300 gpm to 800 gpm

The City of La Habra pumps local groundwater from the La Habra Groundwater Basin from three production wells: the Idaho Street Well, the La Bonita Well, and the Portola Well. The Idaho Street Well has a capacity of 2,000 gpm but is regulated at 1,500 gpm. Water pumped from the Idaho Street Well requires treatment before entering the distribution system. This treatment consists of chlorination, air-stripping to remove ammonia and hydrogen sulfide, and the addition of sodium hexametaphosphate to sequester iron and manganese (Malcolm Pirnie, 2011a). The capacities of the La Bonita Well and the Portola Well are 850 gpm and 1,200 gpm, respectively.

The City of Brea owns and operates one non-potable groundwater well used for irrigation at the Brea Creek Golf Course (Brea, Water Master Plan Update, November 2009). The maximum capacity of this well is 450 gpm.

Table 3-1: Groundwater Production in La Habra Groundwater Basin. Acre-Feet per Year.

Year	City of La Habra	City of Brea[1]	Total
2011	1,849	76	1,925
2012	1,865	86	1,951
2013	3,073	82	3,155
2014	4,094	121	4,215
2015	3,630	50	3,680
2016	3,547	86	3,633

Year	City of La Habra	City of Brea[1]	Total
2017	3,200	96	3,295
2018	2,653	111	2,763
2019	2,158	88	2,245
2020	2,493	108	2,600
AVERAGE	2,856	90	2,946

1 Does not include small additional pumping within the City of Brea by a privately owned groundwater production well.

Sources: 2015 Urban Water Management Plans (Arcadis, 2016). City of La Habra. City of Brea.

Table 3-2: La Habra Groundwater Basin Wells

Well Owner	Well Name	Well Use	Well Depth (ft)	Well Capacity (gpm)
City of La Habra	Idaho Street	Potable	970	2,000
City of La Habra	La Bonita	Potable	890	850
City of La Habra	Portola	Potable	1,010	1,200
City of Brea	Irrigation Well	Irrigation	Unknown	450
Memory Garden Memorial Park	--	Irrigation	Unknown	Unknown

3.2.3 Long-Term Groundwater Elevation Hydrograph

Groundwater level data were compiled from DWR's Water Data Library for eight wells with sufficient data to analyze trends within the La Habra Groundwater Basin. The DWR groundwater data were available for 1970 through 2010. Montgomery's hydrographs from 1922 through 1975 are also included to capture earlier groundwater trends when there was more agricultural groundwater pumping for crop irrigation. Five of the ten monitoring wells had accompanying well logs to determine which aquifer was represented by the data. Figure 3-3 shows the location of these wells and the inferred direction of groundwater flow based on the groundwater level data (Stetson, 2014).

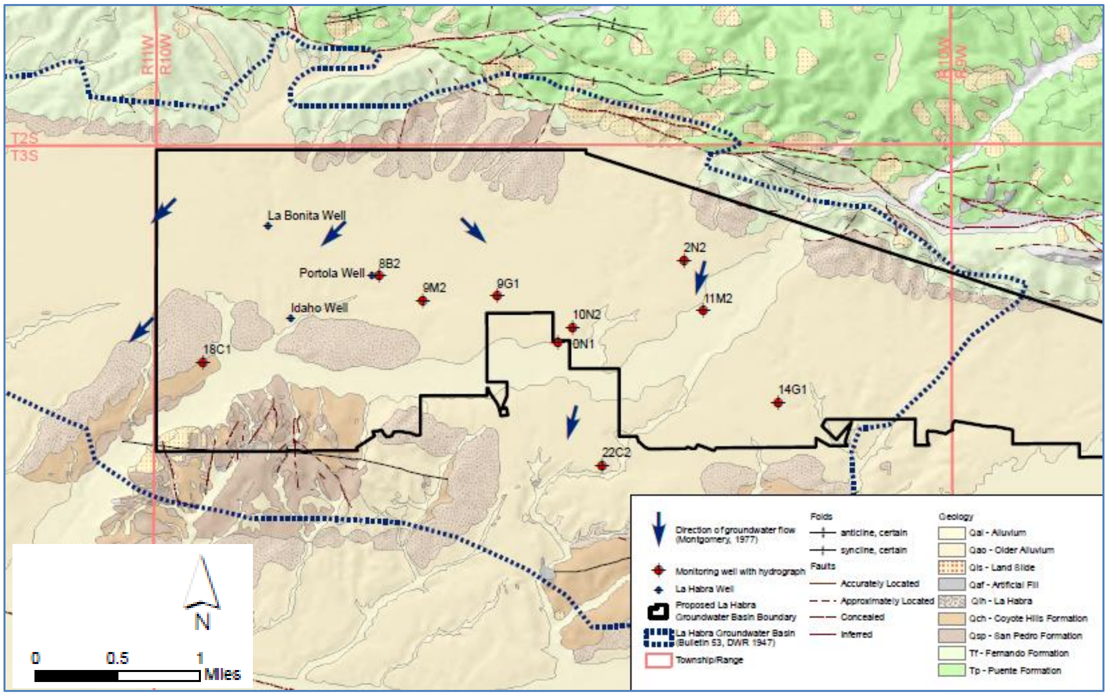


Figure 3-3: Groundwater Elevation Monitoring Wells.

The groundwater level hydrograph for a well completed in the alluvial aquifer (Figure 3-4; T3/R10-10N1) shows water levels declining to their lowest level in the 1950s, and recovering during the 1970s. More recent data from a nearby well (Figure 3-5; T3/R10-10N2) shows a leveling off of water levels through the 1990s. Two other wells completed in the alluvium (T3/R10-2N2 and -9M2) also show relatively flat water levels from the 1970s through the 1990s, (Stetson, 2014).

Wells completed in the San Pedro aquifer show rising groundwater levels. The lowest groundwater levels in this aquifer were observed during the 1930s and 1940s. This corresponds to DWR Bulletin No. 53 (1947) stating that the La Habra Groundwater Basin was in overdraft. Groundwater levels recovered about 60 feet from the 1940s through 1972 at well T3/R10-14G1. More recent data from well T3/R10-18C1 show an overall rising trend of 50 to 60 feet in groundwater levels from 1970 through 2007 and a slight decline during the last three years of data. There were no water levels available for the La Habra aquifer (Stetson, 2014).

Recent data showing the depth to groundwater are presented in Figure 3-6. Wells T3/R10-9G1 and -8B2 show a similar pattern of rising groundwater levels through 2007 as seen at well T3/R10-18C1 completed in the San Pedro aquifer. The alluvial aquifer well data present a relatively flat groundwater level from 10 to 40 feet below land surface. The depth to groundwater graph shows groundwater levels in the San Pedro Aquifer recovering to levels observed in the alluvial aquifer (Stetson, 2014).

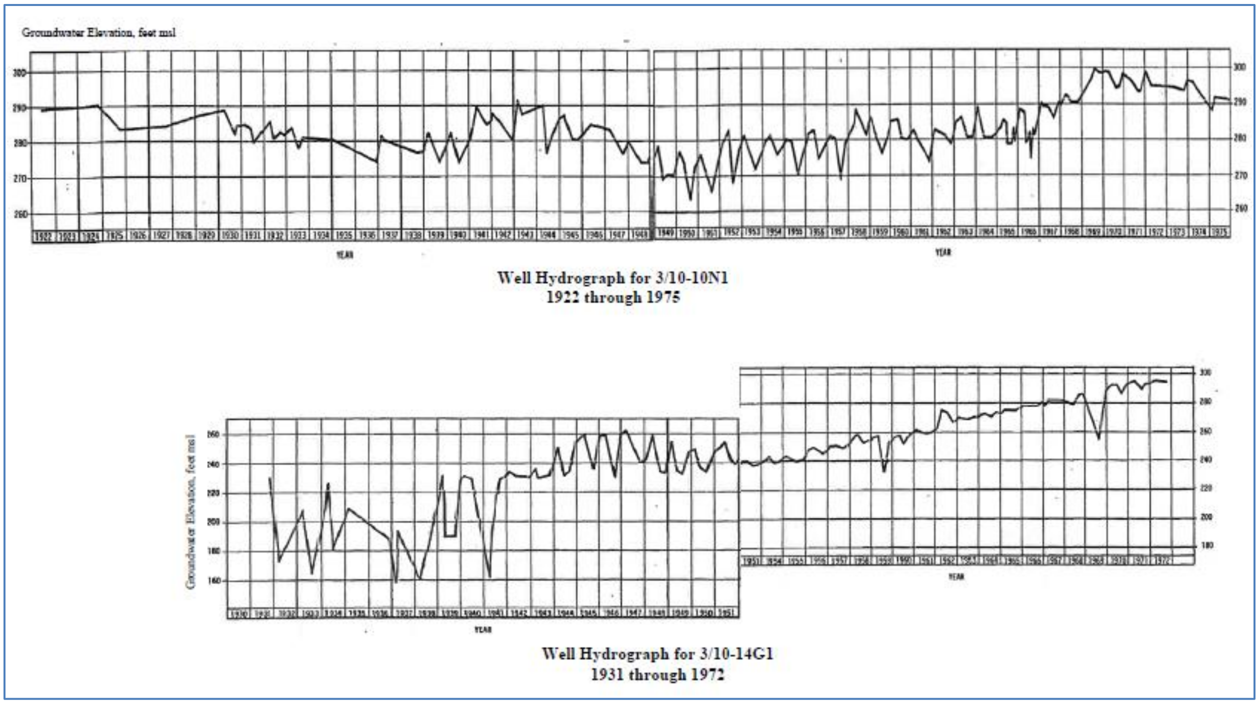


Figure 3-4: Early Well Hydrograph. 1922 Through 1975.

Source: Montgomery, 1977.

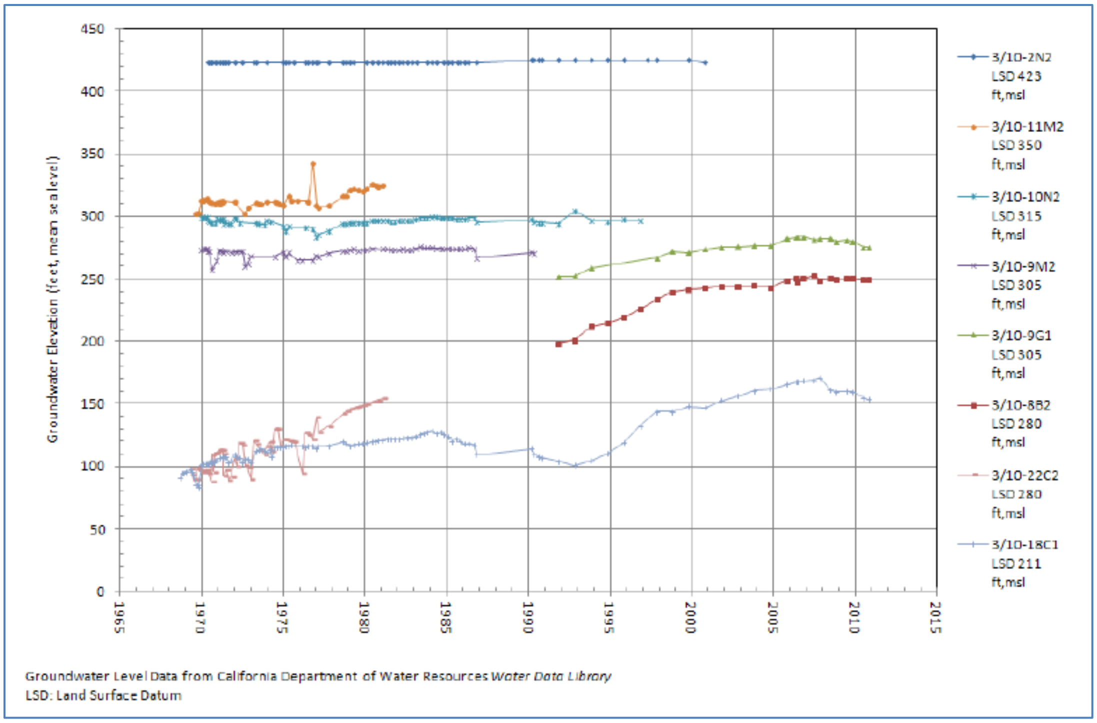


Figure 3-5: Groundwater Level Hydrographs.

Source: Stetson, 2014.

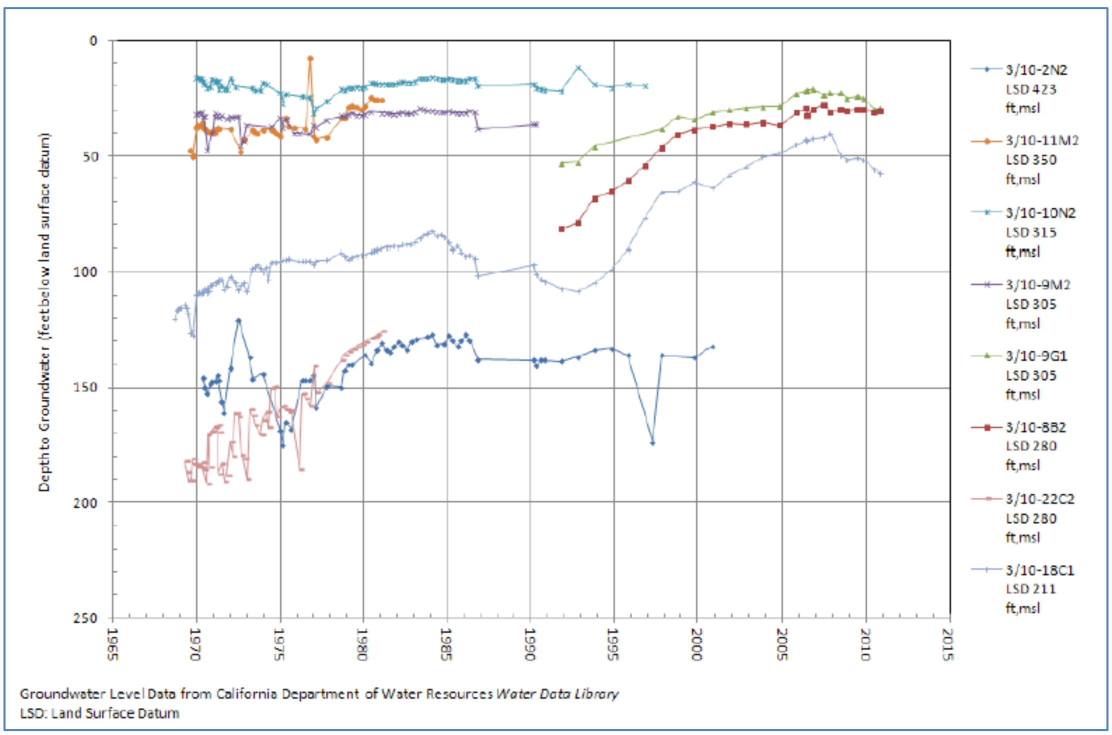


Figure 3-6: Depth to Groundwater.

Source: Stetson, 2014.

The hydrograph for the monitoring well with both recent data and a long period of record is shown in the figure below. Recent groundwater level data suggest that groundwater levels are stable and the basin is in balance.

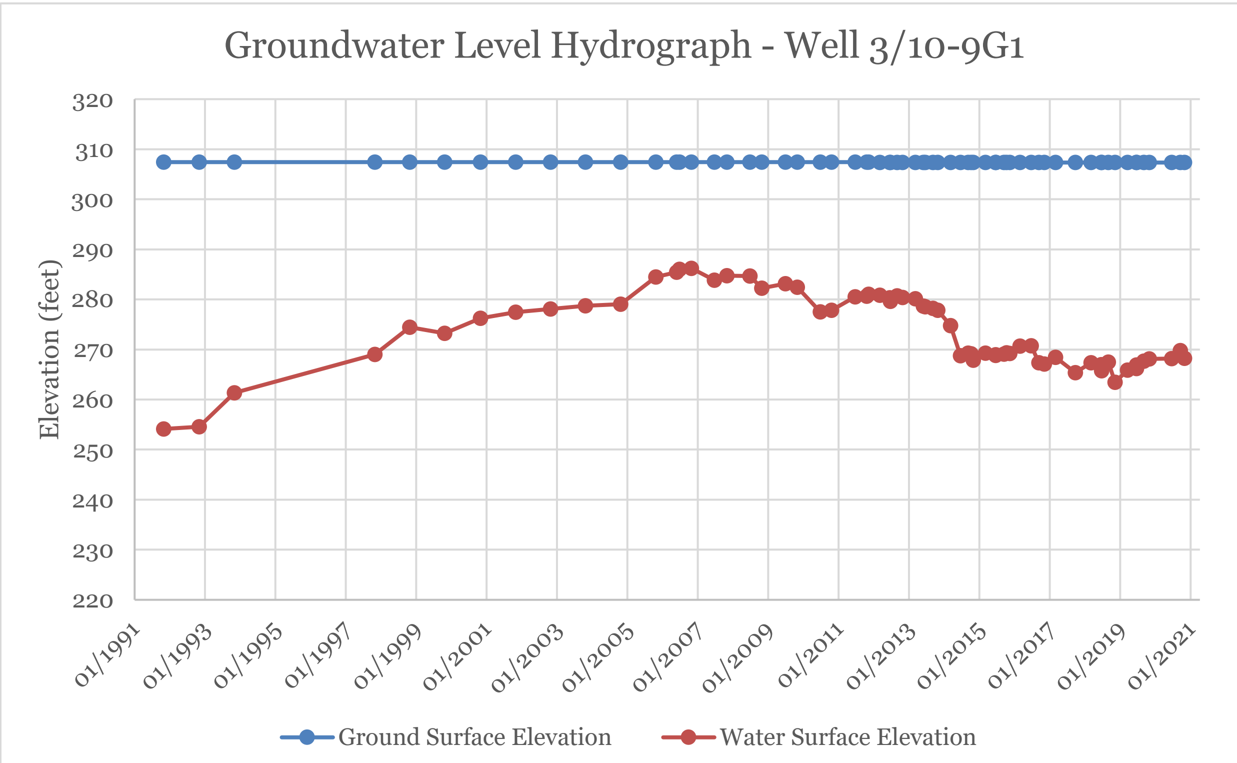


Figure 3-7: Recent Groundwater Level Hydrograph.

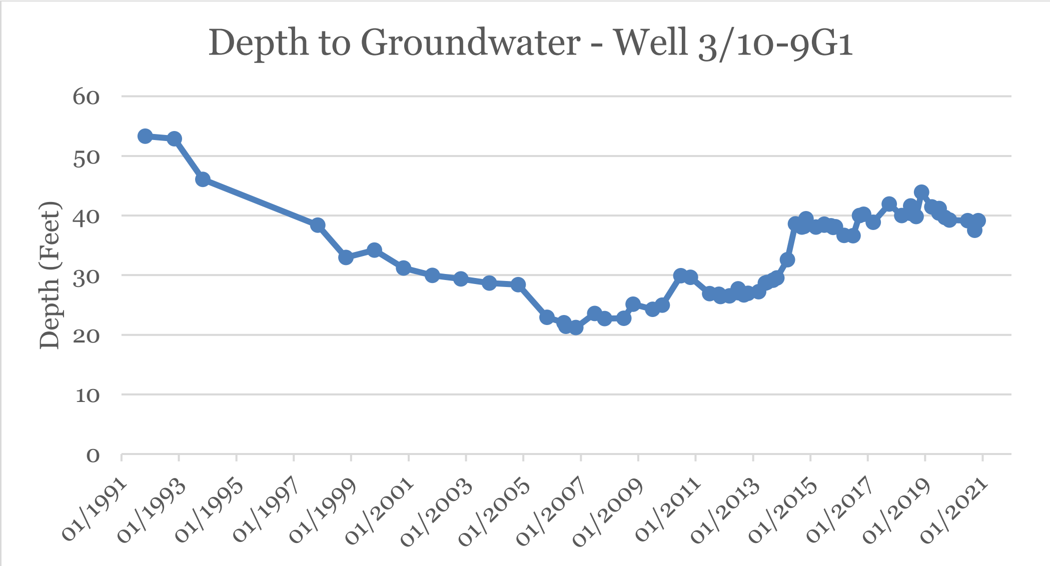


Figure 3-8: Recent Depth to Groundwater.

3.2.4 Groundwater Storage Data

According to the DWR Bulletin 45 (1934), the storage capacity of the historical La Habra Groundwater Basin is approximately 153,000 acre-feet. Approximately 57 percent of the historical La Habra Groundwater Basin is in the eastern portion of the basin which is now designated within Basin 8-1. The Cities of La Habra and Brea overlie approximately 60 percent of the eastern portion of the historical La Habra Groundwater Basin (Stetson, 2014). Accordingly, the storage capacity of the current La Habra Groundwater Basin is approximately 55,000 acre-feet.

3.2.5 Groundwater Quality Conditions

Previous investigations of water quality within the La Habra Basin determined that the quality is extremely variable. It was shown that shallow regions within the central portion of the basin as well as areas recharged by surface water along the basin boundary are of a bicarbonate and chloride character. Sulfate concentration increased with depth in the La Habra and San Pedro water-bearing zones. The historical data also shows that total dissolved solids (TDS) concentrations have remained relatively stable (Montgomery, 1977). The most recent 10-year average TDS concentrations in the La Bonita, Portola, and Idaho wells are 1,052 mg/l, 750 mg/l, and 802 mg/l, respectively.

Overall, groundwater from the San Pedro Aquifer is considered to be of fair to good quality (Montgomery, 1979). However, groundwater produced from the La Habra Groundwater Basin is not currently used directly for potable purposes due to water quality concerns that predate SGMA legislation. Water from the La Bonita and Portola Wells is chlorinated and then blended with water purchased from the California Domestic Water Company in a 250,000-gallon forebay to reduce the concentration of minerals prior to entering the City of La Habra's distribution system (La Habra, 2014).

Groundwater production wells in Brea are strictly used for irrigation purposes as the groundwater beneath the city has poor water quality and would require extensive treatment and blending with higher quality water to meet public health standards (Malcolm Pirnie, 2011).

Table 3-3 below shows historical water quality for select constituents. Recent State database water quality results indicate reported exceedances in raw groundwater for nitrate, perchlorate, volatile organic compounds (VOCs), and radioactivity, with the most recent violation occurring in 2014 (Safe Drinking Water Information System).

Table 3-3: Historical Constituent Concentrations (1927-1977)

Constituent	Minimum	Maximum	Average
Specific Conductance	255	2,235	1,324
Total Dissolved Solids	269	1,696	943
Sulfate	0	672	174
Chloride	18	460	161
Nitrate	0	185	44
Fluoride	0	1.6	0.44
Total Hardness	75	931	489

Source: Montgomery, 1977.

3.2.6 Land Subsidence

Based on Orange County Water District's 2015 Update to its Groundwater Management Plan, there is no evidence that the observed minimal land surface changes in portions of Orange County has caused, or are likely to cause, any structural damage within the area (OCWD, 2015). As long as groundwater elevations and storage within the basin are maintained within their historical operating ranges, the potential for problematic land subsidence is reduced.

Additionally, the United States Geological Survey (USGS) does not show the La Habra Groundwater Basin as an area where there have been historical or current subsidence recorded due to either groundwater pumping, loss of peat, or oil extraction (USGS, 2021). There is also no evidence of land subsidence within the La Habra Groundwater Basin according to the Department of Water Resources' SGMA Data Viewer. Vertical displacement estimates are derived from Interferometric Synthetic Aperture Radar (InSAR) data and show only a minimal positive vertical displacement within the area (DWR, 2021a). Accordingly, there are no known land subsidence undesirable results caused by depletion of groundwater resources.

3.2.7 Groundwater and Surface Water Interactions and Groundwater Dependent Ecosystems

The La Habra Groundwater Basin lies entirely within the Coyote Creek Watershed (see Figure 3-7). The Coyote Creek Watershed drains approximately 165 square miles of densely populated areas of residential, commercial, and industrial areas as well as areas of open space (Atkins, 2012). Coyote Creek is a tributary to the San Gabriel River. Major Creeks within the watershed are: Coyote Creek, Brea Creek, Fullerton Creek, Carbon Creek, Moody Creek, and Los Alamitos Channel, some of which are concrete lined.

Coyote Creek, Brea Creek, and La Mirada Creek (a non-major creek) all flow into and drain out of the La Habra Valley. The total drainage area of these three creeks within the valley is approximately 12,950 acres (Stetson, 2013). Coyote Creek and La Mirada Creek are surface waters flowing through the boundaries of the City of La Habra. Montgomery (1977) determined that about 30% of the runoff available in an average rainfall year percolates to the aquifers underlying the La Habra Valley.

The San Pedro Formation is naturally recharged directly through aquifer outcrops (exposed formation sediments) in the Los Coyote Hills (south of the intersection of Beach Boulevard and Imperial Highway) and in the Puente Hills (along the foothills north of Whittier Boulevard) [Montgomery, 1977]. The San Pedro Formation could also be indirectly recharged through the uplifted and exposed San Pedro beds that lie just below a thin layer of alluvium along the Coyote Creek valley (Montgomery, 1977). Within the La Habra Valley, an estimated 15% of precipitation contributes to aquifer recharge as direct percolation of precipitation. The 40-year average rainfall (14 inches) results in a water supply from precipitation within the 10,160-acre drainage area of approximately 1,780 AFY (Stetson, 2013).

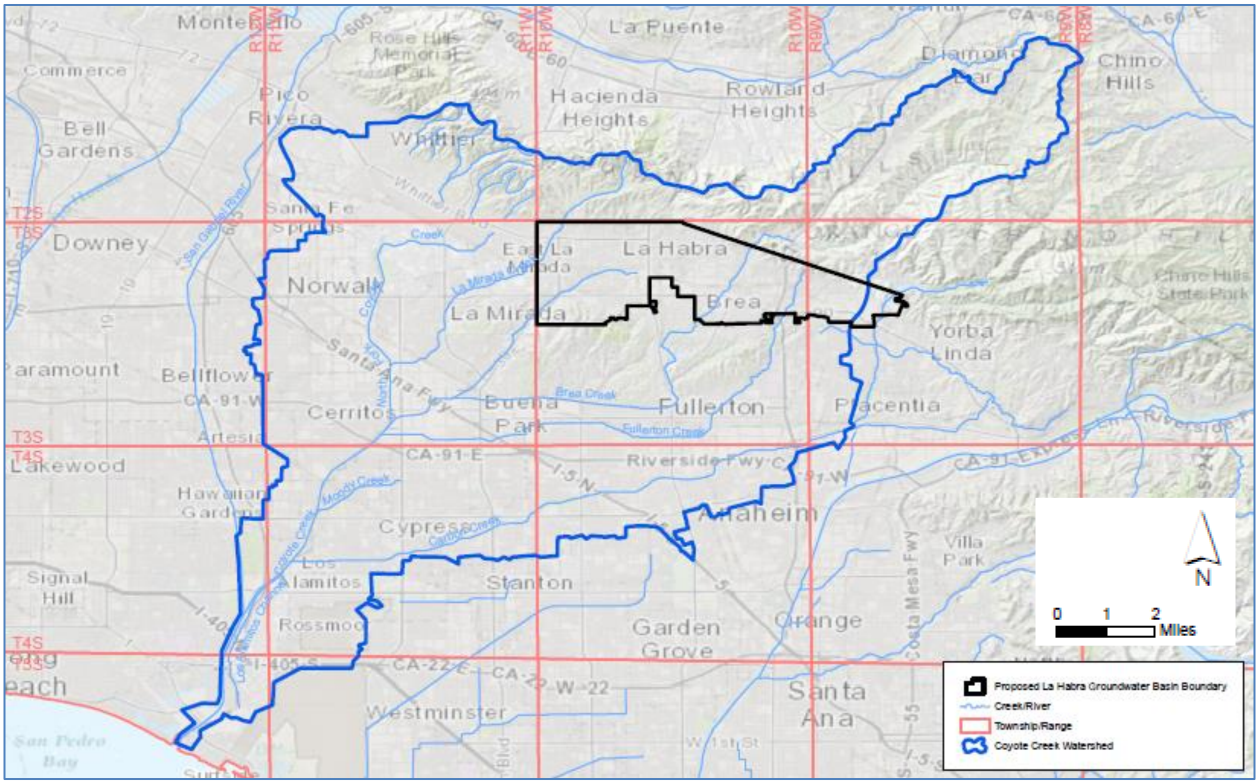


Figure 3-9: Coyote Creek Watershed.

A review of available references was conducted to identify any potential presence of Groundwater Dependent Ecosystems (GDEs) in the La Habra-Brea Management Area and to review potential impacts groundwater extraction may have on the ecosystems. DWR's Natural Communities (NC) dataset includes two habitat classes which are associated with groundwater: wetland features and vegetation types. Small areas of GDEs such as Palustrine, scrub-shrub, seasonally flooded wetlands, have been found on the western portion of the La Habra Groundwater Basin. Groundwater dependent vegetation, such as Coast Live Oak, Willow, and Riparian Mixed Hardwood have been found in small areas within the central and eastern portions of the La Habra Groundwater Basin (DWR, 2021b). As shown in Figure 3-10 below, groundwater extraction does not occur near groundwater dependent vegetation or wetlands. Likewise, potential groundwater recharge locations are not located near groundwater dependent vegetation; therefore, any future recharge project would not alter the current natural ecosystem. La Habra's groundwater production wells extract groundwater from the San Pedro formation, the deepest aquifer unit that forms the La Habra Groundwater basin, which is significantly deeper than the than the perched alluvial (Yerkes, 1972). The areas of vegetation identified as groundwater dependent ecosystems are along the base of the surrounding hills at the limits of the basin and are also supported by surface water runoff and rainfall. Cross sections in the region indicate shallow groundwater in those areas.

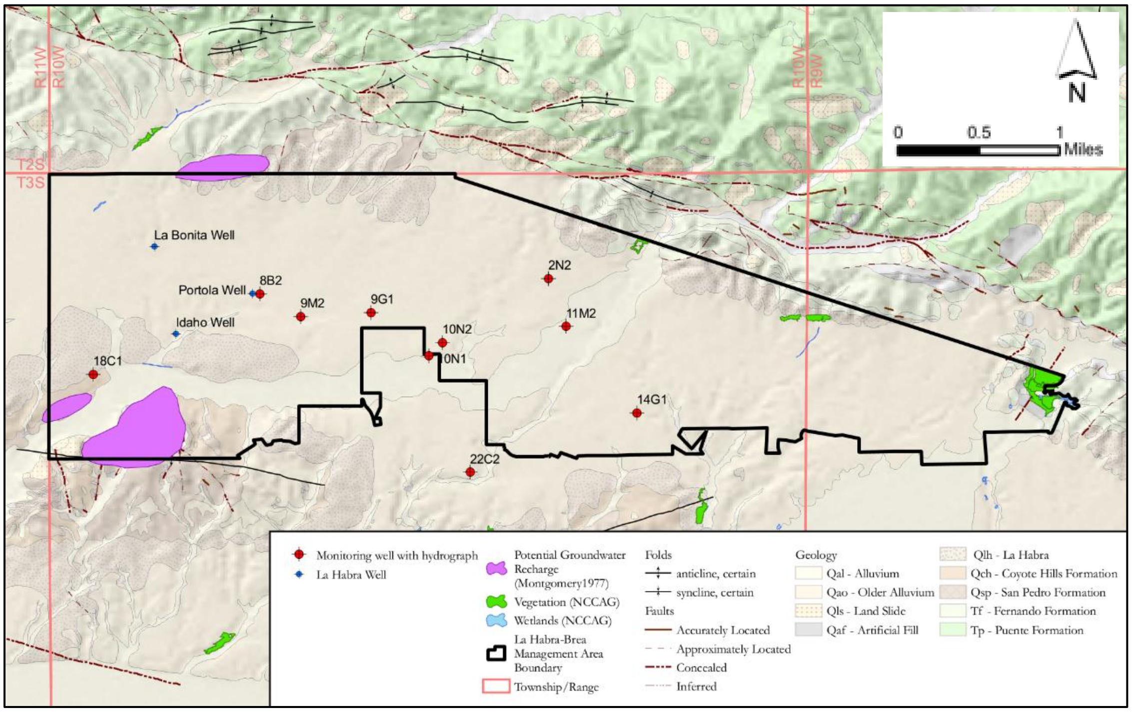


Figure 3-10: Groundwater Dependent Ecosystems.

SECTION 4. WATER BUDGET

4.1 BUDGET COMPONENTS

The components of the water budget generally include recharge from precipitation and runoff, recharge from subsurface inflow, subsurface outflow, and groundwater production.

Recharge components of the water budget consist of mountain front and streamflow recharge and deep percolation of precipitation. Various hydrogeologic studies show that annual natural recharge ranges from 3,300 AFY to 3,900 AFY. No measurable subsurface inflow occurs into the La Habra- Brea Management Area. Additionally, no artificial recharge occurs in the La Habra-Brea Management Area at this time.

Outflow components of the water budget consist of groundwater production and subsurface outflow. Groundwater production in La Habra-Brea Management Area has ranged from approximately 2,000 AFY to 4,200 AFY in recent years (See Table 3-1). Subsurface flow out of the groundwater basin occurs westerly near Coyote and La Mirada Creeks into the Coastal Plain of Los Angeles (Central Basin), and southerly at the gap between the East and West Coyote Hills into the main Coastal Plain of Orange County (Stetson, 2014). Subsurface outflow ranges from 2,200 to 5,500 AFY (OCWD 2015).

4.2 CHANGES IN GROUNDWATER STORAGE

Based on water level measurements the water budget appears to be in balance over the past ten years. Changes in groundwater storage are monitored through the monitoring of groundwater elevations which have shown rising trends since the 1970s. Available groundwater level data indicate groundwater levels have generally increased or remained stable over the last five years. See Section 3.2.3. These conditions indicate groundwater storage changes in the La Habra Groundwater Basin are within an acceptable range and undesirable results are not present.

4.3 WATER YEAR TYPE

The estimated water budget is based on normal/average water year type. However, historical hydrographs indicate stable or rising groundwater levels, even during dry and prolonged drought years, indicating that the water year type has little impact on the water budget.

4.4 ESTIMATE OF SUSTAINABLE YIELD

Groundwater production within the La Habra-Brea Management Area is managed by the establishment of a safe yield so that the groundwater levels and storage capacity in the La Habra Groundwater Basin will be maintained.

In 1977, Montgomery Engineers completed a groundwater study for the City of La Habra and estimated the “probable long-term groundwater basin yield” of the La Habra Groundwater Basin based on the natural recharge and natural discharge methods. Stetson conducted a re-evaluation of Montgomery’s 1977 safe yield analysis in 2013 to re-determine the estimated safe yield based on the natural recharge method. The average of these two methods (natural discharge and natural recharge) results in an approximate safe yield of 4,500 AFY.

The City of La Habra has been producing groundwater since the late 1990s and monitoring static and pumping groundwater elevations since 2008. Previous investigations into groundwater levels and the safe yield have been used to manage the La Habra Groundwater Basin for over 10 years.

4.5 ESTIMATED WATER BUDGET

The estimated water budget is shown in Table 4-1 below. There is currently insufficient data to determine precise estimates of the water budget components; accordingly, the water budget is presented as ranges.

Table 4-1: Estimated Water Budget

Budget Component	Estimated Range [1]
Inflows	
Precipitation	1,600 - 1,800
Mountain Front Recharge	1,700 - 2,100
Incidental/Other Recharge	Unknown
Outflows	
Subsurface Outflow	2,200 – 5,500
Groundwater Extraction	2,000 – 4,000
BALANCE[1]	**0**

1 This water budget is based on previous historically estimated inflows and outflows in the La Habra Groundwater Basin. Available water level data show rising or stable groundwater levels indicating the Basin is in balance. Therefore, the historical estimates may not account for all of the recharge occurring in the Basin.

Sources: Montgomery, 1977. OCWD, 2015. Stetson, 2013.

SECTION 5. WATER RESOURCE MONITORING PROGRAMS

5.1 OVERVIEW

The La Habra Groundwater Basin is currently monitored for groundwater elevations and for groundwater quality through productions wells and monitoring wells within the City of La Habra. Surface water is currently not monitored in the Cities of La Habra and Brea overlying the La Habra Groundwater Basin. Recycled water is not used within the La Habra-Brea Management Area. Imported surface water and groundwater is used within the La Habra-Brea Management Area for potable supply. These potable water sources are monitored prior to delivery and not directly monitored by the Cities of La Habra and Brea.

5.2 GROUNDWATER MONITORING PROGRAMS

Groundwater Elevations

Since 2008, the City of La Habra has measured non-pumping and pumping groundwater elevations at its production wells to review general trends in groundwater elevations in the Basin.

The City of La Habra will supplement its existing groundwater elevation monitoring program by including water level measurements reported by DWR for three monitoring wells in the La Habra Basin. Groundwater elevations have previously been reported by DWR for wells 3/10-9G1, 3/10-8B2, and 3/10-18C1; however, only well 3/10-9G1 is currently being reported. Currently, La Habra is working to expand its monitoring network. See Section 9.2 for additional information.

Groundwater Quality

Currently, the City samples for constituents at its production wells pursuant to Title 22 of the California Code of Regulations (Title 22). Under Title 22, the City monitors and reports groundwater quality for constituents that are regulated by the State Water Resources Control Board Division of Drinking Water pertaining to maximum contaminant levels (MCLs). The City of La Habra also monitors areas of contamination, as described in its Drinking Water Source Assessments provided to the Division of Drinking Water for its production wells. The City of La Habra plans to continue to review and comment on documents regarding these areas within the City limits as well as be aware of any areas outside of its jurisdiction that may affect the water quality of the Basin through surface or subsurface flow.

The City of La Habra plans to continue its existing groundwater water quality monitoring program and will evaluate the need for additional monitoring above its current program in accordance with DWR GSP regulations.

5.3 OTHER MONITORING PROGRAMS

Currently the City of La Habra does not perform any surface water quality monitoring; however, the City of La Habra will investigate any existing programs for the Coyote Creek Watershed including monitoring programs being developed in response to regulations set forth for the watershed by the local Regional Water Quality Control Board (Coyote Creek is shown on the Clean Water Act's 303(d) list of impaired waters). The City of La Habra will consider developing and implementing its own surface and subsurface inflow quality monitoring programs for the local watershed in accordance with DWR GSP regulations.

Likewise, the City of La Habra does not monitor land subsidence within the La Habra-Brea Management Area. However, the City may develop a program to monitor and measure the rate of land surface subsidence in accordance with DWR GSP regulations in the future if a land subsidence is determined to be likely to cause undesirable results.

SECTION 6. WATER RESOURCE MANAGEMENT PROGRAMS

Groundwater resources protection is considered a critical component for safeguarding the long-term sustainability of the La Habra Groundwater Basin. Groundwater resources protection includes water resources planning and an ordinance to prohibit the extraction and exportation of groundwater underlying the City for use outside the City as well as groundwater protection programs including well construction, abandonment, and destruction policies, wellhead protection, and the control of the migration and remediation of contaminated, poor quality, or saline water.

6.1 LAND USE ELEMENTS RELATED TO BASIN MANAGEMENT

The Cities of Brea and La Habra participate in two water resources management planning documents: the Integrated Regional Water Management Plan, and the Urban Water Management Plan.

Integrated Regional Water Management Plan

Integrated Regional Water Management (IRWM) is a collaborative approach of implementing water management solutions on a regional scale in order to address water resources needs. The Greater Los County Region has been designated as an IRWM region and is comprised of the following subregions: North Santa Monica Bay, South Bay, Upper Los Angeles River, Upper San Gabriel and Rio Hondo Rivers, and Lower San Gabriel and Los Angeles Rivers. The Coyote Creek watershed, which overlies the La Habra Groundwater Basin, is within the Lower San Gabriel and Los Angeles Rivers IRWM subregion. The La Habra Groundwater Basin contributes a small portion of the groundwater produced within the subregion.

Urban Water Management Plan

Water Code Sections 10610 through 10656 of the Urban Water Management Planning Act require every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet (AF) of water annually to prepare, adopt, and file an Urban Water Management Plan (UWMP) with the California Department of Water Resources (DWR). The Cities of Brea and La Habra both are required to file an UWMP every five years with DWR. The UWMP is a management tool that provides water planning and identifies water supplies needed to meet existing and future water demands.

6.2 GROUNDWATER WATER QUALITY PROTECTION AND MANAGEMENT

Well Construction, Abandonment, and Destruction Policies

The policies that govern well construction, abandonment, and destruction are designed specifically to protect groundwater quality. The administration of these policies has been delegated to individual counties by California legislature. As stated in Orange County Ordnance No. 2607, all well activity within Orange County will comply with the standards set in DWR Bulletin 74, Chapter 2. These standards are enforced by the Orange County Health Care Agency. The Cities of La Habra and Brea properly construct and abandon wells pursuant to Orange County Ordnance No. 2607.

Wellhead Protection Measures

Wellhead protection is a way to prevent drinking water from being contaminated by managing sources of potential contamination within the vicinity of a production well. Surface contaminants can enter a well through the outside edge of the well casing or directly through opening in the well head. These contaminants can travel in two directions: to the groundwater aquifer or to the distribution system. As defined in the Safe Drinking Water Act Amendments of 1986, a wellhead protection area is “the surface and subsurface area surrounding a water well or well field supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field.”

The Cities of La Habra and Brea design and construct wells in accordance with the measures described in DWR Bulletin 74 so that the wellhead is protected from contamination. Important wellhead protection measures described in Bulletin 74 include: methods for sealing the well from intrusion from surface contaminants, site grading to assure drainage is away from the wellhead, and set-back requirements from known pollution sources.

Control of Migration and Remediation of Contaminated Groundwater

Groundwater can become contaminated naturally or through human activity. Based on a 2010 drinking water assessment performed by the City of La Habra, sources of potential groundwater contamination to the La Habra Basin include: car repair and bodywork shops, gas stations, machine and metalwork shops, and sewer collection systems (La Habra, 2013).

The City of La Habra has previously taken the position that oil and gas mining operations in or up gradient of the basin have the potential to release chemicals that could contaminate groundwater, particularly during fracking activities.

The Cities of La Habra and Brea will monitor the migration of contaminants through its water quality monitoring program and will also monitor nearby oil and gas mining operations. This will allow the point and non-point pollution sources to be identified. If contamination becomes a concern in the future, an approach to address the problem will be developed.

Control of Saline Water Intrusion

Raised salinity is a significant water quality problem in many parts of the southwestern United States and southern California, including Orange County. Elevated salinity is of concern as it can limit the implementation of recycling water projects and potentially require water purveyors to perform additional treatment on their water supplies.

The level of salinity is sometimes measured based on Total Dissolved Solids (TDS) concentrations. The TDS concentrations in the La Habra Basin are naturally occurring and it is not believed that current activities in the basin significantly contribute to the TDS loading in the basin. The TDS concentrations are not a result of saline water intrusion. The TDS concentrations in the City of La Habra's wells are below the secondary Maximum Contaminant Level (MCL) of 1,000 mg/L. TDS is listed as a secondary constituent as it does not directly cause harm to consumers but can affect the aesthetic quality of the water, including taste.

Stormwater Pollution Prevention

The City of La Habra is under the Regional Water Quality Control Board (RWQCB) National Pollutant Discharge Elimination System (NPDES) permit, Order R8-2009-0030. The current adopted permit requires mandates for the implementation of water quality control programs including adopting development standards for existing and new development. Although the NPDES permitting program is intended to protect surface water quality by preventing unauthorized stormwater discharges and discharges to navigable water, groundwater quality is also protected through the NPDES program incidental percolation of surface water into the groundwater occurs.

The City of La Habra implements additional best management practices to prevent pollutant discharges. To assist developers and owners with implementation of NPDES requirements and best management practices for construction projects, the City of La Habra has created a Construction Runoff Guidance Manual. Likewise, the Model Water Quality Management Plan has been developed to address urban runoff and pollution. A water quality ordinance has been adopted (La Habra Municipal Code Chapter 13.24) to locally enforce California stormwater regulations. Additionally, the City of La Habra conducts investigations, inspections, trainings, maintenance, and public education to reduce pollution and contamination. These management practices

Blending Program

As discussed in Section 3.2.5, groundwater contamination exists in portions of the La Habra Groundwater Basin. To manage groundwater quality concerns, the City of La Habra blends groundwater from the La Habra Groundwater Basin with imported water (both groundwater and surface water) in order to reduce contaminant levels prior to distribution. See also Section 11.4 discussion on management programs.

6.3 GROUNDWATER EXPORT PROHIBITION

The protection of the health, welfare, and safety of the residents and economy of the City of La Habra require that the groundwater resources of the City be protected for present and future municipal, industrial, and domestic beneficial uses within the City. The sustainable yield of the portion of the La Habra Basin underlying the City is not sufficient to serve beneficial uses in addition to the beneficial municipal, industrial and domestic uses currently served through the City municipal water system. The best interest of the present and future inhabitants of the City is served by the prohibition against the extraction and exportation of groundwater produced from within the City's jurisdictional boundaries. Accordingly, on December 21, 2015, the City of La Habra adopted Ordinance No. 1767 to prohibit the extraction and exportation of groundwater underlying the City for use outside of the City.

SECTION 7. NOTICE AND COMMUNICATION

7.1 INTRODUCTION

The Cities of La Habra and Brea overlie the La Habra Groundwater Basin and are the only producers of groundwater within the basin. Potential agencies that may additionally have a stake in the successful management of the basin include:

- Central Basin Watermaster (DWR): adjudicated Central Basin (Los Angeles)
- OCWD: actively manages Orange County portion
- City of Fullerton: included in OCWD's service area

7.2 GROUNDWATER PRODUCERS

As the City of Brea is a direct stakeholder in the Orange County portion of the La Habra Basin outside of OCWD's service area, Brea was included in the preparation of this plan.

While the Central Basin Watermaster, OCWD, and the City of Fullerton do not have a direct stake in the Orange County portion of the La Habra Basin outside of OCWD's service area that is the focus of this Plan, the portions of the historical La Habra Basin underlying these entities are hydrologically connected to the portion of the basin that is the subject of this Plan. As such these entities were informed that OCWD was preparing this Plan and the planned management of the basin was discussed with them.

7.3 PUBLIC PARTICIPATION

The City of La Habra has invited the public to participate in City Council meetings where management of the La Habra Basin and future actions have been discussed and presented. See the 2017 Alternative for additional information.

The La Habra GSA will strive to involve the public in groundwater management decisions regarding the La Habra-Brea Management Area. In the future, the La Habra GSA plans to provide copies of the periodic groundwater reports that will be prepared to the public at their request and publish information on groundwater management accomplishments on the City's website. The La Habra GSA will also comply with the public participation requirements under SGMA.

7.4 COMMUNICATION PLAN

The La Habra GSA plans to prepare a summary report of the current conditions of the La Habra Groundwater Basin ideally every two to five years using the results from the monitoring program (see Section 5.0). These informative reports will be used to plan future groundwater projects, develop new groundwater policies, and identify any new concerns with the basin.

SECTION 8. SUSTAINABLE MANAGEMENT APPROACH

As the City of La Habra currently depends on local groundwater to meet approximately 40 percent of its water consumption and the City of Brea uses groundwater to meet irrigation needs, preserving the sustainability of the La Habra Groundwater Basin is essential for the well-being of the two cities. Currently (and historically), the City of La Habra manages (and has managed) the La Habra Groundwater Basin through management plans and programs for groundwater levels, basin storage, and water quality, discussed below in Sections 9, 10, and 11, respectively. Seawater intrusion and land subsidence are not occurring in the La Habra-Brea Management Area, and are not anticipated to occur; therefore, they are not actively managed at this time. Likewise, groundwater-surface water interactions are not actively managed at this time. No undesirable results have been observed in the La Habra Groundwater Basin.

As a key component of sustainable management, the Cities of La Habra and Brea strongly promote conservation as a means to preserve water supplies. Both cities have sections on their websites dedicated to water conservation in addition to including conservation guidance in their annual Consumer Confidence Reports distributed to residents.

SECTION 9. MANAGING GROUNDWATER LEVELS

A solid understanding of groundwater elevations, seasonal fluctuations and response to pumping, existing basin yield, and how groundwater is stored and transmitted through the basin is critical for sustainably managing the La Habra-Brea Management Area.

9.1 HISTORY OF BASIN CONDITIONS AND MANAGEMENT ACTIONS

As shown on Figures 3-4, 3-5, and 3-6, groundwater levels in the La Habra-Brea Management Area have recovered from lows in the 1930 to 1950s and have experienced a general rising trend and leveling off since the 1970s. Given consistent groundwater production within the estimated safe yield of the basin, groundwater levels are expected to remain steady in the future.

9.2 MONITORING OF GROUNDWATER LEVELS

The City of La Habra recognizes the great importance of monitoring groundwater levels and acknowledges the current data gaps in the monitoring network. Monitoring groundwater levels is critical to basin management because water levels impact other potential undesirable results: loss of groundwater in storage, degraded water quality, land subsidence, and depletion of interconnected surface water. Groundwater levels can serve as a proxy for identifying potential impacts related to other groundwater conditions.

As discussed in Section 5.2, the City has measured non-pumping and pumping groundwater elevations at its production wells since 2008. At the time the Alternative was first being developed, there were several additional wells actively being monitored in the La Habra Basin by other agencies. These wells with water level data included wells 3/10-9G1, 3/10-8B2, and 3/10-18C1. Many of these wells are no longer being monitored which is causing data gaps. Accordingly, La Habra is currently evaluating potential groundwater wells for inclusion into an expanded monitoring program as part of compliance under SGMA. The need for standard and multi-level monitoring wells to monitor the three aquifers of the basin is being investigated. The La Habra GSA may potentially request State assistance through the Technical Services Support program to install additional monitoring wells. The proposed monitoring program will include wells located within the vicinity of the La Habra Basin. La Habra has been in coordination with the Department of Water Resources regarding wells located in the La Habra Basin that have previously been included in bulletins/reports published by the Department of Water Resources (DWR) in order to acquire pertinent well information that is not publicly available. These wells and other existing monitoring wells are currently being screened and evaluated for available data and suitability for inclusion in the monitoring network for the La Habra Groundwater Basin. Updates and modifications to the monitoring network will be discussed in the next Annual Report.

Characterization of the conditions of the basin using the City's existing groundwater elevation data from its production wells may not reflect steady state conditions because the wells pump frequently and groundwater levels within the wells do not have enough time to fully recover to obtain a static elevation before the well is put into production once more. Static elevations may be recorded through the use of monitoring wells where no pumping is performed and the well is constantly in a static condition.

9.3 DEFINITION OF SIGNIFICANT AND UNREASONABLE LOWERING OF GROUNDWATER LEVELS

The definition of significant and unreasonable lowering of groundwater levels in the La Habra-Brea Management Area is a lowering of groundwater levels such that a significant loss of well production capacity or a significant degradation of water quality occurs which would impact the intended and current beneficial uses of the groundwater. Currently, the Santa Ana Regional Water Quality Control Board has designated the beneficial uses of groundwater in the La Habra-Brea Management Area to be Municipal and Domestic Supply and Agriculture.

The La Habra Groundwater Basin is currently managed within the safe yield, and groundwater levels have shown rising or stable trends in recent years, as shown by the available groundwater level hydrographs (see Section 3.2). Likewise, no other potential impacts are occurring such as loss of capacity at groundwater production wells, water quality degradation, or land subsidence. Accordingly, there are currently no undesirable results occurring related to the chronic lowering of groundwater levels.

9.4 DETERMINATION OF MINIMUM THRESHOLDS

There are no minimum thresholds established for groundwater levels in the La Habra Groundwater Basin because the basin is currently not in overdraft and is managed within the safe yield of the basin. Accordingly, no undesirable results are occurring. General water levels trends have shown rising and recovering groundwater levels over the past several decades with water levels being relatively stable for the past several years. Additionally, the prolonged and significant regional drought between 2011-2017 did not cause water levels to lower significantly or unreasonably. See Section 3.2.

Recognizing that historical water levels have been significantly lower in previous decades, the La Habra GSA will continue to monitor groundwater levels to determine if chronic or significant lowering of groundwater levels are observed. If declines are observed, the La Habra GSA will evaluate its groundwater management operations, re-evaluate the safe yield, and establish minimum thresholds, where appropriate, and in accordance with SGMA.

SECTION 10. MANAGING BASIN STORAGE

10.1 HISTORY

As discussed in Section 9.1, groundwater levels in the La Habra Groundwater Basin have recovered from lows in the 1930 to 1950s and have experienced a general rising trend and leveling off since the 1970s. Given steady groundwater production within the estimated safe yield of the basin, groundwater levels are expected to remain steady in the future; consequently, water in storage is similarly anticipated to remain steady.

10.2 MONITORING STORAGE LEVELS

The monitoring of storage levels is indirectly monitored through the groundwater level monitoring program described in Section 9.2.

10.3 MANAGEMENT PROGRAMS

10.3.1 Establishment of Safe Yield

A “safe yield” is used for ongoing management and future planning of a groundwater basin for sustained beneficial use. It is generally defined as the volume of groundwater that can be pumped annually without depleting the aquifer beyond its ability to recover through natural recharge over a reasonable hydrologic period. As discussed in Section 4.4, the approximate safe yield of the basin is 4,500 AFY, determined by taking the average of two methods to determine the natural discharge and natural recharge of the basin.

Based on a review of groundwater elevations performed in January 2014, groundwater elevations in the San Pedro aquifer of the La Habra Basin appear to have risen about 100 feet from the 1940s to the present with an overall rising trend of 50 to 60 feet between 1970 and 2007 (Stetson, 2014). Therefore, it appears that the basin is not currently in an overdraft condition. More recently, groundwater levels appear to be stable indicating no unreasonable loss of groundwater in storage.

The City of La Habra maintains sustainable groundwater production by maintaining and coordinating groundwater production within the estimated safe yield of the La Habra Groundwater Basin. This results in no undesirable results caused by depletion of groundwater in storage.

10.3.2 Review and Evaluation of Groundwater Levels

The condition of the basin can be verified through a periodic review of groundwater elevations within the basin. The City can utilize and supplement its existing groundwater elevation monitoring program to review general trends in groundwater elevations in the Basin.

As discussed in Section 9.2, the City has evaluated the current monitoring network and has determined additional monitoring of groundwater elevations is required in the La Habra Groundwater Basin. Additional monitoring wells are currently being evaluated for inclusion into the monitoring program. When the City of La Habra chooses to expand its groundwater monitoring program in the future, the City will prepare basin management reports on a periodic basis (every two to five years) using the results of the monitoring program. These informative reports will be used to review whether groundwater production is within the safe yield of the basin, plan future groundwater projects, develop new groundwater policies, and identify any new concerns within the La Habra-Brea Management Area.

10.3.3 Groundwater Recharge or Storage Projects

The City of La Habra currently does not operate any groundwater recharge or storage projects. In the future, the City may perform a basin replenishment study that identifies potential recharge areas and measures to protect these areas. Two areas where a groundwater recharge project could be studied for implementation are shown in Figure 10-1. The San Pedro Formation is naturally recharged directly through aquifer outcrops (exposed formation sediments) in the Los Coyote Hills (south of the intersection of Beach Boulevard and Imperial Highway) and in the Puente Hills (along the foothills north of Whittier Boulevard) [Montgomery, 1977]. The San Pedro Formation could also be indirectly recharged through the uplifted and exposed San Pedro beds that lie just below a thin layer of alluvium along the Coyote Creek valley (Montgomery, 1977).

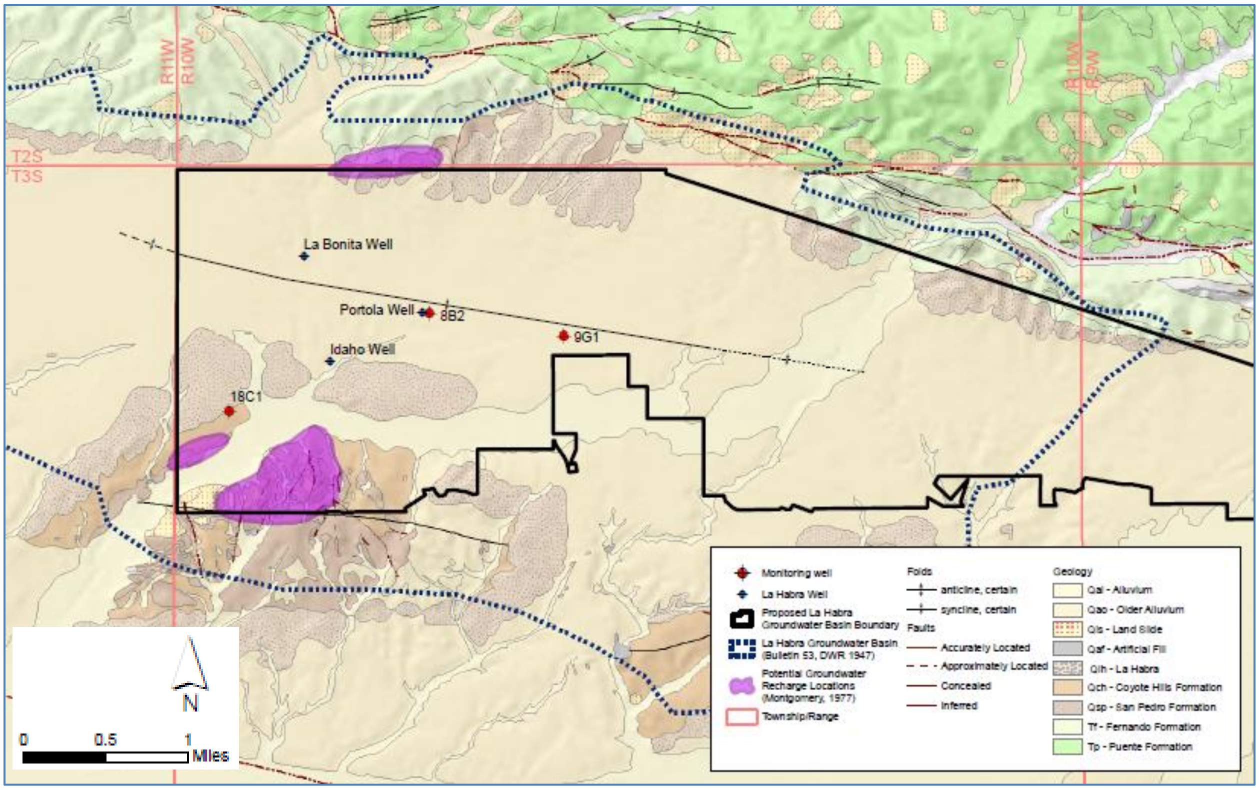


Figure 10-1: Potential Groundwater Recharge Locations.

As discussed in Section 2.2, the City of La Habra is located in the Coyote Creek Watershed. The Coyote Creek Watershed is included in the Municipal Separate Storm Sewer System (MS4) Permit for the Orange County Santa Ana Region. The City implements stormwater control practices as required by the NPDES permit. Stormwater recharge activities in compliance with the NPDES permit program may occur in the future.

The City of La Habra currently does not operate any conjunctive use projects. The City may study the feasibility of conjunctive use projects in the future.

10.3.4 Potential Management Programs

No known desktop flow model exists for the La Habra Basin. As such, the La Habra GSA will consider developing a desktop flow model for the La Habra-Brea Management Area in the future once a sufficient amount of data are collected (as additional monitoring wells are constructed and monitored, for example). Groundwater models are used to represent natural flow conditions of an aquifer and can predict the effects of hydrological changes (such as pumping and replenishment) on the behavior of the aquifer.

10.4 DEFINITION OF SIGNIFICANT AND UNREASONABLE REDUCTION IN STORAGE

As with groundwater levels, the definition of significant and unreasonable reduction in groundwater storage in the La Habra-Brea Management Area is a lowering of groundwater levels such that a significant loss of well production capacity or a significant degradation of water quality occurs which would impact the intended use of the groundwater. Currently, there are no observed undesirable results observed related to the chronic loss of groundwater in storage. Since the Basin is managed within the safe yield, no chronic loss of groundwater in storage is anticipated.

10.5 DETERMINATION OF MINIMUM THRESHOLDS

As with groundwater levels, minimum thresholds have not been established for changes in groundwater storage. If chronic or significant lowering of groundwater levels is observed through groundwater level monitoring, the La Habra GSA will evaluate its groundwater management operations, re-evaluate the safe yield, and establish minimum thresholds, where appropriate, and in accordance with SGMA. Groundwater levels would be used as a proxy to set thresholds for groundwater in storage.

SECTION 11. MANAGING BASIN WATER QUALITY

It is the intent of the La Habra GSA to protect and enhance the groundwater quality in the La Habra-Brea Management Area. This can be achieved through groundwater quality programs, understanding the quality of surface waters and subsurface water that naturally recharge the basin, and implementing measures to protect potential recharge areas.

11.1 HISTORY

Previous investigations of water quality within the La Habra Groundwater Basin determined that the quality is extremely variable. Overall, groundwater from the San Pedro Aquifer is considered to be of fair to good quality (Montgomery, 1979). However, groundwater produced from the La Habra Groundwater Basin is currently blended with imported water prior to distribution in order to reduce certain contaminant levels.

11.2 SUMMARY OF GROUNDWATER QUALITY ISSUES

As discussed in Section 3.2.5, water from the La Bonita and Portola Wells is chlorinated and then blended with water purchased from the California Domestic Water Company in a 250,000-gallon forebay to reduce the concentration of minerals prior to entering the City of La Habra's distribution system (La Habra, 2014).

The City of Brea's non-potable well is strictly used for irrigation purposes as the groundwater beneath the city has poor water quality and would require extensive treatment and blending with higher quality water to meet public health standards (Malcolm Pirnie, 2011).

11.3 MONITORING OF GROUNDWATER QUALITY

The La Habra GSA will continue the City of La Habra's existing water quality monitoring program, described in Section 5.2, and supplement the program as required by SGMA. If the La Habra GSA were to choose to construct monitoring wells for groundwater elevations, these wells can also be sampled for water quality.

The La Habra Basin is recharged through surface runoff and streamflow recharge as well as mountain front recharge (Stetson, 2013). Understanding the quality of the surface and subsurface water that recharges the La Habra Basin is important in protecting and enhancing the water quality of the groundwater basin as the groundwater within the basin originates from these waters. Although the City currently does not have a surface water quality monitoring program for the Coyote Creek Watershed, the La Habra GSA will investigate any existing programs for the watershed including regulations set forth for the watershed by the local Regional Water Quality Control Board (Coyote Creek is shown on the Clean Water Act's 303(d) list of impaired waters). The La Habra GSA will consider developing and implementing its own surface and subsurface inflow quality monitoring programs for the local watershed in the future.

To protect the water quality of the Basin, the La Habra GSA will continue to monitor and review areas of contamination within the La Habra-Brea Management Area, as described in its Drinking Water Source Assessments provided to State Water Resources Control Board Division of Drinking Water (DDW) for its production wells. The La Habra GSA will continue to review and comment on documents within the La Habra-Brea Management Area as well as be aware of any areas outside of its jurisdiction that may affect the water quality of the La Habra-Brea Management Area through surface or subsurface flow.

11.4 DESCRIPTION OF MANAGEMENT PROGRAMS

The management programs intended to protect the groundwater quality of the La Habra-Brea Management Area and prevent groundwater quality degradation include well construction, abandonment, and destruction policies, wellhead protection measures, control of migration and remediation of contaminated water, and control of saline water. Indirectly, the City of La Habra's Stormwater contamination protection programs help prevent groundwater quality degradation as well. See Section 6.

As discussed in Section 3.2.5, groundwater contamination exists in portions of the La Habra Groundwater Basin. The contaminants in the local groundwater are primarily naturally occurring and are not caused by excess groundwater production. Consequently, the only effective management action to address groundwater with existing poor water quality is treatment. As discussed previously, the City of La Habra blends groundwater from the La Habra Groundwater Basin with imported water (both groundwater and surface water) in order to reduce contaminant levels prior to distribution.

11.5 DEFINITION OF SIGNIFICANT AND UNREASONABLE DEGRADATION OF WATER QUALITY

The definition of significant and unreasonable degradation of water quality is a reduction of water quality in the La Habra-Brea Management Area such that the groundwater can no longer be used for the intended purposes even with the implementation of reasonable mitigation measures or management actions. Currently, the City of Brea only uses groundwater produced from the La Habra Groundwater Basin for irrigation; however, the City of La Habra uses groundwater for its potable supply, thus requiring a higher level of quality. Currently, groundwater produced from the La Habra Groundwater Basin is able to be put to beneficial use as a potable water supply. Historically, groundwater quality in the La Habra Groundwater Basin has been variable with areas with poor water quality; however, these historical water quality issues are not caused by groundwater management actions or current groundwater production (see Section 3.2.5). Thus, no undesirable results related to degraded water supply are occurring. See Section 11.6 below for further discussion.

11.6 DETERMINATION OF MINIMUM THREHOLDS

Because groundwater from the La Habra Groundwater Basin is used as a potable source, the minimum thresholds for groundwater quality are exceedances of Maximum Contaminant Levels (MCLs) or other applicable regulatory limits that are directly attributable to groundwater management actions in the La Habra-Brea Management Area that prevents the use of groundwater for its intended purpose. As discussed previously, the current water quality concerns in the La Habra Groundwater Basin are naturally occurring and are not caused by over-production or other groundwater management actions. These concerns pre-date SGMA legislation and are currently being managed through a blending program. Drinking water distributed to residents in the cities of Brea and La Habra currently meet all regulatory requirements. Accordingly, undesirable results as defined above in Section 11.5 by the definition of “significant and unreasonable” are not occurring and are not anticipated to occur due to groundwater production being managed within the Basin sustainable yield. If groundwater water quality trends indicate declining water quality, additional management actions will be established.

SECTION 12. MANAGING SEAWATER INTRUSION

The La Habra Groundwater Basin is not located near the ocean. Accordingly, there is no need to manage or consider the potential impact of seawater intrusion in the La Habra-Brea Management Area.

SECTION 13. MANAGING LAND SUBSIDENCE

As discussed in Section 3.2.6, there is no evidence that land subsidence is, or will likely become, problematic within the La Habra-Brea Management Area. Accordingly, sustainable management criteria or active monitoring are not required at this time. However, the City of La Habra may develop a program to monitor and measure the rate of land surface subsidence within the La Habra-Brea Management Area in accordance with DWR GSP regulations if it is determined that there is a potential for significant or unreasonable land subsidence to occur. The need for land surface subsidence monitoring will be considered on an annual basis.

SECTION 14. MANAGING GROUNDWATER DEPLETIONS IMPACTING SURFACE WATER

As discussed in Section 3.2.7, the La Habra Groundwater Basin lies within the Coyote Creek Watershed with the major creeks in the watershed being Coyote Creek, Brea Creek, Fullerton Creek, Carbon Creek, Moody Creek, and Los Alamitos Channel. The watershed is highly urbanized with densely populated areas of residential, commercial, and industrial areas, as well as open space. Montgomery (1977) determined that about 30% of the runoff available in an average rainfall year percolates to the aquifers underlying the La Habra Valley.

In recent years, the depth to groundwater from the ground surface is approximately 30 feet (see Figure 3-6. However, groundwater production occurs within the confined San Pedro aquifer which is significantly deeper than the perched alluvial aquifer with a depth to groundwater of approximately 140 feet in the year 2000 (see Figure 3-6). As discussed previously in Section 3.2.7, there are small areas overlying the La Habra Groundwater Basin identified as GDEs. The areas of vegetation identified as groundwater dependent ecosystems are along the base of the surrounding hills at the limits of the basin where groundwater is shallow. The vegetation is also supported by surface water runoff and rainfall. Additionally, these areas are not located near the groundwater production wells which produce from the confined San Pedro aquifer. Accordingly, groundwater production is not anticipated impact surface waters and local habitats Thus, there is no evidence that groundwater depletions will impact surface water or groundwater dependent ecosystems within the La Habra-Brea Management Area.

SECTION 15. PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Available data and groundwater management programs are reviewed annually. Additionally, data gaps are identified and evaluated. This plan will be amended to reflect any new policies or practices relevant to the management of the La Habra-Brea Management Area. It will also be updated to reflect changes in groundwater conditions as necessary.

Monitoring protocols are necessary to ensure consistency and accuracy in monitoring efforts and are required for monitoring assessments to be valid. Consistency should be reflected in factors such as the locations of the sampling points, frequency and seasonality of measurements, sampling procedures, and testing procedures. Accordingly, the La Habra GSA will undertake uniform data gathering procedures to ensure comparable measurements of groundwater are taken.

15.1 ESTABLISHMENT OF PROTOCOLS FOR WATER QUALITY

The protocols for water quality sampling are discussed in the 2017 Alternative.

15.2 ESTABLISHMENT OF PROTOCOLS FOR GROUNDWATER ELEVATION/STORAGE

The protocols for groundwater level measurements are discussed in the 2017 Alternative.

SECTION 16. PROCESS TO EVALUATE NEW PROJECTS

The La Habra GSA will evaluate any proposed actions for the La Habra-Brea Management Area pursuant to this Basin 8-1 Alternative in cooperation with the City of Brea. Additionally, new projects would be evaluated through the CEQA process (i.e. by reviewing and commenting on draft CEQA documents). Likewise, OCWD would have an opportunity to comment on projects proposed within the La Habra-Brea Management Area, but OCWD has no authority under this Plan to obstruct any action taken by the La Habra GSA regarding the La Habra-Brea Management Area.

SECTION 17. LIST OF REFERENCES AND TECHNICAL STUDIES

Arcadis. 2016. 2015 Urban Water Management Plan, City of La Habra.

Arcadis. 2016. Draft 2015 Urban Water Management Plan, City of Brea.

Atkins, 2012. City of La Habra General Plan Update. Technical Background Report.

California Department of Water Resources (DWR). 1934. South Coastal Basin Investigation: Geology and Ground Water Storage Capacity of Valley Fill. Bulletin No. 45. Written while DWR was the California Department of Public Works.

DWR. 1947. South Coastal Basin Investigation: Overdraft on Ground Water Basins. Bulletin No. 53. Written while DWR was the California Division of Water Resources.

DWR, 2021a. DWR. SGMA Data Viewer. Accessed November 9, 2021. https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub

DWR, 2021b. DWR. Natural Communities Commonly Associated with Groundwater (NCCAG) Dataset Viewer. Accessed November 9, 2021. https://gis.water.ca.gov/app/NCDatasetViewer/

Geoscience. 2009. Draft Preliminary Geohydrologic Evaluation of the La Habra Basin. Prepared for City of La Habra, April 2, 2009.

Malcolm Pirnie, 2011. Final 2010 Urban Water Management Plan. City of La Habra.

Montgomery, Consulting Engineers Inc. (Montgomery). 1977, November. La Habra Basin Groundwater Study.

Montgomery, 1979, July. Exploratory Drilling in the La Habra Groundwater Basin, Summary Report and Evaluation.

Orange County Water District (OCWD). 2015. Groundwater Management Plan 2105 Update, Orange County Water District.

Stetson Engineers Inc. August, 2013. Draft Technical Report: Task 1 Re-Evaluation of Basin Safe Yield.

Stetson Engineers Inc. 2014. Task 3 Hydrogeologic Investigation of the La Habra Groundwater Basin. Technical Memorandum.

United States Geological Survey (USGS), 2021. Areas of Land Subsidence in California. Accessed November 9, 2021. http://ca.water.usgs.gov/land_subsidence/california-subsidence-areas.html

Yerkes, R.F. 1972. Geology and Oil Resources of the Western Puente Hills Area, Southern California. Geology of the Eastern Los Angeles Basins, Southern California. Geological

Survey Professional Paper 420-C; A study of the stratigraphy, structure, and oil resources of the La Habra and Whittier quadrangles.

Basin 8-1 Alternative

OCWD Management Area

2022 UPDATE

Prepared by: Orange County Water District

January 1, 2022

Basin 8-1 Alternative

OCWD Management Area

2022 UPDATE

PROFESSIONAL GEOLOGIST
ROY L. HERNDON
P.G. No. 4817
CERTIFIED HYDROGEOLOGIST
No. 113
STATE OF CALIFORNIA

Roy Herndon, P.G., C.Hg.

Chief Hydrogeologist
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708

Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3), (c) and §10733.6

January 1, 2022

Table of Contents

Table of Contents

Figure

Table

SECTION 1 EXECUTIVE SUMMARY

The Orange County Water District (OCWD) is a special district formed in 1933 by an act of the California Legislature, the “OCWD Act”. OCWD manages the groundwater basin that underlies north and central Orange County pursuant to the OCWD Act. Water produced from the basin is the primary water supply for approximately 2.5 million residents living within the service area boundaries. The mission of OCWD includes sustainably managing the Orange County Groundwater Basin, Basin 8-1, over the long-term. Additionally, as a special act district listed in Water Code § 10723 (c)(1), OCWD is the exclusive local agency within its jurisdictional boundaries with powers to comply with the Sustainable Groundwater management Act (SGMA) via a groundwater sustainability plan (“GSP”) or via an Alternative prepared in accordance with Water Code § 10733.6.

The OCWD Management Area includes 89 percent of the area designated by the Department of Water Resources (DWR) as Basin 8-1, the “Coastal Plain of Orange County Groundwater Basin” in Bulletin 118 (DWR, 2003). The OCWD Management Area includes the same land area as the OCWD service area within Basin 8-1 except for a small 6.7-square mile area in the northeast corner of the basin that is part of the Santa Ana Canyon Management Area. The boundaries of Basin 8-1, the OCWD service area and the OCWD Management Area are shown in Figure 1-1.

The agencies within Basin 8-1 collaborated to prepare and submit an Alternative to a Groundwater Sustainability Plan (GSP). In accordance with Water Code §10733.6(b)(3)(c), the Basin 8-1 Alternative presented an analysis of basin conditions that demonstrated that Basin 8-1 had operated within its sustainable yield over a period of at least 10 years. The Alternative was submitted to DWR on December 22, 2016. On July 17, 2019, DWR determined that the Alternative satisfied SGMA objectives and was therefore approved.

Approved alternatives are required to submit annual reports to DWR on April 1 of each year. Annual reports for Basin 8-1 were submitted to DWR as follows:

- Water Year 2016-17, submitted on March 29, 2018
- Water Year 2017-18, submitted on March 29, 2019
- Water Year 2018-19, submitted on March 30, 2020
- Water Year 2019-20, submitted on March 30, 2021

*Note, the DWR Water Year extends from Oct. 1 to Sept. 30.

According to Water Code §10733.8, “At least every five years after initial submission of a plan pursuant to Section 10733.4, the department shall review any available groundwater sustainability plan or alternative submitted in accordance with Section 10733.6, and the implementation of the corresponding groundwater sustainability program for consistency with this part, including achieving the sustainability goal. The department shall issue an assessment for each basin for which a plan or alternative has been submitted in accordance with this chapter, with an emphasis on assessing progress in achieving the sustainability goal within the basin. The assessment may include recommended corrective actions to address any deficiencies identified by the department."

This document, called the 2022 Update, represents the first five-year update, which is due January 1, 2022.

For purposes of this report, the Basin 8-1 Alternative submitted on December 22, 2016, will be referred to as the 2017 Alternative. The first five-year update will be referred to as the 2022 Update for ease of reference. The 2017 Alternative was a comprehensive document showing that Basin 8-1 had been managed sustainably for more than 10 years. For the 2022 Update, the focus is on documenting that the basin has been sustainably managed during the five years since the 2017 Alternative was submitted and to present relevant new information from the last five years. As such, the 2017 Alternative is considered a key reference document with background information that is not duplicated in the 2022 Update.

1.1 GROUNDWATER BASIN CONDITIONS

GROUNDWATER ELEVATIONS

OCWD prepares groundwater elevation contour maps for each of the three major aquifer systems (Shallow, Principal, and Deep) annually. In addition to illustrating regional groundwater gradients, the maps are used to prepare water level change maps and to calculate the amount of groundwater in storage and the annual storage change. OCWD's basin-wide network of monitoring wells is used to monitor groundwater levels and quality, assess effects of pumping and recharge, estimate groundwater storage, characterize basin hydrogeology, and develop and calibrate a numerical flow model of the basin. Groundwater elevation contours for the Principal Aquifer as of June 2021 are shown in Figure 1-2.

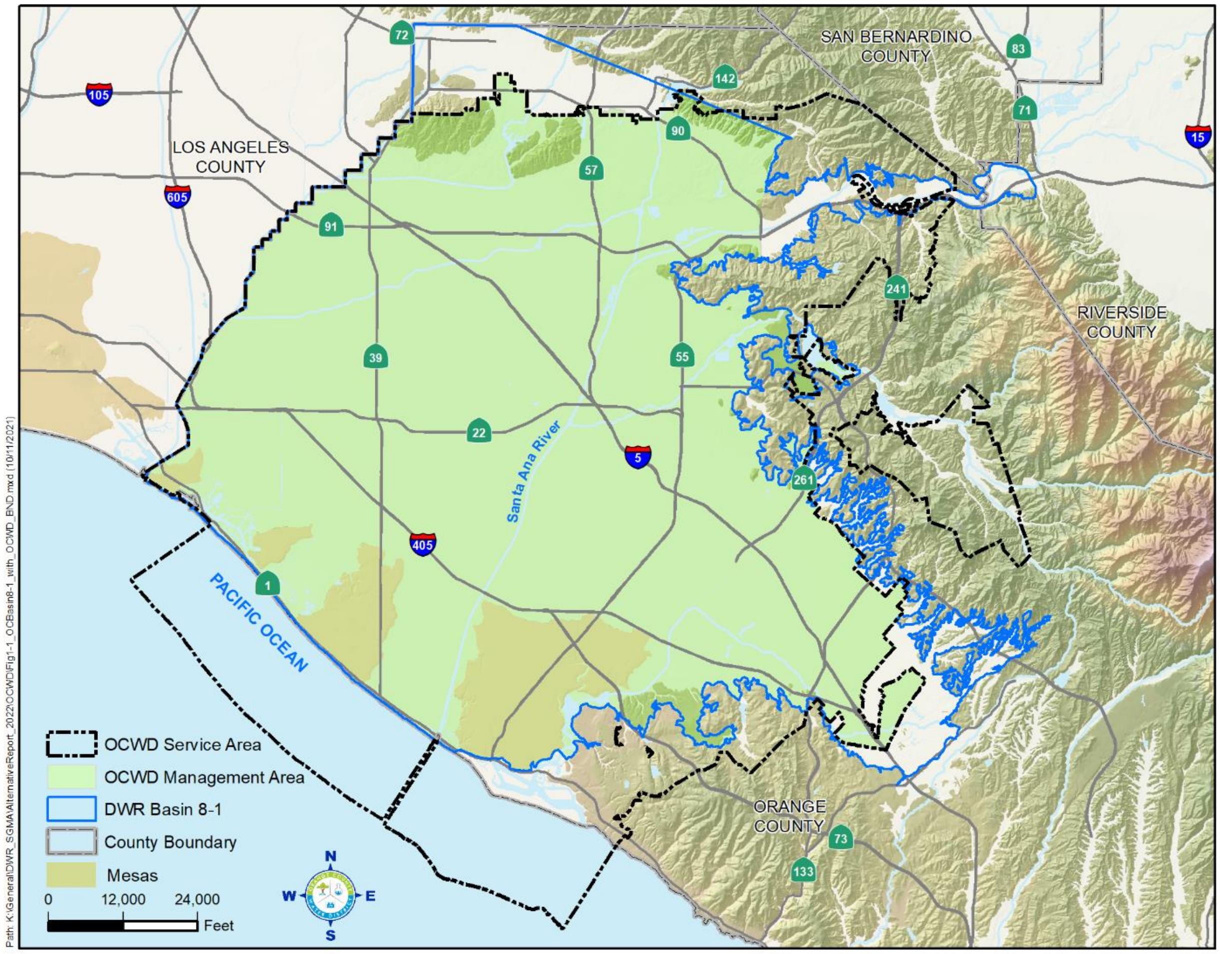


Figure 1-1: Basin 8-1, OCWD Service Area and OCWD Management Area

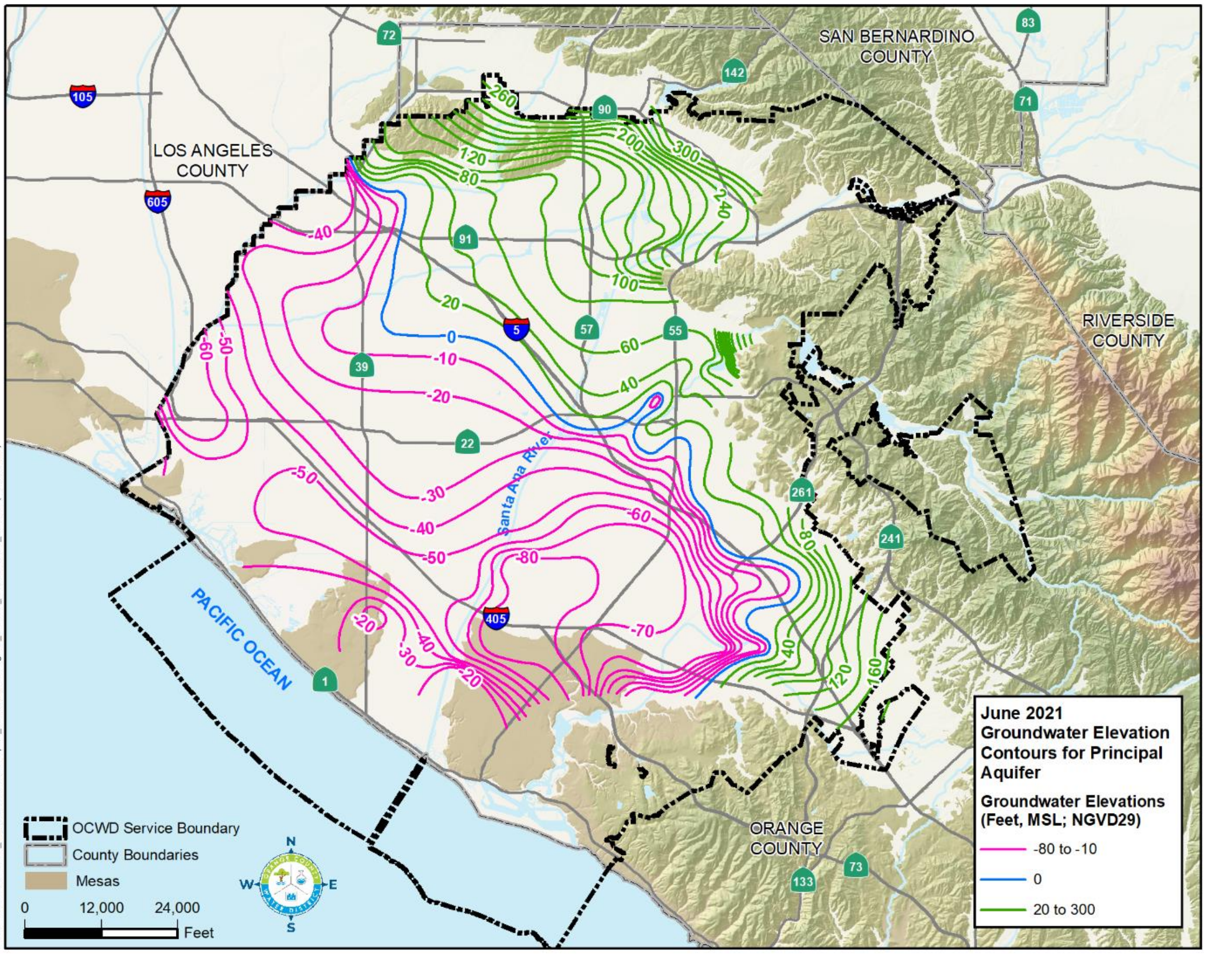


Figure 1-2: Groundwater Elevation Contours for the Principal Aquifer, June 2021

GROUNDWATER STORAGE

The groundwater basin contains an estimated 66 million acre-feet when full. However, OCWD manages the basin within an established operating range of up to 500,000 acre-feet below full condition. This operating range was established to designate the levels of groundwater storage within which the basin that can be maintained without causing adverse impacts. In order to manage the basin within this operating range, OCWD calculates the amount of groundwater in storage on an annual basis. Long-term groundwater storage levels based on OCWD's water year (July 1 to June 30) are shown in Figure 1-3.

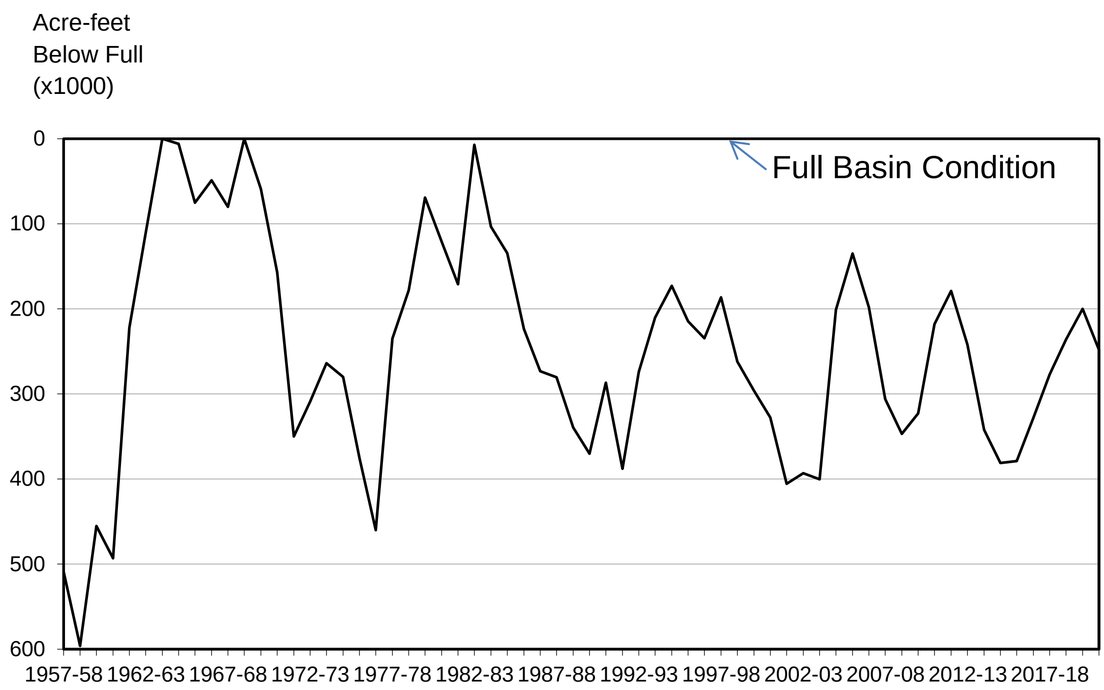


Figure 1-3: Available Basin Storage WY1957-58 to 2020-21

WATER QUALITY

The California Regional Water Quality Control Board, Santa Ana Region (Regional Water Board) is responsible for protection and enhancement of the quality of waters in the watershed, which includes surface water and groundwater in the OCWD Management Area. The watershed's salinity management program, overseen by the Regional Water Board, is managed by the Basin Monitoring Program Task Force. Water quality objectives for total dissolved solids (TDS) and nitrate-nitrogen in groundwater management zones were adopted by the Regional Water Board based on historical water quality data. Every three years the Task Force calculates the current ambient water quality for each groundwater management zone. The most recent recalculation for the groundwater basin was completed in 2020 (OCWD, 2020).

There are several regional groundwater contamination plumes within the OCWD Management Area, all of which are under active remediation, and some are being evaluated for additional remediation. The U.S. Environmental Protection Agency (EPA) is the lead agency in overseeing a remedial investigation/feasibility study (RI/FS) to develop an interim remedy for the VOC plume in the North Basin area. OCWD is conducting an RI/FS to develop an interim remedy for the plume in the South Basin area. Investigations and remediation for individual contaminant source sites within the North Basin and South Basin areas are within the jurisdiction of either the California Department of Toxic Substances Control or the Regional Water Board. The U.S. Navy is taking the lead in remediation of plumes from the former El Toro and Tustin Marine Corps Air Stations and the Naval Weapons Station Seal Beach.

Per- and Polyfluoroalkyl Substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are a group of thousands of manmade chemicals that includes perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). PFAS compounds have been commonly used in many products including, among many others, stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, and fire-fighting foams. Beginning in the summer of 2019, the California Division of Drinking Water (DDW) began requiring testing for PFAS compounds in some groundwater production wells in the OCWD area.

As a result of required testing, as of September 2021, approximately 60 wells in the OCWD service area have been temporarily turned off until treatment systems can be constructed. As additional wells are tested, this figure may increase.

In April 2020, OCWD as the groundwater basin manager, executed a multi-party agreement with the impacted groundwater producers to fund and construct the necessary treatment systems for production wells impacted by PFAS compounds. OCWD expects the treatment systems to be constructed for the approximately 60 impacted wells within the next 2 to 3 years.

LAND SUBSIDENCE

Ground surface elevations rise and fall due to groundwater conditions in the OCWD Management Area and do not show a pattern of widespread, permanent lowering of the ground surface. There is no evidence of permanent, inelastic land subsidence within the OCWD Management Area.

1.2 WATER BUDGET

OCWD developed a hydrologic budget for the purpose of constructing a basin-wide numerical groundwater flow model and for evaluating basin production capacity and recharge requirements. The key components of the budget include measured and unmeasured (estimated) recharge, groundwater production and subsurface outflows.

The groundwater basin is not operated on an annual safe-yield basis. The net change in storage in any given year may be positive or negative; however, over a period of several years, the basin is maintained in an approximate balance. Amounts of total basin production and total water recharged from OCWD water years (WY)1999-2000 to 2020-21 are shown in Figure 1-4. The OCWD water year extends from July 1 to June 30.

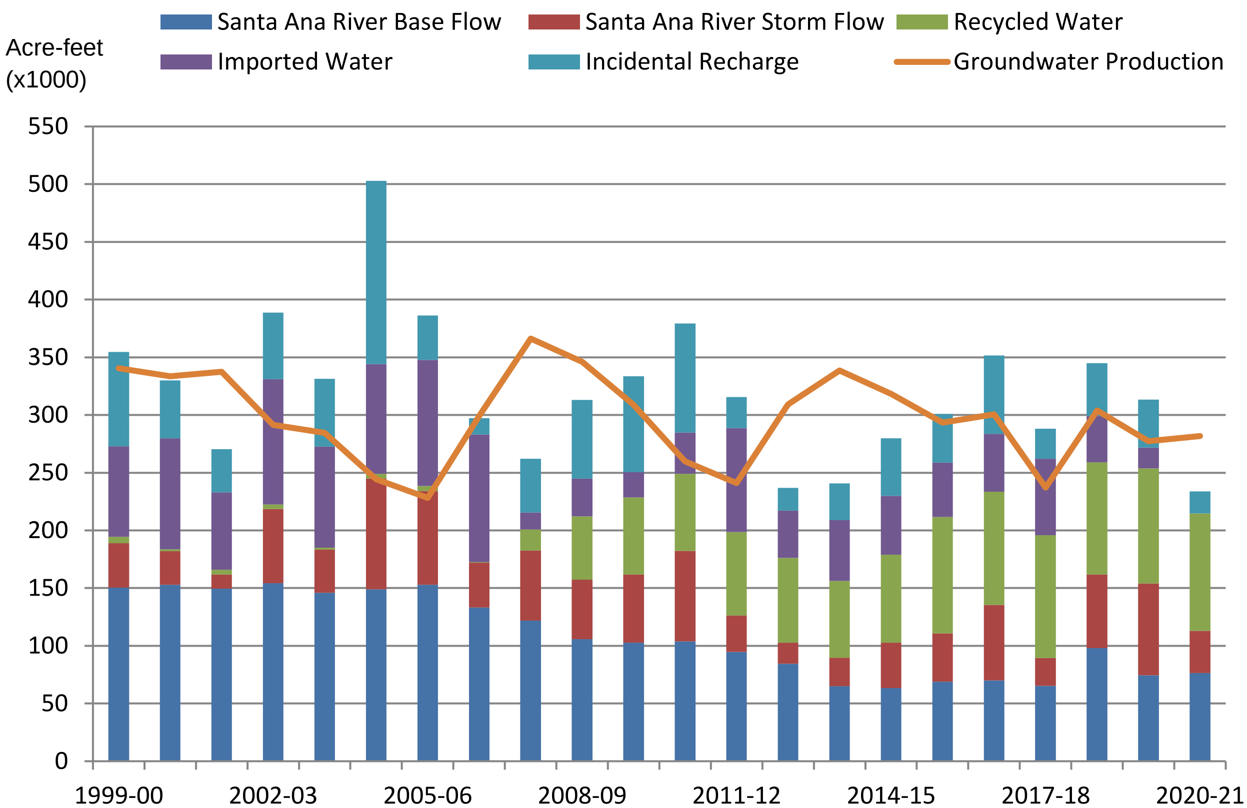


Figure 1-4: Basin Production and Recharge Sources, WY1999-20 to 2020-21

1.3 WATER RESOURCE MONITORING PROGRAMS

Water resource monitoring programs for groundwater, surface water, recycled water, and imported water remain unchanged (see 2017 Alternative for list). The only slight modification is the replacement of the CA Statewide Groundwater Elevation Monitoring (CASGEM) Program with annual data reports required for SGMA compliance.

1.4 GROUNDWATER MANAGEMENT PROGRAMS

LAND USE

The OCWD Management Area is highly urbanized. As such, OCWD monitors, reviews and comments on local land use plans, environmental documents, and proposed regulatory agency permits to provide input to land use planning agencies regarding proposed projects and programs that could cause short- or long-term water quality impacts to the groundwater basin.

DEMAND MANAGEMENT

The average annual water demand within the OCWD Management Area for the most recent five water years, WY2016-17 to 2020-21 is approximately 400,000 acre-feet. Total water demands in the management area are met by a combination of groundwater, imported water, and recycled water. From WY1996-97 to present, water demands have ranged between 367,000 and 526,000 acre-feet per year but have generally decreased, as shown in Figure 1-5. It is noted that water demands in WY2015-16 reflect mandatory demand reductions imposed by the State Water Board in response to an extended drought. OCWD strives to sustainably maximize both production from the basin and recharge of the groundwater basin.

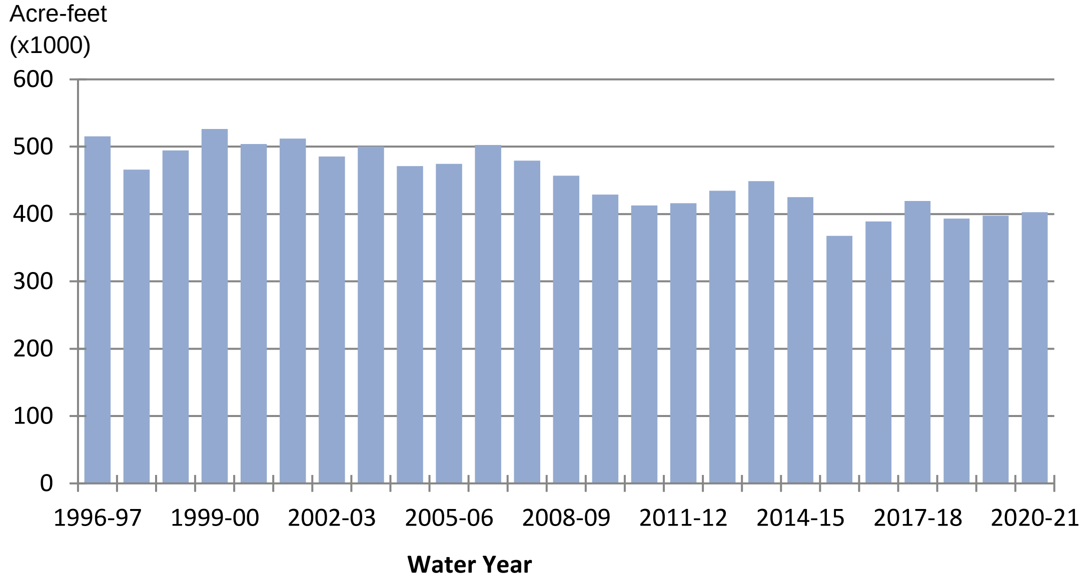


Figure 1-5: Total Water Demands within OCWD, WY1997-98 to 2020-21

GROUNDWATER QUALITY PROTECTION AND MANAGEMENT

OCWD adopted a Groundwater Quality Protection Policy in 1987 and updated it in 2014. This policy guides the actions of OCWD to maintain groundwater quality suitable for all existing and potential beneficial uses; prevent degradation of groundwater quality and protect groundwater from contamination; maintain surface water and groundwater quality monitoring programs, a monitoring well network and data management system; and assist regulatory agencies in remediating contaminated sites.

In January 2020, in preparation for the impacts of PFAS to groundwater supply, OCWD adopted a Per- and Polyfluoroalkyl Substances (PFAS) Policy. Central to this policy is OCWD's desire to maintain a groundwater supply of suitable quality for all existing and potential beneficial uses. Among other items, the policy states that OCWD will fund the lowest reasonable and efficient treatment system design and construction costs to remove PFAS compounds for groundwater producers. Additionally, the policy states that OCWD will fund 50 percent of operation and maintenance expenses up to $75 per acre-foot plus potential adjustments.

As of September 2021, approximately 60 production wells operated by 11 groundwater producers have been temporary shut down until treatment systems can be constructed. OCWD expects these treatment systems to be constructed within the next 2 to 3 years.

RECYCLED WATER PRODUCTION

OCWD's Groundwater Replenishment System (GWRS) produces up to 100 million gallons per day (mgd) of highly treated recycled water. The GWRS Final Expansion is under construction and will be on-line in early 2023. The final expansion will increase plant capacity to 130 mgd. GWRS water is recharged into the groundwater basin and is the primary source of water for the Talbert Seawater Barrier. OCWD also operates the Green Acres Project, a non-potable recycled water supply for irrigation and industrial water users.

CONJUNCTIVE USE PROGRAMS

Recharge water sources include the Santa Ana River and tributaries, imported water, and recycled water supplied by the GWRS as well as incidental recharge from precipitation and subsurface inflow. OCWD's conjunctive use program includes over 1,500 acres of land on which there are 1,067 wetted acres of recharge facilities.

MANAGEMENT OF SEAWATER INTRUSION

The Alamitos and Talbert Seawater Intrusion Barriers control seawater intrusion through the Alamitos and Talbert Gaps by injecting fresh water into susceptible aquifers through a series of injection wells to create a hydraulic barrier.

Work is underway to characterize intrusion in the Sunset Gap, including installation of monitoring wells, development of a groundwater flow model, and feasibility studies. This information is needed to guide design of a potential new seawater barrier in the Sunset Gap.

1.5 NOTICE AND COMMUNICATION

The local agencies that produce the majority of the groundwater from the basin include 19 cities, water districts, and a private water company. OCWD staff holds monthly meetings with this group to provide information and seek input on issues related to groundwater management. OCWD has a proactive community outreach program that includes conducting an annual Children's Water Education Festival attended by over 7,000 elementary school students and a monthly electronic newsletter with approximately 5,700 subscribers.

1.6 SUSTAINABLE BASIN MANAGEMENT

The sustainability goal for the OCWD Management Area is to:

> Continue to manage the groundwater basin to prevent basin conditions that would lead to significant and unreasonable (1) lowering of groundwater levels, (2) reduction in storage, (3) water quality degradation, (4) seawater intrusion, (5) land subsidence and (6) depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

Existing monitoring and management programs in place today enable OCWD to sustainably manage the groundwater basin. Since its founding in 1933, OCWD has developed a managed aquifer recharge program, constructed hundreds of monitoring wells, developed an extensive water quality monitoring program, installed seawater intrusion barriers, and doubled the volume of groundwater production while protecting the long-term sustainability of the groundwater resource. OCWD's management of the OCWD Management Area will continue to provide long-term sustainable basin management that is able to adapt to changing conditions affecting the groundwater basin.

1.6.1 Sustainable Management: Water Levels

OCWD manages the basin for long-term sustainability by maximizing groundwater recharge and managing basin production within sustainable levels. Long-term groundwater level trends demonstrate the undesirable result of "chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply" is not present. Hydrographs representative of long-term water levels in the basin are shown in Figure 1-6. These hydrographs demonstrate that groundwater levels in the OCWD Management Area are being managed at long-term sustainable levels. Chronic lowering of groundwater levels is not anticipated to occur in the future in the OCWD Management Area due to OCWD's management programs.

1.6.2 Sustainable Management: Basin Storage

OCWD manages basin storage within an established operating range of up to 500,000 acre-feet below full condition. Maintaining basin storage within this range protects the basin from detrimental impacts such as land subsidence, chronic lowering of groundwater levels and chronic reduction in storage. OCWD manages groundwater pumping such that it is sustainable over the long-term; however, in any given year pumping may exceed recharge or vice versa. Thus, the amount of groundwater stored in or withdrawn from the basin varies from year to year and often goes through multi-year cycles of emptying and filling, which typically correlates with state-wide and/or local precipitation patterns and other factors.

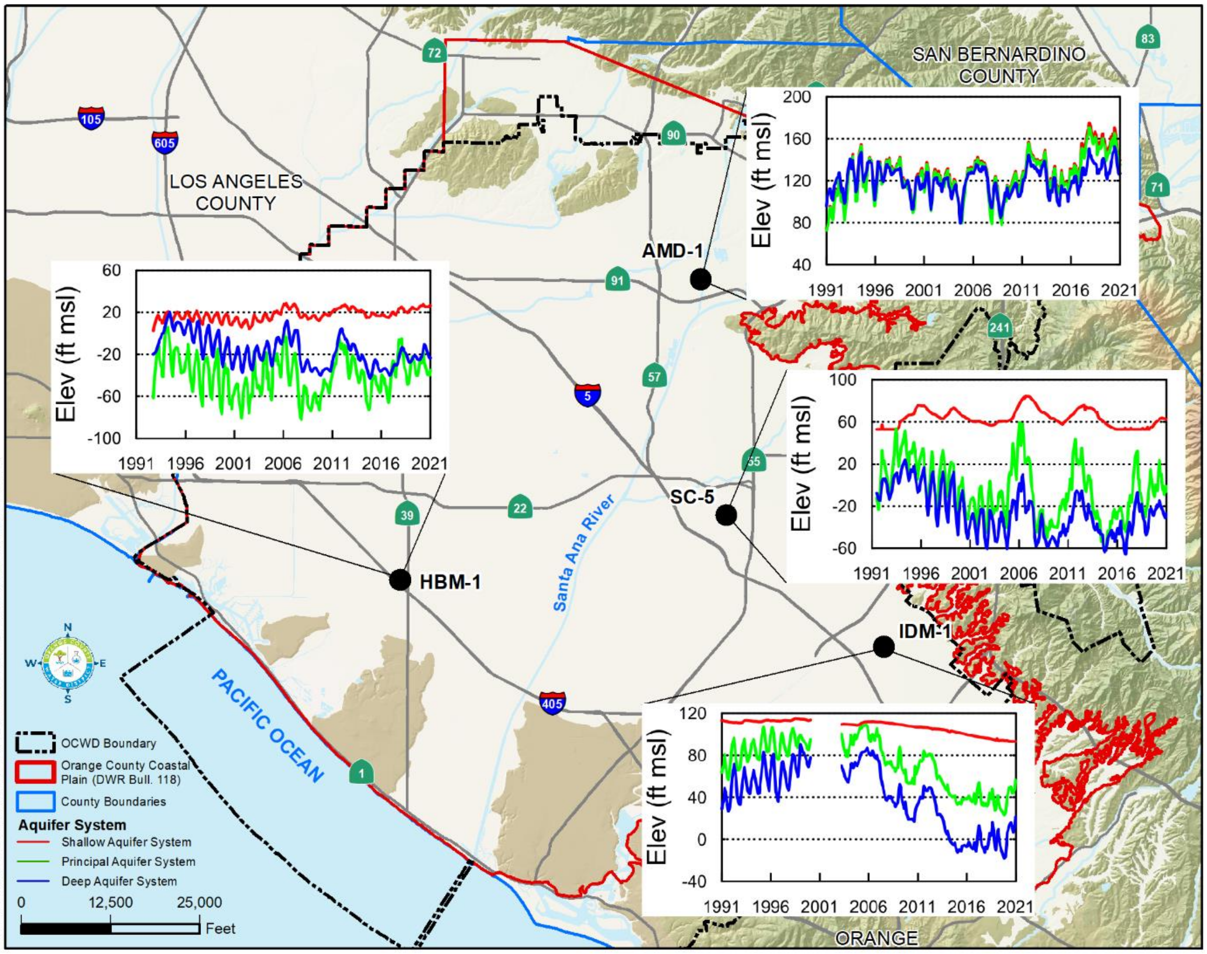


Figure 1-6: Example Hydrographs

Each year OCWD calculates the volume of groundwater storage change from a theoretical “full” benchmark condition based on a calculation using changes in groundwater elevations in each of the three major aquifer systems and aquifer storage properties. This calculation is checked against an annual water budget that accounts for all production, measured recharge and estimated unmeasured recharge (also referred to as “incidental recharge”). The amount of available or unfilled storage from the theoretical full condition is shown on Figure 1-3. Maintaining the basin storage condition on a long-term basis within the established operating range allows for long-term sustainable management of the basin without experiencing undesirable effects. Therefore, the undesirable result of “significant and unreasonable reduction of groundwater storage” is not present and is not anticipated to occur in the OCWD Management Area in the future due to OCWD’s management programs.

1.6.3 Sustainable Management: Water Quality

OCWD has extensive monitoring and management programs in place to monitor and protect groundwater quality. OCWD's network of approximately 400 monitoring wells is distributed throughout the basin. Water quality in these wells is tested on a regular basis for a large number of parameters. OCWD also conducts groundwater quality sampling of approximately 200 production wells on behalf of the groundwater producers to comply with Title 22 requirements. An additional approximately 120 private, domestic, and irrigation production wells area also sampled periodically.

OCWD has a sampling protocol in place that includes standards for increased monitoring of individual wells. In cases where there is a detection of an organic compound for the first time, for example, OCWD will resample that well and if the detection is confirmed will increase the sampling frequency of that well. Another example is an increased frequency for monitoring when there is a detection of nitrate at 50% of the Maximum Contaminant Level (MCL). These sampling protocols are designed to detect water quality problems at the earliest possible stage.

The recent detections of per- and polyfluoroalkyl substances (PFAS) in groundwater have affected the use of groundwater by 11 groundwater producers. As described in detail later in this report, OCWD is taking steps to restore the beneficial uses of impacted groundwater by installing treatment systems to remove PFAS.

The undesirable result of “significant and unreasonable degradation of water quality that impair water supplies” is not present and is not anticipated to occur in the future in the OCWD Management Area due to OCWD's management programs.

1.6.4 Sustainable Management: Seawater Intrusion

OCWD's management of seawater intrusion is implemented through a comprehensive program that includes operating two seawater intrusion barriers, monitoring and evaluating barrier performance, monitoring and evaluating susceptible coastal areas, and coastal groundwater management.

The Alamitos Seawater Intrusion Barrier manages seawater intrusion in the Alamitos Gap. The Talbert Seawater Intrusion Barrier manages seawater intrusion in the Talbert Gap. Work is underway to further characterize intrusion in the Sunset Gap, including construction of additional monitoring wells, further development of the Alamitos Barrier groundwater model to evaluate seawater intrusion in the area of the Sunset Gap, and feasibility studies to evaluate potential future barrier design.

Monitoring and evaluating barrier performance and potential seawater intrusion consists of sampling monitoring wells semi-annually, measuring water levels at least quarterly, installing monitoring wells when needed to fill data gaps, and conducting other management activities to reduce potential for seawater intrusion, such as construction of additional injection wells and the Coastal Pumping Transfer Program.

The undesirable result of “significant and unreasonable seawater intrusion” is not present and is not anticipated to occur in the future in the OCWD Management Area due to OCWD’s management programs.

1.6.5 Sustainable Management: Land Subsidence

Management of the groundwater basin by maintaining storage levels within the established operating range has prevented the undesirable result of significant and unreasonable land subsidence that substantially interferes with surface uses. Within the OCWD Management Area ground surface movements rise and fall as basin storage levels rise and fall. There is no evidence of long-term inelastic land subsidence, nor any land subsidence that has interfered with surface uses. Therefore, the undesirable result of “significant and unreasonable land subsidence that substantially interferes with surface uses” is not present and is not anticipated to occur in the OCWD Management Area in the future due to OCWD’s management programs.

1.6.6 Sustainable Management: Depletion of Interconnected Surface Waters

There are no surface water bodies within the OCWD Management Area that are interconnected with groundwater in which the groundwater connection to the surface water provides surface water flow to sustain beneficial uses in a surface water body. Therefore, the undesirable result of “depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water due to groundwater conditions occurring throughout the basin” is not present and is not anticipated to occur in the OCWD Management Area due to OCWD’s management programs.

1.7 PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Protocols that trigger a change in a monitoring program include a change in regulations, a first-time detection of a constituent in a water sample, an increase in a constituent in a water sample that approaches or exceeds a regulatory limit or MCL, an indication of an adverse water quality trend or water level, a special study, or a recommendation from OCWD’s Independent Expert Panel.

1.8 EVALUATION OF POTENTIAL PROJECTS

OCWD regularly evaluates potential projects and conducts studies to improve existing operations. This may include:

- Increasing the capacity of existing recharge basins
- Constructing new recharge facilities
- Constructing new production wells
- Improving seawater intrusion barriers

- Constructing a new seawater barrier in the Sunset Gap
- Constructing water quality improvement projects

1.9 CONCLUSION

OCWD has been managing the OCWD Management Area since its formation by the State Legislature in 1933. Monitoring and management programs described in the 2017 Alternative, submitted in compliance with CA Code of Regulations (Title 23, Division 2, Chapter 1.5, Subchapter 2) demonstrated that the groundwater basin has been and will continue to be sustainably managed. The Alternative submitted in 2017 and approved by DWR in 2019 demonstrated that the OCWD Management Area operated within its sustainable yield over a period of at least 10 years, as required by CCR Title 23, Division 2, Chapter 1.5, Subchapter 2, Article 9, Section 358.2 (c)(3). The 2022 Update, prepared to satisfy Water Code §10733.8, shows that the OCWD Management area continues to be managed sustainably.

Please note that for consistency, the same chapter headings used in the 2017 Alternative are used in the 2022 Update. The goal of the update is to present new relevant information that has become available over the last five years. Where there is no new relevant information, the reader is directed to the 2017 Alternative by reference.

SECTION 2 AGENCY INFORMATION

2.1 HISTORY OF OCWD

The Orange County Water District (OCWD) is a special district formed in 1933 by an act of the California Legislature, the OCWD Act. Additionally, as a special act district listed in Water Code § 10723 (c)(1), OCWD is the exclusive local agency within its jurisdictional boundaries with powers to comply with the Sustainable Groundwater Management Act (SGMA) via a groundwater sustainability plan ("GSP") or via an Alternative prepared in accordance with Water Code § 10733.6.

OCWD manages the groundwater basin that underlies north and central Orange County. Water produced from the basin is the primary water supply for approximately 2.5 million residents living within OCWD's boundaries. With passage of SGMA (Water Code §10723(c)) in 2014, OCWD was designated the exclusive local agency within its jurisdictional boundaries with powers to comply with SGMA.

Nineteen major groundwater producers, including cities, water districts, and a private water company, pump groundwater from approximately 200 large-capacity wells for retail water use. There are also approximately 120 small-capacity wells that pump water from the basin. OCWD protects and manages the groundwater resource for long-term sustainability, while meeting approximately 75 percent of the water demand within its service area.

Since its founding, OCWD has grown in area from 162,676 to 243,968 acres and has experienced an increase in population from approximately 120,000 to 2.5 million people. OCWD has employed groundwater management techniques to increase the annual yield from the basin including operating over 1,500 acres of recharge basins in the cities of Anaheim, Orange, and unincorporated areas of Orange County. Annual groundwater production increased from approximately 150,000 acre-feet per year in the mid-1950s to a high of over 366,000 acre-feet per year in WY2007-08.

OCWD has managed the basin to provide a reliable supply of relatively low-cost water, accommodating rapid population growth while at the same time avoiding the costly and time-consuming adjudication of water rights experienced in many other major groundwater basins in Southern California. Facing the challenge of increasing demand for water has fostered a history of innovation and creativity that has enabled OCWD to increase available groundwater supply while ensuring the long-term sustainability of the groundwater basin.

A brief history of OCWD from 1933 to 2015 is provided in the 2017 Alternative. Significant events that have occurred during the last five years are as follows:

2018: GWRS sets the Guinness World Record for most wastewater recycled in 24 hours. The official amount was 100,008,000 gallons.

2019: OCWD's Philip L. Anthony Water Quality Laboratory was the first public agency laboratory in California to achieve state certification to analyze for PFAS in drinking water. OCWD launched the nation's largest pilot program to test various treatment options for PFAS.

2019: Construction of the GWRS Final Expansion began. Construction is anticipated to be completed in early 2023. Once complete the plant will produce up to 130 mgd and recycle 100 percent of reclaimable sources from the Orange County Sanitation District.

2021: U.S. Army Corps of Engineers approves Prado Conservation Pool increase up to elevation 505 feet mean sea level (approx. 20,000 acre-feet of storage) based on the Prado Basin Ecosystem Restoration and Water Conservation Feasibility Study.

2021: The first PFAS treatment system, at Fullerton's KIM-1A production well, is completed and the well returned to service.

2.2 GOVERNANCE AND MANAGEMENT STRUCTURE

The Orange County Water District was created by the OCWD Act for the purpose of:

> "providing for the importation of water into said district and preventing waste of water in or exportation of water from said district and providing for reclamation of drainage, storm, flood and other water for beneficial use in said district and for the conservation and control of storm and flood water flowing into said district; providing for the organization and management of said district and establishing the boundaries and divisions thereof and defining the powers of the district, including the right of the district to sue and be sued, and the powers and duties of the officers thereof; providing for the construction of works and acquisition of property by the district to carry out the purposes of this act; authorizing the incurring of indebtedness and the voting, issuing and selling of bonds and the levying and collecting of assessments by said district; and providing for the inclusion of additional lands therein and exclusion of lands therefrom."
> (Stats.1933, c. 924, p. 2400)

Further details on OCWD governance and management are described in the 2017 Alternative. The nineteen major groundwater producers meet on a monthly basis with OCWD staff to consult with and provide advice on basin management issues. This group is described in more detail in Section 7.1.

2.3 LEGAL AUTHORITY

A description of OCWD's legal authority is described in the 2017 Alternative.

A copy of the OCWD Act, which has been the basis for OCWD's sustainable management of its portion of Basin 8-1 over many years, can be found at:
http://www.ocwd.com/media/2681/ocwddistrictact_201501.pdf

2.4 BUDGET

The mission of OCWD is to provide a reliable, high quality water supply in a cost-effective and environmentally responsible manner and to manage the Orange County groundwater basin in a sustainable manner over the long-term.

For a summary description of OCWD's budget structure, see the 2017 Alternative. For more recent information, see OCWD's website at www.ocwd.com where detailed budget reports are published annually.

SECTION 3 MANAGEMENT AREA DESCRIPTION

3.1 OCWD MANAGEMENT AREA

OCWD's service area covers approximately 430 square miles and is co-extensive with the OCWD Management Area for purposes of the Alternative, except as identified below. The OCWD service area includes 90 percent of the area designated by the Department of Water Resources (DWR) as Basin 8-1, the "Coastal Plain of Orange County Groundwater Basin" in Bulletin 118 (DWR, 2003). For the purposes of this Alternative, the OCWD Management Area contains the same geographical area as the portion of the OCWD service area within Basin 8-1 except for a small 6.7-square mile area in the northeast corner of the basin that is part of the Santa Ana Canyon Management Area. The boundaries of Basin 8-1, the OCWD service area and the OCWD Management Area are shown in Figure 3-1.

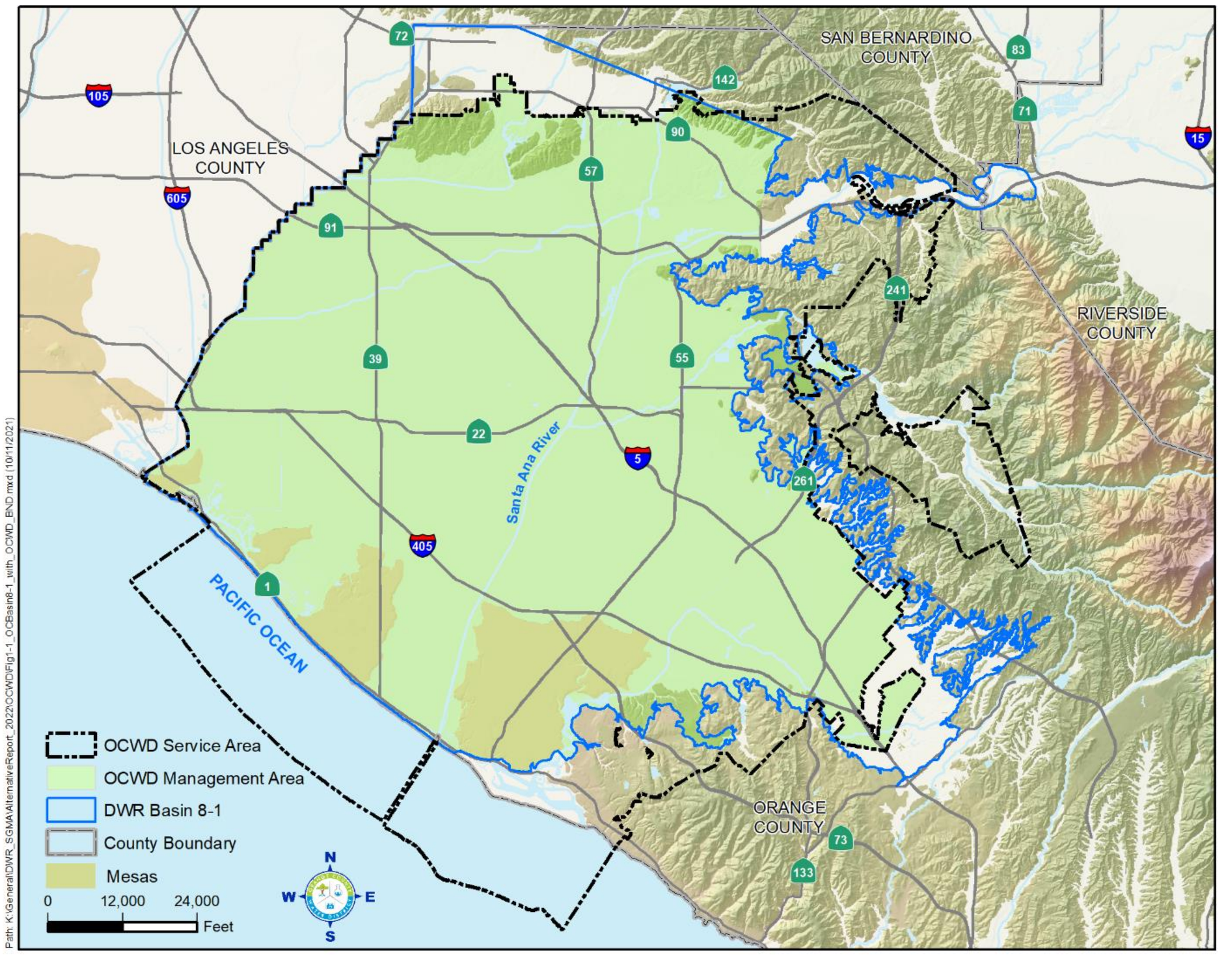


Figure 3-1: Basin 8-1, OCWD Service Area and OCWD Management Area

Jurisdictional Areas within OCWD Management Area

Federal and state lands within the OCWD Management Area as well as city boundaries are shown in Figure 3-2 and have not changed since the 2017 Alternative. Retail water providers within OCWD's service area are shown in Figure 3-3. The OCWD Management Area with a population of approximately 2.5 million is highly urbanized, as shown in Figure 3-4. Each of the 22 cities within OCWD's jurisdiction has an adopted general plan. There are no federally recognized tribes with land and there are no adjudicated groundwater areas within the OCWD Management Area. The unincorporated areas are managed by the County of Orange. Groundwater supplies are managed as a single, shared resource with no separate water use sectors.

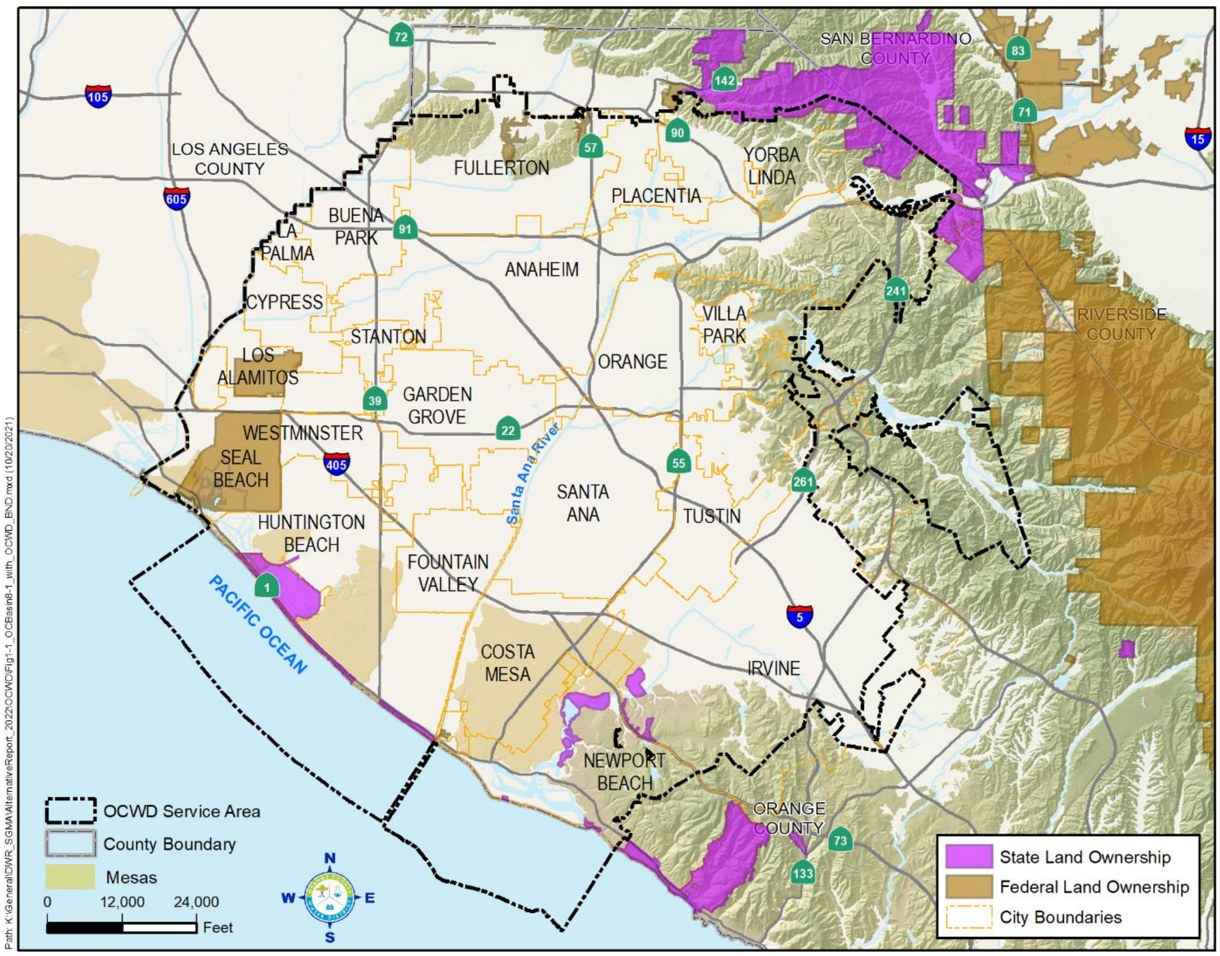


Figure 3-2: Federal and State Lands

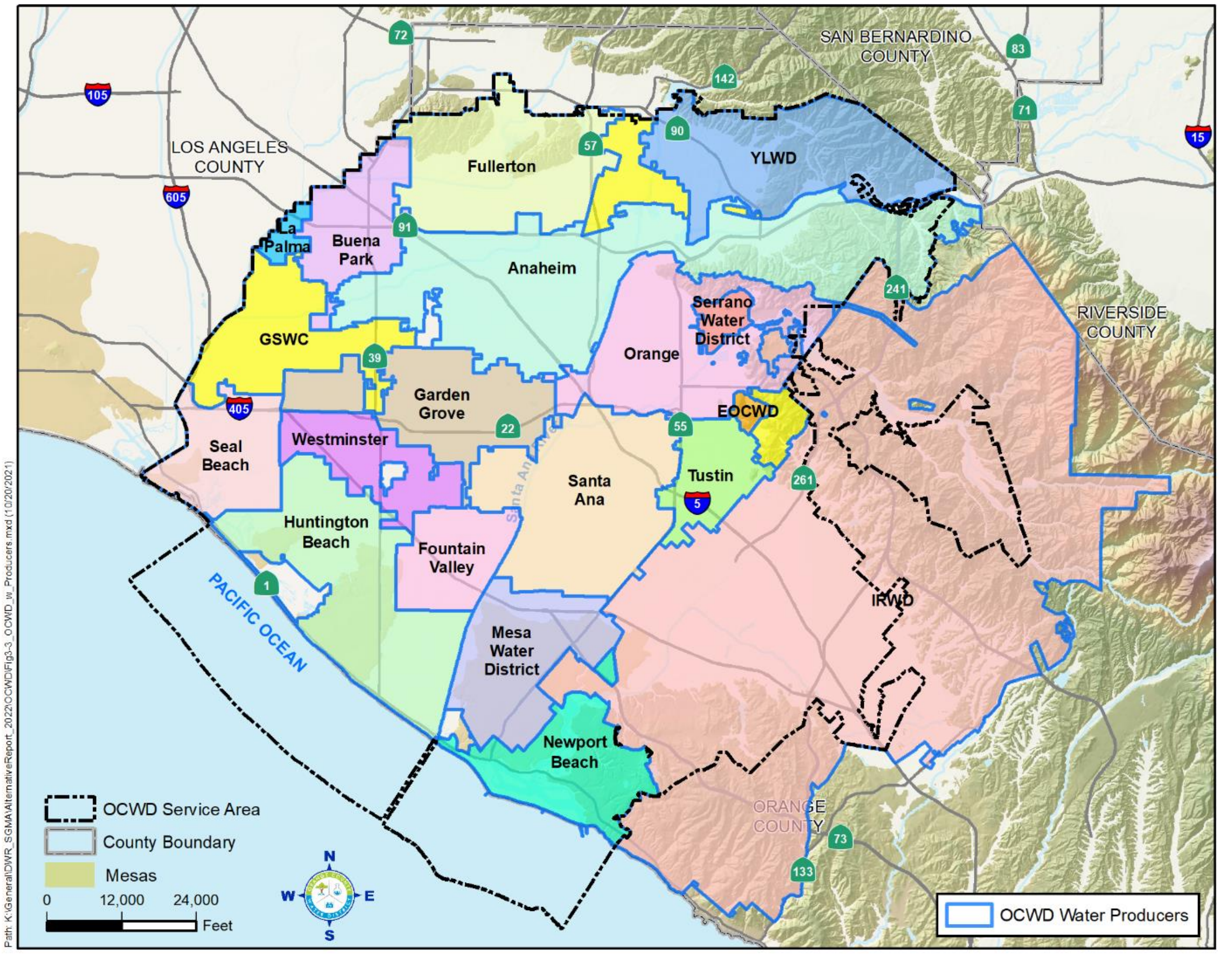


Figure 3-3: Retail Water Supply Agencies

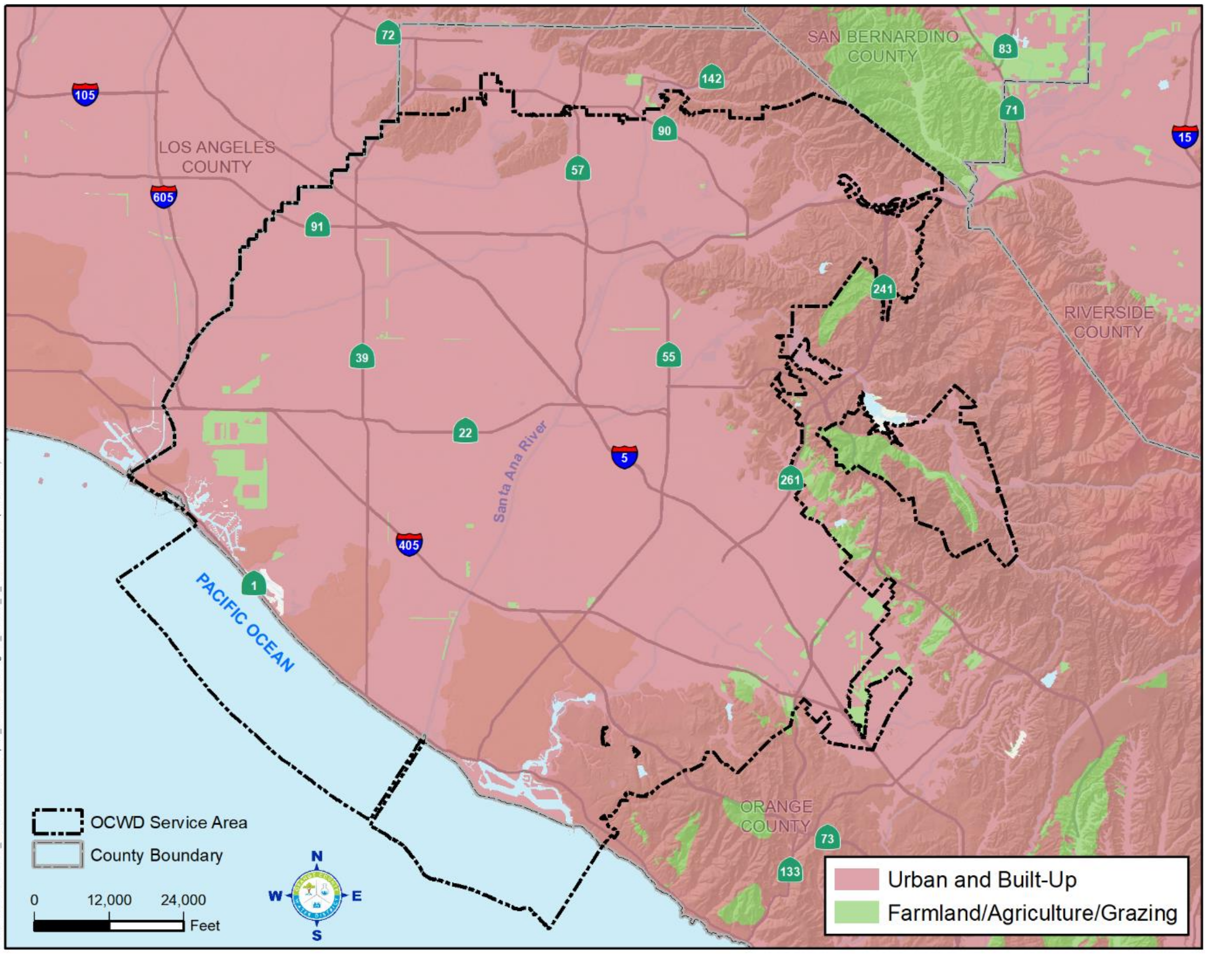


Figure 3-4: Land Uses

3.2 GROUNDWATER CONDITIONS

This section describes the groundwater conditions within the OCWD Management Area. The focus is on data from the last five years. For some historical data, please see the 2017 Alternative. The description includes groundwater elevation, pumping patterns, storage levels, groundwater quality, information concerning land subsidence, seawater intrusion, and interactions between surface water and groundwater. All elevations in this report are in units of feet above mean sea level referenced to vertical datum NGVD29, which can be converted to NAVD88. Geographic locations are reported in GPS State Plane coordinates referenced to NAD83.

3.2.1 Groundwater Elevation Contours

Figures 3-5, 3-6 and 3-7 show the contoured water levels for the Shallow, Principal and Deep Aquifers in June 2021. The contour maps for each of the three aquifer systems are prepared annually. The contour maps are used to prepare water level change maps for the three major aquifer systems and to calculate the amount of groundwater in storage and the annual storage change.

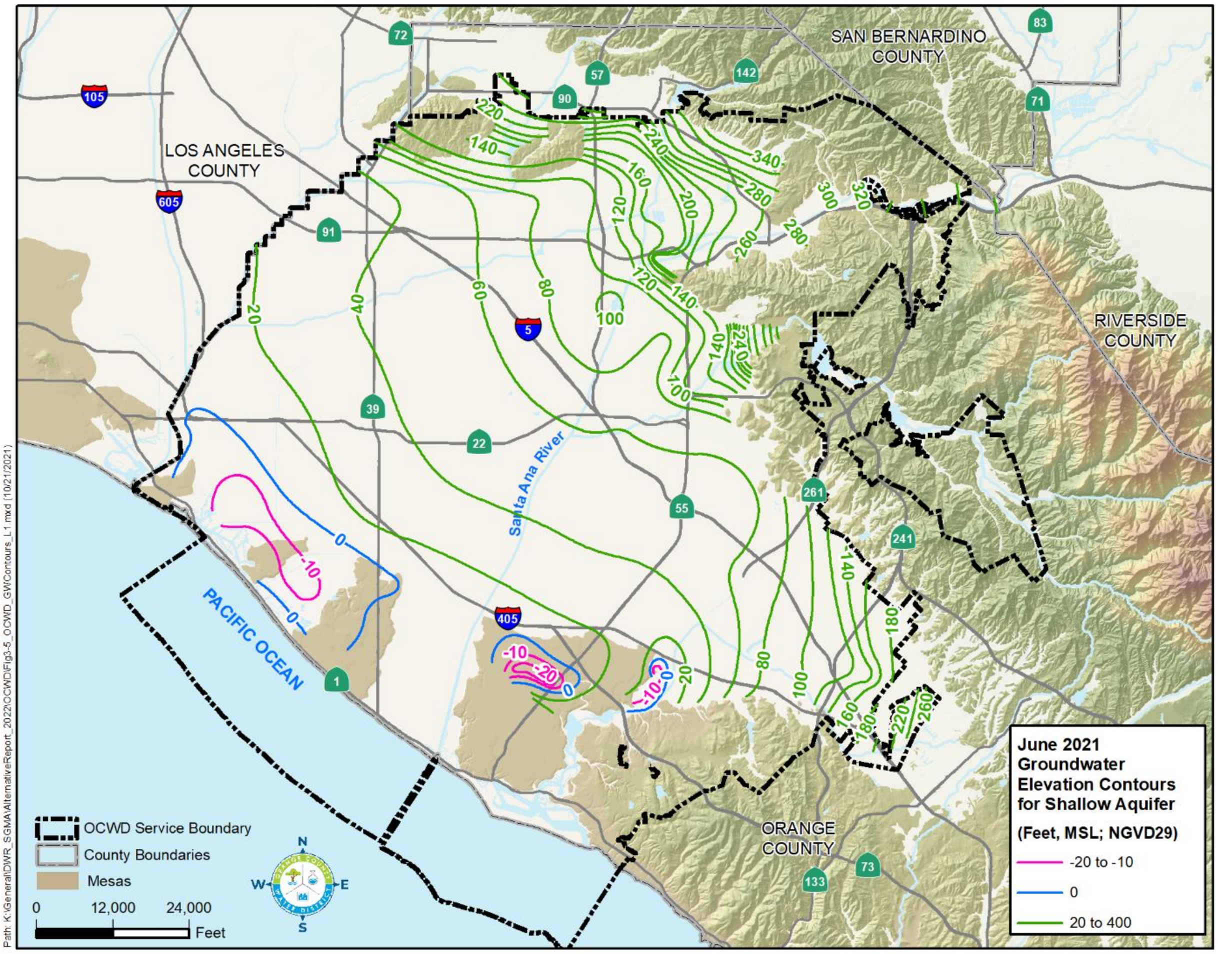


Figure 3-5: Groundwater Elevation Contours for the Shallow Aquifer, June 2021

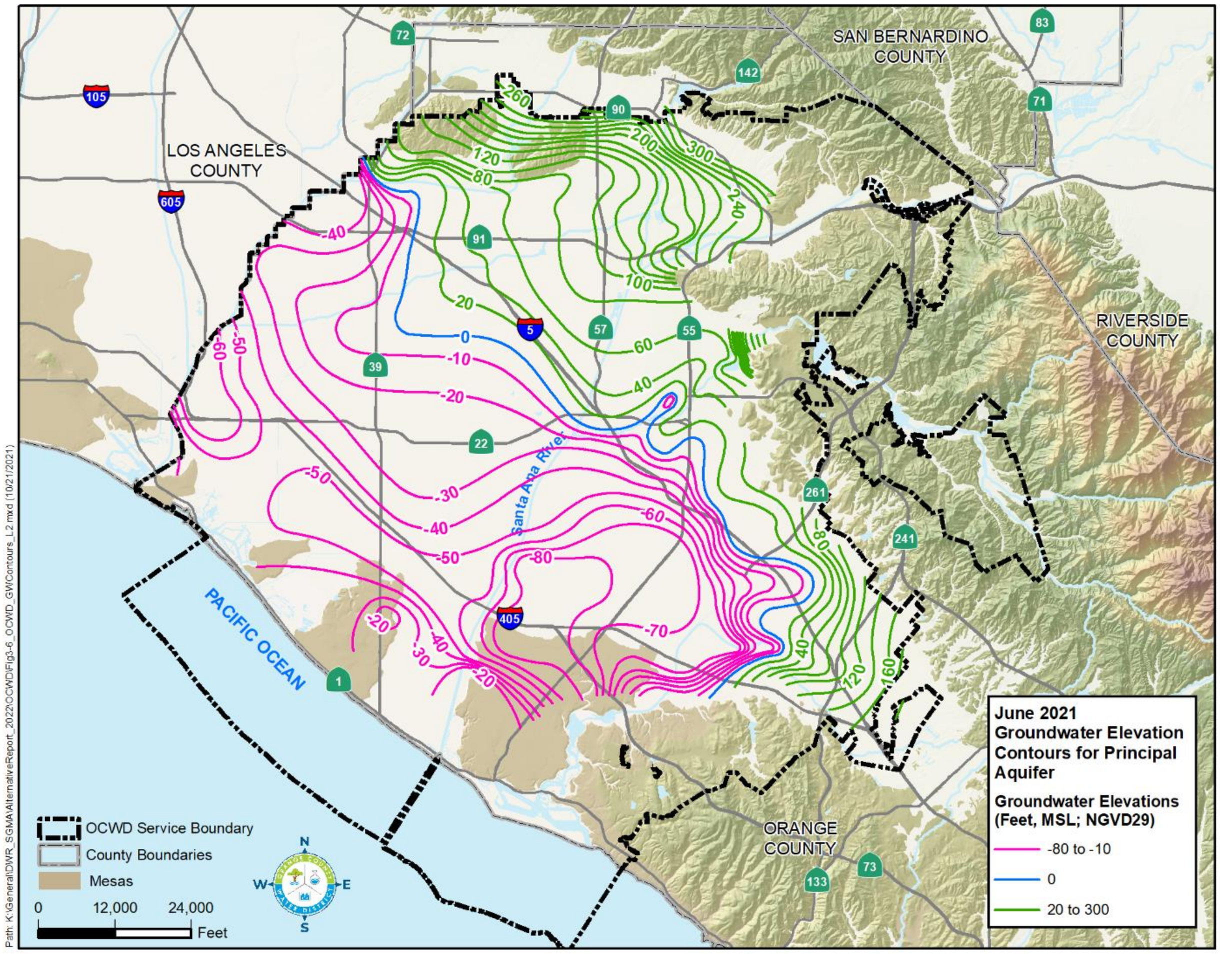


Figure 3-6: Groundwater Elevation Contours for the Principal Aquifer, June 2021

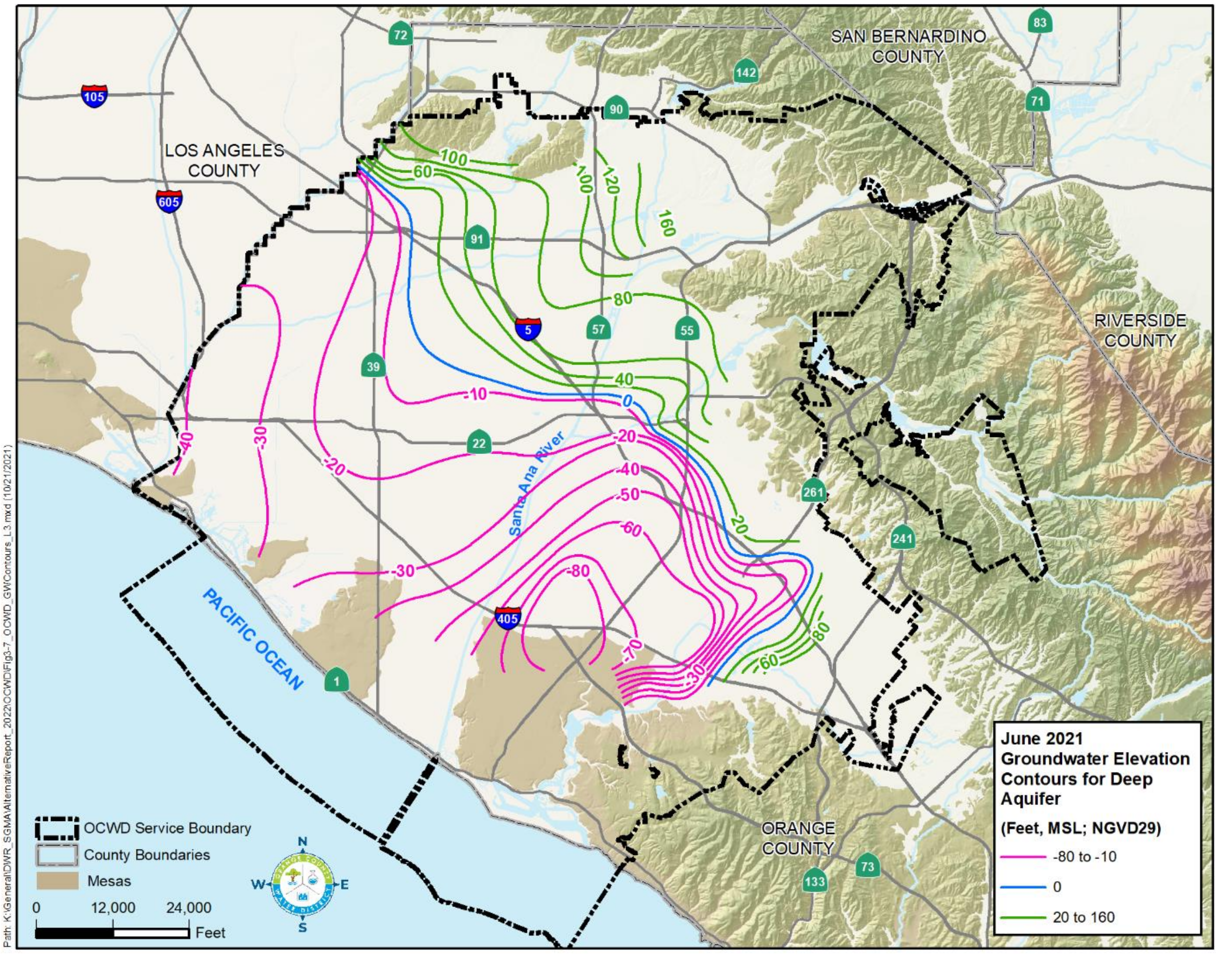
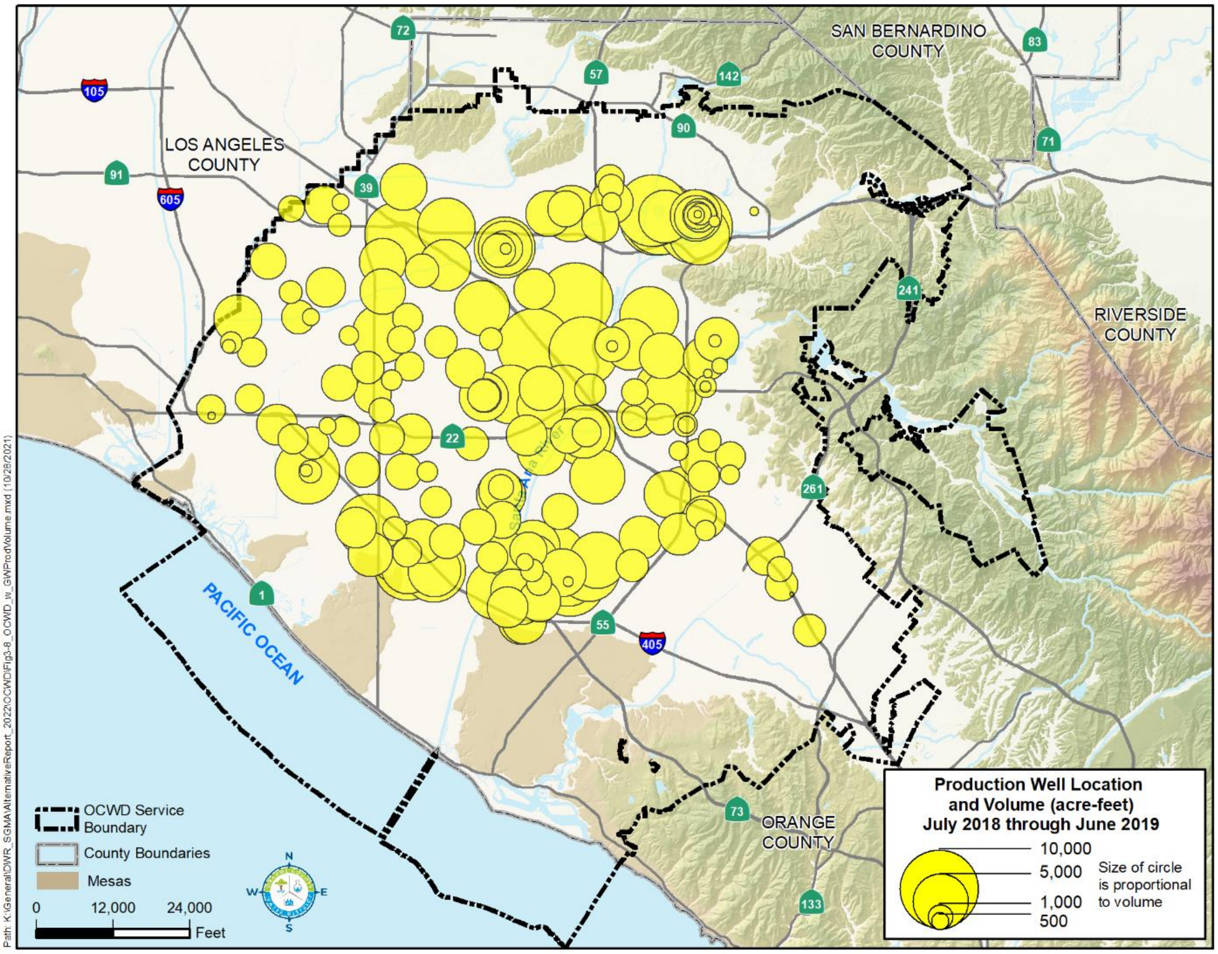


Figure 3-7: Groundwater Elevation Contours for the Deep Aquifer, June 2021

3.2.2 Regional Pumping Patterns

Active wells pumping water from the basin are shown in Figure 3-8. The approximately 200large-system wells account for an estimated 97 percent of the total basin production. The remaining three percent of total basin production includes agricultural and industrial producers, small mutual water companies, domestic well producers, and production from privately-owned wells. As can be seen in Figure 3-8, groundwater production is distributed throughout the basin. Please note that due to the recent impacts of COVID and PFAS, data from WY2018-19 is presented to show the typical average distribution of pumping in the basin.



* Due to impacts from COVID-19 FY 2018-19 groundwater production was chosen to be representative of typical pumping patterns.

Figure 3-8: Groundwater Production, WY2018-19

3.2.3 Long-Term Groundwater Elevation Hydrographs

Groundwater elevation trends exhibit both short-term (seasonal) and long-term fluctuations. Seasonal elevation changes reflect short-term variations in pumping and recharge, while multi-year trends reflect the effects of extended periods of above- or below-average precipitation and/or availability of imported water.

OCWD measures elevations in three principal aquifer systems. In general, groundwater elevations in the Shallow Aquifer system show less amplitude than those in the underlying Principal and Deep Aquifer systems due to the higher degree of pumping and confinement of the Principal and Deep Aquifer systems. Because approximately 95 percent of all production occurs from wells screened within the Principal Aquifer system, groundwater elevations within this system are typically lower than those in the overlying Shallow Aquifer system and, in some areas, the underlying Deep Aquifer system. As a result, vertical gradients created by pumping and recharge drive groundwater into the Principal Aquifer system from the overlying Shallow Aquifer system and, to a lesser extent, from the Deep Aquifer system.

Groundwater elevation trends can be examined using seven wells with long-term groundwater level data, the locations of which are shown in Figure 3-9. Figures 3-10 and 3-11 show water level hydrographs for wells SA-21 and GG-16 representing historical conditions in the Pressure Area and well A-27 representing historical conditions in the Forebay. Water level data for well A-27 near Anaheim Lake dates back to 1932 and indicate that the historic low water level in this area occurred in 1951-52. The subsequent replenishment of Colorado River water essentially refilled the basin by 1965. Water levels in this well reached a historic high in 1994 and have generally remained high as recharge has been nearly continuous at Anaheim Lake since the late 1950s. Well A-27 was destroyed in May 2012. To continue this hydrograph, water levels from nearby OCWD monitoring well, AMD-9/1 is used. A comparison of water levels when the two wells were in operation show they are nearly identical.

The hydrograph for well SA-21 indicates that water levels in this area have decreased since 1970. Also noteworthy is the large range of water level fluctuations from the early 1990s to early 2000s. The increased water level fluctuations during this period were due to a combination seasonal water demand-driven pumping and participation in the Metropolitan Water District of Southern California's (MWD) Short-Term Seasonal Storage Program by local groundwater producers (Boyle Engineering and OCWD, 1997), which encouraged increased pumping from the groundwater basin during summer months when MWD was experiencing high demand for imported water. Although this program did not increase the amount of pumping from the basin on an annual basis, it did result in greater water level declines during the summer during the period of 1989 to 2002 when the program was active.

Figure 3-12 presents water level hydrographs of two OCWD multi-depth monitoring wells, SAR-1 and OCWD-CTG1, showing the relationship between water level elevations in aquifer zones at different depths. The hydrograph of well SAR-1 in the Forebay exhibits a similarity in water levels between shallow and deep aquifers, which indicates the high degree of hydraulic interconnection between aquifers characteristic of much of the Forebay.

The hydrograph of well OCWD-CTG1 is typical of the Pressure Area in that there are large differences in water levels in different aquifers, indicating a reduced level of hydraulic interconnectivity between shallow and deep aquifers caused by fine-grained layers that restrict vertical groundwater flow. Water levels in the deepest aquifer zone at well OCWD-CTG1 are higher than overlying aquifers, in part, because few wells directly produce water from these zones. The lack of production from the deepest aquifers is due to the presences of amber-colored water, the cost to construct very deep wells, and the fact that sufficient high-quality groundwater is readily available within the overlying Principal aquifer.

Two additional hydrographs for wells HBM-1 and IDM-1 show multi-depth water levels representative of the coastal area and the southwestern portion of the management area. The downward trend in water levels at well IDM-1 shows the effects of a water quality improvement project known as the Irvine Desalter Project. This joint project between OCWD and IRWD, in collaboration with the U.S. Department of Navy, went on line in 2006 and consists of production wells, pipelines, and treatment facilities to remove, treat, and put to beneficial use groundwater that contains elevated TDS, nitrate, and/or trichloroethylene. To provide the intended hydraulic containment of this impacted groundwater, lowered groundwater levels in the Irvine area were necessary and expected based on model projections.

For additional information and background information on groundwater level measurements, see the 2017 Alternative.

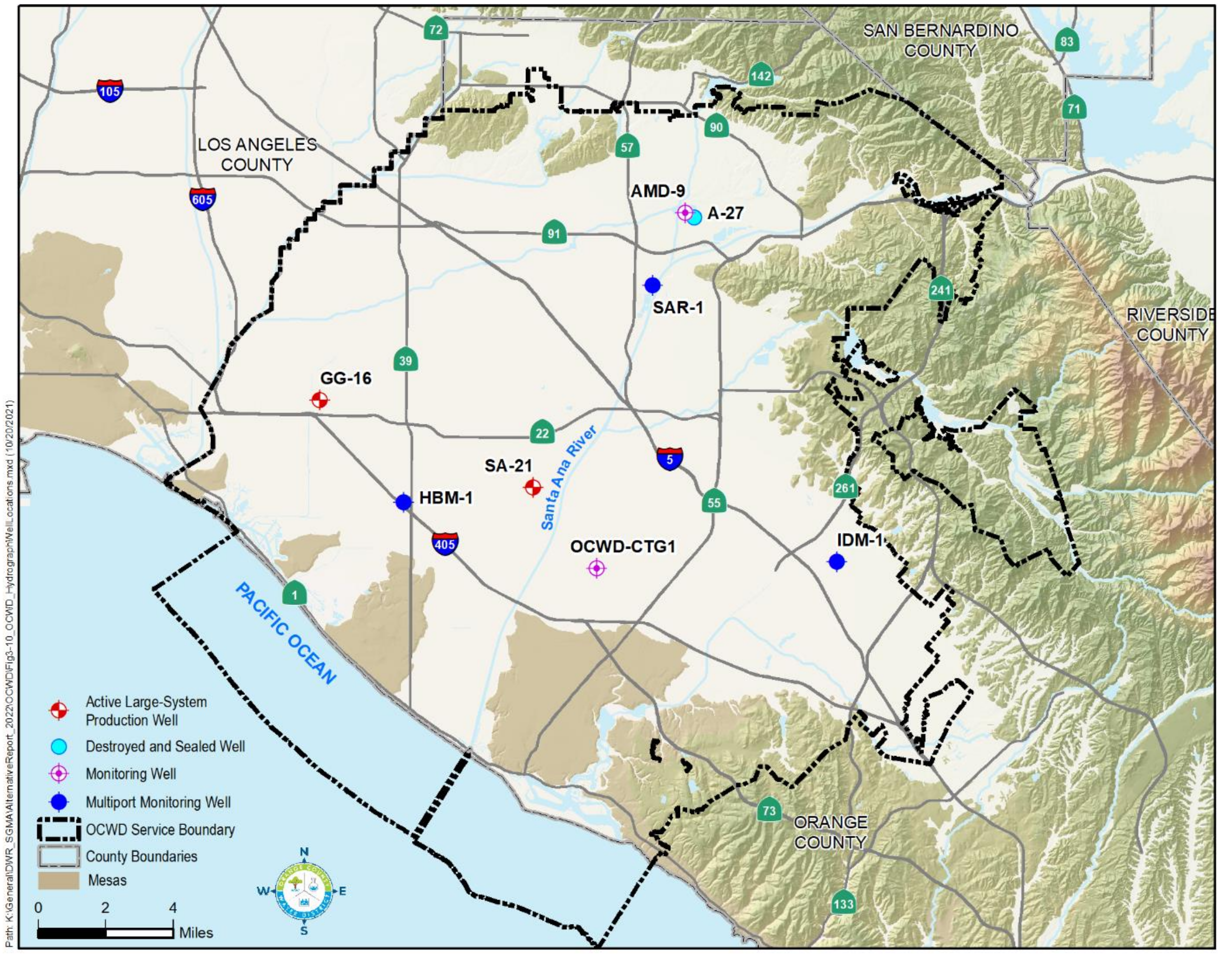
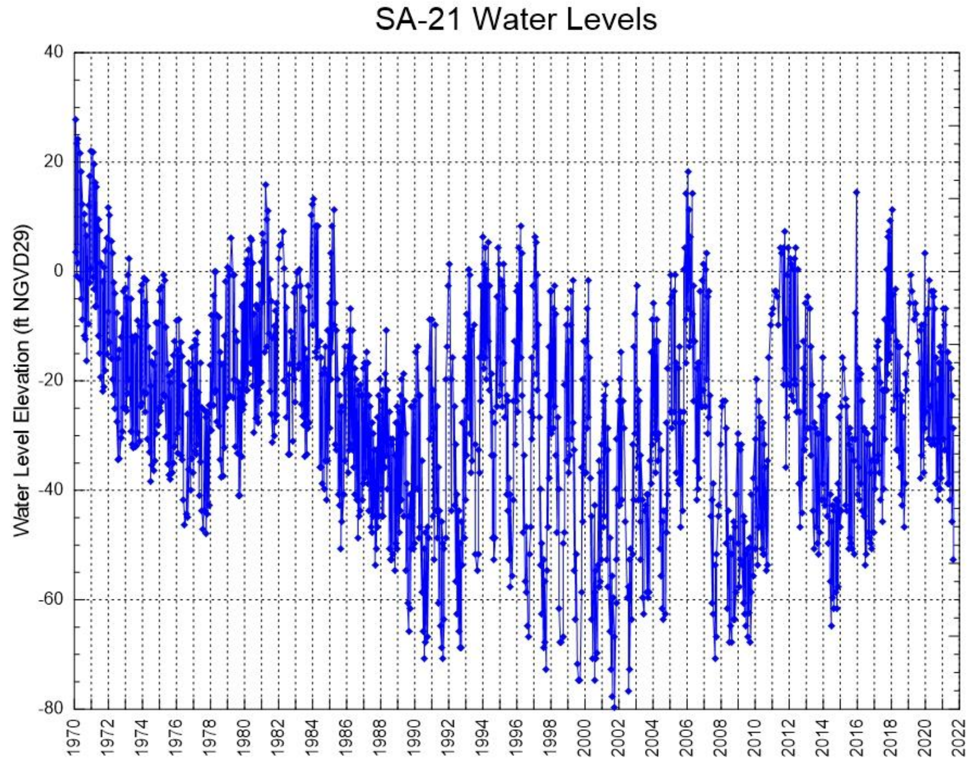


Figure 3-9: Location of Long-Term Groundwater Elevation Hydrographs



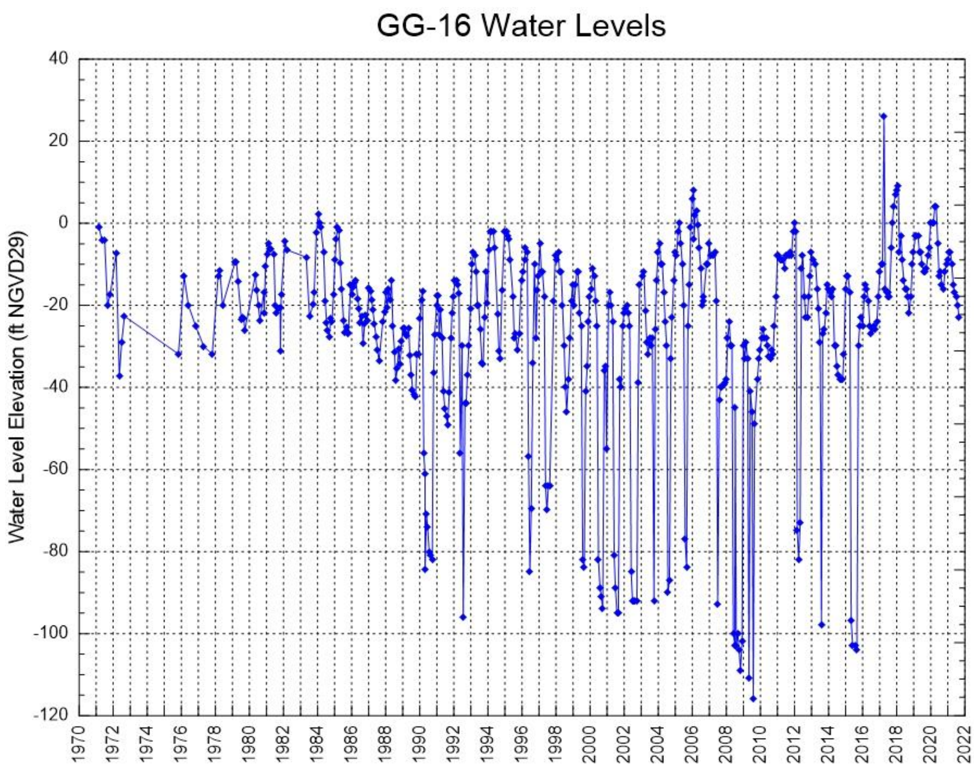


Figure 3-10: Water Level Hydrographs of Wells SA-21 and GG-16 in Pressure Area

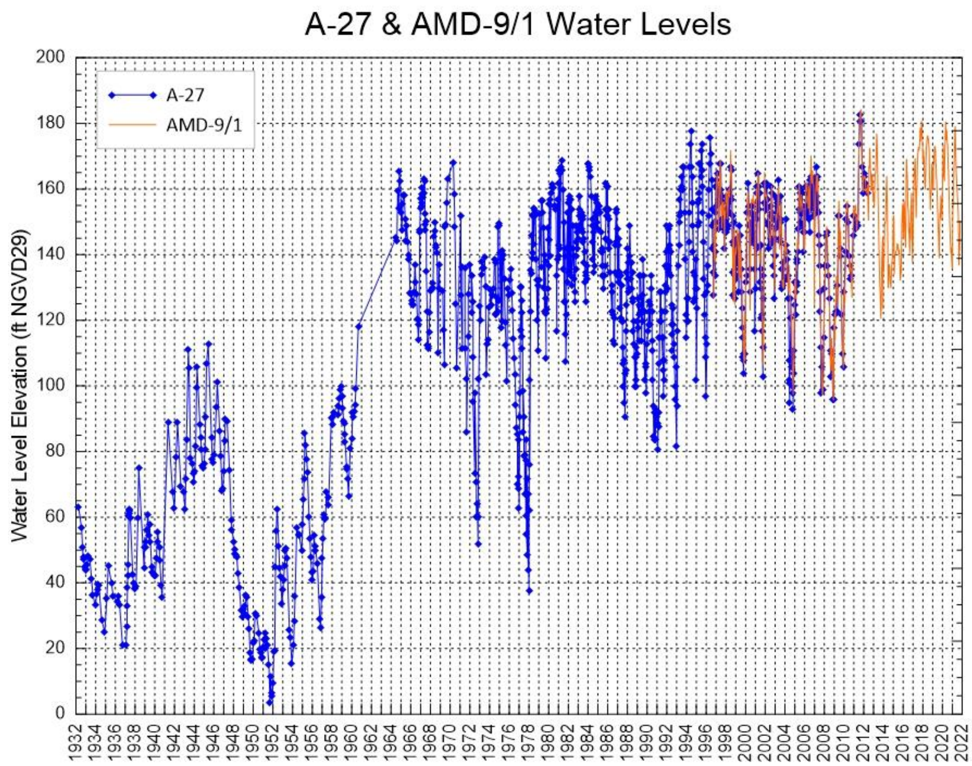


Figure 3-11: Water Level Hydrograph of Well A-27/AMD-9 in Forebay Area

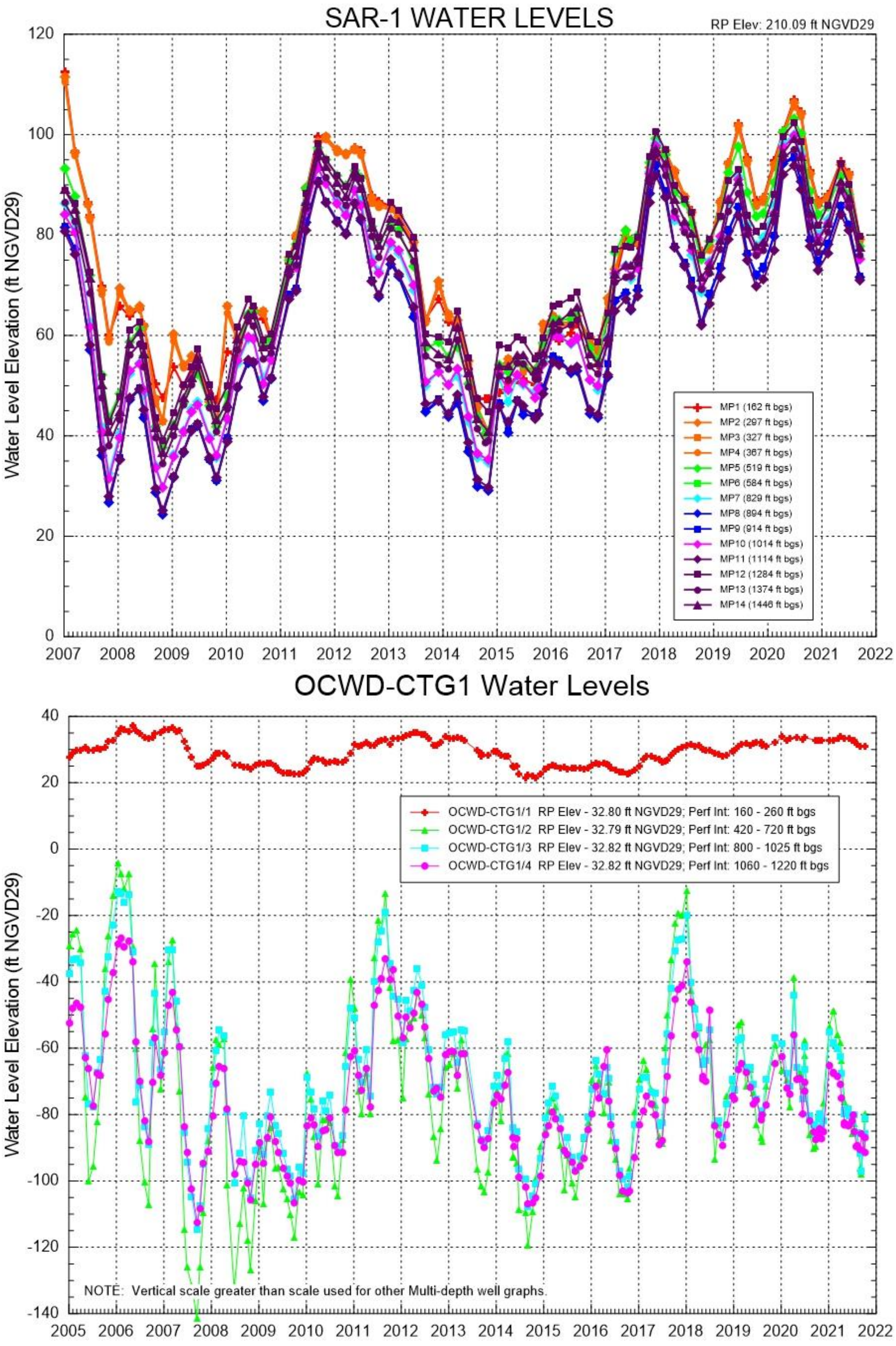


Figure 3-12: Water Level Hydrographs of Wells SAR-1 and OCWD-CTG1

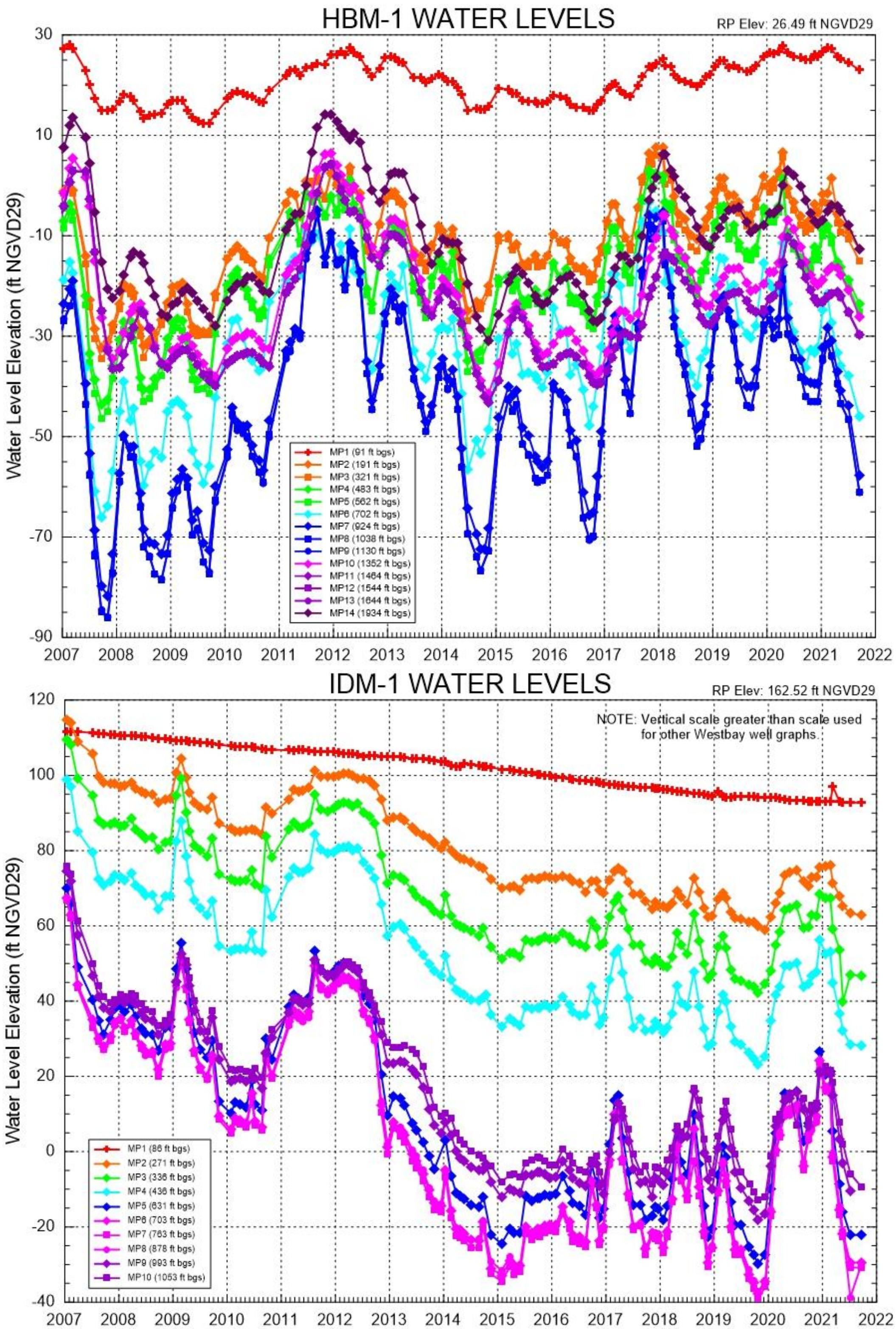


Figure 3-13: Water Level Hydrographs of Wells HBM-1 and IDM-1

3.2.4 Groundwater Storage Data

OCWD operates the basin within an operating range from a full condition to approximately 500,000 acre-feet below full to protect against seawater intrusion, inelastic land subsidence, and other potential undesirable results. Figure 1-3 shows how storage has fluctuated from 1958 to 2021. On a short-term basis, the basin can be operated at an even lower storage level in an emergency.

In order to manage the basin within this operating range, OCWD calculates the change in storage relative to a full basin condition on an annual basis for the three aquifer layers, an example of which is shown in Figure 3-14.

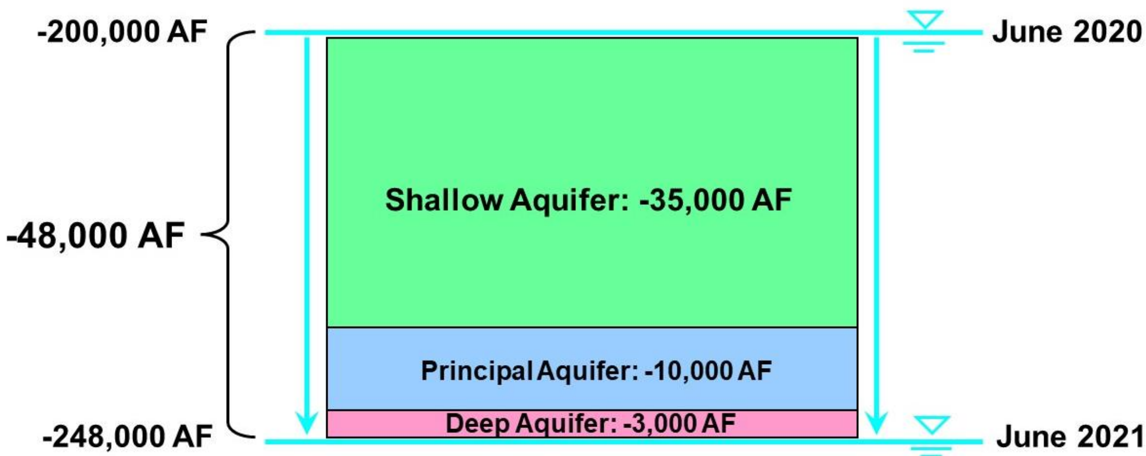


Figure 3-14: Groundwater Storage Change, June 2020 to June 2021

3.3 BASIN MODEL

OCWD's basin model encompasses most of Basin 8-1 and extends approximately three miles into the Central Basin in Los Angeles County to provide for more accurate model results than if the model boundary stopped at the county line (see Figure 3-15). The county line is not a hydrogeologic boundary, and groundwater freely flows through aquifers that have been correlated across the county line. The model provides a tool to supplement the storage change calculations that are done each year with actual groundwater elevation data. The model also provides a tool to conduct evaluations of proposed projects and operating scenarios.

For more detailed information about the model, please refer to the 2017 Alternative.

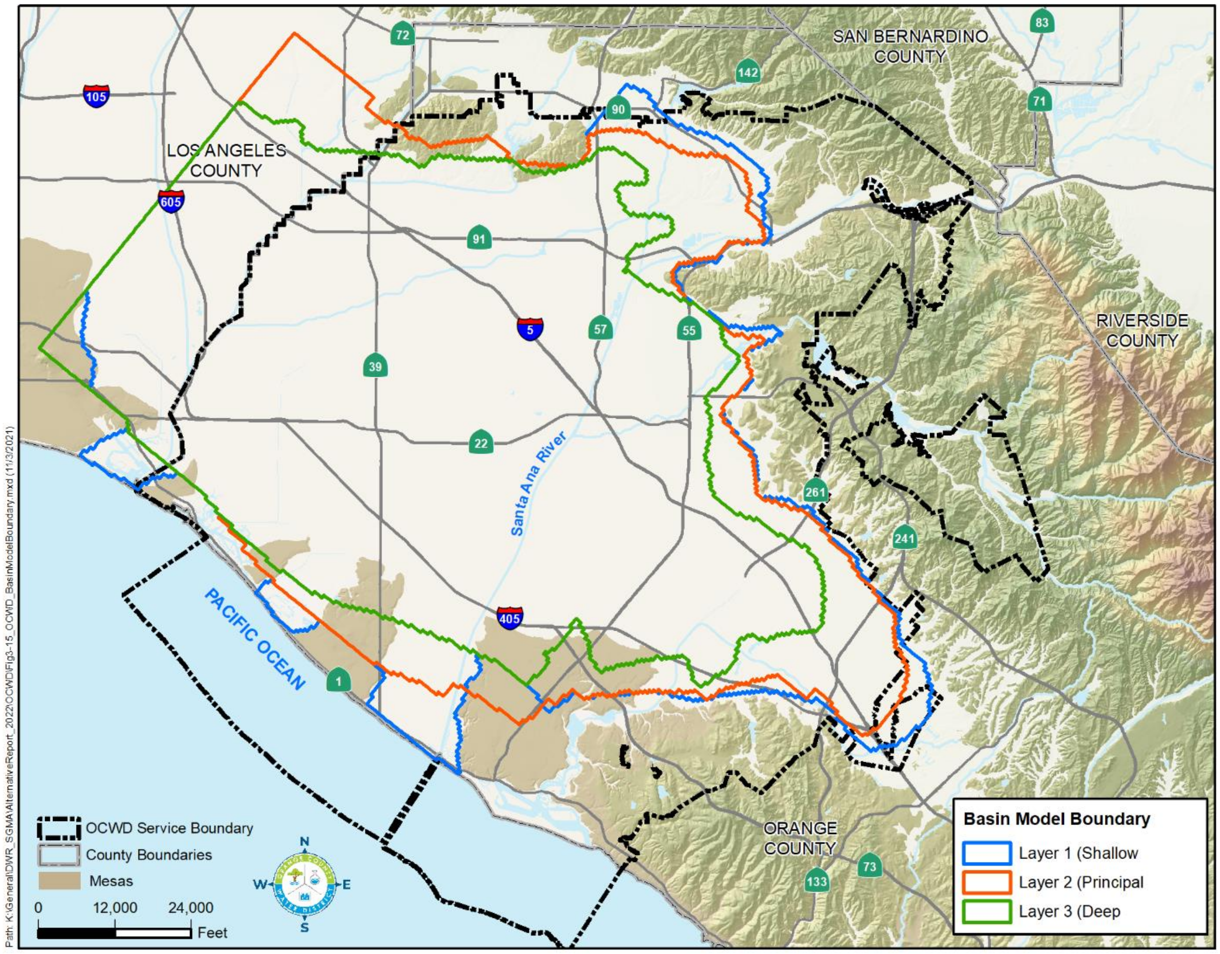


Figure 3-15: OCWD Groundwater Basin Model Boundaries

OCWD staff update the basin groundwater model approximately every three to five years. Major changes and improvements since the 2017 Alternative was submitted include:

1. Extension of the model transient calibration through WY2016-17. The new calibration period is November 1990 to June 2017 which includes a wide range of basin storage conditions as well as a wide range of hydrologic conditions.

2. Addition of new recharge basin, La Palma Basin.

3. Updating aquifer parameters, i.e., hydraulic conductivity and storage parameters, changes during calibration (still in progress).

4. Model layer revision in Irvine Sub Basin area.

3.3.1 Groundwater Quality Conditions

Salinity

At the state level, the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards have authority to manage TDS concentrations in water supplies. The salinity management program for the Santa Ana River Watershed is implemented by the Basin Monitoring Program Task Force (Task Force), a group comprised of water districts, wastewater treatment agencies and the Regional Water Board. OCWD is a member of the Task Force.

Historical ambient or baseline conditions were calculated for levels of TDS and nitrate (as N) in each of the 39 groundwater management zones in the watershed. Management Zones established by the Regional Water Board within the OCWD Management Area are shown in Figure 3-16. The TDS water quality objectives and ambient water quality levels for the two zones within the OCWD Management Area are shown in Table 3-1.

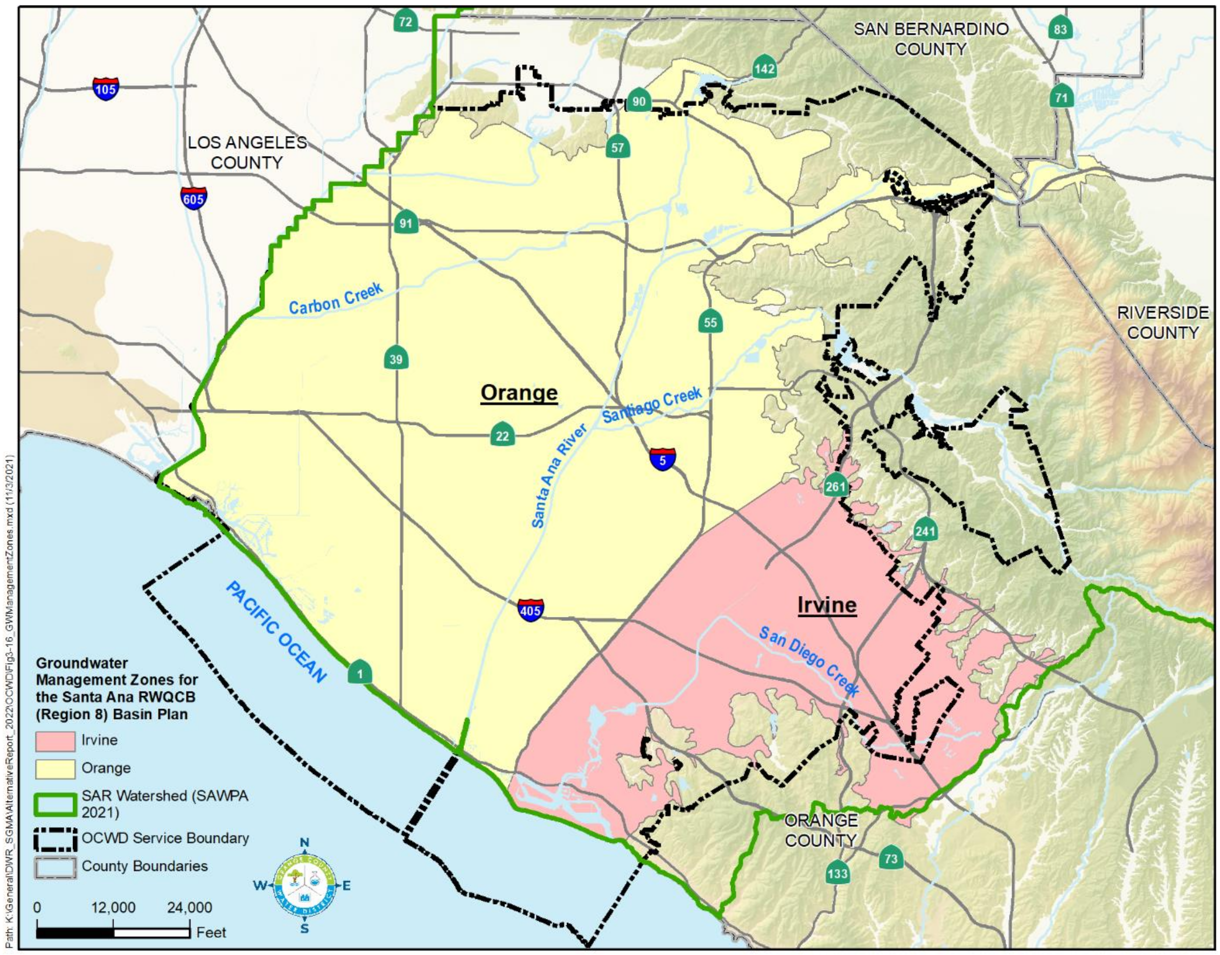


Figure 3-16: Regional Water Board Groundwater Management Zones

Table 3-1: TDS Water Quality Objectives for Lower Santa Ana River Basin Management Zones

Groundwater Management Zone	Water Quality Objective	2018 Ambient Quality*
Orange	580 mg/L	603 mg/L
Irvine	910 mg/L	877 mg/L

*Water Systems Consulting, 2020.

Figure 3-17 shows the average TDS at production wells in the basin for WY2016-17 to 2020-21. In general, the TDS concentrations in the Principal Aquifer in the Orange Groundwater Management Zone generally range from 300 to 400 mg/L in the Pressure Area and from 500 to 700 mg/L in the Forebay Area. In the Irvine Groundwater Management Zone, TDS concentrations range from approximately 400 mg/L west of Culver Drive to 1,000 mg/L in the area northeast of Interstate 5.

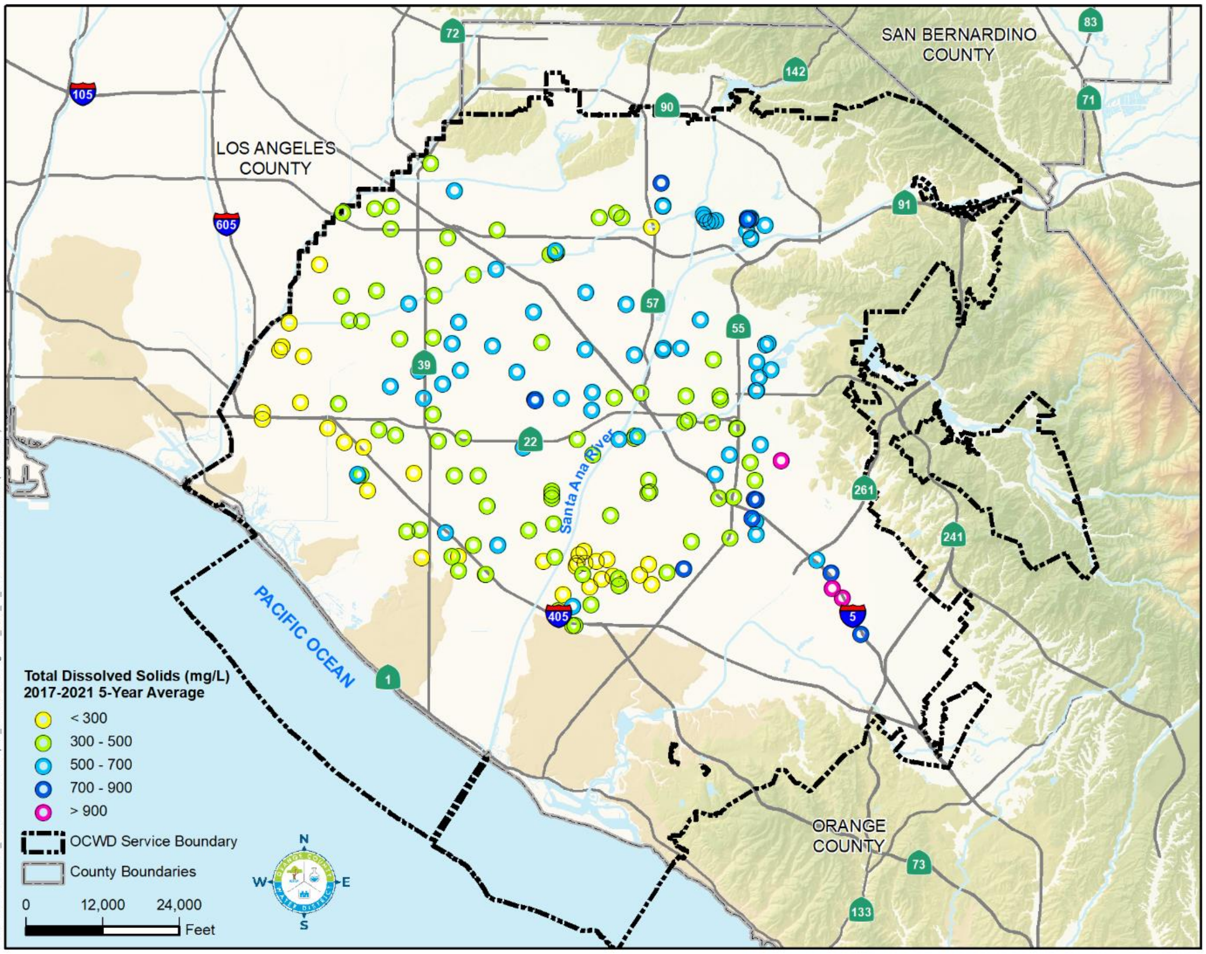


Figure 3-17: TDS in Groundwater Production Wells, 5-year average, WY2016-17 to 2020-21

Nitrate

Management of nitrate is a component of the salinity management program in the Santa Ana River Watershed. Along with TDS objectives, water quality objectives for nitrate (as N) are established for each of the 39 groundwater management zones in the watershed. Water quality objectives and ambient quality levels for the zones within the OCWD Management Area are shown in Table 3-2.

Figure 3-18 shows the 5-year average nitrate (as N) levels in production wells for WY2016-17 to 2020-21. In general, nitrate (as N) concentrations in the Orange Groundwater Management Zone are generally less than 5 mg/L. There are some localized areas with concentrations greater than 10 mg/L. In cases where pumped groundwater exceeds the MCL, the groundwater producer treats the water to reduce nitrate (as N) levels prior to being served to customers.

Table 3-2: Nitrate (as N) Water Quality Objective for Lower Santa Ana River Basin Management Zones

Groundwater Management Zone	Water Quality Objective	2018 Ambient Quality*
Orange	3.4 mg/L	3.0 mg/L
Irvine	5.9 mg/L	6.37 mg/L

*Water Systems Consulting, 2020.

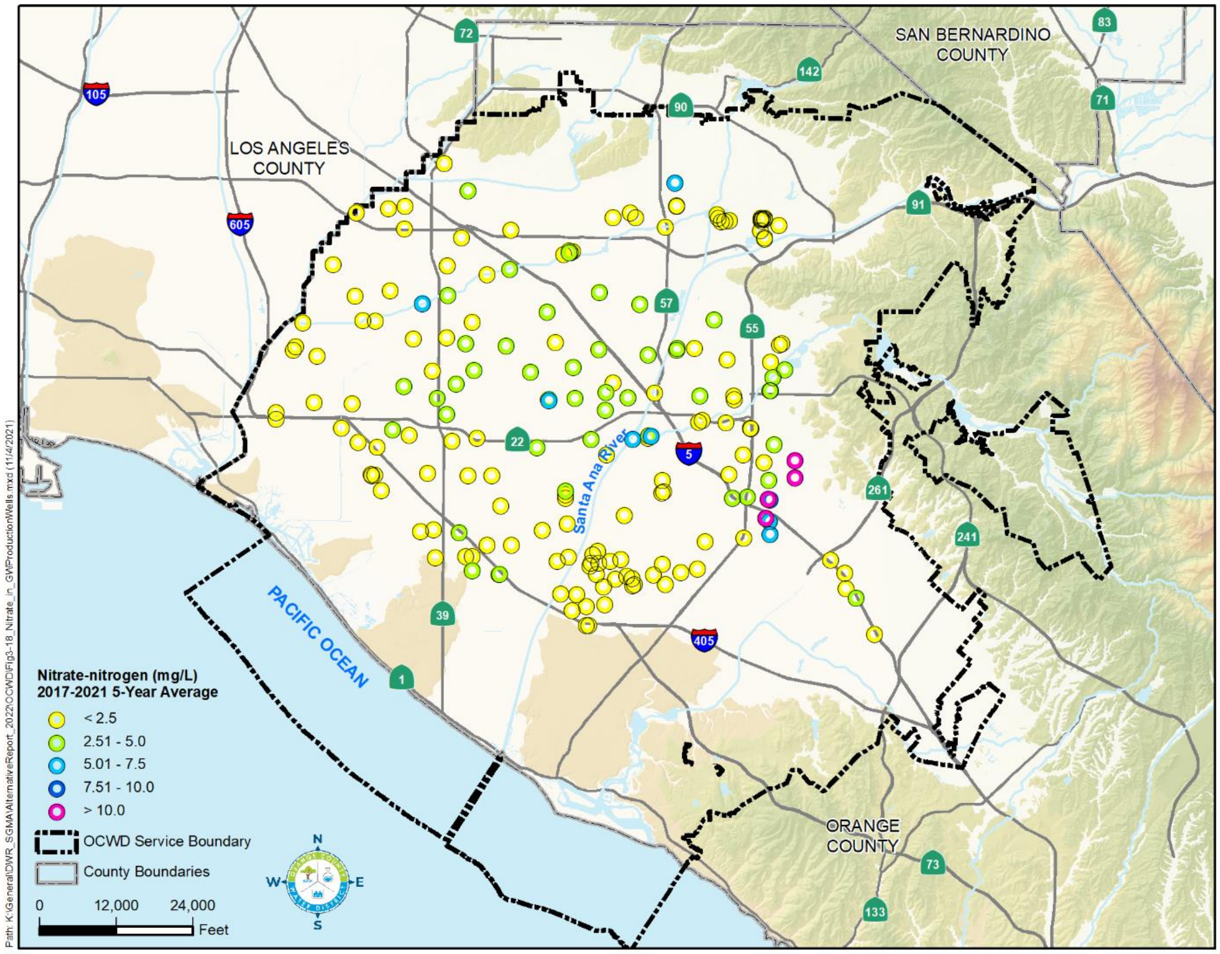


Figure 3-18: Nitrate (as N) Levels in Groundwater Production Wells, 5-year average, WY2016-17 to 2020-21

Per- and polyfluoroalkyl substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are a group of thousands of manmade chemicals that includes perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). PFAS compounds have been commonly used in many products including, among many others, stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, and fire-fighting foams. Beginning in the summer of 2019, the California Division of Drinking Water (DDW) began requiring testing for PFAS compounds in some groundwater production wells in the OCWD area.

In February 2020, the DDW lowered its Response Levels (RL) for PFOA and PFOS to 10 and 40 parts per trillion (ppt or nanogram/L, ng/L), respectively. In March 2021, DDW established a third PFAS RL for perfluorobutane sulfonate (PFBS) at 5,000 ppt. The DDW recommends the public water systems not serve any water exceeding the RL – effectively making the RL a *de facto* interim MCL while the state undertakes the formal process to set an enforceable MCL. In response to DDW's issuance of the revised RL, as of September 2021, approximately 60 wells in the OCWD service area have been temporarily turned off until treatment systems can be constructed. As additional wells are tested, this figure may increase. The state has begun the process of establishing MCLs for PFOA and PFOS; in July 2021, the state Office of Environmental Health Hazard Assessment (OEHHA) released draft Public Health Goals (PHGs) for PFOA and PFOS or 0.007 ng/L and 1 ng/L, respectively, for public comment. After the PHGs are finalized, DDW will formally begin developing corresponding MCLs and currently anticipates issuing a final MCL by 2023 or 2024. OCWD anticipates the MCLs will be set at or below the RLs.

In April 2020, OCWD as the groundwater basin manager, executed a multi-party agreement with the impacted groundwater producers to fund and construct the necessary treatment systems for production wells impacted by PFAS compounds. The PFAS treatment projects include the design, permitting, construction, and operation of PFAS treatment systems for impacted production wells. Each well treatment system will be evaluated for use with either granular activated carbon (GAC), ion exchange (IX), or an alternative novel sorbent for the removal of PFAS compounds. These treatment systems utilize vessels in a lead-lag configuration to remove PFOA and PFOS to less than 2 ppt, the current laboratory detection limit. These PFAS treatment systems are designed to ensure the groundwater supplied by producer wells can be served in compliance with current and future PFAS regulations. The groundwater producers will own the treatment systems once they are completed. With financial assistance from OCWD, the groundwater producers will operate and maintain the new treatment systems once they are constructed.

To minimize alternative water supply expenses and provide maximum protection to the public water supply, OCWD initiated design, permitting, and construction of the PFAS treatment projects on a schedule that allows rapid deployment of treatment systems. As of September 2021, construction contracts have been awarded for treatment systems for production wells owned by the cities of Orange (Phase 1), and Garden Grove, Serrano Water District, and Yorba Linda Water District. The City of Anaheim has also awarded a design-build contact (phase A) for 8 impacted wells, that will be reimbursed by OCWD. The City of Fullerton's well KIM-1A treatment system has been completed and is in operation. Additional construction contracts are anticipated to be awarded for impacted wells operated by the cities of Fullerton (Main Plant), Orange (Phase 2), Santa Ana, Tustin, Irvine Ranch Water District and East Orange County Water District by early 2022. OCWD expects the treatment systems to be constructed for the approximately 60 impacted wells within the next 2 to 3 years.

As monitoring continues and additional wells are taken off-line due to PFAS detections reported at or near the current RL (or future MCL), OCWD will continue to partner with the affected groundwater producers and take action to design and construct necessary treatment systems to bring the impacted wells back online as quickly as possible.

Groundwater production in WY2020-21 was expected to be approximately 325,000 acre-feet but declined to 282,000 acre-feet primarily due to PFAS impacted wells being turned off around February 2020. OCWD expects groundwater production to be in the area of 250,000 acre-feet in WY2021-22 due to the currently idled wells and additional wells being impacted by PFAS and turned off. As PFAS treatment systems are constructed, OCWD expects total annual groundwater production to slowly increase back to levels similar to years prior to PFAS impacts.

Contamination Plumes

Major groundwater contamination sites within the OCWD Management Area include areas where contamination has migrated significantly beyond the contamination sources and threaten to further impact the groundwater quality. These plumes, shown in Figure 3-19, are in the process of being remediated, and some are being evaluated for additional remediation.

The North Basin Volatile Organic Compound (VOC) plume area contains contaminated groundwater primarily in the Shallow Aquifer, which is generally less than 200 feet deep with migration downward into the Principal Aquifer. OCWD is performing a remedial investigation/feasibility study (RI/FS) under the oversight of the U.S. EPA and working with state regulatory agencies and stakeholders to evaluate and develop effective remedies to address the contamination under the National Contingency Plan process. The U.S. EPA is the lead agency for this North Basin RI/FS.

The South Basin plume area contains VOCs and perchlorate. OCWD has collected extensive data to delineate the comingled plumes. OCWD is performing an RI/FS in consultation with the Regional Water Board, Department of Toxic Substances Control, and stakeholders to evaluate and develop effective remedies to address the contamination under the National Contingency Plan process, designated as the South Basin Groundwater Protection Project (SBGPP).

The U.S. Navy is taking the lead in remediation of three groundwater contamination plumes of VOCs in the vicinity of the former El Toro Marine Corps Air Station (MCAS), former Tustin MCAS, and the Naval Weapons Station Seal Beach.

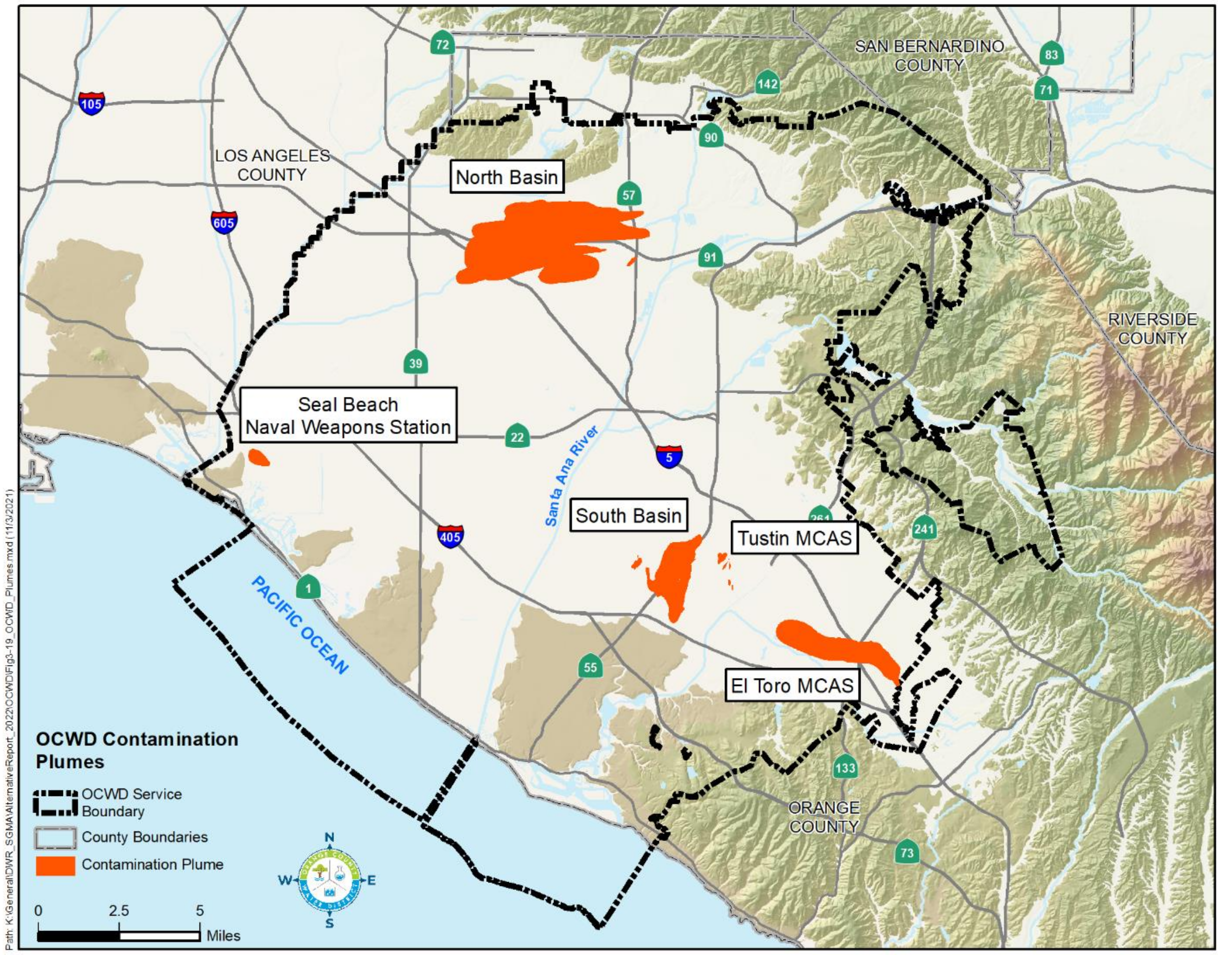


Figure 3-19: Groundwater Contamination Plume Locations

3.3.2 Coastal Gaps

In the coastal area of Orange County, the primary source of saline groundwater is seawater intrusion into the basin through permeable aquifer sediments underlying topographic lowlands or gaps between the erosional remnants or mesas of the Newport-Inglewood Uplift. The susceptible locations from north to south are the Alamitos, Sunset, Bolsa, and Talbert gaps as shown in Figure 3-20. Note that new wells added within the last five years are shown in Figure 3-20.

Background information on these gaps is contained in the 2017 Alternative. Ongoing activities related to seawater intrusion protection is described in subsequent sections of this report.

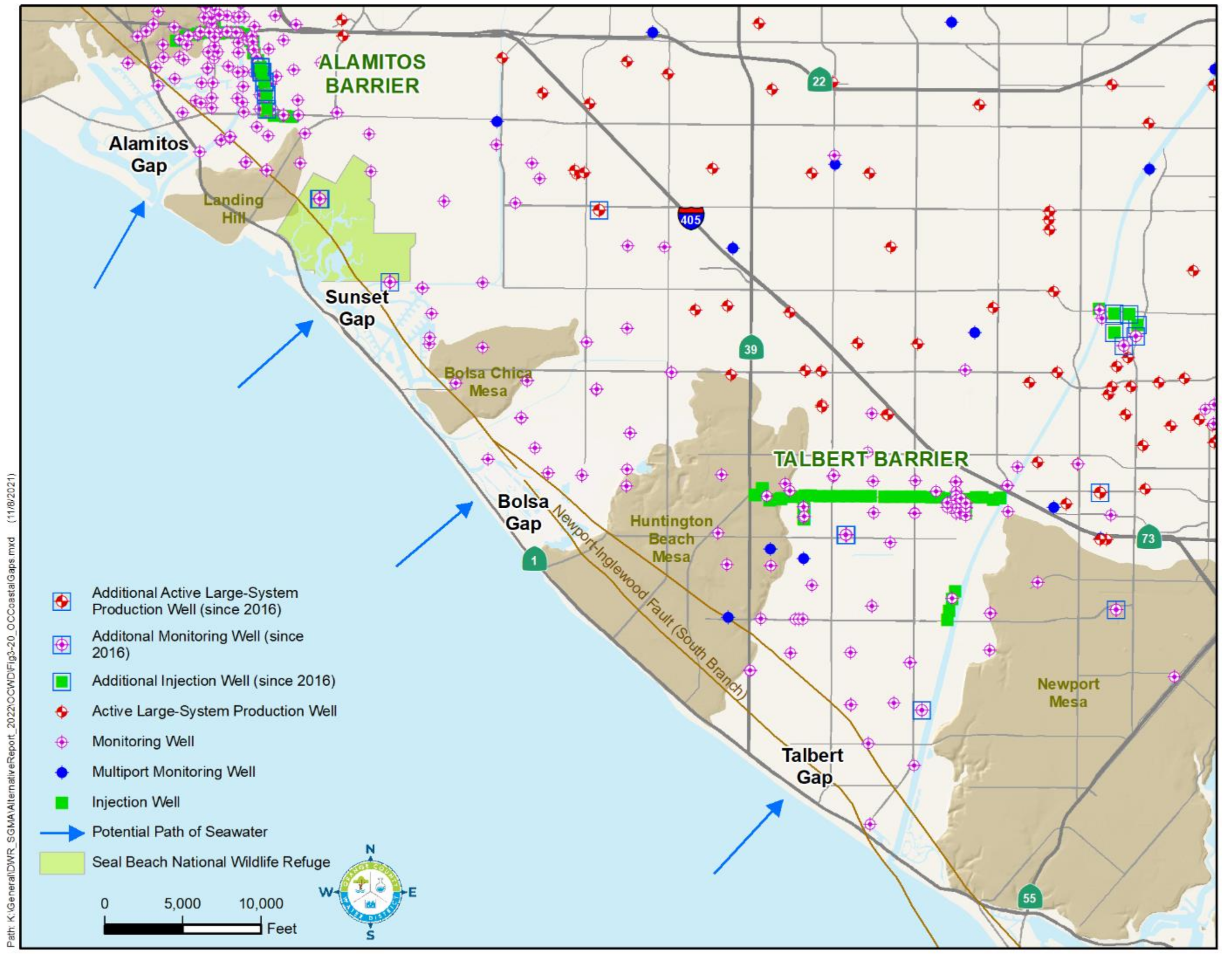


Figure 3-20: Orange County Coastal Gaps

3.3.3 Land Subsidence

In Orange County, subsidence in swampy low-lying coastal areas underlain by shallow organic peat deposits started as early as 1898 when development of these areas for agriculture resulted in excavation of unlined drainage ditches. The ditches drained the swamps and intercepted the shallow water table which was lowered to allow the land to drain adequately for irrigated agriculture. When the shallow water table was lowered, it exposed the formerly saturated peat deposits to oxygen that caused depletion and shrinkage of the peat due to oxidation (Fairchild and Wiebe, 1976).

Subsidence related to shallow peat deposits was associated with land development practices that occurred in Orange County in the late 1800s and early 1900s and, as such, is not something associated with or controlled by groundwater withdrawals in the basin. Another documented cause of subsidence in Orange County unrelated to groundwater basin utilization is oil extraction along the coast, particularly in Huntington Beach (Morton et al., 1976).

Ground surface elevations rise and fall due to groundwater conditions in the OCWD Management Area, and there is no indication of widespread irreversible lowering of the ground surface. Storage conditions in the groundwater basin were at historical lows in the mid-1950s, but since this time OCWD has operated the groundwater basin within a storage range above this historical low. There are reports that some subsidence may have occurred before OCWD began refilling the groundwater basin in the late 1950s (Morton, et al., 1976); however, the magnitude and scope of this subsidence is uncertain, and it is not clear if this subsidence was permanent. As such, there is no evidence of permanent, inelastic land subsidence in the OCWD Management Area (see Section 13), and future subsidence is not expected as long as OCWD continues to manage basin storage above the historic low observed in the late 1950s.

3.3.4 Groundwater/Surface Water Interactions and Groundwater Dependent Ecosystems

Frequent and destructive flooding of the Santa Ana River in Orange County was the impetus for construction of Prado Dam in 1941. Prior to the construction of flood control facilities, the banks of the Santa Ana River naturally overflowed periodically and flooded broad areas of Orange County. Coastal marshes were inundated during winter storms, and the mouth of the river moved both northward and southward of its present location. In the days before flood control, surface water naturally percolated into the groundwater basin, replenishing groundwater supplies.

Subsequent flood protection efforts included construction of levees along the river and concrete-lined bottoms along portions of the river. Flood risk was reduced, increased pumping of groundwater lowered water levels, and low-lying areas were filled in and/or equipped with drains, pumps and other flood control measures to allow for urban development. Since at least the 1950s, groundwater levels throughout the OCWD Management Area have been low enough that the rising and lowering of groundwater levels do not impact surface water flows or ecosystems.

Although it is outside the OCWD Management Area (within the Santa Ana Canyon Management Area described later), it is noted that from Prado Dam to Imperial Highway, the wide soft-bottomed Santa Ana River channel supports riparian habitat. Riparian habitat is dependent on river water released through Prado Dam, which is predominantly treated wastewater discharged in the upper watershed when storm flow is not present. In aggregate, this stretch is generally considered to be in equilibrium between surface water and groundwater based on available stream gage and groundwater level data, although some infiltration may occur due to minor groundwater pumping in the Santa Ana Canyon Management Area.

As the Santa Ana River enters the OCWD Management Area, from Imperial Highway to 17th Street in Santa Ana, there is minimal riparian habitat, and the river is a losing reach with engineered facilities to infiltrate surface water into the groundwater basin. OCWD conducts recharge operations within the soft-bottomed river channel except for a portion of the river where the Riverview Golf Course occupies the river channel. The river levees are constructed of either rip-rap or concrete.

From 17th Street to near Adams Avenue in Costa Mesa, the river channel is concrete-lined for flood control with vertical to sloping concrete side walls and a concrete bottom. From Adams Avenue to the coast, the channel has vertical concrete side walls or rip-rap for flood control and a soft bottom. Estuary conditions within the concrete channel exist at the mouth of the river where the ocean encroaches at high tide. The tidal prism extends from the ocean approximately three miles inland to the Adams Avenue Bridge.

There are no surface water bodies within the boundaries of the OCWD Management Area that are dependent on groundwater. Therefore, there are no groundwater-dependent ecosystems in the OCWD Management Area.

Some areas in the basin experience relatively high groundwater levels due to perched groundwater where shallow groundwater is impeded from flowing into deeper groundwater by a layer of low-permeable clay or silt, known as an aquitard. Except in very low-lying areas near sea level, the high groundwater is not close enough to the surface to support hydrophilic vegetation. OCWD carefully monitors water levels in the vicinity of the Talbert Seawater Barrier in order to maintain injection well rates to assure that groundwater levels do not rise to levels that could threaten urban infrastructure.

SECTION 4 WATER BUDGET

OCWD developed a hydrologic budget (inflows and outflows) for the purpose of constructing a basin-wide groundwater flow model, (Basin Model) and for evaluating basin production capacity and recharge requirements. The key components of the budget include measured and unmeasured (estimated) recharge, groundwater production, and subsurface flows along the coast and across the Orange County/Los Angeles County line. Because the basin is not operated on an annual safe-yield basis, the net change in storage in any given year may be positive or negative; however, over the long-term, the basin is operated within the established operating range. The components of the water budget are described below. OCWD's water year (WY) begins on July 1 and ends on June 30.

4.1 WATER BUDGET COMPONENTS

4.1.1 Measured Recharge

Measured recharge consists of all water artificially recharged at OCWD's surface water recharge facilities, water injected in the Talbert and Alamitos Barriers, and water injected in the Mid-Basin Injection wells. The majority of measured recharge occurs in the District's surface water system, which receives Santa Ana River baseflow and storm flow, GWRS water, and imported water.

4.1.2 Unmeasured Recharge

Unmeasured recharge also referred to as "incidental recharge" accounts for a significant amount of the basin's recharge, particularly in wet periods. This includes recharge from precipitation, irrigation return flows, urban runoff, seawater inflow through the gaps as well as subsurface inflow at the basin margins along the Chino, Coyote, and San Joaquin hills and the Santa Ana Mountains, and beneath the Santa Ana River and Santiago Creek. Subsurface inflow beneath the Santa Ana River and Santiago Creek refers to groundwater that enters the basin at the mouth of Santa Ana Canyon and in the Santiago Creek drainage below Villa Park Dam. Estimated average subsurface inflow to the basin is shown in Figure 4-1.

OCWD has estimated total unmeasured recharge, sometimes referred to as "incidental recharge," between 20,000 and 160,000 acre-feet per year. Net unmeasured recharge is the amount of unmeasured recharge remaining in the basin after accounting for underflow losses to Los Angeles County and relatively minor groundwater inflows/outflows at the coastal gaps. Under average hydrologic conditions, net incidental recharge averages 66,000 acre-feet per year. This average was substantiated during calibration of the Basin Model and is also consistent with the estimate of 58,000 acre-feet per year reported by Hardt and Cordes (1971) as part of a USGS modeling study of the basin. Because unmeasured recharge is one of the least understood components of the basin's water budget, the error margin for any given year is likely in the range of 10,000 to 20,000 acre-feet. Since unmeasured recharge is well distributed throughout the basin, the physical significance (e.g., water level drawdown or mounding in any given area) of overestimating or underestimating the total recharge volume within this error margin is considered to be minor.

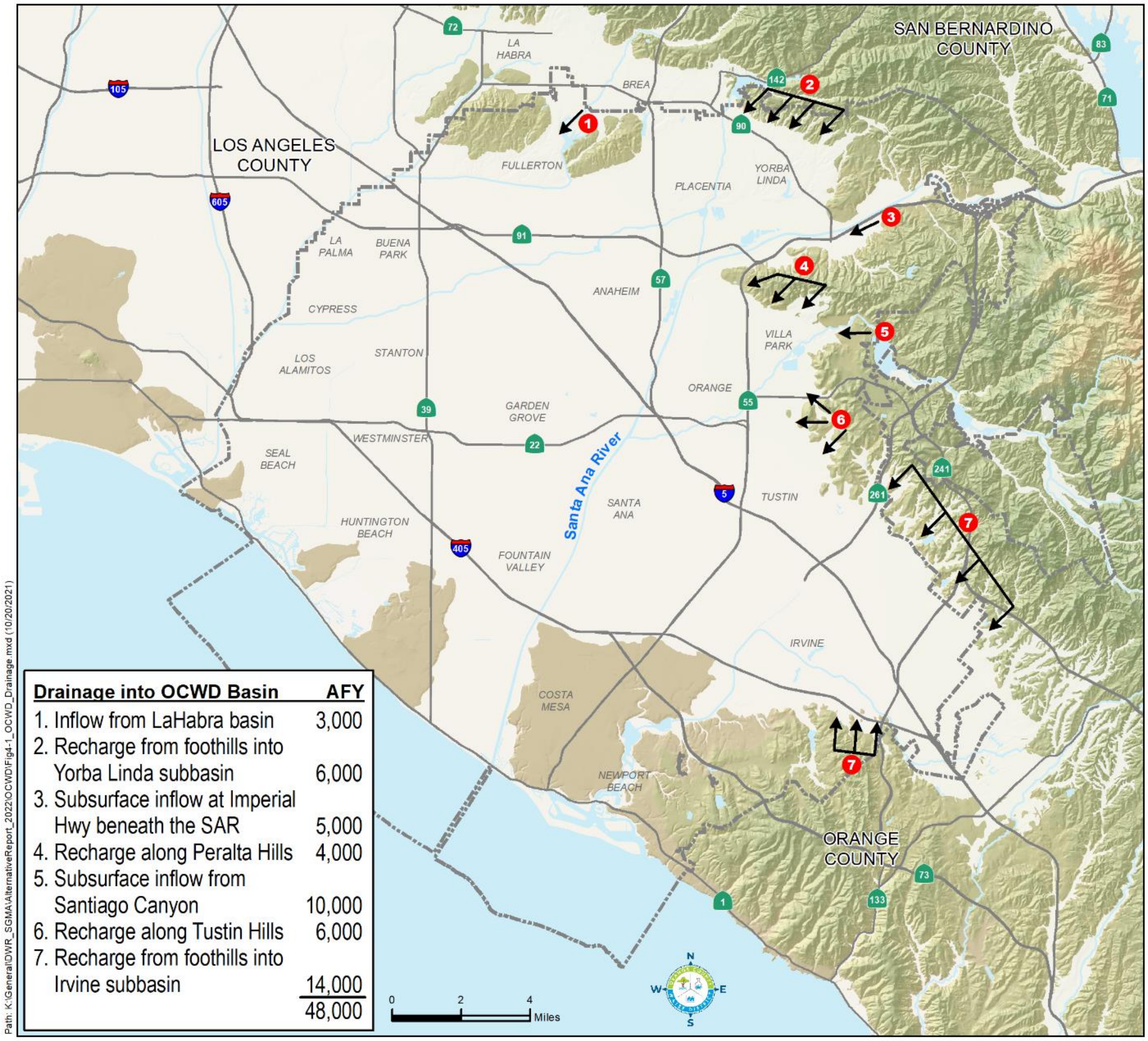


Figure 4-1: Estimated Subsurface Inflow

4.1.3 Groundwater Production

Entities that produce groundwater within the OCWD Management Area include major groundwater producers and small groundwater producers. Ninety-eight percent of groundwater production within Basin 8-1 occurs within the OCWD Management Area. The major groundwater producers include cities, water districts and a private water company that account for approximately 97 percent of the total basin production. These 19 major producers operate approximately 200 large-system wells. Small groundwater producers include entities that typically produce less than 500 acre-feet per year. These include small mutual water companies, agricultural companies, golf courses, cemeteries (irrigation wells), and private-well owners. Groundwater pumping for agricultural irrigation use accounts for less than one percent of total basin production.

4.1.4 Subsurface Outflow

Groundwater outflow from the basin across the Los Angeles County/Orange County line has been estimated to range from approximately 1,000 to 14,000 acre-feet per year based on groundwater elevation gradients and aquifer transmissivity (DWR, 1967; McGillicuddy, 1989). The Water Replenishment District of Southern California (WRD) also has estimated underflow from Orange County to Los Angeles County within the aforementioned range. Groundwater outflow cannot be directly measured and is accounted for in the basin water budget within the net unmeasured recharge described above. Modeling by OCWD indicates that underflow to Los Angeles County increases by approximately 7,500 acre-feet per year for every 100,000 acre-feet of increased groundwater in storage in Orange County, given the assumption that groundwater elevations in Los Angeles County remain constant.

Recent updates to the OCWD groundwater model show that subsurface outflow averaged approximately 13,000 acre-feet per year during the period 1991 to 2017 with a range of 5,000 to 25,000 acre-feet per year. Due to differences in model-estimated inter-basin groundwater flows, OCWD and WRD are jointly conducting a study to evaluate OCWD's Basin Model and WRD's groundwater model of Central Basin in Los Angeles County constructed by the USGS. The goal is to improve each model's ability to more closely represent local groundwater conditions and thereby more accurately estimate inter-basin groundwater flows.

With the exception of unknown amounts of semi-perched (near-surface) groundwater being intercepted and drained by submerged sewer trunk lines and unlined flood control channels along coastal portions of the basin, no other significant basin outflows are known to occur.

4.1.5 Evaporation

The total wetted area of the District's recharge system is over 1,000 acres. OCWD estimates the evaporation from this system on a monthly basis. Generally, total evaporation is on the order of 2,000 acre-feet per year which is approximately one percent of the total volume recharged annually. The relatively minor impact of evaporation reflects moderate temperatures in the region and high percolation rates (1 to 10 feet per day).

4.2 WATER YEAR TYPE

As explained previously, OCWD manages groundwater pumping and basin storage over the long-term, which includes wet and dry years. Basin storage levels from WY1957-58 to 2020-21 are shown in Figure 1-3. Typically, basin storage levels increase during wet periods and decrease during dry periods. Operating the basin within the operating range provides for maximum basin production while preventing significant and unreasonable undesirable results.

4.3 ESTIMATE OF SUSTAINABLE YIELD

Even though the groundwater basin contains an estimated 66 million acre-feet when full, OCWD operates the basin within an operating range of up to 500,000 acre-feet below full condition to protect against seawater intrusion, inelastic land subsidence, and other potential undesirable results. On a short-term basis, the basin can be operated at an even lower storage level in an emergency.

OCWD manages groundwater production and recharge to maintain groundwater storage levels within the established operating range. In this sense, the basin's sustainable yield can be defined as the volume of groundwater production that can be sustained while maintaining groundwater in storage within the operating range. Basin storage is determined on an annual basis by calculating the difference between groundwater production and recharge based on OCWD's July 1 to June 30 water year.

The sustainable yield of the basin is a function of the amount of groundwater recharge from OCWD's managed aquifer recharge program and natural recharge as a result of precipitation and percolation of irrigation flows. The process that determines a sustainable level of pumping on an annual basis considers the basin's operating range, basin storage conditions and the amount of available recharge water supplies.

As mentioned in Section 1.2, the groundwater basin is not operated on an annual safe-yield basis. The net change in storage in any given year may be positive or negative; however, over a period of several years, the basin is maintained in an approximate balance. Amounts of total basin production and total water recharged from WY1999-2000 to 2020-21 are shown in Figure 1-4.

4.4 WATER BUDGETS

The OCWD Management Area water budget for WY2016-17 to 2020-21 is presented in Table 4-1. Estimated water budgets for dry years, average years and wet years as well as a future projected budget are presented in the 2017 Alternative.

Table 4-1 Water Budget, WY2016-17 to 2020-21

FLOW COMPONENT	2016-17	2017-18	2018-19	2019-20	2020-21
INFLOW					
Santa Ana River baseflow	70,000	65,400	98,000	74,500	76,400
Santa Ana River stormflow	65,400	24,100	63,700	79,500	36,600
Recycled Water (GWRS/Alamitos Barrier)	98,000	106,400	97,200	99,700	101,700
Imported Water	50,400	66,100	40,300	18,100	0
Net Estimated Unmeasured or Incidental Recharge*	67,900	26,200	45,600	41,400	19,100
TOTAL INFLOW:	351,700	288,200	344,800	313,200	233,800
OUTFLOW					
Groundwater Production	300,700	237,200	303,800	277,200	281,800
TOTAL OUTFLOW:	300,700	237,200	303,800	277,200	281,800
CHANGE IN STORAGE:	51,000	51,000	41,000	36,000	(48,000)

SECTION 5 WATER RESOURCE MONITORING PROGRAMS

5.1 OVERVIEW

Water resource monitoring programs can be categorized into groundwater, surface water, and recycled and imported water programs. These programs are summarized in Table 5-1 in the 2017 Alternative. The only change is related to the termination of CASGEM, which is being replaced by annual reporting required by SGMA.

5.2 GROUNDWATER MONITORING PROGRAMS

OCWD collects samples and analyzes water elevation and water quality data from approximately 400 District-owned monitoring wells (shown in Figure 5-1) and at over 250 privately-owned and publicly-owned large and small system drinking water wells that are part of OCWD's Title 22 program, shown in Figure 5-2. OCWD also has access agreements to sample a number of non-District-owned monitoring wells and privately-owned irrigation, domestic and industrial wells, shown in Figure 5-3. New wells constructed in the last five years are highlighted in these figures. Inactive wells are included in District monitoring programs when feasible. An inactive well is defined as a well that is not currently being routinely operated. The number and location of wells that are sampled change regularly as new wells come online and old ones are abandoned and destroyed.

The District collects, stores, and uses data from wells owned and sampled by other agencies. For example, data collected by the WRD from wells in Los Angeles County along the Orange County boundary are part of the network of wells evaluated to determine annual groundwater elevations and are used for basin modeling. Also included in OCWD's monitoring network are wells that are owned and operated by the U.S. Navy for remediation of contamination plumes in the cities of Irvine, Seal Beach and Tustin, and wells that are related to operation of the Alamitos Barrier that are located in Los Angeles County. Los Angeles County wells are also used to model the Orange County groundwater basin as groundwater flow is unrestricted across the county line.

Wells sampled under various monitoring programs change in response to fluctuations in the number of available wells, basin conditions, observed water quality, and regulatory and non-regulatory requirements. Appendix A of the 2017 Alternative presented a comprehensive list of all wells in OCWD's database. This list included well name, owner, type of well, casing sequence number, depth, screened interval, and aquifer zone monitored, when known.

In some cases, well depth and screened intervals are listed in the database as unknown. OCWD maintains data on these wells when water quality or elevation data continues to be collected by the owner or operator. OCWD uses data from these wells in monitoring programs, for groundwater modeling, or for other basin programs. Wells on the list also include inactive wells when water quality or water elevation data continues to be collected or the data is utilized in one or more current basin programs. Groundwater elevation and monthly production data are used to quantify total basin pumping, evaluate seasonal groundwater level fluctuations and assess basin storage conditions.

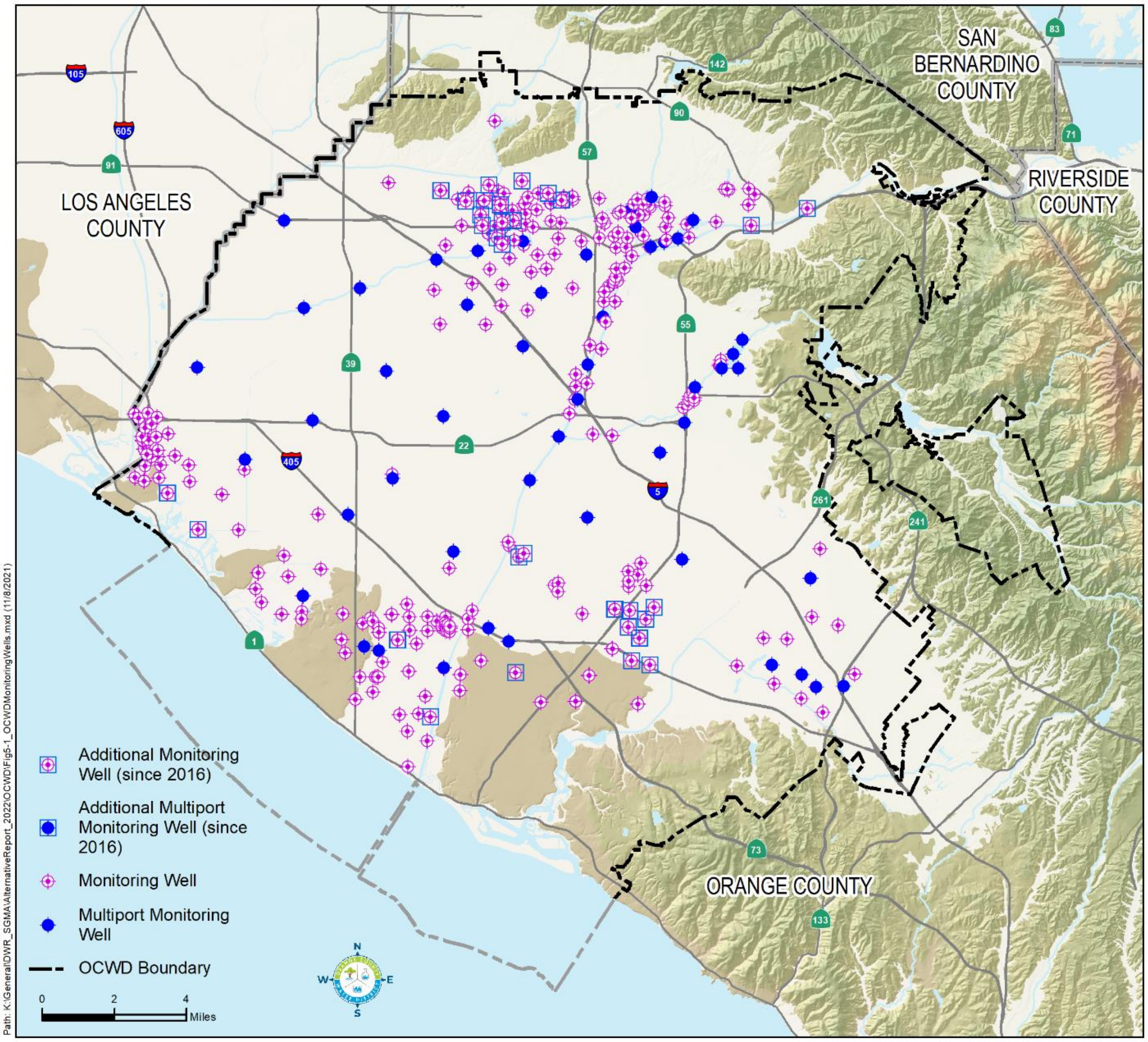


Figure 5-1: OCWD Monitoring Wells

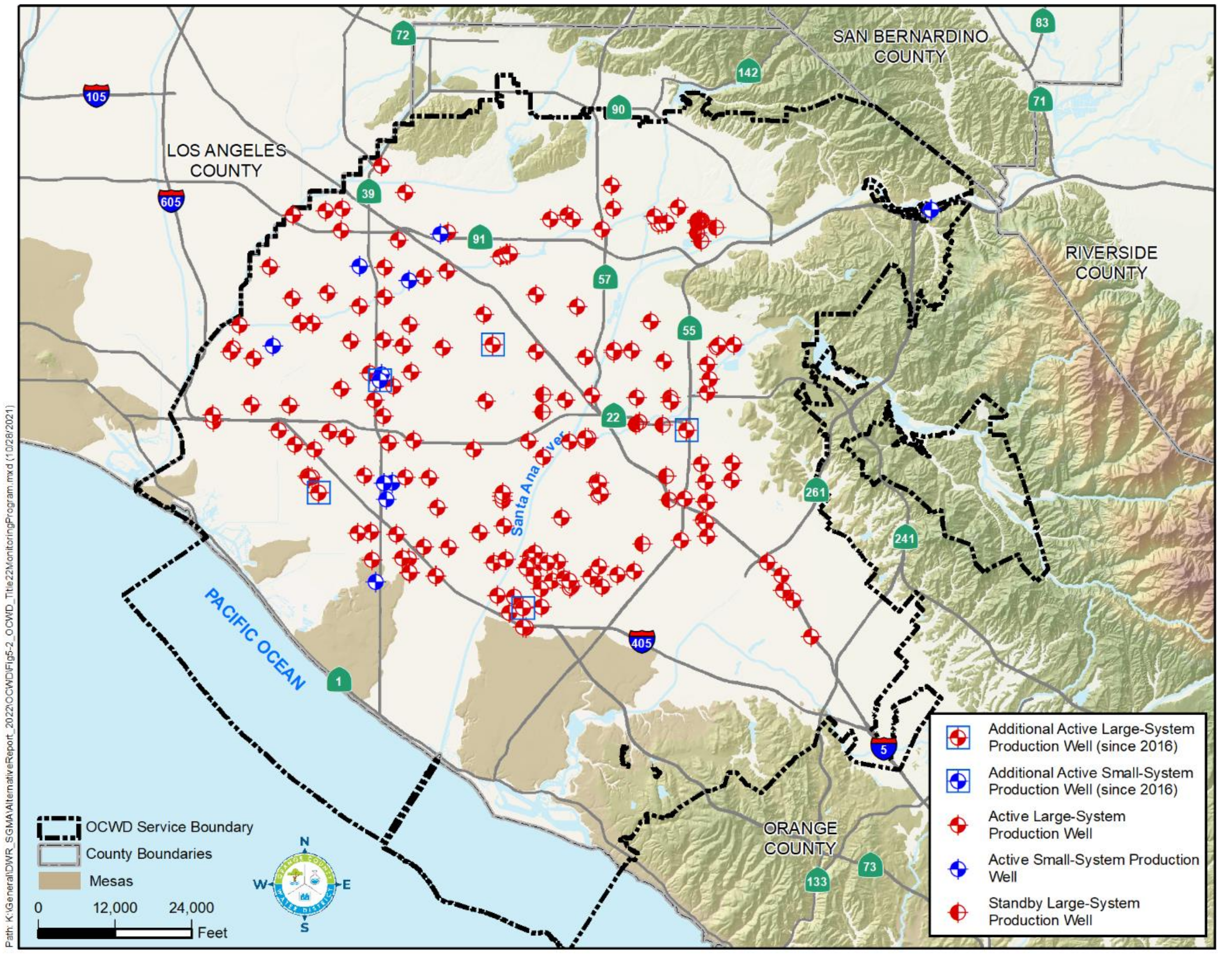


Figure 5-2: Large and Small System Drinking Water Wells
in Title 22 Monitoring Program

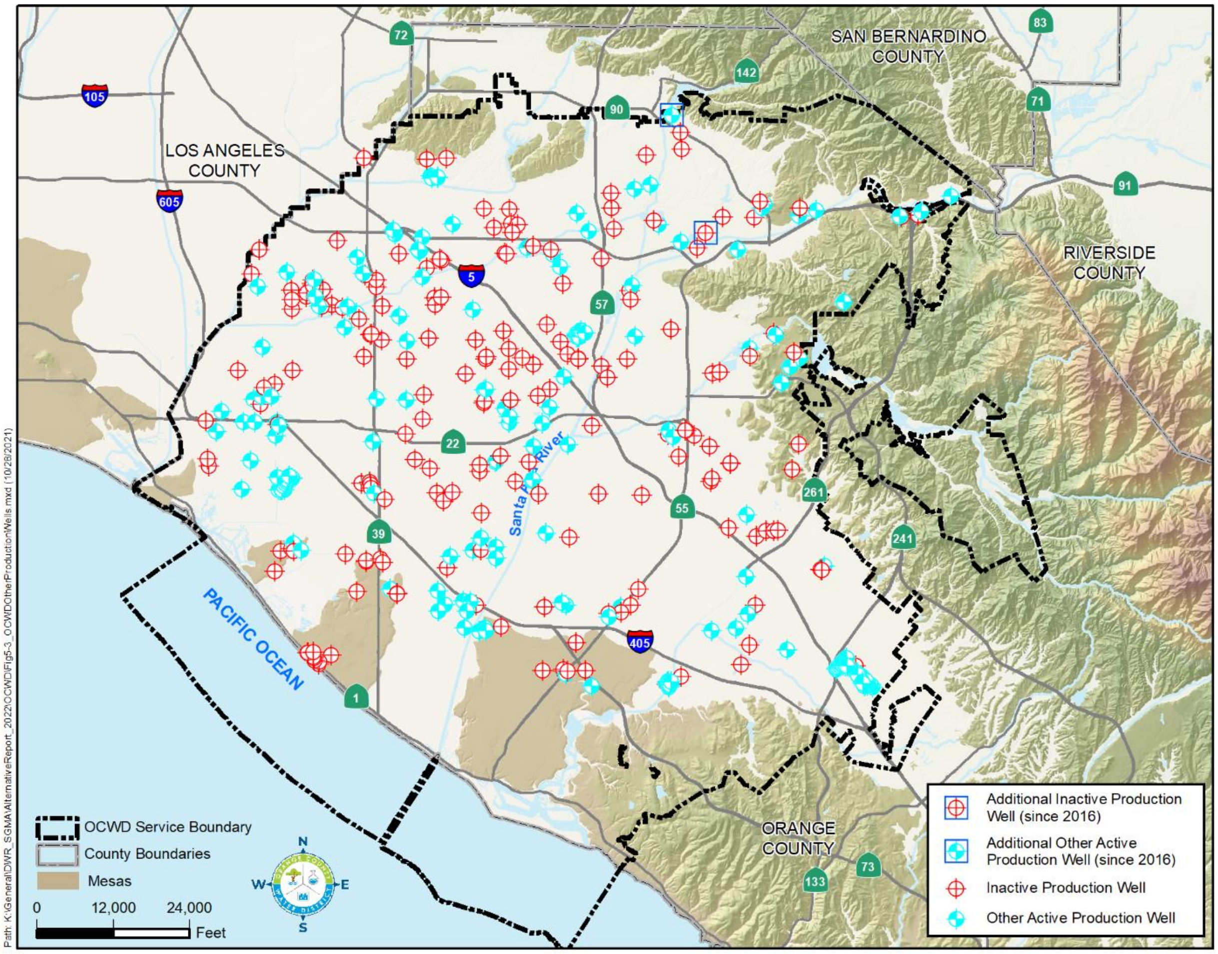


Figure 5-3: Private Domestic, Irrigation and Industrial Wells in OCWD Monitoring Program

5.2.1 Groundwater Production Monitoring

All entities that pump groundwater from the basin are required by the OCWD District Act to report production every six months and pay a Replenishment Assessment. Owners or operators of wells with discharge outlets of two inches in diameter or less and supply an area of no more than one acre pay an annual flat fee as the Replenishment Assessment and do not have to report their production.

Approximately 200 large-capacity production wells owned by 19 major water retail agencies account for ninety-seven percent of production. Large-capacity well owners voluntarily report monthly groundwater production for each of their wells. The production volumes are verified by OCWD field staff. Production data are used to evaluate basin conditions, calculate and manage basin storage, run groundwater model scenarios, and collect revenues.

5.2.2 Groundwater Elevation Monitoring

Production and monitoring wells in the basin are measured for groundwater elevation at varying intervals, as explained below:

- Water elevation measurements are collected for every OCWD monitoring well at least once a year with most wells measured at least monthly;
- Monitoring of production wells is typically monthly but may vary depending on operational status, well maintenance, abandonment, new well construction, and related factors;
- Over 1,000 individual measuring points are monitored for water levels on a monthly or bi-monthly basis to evaluate short-term effects of pumping, recharge or injection operations; and
- Additional monitoring is done as needed in the vicinity of OCWD's recharge facilities, seawater barriers, and areas of special investigation where drawdown, water quality impacts or contamination are of concern.

Beginning in 2011, OCWD began reporting seasonal groundwater elevation measurements to DWR as part of the CASGEM program. The monitoring well network developed for the CASGEM program provide a detailed and representative data set, both spatially and temporally. The initial network established in 2011 consisted of a total of 77 monitoring stations distributed laterally and vertically throughout the groundwater basin. Most of the wells are owned by OCWD and have detailed borehole geologic logs and downhole geophysical logs.

In 2021, DWR instructed agencies that submitted an Alternative to begin submitting data to the SGMA portal. As a result, CASGEM data was incorporated into annual data submittals required for SGMA compliance. For the 2022 Update, OCWD reviewed the CASGEM network and updated it, primarily in removing wells that were no longer accessible, and changed the name to the SGMA Monitoring Well Network.

Figures 5-4 to 5-6 present the monitoring well locations for each of the three aquifer systems. The SGMA network includes wells within the OCWD, La Habra-Brea, Santa Ana Canyon, and Southeast Management Areas. The City of La Habra Groundwater Sustainability Agency will be reporting water levels from the La Habra Management Area separately. Two wells monitored by the Irvine Ranch Water District (IRWD) that are located in the Southeast Management area, IRWD-LA1 and IRWD-LA4 (Figure 5-5) are included in the SGMA reports that OCWD will submit to DWR.

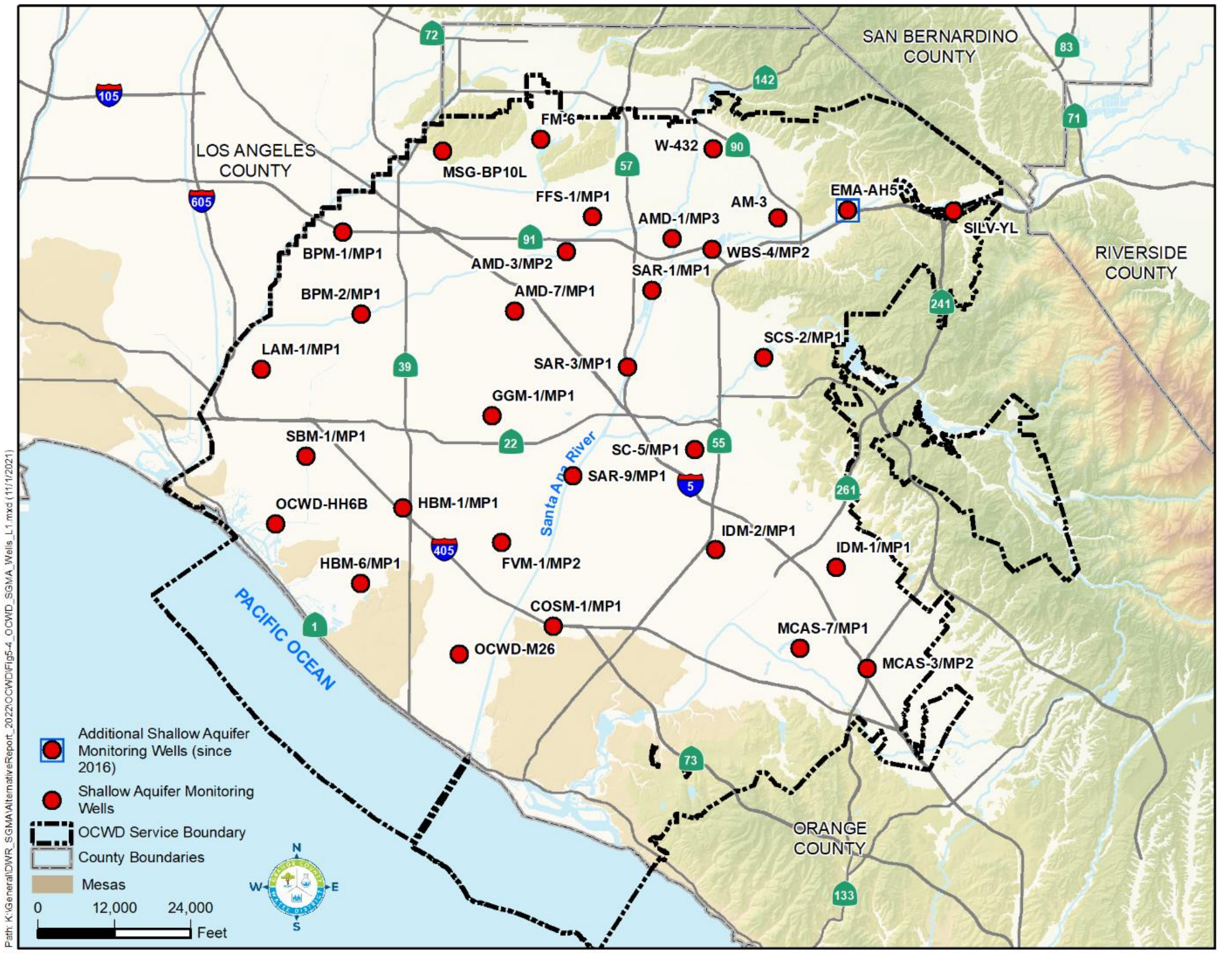


Figure 5-4: SGMA Shallow Aquifer System Monitoring Well Network

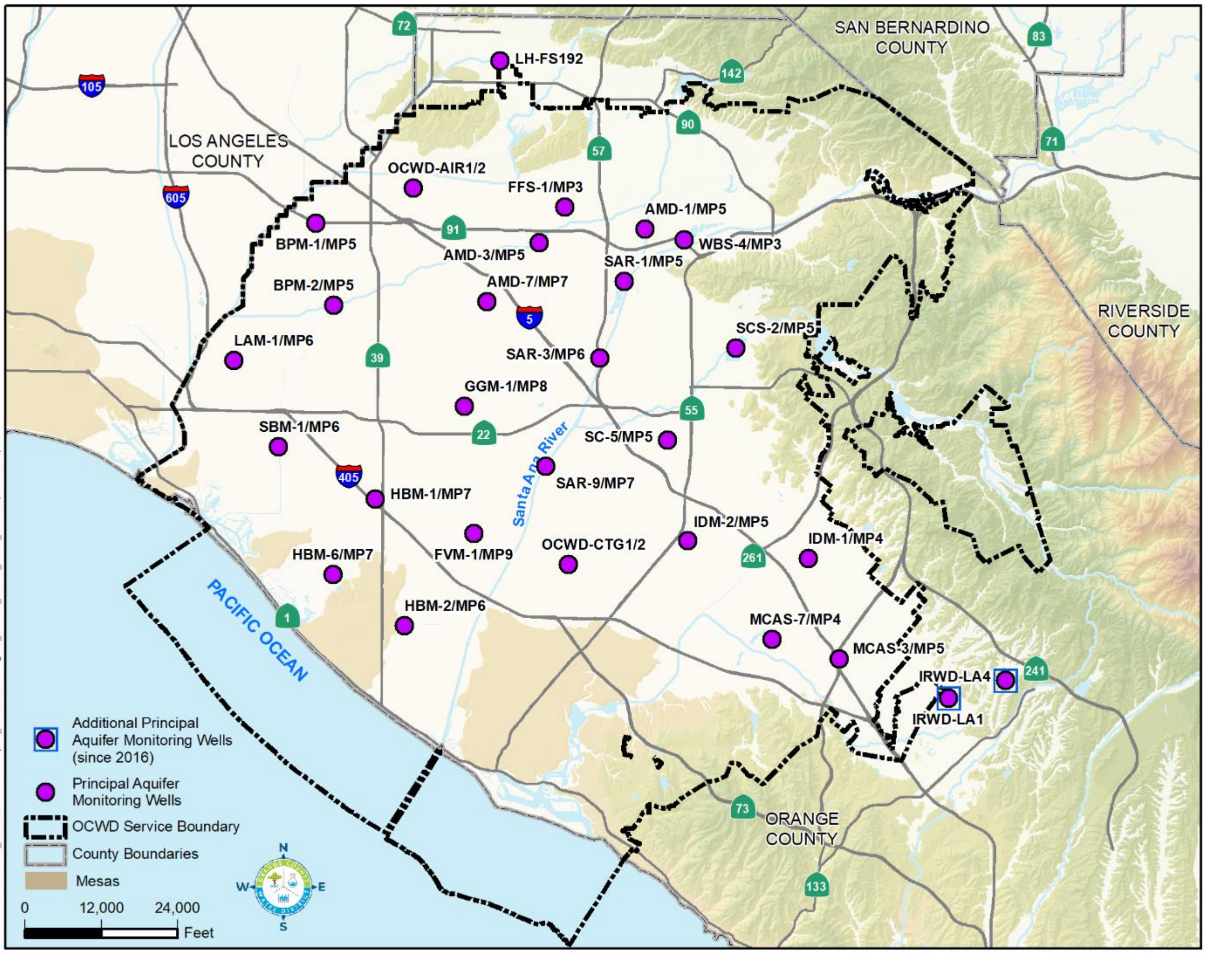


Figure 5-5: SGMA Principal Aquifer System Monitoring Well Network

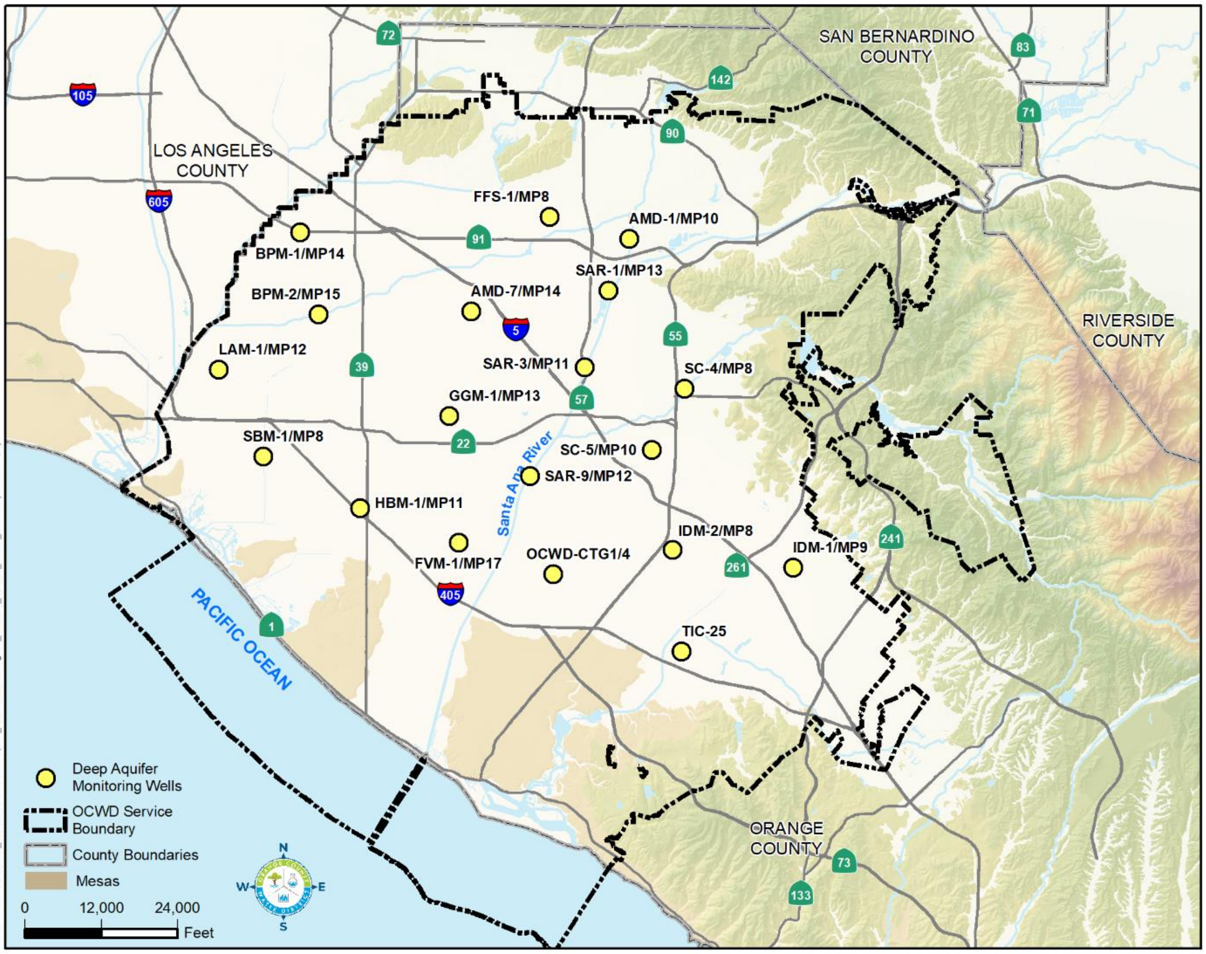


Figure 5-6: SGMA Deep Aquifer System Monitoring Well Network

5.2.3 Groundwater Quality Monitoring

OCWD monitors water quality in production wells on behalf of the groundwater producers for compliance with state and federal drinking water regulations. Samples are analyzed for more than 100 regulated and unregulated chemicals at frequencies established by regulations from the DDW and EPA. Over 425 monitoring and production wells are sampled semi-annually to assess water quality conditions during periods of lowest (winter) and peak production (summer).

The total number of water samples analyzed varies year-to-year due to regulatory requirements, conditions in the basin and applied research and/or special study demands. In 2020, OCWD water quality staff collected 15,496 samples, 4,139 of which were collected from drinking water wells.

OCWD developed specific programs to monitor the North Basin and South Basin plumes \\as described in the 2017 Alternative. Several new monitoring wells were constructed within the last five years for the North Basin and South Basin plume areas as shown on Figures 5-7 and 5-8.

Continual monitoring of groundwater near the coast is done to assess the effectiveness of the Alamitos and Talbert Barriers and track salinity levels in the Bolsa and Sunset Gaps. Key groundwater monitoring parameters used to determine the effectiveness of the barriers include water level elevations, chloride, TDS, electrical conductivity, and bromide. Groundwater elevation contour maps for the aquifers most susceptible to seawater intrusion are prepared to evaluate whether the freshwater mound developed by the barrier injection wells is sufficient to prevent the inland movement of saline water.

OCWD's extensive network of monitoring wells within the groundwater basin includes concentrated monitoring along the seawater barrier and near the recharge basins. GWRS-related monitoring wells in the vicinity of Kraemer, Miller, La Palma and Miraloma basins are used to measure water levels and to collect water quality samples. In addition to ensuring the protection of water quality, these wells have been used to determine travel times from recharge basins to production wells.

Permits regulating operation of GWRS require adherence to rigorous product water quality specifications, extensive groundwater monitoring, buffer zones near recharge operations, reporting requirements, and a detailed treatment plant operation, maintenance and monitoring program. GWRS product water is monitored daily, weekly, and quarterly for general minerals, metals, organics, and microbiological constituents. Focused research-type testing has been conducted on organic contaminants and selected microbial species.

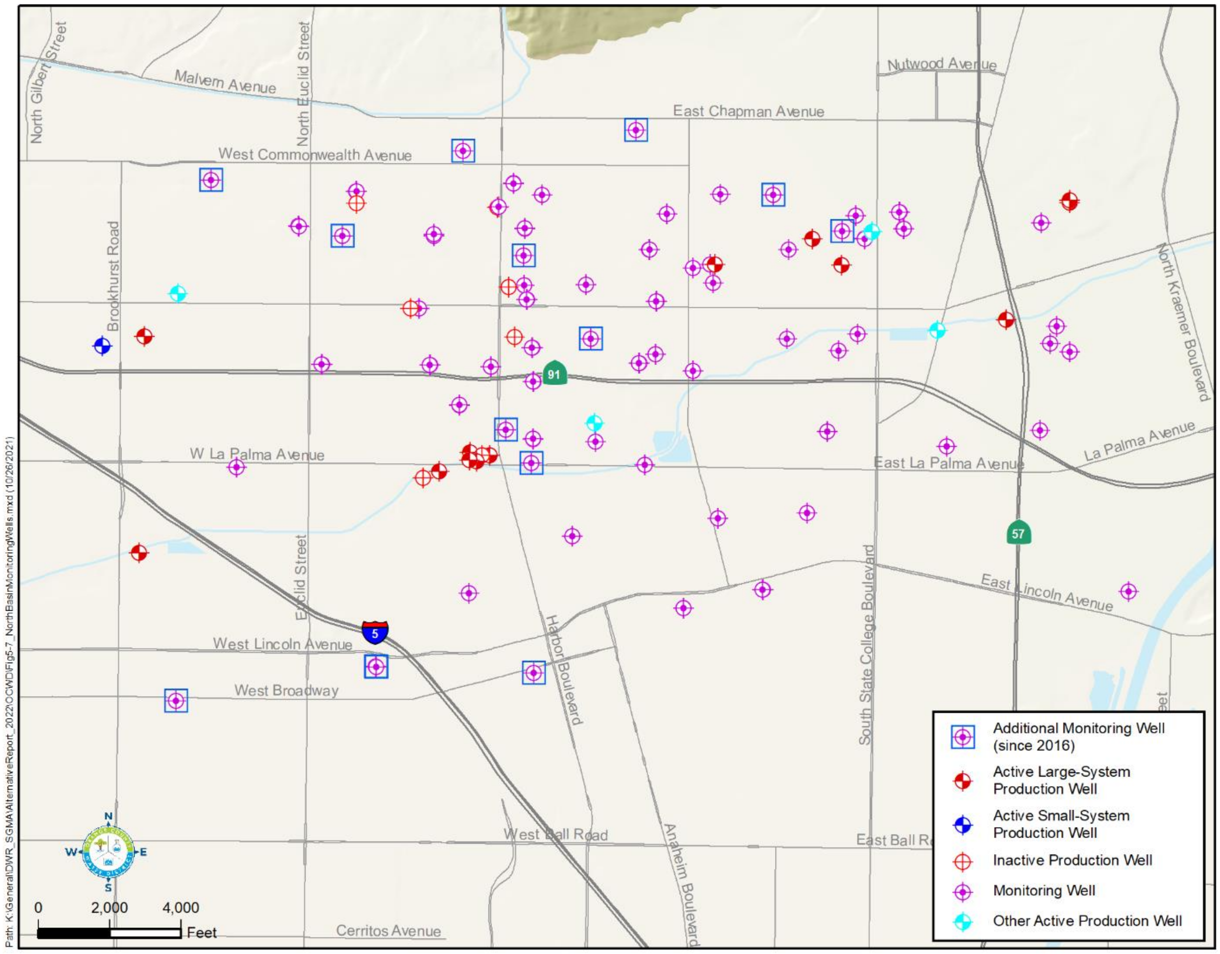


Figure 5-7: North Basin Groundwater Protection Program Monitoring Wells

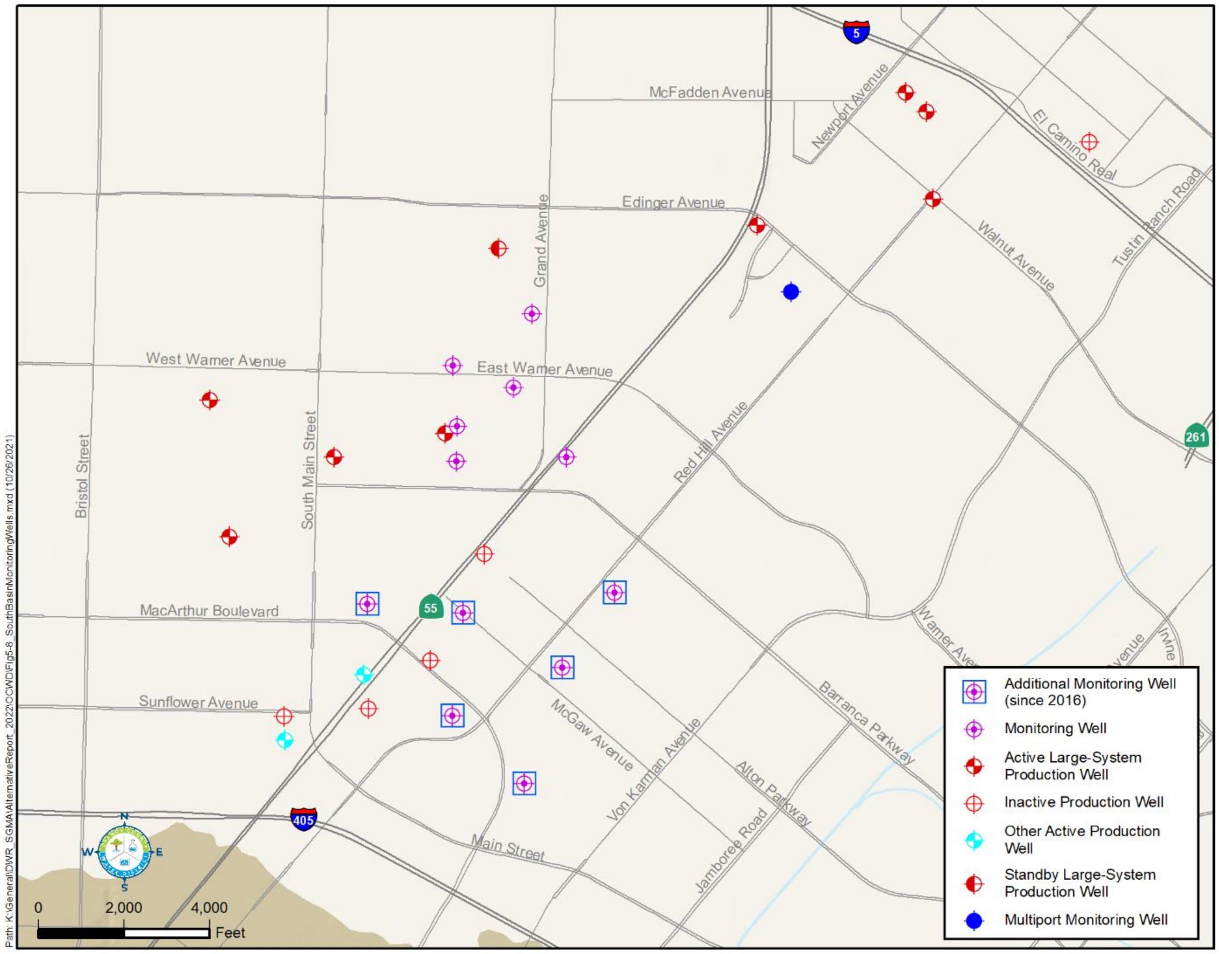


Figure 5-8: South Basin Groundwater Protection Program Monitoring Wells

5.2.4 Coastal Area Monitoring

OCWD operates and maintains a network of coastal area monitoring wells that provide water level and water quality data that allow staff to evaluate the performance of seawater intrusion barriers and to identify potential intrusion in coastal areas. The monitoring well network has been expanded and improved over time based on new information and a greater understanding of the basin hydrogeology.

Approximately 200 monitoring and production well sites are monitored for groundwater levels and quality within a 4- to 5- mile area from the coast, generally seaward or south of the 405 freeway, as shown in Figure 5-9. The monitoring wells are largely located in the coastal gaps as well as on the coastal mesas. The mesas are not impermeable features; rather, the marine deposition Pleistocene aquifers extend beneath the mesas to the basin production wells and provide potential avenues for seawater intrusion.

OCWD conducts the groundwater monitoring for the majority of the monitoring wells with the exception of the Alamitos Barrier monitoring wells. The Alamitos Seawater Intrusion Barrier is located along the border of Los Angeles and Orange counties and is jointly owned by OCWD and Los Angeles County Public Works (LACPW). LACPW operates, maintains, and samples Alamitos Barrier monitoring and injection wells, including those owned by OCWD located within Orange County. Through an interagency cooperative agreement dating to 1964, operational costs and data are shared between the two agencies with a joint report on the status of the barrier prepared on an annual basis.

Most of the monitoring wells shown in Figure 5-9 are owned by OCWD and are either single-point or nested. Single-point monitoring wells have one screened interval in one targeted aquifer zone, while nested wells have multiple (2 to 6) casings within the same borehole, with each casing screened in a separate aquifer zone at a discrete depth. A handful of OCWD monitoring wells in the coastal area are Westbay multi-port type, having only one well casing but with multiple monitoring ports each separated by inflatable packers. Therefore, although there are approximately 200 monitoring and production well sites in the coastal groundwater monitoring program, there are over 430 individual sampling points.

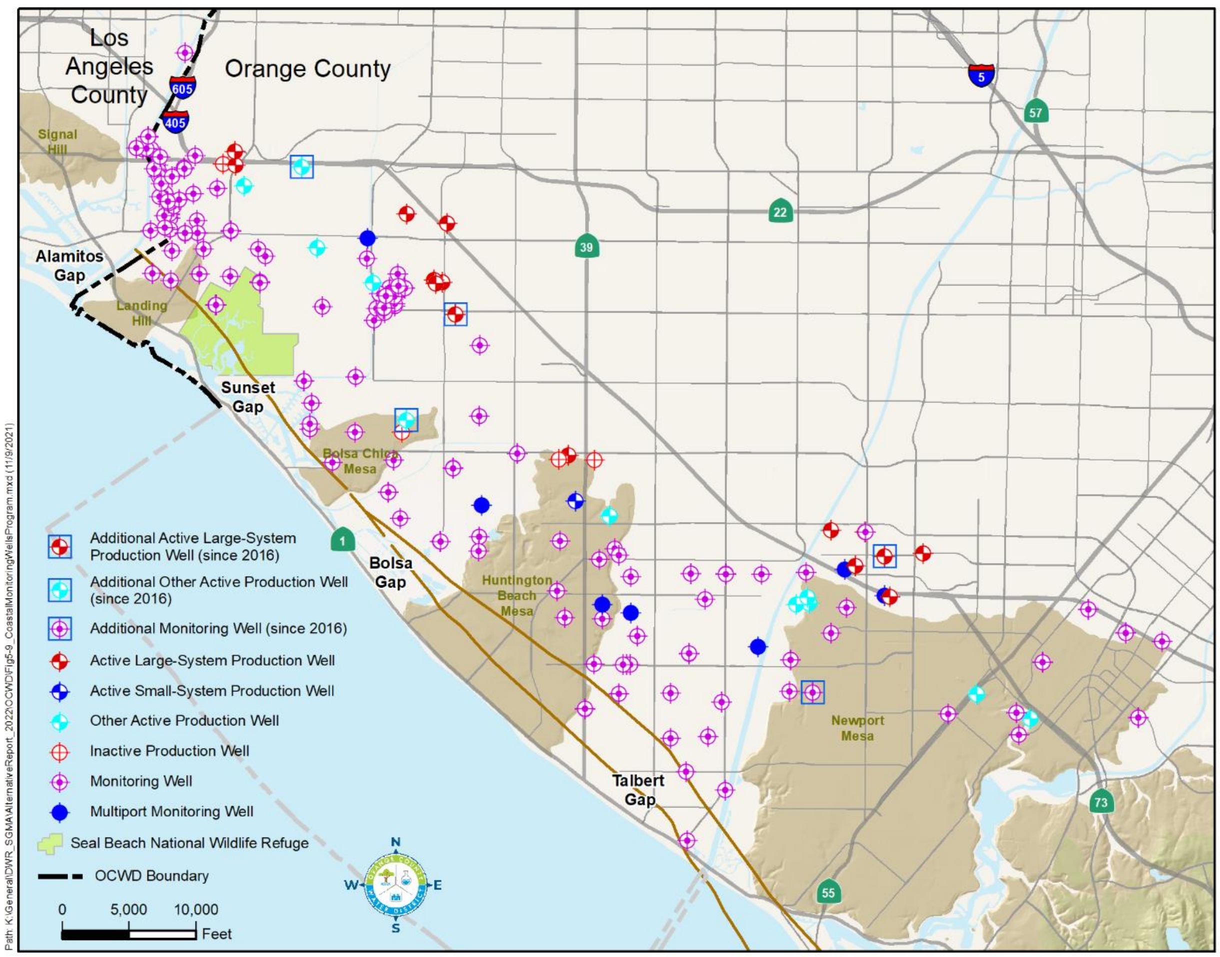


Figure 5-9: Seawater Intrusion Monitoring Wells

In addition to OCWD monitoring wells, there are a few privately owned monitoring wells and active municipal production wells included in OCWD's coastal monitoring program. For example, in Sunset Gap there are a few monitoring wells owned by The Boeing Company (Boeing) related to a shallow VOC plume in the area; Boeing monitors these wells twice a year (groundwater levels and VOCs), and OCWD obtains split samples with Boeing for seawater intrusion monitoring. The retail water agency production wells in the coastal monitoring program include three wells inland of the Alamitos Barrier (City of Seal Beach and Golden State Water Company) and three wells just inland of Sunset Gap (City of Huntington Beach). A complete list of all wells in the coastal groundwater monitoring program, along with their screened interval depths, was presented in Appendix A of the 2017 Alternative.

Groundwater levels are measured bi-monthly (every 2 months) at the majority of coastal monitoring wells and nearly all of the coastal monitoring wells are sampled semi-annually (March and September) for key groundwater quality parameters to assess seawater intrusion and barrier operations. Key groundwater quality parameters analyzed for the coastal monitoring program include chloride, bromide, and electrical conductivity (EC), which is a surrogate for TDS. The EC is typically measured both in the field at the time of sampling and in the laboratory.

Dissolved chloride concentrations and EC are used both to track seawater intrusion and to trace the injection of purified recycled water at the barriers, especially the Talbert Barrier in which the injection supply consists of 100 percent recycled water having a much lower salinity signal than native fresh groundwater. Chloride is considered to be a good conservative intrinsic tracer since it is relatively unaffected by sorption- and chemical-, or biological reactions in the subsurface. Bromide concentrations in brackish groundwater samples are valuable to help determine the origin or source of intrusion by evaluating the chloride to bromide ratio. Chloride to bromide ratios in the range of 280-300 in brackish coastal samples suggest relatively young active intrusion from the ocean or water body connected to the ocean, whereas lower ratios may indicate intrusion from past oil brine disposal or an influence of very old connate water from the original marine depositional process when these coastal aquifers were first formed.

5.3 SURFACE WATER AND RECYCLED WATER MONITORING

Surface water from the Santa Ana River is a major source of recharge supply for the groundwater basin. As a result, the quality of the surface water has a significant influence on groundwater quality. Therefore, characterizing the quality of the river and its effect on the basin is necessary to verify the sustainability of continued use of river water for recharge and to safeguard a high-quality drinking water supply for Orange County. Several on-going programs monitor the condition of Santa Ana River water. OCWD monitoring sites along the river and its tributaries are shown in Figure 5-10.

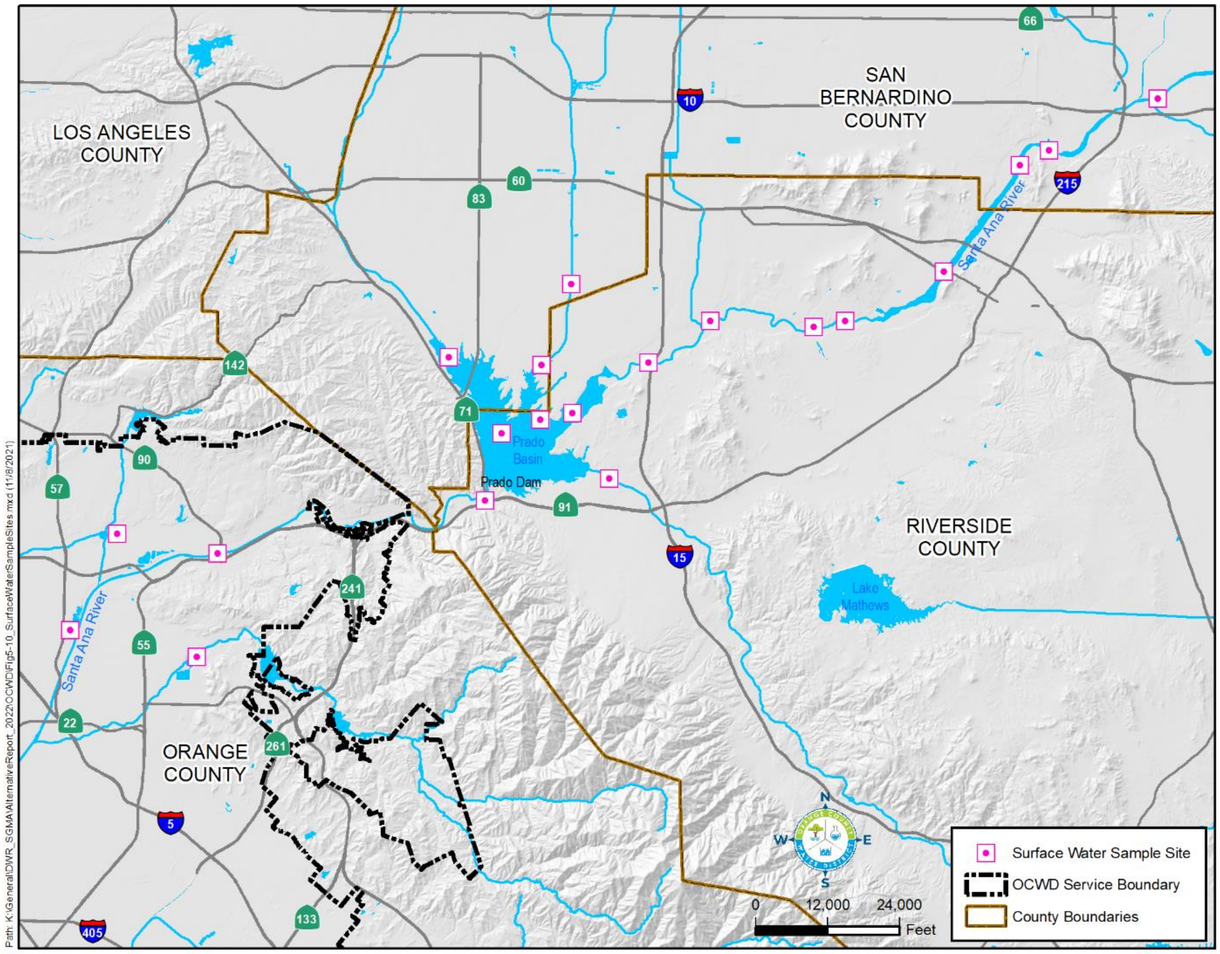


Figure 5-10: Surface Water Monitoring Locations

5.3.1 Surface Water Monitoring Programs

The surface water monitoring programs include:

- Santa Ana River Monitoring (SARMON) Program
- The Basin Monitoring Program Task Force (Task Force)
- Santa Ana River Watermaster
- Emerging constituents
- Imported water from MWD

Detailed descriptions of each program are contained in the 2017 Alternative.

Within the last five years, additional work has been done by the watershed-wide Emerging Constituents Monitoring Task Force administered by the Santa Ana Watershed Project Authority (SAWPA). This group was formed in 2010 to characterize emerging constituents in 1) municipal wastewater effluents, 2) the Santa Ana River at various locations, and 3) imported water. Three years of testing (2011-2013) were completed as directed by the Regional Water Board (R8-

2009-0071). OCWD monitored two sites twice a year on the Santa Ana River for this program. The SAWPA testing program was resumed voluntarily 2019, with the addition of PFAS monitoring; the program was not continued in 2020 and has been functionally replaced by the statewide PFAS Investigation Orders issued to upper watershed wastewater dischargers.

OCWD monitors for Constituents of Emerging Concern (CECs), including PFAS, at two surface water sites quarterly on the Santa Ana River and at various locations within District recharge facilities below Prado Dam. Samples are analyzed for pharmaceuticals, endocrine disruptors and other emerging constituents such as personal care products, food additives, and pesticides.

5.3.2 Recycled Water Monitoring

Use and monitoring of GWRS water is regulated by the Regional Water Board and DDW. Performance of the GWRS is monitored on a routine basis. Monitoring wells to monitor and track GWRS water are located adjacent to surface recharge basins located in Anaheim, downgradient of Mid-Basin Injection wells, and near the injection wells of the Talbert Seawater Barrier as shown on Figure 5-11. Additional details on recycled water monitoring and reporting are presented in the 2017 Alternative. Similar monitoring is performed at the WRD-owned Leo J. Vander Lans Advanced Water Treatment Facility that supplies recycled water to the Alamitos Seawater Barrier for injection.

In March 2020, OCWD's Mid-Basin Injection (MBI) Project went on-line. This project started in April 2015 with the operation of a demonstration well (MBI-1). The MBI Project is located in the city of Santa Ana, primarily at Centennial Park and injects up to 10 million gallons of GWRS water a day into the Principal Aquifer and includes four new injection wells, MBI-2, 3, 4, and 5. Additionally, a total of four nested monitoring wells were installed as part of the MBI Project to track the quality and movement of injection water prior to reaching down gradient production wells. Nested wells SAR-10 and -11 were installed downgradient of MBI-1. To track the movement of GWRS water from the four new injection wells, SAR -12 and -13 were constructed (see Figure 5-11).

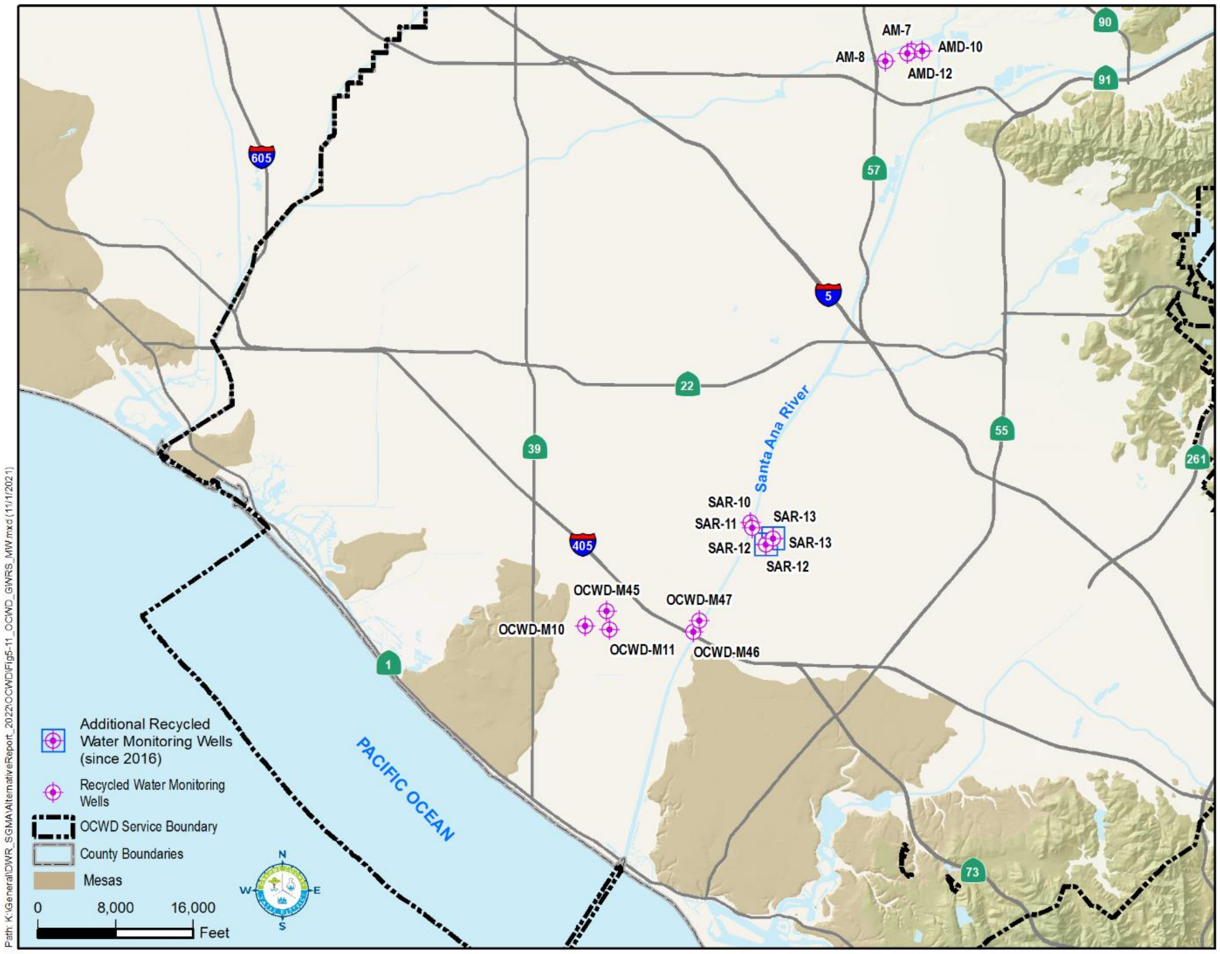


Figure 5-11: Recycled Water Monitoring Wells

SECTION 6 WATER RESOURCE MANAGEMENT PROGRAMS

6.1 LAND USE ELEMENTS RELATED TO BASIN MANAGEMENT

The OCWD Management Area is highly urbanized as shown on Figure 3-4. Monitoring potential impacts from proposed new land uses and planning for future development are key management activities essential for sustainable management of the groundwater basin.

OCWD monitors, reviews and comments on local land use plans and environmental documents such as environmental impact reports, notices of preparation, amendments to local general plans and specific plans, proposed zoning changes, draft water quality management plans, and other land development plans. District staff also review draft National Pollution Discharge Elimination System and waste discharge permits issued by the Regional Water Board. The proposed projects and programs may have elements that could cause short- or long-term water quality impacts to source water used for groundwater replenishment or have the potential to degrade groundwater resources. Monitoring and reviewing waste discharge permits provides OCWD with insight on activities in the watershed that could affect water quality.

The majority of the basin's land area is located in a highly urbanized setting and requires tailored water supply protection strategies. Reviewing and commenting on stormwater permits and waste discharge permits adopted by the Regional Water Board for the portions of Orange, Riverside and San Bernardino counties that are within the Santa Ana River watershed are conducted by OCWD on a routine basis. These permits can affect the quality of water in the Santa Ana River and other water bodies, thereby impacting groundwater quality in the basin.

OCWD works with local agencies having oversight responsibilities on the handling, use and storage of hazardous materials; underground tank permitting; well abandonment programs; septic tank upgrades; and drainage issues. Participating in basin planning activities of the Regional Water Board and serving on technical advisory committees and task forces related to water quality are also valuable activities to protect water quality.

6.1.1 Summary of Plans Related to Basin Management

The 2017 Alternative presented a comprehensive list of plans related to basin management, including:

- Municipal Stormwater Permit
- The OC Plan which is the combined North Orange County Integrated Regional Water Management Plan (IRWM), Central Orange County IRWM, and Coastal Watershed Management Plan
- OWOW 2.0 Plan which is the IRWM Plan for the Santa Ana Watershed

- Municipal Water District of Orange County (MWDOC) 2020 Regional Urban Water Management Plan
- Municipal Water District of Orange County (MWDOC) 2016 Orange County Reliability Study

6.1.2 Land Use Development and Water Demands and Supply

Water demands within the OCWD Management Area between WY1989-90 and 2020-21 have fluctuated between approximately 367,000 and 526,000 acre-feet per year but have leveled off in the past few years to approximately 400,000 acre-feet per year as shown in Figure 1-5.

Since its founding, OCWD has grown in area from 162,676 to 243,968 acres and has experienced an increase in population from approximately 120,000 to 2.5 million people. OCWD has employed groundwater management techniques to increase the annual yield from the basin including operating over 1,000 wetted acres of infiltration basins. Annual groundwater production increased from approximately 150,000 acre-feet in the mid-1950s to a high of over 366,000 acre-feet in WY2007-08. OCWD strives to maximize production from the basin through maximizing recharge of the groundwater basin. The basin is managed within the established groundwater storage operating range independently of total regional water demands as total water demands are met by a combination of groundwater and imported water.

6.1.3 Well Construction, Management, and Closure

Well construction, management and closure are regulated by various state agencies. To comply with federal Safe Drinking Water Act requirements regarding the protection of drinking water sources, the DDW created the Drinking Water Source Assessment and Protection (DWSAP) program. Water suppliers must submit a DWSAP report as part of the drinking water well permitting process and have it approved before providing a new source of water from a new well. OCWD provides technical support to groundwater producers in the preparation of these reports.

Well construction ordinances adopted and implemented by the Orange County Health Care Agency (OCHCA) and certain municipalities follow state well construction standards established to protect water quality under California Water Code Section 231. Cities within OCWD boundaries that have local well construction ordinances and manage well construction within their local jurisdictions include the cities of Anaheim, Fountain Valley, Buena Park, and Orange. To provide guidance and policy recommendations on these ordinances, the County of Orange established the Well Standards Advisory Board in the early 1970s. The five-member appointed Board includes OCWD's Chief Hydrogeologist. Recommendations of the Board are used by the OCHCA and municipalities to enforce well construction ordinances within their jurisdictions.

A well is considered abandoned when the owner has permanently discontinued its use, or it is in such a condition that it can no longer be used for its intended purpose. This often occurs when wells have been forgotten by the owner, were not disclosed to a new property owner, or when the owner is unknown.

A properly destroyed and sealed well has been filled so that it cannot produce water or act as a vertical conduit for the movement of groundwater. In cases where a well is paved over or under a structure and can no longer be accessed it is considered destroyed but not properly sealed. Many of these wells may not be able to be properly closed due to overlying structures, landscaping or pavement. Some of them may pose a threat to water quality because they can be conduits for contaminant movement as well as physical hazards to humans and/or animals.

OCWD supports and encourages efforts to properly destroy abandoned wells. As part of routine monitoring of the groundwater basin, OCWD will investigate on a case-by-case basis any location where data suggests that an abandoned well may be present and may be threatening water quality. When an abandoned well is found to be a significant threat to the quality of groundwater, OCWD will work with OCHCA and the well owner, when appropriate, to properly destroy the well.

The City of Anaheim has a well destruction policy and has an annual budget to destroy one or two wells per year. The funds are used when an abandoned well is determined to be a public nuisance or needs to be destroyed to allow development of the site. The city's well permit program requires all well owners to destroy their wells when they are no longer needed. When grant funding becomes available, the city uses the funds to destroy wells where a responsible party has not been determined and where the well was previously owned by a defunct water consortium.

Information on the status of wells is kept within OCWD's Water Resource Management System data base. Since the 2017 Alternative was submitted, a total of 15 production wells were properly destroyed and sealed. During this same period, a total of 9 new production wells were constructed.

6.2 GROUNDWATER QUALITY PROTECTION AND MANAGEMENT

OCWD has a number of policies and programs to project groundwater quality. The list of programs below is described in detail in the 2017 Alternative.

- OCWD Groundwater Protection Policy (2014)
- Various Salinity Management Programs
    - Seawater Intrusion Barriers
    - Coastal Pumping Transfer Program
    - Groundwater Replenishment System
    - Septic Systems
    - Nitrogen and Selenium Management Program
    - Groundwater Desalters and Inland Empire Brine Line and Non-Reclaimable Waste Line
    - Basin Monitoring Program Task Force
    - Salinity Management and imported Water Workgroup
    - Nitrate Management Program

6.2.1 Regulation and Management of Contaminants

A variety of federal, state, county and local agencies have jurisdiction over the regulation and management of hazardous substances and the remediation of contaminated groundwater supplies. OCWD does not have regulatory authority to require responsible parties to clean up pollutants that have contaminated groundwater. In some cases, OCWD has pursued legal action against entities that are responsible for contaminating the groundwater basin to recover OCWD's remediation costs or to compel those entities to implement remedies. OCWD also coordinates and cooperates with regulatory oversight agencies that investigate sources of contamination. OCWD efforts to assess the potential threat to public health and the environment from contamination in the Santa Ana River Watershed and within the County of Orange include:

- Reviewing ongoing groundwater cleanup site investigations and commenting on the findings, conclusions, and technical merits of progress reports
- Providing knowledge and expertise to assess contaminated sites and evaluating the merits of proposed remedial activities
- Conducting third-party groundwater split samples at contaminated sites to assist regulatory agencies in evaluating progress of groundwater cleanup and/or providing confirmation data of the areal extent of contamination

The following is a list of potential contaminants of greatest concern for basin water quality management. More details on these are presented in the 2017 Alternative.

- Per- and polyfluorinated Alkyl Substances (PFAS)
- Methyl Tertiary Butyl Ether (MTBE)
- Volatile Organic Compounds (VOCs)
- N-Nitrosodimethylamine (NDMA)
- 1,4-Dioxane
- Constituents of Emerging Concern (CECs)

As new chemicals become of scientific interest or are regulated, the OCWD laboratory develops the analytical capability and becomes certified in the approved method to process compliance samples. In 2019, the District's lab became the first public agency laboratory in the state of California to achieve state certification to analyze PFAS in drinking water. The District has invested over $1 million in monitoring equipment to test for PFAS and other CECs.

OCWD is committed to (1) track new compounds of concern; (2) research chemical occurrence and treatment; (3) communicate closely with the DDW on prioritizing investigation and guidance; (4) coordinate with OC San, upper watershed wastewater dischargers and regulatory agencies to identify sources and reduce contaminant releases; and (5) inform the groundwater producers on emerging issues.

6.3 RECYCLED WATER PRODUCTION

6.3.1 Overview

The Groundwater Replenishment System (GWRS) is a joint project built by OCWD and OC San that began operating in 2008. Secondary treated wastewater that otherwise would be discharged to the Pacific Ocean is purified using a three-step process to produce high-quality water used to control seawater intrusion and recharge the basin. As shown on Figure 6-1, the system includes four major components (1) the Advanced Water Purification Facility (AWPF), (2) the Talbert Seawater Intrusion Barrier, (3) Mid-Basin Injection wells, and (4) four dedicated recharge basins.

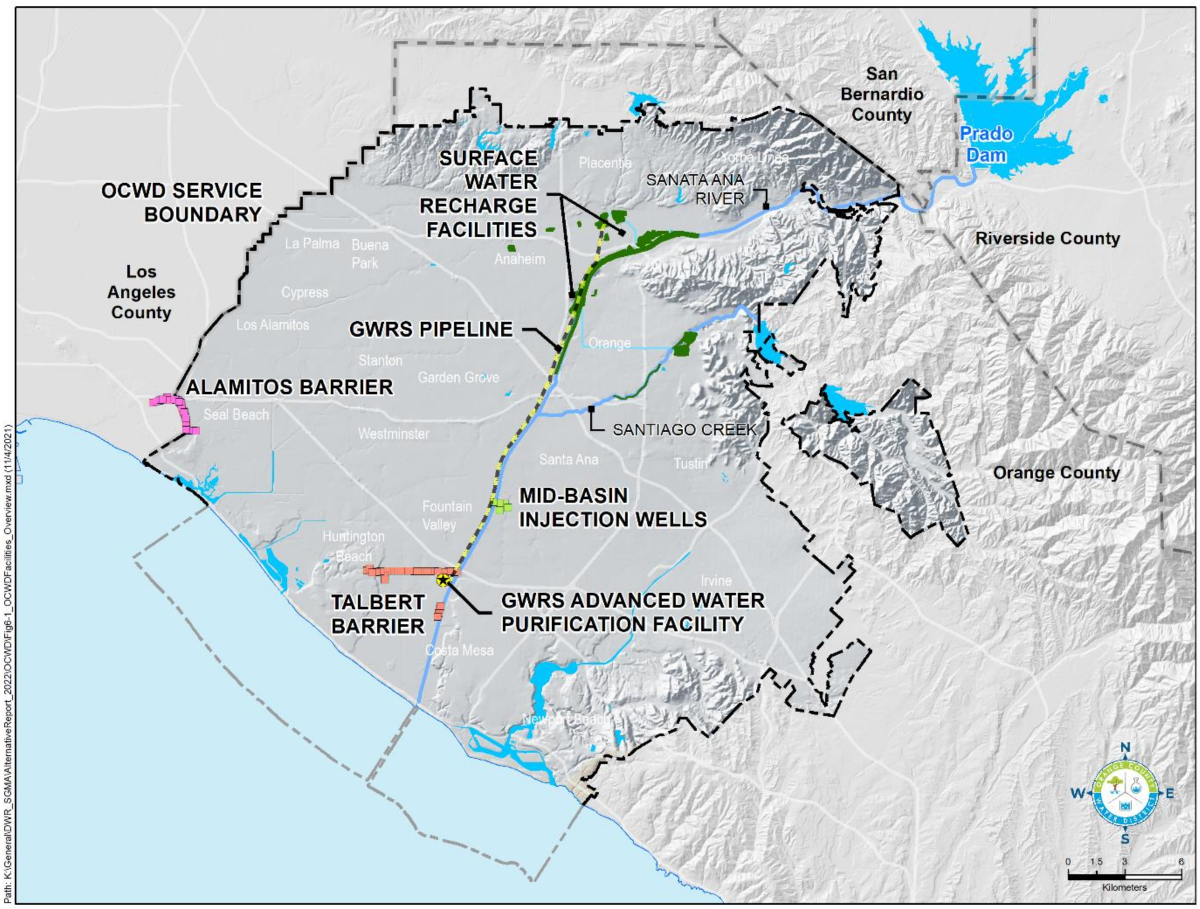


Figure 6-1: Groundwater Replenishment System

6.4 FINAL EXPANSION

The GWRS Final Expansion (GWRSFE) Project began in 2019 with a budget of $310 million. It is the third and final phase of the project to build-out capacity of the GWRS facility that treats secondary effluent from OC San to drinking water standards for groundwater replenishment. As discussed above, the GWRS first began operating in 2008 producing 70 mgd and in 2015, it underwent a 30 mgd expansion. When the Final Expansion is completed in 2023, the plant will have the capacity to produce 130 mgd.

In order to produce 130 mgd, additional treated wastewater from the OC San is required. This additional water will come from OC San's Treatment Plant 2, which is located in the city of Huntington Beach approximately 3.5 miles south of the GWRS. Since the current GWRS facility only receives influent from OC San's Plant No. 1, new secondary effluent conveyance facilities are required at OC San' Plant No. 2 to convey the secondary effluent to GWRS. These conveyance facilities include an effluent pump station, two flow equalization tanks and rehabilitation of an existing pipeline.

In order for secondary effluent from OC San's Plant No. 2 to be recycled by GWRS, Santa Ana Regional Interceptor (SARI) flows must be segregated. Currently, SARI flows are not permitted to be recycled through GWRS due to the industrial and treatment facility discharges that currently flow in the SARI pipeline. Therefore, in addition to the conveyance facilities, modifications will be made to OC San Plant No. 2 headworks facilities to segregate the SARI flows and treat these flows separately for discharge to the ocean outfall. This project is referred to as the Plant No. 2 Headworks Modification Project. In addition to the Plant No. 2 Headworks Modification Project, an upgrade to OC San's Plant No. 2 water pump station is required to feed the headworks with reclaimable water. This Plant Water Pump Station Project is also considered part of the complete GWRSFE Project. An overview of the sites and the project locations of the GWRSFE are shown in Figure 6-2.

Figure 6-2: GWRS Final Expansion Overview

The GWRSFE is anticipated to be completed and operational in 2023. Once completed, the GWRS will recycle 100 percent of OC San's reclaimable sources and produce enough water to meet the needs of over one million people.

6.5 CONJUNCTIVE USE PROGRAMS

The conjunctive use of surface and groundwater has been the foundation of OCWD's basin management strategy since it was formed in 1933. OCWD Managed Aquifer Recharge (MAR) program began in 1936 when it began purchasing portions of the Santa Ana River channel, eventually acquiring six miles of the channel in Orange County, in order to maximize the recharge of river water to the basin.

Recharge of imported water began in 1949 when OCWD began purchasing Colorado River water from MWD. In 1958, OCWD purchased and excavated a 64-acre site one mile north of the Santa Ana River to create Anaheim Lake, OCWD's first recharge basin. Today OCWD operates a network of 25 facilities that recharge an average of over 230,000 acre-feet per year.

OCWD has developed a diverse recharge portfolio including water from the Santa Ana River and tributaries, imported water, and recycled water supplied by the GWRS. The basin also receives natural recharge (also called incidental recharge) from precipitation and subsurface inflow.

6.5.1 Sources of Recharge Water Supplies

Water supplies used to recharge the groundwater basin are listed in Table 6-1. Figure 6-3 shows the historical recharge by source from 1936 to 2021. Table 4-1 presents the annual recharge by source for WY2016-17 to 2020-21.

Santa Ana River

Water from the Santa Ana River is a primary source of water used to recharge the groundwater basin. OCWD diverts river water into recharge facilities where the water percolates into the groundwater basin. Recharge facilities are capable of recharging all of the base flow. Both the Santa Ana River base flow and storm flow vary from year to year. The volume of storm water that can be recharged into the basin is highlight dependent on the amount and timing of precipitation in the upper watershed, which is highly variable. OCWD has water rights to all storm flows and base flows that reach Prado Dam. When storm flows exceed the capacity of the diversion facilities, river water reaches the ocean, and this portion is lost as a water supply.

Santiago Creek

Santiago Creek is the primary drainage for the northwest portion of the Santa Ana Mountains and ultimately drains into the Santa Ana River. OCWD captures and recharges water in Santiago Creek that flows into the Santiago Recharge Basins. During dry periods, the Santiago basins are used to recharge Santa Ana River flows which are pumped to the basins.

Table 6-1: Sources of Recharge Water Supplies

SUPPLY SOURCES AND DESCRIPTION			RECHARGE LOCATION
Santa Ana River	Base Flow	Perennial flows from the upper watershed in Santa Ana River; predominately treated wastewater discharges	Santa Ana River, recharge basins, and Santiago Creek
	Storm Flow	Precipitation from upper watershed flowing in Santa Ana River through Prado Dam	Santa Ana River, recharge basins, and Santiago Creek
Santiago Creek	Storm Flow / Santa Ana River	Storm flows in Santiago Creek and Santa Ana River water pumped from Burris Basin via Santiago Pipeline	Santiago Creek, Santa Ana River, recharge basins
Incidental Recharge	Precipitation and subsurface inflow	Precipitation and runoff from Orange County foothills, subsurface inflow from basin boundaries	Basin-wide
Recycled Water	Groundwater Replenishment System	Advanced treated wastewater produced at GWRS plant in Fountain Valley	Injected into Talbert Barrier and Mid-Basin Injection Wells, recharged in Kraemer, Miller, La Palma and Miraloma basins
	Water Replenishment District of Southern CA	Water purified at the Leo J. Vander Lans Treatment Facility in Long Beach	Injected into Alamitos Barrier
Imported Water	Untreated	State Water Project and Colorado River Aqueduct	Various recharge basins
	Treated	State Water Project and Colorado River Aqueduct treated at MWD Diemer Water Treatment Plant	Injected into Alamitos Barrier

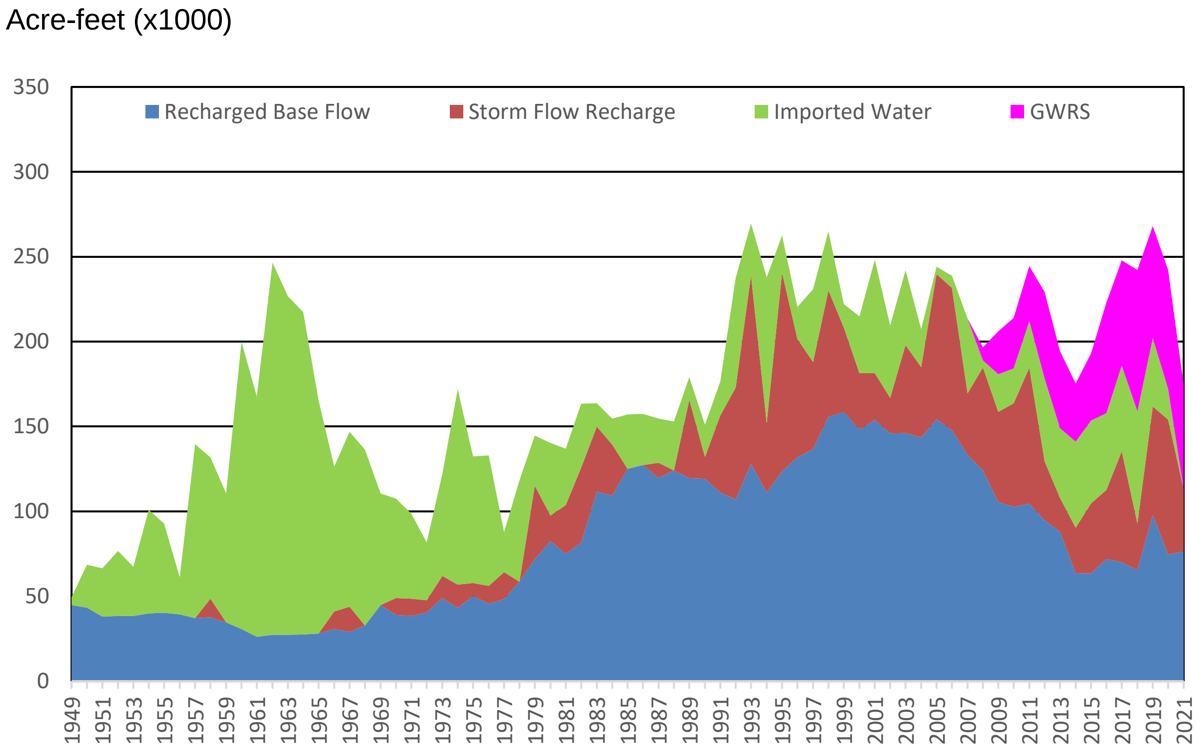


Figure 6-3: Historical Recharge in Surface Water Recharge System

Incidental Recharge

Incidental recharge is comprised of subsurface inflow from the local hills and mountains, infiltration of precipitation and irrigation water, recharge in small flood control channels, and groundwater underflow to and from Los Angeles County and the ocean. Since the amount of incidental recharge cannot be directly measured, it is also referred to as unmeasured recharge. Each year, an estimate is made of the amount of net incidental recharge based on OCWD's annual groundwater storage calculation. In general, since the Central Basin in Los Angeles County is usually operated at a lower level than the Orange County basin, there is usually a net flow of water out of the Orange County basin to the Central Basin. This outflow is subtracted from the total incidental recharge to get the net incidental recharge to the basin, which is the value reported in this document.

Recycled Water

The basin receives two sources of recycled water for recharge. The primary source is the GWRS, which currently has the capacity to produce 103,000 acre-feet per year of recycled water. This will be increasing to 134,000 acre-feet per year, when the GWRS Final Expansion is complete in 2023. Recycled water from the GWRS is percolated in the surface water system and injected into the Talbert Seawater Barrier, and the Mid-Basin Injection wells. Operation of GWRS is explained in detail in Section 5.

The second source of recycled water is the Leo J. Vander Lans Treatment Facility which supplies water to the Alamitos Seawater Barrier. The capacity of the Vander Lans Treatment

Facility was expanded from 3 mgd to 8 mgd but has generally not operated above 4 mgd for extended periods of time for various reasons. WRD is working on increasing this facility's online performance. A portion of the water recharged in the Alamitos Barrier recharges the Orange County Groundwater Basin with the remainder recharging the Central Basin in Los Angeles County.

Imported Water

OCWD purchases imported water for recharge from the Municipal Water District of Orange County (MWDOC), which is a member agency of MWD. Untreated imported water can be delivered to the surface water recharge system in multiple locations, including Anaheim Lake (OC-28/28A), Santa Ana River (OC-11), Irvine Lake (OC-13A), and San Antonio Creek near the City of Upland (OC-59). These locations are shown in Figure 6-4. Connections OC-28, OC-11 and OC-13A supply OCWD with Colorado River Aqueduct water. Connection OC-59 supplies OCWD with State Water Project water, and OC-28A (co-located with OC-28) supplies OCWD with a variable blend of water from these two sources.

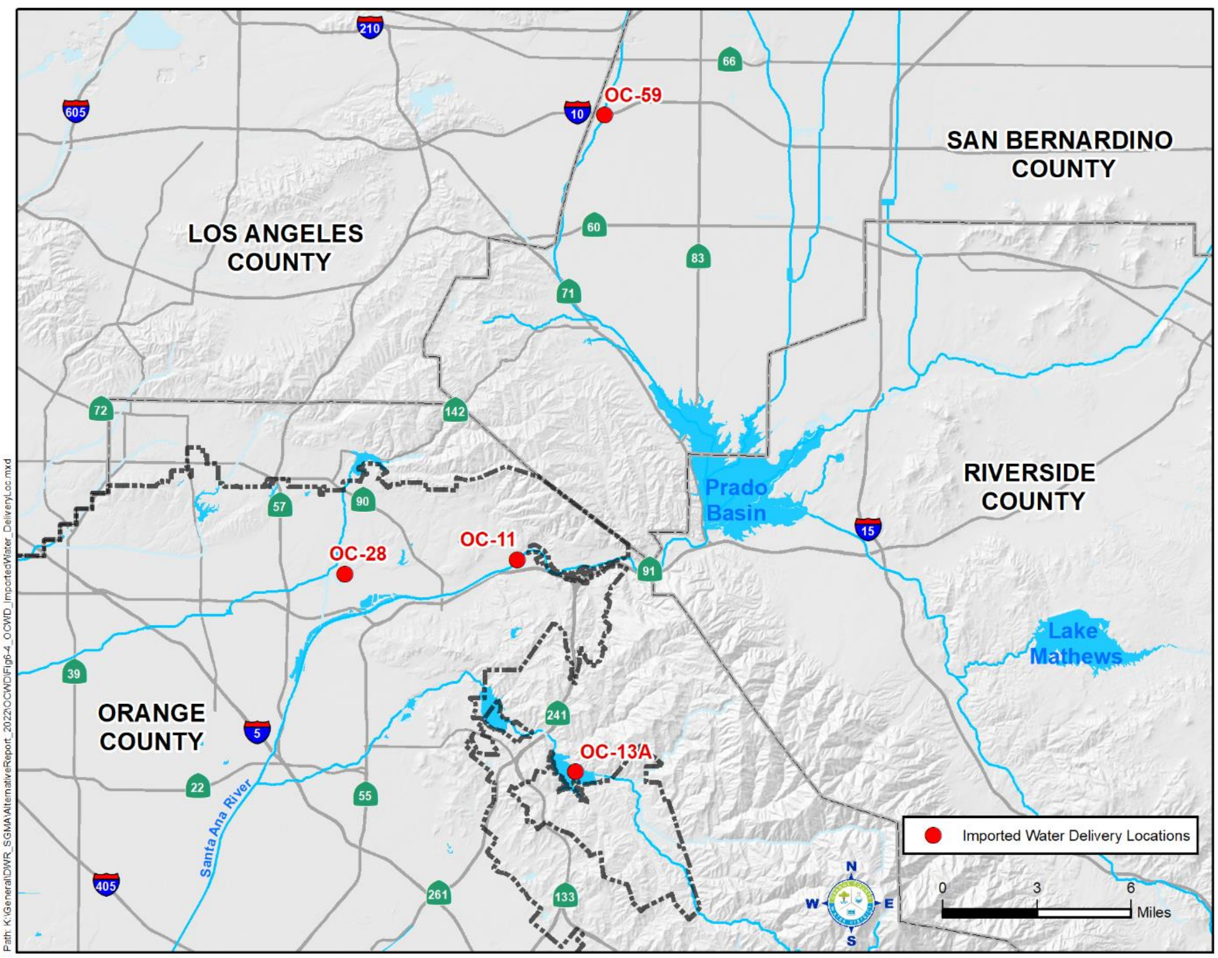


Figure 6-4: Locations of Imported Water Deliveries

6.5.2 Surface Water Recharge Facilities

OCWD operates a network of 25 surface water facilities located adjacent to the Santa Ana River in the City of Anaheim and Santiago Creek in the City of Orange as shown in Figure 6-5. The system has a total storage capacity of over 25,000 acre-feet. OCWD carefully tracks the amount of water being recharged in each facility on a daily basis.

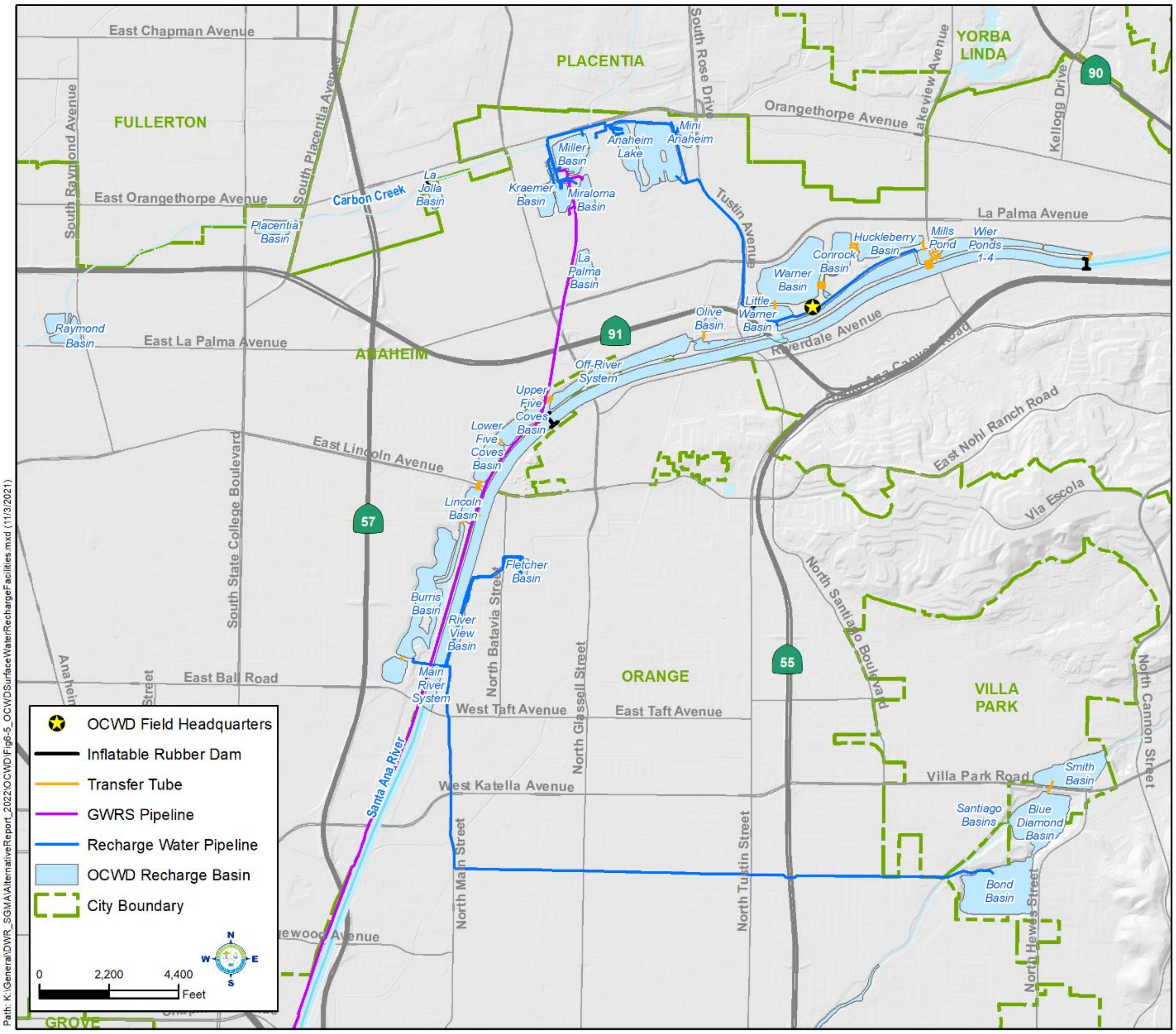


Figure 6-5: OCWD Surface Water Recharge Facilities

Three full-time hydrographers control and monitor the recharge system. These hydrographers and other OCWD staff prepare a monthly *Water Resources Summary Report*, which lists the source and volume for each recharge water supply, provides an estimate of the amount of water percolated in each recharge basin, documents total groundwater production from the basin, and estimates the change in groundwater storage. The report also estimates the amount of incidental recharge, evaporation and losses to the ocean – essentially a monthly water budget accounting. The monthly figures are compiled to determine yearly recharge and production totals and used in the year-end determination of groundwater storage change.

6.6 MANAGEMENT OF SEAWATER INTRUSION

In the coastal area of Orange County, the primary source of saline groundwater is seawater intrusion into the groundwater basin through permeable sediments underlying topographic lowlands or gaps between the erosional remnants or mesas of the Newport-Inglewood Uplift. Areas susceptible to intrusion are the Talbert, Bolsa, Sunset, and Alamitos gaps as shown in Figure 3-26.

Seawater intrusion in the Talbert Gap area began as early as the 1920s as the previously flowing artesian conditions within the shallow Talbert aquifer were gradually lowered until groundwater levels declined below sea level due to unrestricted agricultural pumping. By the 1930s and 1940s, seawater had advanced more than one mile inland within the Talbert Gap, forcing the closure of municipal supply wells owned and operated by the cities of Newport Beach and Laguna Beach due to elevated salinity.

Seawater intrusion became a critical problem in the 1950s. Overdraft of the basin caused water levels to drop as much as 40 feet below sea level. By the mid-1960s seawater had intruded nearly four miles inland within the Talbert Gap. Intrusion was also observed in the Alamitos Gap area along the Orange County/Los Angeles County border. During the 1950s and 1960s seawater intrusion investigations in coastal Orange County were conducted by the USGS, DWR and OCWD to define the nature and extent of the problem. During this time, OCWD slowed seawater intrusion by filling the basin with imported Colorado River water in the Anaheim Forebay area, thus reducing the overdraft throughout the basin and raising coastal groundwater levels (DWR, 1966).

Largely based on the 1966 DWR study, OCWD constructed the initial Talbert Seawater Intrusion Barrier in 1975 with 23 injection well sites. In 1965, a line of injection wells was constructed across the Alamitos Gap to form a subsurface freshwater hydraulic barrier. The Alamitos and Talbert barriers control seawater intrusion in their respective gaps by injecting fresh water into a series of multi-depth wells targeting each individual aquifer zone that is susceptible to seawater intrusion. The pressure mound resulting from this injection minimizes seawater intrusion through these gaps into the basin.

Both the Alamitos and Talbert barriers have been expanded and improved periodically and have allowed the basin to be operated more flexibly as a storage reservoir with an operating range of 500,000 acre-feet below full condition.

In July 2014, the OCWD Board of Directors adopted a Seawater Intrusion Prevention Policy that contained the following tenets:

- Prevent degradation of the quality of the groundwater basin from seawater intrusion
- Effectively operate and evaluate the performance of the seawater barrier facilities

- Adequately identify and track trends in seawater intrusion in susceptible coastal areas and evaluate and act upon this information, as needed, to protect the groundwater basin

6.6.1 Talbert Seawater Intrusion Barrier

The Talbert Barrier consists of 36 injection well sites, shown in Figure 3-26, with the primary alignment along Ellis Avenue approximately four miles inland from the ocean. Barrier injection raises groundwater levels in the immediate vicinity and thus creates a groundwater mound that acts as a hydraulic barrier to seawater that would otherwise migrate inland toward areas of groundwater production.

From 1975 until 2008, a blend of deep well water, imported water and recycled water from the former Water Factory 21 was injected into the barrier. In 2008, GWRS recycled water became the primary supply used for the injection wells, with a small and intermittent portion of the supply from potable imported water delivered via the City of Huntington Beach at the OC-44 turnout and potable water delivered by the City of Fountain Valley (a blend of groundwater and imported water). Since approval by the Regional Water Board in 2009, OCWD uses recycled water for all of the injection well supply at the Talbert Barrier.

Prior to GWRS, barrier capacity averaged approximately 15 mgd but now averages approximately 30 mgd with a typical seasonal range of 20 to nearly 40 mgd. Doubling the injection capacity was necessary to prevent seawater intrusion as groundwater production increased and was made possible by construction of additional injection wells and pipelines, superior water quality (GWRS water), and improved barrier operations, such as more frequent backwashing and rehabilitation. Barrier injection rates are adjusted based on overall basin storage conditions and seasonally varying coastal water levels. Therefore, injection is typically lower in the winter months and higher in the summer when increased coastal production causes lower coastal groundwater levels. Approximately 85 to 90 percent of barrier injection is typically targeted into the shallow and intermediate aquifer zones for seawater intrusion control on an annual basis, while the other 10 to 15 percent goes into the deeper Main aquifer zone primarily for basin replenishment. Based on the much steeper hydraulic gradient inland toward pumping depressions (relative to that toward the coast), OCWD estimates that approximately 95 percent of the water injected at the Talbert Barrier flows inland to replenish the basin, with the remainder ultimately flowing to the ocean as subsurface outflow.

6.6.2 Alamitos Seawater Intrusion Barrier

The Alamitos Barrier Project was initially constructed in 1964 and went into operation in 1965 to create a freshwater pressure ridge to prevent seawater intrusion from migrating through the Alamitos Gap into the Central Basin of Los Angeles County and the Orange County groundwater basin. The barrier alignment straddles the Los Angeles-Orange County line and spans approximately 1.8 miles across the Alamitos Gap from Bixby Ranch Hill in the City of Long Beach to the vicinity of Landing Hill in the City of Seal Beach.

Under the terms of the 1964 Agreement for Cooperative Implementation of the Alamitos Barrier Project (1964 Agreement), the barrier facilities are co-owned by OCWD and the Los Angeles County Flood Control District (LACFCD, a division of LACPW) and currently include 58 injection wells and 238 active monitoring wells as shown in Figure 3-26. The barrier is operated and maintained by LACPW under the direction of the Alamitos Barrier Joint Management Committee (JMC), whose membership includes OCWD, LACPW, WRD, City of Long Beach, and Golden State Water Company.

The barrier has been incrementally expanded over time to include the construction of additional injection and monitoring wells. Since the initial 14 injection wells were constructed in 1964, an additional 44 injection wells have been installed over eight phases of well construction. Most recently in 2018, with the addition of 17 new injection wells at 8 locations to control breaches through the barrier where well spacing was too large and injection capacity too small.

Similar to the Talbert Barrier, the Alamitos Barrier consists of both nested and cluster-type injection wells screened discretely in each aquifer zone in order to control the injection rate and injection pressure into each targeted aquifer zone independently since each aquifer zone has different physical characteristics and groundwater levels. In addition, there are a couple “dual-point” injection wells that consist of only one well casing, but two different screened interval depths separated inside the well by an inflatable packer and two separate injection drop pipes.

SECTION 7 NOTICE AND COMMUNICATION

7.1 DESCRIPTION OF GROUNDWATER USERS

The local agencies that produce the majority of the groundwater from the basin are listed in Table 7-1 with geographic boundaries shown in Figure 3-3. OCWD meets monthly with 19 major water retail agencies, referred to as the groundwater producers, to discuss and evaluate basin management issues and proposed projects and work cooperatively among the agencies in the OCWD Management Area.

Table 7-1: Major Groundwater Producers

CITIES		
Anaheim	Huntington Beach	Santa Ana
Buena Park	La Palma	Seal Beach
Fountain Valley	Newport Beach	Tustin
Fullerton	Orange	Westminster
Garden Grove		

WATER DISTRICTS AND WATER COMPANIES	
East Orange County Water District	Mesa Water District
Golden State Water Company	Serrano Water District
Irvine Ranch Water District	Yorba Linda Water District

The monthly meeting with OCWD staff and the groundwater producers provides a forum for the groundwater producers to provide their input to OCWD on important issues such as:

- Setting the Basin Production Percentage (BPP) each year
- Reviewing the merits of proposed capital improvement projects
- Purchasing imported water to recharge the groundwater basin
- Reviewing water quality data and regulations
- Maintaining and monitoring basin water quality
- Budgeting, replenishment assessment and considering other important policy decisions

7.2 PUBLIC PARTICIPATION

On September 30, 2021, OCWD sent a letter via email to all of the Basin 8-1 agencies to inform them that the 2017 Alternative was being updated and would be available for review and comment. No comments were received by any of the agencies contacted.

A draft of the 2022 Update was presented to the OCWD Board and posted on the OCWD website on November 18, 2021, to allow for public review and comment. The final 2022 Update was presented to the OCWD Board on December 15, 2021. At this board meeting, a resolution was adopted to support the submission of the 2022 Update to DWR.

7.3 COMMUNICATION PLAN

Proactive community outreach and public education are central to OCWD. The 2017 Alternative provides detailed information on OCWD's communication plan.

SECTION 8 SUSTAINABLE BASIN MANAGEMENT

8.1 SUSTAINABILITY GOAL

The sustainability goal for the OCWD Management Area is as follows:

> Continue to manage the groundwater basin to prevent basin conditions that would lead to significant and unreasonable undesirable results as defined by California Water Code Section 10721(x).

Existing monitoring and management programs in place today enable OCWD to sustainably manage the groundwater basin. Since its formation in 1933, OCWD has developed a managed aquifer recharge program, constructed hundreds of monitoring wells, developed water quality monitoring programs, constructed a large surface water recharge system, installed seawater intrusion barriers, and managed the volume of groundwater production through a scientifically based understanding of the basin's sustainable yield and the use of financial incentives. Continued successful protection of the groundwater basin requires that OCWD's management of the basin be able to adapt to changing conditions affecting the groundwater basin. The following sections describe the sustainable basin management for each of the undesirable results as defined in the California Water Code, Section 10721(x).

SECTION 9 SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER LEVELS

9.1 HISTORY/SUMMARY

OCWD manages the basin for long-term sustainability by maximizing recharge of the basin and managing basin production within sustainable levels. This section will discuss the relationship between groundwater elevations and sustainable groundwater management.

Groundwater elevations over the last twenty years exhibit short-term changes and long-term (multi-year) trends see Figures 3-10 through 3-13). Short-term elevation changes typically reflect seasonal variations in pumping and recharge, while multi-year trends reflect the effects of extended periods of above- or below-average precipitation and/or availability of imported water.

Groundwater elevation is monitored at over 1,000 individual measuring points, including key wells formerly designated under the CASGEM program which has been superseded by annual reporting required under SGMA. OCWD will be reporting water level data for the basin except for the La Habra-Brea Management Area.

In general, groundwater elevations in the Shallow Aquifer system show less amplitude than those in the underlying Principal and Deep Aquifer systems due to the higher degree of pumping and confinement of the Principal and Deep Aquifer systems. Because approximately 95 percent of all production occurs from wells screened within the Principal Aquifer system, groundwater elevations within this system are typically lower than those in the overlying Shallow Aquifer system and, in some areas, the underlying Deep Aquifer system. Vertical hydraulic gradients created by pumping and recharge drive groundwater into the Principal Aquifer system from the overlying Shallow Aquifer system and, to a lesser extent, from the Deep Aquifer system.

Long-term data demonstrates that groundwater elevations in the basin have exhibited multi-year cyclical patterns and have not experienced chronic lowering due to OCWD's management approach of maintaining basin storage within the established operating range. As a result, the undesirable effect of "chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply" is not occurring in the OCWD Management Area and is not expected to occur in the future as OCWD continues to manage the basin as described in this report.

9.2 MONITORING OF GROUNDWATER LEVELS FOR SUSTAINABILITY

As explained in Section 3.2, OCWD monitors water levels at over 1,000 individual measuring points on a monthly or bi-monthly basis to evaluate the effects of pumping, recharge or injection operations. Additional monitoring is conducted as needed in the vicinity of OCWD's recharge facilities, seawater barriers and areas of special investigation where drawdown, water quality impacts or contaminants are of concern.

Groundwater elevation contour maps for the Shallow, Principal and Deep Aquifers are prepared annually and are scanned and digitized into OCWD's GIS database. Figures 3-5, 3-6, and 3-7 show the groundwater elevation contours for June 2021 for all three basin aquifers. The changes in groundwater elevations for the three aquifers are also calculated on an annual basis. The water level changes for each of the three aquifers for June 2020 to June 2021 are shown in Figures 9-1, 9-2 and 9-3.

9.3 MANAGEMENT OF GROUNDWATER LEVELS FOR SUSTAINABILITY

For each of the three major aquifer systems, GIS mapping is used to multiply the water level changes by a grid of aquifer storage properties from OCWD's calibrated groundwater flow model. This results in a storage change volume for each of the three aquifer layers which are totaled to provide a net annual storage change for the basin. Thus, measurements of groundwater elevations are ultimately used to calculate total basin storage levels each year.

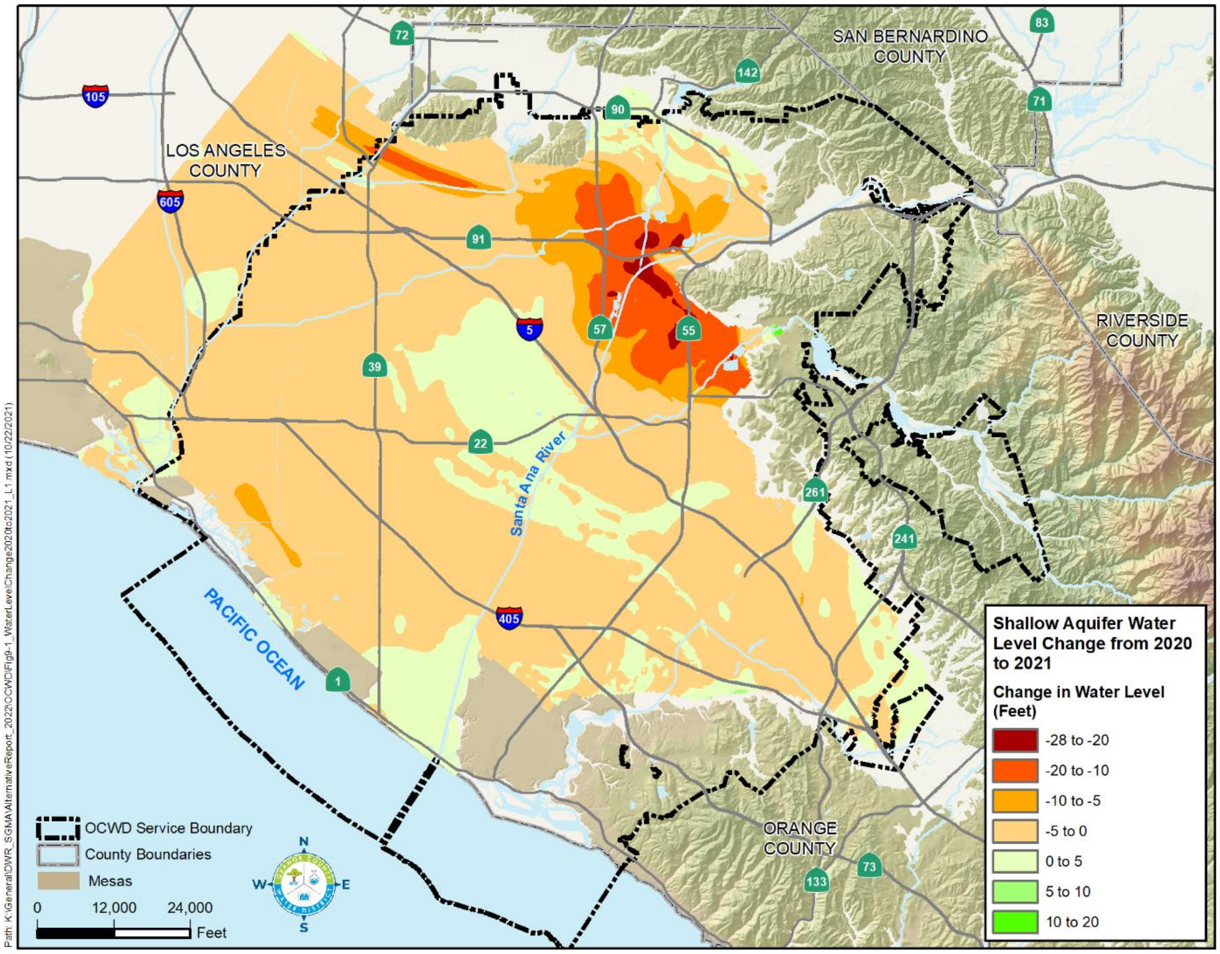


Figure 9-1: Shallow Aquifer Water Level Change, June 2020 to June 2021

In determining the operating range for groundwater storage levels, OCWD considered the potential negative impacts that could occur due to unreasonable and chronic lowering of groundwater elevations. These potential negative impacts include increased costs for groundwater producers to pump groundwater, decreased yield in production wells, increased risk of land subsidence, and increased risk of seawater intrusion.

Monitoring and management of groundwater elevations in the OCWD Management Area is most important in the coastal areas in order to protect groundwater basin water quality from seawater intrusion. Management programs that enable long-term sustainable basin management related to groundwater elevations in the coastal areas include the operation of the Alamitos and Talbert Seawater Intrusion Barriers and the Coastal Pumping Transfer Program.

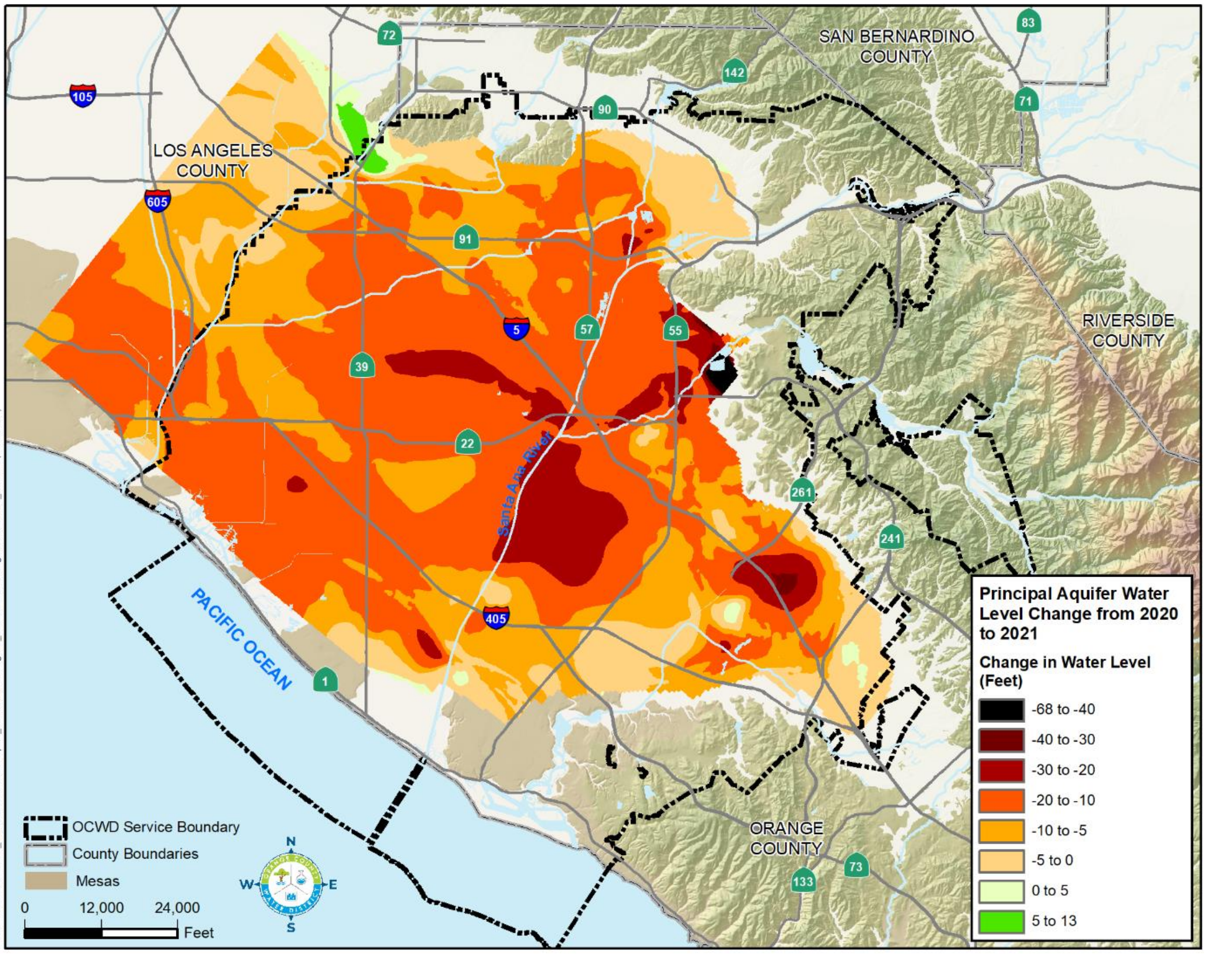


Figure 9-2: Principal Aquifer Water Level Change, June 2020 to June 2021

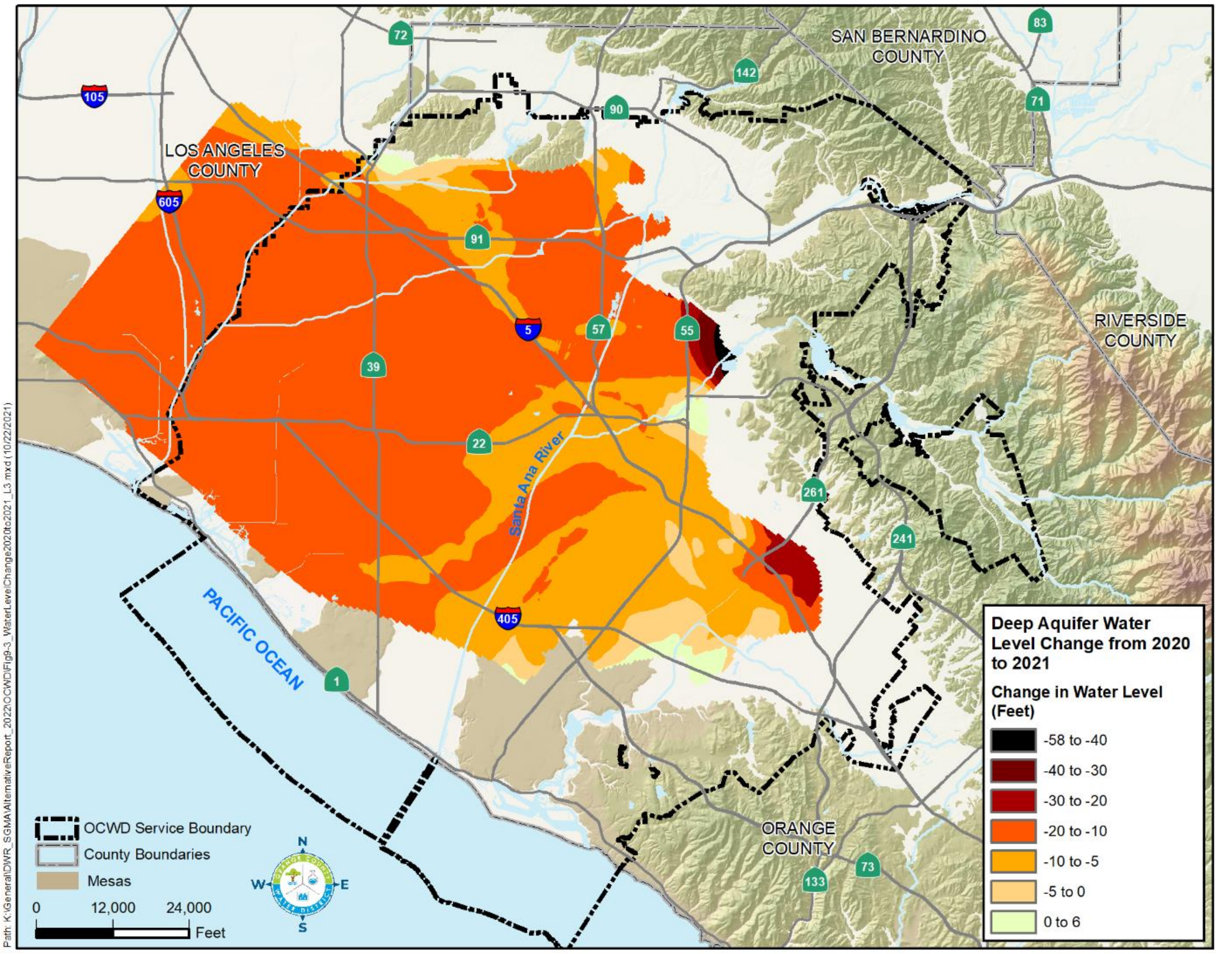


Figure 9-3: Deep Aquifer Water Level Change, June 2020 to June 2021

9.4 DEFINITION OF SIGNIFICANT AND UNREASONABLE LOWERING OF GROUNDWATER LEVELS

OCWD closely monitors groundwater levels in the three major aquifer systems (Shallow, Principal and Deep) for a number of purposes including determination of groundwater storage within the basin. OCWD uses groundwater storage conditions to manage the basin sustainably by keeping storage levels within an operating range up to 500,000 acre-feet below full condition. Significant and unreasonable reduction of groundwater in storage could occur in the event that the volume of groundwater in storage fell below the 500,000 acre-feet below full condition for an extended period of time. If OCWD were to consider an operating range below 500,000 acre-feet from full condition, additional analysis and monitoring would be needed.

9.5 DETERMINATION OF MINIMUM THRESHOLD

The minimum threshold for significant and unreasonable reduction in groundwater levels is reached when the storage volume of the groundwater basin falls below the operating range of up to 500,000 acre-feet below full condition for an extended period of time.

SECTION 10 SUSTAINABLE MANAGEMENT RELATED TO BASIN STORAGE

10.1 HISTORY

Within the Orange County Groundwater Basin, there is an estimated 66 million acre-feet of water in storage (OCWD, 2007). In spite of the large amount of stored water, there is a comparatively narrow operating range within which the basin can be safely operated.

The operating range of the basin is considered to be the maximum allowable storage range over the long-term without incurring detrimental impacts. The upper limit of the operating range is defined by the full basin condition. Although it may be physically possible to fill the basin higher than this full condition, it could lead to detrimental impacts such as percolation reductions in recharge facilities and increased risk of shallow groundwater seepage in low-lying coastal areas.

The lower limit of the operating range is considered to be 500,000 acre-feet below full condition. Although it may be considered to be acceptable to allow the basin to decline below 500,000 acre-feet below full condition for brief periods due to severe drought conditions and lack of imported water for basin recharge, it is not considered to be an acceptable management practice to intentionally manage the basin for sustained periods at this lower limit for the following reasons:

- Increased risk of seawater intrusion
- Increased risk of land subsidence
- Depletion of water in storage available for future drought conditions
- Some wells potentially becoming inoperable due to lower groundwater levels
- Increased costs to pump groundwater for groundwater users
- Increased potential for upwelling of amber-colored groundwater from the Deep Aquifer

It is important to note that detrimental impacts do not suddenly happen when storage levels fall to 500,000 or more acre-feet below full condition; rather, they occur incrementally, or the potential for their occurrence grows as the basin declines to lower levels. OCWD has used the basin model computer simulations to evaluate the potential for detrimental impacts if storage were to fall to 700,000 acre-feet from full. Basin model runs at 700,000 acre-feet below full condition indicates the potential for increased seawater intrusion and considerably more production wells being impacted by low pumping levels. Thus, a reduction of up to 700,000 acre-feet of groundwater in storage is only considered acceptable during an extreme emergency, such as a disruption in imported water supplies due to an earthquake. Negative or adverse impacts that are considered when establishing the operating range include chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the long-term, increased seawater intrusion, significant and unreasonable land subsidence that substantially interferes with surface land uses, and increased pumping costs.

The current policy of maintaining a groundwater storage level of up to 500,000 acre-feet below full was established based on completion of a comprehensive hydrogeological study of the basin in 2007 (OCWD, 2007).

The basin's storage level is quantified based on a benchmark defined as the full basin condition. Although the groundwater basin rarely reaches the full basin condition, basin storage has fluctuated within the operating range for many decades. OCWD manages groundwater pumping such that it is sustainable over the long term; however, in any given year pumping may exceed recharge or vice versa. Thus, the amount of groundwater stored in or withdrawn from the basin varies from year to year and often goes through multi-year cycles of emptying and filling, which generally correlates with state-wide and/or local precipitation patterns.

Each year OCWD calculates the volume of groundwater storage change from a theoretical "full" benchmark condition based on a calculation using changes in groundwater elevations in each of the three major aquifer systems and aquifer storage coefficients. This calculation is checked against an annual water budget that accounts for all production, measured recharge, and estimated unmeasured recharge. The amount of available or unfilled storage from the theoretical full condition from WY1958-59 to 2020-21 is shown in Figure 1-3.

Maintaining the basin storage condition on a long-term basis within this operating range allows for long-term sustainable management of the basin without experiencing undesirable effects. Short-term excursions from the operating range due to extreme drought or other factors are not expected to cause adverse impacts but would need to be monitored closely and be of limited duration. In the California Water Plan Update 2013 (DWR, 2014) this manner of groundwater basin management is described as follows:

> "Change in groundwater storage is the difference in stored groundwater volume between two time periods…However, declining storage over a period characterized by average hydrologic conditions does not necessarily mean that the basin is being managed unsustainably or is subject to conditions of overdraft. Utilization of groundwater in storage during years of diminishing surface water supply, followed by active recharge of the aquifer when surface water or other alternative supplies become available, is a recognized and acceptable approach to conjunctive water management." (p. SC-77)

10.2 CALCULATION OF GROUNDWATER STORAGE LEVELS

The estimated historical minimum storage level of 500,000 to 700,000 acre-feet below full condition occurred in 1956-57 (DWR, 1967; OCWD, 2003). Since this time, the basin storage fluctuated within the operating range reaching a full condition in 1969 and 1983.

OCWD uses two methods to calculate the storage condition of the basin: (1) water budget method and (2) three-layer storage change method. The water budget method is simply an accounting of the inflows to the basin and outflows. This data is collected and compiled on a monthly basis. Estimates of unmeasured or incidental recharge are used based on a statistical relationship between historical local precipitation and calculated unmeasured recharge. Unmeasured recharge is trued up at the end of the year with the final reports of inflows and outflows and basin storage change (based on groundwater level changes). This method produces a monthly estimate of the change in groundwater storage and allows for real-time decision making with respect to managing the basin.

In 2007, OCWD instituted a new three-layer change in storage method for calculating the amount of groundwater in storage (OCWD, 2007). The three-layer method involves creating groundwater elevation contour maps for each of the three aquifer layers (Shallow, Principal and Deep aquifers) for conditions at the end of June of each year. Prior to this time, groundwater storage was determined based on a single groundwater elevation map that was essentially a composite of the Shallow and Principal aquifers.

10.3 SUSTAINABLE MANAGEMENT PROGRAMS

10.3.1 Basin Operating Range

Each year OCWD assesses current basin storage and projected water supply availability as factors in establishing how much groundwater can be pumped from the basin for the following year. If basin storage approaches or falls within the lower end of the established operating range, issues that are evaluated when considering the management of the basin include the current status of seawater intrusion protective measures, monitoring of ground surface elevations to assess the risk of land subsidence, inflow of amber-colored water or poor quality groundwater into the Principal Aquifer from underlying or overlying aquifers, and the number of shallow production wells that would become affected by lower groundwater levels. On the other hand, when operating the basin near the higher end of the storage range, considerations include the potential to increase groundwater pumping, purchase less imported replenishment water, and the potential for more groundwater outflow to Los Angeles County.

10.3.2 Balancing Production and Recharge

Over the long-term, the basin must be maintained in an approximate balance to ensure the long-term viability of basin water supplies. In a given year, water withdrawals may exceed water recharged as long as over the course of a number of years this is balanced by years where water recharged exceeds withdrawals. Levels of total basin production and total water recharged since WY1999-00 are shown in Figure 1-4.

10.3.3 Managing Basin Pumping

The primary mechanisms used by OCWD to manage pumping are the Basin Production Percentage (BPP) and the Basin Equity Assessment (BEA). The ability to assess the BPP and the BEA were provided to OCWD through an amendment to the OCWD Act in 1969. Section 31.5 of the OCWD Act empowers the Board to annually establish the BPP, defined as:

> "…the ratio that all water to be produced from groundwater supplies with the district bears to all water to be produced by persons and operators within the District from supplemental sources and from groundwater within the District during the ensuing water year."

In other words, the BPP is a percentage of each Producer's water supply (supplemental and groundwater sources) that comes from groundwater pumped from the basin. The BPP is set uniformly for all groundwater producers. Groundwater production at or below the BPP is assessed the Replenishment Assessment (RA). Production above the BPP is charged the RA plus the Basin Equity Assessment (BEA). The BEA is set by the Board and is presently calculated so that the cost of groundwater production above the BPP is equivalent to the cost of purchasing imported potable supplies. This approach serves to discourage, but not eliminate, production above the BPP. In practice, groundwater producers rarely pump in excess of the BPP as doing so triggers a requirement to pay the BEA, thereby eliminating any cost savings that a pumper might obtain by pumping an amount in excess of the BPP. Collection of the BEA provides funds for OCWD to purchase additional replenishment water (where determined appropriate by OCWD). If necessary, the BEA can be increased to further discourage production above the BPP.

The BPP is set after evaluating groundwater storage conditions, availability of recharge water supplies and basin management objectives. OCWD's goal is to set the BPP as high as possible to allow groundwater producers to sustainably maximize pumping and reduce their overall water supply cost.

To change the BPP, the Board of Directors must hold a public hearing. Raising or lowering the BPP allows OCWD to manage the amount of pumping from the basin. The BPP is lowered when basin conditions necessitate a decrease in pumping. A lower BPP results in the need for groundwater producers to purchase additional, more expensive imported water.

The methodology for setting the BPP and OCWD polices related to the BPP are described further in the 2017 Alternative.

Table 10-1 shows the management actions to be used to guide OCWD in setting the BPP. As the BPP is annually set in April for the following fiscal year (but may be changed throughout the year), the projected change in basin storage would be estimated for the end of that fiscal year (as of June 30), given various assumptions of basin pumping, inflows and outflows. Maintaining some available storage space in the basin allows for maximizing surface water recharge when such supplies are available, especially in relatively wet years. By keeping the basin relatively full during wet years and for as long as possible in years with near-normal recharge, the maximum amount of groundwater could be maintained in storage for future drought conditions. During dry hydrologic years when less water would be available for recharge, the BPP could be lowered to maintain groundwater storage levels.

At the beginning of 2015, OCWD committed to purchase 650,000 acre-feet of imported water to recharge the basin over a ten-year time period. This amount of imported water for recharge into the basin will help maintain the BPP and assist in managing the basin storage level within the operating range. OCWD works to maintain a Water Reserve Fund to purchase imported water from MWD. Each year, a specific amount of money is budgeted to purchase imported water and, if water is not available from MWD, the funds are carried over to the next year in the Water Reserve Fund.

Table 10-1: Management Actions based on Change in Groundwater Storage

Available Storage Space (amount below full basin condition)	Basin Management Actions to Consider
Less than 100,000 acre-feet	Raise BPP
100,000 to 300,000 acre-feet	Maintain and/or raise BPP towards 75% goal
300,000 to 350,000 acre-feet	Seek additional supplies to refill basin and/or lower the BPP
Greater than 350,000 acre-feet	Seek additional supplies to refill basin & lower the BPP

Basin Production Limitation

Another management tool that enables OCWD to sustainably manage the basin is the Basin Production Limitation. Section 31.5(g)(7) of the OCWD Act authorizes limitations on production and the setting of surcharges when those limits are exceeded. This provision can be used when it is necessary to shift pumping from one area of the basin to another. An example of this is the Coastal Pumping Transfer Program, which shifts pumping from the coastal area to inland to minimize seawater intrusion, when necessary.

10.3.4 Supply Management Strategies

One of OCWD's basin management objectives is to maximize groundwater recharge. This is achieved through increasing the efficiency of and expanding OCWD's recharge facilities and the supply of recharge water. Construction and operation of the GWRS has provided a substantial increase in supply of water available to recharge the basin. Additional OCWD supply management programs include developing increased stormwater capture programs behind Prado Dam in cooperation with the U.S. Army Corps of Engineers, encouraging and participating in water conservation efforts, and working with MWD and the Municipal Water District of Orange County in developing and conducting other supply augmentation projects and strategies.

10.4 DEVELOPING NEW LOCAL WATER RESOURCES POLICY

In July 2020, the District adopted a policy called the Developing New Local Water Resources Policy to acknowledge that the local multi-billion-dollar economy and 2.5 million citizens that rely on groundwater as their primary water supply require a reliable, sustainable and economical water source to remain healthy and strong. It further acknowledges that the imported water that is purchased annually to meet the needs of the groundwater producers is becoming uncertain as environmental, agricultural, and urban interests maneuver to obtain a greater share and is susceptible to impacts from climate change. The Policy contains the following tenets:

- The District recognizes the impacts of climate change and their ability to disrupt predictions of future local water supplies for the District's service territory
- The District will evaluate and undertake economical and environmentally sensitive projects and programs to work towards the goal of ensuring adequate water supplies are always available to its service territory
- The types of projects that will be evaluated include: (1) Maximizing Santa Ana River base and storm flow capture, (2) Increasing water conservation, (3) Increasing water recycling, (4) Improving the reliability of imported water supplies, (5) Brackish water desalination, (6) weather modification/cloud seeding; and (7) Seawater desalination

Conjunctive Use and Water Transfers

By agreement with OCWD, MWD established a Conjunctive Use Project (CUP) in the OCWD Management Area by purchasing the right to store up to 66,000 acre-feet of water in the groundwater basin until 2028. OCWD used the funds provided by MWD to improve basin management facilities including the construction of eight new production wells for water retail agencies and new injection wells for the Talbert Barrier. Under the agreement, MWD may request that stored water be extracted up to a maximum of 22,000 acre-feet each year.

OCWD reviews opportunities for additional conjunctive use projects that would store water in the basin and potentially in other groundwater basins. Additionally, OCWD reviews opportunities for water transfers that could provide additional sources of recharge water. Such projects are evaluated carefully with respect to their impact on available storage, reliability and cost effectiveness.

10.4.1 Water Demands

Water demands within the OCWD Management Area for WY2016-17 to 2020-21 averaged 400,000 acre-feet per year (Figure 6-1). Total demand includes the use of groundwater, surface water from Santiago Creek and Irvine Lake, recycled water, and imported water.

Projected Water Demands

OCWD estimated future total water demands (including recycled water) within the OCWD Management Area to be approximately 431,000 acre-feet per year in 2050. This is based on a water demand study jointly funded by OCWD and MWDOC. This study was undertaken to assist the 19 major groundwater producers in the development of their 2020 Urban Water Management Plans. Water Demands within the OCWD Management Area was determined by summing the 19 producer future estimates and water produced by private, mutual water company, and irrigation wells.

Drought Management

During a drought, flexibility to manage pumping from the basin becomes increasingly important. The OCWD Management Area may experience a decline in the supply of recharge water (local supply of Santa Ana River water and net incidental recharge) of 55,000 acre-feet per year or more during drought.

Provided that the basin has available water in storage within the established operating range, this stored water provides a valuable water supply asset during drought conditions. Ensuring that the basin can provide a buffer against drought conditions requires:

- Maintaining sufficient water in storage that can be pumped out in time of need; and
- Possessing a plan to recover basin storage following the drought, including having a reserve account with sufficient funds to purchase replenishment water.

A sufficient supply of stored groundwater provides a safe and reliable buffer to manage for drought periods. If the basin, for example, has an available storage level of 150,000 acre-feet and can be drawn down to 500,000 acre-feet without irreparable seawater intrusion, a supply of 350,000 acre-feet is available for increased production. In a hypothetical five-year drought, an additional 70,000 acre-feet per year may be produced from the basin for five years without jeopardizing the long-term health of the basin. In addition to reducing pumping when the basin is at lower storage levels, planning for refilling the basin is important. Approaches for refilling the basin are described in Table 10-2.

10.5 DEFINITION OF SIGNIFICANT AND UNREASONABLE REDUCTION OF GROUNDWATER STORAGE

OCWD manages the groundwater basin to maintain groundwater storage levels within an operating range of up to 500,000 acre-feet below the full condition. Significant and unreasonable reduction of groundwater in storage would occur when the volume of groundwater in storage fell below the 500,000 acre-feet below full condition for an extended period of time. If OCWD were to consider an operating range below 500,000 acre-feet additional analysis and monitoring would be needed.

Table 10-2: Approaches to Refilling the Basin

APPROACH	DISCUSSION
Decrease Total Water Demands	• Increase water conservation and water-use efficiency measures
Decrease BPP	• Allows groundwater levels to recover rapidly • Decreases revenue to the OCWD • Increases water cost for groundwater producers • Does not require additional recharge facilities • Dependent upon other sources of water (e.g., imported water) being available to substitute for reduced groundwater pumping
Increase Recharge	• Dependent on increased supply of recharge water • Replenishment could be in the form of in-lieu water (additional imported water delivered to groundwater producers instead of groundwater pumping) • Water transfers and exchanges could be utilized to provide the increased supply of recharge water • May be dependent on building and maintaining excess recharge capacity (which may be underutilized in non-drought years)
Combination of the Above	• A combination of the approaches provides flexibility and a range of options for refilling the basin

10.6 DETERMINATION OF MINIMUM THRESHOLDS

The minimum threshold for significant and unreasonable reduction in groundwater in storage is reached when the storage volume of the groundwater basin falls below the operating range of up to 500,000 acre-feet below full condition for an extended period of time.

SECTION 11 SUSTAINABLE MANAGEMENT RELATED TO WATER QUALITY

OCWD has extensive monitoring and management programs in place to protect the groundwater basin from significant and unreasonable degradation of water quality including migration of contaminant plumes that impair water supplies. These programs include monitoring, remediation of contaminated groundwater, and recharging high-quality recycled water. This section describes sustainable basin management related to the water quality programs and projects instituted to prevent degradation of water quality and to remediate water quality problems in the OCWD Management Area.

11.1 SALINITY MANAGEMENT

Management of salt and nitrate concentrations in groundwater is important to maintaining the long-term sustainable use of groundwater supplies. OCWD also operates the Prado Wetlands to remove nitrate from Santa Ana River (SAR) water that is recharged into the groundwater basin. These efforts help provide high-quality groundwater to water users in Orange County.

In 2020, OCWD completed an evaluation of future TDS and nitrate concentrations in the Orange and Irvine Management Zones (OCWD, 2020). Figure 3-16 shows the areal extent of these zones, which are not to be confused with the OCWD Management Area that is the subject of this report. The 2020 update is similar to an analysis conducted in 2016 (OCWD, 2016) and involved using a model to evaluate the effects of different basin management scenarios on TDS and nitrate concentrations over the next 30 years. One of the key outputs of the model is the calculated ambient TDS and nitrate concentrations for groundwater in the Orange and Irvine Management Zones. The model-calculated ambient concentration represents a volume-weighted average value for the Shallow and Principal Aquifers. The report was prepared to meet regulatory requirements of the Regional Water Board as part of the watershed-wide salt and nutrient management plan.

Data and information used for this analysis included:

- Quantity and quality of water recharged through surface recharge facilities and injection wells
- Quantity and quality of unmeasured recharge, such as percolation of irrigation water into the groundwater basin
- Measurements of groundwater pumping
- Estimates of groundwater outflow from the Orange Management Zone

The most significant change from the prior analysis is the impact of the GWRS Final Expansion, which increases the volume of low-TDS recycled water recharged by 30,000 acre-feet per year. Because OCWD is obtaining the additional water from OC San Plant No. 2, the overall TDS of the recycled water generated increases slightly from 60 mg/L to 86 mg/L.

The quantity and quality of water recharged in the model for the Baseline Scenario are shown in Table 11-1.

Table 11-1: Baseline Projected Future Salt Inflows

Source of Water Recharge	Volume (acre-feet/yr)	TDS Conc. (mg/L)	Mass (tons/yr)
Deep percolation of precipitation*	6,500	100	900
Percolation of applied water*	9,000	1,900	23,200
Subsurface inflow*	44,500	1,290	78,200
SAR base flow	52,000	700	49,500
SAR storm flow	50,000	200	13,600
Recycled water (GWRS)	133,000	86	15,600
Alamitos Barrier	2,500	350	950
MWD imported water	0	0	0
Total	297,000	449	181,200

*Component of unmeasured recharge

The Baseline Scenario assumes that no imported water is used for recharge for the 30-year period and is utilized to compare with other model runs and determine how changing model inputs affect the predicted concentration. The projected trend for TDS for the Baseline declines from the current ambient groundwater concentration of 603 mg/L to 569 mg/L in 30 years as shown in Figure 11-1. Seven additional scenarios were run to model different quantities of recharge source water. The projected 30-year TDS for these scenarios range from 559 mg/L to 580 mg/L. This shows the tremendous impact of low-TDS GWRS water in lowering the overall salinity in the basin over time regardless of how much water is obtained from other recharge sources, such as higher TDS imported water.

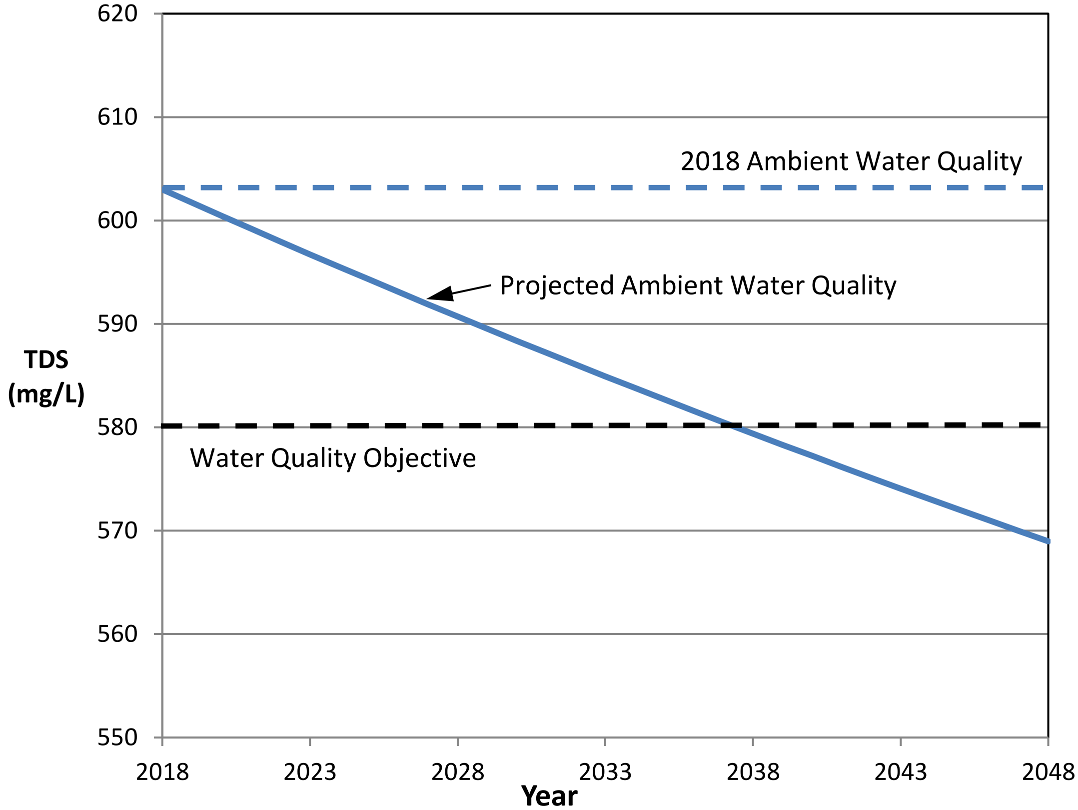


Figure 11-1: Estimated TDS Concentration in Base Case for 30-year Period

With regards to nitrate, the approach used to estimate future nitrate concentrations was similar to the approached used for TDS projections. The nitrate (as nitrogen, N) concentration for each inflow component was estimated using available data. Table 11-2 summarizes the inflow terms and their nitrate-N concentrations for the Baseline Scenario.

The flow-weighted average nitrate (as N) concentration for all inflows to the management zone is 2.3 mg/L. The initial concentration was set at 2.95 mg/L (based on the current ambient concentration for the most recent 20-year period).

Since the inflow concentration is less than the initial concentration, the estimated future nitrate (as N) concentration gradually decreases. For the Baseline Scenario, the ambient nitrate (as N) concentration is projected to decrease from 2.95 mg/L to 2.8 mg/L over the course of 30 years. Again, as with TDS, the impact of recharging large volumes of high quality GWRS water lowers nitrate concentrations in basin groundwater over time.

Table 11-2: Baseline Future Nitrate (as N) Inflows

Inflow	Volume (Acre-Feet/yr)	Nitrate-N Conc.(mg/L)	Mass (tons/yr)
Deep percolation of precipitation*	6,500	1	9
Percolation of applied water*	9,000	10	122
SAR base flow	52,000	3.6	255
SAR storm flow	50,000	1.3	88
Imported water recharge	0	0	0
Recycled water recharge (GWRS)	133,000	1.0	181
Subsurface inflow*	44,500	4.2	253
Alamitos Barrier	2,000	1.4	4
Total	297,000	2.3	657

*component of unmeasured recharge

11.2 GROUNDWATER QUALITY IMPROVEMENT PROJECTS

This section describes specific projects that improve groundwater quality by removing TDS, nitrate, VOCs and other constituents, including PFAS. The locations of these projects, except for PFAS, are shown in Figure 11-2. PFAS projects are located at specific groundwater producer wells.

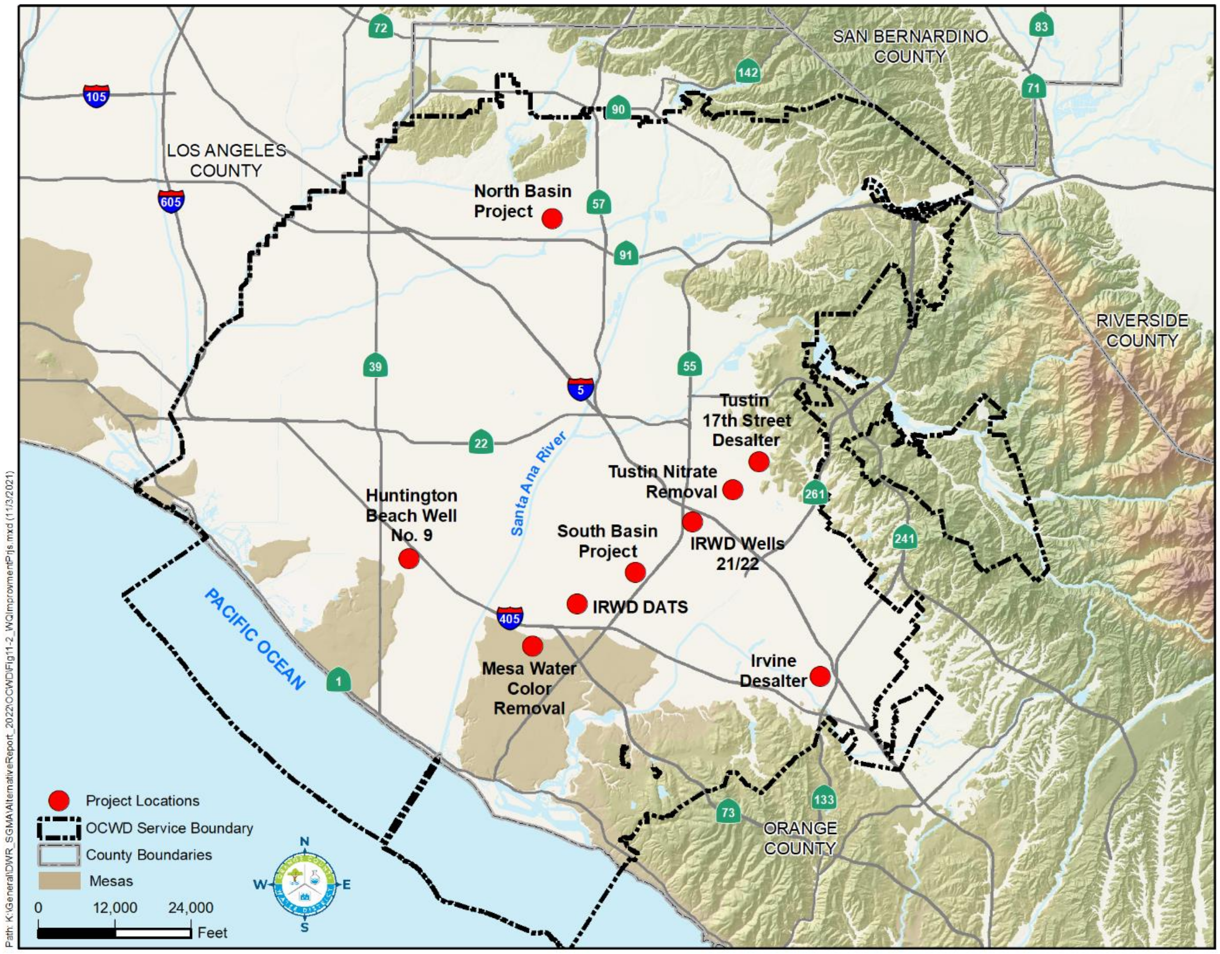


Figure 11-2: Water Quality Improvement Projects and Programs

North Basin Groundwater Protection Program

The U.S. Environmental Protection Agency (USEPA) is taking the lead to remediate a VOC plume in the North Basin area of the groundwater basin as shown in Figure 11-3. Groundwater contamination is primarily found in the Shallow Aquifer, which is generally less than 200 feet deep; however, VOC-impacted groundwater has migrated downward into the Principal Aquifer tapped by production wells. The contamination continues to migrate both laterally and vertically threatening downgradient production wells operated by the cities of Fullerton and Anaheim and other agencies. OCWD is conducting a remedial investigation/feasibility study under USEPA oversight to evaluate and develop effective remedies to address the contamination under the National Contingency Plan (NCP) process. In September 2020 the USEPA included the North Basin site on the National Priorities (Superfund) List.

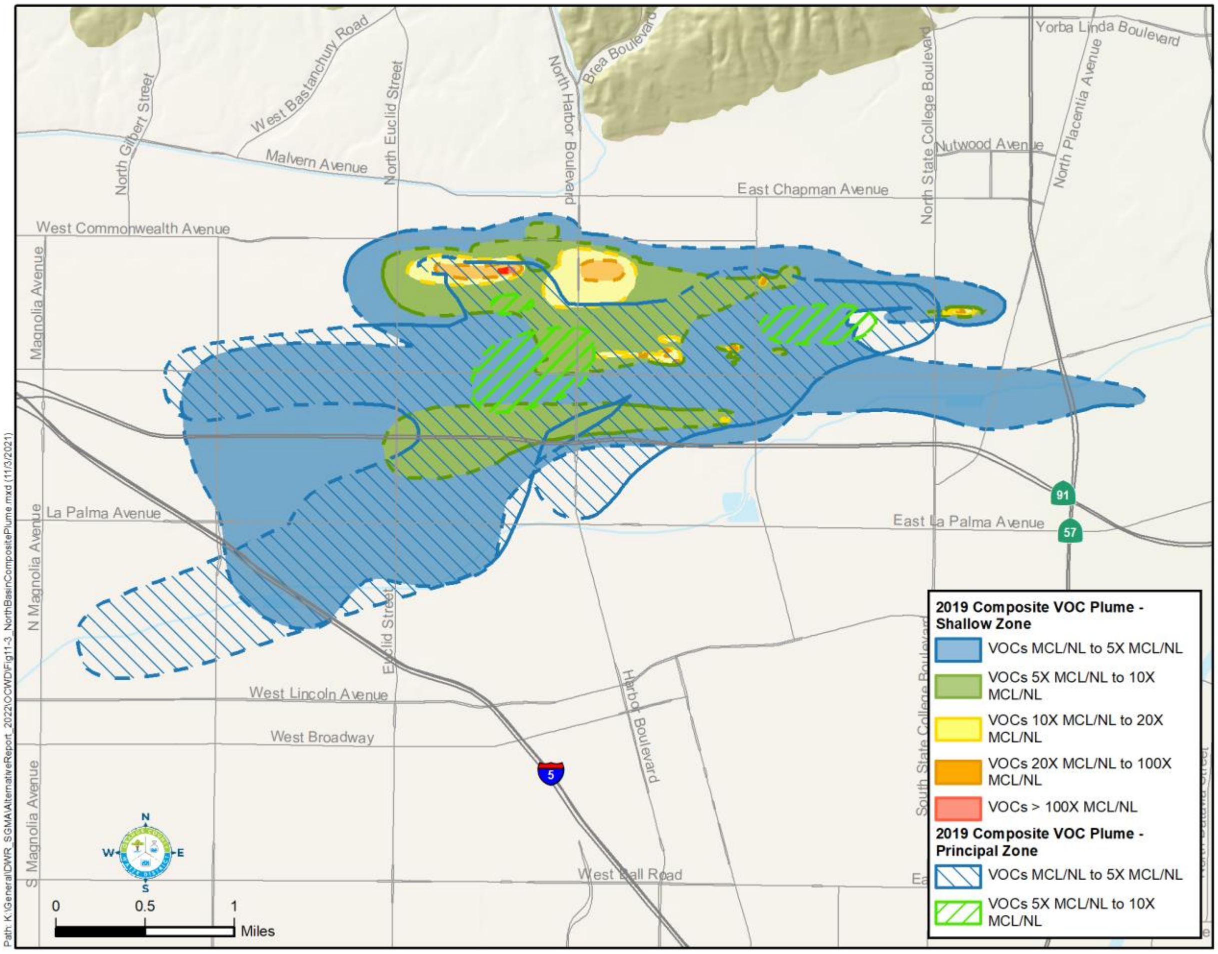


Figure 11-3: North Basin Groundwater VOC Plume

South Basin Groundwater Protection Program

Groundwater contaminated with VOCs and perchlorate in the South Basin area of the groundwater basin is shown in Figure 11-4. Elevated concentrations of perchloroethylene (PCE), trichloroethylene (TCE), and perchlorate were detected in Irvine Ranch Water District's Well No. 3, located in Santa Ana. OCWD's remedial investigation has resulted in the delineation of an approximately 2-mile long comingled contaminant plume. With the remedial investigation complete, OCWD is proceeding with a feasibility study to evaluate and develop remedial measures in cooperation with regulatory agencies and stakeholders following the NCP process. In tandem with OCWD's remediation program to address off-site contamination, the Regional Water Board and DTSC are overseeing investigation and remediation activities at the contaminant source sites.

MTBE Remediation

In 2003, OCWD filed suit against numerous oil and petroleum-related companies that produce, refine, distribute, market, and sell MTBE and other oxygenates. The suit seeks funding from these responsible parties to pay for the investigation, monitoring and removal of oxygenates from the basin. Most of the major defendants have settled the litigation with OCWD, and funds from these settlements have been set aside for use at such time as treatment is required at drinking water wells.

Treatment technologies used to remove MTBE from groundwater include granular activated carbon or advanced oxidation. Depending upon site-specific requirements, a treatment train of two or more technologies in series may be appropriate (i.e., use one technology to remove the bulk of MTBE and a follow-up technology to polish the effluent water stream).

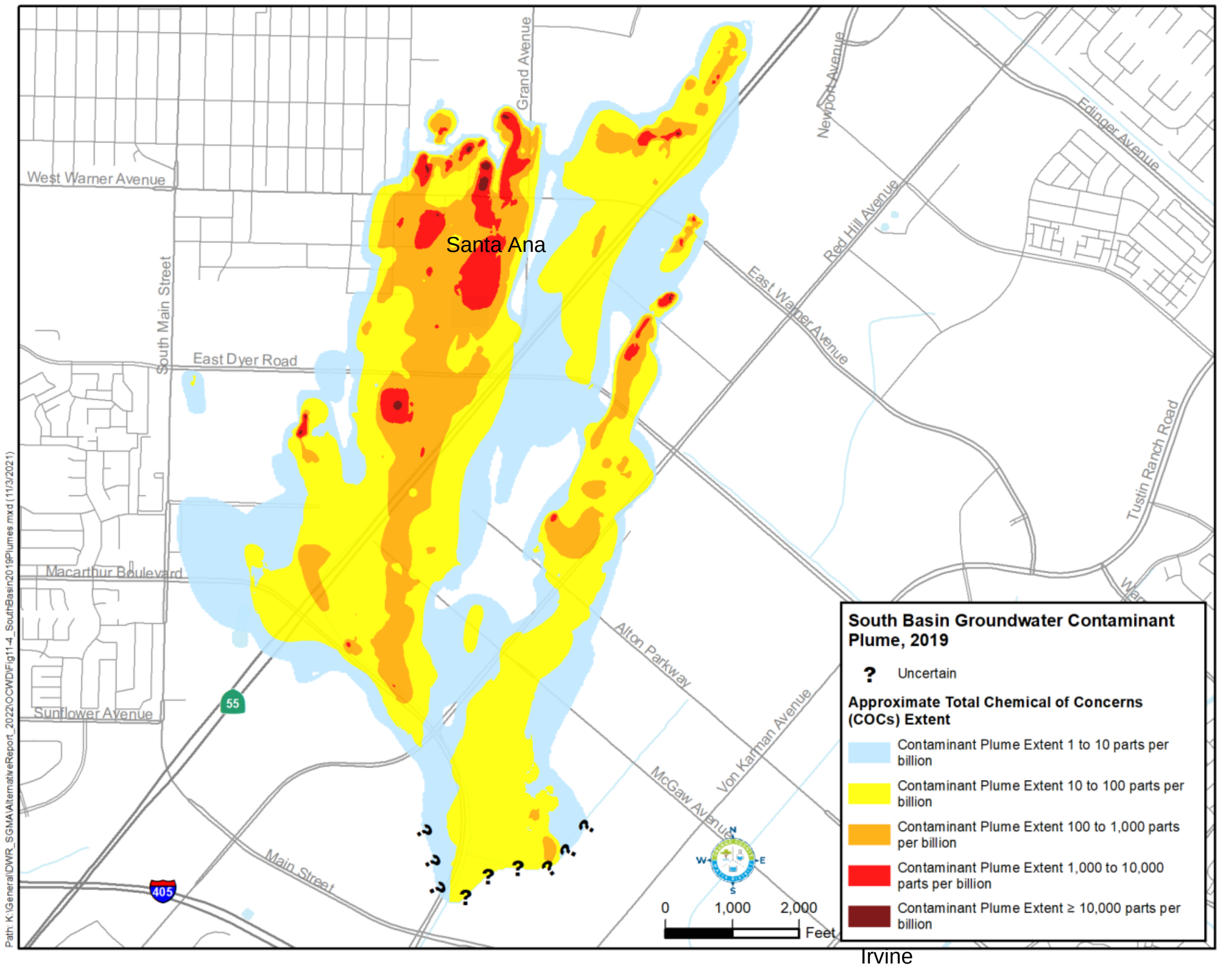


Figure 11-4: South Basin Groundwater Contaminant Plume

Irvine Desalter

The Irvine Desalter was built in response to elevated TDS and nitrate and the discovery in 1985 of VOCs beneath the former El Toro Marine Air Corps Station and the central area of Irvine. A plume of TCE migrated off base and impacted the groundwater basin. In 1990 the USEPA placed the site on the National Priorities List. Irvine Ranch Water District and OCWD cooperated with the U.S. Department of Navy in building production wells, pipelines and two treatment plants, both of which are now owned and managed by IRWD. Operating since 2007, the two plants remove VOCs by air-stripping and vapor-phase carbon adsorption with the treated water used for irrigation and recycled water purposes. A third plant treats groundwater outside the plume to remove excess nitrate and TDS concentrations using reverse osmosis (RO) membranes for drinking water purposes. Combined production of the Irvine Desalter wells is approximately 8,000 acre-feet per year. OCWD provides a financial subsidy to IRWD in the form of a BEA exemption to help offset the treatment costs.

Tustin Desalters

Tustin's Main Street Treatment Plant has operated since 1989 to reduce nitrate levels from the groundwater produced by Tustin's Main Street Wells Nos. 3 and 4. The groundwater undergoes either RO or ion exchange treatment. The RO membranes and ion exchange units operate in a parallel treatment train. Approximately 1 mgd is bypassed and blended with the treatment plant product water to produce up to 2 mgd or 2,000 acre-feet per year.

The Tustin Seventeenth Street Desalter began operation in 1996 to reduce high nitrate and TDS concentrations from the groundwater pumped by Tustin's Seventeenth Street Wells Nos. 2 and 4 and Tustin's Newport Well. The desalter utilizes two RO membrane trains to treat the groundwater. The treatment capacity of each RO train is 1 mgd. Approximately 1 mgd is bypassed and blended with the RO product water to produce up to 3 mgd or 3,000 acre-feet per year. OCWD provides a financial subsidy to the City of Tustin in the form of a BEA exemption to help offset the treatment costs.

Irvine Ranch Water District Wells 21 and 22

Water produced by IRWD Wells 21 and 22 contain nitrate (as N) at levels exceeding the primary MCL of 10 mg/L. TDS concentrations range from 650-740 mg/L, which is above the secondary MCL of 500 mg/L. Because of the elevated nitrate, TDS, and hardness concentrations, IRWD constructed a RO treatment facility to reduce concentrations in the water before conveying to the potable supply distribution system. Operation of the treatment facility provides 6,300 acre-feet per year of drinking water and benefits the groundwater basin by reducing the spread of impaired groundwater to other portions of the basin. OCWD provides a financial subsidy to IRWD in the form of a BEA exemption to help offset the treatment costs.

Amber-Colored Groundwater

Amber-colored water is found in the Deep Aquifer (600 to 2,000 feet below ground surface). Natural organic material from ancient, buried plant and wood material gives the water an amber tint and a sulfur odor. Although this water is of high quality, its color and odor produce negative aesthetic qualities that require treatment before use as drinking water.

Two facilities currently treat colored groundwater in Orange County for potable supply. In 2001, Mesa Water District opened its Colored Water Treatment Facility capable of treating 5.8 mgd. This facility was replaced in 2012 by the 8.6-mgd Mesa Water Reliability Facility that uses nano-filtration membranes to remove color. OCWD provides a financial subsidy to Mesa Water District in the form of a BEA exemption to help offset the treatment costs. The second facility is the Deep Aquifer Treatment System (DATS), a treatment facility owned and operated by the IRWD since 2002 that uses nano-filtration membranes. This facility purifies 7.4 mgd of amber-colored water.

PFAS Treatment Systems

In 2020 OCWD as the groundwater basin manager, executed a multi-party agreement with the impacted groundwater producers to fund and construct the necessary treatment systems for production wells impacted by PFAS compounds. The PFAS treatment projects include the design, permitting, construction, and operation of PFAS treatment systems for impacted production wells. Each well treatment system will be evaluated for use with granular activated carbon (GAC), ion exchange (IX), or an alternative novel sorbent for the removal of PFAS compounds. These treatment systems utilize vessels in a lead-lag configuration to remove PFOA and PFOS to less than 2 ppt, the current laboratory detection limit. These PFAS treatment systems are designed to ensure the groundwater supplied by producer wells can be served in compliance with current and future PFAS regulations. The groundwater producers will own the treatment systems once they are completed; with financial assistance from OCWD, the groundwater producers will operate and maintain the new treatment systems once they are constructed.

To minimize alternative water supply expenses and provide maximum protection to the public water supply, OCWD initiated design, permitting, and construction of the PFAS treatment projects on a schedule that allows rapid deployment of treatment systems. As of September 2021, construction contracts have been awarded for treatment systems for production wells owned by the cities of Orange (Phase 1) and Garden Grove, Serrano Water District, and Yorba Linda Water District. The City of Anaheim has also awarded a design-build contact (Phase A) for 8 impacted wells, that will be reimbursed by OCWD. The City of Fullerton's well KIM-1A treatment system has been completed and is in operation. Additional construction contracts are anticipated to be awarded for impacted wells operated by the cities of Fullerton (Main Plant), Orange (Phase 2), Santa Ana, and Tustin; Irvine Ranch Water District; and East Orange County Water District by early 2022. OCWD expects the treatment systems to be constructed for the approximately 60 impacted wells within the next 2 to 3 years. Figure 11-5 shows locations of wells affected by and to be treated for PFAS.

As monitoring continues and additional wells are anticipated to be taken off-line due to PFAS detections reported at or near the current RL (or future MCL), OCWD will continue to partner with the affected groundwater producers and take action to design and construct necessary treatment systems to bring the impacted wells back online as quickly as possible.

Groundwater production in WY2020-21 was expected to be approximately 325,000 acre-feet but declined to 282,000 acre-feet primarily due to PFAS-impacted wells being turned off around February 2020. OCWD projects groundwater production to be approximately 250,000 acre-feet in WY2021-22 due to the currently idled wells and additional wells being impacted by PFAS and turned off. As PFAS treatment systems are constructed, OCWD expects total annual groundwater production to increase back to levels similar to years prior to PFAS impacts.

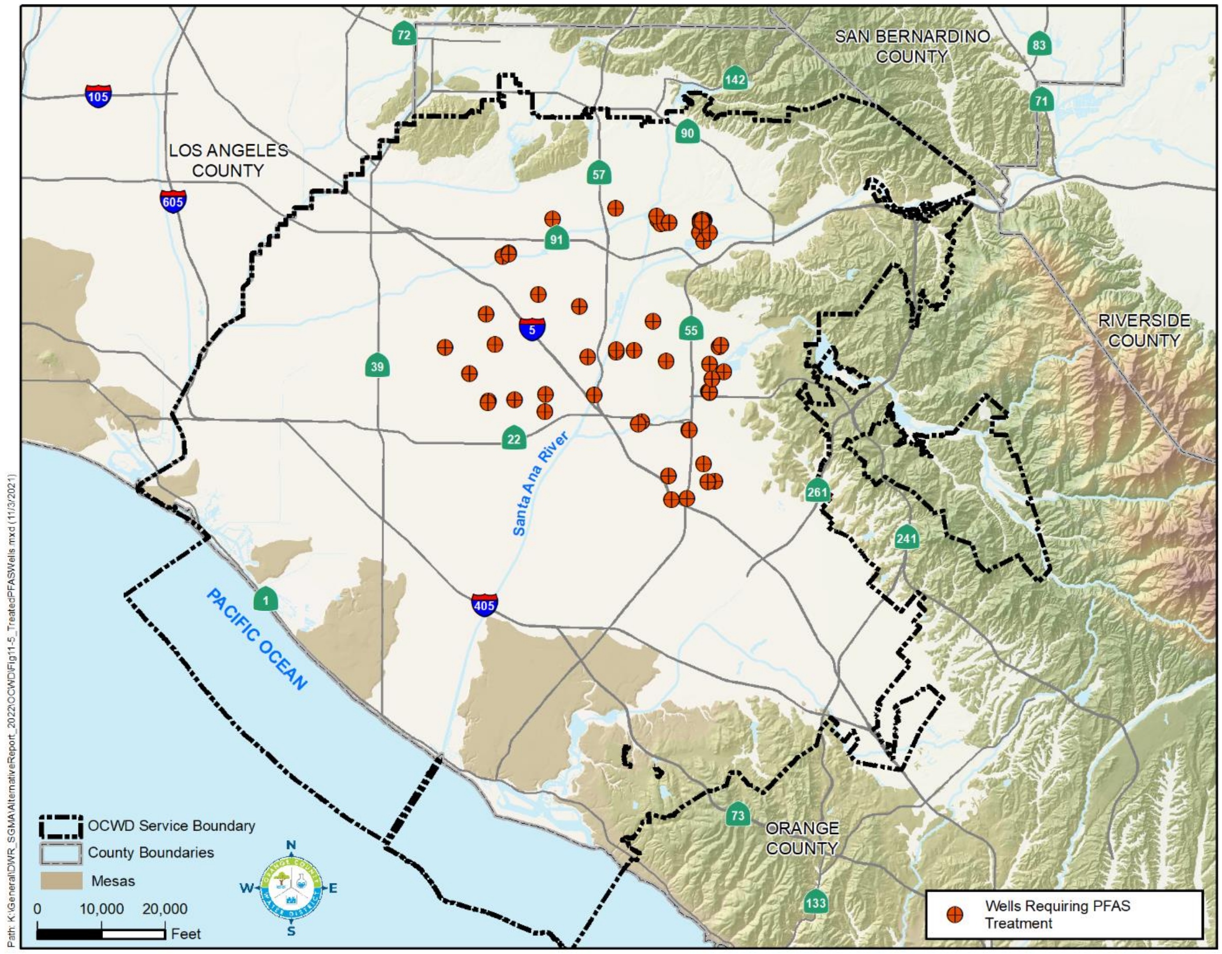


Figure 11-5: Production Wells to be Treated to Remove PFAS

BEA Exemption for Water Quality Improvement Projects

In some cases, OCWD encourages the pumping of groundwater that does not meet drinking water standards in order to protect water quality. This is achieved by using a financial incentive called the Basin Equity Assessment (BEA) Exemption. The benefits to the basin include promoting beneficial uses of poor-quality groundwater and reducing or preventing the spread of poor-quality groundwater into non-degraded aquifer zones.

OCWD uses a partial or total exemption of the BEA to compensate a qualified participating groundwater producer for the costs of treating poor-quality groundwater. These costs typically include capital, interest and operations and maintenance (O&M) costs for the treatment facilities.

Using this approach, OCWD has exempted all or a portion of the BEA for pumping and treating groundwater for removal of nitrates, TDS, VOCs, and other contaminants. Water quality improvement projects that currently are receiving BEA exemptions are listed in Table 11-3.

Table 11-3: Summary of BEA Exemption Projects

Project Name	Project Description	BEA Exemption Approved	Average 5-Year Pumping (afy)	Max Production Above BPP (afy)	OCWD BEA Subsidy
Irvine Desalter	Remove nitrates, TDS, and VOCs	2001	6,990	10,000	Exemption
Tustin Desalter	Remove nitrates and TDS	1998	2,240	3,500	Exemption
Tustin Nitrate Removal	Remove nitrates	1998	170	1,000	Exemption
Mesa Water Colored Water Removal	Remove color	2011	4,605	8,700	Exemption
IRWD Wells No. 21 and 22	Remove nitrates	2012	2,420	7,000	Exemption
Huntington Beach Well No. 9	Remove odor	2018	1,680 (3 yrs)	3,000	Partial exemption

DEFINITION OF SIGNIFICANT AND UNREASONABLE DEGRADATION OF WATER QUALITY

Three elements must be considered when evaluating the impact of groundwater quality degradation with regard to SGMA undesirable results.

The first element is considering the causal nexus between groundwater management activities and groundwater quality. For example, groundwater contamination due to improper handling of toxic materials impacts groundwater quality; however, this water quality degradation is not caused by groundwater management activities.

The second element is the beneficial uses of the groundwater and water quality regulations, such as MCLs and other potable water quality requirements.

The third element that must be considered is the volume of groundwater impacted by quality degradation. If small volumes are negatively affected that do not materially affect the overall use of the aquifer or basin for its existing beneficial uses, then this would not represent a significant and unreasonable degradation of water quality. However, if the impacted volume grows, then it could reach a level that it becomes significant and unreasonable.

When considering all three elements, “significant and unreasonable degradation of water quality” is defined as degradation of groundwater quality attributable to groundwater production or recharge practices in the OCWD Management Area and to the extent that a significant volume of groundwater becomes unusable for its designated beneficial uses.

11.4 DETERMINATION OF MINIMUM THRESHOLDS

The minimum thresholds for groundwater quality are exceedances of MCLs or other applicable regulatory limits that are directly attributable to groundwater management actions in the OCWD Management Area that prevent the use of groundwater for its designated beneficial uses.

SECTION 12 SUSTAINABLE MANAGEMENT RELATED TO SEAWATER INTRUSION

In the coastal area of the Orange County groundwater basin, the primary source of saline groundwater is seawater intrusion through permeable aquifer sediments underlying topographic lowlands or gaps between the erosional remnants or mesas of the Newport-Inglewood Uplift. The susceptible locations from north to south are the Alamitos, Sunset, Bolsa, and Talbert gaps as shown in Figure 3-20.

OCWD's policy regarding control of seawater intrusion is implemented through a comprehensive program that includes operating seawater intrusion barriers, monitoring and evaluating barrier performance, monitoring and evaluating susceptible coastal areas, and coastal groundwater management. These programs enable OCWD to sustainably manage groundwater conditions in the basin in order to prevent significant and unreasonable seawater intrusion.

12.1 TALBERT GAP

The Talbert Gap, also referred to as the Santa Ana Gap, is shown in Figure 12-1. The furthest seaward mergence zone between the Talbert and Lambda aquifers in the vicinity of Adams Avenue is a primary pathway by which seawater can potentially migrate inland and downward within the Talbert Gap.

OCWD monitoring well M26 is a key monitoring well for evaluating barrier injection requirements versus seawater intrusion potential and is used to assess whether protective groundwater elevations are being achieved in the Talbert Gap. The well is strategically located seaward of the barrier in the middle of the Talbert Gap and is screened within the merged Talbert and Lambda aquifers (see Figure 12-2). At the location of well M26, the protective groundwater elevation is approximately 3.5 feet above mean sea level (msl), as explained below.

The protective groundwater elevation is based on the Ghyben-Herzberg relation (Ghyben, 1888; Herzberg, 1901; Freeze and Cherry, 1979, pp. 375-376), which takes into account the depth of the Talbert aquifer at a given location along with the density difference between saline and fresh groundwater. Using this relation, for every 40 feet that the bottom of the aquifer is below sea level, there should be about one foot of head of fresh water above sea level to overcome the density effect of seawater. In the case of well M26, the bottom of the merged Talbert-Lambda aquifer is approximately 140 feet below sea level. Therefore, the freshwater head (protective elevation) should be approximately 140 feet divided by 40 which equals 3.5 feet above sea level. Achieving this protective elevation at well M26 is OCWD's goal to prevent brackish water in the Talbert aquifer from migrating down into the Lambda aquifer that is tapped by inland production wells.

Figure 12-2 shows the historical interrelationship between coastal groundwater production, Talbert Barrier injection, and groundwater elevations at well M26 from 2008 to 2021. This figure shows that groundwater elevations at well M26 have consistently been maintained at or above protective elevations since 2010 with the exception of brief periods related to GWRS shutdowns.

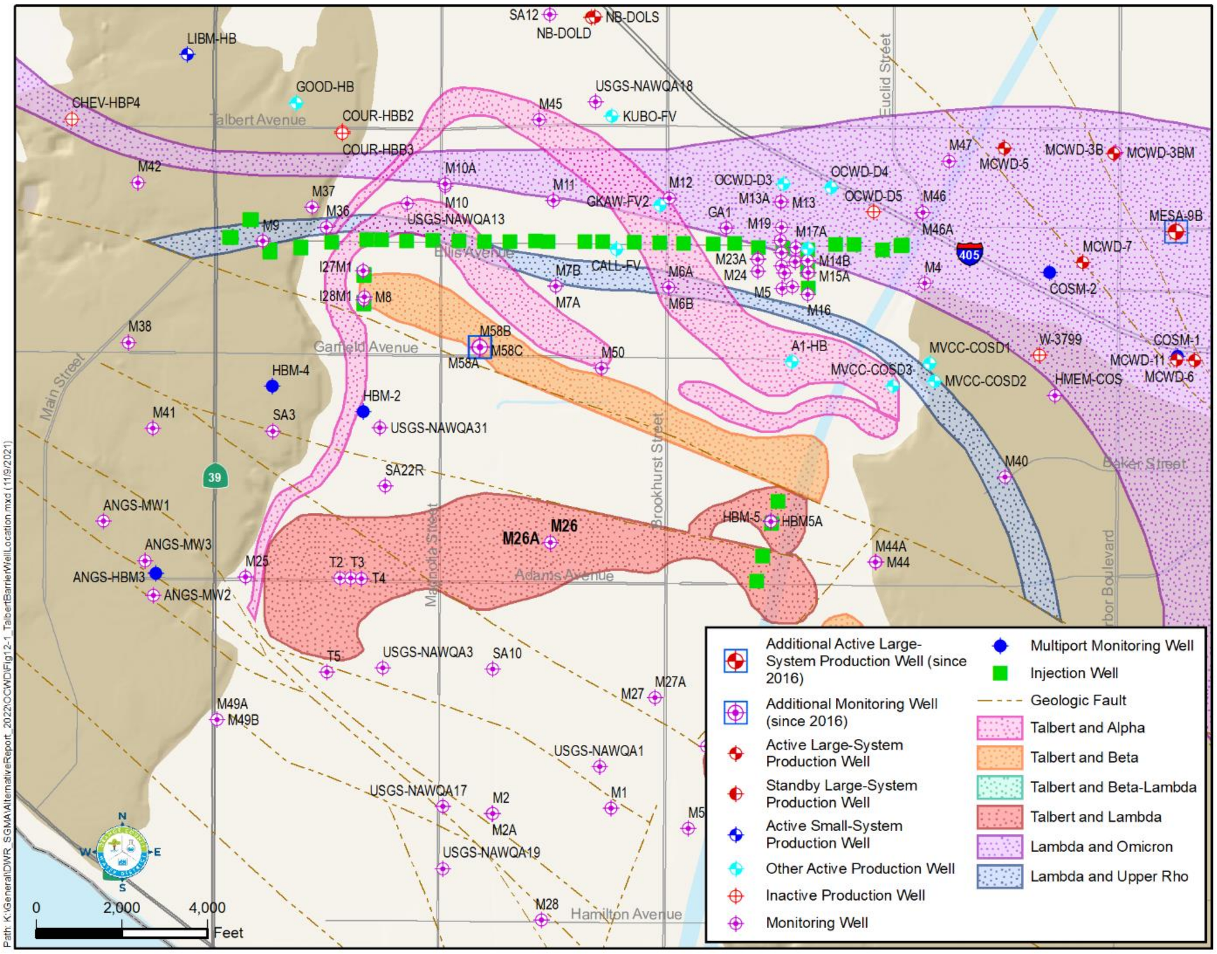
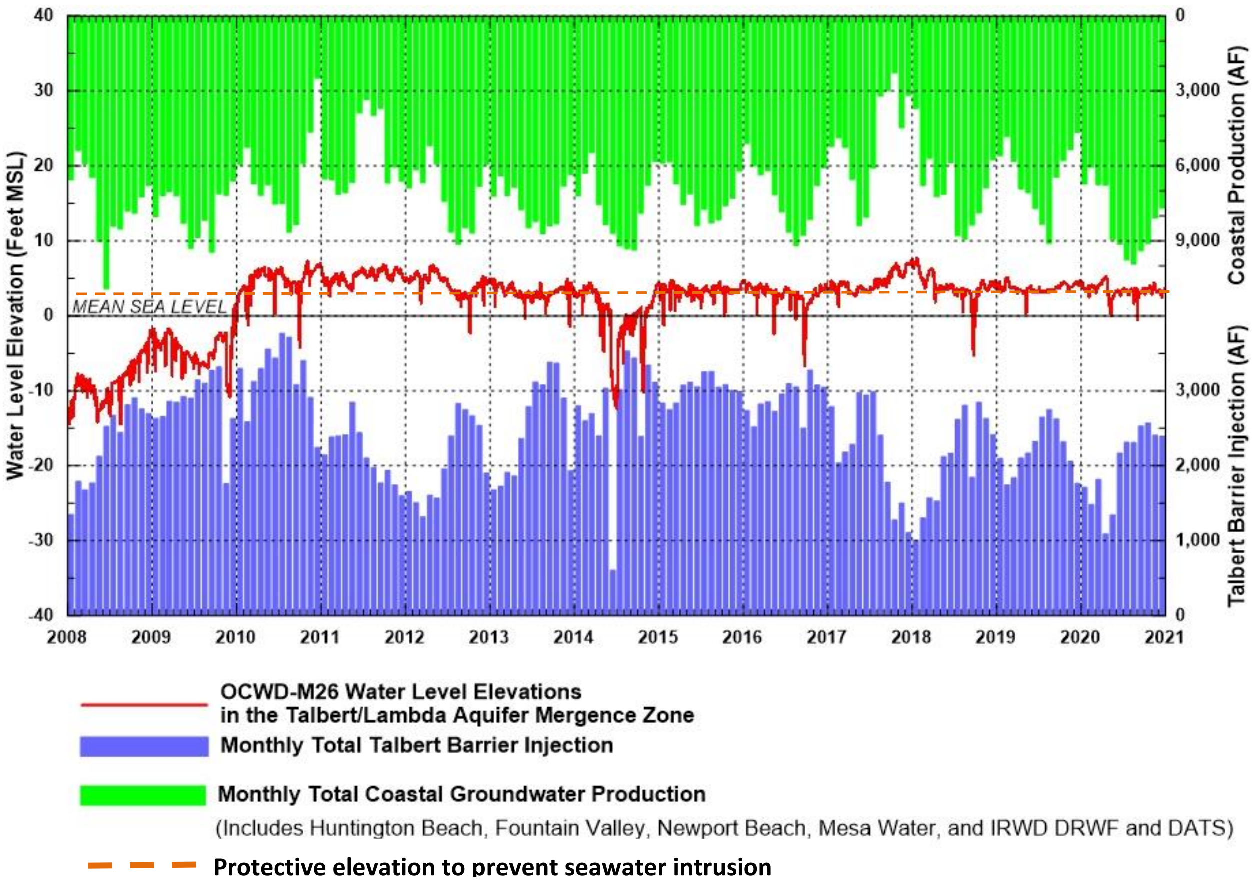


Figure 12-1: Talbert Gap – Seawater Intrusion Barrier

Figure 12-3 shows the 250 mg/L chloride concentration contour in the Talbert and Bolsa gaps and adjacent mesas for 1993, 1998, 2008, and 2020. The 250 mg/L chloride contour is used to delineate the inland extent of intrusion because this is above ambient (non-intruded) groundwater quality and is equal to the secondary drinking water standard. Native fresh groundwater in this area typically has a chloride concentration well below 100 mg/L, while the GWRS injection supply has a chloride concentration of approximately 10 mg/L. This figure shows that the 250 mg/L chloride contour has remained relatively unchanged from 2008 to 2020, indicating that the barrier and other basin management programs are keeping seawater intrusion from taking place.



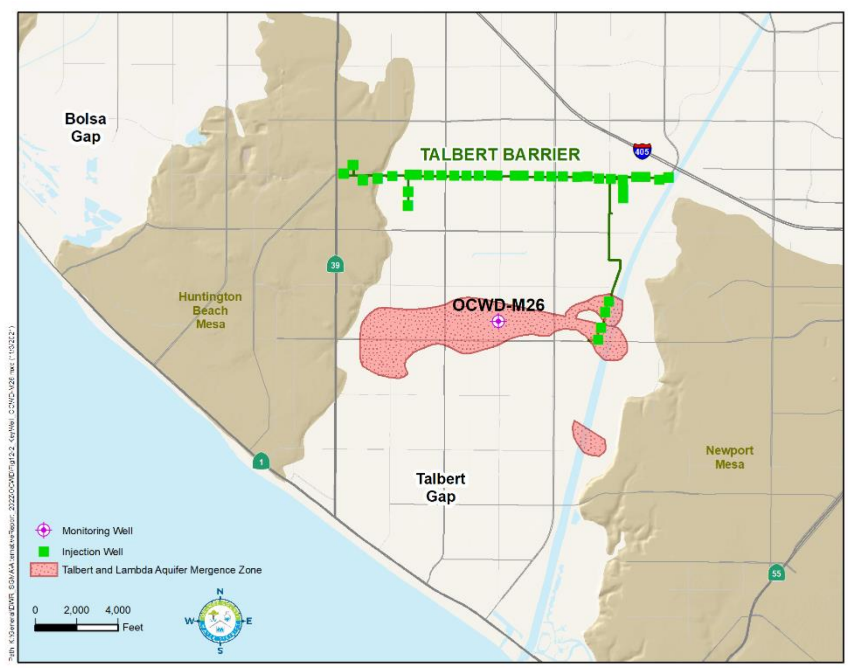


Figure 12-2: Key Well OCWD-M26 Groundwater Levels,
Talbert Barrier Injection, and Coastal Pumping

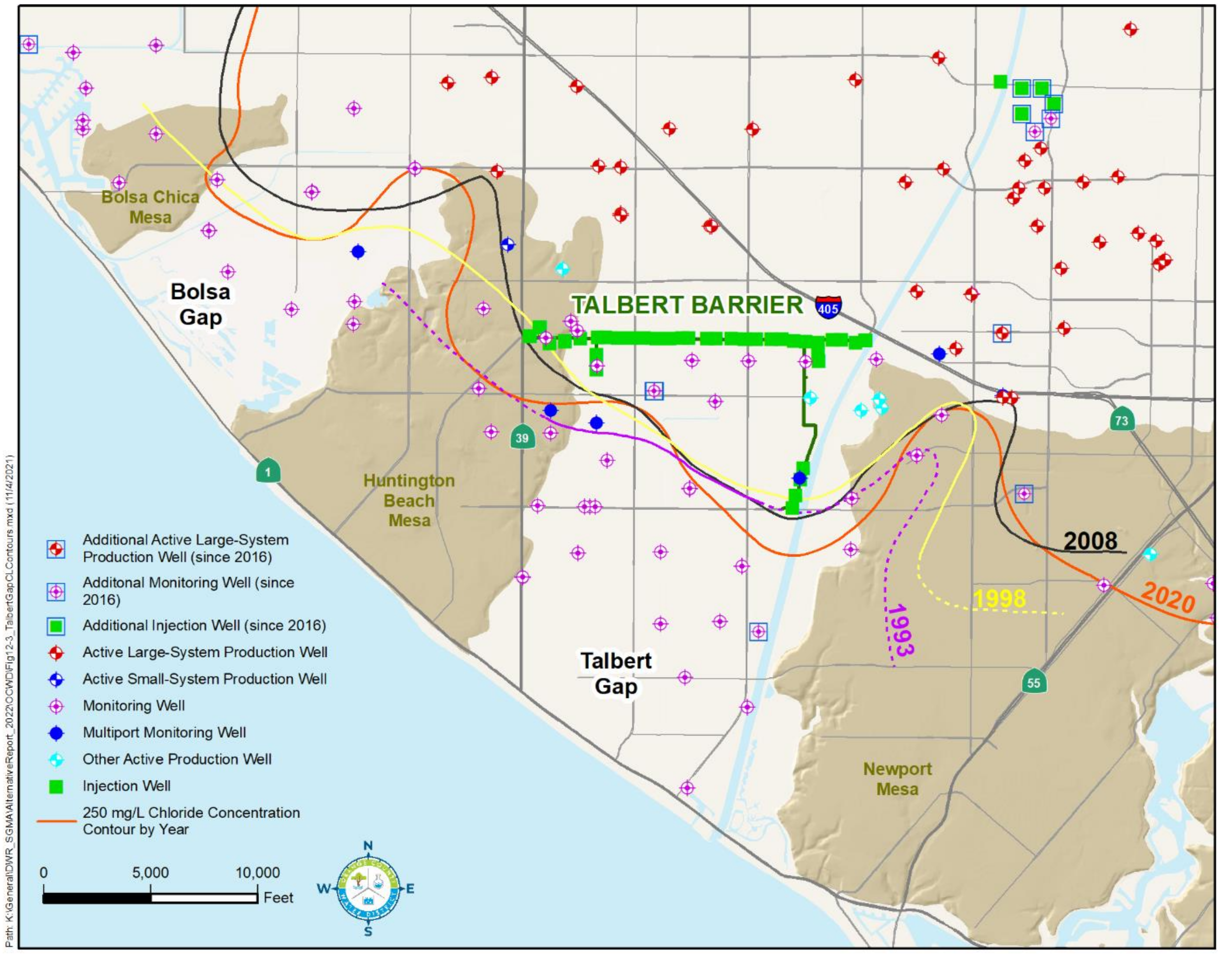


Figure 12-3: Talbert Gap 250 mg/L Chloride Concentration Contours for Selected Years

12.1.1 Talbert Barrier Groundwater Model

OCWD has developed a calibrated MODFLOW groundwater model of the Talbert Barrier and surrounding area (Talbert Model). In addition to helping to guide the planning, location, and hydraulic effectiveness of the supplemental injection wells for the Talbert Barrier during pre-GWRS planning activities, the Talbert Model was also used to estimate the general groundwater flow paths and subsurface residence time of barrier injection water by using the USGS particle tracking code MODPATH (Pollack, 1994). This modeling work provided the basis for delineating a recycled water retention buffer area surrounding the Talbert Barrier at a distance of 2,000 feet and one-year travel distance. No new drinking water production wells are allowed within this buffer area, as required by the California Department of Public Health requirements contained within the original permit to operate GWRS (RWQCB, 2004; OCWD, 2005). For more information on the Talbert Model, see the 2017 Alternative.

12.2 ALAMITOS GAP

The Alamitos Barrier Project was initially constructed in 1964 and became operational in 1965 to manage seawater intrusion in the Alamitos Gap. The barrier has been expanded over time to include the construction of additional injection and monitoring wells (Figure 12-4).

Similar to the Talbert Barrier, the Alamitos Barrier consists of both nested and cluster-type injection wells screened discretely in each aquifer in order to control the injection rate and injection pressure into each targeted aquifer independently since each aquifer has different physical characteristics and groundwater levels.

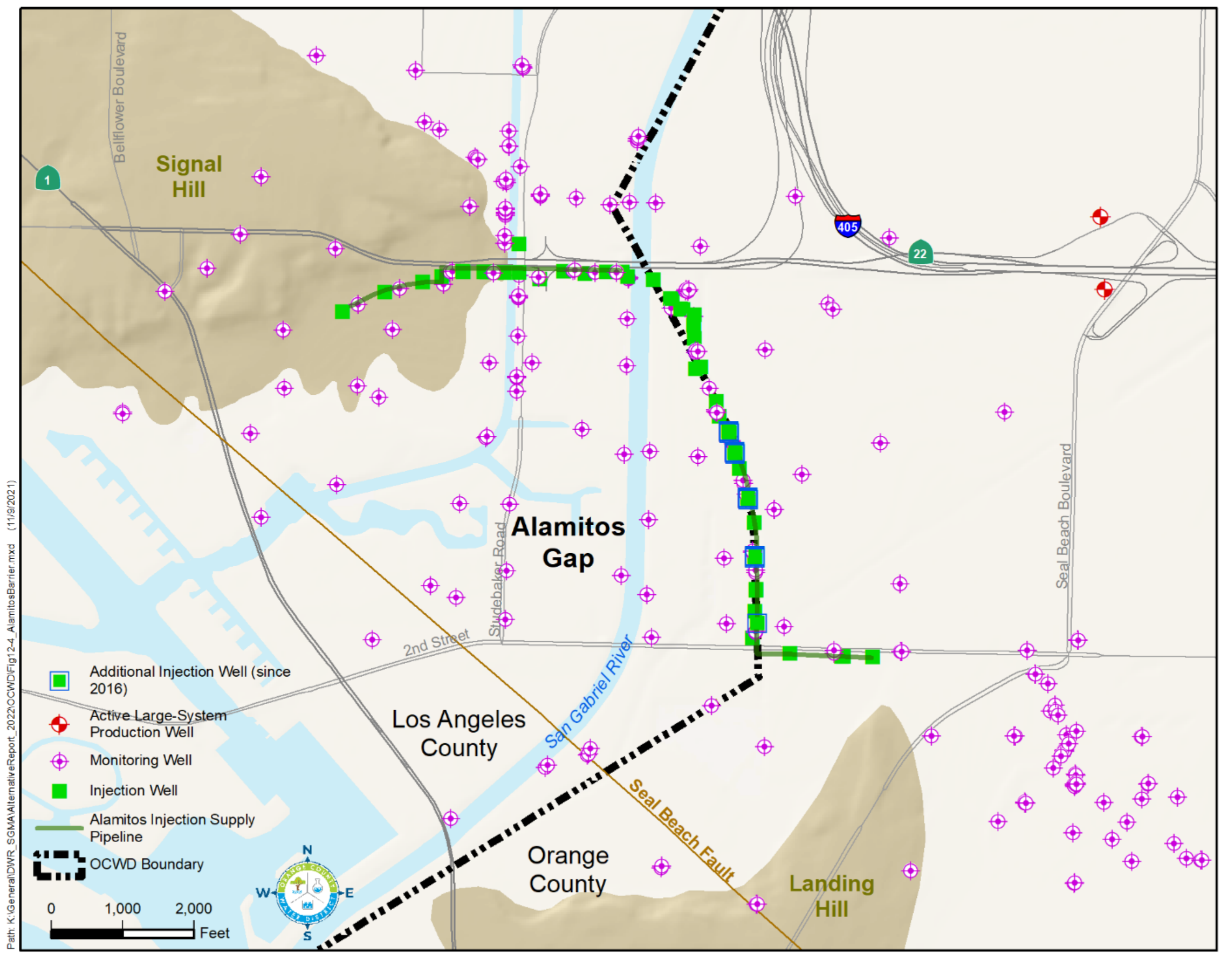


Figure 12-4: Alamitos Gap – Seawater Intrusion Barrier

The pathways for intrusion in Alamitos Gap are similar to the Talbert Gap with the uppermost Recent aquifer connected to the Pacific Ocean. Once seawater migrates inland within the Recent aquifer past the Seal Beach Fault, the brackish water can then migrate downward into the C, B, A, and I aquifers via areas of hydraulic mergence with the Recent aquifer where the intervening low-permeability aquitards are absent. These susceptible Pleistocene aquifers were warped upward by the Newport-Inglewood Fault Zone and then during Recent geologic time were eroded away and subsequently overlain by the Recent aquifer river deposits. The aquifers susceptible to intrusion are generally thinner and finer-grained than their counterparts in Talbert Gap. Therefore, per-well injection capacity in the Alamitos Barrier is about half that of the Talbert Barrier and thus requires more injection wells and denser spacing to achieve sufficient injection for creating a continuous pressure ridge that achieves protective elevations.

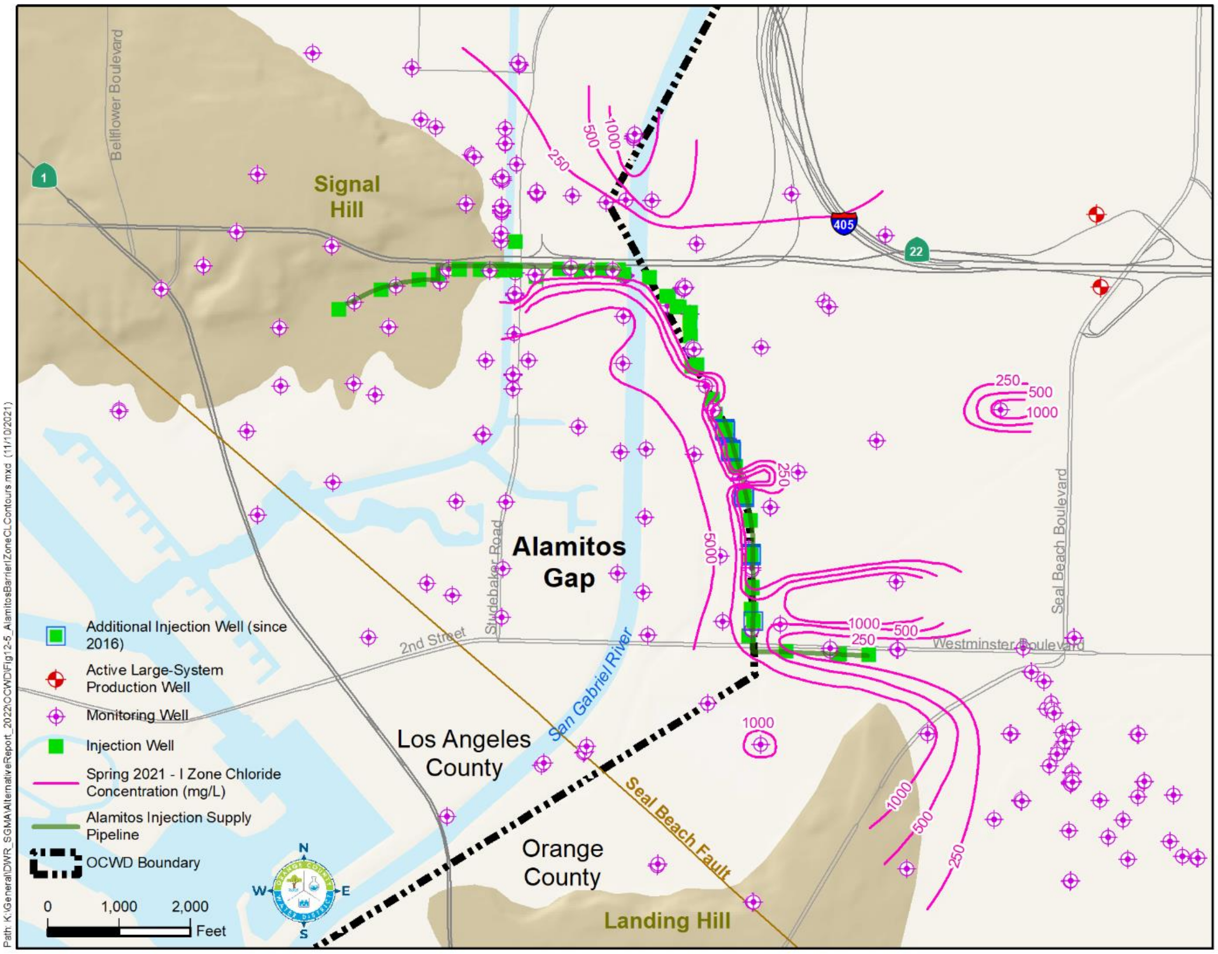


Figure 12-5: Alamitos Gap I Zone Chloride Concentration Contours, 2021

Additional injection wells were constructed as part of the Alamitos Barrier Improvement Project to control the identified breaches through the barrier and to address barrier deficiencies along the north-south reach where injection well spacing was too large and injection well capacity too small. In addition, four monitoring wells and two piezometer were installed to improve monitoring near the barrier. Figure 12-5 shows the extent of chlorine intrusion in the I zone in 2021.

Since the completion of the Alamitos Barrier Improvement Project in 2018, freshwater injection capacity along the north-south barrier alignment has improved with the even distribution of injection flow through the added new wells and water levels along this barrier reach have achieved and maintained protective elevations, a first since the barrier was constructed over 50 years ago.

LACPW continues to operate and maintain the existing and new barrier facilities as OCWD will continue to work alongside LACPW to monitor the water levels and the barrier performance along the stretch affecting Orange County.

12.2.1 Alamitos Barrier Groundwater Model

A transient groundwater flow and solute transport model of the Alamitos Barrier area was developed and calibrated in 2010 by Intera, Inc. with oversight and cost sharing from OCWD, LACPW, and WRD. The model was developed to provide a useful tool to evaluate the existing barrier's effectiveness, determine barrier expansion requirements, evaluate migration of saline intrusion as well as migration of recycled injection water towards production wells for regulatory purposes, and optimize existing barrier operations. For more information on this model, see the 2017 Alternative.

12.3 SUNSET GAP

Sunset Gap was historically considered to be a much lesser seawater intrusion threat compared to the Talbert and Alamitos Gaps. Recent monitoring data, however, indicate that seawater intrusion is occurring in Sunset Gap, as shown schematically in a cross-section in Figure 12-6. Figure 12-7 shows the location of this cross-section.

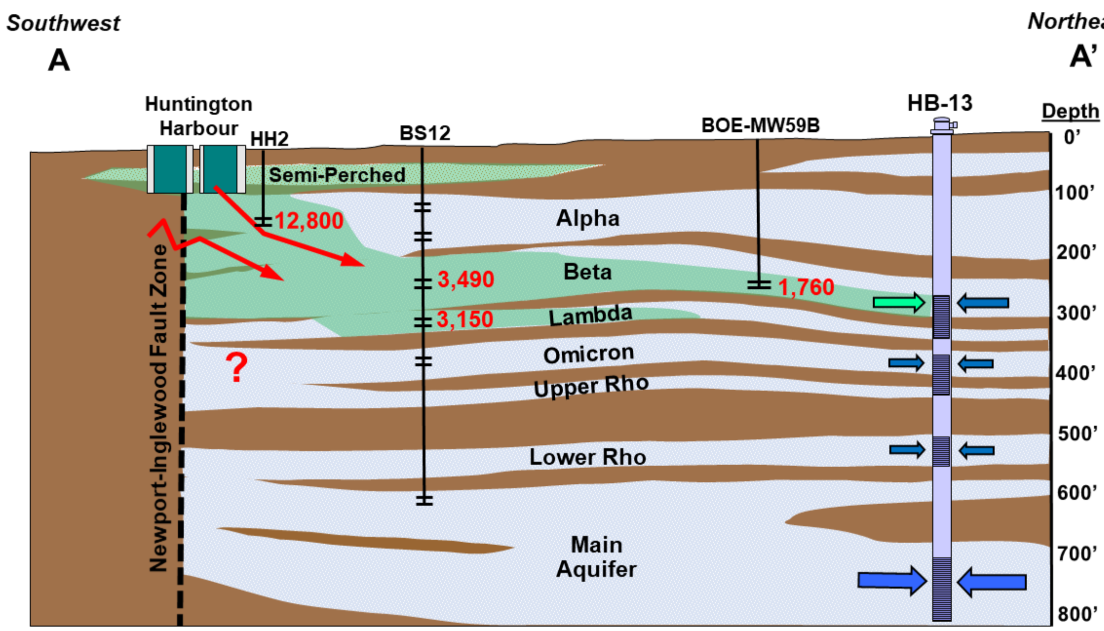


Figure 12-6: Schematic Geologic Cross-Section from Huntington Harbor through Sunset Gap (Fall 2020 Chloride Concentrations, mg/L)

Three potential seawater intrusion source areas appear likely:

- Intrusion from Alamitos Gap south of Alamitos Barrier moving in an easterly direction
- Intrusion moving north-northeasterly from the Huntington Harbor Marina where dredged canals may have breached through the shallow aquitard overlying the shallow-most potable aquifer
- Lateral leakage across the Newport/Inglewood Fault Zone (Seal Beach Fault) in the Landing Hill area in one or more of the Upper Pleistocene aquifers

In the southeast portion of Sunset Gap, dredging associated with construction of the boat canals in Huntington Harbor during the 1960s was the subject of several studies at that time regarding the potential for causing saline intrusion. Conclusions of these studies were inconsistent and inconclusive. Studies done by the USGS (1967) and DWR (1968) found that seawater intrusion into the semi-perched aquifer (generally the uppermost 50 feet) associated with the harbor development was occurring, but this was considered to be of little to no significance due to the lack of beneficial use of this near-surface water-bearing zone.

Approximately 10 years after construction of Huntington Harbor, chloride concentrations began to rise during the mid-1970s at OCWD monitoring well HH2 screened in the shallow-most Pleistocene Alpha aquifer at a depth of 85-95 ft bgs and located just inland of the Bolsa-Fairview Fault in the Huntington Harbor area. The Bolsa-Fairview Fault is the farthest inland branch of the Newport-Inglewood Fault Zone in the area. Chloride concentrations at this well rose steadily over time to very brackish levels today, suggesting an inland gradient and active pathway for inland intrusion.

In 2004, elevated chloride concentrations ranging from 300 to 800 mg/L were discovered at two monitoring wells owned by the Boeing Company (BOE-MW16 and BOE-MW17) screened in the Beta aquifer. OCWD commissioned a geophysical survey in 2010 at the Seal Beach Naval Weapons Station to investigate the extent and depth of intrusion and to help guide the number and location of proposed monitoring wells necessary to sufficiently define the extent of intrusion.

One large system production well (HB-12) was shut down and destroyed due to impacts from advancing intrusion in Sunset Gap. From 2012 to 2016, OCWD constructed seven multi-depth monitoring wells to depths up to 1,000 feet in Sunset Gap to better define the source areas, pathways, and overall inland extent of seawater intrusion as the first step towards identifying feasible remedies.

In 2021, OCWD began a project to install 11 monitoring wells clustered at five locations: one site in Seal Beach (BS25) and four in Huntington Beach (BS23, BS26, BS27 and BS28). Figure 12-7 shows the location of new wells installed in the last five years and the wells being installed in 2021. The multiple wells at each site will allow for the measurement of groundwater levels and collection of groundwater samples for water quality analyses in specific aquifers at different depths. The information from these monitoring wells may be used to determine if the groundwater flow model needs refinement before finalizing recommendations regarding a potential new seawater barrier in Sunset Gap (e.g., locations and number of injection wells and their injection rates).

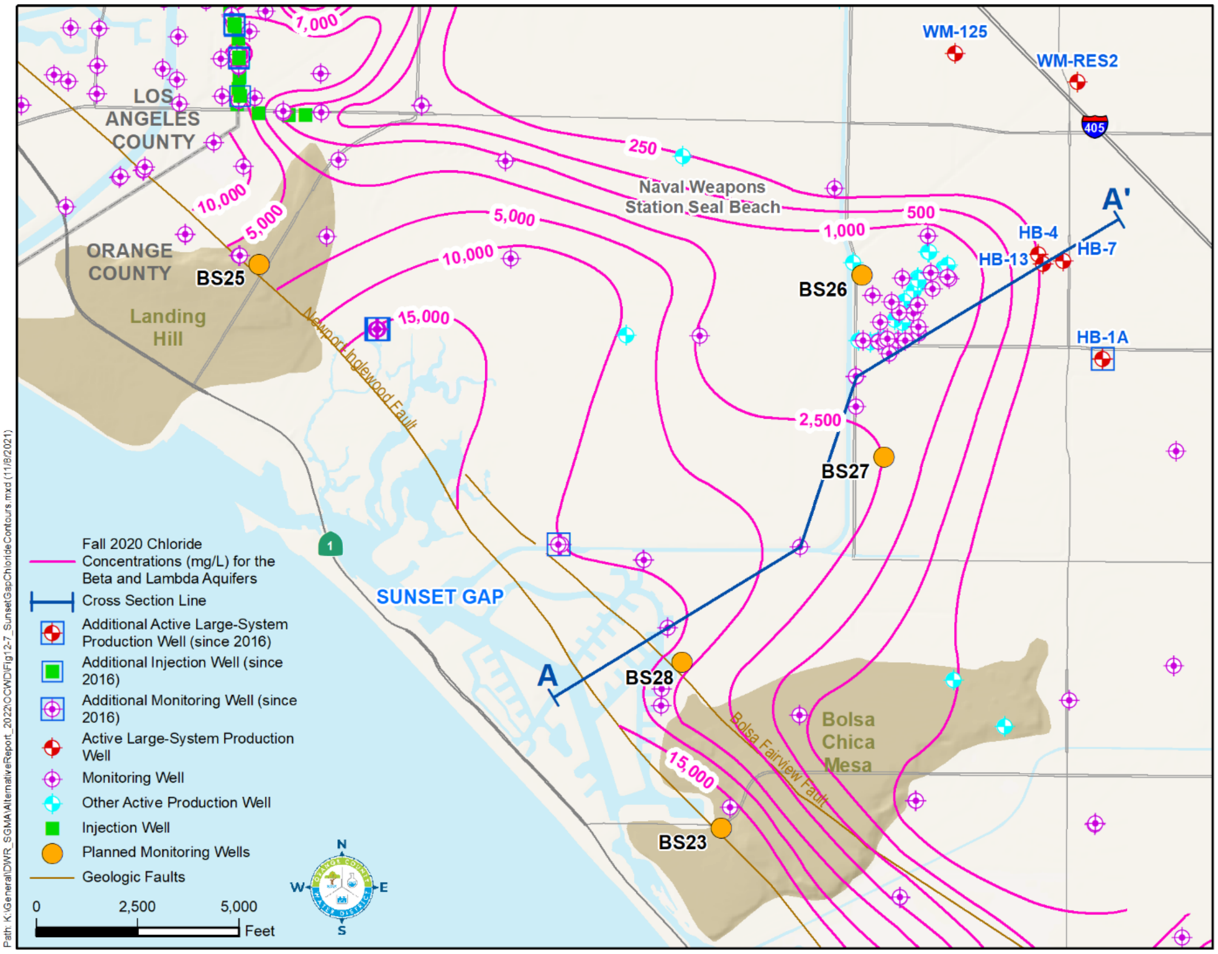


Figure 12-7: Sunset Gap Chloride Concentrations, 2020

12.3.1 Evaluation of Sunset Gap Alternatives

The Alamitos Barrier groundwater flow and transport model was recently updated and expanded to include the Sunset Gap area and thereby utilize data from newer OCWD monitoring wells on the Naval Weapons Station Seal Beach (NWSSB). The Alamitos-Sunset Gap model boundaries are shown in Figure 12-8.

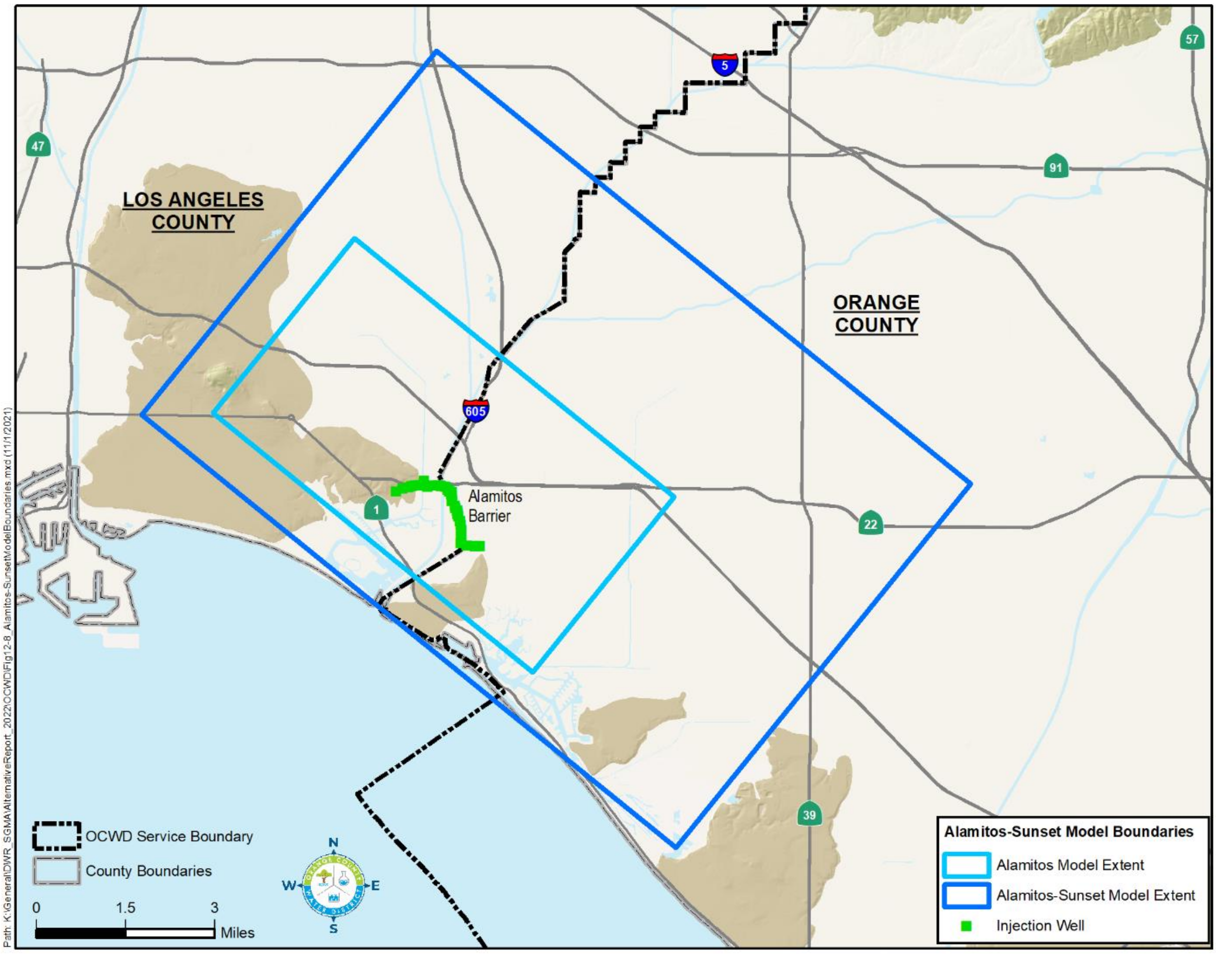


Figure 12-8: Alamitos-Sunset Gap Groundwater Model Boundaries

To date, the calibrated Alamitos-Sunset Gap model has been used to evaluate the effectiveness of five alternatives for a potential seawater intrusion barrier. These and other alternatives will be evaluated with the goal of halting the inland movement of seawater intrusion without significantly raising or lowering groundwater levels in the environmentally sensitive tidal marsh on the NWSSB. The effects, if any, of the simulated alternatives on nearby contaminant plumes will also be evaluated. Other factors to evaluate once the additional predictive scenarios are modeled will include feasibility, constructability, injection water supply, brackish extraction disposal/reuse, and cost.

The number of injection and extraction wells, well spacing, and injection volumes were varied from scenario to scenario to determine the preferred barrier scenario that prevents seawater intrusion by maintaining a seaward gradient without significantly raising or lowering groundwater levels in the environmentally sensitive tidal marsh on the NWSSB. Additionally, the model will run a series of no-barrier predictive scenarios to evaluate the potential maximum future inland extent of seawater intrusion and associated impacts and measures that would likely occur as a result, e.g., groundwater production well loss and/or inland groundwater desalters.

Preliminarily and subject to further analysis, the most favorable approach based on the five predictive scenarios completed so far includes a dual injection/extraction barrier, with an L-shaped injection well alignment around the perimeter of the NWSSB (Figure 12-9). A potential Sunset Gap Barrier Project (SGBP) would be designed to prevent the inland advancement of seawater intrusion near the NWSSB and the Huntington Harbor areas, thus protecting production wells in the cities of Huntington Beach, Seal Beach, and Westminster.

The preliminary favorable injection alignment would include approximately 20 injection well sites spaced approximately 1,500 to 2,000 feet apart (subject to further analysis). Total modeled injection was 13 mgd, with the majority being injected into the Beta and Lambda aquifers.

The preliminary favorable extraction alignment would include three single-point extraction wells screened across the Beta and Lambda aquifers. Total modeled extraction was 3 mgd, or 1 mgd per well. The three potential extraction wells were strategically located just outside (inland) of the Seal Beach National Wildlife Refuge perimeter to provide ample distance from the injection wells while also remaining outside of the NWSSB ordnance areas. Initially, the extracted brackish groundwater would be expected to have a chloride concentration ranging from 5,000 to 15,000 mg/L.

Depending on extracted water disposal/use feasibility and cost, a groundwater treatment plant may be appropriate to remove the high salinity from the groundwater produced by the barrier extraction wells. Reverse osmosis would be the likely treatment process. The technical and economic viability of this supply option would need to be evaluated as part of the future technical work described below.

To provide the injection wells with high-quality fresh water, the several water supply alternatives will be considered, including: (1) Groundwater treatment plant (brackish extraction wells and/or Deep aquifer amber-colored water wells); (2) Satellite wastewater treatment plant; (3) GWRS water via new pipeline; and (4) Imported water.

Future technical analysis that would need to be conducted as part of the feasibility study includes the following:

- Evaluate injection water supply alternatives
- Perform siting study for pipelines and wells
- Evaluate extraction well discharge alternatives
- Identify hydrogeologic data necessary to design, construct, and monitor the performance of barrier facilities
- Develop preliminary project design to support CEQA evaluation
- Estimate staffing needs for barrier operation and maintenance (O&M)
- Provide capital and O&M cost estimate

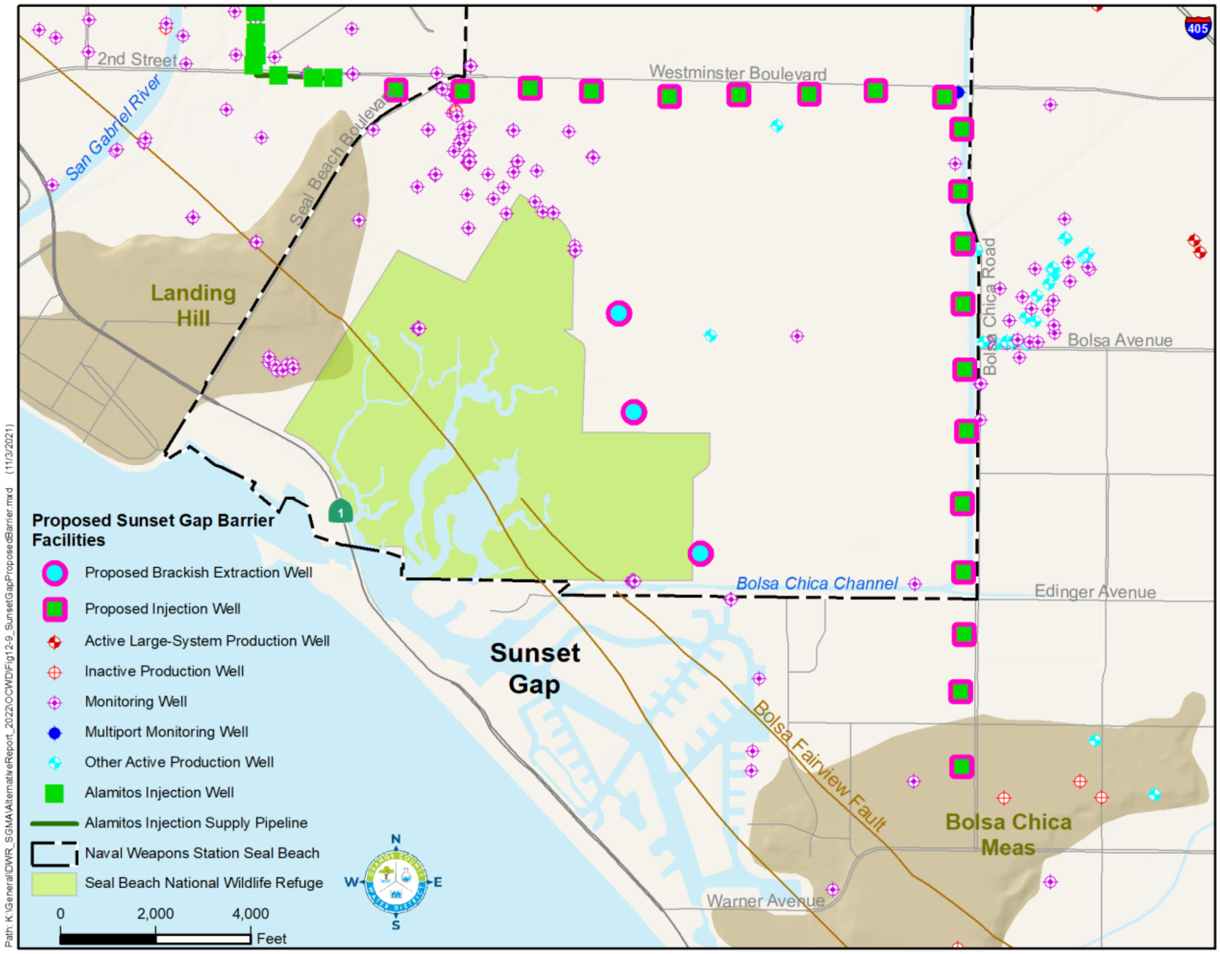


Figure 12-9: Potential Sunset Gap Barrier Project Facilities

12.4 BOLSA GAP

In the Bolsa Gap, seawater intrusion extends approximately 1.3 miles inland from the Pacific Ocean. Groundwater monitoring data show that the highest chloride concentrations in Bolsa Gap have remained seaward of the Bolsa-Fairview Fault, which is the farthest inland branch of the Newport-Inglewood Fault Zone in that area. Therefore, the saline groundwater appears to be largely restricted from migrating inland across the Bolsa-Fairview Fault within the Bolsa aquifer under normal basin conditions, as the Bolsa aquifer zones of mergence with the underlying Pleistocene aquifers are all inland of the Bolsa-Fairview Fault. An area of slightly elevated salinity has existed beneath the Huntington Beach Mesa for many years and is thought to be due to past disposal practices of oil field brines in the early 1900s rather than active seawater intrusion from the ocean. This area of saline groundwater is being pushed westerly into Bolsa Gap due to increased injection at the west end of the Talbert Barrier but is not expected to be a threat to active production wells or groundwater resources.

12.5 NEWPORT MESA

Chloride concentrations in the Beta/Lambda aquifers beneath the Newport Mesa east of the Talbert Gap have either remained stable or decreased over the last 10 years even though groundwater elevations have typically been below sea level in these aquifers in this area. Chloride concentrations in the underlying Main aquifer in this area have either decreased or have remained relatively stable for the last 10 years. A proposed extension of the Talbert Barrier eastward along Adams Avenue onto the Newport Mesa has been preliminarily evaluated and modeled by OCWD staff using the Talbert Model. Such a project would serve to provide insurance against future intrusion in the Beta/Lambda and Main aquifers under lower basin conditions and would thus protect production wells owned by Mesa Water District in addition to replenishing the basin. Based on the stability of chloride concentrations in the Newport Mesa, there is no need to advance this project at this time.

In 2014, OCWD constructed four new multi-depth monitoring wells (M51, M52, M53, MRSH) farther east on the Newport Mesa, as shown on Figure 12-10. These four well sites are now a part of OCWD's coastal monitoring program for both groundwater levels and seawater intrusion sampling. The East Newport Mesa area is at the southern margin of the groundwater basin, which geologic formations (including the aquifers with them) have been faulted, uplifted, and eroded. It has been a data gap in which the aquifer stratigraphy and groundwater flow patterns were not well understood. To further characterize this complex portion of the basin, OCWD plans to install a multi-depth cluster of monitoring wells east of John Wayne Airport in early 2022.

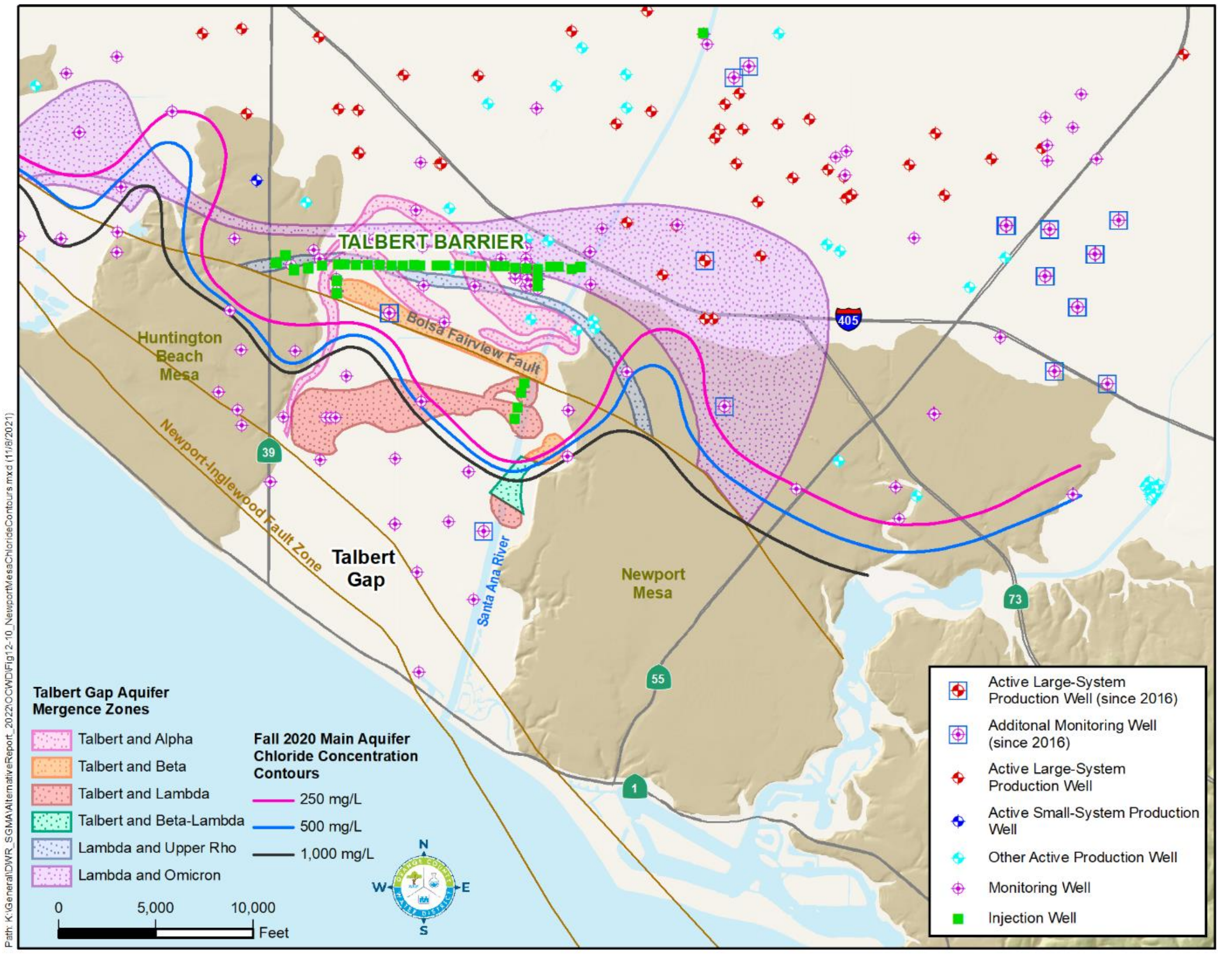


Figure 12-10: Newport Mesa Chloride Contours, 2020

12.6 IMPLEMENTATION OF SEAWATER INTRUSION PREVENTION POLICY

Implementation of OCWD's seawater intrusion prevention policy is summarized below. These programs enable OCWD to continue sustainably managing the groundwater basin to prevent significant and unreasonable seawater intrusion.

12.6.1 Effective Barrier Operations

The effective operation of the Talbert and Alamitos barriers is critical to the protection of the basin aquifers from seawater intrusion. This program includes, but is not limited to, the following activities:

1. Injection of sufficient water quantities combined with other basin management programs, such that protective groundwater elevations are established and maintained, where applicable, based on local hydrogeologic characteristics.
2. Regular maintenance of injection facilities to provide sufficient injection quantities. Such maintenance includes backwashing, redevelopment, and replacement (if necessary) of injection wells and operational fitness checks/repairs of flow meters, pressure reducing valves, and telemetry equipment.
3. Regular communications and coordination between operations, hydrogeology, and engineering staff on barrier operations and activities.
4. Annual reporting on barrier facilities status and operations. The reports include recommendations, as necessary, for barrier improvements to achieve policy objectives.

12.6.2 Barrier Performance Monitoring and Evaluation

Monitoring and evaluating barrier performance provides the basis on which to determine if the barriers are preventing seawater intrusion from occurring. This program consists of the following activities:

1. Semi-annual sampling and testing of designated monitoring wells in the vicinity of the seawater barriers. Testing includes parameters such as TDS, chloride, and electrical conductivity as indicators of seawater intrusion. Wells have been designated to provide adequate spatial coverage, particularly near likely seawater pathways and near the interface between seawater and freshwater.
2. Quarterly water level measurements at designated monitoring wells in the vicinity of the seawater barriers. More frequent measurements will be collected as needed at key locations.
3. Installation of monitoring wells in areas where it is determined that data gaps exist near the seawater barriers that may allow seawater intrusion to go undetected or would otherwise significantly impede the ability to assess barrier performance.
4. Annual evaluation and reporting of barrier performance based on surrounding groundwater level and quality data.

12.6.3 Susceptible Coastal Area Monitoring and Evaluation

This program addresses the assessment and ongoing monitoring of the coastal gaps and other areas that are not currently protected from seawater intrusion by the Talbert and Alamitos barriers. These areas include the Bolsa and Sunset gaps and adjacent mesas. This program includes the following activities:

1. Semi-annual sampling and testing of designated monitoring wells. Testing includes parameters such as TDS, chloride, and electrical conductivity as indicators of seawater

intrusion. Wells have been designated to provide adequate spatial coverage, particularly near likely seawater pathways.

2. Quarterly water level measurements at designated monitoring wells. More frequent measurements will be collected as needed at key locations.
3. Installation of monitoring wells in areas where it is determined that data gaps exist that may allow seawater intrusion to go undetected or would significantly impede the ability to understand the location of and trends in seawater intrusion.
4. Annual evaluation and reporting of the coastal area monitoring program, including recommendations, as needed, for further investigation or other potential actions to address seawater intrusion.

12.6.4 Coastal Groundwater Management

In addition to operating the seawater barriers, OCWD has implemented other basin management activities to lessen the potential for seawater intrusion. These activities have included the Coastal Pumping Transfer Program, Coastal In-Lieu Program, and maintaining basin storage levels within the operating range. Each of these activities shall continue to be considered and implemented as deemed necessary along with other potential actions to complement and enhance the OCWD seawater prevention program.

12.7 DEFINITION OF SIGNIFICANT AND UNREASONABLE SEAWATER INTRUSION

As explained above, OCWD conducts comprehensive programs to protect the groundwater basin from the undesirable effect of significant and unreasonable seawater intrusion. Seawater intrusion in the OCWD Management Area would be considered significant and unreasonable if a significant and continuing reduction in usable storage volume in the groundwater basin occurs as a result of increased salinity due to seawater intrusion.

12.8 DETERMINATION OF MINIMUM THRESHOLDS

The minimum threshold for seawater intrusion that defines an undesirable result is (1) the shutdown of active large system production wells due to seawater-derived salinity, and (2) continuing loss of a significant amount of basin storage due to seawater-derived salinity.

SECTION 13 SUSTAINABLE MANAGEMENT RELATED TO LAND SUBSIDENCE

Management of the groundwater basin by maintaining storage levels within OCWD's established operating range has prevented significant and unreasonable land subsidence that substantially interferes with surface uses. Within the OCWD Management Area there is no evidence of continuing irreversible land subsidence, nor is there evidence that land subsidence has interfered with surface uses. Therefore, the undesirable result of "significant and unreasonable land subsidence that substantially interferes with surface uses" is not present and is not anticipated to occur in the OCWD Management Area in the future.

Subsidence due to changes in groundwater conditions in the Orange County groundwater basin is variable and does not show a pattern of irreversible permanent lowering of the ground surface. Some subsidence may have occurred before OCWD began refilling the groundwater basin in the late 1950s after storage conditions reached a historic low (Morton, et al., 1976); however, the magnitude and scope of this subsidence is uncertain, and it is not clear if this subsidence was permanent. Since this time OCWD has operated the groundwater basin within the established operating range.

More recent data show a consistent pattern of the ground surface rising and falling in tandem with groundwater levels and overall changes in basin groundwater storage. This is referred to as elastic subsidence. Interferometric Synthetic Aperture Radar (InSAR) data collected from satellites and data collected by the Orange County Surveyor (Surveyor) show that ground surface elevations in Orange County both rise and fall in response to groundwater recharge and withdrawals. InSAR data during the period 1993-1999 shows temporary seasonal land surface changes of up to 4.3 inches (total seasonal amplitude from high to low) in the Los Angeles-Orange County area and a net decline of approximately 0.5 inch/year near Santa Ana over the period 1993 to 1999, which happened to coincide with a period of a net decrease in groundwater storage in the basin (Bawden, 2001; 2003).

The 2017 Alternative presented GPS data collected by the Orange County Surveyor's office. These data showed that ground surface elevation changes at selected sites from 2002 to 2014 correlate well with changes in groundwater storage.

Recently, as part of DWR's SGMA technical assistance to provide important SGMA-relevant data to Groundwater Sustainability Agency's (GSAs) for Groundwater Sustainability Plan (GSP) development and implementation, DWR contracted with TRE ALTAMIRA, Inc. to provide vertical displacement estimates derived from InSAR data that are collected by the European Space Agency (ESA) Sentinel-1A satellite.

The DWR-commissioned dataset represents measurements of vertical ground surface displacement in more than 200 of the high-use and populated groundwater basins across the California between January 2015 and October 2020. InSAR data coverage began in late 2014 for parts of California, and coverage for the entire study area began on June 13, 2015. Included in this dataset are point data that represent average vertical displacement values for 100 square meter areas, as well as GIS rasters that were interpolated from the point data; rasters for total vertical displacement relative to June 13, 2015, and rasters for annual vertical displacement rates with earlier coverage for some areas, both in monthly time steps. The level of accuracy is approximately 0.05 feet.

To show subsidence in Basin 8-1, OCWD used the used a layer showing the total land subsidence since the start of the InSAR data on 6/13/2015 and ending on 7/1/2020, which corresponds to the end of the OCWD water year. The GIS layer used was: https://gis.water.ca.gov/arcgisimg/rest/services/SAR/Vertical_Displacement_TRE_ALTAMIRA_v2020_Total_Since_20150613_20200701/ImageServer

Figure 13-1 shows the total land displacement in Basin 8-1 from June 2015 to July 2020. During this time period as shown on Figure 1-3, basin storage increased from 381,000 acre-feet below full conditions to 200,000 acre-feet below full conditions; that is, basin storage increased by 181,000 acre-feet. In addition to increasing groundwater levels, this rise in groundwater storage manifests itself as a rise in ground surface elevation over much of the basin, particularly in the center of the basin where there was as much as 0.15 feet of rise.

A localized area of downward (negative) displacement was observed in Tustin centered around production well T-ED. This is a relatively new well that came on-line in October 2016. Due to pumping of this well, water levels in the Principal Aquifer in the vicinity of the well declined by approximately 60 feet from June 2015 to July 2020. The small decline in ground surface in the vicinity of this well is not surprising given that it is a new well and the relatively fine-grained nature of the aquifer sediments in the area. As with other locations in the basin, we expect the impact of this well to stabilize with future displacements expected to be small.

Finally, there is little potential for future widespread permanent, irreversible subsidence given OCWD's commitment to sustainable groundwater management and policy of maintaining groundwater storage levels within a specified operating range. Nevertheless, OCWD will continue to review InSAR data and other data sources to evaluate ground surface fluctuations within OCWD's service area. If irreversible subsidence was found to occur in a localized area in relation to groundwater pumping patterns or groundwater storage conditions, OCWD would coordinate with local officials to investigate and develop an approach to address the subsidence. This could include OCWD managing the basin at higher groundwater storage levels.

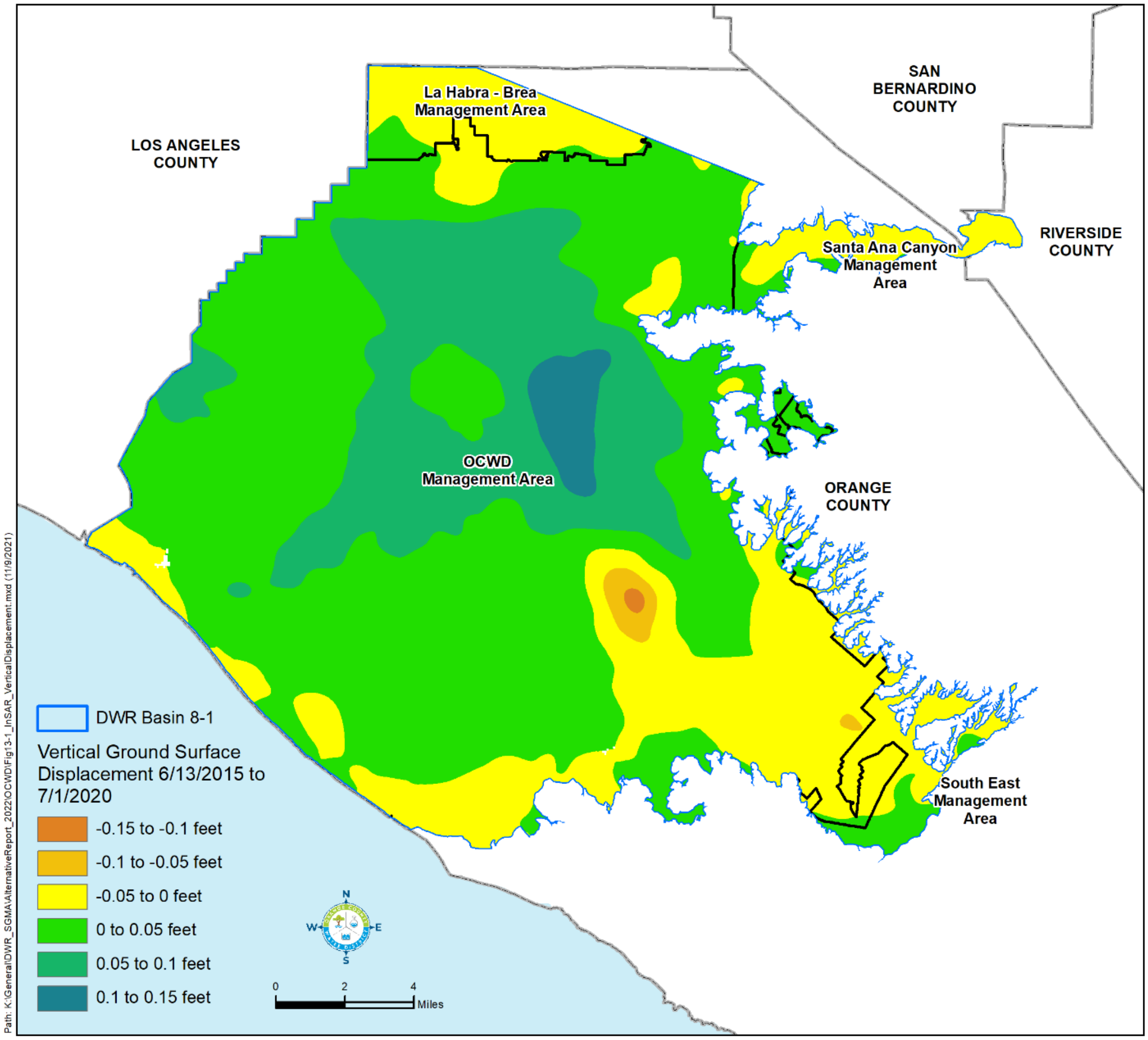


Figure 13-1: Total Vertical Ground Surface Displacement from June 2015 to July 2020

13.1 DEFINITION OF SIGNIFICANT AND UNREASONABLE LAND SUBSIDENCE THAT SUBSTANTIALLY INTERFERES WITH SURFACE USES

As stated above, data indicates that there is no inelastic land subsidence within the OCWD Management Area due to changes in groundwater elevation or groundwater storage levels. Land subsidence would be considered to be significant and unreasonable if ground surface elevation changes are determined to be inelastic over a significant period of time, these elevation changes are attributed to declines in groundwater storage, and these changes are likely to significantly interfere with surface uses.

13.2 DETERMINATION OF MINIMUM THRESHOLDS

The minimum threshold for land subsidence that defines an undesirable result is a sustained lowering of ground surface elevation that is attributable to lowering of groundwater storage in the basin and is likely to significantly interfere with surface uses.

SECTION 14 SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER DEPLETIONS IMPACTING SURFACE WATER

There are no surface water bodies within the OCWD Management Area that are interconnected and dependent on groundwater basin conditions. Therefore, the undesirable result of "depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water due to groundwater conditions occurring throughout the basin" is not present and in the future is not anticipated to occur in the OCWD Management Area due to OCWD's management programs.

The two main surface water sources in Orange County are the Santa Ana River and Santiago Creek. The Santa Ana River in Orange County flows through a highly urbanized environment. Flood protection infrastructure has constrained the flow of the river with engineered levees along most of its course. Santiago Creek, a major tributary of the Santa Ana River, is the primary drainage for the northwest portion of the Santa Ana Mountains. Under natural conditions, the creek is ephemeral, with dry conditions predominant during most of the year. Additional information on these sources can be found in the 2017 Alternative.

SECTION 15 PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Protocols that trigger a change in a monitoring program include:

- a recommendation by the GWRS Independent Advisory Panel for resampling or increased monitoring of a particular constituent of concern;
- a recommendation by the Independent Advisory Panel that reviews OCWD use of Santa Ana River water for groundwater recharge and related water quality;
- a change in regulation or anticipation of a change in regulation;
- a constituent in a sample approaches or exceeds a regulatory water quality limit or Maximum Contaminant Level, notification level, or first-time detection of a constituent;
- the computer program built by OCWD to validate water quality data prior to transfer to the WRMS data base flags a variation in historical data that may indicate a statistically significant change in water quality;
- analysis of water quality trends conducted by water quality, hydrogeology, or recycled water production staff indicate a need to change monitoring; or
- OCWD initiates a special study, such as quantifying the removal of contaminants using treatment wetlands or testing the infiltration rate of a proposed new recharge basins.

SECTION 16 EVALUATION OF POTENTIAL PROJECTS

As described in the 2017 Alternative, OCWD regularly evaluates potential projects, conducts studies and prepares reports and plans (e.g., Long Term Facilities Plan) to continue to sustainably manage the groundwater basin and advance the mission of OCWD. Described below are a few of the key projects and activities OCWD has undertaken over the last five years.

Key activities/projects that were completed in the last five years include:

- Four deep mid-basin injection wells were constructed in Santa Ana (MBI wells). The wells are injecting approximately 8-10 mgd of GWRS water into the center of the basin where groundwater levels tend to be the lowest.
- Alamitos Barrier Improvement Project: 17 new injection wells were constructed at the Alamitos Seawater Barrier to reduce the spacing between wells to improve barrier performance. The additional 1.4-mgd of injection capacity has raised water levels near or at protective elevations.
- Shallow geophysical exploration of the Lower Off-River Channel to characterize the shallow subsurface sediments. This data will be useful in assessing whether or not it is feasible to remove areas of fine-grained sediments to increase facility recharge rates.
- Continued testing of the Riverbed Filtration System (RFS), which is a shallow underdrain system designed to filter SAR water prior to delivery to a recharge basin. Testing conducted thus far shows it has the potential to double the capacity of a receiving basin. Work is also ongoing on how to potentially expand the RFS to the main SAR channel.
- Geophysical evaluation of deeper sediments in the lower SAR to assess the potential of installing a horizonal collector well (e.g., Ranney well) that would be used for recharge of GWRS water. Modeling was also conducted to assess the potential recharge capacity of a “Ranney” type well.

Key activities/projects that are underway include:

- Final expansion of the GWRS to 130 mgd capacity. This is scheduled to be complete in 2023. This project will provide OCWD 30 mgd of new water supply.
- Construction of water treatment facilities at production wells currently impacted by PFAS is ongoing. This is scheduled to be complete by 2024.
- Continued assessment of potential seawater intrusion in the Sunset Gap, including installation of additional monitoring wells, modeling, and feasibility studies.
- Completion of the Integrated Santa Ana River Watershed Model (ISARM), which is the integration of several surface and groundwater models in the upper SAR watershed above Prado Dam. This model will assist OCWD and other upper SAR

watershed stakeholders in determining potential future SAR flows arriving at Prado Dam and the potential impact of future projects on these flows.

- A study to examine the use of Forecast Informed Reservoir Operations (FIRO) at Prado Dam. A Preliminary Viability Assessment (PVA) was completed in July 2021, which showed that FIRO is viable at Prado Dam and able to provide an average of up to 7,000 acre-feet of water depending on how much water can be temporarily impounded (Ralph et al., 2021). Work on the Final Viability Assessment (FVA) is underway and scheduled for completion in mid-2023. In parallel to the FVA is work with the US Army Corps of Engineers to test FIRO at Prado Dam (through a minor deviation from the approved Water Control Plan) for a five-year period, starting in fall 2023.

Future anticipated activities and projects:

- Additional treatment systems may need to be constructed on production wells based on water quality results or changes in regulations.
- Projects may need to be constructed to improve water quality during recharge, such as sorbents to remove contaminants during recharge.
- Projects may needed to facilitate implementation of FIRO at Prado Dam or at Santiago Basins.
- Additional groundwater monitoring wells may need to be constructed to fill data gaps, including the Sunset Gap, and other areas in the basin.
- Design and construction of a potential seawater barrier at the Sunset Gap.
- Implementation of a groundwater contamination remedy in the South Basin area.

SECTION 17 REFERENCES

Bawden, Gerald W., Wayne Thatcher, Ross S. Stein, Ken W. Hudnut, and Gilles Peltzer, 2001. *Tectonic Contraction Across Los Angeles After Removal of Groundwater Pumping Effects*, Nature, Vol. 412, pp. 812-815.

Bawden, G.W., 2003. Separating groundwater and hydrocarbon-induced surface deformation from geodetic tectonic contraction measurements across metropolitan Los Angeles, California. In K.R. Prince and Galloway, D.L., eds., U.S. Geological Survey subsidence interest group conference, proceedings of the technical meeting, Galveston, Texas, November 27-29, 2001. U.S. Geological Survey Open-File Report 03-308. http://pubs.usgs.gov/of/2003/ofr03-308/.

Boyle Engineering Corporation and Orange County Water District, 1997. *Coastal Groundwater Management Investigation*.

California Department of Water Resources, 1966. *Ground Water Basin Protection Project: Santa Ana Gap Salinity Barrier, Orange County*, Bulletin No. 147-1.

***** 1967. *Progress Report on the Ground Water Geology of the Coastal Plain of Orange County*.

***** 1968. *Sea-Water Intrusion: Bolsa-Sunset Area, Orange County*, Bulletin No. 63-2.

***** 2014. *California Water Plan Update*. October 2014.

California Regional Water Quality Control Board, Santa Ana Region (RWQCB), 2004. Order No. R8-2004-0002, Producer/User Water Recycling Requirements and Monitoring and Reporting Program for the Orange County Water District Interim Water Factory 21 and Groundwater Replenishment System Groundwater Recharge and Reuse at Talbert Gap Seawater Intrusion Barrier and Kraemer/Miller Basins. March 12, 2004.

***** 2008. Order No. R8-2008-0058

Fairchild, F.B. and Wiebe, K.H., 1976. Subsidence of organic soils and salinity barrier design in coastal Orange County, California. In A.I. Johnson, ed., Proceedings of the Second International Symposium on Land Subsidence, Anaheim, California, December 13–17,1976, *International Association of Hydrological Sciences Publication* 121, 334-346.

Freeze, R. Allan and John A. Cherry. 1979. *Groundwater*. Prentice-Hall, Inc., 604 pp.

Ghyben, W.B. 1888. Nota in verband met de voorgenomen putboring nabij Amsterdam. *Tijdschrift van Let Koninklijk Inst. Van Ing.*

Hardt, William F. and E. H. Cordes, 1971. *Analysis of Ground-Water System in Orange County, California by Use of an Electrical Analog Model*, USGS Open-File Report.

Herzberg, A. 1901. Die Wasserversorgung einiger Nordseebader. *J. Gasbeleucht. Wasserversorg., 44, pp. 815-819.*

Intera, Inc., 2010. *Alamitos Barrier Model Final Report*, prepared for OCWD.

McGillicuddy, Kevin B., 1989. *Ground Water Underflow Beneath Los Angeles-Orange County Line,* unpubl. M.S. thesis, Univ. of Southern California Dept. of Geological Sciences.

Morton, Paul K., et al., 1976. *Environmental Geology of Orange County, California*, California Division of Mines and Geology Open-File Report No. 79-8 LA.

Municipal Water District of Orange County, 2016. Technical Memorandum on Orange County Reliability Study, Water Demand Forecast and Supply Gap Analysis, prepared by CDM Smith for MWDOC, April 20, 2016.

Orange County Water District, 1997. *Issues Paper – Development of the Colored Water Zone.* June 1997.

***** 2003. *Orange County Water District Recharge Study*.

***** 2005. Board of Directors Resolution No. 05-4-40: Establishing a GWR System Buffer Area around the GWR System injection operation at the Talbert Gap Seawater Intrusion Barrier, April 20, 2005, Fountain Valley, California.

***** 2007. *Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy.*

***** 2016. *Salt and Nitrate Projections for Orange County Management Zone*, Final Technical Memorandum by Greg Woodside, July 18, 2016.

***** 2020. *Salt and Nitrate Projections for Orange County Management Zone*, Technical Memorandum by Adam Hutchinson and Kevin O'Toole, December 28, 2020.

Pollack, D.W., 1994. User's Guide for MODPATH/MODPATH-PLOT, Version 3: A particle tracking post-processing package for MODFLOW, the U. S. Geological Survey finite-difference ground-water flow model, USGS Open File Report 94-464.

Ralph, F. M., Woodside, G., Anderson, M., Cleary-Rose, K., Haynes, A., Jasperse, J., Sweeten,J., Talbot, C.,Tyler, J.,Vermeeren, R., 2021. *Prado Dam Forecast Informed Reservoir Operations Preliminary Viability Assessment.* UC San Diego. Retrieved from https://escholarship.org/uc/item/13091539.

U.S. Geological Survey, 1967. *An Investigation of Potential Salt-Water Intrusion from Inland Waterways in the Shallow Alluvial and Coastal Deposits of Sunset and Bolsa Gaps, Orange County, California*, USGS Water Resources Division, Open-File Report, July 17, 1967.

Water Systems Consulting, Inc., 2020. Technical Memorandum: *Recomputation of Ambient Water Quality in the Santa Ana Watershed for the Period 1999 to 2018*.

Irvine Ranch
WATER DISTRICT

Five Year Update to:
Basin 8-1 Alternative
South East Management Area

CERTIFIED HYDROGEOLOGIST
THOMAS E. HARDER
No: 588
STATE OF CALIFORNIA

Thomas Harder

Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3)

January 1, 2022

Section **Page**

CONTENTS

Figures

Tables

SECTION 1. EXECUTIVE SUMMARY

The South East Management Area is located in the south east portion of the Coastal Plain of Orange County Groundwater Basin (Basin 8-1). The South East Management Area consists of several small, fringe areas south east of the Orange County Water District (OCWD) Management Area. These areas fall within the boundaries of the Irvine Ranch Water District (IRWD), El Toro Water District (ETWD) and the City of Orange service areas. Figure 1-1 shows the IRWD, ETWD and City of Orange areas within the boundaries of the South East Management Area along with the OCWD Management Area.

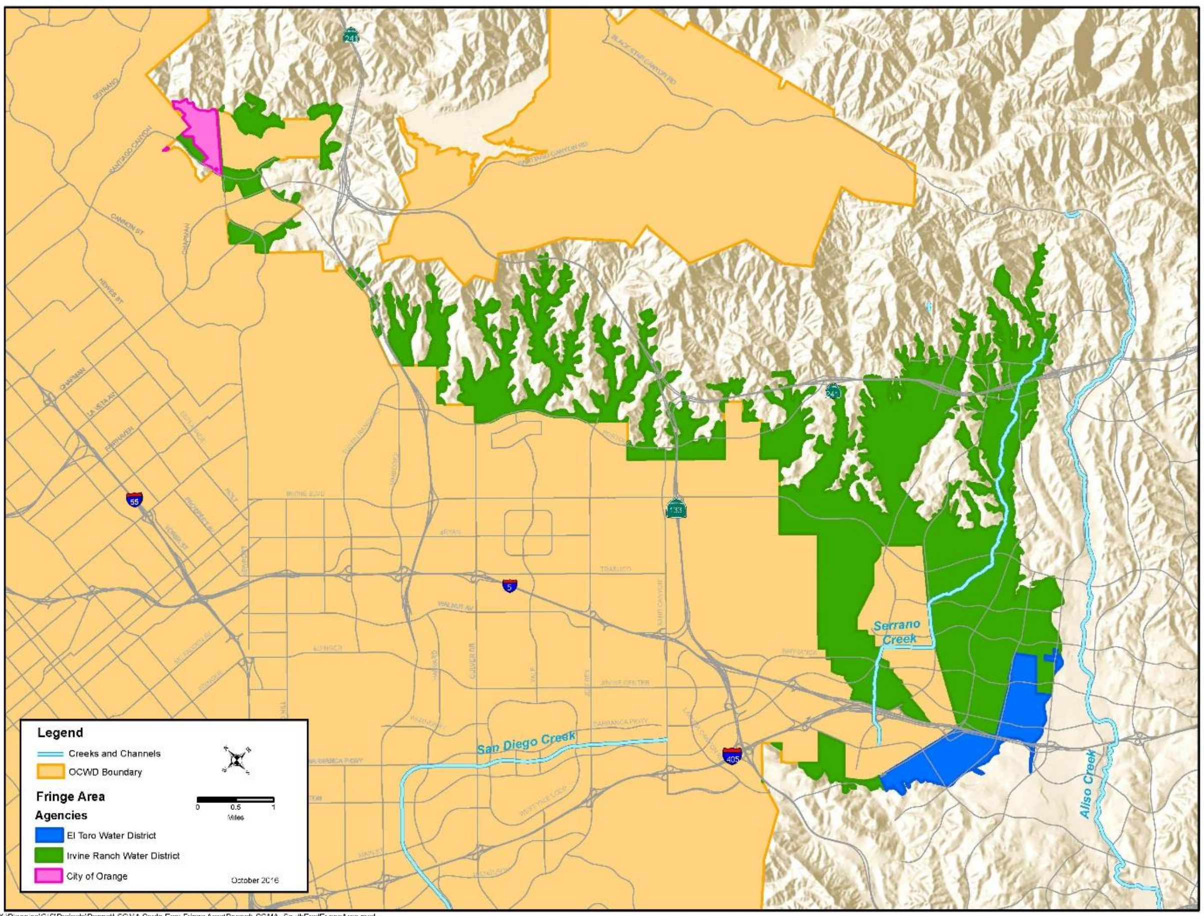


Figure 1-1: Agencies in the South East Management Area

Table 1-1 shows the area (in acres) associated with each agency within the South East Management Area. The South East Management Area covers approximately 4.4 percent of Basin 8-1, which has a total area of 223,600 acres.

Table 1-1: Agencies in South East Management Area and Area Covered

Agency	Area (acres)
Irvine Ranch Water District	8,870
El Toro Water District	762
City of Orange	134
Total Area	9,766

Update to 2017 Alternative

This document provides any updates to the 2017 Alternative for the South East Management Area plan, submitted by OCWD on December 2, 2016. The 2017 Alternative, including the South East Management Area was reviewed by the State of California Department of Water Resources (DWR) in July 2019. Based on DWR's assessment, the 2017 Alternative was found to meet the requirements under SGMA and was approved.

Approved alternatives are required to submit annual reports to DWR on April 1 of each year. Annual reports for Basin 8-1 were submitted to DWR as follows:

- Water Year 2016-17, Submitted on March 29, 2018
- Water Year 2017-18, Submitted on March 29, 2019
- Water Year 2018-19, Submitted on March 30, 2020
- Water Year 2019-20, Submitted on March 30, 2021

According to Water Code §10733.8, "At least every five years after initial submission of a plan pursuant to Section 10733.4, the department shall review any available groundwater sustainability plan or alternative submitted in accordance with Section 10733.6, and the implementation of the corresponding groundwater sustainability program for consistency with this part, including achieving the sustainability goal. The department shall issue an assessment for each basin for which a plan or alternative has been submitted in accordance with this chapter, with an emphasis on assessing progress in achieving the sustainability goal within the basin. The assessment may include recommended corrective actions to address any deficiencies identified by the department."

This document represents the first five-year update, which is due January 1, 2022.

Important Note:

For purposes of this report, the Basin 8-1 Alternative submitted on December 22, 2016, will be referred to as the 2017 Alternative. The first five-year update will be referred to as the 2022 Update for ease of reference. The 2017 Alternative was a comprehensive document showing that Basin 8-1 had been managed sustainably for more than 10 years. For the 2022 Update, the focus is on documenting that the basin has been continued to be sustainably managed during the five years since the 2017 Alternative was submitted and to present any new information from the last five years. As such, the 2017 Alternative is considered a key reference document with background information that is not duplicated in the 2022 Update.

The water resources in the South East Management Area include surface water from Serrano Creek and numerous smaller tributaries, groundwater and imported water. Serrano Creek provides surface waters that flow into and/or out of the IRWD's Lake Forest portion of the South East Management Area (Boyle, 2002). Historically, groundwater production has been a minor source of water supply for the South East Management Area and there has been no groundwater production since February 2018. Imported water received through the Metropolitan Water District of Southern California is the primary water supply source to meet the water demands within the South East Management Area.

Historically, IRWD has produced groundwater from six wells located in the city of Lake Forest. Groundwater production within the South East Management Area has historically represented less than 2 percent of the potable water supply for IRWD's Lake Forest area and less than 0.2 percent of IRWD's overall potable water supply. Due to the relatively low yield of the Aquifer in the South East Management Area, groundwater production is expected to remain a relatively insignificant water supply source for the area.

None of IRWD's six wells have been active since February 2018. At the time of the preparation of the Basin-8 Alternative, IRWD was pumping groundwater from only one active well (Well LF-2) in the South East Management Area. In early 2018, due to poor water quality of the well water, IRWD ceased well pumping and the well has been inactive since. IRWD has plans to rehabilitate Well LF-2 and resume groundwater production in the future. In addition, in February 2020, well LF-5 was destroyed due to low water production and high salinity and to also make way for a new pump station on the site where the well was located. While no plans are currently in place, placement for a potential new well was included with the pump station siting.

The five remaining wells within IRWD's Lake Forest portion of the Management Area are currently monitored for groundwater levels on a monthly basis. There are no other programs in the South East Management Area responsible for managing or monitoring groundwater resources at this time. As of the beginning of 2018, the monthly water quality monitoring of the operational well was halted temporarily due to lack of production. Sampling and water quality monitoring will resume at this well when the planned well rehabilitation project is completed. In addition, two wells are to be designated as groundwater level monitoring wells (LF-1 and LF-4) and added to the Basin 8-1 SGMA monitoring program. The groundwater levels at these wells will be monitored on a monthly basis with the results transmitted to DWR as part of the Basin 8-1 monitoring program.

The approach to sustainably managing the South East Management Area is to continue to monitor groundwater levels and production to ensure that groundwater pumping does not lead to significant and unreasonable conditions such as (1) chronic lowering of groundwater levels, (2) chronic reduction in storage, (3) groundwater quality degradation, (4) inelastic land subsidence or (5) unreasonable adverse effect on surface water resources. Descriptions of these undesirable results can be found in Sections 8 through 14.

SECTION 2. AGENCY INFORMATION

2.1 HISTORY OF AGENCIES IN SOUTH EAST BASIN MANAGEMENT AREA

No update since the 2017 Alternative – See 2017 Alternative.

2.2 GOVERNANCE AND MANAGEMENT STRUCTURE

No update since the 2017 Alternative – See 2017 Alternative.

2.3 LEGAL AUTHORITY

No update since the 2017 Alternative – See 2017 Alternative.

2.4 BUDGET

The budget required to monitor and report groundwater information for the South East Management Area has not been defined. As part of its standard operations, IRWD regularly collects and maintains information on its groundwater production, groundwater levels and water quality testing. Funding for well monitoring, operation, and rehabilitation where applicable is defined in the IRWD's operating or capital budgets. Since the preparation of the 2017 Alternative, there continues to be no groundwater production within ETWD or City of Orange areas of the South East Management Area, therefore these agencies are not be responsible for monitoring and reporting groundwater information.

For this 2022 update, it should be noted that two monitoring wells (LF-1 and LF-4) will be designated to report on monthly water levels which will be transmitted to DWR as part of the Basin 8-1 SGMA monitoring program.

SECTION 3. MANAGEMENT AREA DESCRIPTION

3.1 SOUTH EAST SERVICE AREA

No update since the 2017 Alternative – See 2017 Alternative.

3.1.1 Jurisdictional Boundaries

No update since the 2017 Alternative – See 2017 Alternative.

3.1.2 Land Use Designations

No update since the 2017 Alternative – See 2017 Alternative.

3.2 GROUNDWATER CONDITIONS

Groundwater level trends in the South East Management Area are relatively stable, or rising, consistent with the limited recent groundwater production in the area. Of the six groundwater production wells IRWD has in the area, only one is active and that well is currently not pumping due to groundwater quality issues and required maintenance (see Figure 3-1). As there is no current groundwater pumping and only limited planned future groundwater development, the stable or rising groundwater level trends are expected to continue.

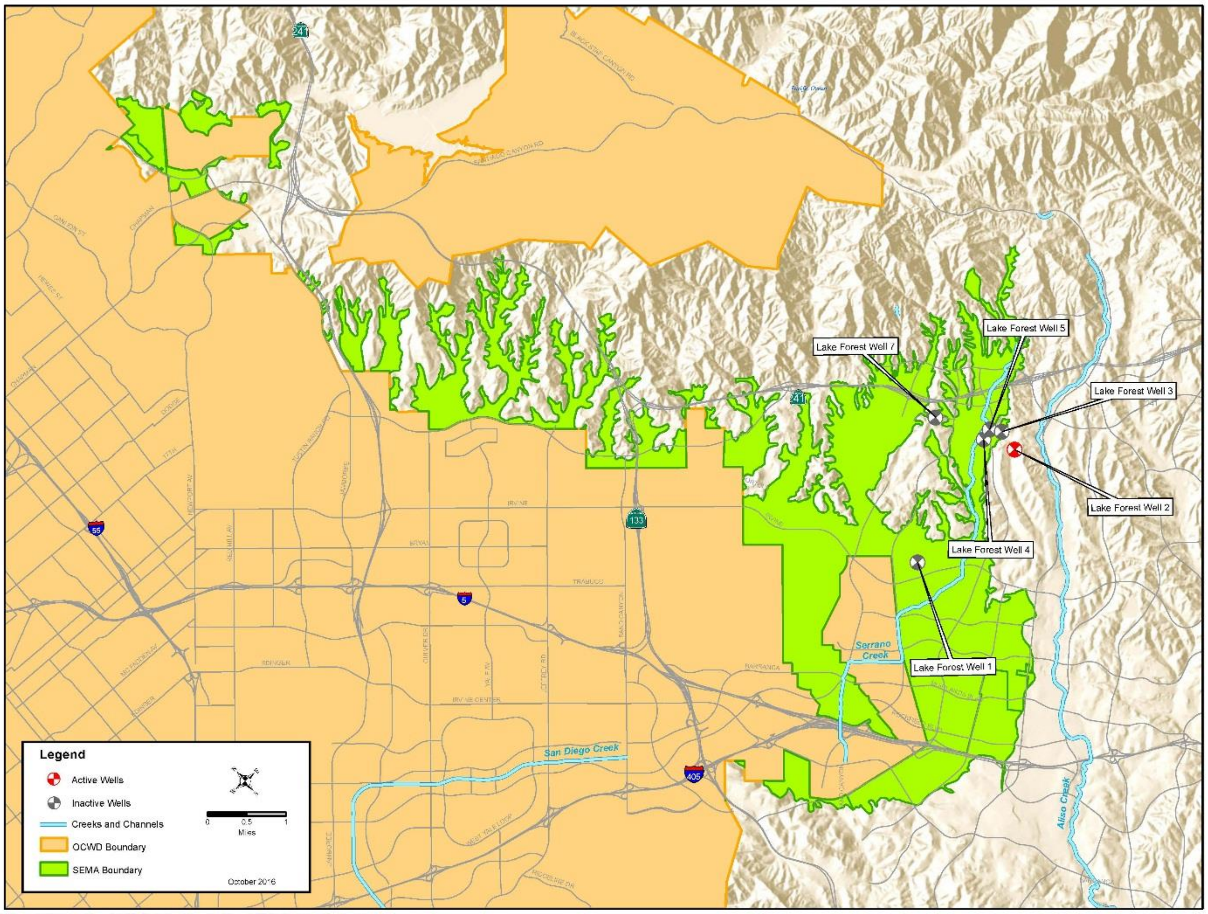


Figure 3-1: Groundwater Production Wells (Active and Inactive)

A study completed in 2002 assessed the potential of the development of future wells in the IRWD Lake Forest area, which is located in the eastern portion of the South East Management Area. It was noted that based on available well driller's logs there was considerable clay in the alluvium and that the specific capacity of these wells is very low. Based on the very low specific capacity results, it appears that the alluvium is characterized by low permeability. This seems to be reflected in the low production capacity of the wells (Boyle 2002).

Since the preparation of the 2017 Alternative, only well LF-2 was operational up through January 2018. Due to water quality issues related to iron and manganese, well LF-2 was taken offline in early 2018 and IRWD plans to rehabilitate the well and construct treatment for the removal of iron and manganese. The rehabilitation project is planned to be performed in late 2022 and depending on the performance and water quality testing results from the well, IRWD may construct a treatment facility to remove iron and manganese. While well LF-2 has not been active in the last few years, it is shown as “active” on Figure 3-1 because IRWD plans to put well LF-2 back into production once it is rehabilitated and treatment facilities are constructed.

In 2020, well LF-5 was destroyed to make way for a new planned pump station on the site. Well LF-5 was previously used to supplement water in IRWD’s recycled water system. However, due to continual poor water production and high salinity, IRWD ceased the operation of well LF-5, and in February 2020, IRWD destroyed the well. At the site, IRWD plans to construct a new recycled water pump station. Although construction and operation of a new well is not a currently planned project, space is being allocated on the existing site adjacent to the pump station to accommodate a potential new well in the future.

3.2.1 Groundwater Levels

The range of observed groundwater levels in the South East Management Area from 2016 to 2021 are summarized in Figure 3-2. It is noted that no groundwater level data exists in the ETWD and City of Orange portions of the South East Management Area. Historic and estimated groundwater levels from 1991 to 2021 for IRWD’s Lake Forest wells are shown in Figure 3-2. Historic groundwater level data is available from 1991 through 2001, after which there is no data available until 2015. More recent groundwater level data is available from 2015 to present. Monthly groundwater levels from IRWD’s Lake Forest wells for 2020 to 2021 are shown in Figure 3-3.

In all IRWD wells, groundwater levels are the same or higher in 2021 than they were in 2017. With the exception of LF-1, groundwater levels show a rising trend, indicating that recharge to the area exceeds the discharge. Well LF-1 shows a stable groundwater level trend.

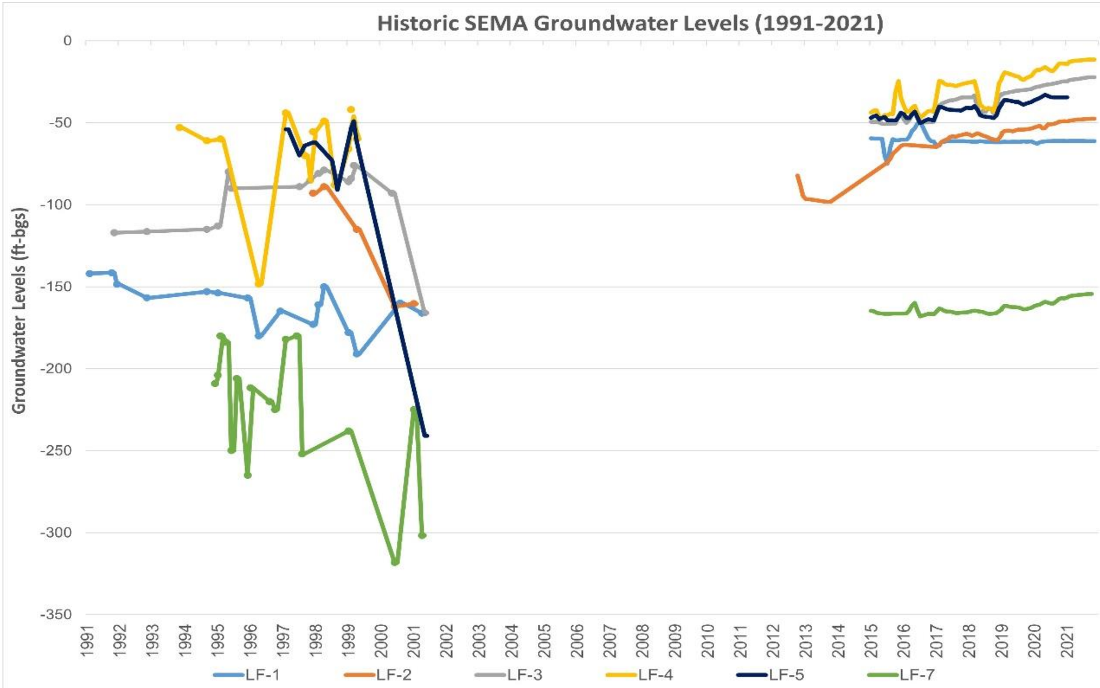


Figure 3-2:Historic Groundwater Levels in South East Management Area, 1991-2021

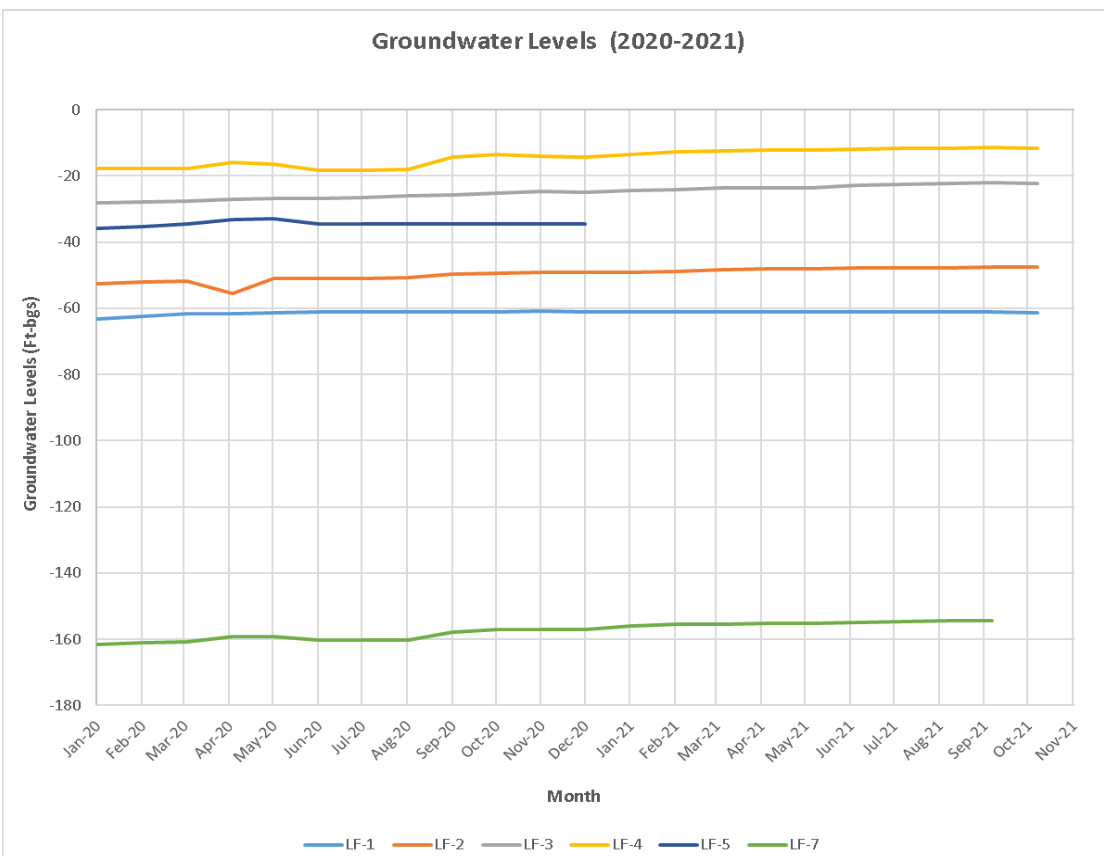


Figure 3-3: Current Groundwater Levels in South East Management Area, 2020-21

3.2.2 Regional Pumping Patterns

Table 3-1 summarizes information on all of the wells that are known to exist within the South East Management Area by agency. As presented, well design flows range from 125 to 350 gallons per minute (gpm) and well depths range from 675 to 1,000 feet below ground surface (ft-bgs).

Table 3-1: Wells and Flow Data

Agency	Well	State Well No.	System	Status	Design Flow (gpm)	Drilled	Depth (ft-bgs)	Perforated Intervals (ft)
IRWD	LF-1	06S/08W-15A00	Nonpotable	Inactive	300	1989	800	200-790
IRWD	LF-2	06S/08W-12Q02	Potable	Inactive	300	1957, redrilled 2010	675	200-675
IRWD	LF-3	06S/08W-12J01	Potable	Inactive	350	1950	800	270-395; 400-785
IRWD	LF-4	06S/08W-12L02	Nonpotable	Inactive	200	1993	810	350-470 510-790
IRWD	LF-5	06S/08W-12A01	Nonpotable	N/A	140	1997	800	350-780
IRWD	LF-7	06S/08W-12E00	Potable	Inactive	125	1994	1000	430-980
ETWD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
City of Orange	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

For the 2022 Update, Table 3-2 summarizes average annual pumping from 2016-2021 within the South East Management Area by agency. As shown, ETWD and City of Orange did not pump any groundwater from the South East Management Area during this time period. In IRWD's portion of the South East Management Area none of the existing wells are currently active. Over the last 5 years, well LF-2 annual pumping ranged from 0 acre-feet to 389 acre-feet and averaged approximately 90 acre-feet.

Table 3-2: Annual Pumping Average 2016-2021

Agency	Average Annual Production (acre-feet/yr.)
IRWD	90
ETWD	0
City of Orange	0
Total	90

In the last five years, pumping from LF-2 occurred in 2016 and 2018, after which LF-2 was taken offline. Figure 3-4 shows monthly pumping patterns for LF-2 from 2016 to 2021. Figure 3-5 shows annual pumping by water year (October-September) for 2017 through 2021.

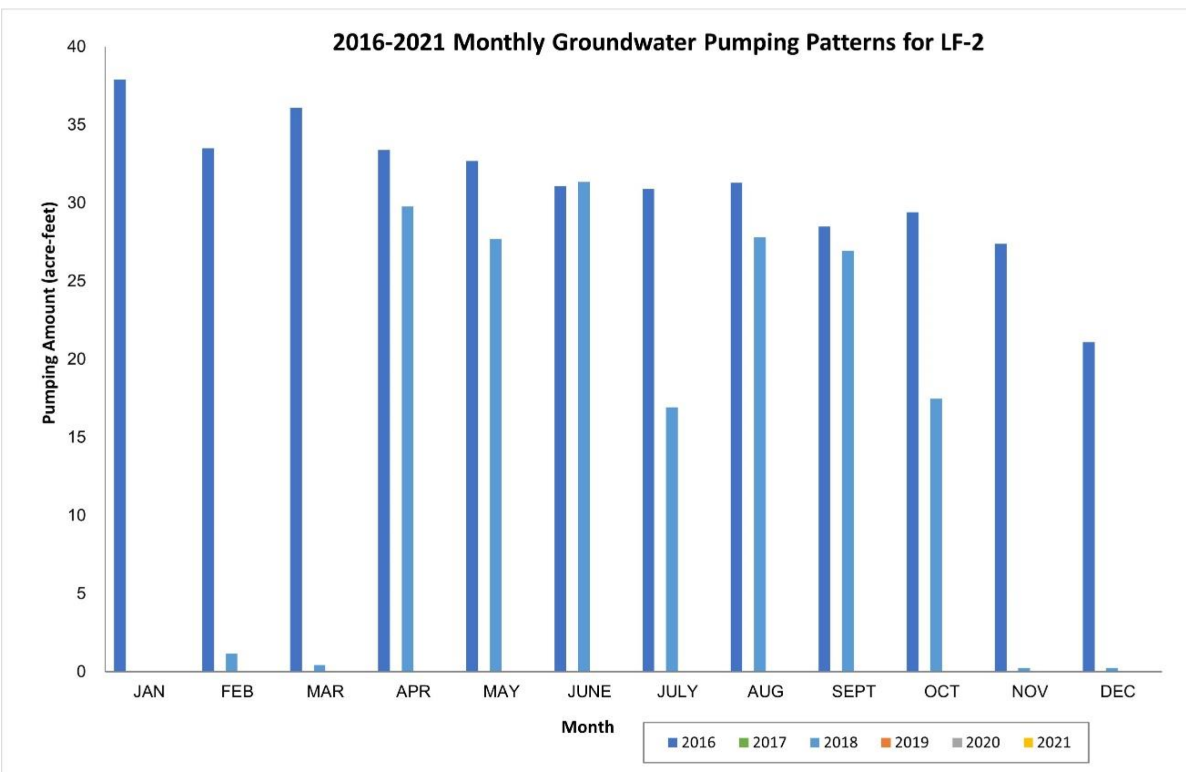


Figure 3-4: Monthly Groundwater Pumping Pattern in Well LF-2, 2016-2021

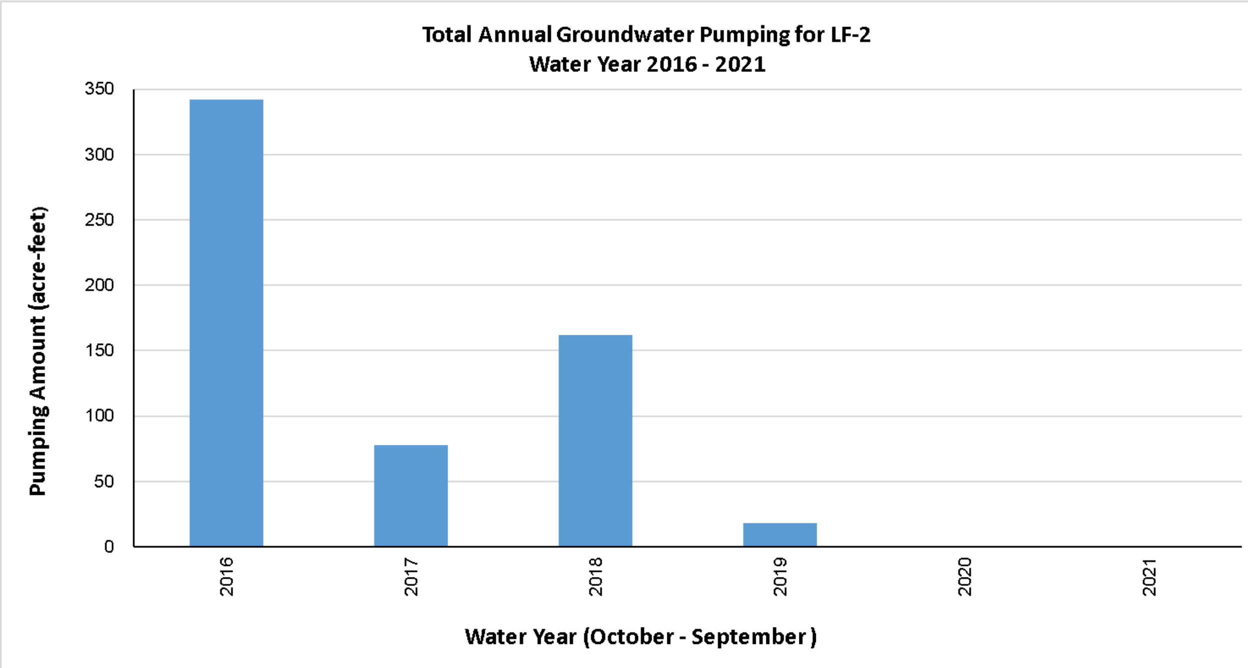


Figure 3-5: Total Annual Pumping for Well LF-2, (Water Year 2016-2021)[1]

1 All data shown for 2017 on this chart occurs between October and December 2016 of the water year.

3.2.3 Groundwater Storage Data

No update since the 2017 Alternative – See 2017 Alternative.

3.2.4 Groundwater Quality Conditions

Historically, only three of the six IRWD Lake Forest wells were permitted for potable use as the other three Lake Forest wells have had elevated levels of iron(Pb), manganese (Mn), electrical conductivity (EC) and total dissolved solids (TDS). Recent groundwater quality data for the South East Management Area which includes arsenic (As) is presented in Table 3-3. As presented, no other water quality data exists for the ETWD and City of Orange areas within the South East Management Area.

Table 3-3: Ground Water Quality in Selected Wells

Agency	Well Name	Well Use	Date Range	Avg TDS (#)[1] (mg/L)	Avg As (ug/L)	Avg Pb (ug/L)	Avg Mn (mg/L)
IRWD	LF-2	Production	2016-2018*	602	0.42	0.51	22.3
IRWD	LF-1	Production	1961-2000	>500 (21)			
IRWD	LF-4	Production	1993-2000	>500 (12)			
IRWD	LF-5	Production	1997-2001	>500 (5)			
IRWD	LF-3	Production	1991-1998	>500 (12)			
IRWD	LF-7	Production	1994-2001	<500 (12)			
City of Orange	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ETWD	N/A	N/A	N/A	N/A	N/A	N/A	N/A

1 # = Number of Samples
* LF-2 Turned Offline in February 2018

3.2.5 Land Subsidence

Non-recoverable land subsidence has not been observed since 2015 in the South East Management Area (see Figure 3-6). The area is not susceptible to land subsidence given the following:

1. Minimal groundwater development exists in the South East Management Area.
2. Groundwater levels are stable or rising and have been for at least the last 10 years.
3. Low risk of future groundwater level declines due to limited planned groundwater production.

As shown in Figure 3-6, the South East Management Area experienced between -0.05 and 0.05 feet of vertical displacement across years 2015 to 2020 with an accuracy of approximately 0.05 feet in data readings.

Recently, as part of DWR's SGMA technical assistance to provide important SGMA-relevant data to Groundwater Sustainability Agency's (GSAs) for Groundwater Sustainability Plan (GSP) development and implementation, DWR contracted with TRE ALTAMIRA, Inc. to provide vertical displacement estimates are derived from InSAR data that are collected by the European Space Agency (ESA) Sentinel-1A satellite.

This dataset represents measurements of vertical ground surface displacement in more than 200 of the high-use and populated groundwater basins across the State of California between January of 2015 and October of 2020. InSAR data coverage began in late 2014 for parts of California, and coverage for the entire study area began in June 13, 2015. Included in this dataset are point data that represent average vertical displacement values for 100 meter by 100 meter areas, as well as GIS rasters that were interpolated from the point data; rasters for total vertical displacement relative to June 13, 2015, and rasters for annual vertical displacement rates with earlier coverage for some areas, both in monthly time steps. The level of accuracy is approximately 0.05 feet.

To show subsidence in Basin 8-1, the layer showing total land subsidence since the start of the InSAR data on 6/13/2015 and ending on 7/1/2020, which corresponds to the end of the water year was used. (GIS layer used: https://gis.water.ca.gov/arcgisimg/rest/services/SAR/Vertical_Displacement_TRE_ALTAMIRA_v2020_Total_Since_20150613_20200701/ImageServer.)

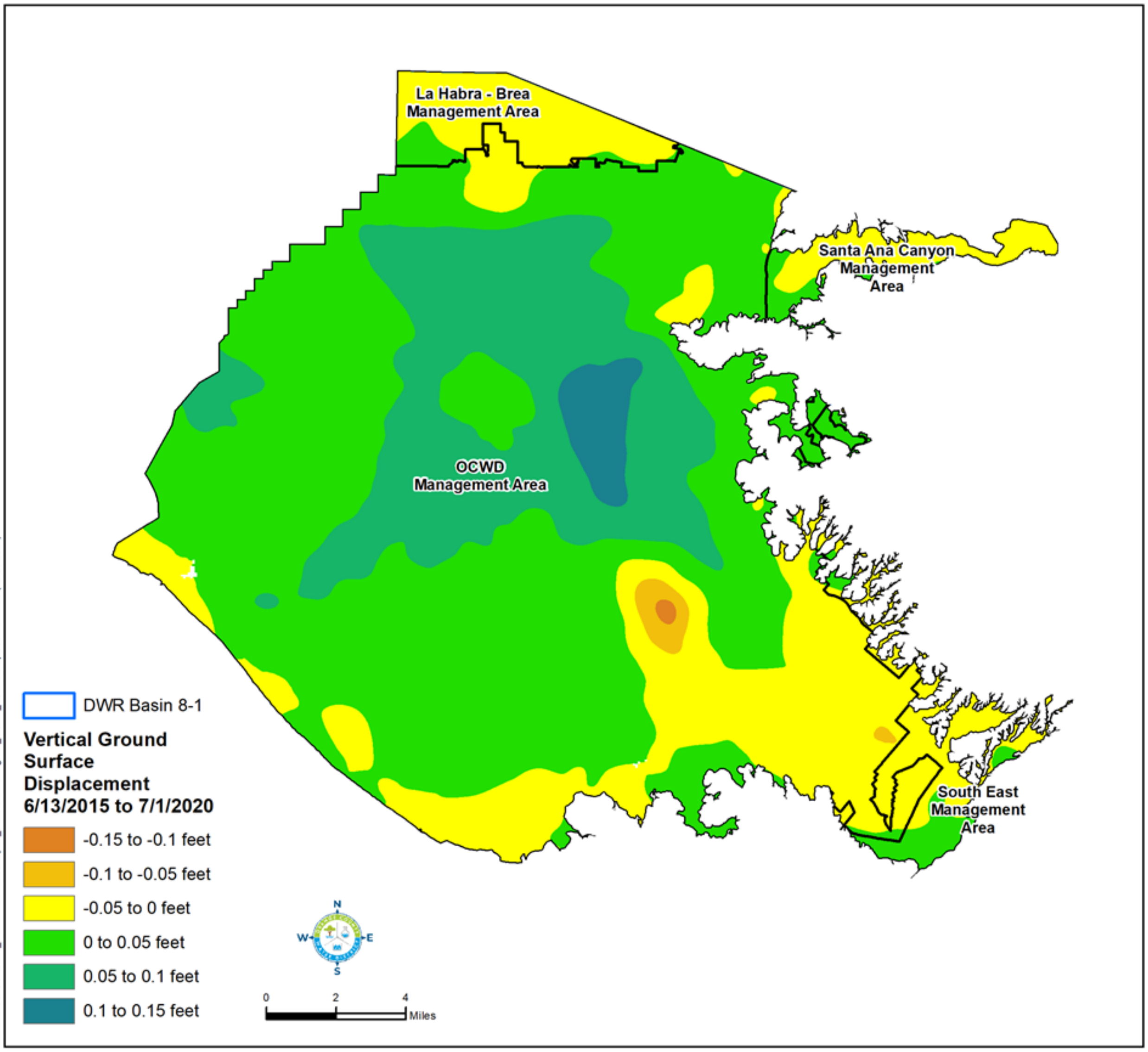


Figure 3-6: Total Vertial Ground Surface Displacement from June 2015 to July 2020

3.2.6 Groundwater and Surface Water Interactions and Groundwater Dependent Ecosystems

The primary surface water drainage in the South East Management Area is Serrano Creek. Serrano Creek is an intermittent stream that only flows during the rainy season following storm events. The predominant interaction between the surface flow in the creek and groundwater is percolation from the creek and recharge of the groundwater (see Boyle 2002 Groundwater Supply Evaluation study). Groundwater does not typically discharge at the land surface near the creek. Data from the California Department of

Water Resources (CDWR) NC dataset viewer indicates that there are some areas along Serrano Creek that are designated as groundwater dependent ecosystems (https://gis.water.ca.gov/app/NCDatasetViewer/).

Planned future groundwater pumping in IRWD's Lake Forest portion of the South East Management Area from Well LF-2 will not occur in areas of groundwater dependent ecosystems (GDEs). Some of IRWD's inactive wells are located near the Serrano Creek drainage, but outside the GDE areas. With the exception of Well LF-5, there are no plans to pump groundwater from any of these wells in the future. Well LF-2, which may be pumped in the future, is located outside the Serrano Creek drainage and is not expected to have an impact on GDEs within the Serrano Creek drainage. In the event that a replacement well is constructed near the existing Well LF-5, groundwater monitoring will be implemented to ensure the production from that well does not have an undesirable result on the GDE along Serrano Creek.

SECTION 4. WATER BUDGET

An average annual groundwater budget for the South East Management Area for the last 5 years is presented in Table 4-1. The simple water budget for the IRWD portion of the South East Management Area is based on measured groundwater production and the subsurface flow calculated by the numerical model for the OCWD Management Area (Basin 8-1 Alternative 2017). The development of individual components in the average annual groundwater budget are described in the following subsections.

4.1 BUDGET COMPONENTS

For IRWD's Lake Forest portion of the South East Management Area, the components of the groundwater budget are presented in Table 4-1 and described below. Groundwater Production includes an average from 2016-2021. As of 2018, the groundwater production is zero until the LF-2 well can be rehabilitated and placed back in service.

Table 4-1: Average Annual Groundwater Budget

South East Management Area Groundwater Budget 2016-2021 (acre-feet)	
Item	**Total (acre-feet)**
Recharge	2,900
Total Inflow	2,900
Groundwater Production	90
Subsurface Outflow	2,810
Total Outflow	2,900
Change in Storage	0

4.1.1 Recharge

Recharge includes infiltration from ephemeral creeks, precipitation and return flow recharge from irrigation. It was estimated to equal the total outflow as summarized in Table 4-1.

4.1.2 Groundwater Production

Groundwater production was taken from measured records by IRWD as summarized in Table 4-1. In the base period 2016 to 2021, groundwater production was only conducted by IRWD's Well LF-2. Groundwater production in this well ranged from 0 to 389 acre-ft/yr. from 2016 to 2021 with an average of approximately 90 acre-ft/yr.

4.1.3 Subsurface Outflow

Subsurface outflow from the South East Management Area into the OCWD Management Area was estimated using the OCWD groundwater flow model (Basin 8-1 Alternative 2017).

4.2 CHANGES IN GROUNDWATER STORAGE

Changes in groundwater storage within the South East Management Area since 2015 have been positive reflecting the rising groundwater levels measured in the wells. As indicated in Section 3.2.1, groundwater levels are the same or higher in 2021 than they were in 2017. With the exception of LF-1, groundwater levels show a rising trend, indicating that recharge to the area exceeds the discharge. Well LF-1 shows a stable groundwater level trend. These trends have persisted despite multiple years of below normal precipitation. As presented in Section 4.1, groundwater pumping in the South East Management Area is relatively minor and averages only 125 acre-feet per year over the previous 10 years (2006-2015), and 90 acre-feet in the last six years (2016-2021). The groundwater level and pumping data indicate groundwater production is below the sustainable yield of the basin.

4.3 WATER YEAR TYPE

No update since the 2017 Alternative – See 2017 Alternative.

4.4 ESTIMATE OF SUSTAINABLE YIELD

The sustainable yield of the South East Management Area is approximated by the volume of average annual recharge that is estimated to enter the basin (approximately 2,900 acre-ft), as shown in Table 4-1. Average annual groundwater production over the last 5 years, ranging from 0 acre-feet to 389 acre-feet and averaging approximately 90 acre-feet, is significantly below the sustainable yield, which is supported by rising groundwater levels in the area over the same time period. Due to production rate limitations and groundwater quality issues, it is unlikely groundwater production in the South East Management Area will ever increase to the sustainable yield.

4.5 CURRENT, HISTORICAL, AND PROJECTED GROUNDWATER BUDGET

IRWD does not plan any significant changes to groundwater use in the South East Management Area that would change the water budget. The historical water budget is discussed in Section 4.1 and summarized in Table 4-1. Currently, there is no groundwater production in the South East Management Area. Future groundwater production could include bringing Well LF-2 online, replacing Well LF-5, and developing two new wells (see Section 16). No projected groundwater production is currently anticipated within the ETWD and city of Orange portions of the South East Management Area. Any future groundwater production will be managed within the sustainable yield of the aquifer system.

SECTION 5. WATER RESOURCE MONITORING PROGRAMS

5.1 OVERVIEW

This section describes surface and groundwater monitoring programs in the South East Management Area

5.2 GROUNDWATER MONITORING PROGRAMS

No groundwater development exists in the ETWD and City of Orange portions of the South East Management Area. In IRWD's Lake Forest portion of the South East Management Area the existing five wells (whether active or inactive) have been, and will continue to be, used to monitor the groundwater levels on a monthly basis. Section 3.2.1 provides information on the South East Management Area groundwater levels, and Figure 3-1 shows the locations of the Lake Forest wells within the South East Management Area.

5.3 OTHER MONITORING PROGRAMS

IRWD monitors groundwater quality in LF-2, when operating, as required by the California Code of Regulation (Title 22) and California Division of Drinking Water, Santa Ana District. In addition, as of 2021 two monitoring wells will be designated (LF-1 and LF-4) for the monitoring and reporting groundwater elevations in the South East Management Area which will be transmitted to the DWR under the SGMA monitoring program for Basin 8-1. DWR currently requires bi-annual reporting for well monitoring data.

SECTION 6. WATER RESOURCE MANAGEMENT PROGRAMS

IRWD works with ETWD and City of Orange on plans for groundwater development within the South East Management Area and updates demand projections and the water budget accordingly.

IRWD: The compilation of land use data is the basis for IRWD's water resource planning including its portion of the South East Management Area. Per IRWD's 2020 Urban Water Management Plan (UWMP), the land use data obtained from multiple jurisdictions in IRWD's service area is used in conjunction with IRWD's applied water use factors in order to estimate water requirements.

ETWD: ETWD's water resource planning is based on the 2020 UWMP demand projections. Regional demands are forecasted by the Municipal Water District of Orange County and are then tailored to ETWD's service area using available data for land use, population, and economic growth, intermixed with a trajectory of conservation, which includes both additional future passive measures and active measures.

City of Orange: The City of Orange's current UWMP (2020) provides the basis for water resource planning in Orange's water service area. The UWMP, in conjunction with applicable water use factors, form the basis for any potential water use estimates required for potential planning use in the service area.

SECTION 7. NOTICE AND COMMUNICATION

There are three agencies within the South East Management Area, as follows:

- IRWD
- ETWD
- City of Orange

On September 30, 2021, OCWD sent a letter via email to all of the Basin 8-1 agencies, including each of the agencies listed above to let them know that the 2017 Alternative was being updated and would be available for review and comment. No comments were received by any of the agencies contacted. The three South East Management Area agencies coordinated with OCWD and the other management areas to prepare the 2022 Update, in accordance with SGMA requirements.

A draft 2022 Update was presented to OCWD staff and posted on the OCWD website on November 17, 2021 to allow for public review and comment. The final 2022 Update was received and filed by the OCWD board in December 2021.

SECTION 8. SUSTAINABLE MANAGEMENT APPROACH

The Sustainable Management Approach for the South East Management Area is to continue monitoring sustainable conditions and monitor to ensure that conditions do not lead to significant and unreasonable (1) lowering of groundwater levels, (2) reduction in storage, (3) water quality degradation, or (4) inelastic land subsidence or (5) unreasonable adverse effect on surface water resources.

SECTION 9. SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER LEVELS

9.1 HISTORY

As shown on Figure 3-2 historical groundwater levels in the IRWD's Lake Forest portion of the South East Management Area have shown stable or rising trends and are, in all cases, at the same level or higher than they were in 2017. Because future groundwater pumping in the South East Management Area is expected to be limited, groundwater levels are expected to remain relatively steady in the future.

9.2 MONITORING OF GROUNDWATER LEVELS

Groundwater levels are currently monitored in the five wells located in IRWD's Lake Forest portion of the South East Management Area on a monthly basis. This monitoring will continue into the future.

9.3 DEFINITION OF SIGNIFICANT AND UNREASONABLE LOWERING OF GROUNDWATER LEVELS

Significant and unreasonable lowering of groundwater levels is defined as a long-term chronic lowering of groundwater levels, despite changes in precipitation patterns. No long-term reduction in groundwater levels in the South East Management Area is expected to occur.

9.4 DETERMINATION OF MINIMUM THRESHOLDS

It is not possible to determine a minimum threshold at this time since no undesirable effects due to groundwater levels have occurred in the past and are not foreseen in the future. Nevertheless, the South East Management Area well monitoring program is expected to continue to monitor water levels and groundwater quality in the future. If water levels start to show a consistent, long-term decline and undesirable results are observed, action would be taken and minimum thresholds would be evaluated and established as appropriate.

SECTION 10. SUSTAINABLE MANAGEMENT RELATED TO BASIN STORAGE

No groundwater development exists in the ETWD and City of Orange portions of the South East Management Area. The total volume of groundwater storage in IRWD's portion of the South East Management Area has been estimated to be approximately 360,000 acre-feet (see Section 3.2.3).

10.1 DEFINITION OF SIGNIFICANT AND UNREASONABLE REDUCTION IN STORAGE

No significant long-term reduction in groundwater storage is expected to occur in the South East Management Area because of the limited groundwater use. However, a decline in groundwater storage may be determined unreasonable if one more of the following occurred:

1. Significant loss of well production capacity.
2. Degradation of water quality that significantly impacts the use of groundwater.

10.2 DETERMINATION OF MINIMUM THRESHOLDS

A minimum threshold for the reduction of groundwater storage in the South East Management Area is not anticipated since no undesirable effects have occurred in the past and are not foreseen in the future. Nevertheless, IRWD's Lake Forest monitoring program continuously tracks water levels and groundwater quality. If water levels show a consistent decline, IRWD's Lake Forest monitoring program would be expanded to examine any potential impacts and action would be taken to identify minimum thresholds as appropriate.

SECTION 11. SUSTAINABLE MANAGEMENT RELATED TO WATER QUALITY

No groundwater development exists in the ETWD and City of Orange portions of the South East Management Area. Groundwater quality in IRWD's portion of the South East Management Area is affected by the quality of recharge from Serrano Creek and precipitation and incidental recharge from irrigation. Groundwater from subsurface inflow could contain naturally elevated concentrations of TDS and manganese. IRWD has the ability to utilize water produced from non-potable wells to supplement its extensive recycled water system which serves irrigation demands.

11.1 DEFINITION OF SIGNIFICANT AND UNREASONABLE DEGREDATION OF WATER QUALITY

There are three elements that must be considered when evaluating the impact of groundwater quality degradation.

The first element is considering the causal nexus between groundwater management activities and groundwater quality. For example, groundwater contamination due to improper handling of toxic materials impacts groundwater quality; however, this water quality degradation is not caused by groundwater management activities.

The second element is the beneficial uses of the groundwater and water quality regulations, such as Maximum Contaminant Levels (MCLs) and other potable water quality requirements.

The third element that must be considered is the volume of groundwater impacted by groundwater quality degradation. If small volumes are negatively affected that don't materially affect the use of the aquifer or basin for its existing beneficial uses, then this would not represent a significant and unreasonable degradation of water quality. However, if the impacted volume grows, then it could reach a level that it becomes significant and unreasonable.

When considering all three elements, the definition of significant and unreasonable degradation of water quality is defined as degradation of groundwater quality in the South East Management Area to the extent that a significant volume of groundwater becomes unusable for its designated beneficial uses.

11.2 DETERMINATION OF MINIMUM THRESHOLDS

The minimum thresholds for groundwater quality are exceedances of Maximum Contaminant Levels (MCLs) or other applicable regulatory limits that are directly attributable to groundwater management actions in the South East Management Area that prevents the use of groundwater for its designated beneficial uses

SECTION 12. SUSTAINABLE MANAGEMENT RELATED TO SEAWATER INTRUSION

The South East Management Area is located far from the ocean and thus there is no reason to consider the potential impact of seawater intrusion in this management area.

SECTION 13. SUSTAINABLE MANAGEMENT RELATED TO LAND SUBSIDENCE

Subsidence is not an issue for the South East Management Area given the following:

- Minimal groundwater development exists in the South East Management Area.
- Groundwater levels are stable or rising and have been for at least 10 years.
- Low risk of future groundwater level declines due to limited planned groundwater production.

As discussed previously in Section 3, the Basin 8-1 area will continue to be monitored for changes in InSAR data (via OCWD and consultants) to evaluate ground surface fluctuations within the service area. If irreversible subsidence was found to occur in a localized area in relation to groundwater pumping patterns or groundwater storage conditions, the South East Management Area managers would coordinate with local officials to investigate and develop an approach to address the subsidence.

SECTION 14. MANAGING GROUNDWATER DEPLETIONS IMPACTING SURFACE WATER

Although IRWD does not have immediate plans for groundwater pumping in areas of GDEs, in the event that replacement or new wells are constructed near sensitive areas, groundwater monitoring will be implemented to ensure the groundwater production does not have an undesirable result on the GDE along Serrano Creek.

SECTION 15. PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Protocols for modifying monitoring programs are based on changes from historical conditions or changes in water quality that begin to approach or exceed regulatory limits.

15.1 ESTABLISHMENT OF PROTOCOLS FOR WATER QUALITY

Protocols for modifying monitoring programs are described in the 2017 Alternative.

SECTION 16. PROCESS TO EVALUATE NEW PROJECTS

When new projects are proposed within the South East Management Area, the agency proposing the project will be responsible for preparing a CEQA document to ensure alternatives have been evaluated and any significant and unreasonable results are mitigated. Plans to rehabilitate the well are currently going out for construction bid with potential construction expected to start in fall of 2022. The project may include facilities to remove high levels of iron and manganese as needed to meet potable water quality requirements.

There are a number of potential well projects currently in development in the South East Management Area. These include:

- LF-1 and LF-4 designated monitoring well operations.
- LF-2 rehabilitation and water quality treatment planned construction in 2022.
- LF-5 (replacement) future projects may include the possible development of a new production well on or near the existing decommissioned site.
- General well rehabilitation and monitoring projects across the South East Management Area, with approved funding allocated in the capital budgets approved for 2021-2023.

In IRWD’s Lake Forest portion of the South East Management Area, a 2002 study by Boyle Engineering Corporation and 2015 study by Dudek were performed in order to assess the potential for development of two future wells, LF-6 and LF-8, as well as the re-drilling of existing inactive wells. Although IRWD has no near-term plans to drill wells LF-6 and LF-8, it has included a capital project for the design, construction and equipping of LF-1.

A capital project for the design, construction and equipping of LF-1 has been included in IRWD’s most recent capital budget, however, there are no plans to begin this specific project. IRWD also has no near-term plans to drill wells LF-6 and LF-8. In 2000, its last active year, LF-1 pumped approximately 230 acre-feet. Over the last 5 years well LF-2 annual pumping has ranged from 0 acre-feet to 389 acre-feet and averaged approximately 90 acre-feet including years of non-operation. It is expected that when LF-1 is redrilled, groundwater production from IRWD’s southern portion of the South East Management Area could increase.

Water produced from LF-1 could be used to provide supply to the nearby lake which currently is supplied by untreated imported water. Water produced could also potentially be pumped and conveyed to the Baker Water Treatment Plant for treatment if needed (Dudek, 2015). Due to the consistently lower yields from the aquifer in this area, it is expected that additional production from LF-1 will continue to be considered supplemental, and therefore insignificant in terms of IRWD's overall water supply for its Lake Forest area. As of 2021, LF-1 is still currently off line although there are future plans to potentially re-drill and rehabilitate the well in the future.

SECTION 17. REFERENCES

Following are references and technical studies for the South East Management Area.

- Basin 8-1 Alternative, 2017
- Communication with OCWD. Email dated November 28, 2016.
- Communication with OCWD. Email dated October 21, 2021.
- Communication with OCWD. Email dated November 17, 2021.
- Geohydrology and Acritical-Recharge Potential of the Irvine Area Orange County, California. J. A. Singer, January 8,1973.
- Groundwater Supply Evaluation for the Los Alisos System Phase 1. Boyle Engineering Corporation, July 2002.
- Ground Water Management, Irvine Area, Orange County, California. Harvey O. Banks, Consulting Engineer, Inc.
- Lake Forest Groundwater Conveyance Analysis Results. Dudek, November 5, 2015.
- 2015 Urban Water Management Plan, Irvine Ranch Water District, 2016
- 2020 Urban Water Management Plan, Irvine Ranch Water District, 2021

Basin 8-1 Alternative

Santa Ana Canyon Management Area

2022 Update

Prepared by: Orange County Water District

January 1, 2021

Basin 8-1 Alternative

2022 Update

Santa Ana Canyon Management Area

Adam Hutchinson, P.G., C.Hg.

Recharge Planning Manager
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708

Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3),(c) and §10733.8

January 1, 2022

Table of Contents

Figure

Table

SECTION 1. EXECUTIVE SUMMARY

The Santa Ana Canyon Management Area covers the easternmost extent of the Department of Water Resources (DWR) Basin 8-1, Coastal Plain of Orange County Groundwater Basin (Basin). This Management Area was created for this Alternative (under 23 CCR 354.20) because of the unique characteristics of the Santa Ana Canyon and the appropriateness of developing different management objectives and strategies for this portion of the Basin. These different objectives and management approaches, as described in this Section, account for the significant differences in groundwater use, geology, aquifer characteristics, and other factors which distinguish Santa Ana Canyon from other portions of the Basin. Figure 1-1 shows the extent of the Santa Ana Canyon Management Area and the agencies with jurisdiction in the Santa Ana Canyon Management Area. Table 1-1 lists the agencies shown on Figure 1-1.

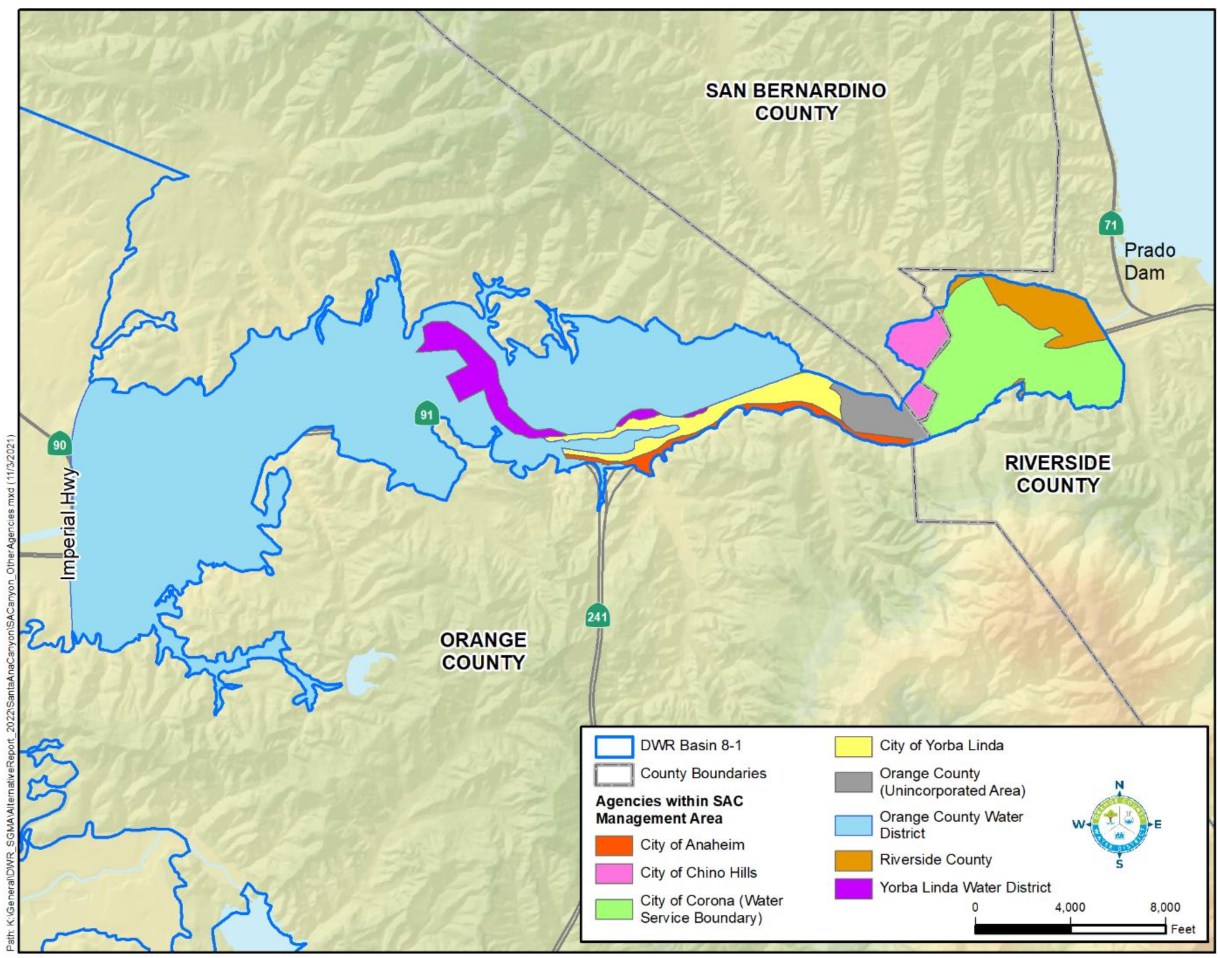


Figure 1-1: Agencies in the Santa Ana Canyon Management Area

The agencies within Basin 8-1 collaborated to prepare and submit an Alternative to a Groundwater Sustainability Plan (GSP). In accordance with Water Code §10733.6(b)(3), the Alternative presented an analysis of basin conditions that demonstrated that the Basin had operated within its sustainable yield over a period of at least 10 years. The Alternative was submitted to DWR on December 22, 2016. On July 17, 2019, DWR determined that the Alternative satisfied SGMA objectives and was therefore approved.

Agencies with approved alternatives are required to submit annual reports to DWR by April 1 of each year. Annual reports for Basin 8-1 were submitted to DWR as follows:

- Water Year 2016-17, submitted on March 29, 2018
- Water Year 2017-18, submitted on March 29, 2019
- Water Year 2018-19, submitted on March 30, 2020
- Water Year 2019-20, submitted on March 30, 2021

According to Water Code §10733.8, "At least every five years after initial submission of a plan pursuant to Section 10733.4, the department shall review any available groundwater sustainability plan or alternative submitted in accordance with Section 10733.6, and the implementation of the corresponding groundwater sustainability program for consistency with this part, including achieving the sustainability goal. The department shall issue an assessment for each basin for which a plan or alternative has been submitted in accordance with this chapter, with an emphasis on assessing progress in achieving the sustainability goal within the basin. The assessment may include recommended corrective actions to address any deficiencies identified by the department."

This document, called the 2022 Update, represents the first five-year update, which is due January 1, 2022.

For purposes of this report, the Basin 8-1 Alternative submitted on December 22, 2016, will be referred to as the 2017 Alternative. The first five-year update will be referred to as the 2022 Update for ease of reference. The 2017 Alternative was a comprehensive document showing that Basin 8-1 had been managed sustainably for more than 10 years. For the 2022 Update, the focus is on documenting that the basin has been sustainably managed during the five years since the 2017 Alternative was submitted and to present relevant new information from the last five years. As such, the 2017 Alternative is considered a key reference document with background information that is not duplicated in the 2022 Update.

The water resources in the Santa Ana Canyon Management Area include the Santa Ana River and limited groundwater. Groundwater is primarily located in a thin alluvial aquifer that is 90 to 100 feet thick and is a combination of infiltrated Santa Ana River water and subsurface inflow from the adjacent foothills. Groundwater produced from the alluvial aquifer is primarily used for irrigation, but some is also used for potable purposes. The volume of produced groundwater represents less than one percent of the total available water supply to the Santa Ana Canyon Management Area due to the significantly larger flow of the Santa Ana River as shown on Table 1-2. Even under projected dry conditions, groundwater production is expected to be less than four percent of the total available water supply (see 2017 Alternative, Santa Ana Canyon Management Area).

Table 1-1: Agencies in Santa Ana Canyon Management Area

Agency
City of Anaheim
City of Chino Hills
City of Yorba Linda
City of Corona
Orange County Water District
County of Orange
Riverside County
Yorba Linda Water District

Table 1-2: Water Budget, 5-Year Average (2016-21)

Flow Component	5-Yr Avg: 2016-21 (afy)
INFLOW	
Santa Ana River Base Flow	76,860
Santa Ana River Storm Flow	78,750
Subsurface Inflow	6,000
TOTAL INFLOW	**161,610**
OUTFLOW	
Santa Ana River Base Flow	76,120
Santa Ana River Storm Flow	78,750
Evapotranspiration	740
Groundwater Production	1,000
Subsurface Outflow	5,000
TOTAL OUTFLOW	**161,610**

Per the monitoring discussed in Section 5, groundwater levels in the Santa Ana Canyon Management Area are relatively stable, having been consistently 20 to 30 feet below ground surface since 1991, indicating that the supply of subsurface inflow and surface water from the Santa Ana River is more than sufficient to sustain local groundwater production. Groundwater quality is suitable for irrigation and potable uses. Native groundwater from the surrounding foothills tends to have naturally elevated total dissolved solids (TDS) and manganese concentrations. Most wells in the canyon appear to produce a blend of infiltrated Santa Ana River water and native groundwater, with some wells producing more infiltrated Santa Ana River water than others.

The Orange County Water District (OCWD) monitors Santa Ana River flow and quality as well as groundwater levels, quality, and production in the Santa Ana Canyon Management Area (see Section 5). Moreover, OCWD has a wide variety of water resource management programs that cover the OCWD Management Area as well as programs in the upper Santa Ana River watershed to address Santa Ana River flow and quality (see Section 6). These programs are important in protecting the quality of the Santa Ana River, which has a significant influence on the groundwater quality in the Santa Ana Canyon Management Area.

The approach to managing the Santa Ana Canyon Management Area is for OCWD, in cooperation with the County of Orange, to continue monitoring groundwater levels and quality to ensure that no significant and unreasonable undesirable results occur in the future, both in the Santa Ana Canyon portion of the Basin and in the other hydrologically connected portions of the Basin.

Due to the conditions documented within the Santa Ana Canyon Management Area, it will <u>not</u> be difficult to prevent conditions that could lead to significant and unreasonable undesirable results due to the low risk of increased groundwater production, little available developable land, and continued high flows of the Santa Ana River relative to the amount of groundwater production. A summary of the applicable undesirable results that must be prevented under SGMA is presented below. A more detailed description of these can be found in Sections 8 to 13.

1. **Water Levels:** Long-term reduction in groundwater levels in the Santa Ana Canyon Management Area are not expected given the high volume of Santa Ana River flow relative to the amount of groundwater production and the ability of the shallow alluvial aquifer to be recharged as a result of continuous and abundant surface flow in the Santa Ana Canyon; however, if an unforeseen long-term reduction in groundwater levels were to occur, water levels could reach a significant and unreasonable level if one or more of the following occurred as a result of reduced groundwater levels:
    a. Significant loss of riparian habitat along the Santa Ana River.
    b. Significant loss of well production capacity (in the Santa Ana Canyon Management Area).
    c. Degradation of water quality that significantly impacts the beneficial uses of groundwater.
2. **Storage:** As with groundwater levels, long-term reduction in groundwater storage in the Santa Ana Canyon Management Area is not projected to occur; however, an unforeseen decline in groundwater storage could reach a significant and unreasonable level if such a decline caused one or more of the following:
    a. Loss of significant riparian habitat along the Santa Ana River.
    b. Significant loss of well production capacity.
    c. Degradation of water quality that significantly impacts the beneficial uses of groundwater.
3. **Water Quality:** The significant and unreasonable degradation of water quality is defined as the degradation of groundwater quality in the Santa Ana Canyon Management Area that is attributable to groundwater production or recharge practices within the Santa Ana

Canyon Management Area that cause a significant volume of groundwater to become unusable for its designated beneficial uses.

4. **Seawater Intrusion:** This does not apply to the Santa Ana Canyon Management Area because this area if far removed from the coastline.
5. **Subsidence:** No vertical changes have been noted using DWR-supplied InSAR data. It is unlikely that this will occur in the Santa Ana Canyon Management Area due to:
    a. The presence of shale and sandstone bedrock underlying the alluvial aquifer.
    b. The alluvial aquifer is thin, generally less than 100 feet, and comprised mainly of sand and gravel with little clay.
    c. Groundwater levels and groundwater storage are stable.
    d. Very low risk of substantial groundwater level declines due to a de minimis amount of groundwater production relative to the overall inflow of water to the Santa Ana Canyon Management Area.
6. **Groundwater Depletions Impacting Surface Water:** Due to hydrogeologic conditions and land use limitations, groundwater production in the Santa Ana Canyon Management area has had and is projected to have a de minimis effect on groundwater conditions and flows of surface water through the canyon. Therefore, this factor does not apply to the Santa Ana Canyon Management Area.

SECTION 2. AGENCY INFORMATION

2.1 HISTORY OF AGENCIES IN SANTA ANA CANYON MANAGEMENT AREA

As shown on Figure 1-1, eight agencies have jurisdiction within the Santa Ana Canyon Management Area. The footprint of the various agencies within the Santa Ana Canyon Management Area has not changed since the 2017 Alternative. Table 1-1 lists the agencies and the approximate area covered by each.

The Santa Ana Canyon Management Area covers 2.6 percent of Basin 8-1, which has a total area of 223,600 acres or 350 mi^2.

2.2 GOVERNANCE AND MANAGEMENT STRUCTURE

There are currently no groundwater withdrawals or plans for withdrawals within the portions of the Santa Ana Canyon Management Area that are within the City of Anaheim, City of Chino Hills, City of Yorba Linda, Riverside County, and the Yorba Linda Water District. Key reasons for the lack of significant groundwater production are the lack of demands in these areas, the relatively high mineral content of groundwater in the Santa Ana Canyon Management Area, and lack of developable land due to land use limitations. In addition, there are no groundwater withdrawals or plans for withdrawals by the City of Corona. Although there are existing groundwater withdrawals within the Corona service area, the wells are owned and operated by the County of Orange for golf course irrigation. As mentioned above, Corona delivers water from sources outside of the Santa Ana Canyon Management Area.

Accordingly, no additional groundwater governance and management structure is needed for the areas in the Santa Ana Canyon Management Area beyond the existing monitoring program that OCWD already carries out in accordance with its authorities under the OCWD Act, in cooperation with the other jurisdictional agencies. The governance and management structure of OCWD is described in the OCWD Management Area part of this report. As will be shown later in this section, groundwater withdrawals by the County of Orange and private well owner within the Santa Ana Canyon Management Area are de minimis compared to the overall flow of water through the Santa Ana Canyon Management Area, and they are expected to remain at current sustainable levels. As a result, there is no need for other agencies to establish groundwater governance or management in the Santa Ana Canyon Management Area beyond the existing groundwater production, level and quality data collection and reporting to DWR by OCWD per SGMA requirements.

2.3 LEGAL AUTHORITY

The legal authority of OCWD is described in the OCWD Management Area part of this report. As described in the OCWD Management Area part of the report, OCWD has obtained water rights from the State Water Resources Control Board (SWRCB) to all of the flows in the Santa Ana River arriving at Prado Dam. As a result, any future groundwater production within the

Santa Ana Canyon Management Area would be reviewed by OCWD and the SWRCB to ensure it does not interfere with OCWD's existing water rights. Moreover, though outside of OCWD's boundaries, OCWD currently monitors portions of Santa Ana Canyon pursuant to its authority under Section 2, subparagraphs 5, 6, 7 and 14, of the OCWD Act.

The Orange County Well Ordinance (County Ordinance No. 2607) requires that a permit be obtained from Orange County prior to the construction or destruction of any well. In unincorporated areas and in 29 of 34 Orange County cities, the Orange County Health Officer is responsible for enforcement of the well ordinance. In the remaining five cities (Anaheim, Buena Park, Fountain Valley, Orange and San Clemente), well ordinances are enforced by city personnel. Any plans for wells in areas covered by Riverside and San Bernardino Counties would be reviewed by OCWD to ensure they did not interfere with OCWD's rights to Santa Ana River flows.

2.4 BUDGET

OCWD's costs for data collection within the Santa Ana Canyon Management Area are contained within OCWD's budget for data collection in the OCWD Management Area, which is presented in the OCWD Management Area portion of this report. The County of Orange is responsible for costs associated with collecting production data from wells used to irrigate the County-owned Green River Golf Course. The other agencies within the Santa Ana Canyon Management Area do not incur any additional data collection costs since no further monitoring other that already undertaken by OCWD, and Orange County is believed needed in order to prevent undesirable results from occurring. As a result, an estimated budget for other agencies has not been prepared for the Santa Ana Canyon Management Area due to the minimal nature of the effort to collect and report groundwater production, level and water quality data.

SECTION 3. MANAGEMENT AREA DESCRIPTION

3.1 SANTA ANA CANYON MANAGEMENT AREA

The Santa Ana Canyon is a narrow east-west trending canyon between the Santa Ana Mountains to the south and the Chino Hills to the north near the intersection of Orange, San Bernardino and Riverside Counties. As shown on Figure 3-1, a key feature is the Santa Ana River. Just upstream of the Santa Ana Canyon is Prado Dam, which was constructed by the US Army Corps of Engineers in 1941 to reduce flood risks to Orange County.

Detailed geologic information, including cross sections, is presented in the 2017 Alternative.

The Santa Ana Canyon Management Area covers the area of alluvial deposits in the Santa Ana Canyon east of Imperial Highway (Hwy 90), as shown on Figure 3-1. Imperial Highway was selected as the western boundary of the Santa Ana Canyon Management Area because this is where the groundwater basin transitions from a relatively thin alluvial aquifer to a deep multi-layered alluvial basin. Moreover, Imperial Highway is the approximate boundary of OCWD's groundwater flow model, allowing subsurface outflows from the entire Santa Ana Canyon Management Area to be readily quantified for purposes of the water budget and monitoring groundwater in storage.

Previously published reports indicated that the alluvial deposits in Santa Ana Canyon ranged from 90 to 100 feet thick (USGS, 1964). Cross-sections presented in the 2017 Alternative using more recent data showed that the thickness of the alluvial deposits in the Santa Ana Canyon are consistent with those reported by the USGS (1964).

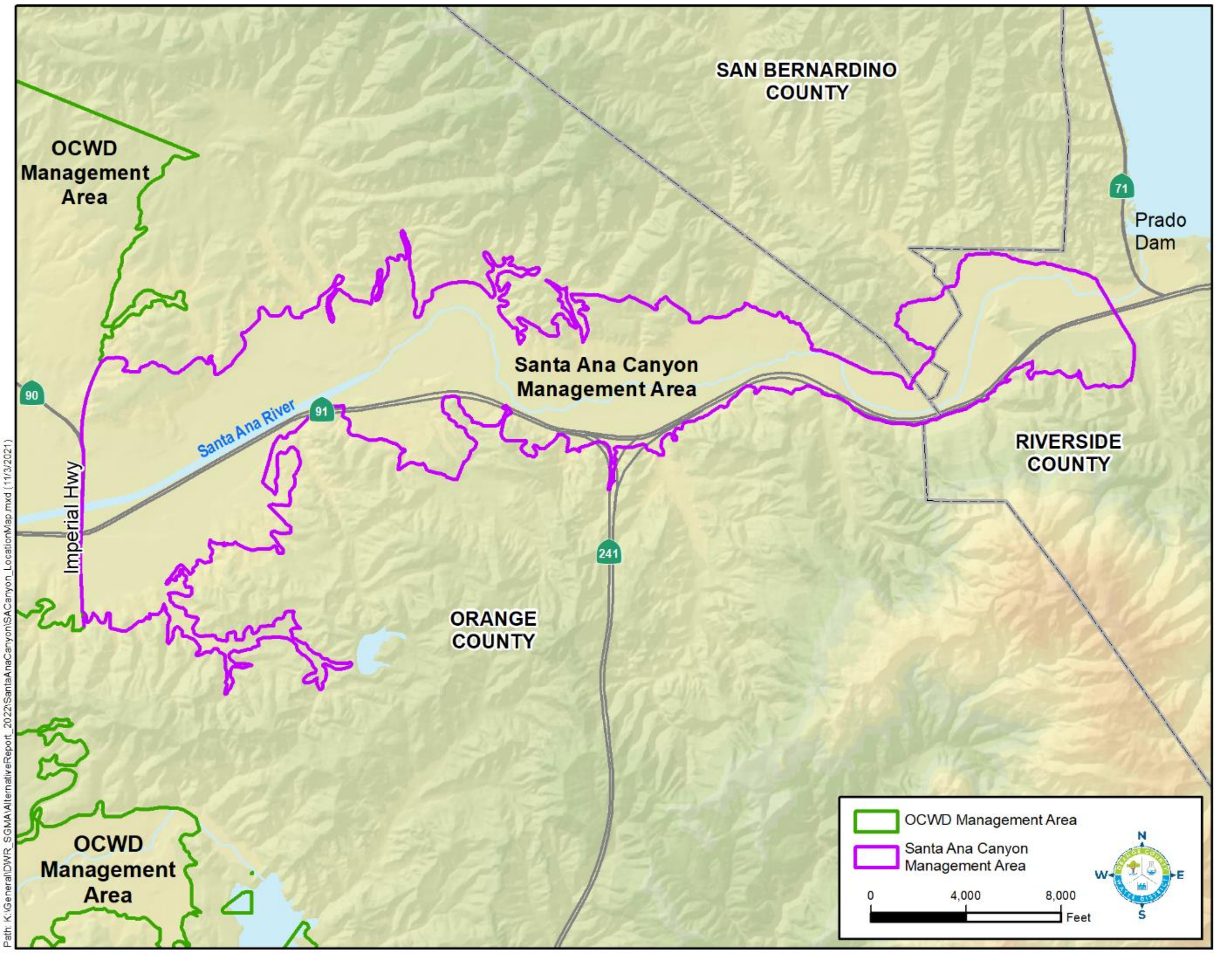


Figure 3-1: Boundary of Santa Ana Canyon Management Area

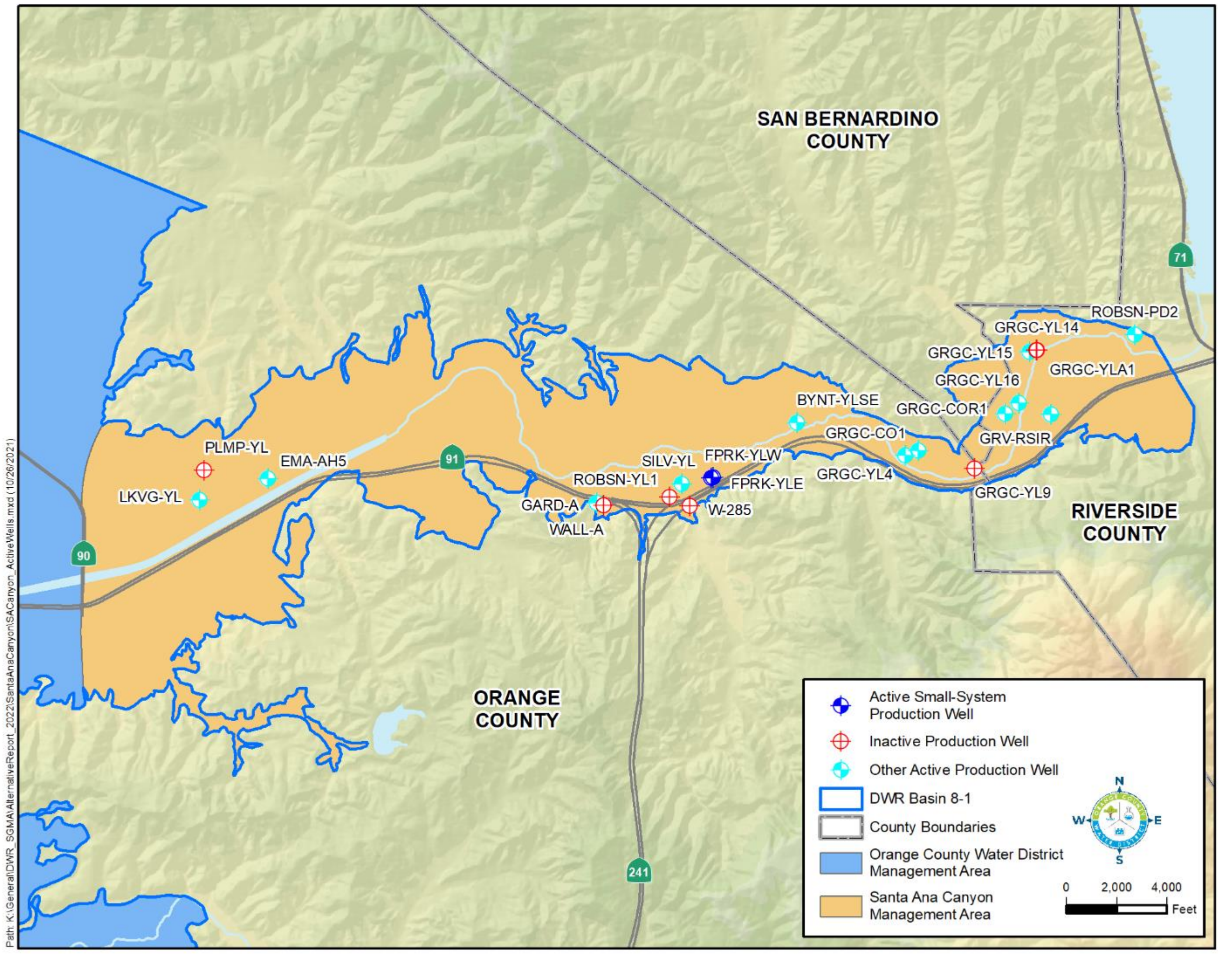


Figure 3-2: Groundwater Production Wells (Active and Inactive)

3.1.1 Jurisdictional Boundaries

As described in Section 2, there are eight agencies with jurisdiction in the Santa Ana Canyon Management Area as shown on Figure 2-1. The western boundary of the Santa Ana Canyon Management Area coincides with Imperial Highway and is within OCWD's jurisdiction.

3.1.2 Existing Land Use Designations

As described in the OCWD Management Area part of this report, much of the land use in Orange County is urban. The Santa Ana Canyon Management Area has some dedicated open-space due to the presence of the Santa Ana River and adjacent floodplain and the Chino Hills State Park, located in the far northeastern portion of the Santa Ana Canyon Management Area. The Green River Golf Club owned by the County of Orange covers approximately 220 acres along the river near the intersections of Orange, Riverside, and San Bernardino counties. Land use has remained essentially unchanged in the last five years.

3.2 GROUNDWATER CONDITIONS

Groundwater within the Santa Ana Canyon Management Area occurs in a narrow canyon within a relatively thin alluvial aquifer that is less than 100 feet thick in most places.

3.2.1 Groundwater Elevation

Groundwater elevations in the Santa Ana Canyon Management Area tend to be stable. Hydrographs from four wells show that water levels vary over a narrow range as shown on Figure 3-3. Well locations are shown on Figure 3-2 and cover the eastern (GRV-RSIR), south-central (FPRK-YLE/SILV-YL), and western (SCE-YLCS, EMA-AH5) areas of the Santa Ana Canyon Management Area.

Maximum water level elevations in many wells were recorded in 2004, which was a record-breaking wet year with very high sustained flows in the Santa Ana River. Low water levels appear to be primarily related to short-term local pumping. In the vicinity of all the wells, groundwater is approximately 20 to 30 feet below ground surface. Since the Santa Ana River channel is incised in some areas by 10 to 15 feet below the surrounding area, the depth to groundwater is even shallower directly beneath the river channel where it is not covered by the river itself.

The consistent, stable nature of groundwater elevations in the Santa Ana Canyon Management Area shows that the aquifer is generally full and at equilibrium, which is consistent with the finding that here are no measurable losses of flows between Prado Dam upstream and OCWD's diversion to its recharge system just below Imperial Highway.

Within the last five years, OCWD, in cooperation with the County of Orange, began collecting groundwater elevation data at selected wells at the Green River Golf Course to complement existing groundwater elevation monitoring data. Note that wells SILV-YL and SCE-YLCS were formerly monitored for the CASGEM program. Well SCE-YLCS was destroyed and replaced by well EMA-AH5. As a result, water level data from SILV-YL and EMA-AH5 will be included in annual reports required to comply with SGMA.

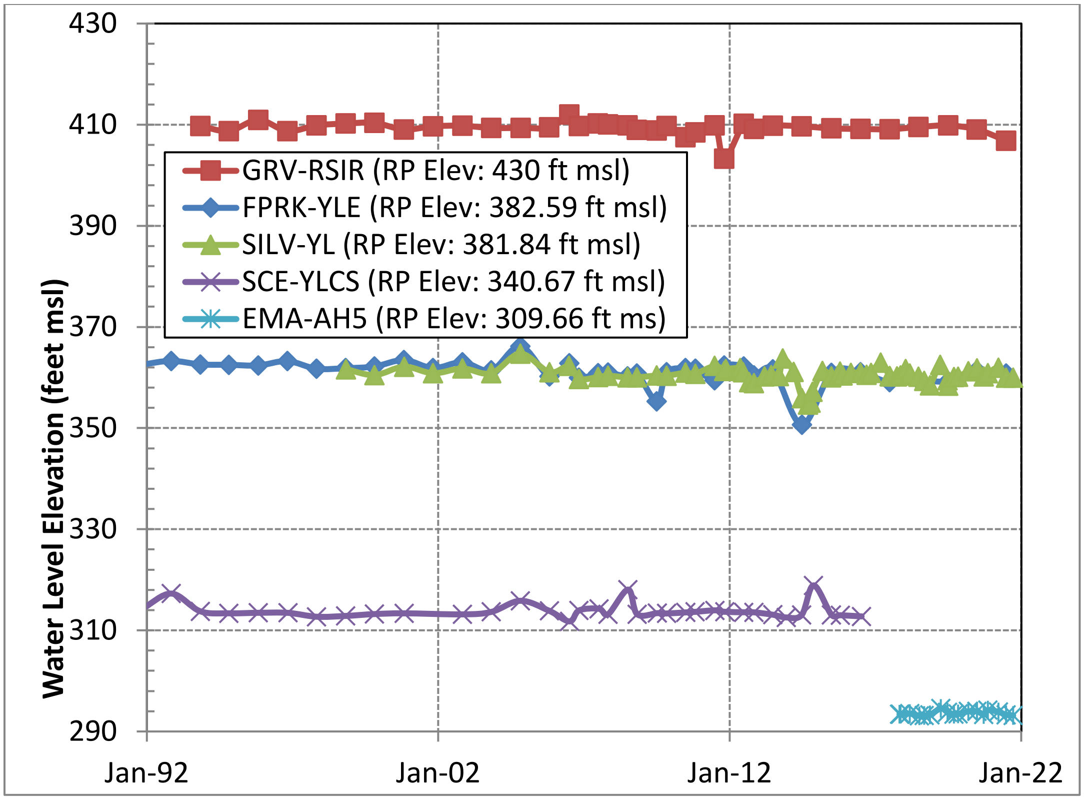


Figure 3-3: Water Level Hydrographs of Selected Wells

3.2.2 Groundwater Beneficial Uses and Regional Pumping Patterns

The Santa Ana Canyon Management Area is within the Santa Ana Region of the California Water Boards and is subject to the Santa Ana Region Basin Plan (January 24, 2014; updated July 2014). The Basin Plan designates zones related to groundwater management. The Santa Ana Canyon Management Area is included in the Orange County Management Zone. Within this Zone, groundwater has been designated for municipal, agricultural, and industrial (service supply and process) beneficial uses. Currently, local groundwater provides primarily irrigation supply with some residential drinking water (RV Park) and domestic uses.

There are 18 wells that can withdraw groundwater within the Santa Ana Canyon Management Area as shown on Figure 3-2; however, some of the wells shown are not currently being used (e.g., inactive). At the time the 2017 Alternative was prepared, some wells, namely those owned by the County of Orange to supply irrigation water to the Green River Golf Course, were not metered. OCWD worked with the County of Orange to have all their wells metered and production reported to OCWD. Prior estimates of pumping before meters were installed was on the order of 1,000 acre-feet per year (Personal Communication, Merrie Weinstock, County of Orange). Data collected in recent years shows that total production is less, averaging just over 600 acre-feet per year.

As shown on Table 3-1, total groundwater production within the Santa Ana Canyon Management Area over the last 5 years has averaged just over 1,000 acre-feet per year. Table

3-1 lists the production wells, meter status, and 5-year average production for wells located within the Santa Ana Canyon Management Area.

Table 3-1: Production Wells, Flow-Meter Status, and 5-Year Average Production

Well Name	Well Use	Owner	Metered	Production 5-Yr Avg 2016-21 (afy)*	Notes
BYNT-YLSE	IR	Neff Ranch, Ltd	Yes	69.8	
EMA-AH5	IR	County Of Orange	Yes	118.2	SGMA monitoring well.
FPRK-YLE	DW/IR	Canyon RV Park	Yes	79.5	
FPRK-YLW	DW/IR	Canyon RV Park	Yes	36.9	
GARD-A	IR	Kindred Outreach Ministries	Yes	1	
GRGC-CO1	IR	OCFCD	Yes	82.2	Monthly metering started Jan. 2019. Avg based on Jan. 2019-June 2021.
GRGC-COR1	IR	OCFCD	Yes	295.0	Monthly metering started Jan. 2019. Avg based on Jan. 2019-June 2021
GRGC-YL14	IR	OCFCD	Yes		Inactive
GRGC-YL15	IR	OCFCD	No		Inactive, only used for emergencies.
GRGC-YL16	IR	OCFCD	Yes	161.0	Monthly metering started Jan. 2019. Avg based on Jan. 2019-June 2021
GRGC-YL4	IR	OCFCD	Yes	75.5	Monthly metering started Jan. 2019. Avg based on Jan. 2019-June 2021
GRGC-YL9	IR	OCFCD	Yes		Inactive
GRGC-YLA1	IR	OCFCD	Yes		Inactive
GRV-RSIR	IR	Green River Village	Yes	6.2	
LKVG-YL	IR	Eastlake Village HOA	Yes	70.8	
ROBSN-PD2	IR	Robertson Ready Mix	Yes	5.4	Monthly metering started Jan. 2018. Avg based on Jan. 2018-June 2021
ROBSN-YL1	IR	Robertson Ready Mix	Yes		Inactive
WALL-A	DOM	Kindred Outreach Ministries	No		Inactive
			Total	**1,007**	

*Five-year average except where noted.
IR= Irrigation; DW=Drinking Water; DOM=Domestic
OCFCD = Orange County Flood Control District

3.2.3 Groundwater Storage Data

Groundwater storage in Basin 8-1 is estimated at 66 million acre-feet (OCWD, 2007), which does not include the Santa Ana Canyon Management Area. To estimate the amount of storage in the alluvial aquifer within Santa Ana Canyon Management Area, all well data were used and depths to bedrock estimated. The thickness of the alluvial deposits is assumed to be zero at the basin margin. Using a Topo to Raster Interpolation function in ArcGIS, the total volume of alluvial deposits was estimated at 174,000 acre-feet. Assuming a porosity of 25 percent gives a total potential groundwater storage volume of 43,500 acre-feet. The actual volume of groundwater in storage is smaller given that this estimate does not take into account that the depth to groundwater is typically 20 to 30 feet below ground surface.

3.2.4 Groundwater Quality Conditions

Groundwater quality in the Santa Ana Canyon Management Area is generally good and suitable to meet beneficial uses. Groundwater in the Santa Ana Canyon Management Area is a mixture of infiltrated Santa Ana River water and subsurface inflow. Detailed water quality information is presented in the 2017 Alternative. No substantive changes in groundwater quality have occurred within the last five years.

3.2.5 Land Subsidence

Land subsidence measurements derived from InSAR data provided by DWR show that land displacement in the Santa Ana Canyon Management Area from June 2015 to July 2020 is within the accuracy of the method (0 to 0.05 ft). This is not surprising given the following:

1. The presence of shale and sandstone bedrock underlying the alluvial aquifer is not thought to be sufficiently compressible to cause inelastic subsidence.
2. The alluvial aquifer is thin, generally less than 100 feet, and composed mainly of sand and gravel with only minor amounts of clay.
3. Groundwater levels and storage volumes have not changed significantly over the last five years.

3.2.6 Groundwater and Surface Water Interactions and Groundwater Dependent Ecosystems

Groundwater within the Santa Ana Canyon alluvial aquifer is consistently 20 to 30 feet below ground surface and even shallower in the incised portions of the Santa Ana River channel. As described in Section 4, Water Budget, the flow of surface water through the canyon dwarfs the documented groundwater production. As a result, groundwater production has a de minimis impact on groundwater conditions and flows of surface water through the canyon. This in turn demonstrates that groundwater production in the Santa Ana Canyon has little to no impact on local groundwater dependent ecosystems in the Santa Ana Canyon Management Area.

SECTION 4. WATER BUDGET

The water budget of the Santa Ana Canyon Management Area is dominated by surface flows of the Santa Ana River with a minor contribution of subsurface inflow, return flows from irrigation, and a small amount of groundwater production. Table 1-2 presents the water budget for the Santa Ana Canyon Management Area for the last five years. Additional water budget information was presented in the 2017 Alternative. The water budget contains both surface water and groundwater components and is not used to analyze change in groundwater storage. The purpose of presenting this water budget is to show the relative contributions of different sources in the Santa Ana Canyon Management Area.

Groundwater level data suggest that groundwater conditions in the Santa Ana Canyon Management Area are essentially at steady state conditions with inflow equaling outflow and no change in groundwater storage. Inflow to the shallow alluvial aquifer includes subsurface inflow and infiltrated Santa Ana River water. Outflow includes evapotranspiration, groundwater production and subsurface outflow. Table 4-1 presents the groundwater budget for the Santa Ana Canyon Management Area.

Table 4-1: Groundwater Budget, 5-Year Average (2016-21)

Flow Component	5-Yr Avg: 2016-21 (afy)
INFLOW	
Subsurface Inflow (1)	6,000
Infiltrated Santa Ana River Flow (2)	740
TOTAL INFLOW	**6,740**
OUTFLOW	
Evapotranspiration (3)	740
Groundwater Production	1,000
Subsurface Outflow to OCWD Management Area (4)	5,000
TOTAL OUTFLOW	**6,740**
NET CHANGE	0

(1) Subsurface inflow is estimated and includes irrigation return flow and areal recharge from precipitation.
(2) Estimated infiltration of Santa Ana River flow to balance outflow.
(3) Evapotranspiration is based on 370 acres of riparian habitat and a usage rate of 2 afy/acre of habitat per Santa Ana River Watermaster Reports.
(4) Subsurface outflow is based on OCWD's calibrated groundwater flow model.

4.1 BUDGET COMPONENTS

The components of the groundwater budget are described below.

4.1.1 Subsurface Inflow/Outflow

In the 2017 Alternative, the estimated subsurface outflow was 4,000 acre-feet per year based on the steady state groundwater flow model. More recent transient groundwater flow modeling using the period 1999 to 2017, showed that average outflow from the Santa Ana Canyon to the main basin to be approximately 5,000 acre-feet per year. As a result, the water budget tables have been updated accordingly.

Subsurface inflow is a combination of subsurface mountain front recharge, areal recharge from precipitation, and irrigation return flow. It is estimated to be approximately 6,000 acre-feet per year.

4.1.2 Infiltrated Santa Ana River Flow

Water quality data suggests that some of the groundwater produced from wells in the Santa Ana Canyon Management Area is a blend of subsurface inflow and infiltrated Santa Ana River water; however, there is not enough data to determine the relative contribution of each source. For purposes of the groundwater budget, the amount of infiltrated Santa Ana River flow is the amount necessary to balance the water budget assuming subsurface inflow is 6,000 acre-feet per year. If the assumed amount of subsurface inflow were to change, the amount of infiltrated Santa Ana River water needed to balance the water budget would change accordingly.

Evapotranspiration

Evapotranspiration is assumed to be due to riparian vegetation adjacent to the Santa Ana River. The County of Orange, as part of developing a Habitat Management Plan (HMP), established a baseline of 370 acres of riparian vegetation within the Santa Ana Canyon Management Area (County of Orange, 2016).

The Santa Ana River Watermaster reports that riparian vegetation consumes approximately 2 acre-feet per year per acre of vegetated area. Using this approach, the estimated evapotranspiration within the Santa Ana Canyon Management area is estimated to be 740 acre-feet per year.

4.1.3 Groundwater Production

As described in Section 3.2.2, there are 18 wells that can withdraw groundwater within the Santa Ana Canyon Management Area (Figure 3-2); however, some of the wells shown are not currently being used (e.g., inactive). Groundwater production from these wells is summarized in Table 3-1.

4.2 CHANGES IN GROUNDWATER STORAGE

As shown in Figure 3-3, groundwater levels in the Santa Ana Canyon Management Area are stable, indicating that the thin, alluvial aquifer is generally always in a near-full equilibrium condition. Therefore, any changes in groundwater storage are small and insignificant.

4.3 WATER YEAR TYPE

The water year type has little impact on the water budget in the Santa Ana Canyon Management Area given the minimal changes in groundwater level observed through time due to the ever-present Santa Ana River flow and subsurface inflow. Water budgets for wet and dry year water types are presented in the 2017 Alternative.

4.4 ESTIMATE OF SUSTAINABLE YIELD

As described in Table 4-1, average groundwater production over the last five years is less than one percent of the total inflow to the Santa Ana Canyon Management Area. This condition is the same as what was presented in the 2017 Alternative. It is clear the sustainable yield of the Santa Ana Canyon Management Area is much greater than current production levels. Nevertheless, there are no plans for additional wells or groundwater production in the Santa Ana Canyon Management Area, and it is highly unlikely that groundwater demands would rise to the level of changing the water budget of this area significantly. In terms of sustainable yield, it is more appropriate to look at Basin 8-1 as a whole.

4.5 CURRENT, HISTORICAL, AND PROJECTED WATER BUDGET

Current water budgets are presented in presented in Tables 4-1 and 4-2. Historical and projected water budgets, including Dry and Wet Year Water Budgets, are presented in the 2017 Alternative.

SECTION 5. WATER RESOURCE MONITORING PROGRAMS

5.1 OVERVIEW

This section describes OCWD's surface water and groundwater monitoring programs in the Santa Ana Canyon Management Area.

5.2 GROUNDWATER MONITORING PROGRAMS

OCWD monitors groundwater levels, quality and production in the Santa Ana Canyon Management Area. As shown on Figure 5-1, groundwater levels are monitored at six wells. Within the last five years, well SCE-YLCS was destroyed and replaced in the monitoring network by well EMA-AH5. Water level data from wells SILV-YL and EMA-AH5 will be reported annually to DWR in compliance with SGMA. In addition, OCWD worked with the County of Orange to install meters on wells used to supply Green River Golf Course and to begin collecting and reporting production data. Data provided in this report utilizes metered data for all wells that pump groundwater in the Santa Ana Canyon Management area.

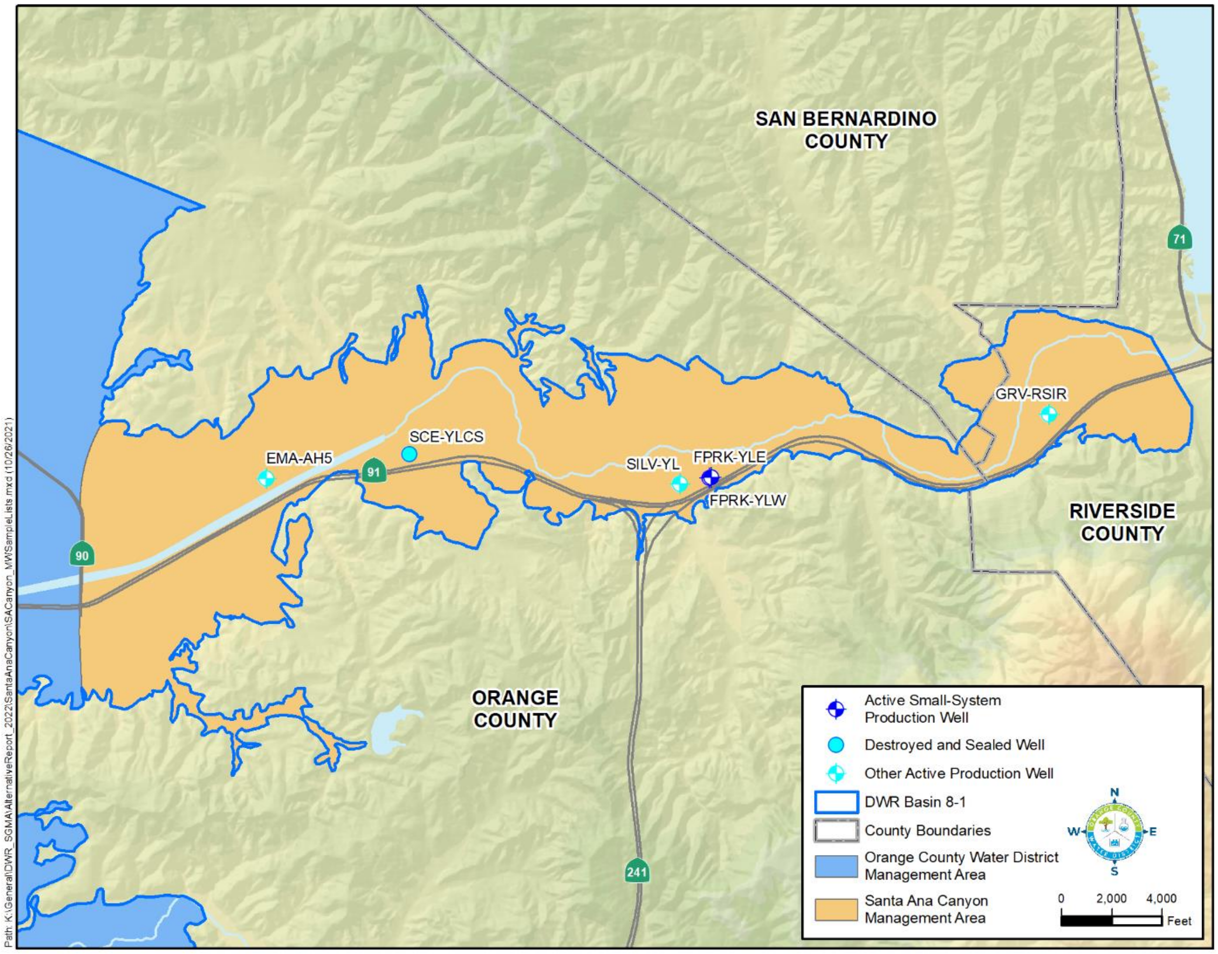


Figure 5-1: Wells Used to Monitor Groundwater Levels

For wells within OCWD's boundaries, groundwater production must be reported at a minimum frequency of every 6 months. Groundwater production volumes from the County of Orange's wells that supply the Green River Golf Course are now being collected monthly.

OCWD also monitors groundwater quality in selected wells in the Santa Ana Canyon Management Area. Table 5-1 lists the wells monitored and the groundwater quality monitoring program each well is part of, which is based on its use (e.g., irrigation, potable). Wells used for irrigation are sampled every year for volatile organic compounds (VOCs) and every three years for general minerals (major cations and anions), 1,4-dioxane, and perchlorate (ClO_4). The two wells in Featherly Park used for potable supplies are monitored in accordance with drinking water regulations.

Table 5-1: Wells Monitored for Water Quality

Well Name	Water Quality Monitoring Program
IRRIGATION WELLS BYNT-YLSE EMA-AH5 GARD-A GRGC-CO1 GRGC-COR1 GRGC-YL15 GRGC-YL16 GRGC-YL4 GRV-RSIR LKVG-YL ROBSN-PD2	Annual: Volatile Organic Compounds (VOCs) Every 3 yrs: General Minerals, 1,4-Dioxane, and ClO_4
POTABLE USE WELLS FPRK-YLE FPRK-YLW	Annual: NO_3, ClO_4, 1,4-Dioxane, Mn, TDS, EC Atrazine/Simazine: every 3 yrs Title 22 Inorganics: every 3 yrs CN: every 9 yrs CrIV: every 3 yrs Radioactivity: every 6 yrs (Gross Alpha, Uranium) Radioactivity: every 9 yrs (Radium 226 & Radium 228)

5.3 OTHER MONITORING PROGRAMS

OCWD monitors the quantity and quality of water in the Santa Ana River just below Prado Dam. The flow of the Santa Ana River below Prado Dam is measured by the United States Geological Survey (USGS) at station No. 11074000 (http://waterdata.usgs.gov/ca/nwis/dv/?site_no=11074000). In addition to flow, the USGS measures the electrical conductivity (EC) of the water as well as sampling the water two times per month for TDS. One use of these data is to calculate the flow-weighted average TDS of base and storm flow discharged from Prado Dam. The flow and quality data are collected for the Santa Ana River Watermaster, which was formed to implement the Stipulated Judgement in the case of Orange County Water District v. City of Chino, et al., Case No. 1172628-County of Orange, entered by the court on April 17, 1969. Copies of the watermaster reports can be found on OCWD's website at http://www.ocwd.com. In addition to OCWD, the Santa Ana River Watermaster is comprised of representatives from the Inland Empire Utilities Agency, San Bernardino Valley Municipal Water District, and Western Municipal Water District.

The significance of the 1969 Judgment is that it guarantees a minimum base flow at Prado Dam of 42,000 acre-feet per year; however, per the terms of the Judgment, the upstream agencies have received (and will continue to receive) credits when base flows exceed of 42,000 acre-feet at Prado. With these cumulative credits, the required minimum base flow is 34,000 acre-feet. As a point of reference, the base flow in Water Year 2020-21 was estimated to be 76,000 acre-feet (Note that this is an OCWD estimate to be finalized in a future SAR Watermaster Report).

OCWD also closely monitors the quality of water in the Santa Ana River before it is diverted into OCWD's recharge system below Imperial Highway. More information about this program can be found in Section 5 of the OCWD Management Area section of this report.

SECTION 6. WATER RESOURCE MANAGEMENT PROGRAMS

OCWD has a wide variety of water resource management programs that cover the main groundwater basin as well as the upper Santa Ana River watershed to address Santa Ana River flow and quality. These programs are important in protecting the quality of the Santa Ana River, which affects groundwater quality in the Santa Ana Canyon Management Area. These programs are described in detail in Section 6 of the OCWD Management Area part of the 2017 Alternative.

SECTION 7. NOTICE AND COMMUNICATION

There are eight stakeholder agencies within the Santa Ana Canyon Management Area, including the following:

- City of Anaheim
- City of Chino Hills
- City of Yorba Linda
- City of Corona
- Orange County Water District
- County of Orange
- Riverside County
- Yorba Linda Water District

On September 30, 2021, OCWD sent a letter via email to all of the Basin 8-1 agencies, including each of the agencies listed above to let them know that the 2017 Alternative was being updated and would be available for review and comment. No comments were received by any of the agencies contacted.

A draft of the 2022 Update was presented to the OCWD Board and posted on the OCWD website on November 18, 2021, to allow for public review and comment. The final 2022 Update was presented to the OCWD Board on December 15, 2021. At this board meeting, a resolution was adopted to support the submission of the 2022 Update to DWR.

SECTION 8. SUSTAINABLE MANAGEMENT APPROACH

The approach to sustainably managing the Santa Ana Canyon Management Area is to continue monitoring conditions to ensure that no significant and unreasonable results occur in the future.

SECTION 9. SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER LEVELS

9.1 HISTORY

As shown on Figure 3-3, groundwater levels in the Santa Ana Canyon Management Area have been steady over the last 20 years. Given the large amount of surface inflow to the Santa Ana Canyon Management Area relative to the amount of groundwater production, groundwater levels are expected to remain steady in the future.

9.2 MONITORING OF GROUNDWATER LEVELS

OCWD monitors groundwater levels at multiple wells in the Santa Ana Canyon Management Area and will continue to do so in the future.

Within the last five years, several wells at the Green River Golf Course were added to the OCWD monitoring network and destroyed well SCE-YLCS was replaced in the network by well EMA-AH5.

9.3 DEFINITION OF SIGNIFICANT AND UNREASONABLE LOWERING OF GROUNDWATER LEVELS

No long-term reduction in groundwater levels is foreseen in the Santa Ana Canyon Management Area; however, if that were to occur, a decline in groundwater levels could reach a significant and unreasonable level if one more of the following occurred as a result of reduced groundwater levels:

1. Significant and unreasonable loss of riparian habitat along the Santa Ana River.
2. Significant and unreasonable loss of well production capacity.
3. Degradation of water quality that significantly impacts the beneficial uses of groundwater.

9.4 DETERMINATION OF MINIMUM THRESHOLDS

It is not possible to determine a minimum threshold at this time since no undesirable effects due to water levels have occurred in the past and are not foreseen. Nevertheless, OCWD's monitoring program continuously tracks water levels and groundwater quality in the Management Area. If water levels started to show a consistent long-term decline, OCWD's monitoring program would be expanded to examine potential impacts to riparian habitat, well yields, and groundwater quality. If impacts were observed, action would be taken, and minimum thresholds would be evaluated and established as appropriate.

SECTION 10. SUSTAINABLE MANAGEMENT RELATED TO BASIN STORAGE

The total volume of groundwater storage in the OCWD Basin is estimated to be 66 million acre-feet (OCWD, 2007). The total potential storage volume in the Santa Ana Canyon Management Area is estimated to be 43,500 acre-feet, as described in Section 3.2.3.

10.1 DEFINITION OF SIGNIFICANT AND UNREASONABLE REDUCTION IN STORAGE

As with groundwater levels, no long-term reduction in groundwater storage is foreseen in the Santa Ana Canyon Management Area; however, if that were to occur, a decline in groundwater storage could reach a significant and unreasonable level if one more of the following occurred due to a reduction in storage:

1. Significant and unreasonable loss of riparian habitat along the Santa Ana River.
2. Significant and unreasonable loss of well production capacity.
3. Degradation of water quality that significantly impacts the beneficial uses of groundwater.

10.2 DETERMINATION OF MINIMUM THRESHOLDS

It is not possible to determine a minimum threshold at this time since no undesirable effects due to a change in groundwater storage levels have occurred in the past and are not foreseen in the future. Nevertheless, OCWD's monitoring program continuously tracks water levels, which is a proxy for groundwater storage, and groundwater quality in the Management Area. If water levels showed a consistent long-term decline, OCWD's monitoring program would be expanded to examine potential impacts to riparian habitat, well yields and groundwater quality. If impacts were observed, action would be taken, and minimum thresholds would be evaluated and established as appropriate.

SECTION 11. SUSTAINABLE MANAGEMENT RELATED TO BASIN WATER QUALITY

Groundwater quality in the Santa Ana Canyon Management Area is affected by the quality of Santa Ana River water and subsurface inflow from the surrounding foothills. As mentioned in Section 6, Water Resource Programs, OCWD is involved in multiple programs to protect and improve the quality of water in the Santa Ana River. Groundwater from subsurface inflow contains naturally elevated concentrations of TDS and manganese.

OCWD has an extensive groundwater monitoring program in the Santa Ana Canyon Management Area as described in Section 5, Water Resource Monitoring Programs.

11.1 DEFINITION OF SIGNIFICANT AND UNREASONABLE DEGRADATION OF WATER QUALITY

There are three elements that must be considered when evaluating the impact of groundwater quality degradation.

The first element is considering the causal nexus between local groundwater management activities and groundwater quality. For example, if subsurface inflow from the surrounding foothills increases during a wet period, TDS and manganese levels could increase; however, this increase is not caused by groundwater management activities, but by natural events. A similar situation applies to the quality of Santa Ana River water. Although OCWD is involved in many programs to protect and improve the quality of Santa Ana River water, there could be changes in water quality that are outside of the control of Santa Ana Canyon Management Area stakeholders.

The second element to consider is if the beneficial uses of the groundwater have been negatively affected and/or if water quality regulations, such as Maximum Contaminant Levels (MCLs) and other potable water quality requirements have been exceeded.

The third element that must be considered is the volume of groundwater impacted by groundwater quality degradation. If small volumes are negatively affected yet do not materially affect the use of the aquifer for its existing beneficial uses, then this would not represent a significant and unreasonable degradation of water quality. However, if the impacted volume grows, then it could reach a level that it becomes significant and unreasonable.

When considering all three elements, “significant and unreasonable degradation of water quality” is defined as degradation of groundwater quality in the Santa Ana Canyon Management Area that is attributable to groundwater production or recharge practices within the Santa Ana Canyon Management Area and to the extent that a significant volume of groundwater becomes unusable for its designated beneficial uses.

11.2 DETERMINATION OF MINIMUM THRESHOLDS

The minimum thresholds for groundwater quality are exceedances of Maximum Contaminant Levels (MCLs) or other applicable regulatory limits that are directly attributable to groundwater production and recharge practices in the Santa Ana Canyon Management Area that prevents the use of groundwater for its designated beneficial uses.

SECTION 12. SUSTAINABLE MANAGEMENT RELATED TO SEAWATER INTRUSION

The Santa Ana Canyon Management Area is located far from the ocean and thus there is no reason to consider the potential impact of seawater intrusion in this management area.

SECTION 13. SUSTAINABLE MANAGEMENT RELATED TO LAND SUBSIDENCE

Recently, as part of DWR's SGMA technical assistance to provide important SGMA-relevant data to Groundwater Sustainability Agency's (GSAs) for Groundwater Sustainability Plan (GSP) development and implementation, DWR contracted with TRE ALTAMIRA, Inc. to provide vertical displacement estimates are derived from InSAR data that are collected by the European Space Agency (ESA) Sentinel-1A satellite.

This dataset represents measurements of vertical ground surface displacement in more than 200 of the high-use and populated groundwater basins across the State of California between January of 2015 and October of 2020. InSAR data coverage began in late 2014 for parts of California, and coverage for the entire study area began on June 13, 2015. Included in this dataset are point data that represent average vertical displacement values for 100 square meter areas, as well as GIS rasters that were interpolated from the point data; rasters for total vertical displacement relative to June 13, 2015, and rasters for annual vertical displacement rates with earlier coverage for some areas, both in monthly time steps. The level of accuracy is approximately 0.05 feet.

To show subsidence in Basin 8-1, OCWD used the used a layer showing the total land subsidence since the start of the InSAR data on 6/13/2015 and ending on 7/1/2020, which corresponds to the end of the OCWD water year. The GIS layer used was: https://gis.water.ca.gov/arcgisimg/rest/services/SAR/Vertical_Displacement_TRE_ALTAMIRA_v2020_Total_Since_20150613_20200701/ImageServer

Figure 13-1 shows the total land displacement in Basin 8-1 from June 2015 to July 2020. In the Santa Ana Canyon Management Area, vertical displacement is essentially unchanged and within the accuracy of the method (0 to 0.05 ft). This is not surprising given the following:

- The presence of shale and sandstone bedrock underlying the alluvial aquifer is not thought to be sufficiently compressible to cause inelastic subsidence.
- The alluvial aquifer is thin, generally less than 100 feet, and composed mainly of sand and gravel with only minor amounts of clay.
- Groundwater levels and storage volumes are stable.
- Substantial groundwater level declines are highly unlikely due to the de minimis amount of groundwater production relative to the overall inflow of water to the Santa Ana Canyon Management Area.

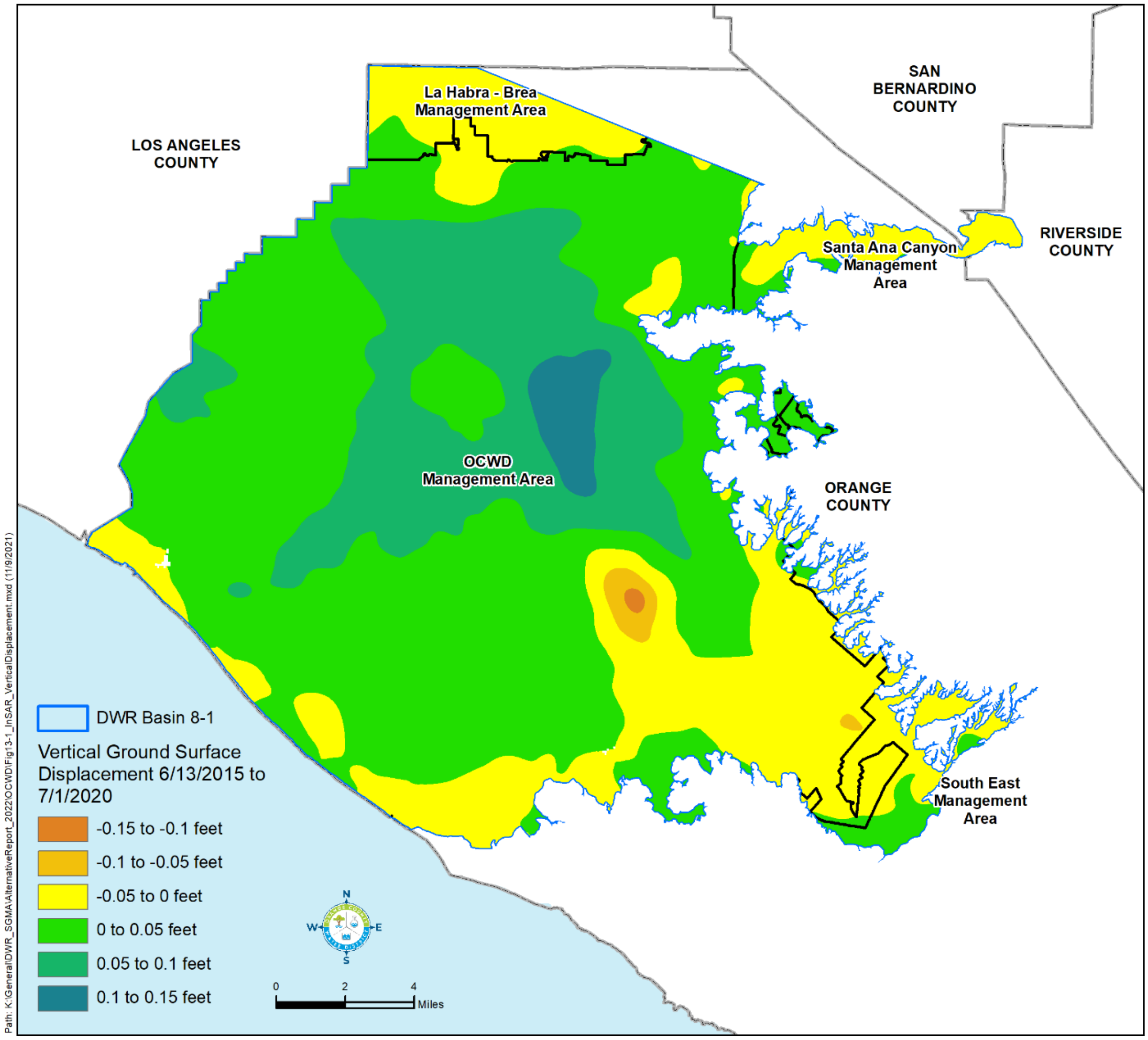


Figure 13-1: Total Vertical Ground Surface Displacement from June 2015 to July 2020

SECTION 14. MANAGING GROUNDWATER DEPLETIONS IMPACTING SURFACE WATER

The primary surface water feature in the Santa Ana Canyon Management Area is the Santa Ana River. In the Santa Ana Canyon Management Area, the Santa Ana River is a soft-bottomed channel that supports riparian habitat. Riparian habitat is dependent on river water released through Prado Dam, which is predominantly treated wastewater discharged in the upper watershed when storm flow is not present.

Groundwater within the Santa Ana Canyon alluvial aquifer is consistently 20 to 30 feet below ground surface and even shallower in the incised portions of the Santa Ana River channel. As described in Section 4, Water Budget, the flow of surface water through the canyon is two orders of magnitude larger than groundwater production. As a result, groundwater production has a de minimis impact on groundwater conditions and the flows of surface water through the canyon. This, in turn, means that groundwater production in the Santa Ana Canyon has a de minimis impact on the groundwater dependent ecosystems in the Santa Ana Canyon Management Area. Therefore, the undesirable result of “depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water due to groundwater conditions occurring throughout the basin” does not apply.

SECTION 15. PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Protocols for modifying monitoring programs are described in the 2017 Alternative.

SECTION 16. PROCESS TO EVALUATE NEW PROJECTS

For projects within OCWD, the process described in the OCWD Management Area part of this report applies. If new projects are proposed by others outside of OCWD's boundaries, OCWD would collaborate with the agency proposing the project to ensure that any proposed project would not cause significant and unreasonable results. Moreover, OCWD would review proposed projects through the CEQA process (i.e., reviewing and commenting on draft CEQA documents).

SECTION 17. REFERENCES

County of Orange, 2016. County of Orange, Santa Ana River Canyon and Brush Canyon Habitat Management Areas, 2016 Annual Monitoring Report, June 2016.

OCWD, 2007. Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy, February 2007.

USGS, 1964. Geology and Oil Resources of the Eastern Puente Hills Area, Southern California. By D.L. Durham and R.F. Yerkes. USGS Professional Paper 420-B.

Attachment 1

Department of Water Resources (DWR) Comments on 2017 Alternative and Responses

Responses to DWR Comments on Alternative Plan

This section provides comments to DWR's Alternative Assessment Staff report, dated July 17, 2019. In addition, responses are provided for the four suggested recommended actions listed in the staff report (Section IV, B).

OCWD Comments on DWR Alternative Assessment Staff Report, July 17, 2019.

Page 7, Part IV, D, Basin coverage. DWR is correct in that the three agencies that collaborated in preparing the Alternative do not cover the entire basin; however, all other agencies with jurisdiction, such as the County of Orange, City of Corona, City of Yorba Linda, City of Anaheim and others were notified and offered the opportunity to be involved. No comments were received from any of the contacted agencies. It is our opinion, that through this process, OCWD, La Habra and IRWD did achieve complete coverage of Basin 8-1.

Page 14, Part V, B.2, Groundwater Conditions DWR staff mentioned that monitoring data showing that there are no depletions of interconnected surface water that will cause significant and unreasonable impacts on beneficial users of surface water is not provided, per Page 9 of the Alternative. Page 9 of the Alternative is part of the Overview of the entire report and does not contain detailed information Detailed monitoring information, including 10 years of water level data (Page 364), water budget information, etc. is presented in the Santa Ana Canyon Management Area section of the Alternative. The information presented in the Santa Ana Canyon Management Area section of the report supports the conclusion that there are no depletions of interconnected surface water that will cause significant and unreasonable impacts on beneficial users of surface water. Additional information has been provided below in response to Recommendation No. 1.

Page 16,. Part V, B.4, Management Areas. At the time the 2017 Alternative was submitted, the City of La Habra Groundwater Sustainability Agency (GSA) was contemplating preparing a GSP to be submitted in 2020. However, the City of La Habra GSA has elected to continue contributing to the Basin 8-1 Alternative.

Response to DWR's Recommended Actions.

Pages 32-33, Part IV, B, Recommended Actions.

> **DWR Recommended Action 1**. Staff recommend the Agencies clarify the basis for the determination that depletions of interconnected surface water in the Santa Ana Canyon Management Area are de minimis, while considering the volume of pumping, the extent of the interconnection between groundwater and surface water, and the beneficial users of the surface water.
>
> Staff recommend clarifying whether surface water bodies in the La Habra-Brea Management Area are interconnected with groundwater and whether groundwater-dependent ecosystems exist within the Santa Ana Canyon and La Habra Management Areas.

OCWD Response:

OCWD provided several lines of evidence for the determination that depletions of interconnected surface water in the Santa Ana Canyon area are insignificant (i.e., de minimis).

1. The large disparity in the supply of surface water to the Santa Ana Canyon area compared to the amount of pumping. The annual flow in the Santa Ana River is much greater than the amount of annual groundwater production. When the 2017 Alternative was prepared, some production wells in the Santa Ana Canyon were estimated, namely production wells supplying irrigation water to the Green River Golf Course. OCWD and Orange County Department of Public Works have worked together to install meters on wells supplying the Green River Golf Course. Now all production wells in the Santa Ana Canyon are metered. This effort resulted in a reduction in pumping as prior estimates were too high. For the 2022 Update, the 5-year water budget is presented in Table 1-2 in the Santa Ana Canyon section (reproduced below). This water budget is a combined surface and groundwater water budget for the Santa Ana Canyon Management Area. As shown on this table, groundwater production over this five-year period is approximately 0.6 percent of the total inflow to the canyon area.

Table1-2: Water Budget, 5-Year Average (2016-21)

Flow Component	5-Yr Avg: 2016-21 (afy)
INFLOW	
Santa Ana River Base Flow	76,860
Santa Ana River Storm Flow	78,750
Subsurface Inflow	6,000
TOTAL INFLOW	**161,610**
OUTFLOW	
Santa Ana River Base Flow	76,120
Santa Ana River Storm Flow	78,750
Evapotranspiration	740
Groundwater Production	1,000
Subsurface Outflow	5,000
TOTAL OUTFLOW	**161,610**

2. The second line of evidence is the stability of groundwater levels as shown in Figure 3-3 in the Santa Ana Canyon section of the report. This figure is reproduced below. The consistent, stable nature of groundwater elevations in the Santa Ana Canyon Management Area shows that the aquifer is generally full and at equilibrium, which is consistent with the finding that here are no measurable losses of flows between Prado Dam upstream and OCWD's diversion to its recharge system just below Imperial Highway.
3. The third line of evidence, mentioned above, is the finding that there are no measurable losses of flows between Prado Dam and OCWD's diversion at the Imperial Rubber Dam. The location of these two measuring locations is shown in the figure below. The measuring location below Prado Dam is operated by the United States Geological Survey (USGS) and is identified as US11074000, Santa Ana R BL Prado Dam, CA. The USGS carefully reviews data from this location and publishes it annually as it is of interest to multiple stakeholders, including OCWD, the US Army Corps of Engineers, and a number of agencies upstream of Prado Dam.

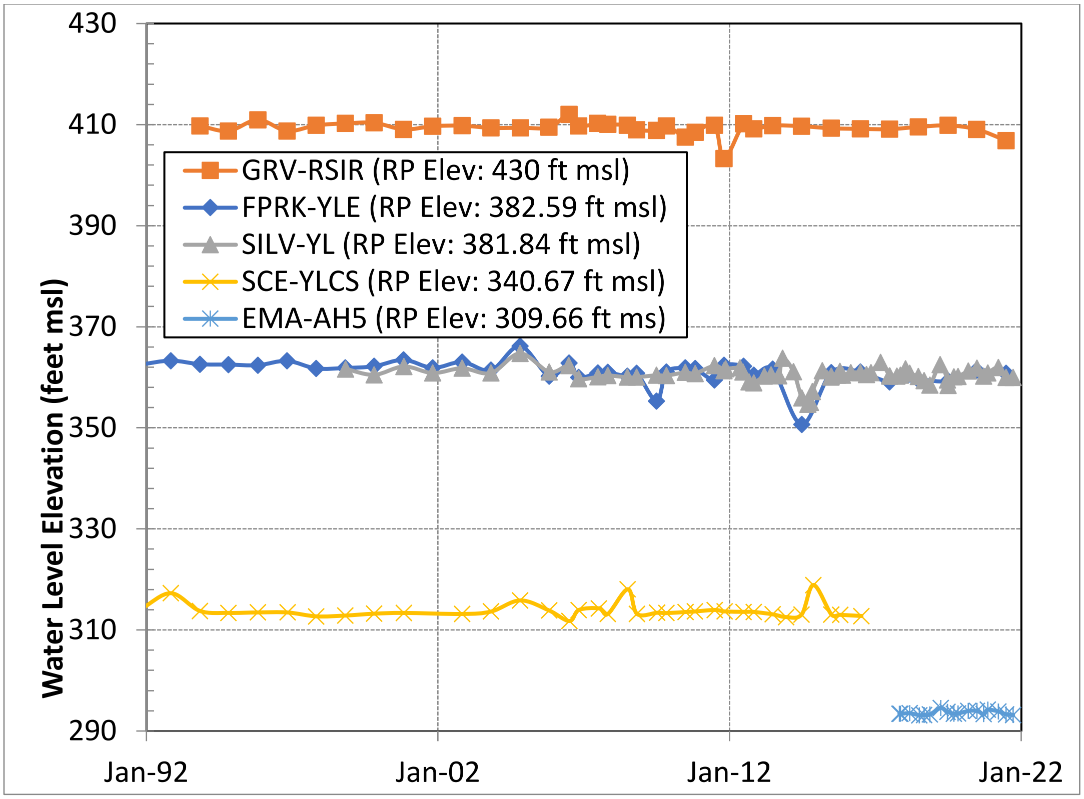
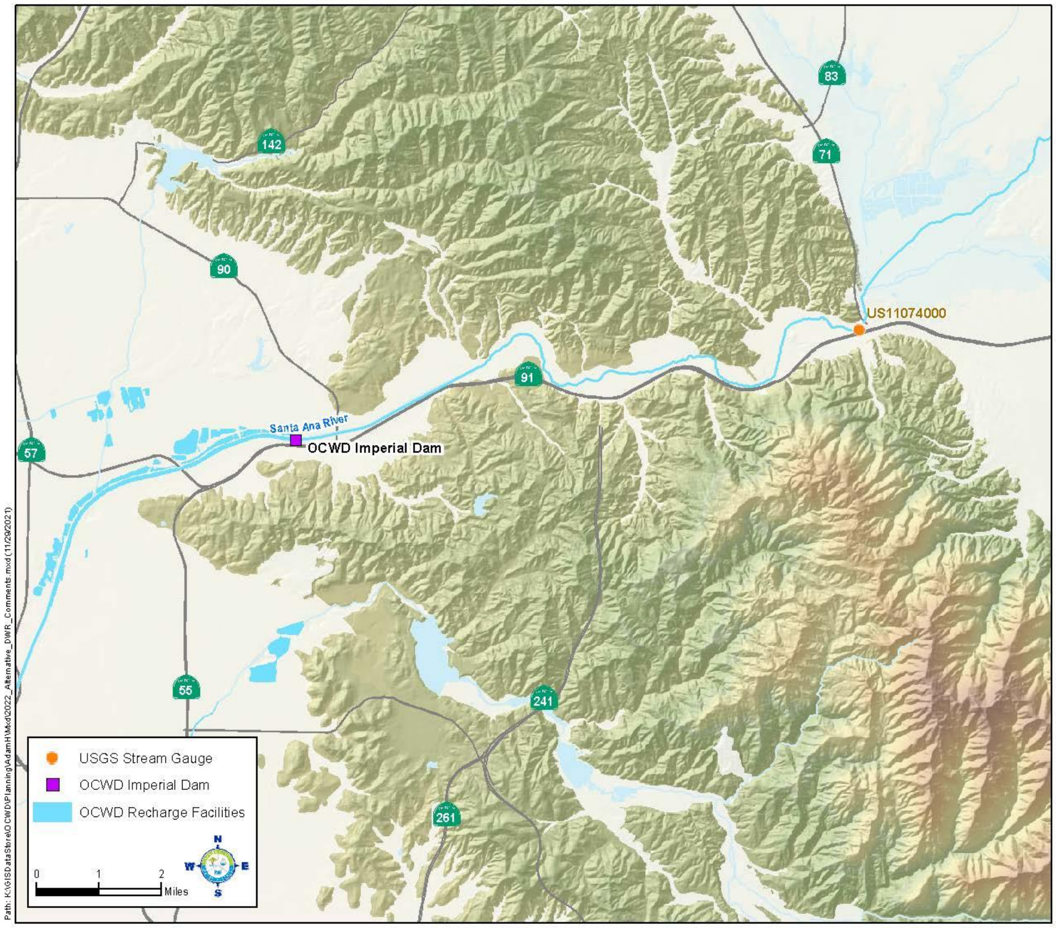


Figure 3-3: Water Level Hydrographs of Selected Wells

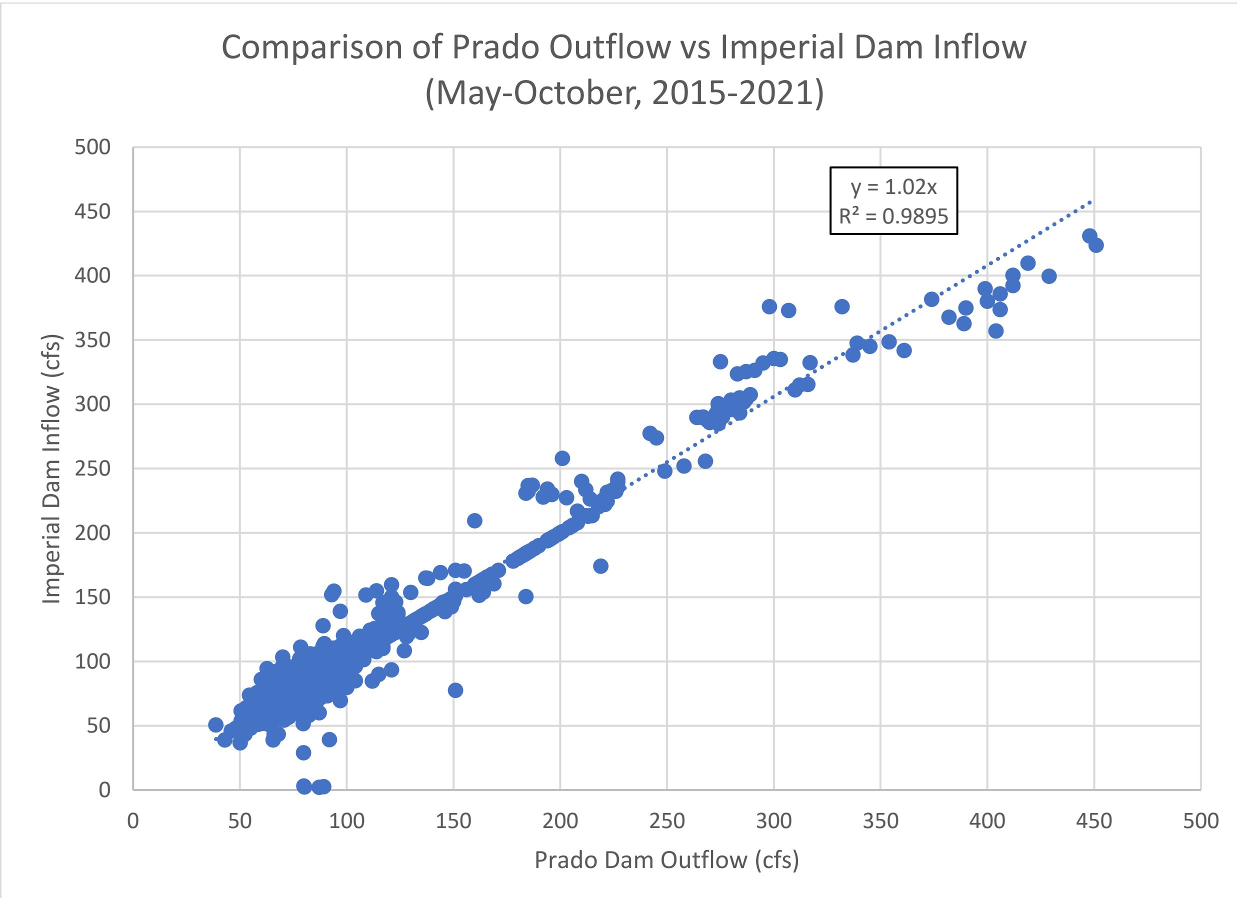


Location of USGS gauging station below Prado Dam and OCWD Imperial Rubber Dam

Inflow from the Santa Ana River to OCWD's recharge system is measured at the Imperial Rubber Dam (see figure). When flows are less than 1,000 cubic feet per second (cfs), the rubber dam remains fully inflated and all surface flows are either diverted from the river to downstream recharge basins or it is bypassed around the dam and placed back into the river channel. Flows that are diverted from the river pass through a Parshall flume, which measures the flow rate. Flows that are bypassed around the dam are measured using sonic flowmeters installed in the bypass pipelines. This arrangement ensures that all flows received by OCWD under 1,000 cfs are measured accurately. OCWD staff routinely check the accuracy of these two measuring stations. OCWD data from the Imperial Rubber Dam location provide data on total flow of the Santa Ana River on a daily basis.

OCWD compiled daily flow measurements for the USGS gauge below Prado Dam (11074000) and at OCWD's Imperial Rubber Dam for the period July 2015 to October 2021. During the winter months, there can be rainfall that occurs between Prado Dam and the Imperial Rubber Dam, resulting in ungauged inflow in this reach. To screen out these periods, the flow data for May through October is used and shown in the graph below. This graph shows there is very good agreement between the outflow at Prado Dam and what is received at the Imperial

Rubber Dam (r^2 =0.99). This demonstrates that there are no net losses in flow between these two locations, at least within the margin of error in the measurement accuracy. The conclusion is that the flow measurements at the two gauges are consistent with the water level data that show that the Santa Ana Canyon Management Area is in hydrologic equilibrium, and also that the volume of groundwater pumping is relatively small so as to not measurably reduce surface water volumes through the canyon.



DWR has made a dataset, called "Natural Communities Commonly Associated with Groundwater (NCCAG) Dataset" available at NC Dataset Viewer (ca.gov). This dataset shows that there is riparian vegetation located in the Santa Ana Management Area along the SAR channel. The evapotranspiration associated with the riparian vegetation was estimated to be 740 afy as shown in Table 1-2.

La Habra GSA Response:

Requested information on whether surface water bodies in the La Habra-Brea Management Area are interconnected with groundwater and whether groundwater-dependent ecosystems exist within the La Habra Management Area is included in the 2022 Update.

DWR Recommended Action 2. Staff recommend a basin-wide water budget utilizing inflow and outflow information from each management area or a water budget for each management area be provided in accordance with the GSP regulations (CCR 23 Section 354.18).

OWWD Response:

Over the years, OCWD has developed a comprehensive data collection system to characterize basin inflows and outflows. In an average year, approximately 80 percent of the inflow to the basin is measured and all of the groundwater production is measured and accounted for. In addition, every year, the change in groundwater storage is estimated based on water level changes in the three basin aquifers. This process defines the current storage condition in the basin and refines the net incidental (unmeasured) recharge portion of the water budget. Section 4 of the OCWD Management Area section of the Alternative describes the various elements of the water budget. The five-year water budget presented in the OCWD Management Area of the report is reproduced below.

Table 4-1: Water Budget, WY2016-17 to 2020-21 (OCWD Management Area)

FLOW COMPONENT	2016-17	2017-18	2018-19	2019-20	2020-21
INFLOW					
Santa Ana River baseflow	70,000	65,400	98,000	74,500	76,400
Santa Ana River stormflow	65,400	24,100	63,700	79,500	36,600
Recycled Water (GWRS/Alamitos Barrier)	98,000	106,400	97,200	99,700	101,700
Imported Water	50,400	66,100	40,300	18,100	0
Net Estimated Unmeasured or Incidental Recharge*	67,900	26,200	45,600	41,400	19,100
TOTAL INFLOW:	351,700	288,200	344,800	313,200	233,800
OUTFLOW					
Groundwater Production	300,700	237,200	303,800	277,200	281,800
TOTAL OUTFLOW:	300,700	237,200	303,800	277,200	281,800
CHANGE IN STORAGE:	51,000	51,000	41,000	36,000	(48,000)

The water budget presented in Table 4-1 is essentially the water budget for Basin 8-1, except for the La Habra Management Area. The water budget for the Santa Ana Canyon Management Area shows that this area provides a net source of water to the OCWD Management area that is captured in the surface water recharge component and net estimated unmeasured recharge (via subsurface inflow). The water budget for the South East Management area is captured in the net unmeasured recharge (via subsurface inflow) minus any groundwater production in this area. Groundwater production in the South East Management area is so small, it is inconsequential in terms of the overall water budget.

Starting in April 2022, OCWD and other agencies within Basin 8-1 will be presenting the various water budget components as defined in CCR 23 Section 354.18 as part of the annual reporting process.

La Habra GSA Response:

Additional information regarding the water budget in the La Habra-Brea Management Area is included in the 2022 Update.

> **DWR Recommended Action 3**. Staff recommend that the Agencies provide the agreements among the different jurisdictions which commit the Agencies to conduct monitoring and implement the Alternative within their management areas. If no GSP is developed for the La Habra-Brea Management Area, the next Alternative update should provide additional explanation and quantification of the management approaches, sustainable management criteria, and evidence for the presence or absence of undesirable results for the La Habra-Brea Management Area.

Response:

The response to this recommended action comes in two parts. The first addresses the commitment of the Agencies to conduct monitoring and implement the Alternative within their management areas. The second addresses additional information requested for the La Habra-Brea Management Area.

Part 1: Commitment to Conduct Monitoring and Implement Alternative:

As part of the process of developing the Basin 8-1 Alternative, OCWD collaborated with the City of La Habra Groundwater Sustainability Agency and the Irvine Ranch Water District (IRWD). Both of these agencies committed resources to prepare their respective sections of the Alternative and submitted letters of support for the Alternative. The letters of support and OCWD's resolution of support were submitted to DWR along with the Alternative in December 2016. These same agencies have committed resources to updating the Alternative and OCWD has again adopted a resolution of support to submit the updated Alternative to DWR. This process demonstrates the continued commitment of the agencies to comply with SGMA and take necessary actions to continue sustainably managing Basin 8-1.

In terms of groundwater monitoring, OCWD has an extensive monitoring well network. A subset of these wells was part of the CASGEM program. As described in the 2022 Update, this well network was updated and is now part of the Monitoring Well Network (MWN), which has replaced CASGEM. Included in the MWN are two wells owned by IRWD that are located in the South East Management Area. As a result, water level data submitted twice a year by OCWD covers all of Basin 8-1 except for the La Habra-Brea Management Area. The City of La Habra GSA will be submitting water level data for their area separately.

In addition to groundwater level monitoring, the agencies are committed to continuing to conduct monitoring of water quality, groundwater production, subsidence, and any other monitoring that may be required to satisfy sustainable management criteria.

Part 2: Additional Information for La Habra-Brea Management Area

The City of La Habra GSA incorporated additional information into the La Habra-Brea Management Area section, including additional explanation and quantification of the management approaches, sustainable management criteria, and clarifying the evidence for the absence of undesirable results for the La Habra-Brea Management Area. Additionally, data gaps within the monitoring network are discussed in the 2022 Update, including steps currently being taken to address and fill the gaps.

> **DWR Recommended Action 4**. Staff recommend the Agencies explain the timeframe that the Basin can safely operate, without experiencing undesirable results, after exceeding 500,000 AF below full conditions (23 CCR Section 354.26(b)(2)) and clarify the wells used to calculate the change in groundwater in storage and the overall groundwater in storage.

Response:

It is important to reiterate that exceeding 500,000 acre-feet from full is a hypothetical situation and is not an intended action under normal basin management circumstances. Such a hypothetical situation is considered an extraordinary circumstance; for example, an extended drought that is exacerbated by a lengthy shutdown of imported water into southern California due to a catastrophic event such as a major earthquake. This hypothetical situation would not be expected to last more than one year; however, other worse hypothetical cases can be conceived. Because the cause(s) and magnitude of a hypothetical temporary storage exceedance beyond 500,000 acre-feet below full are unknown, it is difficult to quantify a precise timeframe that the Basin can operate without experiencing undesirable results. That said, a *cumulative* exceedance of no more than 200,000 acre-feet beyond 500,000 acre-feet below full conditions over five consecutive years is suggested as a general guideline. This means that the average exceedance would be no more than 40,000 acre-feet during a maximum five-year period. If the period of exceedance was two years, then the average exceedance would be 100,000 acre-feet. As a general guideline, limiting the magnitude and duration of the exceedance will lessen the potential for undesirable results, as described below:

1. The rate of inland movement of seawater intrusion with the basin at 500,000 acre-feet below full conditions and with the seawater barriers is expected to be on the order of 1-2 feet per day. Over a 5-year period, this could represent a brackish water encroachment of roughly ½ mile into some of the coastal gaps. While this encroachment could cause localized water quality degradation, it is unlikely to reach production wells which are farther inland. Once the storage exceedance ends, and the basin storage is within the established operating range, the seawater barriers' performance would be expected to recover to their design conditions and subsequently halt and reverse the brackish groundwater inland encroachment.

2. Reduction of pore pressures in and drainage of water from thick, compressible confining layers is a slow process due to the low permeability of the confining layers. Therefore, a maximum five-year period of basin storage exceeding 500,000 acre-feet from full would not be expected to cause significant inelastic land subsidence.

3. Lowering of groundwater levels could temporarily reduce or halt the production potential of an unknown number of water supply wells; however, assuming the distribution of lower groundwater levels is distributed across the Basin, the magnitude of reduced groundwater levels would be lessened, and the number of temporarily-impacted wells would likely be manageable.

Note that this discussion applies to the OCWD portion of the groundwater basin. Storage conditions in the La Habra-Brea Management Area are separate.

OCWD uses a large network of wells to obtain water levels in June every year, including:

1. OCWD owned wells (including multi-port monitoring wells)
2. Groundwater producer wells (must be turned off for 24 hours in advance)
3. Selected wells in Geotracker

The wells/monitoring points used for the June 2021 contour maps of the Shallow, Principal and Deep Aquifers are attached. For 2021, 350 wells/monitoring points were used for the Shallow Aquifer, 421 wells/monitoring points for the Principal Aquifer, and 61 wells/monitoring points for the Deep Aquifer. There may be small changes in this well/monitoring point list on an annual basis.

List of Wells/Monitoring Points Used for June 2021 Water Level Contour Map of Orange County Groundwater Basin (OCWD Management Area)

Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

Shallow Aquifer Wells (Model Layer 1)

STAID1	WELLNM	STAID	STANAME	OWNERNM	NAD83_X	NAD83_Y	GIS_SYMNM	PERF_ZONE	SHORTDATE	WLELEV_2021
19013	CSF-1	19127	CSF-1/1/WB1/MP1	CA. STATE UNIV., FULLERTON	6064343.084	2270822.497	Multiport Monitoring Well	MP1 (132)	<Null>	<Null>
1092	FPRK-YLE	1093	FPRK-YLE/1	CANYON RV PARK	6119133.638	2263083.811	Active Small-System Production Well	60-84	6/29/2021	360.79
1090	FPRK-YLW	1091	FPRK-YLW/1	CANYON RV PARK	6119044.248	2263049.927	Active Small-System Production Well	48-80	6/29/2021	359.55
1136	SULY-OA4	1137	SULY-OA4/1	CHANDLER'S SAND & GRAVEL	6094796.046	2243793.122	Inactive Production Well	-	<Null>	<Null>
23723	CHEV-MW15B	23724	CHEV-MW15B/1	CHEVRON MANAGEMENT COMPANY	6072572.119	2277343.802	Monitoring Well	90-130	<Null>	<Null>
15561	CNXT-NBES2	15562	CNXT-NBES2/1	CONEXANT SYSTEMS, INC.	6071916.005	2188840.827	Monitoring Well	21-41	5/27/2021	21.63
15734	CNXT-NBES3A	15735	CNXT-NBES3A/1	CONEXANT SYSTEMS, INC.	6071601.336	2188635.986	Monitoring Well	23.9-44.3	5/27/2021	21.43
15571	CNXT-NBES4B	15572	CNXT-NBES4B/1	CONEXANT SYSTEMS, INC.	6071542.899	2188493.017	Monitoring Well	23-43	<Null>	<Null>
15569	CNXT-NBES6	15570	CNXT-NBES6/1	CONEXANT SYSTEMS, INC.	6071620.501	2188443.488	Monitoring Well	25-40	<Null>	<Null>
8610	CNXT-NBMW29	8611	CNXT-NBMW29/1	CONEXANT SYSTEMS, INC.	6071755.155	2189235.843	Monitoring Well	21-40	<Null>	<Null>
8608	CNXT-NBMW30	8609	CNXT-NBMW30/1	CONEXANT SYSTEMS, INC.	6071902.892	2189098.302	Monitoring Well	21-42	<Null>	<Null>
14611	SILV-YL	14612	SILV-YL/1	COUNTY OF ORANGE	6117870.025	2262814.346	Other Active Production Well	40-66	6/30/2021	359.99
15932	DAVI-O	15933	DAVI-O/1	DAVIDSON, TOM & CINDY	6090897.443	2241414.862	Other Active Production Well	-	<Null>	<Null>
23713	DLA-GTMW04	23714	DLA-GTMW04/1	DEFENSE LOGISTICS AGENCY	6087208.914	2219923.944	Monitoring Well	90-110	7/7/2021	48.06
4156	OCWD-BS103	5213	OCWD-BS103/1	DEPARTMENT OF WATER RESOURCES	6027754.184	2208435.987	Monitoring Well	43-78	6/29/2021	-4.68
5218	OCWD-BS105	5219	OCWD-BS105/1	DEPARTMENT OF WATER RESOURCES	6022947.616	2207365.785	Monitoring Well	69-85	7/7/2021	-8.97
3071	OCWD-BS106	5222	OCWD-BS106/1	DEPARTMENT OF WATER RESOURCES	6024891.085	2211245.522	Monitoring Well	50-92	6/30/2021	-6.17
5133	OCWD-SA10	5134	OCWD-SA10/1	DEPARTMENT OF WATER RESOURCES	6039247.362	2190515.118	Monitoring Well	90-120	6/28/2021	3.249
5139	OCWD-SA12	5140	OCWD-SA12/1	DEPARTMENT OF WATER RESOURCES	6040581.662	2205805.671	Monitoring Well	86-126	6/30/2021	8.88
5115	OCWD-SA3	5116	OCWD-SA3/1	DEPARTMENT OF WATER RESOURCES	6034107.028	2196075.864	Monitoring Well	100-160	6/28/2021	2.631
1620	CMIL-A	3108	CMIL-A/1	FIRST INTERSTATE BANK	6101671.628	2260355.691	Destroyed and Sealed Well	21-101	<Null>	<Null>
39	GG-28	2687	GG-28/1	GARDEN GROVE	6049374.528	2232905.514	Inactive Production Well	130-240	6/30/2021	59
1407	WWGC-SAK3	1408	WWGC-SAK3/1	GARDEN GROVE	6056974.671	2220835.054	Other Active Production Well	149-170	6/28/2021	50.85
9522	SCWC-YLCO2	9523	SCWC-YLCO2/1	GOLDEN STATE WATER COMPANY	6091725.912	2261952.552	Inactive Production Well	100-480	5/25/2021	254
506	ETCH-AL2	507	ETCH-AL2/1	GOODWIN MUTUAL WATER COMPANY	6086723.02	2261993.771	Inactive Production Well	85-185	6/29/2021	236.58
23034	HEUL-A	23035	HEUL-A/1	HEULER, BARTON	6060159.382	2256110.939	Other Active Production Well	125-145	<Null>	<Null>
2830	OCWD-HH2	2832	OCWD-HH2/2	HUNTINGTON HARBOUR CORPORATION	6012383.001	2212193.192	Monitoring Well	85-95	6/29/2021	-8.893
2845	OCWD-HH3	2847	OCWD-HH3/2	HUNTINGTON HARBOUR CORPORATION	6012242.137	2210674.48	Monitoring Well	75-85	6/29/2021	-7.988
4242	OCWD-HH5	4245	OCWD-HH5/3	HUNTINGTON HARBOUR CORPORATION	6013929.084	2207761.949	Monitoring Well	63-73	6/29/2021	-5.877
20312	OCWD-HH6B	20313	OCWD-HH6B/1	HUNTINGTON HARBOUR CORPORATION	6011785.354	2213862.346	Monitoring Well	90-100	7/1/2021	-10.411
1200	HYNS-S2	1201	HYNS-S2/1	HYNES ESTATES, INC.	6032783.88	2236398.43	Destroyed and Sealed Well	162-182	<Null>	<Null>
23616	IRWD-MICH11	23617	IRWD-MICH11/1	IRVINE RANCH WATER DISTRICT	6078141.044	2188888.245	Other Active Production Well	21-69	<Null>	<Null>
23618	IRWD-MICH12	23622	IRWD-MICH12/1	IRVINE RANCH WATER DISTRICT	6078209.142	2188963.633	Other Active Production Well	19-63	<Null>	<Null>
23623	IRWD-MICH13	23624	IRWD-MICH13/1	IRVINE RANCH WATER DISTRICT	6078263.018	2188904.583	Other Active Production Well	21-67	<Null>	<Null>
23625	IRWD-MICH14	23626	IRWD-MICH14/1	IRVINE RANCH WATER DISTRICT	6078303.831	2188587.342	Other Active Production Well	-	<Null>	<Null>
23627	IRWD-MICH15	23628	IRWD-MICH15/1	IRVINE RANCH WATER DISTRICT	6078219.918	2188672.325	Other Active Production Well	-	<Null>	<Null>
23495	CREA-YL	23496	CREA-YL/1	JOHN CREANGA	6078734.136	2277902.352	Other Active Production Well	135-175	6/30/2021	302.223
1211	ITO-LA	1212	ITO-LA/1	JOINT FORCES TRAINING BASE LOS ALAMITOS	6014444.094	2233893.201	Other Active Production Well	70-710	6/29/2021	14.26
432	W-432	433	W-432/1	KATHY BONANNO	6080325.38	2272580.463	Inactive Production Well	117-137	6/30/2021	286.993
1759	MKAW-FV	3235	MKAW-FV/1	KAWAGUCHI ENTERPRISES, LP	6051164.175	2210349.133	Other Active Production Well	185-225	<Null>	<Null>
11544	LAC-33Y10	11545	LAC-33Y10/1	LOS ANGELES COUNTY	6000026.997	2231221.991	Monitoring Well	75-115	<Null>	<Null>
1160	GHAV-GG	1161	GHAV-GG/1	MAGILL, STANLEY R.	6059608.702	2232220.109	Other Active Production Well	168-188	6/28/2021	61.3
22691	HMW-01	22692	HMW-01/1	MANHEIM CALIFORNIA (COX ENTERPRISES)	6078590.494	2262972.301	Monitoring Well	55-75	<Null>	<Null>
19926	USMC-16MW11	19927	USMC-16MW11/1	MARINE CORPS AIR STATION	6110625.131	2193056.413	Monitoring Well	160-180	<Null>	<Null>
18840	USMC-16MW2	18841	USMC-16MW2/1	MARINE CORPS AIR STATION	6110221.201	2193322.5	Monitoring Well	153-178	<Null>	<Null>
19957	USMC-24EX11	19958	USMC-24EX11/1	MARINE CORPS AIR STATION	6104523.31	2191224.413	Monitoring Well	135-180	<Null>	<Null>
19959	USMC-24EX12A	19960	USMC-24EX12A/1	MARINE CORPS AIR STATION	6105720.54	2190982.863	Monitoring Well	115-160	<Null>	<Null>
19965	USMC-24EX13A	19966	USMC-24EX13A/1	MARINE CORPS AIR STATION	6107553.141	2190629.843	Monitoring Well	110-160	<Null>	<Null>
19971	USMC-24EX14	19972	USMC-24EX14/1	MARINE CORPS AIR STATION	6104912.99	2191678.953	Monitoring Well	115-185	<Null>	<Null>
19953	USMC-24EX9	19954	USMC-24EX9/1	MARINE CORPS AIR STATION	6108691.53	2189395.353	Monitoring Well	120-200	<Null>	<Null>
20253	USMC-24MW10AB	20255	USMC-24MW10AB/2	MARINE CORPS AIR STATION	6107253.063	2191367.404	Monitoring Well	130-140	<Null>	<Null>
20269	USMC-24MW9AB	20271	USMC-24MW9AB/2	MARINE CORPS AIR STATION	6106891.198	2190845.415	Monitoring Well	140-150	<Null>	<Null>
18621	USMC-24NEW7	18622	USMC-24NEW7/1	MARINE CORPS AIR STATION	6108983.5	2190576.7	Monitoring Well	118-158	<Null>	<Null>
18619	USMC-24NEW8	18620	USMC-24NEW8/1	MARINE CORPS AIR STATION	6109711.5	2190269.7	Monitoring Well	122-162	<Null>	<Null>
13875	USMC-MW03E	13876	USMC-MW03E/1	MARINE CORPS AIR STATION	6109510.523	2188847.525	Monitoring Well	124-164	<Null>	<Null>
13833	USMC-MW19E	13834	USMC-MW19E/1	MARINE CORPS AIR STATION	6104580.874	2194499.736	Monitoring Well	98-138	<Null>	<Null>
14336	USMC-MW23	14337	USMC-MW23/1	MARINE CORPS AIR STATION	6105584.809	2185916.035	Monitoring Well	64-104	<Null>	<Null>
18586	USMC-MW29A	18587	USMC-MW29A/1	MARINE CORPS AIR STATION	6110133.9	2187312.33	Monitoring Well	75-100	<Null>	<Null>
22910	USMC-MW2D2	22911	USMC-MW2D2/1	MARINE CORPS AIR STATION	6081840.685	2206480.568	Monitoring Well	76-86	<Null>	<Null>
13861	USMC-MW31	13862	USMC-MW31/1	MARINE CORPS AIR STATION	6107617.015	2189648.229	Monitoring Well	105-145	<Null>	<Null>
13859	USMC-MW37	13860	USMC-MW37/1	MARINE CORPS AIR STATION	6108153.508	2188707.479	Monitoring Well	89-130	<Null>	<Null>
22617	USMC-MW43B	22618	USMC-MW43B/1	MARINE CORPS AIR STATION	6110701.167	2188814.201	Monitoring Well	100.41-140.91	<Null>	<Null>
13817	USMC-MW51	13818	USMC-MW51/1	MARINE CORPS AIR STATION	6107153.052	2192582.528	Monitoring Well	125-165	<Null>	<Null>
13877	USMC-MW70	13878	USMC-MW70/1	MARINE CORPS AIR STATION	6110644.542	2189446.258	Monitoring Well	125-165	<Null>	<Null>
13903	USMC-MW73	13904	USMC-MW73/1	MARINE CORPS AIR STATION	6109324.506	2187794.721	Monitoring Well	90-130	<Null>	<Null>
13889	USMC-MW91	13890	USMC-MW91/1	MARINE CORPS AIR STATION	6108291.003	2188258.73	Monitoring Well	110-150	<Null>	<Null>
7256	USMC-PS1	7257	USMC-PS1/1	MARINE CORPS AIR STATION	6106591.503	2189442.242	Monitoring Well	102-122	<Null>	<Null>
7258	USMC-PS2	7259	USMC-PS2/1	MARINE CORPS AIR STATION	6105657.052	2193519.226	Monitoring Well	103-133	<Null>	<Null>
18564	USMC-PS3A	18565	USMC-PS3A/1	MARINE CORPS AIR STATION	6109290.87	2187093.49	Monitoring Well	70-105	<Null>	<Null>
13849	USMC-MP06	14437	USMC-MP06/1/WB1/MP1	MARINE CORPS AIR STATION	6100689.85	2194415.05	Multiport Monitoring Well	MP1 (110)	<Null>	<Null>
13851	USMC-MP08	14457	USMC-MP08/1/WB1/MP1	MARINE CORPS AIR STATION	6105310.575	2187889.19	Multiport Monitoring Well	MP1 (70)	<Null>	<Null>
13853	USMC-MP10	14501	USMC-MP10/1/WB1/MP1	MARINE CORPS AIR STATION	6089272.939	2200492.977	Multiport Monitoring Well	MP1 (222)	<Null>	<Null>
20296	USMC-24EX20B	20297	USMC-24EX20B/1	MARINE CORPS AIR STATION	6106098.39	2192979.513	Other Active Production Well	106.8-204.8	<Null>	<Null>
20015	USMC-SGU1	20016	USMC-SGU1/1	MARINE CORPS AIR STATION	6109366.294	2188607.434	Other Active Production Well	96-206	3/9/2021	153.37
20090	USMC-SGU16	20091	USMC-SGU16/1	MARINE CORPS AIR STATION	6108500.694	2189851.338	Other Active Production Well	105-185	3/9/2021	128.4
21967	USMC-SGU39	21968	USMC-SGU39/1	MARINE CORPS AIR STATION	6105829.364	2192700.994	Other Active Production Well	90-190	3/8/2021	108.56
15117	MCGN-BP1	15118	MCGN-BP1/1	MC GINNESS, BILL	6030378.839	2253137.368	Other Active Production Well	50-255	6/30/2021	39.29
14284	MSG-BP10L	14285	MSG-BP10L/1	MCCOLL SITE GROUP	6037931.453	2272258.752	Monitoring Well	247-257	6/30/2021	103.92
1134	SULY-OA1	1135	SULY-OA1/1	MILAN REI, LLC	6095028.945	2243462.53	Other Active Production Well	-	6/29/2021	<Null>
428	W-428	429	W-428/1	MONBRI, LLC	6074730.957	2271716.012	Inactive Production Well	-	<Null>	<Null>
3976	OCWD-P10	3977	OCWD-P10/1	ORANGE COUNTY WATER DISTRICT	6044117.886	2186405.599	Destroyed and Sealed Well	90-130	<Null>	<Null>
19007	OCWD-BIO1	19008	OCWD-BIO1/1	ORANGE COUNTY WATER DISTRICT	6082730.975	2257183.878	Inactive Production Well	25-115	7/7/2021	229.84
20858	OCWD-EW2	20859	OCWD-EW2/1	ORANGE COUNTY WATER DISTRICT	6053332.928	2263207.928	Inactive Production Well	130-196	<Null>	<Null>
20851	OCWD-EW2A	20852	OCWD-EW2A/1	ORANGE COUNTY WATER DISTRICT	6049376.318	2263317.874	Inactive Production Well	122-188	<Null>	<Null>
22619	OCWD-EW3A	22620	OCWD-EW3A/1	ORANGE COUNTY WATER DISTRICT	6050896.1	2260365.9	Inactive Production Well	235-290	<Null>	<Null>
21041	OCWD-EW4	21042	OCWD-EW4/1	ORANGE COUNTY WATER DISTRICT	6053819.546	2259558.892	Inactive Production Well	130-255	<Null>	<Null>
18056	OCWD-I26A	18057	OCWD-I26A/1	ORANGE COUNTY WATER DISTRICT	6048813.793	2200416.667	Injection Well	60-195	7/6/2021	5.49
19465	OCWD-I27A	19466	OCWD-I27A/1	ORANGE COUNTY WATER DISTRICT	6036244.383	2199722.281	Injection Well	78-148	<Null>	<Null>
19469	OCWD-I28A	19470	OCWD-I28A/1	ORANGE COUNTY WATER DISTRICT	6036238.41	2199048.656	Injection Well	80-140	7/6/2021	3
19697	OCWD-I29A	19698	OCWD-I29A/1	ORANGE COUNTY WATER DISTRICT	6034766.9	2200360.103	Injection Well	90-120	<Null>	<Null>
19701	OCWD-I30A	19702	OCWD-I30A/1	ORANGE COUNTY WATER DISTRICT	6034047.2	2200278.003	Injection Well	95-160	6/28/2021	2.53
19711	OCWD-I31A	19712	OCWD-I31A/1	ORANGE COUNTY WATER DISTRICT	6033586.7	2201013.903	Injection Well	90-165	7/6/2021	1.67
19707	OCWD-I32A	19708	OCWD-I32A/1	ORANGE COUNTY WATER DISTRICT	6033114.8	2200599.403	Injection Well	90-155	<Null>	<Null>
19654	OCWD-I33A	19655	OCWD-I33A/1	ORANGE COUNTY WATER DISTRICT	6045921.5	2194432.303	Injection Well	61-156	6/30/2021	5.16
19656	OCWD-I34A	19657	OCWD-I34A/1	ORANGE COUNTY WATER DISTRICT	6045756.9	2193917.303	Injection Well	60-135	<Null>	<Null>
19658	OCWD-I35A	19659	OCWD-I35A/1	ORANGE COUNTY WATER DISTRICT	6045558.2	2193150.603	Injection Well	60-115	6/30/2021	7.89
19678	OCWD-I36A	19679	OCWD-I36A/1	ORANGE COUNTY WATER DISTRICT	6045421.1	2192575.403	Injection Well	60-110	<Null>	<Null>
1018	AM-1	1019	AM-1/1	ORANGE COUNTY WATER DISTRICT	6090472.39	2264185.952	Monitoring Well	97-115	6/30/2021	245.03

Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

Shallow Aquifer Wells (Model Layer 1)

STAID1	WELLNM	STAID	STANAME	OWNERNM	NAD83_X	NAD83_Y	GIS_SYMNM	PERF_ZONE	SHORTDATE	WLELEV_2021
545	AM-10	546	AM-10/1	ORANGE COUNTY WATER DISTRICT	6071304.771	2257813.261	Monitoring Well	217-235	7/7/2021	121.51
557	AM-11	558	AM-11/1	ORANGE COUNTY WATER DISTRICT	6072499.755	2255656.617	Monitoring Well	218-240	6/30/2021	121.98
555	AM-12	556	AM-12/1	ORANGE COUNTY WATER DISTRICT	6070962.221	2255565.488	Monitoring Well	210-225	7/7/2021	113.56
553	AM-13	554	AM-13/1	ORANGE COUNTY WATER DISTRICT	6072701.528	2256964.39	Monitoring Well	252-270	6/30/2021	128.38
2744	AM-15A	2745	AM-15A/1	ORANGE COUNTY WATER DISTRICT	6062585.788	2256914.422	Monitoring Well	214-220	6/25/2021	89.81
2895	AM-19A	2896	AM-19A/1	ORANGE COUNTY WATER DISTRICT	6065134.464	2236977.559	Monitoring Well	115-123	6/25/2021	77.56
1022	AM-2	1023	AM-2/1	ORANGE COUNTY WATER DISTRICT	6091404.587	2263383.522	Monitoring Well	87-100	6/30/2021	246.46
6515	AM-21A	6516	AM-21A/1	ORANGE COUNTY WATER DISTRICT	6067232.542	2241283.088	Monitoring Well	157-165	6/25/2021	90.52
7011	AM-25A	7012	AM-25A/1	ORANGE COUNTY WATER DISTRICT	6060775.248	2252483.682	Monitoring Well	188-195	6/25/2021	84.41
1020	AM-3	1021	AM-3/1	ORANGE COUNTY WATER DISTRICT	6090425.411	2261850.384	Monitoring Well	91-107	6/30/2021	245.62
7543	AM-30A	7544	AM-30A/1	ORANGE COUNTY WATER DISTRICT	6046015.103	2255909.924	Monitoring Well	152-159	6/25/2021	55.16
22901	AM-31AR	22902	AM-31AR/1	ORANGE COUNTY WATER DISTRICT	6052258.095	2257683	Monitoring Well	150-170	7/8/2021	69.05
8904	AM-39A	8905	AM-39A/1	ORANGE COUNTY WATER DISTRICT	6057788.178	2260561.644	Monitoring Well	115-135	6/29/2021	82.15
549	AM-4	550	AM-4/1	ORANGE COUNTY WATER DISTRICT	6078257.417	2258629.141	Monitoring Well	187-205	7/7/2021	166.388
8908	AM-40A	8909	AM-40A/1	ORANGE COUNTY WATER DISTRICT	6057765.028	2259083.041	Monitoring Well	145-165	6/25/2021	83.08
10147	AM-41A	10148	AM-41A/1	ORANGE COUNTY WATER DISTRICT	6055818.758	2261031.665	Monitoring Well	156-166	6/30/2021	77.7
8232	AM-42A	8233	AM-42A/1	ORANGE COUNTY WATER DISTRICT	6057305.512	2258837.864	Monitoring Well	115-130	<Null>	<Null>
14615	AM-44	14616	AM-44/1	ORANGE COUNTY WATER DISTRICT	6075009.801	2261947.637	Monitoring Well	140-160	6/30/2021	168.75
15331	AM-45	15332	AM-45/1	ORANGE COUNTY WATER DISTRICT	6071037.809	2252432.19	Monitoring Well	102-132	7/7/2021	104.04
15329	AM-46	15330	AM-46/1	ORANGE COUNTY WATER DISTRICT	6073338.847	2254329.24	Monitoring Well	94-124	7/7/2021	124.15
20711	AM-47A	20712	AM-47A/1	ORANGE COUNTY WATER DISTRICT	6054345.1	2258323.2	Monitoring Well	160-170	6/25/2021	73.68
20703	AM-48A	20704	AM-48A/1	ORANGE COUNTY WATER DISTRICT	6069389.1	2259146.8	Monitoring Well	116-146	7/8/2021	114.1
20760	AM-49	20761	AM-49/1	ORANGE COUNTY WATER DISTRICT	6068833	2259389.2	Monitoring Well	120-150	6/30/2021	112.28
22372	AM-50	22373	AM-50/1	ORANGE COUNTY WATER DISTRICT	6075090.3	2260329.2	Monitoring Well	140-150	7/1/2021	158.68
22714	AM-51	22715	AM-51/1	ORANGE COUNTY WATER DISTRICT	6078407.7	2256724.2	Monitoring Well	105-125	7/1/2021	176.413
23001	AM-52	23002	AM-52/1	ORANGE COUNTY WATER DISTRICT	6074643.8	2257784.5	Monitoring Well	140-150	7/1/2021	145.33
22939	AM-53	22940	AM-53/1	ORANGE COUNTY WATER DISTRICT	6076000.9	2255632.4	Monitoring Well	35-50	6/30/2021	199.08
23209	AM-54A	23210	AM-54A/1	ORANGE COUNTY WATER DISTRICT	6055949.4	2259518.7	Monitoring Well	102-117	6/25/2021	77.92
2732	AM-5A	2733	AM-5A/1	ORANGE COUNTY WATER DISTRICT	6078678.675	2259935.902	Monitoring Well	168-175	7/7/2021	166.45
551	AM-6	552	AM-6/1	ORANGE COUNTY WATER DISTRICT	6075037.515	2257301.421	Monitoring Well	232-250	7/7/2021	143.29
2734	AM-7	2735	AM-7/1	ORANGE COUNTY WATER DISTRICT	6071731.515	2260900.336	Monitoring Well	210-225	7/7/2021	131.58
2736	AM-8	2737	AM-8/1	ORANGE COUNTY WATER DISTRICT	6069027.597	2259867.528	Monitoring Well	268-285	7/7/2021	112.8
2738	AM-9	2739	AM-9/1	ORANGE COUNTY WATER DISTRICT	6068551.962	2256957.039	Monitoring Well	285-303	6/30/2021	106.16
14585	AMD-9	14586	AMD-9/1	ORANGE COUNTY WATER DISTRICT	6075825.081	2261784.701	Monitoring Well	200-220	7/1/2021	158.94
18333	FM-10A	18334	FM-10A/1	ORANGE COUNTY WATER DISTRICT	6057594.391	2262015.979	Monitoring Well	151-171	6/29/2021	80.97
18337	FM-11A	18338	FM-11A/1	ORANGE COUNTY WATER DISTRICT	6054079.666	2261018.177	Monitoring Well	134-154	6/30/2021	73.93
18341	FM-12A	18342	FM-12A/1	ORANGE COUNTY WATER DISTRICT	6058082.287	2263020.488	Monitoring Well	135-155	6/29/2021	82.13
18345	FM-13A	18346	FM-13A/1	ORANGE COUNTY WATER DISTRICT	6064721.254	2262602.268	Monitoring Well	140-160	7/1/2021	93.9
18349	FM-14A	18350	FM-14A/1	ORANGE COUNTY WATER DISTRICT	6064616.249	2263074.072	Monitoring Well	147-167	7/2/2021	93.36
18353	FM-15A	18354	FM-15A/1	ORANGE COUNTY WATER DISTRICT	6054101.553	2262617.193	Monitoring Well	120-140	6/29/2021	71.92
18414	FM-16A	18415	FM-16A/1	ORANGE COUNTY WATER DISTRICT	6063638.746	2262326.768	Monitoring Well	125-145	7/3/2021	91.85
19614	FM-18A	19615	FM-18A/1	ORANGE COUNTY WATER DISTRICT	6049386.482	2263643.669	Monitoring Well	120.5-150.5	6/29/2021	63.93
19618	FM-19A	19619	FM-19A/1	ORANGE COUNTY WATER DISTRICT	6051553.311	2262443.484	Monitoring Well	115-135	6/29/2021	68.63
7019	FM-1A	7020	FM-1A/1	ORANGE COUNTY WATER DISTRICT	6053145.617	2258731.83	Monitoring Well	164-172	6/25/2021	71.88
20764	FM-20A	20765	FM-20A/1	ORANGE COUNTY WATER DISTRICT	6053785.7	2263876.3	Monitoring Well	130-150	6/29/2021	72.54
20768	FM-21A	20769	FM-21A/1	ORANGE COUNTY WATER DISTRICT	6047768.5	2262675.5	Monitoring Well	140-160	6/29/2021	60.141
20753	FM-22A	20754	FM-22A/1	ORANGE COUNTY WATER DISTRICT	6051124.3	2260372.1	Monitoring Well	150-170	6/25/2021	67.28
20884	FM-23A	20885	FM-23A/1	ORANGE COUNTY WATER DISTRICT	6054153.6	2260625.1	Monitoring Well	128-143	6/29/2021	74.3
20701	FM-24A	20702	FM-24A/1	ORANGE COUNTY WATER DISTRICT	6051431.3	2258787.9	Monitoring Well	154-174	6/25/2021	67.61
20316	FM-25	20317	FM-25/1	ORANGE COUNTY WATER DISTRICT	6068593.3	2262774.2	Monitoring Well	132-152	6/30/2021	110.53
20878	FM-26	20879	FM-26/1	ORANGE COUNTY WATER DISTRICT	6053369.5	2263220	Monitoring Well	145-155	<Null>	<Null>
20894	FM-27	20895	FM-27/1	ORANGE COUNTY WATER DISTRICT	6054575.1	2263550.9	Monitoring Well	105-125	6/29/2021	74.86
23221	FM-29A	23222	FM-29A/1	ORANGE COUNTY WATER DISTRICT	6048986.6	2262406	Monitoring Well	150-170	6/29/2021	62.36
23571	FM-30A	23572	FM-30A/1	ORANGE COUNTY WATER DISTRICT	6061066.47	2263552.561	Monitoring Well	106-126	6/29/2021	86.65
23227	FM-31A	23228	FM-31A/1	ORANGE COUNTY WATER DISTRICT	6054066.6	2261852.6	Monitoring Well	122-137	6/29/2021	73.97
23231	FM-32A	23232	FM-32A/1	ORANGE COUNTY WATER DISTRICT	6045296.9	2263968.8	Monitoring Well	135-155	6/29/2021	56.56
23483	FM-33A	23484	FM-33A/1	ORANGE COUNTY WATER DISTRICT	6052364.7	2264780	Monitoring Well	135-155	6/29/2021	69.67
23575	FM-34A	23576	FM-34A/1	ORANGE COUNTY WATER DISTRICT	6057208.2	2265369.9	Monitoring Well	114-124	7/8/2021	81.62
23894	FM-35A	23895	FM-35A/1	ORANGE COUNTY WATER DISTRICT	6062993.381	2262539.528	Monitoring Well	180.1-195.1	7/6/2021	89.8
7521	FM-4A	7522	FM-4A/1	ORANGE COUNTY WATER DISTRICT	6048400.799	2258801.821	Monitoring Well	142-160	6/25/2021	60.89
7932	FM-5	7933	FM-5/1	ORANGE COUNTY WATER DISTRICT	6059389.1	2261084.6	Monitoring Well	121-141	6/29/2021	85
9947	FM-6	9948	FM-6/1	ORANGE COUNTY WATER DISTRICT	6053264.065	2274113.568	Monitoring Well	150-310	6/30/2021	175.28
10145	FM-7A	10146	FM-7A/1	ORANGE COUNTY WATER DISTRICT	6054314.136	2259267.565	Monitoring Well	160-170	6/25/2021	74.11
18325	FM-8	18326	FM-8/1	ORANGE COUNTY WATER DISTRICT	6059585.097	2263564.489	Monitoring Well	114-134	6/29/2021	84.74
18329	FM-9A	18330	FM-9A/1	ORANGE COUNTY WATER DISTRICT	6063388.839	2262959.974	Monitoring Well	166-186	6/30/2021	89
19009	IDM-3	19010	IDM-3/1	ORANGE COUNTY WATER DISTRICT	6099726.882	2201438.084	Monitoring Well	174-194	6/28/2021	94.682
19404	IDM-4	19405	IDM-4/1	ORANGE COUNTY WATER DISTRICT	6103585.541	2200230.218	Monitoring Well	136-156	6/28/2021	107.205
19478	IDP-2R	19479	IDP-2R/1	ORANGE COUNTY WATER DISTRICT	6106015.21	2193086.752	Monitoring Well	155-195	6/28/2021	115.845
721	KBS-1	998	KBS-1/1	ORANGE COUNTY WATER DISTRICT	6074374.124	2260345.831	Monitoring Well	209-219	7/1/2021	154.21
14600	KBS-4	14601	KBS-4/1	ORANGE COUNTY WATER DISTRICT	6073595.666	2262004.207	Monitoring Well	138-158	7/7/2021	154.88
1360	MCAS-4	1361	MCAS-4/1	ORANGE COUNTY WATER DISTRICT	6098189.884	2189446.916	Monitoring Well	181-238	6/28/2021	95.46
10217	MCAS-5A	10218	MCAS-5A/1	ORANGE COUNTY WATER DISTRICT	6101340.027	2187474.726	Monitoring Well	120-130	6/28/2021	118.26
21062	OCWD-34X40	21063	OCWD-34X40/1	ORANGE COUNTY WATER DISTRICT	6005285	2228276.5	Monitoring Well	88-113	<Null>	<Null>
23057	OCWD-34Y01	23058	OCWD-34Y01/1	ORANGE COUNTY WATER DISTRICT	6001790.9	2226024.1	Monitoring Well	60-80	7/6/2021	2.734
5410	OCWD-35H11	5413	OCWD-35H11/1	ORANGE COUNTY WATER DISTRICT	6002891.562	2224892.037	Monitoring Well	44-77	7/6/2021	-1.064
5414	OCWD-35N01	5416	OCWD-35N01/1	ORANGE COUNTY WATER DISTRICT	6001915.345	2223579.533	Monitoring Well	39-79	<Null>	<Null>
2859	OCWD-AIR1	2860	OCWD-AIR1/1	ORANGE COUNTY WATER DISTRICT	6037614.933	2265072.135	Monitoring Well	200-250	6/29/2021	39.807
3327	OCWD-AN2	3328	OCWD-AN2/1	ORANGE COUNTY WATER DISTRICT	6078166.807	2262263.165	Monitoring Well	35-115	6/28/2021	174.34
3317	OCWD-BP3	3318	OCWD-BP3/1	ORANGE COUNTY WATER DISTRICT	6069054.595	2245231.281	Monitoring Well	185-205	7/7/2021	97.415
3311	OCWD-BP4	3312	OCWD-BP4/1	ORANGE COUNTY WATER DISTRICT	6070719.841	2250468.164	Monitoring Well	140-180	7/7/2021	91.57
20224	OCWD-BP5	20226	OCWD-BP5/2	ORANGE COUNTY WATER DISTRICT	6069894.721	2249887.593	Monitoring Well	146.5-166.5	7/7/2021	125.41
20227	OCWD-BP6	20228	OCWD-BP6/1	ORANGE COUNTY WATER DISTRICT	6069328.8	2249065.103	Monitoring Well	148-168	7/7/2021	102.79
20229	OCWD-BP7	20231	OCWD-BP7/2	ORANGE COUNTY WATER DISTRICT	6069218.53	2247697.383	Monitoring Well	148-168	7/7/2021	101.76
22323	OCWD-BS10	22324	OCWD-BS10/1	ORANGE COUNTY WATER DISTRICT	6013179.752	2219396.307	Monitoring Well	100-110	7/1/2021	-13.06
22330	OCWD-BS11	22331	OCWD-BS11/1	ORANGE COUNTY WATER DISTRICT	6008506.1	2221300	Monitoring Well	95-115	7/1/2021	-9.453
22774	OCWD-BS12	22968	OCWD-BS12/1	ORANGE COUNTY WATER DISTRICT	6015660.3	2214181.8	Monitoring Well	115-125	7/1/2021	-12.659
23682	OCWD-BS13A	23683	OCWD-BS13A/1	ORANGE COUNTY WATER DISTRICT	6009763.8	2214240.5	Monitoring Well	127-132	7/1/2021	-10.876
22776	OCWD-BS14	22912	OCWD-BS14/1	ORANGE COUNTY WATER DISTRICT	6003965.9	2221842.9	Monitoring Well	75-85	7/1/2021	-4.65
19673	OCWD-BS16	19674	OCWD-BS16/1	ORANGE COUNTY WATER DISTRICT	6021997.663	2201854.703	Monitoring Well	60-80	7/1/2021	-9.627
19675	OCWD-BS18	19676	OCWD-BS18/1	ORANGE COUNTY WATER DISTRICT	6018119.189	2205526.66	Monitoring Well	72-82	7/1/2021	-11.001
22899	OCWD-BS18B	22900	OCWD-BS18B/1	ORANGE COUNTY WATER DISTRICT	6018114.308	2205521.438	Monitoring Well	52-62	7/1/2021	-11.192
19854	OCWD-BS19	19855	OCWD-BS19/1	ORANGE COUNTY WATER DISTRICT	6019002.9	2203605.503	Monitoring Well	62.5-82.5	7/1/2021	-9.346
20140	OCWD-BS20B	20141	OCWD-BS20B/1	ORANGE COUNTY WATER DISTRICT	6018514.448	2207922.493	Monitoring Well	70.8-80.8	6/24/2021	-9.28
22778	OCWD-BS21	22895	OCWD-BS21/1	ORANGE COUNTY WATER DISTRICT	6004262.7	2223732.4	Monitoring Well	65-85	6/29/2021	-2.96
23498	OCWD-BS24A	23500	OCWD-BS24A/1	ORANGE COUNTY WATER DISTRICT	6005236.2	2219558.6	Monitoring Well	87.5-92.5	7/1/2021	-8.055
2867	OCWD-CTG1	2868	OCWD-CTG1/1	ORANGE COUNTY WATER DISTRICT	6061970.346	2206073.478	Monitoring Well	160-260	6/30/2021	32.73
3309	OCWD-FC2	3310	OCWD-FC2/1	ORANGE COUNTY WATER DISTRICT	6072303.404	2252609.097	Monitoring Well	95-115	7/7/2021	105.49
3305	OCWD-FH1	3306	OCWD-FH1/1	ORANGE COUNTY WATER DISTRICT	6081695.772	2257027.264	Monitoring Well	120-140	7/7/2021	213.83

Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

Shallow Aquifer Wells (Model Layer 1)

STAID1	WELLNM	STAID	STANAME	OWNERNM	NAD83_X	NAD83_Y	GIS_SYMNM	PERF_ZONE	SHORTDATE	WLELEV_2021
7056	OCWD-GA2	7057	OCWD-GA2/1	ORANGE COUNTY WATER DISTRICT	6024924.606	2202223.668	Monitoring Well	30-40	6/24/2021	-4.615
23477	OCWD-HG2	23478	OCWD-HG2/1	ORANGE COUNTY WATER DISTRICT	6090811.6	2258833	Monitoring Well	43-48	7/7/2021	258.38
543	OCWD-KB1	544	OCWD-KB1/1	ORANGE COUNTY WATER DISTRICT	6073294.322	2259903.951	Monitoring Well	180-200	7/7/2021	141.77
20232	OCWD-LB1	20234	OCWD-LB1/2	ORANGE COUNTY WATER DISTRICT	6070964.86	2251336.473	Monitoring Well	148-168	7/7/2021	97.07
20237	OCWD-LB3	20239	OCWD-LB3/2	ORANGE COUNTY WATER DISTRICT	6071277.961	2250678.833	Monitoring Well	145-165	7/7/2021	93.26
21196	OCWD-LB4	21198	OCWD-LB4/2	ORANGE COUNTY WATER DISTRICT	6070798.52	2250812.078	Monitoring Well	78-88	7/7/2021	121.19
3303	OCWD-LV1	3304	OCWD-LV1/1	ORANGE COUNTY WATER DISTRICT	6085675.722	2259327.385	Monitoring Well	135-155	7/7/2021	237.5
3020	OCWD-M1	3021	OCWD-M1/1	ORANGE COUNTY WATER DISTRICT	6042016.978	2187264.062	Monitoring Well	75-110	6/30/2021	2.55
2906	OCWD-M10	2907	OCWD-M10/1	ORANGE COUNTY WATER DISTRICT	6038138.474	2201788.445	Monitoring Well	80-160	6/29/2021	2.175
2911	OCWD-M11	2912	OCWD-M11/1	ORANGE COUNTY WATER DISTRICT	6040661.307	2201457.181	Monitoring Well	70-105	6/30/2021	3.83
2924	OCWD-M12	2925	OCWD-M12/1	ORANGE COUNTY WATER DISTRICT	6043375.718	2201517.376	Monitoring Well	70-110	6/30/2021	5.775
2929	OCWD-M13	2930	OCWD-M13/1	ORANGE COUNTY WATER DISTRICT	6045991.781	2201410.369	Monitoring Well	65-95	6/30/2021	10.798
2947	OCWD-M14A	2948	OCWD-M14A/1	ORANGE COUNTY WATER DISTRICT	6046612.239	2200062.034	Monitoring Well	60-90	6/28/2021	7.94
2954	OCWD-M15A	2955	OCWD-M15A/1	ORANGE COUNTY WATER DISTRICT	6046620.011	2199773.098	Monitoring Well	60-85	6/28/2021	6.96
2961	OCWD-M16	2962	OCWD-M16/1	ORANGE COUNTY WATER DISTRICT	6046615.518	2199268.584	Monitoring Well	65-90	6/28/2021	4.264
2966	OCWD-M17A	2967	OCWD-M17A/1	ORANGE COUNTY WATER DISTRICT	6046331.102	2200365.515	Monitoring Well	60-95	6/28/2021	7.867
2934	OCWD-M19	2935	OCWD-M19/1	ORANGE COUNTY WATER DISTRICT	6046001.209	2200836.043	Monitoring Well	60-110	6/30/2021	8.575
3022	OCWD-M2	3023	OCWD-M2/1	ORANGE COUNTY WATER DISTRICT	6039248.099	2187144.76	Monitoring Well	85-150	6/28/2021	4.202
2938	OCWD-M20	2939	OCWD-M20/1	ORANGE COUNTY WATER DISTRICT	6045975.835	2200531.536	Monitoring Well	60-105	6/30/2021	8.088
4395	OCWD-M21	4398	OCWD-M21/1	ORANGE COUNTY WATER DISTRICT	6046004.999	2200239.171	Monitoring Well	65-100	6/30/2021	7.39
2976	OCWD-M22	2977	OCWD-M22/1	ORANGE COUNTY WATER DISTRICT	6046004.496	2199936.42	Monitoring Well	70-105	6/30/2021	7.525
2987	OCWD-M24	2988	OCWD-M24/1	ORANGE COUNTY WATER DISTRICT	6045442.857	2199803.456	Monitoring Well	70-95	6/24/2021	6.605
3026	OCWD-M25	3027	OCWD-M25/1	ORANGE COUNTY WATER DISTRICT	6033478.884	2192672.122	Monitoring Well	65-185	6/30/2021	4.323
3014	OCWD-M26	3015	OCWD-M26/1	ORANGE COUNTY WATER DISTRICT	6040602.649	2193477.553	Monitoring Well	70-135	7/1/2021	3.386
3016	OCWD-M27	3017	OCWD-M27/1	ORANGE COUNTY WATER DISTRICT	6043039.524	2189845.444	Monitoring Well	60-110	6/30/2021	3.357
3030	OCWD-M28	3031	OCWD-M28/1	ORANGE COUNTY WATER DISTRICT	6040384.981	2184652.638	Monitoring Well	80-145	6/30/2021	3.808
3018	OCWD-M30	3019	OCWD-M30/1	ORANGE COUNTY WATER DISTRICT	6043301.989	2183249.013	Monitoring Well	90-110	6/28/2021	3.325
3024	OCWD-M31	3025	OCWD-M31/1	ORANGE COUNTY WATER DISTRICT	6040492.197	2179496.985	Monitoring Well	82-162	6/28/2021	4.918
11859	OCWD-M36	11860	OCWD-M36/1	ORANGE COUNTY WATER DISTRICT	6035356.833	2200840.246	Monitoring Well	80-90	6/28/2021	2.46
14515	OCWD-M37	14516	OCWD-M37/1	ORANGE COUNTY WATER DISTRICT	6035034.164	2201302.677	Monitoring Well	120-130	6/28/2021	1.78
15127	OCWD-M38	15128	OCWD-M38/1	ORANGE COUNTY WATER DISTRICT	6030736.262	2198146.213	Monitoring Well	94-104	6/30/2021	0.234
2992	OCWD-M4	2993	OCWD-M4/1	ORANGE COUNTY WATER DISTRICT	6049340.682	2199524.535	Monitoring Well	80-120	6/28/2021	3.04
16654	OCWD-M40	16655	OCWD-M40/1	ORANGE COUNTY WATER DISTRICT	6051222.286	2195005.215	Monitoring Well	85-105	6/28/2021	0.72
18425	OCWD-M41	18427	OCWD-M41/2	ORANGE COUNTY WATER DISTRICT	6031312.152	2196141.497	Monitoring Well	95-105	6/30/2021	1.256
18418	OCWD-M42	18419	OCWD-M42/1	ORANGE COUNTY WATER DISTRICT	6030956.495	2201880.558	Monitoring Well	100-120	6/24/2021	-1.085
23769	OCWD-M43R	23770	OCWD-M43R/1	ORANGE COUNTY WATER DISTRICT	6056258.4	2193225.9	Monitoring Well	75-95	6/28/2021	-10.84
20371	OCWD-M44	20372	OCWD-M44/1	ORANGE COUNTY WATER DISTRICT	6048200.8	2193011.3	Monitoring Well	50-60	6/28/2021	5.089
19640	OCWD-M45	19641	OCWD-M45/1	ORANGE COUNTY WATER DISTRICT	6040339.8	2203350.603	Monitoring Well	195-205	6/30/2021	1.11
18766	OCWD-M48	18767	OCWD-M48/1	ORANGE COUNTY WATER DISTRICT	6059972.844	2188953.882	Monitoring Well	80-100	6/28/2021	-25.796
2942	OCWD-M5	2943	OCWD-M5/1	ORANGE COUNTY WATER DISTRICT	6046006.801	2199404.116	Monitoring Well	65-95	6/30/2021	6.035
22780	OCWD-M51A	22847	OCWD-M51A/1	ORANGE COUNTY WATER DISTRICT	6065086.6	2189052.9	Monitoring Well	28-38	6/24/2021	6.643
22782	OCWD-M52A	22845	OCWD-M52A/1	ORANGE COUNTY WATER DISTRICT	6067063.8	2192832.5	Monitoring Well	46-56	6/24/2021	14.66
22783	OCWD-M53A	22849	OCWD-M53A/1	ORANGE COUNTY WATER DISTRICT	6070492.9	2196785	Monitoring Well	21.5-31.5	7/27/2021	21.502
22785	OCWD-M54A	22852	OCWD-M54A/1	ORANGE COUNTY WATER DISTRICT	6074213.9	2188681.7	Monitoring Well	38-43	6/24/2021	-18.326
23136	OCWD-M55B	23137	OCWD-M55B/1	ORANGE COUNTY WATER DISTRICT	6073271.8	2195029.2	Monitoring Well	57-67	6/24/2021	24.195
23138	OCWD-M56	23139	OCWD-M56/1	ORANGE COUNTY WATER DISTRICT	6076007.2	2194374.4	Monitoring Well	106-116	6/24/2021	12.115
23819	OCWD-M57	23820	OCWD-M57/1	ORANGE COUNTY WATER DISTRICT	6043815.8	2186794.1	Monitoring Well	80-130	6/28/2021	3.257
23888	OCWD-M58A	23889	OCWD-M58A/1	ORANGE COUNTY WATER DISTRICT	6038939.075	2198039.987	Monitoring Well	80-90	6/28/2021	2.69
2997	OCWD-M6A	2998	OCWD-M6A/1	ORANGE COUNTY WATER DISTRICT	6043358.318	2199431.427	Monitoring Well	65-125	6/30/2021	5.345
2916	OCWD-M7A	2917	OCWD-M7A/1	ORANGE COUNTY WATER DISTRICT	6040722.972	2199455.757	Monitoring Well	70-135	7/1/2021	4.75
3004	OCWD-M8	3005	OCWD-M8/1	ORANGE COUNTY WATER DISTRICT	6036253.121	2199205.112	Monitoring Well	50-150	6/24/2021	4.403
3009	OCWD-M9	3011	OCWD-M9/2	ORANGE COUNTY WATER DISTRICT	6033874.971	2200507.549	Monitoring Well	135-155	6/30/2021	2.905
22659	OCWD-SA22R	22661	OCWD-SA22R/2	ORANGE COUNTY WATER DISTRICT	6036740.5	2194795.1	Monitoring Well	100-130	6/30/2021	2.618
3978	OCWD-T2	3980	OCWD-T2/2	ORANGE COUNTY WATER DISTRICT	6035679.306	2192640.337	Monitoring Well	70-170	6/24/2021	3.624
4804	OCWD-T3	4805	OCWD-T3/1	ORANGE COUNTY WATER DISTRICT	6035928.37	2192634.905	Monitoring Well	65-85	6/30/2021	2.581
3985	OCWD-T4	4846	OCWD-T4/1	ORANGE COUNTY WATER DISTRICT	6036181.511	2192629.058	Monitoring Well	68-168	6/30/2021	3.314
3982	OCWD-T5	3983	OCWD-T5/1	ORANGE COUNTY WATER DISTRICT	6035375.819	2190450.423	Monitoring Well	110-190	6/30/2021	4.479
20892	OCWD-YLR3	20893	OCWD-YLR3/1	ORANGE COUNTY WATER DISTRICT	6087613.912	2264061.986	Monitoring Well	31-36	6/30/2021	237.2
1052	OM-2A	1053	OM-2A/1	ORANGE COUNTY WATER DISTRICT	6064189.6	2231238.364	Monitoring Well	118-125	6/25/2021	63.638
1039	OM-4A	1040	OM-4A/1	ORANGE COUNTY WATER DISTRICT	6066713.864	2235618.971	Monitoring Well	112-117	6/23/2021	76.25
6519	OM-8A	6520	OM-8A/1	ORANGE COUNTY WATER DISTRICT	6068864.508	2240692.482	Monitoring Well	156-164	6/25/2021	89.55
20962	SAM-1	20964	SAM-1/2	ORANGE COUNTY WATER DISTRICT	6074659.6	2209328.2	Monitoring Well	132-147	6/30/2021	40.67
23285	SAM-10C	23286	SAM-10C/1	ORANGE COUNTY WATER DISTRICT	6075362.1	2201059	Monitoring Well	77.5-82.5	7/1/2021	31.8
23291	SAM-11D	23292	SAM-11D/1	ORANGE COUNTY WATER DISTRICT	6076595.5	2202810.9	Monitoring Well	90-100	6/30/2021	34.47
23297	SAM-13D	23298	SAM-13D/1	ORANGE COUNTY WATER DISTRICT	6073031.3	2202354.5	Monitoring Well	91.5-101.5	6/30/2021	32.14
20984	SAM-2	20986	SAM-2/2	ORANGE COUNTY WATER DISTRICT	6072812.2	2208121.4	Monitoring Well	121-131	6/30/2021	39.83
20958	SAM-3	20960	SAM-3/2	ORANGE COUNTY WATER DISTRICT	6074219.9	2207608.9	Monitoring Well	122-142	6/30/2021	39.53
20970	SAM-4	20972	SAM-4/2	ORANGE COUNTY WATER DISTRICT	6072905.5	2206698.6	Monitoring Well	120-135	6/30/2021	38.16
20966	SAM-5	20968	SAM-5/2	ORANGE COUNTY WATER DISTRICT	6072894	2205886.2	Monitoring Well	115-130	6/30/2021	37.31
20948	SAM-6	20950	SAM-6/2	ORANGE COUNTY WATER DISTRICT	6075457.3	2205983.5	Monitoring Well	114-134	<Null>	<Null>
23263	SAM-7C	23264	SAM-7C/1	ORANGE COUNTY WATER DISTRICT	6070824	2202542.5	Monitoring Well	106-111	7/1/2021	31.32
23301	SAM-8C	23302	SAM-8C/1	ORANGE COUNTY WATER DISTRICT	6072805.6	2199933	Monitoring Well	65.5-75.5	6/30/2021	28.61
23275	SAM-9C	23276	SAM-9C/1	ORANGE COUNTY WATER DISTRICT	6074482.7	2198350.3	Monitoring Well	58.5-63.5	6/30/2021	26.56
23824	SAR-14B	23825	SAR-14B/1	ORANGE COUNTY WATER DISTRICT	6099053.012	2261319.993	Monitoring Well	37-42	<Null>	<Null>
20926	SCS-11	20927	SCS-11/1	ORANGE COUNTY WATER DISTRICT	6070448.4	2228003	Monitoring Well	156-166	7/8/2021	48.71
20929	SCS-12	20930	SCS-12/1	ORANGE COUNTY WATER DISTRICT	6067610.6	2228198.9	Monitoring Well	170-180	7/8/2021	60.2
15392	SCS-6	15394	SCS-6/2	ORANGE COUNTY WATER DISTRICT	6081489.879	2232585.107	Monitoring Well	147-152.5	7/8/2021	85.86
15395	SCS-7	15397	SCS-7/2	ORANGE COUNTY WATER DISTRICT	6080943.41	2232168.833	Monitoring Well	125-140.5	7/8/2021	93.62
15398	SCS-8	15399	SCS-8/1	ORANGE COUNTY WATER DISTRICT	6081887.799	2233776.982	Monitoring Well	108-128.5	7/8/2021	120.23
18179	SCS-9	18180	SCS-9/1	ORANGE COUNTY WATER DISTRICT	6082464.896	2233574.788	Monitoring Well	153-173	7/8/2021	76
997	ABS-1	22665	ABS-1/1/WB2/MP3	ORANGE COUNTY WATER DISTRICT	6076226.851	2262977.612	Multiport Monitoring Well	MP3 (257)	7/7/2021	158.375
547	AMD-1	21135	AMD-1/1/WB2/MP3	ORANGE COUNTY WATER DISTRICT	6073916.932	2258572.091	Multiport Monitoring Well	MP3 (182)	6/30/2021	144.17
565	AMD-2	22202	AMD-2/1/WB2/MP1	ORANGE COUNTY WATER DISTRICT	6066705.21	2254540.618	Multiport Monitoring Well	MP1 (157)	6/29/2021	99.56
6410	AMD-3	6433	AMD-3/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6057347.584	2256481.116	Multiport Monitoring Well	MP2 (135)	<Null>	<Null>
7295	AMD-5	7315	AMD-5/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6060070.244	2248962.576	Multiport Monitoring Well	MP2 (201)	6/28/2021	81.17
7293	AMD-6	7477	AMD-6/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6057374.729	2241092.645	Multiport Monitoring Well	MP2 (152)	6/28/2021	69.17
8596	AMD-7	8748	AMD-7/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6049188.026	2247218.215	Multiport Monitoring Well	MP1 (121)	6/28/2021	59.63
9682	AMD-8	9903	AMD-8/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6033488.697	2249624.328	Multiport Monitoring Well	MP2 (180)	7/12/2021	44.575
9831	BPM-1	9980	BPM-1/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6022348.508	2259541.566	Multiport Monitoring Well	MP1 (129)	7/12/2021	26.87
9832	BPM-2	10174	BPM-2/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6025195.413	2246739.597	Multiport Monitoring Well	MP1 (181)	7/12/2021	35.65
685	CB-1	8787	CB-1/1/WB2/MP2	ORANGE COUNTY WATER DISTRICT	6044695.232	2253837.186	Multiport Monitoring Well	MP2 (143)	7/6/2021	53.15
5155	COSM-1	7143	COSM-1/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6055253.401	2197825.036	Multiport Monitoring Well	MP1 (92)	6/30/2021	2.01
18846	COSM-2	18860	COSM-2/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6052266.414	2199776.431	Multiport Monitoring Well	MP2 (115)	6/30/2021	8.62
719	FFS-1	14241	FFS-1/1/WB2/MP1	ORANGE COUNTY WATER DISTRICT	6061436.461	2262022.62	Multiport Monitoring Well	MP1 (181)	7/6/2021	88.13
1291	FVM-1	15685	FVM-1/1/WB2/MP2	ORANGE COUNTY WATER DISTRICT	6047178.815	2210990.613	Multiport Monitoring Well	MP2 (173)	6/22/2021	28.21
7297	GGM-1	10021	GGM-1/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6045688.299	2230864.24	Multiport Monitoring Well	MP1 (150)	7/8/2021	51.65
8923	GGM-2	9045	GGM-2/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6026525.607	2230233.156	Multiport Monitoring Well	MP1 (213)	6/22/2021	26.83
8592	GGM-3	8661	GGM-3/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6037298.069	2237458.988	Multiport Monitoring Well	MP1 (197)	7/8/2021	43.98

Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

Shallow Aquifer Wells (Model Layer 1)

STAID1	WELLNM	STAID	STANAME	OWNERNM	NAD83_X	NAD83_Y	GIS_SYMNM	PERF_ZONE	SHORTDATE	WLELEV_2021
7178	HBM-1	8433	HBM-1/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6031700.722	2216385.252	Multiport Monitoring Well	MP1 (91)	7/2/2021	24.52
7086	HBM-2	7218	HBM-2/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6036228.737	2196532.383	Multiport Monitoring Well	MP1 (112)	7/2/2021	3.49
9200	HBM-4	9219	HBM-4/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6034095.825	2197123.319	Multiport Monitoring Well	MP2 (120)	7/2/2021	2.99
9688	HBM-5	9873	HBM-5/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6045744.869	2193971.856	Multiport Monitoring Well	MP2 (76)	7/2/2021	9.36
15088	HBM-6	15239	HBM-6/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6025106.578	2204548.969	Multiport Monitoring Well	MP1 (53)	7/2/2021	-6.84
720	IDM-1	18976	IDM-1/1/WB2/MP1	ORANGE COUNTY WATER DISTRICT	6099572.243	2207081.537	Multiport Monitoring Well	MP1 (86)	7/7/2021	92.85
9830	IDM-2	10059	IDM-2/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6080705.598	2209836.046	Multiport Monitoring Well	MP1 (129)	7/7/2021	48.9
541	KBS-2	10226	KBS-2/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6073053.762	2260992.439	Multiport Monitoring Well	MP2 (214)	6/21/2021	144.53
11949	LAM-1	12020	LAM-1/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6009581.587	2238043.705	Multiport Monitoring Well	MP1 (72)	6/15/2021	13.07
1345	MCAS-1	5841	MCAS-1/1/WB2/MP2	ORANGE COUNTY WATER DISTRICT	6098255.481	2192973.357	Multiport Monitoring Well	MP2 (155)	7/6/2021	97.79
759	MCAS-2	5926	MCAS-2/1/WB2/MP2	ORANGE COUNTY WATER DISTRICT	6100360.442	2191167.958	Multiport Monitoring Well	MP2 (135)	7/6/2021	106.75
1339	MCAS-3	5882	MCAS-3/1/WB2/MP2	ORANGE COUNTY WATER DISTRICT	6104434.428	2191276.758	Multiport Monitoring Well	MP2 (166)	7/6/2021	114.92
758	MCAS-7	11826	MCAS-7/1/WB3/MP1	ORANGE COUNTY WATER DISTRICT	6093900.827	2194418.586	Multiport Monitoring Well	MP1 (92)	7/7/2021	83.2
756	SAR-1	9257	SAR-1/1/WB2/MP1	ORANGE COUNTY WATER DISTRICT	6070684.206	2250425.314	Multiport Monitoring Well	MP1 (162)	6/29/2021	92.52
761	SAR-2	11984	SAR-2/1/WB2/MP1	ORANGE COUNTY WATER DISTRICT	6069096.008	2245410.807	Multiport Monitoring Well	MP1 (141)	6/29/2021	99.88
762	SAR-3	9461	SAR-3/1/WB2/MP1	ORANGE COUNTY WATER DISTRICT	6066892.02	2238409.284	Multiport Monitoring Well	MP1 (164)	6/24/2021	81.47
763	SAR-4	14628	SAR-4/1/WB2/MP1	ORANGE COUNTY WATER DISTRICT	6065370.966	2233375.154	Multiport Monitoring Well	MP1 (123)	6/29/2021	70.47
1289	SAR-5	21217	SAR-5/1/WB3/MP2	ORANGE COUNTY WATER DISTRICT	6062597.607	2227874.211	Multiport Monitoring Well	MP2 (172)	6/30/2021	58.48
996	SAR-7	19998	SAR-7/1/WB2/MP2	ORANGE COUNTY WATER DISTRICT	6078049.17	2256383.048	Multiport Monitoring Well	MP2 (171)	6/21/2021	183.21
559	SAR-8	22591	SAR-8/1/WB2/MP3	ORANGE COUNTY WATER DISTRICT	6076100.201	2255671.218	Multiport Monitoring Well	MP3 (161)	6/21/2021	204.32
7181	SAR-9	9796	SAR-9/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6058380.802	2221450.982	Multiport Monitoring Well	MP1 (150)	6/30/2021	49.087
9686	SBM-1	9723	SBM-1/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6016566.11	2224523.54	Multiport Monitoring Well	MP1 (79)	6/15/2021	8.535
1000	SC-1	21651	SC-1/1/WB2/MP1	ORANGE COUNTY WATER DISTRICT	6089555.444	2242038.806	Multiport Monitoring Well	MP1 (47)	<Null>	<Null>
1001	SC-2	18744	SC-2/1/WB2/MP3	ORANGE COUNTY WATER DISTRICT	6086489.295	2237887.557	Multiport Monitoring Well	MP3 (148)	<Null>	<Null>
2888	SC-4	6293	SC-4/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6082605.785	2235080.546	Multiport Monitoring Well	MP1 (102)	3/10/2021	164.02
2854	SC-5	6327	SC-5/1/WB1/MP1	ORANGE COUNTY WATER DISTRICT	6077454.866	2225543.458	Multiport Monitoring Well	MP1 (124)	7/1/2021	59.96
9684	SC-6	9754	SC-6/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6066813.288	2216032.113	Multiport Monitoring Well	MP2 (202)	7/7/2021	47.93
1016	SCS-1	8863	SCS-1/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6088950.708	2237855.374	Multiport Monitoring Well	MP2 (94)	<Null>	<Null>
1014	SCS-2	22649	SCS-2/1/WB2/MP1	ORANGE COUNTY WATER DISTRICT	6088207.123	2239962.183	Multiport Monitoring Well	MP1 (139)	<Null>	<Null>
1008	WBS-2A	10234	WBS-2A/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	6082321.431	2259606.923	Multiport Monitoring Well	MP2 (94)	6/21/2021	208.44
1011	WBS-4	19982	WBS-4/1/WB2/MP2	ORANGE COUNTY WATER DISTRICT	6080099.39	2256910.089	Multiport Monitoring Well	MP2 (122)	6/21/2021	193.21
1293	WMM-1	19877	WMM-1/1/WB2/MP1	ORANGE COUNTY WATER DISTRICT	6038251.554	2221751.195	Multiport Monitoring Well	MP1 (111)	7/8/2021	35.73
1124	OCWD-BESS	1152	OCWD-BESS/1	ORANGE COUNTY WATER DISTRICT	6080158.417	2258062.783	Other Active Production Well	172-189	7/7/2021	171.45
1399	OWOD-GG	1400	OWOD-GG/1	ORANGEWOOD ACADEMY	6057015.043	2226104.239	Other Active Production Well	159-179	6/28/2021	57.78
2268	W-2268	2270	W-2268/1	PRIVATE	6055379.538	2239905.999	Inactive Production Well	140-190	6/28/2021	65.1
2447	W-2447	2448	W-2447/1	PRIVATE	6039781.004	2230376.471	Inactive Production Well	157-178	6/30/2021	45.52
7046	W-7046	7047	W-7046/1	PRIVATE	6078609.174	2244437.793	Inactive Production Well	-	7/8/2021	83.04
23777	PRUD-MW49	23778	PRUD-MW49/1	PRUDENTIAL REALTY CORPORATION	6075571.865	2190248.213	Monitoring Well	22-32	<Null>	<Null>
23783	PRUD-TP07	23784	PRUD-TP07/1	PRUDENTIAL REALTY CORPORATION	6075439.364	2190268.695	Monitoring Well	22-32	<Null>	<Null>
23785	PRUD-TP10	23786	PRUD-TP10/1	PRUDENTIAL REALTY CORPORATION	6075138.851	2190153.723	Monitoring Well	35-45	<Null>	<Null>
22761	RAY-P07	22762	RAY-P07/1	RAYTHEON TECHNOLOGIES CORPORATION	6042051.6	2268371.59	Monitoring Well	107.7-129.6	6/30/2021	56.01
22763	RAY-P09	22764	RAY-P09/1	RAYTHEON TECHNOLOGIES CORPORATION	6042223.4	2268769.56	Monitoring Well	109.6-129.6	6/30/2021	68.63
1194	SANZ-C	1195	SANZ-C/1	SANCHEZ, AMELIA	6023494.753	2248016.248	Other Active Production Well	76-83	6/28/2021	42.58
1164	RODE-A	1165	RODE-A/1	SILICON SALVAGE	6035121.635	2259930.623	Other Active Production Well	178-208	6/28/2021	40.77
3743	TIC-127	3744	TIC-127/1	SOUTHERN CALIFORNIA EDISON	6098420.447	2188499.752	Monitoring Well	-	<Null>	<Null>
19683	BOE-MW31S	19684	BOE-MW31S/1	THE BOEING COMPANY	6017036.97	2217640.872	Monitoring Well	78-88	6/7/2021	-3.481
20244	BOE-EW102	20245	BOE-EW102/1	THE BOEING COMPANY	6017705	2219232.003	Other Active Production Well	62-81.7	<Null>	<Null>
1128	TMIX-O	1129	TMIX-O/1	TRANSIT MIXED CONCRETE COMPANY	6069953.158	2244552.046	Abandoned Well	76-288	6/29/2021	107.06
1370	T-NEWP	1371	T-NEWP/1	TUSTIN	6087882.616	2220782.263	Active Large-System Production Well	234-267	7/1/2021	31.06
21187	WRD-SEALBEACH-1	21188	WRD-SEALBEACH-1/1	WATER REPLENISHMENT DISTRICT	6002807.228	2229796.158	Monitoring Well	60-70	6/7/2021	-0.287
23796	XER-MW3	23797	XER-MW3/1	XEROX CORPORATION	6074925.4	2191231.3	Destroyed and Sealed Well	29-34	<Null>	<Null>
23801	XER-MW5	23802	XER-MW5/1	XEROX CORPORATION	6076231.9	2191234.6	Monitoring Well	34.5-39.5	<Null>	<Null>
23803	XER-OW50	23804	XER-OW50/1	XEROX CORPORATION	6074926.467	2191241.45	Monitoring Well	35-47	<Null>	<Null>
7027	YLWD-16	7028	YLWD-16/1	YORBA LINDA WATER DISTRICT	6123141.996	2265497.536	Destroyed and Sealed Well	40-60	<Null>	<Null>
7529	YLWD-17	7530	YLWD-17/1	YORBA LINDA WATER DISTRICT	6123146.156	2265420.578	Destroyed and Sealed Well	42-82	<Null>	<Null>
1520	YLWD-15	1521	YLWD-15/1	YORBA LINDA WATER DISTRICT	6085437.359	2260363.815	Standby Large-System Production Well	133-198	<Null>	<Null>

Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

Principal Aquifer Wells (Model Layer 2)

STAID1	WELLNM	STAID	STANAME	OWNERNM	GIS_SYMNM	NAD83_X	NAD83_Y	PERF_ZONE	SHORTDATE	WLELEV_2021	NOTES
15484	AVCC-P2	15485	AVCC-P2/1	ALTA VISTA COUNTRY CLUB	Other Active Production Well	6075388.705	2267012.656	210-770	6/29/2021	83.575	<Null>
903	A-39	904	A-39/1	ANAHEIM	Active Large-System Production Well	6029597.629	2248076.493	540-1280	6/24/2021	0.95	<Null>
8	A-40	109	A-40/1	ANAHEIM	Active Large-System Production Well	6042665.936	2241510.291	505-1220	6/25/2021	0.99	<Null>
2	A-42	102	A-42/1	ANAHEIM	Active Large-System Production Well	6076410.19	2260884.14	430-1180	6/24/2021	158.27	<Null>
3	A-44	106	A-44/1	ANAHEIM	Active Large-System Production Well	6075745.03	2262067.192	450-1130	6/24/2021	149.51	<Null>
18323	A-45	18324	A-45/1	ANAHEIM	Active Large-System Production Well	6064928.908	2240047.749	455-1410	6/24/2021	70.25	<Null>
9029	A-46	9030	A-46/1	ANAHEIM	Active Large-System Production Well	6063620.6	2247980.932	599-1529	6/24/2021	78.27	<Null>
3296	A-47	3297	A-47/1	ANAHEIM	Active Large-System Production Well	6043274.016	2253508.899	482-1375	6/25/2021	6.94	<Null>
20128	A-48	20129	A-48/1	ANAHEIM	Active Large-System Production Well	6039676.184	2252635.146	932-1344	6/25/2021	-8	<Null>
7175	A-49	7176	A-49/1	ANAHEIM	Active Large-System Production Well	6051692.012	2255804.997	580-1450	6/24/2021	42.3	<Null>
18380	A-51	18381	A-51/1	ANAHEIM	Active Large-System Production Well	6033547.226	2249423.825	525-965	6/25/2021	-13.82	<Null>
19546	A-52	19547	A-52/1	ANAHEIM	Active Large-System Production Well	6077704.821	2261093.873	570-1066	6/24/2021	169.8	<Null>
19371	A-53	19372	A-53/1	ANAHEIM	Active Large-System Production Well	6037376.558	2245173.272	945-1270	6/25/2021	-15	<Null>
20130	A-54	20131	A-54/1	ANAHEIM	Active Large-System Production Well	6057250.4	2249808.49	680-1480	6/24/2021	37.5	<Null>
15155	A-55	15156	A-55/1	ANAHEIM	Active Large-System Production Well	6057199.693	2240917.141	370-1300	6/24/2021	24.82	<Null>
20814	A-56	20815	A-56/1	ANAHEIM	Active Large-System Production Well	6049068.109	2246784.849	725-1300	6/24/2021	11	<Null>
22689	A-58	22690	A-58/1	ANAHEIM	Active Large-System Production Well	6076957.97	2260975.182	400-930	6/24/2021	157	<Null>
23093	A-59	23094	A-59/1	ANAHEIM	Active Large-System Production Well	6050447.318	2241983.774	740-1270	6/24/2021	18	<Null>
9	A-41	112	A-41/1	ANAHEIM	Inactive Production Well	6053236.333	2238146.843	437-1450	6/29/2021	17.41	<Null>
1	A-43	101	A-43/1	ANAHEIM	Inactive Production Well	6075927.929	2261453.161	530-1210	6/24/2021	155.86	<Null>
882	A-DMGC	883	A-DMGC/1	ANAHEIM	Other Active Production Well	6039662.685	2252561.822	430-482	6/25/2021	3	<Null>
11918	BP-BALL	11919	BP-BALL/1	BUENA PARK	Active Large-System Production Well	6022213.798	2245381.375	260-870	6/28/2021	-8.9	<Null>
11890	BP-BOIS	11891	BP-BOIS/1	BUENA PARK	Active Large-System Production Well	6035674.646	2258374.859	475-1355	6/30/2021	14.03	<Null>
6	BP-CABA	110	BP-CABA/1	BUENA PARK	Active Large-System Production Well	6024286.125	2262965.786	250-1010	6/28/2021	-24.6	<Null>
394	BP-FREE	901	BP-FREE/1	BUENA PARK	Active Large-System Production Well	6026742.413	2259834.394	260-1000	6/28/2021	-24.5	<Null>
13	BP-HOLD	103	BP-HOLD/1	BUENA PARK	Active Large-System Production Well	6024539.646	2250081.536	250-1000	7/1/2021	-6.4	<Null>
205	BP-KNOT	206	BP-KNOT/1	BUENA PARK	Active Large-System Production Well	6026889.096	2263326.166	260-1000	6/28/2021	-22.7	<Null>
19624	BP-LIND	19625	BP-LIND/1	BUENA PARK	Active Large-System Production Well	6033483.531	2254059.483	470-1221	7/1/2021	-11.5	<Null>
4	BP-SM	107	BP-SM/1	BUENA PARK	Active Large-System Production Well	6033035.282	2270048.001	308-1038	6/29/2021	60.3	<Null>
19013	CSF-1	19130	CSF-1/1/WB1/MP4	CA. STATE UNIV., FULLERTON	Multiport Monitoring Well	6064343.084	2270822.497	MP4 (454)	7/6/2021	95.19	<Null>
5133	OCWD-SA10	5136	OCWD-SA10/3	DEPARTMENT OF WATER RESOURCES	Monitoring Well	6039247.362	2190515.118	300-330	6/28/2021	-27.73	<Null>
75	EOCW-E	2624	EOCW-E/1	EAST ORANGE COUNTY WATER DISTRICT	Active Large-System Production Well	6084070.661	2234506.703	324-450	6/9/2021	40.6	<Null>
74	EOCW-W	2623	EOCW-W/1	EAST ORANGE COUNTY WATER DISTRICT	Active Large-System Production Well	6084006.305	2234482.779	315-450	6/9/2021	42.5	<Null>
1636	ANDR-A	3116	ANDR-A/1	ELTISTE, JAMIE	Other Active Production Well	6089089.85	2256920.388	-	6/29/2021	266.7	<Null>
2151	FV-10	2152	FV-10/1	FOUNTAIN VALLEY	Active Large-System Production Well	6050675.518	2207799.966	460-980	3/28/2021	-32.08	<Null>
2218	FV-11	2219	FV-11/1	FOUNTAIN VALLEY	Active Large-System Production Well	6043548.905	2210280.198	440-950	6/28/2021	-13.22	<Null>
15548	FV-12	15549	FV-12/1	FOUNTAIN VALLEY	Active Large-System Production Well	6048362.825	2212580.442	340-1070	6/28/2021	-19.8	<Null>
643	FV-6	1228	FV-6/1	FOUNTAIN VALLEY	Active Large-System Production Well	6052471.003	2208423.32	370-1110	6/27/2021	-57.6	<Null>
989	FV-8	990	FV-8/1	FOUNTAIN VALLEY	Active Large-System Production Well	6052244.232	2213617.679	312-844	6/23/2021	-22.77	<Null>
21043	FV-9	21044	FV-9/1	FOUNTAIN VALLEY	Active Large-System Production Well	6039667.163	2210310.989	415-1070	7/3/2021	-39.2	<Null>
6999	F-10	7000	F-10/1	FULLERTON	Active Large-System Production Well	6062173.417	2262322.138	460-1290	6/30/2021	78.92	<Null>
62	F-4	1066	F-4/1	FULLERTON	Active Large-System Production Well	6053113.41	2256243.518	315-405	<Null>	<Null>	No static water level
60	F-5	1064	F-5/1	FULLERTON	Active Large-System Production Well	6052548.597	2256107.709	350-400	6/30/2021	73.32	<Null>
61	F-6	1065	F-6/1	FULLERTON	Active Large-System Production Well	6052747.388	2256082.222	340-401	<Null>	<Null>	No static water level
58	F-8	1062	F-8/1	FULLERTON	Active Large-System Production Well	6052703.232	2256195.873	324-402	6/30/2021	53.02	<Null>
7	F-AIRP	111	F-AIRP/1	FULLERTON	Active Large-System Production Well	6036730.867	2265796.644	435-1080	6/30/2021	-0.98	<Null>
8250	F-CHRI2	8251	F-CHRI2/1	FULLERTON	Active Large-System Production Well	6043423.817	2259590.954	520-1330	6/30/2021	11	<Null>
18605	F-KIM1A	18606	F-KIM1A/1	FULLERTON	Active Large-System Production Well	6059437.543	2261596.705	500-1225	<Null>	<Null>	No static water level
2614	F-KIM2	2615	F-KIM2/1	FULLERTON	Active Large-System Production Well	6062988.653	2261590.596	320-626	6/30/2021	83.02	<Null>
14527	F-3A	14528	F-3A/1	FULLERTON	Inactive Production Well	6052567.9	2256330.735	580-1280	6/30/2021	43.62	<Null>
8556	F-COYO2	8557	F-COYO2/1	FULLERTON	Inactive Production Well	6040365.852	2271034.694	309-919	6/30/2021	85.12	<Null>
16	GG-16	120	GG-16/1	GARDEN GROVE	Active Large-System Production Well	6018579.01	2232461.498	304-864	6/30/2021	-17.92	<Null>
24	GG-20	126	GG-20/1	GARDEN GROVE	Active Large-System Production Well	6038073.339	2227032.571	360-912	7/2/2021	-3	<Null>
395	GG-22	929	GG-22/1	GARDEN GROVE	Active Large-System Production Well	6026676.395	2235110.939	416-1020	6/28/2021	-8	<Null>
970	GG-25	971	GG-25/1	GARDEN GROVE	Active Large-System Production Well	6047504.135	2225582.455	442-850	7/4/2021	-4	<Null>
968	GG-26	969	GG-26/1	GARDEN GROVE	Active Large-System Production Well	6055989.26	2226872.674	470-1060	6/27/2021	-7.5	<Null>
899	GG-27	900	GG-27/1	GARDEN GROVE	Active Large-System Production Well	6037663.073	2237687.515	520-1160	7/6/2021	-2	<Null>
21518	GG-31	21519	GG-31/1	GARDEN GROVE	Active Large-System Production Well	6049303.952	2233106.343	739-1373	7/7/2021	-12	<Null>
43	GG-19	2673	GG-19/1	GARDEN GROVE	Inactive Production Well	6046486.765	2237386.406	818-892	6/30/2021	12.66	<Null>
10	GG-21	113	GG-21/1	GARDEN GROVE	Inactive Production Well	6053483.401	2233322.843	428-1080	6/28/2021	10	<Null>
40	GG-23	2683	GG-23/1	GARDEN GROVE	Inactive Production Well	6049380.377	2233107.081	474-835	6/30/2021	21	<Null>
11910	GG-29	11911	GG-29/1	GARDEN GROVE	Standby Large-System Production Well	6058221.696	2231433.99	465-1110	6/28/2021	-8	<Null>
19548	GG-30	19549	GG-30/1	GARDEN GROVE	Standby Large-System Production Well	6058357.807	2234214.139	390-1146	6/28/2021	19.2	<Null>
23833	GSWC-CHF3	23834	GSWC-CHF3/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6080817.993	2228562.283	415-825	6/1/2021	2.66	<Null>
20695	GSWC-POR1	20696	GSWC-POR1/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6079506.635	2263540.675	350-895	<Null>	<Null>	No static water level
21249	GSWC-SCL5	21250	GSWC-SCL5/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6033365.183	2242754.29	915-1280	6/26/2021	-14	<Null>
913	SCWC-CBAL	914	SCWC-CBAL/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6020255.615	2245432.308	200-770	6/26/2021	-16.3	<Null>
905	SCWC-CSC	906	SCWC-CSC/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6019058.295	2249273.52	526-556	6/29/2021	-16	<Null>
15059	SCWC-LABL2	15060	SCWC-LABL2/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6010813.626	2245084.513	460-690	6/25/2021	-45	<Null>
909	SCWC-LAC3	910	SCWC-LAC3/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6009351.523	2240861.379	346-593	6/2/2021	-39.28	<Null>
2890	SCWC-LAFL	2891	SCWC-LAFL/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6009761.621	2241392.543	300-680	6/2/2021	-44.7	<Null>
932	SCWC-LAHO	933	SCWC-LAHO/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6013044.186	2239882.249	386-486	6/26/2021	-22.15	<Null>
938	SCWC-LAYT	939	SCWC-LAYT/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6006632.572	2231013.121	250-800	6/29/2021	-47.42	<Null>
83	SCWC-PBF4	1075	SCWC-PBF4/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6069384.796	2263342.45	275-520	5/25/2021	119	<Null>
66	SCWC-PLJ2	1070	SCWC-PLJ2/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6067609.83	2260053.948	402-492	6/25/2021	106	<Null>
15488	SCWC-PRU	15489	SCWC-PRU/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6069096.18	2266983.102	430-790	6/30/2021	98	<Null>
940	SCWC-SBCH	941	SCWC-SBCH/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6031904.764	2233300.581	200-570	<Null>	<Null>	Well in exclusion list
925	SCWC-SDAL	926	SCWC-SDAL/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6034900.671	2235490.72	500-542	6/28/2021	-1	<Null>
1530	SCWC-SLON	1531	SCWC-SLON/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6028180.861	2242547.915	-	6/26/2021	1	<Null>
927	SCWC-SORG	928	SCWC-SORG/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6031153.704	2237527.217	242-286	<Null>	<Null>	Well in exclusion list
919	SCWC-SSHR	920	SCWC-SSHR/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6036356.964	2241844.025	520-580	6/29/2021	14	<Null>
942	SCWC-SSYC	943	SCWC-SSYC/1	GOLDEN STATE WATER COMPANY	Active Large-System Production Well	6033362.684	2230788.849	500-546	6/16/2021	-5	<Null>
18790	RHWC-W2	18791	RHWC-W2/1	GOLDEN STATE WATER COMPANY	Inactive Production Well	6080901.573	2228585.131	474-753	6/1/2021	-4.2	<Null>
19579	SCWC-CVV2	19580	SCWC-CVV2/1	GOLDEN STATE WATER COMPANY	Inactive Production Well	6021484.347	2249526.359	480-981	6/29/2021	-16	<Null>
2616	SCWC-PBF3	2617	SCWC-PBF3/1	GOLDEN STATE WATER COMPANY	Inactive Production Well	6069378.014	2263398.289	220-475	5/25/2021	117	<Null>
9522	SCWC-YLCO2	9523	SCWC-YLCO2/1	GOLDEN STATE WATER COMPANY	Inactive Production Well	6091725.912	2261952.552	100-480	5/25/2021	254	<Null>
1147	HOLY-A	1148	HOLY-A/1	HOLY SEPULCHER CEMETERY	Other Active Production Well	6047567.386	2247438.547	334-364	6/28/2021	23.43	<Null>
1244	HB-10	1245	HB-10/1	HUNTINGTON BEACH	Active Large-System Production Well	6031343.851	2212699.814	232-942	6/30/2021	-39.55	<Null>
18384	HB-13	18385	HB-13/1	HUNTINGTON BEACH	Active Large-System Production Well	6021661.742	2221160.513	280-810	6/14/2021	-44.54	<Null>
23201	HB-1A	23202	HB-1A/1	HUNTINGTON BEACH	Active Large-System Production Well	6023131.185	2218817.882	410-805	4/29/2021	-42.324	<Null>
10208	HB-3A	10209	HB-3A/1	HUNTINGTON BEACH	Active Large-System Production Well	6031590.226	2208300.41	370-640	6/28/2021	-41.53	<Null>
27	HB-4	130	HB-4/1	HUNTINGTON BEACH	Active Large-System Production Well	6021540.371	2221406.93	252-804	6/28/2021	-30.04	<Null>
1252	HB-5	1253	HB-5/1	HUNTINGTON BEACH	Active Large-System Production Well	6036338.835	2208549.742	223-800	6/29/2021	-39.24	<Null>
1246	HB-6	1247	HB-6/1	HUNTINGTON BEACH	Active Large-System Production Well	6029305.314	2212450.473	246-810	6/15/2021	-44.55	<Null>
1261	HB-7	1262	HB-7/1	HUNTINGTON BEACH	Active Large-System Production Well	6022149.127	2221238.007	263-879	6/21/2021	-37.74	<Null>
28	HB-9	129	HB-9/1	HUNTINGTON BEACH	Active Large-System Production Well	6037364.908	2208498.213	556-996	6/30/2021	-55.58	<Null>
1248	HB-8	1249	HB-8/1	HUNTINGTON BEACH	Inactive Production Well	6027670.035	2209264.856	256-704	6/15/2021	-45.53	<Null>
1457	HB-MEA2	1458	HB-MEA2/1	HUNTINGTON BEACH	Other Active Production Well	6020702.13	2209754.143	480-510	6/29/2021	-44.67	<Null>
1643	TAOR-A	3123	TAOR-A/1	HUYNH, TUAN	Inactive Production Well	6067751.89	2255475.782	-	6/28/2021	90.52	<Null>
22	IRWD-1	124	IRWD-1/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6061580.041	2205422.106	410-860	6/23/2021	-85.8	<Null>
11476	IRWD-10	11477	IRWD-10/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6055993.429	2207529.468	419.07-939.6	<Null>	<Null>	No static water level
22342	IRWD-107R	22343	IRWD-107R/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6095711.53	2205898.451	275-1000	<Null>	<Null>	No static water level
393	IRWD-11	1224	IRWD-11/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6059766.912	2205005.285	410-870	6/23/2021	-98.3	<Null>
19366	IRWD-110	19367	IRWD-110/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6100371.561	2196315.961	555-1015	<Null>	<Null>	No static water level
22856	IRWD-115R	22857	IRWD-115R/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6093475.865	2207945.022	290-1080	<Null>	<Null>	No static water level
397	IRWD-12	991	IRWD-12/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6057023.616	2209371.259	580-1040	5/26/2021	-67.4	<Null>

Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

Principal Aquifer Wells (Model Layer 2)

STAID1	WELLNM	STAID	STANAME	OWNERNM	GIS_SYMNM	NAD83_X	NAD83_Y	PERF_ZONE	SHORTDATE	WLELEV_2021	NOTES
392	IRWD-13	1227	IRWD-13/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6056862.056	2205734.981	410-980	6/30/2021	-76	<Null>
1225	IRWD-14	1226	IRWD-14/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6057193.114	2207516.401	470-970	6/30/2021	-90.2	<Null>
7082	IRWD-15	7083	IRWD-15/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6058994.6	2207797.409	470-990	4/21/2021	-62.1	<Null>
14827	IRWD-16	14828	IRWD-16/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6055756.572	2207045.785	406.03-806.73	6/30/2021	-75.3	<Null>
11478	IRWD-17	11479	IRWD-17/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6056285.662	2208810.875	504.06-959.62	4/21/2021	-52.2	<Null>
21	IRWD-18	115	IRWD-18/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6060643.784	2208050.14	390-1080	<Null>	<Null>	No static water level
994	IRWD-2	995	IRWD-2/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6067589.167	2204114.565	385-855	4/21/2021	-75.9	<Null>
8372	IRWD-21	8373	IRWD-21/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6083385.042	2214485.399	290-970	6/29/2021	2.41	<Null>
8370	IRWD-22	8371	IRWD-22/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6083876.226	2214049.348	300-970	<Null>	<Null>	No static water level
11474	IRWD-3	11475	IRWD-3/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6072630.329	2206528.469	483.53-1249.9	6/23/2021	-64.9	<Null>
672	IRWD-4	993	IRWD-4/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6065784.295	2205666.545	440-910	<Null>	<Null>	No static water level
15490	IRWD-5	15491	IRWD-5/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6070026.423	2205985.727	554.42-1028.47	<Null>	<Null>	No static water level
8558	IRWD-6	8559	IRWD-6/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6067126.622	2207312.356	499-1124	3/23/2021	-51.4	<Null>
8560	IRWD-7	8561	IRWD-7/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6057958.676	2203766.228	359-660	6/23/2021	-86.8	<Null>
19412	IRWD-76	19413	IRWD-76/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6097532.587	2201980.705	450-900	<Null>	<Null>	No static water level
19414	IRWD-77	19415	IRWD-77/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6095951.099	2203527.216	330-980	<Null>	<Null>	No static water level
18510	IRWD-C8	18511	IRWD-C8/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6062825.396	2204153.762	1080-1982	<Null>	<Null>	Well in exclusion list
18512	IRWD-C9	18513	IRWD-C9/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6062422.93	2205055.852	1055-1930	<Null>	<Null>	Well in exclusion list
8929	IRWD-51	8930	IRWD-51/1	IRVINE RANCH WATER DISTRICT	Inactive Production Well	6072287.787	2201236.375	310-880	6/29/2021	-51.7	<Null>
22065	IRWD-52	22066	IRWD-52/1	IRVINE RANCH WATER DISTRICT	Inactive Production Well	6073545.847	2203710.984	635-1290	6/29/2021	-62.3	<Null>
1503	IRWD-98	1504	IRWD-98/1	IRVINE RANCH WATER DISTRICT	Inactive Production Well	6080266.015	2190031.269	115-343	6/29/2021	-54.42	<Null>
22710	IRWD-OPA1	22711	IRWD-OPA1/1	IRVINE RANCH WATER DISTRICT	Inactive Production Well	6086291.17	2237727.918	390-750	6/28/2021	41.5	<Null>
1379	TIC-109	1380	TIC-109/1	IRVINE RANCH WATER DISTRICT	Inactive Production Well	6093513	2212849.72	240-1120	6/29/2021	16.9	<Null>
1381	TIC-112	1382	TIC-112/1	IRVINE RANCH WATER DISTRICT	Inactive Production Well	6092052.48	2212026.724	240-1100	6/29/2021	15.23	<Null>
1377	TIC-114	1378	TIC-114/1	IRVINE RANCH WATER DISTRICT	Inactive Production Well	6094747.508	2212848.22	300-960	6/29/2021	19.88	<Null>
1941	TIC-82	1942	TIC-82/1	IRVINE RANCH WATER DISTRICT	Monitoring Well	6090541.059	2199639.983	410-1002	6/29/2021	-8.83	<Null>
1343	IRWD-72	1344	IRWD-72/1	IRVINE RANCH WATER DISTRICT	Other Active Production Well	6090498.014	2215406.267	254-1151	6/29/2021	9.9	<Null>
1389	TIC-106	1390	TIC-106/1	IRVINE RANCH WATER DISTRICT	Other Active Production Well	6084967	2197177.989	405-715	3/23/2021	-45.1	<Null>
432	W-432	433	W-432/1	KATHY BONANNO	Inactive Production Well	6080325.38	2272580.463	117-137	6/30/2021	286.97	<Null>
1176	KNOT-BPBS	1515	KNOT-BPBS/1	KNOTT'S BERRY FARM	Active Small-System Production Well	6029633.814	2254234.979	430-630	6/29/2021	8.14	<Null>
12	LP-CITY	105	LP-CITY/1	LA PALMA	Active Large-System Production Well	6015567.916	2254199.963	290-1415	6/29/2021	-72.67	<Null>
5	LP-WALK	108	LP-WALK/1	LA PALMA	Active Large-System Production Well	6019189.082	2262316.73	489-919	6/25/2021	-25.45	<Null>
14284	MSG-BP10L	14285	MSG-BP10L/1	MCCOLL SITE GROUP	Monitoring Well	6037931.453	2272258.752	247-257	6/30/2021	103.92	<Null>
1505	MVCC-COSD2	1506	MVCC-COSD2/1	MESA VERDE COUNTRY CLUB	Other Active Production Well	6049566.742	2197240.664	200-450	6/30/2021	-65.825	<Null>
15780	MCWD-11	15781	MCWD-11/1	MESA WATER DISTRICT	Active Large-System Production Well	6055237.67	2197733.913	330-1000	7/7/2021	-86.57	<Null>
10138	MCWD-1B	10139	MCWD-1B/1	MESA WATER DISTRICT	Active Large-System Production Well	6058120.94	2200970.067	305-580	<Null>	<Null>	No static water level
31	MCWD-3B	2892	MCWD-3B/1	MESA WATER DISTRICT	Active Large-System Production Well	6053761.218	2202557.912	242-572	<Null>	<Null>	Well in exclusion list
1231	MCWD-5	1232	MCWD-5/1	MESA WATER DISTRICT	Active Large-System Production Well	6051212.891	2202686.998	400-940	<Null>	<Null>	No static water level
2135	MCWD-6	2136	MCWD-6/1	MESA WATER DISTRICT	Active Large-System Production Well	6055652.152	2197722.22	310-1025	<Null>	<Null>	No static water level
1233	MCWD-7	1234	MCWD-7/1	MESA WATER DISTRICT	Active Large-System Production Well	6053044.669	2200013.913	363-753	<Null>	<Null>	No static water level
23121	MESA-9B	23122	MESA-9B/1	MESA WATER DISTRICT	Active Large-System Production Well	6055224.568	2200729.295	350-580	<Null>	<Null>	No static water level
23	MCWD-2	125	MCWD-2/1	MESA WATER DISTRICT	Monitoring Well	6060220.541	2200931.5	300-650	7/7/2021	-88.14	<Null>
7747	MCWD-3BM	7748	MCWD-3BM/1	MESA WATER DISTRICT	Monitoring Well	6053810.232	2202578.466	530-570	7/7/2021	-67.5	<Null>
14833	NB-DOLD	14834	NB-DOLD/1	NEWPORT BEACH	Active Large-System Production Well	6041557.515	2205737.495	399-729	6/30/2021	-41.75	<Null>
14835	NB-DOLS	14836	NB-DOLS/1	NEWPORT BEACH	Active Large-System Production Well	6041637.348	2205746.699	201-356	<Null>	<Null>	Well in exclusion list
14837	NB-TAMD	14838	NB-TAMD/1	NEWPORT BEACH	Active Large-System Production Well	6037391.886	2206329.916	395-690	6/29/2021	-42.79	<Null>
14839	NB-TAMS	14840	NB-TAMS/1	NEWPORT BEACH	Active Large-System Production Well	6037391.924	2206247.365	170-360	<Null>	<Null>	Well in exclusion list
71	O-18	2625	O-18/1	ORANGE	Active Large-System Production Well	6073004.258	2233669.343	372-574	6/28/2021	44.64	<Null>
79	O-19	2618	O-19/1	ORANGE	Active Large-System Production Well	6072211.218	2241094.476	444-1014	6/28/2021	105.35	<Null>
2694	O-20	2696	O-20/1	ORANGE	Active Large-System Production Well	6065992.895	2234093.189	400-1130	6/28/2021	13.83	<Null>
81	O-21	1073	O-21/1	ORANGE	Active Large-System Production Well	6075241.088	2245598.993	482-1252	6/28/2021	90.16	<Null>
2921	O-22	3295	O-22/1	ORANGE	Active Large-System Production Well	6077271.09	2239348.179	342-802	6/28/2021	53.77	<Null>
7173	O-23	7174	O-23/1	ORANGE	Active Large-System Production Well	6084469.321	2236564.181	370-640	6/28/2021	23.32	<Null>
10140	O-24	10141	O-24/1	ORANGE	Active Large-System Production Well	6084080.037	2238925.34	420-800	6/28/2021	42.65	<Null>
15474	O-25	15475	O-25/1	ORANGE	Active Large-System Production Well	6078385.795	2233068.736	430-885	6/28/2021	-9.78	<Null>
18435	O-26	18436	O-26/1	ORANGE	Active Large-System Production Well	6061791.146	2233358.136	460-1170	6/28/2021	-2.58	<Null>
22860	O-27	22861	O-27/1	ORANGE	Active Large-System Production Well	6078303.303	2233680.531	425-890	6/28/2021	-45	<Null>
47	O-8	2652	O-8/1	ORANGE	Active Large-System Production Well	6069397.223	2240803.328	570-850	4/5/2021	53.07	<Null>
46	O-9	2656	O-9/1	ORANGE	Active Large-System Production Well	6069440.354	2241135.949	546-888	<Null>	<Null>	No static water level
22370	MBI-1	22371	MBI-1/1	ORANGE COUNTY WATER DISTRICT	Injection Well	6055132.435	2212498.453	530-1190	7/1/2021	-38.54	<Null>
23015	MBI-2	23016	MBI-2/1	ORANGE COUNTY WATER DISTRICT	Injection Well	6056141.1	2211006.5	646-1085	6/29/2021	-55.78	<Null>
23017	MBI-3	23018	MBI-3/1	ORANGE COUNTY WATER DISTRICT	Injection Well	6056123.8	2212200.9	654-1114	6/29/2021	-42.47	<Null>
23019	MBI-4	23020	MBI-4/1	ORANGE COUNTY WATER DISTRICT	Injection Well	6057084.9	2212185.2	650-1089	6/29/2021	-47.65	<Null>
23021	MBI-5	23022	MBI-5/1	ORANGE COUNTY WATER DISTRICT	Injection Well	6057622.7	2211477.6	609-1059	6/29/2021	-53.62	<Null>
15492	OCWD-I24	15494	OCWD-I24/2	ORANGE COUNTY WATER DISTRICT	Injection Well	6046615.244	2199848.75	420-605	7/6/2021	-59.31	<Null>
18060	OCWD-I26C	18061	OCWD-I26C/1	ORANGE COUNTY WATER DISTRICT	Injection Well	6048796.348	2200397.494	476-660	7/6/2021	-65.21	<Null>
19463	OCWD-I28C	19464	OCWD-I28C/1	ORANGE COUNTY WATER DISTRICT	Injection Well	6036240.299	2199039.947	360-460	7/6/2021	-22.14	<Null>
19648	OCWD-I30C	19649	OCWD-I30C/1	ORANGE COUNTY WATER DISTRICT	Injection Well	6034047	2200300.103	425-650	6/28/2021	-18.35	<Null>
19650	OCWD-I31C	19651	OCWD-I31C/1	ORANGE COUNTY WATER DISTRICT	Injection Well	6033606.9	2201013.303	440-590	7/6/2021	-22.46	<Null>
1018	AM-1	1019	AM-1/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6090472.39	2264185.952	97-115	6/30/2021	245.03	<Null>
545	AM-10	546	AM-10/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6071304.771	2257813.261	217-235	7/7/2021	121.51	<Null>
557	AM-11	558	AM-11/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6072499.755	2255656.617	218-240	6/30/2021	121.98	<Null>
555	AM-12	556	AM-12/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6070962.221	2255565.488	210-225	7/7/2021	113.56	<Null>
553	AM-13	554	AM-13/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6072701.528	2256964.39	252-270	6/30/2021	128.38	<Null>
2740	AM-14	2741	AM-14/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6065935.798	2256505.388	297-315	6/30/2021	96.56	<Null>
2742	AM-15	2743	AM-15/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6062582.08	2256912.924	300-317	6/25/2021	86.54	<Null>
2746	AM-16	2747	AM-16/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6057468.185	2255986.324	300-315	7/1/2021	70.09	<Null>
2750	AM-17	2751	AM-17/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6056078.923	2256637.855	290-308	6/25/2021	67.03	<Null>
2752	AM-18	2753	AM-18/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6054337.392	2256704.097	291-309	7/1/2021	60.89	<Null>
1022	AM-2	1023	AM-2/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6091404.587	2263383.522	87-100	6/30/2021	246.46	<Null>
7535	AM-20	7536	AM-20/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6054209.307	2247063.369	361-379	6/25/2021	34.97	<Null>
7001	AM-22	7002	AM-22/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6059519.306	2254484.798	339-353	6/25/2021	72.1	<Null>
7003	AM-23	7004	AM-23/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6062009.413	2254628.535	330-347	6/25/2021	83.21	<Null>
7005	AM-24	7006	AM-24/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6058556.647	2251960.234	335-350	6/25/2021	69.28	<Null>
7009	AM-25	7010	AM-25/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6060774.466	2252487.982	340-358	6/25/2021	74.37	<Null>
7533	AM-26	7534	AM-26/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6051909.723	2244283.122	377-383	7/1/2021	29.21	<Null>
7013	AM-27	7014	AM-27/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6064651.178	2249603.126	287-305	6/25/2021	82.55	<Null>
7015	AM-29	7016	AM-29/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6062902.901	2259184.123	340-358	6/30/2021	88.5	<Null>
1020	AM-3	1021	AM-3/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6090425.411	2261850.384	91-107	6/30/2021	245.62	<Null>
7541	AM-30	7542	AM-30/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6046016.856	2255914.15	349-367	6/25/2021	41.38	<Null>
8919	AM-31	8920	AM-31/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6052262.726	2257664.465	335-353	6/25/2021	57.41	<Null>
7753	AM-32	7754	AM-32/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6052527.256	2252384.43	335-353	6/25/2021	50.68	<Null>
7523	AM-33	7524	AM-33/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6055430.54	2253987.665	354-372	6/25/2021	61.86	<Null>
7527	AM-34	7528	AM-34/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6049928.243	2250310.571	317-335	6/25/2021	39.01	<Null>
7755	AM-35	7756	AM-35/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6044316.748	2249355.364	332-350	6/25/2021	28.86	<Null>
7759	AM-37	7760	AM-37/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6054347.18	2250152.867	349-367	6/25/2021	46.31	<Null>
7761	AM-38	7762	AM-38/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6058042.463	2246387.411	316-334	6/25/2021	35.25	<Null>
549	AM-4	550	AM-4/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6078257.417	2258629.141	187-205	7/7/2021	166.16	<Null>
20709	AM-47	20710	AM-47/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6054333.5	2258316.7	227-242	6/25/2021	64.05	<Null>
20705	AM-48	20706	AM-48/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6069379.3	2259143.9	270-300	7/8/2021	113.68	<Null>
1024	AM-5	1025	AM-5/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6078674.697	2259936.321	230-245	7/7/2021	156.58	<Null>
23213	AM-54C	23214	AM-54C/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6055965.303	2259518	280-295	6/25/2021	69.46	<Null>
23563	AM-55B	23564	AM-55B/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6054292.1	2256036.6	375-395	7/8/2021	59.8	<Null>
23567	AM-56B	23569	AM-56B/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6053578.9	2256950.9	380-400	7/8/2021	58.82	<Null>
551	AM-6	552	AM-6/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6075037.515	2257301.421	232-250	7/7/2021	143.29	<Null>
2734	AM-7	2735	AM-7/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6071731.515	2260900.336	210-225	7/7/2021	131.58	<Null>

Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

Principal Aquifer Wells (Model Layer 2)

STAID1	WELLNM	STAID	STANAME	OWNERNM	GIS_SYMNM	NAD83_X	NAD83_Y	PERF_ZONE	SHORTDATE	WLELEV_2021	NOTES
2736	AM-8	2737	AM-8/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6069027.597	2259867.528	268-285	7/7/2021	112.8	<Null>
15043	AMD-10	15045	AMD-10/2	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6072825.077	2260900.884	440-460	7/7/2021	135.71	<Null>
15053	AMD-11	15056	AMD-11/3	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6070695.395	2257252.242	600-620	6/30/2021	117.07	<Null>
19507	AMD-12	19510	AMD-12/3	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6071323.1	2260657.003	595-615	6/30/2021	126.14	<Null>
14585	AMD-9	14587	AMD-9/2	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6075825.081	2261784.701	450-470	7/7/2021	151.35	<Null>
7017	FM-1	7018	FM-1/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6053154.441	2258736.246	348-356	6/25/2021	60.62	<Null>
18331	FM-10	18332	FM-10/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6057584.791	2262009.679	215-235	6/29/2021	79.5	<Null>
18335	FM-11	18336	FM-11/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6054079.466	2261009.777	236-256	6/30/2021	69.03	<Null>
18339	FM-12	18340	FM-12/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6058076.487	2263025.088	206-226	6/29/2021	82.04	<Null>
18343	FM-13	18344	FM-13/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6064730.854	2262602.368	210-230	6/30/2021	93.15	<Null>
18347	FM-14	18348	FM-14/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6064606.249	2263073.772	234-254	7/1/2021	93.13	<Null>
18351	FM-15	18352	FM-15/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6054099.553	2262606.493	218-238	6/29/2021	73.72	<Null>
18412	FM-16	18413	FM-16/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6063630.746	2262324.068	248-268	6/30/2021	88.76	<Null>
19626	FM-17	19627	FM-17/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6061492.436	2262019.765	250-270	6/30/2021	84.02	<Null>
19612	FM-18	19613	FM-18/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6049362.557	2263643.539	224-244	6/29/2021	62.44	<Null>
19622	FM-19C	19623	FM-19C/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6051551.893	2262403.786	365-385	6/29/2021	57.84	<Null>
23462	FM-19D	23463	FM-19D/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6051660.8	2262458.6	435-455	6/29/2021	59.85	<Null>
7021	FM-2	7022	FM-2/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6058816.966	2258623.398	320-338	6/25/2021	76.61	<Null>
20762	FM-20	20763	FM-20/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6053785.7	2263886.1	221-241	6/29/2021	72.51	<Null>
20766	FM-21	20767	FM-21/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6047750.6	2262684.3	260-270	6/29/2021	58.02	<Null>
20751	FM-22	20752	FM-22/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6051135	2260372.1	242-262	7/8/2021	60.23	<Null>
23217	FM-22B	23218	FM-22B/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6051128.1	2260379.8	326-346	6/25/2021	56.32	<Null>
20882	FM-23	20883	FM-23/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6054166.9	2260625	234-249	6/29/2021	69.17	<Null>
20699	FM-24	20700	FM-24/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6051441.4	2258786	271-291	6/25/2021	57	<Null>
23219	FM-24B	23220	FM-24B/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6051418.9	2258788.7	338-358	6/25/2021	55.89	<Null>
23225	FM-29C	23226	FM-29C/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6049003.993	2262397.371	340-360	6/29/2021	49.19	<Null>
7025	FM-3	7026	FM-3/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6061451.851	2259514.599	257-263	6/30/2021	84.27	<Null>
23573	FM-30B	23574	FM-30B/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6061056.8	2263552.8	370-390	6/29/2021	83.12	<Null>
23229	FM-31B	23230	FM-31B/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6054065.947	2261842.665	230-250	6/29/2021	70.23	<Null>
23449	FM-32B	23452	FM-32B/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6045316.1	2263964.1	220-230	6/29/2021	56.28	<Null>
23577	FM-34B	23578	FM-34B/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6057207.6	2265354.1	377-397	7/8/2021	66.54	<Null>
23898	FM-35C	23899	FM-35C/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6062992.887	2262505.466	460.5-480.5	7/6/2021	85.12	<Null>
7519	FM-4	7520	FM-4/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6048406.619	2258792.993	327-345	6/25/2021	49.86	<Null>
9947	FM-6	9948	FM-6/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6053264.065	2274113.568	150-310	6/30/2021	175.2	<Null>
23215	FM-7B	23216	FM-7B/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6054304.1	2259270.6	329.5-344.5	6/25/2021	64.28	<Null>
18327	FM-9	18328	FM-9/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6063377.138	2262960.474	220-240	6/30/2021	88.97	<Null>
19009	IDM-3	19012	IDM-3/3	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6099726.882	2201438.084	652-672	6/28/2021	8.37	<Null>
19404	IDM-4	19407	IDM-4/3	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6103585.541	2200230.218	654-674	6/28/2021	51.87	<Null>
19478	IDP-2R	19480	IDP-2R/2	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6106015.21	2193086.752	300-340	6/28/2021	108.257	<Null>
721	KBS-1	998	KBS-1/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6074374.124	2260345.831	209-219	7/1/2021	154.21	<Null>
1285	MCAS-10	1286	MCAS-10/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6096082.894	2198174.236	347-377	6/28/2021	9.88	<Null>
1360	MCAS-4	1361	MCAS-4/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6098189.884	2189446.916	181-238	6/28/2021	95.46	<Null>
10217	MCAS-5A	10218	MCAS-5A/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6101340.027	2187474.726	120-130	6/28/2021	118.26	<Null>
1355	MCAS-8	1356	MCAS-8/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6088737.288	2194284.922	392-410	6/28/2021	-63.35	<Null>
1287	MCAS-9	1288	MCAS-9/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6092651.761	2198312.255	372-445	6/28/2021	2.18	<Null>
23057	OCWD-34Y01	23061	OCWD-34Y01/4	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6001790.9	2226024.1	400-420	7/6/2021	-43.1	<Null>
11700	OCWD-36FP1Z	11701	OCWD-36FP1Z/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6001815.979	2221372.331	504-514	7/1/2021	-42.84	<Null>
2859	OCWD-AIR1	2861	OCWD-AIR1/2	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6037614.933	2265072.135	410-510	6/29/2021	-7.44	<Null>
22323	OCWD-BS10	22329	OCWD-BS10/6	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6013179.752	2219396.307	595-605	7/1/2021	-46.87	<Null>
22330	OCWD-BS11	22336	OCWD-BS11/6	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6008506.1	2221300	580-590	7/1/2021	-47.03	<Null>
22774	OCWD-BS12	22973	OCWD-BS12/6	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6015660.3	2214181.8	585-605	7/1/2021	-49.9	<Null>
23692	OCWD-BS13F	23693	OCWD-BS13F/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6009690	2214241.6	575-595	7/1/2021	-44.86	<Null>
22776	OCWD-BS14	22916	OCWD-BS14/5	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6003965.9	2221842.9	490-510	7/1/2021	-43.9	<Null>
23550	OCWD-BS24F	23554	OCWD-BS24F/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6005185.3	2219560	500-520	7/1/2021	-41.91	<Null>
2867	OCWD-CTG1	2869	OCWD-CTG1/2	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6061970.346	2206073.478	420-720	6/30/2021	-85.71	<Null>
2872	OCWD-CTG5	2873	OCWD-CTG5/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6062530.714	2206394.591	420-620	8/4/2021	-81.04	<Null>
2876	OCWD-CTK1	2878	OCWD-CTK1/2	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6062486.259	2205158.852	780-1015	6/30/2021	-81.99	<Null>
3307	OCWD-FC1	3308	OCWD-FC1/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6072297.077	2252615.883	165-185	7/7/2021	104.96	<Null>
3305	OCWD-FH1	3306	OCWD-FH1/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6081695.772	2257027.264	120-140	7/7/2021	213.83	<Null>
3303	OCWD-LV1	3304	OCWD-LV1/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6085675.722	2259327.385	135-155	7/7/2021	237.5	<Null>
15127	OCWD-M38	15131	OCWD-M38/4	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6030736.262	2198146.213	336-346	6/30/2021	-27.7	<Null>
16021	OCWD-M39	16026	OCWD-M39/5	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6048139.112	2190636.716	250-270	6/28/2021	-16.46	<Null>
16654	OCWD-M40	16658	OCWD-M40/4	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6051222.286	2195005.215	330-520	6/28/2021	-81.04	<Null>
18425	OCWD-M41	18430	OCWD-M41/5	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6031312.152	2196141.497	370-390	6/30/2021	-27.74	<Null>
18418	OCWD-M42	18423	OCWD-M42/5	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6030956.495	2201880.558	500-520	6/24/2021	-30.94	<Null>
23769	OCWD-M43R	23774	OCWD-M43R/5	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6056258.4	2193225.9	530-550	6/28/2021	-82.54	<Null>
20371	OCWD-M44	20376	OCWD-M44/5	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6048200.8	2193011.3	295-305	6/28/2021	-58.37	<Null>
19640	OCWD-M45	19645	OCWD-M45/5	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6040339.8	2203350.603	780-790	6/30/2021	-56.92	<Null>
19482	OCWD-M46	19487	OCWD-M46/5	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6049299	2201186.803	890-910	6/28/2021	-61.24	<Null>
19634	OCWD-M47	19639	OCWD-M47/5	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6049915.7	2202379.503	940-960	6/28/2021	-61.7	<Null>
18766	OCWD-M48	18768	OCWD-M48/2	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6059972.844	2188953.882	175-195	6/28/2021	-73.7	<Null>
22842	OCWD-M52C	22843	OCWD-M52C/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6067045.9	2192841.2	210-230	6/24/2021	-69.15	<Null>
22786	OCWD-MRSH	22854	OCWD-MRSH/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6074220	2188672.3	199-219	6/29/2021	-28.15	<Null>
22659	OCWD-SA22R	22663	OCWD-SA22R/4	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6036740.5	2194795.1	310-330	6/30/2021	-28.24	<Null>
3978	OCWD-T2	3981	OCWD-T2/3	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6035679.306	2192640.337	300-360	6/24/2021	-27.11	<Null>
315	OCWD-W1	316	OCWD-W1/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6081387.171	2258988.611	-	7/7/2021	174.34	<Null>
22347	SAR-10	22351	SAR-10/4	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6055179.3	2212421.7	1100-1115	7/1/2021	-51.98	<Null>
22061	SAR-11	22064	SAR-11/3	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6055349.4	2211898	1100-1110	7/1/2021	-54.34	<Null>
23010	SAR-12	23014	SAR-12/4	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6056736.8	2210170.5	1045-1055	6/30/2021	-67.896	<Null>
23203	SAR-13	23207	SAR-13/4	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6057504.8	2210763.1	1045-1205	6/30/2021	-63.83	<Null>
1851	TIC-67	1852	TIC-67/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6100937.109	2211418.256	245-900	6/29/2021	73.58	<Null>
997	ABS-1	22665	ABS-1/1/WB2/MP3	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6076226.851	2262977.612	MP3 (257)	7/7/2021	158.375	<Null>
547	AMD-1	21137	AMD-1/1/WB2/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6073916.932	2258572.091	MP5 (331)	6/21/2021	143.45	<Null>
565	AMD-2	22205	AMD-2/1/WB2/MP4	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6066705.21	2254540.618	MP4 (512)	6/29/2021	99.11	<Null>
7031	AMD-4	7104	AMD-4/1/WB1/MP4	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6050716.117	2255097.562	MP4 (561)	6/28/2021	43.82	<Null>
7295	AMD-5	7320	AMD-5/1/WB1/MP7	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6060070.244	2248962.576	MP7 (754)	6/28/2021	69.39	<Null>
7293	AMD-6	7482	AMD-6/1/WB1/MP7	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6057374.729	2241092.645	MP7 (622)	6/28/2021	15.03	<Null>
8596	AMD-7	8754	AMD-7/1/WB1/MP7	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6049188.026	2247218.215	MP7 (580)	6/28/2021	15.36	<Null>
9682	AMD-8	9906	AMD-8/1/WB1/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6033488.697	2249624.328	MP5 (662)	7/12/2021	-8.705	<Null>
9831	BPM-1	9985	BPM-1/1/WB1/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6022348.508	2259541.566	MP6 (890)	7/12/2021	-42.1	<Null>
9832	BPM-2	10178	BPM-2/1/WB1/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6025195.413	2246739.597	MP5 (778)	7/12/2021	-11.49	<Null>
685	CB-1	8788	CB-1/1/WB2/MP3	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6044695.232	2253837.186	MP3 (443)	7/6/2021	30.09	<Null>
5155	COSM-1	7147	COSM-1/1/WB1/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6055253.401	2197825.036	MP5 (451)	6/30/2021	-87.65	<Null>
18846	COSM-2	18866	COSM-2/1/WB1/MP8	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6052266.414	2199776.431	MP8 (763)	6/30/2021	-80.87	<Null>
719	FFS-1	14243	FFS-1/1/WB2/MP3	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6061436.461	2262022.62	MP3 (530)	7/6/2021	81.44	<Null>
1291	FVM-1	15692	FVM-1/1/WB2/MP9	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6047178.815	2210990.613	MP9 (814)	6/22/2021	-47.21	<Null>
7297	GGM-1	10028	GGM-1/1/WB1/MP8	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6045688.299	2230864.24	MP8 (1074)	7/8/2021	-22.44	<Null>
8923	GGM-2	9049	GGM-2/1/WB1/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6026525.607	2230233.156	MP5 (954)	6/22/2021	-30.46	<Null>
8592	GGM-3	8666	GGM-3/1/WB1/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6037298.069	2237458.988	MP6 (1007)	7/8/2021	-17.34	<Null>
7178	HBM-1	8439	HBM-1/1/WB1/MP7	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6031700.722	2216385.252	MP7 (924)	7/2/2021	-43.89	<Null>
7086	HBM-2	7223	HBM-2/1/WB1/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6036228.737	2196532.383	MP6 (447)	7/2/2021	-25.01	<Null>
9200	HBM-4	9225	HBM-4/1/WB1/MP8	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6034095.825	2197123.319	MP8 (551)	7/2/2021	-20.86	<Null>
9688	HBM-5	9879	HBM-5/1/WB1/MP8	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6045744.869	2193971.856	MP8 (273)	7/2/2021	-52.65	<Null>
15088	HBM-6	15245	HBM-6/1/WB1/MP7	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6025106.578	2204548.969	MP7 (508)	7/2/2021	-37.1	<Null>
720	IDM-1	18979	IDM-1/1/WB2/MP4	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6099572.243	2207081.537	MP4 (436)	7/7/2021	28.49	<Null>
9830	IDM-2	10064	IDM-2/1/WB1/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6080705.598	2209836.046	MP6 (613)	7/7/2021	-71.94	<Null>

Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

Principal Aquifer Wells (Model Layer 2)

STAID1	WELLNM	STAID	STANAME	OWNERNM	GIS_SYMNM	NAD83_X	NAD83_Y	PERF_ZONE	SHORTDATE	WLELEV_2021	NOTES
541	KBS-2	10226	KBS-2/1/WB1/MP2	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6073053.762	2260992.439	MP2 (214)	6/21/2021	144.53	<Null>
11949	LAM-1	12028	LAM-1/1/WB1/MP9	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6009581.587	2238043.705	MP9 (1153)	6/15/2021	-56.23	<Null>
1345	MCAS-1	5853	MCAS-1/1/WB2/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6098255.481	2192973.357	MP6 (455)	7/6/2021	36.17	<Null>
759	MCAS-2	5935	MCAS-2/1/WB2/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6100360.442	2191167.958	MP5 (425)	7/6/2021	62.46	<Null>
1339	MCAS-3	5891	MCAS-3/1/WB2/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6104434.428	2191276.758	MP5 (426)	7/6/2021	89.45	<Null>
758	MCAS-7	11829	MCAS-7/1/WB3/MP4	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6093900.827	2194418.586	MP4 (442)	7/7/2021	-23.9	<Null>
756	SAR-1	9261	SAR-1/1/WB2/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6070684.206	2250425.314	MP5 (519)	6/29/2021	88.12	<Null>
761	SAR-2	11989	SAR-2/1/WB2/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6069096.008	2245410.807	MP6 (741)	6/29/2021	71.42	<Null>
762	SAR-3	9466	SAR-3/1/WB2/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6066892.02	2238409.284	MP6 (774)	6/24/2021	54.27	<Null>
763	SAR-4	14633	SAR-4/1/WB2/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6065370.966	2233375.154	MP6 (868)	6/29/2021	31.58	<Null>
1289	SAR-5	21220	SAR-5/1/WB3/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6062597.607	2227874.211	MP5 (766)	6/30/2021	-16.37	<Null>
561	SAR-6	10113	SAR-6/1/WB2/MP4	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6073313.538	2254365.369	MP4 (581)	6/21/2021	142.26	<Null>
996	SAR-7	20000	SAR-7/1/WB2/MP4	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6078049.17	2256383.048	MP4 (440)	6/21/2021	192.2	<Null>
7181	SAR-9	9802	SAR-9/1/WB1/MP7	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6058380.802	2221450.982	MP7 (877)	6/30/2021	-40.723	<Null>
9686	SBM-1	9729	SBM-1/1/WB1/MP7	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6016566.11	2224523.54	MP7 (916)	6/15/2021	-47.295	<Null>
1000	SC-1	21654	SC-1/1/WB2/MP4	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6089555.444	2242038.806	MP4 (197)	7/1/2021	213.44	<Null>
1001	SC-2	18747	SC-2/1/WB2/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6086489.295	2237887.557	MP6 (303)	7/1/2021	112.45	<Null>
1005	SC-3	8839	SC-3/1/WB2/MP3	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6081074.85	2229940.413	MP3 (577)	7/1/2021	29.49	<Null>
2888	SC-4	6296	SC-4/1/WB1/MP4	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6082605.785	2235080.546	MP4 (393)	7/1/2021	46.59	<Null>
2854	SC-5	6331	SC-5/1/WB1/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6077454.866	2225543.458	MP5 (670)	7/1/2021	4.73	<Null>
9684	SC-6	9758	SC-6/1/WB1/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6066813.288	2216032.113	MP6 (964)	7/7/2021	-60.78	<Null>
1016	SCS-1	8867	SCS-1/1/WB1/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6088950.708	2237855.374	MP6 (298)	7/1/2021	89.68	<Null>
1014	SCS-2	22653	SCS-2/1/WB2/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6088207.123	2239962.183	MP5 (329)	7/1/2021	72.99	<Null>
1011	WBS-4	19983	WBS-4/1/WB2/MP3	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6080099.39	2256910.089	MP3 (212)	6/21/2021	206.6	<Null>
1293	WMM-1	19884	WMM-1/1/WB2/MP8	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6038251.554	2221751.195	MP8 (985)	7/8/2021	-24.03	<Null>
1423	OCWD-D1	1424	OCWD-D1/1	ORANGE COUNTY WATER DISTRICT	Other Active Production Well	6046612.36	2200327.641	780-880	6/23/2021	-60.642	<Null>
1412	OCWD-D3	1413	OCWD-D3/1	ORANGE COUNTY WATER DISTRICT	Other Active Production Well	6046034.602	2201849.851	560-1000	6/23/2021	-58.66	<Null>
3797	OCWD-D4	3798	OCWD-D4/1	ORANGE COUNTY WATER DISTRICT	Other Active Production Well	6047147.793	2201759.429	531-979	6/23/2021	-61.08	<Null>
1798	NVLW-SB3	3275	NVLW-SB3/1	PURSCHE, ROY	Other Active Production Well	6011353.936	2219409.749	-	6/29/2021	-51.1	<Null>
1126	NOBL-O	1127	NOBL-O/1	R.J. NOBLE COMPANY	Other Active Production Well	6072535.517	2251285.626	290-474	6/29/2021	91.85	<Null>
22874	RAY-MW06	22875	RAY-MW06/1	RAYTHEON TECHNOLOGIES CORPORATION	Monitoring Well	6042228.1	2268828.8	149.6-189.6	6/30/2021	33.58	<Null>
22408	RAY-MW32	22410	RAY-MW32/2	RAYTHEON TECHNOLOGIES CORPORATION	Monitoring Well	6039287.583	2267257.657	969-999	6/30/2021	17.47	<Null>
22416	RAY-MW34B	22417	RAY-MW34B/1	RAYTHEON TECHNOLOGIES CORPORATION	Monitoring Well	6039046.07	2268346.15	486-536	6/30/2021	18.29	<Null>
22420	RAY-MW35	22423	RAY-MW35/3	RAYTHEON TECHNOLOGIES CORPORATION	Monitoring Well	6039878.34	2265861.26	990-1040	6/30/2021	12.69	<Null>
22757	RAY-MW39	22758	RAY-MW39/1	RAYTHEON TECHNOLOGIES CORPORATION	Monitoring Well	6034604.76	2267260.25	982-1012	6/30/2021	14.6	<Null>
22759	RAY-MW40	22760	RAY-MW40/1	RAYTHEON TECHNOLOGIES CORPORATION	Monitoring Well	6042465.71	2267070.62	930-970	6/30/2021	20.33	<Null>
975	SA-16	976	SA-16/1	SANTA ANA	Active Large-System Production Well	6066775.852	2220474.597	305-950	<Null>	<Null>	Well in exclusion list
964	SA-18	965	SA-18/1	SANTA ANA	Active Large-System Production Well	6065423.295	2227343.923	245-623	6/30/2021	6.21	<Null>
983	SA-20	984	SA-20/1	SANTA ANA	Active Large-System Production Well	6051943.524	2218208.729	390-940	6/29/2021	-18.5	<Null>
981	SA-21	982	SA-21/1	SANTA ANA	Active Large-System Production Well	6051992.474	2218775.287	400-960	6/29/2021	-17.7	<Null>
966	SA-24	967	SA-24/1	SANTA ANA	Active Large-System Production Well	6062495.013	2226820.521	352-654	6/30/2021	-4.27	<Null>
19	SA-29	117	SA-29/1	SANTA ANA	Active Large-System Production Well	6067350.619	2218664.363	450-1050	7/1/2021	-48.19	<Null>
985	SA-30	986	SA-30/1	SANTA ANA	Active Large-System Production Well	6051988.27	2217594.374	440-900	6/29/2021	-22.8	<Null>
979	SA-33	980	SA-33/1	SANTA ANA	Active Large-System Production Well	6067018.394	2218472.227	425-935	7/1/2021	-47.2	<Null>
3322	SA-34	3323	SA-34/1	SANTA ANA	Active Large-System Production Well	6062544.736	2203955.867	370-520	7/2/2021	-83	<Null>
8823	SA-35	8824	SA-35/1	SANTA ANA	Active Large-System Production Well	6058367.7	2224408.129	429.2-1480	5/24/2021	-29	<Null>
1993	SA-36	1994	SA-36/1	SANTA ANA	Active Large-System Production Well	6064973.942	2227415.821	570-1290	6/30/2021	-21.75	<Null>
8825	SA-37	8826	SA-37/1	SANTA ANA	Active Large-System Production Well	6061211.41	2214947.524	348-1480	5/24/2021	-48	<Null>
18391	SA-39	18393	SA-39/1	SANTA ANA	Active Large-System Production Well	6064925.485	2227035.79	590-1290	6/30/2021	-26.3	<Null>
19552	SA-41	19553	SA-41/1	SANTA ANA	Active Large-System Production Well	6067142.505	2220423.372	525-978	5/25/2021	-40.58	<Null>
956	SA-26	957	SA-26/1	SANTA ANA	Standby Large-System Production Well	6073873.971	2210851.779	330-1140	7/2/2021	-58.82	<Null>
532	SA-27	533	SA-27/1	SANTA ANA	Standby Large-System Production Well	6072868.882	2229547.215	396-1140	6/30/2021	-6.9	<Null>
70	SA-28	2629	SA-28/1	SANTA ANA	Standby Large-System Production Well	6073394.893	2229877.64	250-980	6/30/2021	11.5	<Null>
18	SA-31	118	SA-31/1	SANTA ANA	Standby Large-System Production Well	6078121.42	2217676.874	465-1240	6/22/2021	-11.32	<Null>
8817	SA-38	8818	SA-38/1	SANTA ANA	Standby Large-System Production Well	6077082.488	2229427.758	400-1270	6/30/2021	27	<Null>
19550	SA-40	19551	SA-40/1	SANTA ANA	Standby Large-System Production Well	6077600.85	2221373.519	550-1305	6/30/2021	-50.75	<Null>
1513	SACC-SA	1514	SACC-SA/1	SANTA ANA COUNTRY CLUB	Other Active Production Well	6062143.936	2190413.821	205-406	6/30/2021	-80.85	<Null>
26	SB-BC	123	SB-BC/1	SEAL BEACH	Active Large-System Production Well	6016910.323	2228579.652	370-1020	6/29/2021	-62	<Null>
1282	SB-BEV	1283	SB-BEV/1	SEAL BEACH	Active Large-System Production Well	6006691.531	2229990.738	400-800	5/26/2021	-58.14	<Null>
21089	SB-LAM	21090	SB-LAM/1	SEAL BEACH	Active Large-System Production Well	6012636.62	2232616.404	360-1170	6/29/2021	-50	<Null>
78	SID-3	2619	SID-3/1	SERRANO WATER DISTRICT	Active Large-System Production Well	6085523.367	2241664.186	296-584	6/30/2021	49	<Null>
7036	SID-4	7037	SID-4/1	SERRANO WATER DISTRICT	Active Large-System Production Well	6088277.371	2242027.33	290-520	<Null>	<Null>	No static water level
15486	SWD-5	15487	SWD-5/1	SERRANO WATER DISTRICT	Active Large-System Production Well	6085860.482	2241857.866	310-720	6/30/2021	53	<Null>
3801	W-3801	3802	W-3801/1	STATE OF CALIFORNIA	Inactive Production Well	6061820.651	2190918.886	254-407	6/30/2021	-80.36	<Null>
1927	TIC-194	1931	TIC-194/1	THE IRVINE COMPANY	Monitoring Well	6085062.044	2200644.721	562-726	6/29/2021	-62.48	<Null>
3524	TIC-25	3525	TIC-25/1	THE IRVINE COMPANY	Monitoring Well	6082128.447	2194002.252	666-760	6/29/2021	-62.21	<Null>
1829	TIC-50	1830	TIC-50/1	THE IRVINE COMPANY	Monitoring Well	6089719.969	2212322.221	475-1070	6/29/2021	19.34	<Null>
1331	TIC-99	1332	TIC-99/1	THE IRVINE COMPANY	Monitoring Well	6094081.516	2213753.527	346-650	6/29/2021	10.69	<Null>
18770	T-17S4	18771	T-17S4/1	TUSTIN	Active Large-System Production Well	6087962.147	2223505.698	200-480	7/1/2021	22	<Null>
950	T-COLU	951	T-COLU/1	TUSTIN	Active Large-System Production Well	6083806.737	2220457.042	560-1160	6/30/2021	-16	<Null>
22699	T-ED	22700	T-ED/1	TUSTIN	Active Large-System Production Well	6079918.435	2211393.25	500-840	7/1/2021	-58	<Null>
954	T-MS3	955	T-MS3/1	TUSTIN	Active Large-System Production Well	6083758.623	2217438.721	300-630	6/30/2021	32	<Null>
15470	T-MS4	15471	T-MS4/1	TUSTIN	Active Large-System Production Well	6084025.072	2217344.269	330-880	6/30/2021	9	<Null>
1370	T-NEWP	1371	T-NEWP/1	TUSTIN	Active Large-System Production Well	6087882.616	2220782.263	234-267	7/1/2021	31	<Null>
20304	T-PAS	20305	T-PAS/1	TUSTIN	Active Large-System Production Well	6080513.128	2217850.37	440-1225	6/30/2021	-11	<Null>
9204	T-VNBG	9205	T-VNBG/1	TUSTIN	Active Large-System Production Well	6083087.233	2223256.938	480-900	<Null>	<Null>	No static water level
958	T-WALN	959	T-WALN/1	TUSTIN	Active Large-System Production Well	6084028.458	2212002.398	397-995	7/2/2021	-40	<Null>
948	T-LIVI	949	T-LIVI/1	TUSTIN	Inactive Production Well	6085117.397	2221039.77	300-617	6/30/2021	21	<Null>
960	T-PANK	961	T-PANK/1	TUSTIN	Inactive Production Well	6087674.762	2213340.094	323-614	6/30/2021	10.88	<Null>
946	T-TUST	947	T-TUST/1	TUSTIN	Inactive Production Well	6079841.655	2224465.712	306-776	5/10/2021	0	<Null>
33	T-YORB	2898	T-YORB/1	TUSTIN	Inactive Production Well	6082254.093	2227714.437	385-850	6/30/2021	12	<Null>
2139	COS-PLAZ	3551	COS-PLAZ/1	UNKNOWN	Monitoring Well	6062779.265	2200089.756	-	6/30/2021	-82.38	<Null>
21187	WRD-SEALBEACH-1	21191	WRD-SEALBEACH-1/4	WATER REPLENISHMENT DISTRICT	Monitoring Well	6002807.228	2229796.158	775-795	6/7/2021	-61.51	<Null>
20132	WM-107A	20133	WM-107A/1	WESTMINSTER	Active Large-System Production Well	6036756.169	2221201.688	350-980	6/23/2021	-3.71	<Null>
18462	WM-11	18463	WM-11/1	WESTMINSTER	Active Large-System Production Well	6030376.492	2221521.749	325-790	6/28/2021	-16	<Null>
15462	WM-125	15463	WM-125/1	WESTMINSTER	Active Large-System Production Well	6019490.522	2226357.926	374-860	6/29/2021	-35	<Null>
1250	WM-3	1251	WM-3/1	WESTMINSTER	Active Large-System Production Well	6035334.153	2212273.162	285-365	<Null>	<Null>	Well in exclusion list
987	WM-4	988	WM-4/1	WESTMINSTER	Active Large-System Production Well	6041811.441	2216473.787	345-1125	6/30/2021	-10	<Null>
973	WM-6	974	WM-6/1	WESTMINSTER	Active Large-System Production Well	6040452.837	2221186.654	176-660	<Null>	<Null>	Well in exclusion list
19581	WM-75A	19582	WM-75A/1	WESTMINSTER	Active Large-System Production Well	6027529.048	2227543.038	410-996	7/1/2021	-18.75	<Null>
2351	WM-RES1	2352	WM-RES1/1	WESTMINSTER	Active Large-System Production Well	6034195.466	2226587.136	390-880	6/29/2021	-13.33	<Null>
25	WM-RES2	127	WM-RES2/1	WESTMINSTER	Active Large-System Production Well	6022510.924	2225649.817	340-937	6/28/2021	-36	<Null>
1549	WM-SC4	1550	WM-SC4/1	WESTMINSTER	Active Large-System Production Well	6024891.234	2228376.544	425-454	6/28/2021	-13	<Null>
1501	WOOD-INLK	1502	WOOD-INLK/1	WOODBRIDGE VILL HOMEOWNER ASSN	Inactive Production Well	6090903.001	2195025.511	370-890	6/28/2021	-33.24	<Null>
2602	YLWD-1	2603	YLWD-1/1	YORBA LINDA WATER DISTRICT	Standby Large-System Production Well	6083180.423	2261475.297	90-340	6/24/2021	201.25	<Null>
2600	YLWD-10	2601	YLWD-10/1	YORBA LINDA WATER DISTRICT	Standby Large-System Production Well	6082573.916	2261063.226	90-406	6/24/2021	199.95	<Null>
2598	YLWD-12	2599	YLWD-12/1	YORBA LINDA WATER DISTRICT	Standby Large-System Production Well	6082579.233	2261460.266	80-498	6/24/2021	194.75	<Null>
18764	YLWD-18	18765	YLWD-18/1	YORBA LINDA WATER DISTRICT	Standby Large-System Production Well	6082572.851	2261290.355	250-570	6/24/2021	202	<Null>
19554	YLWD-19	19555	YLWD-19/1	YORBA LINDA WATER DISTRICT	Standby Large-System Production Well	6082841.553	2261300.166	280-581	6/24/2021	200.7	<Null>
21243	YLWD-20	21244	YLWD-20/1	YORBA LINDA WATER DISTRICT	Standby Large-System Production Well	6083164.301	2258232.562	225-570	6/24/2021	227.32	<Null>
22794	YLWD-21	22795	YLWD-21/1	YORBA LINDA WATER DISTRICT	Standby Large-System Production Well	6082500.179	2259535.434	210-510	6/24/2021	211.25	<Null>
2592	YLWD-5	2593	YLWD-5/1	YORBA LINDA WATER DISTRICT	Standby Large-System Production Well	6083146.35	2261304.493	90-340	6/24/2021	200.5	<Null>
2596	YLWD-7	2597	YLWD-7/1	YORBA LINDA WATER DISTRICT	Standby Large-System Production Well	6082874.48	2261508.045	137-259	6/24/2021	197.25	<Null>

Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

Deep Aquifer Wells (Model Layer 3)

STAID1	WELLNM	STAID	STANAME	OWNERNM	GIS_SYMNM	NAD83_X	NAD83_Y	PERF_ZONE	SHORTDATE	WLELEV	NAD83_X	NAD83_Y
19013	CSF-1	19132	CSF-1/1/WB1/MP6	CA. STATE UNIV., FULLERTON	Multiport Monitoring Well	6064343.084	2270822.497	MP6 (718)	7/6/2021	108.52	6064343.084	2270822.497
8556	F-COYO2	8557	F-COYO2/1	FULLERTON	Inactive Production Well	6040365.852	2271034.694	309-919	6/30/2021	85.12	6040365.852	2271034.694
1387	SNDR-SA	1388	SNDR-SA/1	I & G 4 HUTTON LLC-ASSOC.	Other Active Production Well	6070727.949	2200897.503	930-990	6/30/2021	-71.45	6070727.949	2200897.503
19366	IRWD-110	19367	IRWD-110/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6100371.561	2196315.961	555-1015	<Null>	<Null>	6100371.561	2196315.961
11474	IRWD-3	11475	IRWD-3/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6072630.329	2206528.469	483.53-1249.9	6/23/2021	-64.9	6072630.329	2206528.469
18510	IRWD-C8	18511	IRWD-C8/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6062825.396	2204153.762	1080-1982	<Null>	<Null>	6062825.396	2204153.762
18512	IRWD-C9	18513	IRWD-C9/1	IRVINE RANCH WATER DISTRICT	Active Large-System Production Well	6062422.93	2205055.852	1055-1930	<Null>	<Null>	6062422.93	2205055.852
22065	IRWD-52	22066	IRWD-52/1	IRVINE RANCH WATER DISTRICT	Inactive Production Well	6073545.847	2203710.984	635-1290	6/29/2021	-62.3	6073545.847	2203710.984
1941	TIC-82	1942	TIC-82/1	IRVINE RANCH WATER DISTRICT	Monitoring Well	6090541.059	2199639.983	410-1002	6/29/2021	-8.83	6090541.059	2199639.983
1391	ET-2	1392	ET-2/1	IRVINE RANCH WATER DISTRICT	Other Active Production Well	6090684.562	2199800.983	280-1080	<Null>	<Null>	6090684.562	2199800.983
1389	TIC-106	1390	TIC-106/1	IRVINE RANCH WATER DISTRICT	Other Active Production Well	6084967	2197177.989	405-715	<Null>	<Null>	6084967	2197177.989
15780	MCWD-11	15781	MCWD-11/1	MESA WATER DISTRICT	Active Large-System Production Well	6055237.67	2197733.913	330-1000	7/7/2021	-86.57	6055237.67	2197733.913
2135	MCWD-6	2136	MCWD-6/1	MESA WATER DISTRICT	Active Large-System Production Well	6055652.152	2197722.22	310-1025	<Null>	<Null>	6055652.152	2197722.22
1357	MCAS-6	1358	MCAS-6/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6094225.41	2191657.016	167-222	6/28/2021	76.17	6094225.41	2191657.016
2867	OCWD-CTG1	2871	OCWD-CTG1/4	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6061970.346	2206073.478	1060-1220	6/30/2021	-81.88	6061970.346	2206073.478
2872	OCWD-CTG5	2875	OCWD-CTG5/3	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6062530.714	2206394.591	1040-1120	8/4/2021	-87.56	6062530.714	2206394.591
2876	OCWD-CTK1	2879	OCWD-CTK1/3	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6062486.259	2205158.852	1260-1315	6/30/2021	-83.03	6062486.259	2205158.852
22786	OCWD-MRSH	22854	OCWD-MRSH/1	ORANGE COUNTY WATER DISTRICT	Monitoring Well	6074220	2188672.3	199-219	6/29/2021	-28.15	6074220	2188672.3
547	AMD-1	21142	AMD-1/1/WB2/MP10	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6073916.932	2258572.091	MP10 (1394)	6/21/2021	139.96	6073916.932	2258572.091
565	AMD-2	22211	AMD-2/1/WB2/MP10	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6066705.21	2254540.618	MP10 (1444)	6/29/2021	104.23	6066705.21	2254540.618
7031	AMD-4	7111	AMD-4/1/WB1/MP11	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6050716.117	2255097.562	MP11 (1409)	6/28/2021	60.28	6050716.117	2255097.562
7295	AMD-5	7324	AMD-5/1/WB1/MP11	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6060070.244	2248962.576	MP11 (1324)	6/28/2021	82.65	6060070.244	2248962.576
8596	AMD-7	8761	AMD-7/1/WB1/MP14	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6049188.026	2247218.215	MP14 (1424)	6/28/2021	30.68	6049188.026	2247218.215
9682	AMD-8	9916	AMD-8/1/WB1/MP15	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6033488.697	2249624.328	MP15 (2014)	7/12/2021	-13.155	6033488.697	2249624.328
9831	BPM-1	9993	BPM-1/1/WB1/MP14	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6022348.508	2259541.566	MP14 (2109)	7/12/2021	-25.24	6022348.508	2259541.566
9832	BPM-2	10188	BPM-2/1/WB1/MP15	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6025195.413	2246739.597	MP15 (2173)	7/12/2021	-23.16	6025195.413	2246739.597
685	CB-1	8794	CB-1/1/WB2/MP9	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6044695.232	2253837.186	MP9 (1463)	7/6/2021	29.14	6044695.232	2253837.186
5155	COSM-1	7156	COSM-1/1/WB1/MP14	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6055253.401	2197825.036	MP14 (1599)	6/30/2021	-77.7	6055253.401	2197825.036
719	FFS-1	14248	FFS-1/1/WB2/MP8	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6061436.461	2262022.62	MP8 (1420)	7/6/2021	88.03	6061436.461	2262022.62
1291	FVM-1	15700	FVM-1/1/WB2/MP17	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6047178.815	2210990.613	MP17 (1587)	6/22/2021	-29.3	6047178.815	2210990.613
7297	GGM-1	10033	GGM-1/1/WB1/MP13	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6045688.299	2230864.24	MP13 (2011)	7/8/2021	-13.6	6045688.299	2230864.24
8923	GGM-2	9057	GGM-2/1/WB1/MP13	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6026525.607	2230233.156	MP13 (1994)	6/22/2021	-15.01	6026525.607	2230233.156
7178	HBM-1	8443	HBM-1/1/WB1/MP11	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6031700.722	2216385.252	MP11 (1464)	7/2/2021	-25.08	6031700.722	2216385.252
720	IDM-1	18984	IDM-1/1/WB2/MP9	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6099572.243	2207081.537	MP9 (993)	7/7/2021	-10.34	6099572.243	2207081.537
9830	IDM-2	10066	IDM-2/1/WB1/MP8	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6080705.598	2209836.046	MP8 (890)	7/7/2021	-53.81	6080705.598	2209836.046
11949	LAM-1	12031	LAM-1/1/WB1/MP12	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6009581.587	2238043.705	MP12 (1613)	6/15/2021	-36.83	6009581.587	2238043.705
758	MCAS-7	11831	MCAS-7/1/WB3/MP6	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6093900.827	2194418.586	MP6 (802)	7/7/2021	21.5	6093900.827	2194418.586
756	SAR-1	9269	SAR-1/1/WB2/MP13	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6070684.206	2250425.314	MP13 (1374)	6/29/2021	85.58	6070684.206	2250425.314
761	SAR-2	11995	SAR-2/1/WB2/MP12	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6069096.008	2245410.807	MP12 (1351)	6/29/2021	74.07	6069096.008	2245410.807
762	SAR-3	9471	SAR-3/1/WB2/MP11	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6066892.02	2238409.284	MP11 (1393)	6/24/2021	58.87	6066892.02	2238409.284
763	SAR-4	14637	SAR-4/1/WB2/MP10	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6065370.966	2233375.154	MP10 (1398)	6/29/2021	-9.56	6065370.966	2233375.154
1289	SAR-5	21226	SAR-5/1/WB3/MP11	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6062597.607	2227874.211	MP11 (1735)	6/30/2021	-15.3	6062597.607	2227874.211
7181	SAR-9	9807	SAR-9/1/WB1/MP12	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6058380.802	2221450.982	MP12 (1724)	6/30/2021	-28.443	6058380.802	2221450.982
9686	SBM-1	9730	SBM-1/1/WB1/MP8	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6016566.11	2224523.54	MP8 (1256)	6/15/2021	-28.045	6016566.11	2224523.54
1001	SC-2	6242	SC-2/1/WB2/MP10	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6086489.295	2237887.557	MP10 (664)	<Null>	<Null>	6086489.295	2237887.557
1005	SC-3	8841	SC-3/1/WB2/MP5	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6081074.85	2229940.413	MP5 (1022)	7/1/2021	48.56	6081074.85	2229940.413
2888	SC-4	6300	SC-4/1/WB1/MP8	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6082605.785	2235080.546	MP8 (830)	7/1/2021	44.34	6082605.785	2235080.546
2854	SC-5	6336	SC-5/1/WB1/MP10	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6077454.866	2225543.458	MP10 (1430)	7/1/2021	-27.75	6077454.866	2225543.458
9684	SC-6	9763	SC-6/1/WB1/MP11	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6066813.288	2216032.113	MP11 (1684)	7/7/2021	-50.96	6066813.288	2216032.113
1293	WMM-1	19892	WMM-1/1/WB2/MP16	ORANGE COUNTY WATER DISTRICT	Multiport Monitoring Well	6038251.554	2221751.195	MP16 (1745)	7/8/2021	-23.94	6038251.554	2221751.195
1883	TIC-91	1884	TIC-91/1	PRIVATE	Destroyed and Sealed Well	6075952.042	2204613.252	403-1208	<Null>	<Null>	6075952.042	2204613.252
22391	RAY-MW25	22392	RAY-MW25/1	RAYTHEON TECHNOLOGIES CORPORATION	Monitoring Well	6042037.4	2268206.9	449.4-479.8	6/30/2021	30.11	6042037.4	2268206.9
22408	RAY-MW32	22411	RAY-MW32/3	RAYTHEON TECHNOLOGIES CORPORATION	Monitoring Well	6039287.583	2267257.657	1070-1100	6/30/2021	26.62	6039287.583	2267257.657
8817	SA-38	8818	SA-38/1	SANTA ANA	Standby Large-System Production Well	6077082.488	2229427.758	400-1270	6/30/2021	27	6077082.488	2229427.758
1873	TIC-93	1874	TIC-93/1	THE IRVINE COMPANY	Destroyed and Sealed Well	6080030.447	2205228.503	400-1120	<Null>	<Null>	6080030.447	2205228.503
1927	TIC-194	1931	TIC-194/1	THE IRVINE COMPANY	Monitoring Well	6085062.044	2200644.721	562-726	6/29/2021	-62.48	6085062.044	2200644.721
3524	TIC-25	3525	TIC-25/1	THE IRVINE COMPANY	Monitoring Well	6082128.447	2194002.252	666-760	6/29/2021	-62.21	6082128.447	2194002.252
1829	TIC-50	1830	TIC-50/1	THE IRVINE COMPANY	Monitoring Well	6089719.969	2212322.221	475-1070	6/29/2021	19.34	6089719.969	2212322.221
958	T-WALN	959	T-WALN/1	TUSTIN	Active Large-System Production Well	6084028.458	2212002.398	397-995	7/2/2021	-40	6084028.458	2212002.398
21187	WRD-SEALBEACH-1	21192	WRD-SEALBEACH-1/5	WATER REPLENISHMENT DISTRICT	Monitoring Well	6002807.228	2229796.158	1020-1040	6/7/2021	-39.7	6002807.228	2229796.158
3518	WOOD-ISLK	3519	WOOD-ISLK/1	WOODBRIDGE VILL HOMEOWNER ASSN	Inactive Production Well	6089676.955	2191898.777	210-800	6/28/2021	26.83	6089676.955	2191898.777