# Appendix I:
# Utilities and Services Systems Supporting Information

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# I.1 - Water Supply Assessment

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# Southeast Development Area (SEDA)
# Specific Plan
# Water Supply Assessment

***June 28th, 2023***

*Prepared for:*

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**EXECUTIVE SUMMARY**

## Purpose

The purpose of this report is to provide a Water Supply Assessment (WSA) for the Southeast Development Area (SEDA) Specific Plan Project (Proposed Project) in accordance with the requirements of the California Water Code as established by California Senate Bill 610 (SB 610) and Senate Bill 221 (SB 221), to evaluate whether sufficient water supplies are available to meet existing and future water demands within the City of Fresno's water service area, including the demands associated with the proposed Project, during normal, single dry, and multiple dry years for a 20-year period. The WSA, prepared to support the preparation of the Program Environmental Impact Report (PEIR) for the SEDA Specific Plan, evaluates the sufficiency of the City of Fresno's water supplies (existing and future) to meet the existing and projected water demands for the City's water service area, including the Proposed Project.

## Proposed Project Overview

The Proposed Project is a Specific Plan for SEDA, which includes approximately 8,400 acres of land within the City's Sphere of Influence (SOI), including single-family and multifamily residential, institutional, commercial, employment, mixed use, and public facility land uses. The Proposed Project is located in the southeastern portion of the City limits, and is generally bound by the Gould Canal to the north, McCall and Highland Avenues to the east, Jensen and North Avenues to the south, and Locan, Temperance, and Minnewawa Avenues to the west. The Proposed Project meets the definition of a "Project" in accordance with California Water Code Section 10910 through 10915, thus requiring the preparation of this WSA (see Section 2.2 of this WSA for a full explanation of the applicability of the Water Code).

## Water Demands and Supply Availability

The projected water demand for the SEDA Specific Plan Area (Plan Area) under the Proposed Project at buildout is approximately 19.83 Million Gallons per Day (MGD), or 22,212 acre-ft/year (AFY). The projected water demand for the Plan Area under General Plan conditions was determined to be approximately 19.5 MGD, or 21,843 AFY. Thus, the projected water demand for the Plan Area under the Proposed Project is approximately 0.33 MGD, or 370 AFY greater than the projected water demand for the Plan Area under General Plan conditions. The projected water demands for the land uses included in the City's General Plan were included in the City's 2020 Urban Water Management Plan (UWMP) as part of the projections for future water demand and population growth.

If approved by the City, it is expected that the Proposed Project would be served from the City's existing and future water supplies. The City currently receives water from four sources:

- Groundwater pumped from groundwater wells throughout the City
- Surface water from the San Joaquin River through a contract with the United States Bureau of Reclamation (USBR) as part of the Central Valley Project (CVP)
- Surface water from the Kings River through a contract with the Fresno Irrigation District (FID)
- Recycled water treated from the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) and the North Fresno Wastewater Reclamation Facility (NFWRF) (planned for non-potable uses)

The City has historically met water system demands regardless of regional hydrology. The City expects reductions of normal-year supplies during single and multiple dry years, but is still projected to meet water demands for the service area. If water shortages occur, the City can enact water demand reduction and conservation measures outlined in their Water Shortage Contingency Plan (WSCP) prepared for and included in the 2020 UWMP. These demand reduction and conservation measures would apply to all customers of the City's water system, including those in the Proposed Project area. The projected water supplies available and water demands through 2045 are shown in Table ES-1 for the various hydrologic years, which shows that projected water supplies are sufficient to meet projected water demands for the next 20 years. Table ES-2 shows the projected water supply and demand in 2045 with the incorporation of the projected demand for the Proposed Project; as shown, projected water supplies are sufficient to meet the projected water demands for the City's future water system including the Proposed Project.

Pursuant to Water Code 10910(c)(4), and based on the technical analyses described in this document, this WSA demonstrates that the City's existing and planned future water supplies are sufficient to meet the City's existing and future projected water demands to 2045 under all hydrologic conditions, including those demands associated with the Projected Project.

**Table ES-1 City of Fresno Projected Water Supply Versus Water Demand During Normal, Single Dry, and Multiple Dry Water Years, AFY**

| Water Supply/Demand Property | | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| **Normal Year** | | | | | | |
| Available Water Supply, AFY | | 329,030 | 341,140 | 346,610 | 352,000 | 357,330 |
| Total Water Demand, AFY | | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| Difference, AFY | | 129,826 | 128,384 | 124,300 | 120,124 | 115,883 |
| Amount Short of Demand | | N/A | N/A | N/A | N/A | N/A |
| **Single Dry Year** | | | | | | |
| Available Water Supply, AFY | | 189,852 | 195,392 | 200,862 | 206,252 | 211,582 |
| Total Water Demand, AFY | | 164,092 | 176,132 | 184,174 | 192,228 | 200,287 |
| Difference, AFY | | 25,760 | 19,260 | 16,688 | 14,024 | 11,295 |
| Amount Short of Demand | | N/A | N/A | N/A | N/A | N/A |
| **Multiple Dry Years** | | | | | | |
| Multiple Dry Year 1 | Available Water Supply, AFY | 273,725 | 279,265 | 284,735 | 290,125 | 295,455 |
| | Total Water Demand, AFY | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | Difference, AFY | 74,521 | 66,509 | 62,425 | 58,249 | 54,008 |
| | Amount Short of Demand | N/A | N/A | N/A | N/A | N/A |
| Multiple Dry Year 2 | Available Water Supply, AFY | 274,626 | 280,166 | 285,636 | 291,026 | 296,356 |
| | Total Water Demand, AFY | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | Difference, AFY | 75,422 | 67,410 | 63,326 | 59,150 | 54,909 |
| | Amount Short of Demand | N/A | N/A | N/A | N/A | N/A |
| Multiple Dry Year 3 | Available Water Supply, AFY | 217,568 | 223,108 | 228,578 | 233,968 | 239,298 |
| | Total Water Demand, AFY | 190,267 | 193,637 | 197,736 | 201,753 | 205,708 |
| | Difference, AFY | 27,301 | 29,471 | 30,842 | 32,215 | 33,589 |
| | Amount Short of Demand | N/A | N/A | N/A | N/A | N/A |

| Water Supply/Demand Property | | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| Multiple Dry Year 4 | Available Water Supply, AFY | 189,852 | 195,392 | 200,862 | 206,252 | 211,582 |
| | Total Water Demand, AFY | 162,551 | 165,920 | 170,020 | 174,036 | 177,992 |
| | Difference, AFY | 27,301 | 29,471 | 30,842 | 32,215 | 33589 |
| | Amount Short of Demand | N/A | N/A | N/A | N/A | N/A |
| Multiple Dry Year 5 | Available Water Supply, AFY | 314,840 | 320,380 | 325,850 | 331,240 | 336,570 |
| | Total Water Demand, AFY | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | Difference, AFY | 115,636 | 107,624 | 103,540 | 99,364 | 95,123 |
| | Amount Short of Demand | N/A | N/A | N/A | N/A | N/A |

Source: City of Fresno 2020 UWMP Table 7-1 for Normal Year Data, Table 7-2 for Single Dry Year Data, and Table 7-3 for Multiple Dry Year Data.

**Table ES-2 City of Fresno Projected Water Supply Versus Water Demand During Normal, Single Dry, and Multiple Dry Water Years with Project, AFY**

| Water Supply/Demand Property | | 2045 |
|---|---|---|
| **Normal Year** | | |
| Available Water Supply, AFY | | 357,330 |
| Total Water Demand, AFY | | 241,447 |
| Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | | +370 |
| Total Water Demand (with Project), AFY | | 241,817 |
| | Difference, AFY | 115,513 |
| | Amount Short of Demand | N/A |
| **Single Dry Year** | | |
| Available Water Supply, AFY | | 211,582 |
| Total Water Demand, AFY | | 200,287 |
| Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | | +370 |
| Total Water Demand (with Project), AFY | | 200,657 |
| | Difference, AFY | 10,925 |
| | Amount Short of Demand | N/A |
| **Multiple Dry Year** | | |
| Multiple Dry Year 1 | Available Water Supply, AFY | 295,455 |
| | Total Water Demand, AFY | 241,447 |
| | Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | +370 |
| | Total Water Demand (with Project), AFY | 241,817 |
| | Difference, AFY | 53,638 |
| | Amount Short of Demand | N/A |
| Multiple Dry Year 2 | Available Water Supply, AFY | 296,356 |
| | Total Water Demand, AFY | 241,447 |
| | Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | +370 |
| | Total Water Demand (with Project), AFY | 241,817 |
| | Difference, AFY | 54,539 |
| | Amount Short of Demand | N/A |

| Water Supply/Demand Property | | 2045 |
|---|---|---|
| Multiple Dry Year 3 | Available Water Supply, AFY | 239,298 |
| | Total Water Demand, AFY | 205,708 |
| | Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | +370 |
| | Total Water Demand (with Project), AFY | 206,078 |
| | Difference, AFY | 33,220 |
| | Amount Short of Demand | N/A |
| Multiple Dry Year 4 | Available Water Supply, AFY | 211,582 |
| | Total Water Demand, AFY | 177,992 |
| | Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | +370 |
| | Total Water Demand (with Project), AFY | 178,362 |
| | Difference, AFY | 33,220 |
| | Amount Short of Demand | N/A |
| Multiple Dry Year 5 | Available Water Supply, AFY | 336,570 |
| | Total Water Demand, AFY | 241,447 |
| | Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | +370 |
| | Total Water Demand (with Project), AFY | 241,817 |
| | Difference, AFY | 94,753 |
| | Amount Short of Demand | N/A |

Source: City of Fresno 2020 UWMP Table 7-1 for Normal Year Data, Table 7-2 for Single Dry Year Data, and Table 7-3 for Multiple Dry Year Data.

**Water Supply Assessment Approval Process**

The Fresno City Council must approve this WSA at a regular or special meeting. Furthermore, the City must include this WSA in the Draft Program EIR that is being prepared for the Proposed Project.

In addition, SB 221 applies to residential subdivisions of over 500 dwelling units and requires that the water supplier provide written verification that the water supply for the project is sufficient prior to the issuance of the final permits. Because the Proposed Project includes up to 45,274 residential dwelling units, it is subject to the requirements of SB 221 (Government Code Section 66473.7).

# CHAPTER 1
# INTRODUCTION

## 1.1 Proposed Project Overview

The City of Fresno (City) is preparing a Specific Plan and PEIR for the Southeast Development Area (SEDA). The SEDA Specific Plan Area (Plan Area), previously known as the Southeast Growth Area (SEGA), is located in the southeast portion of the City that is formally designated as a growth area in the City's General Plan (General Plan).

## 1.2 Purpose

The purpose of this report is to provide a Water Supply Assessment (WSA) for the SEDA Specific Plan Project (Proposed Project) in accordance with the requirements of the California Water Code as established by California Senate Bill 610 (SB 610) and Senate Bill 221 (SB 221), to evaluate whether sufficient water supplies are available to meet existing and future water demands within the City of Fresno's water service area, including the demands associated with the proposed Project, during normal, single dry, and multiple dry years for a 20-year period.

SB 610 and SB 221, effective January 1, 2002, amended state law to improve the link between information on water supply availability and certain land use decisions made by cities and counties. SB 610 and SB 221 were companion measures intended to promote more collaborative planning between local water suppliers and cities and counties. Both statutes require detailed information regarding water availability to be provided to the city and county decision-makers prior to approval of large development projects. Both statutes also require this detailed information be included in the administrative record that serves as the evidentiary basis for an approval action by the city or county on such projects. Both measures recognize local control and decision making regarding the availability of water for projects and the approval of projects. The purpose of these statutes was to make confirmation of water supply sufficiency a condition of approval for development projects. Confirmation is completed through an assessment of a water supplier's existing and future water supply sources, and existing and projected water demands for approved and proposed projects. The purpose of a WSA is to demonstrate the sufficiency of a water purveyor's supplies to meet the water demands of a proposed project in addition to the purveyor's existing and planned water demands/uses. California Water Code (Water Code) Sections 10910 through 10915 detail the specific requirements for WSA preparation.

This WSA has been prepared in accordance with the requirements of SB 610, Water Code Section 10910 through 10915, and the California Department of Water Resources' (DWR's) "Guidebook for Implementation of Senate Bills 610 and Senate Bill 221 of 2001: To Assist Water Suppliers, Cities, and Counties in Integrating Water and Land Use Planning."[1] The information contained in this WSA is based primarily on the 2020 Urban Water Management Plan (UWMP) prepared for the City of Fresno and approved in June 2021.[2]

[1] California Department of Water Resources, "Guidebook for Implementation of Senate Bill 610 and Senate Bill 221 of 2001 to Assist Water Suppliers, Cities, and Counties with Integrating Water and Land Use Planning." October 8, 2003.
[2] City of Fresno, "2020 Urban Water Management Plan," July 2021.

# CHAPTER 2
# APPLICABILITY OF SENATE BILL 610

Water Code Section 10910 explains the applicability of SB 610 and what types of projects are subject to the requirements, including the preparation of a WSA. Relevant citations of Water Code sections 10910 through 10915 are included throughout this WSA in *italics*.

The following sections address the questions posed in SB 610 to determine its applicability to the proposed SEDA Specific Plan project.

## 2.1 Is the Proposed Project Subject to CEQA?

Water Code Section 10910 states:

*(a) Any city or county that determines that a project, as defined in Section 10910, is subject to the California Environmental Quality Act Division 13 (commencing with Section 21000) of the Public Resources Code, under Section 21080 of the Public Resources Code shall comply with this part.*

The City has determined that the project is subject to the California Environmental Quality Act (CEQA) and that an EIR is required.

## 2.2 Is the Proposed Project Considered a "Project" as Defined in SB 610?

Water Code Section 10912 states:

*For the purposes of this part, the following terms have the following meanings:*

*(a) "Project" means any of the following:*
*(1) A proposed residential development of more than 500 dwelling units.*
*(2) A proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space.*
*(3) A proposed commercial office building employing more than 1,000 persons or having more than 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 more than 1,000 persons, occupying more than 40 acres of land, or having more than 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.*

The Proposed Project is located in Southeast Fresno within Fresno's Sphere of Influence (SOI), and is approximately 8,400 acres in size consisting of proposed residential, mixed use, employment, and public facility land uses. The Specific Plan for SEDA was developed for the buildout condition of the Plan Area of 45,000 dwelling units, and includes up to 6,728,713 square feet (SF) of office developments (see CHAPTER 3 for land use areas). As such, the project satisfies the definition of a "project" pursuant to Water Code Section 10912(a) paragraph (1), paragraph (3), paragraph (6), and possibly others. Therefore, preparation of a WSA for this project is required.

## 2.3 Who is Identified as the Public Water System?

Water Code Section 10910 states:

> *(b) The city or county, at the time that it determines whether an environmental impact report, a negative declaration or a mitigated negative declaration is required for any project subject to the California Environmental Quality Act pursuant to Section 21080.1 of the Public Resources Code, shall identify any water system that is, or may become as a result of supplying water to the project identified pursuant to this subdivision, a public water system, as defined in Section 10912, that may supply water for the project. If the city or county is not able to identify any public water system that may supply water for the project, the city or county shall prepare the water assessment required by this part after consulting with any entity serving domestic water supplies whose service area includes the project site, the local agency formation commission, and any public water system adjacent to the project site.*

Water Code Section 10912 states:

> *(c) "Public Water System" means a system for the provision of piped water to the public for human consumption that has 3,000 or more service connections. A public water system includes all of the following:*
> *(1) Any collection, treatment, storage, and distribution facility under control of the operator of the system which is used primarily in connection with the system.*
> *(2) Any collection or pretreatment storage facility not under the control of the operator that is used primarily in connection with the system.*
> *(3) Any person who treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption.*

The Proposed Project is located within the City's SOI, and will therefore be supplied by the City's water supply system. The City's water system includes an estimated 140,992 service connections,[3] and therefore is considered a public water system as defined in the Water Code. Therefore, the City of Fresno is the identified public water system for the Proposed Project.

## 2.4 Does the City have an Adopted Urban Water Management Plan (UWMP) that Accounts for the Proposed Project?

Water Code 10910 states:

> *(c) (1) The city or county, at the time it makes the determination required under Section 21080.1 of the Public Resources Code, shall request each public water system identified pursuant to subdivision (b) to determine whether the projected water demand associated with a proposed project was included as part of the most recently adopted urban water management plan adopted pursuant to Part 2.6 (commencing with Section 10610).*
> *(2) If the projected water demand associated with the proposed project was accounted for in the most recently adopted urban water management plan, the public water system may incorporate the requested information from the urban water management plan in preparing the elements of the assessment required to comply with subdivisions (d), (e), (f), and (g).*

The City's most recently adopted UWMP was prepared in 2020 and adopted in July 2021 and is incorporated by reference into this WSA. The City's 2020 UWMP included water demand projections for current water demands within the City and anticipated water demands associated

[3] City of Fresno Department of Public Utilities, "Water Sources." https://www.fresno.gov/publicutilities/water-quality-operations-testing/water-source-distribution/.

with future development projects and planning areas within the City's General Plan SOI through 2045. The City's 2020 UWMP is included in Appendix C of this WSA.

Water demands for the Proposed Project are not specifically designated in the City's 2020 UWMP. However, the General Plan planning area (the SOI) was included in the UWMP and the SEDA Specific Plan is the implementation of the General Plan with slightly different land use types, so the Proposed Project is included in the 2020 UWMP, and the demand projections included in the UWMP may be used in preparing this WSA.

## 2.5 Is Groundwater a Component of the Supplies for the Project?

Water Code Section 10910 states:

> *(d) (1) The assessment required by this section shall include an identification of any existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project, and a description of the quantities of water received in prior years by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), under the existing water supply entitlements, water rights, or water service contracts.*
>
> *(f) If a water supply for the proposed project includes groundwater, the following additional information shall be included in the water assessment…*

Water Code 10910(f) includes additional requirements for information to be included in a WSA if the water supplies for the Proposed Project includes groundwater. Groundwater will likely be a water supply for the Proposed Project. The City produces groundwater from the Kings Subbasin of the San Joaquin Valley Groundwater Basin as one of its water supplies for potable use, and since the City will be the public water system supplying water to the Proposed Project, it will therefore use groundwater as one of its water supplies.

Each potential water supply for the Proposed Project is addressed in the following sections of the WSA with respect to water reliability. Water Code Section 10910 specifically requires an analysis of groundwater sources proposed to be used by a proposed project.

## 2.6 Are there Sufficient Water Supplies to Serve the Proposed Project Over the Next Twenty Years?

The sufficiency of water supplies identified as potential water sources for the Proposed Project is assessed in the following sections of the WSA.

**CHAPTER 3**
**PROJECT DESCRIPTION**

## 3.1 Proposed Project Location

The Proposed Project is located in the southeastern portion of the City, and is generally bound by the Gould Canal to the north, McCall and Highland Avenues to the east, Jensen and North Avenues to the south, and Locan, Temperance, and Minnewawa Avenues to the west; see Figure 3.1 for the Plan Area's location.

The Proposed Project consists of an approximately 8,400-acre area which is located outside of the City limits, but within the City's SOI. The Proposed Project consists of residential, employment, mixed use, open space, and public facility land uses. The Plan Area currently consists mostly of agricultural and farmlands with sparse residential and urban areas.

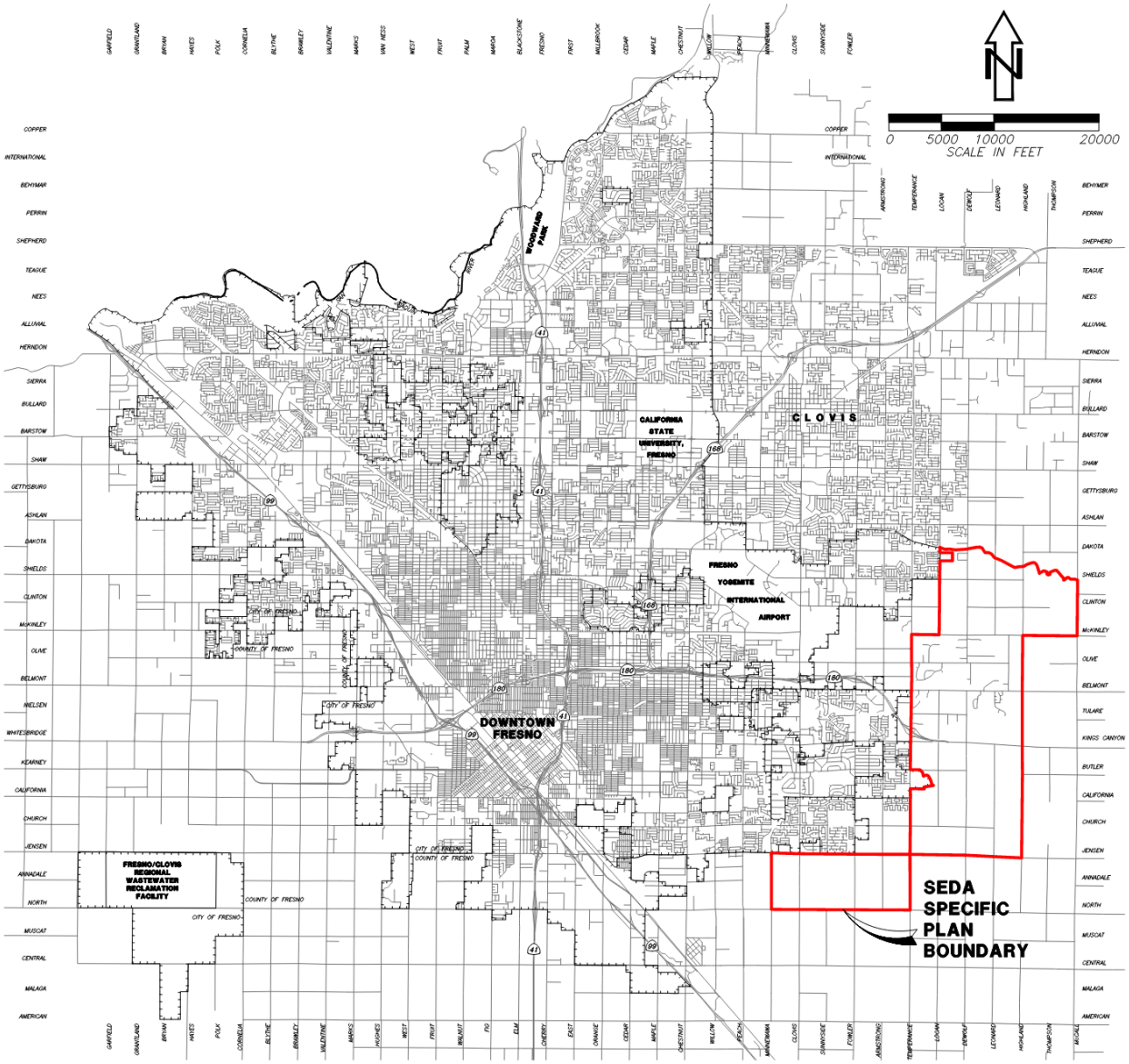



**Figure 3.1 SEDA Specific Plan Location**

## 3.2 Proposed Project Description

SEDA was approved for incorporation into the City by the Local Agency Formation Commission (LAFCo) in 2006, with a number of qualifying provisions, of which included the preparation of a Specific Plan and associated environmental documents before the land could be annexed to the City. Located in Growth Area II, SEDA was planned for development after other infill initiatives from the City's other planning efforts, and would be developed in phases. The General Plan established two levels of development – the General Plan Horizon and the General Plan Buildout. The General Plan Horizon is the level of development predicted to occur by the "Horizon Year," which was established as 2035, in accordance with the General Plan. General Plan Buildout is the level of development characterized by full occupancy of all developable sites in accordance with the General Plan; this was estimated to occur beyond 2035 (defined as past 2050).

As such, the General Plan defined development of SEDA under General Plan Horizon as a portion of the full buildout conditions – specifically, it assumed a residential development capacity of approximately 15,000 dwelling units, one third of the buildout capacity. Accordingly, the residential development capacity of SEDA under General Plan Buildout is approximately 45,000 dwelling units, and the General Plan assumed that the additional 30,000 dwelling units would not be developed until after 2035. However, though the General Plan was analyzed under the General Plan Horizon level, the associated MEIR (Master Environmental Impact Report) analyzed the environmental impacts of the General Plan under the buildout level of the SOI, which encompasses other growth areas, including SEDA.

The Specific Plan for SEDA was developed for the buildout condition of the Plan Area of 45,000 dwelling units, and provides implementation mechanisms for development in the Plan Area that accommodate for increased density and accelerated housing production. As part of the City's General Plan, SEDA was designated with land use classifications as defined in the General Plan. The Specific Plan presents alternative land use classifications for SEDA, and seeks to propose how the Plan Area will develop over time to complete buildout conditions with these newly-defined land use categories.

## 3.3 Proposed Land Uses and Unit Factors

The City's General Plan assigned land use classifications to areas located within the Plan Area. Each land use classification has a set of characteristics assigned to it with respect to a specific utility demand that have been determined and/or calculated by various contributing parties. The SEDA Specific Plan proposes new land use classifications for the Plan Area that may change the area's characteristics as it relates to utilities, e.g., water demand, wastewater generation, or storm water runoff, when compared to the General Plan. Additionally, some land uses have revised areas, which further alters those characteristics.

The SEDA Specific Plan does not use the same land use classifications as defined in the General Plan, and instead utilizes SEDA-specific land use classifications developed as part of the Specific Plan. See Figure 3.2 for the General Plan Land Use Map of the SEDA Specific Plan Area, and Figure 3.3 for the SEDA Specific Plan Proposed Land Use Map for the chosen alternative for the Plan Area.

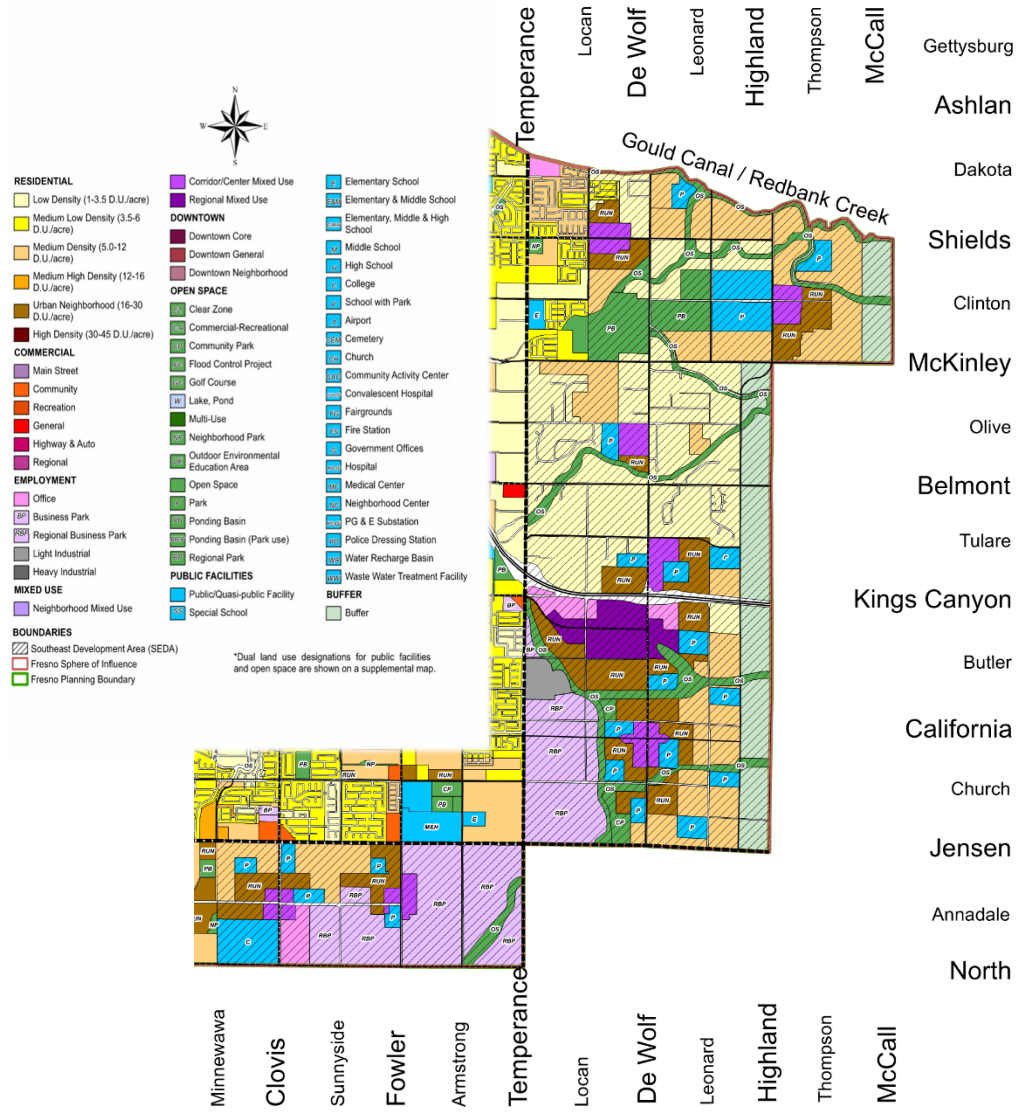
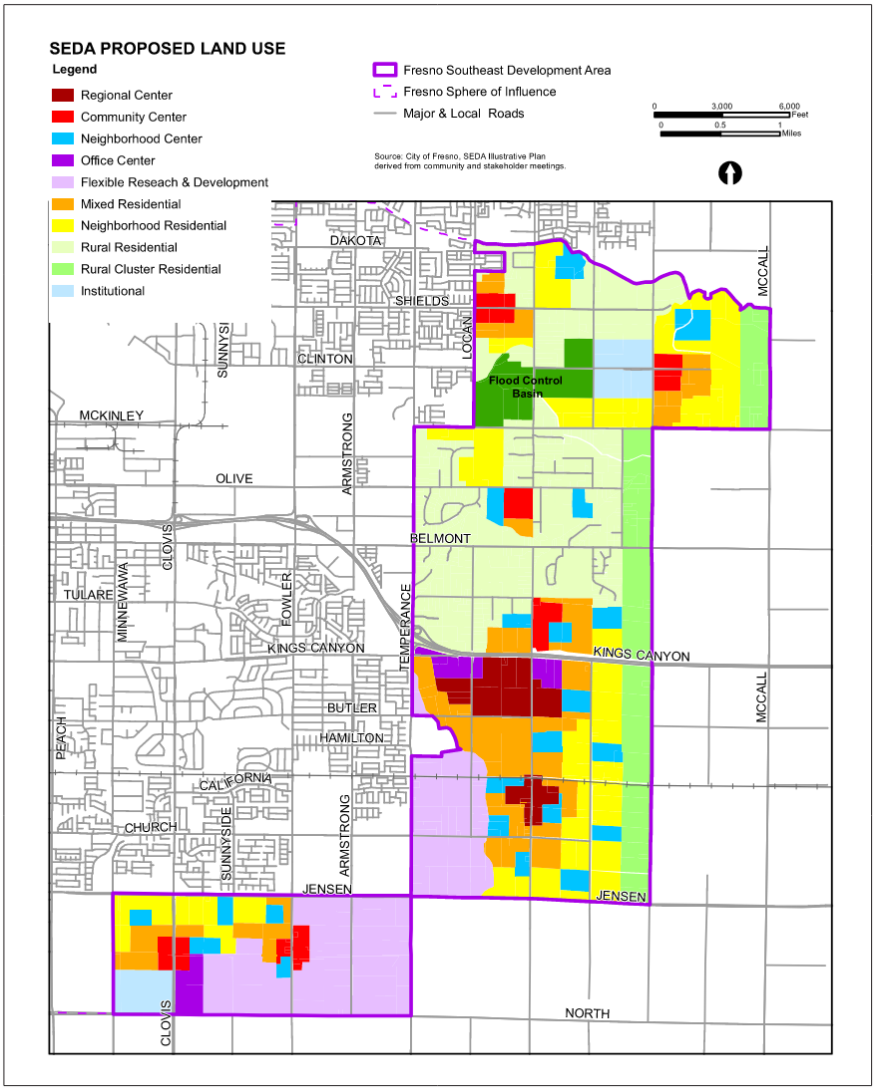



**Figure 3.2 General Plan Land Use Map for SEDA Specific Plan Area**
Source: City of Fresno General Plan, Figure LU-1, December 2014, Figure Updated 3/2/2021




Source: City of Fresno, SEDA Regulating Districts, 02/10/2022.

**Figure 3.3 SEDA Specific Plan Proposed Land Use Map**
Source: Southeast Development Area Specific Plan Notice of Preparation,
First Carbon Solutions, 02/2022

At the time of preparation of the SEDA PEIR documents, including a water technical study prepared by Blair, Church & Flynn, the City was developing water demand factors for the SEDA-specific land uses as was done for the General Plan land uses; these factors were unavailable during the completion of the PEIR documents and water technical study analysis. However, the SEDA-specific land uses are similar in nature to many of the General Plan land uses, and similarities can be drawn between the two land use categories. Thus, a number of reasonable assumptions were made to determine equivalent General Plan land uses for each SEDA-specific land use in order to utilize the water demand factors for General Plan land uses. Table 3.1 shows the equivalent General Plan land uses established for each Specific Plan land use case as described below.

For the General Plan land use case, the technical memorandum prepared for the City of Fresno General Plan Update MEIR[4] was used to obtain projected water demand data for SEDA. In the

[4] West Yost Associates, "Hydraulic Evaluation of the Proposed 2035 General Plan Land Use Update for the Master Environmental Impact Report," "Table 2. Water Demand Comparison for General Land Use Plan Land Changes," January 21, 2013.

memorandum, analyses were completed to project water demands for 2035, which is the buildout year for the City's General Plan. The analyses included one completed for SEDA based on the land uses included in the General Plan; the demand determined for SEDA was 21,834 AFY.

For the Specific Plan analysis, the water demand factors used were prepared by Akel Engineering as part of the Update to the City's Metropolitan Water Resources Management Plan (Metro Plan).[5] Table 3.1 shows the equivalent General Plan land uses and the associated category included in the Metro Plan updated table of factors, and Table 3.2 shows the water demand factors used for each equivalent General Plan land use classification that was determined for each SEDA Specific Plan land use. It should be noted that some General Plan land uses did not exactly match up with those listed in the water demand factors, and some assumptions were made to determine approximate water demand factors; see Appendix B for the full list of water demand factors.

**Table 3.1 General Plan–SEDA–General Plan Equivalent Land Use Classifications**

| SEDA Specific Plan Land Use Classifications [A] | Equivalent General Plan Land Use Classification [B] | Water Demand Factor Category [C] |
|---|---|---|
| Residential – Mixed Residential | Residential – Urban Neighborhood | Residential – Medium High & High Density |
| Residential – Neighborhood Residential | Residential – Medium Density | Residential – Medium Density |
| Residential – Rural Residential | Residential – Low Density | Residential – Low Density |
| Residential – Rural Cluster Residential | Residential – Low Density | Residential – Rural Density |
| Employment – Office Center | Employment – Office | Commercial – Office |
| Employment – Flexible Research & Development | Employment – Business Park | Commercial – Professional Services Office |
| | Employment – Regional Business Park | Commercial – Regional |
| Employment – Institutional | Public Facilities – College | Public Facilities – College |
| Employment – Institutional | Public Facilities – School with Park | Public Facilities – SEGA School with Park |
| Mixed Use – Regional Center | Mixed Use – Regional Mixed Use | Residential – High Density, Commercial – Regional, & Public Facilities – Community Activity Center |
| Mixed Use – Community Center | Mixed Use – Corridor/Center Mixed Use | Public Facilities – Community Activity Center |
| Mixed Use – Neighborhood Center | Public Facilities – Neighborhood Center | Residential – Medium High Density, Commercial – Neighborhood, & Public Facilities – Neighborhood Center |
| Open Space – Flood Control Basin | Open Space – Ponding Basin | Open Space – Ponding Basin |
| Other | Streets/Railroad/Canals/Etc. | N/A |

[A] City of Fresno, "Notice of Preparation of a Program Environmental Impact Report for the Southeast Development Area Specific Plan, Fresno, California," February 22, 2022.

[B] City of Fresno, "Fresno General Plan," December 18, 2014.

[C] Akel Engineering Group Inc., "Water and Wastewater Unit Factor Update for Metropolitan Water Resources Management Plan Update, October 2020.

[5]Akel Engineering Group Inc., "Water and Wastewater Unit Factor Update for Metropolitan Water Resources Management Plan Update," October 2020.

**Table 3.2 Metro Plan Update Water Demand Factors[6]**

| Water Demand Factor Category | Water Demand Factor (gpd/ac) |
|---|---|
| Residential | |
| Medium High & High Density | 5,140 [A] |
| Medium Density | 2,810 |
| Low Density | 2,050 |
| Rural Density | 1,415 |
| Commercial | |
| Office | 2,440 |
| Professional Services Office | 2,420 |
| Regional | 1,685 |
| Public Facilities | |
| College | 1,665 |
| SEGA School with Park | 2,895 |
| High Density Residential, Regional Commercial, & Community Activity Center | 2,106 [B] |
| Community Activity Center | 1,930 |
| Medium High Density Residential, Neighborhood Commercial, & Neighborhood Center | 1,851 [C] |
| Open Space | |
| Ponding Basin | 0 |
| Other | |
| Railroad/Streets/Canals/Etc. | N/A |

[A] Average of Medium High and High Density Residential Water Demand Factors
[B] Combination of High Density Residential, Regional Commercial, and Community Activity Center
[C] Combination of Medium High Density Residential, Neighborhood Commercial, and Neighborhood Center

## 3.4 Projected Water Demand

The analysis completed to determine the change in water demands for the General and Specific Plans involved comparing the total demand determined for the Plan Area under both the General Plan and Specific Plan land use cases. The analysis of the land use changes in the Plan Area was focused on comparing the change in water demand from the General Plan Land Use case to the Specific Plan Land Use case. General Plan land use classifications and Specific Plan land use classifications were provided by the City of Fresno Planning and Development Department in the form of GIS (Geographic Information System) and Shape files. GIS and Shape files were also obtained from the City of Fresno Department of Public Utilities (DPU) for the existing water facilities in the City.

The GIS files for the General and Specific Plan land uses were georeferenced to the California State Plane Coordinate System, Zone 4, Foot, NAD83 Datum for analysis. This allowed mapping of the land uses to pull information necessary to complete the analysis, including the area of each land use. The water demand factors were then used with the area of the corresponding land use classification to determine a total water demand for the Plan Area based on the General Plan and

[6] Akel Engineering Group Inc., "Water and Wastewater Unit Factor Update for Metropolitan Water Resources Management Plan Update," October 2020.

the Specific Plan developments. The total water demand for the Plan Area based on the General Plan case was compared to that of the Specific Plan case, resulting in the total change in water demand for the Plan Area.

The base water demand for all land uses in the Plan Area was found for both the General Plan and the Specific Plan conditions. The total General Plan base water demand was 21,843 AFY, or 19.50 MGD, and the Specific Plan base water demand was found to be 19.83 MGD, resulting in an increase in water demand of approximately 0.33 MGD, or 1.7%. See Table 3.3 and Table 3.4 for the results of the analysis and a direct comparison of the General Plan and Specific Plan water demands; see Appendix A for a more detailed version of the analysis.

**Table 3.3 Specific Plan (SP) Anticipated Water Demand per Land Use Classification**

| GP Land Use Classification | SP Equivalent Land Use Classification | Water Demand Factor [A,B] (GPD/ac) | SP Area (ac) | SP Base Water (MGD) |
|---|---|---|---|---|
| Residential - Low Density | Residential - Rural Residential | 2,050 | 2,037.69 | 4.18 |
| Residential - Medium Density | Residential - Neighborhood Residential | 2,810 | 1,434.91 | 4.03 |
| Residential - Urban Neighborhood | Residential - Mixed Residential | 5,140 [A] | 1,026.26 | 5.27 |
| Employment - Office | Employment - Office Center | 2,440 | 154.47 | 0.38 |
| Employment - Business Park | Employment - Flexible Research and Development | 2,420 | 16.54 | 0.04 |
| Employment - Regional Business Park | | 1,685 | 1,287.53 | 2.17 |
| Mixed Use -Corridor/Center Mixed Use | Mixed Used - Community Center | 1,930 | 273.88 | 0.53 |
| Mixed Use - Regional Mixed Use | Mixed Use - Regional Center | 2,106 [B] | 291.71 | 0.61 |
| Open Space - Open Space | N/A | 865 | 0 | 0.00 |
| Open Space - Community Park | N/A | 2,620 | 0 | 0.00 |
| Open Space - Ponding Basin | Other - Flood Control Basin | 0 | 265.78 | 0.00 |
| Public Facilities - College | Employment - Institutional | 1,665 | 116.26 | 0.19 |
| Public Facilities - School with Park | | 2,895 | 149.77 | 0.43 |
| Public Facilities - School with Park | Mixed Use - Neighborhood Center | 1,851 [C] | 491.38 | 0.91 |
| Buffer - Buffer | Residential - Rural Cluster Residential | 1,415 [D] | 766.47 | 1.08 |
| Other - Street/Rail/ Canal, etc. | Other | 0 | 12.94 | 0.00 |
| **Totals** | **-** | **-** | **8,325.57** | **19.83** |

[A] Average of Medium High and High Density Residential Water Demand Factors

[B] Combination of High Density Residential, Regional Commercial, and Community Activity Center

[C] Combination of Medium High Density Residential, Neighborhood Commercial, and Neighborhood Center

[D] Rural Density Water Demand Factor used for Rural Cluster Residential Land Use.

**Table 3.4 Difference Between General Plan and Specific Plan Anticipated Water Demand**

| SEDA General Plan Total Base Water Demand (MGD) | SEDA Specific Plan Total Base Water Demand (MGD) | Usage Δ (MGD) | Usage Δ (%) |
|---|---|---|---|
| 19.5 | 19.83 | 0.33 | 1.7% |

# CHAPTER 4
# CITY OF FRESNO WATER SERVICE AREA

## 4.1 Water Service Area

The City's water system is managed by the City DPU. Currently, the incorporated area of the City covers approximately 115 square miles (73,500 acres), and largely consists of single-family residential, commercial, public, and industrial development.[7] The City water system currently serves the area encompassed within the City limits, with the exception of customers served by the Bakman Water Company, Pinedale County Water District, Park Van Ness Mutual Water Company, California State University Fresno, and private groundwater users located in Fresno County islands. The City plans to eventually provide water service to all areas included in the General Plan, including the City's SOI, which includes lands outside of the City limits that are expected to be annexed and developed by the City in the future.

According to the City's 2020 UWMP, the City's planning area covers approximately 106,000 acres (165.6 square miles), which includes approximately 73,500 acres (115 square miles) of incorporated land and 32,500 acres (50.8 square miles) of unincorporated land. Of the planning area, the City's water service area covers 70,400 acres (110 square miles) of land within the SOI, which includes most of the 73,500 acres incorporated area and the unincorporated Fresno County islands not within the City limits. The remaining areas within the City's SOI are either served by other systems or are unserved by a water system, mainly consisting of open space, agricultural land, and land used by roads, highways, and railroads. Table 4.1 shows the characteristics of the City's water service area.

**Table 4.1 Current City of Fresno Water Service Area Characteristics**

| Land Use Type | Area (Acres) | % of Total Area | Service Connections | % of Total Connections |
|---|---|---|---|---|
| Single-Family Residential | 27,700 | 39.3% | 118,775 | 85.1% |
| Multifamily Residential | 3,700 | 5.3% | 6,087 | 4.4% |
| Commercial | 4,500 | 6.4% | 11,982 | 8.6% |
| Public | 5,600 | 8.0% | 2,504 | 1.8% |
| Industrial | 4,500 | 6.4% | 175 | 0.1% |
| Open Space/Landscape Irrigation | 13,100 | 18.6% | N/A[1] | N/A |
| **Total** | **59,100** | | **139,523** [2] | **100%** |
| Vacant/Partially Vacant [3] | 11,300 | 15.9% | N/A | N/A |
| **Total** | **70,400** | | | |

Source: City of Fresno 2020 UWMP, Table 3-1.
1. Dedicated irrigation meters are included in commercial and public meter total.
2. Approx. 3,633 dedicated fire service connections are included in the total services connections, most of which are included in the commercial and public meter total.
3. For partially vacant land, half of the area is included in the zoned land use type and the other half is assumed vacant.

## 4.2 Population

Since the City's founding in 1872 through the mid-1990's, the City has experienced an annual growth rate of greater than 2%. However, from 1995 to 2015, the annual growth rate decreased to an average of 1.3%, and it has not surpassed 1.0% since 2015. According to the most recently available United States population data, the population estimate as of July 1, 2021 was 545,567,

[7] City of Fresno, "2020 Urban Water Management Plan," July 2021.

and the population estimate as of April 1, 2020 was 542,107, presenting a growth in population of approximately 0.4%.[8]

The population served by the City water system is slightly higher than the City's population with the inclusion of the unincorporated areas served by the City, the exclusion of areas within the City limits served by private water companies, special districts, or private wells, and inclusion of the Fresno County service areas; the City acquired County service areas and facilities in 1989, which increased the service area population to slightly greater than the City population.

The City's General Plan is the City's primary growth planning document from which baseline water service area population projections were developed for the UWMP.[9] The General Plan includes population estimates for the City planning area that are based on projections developed by the Fresno Council of Governments, which estimates a buildout population of 921,057 in 2056. In 2017, the Fresno Council of Governments developed population projections in 5-year increments through the year 2050 for all cities within Fresno County (Applied Development Economics, Inc. and Mintier Harnish Associates, 2017). The 2017 report published by the Fresno Council of Governments projected that the City's population will grow at an annual growth rate ranging from 0.92% - 1.44%, with an average growth rate between 2020 and 2056 of 1.03% per year.[10]

According to the City's 2020 UWMP, the City's water service area population is expected to continue to grow along with the City; some slightly higher growth years are anticipated within the next 10 years due to multiple large developments planned for completion in the future.[10] The UWMP assumes that the City will slowly incorporate areas served by others within the City's SOI by the buildout year of 2056, and therefore the long-term water service area population annual growth rate is projected to be 1.44% between 2020 and 2056 to account for the City's absorbing of these areas into its water system. Table 4.2 shows the City's water service area population projections through 2045 in five-year increments.

**Table 4.2 City of Fresno Existing and Projected Water Service Area Population**

| Year | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| Population Served Projection | 550,217 | 609,433 | 674,677 | 719,327 | 765,278 | 812,529 |

Source: City of Fresno 2020 UWMP, Table 3-3

## 4.3 Water System

The City's water system consists of approximately 1,860 miles of distribution and transmission pipes, 202 active groundwater wells, three (3) surface water treatment facilities (SWTFs), five (5) water storage facilities with pump stations, and three (3) booster pump facilities. The Service Area declines in elevation generally from the northeast to the southwest; to assist with pressure regulation, the area is divided into five (5) pressure zones: Highway 41, Shepherd, Sierra, Southwest, and Booster Pump 4 (BP04). The zones are separated by a series of closed/partially closed valves to prevent and/or impede flow from one zone to another. See Figure 3-2 of the City of Fresno 2020 UWMP for an overview of the existing water system.

[8] United States Census Bureau, QuickFacts, Fresno City, California. https://www.census.gov/quickfacts/fact/dashboard/fresnocitycalifornia/PST045222.
[9] City of Fresno, "Fresno General Plan," December 18, 2014.
[10] City of Fresno, "2020 Urban Water Management Plan," July 2021.

## 4.4 Climate

The City experiences a wide range of temperatures throughout the year. Fresno is located in the San Joaquin Valley, and the climate is characterized by hot dry summers and cool winters. Precipitation averages around 11 inches per year as shown in Table 4.3, however rainfall can vary significantly from year to year. As shown by the evapotranspiration ($ET_O$) and temperature values in Table 4.3, the City's water use is significantly higher in the summer months compared to the winter months, reflecting an increased water use for irrigation purposes during summer.

**Table 4.3 Average Climate Characteristics**

| Month | $ET_O$ (inches) | Average Precipitation (inches) | Average Temp-High (°F) | Average Temp-Low (°F) |
|---|---|---|---|---|
| Jan | 1.17 | 2.39 | 57.1 | 37.3 |
| Feb | 2.05 | 1.79 | 62.7 | 39.4 |
| Mar | 3.76 | 2.02 | 68.3 | 43.3 |
| Apr | 5.47 | 0.92 | 74.0 | 46.8 |
| May | 7.42 | 0.51 | 81.5 | 53.1 |
| Jun | 8.46 | 0.18 | 89.8 | 59.2 |
| Jul | 8.84 | 0.02 | 95.9 | 63.9 |
| Aug | 7.84 | 0.02 | 94.9 | 62.6 |
| Sept | 5.69 | 0.08 | 89.8 | 58.0 |
| Oct | 3.70 | 0.58 | 79.4 | 49.3 |
| Nov | 1.86 | 0.98 | 66.1 | 40.5 |
| Dec | 1.04 | 2.02 | 56.5 | 36.2 |
| **Total/ Average** | **57.30** | **11.51** | **76.3** | **49.1** |

Source: CIMIS Website: http://www.cimis.water.ca.gov, Station 80 Fresno State (1988 to 2023) Monthly Average ETO Report and Monthly Report, October 1988 – April 2023 (downloaded May 2023)

**CHAPTER 5**
**CITY OF FRESNO WATER DEMAND ANALYSIS**

The WSA must comply with the following requirements with regards to water demand analysis:

*Water Code Section 10910*

*(c) (1) The city or county, at the time it makes the determination required under Section 21080.1 of the Public Resources Code, shall request each public water system identified pursuant to subdivision (b) to determine whether the projected water demand associated with a proposed project was included as part of the most recently adopted urban water management plan adopted pursuant to Part 2.6 (commencing with Section 10610).*

*(2) If the projected water demand associated with the proposed project was accounted for in the most recently adopted urban water management plan, the public water system may incorporate the requested information from the urban water management plan in preparing the elements of the assessment required to comply with subdivisions (d), (e), (f), and (g).*

The descriptions provided in this section for the City's water demand data have been taken, for the most part, from the City's 2020 UWMP. Additional information from other sources has been included as needed.

Water demands for the Proposed Project are not specifically designated in the City's 2020 UWMP. However, the General Plan planning area (the SOI) was included in the UWMP and the SEDA Specific Plan is the implementation of the General Plan with slightly different land use types, so the Proposed Project is included in the 2020 UWMP, and the demand projections included in the UWMP may be used in preparing this WSA.

## 5.1 Historical and Existing Water Demand

The City serves customers for residential, commercial, institutional, industrial, and landscape irrigation demands through its potable water distribution system. The City also diverts raw surface water to recharge basins throughout the service area to recharge the groundwater basin. Groundwater recharge volume varies based on availability and is represented as an addition to annual groundwater supplies. The City also serves a portion of its customers undisinfected secondary treated or disinfected tertiary treated recycled water for agricultural irrigation or landscape irrigation, respectively.

The City tracks water consumption across different water use sectors listed in the Water Code, including Single-Family Residential, Multifamily Residential, Commercial and Institutional/ Governmental, Industrial, Landscape, and Distribution System Losses. The City also participates in exchanges and transfers, provides temporary travel meters for temporary water use, and diverts non-potable surface supplies for groundwater recharge.

The City's water demand has decreased over time in part due to the economic downturn of 2008 to 2011, water use reductions in response to recent drought conditions, and metering of residential properties. Since 2013, all water services in the City's water service area have been metered. As a result of the metering program, single-family residential water use has decreased since 2013. Water use for multifamily residential, commercial, and institutional services have also decreased since 2013, even though these services were metered prior to 2013. Industrial and irrigation demands have remained at similar levels to 2013; irrigation demands have fluctuated over the years due to various conservation restrictions. Table 5.1 details the water consumption for the City's water service area by customer type for the period of 2013 to 2020.

**Table 5.1 Historical Water Demand by Customer Type, 2013-2020**

| | Metered Consumption (AFY) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Customer Type** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| Single-Family Residential | 76,029 | 67,179 | 54,189 | 53,805 | 57,842 | 57,314 | 54,719 | 60,065 |
| Multifamily Residential | 20,901 | 19,807 | 17,522 | 17,774 | 18,393 | 18,448 | 17,922 | 18,842 |
| Commercial/ Institutional | 20,062 | 20,047 | 17,469 | 17,887 | 19,008 | 19,089 | 17,938 | 16,971 |
| Industrial | 5,747 | 5,800 | 5,618 | 5,533 | 5,698 | 5,561 | 5,554 | 5,729 |
| Landscape Irrigation | 10,666 | 9,130 | 7,358 | 7,726 | 9,021 | 9,872 | 10,019 | 10,478 |
| Other (Travel Meters) | 287 | 228 | 152 | 320 | 563 | 441 | 348 | 341 |
| Losses | * | * | * | * | * | * | * | 9,568 |
| **Total:** | **133,692** | **122,191** | **102,308** | **103,045** | **110,525** | **110,725** | **106,500** | **121,993** |

Source: City of Fresno 2020 UWMP, Figure 4-1, City of Fresno 2020 UWMP, Table 4-2.
* Data not provided in City of Fresno 2020 UWMP

The City's 2020 UWMP provides a breakdown of actual water use by sector for the calendar year of 2020. As shown in Figure 5.1, single-family residential use is the largest use type in the City, while multifamily residential use was the second largest, combining for a total of approximately 65% of total water use being attributed to residential demands.

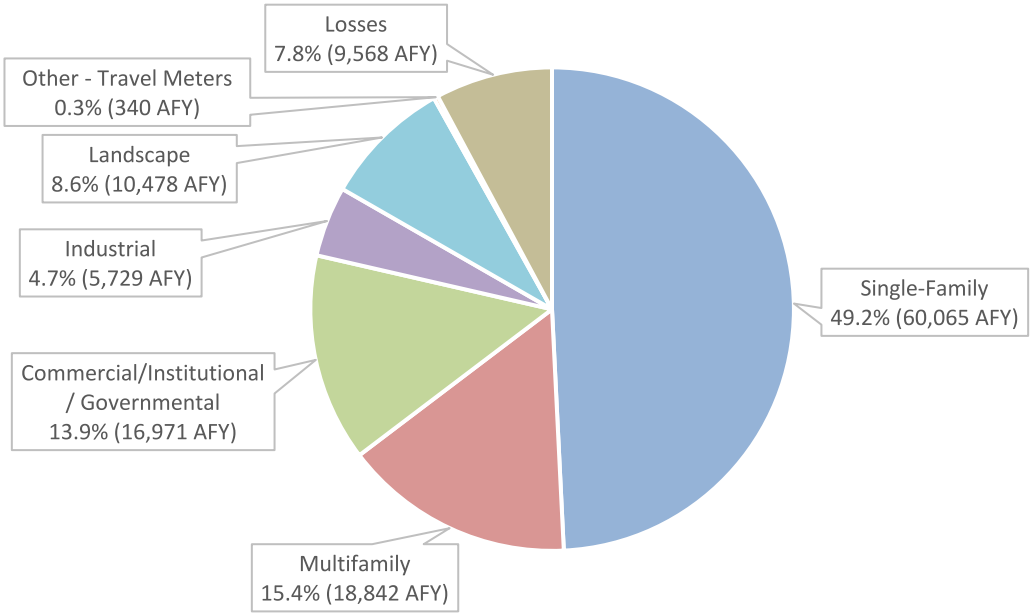



**Figure 5.1 Actual Demands for Potable Water, 2020**
Source: City of Fresno 2020 UWMP, Table 4-2.

For 2020, the City's water use averaged 198 GPCD (Gallons per Capita per Day). This is significantly lower than the City's 2020 daily per capita water use target of 247 GCPD due to extensive conservation efforts implemented by the City in the past decade.

The City utilizes raw surface water for groundwater recharge, which has varied significantly over time. Over a 20-year period from 2000 to 2020, the average annual intentional recharge of surface water was 49,240 AFY. Total recharge has ranged from a high of 82,900 AF in 2019 to a low of 19,700 AF in 2015.[11] Annual variability in raw surface water for groundwater recharge is caused by several factors, including basin availability, water delivery season, pond maintenance, and length of wet seasons. Table 5.2 shows the historic volume of surface water used for recharge each year from 2000 to 2020.

**Table 5.2 Historic Recharge of City Surface Water**

| Year | Volume of Surface Water Used for Recharge (AFY) |
|---|---|
| 2000 | 54,995 |
| 2001 | 46,538 |
| 2002 | 46,514 |
| 2003 | 55,461 |
| 2004 | 44,925 |
| 2005 | 42,881 |
| 2006 | 39,749 |
| 2007 | 36,583 |
| 2008 | 49,852 |
| 2009 | 52,538 |
| 2010 | 50,961 |
| 2011 | 48,919 |
| 2012 | 45,471 |
| 2013 | 45,169 |
| 2014 | 34,681 |
| 2015 | 19,762 |
| 2016 | 65,650 |
| 2017 | 72,116 |
| 2018 | 49,119 |
| 2019 | 82,933 |
| 2020 | 42,686 |

Source: City of Fresno 2020 UWMP, Figure 4-2

As mentioned, the City serves a portion of its customers secondary treated or tertiary treated and disinfected recycled water for agricultural irrigation or landscape irrigation, respectively. Recycled water is produced at the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) and the North Fresno Wastewater Reclamation Facility (NFWRF). The Fresno-Clovis RWRF produces both undisinfected secondary treated recycled water and disinfected tertiary treated recycled water, while the NFWRF only produces disinfected tertiary treated recycled water. The undisinfected secondary treated recycled water is used for the irrigation of non-food crops, and the disinfected tertiary treated recycled water is mainly used for irrigation of landscaping including parks, cemeteries, and golf courses. The recycled water produced by the NFWRF is used exclusively to irrigate the Copper River Golf Course. Table 5.3 shows the previous recycled water demands from 2015 to 2020, and Table 5.4 shows the existing recycled water demand within the City's service area in 2020 and the projected recycled water demands.

[11] City of Fresno, "2020 Urban Water Management Plan," July 2021.

**Table 5.3 Historic Recycled Water Use within Service Area, AFY**

| Recycled Water Facility | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| RWRF, Secondary Treated Effluent | 8,688 | 7,329 | 4,540 | 7,031 | 3,652 | 3,845 |
| RWRF, Tertiary Treated Effluent | 531 | 485 | 423 | 867 | 912 | 858 |
| NFWRF, Tertiary Treated Effluent | 62 | 110 | 0 | 0 | 19 | 54 |
| **Total** | **9,281** | **7,924** | **4,963** | **7,898** | **4,583** | **4,757** |

Source: City of Fresno 2020 UWMP, Table 6-5.

**Table 5.4 Existing and Projected Recycled Water Demand, AFY**

| Beneficial Use Type | Level of Treatment | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|---|
| Agricultural Irrigation | Secondary, Undisinfected | 3,845 | 7,900 | 7,900 | 7,900 | 7,900 | 7,900 |
| Landscape Irrigation (excludes golf courses) | Tertiary | 858 | 5,800 | 5,800 | 5,800 | 5,800 | 5,800 |
| Agricultural Irrigation | Tertiary | 0 | 410 | 410 | 410 | 410 | 410 |
| Golf Course Irrigation | Tertiary | 54 | 110 | 110 | 110 | 110 | 110 |
| | **Total:** | **4,757** | **14,220** | **14,220** | **14,220** | **14,220** | **14,220** |

Source: City of Fresno 2020 UWMP, Table 6-6.

## 5.2 Future Water Demand

The projected water demands presented in the City's 2020 UWMP through 2045 were determined using the methodology for land use-based projections, allowing different demand factors to be applied to current land use areas and future land use areas to determine a projected water demand. The future land use area included the planned land use at buildout of the City's General Plan, which has been represented as the year 2056. Although the City does not have any plans to serve areas currently served by others within the City limits, all areas within the City SOI were assumed to be served by the City by buildout. Demand factors used in the projections were developed using 2018 metered consumption data with 72 categories of land use data. These demand factors were applied to the 2020 land use areas by category to develop the demand projection beginning in 2020. Table 5.5 details the projected potable water demands for the City's service area by use type, and Table 5.6 shows the projected non-potable water demands.

**Table 5.5 Projected Potable Water Demands**

| | Projected Water Use (AFY) | | | | |
|---|---|---|---|---|---|
| **User Type** | **2025** | **2030** | **2035** | **2040** | **2045** |
| Single Family | 76,255 | 80,429 | 82,934 | 85,437 | 87,936 |
| Multifamily | 19,000 | 20,654 | 21,737 | 22,831 | 23,935 |
| Commercial/Institutional/Governmental | 19,052 | 21,135 | 22,587 | 24,041 | 25,496 |
| Industrial | 7,410 | 9,003 | 9,922 | 10,841 | 11,758 |
| Landscape | 4,490 | 5,035 | 5,422 | 5,809 | 6,196 |
| Other (Travel Meters) | 200 | 200 | 200 | 200 | 200 |
| Losses | 10,097 | 10,900 | 11,408 | 11,917 | 12,426 |
| **Total:** | **136,504** | **147,356** | **154,210** | **161,076** | **167,947** |

Source: City of Fresno 2020 UWMP, Figure 4-1, City of Fresno 2020 UWMP, Table 4-6.

**Table 5.6 Projected Non-Potable Water Demands**

| | | Projected Water Use (AFY) | | | | |
|---|---|---|---|---|---|---|
| **Use Type** | **Water Type** | **2025** | **2030** | **2035** | **2040** | **2045** |
| Groundwater Recharge | Raw Water | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| **Total** | | **62,700** | **65,400** | **68,100** | **70,800** | **73,500** |

Source: City of Fresno 2020 UWMP, Figure 4-1, City of Fresno 2020 UWMP, Table 4-7.

The City's 2045 projected water demand at buildout (based on existing water demand, the projected demands for the SEDA under the General Plan conditions, the difference in demands for the SEDA between the Specific Plan and General Plan conditions, and undefined future developments) is summarized on Table 5.7. The General Plan is expected to be built out by 2056, but for the purposes of this WSA, the SEDA was assumed to be annexed and built out by 2045, which is the furthest projected data included in the City's 2020 UWMP.[12]

**Table 5.7 Projected Future Water Demand at 2045**

| | **Water Demand, AFY** |
|---|---|
| Current 2020 Water Demand [1] | 121,993 |
| SEDA Water Demand under General Plan [2] | 21,843 |
| Subtotal (without project) | 143,836 |
| Change in SEDA Water Demand under Specific Plan [3] | +370 |
| Subtotal (with project) | 144,206 |
| Undefined Future Developments [4] | 97,241 |
| **Total Water Demand [5]** | **241,447** |

[1] Data from Table 5.1 of this WSA.
[2] Data from Table 3.4 of this WSA converted to AFY (SEDA General Plan Total Base Water Demand = 19.5 MGD).
[3] Data from Table 3.4 of this WSA converted to AFY (Usage $\Delta$ = 0.33 MGD).
[4] Balance between Subtotal (with project) and Total Water Demand.
[5] Data from Table 5.3 and 5.4 of this WSA (2045 Projected Potable Demand + 2045 Non-Potable Projected Water Demand).

## 5.3 Dry Year Water Demand

As shown in Table 5.1, the City's water demand in 2015 was the lowest amount recorded between the years of 2013 and 2020. Table 5.2 also shows that the lowest amount of recharge also occurred in 2015. This reduction in water demand was a direct result of the drought conditions at the time, and the Governor's April 2015 Executive Order B-29-15 mandating 25% water conservation statewide. Over time, the City has adopted a set of restrictions on water usage to help promote water conservation and overall water consumption. These measures are included in Section 6-520(a) of the City's Municipal Code, which include water conservation measures that are intended to take place under normal water supply conditions. The City's Water Shortage Contingency Plan (WSCP), included in Section 8 and Appendix J of the City's 2020 UWMP, includes a five-stage plan describing specific actions to reduce water demand more than 50% in the event of a water supply shortage or emergency. Demand is expected to decrease over time as conservation measures are enacted in response to single or multiple dry years, or other changes to the City's water supplies.[12]

As of 2023, there are still water consumption restrictions in place due to ongoing drought conditions, which were enacted on January 18, 2022, and readopted in December 2022 for another year. These restrictions include the prohibition of the use of potable water for the following:

[12] City of Fresno, "2020 Urban Water Management Plan," July 2021.

- Outdoor watering that lets water run onto sidewalks and other areas (except incidental runoff)
- Washing vehicles without an automatic shutoff nozzle
- Washing hard surfaces, like driveways and sidewalks, that don't absorb water
- Street cleaning or construction site preparation
- Filling decorative fountains, lakes, or ponds
- Outdoor watering within 48 hours after it rains at least 1/4 inch of rainfall
- Watering ornamental turf on public medians

An additional emergency water conservation regulation was enacted in June 2022 that prohibits the use of potable water to water decorative grass in commercial, industrial, and institutional areas including common areas of homeowners' associations.[13] The regulation also requires urban water suppliers to implement all demand-reduction actions under "Level 2" of their Water Shortage Contingency Plans, which are actions meant to address a 10% to 20% water shortage. Additionally, urban water suppliers are required to fast-track their submissions of supply and demand assessments to plan for potential extended dry conditions. "Level 2" actions vary for each water supplier, but often include things like increasing communication about the importance of water conservation, limiting outdoor irrigation to certain days or hours, increasing patrolling to identify water waste, and enforcing water-use prohibitions.

The City's 2020 UWMP includes characterizations for various year types depending on projected water supplies and drought conditions. These include the Normal Year, Single Dry Year, and Multiple Dry Years. The Normal Year supply availability includes estimated sustainable yield of groundwater supply, long-term allocations of surface water supplies, and projected recycled water supply. The Single-Dry-Year supply availability is based on 2015 data during the 2012-2017 drought because the City had the lowest surface water supply available in 2015; supplies include the estimated sustainable yield for groundwater with pumping beyond sustainable yield as needed during dry periods to be balanced with recharge during normal or wet periods, surface water allocations matching those from 2012 to 2016, and the projected recycled water supply. The Multiple-Dry-Year supply availability is based on the five-year drought condition; supplies are similar to those stated for the single-dry-year supplies. Table 5.8 shows the projected future dry year potable water demands.

**Table 5.8 Projected Normal and Future Dry Year Water Demand, AFY**

| Hydrologic Condition | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| Normal Year | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| Single Dry Year | 164,092 | 176,132 | 184,174 | 192,228 | 200,287 |
| Multiple Dry Year First Year | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| Multiple Dry Year Second Year | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| Multiple Dry Year Third Year | 190,267 | 193,637 | 197,736 | 201,753 | 205,708 |
| Multiple Dry Year Fourth Year | 162,551 | 165,920 | 170,020 | 174,036 | 177,992 |
| Multiple Dry Year Fifth Year | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |

Source: City of Fresno 2020 UWMP Table 7-1 for Normal Year Data, Table 7-2 for Single Dry Year Data, and Table 7-3 for Multiple Dry Year Data.

[13] State Water Resources Control Board Resolution No. 2022-0018, "To Adopt an Emergency Regulation to Reduce Water Demand and Improve Water Conservation." 2022.

The WSA must comply with the following requirements with regards to water supply analysis:

*Water Code Section 10910*

*(c) (2) If the projected water demand associated with the proposed project was accounted for in the most recently adopted urban water management plan, the public water system may incorporate the requested information from the urban water management plan in preparing the elements of the assessment required to comply with subdivisions (d), (e), (f), and (g).*

*(d) (1) The assessment required by this section shall include an identification of any existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project, and a description of the quantities of water received in prior years by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), under the existing water supply entitlements, water rights, or water service contracts.*

*(2) An identification of existing water supply entitlements, water rights, or water service contracts held by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), shall be demonstrated by providing information related to all of the following:*

*(A) Written contracts or other proof of entitlement to an identified water supply.*

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

*(C) Federal, state, and local permits for construction of necessary infrastructure associated with delivering the water supply.*

*(D) Any necessary regulatory approvals that are required in order to be able to coney or deliver the water supply.*

*(e) If no water has been received in prior years by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), under the existing water supply entitlements, water rights, or water service contracts, the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), shall also include in its water assessment pursuant to subdivision (c), an identification of the other public water systems or water service contract holders that receive a water supply or have existing water supply entitlements, water rights, or water service contracts, to the same source of water as the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), has identified as a source of water supply within its water assessments.*

It is anticipated that the Proposed Project will be served from the City's existing and future water supplies, if approved by the City. The inclusion of existing and planned future water supplies is specifically allowed by the Water Code:

*Water Code Section 10631*

*(b) Identify and quantify, to the extent practicable, the existing and planned sources of water available to the supplier over the same five-year increments described in subdivision (a).*

The water supply for the proposed project will have the same water supply reliability and water supply quality as those available to the City's other existing and future customers. The water supplies required to serve the Proposed Project are described in the City's 2020 UWMP. As such, the descriptions provided in this section have been taken, for the most part, from the UWMP.[14] Additional information from other sources has been included as needed.

[14] City of Fresno, "2020 Urban Water Management Plan," July 2021.

## 6.1 Existing Water Supplies

The City relies on water supplies from four main sources:

1. Groundwater pumped from groundwater wells throughout the City
2. Surface water from the San Joaquin River through a contract with the United States Bureau of Reclamation (USBR) as part of the Central Valley Project (CVP)
3. Surface water from the Kings River through a contract with the Fresno Irrigation District (FID)
4. Recycled water treated from the Fresno-Clovis RWRF and the NFWRF

Historically, the City has relied heavily on groundwater pumped from the underground basin and aquifers to provide 100% of its water demands. The City commissioned its first surface water treatment facility (SWTF) in 2004, and currently operates three total SWTFs that provide approximately half of all potable water demands in the City's service area.

### 6.1.1 Groundwater

There are additional requirements included in SB 610 for the preparation of a WSA if groundwater is an existing source of water supply.

*Water Code Section 10910*

*(f) If a water supply for a proposed project includes groundwater, the following additional information shall be included in the water assessment:*

*(1) A review of any information contained in the urban water management plan relevant to the identified water supply for the proposed project.*

*(2) A description of any groundwater basin or basins from which the proposed project will be supplied. For those basins for which a court or board has adjudicated the rights to pump groundwater, a copy of the order or decree adopted by the court or the board and a description of the amount of groundwater the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), has the legal right to pump under the order or decree. For basins that have not been adjudicated, information as to whether the department has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current bulletin of the department that characterizes the condition of the groundwater basin, and a detailed description by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), of the efforts being undertaken in the basin or basins to eliminate the long-term overdraft conditions.*

*(3) A detailed description and analysis of the amount and location of groundwater pumped by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), for the past five years from any groundwater basin from which the proposed project will be supplied. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.*

*(4) A detailed description and analysis of the amount and location of groundwater that is projected to be pumped by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), from any basin from which the proposed project will be supplied. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.*

*(5) An analysis of the sufficiency of the groundwater from the basin or basins from which the proposed project will be supplied to meet the projected water demand associated*

*with the proposed project. A water assessment shall not be required to include the information required by this paragraph if the public water system determines, as part of the review required by paragraph (1), that the sufficiency of groundwater necessary to meet the initial and projected water demand associated with the project was addressed in the description and analysis required by paragraph (4) of subdivision (b) of Section 10631.*

#### 6.1.1.1 Groundwater Supply Overview

The City is located within the Kings Subbasin of the San Joaquin Valley Groundwater Basin. Per the City's 2020 UWMP, the City has a network of over 270 municipal water wells and operates approximately 202 active municipal supply wells that access groundwater from said basin.[15] The production capacity from the active wells is approximately 403 MGD, and the total capacity including inactive wells is approximately 487 MGD. Most wells are directly connected to the water distribution system. The City's water system depended completely upon groundwater as a water source until 2004 when the first SWTF was commissioned. Today, groundwater is still heavily relied upon as a primary water source for the City.

Groundwater quality generally meets primary and secondary drinking water standards for municipal water use, however the groundwater basin has been impacted by several chemical contaminant plumes and nitrates that require monitoring and wellhead treatment or blending plans. Treatment efforts and removal of specific wells from service are conducted as required to maintain drinking water supply quality and standards.

#### 6.1.1.2 Basin Description

The information included here on the subbasin is largely taken from the City's 2020 UWMP and the Department of Water Resources (DWR) Bulletin 118 Interim Update which was most recently updated in 2020.[16] The City's groundwater wells pump water from the northern portion of the Kings Subbasin (DWR Groundwater Subbasin Number 5-22.08) within the larger San Joaquin Valley Basin. The Kings Subbasin covers approximately 1,530 square miles. The Kings Subbasin is unadjudicated and there are no legal restrictions on groundwater pumping.

The San Joaquin Valley Groundwater Basin is generally bound by the Sacramento-San Joaquin Delta and Sacramento Valley to the north, the Sierra Nevada Mountains to the east, the San Emigdio and Tehachapi Mountains to the south, and the Coast Ranges to the west. The Kings Subbasin is located within the southern half of the San Joaquin Valley Groundwater Basin, and is generally bound by the San Joaquin River to the north, the Sierra Nevada foothills to the east, the Kings River to the south, and the Delta-Mendota and Westside Subbasins to the west. The Kings Subbasin is divided into seven Groundwater Sustainability Agency (GSA) management areas, and Fresno is located in the North Kings GSA. The upper several hundred feet of the Kings Subbasin generally consists of highly permeable, coarse-grained deposits, which are termed older alluvium. Coarse-grained stream channel deposits, associated with deposits by the ancestral San Joaquin and Kings Rivers, underlie much of the northwest area of the City. A laterally extensive layer of clay exists beneath most of the south and southeastern portions of the City at an average depth of 250 feet below the ground surface. Below the older alluvium, finer-grained sediments of the tertiary-quaternary continental deposits exist at depths ranging from 600 to 1,200 feet below ground surface. Substantial groundwater has been produced and utilized from these depths by the City. However, deeper deposits located in the southeastern and northern portions of the City have produced less groundwater. There are also reduced deposits in the

[15] City of Fresno, "2020 Urban Water Management Plan," July 2021.
[16] California Department of Water Resources, "California's Groundwater Update 2020 Bulletin 118." November 2021.

northern and eastern portions of the City at depths generally below 700 or 800 feet which are associated with high concentrations of iron, manganese, arsenic, hydrogen sulfide, and methane gas. Groundwater at these depths does not generally provide a significant source for municipal supply wells. Current groundwater depth depends on the location within the City. Figure 6-4 in the City's 2020 UWMP illustrates the City's depth to groundwater for six representative wells across the City's SOI since 1960.[17]

6.1.1.3 Groundwater Management

The Groundwater Management Act (GWMA) was signed into law in 1992, and made groundwater management part of the California Water Code (Division 6, Part 2.75, Chapters 1-5, Section 10750-10755.4). First introduced as Assembly Bill (AB) 3030, the GWMA established specific procedures on how Groundwater Management Plans (GWMPs) are to be developed and adopted by local agencies. The intent of the GWMA is to encourage local agencies to work cooperatively to manage groundwater resources within their jurisdictions and to provide a methodology for developing a GWMP. The GWMA has since been modified by SB 1938 in 2002 and AB 359 in 2011.

- AB 3030 provided a systematic procedure for existing local agencies to develop GWMPs.
- SB 1938 modified the GWMA by requiring any public agency seeking State funds administered through the California DWR for the construction of groundwater projects to prepare and implement a GWMP.
- AB359 further modified the GWMA by requiring public agencies to prepare and implement GWMPs with an additional required component that focused on identifying groundwater recharge areas. It also included several plan adoption procedural changes, requires GWMPs to be submitted to DWR, and requires DWR to provide public access to this information.

Th next step in groundwater management came in 2014 when the Sustainable Groundwater Management Act (SGMA) was signed into law (Water Code Section 10720 et seq.). This act includes a three-bill legislative package composed of AB 1739, SB 1168, and SB 1319, and requires local agencies to form GSAs for high and medium priority basins, and develop and implement Groundwater Sustainability Plans (GSPs) to avoid and mitigate overdraft of groundwater within 20 years. SGMA places the authority of groundwater management with local agencies; it establishes a definition of sustainable groundwater management, establishes a framework for local agencies to develop plans and implement strategies to sustainably manage groundwater resources, prioritizes basins with the greatest problems, and sets a 20-year timeline for implementation. The Kings Subbasin was designated as critically overdrafted in the DWR's Bulletin 118.

The City was a founding member of the North Kings GSA, which includes the following public and participating agencies: Fresno Irrigation District (FID, member), City of Fresno (member), City of Clovis (member), City of Kerman (member), County of Fresno (member), Bakman Water Company (participating agency), Biola Community Services District (member), Garfield Water District (member), International Water District (member), and the Fresno Metropolitan Flood Control District (FMFCD, participating agency). The North Kings GSA cooperates with the other six GSAs within the Kings Subbasin to enact common approaches to sustainability items. The North Kings GSA prepared and submitted its GSP on January 28, 2020 (prepared by Provost & Pritchard, November 2019). The DWR issued a response in January 2022 stating that the GSP was incomplete, after which the GSP was revised and resubmitted on July 27, 2022. As of the preparation of this WSA, the DWR has issued a letter stating that they expect to recommend

[17] City of Fresno, "2020 Urban Water Management Plan," July 2021.

approval of the plan, along with a number of additional recommended corrective actions to be included per the DWR SGMA Portal GSP Status Summary.[18]

#### 6.1.1.4 Conditions of Overdraft

SGMA requires DWR to identify groundwater basins and subbasins that are critically overdrafted. Per SGMA, "A basin is subject to critical overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts." SGMA uses a number of sustainability indicators to make such a determination, which includes chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence, and depletions of interconnected surface water. As mentioned, the Kings Subbasin has been classified as being in a condition of critical overdraft by the DWR in their most recent edition of California's Groundwater Update 2020 (Bulletin 118) published by the DWR in November 2021.[19]

The groundwater levels beneath the City in the Kings Subbasin were relatively shallow in 1940 prior to the start of World War II at about 25 feet below ground surface. After the war, the City rapidly grew, and the groundwater level declined at a rate of 2.8 feet per year from 1959 to 1968.[20] Since 1990, groundwater levels have declined at a slower rate, further slowing after the City brought their first surface water treatment plant online – the Northeast Surface Water Treatment Facility (NESWTF) – which allowed the City to focus on groundwater recharge operations. Groundwater levels have begun to rise in the last few years in various parts of the City due to a decreased dependence on groundwater pumping. The City plans to continue operation of their SWTFs and to increase groundwater recharge efforts to contribute to basin recovery, including via the cooperative agreements that the City maintains with FMFCD and FID for access to recharge basins and the exchange of surface waters. The City has historically averaged 60,000 AFY of recharge, and plans to increase recharge by 540 AFY each year moving forward. During wet years, the City plans on recharging more water when it's available to offset additional groundwater pumping expected during dry years.

DWR is required to prioritize groundwater basins via provisions of SGMA and the California Statewide Groundwater Elevation Monitoring (CASGEM) program into four categories – high-, medium-, low-, or very low-priority. SGMA requires medium- and high-priority basins to develop GSAs, GSPs, and manage groundwater for long-term sustainability. According to the SGMA Basin Prioritization Dashboard, the Kings Subbasin has been prioritized as a high-priority basin, leading to the formation of the North Kings GSA and the preparation of their GSP, as stated above.

#### 6.1.1.5 Groundwater Quality

Groundwater in the Kings Subbasin generally meets the primary and secondary drinking water standards for municipal water use. It is described as being bicarbonate type water containing calcium, magnesium, and sodium as the dominant ions. Total Dissolved Solids (TDS) concentrations range from 200 to 700 mg/L. However, the basin has been impacted by multiple chemical contaminants which has affected the City's ability to fully utilize its resources without some kind of wellhead treatment in certain areas. The primary contaminants present in the basin include nitrate, 1,2-dibromo-3-chloropropane (DBCP), 1,2,3-trichloropropane (1,2,3-TCP), and volatile organic compounds including trichloroethylene (TCE) and perchloroethylene (PCE). The City has installed wellhead treatment systems and implemented blending plans for a number of

[18] California Department of Water Resources, SGMA Portal, "GSP Status Summary." https://sgma.water.ca.gov/portal/gsp/status.
[19] California Department of Water Resources, "California's Groundwater Update 2020 Bulletin 118." November 2021.
[20] City of Fresno, "2020 Urban Water Management Plan," July 2021.

wells around the City that are affected by these contaminants. Approximately 40 wells are being treated for various contaminants, including those listed here, and an additional 20 wells are being treated for iron, manganese, and hydrogen sulfide or corrosion control. The City also actively pumps specific wells within certain contaminant plumes to manage contamination and stop the plume's spread.

#### 6.1.1.6 Historical Groundwater Use

The City has over 270 municipal water wells and operates approximately 202 active municipal supply wells that access groundwater from the Kings Subbasin. The City has reduced it's dependance on groundwater through its investment in surface water infrastructure, which has contributed to a reduction in groundwater pumping. As seen in Table 6.1, the amount of groundwater production has declined significantly from 2003 to 2020.

**Table 6.1 Historic Groundwater Production, 2003-2020**

| Year | Groundwater Production (AFY) |
|---|---|
| 2003 | 165,200 |
| 2004 | 160,000 |
| 2005 | 141,500 |
| 2006 | 136,000 |
| 2007 | 146,300 |
| 2008 | 148,700 |
| 2009 | 138,200 |
| 2010 | 128,600 |
| 2011 | 119,900 |
| 2012 | 119,500 |
| 2013 | 123,200 |
| 2014 | 106,800 |
| 2015 | 82,500 |
| 2016 | 99,100 |
| 2017 | 105,200 |
| 2018 | 76,800 |
| 2019 | 54,600 |
| 2020 | 55,000 |

Source: City of Fresno 2020 UWMP Figure 6-7

#### 6.1.1.7 Projected Groundwater Use

Groundwater consists of three main components – natural recharge, net subsurface inflow, and intentional recharge.

- Natural recharge consists of deep percolation water from rainfall and irrigation-applied water. As urbanization continues within the City's SOI, the amount of deep percolation recharge will decrease due to an increase in impervious surfaces leading to more runoff and less open spaces where natural recharge can occur.
- Net subsurface inflow is the groundwater that flows underground into the basin. This may be from stormwater runoff or other neighboring basins. This amount is projected to increase in future years as the City annexes more land until the SOI is built out.

- Intentional groundwater recharge occurs when surface water is purposefully managed to infiltrate into the groundwater aquifer. The City maintains an intentional recharge program and has recharged approximately 60,000 AFY on average from 2000 to 2019.[21]

Table 6.2 details the existing and projected future groundwater yield for normal years.

**Table 6.2 Existing and Projected Future Groundwater Production in Normal Years, AFY**

| Groundwater Component | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| Natural Recharge | 24,970 | 25,480 | 25,910 | 26,280 | 26,570 | 26,790 |
| Net Subsurface Inflow | 47,510 | 49,910 | 52,320 | 54,720 | 57,120 | 59,530 |
| **Sustainable Yield** | **72,480** | **75,390** | **78,230** | **81,000** | **83,690** | **86,320** |
| Intentional Recharge | 60,000 | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| **Total Estimated Groundwater Yield** | **132,480** | **138,090** | **143,630** | **149,100** | **154,490** | **159,820** |

Source: City of Fresno 2020 UWMP Table 6-1.

Per the City's 2020 UWMP, the amount of groundwater pumped during dry years is not expected to change from the amount pumped during normal years. Table 6.3 shows the projected groundwater production for the normal and dry years combined.

**Table 6.3 Projected Future Groundwater Production in Normal and Dry Years, AFY**

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| Total Groundwater Production During Normal Year | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| Total Groundwater Production During Dry Years (Single and Multiple) | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |

Source: City of Fresno 2020 UWMP Table 7-1, 7-2, and 7-3.

#### 6.1.1.8 Groundwater Sufficiency

The City's 2020 UWMP addressed the sufficiency of the City's groundwater supplies in conjunction with its other water supplies to meet the City's existing and planned future uses. Based on the information provided in this section and in the City's 2020 UWMP, the City's groundwater supply, together with the other existing and planned future City water supplies, is sufficient to meet the water demands of the proposed project, in addition to the City's existing and planned future uses. See CHAPTER 7 for a detailed analysis of the sufficiency of the City's water supplies to meet the demands of the proposed project.

### 6.1.2 Surface Water

The City currently receives surface water from two sources: the San Joaquin River via a contract with the USBR and the CVP Friant Division, and the Kings River via an agreement with FID. Surface water is treated either at the Northeast Surface Water Treatment Facility (NESWTF), which was completed and activated in 2004, or the Southeast Surface Water Treatment Facility (SESWTF), which was completed in 2018. With the NESWTF (30 MGD-rated facility) and the SESWTF (54 MGD design with 80 MGD buildout capacity), the City provided greater than 50% of the City's potable water supply with surface water in 2019 and 2020.[21] The Kings River water year is October through September, while the USBR uses a water year of March through

[21] City of Fresno, "2020 Urban Water Management Plan," July 2021.

February. The City typically uses a calendar year for its analyses, so monthly water supply information was compiled in calendar year format for the City's 2020 UWMP.

#### 6.1.2.1 USBR Agreement Surface Water

Through an agreement originally executed in January 1961, the City secured a surface water supply from the USBR CVP Friant Division. The agreement is for an annual water supply of 60,000 AF of Class 1 water, and was last renewed in 2010 as a Section 9(d) contract that provides water from the San Joaquin River in perpetuity. Class 1 water was intended to be a supply that would be dependable in practically every year, regardless of the type of hydrologic water year. Class 2 water is essentially excess water available as determined by the USBR and less reliable than Class 1 water. The USBR CVP Friant Division facilities generally include the Friant Dam (Millerton Reservoir), the Friant-Kern Canal, and the Madera Canal. The Friant-Kern Canal is maintained and operated by the Friant Water Authority. The USBR water supply is a wholesale supply. The agreement between the City and USBR is included in the City's 2020 UWMP as Appendix H.

Class 1 water has historically been very reliable until the 2006 San Joaquin River Restoration Settlement Agreement between the Department of the Interior and Commerce, the Natural Resources Defense Council, and the Friant Water Users Authority (which is now the Friant Water Authority, of which the City is a member of). The Settlement Agreement characterized Class 1 deliveries by six hydrologic year types based on a recurrence over an 82-year simulation (1922-2003): wet, normal-wet, normal-dry, dry, critical-high, and critical-low. The projected surface water available for the City from the USBR during each hydrologic year defined by the Settlement Agreement is included in Table 6.4. The average simulated delivery is 53,680 AFY and the median simulated delivery is 60,000 AFY, similar to normal year delivery. The dry and critical years of the simulation result in substantial reductions of deliveries, bringing down the average compared to the median allocation. Restrictions on exports from the Delta have also hindered the USBR from making deliveries to Exchange Contractors via the Delta-Mendota Canal. If the USBR is unable to deliver water to the Exchange Contractors, they have the right to receive their water from the San Joaquin River, which reduces the availability of Class 1 water. Table 6.5 shows the annual USBR deliveries received by the City since 2007.

**Table 6.4 Available USBR Simulated Supplies, 1992-2003**

| Water Year Type | % of Years Over Simulated Period of Deliveries | Number of Years in that Year Type | Range of Allocation to City (AFY) | Average Allocation to City (AFY) |
|---|---|---|---|---|
| Wet | Highest 20% | 16 | 60,000 | 60,000 |
| Norma-Wet | 50% to 80% | 25 | 60,000 | 60,000 |
| Normal-Dry | 20% to 50% | 25 | 47,500 to 60,000 | 57,060 |
| Dry | 5% to 20% | 12 | 28,100 to 46,800 | 36,575 |
| Critical | Lowest 5% | 4 | 13,900 to 24,700 | 19,025 |
| | **Total** | **82** | **Average** | **53,680** |
| | | | **Median** | **60,000** |

Source: City of Fresno 2020 UWMP Table 6-2.

**Table 6.5 USBR Deliveries to City**

| Calendar Year | Volume, AFY |
|---|---|
| 2007 | 39,342 |
| 2008 | 59,450 |
| 2009 | 49,776 |
| 2010 | 60,864 |
| 2011 | 59,625 |
| 2012 | 24,492 |
| 2013 | 7,902 |
| 2014 | 12,954 |
| 2015 | 0 |
| 2016 | 47,678 |
| 2017 | 62,919 |
| 2018 | 58,220 |

Source: City of Fresno 2020 UWMP Figure 6-8.

#### 6.1.2.2 FID Agreement Surface Water

FID receives an entitlement of water from the Kings River through the Kings River Water Association. In 1976, FID executed an agreement with the City that stipulated that as land is annexed in the City, the City will receive a pro rata share of FID's Kings River entitlement. The pro rata share is based on the area annexed to the City and within FID's boundaries, as compared to the total area of FID's water service area. The agreement required that the allocation is reviewed by both agencies each year to address new annexations by the City; as such, the allocation will increase as the City annexes new areas.

The agreement was revised, amended and restated in December 2016. The agreement is included in the City's 2020 UWMP as Appendix I. The agreement identifies the City's contracted percentage of FID's Kings River water based on the City's water service area located within FID service area as a percentage of the FID land area. FID land area varies slightly each year because it is dependent on the acreage receiving water deliveries for that year rather than the total acreage within FID (roughly 200,000 acres per the City's 2020 UWMP).[22] As stated, the percentage of FID supply received by the City will increase as the City annexes new land into its service area. However, the 2016 agreement sets the maximum percentage at 29.0%, although the City's service area is expected to expand and encompass more than 29.0% of FID's service area between 2025 and 2030. In 2020, the City's percentage of overall FID Kings River deliveries was 25.79%. The City's supply projections from the FID are limited by the 29.0% restriction, but if the agreement is revised in the future, the City's allocation percentage could increase beyond 29.0% as the City's water service area expands.

The City has historically not used all of its available allocation in any given year, but pays a flat rate for its total allocation regardless. Any unused water is reallocated by FID to its other customers. The City's potential supply has been summarized in the City's 2020 UWMP using actual Kings River deliveries from 1964 to 2019, then categorized by the same water year types defined under the USBR agreement. The range and average FID deliveries by water year are shown in Table 6.6. Table 6.7 shows the projected allocation of FID supplies estimated assuming the City's water service area will grow from 59,100 to 84,300 acres by buildout, as shown in the City's 2020 UWMP[22] using the projected percentage of allocation multiplied by the estimated normal year diversion by FID of 453,800 AFY per Table 6.6.

[22] City of Fresno, "2020 Urban Water Management Plan," July 2021.

**Table 6.6 FID Supplies by Water Year Type, 1964 to 2019**

| Water Year Type | % of Years | No. of Years Between 1964 and 2019 | Total FID Deliveries (AF) | | Example Average Available to City (AF) |
|---|---|---|---|---|---|
| | | | Range | Average | |
| Wet | Highest 20% | 11 | 563,500 to 644,600 | 590,700 | 171,300 |
| Normal-Wet | 50% to 80% | 17 | 452,800 to 563,300 | 213,700 | 149,000 |
| Normal-Dry | 20% to 50% | 17 | 362,600 to 448,000 | 415,000 | 120,400 |
| Dry | 5% to 20% | 8 | 253,700 to 362,000 | 315,700 | 91,600 |
| Critical | Lowest 5% | 3 | 158,100 to 253,300 | 210,200 | 61,000 |
| **Total** | | **56** | **Average** | **453,800** | **131,600** |

Source: City of Fresno 2020 UWMP Table 6-3.

**Table 6.7 Projected FID Allocation to City in Normal Years**

| Year | Projected Total FID Allocation, AFY | Projected Allocation to City, AFY |
|---|---|---|
| 2025 | 27.55% | 125,030 |
| 2030 | 29.00% | 131,600 |
| 2035 | 29.00% | 131,600 |
| 2040 | 29.00% | 131,600 |
| 2045 | 29.00% | 131,600 |

Source: City of Fresno 2020 UWMP Table 6-4.

### 6.1.3 Recycled Water

The City is currently expanding its recycled water supplies to increase offset of potable water use for landscape irrigation and other beneficial uses. In 2010, the City completed a Recycled Water Master Plan (adopted in 2013) to evaluate and plan for increased recycled water use in the City. Additionally, a recycled water engineering report was prepared for the City by Blair Church & Flynn to further explore the recycled water system in 2015.[23] The City's last Metro Plan also included proposed projects and improvements to increase the use of recycled water.[24] The City is currently updating the Metro Plan and will reevaluate recommendations and projects to increase recycled water use. The City owns and operates two water reclamation facilities – the Fresno-Clovis RWRF and the NFWRF.

Since the adoption of the City's Recycled Water Master Plan in 2010, a number of recycled water facilities have been constructed and are currently in service throughout the Fresno area. Segments of the recycled water distribution system outlined in the Recycled Water Master Plan have been designed and constructed over the last several years mainly within the Southwest Quadrant of the distribution system, as well as some small portions of the Northeast and Northwest systems. Pipeline sizes range up to 54 inches in diameter, with several users actively utilizing recycled water for irrigation. These existing facilities represent a portion of the future recycled water system. Per the City's 2020 UWMP, the recycled water distribution system mainly consists of the southwest recycled water system, which includes a 3.2 million-gallon recycled water reservoir located at the Fresno-Clovis RWRF, a 6,000 gpm (8.64 MGD) recycled water

[23] City of Fresno, "Engineering Report for the Production, Distribution and Use of Recycled Water," September 2015.
[24] City of Fresno, "Metropolitan Water Resources Management Plan Update Phase 1 Baseline System Characterization," December 2007, and "Phase 2 Development and Evaluation of Future Water Supply Plan," January 2011.

pump station located at the Fresno-Clovis RWRF, a 640-gpm booster pump station located at Roeding Park (Roeding Park Booster), and approximately 15.7 miles of recycled water distribution pipelines ranging in size from 10-inches to 54-inches in diamater.[25]

#### 6.1.3.1 Fresno-Clovis RWRF

In partnership with the City of Clovis, the City of Fresno owns and operates the Fresno-Clovis RWRF located near the intersection of Jensen and Cornelia Avenues in southwest Fresno. The RWRF receives and treats the majority of domestic, commercial, and industrial wastewater generated within the Cities of Fresno and Clovis, as well was some unincorporated areas of Fresno County. The RWRF is currently operated by the City, who holds responsibility for ensuring regulatory compliance with Waste Discharge Requirements (WDRs), and the Central Valley RWQCB (Regional Water Quality Control Board) Order No. 5-01-254, "Waste Discharge Requirements for Cities of Fresno and Clovis Wastewater Treatment Facility, Fresno County." Developed under a Joint Powers Authority agreement with the City of Fresno, City of Clovis, and County of Fresno, the RWRF has a rated annual monthly average daily discharge flow of 80 MGD and an maximum monthly average daily discharge flow of 88 MGD,[26] but the average annual flow is approximately 68 MGD[27]. The RWRF produces undisinfected secondary-treated wastewater and disinfected tertiary-treated wastewater. The undisinfected secondary-treated wastewater is disposed into on-site disposal ponds and conveyed to farmers for restricted irrigation of non-food crops on agricultural land on surrounding properties. The disinfected tertiary-treated wastewater is delivered through the City's recycled water distribution system to various recycled water use areas around the City, mainly for irrigation of landscaping at sites including but not limited to parks, median landscape strips, and cemeteries. The RWRF also owns and operates a number of reclamation wells that extract water from on-site percolation ponds, and discharges that water into FID canals for irrigation use of farmland downstream of the RWRF.

Flows received at the Fresno-Clovis RWRF peaked in 2006 at 81,000 AFY and have been decreasing steadily since then, with influent flows averaging about 63,000 AFY over the past 5 years. The RWRF includes preliminary, primary, secondary, and tertiary treatment units with disinfection. Secondary treatment has an annual capacity of 87 MGD, and in 2017 a 5-MGD tertiary treatment system (Tertiary Treatment and Disinfection Facility – TTDF) was completed; this TTDF can be expanded to 15 MGD with an ultimate capacity of 30 MGD. The City has three primary means of effluent disposal – undisinfected secondary effluent to onsite and offsite farmland for restricted irrigation, undisinfected secondary effluent to percolation ponds, and disinfected tertiary effluent to the recycled water distribution system. The percolated effluent has been deemed equivalent to Title 22 tertiary treated water by the State Water Resources Control Board Division of Drinking Water (DDW), and the City has been extracting this water for reuse in areas within and surrounding the RWRF and to FID canals through an exchange agreement with FID for delivery of the water to their agricultural customers.

#### 6.1.3.2 North Fresno WRF (NFWRF)

The City owns and operates the NFWRF located in northeast Fresno on the north side of Copper Avenue between Cedar and Maple Avenues. This facility receives and treats wastewater generated within a small area of the City generally bound by Copper, Friant, and Willow Avenues, including wastewater generated from Copper River Ranch. The NFWRF is a tertiary level

[25] City of Fresno, "2020 Urban Water Management Plan," July 2021.
[26] City of Fresno, "Engineering Report for the Production, Distribution and Use of Recycled Water," prepared by Blair, Church & Flynn. September 18, 2015.
[27] City of Fresno, Department of Public Utilities, "Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF)." https://www.fresno.gov/publicutilities/sewer-wastewater/wastewater-facilities-infrastructure/#tab-2.

treatment facility, and the treated wastewater is mainly used for irrigation of the Copper River Country Club and Golf Course. The NFWRF, completed in 2008, was constructed as part of a residential, commercial, and golf course master planned development located in the northern portion of the City.

The facility is presently rated at 0.71 MGD average monthly flow and 1.07 MGD maximum daily flow of tertiary treated disinfected effluent.[28] However, the DDW only approved the UV disinfection system for 300 gpm (0.43 MGD), which is the current flow limit until the DDW approves a higher flow. The NFWRF is expandable to 1.25 MGD average monthly flow. The disinfected tertiary effluent is mainly used for irrigation of the Copper River Ranch Golf Course. In 2020, 54 AF of a total of 325 AF of recycled water was used for irrigation of turf; any remaining recycled water is diverted to the City's collection system to be conveyed to the Fresno-Clovis RWRF.

#### 6.1.3.3 Historic and Projected Recycled Water Use

The City's Metro Plan recommended expanding reuse by using the NFWRF to irrigate the Copper River Ranch Golf Course and up to 25,000 AFY of recycled water for landscape irrigation or other non-potable uses from the Fresno-Clovis RWRF or other new satellite WRFs. Since then, the City has irrigated the Copper River Ranch Golf Course with recycled water and constructed much of the southwest portion of the recycled water distribution system. However, the City is currently updating the Metro Plan and reevaluating the target volume of reuse in the City beyond the southwest system considering new conditions and regulations, including the potential for potable reuse in the future. Table 6.8 shows historical recycled water use within the City's service area from 2015 to 2020. It should be noted that in 2017 and 2018, the NFWRF was offline for repairs and produced no recycled water; per the City's 2020 UWMP, 2016 is representative of operations going forward.[29]

**Table 6.8 Historic Recycled Water Use in Service Area, 2015-2020**

| Recycled Water Facility | Level of Treatment | Quantity (AFY) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| Fresno-Clovis RWRF | Secondary Effluent (Non-Food Crop Irrigation) | 8,688 | 7,329 | 4,540 | 7,031 | 3,652 | 2,845 |
| | Tertiary Effluent | 531 | 485 | 423 | 867 | 912 | 858 |
| NFWRF | Tertiary Effluent | 62 | 110 | 0 | 0 | 19 | 54 |
| **Total** | | **9,281** | **7,924** | **4,963** | **7,898** | **4,583** | **4,757** |

Source: City of Fresno 2020 UWMP Table 6-5.

Table 6.9 shows the current and projected recycled water use in the City's service area. It is expected that secondary undisinfected recycled water will continue to be used to irrigate non-food crops. As such, for the projections included in the City's 2020 UWMP, recycled water for agricultural irrigation does not offset the City's potable water demands and is excluded from the table.

[28] City of Fresno, Department of Public Utilities, "North Fresno Wastewater Treatment Facility (NFWTF)." https://www.fresno.gov/publicutilities/sewer-wastewater/wastewater-facilities-infrastructure/#tab-3.

[29] City of Fresno, "2020 Urban Water Management Plan," July 2021.

**Table 6.9 Existing and Projected Recycled Water Use in City Service Area**

| Recycled Water Use Type | Amount of Potential Uses of Recycled Water (AFY) | Level of Treatment | Quantity, AFY | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
| Landscape Irrigation | 5,800 | Tertiary | 858 | 5,800 | 5,800 | 5,800 | 5,800 | 5,800 |
| Golf Course Irrigation | 110 | Tertiary | 54 | 110 | 110 | 110 | 110 | 110 |
| **Total** | | | **4,757** | **14,220** | **14,220** | **14,220** | **14,220** | **14,220** |

Source: City of Fresno 2020 UWMP Table 6-6.

## 6.2 Future Water Supplies

The inclusion of planned water supplies in this WSA is allowed by the Water Code:

*Water Code Section 10631*

*(b) Identify and quantify, to the extent practicable, the existing and planned sources of water available to the supplier over the same five-year increments described in subdivision (a).*

The City has a number of capital improvement projects planned to maintain and upgrade the existing water supply and distribution systems. The City's ongoing and future projects to improve its water supply portfolio include the expansion of the recycled water distribution system, the expansion of the groundwater recharge program, the expansion of surface water treatment capacity, and beneficial transfers and exchanges. The City is also updating its Metro Plan, which will recommend programs and projects to improve the City's water supply portfolio.

### 6.2.1 Expansion of Recycled Water Distribution System

The City has made significant progress in developing its recycled water distribution system, completing additional sections of the Southwest quadrant of the distribution system in the last few years. The completed distribution system will allow an additional 5,000 AF of recycled water use in the City to offset potable water demands that can be used in all hydrological year types. The expansion is projected to be completed by 2025.[30]

Additionally, the City plans to blend the extracted recycled water from the Fresno-Clovis RWRF with disinfected tertiary treated recycled water to feed the southwest recycled water distribution system. As new sales grow for recycled water, additional recycled extraction well water will be utilized to feed the City's recycled water system.

### 6.2.2 Expansion of Groundwater Recharge Program

The City is currently evaluating an expanded recharge program as part of the Metro Plan update. Expanding intentional groundwater recharge may include the development of new dedicated intentional recharge facilities and/or joint projects for basins with FMFCD and FID. The goal for recharge expansion is to maximize the storage within the groundwater basin and optimize use of available surface water supplies in normal years. The stored water will be used more in the single-

[30] City of Fresno, "2020 Urban Water Management Plan," July 2021.

dry and multiple dry years when surface water supplies are less available. The timing for groundwater recharge expansion will be examined in the Metro Plan update, and is assumed to increase to allow for an additional 540 AFY of recharge to occur on average each year.[30]

#### 6.2.3 Expansion of Surface Water Treatment Capacity

A major component of the City's ability to reverse the long-time overreliance on groundwater is the construction of its surface water treatment facilities. The NESWTF has been upgraded from 30 MGD to 60 MGD, and the SESWTF has been constructed and is producing 54 MGD with an ultimate capacity of 80 MGD, per the City's 2020 UWMP.[31] The timing for SWTF expansion will be examined in the Metro Plan update and determined based on need as the City grows and demands increase.

#### 6.2.4 Beneficial Transfers and Exchanges

The City is evaluating future beneficial transfers and exchanges of the City's USBR water in normal years when available water supplies exceed demands. The Central Valley Project Improvement Act (CVPIA) of 1992 authorized the transfer of all or a portion of a CVP contractor's water supply to any other California water users or water agencies. The CVPIA allows transfers of water as long as they are consistent with federal and state water laws. As part of the Metro Plan update, the City will evaluate potential future water transfers and exchanges of its periodically available USBR water.

The City is also evaluating the agreement with the FID for the exchange of recycled water and surface water. Since 1974, the City has maintained an agreement with FID to exchange recycled water for the delivery of surface water. The agreement specifically allows the exchange of the extracted recycled water from beneath the Fresno-Clovis RWRF (undisinfected secondary treated water that is stored on site and allowed to percolate into the groundwater basin that is later pumped via groundwater extraction wells) to be conveyed to FID's Dry Creek and Houghton Canals for delivery to FID customers west of the City. In exchange, FID agreed to deliver 46% of the total from either its Kings River entitlement of USBR Class 2 supply to growers or basins in the eastern portion of FID "insofar as feasible and practical." The water is considered to be in addition to the water that would have been delivered to the eastern portion of FID such that the additional delivered water used by growers is assumed to offset groundwater pumping in the area and provide a benefit to the groundwater basin. The agreement includes a minimum of 100,000 AF delivered over a 10-year period and no more than 30,000 AF in any given year. The City has maintained more than 100,000 AF of deliveries over a 10-year period since 2000. However, since 2016, the City has reduced the amount of recycled water groundwater exchange deliveries. The City is currently discussing an update to the FID agreement, and the Metro Plan update will identify and recommend other beneficial uses for the City's percolated recycled water effluent.

### 6.3 Summary of Existing and Additional Planned Future Water Supplies

Table 6.10 provides a summary of the City's 2020 actual water supply deliveries included in this WSA and projected future available water supplies. A discussion of the future anticipated availability of these existing and planned water supplies during dry years is included in the following section.

[31] City of Fresno, "2020 Urban Water Management Plan," July 2021.

**Table 6.10 Existing and Projected Water Supplies in City Service Area**

| Water Source | Reasonably Available Volume, AFY | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
| Groundwater | 55,028 | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| Surface Water, USBR CVP | 37,447 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 |
| Surface Water, FID | 71,292 | 125,030 | 131,600 | 131,600 | 131,600 | 131,600 |
| **Total Potable Water Supply** | **163,767** | **323,120** | **335,230** | **340,700** | **346,090** | **351,420** |
| Recycled Water, RWRF | 858 | 5,800 | 5,800 | 5,800 | 5,800 | 5,800 |
| Recycled Water, NFWRF | 54 | 110 | 110 | 110 | 110 | 110 |
| **Total Recycled Water Supply** | **912** | **5,910** | **5,910** | **5,910** | **5,910** | **5,910** |
| **Total Water Supply** | **164,679** | **329,030** | **341,140** | **346,610** | **352,000** | **357,330** |

Source: City of Fresno 2020 UWMP Table 6-7 for 2020 existing data and Table 6-8 for projected data.

## 6.4 Water Supply Availability and Reliability

Water Code Section 10910 requires that a WSA includes a discussion with regard to whether the projected water supplies will be sufficient to supply the Proposed Project as well as existing and planned uses.

*Water Code Section 10910*

> *(c) (4) If the city or county is required to comply with this part pursuant to subdivision (b), the water assessment for the project shall include a discussion with regard to whether the total projected water supplies, determined to be available by the city or county for the project during normal, single dry, and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses.*

In response to the historical drought conditions experienced by California and the Central Valley, this WSA includes a discussion of the availability and reliability of the City's available water supplies to meet the City's water demands in the event of emergency water supply conditions that may limit the City's surface water supplies.

### 6.4.1 Water Supply Management

The City currently balances its surface water and groundwater supplies based on minimum production for operation of the SWTFs and minimum groundwater pumping to manage and control contamination plumes. The minimum operation conditions typically occur during the winter months when demand is historically low, and the City can increase surface water production during peak demand months when surface water is available. The City intends to rely more heavily on surface water supplies and recharge groundwater with raw surface water during normal and wet years to replenish the groundwater basin and build storage for dry years. In dry years, when surface water is less available, the City will increase groundwater production to meet water demands. The City is expected to maintain this management strategy in the future. Current management actions include enhanced groundwater management and intentional recharge, increased recycled water use, and continued conservation through the implementation of demand management measures.

### 6.4.2 Normal, Single Dry, and Multiple Dry Years

The reliability of each of the City's existing and planned water supplies and their projected availability during normal, single dry, and multiple dry years is described in Chapter 7 of the City's 2020 UWMP, and is included below. Table 6.11 includes a summary of the projected water supplies during the aforementioned hydrological years. Normal-water, single-dry-water-year, and five-consecutive-year-drought-period supply projections were made in the City's 2020 UWMP based on historic water allocations for surface water supplies, historic municipal water well pumping for groundwater, and projected utilization for recycled water.[32]

Per the City's 2020 UWMP, the City expects to meet the system water demand regardless of regional hydrology. However, each water source is likely to encompass some degree of constraints associated with it during dry years.

#### 6.4.2.1 Constraints on Groundwater

Prior to the utilization of surface water, groundwater was the primary water supply for the City's water demands. During that time, groundwater levels were declining steadily over time, presenting a potential constraint to groundwater reliability during dry years. However, with the use of surface water, groundwater reliance has decreased, and groundwater levels have either slowed significantly in their decline or increased as a result. Groundwater levels are expected to continue to increase as the City continues to pump less groundwater. Historically, the groundwater supply has declined, requiring new wells to be deeper and existing well pumps to be lowered. A constraint to lowering existing well pumps is the limited depth of numerous existing wells. Another constraint to the use of groundwater is the negative impacts from contamination. To ensure the continued beneficial use of the groundwater supply, the City has set minimum pumping requirements for specific wells to prevent the spread of existing groundwater contaminant plumes to other areas in the City and to protect the groundwater basin. The City will continue to pursue responsible parties so the proper remediation is conducted to preserve the groundwater system as a viable and sustainable resource in perpetuity. Given these constraints, groundwater supply during normal and dry years was still assumed to be constant, per the City's 2020 UWMP and as shown in Table 6.11.

#### 6.4.2.2 Surface Water – USBR

The amount of water supplied from the San Joaquin River via the agreement with the USBR is based on and therefore constrained by flows downstream of Millerton Dam for varying hydrologic conditions, and restrictions on water diversions from the Delta. The restrictions on water diversions have resulted in years in which CVP Friant Division Contractors, including the City, received zero allocations. The water supply is also restricted by regular maintenance of infrastructure, which can result in the termination of water supply. Every three years, the Friant-Kern Canal is taken down for maintenance, causing disruptions to the water supply.[32] However, the City has constructed a 4.6-mile long raw water pipeline to convey USBR water from the Friant-Kern Canal to the NESWTF, known as the Friant-Kern Canal Pipeline. This has improved the reliability and quality of water deliveries to the NESWTF, and has allowed direct delivery of USBR water to allow year-around operation of the NESWTF.

[32] City of Fresno, "2020 Urban Water Management Plan," July 2021.

#### 6.4.2.3 Surface Water – FID

Water supplied from the Kings River via the City's agreement with FID is most susceptible to annual hydrologic conditions. Annual precipitation, Sierra Nevada mountain snowpack, and natural river flow conditions will effect and potentially constrain the City's allocation from this surface water source. Another factor that may constrain the availability of the surface water supply from the Kings River is scheduled maintenance of FID's canal network and infrastructure. FID typically terminates water deliveries to the City's SWTFs in November and/or December so that necessary infrastructure repairs and maintenance can be performed.[32] However, the City has constructed a 13-mile 72-inch raw water pipeline to deliver Kings River water directly to the SESWTF to allow for year-around operations and prevent shutdowns due to FID maintenance. Deliveries to intentional recharge facilities will continue to be supplied through the FID canal system.

#### 6.4.2.4 Recycled Water

The largest constraint to the recycled water supply is the lack of infrastructure to distribute the water to end users. The City has recently increased recycled water production capabilities and constructed much of the southwest recycled water system. The City plans to expand its recycled water delivery system, which will improve availability of recycled water throughout the City. The supply of recycled water is expected to be unaffected by single or multiple dry years, however the supply of wastewater used to produce recycled water may decrease if voluntary or mandatory water conservation measures are enacted.

**Table 6.11 Projected Normal, Single Dry, and Multiple Dry Year Water Supply**

| Water Year Type | Quantity (AFY) | | | | |
|---|---|---|---|---|---|
| | 2025 | 2030 | 2035 | 2040 | 2045 |
| Normal Year | 329,030 | 341,140 | 346,610 | 352,000 | 357,330 |
| Single Dry Year | 189,852 | 195,392 | 200,862 | 206,252 | 211,582 |
| Multiple Dry Year 1 | 273,725 | 279,265 | 284,735 | 290,125 | 295,455 |
| Multiple Dry Year 2 | 274,626 | 280,166 | 285,636 | 291,026 | 296,356 |
| Multiple Dry Year 3 | 217,568 | 223,108 | 228,578 | 233,968 | 239,298 |
| Multiple Dry Year 4 | 189,852 | 195,392 | 200,862 | 206,252 | 211,582 |
| Multiple Dry Year 5 | 314,840 | 320,380 | 325,850 | 331,240 | 336,570 |

Source: City of Fresno 2020 UWMP Table 7-1 for Normal Year Data, Table 7-2 for Single Dry Year Data, and Table 7-3 for Multiple Dry Year Data.

### 6.4.3 Emergency Water Supply Conditions

The City's 2020 UWMP includes a Water Shortage Contingency Plan (WSCP), a detailed plan for how the City intends to respond to expected and unexpected water shortages. Water shortages occur when the water supply is reduced to a level that cannot support typical demand at any given time. Shortages may occur during events such as regional power outages, earthquakes or other natural disasters, and during drought conditions. The City's WSCP includes an analysis of existing and projected water supplies and demands, a water conservation and rationing plan with mandatory prohibitions and penalties, and an analysis of projected revenues and expenditures. The WSCP outlines five stages of action to be taken in response to water supply shortages. The City also has a Water Quality Emergency Notification Plan in place to coordinate the City's response in the event of a catastrophic water supply interruption.

Water supply conditions will determine how the City progresses through the stages of the WSCP. Factors that can affect the water supply conditions include decreases in surface water supplies,

reductions in infrastructure capacity related to water treatment plants or pipelines, a decrease in groundwater levels, or climate or state political conditions that would impact the allotment of water supply. The WSCP also includes significant water consumption reduction measures that subject all water users with mandatory prohibitions and penalties for excessive water use or violation of conservation/reduction ordinances. Water use reduction measures in the WSCP vary depending on the stage of the water shortage. These measures include, but are not limited to: decreasing line flushing, limiting landscape irrigation to specific times or prohibiting landscape irrigation all together, prohibiting the use of potable water for construction and dust control, prohibiting vehicle washing except at facilities using recycled or recirculated water, requiring covers for all pools or spas, prohibiting the use of potable water for sewer system maintenance or fire protection training without prior approval by the City Manager, and limiting or banning new water service connections within the service area (Appendix J of City's 2020 UWMP).[33]

If an emergency were to occur that requires the City to enact its WSCP, all of the City's customers, including those within the Proposed Project Area, would be subject to the same WSCP water conservation measures and restrictions.

[33] City of Fresno, "2020 Urban Water Management Plan," July 2021.

## CHAPTER 7
## DETERMINATION OF WATER SUPPLY SUFFICIENCY

SB 610 requires a WSA to answer a central question: Is the projected water supply sufficient for the proposed project? Specifically, the water code requires the following:

*Water Code Section 10910*

> *(c) (4) If the city or county is required to comply with this part pursuant to subdivision (b), the water assessment for the project shall include a discussion with regard to whether the total projected water supplies, determined to be available by the city or county for the project during normal, single dry, and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses.*

Pursuant to Water Code Section 10910(c)(4) and based on the technical analyses described in this WSA, the total projected water supplies for the Proposed Project during normal, single dry, and multiple dry water years during a 20-year projection will meet the projected water demand associated with the Proposed Project in addition to existing and planned future uses. Table 7.1 summarizes the projected availability of the City's existing and planned future potable water supplies and demands in normal, single dry, and multiple dry years through 2045. As shown, demand within the City's service area is not expected to exceed the City's supplies in any normal, single dry, or multiple dry year between 2020 and 2045. As shown in Section 3.4 of this WSA, the projected increase in water demand for the proposed project is 0.33 MGD, or approximately 370 AFY. Table 7.2 shows the projected water demands from Table 7.1 with the inclusion of the increase associated with the Proposed Plan. As shown, the increase in water demand due to the Proposed Project will not exceed the projected available water supplies for the normal, single dry, and multiple dry years.

**Table 7.1 City of Fresno Projected Water Supply Versus Water Demand During Normal, Single Dry, and Multiple Dry Water Years, AFY**

| Water Supply/Demand Property | | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| **Normal Year** | | | | | | |
| Available Water Supply, AFY | | 329,030 | 341,140 | 346,610 | 352,000 | 357,330 |
| Total Water Demand, AFY | | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| Difference, AFY | | 129,826 | 128,384 | 124,300 | 120,124 | 115,883 |
| Amount Short of Demand | | N/A | N/A | N/A | N/A | N/A |
| **Single Dry Year** | | | | | | |
| Available Water Supply, AFY | | 189,852 | 195,392 | 200,862 | 206,252 | 211,582 |
| Total Water Demand, AFY | | 164,092 | 176,132 | 184,174 | 192,228 | 200,287 |
| Difference, AFY | | 25,760 | 19,260 | 16,688 | 14,024 | 11,295 |
| Amount Short of Demand | | N/A | N/A | N/A | N/A | N/A |
| **Multiple Dry Years** | | | | | | |
| Multiple Dry Year 1 | Available Water Supply, AFY | 273,725 | 279,265 | 284,735 | 290,125 | 295,455 |
| | Total Water Demand, AFY | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | Difference, AFY | 74,521 | 66,509 | 62,425 | 58,249 | 54,008 |
| | Amount Short of Demand | N/A | N/A | N/A | N/A | N/A |
| Multiple Dry Year 2 | Available Water Supply, AFY | 274,626 | 280,166 | 285,636 | 291,026 | 296,356 |
| | Total Water Demand, AFY | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | Difference, AFY | 75,422 | 67,410 | 63,326 | 59,150 | 54,909 |
| | Amount Short of Demand | N/A | N/A | N/A | N/A | N/A |

| Water Supply/Demand Property | | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| Multiple Dry Year 3 | Available Water Supply, AFY | 217,568 | 223,108 | 228,578 | 233,968 | 239,298 |
| | Total Water Demand, AFY | 190,267 | 193,637 | 197,736 | 201,753 | 205,708 |
| | Difference, AFY | 27,301 | 29,471 | 30,842 | 32,215 | 33,589 |
| | Amount Short of Demand | N/A | N/A | N/A | N/A | N/A |
| Multiple Dry Year 4 | Available Water Supply, AFY | 189,852 | 195,392 | 200,862 | 206,252 | 211,582 |
| | Total Water Demand, AFY | 162,551 | 165,920 | 170,020 | 174,036 | 177,992 |
| | Difference, AFY | 27,301 | 29,471 | 30,842 | 32,215 | 33589 |
| | Amount Short of Demand | N/A | N/A | N/A | N/A | N/A |
| Multiple Dry Year 5 | Available Water Supply, AFY | 314,840 | 320,380 | 325,850 | 331,240 | 336,570 |
| | Total Water Demand, AFY | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | Difference, AFY | 115,636 | 107,624 | 103,540 | 99,364 | 95,123 |
| | Amount Short of Demand | N/A | N/A | N/A | N/A | N/A |

Source: City of Fresno 2020 UWMP Table 7-1 for Normal Year Data, Table 7-2 for Single Dry Year Data, and Table 7-3 for Multiple Dry Year Data.

**Table 7.2 City of Fresno Projected Water Supply Versus Water Demand During Normal, Single Dry, and Multiple Dry Water Years with Project, AFY**

| Water Supply/Demand Property | | 2045 |
|---|---|---|
| **Normal Year** | | |
| Available Water Supply, AFY | | 357,330 |
| Total Water Demand, AFY | | 241,447 |
| Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | | +370 |
| Total Water Demand (with Project), AFY | | 241,817 |
| Difference, AFY | | 115,513 |
| Amount Short of Demand | | N/A |
| **Single Dry Year** | | |
| Available Water Supply, AFY | | 211,582 |
| Total Water Demand, AFY | | 200,287 |
| Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | | +370 |
| Total Water Demand (with Project), AFY | | 200,657 |
| Difference, AFY | | 10,925 |
| Amount Short of Demand | | N/A |
| **Multiple Dry Year** | | |
| Multiple Dry Year 1 | Available Water Supply, AFY | 295,455 |
| | Total Water Demand, AFY | 241,447 |
| | Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | +370 |
| | Total Water Demand (with Project), AFY | 241,817 |
| | Difference, AFY | 53,638 |
| | Amount Short of Demand | N/A |

| Water Supply/Demand Property | | 2045 |
|---|---|---|
| Multiple Dry Year 2 | Available Water Supply, AFY | 296,356 |
| | Total Water Demand, AFY | 241,447 |
| | Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | +370 |
| | Total Water Demand (with Project), AFY | 241,817 |
| | Difference, AFY | 54,539 |
| | Amount Short of Demand | N/A |
| Multiple Dry Year 3 | Available Water Supply, AFY | 239,298 |
| | Total Water Demand, AFY | 205,708 |
| | Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | +370 |
| | Total Water Demand (with Project), AFY | 206,078 |
| | Difference, AFY | 33,220 |
| | Amount Short of Demand | N/A |
| Multiple Dry Year 4 | Available Water Supply, AFY | 211,582 |
| | Total Water Demand, AFY | 177,992 |
| | Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | +370 |
| | Total Water Demand (with Project), AFY | 178,362 |
| | Difference, AFY | 33,220 |
| | Amount Short of Demand | N/A |
| Multiple Dry Year 5 | Available Water Supply, AFY | 336,570 |
| | Total Water Demand, AFY | 241,447 |
| | Change in SEDA Water Demand under Specific Plan (Proposed Project), AFY | +370 |
| | Total Water Demand (with Project), AFY | 241,817 |
| | Difference, AFY | 94,753 |
| | Amount Short of Demand | N/A |

Source: City of Fresno 2020 UWMP Table 7-1 for Normal Year Data, Table 7-2 for Single Dry Year Data, and Table 7-3 for Multiple Dry Year Data.

## CHAPTER 8
## WSA APPROVAL PROCESS

The approval process for a WSA is explained in the Water Code as follows:

*Water Code Section 10910*

*(g) (1) Subject to paragraph (2), the governing body of each public water system shall submit the assessment to the city or county not later than 90 days from the date on which the request was received. The governing body of each public water system, or the city or county if either is required to comply with this act pursuant to subdivision (b), shall approve the assessment prepared pursuant to this section at a regular or special meeting.*

*Water Code Section 10911*

*(b) The city or county shall include the water supply assessment provided pursuant to Section 10910, and any information provided pursuant to subdivision (a), in any environmental document prepared fir the project pursuant to Division 13 (commencing with Section 21000) of the Public Resources Code.*

The Fresno City Council must approve this WSA at a regular or special meeting. Furthermore, the City must include this WSA in the Draft PEIR that is being prepared for the Proposed Project.

In addition, SB 221 applies to residential subdivisions of over 500 dwelling units and requires that the water supplier provide written verification that the water supply for the project is sufficient prior to the issuance of the final permits. Because the Proposed Project includes up to 45,274 residential dwelling units, it is subject to the requirements of SB 221 (Government Code Section 66473.7).

**CHAPTER 9**
**REFERENCES**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- West Yost Associates, *City of Fresno Metropolitan Water Resources Management Plan Update Phase 2 Development and Evaluation of Future Water Supply Plan*, prepared for the City of Fresno, January 2011.
- West Yost Associates, *Hydraulic Evaluation of the Proposed 2035 General Plan Land Use Update for the Master Environmental Impact Report*, prepared for the City of Fresno, January 2013.

# APPENDIX A

Proposed Project (SEDA Specific Plan) Water Demand Supporting Calculation

| GP Land Use Classification | Abbrv. | GP Area (ac) | SP Equivalent Land Use Classification | Abbrv. | Water Demand Factor (GPD/ac) | SP Area (ac) | SP Base Water (MGD) |
|---|---|---|---|---|---|---|---|
| Residential - Low Density | RL | 1,700.92 | Residential - Rural Residential | RR | 2,050 | 2,037.69 | 4.18 |
| Residential - Medium Density | RM | 1,473.32 | Residential - Neighborhood Residential | NR | 2,810 | 1,434.91 | 4.03 |
| Residential - Urban Neighborhood | RUN | 891.47 | Residential - Mixed Residential | MR | 5,140 | 1,026.26 | 5.27 |
| Employment - Office | O | 144.37 | Employment - Office Center | OC | 2,440 | 154.47 | 0.38 |
| Employment - Business Park | BP | 12.78 | Employment - Flexible Research and Development | F | 2,420 | 16.54 | 0.04 |
| Employment - Regional Business Park | RBP | 1,219.71 | Employment - Flexible Research and Development | F | 1,685 | 1,287.53 | 2.17 |
| Mixed Use -Corridor/Center Mixed Use | CMX | 315.41 | Mixed Used - Community Center | CC | 1,930 | 273.88 | 0.53 |
| Mixed Use - Regional Mixed Use | RMX | 209.77 | Mixed Use - Regional Center | RC | 2,106 | 291.71 | 0.61 |
| Open Space - Open Space | OS | 569.53 | N/A | N/A | 865 | 0 | 0.00 |
| Open Space - Community Park | CP | 47.46 | N/A | N/A | 2,620 | 0 | 0.00 |
| Open Space - Ponding Basin | PB | 263.32 | Other - Flood Control Basin | POF | 0 | 265.78 | 0.00 |
| Public Facilities - College | C | 116.26 | Employment - Institutional | I | 1,665 | 116.26 | 0.19 |
| Public Facilities - School with Park | P | 149.77 | Employment - Institutional | I | 2,895 | 149.77 | 0.43 |
| Public Facilities - School with Park | P | 413.45 | Mixed Use - Neighborhood Center | NC | 1,851 | 491.38 | 0.91 |

# APPENDIX B

City of Fresno Water and Wastewater Unit Factor Update for Metropolitan Water Resources Management Plan Update (Prepared by Akel Engineering, Inc.)

CITY OF FRESNO

# Water and Wastewater Unit Factor Update

FOR

# Metropolitan Water Resources Management Plan Update

PRELIMINARY

October 2020

AKEL
ENGINEERING GROUP, INC.

# City of Fresno

## Water and Wastewater Unit Factor Update

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## Table 1 Water Demand Factors by Land Use Classification

Metropolitan Water Resources Management Plan Update

City of Fresno

PRELIMINARY

*(Revised October 2020)*

| | Land Use Classifications | Water Service Area[1,2,3] (acres) | 2018 Water Demands[4] (mgd) | Recommended Water Demand Factors[5] (gpd/acre) | (ac-ft/yr/acre) |
|---|---|---|---|---|---|
| **Residential** | | | | | |
| 1 | Rural Density | 746 | 0.85 | 1,415 | 1.59 |
| 2 | Low Density | 1,283 | 2.12 | 2,050 | 2.30 |
| 3 | Medium Low Density | 10,139 | 23.18 | 2,845 | 3.19 |
| 4 | Medium Density | 11,033 | 24.91 | 2,810 | 3.15 |
| 5 | Medium High Density | 1,953 | 6.94 | 4,425 | 4.96 |
| 6 | High Density | 1,314 | 6.19 | 5,855 | 6.56 |
| | **Subtotal - Residential** | **26,467** | **64.18** | | |
| **Commercial** | | | | | |
| 7 | Community | 558 | 1.04 | 2,330 | 2.61 |
| 8 | General Heavy | 1,124 | 2.11 | 2,340 | 2.62 |
| 9 | Neighborhood | 530 | 1.08 | 2,525 | 2.83 |
| 10 | Neighborhood Limited | 0 | 0.00 | - | - |
| 11 | Office | 932 | 1.83 | 2,440 | 2.73 |
| 12 | Professional Services Office | 89 | 0.17 | 2,420 | 2.71 |
| 13 | Regional | 294 | 0.40 | 1,685 | 1.89 |
| 14 | Recreational | 109 | 0.23 | 2,575 | 2.88 |
| 15 | Storage | 273 | 0.07 | 335 | 0.38 |
| | **Subtotal - Commercial** | **3,909** | **6.93** | | |
| **Public Facilities** | | | | | |
| 16 | Airport | 1,147 | 0.12 | 130 | 0.15 |
| 17 | College | 304 | 0.41 | 1,665 | 1.87 |
| 18 | High School | 505 | 0.60 | 1,485 | 1.66 |
| 19 | Elementary and High School | 141 | 0.21 | 1,825 | 2.04 |
| 20 | Middle School | 305 | 0.43 | 1,765 | 1.98 |
| 21 | Elementary and Middle School | 191 | 0.30 | 1,930 | 2.16 |
| 22 | Elementary School | 792 | 1.53 | 2,405 | 2.69 |
| 23 | Special School | 52 | 0.05 | 1,110 | 1.24 |
| 24 | SEGA School with Park | 6 | 0.01 | 2,895 | 3.24 |
| 25 | Cemetery | 159 | 0.10 | 810 | 0.91 |
| 26 | Church | 662 | 0.81 | 1,525 | 1.71 |
| 27 | Community Activity Center | 11 | 0.02 | 1,930 | 2.16 |
| 28 | Neighborhood Center | 10 | 0.01 | 795 | 0.89 |
| 29 | Convention Center | 17 | 0.03 | 1,955 | 2.19 |
| 30 | Fairgrounds | 90 | 0.09 | 1,290 | 1.45 |
| 31 | Fire Station | 15 | 0.02 | 1,855 | 2.08 |
| 32 | Government Offices | 162 | 0.26 | 1,985 | 2.22 |
| 33 | Court House Central Area | 19 | 0.15 | 9,590 | 10.74 |
| 34 | Hospital | 189 | 0.76 | 5,005 | 5.61 |
| 35 | Medical Center | 20 | 0.02 | 1,385 | 1.55 |
| 36 | Convalescent Hospital | 119 | 0.39 | 4,080 | 4.57 |
| 37 | Military | 55 | 0.01 | 170 | 0.19 |
| 38 | Mobile Home Park | 274 | 0.49 | 2,225 | 2.49 |
| 39 | Municipal Service Center | 37 | 0.07 | 2,200 | 2.46 |
| 40 | Post Office | 30 | 0.02 | 750 | 0.84 |
| 41 | Public Facility | 7 | 0.01 | 1,010 | 1.13 |
| 42 | Public/Quasi-Public Facility | 46 | 0.10 | 2,670 | 2.99 |
| 43 | Fresno County Jail | 3 | 0.19 | 80,765 | 90.47 |

## Table 1 Water Demand Factors by Land Use Classification

Metropolitan Water Resources Management Plan Update

City of Fresno

PRELIMINARY

*(Revised October 2020)*

| Land Use Classifications | | Water Service Area[1,2,3] (acres) | 2018 Water Demands[4] (mgd) | Recommended Water Demand Factors[5] (gpd/acre) | (ac-ft/yr/acre) |
|---|---|---|---|---|---|
| 44 | Pump Station | 9 | 0.01 | 805 | 0.90 |
| | **Subtotal - Public Facility** | **5,376** | **7.19** | | |
| **Industrial** | | | | | |
| 45 | Light Industrial | 2,301 | 3.42 | 1,850 | 2.07 |
| 46 | Heavy Industrial | 1,905 | 5.91 | 3,860 | 4.32 |
| | **Subtotal - Industrial** | **4,206** | **9.34** | | |
| **Open Space** | | | | | |
| 47 | Open Space | 177 | 0.12 | 865 | 0.97 |
| 48 | Recreational Use/Clear Zone | 15 | 0.00 | - | - |
| 49 | Ag | 1,531 | 0.00 | - | - |
| 50 | Canal | 20 | 0.00 | - | - |
| 51 | Community Park | 24 | 0.05 | 2,620 | 2.93 |
| 52 | Golf Course | 662 | 0.23 | 435 | 0.49 |
| 53 | Lake or Pond | 54 | 0.00 | - | - |
| 54 | Multi-Use | 0 | 0.00 | - | - |
| 55 | Neighborhood Park | 218 | 0.62 | 3,510 | 3.93 |
| 56 | Recreational Park | 97 | 0.15 | 1,980 | 2.22 |
| 57 | Recreational Use | 17 | 0.02 | 1,235 | 1.38 |
| 58 | Regional Park | 436 | 0.18 | 525 | 0.59 |
| 59 | Recreational Commercial | 0 | 0.00 | - | - |
| 60 | Environmental Education Area | 0 | 0.00 | - | - |
| 61 | Gravel Mining | 0 | 0.00 | - | - |
| 62 | Parking | 48 | 0.00 | - | - |
| 63 | PGE Sub Station | 102 | 0.00 | - | - |
| 64 | Ponding Basin | 236 | 0.00 | - | - |
| 65 | Ponding Basin/Park | 128 | 0.16 | 1,535 | 1.72 |
| | **Subtotal - Open Space** | **3,764** | **1.53** | | |
| **Total** | | | | | |
| | **Subtotal - Residential** | **26,467** | **64.18** | | |
| | **Subtotal - Commercial** | **3,909** | **6.93** | | |
| | **Subtotal - Public Facility** | **5,376** | **7.19** | | |
| | **Subtotal - Industrial** | **4,206** | **9.34** | | |
| | **Subtotal - Open Space** | **3,764** | **1.53** | | |
| | **Total** | **43,722** | **89.17** | | |

AKEL ENGINEERING GROUP, INC.

10/2/2020

Notes:

1. Source: Land use and acreages based on City of Fresno parcel shapefile downloaded July 16, 2019.
2. Acreages exclude Bakman, Pinedale, and CSU Fresno service areas.
3. Acreages reflect demand generating parcels only.
4. Demand based on 2018 annual metered consumption records.
5. Recommended Water Demand Factors include the following adjustments:
   - Demand Factors normalized to 2018 production to account for system losses
   - Demand Factors increased to account for City-wide vacancy rate of 8.1% based on CA Department of Finance population estimat

## Table 2 Sewer Flow Factors by Land Use Classification

Metropolitan Water Resources Management Plan Update
City of Fresno

PRELIMINARY

| | Land Use Classifications | Sewer Service Area[1,2,3] (acres) | Return to Sewer Ratio | Unadjusted Wastewater Unit Factor[4] (gpd/acres) | Estimated Sewer Flow (mgd) | Recommended Wastewater Unit Factor[5] (gpd/acres) |
|---|---|---|---|---|---|---|
| **Residential** | | | | | | |
| 1 | Rural Density | 714 | 0.20 | 227 | 0.16 | 250 |
| 2 | Low Density | 1,063 | 0.35 | 577 | 0.61 | 625 |
| 3 | Medium Low Density | 9,875 | 0.40 | 915 | 9.03 | 990 |
| 4 | Medium Density | 11,001 | 0.50 | 1,129 | 12.42 | 1,225 |
| 5 | Medium High Density | 1,950 | 0.55 | 1,956 | 3.81 | 2,115 |
| 6 | High Density | 1,314 | 0.60 | 2,825 | 3.71 | 3,055 |
| | | | | **Subtotal - Residential Flow** | **29.75** | |
| **Commercial** | | | | | | |
| 7 | Community | 558 | 0.80 | 1,497 | 0.84 | 1,620 |
| 8 | General Heavy | 1,124 | 0.80 | 1,504 | 1.69 | 1,630 |
| 9 | Neighborhood | 530 | 0.80 | 1,623 | 0.86 | 1,755 |
| 10 | Neighborhood Limited | 0 | 0.00 | 0 | 0.00 | 0 |
| 11 | Office | 932 | 0.80 | 1,567 | 1.46 | 1,695 |
| 12 | Professional Services Office | 89 | 0.80 | 1,556 | 0.14 | 1,685 |
| 13 | Regional | 294 | 0.80 | 1,084 | 0.32 | 1,175 |
| 14 | Recreational | 109 | 0.30 | 621 | 0.07 | 675 |
| 15 | Storage | 273 | 0.80 | 213 | 0.06 | 235 |
| | | | | **Subtotal - Commercial Flow** | **5.43** | |
| **Public Facility** | | | | | | |
| 16 | Airport | 1,147 | 0.80 | 81 | 0.09 | 90 |
| 17 | College | 304 | 0.70 | 937 | 0.29 | 1,015 |
| 18 | High School | 505 | 0.70 | 835 | 0.42 | 905 |
| 19 | Elementary and High School | 141 | 0.70 | 1,026 | 0.14 | 1,110 |
| 20 | Middle School | 305 | 0.70 | 993 | 0.30 | 1,075 |
| 21 | Elementary and Middle School | 191 | 0.70 | 1,087 | 0.21 | 1,175 |
| 22 | Elementary School | 792 | 0.70 | 1,354 | 1.07 | 1,465 |
| 23 | Special School | 52 | 0.70 | 625 | 0.03 | 680 |
| 24 | SEGA School with Park | 6 | 0.80 | 1,860 | 0.01 | 2,015 |
| 25 | Cemetery | 159 | 0.25 | 163 | 0.03 | 180 |
| 26 | Church | 662 | 0.80 | 981 | 0.65 | 1,065 |
| 27 | Community Activity Center | 11 | 0.80 | 1,241 | 0.01 | 1,345 |
| 28 | Neighborhood Center | 10 | 0.80 | 510 | 0.00 | 555 |
| 29 | Convention Center | 17 | 0.80 | 1,258 | 0.02 | 1,360 |
| 30 | Fairgrounds | 90 | 0.80 | 827 | 0.07 | 895 |
| 31 | Fire Station | 15 | 0.80 | 1,192 | 0.02 | 1,290 |
| 32 | Government Offices | 162 | 0.80 | 1,277 | 0.21 | 1,385 |
| 33 | Court House Central Area | 19 | 0.80 | 6,169 | 0.12 | 6,670 |
| 34 | Hospital | 189 | 0.80 | 3,219 | 0.61 | 3,480 |
| 35 | Medical Center | 20 | 0.80 | 889 | 0.02 | 965 |
| 36 | Convalescent Hospital | 119 | 0.80 | 2,624 | 0.31 | 2,840 |
| 37 | Military | 55 | 0.80 | 109 | 0.01 | 120 |
| 38 | Mobile Home Park | 274 | 0.60 | 1,072 | 0.29 | 1,160 |
| 39 | Municipal Service Center | 37 | 0.80 | 1,415 | 0.05 | 1,530 |
| 40 | Post Office | 30 | 0.80 | 480 | 0.01 | 520 |
| 41 | Public Facility | 7 | 0.80 | 649 | 0.00 | 705 |
| 42 | Public/Quasi-Public Facility | 46 | 0.80 | 1,716 | 0.08 | 1,855 |
| 43 | Fresno County Jail | 3 | 0.80 | 51,972 | 0.15 | 56,185 |
| 44 | Pump Station | 9 | 0.00 | 0 | 0.00 | 0 |
| | | | | **Subtotal - Public Facility Flow** | **5.24** | |

## Table 2 Sewer Flow Factors by Land Use Classification

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City of Fresno

PRELIMINARY

| | Land Use Classifications | Sewer Service Area[1,2,3] (acres) | Return to Sewer Ratio | Unadjusted Wastewater Unit Factor[4] (gpd/acres) | Estimated Sewer Flow (mgd) | Recommended Wastewater Unit Factor[5] (gpd/acres) |
|---|---|---|---|---|---|---|
| **Industrial[6]** | | | | | | |
| 45 | Light Industrial | 2,301 | 0.80 | 1,190 | 2.74 | 1,290 |
| 46 | Heavy Industrial | 1,905 | 0.80 | 2,484 | 4.73 | 2,690 |
| | | | | **Subtotal - Industrial Flow** | **7.47** | |
| **Open Space** | | | | | | |
| 47 | Open Space | 177 | 0.00 | 0 | 0.00 | 0 |
| 48 | Recreational Use/Clear Zone | 15 | 0.00 | 0 | 0.00 | 0 |
| 49 | Ag | 1,531 | 0.00 | 0 | 0.00 | 0 |
| 50 | Canal | 20 | 0.00 | 0 | 0.00 | 0 |
| 51 | Community Park | 24 | 0.00 | 0 | 0.00 | 0 |
| 52 | Golf Course | 525 | 0.30 | 104 | 0.05 | 115 |
| 53 | Lake or Pond | 54 | 0.00 | 0 | 0.00 | 0 |
| 54 | Multi-Use | 0 | 0.00 | 0 | 0.00 | 0 |
| 55 | Neighborhood Park | 218 | 0.00 | 0 | 0.00 | 0 |
| 56 | Recreational Park | 97 | 0.00 | 0 | 0.00 | 0 |
| 57 | Recreational Use | 17 | 0.00 | 0 | 0.00 | 0 |
| 58 | Regional Park | 436 | 0.00 | 0 | 0.00 | 0 |
| 59 | Recreational Commercial | 0 | 0.00 | 0 | 0.00 | 0 |
| 60 | Environmental Education Area | 0 | 0.00 | 0 | 0.00 | 0 |
| 61 | Gravel Mining | 0 | 0.00 | 0 | 0.00 | 0 |
| 62 | Parking | 48 | 0.00 | 0 | 0.00 | 0 |
| 63 | PGE Sub Station | 102 | 0.00 | 0 | 0.00 | 0 |
| 64 | Ponding Basin | 236 | 0.00 | 0 | 0.00 | 0 |
| 65 | Ponding Basin/Park | 128 | 0.00 | 0 | 0.00 | 0 |
| | | | | **Subtotal - Open Space Flow** | **0.05** | |
| **Non-Metered[7,8,9]** | | | | | | |
| | Pinedale Public Utilities | - | - | - | 0.63 | |
| | Pinedale County Water District | - | - | - | 0.46 | |
| | Tarpey Village | - | - | - | 0.37 | |
| | Bakman | - | - | - | 1.82 | |
| | Clovis | - | - | - | 0.20 | |
| | City of Clovis | - | - | - | 5.12 | |
| | CSU Fresno | - | - | - | 0.13 | |
| | | | | **Subtotal - Non-Metered Flow** | **8.73** | |
| **Total** | | | | | | |
| | | | | **Subtotal - Residential Flow** | **29.75** | |
| | | | | **Subtotal - Commercial Flow** | **5.43** | |
| | | | | **Subtotal - Public Facility Flow** | **5.24** | |
| | | | | **Subtotal - Industrial Flow** | **7.47** | |
| | | | | **Subtotal - Open Space Flow** | **0.05** | |
| | | | | **Subtotal - Non-Metered Flow** | **8.73** | |
| | | | | **Total Balanced WWTP Flow** | **56.68** | |
| | | | | **2018 WWTP Average Annual Flow[10]** | **56.81** | |

AKEL ENGINEERING GROUP, INC.

10/2/2020

Notes:

1. Source: Land use and acreages based on City of Fresno parcel shapefile downloaded July 16, 2019.
2. Acreages exclude Bakman, Pinedale, and CSU Fresno service areas.
3. Acreages reflect flow generating parcels only and do not account for Septic Users.
4. Demand based on 2018 annual metered consumption records.
5. Wastewater Unit Factors increased to account for City-wide vacancy rate of 8.1% based on CA Department of Finance population estimates.
6. Industrial flow does not exclude the City's top industrial users (Foster Farms, Cal Dairies, Gallo, and Cargil Beef).
7. Development information for non-metered areas provided by City Staff.
8. City of Clovis BWF extracted from City of Fresno Wastewater Collection System Master Plan Update (September 2015).
9. CSU Fresno flows extracted from flow meter data provided by City Staff on April 30, 2019.
10. Historical WWTP flows provided by City Staff on February 13, 2019.

## APPENDIX C

City of Fresno 2020 Urban Water Management Plan (UWMP)

Includes:

- Appendix H: City of Fresno's Central Valley Project (CVP) Contract (Surface Water Source)
- Appendix I: City of Fresno and Fresno Irrigation District Agreements (Surface Water Source)
- Appendix J: Water Shortage Contingency Plan

City of FRESNO
Department of Public Utilities

# 2020 Urban Water Management Plan

Final

JULY 2021

CITY OF FRESNO

Photo Credit: Downtown Fresno Partnership

City of FRESNO
Department of Public Utilities

CITY OF FRESNO

# Final 2020 Urban Water Management Plan

**JULY 2021**

Prepared by Water Systems Consulting, Inc.

WSC

# ACKNOWLEDGMENTS

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# ACRONYMS & ABBREVIATIONS

| | |
|---|---|
| °F | degrees Fahrenheit |
| 1,2,3-TCP | 1,2,3-trichloropropane |
| AF | acre-feet |
| AFY | acre-feet per year |
| AMI | advanced metering infrastructure |
| AWE | Alliance for Water Efficiency |
| AWWA | American Water Works Association |
| BP04 | Booster Pump 4 |
| CII | Commercial, Institutional, and Industrial |
| CIMIS | California Irrigation Management Information System |
| City | City of Fresno |
| COG | Council of Governments |
| CPC | California Plumbing Code |
| CSUF | California State University Fresno |
| CVP | Central Valley Project |
| CVPIA | Central Valley Project Improvement Act |
| CVWAC | Central Valley Water Awareness Committee |
| CWC | California Water Code |
| CY | Calendar Year |
| DBCP | 1,2-dibromo-3-chloropropane |
| DMM | Demand Management Measures |
| DDW | Department of Drinking Water |
| DPU | Department of Public Utilities |
| DRA | Drought Risk Assessment |
| DWR | Department of Water Resources |
| EDB | ethylene dibromide or 1,2-dibromoethane |
| ETo | Evapotranspiration |
| FID | Fresno Irrigation District |
| FMFCD | Fresno Metropolitan Flood Control District |
| GIS | Geographic Information System |
| GPCD | gallons per capita per day |
| GSA | Groundwater Sustainability Agency |

| | |
|---|---|
| **GSP** | Groundwater Sustainability Plan |
| **HCF** | hundred cubic feet |
| **IGSM** | Integrated Groundwater and Surface Water Model |
| **Metro Plan** | Fresno Metropolitan Water Resource Management Plan |
| **mgd** | million gallons per day |
| **NESWTF** | Northeast Surface Water Treatment Facility |
| **NFWRF** | North Fresno Wastewater Reclamation Facility |
| **NKGSP** | North Kings Groundwater Sustainability Plan |
| **NRDC** | Natural Resources Defense Council |
| **PCE** | perchloroethylene or tetrachloroethylene |
| **PEIR** | Programmatic Environmental Impact Report |
| **PFAS** | per- and polyfluoroalkyl substances |
| **PFOA** | perfluorooctanoic acid |
| **PFOS** | perfluorooctanesulfonic acid |
| **RHNA** | Regional Housing Needs Allocation |
| **RWMP** | Recycled Water Master Plan |
| **RWRF** | Regional Wastewater Reclamation Facility |
| **SB** | Senate Bill |
| **SBx7-7** | Senate Bill x 7-7 |
| **SESWTF** | Southeast Surface Water Treatment Facility |
| **SGMA** | Sustainable Groundwater Management Act |
| **SOI** | Sphere of Influence |
| **sq mi** | square miles |
| **SWTF** | Surface Water Treatment Facility |
| **T-3 SWTF** | T-3 Water Storage and Modular Surface Water Treatment Facility |
| **TCE** | trichloroethylene |
| **TDS** | total dissolved solids |
| **TTDF** | Tertiary Treatment and Disinfection Facility |
| **USBR** | United States Bureau of Reclamation |
| **UV** | ultraviolet |
| **UWMP** | Urban Water Management Plan |
| **UWMP Act** | Urban Water Management Planning Act |
| **WSCP** | Water Shortage Contingency Plan |
| **WSIP** | Water Storage Investment Program |
| **WY** | Water Year |

CITY OF FRESNO

# Executive Summary

**This section summarizes the 2020 Urban Water Management Plan (UWMP) for the City of Fresno (City). It provides a lay description of the 2020 UWMP in a manner that is accessible to non-technical readers. This summary describes the fundamental purposes of the UWMP, including water service reliability, future challenges, and strategies for managing water reliability risks.**

UWMPs are updated every five years and outline each suppliers' long-term water resource planning to ensure there is enough water to meet both existing and future demands. They set the roadmap for how the City will use water over the coming years.

The original Fresno water system began operations in 1876 as a non-profit organization established by a group of public-minded citizens. Today, the City covers approximately 115 square miles (sq mi) (73,500 acres) consisting largely of single-family residential, commercial, public, and industrial development. The City's General Plan projects buildout of the 106,000 acres planning area in 2056. This UWMP addresses the City's water service reliability, future challenges, and strategies for managing risks to water reliability through 2045. The City's Fresno Metropolitan Water Resource Management Plan (Metro Plan), which is currently being prepared, addresses a 50-year horizon – through 2070.

IN THIS SECTION


- Service Area Description
- Water Use
- Water Sources
- Water Supply Reliability

# Purpose and Organization of the Plan

This plan comprises the 2020 UWMP for the City, as required by the California Urban Water Management Planning Act, which requires all urban water suppliers with more than 3,000 connections or distributing more than 3,000 acre-feet per year (AFY) to complete an UWMP every five years. As of the close of the 2020 calendar year, the City has over 139,500 residential, commercial, industrial, and institutional water service connections and produced nearly 122,000 acre-feet (AF) of water. As a result, the City is required to prepare and adopt an UWMP and submit it to the Department of Water Resources (DWR) by the July 1, 2021, due date.

Requirements for the UWMP include:

- Assessment of current and projected water supplies
- Evaluation of demand and customer types
- Evaluation of the reliability of water supplies
- Description of conservation measures implemented by the urban water supplier
- Response plan, in the event of a water shortage
- Comparison of demand and supply projections

The UWMP is a valuable planning document used for multiple purposes:

- Serves as a valuable resource to the community and other interested parties regarding water supply and demand, conservation, and water related information
- Meets a statutory requirement of the California Water Code (CWC)
- Provides a key source of information for water supply assessments and written verifications of water supply
- Supports regional long-range planning, including City and County General Plans
- Provides a standardized methodology for water utilities to assess their water resource needs and availability
- Provides a resource for regional involvement in the California Water Plan
- Provides for a plan during water drought situations

# Outreach and Engagement

The City has coordinated the preparation of its 2020 UWMP with its water suppliers, Fresno County, the City of Clovis, nearby water agencies, and community members to develop a UWMP that adheres to the requirements of the CWC and plans for a resilient water future. In total, the City has coordinated preparation of the 2020 UWMP and solicited participation and comments with the following agencies:

- Bakman Water Company
- City of Clovis
- County of Fresno
- Fresno Irrigation District
- Fresno Metropolitan Flood Control District
- Friant Water Authority
- Garfield Water District
- Malaga County Water District
- Pinedale County Water District
- North Kings Groundwater Sustainability Agency
- US Bureau of Reclamation

# Service Area Description

The City's General Plan planning area covers approximately 106,000 acres comprised of approximately 73,500 acres of incorporated land and 32,500 acres of unincorporated land. The City's water service area covers 70,400 acres consisting largely of single-family residential, commercial, public, and industrial development, shown in **Figure ES-6** (located at the end of the Executive Summary). The service area excludes areas served by the Bakman Water Company, Pinedale County Water District, Park Van Ness Mutual Water Company, California State University Fresno, and private groundwater users located within Fresno County islands. The City will eventually serve out to the Sphere of Influence (SOI) boundary adopted in the 2014 General Plan and includes all lands planned to be annexed by the City at the projected 2056 buildout of the General Plan, summarized in **Table ES-1**.

**Table ES-1. Existing and Future Water Service Area**

| LAND USE CATEGORY | 2020 WATER SERVICE AREA | | 2056 WATER SERVICE AREA | |
|---|---|---|---|---|
| | ACRES | PERCENT | ACRES | PERCENT |
| Single-Family Residential | 27,700 | 39.3% | 40,000 | 47.4% |
| Multifamily Residential | 3,700 | 5.3% | 3,800 | 4.5% |
| Commercial | 4,500 | 6.4% | 8,600 | 10.2% |
| Public Facility | 5,600 | 8.0% | 7,200 | 8.5% |
| Industrial | 4,500 | 6.4% | 9,300 | 11.0% |
| Open Space/ Landscape Irrigation | 13,100 | 18.6% | 11,000 | 13.0% |
| Mixed Use | 0 | 0% | 3,900 | 4.6% |
| Downtown | 0 | 0% | 600 | 0.7% |
| Vacant / Partially Vacant | 11,300 | 15.9% | 0 | 0% |
| **TOTAL** | **70,400** | **100%** | **84,400** | **100%** |

Note: Acreage from City GIS Shapefile of Land Uses and aligns with the General Plan for buildout in year 2056.

### Population Projections

The City experienced rapid growth since it was founded by the Central Pacific Railroad in 1872 up through the mid-1990s, when the City's annual growth rate was typically greater than 2%. From 1995 to 2015, the annual growth rate has decreased to an average of 1.3%, and since 2015, the rate has not surpassed 1.0%. Achieving General Plan buildout population estimates requires an average annual growth rate of 1.44% from 2020 to 2056. The City's water service area population is anticipated to continue to grow along with the City, with some slightly higher growth years anticipated in the next 10 years due to multiple large developments planned for completion in the near term. As a result, population growth, shown in **Figure ES-1** on the following page, occurs at an annual rate of ranging from 1.1–2.1% between 2020 and 2056.

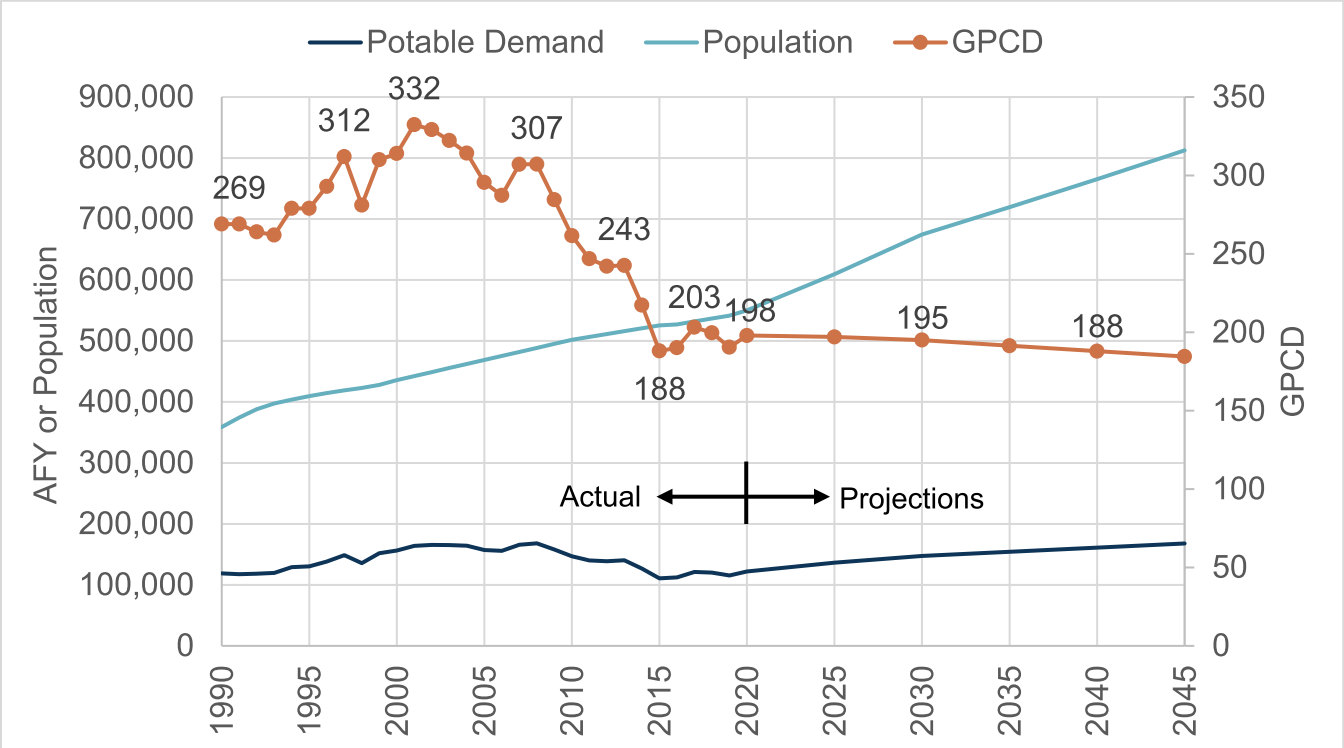
# Water Use

Water consumption in the City is characterized by the typical demand sectors of residential, commercial, institutional, industrial, and irrigational. The difference between production and consumption is losses, which may be attributed to system leaks, meter inaccuracies, fire flows, theft, unmetered use, or other factors.

As shown in **Figure ES-1**, the City's water demand has decreased even as the City has grown over the past several decades, and demands are projected to grow slower than population growth. This trend is captured by the City's daily per capita water use, measured as gallons per capita per day (GPCD). For 2020, the City's water use averaged 198 GPCD based on 121,993 AF of water production and a service area population of 550,217. The City is far below its 2020 daily per capita water use target of 247 GPCD due to the extensive conservation efforts implemented by the City in the past decade.

The City also diverts raw surface water obtained from the United States Bureau of Reclamation (USBR) and the Fresno Irrigation District (FID) to recharge basins throughout the service area. The City coordinates with FID for the delivery of the recharge water, utilizing FID's existing system of channels and pipelines to covey the raw water, and with Fresno Metropolitan Flood Control District (FMFCD) to deliver water to FMFCD's stormwater retention and recharge basins or the City's own recharge basins. The raw surface water recharges the groundwater basin to sustain the groundwater supply for the City. The groundwater recharge volume can vary based on surface water supply availability and is represented as an addition to annual groundwater supplies. In addition, the City serves a limited number of customers secondary treated or tertiary treated and disinfected recycled water for agricultural irrigation or landscape irrigation, respectively.

**Figure ES-1. City of Fresno Demand Projections**



The City's per capita water usage is projected to continue to decline through 2045 due to more water efficiency in future construction and passive conservation; however, due to the increase in population the demand is expected to slowly increase in the next 25 years. The potable demand projections for normal water use are based on land use where future land use areas are expected to be more water efficient than existing land uses and buildings due to the California Plumbing Code (CPC) and use of higher efficiency appliances and landscapes. Demand for existing land uses is also expected to slowly reduce over time due to passive conservation, which includes the replacement of older water fixtures and appliances with more efficient types now required as part of the CPC.

# Water Sources

The City relies on groundwater from the North Kings Subbasin; surface water from Central Valley Project (CVP), through a contract with the USBR; Kings River water, through a contract with FID; and recycled water. Water production in the City has consisted of 100% groundwater prior to the commissioning of the City's first surface water treatment facility (SWTF) in 2004. Since 2004, the City has invested in expanding its surface water treatment capabilities and now has three SWTFs that provide approximately half of all potable water demands in the service area.

**Groundwater**

The City overlies the Kings Subbasin, which is part of the greater San Joaquin Valley Groundwater Basin. The City is one of many water purveyors that use groundwater from the Kings Subbasin. The City has a network of over 270 municipal wells and currently operates approximately 202 municipal supply wells within the Kings Subbasin.

The City was a founding member of the North Kings Groundwater Sustainability Agency (North Kings GSA), which was formed following passage of the Sustainable Groundwater Management Act (SGMA) of 2014. This legislation created a statutory framework for groundwater management in California that can be sustained during the planning and implementation horizon without causing undesirable results. SGMA requires governments and water agencies of "critically overdrafted" basins to reach sustainability by 2040. The Kings Subbasin was designated a critically overdrafted basin by DWR and the North Kings GSA is working within the SGMA framework to reach groundwater sustainability.

Due to the City's investments in other supplies – surface water, recycled water, and conservation – groundwater levels beneath the City have already begun to recover from low levels experienced during the recent drought. The City plans to continue to use groundwater within a larger conjunctive use program that maximizes its existing water rights and surface water supply sources.

**Surface Water**

With the completion and operation of the Southeast Surface Water Treatment Facility (SESWTF), surface water is now a primary water supply used to meet potable demands within the City. The City contracts with FID for Kings River water and with USBR for CVP water from the Friant-Kern Canal. The surface water supply is used either for potable uses through treatment and distribution or delivery to recharge basins for groundwater recharge. The City has historically not used all its available FID allocation in any given year, although it pays a flat rate for its total allocation regardless of use. Water unused by the City is reallocated by FID to its other customers.

The City, through an agreement originally executed in 1961, secured a surface water supply from USBR CVP Friant Division for an annual water supply of 60,000 AF of Class 1 water. The agreement was last renewed in 2010 as a Section 9(d) contract that provides water from the San Joaquin River in perpetuity. Class 1 water has historically been very reliable until the 2006 San Joaquin River Restoration Settlement Agreement, which ended an 18-year legal dispute over the operation of Friant Dam brought by a coalition of conservation and fishing groups. The projected surface water available for the City from USBR is based on USBR simulations for the 2006 Settlement Agreement. Average simulated delivery is 53,680 AFY and the median simulated delivery is 60,000 AFY. However, very dry years have previously resulted in substantial reductions as demonstrated by the zero allocations that occurred in 2014 and 2015.

FID is one of 28 agencies that receives an entitlement of water from the Kings River through the Kings River Water Association. The City executed its most recent agreement with FID in 2016. The 2016 agreement identifies the City's contracted percentage of FID's Kings River water based on the City's water service area located within FID service area as a percentage of the FID land area. FID land area varies slightly every year because it is dependent on the acreage receiving water deliveries for that year rather than the total acreage within FID, and is roughly 200,000 acres. As the City incorporates new users and the water service area expands, the percentage of FID supply increases. However, the 2016 FID Agreement sets the City's maximum percentage of FID's Kings River water as 29.0%, which is expected to be reached between 2025 and 2030.

The City's potential supply from FID was projected using actual Kings River deliveries for 1964–2019. The average FID Kings River delivery over that time was 452,541 AF, which equates to an average potential City supply of 131,237 AF, assuming the maximum 29.0% City supply percentage. The projected City percentage of FID supplies was estimated based on City's water service area growth projections through buildout in 2056.

**Recycled Water**

The Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) has developed from what was once a sewer farm to what is now a state-of-the-art wastewater treatment facility. The RWRF treats flows from not only the City, but also sewered County areas (some county areas remain unsewered), the City of Clovis, Pinedale County Water District, and Pinedale Public Utility District. Flows received at this facility peaked at 81,100 AF in 2006 and have been steadily decreasing since, with the average influent flow about 63,000 AF over the last five years.

The City has three primary means of effluent disposal from the RWRF:

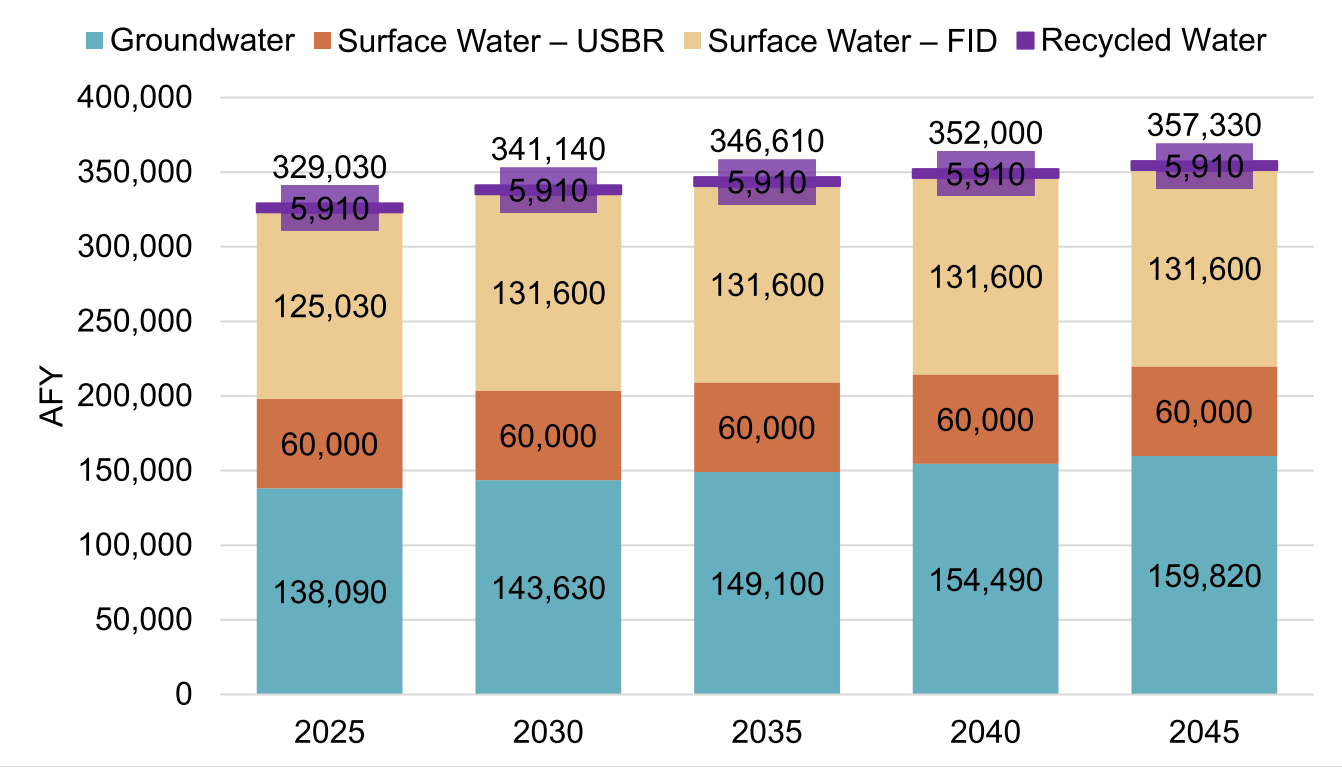
1. Undisinfected secondary effluent to on-site and off-site farmland for restricted irrigation
2. Undisinfected secondary effluent to percolation ponds
3. Disinfected tertiary effluent to the recycled water distribution system

The percolated effluent has been deemed equivalent to tertiary treated water by the State and the City has been extracting this water for reuse in areas within and surrounding the RWRF, as well as to FID's canals, through an exchange agreement for delivery to FID agricultural customers. The City recently constructed the Tertiary Treatment and Disinfection Facility (TTDF) at the RWRF and has constructed most of the southwest recycled water system, which is projected to increase deliveries from roughly 1,000 AFY today to eventually meet 5,800 AFY of non-potable demands. In addition, the City uses recycled water from the North Fresno Wastewater Reclamation Facility (NFWRF) to irrigate Copper River Ranch Golf Course.

### Summary of Supplies

The City currently balances its surface water supplies and groundwater based on minimum production for operation of the SWTFs and minimum groundwater pumping to manage and control contamination plumes and prevent their spread. The minimum operation conditions typically occur in the low-demand winter months, and the City can increase surface water production during peak demand months when surface water is available. In normal and wet years, the City intends to rely on more surface water supply and recharge raw surface water to replenish the groundwater basin and build storage for dry years. In dry years, when surface water is less available, the City will ramp up well production to meet demands. The City is expected to continue this supply management strategy in the future. **Figure ES-2** shows the City's annual average projected water supplies through 2045.

**Figure ES-2. Projected Water Supplies**



# Water Supply Reliability

The City currently manages its surface water and groundwater supply by maximizing surface water for potable use and intentional recharge during wet and normal years, while relying on groundwater during dry years. The City is currently updating its Metro Plan, which will recommend projects and programs to optimize the use of its supply portfolio and further improve supply resilience. Supply management tools are an expected outcome of the Metro Plan update; however, the City's ongoing supply management is intended to maximize local supplies and improve the groundwater basin storage. Current actions include enhanced groundwater management and intentional recharge, increased recycled water use, and continued conservation through the implementation of demand management measures.

Normal water year, single dry water year, and five-year consecutive drought period supply projections were made based on historic water allocations for surface water supplies, sustainable yield for groundwater, and projected utilization for recycled water. For surface water, the single dry year is based on 2015 allocations and the five-year drought is based on 2012 to 2016. Groundwater supplies, due to intentional recharge augmentation, remain reliable in all hydrologic conditions.

Despite severe reductions of surface water supplies during recent dry years, sufficient good-quality water was available to operate the SWTFs. The projected supplies and demands for a normal year, single dry year, and five-year consecutive drought, shown in **Figure ES-3** through **Figure ES-5** on the next page and in **Table 7-1** through **Table 7-3** in **Section 7.1.4**, demonstrate that the City is projected to have greater than 100,000 AF of available supply after meeting demands in normal years; the City's surface water supplies are reduced in a single dry year, but all potable demands are met and groundwater recharge of raw surface water is reduced; and the City is projected to meet all demands during a five-year drought with its existing supplies with reduced groundwater recharge in years three and four of a five-year drought to accommodate low surface water allocations.

Managed recharge of surface water is an essential component of the City's groundwater supply and the City must average 60,000 AFY to 70,000 AFY of recharge with surface water to meet the projections. This highlights the City's priority of recharging available surface water in the coming years.

**Figure ES-3. Normal Year Supply vs. Demand**

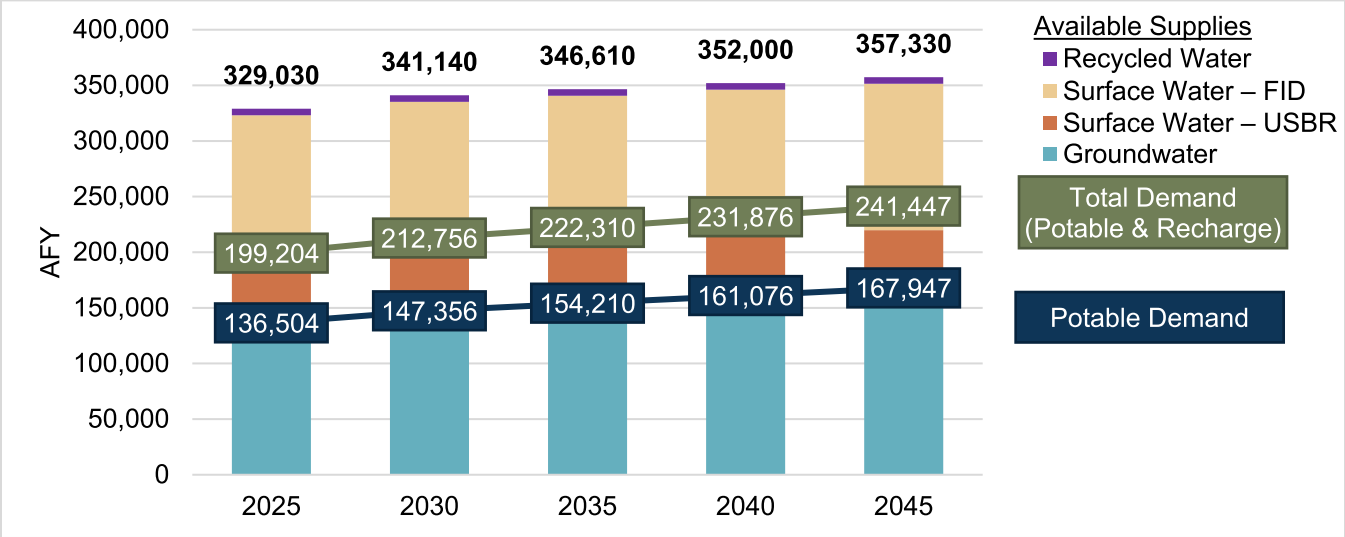



**Figure ES-4. Single Dry Year Supply vs. Demand**

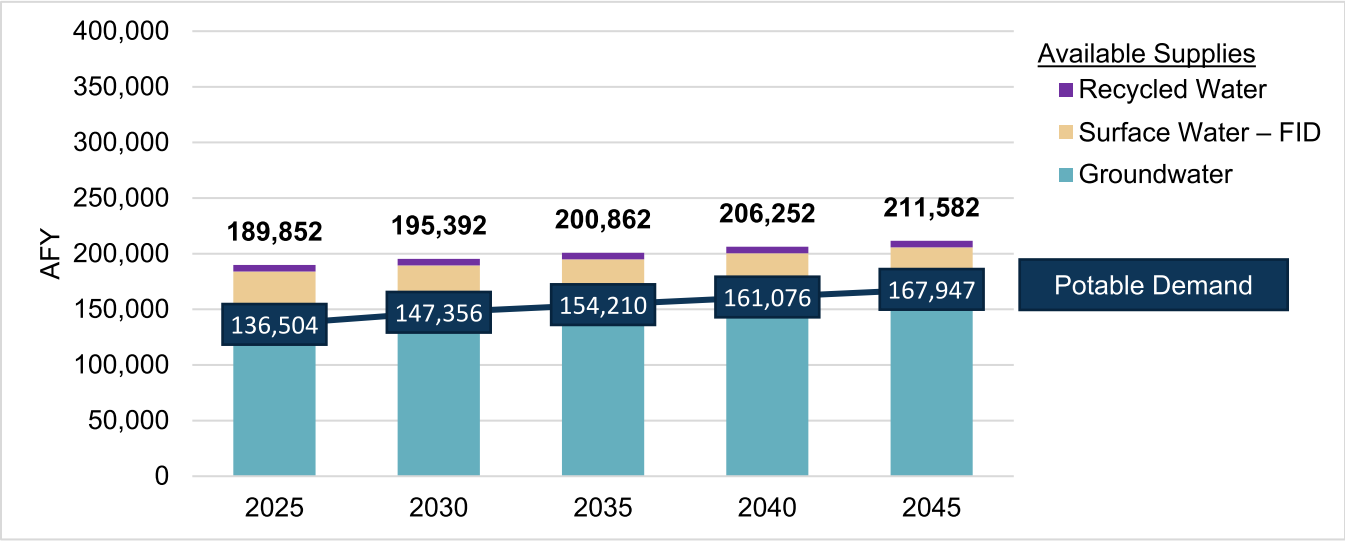
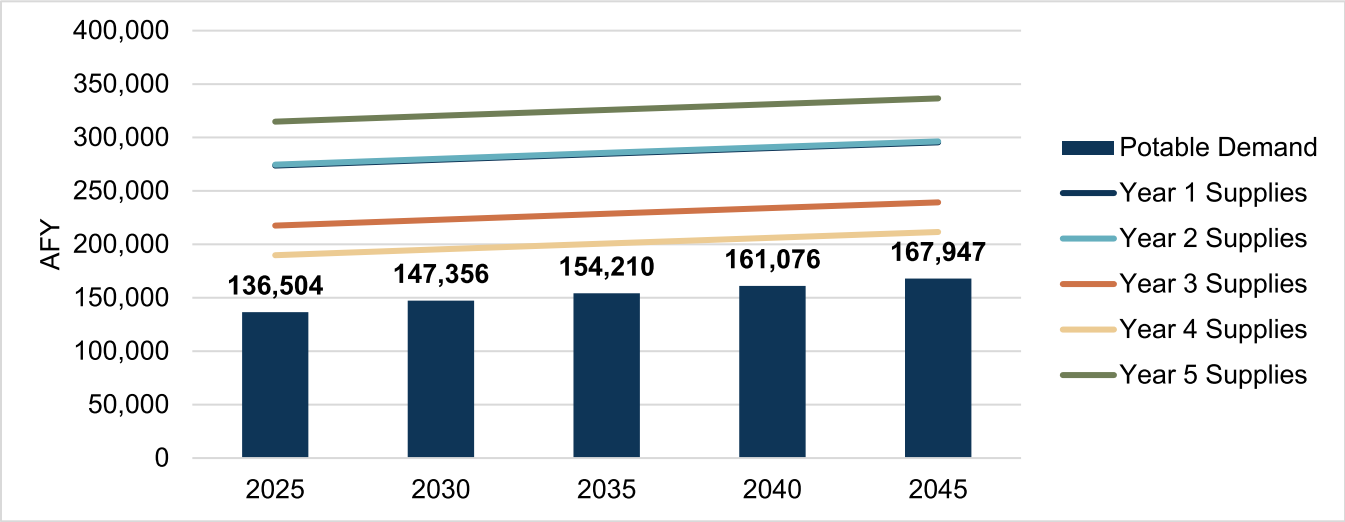



**Figure ES-5. Multiple Dry Years Supply vs. Demand**



### 2021-2025 Drought Risk Assessment

A new provision of the Water Code directs Suppliers to prepare a Drought Risk Assessment (DRA), assuming a drought period lasting five consecutive years, starting from the year following the year when the assessment is conducted. The DRA analysis allows the City to examine the management of its supplies during stressed hydrologic conditions and an opportunity to evaluate whether the City may need to enact its Water Shortage Contingency Plan (WSCP) during the next actual drought period lasting at least five years. The projected gross water use for the five-year DRA is based on unrestricted potable demand, a reduction in raw-water demand for intentional recharge in years three and four of the five-year drought, and unrestricted recycled water demand. Surface water supply availability is based on actual allocations during the previous drought – from 2012 to 2016.

**Table ES-2** compares the total projected supply and demand for the five-year DRA for 2021 through 2025. As shown, the City does not expect to enact its WSCP for a five-consecutive-year drought based on the unrestricted potable demand projections and the reliability of the current supply portfolio. Available surface water supplies during this period would be utilized for groundwater recharge to sustain the groundwater basin.

**Table ES-2. Five-Year Drought Risk Assessment**

| WATER USE TYPE | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|
| Groundwater | 133,602 | 134,724 | 135,846 | 136,968 | 138,090 |
| Surface Water – USBR | 30,000 | 37,200 | 0 | 0 | 45,000 |
| Surface Water – FID | 93,354 | 83,085 | 65,425 | 40,776 | 111,911 |
| Recycled Water | 1,912 | 2,911 | 3,911 | 4,910 | 5,910 |
| **TOTAL SUPPLY** | **258,868** | **257,920** | **205,181** | **182,655** | **300,911** |
| Potable Demand | 124,910 | 127,827 | 130,745 | 133,662 | 136,504 |
| Non-Potable Demand | 60,000 | 60,000 | 48,287 | 22,260 | 60,000 |
| **TOTAL DEMAND** | **184,910** | **187,827** | **179,032** | **155,922** | **196,504** |
| **AVAILABLE SUPPLIES** | **73,958** | **70,093** | **26,149** | **26,732** | **104,407** |

### Water Shortage Contingency Plan

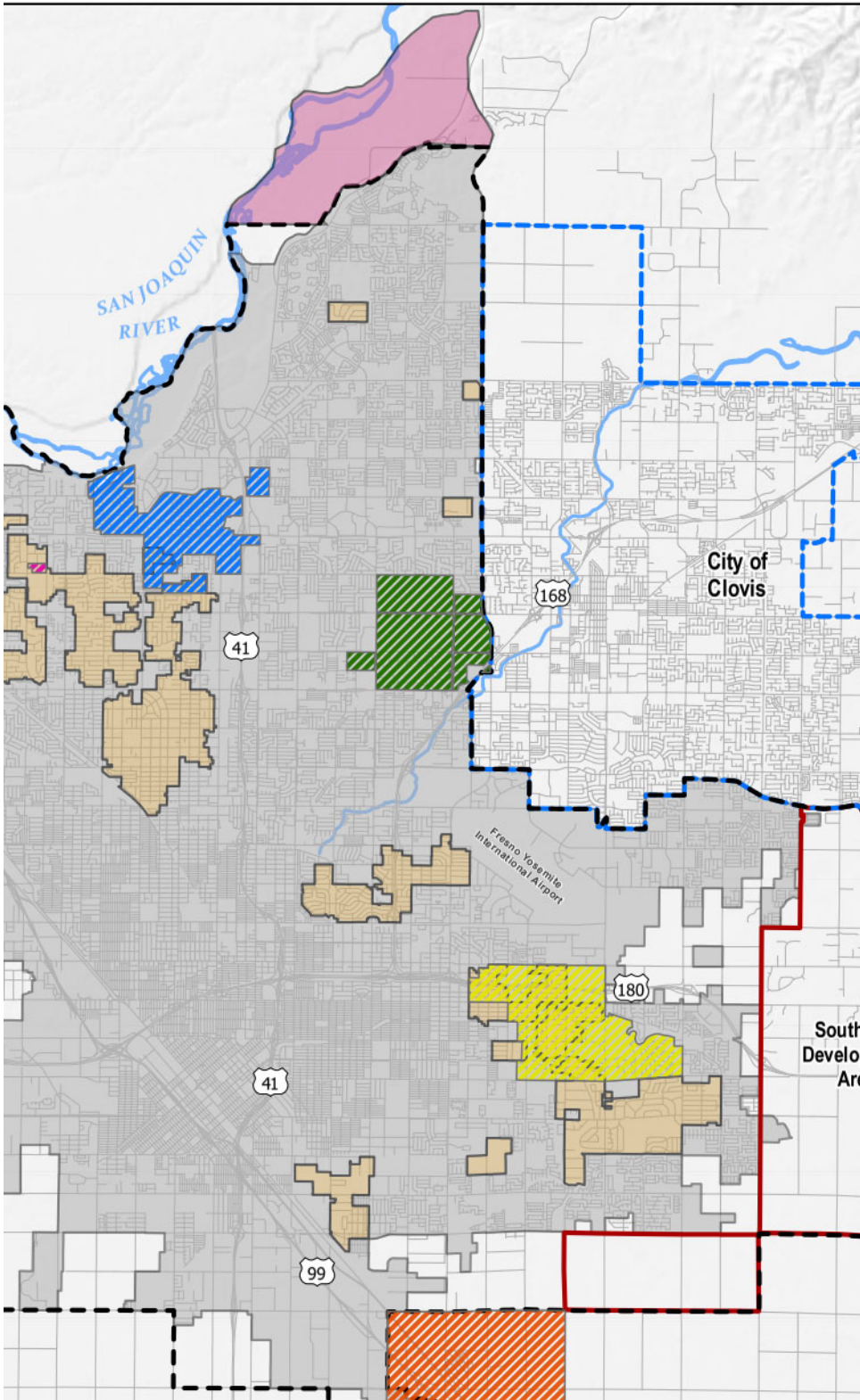
This WSCP is a detailed plan for how the City intends to respond to foreseeable and unforeseeable water shortages. A water shortage occurs when the water supply is reduced to a level that cannot support typical demand at any given time.

The WSCP is used to provide guidance to the City's governing body, staff, and the public by identifying response actions to allow for efficient management of any water shortage with predictability and accountability. Preparation provides the tools to maintain reliable supplies and reduce the impacts of supply interruptions due to extended drought and catastrophic supply interruptions.

The WSCP describes the following:

- Water Supply Reliability Analysis
- Annual Water Supply and Demand Assessment Procedures
- Six Standard Shortage Stages
- Shortage Response Actions
- Communication Protocols
- Compliance and Enforcement
- Legal Authority
- Financial Consequences of WSCP Implementation
- Monitoring and Reporting
- WSCP Refinement Procedures
- Special Water Features Distinctions
- Plan Adoption, Submittal, and Availability

The 2020 WSCP is a standalone document that can be modified as needed and is included as **Appendix J** in the 2020 UWMP.


SAN JOAQUIN
RIVER
City of
Clovis
168
41
Fresno Yosemite
International Airport
180
41
99

# 1 CITY OF FRESNO Introduction

**This plan comprises the 2020 Urban Water Management Plan (UWMP) for the City of Fresno (City), as required by the California Urban Water Management Planning Act (UWMP Act).**

The UWMP Act requires all urban water suppliers with more than 3,000 connections or distributing more than 3,000 acre-feet per year (AFY) to complete an UWMP every five years.

As of the close of the 2020 calendar year, the City has over 139,500 residential, commercial, industrial, and institutional water service connections and produced nearly 122,000 AF of water. As a result, the City is required to prepare and adopt an UWMP and submit it to DWR by the July 1, 2021, due date.

IN THIS SECTION


- California Water Code
- UWMP Organization


**The UWMP is a valuable planning document used for multiple purposes:**

- Serves as a valuable resource to the community and other interested parties regarding water supply and demand, conservation, and water related information
- Meets a statutory requirement of the California Water Code (CWC)
- Provides a key source of information for water supply assessments and written verifications of water supply
- Supports regional long-range planning documents, including City and County General Plans
- Provides a standardized methodology for water utilities to assess their water resource needs and availability
- Provides a resource for regional involvement in the California Water Plan
- Provides for a plan during water drought situations

# 1.1 The California Water Code

The UWMP Act is administered by the California Department of Water Resources (DWR), which is responsible for compiling data for statewide and regional analysis and publishing the adopted documents online for public access. This report was prepared according to the requirements of the CWC, UWMP Act, and the 2020 UWMP Guidebook.

CWC Section 10620 (a) of the UWMP Act states, "Every urban water supplier shall prepare and adopt an urban water management plan in the manner set forth in Article 3 (commencing with Section 10640)." These plans are to be updated every five years and submitted to DWR.

Requirements for the UWMP include:

- Assessment of current and projected water supplies
- Evaluation of demand and customer types
- Evaluation of the reliability of water supplies
- Description of conservation measures implemented by the urban water supplier
- Response plan, in the event of a water shortage
- Comparison of demand and supply projections

In November 2009, the State legislation passed Senate Bill (SB) x 7-7, referred to as SBx7-7 or the Water Conservation Act of 2009. SBx7-7 set the goal of achieving a 20% reduction in urban per capita water use statewide by 2020. Retail water agencies were required to set targets and track progress toward decreasing daily per capita urban water use in their service areas, which would assist the State in meeting its 20% reduction goal by 2020.

This law requires that every UWMP include:

- Baseline per capita water use
- Urban water use target for 2020
- Compliance daily per capita water use

This 2020 UWMP has been prepared to comply with the UWMP Act and SBx7-7. In addition to meeting the requirements of the Act, this report will be used to support water supply assessments and written verifications of water supply required by SB 610 and SB 221 of 2001. These bills require that water supply information be provided to counties and cities for projects of a certain size, prior to discretionary project approval. Both bills allow an UWMP to be used as a source document to fulfill these legislative requirements. The UWMP Act has undergone significant expansion since it was originally passed, particularly since the City's previous UWMP was prepared in 2015. Prolonged droughts, groundwater overdraft, regulatory revisions, and changing climatic conditions affect the reliability of each water supplier as well as the statewide water reliability overseen by DWR, the State Water Resources Control Board, and the Legislature. Accordingly, the UWMP Act has grown to address changing conditions, and the current requirements are found in Sections 10610–10656 and 10608 of the CWC.

Since 2015, several amendments have been added to the UWMP Act. These require urban water suppliers to prepare a five-year consecutive drought supply and demand assessment and a five-year drought risk assessment to evaluate the functionality of the Water Shortage Contingency Plan (WSCP) in the event of a continuous five-year drought beginning next year.

There are also new requirements for the WSCP, and it is now required to be adopted as a separate plan from the UWMP. This 2020 UWMP was developed to incorporate these new requirements, under the guidance of DWR's 2020 UWMPs Guidebook for Urban Water Suppliers. A checklist to document compliance of this 2020 UWMP with the Act and the CWC is provided in **Appendix A**.

This 2020 UWMP includes all required DWR standardized tables for **Chapters 1 to 10** compiled in **Appendix B** and all required SBx7-7 tables in **Appendix C**. A selection of these tables is also provided in the body of this Plan, as necessary to present supporting data.

## 1.2 UWMP Organization

This 2020 UWMP is organized into the following chapters.

- **Chapter 1 - Introduction and Overview:** This chapter provides a discussion of the purpose and content of the 2020 UWMP and the extent of the City's water management planning efforts.
- **Chapter 2 - Plan Preparation:** This chapter provides information on the City's development of the 2020 UWMP, including the basis for plan preparation, planning type, data format, and coordination and outreach to nearby agencies.
- **Chapter 3 - System Description:** This chapter provides a description of the City's water system, including service area maps, climate information, service population and demographic information, and an overview of the City's organizational structure and history.
- **Chapter 4 - Customer Water Use:** This chapter describes the City's historic, current, and projected water uses, system losses, water savings, and water use by lower income households.
- **Chapter 5 - Conservation Target Compliance:** This chapter includes a description of the City's chosen method for calculating baseline per capita water use, the City's calculated baseline, 2015 interim and 2020 per capita demand targets, and compliance with the 2020 target.
- **Chapter 6 - System Supplies:** This chapter includes a discussion of the City's water system supplies, including groundwater, surface water, wastewater, and recycled water, the City's future water projects, and a summary of existing and future water sources.
- **Chapter 7 - Water Supply Reliability Assessment:** This chapter describes the reliability of the City's water supply through a 20-year planning horizon, including a supply and demand assessment and regional reliability evaluation. Supply reliability is presented for a normal, single dry year and five consecutive dry years.
- **Chapter 8 - Water Shortage Contingency Planning:** This chapter provides a description of the City's WSCP, including stages of action, prohibitions, penalties, reduction methods, and catastrophic supply interruption.
- **Chapter 9 - Demand Management Measures:** This chapter explains the City's existing and historic efforts to promote water conservation and the City's plans to use Demand Management Measures to achieve its 2025 water use targets.
- **Chapter 10 - Plan Adoption, Submittal, and Implementation:** This chapter details the steps taken by the City to adopt the 2020 UWMP in accordance with the CWC, make it available to the public, and implement it.

- **Appendices:** These include any additional information to support and clarify any information presented within the 2020 UWMP content.

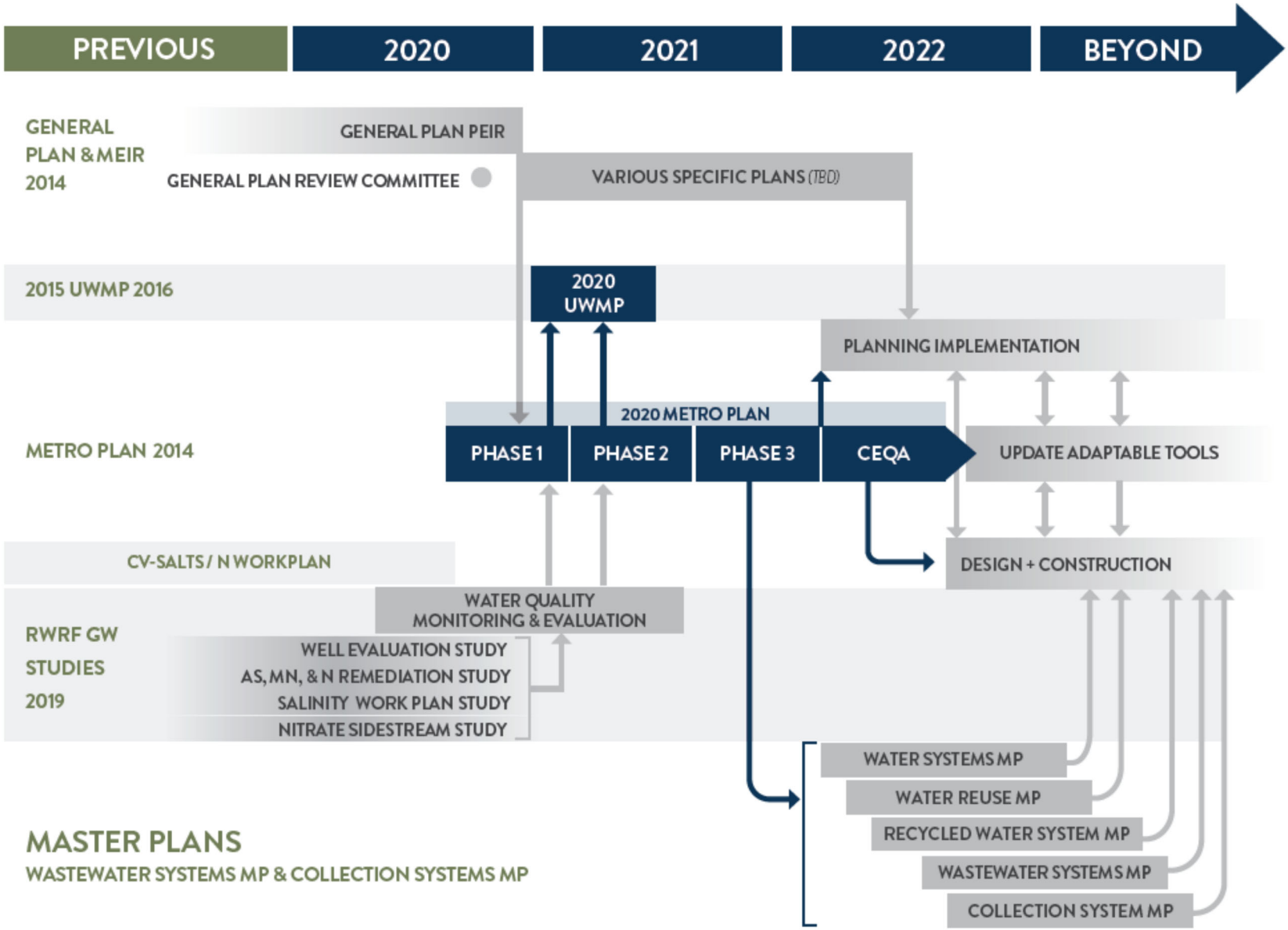
## 1.3 UWMPs in Relation to Other Efforts

The City previously prepared a 2005 UWMP, 2010 UWMP, and 2015 UWMP. This 2020 UWMP serves as an update to the 2015 UWMP and complies with new requirements and regulations. In addition to completing the 2020 UWMP, the City is presently updating its Fresno Metropolitan Water Resource Management Plan (Metro Plan). The last Metro Plan was completed in 2014, and the current Metro Plan update will prepare a fresh look at the City's water resources and consider new conditions and strategies for planning through 2070. **Figure 1-1** shows the City's ongoing and additional future water resources planning efforts.

## 1.4 Demonstration of Consistency with the Delta Plan

A new requirement for the 2020 UWMP is that agencies that anticipate participating in, or receiving water from, a proposed project utilizing Sacramento-San Joaquin Delta (Delta) Water or within the Jurisdiction of the Delta Stewardship Council (covered action) should demonstrate consistency with the Delta Plan's policy to reduce reliance on the Delta. Covered actions include, but are not limited to, projects such as multiyear water transfers, conveyance facilities, or new diversions that involve transferring water through, exporting water from, or using water in the Delta, per California Code of Regulations, Title 23, Section 5003. The City of Fresno contracts with the United States Bureau of Reclamation (USBR) Central Valley Project (CVP) Friant Division for an annual supply of 60,000 AF of Class 1 water. Although the Friant Division of the CVP does not directly divert or convey water from the Delta, the project was developed through an exchange with the Delta-Mendota supply. As restrictions on Delta exports have hindered USBR from making deliveries to the Delta-Mendota Canal, the Friant Division Class 1 allocations are reduced, and the water is transferred back to the users that would typically receive water from the Delta-Mendota Canal. As such, the City is required to demonstrate consistency with the Delta Plan's policy to reduce reliance on the Delta. **Appendix D** includes the reporting and calculations that demonstrate Fresno's reduced reliance on supply from their USBR CVP water supply.

**Figure 1-1. Previous and Ongoing Water Resources Planning Efforts**



# 2 CITY OF FRESNO
# Plan Preparation

**The City has coordinated the preparation of its 2020 UWMP with its water suppliers, the County, the City of Clovis, nearby water agencies, and community members to develop a UWMP that adheres to the requirements of the CWC and plans for a resilient water future.**

The City of Fresno provides water service to a variety of customer sector types within the City limits, inclusive of several historic County Waterworks Districts (county islands) which have been incorporated into the City's water system.

The City has approximately 139,500 service connections and produced just under 122,000 AF of potable water in 2020. The City meets the threshold identified in the CWC to be classified as an urban water supplier and in the California Health and Safety Code as a public water system. The City provides water directly to its customers and does not wholesale water to any other agencies for potable uses (defined as sales greater than 3,000 acre-feet per year). Therefore, the City is required to prepare and update a Retail UWMP every five years. This report was prepared on a calendar year basis.

IN THIS SECTION


- Coordination and Outreach

## 2.1 Coordination and Outreach

The City has water supply contracts with USBR and Fresno Irrigation District (FID). Each of these water suppliers has been notified of the plan update and provided water supply projections for the time period covered by this plan. Additionally, the preparation of this 2020 UWMP was coordinated with other appropriate agencies to ensure regional stakeholders had the opportunity to provide input to this plan. The City has coordinated preparation of the 2020 UWMP and solicited participation and comments with the agencies indicated in **Table 2-1**. The City has also published notices in local newspaper and encouraged the active involvement of the population within the water service area to provide feedback on the UWMP and the WSCP during the public review period, as discussed in **Section 10.1**.

**Table 2-1. Agency Coordination and Outreach**

| AGENCY | NOTIFIED 60 DAYS PRIOR TO PUBLIC HEARING | NOTIFIED OF PUBLIC DRAFT 14 DAYS PRIOR TO PUBLIC HEARING |
|---|---|---|
| Bakman Water Company | ✓ | ✓ |
| City of Clovis | ✓ | ✓ |
| County of Fresno | ✓ | ✓ |
| Fresno Irrigation District | ✓ | ✓ |
| Fresno Metropolitan Flood Control District | ✓ | ✓ |
| Friant Water Authority | ✓ | ✓ |
| Garfield Water District | ✓ | ✓ |
| Malaga County Water District | ✓ | ✓ |
| Pinedale County Water District | ✓ | ✓ |
| North Kings Groundwater Sustainability Agency | ✓ | ✓ |
| US Bureau of Reclamation | ✓ | ✓ |

# 3 CITY OF FRESNO System Description

**This chapter describes the history of the City's water system, its current service area, climate, population, and demographics.**

IN THIS SECTION

- Service Area
- Land Uses
- Water System
- Population and Demographics

The original Fresno water system began operations in 1876 as a non-profit organization inaugurated by a group of public-minded citizens. Initially, the water system consisted of one pumping station composed of small pumps and two storage tanks located above the second floor of one of the early store buildings. This building was located on Fresno Street between "J" and "K" Streets, presently known as Broadway and Fulton.

By 1888, the town had grown to a small city, which demanded an improved water distribution system. This was necessary because of several large fires, including the destruction of the first permanent courthouse. In 1888, the first pumping station and water tower were constructed at Fresno and "O" Street. These facilities were designed to be an integral part of a larger and continually expanding water system. This No. 1 station was in continuous use until 1959, when it was retired having served its useful purpose. Today, this building is known as the "Water Tower" and has been declared a historic structure.

Between the years of 1887 and 1890, 4-inch and 2½-inch cast iron pipe, as well as 4-inch wrought iron water mains were laid out. Most of these original “permanent pipes” have since been replaced in the present water supply system. The owner and operator of the system in 1888 was the Fresno Water Company. In 1904, the Fresno Water Company was purchased by Balch, Kerckhoff & Wishon, and was reorganized as the Fresno City Water Company. In 1926, the facilities were purchased by the California Water Service Company. This company then sold the water system to the City of Fresno in 1931, which operated as a municipal utility. It was first managed under an appointed water board, but currently is a division of the Department of Public Utilities.

Historically, the City’s supply of water consisted of direct pumping from wells drilled into the underground aquifer. Today, groundwater remains one of the City’s primary water supply sources, including 202 active and 56 inactive groundwater wells. The production capacity from the active wells is approximately 403 million gallons per day (mgd) and the total production capacity is 487 mgd, including inactive wells. The wells are located around the City to provide equitable distribution throughout the City’s water system, as described below. Most wells are connected directly into the transmission grid main system (14- to 20-inch diameter pipelines) to convey water throughout the system.

In the 1960s, the City secured a surface water contract made available from the United States Bureau of Reclamation (USBR). The City contracted with USBR for 60,000 acre-feet of water per year from the Friant Division (Millerton Lake) and developed a system to recharge the groundwater basin by “intentional recharge,” percolating the imported surface water supplies in constructed recharge basins. The City’s USBR supplies are conveyed to the City via FID canals. In 1976, the City signed a contract with FID for delivery of surface water supplies from the Kings River based on the City’s pro rata share of FID’s water entitlements. The Kings River water is used for groundwater recharge and treated for potable use.

In 2004, the City also began treating surface water supplies for direct potable use at its first surface water treatment facility located in northeast Fresno (NESWTF). For the period of 2005–2014, this 30 mgd-rated facility provided 10–15% of the City’s potable water supplies. From 2016–2020, this facility produced 15% of the City’s potable water supply, an increase largely attributed to transmission system improvements, which permitted conveying water further into the City’s distribution system, and the City’s lower overall system demands. Also, in 2015, the City commenced operations of its new T-3 Water Storage and modular Surface Water Treatment Facility (T-3 SWTF) in southeast Fresno. In January 2013, the City completed the installation of meters on all single-family residences.

In 2018, the City completed construction of its new 54 mgd surface water treatment facility in southeast Fresno (SESWTF) and large diameter water mains that serve nearly one-half of the City. Production from this facility may ultimately be 80 mgd with the City demonstrating to the Division of Drinking Water (DDW) that the facility is capable of safely running at higher filter loading rates. With the SESWTF operational, along with the NESWTF and T-3 SWTF, the City provided greater than 50% of its potable supply through using surface water for the first time in 2019 and 2020. The City expects to provide half or more of its potable demand using its surface water supply sources going forward.

# 3.1 Service Area

The City of Fresno presently covers approximately 115 square miles (sq mi) (73,500 acres) consisting largely of single-family residential, commercial, public, and industrial development. It also includes several areas not within the City limits (e.g., County islands), as shown in **Figure 3-1**. With the exception of the Bakman Water Company (Bakman), Pinedale County Water District (Pinedale), Park Van Ness Mutual Water Company (Park Van Ness), California State University Fresno (CSUF), and private groundwater users located within County islands, the City currently serves water to the entire area encompassed by its City limits and will eventually serve out to the Sphere of Influence (SOI) boundary. The SOI is coincident with the City of Fresno General Plan Land Use and Circulation Map, which was adopted in the 2014 General Plan and therefore, includes all lands planned to be annexed by the City at the projected 2056 buildout of the General Plan (City of Fresno Development and Resource Management Department, 2014).

## 3.1.1 Land Uses within Service Area

According to the General Plan and the City's Planning and Development Department, the City's planning area covers approximately 106,000 acres (165.6 sq mi) comprised of approximately 73,500 acres (115 sq mi) of incorporated land and 32,500 acres (50.8 sq mi) of unincorporated land based on the City's current shapefiles. The total 106,000-acre planning area includes approximately 84,300 acres of developed or planned to be developed land, approximately 18,500 acres of roads, highways, and railroads with no corresponding water demand, and about 2,500 acres outside of the SOI north of the City's most northwesterly portion referred to as the North Area and shown on **Figure 3-1**.

Of the 106,000 acres within the City's planning area, the City's water service area covers 70,400 acres (110 sq mi) of land within the SOI, which includes most of the 73,500 acres of incorporated area and the unincorporated County Islands not within the City limits. As shown in **Table 3-1**, approximately 59,100 acres of the 70,400 acres within the water service area are developed and served water by the City. The remainder consists of vacant land that will be served by the City when it is developed. Residential units make up the largest portion of water demand served by the City, consisting of over 40% of the total served area and almost 90% of the total service connections.

The remaining areas within the City's SOI are served by other systems or are unserved by a water system, consisting of open space and agricultural land, land used by roads, highways, and railroads, as well as the North Area.

**Table 3-1. Current Service Area Characteristics**

| LAND USE TYPE | AREA (ACRES) | % OF TOTAL AREA | SERVICE CONNECTIONS | % OF TOTAL CONNECTIONS |
|---|---|---|---|---|
| Single-Family Residential | 27,700 | 39.3% | 118,775 | 85.1% |
| Multifamily Residential | 3,700 | 5.3% | 6,087 | 4.4% |
| Commercial | 4,500 | 6.4% | 11,982 | 8.6% |
| Public | 5,600 | 8.0% | 2,504 | 1.8% |
| Industrial | 4,500 | 6.4% | 175 | 0.1% |
| Open Space/ Landscape Irrigation | 13,100 | 18.6% | Note 1 | |
| **Total** | **59,100** | | **139,523[2]** | **100%** |
| Vacant / Partially Vacant[3] | 11,300 | 15.9% | N/A | |
| **Total** | **70,400** | **100%** | | |

Source: Acreage from City of Fresno Geographic Information System Shapefile of Land Uses provided 8/12/20. Number of connections provided by the City for 2020.

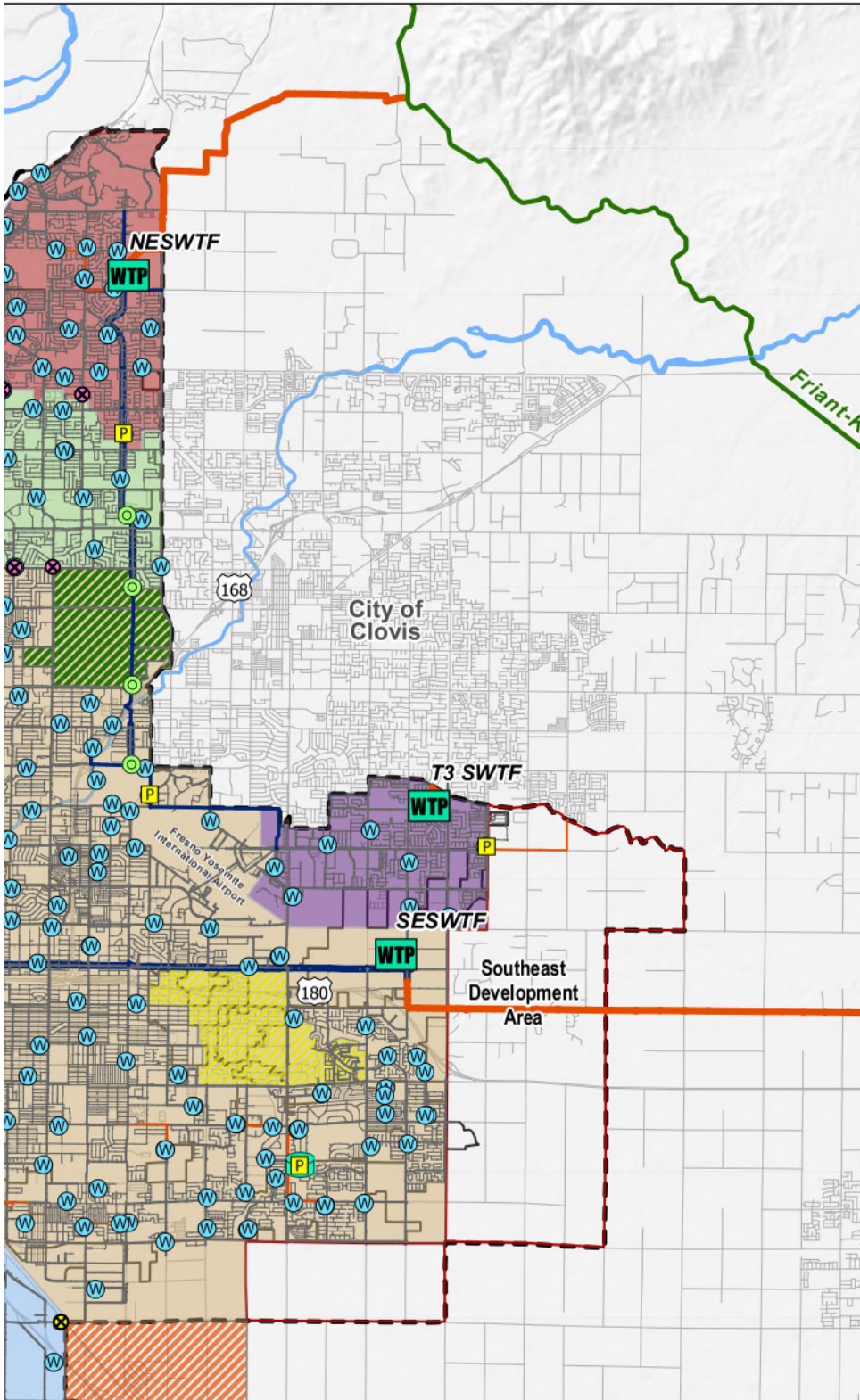
Notes:

1. Dedicated irrigation meters are included in commercial and public meter total.
2. Approximately 3,633 dedicated fire service connections are included in the total services connections, most of which are included in the commercial and public meter total.
3. For partially vacant land, half of the area is included in the zoned land use type and the other half is assumed vacant.

## 3.1.2 Water System

The City's water system consists of about 1,860 miles of distribution and transmission mains, 202 active municipal groundwater wells, three surface water treatment facilities (SWTFs) with current rated capacities ranging from 4 to 54 mgd, five water storage facilities with pump stations, including one at each of the SWTFs plus two in the distribution system, and three booster pump facilities.

The City's service area spans an approximate 120 feet of elevation difference, declining from northeast to southwest. To help regulate pressure throughout the water distribution system, the City utilizes five pressure zones, as shown on **Figure 3-2**: Highway 41, Shepherd, Sierra, Southwest, and Booster Pump 4 (BP04). The pressure zones are separated by a series of closed or partially closed valves between each zone to prevent or impede flow from one zone to the next, referred to as gate systems. There are four gate systems — Shepherd, Sierra, Southwest, and BP04 — separating the five pressures zones. The Highway 41 Pressure Zone was previously split into two pressure zones divided by a series of 26 gate valves closely following the alignment along Highway 41. However, these zones were combined into a single zone in 2015 by fully opening the Highway 41 gate valves, and as a result are not shown on **Figure 3-2**.


NESWTF
WTP
168
City of
Clovis
T3 SWTF
WTP
Fresno Yosemite
International Airport
SESWTF
WTP
180
Southeast
Development
Area

## 3.2 Service Area Climate

The City's service area is in California's San Joaquin Valley in Fresno County along Highway 99. The climate of the area is best described as Mediterranean, characterized by hot dry summers and cool winters. Precipitation in the area averages around 11 inches per year, as shown in **Table 3-2**. However, rainfall can significantly vary year to year, with over 18 inches received in 2011 and less than 4 inches received in 2014. The recent drought was marked by four consecutive years (2012 to 2015) of less than 10 inches of rainfall. As shown by the average evapotranspiration ($ET_o$) and temperature values in **Table 3-2**, the City's water use in the summer months is significantly higher than in the winter, reflecting increased water use for irrigation purposes during the hot, dry summers.

**Table 3-2. Average Climate Characteristics**

| MONTH | $ET_o$ (INCHES) | RAINFALL (INCHES) | TEMP-HIGH (°F) | TEMP-LOW (°F) |
|---|---|---|---|---|
| Jan | 1.17 | 2.33 | 56.9 | 37.4 |
| Feb | 1.98 | 1.8 | 62.6 | 39.8 |
| Mar | 3.73 | 1.99 | 68.4 | 43.6 |
| Apr | 5.43 | 0.99 | 73.7 | 46.9 |
| May | 7.33 | 0.54 | 81.3 | 53.2 |
| Jun | 8.41 | 0.19 | 89.6 | 59.1 |
| Jul | 8.8 | 0.02 | 95.7 | 63.8 |
| Aug | 7.82 | 0.01 | 94.6 | 62.5 |
| Sep | 5.69 | 0.07 | 89.6 | 57.9 |
| Oct | 3.68 | 0.59 | 79.3 | 49.3 |
| Nov | 1.85 | 0.98 | 66.2 | 40.6 |
| Dec | 1.10 | 1.83 | 56.5 | 36.1 |
| **Total/ Average** | **56.99** | **11.34** | **76.2** | **49.2** |

Source: CIMIS Website: http://www.cimis.water.ca.gov, Station 80 Fresno State (1988 to 2020) Monthly Average Report, October 2020 (downloaded November 30, 2020)

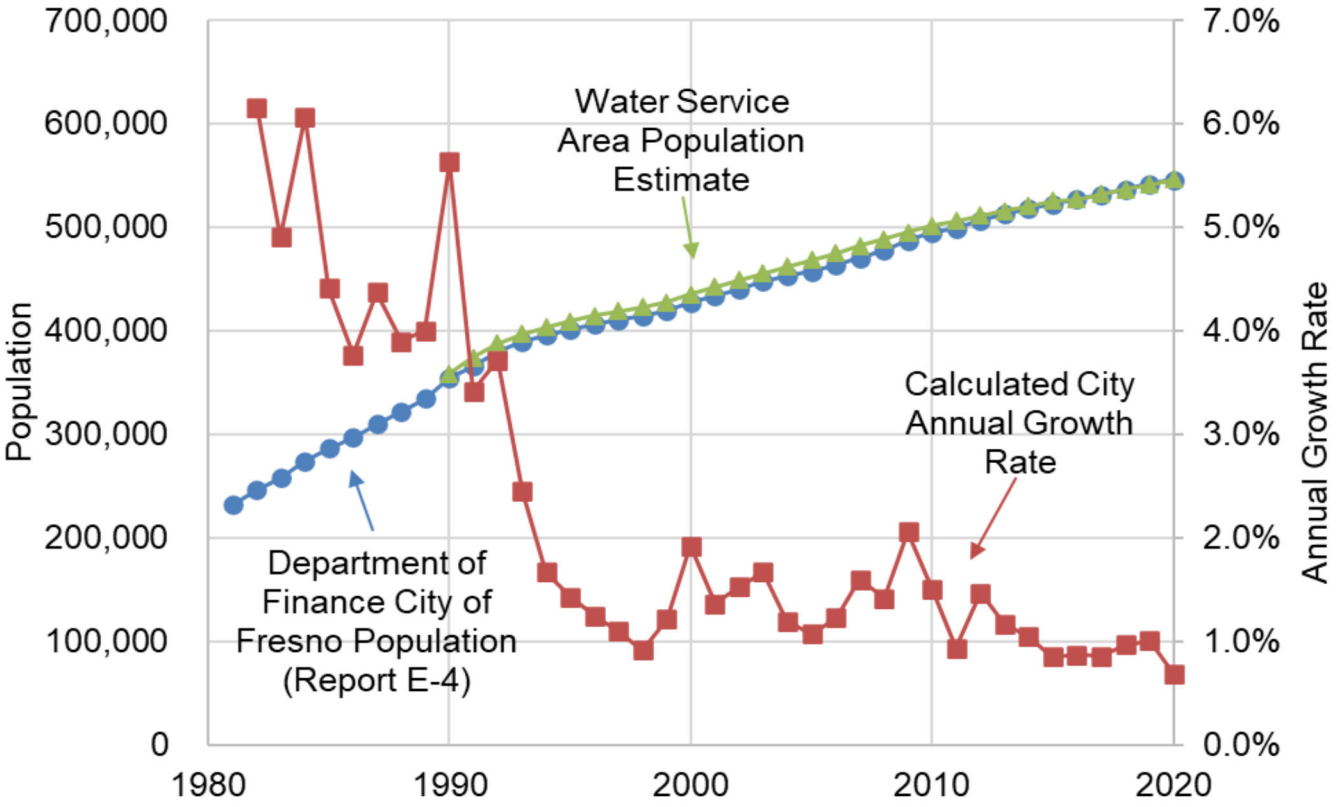
## 3.3 Service Area Population and Demographics

The City experienced rapid growth since it was founded by the Central Pacific Railroad in 1872 up through the mid-1990s, when the City's annual growth rate was typically greater than 2%. From 1995 to 2015, the annual growth rate has decreased to an average of 1.3%, and since 2015, the rate has not surpassed 1.0%.

The population served by the City Water Division is slightly higher than the City's population after adding unincorporated areas served by the City and removing areas within the City limits served by private water companies, special districts, or private wells. The City acquired County service areas and facilities in 1989, which increased the service area population to slightly greater than the City population since 1990.

**Figure 3-3** compares the historic City population to the water service area population since 1990. Water service area population estimates prior to 1990 were unavailable for comparison to the City's population. The City Water Division's methodology for calculating the population of the City's water service area involves summing all the Census tract data for the City's overall service area and subtracting out tracts not served by the City. These tracts included areas served by Pinedale, Bakman, and CSUF, as well as areas outside the City service area, unserved areas within County areas, unserved areas within City areas, and areas with only partial service (i.e., straddling City service areas). Based on the City's methodology, the water service area population was estimated to be 546,502 in 2020, compared to 545,769 for the total City population in January 2020 (California Department of Finance, 2020). For comparison, in the 2015 UWMP, the City Water Division population served was 525,575 compared to the total City population of 522,369 (California Department of Finance, 2020). The City's water service area population in 2020 using the DWR Population Tool is 550,217 and is similar to the population estimate using the City's methodology.

**Figure 3-3. City of Fresno and Water Service Area Historic Population**




The City's General Plan is the City's primary growth planning document from which the baseline water service area population projection for this UWMP was developed. The General Plan includes population estimates for the City planning area, which includes all areas within City limits and unincorporated areas outside of City limits within the City's SOI, based on projections developed by the Fresno Council of Governments and estimates a buildout population of 921,057 in 2056. In 2017 the Fresno Council of Governments developed population projections in 5-year increments through 2050 for all cities within Fresno County (Applied Development Economics, Inc. and Mintier Harnish Associates, 2017). The Fresno Council of Governments' 2017 report projects the City's population will grow at an annual growth rate ranging from 0.92–1.44%, with an average annual growth rate between 2020 and 2056 (buildout) of 1.03% per year. These population projections and growth rate have been incorporated in the City's General Plan population projections.

According to the City's Planning and Development Department, the City's water service area population is anticipated to continue to grow along with the City, with some slightly higher growth years anticipated within the next 10 years due to multiple large developments planned for completion in the near term. For planning purposes, this UWMP assumes the City will slowly incorporate areas served by others within the City's SOI by buildout in year 2056. As such, the long-term water service area population annual growth rate is expected to be 1.44% between 2020 and 2056 to account for absorbing these areas into the City's water system.

The baseline population projection starts with the 2020 water service area population determined using the DWR Population Tool and grows based on areas expected to be developed by 2030,

as provided by the City's Planning Department, and then linearly beyond 2030 to meet the buildout population in 2056. The City's 2020 population estimate includes the entire City planning area, including areas not served water by the City and areas currently outside the City limits but within the SOI, and is higher than the current water service area population. The water service area population projection assumes the City will incorporate all areas currently served by others and grow to provide water service to all areas within the SOI by buildout. Because the water service area has more growth potential than the City planning area, the annual average growth rate as calculated ranges from 1.1–2.1% between 2020 and 2056, with an average annual growth rate of approximately 1.56% between 2020 and 2045 that continues to slow through the buildout. **Table 3-3** shows the water service area population projections through 2045 in five-year increments.

**Table 3-3. Current and Projected Population (DWR 3-1R)**

| POPULATION SERVED | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| **TOTAL** | **550,217** | **609,433** | **674,677** | **719,327** | **765,278** | **812,529** |

## 3.3.1 Other Social, Economic, and Demographic Factors

Most recently, the City is experiencing significant impacts due to the global pandemic caused by COVID-19 (SARS-CoV-2) virus. In March 2020, the State issued a stay-at-home order that forced many businesses to close and other businesses to require residents to continue work only from their home to slow the spread of the virus. Additionally, the forced closure of several businesses caused a historic increase in unemployment across the US and a resulting economic recession. While all the impacts of COVID-19 are not entirely known at this time, it has caused a shift in water use by customer class. In 2020, residential demands increased by over 8% from 2019 demand, while commercial and industrial water use decreased by over 5%. This shift is expected to be temporary with an anticipated return to previous levels once all stay at home orders are lifted and businesses can reopen. However, the economic recession could have longer term impacts to the region.

# 4 CITY OF FRESNO
# Water Use Characterization

**This chapter describes and quantifies 2020 water use and projected water use through 2045 within the City's service area.**

Water consumption in the City is characterized by the typical demand sectors of residential, commercial, institutional, industrial, and irrigational. The difference between production and consumption is losses, which may be attributed to system leaks, meter inaccuracies, fire flows, theft, unmetered use, or other factors.

IN THIS SECTION

- Distribution System Water Losses
- Past and Current Water Use
- Projected Water Use

# 4.1 Non-Potable Versus Potable Water Use

The City serves its customers potable water for residential, commercial, institutional, industrial, and landscape irrigational demands through its potable water distribution system.

The City also diverts raw surface water obtained from the United States Bureau of Reclamation (USBR) and Fresno Irrigation District (FID) to recharge basins throughout the service area. The City coordinates with FID for the delivery of the recharge water, utilizing FID's existing system of channels and pipelines to convey the raw water, and with Fresno Metropolitan Flood Control District (FMFCD) to deliver water to FMFCD's stormwater retention and recharge basins or its own recharge basins. The raw surface water recharges the groundwater basin to sustain the groundwater supply for the City. The groundwater recharge volume can vary based on surface water supply availability and is represented as an addition to annual groundwater supplies as discussed in **Chapter 6**. In addition, the City serves a limited number of customers secondary treated or tertiary treated and disinfected recycled water for agricultural irrigation or landscape irrigation, respectively. The recycled water demands are discussed in **Section 6.4**.

# 4.2 Past, Current, and Projected Water Use by Sector

The following sections document the past and current water use for each sector, and the projected water use through 2045.

## 4.2.1 Water Use Sectors

Records of historical water consumption serve as the basis for developing water demands by water use sector. Water consumption is the volume of water measured at each metered service.

The City tracks water consumption across different water use sectors listed in the California Water Code (CWC), including:

- Single-Family Residential
- Multifamily Residential
- Commercial and Institutional / Governmental
- Industrial
- Landscape
- Distribution System Losses

In addition to the water uses listed in the CWC, the City participates in exchanges and transfers, provides temporary travel meters for temporary water use, and diverts non-potable surface supplies for groundwater recharge, described below. The City does not provide water for sales to other agencies, saline water intrusion barriers, or agricultural use.

### 4.2.1.1 Exchanges

Since 1976, the City has had a water exchange agreement with FID for delivery of the City's percolated wastewater effluent — considered equivalent to tertiary treatment — to FID canals. This is not counted as a water use in this chapter and is discussed as a water supply in **Section 6.6.1.2**.

#### 4.2.1.2 Other

A small, quantified water demand has been classified as “other” to account for temporary travel or construction meters for water used for dust control. This use type typically accounts for less than one percent of total water use.

### 4.2.2 Distribution System Water Losses

Real losses, as defined in the American Water Works Association (AWWA) Water Audit tool are:

“Physical water losses from the pressurized system (water mains and customer service connections) and the utility’s storage tanks, up to the point of customer consumption. In metered systems, this is the customer meter; in unmetered situations, this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks, and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks, and overflows.”

The past five years of distribution system losses are listed in **Table 4-1**, and the results of the 2016-2019 AWWA Water Audit Tool are provided in **Appendix E**. The AWWA Audit Worksheet was not completed for 2020 prior to the submittal of this plan, and the volume of water loss is estimated as the difference between water produced and metered water consumed for each calendar year period.

The overall consumption of water in the system is placed into four different categories:

- Billed Metered Usage
- Billed Unmetered Usage
- Unbilled Metered Usage
- Unbilled Unmetered Usage

The water losses for the system were found by determining the difference between the overall amount of water supplied to the community and the apparent system losses. The City’s system losses have many different possible causes such as hydrant flushing/testing, construction, firefighting, system leaks, water main breaks, and meter error. The estimated loss in 2020 is 9,568 acre-feet (AF), which is the difference between metered production and metered consumption and is approximately 8% of the overall system production. Based on the previous four years of audits, the City has not had to apply meter adjustments in the AWWA Water Audit Tool, and the water losses report is the difference between water produced and metered water consumed each year. It is anticipated that the estimated 2020 water loss volume in **Table 4-1** will be the water losses reported on the 2020 AWWA Audit when it is certified.

Currently, the City does not have a water loss standard but intends to evaluate programs to reduce water losses in their Metro Plan that is currently being updated. The City is also tracking forthcoming water use standards, which will include a water loss standard that is planned to be adopted by the Water Board within the next few years.

**Table 4-1. DWR 4-4R 12 Month Water Loss Audit Reporting**

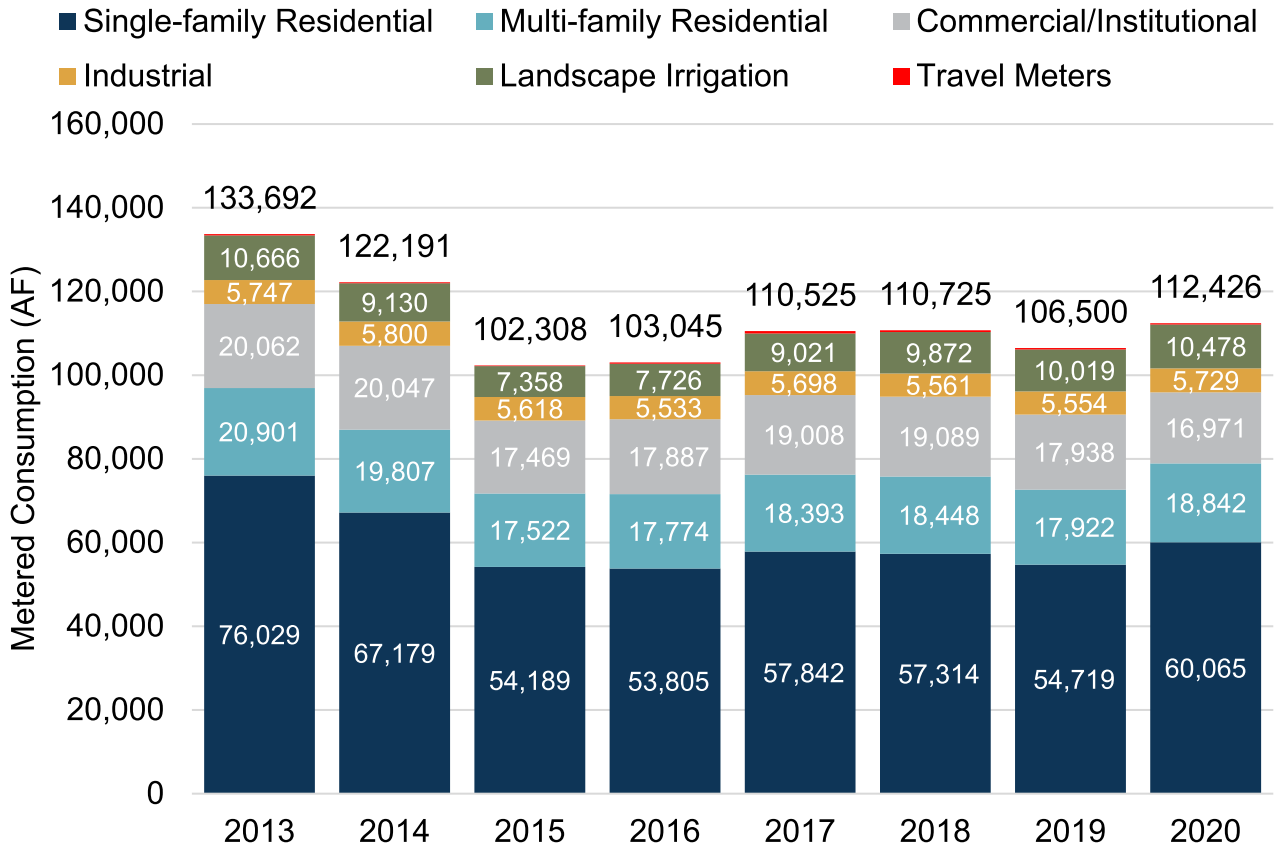
| REPORT PERIOD START DATE | | VOLUME OF WATER LOSS, AFY | PERCENT LOSS OF PRODUCTION |
|---|---|---|---|
| MM | YYYY | | |
| 1 | 2016 | 9,036 | 8.0% |
| 1 | 2017 | 10,235 | 8.5% |
| 1 | 2018 | 9,028 | 7.5% |
| 1 | 2019 | 9,059 | 7.8% |
| 1 | 2020 | 9,568 | 7.8% |

For 2016 through 2019, volume of water loss is taken from the AWWA Water Audit Tool. For 2020, the volume of water loss is the difference in metered production and metered consumption.

## 4.2.3 Past and Current Water Use

Since 2013, all water services in the City's water service area have been metered. Prior to 2013, the City estimated single-family residential water use, since these services were not equipped with meters, by subtracting all other metered uses (commercial, institutional, industrial, and irrigational), plus 10% assumed losses, from production data. Water consumption for the City's water service area by customer type for 2013–2020 is shown on **Figure 4-1**.

**Figure 4-1. Historical Consumption by Customer Type (2013–2020)**



As shown in the figure, single-family residential water use has decreased more than 20,000 AFY since the Single-Family Metering Program was completed in 2013. Multifamily residential, commercial, and institutional services have historically been metered, and consumption has also decreased since 2013, with industrial users and landscape irrigation consumption at similar levels to 2013 consumption, even as new customers are connected to the City's water system. Landscape irrigation demands did decrease in 2015 and 2016, likely due to the drought restrictions, and continue to recover after the drought ended in 2017.

**Table 4-2** provides the breakdown of actual water use by sector type in calendar year 2020. As shown in **Table 4-2**, single-family residential water use is the largest use type in the City and accounted for almost 50% of potable water use in 2020. Multifamily residential use was the second largest, accounting for approximately 15% of water sales in 2020. Together, residential water use accounts for about 65% of all potable water uses in the City's service area. The remaining potable water uses consist of mainly commercial and institutional water use, which are tracked together and included only on the commercial use row on **Table 4-2**, followed by landscape irrigation and industrial usage. Distribution losses accounted for approximately 8% of potable water used in 2020 (per **Section 4.2.2**).

**Table 4-2. Actual Demands for Water: Potable (DWR 4-1R)**

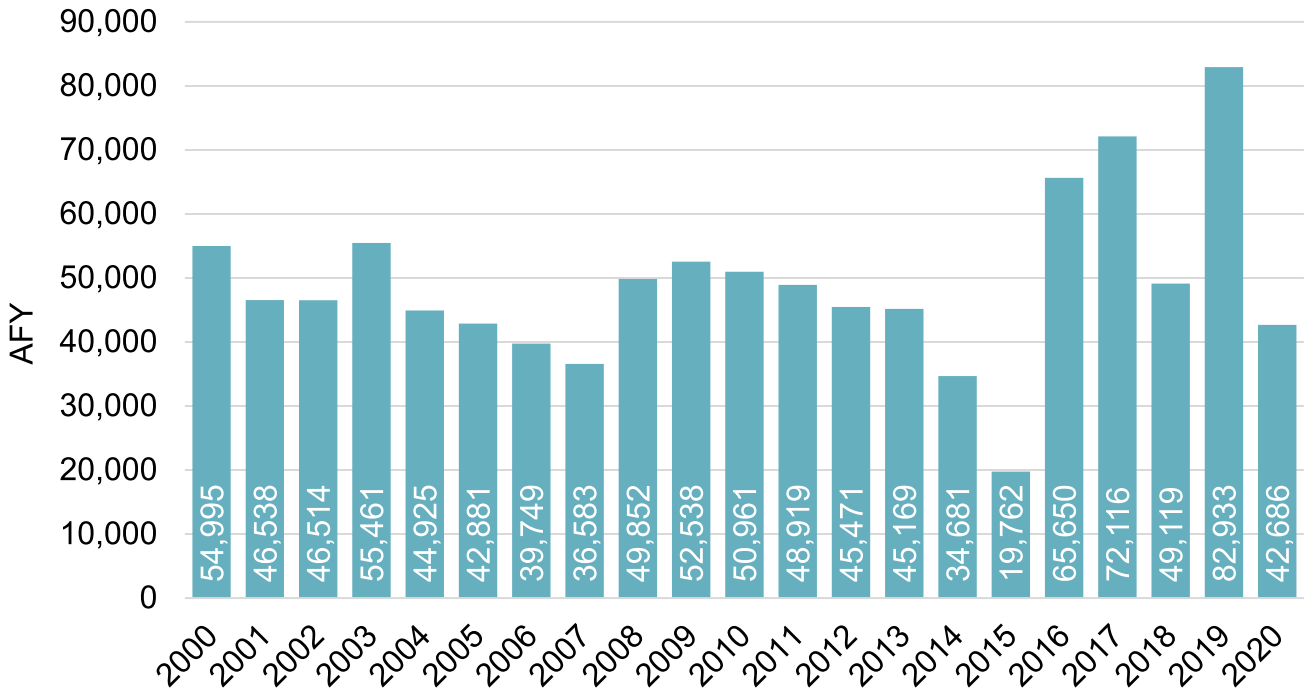
| USE TYPE | ADDITIONAL DESCRIPTION | LEVEL OF TREATMENT WHEN DELIVERED | 2020 VOLUME | PERCENT OF TOTAL |
|---|---|---|---|---|
| Single Family | | Drinking Water | 60,065 | 49.2% |
| Multi-Family | | Drinking Water | 18,842 | 15.4% |
| Commercial | | Drinking Water | 16,971 | 13.9% |
| Industrial | | Drinking Water | 5,729 | 4.7% |
| Institutional/ Governmental | See Note 1 | Drinking Water | --- | --- |
| Landscape | | Drinking Water | 10,478 | 8.6% |
| Other | Travel Meters | Drinking Water | 340 | 0.3% |
| Losses | | Drinking Water | 9,568 | 7.8% |
| **Total:** | | | **121,993** | **100%** |

Note:

1. Institutional and Governmental water usage is included in the Commercial use type.

**Figure 4-2** shows the historic volume of the City's raw surface water used for groundwater recharge since 2000. Over the last 20 years (2000–2020), the average annual intentional recharge of surface water was 49,240 AFY. Total recharge has ranged from a high of 82,900 AF in 2019 and a low of 19,700 AF in 2015. Also, total recharge volumes in 2016, 2017, and 2019 were three of the highest volumes in the last 20 years. The increases were due to over 30% increase in recharge at City basins from the addition of several basins (Nielsen, Fancher) and proactive maintenance of basins to maximize percolation capacity. The annual variability between years is caused by several factors, including basin availability, water delivery season, pond maintenance, or length of wet seasons.

**Figure 4-2. Historic Recharge of City Surface Water**




## 4.2.4 Projected Water Use

### 4.2.4.1 Land Use Projections

The potable demand projections through 2045 for normal water use follow the methodology for land use-based projections described in Appendix K of the 2020 Urban Water Management Plan (UWMP) Guidebook. Under this methodology, existing land use and demand is accounted separately from future land use and demand. This allows different demand factors to be applied to current land use areas and future land use areas. Future land use areas represent future customers and developments that are expected to be more water efficient than existing land uses and buildings due to the California Plumbing Code (CPC) and use of higher efficiency appliances and landscapes.

The existing and future land use acreage was sourced from the City's Geographic Information System (GIS) database and the City's General Plan. The existing land use shapefile and associated acreage for each land use classification were used to represent 2020 land use data. Areas not served by the City were excluded from the existing land use shapefile. The future land use shapefile corresponds with the planned land use at buildout as described in the City's General Plan representing the year 2056. Although the City does not have any plans to serve areas currently served by others within the City limits, all areas within the City Sphere of Influence (SOI) were assumed to be served by the City by buildout for conservative planning purposes. **Table 4-3** lists the land use acreage by land use category for the 2020 and buildout 2056 water service areas.

The land use acreage between 2020 and 2056 was estimated in 5-year increments based on areas planned to be developed by 2030 from the City's Planning Department, and by linearly interpolating the remainder of the change in acreage for each land use category between 2030 and 2056. **Figure 4-3** shows the existing and projected land use by customer class used to develop the projections.

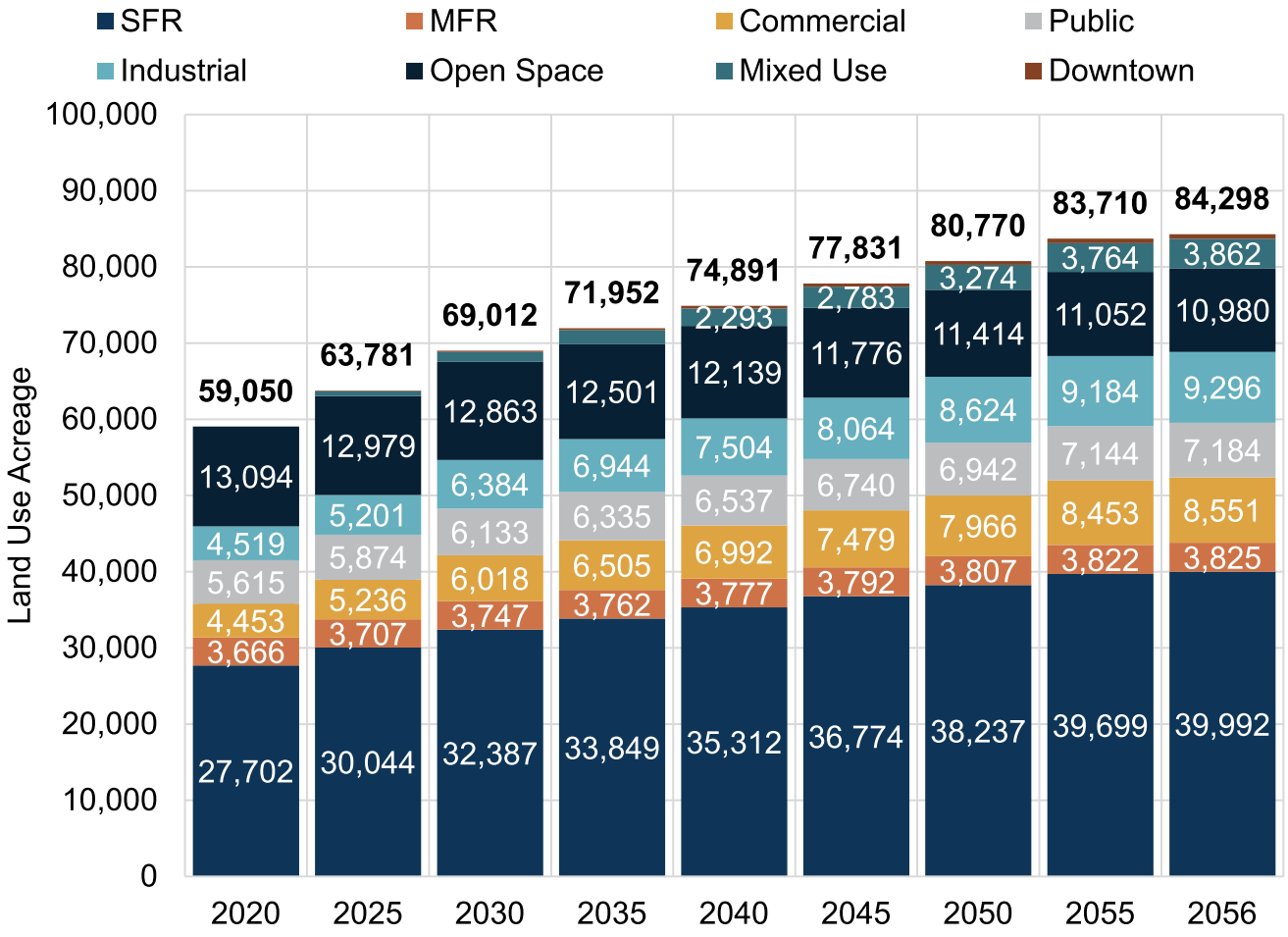
**Table 4-3. Existing and Future Water Service Area Acreage**

| LAND USE CATEGORY | 2020 WATER SERVICE AREA[1, 3, 4] | | 2056 WATER SERVICE AREA[2] | |
|---|---|---|---|---|
| | ACRES | PERCENT | ACRES | PERCENT |
| Single-Family Residential | 27,700 | 47% | 40,000 | 47% |
| Multifamily Residential | 3,700 | 6% | 3,800 | 5% |
| Commercial | 4,500 | 8% | 8,600 | 10% |
| Public Facility | 5,600 | 9% | 7,200 | 9% |
| Industrial | 4,500 | 8% | 9,300 | 11% |
| Open Space/ Landscape Irrigation | 13,100 | 22% | 11,000 | 13% |
| Mixed Use[3] | 0 | 0% | 3,900 | 5% |
| Downtown[3] | 0 | 0% | 600 | 1% |
| **TOTAL** | **59,100** | **100%** | **84,300** | **100%** |

Notes:

1. Acreage from City of Fresno GIS Shapefile of Land Uses provided 8/12/20 and reduced to the City's water service area (excludes Pinedale, Bakman, and California State University Fresno and unserved areas outside the City limit and SOI).
2. Future Land Use Shapefile provided by the City on 8/12/20 and aligns with the General Plan for buildout in year 2056. The buildout service area acreage listed excludes the Fresno-Clovis Regional Wastewater Reclamation Facility, land used for road, highways, and railroads, and the north area outside of the SOI.
3. Mixed use and downtown land use categories are not in the existing land use shapefile. They are described in the General Plan as new designations for redevelopment of existing areas that contain a mix of land uses.
4. Approximately 11,300 acres of non-water demanding vacant/partially vacant land is excluded from the 2020 water service area acreage.

**Figure 4-3. Existing and Projected Land Use**




Note: Acreage for Mixed-use and Downtown land use types are not shown every year for clarity, but are included in the total acreage value.

### 4.2.4.2 Demand Factors and Future Savings

Land use-based water demand factors were developed using 2018 metered consumption data matched to 72 categories of land use data. These demand factors were applied to the 2020 land use acreage by category to develop the demand projection beginning in 2020. Demand factors for land uses that grow over time and represent new developments were assigned a lower demand factor than the demand factors for existing development. Additionally, demand factors were assumed to slowly reduce over time due to passive conservation, which includes the replacement of older water fixtures and appliances with more efficient types now required as part of the CPC. The passive conservation savings are projected to be greater for existing customers than future customers because future customers are already assumed to have a lower water demand factor and meet the plumbing code.

Future savings due to passive conservation were developed using the Alliance for Water Efficiency (AWE) Water Conservation Tracking Tool. The Tracking Tool is an Excel tool that can

incorporate water service area-specific data to estimate natural replacement rates of fixtures and future savings based on the CPC.

**Table 4-4** lists the passive conservation savings assumption incorporated in the potable demand projections. Existing unit demand factors are reduced by the percentages listed to develop the future development unit demand factors. As shown in the table, this assumes future residential and non-residential dwelling units are 10% and 5% more water efficient, respectively, than existing dwelling units due to changes in the plumbing code and ever-increasing new water efficient technology. **Table 4-5** compares the total potable demand projections without the estimated savings due to passive conservation from 2025–2045.

**Table 4-4. Passive Conservation Savings Assumptions**

| LAND USE TYPE | FUTURE DEVELOPMENT UNIT DEMAND FACTOR REDUCTION[1] | EXISTING DEVELOPMENT ANNUAL PASSIVE CONSERVATION SAVINGS[2] | FUTURE DEVELOPMENT ANNUAL PASSIVE CONSERVATION SAVINGS[3] |
|---|---|---|---|
| Residential/Mixed Use | 10% | 0.20% per year | 0.04% per year |
| Commercial/Downtown | 5% | 0.05% per year | 0.01% per year |
| Public | 5% | 0.05% per year | 0.01% per year |
| Industrial | 5% | 0.05% per year | 0.01% per year |
| Open Space/ Landscape Irrigation | 0% | 0% per year | 0% per year |

Notes:

1. Existing (2020) unit demand factors are reduced by the percentages listed to develop the future development unit demand factors.
2. Existing development annual passive conservation savings were developed using the AWE Water Conservation Tracking Tool.
3. Future development passive conservation savings are assumed to be one-fifth the rate of existing development passive conservation savings.

**Table 4-5. Projected Future Savings for Potable Demands, AF**

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| Total Potable Demand with no conservation | 137,521 | 149,361 | 157,204 | 165,047 | 173,160 |
| Estimated Passive Conservation | 1,017 | 2,005 | 2,994 | 3,973 | 5,213 |
| **TOTAL POTABLE DEMAND WITH PASSIVE CONSERVATION** | **136,504** | **147,356** | **154,210** | **161,074** | **167,947** |

### 4.2.4.3 Demand Projections

**Table 4-6** provides the projected demands by use type based on the methodology described above. **Table 4-7** includes the projected raw surface water used for groundwater recharge through the planning period for normal years. The City intends to recharge an average of 60,000 AFY beyond 2020, corresponding with the average recharge volume from 2016 through 2020, and gradually increase recharge by about 540 AFY each year. In 2025, the normal year groundwater recharge is projected to be 62,700 AFY and will continue to increase to 73,500 AFY by 2045. The actual volume recharged is based on the available surface water supplies each year, as well as available basin capacity and other factors, and may be lower in dry years or higher in wet years.

**Table 4-6. Projected Demands for Water: Potable (DWR 4-2R)**

| USE TYPE | ADDITIONAL DESCRIPTION | PROJECTED WATER USE | | | | |
|---|---|---|---|---|---|---|
| | | 2025 | 2030 | 2035 | 2040 | 2045 |
| Single Family | | 76,255 | 80,429 | 82,934 | 85,437 | 87,936 |
| Multi-Family | | 19,000 | 20,654 | 21,737 | 22,831 | 23,935 |
| Commercial | | 19,052 | 21,135 | 22,587 | 24,041 | 25,496 |
| Industrial | | 7,410 | 9,003 | 9,922 | 10,841 | 11,758 |
| Institutional/ Governmental | See Note 1 | | | | | |
| Landscape | | 4,490 | 5,035 | 5,422 | 5,809 | 6,196 |
| Other | Travel Meters | 200 | 200 | 200 | 200 | 200 |
| Losses | | 10,097 | 10,900 | 11,408 | 11,917 | 12,426 |
| **TOTAL:** | | **136,504** | **147,356** | **154,210** | **161,076** | **167,947** |

Note 1: Institutional and Governmental water usage is included in the Commercial use type.

**Table 4-7. Projected Demands for Water: Non-Potable (DWR 4-2R)**

| USE TYPE | ADDITIONAL DESCRIPTION | PROJECTED WATER USE | | | | |
|---|---|---|---|---|---|---|
| | | 2025 | 2030 | 2035 | 2040 | 2045 |
| Groundwater Recharge | Raw-Water | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| **TOTAL:** | | **62,700** | **65,400** | **68,100** | **70,800** | **73,500** |

#### 4.2.4.4 Future Conservation

In 2018, following the unprecedented drought, California Legislature established a framework centered on "Making Water Conservation a California Way of Life." The goal was to help the State better prepare for droughts and climate change by establishing statewide water efficiency standards and incentivizing recycled water (California Department of Water Resources, State Water Resources Control Board, November 2018). The resulting legislation of Senate Bill 606 and Assembly Bill 1668, along with future regulations, will have impacts on water providers over the coming years, requiring indoor, outdoor, and commercial, industrial, and institutional water use goals, water loss standards, annual water budgets, and documented preparation for long-term water shortages. All the water use goals together will form a total urban water use objective specific for each water agency. The Department of Water Resources (DWR) has provided recommended standards for indoor residential water use, and other urban water use goals are currently being developed and are expected to be released in late 2021. The State Water Resources Control Board is anticipated to adopt the element that includes the total water use objective in 2022, and agencies will begin reporting their water use in accordance with their urban water use objective beginning in 2024, with compliance anticipated by 2027. Because most of the water use goals are unknown, and none has been adopted by the State, the City's total urban water use objective is unknown and was not incorporated into the demand projections herein. However, the City is tracking the water use efficiency standards and goals and is aware it may need to implement additional conservation above what is presented in these projections to meet its total urban water use objective as mandated by the State in the future. The City is considering these higher conservation demand projections within a demand envelope in the current Metro Plan update.

### 4.2.5 Characteristic Five-Year Water Use

A new component of the UWMP is to prepare a five-year drought risk assessment (DRA) to evaluate water service reliability for a drought lasting five years from 2021–2025. The five-year DRA assumes potable water demand is unconstrained, and the City will continue to meet all projected potable demands. The raw water demand varies based on the availability of surface water supplies for groundwater recharge. The recycled water supply is not impacted by the drought, and recycled water demands are at normal year projections for the five-year drought. Projected water demands for years 2021–2025 for the DRA are included in **Section 7.2**.

## 4.3 Water Use for Lower Income Households

The Fresno Council of Governments (COG) prepared an update to the Regional Housing Needs Allocation (RHNA) to cover the period of January 1, 2015–December 31, 2023. The City subsequently developed its own Housing Element based on the COG RHNA for the planning period of December 31, 2015–December 31, 2023. The City's current Housing Element was adopted on April 13, 2017.

The City's Housing Element specifies the City will develop 8,955 new housing units through 2023 for extremely low, very low, and low income levels (City of Fresno Development and Resource Management Department, 2017). The City's Planning and Development Department prepares Housing Element Annual Progress Reports to report the progress of the RHNA and housing goals. The City of Fresno 2019 Housing Element Annual Progress Report details that 909 lower income units are approved or permitted (City of Fresno Planning and Development Department,

2020). The remaining number of lower income units needed over the RHNA 2013–2023 period, when subtracting the approved and permitted units, is 8,046.

**Table 4-8** includes the Housing Element identified available single-family and multifamily acres to be developed and dwelling units for Extremely Low, Very Low, Low, Moderate, and Above Moderate income levels (City of Fresno Development and Resource Management Department, 2017). This data was used to determine the number of acres of both single-family and multifamily land use that needs to be developed by 2023 to meet the remaining 8,046 lower income units target for RHNA. The identified acres needed for low-income development by 2023 was applied to the average water demand factor for single-family and multifamily land uses to project the lower income water demands through 2023 to meet RHNA, shown in **Table 4-8**.

**Table 4-8. Lower Income Dwelling Units and Acres to be Developed through 2023 and Estimated Water Demand**

| FRESNO HOUSING ELEMENT | SINGLE-FAMILY RESIDENTIAL | MULTIFAMILY RESIDENTIAL | TOTAL |
|---|---|---|---|
| Acres Available for Low-Income Development | 3,163.6 | 1,310.9 | 4,474.5 |
| Total Dwelling Units | 13,457 | 21,526 | 34,983 |
| Dwelling Unit per Acre | 4.25 | 16.42 | |
| Dwelling Unit Needed to Meet RHNA | 3,095 | 4,951 | 8,046 |
| Acres to be developed to Meet RHNA | 727.6 | 301.5 | 1,029.1 |
| Average Water Demand Factor (AF/ Acre) | 2.54 | 5.13 | |
| Low-Income Demand to meet RHNA from years 2020 – 2023 (AF) | 1,847 | 1,545 | 3,392 |
| **Annual Low-Income Demand to meet RHNA (AFY)** | **462** | **386** | **848** |

Based on the estimated low-income water demand to meet the RHNA requirements by 2023, the annual projected low-income households demand is 462 AFY for single-family residential and 386 AFY for multifamily residential. For the purposes of this plan, the current RHNA projected low-income growth and water demands was applied through the UWMP planning period of 2045 and is presented in **Table 4-9**. However, lower income demands beyond 2023 will be based on the next Housing Element and RHNA Update expected in 2023 and may change in the future. All housing units and associated population are included in the adopted General Plan, and the demands for these units that occur within the water service area boundaries are included in the future water demands presented in this plan.

**Table 4-9. Lower Income Household Projected Water Demands**

| LOW INCOME DEMAND | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| Single-Family Residential Demand | 2,308 | 2,308 | 2,308 | 2,308 | 2,308 |
| Multifamily Residential Demand | 1,932 | 1,932 | 1,932 | 1,932 | 1,932 |
| **TOTAL (AF)** | **4,240** | **4,240** | **4,240** | **4,240** | **4,240** |

## 4.4 Climate Change Considerations

Climate change impacts were considered in the North Kings Groundwater Sustainability Plan (NKGSP) based on DWR's Guidance for Climate Change Data Use during Groundwater Sustainability Plan (Department of Water Resources, 2018) and the related Sustainable Groundwater Management Act climate change website.[1] As documented in the NKGSP, the DWR climate change datasets were developed for the California Water Commission's Water Storage Investment Program (WSIP), are consistent with other DWR programs, are based on the best available science, build on previous efforts, incorporate the latest advances in projections, and follow the Climate Change Technical Advisory Group guidance (Provost & Pritchard, November 2019).

Changing precipitation and evapotranspiration (ETo) rates are expected to have the greatest impact on future demands, especially for outdoor water use. The WSIP climate change data sets estimate minimal changes to precipitation due to climate change from the historic period. The same datasets predict the ETo rate estimates with climate change will increase 3% by 2030 and up to 8% by 2070. More specifically, the ETo rate is predicted to increase the most in typically low ETo months (winter) and when irrigation is limited. The ETo rate is also predicted to be only slightly higher than historic in warmer months during the irrigation season. While higher ETo rates would increase irrigation demands, they are not anticipated to substantially impact the City's urban water use. The climate change impacts to supply sources are discussed in the supply chapter of **Section 6.8.2.1**.

[1] https://data.cnra.ca.gov/dataset/sgma-climate-change-resources

CITY OF FRESNO

# 5 SBX7-7 Baseline, Targets and 2020 Compliance

**Senate Bill x 7-7 (SBx7-7) was signed into law in 2009 and requires the State to achieve a 20% reduction in per capita water use by December 31, 2020, with an interim target of 10% reduction by December 31, 2015.**

IN THIS SECTION

- Baselines & Targets
- 2020 Compliance

The legislation requires each urban water supplier to develop and include in its Urban Water Management Plans (UWMPs) estimates of: 1) *baseline* daily per capita water use; 2) daily per capita water use *target*; 3) daily per capita water use *interim target*; and 4) *compliance* daily per capita water use. The UWMP must also include the basis for determining the estimates, with references to supporting data.

The Department of Water Resources (DWR) developed the Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use Guidebook (GPCD Methodologies Guidebook) to provide appropriate methodologies and criteria guidance (California Department of Water Resources, Feb 2016).

The baseline and 2020 per capita water use targets were calculated in the 2015 UWMP and are provided in **Appendix C**. There have not been significant changes in the City's service area since 2015, thus the calculations included in the 2015 Plan are still valid for compliance in this 2020 UWMP.

## 5.1 General Requirements for Baseline and Target

Methodologies consistent with those described in the GPCD Methodologies Guidebook were used to develop baselines and targets. The selected procedure used to develop the required SBx7-7 estimates includes the following basic steps:

1. Calculate baseline water use, which is the average gross daily water use per capita, reported in gallons per capita per day (GPCD), based on gross water use and service area population for a continuous 10-year period ending no earlier than December 31, 2004.
2. Calculate urban water use target using one of the four methods described below.
3. Check and confirm the urban water use target using the five-year running average.
4. Calculate the interim urban water use target (equal to the average of the baseline and confirmed urban water use target).
5. Calculate the compliance daily per capita water use (equal to the gross daily water use per capita during the final year of the reporting period).

DWR allows the urban water supplier to choose one of four different methods to calculate the urban water use target in Step 2 above.

- **Method 1** involves calculating the target based on 80% of baseline daily per capita water use and the interim target based on 90% of the baseline daily per capita water use.
- **Method 2** involves calculating the per capita daily water use by using the sum of performance standards applied to indoor residential use, landscaped area water use, and commercial, industrial, and institutional uses.
- **Method 3** calculates the water use target as 95% of the applicable state hydrologic region target as stated in the draft 20x2020 Water Conservation Plan.
- **Method 4** is an approach developed by DWR that uses a spreadsheet to calculate estimated water savings factors to estimate targets.

The City selected Method 1 for determining its 2015 Interim and 2020 Final urban water use targets during the preparation of its 2010 UWMP. This selection was made after reviewing the four alternative methods available. Rather than duplicating the evaluation for this plan update, the reader is directed to Appendix I of the City's 2010 UWMP for details, as the previous City adopted evaluation is still applicable and results in the same target method selection.

## 5.2 Service Area Population

The City's 2020 service area population was estimated using the DWR Population Tool consistent with DWR Methodology 3 (Service Area Population) and the 2015 UWMP. Shapefiles of the City's water service area were loaded into the DWR Population Tool along with available residential service connection numbers to develop service area populations for the corresponding census years. The DWR Population Tool, provided in **Appendix F**, estimated the City's water service area population is 550,217. The DWR Population Tool provides a population based on the 2000 and 2010 census data and, published effective as of April 1 of the census year, the water service area during each census year and the number of water service connections. For the 2020 population, the number of services from December 31, 2020, was used, and the 550,217 population is estimated as of the end of 2020.

## 5.3 Gross Water Use

The City's gross water use is comprised of surface water contracted for delivery of allocated supplies from USBR and FID and groundwater produced by its municipal wells. The basis of gross water use are the meters installed at the City's North Fresno Wastewater Reclamation Facility, Southeast Surface Water Treatment Facility, and T-3 Water Storage and modular Surface Water Treatment Facility, and each of its municipal groundwater wells, which are equipped with flow meters. DWR Methodology 1 (gross water use) provides the opportunity to make adjustments and deductions in the reported gross water use for factors such as: meter errors, changes in distribution storage, indirect recycled water use, agricultural water use, and process water use. The City's gross water use has not been adjusted for any of these factors. Therefore, the total water use shown in **Table 4-2** is the City's gross water use.

## 5.4 Baselines and Target Summary

The City's 2015 UWMP reviewed and updated the 10-year and five-year Baseline Daily Per Capita Water Use and 2020 Target, included in **Table 5-1**. The continuous time period used in the 2015 UWMP for the 10-year baseline period is 1999–2008 and has an associated average daily per capita water use of 309 GPCD. The continuous time period that was used in the 2015 UWMP for the five-year target confirmation baseline period was 2003–2007, which has an associated average daily per capita water use of 304 GPCD. The confirmed 2020 target was established as a 20% reduction from the 10-year baseline per capita use and is 247 GPCD. Refer to **Chapter 5** of the City's 2015 UWMP for more information on how the baselines and targets were developed.

**Table 5-1. Per Capita Water Use Baseline and 2020 Target**

| BASELINE PERIOD | TIME PERIOD | AVERAGE BASELINE GPCD (GPCD) | CONFIRMED 2020 TARGET (GPCD) |
|---|---|---|---|
| 10 Year | 1999 – 2008 | 309 | 247 |
| 5 Year | 2003 – 2007 | 304 | |

## 5.5 2020 Compliance Daily Per-Capita Water Use (GPCD)

This section presents the procedure used to meet the requirements of SBx7-7 as defined in the Water Conservation Act of 2009 as incorporated into Division 6 of the California Water Code, commencing with Section 10608 of Part 2.55.

### 5.5.1 Meeting the 2020 Target

The determination of 2020 target compliance is based on gross water use for the 2020 calendar year, which was 121,993 acre-feet (see **Table 4-2**), and a service area population of 550,217 as of December 31, 2020 (see **Table 3-1**). The resultant actual per capita water use for the City in 2020 was 198 GPCD. As such, the City has met and exceeded the 2020 target of 247 GPCD.

The overall water usage patterns of the City have been greatly reduced due to its conservation measures and metering of all services. Prior to January 2013, nearly all of the City's single-family residential water customers had been billed on a monthly flat rate structure; they were unaware of the water they actually used and had no real incentive to conserve water. As of January 2013, the City has completed its residential water meter program, which installed approximately

113,000 water meters for single-family homes. With the completion of this program, all the City's water service connections are now metered, and the City and its customers can work more closely together to optimize water use. Since completion of the project, residential water demands have dramatically decreased. Attainment of the 2020 target has been influenced by the City's investments in metering and the proactive conservation education and outreach to customers. These factors have played a significant role in the City's ability to meet and surpass the 2020 target. In the future, the City will need to remain diligent in monitoring water use and continuing incentive programs to further reduce water consumption. These efforts are necessary so when the current strict reduction requirements are lifted, all water users remain diligent in avoiding unnecessary use of water and upgrade fixtures to eliminate water wasting.

## 5.5.2 2020 Adjustments to 2020 Gross Water Use

No extraordinary events or economic adjustments have taken place that would cause any adverse effects with regards to overall water usage. As was previously mentioned, the City did not make any adjustments to the 2020 gross water use as is permissible with Water Code 10608.24 cited above.

CITY OF FRESNO

# 6 Water Supply Characterization

**This chapter identifies and quantifies, to the extent practicable, the existing and planned sources of water supplies for the City through 2045.**

The City relies on groundwater from the North Kings Subbasin; surface water from Central Valley Project (CVP), through a contract with the United States Bureau of Reclamation (USBR); Kings River water, through a contract with Fresno Irrigation District (FID); and recycled water. This chapter also provides a discussion of supply availability and reliability under normal supply conditions (normal water year), during a single dry year, and for a drought lasting five years.

IN THIS SECTION


- Groundwater
- Surface Water
- Recycled Water
- Projected Water Supply


Water production in the City has consisted of 100% groundwater prior to the commissioning of the City's first surface water treatment facility (SWTF) in 2004. Since 2004, the City has invested in expanding its surface water treatment capabilities and now has three SWTFs that provide approximately half of all potable water demands in the service area.

# 6.1 Groundwater

The City overlies the Kings Subbasin, which is part of the greater San Joaquin Valley Groundwater Basin. The City is one of many water purveyors that use groundwater from the Kings Subbasin. The City has a network of over 270 municipal wells and currently operates approximately 202 municipal supply wells within the Kings Subbasin. Until late 2004, the City relied solely on groundwater to meet the water demands. The City's desire is to continue to use groundwater within a larger conjunctive use program that maximizes its existing water rights and surface water supply sources.

## 6.1.1 Basin Description

The Department of Water Resources (DWR) has partitioned the State into 10 major hydrologic regions (also referred to as "basins") and then further divided each basin into subbasins. The City is located in the Kings Subbasin (DWR Groundwater Subbasin Number 5-22.08) and lies within the larger San Joaquin Valley Groundwater Basin in the Central Valley of California. The Kings Subbasin covers approximately 1,530 square miles (sq mi).

### 6.1.1.1 Basin Location

The San Joaquin Valley Groundwater Basin is bounded to the north by the Sacramento-San Joaquin Delta and Sacramento Valley, to the east by the Sierra Nevada Mountains, to the south by the San Emigdio and Tehachapi Mountains, and to the west by the Coast Ranges. The Kings Subbasin, located within the southern half of the San Joaquin Valley Groundwater Basin, is bounded to the north by the San Joaquin River, to the east by the alluvium-granite rock interface of the Sierra Nevada foothills, to the south by the southern fork of the Kings River, and to the west by the Delta-Mendota and Westside Subbasins (California Department of Water Resources, January 2006). The Kings Subbasin is split into seven Groundwater Sustainability Agency (GSA) management areas, with Fresno located in the North Kings GSA. **Figure 6-1** illustrates the location of the City within the Kings Subbasin.

### 6.1.1.2 Area Geology

The upper several hundred feet of geology within the Kings Subbasin generally consists of highly permeable, coarse-grained deposits, which are termed older alluvium. **Figure 6-2** presents an idealized hydrogeologic cross-section that illustrates the general depth of various lithologic features within the Kings Subbasin, near the City.

Coarse-grained stream channel deposits, associated with deposits by the ancestral San Joaquin and Kings Rivers, underlie much of northwest Fresno (Layer 3 and 4 in **Figure 6-2**). There is a laterally extensive clay layer, at an average depth of approximately 250 feet below the ground surface, beneath most of the south and southeastern portions of the City.

Below the older alluvium, to depths ranging about 600–1,200 feet below ground surface, the finer-grained sediments of the tertiary-quaternary continental deposits are typically encountered (Layer 5 in **Figure 6-2**). Substantial groundwater has been produced and utilized from these depths by the City. However, deeper deposits located in the southeastern and northern portions of the City have produced less groundwater.

There are also reduced deposits in the northern and eastern portions of the City, at depths generally below 700 or 800 feet, which are associated with high concentrations of iron, manganese, arsenic, hydrogen sulfide, and methane gas. Groundwater at these depths does not generally provide a significant source for municipal supply wells.

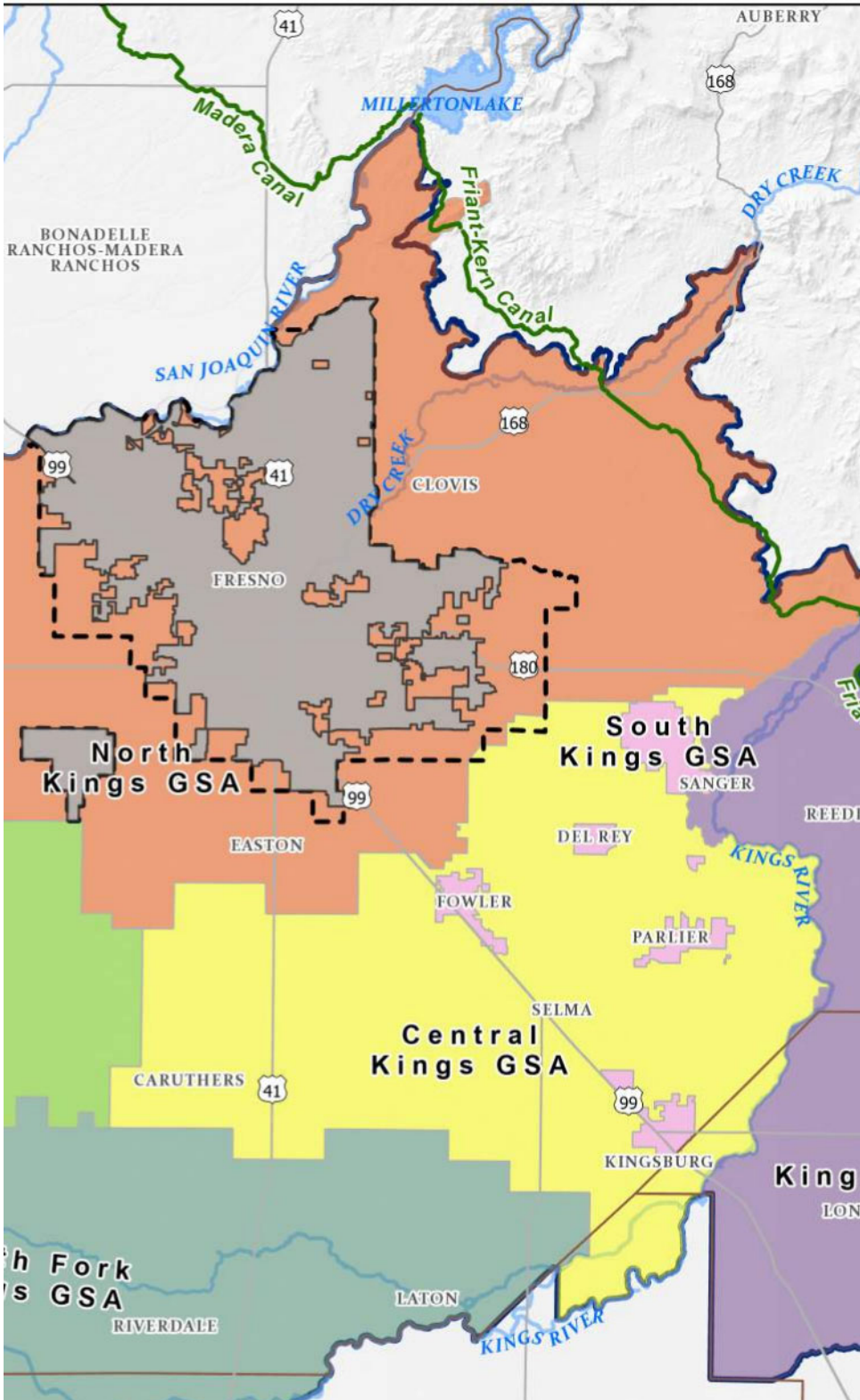
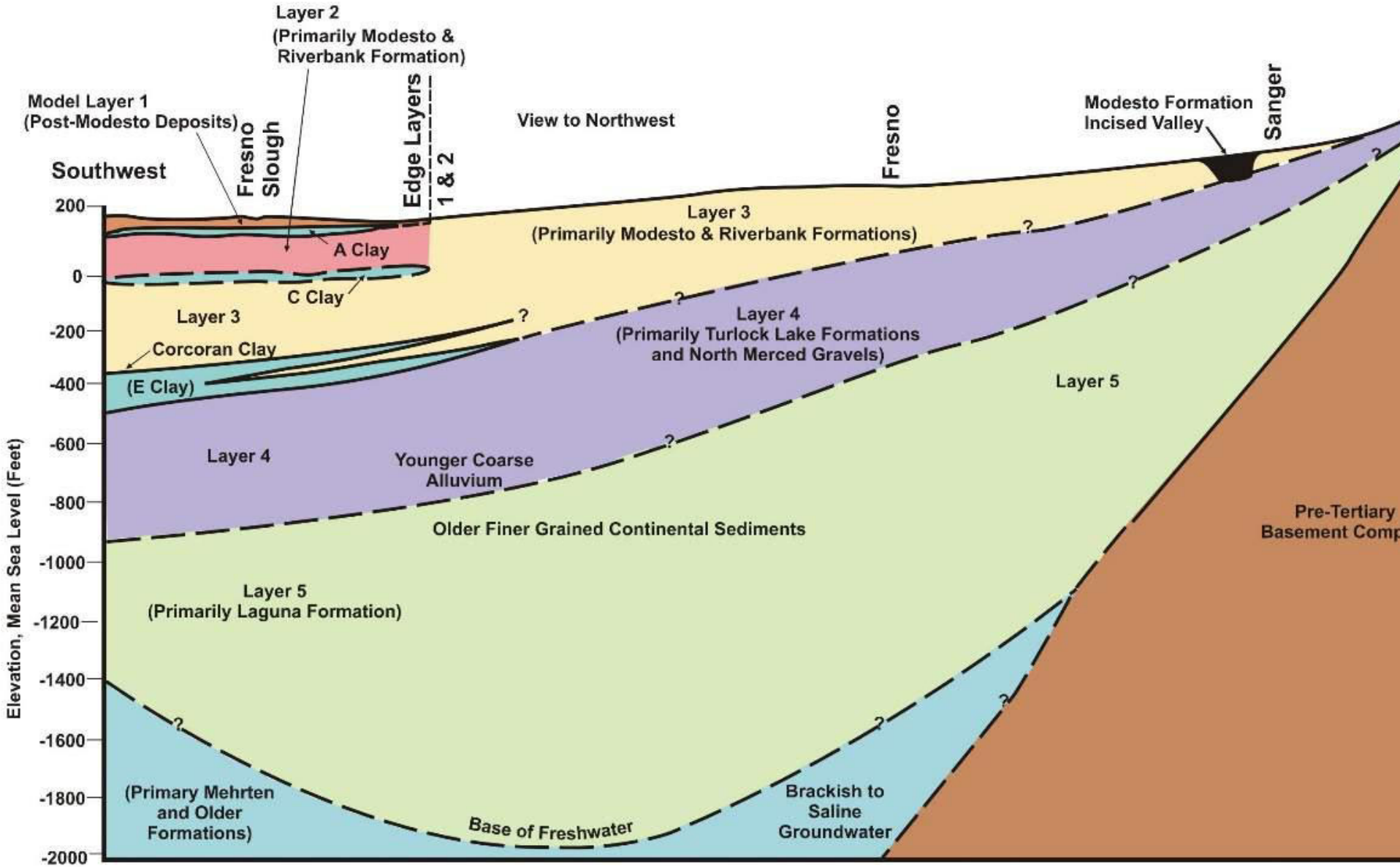

41
AUBERRY
168
MILLERTONLAKE
Madera Canal
Friant-Kern Canal
DRY CREEK
BONADELLE
RANCHOS-MADERA
RANCHOS
SAN JOAQUIN RIVER
168
99
41
DRY CREEK
CLOVIS
FRESNO
180
South
Kings GSA
North
Kings GSA
SANGER
99
DEL REY
EASTON
KINGS RIVER
FOWLER
PARLIER
SELMA
Central
Kings GSA
CARUTHERS
41
99
KINGSBURG
King
LON
h Fork
s GSA
RIVERDALE
LATON
KINGS RIVER

**Figure 6-2. Kings Groundwater Subbasin Conceptual Hydrogeologic Cross-Section, Southwest-Northeast**



#### 6.1.1.3 Aquifer Characteristics

The aquifer beneath the City was characterized using data compiled during aquifer tests performed at the City's production wells. As part of updating the detailed hydrogeologic evaluation, aquifer test data (pump tests) were reviewed to update the hydrogeologic analysis and evaluate the specific capacity data. The specific capacity indicates the ability of a particular well to produce water. **Figure 6-3** presents the estimated specific capacity of each active well from early 2020 pump test data. As shown in the figure, the northwestern and southwestern portions of the City have wells with higher specific capacities.

### 6.1.2 Groundwater Management

In 2014, a three-bill legislative package was signed into law, composed of Assembly Bill 1739, Senate Bill (SB) 1168, and SB 1319, collectively known as the Sustainable Groundwater Management Act (SGMA) of 2014, which is codified in Section 10720 et seq. of the California Water Code. This legislation created a statutory framework for groundwater management in California that can be sustained during the planning and implementation horizon without causing undesirable results. SGMA requires governments and water agencies of "critically overdrafted" basins to reach sustainability by 2040. The Kings Subbasin was designated a critically overdrafted basin in the DWR's Bulletin 118. The North Kings GSA is working within the SGMA framework to reach groundwater sustainability.

The City was a founding member of the North Kings GSA, which consists of the following public agencies and participating agencies:

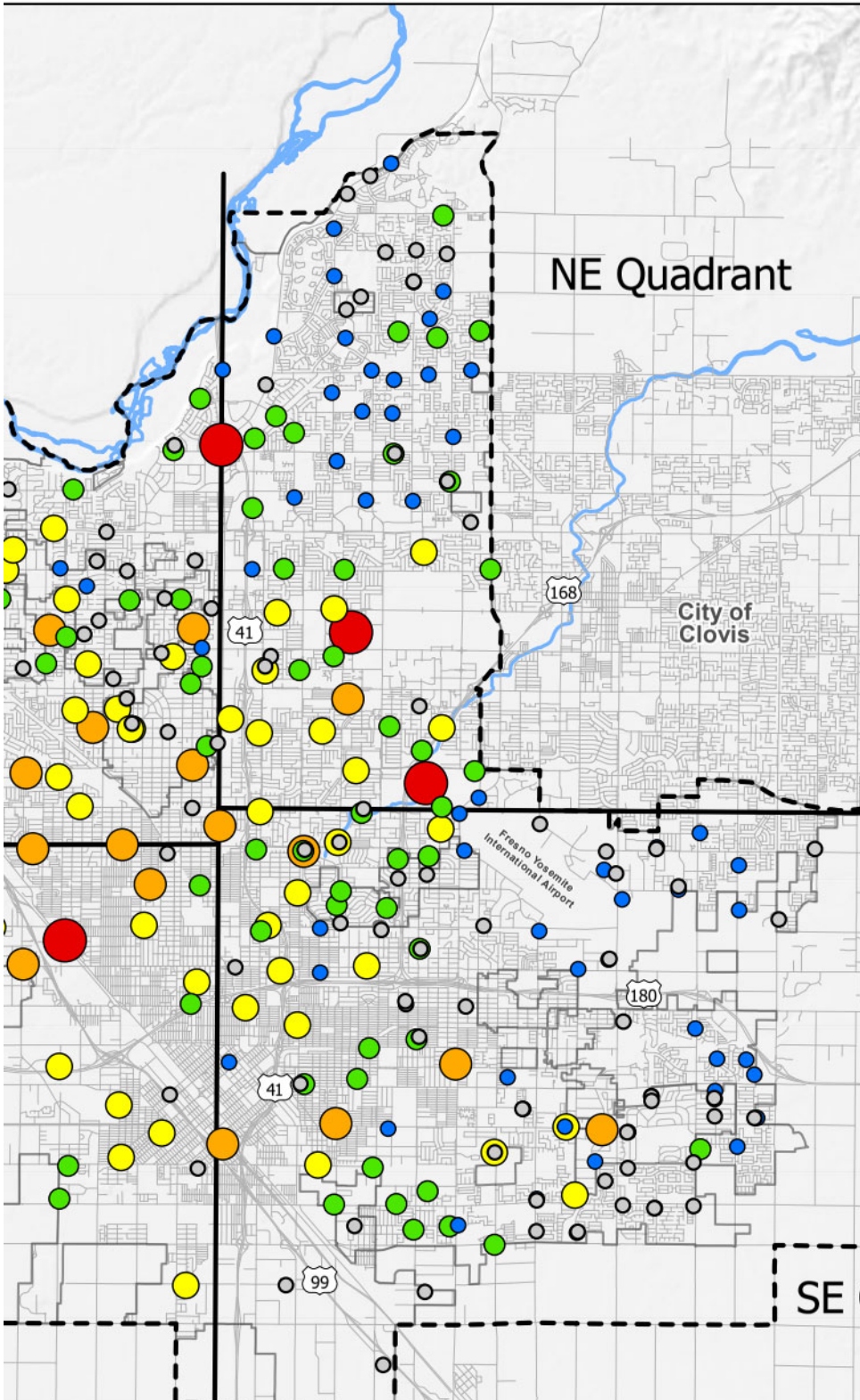
- Fresno Irrigation District (member)
- City of Fresno (member)
- City of Clovis (member)
- City of Kerman (member)
- County of Fresno (member)
- Bakman Water Company (participating agency)
- Biola Community Services District (member)
- Garfield Water District (member)
- International Water District (member)
- Fresno Metropolitan Flood Control District (participating agency)

The Kings Subbasin contains seven GSAs, including the North Kings GSA, as listed below and shown in Figure 6-1:

- Central Kings GSA
- James Irrigation District GSA
- Kings River East GSA
- McMullin Area GSA
- North Kings GSA
- North Fork Kings GSA
- South Kings GSA

The seven GSAs operate cooperatively across the basin via a coordination agreement that ensures common approaches to sustainability items such as similarity of data usage and methodologies, consistent interpretations of the basin setting, and common assumptions and development of water budgets, monitoring networks, sustainable management criteria and data management systems.

The North Kings GSA prepared and submitted its GSP in January 2020 (Provost & Pritchard, November 2019) and is awaiting DWR review by January 2022.


NE Quadrant
City of Clovis
Fresno Yosemite International Airport
168
41
180
41
99
SE

As required by SGMA, the North Kings considers six sustainability indicators:

- Chronic lowering of groundwater levels indicating significant and unreasonable depletion of supply
- Significant and unreasonable reduction of groundwater storage
- Significant and unreasonable seawater intrusion
- Significant and unreasonable degraded water quality
- Significant and unreasonable land subsidence
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

Each indicator has an identified undesirable result, measurable objective, and minimum threshold. The measurable objective and minimum threshold allow the North Kings GSA to evaluate their progress for the subject indicator and determine if conditions are improving, remaining stable or degrading. The sustainability indicators of primary concern within the City are groundwater levels, groundwater storage, and groundwater quality. The methodology for the water quality indicators has been developed and the methodology is still being developed for the groundwater levels and groundwater storage indicators. A copy of the GSP is provided in **Appendix G** of this UWMP[1].

## 6.1.3 Overdraft Conditions

SGMA directs DWR to identify groundwater basins and subbasins in conditions of critical overdraft. As defined by SGMA, "A basin is subject to critical overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts." As mentioned, DWR classifies the Kings Basin as being in a state of critical overdraft in its Bulletin 118, and the future of the groundwater basin has been projected to see continued overdraft conditions.

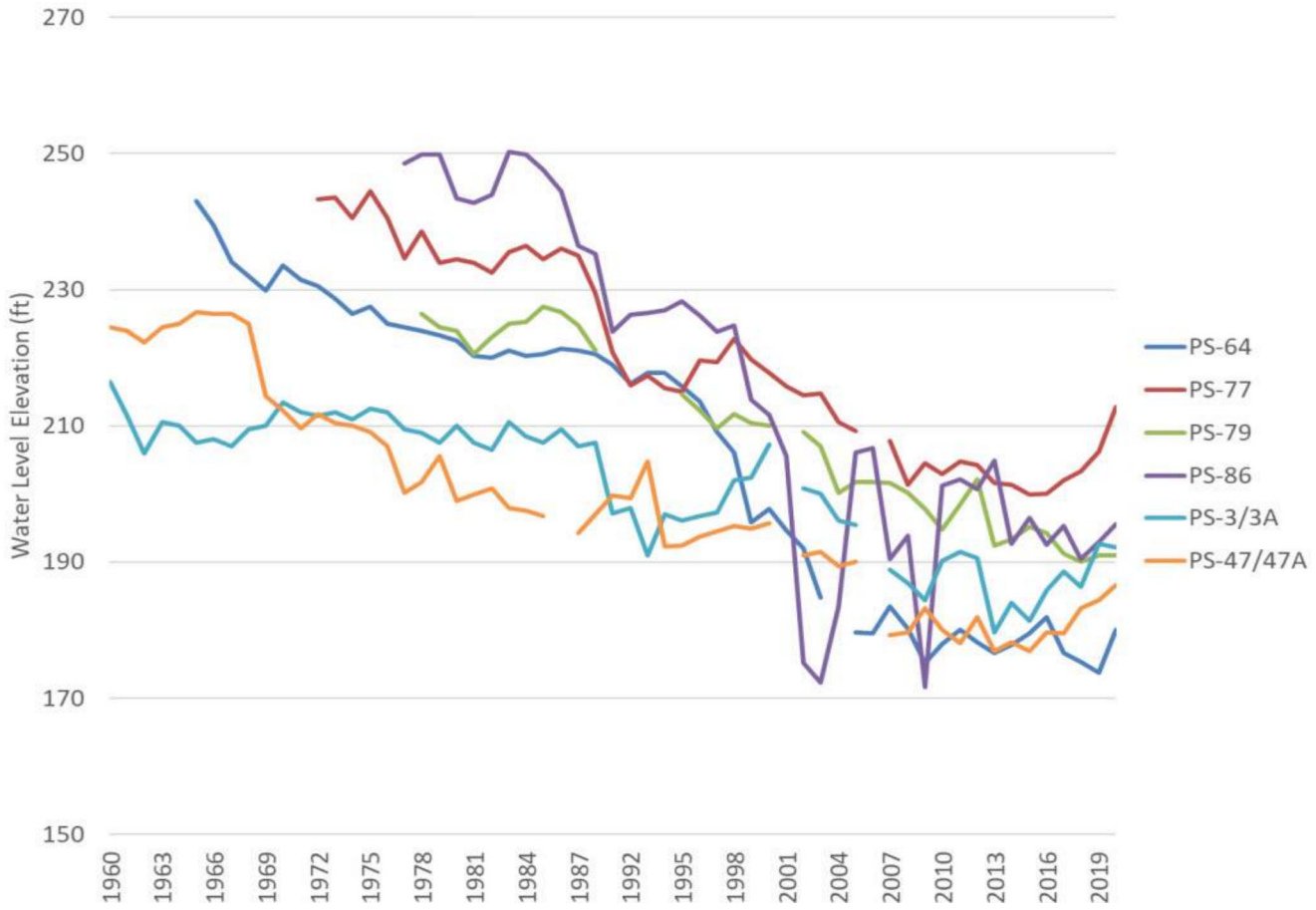
The Kings Subbasin groundwater aquifer supplies the City, other municipalities, agriculture, and rural residential areas with a consistent source of water. Like much of the Kings Subbasin, groundwater levels beneath the City were relatively shallow at 25 feet below ground surface in 1940, prior to the start of World War II (Fresno City Water, Engineering Department, 1940). After the war, the State, including the City, began growing at a rapid rate. For the period from 1959 to 1968 it was reported groundwater levels declined at a rate of 2.8 feet per year (John Carollo Engineers, 1969). The City continued to rely on the groundwater aquifer for decades, monitoring groundwater levels continuously. Groundwater levels since 1990 have declined at a lower rate than previously. Rates of decline slowed further starting in 2004 when the Northeast Surface Water Treatment Facility (NESWTF) started operations and the City renewed focus on increasing groundwater recharge. In 2019 and 2020, surface water accounted for more than half of the total water supply in the City. With the reduced pumping due to higher reliance of surface water, the groundwater levels have begun to increase in certain areas of the City in the last few years. **Figure 6-4** provides a depiction of the City's depth to groundwater for six representative wells across the Sphere of Influence (SOI) since 1960.

The City expects to continue to operate its three SWTFs and pump groundwater at a lower rate than historically so that the groundwater basin can recover. One of the primary objectives for the City as described in its current Metro Plan is to maximize the use of available surface water

[1] Available at https://www.northkingsgsa.org/groundwater-sustainability-plan/

treatment supplies to reduce overall reliance on groundwater. Additionally, as described in **Chapter 4**, the City plans to continue their groundwater recharge program to protect the groundwater basin. **Figure 6-5** shows the active and proposed recharge basins and FID Canals the City utilizes as part of groundwater recharge program.

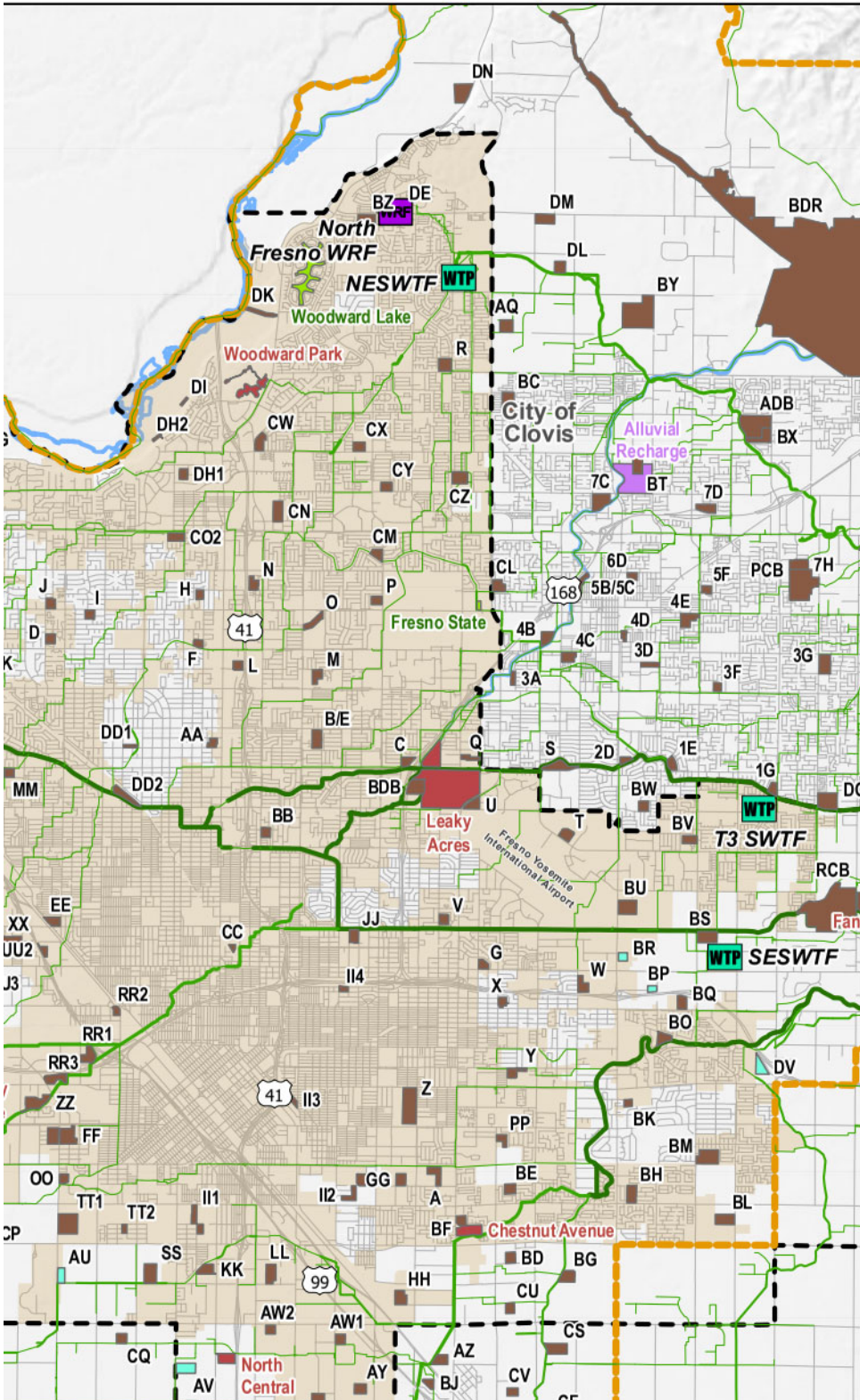
**Figure 6-4. Time Series of Groundwater Levels at Representative Wells**




## 6.1.4 Groundwater Quality

Groundwater within the North Kings Subbasin generally meets primary and secondary drinking water standards for municipal water use and is described as being bicarbonate type water, including calcium, magnesium, and sodium as the dominant ions (California Department of Water Resources, January 2006). Total dissolved solids (TDS) concentrations rarely exceed 600 mg/L and range from 200 to 700 mg/L (California Department of Water Resources, January 2006). However, the groundwater basin has been impacted by multiple chemical contaminants that affect the City's ability to fully utilize the groundwater basin resources without some type of wellhead treatment in certain areas.

**Figure 6-6** presents the general location of regional plumes and major point sources within the City. The primary contaminants are nitrate, 1,2-dibromo-3-chloropropane (DBCP), 1,2,3-trichloropropane (1,2,3-TCP), and other volatile organic compounds like trichloroethylene (TCE) and and perchloroethylene (PCE). The City has received settlements in a number of lawsuits related to these contaminants and has constructed wellhead treatment systems and implemented blending plans for a number of wells.



North Fresno WRF
NESWTF
WTP
Woodward Lake
Woodward Park
City of Clovis
Alluvial Recharge
Fresno State
Leaky Acres
Fresno Yosemite International Airport
T3 SWTF
SESWTF
Chestnut Avenue
North Central
DN
BZ
DE
DM
BDR
DL
BY
DK
AQ
R
BC
DI
DH2
CW
CX
ADB
BX
DH1
CY
CZ
7C
BT
7D
CN
CO2
CM
CL
6D
5F
PCB
7H
J
I
H
N
O
P
168
5B/5C
4E
D
41
4B
4C
4D
3D
3G
F
L
M
3A
3F
B/E
DD1
AA
C
Q
S
2D
1E
1G
MM
DD2
BDB
BW
BB
U
T
BV
RCB
EE
BU
XX
JJ
V
BS
CC
G
BR
W
BP
II4
X
BQ
RR2
BO
RR1
RR3
Y
DV
ZZ
II3
Z
FF
PP
BK
BM
OO
GG
BE
BH
TT1
TT2
II1
II2
A
BL
BF
AU
SS
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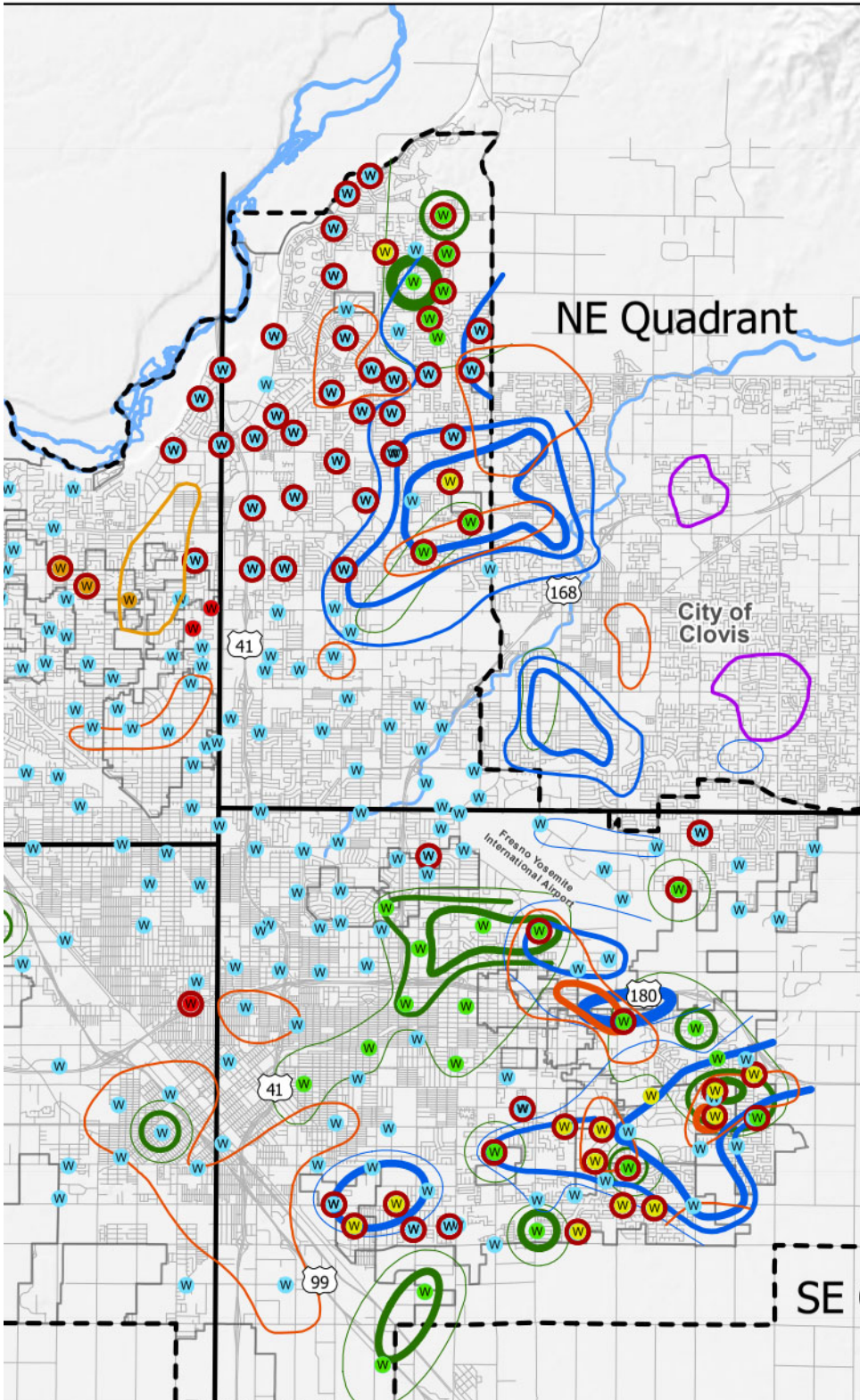
BD
BG
KK
99
HH
CU
AW2
AW1
CS
CQ
AZ
AY
BJ
CV
AV


NE Quadrant
City of Clovis
168
41
180
41
99
SE
Fresno Yosemite International Airport

Approximately 40 City wells are being treated for contaminants such as PCE, DBCP, TCE, 1,2,3-TCP, perfluorooctanoic acid, perfluorooctanesulfonic acid, ethylene dibromide, and nitrate, and an additional 20 wells include treatment for iron, manganese, and hydrogen sulfide removal or corrosion control.

As shown in the figure, extensive groundwater contamination nearly covers the City's entire water service area; only areas located in the northwest appear to be relatively unaffected by regional groundwater contamination. Also, many of the City's wells are impacted by one or more of the contaminant plumes (indicated by the presence of overlapping plumes on the figure). The figure also shows the approximately 93 existing active wells that are impacted by at least one contaminant plume and the 60 existing wells with wellhead treatment. The City is also managing contamination from spreading by pumping specific wells to control the plumes.

## 6.1.5 Estimated Groundwater Yield

As part of the ongoing Metro Plan update, the City is developing a storage accounting framework to estimate groundwater yield. The storage framework will track the City's groundwater recharge, pumping, and flows into and out of the City's SOI and incorporate bi-annual monitoring well water level readings on a grid basis. This work is ongoing, and the City reserves the right to update this analysis with more recent data when available.

Currently, the best available information on the City's groundwater yield is from a hydrologic groundwater and surface water model that was prepared for the Upper Kings Basin Integrated Regional Water Management Authority. The City contributed additional funding to the effort so the model would be more refined for its service area and capable of assisting in the development of the City's previous Metro Plan. The Kings Basin Integrated Groundwater and Surface Water Model (IGSM) was completed in 2007 and provided outputs specific to the City SOI (WRIME, 2007). The IGSM was developed and calibrated utilizing data for the period of 1964–2004. Building off the calibrated IGSM, additional modeling was conducted in 2008 to evaluate the City's proposed water supply plan and its ability to attain the balanced use of groundwater by the buildout year of 2025. The estimated groundwater yield within the City's SOI presented in this section is based on the modeling efforts to establish the various natural elements of the underlying aquifer.

### 6.1.5.1 Natural Recharge

As a result of the IGSM effort, the long-term average deep percolation from rainfall and irrigation-applied water for the period of 1964–2004 was found to be 42,700 acre-feet per year (AFY) for the entire SOI (West Yost Associates, January 2014). However, as urbanization continues within the SOI, the amount of deep percolation will decline because of increased runoff and less open land for natural recharge. For 2005, it was estimated deep percolation would be about 37,000 AFY and would reduce annually, ultimately declining to and remaining at 27,000 AFY by buildout in 2025. The new General Plan now anticipates SOI buildout will occur in 2056. Holding the 2005 value of 37,000 AFY and extending the 27,000 AFY to 2056, intermediate values were straight-line interpolated. Additionally, the City currently covers 73,500 acres of the 100,277 acres within its SOI, representing 73% urbanization, which would approximate the City's water system service area. **Table 6-1** shows estimated natural recharge through 2045.

### 6.1.5.2 Net Subsurface Inflow

Again, utilizing information developed from the IGSM, average net subsurface inflow into the SOI was characterized as being 64,800 AF annually for the period of 1964–2004. Applying the

previously described 73% proportioning factor of the developed SOI area to overall SOI area, approximately 47,510 AFY would be attributed to the City's water service area in 2020. This value will increase in future years as the City annexes more land until the SOI is built out. **Table 6-1** shows the estimated subsurface inflows for future years based on the land use growth presented in **Figure 4-3**. The City has historically benefitted from the net subsurface inflows and requires these flows for replenishment necessary to maintain the sustainable yield of the groundwater aquifer system.

### 6.1.5.3 Intentional Groundwater Recharge

The City has long made efforts toward offsetting the decline of groundwater levels and minimizing overdraft conditions through an active intentional recharge program that started in 1971 (CH2MHill, 1992). Through cooperative agreements with Fresno Metropolitan Flood Control District (FMFCD) and FID, the City has access to not only City-owned basins, but also those of these two agencies. Utilizing available surface water supplies, the City recharged on average approximately 60,000 AFY from 2000–2019; however, with the reduction in available surface water supplies, intentional recharge declined to 34,700 AF in 2014 and 19,800 AF in 2015, followed by an increase in recharge in years 2016, 2017, and 2019 to help replenish the aquifer. In 2019, City recharge of 82,993 AF was the maximum annual recharge attained during this period. The City has averaged over 60,000 AFY the previous five years and plans to gradually increase recharge by about 540 AFY each year. However, during wet years the City will recharge more water when it is available to allow to the City to draw on additional groundwater during dry years when surface water is not available. Intentional recharge is included in the non-potable demand projections as well as contributing to the estimated groundwater yield presented in **Table 6-1**.

**Table 6-1. Components to Groundwater Yield for Normal Years**

| | QUANTITY (AFY) | | | | | |
|---|---|---|---|---|---|---|
| **GROUNDWATER COMPONENT** | **2020** | **2025** | **2030** | **2035** | **2040** | **2045** |
| Natural Recharge[1] | 24,970 | 25,480 | 25,910 | 26,280 | 26,570 | 26,790 |
| Net Subsurface Inflow[1] | 47,510 | 49,910 | 52,320 | 54,720 | 57,120 | 59,530 |
| **SUSTAINABLE YIELD** | **72,480** | **75,390** | **78,230** | **81,000** | **83,690** | **86,320** |
| Intentional Recharge[2] | 60,000 | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| **TOTAL ESTIMATED GROUNDWATER YIELD** | **132,480** | **138,090** | **143,630** | **149,100** | **154,490** | **159,820** |

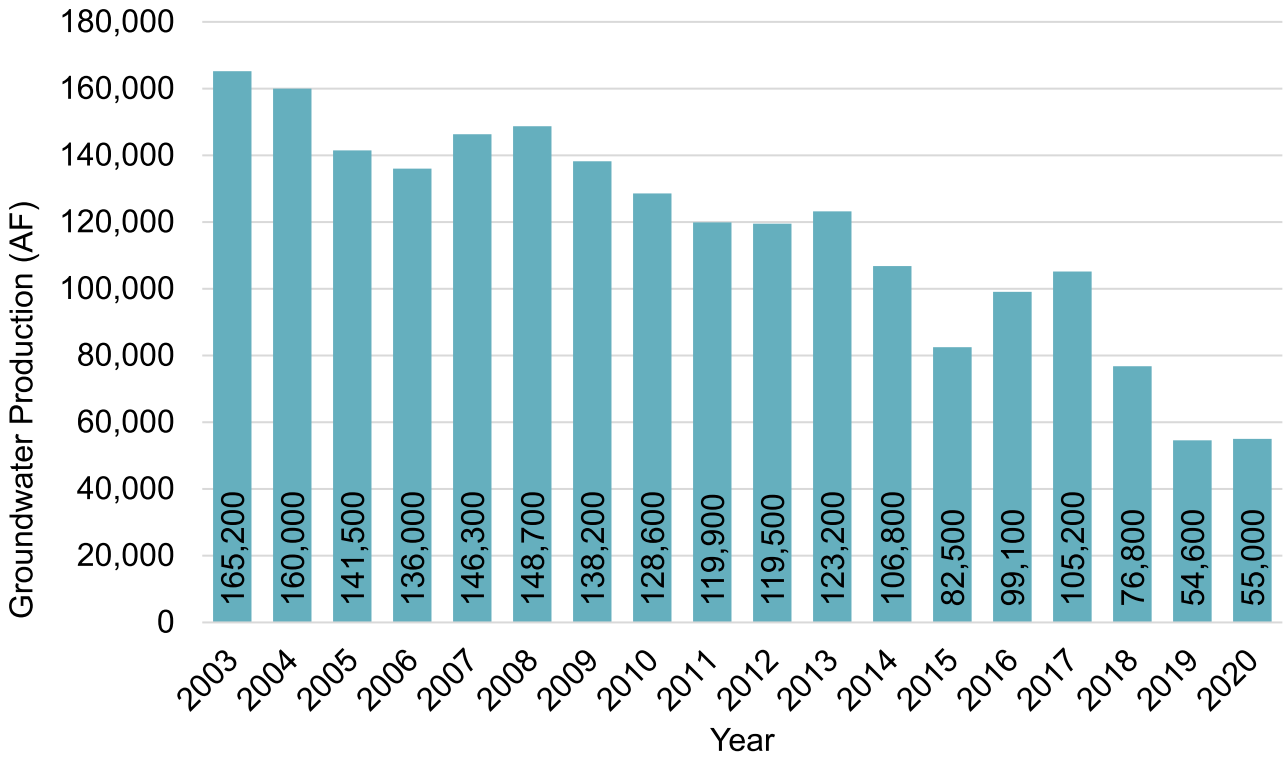
Notes:

1. Based on the Kings Basin IGSM and projected City land growth from **Figure 4-3** as discussed in **Section 3.1.1.**
2. Projected normal year intentional recharge from **Table 4-7**.

### 6.1.6 Historic Groundwater Pumping

The City has historically relied on groundwater as its main supply source prior to the construction of its SWTFs. With the recent investments in surface water infrastructure, the City has been able to drastically reduce its groundwater pumping. **Figure 6-7** shows the historic groundwater pumping since 2003. As shown, pumping has dropped significantly since 2003, the City's peak year for groundwater production.

**Figure 6-7. Historic Groundwater Production**




## 6.2 Surface Water

With the completion and operation of the Southeast Surface Water Treatment Facility (SESWTF), surface water is now a primary water supply used to meet potable demands within the City. The City contracts with FID for Kings River water and with the USBR for CVP water from the Friant-Kern Canal. The surface water supply is used either for potable uses through treatment and distribution or delivery to recharge basins for groundwater recharge.

The Kings River water year (WY) is October through September while USBR uses a WY of March through February. The City has historically used a calendar year (CY) for its analysis, so monthly water supply information was compiled in CY format for this report.

### 6.2.1 USBR Friant Division Contract Supply

The City, through an agreement originally executed in January 1961, secured a surface water supply from USBR CVP Friant Division. This agreement, for an annual water supply of 60,000 AF of Class 1 water, was last renewed in 2010 as a Section 9(d) contract that provides water from the San Joaquin River in perpetuity. A copy of the renewed contract is provided in

**Appendix H** of this UWMP. The USBR CVP Friant Division facilities generally include: Friant Dam (Millerton Reservoir), the Friant-Kern Canal, and the Madera Canal. The Friant-Kern Canal is maintained and operated by the Friant Water Authority. The USBR water supply is a wholesale supply.

Construction of Friant Dam was completed in 1947 and began making diversions to the Friant-Kern Canal in 1949. Full operations of the CVP Friant Division did not commence until the Madera Canal was completed in 1951. Class 1 water was intended to be a supply that would be dependable in practically every year, regardless of the type of hydrologic WY. Class 2 water is essentially excess water available as determined by USBR and less reliable than Class 1 water.

Class 1 water has historically been very reliable until the 2006 San Joaquin River Restoration Settlement Agreement between the Department of the Interior and Commerce, the Natural Resources Defense Council, and the Friant Water Users Authority (which is now the Friant Water Authority). The City is a member of the Friant Water Authority. The Settlement ended an 18-year legal dispute over the operation of Friant Dam brought by a coalition of conservation and fishing groups. The agreement characterized Class 1 deliveries by six hydrologic year types based on a recurrence over an 82-year simulation (1922–2003): wet, normal-wet, normal-dry, dry, critical-high, critical-low. The projected surface water available for the City from USBR during each hydrologic year defined by the 2006 Settlement Agreement is summarized in **Table 6-2**. As shown in the table, the average simulated delivery is 53,680 AFY and the median simulated delivery, which is similar to normal year delivery, is 60,000 AFY. The median value is higher than the average value because 100% allocation of 60,000 AF is simulated in 50 of 82 years but the dry and critical years result in substantial reductions, which bring down the average allocation.

The Settlement Agreement estimates the reduced supply available to the City compared to historic supplies, most evident in dry years. Restrictions on exports from the Delta have hindered the USBR from making deliveries to the Exchange Contractors via the Delta-Mendota Canal. The Exchange Contractors allowed the formation of the CVP Friant Division by agreeing to not exercise their historic pre-1914 water rights to the San Joaquin and Kings Rivers if guaranteed water deliveries continued through the Delta-Mendota Canal or other facilities. If USBR is unable to deliver water to the Exchange Contractors, they have the right to receive their water from the San Joaquin River, which reduces the Class 1 water availability (History of SJRECWA Exchange Contractors, n.d.).

Reduced deliveries from the Delta to the Exchange Contractors resulted in the CVP Friant Division contractors with zero allocations of Class 1 water in USBR WY 2014 and 2015, though the City received USBR deliveries in CY 2014 (prior to the USBR WY starting in March). Annual USBR deliveries since 2007 are shown in **Figure 6-8** for CY. The availability and reliability of the City's surface water supplies through its USBR contract are discussed further in **Chapter 7**.

**Table 6-2. Available USBR Simulated Allocation (1922–2003)**

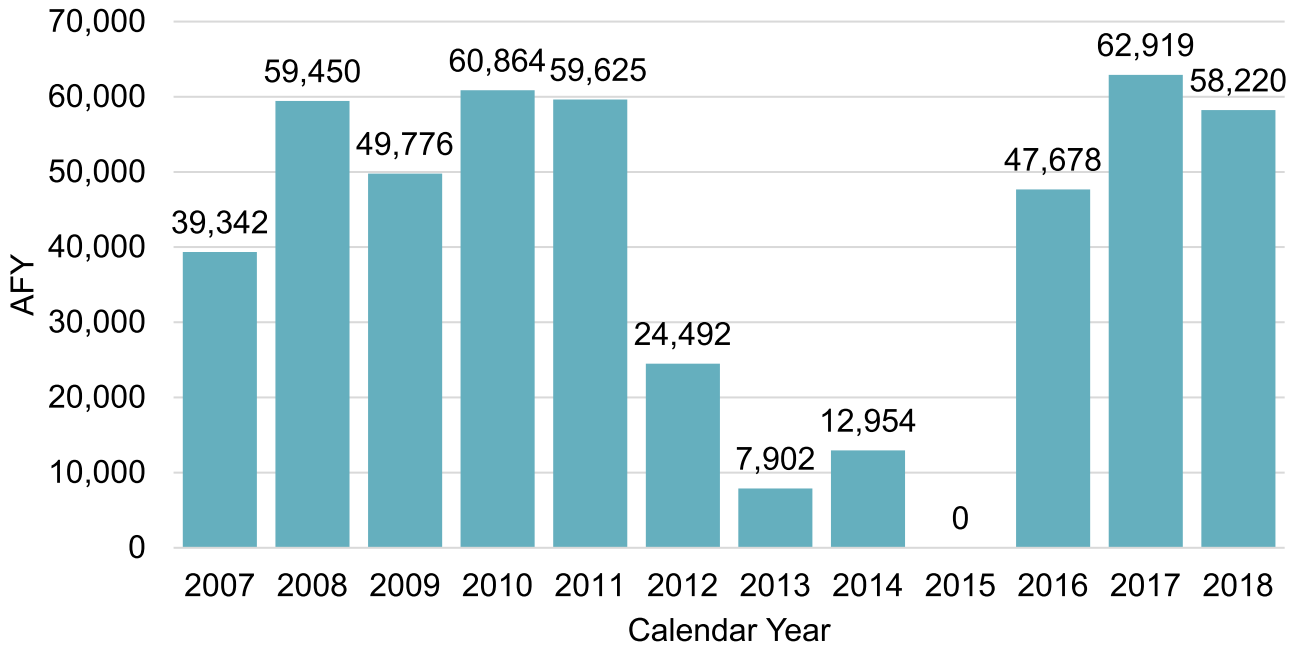
| WATER YEAR TYPE | % OF YEARS OVER SIMULATION PERIOD OF DELIVERIES [1] | NUMBER OF YEARS IN THAT YEAR TYPE | RANGE OF ALLOCATION TO CITY (AF) | AVERAGE ALLOCATION TO CITY (AF) |
|---|---|---|---|---|
| Wet | Highest 20% | 16 | 60,000 | 60,000 |
| Normal-Wet | 50% to 80% | 25 | 60,000 | 60,000 |
| Normal-Dry | 20% to 50% | 25 | 47,500 to 60,000 | 57,060 |
| Dry | 5% to 20% | 12 | 28,100 to 46,800 | 36,575 |
| Critical[2] | Lowest 5% | 4 | 13,900 to 24,700 | 19,025 |
| | **TOTAL** | **82** | **AVERAGE** | **53,680** |
| | | | **MEDIAN** | **60,000** |

Source: 2006 Settlement Agreement

Notes:

1. As defined in 2006 Settlement Agreement
2. Includes both critical-high and critical-low, which are differentiated by the amount of unimpaired runoff. The simulation uses deliveries through 2006 and does not include the zero allocation years in 2014 and 2015.

**Figure 6-8. USBR Deliveries to City Since 2007**



In addition to the Class 1 water available to the City, the USBR contract also makes available water classified as: recovered water account water; Section 215 water; and unreleased restoration flows, unreleased recirculation flows, and uncontrolled season flows. The complexities of each water type are beyond the scope of this report but are mentioned here to reflect the other water acquisition opportunities afforded to the City through this contract.

The San Joaquin River water supply has excellent water quality as it originates from snowmelt from the high Sierras and has not been detrimentally impacted.

### 6.2.2 Fresno Irrigation District Supply

FID is one of 28 agencies that receives an entitlement of water from the Kings River through the Kings River Water Association. Water entitlements for Kings River Water Association contract members is determined based on a methodology that was initially developed in 1917–1919 to established entitlements for early claimed rights holders. The methodology was based on historic mean daily natural flow conditions at Piedra, which is approximately three miles downstream from the then yet to be built Pine Flat Dam and "at the heart of Kings River uses, regulation, and stream control and storage." (Kings River Water Association and Kings River Conservation District, June 2003)

On December 20, 2016, the Revised, Amended, and Restated Cooperative Agreement was executed between FID and the City for Water Utilization and Conveyance (2016 FID Agreement) (**Appendix I**). The 2016 FID Agreement replaces the 1976 Cooperative Agreement and ends in 2035. The Agreement identifies the City's contracted percentage of FID's Kings River water based on the City's water service area located within FID service area as a percentage of the FID land area. FID land area varies slightly every year because it is dependent on the acreage receiving water deliveries for that year rather than the total acreage within FID (roughly 200,000 acres). As the City incorporates new land area into its service area, the percentage of FID supply increases. However, the 2016 FID Agreement sets the maximum percentage as 29.0%, although the City's service area is anticipated to expand and encompass more than 29.0% of FID's service area between 2025 and 2030. In 2020, the City's percentage of overall FID Kings deliveries was 25.79%. The FID Agreement identifies that the 29.0% maximum was based on moderate growth in Growth Area 1 of the City's SOI (shown in Exhibit C in the 2016 Agreement). As such, the supply projections in this plan limit the City's FID supply with the 29.0% cap, but if the agreement were revised in the future the City's FID allocation percentage could grow beyond 29.0% as the water service area expands.

The City has historically not used all of its available allocation in any given year, although it pays a flat rate for its total allocation regardless of use. Water unused by the City is reallocated by FID to its other customers.

The City's potential supply from FID was summarized using actual Kings River deliveries for CYs 1964–2019, then categorized by the same WY types used for the USBR Friant supply. The range and average FID deliveries by WY type is shown in **Table 6-3**. The average of all 56 CY delivery totals of FID Kings River deliveries is 452,541 AF, which equates to an average potential City supply of 131,237 AF, assuming the maximum 29.0% City supply percentage. **Table 6-4** lists the historic and projected allocation of FID's Kings River water for the City in normal (average) CYs. The City percentage of FID supplies was estimated assuming the City's water service area will grow from 59,100 acres to 84,300 acres by buildout at the rate shown in **Figure 4-3**.

**Table 6-3. FID Diversions by Water Year Type (1964 to 2019)**

| WATER YEAR TYPE | % OF YEARS[1] | NUMBER OF YEARS BETWEEN 1964 AND 2019 | TOTAL FID DELIVERIES (AF)[2] | | EXAMPLE AVERAGE AVAILABLE TO CITY[3] |
|---|---|---|---|---|---|
| | | | RANGE | AVERAGE | |
| Wet | Highest 20% | 11 | 563,500 to 644,600 | 590,700 | 171,300 |
| Normal-Wet | 50% to 80% | 17 | 452,800 to 563,300 | 513,700 | 149,000 |
| Normal-Dry | 20% to 50% | 17 | 362,600 to 448,000 | 415,000 | 120,400 |
| Dry | 5% to 20% | 8 | 253,700 to 362,000 | 315,700 | 91,600 |
| Critical | Lowest 5% | 3 | 158,100 to 253,300 | 210,200 | 61,000 |
| | | **56** | **AVERAGE** | **453,800** | **131,600** |

Notes:

1. As defined in 2006 Settlement Agreement
2. Assigns water year type defined in defined in 2006 Settlement Agreement to FID deliveries from 1964 to 2019
3. Based on maximum 29.0% City supply percentage to provide an example City supply amount

**Table 6-4. Projected FID Kings River Allocation for City, Normal Years**

| YEAR | PROJECTED TOTAL FID ALLOCATION, AFY | PROJECTED ALLOCATION TO CITY, AFY[1] |
|---|---|---|
| 2025 | 27.55% | 125,030 |
| 2030 | 29.00% | 131,600 |
| 2035 | 29.00% | 131,600 |
| 2040 | 29.00% | 131,600 |
| 2045 | 29.00% | 131,600 |

[1]Projected City Allocation (%) x 453,800 AFY (estimated normal year diversion by FID, per **Table 6-3**)

## 6.3 Stormwater

The Fresno-Clovis Metropolitan Area and surrounding rural vicinities are within the service area boundaries of the FMFCD, which has primary responsibility for managing the local stormwater flows. Most stormwater in the City drains to urban stormwater basins, where the water is retained to attenuate peak flow runoff and recharge stormwater, or is pumped to local irrigation canals for conveyance away from the municipal areas. FMFCD's operation of stormwater basins is predicated on maintaining storage capacity for rain events, which limits accessibility for recharge activities during the rainy season. FMFCD estimates the amount of stormwater that is recharged each wet season. However, recharge attained with the FMFCD basins largely occurs in May

through October when limited storage capacity is required. Dry-season recharge is accomplished by diverting surface waters, from the Kings River and Millerton Reservoir, using City-allocated surface water. It is difficult to estimate stormwater recharge volumes as there is no physical measurement of stormwater flows into the basins, and infiltration rates can vary with water elevation and degree of siltation in the basin. However, FMFCD estimates that stormwater recharge in urban basins during the winter months may range from 7,000 AF/yr to 22,200 AF/yr. Stormwater capture and infiltration are considered an integral component of natural groundwater recharge discussed in **Section 6.1.5.1**.

# 6.4 Wastewater and Recycled Water

## 6.4.1 Recycled Water Coordination

The City is currently expanding its recycled water supplies to increase offset use of potable water for landscape irrigation. In 2010, the City completed a Recycled Water Master Plan (adopted by the City Council in 2013) to evaluate and plan for increased recycled water use in the City. The City's last Metro Plan, adopted in 2014, also outlined projects to increase the use of recycled water to offset potable demands (Carollo, 2010). The City is currently updating the Metro Plan and will reevaluate recommendations and projects to increase recycled water use.

The City owns and operates two water reclamation facilities: 1) the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) and 2) the North Fresno Wastewater Reclamation Facility (NFWRF), both of which can produce Title 22 recycled water for use within the City's service area. They are described further in **Section 6.4.3**.

Coordination with other water agencies and potential consumers within the planning area is inherently within the purview of the City's Department of Public Utilities (DPU) as this department provides both water and wastewater services. DPU has been on the forefront of numerous water supply preservation, enhancement, and development projects and programs for decades. The concept of multiagency coordination is fully embraced by the department as is evident with the previously discussed joint agency agreements and the commitment to construct new infrastructure to further develop new resources. The endeavor to develop recycled water as a resource was a requirement of a development in north Fresno, where the developer was conditioned to have a net zero impact on water resources. The fundamental component of this development was the construction and dedication of the NFWRF to the City.

There are only a few agencies, besides the City, that have wastewater collection and treatment facilities within and immediately adjacent to the plan area. These agencies include:

| | Collection | Treatment |
|---|---|---|
| City of Clovis | X | X |
| Malaga County Water District | X | X |
| Pinedale County Water District | X | - |
| Pinedale Public Utility District | X | - |

As the City is the primary responsible agency for wastewater collection and treatment for its annexed areas and certain County islands, it has taken the lead role of developing and implementing recycled water facilities to serve the same area.

#### 6.4.1.1 City of Clovis

The RWRF was developed under a Joint Powers Authority agreement executed in 1977 among the City of Fresno, the City of Clovis, and the County of Fresno. Both of the cities contribute to the cost of operations and maintenances and capital expenditures for the RWRF based on formulas in the agreement. This facility provides service for most of Clovis' sewer flows.

The City of Clovis recently constructed its own wastewater treatment facility that produces tertiary level effluent and is distributed in a dedicated purple pipe system within portions of its service area.

#### 6.4.1.2 County of Fresno

The County of Fresno, like the City of Clovis, is a party to the RWRF Joint Powers Authority for treatment of flows from unincorporated areas encompassed by the City's service area.

#### 6.4.1.3 Malaga County Water District

Malaga County Water District provides water and sewer service to an unincorporated county area of about 2.25 sq mi, which covers a small portion of the City's SOI. The district provides wastewater collection and treatment for residential and non-residential customers.

#### 6.4.1.4 Pinedale County Water District

Pinedale County Water District provides water, sewer, and solid waste service to an area of about 2 sq mi, which service area covers an unincorporated County island and a portion of the City. The district provides wastewater collection to an area of 699 acres and diverts the flow to the City's collection system for treatment at the RWRF.

#### 6.4.1.5 Pinedale Public Utility District

Pinedale Public Utility District provides wastewater, street lighting, street sweeping, and landscape maintenance. The district services an area of 362 acres in the northern portion of the City, serving both an unincorporated County island and portions of the City. The collected wastewater is diverted to the City's collection system for treatment at the RWRF.

### 6.4.2 Wastewater Collection, Treatment, and Disposal

The City's wastewater collection system was originally developed in 1891 with the installation of a 24-inch outfall sewer that discharged to a 40-acre sewer farm located southwest of town. The amount of land and facilities at this location continued to be expanded as the City grew over the years. Today, the City's wastewater collection system consists of about 1,630 miles of pipes ranging in size from 4 inches in diameter to 84 inches in diameter. This collection system also utilizes 15 lift stations throughout the City, ranging in pumping capacity from 0.25 mgd to 2.2 mgd.

#### 6.4.2.1 Wastewater Treatment and Discharge Within Service Area

The City is served by two wastewater treatment plants, briefly described below.

**Fresno-Clovis Regional Wastewater Reclamation Facility**

The RWRF has developed from what was once a sewer farm to what is now a state-of-the-art wastewater treatment facility. In 1966, the City of Fresno was appointed the sewering agency

for the local metropolitan region and shortly after began long-range planning and construction of new facilities to handle increasing flows and regulatory requirements. The RWRF treats flows from not only the City, but also sewered County areas (some county areas remain unsewered), the City of Clovis, Pinedale County Water District, and Pinedale Public Utility District.

Flows received at this facility peaked at 81,100 AF in 2006 and have been steadily decreasing since, with the average influent flow about 63,000 AF over the last five years. The RWRF includes preliminary, primary, secondary, and tertiary treatment units with disinfection. Secondary treatment consists of three treatment trains with an annual average capacity of 87 mgd, consisting of 30 mgd for Train A and 57 mgd for Trains B and C combined. In 2017, a 5-mgd tertiary treatment system — the Tertiary Treatment and Disinfection Facility (TTDF) — was completed. The system can be expanded to 15 mgd and ultimately to 30 mgd.

The City has three primary means of effluent disposal:

1. Undisinfected secondary effluent to on-site and off-site farmland for restricted irrigation
2. Undisinfected secondary effluent to percolation ponds
3. Disinfected tertiary effluent to the recycled water distribution system

The percolated effluent has been deemed equivalent to Title 22 tertiary treated water by the State Water Resources Control Board Department of Drinking Water (DDW). The City has been extracting this water for reuse in areas within and surrounding the RWRF, as well as to FID's canals, through an exchange agreement for delivery to FID agricultural customers.

The discharged effluent is within the City boundaries and located just southwest of the metropolitan area. The treated effluent percolation ponds are within the City's SOI and hydrologic sphere that benefit the City's overall regional water budget. See **Figure 3-1** for a depiction of the facility's location relative to the metropolitan area.

#### North Fresno Wastewater Reclamation Facility

The NFWRF was constructed as part of a residential, commercial, and golf course master planned development located in the northern portion of the City. As a condition of the planned community, the developer was required to construct a wastewater treatment facility that would produce tertiary level effluent for use within the development to ensure the overall project had a net zero impact on water resources. This facility is presently rated at 0.71 mgd (average monthly flow) and 1.07 mgd (maximum daily flow). However, the ultraviolet (UV) light disinfection system was only validated for 300 gpm (0.43 mgd), which is the current flow limit until the DDW approves a higher flow. This facility is expandable to 1.25 mgd (average monthly flow). The disinfected tertiary effluent from the plant is largely used to irrigate the Copper River Ranch Golf Course. Of the 325 AF of wastewater treated in 2020, 54 AF was used for irrigation of turf. Treated but unused effluent is diverted to the City's collection system to the RWRF.

### 6.4.3 Recycled Water System Description

The 2014 Metro Plan recommended expanding reuse by: 1) using the NFWRF effluent to irrigate Copper River Ranch Golf Course; and 2) up to 25,000 AFY of recycled water for landscape irrigation or other non-potable uses from the RWRF or new satellite WRFs. Since then, the City has irrigated the Copper River Ranch Golf Course with recycled water and has constructed much of the southwest recycled water distribution system. However, the City is currently updating the Metro Plan and reevaluating the target volume of reuse in the City beyond the southwest system

considering new conditions and regulations, including the potential for potable reuse in the future.

#### 6.4.3.1 Fresno-Clovis Regional Wastewater Reclamation Facility

As mentioned above, the RWRF produces undisinfected secondary effluent for restricted irrigation to on-site and off-site farmlands and disinfected tertiary treated effluent for the recycled water distribution system.

The City's RWRF diverts a portion of the undisinfected secondary effluent to irrigate non-food crops grown adjacent to this facility. The practice of using the secondary effluent to irrigate non-food crops has been carried-out for decades and is expected to continue for the foreseeable future. The City owns nearly 3,300 acres of land for and around the RWRF, consisting of percolation ponds (1,750 acres) and other land available to farm non-food crops. **Table 6-5** provides the annual quantities of recycled water applied to these crops for the period from 2015–2019.

Additionally, the RWRF produces Title 22 disinfected tertiary treated effluent through the TTDF completed in 2017 and through tertiary equivalent soil aquifer treated recycled water recovered from the percolated secondary effluent. A series of 15 groundwater wells located at the RWRF are used to extract previously percolated effluent groundwater from beneath the facility. The extracted groundwater has the potential to be used for higher beneficial use if it can be demonstrated this water has attained a level of treatment satisfactory to meet disinfected tertiary levels. The City embarked on a joint project with the WateReuse Research Foundation to demonstrate to State regulatory agencies the soil aquifer treated recycled water met Title 22 levels. The culmination of this study is presented in a final report entitled "Demonstration of Filtration and Disinfection Compliance Through Soil-Aquifer Treatment," which was completed in 2013 (WateReuse Research Foundation, 2013). This study concluded that, based on the documented sampled water quality data, the extracted groundwater met requirements for classification as disinfected tertiary level recycled water. The SWRCB DDW stated that the percolated effluent water meets the tertiary treatment classification, and the City is making plans for its use as part of its recycled water production and distribution system (California Regional Water Qulaity Control Board, 2018). The combined rated production yield of the 15 wells, if run year-round, would be approximately 32,000 AFY. The City plans to blend the recycled extraction well water with the disinfected tertiary level recycled water produced from the 5 mgd TTDF to feed the southwest recycled water distribution system. As new sales grow for the recycled water, additional recycled extraction well water will be utilized to feed the City's southwest recycled water system.

The tertiary equivalent soil aquifer treated recycled water (recovered groundwater) is also used for on-site irrigation and transport to FID canals for delivery to customers during the irrigation season, as facilitated through an exchange agreement with FID. More information on the City's FID RWRF Exchange Agreement is discussed in **Section 6.6**.

Since the completion of the 2010 Recycled Water Master Plan (RWMP), the City has constructed most of the southwest recycled water system, shown in **Figure 6-9.** The southwest recycled water system consists of a 3.2 MG recycled water reservoir located at the RWRF, a 6,000 gpm (8.64 mgd) recycled water pump station located at the RWRF, a 640-gpm booster pump station (Roeding Park Booster), and 15.7 miles of 10-inch to 54-inch recycled water pipeline. Roughly 7.5 miles of pipeline remain to be constructed. The City also updated the demand and distribution system from the 2010 RWMP with the 2019 Citywide Recycled Water Demand and Southwest

Recycled Water System Analysis (Carollo, 2019) to identify potential recycled water customers. This recent analysis will be incorporated into the latest Metro Plan update.

#### 6.4.3.2 North Fresno Water Reclamation Facility

As described earlier, the City has an existing recycled water plant in the northern portion of the City that receives and treats sewage from the residential, commercial, and golf course master planned community. The NFWRF was constructed in 2008 but was not fully operational until 2009 due to the inability to properly run at extremely low flow conditions. Subsequent modifications at the plant allowed it to run on a regular basis in 2010 and again in 2014 for UV approval. The amount of reuse has varied substantially since 2016 because the delivery system was offline in 2017 and 2018 for treated water basin slope repairs. City staff indicated that 2016 is representative of operations going forward. The disinfected tertiary effluent is conveyed in a dedicated pipeline to an adjacent golf course for irrigation purposes. The quantities used for irrigation purposes are shown in **Table 6-5** for the period of 2015–2019.

**Table 6-5. Historic Recycled Water Used Within Service Area**

| | QUANTITY (AFY) | | | | | |
|---|---|---|---|---|---|---|
| **RECYCLE WATER FACILITY** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| RWRF, Secondary Effluent (Non-Food Crop Irrigation) | 8,688 | 7,329 | 4,540 | 7,031 | 3,652 | 3,845 |
| RWRF, Tertiary Effluent | 531 | 485 | 423 | 867 | 912 | 858 |
| NFWRF | 62 | 110 | 0 | 0 | 19 | 54 |
| **TOTAL** | **9,281** | **7,924** | **4,963** | **7,898** | **4,583** | **4,757** |

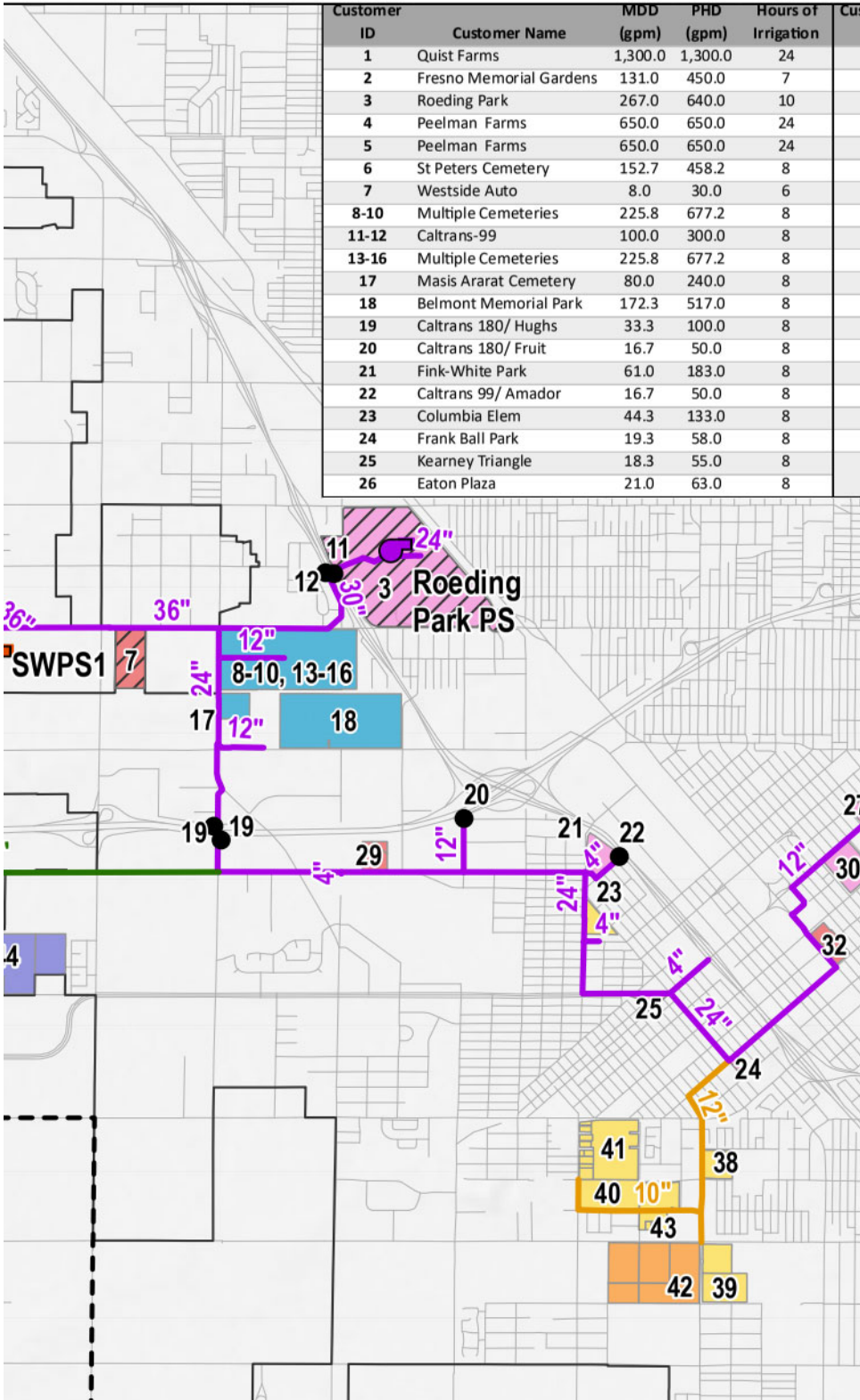
Note: Reuse at the NFWRF was zero in 2017 and 2018 because the recycled water delivery system was offline for system repairs.

### 6.4.4 Potential, Current, and Projected Recycled Water Uses

The 2020 actual recycled water use, and projected recycled water use in the City's service area is included in **Table 6-6**. Secondary undisinfected reuse is projected to continue to be used to irrigate non-food crops adjacent to the RWRF in the future. The projected secondary undisinfected use going forward is based on the average use from 2015 to 2020. Additionally, the amount of tertiary recycled water from the RWRF is projected to increase to provide 6,210 AF for landscape and agricultural irrigation as the southwest recycled water system is built out. Projected tertiary recycled water from the NFWRF for golf course irrigation is projected to be 110 AF annually through 2045.

The 2015 UWMP anticipated that 21,200 AFY of recycled water would be produced and utilized in 2020. The previous projected increases in recycled water were based on recommendations from the 2010 RWMP, which included projects to increase recycled water use for landscape irrigation, agricultural irrigation, industrial use, and blending with raw surface water for groundwater recharge. Since the 2010 RWMP, the City has focused on constructing the southwest recycled water system to increase landscape and agricultural irrigation in the southwest portion of the City. The City is also currently updating the Metro Plan that is evaluating recycled water alternatives in the City and is expected to update its RWMP following the Metro Plan update to serve as a new guiding planning document for recycled water use by the City.

| Customer ID | Customer Name | MDD (gpm) | PHD (gpm) | Hours of Irrigation |
|---|---|---|---|---|
| 1 | Quist Farms | 1,300.0 | 1,300.0 | 24 |
| 2 | Fresno Memorial Gardens | 131.0 | 450.0 | 7 |
| 3 | Roeding Park | 267.0 | 640.0 | 10 |
| 4 | Peelman Farms | 650.0 | 650.0 | 24 |
| 5 | Peelman Farms | 650.0 | 650.0 | 24 |
| 6 | St Peters Cemetery | 152.7 | 458.2 | 8 |
| 7 | Westside Auto | 8.0 | 30.0 | 6 |
| 8-10 | Multiple Cemeteries | 225.8 | 677.2 | 8 |
| 11-12 | Caltrans-99 | 100.0 | 300.0 | 8 |
| 13-16 | Multiple Cemeteries | 225.8 | 677.2 | 8 |
| 17 | Masis Ararat Cemetery | 80.0 | 240.0 | 8 |
| 18 | Belmont Memorial Park | 172.3 | 517.0 | 8 |
| 19 | Caltrans 180/ Hughs | 33.3 | 100.0 | 8 |
| 20 | Caltrans 180/ Fruit | 16.7 | 50.0 | 8 |
| 21 | Fink-White Park | 61.0 | 183.0 | 8 |
| 22 | Caltrans 99/ Amador | 16.7 | 50.0 | 8 |
| 23 | Columbia Elem | 44.3 | 133.0 | 8 |
| 24 | Frank Ball Park | 19.3 | 58.0 | 8 |
| 25 | Kearney Triangle | 18.3 | 55.0 | 8 |
| 26 | Eaton Plaza | 21.0 | 63.0 | 8 |



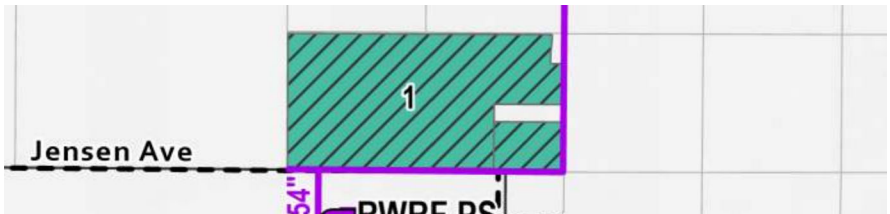



**Table 6-6. Recycled Water within Service Area in 2020 (DWR 6-4R)**

The supplier will complete the table.

| | |
|---|---|
| Name of Supplier Producing (Treating) the Recycled Water: | City of Fresno |
| Name of Supplier Operating the Recycled Water Distribution System: | City of Fresno |
| Supplemental Volume of Water Added in 2020: | 0% |
| Source of 2020 Supplemental Water: | N/A |

| BENEFICIAL USE TYPE | POTENTIAL BENEFICIAL USES OF RECYCLED WATER | AMOUNT OF POTENTIAL USES OF RECYCLED WATER | GENERAL DESCRIPTION OF 2020 USES | LEVEL OF TREATMENT | 2 |
|---|---|---|---|---|---|
| Agricultural Irrigation[1] | Non-foodcrop irrigation | 7,900 | Irrigate non-food crops | Secondary, Undisinfected | 3 |
| Landscape Irrigation (excludes golf courses) | Landscape Irrigation | 5,800 | Landscape irrigation, distributed through the southwest recycled water distribution system | Tertiary | 8 |
| Agricultural Irrigation[1] | Food crop irrigation | 410 | Irrigate limited food crops, distributed through the southwest recycled water distribution system | Tertiary | - |
| Golf Course Irrigation | Landscape Irrigation | 110 | Copper River Golf Course | Tertiary | 5 |
| - | | | | Total: | 4 |

Note:

1. Recycled water for agricultural irrigation does not offset the City's potable water demands, and as such, is excluded from projected recy

### 6.4.5 Actions to Encourage and Optimize Future Recycled Water Use

The 2010 RWMP identified the need for the City to adopt an ordinance to establish a recycled water policy and criteria for its use within the City's SOI. On July 14, 2014, the Recycled Water Ordinance was adopted by the City Council, laying the foundation for the expanded use of recycled water within the City.

**The focus of the ordinance includes the following:**

- Establish an Administrative Authority.
- Establish approved uses of recycled water.
- Define areas of potential eligibility for recycled water service.
- Specify voluntary uses of recycled water, depending on user classifications.
- Require installation of a transmission and distribution infrastructure.
- Encourage the use of voluntary retrofits for existing users that may not be addressed in the ordinance.
- Require the City of Fresno to prepare Rules and Regulations.
- Provide enforcement and severability clauses.
- Establishing a means for the City to provide recycled water at a negotiated price.

Efforts to further the use of recycled water include the requirement that new developments within planned major recycled water distribution mains must install purple pipe. Then, as the City's capital projects construct a distribution infrastructure, these segments will be in place to facilitate connections to new customers, reduce program costs by avoiding digging up new street improvements and reduce disruption to vehicular traffic.

Most of the southwest recycled water distribution system from the RWRF is completed or planned for construction in 2021. The City has identified potential customers to connect to the recycled water system once it is completed to offset potable demand and increase recycled water use in the City.

## 6.5 Desalinated Water Opportunities

The City is located in the central San Joaquin Valley; therefore, seawater desalination is not applicable to the City. Additionally, the groundwater that exists within the immediate area of the City is not brackish in nature and does not require desalination treatment.

## 6.6 Water Exchanges and Transfers

### 6.6.1 Exchanges and Transfer Opportunities

#### 6.6.1.1 USBR Supply

The Central Valley Project Improvement Act (CVPIA) of 1992 authorized the transfer of all or a portion of a CVP contractor's water supply to any other California water users or water agencies. The CVPIA allows water transfers as long as they are consistent with federal and state water laws. The primary component of the CVPIA that specifies water transfer provisions for federal

water supplies is Section 3405(a), which includes provisions regarding maximum annual water transfer, beneficial use, and approvals.

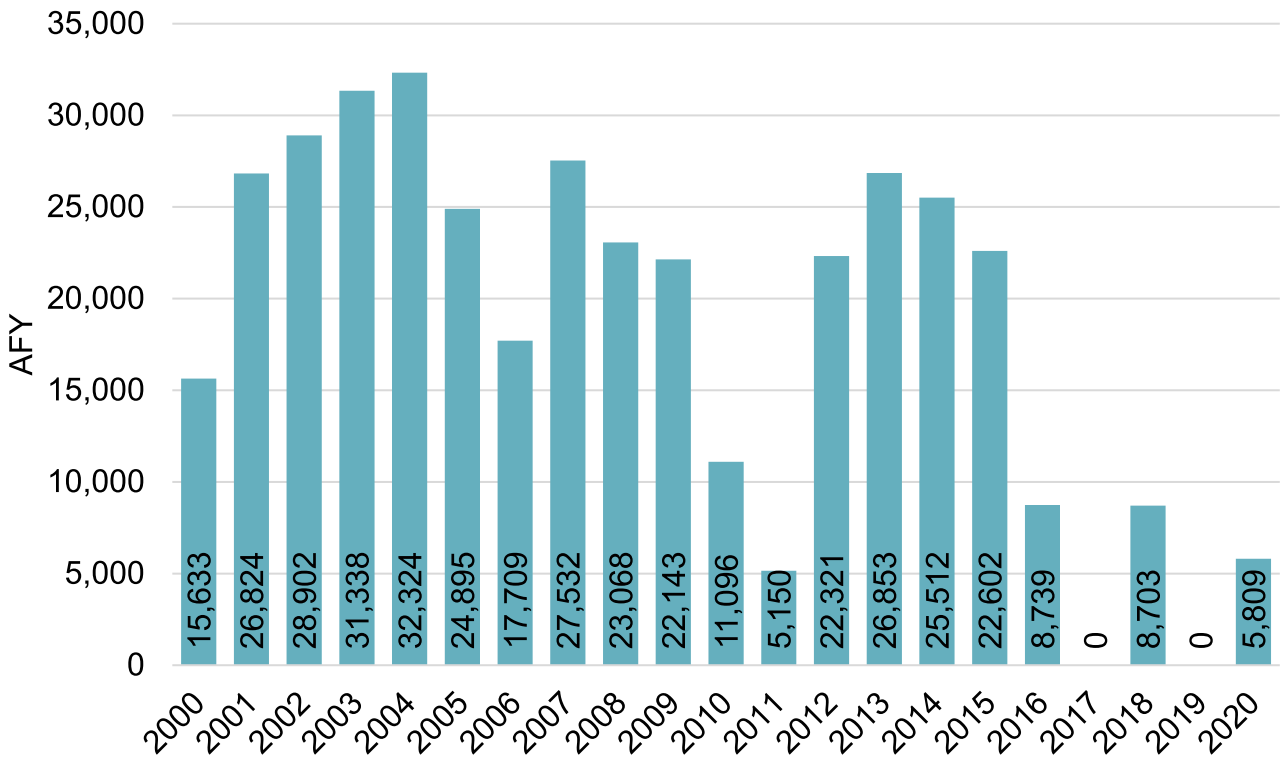
As part of the City's current Metro Plan update, the City is evaluating potential future water transfers and exchanges of its periodically available USBR water. Currently, the City does not have any plans to transfer its USBR water to other California water users.

### 6.6.1.2 FID / RWRF Groundwater Exchange Supply

Since 1974, the City has had an agreement with FID to exchange recycled water for the delivery of surface water east of the City (**Appendix I**). The Agreement between FID and the City for Exchange of Recycled Water allows for water pumped from beneath the RWRF to be conveyed to FID's Dry Creek and Houghton Canals for delivery to growers west of the City. In exchange for the water delivered to FID by the City, FID agreed to deliver 46% of the total from either its Kings River entitlement or USBR Class II supply to growers or basins in the eastern portion of FID "insofar as is feasible and practical." The water is to be considered additional to the water that would have been delivered to the eastern portion of FID, such that the additional delivered water used by growers is assumed to offset groundwater pumping in the area and, therefore, provide a groundwater basin benefit. This is an indirect benefit to the City.

The agreement includes a minimum of 100,000 AF delivered over a 10-year period and no more than 30,000 AF in any given year. As shown in **Figure 6-10**, the City exceeded the maximum yearly delivery in 2003 and 2004 and has maintained more than 100,000 AF of deliveries over a 10-year period. However, since 2016, the City has reduced RWRF groundwater exchange deliveries. The City is currently discussing an update to the agreement with FID, while the 2020 Metro Plan will identify and recommend other beneficial uses for the City's percolated effluent.

**Figure 6-10. Historical RWRF Groundwater Exchange Deliveries**



### 6.6.2 Emergency Interties

In 2007, the Cities of Fresno and Clovis executed an agreement for interconnection of their potable water systems to provide service during emergencies and other times of hardship in either community. The agreement covers interconnections, including apportionment of capital costs, at two locations: Leonard Avenue at the Gould Canal alignment and Behymer Avenue at Willow Avenue.

The agreement provided for temporary deliveries from Clovis to southeast Fresno through the Leonard connection through 2013. The Leonard interconnection was constructed and remains in place for emergency uses through manual operation.

The agreement also provided for temporary deliveries from Fresno to northern Clovis through the Behymer connection through 2015. However, the Behymer interconnection has yet to be constructed and, if constructed in the future, would serve only for emergency use.

## 6.7 Future Water Projects

The City is currently updating its Metro Plan, which will recommend programs and projects to improve the City's water supply portfolio and continue providing a safe, reliable, and sustainable water supply. While the outcomes of the Metro Plan update are currently being developed, the City's ongoing and future projects to improve its supply portfolio include:

- Expansion of recycled water distribution system
- Expansion of groundwater recharge program
- Expansion of surface water treatment capacity
- Beneficial transfers and exchanges

### 6.7.1 Expand Recycled Water Distribution System

As mentioned in **Section 6.4.5**, the City has made significant improvements to their recycled water system over the last five years and is currently expanding their recycled water distribution system. The City expects to implement construction on the final portion of the Southwest recycled water distribution system this year. The completed distribution system will allow an additional 5,000 AF of recycled water use in the City to offset potable demands that can be used in all hydrological year types. The expansion is projected to be completed by 2025.

### 6.7.2 Expand Groundwater Recharge Capacity

With the acknowledgement that the groundwater aquifer is and will remain an integral resource, the City is currently evaluating an expanded recharge program as part of the Metro Plan update. Expanding intentional recharge may include the development of new dedicated intentional recharge facilities and/or joint projects for basins with FMFCD and potentially FID. The target for recharge expansion is to maximize storage within the groundwater basin and optimize use of available surface water supplies in normal years. The stored water will be used more in the single-dry year and consecutive dry years when surface water supplies are less available.

The timing for groundwater recharge capacity expansion will be examined as part of the Metro Plan update and, for the UWMP, is assumed to increase to allow for an additional 540 AFY of recharge to occur on average each year.

### 6.7.3 Expand Surface Water Treatment Capacity

A key component to the success of the City's ability to reverse the long-time overreliance on groundwater is the construction of its surface water treatment facilities. These have allowed the City to optimize the use of available surface water supplies. The City's NESWTF currently has a 30 mgd capacity and the capability to expand up to 60 mgd. The SESWTF is currently permitted to produce up to 54 mgd but, with the subsequent rerating of the media filters, will be capable of operating at a rated capacity of 80 mgd.

The timing for the SWTF expansion will be examined as part of the Metro Plan update and determined based on need as the City grows and demands increase.

### 6.7.4 Beneficial Transfers and Exchanges

As mentioned in **Section 6.6.1**, the City is evaluating future beneficial transfers and exchanges of the City's USBR water in normal water years when available water supplies exceeds demands.

## 6.8 Summary of Existing and Planned Sources of Water

Summaries of the above discussed existing and planned sources of water are provided in **Table 6-7** and **Table 6-8** below.

### 6.8.1 Supply Management

The City currently balances its surface water supplies and groundwater based on minimum production for operation of the SWTFs and minimum groundwater pumping to manage and control contamination plumes and prevent their spread. The minimum operation conditions typically occur in the low-demand winter months, and the City can increase surface water production during peak demand months when surface water is available. In normal and wet years, the City intends to rely on more surface water supply and recharge raw surface water to replenish the groundwater basin and build storage for dry years. In dry years, when surface water is less available, the City will ramp up well production to meet demands. The City is expected to continue this supply management strategy in the future.

**Table 6-7. Actual Water Supplies (DWR 6-8R)**

| | 2020 | |
|---|---|---|
| **WATER SUPPLY** | **ACTUAL VOLUME** | **WATER QUALITY** |
| Groundwater | 55,028 | Drinking Water |
| USBR CVP | 37,447 | Drinking Water |
| FID Kings River | 71,292 | Drinking Water |
| Recycled Water, RWRF | 858 | Recycled Water |
| Recycled Water, NFWRF | 54 | Recycled Water |
| **TOTAL:** | **164,679** | |

**Table 6-8. Projected Water Supplies (DWR 6-9R)**

| | REASONABLY AVAILABLE VOLUME, AFY | | | | |
|---|---|---|---|---|---|
| WATER SUPPLY | 2025 | 2030 | 2035 | 2040 | 2045 |
| Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| USBR CVP | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 |
| FID Kings River | 125,030 | 131,600 | 131,600 | 131,600 | 131,600 |
| Recycled Water, RWRF | 5,800 | 5,800 | 5,800 | 5,800 | 5,800 |
| Recycled Water, NFWRF | 110 | 110 | 110 | 110 | 110 |
| **TOTAL:** | **329,030** | **341,140** | **346,610** | **352,000** | **357,330** |

## 6.8.2 Special Conditions

This section details climate change and future regulatory conditions that impact the City's supply sources.

### 6.8.2.1 Climate Change Effects

Climate models disagree on average annual precipitation projections but agree on other hydrologic metrics relevant to water resources management, including:

- Snowpack declines
- Increased fraction of precipitation on extreme rainfall days
- Shorter, sharper rainy season
- Increased evapotranspiration
- Higher frequency of extremely wet and extremely dry years
- Higher incidence of extreme dry year followed by an extreme wet year or vice versa (Persad, 2020) (Partida, 2020)

As discussed in **Section 4.4**, climate change impacts were evaluated in the North Kings GSP using DWR climate change datasets, which were developed for the California Water Commission's Water Storage Investment Program (WSIP). The North Kings GSP analyzed WSIP water supply projections and found climate change will have no significant impact on the FID Kings River diversions. The North Kings GSP estimates the timing of the inflows to water reservoir and surface water supplies is anticipated to shift significantly due to warmer temperatures causing precipitation to arrive as rainfall instead of snowmelt. The warmer temperatures are also predicted to cause the snowmelt to turn to runoff earlier each spring. These climate impacts are estimated in the North Kings GSP to slightly increase inflows to the Kings River (0.6% in 2040 and 0.3% in 2070); however, it is not expected to impact the Kings River diversions significantly and the timing will have a greater impact on water management, including a possible greater need for additional storage. The North Kings GSP also estimated climate impacts to the San Joaquin River supplies available to the CVP Friant Division Contractors, including the City's USBR Class I supplies, and found the WSIP dataset estimates a slight reduction in future water supplies (Provost & Pritchard, November 2019). This plan

considers water supply during an extreme dry year or multi-dry year scenario, which may occur more often due to climate change, further in **Chapter 7**.

### 6.8.2.2 Regulatory Conditions

The City has existing contracts for its surface water supplies that are not facing any reduction due to forthcoming regulation. The City's groundwater supply is from an unadjudicated basin and is also considered reliable. The GSA is currently working toward determining a safe yield for the Kings Subbasin, which is the amount of water than can be pumped from the basin over a long-term period without producing undesirable results. The City is an active member of the GSA, working collaboratively to bring the basin to balance while protecting the City's groundwater supply.

Additionally, forthcoming California regulations for per- and polyfluoroalkyl substances (PFAS) may impact certain wells within the City. The City is currently monitoring and treating some groundwater wells for PFAS. These regulations are not expected to impact the City's ability to use its full groundwater supply.

## 6.9 Energy Intensity

Pursuant to CWC Section 10631.2(a), readily available information regarding energy intensity shall be reported in the 2020 UWMP. For the City, this includes the total energy usage at each production facility, including each well site and the three SWTFs. The electrical usage includes the energy to produce, treat, and pump the water into the distribution system. Because the City's distribution system includes over 200 groundwater wells, **Table 6-9** presents the total energy usage, water produced, and average energy intensity for all groundwater wells and for each SWTF following the methodology presented in Appendix O of the DWR 2020 UWMP Guidebook. The energy intensity varies significantly between groundwater wells depending on the depth to the groundwater table, if the well includes treatment beyond disinfection, and other local conditions. The total energy intensity for all production and treatment in the City's distribution system in 2020 was 384 kWh/ AF.

**Table 6-9. Water System Energy Intensity in 2020**

| | WELLS | NESWTF | SESWTF | T-3 SWTF | TOTAL |
|---|---|---|---|---|---|
| Electricity (kWh) | 27,667,366 | 5,848,314 | 13,416,000 | 454,470 | 47,386,150 |
| Treated Water Deliveries (AF) | 56,445 | 20,724 | 45,367 | 875 | 123,411 |
| Energy Intensity (kWh/AF) | 490 | 282 | 296 | 520 | 384 |

7

CITY OF FRESNO

# Water Service Reliability and Drought Risk Assessment

**This Section discusses the long-term reliability of surface and groundwater supplies for the City.**

A comparison is made of anticipated supplies and demands through 2045 for a normal year, single dry year, and five-year drought. Shorter-term reliability planning that may require immediate action, such as drought or catastrophic supply interruption, is addressed in **Chapter 8**.

IN THIS SECTION


- Water Service Reliability Assessment
- Drought Risk Assessment

# 7.1 Water Service Reliability Assessment

This section describes the existing constraints on the City's supply sources and reliability in different hydrologic year types.

## 7.1.1 Constraints on Water Sources

### 7.1.1.1 Groundwater

Groundwater has long been the primary water supply source for the City. Before the City's investments to increase its use of surface water with the construction of its NESWTF, T-3 SWTF, and SESWTF, groundwater levels were declining, and the falling levels were a potential constraint. Groundwater levels in some areas of the City have actually been increasing over the last five years as a result of the City's using less groundwater and are expected to continue to increase as the City pumps less in the future.

The North Kings GSP is setting sustainability indicators for groundwater levels and groundwater storage. The current GSP does define a measurable objective and minimum threshold for the basin to allow the North Kings GSA to evaluate its progress for the subject indicator, as defined by SGMA, and determine whether conditions are improving, remaining stable, or degrading.

Another constraint to the use of groundwater stems from the negative impacts from contamination (see **Section 6.1.4**). To ensure the continued beneficial use of the groundwater supply, the City has set minimum pumping requirements for specific wells to prevent the spread of existing groundwater plumes to other areas in the City and to protect the basin. The City will remain proactive in pursuing responsible parties so the proper remediation is conducted to preserve the groundwater system as a viable and sustainable resource in perpetuity. Largely, the City has been able to rely on the relatively good quality of this resource.

### 7.1.1.2 USBR

The City has a contract for 60,000 AFY of Class 1 water with the USBR. Analysis supporting the 2006 San Joaquin River Settlement is the basis for USBR supply projections. The settlement is based on ensuring flows downstream of Millerton Dam for varying hydrologic conditions, which can constrain surface water supplies available to the CVP Friant Division contractors, such as the City.

Another constraint that affects the consistency of this supply are the restrictions that have been imposed on water diversions from the Delta (see **Section 6.2.1**). The resulting impacts associated with the restrictions from the Delta has been more detrimental to water supplies for the CVP Friant Division contractors than the above-discussed settlement, as the latter has resulted in two years of zero allocations for the CVP Friant Division contractors.

The construction of a raw water pipeline in 2018 to convey USBR water from the Friant-Kern Canal to the NESWTF, referred to as the Friant-Kern Canal Pipeline, has improved the reliability and water quality of deliveries to the NESWTF. The NESWTF is now capable of year-round operation, and the original connection from FID's Enterprise Canal still exists as a backup delivery system if needed.

Every three years, the Friant-Kern Canal is taken down for maintenance, and during these shutdowns the City has the flexibility to deliver its Kings River supply to the NESWTF to allow for its continued use.

#### 7.1.1.3 FID

The City has an agreement with FID providing the City an allocation of approximately 115,000 AFY of Kings River water in normal-year conditions. Water supplied from the FID contract is most susceptible to annual hydrologic conditions. The City's annual FID supply allocation is dependent on annual precipitation, Sierra Nevada mountain snowpack, and natural river flow conditions. The annual variability of these sources results in variable allocations to the City. Based on the foregoing data, FID receives an annually adjusted entitlement, the delivery of which will fluctuate throughout the irrigation delivery season. The City in turn receives its pro rata allocation based on the foregoing entitlement determination.

Another factor that may constrain the availability of Kings River water supply is scheduled maintenance of FID's vast canal network. FID typically terminates water deliveries to the City's water treatment facilities in the months of November and/or December so they can perform necessary infrastructure repairs and maintenance. However, the City constructed a dedicated 13-mile, 72-inch-diameter raw water pipeline to deliver Kings River water to the SESWTF to allow for year-round operations and prevent shutdowns due to FID maintenance. Deliveries to intentional recharge facilities will continue to be supplied through the FID canal system.

#### 7.1.1.4 Recycled Water

At present, the largest constraint for recycled water use is the lack of infrastructure to distribute the water to end users. The City has recently increased recycled water production capabilities and constructed much of the southwest recycled water system, as described in **Section 6.4**. The City plans to complete construction of the southwest recycled water distribution system in the near term and expand its recycled water delivery in the City.

### 7.1.2 Description of Management Tools and Options

The City currently manages its surface water and groundwater supply by maximizing surface water for potable use and intentional recharge during wet and normal years, while relying on groundwater during dry years. The City is currently updating its Metro Plan, which will recommend projects and programs to optimize the use of its supply portfolio and further improve supply resilience. Supply management tools are an expected outcome of the Metro Plan update; however, the City's ongoing supply management is intended to maximize local supplies and improve the groundwater basin storage. Current actions include enhanced groundwater management and intentional recharge, increased recycled water use, and continued conservation through the implementation of demand management measures.

### 7.1.3 Year Type Characterization

Normal-water-year, single-dry-water-year, and five-consecutive-year-drought-period supply projections were made based on historic water allocations for surface water supplies, historic municipal water well pumping for groundwater, and projected utilization for recycled water, as described below.

Kings River water supply data was obtained from the Kings River Water Association and FID. USBR CVP Friant Division data was obtained from the USBR website, the City of Fresno, and FID. Groundwater and recycled water supply data was obtained from the City of Fresno.

#### 7.1.3.1 Normal Year

Data for the total water supply for the normal-year condition is provided in **Table 7-1** based on:

- **Groundwater:** estimated sustainable yield from **Table 6-1**.
- **USBR:** long-term average allocation from **Table 6-2**.
- **FID:** long-term average allocation from **Table 6-3**.
- **Recycled Water:** projected supply from **Table 6-6**, excluding agricultural irrigation demand that does not offset the City's potable demand.

#### 7.1.3.2 Single Dry Year

The single-dry-year supply availability is based on 2015, during the 2012-2017 drought, because the City had the lowest surface water supply available in 2015. Data for total water supply for the single-dry-year condition is provided in **Table 7-2** based on:

- **Groundwater:** estimated sustainable yield from **Table 6-1**. If necessary, the City would pump beyond its estimated sustainable yield during dry periods and balance out the pumping with recharge in normal or wet periods.
- **USBR:** actual allocation in 2015 (0 AF).
- **FID:** actual total FID allocation in 2015 (42,935 AF) but with the projected City percentage of FID supply for the future years considered (per **Table 6-3**).
- **Recycled Water:** projected supply from **Table 6-6**, excluding agricultural irrigation demand that does not offset the City's potable demand.

#### 7.1.3.3 Multiple Dry Years

Data for total water supply for the five-year drought condition is provided in

**Table 7-3** based on:

- **Groundwater:** estimated sustainable yield from **Table 6-1**. If necessary, the City would pump beyond its estimated sustainable yield during dry periods and balance out the pumping with recharge in normal or wet periods.
- **USBR:** actual allocations in 2012 to 2016, which ranged from 0 to 45,000 AF.
- **FID:** actual total FID allocations in 2012 to 2016, which ranged from 42,935 to 110,824 but with the projected City percentage of FID supply for the future years considered (per **Table 6-3**).
- **Recycled Water:** projected supply from **Table 6-6**, excluding agricultural irrigation demand that does not offset the City's potable demand**.**

Despite severe reductions of surface water supplies during dry years, sufficient good-quality water was available to permit the SWTFs to operate. As mentioned in the previous section, there is some seasonal vulnerability with surface water availability in dry years, which needs to be closely coordinated with surface water suppliers to minimize impacts to the City's SWTF operations. Groundwater supplies, with intentional recharge augmentation, remain reliable in all hydrologic conditions.

## 7.1.4 Water Service Reliability

This section compares projected supplies and demands for a normal year, single dry year, and five-year consecutive drought. As shown in **Table 7-1**, the City is projected to have greater than 100,000 AF of available supply after meeting demands in normal years. As shown in **Table 7-2**, the City's surface water supplies are reduced in a single dry year, but all potable demands are met and groundwater recharge of raw surface water is reduced. As shown in **Table 7-3**, the City is projected to meet all demands during a five-year drought with its existing supplies. Potable demands are unrestricted, and non-potable water used for groundwater recharge is reduced in years three and four of a five-year drought.

**Table 7-1. Normal Year Supply and Demand Comparison (DWR 7-2R)**

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| Surface Water – USBR | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 |
| Surface Water – FID | 125,030 | 131,600 | 131,600 | 131,600 | 131,600 |
| Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| **SUPPLY TOTALS** | **329,030** | **341,140** | **346,610** | **352,000** | **357,330** |
| Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| Non-Potable (Groundwater Recharge) Demand | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| **DEMAND TOTALS** | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |
| **DIFFERENCE:** | **129,826** | **128,384** | **124,300** | **120,124** | **115,883** |

**Table 7-2. Single Dry Year Supply and Demand Comparison (DWR 7-3R)**

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| Surface Water – USBR | 0 | 0 | 0 | 0 | 0 |
| Surface Water – FID | 45,852 | 45,852 | 45,852 | 45,852 | 45,852 |
| Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| **SUPPLY TOTALS** | **189,852** | **195,392** | **200,862** | **206,252** | **211,582** |
| Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| Non-Potable (Groundwater Recharge) Demand | 27,588 | 28,776 | 29,964 | 31,152 | 32,340 |
| **DEMAND TOTALS** | **164,092** | **176,132** | **184,174** | **192,228** | **200,287** |
| **DIFFERENCE:** | **25,760** | **19,260** | **16,688** | **14,024** | **11,295** |

**Table 7-3. Multiple Dry Years Supply and Demand Comparison (DWR 7-4R)**

| | | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| FIRST YEAR | Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| | Surface Water – USBR | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| | Surface Water – FID | 99,725 | 99,725 | 99,725 | 99,725 | 99,725 |
| | Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| | **SUPPLY TOTALS** | **273,725** | **279,265** | **284,735** | **290,125** | **295,455** |
| | Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| | Non-Potable Demand | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| | **DEMAND TOTALS** | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |
| | **DIFFERENCE:** | **74,521** | **66,509** | **62,425** | **58,249** | **54,008** |
| SECOND YEAR | Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| | Surface Water – USBR | 37,200 | 37,200 | 37,200 | 37,200 | 37,200 |
| | Surface Water – FID | 93,426 | 93,426 | 93,426 | 93,426 | 93,426 |
| | Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| | **SUPPLY TOTALS** | **274,626** | **280,166** | **285,636** | **291,026** | **296,356** |
| | Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| | Non-Potable Demand | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| | **DEMAND TOTALS** | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |
| | **DIFFERENCE:** | **75,422** | **67,410** | **63,326** | **59,150** | **54,909** |
| THIRD YEAR | Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| | Surface Water – USBR | 0 | 0 | 0 | 0 | 0 |
| | Surface Water – FID | 73,568 | 73,568 | 73,568 | 73,568 | 73,568 |
| | Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| | **SUPPLY TOTALS** | **217,568** | **223,108** | **228,578** | **233,968** | **239,298** |
| | Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| | Non-Potable Demand | 53,763 | 46,281 | 43,526 | 40,677 | 37,761 |
| | **DEMAND TOTALS** | **190,267** | **193,637** | **197,736** | **201,753** | **205,708** |
| | **DIFFERENCE:** | **27,301** | **29,471** | **30,842** | **32,215** | **33,589** |

| | | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| FOURTH YEAR | Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| | Surface Water – USBR | 0 | 0 | 0 | 0 | 0 |
| | Surface Water – FID | 45,852 | 45,852 | 45,852 | 45,852 | 45,852 |
| | Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| | **SUPPLY TOTALS** | **189,852** | **195,392** | **200,862** | **206,252** | **211,582** |
| | Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| | Non-Potable Demand | 26,047 | 18,564 | 15,810 | 12,960 | 10,045 |
| | **DEMAND TOTALS** | **162,551** | **165,920** | **170,020** | **174,036** | **177,992** |
| | **DIFFERENCE:** | **27,301** | **29,471** | **30,842** | **32,215** | **33,589** |
| FIFTH YEAR | Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| | Surface Water – USBR | 45,000 | 45,000 | 45,000 | 45,000 | 45,000 |
| | Surface Water – FID | 125,840 | 125,840 | 125,840 | 125,840 | 125,840 |
| | Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| | **SUPPLY TOTALS** | **314,840** | **320,380** | **325,850** | **331,240** | **336,570** |
| | Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| | Non-Potable Demand | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| | **DEMAND TOTALS** | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |
| | **DIFFERENCE:** | **115,636** | **107,624** | **103,540** | **99,364** | **95,123** |

## 7.2 Drought Risk Assessment

A new provision of the Water Code directs Suppliers to prepare a DRA. The DRA considers a drought period lasting five consecutive years, starting from the year following the year when the assessment is conducted. For this plan, the DRA considers five consecutive dry years from 2021 through 2025. The City may conduct an interim update or updates to this DRA within the five-year cycle of its UWMP update. The DRA analysis allows the City to examine the management of its supplies during stressed hydrologic conditions and an opportunity to evaluate whether the City may need to enact its Water Shortage Contingency Plan (WSCP) during the next actual drought period lasting at least five years. The projected gross water use for the five-year DRA is based on unrestricted potable demand, a reduction in raw-water demand for intentional recharge in years three and four of the five-year drought, and unrestricted recycled water demand.

The reliability of supplies over a five-consecutive-year drought is described in **Section 7.1.4** and summarized below for 2021 through 2025:

- **Groundwater:** based on interpolating between the 2020 and 2025 values in **Table 6-1**. If necessary, the City would pump beyond its estimated sustainable yield during dry periods and balance out the pumping with recharge in normal or wet periods.
- **USBR:** based on the actual supply allocations from these sources during the driest consecutive five-year drought (2012–2016).

- **FID:** based on the actual supply allocations from these sources during the driest consecutive five-year drought (2012–2016). For this DRA, the City's percentage of FID supplies are conservatively assumed to remain at the existing 25.79%.
- **Recycled Water:** based on interpolating between the 2020 and 2025 values in **Table 6-6**, excluding agricultural irrigation demand that does not offset the City's potable demand.

**Table 7-4** compares the total projected supply and demand for the five-year DRA for 2021 through 2025. As shown, the City does not expect to enact its WSCP for a five-consecutive-year drought based on the unrestricted potable demand projections and the current supply portfolio and reliability.

**Table 7-4. Five-Year Drought Risk Assessment**

| WATER USE TYPE | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|
| Groundwater | 133,602 | 134,724 | 135,846 | 136,968 | 138,090 |
| Surface Water – USBR | 30,000 | 37,200 | 0 | 0 | 45,000 |
| Surface Water – FID | 93,354 | 83,085 | 65,425 | 40,776 | 111,911 |
| Recycled Water | 1,912 | 2,911 | 3,911 | 4,910 | 5,910 |
| **TOTAL SUPPLY** | **258,868** | **257,920** | **205,181** | **182,655** | **300,911** |
| Potable Demand | 124,910 | 127,827 | 130,745 | 133,662 | 136,504 |
| Non-Potable Demand | 60,000 | 60,000 | 48,287 | 22,260 | 60,000 |
| **TOTAL DEMAND** | **184,910** | **187,827** | **179,032** | **155,922** | **196,504** |
| **AVAILABLE SUPPLIES** | **73,958** | **70,093** | **26,149** | **26,732** | **104,407** |

8

CITY OF FRESNO

# Water Shortage Contingency Plan

**This WSCP is a detailed plan for how the City intends to respond to foreseeable and unforeseeable water shortages. A water shortage occurs when the water supply is reduced to a level that cannot support typical demand at any given time.**

The WSCP is used to provide guidance to the City's governing body and staff and the public by identifying response actions to allow for efficient management of any water shortage with predictability and accountability. Preparation provides the tools to maintain reliable supplies and reduce the impacts of supply interruptions due to extended drought and catastrophic supply interruptions.

IN THIS SECTION


- WSCP Overview

The WSCP describes the following:

1. **Water Supply Reliability Analysis:** summarizes the City's water supply analysis and reliability and identifies any key issues that may trigger a shortage condition
2. **Annual Water Supply and Demand Assessment Procedures:** describes the key data inputs, evaluation criteria, and methodology for assessing the system's reliability for the coming year and the steps to formally declare any water shortage levels and response actions
3. **Six Standard Shortage Stages:** establishes water shortage levels to clearly identify and prepare for shortages
4. **Shortage Response Actions:** describes the response actions that may be implemented or considered for each stage to reduce gaps between supply and demand as well as minimize social and economic impacts to the community
5. **Communication Protocols:** describes communication protocols under each stage to ensure customers, the public, and government agencies are informed of shortage conditions and requirements
6. **Compliance and Enforcement:** defines compliance and enforcement actions available to administer demand reductions
7. **Legal Authority:** lists the legal documents that grant the City the authority to declare a water shortage and implement and enforce response actions
8. **Financial Consequences of WSCP Implementation:** describes the anticipated financial impact of implementing water shortage stages and identifies mitigation strategies to offset financial burdens
9. **Monitoring and Reporting:** summarizes the monitoring and reporting techniques to evaluate the effectiveness of shortage response actions and overall WSCP implementation, with results used to determine if additional shortage response actions should be activated or if efforts are successful and response actions should be reduced
10. **WSCP Refinement Procedures:** describes the factors that may trigger updates to the WSCP and outlines how to complete an update
11. **Special Water Features Distinctions:** identifies exemptions for ponds, lakes, fountains, pools, and spas, etc.
12. **Plan Adoption, Submittal, and Availability:** describes the process for the WSCP adoption, submittal, and availability after each revision

The 2020 WSCP is a standalone document that can be modified as needed and is included as **Appendix J**.

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# 9 Demand Management Measures

**This chapter discusses the City's demand management measures including its water waste prevention ordinances, metering program, public outreach, and water loss reduction measures.**

The City employs several water conservation programs, in excess of State-mandated restrictions, to promote conservation and reduce the water supply demand. These measures help reduce overdraft of the groundwater aquifer that the City uses and have aided in the City's attainment of the urban water use reduction targets discussed in **Chapter 5**. The following sections provide a description of the Demand Management Measures (DMMs), including the nature and extent of each.

IN THIS SECTION

- Water Waste Prevention
- Metering
- Conservation Pricing
- Public Education and Outreach
- Water Loss Reduction Measures

# 9.1 Demand Management Measures for Retail

## 9.1.1 Water Waste Prevention Ordinances

The City prohibits water waste through implementation of the Urban Water Conservation and Excessive Water Use ordinance (see Section 6-520 of the Fresno Municipal Code). The ordinance includes such prohibitions as not washing hardscapes, using a nozzle-controlled hose, and using irrigation practices. The WSCP, included in **Appendix J**, Section 1.5, contains a more in-depth discussion of these prohibitions and consequences associated with them.

The City has a water waste hotline and a reporting form on the City website and keeps records of water waste violations. The City also employs fifteen staff persons year-round to manage and monitor the water conservation programs in place. Communication to the City's diverse customer base is always taken into consideration, so two of the positions require Spanish and Hmong languages. All Water Conservation Representatives use advanced metering infrastructure (AMI) to monitor and confirm excessive or negligent water waste incidents.

The Water Conservation staff can be reached at (559) 621-5300, (559) 621-5480, or (559) 621-CITY for after-hours emergencies. Online forms are also available to the public. Their office is located at 1910 E. University Avenue, Fresno, CA 93703. The Water Conservation Supervisor is Conrad Braganza.

## 9.1.2 Metering

In 2008, the City embarked on an aggressive project to install meters on all single-family residential service connections throughout its service area. The water meter project was completed at the end of 2012. The City already had water meters on all existing multifamily residential, commercial, industrial, landscape irrigation, and fire services.

With completion of the metering project, the City can now monitor water use more closely and provide its customers an understanding of water use (and its fiscal impacts), which has led to reducing water consumption by approximately 13% since 2013. The City will continue to monitor water use through the metering data and use the data to analyze demand trends and plan for future water shortages.

As part of the analysis of the meter data and through customer complaints or comments, the City is able to identify meters that are not working properly. Once identified, the City can have a maintenance crew visit the property and evaluate whether to repair or replace the meter.

The City also routinely tests and calibrates meters to ensure accuracy in reading and billing. Typically, meters are tested in place in the field or at a test bench in the meter shop. Field testing involves using calibrated flow meters to monitor the flow through a test port on or attached to the meter and comparing the measured flow to the meter reading. The majority of large meters, three inches and above, have a bypass valve that will be turned on during the meter test as not to disrupt water use to the property. In the case where a bypass valve is not in place, the customer is notified at least 48 hours before the test date. The City's service area has a total of approximately 135,000 meters, of which approximately 1,100 are three inches or larger. In 2018, of 157 of these large meters were tested, 10 were repaired, and 15 were replaced.

With the majority of meters being two inches or smaller, testing every single one is not logistically or economically feasible; therefore, a statistical sampling of each size is tested each year based on the following criteria:

- Meters six inches and above are tested annually.
- Meters three inches to four inches are tested at least once every two years.
- Meters three-fourths of an inch to two inches are sample tested as needed.

The City performs more frequent testing on larger meters on the basis that an error in their registration has a greater effect on customer equity and revenue issues. Meters registering larger volumes are given priority regardless of when they were last tested.

The City also shares meter data with the customers through its EyeOnWater tool available on its website or on a mobile app. This allows customers to monitor and better understand their hourly, daily, weekly, and monthly water usage, trends, and how they compare to average users.

## 9.1.3 Conservation Pricing

The City's customers are subject to the water rate structure adopted by the City Council through the Proposition 218 process. The approved rate structure has a base price designated by meter size and a volumetric rate for water usage. **Table 9-1** shows the rate structure.

The City will investigate the use of alternative rate structures in the future, which could have specific charges for usage to provide a fiscal incentive for customers to conserve water. This approach would permit customers to directly see the impact of water use reduction each month.

**Table 9-1. Current Water Rate Structure**

| | BASE RATE | | USAGE CHARGES | |
|---|---|---|---|---|
| METER SIZE | DOMESTIC | IRRIGATION | 100 CUBIC FEET (HCF) | 1,000 GALLONS |
| ¾" or smaller | $13.50 | $10.70 | $1.74 (per each HCF) | $2.33 (per each 1,000 gallons) |
| 1" | $17.90 | $13.40 | | |
| 1.5" | $20.80 | $15.20 | | |
| 2" | $35.30 | $24.10 | | |
| 3" | $52.80 | $34.90 | | |
| 4" | $79.00 | $51.00 | | |
| 6" | $152.00 | $96.00 | | |
| 8" | $705.00 | $436.00 | | |
| 10" | $1,113.00 | $687.00 | | |
| 12" | $1,462.00 | $901.00 | | |

## 9.1.4 Public Education and Outreach

The City has worked diligently to connect with and educate the community it serves. Those efforts include an emphasis on water conservation techniques and the importance of reducing overall water demand, both specifically to the resident (in terms of fiscal impacts) and to the overall water supply.

The City's varied programs to incentivize water savings are frequently discussed, including the following items:

- Water-wise landscape consultation
- EyeOnWater tool
- Irrigation efficiency audit
- Assistance with setting irrigation controllers
- Interior/exterior water leak surveys
- Water meter use information
- Water use rebates, coupons, and permits
- Lawn-to-garden rebates
- Water conservation hotlines

### 9.1.4.1 Education and Outreach

The City's water conservation public information program is managed in-house with the assistance of JP Marketing. The firm's services include strategic planning, creative concepts, public relations, marketing, promotion, research, advertising, media design, copywriting, event creation, and online services.

The City's public information program has many components, including multimedia campaigns (paid and public service advertising), customer billing inserts, literature, public outreach activities, a speaker's bureau, and inter-agency partnerships. Many of the City's water conservation materials are provided in three languages: English, Hmong, and Spanish.

The City is a member of the Central Valley Water Awareness Committee (CVWAC), which is composed of several cities, water utilities, irrigation districts, and other groups in the Central Valley. The CVWAC was created to increase the public's understanding of how water is treated, managed, and delivered to customers. The City participates in Water Awareness Month activities through its affiliation with the CVWAC.

The City conducted outreach to the community through approximately 50 events between 2015 and 2020, including:

- Setting up outreach booths providing water-saving info and rebate information at local festivals, parades, plant sales, home and garden shows, and fairs
- Participating in Annual Water Wise Plant Exchanges, a large community event to share water-wise plants and information and participate in hands-on activities
- Hosting Kids Water Camp, a large one-day event with hands-on activities for kids in third grade in all elementary schools in the service area
- Hosting workshops and speaker events about water-wise plants, gardening, and landscaping

A full list of specific education and outreach events over the past five years is included in **Appendix K**. The City also maintains a water conservation page on its website with links to many of the flyers and rebates mentioned above.

### 9.1.4.2 Water Surveys

The City conducted over 24,000 interior and exterior water leak surveys between 2015 and 2020. **Table 9-2** quantifies the number and types of surveys conducted.

**Table 9-2. Interior and Exterior Surveys**

| DESCRIPTION/YEAR | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | TOTAL |
|---|---|---|---|---|---|---|---|
| **EXTERIOR SURVEYS** | | | | | | | |
| Exterior Audit | 942 | 1,289 | 1,359 | 835 | 2,189 | 427 | 7,041 |
| Landscape Consultation | 605 | 382 | 193 | 139 | 149 | 48 | 1,516 |
| Large Turf Survey | 1 | 5 | 1 | 0 | 0 | 0 | 7 |
| Timer Tutorial | 1,644 | 1,967 | 1,873 | 2,170 | 1,346 | 518 | 9,518 |
| **INTERIOR SURVEYS** | | | | | | | |
| Interior Audit | 835 | 1,135 | 1,222 | 748 | 2,137 | 412 | 6,489 |
| **TOTALS** | **4,027** | **4,778** | **4,648** | **3,892** | **5,821** | **1,405** | **24,571** |

### 9.1.4.3 Rebate Programs

The City operates 14 rebate programs. Some of those that were active and used during the 2015–2020 reporting period are summarized in **Table 9-3**.

**Table 9-3. Rebate Program Results (2015–2020)**

| | LAWN TO GARDEN | | WASHING MACHINE | | HIGH EFFIC. TOILET | |
|---|---|---|---|---|---|---|
| YEAR | NO. | REBATE | NO. | REBATE | NO. | REBATE |
| 2015 | 122 | $4,044 | 358 | $46,144 | 301 | $35,344 |
| 2016 | 160 | $71,372 | 247 | $27,600 | 233 | $21,124 |
| 2017 | 103 | $37,157 | 255 | $19,682 | 495 | $18,937 |
| 2018 | 43 | $19,238 | 57 | $5,502 | 145 | $75,721 |
| 2019 | 42 | $19,456 | 84 | $8,000 | 115 | $19,091 |
| 2020 | 25 | $14,521 | 121 | $6,950 | 106 | $18,033 |
| **TOTALS** | **495** | **$165,791** | **1,122** | **$113,880** | **1,395** | **$188,253** |

### 9.1.5 Programs to Assess and Manage Distribution System Real Loss

As discussed in **Chapter 4**, the calculated loss was determined to be 8%, illustrating the City's conservative approach in the past. With completed system metering, the City is able to track losses more closely and understand where possible losses are occurring and correct them as necessary.

The AWWA Water Audit Tool suggested the areas the City could improve to reduce system losses, including calibration of source meters, unauthorized consumption, and data handling errors.

**The following measures are in place or are being developed to improve the system losses:**

- The City installed the remaining source meters on the few unmetered wells within the system in 2017, and now currently all wells and production facilities are fully metered.
- The City has a source meter calibration plan in place.
- The City has implemented meter testing frequency based on service size. This is discussed in more detail in **Section 9.1.2**.
- The City has an online tool as well as a telephone hotline available for the public to report water leaks, either on their property or within the public rights-of-way. This helps reduce detection time and limits the water loss from leaks.
- The City conducted a leak survey on 100 miles of the water system in January 2016. Eight total leaks were pinpointed, one on the main, two on hydrants, two on water service lines, and one at a water meter.
- The City uses meter data to identify any meters not functioning correctly or any leaks in the system so that they can be replaced or repaired. This helps reduce unaccounted for water consumption.

Unauthorized consumption can be determined, at times, through the meter data also. If a meter shows no usage, the City can note the address and schedule a site visit to determine any possible issues.

### 9.1.6 Other Demand Management Measures

In addition to the water conservation programs, the City has also enacted watering schedules for the community that specify days and times that customers are allowed to water, based on odd or even street addresses. The City has also created an automated courtesy notice program that informs customers when they exceed the excessive water use threshold during days and times when outdoor watering is not allowed.

## 9.2 Implementation to Achieve Water Use Targets

As discussed in **Chapter 5**, the City has met and exceeded its 2020 water use target. However, the City also realizes a portion of the observed conservation is due to the strict water use restrictions imposed during the drought. If those restrictions are lifted, the City will be diligent in continuing use of the above described DMMs.

The extensive metering program, replacement of turf, and replacement of over 10,000 high-water-use appliances (toilets and washing machines) over the last several years has helped the City maintain overall lower water consumption.

## 9.3 Water Use Objectives (Future Requirements)

As discussed in **Section 4.2.4.4**, the City is tracking the recommended water use efficiency standards and water use objectives developed due to Senate Bill 606 and Assembly Bill 1668. Currently no water use objectives have been adopted by the State, and are not anticipated to be adopted until 2022, but an indoor residential water use standard has been recommended by DWR, and additional standards are expected to be released in late 2021. The City is aware of the legislation and tracking the forthcoming water use objectives as they are available. The City is currently having ongoing discussions with DWR on clarifying the GIS-based approach for developing the overall water objective for residential customers. Alternatively, the City is also interested in using actual water use data (from the AMI system) to develop these objectives, following discussions and approval from DWR and SWRCB.

# 10 CITY OF FRESNO Plan Adoption, Submittal, and Implementation

**This section provides guidance in the adoption, submittal, and implementation of the 2020 UWMP and WSCP, as well as processes for amending the adopted plans if needed.**

This UWMP update has been prepared on a calendar-year basis and includes all water use and planning data for the 2020 calendar year. Additional details are provided in the preceding chapters.

IN THIS SECTION


- Public Hearing Notices
- Plan Adoption and Submittal

## 10.1 Notice of Public Hearing

The City has notified the County of Fresno, the only city or county in which the City provides water, of its intent to review the UWMP and consider changes to the plan. The City also notified the City of Clovis of plan preparation. Both of these governmental entities as well as a host of local water purveyors and agencies (**Table 2-1**) were notified of the preparation of the UWMP and public hearing and were encouraged to participate in the development of this plan update. Copies of the notification letters are included in **Appendix L**.

Consistent with the legislative requirements for public noticing, the City published two notices in the Fresno Bee, at least five days apart over a two-week period, providing the date and time of the public hearing. The notices were published on July 1, 2021, and July 8, 2021.

## 10.2 Public Hearing and Adoption

The City held a public hearing and adopted the 2020 UWMP on July 15, 2021. A copy of the adopting resolution is included in **Appendix M**. Before the public hearing, notices were published notifying the public of the date and time of the hearing.

## 10.3 Plan Submittal

Once the 2020 UWMP and WSCP have been adopted, a copy of the 2020 UWMP and WSCP and any subsequent amendments will be submitted to DWR, the State Library, and the County of Fresno.

## 10.4 Public Availability

Once the plan has been adopted, a hard copy will be made available for public reference at the City of Fresno Department of Public Utilities office at City Hall (located at 2600 Fresno Street) and the Water Division office (located at 1910 E. University Avenue). Additionally, an electronic copy will be uploaded to the City of Fresno website and made available for public reference.

# 11 CITY OF FRESNO References

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# A

# 2020 UWMP Checklist

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Chapter 1 | 10615 | A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses, reclamation and demand management activities. | Introduction and Overview | Chapter 1 |
| x | x | Chapter 1 | 10630.5 | Each plan shall include a simple description of the supplier's plan including water availability, future requirements, a strategy for meeting needs, and other pertinent information. Additionally, a supplier may also choose to include a simple description at the beginning of each chapter. | Summary | Executive Summary |
| x | x | Section 2.2 | 10620(b) | Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier. | Plan Preparation | Chapter 2, Section 10.2 |
| x | x | Section 2.6 | 10620(d)(2) | Coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable. | Plan Preparation | Section 2.1 |
| x | x | Section 2.6.2 | 10642 | Provide supporting documentation that the water supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan and contingency plan. | Plan Preparation | Section 2.1, Section 10.1 |
| x | | Section 2.6, Section 6.1 | 10631(h) | Retail suppliers will include documentation that they have provided their wholesale supplier(s) - if any - with water use projections from that source. | System Supplies | N/A |
| | x | Section 2.6 | 10631(h) | Wholesale suppliers will include documentation that they have provided their urban water suppliers with identification and quantification of the existing and planned sources of water available from the wholesale to the urban supplier during various water year types. | System Supplies | N/A |
| x | x | Section 3.1 | 10631(a) | Describe the water supplier service area. | System Description | Section 3.1 and 3.2 |
| x | x | Section 3.3 | 10631(a) | Describe the climate of the service area of the supplier. | System Description | Table 3-2 Section 3.3 |
| x | x | Section 3.4 | 10631(a) | Provide population projections for 2025, 2030, 2035, 2040 and optionally 2045. | System Description | Table 3-3 Section 3.4.1 |
| x | x | Section 3.4.2 | 10631(a) | Describe other social, economic, and demographic factors affecting the supplier's water management planning. | System Description | Section 3.3.1 |
| x | x | Sections 3.4 and 5.4 | 10631(a) | Indicate the current population of the service area. | System Description and Baselines and Targets | Table 3-3 Section 3.4.1 |
| x | x | Section 3.5 | 10631(a) | Describe the land uses within the service area. | System Description | Table 3-1 Section 3.1.1, Section 4.2.4.1, Table 4-3, Figure 4-3, |
| x | x | Section 4.2 | 10631(d)(1) | Quantify past, current, and projected water use, identifying the uses among water use sectors. | System Water Use | Section 4.2 |
| x | x | Section 4.2.4 | 10631(d)(3)(C) | Retail suppliers shall provide data to show the distribution loss standards were met. | System Water Use | Losses included Section 4.2.2, City has not adopted loss standards |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 4.2.6 | 10631(d)(4)(A) | In projected water use, include estimates of water savings from adopted codes, plans and other policies or laws. | System Water Use | Table 4-5 Section 4.2.4.2 |
| x | x | Section 4.2.6 | 10631(d)(4)(B) | Provide citations of codes, standards, ordinances, or plans used to make water use projections. | System Water Use | Section 4.2.5.2 |
| x | optional | Section 4.3.2.4 | 10631(d)(3)(A) | Report the distribution system water loss for each of the 5 years preceding the plan update. | System Water Use | Table 4-1 Section 4.2.2 |
| x | optional | Section 4.4 | 10631.1(a) | Include projected water use needed for lower income housing projected in the service area of the supplier. | System Water Use | Table 4-9 Section 4.3 |
| x | x | Section 4.5 | 10635(b) | Demands under climate change considerations must be included as part of the drought risk assessment. | System Water Use | Section 4.4 |
| x | | Chapter 5 | 10608.20(e) | Retail suppliers shall provide baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data. | Baselines and Targets | Table 5-1 Section 5.4 Appendix C |
| x | | Chapter 5 | 10608.24(a) | Retail suppliers shall meet their water use target by December 31, 2020. | Baselines and Targets | Section 5.5 Appendix C |
| | x | Section 5.1 | 10608.36 | Wholesale suppliers shall include an assessment of present and proposed future measures, programs, and policies to help their retail water suppliers achieve targeted water use reductions. | Baselines and Targets | N/A |
| x | | Section 5.2 | 10608.24(d)(2) | If the retail supplier adjusts its compliance GPCD using weather normalization, economic adjustment, or extraordinary events, it shall provide the basis for, and data supporting the adjustment. | Baselines and Targets | N/A |
| x | | Section 5.5 | 10608.22 | Retail suppliers' per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use of the 5 year baseline. This does not apply if the suppliers base GPCD is at or below 100. | Baselines and Targets | N/A |
| x | | Section 5.5 and Appendix E | 10608.4 | Retail suppliers shall report on their compliance in meeting their water use targets. The data shall be reported using a standardized form in the SBX7-7 2020 Compliance Form. | Baselines and Targets | Appendix C |
| x | x | Sections 6.1 and 6.2 | 10631(b)(1) | Provide a discussion of anticipated supply availability under a normal, single dry year, and a drought lasting five years, as well as more frequent and severe periods of drought. | System Supplies | Section 6.1-6.4 Section 7.1.3 |
| x | x | Sections 6.1 | 10631(b)(1) | Provide a discussion of anticipated supply availability under a normal, single dry year, and a drought lasting five years, as well as more frequent and severe periods of drought, *including changes in supply due to climate change.* | System Supplies | Section 6.8.2.1 |
| x | x | Section 6.1 | 10631(b)(2) | When multiple sources of water supply are identified, describe the management of each supply in relationship to other identified supplies. | System Supplies | Section 6.8 |
| x | x | Section 6.1.1 | 10631(b)(3) | Describe measures taken to acquire and develop planned sources of water. | System Supplies | Section 6.7 |
| x | x | Section 6.2.8 | 10631(b) | Identify and quantify the existing and planned sources of water available for 2020, 2025, 2030, 2035, 2040 and optionally 2045. | System Supplies | Table 6-7 and Table 6-8 |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 6.2 | 10631(b) | Indicate whether groundwater is an existing or planned source of water available to the supplier. | System Supplies | Section 6.1 |
| x | x | Section 6.2.2 | 10631(b)(4)(A) | Indicate whether a groundwater sustainability plan or groundwater management plan has been adopted by the water supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization. | System Supplies | Section 6.1<br>Appendix G |
| x | x | Section 6.2.2 | 10631(b)(4)(B) | Describe the groundwater basin. | System Supplies | Section 6.1.1 |
| x | x | Section 6.2.2 | 10631(b)(4)(B) | Indicate if the basin has been adjudicated and include a copy of the court order or decree and a description of the amount of water the supplier has the legal right to pump. | System Supplies | N/A |
| x | x | Section 6.2.2.1 | 10631(b)(4)(B) | For unadjudicated basins, indicate whether or not the department has identified the basin as a high or medium priority. Describe efforts by the supplier to coordinate with sustainability or groundwater agencies to achieve sustainable groundwater conditions. | System Supplies | Section 6.1.2 |
| x | x | Section 6.2.2.4 | 10631(b)(4)(C) | Provide a detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years | System Supplies | Section 6.1.6<br>Figure 6-6 |
| x | x | Section 6.2.2 | 10631(b)(4)(D) | Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped. | System Supplies | Section 6.1.5<br>Table 6-1 |
| x | x | Section 6.2.7 | 10631(c) | Describe the opportunities for exchanges or transfers of water on a short-term or long- term basis. | System Supplies | Section 6-6 |
| x | x | Section 6.2.5 | 10633(b) | Describe the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project. | System Supplies (Recycled Water) | Section 6.4.2, Appendix B<br>Table 6-3R |
| x | x | Section 6.2.5 | 10633(c) | Describe the recycled water currently being used in the supplier's service area. | System Supplies (Recycled Water) | Section 6.4.4 Table 6-5 |
| x | x | Section 6.2.5 | 10633(d) | Describe and quantify the potential uses of recycled water and provide a determination of the technical and economic feasibility of those uses. | System Supplies (Recycled Water) | Section 6.4.4 |
| x | x | Section 6.2.5 | 10633(e) | Describe the projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected. | System Supplies (Recycled Water) | Section 6.4.4 Table 6-6 |
| x | x | Section 6.2.5 | 10633(f) | Describe the actions which may be taken to encourage the use of recycled water and the projected results of these actions in terms of acre-feet of recycled water used per year. | System Supplies (Recycled Water) | Section 6.4.5 |
| x | x | Section 6.2.5 | 10633(g) | Provide a plan for optimizing the use of recycled water in the supplier's service area. | System Supplies (Recycled Water) | Section 6.4.5 |
| x | x | Section 6.2.6 | 10631(g) | Describe desalinated water project opportunities for long-term supply. | System Supplies | Section 6.5 |
| x | x | Section 6.2.5 | 10633(a) | Describe the wastewater collection and treatment systems in the supplier's service area with quantified amount of collection and treatment and the disposal methods. | System Supplies (Recycled Water) | Section 6.4.2, Appendix B<br>Table 6-3R |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 6.2.8, Section 6.3.7 | 10631(f) | Describe the expected future water supply projects and programs that may be undertaken by the water supplier to address water supply reliability in average, single-dry, and for a period of drought lasting 5 consecutive water years. | System Supplies | Section 6.7 |
| x | x | Section 6.4 and Appendix O | 10631.2(a) | The UWMP must include energy information, as stated in the code, that a supplier can readily obtain. | System Suppliers, Energy Intensity | Section 6.9 |
| x | x | Section 7.2 | 10634 | Provide information on the quality of existing sources of water available to the supplier and the manner in which water quality affects water management strategies and supply reliability | Water Supply Reliability Assessment | Section 7.1.1 |
| x | x | Section 7.2.4 | 10620(f) | Describe water management tools and options to maximize resources and minimize the need to import water from other regions. | Water Supply Reliability Assessment | Section 7.1.2 |
| x | x | Section 7.3 | 10635(a) | Service Reliability Assessment: Assess the water supply reliability during normal, dry, and a drought lasting five consecutive water years by comparing the total water supply sources available to the water supplier with the total projected water use over the next 20 years. | Water Supply Reliability Assessment | Section 7.1.4 |
| x | x | Section 7.3 | 10635(b) | Provide a drought risk assessment as part of information considered in developing the demand management measures and water supply projects. | Water Supply Reliability Assessment | Section 7.2 |
| x | x | Section 7.3 | 10635(b)(1) | Include a description of the data, methodology, and basis for one or more supply shortage conditions that are necessary to conduct a drought risk assessment for a drought period that lasts 5 consecutive years. | Water Supply Reliability Assessment | Section 7.1.3.3 |
| x | x | Section 7.3 | 10635(b)(2) | Include a determination of the reliability of each source of supply under a variety of water shortage conditions. | Water Supply Reliability Assessment | Section 7.1.3 |
| x | x | Section 7.3 | 10635(b)(3) | Include a comparison of the total water supply sources available to the water supplier with the total projected water use for the drought period. | Water Supply Reliability Assessment | Section 7.1.4 Table 7-1, Table 7-2, and Table 7-3 |
| x | x | Section 7.3 | 10635(b)(4) | Include considerations of the historical drought hydrology, plausible changes on projected supplies and demands under climate change conditions, anticipated regulatory changes, and other locally applicable criteria. | Water Supply Reliability Assessment | Section 7.1.3 and 7.1.4 |
| x | x | Chapter 8 | 10632(a) | Provide a water shortage contingency plan (WSCP) with specified elements below. | Water Shortage Contingency Planning | Appendix J |
| x | x | Chapter 8 | 10632(a)(1) | Provide the analysis of water supply reliability (from Chapter 7 of Guidebook) in the WSCP | Water Shortage Contingency Planning | Appendix J - Section 1.2 |
| x | x | Section 8.10 | 10632(a)(10) | Describe reevaluation and improvement procedures for monitoring and evaluation the water shortage contingency plan to ensure risk tolerance is adequate and appropriate water shortage mitigation strategies are implemented. | Water Shortage Contingency Planning | Appendix J - Section 1.10 |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 8.2 | 10632(a)(2)(A) | Provide the written decision-making process and other methods that the supplier will use each year to determine its water reliability. | Water Shortage Contingency Planning | Appendix J - Section 1.3 |
| x | x | Section 8.2 | 10632(a)(2)(B) | Provide data and methodology to evaluate the supplier's water reliability for the current year and one dry year pursuant to factors in the code. | Water Shortage Contingency Planning | Appendix J - Section 1.3 |
| x | x | Section 8.3 | 10632(a)(3)(A) | Define six standard water shortage levels of 10, 20, 30, 40, 50 percent shortage and greater than 50 percent shortage. These levels shall be based on supply conditions, including percent reductions in supply, changes in groundwater levels, changes in surface elevation, or other conditions. The shortage levels shall also apply to a catastrophic interruption of supply. | Water Shortage Contingency Planning | Appendix J - Section 1.4 Table 2 |
| x | x | Section 8.3 | 10632(a)(3)(B) | Suppliers with an existing water shortage contingency plan that uses different water shortage levels must cross reference their categories with the six standard categories. | Water Shortage Contingency Planning | Appendix J - Section 1.4 Figure 2 |
| x | x | Section 8.4 | 10632(a)(4)(A) | Suppliers with water shortage contingency plans that align with the defined shortage levels must specify locally appropriate supply augmentation actions. | Water Shortage Contingency Planning | Appendix J - Section 1.5.3 Table 4 |
| x | x | Section 8.4 | 10632(a)(4)(B) | Specify locally appropriate demand reduction actions to adequately respond to shortages. | Water Shortage Contingency Planning | Appendix J - Section 1.5.2 Table 3 |
| x | x | Section 8.4 | 10632(a)(4)(C) | Specify locally appropriate operational changes. | Water Shortage Contingency Planning | Appendix J - Section 1.5.4 |
| x | x | Section 8.4 | 10632(a)(4)(D) | Specify additional mandatory prohibitions against specific water use practices that are in addition to state-mandated prohibitions are appropriate to local conditions. | Water Shortage Contingency Planning | Appendix J - Section 1.5.1 |
| x | x | Section 8.4 | 10632(a)(4)(E) | Estimate the extent to which the gap between supplies and demand will be reduced by implementation of the action. | Water Shortage Contingency Planning | Appendix J - Section 1.5.2 Table 3 |
| x | x | Section 8.4.6 | 10632.5 | The plan shall include a seismic risk assessment and mitigation plan. | Water Shortage Contingency Plan | Appendix J - Section 1.5.6 |
| x | x | Section 8.5 | 10632(a)(5)(A) | Suppliers must describe that they will inform customers, the public and others regarding any current or predicted water shortages. | Water Shortage Contingency Planning | Appendix J - Section 1.6 |
| x | x | Section 8.5 and 8.6 | 10632(a)(5)(B) 10632(a)(5)(C) | Suppliers must describe that they will inform customers, the public and others regarding any shortage response actions triggered or anticipated to be triggered and other relevant communications. | Water Shortage Contingency Planning | Appendix J - Section 1.6 |
| x | | Section 8.6 | 10632(a)(6) | Retail supplier must describe how it will ensure compliance with and enforce provisions of the WSCP. | Water Shortage Contingency Planning | Appendix J - Section 1.7 |
| x | | Section 8.7 | 10632(a)(7)(A) | Describe the legal authority that empowers the supplier to enforce shortage response actions. | Water Shortage Contingency Planning | Appendix J - Section 1.8 |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 8.7 | 10632(a)(7)(B) | Provide a statement that the supplier will declare a water shortage emergency Water Code Chapter 3. | Water Shortage Contingency Planning | Appendix J - Section 1.8 |
| x | x | Section 8.7 | 10632(a)(7)(C) | Provide a statement that the supplier will coordinate with any city or county within which it provides water for the possible proclamation of a local emergency. | Water Shortage Contingency Planning | Appendix J - Section 1.8 |
| x | x | Section 8.8 | 10632(a)(8)(A) | Describe the potential revenue reductions and expense increases associated with activated shortage response actions. | Water Shortage Contingency Planning | Appendix J - Section 1.9 |
| x | x | Section 8.8 | 10632(a)(8)(B) | Provide a description of mitigation actions needed to address revenue reductions and expense increases associated with activated shortage response actions. | Water Shortage Contingency Planning | Appendix J - Section 1.9 |
| x | | Section 8.8 | 10632(a)(8)(C) | Retail suppliers must describe the cost of compliance with Water Code Chapter 3.3: Excessive Residential Water Use During Drought | Water Shortage Contingency Planning | Appendix J - Section 1.9 |
| x | | Section 8.9 | 10632(a)(9) | Retail suppliers must describe the monitoring and reporting requirements and procedures that ensure appropriate data is collected, tracked, and analyzed for purposes of monitoring customer compliance. | Water Shortage Contingency Planning | Appendix J - Section 1.10 |
| x | | Section 8.11 | 10632(b) | Analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas. | Water Shortage Contingency Planning | Appendix J - Section 1.12 |
| x | x | Sections 8.12 and 10.4 | 10635(c) | Provide supporting documentation that Water Shortage Contingency Plan has been, or will be, provided to any city or county within which it provides water, no later than 30 days after the submission of the plan to DWR. | Plan Adoption, Submittal, and Implementation | Appendix J - Section 1.13 |
| x | x | Section 8.14 | 10632(c) | Make available the Water Shortage Contingency Plan to customers and any city or county where it provides water within 30 after adopted the plan. | Water Shortage Contingency Planning | Appendix J - Section 1.13 |
| | x | Sections 9.1 and 9.3 | 10631(e)(2) | Wholesale suppliers shall describe specific demand management measures listed in code, their distribution system asset management program, and supplier assistance program. | Demand Management Measures | N/A |
| x | | Sections 9.2 and 9.3 | 10631(e)(1) | Retail suppliers shall provide a description of the nature and extent of each demand management measure implemented over the past five years. The description will address specific measures listed in code. | Demand Management Measures | Section 9.1 |
| x | | Chapter 10 | 10608.26(a) | Retail suppliers shall conduct a public hearing to discuss adoption, implementation, and economic impact of water use targets (recommended to discuss compliance). | Plan Adoption, Submittal, and Implementation | Section 10.2 |
| x | x | Section 10.2.1 | 10621(b) | Notify, at least 60 days prior to the public hearing, any city or county within which the supplier provides water that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. Reported in Table 10-1. | Plan Adoption, Submittal, and Implementation | Section 10.1, Table 2-1, Appendix L |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 10.4 | 10621(f) | Each urban water supplier shall update and submit its 2020 plan to the department by July 1, 2021. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Sections 10.2.2, 10.3, and 10.5 | 10642 | Provide supporting documentation that the urban water supplier made the plan and contingency plan available for public inspection, published notice of the public hearing, and held a public hearing about the plan and contingency plan. | Plan Adoption, Submittal, and Implementation | Appendix L |
| x | x | Section 10.2.2 | 10642 | The water supplier is to provide the time and place of the hearing to any city or county within which the supplier provides water. | Plan Adoption, Submittal, and Implementation | Appendix L |
| x | x | Section 10.3.2 | 10642 | Provide supporting documentation that the plan and contingency plan has been adopted as prepared or modified. | Plan Adoption, Submittal, and Implementation | Appendix M |
| x | x | Section 10.4 | 10644(a) | Provide supporting documentation that the urban water supplier has submitted this UWMP to the California State Library. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Section 10.4 | 10644(a)(1) | Provide supporting documentation that the urban water supplier has submitted this UWMP to any city or county within which the supplier provides water no later than 30 days after adoption. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Sections 10.4.1 and 10.4.2 | 10644(a)(2) | The plan, or amendments to the plan, submitted to the department shall be submitted electronically. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Section 10.5 | 10645(a) | Provide supporting documentation that, not later than 30 days after filing a copy of its plan with the department, the supplier has or will make the plan available for public review during normal business hours. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Section 10.5 | 10645(b) | Provide supporting documentation that, not later than 30 days after filing a copy of its water shortage contingency plan with the department, the supplier has or will make the plan available for public review during normal business hours. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Section 10.6 | 10621(c) | If supplier is regulated by the Public Utilities Commission, include its plan and contingency plan as part of its general rate case filings. | Plan Adoption, Submittal, and Implementation | N/A |
| x | x | Section 10.7.2 | 10644(b) | If revised, submit a copy of the water shortage contingency plan to DWR within 30 days of adoption. | Plan Adoption, Submittal, and Implementation | TBD |

# B

# DWR Standardized Tables

## **2-1R** | Public Water Systems

| Public Water System Number | Public Water System Name | Number of Municipal Connections 2020 | Volume of Water Supplied 2020 |
|---|---|---|---|
| CA1010007 | CITY OF FRESNO | 139,523 | 121,994 |
| | **Total:** | **139,523** | **121,994** |
| Note: Data provided by City of Fresno Water Division | | | |

## **2-2** | Public Water Systems

| Type of Plan | Member of RUWMP | Member of Regional Alliance | Name of RUWMP or Regional Alliance |
|---|---|---|---|
| Individual UWMP | No | No | N/A |

## **2-3** | Agency Identification

| Type of Supplier | Year Type | First Day of Year | | Unit Type |
|---|---|---|---|---|
| | | DD | MM | |
| Retailer | Calendar Years | | | Acre Feet (AF) |

***Conversion to Gallons:*** *325851*
***Conversion to Gallons per Day:*** *892.7425*

## **2-4R** | Water Supplier Information Exchange

| **Wholesale Water Supplier Name** |
|---|
| United States Bureau of Reclamation |
| Fresno Irrigation District |

## **3-1R** | Current & Projected Population

| Population Served | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| Total | 550,217 | 609,433 | 674,677 | 719,327 | 765,278 | 812,529 |

# **4-1R** | Actual Demands for Water

| Use Type | Additional Description | Level of Treatment When Delivered | 2020 Volume |
|---|---|---|---|
| Single Family | | Drinking Water | 60,065 |
| Multi-Family | | Drinking Water | 18,842 |
| Commercial | | Drinking Water | 16,971 |
| Industrial | | Drinking Water | 5,729 |
| Institutional/Governmental | See Note 1 | Drinking Water | --- |
| Landscape | | Drinking Water | 10,478 |
| Other | Travel Meters | Drinking Water | 340 |
| Losses | | Drinking Water | 9,568 |
| Groundwater Recharge | | Raw Water | 42,686 |
| | | **Total:** | **164,679** |

Notes:
1. Institutional and Governmental water usage is included in the Commercial use type.

## **4-2R** | Projected Demands for Water

| Use Type | Additional Description | Projected Water Use | | | | |
|---|---|---|---|---|---|---|
| | | 2025 | 2030 | 2035 | 2040 | 2045 |
| Single Family | | 76,255 | 80,429 | 82,934 | 85,437 | 87,936 |
| Multi-Family | | 19,000 | 20,654 | 21,737 | 22,831 | 23,935 |
| Commercial | | 19,052 | 21,135 | 22,587 | 24,041 | 25,496 |
| Industrial | | 7,410 | 9,003 | 9,922 | 10,841 | 11,758 |
| Institutional/Governmental | See Note 1 | | | | | |
| Landscape | | 4,490 | 5,035 | 5,422 | 5,809 | 6,196 |
| Other | Travel Meters | 200 | 200 | 200 | 200 | 200 |
| Losses | | 10,097 | 10,900 | 11,408 | 11,917 | 12,426 |
| Groundwater Recharge | Raw Water | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| **Total:** | | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |

Notes:
1. Institutional and Governmental water usage is included in the Commercial use type.

## **4-3R** | Total Gross Water Use

| | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| **Potable and Raw Water** From Table 4-1R and 4-2R | 164,679 | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| **Recycled Water Demand** From Table 6-4R | 4,757 | | | | | |
| **Total Water Use:** | **169,436** | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |

Note: Recycled water supply is a potable water offset, thus the recycled water demand in years 2025-2045 is included in the potable and raw water demand total.

# **4-4R** | 12 Month Water Loss Audit Reporting

| Report Period Start Date | | Volume of Water Loss* |
|---|---|---|
| MM | YYYY | |
| 1 | 2016 | 9,036 |
| 1 | 2017 | 10,235 |
| 1 | 2018 | 9,028 |
| 1 | 2019 | 9,059 |
| 1 | 2020 | 9,568 |

*For years 2016, through 2019, volume of water loss is taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet. For 2020 the volume of water loss is estimates as the difference in metered water produced and entered into the distribution system and metered consumption.

## **4-5R** | Inclusion in Water Use Projections

| | |
|---|---|
| **Are Future Water Savings Included in Projections?**<br>Refer to Appendix K of UWMP Guidebook. | Yes |
| Section or page number where the citations utilized in the demand projects can it be found: | Section 4.2.4.2 |
| **Are Lower Income Residential Demands Included in Projections?** | Yes |

## **5-1R** | Baselines & Targets Summary

| Baseline Period | Start Year | End Year | Average Baseline GPCD* | Confirmed 2020 Target * |
|---|---|---|---|---|
| **10-15 Year** | 1999 | 2008 | 309 | 247 |
| **5 Year** | 2003 | 2007 | 304 | N/A |

*All values are in Gallons per Capita per Day (GPCD)

## **5-2R** | 2020 Compliance

| Actual 2020 GPCD* | Optional Adjustments to 2020 GPCD | | | | | 2020 GPCD* (Adjusted if applicable) | Supplier Achieved Targeted Reduction in 2020 |
|---|---|---|---|---|---|---|---|
| | Extraordinary Events* | Economic Adjustment* | Weather Normalization* | Total Adjustments* | Adjusted 2020 GPCD* | | |
| 198 | 0 | 0 | 0 | 0 | 0 | 0 | Yes |

*All values are in Gallons per Capita per Day (GPCD)

## **6-1R** | Groundwater Volume Pumped

| Groundwater Type | Location or Basin Name | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| **Alluvial Basin** | San Joaquin Groundwater Basin: Kings Subbasin | 99,107 | 105,211 | 76,796 | 54,609 | 55,028 |
| | **Total:** | **99,107** | **105,211** | **76,796** | **54,609** | **55,028** |

# **6-2R** | Wastewater Collected within Service Area in 2020

| **The supplier will complete the table.** | | | | |
|---|---|---|---|---|
| | | | **Percentage of 2020 service area covered** | |
| | | | **Percentage of 2020 service area population covered** | |
| **Wastewater Collection** | | | **Recipient of C** | |
| **Name of Wastewater Collection Agency** | **Wastewater Volume Metered or Estimated** | **Wastewater Volume Collected from UWMP Service Area in 2020** | **Name of Wastewater Agency Receiving Collected Wastewater** | **Wastewater Treatment Plant Name** |
| **City of Fresno** | Metered | 63,652 | **City of Fresno** | RWRF |
| **City of Fresno** | Metered | 325 | **City of Fresno** | NFWRF |
| | **Total:** | **63,977** | | |
| Note: Wastewater Volume in units of AF | | | | |

# **6-3R** | Wastewater Treatment & Discharge Within Service Area in 2020

| **The supplier will complete the table.** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Wastewater Treatment Plant Name** | **Discharge Location Name or Identifier** | **Discharge Location Description** | **Wastewater Discharge ID Number** | **Method of Disposal** | **Plant Treats Wastewater Generated Outside the Service Area** | **Treatment Level** | **Wa Tre** |
| **RWRF** | Treatment Site | Onsite Percolation Ponds | WDR Order R5-2018-0080 | Percolation ponds | Yes | Secondary, Undisinfected | |
| **RWRF** | Treatment Site | Onsite Percolation Ponds | WDR Order R5-2018-0080 | Percolation ponds | Yes | Tertiary | |
| **NFWRF** | Treatment Site | Onsite Pond | WDR Order R5-2014-0162 | Percolation ponds | No | Tertiary | |
| | | | | | | **Total:** | |

# **6-4R** | Recycled Water Direct Beneficial Uses Within Service Area

| **The supplier will complete the table.** | | | | |
|---|---|---|---|---|
| **Name of Supplier Producing (Treating) the Recycled Water:** | | | City of Fresno | |
| **Name of Supplier Operating the Recycled Water Distribution System:** | | | City of Fresno | |
| **Supplemental Volume of Water Added in 2020:** | | | | |
| **Source of 2020 Supplemental Water:** | | | N/A | |
| **Beneficial Use Type** | **Potential Beneficial Uses of Recycled Water** | **Amount of Potential Uses of Recycled Water** | **General Description of 2020 Uses** | **Level of Treatment** |
| **Agricultural Irrigation** | Non-food crop irrigation | 7,900 | Irrigate non-food crops | Secondary, Undisinfected |
| **Landscape Irrigation (excludes golf courses)** | Landscape Irrigation | 5,800 | Landscape irrigation, distribtued through the southwest recycled water distribution system | Tertiary |
| **Agricultural Irrigation** | Food crop irrigation | 410 | Irrigate limited food crops, distribtued through the southwest recycled water distribution system | Tertiary |
| **Golf Course Irrigation** | Landscape Irrigation | 110 | Copper River Golf Course | Tertiary |
| | | | | **Total** |
| **Internal Reuse (Not included in Statewide Recycled Water Volume).** | | | | |

# **6-5R** | 2015 Recycled Water Use Projection Compared to 2020 Actual

**The supplier will complete the table.**

| Use Type | 2015 Projection for 2020 | 2020 Actual Use |
|---|---|---|
| **Agricultural Irrigation** | 14,200 | 3,845 |
| **Landscape Irrigation (excludes golf courses)** | 4,300 | 858 |
| **Golf Course Irrigation** | | 54 |
| **Commercial Use** | | |
| **Industrial Use** | 1,400 | |
| **Geothermal and Other Energy Production** | | |
| **Seawater Intrusion Barrier** | | |
| **Recreational Impoundment** | | |
| **Wetlands or Wildlife Habitat** | | |
| **Groundwater Recharge (IPR)*** | 1,300 | |
| **Surface Water Augmentation (IPR)*** | | |
| **Direct Potable Reuse** | | |
| **Total:** | **21,200** | **4,757** |

## **6-6R** | Methods to Expand Future Recycled Water Use

| **The supplier will complete the table below.** | | | |
|---|---|---|---|
| **Name of Action** | **Description** | **Planned Implementation Year** | **Expected Increase of Recycled Water Use** |
| **Build Infrastructure** | Recycled Water Distribution System Expansion | 2021 | 5,000 |
| | | **Total:** | **5,000** |

# **6-7R** | Expected Future Water Supply Projects or Programs

| **Some or all of the supplier's future water supply projects or programs are not compatible with this table and are described in a narrative format.** | | | | | | |
|---|---|---|---|---|---|---|
| **Page Location for Narrative in UWMP:** | | | Section 6.7 | | | |
| **Name of Future Projects or Programs** | **Joint Project with Other Suppliers** | **Agency Name** | **Description** | **Planned Implementation Year** | **Planned for Use in Year Type** | **Expected Increase in Water Supply to Supplier** |
| **Expansion of Tertiary Recycled Water Treatment** | No | | See Section 6.7 | | All Year Types | |
| **Expansion of Surface Water Treatment Capacity** | No | | See Section 6.7 | | All Year Types | |
| **Expansion of Groundwater Recharge Program** | No | | See Section 6.7 | | All Year Types | |

## **6-8R** | Actual Water Supplies

| Water Supply | Additional Detail on Water Supply | 2020 | | |
|---|---|---|---|---|
| | | Actual Volume | Water Quality | Total Right or Safe Yield |
| **Groundwater (not desalinated)** | | 55,028 | Drinking Water | |
| **Surface water (not desalinated)** | USBR CVP | 37,447 | Drinking Water | |
| **Surface water (not desalinated)** | FID Contract | 71,292 | Drinking Water | |
| **Recycled Water** | RWRF | 858 | Recycled Water | |
| **Recycled Water** | NFWRF | 54 | Recycled Water | |
| | **Total:** | **164,679** | | **-** |

## **6-8DS** | Source Water Desalination

**Neither groundwater nor surface water are reduced in salinity prior to distribution. The supplier will not complete the table.**

# **6-9R** | Projected Water Supplies

| Water Supply | Additional Detail on Water Supply | Projected Water Sup | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2025 | | 2030 | | 2035 | |
| | | Reasonably Available Volume | Total Right or Safe Yield | Reasonably Available Volume | Total Right or Safe Yield | Reasonably Available Volume | Total R Safe |
| Groundwater (not desalinated) | Kings Subbasin | 138,090 | | 143,630 | | 149,100 | |
| Surface water (not desalinated) | USBR CVP | 60,000 | | 60,000 | | 60,000 | |
| Surface water (not desalinated) | FID Contract | 125,030 | | 131,600 | | 131,600 | |
| Recycled Water | NFWRF Tertiary Disinfected | 5,800 | | 5,800 | | 5,800 | |
| Recycled Water | RWRF Tertiary Disinfected | 110 | | 110 | | 110 | |
| | **Total:** | **329,030** | **-** | **341,140** | **-** | **346,610** | |

## 7-1R | Basis of Water Year Data (Reliability Assessment)

| | |
|---|---|
| **Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP.** | |
| **Page Location for Narrative in UWMP:** | See Section 7.1.3 in the UWMP |

## **7-2R** | Normal Year Supply and Demand Comparison

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| **Supply Totals** From Table 6-9R | 329,030 | 341,140 | 346,610 | 352,000 | 357,330 |
| **Demand Totals** From Table 4-3R | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| **Difference:** | **129,826** | **128,384** | **124,300** | **120,124** | **115,883** |

## **7-3R** | Single Dry Year Supply & Demand Comparison

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| **Supply Totals** | 189,852 | 195,392 | 200,862 | 206,252 | 211,582 |
| **Demand Totals** | 164,092 | 176,132 | 184,174 | 192,228 | 200,287 |
| **Difference:** | **25,760** | **19,260** | **16,688** | **14,024** | **11,295** |

# 7-4R | Multiple Dry Years Supply & Demand Comparison

| | | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| **First Year** | **Supply Totals** | 273,725 | 279,265 | 284,735 | 290,125 | 295,455 |
| | **Demand Totals** | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | **Difference:** | **74,521** | **66,509** | **62,425** | **58,249** | **54,008** |
| **Second Year** | **Supply Totals** | 274,626 | 280,166 | 285,636 | 291,026 | 296,356 |
| | **Demand Totals** | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | **Difference:** | **75,422** | **67,410** | **63,326** | **59,150** | **54,909** |
| **Third Year** | **Supply Totals** | 217,568 | 223,108 | 228,578 | 233,968 | 239,298 |
| | **Demand Totals** | 190,267 | 193,637 | 197,736 | 201,753 | 205,708 |
| | **Difference:** | **27,301** | **29,471** | **30,842** | **32,215** | **33,589** |
| **Fourth Year** | **Supply Totals** | 189,852 | 195,392 | 200,862 | 206,252 | 211,582 |
| | **Demand Totals** | 162,551 | 165,920 | 170,020 | 174,036 | 177,992 |
| | **Difference:** | **27,301** | **29,471** | **30,842** | **32,215** | **33,589** |
| **Fifth Year** | **Supply Totals** | 314,840 | 320,380 | 325,850 | 331,240 | 336,570 |
| | **Demand Totals** | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | **Difference:** | **115,636** | **107,624** | **103,540** | **99,364** | **95,123** |

## **7-5** | Five-Year Drought Risk Assessment Tables to Address Water Code Section 10635(b)

| | | |
|---|---|---|
| **2021** | **Gross Water Use** | 184,910 |
| | **Total Supplies** | 240,905 |
| | **Surplus/Shortfall without WSCP Action** | **55,995** |
| | **Planned WSCP Actions (Use Reduction and Supply Augmentation)** | |
| | **WSCP (Supply Augmentation Benefit)** | 0 |
| | **WSCP (Use Reduction Savings Benefit)** | 0 |
| | **Revised Surplus/Shortfall** | **55,995** |
| | **Resulting Percent Use Reduction from WSCP Action** | **0%** |
| **2022** | **Gross Water Use** | 187,827 |
| | **Total Supplies** | 244,448 |
| | **Surplus/Shortfall without WSCP Action** | **56,621** |
| | **Planned WSCP Actions (Use Reduction and Supply Augmentation)** | |
| | **WSCP (Supply Augmentation Benefit)** | 0 |
| | **WSCP (Use Reduction Savings Benefit)** | 0 |
| | **Revised Surplus/Shortfall** | **56,621** |
| | **Resulting Percent Use Reduction from WSCP Action** | **0%** |
| **2023** | **Gross Water Use** | 170,051 |
| | **Total Supplies** | 196,200 |
| | **Surplus/Shortfall without WSCP Action** | **26,149** |
| | **Planned WSCP Actions (Use Reduction and Supply Augmentation)** | |
| | **WSCP (Supply Augmentation Benefit)** | 0 |
| | **WSCP (Use Reduction Savings Benefit)** | 0 |
| | **Revised Surplus/Shortfall** | **26,149** |
| | **Resulting Percent Use Reduction from WSCP Action** | **0%** |
| **2024** | **Gross Water Use** | 151,432 |
| | **Total Supplies** | 178,164 |
| | **Surplus/Shortfall without WSCP Action** | **26,732** |
| | **Planned WSCP Actions (Use Reduction and Supply Augmentation)** | |
| | **WSCP (Supply Augmentation Benefit)** | 0 |
| | **WSCP (Use Reduction Savings Benefit)** | 0 |
| | **Revised Surplus/Shortfall** | **26,732** |
| | **Resulting Percent Use Reduction from WSCP Action** | **0%** |
| **2025** | **Gross Water Use** | 196,504 |
| | **Total Supplies** | 300,911 |
| | **Surplus/Shortfall without WSCP Action** | **104,407** |
| | **Planned WSCP Actions (Use Reduction and Supply Augmentation)** | |
| | **WSCP (Supply Augmentation Benefit)** | 0 |
| | **WSCP (Use Reduction Savings Benefit)** | 0 |
| | **Revised Surplus/Shortfall** | **104,407** |
| | **Resulting Percent Use Reduction from WSCP Action** | **0%** |

**8-1** | Water Shortage Contingency Plan Levels

| Shortage Level | Percent Shortage[1] | Water Shortage Condition |
|---|---|---|
| 0 | | No water shortage condition. Corresponds with year-round water use measures listed in Section 1.5.1 and demand reduction measures listed for "All" stages in Table 3. |
| 1 | 0-10% | Stage 1 may be triggered by any of the following conditions:<br>•The available water supplies for the next year are projected to be less than 100% of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>•After having been in a Stage 2 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[2] or higher; or<br>•After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 2 | 10-25% | Stage 2 may be triggered by any of the following conditions:<br>•The available water supplies for the next year are projected to be less than 90% of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>•After having been in a Stage 3 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[2] or higher; or<br>•After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 3 | 25-35% | Stage 3 may be triggered by any of the following conditions:<br>•The available water supplies for the next year are projected to be less than 75% of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>•After having been in a Stage 4 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[2] or higher; or<br>•After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 4 | 35-50% | Stage 4 may be triggered by any of the following conditions:<br>•The available water supplies for the next year are projected to be less than 65% of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>•After having been in a Stage 5 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[2] or higher; or<br>•After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 5 | >50% | Stage 5 may be triggered by any of the following conditions:<br>•The available water supplies for the next year are projected to be less than 50% of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment. |

[1]Shortage levels indicate the gap between supply and demand compared to normal-year conditions. The Annual Assessment incorporates a 10% buffer on top of projected demands for conservative planning.
[2]Water year types were defined 2006 San Joaquin River Restoration Settlement Agreement for USBR allocations and characterized in Section 6.2 of the City's 2020 UWMP.

**8-2** | Demand Reduction Actions

| Shortage Level | Demand Reduction Actions | How much is this going to reduce the shortage gap?[1] | Additional Explanation or Reference | Penalty, Charge, or Other Enforcement[2] |
|---|---|---|---|---|
| All | Expand Public Information Campaign | Not Applicable | Community outreach includes classroom presentations, outreach educational information, and water tours. Increase communication as drought stages increase. | Not Applicable |
| All | Improve Customer Billing | Not Applicable | Water bills show customer usage vs. average usage for the customer category. Increase customer notifications of high water use based on advanced metering infrastructure (AMI) data as drought stages increase. | Not Applicable |
| All | Offer Water Use Surveys | Not Applicable | Use water leak surveys with all community members. | Not Applicable |
| All | Provide Rebates for Landscape Irrigation Efficiency | Not Applicable | The City offers rebates for micro-irrigation conversions, soil moisture sensors, smart irrigation controller, and rain sensors to improve efficiencies. | Not Applicable |
| All | Provide Rebates for Turf Replacement | Not Applicable | The City provides rebates for community members who wish to replace their turf with a drought-resistant garden. | Not Applicable |
| All | Provide Rebates on Plumbing Fixtures and Devices | Not Applicable | The City offers rebates on a variety of high-efficiency plumbing fixtures, such as washers, toilets, and urinals. | Not Applicable |
| All | Decrease Line Flushing | Not Applicable | The City uses NO-DES for regular pipe flushing to eliminate discharging water. | Not Applicable |
| All | Reduce System Water Loss | Not Applicable | The City has a comprehensive system water loss reduction program in place. Increase efforts to correct water system losses as drought stages increase. | Not Applicable |
| 1 | Decrease Line Flushing | 0 to 100% of shortage gap | For dead-end flushing where the NO-DES truck cannot be used, reduce normal flushing time. | Not Applicable |
| 1 | Increase Water Waste Patrols | 0 to 100% of shortage gap | Increase monitoring of AMI reporting and communication with customers; Conduct patrols based on public input. | Not Applicable |
| 1 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Voluntary limits:<br>Summer: three days/week<br>Winter: one day/week | No |
| 2 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Summer: three days/week<br>Winter: one day/week | Yes |
| 3 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Summer: two days/week<br>Winter: one day/week | Yes |
| 4 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Summer: one day/week<br>Winter: one day/week | Yes |
| 4 | Other — Prohibit use of potable water for construction and dust control | 0 to 100% of shortage gap | The City provides rebates for community members who wish to replace their turf with a drought resistant garden | No |
| 4 | Other — Prohibit use of potable water for construction and dust control | 0 to 100% of shortage gap | Prohibit use of potable water for construction, compaction, dust control, street or parking lot sweeping, and building washdowns where non-potable or recycled water is sufficient. | Yes |
| 4 | Other — Prohibit vehicle washing except at facilities using recycled or recirculating water | 0 to 100% of shortage gap | Prohibit washing cars, boats, trailers, aircraft, or other vehicles, except at commercial or fleet vehicle-washing facilities using water recycling equipment. | Yes |
| 4 | Pools and Spas - Require covers for pools and spas | 0 to 100% of shortage gap | Require covers for swimming pools when not in use. | No |
| 4 | Other | 0 to 100% of shortage gap | Prohibit use of potable water for sewer system maintenance or fire protection training without prior approval by the City manager. | Not Applicable |
| 4 | Other | 0 to 100% of shortage gap | Prohibit use of outdoor misters. | No |
| 5 | Landscape — Prohibit all landscape irrigation | 0 to 100% of shortage gap | Prohibit outdoor irrigation year-round. | Yes |
| 5 | Moratorium or Net Zero Demand Increase on New Connections | 0 to 100% of shortage gap | The City will temporarily limit or ban new water service connections within the service area. | Not Applicable |

[1]Reduction in the shortage gap is estimated and can vary significantly.
[2]Refer to WSCP Section 1.7 for Penalties for Water Wastage.

## 8-3R | Supply Augmentation & Other Actions

| Shortage Level | Supply Augmentation Methods and Other Actions by Water Supplier | How much is this going to reduce the shortage gap? | Additional Explanation or Reference |
|---|---|---|---|
| 1 to 5 | Transfers | As Needed | Purchase or exchange available USBR or FID surface water |
| 1 to 5 | Other Purchases | As Needed | Interconnection with City of Clovis for use in emergencies |

# 10-1R | Notification to Cities & Counties

| City | 60 Day Notice | Notice of Public Hearing | Other |
|---|---|---|---|
| City of Clovis | Yes | Yes | |
| **County** | **60 Day Notice** | **Notice of Public Hearing** | **Other** |
| County of Fresno | Yes | Yes | |
| **Other** | **60 Day Notice** | **Notice of Public Hearing** | **Other** |
| Bakman Water Company | Yes | Yes | |
| Fresno Irrigation District | Yes | Yes | |
| Fresno Metropolitan Flood Control District | Yes | Yes | |
| Friant Water Authority | Yes | Yes | |
| Garfield Water District | Yes | Yes | |
| Malaga County Water District | Yes | Yes | |
| North Kings Groundwater Sustainabilty Agency | Yes | Yes | |
| Pinedale County Water District | Yes | Yes | |
| United Stated Bureau of Reclamation South-Central California Area Office | Yes | Yes | |

# C

# SBx7-7 Tables and Verification Form

| **SB X7-7 Table 7-A: Target Method 1**<br>20% Reduction | |
|---|---|
| 10-15 Year Baseline GPCD | 2020 Target GPCD |
| 309 | 247 |
| NOTES: | |

| **SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target** | | | |
|---|---|---|---|
| 5 Year Baseline GPCD *From SB X7-7 Table 5* | Maximum 2020 Target* | Calculated 2020 Target *Fm Appropriate Target Table* | Confirmed 2020 Target |
| 304 | 288 | 247 | 247 |
| ** Maximum 2020 Target is 95% of the 5 Year Baseline GPCD* | | | |
| NOTES: | | | |

| **SB X7-7 Table 9: 2015 Compliance** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | Optional Adjustments *(in GPCD)* | | | | | 2015 GPCD *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? |
| | | Extraordinary Events | Weather Normalization | Economic Adjustment | TOTAL Adjustments | Adjusted 2015 GPCD | | |
| 190 | 278 | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | 0 | 189.745674 | 189.745674 | YES |
| NOTES: | | | | | | | | |

| **SB X7-7 Table 0: Units of Measure Used in 2020 UWMP*** *(select one from the drop down list)* |
|---|
| Acre Feet |
| **The unit of measure must be consistent throughout the UWMP, as reported in Submittal Table 2-3.* |
| NOTES: |

| SB X7-7 Table 2: Method for 2020 Population Estimate | |
|---|---|
| **Method Used to Determine 2020 Population** (may check more than one) | |
| ☐ | **1. Department of Finance** (DOF) or **American Community Survey** (ACS) |
| ☐ | **2. Persons-per-Connection Method** |
| ☑ | **3. DWR Population Tool** |
| ☐ | **4. Other** DWR recommends pre-review |
| NOTES: | |

| SB X7-7 Table 3: 2020 Service Area Population | |
|---|---|
| **2020 Compliance Year Population** | |
| **2020** | 550,217 |
| NOTES: | |

| SB X7-7 Table 4: 2020 Gross Water Use | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Compliance Year 2020** | **2020 Volume Into Distribution System** *This column will remain blank until SB X7-7 Table 4-A is completed.* | **2020 Deductions** | | | | | **2020 Gross Water Use** |
| | | **Exported Water *** | **Change in Dist. System Storage*** (+/-) | **Indirect Recycled Water** *This column will remain blank until SB X7-7 Table 4-B is completed.* | **Water Delivered for Agricultural Use*** | **Process Water** *This column will remain blank until SB X7-7 Table 4-D is completed.* | |
| | 121,994 | - | - | - | - | - | **121,994** |
| *** Units of measure (AF, MG , or CCF)** must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3. | | | | | | | |
| NOTES: | | | | | | | |

**SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment**
Complete one table for each source.

| **Name of Source** | Groundwater |
|---|---|
| **This water source is** *(check one)* **:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Compliance Year 2020** | Volume Entering Distribution System [1] | Meter Error Adjustment [2] *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|
| | 55,028 | - | 55,028 |

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES

**SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s) Meter Error Adjustment**
Complete one table for each source.

| **Name of Source** | Surface Water- NESWTF |
|---|---|
| **This water source is** *(check one)* **:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Compliance Year 2020** | Volume Entering Distribution System [1] | Meter Error Adjustment [2] *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|
| | 20,724 | | 20,724 |

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

**SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment**
Complete one table for each source.

| **Name of Source** | Surface Water- SESWTF |
|---|---|
| **This water source is** *(check one)* **:** | |

| | |
|---|---|
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| Compliance Year 2020 | Volume Entering Distribution System [1] | Meter Error Adjustment [2] *Optional* (+/-) | Corrected Volume Entering Distribution System |
|---|---|---|---|
| | 45,367 | | 45,367 |

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

**SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment**

Complete one table for each source.

| **Name of Source** | Surface Water- T-3 SWTF |
|---|---|

**This water source is** *(check one)* **:**

| | |
|---|---|
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| Compliance Year 2020 | Volume Entering Distribution System [1] | Meter Error Adjustment [2] *Optional* (+/-) | Corrected Volume Entering Distribution System |
|---|---|---|---|
| | 875 | | 875 |

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

**SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment**

Complete one table for each source.

| **Name of Source** | Enter Name of Source 5 |
|---|---|

**This water source is** *(check one)* **:**

| | |
|---|---|
| ☐ | The supplier's own water source |
| ☐ | A purchased or imported source |

| SB X7-7 Table 5: 2020 Gallons Per Capita Per Day (GPCD) | | |
|---|---|---|
| **2020 Gross Water** *Fm SB X7-7 Table 4* | **2020 Population** *Fm SB X7-7 Table 3* | **2020 GPCD** |
| 121,994 | 550,217 | **198** |
| NOTES: | | |

| SB X7-7 Table 9: 2020 Compliance | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actual 2020 GPCD[1] | Optional Adjustments to 2020 GPCD<br>Enter "0" if Adjustment Not Used<br>Extraordinary Events[1] | Weather Normalization[1] | Economic Adjustment[1] | TOTAL Adjustments[1] | Adjusted 2020 GPCD [1] *(Adjusted if applicable)* | 2020 Confirmed Target GPCD [1, 2] | **Did Supplier Achieve Targeted Reduction for 2020?** |
| 198 | - | - | - | - | 198 | 247 | **YES** |

[1] *All values are reported in GPCD*

[2] ***2020 Confirmed Target GPCD*** *is taken from the Supplier's SB X7-7 Verification Form Table SB X7-7, 7-F.*

NOTES:

# D

# City of Fresno's Reduce Delta Reliance Reporting

# Appendix D - Delta Reliance

## 1. Background

Under the Sacramento-San Joaquin Delta Reform Act of 2009, state and local public agencies proposing a covered action (e.g., a proposed project) in the Sacramento-San Joaquin Delta (Delta), prior to initiating the implementation of that action, must prepare a written certification of consistency with detailed findings as to whether the covered action is consistent with applicable Delta Plan policies and submit that certification to the Delta Stewardship Council.

Anyone may appeal a certification of consistency. If the Delta Stewardship Council grants the appeal, the covered action may not be implemented until the agency proposing the covered action submits a revised certification of consistency. The covered action may be implemented if either: 1) no appeal is filed; or 2) the Delta Stewardship Council denies the appeal to the revised certification of consistency.

The City of Fresno (City) contracts with the United States Bureau of Reclamation (USBR) Central Valley Project (CVP) Friant Division for an annual supply of 60,000 af of Class 1 water through an agreement originally executed in January 1961. Although the Friant Division of the CVP does not pull water from the Delta, the project was developed through an exchange agreement reached in 1939 with the Delta-Mendota supply that provides water to the Exchange Contractors[1] with historic pre-1914 San Joaquin River water rights. As restrictions on Delta exports have hindered USBR from making deliveries to the Delta-Mendota Canal, the Exchange Contractors can call on their historic rights, which reduces the Friant Division Class 1 allocations. As such, the City is required to demonstrate consistency with the Delta Plan's policy to reduce reliance on the Delta.

An urban water supplier that anticipates participating in or receiving water from a proposed covered action such as a multi-year water transfer, conveyance facility, or new diversion that involves transferring water through, exporting water from, or using water in the Delta should provide information in their 2015 and 2020 Urban Water Management Plans (UWMPs) that can then be used in the covered action process to demonstrate consistency with Delta Plan Policy WR P1, Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance (WR P1).

WR P1 details what is needed for a covered action to demonstrate consistency with reduced reliance on the Delta and improved regional self-reliance. WR P1 subsection (a) states that:

[1] The Exchange Contractors are the benefactors of the historic pre-1914 water rights established by Miller and Lux. These contracts include: Central California Irrigation District; San Luis Canal Company; Firebaugh Canal Water District; and Columbia Canal Company, per http://www.sjrecwa.net/history.html (accessed March 10, 2021).

*(a) Water shall not be exported from, transferred through, or used in the Delta if all of the following apply:*

*(1) One or more water suppliers that would receive water as a result of the export, transfer, or use have failed to adequately contribute to reduced reliance on the Delta and improved regional self-reliance consistent with all of the requirements listed in paragraph (1) of subsection (c);*

*(2) That failure has significantly caused the need for the export, transfer, or use; and*

*(3) The export, transfer, or use would have a significant adverse environmental impact in the Delta.*

WR P1 subsection (c)(1) further defines what adequately contributing to reduced reliance on the Delta means in terms of (a)(1) above.

*(c)(1) Water suppliers that have done all the following are contributing to reduced reliance on the Delta and improved regional self-reliance and are therefore consistent with this policy:*

*(A) Completed a current Urban or Agricultural Water Management Plan (Plan) which has been reviewed by the California Department of Water Resources for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;*

*(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta; and*

*(C) Included in the Plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance. The expected outcome for measurable reduction in Delta reliance and improvement in regional self- reliance shall be reported in the Plan as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code section 1011(a).*

The analysis and documentation provided below include all the elements described in WR P1(c)(1) that need to be included in a water supplier's UWMP to support a certification of consistency for a future covered action.

## 2. Methodology

As stated in WR P1(c)(1)(C), the policy requires that, commencing in 2015, UWMPs include expected outcomes for improved regional self-reliance and measurable reduction in Delta reliance. WR P1 further states that those outcomes shall be reported in the UWMP as the reduction in the amount of water used, or in the percentage of water used, from the Delta. The expected outcomes for the City's regional self-reliance and reduced Delta reliance were developed using the approach and guidance described in Appendix C of DWR's Urban Water Management Plan Guidebook 2020 issued in March 2020 (Guidebook Appendix C), including the use of narrative justifications for the accounting of supplies and the documentation of specific data sources.

All data were obtained from planning documents adopted by the City Council, including the current and previous UWMPs and Metropolitan Water Resource Management Plan (Metro Plan) and represent average or normal water year conditions. Using normal water year demands serves as a proxy for the amount of supplies that would be used in a normal water year, which helps alleviate issues associated with how supply capability is presented to fulfill requirements of the UWMP Act versus how supplies might be accounted for to demonstrate consistency with WR P1.

To calculate the expected outcomes for improved regional self-reliance and reduced Delta reliance, a baseline is needed to compare against. This analysis uses a normal water year representation of 2010 as the baseline, which is consistent with the approach described in the Guidebook Appendix C. Data for the 2010 baseline were taken from the City's 2008 UWMP. Consistent with the 2010 baseline data approach, the expected outcomes for improved regional self-reliance and reduced Delta reliance for 2015 and 2020 were taken from the City's 2010 and 2015 UWMPs, respectively. Expected outcomes for 2025-2045 are from the current 2020 UWMP. Documentation of the specific data sources and assumptions are included in the discussions below.

# 3. Demonstration of Regional Self-Reliance

## 3.1 Service Area Demands without Water Use Efficiency

Because WR P1 considers water use efficiency savings a source of water supply, water suppliers such as the City that do not explicitly quantify water use efficiency savings in their UWMPs can calculate their embedded water use efficiency savings based on changes in forecasted per capita water use since the baseline.

Agencies that explicitly calculate and report water use efficiency savings in their UWMP will need to make an adjustment to properly reflect normal water year demands in the calculation of reduced reliance. As explained in the Guidebook Appendix C, water use efficiency savings must be added back to the normal year demands to represent demands without water use efficiency savings accounted for; otherwise the effect of water use efficiency savings on regional self-reliance would be overestimated. **Table 1** (included at the end of this appendix) shows the results of this adjustment for the City. Supporting narratives and documentation for all the data shown in Table 1 are provided below.

Service Area Demands with Water Use Efficiency

The service area demands shown in Table 1 represent the total water demands for the City's service area. The demand data shown in Table 1 were collected from the following sources:

- Baseline (2010): Fresno 2008 UWMP, Table 6-5
- 2015: Fresno 2010 UWMP, Table 7-2
- 2020: Fresno 2015 UWMP, Table 4-4
- 2025-2045: Fresno 2020 UWMP, Table 4-6

Non-Potable Water Demands

The non-potable water demands shown in Table 1 represent recycled water use that offsets potable water use in the City's service area. The demand data shown in Table 1 were collected from the following sources:

- Baseline (2010): Fresno 2008 UWMP, Table 10-7
- 2015: Fresno 2010 UWMP, Table 7-1
- 2020: Fresno 2015 UWMP, Table 6-14
- 2025-2045: Fresno 2020 UWMP, Table 4-7

Potable Service Area Demands with Water Use Efficiency

Subtract "Non-Potable Water Demands" from "Service Area Demands with Water Use Efficiency."

Service Area Population

The population data shown in Table 1 were collected from the following sources:

- Baseline (2010) and 2015: Fresno 2015 UWMP, Table 5-1
- 2020-2045: Fresno 2020 UWMP, Table 3-3

Estimated Water Use Efficiency Since Baseline

The "Per Capita Water Use" calculated using "Potable Service Area Demands with Water Use Efficiency" divided by "Service Area Population". The "Change in Per Capita Water Use from Baseline" was then calculated by comparing with 2010 Per Capita Water Use. Finally, the "Estimated Water Use Efficiency Since Baseline" was calculated by multiplying the "Change in Per Capita Water Use from Baseline" by the population for one (1) year.

Service Area Water Demands without Water Use Efficiency

Add "Service Area Demands with Water Use Efficiency" to "Estimated Water Use Efficiency Since Baseline."

## 3.2 Supplies Contributing to Regional Self-Reliance

For a covered action to demonstrate consistency with the Delta Plan, WR P1 subsection (c)(1)(C) states that water suppliers must report the expected outcomes for measurable improvement in regional self-reliance. Table 2 shows expected outcomes for supplies contributing to regional self-reliance both in amount and as a percentage. The numbers shown in **Table 2** (included at the end of this appendix) represent efforts to improve regional self-reliance for the City's entire service area and include the total contributions of the City and its customers. Supporting narratives and documentation for all of the data shown in Table 2 are provided below.

Estimated Water Use Efficiency Since Baseline

The water use efficiency information shown in Table 2 is taken directly from Table 1.

Water Recycling

The water recycling information shown in Table 2 is taken from the Non-Potable Water Demands row in Table 1.

Local and Regional Water Supply and Storage Programs

The values shown in Table 2 represent groundwater supplies considering both natural recharge and intentional recharge. The supply data shown in Table 2 were collected from the following sources:

- Baseline (2010): Fresno 2008 UWMP, Table 4-9
- 2015: Fresno 2010 UWMP, Table 7-1
- 2020: Fresno 2015 UWMP, Table 6-14

- 2025-2045: Fresno 2020 UWMP, Table 6-8

Other Programs and Projects the Contribute to Regional Self-Reliance

The values shown in Table 2 represent Kings River supplies considering both contracted supplies and recycled water exchange supplies. The supply data shown in Table 2 were collected from the following sources:

- Baseline (2010): Fresno 2008 UWMP, Table 4-11
- 2015: Fresno 2010 UWMP, Table 7-1
- 2020: Fresno 2015 UWMP, Table 6-5
- 2025-2045: Fresno 2020 UWMP, Table 6-8

Water Supplies Contributing to Regional Self Reliance

Sum of:

- Estimated Water Use Efficiency Since Baseline
- Water Recycling
- Local and Regional Water Supply and Storage Programs
- Other Programs and Projects the Contribute to Regional Self-Reliance

Percent of Water Supplies Contributing to Regional Self-Reliance

“Water Supplies Contributing to Regional Self Reliance” divided by “Service Area Water Demands without Water Use Efficiency” (from Section 3.1).

## 3.3 Conclusions

The results shown in Table 2 demonstrate that the City’s service area is measurably improving its regional self-reliance. The following provides a summary of the near-term (2025) and long-term (2045) expected outcomes for the City’s regional self-reliance:

- Near-term (2025): The expected outcome for normal water year regional self-reliance is expected to increase by 129,700 AFY from the 2010 baseline; this represents an increase of about 31 percent of 2025 normal water year demands (Table 2).
- Long-term (2045): The expected outcome for normal water year regional self-reliance is expected to increase by more than 191,600 AFY from the 2010 baseline, this represents an increase of about 14 percent of 2045 normal water year retail demands (Table 2).

The results show that the City is measurably improving regional self-reliance, both as an amount of water used and as a percentage of water used.

# 4. Demonstration of Reduced Reliance on the Delta

The City's service area reduces reliance on the Delta through investments in non-Delta water supplies, local water supplies, and regional and local demand management measures.

## 4.1 Calculation of Reliance on Water Supplies from the Delta Watershed

The calculation of reliance on water supplies from the Delta watershed, shown in **Table 3** (included at the end of this appendix), is based on the following assumptions.

CVP/SWP Contract Supplies

The City water supplies with a connection to the Delta watershed are CVP/SWP Contract Supplies. The supply data shown in Table 3 is for anticipated average yield from the City's USBR contract and were collected from the following sources:

- Baseline (2010): Fresno 2008 UWMP, Table 4-6
- 2015: Fresno 2010 UWMP, Table 7-1
- 2020: Fresno 2015 UWMP, Table 6-14
- 2025-2045: Fresno 2020 UWMP, Table 6-2

Water Supplies from the Delta Watershed

Equal to "CVP/SWP Contract Supplies."

Percent Change in Supplies from the Delta Watershed

Divides "Water Supplies from the Delta Watershed" by "Service Area Demands without Water Use Efficiency" (from Section 3.1) and calculates changes from the 2010 baseline.

## 4.2 Conclusions

The following provides a summary of the near-term (2025) and long-term (2045) expected outcomes for the City's Delta reliance on supplies from the Delta watershed:

- Near-term (2025): The expected outcome for normal water year reliance on supplies from the Delta watershed is expected to decrease by 4,520 AF from the 2010 baseline. With Delta water representing 25.5% of service area water demand without water use efficiency, this represents a decrease from the 2010 baseline of 10.1% (Table 3).
- Long-term (2045): The expected outcome for normal water year reliance on supplies from the Delta watershed is expected to decrease by 4,520 AF from the 2010 baseline. With Delta water representing 19.5% of service area water demand without water use efficiency, this represents a decrease from the 2010 baseline of 16.2% (Table 3).

The results shown in Table 3 demonstrate that City is measurably reducing reliance on the Delta, both as an amount of water used and as a percentage of water used.

## 5. UWMP Implementation

In addition to the analysis and documentation described above, WR P1 subsection (c)(1)(B) requires that all programs and projects included in the UWMP that are locally cost-effective and technically feasible, which reduce reliance on the Delta, are identified, evaluated, and implemented consistent with the implementation schedule. WR P1 (c)(1)(B) states that:

> *(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta[.]*

In accordance with Water Code Section 10631(f), water suppliers must already include in their UWMP a detailed description of expected future projects and programs that they may implement to increase the amount of water supply available to them in normal and single-dry water years and for a period of drought lasting five consecutive years. The UWMP description must also identify specific projects, include a description of the increase in water supply that is expected to be available from each project, and include an estimate regarding the implementation timeline for each project or program.

Chapter 6 of the City's 2020 UWMP summarizes the implementation of future water projects and continued progress in developing a diversified water portfolio to meet the City's water needs.

## 6. 2015 UWMP Appendix L

The information contained in this appendix is also intended to be a new Appendix L attached to the City's 2015 UWMP consistent with WR P1 subsection (c)(1)(C) (Cal. Code Regs. tit. 23, § 5003). The City provided notice of the availability of the draft 2020 UWMP, 2020 WSCP, and a new Appendix L to the 2015 UWMP and the public hearing to consider adoption of the documents in accordance with CWC Sections 10621(b) and 10642, and Government Code Section 6066, and Chapter 17.5 (starting with Section 7290) of Division 7 of Title 1 of the Government Code. The public review drafts of the 2020 UWMP, Appendix L to the 2015 UWMP, and the 2020 WSCP were posted on the City's website, fresno.gov, on June 28, 2021, more than 14 days in advance of the public hearing on July 15, 2021. The notice of availability of the documents was sent to the City's customers, as well as cities and counties in the City's service area. Copies of the notification letter sent to the customers and cities and counties in the City's service area are included in the 2020 UWMP Appendix L. Thus, this Appendix D to the City's 2020 UWMP, which was adopted with the City's 2020 UWMP, will also be recognized and treated as Appendix L to the City's 2015 UWMP.

The City held the public hearing for the draft 2020 UWMP, draft Appendix L to the 2015 UWMP, and draft 2020 WSCP on July 15, 2021, at a regular City Council meeting, held online due to COVID-19 concerns. At the meeting, the City Council determined that the 2020 UWMP and the 2020 WSCP accurately represent the water resources plan for the City's service area. In addition, the City Council determined that Appendix L to the 2015 UWMP and Appendix D to the 2020 UWMP includes all of the elements described in Delta Plan Policy WR P1, Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance (Cal. Code Regs. tit. 23, § 5003), which need to be included in a water supplier's UWMP to support a certification of consistency for a future covered action. As stated in Resolutions 2021-196, 2021-197, and 2021-198, the City Council adopted the 2020 UWMP, the 2020 WSCP, and Appendix L to the 2015 UWMP and authorized their submittal to the State of California. Copies of the resolutions are included in the 2020 UWMP Appendix M.

## Table 1. Calculation of Service Area Water Demands without Water Use Efficiency (UWMP Table C-1 and Table C-2)

**Table C-1: Optional Calculation of Water Use Efficiency -To be completed if Water Supplier does not specifically estimate Water Use Efficiency as a supply**

| Service Area Water Use Efficiency Demands (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands with Water Use Efficiency Accounted For | 163,300 | 172,900 | 168,200 | 136,579 | 147,505 | 154,434 | 161,372 | 168,318 |
| Non-Potable Water Demands | 750 | 1,000 | 9,500 | 14,220 | 14,220 | 14,220 | 14,220 | 14,220 |
| Potable Service Area Demands with Water Use Efficiency Accounted For | 162,550 | 171,900 | 158,700 | 122,359 | 133,285 | 140,214 | 147,152 | 154,098 |

| Total Service Area Population | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Service Area Population | 505,315 | 525,575 | 550,217 | 609,433 | 674,677 | 719,327 | 765,278 | 812,529 |

| Water Use Efficiency Since Baseline (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Per Capita Water Use (GPCD) | 287 | 292 | 257 | 179 | 176 | 174 | 172 | 169 |
| Change in Per Capita Water Use from Baseline (GPCD) | | 5 | (30) | (108) | (111) | (113) | (116) | (118) |
| Estimated Water Use Efficiency Since Baseline | | (2,833) | 18,294 | 73,684 | 83,745 | 91,180 | 99,023 | 107,277 |

**Table C-2: Calculation of Service Area Water Demands Without Water Use Efficiency**

| Total Service Area Water Demands (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands with Water Use Efficiency Accounted For | 163,300 | 172,900 | 168,200 | 136,579 | 147,505 | 154,434 | 161,372 | 168,318 |
| Reported Water Use Efficiency or Estimated Water Use Efficiency Since Baseline | - | (2,833) | 18,294 | 73,684 | 83,745 | 91,180 | 99,023 | 107,277 |
| Service Area Water Demands without Water Use Efficiency Accounted For | 163,300 | 170,067 | 186,494 | 210,263 | 231,250 | 245,614 | 260,395 | 275,595 |

## Table 2. Calculation of Supplies Contributing to Regional Self-Reliance (UWMP Table C-3)

**Table C-3: Calculation of Supplies Contributing to Regional Self-Reliance**

| Water Supplies Contributing to Regional Self-Reliance (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Estimated Water Use Efficiency since Baseline | - | (2,833) | 18,294 | 73,684 | 83,745 | 91,180 | 99,023 | 107,277 |
| Water Recycling | 750 | 1,000 | 9,500 | 14,220 | 14,220 | 14,220 | 14,220 | 14,220 |
| Stormwater Capture and Use | | | | | | | | |
| Advanced Water Technologies | | | | | | | | |
| Conjunctive Use Projects | | | | | | | | |
| Local and Regional Water Supply and Storage Projects | 88,800 | 76,100 | 132,480 | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| Other Programs and Projects the Contribute to Regional Self-Reliance | 131,750 | 117,400 | 116,000 | 125,030 | 131,600 | 131,600 | 131,600 | 131,600 |
| Water Supplies Contributing to Regional Self-Reliance | 221,300 | 191,667 | 276,274 | 351,024 | 373,195 | 386,100 | 399,333 | 412,917 |

| Service Area Water Demands without Water Use Efficiency (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands without Water Use Efficiency Accounted For | 163,300 | 170,067 | 186,494 | 210,263 | 231,250 | 245,614 | 260,395 | 275,595 |

| Change in Regional Self Reliance (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Water Supplies Contributing to Regional Self-Reliance | 221,300 | 191,667 | 276,274 | 351,024 | 373,195 | 386,100 | 399,333 | 412,917 |
| Change in Water Supplies Contributing to Regional Self-Reliance | | (29,633) | 54,974 | 129,724 | 151,895 | 164,800 | 178,033 | 191,617 |

| Percent Change in Regional Self Reliance (As Percent of Demand w/out WUE) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Percent of Water Supplies Contributing to Regional Self-Reliance | 135.5% | 112.7% | 148.1% | 166.9% | 161.4% | 157.2% | 153.4% | 149.8% |
| Change in Percent of Water Supplies Contributing to Regional Self-Reliance | | -22.8% | 12.6% | 31.4% | 25.9% | 21.7% | 17.8% | 14.3% |

## Table 3. Reliance on Water Supplies from the Delta Watershed (UWMP Table C-4)

**Table C-4: Calculation of Reliance on Water Supplies from the Delta Watershed**

| Water Supplies from the Delta Watershed (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| CVP/SWP Contract Supplies | 58,200 | 58,200 | 52,600 | 53,680 | 53,680 | 53,680 | 53,680 | 53,680 |
| Delta/Delta Tributary Diversions | | | | | | | | |
| Transfers and Exchanges of Supplies from the Delta Watershed | | | | | | | | |
| Other Water Supplies from the Delta Watershed | | | | | | | | |
| Total Water Supplies from the Delta Watershed | 58,200 | 58,200 | 52,600 | 53,680 | 53,680 | 53,680 | 53,680 | 53,680 |

| Service Area Water Demands without Water Use Efficiency (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands without Water Use Efficiency Accounted For | 163,300 | 170,067 | 186,494 | 210,263 | 231,250 | 245,614 | 260,395 | 275,595 |

| Change in Supplies from the Delta Watershed (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Water Supplies from the Delta Watershed | 58,200 | 58,200 | 52,600 | 53,680 | 53,680 | 53,680 | 53,680 | 53,680 |
| Change in Water Supplies from the Delta Watershed | | - | (5,600) | (4,520) | (4,520) | (4,520) | (4,520) | (4,520) |

| Percent Change in Supplies from the Delta Watershed (As a Percent of Demand w/out WUE) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Percent of Water Supplies from the Delta Watershed | 35.6% | 34.2% | 28.2% | 25.5% | 23.2% | 21.9% | 20.6% | 19.5% |
| Change in Percent of Water Supplies from the Delta Watershed | | -1.4% | -7.4% | -10.1% | -12.4% | -13.8% | -15.0% | -16.2% |

# E

# AWWA Water Audits

# AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0

American Water Works Association

? Click to access definition

+ Click to add a comment

**Water Audit Report for:** City of Fresno (1010007)

**Reporting Year:** 2016 1/2016 - 12/2016

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: ACRE-FEET PER YEAR**

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

## WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ----------> Pcnt: Value:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Volume from own sources: | 5 | 112,398.020 | acre-ft/yr | 3 | | | acre-ft/yr |
| Water imported: | n/a | 0.000 | acre-ft/yr | | | | acre-ft/yr |
| Water exported: | n/a | 0.000 | acre-ft/yr | | | | acre-ft/yr |

Enter negative % or value for under-registration

Enter positive % or value for over-registration

**WATER SUPPLIED:** 112,398.020 acre-ft/yr

## AUTHORIZED CONSUMPTION

Click here: ? for help using option

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Billed metered: | 9 | 103,038.468 | acre-ft/yr | | | |
| Billed unmetered: | n/a | 0.000 | acre-ft/yr | | | |
| Unbilled metered: | 10 | 42.876 | acre-ft/yr | | | |
| Unbilled unmetered: | 5 | 280.995 | acre-ft/yr | | 280.995 | acre-ft/yr |

Use buttons to select percentage of water supplied OR value

**AUTHORIZED CONSUMPTION:** 103,362.339 acre-ft/yr

## WATER LOSSES (Water Supplied - Authorized Consumption)

**9,035.681** acre-ft/yr

### Apparent Losses

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Unauthorized consumption: | | 280.995 | acre-ft/yr | 0.25% | | acre-ft/yr |

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

| | | | | | | |
|---|---|---|---|---|---|---|
| Customer metering inaccuracies: | 5 | 1,041.226 | acre-ft/yr | 1.00% | | acre-ft/yr |
| Systematic data handling errors: | | 257.596 | acre-ft/yr | 0.25% | | acre-ft/yr |

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

**Apparent Losses:** 1,579.817 acre-ft/yr

### Real Losses (Current Annual Real Losses or CARL)

**Real Losses = Water Losses - Apparent Losses:** 7,455.864 acre-ft/yr

**WATER LOSSES:** 9,035.681 acre-ft/yr

## NON-REVENUE WATER

**NON-REVENUE WATER:** 9,359.552 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

## SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 9 | 1,810.39 | miles |
| Number of active AND inactive service connections: | 9 | 143,916 | |
| Service connection density: | | 79 | conn./mile main |

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 3 50.0 psi

## COST DATA

| | | | | |
|---|---|---|---|---|
| Total annual cost of operating water system: | 10 | $71,848,500 | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | 9 | $1.86 | $/1000 gallons (US) | |
| Variable production cost (applied to Real Losses): | 5 | $152.10 | $/acre-ft | ☐ Use Customer Retail Unit Cost to value real losses |

## WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 66 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

## PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources

2: Customer metering inaccuracies

3: Variable production cost (applied to Real Losses)

# AWWA Free Water Audit Software:
## Reporting Worksheet

WAS v5.0

American Water Works Association.
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? Click to access definition
+ Click to add a comment

**Water Audit Report for:** City of Fresno
**Reporting Year:** 2017 1/2017 - 12/2017

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: ACRE-FEET PER YEAR**

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

### WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ---------->

| | | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|---|
| Volume from own sources: | 5 | 121,079.641 | acre-ft/yr | 5 | | | | acre-ft/yr |
| Water imported: | n/a | 0.000 | acre-ft/yr | | | | | acre-ft/yr |
| Water exported: | n/a | 0.000 | acre-ft/yr | | | | | acre-ft/yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 121,079.641 acre-ft/yr

### AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Billed metered: | 9 | 110,520.840 | acre-ft/yr | | | |
| Billed unmetered: | n/a | 0.000 | acre-ft/yr | | | |
| Unbilled metered: | 10 | 48.124 | acre-ft/yr | | | |
| Unbilled unmetered: | 5 | 276.052 | acre-ft/yr | | 276.052 | acre-ft/yr |

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** ? 110,845.016 acre-ft/yr

### WATER LOSSES (Water Supplied - Authorized Consumption)

**10,234.625** acre-ft/yr

**Apparent Losses**

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Unauthorized consumption: | | 302.699 | acre-ft/yr | 0.25% | | acre-ft/yr |

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

| | | | | | | |
|---|---|---|---|---|---|---|
| Customer metering inaccuracies: | 5 | 1,116.858 | acre-ft/yr | 1.00% | | acre-ft/yr |
| Systematic data handling errors: | | 276.302 | acre-ft/yr | 0.25% | | acre-ft/yr |

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

**Apparent Losses:** ? 1,695.859 acre-ft/yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** ? 8,538.766 acre-ft/yr

**WATER LOSSES:** 10,234.625 acre-ft/yr

### NON-REVENUE WATER

**NON-REVENUE WATER:** ? 10,558.801 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

### SYSTEM DATA

| | | | | |
|---|---|---|---|---|
| Length of mains: | 9 | 1,854.4 | miles | |
| Number of active AND inactive service connections: | 9 | 146,212 | | |
| Service connection density: | | 79 | conn./mile main | |
| Are customer meters typically located at the curbstop or property line? | | Yes | | |
| Average length of customer service line: | | | | (length of service line, beyond the property boundary, that is the responsibility of the utility) |

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

| | | | | |
|---|---|---|---|---|
| Average operating pressure: | 4 | 50.0 | psi | |

### COST DATA

| | | | | |
|---|---|---|---|---|
| Total annual cost of operating water system: | 10 | $76,015,350 | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | 9 | $2.01 | $/1000 gallons (US) | |
| Variable production cost (applied to Real Losses): | 5 | $175.42 | $/acre-ft | ☐ Use Customer Retail Unit Cost to value real losses |

### WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 66 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

### PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

# AWWA Free Water Audit Software:
## Reporting Worksheet

WAS v5.0

American Water Works Association.
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? Click to access definition
+ Click to add a comment

**Water Audit Report for:** City of Fresno
**Reporting Year:** 2018 | 1/2018 - 12/2018

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: ACRE-FEET PER YEAR**

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

### WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ---------->

| | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Volume from own sources: | 5 | 120,065.780 | acre-ft/yr | 8 | | | acre-ft/yr |
| Water imported: | n/a | | acre-ft/yr | | | | acre-ft/yr |
| Water exported: | n/a | | acre-ft/yr | | | | acre-ft/yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 120,065.780 acre-ft/yr

### AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | Pcnt: | Value: | |
|---|---|---|---|---|---|
| Billed metered: | 9 | 110,710.560 | acre-ft/yr | | |
| Billed unmetered: | n/a | 0.000 | acre-ft/yr | | |
| Unbilled metered: | 8 | 27.129 | acre-ft/yr | | |
| Unbilled unmetered: | 5 | 300.164 | acre-ft/yr | 300.164 | acre-ft/yr |

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** 111,037.853 acre-ft/yr

**WATER LOSSES (Water Supplied - Authorized Consumption)** 9,027.927 acre-ft/yr

**Apparent Losses**

| | | | Pcnt: | Value: | |
|---|---|---|---|---|---|
| Unauthorized consumption: | | 300.164 | acre-ft/yr | 0.25% | acre-ft/yr |

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

| | | | | | |
|---|---|---|---|---|---|
| Customer metering inaccuracies: | 5 | 1,118.563 | acre-ft/yr | 1.00% | acre-ft/yr |
| Systematic data handling errors: | | 276.776 | acre-ft/yr | 0.25% | acre-ft/yr |

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

**Apparent Losses:** 1,695.503 acre-ft/yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** 7,332.423 acre-ft/yr

**WATER LOSSES:** 9,027.927 acre-ft/yr

### NON-REVENUE WATER

**NON-REVENUE WATER:** 9,355.220 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

### SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 9 | 1,854.7 | miles |
| Number of active AND inactive service connections: | 9 | 146,608 | |
| Service connection density: | | 79 | conn./mile main |

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

| | | | |
|---|---|---|---|
| Average operating pressure: | 10 | 53.3 | psi |

### COST DATA

| | | | | |
|---|---|---|---|---|
| Total annual cost of operating water system: | 10 | $82,960,821 | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | 10 | $2.33 | $/1000 litres | |
| Variable production cost (applied to Real Losses): | 5 | $178.06 | $/acre-ft | ☐ Use Customer Retail Unit Cost to value real losses |

### WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 66 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

### PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

# AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.

**Water Audit Report for:** City of Fresno

**Audit Year:** 2019 | Jan 01 2019 - Dec 31 2019 | Calendar

Click 'n' to add notes

Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

## WATER SUPPLIED

choose entry option:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| VOS | Volume from Own Sources: | n | g | 115,544.090 | Acre-ft/Yr | n | g | 5.00% | percent | under-registration VOSEA |
| WI | Water Imported: | n | g | 0.000 | Acre-ft/Yr | | | | | WIEA |
| WE | Water Exported: | n | g | 0.000 | Acre-ft/Yr | | | | | WEEA |
| | WATER SUPPLIED: | | | 121,625.358 | Acre-ft/Yr | | | | | |

## AUTHORIZED CONSUMPTION

choose entry option:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BMAC | Billed Metered: | n | g | | 106,485.360 | Acre-ft/Yr | | |
| BUAC | Billed Unmetered: | n | g | | 0.000 | Acre-ft/Yr | | |
| UMAC | Unbilled Metered: | n | g | | 52.635 | Acre-ft/Yr | | |
| UUAC | Unbilled Unmetered: | n | g | 3 | 266.213 | Acre-ft/Yr | 0.25% | default |

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 106,804.208 Acre-ft/Yr

## WATER LOSSES

14,821.149 Acre-ft/Yr

### Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SDHE | Systematic Data Handling Errors: | n | g | 3 | 266.213 | Acre-ft/Yr | 0.25% | default | |
| CMI | Customer Metering Inaccuracies: | n | g | | 1,076.141 | Acre-ft/Yr | 1.00% | percent | under-registration |
| UC | Unauthorized Consumption: | n | g | 3 | 266.213 | Acre-ft/Yr | 0.25% | default | |

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 1,608.568 Acre-ft/Yr

### Real Losses

Real Losses: 13,212.581 Acre-ft/Yr

WATER LOSSES: 14,821.149 Acre-ft/Yr

## NON-REVENUE WATER

NON-REVENUE WATER: 15,139.998 Acre-ft/Yr

## SYSTEM DATA

| | | | | | | |
|---|---|---|---|---|---|---|
| Lm | Length of mains: | n | g | 1,862.2 | miles | (including fire hydrant lead lengths) |
| Nc | Number of service connections: | n | g | 147,633 | | (active *and* inactive) |
| | Service connection density: | | | 79 | conn./mile main | |

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP Average Operating Pressure: n g 50.0 psi

## COST DATA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CRUC | Customer Retail Unit Charge: | n | g | $2.33 | $/1000 gallons (US) | Total Annual Operating Cost | |
| VPC | Variable Production Cost: | n | g | $230.95 | $/acre-ft | $106,528,917 | $/yr (optional input) |

## WATER AUDIT DATA VALIDITY TIER:

**Click 'g' for 10 parameter(s), then complete all visible data grading questions to enable the Data Validity Score to calculate**

go to dashboard

### PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

### KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

| | | |
|---|---|---|
| Unit Total Losses: | | gal/conn/day |
| Unit Apparent Losses: | | gal/conn/day |
| Unit Real Losses[^]: | | gal/conn/day |
| Unit Real Losses[=]: | | gal/mile/day |

If entered above by user, targets will display on KPI gauges (see Dashboard)

# F

# DWR Population Tool Output

# WUEdata - Fresno City Of

Sign Out

*Please print this page to a PDF and include as part of your UWMP submittal.*

## Confirmation Information

| Generated By | Water Supplier Name | Confirmation # | Generated On |
|---|---|---|---|
| Heather Freed | Fresno City Of | 8103177726 | 3/17/2021 12:16:56 PM |

## Boundary Information

| Census Year | Boundary Filename | Internal Boundary ID |
|---|---|---|
| 1990 | fresno_1990_processed.kml | 517 |
| 2000 | fresno_2000_processed.kml | 516 |
| 2010 | fresno_2010_processed.kml | 515 |
| 1990 | fresno_1990_processed.kml | 517 |
| 2000 | fresno_2000_processed.kml | 516 |
| 2010 | fresno_2010_processed.kml | 515 |
| 1990 | fresno_1990_processed.kml | 517 |
| 2000 | fresno_2000_processed.kml | 516 |
| 2010 | fresno_2010_processed.kml | 515 |

## Baseline Period Ranges

### 10 to 15-year baseline period

Number of years in baseline period: 10

Year beginning baseline period range: 1996

Year ending baseline period range[1]: 2005

### 5-year baseline period

Year beginning baseline period range: 2003

Year ending baseline period range[2]: 2007

[1] The ending year must be between December 31, 2004 and December 31, 2010.

[2] The ending year must be between December 31, 2007 and December 31, 2010.

## Persons per Connection

| Year | Census Block Level Total Population | Number of Connections * | Persons per Connection |
|---|---|---|---|
| 1990 | 364,084 | | 4.23 |
| 1991 | - | - | 4.23 |
| 1992 | - | - | 4.24 |
| 1993 | - | - | 4.24 |
| 1994 | - | - | 4.25 |
| 1995 | - | - | 4.26 |
| 1996 | - | - | 4.26 |
| 1997 | - | - | 4.27 |
| 1998 | - | - | 4.27 |
| 1999 | - | - | 4.28 |
| 2000 | 439,062 | 102476 | 4.28 |
| 2001 | - | - | 4.29 |
| 2002 | - | - | 4.29 |
| 2003 | - | - | 4.30 |
| 2004 | - | - | 4.30 |
| 2005 | - | - | 4.31 |
| 2006 | - | - | 4.32 |
| 2007 | - | - | 4.32 |
| 2008 | - | - | 4.33 |
| 2009 | - | - | 4.33 |
| 2010 | 505,315 | 116373 | 4.34 |
| 2011 | - | - | 4.28 |
| 2012 | - | - | 4.28 |
| 2013 | - | - | 4.28 |
| 2014 | - | - | 4.28 |
| 2015 | - | - | 4.28 |
| 2020 | - | - | 4.41 ** |

## Population Using Persons-Per-Connection

| Year | | Number of Connections * | Persons per Connection | Total Population |
|---|---|---|---|---|
| **10 to 15 Year Baseline Population Calculations** | | | | |
| Year 1 | 1996 | | 4.26 | |
| Year 2 | 1997 | | 4.27 | |
| Year 3 | 1998 | | 4.27 | |
| Year 4 | 1999 | | 4.28 | |
| Year 5 | 2000 | 102476 | 4.28 | 439,062 |
| Year 6 | 2001 | | 4.29 | |
| Year 7 | 2002 | | 4.29 | |
| Year 8 | 2003 | | 4.30 | |
| Year 9 | 2004 | | 4.30 | |
| Year 10 | 2005 | | 4.31 | |
| **5 Year Baseline Population Calculations** | | | | |
| Year 1 | 2003 | | 4.30 | |
| Year 2 | 2004 | | 4.30 | |
| Year 3 | 2005 | | 4.31 | |
| Year 4 | 2006 | | 4.32 | |
| Year 5 | 2007 | | 4.32 | |
| **2020 Compliance Year Population Calculations** | | | | |
| 2020 | | 124862 | 4.41 ** | 550,217 |

Hide Print Confirmation

QUESTIONS / ISSUES? CONTACT THE WUEDATA HELP DESK
MWELO QUESTIONS / ISSUES? CONTACT THE MWELO HELP DESK

# G

# North Kings Subbasin Groundwater Sustainability Plan

Reference the North Kings Subbasin Groundwater Sustainability Plan online: https://www.northkingsgsa.org/groundwater-sustainability-plan/

# H

# City of Fresno's Central Valley Project Contract

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Central Valley Project, California

LONG-TERM RENEWAL CONTRACT BETWEEN THE UNITED STATES
AND
CITY OF FRESNO
PROVIDING FOR PROJECT WATER SERVICE
FROM FRIANT DIVISION

THIS CONTRACT, made this 18 day of August, 2005, in pursuance generally of the Act of June 17, 1902 (32 Stat. 388), and acts amendatory or supplementary thereto, including, but not limited to, the Acts of August 26, 1937 (50 Stat. 844), as amended and supplemented, August 4, 1939 (53 Stat. 1187), as amended and supplemented, July 2, 1956 (70 Stat. 483), June 21, 1963 (77 Stat. 68), October 12, 1982 (96 Stat. 1263), October 27, 1986 (100 Stat. 3050), as amended, and Title XXXIV of the Act of October 30, 1992 (106 Stat. 4706), all collectively hereinafter referred to as Federal Reclamation law, between the UNITED STATES OF AMERICA, hereinafter referred to as the United States, and the CITY OF FRESNO, hereinafter referred to as the Contractor, a public agency of the State of California, duly organized, existing, and acting pursuant to the laws thereof;

WITNESSETH, That:

EXPLANATORY RECITALS

[1st] WHEREAS, the United States has constructed and is operating the Central Valley Project (Project), California, for diversion, storage, carriage, distribution and beneficial use, for flood control, irrigation, municipal, domestic, industrial, fish and wildlife mitigation, protection and restoration, generation and distribution of electric energy, salinity control, navigation and other beneficial uses, of waters of the Sacramento River, the American River, the Trinity River, and the San Joaquin River and their tributaries; and

[2nd] WHEREAS, the United States constructed Friant Dam (thereby creating Millerton Lake) and the Friant-Kern and Madera Canals, hereinafter collectively referred to as the Friant Division facilities, which will be used in part for the furnishing of water to the Contractor pursuant to the terms of this Contract; and

[3rd] WHEREAS, pursuant to Section 8 of the Act of June 17, 1902 (32 Stat. 388), the United States has acquired water rights and other rights to the flows of the San Joaquin River, including without limitation the permits issued as the result of Decision 935 by the California State Water Resources Control Board and the contracts described in subdivision (n) of Article 3 of this Contract, pursuant to which the Contracting Officer develops, diverts, stores and delivers Project Water stored or flowing through Millerton Lake in accordance with State and Federal law for the benefit of Project Contractors in the Friant Division; and

[3.1] WHEREAS, the water supplied to the Contractor pursuant to this Contract is Project Water developed through the exercise of the rights described in the third Explanatory Recital of this Contract; and

[4th] WHEREAS, the Contractor and the United States entered into Contract No. 14-06-200-8901, which established terms for the delivery to the Contractor of Project Water from the Friant Division from March 1, 1966, to February 28, 2006, hereinafter referred to as the Existing Contract; and

[5th] WHEREAS, the Contractor and the United States have, pursuant to Subsection 3404(c)(3) of the Central Valley Project Improvement Act (CVPIA), subsequently entered into a Binding Agreement identified as Binding Agreement No. 14-06-200-8901-BA, which sets out the terms pursuant to which the Contractor agreed to renew the Existing Contract before its expiration date after completion of the programmatic environmental impact statement and other appropriate environmental documentation and negotiation of a renewal contract, and which also sets out the consequences of a subsequent decision not to renew; and

[6th] WHEREAS, Section 3404(c) of the CVPIA provides for long-term renewal of the Existing Contract following completion of appropriate environmental documentation, including a programmatic environmental impact statement (PEIS) pursuant to the National Environmental Policy Act (NEPA) analyzing the direct and indirect impacts and benefits of implementing the CVPIA and the potential renewal of all existing contracts for Project Water; and

[7th] WHEREAS, the United States has completed the PEIS and all other appropriate environmental review necessary to provide for long-term renewal of the Existing Contract; and

[8th] WHEREAS, the Contractor has requested the long-term renewal of the Existing Contract, pursuant to the terms of the Existing Contract, Federal Reclamation law, and the laws of the State of California, for water service from the Project; and

[9th] WHEREAS, the United States has determined that the Contractor has fulfilled all of its obligations under the Existing Contract; and

[10th] WHEREAS, the Contractor has demonstrated to the satisfaction of the Contracting Officer that the Contractor has utilized the Project Water supplies available to it for reasonable and beneficial use and/or has demonstrated projected future demand for water use such that the Contractor has the capability and expects to utilize fully for reasonable and beneficial use the quantity of Project Water to be made available to it pursuant to this Contract; and

[11th] WHEREAS, water obtained from the Project has been relied upon by urban and agricultural areas within California for more than 50 years, and is considered by the Contractor as an essential portion of its water supply; and

[12th] WHEREAS, the economies of regions within the Project, including the Contractor's, depend upon the continued availability of water, including water service from the Project; and

[13th] WHEREAS, the Secretary intends through coordination, cooperation, and partnerships to pursue measures to improve water supply, water quality, and reliability of the Project for all Project purposes; and

[14th] WHEREAS, the mutual goals of the United States and the Contractor include: to provide for reliable Project Water supplies; to control costs of those supplies; to achieve repayment of the Project as required by law; to guard reasonably against Project Water shortages; to achieve a reasonable balance among competing demands for use of Project Water; and to comply with all applicable environmental statutes, all consistent with the legal obligations of the United States relative to the Project; and

[15th] WHEREAS, the parties intend by this Contract to develop a more cooperative relationship in order to achieve their mutual goals; and

[15.1] WHEREAS, during uncontrolled seasons, Friant Division Project Contractors utilize undependable Class 2 Water in their service areas to, among other things, assist in the management and alleviation of groundwater overdraft in the Friant Division service area, provide opportunities for environmental enhancement, including restoration of the San Joaquin River below Friant Dam, minimize flooding along the San Joaquin River, encourage optimal water management, and maximize the reasonable and beneficial use of the water; and

[15.2] WHEREAS, the parties desire and intend that this Contract not provide a disincentive to the Friant Division Project Contractors continuing to carry out the beneficial activities set out in the Explanatory Recital immediately above; and

[16th] WHEREAS, the United States and the Contractor are willing to enter into this Contract pursuant to Federal Reclamation law on the terms and conditions set forth below;

NOW, THEREFORE, in consideration of the mutual and dependent covenants herein contained, it is hereby mutually agreed by the parties hereto as follows:

## DEFINITIONS

1. When used herein unless otherwise distinctly expressed, or manifestly incompatible with the intent of the parties as expressed in this Contract, the term:

(a) "Calendar Year" shall mean the period January 1 through December 31, both dates inclusive;

(b) "Charges" shall mean the payments required by Federal Reclamation law in addition to the Rates and Tiered Pricing Component specified in this Contract as determined annually by the Contracting Officer pursuant to this Contract;

(b2) "Class 1 Water" shall mean that supply of water stored in or flowing through Millerton Lake which, subject to the contingencies hereinafter described in Articles 3, 11, and 12 of this Contract, will be available for delivery from Millerton Lake and the Friant-Kern and Madera Canals as a dependable water supply during each Year;

(b3) "Class 2 Water" shall mean that supply of water which can be made available subject to the contingencies hereinafter described in Articles 3, 11, and 12 of this Contract for delivery from Millerton Lake and the Friant-Kern and Madera Canals in addition to the supply of Class 1 Water. Because of its uncertainty as to availability and time of occurrence, such water will be undependable in character and will be furnished only if, as, and when it can be made available as determined by the Contracting Officer;

(c) "Condition of Shortage" shall mean a condition respecting the Project during any Year such that the Contracting Officer is unable to deliver sufficient water to meet the Contract Total;

(d) "Contracting Officer" shall mean the Secretary of the Interior's duly authorized representative acting pursuant to this Contract or applicable Federal Reclamation law or regulation;

(e) "Contract Total" shall mean the maximum amount of Class 1 Water, plus the maximum amount of Class 2 Water to which the Contractor is entitled under subdivision (a) of Article 3 of this Contract;

(f) "Contractor's Service Area" shall mean the area to which the Contractor is permitted to provide Project Water under this Contract as described in Exhibit "A" attached hereto, which may be modified from time to time in accordance with Article 35 of this Contract without amendment of this Contract;

(g) "CVPIA" shall mean the Central Valley Project Improvement Act, Title XXXIV of the Act of October 30, 1992 (106 Stat. 4706);

(h-i) Omitted;

(j) "Full Cost Rate" shall mean an annual rate as determined by the Contracting Officer that shall amortize the expenditures for construction properly allocable to the Project irrigation or M&I functions, as appropriate, of facilities in service including all O&M deficits funded, less payments, over such periods as may be required under Federal Reclamation law or applicable contract provisions. Interest will accrue on both the construction expenditures and funded O&M deficits from October 12, 1982, on costs outstanding at that date, or from the date incurred in the case of costs arising subsequent to October 12, 1982, and shall be calculated in accordance with subsections 202(3)(B) and (3)(C) of the RRA. The Full Cost Rate includes actual operation, maintenance, and replacement costs consistent with Section 426.2 of the Rules and Regulations for the RRA;

(k-l) Omitted;

(m) "Irrigation Water" shall mean water made available from the Project that is used primarily in the production of agricultural crops or livestock, including domestic use incidental thereto, and watering of livestock;

(n) Omitted;

(n2) "Long Term Historic Average" shall mean the average of the final forecast of Water Made Available to the Contractor pursuant to this Contract and the contract referenced in the fourth Explanatory Recital of this Contract;

(o) "Municipal and Industrial (M&I) Water" shall mean Project Water, other than Irrigation Water, made available to the Contractor. M&I Water shall include water used for human use and purposes such as the watering of landscaping or pasture for animals (e.g., horses) which are kept for personal enjoyment or water delivered to land holdings operated in units of less than five acres unless the Contractor establishes to the satisfaction of the Contracting Officer that the use of water delivered to any such landholding is a use described in subdivision (m) of this Article;

(p) "M&I Full Cost Water Rate" shall mean the Full Cost Rate applicable to the delivery of M&I Water;

(q) "Operation and Maintenance" or "O&M" shall mean normal and reasonable care, control, operation, repair, replacement (other than capital replacement), and maintenance of Project facilities;

(r) "Operating Non-Federal Entity" shall mean the Friant Water Authority, its successors or assigns, a non-Federal entity which has the obligation to operate and maintain all or a portion of the Friant Division facilities pursuant to an agreement with the United States, and which may have funding obligations with respect thereto;

(s) "Project" shall mean the Central Valley Project owned by the United States and managed by the Department of the Interior, Bureau of Reclamation;

(t) "Project Contractors" shall mean all parties who have water service contracts for Project Water from the Project with the United States pursuant to Federal Reclamation law;

(u) "Project Water" shall mean all water that is developed, diverted, stored, or delivered by the Secretary in accordance with the statutes authorizing the Project and in accordance with the terms and conditions of water rights acquired pursuant to California law;

(v) "Rates" shall mean the payments determined annually by the Contracting Officer in accordance with the then-current applicable water ratesetting policies for the Project, as described in subdivision (a) of Article 7 of this Contract;

(w) Omitted;

(x) "Secretary" shall mean the Secretary of the Interior, a duly appointed successor, or an authorized representative acting pursuant to any authority of the Secretary and through any agency of the Department of the Interior;

(y) "Tiered Pricing Component" shall be the incremental amount to be paid for each acre-foot of Water Delivered as described in subdivision (j) of Article 7 of this Contract;

(z) "Water Delivered" or "Delivered Water" shall mean Project Water diverted for use by the Contractor at the point(s) of delivery approved by the Contracting Officer;

(aa) "Water Made Available" shall mean the estimated amount of Project Water that can be delivered to the Contractor for the upcoming Year as declared by the Contracting Officer, pursuant to subdivision (a) of Article 4 of this Contract;

(bb) "Water Scheduled" shall mean Project Water made available to the Contractor for which times and quantities for delivery have been established by the Contractor and Contracting Officer, pursuant to subdivision (b) of Article 4 of this Contract; and

(cc) "Year" shall mean the period from and including March 1 of each Calendar Year through the last day of February of the following Calendar Year.

TERM OF CONTRACT

2. (a) This Contract supersedes the Existing Contract and shall be effective on the date first hereinabove written through February 28, 2045. In the event the Contractor wishes to renew this Contract beyond February 28, 2045, the Contractor shall submit a request for renewal in writing to the Contracting Officer no later than two years prior to the date this Contract expires.

(b) Omitted.

(c) Provided the Contractor is complying with all terms and conditions of this Contract and all legal obligations of the Contractor, if any, set forth in an enforceable court order, final judgment and/or settlement relating to restoration of the San Joaquin River, this Contract shall be renewed for successive periods of up to 40 years each, which periods shall be consistent with the then-existing Reclamation-wide policy, under terms and conditions mutually agreeable to the parties and consistent with Federal and State law. The Contractor shall be afforded the opportunity to comment to the Contracting Officer on the proposed adoption and application of any revised policy applicable to the delivery of M&I Water that would limit the term of any subsequent renewal contract with the Contractor for the furnishing of M&I Water to less than 40 years.

(d) The Contracting Officer shall make a determination ten years after the date of execution of this Contract, and every five years thereafter during the term of this Contract, of whether a conversion to a contract under subsection 9(c)(1) of the Reclamation Project Act of 1939 can be accomplished. The Contracting Officer anticipates that during the term of this Contract, all authorized Project construction expected to occur will have occurred, and on that basis the Contracting Officer agrees upon such completion to allocate all costs that are properly assignable to the Contractor, and agrees further that, at any time after such allocation is made, and subject to satisfaction of the conditions set out in this subdivision, this Contract shall, at the request of the Contractor, be converted to a contract under subsection 9(c)(1) of the Reclamation Project Act of 1939, subject to applicable Federal law and under stated terms and conditions mutually agreeable to the Contractor and the Contracting Officer. A condition for such conversion to occur shall be a determination by the Contracting Officer that, account being taken of the amount credited to return by the Contractor as provided for under Federal Reclamation law, the remaining amount of construction costs assignable for ultimate return by the Contractor can probably be repaid to the United States within the term of a contract under subsection 9(c)(1). If the remaining amount of costs that are properly assignable to the Contractor cannot be determined during the term of this Contract, the Contracting Officer shall notify the Contractor, and provide the reason(s) why such a determination could not be made. Further, the Contracting Officer shall make such a determination as soon thereafter as possible so as to permit, upon request of the Contractor and satisfaction of the conditions set out above, conversion to a contract under subsection 9(c)(1). In the event such determination of costs has not been made at a time which allows conversion of this Contract during the term of this

Contract or the Contractor has not requested conversion of this Contract within such term, the parties shall incorporate in any subsequent renewal contract as described in subdivision (c) of this Article a provision that carries forth in substantially identical terms the provisions of this subdivision.

WATER TO BE MADE AVAILABLE AND DELIVERED TO THE CONTRACTOR

3. (a) During each Year, consistent with all applicable State water rights, permits, and licenses, Federal law, and subject to the provisions set forth in Articles 11 and 12 of this Contract, the Contracting Officer shall make available for delivery to the Contractor 60,000 acre-feet of Class 1 Water for M&I purposes. Water Delivered to the Contractor in accordance with this subdivision shall be scheduled and paid for pursuant to the provisions of Articles 4 and 7 of this Contract.

(b) Omitted.

(c) The Contractor shall utilize the Project Water in accordance with all applicable legal requirements.

(d) The Contractor shall make reasonable and beneficial use of all water furnished pursuant to this Contract. Groundwater recharge programs (direct, indirect, or in lieu), groundwater banking programs, surface water storage programs, and other similar programs utilizing Project Water or other water furnished pursuant to this Contract conducted within the Contractor's Service Area which are consistent with applicable State law and result in use consistent with Federal Reclamation law will be allowed: Provided, That any direct recharge program(s) is (are) described in the Contractor's water conservation plan submitted pursuant to Article 26 of this Contract: Provided further, That such water conservation plan demonstrates sufficient lawful uses exist in the

Contractor's Service Area so that using a long-term average, the quantity of Delivered Water is demonstrated to be reasonable for such uses and in compliance with Federal Reclamation law. Groundwater recharge programs, groundwater banking programs, surface water storage programs, and other similar programs utilizing Project Water or other water furnished pursuant to this Contract conducted outside the Contractor's Service Area may be permitted upon written approval of the Contracting Officer, which approval will be based upon environmental documentation, Project Water rights, and Project operational concerns. The Contracting Officer will address such concerns in regulations, policies, or guidelines.

(e) The Contractor shall comply with requirements applicable to the Contractor in biological opinion(s) prepared as a result of a consultation regarding the execution of this Contract undertaken pursuant to Section 7 of the Endangered Species Act of 1973 (ESA), as amended, that are within the Contractor's legal authority to implement. The Existing Contract, which evidences in excess of 39 years of diversions for M&I purposes of the quantities of water provided in subdivision (a) of Article 3 of this Contract, will be considered in developing an appropriate baseline for the biological assessment(s) prepared pursuant to the ESA, and any other needed environmental review. Nothing herein shall be construed to prevent the Contractor from challenging or seeking judicial relief in a court of competent jurisdiction with respect to any biological opinion or other environmental documentation referred to in this Article.

(f) Subject to subdivisions (l) and (n) of Article 3 of this Contract, following the declaration of Water Made Available under Article 4 of this Contract, the Contracting Officer will make a determination whether Project Water, or other water available to the Project, can be made

available to the Contractor in addition to the Contract Total under Article 3 of this Contract during the Year without adversely impacting other Project Contractors. At the request of the Contractor, the Contracting Officer will consult with the Contractor prior to making such a determination. Subject to subdivisions (l) and (n) of Article 3 of this Contract, if the Contracting Officer determines that Project Water, or other water available to the Project, can be made available to the Contractor, the Contracting Officer will announce the availability of such water and shall so notify the Contractor as soon as practicable. The Contracting Officer will thereafter meet with the Contractor and other Project Contractors capable of taking such water to determine the most equitable and efficient allocation of such water. If the Contractor requests the delivery of any quantity of such water, the Contracting Officer shall make such water available to the Contractor in accordance with applicable statutes, regulations, guidelines, and policies.

(g) The Contractor may request permission to reschedule for use during the subsequent Year some or all of the Water Made Available to the Contractor during the current Year referred to as "carryover." The Contractor may request permission to use during the current Year a quantity of Project Water which may be made available by the United States to the Contractor during the subsequent Year referred to as "preuse." The Contracting Officer's written approval may permit such uses in accordance with applicable statutes, regulations, guidelines, and policies.

(h) The Contractor's right pursuant to Federal Reclamation law and applicable State law to the reasonable and beneficial use of Water Delivered pursuant to this Contract during the term thereof and any subsequent renewal contracts, as described in Article 2 of this Contract, during the terms thereof shall not be disturbed so long as the Contractor shall fulfill all of its obligations

under this Contract and any renewals thereof. Nothing in the preceding sentence shall affect the Contracting Officer's ability to impose shortages under Article 11 or subdivision (b) of Article 12 of this Contract or applicable provisions of any subsequent renewal contracts.

(i) Project Water furnished to the Contractor pursuant to this Contract may be delivered for other than M&I purposes upon written approval by the Contracting Officer in accordance with the terms and conditions of such approval.

(j) The Contracting Officer shall make reasonable efforts to protect the water rights and other rights described in the third Explanatory Recital of this Contract necessary for the Project and to provide the water available under this Contract. The Contracting Officer shall not object to participation by the Contractor, in the capacity and to the extent permitted by law, in administrative proceedings related to the water rights and other rights described in the third Explanatory Recital of this Contract: Provided, That the Contracting Officer retains the right to object to the substance of the Contractor's position in such a proceeding: Provided further, That in such proceedings the Contracting Officer shall recognize the Contractor has a legal right under the terms of this Contract to use Project Water.

(k) Project Water furnished to the Contractor during any month designated in a schedule or revised schedule submitted by the Contractor and approved by the Contracting Officer shall be deemed to have been accepted by the Contractor as Class 1 Water to the extent that Class 1 Water is called for in such schedule for such month and shall be deemed to have been accepted as Class 2 Water to the extent Class 2 Water is called for in such schedule for such month. If in any month the Contractor diverts a quantity of water in addition to the total amount of Class 1 Water and

Class 2 Water set forth in the Contractor's approved schedule or revised schedule for such month, such additional diversions shall be charged first against the Contractor's remaining Class 2 Water supply available in the current Year. To the extent the Contractor's remaining Class 2 Water supply available in the current Year is not sufficient to account for such additional diversions, such additional diversions shall be charged against the Contractor's remaining Class 1 Water supply available in the current Year. To the extent the Contractor's remaining Class 1 Water and Class 2 Water supplies available in the current Year are not sufficient to account for such additional diversions, such additional diversions shall be charged first against the Contractor's available Class 2 Water supply and then against the Contractor's available Class 1 Water supply, both for the following Year. Payment for all additional diversions of water shall be made in accordance with Article 7 of this Contract.

(l) If the Contracting Officer determines there is a Project Water supply available at Friant Dam as the result of an unusually large water supply not otherwise storable for Project purposes or infrequent and otherwise unmanaged flood flows of short duration, such water will be made available to the Contractor and others under Section 215 of the RRA pursuant to the priorities specified below if the Contractor enters into a temporary contract with the United States not to exceed one year for the delivery of such water or, as otherwise provided for in Federal Reclamation law and associated regulations. Such water may be identified by the Contractor either (i) as additional water to supplement the supply of Class 1 Water and/or Class 2 Water made available to it pursuant to this Contract or, (ii) upon written notification to the Contracting Officer, as water to be credited against the Contractor's Class 2 Water supply available pursuant to this Contract. The Contracting Officer

shall make water determined to be available pursuant to this subsection according to the following priorities: first, to long-term contractors for Class 1 Water and/or Class 2 Water within the Friant Division; second, to long-term contractors in the Cross Valley Division of the Project. The Contracting Officer will consider and seek to accommodate requests from other parties for Section 215 Water for use within the area identified as the Friant Division service area in the environmental assessment developed in connection with the execution of this Contract.

(m) Nothing in this Contract, nor any action or inaction of the Contractor or Contracting Officer in connection with the implementation of this Contract, is intended to override, modify, supersede, or otherwise interfere with any term or condition of the water rights and other rights referred in the third Explanatory Recital of this Contract.

(n) The rights of the Contractor under this Contract are subject to the terms of the contract for exchange waters, dated July 27, 1939, between the United States and the San Joaquin and Kings River Canal and Irrigation Company, Incorporated, et al., (hereinafter referred to as the Exchange Contractors), Contract No. I1r-1144, as amended. The United States agrees that it will not deliver to the Exchange Contractors thereunder waters of the San Joaquin River unless and until required by the terms of said contract, and the United States further agrees that it will not voluntarily and knowingly determine itself unable to deliver to the Exchange Contractors entitled thereto from water that is available or that may become available to it from the Sacramento River and its tributaries or the Sacramento-San Joaquin Delta those quantities required to satisfy the obligations of the United States under said Exchange Contract and under Schedule 2 of the Contract for Purchase of Miller and Lux Water Rights (Contract No. I1r-1145, dated July 27, 1939).

TIME FOR DELIVERY OF WATER

4. (a) On or about February 20 of each Calendar Year, the Contracting Officer shall announce the Contracting Officer's expected declaration of the Water Made Available. Such declaration will be expressed in terms of both Water Made Available and the Long Term Historic Average and will be updated monthly, and more frequently if necessary, based on then-current operational and hydrologic conditions and a new declaration with changes, if any, to the Water Made Available will be made. The Contracting Officer shall provide forecasts of Project operations and the basis of the estimate, with relevant supporting information, upon the written request of the Contractor. Concurrently with the declaration of the Water Made Available, the Contracting Officer shall provide the Contractor with the updated Long-Term Historic Average.

(b) On or before each March 1 and at such other times as necessary, the Contractor shall submit to the Contracting Officer a written schedule, satisfactory to the Contracting Officer, showing the monthly quantities of Project Water to be delivered by the United States to the Contractor pursuant to this Contract for the Year commencing on such March 1. The Contracting Officer shall use all reasonable means to deliver Project Water according to the approved schedule for the Year commencing on such March 1.

(c) The Contractor shall not schedule Project Water in excess of the quantity of Project Water the Contractor intends to put to reasonable and beneficial use within the Contractor's Service Area or to sell, transfer, or exchange pursuant to Article 9 of this Contract during any Year.

(d) Subject to the conditions set forth in subdivision (a) of Article 3 of this Contract, the United States shall deliver Project Water to the Contractor in accordance with the initial

schedule submitted by the Contractor pursuant to subdivision (b) of this Article, or any written revision(s), satisfactory to the Contracting Officer, thereto submitted within a reasonable time prior to the date(s) on which the requested change(s) is/are to be implemented: Provided, That the total amount of water requested in that schedule or revision does not exceed the quantities announced by the Contracting Officer pursuant to the provisions of subdivision (a) of Article 3, and the Contracting Officer determines that there will be sufficient capacity available in the appropriate Friant Division facilities to deliver the water in accordance with that schedule: Provided further, That the Contractor shall not schedule the delivery of any water during any period as to which the Contractor is notified by the Contracting Officer or Operating Non-Federal Entity that Project facilities required to make deliveries to the Contractor will not be in operation because of scheduled O&M.

(e) The Contractor may, during the period from and including November 1 of each Year through and including the last day of February of that Year, request delivery of any amount of the Class 1 Water estimated by the Contracting Officer to be made available to it during the following Year. The Contractor may, during the period from and including January 1 of each Year (or such earlier date as may be determined by the Contracting Officer) through and including the last day of February of that Year, request delivery of any amount of Class 2 Water estimated by the Contracting Officer to be made available to it during the following Year. Such water shall hereinafter be referred to as preuse water. Such request must be submitted in writing by the Contractor for a specified quantity of preuse water and shall be subject to the approval of the Contracting Officer. Payment for preuse water so requested shall be at the appropriate rate(s) for the following Year in accordance with Article 7 of this Contract and shall be made in advance of delivery of any preuse water. The

Contracting Officer shall deliver such preuse water in accordance with a schedule or any revision thereof submitted by the Contractor and approved by the Contracting Officer, to the extent such water is available and to the extent such deliveries will not interfere with the delivery of Project Water entitlements to other Friant Division contractors or the physical maintenance of the Project facilities. The quantities of preuse water delivered pursuant to this subdivision shall be deducted from the quantities of water that the Contracting Officer would otherwise be obligated to make available to the Contractor during the following Year: Provided, That the quantity of preuse water to be deducted from the quantities of either Class 1 Water or Class 2 Water to be made available to the Contractor in the following Year shall be specified by the Contractor at the time the preuse water is requested or as revised in its first schedule for the following Year submitted in accordance with subdivision (b) of this Article, based on the availability of the following Year water supplies as determined by the Contracting Officer.

POINT OF DIVERSION AND RESPONSIBILITY FOR DISTRIBUTION OF WATER

5. (a) Project Water scheduled pursuant to subdivision (b) of Article 4 of this Contract shall be delivered to the Contractor at a point or points of delivery either on Project facilities or another location or locations mutually agreed to in writing by the Contracting Officer and the Contractor.

(b) The Contracting Officer, either directly or through its written agreement(s) with the Operating Non-Federal Entity, shall make all reasonable efforts to maintain sufficient flows and levels of water in the Friant-Kern Canal to deliver Project Water to the Contractor at specific turnouts established pursuant to subdivision (a) of this Article.

(c) The Contractor shall not deliver Project Water to land outside the Contractor's Service Area unless approved in advance by the Contracting Officer.

(d) All Water Delivered to the Contractor pursuant to this Contract shall be measured and recorded with equipment furnished, installed, operated, and maintained by the United States or the Operating Non-Federal Entity at the point or points of delivery established pursuant to subdivision (a) of this Article. Upon the request of either party to this Contract, the Contracting Officer shall investigate, or cause to be investigated by the appropriate Operating Non-Federal Entity, the accuracy of such measurements and shall take any necessary steps to adjust any errors appearing therein. For any period of time when accurate measurements have not been made, the Contracting Officer shall consult with the Contractor and the responsible Operating Non-Federal Entity prior to making a final determination of the quantity delivered for that period of time.

(e) Neither the Contracting Officer nor any Operating Non-Federal Entity shall be responsible for the control, carriage, handling, use, disposal, or distribution of Water Delivered to the Contractor pursuant to this Contract beyond the delivery points specified in subdivision (a) of this Article. The Contractor shall indemnify the United States, its officers, employees, agents, and assigns on account of damage or claim of damage of any nature whatsoever for which there is legal responsibility, including property damage, personal injury, or death arising out of or connected with the control, carriage, handling, use, disposal, or distribution of such Project Water Delivered beyond such delivery points, except for any damage or claim arising out of: (i) acts or omissions of the Contracting Officer or any of its officers, employees, agents, or assigns, including the Operating Non-Federal Entity, with the intent of creating the situation resulting in any damage or claim;

(ii) willful misconduct of the Contracting Officer or any of its officers, employees, agents, or assigns, including the Operating Non-Federal Entity; (iii) negligence of the Contracting Officer or any of its officers, employees, agents, or assigns including the Operating Non-Federal Entity; or (iv) damage or claims resulting from a malfunction of facilities owned and/or operated by the United States or responsible Operating Non-Federal Entity.

MEASUREMENT OF WATER WITHIN THE CONTRACTOR'S SERVICE AREA

6. (a) Within five years of the date of Contract execution, the Contractor will have an established measuring program satisfactory to the Contracting Officer. The Contractor shall ensure that all surface water delivered for M&I purposes is measured at each M&I service connection. The water measuring devices or water measuring methods of comparable effectiveness must be acceptable to the Contracting Officer. The Contractor shall be responsible for installing, operating, and maintaining and repairing all such measuring devices and implementing all such water measuring methods at no cost to the United States. The Contracting Officer acknowledges that the Contractor has a metering plan (Exhibit "C") setting forth the milestones and schedule that the Contractor will implement to comply with the requirements of this Article. Beginning January 2006, the Contractor shall provide an annual written report to the Contracting Officer describing the Contractor's metering plan implementation progress. The Contractor shall use the information obtained from such water measuring devices or water measuring methods to ensure its proper management of the water, to bill water users for water delivered by the Contractor; and, if applicable, to record water delivered for M&I purposes by customer class as defined in the Contractor's water conservation plan provided for in Article 26 of this Contract. Nothing herein contained, however, shall preclude the Contractor from

establishing and collecting any charges, assessments, or other revenues authorized by California law. The Contractor shall include a summary of all its annual surface water deliveries in the annual report described in subdivision (c) of Article 26.

(b) To the extent the information has not otherwise been provided, upon execution of this Contract, the Contractor shall provide to the Contracting Officer a written report describing the measurement devices or water measuring methods being used or to be used to implement subdivision (a) of this Article and identifying the M&I service connections or alternative measurement programs approved by the Contracting Officer, at which such measurement devices or water measuring methods are being used, and, if applicable, identifying the locations at which such devices and/or methods are not yet being used including a time schedule for implementation at such locations. The Contracting Officer shall advise the Contractor in writing within 60 days as to the adequacy, and necessary modifications, if any, of the measuring devices or water measuring methods identified in the Contractor's report and if the Contracting Officer does not respond in such time, they shall be deemed adequate. If the Contracting Officer notifies the Contractor that the measuring devices or methods are inadequate, the parties shall within 60 days following the Contracting Officer's response, negotiate in good faith the earliest practicable date by which the Contractor shall modify said measuring devices and/or measuring methods as required by the Contracting Officer to ensure compliance with subdivision (a) of this Article.

(c) All new surface water delivery systems installed within the Contractor's Service Area after the effective date of this Contract shall also comply with the measurement provisions described in subdivision (a) of this Article.

(d) The Contractor shall inform the Contracting Officer and the State of California in writing by April 30 of each Year of the monthly volume of surface water delivered within the Contractor's Service Area during the previous Year.

(e) The Contractor shall inform the Contracting Officer and the Operating Non-Federal Entity on or before the 20th calendar day of each month of the quantity of M&I Water taken during the preceding month.

(f) In the event the provisions of subdivision (a) of this Article or any portion thereof, are challenged in a judicial proceeding, the parties agree to meet and confer promptly and as often as necessary to employ their reasonable best efforts to coordinate their response to the challenge and, as appropriate, develop revisions to this Contract.

RATES AND METHOD OF PAYMENT FOR WATER

7. (a) The Contractor shall pay the United States as provided in this Article for all Delivered Water at Rates, Charges, and the Tiered Pricing Component established in accordance with (i) the Secretary's then-existing ratesetting policy for M&I Water. Such ratesetting policies shall be amended, modified, or superseded only through a public notice and comment procedure; (ii) applicable Federal Reclamation law and associated rules and regulations, or policies; and (iii) other applicable provisions of this Contract. Payments shall be made by cash transaction, electronic funds transfer, or any other mechanism as may be agreed to in writing by the Contractor and the Contracting Officer. The Rates, Charges, and Tiered Pricing Component applicable to the Contractor upon execution of this Contract are set forth in Exhibit "B", as may be revised annually.

(b) The Contracting Officer shall notify the Contractor of the Rates, Charges, and Tiered Pricing Component as follows:

(1) Prior to July 1 of each Calendar Year, the Contracting Officer shall provide the Contractor an estimate of the Charges for Project Water that will be applied to the period October 1, of the current Calendar Year, through September 30, of the following Calendar Year, and the basis for such estimate. The Contractor shall be allowed not less than two months to review and comment on such estimates. On or before September 15 of each Calendar Year, the Contracting Officer shall notify the Contractor in writing of the Charges to be in effect during the period October 1 of the current Calendar Year, through September 30, of the following Calendar Year, and such notification shall revise Exhibit "B."

(2) Prior to October 1 of each Calendar Year, the Contracting Officer shall make available to the Contractor an estimate of the Rates and Tiered Pricing Component for Project Water for the following Year and the computations and cost allocations upon which those Rates are based. The Contractor shall be allowed not less than two months to review and comment on such computations and cost allocations. By December 31 of each Calendar Year, the Contracting Officer shall provide the Contractor with the final Rates and Tiered Pricing Component to be in effect for the upcoming Year, and such notification shall revise Exhibit "B."

(c) At the time the Contractor submits the initial schedule for the delivery of Project Water for each Year pursuant to subdivision (b) of Article 4 of this Contract, the Contractor shall make an advance payment to the United States equal to the total amount payable pursuant to the applicable Rate(s) set under subdivision (a) of this Article, for the Project Water scheduled to be

delivered pursuant to this Contract during the first two calendar months of the Year. Before the end of the first month and before the end of each calendar month thereafter, the Contractor shall make an advance payment to the United States, at the Rate(s) set under subdivision (a) of this Article, for the Water Scheduled to be delivered pursuant to this Contract during the second month immediately following. Adjustments between advance payments for Water Scheduled and payments at Rates due for Water Delivered shall be made before the end of the following month: Provided, That any revised schedule submitted by the Contractor pursuant to Article 4 of this Contract which increases the amount of Water Delivered pursuant to this Contract during any month shall be accompanied with appropriate advance payment, at the Rates then in effect, to assure that Project Water is not delivered to the Contractor in advance of such payment. In any month in which the quantity of Water Delivered to the Contractor pursuant to this Contract equals the quantity of Water Scheduled and paid for by the Contractor, no additional Project Water shall be delivered to the Contractor unless and until an advance payment at the Rates then in effect for such additional Project Water is made. Final adjustment between the advance payments for the Water Scheduled and payments for the quantities of Water Delivered during each Year pursuant to this Contract shall be made as soon as practicable but no later than April 30th of the following Year, or 60 days after the delivery of Project Water carried over under subdivision (g) of Article 3 of this Contract if such water is not delivered by the last day of February.

(d) The Contractor shall also make a payment in addition to the Rate(s) in subdivision (c) of this Article to the United States for Water Delivered, at the Charges and the appropriate Tiered Pricing Component then in effect, before the end of the month following the

month of delivery. The payments shall be consistent with the quantities of M&I Water Delivered as shown in the water delivery report for the subject month prepared by the Operating Non-Federal Entity or, if there is no Operating Non-Federal Entity, by the Contracting Officer. Such water delivery report shall be the basis for payment of Charges and Tiered Pricing Component by the Contractor, and shall be provided to the Contractor by the Operating Non-Federal Entity or the Contracting Officer (as applicable) within five days after the end of the month of delivery. The water delivery report shall be deemed a bill for the payment of Charges and the applicable Tiered Pricing Component for Water Delivered. Adjustment for overpayment or underpayment of Charges shall be made through the adjustment of payments due to the United States for Charges for the next month. Any amount to be paid for past due payment of Charges and the Tiered Pricing Component shall be computed pursuant to Article 20 of this Contract.

(e) The Contractor shall pay for any Water Delivered under subdivision (a), (f), or (g) of Article 3 of this Contract as determined by the Contracting Officer pursuant to applicable statutes, associated regulations, any applicable provisions of guidelines or ratesetting policies: Provided, That the Rate for Water Delivered under subdivision (f) of Article 3 of this Contract shall be no more than the otherwise applicable Rate for M&I Water under subdivision (a) of this Article.

(f) Payments to be made by the Contractor to the United States under this Contract may be paid from any revenues available to the Contractor.

(g) All revenues received by the United States from the Contractor relating to the delivery of Project Water or the delivery of non-Project water through Project facilities shall be

allocated and applied in accordance with Federal Reclamation law and the associated rules or regulations, and the then-current Project ratesetting policies for M&I Water.

(h) The Contracting Officer shall keep its accounts pertaining to the administration of the financial terms and conditions of its long-term contracts, in accordance with applicable Federal standards, so as to reflect the application of Project costs and revenues. The Contracting Officer shall, each Year upon request of the Contractor, provide to the Contractor a detailed accounting of all Project and Contractor expense allocations, the disposition of all Project and Contractor revenues, and a summary of all water delivery information. The Contracting Officer and the Contractor shall enter into good faith negotiations to resolve any discrepancies or disputes relating to accountings, reports, or information.

(i) The parties acknowledge and agree that the efficient administration of this Contract is their mutual goal. Recognizing that experience has demonstrated that mechanisms, policies, and procedures used for establishing Rates, Charges, and Tiered Pricing Components, and/or for making and allocating payments, other than those set forth in this Article may be in the mutual best interest of the parties, it is expressly agreed that the parties may enter into agreements to modify the mechanisms, policies, and procedures for any of those purposes while this Contract is in effect without amending this Contract.

(j) (1) Beginning at such time as the total of the deliveries of Class 1 Water and Class 2 Water in a Year exceed 80 percent of the Contract Total, then before the end of the month following the month of delivery the Contractor shall make an additional payment to the United States equal to the applicable Tiered Pricing Component. The Tiered Pricing Component for the total of the

deliveries of Class 1 Water and Class 2 Water in excess of 80 percent of the Contract Total, but less than or equal to 90 percent of the Contract Total, shall equal one-half of the difference between the Rate established under subdivision (a) of this Article and the M&I Full Cost Water Rate. The Tiered Pricing Component for the total of the deliveries of Class 1 Water and Class 2 Water which exceeds 90 percent of the Contract total shall equal the difference between (i) the Rate established under subdivision (a) of this Article and (ii) the M&I Full Cost Water Rate.

(2) Omitted.

(3) For purposes of determining the applicability of the Tiered Pricing Component pursuant to this Article, Water Delivered shall include Project Water that the Contractor transfers to others but shall not include Project Water transferred and delivered to the Contractor.

(k) For the term of this Contract, Rates under the respective ratesetting policies will be established to recover only reimbursable O&M (including any deficits) and capital costs of the Project, as those terms are used in the then-current Project ratesetting policies, and interest, where appropriate, except in instances where a minimum Rate is applicable in accordance with the relevant Project ratesetting policy. Changes of significance in practices which implement the Contracting Officer's ratesetting policies will not be implemented until the Contracting Officer has provided the Contractor an opportunity to discuss the nature, need, and impact of the proposed change.

(l) Except as provided in subsections 3405(a)(1)(B) and 3405(f) of the CVPIA, the Rates for Project Water transferred by the Contractor shall be the Contractor's Rates adjusted upward or downward to reflect the changed costs, if any, incurred by the Contracting Officer in the

delivery of the transferred Project Water to the transferee's point of delivery in accordance with the then-applicable Project ratesetting policy.

(m) Omitted.

(n) Omitted.

8. Omitted.

SALES, TRANSFERS, OR EXCHANGES OF WATER

9. (a) The right to receive Project Water provided for in this Contract may be sold, transferred, or exchanged to others for reasonable and beneficial uses within the State of California if such sale, transfer, or exchange is authorized by applicable Federal and State laws, and applicable guidelines or regulations then in effect. No sale, transfer, or exchange of Project Water under this Contract may take place without the prior written approval of the Contracting Officer, except as provided for in subdivision (b) of this Article, and no such sales, transfers, or exchanges shall be approved absent all appropriate environmental documentation including, but not limited to, documents prepared pursuant to the NEPA and ESA. Such environmental documentation should include, as appropriate, an analysis of groundwater impacts and economic and social effects, including environmental justice, of the proposed water transfers on both the transferor and transferee.

(b) In order to facilitate efficient water management by means of water transfers of the type historically carried out among Project Contractors located within the same geographical area and to allow the Contractor to participate in an accelerated water transfer program during the term of this Contract, the Contracting Officer shall prepare, as appropriate, all necessary environmental

documentation including, but not limited to, documents prepared pursuant to NEPA and ESA, analyzing annual transfers within such geographical areas, and the Contracting Officer shall determine whether such transfers comply with applicable law. Following the completion of the environmental documentation, such transfers addressed in such documentation shall be conducted with advance notice to the Contracting Officer, but shall not require prior written approval by the Contracting Officer. Such environmental documentation and the Contracting Officer's compliance determination shall be reviewed every five years and updated, as necessary, prior to the expiration of the then-existing five-year period. All subsequent environmental documentation shall include an alternative to evaluate not less than the quantity of Project Water historically transferred within the same geographical area.

(c) For a water transfer to qualify under subdivision (b) of this Article, such water transfer must: (i) be for irrigation purposes for lands irrigated within the previous three years, for M&I use, groundwater recharge, water banking, or fish and wildlife resources; not lead to land conversion; and be delivered to established cropland, wildlife refuges, groundwater basins or M&I use; (ii) occur within a single Year; (iii) occur between a willing seller and a willing buyer; (iv) convey water through existing facilities with no new construction or modifications to facilities and be between existing Project Contractors and/or the Contractor and the United States, Department of the Interior; and (v) comply with all applicable Federal, State, and local or tribal laws and requirements imposed for protection of the environment and Indian Trust Assets, as defined under Federal law.

APPLICATION OF PAYMENTS AND ADJUSTMENTS

10. (a) The amount of any overpayment by the Contractor of the Contractor's O&M, capital, and deficit (if any) obligations for the Year shall be applied first to any current liabilities of the Contractor arising out of this Contract then due and payable. Overpayments of more than $1,000 shall be refunded at the Contractor's request. In lieu of a refund, any amount of such overpayment, at the option of the Contractor, may be credited against amounts to become due to the United States by the Contractor. With respect to overpayment, such refund or adjustment shall constitute the sole remedy of the Contractor or anyone having or claiming to have the right to the use of any of the Project Water supply provided for herein. All credits and refunds of overpayments shall be made within 30 days of the Contracting Officer obtaining direction as to how to credit or refund such overpayment in response to the notice to the Contractor that it has finalized the accounts for the Year in which the overpayment was made.

(b) All advances for miscellaneous costs incurred for work requested by the Contractor pursuant to Article 25 of this Contract shall be adjusted to reflect the actual costs when the work has been completed. If the advances exceed the actual costs incurred, the difference will be refunded to the Contractor. If the actual costs exceed the Contractor's advances, the Contractor will be billed for the additional costs pursuant to Article 25.

TEMPORARY REDUCTIONS--RETURN FLOWS

11. (a) Subject to: (i) the authorized purposes and priorities of the Project and the requirements of Federal law and (ii) the obligations of the United States under existing contracts, or renewals thereof, providing for water deliveries from the Project, the Contracting Officer shall make

all reasonable efforts to optimize Project Water deliveries to the Contractor as provided in this Contract.

(b) The Contracting Officer or Operating Non-Federal Entity may temporarily discontinue or reduce the quantity of Water Delivered to the Contractor as herein provided for the purposes of investigation, inspection, maintenance, repair, or replacement of any of the Project facilities or any part thereof necessary for the delivery of Project Water to the Contractor, but so far as feasible the Contracting Officer or Operating Non-Federal Entity will give the Contractor due notice in advance of such temporary discontinuance or reduction, except in case of emergency, in which case no notice need be given: Provided, That the United States shall use its best efforts to avoid any discontinuance or reduction in such service. Upon resumption of service after such reduction or discontinuance, and if requested by the Contractor, the United States will, if possible, deliver the quantity of Project Water which would have been delivered hereunder in the absence of such discontinuance or reduction.

(c) The United States reserves the right to all seepage and return flow water derived from Water Delivered to the Contractor hereunder which escapes or is discharged beyond the Contractor's Service Area: Provided, That this shall not be construed as claiming for the United States any right to seepage or return flow being put to reasonable and beneficial use pursuant to this Contract within the Contractor's Service Area by the Contractor or those claiming by, through, or under the Contractor.

CONSTRAINTS ON THE AVAILABILITY OF WATER

12. (a) In its operation of the Project, the Contracting Officer will use all reasonable means to guard against a Condition of Shortage in the quantity of water to be made available to the Contractor pursuant to this Contract. In the event the Contracting Officer determines that a Condition of Shortage appears probable, the Contracting Officer will notify the Contractor of said determination as soon as practicable.

(b) If there is a Condition of Shortage because of errors in physical operations of the Project, drought, other physical causes beyond the control of the Contracting Officer, or actions taken by the Contracting Officer to meet legal obligations then, except as provided in subdivision (a) of Article 18 of this Contract, no liability shall accrue against the United States or any of its officers, agents, or employees for any damage, direct or indirect, arising therefrom.

(c) The United States shall not execute contracts which together with this Contract, shall in the aggregate provide for furnishing during the life of this Contract or any renewals hereof Class 1 Water in excess of 800,000 acre-feet per Year or Class 2 Water in excess of 1,401,475 acre-feet per Year: Provided, That, subject to subdivision (l) of Article 3 of this Contract, the limitation placed on Class 2 Water contracts shall not prohibit the United States from entering into temporary contracts of one year or less in duration for delivery of Project Water to other entities if such water is not necessary to meet the schedules as may be submitted by all Friant Division long-term water service contractors entitled to receive Class 1 Water and/or Class 2 Water under their water service contracts. Nothing in this subdivision shall limit the Contracting Officer's ability to take actions that result in the availability of new water supplies to be used for Project purposes and

allocating such new supplies: Provided, That the Contracting Officer shall not take such actions until after consultation with the Friant Division Project Contractors.

(d) The Contracting Officer shall not deliver any Class 2 Water pursuant to this or any other contract for water service heretofore or hereafter entered into any Year unless and until the Contracting Officer determines that the cumulative total quantity of Class 1 Water specified in subdivision (c) of this Article will be available for delivery in said Year. If the Contracting Officer determines there is or will be a shortage in any Year in the quantity of Class 1 Water available for delivery, the Contracting Officer shall apportion the available Class 1 Water among all contractors entitled to receive such water that will be made available at Friant Dam in accordance with the following:

(1) A determination shall be made of the total quantity of Class 1 Water at Friant Dam which is available for meeting Class 1 Water contractual commitments, the amount so determined being herein referred to as the available supply.

(2) The total available Class 1 supply shall be divided by the Class 1 Water contractual commitments, the quotient thus obtained being herein referred to as the Class 1 apportionment coefficient.

(3) The total quantity of Class 1 Water under Article 3 of this Contract shall be multiplied by the Class 1 apportionment coefficient and the result shall be the quantity of Class 1 Water required to be delivered by the Contracting Officer to the Contractor for the respective Year, but in no event shall such amount exceed the total quantity of Class 1 Water specified in subdivision (a) of Article 3 of this Contract.

(e) If the Contracting Officer determines there is less than the quantity of Class 2 Water which the Contractor otherwise would be entitled to receive pursuant to Article 3 of this Contract, the quantity of Class 2 Water which shall be furnished to the Contractor by the Contracting Officer will be determined in the manner set forth in paragraphs (1), (2), and (3), of subdivision (d) of this Article substituting the term "Class 2" for the term "Class 1."

(f) In the event that in any Year there is made available to the Contractor, by reason of any shortage or apportionment as provided in subdivisions (a), (d), or (e) of this Article, or any discontinuance or reduction of service as set forth in subdivision (b) of Article 11 of this Contract, less than the quantity of water which the Contractor otherwise would be entitled to receive hereunder, there shall be made an adjustment on account of the amounts already paid to the Contracting Officer by the Contractor for Class 1 Water and Class 2 Water for said Year in accordance with Article 10 of this Contract.

13. Omitted.

RULES AND REGULATIONS

14. (a) The parties agree that the delivery of Project Water or use of Federal facilities pursuant to this Contract is subject to Federal Reclamation law, as amended and supplemented, and the rules and regulations promulgated by the Secretary of the Interior under Federal Reclamation law.

(b) The terms of this Contract are subject to any enforceable order, judgment, and/or settlement in NRDC v. Patterson, No. CIVS 88-1658-LKK-EM and shall be timely modified as necessary to effectuate or facilitate any final order, judgment, or settlement in said litigation.

(c) Omitted.

## WATER AND AIR POLLUTION CONTROL

15. The Contractor, in carrying out this Contract, shall comply with all applicable water and air pollution laws and regulations of the United States and the State of California, and shall obtain all required permits or licenses from the appropriate Federal, State, or local authorities.

## QUALITY OF WATER

16. (a) Project facilities used to deliver Project Water to the Contractor pursuant to this Contract shall be operated and maintained to enable the United States to deliver Project Water to the Contractor in accordance with the water quality standards specified in subsection 2(b) of the Act of August 26, 1937 (50 Stat. 865), as added by Section 101 of the Act of October 27, 1986 (100 Stat. 3050) or other existing Federal laws. The United States is under no obligation to construct or furnish water treatment facilities to maintain or to improve the quality of Water Delivered to the Contractor pursuant to this Contract. The United States does not warrant the quality of Water Delivered to the Contractor pursuant to this Contract.

(b) The O&M of Project facilities shall be performed in such manner as is practicable to maintain the quality of raw water made available through such facilities at the highest level reasonably attainable as determined by the Contracting Officer. The Contractor shall be responsible for compliance with all State and Federal water quality standards applicable to surface and subsurface agricultural drainage discharges generated through the use of Federal or Contractor facilities or Project Water provided by the Contractor within the Contractor's Service Area.

WATER ACQUIRED BY THE CONTRACTOR
OTHER THAN FROM THE UNITED STATES

17. (a) Omitted.

(b) Water or water rights now owned or hereafter acquired by the Contractor, other than from the United States, may be stored, conveyed, and/or diverted through Project facilities, subject to the completion of appropriate environmental documentation, with the approval of the Contracting Officer and the execution of any contract determined by the Contracting Officer to be necessary, consistent with the following provisions:

(1) The Contractor may introduce non-Project water into Project facilities and deliver said water within the Contractor's Service Area subject to payment to the United States and/or to any applicable Operating Non-Federal Entity of an appropriate rate as determined by the applicable Project ratesetting policy, the RRA, and the Project use power policy, if such Project use power policy is applicable, each as amended, modified, or superseded from time to time.

(2) Delivery of such non-Project water in and through Project facilities shall only be allowed to the extent such deliveries do not: (i) interfere with other Project purposes as determined by the Contracting Officer; (ii) reduce the quantity or quality of water available to other Project Contractors; (iii) interfere with the delivery of contractual water entitlements to any other Project Contractors; or (iv) interfere with the physical maintenance of the Project facilities.

(3) Neither the United States nor the Operating Non-Federal Entity shall be responsible for control, care, or distribution of the non-Project water before it is introduced into or after it is delivered from the Project facilities. The Contractor hereby releases and agrees to defend

and indemnify the United States and the Operating Non-Federal Entity, and their respective officers, agents, and employees, from any claim for damage to persons or property, direct or indirect, resulting from the acts of the Contractor its officers', employees', agents', or assigns' act(s) in (i) extracting or diverting non-Project water from any source, or (ii) diverting such non-Project water into Project facilities.

(4) Diversion of such non-Project water into Project facilities shall be consistent with all applicable laws, and if involving groundwater, consistent with any groundwater management plan for the area from which it was extracted.

(5) After Project purposes are met, as determined by the Contracting Officer, the United States and the Contractor shall share priority to utilize the remaining capacity of the facilities declared to be available by the Contracting Officer for conveyance and transportation of non-Project water prior to any such remaining capacity being made available to non-Project contractors.

OPINIONS AND DETERMINATIONS

18. (a) Where the terms of this Contract provide for actions to be based upon the opinion or determination of either party to this Contract, said terms shall not be construed as permitting such action to be predicated upon arbitrary, capricious, or unreasonable opinions or determinations. Both parties, notwithstanding any other provisions of this Contract, expressly reserve the right to seek relief from and appropriate adjustment for any such arbitrary, capricious, or unreasonable opinion or determination. Each opinion or determination by either party shall be provided in a timely manner. Nothing in subdivision (a) of Article 18 of this Contract is intended to

or shall affect or alter the standard of judicial review applicable under Federal law to any opinion or determination implementing a specific provision of Federal law embodied in statute or regulation.

(b) The Contracting Officer shall have the right to make determinations necessary to administer this Contract that are consistent with the expressed and implied provisions of this Contract, the laws of the United States and of the State of California, and the rules and regulations promulgated by the Secretary of the Interior. Such determinations shall be made in consultation with the Contractor to the extent reasonably practicable.

COORDINATION AND COOPERATION

19. (a) In order to further their mutual goals and objectives, the Contracting Officer and the Contractor shall communicate, coordinate, and cooperate with each other, and with other affected Project Contractors, in order to improve the operation and management of the Project. The communication, coordination, and cooperation regarding operations and management shall include, but not be limited to, any action which will or may materially affect the quantity or quality of Project Water supply, the allocation of Project Water supply, and Project financial matters including, but not limited to, budget issues. The communication, coordination, and cooperation provided for hereunder shall extend to all provisions of this Contract. Each party shall retain exclusive decision making authority for all actions, opinion, and determinations to be made by the respective party.

(b) Within 120 days following the effective date of this Contract, the Contractor, other affected Project Contractors, and the Contracting Officer shall arrange to meet with interested Project Contractors to develop a mutually agreeable, written Project-wide process, which may be amended as necessary, separate and apart from this Contract. The goal of this process shall be to

provide, to the extent practicable, the means of mutual communication and interaction regarding significant decisions concerning Project operation and management on a real-time basis.

(c) It is the intent of the Secretary to improve water supply reliability. To carry out this intent:

(1) The Contracting Officer will, at the request of the Contractor, assist in the development of integrated resource management plans for the Contractor. Further, the Contracting Officer will, as appropriate, seek authorizations for implementation of partnerships to improve water supply, water quality, and reliability.

(2) The Secretary will, as appropriate, pursue program and project implementation and authorization in coordination with Project Contractors to improve the water supply, water quality, and reliability of the Project for all Project purposes.

(3) The Secretary will coordinate with Project Contractors and the State of California to seek improved water resource management.

(4) The Secretary will coordinate actions of agencies within the Department of the Interior that may impact the availability of water for Project purposes.

(5) The Contracting Officer shall periodically, but not less than annually, hold division level meetings to discuss Project operations, division level water management activities, and other issues as appropriate.

(d) Without limiting the contractual obligations of the Contracting Officer under the other Articles of this Contract, nothing in this Article shall be construed to limit or constrain the Contracting Officer's ability to communicate, coordinate, and cooperate with the Contractor or other

interested stakeholders or to make decisions in a timely fashion as needed to protect health, safety, or the physical integrity of structures or facilities.

## CHARGES FOR DELINQUENT PAYMENTS

20. (a) The Contractor shall be subject to interest, administrative, and penalty charges on delinquent installments or payments. When a payment is not received by the due date, the Contractor shall pay an interest charge for each day the payment is delinquent beyond the due date. When a payment becomes sixty (60) days delinquent, the Contractor shall pay an administrative charge to cover additional costs of billing and processing the delinquent payment. When a payment is delinquent ninety (90) days or more, the Contractor shall pay an additional penalty charge of six (6%) percent per year for each day the payment is delinquent beyond the due date. Further, the Contractor shall pay any fees incurred for debt collection services associated with a delinquent payment.

(b) The interest charge rate shall be the greater of the rate prescribed quarterly in the Federal Register by the Department of the Treasury for application to overdue payments, or the interest rate of one-half of one (0.5%) percent per month prescribed by Section 6 of the Reclamation Project Act of 1939 (Public Law 76-260). The interest charge rate shall be determined as of the due date and remain fixed for the duration of the delinquent period.

(c) When a partial payment on a delinquent account is received, the amount received shall be applied, first to the penalty, second to the administrative charges, third to the accrued interest, and finally to the overdue payment.

## EQUAL OPPORTUNITY

21. During the performance of this Contract, the Contractor agrees as follows:

(a) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination, rates of payment or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of this nondiscrimination clause.

(b) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without discrimination because of race, color, religion, sex, or national origin.

(c) The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the Contracting Officer, advising the said labor union or workers' representative of the Contractor's commitments under Section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(d) The Contractor will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(e) The Contractor will furnish all information and reports required by said amended Executive Order and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records, and accounts by the Contracting Officer and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(f) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this Contract or with any of the said rules, regulations, or orders, this Contract may be canceled, terminated, or suspended, in whole or in part, and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in said amended Executive Order, and such other sanctions may be imposed and remedies invoked as provided in said Executive Order, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(g) The Contractor will include the provisions of paragraphs (a) through (g) in every subcontract or purchase order unless exempted by the rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of said amended Executive Order, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, That in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

## GENERAL OBLIGATION--BENEFITS CONDITIONED UPON PAYMENT

22. (a) The obligation of the Contractor to pay the United States as provided in this Contract is a general obligation of the Contractor notwithstanding the manner in which the obligation may be distributed among the Contractor's water users and notwithstanding the default of individual water users in their obligations to the Contractor.

(b) The payment of charges becoming due hereunder is a condition precedent to receiving benefits under this Contract. The United States shall not make water available to the Contractor through Project facilities during any period in which the Contractor may be in arrears in the advance payment of water rates due the United States. The Contractor shall not furnish water made available pursuant to this Contract for lands or parties which are in arrears in the advance payment of water rates levied or established by the Contractor.

(c) With respect to subdivision (b) of this Article, the Contractor shall have no obligation to require advance payment for water rates which it levies.

COMPLIANCE WITH CIVIL RIGHTS LAWS AND REGULATIONS

23. (a) The Contractor shall comply with Title VI of the Civil Rights Act of 1964 (42 U.S.C. 2000d), Section 504 of the Rehabilitation Act of 1975 (P.L. 93-112, as amended), the Age Discrimination Act of 1975 (42 U.S.C. 6101, et seq.) and any other applicable civil rights laws, as well as with their respective implementing regulations and guidelines imposed by the U.S. Department of the Interior and/or Bureau of Reclamation.

(b) These statutes require that no person in the United States shall, on the grounds of race, color, national origin, handicap, or age, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving financial assistance from the Bureau of Reclamation. By executing this Contract, the Contractor agrees to immediately take any measures necessary to implement this obligation, including permitting officials of the United States to inspect premises, programs, and documents.

(c) The Contractor makes this agreement in consideration of and for the purpose of obtaining any and all Federal grants, loans, contracts, property discounts, or other Federal financial assistance extended after the date hereof to the Contractor by the Bureau of Reclamation, including installment payments after such date on account of arrangements for Federal financial assistance which were approved before such date. The Contractor recognizes and agrees that such Federal assistance will be extended in reliance on the representations and agreements made in this Article, and that the United States reserves the right to seek judicial enforcement thereof.

24. Omitted.

CONTRACTOR TO PAY CERTAIN MISCELLANEOUS COSTS

25. In addition to all other payments to be made by the Contractor pursuant to this Contract, the Contractor shall pay to the United States, within 60 days after receipt of a bill and detailed statement submitted by the Contracting Officer to the Contractor for such specific items of direct cost incurred by the United States for work requested by the Contractor associated with this Contract plus indirect costs in accordance with applicable Bureau of Reclamation policies and procedures. All such amounts referred to in this Article shall not exceed the amount agreed to in writing in advance by the Contractor. This Article shall not apply to costs for routine contract administration.

WATER CONSERVATION

26. (a) Prior to the delivery of water provided from or conveyed through Federally constructed or Federally financed facilities pursuant to this Contract, the Contractor shall be implementing an effective water conservation and efficiency program based on the Contractor's water conservation plan that has been determined by the Contracting Officer to meet the conservation and efficiency criteria for evaluating water conservation plans established under Federal law. The water conservation and efficiency program shall contain definite water conservation objectives, appropriate economically feasible water conservation measures, and time schedules for meeting those objectives. Continued Project Water delivery pursuant to this Contract shall be contingent upon the Contractor's continued implementation of such water conservation program. In the event the Contractor's water conservation plan or any revised water conservation plan completed pursuant to subdivision (d) of Article 26 of this Contract have not yet been determined by the Contracting Officer to meet such

criteria, due to circumstances which the Contracting Officer determines are beyond the control of the Contractor, water deliveries shall be made under this Contract so long as the Contractor diligently works with the Contracting Officer to obtain such determination at the earliest practicable date, and thereafter the Contractor immediately begins implementing its water conservation and efficiency program in accordance with the time schedules therein.

(b) Should the amount of M&I Water delivered pursuant to subdivision (a) of Article 3 of this Contract equal or exceed 2,000 acre-feet per Year, the Contractor shall implement the Best Management Practices identified by the time frames issued by the California Urban Water Conservation Council for such M&I Water unless any such practice is determined by the Contracting Officer to be inappropriate for the Contractor.

(c) The Contractor shall submit to the Contracting Officer a report on the status of its implementation of the water conservation plan on the reporting dates specified in the then-existing conservation and efficiency criteria established under Federal law.

(d) At five-year intervals, the Contractor shall revise its water conservation plan to reflect the then-current conservation and efficiency criteria for evaluating water conservation plans established under Federal law and submit such revised water management plan to the Contracting Officer for review and evaluation. The Contracting Officer will then determine if the water conservation plan meets Reclamation's then-current conservation and efficiency criteria for evaluating water conservation plans established under Federal law.

(e) If the Contractor is engaged in direct groundwater recharge, such activity shall be described in the Contractor's water conservation plan.

EXISTING OR ACQUIRED WATER OR WATER RIGHTS

27. Except as specifically provided in Article 17 of this Contract, the provisions of this Contract shall not be applicable to or affect non-Project water or water rights now owned or hereafter acquired by the Contractor or any user of such water within the Contractor's Service Area. Any such water shall not be considered Project Water under this Contract. In addition, this Contract shall not be construed as limiting or curtailing any rights which the Contractor or any water user within the Contractor's Service Area acquires or has available under any other contract pursuant to Federal Reclamation law.

OPERATION AND MAINTENANCE BY OPERATING NON-FEDERAL ENTITY

28. (a) The O&M of a portion of the Project facilities which serve the Contractor, and responsibility for funding a portion of the costs of such O&M, have been transferred to the Operating Non-Federal Entity by separate agreement between the United States and the Operating Non-Federal Entity. That separate agreement shall not interfere with or affect the rights or obligations of the Contractor or the United States hereunder.

(b) The Contracting Officer has previously notified the Contractor in writing that the O&M of a portion of the Project facilities which serve the Contractor has been transferred to the Operating Non-Federal Entity, and therefore, the Contractor shall pay directly to the Operating Non-Federal Entity, or to any successor approved by the Contracting Officer under the terms and conditions of the separate agreement between the United States and the Operating Non-Federal Entity described in subdivision (a) of this Article, all rates, charges, or assessments of any kind, including any assessment for reserve funds, which the Operating Non-Federal Entity or such successor

determines, sets, or establishes for (i) the O&M of the portion of the Project facilities operated and maintained by the Operating Non-Federal Entity or such successor, or (ii) the Friant Division's share of the operation, maintenance, and replacement costs for physical works and appurtenances associated with the Tracy Pumping Plant, the Delta-Mendota Canal, the O'Neill Pumping/Generating Plant, the Federal share of the O'Neill Forebay, the Mendota Pool, and the Federal share of San Luis Unit joint use conveyance and conveyance pumping facilities. Such direct payments to the Operating Non-Federal Entity or such successor shall not relieve the Contractor of its obligation to pay directly to the United States the Contractor's share of the Project Rates, Charges, and Tiered Pricing Component(s) except to the extent the Operating Non-Federal Entity collects payments on behalf of the United States in accordance with the separate agreement identified in subdivision (a) of this Article.

(c) For so long as the O&M of any portion of the Project facilities serving the Contractor is performed by the Operating Non-Federal Entity, or any successor thereto, the Contracting Officer shall adjust those components of the Rates for Water Delivered under this Contract representing the cost associated with the activity being performed by the Operating Non-Federal Entity or its successor.

(d) In the event the O&M of the Project facilities operated and maintained by the Operating Non-Federal Entity is re-assumed by the United States during the term of this Contract, the Contracting Officer shall so notify the Contractor, in writing, and present to the Contractor a revised Exhibit "B" which shall include the portion of the Rates to be paid by the Contractor for Project Water under this Contract representing the O&M costs of the portion of such Project facilities which

have been re-assumed. The Contractor shall, thereafter, in the absence of written notification from the Contracting Officer to the contrary, pay the Rates, Charges, and Tiered Pricing Component(s) specified in the revised Exhibit "B" directly to the United States in compliance with Article 7 of this Contract.

CONTINGENT UPON APPROPRIATION OR ALLOTMENT OF FUNDS

29. The expenditure or advance of any money or the performance of any obligation of the United States under this Contract shall be contingent upon appropriation or allotment of funds. Absence of appropriation or allotment of funds shall not relieve the Contractor from any obligations under this Contract. No liability shall accrue to the United States in case funds are not appropriated or allotted.

BOOKS, RECORDS, AND REPORTS

30. (a) The Contractor shall establish and maintain accounts and other books and records pertaining to administration of the terms and conditions of this Contract, including: the Contractor's financial transactions, water supply data, and Project land and right-of-way agreements; water use data; and other matters that the Contracting Officer may require. Reports thereon shall be furnished to the Contracting Officer in such form and on such date or dates as the Contracting Officer may require. Subject to applicable Federal laws and regulations, each party to this Contract shall have the right during office hours to examine and make copies of the other party's books and records relating to matters covered by this Contract.

(b) Notwithstanding the provisions of subdivision (a) of this Article, no books, records, or other information shall be requested from the Contractor by the Contracting Officer unless such books, records, or information are reasonably related to the administration or performance of this Contract. Any such request shall allow the Contractor a reasonable period of time within which to provide the requested books, records, or information.

(c) At such time as the Contractor provides information to the Contracting Officer pursuant to subdivision (a) of this Article, a copy of such information shall be provided to the Operating Non-Federal Entity.

ASSIGNMENT LIMITED--SUCCESSORS AND ASSIGNS OBLIGATED

31. (a) The provisions of this Contract shall apply to and bind the successors and assigns of the parties hereto, but no assignment or transfer of this Contract or any right or interest therein shall be valid until approved in writing by the Contracting Officer.

(b) The assignment of any right or interest in this Contract by either party shall not interfere with the rights or obligations of the other party to this Contract absent the written concurrence of said other party.

(c) The Contracting Officer shall not unreasonably condition or withhold approval of any proposed assignment.

SEVERABILITY

32. In the event that a person or entity who is neither (i) a party to a Project contract, nor (ii) a person or entity that receives Project Water from a party to a Project contract, nor (iii) an association or other form of organization whose primary function is to represent parties to Project contracts, brings an action in a court of competent jurisdiction challenging the legality or enforceability of a provision included in this Contract and said person, entity, association, or organization obtains a final court decision holding that such provision is legally invalid or unenforceable and the Contractor has not intervened in that lawsuit in support of the plaintiff(s), the parties to this Contract shall use their best efforts to (i) within 30 days of the date of such final court decision identify by mutual agreement the provisions in this Contract which must be revised and

(ii) within three months thereafter promptly agree on the appropriate revision(s). The time periods specified above may be extended by mutual agreement of the parties. Pending the completion of the actions designated above, to the extent it can do so without violating any applicable provisions of law, the United States shall continue to make the quantities of Project Water specified in this Contract available to the Contractor pursuant to the provisions of this Contract which were not found to be legally invalid or unenforceable in the final court decision.

RESOLUTION OF DISPUTES

33. Should any dispute arise concerning any provisions of this Contract, or the parties' rights and obligations thereunder, the parties shall meet and confer in an attempt to resolve the dispute. Prior to the Contractor commencing any legal action, or the Contracting Officer referring any matter to Department of Justice, the party shall provide to the other party 30 days' written notice of the intent to take such action: Provided, That such notice shall not be required where a delay in commencing an action would prejudice the interests of the party that intends to file suit. During the 30-day notice period, the Contractor and the Contracting Officer shall meet and confer in an attempt to resolve the dispute. Except as specifically provided, nothing herein is intended to waive or abridge any right or remedy that the Contractor or the United States may have.

OFFICIALS NOT TO BENEFIT

34. No Member of or Delegate to Congress, Resident Commissioner, or official of the Contractor shall benefit from this Contract other than as a water user or landowner in the same manner as other water users or landowners.

CHANGES IN CONTRACTOR'S SERVICE AREA

35. (a) While this Contract is in effect, no change may be made in the Contractor's Service Area, by inclusion or exclusion of lands, dissolution, consolidation, merger, or otherwise, except upon the Contracting Officer's written consent.

(b) Within 30 days of receipt of a request for such a change, the Contracting Officer will notify the Contractor of any additional information required by the Contracting Officer for processing said request, and both parties will meet to establish a mutually agreeable schedule for timely completion of the process. Such process will analyze whether the proposed change is likely to: (i) result in the use of Project Water contrary to the terms of this Contract; (ii) impair the ability of the Contractor to pay for Project Water furnished under this Contract or to pay for any Federally-constructed facilities for which the Contractor is responsible; and (iii) have an impact on any Project Water rights applications, permits, or licenses. In addition, the Contracting Officer shall comply with the NEPA and the ESA. The Contractor will be responsible for all costs incurred by the Contracting Officer in this process, and such costs will be paid in accordance with Article 25 of this Contract.

FEDERAL LAWS

36. By entering into this Contract, the Contractor does not waive its rights to contest the validity or application in connection with the performance of the terms and conditions of this Contract of any Federal law or regulation: Provided, That the Contractor agrees to comply with the terms and conditions of this Contract unless and until relief from application of such Federal law or regulation to the implementing provision of the Contract is granted by a court of competent jurisdiction.

## NOTICES

37. Any notice, demand, or request authorized or required by this Contract shall be deemed to have been given, on behalf of the Contractor, when mailed, postage prepaid, or delivered to the Area Manager, South-Central California Area Office, 1243 "N" Street, Fresno, California 93721, and on behalf of the United States, when mailed, postage prepaid, or delivered to the City of Fresno, Public Utilities Director, 2600 Fresno Street, Room 3065, Fresno, California 93721-3624. The designation of the addressee or the address may be changed by notice given in the same manner as provided in this Article for other notices.

## CONFIRMATION OF CONTRACT

38. The Contractor, after the execution of this Contract, shall furnish to the Contracting Officer evidence that pursuant to the laws of the State of California the Contractor is a legally constituted entity, and the Contract is lawful, valid, and binding on the Contractor. This Contract shall not be binding on the United States until such evidence has been provided to the Contracting Officer's satisfaction.

IN WITNESS WHEREOF, the parties hereto have executed this Contract as of the day and year first above written.

THE UNITED STATES OF AMERICA

APPROVED AS TO LEGAL FORM AND SUFFICIENCY
James E Jackson
OFFICE OF REGIONAL SOLICITOR
DEPARTMENT OF THE INTERIOR

By: _____
Regional Director, Mid-Pacific Region
Bureau of Reclamation

(SEAL)

CITY OF FRESNO

By: _____
City Manager

Attest:

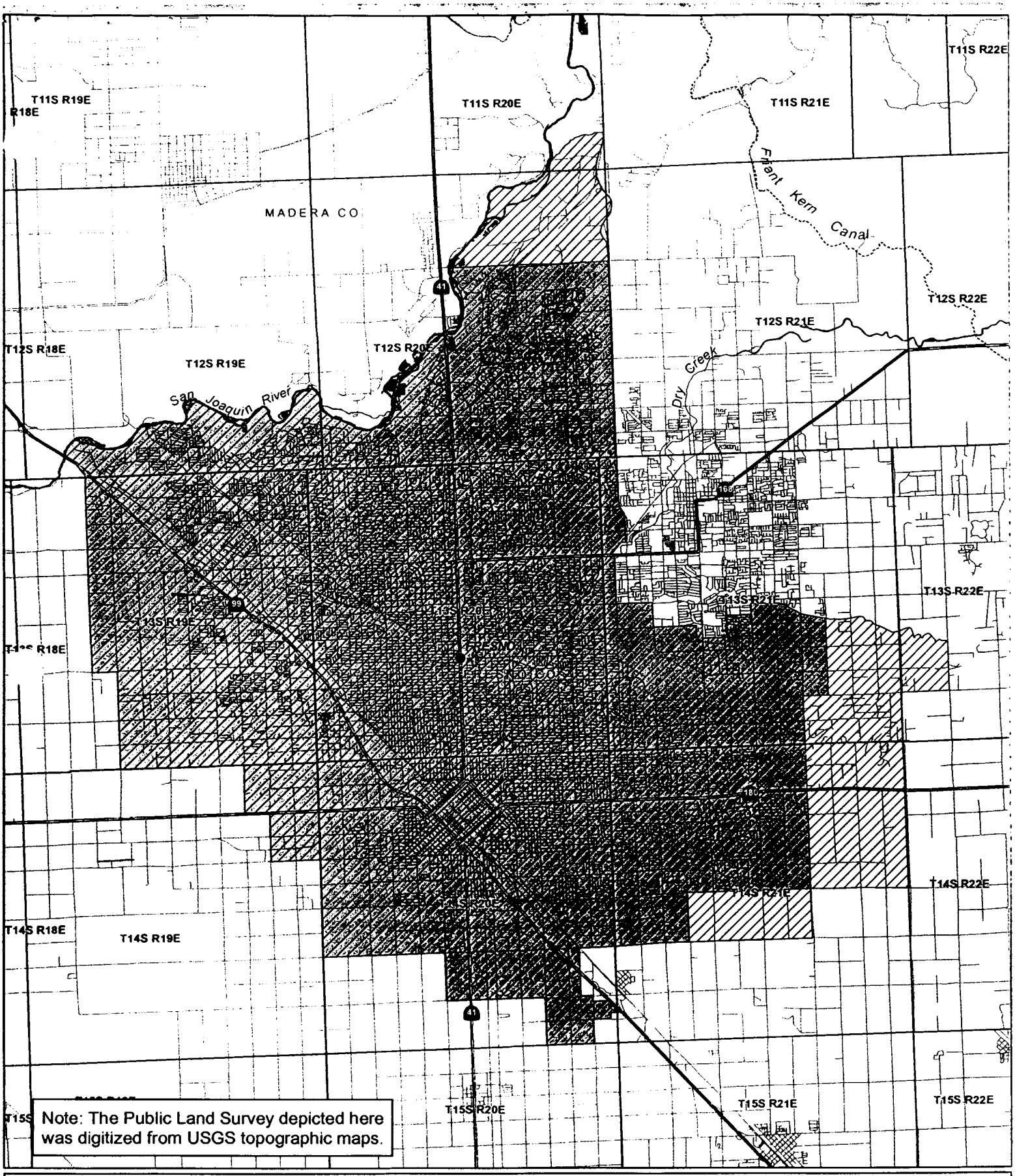
By: Rebecca E Klisch
City Clerk 7-25-05

By: _____
Public Utilities Director

Approved as to form:

Hilda Cantu Montez
City Attorney

(I:\LTRC\Final Draft LTRC's – Fresno, Tracy\City of Fresno R. O. Final Draft Contract 05-04-2005.doc)




Contractor's Proposed Service Area (Sphere of Influence)

Contractor's Current Service Area

# City of Fresno

Contract No. 14-06-200-8901-LTR1

EXHIBIT A

Miles

0 0.5 1 2 3 4

Date: October 26, 2004

File Name: N:\districts\contracts\city_of_fresno\city_of_fresno2.mxd

214-208-12705

# EXHIBIT B
# CITY OF FRESNO
# WATER RATES AND CHARGES

| | 2005 Rates Per Acre-Foot M&I Water |
|---|---|
| O&M AND COST-OF-SERVICE RATES: | |
| Capital Rates: | $20.04 |
| O&M Rates: | |
| Water Marketing | $ 3.89 |
| Storage | $ 6.67 |
| Conveyance | * |
| Deficit Rates: | |
| Non-Interest Bearing | |
| Interest Bearing | $53.53 |
| CFO/PER Adj. Rate ** | $ 1.70 |
| TOTAL COST-OF-SERVICE RATES (COS): | $85.83 |
| M&I FULL-COST RATE | $97.15 |
| Tiered Pricing Component>80%<=90% of Contract Total [Full Cost Rate – COS Rate /2]: | $ 5.66 |
| Tiered Pricing Component>90% of Contract Total [Full Cost Rate – COS Rate]: | $11.32 |
| SURCHARGES UNDER PUB. L. 102-575 TO RESTORATION FUND*** | |
| Friant Surcharge [3406(c)(1)] | $ 7.00 |
| Restoration Payments [3407(d)(2)(A)] | $15.87 |

* Conveyance and Conveyance Pumping Operation and Maintenance Costs were removed for ratesetting purposes and are to be billed directly to the water authorities.

** Chief Financial Officer (CFO) Adjustment and Provision for Replacement (PFR) Credit are being distributed over a 5-year period beginning in FY2003 for the contractors that requested that the costs be deferred.

*** The surcharges are payments in addition to the water rates and were determined pursuant to Title XXXIV of Public Law 102-575. Restoration fund surcharges under P. L. 102-575 are on a fiscal year basis (10/1-9/30).

EXHIBIT C
METERING PLAN

| Completion Date | Item | Comments |
|---|---|---|
| 03/05* | Contract effective | |
| 01/06 | Implementation study | Select and obtain consultant study re implementation |
| 01/06 | Submit progress report to Bureau | |
| 12/06 | Confirmation of existing meters | Verify integrity and servicing of existing meters |
| 01/07 | Submit progress report to Bureau | |
| 06/07 | Secure installation contract | Begin implementation of consultant recommendations |
| 12/07 | Draft rate ordinance | Initial development of tiered rate structure |
| 01/08 | Submit progress report to Bureau | |
| 01/08 | Initiate retrofit | Begin installation of meters on existing dwellings |
| 12/08 | Meter installation progress | 29% (30,000 of approximately 105,000 units installed) |
| 01/09 | Submit progress report to Bureau | |
| 12/09 | Meter installation progress | 43% (45,000 units) |
| 01/10 | Submit progress report to Bureau | |
| 03/10 | Impose new rate ordinance (fees based on metered use) | New rate structure applicable to currently metered customers. Rates to be effective as new meter installations occur. |
| 12/10 | Meter installation progress | 62% (65,000 units) |
| 01/11 | Submit progress report to Bureau | |
| 12/11 | Adopt new rate ordinance | 81% (85,000 units) |
| 01/12 | Submit compliance report to Bureau | |
| 12/12 | Meter installation progress | 100% (105,000 units) |
| 01/13 | Submit completion report | Retrofit complete. |

**Schedule subject to change due to unforeseen circumstances.**

*This date will be revised at the time the contract is executed on behalf of the United States.

Amendment to Contract
No. 14-06-200-8901-LTR1

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Central Valley Project, California

AMENDMENT TO LONG-TERM RENEWAL CONTRACT BETWEEN
THE UNITED STATES
AND
CITY OF FRESNO
PROVIDING FOR PROJECT WATER SERVICE FROM FRIANT DIVISION

THIS CONTRACT AMENDMENT, is made this 6th day of April, 2007, in pursuance generally of the Act of Congress of June 17, 1902 (32 Stat. 388), and the acts amendatory thereof or supplementary thereto, including, but not limited to, the Acts of August 26, 1937 (50 Stat. 844), as amended and supplemented, August 4, 1939 (53 Stat. 1187), as amended and supplemented, July 2, 1956 (70 Stat. 483), June 21, 1963 (77 Stat. 68), October 12, 1982 (96 Stat. 1263), October 27, 1986 (100 Stat. 3050), as amended, and Title XXXIV of the Act of October 30, 1992 (106 Stat. 4706), all collectively hereinafter referred to as Federal Reclamation law, between THE UNITED STATES OF AMERICA, hereinafter referred to as the United States, and, CITY OF FRESNO, hereinafter referred to as the Contractor, a public agency of the State of California, duly organized, existing, and acting pursuant to the laws thereof;

WITNESSETH, That:

EXPLANATORY RECITALS

[1st] WHEREAS, the United States and the Contractor entered into a contract dated August 18, 2005, designated Contract No. 14-06-200-8901-LTR1, providing for water service from the Central Valley Project, hereinafter referred to as the "Existing Contract;" and

[2nd] WHEREAS, pursuant to subdivision (b) of Article 14 of the Existing Contract, the terms of the Existing Contract are subject to any enforceable order, judgment and/or settlement in *NRDC* v. *Patterson*, No. CIVS 88-1658-LKK-EM (now styled *Natural Resources Defense Council, et al.* v. *Rodgers, et al.,* No. CIV-S-88-1658 LKK/GGH) and that the Existing Contract shall be timely modified as necessary to effectuate or facilitate any final order, judgment or settlement in said litigation; and

[3rd] WHEREAS, the parties to said litigation have reached agreement on a global resolution of all Claims for Relief in the Seventh Amended Complaint, on the terms and conditions stated in the Stipulation of Settlement dated September 13, 2006, designated Exhibit 1 in the Order Approving Stipulation dated October 23, 2006; and

[4th] WHEREAS, the parties hereto desire to amend the Existing Contract as required by said Stipulation of Settlement.

NOW, THEREFORE, in consideration of the mutual and dependent covenants herein contained, it is hereby agreed as follows:

1. Subdivision (a) of Article 3 of the Existing Contract is deleted in its entirety, and the following is substituted in lieu thereof:

"(a) During each Year, consistent with all applicable State water rights, permits, and licenses, Federal law, and the Stipulation of Settlement dated September 13, 2006, the Order Approving Stipulation of Settlement, and the Judgment and further orders issued by the Court pursuant to terms and conditions of the Settlement in *Natural Resources Defense Council, et al.* v. *Rodgers, et al.*, No. CIV-S-88-1658 LKK/GGH, and subject to the provisions set forth in Articles 11 and 12 of this Contract, the Contracting Officer shall make available for delivery to the Contractor 60,000 acre-feet of Class 1 Water for M&I purposes. The quantity of Water Delivered to the Contractor in accordance with this subdivision shall be scheduled and paid for pursuant to the provisions of Articles 4 and 7 of this Contract."

2. Subdivision (a) of Article 11 of the Existing Contract is deleted in its entirety, and the following is substituted in lieu thereof:

"(a) Subject to: (i) the authorized purposes and priorities of the Project and the requirements of Federal law, and the Stipulation of Settlement dated September 13, 2006, the Order Approving Stipulation of Settlement, the Judgment and further orders issued by the Court pursuant to terms and conditions of the Settlement in *Natural Resources Defense Council, et al.* v. *Rodgers, et al.*, No. CIV-S-88-1658 LKK/GGH and (ii) the obligations of the United States under existing contracts, or renewals thereof, providing for water deliveries from the Project, the Contracting Officer shall make all reasonable efforts to optimize Project Water deliveries to the Contractor as provided in this Contract."

3. Subdivision (b) of Article 12 of the Existing Contract is deleted in its entirety, and the following is substituted in lieu thereof:

"(b) If there is a Condition of Shortage because of errors in physical operations of the Project, drought, other physical causes beyond the control of the Contracting Officer or actions taken by the Contracting Officer to meet legal obligations, including but not limited to obligations pursuant to the Stipulation of Settlement dated September 13, 2006, the Order Approving Stipulation of Settlement, the Judgment and further orders issued by the Court pursuant to terms and conditions of the Settlement in *Natural Resources Defense Council, et al.* v. *Rodgers, et al.*, No. CIV-S-88-1658 LKK/GGH then, except as provided in subdivision (a) of Article 18 of this Contract, no liability shall accrue against the United States or any of its officers, agents, or employees for any damage, direct or indirect, arising therefrom."

4. Subdivision (b) of Article 14 of the Existing Contract is deleted in its entirety, and the following is substituted in lieu thereof:

"(b) The terms of this Contract are subject to the Stipulation of Settlement dated September 13, 2006, the Order Approving Stipulation of Settlement, the Judgment and further orders issued by the Court pursuant to terms and conditions of the Settlement in *Natural Resources Defense Council, et al.* v. *Rodgers, et al.*, No. CIV-S-88-1658 LKK/GGH. Nothing in this Contract shall be interpreted to limit or interfere with the full implementation of this Settlement, Order, the Judgment and further orders issued by the Court pursuant to terms and conditions of the Settlement."

5. Except as specifically amended herein, the Existing Contract is valid and shall continue in full force and effect as originally written and executed.

IN WITNESS WHEREOF, the parties hereto have executed this Contract Amendment as of the day and year first above written.

APPROVED AS TO LEGAL FORM AND SUFFICIENCY
OFFICE OF REGIONAL SOLICITOR
DEPARTMENT OF THE INTERIOR

THE UNITED STATES OF AMERICA

By: _____
Regional Director, Mid-Pacific Region
Bureau of Reclamation

CITY OF FRESNO

(SEAL)

By: _____
City Manager

By: _____
Public Utilities Director

Attest:

By: _____ (3/26/07)
City Clerk

Approved as to form:

By: _____
City Attorney

(Fresno (City of) Friant Settlement Amendment Final 11-28-06.doc)

# City of Fresno and Fresno Irrigation District Agreements

**REVISED, AMENDED AND RESTATED COOPERATIVE AGREEMENT BETWEEN FRESNO IRRIGATION DISTRICT AND CITY OF FRESNO FOR WATER UTILIZATION AND CONVEYANCE**

THIS AGREEMENT is entered into as of December 20, 2016 by and between the Fresno Irrigation District, an irrigation district (herein called "District") and City of Fresno, a municipal corporation (herein called "City").

WITNESSETH:

WHEREAS, District is an irrigation district organized and existing under the laws of the State of California and is the owner of certain water supplies, water rights and a water distribution system that can convey water to lands both within and outside District boundaries; and

WHEREAS, City is a municipal corporation with boundaries largely overlapping those of District and is the owner of a water distribution system for the distribution of water to lands both in and outside the exterior boundaries of City; and

WHEREAS, District and City have heretofore entered into a cooperative program of water utilization between said parties evidenced by a written agreement for such water utilization and conveyance dated August 12, 1970, which by its terms and by the terms of amendments thereto terminated on May 30, 1976; and

WHEREAS, District and City continued with said cooperative program and entered into a replacement contract for water utilization and conveyance dated May 25, 1976 ("1976 Agreement"); and

WHEREAS, District and City wish to amend and restate the 1976 Agreement in its entirety in order to continue with and expand said cooperative program to recognize changed circumstances affecting them via this Revised, Amended and Restated Cooperative Agreement between Fresno Irrigation District and City of Fresno for Water Utilization and Conveyance ; and

WHEREAS, certain provisions of this Agreement are specifically authorized by, and entered into pursuant to, Chapter 9 (commencing with Section 26670), Part 10, Division 11 of the California Water Code; and

WHEREAS, by agreement dated December 22, 2010 between City and the United States of America identified as Contract No. 14-06-200-8901D (the "City Bureau Contract"), City is entitled to purchase certain water from the United States; and

WHEREAS, by agreement dated December 22, 2010 between District and the United States of America identified as Contract No. 14-06-200-1122D (the "District Bureau Contract"), District is entitled to purchase certain water from the United States; and

WHEREAS, District holds rights to Kings River water and storage in Pine Flat Reservoir on the Kings River, subject to various contracts with the United States of America, water supply schedules and agreements by and among members of the Kings River Water Association and others, judicial and regulatory decrees, and the water rights governing the diversion and use of Kings River water, all as they may be amended or supplemented from time to time (collectively, the "Kings River Agreements"); and

WHEREAS, it is recognized by District and City that District is primarily charged with the distribution and delivery of water within District for Agricultural Use and that its canals and distribution system must primarily be used for that purpose; and

WHEREAS, it is recognized by both District and City that many inhabitants of District also require water for domestic, industrial or fire protection purposes supplied to them by City; and

WHEREAS, under the 1976 Agreement, Kings River water was available to City once lands within District boundaries with surface water allotments were annexed into City and were covered by the 1976 Agreement's contract rate for surface water delivery to City by District for those lands; and

WHEREAS, City and District now wish to limit the amount of Kings River water available to City to provide more certainty regarding water supply availability and to address City's current and anticipated needs and circumstances; and

WHEREAS, City and District are both committed to working cooperatively under the Sustainable Groundwater Management Act ("SGMA") so that the groundwater basin shared by City and District is sustainable and so that undesirable results (as defined in SGMA) are minimized or avoided; and

WHEREAS, City and District recognize that changes to the operations of the Central Valley Project have impacted the availability of water from said project; and

WHEREAS, City has heretofore used much of the water delivered to it under the 1976 Agreement for groundwater recharge because of City's historical reliance on groundwater, and therefore did not require delivery of water year around; and

WHEREAS, City desires to use more of its surface water for direct delivery to its water users and ratepayers while limiting its reliance on groundwater; and

WHEREAS, with the development of its surface water treatment facilities ("SWTFs") City now requires a long-term, reliable and certain surface water supply, deliverable continuously year around; and

WHEREAS, conveyance of raw surface water to the SWTFs on a continuous year around basis will require, among other things, (i) new conveyance infrastructure built by City to overcome certain operational challenges and/or interruptions to District's infrastructure to accommodate normal and routine maintenance of District's canals and pipelines than have historically delivered surface water to City, (ii) District to alter its operations and incur additional

costs to make Out of Season Deliveries, and (iii) the use of new management techniques by District, with the attendant costs, including without limitation water sales, purchases, transfers and exchanges, to meet the need for a continuous supply of surface water to City's SWTFs, all while addressing SGMA and other legal and regulatory requirements that impact the groundwater basin shared by District and City; and

WHEREAS, providing Out of Season Deliveries by District to City may also require the development of new water supplies and projects to provide the water being sought by City; and

WHEREAS, City acknowledges that District has a great depth of experience, knowledge and expertise in the management of surface water supply resources (including but not limited to water supply sales, purchases, transfers and exchanges); and

WHEREAS, City recognizes that the coordinated management of both District's and City's water supplies by District is desirable to maximize the use of the current water supplies and the future development of water supplies for both parties; and

WHEREAS, City has determined that it is in City's interest, and in the interest of its water users and ratepayers, to engage District to employ District's experience, knowledge and expertise on behalf of City in the management of City's Surface Water pursuant to the terms hereof in order to achieve City's and District's goals described herein and to accommodate City's desire for a continuous year around surface water supply, and District has agreed to be so engaged; and

WHEREAS, the changing conditions and manner of management of water supplies throughout the State of California, and other factors beyond the control of City and District, will require increased vigilance on the part of water purveyors in the Fresno area to cooperate with each other on long-range implementation strategies to improve the availability, reliability, and drought resiliency of water supplies; and

WHEREAS, through this Agreement and additional cooperative efforts, City, District and other entities in the region intend to capture of flood released waters, optimize existing water supply storage assets, develop new water supply storage assets, expand groundwater recharge capacities, engage in strategic water supply sales, transfers and exchanges and enhance the utilization of recycled and/or treated waters; and

WHEREAS, in light of SGMA, environmental regulations, water supply challenges and competition with other users and regions in the State for water supplies, City and District wish to further enhance their cooperative working relationship for the benefit of the water users and ratepayers they serve by entering into this Agreement to provide for strategic, long-range and coordinated water supply planning and management that will optimize water conservation, the efficient uses of water for agricultural and municipal uses, the capture of flood released water, the use of existing water supply storage assets, the development of new water supply storage assets, the expansion of groundwater recharge capacity, the effectiveness of strategic water supply sales, transfers, exchanges and purchases, and the enhancement of recycled water utilization.

NOW, THEREFORE, adopting the foregoing recitals as being applicable to this Agreement, it is mutually agreed as follows:

1. Term. The term of this Agreement shall be for a period commencing on the date it is executed by both District and City and ending at 12:00 o'clock p.m. on the last day of June in the year 2035, and thereafter until terminated by either party as of the last day of February of any subsequent year by written notice to the other party mailed prior to September 1st of the previous year. Upon the execution of this Agreement the 1976 Agreement and all amendments thereto shall be of no further force or effect, except that City agrees to pay District any monies owing or to become owing to District under and according to the terms of the 1976 Agreement, if any.

2. Agreement Subject to Other Obligations. This Agreement shall be at all times subject to all of the terms and conditions of the City Bureau Contract, the District Bureau Contract and the Kings River Agreements, and to the extent that any agreement contained herein is contrary to or inconsistent with any term or condition of those contracts or agreements, that contrary provision of this Agreement shall be unenforceable. In the event any such agreement contained herein shall become unenforceable, the entire Agreement may be terminated by the party adversely affected as of the last day of February of the next succeeding year, by written notice served upon the other party on or before the first day of September of the year preceding such termination.

3. Definitions. For the purpose of this Agreement, the following terms shall be defined as follows:

(a) "Agricultural Use" means the use of water primarily in the production of agricultural crops or livestock including but not restricted to domestic use incidental to such agricultural purposes, the watering of livestock, and underground water replenishment conducted by District.

(b) "City's Friant Supply" means all water to which City is entitled under the City Bureau Contract or otherwise as a result of City's status as a long-term repayment contractor for water service from the Friant Division of the Central Valley Project (CVP), including without limitation Class 1 water, Section 215 water, uncontrolled season water, unreleased restoration flows and recirculated water. City's Friant Supply shall not include any water available to District under the District Bureau Contract or as a result of District's status as a long-term repayment contractor in the Friant Division of the CVP, which water is not governed by this Agreement.

(c) "City's Kings River Supply" means the percentage of District's Kings River Supply available to be delivered to City in a Water Year under this Agreement.

(d) "District's Kings River Supply" means the Kings River water District may deliver to its water users under the Kings River Agreements and applicable judicial and regulatory decrees in a Water Year as the result of the calculated natural flow of the Kings River during that Water Year.

(e) "City's Surface Water" means all water available to City in a Water Year by means other than pumping from the underground water supply, including without limitation

City's Kings River Supply and City's Friant Supply and any surface water supply acquired or developed after the date of this Agreement.

(f) "City's Water Service Area" means all lands within the exterior boundaries of City, and also all lands outside such boundaries that are within the exterior boundaries of District, to which City now delivers water or hereafter consents to deliver water by means of the City Water System and that are not hereafter designated or assessed by District as lands receiving or to receive District Water Service.

(g) "City Water System" means the conduits, pipes and other facilities (including without limitation the SWTFs) owned by City and used by City to convey water to lands whether in or outside City.

(h) "District Water Service" means the furnishing of water by District directly to lands within District by means of the District Water System other than pumping conducted by a landowner or water user directly from the underground water supply upon the lands receiving such water.

(i) "District Water System" means the conduits, pipes, canals, pumping stations and other facilities owned and/or used by District to convey water to lands or facilities whether in or outside of District.

(j) "Excluded Areas" means those acres within the City's Water Service Area that are outside of the District's boundaries.

(k) "Included Acres" means those acres within the City's Water Service Area that are within the District's boundaries.

(l) "Municipal, Industrial and Domestic Uses" means the use of water other than for Agricultural Use, and underground water replenishment conducted by City.

(m) "Out of Season Deliveries" means deliveries of City's Surface Water via the District Water System during periods when District is not otherwise delivering irrigation water to its landowners or water users via the portions of the District Water System used to convey City's Surface Water to the points on the District Water System where City will assume physical control of the delivered water.

(n) "Point of Delivery" means, for water delivered to City via the District Water System, the headworks of the Gould Canal and the Fresno Canal as specified in the applicable schedule, for water delivered to City via the Friant-Kern Canal Raw Water Pipeline, the headworks of the Friant-Kern Canal Raw Water Pipeline, for water delivered to City via the South Raw Water Pipeline, the headworks of the Fresno Canal, and such other location(s) as City and District may mutually agree.

(o) "Transfer" means a water sale, transfer or exchange involving any of City's Friant Supply.

(p) "Water Year" means March 1 of one year through the last day of the following February when used in reference to City's Friant Supply and October 1 of one year through September 30 for the following year when used in reference to City's Kings River Supply or District's Kings River Supply.

4. Management of City's Surface Water. To fulfill the purposes of this Agreement, and to facilitate the continuous and year around supply of water to City's Water System and facilities, District shall undertake, and is hereby appointed by City as City's exclusive agent for the management of City's Surface Water pursuant and subject to the terms of this Agreement, including but not limited to subsection 4(f) below. District's management authority and responsibilities shall terminate with respect to any of City's Surface Water upon delivery of that water to City.

(a) The management authority hereby granted to District shall include without limitation the exclusive right to:

i. Direct the storage and release of City's Surface Water;

ii. Schedule, order and provide for the delivery of City's Surface Water to District's points of diversion;

iii. Facilitate the reasonable and beneficial use of City's Surface Water and other water supplies available to City, while also providing for delivery of water to the applicable Point(s) of Delivery as specified in this Agreement;

iv. Pursue and implement Transfers pursuant to this Agreement; and

v. Take all other actions associated with the management and administration of City's Surface Water prior to its delivery to the applicable Point of Delivery in furtherance of the goals provided in subsection 4(f).

(b) District shall not voluntarily take any action that would:

i. Breach City's Bureau Contract or any other agreement governing any of City's Surface Water;

ii. Result in a long-term reduction in amount of City's Surface Water; or

iii. Result in management or use of City Surface Water inconsistent with the goals provided in subsection 4(f) below, unless City provides prior written authorization of such management or use.

(c) Notwithstanding District's management of City's Surface Water, City shall be solely responsible for, and shall timely pay, all charges and other amounts payable in connection with any of City's Surface Water.

(d) Subject to the express rights of City under this Agreement, City shall take no action that interferes with District's management of City's Surface Water as long as District provides the deliveries thereof in accordance with Section 5.

(e) District shall coordinate with City to define and identify uses of City's Surface Water that benefit City's water users and ratepayers. This coordination shall be performed as described in this subsection.

i. As frequently as appropriate and necessary, and at least annually, City and District shall confer to review available water supply information and data, including without limitation: precipitation, snow pack, and runoff conditions; water storage conditions; relevant environmental programs and projects; forecasted Municipal, Industrial and Domestic Uses; surface water delivery priorities for City; forecasted groundwater pumping required to meet City's forecasted Municipal, Industrial and Domestic Uses; and other pertinent information and data related to water supply availability and water demands for the relevant Water Year(s). City and District shall also confer regarding the anticipated availability of City's Friant Supply, if any, for Transfers.

ii. City will be responsible for providing periodic updates to the City Council and City administration. At least annually, City staff shall provide an informational workshop to the City Council, summarizing ongoing water supply conditions, the implementation of this Agreement and fulfillment of the water supply goals as listed in 4(f), as well as any anticipated water supply issues of concern for the relevant Water Year(s). District shall make reasonable efforts to coordinate with City staff to provide any data, information, and materials required for this annual informational workshop to the City Council.

iii. It is understood that during any given Water Year it may be necessary to adjust the water supply planning forecast established pursuant to the above described process as water supply availability and demands change, and additional information and data are obtained, reviewed, and assessed. City and District shall employ reasonable efforts to meet and confer as necessary to keep each party informed to the extent water supply conditions and plans may change through the relevant Water Year. City shall be responsible for providing informational updates to the City administration to the extent there are material changes to the water supply conditions in any given Water Year.

(f) District's management of City's Surface Water shall at all times be in furtherance of one or more of the following water supply goals:

i. Providing continuous year around water supply to City's SWTFs;

ii. Improving the water supply reliability and drought-resiliency for City;

iii. Improving the operation and utilization of City-owned recharge basins;

iv. Implementing conjunctive-use water management strategies to comply with the SGMA that directly benefit City's water users and ratepayers and indirectly benefit groundwater users in the North Kings Subbasin.

(g) Included as a part of the management of City's Surface Water as described above, District shall diligently pursue Transfers of any of City's Friant Supply that City advises District that City will not require during a particular Water Year ("Temporarily Unused Friant Water").

i. Upon identifying a potential Transfer opportunity, and prior to executing the Transfer, District shall notify City of the potential Transfer opportunity, and the water quantity, unit price, delivery dates and terms, and any other material matters associated with the Transfer. This is a notification procedure and not an approval procedure.

ii. All Transfers of Temporarily Unused Friant Water pursued by District shall be in full conformance with City's water supply goals as described in Section 4(f) or otherwise agreed by City and District, and shall be limited to supporting Agricultural Use rather than urban growth or development in other jurisdictions.

iii. City shall not be prohibited from unilaterally pursuing Transfers of Temporarily Unused Friant Water; provided, that any such Transfers shall first be discussed and coordinated with District before they are implemented and shall not be undertaken over District's reasonable objection and the benefits of any such Transfer shall be allocated in accordance with subsections (h), (i) and (j) below.

iv. For avoidance of doubt, District's obligations under this Section 4(g) are limited to making reasonable and diligent efforts to pursue Transfers of Temporarily Unused Friant Water, and City acknowledges that no assurances can be provided by District that such Transfers can be made or arranged.

(h) The benefits resulting from Transfers shall be allocated in accordance with this subsection. For purposes of this Section 4, "benefits" of a Transfer include, without limitation:

i. The difference between all costs incurred in connection with a Transfer and the amount(s) received as a result of the Transfer,

ii. Water returned as a result of a Transfer, and

iii. Water supply storage or conveyance capacities made available as a result of a Transfer.

To the extent benefits include payments, City shall be reimbursed for its actual and reasonable out of pocket expenses incurred for City's Friant Supply involved in the Transfer,

and each of the parties shall next be reimbursed for any actual and reasonable out of pocket expenses incurred in connection with the Transfer. The net revenue associated with a Transfer shall be the revenue remaining after all parties have been reimbursed their actual and reasonable expenses incurred for the Transfer.

(i) To the extent benefits of a Transfer consist of water supplies, water supply storage or conveyance capacities, the allocation of such benefits as between the parties shall be negotiated by the parties before the Transfer is implemented. In the event the parties cannot negotiate such allocation, the Transfer shall not be pursued.

(j) For each Transfer that generates net revenue, City and District agree that the net revenue shall be distributed and used as follows:

i. 25-percent of the net revenue shall be deposited with City's water enterprise fund;

ii. 25-percent of the net revenue shall be deposited with District for the inspection, operations, maintenance and repair of the District's Conveyance System, which City acknowledges provides a benefit to City ratepayers;

iii. 50-percent off the net revenue shall be deposited into a Water Supply Development Fund to be used to finance water supply development programs and projects that mutually-benefit City and District.

The Water Supply Development Fund shall be a restricted-use fund to be used exclusively for water supply programs and projects that improve water supply availability, reliability and drought resiliency for both District and City. Programs and projects that may be financed from the Water Supply Development Fund include, but are not limited to, water supply purchases, transfers, and exchanges; groundwater storage; and groundwater recharge. Expenditures for water supply purchases, transfers, and exchanges may include any carryover charges and conveyance charges that may be assessed by the State of California, the United States, or other agency, to store, transport and deliver surface water, for the mutual benefit of City and District, using state or federal storage and conveyance facilities.

The Water Supply Development Fund may receive contributions from City, District, and other public agencies approved by both City and District. The Water Supply Development Fund may not receive contributions from private persons, companies, businesses, or organizations.

Prior to encumbering funds from the Water Supply Development Fund, District and City shall mutually agree in writing on the recommended expenditure and the amount to be financed with the Water Supply Development Fund.

District shall serve as the fiscal agent for the Water Supply Development Fund and implement generally accepted public agency or governmental accounting practices in managing the fund assets. District shall subject the fund to an annual audit by independent auditors during the course of District's annual audit of its financial statements. The audit shall

be conducted in accordance with the generally accepted auditing standards by the independent certified public accountant auditing District's financial statements. Upon presentation of District's comprehensive audit report to the District Board of Directors, District shall provide City with a copy of District's audit report. At any time during the term of this Agreement, City may, at its own cost, request to review and audit the financial and accounting records associated with the Water Supply Development Fund. District shall have 30 working days to submit the requested records to City for review and audit.

In the event this Agreement terminates and uncommitted amounts remain in the Water Supply Development Fund, one half of all such amounts shall be promptly distributed free of any restrictions to each of the parties.

(k) By the 25th day of each month, District shall provide City with a written summary of District's utilization of City's Friant Supply for the previous month in substantially the form attached hereto as **Exhibit A**. The written summary will identify water volumes delivered to recharge basins, surface water treatment facilities, other Points of Delivery designated by City, and Transfers. The written summary may be delivered to City by email, facsimile or U.S. mail. For Transfers, the monthly report shall include information regarding the parties involved in the Transfer, the water quantity, unit price, delivery dates and terms, and any other material matters associated with the Transfer.

5. Water Made Available to City.

(a) Subject to all other provisions of this Agreement, District shall deliver to City during each applicable Water Year, for distribution and use by City within City's Water Service Area, each day of each year on a continuous basis in accordance with Section 8 of this Agreement, the City's Surface Water available during relevant Water Year(s) that can be diverted by District at the headworks of the Gould Canal, the Fresno Canal or the Friant-Kern Canal Raw Water Pipeline. City acknowledges that the water delivered may not be City's Surface Water, but rather other water controlled by District in the District Water System of similar quality and equal quantity, including without limitation water recovered from water banks, other water for which City's Surface Water is exchanged, and/or water purchased by District for delivery to City at District's cost, and that references in this Agreement to deliveries of City's Surface Water shall include deliveries thereof of a substitute supply by means of one or more exchanges, transfers, purchases or combinations thereof. At all times, District shall have the right to exchange and to convey for City in place thereof other water of similar quality and equal quantity (except sewer effluent or industrial wastes) available to District.

(b) City's Surface Water shall be deemed delivered to City when it reaches the Point of Delivery specified in the applicable schedule provided and approved under Section 8 of this Agreement, provided that for deliveries made via the District Water System, District shall thereafter convey such water to the points on the District Water System where City will assume physical control of the delivered water.

(c) The parties acknowledge that there may be times when the City Water System is undergoing routine or emergency repairs and maintenance, or subject to other conditions, that preclude City from accepting deliveries under this Agreement. Similarly, the parties

acknowledge that there may be times when the District Water System is undergoing routine or emergency repairs and maintenance, or subject to other conditions, that preclude District from delivering water to City under this Agreement. The parties shall cooperate with the other to minimize the impacts of such events, but neither shall be in breach of this Agreement as a result thereof.

(d) Water delivered to City under this Agreement shall be used by City within City's Water Service Area only for Municipal, Industrial and Domestic Uses, Agricultural Uses incidental thereto, and within the boundaries of District for recharge of the underground water supply by percolation.

City shall not sell, transfer, deliver or exchange any surface water or groundwater to or with any other person or entity without written consent of District first had and obtained.

However, this provision shall not prevent City from entering into separate agreements with any other entity which may have a similar agreement with District for the distribution and use of water received from District under such agreements, provided such separate agreements are entered into with the written consent of District first had and obtained and are subject to all the terms and conditions of this Agreement and District's agreements with such other entities.

(e) District has entered into this Agreement with the understanding that it is, and will continue to be, City's policy to (i) require urban growth to occur sequentially in designated growth areas around City, (ii) promote infill development with City's existing boundaries and (iii) facilitate the successful implementation of SGMA within the groundwater basin shared by City and District by conditioning land use and annexation decisions on the existence of an available water supply to support new development in annexed areas. Consistent with that understanding, for the term of this Agreement, as a condition of the provision of City water service, City shall require the proponent of any proposed development project located outside of City's Water Service Area boundary as of the date of this Agreement to:

i. Define the peak water demands, plus fire protection demands, required to meet the total water supply demands of the entire project at build-out conditions;

ii. Obtain a perpetual surface water supply allocation, right, entitlement or similar from District, or other surface water supply agency, to meet the peak water demands, plus fire protection demands, at build out conditions; and

iii. Dedicate, transfer or assign the perpetual surface water supply allocation, right, entitlement or similar to City.

Once the perpetual water supply has been dedicated, transferred, or assigned to City, the water supply shall be incorporated into City's Surface Water managed by District for City under this Agreement.

In addition, to improve, restore, and maintain the availability, reliability, and drought resiliency of the groundwater and surface water resources in the North Kings Subbasin,

City and District shall jointly advocate that all public water supply systems in the North Kings Subbasin should require the proponents of new development projects to obtain perpetual surface water supply rights, allocations, entitlements, and similar, in sufficient quantity, to meet the all demands at full build out.

(f) In furtherance of the parties' goals under this Agreement, City shall utilize City's Friant Supply to provide water to the City's SWTF served by the South Raw Water Pipeline (as defined below) for the purpose of serving the Excluded Area.

6. Raw Water Pipelines. As soon as reasonably practicable, City shall construct, at its sole cost and expense, two raw water pipelines to serve City's SWTFs (the "Raw Water Pipelines"). One Raw Water Pipeline shall be a direct connection from the Friant-Kern Canal to City's SWTF located at Mile Point 7.58 (the "Friant-Kern Canal Raw Water Pipeline"). The other Raw Water Pipeline shall be a direct connection from the Fresno Canal downstream of the headworks for such canal to City's SWTF located at Trimmer Spring Road (the "South Raw Water Pipeline"). City's T3 SWTF shall continue to be served by the Enterprise and Jefferson Canals that are a part of the District Water System. Once operational, the Raw Water Pipelines shall be used to convey portions of City's Surface Water directly to the SWTFs, and all costs of the operation, maintenance, repair and replacement of the Raw Water Pipelines shall be borne by City; provided, that District shall be entitled to utilize for its own purposes any capacity in the Raw Water Pipelines not required to deliver City's Surface Water, and District shall reimburse City upon demand for any operational costs incurred as a result of District's use of the Raw Water Pipelines. Any third-party property damages resulting from City's efforts and activities related to the operation, maintenance, repair, and replacement of the Raw Water Pipelines shall be received and processed by City in accordance with City's Risk Management policies and procedures.

7. City's Friant Supply. While this Agreement is in effect, City (i) shall not convey any interest in the City Bureau Contract to any party other than District, (ii) shall at all times maintain the City Bureau Contract in effect and (ii) shall not voluntarily decrease the quantity of City's Friant Supply to be made available to City thereunder without the written consent of District. City will use every effort to obtain its maximum entitlement to City's Friant Supply annually as it may become available, and will seek to maximize any other surface water opportunities that may be available to City via the Friant Division of the Central Valley Project. Nothing in this Agreement conveys any ownership interest in the City Bureau Contract to District, which shall at all times remain the sole property of City, nor does this Agreement convey any interest in the District Bureau Contract to City, which shall at all times remain the sole property of District.

8. Schedules of Delivery and Conveyance of Water.

(a) District shall deliver City's Surface Water to City in accordance with schedules provided from time to time by City for approval by District, which approval shall not be unreasonably withheld, delayed or conditioned. Such schedules shall set forth the amounts of water desired by City, the desired timing of deliveries, the facilities by which such water is to be delivered, and the point(s) on the District Water System where City will assume physical control of the delivered water. Deliveries of water by District will take into consideration all relevant

factors, including without limitation (i) the capacity and condition the applicable portions of the District Water System, (ii) City's Bureau Contract, (iii) the District Bureau Contract, (iv) the Kings River Agreements, (v) actual and anticipated water supply conditions, (vi) the requirements of other contracts between the District and third parties (including without limitation the City of Clovis and Fresno County Waterworks District No. 19) and (vii) all other factors pertaining to the distribution, apportionment and use of water available to District.

(b) All schedules submitted by City during each Water Year shall provide for the delivery during that Water Year of all of City's Surface Water that becomes available to City during that Water Year. Notwithstanding the foregoing, City may schedule up to 10,000 acre feet of City's Surface Water that becomes available to City during one Water Year for delivery in the succeeding Water Year ("Rescheduled Water"). City shall timely pay in full all costs imposed by third parties, including without limitation the United States Bureau of Reclamation, as the result of any Rescheduled Water requests or deliveries.

9. Conveyance Losses. City shall bear all losses incurred in the District Water System downstream of the applicable Point of Delivery; provided, that no such losses shall be assessed against City when District is delivering irrigation water to its landowners or water users via the portions of the District Water System used to convey City's Surface Water to the points on the District Water System where City will assume physical control of the delivered water. Conveyance losses chargeable to City shall be computed by multiplying the losses in that portion of any canal used for conveyance of City's Surface Water during the period such water is being so conveyed by the total amount of water being conveyed for City in that canal during such time, divided by the total amount of water flowing in that portion of that canal during the same period.

10. Use by District of Water Not Used by City.

(a) Except for Rescheduled Water, in the event City is unable to use or does not use any of City's Kings River Supply in any Water Year, City shall lose the right to receive such water, and District shall have the right to take and use such water for Agricultural Use in such manner as it may determine.

(b) Except for Rescheduled Water, in the event City is unable to use or does not use any part of City's Friant Supply and District reasonably concludes that it cannot effect a Transfer for all of such unused water as Temporarily Unused Friant Water as described in Section 4(g), City shall nevertheless take and pay for such unused water and District shall have the right to use such water for Agricultural Use, but City may require District to so use such water at such locations as City may direct; provided, however, in the event City does not direct the location at which said water shall be used in time that it may be so used or in the event the District Water System will not permit the conveyance of such water to such location when so directed, or if for any other reason the conveyance of such water to such location at that time is not feasible or practicable, District shall have the right to use such water upon the same conditions as are provided in Section 10(a). Such use of any such water by District shall not relieve City from any payments required to be made by it under the City Bureau Contract or under the terms of this Agreement and its use by District shall not require any payment from District to City.

(c) Except for Rescheduled Water, in the event City is unable to use or does not use any of City's Surface Water that is neither City's Kings River Supply or City's Friant Supply in any Water Year, City shall lose the right to receive such water, and District shall have the right to take and use such water for Agricultural Use in such manner as it may determine. In such event, insofar as the District Water System will permit, and insofar as otherwise may be practicable and equitable as to other landowners, District will use such water for irrigation or percolation in areas in City or east or northeast of City, and will discuss its use with City before it is used elsewhere. However, the ultimate decision concerning such use of such water shall be within the discretion of District.

11. Water Rights Not Transferred. As was the case under the 1976 Agreement, City acknowledges that its rights to City's Kings River Supply under this Agreement are contractual rights and not water rights. Nothing in this Agreement authorizes or shall be construed or deemed to constitute the sale or transfer of a water right from either party to the other and nothing in this Agreement shall constitute the dedication by either party of water or storage to a public use. No right in any water, storage right or water right owned by District or City shall be acquired or lost by virtue of this Agreement or the actions contemplated hereby. At no time shall City make any claim, assert any right or otherwise seek, confirm or perfect in any forum any legal or beneficial interest, right or title to any of District's water supply or storage rights except as expressly set forth herein.

12. City's Sewage Effluent. City shall retain its sewage effluent and recycled water within the boundaries of District for the term of this Agreement, except with the written consent of District first had and obtained. It is the intent of City and District to develop and execute a new agreement addressing such effluent and recycled water use, and this Agreement is to be interpreted so as to be consistent with such new agreement if and when it is executed by the parties.

13. Acreages and City's Kings River Supply.

(a) City's Water Service Area consists of Included Acres and Excluded Acres, and on an annual basis City and District shall prepare a map showing the total number of acres in each area as of the first day of March of each year. When so approved, said map shall be incorporated herein by reference as **Exhibit B** and shall become a part hereof. Said map shall be amended and reapproved by both parties as of the first day of March each year and added to this Agreement as an updated **Exhibit B**. However, City shall keep the District currently advised during the year of any new lands outside of City's Water Service Area to which it commences or consents to deliver water, and District shall keep City so advised as to any new lands designated or assessed by it as lands receiving or to receive District Water Service. When so amended and reapproved as of the first day of March of each year, said map shall conclusively establish the boundaries of and the acreage in each area for all purposes of this Agreement.

(b) City's Kings River Supply shall be the herein-contracted for percentage of District's Kings River Water Supply. Such percentage shall be based on the ratio of Included Acres within City's Water Service Area to the total acres within District's boundaries. In computing the acreage within the Included Acres, the entire acreage shall be measured including properties that may be exempt from assessment for taxation and including adjacent streets,

alleys, roads, highways and other public ways to the center lines thereof. As of the execution of Agreement, and based on the land area sizes defined above, City's Kings River Supply is 25.54 percent of the District's Kings River Supply.

(c) Notwithstanding any other provision of this Agreement, and notwithstanding increases in the Included Acres, City's Kings River Supply shall be limited to 29.00 percent of District's Kings River Supply. At such time when the ratio of Included Acres within City's Water Service Area to the total acres within District equals 29.00 percent, City's Kings River Supply shall remain fixed at 29.00 percent. City and District mutually agree that the increase percentages reflected in this Section 13 include allowances for moderate growth in Growth Area 1 of City's Sphere of Influence as shown in **Exhibit C** (as depicted as Figure IM-2 of the Fresno General Plan).

(d) To improve, restore, and maintain the availability, reliability, and drought resiliency of the groundwater and surface water resources in the North Kings Subbasin, District shall support, and to the extent it has the legal authority to do so shall require, the establishment of water supply limits on all municipal water systems in the North Kings Subbasin.

District acknowledges that it may enter into surface water utilization and conveyance agreements similar to this one with other municipalities in the Kings Subbasin that provide for the delivery of portions of District's Kings River Supply. Subject to the following paragraph of this Agreement, all such agreements entered into after the date of this Agreement shall provide that the percentage of District's Kings River Supply made available to the municipality entering into such agreement shall be determined in a manner similar and comparable to that applied to City in this Agreement.

Should the District enter into such a water utilization and conveyance agreement with another municipality in the Kings River Subbasin after the date of this Agreement that makes available a percentage of District's Kings River Supply to such municipality determined in a manner that is not similar and comparable to that applied to City in this Agreement, at City's request the parties shall negotiate in good faith an adjustment in City's Kings River Supply to apply the same methodology used, and provide the same percentage increase, as granted to the other municipality; provided, that to the extent such other municipality provides additional consideration to District for such different methodology, City shall provide comparable consideration if it requests that such different methodology be used for this Agreement. Any disputes arising as a result of such negotiation shall be resolved pursuant to Section 19.

14. Payment by City to District. In consideration of the water supplies and services provided by District to City under this Agreement, City shall pay to District each Water Year in which this Agreement is effective the following:

(a) The sum calculated by multiplying the number of Included Acres by the per acre assessment imposed as of March 1 of that Water Year on lands in District receiving District Water Service, plus the sum calculated by multiplying the number of Excluded Acres by the per acre assessment imposed as of March 1 of that Water Year on lands in District not receiving District Water Service. Amounts payable to District pursuant to this Section 14(a) shall be paid by City 60% on or before the 20th day of December preceding the Water Year for which such

amounts are due, and the remaining 40% shall be paid on or before the 20th day of June of the following Water Year. City and District acknowledge that during the term of this Agreement, District may convert its rate structure to include a volumetric charge. Concurrently with such a rate structure modification, the parties shall negotiate modifications to this Section 14 so that charges imposed on City under the revised District rate structure are equitable and comparable in proportion and magnitude to the charges imposed on other District customers receiving water for Agricultural Use. Without limiting the foregoing, any volumetric charges imposed on City shall be determined in the same manner as volumetric charges imposed on other District customers receiving water for Agricultural Use.

(b) An out of season water delivery fee determined in accordance with the procedure described in the attached **Exhibit D** for each acre foot of water delivered to City under this Agreement as an Out of Season Delivery (the "Water Delivery Fee"). The Water Delivery Fee shall be payable within 30 days after District delivers City an invoice for such fee indicating the amount of water delivered during the invoice period and the total Water Delivery Fee due. City acknowledges that such fee is in part to compensate District for additional costs and risks incurred for operating its system to make Out of Season Deliveries. No such fee shall be due for water deliveries to City under this Agreement that are not Out of Season Deliveries.

(c) A rescheduling fee for each acre foot of Rescheduled Water determined in accordance with the procedure described in the attached **Exhibit E** (the "Rescheduling Fee"). The Rescheduling Fee shall be payable annually after March 1 of each Water Year within 30 days after District delivers City an invoice for such fee indicating the amount of Rescheduled Water for the applicable Water Year and the total Rescheduling Fee due. City acknowledges that the Rescheduling Fee is necessary to compensate District for additional costs and risks incurred to reschedule water for City from one Water Year to the succeeding Water Year. The Rescheduled Water Fee shall not be applied to any of City's Friant Supply carried over in Millerton Lake, as the Bureau has established a separate fee schedule for City to reschedule City's Friant Water Supply from one Water Year to the succeeding Water Year.

(d) While this Agreement is in effect, District shall not impose District assessments or other charges on landowners within City's Water Service Area or adopt special "municipal and industrial" assessments, rates or charges that would be imposed on or as a result of water deliveries to City under this Agreement. Only the amounts described in this Agreement shall be imposed on any party as a result of deliveries of City's Surface Water by District to City.

(e) Time shall be of the essence for the making of the payments described in this Section 14. If any such payment is not made on the date provided, City shall pay to District in addition to said payment costs, penalties and interest equal to those provided by law to be paid by landowners within District for the late payment of assessments. Such costs, penalties and interest are in addition to any other remedy which District may have against City because of City's failure to pay said payment as above provided.

(f) City acknowledges and agrees that the amounts payable by City pursuant to this Section 14 will vary from year to year and may increase over time. City further acknowledges that, while some of such amounts will be determined with reference to District assessments on its landowners, no amounts payable by City under this Agreement are assessments on City's

landowners. City further agrees that, as they relate to City, such amounts will be imposed as a matter of contract and are not assessments, fees or charges to which Article XIIID of the California Constitution applies. City shall be permitted to participate in public hearings and meetings held in connection with rate-setting, but City shall not assert that Article XIIID of the California Constitution applies to payments required under this Agreement. If City makes such an assertion, this Agreement may be terminated by District in its entirety as of the last day of February of the next succeeding year by written notice served upon City. City shall be responsible to set its rates to its utility users in accordance with applicable law, and shall indemnify and defend District against any claims or legal actions commenced by City's water users or ratepayers to challenge the amounts payable by or to City.

15. Re-negotiations. City and District acknowledge that changed circumstances in the future may:

i. Result in material changes in the size of City's Water Service Area, the number of Excluded Acres and/or the number of Included Acres, and/or

ii. Render the amount of City's Kings River Supply as an increasing percentage of District's Kings River Water Supply inequitable.

Such changed circumstances could result from, among other causes:

i. Annexations or detachments from City and/or District;

ii. Updates in City's Urban Water Management Plan or the Fresno General Plan;

iii. Significant regional economic development projects that require the extension of the City Water System outside of City's Water Service Area. Significant regional economic development projects shall be those that qualify for federal, state, county, or local economic development incentives; or

iv. New legal, regulatory, or environmental requirements placed on water supply agencies by a state or federal government agency.

Should either party to this Agreement determine after January 1, 2036 that such changed circumstances have arisen, it may notify the other of such determination and request that the parties meet to discuss mutually acceptable changes in the number of Excluded Acres, the number of Included Acres and/or the percentage used to determine City's Kings River Supply. Neither party shall be required to engage in such discussions prior to January 1, 2036.

The parties shall thereupon meet in good faith in an attempt to reach agreement on such changes; provided, that if no such agreement is reached within 180 days of the initial meeting, neither party shall be obligated to continue such meetings.

The number of Excluded Acres, the number of Included Acres and City's Kings River Supply shall remain unchanged pending agreement on the changes, and therein documented by a written amendment to this Agreement and executed by both parties.

16. Protection of District Facilities. City shall not permit the development of any parcel of land or the use of any public utility or other easements affecting land within its boundaries if any of the District Water System is located on, under or adjacent to such parcel until City, the landowner and/or the developer enters into an agreement acceptable to District for the repair, rehabilitation, relocation, replacement, reconfiguration or pipelining of the facilities on the parcel, and on any adjacent parcels, all as District determines is necessary or appropriate in order to (i) avoid disruption of District operations or maintenance activities as a result of the development, (ii) make District facilities suitable for operation within a developed area, or (iii) address public safety concerns.

17. No Warranty of Quality. City recognizes that City's Surface Water will be "raw," non-potable and untreated, and that the amount of water included in City's Surface Water will vary from year to year due to a variety of factors beyond the control of District. City further recognizes that wastewater (both treated and untreated) and drainage water are sometimes discharged into the District's canals, and that such discharges from a number or sources will occur and/or continue during the term of this Agreement. Accordingly, except as expressly set forth in this Agreement, District makes no representations or warranties regarding the quality of the water or the amount of water to be delivered to City each Water Year. City recognizes that the treatment of City's Surface Water to make it potable shall be the sole responsibility of City, and City shall assume all risk and responsibility therefor. The character or quality of the water furnished or conveyed hereunder may vary from time to time for reasons including, but not restricted to, the application by District of chemicals to control aquatic and ditch bank weeds, and the open canals of District are always subject to possible pollution from outside sources. District does not guarantee in any respect or assume any responsibility for the chemical, bacterial or other quality of the water made available to City through the District Water System.

18. Indemnity. City and District each agree to indemnify the other and save the other free and harmless of and from any and all liability, damage, loss, cost or expense, incurred or suffered by the other, by reason of damage to the property of the other or injury to any other person or property arising out of its own conduct, acts, omissions or faults, in connection with any matter related to this contract.

19. Dispute Resolution.

(a) District and City staff shall exercise every effort to resolve disputes through the development of a consensus.

(b) To the extent District and City staff cannot promptly resolve an issue in dispute; the parties shall promptly convene a meeting of senior party representatives to attempt to resolve the dispute. Either party may request a dispute resolution meeting pursuant to this section by providing written notice to the other party, including a summary of the issue in dispute. District representatives shall be its Board chair or president and another Board member. City representatives shall be the Mayor and City Council President. These senior party representatives shall make reasonable efforts to meet as frequently and as promptly as possible to negotiate the terms and conditions of a resolution. If these party representatives are unable to resolve the dispute through this informal process within a reasonable period, either party may pursue any remedy it may have under law or equity.

(c) The dispute resolution process described above shall be limited to material disputes regarding matters related to Transfers, expenditures from the Water Supply Development Fund, changes in City's Kings River Supply, revisions of this Agreement pursuant to Section 13(d), City's Friant Supply, changes proposed for **Exhibits B or C**, calculation procedures for fees for Out Of Season Deliveries and Rescheduling Fees, and similar matters.

(d) In cases where a dispute arises between the parties that, if unresolved, may result in imminent danger to the public, health, safety or welfare, the parties shall not be obligated to engage in dispute resolution pursuant to this Section 19.

20. Defense of Agreement. In the event of litigation this Agreement, the parties shall cooperate to provide a joint defense of the litigation. Each party shall bear its own costs of such litigation, including attorneys' fees and expert witness fees.

21. No New Agency. This Agreement is not intended to create a new joint powers authority or other entity. Each party shall conduct itself under this Agreement in good faith, using its diligent best efforts to comply with this Agreement and to achieve the objectives of the parties set forth herein. Each party shall make its personnel and resources reasonably available as required to achieve the purposes of this Agreement.

22. Approvals. Except as expressly provided in this Agreement, compliance with all legal/regulatory requirements and governmental or other third party restrictions on the use or delivery of City's Surface Water to it City water users shall be the responsibility of City. District shall be excused from delivering any water supply under this Agreement if, by so doing, District would become subject to additional legal requirements or third party restrictions imposed on deliveries of water to City's water users.

23. Entire Agreement. This Agreement and each of the exhibits referred to herein, which are incorporated by this reference, constitute the entire agreement between the parties pertaining to the subject matter hereof and supersede all prior and contemporaneous agreements and/or obligations concerning these obligations which are merged into this Agreement. Each party has made its own independent investigation of the matters settled and is not relying upon any representation not specified herein.

24. Applicable Law. This Agreement shall be construed under and shall be governed by the laws of the State of California. Any action to interpret or enforce any aspect of this Agreement shall be brought in the California Superior Court of Fresno County, California. City and District hereby expressly waive any right to remove any action to a county other than Fresno County as permitted pursuant to California Code of Civil Procedure Section 394.

25. Construction of Agreement. This Agreement is the product of negotiation and preparation by and among each party hereto and its attorneys, and the parties agree that this Agreement shall not be deemed to have been prepared or drafted by any one party. Accordingly, the normal rule of construction to the effect that any ambiguities are to be resolved against the drafting party shall not be employed in the interpretation of this Agreement.

26. Modification of Agreement. No supplement, modification, waiver, or amendment with respect to this Agreement shall be binding unless executed in writing by the party against whom enforcement of such supplement, modification, waiver or amendment is sought.

27. Counterparts. This Agreement may be signed in any number of counterparts by the parties, each of which shall be deemed to be an original, and all of which together shall be deemed one and the same instrument. Facsimile or other electronic signatures shall be binding.

28. Further Acts. The parties shall reasonably cooperate with each and take such further actions as may be necessary, including the execution of all necessary further documents, to carry out the purpose and intent of this Agreement. Each of the parties shall diligently and in good faith proceed to negotiate such other agreements as may be necessary to implement this Agreement.

29. Binding Effect. This Agreement shall be of binding legal effect only when it has been executed by all of the parties. No rights or duties under this Agreement may be assigned or delegated by a party without the express written consent of the other party, which may be withheld in the sole and absolute discretion of such other party. Subject to the foregoing, this Agreement shall be binding upon and inure to the benefit of the successors and assigns of the parties.

30. Notice to Parties. Any notice or other communication given under the terms of this Agreement shall be in writing and shall be given personally, by facsimile or by certified mail, postage prepaid and return receipt requested. Any notice shall be delivered or addressed to the parties at the addresses or facsimile numbers set forth below or at such other address or facsimile numbers as shall be designated by notice in writing in accordance with the terms of this Agreement. The date of receipt of the notice shall be the date of actual personal service or facsimile transmission with written confirmation of successful transmission, or three days after the postmark on certified mail. All notices required under or regarding this Agreement shall be made in writing addressed as follows:

| | |
|---|---|
| Fresno Irrigation District<br>2907 S Maple Avenue<br>Fresno, CA 93725<br>Attn: General Manager<br>Facsimile No.: 559-233-8227 | City of Fresno<br>2600 Fresno Street<br>Fresno, CA, 93721<br>Attn: Director of Public Utilities<br>Facsimile No.: 559-498-1304 |

31. Attorneys' Fees. In the event of any action or arbitration between the parties seeking enforcement or interpretation of any of the terms and conditions of this Agreement, the prevailing party in such action shall be awarded, in addition to damages, injunctive or other relief, its reasonable costs and expenses, including, but not limited to, taxable costs and reasonable attorneys' fees.

32. Cumulative Rights; Waiver. No failure by any party to exercise, and no delay in exercising any rights, shall be construed or deemed to be a waiver thereof, nor shall any single or partial exercise by any party preclude any other or future exercise thereof or the exercise of any other right. Any waiver of any provision or of any breach of any provision of this Agreement

must be in writing, and any waiver by a party of any breach of any provision of this Agreement shall not operate as or be construed to be a waiver of any other breach of that provision or of any breach of any other provision of this Agreement.

33. Severability. Subject to the parties' rights under Section 2 of this Agreement, if any provision of this Agreement is determined by a court of competent jurisdiction to be invalid, illegal or unenforceable, such provision shall be automatically reformed so as to be valid, legal and enforceable to the maximum extent permitted and the balance of this Agreement shall remain in full force and effect notwithstanding such invalidity, illegality or unenforceability.

34. No Third Party Beneficiaries. This Agreement does not create, and shall not be construed to create, any rights enforceable by any person, partnership, corporation, joint venture, limited liability company, district or other form of organization or association of any kind that is not a party. Without limiting the generality of the foregoing, landowners, residents, water users and ratepayers of the parties are not intended to be third party beneficiaries of this Agreement.

35. Force Majeure. Notwithstanding any other provision of this Agreement, neither party shall be liable for any failure to perform resulting from any cause outside the reasonable control of that party. For purposes of this Agreement, routine and emergency repairs and maintenance of the District Water System shall be deemed causes outside of the reasonable control of District (including without limitation the annual shut down of the Enterprise Canal for maintenance), provided that District shall use reasonable efforts to schedule routine maintenance so as to avoid interference with deliveries of City's Surface Water.

//

IN WITNESS WHEREOF, the parties have executed this Agreement to be effective as of the date first above written.

"District"

The Fresno Irrigation District, a California irrigation district

By _____
Ryan Jacobsen, President

By _____
Gary R. Serrato, General Manager

ATTEST:

_____
Secretary

"City"

The City of Fresno, a municipal corporation

By: _____
Ashley Swearengin, Mayor

By _____
Bruce Rudd, City Manager

ATTEST:
Yvonne Spence, CMC
City Clerk

By: _____ 1/11/17
Deputy

APPROVED AS TO FORM:
City Attorney, Douglas Sloan

By: _____ 12/22/16
AMANDA FREEMAN, DEPUTY

ATTACHMENTS:

**EXHIBITS**

Exhibit A – Monthly Water Supply Utilization Report
Exhibit B – City Water Service Area Map
Exhibit C – Fresno General Plan Map
Exhibit D – Out of Season Delivery Cost Methodology
Exhibit E – Rescheduled Water Cost Methodology

EXHIBIT A

EXHIBIT A

**CITY OF FRESNO FMFCD BASINS**
**MONTHLY REPORT (AC.FT.)**
**2015-2016**

| FMFCD BASINS IN FRESNO | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | YEAR TO DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Basin A | | | | | | | | | | | | | |
| Basin AB | | | | | | | | | | | | | |
| Basin AC | | | | | | | | | | | | | |
| Basin AD | | | | | | | | | | | | | |
| Basin AE | | | | | | | | | | | | | |
| Basin AF | | | | | | | | | | | | | |
| Basin AG | | | | | | | | | | | | | |
| Basin AH | | | | | | | | | | | | | |
| Basin AJ | | | | | | | | | | | | | |
| Basin AL | | | | | | | | | | | | | |
| Basin AO | | | | | | | | | | | | | |
| Basin AW2 | | | | | | | | | | | | | |
| Basin AZ | | | | | | | | | | | | | |
| Basin BE | | | | | | | | | | | | | |
| Basin BF | | | | | | | | | | | | | |
| Basin BH | | | | | | | | | | | | | |
| Basin BM | | | | | | | | | | | | | |
| Basin BO | | | | | | | | | | | | | |
| Basin BQ | | | | | | | | | | | | | |
| Basin BU | | | | | | | | | | | | | |
| Basin BV | | | | | | | | | | | | | |
| Basin BW | | | | | | | | | | | | | |
| Basin BZ | | | | | | | | | | | | | |
| Basin CC | | | | | | | | | | | | | |
| Basin CL | | | | | | | | | | | | | |
| Basin CM | | | | | | | | | | | | | |
| Basin CN | | | | | | | | | | | | | |
| Basin CO2 | | | | | | | | | | | | | |
| Basin CS | | | | | | | | | | | | | |
| Basin CW | | | | | | | | | | | | | |
| Basin CX | | | | | | | | | | | | | |
| Basin CY | | | | | | | | | | | | | |
| Basin CZ | | | | | | | | | | | | | |
| Basin DD | | | | | | | | | | | | | |
| Basin DH | | | | | | | | | | | | | |
| Basin EE | | | | | | | | | | | | | |
| Basin EF | | | | | | | | | | | | | |
| Basin EG | | | | | | | | | | | | | |

**CITY OF FRESNO FMFCD BASINS**
**MONTHLY REPORT (AC.FT.)**
**2015-2016**

| FMFCD BASINS IN FRESNO | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | YEAR TO DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Basin EL | | | | | | | | | | | | | |
| Basin EM | | | | | | | | | | | | | |
| Basin FF | | | | | | | | | | | | | |
| Basin GG | | | | | | | | | | | | | |
| Basin HH | | | | | | | | | | | | | |
| Basin II1 | | | | | | | | | | | | | |
| Basin II2 | | | | | | | | | | | | | |
| Basin J | | | | | | | | | | | | | |
| Basin JJ | | | | | | | | | | | | | |
| Basin K | | | | | | | | | | | | | |
| Basin KK | | | | | | | | | | | | | |
| Basin L | | | | | | | | | | | | | |
| Basin LL | | | | | | | | | | | | | |
| Basin MM | | | | | | | | | | | | | |
| Basin N | | | | | | | | | | | | | |
| Basin O | | | | | | | | | | | | | |
| Basin OO | | | | | | | | | | | | | |
| Basin P | | | | | | | | | | | | | |
| Basin R | | | | | | | | | | | | | |
| Basin RR1 | | | | | | | | | | | | | |
| Basin RR2 | | | | | | | | | | | | | |
| Basin RR3 | | | | | | | | | | | | | |
| Basin S | | | | | | | | | | | | | |
| Basin T | | | | | | | | | | | | | |
| Basin TT | | | | | | | | | | | | | |
| Basin U | | | | | | | | | | | | | |
| Basin UU2 | | | | | | | | | | | | | |
| Basin UU3 | | | | | | | | | | | | | |
| Basin Y | | | | | | | | | | | | | |
| Basin Z | | | | | | | | | | | | | |
| Basin ZZ | | | | | | | | | | | | | |
| Fresno's FMFCD Total | | | | | | | | | | | | | |

**CITY OF FRESNO RECHARGE**
**MONTHLY REPORT (AC.FT.)**
**2015-2016**

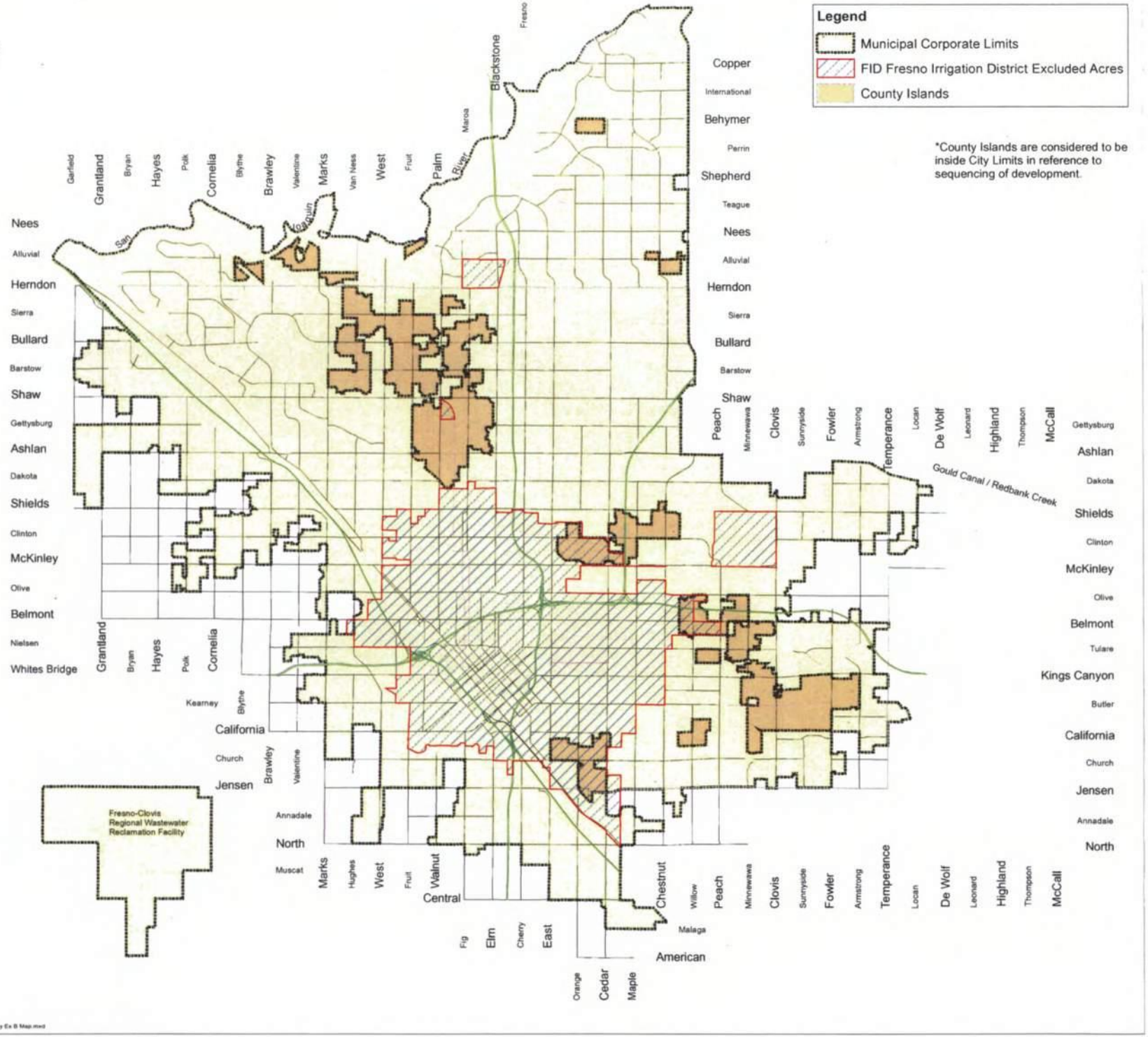
| OTHER FRESNO RECHARGE | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | YEAR TO DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leaky Acres | | | | | | | | | | | | | |
| Woodward Park | | | | | | | | | | | | | |
| Copper River Country Club | | | | | | | | | | | | | |
| Big Dry Detention | | | | | | | | | | | | | |
| Fancher Basin (South) | | | | | | | | | | | | | |
| Chestnut Ave. Basin | | | | | | | | | | | | | |
| North Central Basin | | | | | | | | | | | | | |
| Kearney Basin | | | | | | | | | | | | | |
| Big Dry Creek West of Winery Ave. | | | | | | | | | | | | | |
| Delivery System Recharge Fresno | | | | | | | | | | | | | |
| Copper River Country Club total is the amount exceeding the Phillips Ditch entitlement of 77 ac ft per month (during FID's irrigation season). | | | | | | | | | | | | | |
| Basin BF Water comes from Chestnut Ave. Basin | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Fresno's Total Recharge | | | | | | | | | | | | | |
| Fresno's SWTP N/E & T-3 | | | | | | | | | | | | | |
| Fresno's Total Usage | | | | | | | | | | | | | |

EXHIBIT B

# City of Fresno
# Water Service Area Boundary
# Exhibit "B"
# December 13, 2016

*"The City's Water Service Area consists of Included Acres and Excluded Acres, and on an annual basis City and District shall revised this Exhibit B map to show the total number of acres in each area as of the first day of March of each year."*

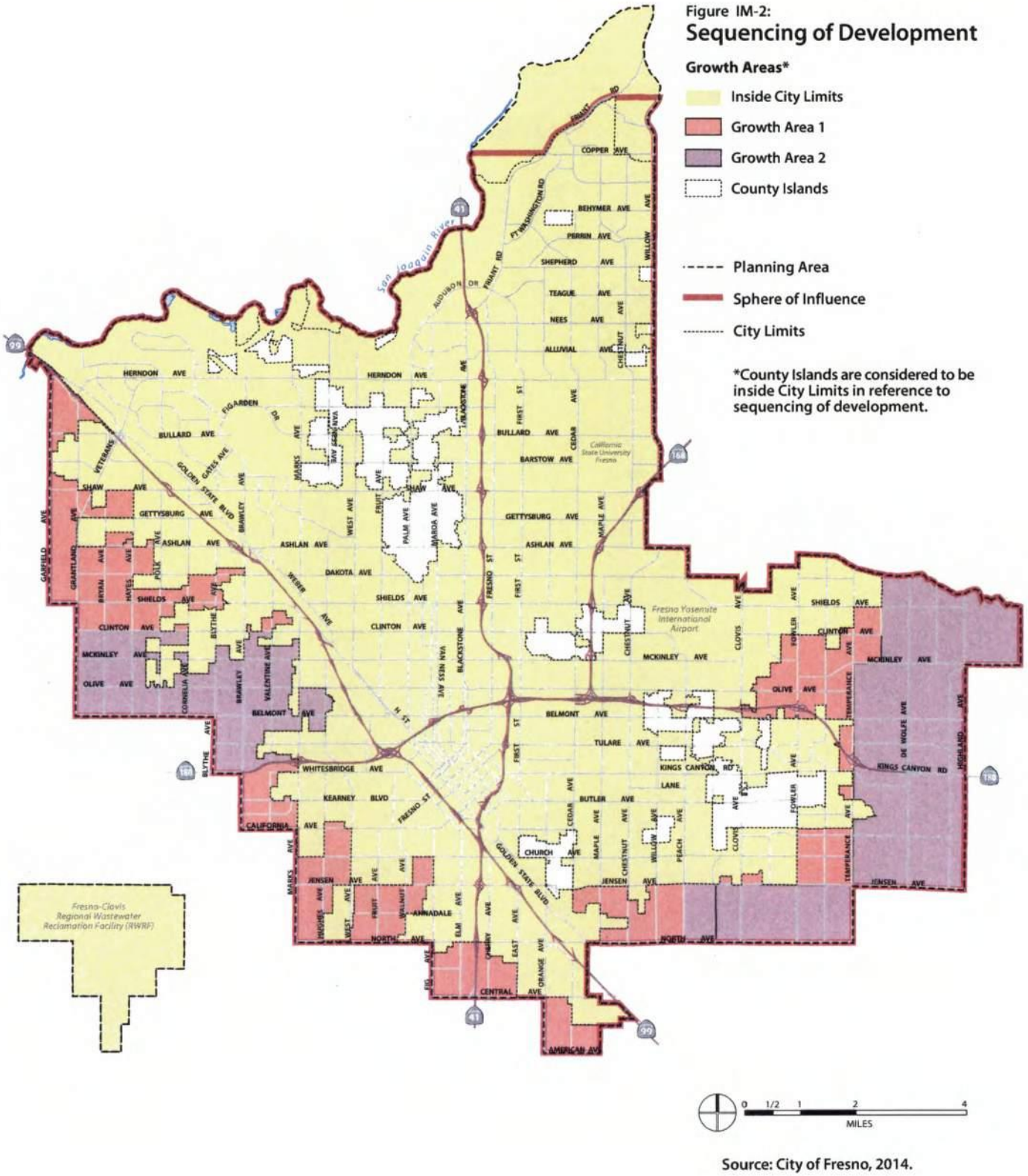
Miles
0 0.5 1 2 3




S:\USERS\PET\2016\Thomas Esqueda\Water Service Areas Map\Water Service Area Boundary Ex B Map.mxd

EXHIBIT C

# EXHIBIT C




Source: City of Fresno, 2014.

EXHIBIT D

# EXHIBIT D

The City will be responsible for paying the District for all costs associated with delivering water Out of Season Deliveries which will include but not limited to:

i. Staff time to deliver water (includes salary wage, labor burden and overhead.
ii. Cost to operate vehicles to operate and inspect the canal system.
iii. Power costs associated with running District's SCADA/Telemetry system, automated gate valves, flow meters, automated trash screens, etc.
iv. Repairs to the canals system which are caused by water running outside the normal irrigation season. Repairs may include but not limited to canal lining, gate replacement, structure replacement, earthwork (grading, dredging, etc.) weed treatment (aquatic or terrestrial), all-weather road maintenance, trash/debris removal, etc.

EXHIBIT E

# EXHIBIT E

The Rescheduling Fee for each rescheduling request here under shall be equal to the last Friant carry over charge assessed for a water year prior to the date to the request.

47087

RECORDED IN OFFICIAL RECORDS OF FRESNO COUNTY, CALIFORNIA
AT 41 MIN. PAST 3
JUN 24 1974
H. L. MASINI, County Recorder
FEE $

BOOK 6316 PAGE 31

# AGREEMENT BETWEEN FRESNO IRRIGATION DISTRICT AND CITY OF FRESNO FOR EXCHANGE OF RECYCLED WATER

This agreement entered into this 20th day of June 1974, by and between FRESNO IRRIGATION DISTRICT, a public corporation (herein called "District"), and the CITY OF FRESNO, a municipal corporation (herein called "City");

WITNESSETH:

WHEREAS, Fresno Irrigation District is the owner of water rights on the Kings River and a water distribution system for the distribution of irrigation waters for agricultural use within the District and has entered into contracts with the United States for an additional supply of water from the Friant-Kern Canal and for storage in Pine Flat Reservoir on the Kings River for the purpose of supplementing the water available for such use within the District; and

WHEREAS, the City of Fresno is located entirely within the exterior boundaries of the District and is the owner of a water distribution system used by City for delivering water to persons and lands both within and outside its City limits for municipal, industrial and domestic uses and is also the owner of a liquid waste treatment plant located within the District southwest of the city limits which is used for the treatment, percolation, purification, recycling and other disposition of liquid effluent from the City and intends to enlarge and improve said facilities and to produce by such treatment, percolation, purification and recycling, water which is of a quality suitable for agricultural use; and

WHEREAS, the entire area represented by the District and by the City is a water deficient area and the District is in need of additional waters for agricultural use and the City is in need of additional water for municipal, industrial and domestic uses; and

To be recorded without fee on behalf of Fresno Irrigation District

WHEREAS, the amount of water available to the District for agricultural use may be increased by the use of water recycled by the City as above described and the amount of water available to the City for use in its water distribution system for municipal, industrial and domestic uses may be increased by the exchange of such recycled water for the use by District of additional Kings River and/or Friant-Kern Canal water in that portion of the District northeast of the City; and

WHEREAS, City is desirous of maintaining a water level under its liquid waste treatment plant that will provide for maximum efficiency in the operation of its said plant; and

WHEREAS, a greater beneficial use and more economical utilization of all of the waters available to both the District and to the City can be obtained by the use of such waters as herein provided and both parties believe it is in the best interests of all the landowners and inhabitants within the District and within the City to enter into such an agreement;

NOW, THEREFORE, it is mutually agreed as follows:

1. Approval by United States and State Water Quality Board. Immediately upon the approval of this contract by the parties hereto, it shall be presented to the United States, and also to the California Regional Water Quality Control Board, or its successor agency, for their approval and shall not become effective for any purpose until such approval has been obtained.

This contract shall be at all times subject to all of the terms and conditions of the City Bureau Contract, the District Bureau Contracts and the District Kings River Intra-Association Agreements and to the extent that any agreement contained herein is contrary to or inconsistent with any term or condition of those contracts or agreements, this contract shall be unenforceable. In the event the performance of any agreement contained herein shall become unenforceable or shall be in violation of any Federal,

State or local statute or ordinance or of any decision of any court of competent jurisdiction, the entire contract may be terminated by either party upon written notice mailed to the other party.

2. Definitions. For purposes of this agreement the following words and phrases shall be defined as follows:

(a) "Agricultural use" means the use of water primarily in the production of agricultural crops, including the irrigation of lands and underground water replenishment.

(b) "Recycled water" means water which has been treated and percolated into the underground water supply under the City's liquid waste treatment plant in the southwest portion of the District which is thereafter pumped from said underground water supply.

(c) "City Bureau Contract" means that certain contract between the United States and the City of Fresno providing for water service dated January 12, 1961.

(d) "District Bureau Contracts" means those certain contracts between the United States and Fresno Irrigation District more particularly described as follows:

Contract between the United States of America and Fresno Irrigation District Providing for the Payment of the District's Share of the Cost of Pine Flat Dam and Reservoir Allocated to Irrigation, dated December 23, 1963.

Contract for Operation and Maintenance of Irrigation Storage Space of Pine Flat Reservoir dated December 23, 1963.

Kings River Allocation Contract, dated December 23, 1963.

Conveyance and Covenants in Compromise and Settlement of Fresno Slough Claims, dated April 23, 1965.

Contract between the United States and Fresno Irrigation District Providing for Water Service, dated July 20, 1964.

(e) "District Kings River Intra-Association Agreements" means those certain contracts relating to Kings River and storage in Pine Flat Reservoir more particularly described as follows:

Water Right Indenture, dated May 3, 1927.

Administrative Agreement and Monthly Diversion Schedule dated May 3, 1927.

Agreement Supplementing and Amending Water Right Indenture Dated May 3, 1927, and Supplementing and Amending Administrative Agreement Dated May 3, 1927, Relating to Kings River Water Association, and Amended Monthly Diversion Schedule, dated June 1, 1949.

Agreement Admitting Kings River Water District As a Member of Kings River Water Association and Agreement Re: Centerville Bottoms Schedule, dated September 10, 1963.

Agreement Supplementing and Amending Water Right Indenture Dated May 3, 1927, and Administrative Agreement Dated May 3, 1927, Each as Amended and Supplemented June 1, 1949, Relating to Kings River Water Association, dated September 10, 1963.

3. Agreement to Deliver and Accept Recycled Water. During the term of this agreement City agrees to deliver and District agrees to accept from City recycled water pumped by City from the area under its liquid waste treatment plant in amounts and under the terms and conditions hereinafter provided. When so delivered to District said water shall become the property of the District to be used for agricultural purposes and for underground water replenishment in the southwest portion of the District as the District shall see fit.

4. Water Quality. The City shall not deliver to District or discharge into District's canals any such recycled water which is not of a quality suitable for all agricultural use or which shall be deleterious to plant or animal life and all water so delivered shall meet all the quality standards of the California Regional Water Quality Control Board, or its successor agency, for agriculture and irrigation use and any other federal, state or local agency having jurisdiction or control over water quality standards. City agrees at its expense to make such periodical tests to determine the quality of the water discharged into District's canals at the point where said water is so discharged as may be required by any such board or agency or as may be required by the District's manager and to submit the results

of such tests in writing to the District forthwith after such tests are made. City further agrees that any complaint that said recycled water does not meet the above standards, including but not limited to complaints from any such board or agency, the County of Fresno, any mosquito abatement district or any user of such recycled water, must be corrected and resolved to the satisfaction of District before any further discharge of water into said canals shall be made without the express consent of the District.

5. Exhibit A. A map showing the exterior boundaries of the District, the District's canal system, the city limits of the City of Fresno, the location of City's liquid waste treatment plant site, the exact locations at which City may discharge water into the District's canal system, the type and capacity of the discharge facilities by which each such discharge may be made, the location of observation wells as provided in Paragraph 9, and those portions of the District designated by the parties as the "easterly" and "westerly" portions of the District for purposes of this agreement shall be prepared by the District's engineering department and approved in writing upon said map by the authorized representatives of the District and the City. When so approved said maps shall be incorporated herein by reference as Exhibit A and shall become a part hereof. One duplicate so approved shall be kept in the office of the City and one in the office of the District. Said map may be amended in writing upon said map and reapproved in writing as above set forth.

6. Place and Time of Delivery. City will deliver all such water to the District during the District's irrigation season which may at the election of the District be extended to accommodate the recycled water received under this agreement. Said water delivered by the City to the District shall be discharged by the City into the District's Dry Creek Canal No. 77 and/or Houghton-

Canal No. 78 at the locations approved by the District and shown on the map marked Exhibit A and at no other location or locations.

7. Amount to be Delivered. The City shall deliver to the District under this agreement, subject to District's acceptance as provided herein, recycled water pumped by the City, which shall be delivered at a minimum rate of delivery of 100,000 acre feet in each ten-year period of this contract, provided, however, such delivery will not exceed the amount of 30,000 acre feet in any one year except that such maximum may be increased upon agreement between the District's manager and the Director of Public Works of the City. At least 10 days prior to the first day of each calendar month during the term of this agreement City will submit to District in writing a schedule of the daily amount of such water proposed to be delivered to District at each discharge point during that month and the rate of flow indicated in cubic feet per second at which said water will be delivered. Upon receiving said schedule District's manager will approve the amount of such water the District is willing to accept at each said discharge point during each day of that month and thereafter City shall deliver to District the daily amount of such water so approved. Said daily deliveries shall be at a continuous and constant rate of flow during the entire 24 hour period of each said day. In no event shall the discharge into Dry Creek Canal No. 77 in any one month be in excess of one-half of the total amount delivered to District in that month or the discharge into the Houghton Canal No. 78 in any one month be more than two-thirds of the total amount delivered to the District in that month and in no event shall the rate of discharge of water into Dry Creek Canal No. 77 exceed 60 c.f.s. or the rate of discharge into Houghton Canal No. 78 exceed 120 c.f.s. No such discharges shall be made into District's canals until said discharges have been approved

gives immediate notice thereof to the District. In such event City shall use all reasonable effort to immediately restore the delivery of water to the level approved by District's manager as provided in paragraph 7. District's manager may refuse to agree to any such change in schedule or to accept water under such changed schedule if he reasonably determines that such change may result in damage to a District canal or to other property of the District or any other person or will interfere with the operation, alteration, repair or maintenance of the canal into which said discharge is to be made or will interfere with some other operation or function of the District.

9. Ground Water Level. City shall not pump said recycled water from the underground water reservoir in such a manner or to the extent that it will adversely affect the elevation of the water table in the area surrounding its liquid waste treatment plant as determined by the District. Such effect shall not be deemed to be adverse if the ground water level is not lowered below the gradients established by the District as existing on August 1 of the previous year. City agrees to monitor ground water levels in the area from which said recycled water is pumped on a monthly basis by means of observation wells located within an area surrounding its liquid waste treatment plant. The number and location of said wells shall be agreed upon by the City and the District, and when so agreed upon shall be shown on Exhibit A as provided in paragraph 5. Each month at the time City submits its schedule of proposed discharges, City shall supply District with the results of said observations and shall also supply District with a statement of the amounts discharged into District's canals during the previous month. Said schedule and said information shall be given to District upon a standard form approved by District's manager.

10. Construction and Maintenance of Facilities. All

discharge facilities to be used by City in discharging said water into said canals and suitable measuring devices required to measure the amount of water discharged into District's canals shall be constructed by City at its expense according to plans and specifications approved by District and shall thereafter be maintained in good operating and working condition by and at the expense of City. Said discharge facilities shall have a discharge capacity not greater than that shown on said map marked Exhibit A and shall be equipped with positive shut-off controls by which any and all discharges of water into District's canal system may be shut off immediately and at any time. City shall at all times protect said canals and their banks from any damage, injury or erosion at the locations of said facilities into said canals and any such damage or injury at such locations shall be repaired at the expense of City. If City fails to do so District shall be entitled to make said repairs and the expense thereof shall forthwith be reimbursed by City.

11. Use of Water Available to District. In consideration of the agreements of the City herein contained, District agrees that insofar as feasible and practical, it will make available from its Kings River water or from the water received by it under its Bureau Contracts an additional amount of water equivalent to 46% of the water received by it from the City under this agreement for agricultural use and for ground water replenishment in the easterly portion of the District as indicated on Exhibit A. The term "additional amount of water" as above used shall mean water in addition to the amount of water which would have been made available for use in that area if said recycled water had not been received by the District and used in the westerly portion of the District as indicated on Exhibit A. If the District shall determine that the use of said water in said area is not feasible or practicable it may, after discussion with the City, use such

water elsewhere. If in the future it is deemed desirable to do so, City, with the approval of District, may cause the dividing line between the easterly portion of the District and the westerly portion of the District to be moved to the west and the percentage of water to be made available in said easterly portion of the District to be increased in proportion to the increase in the area of land within said easterly portion.

12. District's Representative. Wherever it is provided in this agreement that District's manager shall do and act or exercise his discretion in respect to any particular matter said act and said exercise of discretion may be performed by any other representative of the District to whom such authority shall be delegated either by the District's Board of Directors or by said manager. In exercising his said discretion, the District's manager or his authorized representative shall weigh and balance the equities of the parties in respect to the interests of each and the necessities of District's operations in relation to those of the City. However, in any such case, his decision shall be final.

13. Ownership of District's Water Rights, Canals and Storage. Nothing contained in this agreement shall in any way affect District's ownership of its canal system or of its water right or its right to storage in Pine Flat Reservoir or give City any right or interest therein.

14. Expense of Performance. The performance of all terms and conditions of this agreement to be performed by City shall be at the expense of City and the performance of all terms of this agreement to be performed by District shall be at the expense of District.

15. Indemnity. City agrees to indemnify District and save District harmless of, from and against any loss, cost, expense, liability or attorney's fees incurred by District as the result of

any claim made by any third party because of the City's pumping from the underground water supply as above described or in any way arising out of the execution or performance of this agreement unless such loss, cost, expense or liability is caused by independent negligence on the part of the District in performing the terms and conditions of this agreement on its part to be performed.

16. Successors and Assigns. This agreement shall be binding upon the successors and assigns of the parties hereto provided that City's right to discharge water into District's canal system is not transferable or assignable and shall not pass to any successor in interest without the consent of District. This agreement is not made for the benefit of any person, firm, corporation or public entity not a party hereto and no person, firm, corporation or public entity except a party hereto or its successor or assign shall have any right to enforce said agreement under California Civil Code §1559 or otherwise.

17. Amendments. Except as otherwise provided herein this agreement may not be amended except by the written agreement of the parties hereto.

18. Term, Termination. The term of this contract shall be twenty years from its date, except that it may be cancelled upon mutual agreement between the parties hereto. The contract shall continue in effect after the end of said term except that it may be terminated thereafter by either party upon one year's written notice of such termination. Notwithstanding the foregoing, this contract may be terminated at any time, upon sixty days' written notice by either party, given on and because of substantial breach by the other party, which breach is not repaired or corrected before the end of said sixty-day period.

IN WITNESS WHEREOF, the parties hereto have executed this

agreement the day and year first above written.

FRESNO IRRIGATION DISTRICT

By Winston Strong
President

By Ardys T. Gorder
Secretary

ATTEST:

Dahlia Aguilar
City Clerk Deputy

CITY OF FRESNO

By E. W. Hanley
Chief Administrative Officer

State of California }
County of Fresno } ss.

On this 20th day of June in the year one thousand nine hundred and seventy-four, before me, Paul H. Willison a Notary Public in and for said County and State, residing therein, duly commissioned and sworn, personally appeared Winston Strong known to me to be the President and Ardys T. Gorder known to me to be the Secretary of the Fresno Irrigation District the corporation that executed the within instrument, and known to me to be the persons who executed the within instrument on behalf of the corporation therein named, and acknowledged to me that such corporation executed the same.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal at my office in said County, the day and year in this Certificate first above written.

CORPORATION ACKNOWLEDGMENT
Kilner Stationery Co.
1916 Echo

FORM K108

Paul H. Willison
Notary Public in and for said County and State

OFFICIAL SEAL
PAUL H. WILLISON
NOTARY PUBLIC, CALIFORNIA
PRINCIPAL OFFICE IN
FRESNO COUNTY
My Commission Expires November 19, 1977

APPROVED AS TO FORM
SPENCER THOMAS, JR., City Attorney

By A. Grant Macomber
Senior Deputy

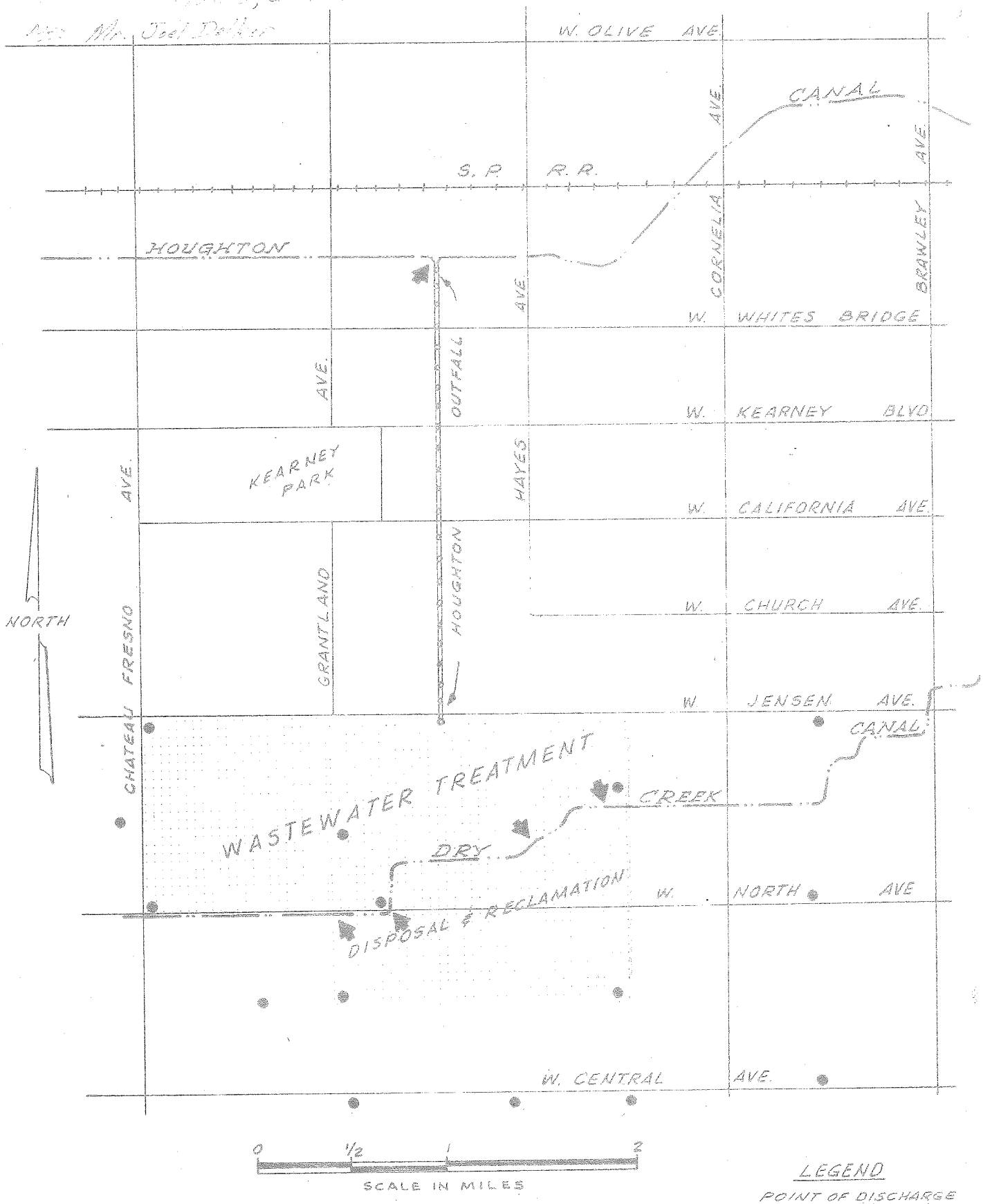

W. OLIVE AVE.
CANAL
S. P. R. R.
HOUGHTON
CORNELIA AVE.
BRAWLEY AVE.
W. WHITES BRIDGE
OUTFALL
AVE.
W. KEARNEY BLVD.
KEARNEY PARK
HAYES
W. CALIFORNIA AVE.
NORTH
CHATEAU FRESNO
GRANTLAND
HOUGHTON
W. CHURCH AVE.
W. JENSEN AVE.
CANAL
WASTEWATER TREATMENT
CREEK
DRY
W. NORTH AVE
DISPOSAL & RECLAMATION
W. CENTRAL AVE.
0 1/2 1 2
SCALE IN MILES
LEGEND
POINT OF DISCHARGE
City's recycled water
into F.I.D. Canal
OBSERVATION WELLS

EXHIBIT A-1

# J

# Water Shortage Contingency Plan

City of FRESNO
Department of Public Utilities

# 2020 Water Shortage Contingency Plan

Final

JULY 2021

CITY OF FRESNO

Photo Credit: Downtown Fresno Partnership

WSC

City of FRESNO
Department of Public Utilities

CITY OF FRESNO

# Final
# 2020 Water Shortage Contingency Plan

**JULY 2021**

Prepared by Water Systems Consulting, Inc.

WSC

# ACKNOWLEDGMENTS

The 2020 Water Shortage Contingency Plan was prepared by Water Systems Consulting, Inc. The primary authors are listed below.

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# ACRONYMS & ABBREVIATIONS

| | |
|---|---|
| **AMI** | advanced metering infrastructure |
| **City** | City of Fresno |
| **CWC** | California Water Code |
| **DPU** | Department of Public Utilities |
| **DRA** | Drought Risk Assessment |
| **DWR** | Department of Water Resources |
| **FID** | Fresno Irrigation District |
| **FMC** | Fresno Municipal Code |
| **SWTF** | Surface Water Treatment Facility |
| **USBR** | United States Bureau of Reclamation |
| **UWMP** | Urban Water Management Plan |
| **WSCP** | Water Shortage Contingency Plan |
| **WSIP** | Water Storage Investment Program |

# 1.1 Introduction

The Water Shortage Contingency Plan (WSCP) is a detailed plan on how the City of Fresno (City) intends to respond to foreseeable and unforeseeable water shortages. A water shortage occurs when the water supply is reduced to a level that cannot support typical demand at any given time. The WSCP is used to provide guidance to the City's governing body and staff and the public by identifying response actions to allow for responsible management of any water shortage with predictability and accountability. Preparation provides the tools to maintain reliable supplies and reduce the impacts of supply interruptions due to extended drought and catastrophic supply interruptions.

The WSCP describes the following:

1. **Water Supply Reliability Analysis:** summarizes the City's water supply analysis and reliability and identifies any key issues that may trigger a shortage condition
2. **Annual Water Supply and Demand Assessment Procedures:** describes the key data inputs, evaluation criteria, and methodology for assessing the system's reliability for the coming year and the steps to formally declare any water shortage levels and response actions
3. **Six Standard Shortage Stages:** establishes water shortage levels to clearly identify and prepare for shortages
4. **Shortage Response Actions:** describes the response actions that may be implemented or considered for each stage to reduce gaps between supply and demand as well as minimize social and economic impacts to the community
5. **Communication Protocols:** describes communication protocols under each stage to ensure customers, the public, and government agencies are informed of shortage conditions and requirements
6. **Compliance and Enforcement:** defines compliance and enforcement actions available to administer demand reductions
7. **Legal Authority:** lists the legal documents that grant the City the authority to declare a water shortage and implement and enforce response actions
8. **Financial Consequences of WSCP Implementation:** describes the anticipated financial impact of implementing water shortage stages and identifies mitigation strategies to offset financial burdens
9. **Monitoring and Reporting:** summarizes the monitoring and reporting techniques to evaluate the effectiveness of shortage response actions and overall WSCP implementation, with results used to determine if additional shortage response actions should be activated or if efforts are successful and response actions should be reduced
10. **WSCP Refinement Procedures:** describes the factors that may trigger updates to the WSCP and outlines how to complete an update
11. **Special Water Features Distinctions:** identifies exemptions for ponds, lakes, fountains, pools, and spas, etc.
12. **Plan Adoption, Submittal, and Availability:** describes the process for the WSCP adoption, submittal, and availability after each revision

This WSCP was prepared in conjunction with the City's 2020 Urban Water Management Plan (UWMP) and is a standalone document that can be modified as needed. This document is compliant with the California Water Code (CWC) Section 10632 and incorporated guidance from the State of California Department of Water Resources (DWR) UWMP Guidebook.

Water purveyor planning for possible water supply shortages has become an increasingly important subject considering the drought conditions over the last several years. The City adopted its first WSCP in 1994 in response to the 1991 Assembly Bill 11X, which mandated all water purveyors with more than 3,000 connections develop a WSCP. The WSCP was revised as part of the 2005 UWMP and adopted by the City in 2008. The WSCP was further refined in 2016 during preparation of the 2015 UWMP and is being updated in 2021 as a standalone document, developed in parallel with the 2020 UWMP. The 2020 WSCP is still based on the original 1994 plan. The revisions are intended to meet new CWC requirements and streamline the plan's usefulness and enable the City to manage the necessary conservation measures to be enacted if a water shortage condition exists. The 2020 WSCP will be reviewed and adopted in conjunction with the 2020 UWMP.

The plan is intended to provide guidance, rather than absolute direction, for City action in response to water shortages and provide the City with options to responsibly manage water shortages.

## 1.2 Water Supply Reliability Analysis

This section is consistent with CWC Section 10632(a)(1) and describes the key findings of the water supply reliability analysis conducted pursuant to CWC Section 10635, which is presented in **Chapter 7** of the City's 2020 UWMP. As part of the 2020 UWMP, water suppliers must perform long-term (2025-2045) water service reliability assessment to evaluate reliability under normal, single dry year, and five-year consecutive dry year periods and a short-term (2021-2025) Drought Risk Assessment (DRA) to evaluate reliability under a five-year consecutive dry year period. Water supply reliability reflects the City's ability to meet the water needs of its customers with water supplies under varying conditions. The analysis considers plausible hydrological and regulatory variability, infrastructure capacity, climate conditions, and other factors that affect the City's water supply and demand.

The City's current water supply portfolio includes groundwater from the Kings Subbasin, surface water from the Central Valley Project Friant Division through a contract with the United States Bureau of Reclamation (USBR), and surface water from the Kings River through a contract with Fresno Irrigation District (FID), as well as recycled water produced at the Fresno-Clovis Regional Water Reclamation Facility and North Fresno Water Reclamation Facility. The City manages the surface water supplies and groundwater conjunctively such that surface water supplies are used more heavily for direct use and recharge during wet periods and groundwater is used more heavily during dry periods. Over the long term, the City aims to maximize recharge to store water for future use and help groundwater levels recover. Key issues that may create a shortage conditions include reduced surface water availability due to dry hydrologic conditions, reduction in groundwater due to contamination issues, or emergency conditions that reduce the City's water supply.

The water supply reliability analysis concluded that the City's supply portfolio is highly reliable and allows the City flexibility to use a majority of surface water when available in normal years and switch to a majority of groundwater in dry years, when surface water supplies are reduced.

The City is projected to meet potable demands with its existing supplies in all year types through conjunctive use of its groundwater and the City is projected to recharge water in most years to help store water for dry years.

## 1.3 Annual Water Supply and Demand Assessment

As established by CWC Section 10632.1, urban water suppliers must conduct an Annual Water Supply and Demand Assessment (Annual Assessment) and submit an Annual Water Shortage Assessment Report to DWR, with the first deadline July 1, 2022[1]. The Annual Assessment is an evaluation of the short-term outlook for supplies and demands for the current year and one projected single dry year conditions to determine whether the potential for a supply shortage exists and whether there is a need to trigger a WSCP shortage stage, appropriate response actions, compliance and enforcement actions, and communication protocols.

### 1.3.1 Key Data Inputs

Key data inputs and their sources for the Annual Assessments are summarized in **Table 1,** and described below**.**

**Table 1. Key Data Inputs for the Annual Assessment**

| KEY DATA INPUT | DESCRIPTION | SOURCE |
|---|---|---|
| Customer demands | Estimates current year unconstrained demand plus a modest growth factor | Customer billing data, 2020 UWMP projections, input from City staff |
| Recharge demands | Estimates current year recharge demand | Surface water allocations, historical recharge, groundwater levels |
| State mandates | Reflects State orders and mandatory compliance with water use efficiency standards | Executive orders from the governor, orders and policies from the State Water Resources Control Board, input from City staff, or other sources |
| Surface water allocation | Reflects the City's available surface water supplies for treatment, recharge, and potential exchanges and transfers | Initial allocations from USBR and FID, typically available in April |
| Groundwater conditions | Reflects status of groundwater conditions | Production data, static water levels, and input from City staff |
| Infrastructure capacity | Reflects production and distribution capacity due to a variety of factors, including human-caused or natural catastrophic events | Production data, well production capacity, wells impacted by contamination, surface water treatment facilities' capacity, distribution system constraints, input from City staff |

[1] For USBR contractors, the assessment is due by July 1 or within 14 days of receiving final USBR water allocation, whichever is later.

#### 1.3.1.1 Customer Demands

Upcoming year customer demands will be estimated based on the previous year's demand, with increases to address: (1) near-term projected growth of customers; (2) unconstrained water use if the previous year included any water use restrictions; and (3) potential water losses not accounted for in the previous year's demand.

#### 1.3.1.2 Recharge Demands

Upcoming year recharge demands will be estimated by (1) availability of surface water not used at the surface water treatment facilities (SWTFs) and (2) projected availability of recharge basins.

#### 1.3.1.3 State Mandates

The City has historically been required by the State to reduce demand regardless of supply reliability at the given time. As described previously, compliance with State mandates for water use efficiency can be declared during drought or in preparation for future droughts, such as in response to the governor's drought declarations in the 2012–2016 drought with subsequent Executive Order B-37-16 and related legislation for Making Conservation a California Way of Life. The City may consider State mandates and mandatory compliance with water use efficiency standards in determining water shortage levels.

#### 1.3.1.4 Surface Water

The City has contracts for surface water with USBR and FID. The available surface water is dependent on hydrology, and in dry years less surface water is available to the City. Final allocations from both USBR and FID are known in April of each year, following the rainy season. In April, the City works with FID to develop a delivery schedule of surface water supplies and submits it USBR. The surface water allocation and delivery schedule will determine the City's operation of its SWTFs for the year, recharge operations, and if it will engage in any exchanges or transfers of supplies. In dry years, when less surface water is available, the City will also plan for increased groundwater use to meet its demands.

#### 1.3.1.5 Groundwater Conditions

Groundwater level and production trends will be compiled and considered by the City staff, or with a hydrogeologist, based on the following actions:

- Plot static groundwater levels on hydrographs to determine trends.
- Plot historic and projected production data to determine trends.
- Compare historic and projected groundwater levels against production data for average and dry years.

#### 1.3.1.6 Infrastructure Capacity

Infrastructure capabilities and overall production will be analyzed to determine if a possible power outage or deficiency may occur or continue in the coming year due to a variety of factors, potentially including human-caused or natural catastrophic events. This analysis may include well replacement, evaluation of wells for possible contamination, SWTFs capacities, and other considerations.

## 1.3.2 Evaluation Criteria

Staff will use the key data inputs to develop and compare supply and demand projections to determine if water shortage actions may be necessary. A preliminary Annual Assessment template is included in **Attachment 1**. Note that supply projections will incorporate infrastructure constraints and an operational buffer factor of 10% will be added to the demand estimate to account for supply and demand projection uncertainties. The estimated amount of supply available versus the estimated demand will be compared with the water shortage condition triggers presented in **Table 2**. Various trigger conditions, which summarize specific evaluation criteria for each shortage level and can be used to determine a water shortage level, are described in the following sections. Triggers are based on current conditions, and the City will evaluate these triggers and modify them as needed.

A shortage emergency may be declared when it is demonstrated that conditions threaten the ability to provide water for public health, safety, and welfare of the community. Furthermore, compliance with State mandates for water use efficiency can be declared during drought or in preparation for future droughts, such as in response to the governor's drought declarations in the 2012–2016 drought with subsequent Executive Order B-37-16 and related legislation for "Making Conservation a California Way of Life".

Short-term and long-term supply shortages may be caused by constrained production capacity or natural or human-caused catastrophic emergencies, such as: power outages, winter storms, wildfires, earthquakes, structural failures, contamination, and bomb threats. These types of emergencies may limit the City's immediate ability to provide adequate water service to meet the requirements for human consumption, sanitation, and fire protection. Impacts of such emergencies vary in duration. Thus, consumption reduction measures and prohibitions may differ for short-term and long-term conditions or shortages.

## 1.3.3 Annual Assessment Procedures

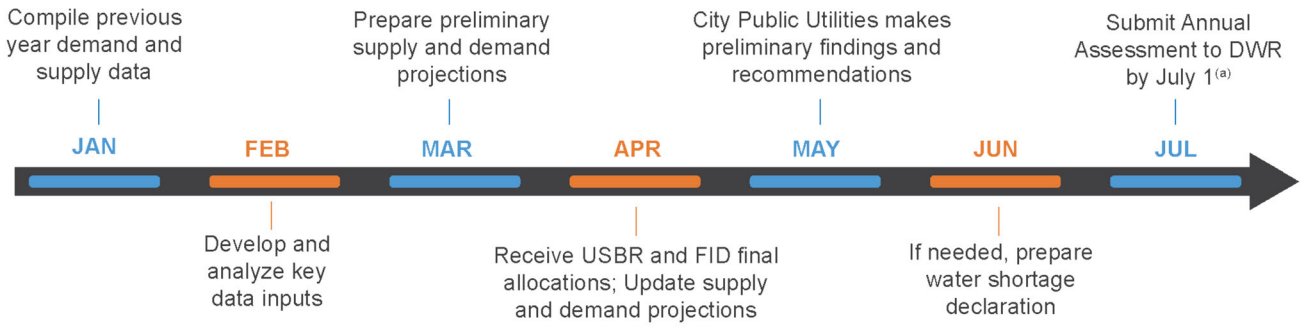
City staff will perform the Annual Assessment following initial allocations from USBR and initial projections for Kings River entitlements by FID, which is typically at the end of rainy season in April. The Annual Assessments are due to DWR by July 1 of each year[2] with the first Annual Assessment Report due to DWR by July 1, 2022. A preliminary annual assessment timeline is shown in **Figure 1.** The City may update the assessment after submission if key data inputs substantially change or other new information becomes available.

[2] For USBR contractors, the assessment is due by July 1 or within 14 days of receiving final USBR water allocation, whichever is later.

**Steps to conduct the Annual Assessment are as follows:**

1. Staff gathers the key inputs, compiles historical data, and analyzes potential supply and demand gaps.
2. Demand trends, water supply conditions, and production capacity are analyzed.
3. A hydrogeologist may be consulted to provide additional groundwater condition information.
4. City Public Utilities staff will review findings and, if necessary, determine a recommended level of conservation required at the implementation or termination of each stage that will then be brought to the City Manager or Mayor for approval.
5. The City Manager, or designee, will declare and implement the level of conservation required at the implementation or termination of each level, and the declaration shall remain in effect until the City Manager, or designee, so otherwise declares. If a conservation level declaration is made, the declaration shall be published at least once in a newspaper of general circulation.
6. The City will develop and/or implement appropriate communication protocols and applicable response actions.

**Figure 1. Annual Assessment Approximate Timeline**




[a] For USBR contractors, the assessment is due by July 1 or within 14 days of receiving final USBR water allocation, whichever is later.

# 1.4 Standard Water Shortage Levels

This section is consistent with CWC Section 10632(a)(2) and describes the City's water shortage levels. New to the 2020 UWMP, water suppliers must now consider six standard water shortage levels. Shortage levels indicate the gap between supply and demand compared to normal-year conditions. DWR standardized six shortage levels to provide a consistent regional and statewide approach to measure water supply shortage conditions. The six shortage levels correspond to 10%, 20%, 30%, 40%, 50%, and greater than 50% shortage in supplies compared to demands under normal conditions. However, a water supplier may use its own shortage levels if a crosswalk is included, relating its existing shortage levels to the six standard levels.

The City has elected to keep the previously established four water shortage stages from the 2016 WSCP and add a fifth stage to classify supply shortage greater than 50%. A crosswalk between the City's stages and DWR's standard levels is shown in **Figure 2**.

**Figure 2. Water Shortage Stages Crosswalk**

| City of Fresno Shortage Stage | Percent Shortage Range | Standard WSCP Level | Percent Shortage Level |
|---|---|---|---|
| 1 | 10% | 1 | 10% |
| 2 | 10 - 25% | 2 | 20% |
| 3 | 25 - 35% | 3 | 30% |
| 4 | 35 - 50% | 4 | 40% |
| 5 | >50% | 5 | 50% |
| | | 6 | >50% |

Although the water shortage stages are classified by the same percentages as the 2015 UWMP, the City has reevaluated the supply conditions and criteria to enter that stage to better reflect its supply portfolio in comparison to demand. **Table 2** lists the water shortage stages and the conditions that would trigger each stage. Any stage listed within the WSCP may be enacted by the City Manager, or designee, as deemed appropriate based on the water shortage condition.

**Table 2. Water Shortage Contingency Plan Levels (DWR 8-1)**

| SHORTAGE LEVEL | PERCENT SHORTAGE[a] | WATER SHORTAGE CONDITION |
|---|---|---|
| 0 | | No water shortage condition. Corresponds with year-round water use measures listed in Section 1.5.1 and d |
| 1 | 0-10% | Stage 1 may be triggered by any of the following conditions:<br>• The available water supplies for the next year are projected to be less than **100%** of projected demand available water supplies, infrastructure constraints, projected demand, and operational buffer will be estim as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage C procedures for the annual assessment; or<br>• After having been in a Stage 2 classification from drought conditions, the upcoming water year USBR and<br>• After having been in a higher classification as a result of emergency, original trigger for a previous higher the above conditions for this stage. |
| 2 | 10-25% | Stage 2 may be triggered by any of the following conditions:<br>• The available water supplies for the next year are projected to be less than **90%** of projected demand available water supplies, infrastructure constraints, projected demand, and operational buffer will be estim as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage C procedures for the annual assessment; or<br>• After having been in a Stage 3 classification from drought conditions, the upcoming water year USBR and<br>• After having been in a higher classification as a result of emergency, original trigger for a previous higher the above conditions for this stage. |
| 3 | 25-35% | Stage 3 may be triggered by any of the following conditions:<br>• The available water supplies for the next year are projected to be less than **75%** of projected demand available water supplies, infrastructure constraints, projected demand, and operational buffer will be estim as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage C procedures for the annual assessment; or<br>• After having been in a Stage 4 classification from drought conditions, the upcoming water year USBR and<br>• After having been in a higher classification as a result of emergency, original trigger for a previous higher the above conditions for this stage. |
| 4 | 35-50% | Stage 4 may be triggered by any of the following conditions:<br>• The available water supplies for the next year are projected to be less than **65%** of projected demand available water supplies, infrastructure constraints, projected demand, and operational buffer will be estim as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage C procedures for the annual assessment; or<br>• After having been in a Stage 5 classification from drought conditions, the upcoming water year USBR and<br>• After having been in a higher classification as a result of emergency, original trigger for a previous higher the above conditions for this stage. |

# 1.5 Shortage Response Actions

The Fresno Municipal Code (FMC) contains sections on water conservation that are to take place under normal water supply conditions. Regulations in place under normal water supply conditions encourage smart water use and help the City manage its water supply. Some of those regulations include year-round outdoor water schedules; turf type restrictions; turf irrigation methods; and prohibition of willful or negligent water wasting, flood irrigating, washing hardscape with potable water, and frequent draining of pools. Additional details of these regulations can be found in FMC Section 6-520(a) (**Attachment 2**). These restrictions are mandated year-round by the City and must be observed. In addition to the normal restrictions on water usage, the City developed shortage response actions to implement during a water shortage on the City level and consumer level in order to reduce demands that are described in **Section 1.5.2** and detailed in **Table 3**.

In the event of a potential water shortage, the City will evaluate the cause of the shortage to help inform which response actions should be implemented. Depending on the nature of the water shortage, the City can elect to implement one or several response actions to mitigate the shortage and reduce gaps between supply and demand. The City has identified actions that fall within the demand reduction, supply augmentation, operational changes, and additional mandatory restrictions, as stated by DWR. It should be noted that all prohibitions listed for Stage 1 will apply to Stage 2 and, likewise, all restrictions that apply to Stage 2 will apply to Stage 3 and so on, until Stage 5 is reached. Also, due to the City's diverse supply portfolio, Stage 1 imposes only voluntary consumer reductions, while Stages 2–5 all include mandatory reduction actions. If necessary, the City may adopt additional actions not listed here in extreme circumstances.

## 1.5.1 Year-Round Measures

FMC Section 6-520(a) lists actions that are prohibited at all times, whether or not there is a shortage condition and include:

- Use of potable water to irrigate or water outdoor landscaping in a manner that causes runoff.
- Keep, maintain, operate, or use any water connection, hose, faucet, hydrant, pipe, outlet, or plumbing fixture which is not tight and free from leakage.
- Willfully or negligently waste water as defined in FMC Section 6-501.
- Sprinkle or irrigate any yard, ground, premise, or vegetation except as set forth in the City's Outdoor Water Use Schedule.
- Sprinkle or irrigate any yard, ground, premise, or vegetation, unless watering device used is controlled by a shutoff device or a person is in immediate attendance of the hose or watering device.
- Prohibit use of potable water to wash sidewalks, walkways, driveways, parking lots, open ground, or other hard-surfaced areas, except where necessary for public health or safety.
- Use potable water in a fountain or other decorative water feature, except where the water is part of a recirculating system.
- Irrigation of ornamental turf on public street medians with potable water, except where the turf serves a community or neighborhood function, there is incidental irrigation by an irrigation system designed to irrigate trees, or the turf is irrigated with recycled water.

- Irrigating outdoor landscapes with potable water during and within 48 hours after measurable rain.
- Serve drinking water other than upon request in eating or drinking establishments, including but not limited to, restaurants, hotels, cafes, cafeterias, bars, or other public places where food or drink are served or purchased.
- Irrigate landscapes outside of newly constructed homes and buildings in a manner inconsistent with regulations or other requirements established by the California Building Standards Commission and the Department of Housing and Community Development.
- Automatically changing towels and linens in hotels and motels daily. Operators of hotels and motels shall provide guests the option of choosing not to have towels and linens laundered daily.
- Drain swimming pools more than once every three years, except as necessary to complete structural repairs or to comply with public health standards, as determined by the County Health Officer.
- Prohibit filling new or refurbished swimming pools without obtaining a pool fill permit from the City.
- Refill (top off) established swimming pools except during times when outdoor water use is allowed at the property address pursuant to the Outdoor Water Use Schedule

The City may update these year-round restrictions in the future as needed. For the latest permanent restrictions refer to FMC Section 6-520(a) (**Attachment 2**) and the latest WSCP Resolution (**Attachment 3**).

## 1.5.2 Demand Reduction

The City has identified a variety of demand reduction actions to offset supply shortages. Demand reduction measures are strategies intended to decrease water demand to close the gap between supply and demand. Demand reduction actions available to the City that may be considered during water shortage conditions are summarized in **Table 3**. Although it is difficult to estimate the volume of savings for each action, the City expects to meet required reductions through a combination of response actions in conjunction with outreach and communication efforts to the extent necessary to mitigate any impacts from a water shortage.

**Table 3. Demand Reduction Actions by City (DWR 8-2)**

| SHORTAGE LEVEL | DEMAND REDUCTION ACTIONS | HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP?[(a)] | ADDITIONAL EXPLANATION OR REFERENCE |
|---|---|---|---|
| All | Expand Public Information Campaign | Not Applicable | Community outreach includes classroom presentatio water tours. Increase communication as drought sta |
| All | Improve Customer Billing | Not Applicable | Water bills show customer usage vs. average usage customer notifications of high water use based on a drought stages increase. |
| All | Offer Water Use Surveys | Not Applicable | Use water leak surveys with all community member |
| All | Provide Rebates for Landscape Irrigation Efficiency | Not Applicable | The City offers rebates for micro-irrigation conversio controller, and rain sensors to improve efficiencies. |
| All | Provide Rebates for Turf Replacement | Not Applicable | The City provides rebates for community members v drought-resistant garden. |
| All | Provide Rebates on Plumbing Fixtures and Devices | Not Applicable | The City offers rebates on a variety of high-efficienc toilets, and urinals. |
| All | Decrease Line Flushing | Not Applicable | The City uses NO-DES for regular pipe flushing to e |
| All | Reduce System Water Loss | Not Applicable | The City has a comprehensive system water loss re to correct water system losses as drought stages in |
| 1 | Decrease Line Flushing | 0 to 100% of shortage gap | For dead-end flushing where the NO-DES truck can |
| 1 | Increase Water Waste Patrols | 0 to 100% of shortage gap | Increase monitoring of AMI reporting and communic based on public input. |
| 1 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Voluntary limits:<br>Summer: three days/week<br>Winter: one day/week |
| 2 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Summer: three days/week<br>Winter: one day/week |
| 3 | Landscape — Limit landscape irrigation to | 0 to 100% of shortage gap | Summer: two days/week |

| SHORTAGE LEVEL | DEMAND REDUCTION ACTIONS | HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP?[a] | ADDITIONAL EXPLANATION OR REFERENCE |
|---|---|---|---|
| 4 | Other — Prohibit vehicle washing except at facilities using recycled or recirculating water | 0 to 100% of shortage gap | Prohibit washing cars, boats, trailers, aircraft, or oth vehicle-washing facilities using water recycling equi |
| 4 | Pools and Spas - Require covers for pools and spas | 0 to 100% of shortage gap | Require covers for swimming pools when not in use |
| 4 | Other | 0 to 100% of shortage gap | Prohibit use of potable water for sewer system main prior approval by the City manager. |
| 4 | Other | 0 to 100% of shortage gap | Prohibit use of outdoor misters. |
| 5 | Landscape — Prohibit all landscape irrigation | 0 to 100% of shortage gap | Prohibit outdoor irrigation year-round. |
| 5 | Moratorium or Net Zero Demand Increase on New Connections | 0 to 100% of shortage gap | The City will temporarily limit or ban new water servi |

[a] Reduction in the shortage gap is estimated and can vary significantly.
[b] Refer to Section 1.7 for Penalties for Water Wastage.

## 1.5.3 Supply Augmentation

Given the consistent supply of groundwater through pumping, the City has no immediate plan to augment supply. However, the City could purchase additional USBR or FID surface water, if available. Also, the Cities of Fresno and Clovis have an agreement for interconnection of their potable water systems to provide service during emergencies and other times of hardship in either community. Although these options are discretionary and quantifying their ability to reduce the shortage gap can vary significantly, they are readily available if needed, as indicated in **Table 4**.

**Table 4. Supply Augmentation & Other Actions (DWR 8-3R)**

| SHORTAGE LEVEL | SUPPLY AUGMENTATION METHODS AND OTHER ACTIONS BY WATER SUPPLIER | HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP? | ADDITIONAL EXPLANATION OR REFERENCE |
|---|---|---|---|
| 1 to 5 | Transfers | As Needed | Purchase or exchange available USBR or FID surface water |
| 1 to 5 | Other Purchases | As Needed | Interconnection with City of Clovis for use in emergencies |

## 1.5.4 Operational Changes

Operational changes to address a short-term water shortage may be implemented based on the severity of the reduction goal. The City can maximize its supply by implementing operational strategies and demand reduction measures. As part of the Annual Assessment process, the City will consider their operational procedures at the time of a shortage to identify changes that can be implemented to address water shortage on a short-term basis, including but not limited to:

- Utilization of a SWTF to treat pumped groundwater to offset lack of surface water supply
- Expansion of public information campaign to educate and inform customers of the water shortage emergency and required water savings
- Decrease line flushing to only on a compliant basis strictly using the currently operational NO DES truck
- Use water patrols and increase frequency of meter reading by recruiting staff from other departments if necessary
- Offer water use surveys
- Implementing or modifying drought rate structure or surcharge or water emergency tiered pricing, pursuant to the requirements of Proposition 218 and in accordance with California Law
- Prohibit any new permits for hydrant-construction or temporary construction meters.
- Monitoring construction meters and fire hydrant meters for efficient water use in the event that a meter identified wastes water.

- Moratorium on issuing any new building permit unless the: (a) Project is found by the City Manager, or designee, to be necessary for public health, safety. (b) Project will use recycled water for construction. (c) Project will not result in a net increase in non-recycled water use. (d) Project has adequate Conservation Offsets
- Suspending the consideration of annexation to its service area unless the annexation increases the water supply available more than the anticipated demands of the property to be annexed
- Reducing overhead in the short-term and mid-term by deferring non-critical Capital Improvement Plan projects and major maintenance expenditures, and in the long-term by adjusting operational and staffing levels and retail water rate structures to incorporate the reality of lower retail water sales than previously anticipated.
- Decrease in the level or, if need be, even a total interruption in the expenditures for the agency's facility replacement program. Non-critical replacement projects will have little or no impact on the agency or its customers and would only extend the master planned replacement schedule.

## 1.5.5 Emergency Response Plan

In addition to responding to drought conditions, the City's WSCP can be used to respond to emergency or catastrophic conditions that impact the availability of the City's water supplies, and/or the ability to deliver water within the City's service area. Potential events are listed below:

- Loss of surface water supply
- Loss of groundwater supply
- Area-wide electrical power failure
- Natural disaster — earthquake or flood

In the event of a supply interruption, there are several measures that could be taken that would mitigate the overall negative impacts of a water shortage. The following discussion indicates possible events and actions to maintain water service to the service area.

The City has an agreement with the City of Clovis that discusses an intertie system between the two cities that could provide service during emergencies and other times of hardship in either community. The agreement covers interconnections, including apportionment of capital costs, at two locations: Leonard Avenue at the Gould Canal alignment and Behymer Avenue at Willow Avenue. The Leonard interconnection was constructed and remains in place for emergency uses through manual operation. The agreement also provided for temporary deliveries from Fresno to northern Clovis through the Behymer connection through 2015. However, the Behymer interconnection has yet to be constructed.

The City also cooperates with the County of Fresno's Office of Emergency Services, and the WSCP is included in the County's Disaster Plan. The goal during any emergency scenario is to maintain water supply such that the health and safety of the community is protected.

In the event of contamination of either the surface or ground water supplies, the non-impacted water supply could be used more heavily or the intertie with the City of Clovis could be activated. Additionally, overall demand reduction and the use of other wells or treated surface water would help meet demands.

If a regional power outage were to occur, the City could use backup power generators to operate wells. This measure, in conjunction with demand reduction, could supply sufficient water for health and safety purposes. The City has more than 35 wells with backup power sources. The

City has budgeted for the installation of a backup generator for the Northeast Wastewater Reclamation Facility. The Southeast SWTF and T-3 SWTF are also equipped with backup power generators.

If a natural disaster occurs, in addition to the actions discussed above, the City will isolate any areas of the system that were compromised for emergency repairs and, potentially, use of the intertie with the City of Clovis. Implementing the WSCP could also occur to reduce demands.

For more information on actions during an emergency, refer to the City of Fresno's Risk and Resilience Assessment Report finalized in September 2020 (AARC Consultants, LLC, 2020) and the City of Fresno Emergency Response Plan finalized in March 2020 (AARC Consultants, LLC, 2020).

### 1.5.6 Seismic Risk Assessment and Mitigation Plan

Refer to Fresno County Multi-Jurisdictional Hazard Mitigation Plan implemented in May 2018, Annex E: City of Fresno attached in **Attachment 4**, for appropriate Seismic Risk Assessment and Mitigation Plan procedures.

### 1.5.7 Shortage Response Action Effectiveness

The City of Fresno has assessed its overall water reduction by evaluating the water usage trends that were discussed in SBX7-7 in conjunction with the American Water Works Association water loss calculator. See Chapters 5 and 4 of the 2020 UWMP, respectively, for additional information.

The overall decrease of water use per capita and compliance with the 2020 per capita water use target indicate that the reduction measures have been effective in the community. All of the City's customers are metered and the City will use these devices to monitor actual reductions in water use during enacted shortage levels compared to normal year conditions. This data allows the City to determine the effectiveness of the implemented shortage response actions. If reduction goals are not being met, the City Manager, or designee, can make the necessary decisions for corrective action to be taken.

## 1.6 Communication Protocols

The City's Department of Public Utilities (DPU) currently has a contract with JP Marketing to manage communication and outreach to the customers. The firm's services include strategic planning, creative concepts, public relations, marketing, promotion, research, advertising, media design, copywriting, event creation, and online services. The City also has a public information officer and communications team whose purpose is to communicate water shortage procedures or general utility information effectively and efficiently to the customers.

During normal supply conditions, the Water Division implements informational campaigns to customers that emphasize user-level changes in water use and overall mindfulness of water waste while promoting voluntary conservation. Over the past few years, DPU has increased use of social media to communicate with customers quickly and organically. The City uses Facebook, Twitter, and Instagram to promote water saving tips, notify of shortage conditions, and spotlight DPU employees to foster a sense of community centered around the water supply. The City strives to be proactive in communicating work strategy and conservation efforts with customers.

This WSCP includes a staged plan to communicate the declaration of a shortage stage, inform restrictions, and provide updates during a water shortage emergency. A summary of actions the City could potentially take during a specific shortage stage is outlined in **Table 5**.

**Table 5. Communication Protocol During Water Shortage Conditions**

| SHORTAGE STAGE | ACTION |
|---|---|
| 1 | Information posted on the City's website |
| 1 | Social media posts (Facebook, Twitter, Instagram, and Nextdoor) |
| 2 | Information included in utility bill inserts on a regular basis |
| 2 | Promotion of rebates and water conservation services |
| 2 | Letters, postcards, and flyers mailed to customers impacted by water use regulations |
| 2 | Targeted outreach and technical assistance to highest water users in each use class |
| 2 | Engage City councilmembers with resources to share with constituents |
| 3 | Increased paid advertising — print, online, radio, TV, streaming, social media, etc. |
| 3 | Messaging printed directly on utility bills |
| 3 | Press releases to local media (online and print newspapers, TV, radio, etc.) |
| 3 | Assembly and promotion of the speaker's bureau for water shortage presentations for neighborhood groups, gardening clubs, homeowners' associations, churches, senior centers, neighborhood associations, business associations, community groups, property management companies, etc. |
| 4 | Increased coordination with the local landscaping industry, including water shortage information in their newsletters, publications, and facilities; local wholesale and retail nurseries; and irrigation supply stores |
| 4 | Signage posted at nurseries and irrigation supply stores |
| 4 | Outreach materials and drought notices mailed to the hospitality industry, including restaurants and lodging |

Note: If a water shortage progresses through multiple stages all measures in the previous stage(s) are implemented in addition to current stage actions.

## 1.7 Compliance and Enforcement

The City has penalties for violation of the water use restrictions in **Table 3**. The City tracks customer usage through advanced metering infrastructure (AMI) in order to enforce water wastage during shortage conditions as detailed in **Section 1.10**. The fines are noted in **Table 6**. Penalties for water waste are based on FMC, Section 6-520(e).

**Table 6. Penalties for Water Wastage**

| INCIDENT MONTH[(a)] | PENALTY AND FINE |
|---|---|
| 1 | $0 – Issued a Notice of Water Waste |
| 2 | $25 |
| 3 | $50 |
| 4-12 | $100 |
| 6 | If a customer has more than six incident months of water wastage within a one-year period, the City may implement any or all of the following measures:<br>• Require the customer to get a landscape evaluation, lawn water audit, and water budget, as appropriate, in order to learn efficient water use. This work shall be completed at the customer's expense by landscape irrigation auditors certified by the Irrigation Association.<br>• Installation by the City of flow restrictors or termination of water service.<br>• Require a customer to repair any defects in their watering system within 14 days of notice by the City. |

Note:
[a] Number of incident months are based on a calendar year.

# 1.8 Legal Authorities

CWC Section 375 provides the City with the statutory authority to adopt and enforce water conservation restrictions, and CWC Sections 350 et seq. authorize the City to declare a water shortage emergency and impose water conservation measures when it is determined that the City may not be able to satisfy ordinary demands without depleting supplies to an insufficient level.

If necessary, the City will declare a water shortage emergency in accordance with CWC Chapter 3 (commencing with Section 350) of Division 1. Once having declared a water shortage, the City is provided with broad powers to implement and enforce regulations and restrictions for managing a water shortage. For example, CWC section 375(a) provides the following:

> *"Notwithstanding any other provision of the law, any public entity which supplies water at retail or wholesale for the benefit of persons within the service area or area of jurisdiction of the public entity may, by ordinance or resolution adopted by a majority of the members of the governing body after holding a public hearing upon notice and making appropriate findings of necessity for the adoption of a water conservation program, adopt and enforce a water conservation program to reduce the quantity of water used by those persons for the purpose of conserving the water supplies of the public entity."*

Water Code Section 375(a). CWC Section 375(b) grants the City with the authority to set prices to encourage water conservation.

Under California law, including CWC Chapter 3.3 and Chapter 3.5 of Division 1, Parts 2.55 and 2.6 of Division 6, Division 13, and Article X, Section 2 of the California Constitution, the City is authorized to implement the water shortage actions outlined in this WSCP. Prior to enacting a shortage level, the resolution providing the Council with authority to enact each level of the WSCP will be adopted. Resolutions to enact the WSCP can be adopted at any meeting of the City Council. The resolution providing the City Manager, or designee, with authority to enact each stage of the WSCP is included in **Attachment 6**.

The City shall also coordinate with any city or county within which it provides water supply services, as listed below, for the possible proclamation of a local emergency under California Government Code, California Emergency Services Act (Article 2, Section 8558).

## 1.9 Financial Consequences of WSCP

This section is in accordance with CWC Section 10632(a)(8) and describes the financial consequences of implementing the WSCP and potential mitigation strategies. The City anticipates reduced revenue while implementing the WSCP because of decreased water use by its customers and additional costs associated with implementing water use restrictions and associated reduction actions. The incurred cost may vary depending on the shortage stage and duration of the water shortage emergency. The cost of compliance may be tracked when a shortage is declared. The City may track the staff time and resources used to implement the WSCP, including reduced revenue, implementation and enforcement of shortage response actions, and communication and outreach efforts. Impacts of implementing the WSCP include:

- Impact of quantity of water sales on revenue
- Increased staff, salaries, and overtime required for implementing and enforcing restrictions
- Increased costs of new supplies, transfers, or other exchanges

In 2015, the mandatory conservation goal for the City was 28%, however the corresponding revenue reductions were less than 28% due to the City having a two-component water rate structure that includes the fixed “water meter service charge” for all service connections and a volumetric-based “water quantity charge.” Therefore, the reduction in revenues was affected by a lesser percentage than the overall total reduction in water use. In general, revenue impacts specified in the WSCP would be offset with a combination of the following:

- An increase in water commodity and service charges
- A reduction in annual operating expenses due to decreased demands
- Reserves currently earmarked for long range capital
- General tax fund revenues currently earmarked for future capital improvements

Methods to mitigate revenue/expenditure impacts are discussed in detail below.

### 1.9.1 Drought Rate Structures and Surcharges

At present, the City does not have in place a drought rate structure. The City plans to hire a rate consultant to review existing water rates and, if appropriate, develop new future water rates. As an additional task to this effort, the consultant will review, develop, and recommend a drought rate structure for the City’s consideration. With such a rate structure in place, should a water shortage take place, the City will be able to institute an alternate water rate structure that may

apply and change depending on the stage of drought that the community is experiencing. At this time, there are no details as to how the rate structure will be developed, but conceptually each of the five stages specified in the WSCP would have a water rate increase associated with it.

The use of this type of structure during a drought will minimize expenditure impacts that are incurred during a drought. The effects of the decrease in revenue due to the drought, with a corresponding increase in expenditure, will allow for the City to function without going into debt.

### 1.9.2 Use of Financial Reserves

The City of Fresno Water System maintains two reserve funding sources that can be used to meet a portion of the utility's revenue requirements during emergency or drought conditions. They are as follows:

- **Water Operating Reserves** – This is cash set aside in the Water Enterprise Fund that provides a "rainy day savings account" for unexpected cash flow shortages and large, unexpected expenses or losses. Normally, these reserves are not intended to be used to make up income shortfalls. However, in an emergency situation, they can be transferred to the Water Rate Stabilization Fund (see below) for transfer back to the Water Enterprise Fund to meet revenue requirements, including debt coverage ratios.
- **Water Rate Stabilization Fund** – Indentures from previous bond issuances required the establishment of the Water Rate Stabilization Fund. These funds can be drawn on to meet a portion of the utility's revenue requirements through unexpected low-revenue periods and may be applied to debt coverage ratio calculations to help avoid technical default of bond covenants and loan agreements.

In addition, the City maintains funding in the Emergency Reserve Fund for the purpose of meeting unforeseen emergencies (see Section 1212 of the City's Charter for more information). This funding may be used by an affirmative vote of at least five members of the City Council upon presentation of a statement declaring the reason for use of the funding. This funding would be used only if the Water System reserves were insufficient to meet revenue requirements.

### 1.9.3 Other Measures

If the funding mentioned above is not sufficient to compensate for loss of revenue during a water shortage, the City may temporarily suspend components of its operations and maintenance activities.

## 1.10 Monitoring and Reporting

As described in **Section 1.3**, the City will track its supplies and project demands annually as part of the Annual Water Supply and Demand Assessment, and, if conditions described in **Table 2** are projected, the City will enact its WSCP. Monitoring demands is essential to ensure the WSCP response actions are adequately meeting reductions and decreasing the supply/demand gap. This will help to analyze the effectiveness of the WSCP or identify the need to activate additional response actions.

The City currently has AMI technology to monitor customer water usage and uses its AMI system to automatically enforce demand reduction measures and restrictions. The AMI system is currently set up to monitor and enforce outdoor watering restrictions. The program monitors customer meter flows against an "excessive use" flowrate, which will vary based on the WSCP stage. The system flags customer meters exceeding the excessive use flowrate during a

day/time outside of permitted outdoor watering hours as excessive use and an incident of water waste. If a customer has one or more incidents of water waste during a month, the customer shall be issued a Notice of Water Waste and, if applicable, be charged fines and penalties. The City may expand this monitoring program in the future to monitor other uses beyond outdoor watering restrictions.

The City can also use the detailed water usage data to monitor customers' response and demand reduction due to restrictions for each stage in the WSCP. The many restrictions and prohibitions assigned to each stage in **Table 3** are inherently flexible so the City can implement certain the restrictions, monitor customer usage, and implement additional restrictions if the demand reductions are not sufficient to close the supply and demand gap. The City also intends to provide reporting to the State based on forthcoming regulations for monthly reporting of water production and other water uses, along with associated enforcement metrics.

## 1.11 WSCP Refinement Procedures

The City intends to use this WSCP as an adaptive management plan to respond to foreseeable and unforeseeable water shortages. The WSCP is used to provide guidance to the City's governing body and staff and the public by identifying response actions to allow for efficient management of any water shortage with predictability and accountability. To maintain a useful and efficient standard of practice in water shortage conditions, the requirements, criteria, and response actions need to be continually evaluated and improved on to make sure the WSCP provides the tools to maintain reliable supplies and reduce the impacts of supply shortages.

This 2020 WSCP accounts for the latest analysis of the City's robust supply portfolio in relation to demand and adjusted percentage reduction stages to reflect a more appropriate supply shortage that should trigger stages. This is a process that should be reevaluated annually and updated as necessary. Potential changes to the WSCP that would warrant an update include any changes to shortage level triggers, changes to the shortage level structure, and changes to the response actions. Any prospective changes to the WSCP would need to be presented at a public hearing; staff would obtain any comments and adopt the updated WSCP. The steps to formally amend the WSCP are discussed in **Section 1.13**.

Potential refinements will be documented and integrated into the next WSCP update. If new response actions are identified by staff or the public, these could be advertised as voluntary actions until they are formally adopted as mandatory.

## 1.12 Special Water Feature Distinction

CWC Section 10623 (b) requires that suppliers analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas, as defined in subdivision (a) of Section 115921 of the Health and Safety Code. As listed in **Table 3 and Section 1.5.1**, there are separate requirements for decorative water features — including decorative fountains, lakes, or ponds — and for pools and spas. The City has separate response actions, enforcement actions, and monitoring programs for both decorative water features and pools and spas. Non-pool or non-spa water features may use or be able to use recycled water, whereas pools and spas must use potable water for health and safety considerations. Limitations to pools and spas may require different considerations compared to non-pool or non-spa water features.

## 1.13 Plan Adoption, Submittal and Availability

This WSCP update was prepared in tandem with the 2020 UWMP. The City held a public hearing and adopted the 2020 WSCP on July 15, 2021. A copy of the published Notice of Public Hearing is included in **Attachment 5** and a copy of the adopting resolution is included in **Attachment 6**. Before the public hearing, notices were published notifying the public of the date and time of the hearing.

Once the 2020 WSCP has been adopted, a copy will be submitted to DWR, the State Library, and the County of Fresno. Also, a hard copy will be made available for public reference at the City of Fresno Department of Public Utilities office at City Hall (located at 2600 Fresno Street) and the Water Division office (located at 1910 E. University Avenue). Additionally, an electronic copy will be uploaded to the City of Fresno website[1] and made available for public reference.

Based on DWR's review of the WSCP, the City will make any amendments in its adopted WSCP, as required and directed by DWR. If the City revises its WSCP after the UWMP is approved by DWR, then an electronic copy of the revised WSCP will be submitted to DWR within 30 days of its adoption.

[1] www.fresno.gov/Government/DepartmentDirectory/PublicUtilities/Watermanagement/importantdocuments.htm

# References

AARC Consultants, LLC. (2020). *City of Fresno Department of Public Utilites Risk and Resilience Assessment for the America's Water Infrastructure Act 2018.* Fresno, California.

AARC Consultants, LLC. (2020). *City of Fresno Water Divsion All Hazards Emergency Response Plan.*

# Attachment 1
# Preliminary Annual Assessment Template

# DWR ASSESSMENT TABLE TEMPLATE - EXAMPLE VALUES FOR 2021 SHOWN

**City of Fresno**
**DWR Annual Water Supply and Demand Assessm**
**Supply and Demand Estimates**

**Current Year: <YEAR>**
**Updated: <DATE>**

| | Current Year | Following Year | |
|---|---|---|---|
| **Demand Use Type** | **2021** | **2022** | **Notes** |
| Single Family | 60,666 | 61,272 | 1% annual increase from 2020 |
| Multi-Family | 19,030 | 19,221 | 1% annual increase from 2020 |
| Commercial | 17,141 | 17,312 | 1% annual increase from 2020 |
| Industrial | 5,786 | 5,844 | 1% annual increase from 2020 |
| Landscape | 9,583 | 8,680 | 1% annual increase from 2020; Reduced by increased recycled water use |
| Other | 343 | 347 | 1% annual increase from 2020 |
| Losses | 9,664 | 9,760 | 1% annual increase from 2020 |
| Recycled Water | 1,912 | 2,911 | Estimates per 2020 UWMP Table 7-4 |
| **M&I Demand Subtotal** | **124,125** | **125,347** | |
| Operational Buffer (10%) | 12,410 | 12,530 | To account for supply and demand uncertainties |
| **M&I Demand Total** | **136,535** | **137,877** | |
| Groundwater Recharge | - | - | No recharge assumed due to low surface water supply availability |
| **Total Demand** | **136,535** | **137,877** | |

| **Supply** | **2021** | **2022** | |
|---|---|---|---|
| Groundwater, Sustainable Yield | 73,062 | 73,644 | Sustainable groundwater yield per 2020 UWMP Table 6-1 |
| Groundwater, Allocated from Storage | - | - | Groundwater in storage built up over time from recharge and reduced pumping; Not used since supply is greater than demand |
| USBR Contract Allocation | 17,612 | 19,025 | Current Year: USBR Allocation = 20% plus 5,612 AF of carryover<br>Following Year: Average of "Critical" year per 2020 UWMP Table 6-2 |
| FID Contract Allocation | 51,580 | 61,000 | Current Year: FID Kings River Allocation = 26%<br>Following Year: Average of "Critical" year per 2020 UWMP Table 6-3 |
| Recycled Water, RWRF | 1,802 | 2,801 | Estimates per 2020 UWMP Table 6-6 |
| Recycled Water, NFWRF | 110 | 110 | Estimates per 2020 UWMP Table 6-6 |
| **Total Supplies** | **144,166** | **156,580** | |

| **Supply vs. Demand** | **2021** | **2022** |
|---|---|---|
| Supply minus Demand (AF) | **7,631** | **18,703** |
| Supply divided by Demand (%) | **106%** | **114%** |

# WATER SHORTAGE STAGE TEMPLATE - EXAMPLE VALUES FOR 2021 SHOWN

**City of Fresno**
**DWR Annual Water Supply and Demand Assessment**
**Water Shortage Stage Comparison**

**Current Year: <YEAR>**
**Updated: <DATE>**

## 2021 Water Supplies (AFY)

| Supplies | Maximum Available Supplies | Projected Available Supplies |
|---|---|---|
| GW, Sustainable Yield | 73,062 | 73,062 |
| GW, from Storage | *Not Used* | |
| Surface Water | 176,055 | 69,192 |
| Recycled Water | 1,912 | 1,912 |
| **Total** | **251,029** | **144,166** |

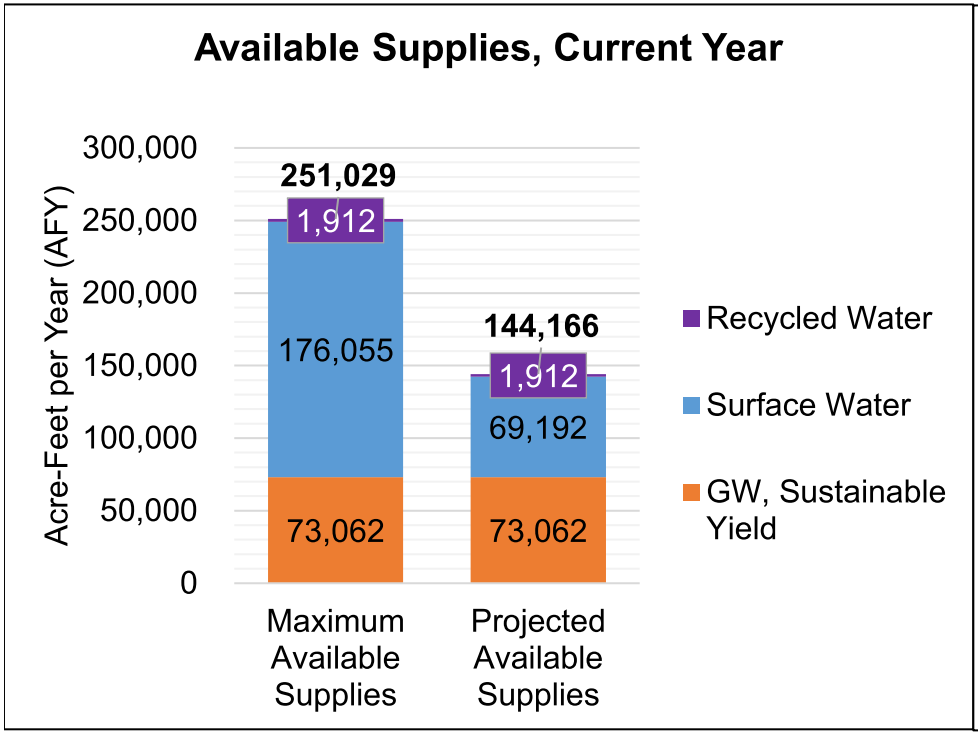
## 2021 Water Demands (AFY)

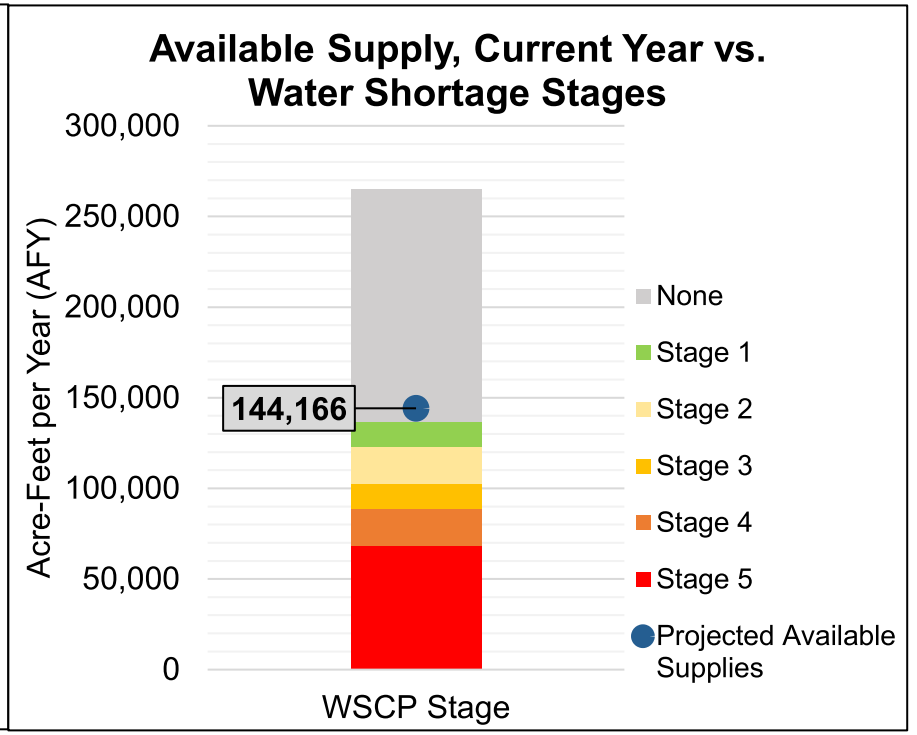
| Demand Type | Estimated Demands |
|---|---|
| M&I | 124,125 |
| Buffer | 12,410 |
| **Retail Subtotal** | **136,535** |
| Recharge | 0 |
| **Total** | **136,535** |

## Water Shortage Stages

| WSCP Stage | Reduction Upper End | Reduction Lower End | (AFY) Upper End | (AFY) Lower End |
|---|---|---|---|---|
| None | | | | 136,500 |
| Stage 1 | 0% | 10% | 136,500 | 122,900 |
| Stage 2 | 10% | 25% | 122,900 | 102,400 |
| Stage 3 | 25% | 35% | 102,400 | 88,700 |
| Stage 4 | 35% | 50% | 88,700 | 68,300 |
| Stage 5 | | > 50% | 68,300 | |

*Note: Refer to seperate Supply and Demand projections table for assumptions.*



# Attachment 2
# City of Fresno Municipal Code Chapter 6-520

SEC. 6-520. - WATER CONSERVATION.

(a) In the use of potable water supplied by the city, no customer shall do or permit any of the following:

(1) Use potable water to irrigate or water outdoor landscaping in a manner that causes runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots or structures,

(2) Keep, maintain, operate, or use any water connection, hose, faucet, hydrant, pipe, outlet, or plumbing fixture which is not tight and free from leakage,

(3) Willfully or negligently waste water,

(4) Flood any part of the premises of another,

(5) Sprinkle the premises of another so as to prevent the normal use thereof or unreasonably wet objects thereon which should not be subjected to a spray of water except as naturally caused by the elements or by action of the owner of the object,

(6) Sprinkle or irrigate any yard, ground, premise, or vegetation except as set forth in the City's Outdoor Water Use Schedule,

(i) Annual Exemptions. The following properties may submit an application for a one-year exemption to the Outdoor Water Use Schedule in effect at the time of the application:

a. Properties with multiple addresses, and

b. Properties with turfed or landscaped areas of two acres or larger, and

c. Properties without street addresses.

The owners of such properties shall submit a proposed modified Outdoor Water Use Schedule in writing to the Director or designee for approval or modification. The Director may approve a modified Outdoor Water Use Schedule for with more frequent watering or different watering days than allowed by the Outdoor Water Use Schedule in effect at the time the application for an exemption is submitted for consideration. If the Director determines the proposed exemption will adversely impact system water pressures in the service area, the proposed exemption will be denied. All Annual Exemptions approved by the Director shall automatically expire on December 31 of each year, and the property owners must re-apply for an exemption to the Outdoor Water Use Schedule.

(ii) Short-term Exemptions. The following properties may submit an application for an exemption from the Outdoor Water Use Schedule for a specific time period not to exceed one month.

a. Properties with new lawns not yet established.

b. Properties seeking to use water for a bona fide use, such as solar panel cleaning or other use necessary for health or preservation of property.

The owners of such properties shall submit a proposed modified Outdoor Water Use Schedule in writing to the Director or designee for approval or modification no less than 48 hours before the proposed non-compliant water usage. The Director may approve a modified Outdoor Water Use Schedule that may provide for more frequent outdoor water use or different outdoor water use days than allowed by the Outdoor Water Use Schedule in effect at the time the application for an exemption is submitted for consideration. If the Director determines the proposed exemption will adversely impact system water pressures in the service area, the proposed exemption will be denied. All Short-term Exemptions approved by the Director shall automatically expire on the date set forth on the Short-Term Exemption permit.

(7) Sprinkle or irrigate any yard, ground, premise, or vegetation unless the watering device used is controlled by an shut-off device, or a person is in immediate attendance of the hose or watering device,

(8) Wash any privately owned motor vehicle, trailer, or boat except from a bucket or in a commercial car wash, provided a hose equipped with a shut-off nozzle may be used for a quick rinse without causing water to flow onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots, or structures,

(9) Wash or rinse with a hose or watering device any sidewalk, driveway, parking area, tennis court, patio, or any other exterior paved area, except for public health and safety reasons at public gathering places, or

(10) Use potable water in a fountain or other decorative water feature, except where the water is part of a recirculating system.

(11) Irrigate ornamental turf on public street medians with potable water, except where:

(i) The turf serves a community or neighborhood function, including but not limited to, recreational uses and civic or community events;

(ii) The turf is irrigated incidentally by an irrigation system primarily intended to irrigate trees;

(iii) The turf is irrigated with recycled water.

This prohibition does not include trees and shrubs on public medians, which may be irrigated.

(12) Irrigate outdoor landscapes with potable water during and within 48 hours after measurable rainfall.

(13) Serve drinking water other than upon request in eating or drinking establishments, including but not limited to, restaurants, hotels, cafes, cafeterias, bars, or other public places where food or drink are served or purchased.

(14) Irrigate landscapes outside of newly constructed homes and buildings in a manner inconsistent with regulations or other requirements established by the California Building Standards Commission and the Department of Housing and Community Development.

(15) Automatically change towels and linens in hotels and motels daily. Operators of hotels and motels shall provide guests the option of choosing not to have towels and linens laundered daily. The hotel or motel shall prominently display notice of this option in each guestroom using clear and easily understood language.

(16) Drain swimming pools more than once every three years, except as necessary to complete structural repairs or to comply with public health standards, as determined by the County Health Officer. Residents with private swimming pools shall file a written application for a permit with the City of Fresno Water Division at least 48 hours prior to draining the pool. Any customer whose swimming pool is drained by order of the Department of Health for failure to maintain it properly will also be issued a notice of violation of the City of Fresno Municipal Code. The draining of pools for reasons of health and safety hazards as determined by the City of Fresno Water Division and/or the Department of Health is permitted. The application shall include the results of a pool water test conducted by an independent testing organization which shows a cyanuric acid level above 100 parts per million, total dissolved solids over 2,500 parts per million, or calcium over 450 parts per million, or stating the nature and duration of repairs to be made and the date on which the pool will be drained.

(17) Fill newly constructed or refurbished swimming pools without a pool fill permit from the City of Fresno Water Division.

(18) Refill (top off) established swimming pools except during times when outdoor water use is allowed at the property address pursuant to the Outdoor Water Use Schedule.

(b) Notwithstanding the foregoing, drip irrigation of community and residential fruit and vegetable gardens and fruit tr permitted any day of the week; for this subsection, "drip irrigation system" means a non-spray, low-pressure, and lc volume irrigation system in good working order utilizing emission devices with a flow rate of less than four gallons p hour, designed to slowly apply small volumes of water at or near the root zone of plants, when used primarily for ir of fruit and vegetable gardens and fruit trees; should any city water customer be cited for excessive water use, the customer may contact the Water Division and request an exemption from the Outdoor Water Use Schedule for a hc community garden that is irrigated with a drip irrigation system. Upon being contacted, the Water Division will sche visit to the subject property to inspect the garden and the drip irrigation system used to irrigate the garden. The Wa Division shall grant an exemption for home or community garden with the following conditions:

(1) The property must limit water use to an amount equal to, or less than, the average monthly water use for the single-family residential customer class. The monthly average water use for the single-family residential customer class is printed on monthly utility bills issued by the City.

(2) The drip irrigation system must be in good working order with no leaks, line breaks, or other deficiencies that will contribute to water waste. Exemptions shall be withheld until corrective action is taken to address system deficiencies.

(3) The drip irrigation system must be used primarily for the home or community garden, and not for other landscape on the property- Exemptions shall be withheld until the drip irrigation system for the home or community garden can be isolated from other landscape on the property.

(4) No flood irrigation will be allowed with the drip irrigation system, and water must remain on the subject property with no runoff to sidewalks, driveways, pavements, or adjacent properties.

(5) The home and community garden exemption is provided exclusively for drip irrigation systems only, and will not be allowed for other types of irrigation systems.

(6) This exemption shall only apply to properties ¼ acre or smaller. For properties greater than ¼ acre, the property owner may apply to the Director or designee for an exemption.

(c) Lawn sprinkling systems shall be properly designed, installed, maintained, and operated to prevent waste of water.

(d) Repealed.

(e) The provisions of this section are conditions of service.

(1) Each incident of Excessive Use as defined in section 6-501, or use of water inconsistent with the provisions of this section, is an incident of water waste.

(2) If a customer has one or more incidents of water waste during a month, as observed by City staff or as recorded by the City's water meter reading system, the customer shall be issued a Notice of Water Waste and, if applicable, charged a fine as set forth in the Master Fee Schedule. Such fines shall be added to the customer's monthly utility bill and shall be due and payable with that utility bill and subject to the FMC 6-106, Late Payment of Municipal Service Bills.

(3) Incident counts for water waste shall be monitored, recorded, documented and enforced on a monthly basis during the calendar year for individual customers, and the incident counts shall be reset January 1 of each year.

(4) If a customer performs or permits incidents of water waste more than six consecutive months, the water service to the customer may be terminated unless in the opinion of the Director such termination would result in an unreasonable risk to the health and safety of persons. If water service is terminated for

successive incident of water waste, the water service may only be restored upon execution of an agreement with the customer to adhere to the conditions of service described in this section.

(5) If a customer objects to a fine imposed for an incident of water waste pursuant to this section, the following appeal process may be used.

Step 1.

(a) Within thirty days of issuance of the utility bill including the fine, the customer may contact the Water Conservation Program to appeal an incident of water waste resulting in a fine with the staff person who initiated the enforcement measure. The staff person shall gather the facts about the incident.

(b) The customer may provide staff with evidence there was no incident of water waste, or of a bona fide reason for the incident of water waste, including evidence of a water leak, or another reasonable justification for the water use, within ten business days of the customer's first communication with the Water Conservation Program regarding the alleged incident of water waste.

(c) Within ten business days of the initiation of an appeal, staff shall provide the customer with documentation demonstrating the incident of water waste, if applicable.

(d) The staff will provide the facts and evidence related to the appeal to the Water Conservation Program Supervisor, who will determine whether to rescind the enforcement measure. The Water Conservation Program Supervisor will provide a written decision to the customer within fifteen business days of the customer's appeal, or receiving any applicable evidence from the customer, whichever comes later.

Step 2. If the customer is not satisfied with the decision of the Water Conservation Program Supervisor, they may appeal to the Director or designee within ten business days of the date of the Water Conservation Program Supervisor's decision. The Director or designee shall review the appeal and any evidence the customer previously submitted, and provide a written decision within thirty days of receiving the appeal.

Step 3. If the customer is not satisfied with the decision of the Director of Public Utilities, the customer may appeal to the City's Administrative Hearing Officer in the manner provided in Chapter 1, Article 4 of this code. Such decision shall be final.

(Orig. Ord. 4481; Am. Ord. 6486, 1964; Am. Ord. 73-120, § 6, eff. 8-16-73; Am. Ord. 77-99, § 1, eff. 9-23-77; Am. Ord. 78-74, §§ 1, 2, eff. 5-26-78; Am. Ord. 80-115, § 149, eff. 8-8-80; Am. Ord. 89-48, §§ 1, 2, eff. 4-18-89; Am. Ord. 89-77, § 1, eff. 6-7-89; Am. Ord. 89-102, § 1, eff. 9-22-89; Am. Ord. 90-72, § 1, eff. 8-24-90; Am. Ord. 90-97, § 1, eff. 10-12-90; Am. Ord. 91-104, § 1, eff. 10-18-91; Am. Ord. 91-112, § 1, eff. 11-22-91; Am. Ord. 93-14, § 1, eff. 2-23-93; Am. Ord. 93-20, § 2, eff. 4-30-93; Am. Ord. 2015-13, § 1, eff. 5-21-15; Am. Ord. 2015-29, § 1, eff. 8-27-15; Am. Ord. 2017-56, § 3, eff. 11-19-17; Am. Ord. 2018-45, § 1, eff. 8-10-18; Am. Ord. 2019-011, § 3, eff. 5-31-19).

**Editor's note—** The provisions in subsection 6-520(e) regarding the enforcement program for incidents of water waste are effective January 1, 2018.

# Attachment 3
# Water Shortage Resolution

RESOLUTION NO. 2019-073

A RESOLUTION OF THE COUNCIL OF THE CITY OF FRESNO, CALIFORNIA, TO AMEND THE WATER SHORTAGE CONTINGENCY PLAN

WHEREAS, the Urban Water Management Planning Act requires the City of Fresno (City) to describe its water conservation measures within its Water Shortage Contingency Plan (WSCP);

WHEREAS, the City adopted its current WSCP on June 23, 2016, as part of the City's 2015 Urban Water Management Plan (UWMP);

WHEREAS, the City Council adopted amendments to the WSCP on October 12, 2017;

WHEREAS, in response to water conservation mandates from the State of California and to provide flexibility to its customers, the City has prepared further amendments to the WSCP to update water conservation requirements and watering restrictions in different water conservation stages in the City of Fresno.

NOW THEREFORE, BE IT RESOLVED by the Council of the City of Fresno as follows:

1. The City hereby adopts the amended Water Shortage Contingency Plan, as attached in Tables 1-3 of Exhibit A herein.

2. Resolution 2018-253 shall be repealed on the effective date of this Resolution.

* * * * * * * * * * * * * * *



Date Adopted: 4/11/2019
Date Approved: 4/16/2019
Effective Date: 4/16/2019

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, YVONNE SPENCE, MMC CRM, City Clerk of the City of Fresno, certify that the foregoing resolution was adopted by the Council of the City of Fresno, at a regular meeting held on the 11th day of April, 2019.

AYES : Arias, Bredefeld, Chavez, Esparza, Soria, Caprioglio
NOES : None
ABSENT : None
ABSTAIN : None

Mayor Approval: April 16th, 2019
Mayor Approval/No Return: N/A, 2019
Mayor Veto: N/A, 2019
Council Override Vote: N/A, 2019

YVONNE SPENCE, MMC CRM
City Clerk

By: Yvonne Spence
Deputy

APPROVED AS TO FORM:
DOUGLAS T. SLOAN
City Attorney

By: Amanda Freeman 04/18/19
Amanda B Freeman Date
Senior Deputy City Attorney

Attachment:
Exhibit A – Revised Water Shortage Contingency Plan, Tables 1-3

# EXHIBIT A

## Revised Water Shortage Contingency Plan

## Table 1: Stages of Water Shortage Contingency Plan (WSCP)

| Stage | Percent Supply Reduction | Water Supply Condition |
|---|---|---|
| 1 | 10% | Stage 1 of the Water Shortage Contingency Plan may be triggered by any of the following conditions:<br>• In the second of two consecutive years, the volume of surface water available to the City through USBR and FID is projected to be less than the long-term average and the reduction in supply, averaged over the consecutive years, is equal to 10% or greater, or<br>• Groundwater contamination conditions exists (DDW required the City to shut down wells) or a large-scale infrastructure failure occurs that results in a 10% loss in water production capacity, or<br>• Localized groundwater cones of depression develop exceeding historic low water levels and, to avoid possible litigation with responsible parties of point source contaminant plumes, the City must shut down existing wells that result in a 10% loss in groundwater production capacity, or<br>• A combination of the above mentioned circumstances or a disaster reduced the City's overall water supply or production capabilities by 10% or more.<br>• After having been in a Stage 2 classification, the following water year results in a declaration by the jurisdictional authority in determining entitlements for the respective surface water supply of normal or above normal water deliveries; or the original trigger for a previous higher stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 2 | 10 - 25% | Stage 2 of the Water Shortage Contingency Plan may be triggered by any of the following conditions:<br>• In the third of three consecutive years, the projected volume of surface water available to the City through USBR or FID is less than the long term average and the reduction in supply, averaged over the three consecutive years equals 10% or greater, or<br>• The volume of surface water available to the City through FID is reduced by 25% of the long-term average, or<br>• The volume of surface water available to the City through USBR is reduced by 25% of the long-term average, or<br>• One-year change in average groundwater level in 30 key City wells exceeds 3 feet or two-year change in average groundwater level in 30 key City wells exceeds 6 feet and exceeds historic low groundwater levels, or<br>• Groundwater contamination condition exists (DDW requires the City to shut down wells) or a large-scale infrastructure failure occurs that results in a 25% loss in water production capacity, or<br>• A combination of the above mentioned circumstances or disaster reduces the City's overall water supply or production capabilities |

| Stage | Percent Supply Reduction | Water Supply Condition |
|---|---|---|
| | | by 25% or more.<br>• After having been in a Stage 3 classification, the following water year results in a declaration by the jurisdictional authority in determining entitlements for the respective surface water supply of normal or above normal water deliveries on the Friant-Kern system; or the original trigger for a previous higher stage classification has been rectified to a point consistent with the above conditions for this stage. |
| 3 | 25 to 35% | Stage 3 of the Water Shortage Contingency Plan may be triggered by any of the following conditions:<br>• In the fourth of four consecutive years, the projected volume of surface water available to the City through USBR or FID is less than the long term average and the reduction in supply, averaged over the four consecutive years equals 10% or greater, or<br>• The volume of surface water available to the City through FID is reduced by 35% of the long-term average, or<br>• The volume of surface water available to the City through USBR is reduced by 35% of the long-term average, or<br>• One-year change in average groundwater level in 30 key City wells exceeds 5 feet or two-year change in average groundwater level in 30 key City wells exceeds 10 feet and exceeds historic low groundwater levels, or<br>• Groundwater contamination condition exists (DDW requires the City to shut down wells) or a large-scale infrastructure failure occurs that results in a 35% loss in water production capacity, or<br>• A combination of the above mentioned circumstances or disaster reduces the City's overall water supply or production capabilities by 35% or more.<br>• After having been in a Stage 4 classification, the following water year results in a declaration by the jurisdictional authority in determining entitlements for the respective surface water supply of normal or above normal water deliveries on the Friant-Kern system; or the original trigger for a previous higher stage classification has been rectified to a point that is consistent with the above conditions for this stage. |

| Stage | Percent Supply Reduction | Water Supply Condition |
|---|---|---|
| 4 | 35 - 50% | Stage 4 of the Water Shortage Contingency Plan may be triggered by any of the following conditions:<br>• In the fifth of five consecutive years, the projected volume of surface water available to the City through USBR or FID is less than the long term average and the reduction in supply, averaged over the five consecutive years equals 10% or greater, or<br>• The volume of surface water available to the City through FID is reduced by 50% of the long-term average, or<br>• The volume of surface water available to the City through USBR is reduced by 50% of the long-term average, or<br>• One-year change in average groundwater level in 30 key wells exceeds 7.5 feet or two-year change in average groundwater level in 30 key City wells exceeds 12 feet and exceeds historic low groundwater levels, or<br>• Groundwater contamination condition exists (DDW requires the City to shut down wells) or a large-scale infrastructure failure occurs that results in a 50% loss in water production capacity, or<br>• A combination of the above mentioned circumstances or disaster reduces the City's overall water supply or production capabilities by 50% or more. |

## Table 2: Restrictions and Prohibitions on End Uses

| (#) | Stage | Restrictions and Prohibitions | Additional Explanation or Reference | Penalty, Charge or Other Enforcement |
|---|---|---|---|---|
| a | 1-4 | Landscape – Limit landscape irrigation to specific times (Outdoor Water Use Schedule) | See Outdoor Water Use Schedule, Table 2a. | Yes<br>See Table 3 |
| b | 1-3 | Other | Prohibit car washing except with a bucket only (a hose equipped with a shut off nozzle may be used for a quick rinse) | Yes<br>See Table 3 |
| c | 1-4 | Other – Prohibit use of potable water for washing hard surfaces | Prohibit use of potable water to wash sidewalks, walkways, driveways, parking lots, open ground or other hard surfaced areas except where necessary for public health or safety | Yes<br>See Table 3 |
| d | 1-4 | Landscape – Prohibit certain types of landscape irrigation | Prohibit irrigating outdoor landscapes with potable water during and within 48 hours after measurable rainfall | Yes<br>See Table 3 |
| e | 1-4 | Landscape – Prohibit certain types of landscape irrigation | Sprinkle or irrigate any yard, ground, premise, or vegetation unless the watering device used is controlled by an automatic shut-off device, or a person is in immediate attendance of the hose or watering device | Yes<br>See Table 3 |
| f | 1-4 | Landscape – Prohibit certain types of landscape irrigation | Prohibit using potable water to irrigate or water outdoor landscaping in a manner that causes runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots or structures | Yes<br>See Table 3 |
| g | 1-4 | Landscape – Prohibit certain types of landscape irrigation | Prohibit irrigation of ornamental turf on public street medians with potable water, except where the turf serves a community or neighborhood function, it's irrigated incidentally by an irrigation systems designed to irrigate trees, or the turf is irrigated with recycled water | Yes<br>See Table 3 |

| | | | | |
|---|---|---|---|---|
| h | 4 | Other | Prohibit car washing | Yes<br>See Table 3 |
| i | 1-4 | Other – Restaurants may only serve water upon request | No restaurant, hotel, café, cafeteria, or other public place where food is sold is served or offered for sale, shall serve drinking water to any customer unless expressly requested | Yes<br>See Table 3 |
| j | 1-4 | Landscape – Prohibit certain types of landscape irrigation | Irrigate landscapes outside of newly constructed homes and buildings in a manner inconsistent with regulations or other requirements established by the California Building Standards Commission and the Department of Housing and Community Development | Yes<br>See Table 3 |
| k | 1-4 | Water Features – Restrict water use for decorative water features, such as fountains | Prohibit use of potable water to clean, fill or maintain decorative fountains, lakes, or ponds unless such water is reclaimed | Yes<br>See Table 3 |
| l | 4 | Other – Prohibit use of potable water for construction and dust control | Prohibit use of potable water for construction, compaction, dust control, street or parking lot sweeping, building wash down where non-potable or recycled water is sufficient | Yes<br>See Table 3 |
| m | 1-4 | Other – Prohibit automatic linen service in hotels and motels | Prohibit automatically changing towels and linens in hotels and motels daily. Operators of hotels and motels shall provide guests the option of choosing not to have towels and linens laundered daily | Yes<br>See Table 3 |
| n | 4 | Other | Prohibit use of potable water for sewer system maintenance or fire protection training without prior approval by the City Manager | No |
| o | 4 | Other – Customers must repair leaks, breaks, and malfunctions in a timely manner | Prohibit allowing potable water to escape from breaks within the customer's plumbing system for more than twenty-four (24) hours after the customer is notified or discovers the break | Yes<br>See Table 3 |

| | | | | |
|---|---|---|---|---|
| p | 4 | Other – Prohibit vehicle washing except at facilities using recycled or recirculating water | Prohibit washings cars, boats, trailers, aircraft, or other vehicles except to wash such vehicles at commercial or fleet vehicle washing facilities using water recycling equipment | Yes<br>See Table 3 |
| q | 1-4 | Swimming Pools – Prohibit draining swimming pools more than once every three years | Prohibit draining swimming pools more than once every three years, except as necessary to complete structural repairs or to comply with public health standards, as determined by the County Health Officer | Yes<br>See Table 3 |
| r | 1-4 | Swimming Pools – Limit filling new or refurbished pools by requiring a pool fill permit | Prohibit filling new or refurbished swimming pools without obtaining a pool fill permit from the City | Yes<br>See Table 3 |
| s | 1-4 | Swimming Pools – limit filling (topping off) established pools to times and days permitted by the Outdoor Water Use Schedule | Prohibit filling (topping off) swimming pools during times when outdoor irrigation is allowed according to the Outdoor Water Use Schedule | Yes<br>See Table 3 |
| t | 4 | Pools and Spas – Require covers for pools and spas | Require covers for swimming pools when not in use | No |
| u | 4 | Other | Prohibit Use of Outdoor Misters | No |

**Table 2a: Outdoor Water Use Schedule**

| Stage | Summer (April 1 – October 31) | Summer Outdoor Water Use days | Winter (November 1 – March 31) | Winter Outdoor Water Use days | Outdoor Water Use Times |
|---|---|---|---|---|---|
| 1 | 3 days/week recommended | Even addresses: Wednesday, Friday, Sunday<br><br>Odd addresses: Tuesday, Thursday, Saturday | 1 day/week recommended | Even addresses: Sunday<br><br>Odd addresses: Saturday | Outdoor Water Use allowed 12:00 AM – 9:59 AM & 6:00 PM – 11:59 PM<br><br>Outdoor Water Use is prohibited all days 10:00 AM – 6:00 PM |
| 2 | 3 days/week | Even addresses: Wednesday, Friday, Sunday<br><br>Odd addresses: Tuesday, Thursday, Saturday | 1 day/week | Even addresses: Sunday<br><br>Odd addresses: Saturday | |
| 3 | 2 days/week | Even: Wednesday and Sunday<br><br>Odd: Tuesday and Saturday | 1 day/week | Even addresses: Sunday<br><br>Odd addresses: Saturday | |
| 4 | 1 day/week | Even addresses: Sunday<br><br>Odd addresses: Saturday | No outdoor water use | | |

**Table 3: Penalties for Incidents of Water Waste**

| Incident Month | Incident Fine | Enforcement Schedule |
|---|---|---|
| 1 | $0 | The first month an incident of water waste is recorded during the calendar year, the City shall issue a Notice of Water Waste to the customer for the incident observed by City staff or as recorded directly by the City's water meter reading system. |
| 2 | $25 | The second month an incident of water waste is recorded is recorded for a customer during the calendar year, the City shall assess a fine of $25 to the customer, and the fine shall be applied to the customer's monthly utility bill. |
| 3 | $50 | The third month an incident of water waste is recorded for a customer during the calendar year, the City shall assess a fine of $50 to the customer, and the fine shall be applied to the customer's monthly utility bill. |
| 4 | $100 | The fourth month an incident of water waste is recorded for a customer during the calendar year, the City shall assess a fine of $100 to the customer, and the fine shall be applied to the customer's monthly utility bill. |
| 5 -12 | $100 | For the fifth month an incident of water waste is recorded during the calendar year, and every month thereafter for the remainder of the calendar year during which an incident of water waste is recorded, the City shall assess a fine of $100 to the customer, and the fine shall be applied to the customer's monthly utility bill. |
| After 6 | N/A | If a customer has more than six consecutive months of documented water waste incidents, the water service to the customer may be restricted or terminated unless in the opinion of the Director such restriction or termination would result in an unreasonable risk to the health and safety of persons. If water service is terminated for excessive violations of the water waste provisions as defined herein, the water service may only be restored upon execution of an agreement with the customer to adhere to the conditions of service described in this section. |

*April 12, 2019*

Council Adoption: 4/11/19
Mayor Approval:
Mayor Veto:
Override Request:

TO: MAYOR LEE BRAND

FROM: YVONNE SPENCE, MMC
City Clerk

SUBJECT: TRANSMITTAL OF COUNCIL ACTION FOR APPROVAL OR VETO

At the City Council meeting of 4/11/19, Council adopted the attached Resolution No. 2019-073, entitled **Amending the City of Fresno Water Shortage Contingency Plan.** Item No. 3-B (3), File ID19-1472, by the following vote:

| | | |
|---|---|---|
| Ayes | : | Arias, Bredefeld, Caprioglio, Chavez, Esparza, Soria |
| Noes | : | None |
| Absent | : | None |
| Abstain | : | None |

Please indicate either your formal approval or veto by completing the following sections and executing and dating your action. Please file the completed memo with the Clerk's office on or before April 22, 2019. In computing the ten day period required by Charter, the first day has been excluded and the tenth day has been included unless the 10th day is a Saturday, Sunday, or holiday, in which case it has also been excluded. Failure to file this memo with the Clerk's office within the required time limit shall constitute approval of the ordinance, resolution or action, and it shall take effect without the Mayor's signed approval

**********

Thank you.

**APPROVED/NO RETURN:** _____

**VETOED** for the following reasons: (Written objections are required by Charter; attach additional sheets if necessary.)

_____

_____

_____ Date: 4-16-19
Lee Brand, Mayor

**COUNCIL OVERRIDE ACTION:** Date: _____

Ayes :
Noes :
Absent :
Abstain :

RECEIVED
2019 APR 17 P 1:57
CITY OF FRESNO
CITY CLERK'S OFFICE

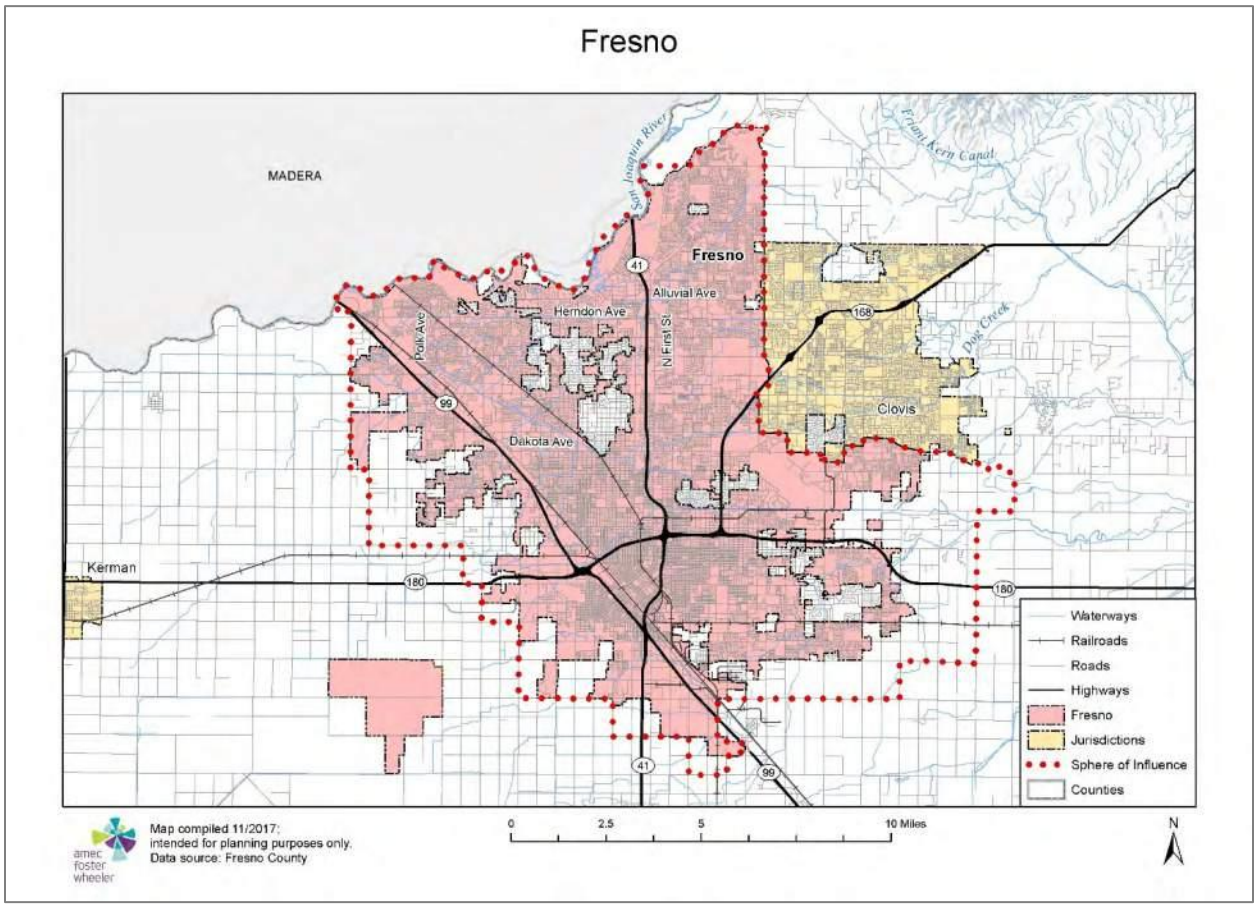
# Attachment 4
# Fresno County Multi-Jurisdictional Hazard Mitigation Plan, Annex E: City of Fresno

Reference the complete Fresno County Multi-Jurisdictional Hazard Mitigation Plan online:
https://www.fresno.gov/darm/wp-content/uploads/sites/10/2020/12/FresnoCountyHMPFinal.pdf

## E.1 Community Profile

Figure E.1 displays a map and the location within Fresno County of the City of Fresno and its Sphere of Influence.

**Figure E.1: The City of Fresno**




### E.1.1 Geography and Climate

The City of Fresno and its Sphere of Influence encompass a 100,400-acre area in central Fresno County. Over the past decade, the City has expanded into the northern, northwestern, and eastern reaches of its Sphere of Influence. Except for the deep channel of the San Joaquin River at the northern boundary of the City, Fresno's topography is generally level and slopes gently to the southwest. The upper San Joaquin River lies at the City's northerly boundary and has carved a deep channel, confining the river between steep bluffs that range from 20 to approximately 100 feet in height.

Fresno has a Mediterranean climate, averaging over 262 sunny days per year and little or no measurable precipitation from June through September. Annual rainfall typically totals 12-14 inches in episodic events lasting up to a few days at most. Fresno's prevailing winds are typically light and from the northwest.

Storms with strong weather disturbances (lightning and very agitated winds) may occur from autumn months through the spring, with the strength of the storm dependent upon temperature gradients between moving weather fronts.

Winter mornings in December and January approach freezing but only rarely reach as low as, or below, 32ºF; winter daytime high temperatures almost always approach or exceed 40ºF. Snowfall is an extremely rare and transient phenomenon; the last recorded snowfall in Fresno was ½ inch on December 20, 1998. The Tule fog, a thick ground fog that settles in the San Joaquin Valley from late fall through early spring, is the leading cause of weather-related accidents in California. In addition to causing visibility issues, "black ice" from precipitated fog may temporarily affect some roadways and bridges during the winter.

Summer daytime peak temperatures are high in Fresno. Some heat waves last over a week with daytime highs well over 100ºF and issuance of health advisories. Summer evenings provide for some cooling of 10-15ºF with the early morning daybreak hours cooling by 20-30ºF, depending on humidity (low humidity allows for more radiant cooling).

Geography and climate combine to create a general accumulation of air pollutants in the San Joaquin Valley (and in the City of Fresno) that occasionally result in unhealthy air quality conditions. Air quality problems are exacerbated by dust storms, human activities (e.g., vehicle emissions and fireplace and wood stove use), atmospheric photochemical processes, and forest fires from local and regional fires. The City has chronically failed to attain some of the national and state ambient air quality standards, but due to the efforts of the California Air Resources Board and the regional San Joaquin Valley Unified Air Pollution Control District, progress toward attainment of ozone (oxidant) and particulate matter standards is being made. Carbon monoxide standards were deemed to have been attained in the 1990s.

## E.1.2 History

Development of what today is the City of Fresno began in 1871, when the Central Pacific Railroad chose the Fresno Station for its San Joaquin Valley rail line. The City soon became the County seat and the shipping and distribution hub for the region's agricultural industry. An economic boom across California in the 1880s helped transform Fresno from a village to a city, and helped drive its incorporation in 1885. Today, the City of Fresno is the center of trade, commerce, finance, and transportation for the San Joaquin Valley.

## E.1.3 Economy

The most comprehensive economic data available for the City of Fresno comes from the U.S. Census Bureau by way of the American Community Survey (ACS). Select estimates of economic characteristics for the City of Fresno are shown in Table E.1.

**Table E.1: City of Fresno's Economic Characteristics, 2015**

| Characteristic | City of Fresno |
|---|---|
| Families below Poverty Level | 24.4% |
| All People below Poverty Level | 29.8% |
| Median Family Income | $45,806 |
| Median Household Income | $41,531 |
| Per Capita Income | $19,465 |
| Population in Labor Force | 231,332 |
| Population Employed* | 198,113 |
| Unemployment | 14.3% |

Source: U.S. Census Bureau American Community Survey 2011-2015 5-Year Estimates, www.census.gov/
*Excludes armed forces

Tables E.2 and E.3 show how the City of Fresno's labor force breaks down by occupation and industry based on 5-year estimates from the 2015 American Community Survey.

**Table E.2: City of Fresno's Employment by Occupation, 2015**

| Occupation | # Employed | % Employed |
|---|---|---|
| Management, Business, Science and Arts Occupations | 57,374 | 29.0 |
| *Management, Business, and Financial Occupations* | *(20,767)* | *(10.5)* |
| *Computer, Engineering, and Science Occupations* | *(6,018)* | *(3.0)* |
| *Education, Legal, Community Service, Arts, and Media Occupations* | *(20,262)* | *(10.2)* |
| *Healthcare Practitioner and Technical Occupations* | *(10,327)* | *(5.2)* |
| Sales and Office Occupations | 49,752 | 25.1 |
| Service Occupations | 41,528 | 21.0 |
| Production, Transportation, and Material Moving Occupations | 26,738 | 13.5 |
| Natural Resources, Construction, and Maintenance Occupations | 22,721 | 11.5 |
| **Total** | **198,113** | **100.00** |

Source: U.S. Census Bureau American Community Survey 2011-2015 5-Year Estimates, www.census.gov/

**Table E.3: City of Fresno's Employment by Industry, 2015**

| Industry | # Employed | % Employed |
|---|---|---|
| Educational Services, and Health Care, and Social Assistance | 48,557 | 24.5 |
| Retail Trade | 23,337 | 11.8 |
| Arts, Entertainment, and Recreation, and Accommodation, and Food Services | 20,643 | 10.4 |
| Professional, Scientific, and Management, and Administrative and Waste Management Services | 16,742 | 8.5 |
| Manufacturing | 14,869 | 7.5 |

| Industry | # Employed | % Employed |
|---|---|---|
| Public Administration | 12,030 | 6.1 |
| Finance and Insurance, and Real Estate and Rental and Leasing | 10,875 | 5.5 |
| Other Services, Except Public Administration | 10,710 | 5.4 |
| Construction | 10,586 | 5.3 |
| Agriculture, Forestry, Fishing and Hunting, and Mining | 10,446 | 5.3 |
| Transportation and Warehousing, and Utilities | 9,476 | 4.8 |
| Wholesale Trade | 7,158 | 3.6 |
| Information | 2,684 | 1.4 |
| **Total** | **198,113** | **100.00** |

Source: U.S. Census Bureau American Community Survey 2011-2015 5-Year Estimates, www.census.gov/

With the depressed real estate and construction market and economic recession toward the end of the 2000-2010 decade, unemployment rates increased to a peak of 18.0 percent in 2010. Since then, the unemployment rate has steadily decreased. The most recent annual data from the State of California Employment Development Department indicates that in 2016 there were 238,400 people in the City of Fresno labor force. Of these, 214,000 were employed; 24,400 were not. The unemployment rate was 10.2 percent.

## E.1.4 Population

According to the California Department of Finance, Fresno's population was estimated to be 520,778 in 2016. Select demographic and social characteristics for the City from the U.S. Census Bureau's 2015 American Community Survey 5-year estimates are shown in Table E.4.

**Table E.4: City of Fresno's Demographic and Social Characteristics, 2015***

| Characteristic | City of Fresno |
|---|---|
| **Gender/Age** | |
| Male | 49.2% |
| Female | 50.8% |
| Median age | 30.0 |
| Under 5 years | 8.9% |
| Under 18 years | 29.5% |
| 65 years and over | 9.9% |
| **Race/Ethnicity**** | |
| White | 52.2% |
| Asian | 13.0% |
| Black or African American | 7.9% |
| American Indian/Alaska Native | 1.1% |
| Hispanic or Latino (of any race) | 48.5% |
| **Education** | |
| High school graduate or higher | 75.2% |
| **Disability Status** | |
| Population 5 years and over | 11.75% |

Source: U.S. Census Bureau American Community Survey 2011-2015 5-Year Estimates, www.census.gov/
*Based on a 2015 estimated population of 510,451
**Of the 95.4% reporting one race

For information about how some of these demographics affect social vulnerability and how they compare to other Fresno County jurisdictions, California, and the United States, see "Social Vulnerability" in Section 4.3.1 Fresno County Vulnerability and Assets at Risk of the main plan. A more in-depth look at the population of the City of Fresno, including the City's special needs populations, is available in the City of Fresno General Plan 2015-2023 Housing Element commissioned by the City of Fresno Development and Resource Management Department and prepared by MIG, Inc (available at www.fresno.gov/housingelement).

## E.2 Hazard Identification and Summary

The City of Fresno's planning team identified the hazards that affect the City and summarized their frequency of occurrence, spatial extent, potential magnitude, and significance specific to Fresno (see Table E.5). In the context of the plan's planning area, there are no hazards unique to Fresno.

**Table E.5: City of Fresno—Hazard Summaries**

| Hazard | Geographic Extent | Probability of Future Occurrences | Magnitude/ Severity | Significance |
|---|---|---|---|---|
| Agricultural Hazards | Limited | Highly Likely | Critical | Low |
| Avalanche | N/A | N/A | N/A | N/A |
| Dam Failure | Significant | Unlikely | Limited | Medium |
| Drought | Significant | Likely | Critical | High |
| Earthquake | Extensive | Occasional | Critical | Medium |
| Flood/Levee Failure | Significant | Occasional | Critical | High |
| Hazardous Materials Incident | Significant | Likely | Critical | High |
| Human Health Hazards: | | | | |
| Epidemic/Pandemic | Extensive | Occasional | Critical | Medium |
| West Nile Virus | Limited | Highly Likely | Negligible | Low |
| Landslide | Limited | Unlikely | Negligible | Low |
| Severe Weather | | | | |
| Extreme Cold/Freeze | Significant | Occasional | Negligible | Low |
| Extreme Heat | Extensive | Highly Likely | Limited | Medium |
| Fog | Extensive | Likely | Limited | Medium |
| Heavy Rain/Thunderstorm/ Hail/Lightning | Extensive | Highly Likely | Limited | Low |
| Tornado | Extensive | Occasional | Negligible | Low |
| Windstorm | Extensive | Likely | Limited | Medium |
| Winter Storm | Extensive | Highly Likely | Negligible | Low |
| Soil Hazards: | | | | |
| Erosion | No Data | Likely | No Data | Low |
| Expansive Soils | No Data | Occasional | No Data | Low |
| Land Subsidence | Limited | Occasional | No Data | Low |
| Volcano | Extensive | Unlikely | Negligible | Low |
| Wildfire | Extensive | Highly Likely | Critical | Medium |

**Geographic Extent**
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

**Magnitude/Severity**
Catastrophic—More than 50 percent of property severely damaged; shutdown of facilities for more than 30 days; and/or multiple deaths

| | |
|---|---|
| **Probability of Future Occurrences**<br>Highly Likely: Near 100% chance of occurrence in next year, or happens every year.<br>Likely: Between 10 and 100% chance of occurrence in next year, or has a recurrence interval of 10 years or less.<br>Occasional: Between 1 and 10% chance of occurrence in the next year, or has a recurrence interval of 11 to 100 years.<br>Unlikely: Less than 1% chance of occurrence in next 100 years, or has a recurrence interval of greater than every 100 years. | Critical—25-50 percent of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries and/or illnesses result in permanent disability<br>Limited—10-25 percent of property severely damaged; shutdown of facilities for more than a week; and/or injuries/illnesses treatable do not result in permanent disability<br>Negligible—Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid<br><br>**Significance**<br>Low: minimal potential impact<br>Medium: moderate potential impact<br>High: widespread potential impact |

# E.3 Vulnerability Assessment

The intent of this section is to assess the City of Fresno's vulnerability separate from that of the planning area as a whole, which has already been assessed in Section 4.3 Vulnerability Assessment in the main plan. This vulnerability assessment analyzes the population, property, and other assets at risk to hazards ranked of medium or high significance that may vary from other parts of the planning area.

The information to support the hazard identification and risk assessment for this Annex was collected through a Data Collection Guide, which was distributed to each participating municipality or special district to complete during the original outreach process in 2009. Information collected was analyzed and summarized in order to identify and rank all the hazards that could impact anywhere within the County, as well as to rank the hazards and identify related vulnerabilities unique to each jurisdiction. In addition, the City of Fresno's HMPC team members were asked to validate the matrix that was originally scored in 2009 based on the experience and perspective of each planning team member relative to the City of Fresno.

Each participating jurisdiction was in support of the main hazard summary identified in the base plan (See Table 4.1). However, the hazard summary rankings for each jurisdictional annex may vary slightly due to specific hazard risk and vulnerabilities unique to that jurisdiction (See Table E.5). Identifying these differences helps the reader to differentiate the jurisdiction's risk and vulnerabilities from that of the overall County.

Note: The hazard "Significance" reflects overall ranking for each hazard, and is based on the City of Fresno's HMPC member input from the Data Collection Guide and the risk assessment developed during the planning process (see Chapter 4 of the base plan), which included a more detailed qualitative analysis with best available data.

The hazard summaries in Table E.5 reflect the hazards that could potentially affect the City. Those of Medium or High significance for the City of Fresno are identified below. The discussion of vulnerability for each of the following hazards is located in Section E.3.2 Estimating Potential

Losses. Based on this analysis, the priority hazards (High Significance) for mitigation include drought, flood/levee failure, and hazardous materials incidents.

- dam failure
- drought
- earthquake
- epidemic/pandemic
- extreme heat
- flood/levee failure
- fog
- hazardous materials incidents
- wildfire
- windstorm

## Other Hazards

Hazards assigned a Significance rating of Low and which do not differ significantly from the County ranking (e.g., Low vs. High) are not addressed further in this plan, and are not assessed individually for specific vulnerabilities in this section. In the City of Fresno, those hazards ranked Low are as follows:

- agricultural hazards*
- human health hazards: West Nile Virus
- landslide
- severe weather: heavy rain/thunderstorm/hail/lightning, tornado
- soil hazards
- volcano
- extreme cold
- winter storm

**Note on Agricultural Hazards*:** Agricultural hazards are ranked Low in the City of Fresno than for the County overall (ranked High) because very little land in the City is used for agricultural purposes.

Additionally, the City's Committee members decided to rate several hazards as Not Applicable (N/A) to the planning area due to a lack of exposure, vulnerability, and no probability of occurrence. **Avalanche** is considered Not Applicable (N/A) to the City of Fresno.

## E.3.1 Assets at Risk

This section considers Fresno's assets at risk, including values at risk; critical facilities and infrastructure; historic, cultural, and natural resources; economic assets; and growth and development trends.

### Values at Risk

The following data on property exposure is derived from the Fresno County 2017 Parcel and Assessor data. This data should only be used as a guideline to overall values in the City as the

information has some limitations. The most significant limitation is created by Proposition 13. Instead of adjusting property values annually, the values are not adjusted or assessed at fair market value until a property transfer occurs. As a result, overall value information is likely low and does not reflect current market value of properties. It is also important to note that in the event of a disaster it is generally the value of the infrastructure or improvements to the land that is of concern or at risk. Generally, the land itself is not a loss. Table E.6 shows the 2017 values at risk broken down by property type for the City of Fresno.

**Table E.6: 2017 Property Exposure for the City of Fresno by Property Type**

| Property Type | Parcel Count | Building Count | Improved Value | Content Value | Total Value |
|---|---|---|---|---|---|
| Agricultural | 76 | 53 | $2,887,304 | $2,887,304 | $5,774,608 |
| Commercial | 6,110 | 24,004 | $5,471,778,084 | $5,471,778,084 | $10,943,556,168 |
| Exempt | 1,012 | 3,881 | $0 | $0 | $0 |
| Industrial | 2,575 | 5,630 | $1,420,216,900 | $2,130,325,350 | $3,550,542,250 |
| Multi-Residential | 5,793 | 52,504 | $2,416,885,833 | $1,208,442,917 | $3,625,328,750 |
| Open Space | 1 | 1 | $150,882 | $150,882 | $301,764 |
| Residential | 113,468 | 117,771 | $15,122,142,902 | $7,561,071,451 | $22,683,214,353 |
| Unknown | 2 | 2 | $530,082 | $530,082 | $1,060,164 |
| **Total** | **129,037** | **203,846** | **$24,434,591,987** | **$16,375,186,070** | **$40,809,778,057** |

Source: Fresno County 2017 Parcel and Assessor data

Since the 2009 Plan, the City of Fresno has experienced notable increases in agricultural, commercial, and residential properties and property values at risk. Compared to improved values from the Fresno County Assessor's Office's 2007 Certified Roll Values, agricultural improved value has increased by 254.2 percent, commercial improved value has increased by 299.8 percent and total residential improved value has increased by 265.8 percent. Part of this dramatic increase in exposure of commercial and residential properties can be attributed to annexations of previously unincorporated County land that have occurred within the last decade.

## Critical Facilities and Infrastructure

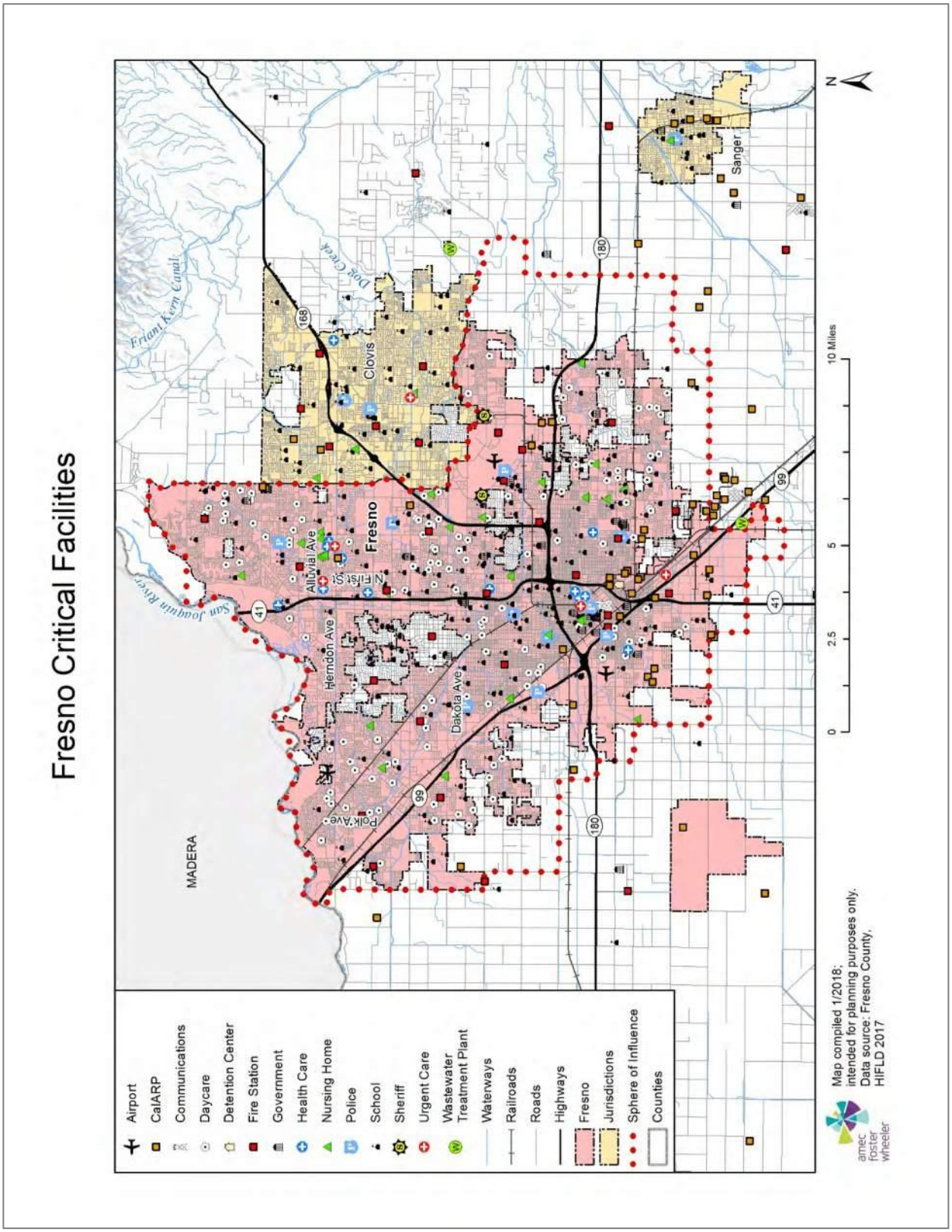
A critical facility may be defined as one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. An inventory of critical facilities in the City of Fresno from Fresno County GIS is provided in Table E.7 and mapped in Figure E.2.

## Table E.7: City of Fresno's Critical Facilities

| Critical Facility Type | Number |
|---|---|
| Airport | 3 |
| Behavioral Health | 4 |
| CalARP | 28 |
| Colleges & Universities | 14 |
| Communications | 1 |
| County Government | 4 |
| Courthouse | 1 |
| Daycare | 155 |
| Department of Agriculture | 2 |
| Department of Public Health | 4 |
| Department of Public Works | 1 |
| Department of Social Services | 9 |
| Detention Center | 4 |
| District Attorney | 2 |
| Fire Station | 21 |
| General Services | 3 |
| Health Care | 12 |
| Nursing Home | 27 |
| Police | 10 |
| School | 183 |
| Sheriff | 3 |
| Supplemental College | 4 |
| Urgent Care | 4 |
| **Total** | **499** |

Source: Fresno County, HIFLD 2017

## Figure E.2: City of Fresno's Critical Facilities



The list of specific critical facilities and community assets is maintained by the City of Fresno Police Department. The Fresno Urban Area Critical Infrastructure List is considered confidential and may be accessed through the Fresno Police Department Homeland Security Division.

## Historic, Cultural, and Natural Resources

### *Historic and Cultural Sites*

The Cultural Resource Facility located on the California State University, Bakersfield campus maintains a database, maps, and descriptive surveys of prehistoric sites in the Fresno area. Details of the locations are kept confidential due to the risk of theft or vandalism of artifacts. The general location of these sites is along the San Joaquin River and its bluffs, where permanent Native American settlements were established near a permanent water supply and seasonal salmon fishery.

The City of Fresno maintains a local official register of historic resources (available from the historic preservation officer in the City's Planning and Development Department). There are approximately 284 properties on the register. Twenty-one of the properties were demolished or destroyed by fire after being placed on the list, and three other properties have been relocated to sites outside the City of Fresno. The local register includes 31 properties that are on the National Register of Historic Places (see Table E.8).

**Table E.8: City of Fresno's Properties on the National Register of Historic Places**

| Property Name | Address | Date Listed |
|---|---|---|
| Azteca Theater | 836-840 F Street | 4/21/2017 |
| Bank of Italy | 1015 Fulton Mall | 10/29/1982 |
| Brix, H. H., Mansion | 2844 Fresno Street | 9/15/1983 |
| Einstein House | 1600 M Street | 1/31/1978 |
| Forestiere Underground Gardens | 5021 W. Shaw Avenue | 10/28/1977 |
| Fresno Bee Building | 1555 Van Ness Avenue | 11/1/1982 |
| Fresno Brewing Company Office and Warehouse | 100 M Street | 1/5/1984 |
| Fresno County Hall of Records | 2281 Tulare Street | 12/22/2011 |
| Fresno Memorial Auditorium | 2425 Fresno Street | 5/10/1994 |
| Fresno Republican Printery Building | 2130 Kern Street | 1/2/1979 |
| Fresno Sanitary Landfill | West and Jensen Avenues | 8/7/2001 |
| Holy Trinity Armenian Apostolic Church | 2226 Ventura Street | 7/31/1986 |
| Hotel Californian | 851 Van Ness Avenue | 4/21/2004 |
| Kearney, M. Theo, Park and Mansion | 7160 Kearney Boulevard | 3/13/1975 |
| Kindler, Paul, House | 1520 E. Olive Avenue | 10/29/1982 |
| Maulbridge Apartments | 2344 Tulare Street | 5/6/1982 |
| Meux House | 1007 R Street | 1/13/1975 |
| Old Administration Building, Fresno City College | 1101 University Avenue | 5/1/1974 |
| Old Fresno Water Tower | 2444 Fresno Street | 10/14/1971 |
| Pantages, Alexander, Theater | 1400 Fulton Street | 2/23/1978 |
| Physicians Building | 2607 Fresno Street | 11/20/1978 |

| Property Name | Address | Date Listed |
|---|---|---|
| Rehorn House | 1050 S Street | 1/8/1982 |
| Romain, Frank, House | 2055 San Joaquin Street | 1/11/1982 |
| San Joaquin Light & Power Corporation Building | 1401 Fulton Street | 1/3/2006 |
| Santa Fe Hotel | 935 Santa Fe Avenue | 3/14/1991 |
| Santa Fe Passenger Depot | 2650 Tulare Street | 11/7/1976 |
| Southern Pacific Passenger Depot | 1033 H Street | 3/21/1978 |
| Tower Theatre | 1201 N. Wishon Avenue | 9/24/1992 |
| Twining Laboratories | 2527 Fresno Street | 3/26/1991 |
| Warehouse Row | 722, 744, and 764 P Street | 3/24/1978 |
| YWCA Building | 1660 M Street | 9/21/1978 |

Source: National Register of Historic Places, www.nps.gov/nr/

Other historic resources in the City of Fresno include the following historic districts:

- The Porter Tract Historic District (45 homes)
- The Chandler Field/Fresno Municipal Airport Historic District (four historic structures)
- The Wilson Island Historic District (78 homes)
- The Huntington Boulevard Historic Districts (81 homes)

As comprehensive as the City's register may be, it does not include all properties in the City with potential historic or cultural significance. The list is continually being expanded as sites are discovered through routine analysis of proposed development areas and through proposed new listings of historic districts. The pool of potentially historic properties also changes through time, since federal law provides for a 50-year retrospective review, which now encompasses the post-World War II building boom era. Ten properties that were recommended for the City's register but were denied inclusion by the Fresno City Council are still recognized for their historic/cultural significance (heritage properties), which is taken into account when any actions are undertaken on them pursuant to provisions of the California Environmental Quality Act. (Three of these properties have been since been demolished.)

While a detailed assessment of seismic and flood risks for the listed properties in Fresno is currently beyond the available staff resources of the City's Historic Preservation Office, it can be generally assumed that most of the structures have not been seismically reinforced and that their masonry is vulnerable to strong ground shaking.

While many of the structures are in Fresno's old downtown and were built when this area was largely within the 100-year floodplain of the Fresno Stream Group, efforts by the Fresno Metropolitan Flood Control District in conjunction with the U.S. Army Corps of Engineers and the City of Fresno have provided for flood detention structures and ponding basins that have greatly reduced the size and extent of the floodplain in the downtown, helping to preserve these historic resources.

### *Natural Resource Areas*

#### San Joaquin River Corridor

While the City maintains many community and neighborhood parks, its natural resources are primarily along the San Joaquin River. Owing to the year-round presence of water, the river bottom and bluffs host the richest aquatic and riparian forest biota in the City. It is in this area where migratory waterfowl and federally and state-listed endangered wildlife are most likely be encountered. These species include the valley elderberry longhorn beetle, the giant garter snake, and the American bald eagle (recently recommended for delisting from the National Endangered Species list).

Over past decades, land in the river corridor has been purchased and aggregated by state agencies (Department of Fish and Game, San Joaquin River Conservancy), by nonprofit groups (San Joaquin River Parkway Trust, Fresno Sportsmen's Club), and by the City and County (the City's Woodward Park and Milburn Unit, the County's Lost Lake Park). The ultimate goal of the San Joaquin River Conservancy Plan is to fashion a regional parkway with continuity of wildlife corridors and to manage it for joint recreational, habitat conservation, and floodplain protection uses.

Due to its location, this natural resource area is flood-prone. In some areas, this risk has been increased due to removal of massive amounts of sand and gravel (from mining), which lowered the ground surface over past decades. While the native riparian plants and animals have largely evolved with coping mechanisms for periodic severe flooding, any developed recreation facilities would be at risk. The face of the bluff is also very vulnerable to wildfire because of its vegetative overgrowth and nearly vertical slopes. Fire prevention efforts are difficult here because the soils are too unstable for vegetative removal projects or for irrigation that would keep the plants well-watered.

#### Vernal Pool Areas

In the northerly parts of the City, outside the river corridor, certain clay soils have the capacity to form impermeable hardpans and layers that do not allow rapid percolation of rainwater. During the rainy season, shallow vernal pools form that are populated by a host of specialized plants and animals. Many species associated with vernal pools are federally and state-listed species (e.g., the California tiger salamander, various types of fairy shrimp crustaceans, orcutt grass, button celery species, meadowfoam, and owl clover). Vernal pools are also heavily utilized by nonlisted species, such as migratory waterfowl, rodents, furbearing predators, and raptors that prey on other animals.

Wildfire is not considered a major risk to these natural communities, because they evolved with dry season fires as a common occurrence (the plants have very resistant seeds and the crustaceans and amphibians go into protected parts of their life cycles such as deep dormancy). Human encroachment through agriculture and land development is the greatest risk to vernal pool areas. If the clay layers are disrupted by "deep ripping" plowing, water cannot accumulate on the surface and the pools will not form. If the land is subjected to year-round irrigation, specially adapted

vernal pool species will be out-competed by other species. Conversion of land to urban development with structures, paving, lawns, pets, and people will destroy vernal pool natural communities.

## Economic Assets

The City of Fresno's economic sector includes both private and public entities that have been compiled into clusters in order to identify key economic assets. These ten clusters, known as the Regional Job Initiative (RJI) clusters, are Advanced Manufacturing, Clean Energy, Construction, Food Processing, Healthcare, Info Processing (Call Centers, Logistics, and Distribution), Software Development, Tourism, and Water Technology. Among these clusters are major employers like Saint Agnes, Pelco, Gottschalks, and Ruiz Foods that both boost Fresno's economic growth and provide employment opportunities.

If a disaster struck the City, it could have a severe impact on Fresno's economic assets. Sectors of greatest concern include all the RJI clusters, but in particular Food Processing, which includes the agricultural industry, and Healthcare.

## Growth and Development Trends

The City of Fresno is growing at a rapid pace. Its expansion from incorporation in 1885 to the present day (August 2017) is illustrated in Figure E.3. Even more growth is anticipated in the years to come, based on current trends.

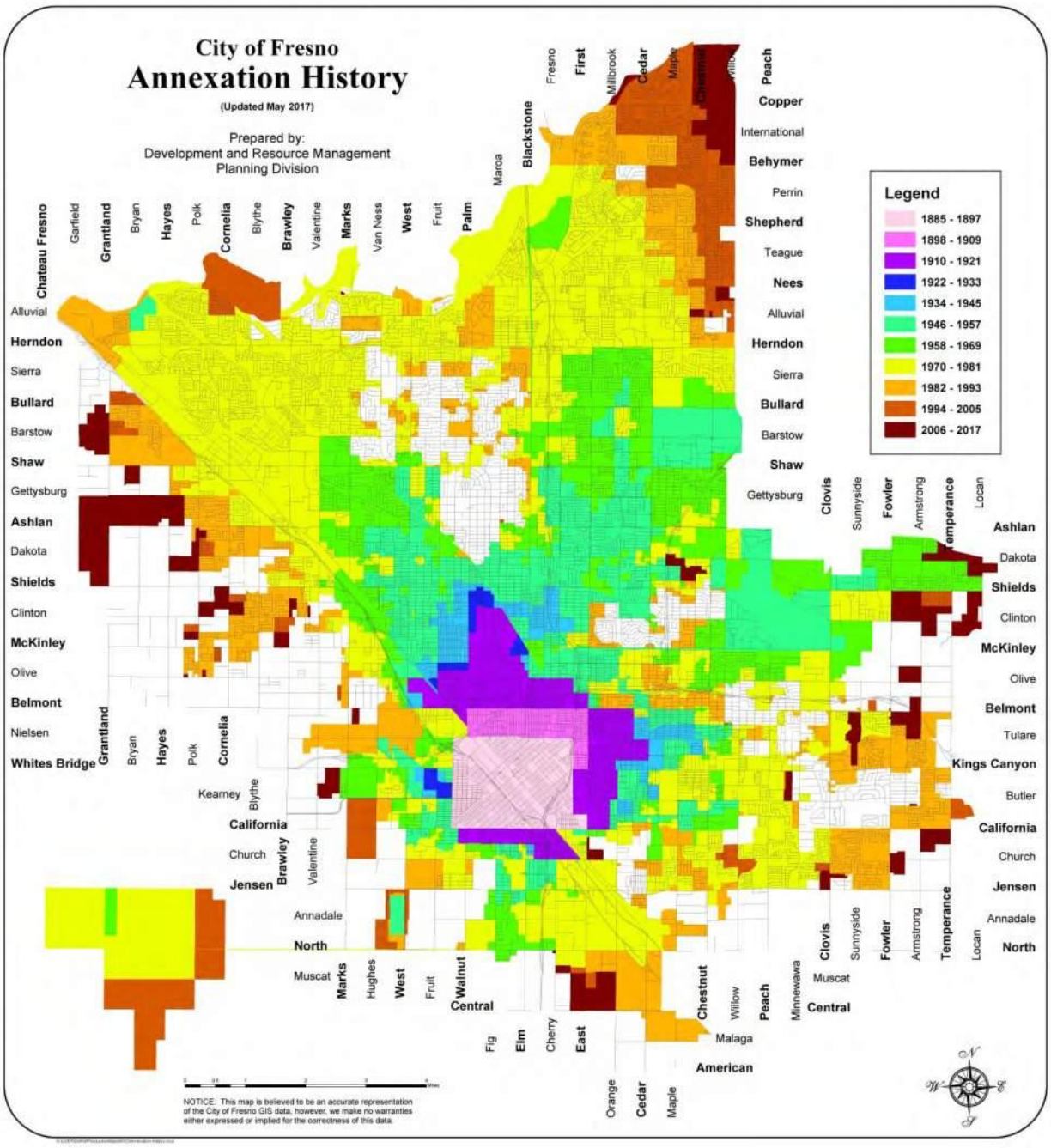
Table E.9 illustrates how the City has grown in terms of population and number of housing units between 2011 and 2017 alone.

**Table E.9: City of Fresno's Change in Population and Housing Units, 2011-2017**

| 2011 Population | 2017 Population Estimate | Estimated Percent Change 2011-2017 | 2011 # of Housing Units | 2017 Estimated # of Housing Units | Estimated Percent Change 2011-2017 |
|---|---|---|---|---|---|
| 498,664 | 525,832 | +5,49 | 172,171 | 178,819 | +3.86 |

Source: California Department of Finance, www.dof.ca.gov/Forecasting

## Figure E.3: City of Fresno's Annexation History




Source: City of Fresno Development Department. This map is believed to be an accurate representation of the City of Fresno GIS data, however, we make no warranties either expressed or implied for the correctness of this data.

By December 31, 2035 (the "Horizon" year of the most recent Fresno General Plan), it is estimated that 771,000 people will reside in the Fresno Metropolitan Area (which would include County islands and areas inside the City's Sphere of Influence but not yet annexed). This figure of 771,000 would be 64 percent of the projected 2035 Fresno County population of 1,201,416 (State of California Department of Finance population projections).

As of August of 2017, the City of Fresno comprised 115.3 square miles of annexed (incorporated) land within its 161.8-square mile Sphere of Influence. Development had reached the natural and political northerly boundary of the City, the San Joaquin River, and began expanding to the west and southeast through conversion of rural residential and agricultural land. Within the Sphere of Influence, there continued to be "County islands" and partially urbanized fringe areas. An urban unification annexation program may reduce the numbers and sizes of these enclaves in the coming decade.

The Fresno General Plan made a concerted effort to revitalize the City's downtown by balancing new growth areas to geographically recenter the downtown. With construction of a major sewer trunk along the Grantland Avenue alignment and proposed construction of new wastewater and water treatment plants in the southeastern area, the City's future growth is expected to concentrate primarily to the west and southeast.

The Fresno Metropolitan Flood Control District (FMFCD) has commenced major flood control facility construction on Fancher Creek in the eastern portion of the City's Sphere of Influence. Since the Fresno General Plan was completed in December 2014, the FMFCD will compile technical studies and update its master service plan in conjunction with the City's land use plan for this new growth area.

The Fresno General Plan also directed that new development be more compact and that single-family residential densities be higher than the City's traditional 4± dwelling units/acre pattern for subdivisions. The recently adopted Fulton Corridor Specific Plan and Downtown Neighborhoods Community Plan and other plan amendments and projects in process (and proposed in the future) feature smaller lots, multi-story housing, multi-family units, and reduced setbacks.

Unless the cost of manufactured housing units would provide a substantial savings over site-built homes, it is not expected that the proportion of manufactured housing in the City of Fresno will greatly increase. It is possible that there will be some increase as producers of these units create models with appropriate roof pitches and other features to meet the City's design review standards.

More information about the City of Fresno's growth and current housing stock is available in the City of Fresno General Plan 2015-2023 Housing Element commissioned by the City of Fresno Development and Resource Management Department and prepared by MIG, Inc (available at www.fresno.gov/housingelement). More general information on growth and development in Fresno County as a whole can be found in "Growth and Development Trends" in Section 4.3.1 Fresno County Vulnerability and Assets at Risk of the main plan.

## E.3.2 Estimating Potential Losses

Note: This section details vulnerability to specific hazards, where quantifiable, and/or where (through HMPC member input) it differs from that of the overall County.

Table E.6 above shows Fresno's exposure to hazards in terms of number and value of structures. Fresno County's parcel and assessor data was used to calculate the improved value of parcels. The most vulnerable structures are those in the floodplain (especially those that have been flooded in the past), unreinforced masonry buildings, and buildings built prior to the introduction of modern day building codes. No further information on vulnerable structures is available. Impacts of past events and vulnerability to specific hazards are further discussed below (see Section 4.1 Hazard Identification for more detailed information about these hazards and their impacts on Fresno County).

### Agricultural Hazards

Agricultural hazards are ranked with a Low significance in the City of Fresno; lower than for the County overall (ranked High) because very little land in the City is used for agricultural purposes. Agricultural losses due to hazard events have greater economic impact on the small communities and rural areas of the County than on the City of Fresno. However, ornamental and garden plants in the City, and pets and incidental livestock kept within City limits, may become involved in any countywide responses to crop pests or infectious agents, because these urban plants and animals provide reservoirs for the diseases and crop pests that threaten the County's agriculture.

### Dam Failure

The National Inventory of Dams lists five dams located in the City of Fresno, including the Redbank Creek Detention basin, Fancher Creek Detention, Friant Millerton Road Embankment A, Redbank, and Friant Dike 3.

### Drought

Annual rainfall in the City of Fresno is typically 12-14 inches. This makes the region vulnerable to episodic drought and to chronic drawdown of aquifer levels (the U.S. Environmental Protection Agency has designated the groundwater below Fresno as a sole source aquifer). Water in this aquifer has historically flowed through permeable strata from north and northeast toward the south and west, but the aquifer has been so affected by drawdown that a "cone of depression" has been created, reversing the historic flow directions (the "groundwater gradient") in portions of west and south Fresno.

In the last 10 years the City of Fresno has made strides to reduce dependence on groundwater by setting a course to implement water plans, which include the Urban Water Management Plan, Recycled Water Waster Plan, and the recently adopted Water Capital Program. A surface water treatment plant is currently under construction in Southeast Fresno and should be completed by 2018. When operational, the plant will maximize use of Fresno's surface water allocations during

normal years and allow the City to reduce overuse of groundwater. Recycled water use will also grow in Fresno with the new recycled water mains now being constructed. The City has plans to use 25,000 acre-feet per year of recycled water for irrigating open spaces, parks, street medians and golf courses.

## Earthquake

The seismic hazard in the City of Fresno is low relative to California coastal and mountain communities and is lower than in the Sierra and western areas of Fresno County. There are no known earthquake faults underlying Fresno, and the City has never been the epicenter of a known seismic event. However, Fresno is considered to have a moderate risk of earthquake damage due to the presence of major fault systems to the west, south, and east and due to Fresno's large population and number of buildings, critical facilities, and infrastructure and other development that could be vulnerable to more severe ground shaking.

Historically, Fresno has sustained very little damage from major earthquakes occurring on California's major faults: the Owens Valley earthquake of 1872 toppled an unreinforced masonry (brick) church steeple. More recent major earthquakes in the past four decades (with epicenters near Coalinga and the Bay Area) have resulted in perceptible tall building swaying in Fresno, minor injuries (attributable to shelved items falling), and slight damage (e.g., minor cracked plaster, etc.). To date, no soil liquefaction has been observed in Fresno from any seismic event.

The most serious impacts of an earthquake in Fresno would probably arise from damage to large dams in the Sierra Nevada on the upper reaches of the San Joaquin River very close to active Long Valley Caldera-related faults. Should either of the two most easterly (and largest) dams in this area be severely damaged or breached, the resulting sequential dam failures could cause floodwaters to overtop Friant Dam northeast of the City. While the dam failure inundation map for Friant shows that most of the flooded area would be expected in the northwest part of town (where the confining river bluffs are not as high), there are some residences and important infrastructure in the river channel itself that would be inundated and gravely damaged (or destroyed), including highway bridges and the inlet of the Friant-Kern Canal, which supplies Bureau of Reclamation surface water to the Fresno area and to other communities in the southern San Joaquin Valley.

## Epidemic/Pandemic

Fresno's population includes many residents who have limited access to health care, with causes related to low household income levels, lack of insurance coverage, a limited number of primary health care facilities and acute care beds, a low ratio of public health and medical professionals to population, and language barriers. Highly communicable diseases tend to affect a large percentage of the City, perhaps due to large household size and the mobility of the population. If a highly communicable disease outbreak occurred that caused serious or life-threatening illness for most infected persons, health care and other public service systems would experience disruption or breakdown and would require outside intervention with resources from other communities, the state, or the federal government.

## Extreme Cold/Freeze

Freeze events occur occasionally in Fresno, but impacts are greater to the agriculture industry in the County than to the City. In January 2007, overnight minimum temperatures fell below freezing between January 6 and 10. The event led to a presidential disaster declaration due to the estimated $710 million in agricultural damage in the Central and South Valley. The 2007 event occurred in another eight-year interval after the devastating citrus freezes of 1998 and 1990. The event caused frozen pipes in Fresno but little other property damage. The City also has a plan for freezing temperature events and opens warming centers. These centers are primarily geared toward the homeless population.

## Extreme Heat

Fresno uses a local version of the California State Plan for Extreme Heat. This plan was used during the extreme heat event during the summer of 2006 and worked well. The City operates cooling centers, which are primarily geared toward the homeless. Public notification for extreme heat events is conducted through the Public Affairs office in coordination with Fresno County.

## Expansive Soils

These types of soils occur in northern Fresno in the far northeastern portions of its Sphere of Influence (in the "Copper River" area). Expansive clay soils can cause cavitation over time and require special construction standards for foundations.

## Flood

As noted in the preceding section, there is some flood risk to the City from San Joaquin River major dam failure inundation, but the more common flood risk, repetitively experienced in Fresno, is that of shallow "sheet" flooding from major precipitation events. Except for the San Joaquin River, streams in the Fresno-Clovis Metropolitan Area originate in the Sierra foothills to the east and extend into the valley floor west of State Route 99 by way of dual-use irrigation and storm runoff channels and disperse into numerous smaller irrigation canals. Overflow from these canals and urban stormwater from intense precipitation events is sent back to the San Joaquin River or to farmland southwest of Fresno via spillway channels.

In the City of Fresno, these canals and channels are under control of the Fresno Irrigation District, an independent public agency, but their use during storm events is shared by another independent district, the Fresno Metropolitan Flood Control District (FMFCD). The FMFCD was created to develop flood control facilities to prevent further repetitive losses created by the Fresno Stream Group and to provide an urban drainage network. This District is responsible for administering a Storm Drainage and Flood Control Master Plan. The City's municipal code supports these efforts by including a Drainage Fee Ordinance to ensure that grading and development comply with the FMFCD's Master Plan and standards and provide proportionate shares of storm drain and ponding basin infrastructure.

The City of Fresno's Floodplain Ordinance further coordinates and supports FMFCD efforts. This ordinance and the Fresno General Plan Safety Element policies require conformance to FEMA floodplain management policies and to those of California's Central Valley Flood Prevention Board (which regulates the designated floodway along the San Joaquin River channel). Still, in areas not completely developed to urban standards, areas where the urban drainage network is not yet completed, and in some County "island" areas (land within the City that the County has authority over), stormwater drainage facilities may not prevent localized shallow flooding during intense runoff events.

According to FEMA's 2016 Flood Insurance Study (FIS), the following major canals and ditches run through the City:

- **Central Canal** flows southwest through the southeastern part of the City of Fresno.
- **Dry Creek Canal** begins at the confluence of Mill Ditch and Herndon Canal, just downstream of North Millbrook Avenue, and flows southwest through the southwestern portion of the City.
- **Fancher Creek Canal** flows southwest along the eastern corporate limits of the City of Fresno and joins Central Canal at the southeast corner of the City.
- **Herndon Canal** begins at the confluence of Mill Ditch and Dry Creek Canal. It flows west through the center of the City of Fresno, then flows northwest through the northwestern part of the City.
- **Mill Ditch** flows west along East McKinley Avenue to its confluence with Herndon and Dry Creek Canals.

The FIS details the City of Fresno's flood history as follows:

In February 1884, flood flows from streams of the Fresno-Clovis group inundated the business section of the City of Fresno. Frequent flooding was a problem in the City throughout the 1880. Suburban areas of the City were flooded in spring 1920; the downtown area was inundated in 1923; flooding occurred in the Fig Garden area in 1936; and parts of the City, especially in the northeast section, were flooded in March 1938. Since the 1938 flood, which had an estimated discharge of 2,700 cubic feet per second (cfs) on Dry Creek at the Big Dry Creek Dam site, high flows occurred on that stream in December 1955 (3,800 cfs), January 1969 (5,700 cfs), and February 1969 (4,500 cfs). During December 1955, approximately 500 acres of agricultural and suburban land were flooded by overflow from irrigation canals, and damage, mostly to public facilities, totaled approximately $50,000. The largest and most damaging flood period was January and February 1969, when the combined discharges of Dry, Dog, Redbank, Fancher, and Mud Creeks flooded an estimated 14,500 acres and caused almost $4.7 million in damage. Most of the flooding was in the eastern and northeastern parts of the City. It occurred because many of the streams in the Fresno-Clovis group discharged floodwater into various irrigation canals, causing them to overflow.

### *Values at Risk*

Following the methodology described in Section 4.3.2 Vulnerability of Fresno County to Specific Hazards, a flood map for the City of Fresno was created (see Figure E.4). Tables E.10 and E.11 summarize the values at risk in the City's 100-year and 500-year floodplain, respectively. These tables also detail loss estimates for each flood.

## Figure E.4: City of Fresno's 100- and 500-Year Floodplains

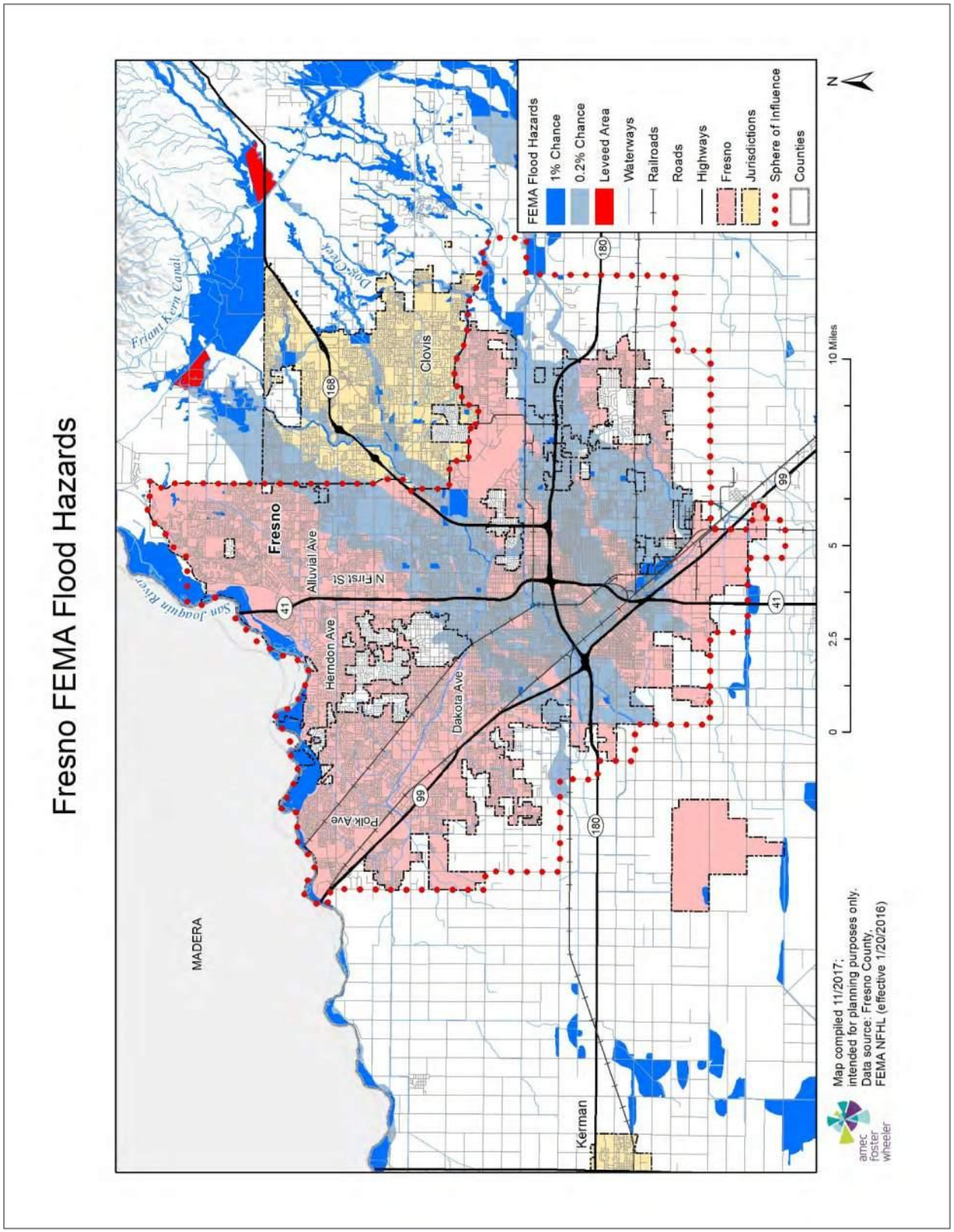


**Table E.10: City of Fresno's FEMA 1% Annual Chance Flood Hazard by Property Type**

| Property Type | Parcel Count | Building Count | Improved Value | Content Value | Total Value | Loss Estimate |
|---|---|---|---|---|---|---|
| Agricultural | 1 | 0 | $60,933 | $60,933 | $121,866 | $30,467 |
| Commercial | 23 | 210 | $6,222,246 | $6,222,246 | $12,444,492 | $3,111,123 |
| Exempt | 29 | 35 | $0 | $0 | $0 | $0 |
| Industrial | 70 | 107 | $30,681,072 | $46,021,608 | $76,702,680 | $19,175,670 |
| Multi-Residential | 11 | 84 | $2,529,983 | $1,264,992 | $3,794,975 | $948,744 |
| Residential | 97 | 120 | $23,269,875 | $11,634,938 | $34,904,813 | $8,726,203 |
| **Total** | **231** | **556** | **$62,764,109** | **$65,204,716** | **$127,968,825** | **$31,992,206** |

Sources: Fresno County 2017 Parcel and Assessor data; FEMA 2009 FIRM

**Table E.11: City of Fresno's FEMA 0.2% Annual Chance Flood Hazard by Property Type**

| Property Type | Parcel Count | Building Count | Improved Value | Content Value | Total Value | Loss Estimate |
|---|---|---|---|---|---|---|
| Agricultural | 29 | 29 | $746,974 | $746,974 | $1,493,948 | $373,487 |
| Commercial | 2,814 | 9,030 | $1,574,492,657 | $1,574,492,657 | $3,148,985,314 | $787,246,329 |
| Exempt | 381 | 1,404 | $0 | $0 | $0 | $0 |
| Industrial | 745 | 1,435 | $309,126,790 | $463,690,185 | $772,816,975 | $193,204,244 |
| Multi-Residential | 2,299 | 20,013 | $797,001,401 | $398,500,701 | $1,195,502,102 | $298,875,525 |
| Residential | 31,581 | 32,817 | $2,677,387,750 | $2,677,387,750 | $5,354,775,500 | $1,338,693,875 |
| **Total** | **37,849** | **64,728** | **$5,358,755,572** | **$5,114,818,267** | **$10,473,573,839** | **$2,618,393,460** |

Sources: Fresno County 2017 Parcel and Assessor data; FEMA 2009 FIRM

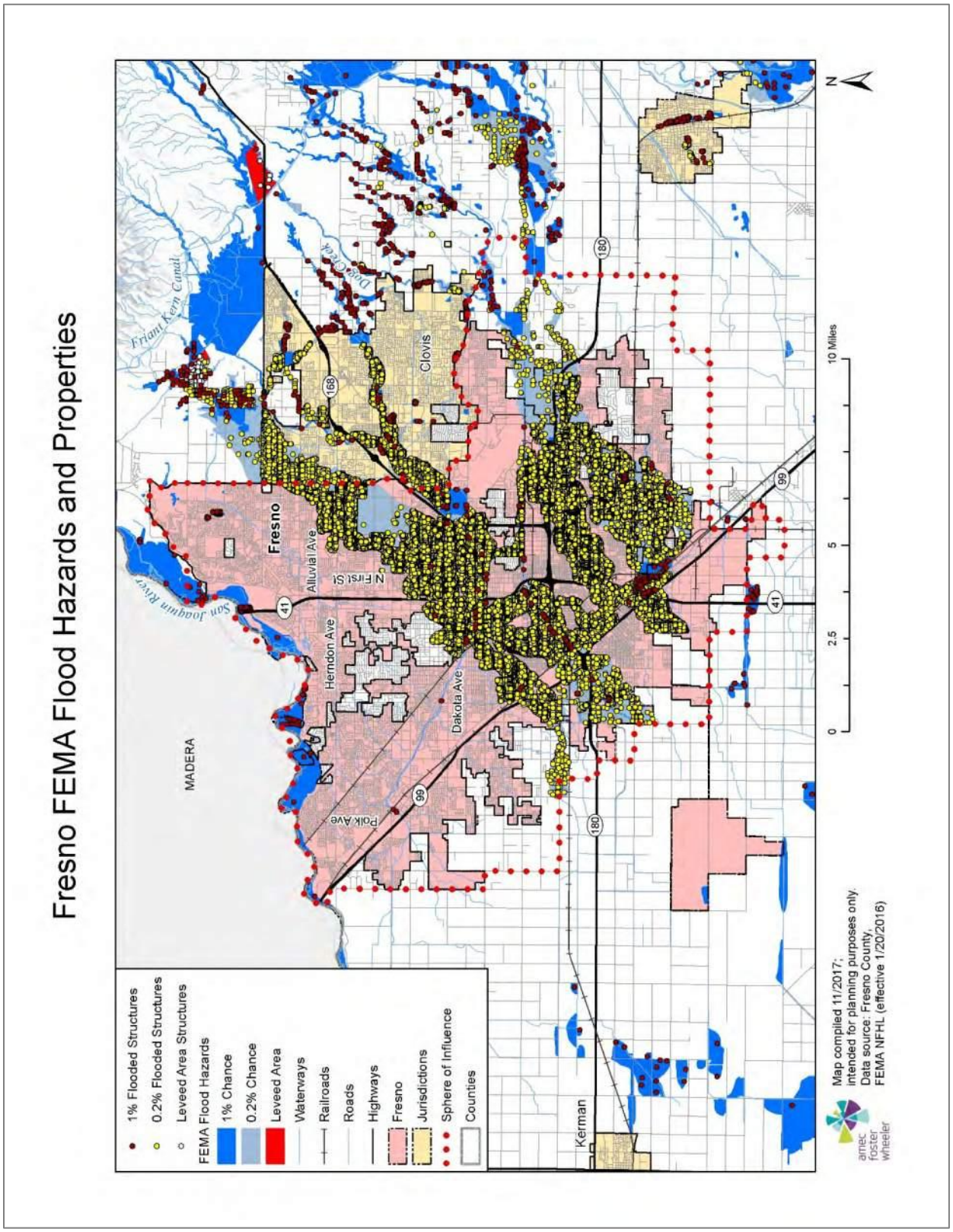
Based on this analysis, the City of Fresno has significant assets at risk to the 100-year and greater floods. There are 231 improved parcels within the 100-year floodplain for a total value of roughly $128 million, including building and content value. An additional 37,849 improved parcels valued at roughly $10.5 billion fall within the 500-year floodplain.

Applying the 25 percent damage factor as described in Section 4.3.2, there is a 1 percent chance in any given year of a 100-year flood causing roughly $32.0 million in damage in the City of Fresno and a 0.2 percent chance in any given year of a 500-year flood causing roughly $2.65 billion in damage (combined damage from both floods).

Properties at risk to flooding are shown in relation to the mapped floodplains in Figure E.5.

**Limitations:** This model may include structures in the floodplains that are elevated at or above the level of the base-flood elevation, which will likely mitigate flood damage. Also, the assessed values are well below the actual market values. Thus, the actual value of assets at risk may be significantly higher than those included herein.

**Figure E.5: City of Fresno's Properties at Risk in the 100- and 500-Year Floodplains**



In addition to the 100-year and 500-year floodplains mapped by FEMA, the California Department of Water Resources maintains Best Available Maps (BAM) which include the floodplains in the Sacramento and San Joaquin River Basins, based on a study performed in 2002 by the U.S. Army Corps of Engineers (USACE). Though limited to the San Joaquin River as a flood source and thus not as comprehensive as the FEMA FIRM, the USACE study shows additional differentiation in flood risk by modeling the 200-year floodplain (the flood with a 0.5 percent annual chance of occurring). Table E.12 summarizes the values at risk by property type within the 200-year floodplain and loss estimates to the 200-year storm using the same methodology described above.

**Table E.12: City of Fresno's FEMA 0.5% Annual Chance Flood Hazard by Property Type**

| Property Type | Parcel Count | Building Count | Improved Value | Content Value | Total Value | Loss Estimate |
|---|---|---|---|---|---|---|
| Agricultural | 1 | 0 | $60,933 | $60,933 | $121,866 | $30,467 |
| Commercial | 3 | 139 | $4,322,495 | $4,322,495 | $8,644,990 | $2,161,248 |
| Exempt | 5 | 5 | $0 | $0 | $0 | $0 |
| Residential | 18 | 19 | $12,103,507 | $6,051,754 | $18,155,261 | $4,538,815 |
| **Total** | **27** | **163** | **$16,486,935** | **$10,435,182** | **$26,922,117** | **$6,730,529** |

Sources: Fresno County 2017 Parcel and Assessor data; CA DWR BAM; USACE

Based on this analysis, there are 27 parcels within the 200-year floodplain valued at nearly $10.5 million. Applying the 25 percent damage factor, there is a 0.5 percent annual chance of a 200-year flood causing $6.73 million in damage in the City of Fresno.

### *Insurance Coverage, Claims Paid, and Repetitive Losses*

The City of Fresno joined the National Flood Insurance Program (NFIP) on December 1, 1982. In addition to providing insurance for properties at risk of flooding, the program collects and publishes statistics on flood-related losses in participating jurisdictions.

NFIP insurance data for the City of Fresno indicates that as of March 30, 2017, there were 323 flood insurance policies in force in the City with $99,316,700 in coverage. This coverage represents a decline of nearly 200 policies over the last decade. Of the 323 policies, 277 were residential (267 for single-family homes) and 46 were nonresidential. 56 of the policies were in A zones (including A01-30, AE, AO, and AH), and the remaining 267 policies were in B, C, and X zones. Policies in B, C, and X zones have increased slightly over the past decade, while policies in the 100-year floodplain have dramatically declined.

There have been 81 historical claims for flood losses totaling $765,183; 73 were for residential properties; 37 were in A zones and 36 were in B, C, or X zones; and 54 were pre-FIRM structures (17 of the 19 post-FIRM structures with reported losses were in a B, C, or X zone). According to the FEMA Community Information System accessed 9/17/2018 there was one Repetitive Loss and no Severe Repetitive Loss properties located in the jurisdiction.

### *Population at Risk*

Using parcel data from the County, the digital flood insurance rate map, population at risk was calculated for the 100-year and 500-year floods based on the number of residential properties at risk and the U.S. Census Bureau 2016 estimate for the average number of persons per household (3.17). The following are at risk to flooding in the City of Fresno:

- 100-year flood—342 people
- 500-year flood—107,400 people
- **Total flood**—107,742 people

### *Critical Facilities at Risk*

Critical facilities are those community components that are most needed to withstand the impacts of disaster as previously described. Table E.13 lists the critical facilities in the City's 100- and 500-year floodplains.

**Table E.13: Critical Facilities in the 100- and 500-Year Floodplains: City of Fresno**

| Critical Facility Type | 100-Year Floodplain | 500-Year Floodplain |
|---|---|---|
| Airport | - | 1 |
| Behavioral Health | - | 1 |
| CalARP | 1 | 12 |
| Colleges & Universities | - | 5 |
| Communications | - | 1 |
| County Government | - | 2 |
| Daycare | - | 52 |
| Department of Agriculture | - | 2 |
| Department of Public Health | - | 2 |
| Department of Social Services | - | 6 |
| District Attorney | - | 1 |
| Fire Station | - | 7 |
| General Services | - | 3 |
| Health Care | - | 1 |
| Nursing Home | - | 12 |
| Police | - | 5 |
| School | - | 68 |
| Urgent Care | - | 2 |
| **Total** | **1** | **183** |

Source: Fresno County, HIFLD 2017

## Hazardous Materials Incident

The following are the primary concerns for the City of Fresno related to hazardous materials release:

- Train derailments

- Kinder-Morgan pipeline
- Chevron petroleum pipelines
- Storage facilities

There are 28 CalARP hazardous materials facilities located in the City of Fresno. As detailed in Table E.14, there are 62 critical facilities located within a half mile of a CalARP facility.

**Table E.14: Critical Facilities within ½ mile of CalARP Facility: City of Fresno**

| Critical Facility Type | Count |
|---|---|
| Colleges & Universities | 1 |
| Communications | 1 |
| County Government | 4 |
| Courthouse | 1 |
| Daycare | 11 |
| Department of Public Health | 2 |
| Department of Social Services | 4 |
| Detention Center | 4 |
| District Attorney | 2 |
| Fire Station | 4 |
| Health Care | 3 |
| Nursing Home | 4 |
| Police | 1 |
| School | 17 |
| Sheriff | 1 |
| Supplemental College | 1 |
| Urgent Care | 1 |
| **Total** | **62** |

Source: Fresno County, HIFLD 2017

For more information on this hazard please refer to the main plan, Section 4.

## Severe Weather: Fog

The risk and vulnerability factors for fog in the City is not unique from the County at large. Please refer to the main plan's discussion of the fog hazard in section 4.

## Severe Weather: Windstorm

Fresno's prevailing winds are typically light and from the northwest. High wind conditions are occasionally created by strong weather fronts. Occasionally, there are funnel clouds of low intensity. Past structural damage has been light, infrequent, and very limited in geographic extent. Injuries have been extremely rare. Most of this damage has occurred secondary to large trees being blown over. The City's design wind load, the level of wind force that new structures are required to be engineered to withstand, is 70 mph.

## Soil Hazards: Land Subsidence

Despite long-term over-drafting of groundwater that has lowered the static water table under Fresno by as much as 100 feet over the past century, ground level subsidence has not been noted in the vicinity of the City (this is probably due to the geologic strata underlying the City, which features layers of clay and hardpan interleaved with sand and gravel layers).

## Wildfire

Similar to many areas of the County, Fresno has high temperatures in the summer with low rainfall creating fire hazard conditions. There is some wildfire risk in the San Joaquin River Bluff area in northern Fresno due to vegetation and steep slopes.

Following the methodology described in Section 4.3.2 Vulnerability of Fresno County to Specific Hazards, a wildfire map for the City of Fresno was created (see Figure E.6). An analysis was performed using GIS software to determine where populations, values at risk, and critical facilities are located within wildfire threat zones. Table E.15 shows the values at risk in the moderate wildfire threat zone (there are no values at risk in the high or very high threat zones). There are not any critical facilities in wildfire threat zones in the City of Fresno.

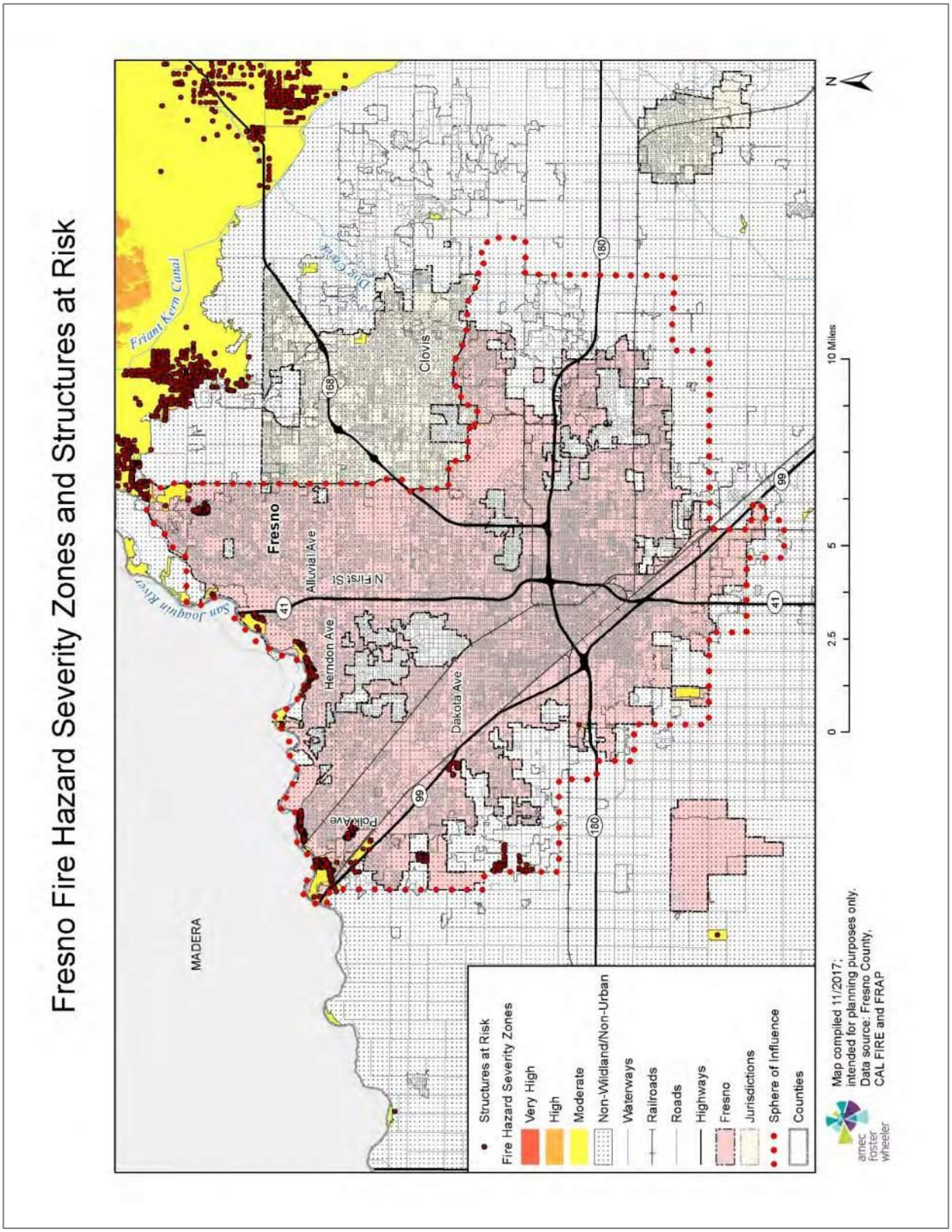
**Table E.15: Values at Risk to Wildfire (Moderate Threat) in the City of Fresno**

| Property Type | Parcel Count | Building Count | Improved Value | Content Value | Total Value |
|---|---|---|---|---|---|
| Agricultural | 1 | 0 | $60,933 | $60,933 | $121,866 |
| Commercial | 13 | 36 | $24,379,836 | $24,379,836 | $48,759,672 |
| Exempt | 12 | 13 | $0 | $0 | $0 |
| Industrial | 4 | 4 | $2,105,480 | $3,158,220 | $5,263,700 |
| Multi-Residential | 1 | 16 | $255,200 | $127,600 | $382,800 |
| Residential | 772 | 779 | $180,172,709 | $90,086,355 | $270,259,064 |
| **Total** | **803** | **848** | **$206,974,158** | **$117,812,944** | **$324,787,102** |

Sources: Fresno County 2017 Parcel and Assessor data

Based on this analysis, the City of Fresno's moderate wildfire threat affects 2,450 people and 803 improved parcels valued at roughly $324,787,102. Almost all of the parcels at risk are in the San Joaquin River corridor, where development is very restricted due to flood risk and bluff instability. Other parcels are in industrial areas along the western edge of the City, where the City's weed abatement ordinances (requiring vegetation control by April) would reduce the wildfire risk.

**Figure E.6: City of Fresno's Wildfire Threat**



# E.4 Capability Assessment

Capabilities are the programs and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. This capabilities assessment is divided into five sections: regulatory mitigation capabilities, administrative and technical mitigation capabilities, fiscal mitigation capabilities, mitigation outreach and partnerships, and other mitigation efforts.

To develop this capability assessment, the jurisdictional planning representatives used a matrix of common mitigation activities to inventory which of these policies or programs were in place. The team then supplemented this inventory by reviewing additional existing policies, regulations, plans, and programs to determine if they contributed to reducing hazard-related losses.

During the plan update process, this inventory was reviewed by the jurisdictional planning representatives and Amec Foster Wheeler consultant team staff to update information where applicable and note ways in which these capabilities have improved or expanded. Additionally, in summarizing current capabilities and identifying gaps, the jurisdictional planning representatives also considered their ability to expand or improve upon existing policies and programs as potential new mitigation strategies. The City of Fresno's updated capabilities are summarized below.

## E.4.1 Regulatory Mitigation Capabilities

Table E.16 lists regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Fresno.

**Table E.16: City of Fresno's Regulatory Mitigation Capabilities**

| Regulatory Tool | Yes/No | Comments |
|---|---|---|
| General Plan | Yes | The Fresno General Plan has a Noise and Safety Element with policies for wildland fire hazards, seismic/geologic hazards, storm drainage and flood control, hazardous materials, airport safety, and emergency response |
| Zoning Ordinance | Yes | Fresno Municipal Code Chapter 15; Zoning Ordinance has requirements related to health and safety (e.g., dwelling unit density controls, building setbacks for fire protection, masonry walls along major streets) |
| Subdivision Ordinance | Yes | Fresno Municipal Code Chapter 15 requires multiple points of access for ingress/egress, fire protection provisions, etc. |
| Development Permit (formerly Site Plan Review) requirements | Yes | Required for all nonresidential development projects and multi-family projects over two units; required for duplexes in some zone districts; plot plan review required for even single-family residential construction |
| Growth Management Ordinance | Yes | Fresno Municipal Code Chapter 12 provides for extension of urban infrastructure and services including sewer treatment, water supply, and fire protection |
| Floodplain Ordinance | Yes | Fresno Municipal Code Chapter 13 (local building codes) includes the Flood Damage Prevention Ordinance |
| Other special purpose ordinance (stormwater, water conservation, wildfire) | Yes | - Within the Zoning Ordinance, there is a Bluff Preservation Overlay district with requirements for soil stability analysis and setbacks from the San Joaquin bluff edge |

| Regulatory Tool | Yes/No | Comments |
|---|---|---|
| | | - Pretreatment Ordinance and environmental control program for wastewater system to prevent and abate any hazardous material releases |
| Building Code | Yes | Version: 2016 California Building Code with a few City modifications: fire sprinkler ordinance, swimming pool ordinance, and security ordinance |
| Fire Department ISO Rating | Yes | Rating: 3 |
| Erosion or Sediment Control Program | Yes | The Bluff Preservation Ordinance, as well as grading plan review and stormwater pollution prevention plans, which are required for all development projects through project conditions and CEQA review |
| Stormwater Management Program | Yes | In conjunction with Cal-EPA, Regional Water Quality Control Board, and Fresno Metropolitan Flood Control District |
| Capital Improvements Plan | Yes | Public Works Department and Department of Public Utilities formulate and administer these plans |
| Economic Development Plan | Yes | Fresno Redevelopment Agency and Economic Development Division of the Planning and Development Department |
| Local Emergency Operations Plan | Yes | Ratified by City Council in 2005 and last updated in 2015 |
| Flood Insurance Study or other engineering study for streams | Yes | FEMA Flood Insurance Study, 2005 |

## Fresno General Plan (Adopted December 18, 2014)

The Fresno General Plan is a blueprint of how the City anticipates directing and managing growth while minimizing potential impacts for existing and future generations. It provides long-range planning strategies for the continued development, enhancement, and revitalization of the Fresno Metropolitan Area. The plan goals are the guiding principles and provide the framework for the objectives and policies that can be found in the plan elements. The following general plan goals directly or indirectly mitigate hazards identified in this plan:

- **Goal 9**—Promote a city of healthy communities and improve quality of life in established neighborhoods.
  - *Emphasize supporting established neighborhoods in Fresno with safe, well maintained, and accessible streets, public utilities, education and job training, proximity to jobs, retail services, health care, affordable housing, youth development opportunities, open space and parks, transportation options, and opportunities for home grown businesses.*
- **Goal 12**— Resolve existing public infrastructure and service deficiencies, make full use of existing infrastructure, and invest in improvements to increase competitiveness and promote economic growth.
  - *Emphasize the fair and necessary costs of maintaining sustainable water, sewer, streets, and other public infrastructure and service systems in rates, fees, financing and public investments to implement the General Plan. Adequately address accumulated deferred maintenance, aging infrastructure, risks to service continuity, desired standards of service to meet quality-of-life goals, and required infrastructure to support growth, economic competitiveness and business development.*
- **Goal 16**— Protect and improve public health and safety.

Some of the elements of the General Plan also contain objectives and policies relevant to protecting human health and safety (e.g., supporting objectives and policies in the Public Utilities and Services Element direct that amendments to construction and fire codes to reduce the level of risk to life and property from fire commensurate with the City's fire suppression capabilities and that fire and police services be provided). Because the Noise and Safety Element is the portion of the General Plan most relevant to hazard mitigation, select objectives and policies are extracted and included below.

### *The Noise and Safety Element*

The Noise and Safety Element seeks to reduce deaths, injuries, illnesses, damage to property, and economic and social dislocation that could result from hazards. Of specific relevance to this plan, it addresses seismic and geologic conditions, flooding, hazardous materials, and emergency response.

## Seismic and Geologic Hazards

| **NS-2. Objective: Minimize risks of property damage and personal injury posed by geologic and seismic risks.** |
|---|
| **NS-2-a. Policy**: Seismic Protection. Ensure seismic protection is incorporated into new and existing construction, consistent with the Fresno Municipal Code. |
| **NS-2-b. Policy**: Soil Analysis Requirement. Identify areas with potential geologic and/or soils hazards, and require development in these areas to conduct a soil analysis and mitigation plan by a registered civil engineer (or engineering geologist specializing in soil geology) prior to allowing on-site drainage or disposal for wastewater, stormwater runoff, or swimming pool/spa water. |
| **NS-2-c. Policy**: Landfill Areas. Require proposed land uses on or near landfill areas to be designed and maintained to comply with California Code of Regulations, Title 27, Section 21190, Post Closure Land Use. |
| **NS-2-d. Policy**: Bluff Preservation Overlay Zone. Per the requirements of the Bluff Preservation Overlay Zone District and Policy POSS-7-f (Chapter 5, Parks and Open Space), the following standards shall be applicable for property located within the Bluff Preservation zone:<br>• Require proposed development within 300 feet of the toe of the San Joaquin River bluffs to undertake an engineering soils investigation and evaluation report that demonstrates that the site is sufficiently stable to support the proposed development, or provide mitigations to provide sufficient stability; and<br>• Establish a minimum setback of 30 feet from the San Joaquin River bluff edge for all buildings, structures, decks, pools and spas (which may be above or below grade), fencing, lighting, steps, etc.<br>o An applicant may request to reduce the minimum setback to 20 feet from the bluff edge if it can be demonstrated, to the satisfaction of the City's Building Official and the Planning Director, that the proposed building, structure, deck, pool and/or spas (which may be above or below grade), fencing, steps, etc., will meet the objectives of the Bluff Preservation Overlay Ordinance. In no case shall the setback be reduced to less than 20 feet. |

## Flooding Hazards

| **NS-3. Objective: Minimize the risks to property, life, and the environment due to flooding and stormwater runoff hazards.** |
|---|
| **NS-3-a. Policy**: Stormwater Drainage and Flood Control Master Plan. Support the full implementation of the FMFCD Storm Drainage and Flood Control Master Plan, the completion of planned flood control and drainage system facilities, and the continued maintenance of stormwater and flood water retention and conveyance facilities and capacities. Work with the FMFCD to make sure that its Storm Drainage and Flood Control Master Plan is consistent with the General Plan. |

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|---|
| **NS-3-b. Policy**: Curb and Gutter Installation. Coordinate with Fresno Metropolitan Flood Control District (FMFCD) to install curbing, gutters, and other drainage facilities with priority to existing neighborhoods with the greatest deficiencies and consistent with the Storm Drainage and Flood Control Master Plan. |
| **NS-3-c. Policy**: Dual Use Facilities. Support multiple uses of flood control and drainage facilities as follows:<br>• Use, wherever practical, FMFCD facilities for groundwater management and recharge; and<br>• Promote recreational development of ponding basin facilities located within or near residential areas, compatible with the stormwater and groundwater recharge functions. |
| **NS-3-d. Policy**: Landscaped Buffer. City will support the development of FMFCD ponding basins including the landscaping and irrigation for the top one third of the side sloped areas consistent with the FMFCD Basin Design Criteria. |
| **NS-3-e. Policy**: Pollutants. Work with FMFCD to prevent and reduce the existence of urban stormwater pollutants pursuant to the requirements of the National Pollution Discharge Elimination Systems Act. |
| **NS-3-f. Policy**: Flooding Emergency Response Plans. Work with responsible agencies to update emergency dam failure inundation plans, evacuation plans and other emergency response plans for designated flood-prone areas, including the San Joaquin river bottom. |
| **NS-3-g. Policy**: Essential Facilities Siting Outside of Floodplains. Avoid siting emergency response and essential public facilities, such as fire and police stations, within a 100-year floodplain, unless it can be demonstrated that the facility can be safely operated and accessed during flood events. |
| **NS-3-h. Policy**: Runoff Controls. Implement grading regulations and related development policies that protect area residents from flooding caused by urban runoff produced from events that exceed the capacity of the Storm Drainage and Flood Control Master Plan system of facilities. Place all structures and/or flood-proofing in a manner that does not cause floodwaters to be diverted onto adjacent property, increase flood hazards to other property, or otherwise adversely affect other property. |
| **NS-3-i. Policy**: New Development Must Mitigate Impact. Require new development to not significantly impact the existing storm drainage and flood control system by imposing conditions of approval as project mitigation, as authorized by law. As part of this process, closely coordinate and consult with the FMFCD to identify appropriate conditions that will result in mitigation acceptable and preferred by FMFCD for each project.<br>*Commentary: The City recognizes the expertise and significant role of the FMFCD, and will give the highest deference to its recommendations for mitigation measures, consistent with applicable law.* |
| **NS-3-j. Policy**: National Flood Insurance Program. Continue to participate in the National Flood Insurance Program (NFIP) by ensuring compliance with applicable requirements. Review NFIP maps periodically to determine if areas subject to flooding have been added or removed and make adjustments to the Land Use Diagram Figure LU-1. |
| **NS-3-k. Policy**: 100-Year Floodplain Policy. Require developers of residential subdivisions to preserve those portions of development sites as open space that may be subject to 100-year flood events, unless the flood hazard can be substantially mitigated by development project design. |
| **NS-3-l. Policy**: 200-Year Floodplain Protection. Promote flood control measures that maintain natural conditions within the 200-year floodplain of rivers and streams and, to the extent possible, combine flood control, recreation, water quality, and open space functions. Discourage construction of permanent improvements that would be adversely affected by periodic floods within the 200-year floodplain, particularly in the San Joaquin river bottom. |
| **NS-3-m. Policy**: Flood Risk Public Awareness. Continue public awareness programs to inform the general public and potentially affected property owners of flood hazards and potential dam failure inundation. Remind households and businesses located in flood-prone areas of opportunities to purchase flood insurance. |
| **NS-3-n. Policy**: Precipitation Changes. Work with FMFCD to evaluate the planned and existing stormwater conveyance system in light of possible changes to precipitation patterns in the future. |

## Hazardous Materials

| **NS-4. Objective: Minimize the risk of loss of life, injury, serious illness, and damage to property resulting from the use, transport, treatment, and disposal of hazardous materials and hazardous wastes.** |
|---|
| **NS-4-a. Policy**: Processing and Storage. Require safe processing and storage of hazardous materials, consistent with the California Building Code and the Uniform Fire Code, as adopted by the City. |
| **NS-4-b. Policy**: Coordination. Maintain a close liaison with the Fresno County Environmental Health Department, Cal-EPA Division of Toxics, and the State Office of Emergency Services to assist in developing and maintaining |

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| hazardous material business plans, inventory statements, risk management prevention plans, and contingency/emergency response action plans. |
| **NS-4-c. Policy**: Soil and Groundwater Contamination Reports. Require an investigation of potential soil or groundwater contamination whenever justified by past site uses. Require appropriate mitigation as a condition of project approval in the event soil or groundwater contamination is identified or could be encountered during site development. |
| **NS-4-d. Policy**: Site Identification. Continue to aid federal, State, and County agencies in the identification and mapping of waste disposal sites (including abandoned waste sites), and to assist in the survey of the kinds, amounts, and locations of hazardous wastes. |
| **NS-4-e. Policy**: Compliance with County Program. Require that the production, use, storage, disposal, and transport of hazardous materials conform to the standards and procedures established by the County Division of Environmental Health. Require compliance with the County's Hazardous Waste Generator Program, including the submittal and implementation of a Hazardous Materials Business Plan, when applicable. |
| **NS-4-f. Policy**: Hazardous Materials Facilities. Require facilities that handle hazardous materials or hazardous wastes to be designed, constructed, and operated in accordance with applicable hazardous materials and waste management laws and regulations. |
| **NS-4-g. Policy**: Hazmat Response. Include policies and procedures appropriate to hazardous materials in the City's disaster and emergency response preparedness and planning, coordinating with implementation of Fresno County's Hazardous Materials Incident Response Plan. |
| **NS-4-h. Policy**: Household Collection. Continue to support and assist with Fresno County's special household hazardous waste collection activities, to reduce the amount of this material being improperly discarded. |
| **NS-4-i. Policy**: Public Information. Continue to assist in providing information to the public on hazardous materials. |

## Emergency Response

| **NS-6. Objective: Foster an efficient and coordinated response to emergencies and natural disasters.** |
|---|
| **NS-6-a. Policy**: County Multi-Jurisdiction Hazard Mitigation Plan. Adopt and implement the Fresno County Multi-Jurisdiction Hazard Mitigation Plan and City of Fresno Local Hazard Mitigation Plan Annex.<br>*Commentary: The federal Disaster Mitigation Act of 2000 requires that cities, counties, and special districts have a Local Hazard Mitigation Plan to be eligible to receive FEMA hazard mitigation funds. Cities and counties can adopt and use all or part of a regional multi-jurisdictional plan, such as the one prepared by Fresno County, in lieu of preparing all or part of a Local Hazard Mitigation Plan.* |
| **NS-6-b. Policy**: Disaster Response Coordination. Maintain coordination with other local, State, and Federal agencies to provide coordinated disaster response. |
| **NS-6-c. Policy**: Emergency Operations Plan. Update the City's Emergency Operations Plan periodically, using a whole community approach which integrates considerations for People with access and functional needs in all aspects of planning. |
| **NS-6-d. Policy**: Evacuation Planning. Maintain an emergency evacuation plan in consultation with the Police and Fire Departments and other emergency service providers, which shows potential evacuation routes and a list of emergency shelters to be used in case of catastrophic emergencies.<br>Commentary: The evacuation plan will be flexible in order to consider many scenarios and multiple modes of transportation beyond private automobiles. It will provide special provisions for disadvantaged populations, such as those with physical disabilities or those with low or very low incomes, and for areas with fewer resources through neighborhood emergency preparedness programs. |
| **NS-6-e. Policy**: Critical Use Facilities. Ensure critical use facilities (e.g. City Hall, police and fire stations, schools, hospitals, public assembly facilities, transportation services) and other structures that are important to protecting health and safety in the community remain operational during an emergency.<br>• Site and design these facilities to minimize their exposure and susceptibility to flooding, seismic and geological effects, fire, and explosions.<br>• Work with the owners and operators of critical use facilities to ensure they can provide alternate sources of electricity, water, and sewerage in the event that regular utilities are interrupted in a disaster. |
| **NS-6-f. Policy**: Emergency Vehicle Access. Require adequate access for emergency vehicles in all new development, including adequate widths, turning radii, hard standing areas, and vertical clearance. |

**NS-6-g. Policy**: Emergency Preparedness Public Awareness Programs. Continue to conduct programs to inform the general public, including people with access and functional needs, of the City's emergency preparedness and disaster response procedures.

## Fresno Flood Plain Ordinance

The City of Fresno's Flood Plain Ordinance was revised in the late 1990s and formally adopted by the Fresno City Council on September 20, 2005. (In late 2007, the Fresno Municipal Code was republished with its chapters somewhat reorganized. There was no change in the text of the Flood Plain Ordinance at that time, but due to the reorganization of its content, its most recent adoption effective date is January 17, 2008.) The Fresno Flood Plain Ordinance is Article 6 of Chapter 11 of the Fresno Municipal Code.

The purpose of this ordinance is to promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

- Protect human life and health;
- Minimize expenditure of public money for costly flood control projects;
- Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- Minimize prolonged business interruptions;
- Minimize damage to public facilities and utilities such as water and gas mains; electric, telephone, and sewer lines; and streets and bridges located in areas of special flood hazard;
- Help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future blighted areas caused by flood damage;
- Ensure that potential buyers are notified that property is in an area of flood hazard; and
- Ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

In order to accomplish its purposes, the ordinance includes the following methods and provisions:

- Restrict or prohibit uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or flood heights or velocities
- Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction
- Control filling, grading, dredging, and other development which may increase flood damage
- Prevent or regulate the construction of flood barriers which will unnaturally divert flood water or which may increase flood hazards in other areas
- Control the alteration of natural flood plains, stream channels, and natural protective barriers, which help accommodate or channel floodwaters

This ordinance applies to all areas of special flood hazards within the jurisdiction of the City as identified by FEMA's Flood Insurance Study for Fresno County, California and incorporated areas dated September 30, 2005, with accompanying Flood Insurance Rate Maps, and all subsequent amendments and/or revisions. It appoints the building official to administer, implement, and enforce the ordinance by granting or denying development permits in accord with its provisions.

This ordinance includes the following standards of construction related to special flood hazard areas:

- Anchoring
- Construction materials and methods
- Elevation and floodproofing
- Residential construction
- Nonresidential construction
- Flood venting
- Standards for utilities
- Standards for subdivisions
- Standards for manufactured homes
- Standards for recreational vehicles
- Floodways
- Standards for storage of materials and equipment

In conjunction with Fresno's Drainage Fee Ordinance (Fresno Municipal Code Chapter 12, Article 19), which requires local grading and development to conform to the Fresno Metropolitan Flood Control District Master Drainage Plan and to provide proportionate shares of drainage infrastructure, the Fresno Flood Plain Ordinance and its preceding Flood Damage Prevention Ordinance have reduced flood damage losses in the City.

## National Flood Insurance Program/Community Rating System

The City of Fresno joined the National Flood Insurance Program (NFIP) on December 1, 1982. It has been a member of the Community Rating System (CRS) since October 1, 1992. The City's Floodplain Administrator duties are assigned to the building official. The Building and Safety Division of the Planning and Development Department works to improve the City's CRS rating, which determines the price paid for flood insurance policies issued in the jurisdiction. The rating is based on detailed biannual audits conducted by FEMA and/or a designee agency (currently, the California Department of Water Resources). The primary means of improving and maintaining a good CRS rating is through administration of the Fresno Flood Plain Ordinance. As part of its efforts to improve its community rating, the City of Fresno has hosted periodic FEMA Region IX NFIP/CRS training.

The City's current CRS rating from October 2016 is Class 8, which reflects the loss of two class levels in the most recent audit.

### San Joaquin River Bluff Preservation Ordinance, 1980

After an interagency San Joaquin River Reconnaissance Plan was completed in the late 1970s, the City of Fresno adopted the San Joaquin River Bluff Specific Plan to preserve this important open space and habitat feature and to safeguard the bluff face, which is the most unstable geologic feature in the City. The San Joaquin River Bluff Specific Plan was later subsumed by the 1988 Bullard Community Plan, which carried forward protective policies for this area of Fresno.

The regulation of land use, development, and grading in this portion of Fresno is ongoing pursuant to the Bluff Preservation Ordinance. This ordinance, part of the City's zoning regulations, delineates an overlay zone district along the river bluff (the Bluff Preservation Overlay District), established allowable and prohibited land uses, and set forth conditions and requirements for using or modifying property in the district. The regulations of the district are deemed to be necessary for the preservation of the special qualities of the bluffs and for the protection of the health, safety, and general welfare of owners and users of property in the area.

The Bluff Preservation Ordinance is administered by the Fresno Development and Resource Management Department through its special permit process and grading plan checks. Anyone applying for a building permit is required to submit a site plan review with accompanying soil investigation and evaluation report (prepared by an appropriately licensed professional engineer or registered geologist). The Department's Code Enforcement Division also conducts periodic surveillance of bluff properties for grading and construction done without permits and institutes abatement actions when these conditions are discovered.

### Hazardous Material Incident Safeguards

The Fresno Fire Department works with Fresno County Environmental Health to review hazardous material business plans that detail flammable, explosive, toxic, and otherwise hazardous materials used by businesses in the City. The Fire Department has its own permitting requirement for liquid and gaseous fuel tanks to ensure that they are installed and maintained safely. The City's Hazardous Materials Response Unit (housed in a City fire station) maintains the capability to quickly characterize material releases and spills, to evaluate risks to life and property, and to implement appropriate controls and evacuation measures.

### Fire Prevention Policy

The City of Fresno has some of the most progressive and effective fire prevention policies and regulations in the nation relating to water supply (fire flow) required for development, ingress and egress from developed buildings and subdivisions, on-site automatic fire suppression systems (sprinkler and on-site private hydrants), building addressing to facilitate rapid emergency response, marking of unsafe buildings (those older structures with hazardous conditions or a lack of water supply), and instant aid/mutual aid with adjacent fire departments belonging to Fresno County special districts and the City of Clovis.

In addition to its extensive network of well-trained and well-equipped firefighting stations, the Fresno Fire Department has a Fire Prevention Bureau, under supervision of the City's fire marshal, to administer regulations adopted and referenced by the Fresno Municipal Code Chapter 6, Article 5 relating to fire prevention. The Fire Prevention Bureau carries out these responsibilities by conducting routine inspections of all public and commercial buildings, performing detailed development permit and construction plan checks, and investigating arson.

Another component of the City's overall fire protection program is the administration of its public nuisance ordinances to require properties to be kept clean and free of flammable debris and to annually abate weeds and overgrown vegetation before these materials can dry out in the spring to pose a wildfire hazard (Fresno Municipal Code Chapter 10, Article 6 relating to public nuisance abatement). The Planning and Development Department Code Enforcement Division and Department of Public Utilities Community Sanitation Division coordinate their efforts to enforce the nuisance abatement regulations and provide cleanup services when property owners do not take care of matters themselves.

### City of Fresno Emergency Operations Plan, 2015, Updated 2015

The City of Fresno Emergency Operations Plan (EOP) addresses the planned response to extraordinary emergency situations associated with natural disasters, technological incidents, excessive heat/cold, power outages, and national security emergencies in or affecting the City of Fresno. The Plan, which was updated in 2015, does the following:

- Establishes the emergency management organization required to mitigate any significant emergency or disaster affecting the City of Fresno.
- Identifies the policies, responsibilities, and procedures required to protect the health and safety of City communities, public and private property, and the environment from natural or technological disasters.
- Establishes the operational concepts and procedures associated with initial response operations to emergencies, the extended response operations, and the recovery process.

The EOP is designed to establish the framework for implementation of the California Standardized Emergency Management System/National Incident Management System for the City of Fresno, which is located within the California Governor's Office of Emergency Services' Mutual Aid Region V. It is intended to facilitate multi-agency and multi-jurisdictional coordination, particularly between the City of Fresno and the Fresno County Operational Area, including special districts and state agencies, in emergency operations. This plan will be used in conjunction with the Fresno County EOP and the State of California Emergency Plan. The plan is designed to guide the reader or user through each phase of an emergency: preparedness, response, recovery, and mitigation.

### Other Plans and Policies

Other hazard mitigation-related policies and plans in place in and observed by the City of Fresno include the following:

- California Code of Regulations Title 23 administrative law for development and use of land in designated floodway areas along the San Joaquin River administered by the Central Valley Flood Protection Board, staffed by the California Department of Water Resources.
- Standards for constructing and maintaining drainage basins and ponds to prevent mosquito breeding and to provide for mosquito control district access for inspection and abatement activities (jointly promulgated by the Planning and Development Department and Public Works Department in fall of 2005).
- Dam failure inundation plans prepared and administered by the U.S. Bureau of Reclamation, the U.S. Army Corps of Engineers, Fresno Metropolitan Flood Control District, Southern California Edison, and Pacific Gas and Electric Company.
- The California Environmental Quality Act, overseen by the Fresno City Attorney's Office and administered by several City departments, requires consideration of health and safety impacts as they may relate to projects, which are defined as any action that may result in a change in the physical environment and that would include public facilities, and private development, and even adoption/amendment of land use plans and ordinances. An analysis of every project is conducted by the appropriate City department (the Development and Resource Management Department does the bulk of these analyses). Inquiries regarding project sites and features are distributed to departments and outside agencies that may have knowledge of, or which may regulate, aspects of the proposed project. The information obtained from these requests for comment and from other staff research is compiled into an informational document for decision-makers and the public. The information is also used to develop a list of mitigation actions to reduce or abate potential adverse impacts of the project. For those projects which may involve federal funds or require federal approvals, a parallel National Environmental Policy Act assessment is also prepared by the City.
- The Development and Resource Management Department administers regulations in the California Building Code and in Uniform Electrical, Plumbing, and Mechanical Codes as those codes are modified through adoption by the state and City. Plan check and inspection activities of the Department ensure structural soundness and compliance with seismic and other regulations.

## E.4.2 Administrative/Technical Mitigation Capabilities

Table E.17 identifies the personnel responsible for activities related to mitigation and loss prevention in Fresno.

**Table E.17: City of Fresno's Administrative and Technical Mitigation Capabilities**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/engineer with knowledge of land development/land management practices | Yes | Planning and Development Department (planners), Department of Public Utilities (engineers), Public Works Department (engineers), Fresno Metropolitan Flood Control District (engineers) |
| Engineer/professional trained in construction practices related to buildings and/or infrastructure | Yes | Planning and Development Department (engineers), Department of Public Utilities (engineers), Public Works Department (engineers), Fresno Metropolitan Flood Control District (engineers) |
| Planner/engineer/scientist with an understanding of natural hazards | Yes | Planning and Development Department (planners and engineers), Department of Public Utilities (engineers), Public Works Department (engineers), Fresno Metropolitan Flood Control District (engineers) |
| Personnel skilled in GIS | Yes | Planning and Development Department, Department of Public Utilities, Public Works Department, Information Services Department |
| Full time building official | Yes | Planning and Development Department |
| Floodplain administrator | Yes | Planning and Development Department |
| Emergency manager | Yes | Fresno Fire Department |
| Grant writer | Yes | Planning and Development Department, Police Department, Public Works Department, Fire Department |
| Other personnel | Yes | California registered geologist (Department of Public Utilities), California registered environmental health specialist (Planning and Development Department), licensed water and wastewater treatment operators |
| Warning systems/services (Reverse 9-11, outdoor warning signals) | Yes | State Emergency Alert System is coordinated by emergency management team through the National Weather Service |
| Other | Yes | Emergency notification of San Joaquin River bottom residents in conjunction with the U.S. Bureau of Reclamation and Fresno County |

## E.4.3 Fiscal Mitigation Capabilities

Table E.18 identifies financial tools or resources that the City could potentially use to help fund mitigation activities.

**Table E.18: City of Fresno's Fiscal Mitigation Capabilities**

| Financial Resources | Accessible/Eligible to Use (Yes/No) | Comments |
|---|---|---|
| Community Development Block Grants | Yes | Geographically restricted to designated portions of Fresno based on area income |
| Capital improvements project funding | Yes | Budgeted out of utility fees and often related to issuance of bonds; City also obtains grants, shares of state gas tax and sales taxes, ballot measure tax revenue, etc. |
| Authority to levy taxes for specific purposes | Yes | Subject to California Proposition 218 restrictions on new and increased assessments |
| Authority to levy fees and fines, and to recover costs through lien processes, for nuisance abatement | Yes | Subject to an appeal process that involves administrative law judges retained by the City |
| Fees for water, sewer, gas, or electric services | Yes | Water, sewer, solid waste, code enforcement (cleanup) |

| Financial Resources | Accessible/Eligible to Use (Yes/No) | Comments |
|---|---|---|
| Impact fees for new development | Yes | Master Fee Schedule as originally chartered under the City's Urban Growth Management Ordinance |
| Incur debt through general obligation bonds | Yes | Would need vote of the taxpayers to enact. |
| Incur debt through special tax bonds | Yes | Special Assessment Districts that issue debt and incur the debt but the City only administers |
| Incur debt through private activities | Yes | The City has the capability of doing them and have in the past |
| Withhold spending or public infrastructure investment in hazard prone areas | Yes | The Department of Public Utilities retains jurisdiction over water and sewer services and determines its appropriate service areas with risk to facilities being one of the factors leading to a decision not to extend services to River bottom properties |

## E.4.4 Mitigation Outreach and Partnerships

The Fresno Department of Public Utilities, in conjunction with other agencies, provides water conservation and stormwater quality protection public information programs. The Fire Department provides personal preparedness outreach for heat and freeze emergencies and shelter-in-place information for hazardous materials emergencies. Additionally, the City has developed public service announcements for smoke detector battery life, canal safety, and fireworks safety.

The City's Joint Information System disseminates information in Spanish, and the City can obtain translation services for other languages when necessary. A Joint Information Center plan is an annex to the City of Fresno Emergency Operations Plan and provides comprehensive guidance for early warning notification in all languages and specifically the Americans with Disabilities Act (ADA) community.

Preparedness Exercises afford the opportunity to include the City of Fresno ADA Committee. Members of the committee and volunteers from the ADA community role play for realistic first responder training.

## E.4.5 Other Mitigation Efforts

- The City is a certified StormReady community through the National Weather Service.
- The Fire Department, Police Department, and Solid Waste Division are nationally accredited.
- The City has installed security systems for the wastewater treatment facility and for its surface water treatment plant. Generators are installed in critical groundwater pumping stations and these facilities are secured.

## E.4.6 Opportunities for Enhancement

Based on the capabilities assessment, the City of Fresno has several existing mechanisms in place that already help to mitigate hazards. In addition to these existing capabilities, there are also opportunities for the City to expand or improve on these policies and programs to further protect

the community. Future improvements may include providing training for staff members related to hazards or hazard mitigation grant funding in partnership with the County and Cal OES. Additional training opportunities will help to inform City staff members on how best to integrate hazard information and mitigation projects into their departments. Continuing to train City staff on mitigation and the hazards that pose a risk to the City of Fresno will lead to more informed staff members who can better communicate this information to the public. In addition, the City could work to improve the CRS rating through additional floodplain management program enhancements. This could further lower the cost of flood insurance for residents.

# E.5 Mitigation Strategy

## E.5.1 Mitigation Goals and Objectives

The City of Fresno adopts the hazard mitigation goals and objectives developed by the HMPC and described in Chapter 5 Mitigation Strategy.

### Incorporation into Existing Planning Mechanisms

The information contained within this plan, including results from the Vulnerability Assessment, and the Mitigation Strategy will be used by the City to help inform updates and the development of local plans, programs and policies. The Public Works Department may utilize the hazard information when implementing Capital Improvement projects and the Planning and Development Department may utilize the hazard information when reviewing a site plan or other type of development applications. The City will also incorporate this LHMP into the Safety Element of their General Plan, as recommended by Assembly Bill (AB) 2140.

As noted in Chapter 7 Plan Implementation, the HMPC representatives from Fresno will report on efforts to integrate the hazard mitigation plan into local plans, programs and policies and will report on these efforts at the annual HMPC plan review meeting.

### Continued Compliance with the National Flood Insurance Program

In addition to the mitigation actions identified herein the City will continue to comply with the National Flood Insurance Program as specified in General Plan Policy NS-3-j: *"National Flood Insurance Program. Continue to participate in the National Flood Insurance Program (NFIP) by ensuring compliance with applicable requirements."*

## E.5.2 Completed 2009 Mitigation Actions

The City of Fresno did not complete any of the mitigation actions identified in the 2009 plan. However, implementation is in progress for several of these actions and will be continued as part of the mitigation strategy for this plan update.

## E.5.3 Mitigation Actions

The planning team for the City of Fresno identified and prioritized the following mitigation actions based on the risk assessment. Background information as well as information on how each action will be implemented and administered, such as ideas for implementation, responsible office, partners, potential funding, estimated cost, and schedule are also included.

In addition to implementing the mitigation actions below the City of Fresno will be participating in the county-wide, multi-jurisdictional action of developing and conducting a multi-hazard seasonal public awareness program. The county-wide project will be led by the County in

partnership with all municipalities and special districts. The City agrees to help disseminate information on hazards provided by the County. More information on the action can be found in the base plan Chapter 5 Mitigation Strategy (see Section 5.3.3 Multi-Jurisdictional Mitigation Actions, Action #1. Develop and Conduct a Multi-Hazard Seasonal Public Awareness Program).

### *1. Establish Post-Disaster Action Plan for City Continuity of Operations Plan*

**Hazard(s) Addressed:** Multi-Hazard: dam failure, earthquake, flood, severe weather, wildfire, hazardous materials

**Issue/Background:** Establish a post-disaster action plan to be part of the City of Fresno Continuity of Operations Plan (COOP) that will include the following elements:

- Procedures for public information
- Post-disaster damage assessment
- Grant writing
- Code enforcement
- Redundant operations

The plan will also include annexes from local businesses and large employers to improve economic and employment recovery. The plan will also identify a mechanism for the City to help businesses without COOPs develop a COOP to be incorporated, as an annex, into the City's Emergency Operations Plan.

**Other Alternatives**: No action

**Responsible Office**: City of Fresno Emergency Preparedness Officer

**Priority (High, Medium, Low)**: High

**Cost Estimate**: $150,000

**Potential Funding**: Local funds, grants

**Benefits (Avoided Losses)**: This will improve response/recovery during an event through pre-planning. A City COOP and local business COOPs will reduce the impact of a disaster to the local economy and employment.

**Schedule:** Long term

**Status**: 2009 project, implementation in progress

### *2. Improve the City's Capabilities for Sheltering Animals in a Disaster*

**Hazard(s) Addressed**: Multi-Hazard: dam failure, earthquake, flood, severe weather, wildfire, hazardous materials

**Issue/Background**: During a disaster, not only do people need to be rescued, but their pets do also. Hurricane Katrina showed the nation that shelters do not typically allow pets, so pets may be left behind when their owners evacuate. The care of the animals left behind falls to local animal shelters. Currently, the SPCA Animal Shelter does not have the supplies to handle a large scale animal emergency. The City has approximately 18,000 licensed dogs. If a disaster occurred, they would only be able to house a small percentage of them. Overcrowding of animals usually causes diseases and loss of animal life. Purchasing new cages would alleviate some of the overcrowding created by a disaster.

**Other Alternatives**: Ask other agencies for supplies, if they have them available.

**Responsible Office**: City of Fresno Emergency Preparedness Officer

**Priority (High, Medium, Low)**: High

**Cost Estimate**: $50,000

**Potential Funding**: General fund

**Benefits (Avoided Losses)**: This will cut down on the spread of disease and animal loss during an emergency or disaster.

**Schedule:** Short term

**Status**: 2009 project, implementation in progress

### *3. Train and Certify City Inspectors to Conduct Post-Disaster Damage Assessment*

**Hazard(s) Addressed:** Multi-Hazard: dam failure, earthquake, flood, severe weather, wildfire, hazardous materials

**Issue/Background**: City inspectors play a vital role in post-disaster building assessment and damage assessment. Pre-training and certification is vital in response and recovery to reduce loss of life, relocate populations, and ensure the rebuilding of local economies.

**Other Alternatives**: No action

**Responsible Office**: City of Fresno Emergency Preparedness Officer and Planning and Development Department

**Priority (High, Medium, Low)**: High

**Cost Estimate**: $250,000

**Potential Funding**: Grants

**Benefits (Avoided Losses)**: This will improve response/recovery during an event through pre-training and certification of individuals responsible for performing assessment of structures and facilities impacted by disasters. Certification will also allow qualified staff to mobilize with the State of California Office of Emergency Services (Region 5) Urban Search and Rescue Task Force.

**Schedule:** Long term

**Status**: 2009 project, implementation not yet started

### *4. Implement a Flood Awareness Program for the Public*

**Hazard(s) Addressed:** Flood

**Issue/Background**: The City needs a program to educate flood-prone property owners along the San Joaquin River and in frequent annual flooding areas about the flood threat and how best to prepare, mitigate, and insure their properties.

**Other Alternatives**: No action

**Responsible Office**: City of Fresno Emergency Preparedness Officer and Planning and Development Department

**Priority (High, Medium, Low)**: Medium

**Cost Estimate**: $15,000/year

**Potential Funding**: General fund, grants

**Benefits (Avoided Losses)**: This will prevent the loss of human life and economic and property losses.

**Schedule**: Long term

**Status**: 2009 project, implementation not yet started

### *5. Southwest Fresno – Recycled Water Distribution System Construction*

**Hazard(s) Addressed:** Drought

**Issue/Background**: In 2009, the State of California adopted a recycled water policy establishing a mandate to increase the use of recycled water in California by 200,000 acre-feet per year by 2020 and an additional 300,000 acre-feet per year by 2030. The Recycled Water Master Plan prepared by the City of Fresno, Department of Public Utilities (DPU), identifies opportunities to assist with compliance of this law by reducing groundwater pumping and replacing groundwater with recycled water for non-potable purposes (i.e. outdoor irrigation, dust control, fountains, etc.). On April 11, 2013, the Council adopted the Recycled Water Master Plan and associated environmental documents.

In 2017, the DPU commissioned a 5 MGD Tertiary Treatment Facility at the Fresno-Clovis Regional Wastewater Treatment Facility. DPU is currently constructing a Recycled Water Distribution System in Southwest Fresno to deliver recycled water to parks, cemeteries, schools, agricultural uses, etc., to offset potable water irrigation demands. This will help mitigate drought by enabling the use of recycled water for certain uses instead of tapping potable water supplies.

**Other Alternatives**: DPU has a Water Shortage Contingency Plan (WSCP) which was updated in the City of Fresno's 2015 Urban Water Management Plan to manage water shortages including drought conditions. The WSCP consists of four stages allowing the City to ultimately reduce its water demand to a level commensurate with the water supplies available to a maximum reduction of 50 percent.

**Responsible Office**: City of Fresno Department of Public Utilities

**Priority (High, Medium, Low)**: High

**Cost Estimate**: $75,000,000

**Potential Funding**: California State Water Resources Control Board – Clean Water State Revolving Fund

**Benefits (Avoided Losses)**: Reduced ground water pumping by using recycled water for non-potable purposes.

**Schedule:** Ongoing with completion in 2019

**Status**: New project

### *6. Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation*

**Hazard(s) Addressed:** Drought

**Issue/Background:** The Kings subbasin underlays the City of Fresno and like many groundwater basins throughout the State, this subbasin is in overdraft condition with underground aquifers adversely impacted by overuse. Such impacts include significant decline in water storage and water levels, degradation of water quality, and land subsidence resulting in the permanent loss of storage capacity. The Sustainable Groundwater Management Act (SGMA) provides for the establishment of local Groundwater Sustainability Agencies (GSAs) to manage groundwater sustainability within groundwater subbasins defined by the California Department of Water Resources (DWR). The City of Fresno has become a joint power authority of the North Kings Groundwater Sustainability Agency, other members of the Agency include the County of Fresno, City of Kerman, City of Clovis, Biola Community Services District, Garfield Water District and International Water District. As a member of the North Kings GSA, the City of Fresno is required to participate in the development and implementation, no later than January 31, 2020, of a

Groundwater Sustainability Plan (GSP) to ensure a sustainable yield of groundwater, without causing undesirable results. Failure to comply with that requirement could result in the State asserting its power to manage local groundwater resources. Participation in the North Kings GSA and the implementation of a GSP will allow the City to maintain sustainable groundwater supplies while providing insurance against periods of long-term drought, a high significance hazard for the City of Fresno.

**Other Alternatives**: None, compliance required by law, failure to meet requirements will result in State intervention and oversight.

**Responsible Office**: City Engineer and North Kings GSA

**Priority (High, Medium, Low):** High

**Cost Estimate:** Varies by GSA for preparation of the required GSP. Further expenses are anticipated to be accrued for the planning and construction of groundwater recharge projects.

**Potential Funding**: Property owner assessments along with grant funding opportunities from the State.

**Benefits (Avoided Losses):** Preparation and implementation of the GSP by the respective GSAs will result in the management of groundwater in a manner that is sustainable and avoids undesirable results as defined by the California State Department of Water Resources.

**Schedule:** GSAs must complete and submit the required GSP to DWR by January 31, 2020, which is to be fully implemented and result in sustainability of the groundwater basin, with no undesirable effects, by the year 2040.

**Status:** New project in 2018

# Attachment 5
# Notice of Public Hearing

Notice of Public Hearing

City of Fresno

Draft 2020 Urban Water Management Plan,

Draft 2020 Water Shortage Contingency Plan, &

Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed"

The City of Fresno (City) will hold a public hearing at 10:05 A.M. on Thursday, July 15, 2021, at the City Council Chambers at the City Hall located at 2600 Fresno Street to receive public comments on the City's Draft 2020 Urban Water Management Plan (2020 UWMP), the City's Draft 2020 Water Shortage Contingency Plan (2020 WSCP), and a Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed" (Addendum). The Draft 2020 UWMP addresses current and projected water supply availability and reliability and provides a comparison with current and projected water demands through the year 2045. The Draft 2020 WSCP details the City's potential actions in response to a severe water shortage or water supply emergency. Sections 1.3, 1.4, 1.5, and 1.8 of the Draft 2020 WSCP were revised from a version of the document that was previously released on Monday, July 28, 2021. The Draft Addendum discusses the City's reduced reliance on the Sacramento-San Joaquin River Delta surface water.

Interested citizens are invited to make public comments on the three documents at the public hearing. Services of an interpreter and additional accommodations such as assistive listening devices can be made available. Requests for accommodations should be made more than five working days but no later than 48 hours prior to the scheduled hearing. Please contact Mr. Peter Maraccini at 559-621-1603 or Peter.Maraccini@Fresno.gov.

The three documents will be made available for public review starting July 1, 2021. Physical copies of the three documents can be found at the following Fresno County Libraries: Central Library (2420 Mariposa St.), Woodward Park Regional Library (944 E Perrin Ave.), Betty Rodriguez Regional Library (3040 N Cedar Ave.), and Sunnyside Regional Library (5566 E Kings Canyon Rd.). Electronic copies of the three documents are available online at https://www.fresno.gov/publicutilities/about-dpu/plans-reports-resources/. Documents can be provided in alternate formats upon request.

Comments may be submitted by calling Utilities Planning & Engineering at 559-621-1603, by writing to Mr. Peter Maraccini, Utilities Planning & Engineering Division, 2101 G Street

Bldg. A, Fresno, CA 93706, or by emailing at Peter.Maraccini@Fresno.gov. All written comments must be received no later than July 14, 2021, at 11:59 P.M.

# Attachment 6
# Resolution Approving the WSCP

RESOLUTION NO. 2021-197

A RESOLUTION OF THE COUNCIL OF THE CITY OF FRESNO, CALIFORNIA, TO ADOPT THE 2020 WATER SHORTAGE CONTINGENCY PLAN AND AUTHORIZE THE CITY MANAGER TO DECLARE THE APPROPRIATE WATER CONSERVATION STAGES AND IMPLEMENT THE ASSOCIATED SHORTAGE RESPONSE ACTIONS

WHEREAS, the Urban Water Management Planning Act, codified at California Water Code Sections 10610, et seq., requires every urban water supplier to prepare and adopt an Urban Water Management Plan (UWMP) and update said plan at least once every five years; and

WHEREAS, Water Code Section 10632 requires every urban water supplier to prepare and adopt a Water Shortage Contingency Plan (WSCP) as part of its UWMP; and

WHEREAS, the WSCP details intended City actions to respond to water shortages; and

WHEREAS, as an urban water supplier, the City of Fresno has prepared a WSCP that complies with the requirements of the Urban Water Management Planning Act; and

WHEREAS, the City consulted with, and requested comments from, regional water related agencies such as the County of Fresno, Fresno Irrigation District, the City of Clovis, etc., as required by Water Code Section 10641; and

WHEREAS, prior to the public hearing on July 15, 2021, the City made the draft 2020 WSCP available for public inspection and placed copies for public review at the following Fresno County Libraries: Central Library, Woodward Park Regional Library,



Date Adopted: 07/15/2021
Date Approved: 07/19/2021
Effective Date: 07/19/2021

Betty Rodriguez Regional Library, and Sunnyside Regional Library, as well as making electronic copies available to agencies and the public, as required by Water Code Section 10642; and

WHEREAS, on July 1, 2021, and July 8, 2021, respectively, the City published notices on the City Clerk's website and in the Fresno Bee that on July 15, 2021 at 10:05 a.m. a public hearing regarding the draft 2020 WSCP would be held in Council Chambers at which time public comment on the plan would be received, as required by Water Code Section 10642; and

WHEREAS, on July 15, 2021, at 10:05 a.m. the public hearing was conducted in Council Chambers at which the public was provided the opportunity to comment on the 2020 WSCP.

NOW, THEREFORE, BE IT RESOLVED BY THE Council of the City of Fresno as follows:

1. The City hereby adopts the 2020 Water Shortage Contingency Plan.

2. The City Manager, or designee, is hereby authorized and directed to file the City of Fresno 2020 Water Shortage Contingency Plan with the California Department of Water Resources, the California State Library, and the County of Fresno within 30 days after adoption.

3. The City Manager, or designee, is hereby authorized to declare the appropriate Water Conservation Stages outlined in the 2020 Water Shortage Contingency Plan and implement the associated shortage response actions specified for the appropriate Water Conservation Stage in the Water Shortage Contingency Plan.

* * * * * * * * * * * * * * *

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, BRIANA PARRA, Interim City Clerk of the City of Fresno, certify that the foregoing resolution was adopted by the Council of the City of Fresno, at a regular meeting held on the 15th day of July, 2021.

AYES :Arias, Esparza, Karbassi, Maxwell, Chavez
NOES :None
ABSENT :Bredefeld, Soria
ABSTAIN :None

Mayor Approval: July 19th, 2021
Mayor Approval/No Return: N/A, 2021
Mayor Veto: N/A, 2021
Council Override Veto: N/A, 2021

BRIANA PARRA, CMC
Interim City Clerk

BY: Briana Parra 7/20/2021
Deputy Date

APPROVED AS TO FORM:
DOUGLAS T. SLOAN
City Attorney

BY: 7/20/21
Jennifer M. Quintanilla Date
Senior Deputy

*July 19, 2021*

Council Adoption: 07/15/2021
Mayor Approval:
Mayor Veto:
Override Request:

TO: MAYOR JERRY DYER

FROM BRIANA PARRA, CMC
Interim City Clerk

SUBJECT: TRANSMITTAL OF COUNCIL ACTION FOR APPROVAL OR VETO

At the City Council meeting of July 15, 2021, Council adopted the attached Resolution No. 2021-197, entitled ***RESOLUTION – **Adopting 2020 Water Shortage Contingency Plan and authorizing the City Manager to declare the appropriate water conservation stages and implement the associated shortage response actions (Subject to Mayor's veto).** Item 10:05 A.M. (4), File ID21-22925, by the following vote:

| | | |
|---|---|---|
| Ayes | : | Arias, Esparza, Karbassi, Maxwell, Chavez |
| Noes | : | None |
| Absent | : | Bredefeld, Soria |
| Abstain | : | None |

Please indicate either your formal approval or veto by completing the following sections and executing and dating your action. Please file the completed memo with the Clerk's office on or before July 29, 2021. In computing the ten day period required by Charter, the first day has been excluded and the tenth day has been included unless the 10th day is a Saturday, Sunday, or holiday, in which case it has also been excluded. Failure to file this memo with the Clerk's office within the required time limit shall constitute approval of the ordinance, resolution or action, and it shall take effect without the Mayor's signed approval.

**APPROVED /** **NO RETURN:** _____

**VETOED** for the following reasons: (Written objections are required by Charter; attach additional sheets if necessary.)

_____

_____

_____ Date: 7/19/2021

Jerry Dyer, Mayor

**COUNCIL OVERRIDE ACTION:** Date: _____

Ayes :
Noes :
Absent :
Abstain :

RECEIVED
2021 JUL 19 P 4:52
CITY OF FRESNO
CITY CLERK'S OFFICE

# K

# Outreach Events

| 2015 Outreach Events | | |
|---|---|---|
| Date | Name of Event | Description |
| Jan | "Creating a Water-wise Landscape: Seven Steps to Follow our Climate" | Landscape Workshop by Susan Stiltz as SPEAKER for City employees at City Hall 2600 Fresno St 93721.Distribute literature E. Social media: sent email with flier to City employees. Contact: Melany Felton. LITERATURE |
| Jan | Fresno Chinese New Year Parade | Outreach booth providing water saving info & rebate information |
| March | Spring Festival - Clovis Botanical Garden | Outreach booth providing water saving info & rebate information |
| April | Home Depot - Riverpark Kid's Day Spring Event | Hands on activity for kids, drought tolerant plants planting, literature for adults |
| April | America's Party for the Planet | Outreach booth providing water saving info & rebate information |
| April | Sequoia Middle School Outdoor Club | Outreach booth providing water saving info & rebate information |
| May | Spring Fling - Master Gardener | Provided literature for event held at Garden of the Sun |
| May | Madden Library Water-wise Plant Exchange event | Water wise garden speaker, materials handed out |
| May | Water-Wise Plant Exchange | Large community event collaborating with several agencies to share water-wise plants & information, hands on activities |
| June | Kids Water Camp | Large one day event, hands on activites, educational for kids 3rd grade (all elementary schools invited to participate) |
| July | Fresno Home Remodeling & Decorating Show | Fresno Fairgrounds 3 day event. Outreach booth with visual displays & information |
| Sept | Carnaval Children's Festival | Mosqueda Center Outreach booth, providing water saving information & rebates |
| Sept | Fresno State partnership | Susan Hawksworth extended education. Began planning for Feb classes with landscape specialists |
| Oct | Clovis Botanical Plant Sale & Fair | Outreach booth providing water saving info & rebate information |
| Nov | Fresno Fall Improvement Show | Inspiration Park Grand opening |
| Nov | Inspiration Park Grand opening | Outreach booth providing water saving info & rebate information |

| 2016 Outreach Events | | |
|---|---|---|
| March | Fresno Home & Garden Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |

| | | |
|---|---|---|
| March | Spring Into Your Garden | Outreach booth providing water saving info & rebate information. Visual displays |
| April | Water Planet Day | Outreach booth providing water saving info & rebate information. Visual displays |
| April | 8th Annual Water-Wise Plant Exchange | Large community event collaborating with several agencies to share water-wise plants & information, hands on activities |
| May | Senior Spring Fling @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information. Visual displays |
| July | Fresno Remodeling & Decorating Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |
| Sept | Carnaval @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information. Visual displays |
| Oct | Clovis Botanical Plant Sale & Fair | Outreach booth providing water saving info & rebate information. Visual displays |
| Nov | Fresno Fall Home Improvement Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |
| Dec | Fresno Neighborhood Revitalization | Work with FNR team to reach customers in lower income areas about City services. Orchard St. & Grant Ave |

| 2017 Outreach Events | | |
|---|---|---|
| Jan | Hmong New Year | Outreach booth providing water saving info & rebate information. Hmong translator & printed materials in Hmong |
| Feb | Fresno Neighborhood Revitalization | Work with FNR team to reach customers in lower income areas about City services. Hildago Elementary 3550 E Thomas 93702 |
| March | Fresno Home & Garden Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |
| March | Fresno Neighborhood Revitalization | Work with FNR team to reach customers in lower income areas about City services. Leavenworth Elementary School, 4420 E Thomas |

| | | |
|---|---|---|
| April | Fresno Neighborhood Revitalization | Work with FNR team to reach customers in lower income areas about City services. Webster Elementary School, 2600 E Tyler 93701 |
| April | 9th Annual Water-Wise Plant Exchange | Large community event collaborating with several agencies to share water-wise plants & information, hands on activities |
| April | Senior Spring Fling @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information |
| May | Fresno Neighborhood Revitalization | Work with FNR team to reach customers in lower income areas about City services. Slater Elementary school 4472 N Emerson 93705 |
| July | Fresno Remodeling & Decorating Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |
| Sept | Carnaval @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information |
| Oct | Clovis Botanical Plant Sale & Fair | Outreach booth providing water saving info & rebate information. Visual displays |
| Oct | Make A Difference Day @ Chukchansi Park | Outreach booth providing water saving info & rebate information. Visual displays |
| Nov | Fresno Fall Home Improvement Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 day event |

| 2018 Outreach Events | | |
|---|---|---|
| March | Fresno Home & Garden Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 day event |
| March | Spring Into Your Garden Festival | Outreach booth providing water saving info & rebate information. Visual displays |
| April | 10th Annual Water Wise Plant Exchange | Large community event collaborating with several agencies to share water-wise plants & information, hands on activities |
| May | Senior Spring Fling @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information |
| July | Fresno Remodeling & Decorating Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |

| | | |
|---|---|---|
| Sept | Carnaval @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information. Visual Display |
| Sept | Central California Women's Conference | Outreach booth providing water saving info & rebate information. Visual Display |
| Oct | Clovis Botanical Plant Sale & Fair | Outreach booth providing water saving info & rebate information. Visual Display |
| Nov | Fresno Fall Home Improvement Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 day event |

| 2019 Outreach Events | | |
|---|---|---|
| March | Fresno Home & Garden Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 day event |
| March | Spring Into Your Garden Festival | Outreach booth providing water saving info & rebate information. Visual displays |
| April | Outreach booth @ Manchester Mall | Outreach booth providing water saving info & rebate information. Visual displays |
| April | Party for the Planet @ Chaffee Zoo | Outreach booth providing water saving info & rebate information. Visual displays |
| May | Senior Spring Fling @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information. Visual displays |
| May | 11th Annual Water Wise Plant Exchange | Large community event collaborating with several agencies to share water-wise plants & information, hands on activities |
| July | Fresno Remodeling & Decorating Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |
| Sept | Carnaval @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information. Visual displays |
| Oct | Clovis Botanical Plant Sale & Fair | Outreach booth providing water saving info & rebate information. Visual displays |
| Nov | Fresno Fall Home Improvement Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 day event |

| 2020 Outreach Events |
|---|
| All Outreach Suspended |

# L

# Notification Letters

City of
FRESNO

**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Shay Bakman
Bakman Water Company
PO Box 7965
Fresno, CA 93747

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Bakman:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Scott Redelfs
City of Clovis Public Utilities
155 N. Sunnyside Ave
Clovis, CA 93611

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Redelfs:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Bill Stretch
Fresno Irrigation District
2907 South Maple Ave
Fresno, CA 93725

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Stretch:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of FRESNO

**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Peter Sanchez
Fresno Metropolitan Flood Control District
5469 East Olive Ave
Fresno, CA 93727

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Sanchez:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Steven White
Fresno County Public Works
2220 Tulare St, 6th Floor
Fresno, CA 93721

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. White:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Jason Phillips
Friant Water Authority
4969 E. McKinley Ave, Suite 201
Fresno, CA 93727

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Phillips:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Nick Keller
Garfield Water District
PO Box 337
Clovis, CA 93613

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Keller:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Moises Ortiz
Malaga County Water District
3580 South Frank Street
Fresno, CA 93725-2511

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Ortiz:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO

**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Kassy D. Chauhan, PE
North Kings Groundwater Sustainability Agency
2907 S. Maple Avenue
Fresno, CA 93725

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mrs. Chauhan:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of FRESNO

**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Jason Franklin
Pinedale County Water District
480 West Birch Ave
Pinedale, CA 93650

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Franklin:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Michael P. Jackson, PE
United States Bureau of Reclamation South-Central California Area Office
1243 N Street
Fresno, CA 93721-1813

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Jackson:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

Notice of Public Hearing

City of Fresno

Draft 2020 Urban Water Management Plan,

Draft 2020 Water Shortage Contingency Plan, &

Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed"

The City of Fresno (City) will hold a public hearing at 10:05 A.M. on Thursday, July 15, 2021, at the City Council Chambers at the City Hall located at 2600 Fresno Street to receive public comments on the City's Draft 2020 Urban Water Management Plan (2020 UWMP), the City's Draft 2020 Water Shortage Contingency Plan (2020 WSCP), and a Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed" (Addendum). The Draft 2020 UWMP addresses current and projected water supply availability and reliability and provides a comparison with current and projected water demands through the year 2045. The Draft 2020 WSCP details the City's potential actions in response to a severe water shortage or water supply emergency. Sections 1.3, 1.4, 1.5, and 1.8 of the Draft 2020 WSCP were revised from a version of the document that was previously released on Monday, July 28, 2021. The Draft Addendum discusses the City's reduced reliance on the Sacramento-San Joaquin River Delta surface water.

Interested citizens are invited to make public comments on the three documents at the public hearing. Services of an interpreter and additional accommodations such as assistive listening devices can be made available. Requests for accommodations should be made more than five working days but no later than 48 hours prior to the scheduled hearing. Please contact Mr. Peter Maraccini at 559-621-1603 or Peter.Maraccini@Fresno.gov.

The three documents will be made available for public review starting July 1, 2021. Physical copies of the three documents can be found at the following Fresno County Libraries: Central Library (2420 Mariposa St.), Woodward Park Regional Library (944 E Perrin Ave.), Betty Rodriguez Regional Library (3040 N Cedar Ave.), and Sunnyside Regional Library (5566 E Kings Canyon Rd.). Electronic copies of the three documents are available online at https://www.fresno.gov/publicutilities/about-dpu/plans-reports-resources/. Documents can be provided in alternate formats upon request.

Comments may be submitted by calling Utilities Planning & Engineering at 559-621-1603, by writing to Mr. Peter Maraccini, Utilities Planning & Engineering Division, 2101 G Street Bldg. A, Fresno, CA 93706, or by emailing at Peter.Maraccini@Fresno.gov. All written comments must be received no later than July 14, 2021, at 11:59 P.M.

McClatchy

Beaufort Gazette
Belleville News-Democrat
Bellingham Herald
Bradenton Herald
Centre Daily Times
Charlotte Observer
Columbus Ledger-Enquirer
Fresno Bee
The Herald - Rock Hill
Herald Sun - Durham
Idaho Statesman
Island Packet
Kansas City Star
Lexington Herald-Leader
Merced Sun-Star
Miami Herald
el Nuevo Herald - Miami
Modesto Bee
Raleigh News & Observer
The Olympian
Sacramento Bee
Fort Worth Star-Telegram
The State - Columbia
Sun Herald - Biloxi
Sun News - Myrtle Beach
The News Tribune Tacoma
The Telegraph - Macon
San Luis Obispo Tribune
Tri-City Herald
Wichita Eagle

# AFFIDAVIT OF PUBLICATION

| Account # | Order Number | Identification | Order PO | Amount | Cols | Depth |
|---|---|---|---|---|---|---|
| 59161 | 92995 | Print Legal Ad - IPL0030763 | | $861.84 | 2 | 5.31 |

**Attention:** City of

City of Fresno Dept. Public Utilities
2101 G Street Bldg A
Fresno, CA 93706

PUBLIC NOTICE

**Notice of Public Hearing**

**City of Fresno**
Draft 2020 Urban Water Management Plan,

Draft 2020 Water Shortage Contingency Plan, &

Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed"

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IPL0030763
Jul 1 2021

## COUNTY OF DALLAS
## STATE OF TEXAS

The undersigned states:

McClatchy Newspapers in and on all dates herein stated was a corporation, and the owner and publisher of The Fresno Bee.
The Fresno Bee is a daily newspaper of general circulation now published, and on all-the-dates herein stated was published in the City of Fresno, County of Fresno, and has been adjudged a newspaper of general circulation by the Superior Court of the County of Fresno, State of California, under the date of November 28, 1994, Action No. 520058-9.
The undersigned is and on all dates herein mentioned was a citizen of the United States, over the age of twenty-one years, and is the principal clerk of the printer and publisher of said newspaper; and that the notice, a copy of which is hereto annexed, marked Exhibit A, hereby made a part hereof, was published in The Fresno Bee in each issue thereof (in type not smaller than nonpareil), on the following dates.

No. of Insertions: 1

Beginning Issue of: 07/01/2021

Ending Issue of: 07/01/2021

Isabel Capps

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

Dated: 07/01/2021

Amanda Grisham

Notary Public in and for the state of Texas, residing in Dallas County

AMANDA DAWN GRISHAM
My Notary ID # 132031326
Expires May 30, 2023

**Extra charge for lost or duplicate affidavits.**
**Legal document please do not destroy!**

McClatchy

Beaufort Gazette
Belleville News-Democrat
Bellingham Herald
Bradenton Herald
Centre Daily Times
Charlotte Observer
Columbus Ledger-Enquirer
Fresno Bee
The Herald - Rock Hill
Herald Sun - Durham
Idaho Statesman
Island Packet
Kansas City Star
Lexington Herald-Leader
Merced Sun-Star
Miami Herald
el Nuevo Herald - Miami
Modesto Bee
Raleigh News & Observer
The Olympian
Sacramento Bee
Fort Worth Star-Telegram
The State - Columbia
Sun Herald - Biloxi
Sun News - Myrtle Beach
The News Tribune Tacoma
The Telegraph - Macon
San Luis Obispo Tribune
Tri-City Herald
Wichita Eagle

# AFFIDAVIT OF PUBLICATION

| Account # | Order Number | Identification | Order PO | Amount | Cols | Depth |
|---|---|---|---|---|---|---|
| 59161 | 95606 | Print Legal Ad - IPL0031437 | | $861.84 | 2 | 53 L |

**Attention:** City of

City of Fresno Dept. Public Utilities
2101 G Street Bldg A
Fresno, CA 93706

PUBLIC NOTICE

**Notice of Public Hearing**

**City of Fresno**
Draft 2020 Urban Water Management Plan,

Draft 2020 Water Shortage Contingency Plan, &

Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed"

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IPL0031437
Jul 8 2021

## COUNTY OF DALLAS
## STATE OF TEXAS

The undersigned states:

McClatchy Newspapers in and on all dates herein stated was a corporation, and the owner and publisher of The Fresno Bee.
The Fresno Bee is a daily newspaper of general circulation now published, and on all-the-dates herein stated was published in the City of Fresno, County of Fresno, and has been adjudged a newspaper of general circulation by the Superior Court of the County of Fresno, State of California, under the date of November 28, 1994, Action No. 520058-9.
The undersigned is and on all dates herein mentioned was a citizen of the United States, over the age of twenty-one years, and is the principal clerk of the printer and publisher of said newspaper; and that the notice, a copy of which is hereto annexed, marked Exhibit A, hereby made a part hereof, was published in The Fresno Bee in each issue thereof (in type not smaller than nonpareil), on the following dates.

No. of Insertions: 1

Beginning Issue of: 07/08/2021

Ending Issue of: 07/08/2021

Isabel Capps

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

Dated: 07/08/2021

Amanda Grisham

Notary Public in and for the state of Texas, residing in Dallas County

AMANDA DAWN GRISHAM
My Notary ID # 132031326
Expires May 30, 2023

**Extra charge for lost or duplicate affidavits.**
**Legal document please do not destroy!**

# M

# Adopting Resolutions

RESOLUTION NO. 2021-196

A RESOLUTION OF THE COUNCIL OF THE CITY OF FRESNO, CALIFORNIA, TO ADOPT THE 2020 URBAN WATER MANAGEMENT PLAN

WHEREAS, the Urban Water Management Planning Act, codified at California Water Code Sections 10610, et seq., requires every urban water supplier to prepare and adopt an Urban Water Management Plan (UWMP) and update said plan at least once every five years; and

WHEREAS, the City adopted its current UWMP on June 23, 2016; and

WHEREAS, the requirements of an UWMP are to generally: (1) assess current and projected water supplies, (2) evaluate water demand and customer types, (3) evaluate reliability of water supplies, (4) compare demand and supply projections for a 20-year period, and (5) detail response actions in the event of a water shortage; and

WHEREAS, as an urban water supplier, the City of Fresno has prepared the UWMP to comply with the requirements of the Urban Water Management Planning Act; and

WHEREAS, the City consulted with, and requested comments from, regional water related agencies such as the County of Fresno, Fresno Irrigation District, the City of Clovis, etc., as required by Water Code Section 10641; and

WHEREAS, prior to the public hearing on July 15, 2021, the City made the draft 2020 UWMP available for public inspection and placed copies for public review at the following Fresno County Libraries: Central Library, Woodward Park Regional Library, Betty Rodriguez Regional Library, and Sunnyside Regional Library, as well as making



Date Adopted: 07/15/2021
Date Approved: 07/19/2021
Effective Date: 07/19/2021

electronic copies available to agencies and the public, as required by Water Code Section 10642; and

WHEREAS, on July 1, 2021, and July 8, 2021, respectively, the City published notices on the City Clerk's website and in the Fresno Bee that on July 15, 2021 at 10:05 a.m. a public hearing regarding the draft 2020 UWMP would be held in Council Chambers at which public comment on the plan would be received, as required by Water Code Section 10642; and

WHEREAS, on July 15, 2021, at 10:05 a.m. the public hearing was conducted in Council Chambers at which the public was provided the opportunity to comment on the 2020 UWMP.

NOW, THEREFORE, BE IT RESOLVED BY THE Council of the City of Fresno as follows:

1. The City hereby adopts the 2020 Urban Water Management Plan.

2. The City Manager, or designee, is hereby authorized and directed to file the City of Fresno 2020 Urban Water Management Plan with the California Department of Water Resources, the California State Library, and the County of Fresno within 30 days after adoption.

* * * * * * * * * * * * * * *

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, BRIANA PARRA, Interim City Clerk of the City of Fresno, certify that the foregoing resolution was adopted by the Council of the City of Fresno, at a regular meeting held on the 15th day of July, 2021.

AYES :Arias, Esparza, Karbassi, Maxwell, Chavez
NOES :None
ABSENT :Bredefeld, Soria
ABSTAIN :None

Mayor Approval: July 19th, 2021
Mayor Approval/No Return: N/A, 2021
Mayor Veto: N/A, 2021
Council Override Veto: N/A, 2021

BRIANA PARRA, CMC
Interim City Clerk

BY: Briana Parra 7/20/2021
Deputy Date

APPROVED AS TO FORM:
DOUGLAS T. SLOAN
City Attorney

BY: 7/20/21
Jennifer M. Quintanilla Date
Senior Deputy

*July 19, 2021*

Council Adoption: 07/15/2021
Mayor Approval:
Mayor Veto:
Override Request:

TO: MAYOR JERRY DYER

FROM BRIANA PARRA, CMC
Interim City Clerk

SUBJECT: TRANSMITTAL OF COUNCIL ACTION FOR APPROVAL OR VETO

At the City Council meeting of July 15, 2021, Council adopted the attached Resolution No. 2021-196, entitled ***RESOLUTION – Adopting 2020 Urban Water Management Plan (Subject to Mayor's veto).** Item 10:05 A.M. (3), File ID21-22925, by the following vote:

| | | |
|---|---|---|
| Ayes | : | Arias, Esparza, Karbassi, Maxwell, Chavez |
| Noes | : | None |
| Absent | : | Bredefeld, Soria |
| Abstain | : | None |

Please indicate either your formal approval or veto by completing the following sections and executing and dating your action. Please file the completed memo with the Clerk's office on or before July 29, 2021. In computing the ten day period required by Charter, the first day has been excluded and the tenth day has been included unless the 10th day is a Saturday, Sunday, or holiday, in which case it has also been excluded. Failure to file this memo with the Clerk's office within the required time limit shall constitute approval of the ordinance, resolution or action, and it shall take effect without the Mayor's signed approval.

**APPROVED /** **NO RETURN:** _____

**VETOED** for the following reasons: (Written objections are required by Charter; attach additional sheets if necessary.)

_____

_____

_____ Date: 7/19/2021

Jerry Dyer, Mayor

**COUNCIL OVERRIDE ACTION:** Date: _____

Ayes :
Noes :
Absent :
Abstain :

RECEIVED
2021 JUL 19 P 4:52
CITY OF FRESNO
CITY CLERK'S OFFICE

RESOLUTION NO. 2021-197

A RESOLUTION OF THE COUNCIL OF THE CITY OF FRESNO, CALIFORNIA, TO ADOPT THE 2020 WATER SHORTAGE CONTINGENCY PLAN AND AUTHORIZE THE CITY MANAGER TO DECLARE THE APPROPRIATE WATER CONSERVATION STAGES AND IMPLEMENT THE ASSOCIATED SHORTAGE RESPONSE ACTIONS

WHEREAS, the Urban Water Management Planning Act, codified at California Water Code Sections 10610, et seq., requires every urban water supplier to prepare and adopt an Urban Water Management Plan (UWMP) and update said plan at least once every five years; and

WHEREAS, Water Code Section 10632 requires every urban water supplier to prepare and adopt a Water Shortage Contingency Plan (WSCP) as part of its UWMP; and

WHEREAS, the WSCP details intended City actions to respond to water shortages; and

WHEREAS, as an urban water supplier, the City of Fresno has prepared a WSCP that complies with the requirements of the Urban Water Management Planning Act; and

WHEREAS, the City consulted with, and requested comments from, regional water related agencies such as the County of Fresno, Fresno Irrigation District, the City of Clovis, etc., as required by Water Code Section 10641; and

WHEREAS, prior to the public hearing on July 15, 2021, the City made the draft 2020 WSCP available for public inspection and placed copies for public review at the following Fresno County Libraries: Central Library, Woodward Park Regional Library,



Date Adopted: 07/15/2021
Date Approved: 07/19/2021
Effective Date: 07/19/2021

Betty Rodriguez Regional Library, and Sunnyside Regional Library, as well as making electronic copies available to agencies and the public, as required by Water Code Section 10642; and

WHEREAS, on July 1, 2021, and July 8, 2021, respectively, the City published notices on the City Clerk's website and in the Fresno Bee that on July 15, 2021 at 10:05 a.m. a public hearing regarding the draft 2020 WSCP would be held in Council Chambers at which time public comment on the plan would be received, as required by Water Code Section 10642; and

WHEREAS, on July 15, 2021, at 10:05 a.m. the public hearing was conducted in Council Chambers at which the public was provided the opportunity to comment on the 2020 WSCP.

NOW, THEREFORE, BE IT RESOLVED BY THE Council of the City of Fresno as follows:

1. The City hereby adopts the 2020 Water Shortage Contingency Plan.

2. The City Manager, or designee, is hereby authorized and directed to file the City of Fresno 2020 Water Shortage Contingency Plan with the California Department of Water Resources, the California State Library, and the County of Fresno within 30 days after adoption.

3. The City Manager, or designee, is hereby authorized to declare the appropriate Water Conservation Stages outlined in the 2020 Water Shortage Contingency Plan and implement the associated shortage response actions specified for the appropriate Water Conservation Stage in the Water Shortage Contingency Plan.

* * * * * * * * * * * * * * *

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, BRIANA PARRA, Interim City Clerk of the City of Fresno, certify that the foregoing resolution was adopted by the Council of the City of Fresno, at a regular meeting held on the 15th day of July, 2021.

AYES :Arias, Esparza, Karbassi, Maxwell, Chavez
NOES :None
ABSENT :Bredefeld, Soria
ABSTAIN :None

Mayor Approval: July 19th, 2021
Mayor Approval/No Return: N/A, 2021
Mayor Veto: N/A, 2021
Council Override Veto: N/A, 2021

BRIANA PARRA, CMC
Interim City Clerk

BY: Briana Parra 7/20/2021
Deputy Date

APPROVED AS TO FORM:
DOUGLAS T. SLOAN
City Attorney

BY: 7/20/21
Jennifer M. Quintanilla Date
Senior Deputy

*July 19, 2021*

Council Adoption: 07/15/2021
Mayor Approval:
Mayor Veto:
Override Request:

TO: MAYOR JERRY DYER

FROM BRIANA PARRA, CMC
Interim City Clerk

SUBJECT: TRANSMITTAL OF COUNCIL ACTION FOR APPROVAL OR VETO

At the City Council meeting of July 15, 2021, Council adopted the attached Resolution No. 2021-197, entitled ***RESOLUTION – **Adopting 2020 Water Shortage Contingency Plan and authorizing the City Manager to declare the appropriate water conservation stages and implement the associated shortage response actions (Subject to Mayor's veto).** Item 10:05 A.M. (4), File ID21-22925, by the following vote:

| | | |
|---|---|---|
| Ayes | : | Arias, Esparza, Karbassi, Maxwell, Chavez |
| Noes | : | None |
| Absent | : | Bredefeld, Soria |
| Abstain | : | None |

Please indicate either your formal approval or veto by completing the following sections and executing and dating your action. Please file the completed memo with the Clerk's office on or before July 29, 2021. In computing the ten day period required by Charter, the first day has been excluded and the tenth day has been included unless the 10th day is a Saturday, Sunday, or holiday, in which case it has also been excluded. Failure to file this memo with the Clerk's office within the required time limit shall constitute approval of the ordinance, resolution or action, and it shall take effect without the Mayor's signed approval.

**APPROVED /** **NO RETURN:** _____

**VETOED** for the following reasons: (Written objections are required by Charter; attach additional sheets if necessary.)

_____

_____

_____ Date: 7/19/2021

Jerry Dyer, Mayor

**COUNCIL OVERRIDE ACTION:** Date: _____

Ayes :
Noes :
Absent :
Abstain :

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2021 JUL 19 P 4:52
CITY OF FRESNO
CITY CLERK'S OFFICE

RESOLUTION NO. 2021-198

A RESOLUTION OF THE COUNCIL OF THE CITY OF FRESNO, CALIFORNIA, TO ADOPT APPENDIX L - ADDENDUM TO THE CITY OF FRESNO'S 2015 URBAN WATER MANAGEMENT PLAN

WHEREAS, the City of Fresno (City) contracts with the United States Bureau of Reclamation (USBR) Central Valley Project (CVP) Friant Division for an annual supply of 60,000 acre-feet of Class 1 surface water; and,

WHEREAS, the CVP was developed through an agreement with the Exchange Contractors that have historic pre-1914 San Joaquin River water rights; and,

WHEREAS, the Exchange Contractors receive water from the Sacramento-San Joaquin River Delta (Delta) in exchange for the CVP Friant Division water; and,

WHEREAS, during times of severe drought when the Exchange Contractors don't receive their full allocations from the Delta, the Exchange Contractors can call on their historic pre-1914 San Joaquin River water rights to fulfill their allocations, which reduces CVP Friant Division allocations to the City; and,

WHEREAS, due to the indirect connection of the City's Class 1 surface water allocation from the CVP Friant Division to the Exchange Contractors allocation from the Delta, the City is required to demonstrate consistency with the Delta Plan established via the Sacramento-San Joaquin Delta Reform Act of 2009; and,

WHEREAS, Delta Plan Policy WR P1 requires urban water suppliers to demonstrate reduced Delta reliance in the 2015 and 2020 Urban Water Management Plans (UWMPs); and,

WHEREAS, the City's 2015 UWMP did not include information regarding Delta



Date Adopted: 07/15/2021
Date Approved: 07/19/2021
Effective Date: 07/19/2021

Plan Policy WR P1, Reduce Reliance on the Delta Through Improved Regional Water Self -Reliance; and

WHEREAS, the City prepared the 2015 UWMP following the Department of Water Resources (DWR) UWMP Guidebook 2015, which made such reporting optional; and,

WHEREAS, the DWR UWMP Guidebook 2020 instructs urban water suppliers to amend 2015 UWMP with reporting on reduced Delta reliance if not already included; and,

WHEREAS, the City has prepared Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed" that follows the instructions of the DWR UWMP Guidebook 2020, fulfills the requirements of the Delta Plan Policy WR P1, and complies with the requirements of the Urban Water Management Planning Act; and,

WHEREAS, the City desires to amend its 2015 UWMP to incorporate Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed;" and

WHEREAS, prior to the public hearing on July 15, 2021, the City made the draft Appendix L – Addendum to the 2015 UWMP available for public inspection and placed copies for public review at the following Fresno County Libraries: Central Library, Woodward Park Regional Library, Betty Rodriguez Regional Library, and Sunnyside Regional Library, as well as making electronic copies available to agencies and the public, as required by Water Code Section 10642; and

WHEREAS, on July 1, 2021 and July 8, 2021, respectively, the City published notices on the City Clerk's website and in the Fresno Bee that on July 15, 2021 at 10:05 a.m. a public hearing regarding the draft Appendix L – Addendum to the 2015 UWMP would be held in Council Chambers at which time public comment on the draft Addendum would be received, as required by Water Code Section 10642; and,

WHEREAS, on July 15, 2021, at 10:05 a.m. the public hearing was conducted in Council Chambers at which the public was provided the opportunity to comment on the draft Appendix L Addendum to the 2015 UWMP.

NOW, THEREFORE, BE IT RESOLVED BY THE Council of the City of Fresno as follows:

1. The City hereby adopts Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed."

2. The City Manager, or designee, is hereby authorized and directed to file Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed" with the California Department of Water Resources, the California State Library, and the County of Fresno within 30 days after adoption.

* * * * * * * * * * * * * * *

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, BRIANA PARRA, Interim City Clerk of the City of Fresno, certify that the foregoing resolution was adopted by the Council of the City of Fresno, at a regular meeting held on the 15th day of July, 2021.

AYES :Arias, Esparza, Karbassi, Maxwell, Chavez
NOES :None
ABSENT :Bredefeld, Soria
ABSTAIN :None

Mayor Approval: July 19th, 2021
Mayor Approval/No Return: N/A, 2021
Mayor Veto: N/A, 2021
Council Override Veto: N/A, 2021

BRIANA PARRA, CMC
Interim City Clerk

BY: Briana Parra 7/20/2021
Deputy Date

APPROVED AS TO FORM:
DOUGLAS T. SLOAN
City Attorney

BY: 7/20/21
Jennifer M. Quintanilla Date
Senior Deputy

*July 19, 2021*

Council Adoption: 07/15/2021
Mayor Approval:
Mayor Veto:
Override Request:

TO: MAYOR JERRY DYER

FROM BRIANA PARRA, CMC
Interim City Clerk

SUBJECT: TRANSMITTAL OF COUNCIL ACTION FOR APPROVAL OR VETO

At the City Council meeting of July 15, 2021, Council adopted the attached Resolution No. 2021-198, entitled ***RESOLUTION – Adopting Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan (Subject to Mayor's veto).** Item 10:05 A.M. (5), File ID21-22925, by the following vote:

| | | |
|---|---|---|
| Ayes | : | Arias, Esparza, Karbassi, Maxwell, Chavez |
| Noes | : | None |
| Absent | : | Bredefeld, Soria |
| Abstain | : | None |

Please indicate either your formal approval or veto by completing the following sections and executing and dating your action. Please file the completed memo with the Clerk's office on or before July 29, 2021. In computing the ten day period required by Charter, the first day has been excluded and the tenth day has been included unless the 10th day is a Saturday, Sunday, or holiday, in which case it has also been excluded. Failure to file this memo with the Clerk's office within the required time limit shall constitute approval of the ordinance, resolution or action, and it shall take effect without the Mayor's signed approval.

**APPROVED** / **NO RETURN:** _____

**VETOED** for the following reasons: (Written objections are required by Charter; attach additional sheets if necessary.)

_____

_____

_____ Date: 7/19/2021

Jerry Dyer, Mayor

**COUNCIL OVERRIDE ACTION:** Date: _____

| | | |
|---|---|---|
| Ayes | : | |
| Noes | : | |
| Absent | : | |
| Abstain | : | |

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CITY OF FRESNO
CITY CLERK'S OFFICE

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# I.2 - Utilities Technical Study

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# Southeast Development Area (SEDA)
# Specific Plan
# Water Technical Study

***April 26th, 2023***

*Prepared for:*

City of FRESNO

*City of Fresno, California*

*Prepared by:*

Blair, Church & Flynn
CONSULTING ENGINEERS

451 Clovis Avenue, Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500
www.bcf-engr.com

Date signed: 04/26/2023

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Appendix C – Water Technical Report for the City of Fresno General Plan Update MEIR (Prepared by Blair, Church & Flynn), City of Fresno Hydraulic Evaluation of the Proposed 2035 General Plan Land Use Updated for the Master Environmental Impact Report Technical Memorandum (Prepared by West Yost Associates)
Appendix D – City of Fresno 2020 Urban Water Management Plan

# CHAPTER 1
# INTRODUCTION

## 1.1 Project Description and Background

The City of Fresno (City) is preparing a Specific Plan and Program Environmental Impact Report (PEIR) for the Southeast Development Area (SEDA). The SEDA Specific Plan Area (Plan Area), previously known as the Southeast Growth Area (SEGA), is an approximately 9,000-acre area in the southeast portion of the City of Fresno that is formally designated as a growth area in the City of Fresno General Plan (General Plan). The Plan Area is generally bound by the Gould Canal to the north, McCall and Highland Avenues to the east, Jenson and North Avenues to the south, and Locan, Temperance, and Minnewawa Avenues to the west; see Figure 1.1 for the Plan Area's location.

SEDA was approved for incorporation into the City by the Local Agency Formation Commission (LAFCo) in 2006, with a number of qualifying provisions, of which included the preparation of a Specific Plan and associated environmental documents before the land could be annexed to the City. Located in Growth Area II, SEDA was planned for development after other infill initiatives from the City's other planning efforts, and would be developed in phases. The General Plan established two levels of development – the General Plan Horizon and the General Plan Buildout. The General Plan Horizon is the level of development predicted to occur by the "Horizon Year," which was established as 2035, in accordance with the General Plan. General Plan Buildout is the level of development characterized by full occupancy of all developable sites in accordance with the General Plan; this was estimated to occur beyond 2035 (defined as past 2050).

As such, the General Plan defined development of SEDA under General Plan Horizon as a portion of the full buildout conditions – specifically, it assumed a residential development capacity of approximately 15,000 dwelling units, one third of the buildout capacity. Accordingly, the residential development capacity of SEDA under General Plan Buildout is approximately 45,000 dwelling units, and the General Plan assumed that the additional 30,000 dwelling units would not be developed until after 2035. However, though the General Plan was analyzed under the General Plan Horizon level, the associated MEIR (Master Environmental Impact Report) analyzed the environmental impacts of the General Plan under the buildout level of the Sphere of Influence (SOI), which encompasses other growth areas, including SEDA.

The Specific Plan for SEDA was developed for the buildout condition of the Plan Area of 45,000 dwelling units, and provides implementation mechanisms for development in the Plan Area that accommodate for increased density and accelerate housing production. As part of the City's General Plan, SEDA was designated with land use classifications as defined in the General Plan. The Specific Plan presents alternative land use classifications for SEDA, and seeks to propose how the Plan Area will develop over time to complete buildout conditions with these newly-defined land use categories.

As part of the Specific Plan process, a PEIR needs to be developed to evaluate the impacts associated with the proposed improvements to the Plan Area, and what, if any, mitigation measures are necessary to account for such impacts. This technical report will focus on the impacts of the SEDA Specific Plan on the water supply and distribution system proposed for the Plan Area.

## 1.2 Summary of Analysis

The City's General Plan assigned land use classifications to areas located within the SEDA Specific Plan Area. Each land use classification has a set of characteristics assigned to it with respect to a specific utility demand that have been determined and/or calculated by various contributing parties. The SEDA Specific Plan proposes new land use classifications for the Plan Area that may change the area's characteristics as it relates to utilities, e.g., water demand, wastewater generation, or storm water runoff, when compared to the General Plan. Additionally, some land uses have revised areas, which further alters those characteristics.

Changes in land use can affect a water distribution system's ability to supply, store, and distribute water to the City's residents. New development will require the construction of new water distribution facilities which may include water mains, valves, storage tanks, and booster pump stations, as well as potential new sources of water supply, such as new domestic water wells or surface water treatment plants. The City of Fresno's Metropolitan Water Resources Management Plan (Metro Plan)[1] and the Fresno General Plan Master Environmental Impact Report (MEIR)[2] include a number of proposed water facilities improvements to account for increased development and water demand based on the General Plan buildout conditions. The City of Fresno is currently developing an update to the Metro Plan, which includes an updated analysis of water demand factors for General Plan land uses developed by Akel Engineering Group, Inc,[3] which have been utilized in this analysis.

This technical study will focus on the analysis of water demand in the Plan Area, and how it may change based on Specific Plan development. The analysis to determine the change in water demands involved comparing the total demand determined for the Plan Area under both the General Plan and Specific Plan land use cases.

At the time of preparation of this study, the City was developing water demand factors for the new SEDA land use classifications. These factors were not available when completing the above stated analysis. Thus, a number of reasonable assumptions were made to correlate Specific Plan land uses with General Plan land uses in order to use the water demand factors prepared for the Metro Plan update.

This technical study focuses on specifically analyzing the change in water demand between the General Plan and the Specific Plan for SEDA in order to assist with the development of mitigation measures as needed.

[1] City of Fresno, "Metropolitan Water Resources Management Plan Update," Phase 1 – 2007, Phase 2 – 2011, Phase 3 – 2011, Phase 4 – 2014.
[2] City of Fresno, "Master Environmental Impact Report General Plan and Development Code Update," 2014.
[3] Akel Engineering Group Inc., "Water and Wastewater Unit Factor Update for Metropolitan Water Resources Management Plan Update."

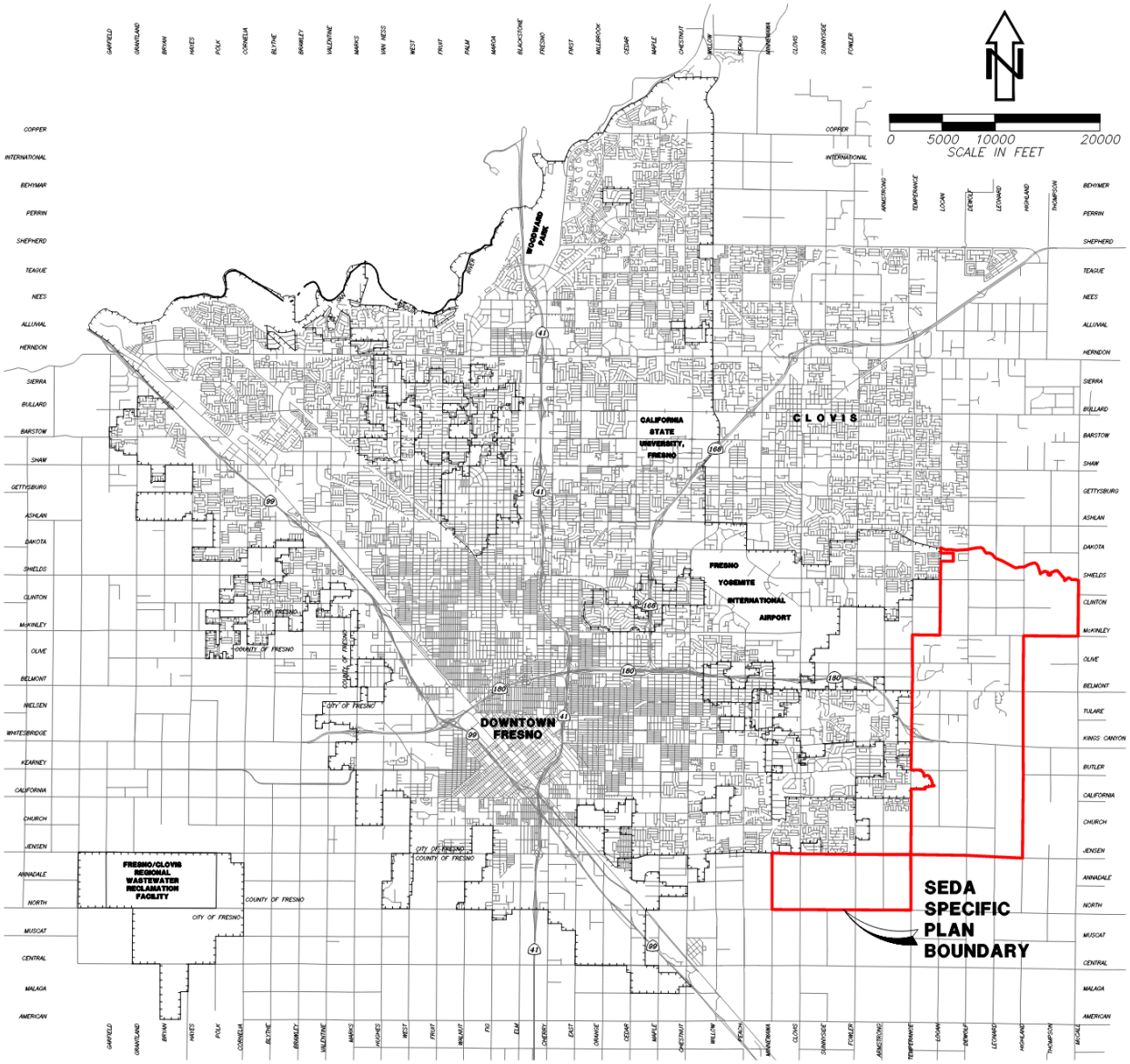



**Figure 1.1 SEDA Specific Plan Location**

**CHAPTER 2**
**REGULATORY FRAMEWORK**

## 2.1 General

The City of Fresno owns and operates the potable water distribution system that serves Fresno and other participating agencies, as well as the water supply sources and treatment facilities; specifically, the City Water Division manages the system. The City delivers potable water to urban residential, commercial, and industrial customers in over 115 square miles of the City, including many County islands and areas within the City's Sphere of Influence (SOI). Fresno's main sources of water include groundwater, treated surface water, and reclaimed water; groundwater is obtained through approximately 202 municipal supply wells located throughout Fresno; surface water is collected and treated at the Northeast Surface Water Treatment Facility (NESWTF), and the Southeast Surface Water Treatment Facility (SESWTF); reclaimed water is collected and treated at the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) and the North Fresno Wastewater Reclamation Facility (NFWRF), and is mainly utilized for landscape irrigation.

There are a number of federal, state, and local regulations that must be adhered to when planning potable water facilities, many of which provide guidance and requirements for the handling and distribution of potable water, as well as regulations to safeguard water quality; several are discussed in the following sections.

## 2.2 Federal Regulations

Clean Water Act[4]

The Federal Water Pollution Control Act of 1972, commonly referred to as the Clean Water Act (CWA), regulates the discharge of pollutants into watersheds throughout the United States and quality standards for surface waters. It is the primary federal law regulating and governing water pollution, with the objective of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. The CWA establishes the basic structure for regulating discharges of pollutants in waters of the United States and regulating quality standards for surface waters. Under the CWA, the Environmental Protection Agency (EPA) is tasked with developing national water quality criteria used as the basis for state water quality standards, and developing national water quality criteria recommendations for pollutants in surface waters. Water quality standards establish the designated use of a body of water (e.g., recreation, water supply, industrial, etc.), and a statement identifying the maximum concentrations of various pollutants that would not interfere with the designated use. Each state must set specific water quality standards, which serve as backup to federally set technology-based requirements. The City is responsible for monitoring water quality and conforming to the requirements of the CWA for all water sources.

Federal Safe Drinking Water Act[5]

The Federal Safe Drinking Water Act (SDWA) was established to protect the quality of drinking water in the United States. This law focuses on all waters actually or potentially designed for drinking, whether from above- or below-ground sources. The SDWA authorizes the EPA to establish national health-based minimum standards for drinking water to protect the public from naturally-occurring and man-made contaminants that may be found in drinking water. These standards, known as the National Primary Drinking Water Regulations, set enforceable maximum

[4] Clean Water Act, 33 U.S.C. §1251 et seq. (1972).
[5] Federal Safe Drinking Water Act, 42 U.S.C. §300f et seq. (1974).

contaminant levels for specific contaminants in drinking water, as well as required methods of treatment to remove said contaminants. The SDWA applies to all public water systems in the United States, except for private wells serving less than 25 people. In California, the Division of Drinking Water (DDW) within the State Water Resources Control Board (SWRCB) regulates public drinking water systems. If the water system does not meet the aforementioned standards, it is the responsibility of the water supplier to notify its customers.

## 2.3 State Regulations

California Porter-Cologne Water Quality Control Act[6]

The Porter-Cologne Water Quality Control Act is the principal law governing water quality in California, for both above- and below-ground supplies. This act designated the SWRCB as the statewide water quality planning agency, and gave authority to nine Regional Water Quality Control Boards (RWQCB) to oversee water quality on a day-to-day basis at both the local and regional levels. RWQCBs develop Regional Water Quality Plans (Basin Plans), regulate all pollutant or nuisance discharges that may affect either surface water or groundwater, and implement said water quality plans. The Central Valley RWQCB oversees the Fresno area.

California Urban Water Management Planning Act[7]

The Urban Water Management Planning Act updated the California Water Code (§10610-10656 and 10608) to include a requirement that all urban water suppliers within California prepare and adopt an Urban Water Management Plan (UWMP) and update it every five years. This applies to suppliers that provide either 3,000 acre-feet of water annually, or who serve more than 3,000 customers. UWMPs support suppliers' long-term resource planning to ensure that adequate water supplies are available to meet existing and future water demands. The Act is intended to encourage and support water conservation efforts, and ensure efficient use of available water supplies. UWMPs must assess the reliability of water sources over a 20-year planning time period, describe demand management measures and water shortage contingency plans, planning for single and multiple dry water years, and discuss the use and planned use of recycled water.

Senate Bills 610 and 221[8]

Senate Bill (SB) 610 and SB 221 amended state law in 2002 to ensure better coordination between local water supply and land use decisions, and to confirm that there is an adequate water supply for new developments. These two companion measures require authorities to demonstrate that adequate and reliable 20-year water supplies are available for any new development, as well as existing water users.

SB 610 requires the preparation of UWMPs and Water Supply Assessments (WSAs) for projects (as defined by Water Code §10912) which are subject to California Environmental Quality Act (CEQA) provisions. Projects required to prepare a WSA include:

- Residential developments of more than 500 dwelling units;
- Shopping centers or business establishments employing more than 1,000 persons or having more than 500,000 square feet of floor area;
- Hotels or motels, or both, having more than 500 rooms;

[6] California Porter-Cologne Water Quality Act, California Water Code Div. 7 §13000 et seq. (1969).
[7] California Urban Water Management Plan Act, California Water Code §10610-10656, 10608.
[8] SB 610 Water Supply Planning, Chapter 643, Statutes of 2001, Costa; SB 221 Land Use: Water Supplies, Chapter 642, Statutes of 2001, Kuehl.

- Industrial, manufacturing or processing plants, or industrial parks planned to employ more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area;
- Mixed-use projects that include one or more of the projects specified above;
- Projects that would demand an amount of water equivalent to, or greater than, the amount of water required for 500 dwelling units.

SB 221 establishes consultation and analysis requirements for water supply planning for residential subdivisions including more than 500 dwelling units. Written verification by the water supplier that sufficient water is available for the proposed plan is required before construction can begin.

California Groundwater Management Act of 1992[9]

The Groundwater Management Act was signed into law in 1992, and made groundwater management part of the California Water Code (Division 6, Part 2.75, Chapters 1-5, §10750-10755.4). First introduced as Assembly Bill (AB) 3030, the Act established specific procedures on how Groundwater Management Plans (GWMPs) are to be developed and adopted by local agencies. The intent of the Act is to encourage local agencies to work cooperatively to manage groundwater resources within their jurisdictions and to provide a methodology for developing a GWMP. The Act has since been modified by Senate Bill (SB) 1938 in 2002 and AB 359 in 2011.

- AB 3030 provided a systematic procedure for existing local agencies to develop GWMPs.
- SB 1938 modified the Act by requiring any public agency seeking State funds administered through the California Department of Water Resources (DWR) for the construction of groundwater projects to prepare and implement a GWMP.
- AB359 further modified the Act by requiring public agencies to prepare and implement GWMPs with an additional required component that focused on identifying groundwater recharge areas. It also included several plan adoption procedural changes, requires GWMPs to be submitted to DWR, and requires DWR to provide public access to this information.

Sustainable Groundwater Management Act of 2014 (SGMA)[10]

The Sustainable Groundwater Management Act (SGMA) includes a three-bill legislative package composed of AB 1739, SB 1168, and SB 1319. SGMA requires local agencies to form Groundwater Sustainability Agencies (GSAs) for high and medium priority basins, and develop and implement Groundwater Sustainability Plans (GSPs) to avoid and mitigate overdraft of groundwater within 20 years. SGMA places the authority of groundwater management with local agencies; it establishes a definition of sustainable groundwater management, establishes a framework for local agencies to develop plans and implement strategies to sustainably manage groundwater resources, prioritizes basins with the greatest problems, and sets a 20-year timeline for implementation.

State Updated Model Water Efficient Landscape Ordinance (AB 1881) (2015)[11]

The Model Water Efficient Landscape Ordinance (MWELO) is a state regulation designed to prevent water from being wasted on irrigated landscapes. Created in 1993, the MWELO was updated in 2015 by Executive Order EO B-29-15. Land use authorities (Cities and Counties) must ensure MWELO compliance on development projects with landscaped areas of 500 square feet or more. This applies to residential, commercial, industrial and institutional projects that require a

[9] California Groundwater Management Act, California Water Code Division 6, Part 2.75, Chapters 1-5, §10750-10755.4.
[10] Sustainable Groundwater Management Act (SGMA), California Water Code Div. 6, Part 2.74 §10720-10737.8 (2014).
[11] Model Water Efficient Landscape Ordinance (MWELO), Title 23 CCR, Div. 2, Chap. 2.7 §490 et seq.

permit, plan check, or design review. The California DWR provides technical assistance in helping Land Use Authorities adhere to the ordinance. The Fresno Municipal Code includes local ordinances that are required to reduce water consumption and conserve water.

State Mandated Water Reductions[12]

On January 18, 2022, as a result of drought conditions in California, the California SWRCB adopted Emergency Regulation Requirements for water conservation. The Governor previously urged Californians to reduce water usage in 2021 by 15%, however actual reduction was only about 6%. Thus, the SWRCB has enacted emergency regulations that will remain in effect for one year unless the SWRCB acts to end, modify, or readopt it. These regulations were readopted in December 2022 for another year. The regulations prohibit certain wasteful water use practices statewide, and encourage Californians to monitor their water usage more closely. Emergency Regulation Requirements prohibit using potable water for:

- Outdoor watering that lets water run onto sidewalks and other areas (except incidental runoff)
- Washing vehicles without an automatic shutoff nozzle
- Washing hard surfaces, like driveways and sidewalks, that don't absorb water
- Street cleaning or construction site preparation
- Filling decorative fountains, lakes, or ponds
- Outdoor watering within 48 hours after it rains at least 1/4 inch of rainfall
- Watering ornamental turf on public medians

An additional emergency water conservation regulation was enacted in June 2022 that prohibits the use of potable water to water decorative grass in commercial, industrial, and institutional areas including common areas of homeowners' associations.[13] The regulation also requires urban water suppliers to implement all demand-reduction actions under "Level 2" of their Water Shortage Contingency Plans, which are actions meant to address a 10% to 20% water shortage. Additionally, urban water suppliers are required to fast-track their submissions of supply and demand assessments to plan for potential extended dry conditions. "Level 2" actions vary for each water supplier, but often include things like increasing communication about the importance of water conservation, limiting outdoor irrigation to certain days or hours, increasing patrolling to identify water waste, and enforcing water-use prohibitions.

CALGreen Building Code[14]

The California Building Standards Commission adopted the nation's first green building standards in 2008. The standards code (Part 11, Title 24 CCR, known as "CALGreen") was adopted to apply to the planning, design, operation, construction, use, and occupancy of every newly constructed building or structure, unless otherwise indicated in the CCR, throughout California. CALGreen established planning and design standards for sustainable site development including water conservation. CALGreen provisions became effective on January 1, 2011. The purpose of the CALGreen provisions is to improve public health, safety, and general welfare by enhancing the design and construction of buildings through the use of concepts having reduced negative impact or positive environmental impact and encouraging sustainable construction practices.

[12] State Water Resources Control Board Resolution No. 2022-0002, "To Adopt an Emergency Regulation to Supplement Voluntary Water Conservation," 2022.
[13] State Water Resources Control Board Resolution No. 2022-0018, "To Adopt an Emergency Regulation to Reduce Water Demand and Improve Water Conservation." 2022.
[14] California Green Building Standards Code (CALGreen), Title 24 CCR Part 11.

California Plumbing Code[15]

The California Plumbing Code (Part 5, Title 24 CCR) serves to prevent disorder in the industry and to consolidate plumbing codes utilized by local jurisdictions to reduce confusion and conflicts among varying practices. The Plumbing Code covers water fixtures, potable and non-potable water systems, and recycled water systems, among other topics. Potable water supply and distribution facilities shall comply with all applicable provisions of the current edition of the California Plumbing Code.

## 2.4 Local Regulations

Fresno General Plan

The City's General Plan contains the following goals, policies, and objectives relevant to the provision of potable water service and facilities (Table 2.1):

**Table 2.1 City of Fresno General Plan Objectives and Policies Relevant to Potable Water Supply**

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| Objective PU-3 | Enhance the level of fire protection to meet the increasing demand for services from an increasing population. |
| Policy PU-3-f | **Adequate Infrastructure.** Continue to pursue the provision of adequate water supplies, hydrants, and appropriate property access to allow for adequate fire suppression throughout the City. |
| Objective PU-8 | Manage and Develop the City's water facilities on a strategic timeline basis that recognizes the long life cycle of the assets and the duration of the resources, to ensure a safe, economical, and reliable water supply for existing customers and planned urban development and economic diversification. |
| Policy PU-8-a | **Forecast Need.** Use available and innovative tools, such as computerized flow modeling to determine system capacity, as necessary to forecast demand on water production and distribution systems by urban development, and to determine appropriate facility needs. |
| Policy PU-8-b | **Potable Water Supply and Cost Recovery.** Prepare for provision of increased potable water capacity (including surface water treatment capacity) in a timely manner to facilitate planned urban development consistent with the General Plan. Accommodate increase in water demand from the existing community with the capital costs and benefits allocated equitably and fairly between existing users and new users, as authorized by law, and recognizing the differences in terms of quantity, quality and reliability of the various types of water in the City's portfolio. |
| Policy PU-8-c | **Conditions of Approval.** Set appropriate conditions of approval for each new development proposal to ensure that the necessary potable water production and supply facilities and water resources are in place prior to occupancy. |
| Policy PU-8-d | **CIP Update.** Continue to evaluate Capital Improvement Programs and update them, as appropriate, to meet the demands of both existing and planned development consistent with the General Plan. |
| Policy PU-8-f | **Water Quality.** Continue to evaluate and implement measures determined to be appropriate and consistent with water system policies, including prioritizing |

[15] California Plumbing Code, Title 24 CCR Part 5.

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| | the use of groundwater, installing wellhead treatment facilities, and enhancing transmission grid mains to promote adequate water quality and quantity. |
| Policy PU-8-g | **Review Project Impact on Supply.** Mitigate the effects of development and capital improvement projects on the long-range water budget to ensure an adequate water supply for current and future users. |
| Objective RC-6 | Ensure that Fresno has a reliable, long-range source of drinkable water. |
| Policy RC-6-a | **Regional Efforts.** Support cooperative, multi-agency regional water resource planning efforts and activities on developing and implementing the Upper Kings Basin Integrated Regional Water Management Plan. |
| Policy RC-6-b | **Water Plans.** Adopt and Implement ordinances, standards, and policies to achieve the intent of the City of Fresno Urban Water Management Plan, Fresno-Area Regional Groundwater Management Plan, and City of Fresno Metropolitan Water Resources Management Plan to ensure a dependable supply of water. |
| Policy RC-6-c | **Land Use and Development Compliance.** Ensure that land use and development projects adhere to the objective of the Fresno Metropolitan Water Resources Management Plan to provide sustainable and reliable water supplies to meet the demand of existing and future customers through 2025. |
| Objective RC-7 | Promote water conservation through standards, incentives and capital investments. |

Fresno Municipal Code – Model Water Efficient Landscape Ordinance (MWELO)

As stated, MWELO requires local agencies to implement water efficiency measures as part of its review of landscaping plans. Local agencies can either adopt the MWELO or incorporate provisions of the ordinance into its own code requirements for landscaping. Section 11 of Chapter 11, "Building Permits and Regulations," and Section 23 of Chapter 15, "Citywide Development Code," of the City Municipal Code include requirements for landscape design and incorporates the requirements of the California MWELO, among other state codes and regulations. For new landscaping projects of 2,500 square feet of more that require a discretionary or ministerial approval, the applicant is required to submit a detailed "Landscape Documentation Package" that discusses water efficiency, soil management, and landscape design elements.

City of Fresno Metropolitan Water Resources Management Plan

The City of Fresno Metropolitan Water Resources Management Plan (Metro Plan) was prepared to document the existing conditions of the City's water system, and facilitate future water resources decisions and facilities improvements. Phase 1 consists of a baseline system characterization[16], Phase 2 consists of the development and evaluation of future water supplies[17], Phase 3 consists of implementation of the management plan[18], and Phase 4 included the preparation of an Environmental Impact Report (EIR) for the City. [19] Chapters 4, 5, 6 and 8 of Phase 2 discuss objectives, goals and policies related to potable water, including water conservation (Chapter 4), groundwater (Chapter 5), surface water (Chapter 6), and future water supplies (Chapter 8). It should be noted that this plan was prepared in 2011, and a number of the

[16] City of Fresno, "Metropolitan Water Resources Management Plan, Phase 1 Baseline System Characterization," December 2007.
[17] City of Fresno, "Metropolitan Water Resources Management Plan, Phase 2 Alternative Development and Evaluation of Future Water Supply Plan," January 2011.
[18] City of Fresno, "Metropolitan Water Resources Management Plan, Phase 3 Implementation Plan," January 2011.
[19] City of Fresno, "Metropolitan Water Resources Management Plan Update, Final Environmental Impact Report," May 2014.

stated objectives/goals/policies have already been completed. At the time of preparation of this study, an update to the Metro Plan is being developed by the City.

Urban Water Management Plan[20]

The City's Urban Water Management Plan (UWMP) was prepared as a requirement of the Urban Water Management Planning Act (UWMPA).[21] The UWMP outlines a water supplier's long-term water resource planning to ensure sufficient water supplies for existing and future demands; it essentially sets the roadmap for how the City will utilize water over the coming years. UWMPs are updated and submitted to the Department of Water Resources (DWR) every five (5) years. The UWMPA applies to urban water suppliers with 3,000 or more connections being served, or supplying more than 3,000 acre-feet of water annually. The most recent version of the City's UWMP was prepared for 2020.

City of Fresno Standard Specifications and Plans

The City maintains its own set of standard Specifications and Plans to be followed when designing and constructing City projects. Those related to the water distribution system include, but are not limited to:

- Standard Specifications
    - Section 21 – Domestic Water Facilities Design Criteria
    - Section 22 – Water Facilities
    - Section 25 – Landscape Irrigation Systems
- Standard Plans
    - Plans W-1 through W-45

[20] City of Fresno, "2020 Urban Water Management Plan," July 2021.
[21] Division 6, Part 2.6, California Water Code, §10610-10656.

**CHAPTER 3**
**EXISTING CONDITIONS**

## 3.1 Water Infrastructure

### 3.1.1 General

The City of Fresno Water Division manages and operates the City's water system. The City provides potable water to over 550,000 customers including residential, commercial, and industrial users, in an approximately 115 square mile (73,500 acre) area that includes many County islands (unincorporated areas within the City), and areas within the City's Sphere of Influence (SOI). Fresno's domestic water supplies include groundwater, surface water, and reclaimed water.

The City's water system consists of approximately 1,860 miles of distribution and transmission pipes, 202 active groundwater wells, three (3) surface water treatment facilities (SWTFs), five (5) water storage facilities with pump stations, and three (3) booster pump facilities. The Service Area declines in elevation generally from the northeast to the southwest; to assist with pressure regulation, the area is divided into five (5) pressure zones: Highway 41, Shepherd, Sierra, Southwest, and Booster Pump 4 (BP04). The zones are separated by a series of closed/partially closed valves to prevent and/or impede flow from one zone to another.

### 3.1.2 Water Sources

The City is located within the Kings River Subbasin of the San Joaquin Valley Groundwater Basin. Historically, the City has relied heavily on groundwater pumped from the underground basin and aquifers. The City has a network of over 270 municipal water wells and operates approximately 202 active municipal supply wells that access groundwater from said basin.[22] The production capacity from the active wells is approximately 403 MGD (million gallons per day), and the total capacity including inactive wells is approximately 487 MGD. The wells are located around the City, and most are directly connected into the water distribution system. The City's water system depended completely upon groundwater as a water source until 2004 when the first surface water treatment facility (SWTF) was commissioned. Today, groundwater is still heavily relied upon as a primary water source for the City.

Groundwater quality generally meets primary and secondary drinking water standards for municipal water use, however the groundwater basin has been impacted by several chemical contaminant plumes and nitrates that require monitoring and wellhead treatment. Treatment efforts and removal of specific wells from service are conducted as required to maintain drinking water supply quality and standards.

In 2004, the City commissioned the Northeast Surface Water Treatment Facility (NESWTF). The facility, located at Chestnut and Behymer Avenues, is designed for a 30-MGD capacity, and is planned to be expanded to a total of 60 MGD as development in Fresno continues. The NESWTF has reduced the City's dependance on groundwater and allowed an increased degree of groundwater recharge to occur. The City also constructed a water storage and modular surface water treatment facility (T-3 SWTF) in 2015 in southeast Fresno, which has a design capacity of 8 MGD.

[22] City of Fresno, "2020 Urban Water Management Plan," July 2021.

Most recently, the City completed construction of the Southeast Surface Water Treatment Facility (SESWTF) in 2018, which is a 54-MGD facility with an ultimate capacity of 80 MGD. This included a 72-inch raw water transmission main to convey surface water from FID's Fresno Canal to the SESWTF. T-3 was shut down after the SESWTF was activated, however the City has indicated that there are future plans to reactivate the site. With the SESWTF and NESWTF combined, the City provided greater than 50% of its potable water supply through the use of surface water in 2019 and 2020.[23] Moving forward, the City expects to provide half or more of its potable water demand with surface water supplies. According to the 2020 Urban Water Management Plan, groundwater pumping has decreased steadily since Fresno began utilizing surface water; groundwater production decreased from 160,000 acre-feet in 2004 to 55,000 acre-feet in 2020.[23]

A portion of the surface water that is treated at the SWTFs is supplied via agreements that the City maintains with the United States Bureau of Reclamation (USBR) and the FID. In the 1960s, the City contracted with the USBR to receive 60,000 acre-feet of surface water per year to utilize for "intentional recharge" of the groundwater basin. This was completed by constructing recharge basins to store the surface water which was allowed to percolate through the soil to the aquifer. The surface water is conveyed to these basins through FID (Fresno Irrigation District) canals. Historically, the amount of water supplied varies year to year, averaging around 60,000 acre-feet; however, there have been extremely dry years in which no water was supplied. Additionally, the City signed an agreement with FID in 1976 for the delivery of surface water supplies from the Kings River based on the City's pro rata share of FID's water entitlements. The most recent agreement with FID made in 2016 placed a maximum percentage of FID's Kings River water at 29%. The average FID delivery between 1964 and 2019 was 452,541 acre-feet, which equates to an average City supply of 131,237 acre-feet, assuming the maximum 29% City supply percentage. The water supplied from both the USBR and FID agreements is used for groundwater recharge and potable use after treatment at one of the SWTFs.

Fresno is located within the North Kings Groundwater Sustainability Agency (GSA), which is working to reach groundwater sustainability in accordance with SGMA. SGMA requires governments and water agencies of "critically overdrafted" basins to reach sustainability by 2040; the Kings River Subbasin was identified as a critically overdrafted basin. As a result, the City has placed a higher priority on developing its surface water supply and decreasing its reliability on groundwater to allow the basin to recharge. This is being accomplished via intentional groundwater recharge in dedicated recharge basins around Fresno. The City also contracts with FID and FMFCD to utilize some of their facilities as additional recharge basins.

With the completion of various portions of the City's recycled water distribution system, and the upgrades at the Fresno-Clovis RWRF to allow disinfected tertiary-treatment of collected wastewater, the City has been using recycled water for beneficial uses in an effort to reduce reliance on potable water for non-potable uses. Disinfected tertiary treated wastewater can be used for a number of non-potable uses, including but not limited to landscaping irrigation, industrial processes, golf course irrigation, and agricultural irrigation. Additionally, the City discharges undisinfected secondary-treated wastewater into nearby percolation ponds at the Fresno-Clovis RWRF to allow the effluent to percolate through the soil into the aquifer. The City then extracts this water for delivery through FID facilities for agricultural users. The City also owns and operates the NFWRF, which produces recycled water used for irrigation at the Copper River Ranch Golf Course. Flows received at the Fresno-Clovis RWRF have averaged approximately 63,000 acre-feet over the last 5 years, and the City projects that recycled water deliveries will increase to 5,800 acre-feet per year of non-potable demand. These supplies will continue to help reduce potable water demand, and lend themselves to water conservation efforts.

[23] City of Fresno, "2020 Urban Water Management Plan," July 2021.

### 3.1.3 Water Distribution

The City's water distribution system consists of approximately 1,800 miles of distribution pipeline ranging in size from ¾-inch to 66 inches, 140,000+ service connections, 12,000+ fire hydrants, 18,000+ main line valves, and several booster pumps and storage tanks.

Generally, the Transmission Grid Mains (TGMs) convey water directly from municipal supply wells to customers, and Regional Transmission Mains (RTMs) convey water from surface water treatment plants to TGMs. TGM pipes range in size from 10 to 16 inches in diameter, and RTM pipes are 18 inches and larger. There is also a network of smaller distribution mains that serve individual customers via TGMs. Fire hydrants are located at regular intervals and served from the same distribution mains as all other customers. Main line valves are located at regular intervals and are used to shut down and isolate sections of the distribution system for emergency repairs, regular maintenance, or replacement projects. These valves are also used to regulate flows between the pressure zones as mentioned in Section 3.1.1. Booster pump stations help maintain the pressure within the system. There are a number of other miscellaneous appurtenances associated with the distribution system designed to assist regular operation, including air release/vacuum breaker assemblies, blow-off valves, backflow preventers, and access manways. Figure 3.1 shows the main infrastructure of the existing City water distribution system.

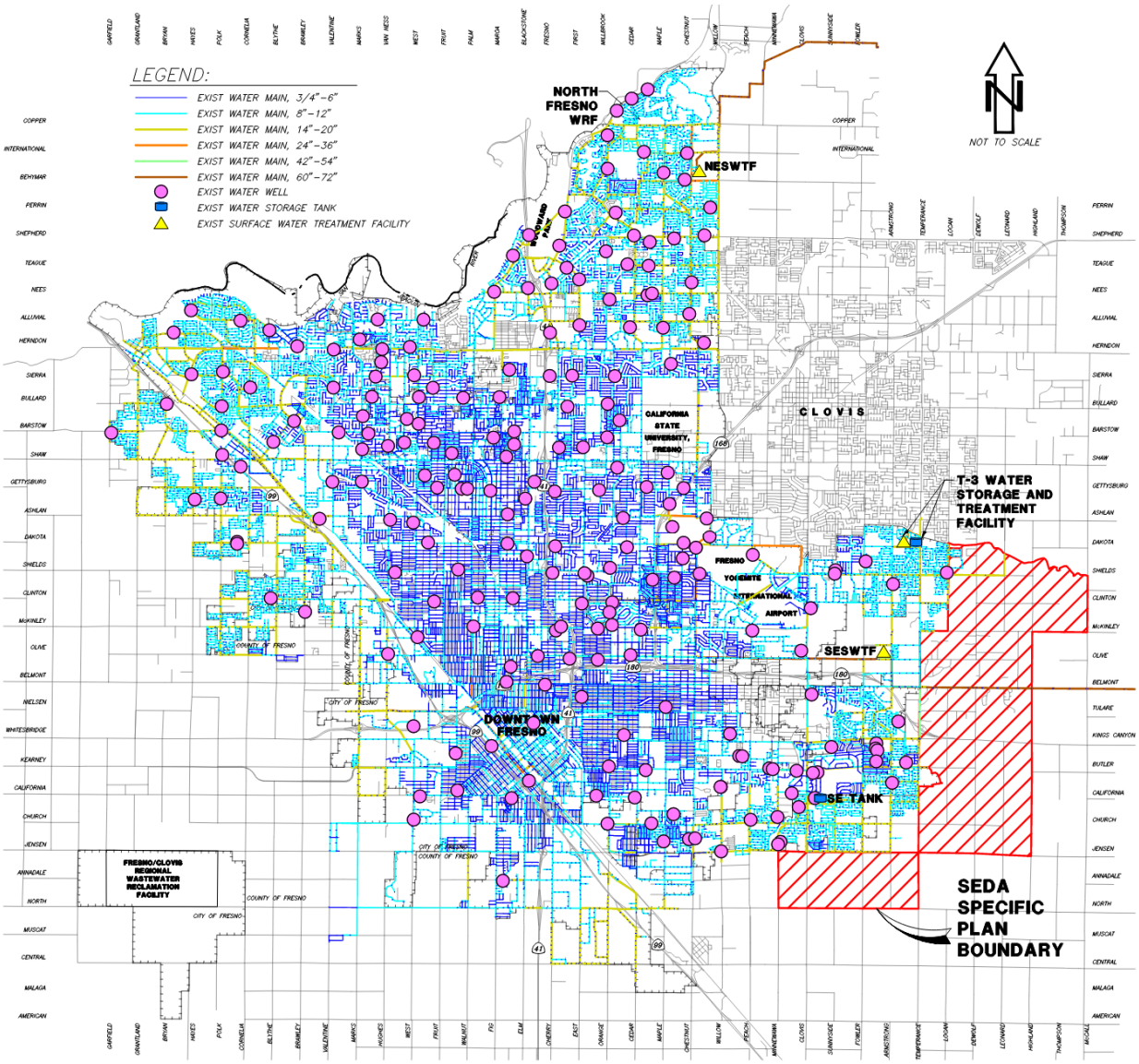



**Figure 3.1 Existing City Water Distribution System**

# CHAPTER 4
# FUTURE WATER INFRASTRUCTURE

## 4.1 General

Future water supply and distribution facilities are included in the City's Metro Plan. The City's General Plan includes developmental policies for water supply and distribution facilities for the City of Fresno, including growth areas such as SEDA.

## 4.2 General Plan Policies

The General Plan discusses aspects of the water supply and distribution system as they pertain to development in Fresno. As mentioned, the City owns, operates, and maintains the water supply and distribution system that serves Fresno and other participating agencies. See Table 2.1 for a summary of objectives and policies related to water facilities and infrastructure.

## 4.3 Buildout Improvements

The City Metro Plan analyzed the City's water supplies, treatment, storage, and distribution facilities for the existing conditions at the time the plan was drafted, and future needs based on General Planning policies and goals. The current version of the Metro Plan was completed in four (4) phases – Phase 1, "Baseline System Characterization," covered the existing conditions and analyzed the "Future without Project" alternative, or the impacts of development without additional planning; Phase 2, "Alternative Development and Evaluation of Future Water Supply Plan," analyzed different alternatives for development and infrastructure improvements to meet water resource challenges resulting from future development identified in Phase 1; Phase 3, "Implementation Plan," described the recommended alternative from Phase 2 and the funding and implementation plan for the alternative; and Phase 4, "Project/Programmatic Environmental Impact Report (EIR)," included the preparation of an EIR to evaluate potential impacts from the infrastructure improvements and future development included in the chosen alternative. The Phases were each developed and finalized at different times, with Phase 1 being approved in 2007, Phase 2 and 3 approved in 2011, and Phase 4 approved in 2014.

The Metro Plan and the Urban Water Management Plan (2020) include several objectives, goals, and policies to improve and develop water infrastructure as development progresses in the City. The critical focal points of the water system development are the implementation of further water conservation measures, installation of new municipal groundwater wells, increased groundwater recharge efforts to bring the City's groundwater pumpage into balance with its recharge rate, maximize use of available surface water, increased use of recycled water for landscape irrigation and other non-potable uses, and the acquisition of future water supplies when available.

At the time of preparation of this study, an update to the Metro Plan is being developed by the City. This update is revising the proposed improvements to the City's future water infrastructure, including that for the SEDA Specific Plan Area. There are a number of general improvements for the Plan Area included in the previous Metro Plan that will remain, including new municipal groundwater wells, water storage facilities, expansions to surface water treatment facilities, water booster pumps, and new water distribution mains, including Regional Transmission Mains (RTMs) and Transmission Grid Mains (TGMs). Improvements may include:

- New municipal groundwater wells
    - Municipal wells with wellhead treatment as needed

- Expansion of the NESWTF
- Water storage tanks and booster pump stations
- Extension of 48-inch diameter RTM
- Transmission Grid Mains of various sizes
- Recharge inter-ties to FMFCD basins.

**CHAPTER 5**
**SPECIFIC PLAN WATER DEMAND ANALYSIS**

## 5.1 General

The SEDA Specific Plan revised the General Plan buildout land use classifications in the Plan Area to new SEDA-specific land use classifications – see Figure 5.1 for the General Plan Land Use Map of the Plan Area, and Figure 5.2 for the SEDA Specific Plan Land Use Map for the chosen alternative for the Plan Area. With changes in land use classifications, the Plan Area will need to be evaluated for impacts to the proposed water supply and distribution system due to changes in water demand.

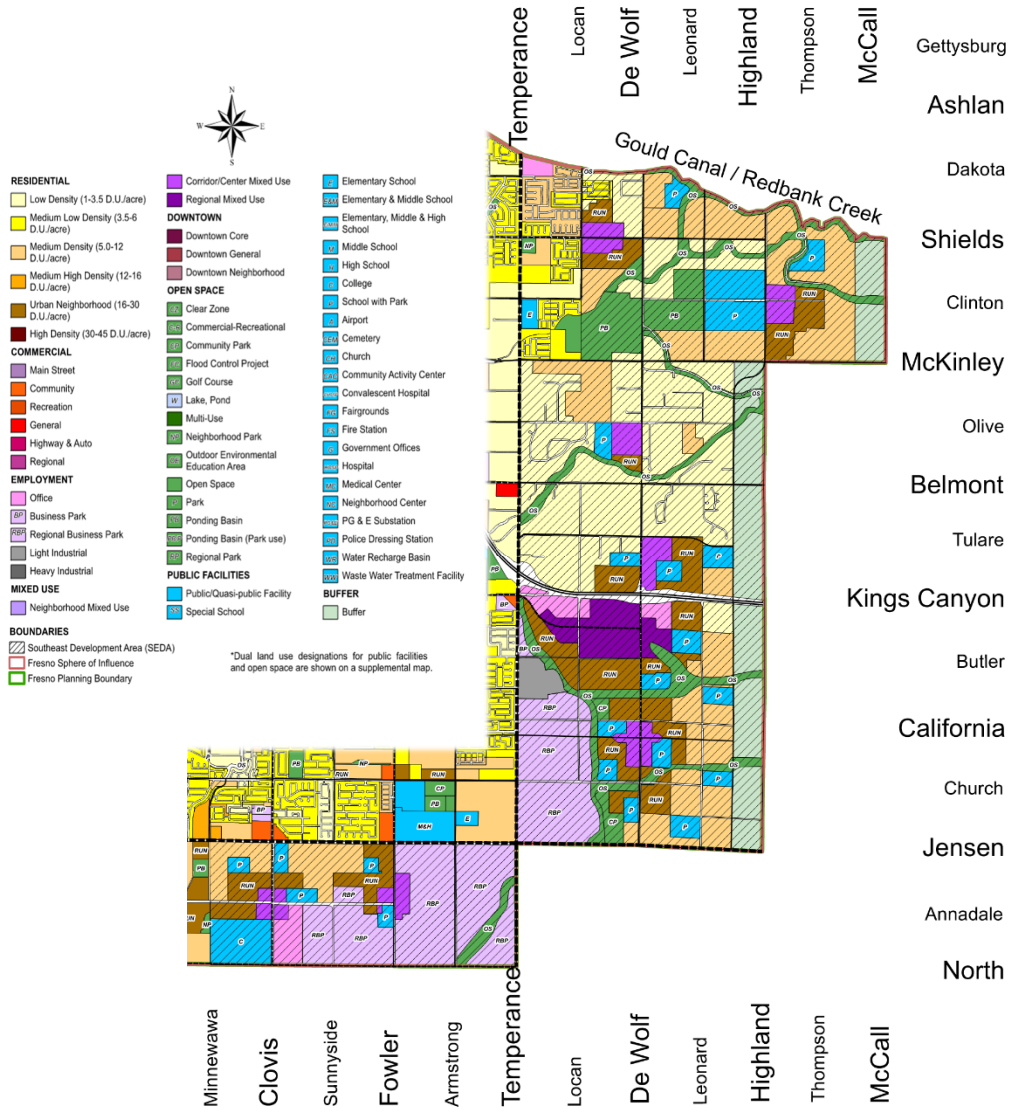
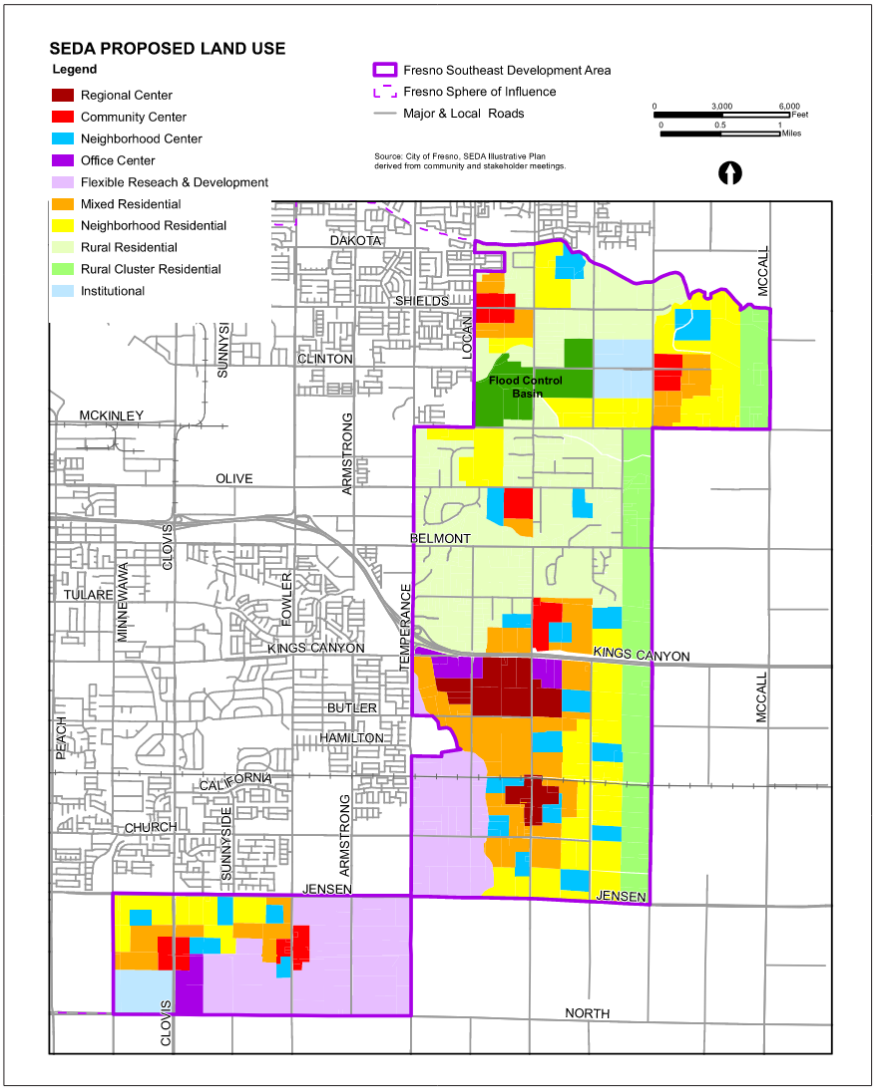



**Figure 5.1 General Plan Land Use Map for SEDA Plan Area**
Source: City of Fresno General Plan, Figure LU-1, December 2014, Figure Updated 3/2/2021




Source: City of Fresno, SEDA Regulating Districts, 02/10/2022.

**Figure 5.2 SEDA Proposed Land Use**
Source: Southeast Development Area Specific Plan Notice of Preparation,
First Carbon Solutions, 02/2022

## 5.2 Analysis Methodology

The technical analysis of the land use changes in the Plan Area was focused on comparing the change in water demand from the General Plan Land Use case to the Specific Plan Land Use case to determine potential impacts to the water supply and distribution system, and to assist in the development of mitigation measures if necessary. General Plan land use classifications and Specific Plan land use classifications were provided by the City of Fresno Planning and Development Department in the form of GIS (Geographic Information System) and Shape files. GIS and Shape files were also obtained from the City of Fresno Department of Public Utilities for the existing water facilities in Fresno.

The SEDA Specific Plan does not use the same land use classifications as defined in the General Plan, and instead utilizes SEDA-specific land use classifications developed as part of the Specific Plan. At the time of preparation of this technical study, the City was developing water demand

factors for the SEDA-specific land uses as was done for the General Plan land uses; these factors were unavailable during the completion of the analysis for this technical study. However, the SEDA-specific land uses are similar in nature to many of the General Plan land uses, and similarities can be drawn between the two land use categories. Thus, a number of reasonable assumptions were made to determine equivalent General Plan land uses for each SEDA-specific land use in order to utilize the water demand factors for General Plan land uses. Table 5.1 shows the equivalent General Plan land uses established for each Specific Plan land use case as described below.

For the General Plan land use case, the technical memorandum prepared for the City of Fresno General Plan Update MEIR[24] was used to obtain projected water demand data for SEDA. In the memorandum, analyses were completed to project water demands for 2035, which is the buildout year for the City's General Plan. The analyses included one completed for the SEDA based on the land uses included in the General Plan; the demand determined for SEDA was 21,834 ac-ft/year.

For the Specific Plan analysis, the water demand factors used were prepared by Akel Engineering as part of the Metro Plan Update.[25] Table 5.1 shows the equivalent General Plan land uses and the associated category included in the Metro Plan updated table of factors, and

Table 5.2 shows the water demand factors used for each equivalent General Plan land use classification that was determined for each SEDA Specific Plan land use. It should be noted that some General Plan land uses did not exactly match up with those listed in the water demand factors, and some assumptions were made to determine approximate water demand factors; see Appendix B for the full list of water demand factors.

The GIS files for the General and Specific Plan land uses were georeferenced to the California State Plane Coordinate System, Zone 4, Foot, NAD83 Datum for analysis. This allowed mapping of the land uses to pull information necessary to complete the analysis, including the area of each land use. The water demand factors were then used with the area of the corresponding land use classification to determine a total water demand for the Plan Area based on the General Plan and the Specific Plan developments. The total water demand for the Plan Area based on the General Plan case was compared to that of the Specific Plan case, resulting in the total change in water demand for the Plan Area.

## 5.3 Analysis Results

The base water demand for all land uses in the Plan Area was found for both the General Plan and the Specific Plan conditions. The total General Plan base water demand was 21,843 AF/year, or 19.50 MGD,[24] and the Specific Plan base water demand was found to be 19.83 MGD, resulting in an increase in water demand of approximately 0.33 MGD, or 1.7%. See Table 5.3 and Table 5.4 for the results of the analysis and a direct comparison of the General Plan and Specific Plan water demands; see Appendix A for a more detailed version of the analysis.

There may be a number of reasons as to why water demand increased from the General Plan to the Specific Plan. One reason may be that the SEDA boundary increased from that shown in the General Plan, indicated by the increased area of total land uses. The total area of the General

[24] West Yost Associates, "Hydraulic Evaluation of the Proposed 2035 General Plan Land Use Update for the Master Environmental Impact Report," "Table 2. Water Demand Comparison for General Land Use Plan Land Changes," January 21, 2013.
[25] Akel Engineering Group Inc., "Water and Wastewater Unit Factor Update for Metropolitan Water Resources Management Plan Update," October 2020.

Plan land uses is 8,253.76 acres, while the total area of the Specific Plan land uses is 8,325.57 acres – an increase of approximately 72 acres. This increase will lend itself to an increase in water demand based on which land uses increased in area.

Another contributor to increased water demands is changes in land use classifications. For the most part, the land use classifications remained fairly similar in nature and category when transitioning from the General Plan to the Specific Plan. However, a few areas of land uses changed to different land uses that have larger water demand factors; these include "Public Facilities – School with Park," "Buffer," and some low density residential areas. Per the SEDA Specific Plan land use map, all but one area defined as "School with Park" in the General Plan land use map changed to the SEDA "Neighborhood Center" land use. Similarly, the areas denoted as "Buffer" land use in the General Plan changed to "Rural Cluster Residential" in the SEDA Specific Plan. To a lesser extent, some of the "Low Density" residential areas in the General Plan were changed to residential land uses with higher densities in the Specific Plan. These combined changes lead to cumulative increases in the water demand of the Plan Area.

Finally, many SEDA land uses increased in area from their General Plan counterparts seemingly due to the elimination of the "Open Space" land uses included in the General Plan for the Plan Area, which totaled approximately 617 acres. As shown in Figure 5.1 and Table 5.3, "Open Space," and "Community Park," were removed from the Plan Area, and those areas were absorbed by adjacent land uses, including various residential, mixed use, and employment land uses. Several Open Space land uses have a water demand factor of 0 gpd/ac, and many others have significantly smaller demand factors than other land uses; consequently, this means that some portion of the 617 acres were added to other land uses with larger water demand factors, thereby increasing the total water demand of the SEDA Plan Area when compared to the General Plan buildout condition.

**Table 5.1 General Plan–SEDA–General Plan Equivalent Land Use Classifications**

| SEDA Specific Plan Land Use Classifications [A] | Equivalent General Plan Land Use Classification [B] | Water Demand Factor Category [C] |
|---|---|---|
| Residential – Mixed Residential | Residential – Urban Neighborhood | Residential – Medium High & High Density |
| Residential – Neighborhood Residential | Residential – Medium Density | Residential – Medium Density |
| Residential – Rural Residential | Residential – Low Density | Residential – Low Density |
| Residential – Rural Cluster Residential | Residential – Low Density | Residential – Rural Density |
| Employment – Office Center | Employment – Office | Commercial – Office |
| Employment – Flexible Research & Development | Employment – Business Park | Commercial – Professional Services Office |
| | Employment – Regional Business Park | Commercial – Regional |
| Employment – Institutional | Public Facilities – College | Public Facilities – College |
| Employment – Institutional | Public Facilities – School with Park | Public Facilities – SEGA School with Park |
| Mixed Use – Regional Center | Mixed Use – Regional Mixed Use | Residential – High Density, Commercial – Regional, & Public Facilities – Community Activity Center |
| Mixed Use – Community Center | Mixed Use – Corridor/Center Mixed Use | Public Facilities – Community Activity Center |

| SEDA Specific Plan Land Use Classifications [A] | Equivalent General Plan Land Use Classification [B] | Water Demand Factor Category [C] |
|---|---|---|
| Mixed Use – Neighborhood Center | Public Facilities – Neighborhood Center | Residential – Medium High Density, Commercial – Neighborhood, & Public Facilities – Neighborhood Center |
| Open Space – Flood Control Basin | Open Space – Ponding Basin | Open Space – Ponding Basin |
| Other | Streets/Railroad/Canals/Etc. | N/A |

[A] City of Fresno, "Notice of Preparation of a Program Environmental Impact Report for the Southeast Development Area Specific Plan, Fresno, California," February 22, 2022.

[B] City of Fresno, "Fresno General Plan," December 18, 2014.

[C] Akel Engineering Group Inc., "Water and Wastewater Unit Factor Update for Metropolitan Water Resources Management Plan Update

**Table 5.2 Metro Plan Update Water Demand Factors[26]**

| Water Demand Factor Category | Water Demand Factor (gpd/ac) |
|---|---|
| Residential | |
| Medium High & High Density | 5,140 [A] |
| Medium Density | 2,810 |
| Low Density | 2,050 |
| Rural Density | 1,415 |
| Commercial | |
| Office | 2,440 |
| Professional Services Office | 2,420 |
| Regional | 1,685 |
| Public Facilities | |
| College | 1,665 |
| SEGA School with Park | 2,895 |
| High Density Residential, Regional Commercial, & Community Activity Center | 2,106 [B] |
| Community Activity Center | 1,930 |
| Medium High Density Residential, Neighborhood Commercial, & Neighborhood Center | 1,851 [C] |
| Open Space | |
| Ponding Basin | 0 |
| Other | |
| Railroad/Streets/Canals/Etc. | N/A |

[A] Average of Medium High and High Density Residential Water Demand Factors

[B] Combination of High Density Residential, Regional Commercial, and Community Activity Center

[C] Combination of Medium High Density Residential, Neighborhood Commercial, and Neighborhood Center

[26] Akel Engineering Group Inc., "Water and Wastewater Unit Factor Update for Metropolitan Water Resources Management Plan Update," October 2020.

**Table 5.3 Specific Plan (SP) Anticipated Water Demand per Land Use Classification**

| GP Land Use Classification | SP Equivalent Land Use Classification | Water Demand Factor [A,B] (GPD/ac) | SP Area (ac) | SP Base Water (MGD) |
|---|---|---|---|---|
| Residential - Low Density | Residential - Rural Residential | 2,050 | 2,037.69 | 4.18 |
| Residential - Medium Density | Residential - Neighborhood Residential | 2,810 | 1,434.91 | 4.03 |
| Residential - Urban Neighborhood | Residential - Mixed Residential | 5,140 [A] | 1,026.26 | 5.27 |
| Employment - Office | Employment - Office Center | 2,440 | 154.47 | 0.38 |
| Employment - Business Park | Employment - Flexible Research and Development | 2,420 | 16.54 | 0.04 |
| Employment - Regional Business Park | | 1,685 | 1,287.53 | 2.17 |
| Mixed Use -Corridor/Center Mixed Use | Mixed Used - Community Center | 1,930 | 273.88 | 0.53 |
| Mixed Use - Regional Mixed Use | Mixed Use - Regional Center | 2,106 [B] | 291.71 | 0.61 |
| Open Space - Open Space | N/A | 865 | 0 | 0.00 |
| Open Space - Community Park | N/A | 2,620 | 0 | 0.00 |
| Open Space - Ponding Basin | Other - Flood Control Basin | 0 | 265.78 | 0.00 |
| Public Facilities - College | Employment - Institutional | 1,665 | 116.26 | 0.19 |
| Public Facilities - School with Park | | 2,895 | 149.77 | 0.43 |
| Public Facilities - School with Park | Mixed Use - Neighborhood Center | 1,851 [C] | 491.38 | 0.91 |
| Buffer - Buffer | Residential - Rural Cluster Residential | 1,415 [D] | 766.47 | 1.08 |
| Other - Street/Rail/ Canal, etc. | Other | 0 | 12.94 | 0.00 |
| Totals | - | - | 8,325.57 | 19.83 |

[A] Average of Medium High and High Density Residential Water Demand Factors
[B] Combination of High Density Residential, Regional Commercial, and Community Activity Center
[C] Combination of Medium High Density Residential, Neighborhood Commercial, and Neighborhood Center
[D] Rural Density Water Demand Factor used for Rural Cluster Residential Land Use.

**Table 5.4 Difference Between General Plan and Specific Plan Anticipated Water Demand**

| SEDA General Plan Total Base Water Demand (MGD) | SEDA Specific Plan Total Base Water Demand (MGD) | Usage Δ (MGD) | Usage Δ (%) |
|---|---|---|---|
| 19.5 | 19.83 | 0.33 | 1.7% |

**CHAPTER 6**
**IMPACTS AND MITIGATION**

## 6.1 SEDA Planning

Improvements within the Plan Area will require modifications to master planned potable water facilities and infrastructure.

A draft policy document has been completed for the SEDA Specific Plan (March 2022), which includes updated policies for the Plan Area, and proposed improvements to meet the chosen alternative for development of the area. Included among these are policies directly related to potable water in the Plan Area.[27] Refer to the SEDA Specific Plan policy document for details on policies related to potable water.

## 6.2 Impacts of Significance

The proposed Specific Plan would result in a significant impact if it would:

1. Require or result in the relocation or construction of new or expanded water or wastewater treatment facilities, the construction of which could cause significant environmental effects.

   The potential long-term impacts related to water supply, treatment, and distribution requirements of the General Plan versus the Specific Plan differ by 1.7%; the implementation of the proposed Specific Plan may result in the need for expansion of water supply and treatment facilities, and will require construction of new distribution facilities to serve future land uses in the Plan Area. Thus, development of the Plan Area could result in significant impacts to the existing water supply and distribution system. A summary of master planned proposed water supply, treatment, and distribution infrastructure that may accommodate future development associated with the Specific Plan include:

   - New municipal groundwater wells
     - Municipal wells with wellhead treatment as needed
   - Expansion of the NESWTF
   - Water storage tanks and booster pump stations
   - Extension of 48-inch diameter RTM
   - Transmission Grid Mains of various sizes
   - Recharge inter-ties to FMFCD basins.

   Potential environmental impacts associated with such improvements include but are not limited to: traffic, air emissions, noise, water quality, aesthetics, agricultural resources, biological resources, and cultural resources. The Specific Plan establishes mitigation measures for impacts in these areas associated with construction of expanded or new water infrastructure. These may include traffic control/management plans to address traffic impacts during construction, various capital improvement plans, and the reevaluation of water master plan documents. Without mitigation, the impacts would be significant.

2. Have insufficient water supplies available to serve the project reasonably for the foreseeable future development during normal, dry and multiple dry years.

[27] City of Fresno, "Southeast Development Area Specific Plan Policy Draft," March 2022.

As shown by the 1.7% increase in water demand, existing City of Fresno water supplies could be sufficient to supply the future development in SEDA in addition to the existing demands. Current City water supply sources are as follows:

Groundwater – The City owns and operates 270 municipal water wells with 202 active wells; projected groundwater supply for the City of Fresno in 2035 is 149,100 AFY (acre-ft per year).[28]

Surface Water – The City owns and operates two (2) surface water treatment facilities – the NESWTF and the SESWTF. The NESWTF has a design capacity of 30 MGD expandable to 60 MGD, and the SESWTF has a design capacity of 54 MGD expandable to 80 MGD. The surface water is obtained from the Kings River via an agreement with FID, and from the Friant-Kern Canal through an agreement with the USBR. Treated surface water is used for potable uses and groundwater recharge. The projected surface water supply for the City of Fresno in 2035 is 191,600 AFY (60,000 via USBR, 131,600 via FID).[28]

Recycled Water – The City owns and operates the Fresno-Clovis RWRF and the NFWRF, which collect and treat wastewater from City users to various levels of treatment for non-potable uses. The Fresno-Clovis RWRF produces undisinfected secondary-treated effluent for use as restricted irrigation water for farmland and for groundwater recharge via discharge into adjacent percolation ponds, and disinfected tertiary-treated effluent for distribution through the City's recycled water distribution system for non-potable uses, including landscape irrigation and industrial processes. The NFWRF collects and treats wastewater to a disinfected tertiary-treated level for use as landscape irrigation supply for the Copper River Ranch Golf Course. The projected supply of recycled water for the City of Fresno in 2035 is 5,910 AFY.[28]

The UWMP presents actual data available for water supply and demand for the year 2020, as well as projected water usage. For 2020, the actual total potable water demand for the City was 121,993 AF[28], and the projected potable water demand for the City in 2035 is 154,210 AF.[28] Additionally, the projected non-potable water demand for the City for groundwater recharge is 68,100 AF for 2035.[28]

The estimated groundwater yield for the City in 2035 was projected to be 149,100 AF[28], assuming groundwater characteristics are not altered due to climatic events or regulatory influences from SGMA, indicating that groundwater alone will not be sufficient to meet future City demands, including those for SEDA. However, estimated surface water supplies for the City are projected to be 191,600 AF for 2035 (60,000 via USBR, 131,600 via FID) during normal water years, as well as 5,910 AF of recycled water.[28] Total projected water supply for the City in 2035 is 346,610 AF during normal water years and assuming groundwater characteristics are not altered due to climatic events or regulatory influences from SGMA, and total projected demand is 222,310 AF. The estimated increase in total water use for SEDA in accordance with the Specific Plan selected alternative is 0.33 MGD, or 1.03 AF. This results in a modified projected potable demand for the City of 154,211 AF, with a total water demand (potable and non-potable) of 222,311 AF.

In the event of a single dry year, the projected water supply for 2035 is 200,862 AF assuming groundwater characteristics are not altered due to climatic events or regulatory influences from SGMA, and the projected demand is 184,174 AF; Table 7-3 of the UWMP shows the projected water supplies and demands for multiple dry years.[28]

[28] City of Fresno, "2020 Urban Water Management Plan," July 2021.

The City Metro Plan Update will include proposed infrastructure improvements necessary to sustain development in SEDA, including the construction of new groundwater wells, surface water treatment plant expansions, and expansion of the Regional Transmission water distribution system. Impacts would be significant without mitigation measures. Since the increase in water demand for the Specific Plan Area is 1.7% from the General Plan condition, the impacts to water supply could be potentially significant; upon compliance with regulatory requirements, proposed policies for full implementation of the proposed Specific Plan, proposed mitigation measures, and construction of proposed water supply and distribution system infrastructure, the impact could be reduced. The normal water year supply projected for the City of Fresno in 2035 is 346,610 AF, and total projected demand is 222,310 AF. All water supply scenarios for dry years for 2035 are sufficient to accommodate the increase in water demand for the Specific Plan Area of 1.03 AF assuming groundwater characteristics are not altered due to climatic events or regulatory influences from SGMA.

The City shall develop and implement water conservation measures to reduce the per capita water use, and continue to refine and implement water saving and conservation standards for new developments approved under the Specific Plan. The City shall complete these measures and standards prior to approving any new project applications for future development in the Plan Area that require a discretionary approval and shall confirm that each project has incorporated the refined measures and standards prior to issuing approval. The City shall also continue to implement the City of Fresno Water Conservation Program, as may be updated, and periodically update restrictions on water uses, and evaluate the feasibility of the conservation target identified as part of the Fresno General Plan MEIR. The City shall complete these measures prior to approving any new project applications for future development in the Plan Area that require a discretionary approval and shall confirm that each project has incorporated any resulting standards prior to issuing approval.

The City shall refine landscape water conservation standards that will apply to new development installed landscapes, building on the State Model Water Efficient Landscape Ordinance (MWELO) and other state regulations. The City shall complete these standards prior to approving any new project applications for future development in the Plan Area that require a discretionary approval and shall confirm that each project has incorporated any resulting standards prior to issuing approval.

Additionally, the City shall evaluate the water supply system at the time that discretionary projects are submitted for approval by the City, and the City shall not approve development that would demand additional water until additional water sources are secured and provided. The City shall evaluate proposed water supply improvements for potential environmental impacts, and shall construct such improvements prior to exceedance of demand to accommodate full buildout of the Specific Plan.

## 6.3 Conclusions

City planning documents, including but not limited to the General Plan and the Metro Plan, will need to be updated to account for the development of the SEDA, and account for the policies and revisions present in the Specific Plan.

Mitigations for SEDA from the General Plan to the SEDA Specific Plan include:

a) Develop an update to the City General Plan
b) Develop an update to the City Metro Plan

c) Develop additional water conservation measures in accordance with the City Metro Plan
d) Construct new water supply infrastructure in the Plan Area
e) Construct new water distribution infrastructure in the Plan Area
f) Construct new water storage facilities in the Plan Area
g) Construct groundwater recharge facilities in the Plan Area
h) Construct water treatment facilities in the Plan Area
i) Expand water treatment facilities
j) Secure additional water sources for the City to support development in the Plan Area

# Appendix A

Supporting Calculations

| GP Land Use Classification | Abbrv. | GP Area (ac) | SP Equivalent Land Use Classification | Abbrv. | Water Demand Factor (GPD/ac) | SP Area (ac) | SP Base Water (MGD) |
|---|---|---|---|---|---|---|---|
| Residential - Low Density | RL | 1,700.92 | Residential - Rural Residential | RR | 2,050 | 2,037.69 | 4.18 |
| Residential - Medium Density | RM | 1,473.32 | Residential - Neighborhood Residential | NR | 2,810 | 1,434.91 | 4.03 |
| Residential - Urban Neighborhood | RUN | 891.47 | Residential - Mixed Residential | MR | 5,140 | 1,026.26 | 5.27 |
| Employment - Office | O | 144.37 | Employment - Office Center | OC | 2,440 | 154.47 | 0.38 |
| Employment - Business Park | BP | 12.78 | Employment - Flexible Research and Development | F | 2,420 | 16.54 | 0.04 |
| Employment - Regional Business Park | RBP | 1,219.71 | Employment - Flexible Research and Development | F | 1,685 | 1,287.53 | 2.17 |
| Mixed Use -Corridor/Center Mixed Use | CMX | 315.41 | Mixed Used - Community Center | CC | 1,930 | 273.88 | 0.53 |
| Mixed Use - Regional Mixed Use | RMX | 209.77 | Mixed Use - Regional Center | RC | 2,106 | 291.71 | 0.61 |
| Open Space - Open Space | OS | 569.53 | N/A | N/A | 865 | 0 | 0.00 |
| Open Space - Community Park | CP | 47.46 | N/A | N/A | 2,620 | 0 | 0.00 |
| Open Space - Ponding Basin | PB | 263.32 | Other - Flood Control Basin | POF | 0 | 265.78 | 0.00 |
| Public Facilities - College | C | 116.26 | Employment - Institutional | I | 1,665 | 116.26 | 0.19 |
| Public Facilities - School with Park | P | 149.77 | Employment - Institutional | I | 2,895 | 149.77 | 0.43 |
| Public Facilities - School with Park | P | 413.45 | Mixed Use - Neighborhood Center | NC | 1,851 | 491.38 | 0.91 |
| Buffer - Buffer | BUFFER | 715.04 | Residential - Rural Cluster Residential | RCR | 1,415 | 766.47 | 1.08 |
| Other - Street/Rail/ Canal, etc. | N/A | 11.21 | Other | N/A | 0 | 12.94 | 0.00 |
| Totals | | 8,253.76 | | | | 8,325.57 | 19.83 |

| | |
|---|---|
| **SEDA Projected 2035 General Plan Water Demand [A]** | 21,843 AF/yr<br>19.50 MGD |
| **SEDA Specific Plan Total Base Water Demand** | 19.83 MGD |
| **Usage Δ** | 0.33 MGD |
| **Usage Δ (%)** | 1.7% |

[A] West Yost Associates, "Hydraulic Evaluation of the Proposed 2035 General Plan Land Use Updated for the Master Environmental Impact Report," Technical Memorandum, Table 2, "Water Demand Comparison for General Plan Land Use Changes," January 21, 2013.

## Appendix B

City of Fresno Water and Wastewater Unit Factor Update for Metropolitan Water Resources Management Plan Update (Prepared by Akel Engineering, Inc.)

CITY OF FRESNO

# Water and Wastewater Unit Factor Update

FOR

# Metropolitan Water Resources Management Plan Update

PRELIMINARY

October 2020

AKEL
ENGINEERING GROUP, INC.

# City of Fresno

## Water and Wastewater Unit Factor Update

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Table 2 Sewer Flow Factors by Land Use Classification

## Table 1 Water Demand Factors by Land Use Classification

Metropolitan Water Resources Management Plan Update

City of Fresno

PRELIMINARY

*(Revised October 2020)*

| | Land Use Classifications | Water Service Area[1,2,3] (acres) | 2018 Water Demands[4] (mgd) | Recommended Water Demand Factors[5] (gpd/acre) | (ac-ft/yr/acre) |
|---|---|---|---|---|---|
| **Residential** | | | | | |
| 1 | Rural Density | 746 | 0.85 | 1,415 | 1.59 |
| 2 | Low Density | 1,283 | 2.12 | 2,050 | 2.30 |
| 3 | Medium Low Density | 10,139 | 23.18 | 2,845 | 3.19 |
| 4 | Medium Density | 11,033 | 24.91 | 2,810 | 3.15 |
| 5 | Medium High Density | 1,953 | 6.94 | 4,425 | 4.96 |
| 6 | High Density | 1,314 | 6.19 | 5,855 | 6.56 |
| | **Subtotal - Residential** | **26,467** | **64.18** | | |
| **Commercial** | | | | | |
| 7 | Community | 558 | 1.04 | 2,330 | 2.61 |
| 8 | General Heavy | 1,124 | 2.11 | 2,340 | 2.62 |
| 9 | Neighborhood | 530 | 1.08 | 2,525 | 2.83 |
| 10 | Neighborhood Limited | 0 | 0.00 | - | - |
| 11 | Office | 932 | 1.83 | 2,440 | 2.73 |
| 12 | Professional Services Office | 89 | 0.17 | 2,420 | 2.71 |
| 13 | Regional | 294 | 0.40 | 1,685 | 1.89 |
| 14 | Recreational | 109 | 0.23 | 2,575 | 2.88 |
| 15 | Storage | 273 | 0.07 | 335 | 0.38 |
| | **Subtotal - Commercial** | **3,909** | **6.93** | | |
| **Public Facilities** | | | | | |
| 16 | Airport | 1,147 | 0.12 | 130 | 0.15 |
| 17 | College | 304 | 0.41 | 1,665 | 1.87 |
| 18 | High School | 505 | 0.60 | 1,485 | 1.66 |
| 19 | Elementary and High School | 141 | 0.21 | 1,825 | 2.04 |
| 20 | Middle School | 305 | 0.43 | 1,765 | 1.98 |
| 21 | Elementary and Middle School | 191 | 0.30 | 1,930 | 2.16 |
| 22 | Elementary School | 792 | 1.53 | 2,405 | 2.69 |
| 23 | Special School | 52 | 0.05 | 1,110 | 1.24 |
| 24 | SEGA School with Park | 6 | 0.01 | 2,895 | 3.24 |
| 25 | Cemetery | 159 | 0.10 | 810 | 0.91 |
| 26 | Church | 662 | 0.81 | 1,525 | 1.71 |
| 27 | Community Activity Center | 11 | 0.02 | 1,930 | 2.16 |
| 28 | Neighborhood Center | 10 | 0.01 | 795 | 0.89 |
| 29 | Convention Center | 17 | 0.03 | 1,955 | 2.19 |
| 30 | Fairgrounds | 90 | 0.09 | 1,290 | 1.45 |
| 31 | Fire Station | 15 | 0.02 | 1,855 | 2.08 |
| 32 | Government Offices | 162 | 0.26 | 1,985 | 2.22 |
| 33 | Court House Central Area | 19 | 0.15 | 9,590 | 10.74 |
| 34 | Hospital | 189 | 0.76 | 5,005 | 5.61 |
| 35 | Medical Center | 20 | 0.02 | 1,385 | 1.55 |
| 36 | Convalescent Hospital | 119 | 0.39 | 4,080 | 4.57 |
| 37 | Military | 55 | 0.01 | 170 | 0.19 |
| 38 | Mobile Home Park | 274 | 0.49 | 2,225 | 2.49 |
| 39 | Municipal Service Center | 37 | 0.07 | 2,200 | 2.46 |
| 40 | Post Office | 30 | 0.02 | 750 | 0.84 |
| 41 | Public Facility | 7 | 0.01 | 1,010 | 1.13 |
| 42 | Public/Quasi-Public Facility | 46 | 0.10 | 2,670 | 2.99 |
| 43 | Fresno County Jail | 3 | 0.19 | 80,765 | 90.47 |

## Table 1 Water Demand Factors by Land Use Classification

Metropolitan Water Resources Management Plan Update

City of Fresno

PRELIMINARY

*(Revised October 2020)*

| Land Use Classifications | | Water Service Area[1,2,3] (acres) | 2018 Water Demands[4] (mgd) | Recommended Water Demand Factors[5] (gpd/acre) | (ac-ft/yr/acre) |
|---|---|---|---|---|---|
| 44 | Pump Station | 9 | 0.01 | 805 | 0.90 |
| | **Subtotal - Public Facility** | **5,376** | **7.19** | | |
| **Industrial** | | | | | |
| 45 | Light Industrial | 2,301 | 3.42 | 1,850 | 2.07 |
| 46 | Heavy Industrial | 1,905 | 5.91 | 3,860 | 4.32 |
| | **Subtotal - Industrial** | **4,206** | **9.34** | | |
| **Open Space** | | | | | |
| 47 | Open Space | 177 | 0.12 | 865 | 0.97 |
| 48 | Recreational Use/Clear Zone | 15 | 0.00 | - | - |
| 49 | Ag | 1,531 | 0.00 | - | - |
| 50 | Canal | 20 | 0.00 | - | - |
| 51 | Community Park | 24 | 0.05 | 2,620 | 2.93 |
| 52 | Golf Course | 662 | 0.23 | 435 | 0.49 |
| 53 | Lake or Pond | 54 | 0.00 | - | - |
| 54 | Multi-Use | 0 | 0.00 | - | - |
| 55 | Neighborhood Park | 218 | 0.62 | 3,510 | 3.93 |
| 56 | Recreational Park | 97 | 0.15 | 1,980 | 2.22 |
| 57 | Recreational Use | 17 | 0.02 | 1,235 | 1.38 |
| 58 | Regional Park | 436 | 0.18 | 525 | 0.59 |
| 59 | Recreational Commercial | 0 | 0.00 | - | - |
| 60 | Environmental Education Area | 0 | 0.00 | - | - |
| 61 | Gravel Mining | 0 | 0.00 | - | - |
| 62 | Parking | 48 | 0.00 | - | - |
| 63 | PGE Sub Station | 102 | 0.00 | - | - |
| 64 | Ponding Basin | 236 | 0.00 | - | - |
| 65 | Ponding Basin/Park | 128 | 0.16 | 1,535 | 1.72 |
| | **Subtotal - Open Space** | **3,764** | **1.53** | | |
| **Total** | | | | | |
| | **Subtotal - Residential** | **26,467** | **64.18** | | |
| | **Subtotal - Commercial** | **3,909** | **6.93** | | |
| | **Subtotal - Public Facility** | **5,376** | **7.19** | | |
| | **Subtotal - Industrial** | **4,206** | **9.34** | | |
| | **Subtotal - Open Space** | **3,764** | **1.53** | | |
| | **Total** | **43,722** | **89.17** | | |

AKEL ENGINEERING GROUP, INC.

10/2/2020

Notes:

1. Source: Land use and acreages based on City of Fresno parcel shapefile downloaded July 16, 2019.
2. Acreages exclude Bakman, Pinedale, and CSU Fresno service areas.
3. Acreages reflect demand generating parcels only.
4. Demand based on 2018 annual metered consumption records.
5. Recommended Water Demand Factors include the following adjustments:
   - Demand Factors normalized to 2018 production to account for system losses
   - Demand Factors increased to account for City-wide vacancy rate of 8.1% based on CA Department of Finance population estimat

## Table 2 Sewer Flow Factors by Land Use Classification

Metropolitan Water Resources Management Plan Update
City of Fresno

PRELIMINARY

| | Land Use Classifications | Sewer Service Area[1,2,3] (acres) | Return to Sewer Ratio | Unadjusted Wastewater Unit Factor[4] (gpd/acres) | Estimated Sewer Flow (mgd) | Recommended Wastewater Unit Factor[5] (gpd/acres) |
|---|---|---|---|---|---|---|
| **Residential** | | | | | | |
| 1 | Rural Density | 714 | 0.20 | 227 | 0.16 | 250 |
| 2 | Low Density | 1,063 | 0.35 | 577 | 0.61 | 625 |
| 3 | Medium Low Density | 9,875 | 0.40 | 915 | 9.03 | 990 |
| 4 | Medium Density | 11,001 | 0.50 | 1,129 | 12.42 | 1,225 |
| 5 | Medium High Density | 1,950 | 0.55 | 1,956 | 3.81 | 2,115 |
| 6 | High Density | 1,314 | 0.60 | 2,825 | 3.71 | 3,055 |
| | | | | **Subtotal - Residential Flow** | **29.75** | |
| **Commercial** | | | | | | |
| 7 | Community | 558 | 0.80 | 1,497 | 0.84 | 1,620 |
| 8 | General Heavy | 1,124 | 0.80 | 1,504 | 1.69 | 1,630 |
| 9 | Neighborhood | 530 | 0.80 | 1,623 | 0.86 | 1,755 |
| 10 | Neighborhood Limited | 0 | 0.00 | 0 | 0.00 | 0 |
| 11 | Office | 932 | 0.80 | 1,567 | 1.46 | 1,695 |
| 12 | Professional Services Office | 89 | 0.80 | 1,556 | 0.14 | 1,685 |
| 13 | Regional | 294 | 0.80 | 1,084 | 0.32 | 1,175 |
| 14 | Recreational | 109 | 0.30 | 621 | 0.07 | 675 |
| 15 | Storage | 273 | 0.80 | 213 | 0.06 | 235 |
| | | | | **Subtotal - Commercial Flow** | **5.43** | |
| **Public Facility** | | | | | | |
| 16 | Airport | 1,147 | 0.80 | 81 | 0.09 | 90 |
| 17 | College | 304 | 0.70 | 937 | 0.29 | 1,015 |
| 18 | High School | 505 | 0.70 | 835 | 0.42 | 905 |
| 19 | Elementary and High School | 141 | 0.70 | 1,026 | 0.14 | 1,110 |
| 20 | Middle School | 305 | 0.70 | 993 | 0.30 | 1,075 |
| 21 | Elementary and Middle School | 191 | 0.70 | 1,087 | 0.21 | 1,175 |
| 22 | Elementary School | 792 | 0.70 | 1,354 | 1.07 | 1,465 |
| 23 | Special School | 52 | 0.70 | 625 | 0.03 | 680 |
| 24 | SEGA School with Park | 6 | 0.80 | 1,860 | 0.01 | 2,015 |
| 25 | Cemetery | 159 | 0.25 | 163 | 0.03 | 180 |
| 26 | Church | 662 | 0.80 | 981 | 0.65 | 1,065 |
| 27 | Community Activity Center | 11 | 0.80 | 1,241 | 0.01 | 1,345 |
| 28 | Neighborhood Center | 10 | 0.80 | 510 | 0.00 | 555 |
| 29 | Convention Center | 17 | 0.80 | 1,258 | 0.02 | 1,360 |
| 30 | Fairgrounds | 90 | 0.80 | 827 | 0.07 | 895 |
| 31 | Fire Station | 15 | 0.80 | 1,192 | 0.02 | 1,290 |
| 32 | Government Offices | 162 | 0.80 | 1,277 | 0.21 | 1,385 |
| 33 | Court House Central Area | 19 | 0.80 | 6,169 | 0.12 | 6,670 |
| 34 | Hospital | 189 | 0.80 | 3,219 | 0.61 | 3,480 |
| 35 | Medical Center | 20 | 0.80 | 889 | 0.02 | 965 |
| 36 | Convalescent Hospital | 119 | 0.80 | 2,624 | 0.31 | 2,840 |
| 37 | Military | 55 | 0.80 | 109 | 0.01 | 120 |
| 38 | Mobile Home Park | 274 | 0.60 | 1,072 | 0.29 | 1,160 |
| 39 | Municipal Service Center | 37 | 0.80 | 1,415 | 0.05 | 1,530 |
| 40 | Post Office | 30 | 0.80 | 480 | 0.01 | 520 |
| 41 | Public Facility | 7 | 0.80 | 649 | 0.00 | 705 |
| 42 | Public/Quasi-Public Facility | 46 | 0.80 | 1,716 | 0.08 | 1,855 |
| 43 | Fresno County Jail | 3 | 0.80 | 51,972 | 0.15 | 56,185 |
| 44 | Pump Station | 9 | 0.00 | 0 | 0.00 | 0 |
| | | | | **Subtotal - Public Facility Flow** | **5.24** | |

## Table 2 Sewer Flow Factors by Land Use Classification

Metropolitan Water Resources Management Plan Update
City of Fresno

PRELIMINARY

| | Land Use Classifications | Sewer Service Area[1,2,3] (acres) | Return to Sewer Ratio | Unadjusted Wastewater Unit Factor[4] (gpd/acres) | Estimated Sewer Flow (mgd) | Recommended Wastewater Unit Factor[5] (gpd/acres) |
|---|---|---|---|---|---|---|
| **Industrial[6]** | | | | | | |
| 45 | Light Industrial | 2,301 | 0.80 | 1,190 | 2.74 | 1,290 |
| 46 | Heavy Industrial | 1,905 | 0.80 | 2,484 | 4.73 | 2,690 |
| | | | | **Subtotal - Industrial Flow** | **7.47** | |
| **Open Space** | | | | | | |
| 47 | Open Space | 177 | 0.00 | 0 | 0.00 | 0 |
| 48 | Recreational Use/Clear Zone | 15 | 0.00 | 0 | 0.00 | 0 |
| 49 | Ag | 1,531 | 0.00 | 0 | 0.00 | 0 |
| 50 | Canal | 20 | 0.00 | 0 | 0.00 | 0 |
| 51 | Community Park | 24 | 0.00 | 0 | 0.00 | 0 |
| 52 | Golf Course | 525 | 0.30 | 104 | 0.05 | 115 |
| 53 | Lake or Pond | 54 | 0.00 | 0 | 0.00 | 0 |
| 54 | Multi-Use | 0 | 0.00 | 0 | 0.00 | 0 |
| 55 | Neighborhood Park | 218 | 0.00 | 0 | 0.00 | 0 |
| 56 | Recreational Park | 97 | 0.00 | 0 | 0.00 | 0 |
| 57 | Recreational Use | 17 | 0.00 | 0 | 0.00 | 0 |
| 58 | Regional Park | 436 | 0.00 | 0 | 0.00 | 0 |
| 59 | Recreational Commercial | 0 | 0.00 | 0 | 0.00 | 0 |
| 60 | Environmental Education Area | 0 | 0.00 | 0 | 0.00 | 0 |
| 61 | Gravel Mining | 0 | 0.00 | 0 | 0.00 | 0 |
| 62 | Parking | 48 | 0.00 | 0 | 0.00 | 0 |
| 63 | PGE Sub Station | 102 | 0.00 | 0 | 0.00 | 0 |
| 64 | Ponding Basin | 236 | 0.00 | 0 | 0.00 | 0 |
| 65 | Ponding Basin/Park | 128 | 0.00 | 0 | 0.00 | 0 |
| | | | | **Subtotal - Open Space Flow** | **0.05** | |
| **Non-Metered[7,8,9]** | | | | | | |
| | Pinedale Public Utilities | - | - | - | 0.63 | |
| | Pinedale County Water District | - | - | - | 0.46 | |
| | Tarpey Village | - | - | - | 0.37 | |
| | Bakman | - | - | - | 1.82 | |
| | Clovis | - | - | - | 0.20 | |
| | City of Clovis | - | - | - | 5.12 | |
| | CSU Fresno | - | - | - | 0.13 | |
| | | | | **Subtotal - Non-Metered Flow** | **8.73** | |
| **Total** | | | | | | |
| | | | | **Subtotal - Residential Flow** | **29.75** | |
| | | | | **Subtotal - Commercial Flow** | **5.43** | |
| | | | | **Subtotal - Public Facility Flow** | **5.24** | |
| | | | | **Subtotal - Industrial Flow** | **7.47** | |
| | | | | **Subtotal - Open Space Flow** | **0.05** | |
| | | | | **Subtotal - Non-Metered Flow** | **8.73** | |
| | | | | **Total Balanced WWTP Flow** | **56.68** | |
| | | | | **2018 WWTP Average Annual Flow[10]** | **56.81** | |

AKEL ENGINEERING GROUP, INC.

10/2/2020

Notes:

1. Source: Land use and acreages based on City of Fresno parcel shapefile downloaded July 16, 2019.
2. Acreages exclude Bakman, Pinedale, and CSU Fresno service areas.
3. Acreages reflect flow generating parcels only and do not account for Septic Users.
4. Demand based on 2018 annual metered consumption records.
5. Wastewater Unit Factors increased to account for City-wide vacancy rate of 8.1% based on CA Department of Finance population estimates.
6. Industrial flow does not exclude the City's top industrial users (Foster Farms, Cal Dairies, Gallo, and Cargil Beef).
7. Development information for non-metered areas provided by City Staff.
8. City of Clovis BWF extracted from City of Fresno Wastewater Collection System Master Plan Update (September 2015).
9. CSU Fresno flows extracted from flow meter data provided by City Staff on April 30, 2019.
10. Historical WWTP flows provided by City Staff on February 13, 2019.

## Appendix C

Water Technical Report for the City of Fresno General Plan Update MEIR (Prepared by Blair, Church & Flynn), City of Fresno Hydraulic Evaluation of the Proposed 2035 General Plan Land Use Updated for the Master Environmental Impact Report Technical Memorandum (Prepared by West Yost Associates)

# Water Technical Report

# for the

# City of Fresno General Plan Update MEIR

June 18, 2013

## Introduction

The City of Fresno (City) is in the process of developing their General Plan Update. The last update to the City's General Plan was in 2002. The General Plan Update, in part, encourages infill projects and facilitates revitalization. The Master Environmental Impact Report evaluates the impacts associated with the General Plan Update and proposes mitigation measures. West Yost Associates (West Yost) has analyzed the impacts associated with the General Plan Update and prepared recommendations to meet increased demand and additional storage requirements. West Yost's analysis is summarized in their Technical Memorandum entitled "Hydraulic Evaluation of the Proposed 2035 General Plan Land Use Update for the Master Environmental Impact Report" (Technical Evaluation), attached as Appendix A. The recommendations included in the Technical Evaluation are based on general land use data available as part of the General Plan Update. See Figure 5 in the Technical Report for proposed water infrastructure improvements. As actual development projects are proposed with more specific information, additional evaluation will be required to confirm that the local distribution system and infrastructure are sufficient to meet the City minimum service requirements for service to the end users.

## Summary of Analysis

The Technical Evaluation used the land use data obtained from the City's General Plan Update as contained in Geographic Information System geodatabase files provided by the City's Planning and Development Department. These General Plan Update land uses were used, together with appropriate water duty factors to calculate the water demand. Tables 1 and 2 in the Technical Evaluation include the water duty factors per customer class and the calculated water demand, respectively. The calculated water demand as a result of the General Plan Update is 243,570 acre-feet per year (af/yr) and exceeds the water demand projected in the 2012 City of Fresno Metropolitan Water Resources Management Plan by 10,170 af/yr. In order to meet this higher water demand, additional groundwater pumpage or combination of groundwater pumpage and increased surface water treatment capacity will be required. An additional 10,170 af/yr of intentional groundwater recharge, via an additional 210 acres of new recharge basins, would be required to balance the additional groundwater pumpage.

Potable water storage requirements were considered in the Technical Evaluation. The total storage required to meet the daily water demand that is projected to be generated by the 2035 General Plan Update land uses is 250.7 million gallons, see Table 4 in the Technical Evaluation. The storage requirement exceeds the 2025 general plan update storage requirement by 10.1 million gallons. The Technical Evaluation, in Figure 5, indicates proposed locations for the additional storage. The next water master plan update should include recommendations for overall water system improvements, including recommendations for storage improvements.

The West Yost Technical Evaluation indicates that the water infrastructure recommended in the 2012 City of Fresno Metropolitan Water Resources Management Plan is adequate to convey the peak hourly plus fire flow for the General Plan Update land uses and meets the City's service criteria. Therefore, no previously unplanned conveyance or pump systems are needed for that reason.

Additionally, West Yost has analyzed the impacts to the downtown area. West Yost's analysis is summarized in their Technical Memorandum entitled "Hydraulic Evaluation of the Proposed Fulton Corridor Specific Plan Project", attached as Appendix B.

**Mitigations (Existing Condition to 2025 General Plan)**

a. Construct an 80 million gallon per day (MGD) surface water treatment plant near the intersection of Fowler and Olive Avenues, in accordance with Chapter 9 and Figure 9-1 of the City of Fresno Metropolitan Water Resources Management Plan Update Phase 2 Report, January 2012 (2012 Metro Plan Update).

b. Construct a 30 MGD expansion of the existing northeast surface water treatment plant for a total capacity of 60 MGD, in accordance with Chapter 9 and Figure 9-1 of the 2012 Metro Plan Update.

c. Construct a 20 MGD surface water treatment plant in the southwest portion of the City, in accordance with Chapter 9 and Figure 9-1 of the 2012 Metro Plan Update.

d. Construct 65 new groundwater wells, in accordance with Chapter 9 and Figure 9-1 of the 2012 Metro Plan Update.

e. Construct a 2.0 million gallon potable water reservoir (Reservoir T2) near the intersection of Clovis and California Avenues, in accordance with Chapter 9 and Figure 9-1 of the 2012 Metro Plan Update.

f. Construct a 3.0 million gallon potable water reservoir (Reservoir T3) near the intersection of Temperance and Dakota Avenues, in accordance with Chapter 9 and Figure 9-1 of the 2012 Metro Plan Update.

g. Construct a 3.0 million gallon potable water reservoir (Reservoir T4) in the downtown area, in accordance with Chapter 9 and Figure 9-1 of the 2012 Metro Plan Update.

h. Construct a 4.0 million gallon potable water reservoir (Reservoir T5) near the intersection of Ashlan and Chestnut Avenues, in accordance with Chapter 9 and Figure 9-1 of the 2012 Metro Plan Update.

i. Construct a 4.0 million gallon potable water reservoir (Reservoir T6) near the intersection of Ashlan Avenue and Highway 99, in accordance with Chapter 9 and Figure 9-1 of the 2012 Metro Plan Update.

j. Construct 50.3 miles of regional water transmission mains ranging in size from 24-inch to 48-inch, in accordance with Chapter 9 and Figure 9-1 of the 2012 Metro Plan Update.

k. Construct 95.9 miles of 16-inch transmission grid mains, in accordance with Chapter 9 and Figure 9-1 of the 2012 Metro Plan Update.

l. Develop additional water conservation measures in accordance with Chapter 4 of the 2012 Metro Plan Update.

m. Implement groundwater objectives, goals and policies as described in Chapter 5 of the 2012 Metro Plan Update.

n. Implement surface water objectives, goals and policies as described in Chapter 6 of the 2012 Metro Plan Update.

o. Implement recycled water objectives, goals and policies as described in Chapter 7 of the 2012 Metro Plan Update.

**Mitigations (2025 General Plan to General Plan Update)**

a. Construct a 4.0 million gallon potable water reservoir (SEGA Reservoir 1) within the northern part of the Southeast Growth Area.

b. Construct a 4.0 million gallon potable water reservoir (SEGA Reservoir 2) within the southern part of the Southeast Growth Area.

c. Develop an update to the water master plan.

# Appendix A

WEST YOST
ASSOCIATES
*Consulting Engineers*

# TECHNICAL MEMORANDUM

DATE: January 21, 2013 Project No.: 439-00-12-11

TO: Brock Buche, City of Fresno Water Division Project Manager

CC: Martin Querin, City of Fresno Assistant Public Utilities Director—Water Division
Keith Bergthold, City of Fresno Assistant Director of Development and Resource Management

FROM: Brenda Estrada, Project Engineer, R.C.E. #67062

REVIEWED BY: Charles Duncan, Project Manager, R.C.E. #55498

SUBJECT: Hydraulic Evaluation of the Proposed 2035 General Plan Land Use Update for the Master Environmental Impact Report

## INTRODUCTION

The purpose of this technical memorandum (TM) is to present West Yost Associates' (West Yost's) evaluation of the potential hydraulic impacts on the City of Fresno (City) water system of the proposed 2035 General Plan Land Use Update (2035 GP) for the Master Environmental Impact Report (MEIR). As described in this TM, West Yost has used the City's water system hydraulic model to evaluate the ability of the City's existing and proposed water system to provide minimum required pressures and flows under the future, projected demands associated with the update to land use. Our evaluation findings and recommendations to serve the 2035 GP are described below.

## PROJECT BACKGROUND AND DESCRIPTION

The City has begun the process of updating their General Plan which was last updated in 2002. The previous General Plan included land use development projections to the year 2025. The 2035 GP will create a blueprint for development over the next 20 years to 2035. The changes in the 2035 GP look to facilitate revitalization, infill, transit-oriented development and more sustainable development practices. The MEIR evaluates the impacts to City infrastructure associated with the proposed changes to development.

The City has performed extensive planning for the future water system as documented in the Metropolitan Plan Update (Metro Plan Update). The Metro Plan Update used the City's 2025 General Plan Land Use Update (2025 GP) land use to project future water demands. These demands are the basis for the City's proposed supply portfolio and transmission pipeline grid developed in the Metro Plan Update to meet the City's future needs. Updates to the proposed land use impacts the City's overall system demands. This TM evaluates how the changes to demands impact the planned infrastructure for the City's water system.

## PROJECTED WATER DEMANDS

The City has been using water demands developed in the Metro Plan Update to plan for the future water system infrastructure and supply needs. As described in detail in the Metro Plan Update, West Yost obtained future land use data from the City's GIS, which used land use designation adopted as part of the City's 2025 GP. West Yost consolidated the various land use designations from the City's 2025 GP into the City's Water Division's five existing customer classes (single family residential, multi-family residential, commercial/institutional, industrial, and landscape irrigation) to facilitate development of unit factors. In addition to these five existing customer classes, West Yost had added a sixth customer class category for the Southeast Growth Area (SEGA) which had recently been added to the City's Sphere of Influence (SOI) at the time the Metro Plan Update was developed.

The 2035 GP updates the land use designation for several locations within the City's SOI including detailed land use information for the SEGA. The 2035 GP also includes new land use designations which include mixed use for areas outside of the Downtown Central Area. The main change to the land use designations occur along Blackstone Avenue corridor, Shaw Avenue corridor, SEGA, and the southwest section of the City SOI. Figure 1 shows the parcels within the City's SOI where the planned land use designations were updated in the 2035 GP.

The new mixed use designations required the development of new water customer classes to account for the change in anticipated water use. The mixed use designations combine commercial, office and residential land uses on a single parcel. For the downtown mixed use designated parcels, the water duty factor is higher than for the areas outside of downtown. The mixed use planned in the Downtown Central Area is expected to be high densification of residential, commercial, and office in multiple story buildings. It is anticipated the mixed use downtown will include greater square footage of office and commercial as well as higher density residential than the areas outside of downtown and therefore, different water duty factors were developed for the two areas.

The Metro Plan Update used the assumption that open space land designations did not require irrigation. Since the Metro Plan Update, additional evaluation on how open space area is irrigated within the City has resulted in the development of water duty factors to account for irrigation of turf areas within an open space designated parcel. Depending on the primary purpose of the open space, new park, nature preserve, flood control, or greenbelt, a percentage of the parcel is now assumed to be irrigated.

Table 1 provides a summary of the water duty factors used for the different water customer classes and the land use code for the evaluation.

**Table 1. Summary of Unit Water Use Factors**

| Water Customer Class | Land Use Code | Water Duty Factor[(a)], afa/ac |
|---|---|---|
| Single Family Residential | rl, rm, rml, run | 3.2 |
| Multi-Family Residential | rh, rmh | 6.2 |
| Commercial/Institutional | cbp, cc, cgh, cms, co, cr, crbp, hwy, il, pf, pfs, pqch, pse, psm, psp, pss | 1.9 |
| Industrial | Ih | 1.9 |
| Landscape Irrigation | ccr, orbp, orp, orpr | 2.9 |
| Open Space[(b)]<br>• New parks<br>• Nature preserve park<br>• Ponding basin/Regional flood control<br>• SEGA open space | obp, os | <br>3.4 (80% of area)<br>3.4 (15% of area)<br>0<br>3.4 (47% of area) |
| Mixed Use Downtown | Cce | 7.5 |
| Mixed use Outside of Downtown | cmx, nmx, rmx | 6.6 |
| No Water Use[(c)] | ag, rail, road | 0 |

(a) Assumes water conservation achieved through water conservations implemented by the City and single family meter implementation program.
(b) Open space designations assumed to have a percentage of area irrigated based on type of open space use.
(c) No water use includes roadways, railroads, and agricultural land use designations. The eastside agricultural buffer for SEGA is assumed to have no water use.

Demands were calculated for the parcels with a change in land use. Table 2 provides a comparison of the calculated water demand for the 2025 GP land use and the 2035 GP land use for parcels with a change to its land use designation. Parcels without a land use designation change are assumed to have no change in demands. Demand changes to the downtown area are based on work West Yost has conducted based on densification of the proposed mixed use parcels in the downtown area, as well as specific demand for the Fulton Corridor Specific Plan developed by Sherwood Design Engineers.

For purposes of West Yost's hydraulic evaluation of the demand changes due to the 2035 GP, the water demands associated with the parcels having a change in land use were updated in the hydraulic model. The projected demands for the SEGA are decreased from what was projected as part of the Metro Plan Update. However, the downtown area and the remainder of the City demands increase. The calculated demands show an overall increase for the City due to the changes in the 2035 GP land use of 10,170 acre-feet/year (afa). Figure 2 shows how the changes to demands are spatially located throughout the City.

**Table 2. Water Demand Comparison for General Plan Land Use Changes[a]**

| Water Customer Category | Water Duty Factor | 2025 General Plan | | 2035 General Plan | | Difference (2035-2025) | |
|---|---|---|---|---|---|---|---|
| | | Area, acres | Annual Water Demand, afa | Area, acres | Annual Water Demand, afa | Area, acres | Annual Water Demand, afa |
| **Downtown Area[b]** | | | | | | | |
| Commercial/Institutional | 1.9 | 2,179 | 4,140 | 1,699 | 3,229 | -480 | -911 |
| Commercial/Mixed Use[c] | 7.5 | 0 | 0 | 480 | 3,600 | 480 | 3,600 |
| Industrial | 1.9 | 237 | 450 | 237 | 450 | 0 | 0 |
| Landscape Irrigation | 2.9 | 185 | 537 | 185 | 537 | 0 | 0 |
| Multi-Family Residential | 6.2 | 367 | 2,278 | 367 | 2,278 | 0 | 0 |
| No Water Use | 0.0 | 83 | 0 | 83 | 0 | 0 | 0 |
| Open Space[d] | 2.9 | 65 | 0 | 65 | 188 | 0 | 188 |
| Single Family Residential | 3.2 | 1,851 | 5,923 | 1,851 | 5,923 | 0 | 0 |
| Increase for Fulton Corridor[e] | - | - | 0 | - | 1,020 | - | 1,020 |
| *Subtotal Downtown Area* | | *4,967* | *13,329* | *4,967* | *17,225* | *0* | *3,896* |
| **SEGA** | | | | | | | |
| South East Growth Area | 3.2 | 8,227 | 26,328 | 0 | 0 | -8,227 | -26,328 |
| Commercial/Institutional | 1.9 | 0 | 0 | 1,715 | 3,258 | 1,715 | 3,258 |
| Irrigated School Parks | 3.4 | 0 | 0 | 354 | 1,204 | 354 | 1,204 |
| Industrial | 1.9 | 0 | 0 | 0 | 0 | 0 | 0 |
| Landscape Irrigation | 2.9 | 0 | 0 | 34 | 97 | 34 | 97 |
| Multi-Family Residential | 6.2 | 0 | 0 | 0 | 0 | 0 | 0 |
| No Water Use | 0.0 | 0 | 0 | 733 | 0 | 733 | 0 |
| Open Space[d] | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Regional Flood Control[f] | 0.0 | 0 | 0 | 269 | 0 | 269 | 0 |
| SEGA Open Space[g] | 3.4 | 0 | 0 | 564 | 901 | 564 | 901 |
| Single Family Residential | 3.2 | 0 | 0 | 4,039 | 12,924 | 4,039 | 12,924 |
| Mixed Use[h] | 6.6 | 0 | 0 | 524 | 3,460 | 524 | 3,460 |
| *Subtotal SEGA* | | *8,227* | *26,328* | *8,230* | *21,843* | *3* | *-4,485* |
| **Remainder of City** | | | | | | | |
| Commercial/Institutional | 1.9 | 6,131 | 11,650 | 3,309 | 6,287 | -2,822 | -5,362 |
| Industrial | 1.9 | 3 | 7 | 121 | 230 | 118 | 223 |
| Landscape Irrigation | 2.9 | 157 | 455 | 257 | 745 | 100 | 290 |
| Multi-Family Residential | 6.2 | 884 | 5,482 | 372 | 2,307 | -512 | -3,175 |
| No Water Use | 0.0 | 8 | 0 | 31 | 0 | 23 | 0 |
| Open Space[d] | 0.0 | 280 | 0 | 0 | 0 | -280 | 0 |
| New Parks[i] | 3.4 | 0 | 0 | 359 | 977 | 359 | 977 |
| Nature Preserve[j] | 3.4 | 0 | 0 | 135 | 69 | 135 | 69 |
| Ponding Basin[k] | 0.0 | 0 | 0 | 56 | 0 | 56 | 0 |
| Regional Flood Control(f) | 0.0 | 0 | 0 | 32 | | 32 | |
| Single Family Residential | 3.2 | 3,699 | 11,838 | 3,874 | 12,397 | 175 | 558 |
| Mixed Use[h] | 6.6 | 0 | 0 | 2,603 | 17,180 | 2,603 | 17,180 |
| *Subtotal Remainder of City* | | *11,163* | *29,431* | *11,150* | *40,192* | *-13* | *10,761* |
| ***Total*** | | ***24,358*** | ***69,088*** | ***24,348*** | ***79,260*** | ***-10*** | ***10,172*** |

[a] Demands shown for parcels with a change in Land Use from the 2025 General Plan to the 2035 General Plan Update.

[b] Demands for the Downtown Area based on increase in densification to mixed use land use designation and Fulton Corridor Specific Plan detailed demand use.

[c] Downtown Commercial/Mixed Use water duty factor based on densification of mixed use within the downtown area and proposed population increases. Downtown Area commercial/mixed use assumed to contain a greater building square footage than mixed use in other parts of the City and therefore, a larger water duty factor is applied to the Downtown Commercial/Mixed Use land categories.

[d] Open Space water duty factor developed for original Metro Plan demand projections assumed 0 water usage. Additional research on the type of irrigation needs for various open space uses has resulted in new water duty factors for the 2035 General Plan land use.

[e] Demands for Fulton Corridor Specific Plan are based on building type and proposed square footage as provided by Sherwood Engineering. Demands for Fulton Corridor are not tied to a specific land use type.

[f] The water duty for the Open Space land use areas planned to be used as Regional Flood Control facilities is assumed to be 0 afa. A total of 300.7 acres is planned with a majority of the land use within SEGA.

[g] SEGA open space/mixed vegetation area is assumed to be approximately 47 percent irrigated. This assumes 263.6 acres of the total 563.6 acres of open space will require irrigation.

[h] Mixed Use land designations outside of the downtown area are assumed to contain less square footage than mixed use within the Downtown Area. Mixed use water duty factor is based on assumptions for building and population projections for SEGA.

[i] Open Space land uses assumed to be used as new parks are assumed to be 80 percent irrigated. A total of 359.3 acres of new park is planned for the remainder area of the City.

[j] The water duty for the Open Space land use area planned to be used as a nature preserve type park located in the northwest part of the City is assumed to be 15 percent irrigated. A total of 135.1 acres is currently planned.

[k] The water duty for the Open Space land use areas planned to be used as Ponding Basis facilities is assumed to be 0 afa. A total of 56.4 acres is currently planned.

## WATER SUPPLY

As described in the City's Metro Plan Update, the City's Water Master Plan, the City's 2010 Urban Water Management Plan (2010 UWMP) and West Yost's March 2009 TM "Hydraulic Evaluation of the Downtown Central Area," the City's available water supplies are confined to a finite quantity and are extremely limited. Therefore, water supplies to meet the projected increase in water demand must come from within the City's existing, limited water supply portfolio. The availability and reliability of the City's water supplies to meet the City's projected water demands under various hydrologic conditions were evaluated in the City's 2010 UWMP which was adopted by City Council in November 2012.

The projected water demands in the 2010 UWMP were based on the City's anticipated compliance with adopted per capita water use targets in accordance with the Water Conservation Act of 2009 (SBx7-7) and the projected City population in 2035[1]. As documented in the 2010 UWMP, the City population in 2035 is projected to be 786,000 (this is based on the Fresno Council of Governments estimate of 1,290,000 people countywide in 2035, with 61 percent of the population residing in the City of Fresno). Assuming that the land use changes proposed for the 2035 General Plan do not result in an increase in the total projected City population, but instead result in an increased densification of population in some parts of the City and reduced densification in other parts of the City, the projected water demand per SBx7-7, based on per capita consumption, in 2035 (220,100 af) would be unchanged as a result of the proposed land use changes.

The projected water supplies in the 2010 UWMP were calculated using land-use based water demand projection using the 2025 General Plan land uses (shifted out 10 years to 2035 to account for the slowdown in development in the City) and assuming water conservation by all users. This land use-based water demand projection (233,400 af) is higher than the SBx7-7 water demand projection (220,100 af) and is more conservative for water supply planning purposes as it provides for additional water supplies in the event that the City were not able to comply with the SBx7-7 requirements. With the land use changes proposed for the 2035 General Plan, this 2035 water demand estimate would increase to 243,570 af (233,400 af + 10,170 af). This increased land use-based water demand projection is shown on Figure 3.

To meet this higher land use-based water demand projection in 2035, additional water supplies would be required. The City's water supply portfolio in 2035 is projected to include treated surface water supplies, groundwater supplies and recycled water supplies (see Figure 3). Supplies to meet additional water demands would likely be derived from additional groundwater pumpage in conjunction with additional intentional groundwater recharge. The groundwater pumpage projected for 2035 in the 2010 UWMP (85,000 af) would increase to 95,170 af (85,000 af + 10,170 af) with the land use changes proposed for the 2035 General Plan. This increase in groundwater pumpage would require a like amount of additional intentional groundwater recharge to keep the City's groundwater operations in balance. As described in the City's 2010 UWMP, the projected future increase in intentional groundwater recharge is assumed to occur due to the increased use of existing recharge basins, construction of new recharge basins, and/or development of a groundwater bank and maximizing the use of available surface water supplies[2].

[1] See Chapter 6 of the City of Fresno 2010 Urban Water Management Plan dated November 2012.
[2] See Section 4.2.3 of the City's 2010 Urban Water Management Plan dated November 2012.

An additional 210 acres[3] of new recharge basins (beyond those previously identified) would be required to balance the additional required groundwater pumpage of 10,170 af associated with the 2035 General Plan.

## EVALUATION CRITERIA

The planning and modeling criteria used for this evaluation are based on West Yost's recent work with the City. The August 2008 verified hydraulic model of the City's water distribution system was used as the basis for the evaluation. The hydraulic model has been updated since 2008 to account for the updates to demand within the Downtown Central Area.

### Planning and Modeling Criteria

The criteria used to evaluate the potential impacts to the City's existing water system are as follows:

- Minimum peak hour demand pressure 40 pounds per square inch (psi);
- Maximum allowable velocity is 7 feet per second (fps) during a peak hour condition for distribution pipelines and 5 fps during a peak hour condition for transmission pipelines;
- Maximum allowable head loss rate is 10 feet per 1,000 feet during any condition[4];
- Any new, required pipelines will be modeled with a roughness coefficient (C-factor) of 130; and
- Assumed peaking factors for maximum day and peak hour demand conditions are consistent with the City's adopted peaking factors and are as follows:
  - Maximum Day Demand = 2.0 times Average Day Demand
  - Peak Hour Demand = 2.9 times Average Day Demand

### Fire Flow Requirements

As a purveyor of water, the City is responsible for providing a realistic water supply to meet fire flow requirements. The City's Fire Department establishes minimum water flows and pressures required for firefighting purposes. The Fire Department uses the 2007 California Fire Code (CFC) (*Table B105.1 – Minimum Required Fire-Flow and Flow Duration for Buildings*) to assist them in establishing minimum fire flows and durations for individual structures.

The fire flow requirements based on land use type are presented in Table 3. Fire flow requirements do not change significantly due to the 2035 GP land use change. Figure 4 shows how the land use changes impact the required fire flow. The most significant change is to the SEGA area. Prior to having a land use plan for SEGA, the area was assigned a conservative fire flow requirement of 4,000 gpm. Therefore, the fire flow in SEGA have been adjusted to reflect

[3] Based on a recharge rate of 0.2 acre-feet per acre per day over a 10-month per year operational cycle (per the Metropolitan Water Resources Management Plan Phase 2 Report (Chapter 5), January 2011) plus 25 percent to account for inactive portions of the recharge area (setbacks and roadways within the recharge areas).

[4] This criteria was developed primarily for new development; ability to meet this criteria within existing distribution systems (such as that in the City's downtown area) can be difficult due to existing small diameter pipelines and aging pipelines.

the proposed land use designations and results in a reduction to projected fire flow requirements for most of the area.

Although these criteria have been established, and used to size new pipelines, the existing system should be evaluated using pressure as the primary criterion. Secondary criteria, such as velocity, head loss, age, and material type, are used as indicators for areas of the water system that also may need improvements, but may not be required as part of this evaluation.

**Table 3. Recommended Fire Flow Requirements[a,b]**

| Designation | Non-Sprinklered | | Sprinklered[c,d,e] | |
|---|---|---|---|---|
| | Fire Flow, gpm | Duration, hours | Fire Flow, gpm | Duration, hours |
| Single Family Residential | 2,000 | 2 | — | — |
| Multi-Family Residential | 3,000 | 3 | — | — |
| Commercial/Institutional | 6,000 | 4 | 3,500 | 4 |
| Industrial | 8,000 | 4 | 4,500 | 4 |

(a) Construction type and fire area are not generally known during the development of a master plan; consequently, fire flow requirements set forth in this table are based on previous estimates for these land use types and similar communities.
(b) Unique projects or projects with alternate materials may require higher fire flows and will be reviewed by the City's Fire Marshal on a case-by-case basis (e.g., proposed commercial/industrial areas and schools).
(c) The City's Fire Marshal normally allows up to a 50 percent reduction in fire flows if a building is sprinklered. However, the CFC also requires that no fire flow be less than 1,000 gpm for single family residential or 1,500 gpm for all other building types. For a more conservative fire flow estimate, single family and multiple family buildings were considered non-sprinklered for this evaluation.
(d) Specific fire flows were determined from Table B105.1 of the 2007 CFC, and depend on construction type and fire area. These fire flow requirements are based on buildings being fully sprinklered.
(e) Fire flow includes a 500 gpm demand for on-site sprinkler flow.

## WATER SYSTEM FACILITY ASSUMPTIONS

The City's hydraulic model was verified for August 2008 operating conditions. Since the initial verification and allocation of existing and proposed demands, West Yost has prepared several evaluation of the proposed infrastructure required to meet future demands.

### Recommendations from Previous Evaluations

In March 2009, West Yost completed a hydraulic evaluation of the Downtown Central Area to evaluate available supplies in the City's downtown area and address the loss of supply in the downtown area due to aging wells and water quality issues[5]. This evaluation also considered changes to demands in the downtown area based on densification of the mixed use land designations. Based on population projections, projected per capita water demand factors, and proposed land use designations for the downtown Central Area, a unit water demand factor was calculated for mixed use designations. The calculated mixed use water duty factor is used in the evaluation for 2035 GP land use changes.

[5] "Hydraulic Evaluation of the Downtown Central Area", TM, prepared by West Yost, March 12, 2009.

In May 2011, West Yost conducted a re-evaluation of the Downtown Central Area to determine what potential alternatives existed other than the March 2009 recommendation for increasing the pumping capacity of Well 172[6]. The recommendations of the May 2011 evaluation were to make distribution pipeline improvements to improve flow from Well 172 (as recommended in the March 2009 evaluation), but instead of upgrading the pumping capacity of Well 172, distribution system improvements should be made to convey supplies from Well 313 to the Downtown Central Area.

In July 2011, West Yost conducted additional evaluation of the downtown area to determine the impacts of proposed demands for the Fulton Corridor Specific Plan Project.

For purposes of this evaluation, it has been assumed that the pipeline and storage infrastructure recommendations from these prior hydraulic evaluations will be implemented by the City and will be available to serve the 2035 GP requirements.

### Specific System Assumptions

The following specific assumptions have been made related to available water system facilities within the City's service area:

- The Northeast Surface Water Treatment Facility (SWTF) has a future production capacity of 60 million gallons per day (mgd) and a firm capacity of 54 mgd to serve maximum day and peak hour demands;
- The proposed Southeast SWTF has a production capacity of 80 mgd and a firm capacity of 72 mgd to serve maximum day and peak hour demands;
- The City's proposed future groundwater production capacity is assumed to be approximately 549 mgd with a firm capacity of 439 mgd to supplement the surface water supplies during maximum day and peak hour demand conditions, as calculated in the Metro Plan Update Phase 2;
- For peak hour demands, the City will supplement surface and groundwater supplies with existing and proposed storage tank capacity;
    - Northeast SWTF Clearwell (1.5 MG existing + 4.5 MG proposed)
    - T-1 and T-2 Southeast Tanks (2.0 MG existing + 2.0 MG proposed)
    - T-3 Tank (3.0 MG existing)
    - Southeast SWTF Clearwell (8.0 MG proposed)
    - T-4 Downtown Tank (3.0 MG proposed)
    - SEGA Tanks (2- 4.0 MG proposed)
    - T-5 Tank ( 3.0 MG proposed)
    - T-6 Tank (3.0 MG proposed)

[6] "Hydraulic Re-Evaluation of the Downtown Central Area Water Distribution System", TM, prepared by West Yost, May 10, 2011.

- Major regional transmission mains and transmission grid mains (TGMs) as recommended in the Metro Plan Update Phase 3 report are assumed to be active for the 2035 GP evaluation.

The City's planned water system facilities based on the 2025 GP are shown on Figure 5.

## EVALUATION SCENARIOS

To evaluate the adequacy of the City's water system to serve the Proposed 2035 GP land use changes, West Yost has evaluated the City's system at buildout (2035) under the following two demand conditions:

- A future maximum day demand condition concurrent with fire flow demand while maintaining a minimum residual system pressure of 20 psi along the corridors with significant changes to future demands; and
- A peak hour demand condition while maintaining a minimum system pressure of 40 psi.

Figure 6 shows how the demands are changed based on the proposed 2035 GP land use for maximum day demands for the City. Figure 7 shows how the demands are changed based on the proposed 2035 GP land use for peak hour demands for the City.

## EVALUATION FINDINGS

### Storage Capacity Evaluation

Treated water storage capacity requirements for the City were evaluated based on the following three components: operational storage, emergency storage and fire storage. The principal advantage that storage provides is to equalize demands on supply sources and production facilities.

Table 4 shows the storage requirement calculated for the 2025 GP land use demands, the incremental increase to storage requirements based on the demand changes for the 2035 GP land use designations, and the available system storage and storage credits.

**Table 4. City of Fresno Storage Requirements**

| Storage Component | Required Storage, MG |
|---|---|
| *Required Storage - 2025 GP Land Use Demands* | |
| Operational[(a)] | 62.5 |
| Emergency[(b)] | 177.1 |
| Fire Flow[(c)] | 1.0 |
| Subtotal 2025 GP Land Use | **240.6** |
| *Required Storage - 2035 GP Incremental Increase* | |
| Operational[(d)] | 2.7 |
| Emergency[(e)] | 7.4 |
| Fire Flow[(f)] | — |
| Subtotal 2035 GP Incremental Increase | 10.1 |
| **Total System Storage 2035 GP Land Use** | **250.7** |
| *Available Storage and Storage Credits* | |
| Planned Reservoir Capacity[(g)] | 38.0 |
| Emergency Storage Credit[(h)] | 92.6 |
| Operational Storage Credit[(i)] | 60.9 |
| Surface Storage Credit[(j)] | 60.0 |
| **Total Available Storage and Storage Credits** | **251.6** |
| *Future System Storage Needs* | |
| Total System Storage 2035 GP Land Use | 250.7 |
| Total Available Storage and Storage Credit | 251.6 |
| **Future Storage Surplus (Deficit)[(k)]** | **0.9** |

(a) Based on 15 percent maximum day demand (MDD = 416.7 million gallons per day (mgd).
(b) Based on 85 percent of an average day demand (ADD = 208.4 mgd).
(c) Based on a fire flow of 4,000 gallons per minute (gpm) multiplied by a 4 hour duration.
(d) Based on 15 percent of maximum day demand resulting from change in demand due to 2035 General Plan Land Use update (MDD = 12,605 gpm).
(e) Based on 85 percent of an average day demand resulting from change in demand due to 2035 General Plan Land Use update (ADD = 6,033 gpm).
(f) Fire flow already accounted for in City-wide storage calculations and not needed for the incremental land use change.
(g) Assumes the following for reservoir capacity: 6.0 Million Gallons (MG) Northeast SWTF (1.5 MG existing + 4.5 MG future); 4.0 MG T-1 and T-2 Southeast Tank (2.0 MG existing + 2.0 MG future); 3.0 MG T-4 Downtown Tank; 8.0 MG SEGA Proposed; 8.0 MG Southeast SWTF; 3 MG Existing T-3; 3.0 MG Proposed T-5; and, 3.0 MG Proposed T-6.
(h) Equal to the sum of the groundwater pumping capacity of active wells with backup power. Minimum credit is zero, and the maximum credit is the recommended emergency storage capacity.
(i) 56 percent of the difference between the firm groundwater capacity and a maximum day demand. Minimum credit is zero and the maximum credit is the recommended operational storage capacity. Firm groundwater pumping capacity assumes 20 percent of groundwater production capacity is out of service (FPC = 522 mgd) Draft Chapter 4 in the Water Master Plan further defines operational storage credit assumptions.
(j) Equal to the capacity of the smallest surface water treatment facility.
(k) Equal to the difference between total available storage and storage credits, and the total required storage.

MG = Million Gallons

The City's Water Master Plan is evaluating the overall system and will make recommendations for overall system improvements, including recommendations for storage improvements. As shown in Table 4, the preliminary storage calculations indicate the City has planned for adequate storage to include the proposed 2035 GP land use changes.

### Distribution System Evaluation

The impacts from the 2035 GP land use changes on the water system infrastructure proposed for the 2025 GP land use was evaluated using the City's hydraulic model. Scenarios were run for 2025 GP demands and 2035 GP demands under maximum day plus fire flow and peak hour conditions. The ability to maintain system pressure, velocity, and available fire flow criteria for the increase in demands due to the land use changes was evaluated. The evaluation results are described below.

#### Maximum Day Plus Fire Flow for 2025 GP Land Use

As discussed under the fire flow requirements section, the SEGA area was initially evaluated using a conservative fire flow of 4,000 gpm prior to a detailed land use plan being available. The required fire flow for the land use plan for the 2035 GP shows a reduction in the required fire flow for this area. Due to this conservative approach taken initially, it is assumed, for this evaluation, that the SEGA area has been adequately planned to meet fire flow requirements. In addition, the downtown area has been evaluated for fire flow requirements as part of the densification in the Central Area and the Fulton Corridor Specific Plan hydraulic analysis performed. Therefore, the maximum day plus fire flow evaluation for this TM examines the corridors along Blackstone Avenue, Shaw Avenue, and the southwest section of the City where demands are shown to increase due to the proposed change in land use.

The results of the maximum day demand plus fire flow condition for the system with the 2025 GP land use are shown on Figure 8. The available flow at nodes along Blackstone Avenue, Shaw Avenue, and the southwest corridors in the hydraulic model are shown assuming that a minimum system pressure residual of 20 psi is maintained. Nodes that are shown in "green" have available flows of 3,500 gpm or more, indicating that they meet the fire flow requirement. Nodes shown in "red" have available flows that are less than 3,500 gpm, indicating that they do not meet the fire flow requirement for the 2025 GP land use. As shown, a node along Blackstone Avenue near Shields Avenue does not meet the minimum of 3,500 gpm (see "red" node on Figure 8). The inability of this node to meet the required 3,500 gpm fire flow is due to the age and small diameter of the pipeline at this location. Therefore, specific infrastructure improvements to meet required fire flow in older areas of the City with small diameter pipelines are addressed as part of the system's rehab and replacement program for aging infrastructure.

It should be noted that the City's pipeline velocity criteria of a maximum of 10 fps during a simulated fire flow condition was not used as a constraint for this evaluation. Typically, the pipeline velocity criteria for fire flow conditions is used for planning and design of new pipelines, and not for evaluation of existing pipeline systems due to the fact that new criteria standards might have been put in place since the construction of these existing pipelines.

### Maximum Day Plus Fire Flow for 2035 GP Land Use

The hydraulic model was used to run the maximum day plus fire flow for the updated demands based on the 2035 GP land use changes. The initial run for this scenario assumed no changes to infrastructure or operations of the City's system to assess whether required fire flow was impacted by the increased system demands. Results indicated additional locations were not able to meet the 3,500 gpm fire flow. However, the reduction in available fire flow was mitigated in the hydraulic model by adjusting the operational settings for wells. An additional six wells in the vicinity of Blackstone Avenue and Shaw Avenue were assumed to be active for the maximum day plus fire flow scenario with the increased demands. As shown on Figure 9, the changes to operational settings were able to mitigate the reduction in available fire flow.

The results for the maximum day plus fire flow scenarios for the change in demands indicate the infrastructure recommendations for the 2025 GP land use is adequate to convey the additional demand. Mitigation through operation of system wells addresses any reduction in available fire flow.

### Peak Hour Demands for 2025 GP Land Use

The results of the peak hour demand condition for the buildout with the 2025 GP demands are shown on Figure 10. Figure 10 shows the system pressure at each node in the hydraulic model based on peak hour demand conditions. As shown, system pressures throughout most of the City are above the minimum pressure criteria of 40 psi (indicated by the "green" nodes). One location, in the northwest part of the City indicates pressures drop below the minimum pressure of 40 psi (indicated by the "red" nodes). This location is a subzone within the City's system and there are constraints to how water is conveyed to this area. Improvement options are being evaluated to determine how to best improve pressures to this area. The City's minimum peak hour pressure criterion is being met throughout the rest of the City with the infrastructure being proposed for the 2025 GP land use demands.

### Peak Hour Demands for 2035 GP Land Use

The results of the peak hour demand condition for the buildout with the 2035 GP demands are shown on Figure 11. Figure 11 shows the system pressure at each node in the hydraulic model based on peak hour demand conditions. As shown, system pressures throughout most of the City are able to meet the minimum pressure criterion. The results indicate the area in the northwest is still below criteria but the remainder of the City is above the minimum criterion of 40 psi. Like the maximum day demand plus fire flow scenario, operational adjustments were made for the peak hour demand scenario to mitigate areas where pressure in the system had dropped due to the increase demands. An additional five wells were activated in the southwest area of the City to ensure the minimum pressure criterion was being met for this area. The operation of these additional wells was confirmed to be within the firm pumping capacity for groundwater for the City's supply availability. Therefore, no specific improvements are required for the peak hour demand condition based on the increase in demands due to the 2035 GP changes.

## EVALUATION RECOMMENDATIONS

As indicated through the results from the system evaluations, the infrastructure recommended in the Metro Plan Update reports is adequate to convey the increased demands throughout the system. However, operational changes are needed to maintain system pressure and velocity criteria. In order to maintain pressure in the southwest area during peak hour conditions, the City will need to operate additional wells without exceeding the firm production capacity of their groundwater supply. For maximum day demand plus fire flow conditions the City will also need to rely on additional wells to provide required fire flow to the corridors where demands have been increased.

This evaluation looked at the impact of the increased demands due to the 2035 GP land use changes on the City's infrastructure's ability to maintain minimum system service standards. The evaluation did not look at specific recommendations for distribution system infrastructure improvements to address localized pressure or available fire flow conditions. The City's Water Master Plan is evaluating the overall system and will make recommendations for overall system improvements, including recommendations to address localized areas of concern such as pipeline rehab and replacement for older areas of the City. Generally, however, the existing and planned infrastructure improvements are capable of meeting 2035 GP demands.

The recommendations in this TM are based on the general land use data available for the 2035 GP. As projects develop with more specific information, additional evaluation will need to be conducted to confirm the local distribution system and infrastructure is adequate to maintain the City system criteria.

# 2035 GENERAL PLAN LAND USE

## Residential
- Low Density (1-3 D.U./acre)
- Medium Low Density (3.5-6 D.U./acre)
- Medium Density (5.0 - 12 D.U./acre)
- Medium High Density (12-16 D.U./acre)
- Urban Neighborhood (16-30 D.U./acre)
- High Density (30-45 D.U./acre)

## Industrial
- Light Industrial
- Heavy Industrial

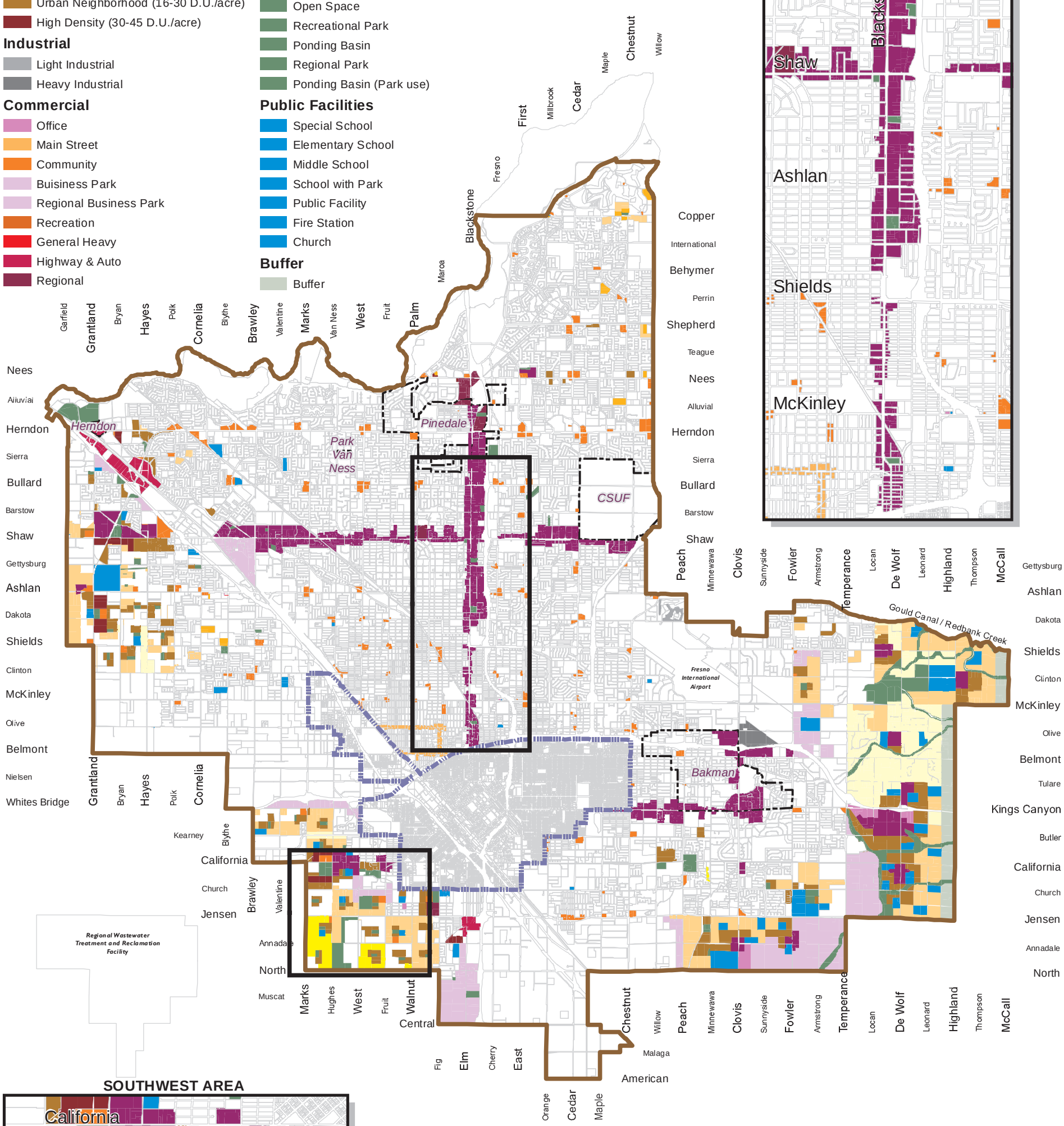
## Commercial
- Office
- Main Street
- Community
- Buisiness Park
- Regional Business Park
- Recreation
- General Heavy
- Highway & Auto
- Regional

## Mixed Use
- Corridor/Center Mixed Use
- Regional Mixed Use
- Neighborhood Mixed Use

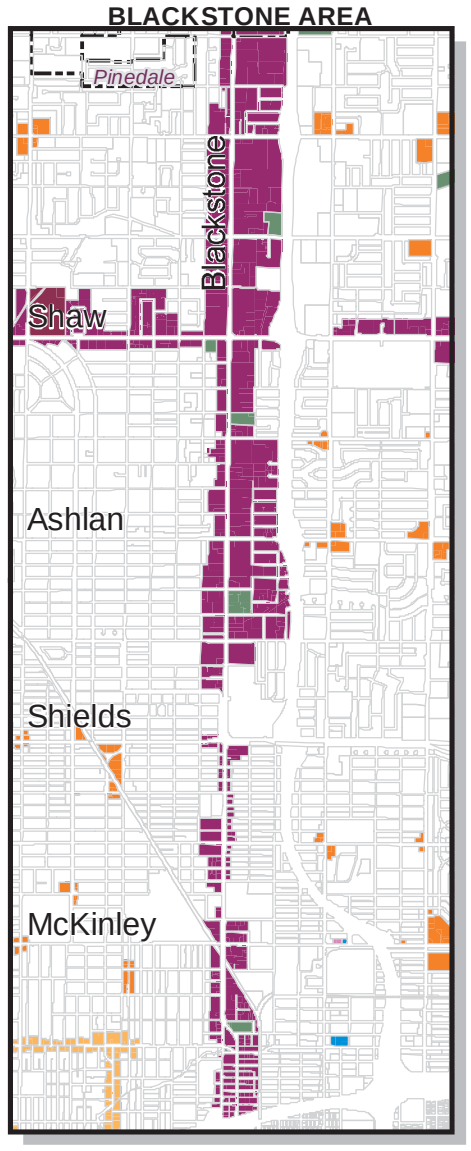
## Open Space
- Open Space
- Recreational Park
- Ponding Basin
- Regional Park
- Ponding Basin (Park use)

## Public Facilities
- Special School
- Elementary School
- Middle School
- School with Park
- Public Facility
- Fire Station
- Church

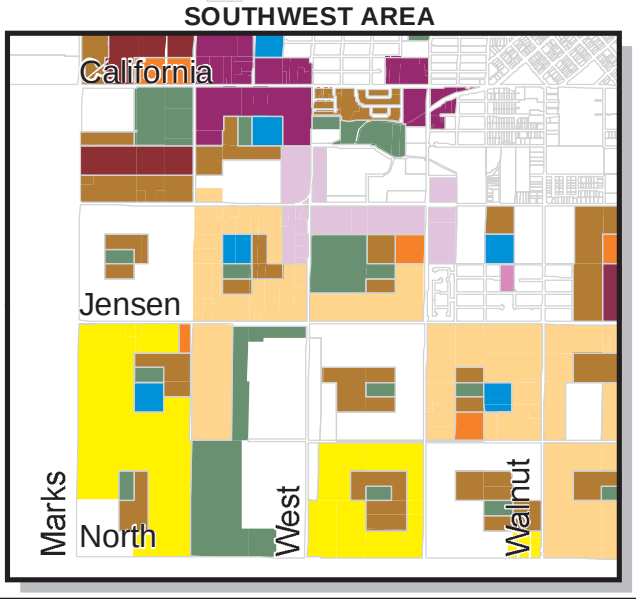
## Buffer
- Buffer




## BLACKSTONE AREA




## SOUTHWEST AREA




Note:
- Land use only shown for areas where 2035 General Plan Update is proposing a change to the 2025 General Plan Land use.
- Downtown Area land use expected to be refined through specific and community plans.
- Areas with land use change based on GIS data provided by the City.

## LEGEND
- Independent Water System
- Downtown Boundary
- Sphere of Influence

N

0 1 2
Miles

# FIGURE 1

**City of Fresno**
**General Plan Land Use Change Evaluation**

## 2035 GENERAL PLAN LAND USE CHANGE AREAS

City of FRESNO

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Consulting Engineers

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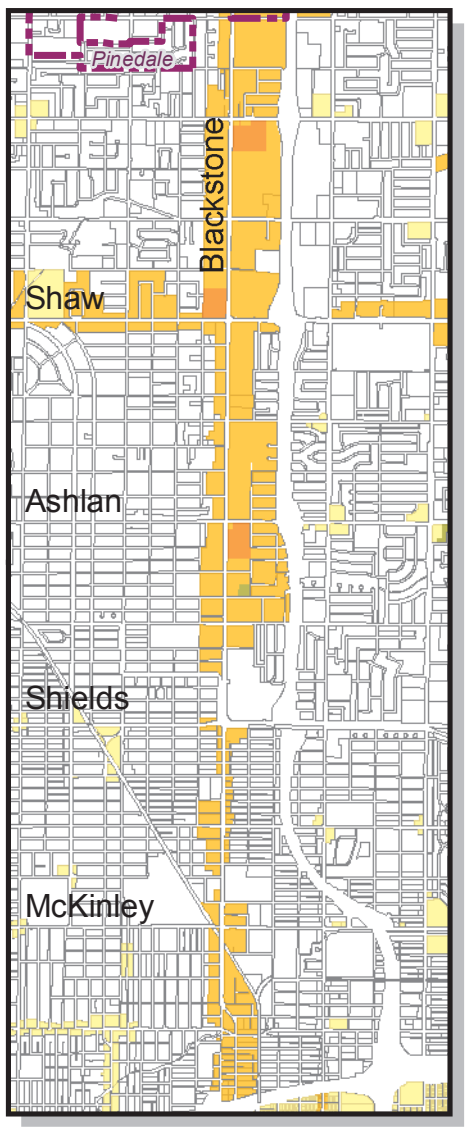
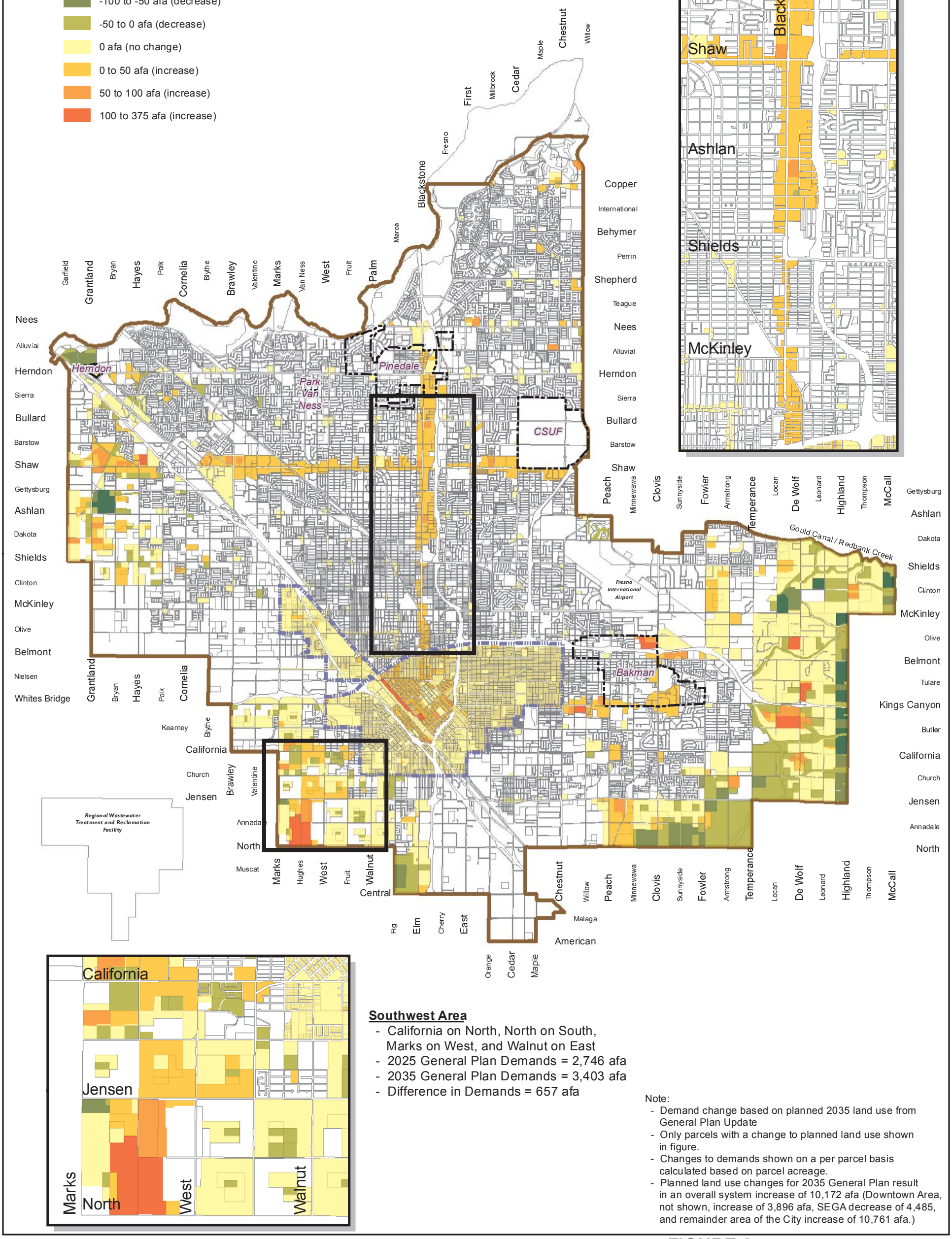
**Annual Demand Comparison**

- -232 to -100 afa (decrease)
- -100 to -50 afa (decrease)
- -50 to 0 afa (decrease)
- 0 afa (no change)
- 0 to 50 afa (increase)
- 50 to 100 afa (increase)
- 100 to 375 afa (increase)

**Blackstone Area**

- 2025 General Plan Demands = 1,567 afa
- 2035 General Plan Demands = 4,410 afa
- Difference in Demands = 2,844 afa







**Southwest Area**

- California on North, North on South, Marks on West, and Walnut on East
- 2025 General Plan Demands = 2,746 afa
- 2035 General Plan Demands = 3,403 afa
- Difference in Demands = 657 afa

Note:

- Demand change based on planned 2035 land use from General Plan Update
- Only parcels with a change to planned land use shown in figure.
- Changes to demands shown on a per parcel basis calculated based on parcel acreage.
- Planned land use changes for 2035 General Plan result in an overall system increase of 10,172 afa (Downtown Area, not shown, increase of 3,896 afa, SEGA decrease of 4,485, and remainder area of the City increase of 10,761 afa.)

LEGEND

- Independent Water System
- Downtown Boundary
- Sphere of Influence

N

0 1 2

Miles

# FIGURE 2

## City of Fresno General Plan Land Use Change Evaluation

## CHANGES TO ANNUAL DEMANDS

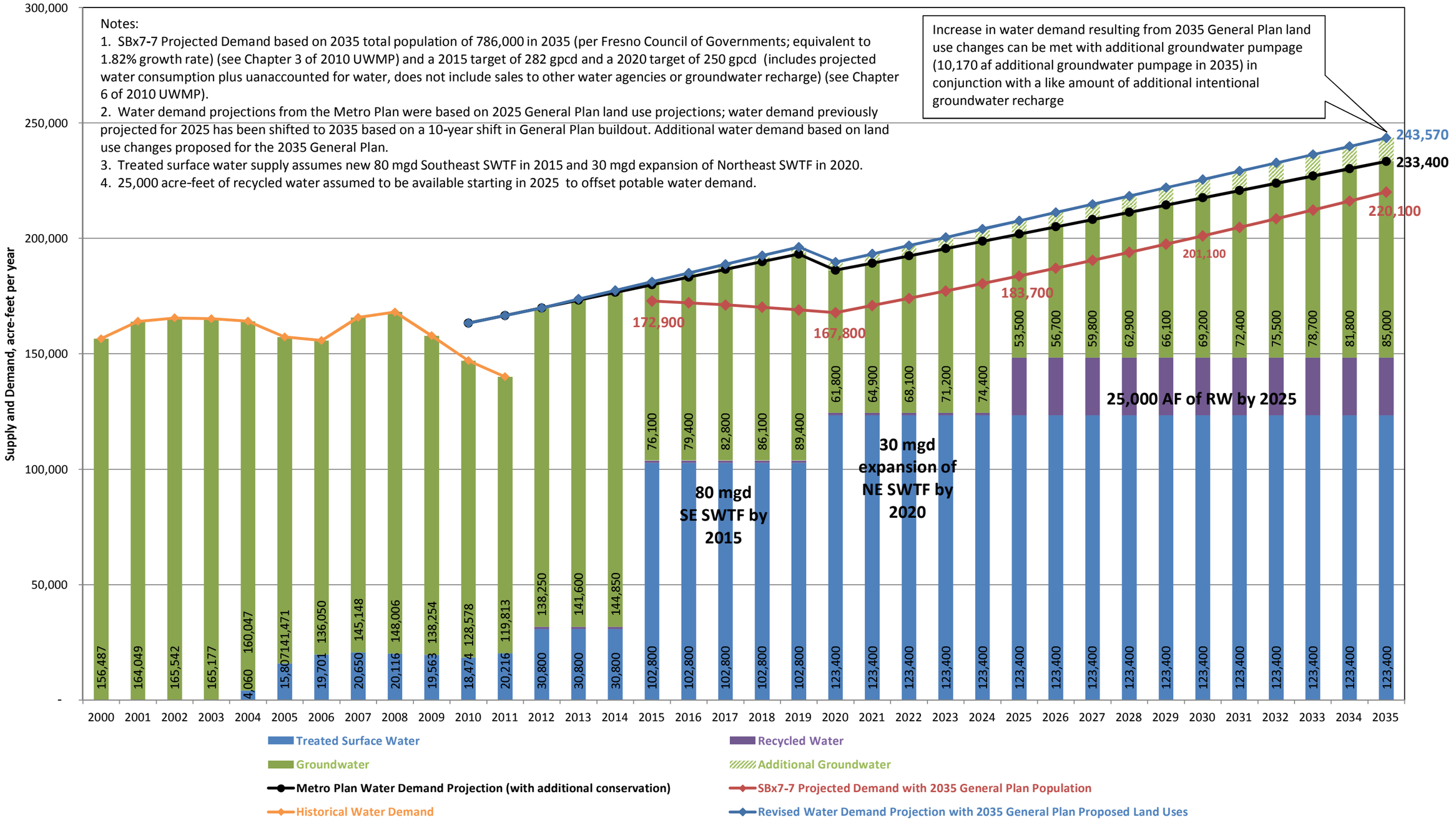
City of FRESNO

WEST YOST ASSOCIATES
Consulting Engineers

## Figure 3. Changes to Future Supply and Demand

Notes:
1. SBx7-7 Projected Demand based on 2035 total population of 786,000 in 2035 (per Fresno Council of Governments; equivalent to 1.82% growth rate) (see Chapter 3 of 2010 UWMP) and a 2015 target of 282 gpcd and a 2020 target of 250 gpcd (includes projected water consumption plus uanaccounted for water, does not include sales to other water agencies or groundwater recharge) (see Chapter 6 of 2010 UWMP).
2. Water demand projections from the Metro Plan were based on 2025 General Plan land use projections; water demand previously projected for 2025 has been shifted to 2035 based on a 10-year shift in General Plan buildout. Additional water demand based on land use changes proposed for the 2035 General Plan.
3. Treated surface water supply assumes new 80 mgd Southeast SWTF in 2015 and 30 mgd expansion of Northeast SWTF in 2020.
4. 25,000 acre-feet of recycled water assumed to be available starting in 2025 to offset potable water demand.

Increase in water demand resulting from 2035 General Plan land use changes can be met with additional groundwater pumpage (10,170 af additional groundwater pumpage in 2035) in conjunction with a like amount of additional intentional groundwater recharge



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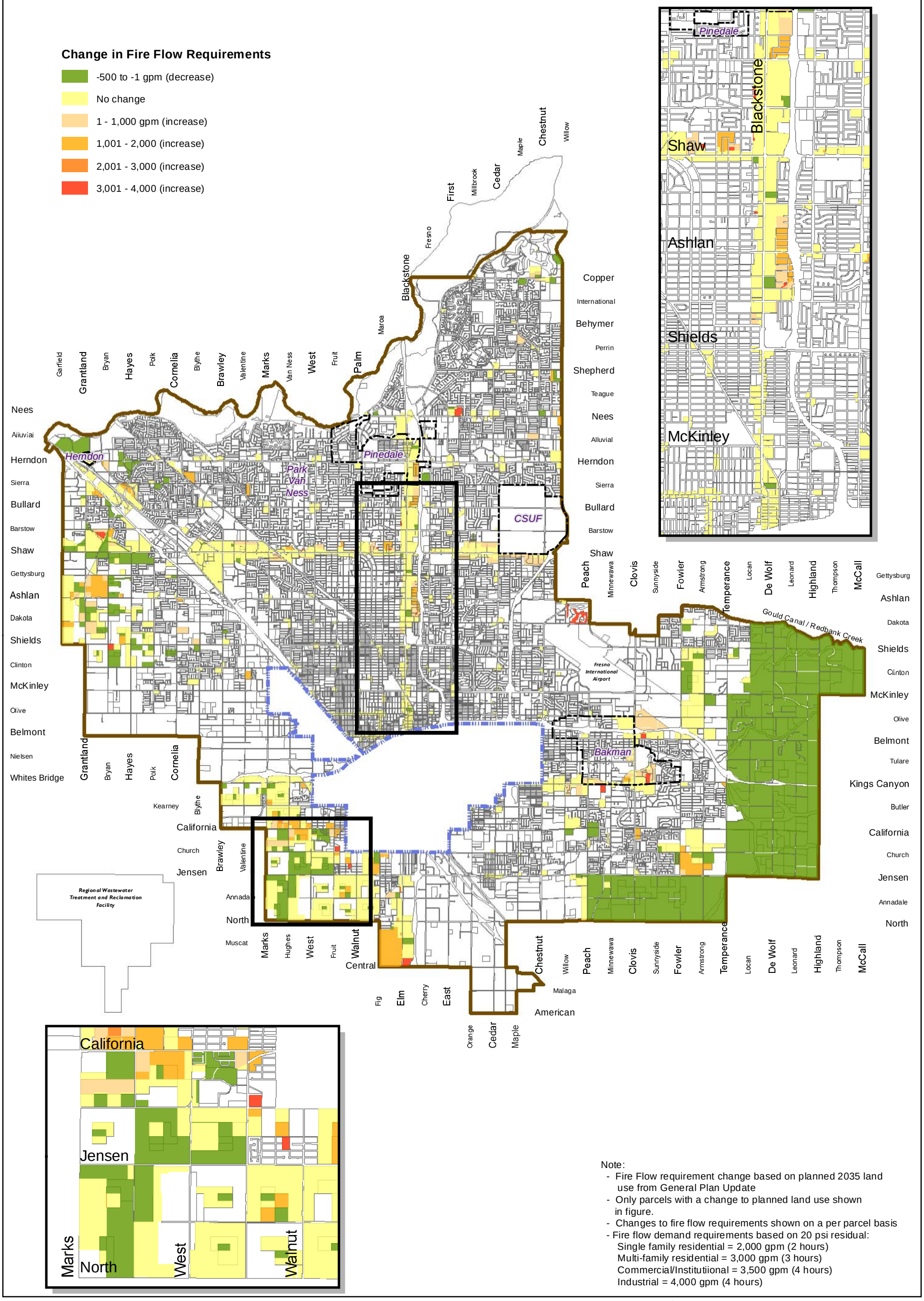
## Change in Fire Flow Requirements

- -500 to -1 gpm (decrease)
- No change
- 1 - 1,000 gpm (increase)
- 1,001 - 2,000 (increase)
- 2,001 - 3,000 (increase)
- 3,001 - 4,000 (increase)




Note:
- Fire Flow requirement change based on planned 2035 land use from General Plan Update
- Only parcels with a change to planned land use shown in figure.
- Changes to fire flow requirements shown on a per parcel basis
- Fire flow demand requirements based on 20 psi residual:
  Single family residential = 2,000 gpm (2 hours)
  Multi-family residential = 3,000 gpm (3 hours)
  Commercial/Institutiional = 3,500 gpm (4 hours)
  Industrial = 4,000 gpm (4 hours)

# FIGURE 4

LEGEND

- Independent Water System
- Downtown Boundary
- Sphere of Influence

N

0 1 2

Miles

**City of Fresno**
**General Plan Land Use Change Evaluation**

**CHANGES TO FIRE FLOW REQUIREMENTS**

City of FRESNO

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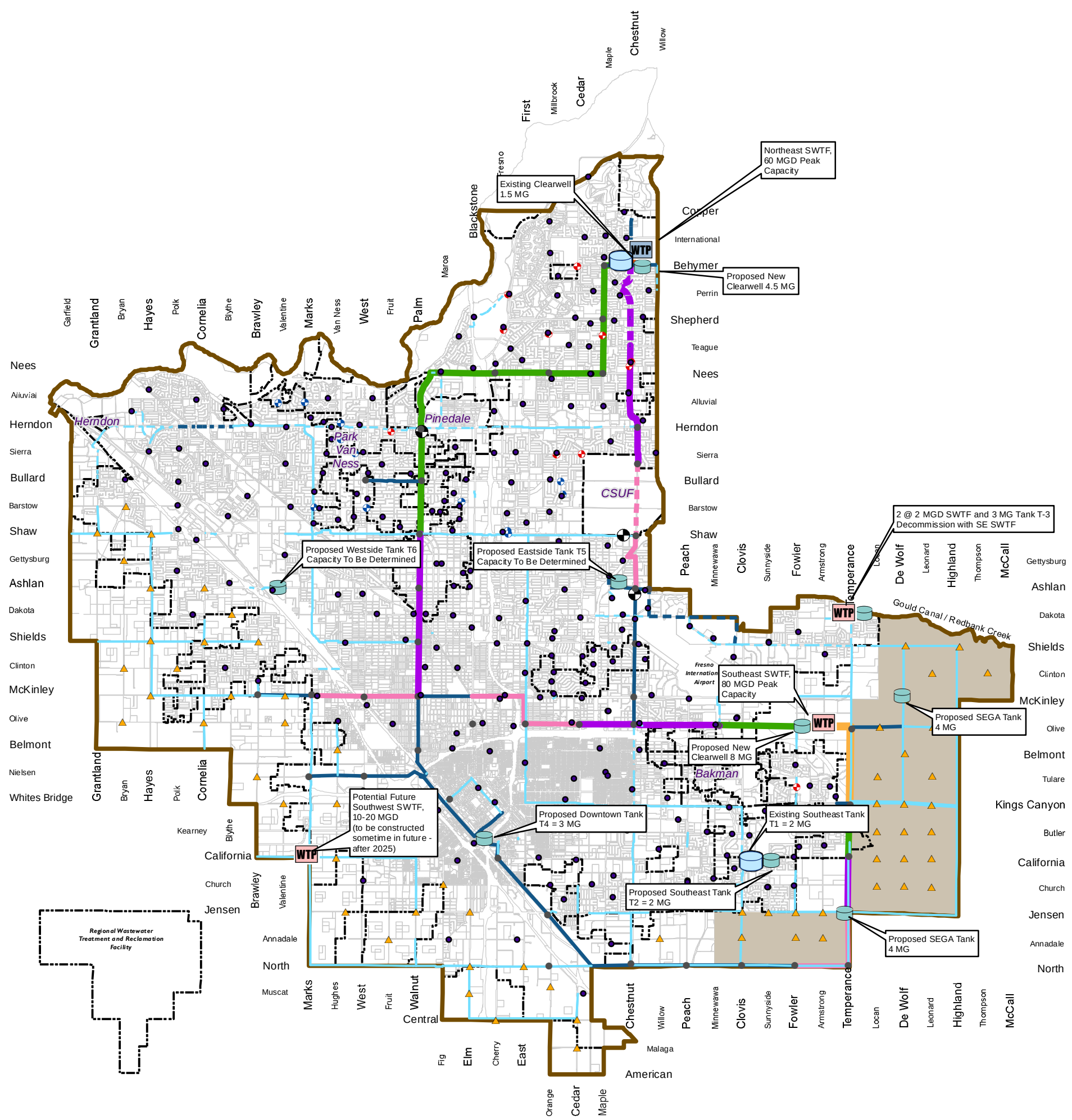


## LEGEND

- WTP — Existing Water Treatment Plant
- Proposed Tank Site
- WTP — Future Water Treatment Plant
- Future Pressure Reducing Valve
- TGM Tie-in Location
- Existing Well
- Future Well 2010-2025
- Existing City Limit
- Sphere of Influence
- Independent Water System
- Southeast Growth Area
- 16-inch Diameter
- 24-inch Diameter
- 30-inch Diameter
- 36-inch Diameter
- 42-inch Diameter
- 48-inch Diameter

Note:
- Dashed line indicates an existing pipeline
- Infrastructure shown proposed in the Metro Plan Update Phase 3.
- New well locations shown are for display purposes. The City will conduct well siting studies to determine actual well locations.

N

0 1 2
Miles

# FIGURE 5

## City of Fresno General Plan Land Use Change Evaluation

## 2025 PROPOSED REGIONAL AND TGM INFRASTRUCTURE

City of FRESNO

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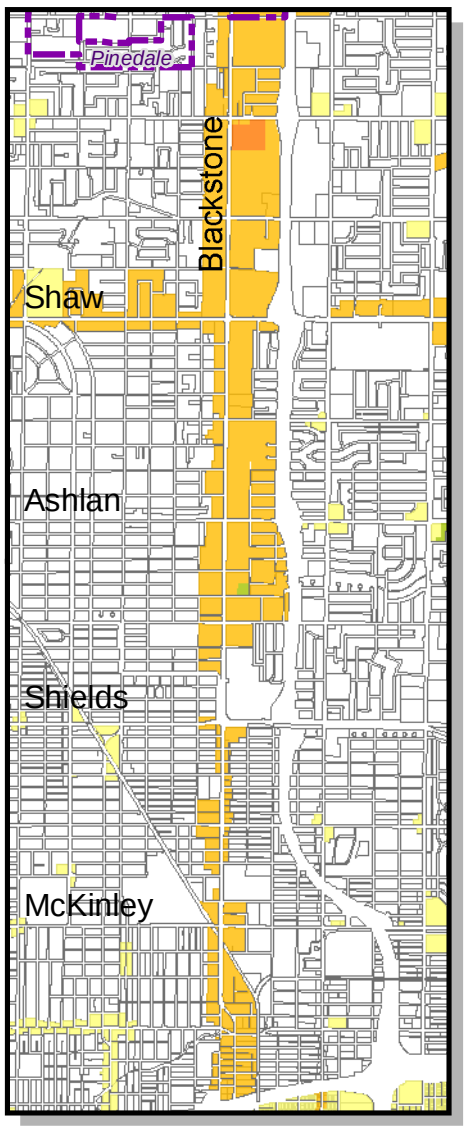
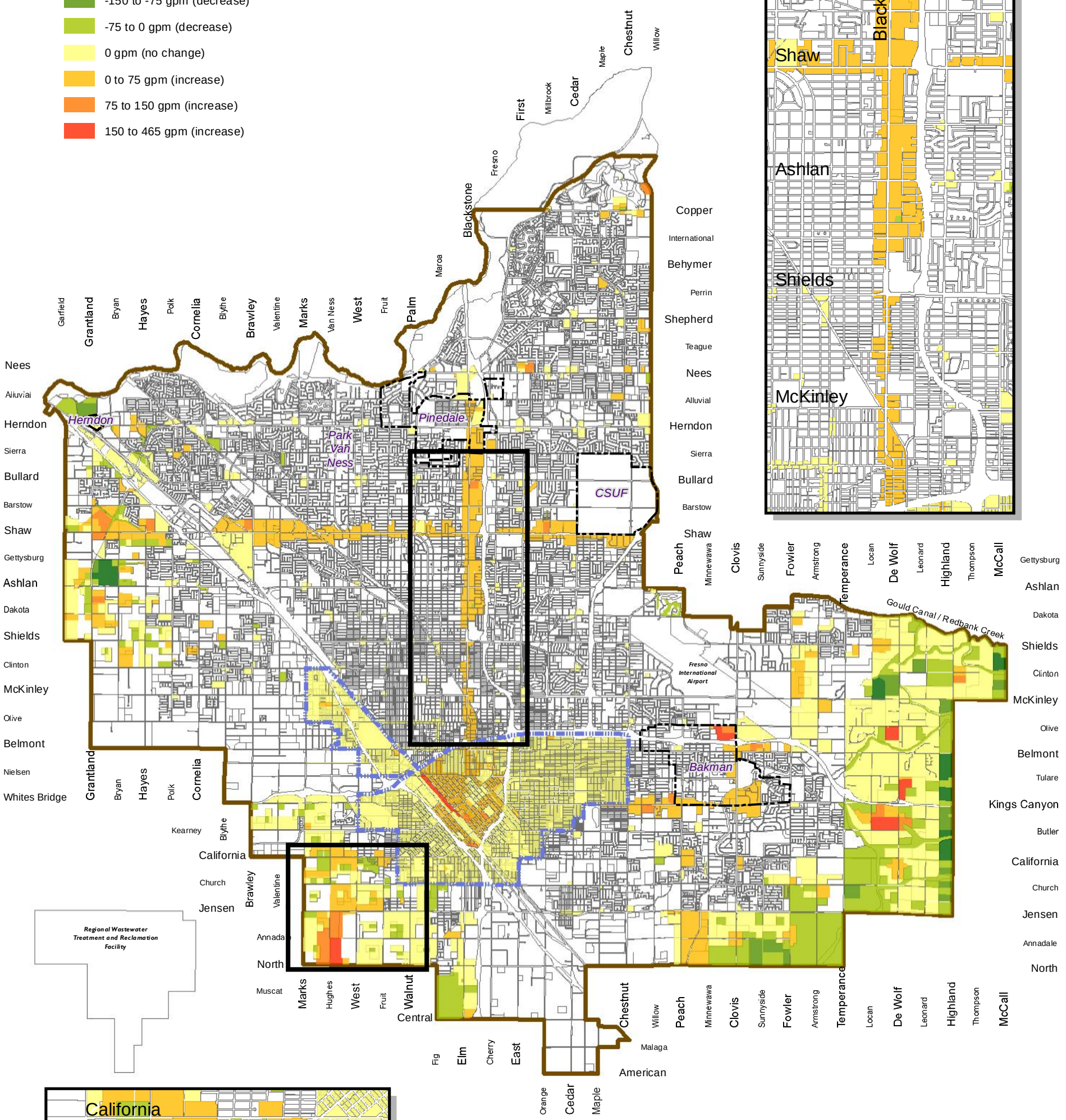
**Maximum Day Demand Comparison**

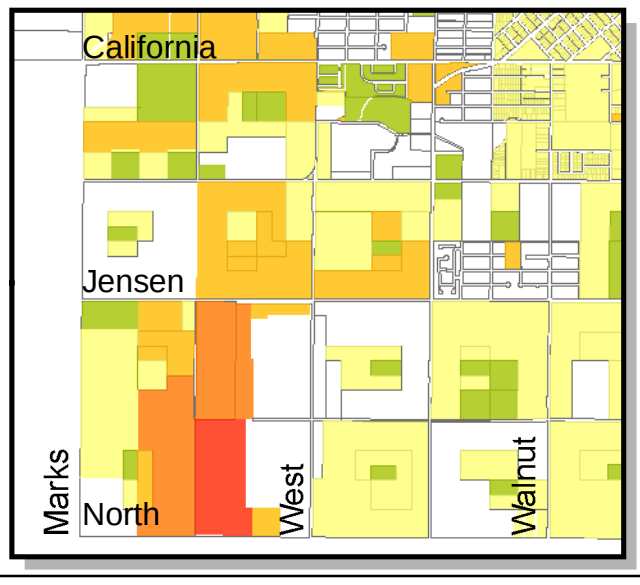
- -288 to -150 gpm (decrease)
- -150 to -75 gpm (decrease)
- -75 to 0 gpm (decrease)
- 0 gpm (no change)
- 0 to 75 gpm (increase)
- 75 to 150 gpm (increase)
- 150 to 465 gpm (increase)

**Blackstone Area**

- 2025 General Plan Demands = 1,942 gpm
- 2035 General Plan Demands = 5,466 gpm
- Difference in Demands = 3,524 gpm




**Southwest Area**

- 2025 General Plan Demands = 3,403 gpm
- 2035 General Plan Demands = 4,216 gpm
- Difference in Demands = 813 gpm

Note:

- Demand change based on planned 2035 land use from General Plan Update
- Only parcels with a change to planned land use shown in figure.
- Changes to demands shown on a per parcel basis calculated based on parcel acreage.
- Planned land use changes for 2035 General Plan result in an overall system increase of 12,605 gpm for maximum day demands.

LEGEND

- Independent Water System
- Downtown Boundary
- Sphere of Influence

N

0 1 2

Miles

**FIGURE 6**

**City of Fresno**
**General Plan Land Use Change Evaluation**

**CHANGES TO MAX DAY DEMANDS**

City of FRESNO

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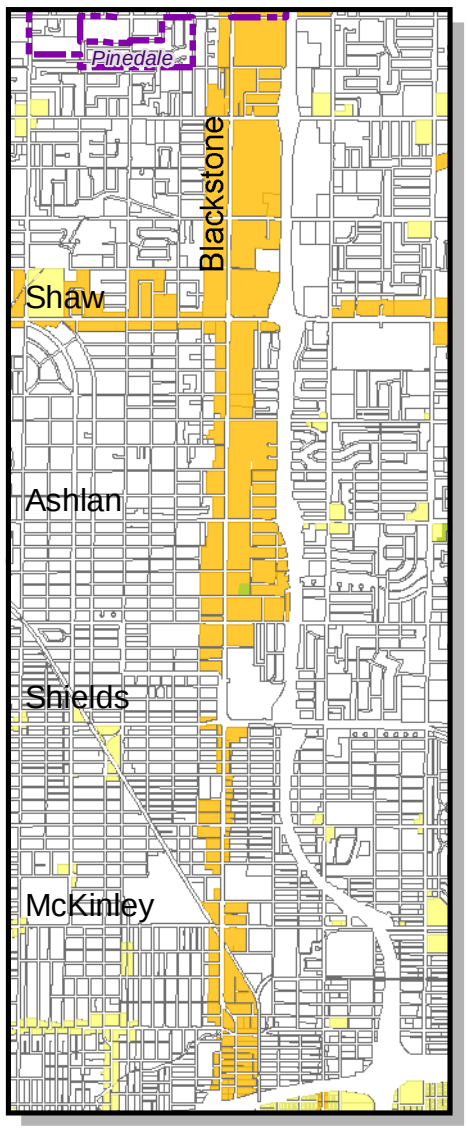
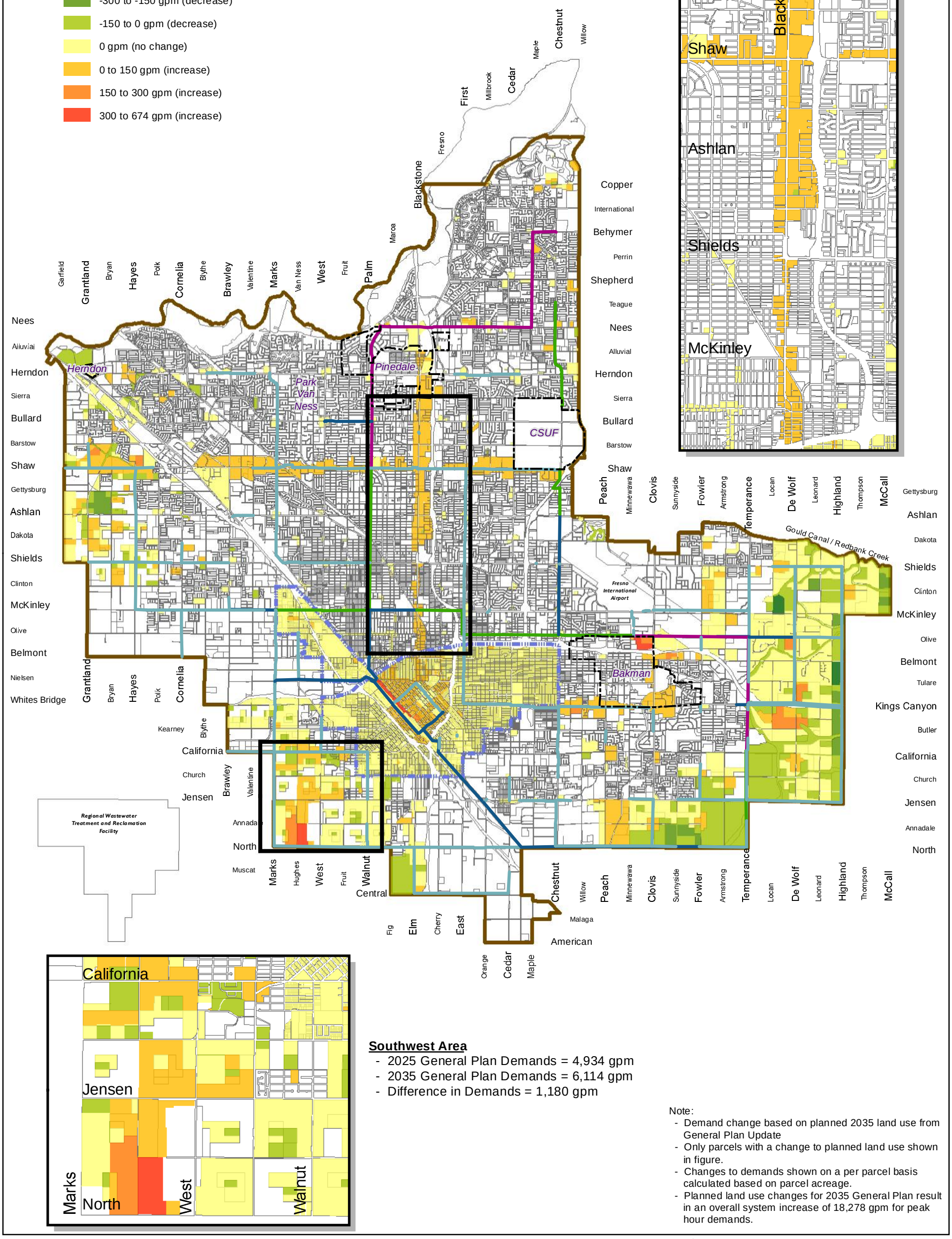
**Peak Hour Demand Comparison**

- -418 TO -300 gpm (decrease)
- -300 to -150 gpm (decrease)
- -150 to 0 gpm (decrease)
- 0 gpm (no change)
- 0 to 150 gpm (increase)
- 150 to 300 gpm (increase)
- 300 to 674 gpm (increase)

**Blackstone Area**

- 2025 General Plan Demands = 2,816 gpm
- 2035 General Plan Demands = 7,926 gpm
- Difference in Demands = 5,110 gpm







**Southwest Area**

- 2025 General Plan Demands = 4,934 gpm
- 2035 General Plan Demands = 6,114 gpm
- Difference in Demands = 1,180 gpm

Note:

- Demand change based on planned 2035 land use from General Plan Update
- Only parcels with a change to planned land use shown in figure.
- Changes to demands shown on a per parcel basis calculated based on parcel acreage.
- Planned land use changes for 2035 General Plan result in an overall system increase of 18,278 gpm for peak hour demands.

LEGEND

- Independent Water System
- Downtown Boundary
- Sphere of Influence

**Proposed Transmission Pipelines**

- 16-inch Diameter
- 24-inch Diameter
- 30 to 36-inch Diameter
- 42 to 48-inch Diameter

N

0 1 2

Miles

**FIGURE 7**

**City of Fresno**
**General Plan Land Use Change Evaluation**

**CHANGES TO PEAK HOUR DEMANDS**

City of FRESNO

WEST YOST ASSOCIATES
Consulting Engineers

Note:
- Demand based on proposed 2025 General Plan land use
- Availalbe fire flow shown for 20 psi residual

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3189 gpm

WTP

WTP

Pinedale

Park Van Ness

CSUF

Bakman

Fresno International Airport

Regional Wastewater Treatment and Reclamation Facility

Herndon

Gould Canal / Redbank Creek

Nees
Alluvial
Herndon
Sierra
Bullard
Barstow
Shaw
Gettysburg
Ashlan
Dakota
Shields
Clinton
McKinley
Olive
Belmont
Nielsen
Whites Bridge
Kearney
California
Church
Jensen
Annadale
North
Muscat
Central
American
Malaga

Garfield Grantland Bryan Hayes Polk Cornelia Blythe Brawley Valentine Marks Van Ness West Fruit Palm Maroa Blackstone Fresno First Millbrook Cedar Maple Chestnut Willow

Copper
International
Behymer
Perrin
Shepherd
Teague
Nees
Alluvial
Herndon
Sierra
Bullard
Barstow
Shaw
Gettysburg
Ashlan
Dakota
Shields
Clinton
McKinley
Olive
Belmont
Tulare
Kings Canyon
Butler
California
Church
Jensen
Annadale
North

Peach Minnewawa Clovis Sunnyside Fowler Armstrong Temperance Locan De Wolf Leonard Highland Thompson McCall

Grantland Bryan Hayes Polk Cornelia Blythe Brawley Valentine Marks Hughes West Fruit Walnut Fig Elm Cherry East Orange Cedar Maple Chestnut Willow Peach Minnewawa Clovis Sunnyside Fowler Armstrong Temperance Locan De Wolf Leonard Highland Thompson McCall

## LEGEND

**Required Fire Flow (2025 GP)**
- No Fire Flow
- 2,000 gpm
- 3,000 gpm
- 3,500 gpm
- 4,000 gpm

**Available Fire Flow**
- Less than 3,500 gpm
- 3,500 gpm and Greater
- Distribution Pipeline
- Transmission Pipeline

N

0 1 2
Miles

# FIGURE 8

## City of Fresno General Plan Land Use Change Evaluation

## 2025 GENERAL PLAN AVAILABLE FIRE FLOW

City of FRESNO

WEST YOST ASSOCIATES Consulting Engineers

Note:
- Required Fire Flow based on proposed 2035 General Plan land use
- Availalbe fire flow shown for 20 psi residual



**FIGURE 9**

**City of Fresno**
**General Plan Land Use Change Evaluation**

**2035 GENERAL PLAN AVAILABLE FIRE FLOW**

City of FRESNO

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Consulting Engineers

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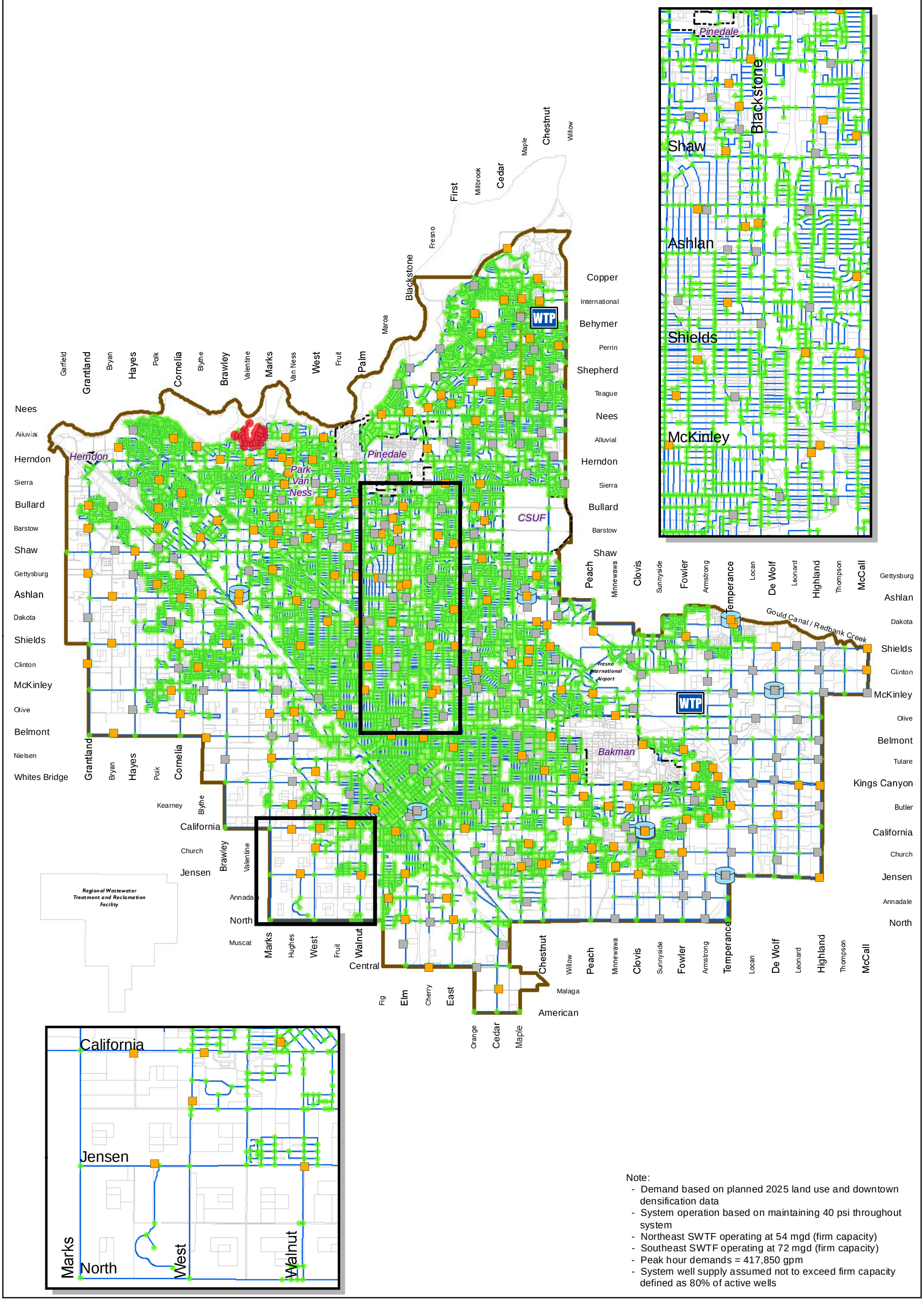



Note:
- Demand based on planned 2025 land use and downtown densification data
- System operation based on maintaining 40 psi throughout system
- Northeast SWTF operating at 54 mgd (firm capacity)
- Southeast SWTF operating at 72 mgd (firm capacity)
- Peak hour demands = 417,850 gpm
- System well supply assumed not to exceed firm capacity defined as 80% of active wells

LEGEND

**System Pressure**
- Less than 40 psi (Below Criteria)
- 40 psi and Greater

**Pump Status**
- Inactive
- Active

**Distribution Pipeline (Less than 18")**
- 7 fps or Less
- Greater than 7 fps

**Transmission Pipeline (18" and greater)**
- 5 fps or Less
- Greater than 5 fps

N

0 1 2
Miles

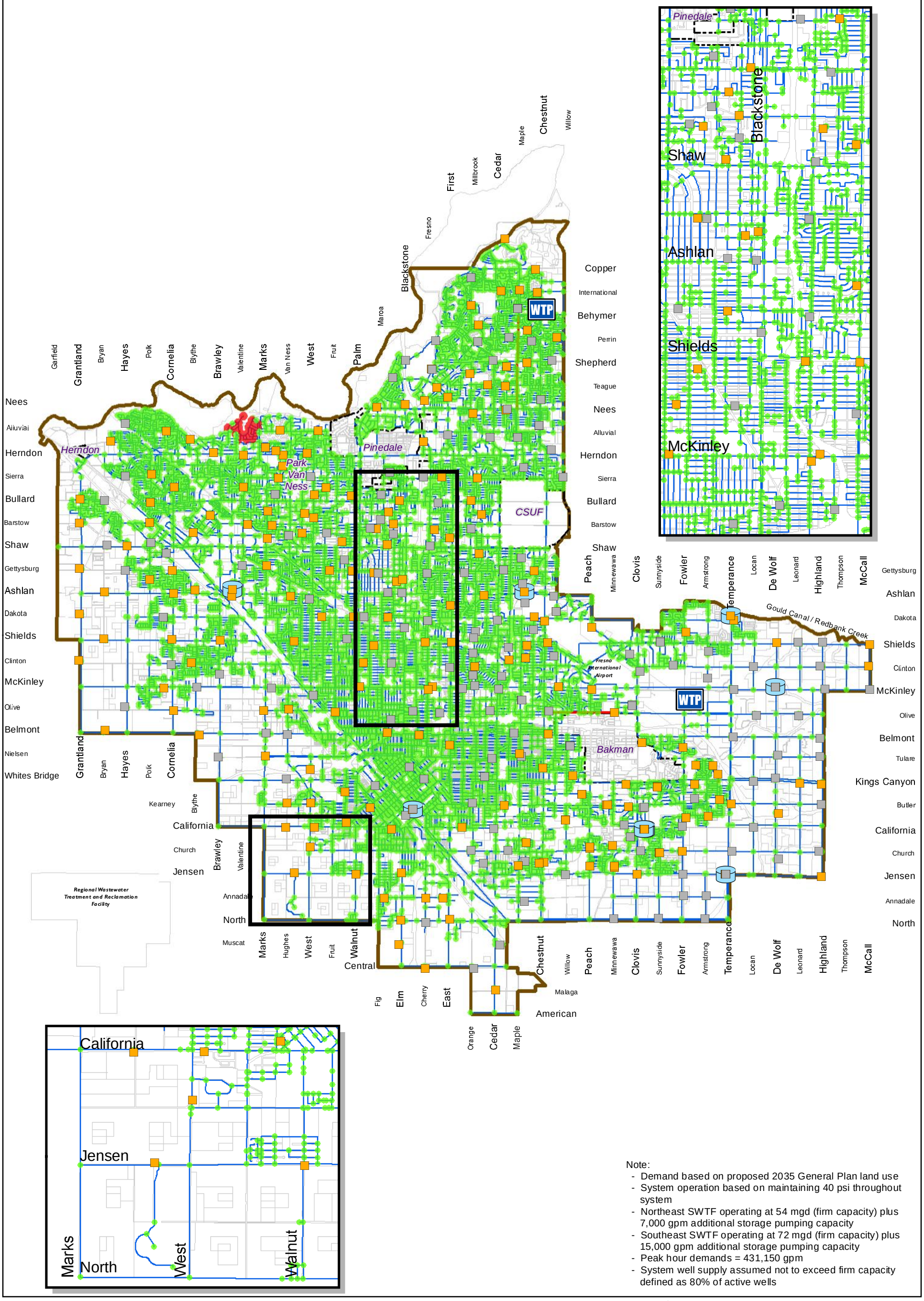
# FIGURE 10

## City of Fresno General Plan Land Use Change Evaluation

## 2025 GENERAL PLAN PEAK HOUR RESULTS

City of FRESNO

WEST YOST ASSOCIATES
Consulting Engineers




Note:
- Demand based on proposed 2035 General Plan land use
- System operation based on maintaining 40 psi throughout system
- Northeast SWTF operating at 54 mgd (firm capacity) plus 7,000 gpm additional storage pumping capacity
- Southeast SWTF operating at 72 mgd (firm capacity) plus 15,000 gpm additional storage pumping capacity
- Peak hour demands = 431,150 gpm
- System well supply assumed not to exceed firm capacity defined as 80% of active wells

LEGEND

**System Pressure**
- Less than 40 psi (Below Criteria)
- 40 psi and Greater

**Pump Status**
- Inactive
- Active

**Distribution Pipeline (Less than 18")**
- 7 fps or Less
- Greater than 7 fps

**Transmission Pipeline (18" and greater)**
- 5 fps or Less
- Greater than 5 fps

N

0 1 2
Miles

# FIGURE 11

## City of Fresno General Plan Land Use Change Evaluation

## 2035 GENERAL PLAN PEAK HOUR RESULTS

City of FRESNO

WEST YOST ASSOCIATES
Consulting Engineers

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# Appendix B

WEST YOST ASSOCIATES

# TECHNICAL MEMORANDUM

DATE: July 22, 2011 Project No.: 439-02-10-07

TO: Brock Buche, City of Fresno Water Division Project Manager
Martin Querin, City of Fresno Assistant Public Utilities Director—Water Division

FROM: Brenda Estrada, Project Engineer, R.C.E. #67062
Elizabeth Drayer, Project Engineer, R.C.E. #46872

REVIEWED BY: Charles Duncan, Project Manager, R.C.E. #55498

SUBJECT: Hydraulic Evaluation of the Proposed Fulton Corridor Specific Plan Project

## INTRODUCTION

The purpose of this memorandum is to present West Yost Associates' (West Yost's) evaluation of the potential hydraulic impacts on the City of Fresno (City) water system of the proposed Fulton Corridor Specific Plan Project (Proposed Project) located in the City's downtown area. As described in this memorandum, West Yost has used the City's water system hydraulic model to evaluate the ability of the City's existing water system to provide minimum required pressures and flows under the future, projected demands associated with the buildout of the Proposed Project. Our findings and recommendations for water system infrastructure improvements to serve the Proposed Project are described below.

## PROJECT DESCRIPTION

The Proposed Project is located in the City's Downtown area and encompasses several distinct center city areas (districts) including the Central Business District, the Cultural Arts District, the South Stadium zone, and Chinatown. As shown on Figure 1, the approximate boundaries of the Proposed Project are East Divisadero Street to the north, N and O Streets to the east, Highway 41 to the south, and Highway 99 to the west. In all, the combined Proposed Project area comprises approximately 440 acres and includes a mix of multi-family residential, industrial mixed use, office and retail land uses.

As described below, three different land use development scenarios for the Proposed Project have been evaluated by Sherwood Design Engineers (Sherwood) based on a range of Floor Area Ratio (FAR) assumptions. The total building area for the three development scenarios ranges from 5.2 million square feet for the minimum proposed FAR scenario to 14.1 million square feet for the maximum proposed FAR scenario.

## PROJECTED WATER DEMANDS

The analysis of the potable water demand within the Proposed Project was performed by Sherwood[1]. The demand analysis utilized the proposed building areas and FARs as developed by Moule & Polyzoides (M&P) and the Project planning team. The water demands were calculated for each development scenario using water demand rates based on built area per land use types. Unit water use factors were based on the increased densification and proposed land uses for underutilized parcels included in each district within the Proposed Project area and were taken from Sherwood's existing internal data/research and cross-referenced with the City of Oakland's land use demand values[2]. Proposed average daily flow rates per district were calculated as weighted averages based on M&P's distribution of land uses within each district.

Table 1 provides a summary of the unit water use factors used by Sherwood for each district for the evaluation.

**Table 1. Summary of Unit Water Use Factors Used for Proposed Project**

| District | Unit Water Use Factor, gallons per day per 1,000 square feet |
|---|---|
| Central Business District 1 (CBD1) | 204 |
| Central Business District 2 (CBD2) | 202 |
| Civic Center | 210 |
| Chinatown District | 196 |
| Cultural Arts/South Stadium District | 192 |
| Chinatown Industrial District | 150 |
| Town Center | 210 |
| Neighborhood General | 200 |
| Neighborhood General Preservation | 200 |
| Special District | 130 |

*Source: Sherwood Design Engineers Water Demand Calculations received May 23, 2011 (FCSP_Water_Analysis_110513.pdf) (Water_Flow_SP.xlsx).*

Three development scenarios were evaluated by Sherwood:

- A minimum buildout scenario (minimum FAR),
- A median buildout scenario (median FAR), and
- A maximum buildout scenario (maximum FAR).

1 Sherwood Design Engineers Water Demand Calculations received May 23, 2011 (FCSP_Water_Analysis_110513.pdf) (Water_Flow_SP.xlsx).

2 The data available for the City of Oakland was based on estimated wastewater flows for various types of development. To back-calculate water use based on this data, the estimated wastewater flows were multiplied by a factor of 1.20 to account for consumptive water uses which do not result in wastewater flows.

Table 2 provides a summary of the calculated water demands for the three development scenarios evaluated by Sherwood for the Proposed Project. Demands were calculated for underutilized parcels within the Proposed Project area, such that the calculated additional demand represents the projected demand associated with the Proposed Project for various FAR scenarios. Based on the current land use of the underutilized parcels, the existing demand was estimated at 170,822 gallons per day (gpd), or 191 acre-feet per year (af/yr). The estimated water demands on other parcels within the Proposed Project were assumed not to change. A copy of Sherwood's water demand calculation spreadsheet showing the calculated water demand for each underutilized parcel for each development scenario is provided in Attachment 1.

**Table 2. Summary of Projected Water Demand for Various Development Scenarios**

| Development Scenario | Total Projected Building Area on Underutilized Parcels, square feet | Existing Demand on Underutilized Parcels, gpd | Additional Demand on Underutilized Parcels as a result of Proposed Project, gpd | Total Demand on Underutilized Parcels within Proposed Project Area, gpd | Total Existing Demand on All Parcels within Proposed Project Area, gpd | Total Demand within Proposed Project Area, gpd |
|---|---|---|---|---|---|---|
| | | [1] | [2] | [3] = [1] + [2] | [4] | [5] = [2] + [4] |
| Minimum Buildout Scenario (Minimum FAR) | 5,240,428 | 170,822 | 870,835 | 1,041,656 | 683,983 | 1,554,818 |
| Median Buildout Scenario (Median FAR) | 9,572,280 | 170,822 | 1,733,744 | 1,904,565 | 683,983 | 2,417,727 |
| Maximum Buildout Scenario (Maximum FAR)[(a)] | 14,123,642 | 170,822 | 2,637,503 | 2,808,324 | 683,983 | 3,321,486 |

*Source: Sherwood Design Engineers Water Demand Calculations received May 23, 2011 (FCSP_Water_Analysis_110513.pdf) (Water_Flow_SP.xlsx).*

[(a)] The Maximum Buildout Scenario (Maximum FAR) is the basis for West Yost's analysis.

For purposes of West Yost's hydraulic evaluation of the Proposed Project, West Yost has evaluated the water demands associated with only the maximum buildout (maximum FAR) development scenario which equate to an additional average day demand of approximately 2.6 million gallons per day, which equals an additional annual demand of 2,955 af/yr.

Figure 2 shows the projected demands by parcel within the Proposed Project area for the maximum buildout development scenario.

## WATER SUPPLY

As described in the City's Metro Plan Update, the City's Water Master Plan, and West Yost's March 2009 Technical Memorandum "Hydraulic Evaluation of the Downtown Central Area," the City's available water supplies are limited to a finite quantity and are extremely limited. As shown in Table 2, the estimated annual demand for the maximum buildout scenario for the Proposed Project will further increase required water supplies by an additional 2,955 af/yr. Water supplies to meet this estimated additional demand must come from within the City's existing, limited water supply portfolio and may need to be "imported" from other parts of the City and/or require reduced water use (additional water conservation) in other parts of the City.

Water supplies for the Proposed Project will probably need to be evaluated as part of an SB 610 Water Supply Assessment to evaluate the availability and reliability of the City's water supplies to meet the projected increased water demands of the Proposed Project under various hydrologic conditions and whether these demands were anticipated as part of the City's most recent Urban Water Management Plan.

## EVALUATION CRITERIA

### Planning and Modeling Criteria

The planning and modeling criteria used for this evaluation are based on West Yost's recent work with the City. The August 2008 verified hydraulic model of the City's water distribution system was used as the basis for the evaluation. The criteria used to evaluate the potential impacts to the City's existing water system are as follows:

- Minimum peak hour demand pressure 40 pounds per square inch (psi);
- Maximum allowable velocity is 7 feet per second (fps) during a peak hour condition;
- Maximum day plus fire flow residual pressure at the flowing hydrant must be equal to or greater than 20 psi;
- Maximum allowable velocity is 10 fps during the simulated fire flow condition[3];
- Maximum allowable head loss rate is 10 feet per 1,000 feet during any condition[4];
- Any new, required pipelines will be modeled with a roughness coefficient (C-factor) of 130;

[3] This criteria was developed primarily for new development; ability to meet this criteria within existing distribution systems (such as that in the City's downtown area) can be difficult due to existing small diameter pipelines and aging pipelines.

[4] This criteria was developed primarily for new development; ability to meet this criteria within existing distribution systems (such as that in the City's downtown area) can be difficult due to existing small diameter pipelines and aging pipelines.

- Assumed peaking factors for maximum day and peak hour demand conditions are consistent with the City's adopted peaking factors and are as follows:
  - Maximum Day Demand = 2.0 times Average Day Demand
  - Peak Hour Demand = 2.9 times Average Day Demand

### Fire Flow Requirements

Fire flow requirements based on proposed land use for each parcel were determined by Sherwood and were based on the California Building Code (CBC) and the 2007 California Fire Code (CFC) (Table B105.1). Sherwood assumed maximum potential building footprints for each parcel and assumed CBC construction type (IA, IIIB, etc.) for each land use zone based on the building type with the maximum FAR. Based on this methodology, fire flow requirements of up to 6,250 gallons per minute (gpm) for a four-hour duration were identified for some of the parcels. The projected fire flow requirements by parcel are shown on Figure 3. A copy of Sherwood's fire flow calculation spreadsheet showing the calculated fire flow requirement by parcel is provided in Attachment 2.

Some of the larger buildings included in the Proposed Project will be fully sprinklered which results in a reduction of the required fire flow. Therefore, based on direction received from Byron Beagles (City of Fresno Fire Prevention Engineer), a fire flow requirement of 3,500 gpm for a four-hour duration with a minimum 20 psi residual pressure will be assumed for the Proposed Project[5].

It should be noted that evaluated fire flows and residual pressures are based on ground surface elevations, and do not account for required minimum water service pressures on higher floors in multi-story buildings. As such, utility system designs for some buildings within the Proposed Project may require the provision of booster pumps to provide adequate water service pressures on higher floors and for fire suppression systems.

Although these criteria have been established, and used to size new pipelines, the existing system in the City's downtown area should be evaluated using pressure as the primary criterion. Secondary criteria, such as velocity, head loss, age, and material type, are used as indicators for areas of the water system that also may need improvements, but may not be required as part of this evaluation.

[5] February 6, 2011 e-mail from Byron Beagles to Brock Buche, re: Fire Flow Requirements.

## WATER SYSTEM FACILITY ASSUMPTIONS

### Recommendations from Previous Evaluations

In March 2009, West Yost completed a hydraulic evaluation of the Downtown Central Area to evaluate available supplies in the City's downtown area and address the loss of supply in the downtown area due to aging wells and water quality issues[6]. The following recommendations for water system improvements were made:

- Additional storage to increase system reliability during peak hour and fire flow conditions;
- Replacement or rehabilitation of Wells 1A and 21A;
- Upgrade of Well 172 pumping capacity along with associated distribution system improvements from Well 172 to the City's downtown area; and
- Addition of 24-inch and 16-inch diameter pipelines through the Central Area to support integrating surface water supply from the east and continuing the City's goal of developing opportunities to transition their predominate groundwater supply to a more balanced conjunctive use system.

In May 2011, West Yost conducted a re-evaluation of the Downtown Central Area to determine what potential alternatives existed other than the March 2009 recommendation for increasing the pumping capacity of Well 172[7]. The recommendations of the May 2011 evaluation were to make distribution pipeline improvements to improve flow from Well 172 (as recommended in the March 2009 evaluation), but instead of upgrading the pumping capacity of Well 172, distribution system improvements should be made to convey supplies from Well 313 to the Downtown Central Area.

For purposes of this evaluation, it has been assumed that the pipeline and storage infrastructure recommendations from these prior hydraulic evaluations of the Downtown Central Area without the pumping capacity increase of Well 172 will be implemented by the City and will be available to serve the Proposed Project.

### Specific Facility Assumptions

The following specific assumptions have been made related to available water system facilities and other water demands within the City's service area:

- Wells 1A and 21A in the City's downtown area (located just northeast of the Proposed Project) area are assumed to be inactive;

[6] "Hydraulic Evaluation of the Downtown Central Area", Technical Memorandum, prepared by West Yost Associates, March 12, 2009.

[7] "Hydraulic Re-Evaluation of the Downtown Central Area Water Distribution System", Technical Memorandum, prepared by West Yost Associates, May 10, 2011.

- New Well 1B (located just outside the City's downtown area) is assumed to be operational and active (recommended as part of West Yost's March 2009 Hydraulic Evaluation of the Downtown Central Area as a replacement for Wells 1A and 21A);
- The new 3.0 million gallon (MG) Downtown tank and associated pipelines (along Nielsen Avenue and G Street) (currently under design) are assumed to be operational (recommended as part of West Yost's March 2009 Hydraulic Evaluation of the Downtown Central Area);
- The distribution system improvements from Well 172 to the Central Area are assumed to be operational. The associated distribution system improvements include a new 16-inch diameter pipeline south along Hughes Avenue and a new 24-inch diameter pipeline along Nielsen Avenue to convey supplies from Well 172 to the Central Area (recommended as part of West Yost's March 2009 Hydraulic Evaluation of the Downtown Central Area);
- A 12-inch diameter connection at West Avenue to the 24-inch diameter pipeline in Nielsen Avenue to convey supplies from Well 313 to the Central Area is assumed to be operational (recommended as part of West Yost's May 2011 Hydraulic Re-Evaluation of the Downtown Central Area Water Distribution System);
- New 24-inch and 16-inch diameter pipelines through the Central Area along G Street, Ventura Street, O Street and Stanislaus Street are assumed to be operational to support integrating surface water supply from the east and continuing the City's goal of developing opportunities to transition their predominate groundwater supply to a more balanced conjunctive use system (recommended as part of West Yost's March 2009 Hydraulic Evaluation of the Downtown Central Area);
- The new Chestnut Avenue transmission pipeline from the City's Northeast Surface Water Treatment Facility (SWTF) is assumed to be operational;
- The regional Transmission Grid Mains (TGMs) are included and assumed to be operational;
- Future water demands in the southwest part of the City service area are included (per June 8, 2011 e-mail from Brock Buche, the City's Development Department has indicated that development in the southwest part of the City will occur concurrently with the Proposed Project);
- The proposed new Southeast SWTF is <u>not</u> included; and
- Future water demands associated with the Southeast Growth Area (SEGA) are <u>not</u> included.

The City's assumed water system facilities available to serve the Proposed Project in the downtown area are shown on Figure 4.

## EVALUATION SCENARIOS

As described above, only the maximum buildout (maximum FAR) development scenario of the Proposed Project has been analyzed by West Yost for this evaluation; no other development scenarios or phasing plans were evaluated.

To evaluate the adequacy of the City's water system to serve the Proposed Project, West Yost has evaluated buildout of the Proposed Project under the following two demand conditions:

- A future maximum day demand condition concurrent with a 3,500 gpm fire flow demand while maintaining a minimum residual system pressure of 20 psi; and
- A peak hour demand condition while maintaining a minimum system pressure of 40 psi.

## EVALUATION FINDINGS

### Storage Capacity Evaluation

Treated water storage capacity requirements for the City were evaluated based on the following three components: operational storage, emergency storage and fire storage. The principal advantage that storage provides is to equalize demands on supply sources and production facilities. The City's Metro Plan Update and Water Master Plan both indicate a need for water storage in the City's downtown area.

West Yost's March 2009 evaluation of the City's Central Area recommended that approximately 3 million gallons (MG) of storage be constructed in the City's Central Area to increase system reliability during peak hour and fire flow conditions. As described above, a new 3 MG Downtown Tank is currently under design and is assumed to be operational for the purposes of this evaluation. However, the required storage capacity previously calculated for the City's Central Area did not take into account the increased densification associated with the Proposed Project. This increased densification will increase the need for storage in the City's Downtown area. Table 3 shows the increased storage requirement attributed to the increased demands associated with the Proposed Project.

**Table 3. Additional Storage Required Due to Densification Associated with Proposed Project**

| Storage Component | Required Storage based on Current Buildout of Fulton Corridor Area without Proposed Project, MG | Required Storage based on Current Buildout of Fulton Corridor Area with Proposed Project, MG | Increased Storage Requirement Attributed to Proposed Project, MG |
|---|---|---|---|
| Operational: Equal to 25% of the Maximum Day Demand | 1.17 | 1.65 | 0.48 |
| Emergency: Equal to Average Day Demand | 2.33 | 3.30 | 0.96 |
| Fire Flow: Equal to the highest fire flow demand for an area multiplied by the required duration. | 0.84 | 0.84 | 0.00 |
| Total | 4.34[(a)] | 5.78 | 1.45 |

[(a)] The storage requirement shown for buildout of the Fulton Corridor Area without the Proposed Project (4.34 MG) is part of required storage previously calculated for the Downtown Central Area. As described in West Yost's March 2009 Hydraulic Evaluation of the Downtown Central Area, required storage within the Downtown Central Area was previously calculated to 8.3 MG, which will be met by a combination of groundwater credits (5.2 MG) and a new Downtown storage tank (3.0 MG). These previous storage calculations for the Downtown Central Area did not include the Proposed Project described in this technical memorandum.

As shown in Table 3, the additional storage requirement resulting from the increased densification associated with the Proposed Project is 1.45 MG.

As described in West Yost's March 2009 evaluation of the City's Central Area, water storage within the City is considered on a regional basis with the water storage requirements for the downtown area being a portion of the overall system requirements. The City's Water Master Plan is evaluating the overall system and will make recommendations for overall system improvements, including recommendations for storage improvements. The 3.0 MG Downtown tank (currently being designed) does not provide adequate capacity for the additional storage required for the Proposed Project, therefore additional operational and emergency storage will need to be provided within the City's overall system to meet the storage needs for the Proposed Project.

## Pumping Capacity Evaluation

Along with the increased storage due to the demand densification, the City will require additional pumping capacity for the Proposed Project to meet operational demands. The operational pumping requirements are used to help meet the City's performance criteria during peak demand conditions. The pumping capacity for fire flow has been accounted for on a regional basis and will not increase as a result of the densification. Emergency pumping capacity is based on an average day demand and is generally met by wells and pump stations equipped with auxiliary power. The recommended pumping required to serve the operational needs of the Proposed Project is approximately 1.44 mgd (1,000 gpm). This increased pumping capacity will need to be added within the City's overall system to meet peak demand operations.

### Distribution System Evaluation

The City's existing water system hydraulic model was modified by West Yost to be representative of the projected water demands associated with the maximum buildout (maximum FAR) development scenario of the Proposed Project. The estimated future demands were distributed throughout the Proposed Project area, as appropriate, according to the proposed development plans.

The future buildout system with the Proposed Project, and the previously recommended Downtown Central Area water system infrastructure improvements described above, was evaluated under maximum day demand plus fire flow conditions and peak hour demand conditions. The evaluation results are described below.

The results of the maximum day demand plus fire flow condition for the future buildout system with the Proposed Project are shown on Figure 5. Figure 5 shows the available flow at each node in the hydraulic model assuming that a minimum system pressure of 20 psi is maintained. Nodes that are shown in "green" have available flows of 3,500 gpm or more, indicating that they meet the fire flow requirement for the Proposed Project. Nodes shown in "red" have available flows that are less than 3,500 gpm, indicating that they do not meet the fire flow requirement for the Proposed Project. As shown, in the northern part of the Proposed Project area, there are several locations where available flows are below the required minimum of 3,500 gpm (see "red" nodes on Figure 5); the lowest available flow in this area is 1,617 gpm. Similarly, there are several locations in the southern part of the Proposed Project area where available flows are below the required minimum of 3,500 gpm (see "red" nodes on Figure 5); the lowest available flow in this area is 1,497 gpm. It should also be noted that the City's pipeline velocity criteria of a maximum of 10 fps during a simulated fire flow condition is not being met in many locations within the Proposed Project area; however, this is expected due to the age and small diameter size of the existing pipelines in the downtown area. Therefore, infrastructure improvements will be required to meet the City's fire flow pressure and flow criteria (these recommendations are described below).

The results of the peak hour demand condition for the future buildout with the Proposed Project are shown on Figure 6. Figure 6 shows the system pressure at each node in the hydraulic model based on peak hour demand conditions. As shown, system pressures throughout most of the Proposed Project area are between 40 and 50 psi under buildout peak hour demand conditions (indicated by the "green" nodes), and some are between 50 to 60 psi (indicated by the "blue" nodes). Therefore, the City's minimum peak hour pressure criteria of 40 psi is being met throughout the Proposed Project area and no specific improvements are required for the peak hour demand condition.

## EVALUATION RECOMMENDATIONS

Figure 7 shows the following recommended infrastructure improvements to resolve the fire flow deficiencies described above as a result of the increased water demands associated with the Proposed Project. The recommended improvements include the replacement of existing smaller diameter pipelines with 8-inch diameter pipelines (approximately 1,400 linear feet in total) and the installation of new 8-inch diameter pipelines where pipelines did not previously exist

(approximately 7,660 linear feet in total). A table listing the proposed pipeline improvements by street is provided as Attachment 3.

Also, as described below, West Yost recommends that an additional 1.5 MG of storage be located within the City's overall water system to meet the operational and emergency storage needs of the Proposed Project.

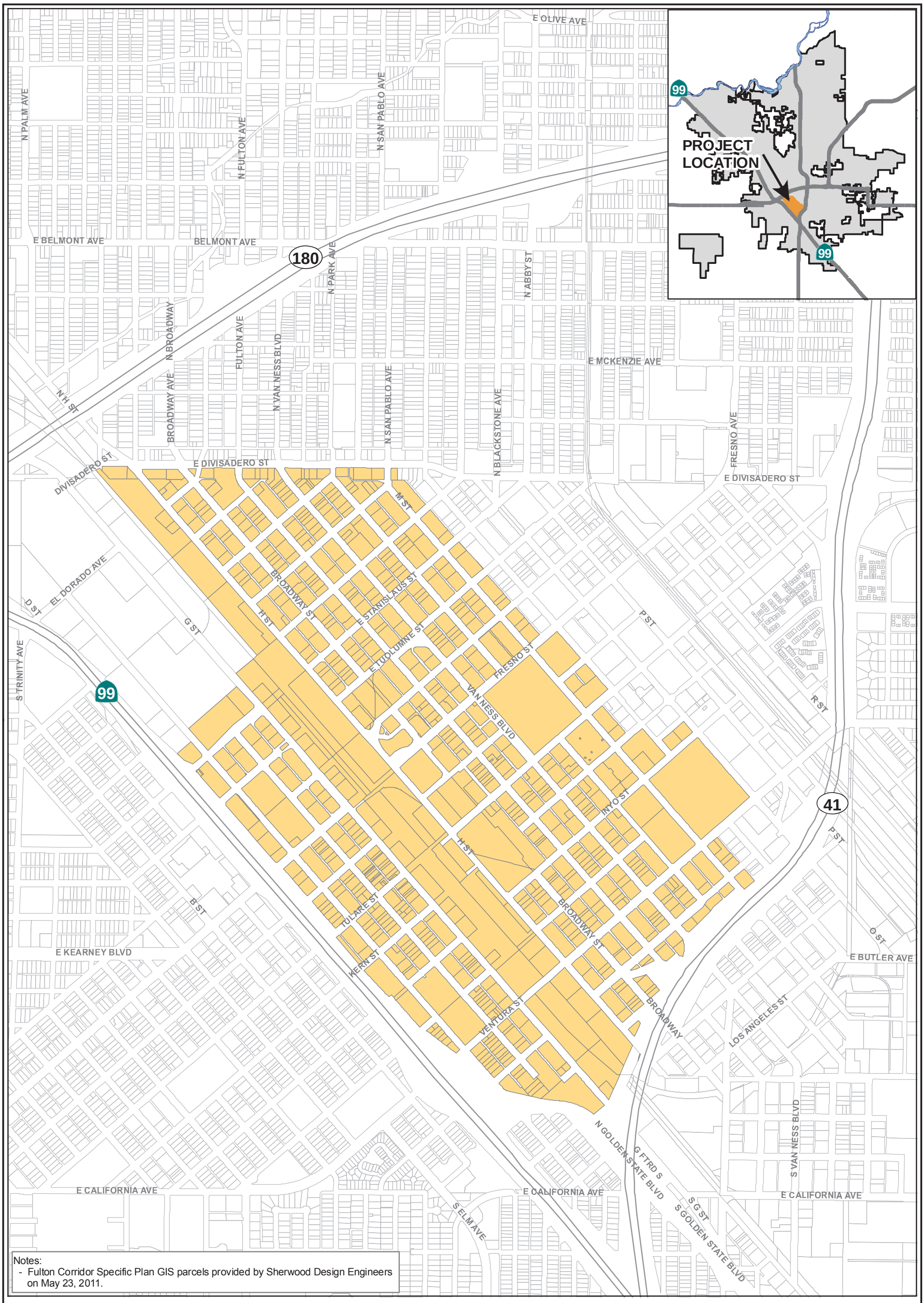
Figure 8 shows the maximum day demand plus fire flow scenario with the Proposed Project with the recommended pipeline improvements as listed above. As shown, with the recommended improvements, the fire flow requirement of 3,500 gpm is met throughout the entire Proposed Project area, with the exception of the following two locations:

- G Street (just north of Stanislaus Street): The available fire flow at this location is 1,972 gpm. This node is located at the end of an approximately 440 foot long, 8-inch diameter pipeline (which appears to be a hydrant lateral). Flows from this location could be combined with flows from other nearby hydrants to provide the fire flow requirement of 3,500 gpm for the Proposed Project.
- Mono Street (just east of E Street): The available fire flow at this location is 2,140 gpm. This location has smaller parcels and no proposed multi-story buildings, therefore, this available fire flow appears to be adequate for this area. Also, flows from this location could be combined with flows from other nearby hydrants to provide the fire flow requirement of 3,500 gpm for the Proposed Project.

It should be noted that the City's pipeline velocity criteria of a maximum of 10 fps during a simulated fire flow condition is still not being met in many locations within the Proposed Project area, even with the recommended improvements described above and shown on Figure 7; however, this is expected due to the age and small diameter size of the existing pipelines in the downtown area. Because fire flow pressure and flow requirements are being met, this velocity criteria, by itself, is not considered as being critical enough to require replacement of additional existing pipelines with larger diameter pipelines in the downtown area.

Figure 9 shows the peak hour demand scenario with the Proposed Project with the recommended improvements. As noted above, no specific improvements were required for the peak hour demand condition for the Proposed Project. Similar to the peak hour results shown in Figure 6, the minimum peak hour system pressure of 40 psi is met throughout the entire Proposed Project area.

An estimation of probable construction costs for these recommended water system infrastructure improvements to serve the Proposed Project was not included in West Yost's Scope of Work for this evaluation. However, these cost estimates can be provided if requested and if a budget augmentation is approved by the City.




Notes:
- Fulton Corridor Specific Plan GIS parcels provided by Sherwood Design Engineers on May 23, 2011.

LEGEND

Fulton Corridor Specific Plan

N

0 500 1,000

Scale in Feet

**FIGURE 1**

**City of Fresno**

**Fulton Corridor Hydraulic Analysis**

**PROJECT LOCATION**

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\439_Fresno\02-10-07 Fulton Corridor Specific Plan \Water Infrastructure Evaluation\GIS\Figures\Figure 1 Location.mxd 6/28/2011

Notes:
- Demand projections based on Sherwood Design Engineers provided data (5/13/2011).
- Shown demands are based on the maximum proposed FAR.
- Proposed densification demands are only calculated for underutilized parcels. All other parcels are assumed not to change.

LEGEND

Fulton Corridor Projected Demands

- 0 - 5,000 gpd
- 5,001 - 10,000 gpd
- 10,001 - 20,000 gpd
- 20,001 - 30,000 gpd
- 30,001 - 286,209 gpd

N

0 500 1,000

Scale in Feet

# FIGURE 2

City of Fresno

Fulton Corridor Hydraulic Analysis

PROJECTED DEMAND DENSIFICATION

WEST YOST ASSOCIATES
Consulting Engineers

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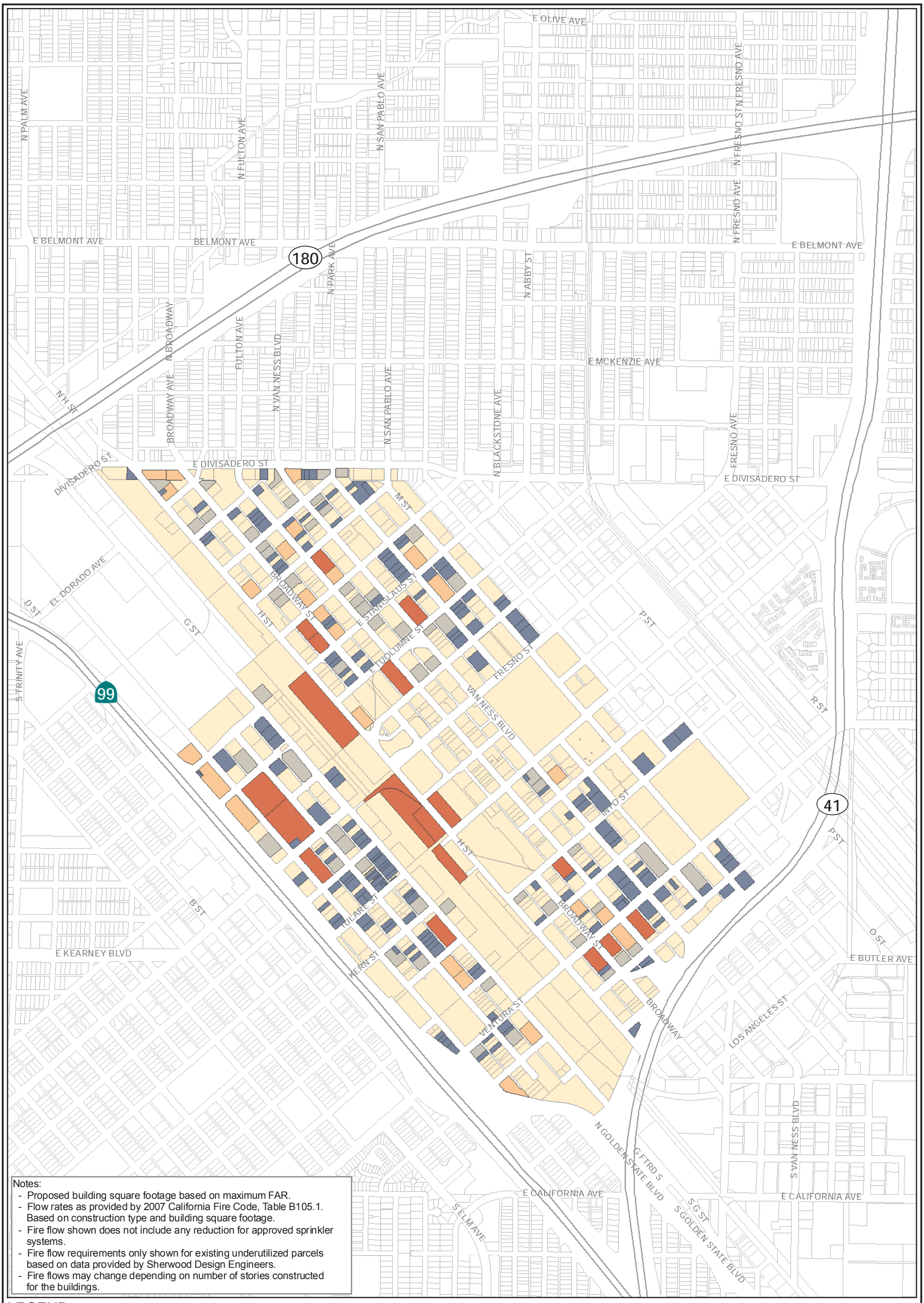


Notes:
- Proposed building square footage based on maximum FAR.
- Flow rates as provided by 2007 California Fire Code, Table B105.1. Based on construction type and building square footage.
- Fire flow shown does not include any reduction for approved sprinkler systems.
- Fire flow requirements only shown for existing underutilized parcels based on data provided by Sherwood Design Engineers.
- Fire flows may change depending on number of stories constructed for the buildings.

LEGEND

Underutilized Parcel Fire Flow

- 1,500 - 3,000 gpm
- 3,001 - 4,000 gpm
- 4,001 - 5,000 gpm
- 5,001 - 6,500 gpm
- Fire Flow not updated

N

0 500 1,000

Scale in Feet

# FIGURE 3

City of Fresno

Fulton Corridor Hydraulic Analysis

PROJECTED FIRE FLOW REQUIREMENTS

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Consulting Engineers

O:\Clients\439_Fresno\02-10-07 Fulton Corridor Specific Plan \Water Infrastructure Evaluation\GIS\Figures\Figure 3 Projected Fire Flow.mxd 6/28/2011

WELL 010A
WELL 018A
WELL 066
WELL 002B
WELL 050A
WELL 021A
WELL 001A
WELL 022A
WELL 009A
WELL 003A
WELL 16A
3 MG Downtown Storage Tank and Booster Pump Station
E BELMONT AVE
BELMONT AVE
N PALM AVE
N FULTON AVE
N SAN PABLO AVE
N FRESNO ST
N PARK AVE
N ABBY ST
E MCKENZIE AVE
N BROADWAY
FULTON AVE
N VAN NESS BLVD
N H ST
E DIVISADERO ST
FRESNO AVE
M ST
BROADWAY ST
EL DORADO AVE
D ST
G ST
P ST
E LUDLOW ST
FRESNO ST
VAN NESS BLVD
R ST
S TRINITY AVE
99
41
O ST
E KEARNEY BLVD
TULARE ST
KERN ST
VENTURA ST
E BUTLER AVE
LOS ANGELES ST
N GOLDEN STATE BLVD
GOLDEN STATE BLVD
S VAN NESS BLVD
E CALIFORNIA AVE
S ELM AVE
S G ST
180

Notes:
- Downtown tank and transmission pipeline along G Street currently under design.
- Planned transmission pipeline recommendations based on the City of Fresno Metropolitan Plan to supply surface water throughout the City.

LEGEND

- Existing Pipelines
- **Planned Transmission Pipelines**
  - 12 inch diameter
  - 16 inch diameter
  - 24 inch diameter
  - 30 inch diameter
- Well/Pump Station
- Inactive Well
- Storage Tank
- Fulton Corridor SP

N

0 500 1,000

Scale in Feet

# FIGURE 4

**City of Fresno**

**Fulton Corridor Hydraulic Analysis**

**PLANNED BUILDOUT FACILITIES**

WEST YOST ASSOCIATES
Consulting Engineers

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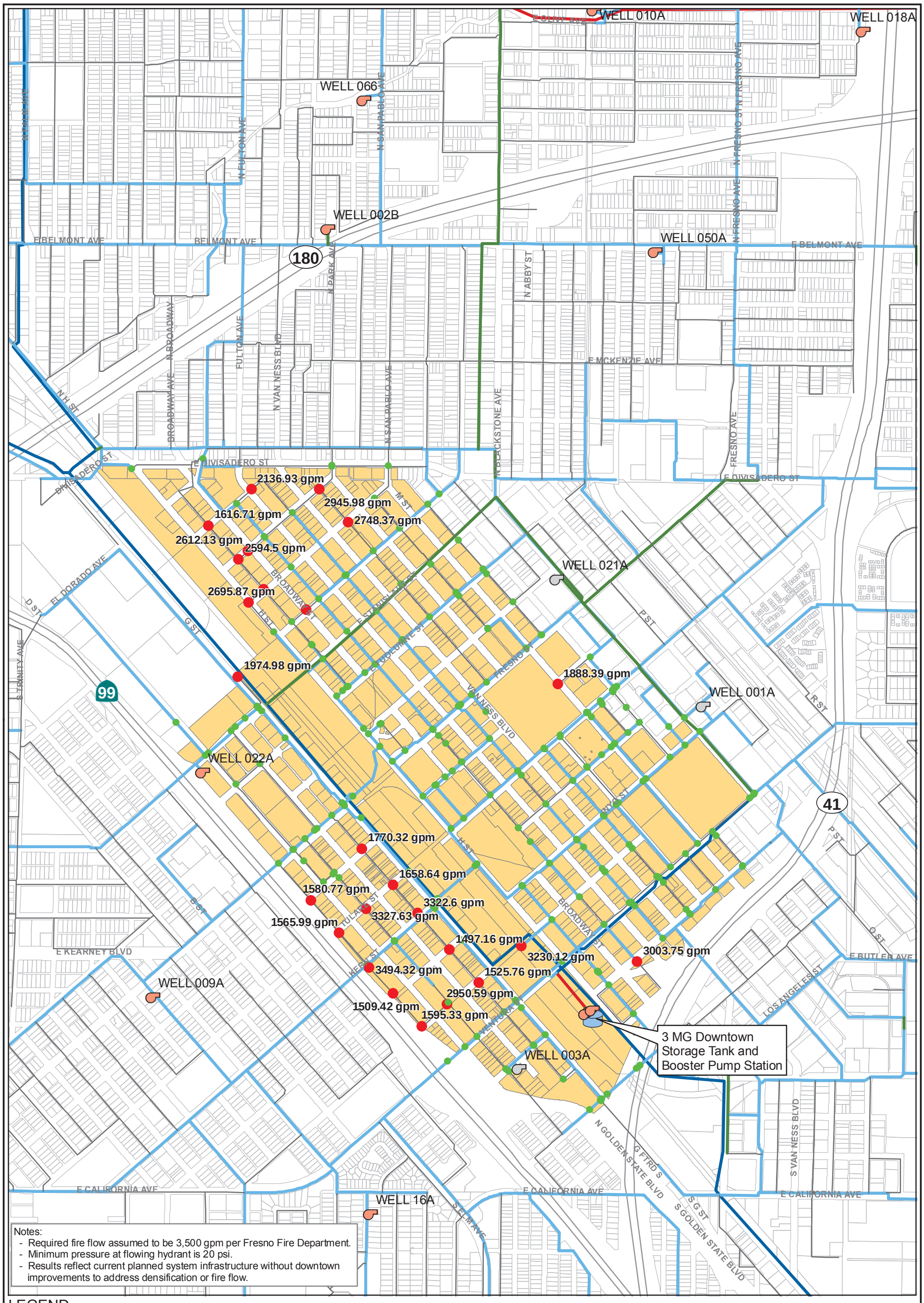


Notes:
- Required fire flow assumed to be 3,500 gpm per Fresno Fire Department.
- Minimum pressure at flowing hydrant is 20 psi.
- Results reflect current planned system infrastructure without downtown improvements to address densification or fire flow.

LEGEND

**Available Flow @ 20 psi**
- Less than 3,500 gpm
- Greater than 3,500 gpm
- Well/Pump Station
- Inactive Well
- Storage Tank

**Pipe Diameters**
- 6 to 8 inch
- 10 to 12 inch
- 14 to 16 inch
- 24 inch
- 30 inch

N

0 500 1,000

Scale in Feet

# FIGURE 5

**City of Fresno**

**Fulton Corridor Hydraulic Analysis**

**PROPOSED Ddensification FIRE FLOW**

WEST YOST ASSOCIATES
Consulting Engineers

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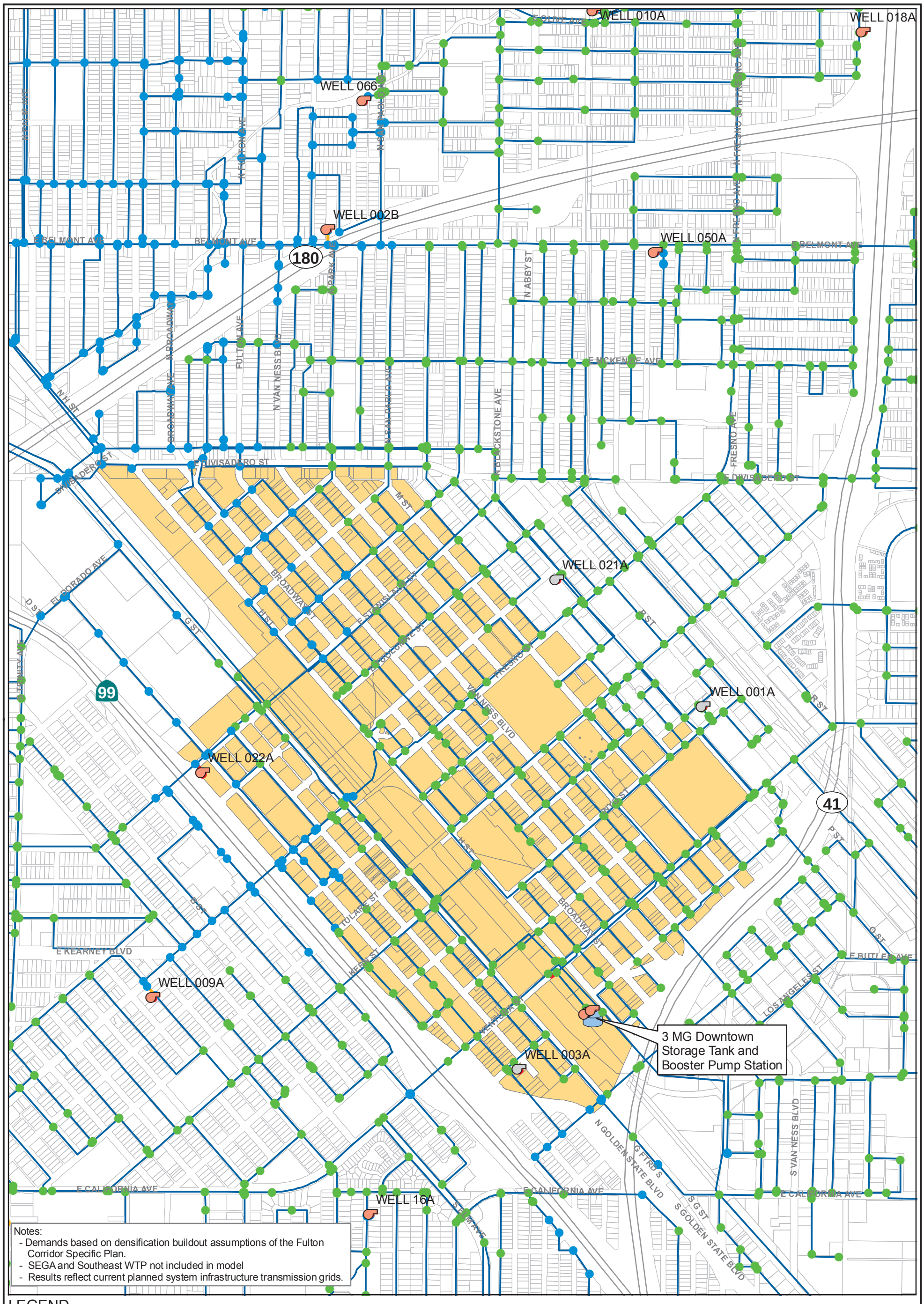


Notes:
- Demands based on densification buildout assumptions of the Fulton Corridor Specific Plan.
- SEGA and Southeast WTP not included in model
- Results reflect current planned system infrastructure transmission grids.

LEGEND

**System Pressure**
- Less than 35 psi
- 35 to 40 psi
- 40 to 50 psi
- 50 to 60 psi
- 60 psi and Greater

**Pipeline Velocity**
- Less than 6 fps
- 6 to 7 fps
- 7 fps and Greater
- Well/Pump Station
- Inactive Well

- Storage Tank
- Fulton Corridor SP

N

0 500 1,000

Scale in Feet

# FIGURE 6

**City of Fresno**

**Fulton Corridor Hydraulic Analysis**

**PROPOSED Ddensification PEAK HOUR**

WEST YOST ASSOCIATES
Consulting Engineers

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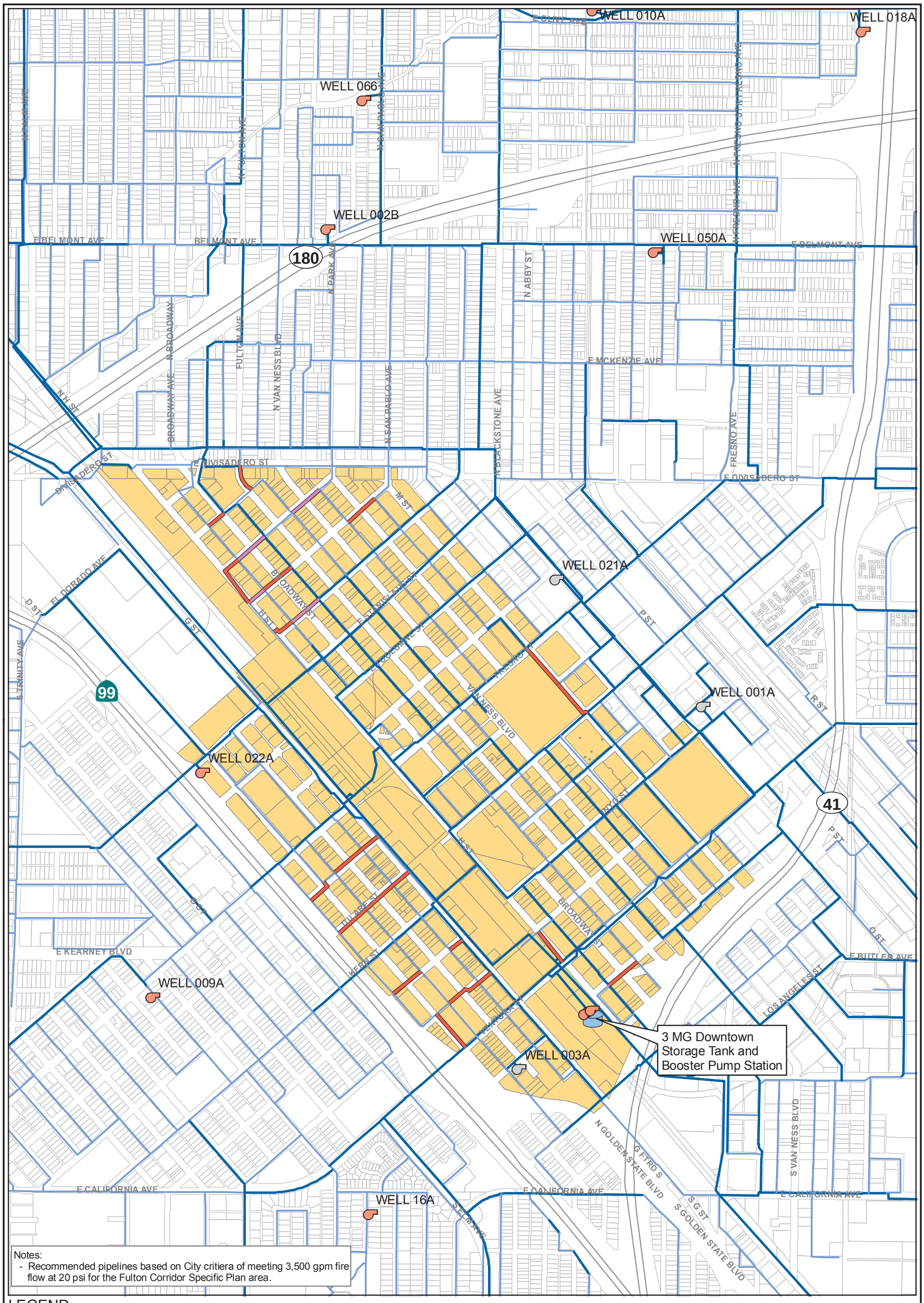


Notes:
- Recommended pipelines based on City critiera of meeting 3,500 gpm fire flow at 20 psi for the Fulton Corridor Specific Plan area.

LEGEND

**Recommended Improvements**
- New Pipeline (8 inch)
- Replacement Pipeline (8 inch)
- Well/Pump Station
- Inactive Well
- Storage Tank

**Existing/Planned Pipeline**
- Distribution (less than 12 inch)
- Transmission (12 inch and greater)

N

0 500 1,000

Scale in Feet

# FIGURE 7

**City of Fresno**

**Fulton Corridor Hydraulic Analysis**

## RECOMMENDED PIPELINE IMPROVEMENTS

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\439_Fresno\02-10-07 Fulton Corridor Specific Plan \Water Infrastructure Evaluation\GIS\Figures\Figure 7 Sw System Improvements.mxd 6/30/2011

WELL 010A
WELL 018A
WELL 066
WELL 002B
WELL 050A
WELL 021A
WELL 001A
WELL 022A
WELL 009A
WELL 003A
WELL 16A
1,972 gpm
2,140 gpm
3 MG Downtown Storage Tank and Booster Pump Station
E BELMONT AVE
N FULTON AVE
N SAN PABLO AVE
N FRESNO ST
N ABBY ST
N PARK AVE
N BROADWAY
FULTON AVE
N VAN NESS BLVD
E MCKENZIE AVE
N BLACKSTONE AVE
FRESNO AVE
E DIVISADERO ST
M ST
BROADWAY ST
EL DORADO AVE
D ST
G ST
H ST
I ST
P ST
R ST
O ST
TRINITY AVE
E KEARNEY BLVD
E BUTLER AVE
LOS ANGELES ST
N GOLDEN STATE BLVD
S VAN NESS BLVD
E CALIFORNIA AVE
S GOLDEN STATE BLVD
S G ST
SELMA AVE
180
99
41

Notes:
- Required fire flow assumed to be 3,500 gpm per Fresno Fire Department.
- Minimum pressure at flowing hydarnt is 20 psi.
- Results reflect current planned system infrastructure plus the recommended improvements to address densification fire flow.

LEGEND

**Available Flow @ 20 psi**
- Less than 3,500 gpm
- Greater than 3,500 gpm
- Well/Pump Station
- Inactive Well
- Storage Tank

**Pipe Diameters**
- 6 to 8 inch
- 10 to 12 inch
- 14 to 16 inch
- 24 inch
- 30 inch

N

0 500 1,000
Scale in Feet

# FIGURE 8

**City of Fresno**
**Fulton Corridor Hydraulic Analysis**
**DENSIFICATION FIRE FLOW IMPROVEMENTS**

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\439_Fresno\02-10-07 Fulton Corridor Specific Plan Water Infrastructure Evaluation\GIS\Figures\Figure 8 Sw System FF Improvements.mxd 6/30/2011

WELL 010A
WELL 018A
WELL 066
WELL 002B
WELL 050A
WELL 021A
WELL 001A
WELL 022A
WELL 009A
WELL 003A
WELL 16A
3 MG Downtown Storage Tank and Booster Pump Station
180
99
41
E BELMONT AVE
N FULTON AVE
N PARK AVE
N ABBY ST
N FRESNO ST
E OLIVE AVE
N VAN NESS BLVD
N BROADWAY
FULTON AVE
E MCKENZIE AVE
N H ST
E DIVISADERO ST
M ST
BROADWAY ST
E STANISLAUS ST
H ST
P ST
R ST
G ST
D ST
EL DORADO AVE
TRINITY AVE
E KEARNEY BLVD
E CALIFORNIA AVE
S VAN NESS BLVD
N GOLDEN STATE BLVD
S GOLDEN STATE BLVD
LOS ANGELES ST
E BUTLER AVE
O ST

Notes:
- Demands based on densification buildout assumptions of the Fulton Corridor Specific Plan.
- SEGA and Southeast WTP not included in model.
- Results reflect current planned system infrastructure transmission grids plus recommended improvements in the Fulton Corridor Specific Plan.

LEGEND

**System Pressure**
- Less than 35 psi
- 35 to 40 psi
- 40 to 50 psi
- 50 to 60 psi
- 60 psi and Greater

**Pipeline Velocity**
- Less than 6 fps
- 6 to 7 fps
- 7 fps and Greater
- Well/Pump Station
- Inactive Well

Storage Tank

N

0 500 1,000
Scale in Feet

# FIGURE 9

**City of Fresno**
**Fulton Corridor Hydraulic Analysis**
**DENSIFICATION PEAK HOUR IMPROVEMENTS**

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\439_Fresno\02-10-07 Fulton Corridor Specific Plan Water Infrastructure Evaluation\GIS\Figures\Figure 9 Sw System Peak hour Improvements.mxd 6/30/2011

**Appendix D**

City of Fresno 2020 Urban Water Management Plan

City of FRESNO
Department of Public Utilities

# 2020 Urban Water Management Plan

Final

JULY 2021

CITY OF FRESNO

Photo Credit: Downtown Fresno Partnership

City of FRESNO
Department of Public Utilities

CITY OF FRESNO

# Final 2020 Urban Water Management Plan

**JULY 2021**

Prepared by Water Systems Consulting, Inc.

WSC

# ACKNOWLEDGMENTS

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# ACRONYMS & ABBREVIATIONS

| | |
|---|---|
| °F | degrees Fahrenheit |
| 1,2,3-TCP | 1,2,3-trichloropropane |
| AF | acre-feet |
| AFY | acre-feet per year |
| AMI | advanced metering infrastructure |
| AWE | Alliance for Water Efficiency |
| AWWA | American Water Works Association |
| BP04 | Booster Pump 4 |
| CII | Commercial, Institutional, and Industrial |
| CIMIS | California Irrigation Management Information System |
| City | City of Fresno |
| COG | Council of Governments |
| CPC | California Plumbing Code |
| CSUF | California State University Fresno |
| CVP | Central Valley Project |
| CVPIA | Central Valley Project Improvement Act |
| CVWAC | Central Valley Water Awareness Committee |
| CWC | California Water Code |
| CY | Calendar Year |
| DBCP | 1,2-dibromo-3-chloropropane |
| DMM | Demand Management Measures |
| DDW | Department of Drinking Water |
| DPU | Department of Public Utilities |
| DRA | Drought Risk Assessment |
| DWR | Department of Water Resources |
| EDB | ethylene dibromide or 1,2-dibromoethane |
| ETo | Evapotranspiration |
| FID | Fresno Irrigation District |
| FMFCD | Fresno Metropolitan Flood Control District |
| GIS | Geographic Information System |
| GPCD | gallons per capita per day |
| GSA | Groundwater Sustainability Agency |

| | |
|---|---|
| **GSP** | Groundwater Sustainability Plan |
| **HCF** | hundred cubic feet |
| **IGSM** | Integrated Groundwater and Surface Water Model |
| **Metro Plan** | Fresno Metropolitan Water Resource Management Plan |
| **mgd** | million gallons per day |
| **NESWTF** | Northeast Surface Water Treatment Facility |
| **NFWRF** | North Fresno Wastewater Reclamation Facility |
| **NKGSP** | North Kings Groundwater Sustainability Plan |
| **NRDC** | Natural Resources Defense Council |
| **PCE** | perchloroethylene or tetrachloroethylene |
| **PEIR** | Programmatic Environmental Impact Report |
| **PFAS** | per- and polyfluoroalkyl substances |
| **PFOA** | perfluorooctanoic acid |
| **PFOS** | perfluorooctanesulfonic acid |
| **RHNA** | Regional Housing Needs Allocation |
| **RWMP** | Recycled Water Master Plan |
| **RWRF** | Regional Wastewater Reclamation Facility |
| **SB** | Senate Bill |
| **SBx7-7** | Senate Bill x 7-7 |
| **SESWTF** | Southeast Surface Water Treatment Facility |
| **SGMA** | Sustainable Groundwater Management Act |
| **SOI** | Sphere of Influence |
| **sq mi** | square miles |
| **SWTF** | Surface Water Treatment Facility |
| **T-3 SWTF** | T-3 Water Storage and Modular Surface Water Treatment Facility |
| **TCE** | trichloroethylene |
| **TDS** | total dissolved solids |
| **TTDF** | Tertiary Treatment and Disinfection Facility |
| **USBR** | United States Bureau of Reclamation |
| **UV** | ultraviolet |
| **UWMP** | Urban Water Management Plan |
| **UWMP Act** | Urban Water Management Planning Act |
| **WSCP** | Water Shortage Contingency Plan |
| **WSIP** | Water Storage Investment Program |
| **WY** | Water Year |

CITY OF FRESNO

# Executive Summary

**This section summarizes the 2020 Urban Water Management Plan (UWMP) for the City of Fresno (City). It provides a lay description of the 2020 UWMP in a manner that is accessible to non-technical readers. This summary describes the fundamental purposes of the UWMP, including water service reliability, future challenges, and strategies for managing water reliability risks.**

UWMPs are updated every five years and outline each suppliers' long-term water resource planning to ensure there is enough water to meet both existing and future demands. They set the roadmap for how the City will use water over the coming years.

The original Fresno water system began operations in 1876 as a non-profit organization established by a group of public-minded citizens. Today, the City covers approximately 115 square miles (sq mi) (73,500 acres) consisting largely of single-family residential, commercial, public, and industrial development. The City's General Plan projects buildout of the 106,000 acres planning area in 2056. This UWMP addresses the City's water service reliability, future challenges, and strategies for managing risks to water reliability through 2045. The City's Fresno Metropolitan Water Resource Management Plan (Metro Plan), which is currently being prepared, addresses a 50-year horizon – through 2070.

IN THIS SECTION


- Service Area Description
- Water Use
- Water Sources
- Water Supply Reliability

# Purpose and Organization of the Plan

This plan comprises the 2020 UWMP for the City, as required by the California Urban Water Management Planning Act, which requires all urban water suppliers with more than 3,000 connections or distributing more than 3,000 acre-feet per year (AFY) to complete an UWMP every five years. As of the close of the 2020 calendar year, the City has over 139,500 residential, commercial, industrial, and institutional water service connections and produced nearly 122,000 acre-feet (AF) of water. As a result, the City is required to prepare and adopt an UWMP and submit it to the Department of Water Resources (DWR) by the July 1, 2021, due date.

Requirements for the UWMP include:

- Assessment of current and projected water supplies
- Evaluation of demand and customer types
- Evaluation of the reliability of water supplies
- Description of conservation measures implemented by the urban water supplier
- Response plan, in the event of a water shortage
- Comparison of demand and supply projections

The UWMP is a valuable planning document used for multiple purposes:

- Serves as a valuable resource to the community and other interested parties regarding water supply and demand, conservation, and water related information
- Meets a statutory requirement of the California Water Code (CWC)
- Provides a key source of information for water supply assessments and written verifications of water supply
- Supports regional long-range planning, including City and County General Plans
- Provides a standardized methodology for water utilities to assess their water resource needs and availability
- Provides a resource for regional involvement in the California Water Plan
- Provides for a plan during water drought situations

# Outreach and Engagement

The City has coordinated the preparation of its 2020 UWMP with its water suppliers, Fresno County, the City of Clovis, nearby water agencies, and community members to develop a UWMP that adheres to the requirements of the CWC and plans for a resilient water future. In total, the City has coordinated preparation of the 2020 UWMP and solicited participation and comments with the following agencies**:**

- Bakman Water Company
- City of Clovis
- County of Fresno
- Fresno Irrigation District
- Fresno Metropolitan Flood Control District
- Friant Water Authority
- Garfield Water District
- Malaga County Water District
- Pinedale County Water District
- North Kings Groundwater Sustainability Agency
- US Bureau of Reclamation

# Service Area Description

The City's General Plan planning area covers approximately 106,000 acres comprised of approximately 73,500 acres of incorporated land and 32,500 acres of unincorporated land. The City's water service area covers 70,400 acres consisting largely of single-family residential, commercial, public, and industrial development, shown in **Figure ES-6** (located at the end of the Executive Summary). The service area excludes areas served by the Bakman Water Company, Pinedale County Water District, Park Van Ness Mutual Water Company, California State University Fresno, and private groundwater users located within Fresno County islands. The City will eventually serve out to the Sphere of Influence (SOI) boundary adopted in the 2014 General Plan and includes all lands planned to be annexed by the City at the projected 2056 buildout of the General Plan, summarized in **Table ES-1**.

**Table ES-1. Existing and Future Water Service Area**

| LAND USE CATEGORY | 2020 WATER SERVICE AREA | | 2056 WATER SERVICE AREA | |
|---|---|---|---|---|
| | ACRES | PERCENT | ACRES | PERCENT |
| Single-Family Residential | 27,700 | 39.3% | 40,000 | 47.4% |
| Multifamily Residential | 3,700 | 5.3% | 3,800 | 4.5% |
| Commercial | 4,500 | 6.4% | 8,600 | 10.2% |
| Public Facility | 5,600 | 8.0% | 7,200 | 8.5% |
| Industrial | 4,500 | 6.4% | 9,300 | 11.0% |
| Open Space/ Landscape Irrigation | 13,100 | 18.6% | 11,000 | 13.0% |
| Mixed Use | 0 | 0% | 3,900 | 4.6% |
| Downtown | 0 | 0% | 600 | 0.7% |
| Vacant / Partially Vacant | 11,300 | 15.9% | 0 | 0% |
| **TOTAL** | **70,400** | **100%** | **84,400** | **100%** |

Note: Acreage from City GIS Shapefile of Land Uses and aligns with the General Plan for buildout in year 2056.

### Population Projections

The City experienced rapid growth since it was founded by the Central Pacific Railroad in 1872 up through the mid-1990s, when the City's annual growth rate was typically greater than 2%. From 1995 to 2015, the annual growth rate has decreased to an average of 1.3%, and since 2015, the rate has not surpassed 1.0%. Achieving General Plan buildout population estimates requires an average annual growth rate of 1.44% from 2020 to 2056. The City's water service area population is anticipated to continue to grow along with the City, with some slightly higher growth years anticipated in the next 10 years due to multiple large developments planned for completion in the near term. As a result, population growth, shown in **Figure ES-1** on the following page, occurs at an annual rate of ranging from 1.1–2.1% between 2020 and 2056.

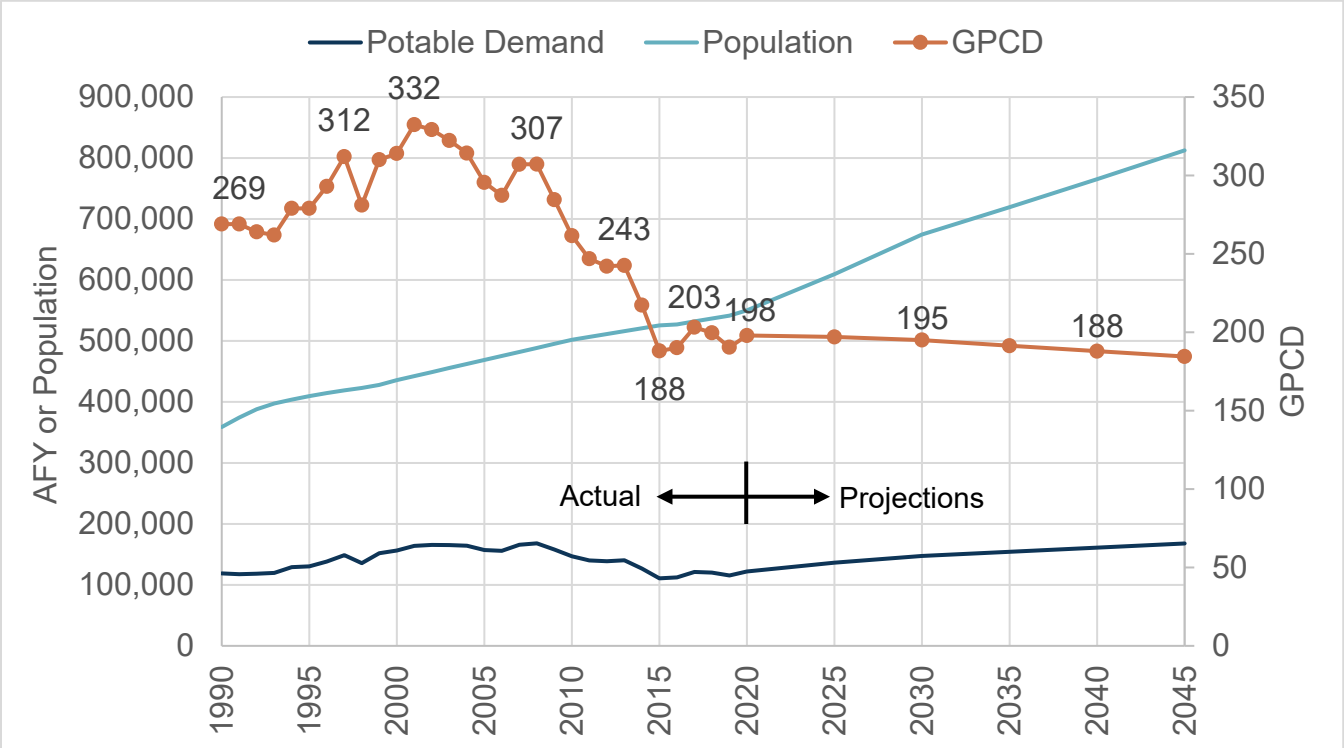
# Water Use

Water consumption in the City is characterized by the typical demand sectors of residential, commercial, institutional, industrial, and irrigational. The difference between production and consumption is losses, which may be attributed to system leaks, meter inaccuracies, fire flows, theft, unmetered use, or other factors.

As shown in **Figure ES-1**, the City's water demand has decreased even as the City has grown over the past several decades, and demands are projected to grow slower than population growth. This trend is captured by the City's daily per capita water use, measured as gallons per capita per day (GPCD). For 2020, the City's water use averaged 198 GPCD based on 121,993 AF of water production and a service area population of 550,217. The City is far below its 2020 daily per capita water use target of 247 GPCD due to the extensive conservation efforts implemented by the City in the past decade.

The City also diverts raw surface water obtained from the United States Bureau of Reclamation (USBR) and the Fresno Irrigation District (FID) to recharge basins throughout the service area. The City coordinates with FID for the delivery of the recharge water, utilizing FID's existing system of channels and pipelines to covey the raw water, and with Fresno Metropolitan Flood Control District (FMFCD) to deliver water to FMFCD's stormwater retention and recharge basins or the City's own recharge basins. The raw surface water recharges the groundwater basin to sustain the groundwater supply for the City. The groundwater recharge volume can vary based on surface water supply availability and is represented as an addition to annual groundwater supplies. In addition, the City serves a limited number of customers secondary treated or tertiary treated and disinfected recycled water for agricultural irrigation or landscape irrigation, respectively.

**Figure ES-1. City of Fresno Demand Projections**



The City's per capita water usage is projected to continue to decline through 2045 due to more water efficiency in future construction and passive conservation; however, due to the increase in population the demand is expected to slowly increase in the next 25 years. The potable demand projections for normal water use are based on land use where future land use areas are expected to be more water efficient than existing land uses and buildings due to the California Plumbing Code (CPC) and use of higher efficiency appliances and landscapes. Demand for existing land uses is also expected to slowly reduce over time due to passive conservation, which includes the replacement of older water fixtures and appliances with more efficient types now required as part of the CPC.

# Water Sources

The City relies on groundwater from the North Kings Subbasin; surface water from Central Valley Project (CVP), through a contract with the USBR; Kings River water, through a contract with FID; and recycled water. Water production in the City has consisted of 100% groundwater prior to the commissioning of the City's first surface water treatment facility (SWTF) in 2004. Since 2004, the City has invested in expanding its surface water treatment capabilities and now has three SWTFs that provide approximately half of all potable water demands in the service area.

**Groundwater**

The City overlies the Kings Subbasin, which is part of the greater San Joaquin Valley Groundwater Basin. The City is one of many water purveyors that use groundwater from the Kings Subbasin. The City has a network of over 270 municipal wells and currently operates approximately 202 municipal supply wells within the Kings Subbasin.

The City was a founding member of the North Kings Groundwater Sustainability Agency (North Kings GSA), which was formed following passage of the Sustainable Groundwater Management Act (SGMA) of 2014. This legislation created a statutory framework for groundwater management in California that can be sustained during the planning and implementation horizon without causing undesirable results. SGMA requires governments and water agencies of "critically overdrafted" basins to reach sustainability by 2040. The Kings Subbasin was designated a critically overdrafted basin by DWR and the North Kings GSA is working within the SGMA framework to reach groundwater sustainability.

Due to the City's investments in other supplies – surface water, recycled water, and conservation – groundwater levels beneath the City have already begun to recover from low levels experienced during the recent drought. The City plans to continue to use groundwater within a larger conjunctive use program that maximizes its existing water rights and surface water supply sources.

**Surface Water**

With the completion and operation of the Southeast Surface Water Treatment Facility (SESWTF), surface water is now a primary water supply used to meet potable demands within the City. The City contracts with FID for Kings River water and with USBR for CVP water from the Friant-Kern Canal. The surface water supply is used either for potable uses through treatment and distribution or delivery to recharge basins for groundwater recharge. The City has historically not used all its available FID allocation in any given year, although it pays a flat rate for its total allocation regardless of use. Water unused by the City is reallocated by FID to its other customers.

The City, through an agreement originally executed in 1961, secured a surface water supply from USBR CVP Friant Division for an annual water supply of 60,000 AF of Class 1 water. The agreement was last renewed in 2010 as a Section 9(d) contract that provides water from the San Joaquin River in perpetuity. Class 1 water has historically been very reliable until the 2006 San Joaquin River Restoration Settlement Agreement, which ended an 18-year legal dispute over the operation of Friant Dam brought by a coalition of conservation and fishing groups. The projected surface water available for the City from USBR is based on USBR simulations for the 2006 Settlement Agreement. Average simulated delivery is 53,680 AFY and the median simulated delivery is 60,000 AFY. However, very dry years have previously resulted in substantial reductions as demonstrated by the zero allocations that occurred in 2014 and 2015.

FID is one of 28 agencies that receives an entitlement of water from the Kings River through the Kings River Water Association. The City executed its most recent agreement with FID in 2016. The 2016 agreement identifies the City's contracted percentage of FID's Kings River water based on the City's water service area located within FID service area as a percentage of the FID land area. FID land area varies slightly every year because it is dependent on the acreage receiving water deliveries for that year rather than the total acreage within FID, and is roughly 200,000 acres. As the City incorporates new users and the water service area expands, the percentage of FID supply increases. However, the 2016 FID Agreement sets the City's maximum percentage of FID's Kings River water as 29.0%, which is expected to be reached between 2025 and 2030.

The City's potential supply from FID was projected using actual Kings River deliveries for 1964–2019. The average FID Kings River delivery over that time was 452,541 AF, which equates to an average potential City supply of 131,237 AF, assuming the maximum 29.0% City supply percentage. The projected City percentage of FID supplies was estimated based on City's water service area growth projections through buildout in 2056.

**Recycled Water**

The Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) has developed from what was once a sewer farm to what is now a state-of-the-art wastewater treatment facility. The RWRF treats flows from not only the City, but also sewered County areas (some county areas remain unsewered), the City of Clovis, Pinedale County Water District, and Pinedale Public Utility District. Flows received at this facility peaked at 81,100 AF in 2006 and have been steadily decreasing since, with the average influent flow about 63,000 AF over the last five years.

The City has three primary means of effluent disposal from the RWRF:

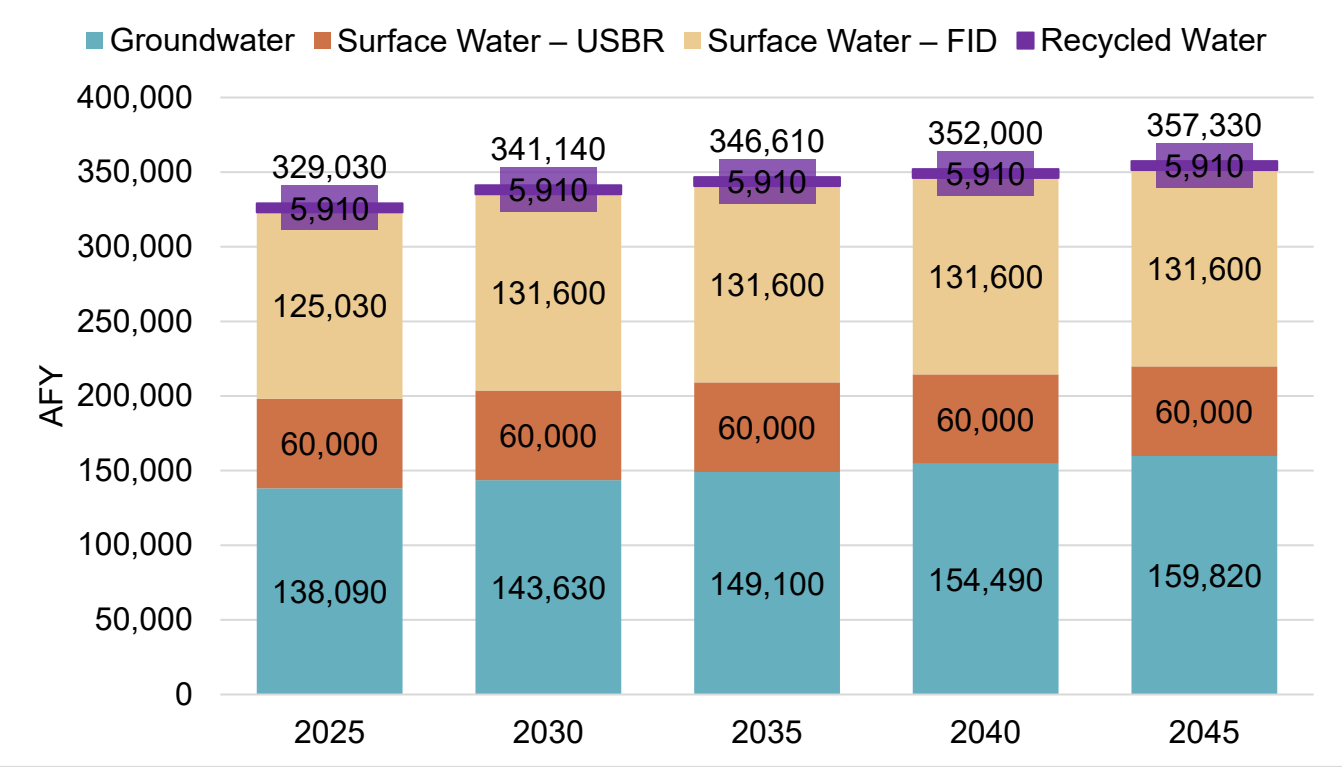
1. Undisinfected secondary effluent to on-site and off-site farmland for restricted irrigation
2. Undisinfected secondary effluent to percolation ponds
3. Disinfected tertiary effluent to the recycled water distribution system

The percolated effluent has been deemed equivalent to tertiary treated water by the State and the City has been extracting this water for reuse in areas within and surrounding the RWRF, as well as to FID's canals, through an exchange agreement for delivery to FID agricultural customers. The City recently constructed the Tertiary Treatment and Disinfection Facility (TTDF) at the RWRF and has constructed most of the southwest recycled water system, which is projected to increase deliveries from roughly 1,000 AFY today to eventually meet 5,800 AFY of non-potable demands. In addition, the City uses recycled water from the North Fresno Wastewater Reclamation Facility (NFWRF) to irrigate Copper River Ranch Golf Course.

### Summary of Supplies

The City currently balances its surface water supplies and groundwater based on minimum production for operation of the SWTFs and minimum groundwater pumping to manage and control contamination plumes and prevent their spread. The minimum operation conditions typically occur in the low-demand winter months, and the City can increase surface water production during peak demand months when surface water is available. In normal and wet years, the City intends to rely on more surface water supply and recharge raw surface water to replenish the groundwater basin and build storage for dry years. In dry years, when surface water is less available, the City will ramp up well production to meet demands. The City is expected to continue this supply management strategy in the future. **Figure ES-2** shows the City's annual average projected water supplies through 2045.

**Figure ES-2. Projected Water Supplies**



# Water Supply Reliability

The City currently manages its surface water and groundwater supply by maximizing surface water for potable use and intentional recharge during wet and normal years, while relying on groundwater during dry years. The City is currently updating its Metro Plan, which will recommend projects and programs to optimize the use of its supply portfolio and further improve supply resilience. Supply management tools are an expected outcome of the Metro Plan update; however, the City's ongoing supply management is intended to maximize local supplies and improve the groundwater basin storage. Current actions include enhanced groundwater management and intentional recharge, increased recycled water use, and continued conservation through the implementation of demand management measures.

Normal water year, single dry water year, and five-year consecutive drought period supply projections were made based on historic water allocations for surface water supplies, sustainable yield for groundwater, and projected utilization for recycled water. For surface water, the single dry year is based on 2015 allocations and the five-year drought is based on 2012 to 2016. Groundwater supplies, due to intentional recharge augmentation, remain reliable in all hydrologic conditions.

Despite severe reductions of surface water supplies during recent dry years, sufficient good-quality water was available to operate the SWTFs. The projected supplies and demands for a normal year, single dry year, and five-year consecutive drought, shown in **Figure ES-3** through **Figure ES-5** on the next page and in **Table 7-1** through **Table 7-3** in **Section 7.1.4**, demonstrate that the City is projected to have greater than 100,000 AF of available supply after meeting demands in normal years; the City's surface water supplies are reduced in a single dry year, but all potable demands are met and groundwater recharge of raw surface water is reduced; and the City is projected to meet all demands during a five-year drought with its existing supplies with reduced groundwater recharge in years three and four of a five-year drought to accommodate low surface water allocations.

Managed recharge of surface water is an essential component of the City's groundwater supply and the City must average 60,000 AFY to 70,000 AFY of recharge with surface water to meet the projections. This highlights the City's priority of recharging available surface water in the coming years.

**Figure ES-3. Normal Year Supply vs. Demand**

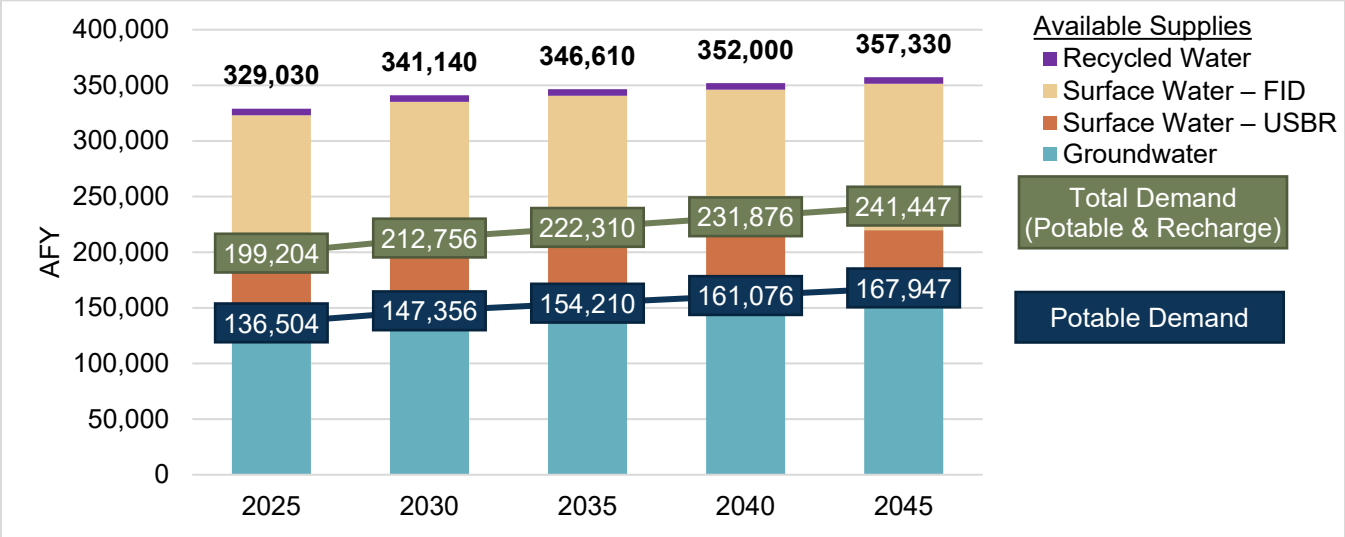



**Figure ES-4. Single Dry Year Supply vs. Demand**

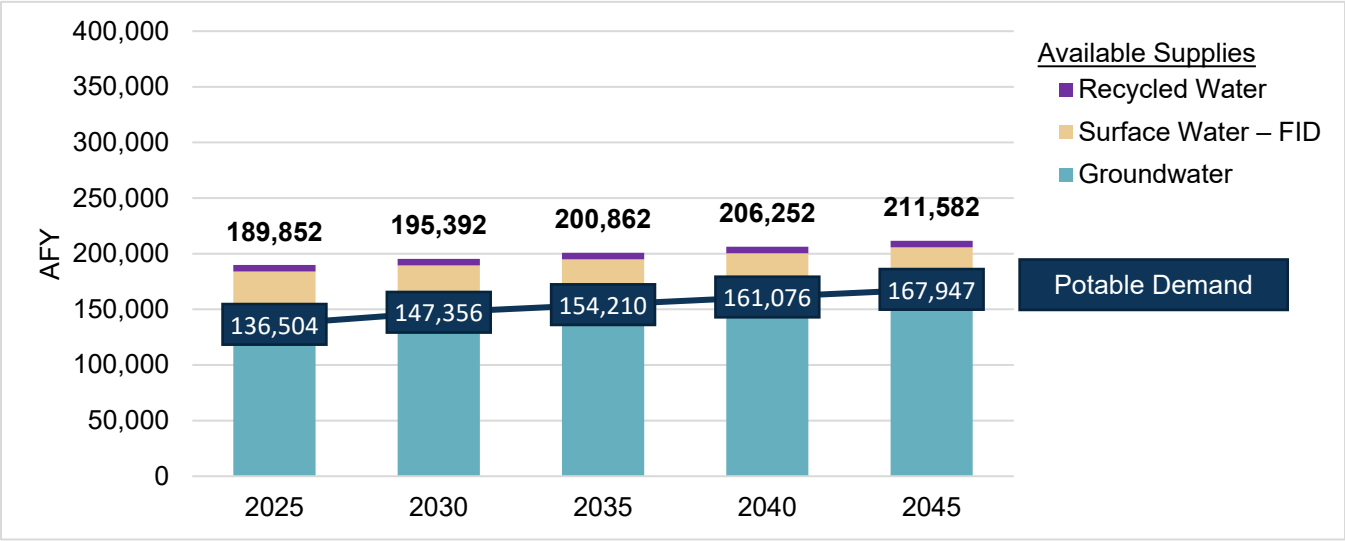
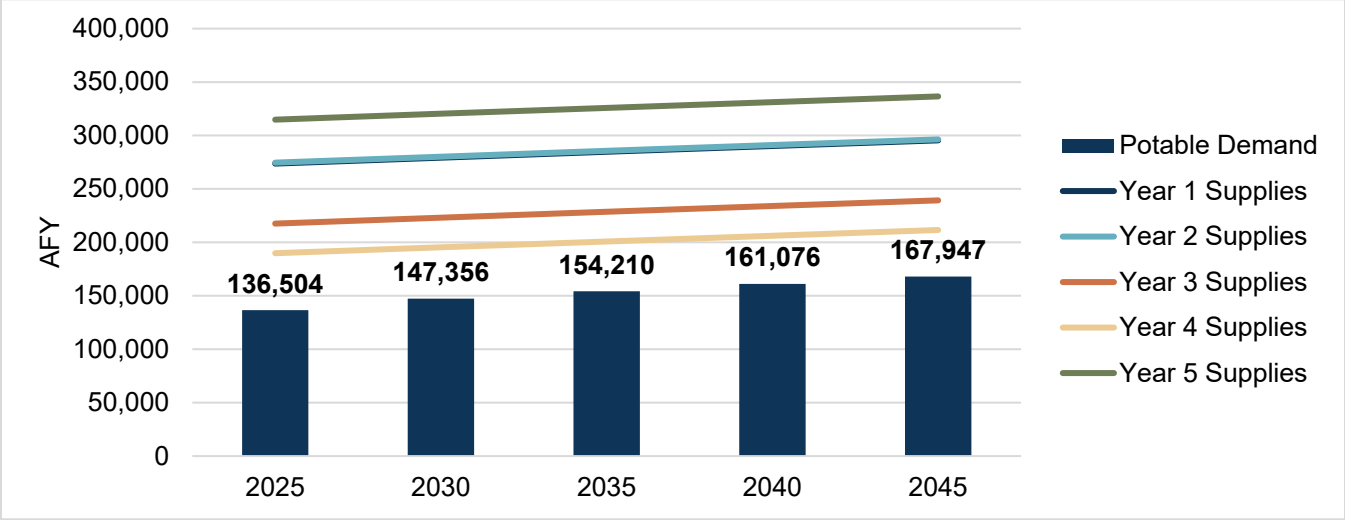



**Figure ES-5. Multiple Dry Years Supply vs. Demand**



### 2021-2025 Drought Risk Assessment

A new provision of the Water Code directs Suppliers to prepare a Drought Risk Assessment (DRA), assuming a drought period lasting five consecutive years, starting from the year following the year when the assessment is conducted. The DRA analysis allows the City to examine the management of its supplies during stressed hydrologic conditions and an opportunity to evaluate whether the City may need to enact its Water Shortage Contingency Plan (WSCP) during the next actual drought period lasting at least five years. The projected gross water use for the five-year DRA is based on unrestricted potable demand, a reduction in raw-water demand for intentional recharge in years three and four of the five-year drought, and unrestricted recycled water demand. Surface water supply availability is based on actual allocations during the previous drought – from 2012 to 2016.

**Table ES-2** compares the total projected supply and demand for the five-year DRA for 2021 through 2025. As shown, the City does not expect to enact its WSCP for a five-consecutive-year drought based on the unrestricted potable demand projections and the reliability of the current supply portfolio. Available surface water supplies during this period would be utilized for groundwater recharge to sustain the groundwater basin.

**Table ES-2. Five-Year Drought Risk Assessment**

| WATER USE TYPE | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|
| Groundwater | 133,602 | 134,724 | 135,846 | 136,968 | 138,090 |
| Surface Water – USBR | 30,000 | 37,200 | 0 | 0 | 45,000 |
| Surface Water – FID | 93,354 | 83,085 | 65,425 | 40,776 | 111,911 |
| Recycled Water | 1,912 | 2,911 | 3,911 | 4,910 | 5,910 |
| **TOTAL SUPPLY** | **258,868** | **257,920** | **205,181** | **182,655** | **300,911** |
| Potable Demand | 124,910 | 127,827 | 130,745 | 133,662 | 136,504 |
| Non-Potable Demand | 60,000 | 60,000 | 48,287 | 22,260 | 60,000 |
| **TOTAL DEMAND** | **184,910** | **187,827** | **179,032** | **155,922** | **196,504** |
| **AVAILABLE SUPPLIES** | **73,958** | **70,093** | **26,149** | **26,732** | **104,407** |

### Water Shortage Contingency Plan

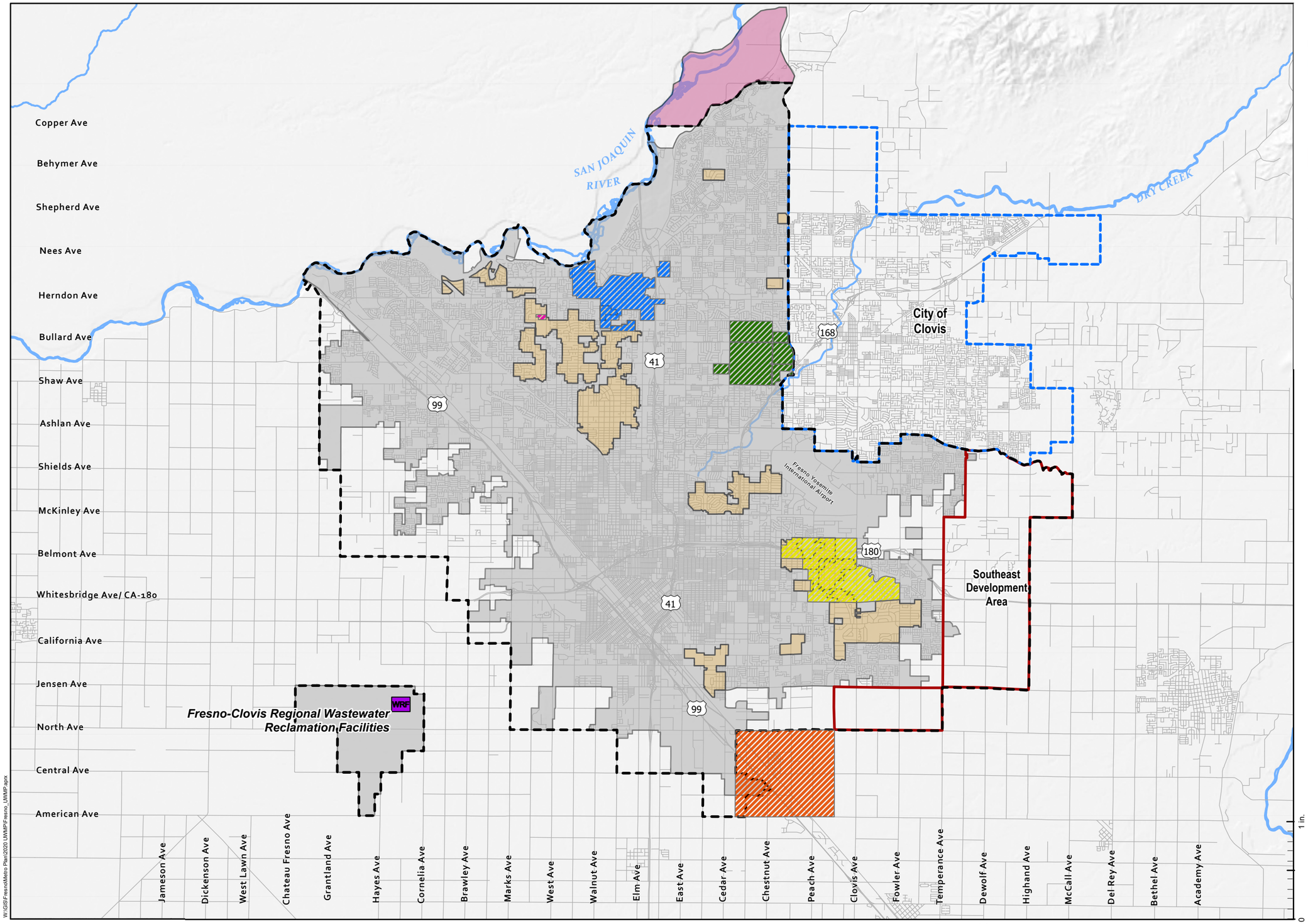
This WSCP is a detailed plan for how the City intends to respond to foreseeable and unforeseeable water shortages. A water shortage occurs when the water supply is reduced to a level that cannot support typical demand at any given time.

The WSCP is used to provide guidance to the City's governing body, staff, and the public by identifying response actions to allow for efficient management of any water shortage with predictability and accountability. Preparation provides the tools to maintain reliable supplies and reduce the impacts of supply interruptions due to extended drought and catastrophic supply interruptions.

The WSCP describes the following:

- Water Supply Reliability Analysis
- Annual Water Supply and Demand Assessment Procedures
- Six Standard Shortage Stages
- Shortage Response Actions
- Communication Protocols
- Compliance and Enforcement
- Legal Authority
- Financial Consequences of WSCP Implementation
- Monitoring and Reporting
- WSCP Refinement Procedures
- Special Water Features Distinctions
- Plan Adoption, Submittal, and Availability

The 2020 WSCP is a standalone document that can be modified as needed and is included as **Appendix J** in the 2020 UWMP.




## Legend

- Fresno Sphere of Influence
- Clovis Sphere of Influence
- Fresno City Limits
- County Islands
- North Area
- Southeast Development Area
- WRF Wastewater Reclamation Facility
- Streets

*Areas Served Water by Others*

- Bakman Water District
- Malaga Water District
- Park Van Ness Mutual Water District
- Pinedale County Water District
- CA State University, Fresno

**Prepared by:** WSC

N

1:140,000

0 0.75 1.5 3 Mi

0 3,750 7,500 15,000 US Feet

**References:**

1. Coordinate System: NAD 1983 StatePlane California IV FIPS 0404 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

**Notes:**

**Prepared for:** City of Fresno Department of Public Utilities

**City of Fresno**
**2020 Urban Water Management Plan**

**Figure ES-6. City Service Area**

# 1 CITY OF FRESNO Introduction

**This plan comprises the 2020 Urban Water Management Plan (UWMP) for the City of Fresno (City), as required by the California Urban Water Management Planning Act (UWMP Act).**

The UWMP Act requires all urban water suppliers with more than 3,000 connections or distributing more than 3,000 acre-feet per year (AFY) to complete an UWMP every five years.

As of the close of the 2020 calendar year, the City has over 139,500 residential, commercial, industrial, and institutional water service connections and produced nearly 122,000 AF of water. As a result, the City is required to prepare and adopt an UWMP and submit it to DWR by the July 1, 2021, due date.

IN THIS SECTION


- California Water Code
- UWMP Organization


**The UWMP is a valuable planning document used for multiple purposes:**

- Serves as a valuable resource to the community and other interested parties regarding water supply and demand, conservation, and water related information
- Meets a statutory requirement of the California Water Code (CWC)
- Provides a key source of information for water supply assessments and written verifications of water supply
- Supports regional long-range planning documents, including City and County General Plans
- Provides a standardized methodology for water utilities to assess their water resource needs and availability
- Provides a resource for regional involvement in the California Water Plan
- Provides for a plan during water drought situations

# 1.1 The California Water Code

The UWMP Act is administered by the California Department of Water Resources (DWR), which is responsible for compiling data for statewide and regional analysis and publishing the adopted documents online for public access. This report was prepared according to the requirements of the CWC, UWMP Act, and the 2020 UWMP Guidebook.

CWC Section 10620 (a) of the UWMP Act states, "Every urban water supplier shall prepare and adopt an urban water management plan in the manner set forth in Article 3 (commencing with Section 10640)." These plans are to be updated every five years and submitted to DWR.

Requirements for the UWMP include:

- Assessment of current and projected water supplies
- Evaluation of demand and customer types
- Evaluation of the reliability of water supplies
- Description of conservation measures implemented by the urban water supplier
- Response plan, in the event of a water shortage
- Comparison of demand and supply projections

In November 2009, the State legislation passed Senate Bill (SB) x 7-7, referred to as SBx7-7 or the Water Conservation Act of 2009. SBx7-7 set the goal of achieving a 20% reduction in urban per capita water use statewide by 2020. Retail water agencies were required to set targets and track progress toward decreasing daily per capita urban water use in their service areas, which would assist the State in meeting its 20% reduction goal by 2020.

This law requires that every UWMP include:

- Baseline per capita water use
- Urban water use target for 2020
- Compliance daily per capita water use

This 2020 UWMP has been prepared to comply with the UWMP Act and SBx7-7. In addition to meeting the requirements of the Act, this report will be used to support water supply assessments and written verifications of water supply required by SB 610 and SB 221 of 2001. These bills require that water supply information be provided to counties and cities for projects of a certain size, prior to discretionary project approval. Both bills allow an UWMP to be used as a source document to fulfill these legislative requirements. The UWMP Act has undergone significant expansion since it was originally passed, particularly since the City's previous UWMP was prepared in 2015. Prolonged droughts, groundwater overdraft, regulatory revisions, and changing climatic conditions affect the reliability of each water supplier as well as the statewide water reliability overseen by DWR, the State Water Resources Control Board, and the Legislature. Accordingly, the UWMP Act has grown to address changing conditions, and the current requirements are found in Sections 10610–10656 and 10608 of the CWC.

Since 2015, several amendments have been added to the UWMP Act. These require urban water suppliers to prepare a five-year consecutive drought supply and demand assessment and a five-year drought risk assessment to evaluate the functionality of the Water Shortage Contingency Plan (WSCP) in the event of a continuous five-year drought beginning next year.

There are also new requirements for the WSCP, and it is now required to be adopted as a separate plan from the UWMP. This 2020 UWMP was developed to incorporate these new requirements, under the guidance of DWR's 2020 UWMPs Guidebook for Urban Water Suppliers. A checklist to document compliance of this 2020 UWMP with the Act and the CWC is provided in **Appendix A**.

This 2020 UWMP includes all required DWR standardized tables for **Chapters 1 to 10** compiled in **Appendix B** and all required SBx7-7 tables in **Appendix C**. A selection of these tables is also provided in the body of this Plan, as necessary to present supporting data.

## 1.2 UWMP Organization

This 2020 UWMP is organized into the following chapters.

- **Chapter 1 - Introduction and Overview:** This chapter provides a discussion of the purpose and content of the 2020 UWMP and the extent of the City's water management planning efforts.
- **Chapter 2 - Plan Preparation:** This chapter provides information on the City's development of the 2020 UWMP, including the basis for plan preparation, planning type, data format, and coordination and outreach to nearby agencies.
- **Chapter 3 - System Description:** This chapter provides a description of the City's water system, including service area maps, climate information, service population and demographic information, and an overview of the City's organizational structure and history.
- **Chapter 4 - Customer Water Use:** This chapter describes the City's historic, current, and projected water uses, system losses, water savings, and water use by lower income households.
- **Chapter 5 - Conservation Target Compliance:** This chapter includes a description of the City's chosen method for calculating baseline per capita water use, the City's calculated baseline, 2015 interim and 2020 per capita demand targets, and compliance with the 2020 target.
- **Chapter 6 - System Supplies:** This chapter includes a discussion of the City's water system supplies, including groundwater, surface water, wastewater, and recycled water, the City's future water projects, and a summary of existing and future water sources.
- **Chapter 7 - Water Supply Reliability Assessment:** This chapter describes the reliability of the City's water supply through a 20-year planning horizon, including a supply and demand assessment and regional reliability evaluation. Supply reliability is presented for a normal, single dry year and five consecutive dry years.
- **Chapter 8 - Water Shortage Contingency Planning:** This chapter provides a description of the City's WSCP, including stages of action, prohibitions, penalties, reduction methods, and catastrophic supply interruption.
- **Chapter 9 - Demand Management Measures:** This chapter explains the City's existing and historic efforts to promote water conservation and the City's plans to use Demand Management Measures to achieve its 2025 water use targets.
- **Chapter 10 - Plan Adoption, Submittal, and Implementation:** This chapter details the steps taken by the City to adopt the 2020 UWMP in accordance with the CWC, make it available to the public, and implement it.

- **Appendices:** These include any additional information to support and clarify any information presented within the 2020 UWMP content.

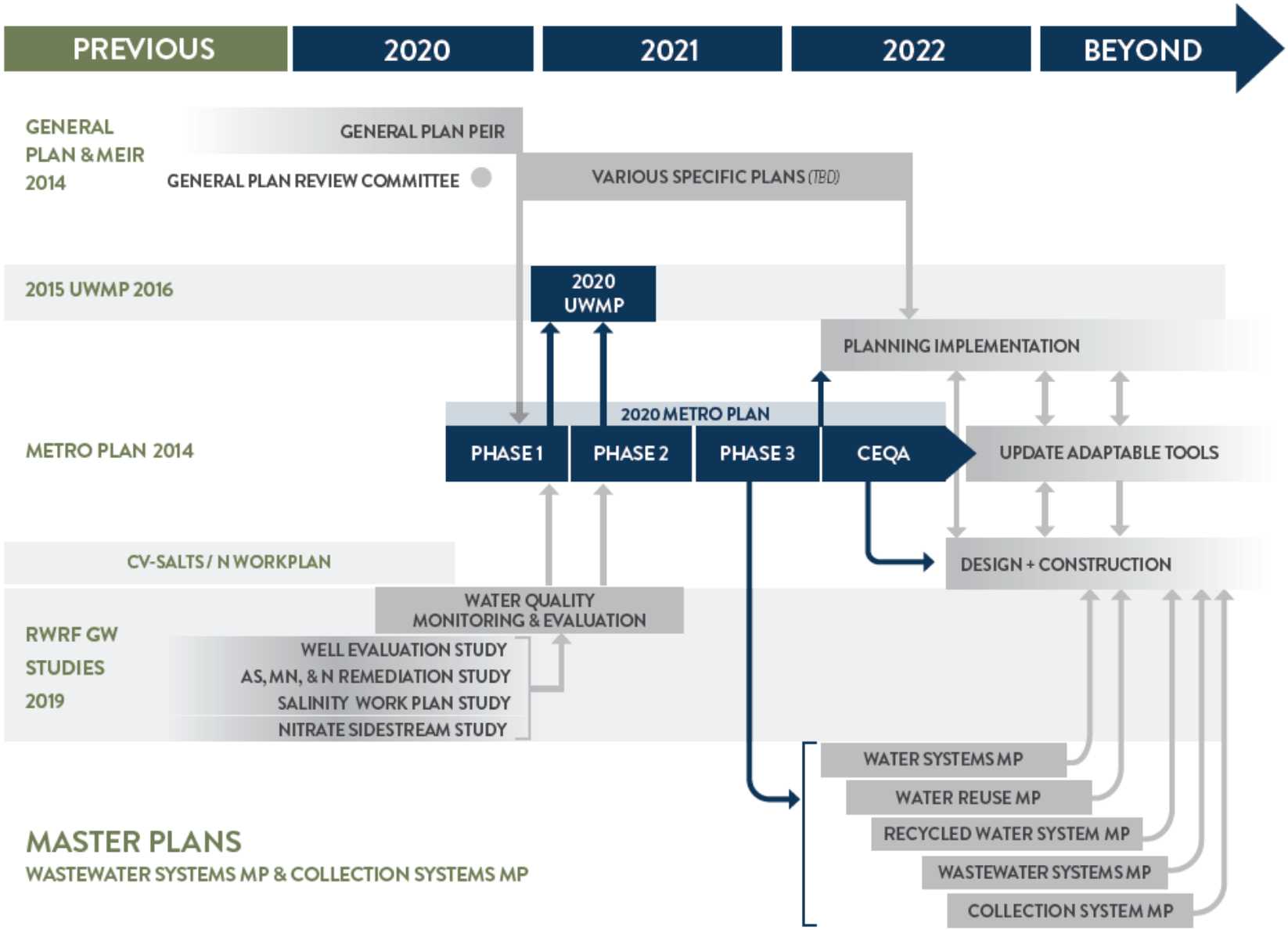
## 1.3 UWMPs in Relation to Other Efforts

The City previously prepared a 2005 UWMP, 2010 UWMP, and 2015 UWMP. This 2020 UWMP serves as an update to the 2015 UWMP and complies with new requirements and regulations. In addition to completing the 2020 UWMP, the City is presently updating its Fresno Metropolitan Water Resource Management Plan (Metro Plan). The last Metro Plan was completed in 2014, and the current Metro Plan update will prepare a fresh look at the City's water resources and consider new conditions and strategies for planning through 2070. **Figure 1-1** shows the City's ongoing and additional future water resources planning efforts.

## 1.4 Demonstration of Consistency with the Delta Plan

A new requirement for the 2020 UWMP is that agencies that anticipate participating in, or receiving water from, a proposed project utilizing Sacramento-San Joaquin Delta (Delta) Water or within the Jurisdiction of the Delta Stewardship Council (covered action) should demonstrate consistency with the Delta Plan's policy to reduce reliance on the Delta. Covered actions include, but are not limited to, projects such as multiyear water transfers, conveyance facilities, or new diversions that involve transferring water through, exporting water from, or using water in the Delta, per California Code of Regulations, Title 23, Section 5003. The City of Fresno contracts with the United States Bureau of Reclamation (USBR) Central Valley Project (CVP) Friant Division for an annual supply of 60,000 AF of Class 1 water. Although the Friant Division of the CVP does not directly divert or convey water from the Delta, the project was developed through an exchange with the Delta-Mendota supply. As restrictions on Delta exports have hindered USBR from making deliveries to the Delta-Mendota Canal, the Friant Division Class 1 allocations are reduced, and the water is transferred back to the users that would typically receive water from the Delta-Mendota Canal. As such, the City is required to demonstrate consistency with the Delta Plan's policy to reduce reliance on the Delta. **Appendix D** includes the reporting and calculations that demonstrate Fresno's reduced reliance on supply from their USBR CVP water supply.

**Figure 1-1. Previous and Ongoing Water Resources Planning Efforts**



# 2 CITY OF FRESNO
# Plan Preparation

**The City has coordinated the preparation of its 2020 UWMP with its water suppliers, the County, the City of Clovis, nearby water agencies, and community members to develop a UWMP that adheres to the requirements of the CWC and plans for a resilient water future.**

IN THIS SECTION


- Coordination and Outreach


The City of Fresno provides water service to a variety of customer sector types within the City limits, inclusive of several historic County Waterworks Districts (county islands) which have been incorporated into the City's water system.

The City has approximately 139,500 service connections and produced just under 122,000 AF of potable water in 2020. The City meets the threshold identified in the CWC to be classified as an urban water supplier and in the California Health and Safety Code as a public water system. The City provides water directly to its customers and does not wholesale water to any other agencies for potable uses (defined as sales greater than 3,000 acre-feet per year). Therefore, the City is required to prepare and update a Retail UWMP every five years. This report was prepared on a calendar year basis.

## 2.1 Coordination and Outreach

The City has water supply contracts with USBR and Fresno Irrigation District (FID). Each of these water suppliers has been notified of the plan update and provided water supply projections for the time period covered by this plan. Additionally, the preparation of this 2020 UWMP was coordinated with other appropriate agencies to ensure regional stakeholders had the opportunity to provide input to this plan. The City has coordinated preparation of the 2020 UWMP and solicited participation and comments with the agencies indicated in **Table 2-1**. The City has also published notices in local newspaper and encouraged the active involvement of the population within the water service area to provide feedback on the UWMP and the WSCP during the public review period, as discussed in **Section 10.1**.

**Table 2-1. Agency Coordination and Outreach**

| AGENCY | NOTIFIED 60 DAYS PRIOR TO PUBLIC HEARING | NOTIFIED OF PUBLIC DRAFT 14 DAYS PRIOR TO PUBLIC HEARING |
|---|---|---|
| Bakman Water Company | ✓ | ✓ |
| City of Clovis | ✓ | ✓ |
| County of Fresno | ✓ | ✓ |
| Fresno Irrigation District | ✓ | ✓ |
| Fresno Metropolitan Flood Control District | ✓ | ✓ |
| Friant Water Authority | ✓ | ✓ |
| Garfield Water District | ✓ | ✓ |
| Malaga County Water District | ✓ | ✓ |
| Pinedale County Water District | ✓ | ✓ |
| North Kings Groundwater Sustainability Agency | ✓ | ✓ |
| US Bureau of Reclamation | ✓ | ✓ |

# 3 CITY OF FRESNO System Description

**This chapter describes the history of the City's water system, its current service area, climate, population, and demographics.**

IN THIS SECTION

- Service Area
- Land Uses
- Water System
- Population and Demographics

The original Fresno water system began operations in 1876 as a non-profit organization inaugurated by a group of public-minded citizens. Initially, the water system consisted of one pumping station composed of small pumps and two storage tanks located above the second floor of one of the early store buildings. This building was located on Fresno Street between "J" and "K" Streets, presently known as Broadway and Fulton.

By 1888, the town had grown to a small city, which demanded an improved water distribution system. This was necessary because of several large fires, including the destruction of the first permanent courthouse. In 1888, the first pumping station and water tower were constructed at Fresno and "O" Street. These facilities were designed to be an integral part of a larger and continually expanding water system. This No. 1 station was in continuous use until 1959, when it was retired having served its useful purpose. Today, this building is known as the "Water Tower" and has been declared a historic structure.

Between the years of 1887 and 1890, 4-inch and 2½-inch cast iron pipe, as well as 4-inch wrought iron water mains were laid out. Most of these original “permanent pipes” have since been replaced in the present water supply system. The owner and operator of the system in 1888 was the Fresno Water Company. In 1904, the Fresno Water Company was purchased by Balch, Kerckhoff & Wishon, and was reorganized as the Fresno City Water Company. In 1926, the facilities were purchased by the California Water Service Company. This company then sold the water system to the City of Fresno in 1931, which operated as a municipal utility. It was first managed under an appointed water board, but currently is a division of the Department of Public Utilities.

Historically, the City’s supply of water consisted of direct pumping from wells drilled into the underground aquifer. Today, groundwater remains one of the City’s primary water supply sources, including 202 active and 56 inactive groundwater wells. The production capacity from the active wells is approximately 403 million gallons per day (mgd) and the total production capacity is 487 mgd, including inactive wells. The wells are located around the City to provide equitable distribution throughout the City’s water system, as described below. Most wells are connected directly into the transmission grid main system (14- to 20-inch diameter pipelines) to convey water throughout the system.

In the 1960s, the City secured a surface water contract made available from the United States Bureau of Reclamation (USBR). The City contracted with USBR for 60,000 acre-feet of water per year from the Friant Division (Millerton Lake) and developed a system to recharge the groundwater basin by “intentional recharge,” percolating the imported surface water supplies in constructed recharge basins. The City’s USBR supplies are conveyed to the City via FID canals. In 1976, the City signed a contract with FID for delivery of surface water supplies from the Kings River based on the City’s pro rata share of FID’s water entitlements. The Kings River water is used for groundwater recharge and treated for potable use.

In 2004, the City also began treating surface water supplies for direct potable use at its first surface water treatment facility located in northeast Fresno (NESWTF). For the period of 2005–2014, this 30 mgd-rated facility provided 10–15% of the City’s potable water supplies. From 2016–2020, this facility produced 15% of the City’s potable water supply, an increase largely attributed to transmission system improvements, which permitted conveying water further into the City’s distribution system, and the City’s lower overall system demands. Also, in 2015, the City commenced operations of its new T-3 Water Storage and modular Surface Water Treatment Facility (T-3 SWTF) in southeast Fresno. In January 2013, the City completed the installation of meters on all single-family residences.

In 2018, the City completed construction of its new 54 mgd surface water treatment facility in southeast Fresno (SESWTF) and large diameter water mains that serve nearly one-half of the City. Production from this facility may ultimately be 80 mgd with the City demonstrating to the Division of Drinking Water (DDW) that the facility is capable of safely running at higher filter loading rates. With the SESWTF operational, along with the NESWTF and T-3 SWTF, the City provided greater than 50% of its potable supply through using surface water for the first time in 2019 and 2020. The City expects to provide half or more of its potable demand using its surface water supply sources going forward.

# 3.1 Service Area

The City of Fresno presently covers approximately 115 square miles (sq mi) (73,500 acres) consisting largely of single-family residential, commercial, public, and industrial development. It also includes several areas not within the City limits (e.g., County islands), as shown in **Figure 3-1**. With the exception of the Bakman Water Company (Bakman), Pinedale County Water District (Pinedale), Park Van Ness Mutual Water Company (Park Van Ness), California State University Fresno (CSUF), and private groundwater users located within County islands, the City currently serves water to the entire area encompassed by its City limits and will eventually serve out to the Sphere of Influence (SOI) boundary. The SOI is coincident with the City of Fresno General Plan Land Use and Circulation Map, which was adopted in the 2014 General Plan and therefore, includes all lands planned to be annexed by the City at the projected 2056 buildout of the General Plan (City of Fresno Development and Resource Management Department, 2014).

## 3.1.1 Land Uses within Service Area

According to the General Plan and the City's Planning and Development Department, the City's planning area covers approximately 106,000 acres (165.6 sq mi) comprised of approximately 73,500 acres (115 sq mi) of incorporated land and 32,500 acres (50.8 sq mi) of unincorporated land based on the City's current shapefiles. The total 106,000-acre planning area includes approximately 84,300 acres of developed or planned to be developed land, approximately 18,500 acres of roads, highways, and railroads with no corresponding water demand, and about 2,500 acres outside of the SOI north of the City's most northwesterly portion referred to as the North Area and shown on **Figure 3-1**.

Of the 106,000 acres within the City's planning area, the City's water service area covers 70,400 acres (110 sq mi) of land within the SOI, which includes most of the 73,500 acres of incorporated area and the unincorporated County Islands not within the City limits. As shown in **Table 3-1**, approximately 59,100 acres of the 70,400 acres within the water service area are developed and served water by the City. The remainder consists of vacant land that will be served by the City when it is developed. Residential units make up the largest portion of water demand served by the City, consisting of over 40% of the total served area and almost 90% of the total service connections.

The remaining areas within the City's SOI are served by other systems or are unserved by a water system, consisting of open space and agricultural land, land used by roads, highways, and railroads, as well as the North Area.

**Table 3-1. Current Service Area Characteristics**

| LAND USE TYPE | AREA (ACRES) | % OF TOTAL AREA | SERVICE CONNECTIONS | % OF TOTAL CONNECTIONS |
|---|---|---|---|---|
| Single-Family Residential | 27,700 | 39.3% | 118,775 | 85.1% |
| Multifamily Residential | 3,700 | 5.3% | 6,087 | 4.4% |
| Commercial | 4,500 | 6.4% | 11,982 | 8.6% |
| Public | 5,600 | 8.0% | 2,504 | 1.8% |
| Industrial | 4,500 | 6.4% | 175 | 0.1% |
| Open Space/ Landscape Irrigation | 13,100 | 18.6% | Note 1 | |
| **Total** | **59,100** | | **139,523[2]** | **100%** |
| Vacant / Partially Vacant[3] | 11,300 | 15.9% | N/A | |
| **Total** | **70,400** | **100%** | | |

Source: Acreage from City of Fresno Geographic Information System Shapefile of Land Uses provided 8/12/20. Number of connections provided by the City for 2020.

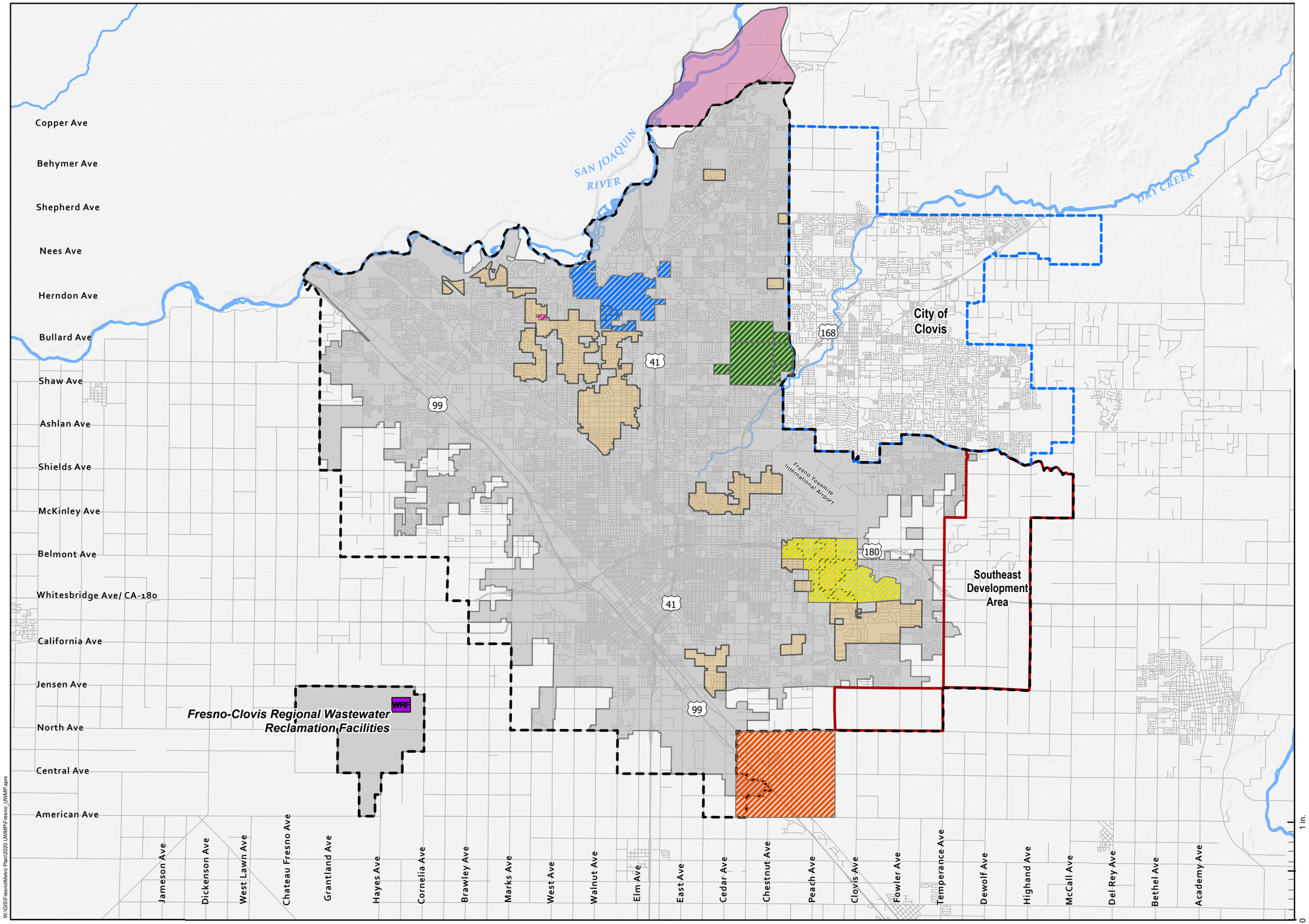
Notes:

1. Dedicated irrigation meters are included in commercial and public meter total.
2. Approximately 3,633 dedicated fire service connections are included in the total services connections, most of which are included in the commercial and public meter total.
3. For partially vacant land, half of the area is included in the zoned land use type and the other half is assumed vacant.

## 3.1.2 Water System

The City's water system consists of about 1,860 miles of distribution and transmission mains, 202 active municipal groundwater wells, three surface water treatment facilities (SWTFs) with current rated capacities ranging from 4 to 54 mgd, five water storage facilities with pump stations, including one at each of the SWTFs plus two in the distribution system, and three booster pump facilities.

The City's service area spans an approximate 120 feet of elevation difference, declining from northeast to southwest. To help regulate pressure throughout the water distribution system, the City utilizes five pressure zones, as shown on **Figure 3-2**: Highway 41, Shepherd, Sierra, Southwest, and Booster Pump 4 (BP04). The pressure zones are separated by a series of closed or partially closed valves between each zone to prevent or impede flow from one zone to the next, referred to as gate systems. There are four gate systems — Shepherd, Sierra, Southwest, and BP04 — separating the five pressures zones. The Highway 41 Pressure Zone was previously split into two pressure zones divided by a series of 26 gate valves closely following the alignment along Highway 41. However, these zones were combined into a single zone in 2015 by fully opening the Highway 41 gate valves, and as a result are not shown on **Figure 3-2**.




## Legend

- Fresno Sphere of Influence
- Clovis Sphere of Influence
- Fresno City Limits
- County Islands
- North Area
- Southeast Development Area
- WRF Wastewater Reclamation Facility
- Streets

*Areas Served Water by Others*

- Bakman Water District
- Malaga Water District
- Park Van Ness Mutual Water District
- Pinedale County Water District
- CA State University, Fresno

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**Prepared by:** WSC

N

1:140,000

0 0.75 1.5 3 Mi

0 3,750 7,500 15,000 US Feet

**References:**

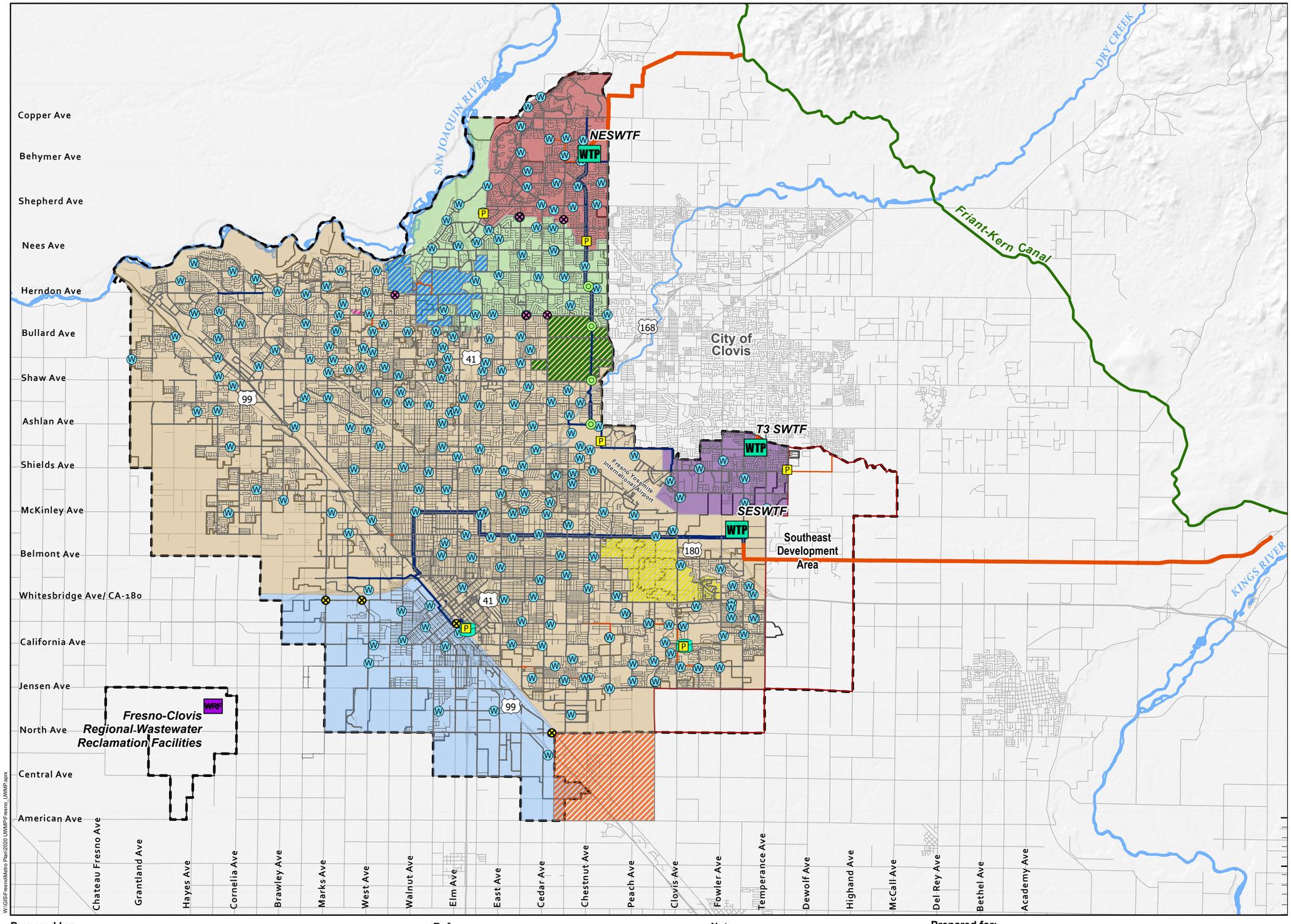
1. Coordinate System: NAD 1983 StatePlane California IV FIPS 0404 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

**Notes:**

**Prepared for:** City of Fresno Department of Public Utilities

**City of Fresno**
**2020 Urban Water Management Plan**

**Figure 3-1. City Service Area**




## Legend

*City Facilities*

- WTP — Water Treatment Plant
- P — Booster Pump Station
- Storage Facility
- W — Active Well
- Existing Turnout
- WRF — Wastewater Reclamation Facility

*Gate System Valves*

- Pressure Relief Valve
- Pressure Sustaining Valve

*Water Mains by Diameter (inch)*

- <10
- 10 - 16
- 16 - 30
- 30 - 72

*Raw Water Mains by Diameter (inch)*

- <10
- 10 - 16
- 16 - 30
- 30 - 72
- Friant-Kern Canal

*Areas Served Water by Others*

- Bakman Water District
- Malaga Water District
- Park Van Ness Mutual Water District
- Pinedale County Water District
- CA State University, Fresno

*Pressure Zones*

- Highway 41
- Booster Station 4
- Shepherd
- Sierra
- Southwest

*City Features*

- Southeast Development Area
- Fresno Sphere of Influence
- Fresno City Limits
- Streets

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**Prepared by:** WSC

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0 3,500 7,000 14,000 US Feet

**References:**

1. Coordinate System: NAD 1983 StatePlane California IV FIPS 0404 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

**Notes:**

**Prepared for:** City of Fresno Department of Public Utilities

**City of Fresno**
**2020 Urban Water Management Plan**

**Figure 3-2. Water System**

## 3.2 Service Area Climate

The City's service area is in California's San Joaquin Valley in Fresno County along Highway 99. The climate of the area is best described as Mediterranean, characterized by hot dry summers and cool winters. Precipitation in the area averages around 11 inches per year, as shown in **Table 3-2**. However, rainfall can significantly vary year to year, with over 18 inches received in 2011 and less than 4 inches received in 2014. The recent drought was marked by four consecutive years (2012 to 2015) of less than 10 inches of rainfall. As shown by the average evapotranspiration ($ET_o$) and temperature values in **Table 3-2**, the City's water use in the summer months is significantly higher than in the winter, reflecting increased water use for irrigation purposes during the hot, dry summers.

**Table 3-2. Average Climate Characteristics**

| MONTH | $ET_o$ (INCHES) | RAINFALL (INCHES) | TEMP-HIGH (°F) | TEMP-LOW (°F) |
|---|---|---|---|---|
| Jan | 1.17 | 2.33 | 56.9 | 37.4 |
| Feb | 1.98 | 1.8 | 62.6 | 39.8 |
| Mar | 3.73 | 1.99 | 68.4 | 43.6 |
| Apr | 5.43 | 0.99 | 73.7 | 46.9 |
| May | 7.33 | 0.54 | 81.3 | 53.2 |
| Jun | 8.41 | 0.19 | 89.6 | 59.1 |
| Jul | 8.8 | 0.02 | 95.7 | 63.8 |
| Aug | 7.82 | 0.01 | 94.6 | 62.5 |
| Sep | 5.69 | 0.07 | 89.6 | 57.9 |
| Oct | 3.68 | 0.59 | 79.3 | 49.3 |
| Nov | 1.85 | 0.98 | 66.2 | 40.6 |
| Dec | 1.10 | 1.83 | 56.5 | 36.1 |
| **Total/ Average** | **56.99** | **11.34** | **76.2** | **49.2** |

Source: CIMIS Website: http://www.cimis.water.ca.gov, Station 80 Fresno State (1988 to 2020) Monthly Average Report, October 2020 (downloaded November 30, 2020)

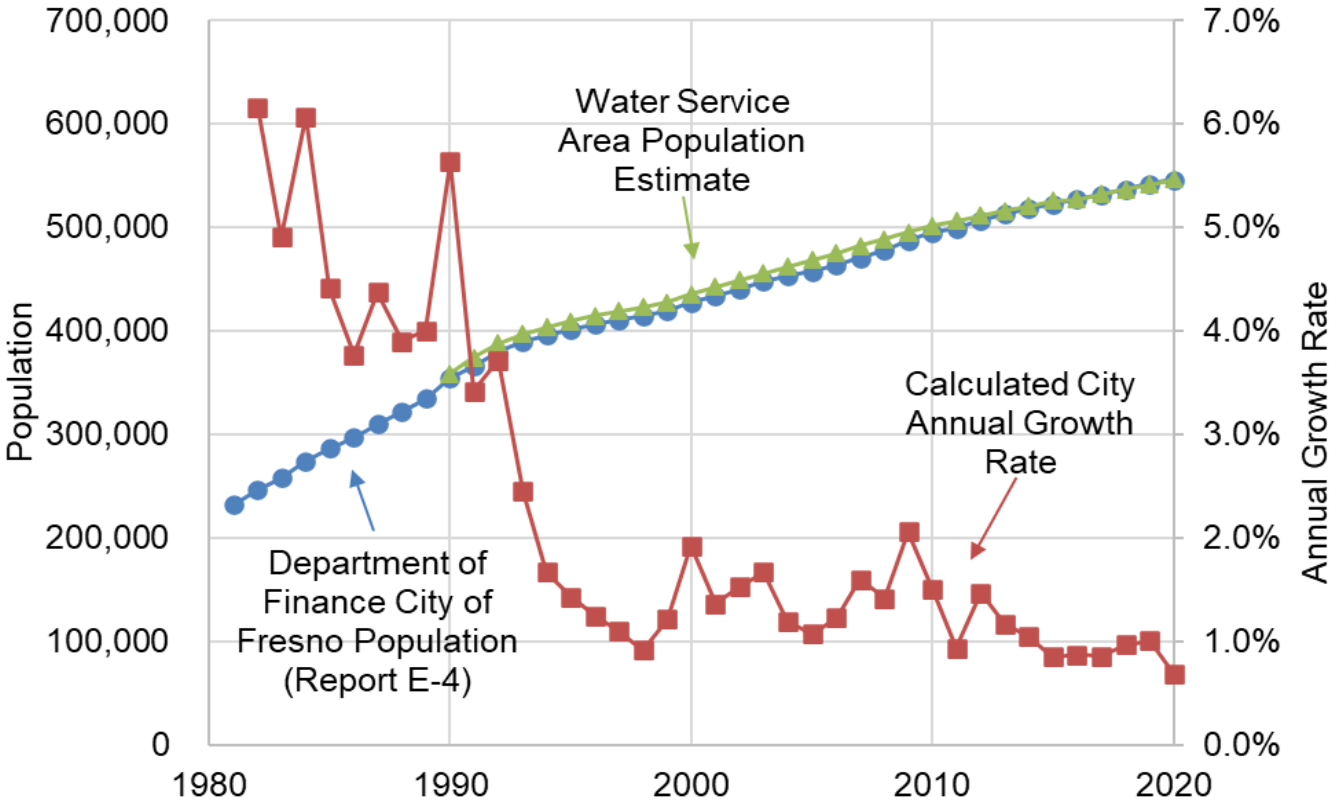
## 3.3 Service Area Population and Demographics

The City experienced rapid growth since it was founded by the Central Pacific Railroad in 1872 up through the mid-1990s, when the City's annual growth rate was typically greater than 2%. From 1995 to 2015, the annual growth rate has decreased to an average of 1.3%, and since 2015, the rate has not surpassed 1.0%.

The population served by the City Water Division is slightly higher than the City's population after adding unincorporated areas served by the City and removing areas within the City limits served by private water companies, special districts, or private wells. The City acquired County service areas and facilities in 1989, which increased the service area population to slightly greater than the City population since 1990.

**Figure 3-3** compares the historic City population to the water service area population since 1990. Water service area population estimates prior to 1990 were unavailable for comparison to the City's population. The City Water Division's methodology for calculating the population of the City's water service area involves summing all the Census tract data for the City's overall service area and subtracting out tracts not served by the City. These tracts included areas served by Pinedale, Bakman, and CSUF, as well as areas outside the City service area, unserved areas within County areas, unserved areas within City areas, and areas with only partial service (i.e., straddling City service areas). Based on the City's methodology, the water service area population was estimated to be 546,502 in 2020, compared to 545,769 for the total City population in January 2020 (California Department of Finance, 2020). For comparison, in the 2015 UWMP, the City Water Division population served was 525,575 compared to the total City population of 522,369 (California Department of Finance, 2020). The City's water service area population in 2020 using the DWR Population Tool is 550,217 and is similar to the population estimate using the City's methodology.

**Figure 3-3. City of Fresno and Water Service Area Historic Population**




The City's General Plan is the City's primary growth planning document from which the baseline water service area population projection for this UWMP was developed. The General Plan includes population estimates for the City planning area, which includes all areas within City limits and unincorporated areas outside of City limits within the City's SOI, based on projections developed by the Fresno Council of Governments and estimates a buildout population of 921,057 in 2056. In 2017 the Fresno Council of Governments developed population projections in 5-year increments through 2050 for all cities within Fresno County (Applied Development Economics, Inc. and Mintier Harnish Associates, 2017). The Fresno Council of Governments' 2017 report projects the City's population will grow at an annual growth rate ranging from 0.92–1.44%, with an average annual growth rate between 2020 and 2056 (buildout) of 1.03% per year. These population projections and growth rate have been incorporated in the City's General Plan population projections.

According to the City's Planning and Development Department, the City's water service area population is anticipated to continue to grow along with the City, with some slightly higher growth years anticipated within the next 10 years due to multiple large developments planned for completion in the near term. For planning purposes, this UWMP assumes the City will slowly incorporate areas served by others within the City's SOI by buildout in year 2056. As such, the long-term water service area population annual growth rate is expected to be 1.44% between 2020 and 2056 to account for absorbing these areas into the City's water system.

The baseline population projection starts with the 2020 water service area population determined using the DWR Population Tool and grows based on areas expected to be developed by 2030,

as provided by the City's Planning Department, and then linearly beyond 2030 to meet the buildout population in 2056. The City's 2020 population estimate includes the entire City planning area, including areas not served water by the City and areas currently outside the City limits but within the SOI, and is higher than the current water service area population. The water service area population projection assumes the City will incorporate all areas currently served by others and grow to provide water service to all areas within the SOI by buildout. Because the water service area has more growth potential than the City planning area, the annual average growth rate as calculated ranges from 1.1–2.1% between 2020 and 2056, with an average annual growth rate of approximately 1.56% between 2020 and 2045 that continues to slow through the buildout. **Table 3-3** shows the water service area population projections through 2045 in five-year increments.

**Table 3-3. Current and Projected Population (DWR 3-1R)**

| POPULATION SERVED | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| **TOTAL** | **550,217** | **609,433** | **674,677** | **719,327** | **765,278** | **812,529** |

## 3.3.1 Other Social, Economic, and Demographic Factors

Most recently, the City is experiencing significant impacts due to the global pandemic caused by COVID-19 (SARS-CoV-2) virus. In March 2020, the State issued a stay-at-home order that forced many businesses to close and other businesses to require residents to continue work only from their home to slow the spread of the virus. Additionally, the forced closure of several businesses caused a historic increase in unemployment across the US and a resulting economic recession. While all the impacts of COVID-19 are not entirely known at this time, it has caused a shift in water use by customer class. In 2020, residential demands increased by over 8% from 2019 demand, while commercial and industrial water use decreased by over 5%. This shift is expected to be temporary with an anticipated return to previous levels once all stay at home orders are lifted and businesses can reopen. However, the economic recession could have longer term impacts to the region.

CITY OF FRESNO

# 4 Water Use Characterization

**This chapter describes and quantifies 2020 water use and projected water use through 2045 within the City's service area.**

Water consumption in the City is characterized by the typical demand sectors of residential, commercial, institutional, industrial, and irrigational. The difference between production and consumption is losses, which may be attributed to system leaks, meter inaccuracies, fire flows, theft, unmetered use, or other factors.

IN THIS SECTION

- Distribution System Water Losses
- Past and Current Water Use
- Projected Water Use

# 4.1 Non-Potable Versus Potable Water Use

The City serves its customers potable water for residential, commercial, institutional, industrial, and landscape irrigational demands through its potable water distribution system.

The City also diverts raw surface water obtained from the United States Bureau of Reclamation (USBR) and Fresno Irrigation District (FID) to recharge basins throughout the service area. The City coordinates with FID for the delivery of the recharge water, utilizing FID's existing system of channels and pipelines to convey the raw water, and with Fresno Metropolitan Flood Control District (FMFCD) to deliver water to FMFCD's stormwater retention and recharge basins or its own recharge basins. The raw surface water recharges the groundwater basin to sustain the groundwater supply for the City. The groundwater recharge volume can vary based on surface water supply availability and is represented as an addition to annual groundwater supplies as discussed in **Chapter 6**. In addition, the City serves a limited number of customers secondary treated or tertiary treated and disinfected recycled water for agricultural irrigation or landscape irrigation, respectively. The recycled water demands are discussed in **Section 6.4**.

# 4.2 Past, Current, and Projected Water Use by Sector

The following sections document the past and current water use for each sector, and the projected water use through 2045.

## 4.2.1 Water Use Sectors

Records of historical water consumption serve as the basis for developing water demands by water use sector. Water consumption is the volume of water measured at each metered service.

The City tracks water consumption across different water use sectors listed in the California Water Code (CWC), including:

- Single-Family Residential
- Multifamily Residential
- Commercial and Institutional / Governmental
- Industrial
- Landscape
- Distribution System Losses

In addition to the water uses listed in the CWC, the City participates in exchanges and transfers, provides temporary travel meters for temporary water use, and diverts non-potable surface supplies for groundwater recharge, described below. The City does not provide water for sales to other agencies, saline water intrusion barriers, or agricultural use.

### 4.2.1.1 Exchanges

Since 1976, the City has had a water exchange agreement with FID for delivery of the City's percolated wastewater effluent — considered equivalent to tertiary treatment — to FID canals. This is not counted as a water use in this chapter and is discussed as a water supply in **Section 6.6.1.2**.

#### 4.2.1.2 Other

A small, quantified water demand has been classified as “other” to account for temporary travel or construction meters for water used for dust control. This use type typically accounts for less than one percent of total water use.

### 4.2.2 Distribution System Water Losses

Real losses, as defined in the American Water Works Association (AWWA) Water Audit tool are:

“Physical water losses from the pressurized system (water mains and customer service connections) and the utility’s storage tanks, up to the point of customer consumption. In metered systems, this is the customer meter; in unmetered situations, this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks, and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks, and overflows.”

The past five years of distribution system losses are listed in **Table 4-1**, and the results of the 2016-2019 AWWA Water Audit Tool are provided in **Appendix E**. The AWWA Audit Worksheet was not completed for 2020 prior to the submittal of this plan, and the volume of water loss is estimated as the difference between water produced and metered water consumed for each calendar year period.

The overall consumption of water in the system is placed into four different categories:

- Billed Metered Usage
- Billed Unmetered Usage
- Unbilled Metered Usage
- Unbilled Unmetered Usage

The water losses for the system were found by determining the difference between the overall amount of water supplied to the community and the apparent system losses. The City’s system losses have many different possible causes such as hydrant flushing/testing, construction, firefighting, system leaks, water main breaks, and meter error. The estimated loss in 2020 is 9,568 acre-feet (AF), which is the difference between metered production and metered consumption and is approximately 8% of the overall system production. Based on the previous four years of audits, the City has not had to apply meter adjustments in the AWWA Water Audit Tool, and the water losses report is the difference between water produced and metered water consumed each year. It is anticipated that the estimated 2020 water loss volume in **Table 4-1** will be the water losses reported on the 2020 AWWA Audit when it is certified.

Currently, the City does not have a water loss standard but intends to evaluate programs to reduce water losses in their Metro Plan that is currently being updated. The City is also tracking forthcoming water use standards, which will include a water loss standard that is planned to be adopted by the Water Board within the next few years.

**Table 4-1. DWR 4-4R 12 Month Water Loss Audit Reporting**

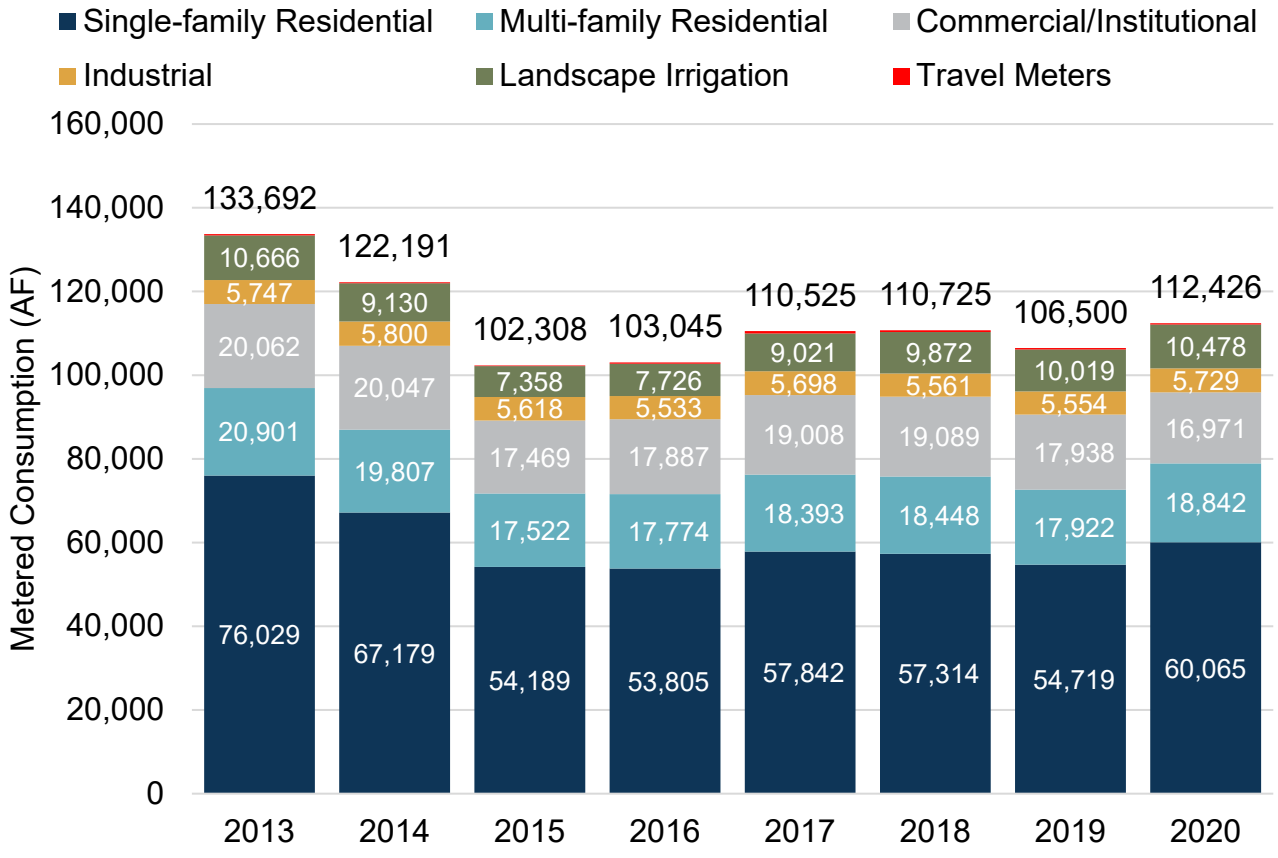
| REPORT PERIOD START DATE | | VOLUME OF WATER LOSS, AFY | PERCENT LOSS OF PRODUCTION |
|---|---|---|---|
| MM | YYYY | | |
| 1 | 2016 | 9,036 | 8.0% |
| 1 | 2017 | 10,235 | 8.5% |
| 1 | 2018 | 9,028 | 7.5% |
| 1 | 2019 | 9,059 | 7.8% |
| 1 | 2020 | 9,568 | 7.8% |

For 2016 through 2019, volume of water loss is taken from the AWWA Water Audit Tool. For 2020, the volume of water loss is the difference in metered production and metered consumption.

## 4.2.3 Past and Current Water Use

Since 2013, all water services in the City's water service area have been metered. Prior to 2013, the City estimated single-family residential water use, since these services were not equipped with meters, by subtracting all other metered uses (commercial, institutional, industrial, and irrigational), plus 10% assumed losses, from production data. Water consumption for the City's water service area by customer type for 2013–2020 is shown on **Figure 4-1**.

**Figure 4-1. Historical Consumption by Customer Type (2013–2020)**



As shown in the figure, single-family residential water use has decreased more than 20,000 AFY since the Single-Family Metering Program was completed in 2013. Multifamily residential, commercial, and institutional services have historically been metered, and consumption has also decreased since 2013, with industrial users and landscape irrigation consumption at similar levels to 2013 consumption, even as new customers are connected to the City's water system. Landscape irrigation demands did decrease in 2015 and 2016, likely due to the drought restrictions, and continue to recover after the drought ended in 2017.

**Table 4-2** provides the breakdown of actual water use by sector type in calendar year 2020. As shown in **Table 4-2**, single-family residential water use is the largest use type in the City and accounted for almost 50% of potable water use in 2020. Multifamily residential use was the second largest, accounting for approximately 15% of water sales in 2020. Together, residential water use accounts for about 65% of all potable water uses in the City's service area. The remaining potable water uses consist of mainly commercial and institutional water use, which are tracked together and included only on the commercial use row on **Table 4-2**, followed by landscape irrigation and industrial usage. Distribution losses accounted for approximately 8% of potable water used in 2020 (per **Section 4.2.2**).

**Table 4-2. Actual Demands for Water: Potable (DWR 4-1R)**

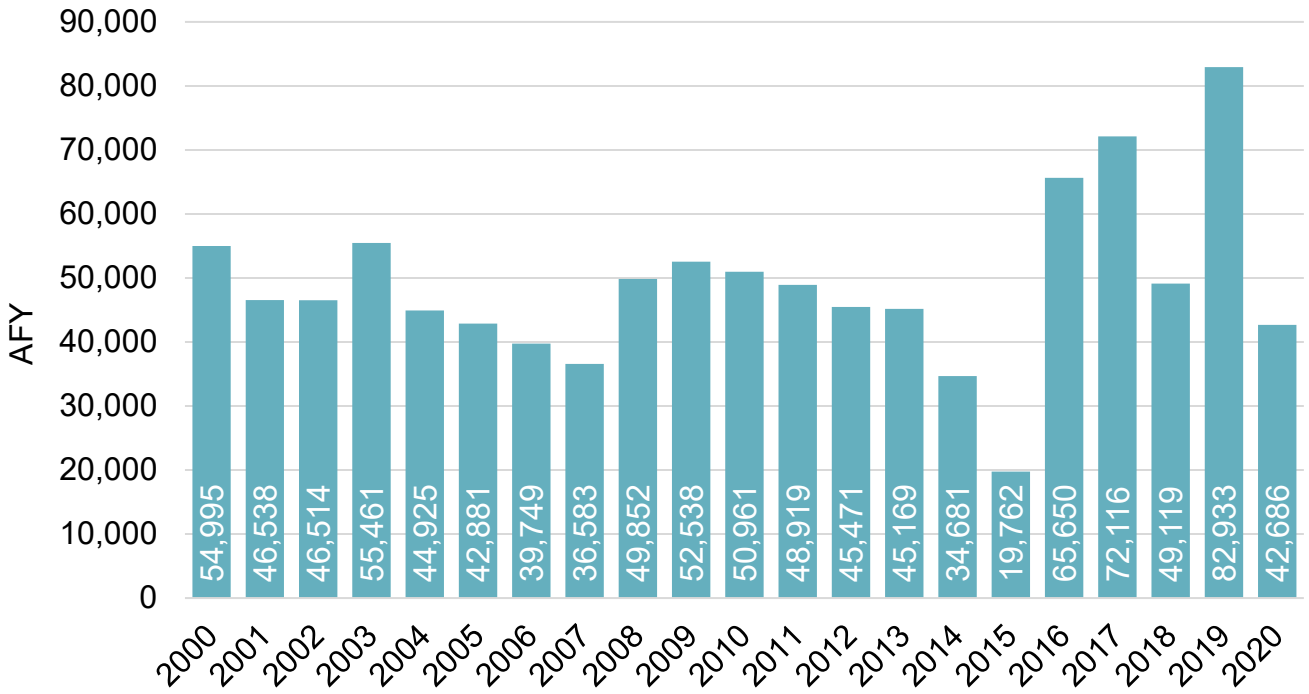
| USE TYPE | ADDITIONAL DESCRIPTION | LEVEL OF TREATMENT WHEN DELIVERED | 2020 VOLUME | PERCENT OF TOTAL |
|---|---|---|---|---|
| Single Family | | Drinking Water | 60,065 | 49.2% |
| Multi-Family | | Drinking Water | 18,842 | 15.4% |
| Commercial | | Drinking Water | 16,971 | 13.9% |
| Industrial | | Drinking Water | 5,729 | 4.7% |
| Institutional/ Governmental | See Note 1 | Drinking Water | --- | --- |
| Landscape | | Drinking Water | 10,478 | 8.6% |
| Other | Travel Meters | Drinking Water | 340 | 0.3% |
| Losses | | Drinking Water | 9,568 | 7.8% |
| **Total:** | | | **121,993** | **100%** |

Note:

1. Institutional and Governmental water usage is included in the Commercial use type.

**Figure 4-2** shows the historic volume of the City's raw surface water used for groundwater recharge since 2000. Over the last 20 years (2000–2020), the average annual intentional recharge of surface water was 49,240 AFY. Total recharge has ranged from a high of 82,900 AF in 2019 and a low of 19,700 AF in 2015. Also, total recharge volumes in 2016, 2017, and 2019 were three of the highest volumes in the last 20 years. The increases were due to over 30% increase in recharge at City basins from the addition of several basins (Nielsen, Fancher) and proactive maintenance of basins to maximize percolation capacity. The annual variability between years is caused by several factors, including basin availability, water delivery season, pond maintenance, or length of wet seasons.

**Figure 4-2. Historic Recharge of City Surface Water**




## 4.2.4 Projected Water Use

### 4.2.4.1 Land Use Projections

The potable demand projections through 2045 for normal water use follow the methodology for land use-based projections described in Appendix K of the 2020 Urban Water Management Plan (UWMP) Guidebook. Under this methodology, existing land use and demand is accounted separately from future land use and demand. This allows different demand factors to be applied to current land use areas and future land use areas. Future land use areas represent future customers and developments that are expected to be more water efficient than existing land uses and buildings due to the California Plumbing Code (CPC) and use of higher efficiency appliances and landscapes.

The existing and future land use acreage was sourced from the City's Geographic Information System (GIS) database and the City's General Plan. The existing land use shapefile and associated acreage for each land use classification were used to represent 2020 land use data. Areas not served by the City were excluded from the existing land use shapefile. The future land use shapefile corresponds with the planned land use at buildout as described in the City's General Plan representing the year 2056. Although the City does not have any plans to serve areas currently served by others within the City limits, all areas within the City Sphere of Influence (SOI) were assumed to be served by the City by buildout for conservative planning purposes. **Table 4-3** lists the land use acreage by land use category for the 2020 and buildout 2056 water service areas.

The land use acreage between 2020 and 2056 was estimated in 5-year increments based on areas planned to be developed by 2030 from the City's Planning Department, and by linearly interpolating the remainder of the change in acreage for each land use category between 2030 and 2056. **Figure 4-3** shows the existing and projected land use by customer class used to develop the projections.

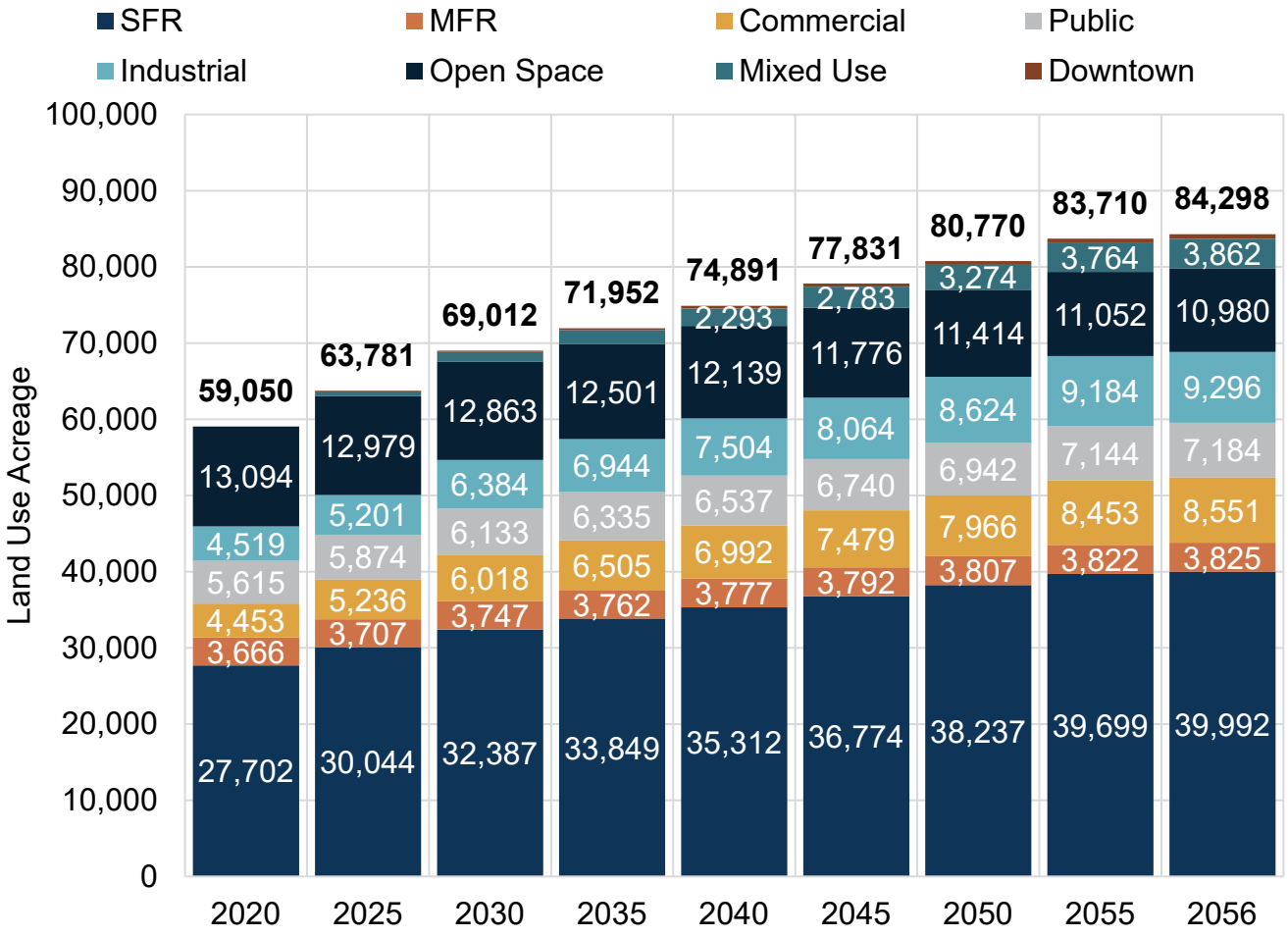
**Table 4-3. Existing and Future Water Service Area Acreage**

| LAND USE CATEGORY | 2020 WATER SERVICE AREA[1, 3, 4] | | 2056 WATER SERVICE AREA[2] | |
|---|---|---|---|---|
| | ACRES | PERCENT | ACRES | PERCENT |
| Single-Family Residential | 27,700 | 47% | 40,000 | 47% |
| Multifamily Residential | 3,700 | 6% | 3,800 | 5% |
| Commercial | 4,500 | 8% | 8,600 | 10% |
| Public Facility | 5,600 | 9% | 7,200 | 9% |
| Industrial | 4,500 | 8% | 9,300 | 11% |
| Open Space/ Landscape Irrigation | 13,100 | 22% | 11,000 | 13% |
| Mixed Use[3] | 0 | 0% | 3,900 | 5% |
| Downtown[3] | 0 | 0% | 600 | 1% |
| **TOTAL** | **59,100** | **100%** | **84,300** | **100%** |

Notes:

1. Acreage from City of Fresno GIS Shapefile of Land Uses provided 8/12/20 and reduced to the City's water service area (excludes Pinedale, Bakman, and California State University Fresno and unserved areas outside the City limit and SOI).
2. Future Land Use Shapefile provided by the City on 8/12/20 and aligns with the General Plan for buildout in year 2056. The buildout service area acreage listed excludes the Fresno-Clovis Regional Wastewater Reclamation Facility, land used for road, highways, and railroads, and the north area outside of the SOI.
3. Mixed use and downtown land use categories are not in the existing land use shapefile. They are described in the General Plan as new designations for redevelopment of existing areas that contain a mix of land uses.
4. Approximately 11,300 acres of non-water demanding vacant/partially vacant land is excluded from the 2020 water service area acreage.

**Figure 4-3. Existing and Projected Land Use**




Note: Acreage for Mixed-use and Downtown land use types are not shown every year for clarity, but are included in the total acreage value.

### 4.2.4.2 Demand Factors and Future Savings

Land use-based water demand factors were developed using 2018 metered consumption data matched to 72 categories of land use data. These demand factors were applied to the 2020 land use acreage by category to develop the demand projection beginning in 2020. Demand factors for land uses that grow over time and represent new developments were assigned a lower demand factor than the demand factors for existing development. Additionally, demand factors were assumed to slowly reduce over time due to passive conservation, which includes the replacement of older water fixtures and appliances with more efficient types now required as part of the CPC. The passive conservation savings are projected to be greater for existing customers than future customers because future customers are already assumed to have a lower water demand factor and meet the plumbing code.

Future savings due to passive conservation were developed using the Alliance for Water Efficiency (AWE) Water Conservation Tracking Tool. The Tracking Tool is an Excel tool that can

incorporate water service area-specific data to estimate natural replacement rates of fixtures and future savings based on the CPC.

**Table 4-4** lists the passive conservation savings assumption incorporated in the potable demand projections. Existing unit demand factors are reduced by the percentages listed to develop the future development unit demand factors. As shown in the table, this assumes future residential and non-residential dwelling units are 10% and 5% more water efficient, respectively, than existing dwelling units due to changes in the plumbing code and ever-increasing new water efficient technology. **Table 4-5** compares the total potable demand projections without the estimated savings due to passive conservation from 2025–2045.

**Table 4-4. Passive Conservation Savings Assumptions**

| LAND USE TYPE | FUTURE DEVELOPMENT UNIT DEMAND FACTOR REDUCTION[1] | EXISTING DEVELOPMENT ANNUAL PASSIVE CONSERVATION SAVINGS[2] | FUTURE DEVELOPMENT ANNUAL PASSIVE CONSERVATION SAVINGS[3] |
|---|---|---|---|
| Residential/Mixed Use | 10% | 0.20% per year | 0.04% per year |
| Commercial/Downtown | 5% | 0.05% per year | 0.01% per year |
| Public | 5% | 0.05% per year | 0.01% per year |
| Industrial | 5% | 0.05% per year | 0.01% per year |
| Open Space/ Landscape Irrigation | 0% | 0% per year | 0% per year |

Notes:

1. Existing (2020) unit demand factors are reduced by the percentages listed to develop the future development unit demand factors.
2. Existing development annual passive conservation savings were developed using the AWE Water Conservation Tracking Tool.
3. Future development passive conservation savings are assumed to be one-fifth the rate of existing development passive conservation savings.

**Table 4-5. Projected Future Savings for Potable Demands, AF**

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| Total Potable Demand with no conservation | 137,521 | 149,361 | 157,204 | 165,047 | 173,160 |
| Estimated Passive Conservation | 1,017 | 2,005 | 2,994 | 3,973 | 5,213 |
| **TOTAL POTABLE DEMAND WITH PASSIVE CONSERVATION** | **136,504** | **147,356** | **154,210** | **161,074** | **167,947** |

### 4.2.4.3 Demand Projections

**Table 4-6** provides the projected demands by use type based on the methodology described above. **Table 4-7** includes the projected raw surface water used for groundwater recharge through the planning period for normal years. The City intends to recharge an average of 60,000 AFY beyond 2020, corresponding with the average recharge volume from 2016 through 2020, and gradually increase recharge by about 540 AFY each year. In 2025, the normal year groundwater recharge is projected to be 62,700 AFY and will continue to increase to 73,500 AFY by 2045. The actual volume recharged is based on the available surface water supplies each year, as well as available basin capacity and other factors, and may be lower in dry years or higher in wet years.

**Table 4-6. Projected Demands for Water: Potable (DWR 4-2R)**

| USE TYPE | ADDITIONAL DESCRIPTION | PROJECTED WATER USE | | | | |
|---|---|---|---|---|---|---|
| | | 2025 | 2030 | 2035 | 2040 | 2045 |
| Single Family | | 76,255 | 80,429 | 82,934 | 85,437 | 87,936 |
| Multi-Family | | 19,000 | 20,654 | 21,737 | 22,831 | 23,935 |
| Commercial | | 19,052 | 21,135 | 22,587 | 24,041 | 25,496 |
| Industrial | | 7,410 | 9,003 | 9,922 | 10,841 | 11,758 |
| Institutional/ Governmental | See Note 1 | | | | | |
| Landscape | | 4,490 | 5,035 | 5,422 | 5,809 | 6,196 |
| Other | Travel Meters | 200 | 200 | 200 | 200 | 200 |
| Losses | | 10,097 | 10,900 | 11,408 | 11,917 | 12,426 |
| **TOTAL:** | | **136,504** | **147,356** | **154,210** | **161,076** | **167,947** |

Note 1: Institutional and Governmental water usage is included in the Commercial use type.

**Table 4-7. Projected Demands for Water: Non-Potable (DWR 4-2R)**

| USE TYPE | ADDITIONAL DESCRIPTION | PROJECTED WATER USE | | | | |
|---|---|---|---|---|---|---|
| | | 2025 | 2030 | 2035 | 2040 | 2045 |
| Groundwater Recharge | Raw-Water | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| **TOTAL:** | | **62,700** | **65,400** | **68,100** | **70,800** | **73,500** |

#### 4.2.4.4 Future Conservation

In 2018, following the unprecedented drought, California Legislature established a framework centered on "Making Water Conservation a California Way of Life." The goal was to help the State better prepare for droughts and climate change by establishing statewide water efficiency standards and incentivizing recycled water (California Department of Water Resources, State Water Resources Control Board, November 2018). The resulting legislation of Senate Bill 606 and Assembly Bill 1668, along with future regulations, will have impacts on water providers over the coming years, requiring indoor, outdoor, and commercial, industrial, and institutional water use goals, water loss standards, annual water budgets, and documented preparation for long-term water shortages. All the water use goals together will form a total urban water use objective specific for each water agency. The Department of Water Resources (DWR) has provided recommended standards for indoor residential water use, and other urban water use goals are currently being developed and are expected to be released in late 2021. The State Water Resources Control Board is anticipated to adopt the element that includes the total water use objective in 2022, and agencies will begin reporting their water use in accordance with their urban water use objective beginning in 2024, with compliance anticipated by 2027. Because most of the water use goals are unknown, and none has been adopted by the State, the City's total urban water use objective is unknown and was not incorporated into the demand projections herein. However, the City is tracking the water use efficiency standards and goals and is aware it may need to implement additional conservation above what is presented in these projections to meet its total urban water use objective as mandated by the State in the future. The City is considering these higher conservation demand projections within a demand envelope in the current Metro Plan update.

### 4.2.5 Characteristic Five-Year Water Use

A new component of the UWMP is to prepare a five-year drought risk assessment (DRA) to evaluate water service reliability for a drought lasting five years from 2021–2025. The five-year DRA assumes potable water demand is unconstrained, and the City will continue to meet all projected potable demands. The raw water demand varies based on the availability of surface water supplies for groundwater recharge. The recycled water supply is not impacted by the drought, and recycled water demands are at normal year projections for the five-year drought. Projected water demands for years 2021–2025 for the DRA are included in **Section 7.2**.

## 4.3 Water Use for Lower Income Households

The Fresno Council of Governments (COG) prepared an update to the Regional Housing Needs Allocation (RHNA) to cover the period of January 1, 2015–December 31, 2023. The City subsequently developed its own Housing Element based on the COG RHNA for the planning period of December 31, 2015–December 31, 2023. The City's current Housing Element was adopted on April 13, 2017.

The City's Housing Element specifies the City will develop 8,955 new housing units through 2023 for extremely low, very low, and low income levels (City of Fresno Development and Resource Management Department, 2017). The City's Planning and Development Department prepares Housing Element Annual Progress Reports to report the progress of the RHNA and housing goals. The City of Fresno 2019 Housing Element Annual Progress Report details that 909 lower income units are approved or permitted (City of Fresno Planning and Development Department,

2020). The remaining number of lower income units needed over the RHNA 2013–2023 period, when subtracting the approved and permitted units, is 8,046.

**Table 4-8** includes the Housing Element identified available single-family and multifamily acres to be developed and dwelling units for Extremely Low, Very Low, Low, Moderate, and Above Moderate income levels (City of Fresno Development and Resource Management Department, 2017). This data was used to determine the number of acres of both single-family and multifamily land use that needs to be developed by 2023 to meet the remaining 8,046 lower income units target for RHNA. The identified acres needed for low-income development by 2023 was applied to the average water demand factor for single-family and multifamily land uses to project the lower income water demands through 2023 to meet RHNA, shown in **Table 4-8**.

**Table 4-8. Lower Income Dwelling Units and Acres to be Developed through 2023 and Estimated Water Demand**

| FRESNO HOUSING ELEMENT | SINGLE-FAMILY RESIDENTIAL | MULTIFAMILY RESIDENTIAL | TOTAL |
|---|---|---|---|
| Acres Available for Low-Income Development | 3,163.6 | 1,310.9 | 4,474.5 |
| Total Dwelling Units | 13,457 | 21,526 | 34,983 |
| Dwelling Unit per Acre | 4.25 | 16.42 | |
| Dwelling Unit Needed to Meet RHNA | 3,095 | 4,951 | 8,046 |
| Acres to be developed to Meet RHNA | 727.6 | 301.5 | 1,029.1 |
| Average Water Demand Factor (AF/ Acre) | 2.54 | 5.13 | |
| Low-Income Demand to meet RHNA from years 2020 – 2023 (AF) | 1,847 | 1,545 | 3,392 |
| **Annual Low-Income Demand to meet RHNA (AFY)** | **462** | **386** | **848** |

Based on the estimated low-income water demand to meet the RHNA requirements by 2023, the annual projected low-income households demand is 462 AFY for single-family residential and 386 AFY for multifamily residential. For the purposes of this plan, the current RHNA projected low-income growth and water demands was applied through the UWMP planning period of 2045 and is presented in **Table 4-9**. However, lower income demands beyond 2023 will be based on the next Housing Element and RHNA Update expected in 2023 and may change in the future. All housing units and associated population are included in the adopted General Plan, and the demands for these units that occur within the water service area boundaries are included in the future water demands presented in this plan.

**Table 4-9. Lower Income Household Projected Water Demands**

| LOW INCOME DEMAND | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| Single-Family Residential Demand | 2,308 | 2,308 | 2,308 | 2,308 | 2,308 |
| Multifamily Residential Demand | 1,932 | 1,932 | 1,932 | 1,932 | 1,932 |
| **TOTAL (AF)** | **4,240** | **4,240** | **4,240** | **4,240** | **4,240** |

## 4.4 Climate Change Considerations

Climate change impacts were considered in the North Kings Groundwater Sustainability Plan (NKGSP) based on DWR's Guidance for Climate Change Data Use during Groundwater Sustainability Plan (Department of Water Resources, 2018) and the related Sustainable Groundwater Management Act climate change website.[1] As documented in the NKGSP, the DWR climate change datasets were developed for the California Water Commission's Water Storage Investment Program (WSIP), are consistent with other DWR programs, are based on the best available science, build on previous efforts, incorporate the latest advances in projections, and follow the Climate Change Technical Advisory Group guidance (Provost & Pritchard, November 2019).

Changing precipitation and evapotranspiration (ETo) rates are expected to have the greatest impact on future demands, especially for outdoor water use. The WSIP climate change data sets estimate minimal changes to precipitation due to climate change from the historic period. The same datasets predict the ETo rate estimates with climate change will increase 3% by 2030 and up to 8% by 2070. More specifically, the ETo rate is predicted to increase the most in typically low ETo months (winter) and when irrigation is limited. The ETo rate is also predicted to be only slightly higher than historic in warmer months during the irrigation season. While higher ETo rates would increase irrigation demands, they are not anticipated to substantially impact the City's urban water use. The climate change impacts to supply sources are discussed in the supply chapter of **Section 6.8.2.1**.

[1] https://data.cnra.ca.gov/dataset/sgma-climate-change-resources

CITY OF FRESNO

# 5 SBX7-7 Baseline, Targets and 2020 Compliance

**Senate Bill x 7-7 (SBx7-7) was signed into law in 2009 and requires the State to achieve a 20% reduction in per capita water use by December 31, 2020, with an interim target of 10% reduction by December 31, 2015.**

IN THIS SECTION

- Baselines & Targets
- 2020 Compliance

The legislation requires each urban water supplier to develop and include in its Urban Water Management Plans (UWMPs) estimates of: 1) *baseline* daily per capita water use; 2) daily per capita water use *target*; 3) daily per capita water use *interim target*; and 4) *compliance* daily per capita water use. The UWMP must also include the basis for determining the estimates, with references to supporting data.

The Department of Water Resources (DWR) developed the Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use Guidebook (GPCD Methodologies Guidebook) to provide appropriate methodologies and criteria guidance (California Department of Water Resources, Feb 2016).

The baseline and 2020 per capita water use targets were calculated in the 2015 UWMP and are provided in **Appendix C**. There have not been significant changes in the City's service area since 2015, thus the calculations included in the 2015 Plan are still valid for compliance in this 2020 UWMP.

# 5.1 General Requirements for Baseline and Target

Methodologies consistent with those described in the GPCD Methodologies Guidebook were used to develop baselines and targets. The selected procedure used to develop the required SBx7-7 estimates includes the following basic steps:

1. Calculate baseline water use, which is the average gross daily water use per capita, reported in gallons per capita per day (GPCD), based on gross water use and service area population for a continuous 10-year period ending no earlier than December 31, 2004.
2. Calculate urban water use target using one of the four methods described below.
3. Check and confirm the urban water use target using the five-year running average.
4. Calculate the interim urban water use target (equal to the average of the baseline and confirmed urban water use target).
5. Calculate the compliance daily per capita water use (equal to the gross daily water use per capita during the final year of the reporting period).

DWR allows the urban water supplier to choose one of four different methods to calculate the urban water use target in Step 2 above.

- **Method 1** involves calculating the target based on 80% of baseline daily per capita water use and the interim target based on 90% of the baseline daily per capita water use.
- **Method 2** involves calculating the per capita daily water use by using the sum of performance standards applied to indoor residential use, landscaped area water use, and commercial, industrial, and institutional uses.
- **Method 3** calculates the water use target as 95% of the applicable state hydrologic region target as stated in the draft 20x2020 Water Conservation Plan.
- **Method 4** is an approach developed by DWR that uses a spreadsheet to calculate estimated water savings factors to estimate targets.

The City selected Method 1 for determining its 2015 Interim and 2020 Final urban water use targets during the preparation of its 2010 UWMP. This selection was made after reviewing the four alternative methods available. Rather than duplicating the evaluation for this plan update, the reader is directed to Appendix I of the City's 2010 UWMP for details, as the previous City adopted evaluation is still applicable and results in the same target method selection.

# 5.2 Service Area Population

The City's 2020 service area population was estimated using the DWR Population Tool consistent with DWR Methodology 3 (Service Area Population) and the 2015 UWMP. Shapefiles of the City's water service area were loaded into the DWR Population Tool along with available residential service connection numbers to develop service area populations for the corresponding census years. The DWR Population Tool, provided in **Appendix F**, estimated the City's water service area population is 550,217. The DWR Population Tool provides a population based on the 2000 and 2010 census data and, published effective as of April 1 of the census year, the water service area during each census year and the number of water service connections. For the 2020 population, the number of services from December 31, 2020, was used, and the 550,217 population is estimated as of the end of 2020.

## 5.3 Gross Water Use

The City's gross water use is comprised of surface water contracted for delivery of allocated supplies from USBR and FID and groundwater produced by its municipal wells. The basis of gross water use are the meters installed at the City's North Fresno Wastewater Reclamation Facility, Southeast Surface Water Treatment Facility, and T-3 Water Storage and modular Surface Water Treatment Facility, and each of its municipal groundwater wells, which are equipped with flow meters. DWR Methodology 1 (gross water use) provides the opportunity to make adjustments and deductions in the reported gross water use for factors such as: meter errors, changes in distribution storage, indirect recycled water use, agricultural water use, and process water use. The City's gross water use has not been adjusted for any of these factors. Therefore, the total water use shown in **Table 4-2** is the City's gross water use.

## 5.4 Baselines and Target Summary

The City's 2015 UWMP reviewed and updated the 10-year and five-year Baseline Daily Per Capita Water Use and 2020 Target, included in **Table 5-1**. The continuous time period used in the 2015 UWMP for the 10-year baseline period is 1999–2008 and has an associated average daily per capita water use of 309 GPCD. The continuous time period that was used in the 2015 UWMP for the five-year target confirmation baseline period was 2003–2007, which has an associated average daily per capita water use of 304 GPCD. The confirmed 2020 target was established as a 20% reduction from the 10-year baseline per capita use and is 247 GPCD. Refer to **Chapter 5** of the City's 2015 UWMP for more information on how the baselines and targets were developed.

**Table 5-1. Per Capita Water Use Baseline and 2020 Target**

| BASELINE PERIOD | TIME PERIOD | AVERAGE BASELINE GPCD (GPCD) | CONFIRMED 2020 TARGET (GPCD) |
|---|---|---|---|
| 10 Year | 1999 – 2008 | 309 | 247 |
| 5 Year | 2003 – 2007 | 304 | |

## 5.5 2020 Compliance Daily Per-Capita Water Use (GPCD)

This section presents the procedure used to meet the requirements of SBx7-7 as defined in the Water Conservation Act of 2009 as incorporated into Division 6 of the California Water Code, commencing with Section 10608 of Part 2.55.

### 5.5.1 Meeting the 2020 Target

The determination of 2020 target compliance is based on gross water use for the 2020 calendar year, which was 121,993 acre-feet (see **Table 4-2**), and a service area population of 550,217 as of December 31, 2020 (see **Table 3-1**). The resultant actual per capita water use for the City in 2020 was 198 GPCD. As such, the City has met and exceeded the 2020 target of 247 GPCD.

The overall water usage patterns of the City have been greatly reduced due to its conservation measures and metering of all services. Prior to January 2013, nearly all of the City's single-family residential water customers had been billed on a monthly flat rate structure; they were unaware of the water they actually used and had no real incentive to conserve water. As of January 2013, the City has completed its residential water meter program, which installed approximately

113,000 water meters for single-family homes. With the completion of this program, all the City's water service connections are now metered, and the City and its customers can work more closely together to optimize water use. Since completion of the project, residential water demands have dramatically decreased. Attainment of the 2020 target has been influenced by the City's investments in metering and the proactive conservation education and outreach to customers. These factors have played a significant role in the City's ability to meet and surpass the 2020 target. In the future, the City will need to remain diligent in monitoring water use and continuing incentive programs to further reduce water consumption. These efforts are necessary so when the current strict reduction requirements are lifted, all water users remain diligent in avoiding unnecessary use of water and upgrade fixtures to eliminate water wasting.

## 5.5.2 2020 Adjustments to 2020 Gross Water Use

No extraordinary events or economic adjustments have taken place that would cause any adverse effects with regards to overall water usage. As was previously mentioned, the City did not make any adjustments to the 2020 gross water use as is permissible with Water Code 10608.24 cited above.

CITY OF FRESNO

# 6 Water Supply Characterization

**This chapter identifies and quantifies, to the extent practicable, the existing and planned sources of water supplies for the City through 2045.**

The City relies on groundwater from the North Kings Subbasin; surface water from Central Valley Project (CVP), through a contract with the United States Bureau of Reclamation (USBR); Kings River water, through a contract with Fresno Irrigation District (FID); and recycled water. This chapter also provides a discussion of supply availability and reliability under normal supply conditions (normal water year), during a single dry year, and for a drought lasting five years.

IN THIS SECTION


- Groundwater
- Surface Water
- Recycled Water
- Projected Water Supply


Water production in the City has consisted of 100% groundwater prior to the commissioning of the City's first surface water treatment facility (SWTF) in 2004. Since 2004, the City has invested in expanding its surface water treatment capabilities and now has three SWTFs that provide approximately half of all potable water demands in the service area.

# 6.1 Groundwater

The City overlies the Kings Subbasin, which is part of the greater San Joaquin Valley Groundwater Basin. The City is one of many water purveyors that use groundwater from the Kings Subbasin. The City has a network of over 270 municipal wells and currently operates approximately 202 municipal supply wells within the Kings Subbasin. Until late 2004, the City relied solely on groundwater to meet the water demands. The City's desire is to continue to use groundwater within a larger conjunctive use program that maximizes its existing water rights and surface water supply sources.

## 6.1.1 Basin Description

The Department of Water Resources (DWR) has partitioned the State into 10 major hydrologic regions (also referred to as "basins") and then further divided each basin into subbasins. The City is located in the Kings Subbasin (DWR Groundwater Subbasin Number 5-22.08) and lies within the larger San Joaquin Valley Groundwater Basin in the Central Valley of California. The Kings Subbasin covers approximately 1,530 square miles (sq mi).

### 6.1.1.1 Basin Location

The San Joaquin Valley Groundwater Basin is bounded to the north by the Sacramento-San Joaquin Delta and Sacramento Valley, to the east by the Sierra Nevada Mountains, to the south by the San Emigdio and Tehachapi Mountains, and to the west by the Coast Ranges. The Kings Subbasin, located within the southern half of the San Joaquin Valley Groundwater Basin, is bounded to the north by the San Joaquin River, to the east by the alluvium-granite rock interface of the Sierra Nevada foothills, to the south by the southern fork of the Kings River, and to the west by the Delta-Mendota and Westside Subbasins (California Department of Water Resources, January 2006). The Kings Subbasin is split into seven Groundwater Sustainability Agency (GSA) management areas, with Fresno located in the North Kings GSA. **Figure 6-1** illustrates the location of the City within the Kings Subbasin.

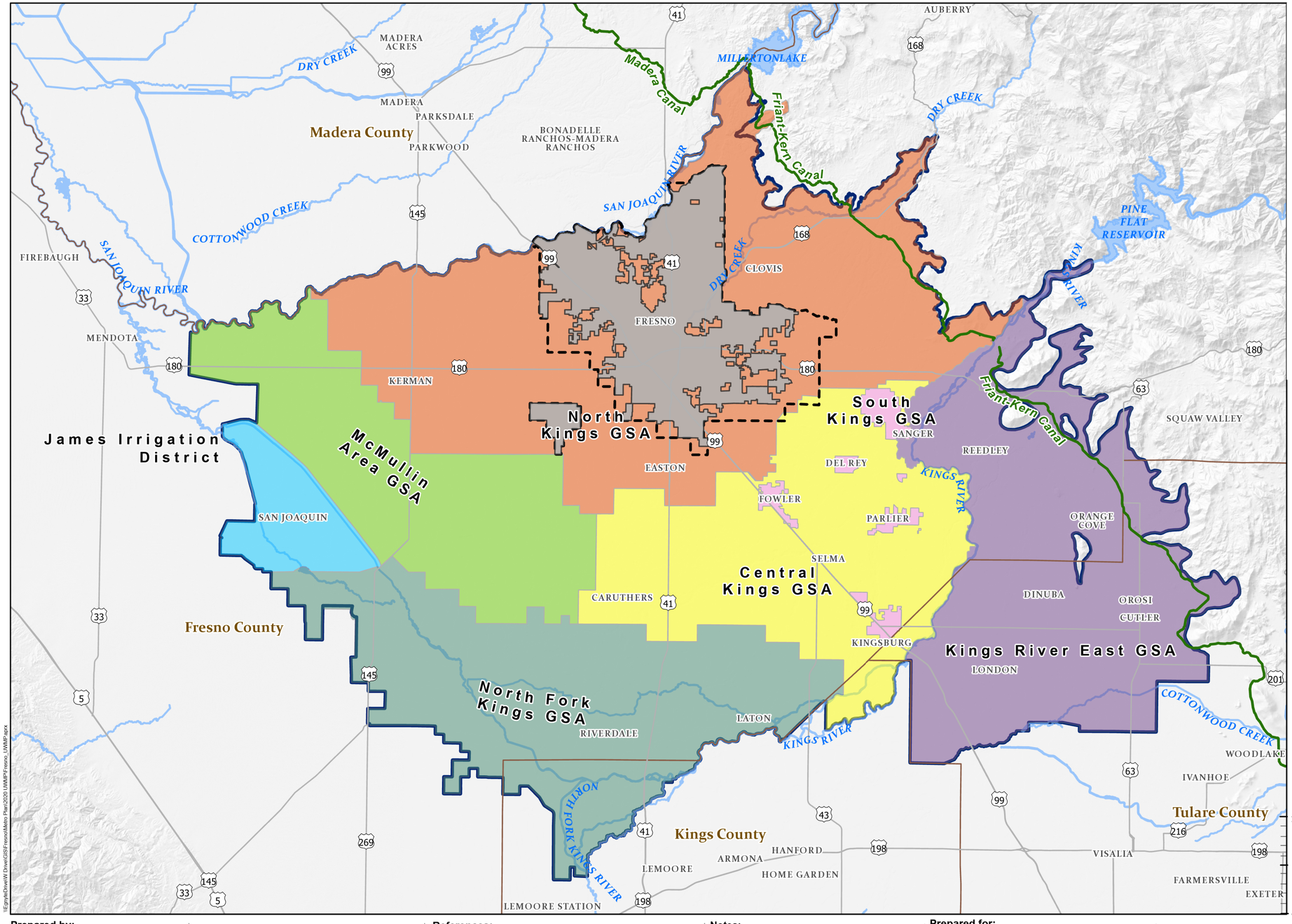
### 6.1.1.2 Area Geology

The upper several hundred feet of geology within the Kings Subbasin generally consists of highly permeable, coarse-grained deposits, which are termed older alluvium. **Figure 6-2** presents an idealized hydrogeologic cross-section that illustrates the general depth of various lithologic features within the Kings Subbasin, near the City.

Coarse-grained stream channel deposits, associated with deposits by the ancestral San Joaquin and Kings Rivers, underlie much of northwest Fresno (Layer 3 and 4 in **Figure 6-2**). There is a laterally extensive clay layer, at an average depth of approximately 250 feet below the ground surface, beneath most of the south and southeastern portions of the City.

Below the older alluvium, to depths ranging about 600–1,200 feet below ground surface, the finer-grained sediments of the tertiary-quaternary continental deposits are typically encountered (Layer 5 in **Figure 6-2**). Substantial groundwater has been produced and utilized from these depths by the City. However, deeper deposits located in the southeastern and northern portions of the City have produced less groundwater.

There are also reduced deposits in the northern and eastern portions of the City, at depths generally below 700 or 800 feet, which are associated with high concentrations of iron, manganese, arsenic, hydrogen sulfide, and methane gas. Groundwater at these depths does not generally provide a significant source for municipal supply wells.

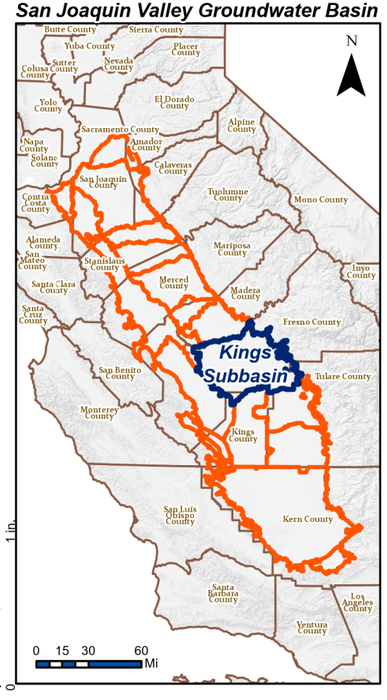



## Legend

*Groundwater Sustainability Agency*

- Central Kings GSA
- James Irrigation District
- Kings River East GSA
- McMullin Area GSA
- North Fork Kings GSA
- North Kings GSA
- South Kings GSA
- Fresno City Limits
- Fresno Sphere of Influence
- Kings Groundwater Subbasin
- Major Watercourses
- Lakes and Reservoirs
- County Boundary
- Canal

*San Joaquin Valley Groundwater Basin*

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**Prepared by:** WSC

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**References:**

1. Coordinate System: NAD 1983 StatePlane California IV FIPS 0404 Feet
Projection: Lambert Conformal Conic
Datum North American 1983

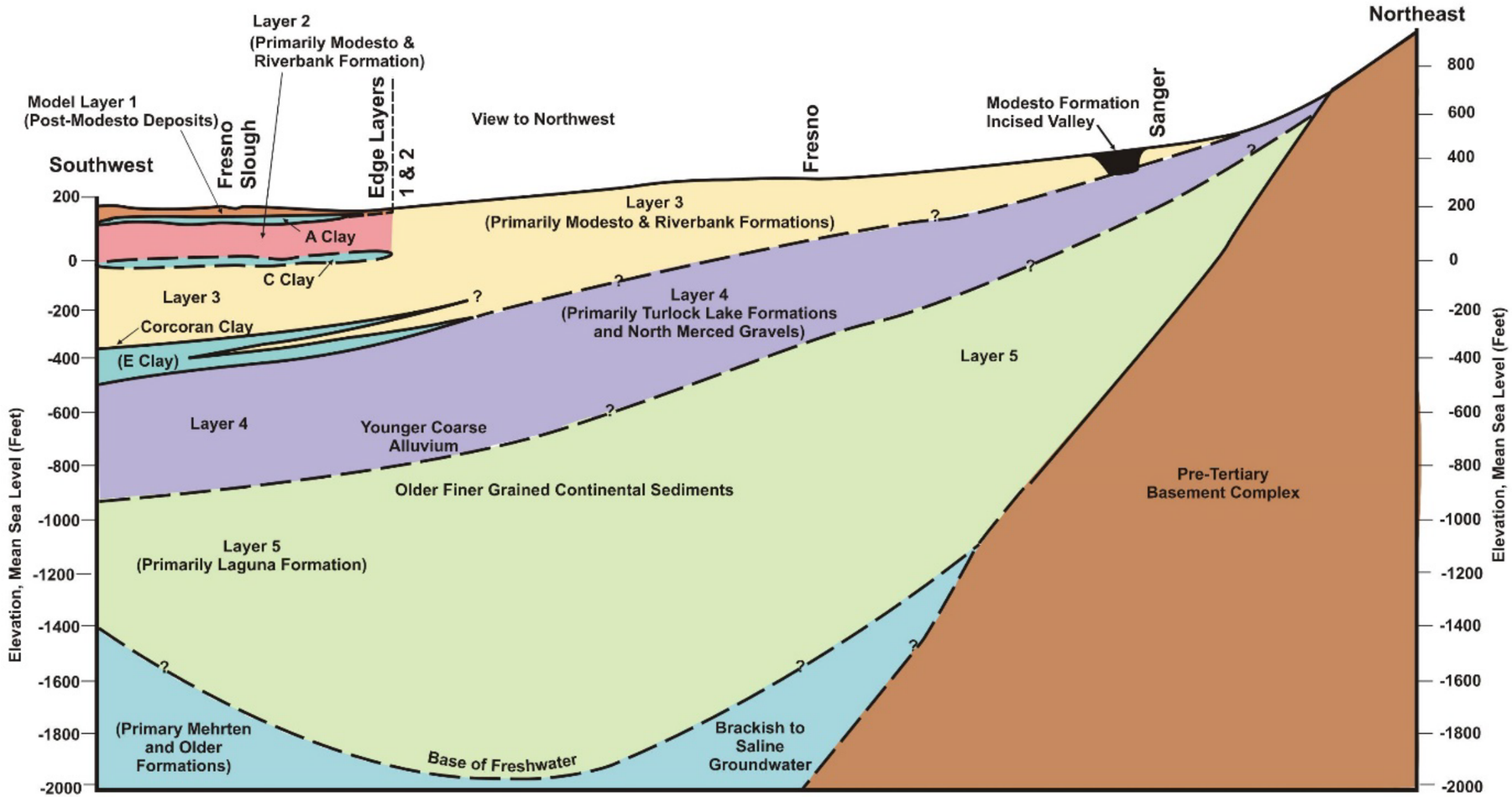
**Notes:**

**Prepared for:** City of Fresno Department of Public Utilities

**City of Fresno**
**2020 Urban Water Management Plan**

**Figure 6-1. Kings Subbasin**

**Figure 6-2. Kings Groundwater Subbasin Conceptual Hydrogeologic Cross-Section, Southwest-Northeast**




**Primary Sources**

**Croft, 1969**
**Muir, 1977**
**Lettis, 1982**
**Page and LeBlanc, 1969**
**Cehrs, et. al. 1980**
**Wiseman, et. al: 2002b**

Figure from *Kings Basin Integrated Hydrologic Modeling Hydrogeologic Investigation Technical Memorandum*, dated February 2006, prepared by Brown & Caldwell and Wrime.

#### 6.1.1.3 Aquifer Characteristics

The aquifer beneath the City was characterized using data compiled during aquifer tests performed at the City's production wells. As part of updating the detailed hydrogeologic evaluation, aquifer test data (pump tests) were reviewed to update the hydrogeologic analysis and evaluate the specific capacity data. The specific capacity indicates the ability of a particular well to produce water. **Figure 6-3** presents the estimated specific capacity of each active well from early 2020 pump test data. As shown in the figure, the northwestern and southwestern portions of the City have wells with higher specific capacities.

### 6.1.2 Groundwater Management

In 2014, a three-bill legislative package was signed into law, composed of Assembly Bill 1739, Senate Bill (SB) 1168, and SB 1319, collectively known as the Sustainable Groundwater Management Act (SGMA) of 2014, which is codified in Section 10720 et seq. of the California Water Code. This legislation created a statutory framework for groundwater management in California that can be sustained during the planning and implementation horizon without causing undesirable results. SGMA requires governments and water agencies of "critically overdrafted" basins to reach sustainability by 2040. The Kings Subbasin was designated a critically overdrafted basin in the DWR's Bulletin 118. The North Kings GSA is working within the SGMA framework to reach groundwater sustainability.

The City was a founding member of the North Kings GSA, which consists of the following public agencies and participating agencies:

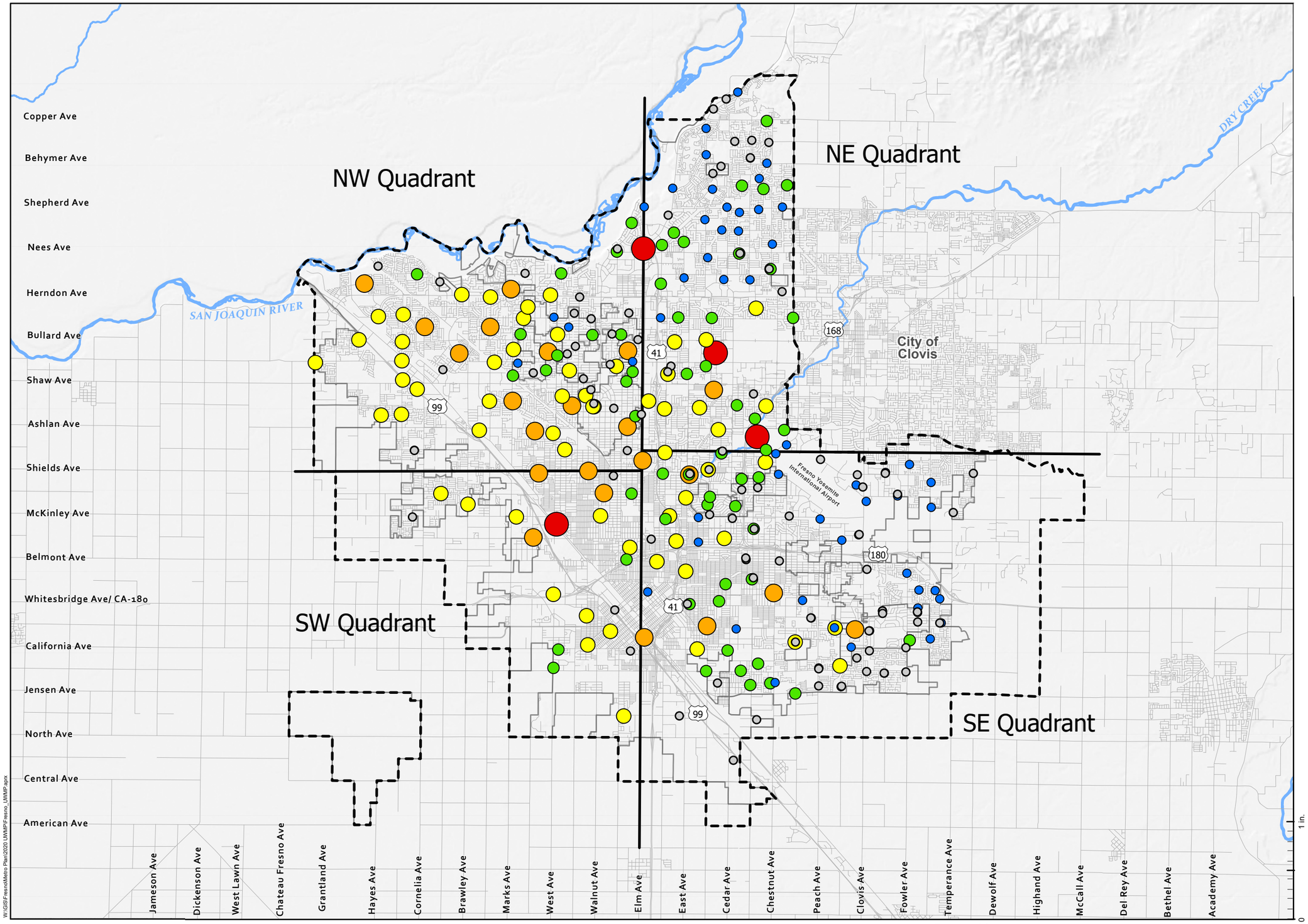
- Fresno Irrigation District (member)
- City of Fresno (member)
- City of Clovis (member)
- City of Kerman (member)
- County of Fresno (member)
- Bakman Water Company (participating agency)
- Biola Community Services District (member)
- Garfield Water District (member)
- International Water District (member)
- Fresno Metropolitan Flood Control District (participating agency)

The Kings Subbasin contains seven GSAs, including the North Kings GSA, as listed below and shown in Figure 6-1:

- Central Kings GSA
- James Irrigation District GSA
- Kings River East GSA
- McMullin Area GSA
- North Kings GSA
- North Fork Kings GSA
- South Kings GSA

The seven GSAs operate cooperatively across the basin via a coordination agreement that ensures common approaches to sustainability items such as similarity of data usage and methodologies, consistent interpretations of the basin setting, and common assumptions and development of water budgets, monitoring networks, sustainable management criteria and data management systems.

The North Kings GSA prepared and submitted its GSP in January 2020 (Provost & Pritchard, November 2019) and is awaiting DWR review by January 2022.




**Legend**

*Well Specific Capacity (gpm/ft)*

- Unknown
- < 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 450
- Groundwater Quadrant Divide
- Fresno Sphere of Influence
- Fresno City Limits
- Streets

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**Prepared by:** WSC

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0 0.75 1.5 3 Mi

0 3,500 7,000 14,000 US Feet

**References:**

1. Coordinate System: NAD 1983 StatePlane California IV FIPS 0404 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

**Notes:**

1. Well specific capacity was provided by the City and calculated using 2020 data.

**Prepared for:** City of FRESNO Department of Public Utilities

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**Figure 6-3. City Wells Specific Capacity**

As required by SGMA, the North Kings considers six sustainability indicators:

- Chronic lowering of groundwater levels indicating significant and unreasonable depletion of supply
- Significant and unreasonable reduction of groundwater storage
- Significant and unreasonable seawater intrusion
- Significant and unreasonable degraded water quality
- Significant and unreasonable land subsidence
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

Each indicator has an identified undesirable result, measurable objective, and minimum threshold. The measurable objective and minimum threshold allow the North Kings GSA to evaluate their progress for the subject indicator and determine if conditions are improving, remaining stable or degrading. The sustainability indicators of primary concern within the City are groundwater levels, groundwater storage, and groundwater quality. The methodology for the water quality indicators has been developed and the methodology is still being developed for the groundwater levels and groundwater storage indicators. A copy of the GSP is provided in **Appendix G** of this UWMP[1].

## 6.1.3 Overdraft Conditions

SGMA directs DWR to identify groundwater basins and subbasins in conditions of critical overdraft. As defined by SGMA, "A basin is subject to critical overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts." As mentioned, DWR classifies the Kings Basin as being in a state of critical overdraft in its Bulletin 118, and the future of the groundwater basin has been projected to see continued overdraft conditions.

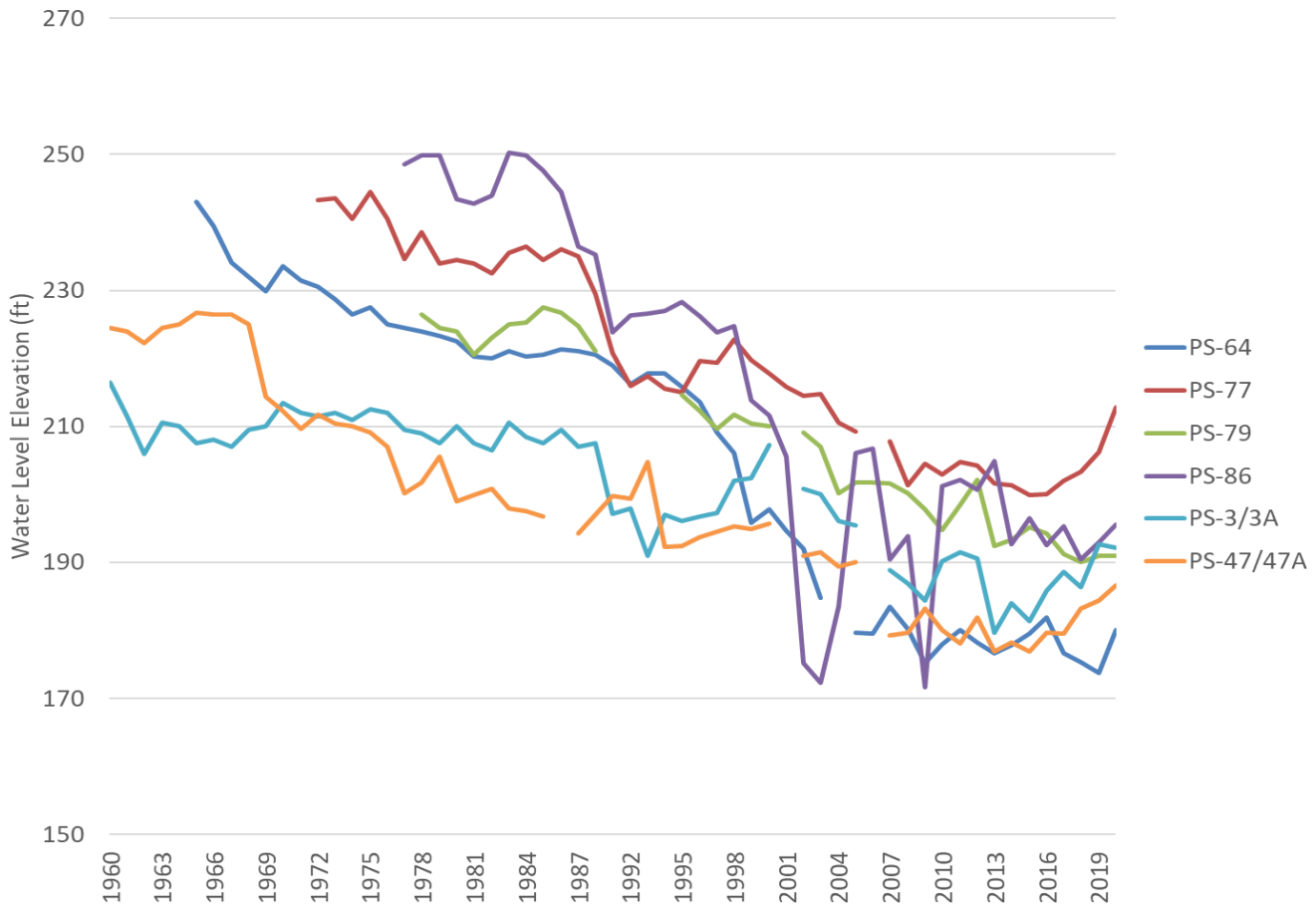
The Kings Subbasin groundwater aquifer supplies the City, other municipalities, agriculture, and rural residential areas with a consistent source of water. Like much of the Kings Subbasin, groundwater levels beneath the City were relatively shallow at 25 feet below ground surface in 1940, prior to the start of World War II (Fresno City Water, Engineering Department, 1940). After the war, the State, including the City, began growing at a rapid rate. For the period from 1959 to 1968 it was reported groundwater levels declined at a rate of 2.8 feet per year (John Carollo Engineers, 1969). The City continued to rely on the groundwater aquifer for decades, monitoring groundwater levels continuously. Groundwater levels since 1990 have declined at a lower rate than previously. Rates of decline slowed further starting in 2004 when the Northeast Surface Water Treatment Facility (NESWTF) started operations and the City renewed focus on increasing groundwater recharge. In 2019 and 2020, surface water accounted for more than half of the total water supply in the City. With the reduced pumping due to higher reliance of surface water, the groundwater levels have begun to increase in certain areas of the City in the last few years. **Figure 6-4** provides a depiction of the City's depth to groundwater for six representative wells across the Sphere of Influence (SOI) since 1960.

The City expects to continue to operate its three SWTFs and pump groundwater at a lower rate than historically so that the groundwater basin can recover. One of the primary objectives for the City as described in its current Metro Plan is to maximize the use of available surface water

[1] Available at https://www.northkingsgsa.org/groundwater-sustainability-plan/

treatment supplies to reduce overall reliance on groundwater. Additionally, as described in **Chapter 4**, the City plans to continue their groundwater recharge program to protect the groundwater basin. **Figure 6-5** shows the active and proposed recharge basins and FID Canals the City utilizes as part of groundwater recharge program.

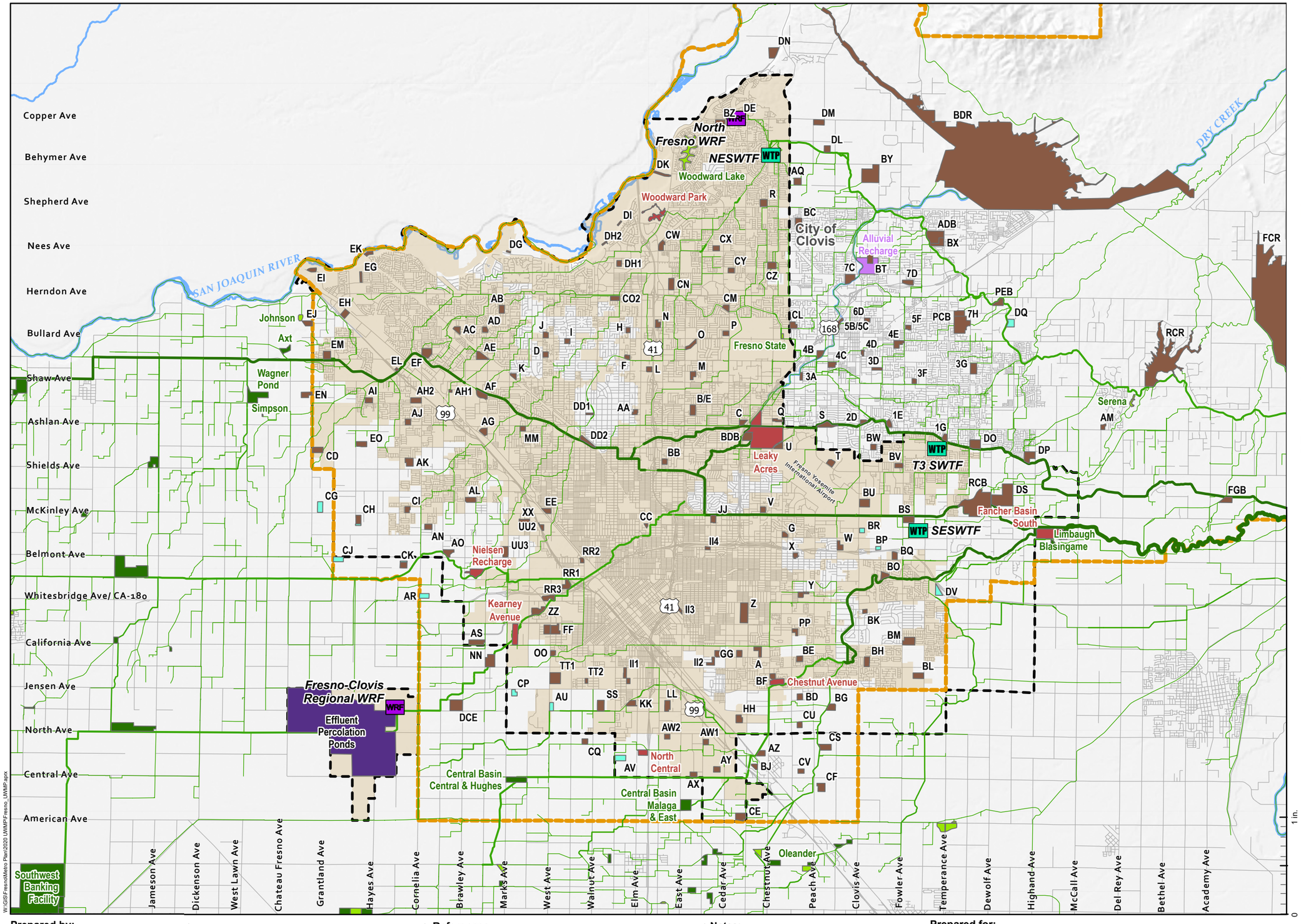
**Figure 6-4. Time Series of Groundwater Levels at Representative Wells**




## 6.1.4 Groundwater Quality

Groundwater within the North Kings Subbasin generally meets primary and secondary drinking water standards for municipal water use and is described as being bicarbonate type water, including calcium, magnesium, and sodium as the dominant ions (California Department of Water Resources, January 2006). Total dissolved solids (TDS) concentrations rarely exceed 600 mg/L and range from 200 to 700 mg/L (California Department of Water Resources, January 2006). However, the groundwater basin has been impacted by multiple chemical contaminants that affect the City's ability to fully utilize the groundwater basin resources without some type of wellhead treatment in certain areas.

**Figure 6-6** presents the general location of regional plumes and major point sources within the City. The primary contaminants are nitrate, 1,2-dibromo-3-chloropropane (DBCP), 1,2,3-trichloropropane (1,2,3-TCP), and other volatile organic compounds like trichloroethylene (TCE) and and perchloroethylene (PCE). The City has received settlements in a number of lawsuits related to these contaminants and has constructed wellhead treatment systems and implemented blending plans for a number of wells.




## Legend

*Groundwater Recharge Basins*

- FID Basin
- Privately Owned Basin
- City of Clovis Basin
- City of Fresno Basin
- RWRF Effluent Percolation Area
- FMFCD Basin
- FMFCD Proposed Basin
- FMFCD Boundary
- WRF Wastewater Reclamation Facility
- WTP Water Treatment Plant

*FID Facilities by Capacity*

- Less than 35 cfs
- 35 - 150 cfs
- 150 - 350 cfs
- 350 - 900 cfs
- 900 - 1500 cfs

- Fresno Sphere of Influence
- Fresno City Limits
- Streets

### Recharge Basin Summary

| Owner/ Operator | No. of Basins | Total Area (acres) |
|---|---|---|
| FID | 25 | 2,900 |
| Private Owner | 8 | 300 |
| City of Clovis | 1 | 90 |
| City of Fresno | 11 | 450 |
| City of Fresno RWRF | --- | 2,000 |
| FMFCD (Existing) | 166 | 8,500 |
| FMFCD (Proposed) | 12 | 140 |

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**Prepared by:** WSC

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0 0.75 1.5 3 Mi

0 3,500 7,000 14,000 US Feet

**References:**

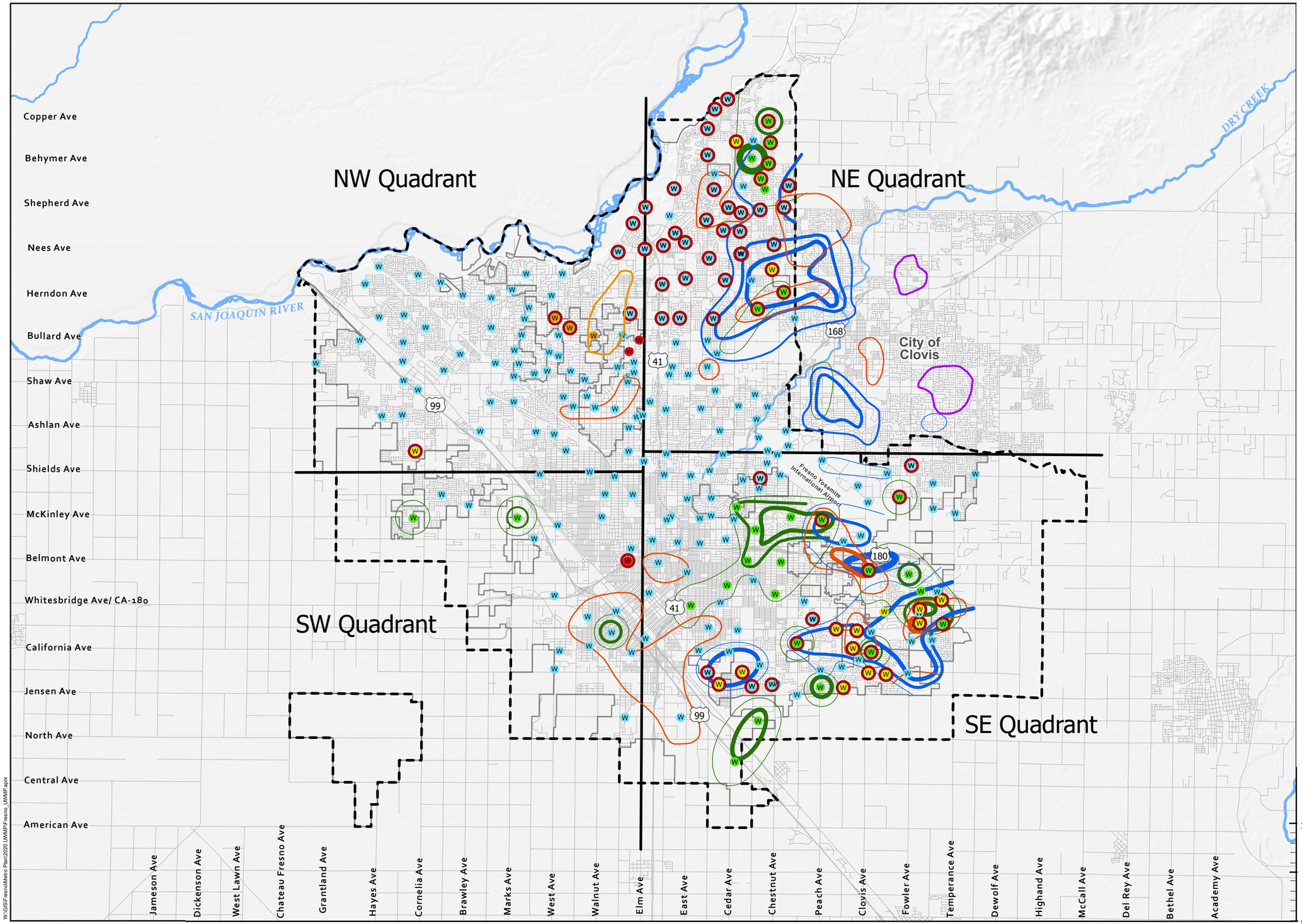
1. Coordinate System: NAD 1983 StatePlane California IV FIPS 0404 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

**Notes:**

**Prepared for:** City of Fresno Department of Public Utilities

**City of Fresno**
**2020 Urban Water Management Plan**

**Figure 6-5. Groundwater Recharge System**




## Legend

*Nitrate-Nitrogen Contamination and Concentration*

- 5 mg/L
- 10 mg/L

*DBCP Contamination and Concentration*

- 0.01 ppb
- 0.02 ppb
- 0.05 ppb
- 0.1 ppb
- 0.2 ppb

*1,2,3-TCP Contamination and Concentration*

- 5 ppt
- 10 ppt
- 20 ppt
- 50 ppt
- 100 ppt

*Other Plumes*

- TCE Plume
- EDB Plume (old)

*Well Pumped to Control Contaminant Plumes*

- DBCP
- PCE
- TCE
- TCP
- No Minimum Pumping
- Well Head Treatment
- Groundwater Quadrant Divide
- Fresno Sphere of Influence
- Fresno City Limits
- Streets

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**Prepared by:**

WSC

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0 0.75 1.5 3 Mi

0 3,500 7,000 14,000 US Feet

**References:**

1. Coordinate System: NAD 1983 StatePlane California IV FIPS 0404 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

**Notes:**

1.A list of wells with treatment was provided by the City as of September 2020. Some wells share treatment and convey water via a raw water pipeline to another well's treatment site. Wellhead treatment types includes activated carbon for VOC/SOCs, air stripping for VOCs, blending, degassing tank, corrosion control treatment, H2S odor control, and manganese treatment, or a combination of such.

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**Figure 6-6. Regional Groundwater Contamination**

Approximately 40 City wells are being treated for contaminants such as PCE, DBCP, TCE, 1,2,3-TCP, perfluorooctanoic acid, perfluorooctanesulfonic acid, ethylene dibromide, and nitrate, and an additional 20 wells include treatment for iron, manganese, and hydrogen sulfide removal or corrosion control.

As shown in the figure, extensive groundwater contamination nearly covers the City's entire water service area; only areas located in the northwest appear to be relatively unaffected by regional groundwater contamination. Also, many of the City's wells are impacted by one or more of the contaminant plumes (indicated by the presence of overlapping plumes on the figure). The figure also shows the approximately 93 existing active wells that are impacted by at least one contaminant plume and the 60 existing wells with wellhead treatment. The City is also managing contamination from spreading by pumping specific wells to control the plumes.

## 6.1.5 Estimated Groundwater Yield

As part of the ongoing Metro Plan update, the City is developing a storage accounting framework to estimate groundwater yield. The storage framework will track the City's groundwater recharge, pumping, and flows into and out of the City's SOI and incorporate bi-annual monitoring well water level readings on a grid basis. This work is ongoing, and the City reserves the right to update this analysis with more recent data when available.

Currently, the best available information on the City's groundwater yield is from a hydrologic groundwater and surface water model that was prepared for the Upper Kings Basin Integrated Regional Water Management Authority. The City contributed additional funding to the effort so the model would be more refined for its service area and capable of assisting in the development of the City's previous Metro Plan. The Kings Basin Integrated Groundwater and Surface Water Model (IGSM) was completed in 2007 and provided outputs specific to the City SOI (WRIME, 2007). The IGSM was developed and calibrated utilizing data for the period of 1964–2004. Building off the calibrated IGSM, additional modeling was conducted in 2008 to evaluate the City's proposed water supply plan and its ability to attain the balanced use of groundwater by the buildout year of 2025. The estimated groundwater yield within the City's SOI presented in this section is based on the modeling efforts to establish the various natural elements of the underlying aquifer.

### 6.1.5.1 Natural Recharge

As a result of the IGSM effort, the long-term average deep percolation from rainfall and irrigation-applied water for the period of 1964–2004 was found to be 42,700 acre-feet per year (AFY) for the entire SOI (West Yost Associates, January 2014). However, as urbanization continues within the SOI, the amount of deep percolation will decline because of increased runoff and less open land for natural recharge. For 2005, it was estimated deep percolation would be about 37,000 AFY and would reduce annually, ultimately declining to and remaining at 27,000 AFY by buildout in 2025. The new General Plan now anticipates SOI buildout will occur in 2056. Holding the 2005 value of 37,000 AFY and extending the 27,000 AFY to 2056, intermediate values were straight-line interpolated. Additionally, the City currently covers 73,500 acres of the 100,277 acres within its SOI, representing 73% urbanization, which would approximate the City's water system service area. **Table 6-1** shows estimated natural recharge through 2045.

### 6.1.5.2 Net Subsurface Inflow

Again, utilizing information developed from the IGSM, average net subsurface inflow into the SOI was characterized as being 64,800 AF annually for the period of 1964–2004. Applying the

previously described 73% proportioning factor of the developed SOI area to overall SOI area, approximately 47,510 AFY would be attributed to the City's water service area in 2020. This value will increase in future years as the City annexes more land until the SOI is built out. **Table 6-1** shows the estimated subsurface inflows for future years based on the land use growth presented in **Figure 4-3**. The City has historically benefitted from the net subsurface inflows and requires these flows for replenishment necessary to maintain the sustainable yield of the groundwater aquifer system.

### 6.1.5.3 Intentional Groundwater Recharge

The City has long made efforts toward offsetting the decline of groundwater levels and minimizing overdraft conditions through an active intentional recharge program that started in 1971 (CH2MHill, 1992). Through cooperative agreements with Fresno Metropolitan Flood Control District (FMFCD) and FID, the City has access to not only City-owned basins, but also those of these two agencies. Utilizing available surface water supplies, the City recharged on average approximately 60,000 AFY from 2000–2019; however, with the reduction in available surface water supplies, intentional recharge declined to 34,700 AF in 2014 and 19,800 AF in 2015, followed by an increase in recharge in years 2016, 2017, and 2019 to help replenish the aquifer. In 2019, City recharge of 82,993 AF was the maximum annual recharge attained during this period. The City has averaged over 60,000 AFY the previous five years and plans to gradually increase recharge by about 540 AFY each year. However, during wet years the City will recharge more water when it is available to allow to the City to draw on additional groundwater during dry years when surface water is not available. Intentional recharge is included in the non-potable demand projections as well as contributing to the estimated groundwater yield presented in **Table 6-1**.

**Table 6-1. Components to Groundwater Yield for Normal Years**

| | QUANTITY (AFY) | | | | | |
|---|---|---|---|---|---|---|
| **GROUNDWATER COMPONENT** | **2020** | **2025** | **2030** | **2035** | **2040** | **2045** |
| Natural Recharge[1] | 24,970 | 25,480 | 25,910 | 26,280 | 26,570 | 26,790 |
| Net Subsurface Inflow[1] | 47,510 | 49,910 | 52,320 | 54,720 | 57,120 | 59,530 |
| **SUSTAINABLE YIELD** | **72,480** | **75,390** | **78,230** | **81,000** | **83,690** | **86,320** |
| Intentional Recharge[2] | 60,000 | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| **TOTAL ESTIMATED GROUNDWATER YIELD** | **132,480** | **138,090** | **143,630** | **149,100** | **154,490** | **159,820** |

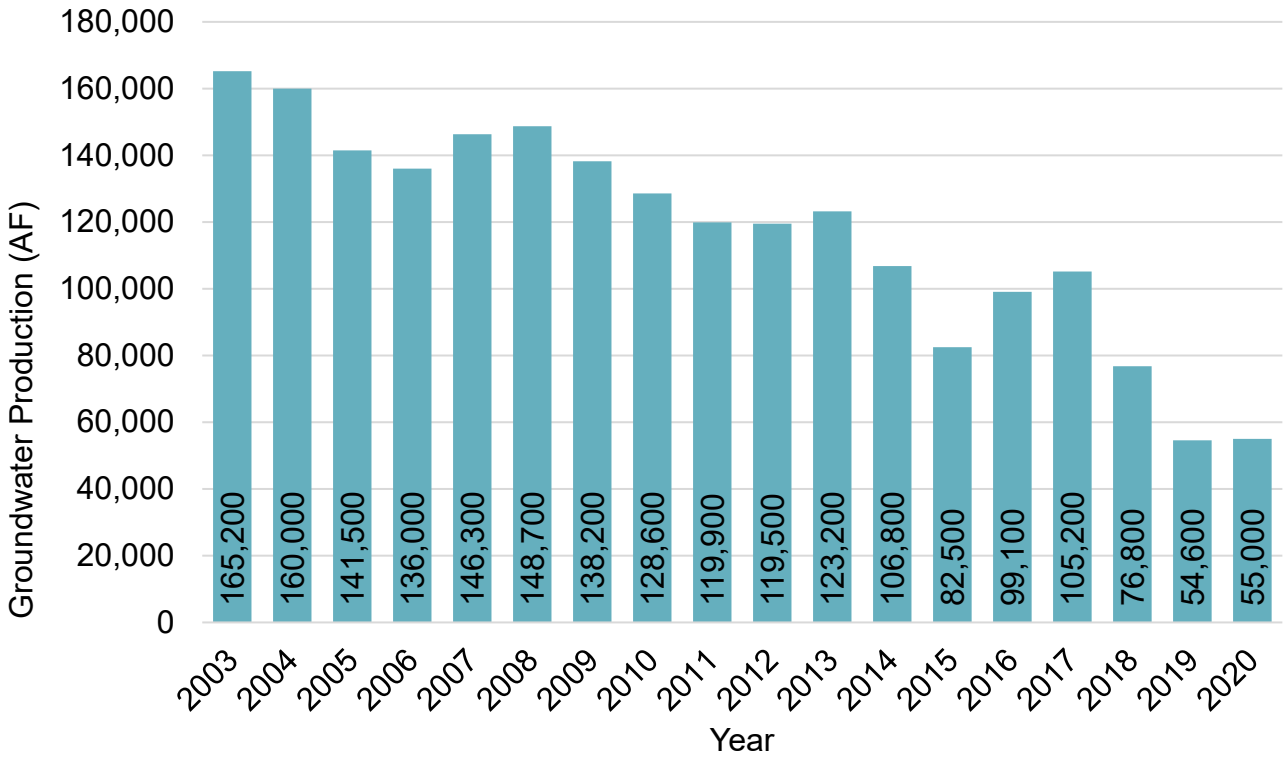
Notes:

1. Based on the Kings Basin IGSM and projected City land growth from **Figure 4-3** as discussed in **Section 3.1.1.**
2. Projected normal year intentional recharge from **Table 4-7**.

### 6.1.6 Historic Groundwater Pumping

The City has historically relied on groundwater as its main supply source prior to the construction of its SWTFs. With the recent investments in surface water infrastructure, the City has been able to drastically reduce its groundwater pumping. **Figure 6-7** shows the historic groundwater pumping since 2003. As shown, pumping has dropped significantly since 2003, the City's peak year for groundwater production.

**Figure 6-7. Historic Groundwater Production**




## 6.2 Surface Water

With the completion and operation of the Southeast Surface Water Treatment Facility (SESWTF), surface water is now a primary water supply used to meet potable demands within the City. The City contracts with FID for Kings River water and with the USBR for CVP water from the Friant-Kern Canal. The surface water supply is used either for potable uses through treatment and distribution or delivery to recharge basins for groundwater recharge.

The Kings River water year (WY) is October through September while USBR uses a WY of March through February. The City has historically used a calendar year (CY) for its analysis, so monthly water supply information was compiled in CY format for this report.

### 6.2.1 USBR Friant Division Contract Supply

The City, through an agreement originally executed in January 1961, secured a surface water supply from USBR CVP Friant Division. This agreement, for an annual water supply of 60,000 AF of Class 1 water, was last renewed in 2010 as a Section 9(d) contract that provides water from the San Joaquin River in perpetuity. A copy of the renewed contract is provided in

**Appendix H** of this UWMP. The USBR CVP Friant Division facilities generally include: Friant Dam (Millerton Reservoir), the Friant-Kern Canal, and the Madera Canal. The Friant-Kern Canal is maintained and operated by the Friant Water Authority. The USBR water supply is a wholesale supply.

Construction of Friant Dam was completed in 1947 and began making diversions to the Friant-Kern Canal in 1949. Full operations of the CVP Friant Division did not commence until the Madera Canal was completed in 1951. Class 1 water was intended to be a supply that would be dependable in practically every year, regardless of the type of hydrologic WY. Class 2 water is essentially excess water available as determined by USBR and less reliable than Class 1 water.

Class 1 water has historically been very reliable until the 2006 San Joaquin River Restoration Settlement Agreement between the Department of the Interior and Commerce, the Natural Resources Defense Council, and the Friant Water Users Authority (which is now the Friant Water Authority). The City is a member of the Friant Water Authority. The Settlement ended an 18-year legal dispute over the operation of Friant Dam brought by a coalition of conservation and fishing groups. The agreement characterized Class 1 deliveries by six hydrologic year types based on a recurrence over an 82-year simulation (1922–2003): wet, normal-wet, normal-dry, dry, critical-high, critical-low. The projected surface water available for the City from USBR during each hydrologic year defined by the 2006 Settlement Agreement is summarized in **Table 6-2**. As shown in the table, the average simulated delivery is 53,680 AFY and the median simulated delivery, which is similar to normal year delivery, is 60,000 AFY. The median value is higher than the average value because 100% allocation of 60,000 AF is simulated in 50 of 82 years but the dry and critical years result in substantial reductions, which bring down the average allocation.

The Settlement Agreement estimates the reduced supply available to the City compared to historic supplies, most evident in dry years. Restrictions on exports from the Delta have hindered the USBR from making deliveries to the Exchange Contractors via the Delta-Mendota Canal. The Exchange Contractors allowed the formation of the CVP Friant Division by agreeing to not exercise their historic pre-1914 water rights to the San Joaquin and Kings Rivers if guaranteed water deliveries continued through the Delta-Mendota Canal or other facilities. If USBR is unable to deliver water to the Exchange Contractors, they have the right to receive their water from the San Joaquin River, which reduces the Class 1 water availability (History of SJRECWA Exchange Contractors, n.d.).

Reduced deliveries from the Delta to the Exchange Contractors resulted in the CVP Friant Division contractors with zero allocations of Class 1 water in USBR WY 2014 and 2015, though the City received USBR deliveries in CY 2014 (prior to the USBR WY starting in March). Annual USBR deliveries since 2007 are shown in **Figure 6-8** for CY. The availability and reliability of the City's surface water supplies through its USBR contract are discussed further in **Chapter 7**.

**Table 6-2. Available USBR Simulated Allocation (1922–2003)**

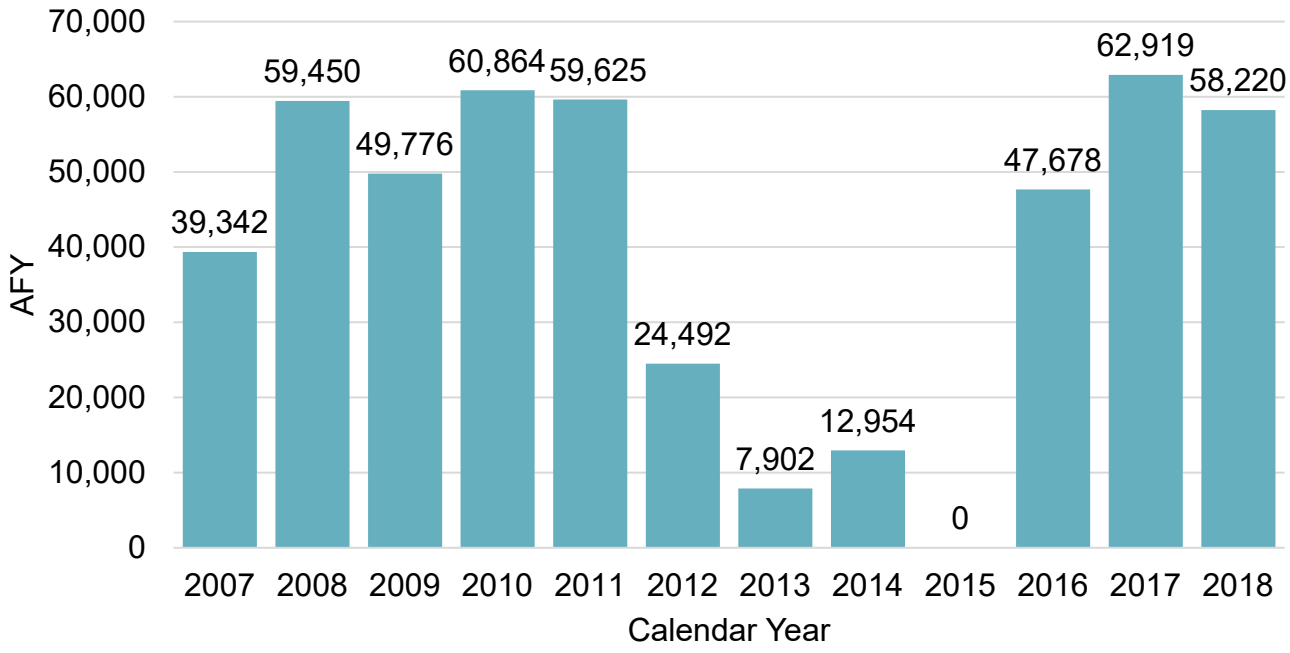
| WATER YEAR TYPE | % OF YEARS OVER SIMULATION PERIOD OF DELIVERIES [1] | NUMBER OF YEARS IN THAT YEAR TYPE | RANGE OF ALLOCATION TO CITY (AF) | AVERAGE ALLOCATION TO CITY (AF) |
|---|---|---|---|---|
| Wet | Highest 20% | 16 | 60,000 | 60,000 |
| Normal-Wet | 50% to 80% | 25 | 60,000 | 60,000 |
| Normal-Dry | 20% to 50% | 25 | 47,500 to 60,000 | 57,060 |
| Dry | 5% to 20% | 12 | 28,100 to 46,800 | 36,575 |
| Critical[2] | Lowest 5% | 4 | 13,900 to 24,700 | 19,025 |
| | **TOTAL** | **82** | **AVERAGE** | **53,680** |
| | | | **MEDIAN** | **60,000** |

Source: 2006 Settlement Agreement

Notes:

1. As defined in 2006 Settlement Agreement
2. Includes both critical-high and critical-low, which are differentiated by the amount of unimpaired runoff. The simulation uses deliveries through 2006 and does not include the zero allocation years in 2014 and 2015.

**Figure 6-8. USBR Deliveries to City Since 2007**



In addition to the Class 1 water available to the City, the USBR contract also makes available water classified as: recovered water account water; Section 215 water; and unreleased restoration flows, unreleased recirculation flows, and uncontrolled season flows. The complexities of each water type are beyond the scope of this report but are mentioned here to reflect the other water acquisition opportunities afforded to the City through this contract.

The San Joaquin River water supply has excellent water quality as it originates from snowmelt from the high Sierras and has not been detrimentally impacted.

### 6.2.2 Fresno Irrigation District Supply

FID is one of 28 agencies that receives an entitlement of water from the Kings River through the Kings River Water Association. Water entitlements for Kings River Water Association contract members is determined based on a methodology that was initially developed in 1917–1919 to established entitlements for early claimed rights holders. The methodology was based on historic mean daily natural flow conditions at Piedra, which is approximately three miles downstream from the then yet to be built Pine Flat Dam and "at the heart of Kings River uses, regulation, and stream control and storage." (Kings River Water Association and Kings River Conservation District, June 2003)

On December 20, 2016, the Revised, Amended, and Restated Cooperative Agreement was executed between FID and the City for Water Utilization and Conveyance (2016 FID Agreement) (**Appendix I**). The 2016 FID Agreement replaces the 1976 Cooperative Agreement and ends in 2035. The Agreement identifies the City's contracted percentage of FID's Kings River water based on the City's water service area located within FID service area as a percentage of the FID land area. FID land area varies slightly every year because it is dependent on the acreage receiving water deliveries for that year rather than the total acreage within FID (roughly 200,000 acres). As the City incorporates new land area into its service area, the percentage of FID supply increases. However, the 2016 FID Agreement sets the maximum percentage as 29.0%, although the City's service area is anticipated to expand and encompass more than 29.0% of FID's service area between 2025 and 2030. In 2020, the City's percentage of overall FID Kings deliveries was 25.79%. The FID Agreement identifies that the 29.0% maximum was based on moderate growth in Growth Area 1 of the City's SOI (shown in Exhibit C in the 2016 Agreement). As such, the supply projections in this plan limit the City's FID supply with the 29.0% cap, but if the agreement were revised in the future the City's FID allocation percentage could grow beyond 29.0% as the water service area expands.

The City has historically not used all of its available allocation in any given year, although it pays a flat rate for its total allocation regardless of use. Water unused by the City is reallocated by FID to its other customers.

The City's potential supply from FID was summarized using actual Kings River deliveries for CYs 1964–2019, then categorized by the same WY types used for the USBR Friant supply. The range and average FID deliveries by WY type is shown in **Table 6-3**. The average of all 56 CY delivery totals of FID Kings River deliveries is 452,541 AF, which equates to an average potential City supply of 131,237 AF, assuming the maximum 29.0% City supply percentage. **Table 6-4** lists the historic and projected allocation of FID's Kings River water for the City in normal (average) CYs. The City percentage of FID supplies was estimated assuming the City's water service area will grow from 59,100 acres to 84,300 acres by buildout at the rate shown in **Figure 4-3**.

**Table 6-3. FID Diversions by Water Year Type (1964 to 2019)**

| WATER YEAR TYPE | % OF YEARS[1] | NUMBER OF YEARS BETWEEN 1964 AND 2019 | TOTAL FID DELIVERIES (AF)[2] | | EXAMPLE AVERAGE AVAILABLE TO CITY[3] |
|---|---|---|---|---|---|
| | | | RANGE | AVERAGE | |
| Wet | Highest 20% | 11 | 563,500 to 644,600 | 590,700 | 171,300 |
| Normal-Wet | 50% to 80% | 17 | 452,800 to 563,300 | 513,700 | 149,000 |
| Normal-Dry | 20% to 50% | 17 | 362,600 to 448,000 | 415,000 | 120,400 |
| Dry | 5% to 20% | 8 | 253,700 to 362,000 | 315,700 | 91,600 |
| Critical | Lowest 5% | 3 | 158,100 to 253,300 | 210,200 | 61,000 |
| | | **56** | **AVERAGE** | **453,800** | **131,600** |

Notes:

1. As defined in 2006 Settlement Agreement
2. Assigns water year type defined in defined in 2006 Settlement Agreement to FID deliveries from 1964 to 2019
3. Based on maximum 29.0% City supply percentage to provide an example City supply amount

**Table 6-4. Projected FID Kings River Allocation for City, Normal Years**

| YEAR | PROJECTED TOTAL FID ALLOCATION, AFY | PROJECTED ALLOCATION TO CITY, AFY[1] |
|---|---|---|
| 2025 | 27.55% | 125,030 |
| 2030 | 29.00% | 131,600 |
| 2035 | 29.00% | 131,600 |
| 2040 | 29.00% | 131,600 |
| 2045 | 29.00% | 131,600 |

[1]Projected City Allocation (%) x 453,800 AFY (estimated normal year diversion by FID, per **Table 6-3**)

## 6.3 Stormwater

The Fresno-Clovis Metropolitan Area and surrounding rural vicinities are within the service area boundaries of the FMFCD, which has primary responsibility for managing the local stormwater flows. Most stormwater in the City drains to urban stormwater basins, where the water is retained to attenuate peak flow runoff and recharge stormwater, or is pumped to local irrigation canals for conveyance away from the municipal areas. FMFCD's operation of stormwater basins is predicated on maintaining storage capacity for rain events, which limits accessibility for recharge activities during the rainy season. FMFCD estimates the amount of stormwater that is recharged each wet season. However, recharge attained with the FMFCD basins largely occurs in May

through October when limited storage capacity is required. Dry-season recharge is accomplished by diverting surface waters, from the Kings River and Millerton Reservoir, using City-allocated surface water. It is difficult to estimate stormwater recharge volumes as there is no physical measurement of stormwater flows into the basins, and infiltration rates can vary with water elevation and degree of siltation in the basin. However, FMFCD estimates that stormwater recharge in urban basins during the winter months may range from 7,000 AF/yr to 22,200 AF/yr. Stormwater capture and infiltration are considered an integral component of natural groundwater recharge discussed in **Section 6.1.5.1**.

# 6.4 Wastewater and Recycled Water

## 6.4.1 Recycled Water Coordination

The City is currently expanding its recycled water supplies to increase offset use of potable water for landscape irrigation. In 2010, the City completed a Recycled Water Master Plan (adopted by the City Council in 2013) to evaluate and plan for increased recycled water use in the City. The City's last Metro Plan, adopted in 2014, also outlined projects to increase the use of recycled water to offset potable demands (Carollo, 2010). The City is currently updating the Metro Plan and will reevaluate recommendations and projects to increase recycled water use.

The City owns and operates two water reclamation facilities: 1) the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) and 2) the North Fresno Wastewater Reclamation Facility (NFWRF), both of which can produce Title 22 recycled water for use within the City's service area. They are described further in **Section 6.4.3**.

Coordination with other water agencies and potential consumers within the planning area is inherently within the purview of the City's Department of Public Utilities (DPU) as this department provides both water and wastewater services. DPU has been on the forefront of numerous water supply preservation, enhancement, and development projects and programs for decades. The concept of multiagency coordination is fully embraced by the department as is evident with the previously discussed joint agency agreements and the commitment to construct new infrastructure to further develop new resources. The endeavor to develop recycled water as a resource was a requirement of a development in north Fresno, where the developer was conditioned to have a net zero impact on water resources. The fundamental component of this development was the construction and dedication of the NFWRF to the City.

There are only a few agencies, besides the City, that have wastewater collection and treatment facilities within and immediately adjacent to the plan area. These agencies include:

| | Collection | Treatment |
|---|---|---|
| City of Clovis | X | X |
| Malaga County Water District | X | X |
| Pinedale County Water District | X | - |
| Pinedale Public Utility District | X | - |

As the City is the primary responsible agency for wastewater collection and treatment for its annexed areas and certain County islands, it has taken the lead role of developing and implementing recycled water facilities to serve the same area.

#### 6.4.1.1 City of Clovis

The RWRF was developed under a Joint Powers Authority agreement executed in 1977 among the City of Fresno, the City of Clovis, and the County of Fresno. Both of the cities contribute to the cost of operations and maintenances and capital expenditures for the RWRF based on formulas in the agreement. This facility provides service for most of Clovis' sewer flows.

The City of Clovis recently constructed its own wastewater treatment facility that produces tertiary level effluent and is distributed in a dedicated purple pipe system within portions of its service area.

#### 6.4.1.2 County of Fresno

The County of Fresno, like the City of Clovis, is a party to the RWRF Joint Powers Authority for treatment of flows from unincorporated areas encompassed by the City's service area.

#### 6.4.1.3 Malaga County Water District

Malaga County Water District provides water and sewer service to an unincorporated county area of about 2.25 sq mi, which covers a small portion of the City's SOI. The district provides wastewater collection and treatment for residential and non-residential customers.

#### 6.4.1.4 Pinedale County Water District

Pinedale County Water District provides water, sewer, and solid waste service to an area of about 2 sq mi, which service area covers an unincorporated County island and a portion of the City. The district provides wastewater collection to an area of 699 acres and diverts the flow to the City's collection system for treatment at the RWRF.

#### 6.4.1.5 Pinedale Public Utility District

Pinedale Public Utility District provides wastewater, street lighting, street sweeping, and landscape maintenance. The district services an area of 362 acres in the northern portion of the City, serving both an unincorporated County island and portions of the City. The collected wastewater is diverted to the City's collection system for treatment at the RWRF.

### 6.4.2 Wastewater Collection, Treatment, and Disposal

The City's wastewater collection system was originally developed in 1891 with the installation of a 24-inch outfall sewer that discharged to a 40-acre sewer farm located southwest of town. The amount of land and facilities at this location continued to be expanded as the City grew over the years. Today, the City's wastewater collection system consists of about 1,630 miles of pipes ranging in size from 4 inches in diameter to 84 inches in diameter. This collection system also utilizes 15 lift stations throughout the City, ranging in pumping capacity from 0.25 mgd to 2.2 mgd.

#### 6.4.2.1 Wastewater Treatment and Discharge Within Service Area

The City is served by two wastewater treatment plants, briefly described below.

**Fresno-Clovis Regional Wastewater Reclamation Facility**

The RWRF has developed from what was once a sewer farm to what is now a state-of-the-art wastewater treatment facility. In 1966, the City of Fresno was appointed the sewering agency

for the local metropolitan region and shortly after began long-range planning and construction of new facilities to handle increasing flows and regulatory requirements. The RWRF treats flows from not only the City, but also sewered County areas (some county areas remain unsewered), the City of Clovis, Pinedale County Water District, and Pinedale Public Utility District.

Flows received at this facility peaked at 81,100 AF in 2006 and have been steadily decreasing since, with the average influent flow about 63,000 AF over the last five years. The RWRF includes preliminary, primary, secondary, and tertiary treatment units with disinfection. Secondary treatment consists of three treatment trains with an annual average capacity of 87 mgd, consisting of 30 mgd for Train A and 57 mgd for Trains B and C combined. In 2017, a 5-mgd tertiary treatment system — the Tertiary Treatment and Disinfection Facility (TTDF) — was completed. The system can be expanded to 15 mgd and ultimately to 30 mgd.

The City has three primary means of effluent disposal:

1. Undisinfected secondary effluent to on-site and off-site farmland for restricted irrigation
2. Undisinfected secondary effluent to percolation ponds
3. Disinfected tertiary effluent to the recycled water distribution system

The percolated effluent has been deemed equivalent to Title 22 tertiary treated water by the State Water Resources Control Board Department of Drinking Water (DDW). The City has been extracting this water for reuse in areas within and surrounding the RWRF, as well as to FID's canals, through an exchange agreement for delivery to FID agricultural customers.

The discharged effluent is within the City boundaries and located just southwest of the metropolitan area. The treated effluent percolation ponds are within the City's SOI and hydrologic sphere that benefit the City's overall regional water budget. See **Figure 3-1** for a depiction of the facility's location relative to the metropolitan area.

#### North Fresno Wastewater Reclamation Facility

The NFWRF was constructed as part of a residential, commercial, and golf course master planned development located in the northern portion of the City. As a condition of the planned community, the developer was required to construct a wastewater treatment facility that would produce tertiary level effluent for use within the development to ensure the overall project had a net zero impact on water resources. This facility is presently rated at 0.71 mgd (average monthly flow) and 1.07 mgd (maximum daily flow). However, the ultraviolet (UV) light disinfection system was only validated for 300 gpm (0.43 mgd), which is the current flow limit until the DDW approves a higher flow. This facility is expandable to 1.25 mgd (average monthly flow). The disinfected tertiary effluent from the plant is largely used to irrigate the Copper River Ranch Golf Course. Of the 325 AF of wastewater treated in 2020, 54 AF was used for irrigation of turf. Treated but unused effluent is diverted to the City's collection system to the RWRF.

### 6.4.3 Recycled Water System Description

The 2014 Metro Plan recommended expanding reuse by: 1) using the NFWRF effluent to irrigate Copper River Ranch Golf Course; and 2) up to 25,000 AFY of recycled water for landscape irrigation or other non-potable uses from the RWRF or new satellite WRFs. Since then, the City has irrigated the Copper River Ranch Golf Course with recycled water and has constructed much of the southwest recycled water distribution system. However, the City is currently updating the Metro Plan and reevaluating the target volume of reuse in the City beyond the southwest system

considering new conditions and regulations, including the potential for potable reuse in the future.

#### 6.4.3.1 Fresno-Clovis Regional Wastewater Reclamation Facility

As mentioned above, the RWRF produces undisinfected secondary effluent for restricted irrigation to on-site and off-site farmlands and disinfected tertiary treated effluent for the recycled water distribution system.

The City's RWRF diverts a portion of the undisinfected secondary effluent to irrigate non-food crops grown adjacent to this facility. The practice of using the secondary effluent to irrigate non-food crops has been carried-out for decades and is expected to continue for the foreseeable future. The City owns nearly 3,300 acres of land for and around the RWRF, consisting of percolation ponds (1,750 acres) and other land available to farm non-food crops. **Table 6-5** provides the annual quantities of recycled water applied to these crops for the period from 2015–2019.

Additionally, the RWRF produces Title 22 disinfected tertiary treated effluent through the TTDF completed in 2017 and through tertiary equivalent soil aquifer treated recycled water recovered from the percolated secondary effluent. A series of 15 groundwater wells located at the RWRF are used to extract previously percolated effluent groundwater from beneath the facility. The extracted groundwater has the potential to be used for higher beneficial use if it can be demonstrated this water has attained a level of treatment satisfactory to meet disinfected tertiary levels. The City embarked on a joint project with the WateReuse Research Foundation to demonstrate to State regulatory agencies the soil aquifer treated recycled water met Title 22 levels. The culmination of this study is presented in a final report entitled "Demonstration of Filtration and Disinfection Compliance Through Soil-Aquifer Treatment," which was completed in 2013 (WateReuse Research Foundation, 2013). This study concluded that, based on the documented sampled water quality data, the extracted groundwater met requirements for classification as disinfected tertiary level recycled water. The SWRCB DDW stated that the percolated effluent water meets the tertiary treatment classification, and the City is making plans for its use as part of its recycled water production and distribution system (California Regional Water Qulaity Control Board, 2018). The combined rated production yield of the 15 wells, if run year-round, would be approximately 32,000 AFY. The City plans to blend the recycled extraction well water with the disinfected tertiary level recycled water produced from the 5 mgd TTDF to feed the southwest recycled water distribution system. As new sales grow for the recycled water, additional recycled extraction well water will be utilized to feed the City's southwest recycled water system.

The tertiary equivalent soil aquifer treated recycled water (recovered groundwater) is also used for on-site irrigation and transport to FID canals for delivery to customers during the irrigation season, as facilitated through an exchange agreement with FID. More information on the City's FID RWRF Exchange Agreement is discussed in **Section 6.6**.

Since the completion of the 2010 Recycled Water Master Plan (RWMP), the City has constructed most of the southwest recycled water system, shown in **Figure 6-9.** The southwest recycled water system consists of a 3.2 MG recycled water reservoir located at the RWRF, a 6,000 gpm (8.64 mgd) recycled water pump station located at the RWRF, a 640-gpm booster pump station (Roeding Park Booster), and 15.7 miles of 10-inch to 54-inch recycled water pipeline. Roughly 7.5 miles of pipeline remain to be constructed. The City also updated the demand and distribution system from the 2010 RWMP with the 2019 Citywide Recycled Water Demand and Southwest

Recycled Water System Analysis (Carollo, 2019) to identify potential recycled water customers. This recent analysis will be incorporated into the latest Metro Plan update.

#### 6.4.3.2 North Fresno Water Reclamation Facility

As described earlier, the City has an existing recycled water plant in the northern portion of the City that receives and treats sewage from the residential, commercial, and golf course master planned community. The NFWRF was constructed in 2008 but was not fully operational until 2009 due to the inability to properly run at extremely low flow conditions. Subsequent modifications at the plant allowed it to run on a regular basis in 2010 and again in 2014 for UV approval. The amount of reuse has varied substantially since 2016 because the delivery system was offline in 2017 and 2018 for treated water basin slope repairs. City staff indicated that 2016 is representative of operations going forward. The disinfected tertiary effluent is conveyed in a dedicated pipeline to an adjacent golf course for irrigation purposes. The quantities used for irrigation purposes are shown in **Table 6-5** for the period of 2015–2019.

**Table 6-5. Historic Recycled Water Used Within Service Area**

| | QUANTITY (AFY) | | | | | |
|---|---|---|---|---|---|---|
| **RECYCLE WATER FACILITY** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| RWRF, Secondary Effluent (Non-Food Crop Irrigation) | 8,688 | 7,329 | 4,540 | 7,031 | 3,652 | 3,845 |
| RWRF, Tertiary Effluent | 531 | 485 | 423 | 867 | 912 | 858 |
| NFWRF | 62 | 110 | 0 | 0 | 19 | 54 |
| **TOTAL** | **9,281** | **7,924** | **4,963** | **7,898** | **4,583** | **4,757** |

Note: Reuse at the NFWRF was zero in 2017 and 2018 because the recycled water delivery system was offline for system repairs.

### 6.4.4 Potential, Current, and Projected Recycled Water Uses

The 2020 actual recycled water use, and projected recycled water use in the City's service area is included in **Table 6-6**. Secondary undisinfected reuse is projected to continue to be used to irrigate non-food crops adjacent to the RWRF in the future. The projected secondary undisinfected use going forward is based on the average use from 2015 to 2020. Additionally, the amount of tertiary recycled water from the RWRF is projected to increase to provide 6,210 AF for landscape and agricultural irrigation as the southwest recycled water system is built out. Projected tertiary recycled water from the NFWRF for golf course irrigation is projected to be 110 AF annually through 2045.

The 2015 UWMP anticipated that 21,200 AFY of recycled water would be produced and utilized in 2020. The previous projected increases in recycled water were based on recommendations from the 2010 RWMP, which included projects to increase recycled water use for landscape irrigation, agricultural irrigation, industrial use, and blending with raw surface water for groundwater recharge. Since the 2010 RWMP, the City has focused on constructing the southwest recycled water system to increase landscape and agricultural irrigation in the southwest portion of the City. The City is also currently updating the Metro Plan that is evaluating recycled water alternatives in the City and is expected to update its RWMP following the Metro Plan update to serve as a new guiding planning document for recycled water use by the City.

| Customer ID | Customer Name | MDD (gpm) | PHD (gpm) | Hours of Irrigation |
|---|---|---|---|---|
| 1 | Quist Farms | 1,300.0 | 1,300.0 | 24 |
| 2 | Fresno Memorial Gardens | 131.0 | 450.0 | 7 |
| 3 | Roeding Park | 267.0 | 640.0 | 10 |
| 4 | Peelman Farms | 650.0 | 650.0 | 24 |
| 5 | Peelman Farms | 650.0 | 650.0 | 24 |
| 6 | St Peters Cemetery | 152.7 | 458.2 | 8 |
| 7 | Westside Auto | 8.0 | 30.0 | 6 |
| 8-10 | Multiple Cemeteries | 225.8 | 677.2 | 8 |
| 11-12 | Caltrans-99 | 100.0 | 300.0 | 8 |
| 13-16 | Multiple Cemeteries | 225.8 | 677.2 | 8 |
| 17 | Masis Ararat Cemetery | 80.0 | 240.0 | 8 |
| 18 | Belmont Memorial Park | 172.3 | 517.0 | 8 |
| 19 | Caltrans 180/ Hughs | 33.3 | 100.0 | 8 |
| 20 | Caltrans 180/ Fruit | 16.7 | 50.0 | 8 |
| 21 | Fink-White Park | 61.0 | 183.0 | 8 |
| 22 | Caltrans 99/ Amador | 16.7 | 50.0 | 8 |
| 23 | Columbia Elem | 44.3 | 133.0 | 8 |
| 24 | Frank Ball Park | 19.3 | 58.0 | 8 |
| 25 | Kearney Triangle | 18.3 | 55.0 | 8 |
| 26 | Eaton Plaza | 21.0 | 63.0 | 8 |

| Customer ID | Customer Name | MDD (gpm) | PHD (gpm) | Hours of Irrigation |
|---|---|---|---|---|
| 27 | Veteran's Memorial | 27.7 | 83.0 | 8 |
| 28 | City Hall | 27.7 | 83.0 | 8 |
| 29 | AmeriPride | 67.3 | 202.0 | 8 |
| 30 | Courthouse Park | 116.7 | 350.0 | 8 |
| 31 | Community Regional | 173.0 | 519.0 | 8 |
| 32 | Chukchansi Park | 59.3 | 178.0 | 8 |
| 33 | Caltrans 41/H | 16.7 | 50.0 | 8 |
| 34 | McKinley Elem | 66.7 | 200.0 | 8 |
| 35 | El Capitan Middle | 83.3 | 250.0 | 8 |
| 36 | Polk Elem | 74.7 | 224.0 | 8 |
| 37 | Madison Elem | 56.1 | 168.3 | 8 |
| 38 | King Elem | 44.3 | 101.6 | 8 |
| 39 | Gaston Middle | 87.5 | 350.0 | 8 |
| 40 | Computech Middle | 63.0 | 245.5 | 8 |
| 41 | Edison High | 43.7 | 166.0 | 8 |
| 42 | Fresno City College | 639.4 | 871.9 | 24 |
| 43 | Hinton Park | 19.3 | 58.0 | 8 |
| 44 | Oasis Residential Development | 210.5 | 631.5 | 8 |
| | **Total** | **6,070.0** | **12,013.4** | **---** |

## Legend

*Existing Facilities*

- Wastewater Reclamation Facility
- Existing Recycled Water Pipeline
- Recycled Water Reservoir

*Recycled Water Pump Station*

- Existing
- Future

*Future/ Proposed Recycled Water Pipelines*

- Oasis Development
- SW1D
- South Pipeline

*Recycled Water Customer*

- Existing Recycled Water Customer
- Agriculture
- Cemetery
- Central Unified School District
- College
- Fresno Unified School District
- Park
- Private/Commercial
- Residential
- Freeway

*City Features*

- Fresno Sphere of Influence
- Fresno City Limits
- Streets

Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/ CA-180
California Ave
Jensen Ave
Brawley Ave
Marks Ave
West Ave
Walnut Ave
Elm Ave
SWPS1
Roeding Park PS
RWRF PS
Fresno-Clovis Regional WRF
3.2 MG Recycled Water Reservoir

**Prepared by:** WSC

N
1:44,248
0 0.28 0.55 1.1 Mi
0 1,000 2,000 4,000 US Feet

**References:**

1. Coordinate System: NAD 1983 StatePlane California IV FIPS 0404 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. Figure recreated from Figure 7 Potential Southwest Recycled Water Users from the 2019 City Wide Recycled Water Demand and Southwest Recycled Water System Analysis prepared by Carollo Engineers, Inc.

**Notes:**

**Prepared for:** City of Fresno Department of Public Utilities

**City of Fresno**
**2020 Urban Water Management Plan**

**Figure 6-9. Southwest Recycled Water System**

W:\GIS\FresnoMetro Plan\2020 UWMP\Fresno_UWMP.aprx

**Table 6-6. Recycled Water within Service Area in 2020 (DWR 6-4R)**

The supplier will complete the table.

| | |
|---|---|
| Name of Supplier Producing (Treating) the Recycled Water: | City of Fresno |
| Name of Supplier Operating the Recycled Water Distribution System: | City of Fresno |
| Supplemental Volume of Water Added in 2020: | 0% |
| Source of 2020 Supplemental Water: | N/A |

| BENEFICIAL USE TYPE | POTENTIAL BENEFICIAL USES OF RECYCLED WATER | AMOUNT OF POTENTIAL USES OF RECYCLED WATER | GENERAL DESCRIPTION OF 2020 USES | LEVEL OF TREATMENT | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|---|---|---|---|
| Agricultural Irrigation[1] | Non-foodcrop irrigation | 7,900 | Irrigate non-food crops | Secondary, Undisinfected | 3,845 | 7,900 | 7,900 | 7,900 | 7,900 | 7,900 |
| Landscape Irrigation (excludes golf courses) | Landscape Irrigation | 5,800 | Landscape irrigation, distributed through the southwest recycled water distribution system | Tertiary | 858 | 5,800 | 5,800 | 5,800 | 5,800 | 5,800 |
| Agricultural Irrigation[1] | Food crop irrigation | 410 | Irrigate limited food crops, distributed through the southwest recycled water distribution system | Tertiary | - | 410 | 410 | 410 | 410 | 410 |
| Golf Course Irrigation | Landscape Irrigation | 110 | Copper River Golf Course | Tertiary | 54 | 110 | 110 | 110 | 110 | 110 |
| - | | | | Total: | 4,757 | 14,220 | 14,220 | 14,220 | 14,220 | 14,220 |

Note:

1. Recycled water for agricultural irrigation does not offset the City's potable water demands, and as such, is excluded from projected recycled water in subsequent tables.

### 6.4.5 Actions to Encourage and Optimize Future Recycled Water Use

The 2010 RWMP identified the need for the City to adopt an ordinance to establish a recycled water policy and criteria for its use within the City's SOI. On July 14, 2014, the Recycled Water Ordinance was adopted by the City Council, laying the foundation for the expanded use of recycled water within the City.

**The focus of the ordinance includes the following:**

- Establish an Administrative Authority.
- Establish approved uses of recycled water.
- Define areas of potential eligibility for recycled water service.
- Specify voluntary uses of recycled water, depending on user classifications.
- Require installation of a transmission and distribution infrastructure.
- Encourage the use of voluntary retrofits for existing users that may not be addressed in the ordinance.
- Require the City of Fresno to prepare Rules and Regulations.
- Provide enforcement and severability clauses.
- Establishing a means for the City to provide recycled water at a negotiated price.

Efforts to further the use of recycled water include the requirement that new developments within planned major recycled water distribution mains must install purple pipe. Then, as the City's capital projects construct a distribution infrastructure, these segments will be in place to facilitate connections to new customers, reduce program costs by avoiding digging up new street improvements and reduce disruption to vehicular traffic.

Most of the southwest recycled water distribution system from the RWRF is completed or planned for construction in 2021. The City has identified potential customers to connect to the recycled water system once it is completed to offset potable demand and increase recycled water use in the City.

## 6.5 Desalinated Water Opportunities

The City is located in the central San Joaquin Valley; therefore, seawater desalination is not applicable to the City. Additionally, the groundwater that exists within the immediate area of the City is not brackish in nature and does not require desalination treatment.

## 6.6 Water Exchanges and Transfers

### 6.6.1 Exchanges and Transfer Opportunities

#### 6.6.1.1 USBR Supply

The Central Valley Project Improvement Act (CVPIA) of 1992 authorized the transfer of all or a portion of a CVP contractor's water supply to any other California water users or water agencies. The CVPIA allows water transfers as long as they are consistent with federal and state water laws. The primary component of the CVPIA that specifies water transfer provisions for federal

water supplies is Section 3405(a), which includes provisions regarding maximum annual water transfer, beneficial use, and approvals.

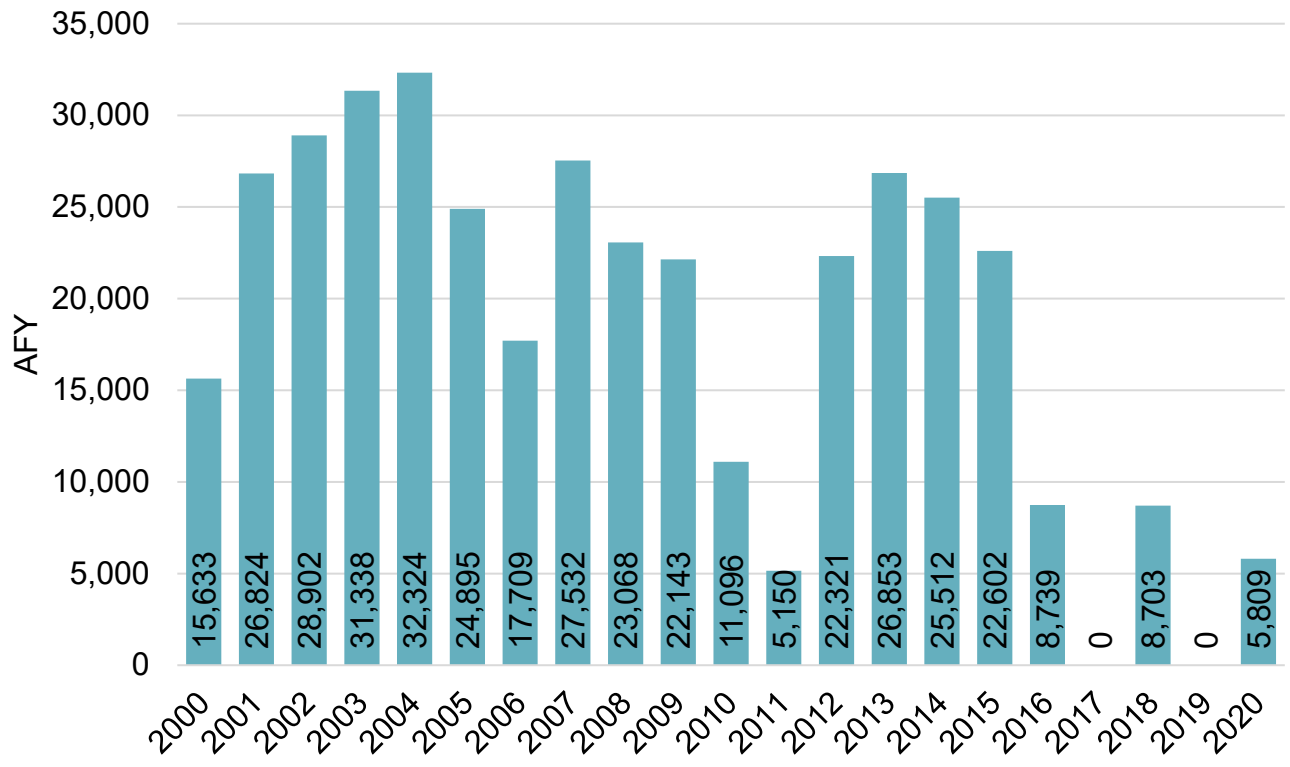
As part of the City's current Metro Plan update, the City is evaluating potential future water transfers and exchanges of its periodically available USBR water. Currently, the City does not have any plans to transfer its USBR water to other California water users.

### 6.6.1.2 FID / RWRF Groundwater Exchange Supply

Since 1974, the City has had an agreement with FID to exchange recycled water for the delivery of surface water east of the City (**Appendix I**). The Agreement between FID and the City for Exchange of Recycled Water allows for water pumped from beneath the RWRF to be conveyed to FID's Dry Creek and Houghton Canals for delivery to growers west of the City. In exchange for the water delivered to FID by the City, FID agreed to deliver 46% of the total from either its Kings River entitlement or USBR Class II supply to growers or basins in the eastern portion of FID "insofar as is feasible and practical." The water is to be considered additional to the water that would have been delivered to the eastern portion of FID, such that the additional delivered water used by growers is assumed to offset groundwater pumping in the area and, therefore, provide a groundwater basin benefit. This is an indirect benefit to the City.

The agreement includes a minimum of 100,000 AF delivered over a 10-year period and no more than 30,000 AF in any given year. As shown in **Figure 6-10**, the City exceeded the maximum yearly delivery in 2003 and 2004 and has maintained more than 100,000 AF of deliveries over a 10-year period. However, since 2016, the City has reduced RWRF groundwater exchange deliveries. The City is currently discussing an update to the agreement with FID, while the 2020 Metro Plan will identify and recommend other beneficial uses for the City's percolated effluent.

**Figure 6-10. Historical RWRF Groundwater Exchange Deliveries**



### 6.6.2 Emergency Interties

In 2007, the Cities of Fresno and Clovis executed an agreement for interconnection of their potable water systems to provide service during emergencies and other times of hardship in either community. The agreement covers interconnections, including apportionment of capital costs, at two locations: Leonard Avenue at the Gould Canal alignment and Behymer Avenue at Willow Avenue.

The agreement provided for temporary deliveries from Clovis to southeast Fresno through the Leonard connection through 2013. The Leonard interconnection was constructed and remains in place for emergency uses through manual operation.

The agreement also provided for temporary deliveries from Fresno to northern Clovis through the Behymer connection through 2015. However, the Behymer interconnection has yet to be constructed and, if constructed in the future, would serve only for emergency use.

## 6.7 Future Water Projects

The City is currently updating its Metro Plan, which will recommend programs and projects to improve the City's water supply portfolio and continue providing a safe, reliable, and sustainable water supply. While the outcomes of the Metro Plan update are currently being developed, the City's ongoing and future projects to improve its supply portfolio include:

- Expansion of recycled water distribution system
- Expansion of groundwater recharge program
- Expansion of surface water treatment capacity
- Beneficial transfers and exchanges

### 6.7.1 Expand Recycled Water Distribution System

As mentioned in **Section 6.4.5**, the City has made significant improvements to their recycled water system over the last five years and is currently expanding their recycled water distribution system. The City expects to implement construction on the final portion of the Southwest recycled water distribution system this year. The completed distribution system will allow an additional 5,000 AF of recycled water use in the City to offset potable demands that can be used in all hydrological year types. The expansion is projected to be completed by 2025.

### 6.7.2 Expand Groundwater Recharge Capacity

With the acknowledgement that the groundwater aquifer is and will remain an integral resource, the City is currently evaluating an expanded recharge program as part of the Metro Plan update. Expanding intentional recharge may include the development of new dedicated intentional recharge facilities and/or joint projects for basins with FMFCD and potentially FID. The target for recharge expansion is to maximize storage within the groundwater basin and optimize use of available surface water supplies in normal years. The stored water will be used more in the single-dry year and consecutive dry years when surface water supplies are less available.

The timing for groundwater recharge capacity expansion will be examined as part of the Metro Plan update and, for the UWMP, is assumed to increase to allow for an additional 540 AFY of recharge to occur on average each year.

### 6.7.3 Expand Surface Water Treatment Capacity

A key component to the success of the City's ability to reverse the long-time overreliance on groundwater is the construction of its surface water treatment facilities. These have allowed the City to optimize the use of available surface water supplies. The City's NESWTF currently has a 30 mgd capacity and the capability to expand up to 60 mgd. The SESWTF is currently permitted to produce up to 54 mgd but, with the subsequent rerating of the media filters, will be capable of operating at a rated capacity of 80 mgd.

The timing for the SWTF expansion will be examined as part of the Metro Plan update and determined based on need as the City grows and demands increase.

### 6.7.4 Beneficial Transfers and Exchanges

As mentioned in **Section 6.6.1**, the City is evaluating future beneficial transfers and exchanges of the City's USBR water in normal water years when available water supplies exceeds demands.

## 6.8 Summary of Existing and Planned Sources of Water

Summaries of the above discussed existing and planned sources of water are provided in **Table 6-7** and **Table 6-8** below.

### 6.8.1 Supply Management

The City currently balances its surface water supplies and groundwater based on minimum production for operation of the SWTFs and minimum groundwater pumping to manage and control contamination plumes and prevent their spread. The minimum operation conditions typically occur in the low-demand winter months, and the City can increase surface water production during peak demand months when surface water is available. In normal and wet years, the City intends to rely on more surface water supply and recharge raw surface water to replenish the groundwater basin and build storage for dry years. In dry years, when surface water is less available, the City will ramp up well production to meet demands. The City is expected to continue this supply management strategy in the future.

**Table 6-7. Actual Water Supplies (DWR 6-8R)**

| | 2020 | |
|---|---|---|
| **WATER SUPPLY** | **ACTUAL VOLUME** | **WATER QUALITY** |
| Groundwater | 55,028 | Drinking Water |
| USBR CVP | 37,447 | Drinking Water |
| FID Kings River | 71,292 | Drinking Water |
| Recycled Water, RWRF | 858 | Recycled Water |
| Recycled Water, NFWRF | 54 | Recycled Water |
| **TOTAL:** | **164,679** | |

**Table 6-8. Projected Water Supplies (DWR 6-9R)**

| | REASONABLY AVAILABLE VOLUME, AFY | | | | |
|---|---|---|---|---|---|
| **WATER SUPPLY** | **2025** | **2030** | **2035** | **2040** | **2045** |
| Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| USBR CVP | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 |
| FID Kings River | 125,030 | 131,600 | 131,600 | 131,600 | 131,600 |
| Recycled Water, RWRF | 5,800 | 5,800 | 5,800 | 5,800 | 5,800 |
| Recycled Water, NFWRF | 110 | 110 | 110 | 110 | 110 |
| **TOTAL:** | **329,030** | **341,140** | **346,610** | **352,000** | **357,330** |

## 6.8.2 Special Conditions

This section details climate change and future regulatory conditions that impact the City's supply sources.

### 6.8.2.1 Climate Change Effects

Climate models disagree on average annual precipitation projections but agree on other hydrologic metrics relevant to water resources management, including:

- Snowpack declines
- Increased fraction of precipitation on extreme rainfall days
- Shorter, sharper rainy season
- Increased evapotranspiration
- Higher frequency of extremely wet and extremely dry years
- Higher incidence of extreme dry year followed by an extreme wet year or vice versa (Persad, 2020) (Partida, 2020)

As discussed in **Section 4.4**, climate change impacts were evaluated in the North Kings GSP using DWR climate change datasets, which were developed for the California Water Commission's Water Storage Investment Program (WSIP). The North Kings GSP analyzed WSIP water supply projections and found climate change will have no significant impact on the FID Kings River diversions. The North Kings GSP estimates the timing of the inflows to water reservoir and surface water supplies is anticipated to shift significantly due to warmer temperatures causing precipitation to arrive as rainfall instead of snowmelt. The warmer temperatures are also predicted to cause the snowmelt to turn to runoff earlier each spring. These climate impacts are estimated in the North Kings GSP to slightly increase inflows to the Kings River (0.6% in 2040 and 0.3% in 2070); however, it is not expected to impact the Kings River diversions significantly and the timing will have a greater impact on water management, including a possible greater need for additional storage. The North Kings GSP also estimated climate impacts to the San Joaquin River supplies available to the CVP Friant Division Contractors, including the City's USBR Class I supplies, and found the WSIP dataset estimates a slight reduction in future water supplies (Provost & Pritchard, November 2019). This plan

considers water supply during an extreme dry year or multi-dry year scenario, which may occur more often due to climate change, further in **Chapter 7**.

### 6.8.2.2 Regulatory Conditions

The City has existing contracts for its surface water supplies that are not facing any reduction due to forthcoming regulation. The City's groundwater supply is from an unadjudicated basin and is also considered reliable. The GSA is currently working toward determining a safe yield for the Kings Subbasin, which is the amount of water than can be pumped from the basin over a long-term period without producing undesirable results. The City is an active member of the GSA, working collaboratively to bring the basin to balance while protecting the City's groundwater supply.

Additionally, forthcoming California regulations for per- and polyfluoroalkyl substances (PFAS) may impact certain wells within the City. The City is currently monitoring and treating some groundwater wells for PFAS. These regulations are not expected to impact the City's ability to use its full groundwater supply.

## 6.9 Energy Intensity

Pursuant to CWC Section 10631.2(a), readily available information regarding energy intensity shall be reported in the 2020 UWMP. For the City, this includes the total energy usage at each production facility, including each well site and the three SWTFs. The electrical usage includes the energy to produce, treat, and pump the water into the distribution system. Because the City's distribution system includes over 200 groundwater wells, **Table 6-9** presents the total energy usage, water produced, and average energy intensity for all groundwater wells and for each SWTF following the methodology presented in Appendix O of the DWR 2020 UWMP Guidebook. The energy intensity varies significantly between groundwater wells depending on the depth to the groundwater table, if the well includes treatment beyond disinfection, and other local conditions. The total energy intensity for all production and treatment in the City's distribution system in 2020 was 384 kWh/ AF.

**Table 6-9. Water System Energy Intensity in 2020**

| | WELLS | NESWTF | SESWTF | T-3 SWTF | TOTAL |
|---|---|---|---|---|---|
| Electricity (kWh) | 27,667,366 | 5,848,314 | 13,416,000 | 454,470 | 47,386,150 |
| Treated Water Deliveries (AF) | 56,445 | 20,724 | 45,367 | 875 | 123,411 |
| Energy Intensity (kWh/AF) | 490 | 282 | 296 | 520 | 384 |

7

CITY OF FRESNO

# Water Service Reliability and Drought Risk Assessment

**This Section discusses the long-term reliability of surface and groundwater supplies for the City.**

A comparison is made of anticipated supplies and demands through 2045 for a normal year, single dry year, and five-year drought. Shorter-term reliability planning that may require immediate action, such as drought or catastrophic supply interruption, is addressed in **Chapter 8**.

IN THIS SECTION


- Water Service Reliability Assessment
- Drought Risk Assessment

# 7.1 Water Service Reliability Assessment

This section describes the existing constraints on the City's supply sources and reliability in different hydrologic year types.

## 7.1.1 Constraints on Water Sources

### 7.1.1.1 Groundwater

Groundwater has long been the primary water supply source for the City. Before the City's investments to increase its use of surface water with the construction of its NESWTF, T-3 SWTF, and SESWTF, groundwater levels were declining, and the falling levels were a potential constraint. Groundwater levels in some areas of the City have actually been increasing over the last five years as a result of the City's using less groundwater and are expected to continue to increase as the City pumps less in the future.

The North Kings GSP is setting sustainability indicators for groundwater levels and groundwater storage. The current GSP does define a measurable objective and minimum threshold for the basin to allow the North Kings GSA to evaluate its progress for the subject indicator, as defined by SGMA, and determine whether conditions are improving, remaining stable, or degrading.

Another constraint to the use of groundwater stems from the negative impacts from contamination (see **Section 6.1.4**). To ensure the continued beneficial use of the groundwater supply, the City has set minimum pumping requirements for specific wells to prevent the spread of existing groundwater plumes to other areas in the City and to protect the basin. The City will remain proactive in pursuing responsible parties so the proper remediation is conducted to preserve the groundwater system as a viable and sustainable resource in perpetuity. Largely, the City has been able to rely on the relatively good quality of this resource.

### 7.1.1.2 USBR

The City has a contract for 60,000 AFY of Class 1 water with the USBR. Analysis supporting the 2006 San Joaquin River Settlement is the basis for USBR supply projections. The settlement is based on ensuring flows downstream of Millerton Dam for varying hydrologic conditions, which can constrain surface water supplies available to the CVP Friant Division contractors, such as the City.

Another constraint that affects the consistency of this supply are the restrictions that have been imposed on water diversions from the Delta (see **Section 6.2.1**). The resulting impacts associated with the restrictions from the Delta has been more detrimental to water supplies for the CVP Friant Division contractors than the above-discussed settlement, as the latter has resulted in two years of zero allocations for the CVP Friant Division contractors.

The construction of a raw water pipeline in 2018 to convey USBR water from the Friant-Kern Canal to the NESWTF, referred to as the Friant-Kern Canal Pipeline, has improved the reliability and water quality of deliveries to the NESWTF. The NESWTF is now capable of year-round operation, and the original connection from FID's Enterprise Canal still exists as a backup delivery system if needed.

Every three years, the Friant-Kern Canal is taken down for maintenance, and during these shutdowns the City has the flexibility to deliver its Kings River supply to the NESWTF to allow for its continued use.

#### 7.1.1.3 FID

The City has an agreement with FID providing the City an allocation of approximately 115,000 AFY of Kings River water in normal-year conditions. Water supplied from the FID contract is most susceptible to annual hydrologic conditions. The City's annual FID supply allocation is dependent on annual precipitation, Sierra Nevada mountain snowpack, and natural river flow conditions. The annual variability of these sources results in variable allocations to the City. Based on the foregoing data, FID receives an annually adjusted entitlement, the delivery of which will fluctuate throughout the irrigation delivery season. The City in turn receives its pro rata allocation based on the foregoing entitlement determination.

Another factor that may constrain the availability of Kings River water supply is scheduled maintenance of FID's vast canal network. FID typically terminates water deliveries to the City's water treatment facilities in the months of November and/or December so they can perform necessary infrastructure repairs and maintenance. However, the City constructed a dedicated 13-mile, 72-inch-diameter raw water pipeline to deliver Kings River water to the SESWTF to allow for year-round operations and prevent shutdowns due to FID maintenance. Deliveries to intentional recharge facilities will continue to be supplied through the FID canal system.

#### 7.1.1.4 Recycled Water

At present, the largest constraint for recycled water use is the lack of infrastructure to distribute the water to end users. The City has recently increased recycled water production capabilities and constructed much of the southwest recycled water system, as described in **Section 6.4**. The City plans to complete construction of the southwest recycled water distribution system in the near term and expand its recycled water delivery in the City.

### 7.1.2 Description of Management Tools and Options

The City currently manages its surface water and groundwater supply by maximizing surface water for potable use and intentional recharge during wet and normal years, while relying on groundwater during dry years. The City is currently updating its Metro Plan, which will recommend projects and programs to optimize the use of its supply portfolio and further improve supply resilience. Supply management tools are an expected outcome of the Metro Plan update; however, the City's ongoing supply management is intended to maximize local supplies and improve the groundwater basin storage. Current actions include enhanced groundwater management and intentional recharge, increased recycled water use, and continued conservation through the implementation of demand management measures.

### 7.1.3 Year Type Characterization

Normal-water-year, single-dry-water-year, and five-consecutive-year-drought-period supply projections were made based on historic water allocations for surface water supplies, historic municipal water well pumping for groundwater, and projected utilization for recycled water, as described below.

Kings River water supply data was obtained from the Kings River Water Association and FID. USBR CVP Friant Division data was obtained from the USBR website, the City of Fresno, and FID. Groundwater and recycled water supply data was obtained from the City of Fresno.

#### 7.1.3.1 Normal Year

Data for the total water supply for the normal-year condition is provided in **Table 7-1** based on:

- **Groundwater:** estimated sustainable yield from **Table 6-1**.
- **USBR:** long-term average allocation from **Table 6-2**.
- **FID:** long-term average allocation from **Table 6-3**.
- **Recycled Water:** projected supply from **Table 6-6**, excluding agricultural irrigation demand that does not offset the City's potable demand.

#### 7.1.3.2 Single Dry Year

The single-dry-year supply availability is based on 2015, during the 2012-2017 drought, because the City had the lowest surface water supply available in 2015. Data for total water supply for the single-dry-year condition is provided in **Table 7-2** based on:

- **Groundwater:** estimated sustainable yield from **Table 6-1**. If necessary, the City would pump beyond its estimated sustainable yield during dry periods and balance out the pumping with recharge in normal or wet periods.
- **USBR:** actual allocation in 2015 (0 AF).
- **FID:** actual total FID allocation in 2015 (42,935 AF) but with the projected City percentage of FID supply for the future years considered (per **Table 6-3**).
- **Recycled Water:** projected supply from **Table 6-6**, excluding agricultural irrigation demand that does not offset the City's potable demand.

#### 7.1.3.3 Multiple Dry Years

Data for total water supply for the five-year drought condition is provided in

**Table 7-3** based on:

- **Groundwater:** estimated sustainable yield from **Table 6-1**. If necessary, the City would pump beyond its estimated sustainable yield during dry periods and balance out the pumping with recharge in normal or wet periods.
- **USBR:** actual allocations in 2012 to 2016, which ranged from 0 to 45,000 AF.
- **FID:** actual total FID allocations in 2012 to 2016, which ranged from 42,935 to 110,824 but with the projected City percentage of FID supply for the future years considered (per **Table 6-3**).
- **Recycled Water:** projected supply from **Table 6-6**, excluding agricultural irrigation demand that does not offset the City's potable demand**.**

Despite severe reductions of surface water supplies during dry years, sufficient good-quality water was available to permit the SWTFs to operate. As mentioned in the previous section, there is some seasonal vulnerability with surface water availability in dry years, which needs to be closely coordinated with surface water suppliers to minimize impacts to the City's SWTF operations. Groundwater supplies, with intentional recharge augmentation, remain reliable in all hydrologic conditions.

## 7.1.4 Water Service Reliability

This section compares projected supplies and demands for a normal year, single dry year, and five-year consecutive drought. As shown in **Table 7-1**, the City is projected to have greater than 100,000 AF of available supply after meeting demands in normal years. As shown in **Table 7-2**, the City's surface water supplies are reduced in a single dry year, but all potable demands are met and groundwater recharge of raw surface water is reduced. As shown in **Table 7-3**, the City is projected to meet all demands during a five-year drought with its existing supplies. Potable demands are unrestricted, and non-potable water used for groundwater recharge is reduced in years three and four of a five-year drought.

**Table 7-1. Normal Year Supply and Demand Comparison (DWR 7-2R)**

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| Surface Water – USBR | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 |
| Surface Water – FID | 125,030 | 131,600 | 131,600 | 131,600 | 131,600 |
| Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| **SUPPLY TOTALS** | **329,030** | **341,140** | **346,610** | **352,000** | **357,330** |
| Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| Non-Potable (Groundwater Recharge) Demand | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| **DEMAND TOTALS** | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |
| **DIFFERENCE:** | **129,826** | **128,384** | **124,300** | **120,124** | **115,883** |

**Table 7-2. Single Dry Year Supply and Demand Comparison (DWR 7-3R)**

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| Surface Water – USBR | 0 | 0 | 0 | 0 | 0 |
| Surface Water – FID | 45,852 | 45,852 | 45,852 | 45,852 | 45,852 |
| Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| **SUPPLY TOTALS** | **189,852** | **195,392** | **200,862** | **206,252** | **211,582** |
| Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| Non-Potable (Groundwater Recharge) Demand | 27,588 | 28,776 | 29,964 | 31,152 | 32,340 |
| **DEMAND TOTALS** | **164,092** | **176,132** | **184,174** | **192,228** | **200,287** |
| **DIFFERENCE:** | **25,760** | **19,260** | **16,688** | **14,024** | **11,295** |

**Table 7-3. Multiple Dry Years Supply and Demand Comparison (DWR 7-4R)**

| | | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| FIRST YEAR | Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| | Surface Water – USBR | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| | Surface Water – FID | 99,725 | 99,725 | 99,725 | 99,725 | 99,725 |
| | Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| | **SUPPLY TOTALS** | **273,725** | **279,265** | **284,735** | **290,125** | **295,455** |
| | Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| | Non-Potable Demand | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| | **DEMAND TOTALS** | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |
| | **DIFFERENCE:** | **74,521** | **66,509** | **62,425** | **58,249** | **54,008** |
| SECOND YEAR | Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| | Surface Water – USBR | 37,200 | 37,200 | 37,200 | 37,200 | 37,200 |
| | Surface Water – FID | 93,426 | 93,426 | 93,426 | 93,426 | 93,426 |
| | Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| | **SUPPLY TOTALS** | **274,626** | **280,166** | **285,636** | **291,026** | **296,356** |
| | Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| | Non-Potable Demand | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| | **DEMAND TOTALS** | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |
| | **DIFFERENCE:** | **75,422** | **67,410** | **63,326** | **59,150** | **54,909** |
| THIRD YEAR | Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| | Surface Water – USBR | 0 | 0 | 0 | 0 | 0 |
| | Surface Water – FID | 73,568 | 73,568 | 73,568 | 73,568 | 73,568 |
| | Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| | **SUPPLY TOTALS** | **217,568** | **223,108** | **228,578** | **233,968** | **239,298** |
| | Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| | Non-Potable Demand | 53,763 | 46,281 | 43,526 | 40,677 | 37,761 |
| | **DEMAND TOTALS** | **190,267** | **193,637** | **197,736** | **201,753** | **205,708** |
| | **DIFFERENCE:** | **27,301** | **29,471** | **30,842** | **32,215** | **33,589** |

| | | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| FOURTH YEAR | Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| | Surface Water – USBR | 0 | 0 | 0 | 0 | 0 |
| | Surface Water – FID | 45,852 | 45,852 | 45,852 | 45,852 | 45,852 |
| | Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| | **SUPPLY TOTALS** | **189,852** | **195,392** | **200,862** | **206,252** | **211,582** |
| | Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| | Non-Potable Demand | 26,047 | 18,564 | 15,810 | 12,960 | 10,045 |
| | **DEMAND TOTALS** | **162,551** | **165,920** | **170,020** | **174,036** | **177,992** |
| | **DIFFERENCE:** | **27,301** | **29,471** | **30,842** | **32,215** | **33,589** |
| FIFTH YEAR | Groundwater | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| | Surface Water – USBR | 45,000 | 45,000 | 45,000 | 45,000 | 45,000 |
| | Surface Water – FID | 125,840 | 125,840 | 125,840 | 125,840 | 125,840 |
| | Recycled Water | 5,910 | 5,910 | 5,910 | 5,910 | 5,910 |
| | **SUPPLY TOTALS** | **314,840** | **320,380** | **325,850** | **331,240** | **336,570** |
| | Potable Demand | 136,504 | 147,356 | 154,210 | 161,076 | 167,947 |
| | Non-Potable Demand | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| | **DEMAND TOTALS** | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |
| | **DIFFERENCE:** | **115,636** | **107,624** | **103,540** | **99,364** | **95,123** |

## 7.2 Drought Risk Assessment

A new provision of the Water Code directs Suppliers to prepare a DRA. The DRA considers a drought period lasting five consecutive years, starting from the year following the year when the assessment is conducted. For this plan, the DRA considers five consecutive dry years from 2021 through 2025. The City may conduct an interim update or updates to this DRA within the five-year cycle of its UWMP update. The DRA analysis allows the City to examine the management of its supplies during stressed hydrologic conditions and an opportunity to evaluate whether the City may need to enact its Water Shortage Contingency Plan (WSCP) during the next actual drought period lasting at least five years. The projected gross water use for the five-year DRA is based on unrestricted potable demand, a reduction in raw-water demand for intentional recharge in years three and four of the five-year drought, and unrestricted recycled water demand.

The reliability of supplies over a five-consecutive-year drought is described in **Section 7.1.4** and summarized below for 2021 through 2025:

- **Groundwater:** based on interpolating between the 2020 and 2025 values in **Table 6-1**. If necessary, the City would pump beyond its estimated sustainable yield during dry periods and balance out the pumping with recharge in normal or wet periods.
- **USBR:** based on the actual supply allocations from these sources during the driest consecutive five-year drought (2012–2016).

- **FID:** based on the actual supply allocations from these sources during the driest consecutive five-year drought (2012–2016). For this DRA, the City's percentage of FID supplies are conservatively assumed to remain at the existing 25.79%.
- **Recycled Water:** based on interpolating between the 2020 and 2025 values in **Table 6-6**, excluding agricultural irrigation demand that does not offset the City's potable demand.

**Table 7-4** compares the total projected supply and demand for the five-year DRA for 2021 through 2025. As shown, the City does not expect to enact its WSCP for a five-consecutive-year drought based on the unrestricted potable demand projections and the current supply portfolio and reliability.

**Table 7-4. Five-Year Drought Risk Assessment**

| WATER USE TYPE | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|
| Groundwater | 133,602 | 134,724 | 135,846 | 136,968 | 138,090 |
| Surface Water – USBR | 30,000 | 37,200 | 0 | 0 | 45,000 |
| Surface Water – FID | 93,354 | 83,085 | 65,425 | 40,776 | 111,911 |
| Recycled Water | 1,912 | 2,911 | 3,911 | 4,910 | 5,910 |
| **TOTAL SUPPLY** | **258,868** | **257,920** | **205,181** | **182,655** | **300,911** |
| Potable Demand | 124,910 | 127,827 | 130,745 | 133,662 | 136,504 |
| Non-Potable Demand | 60,000 | 60,000 | 48,287 | 22,260 | 60,000 |
| **TOTAL DEMAND** | **184,910** | **187,827** | **179,032** | **155,922** | **196,504** |
| **AVAILABLE SUPPLIES** | **73,958** | **70,093** | **26,149** | **26,732** | **104,407** |

8

CITY OF FRESNO

# Water Shortage Contingency Plan

**This WSCP is a detailed plan for how the City intends to respond to foreseeable and unforeseeable water shortages. A water shortage occurs when the water supply is reduced to a level that cannot support typical demand at any given time.**

The WSCP is used to provide guidance to the City's governing body and staff and the public by identifying response actions to allow for efficient management of any water shortage with predictability and accountability. Preparation provides the tools to maintain reliable supplies and reduce the impacts of supply interruptions due to extended drought and catastrophic supply interruptions.

IN THIS SECTION


- WSCP Overview

The WSCP describes the following:

1. **Water Supply Reliability Analysis:** summarizes the City's water supply analysis and reliability and identifies any key issues that may trigger a shortage condition
2. **Annual Water Supply and Demand Assessment Procedures:** describes the key data inputs, evaluation criteria, and methodology for assessing the system's reliability for the coming year and the steps to formally declare any water shortage levels and response actions
3. **Six Standard Shortage Stages:** establishes water shortage levels to clearly identify and prepare for shortages
4. **Shortage Response Actions:** describes the response actions that may be implemented or considered for each stage to reduce gaps between supply and demand as well as minimize social and economic impacts to the community
5. **Communication Protocols:** describes communication protocols under each stage to ensure customers, the public, and government agencies are informed of shortage conditions and requirements
6. **Compliance and Enforcement:** defines compliance and enforcement actions available to administer demand reductions
7. **Legal Authority:** lists the legal documents that grant the City the authority to declare a water shortage and implement and enforce response actions
8. **Financial Consequences of WSCP Implementation:** describes the anticipated financial impact of implementing water shortage stages and identifies mitigation strategies to offset financial burdens
9. **Monitoring and Reporting:** summarizes the monitoring and reporting techniques to evaluate the effectiveness of shortage response actions and overall WSCP implementation, with results used to determine if additional shortage response actions should be activated or if efforts are successful and response actions should be reduced
10. **WSCP Refinement Procedures:** describes the factors that may trigger updates to the WSCP and outlines how to complete an update
11. **Special Water Features Distinctions:** identifies exemptions for ponds, lakes, fountains, pools, and spas, etc.
12. **Plan Adoption, Submittal, and Availability:** describes the process for the WSCP adoption, submittal, and availability after each revision

The 2020 WSCP is a standalone document that can be modified as needed and is included as **Appendix J**.

# 9 CITY OF FRESNO
# Demand Management Measures

**This chapter discusses the City's demand management measures including its water waste prevention ordinances, metering program, public outreach, and water loss reduction measures.**

The City employs several water conservation programs, in excess of State-mandated restrictions, to promote conservation and reduce the water supply demand. These measures help reduce overdraft of the groundwater aquifer that the City uses and have aided in the City's attainment of the urban water use reduction targets discussed in **Chapter 5**. The following sections provide a description of the Demand Management Measures (DMMs), including the nature and extent of each.

IN THIS SECTION

- Water Waste Prevention
- Metering
- Conservation Pricing
- Public Education and Outreach
- Water Loss Reduction Measures

# 9.1 Demand Management Measures for Retail

## 9.1.1 Water Waste Prevention Ordinances

The City prohibits water waste through implementation of the Urban Water Conservation and Excessive Water Use ordinance (see Section 6-520 of the Fresno Municipal Code). The ordinance includes such prohibitions as not washing hardscapes, using a nozzle-controlled hose, and using irrigation practices. The WSCP, included in **Appendix J**, Section 1.5, contains a more in-depth discussion of these prohibitions and consequences associated with them.

The City has a water waste hotline and a reporting form on the City website and keeps records of water waste violations. The City also employs fifteen staff persons year-round to manage and monitor the water conservation programs in place. Communication to the City's diverse customer base is always taken into consideration, so two of the positions require Spanish and Hmong languages. All Water Conservation Representatives use advanced metering infrastructure (AMI) to monitor and confirm excessive or negligent water waste incidents.

The Water Conservation staff can be reached at (559) 621-5300, (559) 621-5480, or (559) 621-CITY for after-hours emergencies. Online forms are also available to the public. Their office is located at 1910 E. University Avenue, Fresno, CA 93703. The Water Conservation Supervisor is Conrad Braganza.

## 9.1.2 Metering

In 2008, the City embarked on an aggressive project to install meters on all single-family residential service connections throughout its service area. The water meter project was completed at the end of 2012. The City already had water meters on all existing multifamily residential, commercial, industrial, landscape irrigation, and fire services.

With completion of the metering project, the City can now monitor water use more closely and provide its customers an understanding of water use (and its fiscal impacts), which has led to reducing water consumption by approximately 13% since 2013. The City will continue to monitor water use through the metering data and use the data to analyze demand trends and plan for future water shortages.

As part of the analysis of the meter data and through customer complaints or comments, the City is able to identify meters that are not working properly. Once identified, the City can have a maintenance crew visit the property and evaluate whether to repair or replace the meter.

The City also routinely tests and calibrates meters to ensure accuracy in reading and billing. Typically, meters are tested in place in the field or at a test bench in the meter shop. Field testing involves using calibrated flow meters to monitor the flow through a test port on or attached to the meter and comparing the measured flow to the meter reading. The majority of large meters, three inches and above, have a bypass valve that will be turned on during the meter test as not to disrupt water use to the property. In the case where a bypass valve is not in place, the customer is notified at least 48 hours before the test date. The City's service area has a total of approximately 135,000 meters, of which approximately 1,100 are three inches or larger. In 2018, of 157 of these large meters were tested, 10 were repaired, and 15 were replaced.

With the majority of meters being two inches or smaller, testing every single one is not logistically or economically feasible; therefore, a statistical sampling of each size is tested each year based on the following criteria:

- Meters six inches and above are tested annually.
- Meters three inches to four inches are tested at least once every two years.
- Meters three-fourths of an inch to two inches are sample tested as needed.

The City performs more frequent testing on larger meters on the basis that an error in their registration has a greater effect on customer equity and revenue issues. Meters registering larger volumes are given priority regardless of when they were last tested.

The City also shares meter data with the customers through its EyeOnWater tool available on its website or on a mobile app. This allows customers to monitor and better understand their hourly, daily, weekly, and monthly water usage, trends, and how they compare to average users.

## 9.1.3 Conservation Pricing

The City's customers are subject to the water rate structure adopted by the City Council through the Proposition 218 process. The approved rate structure has a base price designated by meter size and a volumetric rate for water usage. **Table 9-1** shows the rate structure.

The City will investigate the use of alternative rate structures in the future, which could have specific charges for usage to provide a fiscal incentive for customers to conserve water. This approach would permit customers to directly see the impact of water use reduction each month.

**Table 9-1. Current Water Rate Structure**

| | BASE RATE | | USAGE CHARGES | |
|---|---|---|---|---|
| METER SIZE | DOMESTIC | IRRIGATION | 100 CUBIC FEET (HCF) | 1,000 GALLONS |
| ¾" or smaller | $13.50 | $10.70 | $1.74 (per each HCF) | $2.33 (per each 1,000 gallons) |
| 1" | $17.90 | $13.40 | | |
| 1.5" | $20.80 | $15.20 | | |
| 2" | $35.30 | $24.10 | | |
| 3" | $52.80 | $34.90 | | |
| 4" | $79.00 | $51.00 | | |
| 6" | $152.00 | $96.00 | | |
| 8" | $705.00 | $436.00 | | |
| 10" | $1,113.00 | $687.00 | | |
| 12" | $1,462.00 | $901.00 | | |

## 9.1.4 Public Education and Outreach

The City has worked diligently to connect with and educate the community it serves. Those efforts include an emphasis on water conservation techniques and the importance of reducing overall water demand, both specifically to the resident (in terms of fiscal impacts) and to the overall water supply.

The City's varied programs to incentivize water savings are frequently discussed, including the following items:

- Water-wise landscape consultation
- EyeOnWater tool
- Irrigation efficiency audit
- Assistance with setting irrigation controllers
- Interior/exterior water leak surveys
- Water meter use information
- Water use rebates, coupons, and permits
- Lawn-to-garden rebates
- Water conservation hotlines

### 9.1.4.1 Education and Outreach

The City's water conservation public information program is managed in-house with the assistance of JP Marketing. The firm's services include strategic planning, creative concepts, public relations, marketing, promotion, research, advertising, media design, copywriting, event creation, and online services.

The City's public information program has many components, including multimedia campaigns (paid and public service advertising), customer billing inserts, literature, public outreach activities, a speaker's bureau, and inter-agency partnerships. Many of the City's water conservation materials are provided in three languages: English, Hmong, and Spanish.

The City is a member of the Central Valley Water Awareness Committee (CVWAC), which is composed of several cities, water utilities, irrigation districts, and other groups in the Central Valley. The CVWAC was created to increase the public's understanding of how water is treated, managed, and delivered to customers. The City participates in Water Awareness Month activities through its affiliation with the CVWAC.

The City conducted outreach to the community through approximately 50 events between 2015 and 2020, including:

- Setting up outreach booths providing water-saving info and rebate information at local festivals, parades, plant sales, home and garden shows, and fairs
- Participating in Annual Water Wise Plant Exchanges, a large community event to share water-wise plants and information and participate in hands-on activities
- Hosting Kids Water Camp, a large one-day event with hands-on activities for kids in third grade in all elementary schools in the service area
- Hosting workshops and speaker events about water-wise plants, gardening, and landscaping

A full list of specific education and outreach events over the past five years is included in **Appendix K**. The City also maintains a water conservation page on its website with links to many of the flyers and rebates mentioned above.

### 9.1.4.2 Water Surveys

The City conducted over 24,000 interior and exterior water leak surveys between 2015 and 2020. **Table 9-2** quantifies the number and types of surveys conducted.

**Table 9-2. Interior and Exterior Surveys**

| DESCRIPTION/YEAR | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | TOTAL |
|---|---|---|---|---|---|---|---|
| **EXTERIOR SURVEYS** | | | | | | | |
| Exterior Audit | 942 | 1,289 | 1,359 | 835 | 2,189 | 427 | 7,041 |
| Landscape Consultation | 605 | 382 | 193 | 139 | 149 | 48 | 1,516 |
| Large Turf Survey | 1 | 5 | 1 | 0 | 0 | 0 | 7 |
| Timer Tutorial | 1,644 | 1,967 | 1,873 | 2,170 | 1,346 | 518 | 9,518 |
| **INTERIOR SURVEYS** | | | | | | | |
| Interior Audit | 835 | 1,135 | 1,222 | 748 | 2,137 | 412 | 6,489 |
| **TOTALS** | **4,027** | **4,778** | **4,648** | **3,892** | **5,821** | **1,405** | **24,571** |

### 9.1.4.3 Rebate Programs

The City operates 14 rebate programs. Some of those that were active and used during the 2015–2020 reporting period are summarized in **Table 9-3**.

**Table 9-3. Rebate Program Results (2015–2020)**

| | LAWN TO GARDEN | | WASHING MACHINE | | HIGH EFFIC. TOILET | |
|---|---|---|---|---|---|---|
| YEAR | NO. | REBATE | NO. | REBATE | NO. | REBATE |
| 2015 | 122 | $4,044 | 358 | $46,144 | 301 | $35,344 |
| 2016 | 160 | $71,372 | 247 | $27,600 | 233 | $21,124 |
| 2017 | 103 | $37,157 | 255 | $19,682 | 495 | $18,937 |
| 2018 | 43 | $19,238 | 57 | $5,502 | 145 | $75,721 |
| 2019 | 42 | $19,456 | 84 | $8,000 | 115 | $19,091 |
| 2020 | 25 | $14,521 | 121 | $6,950 | 106 | $18,033 |
| **TOTALS** | **495** | **$165,791** | **1,122** | **$113,880** | **1,395** | **$188,253** |

### 9.1.5 Programs to Assess and Manage Distribution System Real Loss

As discussed in **Chapter 4**, the calculated loss was determined to be 8%, illustrating the City's conservative approach in the past. With completed system metering, the City is able to track losses more closely and understand where possible losses are occurring and correct them as necessary.

The AWWA Water Audit Tool suggested the areas the City could improve to reduce system losses, including calibration of source meters, unauthorized consumption, and data handling errors.

**The following measures are in place or are being developed to improve the system losses:**

- The City installed the remaining source meters on the few unmetered wells within the system in 2017, and now currently all wells and production facilities are fully metered.
- The City has a source meter calibration plan in place.
- The City has implemented meter testing frequency based on service size. This is discussed in more detail in **Section 9.1.2**.
- The City has an online tool as well as a telephone hotline available for the public to report water leaks, either on their property or within the public rights-of-way. This helps reduce detection time and limits the water loss from leaks.
- The City conducted a leak survey on 100 miles of the water system in January 2016. Eight total leaks were pinpointed, one on the main, two on hydrants, two on water service lines, and one at a water meter.
- The City uses meter data to identify any meters not functioning correctly or any leaks in the system so that they can be replaced or repaired. This helps reduce unaccounted for water consumption.

Unauthorized consumption can be determined, at times, through the meter data also. If a meter shows no usage, the City can note the address and schedule a site visit to determine any possible issues.

### 9.1.6 Other Demand Management Measures

In addition to the water conservation programs, the City has also enacted watering schedules for the community that specify days and times that customers are allowed to water, based on odd or even street addresses. The City has also created an automated courtesy notice program that informs customers when they exceed the excessive water use threshold during days and times when outdoor watering is not allowed.

## 9.2 Implementation to Achieve Water Use Targets

As discussed in **Chapter 5**, the City has met and exceeded its 2020 water use target. However, the City also realizes a portion of the observed conservation is due to the strict water use restrictions imposed during the drought. If those restrictions are lifted, the City will be diligent in continuing use of the above described DMMs.

The extensive metering program, replacement of turf, and replacement of over 10,000 high-water-use appliances (toilets and washing machines) over the last several years has helped the City maintain overall lower water consumption.

## 9.3 Water Use Objectives (Future Requirements)

As discussed in **Section 4.2.4.4**, the City is tracking the recommended water use efficiency standards and water use objectives developed due to Senate Bill 606 and Assembly Bill 1668. Currently no water use objectives have been adopted by the State, and are not anticipated to be adopted until 2022, but an indoor residential water use standard has been recommended by DWR, and additional standards are expected to be released in late 2021. The City is aware of the legislation and tracking the forthcoming water use objectives as they are available. The City is currently having ongoing discussions with DWR on clarifying the GIS-based approach for developing the overall water objective for residential customers. Alternatively, the City is also interested in using actual water use data (from the AMI system) to develop these objectives, following discussions and approval from DWR and SWRCB.

# 10 CITY OF FRESNO
# Plan Adoption, Submittal, and Implementation

**This section provides guidance in the adoption, submittal, and implementation of the 2020 UWMP and WSCP, as well as processes for amending the adopted plans if needed.**

This UWMP update has been prepared on a calendar-year basis and includes all water use and planning data for the 2020 calendar year. Additional details are provided in the preceding chapters.

IN THIS SECTION


- Public Hearing Notices
- Plan Adoption and Submittal

# 10.1 Notice of Public Hearing

The City has notified the County of Fresno, the only city or county in which the City provides water, of its intent to review the UWMP and consider changes to the plan. The City also notified the City of Clovis of plan preparation. Both of these governmental entities as well as a host of local water purveyors and agencies (**Table 2-1**) were notified of the preparation of the UWMP and public hearing and were encouraged to participate in the development of this plan update. Copies of the notification letters are included in **Appendix L**.

Consistent with the legislative requirements for public noticing, the City published two notices in the Fresno Bee, at least five days apart over a two-week period, providing the date and time of the public hearing. The notices were published on July 1, 2021, and July 8, 2021.

# 10.2 Public Hearing and Adoption

The City held a public hearing and adopted the 2020 UWMP on July 15, 2021. A copy of the adopting resolution is included in **Appendix M**. Before the public hearing, notices were published notifying the public of the date and time of the hearing.

# 10.3 Plan Submittal

Once the 2020 UWMP and WSCP have been adopted, a copy of the 2020 UWMP and WSCP and any subsequent amendments will be submitted to DWR, the State Library, and the County of Fresno.

# 10.4 Public Availability

Once the plan has been adopted, a hard copy will be made available for public reference at the City of Fresno Department of Public Utilities office at City Hall (located at 2600 Fresno Street) and the Water Division office (located at 1910 E. University Avenue). Additionally, an electronic copy will be uploaded to the City of Fresno website and made available for public reference.

# 11 CITY OF FRESNO References

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# A

# 2020 UWMP Checklist

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Chapter 1 | 10615 | A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses, reclamation and demand management activities. | Introduction and Overview | Chapter 1 |
| x | x | Chapter 1 | 10630.5 | Each plan shall include a simple description of the supplier's plan including water availability, future requirements, a strategy for meeting needs, and other pertinent information. Additionally, a supplier may also choose to include a simple description at the beginning of each chapter. | Summary | Executive Summary |
| x | x | Section 2.2 | 10620(b) | Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier. | Plan Preparation | Chapter 2, Section 10.2 |
| x | x | Section 2.6 | 10620(d)(2) | Coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable. | Plan Preparation | Section 2.1 |
| x | x | Section 2.6.2 | 10642 | Provide supporting documentation that the water supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan and contingency plan. | Plan Preparation | Section 2.1, Section 10.1 |
| x | | Section 2.6, Section 6.1 | 10631(h) | Retail suppliers will include documentation that they have provided their wholesale supplier(s) - if any - with water use projections from that source. | System Supplies | N/A |
| | x | Section 2.6 | 10631(h) | Wholesale suppliers will include documentation that they have provided their urban water suppliers with identification and quantification of the existing and planned sources of water available from the wholesale to the urban supplier during various water year types. | System Supplies | N/A |
| x | x | Section 3.1 | 10631(a) | Describe the water supplier service area. | System Description | Section 3.1 and 3.2 |
| x | x | Section 3.3 | 10631(a) | Describe the climate of the service area of the supplier. | System Description | Table 3-2 Section 3.3 |
| x | x | Section 3.4 | 10631(a) | Provide population projections for 2025, 2030, 2035, 2040 and optionally 2045. | System Description | Table 3-3 Section 3.4.1 |
| x | x | Section 3.4.2 | 10631(a) | Describe other social, economic, and demographic factors affecting the supplier's water management planning. | System Description | Section 3.3.1 |
| x | x | Sections 3.4 and 5.4 | 10631(a) | Indicate the current population of the service area. | System Description and Baselines and Targets | Table 3-3 Section 3.4.1 |
| x | x | Section 3.5 | 10631(a) | Describe the land uses within the service area. | System Description | Table 3-1 Section 3.1.1, Section 4.2.4.1, Table 4-3, Figure 4-3, |
| x | x | Section 4.2 | 10631(d)(1) | Quantify past, current, and projected water use, identifying the uses among water use sectors. | System Water Use | Section 4.2 |
| x | x | Section 4.2.4 | 10631(d)(3)(C) | Retail suppliers shall provide data to show the distribution loss standards were met. | System Water Use | Losses included Section 4.2.2, City has not adopted loss standards |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 4.2.6 | 10631(d)(4)(A) | In projected water use, include estimates of water savings from adopted codes, plans and other policies or laws. | System Water Use | Table 4-5 Section 4.2.4.2 |
| x | x | Section 4.2.6 | 10631(d)(4)(B) | Provide citations of codes, standards, ordinances, or plans used to make water use projections. | System Water Use | Section 4.2.5.2 |
| x | optional | Section 4.3.2.4 | 10631(d)(3)(A) | Report the distribution system water loss for each of the 5 years preceding the plan update. | System Water Use | Table 4-1 Section 4.2.2 |
| x | optional | Section 4.4 | 10631.1(a) | Include projected water use needed for lower income housing projected in the service area of the supplier. | System Water Use | Table 4-9 Section 4.3 |
| x | x | Section 4.5 | 10635(b) | Demands under climate change considerations must be included as part of the drought risk assessment. | System Water Use | Section 4.4 |
| x | | Chapter 5 | 10608.20(e) | Retail suppliers shall provide baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data. | Baselines and Targets | Table 5-1 Section 5.4 Appendix C |
| x | | Chapter 5 | 10608.24(a) | Retail suppliers shall meet their water use target by December 31, 2020. | Baselines and Targets | Section 5.5 Appendix C |
| | x | Section 5.1 | 10608.36 | Wholesale suppliers shall include an assessment of present and proposed future measures, programs, and policies to help their retail water suppliers achieve targeted water use reductions. | Baselines and Targets | N/A |
| x | | Section 5.2 | 10608.24(d)(2) | If the retail supplier adjusts its compliance GPCD using weather normalization, economic adjustment, or extraordinary events, it shall provide the basis for, and data supporting the adjustment. | Baselines and Targets | N/A |
| x | | Section 5.5 | 10608.22 | Retail suppliers' per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use of the 5 year baseline. This does not apply if the suppliers base GPCD is at or below 100. | Baselines and Targets | N/A |
| x | | Section 5.5 and Appendix E | 10608.4 | Retail suppliers shall report on their compliance in meeting their water use targets. The data shall be reported using a standardized form in the SBX7-7 2020 Compliance Form. | Baselines and Targets | Appendix C |
| x | x | Sections 6.1 and 6.2 | 10631(b)(1) | Provide a discussion of anticipated supply availability under a normal, single dry year, and a drought lasting five years, as well as more frequent and severe periods of drought. | System Supplies | Section 6.1-6.4 Section 7.1.3 |
| x | x | Sections 6.1 | 10631(b)(1) | Provide a discussion of anticipated supply availability under a normal, single dry year, and a drought lasting five years, as well as more frequent and severe periods of drought, *including changes in supply due to climate change*. | System Supplies | Section 6.8.2.1 |
| x | x | Section 6.1 | 10631(b)(2) | When multiple sources of water supply are identified, describe the management of each supply in relationship to other identified supplies. | System Supplies | Section 6.8 |
| x | x | Section 6.1.1 | 10631(b)(3) | Describe measures taken to acquire and develop planned sources of water. | System Supplies | Section 6.7 |
| x | x | Section 6.2.8 | 10631(b) | Identify and quantify the existing and planned sources of water available for 2020, 2025, 2030, 2035, 2040 and optionally 2045. | System Supplies | Table 6-7 and Table 6-8 |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 6.2 | 10631(b) | Indicate whether groundwater is an existing or planned source of water available to the supplier. | System Supplies | Section 6.1 |
| x | x | Section 6.2.2 | 10631(b)(4)(A) | Indicate whether a groundwater sustainability plan or groundwater management plan has been adopted by the water supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization. | System Supplies | Section 6.1<br>Appendix G |
| x | x | Section 6.2.2 | 10631(b)(4)(B) | Describe the groundwater basin. | System Supplies | Section 6.1.1 |
| x | x | Section 6.2.2 | 10631(b)(4)(B) | Indicate if the basin has been adjudicated and include a copy of the court order or decree and a description of the amount of water the supplier has the legal right to pump. | System Supplies | N/A |
| x | x | Section 6.2.2.1 | 10631(b)(4)(B) | For unadjudicated basins, indicate whether or not the department has identified the basin as a high or medium priority. Describe efforts by the supplier to coordinate with sustainability or groundwater agencies to achieve sustainable groundwater conditions. | System Supplies | Section 6.1.2 |
| x | x | Section 6.2.2.4 | 10631(b)(4)(C) | Provide a detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years | System Supplies | Section 6.1.6<br>Figure 6-6 |
| x | x | Section 6.2.2 | 10631(b)(4)(D) | Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped. | System Supplies | Section 6.1.5<br>Table 6-1 |
| x | x | Section 6.2.7 | 10631(c) | Describe the opportunities for exchanges or transfers of water on a short-term or long- term basis. | System Supplies | Section 6-6 |
| x | x | Section 6.2.5 | 10633(b) | Describe the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project. | System Supplies (Recycled Water) | Section 6.4.2, Appendix B<br>Table 6-3R |
| x | x | Section 6.2.5 | 10633(c) | Describe the recycled water currently being used in the supplier's service area. | System Supplies (Recycled Water) | Section 6.4.4 Table 6-5 |
| x | x | Section 6.2.5 | 10633(d) | Describe and quantify the potential uses of recycled water and provide a determination of the technical and economic feasibility of those uses. | System Supplies (Recycled Water) | Section 6.4.4 |
| x | x | Section 6.2.5 | 10633(e) | Describe the projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected. | System Supplies (Recycled Water) | Section 6.4.4 Table 6-6 |
| x | x | Section 6.2.5 | 10633(f) | Describe the actions which may be taken to encourage the use of recycled water and the projected results of these actions in terms of acre-feet of recycled water used per year. | System Supplies (Recycled Water) | Section 6.4.5 |
| x | x | Section 6.2.5 | 10633(g) | Provide a plan for optimizing the use of recycled water in the supplier's service area. | System Supplies (Recycled Water) | Section 6.4.5 |
| x | x | Section 6.2.6 | 10631(g) | Describe desalinated water project opportunities for long-term supply. | System Supplies | Section 6.5 |
| x | x | Section 6.2.5 | 10633(a) | Describe the wastewater collection and treatment systems in the supplier's service area with quantified amount of collection and treatment and the disposal methods. | System Supplies (Recycled Water) | Section 6.4.2, Appendix B<br>Table 6-3R |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 6.2.8, Section 6.3.7 | 10631(f) | Describe the expected future water supply projects and programs that may be undertaken by the water supplier to address water supply reliability in average, single-dry, and for a period of drought lasting 5 consecutive water years. | System Supplies | Section 6.7 |
| x | x | Section 6.4 and Appendix O | 10631.2(a) | The UWMP must include energy information, as stated in the code, that a supplier can readily obtain. | System Suppliers, Energy Intensity | Section 6.9 |
| x | x | Section 7.2 | 10634 | Provide information on the quality of existing sources of water available to the supplier and the manner in which water quality affects water management strategies and supply reliability | Water Supply Reliability Assessment | Section 7.1.1 |
| x | x | Section 7.2.4 | 10620(f) | Describe water management tools and options to maximize resources and minimize the need to import water from other regions. | Water Supply Reliability Assessment | Section 7.1.2 |
| x | x | Section 7.3 | 10635(a) | Service Reliability Assessment: Assess the water supply reliability during normal, dry, and a drought lasting five consecutive water years by comparing the total water supply sources available to the water supplier with the total projected water use over the next 20 years. | Water Supply Reliability Assessment | Section 7.1.4 |
| x | x | Section 7.3 | 10635(b) | Provide a drought risk assessment as part of information considered in developing the demand management measures and water supply projects. | Water Supply Reliability Assessment | Section 7.2 |
| x | x | Section 7.3 | 10635(b)(1) | Include a description of the data, methodology, and basis for one or more supply shortage conditions that are necessary to conduct a drought risk assessment for a drought period that lasts 5 consecutive years. | Water Supply Reliability Assessment | Section 7.1.3.3 |
| x | x | Section 7.3 | 10635(b)(2) | Include a determination of the reliability of each source of supply under a variety of water shortage conditions. | Water Supply Reliability Assessment | Section 7.1.3 |
| x | x | Section 7.3 | 10635(b)(3) | Include a comparison of the total water supply sources available to the water supplier with the total projected water use for the drought period. | Water Supply Reliability Assessment | Section 7.1.4 Table 7-1, Table 7-2, and Table 7-3 |
| x | x | Section 7.3 | 10635(b)(4) | Include considerations of the historical drought hydrology, plausible changes on projected supplies and demands under climate change conditions, anticipated regulatory changes, and other locally applicable criteria. | Water Supply Reliability Assessment | Section 7.1.3 and 7.1.4 |
| x | x | Chapter 8 | 10632(a) | Provide a water shortage contingency plan (WSCP) with specified elements below. | Water Shortage Contingency Planning | Appendix J |
| x | x | Chapter 8 | 10632(a)(1) | Provide the analysis of water supply reliability (from Chapter 7 of Guidebook) in the WSCP | Water Shortage Contingency Planning | Appendix J - Section 1.2 |
| x | x | Section 8.10 | 10632(a)(10) | Describe reevaluation and improvement procedures for monitoring and evaluation the water shortage contingency plan to ensure risk tolerance is adequate and appropriate water shortage mitigation strategies are implemented. | Water Shortage Contingency Planning | Appendix J - Section 1.10 |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 8.2 | 10632(a)(2)(A) | Provide the written decision-making process and other methods that the supplier will use each year to determine its water reliability. | Water Shortage Contingency Planning | Appendix J - Section 1.3 |
| x | x | Section 8.2 | 10632(a)(2)(B) | Provide data and methodology to evaluate the supplier's water reliability for the current year and one dry year pursuant to factors in the code. | Water Shortage Contingency Planning | Appendix J - Section 1.3 |
| x | x | Section 8.3 | 10632(a)(3)(A) | Define six standard water shortage levels of 10, 20, 30, 40, 50 percent shortage and greater than 50 percent shortage. These levels shall be based on supply conditions, including percent reductions in supply, changes in groundwater levels, changes in surface elevation, or other conditions. The shortage levels shall also apply to a catastrophic interruption of supply. | Water Shortage Contingency Planning | Appendix J - Section 1.4 Table 2 |
| x | x | Section 8.3 | 10632(a)(3)(B) | Suppliers with an existing water shortage contingency plan that uses different water shortage levels must cross reference their categories with the six standard categories. | Water Shortage Contingency Planning | Appendix J - Section 1.4 Figure 2 |
| x | x | Section 8.4 | 10632(a)(4)(A) | Suppliers with water shortage contingency plans that align with the defined shortage levels must specify locally appropriate supply augmentation actions. | Water Shortage Contingency Planning | Appendix J - Section 1.5.3 Table 4 |
| x | x | Section 8.4 | 10632(a)(4)(B) | Specify locally appropriate demand reduction actions to adequately respond to shortages. | Water Shortage Contingency Planning | Appendix J - Section 1.5.2 Table 3 |
| x | x | Section 8.4 | 10632(a)(4)(C) | Specify locally appropriate operational changes. | Water Shortage Contingency Planning | Appendix J - Section 1.5.4 |
| x | x | Section 8.4 | 10632(a)(4)(D) | Specify additional mandatory prohibitions against specific water use practices that are in addition to state-mandated prohibitions are appropriate to local conditions. | Water Shortage Contingency Planning | Appendix J - Section 1.5.1 |
| x | x | Section 8.4 | 10632(a)(4)(E) | Estimate the extent to which the gap between supplies and demand will be reduced by implementation of the action. | Water Shortage Contingency Planning | Appendix J - Section 1.5.2 Table 3 |
| x | x | Section 8.4.6 | 10632.5 | The plan shall include a seismic risk assessment and mitigation plan. | Water Shortage Contingency Plan | Appendix J - Section 1.5.6 |
| x | x | Section 8.5 | 10632(a)(5)(A) | Suppliers must describe that they will inform customers, the public and others regarding any current or predicted water shortages. | Water Shortage Contingency Planning | Appendix J - Section 1.6 |
| x | x | Section 8.5 and 8.6 | 10632(a)(5)(B) 10632(a)(5)(C) | Suppliers must describe that they will inform customers, the public and others regarding any shortage response actions triggered or anticipated to be triggered and other relevant communications. | Water Shortage Contingency Planning | Appendix J - Section 1.6 |
| x | | Section 8.6 | 10632(a)(6) | Retail supplier must describe how it will ensure compliance with and enforce provisions of the WSCP. | Water Shortage Contingency Planning | Appendix J - Section 1.7 |
| x | | Section 8.7 | 10632(a)(7)(A) | Describe the legal authority that empowers the supplier to enforce shortage response actions. | Water Shortage Contingency Planning | Appendix J - Section 1.8 |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 8.7 | 10632(a)(7)(B) | Provide a statement that the supplier will declare a water shortage emergency Water Code Chapter 3. | Water Shortage Contingency Planning | Appendix J - Section 1.8 |
| x | x | Section 8.7 | 10632(a)(7)(C) | Provide a statement that the supplier will coordinate with any city or county within which it provides water for the possible proclamation of a local emergency. | Water Shortage Contingency Planning | Appendix J - Section 1.8 |
| x | x | Section 8.8 | 10632(a)(8)(A) | Describe the potential revenue reductions and expense increases associated with activated shortage response actions. | Water Shortage Contingency Planning | Appendix J - Section 1.9 |
| x | x | Section 8.8 | 10632(a)(8)(B) | Provide a description of mitigation actions needed to address revenue reductions and expense increases associated with activated shortage response actions. | Water Shortage Contingency Planning | Appendix J - Section 1.9 |
| x | | Section 8.8 | 10632(a)(8)(C) | Retail suppliers must describe the cost of compliance with Water Code Chapter 3.3: Excessive Residential Water Use During Drought | Water Shortage Contingency Planning | Appendix J - Section 1.9 |
| x | | Section 8.9 | 10632(a)(9) | Retail suppliers must describe the monitoring and reporting requirements and procedures that ensure appropriate data is collected, tracked, and analyzed for purposes of monitoring customer compliance. | Water Shortage Contingency Planning | Appendix J - Section 1.10 |
| x | | Section 8.11 | 10632(b) | Analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas. | Water Shortage Contingency Planning | Appendix J - Section 1.12 |
| x | x | Sections 8.12 and 10.4 | 10635(c) | Provide supporting documentation that Water Shortage Contingency Plan has been, or will be, provided to any city or county within which it provides water, no later than 30 days after the submission of the plan to DWR. | Plan Adoption, Submittal, and Implementation | Appendix J - Section 1.13 |
| x | x | Section 8.14 | 10632(c) | Make available the Water Shortage Contingency Plan to customers and any city or county where it provides water within 30 after adopted the plan. | Water Shortage Contingency Planning | Appendix J - Section 1.13 |
| | x | Sections 9.1 and 9.3 | 10631(e)(2) | Wholesale suppliers shall describe specific demand management measures listed in code, their distribution system asset management program, and supplier assistance program. | Demand Management Measures | N/A |
| x | | Sections 9.2 and 9.3 | 10631(e)(1) | Retail suppliers shall provide a description of the nature and extent of each demand management measure implemented over the past five years. The description will address specific measures listed in code. | Demand Management Measures | Section 9.1 |
| x | | Chapter 10 | 10608.26(a) | Retail suppliers shall conduct a public hearing to discuss adoption, implementation, and economic impact of water use targets (recommended to discuss compliance). | Plan Adoption, Submittal, and Implementation | Section 10.2 |
| x | x | Section 10.2.1 | 10621(b) | Notify, at least 60 days prior to the public hearing, any city or county within which the supplier provides water that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. Reported in Table 10-1. | Plan Adoption, Submittal, and Implementation | Section 10.1, Table 2-1, Appendix L |

| Retail | Wholesale | 2020 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | 2020 UWMP Location (Optional Column for Agency Review Use) |
|---|---|---|---|---|---|---|
| x | x | Section 10.4 | 10621(f) | Each urban water supplier shall update and submit its 2020 plan to the department by July 1, 2021. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Sections 10.2.2, 10.3, and 10.5 | 10642 | Provide supporting documentation that the urban water supplier made the plan and contingency plan available for public inspection, published notice of the public hearing, and held a public hearing about the plan and contingency plan. | Plan Adoption, Submittal, and Implementation | Appendix L |
| x | x | Section 10.2.2 | 10642 | The water supplier is to provide the time and place of the hearing to any city or county within which the supplier provides water. | Plan Adoption, Submittal, and Implementation | Appendix L |
| x | x | Section 10.3.2 | 10642 | Provide supporting documentation that the plan and contingency plan has been adopted as prepared or modified. | Plan Adoption, Submittal, and Implementation | Appendix M |
| x | x | Section 10.4 | 10644(a) | Provide supporting documentation that the urban water supplier has submitted this UWMP to the California State Library. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Section 10.4 | 10644(a)(1) | Provide supporting documentation that the urban water supplier has submitted this UWMP to any city or county within which the supplier provides water no later than 30 days after adoption. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Sections 10.4.1 and 10.4.2 | 10644(a)(2) | The plan, or amendments to the plan, submitted to the department shall be submitted electronically. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Section 10.5 | 10645(a) | Provide supporting documentation that, not later than 30 days after filing a copy of its plan with the department, the supplier has or will make the plan available for public review during normal business hours. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Section 10.5 | 10645(b) | Provide supporting documentation that, not later than 30 days after filing a copy of its water shortage contingency plan with the department, the supplier has or will make the plan available for public review during normal business hours. | Plan Adoption, Submittal, and Implementation | TBD |
| x | x | Section 10.6 | 10621(c) | If supplier is regulated by the Public Utilities Commission, include its plan and contingency plan as part of its general rate case filings. | Plan Adoption, Submittal, and Implementation | N/A |
| x | x | Section 10.7.2 | 10644(b) | If revised, submit a copy of the water shortage contingency plan to DWR within 30 days of adoption. | Plan Adoption, Submittal, and Implementation | TBD |

# B

# DWR Standardized Tables

## **2-1R** | Public Water Systems

| Public Water System Number | Public Water System Name | Number of Municipal Connections 2020 | Volume of Water Supplied 2020 |
|---|---|---|---|
| CA1010007 | CITY OF FRESNO | 139,523 | 121,994 |
| | **Total:** | **139,523** | **121,994** |
| Note: Data provided by City of Fresno Water Division | | | |

## **2-2** | Public Water Systems

| Type of Plan | Member of RUWMP | Member of Regional Alliance | Name of RUWMP or Regional Alliance |
|---|---|---|---|
| Individual UWMP | No | No | N/A |

## **2-3** | Agency Identification

| Type of Supplier | Year Type | First Day of Year | | Unit Type |
|---|---|---|---|---|
| | | DD | MM | |
| Retailer | Calendar Years | | | Acre Feet (AF) |

***Conversion to Gallons:*** *325851*
***Conversion to Gallons per Day:*** *892.7425*

## **2-4R** | Water Supplier Information Exchange

| **Wholesale Water Supplier Name** |
|---|
| United States Bureau of Reclamation |
| Fresno Irrigation District |

## **3-1R** | Current & Projected Population

| Population Served | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| Total | 550,217 | 609,433 | 674,677 | 719,327 | 765,278 | 812,529 |

# **4-1R** | Actual Demands for Water

| Use Type | Additional Description | Level of Treatment When Delivered | 2020 Volume |
|---|---|---|---|
| Single Family | | Drinking Water | 60,065 |
| Multi-Family | | Drinking Water | 18,842 |
| Commercial | | Drinking Water | 16,971 |
| Industrial | | Drinking Water | 5,729 |
| Institutional/Governmental | See Note 1 | Drinking Water | --- |
| Landscape | | Drinking Water | 10,478 |
| Other | Travel Meters | Drinking Water | 340 |
| Losses | | Drinking Water | 9,568 |
| Groundwater Recharge | | Raw Water | 42,686 |
| | | **Total:** | **164,679** |

Notes:
1. Institutional and Governmental water usage is included in the Commercial use type.

## **4-2R** | Projected Demands for Water

| Use Type | Additional Description | Projected Water Use | | | | |
|---|---|---|---|---|---|---|
| | | 2025 | 2030 | 2035 | 2040 | 2045 |
| Single Family | | 76,255 | 80,429 | 82,934 | 85,437 | 87,936 |
| Multi-Family | | 19,000 | 20,654 | 21,737 | 22,831 | 23,935 |
| Commercial | | 19,052 | 21,135 | 22,587 | 24,041 | 25,496 |
| Industrial | | 7,410 | 9,003 | 9,922 | 10,841 | 11,758 |
| Institutional/Governmental | See Note 1 | | | | | |
| Landscape | | 4,490 | 5,035 | 5,422 | 5,809 | 6,196 |
| Other | Travel Meters | 200 | 200 | 200 | 200 | 200 |
| Losses | | 10,097 | 10,900 | 11,408 | 11,917 | 12,426 |
| Groundwater Recharge | Raw Water | 62,700 | 65,400 | 68,100 | 70,800 | 73,500 |
| **Total:** | | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |

Notes:
1. Institutional and Governmental water usage is included in the Commercial use type.

## **4-3R** | Total Gross Water Use

| | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| **Potable and Raw Water** From Table 4-1R and 4-2R | 164,679 | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| **Recycled Water Demand** From Table 6-4R | 4,757 | | | | | |
| **Total Water Use:** | **169,436** | **199,204** | **212,756** | **222,310** | **231,876** | **241,447** |

Note: Recycled water supply is a potable water offset, thus the recycled water demand in years 2025-2045 is included in the potable and raw water demand total.

# **4-4R** | 12 Month Water Loss Audit Reporting

| Report Period Start Date | | Volume of Water Loss* |
|---|---|---|
| MM | YYYY | |
| 1 | 2016 | 9,036 |
| 1 | 2017 | 10,235 |
| 1 | 2018 | 9,028 |
| 1 | 2019 | 9,059 |
| 1 | 2020 | 9,568 |

*For years 2016, through 2019, volume of water loss is taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet. For 2020 the volume of water loss is estimates as the difference in metered water produced and entered into the distribution system and metered consumption.

## **4-5R** | Inclusion in Water Use Projections

| | |
|---|---|
| **Are Future Water Savings Included in Projections?**<br>Refer to Appendix K of UWMP Guidebook. | Yes |
| Section or page number where the citations utilized in the demand projects can it be found: | Section 4.2.4.2 |
| **Are Lower Income Residential Demands Included in Projections?** | Yes |

## **5-1R** | Baselines & Targets Summary

| Baseline Period | Start Year | End Year | Average Baseline GPCD* | Confirmed 2020 Target * |
|---|---|---|---|---|
| **10-15 Year** | 1999 | 2008 | 309 | 247 |
| **5 Year** | 2003 | 2007 | 304 | N/A |

*All values are in Gallons per Capita per Day (GPCD)

## **5-2R** | 2020 Compliance

| Actual 2020 GPCD* | Optional Adjustments to 2020 GPCD | | | | | 2020 GPCD* (Adjusted if applicable) | Supplier Achieved Targeted Reduction in 2020 |
|---|---|---|---|---|---|---|---|
| | Extraordinary Events* | Economic Adjustment* | Weather Normalization* | Total Adjustments* | Adjusted 2020 GPCD* | | |
| 198 | 0 | 0 | 0 | 0 | 0 | 0 | Yes |

*All values are in Gallons per Capita per Day (GPCD)

## **6-1R** | Groundwater Volume Pumped

| Groundwater Type | Location or Basin Name | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| **Alluvial Basin** | San Joaquin Groundwater Basin: Kings Subbasin | 99,107 | 105,211 | 76,796 | 54,609 | 55,028 |
| | **Total:** | **99,107** | **105,211** | **76,796** | **54,609** | **55,028** |

## **6-2R** | Wastewater Collected within Service Area in 2020

| The supplier will complete the table. | | | | | | |
|---|---|---|---|---|---|---|
| | | | 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** | **Wastewater Volume Collected from UWMP Service Area in 2020** | **Name of Wastewater Agency Receiving Collected Wastewater** | **Wastewater Treatment Plant Name** | **Wastewater Treatment Plant Located within UWMP Area** | **WWTP Operation Contracted to a Third Party** |
| **City of Fresno** | Metered | 63,652 | **City of Fresno** | RWRF | Yes | No |
| **City of Fresno** | Metered | 325 | **City of Fresno** | NFWRF | Yes | No |
| | **Total:** | **63,977** | | | | |
| Note: Wastewater Volume in units of AF | | | | | | |

## **6-3R** | Wastewater Treatment & Discharge Within Service Area in 2020

| **The supplier will complete the table.** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Wastewater Treatment Plant Name** | **Discharge Location Name or Identifier** | **Discharge Location Description** | **Wastewater Discharge ID Number** | **Method of Disposal** | **Plant Treats Wastewater Generated Outside the Service Area** | **Treatment Level** | **2020 Volumes** | | | | |
| | | | | | | | **Wastewater Treated** | **Discharged Treated Wastewater** | **Recycled Within Service Area** | **Recycled Outside of Service Area** | **Instream Flow Permit Requirement** |
| **RWRF** | Treatment Site | Onsite Percolation Ponds | WDR Order R5-2018-0080 | Percolation ponds | Yes | Secondary, Undisinfected | 63,652 | 58,949 | - | 3,845 | - |
| **RWRF** | Treatment Site | Onsite Percolation Ponds | WDR Order R5-2018-0080 | Percolation ponds | Yes | Tertiary | | | 858 | - | - |
| **NFWRF** | Treatment Site | Onsite Pond | WDR Order R5-2014-0162 | Percolation ponds | No | Tertiary | 325 | 271 | 54 | - | - |
| | | | | | | **Total:** | **63,977** | **59,220** | **912** | **3,845** | **-** |

## **6-4R** | Recycled Water Direct Beneficial Uses Within Service Area

| The supplier will complete the table. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Name of Supplier Producing (Treating) the Recycled Water:** | | | City of Fresno | | | | | | | |
| **Name of Supplier Operating the Recycled Water Distribution System:** | | | City of Fresno | | | | | | | |
| **Supplemental Volume of Water Added in 2020:** | | | | | | | | | | 0% |
| **Source of 2020 Supplemental Water:** | | | N/A | | | | | | | |
| **Beneficial Use Type** | **Potential Beneficial Uses of Recycled Water** | **Amount of Potential Uses of Recycled Water** | **General Description of 2020 Uses** | **Level of Treatment** | **2020** | **2025** | **2030** | **2035** | **2040** | **2045** |
| **Agricultural Irrigation** | Non-food crop irrigation | 7,900 | Irrigate non-food crops | Secondary, Undisinfected | 3,845 | 7,900 | 7,900 | 7,900 | 7,900 | 7,900 |
| **Landscape Irrigation (excludes golf courses)** | Landscape Irrigation | 5,800 | Landscape irrigation, distribtued through the southwest recycled water distribution system | Tertiary | 858 | 5,800 | 5,800 | 5,800 | 5,800 | 5,800 |
| **Agricultural Irrigation** | Food crop irrigation | 410 | Irrigate limited food crops, distribtued through the southwest recycled water distribution system | Tertiary | - | 410 | 410 | 410 | 410 | 410 |
| **Golf Course Irrigation** | Landscape Irrigation | 110 | Copper River Golf Course | Tertiary | 54 | 110 | 110 | 110 | 110 | 110 |
| | | | | **Total:** | **4,757** | **14,220** | **14,220** | **14,220** | **14,220** | **14,220** |
| **Internal Reuse (Not included in Statewide Recycled Water Volume).** | | | | | 11 | 30 | 30 | 30 | 30 | 30 |

# **6-5R** | 2015 Recycled Water Use Projection Compared to 2020 Actual

**The supplier will complete the table.**

| Use Type | 2015 Projection for 2020 | 2020 Actual Use |
|---|---|---|
| **Agricultural Irrigation** | 14,200 | 3,845 |
| **Landscape Irrigation (excludes golf courses)** | 4,300 | 858 |
| **Golf Course Irrigation** | | 54 |
| **Commercial Use** | | |
| **Industrial Use** | 1,400 | |
| **Geothermal and Other Energy Production** | | |
| **Seawater Intrusion Barrier** | | |
| **Recreational Impoundment** | | |
| **Wetlands or Wildlife Habitat** | | |
| **Groundwater Recharge (IPR)*** | 1,300 | |
| **Surface Water Augmentation (IPR)*** | | |
| **Direct Potable Reuse** | | |
| **Total:** | **21,200** | **4,757** |

## **6-6R** | Methods to Expand Future Recycled Water Use

| **The supplier will complete the table below.** | | | |
|---|---|---|---|
| **Name of Action** | **Description** | **Planned Implementation Year** | **Expected Increase of Recycled Water Use** |
| **Build Infrastructure** | Recycled Water Distribution System Expansion | 2021 | 5,000 |
| | | **Total:** | **5,000** |

# **6-7R** | Expected Future Water Supply Projects or Programs

| **Some or all of the supplier's future water supply projects or programs are not compatible with this table and are described in a narrative format.** | | | | | | |
|---|---|---|---|---|---|---|
| **Page Location for Narrative in UWMP:** | | | Section 6.7 | | | |
| **Name of Future Projects or Programs** | **Joint Project with Other Suppliers** | **Agency Name** | **Description** | **Planned Implementation Year** | **Planned for Use in Year Type** | **Expected Increase in Water Supply to Supplier** |
| **Expansion of Tertiary Recycled Water Treatment** | No | | See Section 6.7 | | All Year Types | |
| **Expansion of Surface Water Treatment Capacity** | No | | See Section 6.7 | | All Year Types | |
| **Expansion of Groundwater Recharge Program** | No | | See Section 6.7 | | All Year Types | |

## **6-8R** | Actual Water Supplies

| Water Supply | Additional Detail on Water Supply | 2020 | | |
|---|---|---|---|---|
| | | Actual Volume | Water Quality | Total Right or Safe Yield |
| **Groundwater (not desalinated)** | | 55,028 | Drinking Water | |
| **Surface water (not desalinated)** | USBR CVP | 37,447 | Drinking Water | |
| **Surface water (not desalinated)** | FID Contract | 71,292 | Drinking Water | |
| **Recycled Water** | RWRF | 858 | Recycled Water | |
| **Recycled Water** | NFWRF | 54 | Recycled Water | |
| | **Total:** | **164,679** | | **-** |

## **6-8DS** | Source Water Desalination

**Neither groundwater nor surface water are reduced in salinity prior to distribution. The supplier will not complete the table.**

## **6-9R** | Projected Water Supplies

| Water Supply | Additional Detail on Water Supply | Projected Water Supply | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2025 | | 2030 | | 2035 | | 2040 | | 2045 | |
| | | Reasonably Available Volume | Total Right or Safe Yield | Reasonably Available Volume | Total Right or Safe Yield | Reasonably Available Volume | Total Right or Safe Yield | Reasonably Available Volume | Total Right or Safe Yield | Reasonably Available Volume | Total Right or Safe Yield |
| Groundwater (not desalinated) | Kings Subbasin | 138,090 | | 143,630 | | 149,100 | | 154,490 | | 159,820 | |
| Surface water (not desalinated) | USBR CVP | 60,000 | | 60,000 | | 60,000 | | 60,000 | | 60,000 | |
| Surface water (not desalinated) | FID Contract | 125,030 | | 131,600 | | 131,600 | | 131,600 | | 131,600 | |
| Recycled Water | NFWRF Tertiary Disinfected | 5,800 | | 5,800 | | 5,800 | | 5,800 | | 5,800 | |
| Recycled Water | RWRF Tertiary Disinfected | 110 | | 110 | | 110 | | 110 | | 110 | |
| **Total:** | | **329,030** | **-** | **341,140** | **-** | **346,610** | **-** | **352,000** | **-** | **357,330** | **-** |

# 7-1R | Basis of Water Year Data (Reliability Assessment)

| | |
|---|---|
| **Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP.** | |
| **Page Location for Narrative in UWMP:** | See Section 7.1.3 in the UWMP |

## **7-2R** | Normal Year Supply and Demand Comparison

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| **Supply Totals** From Table 6-9R | 329,030 | 341,140 | 346,610 | 352,000 | 357,330 |
| **Demand Totals** From Table 4-3R | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| **Difference:** | **129,826** | **128,384** | **124,300** | **120,124** | **115,883** |

## **7-3R** | Single Dry Year Supply & Demand Comparison

| | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|
| **Supply Totals** | 189,852 | 195,392 | 200,862 | 206,252 | 211,582 |
| **Demand Totals** | 164,092 | 176,132 | 184,174 | 192,228 | 200,287 |
| **Difference:** | **25,760** | **19,260** | **16,688** | **14,024** | **11,295** |

# 7-4R | Multiple Dry Years Supply & Demand Comparison

| | | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|
| **First Year** | **Supply Totals** | 273,725 | 279,265 | 284,735 | 290,125 | 295,455 |
| | **Demand Totals** | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | **Difference:** | **74,521** | **66,509** | **62,425** | **58,249** | **54,008** |
| **Second Year** | **Supply Totals** | 274,626 | 280,166 | 285,636 | 291,026 | 296,356 |
| | **Demand Totals** | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | **Difference:** | **75,422** | **67,410** | **63,326** | **59,150** | **54,909** |
| **Third Year** | **Supply Totals** | 217,568 | 223,108 | 228,578 | 233,968 | 239,298 |
| | **Demand Totals** | 190,267 | 193,637 | 197,736 | 201,753 | 205,708 |
| | **Difference:** | **27,301** | **29,471** | **30,842** | **32,215** | **33,589** |
| **Fourth Year** | **Supply Totals** | 189,852 | 195,392 | 200,862 | 206,252 | 211,582 |
| | **Demand Totals** | 162,551 | 165,920 | 170,020 | 174,036 | 177,992 |
| | **Difference:** | **27,301** | **29,471** | **30,842** | **32,215** | **33,589** |
| **Fifth Year** | **Supply Totals** | 314,840 | 320,380 | 325,850 | 331,240 | 336,570 |
| | **Demand Totals** | 199,204 | 212,756 | 222,310 | 231,876 | 241,447 |
| | **Difference:** | **115,636** | **107,624** | **103,540** | **99,364** | **95,123** |

## **7-5** | Five-Year Drought Risk Assessment Tables to Address Water Code Section 10635(b)

| | | |
|---|---|---|
| **2021** | **Gross Water Use** | 184,910 |
| | **Total Supplies** | 240,905 |
| | **Surplus/Shortfall without WSCP Action** | **55,995** |
| | **Planned WSCP Actions (Use Reduction and Supply Augmentation)** | |
| | **WSCP (Supply Augmentation Benefit)** | 0 |
| | **WSCP (Use Reduction Savings Benefit)** | 0 |
| | **Revised Surplus/Shortfall** | **55,995** |
| | **Resulting Percent Use Reduction from WSCP Action** | **0%** |
| **2022** | **Gross Water Use** | 187,827 |
| | **Total Supplies** | 244,448 |
| | **Surplus/Shortfall without WSCP Action** | **56,621** |
| | **Planned WSCP Actions (Use Reduction and Supply Augmentation)** | |
| | **WSCP (Supply Augmentation Benefit)** | 0 |
| | **WSCP (Use Reduction Savings Benefit)** | 0 |
| | **Revised Surplus/Shortfall** | **56,621** |
| | **Resulting Percent Use Reduction from WSCP Action** | **0%** |
| **2023** | **Gross Water Use** | 170,051 |
| | **Total Supplies** | 196,200 |
| | **Surplus/Shortfall without WSCP Action** | **26,149** |
| | **Planned WSCP Actions (Use Reduction and Supply Augmentation)** | |
| | **WSCP (Supply Augmentation Benefit)** | 0 |
| | **WSCP (Use Reduction Savings Benefit)** | 0 |
| | **Revised Surplus/Shortfall** | **26,149** |
| | **Resulting Percent Use Reduction from WSCP Action** | **0%** |
| **2024** | **Gross Water Use** | 151,432 |
| | **Total Supplies** | 178,164 |
| | **Surplus/Shortfall without WSCP Action** | **26,732** |
| | **Planned WSCP Actions (Use Reduction and Supply Augmentation)** | |
| | **WSCP (Supply Augmentation Benefit)** | 0 |
| | **WSCP (Use Reduction Savings Benefit)** | 0 |
| | **Revised Surplus/Shortfall** | **26,732** |
| | **Resulting Percent Use Reduction from WSCP Action** | **0%** |
| **2025** | **Gross Water Use** | 196,504 |
| | **Total Supplies** | 300,911 |
| | **Surplus/Shortfall without WSCP Action** | **104,407** |
| | **Planned WSCP Actions (Use Reduction and Supply Augmentation)** | |
| | **WSCP (Supply Augmentation Benefit)** | 0 |
| | **WSCP (Use Reduction Savings Benefit)** | 0 |
| | **Revised Surplus/Shortfall** | **104,407** |
| | **Resulting Percent Use Reduction from WSCP Action** | **0%** |

**8-1** | Water Shortage Contingency Plan Levels

| Shortage Level | Percent Shortage[1] | Water Shortage Condition |
|---|---|---|
| 0 | | No water shortage condition. Corresponds with year-round water use measures listed in Section 1.5.1 and demand reduction measures listed for "All" stages in Table 3. |
| 1 | 0-10% | Stage 1 may be triggered by any of the following conditions:<br>•The available water supplies for the next year are projected to be less than 100% of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>•After having been in a Stage 2 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[2] or higher; or<br>•After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 2 | 10-25% | Stage 2 may be triggered by any of the following conditions:<br>•The available water supplies for the next year are projected to be less than 90% of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>•After having been in a Stage 3 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[2] or higher; or<br>•After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 3 | 25-35% | Stage 3 may be triggered by any of the following conditions:<br>•The available water supplies for the next year are projected to be less than 75% of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>•After having been in a Stage 4 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[2] or higher; or<br>•After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 4 | 35-50% | Stage 4 may be triggered by any of the following conditions:<br>•The available water supplies for the next year are projected to be less than 65% of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>•After having been in a Stage 5 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[2] or higher; or<br>•After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 5 | >50% | Stage 5 may be triggered by any of the following conditions:<br>•The available water supplies for the next year are projected to be less than 50% of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment. |

[1]Shortage levels indicate the gap between supply and demand compared to normal-year conditions. The Annual Assessment incorporates a 10% buffer on top of projected demands for conservative planning.
[2]Water year types were defined 2006 San Joaquin River Restoration Settlement Agreement for USBR allocations and characterized in Section 6.2 of the City's 2020 UWMP.

**8-2** | Demand Reduction Actions

| Shortage Level | Demand Reduction Actions | How much is this going to reduce the shortage gap?[1] | Additional Explanation or Reference | Penalty, Charge, or Other Enforcement[2] |
|---|---|---|---|---|
| All | Expand Public Information Campaign | Not Applicable | Community outreach includes classroom presentations, outreach educational information, and water tours. Increase communication as drought stages increase. | Not Applicable |
| All | Improve Customer Billing | Not Applicable | Water bills show customer usage vs. average usage for the customer category. Increase customer notifications of high water use based on advanced metering infrastructure (AMI) data as drought stages increase. | Not Applicable |
| All | Offer Water Use Surveys | Not Applicable | Use water leak surveys with all community members. | Not Applicable |
| All | Provide Rebates for Landscape Irrigation Efficiency | Not Applicable | The City offers rebates for micro-irrigation conversions, soil moisture sensors, smart irrigation controller, and rain sensors to improve efficiencies. | Not Applicable |
| All | Provide Rebates for Turf Replacement | Not Applicable | The City provides rebates for community members who wish to replace their turf with a drought-resistant garden. | Not Applicable |
| All | Provide Rebates on Plumbing Fixtures and Devices | Not Applicable | The City offers rebates on a variety of high-efficiency plumbing fixtures, such as washers, toilets, and urinals. | Not Applicable |
| All | Decrease Line Flushing | Not Applicable | The City uses NO-DES for regular pipe flushing to eliminate discharging water. | Not Applicable |
| All | Reduce System Water Loss | Not Applicable | The City has a comprehensive system water loss reduction program in place. Increase efforts to correct water system losses as drought stages increase. | Not Applicable |
| 1 | Decrease Line Flushing | 0 to 100% of shortage gap | For dead-end flushing where the NO-DES truck cannot be used, reduce normal flushing time. | Not Applicable |
| 1 | Increase Water Waste Patrols | 0 to 100% of shortage gap | Increase monitoring of AMI reporting and communication with customers; Conduct patrols based on public input. | Not Applicable |
| 1 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Voluntary limits:<br>Summer: three days/week<br>Winter: one day/week | No |
| 2 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Summer: three days/week<br>Winter: one day/week | Yes |
| 3 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Summer: two days/week<br>Winter: one day/week | Yes |
| 4 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Summer: one day/week<br>Winter: one day/week | Yes |
| 4 | Other — Prohibit use of potable water for construction and dust control | 0 to 100% of shortage gap | The City provides rebates for community members who wish to replace their turf with a drought resistant garden | No |
| 4 | Other — Prohibit use of potable water for construction and dust control | 0 to 100% of shortage gap | Prohibit use of potable water for construction, compaction, dust control, street or parking lot sweeping, and building washdowns where non-potable or recycled water is sufficient. | Yes |
| 4 | Other — Prohibit vehicle washing except at facilities using recycled or recirculating water | 0 to 100% of shortage gap | Prohibit washing cars, boats, trailers, aircraft, or other vehicles, except at commercial or fleet vehicle-washing facilities using water recycling equipment. | Yes |
| 4 | Pools and Spas - Require covers for pools and spas | 0 to 100% of shortage gap | Require covers for swimming pools when not in use. | No |
| 4 | Other | 0 to 100% of shortage gap | Prohibit use of potable water for sewer system maintenance or fire protection training without prior approval by the City manager. | Not Applicable |
| 4 | Other | 0 to 100% of shortage gap | Prohibit use of outdoor misters. | No |
| 5 | Landscape — Prohibit all landscape irrigation | 0 to 100% of shortage gap | Prohibit outdoor irrigation year-round. | Yes |
| 5 | Moratorium or Net Zero Demand Increase on New Connections | 0 to 100% of shortage gap | The City will temporarily limit or ban new water service connections within the service area. | Not Applicable |

[1]Reduction in the shortage gap is estimated and can vary significantly.
[2]Refer to WSCP Section 1.7 for Penalties for Water Wastage.

## 8-3R | Supply Augmentation & Other Actions

| Shortage Level | Supply Augmentation Methods and Other Actions by Water Supplier | How much is this going to reduce the shortage gap? | Additional Explanation or Reference |
|---|---|---|---|
| 1 to 5 | Transfers | As Needed | Purchase or exchange available USBR or FID surface water |
| 1 to 5 | Other Purchases | As Needed | Interconnection with City of Clovis for use in emergencies |

# 10-1R | Notification to Cities & Counties

| City | 60 Day Notice | Notice of Public Hearing | Other |
|---|---|---|---|
| City of Clovis | Yes | Yes | |
| **County** | **60 Day Notice** | **Notice of Public Hearing** | **Other** |
| County of Fresno | Yes | Yes | |
| **Other** | **60 Day Notice** | **Notice of Public Hearing** | **Other** |
| Bakman Water Company | Yes | Yes | |
| Fresno Irrigation District | Yes | Yes | |
| Fresno Metropolitan Flood Control District | Yes | Yes | |
| Friant Water Authority | Yes | Yes | |
| Garfield Water District | Yes | Yes | |
| Malaga County Water District | Yes | Yes | |
| North Kings Groundwater Sustainabilty Agency | Yes | Yes | |
| Pinedale County Water District | Yes | Yes | |
| United Stated Bureau of Reclamation South-Central California Area Office | Yes | Yes | |

# C

# SBx7-7 Tables and Verification Form

| **SB X7-7 Table 7-A: Target Method 1**<br>20% Reduction | |
|---|---|
| 10-15 Year Baseline GPCD | 2020 Target GPCD |
| 309 | 247 |
| NOTES: | |

| **SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target** | | | |
|---|---|---|---|
| 5 Year Baseline GPCD *From SB X7-7 Table 5* | Maximum 2020 Target* | Calculated 2020 Target *Fm Appropriate Target Table* | Confirmed 2020 Target |
| 304 | 288 | 247 | 247 |
| ** Maximum 2020 Target is 95% of the 5 Year Baseline GPCD* | | | |
| NOTES: | | | |

| **SB X7-7 Table 9: 2015 Compliance** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | Optional Adjustments *(in GPCD)* | | | | | 2015 GPCD *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? |
| | | Extraordinary Events | Weather Normalization | Economic Adjustment | TOTAL Adjustments | Adjusted 2015 GPCD | | |
| 190 | 278 | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | 0 | 189.745674 | 189.745674 | YES |
| NOTES: | | | | | | | | |

| **SB X7-7 Table 0: Units of Measure Used in 2020 UWMP*** *(select one from the drop down list)* |
|---|
| Acre Feet |
| **The unit of measure must be consistent throughout the UWMP, as reported in Submittal Table 2-3.* |
| NOTES: |

| SB X7-7 Table 2: Method for 2020 Population Estimate | |
|---|---|
| **Method Used to Determine 2020 Population** (may check more than one) | |
| ☐ | **1. Department of Finance** (DOF) or **American Community Survey** (ACS) |
| ☐ | **2. Persons-per-Connection Method** |
| ☑ | **3. DWR Population Tool** |
| ☐ | **4. Other** DWR recommends pre-review |
| NOTES: | |

| SB X7-7 Table 3: 2020 Service Area Population | |
|---|---|
| **2020 Compliance Year Population** | |
| **2020** | 550,217 |
| NOTES: | |

| SB X7-7 Table 4: 2020 Gross Water Use | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Compliance Year 2020** | **2020 Volume Into Distribution System** *This column will remain blank until SB X7-7 Table 4-A is completed.* | **2020 Deductions** | | | | | **2020 Gross Water Use** |
| | | **Exported Water *** | **Change in Dist. System Storage*** (+/-) | **Indirect Recycled Water** *This column will remain blank until SB X7-7 Table 4-B is completed.* | **Water Delivered for Agricultural Use*** | **Process Water** *This column will remain blank until SB X7-7 Table 4-D is completed.* | |
| | 121,994 | - | - | - | - | - | **121,994** |
| *** Units of measure (AF, MG , or CCF)** must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3. | | | | | | | |
| NOTES: | | | | | | | |

**SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment**

Complete one table for each source.

| **Name of Source** | Groundwater |
|---|---|
| **This water source is** *(check one)* **:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Compliance Year 2020** | Volume Entering Distribution System [1] | Meter Error Adjustment [2] *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|
| | 55,028 | - | 55,028 |

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES

**SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s) Meter Error Adjustment**

Complete one table for each source.

| **Name of Source** | Surface Water- NESWTF |
|---|---|
| **This water source is** *(check one)* **:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Compliance Year 2020** | Volume Entering Distribution System [1] | Meter Error Adjustment [2] *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|
| | 20,724 | | 20,724 |

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

**SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment**

Complete one table for each source.

| **Name of Source** | Surface Water- SESWTF |
|---|---|
| **This water source is** *(check one)* **:** | |

| | |
|---|---|
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| Compliance Year 2020 | Volume Entering Distribution System [1] | Meter Error Adjustment [2] *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|
| | 45,367 | | 45,367 |

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

**SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment**

Complete one table for each source.

| **Name of Source** | Surface Water- T-3 SWTF |
|---|---|

**This water source is** *(check one)* **:**

| | |
|---|---|
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| Compliance Year 2020 | Volume Entering Distribution System [1] | Meter Error Adjustment [2] *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|
| | 875 | | 875 |

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

**SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment**

Complete one table for each source.

| **Name of Source** | Enter Name of Source 5 |
|---|---|

**This water source is** *(check one)* **:**

| | |
|---|---|
| ☐ | The supplier's own water source |
| ☐ | A purchased or imported source |

| SB X7-7 Table 5: 2020 Gallons Per Capita Per Day (GPCD) | | |
|---|---|---|
| **2020 Gross Water** *Fm SB X7-7 Table 4* | **2020 Population** *Fm SB X7-7 Table 3* | **2020 GPCD** |
| 121,994 | 550,217 | **198** |
| NOTES: | | |

| SB X7-7 Table 9: 2020 Compliance | | | | | | | |
|---|---|---|---|---|---|---|---|
| Actual 2020 GPCD[1] | Optional Adjustments to 2020 GPCD<br>Enter "0" if Adjustment Not Used<br>Extraordinary Events[1] | Weather Normalization[1] | Economic Adjustment[1] | TOTAL Adjustments[1] | Adjusted 2020 GPCD [1] *(Adjusted if applicable)* | 2020 Confirmed Target GPCD [1, 2] | **Did Supplier Achieve Targeted Reduction for 2020?** |
| 198 | - | - | - | - | 198 | 247 | **YES** |

[1] *All values are reported in GPCD*

[2] ***2020 Confirmed Target GPCD*** *is taken from the Supplier's SB X7-7 Verification Form Table SB X7-7, 7-F.*

NOTES:

# D

# City of Fresno's Reduce Delta Reliance Reporting

# Appendix D - Delta Reliance

## 1. Background

Under the Sacramento-San Joaquin Delta Reform Act of 2009, state and local public agencies proposing a covered action (e.g., a proposed project) in the Sacramento-San Joaquin Delta (Delta), prior to initiating the implementation of that action, must prepare a written certification of consistency with detailed findings as to whether the covered action is consistent with applicable Delta Plan policies and submit that certification to the Delta Stewardship Council.

Anyone may appeal a certification of consistency. If the Delta Stewardship Council grants the appeal, the covered action may not be implemented until the agency proposing the covered action submits a revised certification of consistency. The covered action may be implemented if either: 1) no appeal is filed; or 2) the Delta Stewardship Council denies the appeal to the revised certification of consistency.

The City of Fresno (City) contracts with the United States Bureau of Reclamation (USBR) Central Valley Project (CVP) Friant Division for an annual supply of 60,000 af of Class 1 water through an agreement originally executed in January 1961. Although the Friant Division of the CVP does not pull water from the Delta, the project was developed through an exchange agreement reached in 1939 with the Delta-Mendota supply that provides water to the Exchange Contractors[1] with historic pre-1914 San Joaquin River water rights. As restrictions on Delta exports have hindered USBR from making deliveries to the Delta-Mendota Canal, the Exchange Contractors can call on their historic rights, which reduces the Friant Division Class 1 allocations. As such, the City is required to demonstrate consistency with the Delta Plan's policy to reduce reliance on the Delta.

An urban water supplier that anticipates participating in or receiving water from a proposed covered action such as a multi-year water transfer, conveyance facility, or new diversion that involves transferring water through, exporting water from, or using water in the Delta should provide information in their 2015 and 2020 Urban Water Management Plans (UWMPs) that can then be used in the covered action process to demonstrate consistency with Delta Plan Policy WR P1, Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance (WR P1).

WR P1 details what is needed for a covered action to demonstrate consistency with reduced reliance on the Delta and improved regional self-reliance. WR P1 subsection (a) states that:

[1] The Exchange Contractors are the benefactors of the historic pre-1914 water rights established by Miller and Lux. These contracts include: Central California Irrigation District; San Luis Canal Company; Firebaugh Canal Water District; and Columbia Canal Company, per http://www.sjrecwa.net/history.html (accessed March 10, 2021).

*(a) Water shall not be exported from, transferred through, or used in the Delta if all of the following apply:*

*(1) One or more water suppliers that would receive water as a result of the export, transfer, or use have failed to adequately contribute to reduced reliance on the Delta and improved regional self-reliance consistent with all of the requirements listed in paragraph (1) of subsection (c);*

*(2) That failure has significantly caused the need for the export, transfer, or use; and*

*(3) The export, transfer, or use would have a significant adverse environmental impact in the Delta.*

WR P1 subsection (c)(1) further defines what adequately contributing to reduced reliance on the Delta means in terms of (a)(1) above.

*(c)(1) Water suppliers that have done all the following are contributing to reduced reliance on the Delta and improved regional self-reliance and are therefore consistent with this policy:*

*(A) Completed a current Urban or Agricultural Water Management Plan (Plan) which has been reviewed by the California Department of Water Resources for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;*

*(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta; and*

*(C) Included in the Plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance. The expected outcome for measurable reduction in Delta reliance and improvement in regional self- reliance shall be reported in the Plan as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code section 1011(a).*

The analysis and documentation provided below include all the elements described in WR P1(c)(1) that need to be included in a water supplier's UWMP to support a certification of consistency for a future covered action.

## 2. Methodology

As stated in WR P1(c)(1)(C), the policy requires that, commencing in 2015, UWMPs include expected outcomes for improved regional self-reliance and measurable reduction in Delta reliance. WR P1 further states that those outcomes shall be reported in the UWMP as the reduction in the amount of water used, or in the percentage of water used, from the Delta. The expected outcomes for the City's regional self-reliance and reduced Delta reliance were developed using the approach and guidance described in Appendix C of DWR's Urban Water Management Plan Guidebook 2020 issued in March 2020 (Guidebook Appendix C), including the use of narrative justifications for the accounting of supplies and the documentation of specific data sources.

All data were obtained from planning documents adopted by the City Council, including the current and previous UWMPs and Metropolitan Water Resource Management Plan (Metro Plan) and represent average or normal water year conditions. Using normal water year demands serves as a proxy for the amount of supplies that would be used in a normal water year, which helps alleviate issues associated with how supply capability is presented to fulfill requirements of the UWMP Act versus how supplies might be accounted for to demonstrate consistency with WR P1.

To calculate the expected outcomes for improved regional self-reliance and reduced Delta reliance, a baseline is needed to compare against. This analysis uses a normal water year representation of 2010 as the baseline, which is consistent with the approach described in the Guidebook Appendix C. Data for the 2010 baseline were taken from the City's 2008 UWMP. Consistent with the 2010 baseline data approach, the expected outcomes for improved regional self-reliance and reduced Delta reliance for 2015 and 2020 were taken from the City's 2010 and 2015 UWMPs, respectively. Expected outcomes for 2025-2045 are from the current 2020 UWMP. Documentation of the specific data sources and assumptions are included in the discussions below.

# 3. Demonstration of Regional Self-Reliance

## 3.1 Service Area Demands without Water Use Efficiency

Because WR P1 considers water use efficiency savings a source of water supply, water suppliers such as the City that do not explicitly quantify water use efficiency savings in their UWMPs can calculate their embedded water use efficiency savings based on changes in forecasted per capita water use since the baseline.

Agencies that explicitly calculate and report water use efficiency savings in their UWMP will need to make an adjustment to properly reflect normal water year demands in the calculation of reduced reliance. As explained in the Guidebook Appendix C, water use efficiency savings must be added back to the normal year demands to represent demands without water use efficiency savings accounted for; otherwise the effect of water use efficiency savings on regional self-reliance would be overestimated. **Table 1** (included at the end of this appendix) shows the results of this adjustment for the City. Supporting narratives and documentation for all the data shown in Table 1 are provided below.

Service Area Demands with Water Use Efficiency

The service area demands shown in Table 1 represent the total water demands for the City's service area. The demand data shown in Table 1 were collected from the following sources:

- Baseline (2010): Fresno 2008 UWMP, Table 6-5
- 2015: Fresno 2010 UWMP, Table 7-2
- 2020: Fresno 2015 UWMP, Table 4-4
- 2025-2045: Fresno 2020 UWMP, Table 4-6

Non-Potable Water Demands

The non-potable water demands shown in Table 1 represent recycled water use that offsets potable water use in the City's service area. The demand data shown in Table 1 were collected from the following sources:

- Baseline (2010): Fresno 2008 UWMP, Table 10-7
- 2015: Fresno 2010 UWMP, Table 7-1
- 2020: Fresno 2015 UWMP, Table 6-14
- 2025-2045: Fresno 2020 UWMP, Table 4-7

Potable Service Area Demands with Water Use Efficiency

Subtract "Non-Potable Water Demands" from "Service Area Demands with Water Use Efficiency."

Service Area Population

The population data shown in Table 1 were collected from the following sources:

- Baseline (2010) and 2015: Fresno 2015 UWMP, Table 5-1
- 2020-2045: Fresno 2020 UWMP, Table 3-3

Estimated Water Use Efficiency Since Baseline

The "Per Capita Water Use" calculated using "Potable Service Area Demands with Water Use Efficiency" divided by "Service Area Population". The "Change in Per Capita Water Use from Baseline" was then calculated by comparing with 2010 Per Capita Water Use. Finally, the "Estimated Water Use Efficiency Since Baseline" was calculated by multiplying the "Change in Per Capita Water Use from Baseline" by the population for one (1) year.

Service Area Water Demands without Water Use Efficiency

Add "Service Area Demands with Water Use Efficiency" to "Estimated Water Use Efficiency Since Baseline."

## 3.2 Supplies Contributing to Regional Self-Reliance

For a covered action to demonstrate consistency with the Delta Plan, WR P1 subsection (c)(1)(C) states that water suppliers must report the expected outcomes for measurable improvement in regional self-reliance. Table 2 shows expected outcomes for supplies contributing to regional self-reliance both in amount and as a percentage. The numbers shown in **Table 2** (included at the end of this appendix) represent efforts to improve regional self-reliance for the City's entire service area and include the total contributions of the City and its customers. Supporting narratives and documentation for all of the data shown in Table 2 are provided below.

Estimated Water Use Efficiency Since Baseline

The water use efficiency information shown in Table 2 is taken directly from Table 1.

Water Recycling

The water recycling information shown in Table 2 is taken from the Non-Potable Water Demands row in Table 1.

Local and Regional Water Supply and Storage Programs

The values shown in Table 2 represent groundwater supplies considering both natural recharge and intentional recharge. The supply data shown in Table 2 were collected from the following sources:

- Baseline (2010): Fresno 2008 UWMP, Table 4-9
- 2015: Fresno 2010 UWMP, Table 7-1
- 2020: Fresno 2015 UWMP, Table 6-14

- 2025-2045: Fresno 2020 UWMP, Table 6-8

Other Programs and Projects the Contribute to Regional Self-Reliance

The values shown in Table 2 represent Kings River supplies considering both contracted supplies and recycled water exchange supplies. The supply data shown in Table 2 were collected from the following sources:

- Baseline (2010): Fresno 2008 UWMP, Table 4-11
- 2015: Fresno 2010 UWMP, Table 7-1
- 2020: Fresno 2015 UWMP, Table 6-5
- 2025-2045: Fresno 2020 UWMP, Table 6-8

Water Supplies Contributing to Regional Self Reliance

Sum of:

- Estimated Water Use Efficiency Since Baseline
- Water Recycling
- Local and Regional Water Supply and Storage Programs
- Other Programs and Projects the Contribute to Regional Self-Reliance

Percent of Water Supplies Contributing to Regional Self-Reliance

"Water Supplies Contributing to Regional Self Reliance" divided by "Service Area Water Demands without Water Use Efficiency" (from Section 3.1).

## 3.3 Conclusions

The results shown in Table 2 demonstrate that the City's service area is measurably improving its regional self-reliance. The following provides a summary of the near-term (2025) and long-term (2045) expected outcomes for the City's regional self-reliance:

- Near-term (2025): The expected outcome for normal water year regional self-reliance is expected to increase by 129,700 AFY from the 2010 baseline; this represents an increase of about 31 percent of 2025 normal water year demands (Table 2).
- Long-term (2045): The expected outcome for normal water year regional self-reliance is expected to increase by more than 191,600 AFY from the 2010 baseline, this represents an increase of about 14 percent of 2045 normal water year retail demands (Table 2).

The results show that the City is measurably improving regional self-reliance, both as an amount of water used and as a percentage of water used.

# 4. Demonstration of Reduced Reliance on the Delta

The City's service area reduces reliance on the Delta through investments in non-Delta water supplies, local water supplies, and regional and local demand management measures.

## 4.1 Calculation of Reliance on Water Supplies from the Delta Watershed

The calculation of reliance on water supplies from the Delta watershed, shown in **Table 3** (included at the end of this appendix), is based on the following assumptions.

CVP/SWP Contract Supplies

The City water supplies with a connection to the Delta watershed are CVP/SWP Contract Supplies. The supply data shown in Table 3 is for anticipated average yield from the City's USBR contract and were collected from the following sources:

- Baseline (2010): Fresno 2008 UWMP, Table 4-6
- 2015: Fresno 2010 UWMP, Table 7-1
- 2020: Fresno 2015 UWMP, Table 6-14
- 2025-2045: Fresno 2020 UWMP, Table 6-2

Water Supplies from the Delta Watershed

Equal to "CVP/SWP Contract Supplies."

Percent Change in Supplies from the Delta Watershed

Divides "Water Supplies from the Delta Watershed" by "Service Area Demands without Water Use Efficiency" (from Section 3.1) and calculates changes from the 2010 baseline.

## 4.2 Conclusions

The following provides a summary of the near-term (2025) and long-term (2045) expected outcomes for the City's Delta reliance on supplies from the Delta watershed:

- Near-term (2025): The expected outcome for normal water year reliance on supplies from the Delta watershed is expected to decrease by 4,520 AF from the 2010 baseline. With Delta water representing 25.5% of service area water demand without water use efficiency, this represents a decrease from the 2010 baseline of 10.1% (Table 3).
- Long-term (2045): The expected outcome for normal water year reliance on supplies from the Delta watershed is expected to decrease by 4,520 AF from the 2010 baseline. With Delta water representing 19.5% of service area water demand without water use efficiency, this represents a decrease from the 2010 baseline of 16.2% (Table 3).

The results shown in Table 3 demonstrate that City is measurably reducing reliance on the Delta, both as an amount of water used and as a percentage of water used.

## 5. UWMP Implementation

In addition to the analysis and documentation described above, WR P1 subsection (c)(1)(B) requires that all programs and projects included in the UWMP that are locally cost-effective and technically feasible, which reduce reliance on the Delta, are identified, evaluated, and implemented consistent with the implementation schedule. WR P1 (c)(1)(B) states that:

> *(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta[.]*

In accordance with Water Code Section 10631(f), water suppliers must already include in their UWMP a detailed description of expected future projects and programs that they may implement to increase the amount of water supply available to them in normal and single-dry water years and for a period of drought lasting five consecutive years. The UWMP description must also identify specific projects, include a description of the increase in water supply that is expected to be available from each project, and include an estimate regarding the implementation timeline for each project or program.

Chapter 6 of the City's 2020 UWMP summarizes the implementation of future water projects and continued progress in developing a diversified water portfolio to meet the City's water needs.

## 6. 2015 UWMP Appendix L

The information contained in this appendix is also intended to be a new Appendix L attached to the City's 2015 UWMP consistent with WR P1 subsection (c)(1)(C) (Cal. Code Regs. tit. 23, § 5003). The City provided notice of the availability of the draft 2020 UWMP, 2020 WSCP, and a new Appendix L to the 2015 UWMP and the public hearing to consider adoption of the documents in accordance with CWC Sections 10621(b) and 10642, and Government Code Section 6066, and Chapter 17.5 (starting with Section 7290) of Division 7 of Title 1 of the Government Code. The public review drafts of the 2020 UWMP, Appendix L to the 2015 UWMP, and the 2020 WSCP were posted on the City's website, fresno.gov, on June 28, 2021, more than 14 days in advance of the public hearing on July 15, 2021. The notice of availability of the documents was sent to the City's customers, as well as cities and counties in the City's service area. Copies of the notification letter sent to the customers and cities and counties in the City's service area are included in the 2020 UWMP Appendix L. Thus, this Appendix D to the City's 2020 UWMP, which was adopted with the City's 2020 UWMP, will also be recognized and treated as Appendix L to the City's 2015 UWMP.

The City held the public hearing for the draft 2020 UWMP, draft Appendix L to the 2015 UWMP, and draft 2020 WSCP on July 15, 2021, at a regular City Council meeting, held online due to COVID-19 concerns. At the meeting, the City Council determined that the 2020 UWMP and the 2020 WSCP accurately represent the water resources plan for the City's service area. In addition, the City Council determined that Appendix L to the 2015 UWMP and Appendix D to the 2020 UWMP includes all of the elements described in Delta Plan Policy WR P1, Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance (Cal. Code Regs. tit. 23, § 5003), which need to be included in a water supplier's UWMP to support a certification of consistency for a future covered action. As stated in Resolutions 2021-196, 2021-197, and 2021-198, the City Council adopted the 2020 UWMP, the 2020 WSCP, and Appendix L to the 2015 UWMP and authorized their submittal to the State of California. Copies of the resolutions are included in the 2020 UWMP Appendix M.

## Table 1. Calculation of Service Area Water Demands without Water Use Efficiency (UWMP Table C-1 and Table C-2)

**Table C-1: Optional Calculation of Water Use Efficiency -To be completed if Water Supplier does not specifically estimate Water Use Efficiency as a supply**

| Service Area Water Use Efficiency Demands (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands with Water Use Efficiency Accounted For | 163,300 | 172,900 | 168,200 | 136,579 | 147,505 | 154,434 | 161,372 | 168,318 |
| Non-Potable Water Demands | 750 | 1,000 | 9,500 | 14,220 | 14,220 | 14,220 | 14,220 | 14,220 |
| Potable Service Area Demands with Water Use Efficiency Accounted For | 162,550 | 171,900 | 158,700 | 122,359 | 133,285 | 140,214 | 147,152 | 154,098 |

| Total Service Area Population | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Service Area Population | 505,315 | 525,575 | 550,217 | 609,433 | 674,677 | 719,327 | 765,278 | 812,529 |

| Water Use Efficiency Since Baseline (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Per Capita Water Use (GPCD) | 287 | 292 | 257 | 179 | 176 | 174 | 172 | 169 |
| Change in Per Capita Water Use from Baseline (GPCD) | | 5 | (30) | (108) | (111) | (113) | (116) | (118) |
| Estimated Water Use Efficiency Since Baseline | | (2,833) | 18,294 | 73,684 | 83,745 | 91,180 | 99,023 | 107,277 |

**Table C-2: Calculation of Service Area Water Demands Without Water Use Efficiency**

| Total Service Area Water Demands (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands with Water Use Efficiency Accounted For | 163,300 | 172,900 | 168,200 | 136,579 | 147,505 | 154,434 | 161,372 | 168,318 |
| Reported Water Use Efficiency or Estimated Water Use Efficiency Since Baseline | - | (2,833) | 18,294 | 73,684 | 83,745 | 91,180 | 99,023 | 107,277 |
| Service Area Water Demands without Water Use Efficiency Accounted For | 163,300 | 170,067 | 186,494 | 210,263 | 231,250 | 245,614 | 260,395 | 275,595 |

## Table 2. Calculation of Supplies Contributing to Regional Self-Reliance (UWMP Table C-3)

**Table C-3: Calculation of Supplies Contributing to Regional Self-Reliance**

| Water Supplies Contributing to Regional Self-Reliance (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Estimated Water Use Efficiency since Baseline | - | (2,833) | 18,294 | 73,684 | 83,745 | 91,180 | 99,023 | 107,277 |
| Water Recycling | 750 | 1,000 | 9,500 | 14,220 | 14,220 | 14,220 | 14,220 | 14,220 |
| Stormwater Capture and Use | | | | | | | | |
| Advanced Water Technologies | | | | | | | | |
| Conjunctive Use Projects | | | | | | | | |
| Local and Regional Water Supply and Storage Projects | 88,800 | 76,100 | 132,480 | 138,090 | 143,630 | 149,100 | 154,490 | 159,820 |
| Other Programs and Projects the Contribute to Regional Self-Reliance | 131,750 | 117,400 | 116,000 | 125,030 | 131,600 | 131,600 | 131,600 | 131,600 |
| Water Supplies Contributing to Regional Self-Reliance | 221,300 | 191,667 | 276,274 | 351,024 | 373,195 | 386,100 | 399,333 | 412,917 |

| Service Area Water Demands without Water Use Efficiency (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands without Water Use Efficiency Accounted For | 163,300 | 170,067 | 186,494 | 210,263 | 231,250 | 245,614 | 260,395 | 275,595 |

| Change in Regional Self Reliance (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Water Supplies Contributing to Regional Self-Reliance | 221,300 | 191,667 | 276,274 | 351,024 | 373,195 | 386,100 | 399,333 | 412,917 |
| Change in Water Supplies Contributing to Regional Self-Reliance | | (29,633) | 54,974 | 129,724 | 151,895 | 164,800 | 178,033 | 191,617 |

| Percent Change in Regional Self Reliance (As Percent of Demand w/out WUE) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Percent of Water Supplies Contributing to Regional Self-Reliance | 135.5% | 112.7% | 148.1% | 166.9% | 161.4% | 157.2% | 153.4% | 149.8% |
| Change in Percent of Water Supplies Contributing to Regional Self-Reliance | | -22.8% | 12.6% | 31.4% | 25.9% | 21.7% | 17.8% | 14.3% |

## Table 3. Reliance on Water Supplies from the Delta Watershed (UWMP Table C-4)

**Table C-4: Calculation of Reliance on Water Supplies from the Delta Watershed**

| Water Supplies from the Delta Watershed (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| CVP/SWP Contract Supplies | 58,200 | 58,200 | 52,600 | 53,680 | 53,680 | 53,680 | 53,680 | 53,680 |
| Delta/Delta Tributary Diversions | | | | | | | | |
| Transfers and Exchanges of Supplies from the Delta Watershed | | | | | | | | |
| Other Water Supplies from the Delta Watershed | | | | | | | | |
| Total Water Supplies from the Delta Watershed | 58,200 | 58,200 | 52,600 | 53,680 | 53,680 | 53,680 | 53,680 | 53,680 |

| Service Area Water Demands without Water Use Efficiency (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands without Water Use Efficiency Accounted For | 163,300 | 170,067 | 186,494 | 210,263 | 231,250 | 245,614 | 260,395 | 275,595 |

| Change in Supplies from the Delta Watershed (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Water Supplies from the Delta Watershed | 58,200 | 58,200 | 52,600 | 53,680 | 53,680 | 53,680 | 53,680 | 53,680 |
| Change in Water Supplies from the Delta Watershed | | - | (5,600) | (4,520) | (4,520) | (4,520) | (4,520) | (4,520) |

| Percent Change in Supplies from the Delta Watershed (As a Percent of Demand w/out WUE) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 (Optional) |
|---|---|---|---|---|---|---|---|---|
| Percent of Water Supplies from the Delta Watershed | 35.6% | 34.2% | 28.2% | 25.5% | 23.2% | 21.9% | 20.6% | 19.5% |
| Change in Percent of Water Supplies from the Delta Watershed | | -1.4% | -7.4% | -10.1% | -12.4% | -13.8% | -15.0% | -16.2% |

# E

# AWWA Water Audits

# AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0
American Water Works Association.

? Click to access definition
+ Click to add a comment

**Water Audit Report for:** City of Fresno (1010007)
**Reporting Year:** 2016 1/2016 - 12/2016

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: ACRE-FEET PER YEAR**

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

## WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ---------->

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Volume from own sources: | 5 | 112,398.020 | acre-ft/yr | 3 | | | | acre-ft/yr |
| Water imported: | n/a | 0.000 | acre-ft/yr | | | | | acre-ft/yr |
| Water exported: | n/a | 0.000 | acre-ft/yr | | | | | acre-ft/yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 112,398.020 acre-ft/yr

## AUTHORIZED CONSUMPTION

Click here: ? for help using option

| | | | | | | |
|---|---|---|---|---|---|---|
| Billed metered: | 9 | 103,038.468 | acre-ft/yr | | | |
| Billed unmetered: | n/a | 0.000 | acre-ft/yr | | | |
| Unbilled metered: | 10 | 42.876 | acre-ft/yr | | | |
| Unbilled unmetered: | 5 | 280.995 | acre-ft/yr | | 280.995 | acre-ft/yr |

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** 103,362.339 acre-ft/yr

## WATER LOSSES (Water Supplied - Authorized Consumption)

9,035.681 acre-ft/yr

### Apparent Losses

| | | | | | | |
|---|---|---|---|---|---|---|
| Unauthorized consumption: | | 280.995 | acre-ft/yr | 0.25% | | acre-ft/yr |

**Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed**

| | | | | | | |
|---|---|---|---|---|---|---|
| Customer metering inaccuracies: | 5 | 1,041.226 | acre-ft/yr | 1.00% | | acre-ft/yr |
| Systematic data handling errors: | | 257.596 | acre-ft/yr | 0.25% | | acre-ft/yr |

**Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed**

**Apparent Losses:** 1,579.817 acre-ft/yr

### Real Losses (Current Annual Real Losses or CARL)

**Real Losses = Water Losses - Apparent Losses:** 7,455.864 acre-ft/yr

**WATER LOSSES:** 9,035.681 acre-ft/yr

## NON-REVENUE WATER

**NON-REVENUE WATER:** 9,359.552 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

## SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 9 | 1,810.39 | miles |
| Number of active AND inactive service connections: | 9 | 143,916 | |
| Service connection density: | | 79 | conn./mile main |

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

**Average length of customer service line has been set to zero and a data grading score of 10 has been applied**

Average operating pressure: 3 50.0 psi

## COST DATA

| | | | |
|---|---|---|---|
| Total annual cost of operating water system: | 10 | $71,848,500 | $/Year |
| Customer retail unit cost (applied to Apparent Losses): | 9 | $1.86 | $/1000 gallons (US) |
| Variable production cost (applied to Real Losses): | 5 | $152.10 | $/acre-ft |

☐ Use Customer Retail Unit Cost to value real losses

## WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 66 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

## PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

# AWWA Free Water Audit Software:
## Reporting Worksheet

WAS v5.0

American Water Works Association.
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? Click to access definition
+ Click to add a comment

**Water Audit Report for:** City of Fresno
**Reporting Year:** 2017 (1/2017 - 12/2017)

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: ACRE-FEET PER YEAR**

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

### WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ---------->

| | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Volume from own sources: | 5 | 121,079.641 | acre-ft/yr | 5 | | | acre-ft/yr |
| Water imported: | n/a | 0.000 | acre-ft/yr | | | | acre-ft/yr |
| Water exported: | n/a | 0.000 | acre-ft/yr | | | | acre-ft/yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 121,079.641 acre-ft/yr

### AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | Pcnt: | Value: | |
|---|---|---|---|---|---|
| Billed metered: | 9 | 110,520.840 | acre-ft/yr | | | |
| Billed unmetered: | n/a | 0.000 | acre-ft/yr | | | |
| Unbilled metered: | 10 | 48.124 | acre-ft/yr | | | |
| Unbilled unmetered: | 5 | 276.052 | acre-ft/yr | | 276.052 | acre-ft/yr |

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** 110,845.016 acre-ft/yr

### WATER LOSSES (Water Supplied - Authorized Consumption)

**10,234.625** acre-ft/yr

**Apparent Losses**

| | | | Pcnt: | Value: | |
|---|---|---|---|---|---|
| Unauthorized consumption: | | 302.699 | acre-ft/yr | 0.25% | | acre-ft/yr |

**Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed**

| | | | | | |
|---|---|---|---|---|---|
| Customer metering inaccuracies: | 5 | 1,116.858 | acre-ft/yr | 1.00% | acre-ft/yr |
| Systematic data handling errors: | | 276.302 | acre-ft/yr | 0.25% | acre-ft/yr |

**Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed**

**Apparent Losses:** 1,695.859 acre-ft/yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** 8,538.766 acre-ft/yr

**WATER LOSSES:** 10,234.625 acre-ft/yr

### NON-REVENUE WATER

**NON-REVENUE WATER:** 10,558.801 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

### SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 9 | 1,854.4 | miles |
| Number of active AND inactive service connections: | 9 | 146,212 | |
| Service connection density: | | 79 | conn./mile main |

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

**Average length of customer service line has been set to zero and a data grading score of 10 has been applied**

Average operating pressure: 4 — 50.0 psi

### COST DATA

| | | | | |
|---|---|---|---|---|
| Total annual cost of operating water system: | 10 | $76,015,350 | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | 9 | $2.01 | $/1000 gallons (US) | |
| Variable production cost (applied to Real Losses): | 5 | $175.42 | $/acre-ft | ☐ Use Customer Retail Unit Cost to value real losses |

### WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 66 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

### PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

# AWWA Free Water Audit Software:
## Reporting Worksheet

WAS v5.0

American Water Works Association.
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? Click to access definition
+ Click to add a comment

**Water Audit Report for:** City of Fresno
**Reporting Year:** 2018 1/2018 - 12/2018

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: ACRE-FEET PER YEAR**

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

### WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ---------->

| | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Volume from own sources: | 5 | 120,065.780 | acre-ft/yr | 8 | | | acre-ft/yr |
| Water imported: | n/a | | acre-ft/yr | | | | acre-ft/yr |
| Water exported: | n/a | | acre-ft/yr | | | | acre-ft/yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 120,065.780 acre-ft/yr

### AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | Pcnt: | Value: | |
|---|---|---|---|---|---|
| Billed metered: | 9 | 110,710.560 | acre-ft/yr | | | |
| Billed unmetered: | n/a | 0.000 | acre-ft/yr | | | |
| Unbilled metered: | 8 | 27.129 | acre-ft/yr | | | |
| Unbilled unmetered: | 5 | 300.164 | acre-ft/yr | | 300.164 | acre-ft/yr |

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** 111,037.853 acre-ft/yr

### WATER LOSSES (Water Supplied - Authorized Consumption)

**9,027.927** acre-ft/yr

**Apparent Losses**

| | | | Pcnt: | Value: | |
|---|---|---|---|---|---|
| Unauthorized consumption: | | 300.164 | acre-ft/yr | 0.25% | | acre-ft/yr |

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

| | | | | | |
|---|---|---|---|---|---|
| Customer metering inaccuracies: | 5 | 1,118.563 | acre-ft/yr | 1.00% | acre-ft/yr |
| Systematic data handling errors: | | 276.776 | acre-ft/yr | 0.25% | acre-ft/yr |

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

**Apparent Losses:** 1,695.503 acre-ft/yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** 7,332.423 acre-ft/yr

**WATER LOSSES:** 9,027.927 acre-ft/yr

### NON-REVENUE WATER

**NON-REVENUE WATER:** 9,355.220 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

### SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 9 | 1,854.7 | miles |
| Number of active AND inactive service connections: | 9 | 146,608 | |
| Service connection density: | | 79 | conn./mile main |

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

| | | | |
|---|---|---|---|
| Average operating pressure: | 10 | 53.3 | psi |

### COST DATA

| | | | | |
|---|---|---|---|---|
| Total annual cost of operating water system: | 10 | $82,960,821 | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | 10 | $2.33 | $/1000 litres | |
| Variable production cost (applied to Real Losses): | 5 | $178.06 | $/acre-ft | ☐ Use Customer Retail Unit Cost to value real losses |

### WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 66 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

### PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

# AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.

**Water Audit Report for:** City of Fresno
**Audit Year:** 2019 | Jan 01 2019 - Dec 31 2019 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

## WATER SUPPLIED

choose entry option:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| VOS | Volume from Own Sources: | n | g | 115,544.090 | Acre-ft/Yr | n | g | 5.00% | percent | under-registration VOSEA |
| WI | Water Imported: | n | g | 0.000 | Acre-ft/Yr | | | | | WIEA |
| WE | Water Exported: | n | g | 0.000 | Acre-ft/Yr | | | | | WEEA |
| | WATER SUPPLIED: | | | 121,625.358 | Acre-ft/Yr | | | | | |

## AUTHORIZED CONSUMPTION

choose entry option:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BMAC | Billed Metered: | n | g | 106,485.360 | Acre-ft/Yr | | | |
| BUAC | Billed Unmetered: | n | g | 0.000 | Acre-ft/Yr | | | |
| UMAC | Unbilled Metered: | n | g | 52.635 | Acre-ft/Yr | | | |
| UUAC | Unbilled Unmetered: | n | g 3 | 266.213 | Acre-ft/Yr | 0.25% | default | |

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 106,804.208 Acre-ft/Yr

## WATER LOSSES

14,821.149 Acre-ft/Yr

### Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SDHE | Systematic Data Handling Errors: | n | g 3 | 266.213 | Acre-ft/Yr | 0.25% | default | |
| CMI | Customer Metering Inaccuracies: | n | g | 1,076.141 | Acre-ft/Yr | 1.00% | percent | under-registration |
| UC | Unauthorized Consumption: | n | g 3 | 266.213 | Acre-ft/Yr | 0.25% | default | |

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 1,608.568 Acre-ft/Yr

### Real Losses

Real Losses: 13,212.581 Acre-ft/Yr

WATER LOSSES: 14,821.149 Acre-ft/Yr

## NON-REVENUE WATER

NON-REVENUE WATER: 15,139.998 Acre-ft/Yr

## SYSTEM DATA

| | | | | | | |
|---|---|---|---|---|---|---|
| Lm | Length of mains: | n | g | 1,862.2 | miles | (including fire hydrant lead lengths) |
| Nc | Number of service connections: | n | g | 147,633 | | (active *and* inactive) |
| | Service connection density: | | | 79 | conn./mile main | |

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP Average Operating Pressure: n g 50.0 psi

## COST DATA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CRUC | Customer Retail Unit Charge: | n | g | $2.33 | $/1000 gallons (US) | Total Annual Operating Cost | |
| VPC | Variable Production Cost: | n | g | $230.95 | $/acre-ft | $106,528,917 | $/yr (optional input) |

## WATER AUDIT DATA VALIDITY TIER:

**Click 'g' for 10 parameter(s), then complete all visible data grading questions to enable the Data Validity Score to calculate**

go to dashboard

### PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

### KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

| | | |
|---|---|---|
| Unit Total Losses: | | gal/conn/day |
| Unit Apparent Losses: | | gal/conn/day |
| Unit Real Losses[^]: | | gal/conn/day |
| Unit Real Losses[=]: | | gal/mile/day |

If entered above by user, targets will display on KPI gauges (see Dashboard)

# F

# DWR Population Tool Output

# WUEdata - Fresno City Of

Sign Out

*Please print this page to a PDF and include as part of your UWMP submittal.*

## Confirmation Information

| Generated By | Water Supplier Name | Confirmation # | Generated On |
|---|---|---|---|
| Heather Freed | Fresno City Of | 8103177726 | 3/17/2021 12:16:56 PM |

## Boundary Information

| Census Year | Boundary Filename | Internal Boundary ID |
|---|---|---|
| 1990 | fresno_1990_processed.kml | 517 |
| 2000 | fresno_2000_processed.kml | 516 |
| 2010 | fresno_2010_processed.kml | 515 |
| 1990 | fresno_1990_processed.kml | 517 |
| 2000 | fresno_2000_processed.kml | 516 |
| 2010 | fresno_2010_processed.kml | 515 |
| 1990 | fresno_1990_processed.kml | 517 |
| 2000 | fresno_2000_processed.kml | 516 |
| 2010 | fresno_2010_processed.kml | 515 |

## Baseline Period Ranges

### 10 to 15-year baseline period

Number of years in baseline period: 10

Year beginning baseline period range: 1996

Year ending baseline period range[1]: 2005

### 5-year baseline period

Year beginning baseline period range: 2003

Year ending baseline period range[2]: 2007

[1] The ending year must be between December 31, 2004 and December 31, 2010.

[2] The ending year must be between December 31, 2007 and December 31, 2010.

## Persons per Connection

| Year | Census Block Level Total Population | Number of Connections * | Persons per Connection |
|---|---|---|---|
| **1990** | **364,084** | | **4.23** |
| **1991** | - | - | 4.23 |
| **1992** | - | - | 4.24 |
| **1993** | - | - | 4.24 |
| **1994** | - | - | 4.25 |
| **1995** | - | - | 4.26 |
| **1996** | - | - | 4.26 |
| **1997** | - | - | 4.27 |
| **1998** | - | - | 4.27 |
| **1999** | - | - | 4.28 |
| **2000** | **439,062** | **102476** | **4.28** |
| **2001** | - | - | 4.29 |
| **2002** | - | - | 4.29 |
| **2003** | - | - | 4.30 |
| **2004** | - | - | 4.30 |
| **2005** | - | - | 4.31 |
| **2006** | - | - | 4.32 |
| **2007** | - | - | 4.32 |
| **2008** | - | - | 4.33 |
| **2009** | - | - | 4.33 |
| **2010** | **505,315** | **116373** | **4.34** |
| **2011** | - | - | 4.28 |
| **2012** | - | - | 4.28 |
| **2013** | - | - | 4.28 |
| **2014** | - | - | 4.28 |
| **2015** | - | - | 4.28 |
| **2020** | **-** | **-** | **4.41 **** |

## Population Using Persons-Per-Connection

| Year | | Number of Connections * | Persons per Connection | Total Population |
|---|---|---|---|---|
| **10 to 15 Year Baseline Population Calculations** | | | | |
| **Year 1** | 1996 | | 4.26 | |
| **Year 2** | 1997 | | 4.27 | |
| **Year 3** | 1998 | | 4.27 | |
| **Year 4** | 1999 | | 4.28 | |
| **Year 5** | 2000 | 102476 | 4.28 | **439,062** |
| **Year 6** | 2001 | | 4.29 | |
| **Year 7** | 2002 | | 4.29 | |
| **Year 8** | 2003 | | 4.30 | |
| **Year 9** | 2004 | | 4.30 | |
| **Year 10** | 2005 | | 4.31 | |
| **5 Year Baseline Population Calculations** | | | | |
| **Year 1** | 2003 | | 4.30 | |
| **Year 2** | 2004 | | 4.30 | |
| **Year 3** | 2005 | | 4.31 | |
| **Year 4** | 2006 | | 4.32 | |
| **Year 5** | 2007 | | 4.32 | |
| **2020 Compliance Year Population Calculations** | | | | |
| **2020** | | 124862 | 4.41 ** | **550,217** |

Hide Print Confirmation

QUESTIONS / ISSUES? CONTACT THE WUEDATA HELP DESK
MWELO QUESTIONS / ISSUES? CONTACT THE MWELO HELP DESK

# G

# North Kings Subbasin Groundwater Sustainability Plan

Reference the North Kings Subbasin Groundwater Sustainability Plan online: https://www.northkingsgsa.org/groundwater-sustainability-plan/

# H

# City of Fresno's Central Valley Project Contract

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Central Valley Project, California

LONG-TERM RENEWAL CONTRACT BETWEEN THE UNITED STATES
AND
CITY OF FRESNO
PROVIDING FOR PROJECT WATER SERVICE
FROM FRIANT DIVISION

THIS CONTRACT, made this 18 day of August, 2005, in pursuance generally of the Act of June 17, 1902 (32 Stat. 388), and acts amendatory or supplementary thereto, including, but not limited to, the Acts of August 26, 1937 (50 Stat. 844), as amended and supplemented, August 4, 1939 (53 Stat. 1187), as amended and supplemented, July 2, 1956 (70 Stat. 483), June 21, 1963 (77 Stat. 68), October 12, 1982 (96 Stat. 1263), October 27, 1986 (100 Stat. 3050), as amended, and Title XXXIV of the Act of October 30, 1992 (106 Stat. 4706), all collectively hereinafter referred to as Federal Reclamation law, between the UNITED STATES OF AMERICA, hereinafter referred to as the United States, and the CITY OF FRESNO, hereinafter referred to as the Contractor, a public agency of the State of California, duly organized, existing, and acting pursuant to the laws thereof;

WITNESSETH, That:

EXPLANATORY RECITALS

[1st] WHEREAS, the United States has constructed and is operating the Central Valley Project (Project), California, for diversion, storage, carriage, distribution and beneficial use, for flood control, irrigation, municipal, domestic, industrial, fish and wildlife mitigation, protection and restoration, generation and distribution of electric energy, salinity control, navigation and other beneficial uses, of waters of the Sacramento River, the American River, the Trinity River, and the San Joaquin River and their tributaries; and

[2nd] WHEREAS, the United States constructed Friant Dam (thereby creating Millerton Lake) and the Friant-Kern and Madera Canals, hereinafter collectively referred to as the Friant Division facilities, which will be used in part for the furnishing of water to the Contractor pursuant to the terms of this Contract; and

[3rd] WHEREAS, pursuant to Section 8 of the Act of June 17, 1902 (32 Stat. 388), the United States has acquired water rights and other rights to the flows of the San Joaquin River, including without limitation the permits issued as the result of Decision 935 by the California State Water Resources Control Board and the contracts described in subdivision (n) of Article 3 of this Contract, pursuant to which the Contracting Officer develops, diverts, stores and delivers Project Water stored or flowing through Millerton Lake in accordance with State and Federal law for the benefit of Project Contractors in the Friant Division; and

[3.1] WHEREAS, the water supplied to the Contractor pursuant to this Contract is Project Water developed through the exercise of the rights described in the third Explanatory Recital of this Contract; and

[4th] WHEREAS, the Contractor and the United States entered into Contract No. 14-06-200-8901, which established terms for the delivery to the Contractor of Project Water from the Friant Division from March 1, 1966, to February 28, 2006, hereinafter referred to as the Existing Contract; and

[5th] WHEREAS, the Contractor and the United States have, pursuant to Subsection 3404(c)(3) of the Central Valley Project Improvement Act (CVPIA), subsequently entered into a Binding Agreement identified as Binding Agreement No. 14-06-200-8901-BA, which sets out the terms pursuant to which the Contractor agreed to renew the Existing Contract before its expiration date after completion of the programmatic environmental impact statement and other appropriate environmental documentation and negotiation of a renewal contract, and which also sets out the consequences of a subsequent decision not to renew; and

[6th] WHEREAS, Section 3404(c) of the CVPIA provides for long-term renewal of the Existing Contract following completion of appropriate environmental documentation, including a programmatic environmental impact statement (PEIS) pursuant to the National Environmental Policy Act (NEPA) analyzing the direct and indirect impacts and benefits of implementing the CVPIA and the potential renewal of all existing contracts for Project Water; and

[7th] WHEREAS, the United States has completed the PEIS and all other appropriate environmental review necessary to provide for long-term renewal of the Existing Contract; and

[8th] WHEREAS, the Contractor has requested the long-term renewal of the Existing Contract, pursuant to the terms of the Existing Contract, Federal Reclamation law, and the laws of the State of California, for water service from the Project; and

[9th] WHEREAS, the United States has determined that the Contractor has fulfilled all of its obligations under the Existing Contract; and

[10th] WHEREAS, the Contractor has demonstrated to the satisfaction of the Contracting Officer that the Contractor has utilized the Project Water supplies available to it for reasonable and beneficial use and/or has demonstrated projected future demand for water use such that the Contractor has the capability and expects to utilize fully for reasonable and beneficial use the quantity of Project Water to be made available to it pursuant to this Contract; and

[11th] WHEREAS, water obtained from the Project has been relied upon by urban and agricultural areas within California for more than 50 years, and is considered by the Contractor as an essential portion of its water supply; and

[12th] WHEREAS, the economies of regions within the Project, including the Contractor's, depend upon the continued availability of water, including water service from the Project; and

[13th] WHEREAS, the Secretary intends through coordination, cooperation, and partnerships to pursue measures to improve water supply, water quality, and reliability of the Project for all Project purposes; and

[14th] WHEREAS, the mutual goals of the United States and the Contractor include: to provide for reliable Project Water supplies; to control costs of those supplies; to achieve repayment of the Project as required by law; to guard reasonably against Project Water shortages; to achieve a reasonable balance among competing demands for use of Project Water; and to comply with all applicable environmental statutes, all consistent with the legal obligations of the United States relative to the Project; and

[15th] WHEREAS, the parties intend by this Contract to develop a more cooperative relationship in order to achieve their mutual goals; and

[15.1] WHEREAS, during uncontrolled seasons, Friant Division Project Contractors utilize undependable Class 2 Water in their service areas to, among other things, assist in the management and alleviation of groundwater overdraft in the Friant Division service area, provide opportunities for environmental enhancement, including restoration of the San Joaquin River below Friant Dam, minimize flooding along the San Joaquin River, encourage optimal water management, and maximize the reasonable and beneficial use of the water; and

[15.2] WHEREAS, the parties desire and intend that this Contract not provide a disincentive to the Friant Division Project Contractors continuing to carry out the beneficial activities set out in the Explanatory Recital immediately above; and

[16th] WHEREAS, the United States and the Contractor are willing to enter into this Contract pursuant to Federal Reclamation law on the terms and conditions set forth below;

NOW, THEREFORE, in consideration of the mutual and dependent covenants herein contained, it is hereby mutually agreed by the parties hereto as follows:

## DEFINITIONS

1. When used herein unless otherwise distinctly expressed, or manifestly incompatible with the intent of the parties as expressed in this Contract, the term:

(a) "Calendar Year" shall mean the period January 1 through December 31, both dates inclusive;

(b) "Charges" shall mean the payments required by Federal Reclamation law in addition to the Rates and Tiered Pricing Component specified in this Contract as determined annually by the Contracting Officer pursuant to this Contract;

(b2) "Class 1 Water" shall mean that supply of water stored in or flowing through Millerton Lake which, subject to the contingencies hereinafter described in Articles 3, 11, and 12 of this Contract, will be available for delivery from Millerton Lake and the Friant-Kern and Madera Canals as a dependable water supply during each Year;

(b3) "Class 2 Water" shall mean that supply of water which can be made available subject to the contingencies hereinafter described in Articles 3, 11, and 12 of this Contract for delivery from Millerton Lake and the Friant-Kern and Madera Canals in addition to the supply of Class 1 Water. Because of its uncertainty as to availability and time of occurrence, such water will be undependable in character and will be furnished only if, as, and when it can be made available as determined by the Contracting Officer;

(c) "Condition of Shortage" shall mean a condition respecting the Project during any Year such that the Contracting Officer is unable to deliver sufficient water to meet the Contract Total;

(d) "Contracting Officer" shall mean the Secretary of the Interior's duly authorized representative acting pursuant to this Contract or applicable Federal Reclamation law or regulation;

(e) "Contract Total" shall mean the maximum amount of Class 1 Water, plus the maximum amount of Class 2 Water to which the Contractor is entitled under subdivision (a) of Article 3 of this Contract;

(f) "Contractor's Service Area" shall mean the area to which the Contractor is permitted to provide Project Water under this Contract as described in Exhibit "A" attached hereto, which may be modified from time to time in accordance with Article 35 of this Contract without amendment of this Contract;

(g) "CVPIA" shall mean the Central Valley Project Improvement Act, Title XXXIV of the Act of October 30, 1992 (106 Stat. 4706);

(h-i) Omitted;

(j) "Full Cost Rate" shall mean an annual rate as determined by the Contracting Officer that shall amortize the expenditures for construction properly allocable to the Project irrigation or M&I functions, as appropriate, of facilities in service including all O&M deficits funded, less payments, over such periods as may be required under Federal Reclamation law or applicable contract provisions. Interest will accrue on both the construction expenditures and funded O&M deficits from October 12, 1982, on costs outstanding at that date, or from the date incurred in the case of costs arising subsequent to October 12, 1982, and shall be calculated in accordance with subsections 202(3)(B) and (3)(C) of the RRA. The Full Cost Rate includes actual operation, maintenance, and replacement costs consistent with Section 426.2 of the Rules and Regulations for the RRA;

(k-l) Omitted;

(m) "Irrigation Water" shall mean water made available from the Project that is used primarily in the production of agricultural crops or livestock, including domestic use incidental thereto, and watering of livestock;

(n) Omitted;

(n2) "Long Term Historic Average" shall mean the average of the final forecast of Water Made Available to the Contractor pursuant to this Contract and the contract referenced in the fourth Explanatory Recital of this Contract;

(o) "Municipal and Industrial (M&I) Water" shall mean Project Water, other than Irrigation Water, made available to the Contractor. M&I Water shall include water used for human use and purposes such as the watering of landscaping or pasture for animals (e.g., horses) which are kept for personal enjoyment or water delivered to land holdings operated in units of less than five acres unless the Contractor establishes to the satisfaction of the Contracting Officer that the use of water delivered to any such landholding is a use described in subdivision (m) of this Article;

(p) "M&I Full Cost Water Rate" shall mean the Full Cost Rate applicable to the delivery of M&I Water;

(q) "Operation and Maintenance" or "O&M" shall mean normal and reasonable care, control, operation, repair, replacement (other than capital replacement), and maintenance of Project facilities;

(r) "Operating Non-Federal Entity" shall mean the Friant Water Authority, its successors or assigns, a non-Federal entity which has the obligation to operate and maintain all or a portion of the Friant Division facilities pursuant to an agreement with the United States, and which may have funding obligations with respect thereto;

(s) "Project" shall mean the Central Valley Project owned by the United States and managed by the Department of the Interior, Bureau of Reclamation;

(t) "Project Contractors" shall mean all parties who have water service contracts for Project Water from the Project with the United States pursuant to Federal Reclamation law;

(u) "Project Water" shall mean all water that is developed, diverted, stored, or delivered by the Secretary in accordance with the statutes authorizing the Project and in accordance with the terms and conditions of water rights acquired pursuant to California law;

(v) "Rates" shall mean the payments determined annually by the Contracting Officer in accordance with the then-current applicable water ratesetting policies for the Project, as described in subdivision (a) of Article 7 of this Contract;

(w) Omitted;

(x) "Secretary" shall mean the Secretary of the Interior, a duly appointed successor, or an authorized representative acting pursuant to any authority of the Secretary and through any agency of the Department of the Interior;

(y) "Tiered Pricing Component" shall be the incremental amount to be paid for each acre-foot of Water Delivered as described in subdivision (j) of Article 7 of this Contract;

(z) "Water Delivered" or "Delivered Water" shall mean Project Water diverted for use by the Contractor at the point(s) of delivery approved by the Contracting Officer;

(aa) "Water Made Available" shall mean the estimated amount of Project Water that can be delivered to the Contractor for the upcoming Year as declared by the Contracting Officer, pursuant to subdivision (a) of Article 4 of this Contract;

(bb) "Water Scheduled" shall mean Project Water made available to the Contractor for which times and quantities for delivery have been established by the Contractor and Contracting Officer, pursuant to subdivision (b) of Article 4 of this Contract; and

(cc) "Year" shall mean the period from and including March 1 of each Calendar Year through the last day of February of the following Calendar Year.

TERM OF CONTRACT

2. (a) This Contract supersedes the Existing Contract and shall be effective on the date first hereinabove written through February 28, 2045. In the event the Contractor wishes to renew this Contract beyond February 28, 2045, the Contractor shall submit a request for renewal in writing to the Contracting Officer no later than two years prior to the date this Contract expires.

(b) Omitted.

(c) Provided the Contractor is complying with all terms and conditions of this Contract and all legal obligations of the Contractor, if any, set forth in an enforceable court order, final judgment and/or settlement relating to restoration of the San Joaquin River, this Contract shall be renewed for successive periods of up to 40 years each, which periods shall be consistent with the then-existing Reclamation-wide policy, under terms and conditions mutually agreeable to the parties and consistent with Federal and State law. The Contractor shall be afforded the opportunity to comment to the Contracting Officer on the proposed adoption and application of any revised policy applicable to the delivery of M&I Water that would limit the term of any subsequent renewal contract with the Contractor for the furnishing of M&I Water to less than 40 years.

(d) The Contracting Officer shall make a determination ten years after the date of execution of this Contract, and every five years thereafter during the term of this Contract, of whether a conversion to a contract under subsection 9(c)(1) of the Reclamation Project Act of 1939 can be accomplished. The Contracting Officer anticipates that during the term of this Contract, all authorized Project construction expected to occur will have occurred, and on that basis the Contracting Officer agrees upon such completion to allocate all costs that are properly assignable to the Contractor, and agrees further that, at any time after such allocation is made, and subject to satisfaction of the conditions set out in this subdivision, this Contract shall, at the request of the Contractor, be converted to a contract under subsection 9(c)(1) of the Reclamation Project Act of 1939, subject to applicable Federal law and under stated terms and conditions mutually agreeable to the Contractor and the Contracting Officer. A condition for such conversion to occur shall be a determination by the Contracting Officer that, account being taken of the amount credited to return by the Contractor as provided for under Federal Reclamation law, the remaining amount of construction costs assignable for ultimate return by the Contractor can probably be repaid to the United States within the term of a contract under subsection 9(c)(1). If the remaining amount of costs that are properly assignable to the Contractor cannot be determined during the term of this Contract, the Contracting Officer shall notify the Contractor, and provide the reason(s) why such a determination could not be made. Further, the Contracting Officer shall make such a determination as soon thereafter as possible so as to permit, upon request of the Contractor and satisfaction of the conditions set out above, conversion to a contract under subsection 9(c)(1). In the event such determination of costs has not been made at a time which allows conversion of this Contract during the term of this

Contract or the Contractor has not requested conversion of this Contract within such term, the parties shall incorporate in any subsequent renewal contract as described in subdivision (c) of this Article a provision that carries forth in substantially identical terms the provisions of this subdivision.

WATER TO BE MADE AVAILABLE AND DELIVERED TO THE CONTRACTOR

3. (a) During each Year, consistent with all applicable State water rights, permits, and licenses, Federal law, and subject to the provisions set forth in Articles 11 and 12 of this Contract, the Contracting Officer shall make available for delivery to the Contractor 60,000 acre-feet of Class 1 Water for M&I purposes. Water Delivered to the Contractor in accordance with this subdivision shall be scheduled and paid for pursuant to the provisions of Articles 4 and 7 of this Contract.

(b) Omitted.

(c) The Contractor shall utilize the Project Water in accordance with all applicable legal requirements.

(d) The Contractor shall make reasonable and beneficial use of all water furnished pursuant to this Contract. Groundwater recharge programs (direct, indirect, or in lieu), groundwater banking programs, surface water storage programs, and other similar programs utilizing Project Water or other water furnished pursuant to this Contract conducted within the Contractor's Service Area which are consistent with applicable State law and result in use consistent with Federal Reclamation law will be allowed: Provided, That any direct recharge program(s) is (are) described in the Contractor's water conservation plan submitted pursuant to Article 26 of this Contract: Provided further, That such water conservation plan demonstrates sufficient lawful uses exist in the

Contractor's Service Area so that using a long-term average, the quantity of Delivered Water is demonstrated to be reasonable for such uses and in compliance with Federal Reclamation law. Groundwater recharge programs, groundwater banking programs, surface water storage programs, and other similar programs utilizing Project Water or other water furnished pursuant to this Contract conducted outside the Contractor's Service Area may be permitted upon written approval of the Contracting Officer, which approval will be based upon environmental documentation, Project Water rights, and Project operational concerns. The Contracting Officer will address such concerns in regulations, policies, or guidelines.

(e) The Contractor shall comply with requirements applicable to the Contractor in biological opinion(s) prepared as a result of a consultation regarding the execution of this Contract undertaken pursuant to Section 7 of the Endangered Species Act of 1973 (ESA), as amended, that are within the Contractor's legal authority to implement. The Existing Contract, which evidences in excess of 39 years of diversions for M&I purposes of the quantities of water provided in subdivision (a) of Article 3 of this Contract, will be considered in developing an appropriate baseline for the biological assessment(s) prepared pursuant to the ESA, and any other needed environmental review. Nothing herein shall be construed to prevent the Contractor from challenging or seeking judicial relief in a court of competent jurisdiction with respect to any biological opinion or other environmental documentation referred to in this Article.

(f) Subject to subdivisions (l) and (n) of Article 3 of this Contract, following the declaration of Water Made Available under Article 4 of this Contract, the Contracting Officer will make a determination whether Project Water, or other water available to the Project, can be made

available to the Contractor in addition to the Contract Total under Article 3 of this Contract during the Year without adversely impacting other Project Contractors. At the request of the Contractor, the Contracting Officer will consult with the Contractor prior to making such a determination. Subject to subdivisions (l) and (n) of Article 3 of this Contract, if the Contracting Officer determines that Project Water, or other water available to the Project, can be made available to the Contractor, the Contracting Officer will announce the availability of such water and shall so notify the Contractor as soon as practicable. The Contracting Officer will thereafter meet with the Contractor and other Project Contractors capable of taking such water to determine the most equitable and efficient allocation of such water. If the Contractor requests the delivery of any quantity of such water, the Contracting Officer shall make such water available to the Contractor in accordance with applicable statutes, regulations, guidelines, and policies.

(g) The Contractor may request permission to reschedule for use during the subsequent Year some or all of the Water Made Available to the Contractor during the current Year referred to as "carryover." The Contractor may request permission to use during the current Year a quantity of Project Water which may be made available by the United States to the Contractor during the subsequent Year referred to as "preuse." The Contracting Officer's written approval may permit such uses in accordance with applicable statutes, regulations, guidelines, and policies.

(h) The Contractor's right pursuant to Federal Reclamation law and applicable State law to the reasonable and beneficial use of Water Delivered pursuant to this Contract during the term thereof and any subsequent renewal contracts, as described in Article 2 of this Contract, during the terms thereof shall not be disturbed so long as the Contractor shall fulfill all of its obligations

under this Contract and any renewals thereof. Nothing in the preceding sentence shall affect the Contracting Officer's ability to impose shortages under Article 11 or subdivision (b) of Article 12 of this Contract or applicable provisions of any subsequent renewal contracts.

(i) Project Water furnished to the Contractor pursuant to this Contract may be delivered for other than M&I purposes upon written approval by the Contracting Officer in accordance with the terms and conditions of such approval.

(j) The Contracting Officer shall make reasonable efforts to protect the water rights and other rights described in the third Explanatory Recital of this Contract necessary for the Project and to provide the water available under this Contract. The Contracting Officer shall not object to participation by the Contractor, in the capacity and to the extent permitted by law, in administrative proceedings related to the water rights and other rights described in the third Explanatory Recital of this Contract: Provided, That the Contracting Officer retains the right to object to the substance of the Contractor's position in such a proceeding: Provided further, That in such proceedings the Contracting Officer shall recognize the Contractor has a legal right under the terms of this Contract to use Project Water.

(k) Project Water furnished to the Contractor during any month designated in a schedule or revised schedule submitted by the Contractor and approved by the Contracting Officer shall be deemed to have been accepted by the Contractor as Class 1 Water to the extent that Class 1 Water is called for in such schedule for such month and shall be deemed to have been accepted as Class 2 Water to the extent Class 2 Water is called for in such schedule for such month. If in any month the Contractor diverts a quantity of water in addition to the total amount of Class 1 Water and

Class 2 Water set forth in the Contractor's approved schedule or revised schedule for such month, such additional diversions shall be charged first against the Contractor's remaining Class 2 Water supply available in the current Year. To the extent the Contractor's remaining Class 2 Water supply available in the current Year is not sufficient to account for such additional diversions, such additional diversions shall be charged against the Contractor's remaining Class 1 Water supply available in the current Year. To the extent the Contractor's remaining Class 1 Water and Class 2 Water supplies available in the current Year are not sufficient to account for such additional diversions, such additional diversions shall be charged first against the Contractor's available Class 2 Water supply and then against the Contractor's available Class 1 Water supply, both for the following Year. Payment for all additional diversions of water shall be made in accordance with Article 7 of this Contract.

(l) If the Contracting Officer determines there is a Project Water supply available at Friant Dam as the result of an unusually large water supply not otherwise storable for Project purposes or infrequent and otherwise unmanaged flood flows of short duration, such water will be made available to the Contractor and others under Section 215 of the RRA pursuant to the priorities specified below if the Contractor enters into a temporary contract with the United States not to exceed one year for the delivery of such water or, as otherwise provided for in Federal Reclamation law and associated regulations. Such water may be identified by the Contractor either (i) as additional water to supplement the supply of Class 1 Water and/or Class 2 Water made available to it pursuant to this Contract or, (ii) upon written notification to the Contracting Officer, as water to be credited against the Contractor's Class 2 Water supply available pursuant to this Contract. The Contracting Officer

shall make water determined to be available pursuant to this subsection according to the following priorities: first, to long-term contractors for Class 1 Water and/or Class 2 Water within the Friant Division; second, to long-term contractors in the Cross Valley Division of the Project. The Contracting Officer will consider and seek to accommodate requests from other parties for Section 215 Water for use within the area identified as the Friant Division service area in the environmental assessment developed in connection with the execution of this Contract.

(m) Nothing in this Contract, nor any action or inaction of the Contractor or Contracting Officer in connection with the implementation of this Contract, is intended to override, modify, supersede, or otherwise interfere with any term or condition of the water rights and other rights referred in the third Explanatory Recital of this Contract.

(n) The rights of the Contractor under this Contract are subject to the terms of the contract for exchange waters, dated July 27, 1939, between the United States and the San Joaquin and Kings River Canal and Irrigation Company, Incorporated, et al., (hereinafter referred to as the Exchange Contractors), Contract No. I1r-1144, as amended. The United States agrees that it will not deliver to the Exchange Contractors thereunder waters of the San Joaquin River unless and until required by the terms of said contract, and the United States further agrees that it will not voluntarily and knowingly determine itself unable to deliver to the Exchange Contractors entitled thereto from water that is available or that may become available to it from the Sacramento River and its tributaries or the Sacramento-San Joaquin Delta those quantities required to satisfy the obligations of the United States under said Exchange Contract and under Schedule 2 of the Contract for Purchase of Miller and Lux Water Rights (Contract No. I1r-1145, dated July 27, 1939).

TIME FOR DELIVERY OF WATER

4. (a) On or about February 20 of each Calendar Year, the Contracting Officer shall announce the Contracting Officer's expected declaration of the Water Made Available. Such declaration will be expressed in terms of both Water Made Available and the Long Term Historic Average and will be updated monthly, and more frequently if necessary, based on then-current operational and hydrologic conditions and a new declaration with changes, if any, to the Water Made Available will be made. The Contracting Officer shall provide forecasts of Project operations and the basis of the estimate, with relevant supporting information, upon the written request of the Contractor. Concurrently with the declaration of the Water Made Available, the Contracting Officer shall provide the Contractor with the updated Long-Term Historic Average.

(b) On or before each March 1 and at such other times as necessary, the Contractor shall submit to the Contracting Officer a written schedule, satisfactory to the Contracting Officer, showing the monthly quantities of Project Water to be delivered by the United States to the Contractor pursuant to this Contract for the Year commencing on such March 1. The Contracting Officer shall use all reasonable means to deliver Project Water according to the approved schedule for the Year commencing on such March 1.

(c) The Contractor shall not schedule Project Water in excess of the quantity of Project Water the Contractor intends to put to reasonable and beneficial use within the Contractor's Service Area or to sell, transfer, or exchange pursuant to Article 9 of this Contract during any Year.

(d) Subject to the conditions set forth in subdivision (a) of Article 3 of this Contract, the United States shall deliver Project Water to the Contractor in accordance with the initial

schedule submitted by the Contractor pursuant to subdivision (b) of this Article, or any written revision(s), satisfactory to the Contracting Officer, thereto submitted within a reasonable time prior to the date(s) on which the requested change(s) is/are to be implemented: Provided, That the total amount of water requested in that schedule or revision does not exceed the quantities announced by the Contracting Officer pursuant to the provisions of subdivision (a) of Article 3, and the Contracting Officer determines that there will be sufficient capacity available in the appropriate Friant Division facilities to deliver the water in accordance with that schedule: Provided further, That the Contractor shall not schedule the delivery of any water during any period as to which the Contractor is notified by the Contracting Officer or Operating Non-Federal Entity that Project facilities required to make deliveries to the Contractor will not be in operation because of scheduled O&M.

(e) The Contractor may, during the period from and including November 1 of each Year through and including the last day of February of that Year, request delivery of any amount of the Class 1 Water estimated by the Contracting Officer to be made available to it during the following Year. The Contractor may, during the period from and including January 1 of each Year (or such earlier date as may be determined by the Contracting Officer) through and including the last day of February of that Year, request delivery of any amount of Class 2 Water estimated by the Contracting Officer to be made available to it during the following Year. Such water shall hereinafter be referred to as preuse water. Such request must be submitted in writing by the Contractor for a specified quantity of preuse water and shall be subject to the approval of the Contracting Officer. Payment for preuse water so requested shall be at the appropriate rate(s) for the following Year in accordance with Article 7 of this Contract and shall be made in advance of delivery of any preuse water. The

Contracting Officer shall deliver such preuse water in accordance with a schedule or any revision thereof submitted by the Contractor and approved by the Contracting Officer, to the extent such water is available and to the extent such deliveries will not interfere with the delivery of Project Water entitlements to other Friant Division contractors or the physical maintenance of the Project facilities. The quantities of preuse water delivered pursuant to this subdivision shall be deducted from the quantities of water that the Contracting Officer would otherwise be obligated to make available to the Contractor during the following Year: Provided, That the quantity of preuse water to be deducted from the quantities of either Class 1 Water or Class 2 Water to be made available to the Contractor in the following Year shall be specified by the Contractor at the time the preuse water is requested or as revised in its first schedule for the following Year submitted in accordance with subdivision (b) of this Article, based on the availability of the following Year water supplies as determined by the Contracting Officer.

POINT OF DIVERSION AND RESPONSIBILITY FOR DISTRIBUTION OF WATER

5. (a) Project Water scheduled pursuant to subdivision (b) of Article 4 of this Contract shall be delivered to the Contractor at a point or points of delivery either on Project facilities or another location or locations mutually agreed to in writing by the Contracting Officer and the Contractor.

(b) The Contracting Officer, either directly or through its written agreement(s) with the Operating Non-Federal Entity, shall make all reasonable efforts to maintain sufficient flows and levels of water in the Friant-Kern Canal to deliver Project Water to the Contractor at specific turnouts established pursuant to subdivision (a) of this Article.

(c) The Contractor shall not deliver Project Water to land outside the Contractor's Service Area unless approved in advance by the Contracting Officer.

(d) All Water Delivered to the Contractor pursuant to this Contract shall be measured and recorded with equipment furnished, installed, operated, and maintained by the United States or the Operating Non-Federal Entity at the point or points of delivery established pursuant to subdivision (a) of this Article. Upon the request of either party to this Contract, the Contracting Officer shall investigate, or cause to be investigated by the appropriate Operating Non-Federal Entity, the accuracy of such measurements and shall take any necessary steps to adjust any errors appearing therein. For any period of time when accurate measurements have not been made, the Contracting Officer shall consult with the Contractor and the responsible Operating Non-Federal Entity prior to making a final determination of the quantity delivered for that period of time.

(e) Neither the Contracting Officer nor any Operating Non-Federal Entity shall be responsible for the control, carriage, handling, use, disposal, or distribution of Water Delivered to the Contractor pursuant to this Contract beyond the delivery points specified in subdivision (a) of this Article. The Contractor shall indemnify the United States, its officers, employees, agents, and assigns on account of damage or claim of damage of any nature whatsoever for which there is legal responsibility, including property damage, personal injury, or death arising out of or connected with the control, carriage, handling, use, disposal, or distribution of such Project Water Delivered beyond such delivery points, except for any damage or claim arising out of: (i) acts or omissions of the Contracting Officer or any of its officers, employees, agents, or assigns, including the Operating Non-Federal Entity, with the intent of creating the situation resulting in any damage or claim;

(ii) willful misconduct of the Contracting Officer or any of its officers, employees, agents, or assigns, including the Operating Non-Federal Entity; (iii) negligence of the Contracting Officer or any of its officers, employees, agents, or assigns including the Operating Non-Federal Entity; or (iv) damage or claims resulting from a malfunction of facilities owned and/or operated by the United States or responsible Operating Non-Federal Entity.

MEASUREMENT OF WATER WITHIN THE CONTRACTOR'S SERVICE AREA

6. (a) Within five years of the date of Contract execution, the Contractor will have an established measuring program satisfactory to the Contracting Officer. The Contractor shall ensure that all surface water delivered for M&I purposes is measured at each M&I service connection. The water measuring devices or water measuring methods of comparable effectiveness must be acceptable to the Contracting Officer. The Contractor shall be responsible for installing, operating, and maintaining and repairing all such measuring devices and implementing all such water measuring methods at no cost to the United States. The Contracting Officer acknowledges that the Contractor has a metering plan (Exhibit "C") setting forth the milestones and schedule that the Contractor will implement to comply with the requirements of this Article. Beginning January 2006, the Contractor shall provide an annual written report to the Contracting Officer describing the Contractor's metering plan implementation progress. The Contractor shall use the information obtained from such water measuring devices or water measuring methods to ensure its proper management of the water, to bill water users for water delivered by the Contractor; and, if applicable, to record water delivered for M&I purposes by customer class as defined in the Contractor's water conservation plan provided for in Article 26 of this Contract. Nothing herein contained, however, shall preclude the Contractor from

establishing and collecting any charges, assessments, or other revenues authorized by California law. The Contractor shall include a summary of all its annual surface water deliveries in the annual report described in subdivision (c) of Article 26.

(b) To the extent the information has not otherwise been provided, upon execution of this Contract, the Contractor shall provide to the Contracting Officer a written report describing the measurement devices or water measuring methods being used or to be used to implement subdivision (a) of this Article and identifying the M&I service connections or alternative measurement programs approved by the Contracting Officer, at which such measurement devices or water measuring methods are being used, and, if applicable, identifying the locations at which such devices and/or methods are not yet being used including a time schedule for implementation at such locations. The Contracting Officer shall advise the Contractor in writing within 60 days as to the adequacy, and necessary modifications, if any, of the measuring devices or water measuring methods identified in the Contractor's report and if the Contracting Officer does not respond in such time, they shall be deemed adequate. If the Contracting Officer notifies the Contractor that the measuring devices or methods are inadequate, the parties shall within 60 days following the Contracting Officer's response, negotiate in good faith the earliest practicable date by which the Contractor shall modify said measuring devices and/or measuring methods as required by the Contracting Officer to ensure compliance with subdivision (a) of this Article.

(c) All new surface water delivery systems installed within the Contractor's Service Area after the effective date of this Contract shall also comply with the measurement provisions described in subdivision (a) of this Article.

(d) The Contractor shall inform the Contracting Officer and the State of California in writing by April 30 of each Year of the monthly volume of surface water delivered within the Contractor's Service Area during the previous Year.

(e) The Contractor shall inform the Contracting Officer and the Operating Non-Federal Entity on or before the 20th calendar day of each month of the quantity of M&I Water taken during the preceding month.

(f) In the event the provisions of subdivision (a) of this Article or any portion thereof, are challenged in a judicial proceeding, the parties agree to meet and confer promptly and as often as necessary to employ their reasonable best efforts to coordinate their response to the challenge and, as appropriate, develop revisions to this Contract.

RATES AND METHOD OF PAYMENT FOR WATER

7. (a) The Contractor shall pay the United States as provided in this Article for all Delivered Water at Rates, Charges, and the Tiered Pricing Component established in accordance with (i) the Secretary's then-existing ratesetting policy for M&I Water. Such ratesetting policies shall be amended, modified, or superseded only through a public notice and comment procedure; (ii) applicable Federal Reclamation law and associated rules and regulations, or policies; and (iii) other applicable provisions of this Contract. Payments shall be made by cash transaction, electronic funds transfer, or any other mechanism as may be agreed to in writing by the Contractor and the Contracting Officer. The Rates, Charges, and Tiered Pricing Component applicable to the Contractor upon execution of this Contract are set forth in Exhibit "B", as may be revised annually.

(b) The Contracting Officer shall notify the Contractor of the Rates, Charges, and Tiered Pricing Component as follows:

(1) Prior to July 1 of each Calendar Year, the Contracting Officer shall provide the Contractor an estimate of the Charges for Project Water that will be applied to the period October 1, of the current Calendar Year, through September 30, of the following Calendar Year, and the basis for such estimate. The Contractor shall be allowed not less than two months to review and comment on such estimates. On or before September 15 of each Calendar Year, the Contracting Officer shall notify the Contractor in writing of the Charges to be in effect during the period October 1 of the current Calendar Year, through September 30, of the following Calendar Year, and such notification shall revise Exhibit "B."

(2) Prior to October 1 of each Calendar Year, the Contracting Officer shall make available to the Contractor an estimate of the Rates and Tiered Pricing Component for Project Water for the following Year and the computations and cost allocations upon which those Rates are based. The Contractor shall be allowed not less than two months to review and comment on such computations and cost allocations. By December 31 of each Calendar Year, the Contracting Officer shall provide the Contractor with the final Rates and Tiered Pricing Component to be in effect for the upcoming Year, and such notification shall revise Exhibit "B."

(c) At the time the Contractor submits the initial schedule for the delivery of Project Water for each Year pursuant to subdivision (b) of Article 4 of this Contract, the Contractor shall make an advance payment to the United States equal to the total amount payable pursuant to the applicable Rate(s) set under subdivision (a) of this Article, for the Project Water scheduled to be

delivered pursuant to this Contract during the first two calendar months of the Year. Before the end of the first month and before the end of each calendar month thereafter, the Contractor shall make an advance payment to the United States, at the Rate(s) set under subdivision (a) of this Article, for the Water Scheduled to be delivered pursuant to this Contract during the second month immediately following. Adjustments between advance payments for Water Scheduled and payments at Rates due for Water Delivered shall be made before the end of the following month: Provided, That any revised schedule submitted by the Contractor pursuant to Article 4 of this Contract which increases the amount of Water Delivered pursuant to this Contract during any month shall be accompanied with appropriate advance payment, at the Rates then in effect, to assure that Project Water is not delivered to the Contractor in advance of such payment. In any month in which the quantity of Water Delivered to the Contractor pursuant to this Contract equals the quantity of Water Scheduled and paid for by the Contractor, no additional Project Water shall be delivered to the Contractor unless and until an advance payment at the Rates then in effect for such additional Project Water is made. Final adjustment between the advance payments for the Water Scheduled and payments for the quantities of Water Delivered during each Year pursuant to this Contract shall be made as soon as practicable but no later than April 30th of the following Year, or 60 days after the delivery of Project Water carried over under subdivision (g) of Article 3 of this Contract if such water is not delivered by the last day of February.

(d) The Contractor shall also make a payment in addition to the Rate(s) in subdivision (c) of this Article to the United States for Water Delivered, at the Charges and the appropriate Tiered Pricing Component then in effect, before the end of the month following the

month of delivery. The payments shall be consistent with the quantities of M&I Water Delivered as shown in the water delivery report for the subject month prepared by the Operating Non-Federal Entity or, if there is no Operating Non-Federal Entity, by the Contracting Officer. Such water delivery report shall be the basis for payment of Charges and Tiered Pricing Component by the Contractor, and shall be provided to the Contractor by the Operating Non-Federal Entity or the Contracting Officer (as applicable) within five days after the end of the month of delivery. The water delivery report shall be deemed a bill for the payment of Charges and the applicable Tiered Pricing Component for Water Delivered. Adjustment for overpayment or underpayment of Charges shall be made through the adjustment of payments due to the United States for Charges for the next month. Any amount to be paid for past due payment of Charges and the Tiered Pricing Component shall be computed pursuant to Article 20 of this Contract.

(e) The Contractor shall pay for any Water Delivered under subdivision (a), (f), or (g) of Article 3 of this Contract as determined by the Contracting Officer pursuant to applicable statutes, associated regulations, any applicable provisions of guidelines or ratesetting policies: Provided, That the Rate for Water Delivered under subdivision (f) of Article 3 of this Contract shall be no more than the otherwise applicable Rate for M&I Water under subdivision (a) of this Article.

(f) Payments to be made by the Contractor to the United States under this Contract may be paid from any revenues available to the Contractor.

(g) All revenues received by the United States from the Contractor relating to the delivery of Project Water or the delivery of non-Project water through Project facilities shall be

allocated and applied in accordance with Federal Reclamation law and the associated rules or regulations, and the then-current Project ratesetting policies for M&I Water.

(h) The Contracting Officer shall keep its accounts pertaining to the administration of the financial terms and conditions of its long-term contracts, in accordance with applicable Federal standards, so as to reflect the application of Project costs and revenues. The Contracting Officer shall, each Year upon request of the Contractor, provide to the Contractor a detailed accounting of all Project and Contractor expense allocations, the disposition of all Project and Contractor revenues, and a summary of all water delivery information. The Contracting Officer and the Contractor shall enter into good faith negotiations to resolve any discrepancies or disputes relating to accountings, reports, or information.

(i) The parties acknowledge and agree that the efficient administration of this Contract is their mutual goal. Recognizing that experience has demonstrated that mechanisms, policies, and procedures used for establishing Rates, Charges, and Tiered Pricing Components, and/or for making and allocating payments, other than those set forth in this Article may be in the mutual best interest of the parties, it is expressly agreed that the parties may enter into agreements to modify the mechanisms, policies, and procedures for any of those purposes while this Contract is in effect without amending this Contract.

(j) (1) Beginning at such time as the total of the deliveries of Class 1 Water and Class 2 Water in a Year exceed 80 percent of the Contract Total, then before the end of the month following the month of delivery the Contractor shall make an additional payment to the United States equal to the applicable Tiered Pricing Component. The Tiered Pricing Component for the total of the

deliveries of Class 1 Water and Class 2 Water in excess of 80 percent of the Contract Total, but less than or equal to 90 percent of the Contract Total, shall equal one-half of the difference between the Rate established under subdivision (a) of this Article and the M&I Full Cost Water Rate. The Tiered Pricing Component for the total of the deliveries of Class 1 Water and Class 2 Water which exceeds 90 percent of the Contract total shall equal the difference between (i) the Rate established under subdivision (a) of this Article and (ii) the M&I Full Cost Water Rate.

(2) Omitted.

(3) For purposes of determining the applicability of the Tiered Pricing Component pursuant to this Article, Water Delivered shall include Project Water that the Contractor transfers to others but shall not include Project Water transferred and delivered to the Contractor.

(k) For the term of this Contract, Rates under the respective ratesetting policies will be established to recover only reimbursable O&M (including any deficits) and capital costs of the Project, as those terms are used in the then-current Project ratesetting policies, and interest, where appropriate, except in instances where a minimum Rate is applicable in accordance with the relevant Project ratesetting policy. Changes of significance in practices which implement the Contracting Officer's ratesetting policies will not be implemented until the Contracting Officer has provided the Contractor an opportunity to discuss the nature, need, and impact of the proposed change.

(l) Except as provided in subsections 3405(a)(1)(B) and 3405(f) of the CVPIA, the Rates for Project Water transferred by the Contractor shall be the Contractor's Rates adjusted upward or downward to reflect the changed costs, if any, incurred by the Contracting Officer in the

delivery of the transferred Project Water to the transferee's point of delivery in accordance with the then-applicable Project ratesetting policy.

(m) Omitted.

(n) Omitted.

8. Omitted.

SALES, TRANSFERS, OR EXCHANGES OF WATER

9. (a) The right to receive Project Water provided for in this Contract may be sold, transferred, or exchanged to others for reasonable and beneficial uses within the State of California if such sale, transfer, or exchange is authorized by applicable Federal and State laws, and applicable guidelines or regulations then in effect. No sale, transfer, or exchange of Project Water under this Contract may take place without the prior written approval of the Contracting Officer, except as provided for in subdivision (b) of this Article, and no such sales, transfers, or exchanges shall be approved absent all appropriate environmental documentation including, but not limited to, documents prepared pursuant to the NEPA and ESA. Such environmental documentation should include, as appropriate, an analysis of groundwater impacts and economic and social effects, including environmental justice, of the proposed water transfers on both the transferor and transferee.

(b) In order to facilitate efficient water management by means of water transfers of the type historically carried out among Project Contractors located within the same geographical area and to allow the Contractor to participate in an accelerated water transfer program during the term of this Contract, the Contracting Officer shall prepare, as appropriate, all necessary environmental

documentation including, but not limited to, documents prepared pursuant to NEPA and ESA, analyzing annual transfers within such geographical areas, and the Contracting Officer shall determine whether such transfers comply with applicable law. Following the completion of the environmental documentation, such transfers addressed in such documentation shall be conducted with advance notice to the Contracting Officer, but shall not require prior written approval by the Contracting Officer. Such environmental documentation and the Contracting Officer's compliance determination shall be reviewed every five years and updated, as necessary, prior to the expiration of the then-existing five-year period. All subsequent environmental documentation shall include an alternative to evaluate not less than the quantity of Project Water historically transferred within the same geographical area.

(c) For a water transfer to qualify under subdivision (b) of this Article, such water transfer must: (i) be for irrigation purposes for lands irrigated within the previous three years, for M&I use, groundwater recharge, water banking, or fish and wildlife resources; not lead to land conversion; and be delivered to established cropland, wildlife refuges, groundwater basins or M&I use; (ii) occur within a single Year; (iii) occur between a willing seller and a willing buyer; (iv) convey water through existing facilities with no new construction or modifications to facilities and be between existing Project Contractors and/or the Contractor and the United States, Department of the Interior; and (v) comply with all applicable Federal, State, and local or tribal laws and requirements imposed for protection of the environment and Indian Trust Assets, as defined under Federal law.

APPLICATION OF PAYMENTS AND ADJUSTMENTS

10. (a) The amount of any overpayment by the Contractor of the Contractor's O&M, capital, and deficit (if any) obligations for the Year shall be applied first to any current liabilities of the Contractor arising out of this Contract then due and payable. Overpayments of more than $1,000 shall be refunded at the Contractor's request. In lieu of a refund, any amount of such overpayment, at the option of the Contractor, may be credited against amounts to become due to the United States by the Contractor. With respect to overpayment, such refund or adjustment shall constitute the sole remedy of the Contractor or anyone having or claiming to have the right to the use of any of the Project Water supply provided for herein. All credits and refunds of overpayments shall be made within 30 days of the Contracting Officer obtaining direction as to how to credit or refund such overpayment in response to the notice to the Contractor that it has finalized the accounts for the Year in which the overpayment was made.

(b) All advances for miscellaneous costs incurred for work requested by the Contractor pursuant to Article 25 of this Contract shall be adjusted to reflect the actual costs when the work has been completed. If the advances exceed the actual costs incurred, the difference will be refunded to the Contractor. If the actual costs exceed the Contractor's advances, the Contractor will be billed for the additional costs pursuant to Article 25.

TEMPORARY REDUCTIONS--RETURN FLOWS

11. (a) Subject to: (i) the authorized purposes and priorities of the Project and the requirements of Federal law and (ii) the obligations of the United States under existing contracts, or renewals thereof, providing for water deliveries from the Project, the Contracting Officer shall make

all reasonable efforts to optimize Project Water deliveries to the Contractor as provided in this Contract.

(b) The Contracting Officer or Operating Non-Federal Entity may temporarily discontinue or reduce the quantity of Water Delivered to the Contractor as herein provided for the purposes of investigation, inspection, maintenance, repair, or replacement of any of the Project facilities or any part thereof necessary for the delivery of Project Water to the Contractor, but so far as feasible the Contracting Officer or Operating Non-Federal Entity will give the Contractor due notice in advance of such temporary discontinuance or reduction, except in case of emergency, in which case no notice need be given: Provided, That the United States shall use its best efforts to avoid any discontinuance or reduction in such service. Upon resumption of service after such reduction or discontinuance, and if requested by the Contractor, the United States will, if possible, deliver the quantity of Project Water which would have been delivered hereunder in the absence of such discontinuance or reduction.

(c) The United States reserves the right to all seepage and return flow water derived from Water Delivered to the Contractor hereunder which escapes or is discharged beyond the Contractor's Service Area: Provided, That this shall not be construed as claiming for the United States any right to seepage or return flow being put to reasonable and beneficial use pursuant to this Contract within the Contractor's Service Area by the Contractor or those claiming by, through, or under the Contractor.

CONSTRAINTS ON THE AVAILABILITY OF WATER

12. (a) In its operation of the Project, the Contracting Officer will use all reasonable means to guard against a Condition of Shortage in the quantity of water to be made available to the Contractor pursuant to this Contract. In the event the Contracting Officer determines that a Condition of Shortage appears probable, the Contracting Officer will notify the Contractor of said determination as soon as practicable.

(b) If there is a Condition of Shortage because of errors in physical operations of the Project, drought, other physical causes beyond the control of the Contracting Officer, or actions taken by the Contracting Officer to meet legal obligations then, except as provided in subdivision (a) of Article 18 of this Contract, no liability shall accrue against the United States or any of its officers, agents, or employees for any damage, direct or indirect, arising therefrom.

(c) The United States shall not execute contracts which together with this Contract, shall in the aggregate provide for furnishing during the life of this Contract or any renewals hereof Class 1 Water in excess of 800,000 acre-feet per Year or Class 2 Water in excess of 1,401,475 acre-feet per Year: Provided, That, subject to subdivision (l) of Article 3 of this Contract, the limitation placed on Class 2 Water contracts shall not prohibit the United States from entering into temporary contracts of one year or less in duration for delivery of Project Water to other entities if such water is not necessary to meet the schedules as may be submitted by all Friant Division long-term water service contractors entitled to receive Class 1 Water and/or Class 2 Water under their water service contracts. Nothing in this subdivision shall limit the Contracting Officer's ability to take actions that result in the availability of new water supplies to be used for Project purposes and

allocating such new supplies: Provided, That the Contracting Officer shall not take such actions until after consultation with the Friant Division Project Contractors.

(d) The Contracting Officer shall not deliver any Class 2 Water pursuant to this or any other contract for water service heretofore or hereafter entered into any Year unless and until the Contracting Officer determines that the cumulative total quantity of Class 1 Water specified in subdivision (c) of this Article will be available for delivery in said Year. If the Contracting Officer determines there is or will be a shortage in any Year in the quantity of Class 1 Water available for delivery, the Contracting Officer shall apportion the available Class 1 Water among all contractors entitled to receive such water that will be made available at Friant Dam in accordance with the following:

(1) A determination shall be made of the total quantity of Class 1 Water at Friant Dam which is available for meeting Class 1 Water contractual commitments, the amount so determined being herein referred to as the available supply.

(2) The total available Class 1 supply shall be divided by the Class 1 Water contractual commitments, the quotient thus obtained being herein referred to as the Class 1 apportionment coefficient.

(3) The total quantity of Class 1 Water under Article 3 of this Contract shall be multiplied by the Class 1 apportionment coefficient and the result shall be the quantity of Class 1 Water required to be delivered by the Contracting Officer to the Contractor for the respective Year, but in no event shall such amount exceed the total quantity of Class 1 Water specified in subdivision (a) of Article 3 of this Contract.

(e) If the Contracting Officer determines there is less than the quantity of Class 2 Water which the Contractor otherwise would be entitled to receive pursuant to Article 3 of this Contract, the quantity of Class 2 Water which shall be furnished to the Contractor by the Contracting Officer will be determined in the manner set forth in paragraphs (1), (2), and (3), of subdivision (d) of this Article substituting the term "Class 2" for the term "Class 1."

(f) In the event that in any Year there is made available to the Contractor, by reason of any shortage or apportionment as provided in subdivisions (a), (d), or (e) of this Article, or any discontinuance or reduction of service as set forth in subdivision (b) of Article 11 of this Contract, less than the quantity of water which the Contractor otherwise would be entitled to receive hereunder, there shall be made an adjustment on account of the amounts already paid to the Contracting Officer by the Contractor for Class 1 Water and Class 2 Water for said Year in accordance with Article 10 of this Contract.

13. Omitted.

RULES AND REGULATIONS

14. (a) The parties agree that the delivery of Project Water or use of Federal facilities pursuant to this Contract is subject to Federal Reclamation law, as amended and supplemented, and the rules and regulations promulgated by the Secretary of the Interior under Federal Reclamation law.

(b) The terms of this Contract are subject to any enforceable order, judgment, and/or settlement in NRDC v. Patterson, No. CIVS 88-1658-LKK-EM and shall be timely modified as necessary to effectuate or facilitate any final order, judgment, or settlement in said litigation.

(c) Omitted.

## WATER AND AIR POLLUTION CONTROL

15. The Contractor, in carrying out this Contract, shall comply with all applicable water and air pollution laws and regulations of the United States and the State of California, and shall obtain all required permits or licenses from the appropriate Federal, State, or local authorities.

## QUALITY OF WATER

16. (a) Project facilities used to deliver Project Water to the Contractor pursuant to this Contract shall be operated and maintained to enable the United States to deliver Project Water to the Contractor in accordance with the water quality standards specified in subsection 2(b) of the Act of August 26, 1937 (50 Stat. 865), as added by Section 101 of the Act of October 27, 1986 (100 Stat. 3050) or other existing Federal laws. The United States is under no obligation to construct or furnish water treatment facilities to maintain or to improve the quality of Water Delivered to the Contractor pursuant to this Contract. The United States does not warrant the quality of Water Delivered to the Contractor pursuant to this Contract.

(b) The O&M of Project facilities shall be performed in such manner as is practicable to maintain the quality of raw water made available through such facilities at the highest level reasonably attainable as determined by the Contracting Officer. The Contractor shall be responsible for compliance with all State and Federal water quality standards applicable to surface and subsurface agricultural drainage discharges generated through the use of Federal or Contractor facilities or Project Water provided by the Contractor within the Contractor's Service Area.

## WATER ACQUIRED BY THE CONTRACTOR OTHER THAN FROM THE UNITED STATES

17. (a) Omitted.

(b) Water or water rights now owned or hereafter acquired by the Contractor, other than from the United States, may be stored, conveyed, and/or diverted through Project facilities, subject to the completion of appropriate environmental documentation, with the approval of the Contracting Officer and the execution of any contract determined by the Contracting Officer to be necessary, consistent with the following provisions:

(1) The Contractor may introduce non-Project water into Project facilities and deliver said water within the Contractor's Service Area subject to payment to the United States and/or to any applicable Operating Non-Federal Entity of an appropriate rate as determined by the applicable Project ratesetting policy, the RRA, and the Project use power policy, if such Project use power policy is applicable, each as amended, modified, or superseded from time to time.

(2) Delivery of such non-Project water in and through Project facilities shall only be allowed to the extent such deliveries do not: (i) interfere with other Project purposes as determined by the Contracting Officer; (ii) reduce the quantity or quality of water available to other Project Contractors; (iii) interfere with the delivery of contractual water entitlements to any other Project Contractors; or (iv) interfere with the physical maintenance of the Project facilities.

(3) Neither the United States nor the Operating Non-Federal Entity shall be responsible for control, care, or distribution of the non-Project water before it is introduced into or after it is delivered from the Project facilities. The Contractor hereby releases and agrees to defend

and indemnify the United States and the Operating Non-Federal Entity, and their respective officers, agents, and employees, from any claim for damage to persons or property, direct or indirect, resulting from the acts of the Contractor its officers', employees', agents', or assigns' act(s) in (i) extracting or diverting non-Project water from any source, or (ii) diverting such non-Project water into Project facilities.

(4) Diversion of such non-Project water into Project facilities shall be consistent with all applicable laws, and if involving groundwater, consistent with any groundwater management plan for the area from which it was extracted.

(5) After Project purposes are met, as determined by the Contracting Officer, the United States and the Contractor shall share priority to utilize the remaining capacity of the facilities declared to be available by the Contracting Officer for conveyance and transportation of non-Project water prior to any such remaining capacity being made available to non-Project contractors.

OPINIONS AND DETERMINATIONS

18. (a) Where the terms of this Contract provide for actions to be based upon the opinion or determination of either party to this Contract, said terms shall not be construed as permitting such action to be predicated upon arbitrary, capricious, or unreasonable opinions or determinations. Both parties, notwithstanding any other provisions of this Contract, expressly reserve the right to seek relief from and appropriate adjustment for any such arbitrary, capricious, or unreasonable opinion or determination. Each opinion or determination by either party shall be provided in a timely manner. Nothing in subdivision (a) of Article 18 of this Contract is intended to

or shall affect or alter the standard of judicial review applicable under Federal law to any opinion or determination implementing a specific provision of Federal law embodied in statute or regulation.

(b) The Contracting Officer shall have the right to make determinations necessary to administer this Contract that are consistent with the expressed and implied provisions of this Contract, the laws of the United States and of the State of California, and the rules and regulations promulgated by the Secretary of the Interior. Such determinations shall be made in consultation with the Contractor to the extent reasonably practicable.

COORDINATION AND COOPERATION

19. (a) In order to further their mutual goals and objectives, the Contracting Officer and the Contractor shall communicate, coordinate, and cooperate with each other, and with other affected Project Contractors, in order to improve the operation and management of the Project. The communication, coordination, and cooperation regarding operations and management shall include, but not be limited to, any action which will or may materially affect the quantity or quality of Project Water supply, the allocation of Project Water supply, and Project financial matters including, but not limited to, budget issues. The communication, coordination, and cooperation provided for hereunder shall extend to all provisions of this Contract. Each party shall retain exclusive decision making authority for all actions, opinion, and determinations to be made by the respective party.

(b) Within 120 days following the effective date of this Contract, the Contractor, other affected Project Contractors, and the Contracting Officer shall arrange to meet with interested Project Contractors to develop a mutually agreeable, written Project-wide process, which may be amended as necessary, separate and apart from this Contract. The goal of this process shall be to

provide, to the extent practicable, the means of mutual communication and interaction regarding significant decisions concerning Project operation and management on a real-time basis.

(c) It is the intent of the Secretary to improve water supply reliability. To carry out this intent:

(1) The Contracting Officer will, at the request of the Contractor, assist in the development of integrated resource management plans for the Contractor. Further, the Contracting Officer will, as appropriate, seek authorizations for implementation of partnerships to improve water supply, water quality, and reliability.

(2) The Secretary will, as appropriate, pursue program and project implementation and authorization in coordination with Project Contractors to improve the water supply, water quality, and reliability of the Project for all Project purposes.

(3) The Secretary will coordinate with Project Contractors and the State of California to seek improved water resource management.

(4) The Secretary will coordinate actions of agencies within the Department of the Interior that may impact the availability of water for Project purposes.

(5) The Contracting Officer shall periodically, but not less than annually, hold division level meetings to discuss Project operations, division level water management activities, and other issues as appropriate.

(d) Without limiting the contractual obligations of the Contracting Officer under the other Articles of this Contract, nothing in this Article shall be construed to limit or constrain the Contracting Officer's ability to communicate, coordinate, and cooperate with the Contractor or other

interested stakeholders or to make decisions in a timely fashion as needed to protect health, safety, or the physical integrity of structures or facilities.

## CHARGES FOR DELINQUENT PAYMENTS

20. (a) The Contractor shall be subject to interest, administrative, and penalty charges on delinquent installments or payments. When a payment is not received by the due date, the Contractor shall pay an interest charge for each day the payment is delinquent beyond the due date. When a payment becomes sixty (60) days delinquent, the Contractor shall pay an administrative charge to cover additional costs of billing and processing the delinquent payment. When a payment is delinquent ninety (90) days or more, the Contractor shall pay an additional penalty charge of six (6%) percent per year for each day the payment is delinquent beyond the due date. Further, the Contractor shall pay any fees incurred for debt collection services associated with a delinquent payment.

(b) The interest charge rate shall be the greater of the rate prescribed quarterly in the Federal Register by the Department of the Treasury for application to overdue payments, or the interest rate of one-half of one (0.5%) percent per month prescribed by Section 6 of the Reclamation Project Act of 1939 (Public Law 76-260). The interest charge rate shall be determined as of the due date and remain fixed for the duration of the delinquent period.

(c) When a partial payment on a delinquent account is received, the amount received shall be applied, first to the penalty, second to the administrative charges, third to the accrued interest, and finally to the overdue payment.

## EQUAL OPPORTUNITY

21. During the performance of this Contract, the Contractor agrees as follows:

(a) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination, rates of payment or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of this nondiscrimination clause.

(b) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without discrimination because of race, color, religion, sex, or national origin.

(c) The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the Contracting Officer, advising the said labor union or workers' representative of the Contractor's commitments under Section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(d) The Contractor will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(e) The Contractor will furnish all information and reports required by said amended Executive Order and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records, and accounts by the Contracting Officer and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(f) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this Contract or with any of the said rules, regulations, or orders, this Contract may be canceled, terminated, or suspended, in whole or in part, and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in said amended Executive Order, and such other sanctions may be imposed and remedies invoked as provided in said Executive Order, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(g) The Contractor will include the provisions of paragraphs (a) through (g) in every subcontract or purchase order unless exempted by the rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of said amended Executive Order, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, That in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

## GENERAL OBLIGATION--BENEFITS CONDITIONED UPON PAYMENT

22. (a) The obligation of the Contractor to pay the United States as provided in this Contract is a general obligation of the Contractor notwithstanding the manner in which the obligation may be distributed among the Contractor's water users and notwithstanding the default of individual water users in their obligations to the Contractor.

(b) The payment of charges becoming due hereunder is a condition precedent to receiving benefits under this Contract. The United States shall not make water available to the Contractor through Project facilities during any period in which the Contractor may be in arrears in the advance payment of water rates due the United States. The Contractor shall not furnish water made available pursuant to this Contract for lands or parties which are in arrears in the advance payment of water rates levied or established by the Contractor.

(c) With respect to subdivision (b) of this Article, the Contractor shall have no obligation to require advance payment for water rates which it levies.

COMPLIANCE WITH CIVIL RIGHTS LAWS AND REGULATIONS

23. (a) The Contractor shall comply with Title VI of the Civil Rights Act of 1964 (42 U.S.C. 2000d), Section 504 of the Rehabilitation Act of 1975 (P.L. 93-112, as amended), the Age Discrimination Act of 1975 (42 U.S.C. 6101, et seq.) and any other applicable civil rights laws, as well as with their respective implementing regulations and guidelines imposed by the U.S. Department of the Interior and/or Bureau of Reclamation.

(b) These statutes require that no person in the United States shall, on the grounds of race, color, national origin, handicap, or age, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving financial assistance from the Bureau of Reclamation. By executing this Contract, the Contractor agrees to immediately take any measures necessary to implement this obligation, including permitting officials of the United States to inspect premises, programs, and documents.

(c) The Contractor makes this agreement in consideration of and for the purpose of obtaining any and all Federal grants, loans, contracts, property discounts, or other Federal financial assistance extended after the date hereof to the Contractor by the Bureau of Reclamation, including installment payments after such date on account of arrangements for Federal financial assistance which were approved before such date. The Contractor recognizes and agrees that such Federal assistance will be extended in reliance on the representations and agreements made in this Article, and that the United States reserves the right to seek judicial enforcement thereof.

24. Omitted.

CONTRACTOR TO PAY CERTAIN MISCELLANEOUS COSTS

25. In addition to all other payments to be made by the Contractor pursuant to this Contract, the Contractor shall pay to the United States, within 60 days after receipt of a bill and detailed statement submitted by the Contracting Officer to the Contractor for such specific items of direct cost incurred by the United States for work requested by the Contractor associated with this Contract plus indirect costs in accordance with applicable Bureau of Reclamation policies and procedures. All such amounts referred to in this Article shall not exceed the amount agreed to in writing in advance by the Contractor. This Article shall not apply to costs for routine contract administration.

WATER CONSERVATION

26. (a) Prior to the delivery of water provided from or conveyed through Federally constructed or Federally financed facilities pursuant to this Contract, the Contractor shall be implementing an effective water conservation and efficiency program based on the Contractor's water conservation plan that has been determined by the Contracting Officer to meet the conservation and efficiency criteria for evaluating water conservation plans established under Federal law. The water conservation and efficiency program shall contain definite water conservation objectives, appropriate economically feasible water conservation measures, and time schedules for meeting those objectives. Continued Project Water delivery pursuant to this Contract shall be contingent upon the Contractor's continued implementation of such water conservation program. In the event the Contractor's water conservation plan or any revised water conservation plan completed pursuant to subdivision (d) of Article 26 of this Contract have not yet been determined by the Contracting Officer to meet such

criteria, due to circumstances which the Contracting Officer determines are beyond the control of the Contractor, water deliveries shall be made under this Contract so long as the Contractor diligently works with the Contracting Officer to obtain such determination at the earliest practicable date, and thereafter the Contractor immediately begins implementing its water conservation and efficiency program in accordance with the time schedules therein.

(b) Should the amount of M&I Water delivered pursuant to subdivision (a) of Article 3 of this Contract equal or exceed 2,000 acre-feet per Year, the Contractor shall implement the Best Management Practices identified by the time frames issued by the California Urban Water Conservation Council for such M&I Water unless any such practice is determined by the Contracting Officer to be inappropriate for the Contractor.

(c) The Contractor shall submit to the Contracting Officer a report on the status of its implementation of the water conservation plan on the reporting dates specified in the then-existing conservation and efficiency criteria established under Federal law.

(d) At five-year intervals, the Contractor shall revise its water conservation plan to reflect the then-current conservation and efficiency criteria for evaluating water conservation plans established under Federal law and submit such revised water management plan to the Contracting Officer for review and evaluation. The Contracting Officer will then determine if the water conservation plan meets Reclamation's then-current conservation and efficiency criteria for evaluating water conservation plans established under Federal law.

(e) If the Contractor is engaged in direct groundwater recharge, such activity shall be described in the Contractor's water conservation plan.

EXISTING OR ACQUIRED WATER OR WATER RIGHTS

27. Except as specifically provided in Article 17 of this Contract, the provisions of this Contract shall not be applicable to or affect non-Project water or water rights now owned or hereafter acquired by the Contractor or any user of such water within the Contractor's Service Area. Any such water shall not be considered Project Water under this Contract. In addition, this Contract shall not be construed as limiting or curtailing any rights which the Contractor or any water user within the Contractor's Service Area acquires or has available under any other contract pursuant to Federal Reclamation law.

OPERATION AND MAINTENANCE BY OPERATING NON-FEDERAL ENTITY

28. (a) The O&M of a portion of the Project facilities which serve the Contractor, and responsibility for funding a portion of the costs of such O&M, have been transferred to the Operating Non-Federal Entity by separate agreement between the United States and the Operating Non-Federal Entity. That separate agreement shall not interfere with or affect the rights or obligations of the Contractor or the United States hereunder.

(b) The Contracting Officer has previously notified the Contractor in writing that the O&M of a portion of the Project facilities which serve the Contractor has been transferred to the Operating Non-Federal Entity, and therefore, the Contractor shall pay directly to the Operating Non-Federal Entity, or to any successor approved by the Contracting Officer under the terms and conditions of the separate agreement between the United States and the Operating Non-Federal Entity described in subdivision (a) of this Article, all rates, charges, or assessments of any kind, including any assessment for reserve funds, which the Operating Non-Federal Entity or such successor

1007 determines, sets, or establishes for (i) the O&M of the portion of the Project facilities operated and
1008 maintained by the Operating Non-Federal Entity or such successor, or (ii) the Friant Division's share
1009 of the operation, maintenance, and replacement costs for physical works and appurtenances
1010 associated with the Tracy Pumping Plant, the Delta-Mendota Canal, the O'Neill Pumping/Generating
1011 Plant, the Federal share of the O'Neill Forebay, the Mendota Pool, and the Federal share of San Luis
1012 Unit joint use conveyance and conveyance pumping facilities. Such direct payments to the Operating
1013 Non-Federal Entity or such successor shall not relieve the Contractor of its obligation to pay directly
1014 to the United States the Contractor's share of the Project Rates, Charges, and Tiered Pricing
1015 Component(s) except to the extent the Operating Non-Federal Entity collects payments on behalf of
1016 the United States in accordance with the separate agreement identified in subdivision (a) of this
1017 Article.

1018 (c) For so long as the O&M of any portion of the Project facilities serving the
1019 Contractor is performed by the Operating Non-Federal Entity, or any successor thereto, the
1020 Contracting Officer shall adjust those components of the Rates for Water Delivered under this
1021 Contract representing the cost associated with the activity being performed by the Operating
1022 Non-Federal Entity or its successor.

1023 (d) In the event the O&M of the Project facilities operated and maintained by the
1024 Operating Non-Federal Entity is re-assumed by the United States during the term of this Contract, the
1025 Contracting Officer shall so notify the Contractor, in writing, and present to the Contractor a revised
1026 Exhibit "B" which shall include the portion of the Rates to be paid by the Contractor for Project
1027 Water under this Contract representing the O&M costs of the portion of such Project facilities which

have been re-assumed. The Contractor shall, thereafter, in the absence of written notification from the Contracting Officer to the contrary, pay the Rates, Charges, and Tiered Pricing Component(s) specified in the revised Exhibit "B" directly to the United States in compliance with Article 7 of this Contract.

CONTINGENT UPON APPROPRIATION OR ALLOTMENT OF FUNDS

29. The expenditure or advance of any money or the performance of any obligation of the United States under this Contract shall be contingent upon appropriation or allotment of funds. Absence of appropriation or allotment of funds shall not relieve the Contractor from any obligations under this Contract. No liability shall accrue to the United States in case funds are not appropriated or allotted.

BOOKS, RECORDS, AND REPORTS

30. (a) The Contractor shall establish and maintain accounts and other books and records pertaining to administration of the terms and conditions of this Contract, including: the Contractor's financial transactions, water supply data, and Project land and right-of-way agreements; water use data; and other matters that the Contracting Officer may require. Reports thereon shall be furnished to the Contracting Officer in such form and on such date or dates as the Contracting Officer may require. Subject to applicable Federal laws and regulations, each party to this Contract shall have the right during office hours to examine and make copies of the other party's books and records relating to matters covered by this Contract.

(b) Notwithstanding the provisions of subdivision (a) of this Article, no books, records, or other information shall be requested from the Contractor by the Contracting Officer unless such books, records, or information are reasonably related to the administration or performance of this Contract. Any such request shall allow the Contractor a reasonable period of time within which to provide the requested books, records, or information.

(c) At such time as the Contractor provides information to the Contracting Officer pursuant to subdivision (a) of this Article, a copy of such information shall be provided to the Operating Non-Federal Entity.

ASSIGNMENT LIMITED--SUCCESSORS AND ASSIGNS OBLIGATED

31. (a) The provisions of this Contract shall apply to and bind the successors and assigns of the parties hereto, but no assignment or transfer of this Contract or any right or interest therein shall be valid until approved in writing by the Contracting Officer.

(b) The assignment of any right or interest in this Contract by either party shall not interfere with the rights or obligations of the other party to this Contract absent the written concurrence of said other party.

(c) The Contracting Officer shall not unreasonably condition or withhold approval of any proposed assignment.

SEVERABILITY

32. In the event that a person or entity who is neither (i) a party to a Project contract, nor (ii) a person or entity that receives Project Water from a party to a Project contract, nor (iii) an association or other form of organization whose primary function is to represent parties to Project contracts, brings an action in a court of competent jurisdiction challenging the legality or enforceability of a provision included in this Contract and said person, entity, association, or organization obtains a final court decision holding that such provision is legally invalid or unenforceable and the Contractor has not intervened in that lawsuit in support of the plaintiff(s), the parties to this Contract shall use their best efforts to (i) within 30 days of the date of such final court decision identify by mutual agreement the provisions in this Contract which must be revised and

(ii) within three months thereafter promptly agree on the appropriate revision(s). The time periods specified above may be extended by mutual agreement of the parties. Pending the completion of the actions designated above, to the extent it can do so without violating any applicable provisions of law, the United States shall continue to make the quantities of Project Water specified in this Contract available to the Contractor pursuant to the provisions of this Contract which were not found to be legally invalid or unenforceable in the final court decision.

RESOLUTION OF DISPUTES

33. Should any dispute arise concerning any provisions of this Contract, or the parties' rights and obligations thereunder, the parties shall meet and confer in an attempt to resolve the dispute. Prior to the Contractor commencing any legal action, or the Contracting Officer referring any matter to Department of Justice, the party shall provide to the other party 30 days' written notice of the intent to take such action: Provided, That such notice shall not be required where a delay in commencing an action would prejudice the interests of the party that intends to file suit. During the 30-day notice period, the Contractor and the Contracting Officer shall meet and confer in an attempt to resolve the dispute. Except as specifically provided, nothing herein is intended to waive or abridge any right or remedy that the Contractor or the United States may have.

OFFICIALS NOT TO BENEFIT

34. No Member of or Delegate to Congress, Resident Commissioner, or official of the Contractor shall benefit from this Contract other than as a water user or landowner in the same manner as other water users or landowners.

## CHANGES IN CONTRACTOR'S SERVICE AREA

35. (a) While this Contract is in effect, no change may be made in the Contractor's Service Area, by inclusion or exclusion of lands, dissolution, consolidation, merger, or otherwise, except upon the Contracting Officer's written consent.

(b) Within 30 days of receipt of a request for such a change, the Contracting Officer will notify the Contractor of any additional information required by the Contracting Officer for processing said request, and both parties will meet to establish a mutually agreeable schedule for timely completion of the process. Such process will analyze whether the proposed change is likely to: (i) result in the use of Project Water contrary to the terms of this Contract; (ii) impair the ability of the Contractor to pay for Project Water furnished under this Contract or to pay for any Federally-constructed facilities for which the Contractor is responsible; and (iii) have an impact on any Project Water rights applications, permits, or licenses. In addition, the Contracting Officer shall comply with the NEPA and the ESA. The Contractor will be responsible for all costs incurred by the Contracting Officer in this process, and such costs will be paid in accordance with Article 25 of this Contract.

## FEDERAL LAWS

36. By entering into this Contract, the Contractor does not waive its rights to contest the validity or application in connection with the performance of the terms and conditions of this Contract of any Federal law or regulation: Provided, That the Contractor agrees to comply with the terms and conditions of this Contract unless and until relief from application of such Federal law or regulation to the implementing provision of the Contract is granted by a court of competent jurisdiction.

## NOTICES

37. Any notice, demand, or request authorized or required by this Contract shall be deemed to have been given, on behalf of the Contractor, when mailed, postage prepaid, or delivered to the Area Manager, South-Central California Area Office, 1243 "N" Street, Fresno, California 93721, and on behalf of the United States, when mailed, postage prepaid, or delivered to the City of Fresno, Public Utilities Director, 2600 Fresno Street, Room 3065, Fresno, California 93721-3624. The designation of the addressee or the address may be changed by notice given in the same manner as provided in this Article for other notices.

## CONFIRMATION OF CONTRACT

38. The Contractor, after the execution of this Contract, shall furnish to the Contracting Officer evidence that pursuant to the laws of the State of California the Contractor is a legally constituted entity, and the Contract is lawful, valid, and binding on the Contractor. This Contract shall not be binding on the United States until such evidence has been provided to the Contracting Officer's satisfaction.

IN WITNESS WHEREOF, the parties hereto have executed this Contract as of the day and year first above written.

THE UNITED STATES OF AMERICA

APPROVED AS TO LEGAL FORM AND SUFFICIENCY
James E Jackson
OFFICE OF REGIONAL SOLICITOR
DEPARTMENT OF THE INTERIOR

By: _____
Regional Director, Mid-Pacific Region
Bureau of Reclamation

(SEAL)

CITY OF FRESNO

By: _____
City Manager

Attest:

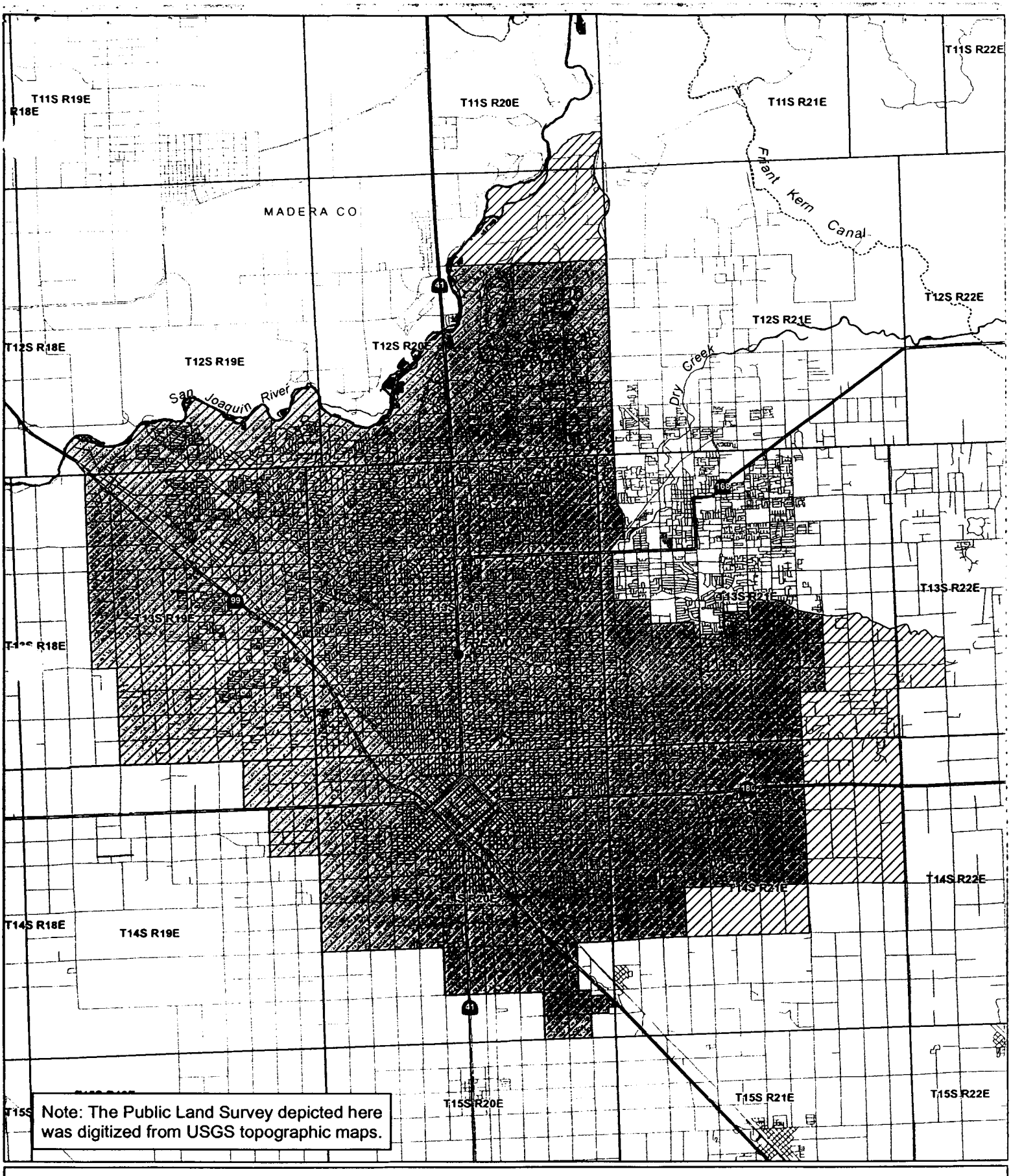
By: Rebecca E Klisch
City Clerk 7-25-05

By: _____
Public Utilities Director

Approved as to form:

Hilda Cantu Montez
City Attorney

(I:\LTRC\Final Draft LTRC's – Fresno, Tracy\City of Fresno R. O. Final Draft Contract 05-04-2005.doc)




Contractor's Proposed Service Area (Sphere of Influence)

Contractor's Current Service Area

# City of Fresno

Contract No. 14-06-200-8901-LTR1

EXHIBIT A

Miles

0 0.5 1 2 3 4

Date: October 26, 2004

File Name: N:\districts\contracts\city_of_fresno\city_of_fresno2.mxd

214-208-12705

EXHIBIT B
CITY OF FRESNO
WATER RATES AND CHARGES

| | 2005 Rates Per Acre-Foot M&I Water |
|---|---|
| O&M AND COST-OF-SERVICE RATES: | |
| Capital Rates: | $20.04 |
| O&M Rates: | |
| Water Marketing | $ 3.89 |
| Storage | $ 6.67 |
| Conveyance | * |
| Deficit Rates: | |
| Non-Interest Bearing | |
| Interest Bearing | $53.53 |
| CFO/PER Adj. Rate ** | $ 1.70 |
| TOTAL COST-OF-SERVICE RATES (COS): | $85.83 |
| M&I FULL-COST RATE | $97.15 |
| Tiered Pricing Component>80%<=90% of Contract Total [Full Cost Rate – COS Rate /2]: | $ 5.66 |
| Tiered Pricing Component>90% of Contract Total [Full Cost Rate – COS Rate]: | $11.32 |
| SURCHARGES UNDER PUB. L. 102-575 TO RESTORATION FUND*** | |
| Friant Surcharge [3406(c)(1)] | $ 7.00 |
| Restoration Payments [3407(d)(2)(A)] | $15.87 |

* Conveyance and Conveyance Pumping Operation and Maintenance Costs were removed for ratesetting purposes and are to be billed directly to the water authorities.

** Chief Financial Officer (CFO) Adjustment and Provision for Replacement (PFR) Credit are being distributed over a 5-year period beginning in FY2003 for the contractors that requested that the costs be deferred.

*** The surcharges are payments in addition to the water rates and were determined pursuant to Title XXXIV of Public Law 102-575. Restoration fund surcharges under P. L. 102-575 are on a fiscal year basis (10/1-9/30).

EXHIBIT C
METERING PLAN

| Completion Date | Item | Comments |
|---|---|---|
| 03/05* | Contract effective | |
| 01/06 | Implementation study | Select and obtain consultant study re implementation |
| 01/06 | Submit progress report to Bureau | |
| 12/06 | Confirmation of existing meters | Verify integrity and servicing of existing meters |
| 01/07 | Submit progress report to Bureau | |
| 06/07 | Secure installation contract | Begin implementation of consultant recommendations |
| 12/07 | Draft rate ordinance | Initial development of tiered rate structure |
| 01/08 | Submit progress report to Bureau | |
| 01/08 | Initiate retrofit | Begin installation of meters on existing dwellings |
| 12/08 | Meter installation progress | 29% (30,000 of approximately 105,000 units installed) |
| 01/09 | Submit progress report to Bureau | |
| 12/09 | Meter installation progress | 43% (45,000 units) |
| 01/10 | Submit progress report to Bureau | |
| 03/10 | Impose new rate ordinance (fees based on metered use) | New rate structure applicable to currently metered customers. Rates to be effective as new meter installations occur. |
| 12/10 | Meter installation progress | 62% (65,000 units) |
| 01/11 | Submit progress report to Bureau | |
| 12/11 | Adopt new rate ordinance | 81% (85,000 units) |
| 01/12 | Submit compliance report to Bureau | |
| 12/12 | Meter installation progress | 100% (105,000 units) |
| 01/13 | Submit completion report | Retrofit complete. |

**Schedule subject to change due to unforeseen circumstances.**

*This date will be revised at the time the contract is executed on behalf of the United States.

Amendment to Contract
No. 14-06-200-8901-LTR1

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Central Valley Project, California

AMENDMENT TO LONG-TERM RENEWAL CONTRACT BETWEEN
THE UNITED STATES
AND
CITY OF FRESNO
PROVIDING FOR PROJECT WATER SERVICE FROM FRIANT DIVISION

THIS CONTRACT AMENDMENT, is made this 6th day of April, 2007, in pursuance generally of the Act of Congress of June 17, 1902 (32 Stat. 388), and the acts amendatory thereof or supplementary thereto, including, but not limited to, the Acts of August 26, 1937 (50 Stat. 844), as amended and supplemented, August 4, 1939 (53 Stat. 1187), as amended and supplemented, July 2, 1956 (70 Stat. 483), June 21, 1963 (77 Stat. 68), October 12, 1982 (96 Stat. 1263), October 27, 1986 (100 Stat. 3050), as amended, and Title XXXIV of the Act of October 30, 1992 (106 Stat. 4706), all collectively hereinafter referred to as Federal Reclamation law, between THE UNITED STATES OF AMERICA, hereinafter referred to as the United States, and, CITY OF FRESNO, hereinafter referred to as the Contractor, a public agency of the State of California, duly organized, existing, and acting pursuant to the laws thereof;

WITNESSETH, That:

EXPLANATORY RECITALS

[1st] WHEREAS, the United States and the Contractor entered into a contract dated August 18, 2005, designated Contract No. 14-06-200-8901-LTR1, providing for water service from the Central Valley Project, hereinafter referred to as the "Existing Contract;" and

[2nd] WHEREAS, pursuant to subdivision (b) of Article 14 of the Existing Contract, the terms of the Existing Contract are subject to any enforceable order, judgment and/or settlement in *NRDC* v. *Patterson*, No. CIVS 88-1658-LKK-EM (now styled *Natural Resources Defense Council, et al.* v. *Rodgers, et al.*, No. CIV-S-88-1658 LKK/GGH) and that the Existing Contract shall be timely modified as necessary to effectuate or facilitate any final order, judgment or settlement in said litigation; and

[3rd] WHEREAS, the parties to said litigation have reached agreement on a global resolution of all Claims for Relief in the Seventh Amended Complaint, on the terms and conditions stated in the Stipulation of Settlement dated September 13, 2006, designated Exhibit 1 in the Order Approving Stipulation dated October 23, 2006; and

[4th] WHEREAS, the parties hereto desire to amend the Existing Contract as required by said Stipulation of Settlement.

NOW, THEREFORE, in consideration of the mutual and dependent covenants herein contained, it is hereby agreed as follows:

1. Subdivision (a) of Article 3 of the Existing Contract is deleted in its entirety, and the following is substituted in lieu thereof:

"(a) During each Year, consistent with all applicable State water rights, permits, and licenses, Federal law, and the Stipulation of Settlement dated September 13, 2006, the Order Approving Stipulation of Settlement, and the Judgment and further orders issued by the Court pursuant to terms and conditions of the Settlement in *Natural Resources Defense Council, et al.* v. *Rodgers, et al.*, No. CIV-S-88-1658 LKK/GGH, and subject to the provisions set forth in Articles 11 and 12 of this Contract, the Contracting Officer shall make available for delivery to the Contractor 60,000 acre-feet of Class 1 Water for M&I purposes. The quantity of Water Delivered to the Contractor in accordance with this subdivision shall be scheduled and paid for pursuant to the provisions of Articles 4 and 7 of this Contract."

2. Subdivision (a) of Article 11 of the Existing Contract is deleted in its entirety, and the following is substituted in lieu thereof:

"(a) Subject to: (i) the authorized purposes and priorities of the Project and the requirements of Federal law, and the Stipulation of Settlement dated September 13, 2006, the Order Approving Stipulation of Settlement, the Judgment and further orders issued by the Court pursuant to terms and conditions of the Settlement in *Natural Resources Defense Council, et al.* v. *Rodgers, et al.*, No. CIV-S-88-1658 LKK/GGH and (ii) the obligations of the United States under existing contracts, or renewals thereof, providing for water deliveries from the Project, the Contracting Officer shall make all reasonable efforts to optimize Project Water deliveries to the Contractor as provided in this Contract."

3. Subdivision (b) of Article 12 of the Existing Contract is deleted in its entirety, and the following is substituted in lieu thereof:

"(b) If there is a Condition of Shortage because of errors in physical operations of the Project, drought, other physical causes beyond the control of the Contracting Officer or actions taken by the Contracting Officer to meet legal obligations, including but not limited to obligations pursuant to the Stipulation of Settlement dated September 13, 2006, the Order Approving Stipulation of Settlement, the Judgment and further orders issued by the Court pursuant to terms and conditions of the Settlement in *Natural Resources Defense Council, et al.* v. *Rodgers, et al.*, No. CIV-S-88-1658 LKK/GGH then, except as provided in subdivision (a) of Article 18 of this Contract, no liability shall accrue against the United States or any of its officers, agents, or employees for any damage, direct or indirect, arising therefrom."

4. Subdivision (b) of Article 14 of the Existing Contract is deleted in its entirety, and the following is substituted in lieu thereof:

"(b) The terms of this Contract are subject to the Stipulation of Settlement dated September 13, 2006, the Order Approving Stipulation of Settlement, the Judgment and further orders issued by the Court pursuant to terms and conditions of the Settlement in *Natural Resources Defense Council, et al.* v. *Rodgers, et al.*, No. CIV-S-88-1658 LKK/GGH. Nothing in this Contract shall be interpreted to limit or interfere with the full implementation of this Settlement, Order, the Judgment and further orders issued by the Court pursuant to terms and conditions of the Settlement."

5. Except as specifically amended herein, the Existing Contract is valid and shall continue in full force and effect as originally written and executed.

IN WITNESS WHEREOF, the parties hereto have executed this Contract Amendment as of the day and year first above written.

APPROVED AS TO LEGAL FORM AND SUFFICIENCY
James E. Turner
OFFICE OF REGIONAL SOLICITOR
DEPARTMENT OF THE INTERIOR

THE UNITED STATES OF AMERICA

By: _____
Regional Director, Mid-Pacific Region
Bureau of Reclamation

CITY OF FRESNO

(SEAL)

By: _____
City Manager

By: _____
Public Utilities Director

Attest:

By: Elvira Sommerville (3/26/07)
City Clerk

Approved as to form:

By: _____
City Attorney

# City of Fresno and Fresno Irrigation District Agreements

**REVISED, AMENDED AND RESTATED COOPERATIVE AGREEMENT BETWEEN FRESNO IRRIGATION DISTRICT AND CITY OF FRESNO FOR WATER UTILIZATION AND CONVEYANCE**

THIS AGREEMENT is entered into as of December 20, 2016 by and between the Fresno Irrigation District, an irrigation district (herein called "District") and City of Fresno, a municipal corporation (herein called "City").

WITNESSETH:

WHEREAS, District is an irrigation district organized and existing under the laws of the State of California and is the owner of certain water supplies, water rights and a water distribution system that can convey water to lands both within and outside District boundaries; and

WHEREAS, City is a municipal corporation with boundaries largely overlapping those of District and is the owner of a water distribution system for the distribution of water to lands both in and outside the exterior boundaries of City; and

WHEREAS, District and City have heretofore entered into a cooperative program of water utilization between said parties evidenced by a written agreement for such water utilization and conveyance dated August 12, 1970, which by its terms and by the terms of amendments thereto terminated on May 30, 1976; and

WHEREAS, District and City continued with said cooperative program and entered into a replacement contract for water utilization and conveyance dated May 25, 1976 ("1976 Agreement"); and

WHEREAS, District and City wish to amend and restate the 1976 Agreement in its entirety in order to continue with and expand said cooperative program to recognize changed circumstances affecting them via this Revised, Amended and Restated Cooperative Agreement between Fresno Irrigation District and City of Fresno for Water Utilization and Conveyance ; and

WHEREAS, certain provisions of this Agreement are specifically authorized by, and entered into pursuant to, Chapter 9 (commencing with Section 26670), Part 10, Division 11 of the California Water Code; and

WHEREAS, by agreement dated December 22, 2010 between City and the United States of America identified as Contract No. 14-06-200-8901D (the "City Bureau Contract"), City is entitled to purchase certain water from the United States; and

WHEREAS, by agreement dated December 22, 2010 between District and the United States of America identified as Contract No. 14-06-200-1122D (the "District Bureau Contract"), District is entitled to purchase certain water from the United States; and

WHEREAS, District holds rights to Kings River water and storage in Pine Flat Reservoir on the Kings River, subject to various contracts with the United States of America, water supply schedules and agreements by and among members of the Kings River Water Association and others, judicial and regulatory decrees, and the water rights governing the diversion and use of Kings River water, all as they may be amended or supplemented from time to time (collectively, the "Kings River Agreements"); and

WHEREAS, it is recognized by District and City that District is primarily charged with the distribution and delivery of water within District for Agricultural Use and that its canals and distribution system must primarily be used for that purpose; and

WHEREAS, it is recognized by both District and City that many inhabitants of District also require water for domestic, industrial or fire protection purposes supplied to them by City; and

WHEREAS, under the 1976 Agreement, Kings River water was available to City once lands within District boundaries with surface water allotments were annexed into City and were covered by the 1976 Agreement's contract rate for surface water delivery to City by District for those lands; and

WHEREAS, City and District now wish to limit the amount of Kings River water available to City to provide more certainty regarding water supply availability and to address City's current and anticipated needs and circumstances; and

WHEREAS, City and District are both committed to working cooperatively under the Sustainable Groundwater Management Act ("SGMA") so that the groundwater basin shared by City and District is sustainable and so that undesirable results (as defined in SGMA) are minimized or avoided; and

WHEREAS, City and District recognize that changes to the operations of the Central Valley Project have impacted the availability of water from said project; and

WHEREAS, City has heretofore used much of the water delivered to it under the 1976 Agreement for groundwater recharge because of City's historical reliance on groundwater, and therefore did not require delivery of water year around; and

WHEREAS, City desires to use more of its surface water for direct delivery to its water users and ratepayers while limiting its reliance on groundwater; and

WHEREAS, with the development of its surface water treatment facilities ("SWTFs") City now requires a long-term, reliable and certain surface water supply, deliverable continuously year around; and

WHEREAS, conveyance of raw surface water to the SWTFs on a continuous year around basis will require, among other things, (i) new conveyance infrastructure built by City to overcome certain operational challenges and/or interruptions to District's infrastructure to accommodate normal and routine maintenance of District's canals and pipelines than have historically delivered surface water to City, (ii) District to alter its operations and incur additional

costs to make Out of Season Deliveries, and (iii) the use of new management techniques by District, with the attendant costs, including without limitation water sales, purchases, transfers and exchanges, to meet the need for a continuous supply of surface water to City's SWTFs, all while addressing SGMA and other legal and regulatory requirements that impact the groundwater basin shared by District and City; and

WHEREAS, providing Out of Season Deliveries by District to City may also require the development of new water supplies and projects to provide the water being sought by City; and

WHEREAS, City acknowledges that District has a great depth of experience, knowledge and expertise in the management of surface water supply resources (including but not limited to water supply sales, purchases, transfers and exchanges); and

WHEREAS, City recognizes that the coordinated management of both District's and City's water supplies by District is desirable to maximize the use of the current water supplies and the future development of water supplies for both parties; and

WHEREAS, City has determined that it is in City's interest, and in the interest of its water users and ratepayers, to engage District to employ District's experience, knowledge and expertise on behalf of City in the management of City's Surface Water pursuant to the terms hereof in order to achieve City's and District's goals described herein and to accommodate City's desire for a continuous year around surface water supply, and District has agreed to be so engaged; and

WHEREAS, the changing conditions and manner of management of water supplies throughout the State of California, and other factors beyond the control of City and District, will require increased vigilance on the part of water purveyors in the Fresno area to cooperate with each other on long-range implementation strategies to improve the availability, reliability, and drought resiliency of water supplies; and

WHEREAS, through this Agreement and additional cooperative efforts, City, District and other entities in the region intend to capture of flood released waters, optimize existing water supply storage assets, develop new water supply storage assets, expand groundwater recharge capacities, engage in strategic water supply sales, transfers and exchanges and enhance the utilization of recycled and/or treated waters; and

WHEREAS, in light of SGMA, environmental regulations, water supply challenges and competition with other users and regions in the State for water supplies, City and District wish to further enhance their cooperative working relationship for the benefit of the water users and ratepayers they serve by entering into this Agreement to provide for strategic, long-range and coordinated water supply planning and management that will optimize water conservation, the efficient uses of water for agricultural and municipal uses, the capture of flood released water, the use of existing water supply storage assets, the development of new water supply storage assets, the expansion of groundwater recharge capacity, the effectiveness of strategic water supply sales, transfers, exchanges and purchases, and the enhancement of recycled water utilization.

NOW, THEREFORE, adopting the foregoing recitals as being applicable to this Agreement, it is mutually agreed as follows:

1. Term. The term of this Agreement shall be for a period commencing on the date it is executed by both District and City and ending at 12:00 o'clock p.m. on the last day of June in the year 2035, and thereafter until terminated by either party as of the last day of February of any subsequent year by written notice to the other party mailed prior to September 1st of the previous year. Upon the execution of this Agreement the 1976 Agreement and all amendments thereto shall be of no further force or effect, except that City agrees to pay District any monies owing or to become owing to District under and according to the terms of the 1976 Agreement, if any.

2. Agreement Subject to Other Obligations. This Agreement shall be at all times subject to all of the terms and conditions of the City Bureau Contract, the District Bureau Contract and the Kings River Agreements, and to the extent that any agreement contained herein is contrary to or inconsistent with any term or condition of those contracts or agreements, that contrary provision of this Agreement shall be unenforceable. In the event any such agreement contained herein shall become unenforceable, the entire Agreement may be terminated by the party adversely affected as of the last day of February of the next succeeding year, by written notice served upon the other party on or before the first day of September of the year preceding such termination.

3. Definitions. For the purpose of this Agreement, the following terms shall be defined as follows:

(a) "Agricultural Use" means the use of water primarily in the production of agricultural crops or livestock including but not restricted to domestic use incidental to such agricultural purposes, the watering of livestock, and underground water replenishment conducted by District.

(b) "City's Friant Supply" means all water to which City is entitled under the City Bureau Contract or otherwise as a result of City's status as a long-term repayment contractor for water service from the Friant Division of the Central Valley Project (CVP), including without limitation Class 1 water, Section 215 water, uncontrolled season water, unreleased restoration flows and recirculated water. City's Friant Supply shall not include any water available to District under the District Bureau Contract or as a result of District's status as a long-term repayment contractor in the Friant Division of the CVP, which water is not governed by this Agreement.

(c) "City's Kings River Supply" means the percentage of District's Kings River Supply available to be delivered to City in a Water Year under this Agreement.

(d) "District's Kings River Supply" means the Kings River water District may deliver to its water users under the Kings River Agreements and applicable judicial and regulatory decrees in a Water Year as the result of the calculated natural flow of the Kings River during that Water Year.

(e) "City's Surface Water" means all water available to City in a Water Year by means other than pumping from the underground water supply, including without limitation

City's Kings River Supply and City's Friant Supply and any surface water supply acquired or developed after the date of this Agreement.

(f) "City's Water Service Area" means all lands within the exterior boundaries of City, and also all lands outside such boundaries that are within the exterior boundaries of District, to which City now delivers water or hereafter consents to deliver water by means of the City Water System and that are not hereafter designated or assessed by District as lands receiving or to receive District Water Service.

(g) "City Water System" means the conduits, pipes and other facilities (including without limitation the SWTFs) owned by City and used by City to convey water to lands whether in or outside City.

(h) "District Water Service" means the furnishing of water by District directly to lands within District by means of the District Water System other than pumping conducted by a landowner or water user directly from the underground water supply upon the lands receiving such water.

(i) "District Water System" means the conduits, pipes, canals, pumping stations and other facilities owned and/or used by District to convey water to lands or facilities whether in or outside of District.

(j) "Excluded Areas" means those acres within the City's Water Service Area that are outside of the District's boundaries.

(k) "Included Acres" means those acres within the City's Water Service Area that are within the District's boundaries.

(l) "Municipal, Industrial and Domestic Uses" means the use of water other than for Agricultural Use, and underground water replenishment conducted by City.

(m) "Out of Season Deliveries" means deliveries of City's Surface Water via the District Water System during periods when District is not otherwise delivering irrigation water to its landowners or water users via the portions of the District Water System used to convey City's Surface Water to the points on the District Water System where City will assume physical control of the delivered water.

(n) "Point of Delivery" means, for water delivered to City via the District Water System, the headworks of the Gould Canal and the Fresno Canal as specified in the applicable schedule, for water delivered to City via the Friant-Kern Canal Raw Water Pipeline, the headworks of the Friant-Kern Canal Raw Water Pipeline, for water delivered to City via the South Raw Water Pipeline, the headworks of the Fresno Canal, and such other location(s) as City and District may mutually agree.

(o) "Transfer" means a water sale, transfer or exchange involving any of City's Friant Supply.

(p) "Water Year" means March 1 of one year through the last day of the following February when used in reference to City's Friant Supply and October 1 of one year through September 30 for the following year when used in reference to City's Kings River Supply or District's Kings River Supply.

4. Management of City's Surface Water. To fulfill the purposes of this Agreement, and to facilitate the continuous and year around supply of water to City's Water System and facilities, District shall undertake, and is hereby appointed by City as City's exclusive agent for the management of City's Surface Water pursuant and subject to the terms of this Agreement, including but not limited to subsection 4(f) below. District's management authority and responsibilities shall terminate with respect to any of City's Surface Water upon delivery of that water to City.

(a) The management authority hereby granted to District shall include without limitation the exclusive right to:

i. Direct the storage and release of City's Surface Water;

ii. Schedule, order and provide for the delivery of City's Surface Water to District's points of diversion;

iii. Facilitate the reasonable and beneficial use of City's Surface Water and other water supplies available to City, while also providing for delivery of water to the applicable Point(s) of Delivery as specified in this Agreement;

iv. Pursue and implement Transfers pursuant to this Agreement; and

v. Take all other actions associated with the management and administration of City's Surface Water prior to its delivery to the applicable Point of Delivery in furtherance of the goals provided in subsection 4(f).

(b) District shall not voluntarily take any action that would:

i. Breach City's Bureau Contract or any other agreement governing any of City's Surface Water;

ii. Result in a long-term reduction in amount of City's Surface Water; or

iii. Result in management or use of City Surface Water inconsistent with the goals provided in subsection 4(f) below, unless City provides prior written authorization of such management or use.

(c) Notwithstanding District's management of City's Surface Water, City shall be solely responsible for, and shall timely pay, all charges and other amounts payable in connection with any of City's Surface Water.

(d) Subject to the express rights of City under this Agreement, City shall take no action that interferes with District's management of City's Surface Water as long as District provides the deliveries thereof in accordance with Section 5.

(e) District shall coordinate with City to define and identify uses of City's Surface Water that benefit City's water users and ratepayers. This coordination shall be performed as described in this subsection.

i. As frequently as appropriate and necessary, and at least annually, City and District shall confer to review available water supply information and data, including without limitation: precipitation, snow pack, and runoff conditions; water storage conditions; relevant environmental programs and projects; forecasted Municipal, Industrial and Domestic Uses; surface water delivery priorities for City; forecasted groundwater pumping required to meet City's forecasted Municipal, Industrial and Domestic Uses; and other pertinent information and data related to water supply availability and water demands for the relevant Water Year(s). City and District shall also confer regarding the anticipated availability of City's Friant Supply, if any, for Transfers.

ii. City will be responsible for providing periodic updates to the City Council and City administration. At least annually, City staff shall provide an informational workshop to the City Council, summarizing ongoing water supply conditions, the implementation of this Agreement and fulfillment of the water supply goals as listed in 4(f), as well as any anticipated water supply issues of concern for the relevant Water Year(s). District shall make reasonable efforts to coordinate with City staff to provide any data, information, and materials required for this annual informational workshop to the City Council.

iii. It is understood that during any given Water Year it may be necessary to adjust the water supply planning forecast established pursuant to the above described process as water supply availability and demands change, and additional information and data are obtained, reviewed, and assessed. City and District shall employ reasonable efforts to meet and confer as necessary to keep each party informed to the extent water supply conditions and plans may change through the relevant Water Year. City shall be responsible for providing informational updates to the City administration to the extent there are material changes to the water supply conditions in any given Water Year.

(f) District's management of City's Surface Water shall at all times be in furtherance of one or more of the following water supply goals:

i. Providing continuous year around water supply to City's SWTFs;

ii. Improving the water supply reliability and drought-resiliency for City;

iii. Improving the operation and utilization of City-owned recharge basins;

iv. Implementing conjunctive-use water management strategies to comply with the SGMA that directly benefit City's water users and ratepayers and indirectly benefit groundwater users in the North Kings Subbasin.

(g) Included as a part of the management of City's Surface Water as described above, District shall diligently pursue Transfers of any of City's Friant Supply that City advises District that City will not require during a particular Water Year ("Temporarily Unused Friant Water").

i. Upon identifying a potential Transfer opportunity, and prior to executing the Transfer, District shall notify City of the potential Transfer opportunity, and the water quantity, unit price, delivery dates and terms, and any other material matters associated with the Transfer. This is a notification procedure and not an approval procedure.

ii. All Transfers of Temporarily Unused Friant Water pursued by District shall be in full conformance with City's water supply goals as described in Section 4(f) or otherwise agreed by City and District, and shall be limited to supporting Agricultural Use rather than urban growth or development in other jurisdictions.

iii. City shall not be prohibited from unilaterally pursuing Transfers of Temporarily Unused Friant Water; provided, that any such Transfers shall first be discussed and coordinated with District before they are implemented and shall not be undertaken over District's reasonable objection and the benefits of any such Transfer shall be allocated in accordance with subsections (h), (i) and (j) below.

iv. For avoidance of doubt, District's obligations under this Section 4(g) are limited to making reasonable and diligent efforts to pursue Transfers of Temporarily Unused Friant Water, and City acknowledges that no assurances can be provided by District that such Transfers can be made or arranged.

(h) The benefits resulting from Transfers shall be allocated in accordance with this subsection. For purposes of this Section 4, "benefits" of a Transfer include, without limitation:

i. The difference between all costs incurred in connection with a Transfer and the amount(s) received as a result of the Transfer,

ii. Water returned as a result of a Transfer, and

iii. Water supply storage or conveyance capacities made available as a result of a Transfer.

To the extent benefits include payments, City shall be reimbursed for its actual and reasonable out of pocket expenses incurred for City's Friant Supply involved in the Transfer,

and each of the parties shall next be reimbursed for any actual and reasonable out of pocket expenses incurred in connection with the Transfer. The net revenue associated with a Transfer shall be the revenue remaining after all parties have been reimbursed their actual and reasonable expenses incurred for the Transfer.

(i) To the extent benefits of a Transfer consist of water supplies, water supply storage or conveyance capacities, the allocation of such benefits as between the parties shall be negotiated by the parties before the Transfer is implemented. In the event the parties cannot negotiate such allocation, the Transfer shall not be pursued.

(j) For each Transfer that generates net revenue, City and District agree that the net revenue shall be distributed and used as follows:

i. 25-percent of the net revenue shall be deposited with City's water enterprise fund;

ii. 25-percent of the net revenue shall be deposited with District for the inspection, operations, maintenance and repair of the District's Conveyance System, which City acknowledges provides a benefit to City ratepayers;

iii. 50-percent off the net revenue shall be deposited into a Water Supply Development Fund to be used to finance water supply development programs and projects that mutually-benefit City and District.

The Water Supply Development Fund shall be a restricted-use fund to be used exclusively for water supply programs and projects that improve water supply availability, reliability and drought resiliency for both District and City. Programs and projects that may be financed from the Water Supply Development Fund include, but are not limited to, water supply purchases, transfers, and exchanges; groundwater storage; and groundwater recharge. Expenditures for water supply purchases, transfers, and exchanges may include any carryover charges and conveyance charges that may be assessed by the State of California, the United States, or other agency, to store, transport and deliver surface water, for the mutual benefit of City and District, using state or federal storage and conveyance facilities.

The Water Supply Development Fund may receive contributions from City, District, and other public agencies approved by both City and District. The Water Supply Development Fund may not receive contributions from private persons, companies, businesses, or organizations.

Prior to encumbering funds from the Water Supply Development Fund, District and City shall mutually agree in writing on the recommended expenditure and the amount to be financed with the Water Supply Development Fund.

District shall serve as the fiscal agent for the Water Supply Development Fund and implement generally accepted public agency or governmental accounting practices in managing the fund assets. District shall subject the fund to an annual audit by independent auditors during the course of District's annual audit of its financial statements. The audit shall

be conducted in accordance with the generally accepted auditing standards by the independent certified public accountant auditing District's financial statements. Upon presentation of District's comprehensive audit report to the District Board of Directors, District shall provide City with a copy of District's audit report. At any time during the term of this Agreement, City may, at its own cost, request to review and audit the financial and accounting records associated with the Water Supply Development Fund. District shall have 30 working days to submit the requested records to City for review and audit.

In the event this Agreement terminates and uncommitted amounts remain in the Water Supply Development Fund, one half of all such amounts shall be promptly distributed free of any restrictions to each of the parties.

(k) By the 25th day of each month, District shall provide City with a written summary of District's utilization of City's Friant Supply for the previous month in substantially the form attached hereto as **Exhibit A**. The written summary will identify water volumes delivered to recharge basins, surface water treatment facilities, other Points of Delivery designated by City, and Transfers. The written summary may be delivered to City by email, facsimile or U.S. mail. For Transfers, the monthly report shall include information regarding the parties involved in the Transfer, the water quantity, unit price, delivery dates and terms, and any other material matters associated with the Transfer.

5. Water Made Available to City.

(a) Subject to all other provisions of this Agreement, District shall deliver to City during each applicable Water Year, for distribution and use by City within City's Water Service Area, each day of each year on a continuous basis in accordance with Section 8 of this Agreement, the City's Surface Water available during relevant Water Year(s) that can be diverted by District at the headworks of the Gould Canal, the Fresno Canal or the Friant-Kern Canal Raw Water Pipeline. City acknowledges that the water delivered may not be City's Surface Water, but rather other water controlled by District in the District Water System of similar quality and equal quantity, including without limitation water recovered from water banks, other water for which City's Surface Water is exchanged, and/or water purchased by District for delivery to City at District's cost, and that references in this Agreement to deliveries of City's Surface Water shall include deliveries thereof of a substitute supply by means of one or more exchanges, transfers, purchases or combinations thereof. At all times, District shall have the right to exchange and to convey for City in place thereof other water of similar quality and equal quantity (except sewer effluent or industrial wastes) available to District.

(b) City's Surface Water shall be deemed delivered to City when it reaches the Point of Delivery specified in the applicable schedule provided and approved under Section 8 of this Agreement, provided that for deliveries made via the District Water System, District shall thereafter convey such water to the points on the District Water System where City will assume physical control of the delivered water.

(c) The parties acknowledge that there may be times when the City Water System is undergoing routine or emergency repairs and maintenance, or subject to other conditions, that preclude City from accepting deliveries under this Agreement. Similarly, the parties

acknowledge that there may be times when the District Water System is undergoing routine or emergency repairs and maintenance, or subject to other conditions, that preclude District from delivering water to City under this Agreement. The parties shall cooperate with the other to minimize the impacts of such events, but neither shall be in breach of this Agreement as a result thereof.

(d) Water delivered to City under this Agreement shall be used by City within City's Water Service Area only for Municipal, Industrial and Domestic Uses, Agricultural Uses incidental thereto, and within the boundaries of District for recharge of the underground water supply by percolation.

City shall not sell, transfer, deliver or exchange any surface water or groundwater to or with any other person or entity without written consent of District first had and obtained.

However, this provision shall not prevent City from entering into separate agreements with any other entity which may have a similar agreement with District for the distribution and use of water received from District under such agreements, provided such separate agreements are entered into with the written consent of District first had and obtained and are subject to all the terms and conditions of this Agreement and District's agreements with such other entities.

(e) District has entered into this Agreement with the understanding that it is, and will continue to be, City's policy to (i) require urban growth to occur sequentially in designated growth areas around City, (ii) promote infill development with City's existing boundaries and (iii) facilitate the successful implementation of SGMA within the groundwater basin shared by City and District by conditioning land use and annexation decisions on the existence of an available water supply to support new development in annexed areas. Consistent with that understanding, for the term of this Agreement, as a condition of the provision of City water service, City shall require the proponent of any proposed development project located outside of City's Water Service Area boundary as of the date of this Agreement to:

i. Define the peak water demands, plus fire protection demands, required to meet the total water supply demands of the entire project at build-out conditions;

ii. Obtain a perpetual surface water supply allocation, right, entitlement or similar from District, or other surface water supply agency, to meet the peak water demands, plus fire protection demands, at build out conditions; and

iii. Dedicate, transfer or assign the perpetual surface water supply allocation, right, entitlement or similar to City.

Once the perpetual water supply has been dedicated, transferred, or assigned to City, the water supply shall be incorporated into City's Surface Water managed by District for City under this Agreement.

In addition, to improve, restore, and maintain the availability, reliability, and drought resiliency of the groundwater and surface water resources in the North Kings Subbasin,

City and District shall jointly advocate that all public water supply systems in the North Kings Subbasin should require the proponents of new development projects to obtain perpetual surface water supply rights, allocations, entitlements, and similar, in sufficient quantity, to meet the all demands at full build out.

(f) In furtherance of the parties' goals under this Agreement, City shall utilize City's Friant Supply to provide water to the City's SWTF served by the South Raw Water Pipeline (as defined below) for the purpose of serving the Excluded Area.

6. Raw Water Pipelines. As soon as reasonably practicable, City shall construct, at its sole cost and expense, two raw water pipelines to serve City's SWTFs (the "Raw Water Pipelines"). One Raw Water Pipeline shall be a direct connection from the Friant-Kern Canal to City's SWTF located at Mile Point 7.58 (the "Friant-Kern Canal Raw Water Pipeline"). The other Raw Water Pipeline shall be a direct connection from the Fresno Canal downstream of the headworks for such canal to City's SWTF located at Trimmer Spring Road (the "South Raw Water Pipeline"). City's T3 SWTF shall continue to be served by the Enterprise and Jefferson Canals that are a part of the District Water System. Once operational, the Raw Water Pipelines shall be used to convey portions of City's Surface Water directly to the SWTFs, and all costs of the operation, maintenance, repair and replacement of the Raw Water Pipelines shall be borne by City; provided, that District shall be entitled to utilize for its own purposes any capacity in the Raw Water Pipelines not required to deliver City's Surface Water, and District shall reimburse City upon demand for any operational costs incurred as a result of District's use of the Raw Water Pipelines. Any third-party property damages resulting from City's efforts and activities related to the operation, maintenance, repair, and replacement of the Raw Water Pipelines shall be received and processed by City in accordance with City's Risk Management policies and procedures.

7. City's Friant Supply. While this Agreement is in effect, City (i) shall not convey any interest in the City Bureau Contract to any party other than District, (ii) shall at all times maintain the City Bureau Contract in effect and (ii) shall not voluntarily decrease the quantity of City's Friant Supply to be made available to City thereunder without the written consent of District. City will use every effort to obtain its maximum entitlement to City's Friant Supply annually as it may become available, and will seek to maximize any other surface water opportunities that may be available to City via the Friant Division of the Central Valley Project. Nothing in this Agreement conveys any ownership interest in the City Bureau Contract to District, which shall at all times remain the sole property of City, nor does this Agreement convey any interest in the District Bureau Contract to City, which shall at all times remain the sole property of District.

8. Schedules of Delivery and Conveyance of Water.

(a) District shall deliver City's Surface Water to City in accordance with schedules provided from time to time by City for approval by District, which approval shall not be unreasonably withheld, delayed or conditioned. Such schedules shall set forth the amounts of water desired by City, the desired timing of deliveries, the facilities by which such water is to be delivered, and the point(s) on the District Water System where City will assume physical control of the delivered water. Deliveries of water by District will take into consideration all relevant

factors, including without limitation (i) the capacity and condition the applicable portions of the District Water System, (ii) City's Bureau Contract, (iii) the District Bureau Contract, (iv) the Kings River Agreements, (v) actual and anticipated water supply conditions, (vi) the requirements of other contracts between the District and third parties (including without limitation the City of Clovis and Fresno County Waterworks District No. 19) and (vii) all other factors pertaining to the distribution, apportionment and use of water available to District.

(b) All schedules submitted by City during each Water Year shall provide for the delivery during that Water Year of all of City's Surface Water that becomes available to City during that Water Year. Notwithstanding the foregoing, City may schedule up to 10,000 acre feet of City's Surface Water that becomes available to City during one Water Year for delivery in the succeeding Water Year ("Rescheduled Water"). City shall timely pay in full all costs imposed by third parties, including without limitation the United States Bureau of Reclamation, as the result of any Rescheduled Water requests or deliveries.

9. Conveyance Losses. City shall bear all losses incurred in the District Water System downstream of the applicable Point of Delivery; provided, that no such losses shall be assessed against City when District is delivering irrigation water to its landowners or water users via the portions of the District Water System used to convey City's Surface Water to the points on the District Water System where City will assume physical control of the delivered water. Conveyance losses chargeable to City shall be computed by multiplying the losses in that portion of any canal used for conveyance of City's Surface Water during the period such water is being so conveyed by the total amount of water being conveyed for City in that canal during such time, divided by the total amount of water flowing in that portion of that canal during the same period.

10. Use by District of Water Not Used by City.

(a) Except for Rescheduled Water, in the event City is unable to use or does not use any of City's Kings River Supply in any Water Year, City shall lose the right to receive such water, and District shall have the right to take and use such water for Agricultural Use in such manner as it may determine.

(b) Except for Rescheduled Water, in the event City is unable to use or does not use any part of City's Friant Supply and District reasonably concludes that it cannot effect a Transfer for all of such unused water as Temporarily Unused Friant Water as described in Section 4(g), City shall nevertheless take and pay for such unused water and District shall have the right to use such water for Agricultural Use, but City may require District to so use such water at such locations as City may direct; provided, however, in the event City does not direct the location at which said water shall be used in time that it may be so used or in the event the District Water System will not permit the conveyance of such water to such location when so directed, or if for any other reason the conveyance of such water to such location at that time is not feasible or practicable, District shall have the right to use such water upon the same conditions as are provided in Section 10(a). Such use of any such water by District shall not relieve City from any payments required to be made by it under the City Bureau Contract or under the terms of this Agreement and its use by District shall not require any payment from District to City.

(c) Except for Rescheduled Water, in the event City is unable to use or does not use any of City's Surface Water that is neither City's Kings River Supply or City's Friant Supply in any Water Year, City shall lose the right to receive such water, and District shall have the right to take and use such water for Agricultural Use in such manner as it may determine. In such event, insofar as the District Water System will permit, and insofar as otherwise may be practicable and equitable as to other landowners, District will use such water for irrigation or percolation in areas in City or east or northeast of City, and will discuss its use with City before it is used elsewhere. However, the ultimate decision concerning such use of such water shall be within the discretion of District.

11. Water Rights Not Transferred. As was the case under the 1976 Agreement, City acknowledges that its rights to City's Kings River Supply under this Agreement are contractual rights and not water rights. Nothing in this Agreement authorizes or shall be construed or deemed to constitute the sale or transfer of a water right from either party to the other and nothing in this Agreement shall constitute the dedication by either party of water or storage to a public use. No right in any water, storage right or water right owned by District or City shall be acquired or lost by virtue of this Agreement or the actions contemplated hereby. At no time shall City make any claim, assert any right or otherwise seek, confirm or perfect in any forum any legal or beneficial interest, right or title to any of District's water supply or storage rights except as expressly set forth herein.

12. City's Sewage Effluent. City shall retain its sewage effluent and recycled water within the boundaries of District for the term of this Agreement, except with the written consent of District first had and obtained. It is the intent of City and District to develop and execute a new agreement addressing such effluent and recycled water use, and this Agreement is to be interpreted so as to be consistent with such new agreement if and when it is executed by the parties.

13. Acreages and City's Kings River Supply.

(a) City's Water Service Area consists of Included Acres and Excluded Acres, and on an annual basis City and District shall prepare a map showing the total number of acres in each area as of the first day of March of each year. When so approved, said map shall be incorporated herein by reference as **Exhibit B** and shall become a part hereof. Said map shall be amended and reapproved by both parties as of the first day of March each year and added to this Agreement as an updated **Exhibit B**. However, City shall keep the District currently advised during the year of any new lands outside of City's Water Service Area to which it commences or consents to deliver water, and District shall keep City so advised as to any new lands designated or assessed by it as lands receiving or to receive District Water Service. When so amended and reapproved as of the first day of March of each year, said map shall conclusively establish the boundaries of and the acreage in each area for all purposes of this Agreement.

(b) City's Kings River Supply shall be the herein-contracted for percentage of District's Kings River Water Supply. Such percentage shall be based on the ratio of Included Acres within City's Water Service Area to the total acres within District's boundaries. In computing the acreage within the Included Acres, the entire acreage shall be measured including properties that may be exempt from assessment for taxation and including adjacent streets,

alleys, roads, highways and other public ways to the center lines thereof. As of the execution of Agreement, and based on the land area sizes defined above, City's Kings River Supply is 25.54 percent of the District's Kings River Supply.

(c) Notwithstanding any other provision of this Agreement, and notwithstanding increases in the Included Acres, City's Kings River Supply shall be limited to 29.00 percent of District's Kings River Supply. At such time when the ratio of Included Acres within City's Water Service Area to the total acres within District equals 29.00 percent, City's Kings River Supply shall remain fixed at 29.00 percent. City and District mutually agree that the increase percentages reflected in this Section 13 include allowances for moderate growth in Growth Area 1 of City's Sphere of Influence as shown in **Exhibit C** (as depicted as Figure IM-2 of the Fresno General Plan).

(d) To improve, restore, and maintain the availability, reliability, and drought resiliency of the groundwater and surface water resources in the North Kings Subbasin, District shall support, and to the extent it has the legal authority to do so shall require, the establishment of water supply limits on all municipal water systems in the North Kings Subbasin.

District acknowledges that it may enter into surface water utilization and conveyance agreements similar to this one with other municipalities in the Kings Subbasin that provide for the delivery of portions of District's Kings River Supply. Subject to the following paragraph of this Agreement, all such agreements entered into after the date of this Agreement shall provide that the percentage of District's Kings River Supply made available to the municipality entering into such agreement shall be determined in a manner similar and comparable to that applied to City in this Agreement.

Should the District enter into such a water utilization and conveyance agreement with another municipality in the Kings River Subbasin after the date of this Agreement that makes available a percentage of District's Kings River Supply to such municipality determined in a manner that is not similar and comparable to that applied to City in this Agreement, at City's request the parties shall negotiate in good faith an adjustment in City's Kings River Supply to apply the same methodology used, and provide the same percentage increase, as granted to the other municipality; provided, that to the extent such other municipality provides additional consideration to District for such different methodology, City shall provide comparable consideration if it requests that such different methodology be used for this Agreement. Any disputes arising as a result of such negotiation shall be resolved pursuant to Section 19.

14. Payment by City to District. In consideration of the water supplies and services provided by District to City under this Agreement, City shall pay to District each Water Year in which this Agreement is effective the following:

(a) The sum calculated by multiplying the number of Included Acres by the per acre assessment imposed as of March 1 of that Water Year on lands in District receiving District Water Service, plus the sum calculated by multiplying the number of Excluded Acres by the per acre assessment imposed as of March 1 of that Water Year on lands in District not receiving District Water Service. Amounts payable to District pursuant to this Section 14(a) shall be paid by City 60% on or before the 20th day of December preceding the Water Year for which such

amounts are due, and the remaining 40% shall be paid on or before the 20th day of June of the following Water Year. City and District acknowledge that during the term of this Agreement, District may convert its rate structure to include a volumetric charge. Concurrently with such a rate structure modification, the parties shall negotiate modifications to this Section 14 so that charges imposed on City under the revised District rate structure are equitable and comparable in proportion and magnitude to the charges imposed on other District customers receiving water for Agricultural Use. Without limiting the foregoing, any volumetric charges imposed on City shall be determined in the same manner as volumetric charges imposed on other District customers receiving water for Agricultural Use.

(b) An out of season water delivery fee determined in accordance with the procedure described in the attached **Exhibit D** for each acre foot of water delivered to City under this Agreement as an Out of Season Delivery (the "Water Delivery Fee"). The Water Delivery Fee shall be payable within 30 days after District delivers City an invoice for such fee indicating the amount of water delivered during the invoice period and the total Water Delivery Fee due. City acknowledges that such fee is in part to compensate District for additional costs and risks incurred for operating its system to make Out of Season Deliveries. No such fee shall be due for water deliveries to City under this Agreement that are not Out of Season Deliveries.

(c) A rescheduling fee for each acre foot of Rescheduled Water determined in accordance with the procedure described in the attached **Exhibit E** (the "Rescheduling Fee"). The Rescheduling Fee shall be payable annually after March 1 of each Water Year within 30 days after District delivers City an invoice for such fee indicating the amount of Rescheduled Water for the applicable Water Year and the total Rescheduling Fee due. City acknowledges that the Rescheduling Fee is necessary to compensate District for additional costs and risks incurred to reschedule water for City from one Water Year to the succeeding Water Year. The Rescheduled Water Fee shall not be applied to any of City's Friant Supply carried over in Millerton Lake, as the Bureau has established a separate fee schedule for City to reschedule City's Friant Water Supply from one Water Year to the succeeding Water Year.

(d) While this Agreement is in effect, District shall not impose District assessments or other charges on landowners within City's Water Service Area or adopt special "municipal and industrial" assessments, rates or charges that would be imposed on or as a result of water deliveries to City under this Agreement. Only the amounts described in this Agreement shall be imposed on any party as a result of deliveries of City's Surface Water by District to City.

(e) Time shall be of the essence for the making of the payments described in this Section 14. If any such payment is not made on the date provided, City shall pay to District in addition to said payment costs, penalties and interest equal to those provided by law to be paid by landowners within District for the late payment of assessments. Such costs, penalties and interest are in addition to any other remedy which District may have against City because of City's failure to pay said payment as above provided.

(f) City acknowledges and agrees that the amounts payable by City pursuant to this Section 14 will vary from year to year and may increase over time. City further acknowledges that, while some of such amounts will be determined with reference to District assessments on its landowners, no amounts payable by City under this Agreement are assessments on City's

landowners. City further agrees that, as they relate to City, such amounts will be imposed as a matter of contract and are not assessments, fees or charges to which Article XIIID of the California Constitution applies. City shall be permitted to participate in public hearings and meetings held in connection with rate-setting, but City shall not assert that Article XIIID of the California Constitution applies to payments required under this Agreement. If City makes such an assertion, this Agreement may be terminated by District in its entirety as of the last day of February of the next succeeding year by written notice served upon City. City shall be responsible to set its rates to its utility users in accordance with applicable law, and shall indemnify and defend District against any claims or legal actions commenced by City's water users or ratepayers to challenge the amounts payable by or to City.

15. Re-negotiations. City and District acknowledge that changed circumstances in the future may:

i. Result in material changes in the size of City's Water Service Area, the number of Excluded Acres and/or the number of Included Acres, and/or

ii. Render the amount of City's Kings River Supply as an increasing percentage of District's Kings River Water Supply inequitable.

Such changed circumstances could result from, among other causes:

i. Annexations or detachments from City and/or District;

ii. Updates in City's Urban Water Management Plan or the Fresno General Plan;

iii. Significant regional economic development projects that require the extension of the City Water System outside of City's Water Service Area. Significant regional economic development projects shall be those that qualify for federal, state, county, or local economic development incentives; or

iv. New legal, regulatory, or environmental requirements placed on water supply agencies by a state or federal government agency.

Should either party to this Agreement determine after January 1, 2036 that such changed circumstances have arisen, it may notify the other of such determination and request that the parties meet to discuss mutually acceptable changes in the number of Excluded Acres, the number of Included Acres and/or the percentage used to determine City's Kings River Supply. Neither party shall be required to engage in such discussions prior to January 1, 2036.

The parties shall thereupon meet in good faith in an attempt to reach agreement on such changes; provided, that if no such agreement is reached within 180 days of the initial meeting, neither party shall be obligated to continue such meetings.

The number of Excluded Acres, the number of Included Acres and City's Kings River Supply shall remain unchanged pending agreement on the changes, and therein documented by a written amendment to this Agreement and executed by both parties.

16. Protection of District Facilities. City shall not permit the development of any parcel of land or the use of any public utility or other easements affecting land within its boundaries if any of the District Water System is located on, under or adjacent to such parcel until City, the landowner and/or the developer enters into an agreement acceptable to District for the repair, rehabilitation, relocation, replacement, reconfiguration or pipelining of the facilities on the parcel, and on any adjacent parcels, all as District determines is necessary or appropriate in order to (i) avoid disruption of District operations or maintenance activities as a result of the development, (ii) make District facilities suitable for operation within a developed area, or (iii) address public safety concerns.

17. No Warranty of Quality. City recognizes that City's Surface Water will be "raw," non-potable and untreated, and that the amount of water included in City's Surface Water will vary from year to year due to a variety of factors beyond the control of District. City further recognizes that wastewater (both treated and untreated) and drainage water are sometimes discharged into the District's canals, and that such discharges from a number or sources will occur and/or continue during the term of this Agreement. Accordingly, except as expressly set forth in this Agreement, District makes no representations or warranties regarding the quality of the water or the amount of water to be delivered to City each Water Year. City recognizes that the treatment of City's Surface Water to make it potable shall be the sole responsibility of City, and City shall assume all risk and responsibility therefor. The character or quality of the water furnished or conveyed hereunder may vary from time to time for reasons including, but not restricted to, the application by District of chemicals to control aquatic and ditch bank weeds, and the open canals of District are always subject to possible pollution from outside sources. District does not guarantee in any respect or assume any responsibility for the chemical, bacterial or other quality of the water made available to City through the District Water System.

18. Indemnity. City and District each agree to indemnify the other and save the other free and harmless of and from any and all liability, damage, loss, cost or expense, incurred or suffered by the other, by reason of damage to the property of the other or injury to any other person or property arising out of its own conduct, acts, omissions or faults, in connection with any matter related to this contract.

19. Dispute Resolution.

(a) District and City staff shall exercise every effort to resolve disputes through the development of a consensus.

(b) To the extent District and City staff cannot promptly resolve an issue in dispute; the parties shall promptly convene a meeting of senior party representatives to attempt to resolve the dispute. Either party may request a dispute resolution meeting pursuant to this section by providing written notice to the other party, including a summary of the issue in dispute. District representatives shall be its Board chair or president and another Board member. City representatives shall be the Mayor and City Council President. These senior party representatives shall make reasonable efforts to meet as frequently and as promptly as possible to negotiate the terms and conditions of a resolution. If these party representatives are unable to resolve the dispute through this informal process within a reasonable period, either party may pursue any remedy it may have under law or equity.

(c) The dispute resolution process described above shall be limited to material disputes regarding matters related to Transfers, expenditures from the Water Supply Development Fund, changes in City's Kings River Supply, revisions of this Agreement pursuant to Section 13(d), City's Friant Supply, changes proposed for **Exhibits B or C**, calculation procedures for fees for Out Of Season Deliveries and Rescheduling Fees, and similar matters.

(d) In cases where a dispute arises between the parties that, if unresolved, may result in imminent danger to the public, health, safety or welfare, the parties shall not be obligated to engage in dispute resolution pursuant to this Section 19.

20. Defense of Agreement. In the event of litigation this Agreement, the parties shall cooperate to provide a joint defense of the litigation. Each party shall bear its own costs of such litigation, including attorneys' fees and expert witness fees.

21. No New Agency. This Agreement is not intended to create a new joint powers authority or other entity. Each party shall conduct itself under this Agreement in good faith, using its diligent best efforts to comply with this Agreement and to achieve the objectives of the parties set forth herein. Each party shall make its personnel and resources reasonably available as required to achieve the purposes of this Agreement.

22. Approvals. Except as expressly provided in this Agreement, compliance with all legal/regulatory requirements and governmental or other third party restrictions on the use or delivery of City's Surface Water to it City water users shall be the responsibility of City. District shall be excused from delivering any water supply under this Agreement if, by so doing, District would become subject to additional legal requirements or third party restrictions imposed on deliveries of water to City's water users.

23. Entire Agreement. This Agreement and each of the exhibits referred to herein, which are incorporated by this reference, constitute the entire agreement between the parties pertaining to the subject matter hereof and supersede all prior and contemporaneous agreements and/or obligations concerning these obligations which are merged into this Agreement. Each party has made its own independent investigation of the matters settled and is not relying upon any representation not specified herein.

24. Applicable Law. This Agreement shall be construed under and shall be governed by the laws of the State of California. Any action to interpret or enforce any aspect of this Agreement shall be brought in the California Superior Court of Fresno County, California. City and District hereby expressly waive any right to remove any action to a county other than Fresno County as permitted pursuant to California Code of Civil Procedure Section 394.

25. Construction of Agreement. This Agreement is the product of negotiation and preparation by and among each party hereto and its attorneys, and the parties agree that this Agreement shall not be deemed to have been prepared or drafted by any one party. Accordingly, the normal rule of construction to the effect that any ambiguities are to be resolved against the drafting party shall not be employed in the interpretation of this Agreement.

26. Modification of Agreement. No supplement, modification, waiver, or amendment with respect to this Agreement shall be binding unless executed in writing by the party against whom enforcement of such supplement, modification, waiver or amendment is sought.

27. Counterparts. This Agreement may be signed in any number of counterparts by the parties, each of which shall be deemed to be an original, and all of which together shall be deemed one and the same instrument. Facsimile or other electronic signatures shall be binding.

28. Further Acts. The parties shall reasonably cooperate with each and take such further actions as may be necessary, including the execution of all necessary further documents, to carry out the purpose and intent of this Agreement. Each of the parties shall diligently and in good faith proceed to negotiate such other agreements as may be necessary to implement this Agreement.

29. Binding Effect. This Agreement shall be of binding legal effect only when it has been executed by all of the parties. No rights or duties under this Agreement may be assigned or delegated by a party without the express written consent of the other party, which may be withheld in the sole and absolute discretion of such other party. Subject to the foregoing, this Agreement shall be binding upon and inure to the benefit of the successors and assigns of the parties.

30. Notice to Parties. Any notice or other communication given under the terms of this Agreement shall be in writing and shall be given personally, by facsimile or by certified mail, postage prepaid and return receipt requested. Any notice shall be delivered or addressed to the parties at the addresses or facsimile numbers set forth below or at such other address or facsimile numbers as shall be designated by notice in writing in accordance with the terms of this Agreement. The date of receipt of the notice shall be the date of actual personal service or facsimile transmission with written confirmation of successful transmission, or three days after the postmark on certified mail. All notices required under or regarding this Agreement shall be made in writing addressed as follows:

| | |
|---|---|
| Fresno Irrigation District<br>2907 S Maple Avenue<br>Fresno, CA 93725<br>Attn: General Manager<br>Facsimile No.: 559-233-8227 | City of Fresno<br>2600 Fresno Street<br>Fresno, CA, 93721<br>Attn: Director of Public Utilities<br>Facsimile No.: 559-498-1304 |

31. Attorneys' Fees. In the event of any action or arbitration between the parties seeking enforcement or interpretation of any of the terms and conditions of this Agreement, the prevailing party in such action shall be awarded, in addition to damages, injunctive or other relief, its reasonable costs and expenses, including, but not limited to, taxable costs and reasonable attorneys' fees.

32. Cumulative Rights; Waiver. No failure by any party to exercise, and no delay in exercising any rights, shall be construed or deemed to be a waiver thereof, nor shall any single or partial exercise by any party preclude any other or future exercise thereof or the exercise of any other right. Any waiver of any provision or of any breach of any provision of this Agreement

must be in writing, and any waiver by a party of any breach of any provision of this Agreement shall not operate as or be construed to be a waiver of any other breach of that provision or of any breach of any other provision of this Agreement.

33. Severability. Subject to the parties' rights under Section 2 of this Agreement, if any provision of this Agreement is determined by a court of competent jurisdiction to be invalid, illegal or unenforceable, such provision shall be automatically reformed so as to be valid, legal and enforceable to the maximum extent permitted and the balance of this Agreement shall remain in full force and effect notwithstanding such invalidity, illegality or unenforceability.

34. No Third Party Beneficiaries. This Agreement does not create, and shall not be construed to create, any rights enforceable by any person, partnership, corporation, joint venture, limited liability company, district or other form of organization or association of any kind that is not a party. Without limiting the generality of the foregoing, landowners, residents, water users and ratepayers of the parties are not intended to be third party beneficiaries of this Agreement.

35. Force Majeure. Notwithstanding any other provision of this Agreement, neither party shall be liable for any failure to perform resulting from any cause outside the reasonable control of that party. For purposes of this Agreement, routine and emergency repairs and maintenance of the District Water System shall be deemed causes outside of the reasonable control of District (including without limitation the annual shut down of the Enterprise Canal for maintenance), provided that District shall use reasonable efforts to schedule routine maintenance so as to avoid interference with deliveries of City's Surface Water.

//

IN WITNESS WHEREOF, the parties have executed this Agreement to be effective as of the date first above written.

"District"

The Fresno Irrigation District, a California irrigation district

By _____
Ryan Jacobsen, President

By _____
Gary R. Serrato, General Manager

ATTEST:

_____
Secretary

"City"

The City of Fresno, a municipal corporation

By: _____
Ashley Swearengin, Mayor

By _____
Bruce Rudd, City Manager

ATTEST:
Yvonne Spence, CMC
City Clerk

By: _____ 1/11/17
Deputy

APPROVED AS TO FORM:
City Attorney, Douglas Sloan

By: _____ 12/22/16
AMANDA FREEMAN, DEPUTY

ATTACHMENTS:

**EXHIBITS**

Exhibit A – Monthly Water Supply Utilization Report
Exhibit B – City Water Service Area Map
Exhibit C – Fresno General Plan Map
Exhibit D – Out of Season Delivery Cost Methodology
Exhibit E – Rescheduled Water Cost Methodology

EXHIBIT A

EXHIBIT A

**CITY OF FRESNO FMFCD BASINS**
**MONTHLY REPORT (AC.FT.)**
**2015-2016**

| FMFCD BASINS IN FRESNO | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | YEAR TO DATE |
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| Basin AC | | | | | | | | | | | | | |
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**CITY OF FRESNO FMFCD BASINS**
**MONTHLY REPORT (AC.FT.)**
**2015-2016**

| FMFCD BASINS IN FRESNO | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | YEAR TO DATE |
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| Basin R | | | | | | | | | | | | | |
| Basin RR1 | | | | | | | | | | | | | |
| Basin RR2 | | | | | | | | | | | | | |
| Basin RR3 | | | | | | | | | | | | | |
| Basin S | | | | | | | | | | | | | |
| Basin T | | | | | | | | | | | | | |
| Basin TT | | | | | | | | | | | | | |
| Basin U | | | | | | | | | | | | | |
| Basin UU2 | | | | | | | | | | | | | |
| Basin UU3 | | | | | | | | | | | | | |
| Basin Y | | | | | | | | | | | | | |
| Basin Z | | | | | | | | | | | | | |
| Basin ZZ | | | | | | | | | | | | | |
| Fresno's FMFCD Total | | | | | | | | | | | | | |

**CITY OF FRESNO RECHARGE**
**MONTHLY REPORT (AC.FT.)**
**2015-2016**

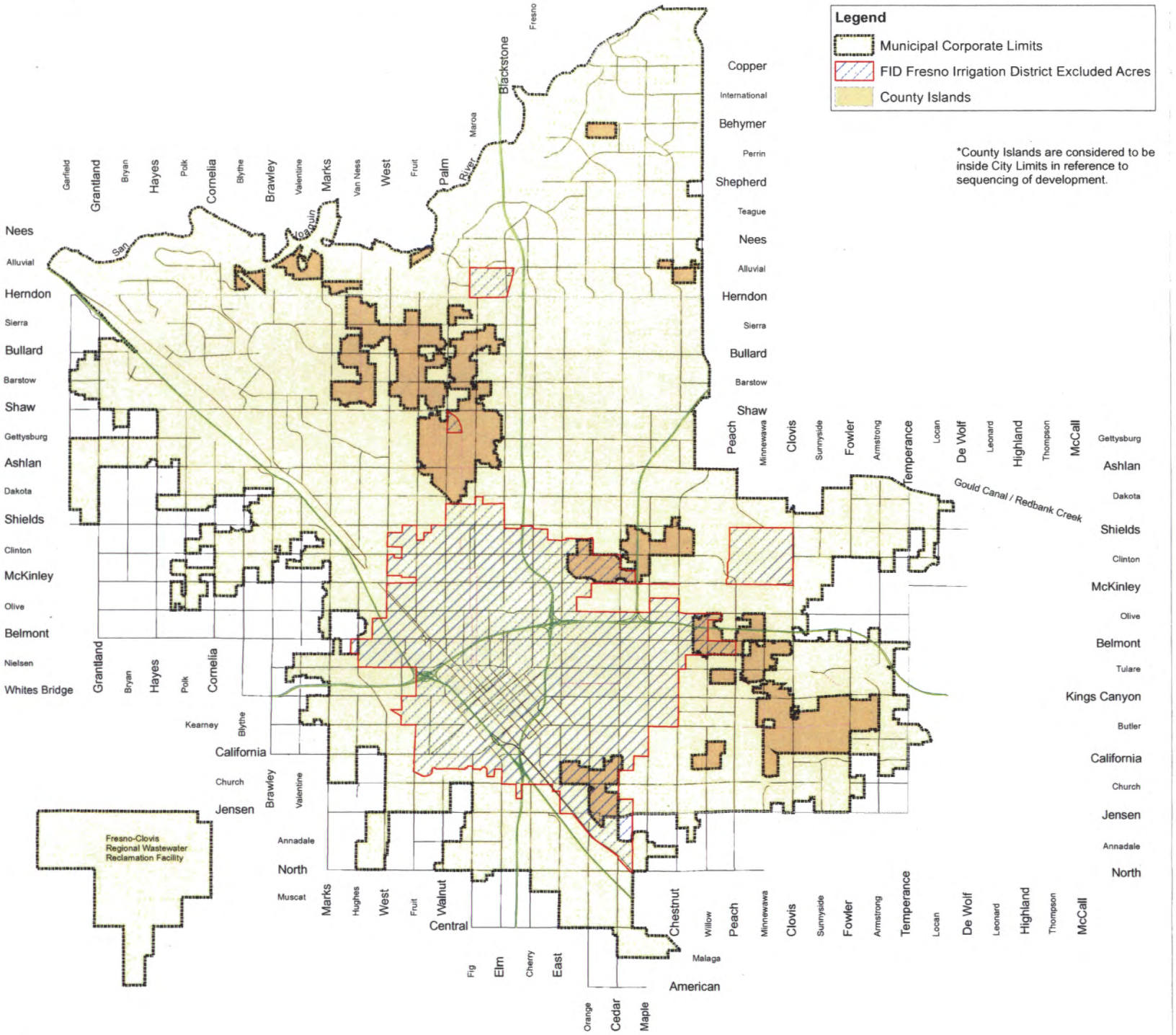
| OTHER FRESNO RECHARGE | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | YEAR TO DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leaky Acres | | | | | | | | | | | | | |
| Woodward Park | | | | | | | | | | | | | |
| Copper River Country Club | | | | | | | | | | | | | |
| Big Dry Detention | | | | | | | | | | | | | |
| Fancher Basin (South) | | | | | | | | | | | | | |
| Chestnut Ave. Basin | | | | | | | | | | | | | |
| North Central Basin | | | | | | | | | | | | | |
| Kearney Basin | | | | | | | | | | | | | |
| Big Dry Creek West of Winery Ave. | | | | | | | | | | | | | |
| Delivery System Recharge Fresno | | | | | | | | | | | | | |
| Copper River Country Club total is the amount exceeding the Phillips Ditch entitlement of 77 ac ft per month (during FID's irrigation season). | | | | | | | | | | | | | |
| Basin BF Water comes from Chestnut Ave. Basin | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Fresno's Total Recharge | | | | | | | | | | | | | |
| Fresno's SWTP N/E & T-3 | | | | | | | | | | | | | |
| Fresno's Total Usage | | | | | | | | | | | | | |

EXHIBIT B

# City of Fresno
# Water Service Area Boundary
# Exhibit "B"
# December 13, 2016

*"The City's Water Service Area consists of Included Acres and Excluded Acres, and on an annual basis City and District shall revised this Exhibit B map to show the total number of acres in each area as of the first day of March of each year."*

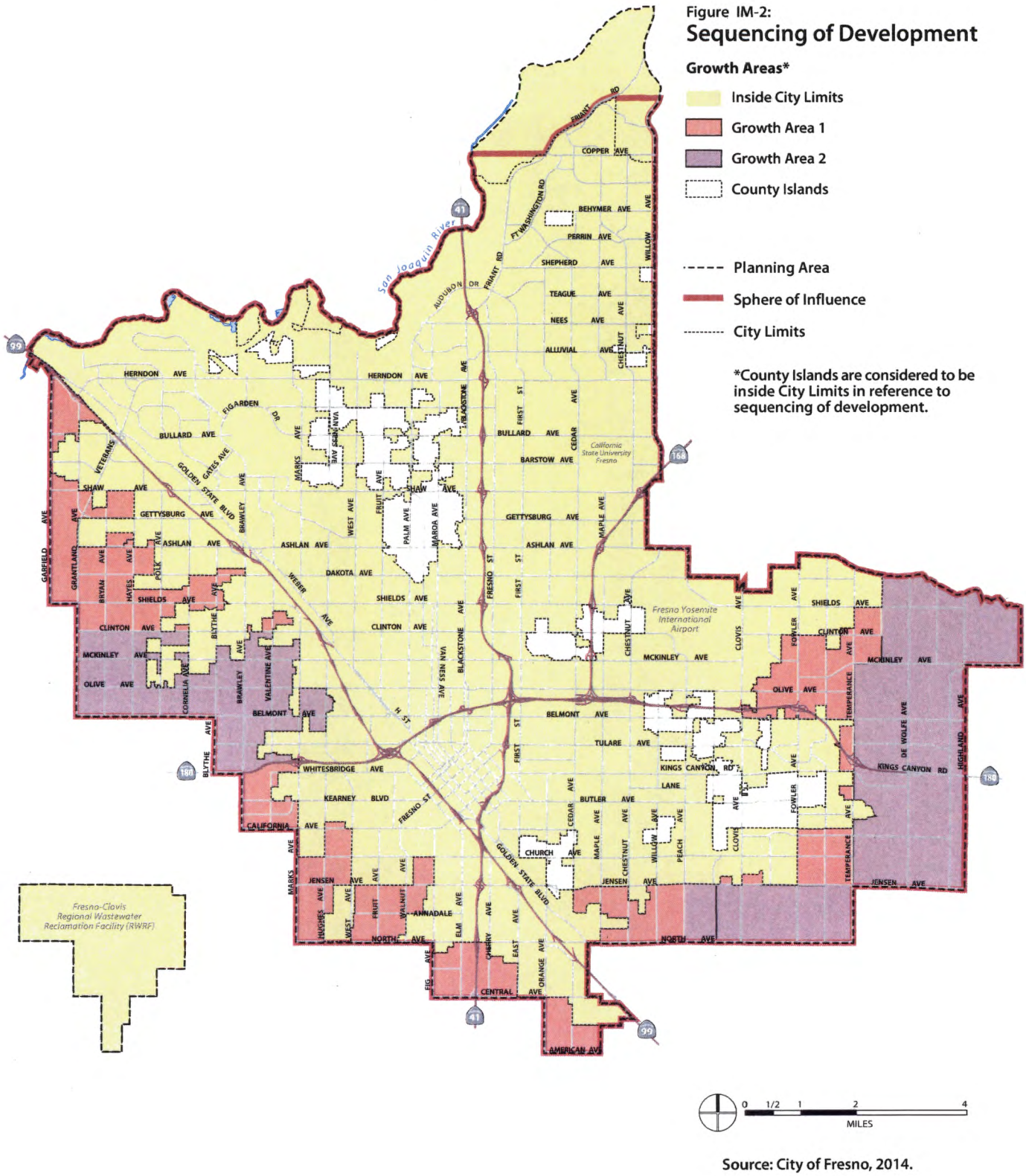
Miles
0 0.5 1 2 3




S:\USERS\PET\2016\Thomas Esqueda\Water Service Areas Map\Water Service Area Boundary Ex B Map.mxd

EXHIBIT C

# EXHIBIT C




Source: City of Fresno, 2014.

EXHIBIT D

# EXHIBIT D

The City will be responsible for paying the District for all costs associated with delivering water Out of Season Deliveries which will include but not limited to:

i. Staff time to deliver water (includes salary wage, labor burden and overhead.
ii. Cost to operate vehicles to operate and inspect the canal system.
iii. Power costs associated with running District's SCADA/Telemetry system, automated gate valves, flow meters, automated trash screens, etc.
iv. Repairs to the canals system which are caused by water running outside the normal irrigation season. Repairs may include but not limited to canal lining, gate replacement, structure replacement, earthwork (grading, dredging, etc.) weed treatment (aquatic or terrestrial), all-weather road maintenance, trash/debris removal, etc.

EXHIBIT E

# EXHIBIT E

The Rescheduling Fee for each rescheduling request here under shall be equal to the last Friant carry over charge assessed for a water year prior to the date to the request.

47087

RECORDED IN OFFICIAL RECORDS OF FRESNO COUNTY, CALIFORNIA
AT 41 MIN. PAST 3 P.M.
JUN 24 1974
H. L. MASINI, County Recorder
FEE $

6316 PAGE 31

# AGREEMENT BETWEEN FRESNO IRRIGATION DISTRICT AND CITY OF FRESNO FOR EXCHANGE OF RECYCLED WATER

This agreement entered into this 20th day of June 1974, by and between FRESNO IRRIGATION DISTRICT, a public corporation (herein called "District"), and the CITY OF FRESNO, a municipal corporation (herein called "City");

WITNESSETH:

WHEREAS, Fresno Irrigation District is the owner of water rights on the Kings River and a water distribution system for the distribution of irrigation waters for agricultural use within the District and has entered into contracts with the United States for an additional supply of water from the Friant-Kern Canal and for storage in Pine Flat Reservoir on the Kings River for the purpose of supplementing the water available for such use within the District; and

WHEREAS, the City of Fresno is located entirely within the exterior boundaries of the District and is the owner of a water distribution system used by City for delivering water to persons and lands both within and outside its City limits for municipal, industrial and domestic uses and is also the owner of a liquid waste treatment plant located within the District southwest of the city limits which is used for the treatment, percolation, purification, recycling and other disposition of liquid effluent from the City and intends to enlarge and improve said facilities and to produce by such treatment, percolation, purification and recycling, water which is of a quality suitable for agricultural use; and

WHEREAS, the entire area represented by the District and by the City is a water deficient area and the District is in need of additional waters for agricultural use and the City is in need of additional water for municipal, industrial and domestic uses; and

To be recorded without fee on behalf of Fresno Irrigation District

WHEREAS, the amount of water available to the District for agricultural use may be increased by the use of water recycled by the City as above described and the amount of water available to the City for use in its water distribution system for municipal, industrial and domestic uses may be increased by the exchange of such recycled water for the use by District of additional Kings River and/or Friant-Kern Canal water in that portion of the District northeast of the City; and

WHEREAS, City is desirous of maintaining a water level under its liquid waste treatment plant that will provide for maximum efficiency in the operation of its said plant; and

WHEREAS, a greater beneficial use and more economical utilization of all of the waters available to both the District and to the City can be obtained by the use of such waters as herein provided and both parties believe it is in the best interests of all the landowners and inhabitants within the District and within the City to enter into such an agreement;

NOW, THEREFORE, it is mutually agreed as follows:

1. Approval by United States and State Water Quality Board. Immediately upon the approval of this contract by the parties hereto, it shall be presented to the United States, and also to the California Regional Water Quality Control Board, or its successor agency, for their approval and shall not become effective for any purpose until such approval has been obtained.

This contract shall be at all times subject to all of the terms and conditions of the City Bureau Contract, the District Bureau Contracts and the District Kings River Intra-Association Agreements and to the extent that any agreement contained herein is contrary to or inconsistent with any term or condition of those contracts or agreements, this contract shall be unenforceable. In the event the performance of any agreement contained herein shall become unenforceable or shall be in violation of any Federal,

State or local statute or ordinance or of any decision of any court of competent jurisdiction, the entire contract may be terminated by either party upon written notice mailed to the other party.

2. Definitions. For purposes of this agreement the following words and phrases shall be defined as follows:

(a) "Agricultural use" means the use of water primarily in the production of agricultural crops, including the irrigation of lands and underground water replenishment.

(b) "Recycled water" means water which has been treated and percolated into the underground water supply under the City's liquid waste treatment plant in the southwest portion of the District which is thereafter pumped from said underground water supply.

(c) "City Bureau Contract" means that certain contract between the United States and the City of Fresno providing for water service dated January 12, 1961.

(d) "District Bureau Contracts" means those certain contracts between the United States and Fresno Irrigation District more particularly described as follows:

Contract between the United States of America and Fresno Irrigation District Providing for the Payment of the District's Share of the Cost of Pine Flat Dam and Reservoir Allocated to Irrigation, dated December 23, 1963.

Contract for Operation and Maintenance of Irrigation Storage Space of Pine Flat Reservoir dated December 23, 1963.

Kings River Allocation Contract, dated December 23, 1963.

Conveyance and Covenants in Compromise and Settlement of Fresno Slough Claims, dated April 23, 1965.

Contract between the United States and Fresno Irrigation District Providing for Water Service, dated July 20, 1964.

(e) "District Kings River Intra-Association Agreements" means those certain contracts relating to Kings River and storage in Pine Flat Reservoir more particularly described as follows:

Water Right Indenture, dated May 3, 1927.

Administrative Agreement and Monthly Diversion Schedule dated May 3, 1927.

Agreement Supplementing and Amending Water Right Indenture Dated May 3, 1927, and Supplementing and Amending Administrative Agreement Dated May 3, 1927, Relating to Kings River Water Association, and Amended Monthly Diversion Schedule, dated June 1, 1949.

Agreement Admitting Kings River Water District As a Member of Kings River Water Association and Agreement Re: Centerville Bottoms Schedule, dated September 10, 1963.

Agreement Supplementing and Amending Water Right Indenture Dated May 3, 1927, and Administrative Agreement Dated May 3, 1927, Each as Amended and Supplemented June 1, 1949, Relating to Kings River Water Association, dated September 10, 1963.

3. Agreement to Deliver and Accept Recycled Water. During the term of this agreement City agrees to deliver and District agrees to accept from City recycled water pumped by City from the area under its liquid waste treatment plant in amounts and under the terms and conditions hereinafter provided. When so delivered to District said water shall become the property of the District to be used for agricultural purposes and for underground water replenishment in the southwest portion of the District as the District shall see fit.

4. Water Quality. The City shall not deliver to District or discharge into District's canals any such recycled water which is not of a quality suitable for all agricultural use or which shall be deleterious to plant or animal life and all water so delivered shall meet all the quality standards of the California Regional Water Quality Control Board, or its successor agency, for agriculture and irrigation use and any other federal, state or local agency having jurisdiction or control over water quality standards. City agrees at its expense to make such periodical tests to determine the quality of the water discharged into District's canals at the point where said water is so discharged as may be required by any such board or agency or as may be required by the District's manager and to submit the results

of such tests in writing to the District forthwith after such tests are made. City further agrees that any complaint that said recycled water does not meet the above standards, including but not limited to complaints from any such board or agency, the County of Fresno, any mosquito abatement district or any user of such recycled water, must be corrected and resolved to the satisfaction of District before any further discharge of water into said canals shall be made without the express consent of the District.

5. Exhibit A. A map showing the exterior boundaries of the District, the District's canal system, the city limits of the City of Fresno, the location of City's liquid waste treatment plant site, the exact locations at which City may discharge water into the District's canal system, the type and capacity of the discharge facilities by which each such discharge may be made, the location of observation wells as provided in Paragraph 9, and those portions of the District designated by the parties as the "easterly" and "westerly" portions of the District for purposes of this agreement shall be prepared by the District's engineering department and approved in writing upon said map by the authorized representatives of the District and the City. When so approved said maps shall be incorporated herein by reference as Exhibit A and shall become a part hereof. One duplicate so approved shall be kept in the office of the City and one in the office of the District. Said map may be amended in writing upon said map and reapproved in writing as above set forth.

6. Place and Time of Delivery. City will deliver all such water to the District during the District's irrigation season which may at the election of the District be extended to accommodate the recycled water received under this agreement. Said water delivered by the City to the District shall be discharged by the City into the District's Dry Creek Canal No. 77 and/or Houghton-

Canal No. 78 at the locations approved by the District and shown on the map marked Exhibit A and at no other location or locations.

7. Amount to be Delivered. The City shall deliver to the District under this agreement, subject to District's acceptance as provided herein, recycled water pumped by the City, which shall be delivered at a minimum rate of delivery of 100,000 acre feet in each ten-year period of this contract, provided, however, such delivery will not exceed the amount of 30,000 acre feet in any one year except that such maximum may be increased upon agreement between the District's manager and the Director of Public Works of the City. At least 10 days prior to the first day of each calendar month during the term of this agreement City will submit to District in writing a schedule of the daily amount of such water proposed to be delivered to District at each discharge point during that month and the rate of flow indicated in cubic feet per second at which said water will be delivered. Upon receiving said schedule District's manager will approve the amount of such water the District is willing to accept at each said discharge point during each day of that month and thereafter City shall deliver to District the daily amount of such water so approved. Said daily deliveries shall be at a continuous and constant rate of flow during the entire 24 hour period of each said day. In no event shall the discharge into Dry Creek Canal No. 77 in any one month be in excess of one-half of the total amount delivered to District in that month or the discharge into the Houghton Canal No. 78 in any one month be more than two-thirds of the total amount delivered to the District in that month and in no event shall the rate of discharge of water into Dry Creek Canal No. 77 exceed 60 c.f.s. or the rate of discharge into Houghton Canal No. 78 exceed 120 c.f.s. No such discharges shall be made into District's canals until said discharges have been approved

gives immediate notice thereof to the District. In such event City shall use all reasonable effort to immediately restore the delivery of water to the level approved by District's manager as provided in paragraph 7. District's manager may refuse to agree to any such change in schedule or to accept water under such changed schedule if he reasonably determines that such change may result in damage to a District canal or to other property of the District or any other person or will interfere with the operation, alteration, repair or maintenance of the canal into which said discharge is to be made or will interfere with some other operation or function of the District.

9. Ground Water Level. City shall not pump said recycled water from the underground water reservoir in such a manner or to the extent that it will adversely affect the elevation of the water table in the area surrounding its liquid waste treatment plant as determined by the District. Such effect shall not be deemed to be adverse if the ground water level is not lowered below the gradients established by the District as existing on August 1 of the previous year. City agrees to monitor ground water levels in the area from which said recycled water is pumped on a monthly basis by means of observation wells located within an area surrounding its liquid waste treatment plant. The number and location of said wells shall be agreed upon by the City and the District, and when so agreed upon shall be shown on Exhibit A as provided in paragraph 5. Each month at the time City submits its schedule of proposed discharges, City shall supply District with the results of said observations and shall also supply District with a statement of the amounts discharged into District's canals during the previous month. Said schedule and said information shall be given to District upon a standard form approved by District's manager.

10. Construction and Maintenance of Facilities. All

discharge facilities to be used by City in discharging said water into said canals and suitable measuring devices required to measure the amount of water discharged into District's canals shall be constructed by City at its expense according to plans and specifications approved by District and shall thereafter be maintained in good operating and working condition by and at the expense of City. Said discharge facilities shall have a discharge capacity not greater than that shown on said map marked Exhibit A and shall be equipped with positive shut-off controls by which any and all discharges of water into District's canal system may be shut off immediately and at any time. City shall at all times protect said canals and their banks from any damage, injury or erosion at the locations of said facilities into said canals and any such damage or injury at such locations shall be repaired at the expense of City. If City fails to do so District shall be entitled to make said repairs and the expense thereof shall forthwith be reimbursed by City.

11. Use of Water Available to District. In consideration of the agreements of the City herein contained, District agrees that insofar as feasible and practical, it will make available from its Kings River water or from the water received by it under its Bureau Contracts an additional amount of water equivalent to 46% of the water received by it from the City under this agreement for agricultural use and for ground water replenishment in the easterly portion of the District as indicated on Exhibit A. The term "additional amount of water" as above used shall mean water in addition to the amount of water which would have been made available for use in that area if said recycled water had not been received by the District and used in the westerly portion of the District as indicated on Exhibit A. If the District shall determine that the use of said water in said area is not feasible or practicable it may, after discussion with the City, use such

water elsewhere. If in the future it is deemed desirable to do so, City, with the approval of District, may cause the dividing line between the easterly portion of the District and the westerly portion of the District to be moved to the west and the percentage of water to be made available in said easterly portion of the District to be increased in proportion to the increase in the area of land within said easterly portion.

12. District's Representative. Wherever it is provided in this agreement that District's manager shall do and act or exercise his discretion in respect to any particular matter said act and said exercise of discretion may be performed by any other representative of the District to whom such authority shall be delegated either by the District's Board of Directors or by said manager. In exercising his said discretion, the District's manager or his authorized representative shall weigh and balance the equities of the parties in respect to the interests of each and the necessities of District's operations in relation to those of the City. However, in any such case, his decision shall be final.

13. Ownership of District's Water Rights, Canals and Storage. Nothing contained in this agreement shall in any way affect District's ownership of its canal system or of its water right or its right to storage in Pine Flat Reservoir or give City any right or interest therein.

14. Expense of Performance. The performance of all terms and conditions of this agreement to be performed by City shall be at the expense of City and the performance of all terms of this agreement to be performed by District shall be at the expense of District.

15. Indemnity. City agrees to indemnify District and save District harmless of, from and against any loss, cost, expense, liability or attorney's fees incurred by District as the result of

any claim made by any third party because of the City's pumping from the underground water supply as above described or in any way arising out of the execution or performance of this agreement unless such loss, cost, expense or liability is caused by independent negligence on the part of the District in performing the terms and conditions of this agreement on its part to be performed.

16. Successors and Assigns. This agreement shall be binding upon the successors and assigns of the parties hereto provided that City's right to discharge water into District's canal system is not transferable or assignable and shall not pass to any successor in interest without the consent of District. This agreement is not made for the benefit of any person, firm, corporation or public entity not a party hereto and no person, firm, corporation or public entity except a party hereto or its successor or assign shall have any right to enforce said agreement under California Civil Code §1559 or otherwise.

17. Amendments. Except as otherwise provided herein this agreement may not be amended except by the written agreement of the parties hereto.

18. Term, Termination. The term of this contract shall be twenty years from its date, except that it may be cancelled upon mutual agreement between the parties hereto. The contract shall continue in effect after the end of said term except that it may be terminated thereafter by either party upon one year's written notice of such termination. Notwithstanding the foregoing, this contract may be terminated at any time, upon sixty days' written notice by either party, given on and because of substantial breach by the other party, which breach is not repaired or corrected before the end of said sixty-day period.

IN WITNESS WHEREOF, the parties hereto have executed this

agreement the day and year first above written.

FRESNO IRRIGATION DISTRICT

By Winston Strong
President

By Ardys T. Gorder
Secretary

ATTEST:

Corbin Douglass
City Clerk Deputy

CITY OF FRESNO

By F. W. Hanley
Chief Administrative Officer

State of California)
County of Fresno) ss.

On this 20th day of June in the year one thousand nine hundred and seventy-four, before me, Paul H. Willison a Notary Public in and for said County and State, residing therein, duly commissioned and sworn, personally appeared ..... known to me to be the President and Winston Strong known to me to be the Secretary of the Fresno Irrigation District the corporation that executed the within instrument, and known to me to be the person S who executed the within instrument on behalf of the corporation therein named, and acknowledged to me that such corporation executed the same.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal at my office in said County, the day and year in this Certificate first above written.

Paul H. Willison
Notary Public in and for said County and State

OFFICIAL SEAL
PAUL H. WILLISON
NOTARY PUBLIC - CALIFORNIA
PRINCIPAL OFFICE IN
FRESNO COUNTY
My Commission Expires November 19, 1977

CORPORATION ACKNOWLEDGMENT
Kilner Stationery Co.
1916 Echo

FORM K108

APPROVED AS TO FORM
SPENCER THOMAS, JR., City Attorney

By Assistant Macomber
Senior Deputy

Mail to: City of Fresno Waste Water Treatment Plant
5607 W Jensen Avenue
Fresno, Ca. 93706
Attn: Mr. Joel Dolker

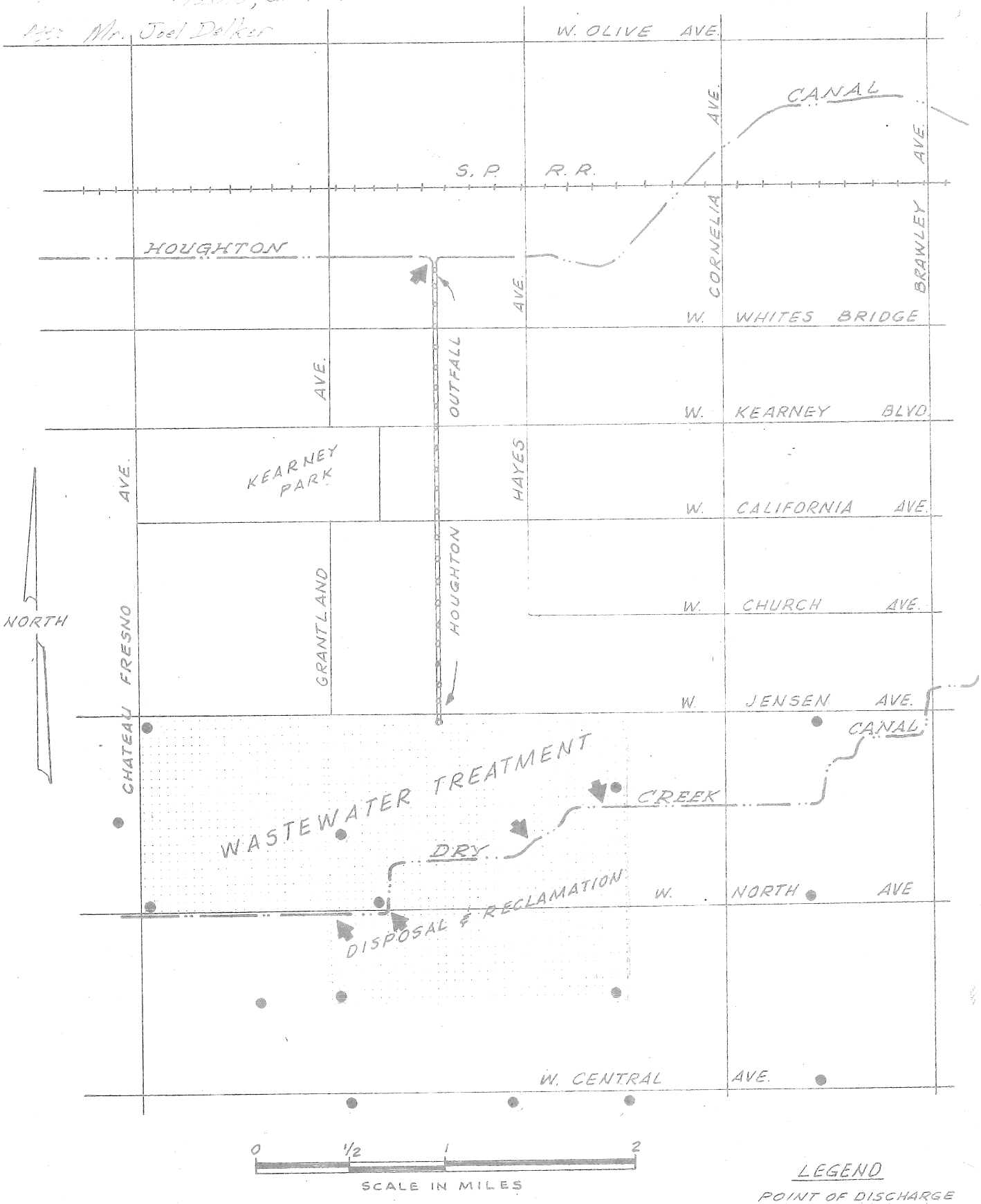



EXHIBIT A-1

# J

# Water Shortage Contingency Plan

City of FRESNO
Department of Public Utilities

# 2020 Water Shortage Contingency Plan

Final

JULY 2021 | CITY OF FRESNO

Photo Credit: Downtown Fresno Partnership

WSC

City of FRESNO
Department of Public Utilities

CITY OF FRESNO

# Final
# 2020 Water Shortage Contingency Plan

**JULY 2021**

Prepared by Water Systems Consulting, Inc.

WSC

# ACKNOWLEDGMENTS

The 2020 Water Shortage Contingency Plan was prepared by Water Systems Consulting, Inc. The primary authors are listed below.

Jeff Szytel, PE
Rob Morrow, PE
Lauren Cetin, EIT
Heather Freed, PE

Water Systems Consulting, Inc. would like to acknowledge the significant contributions of the City of Fresno, including the following staff.

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**Professional Engineer** Peter Maraccini, PE

**Water Division**

**Assistant Director** Bud Tickel
**Water System Manager** Chris Carroll
**Water System Manager** Russell Guilliams
**Business Manager** Henry McLaughlin
**Water Conservation Supervisor** Conrad Braganza

**Wastewater Division**

**Wastewater Manager** Rosa Staggs
**Operations Supervisor** Cory Asher
**Reclamation Coordinator** Setrag Cherchian

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# ACRONYMS & ABBREVIATIONS

| | |
|---|---|
| **AMI** | advanced metering infrastructure |
| **City** | City of Fresno |
| **CWC** | California Water Code |
| **DPU** | Department of Public Utilities |
| **DRA** | Drought Risk Assessment |
| **DWR** | Department of Water Resources |
| **FID** | Fresno Irrigation District |
| **FMC** | Fresno Municipal Code |
| **SWTF** | Surface Water Treatment Facility |
| **USBR** | United States Bureau of Reclamation |
| **UWMP** | Urban Water Management Plan |
| **WSCP** | Water Shortage Contingency Plan |
| **WSIP** | Water Storage Investment Program |

# 1.1 Introduction

The Water Shortage Contingency Plan (WSCP) is a detailed plan on how the City of Fresno (City) intends to respond to foreseeable and unforeseeable water shortages. A water shortage occurs when the water supply is reduced to a level that cannot support typical demand at any given time. The WSCP is used to provide guidance to the City's governing body and staff and the public by identifying response actions to allow for responsible management of any water shortage with predictability and accountability. Preparation provides the tools to maintain reliable supplies and reduce the impacts of supply interruptions due to extended drought and catastrophic supply interruptions.

The WSCP describes the following:

1. **Water Supply Reliability Analysis:** summarizes the City's water supply analysis and reliability and identifies any key issues that may trigger a shortage condition
2. **Annual Water Supply and Demand Assessment Procedures:** describes the key data inputs, evaluation criteria, and methodology for assessing the system's reliability for the coming year and the steps to formally declare any water shortage levels and response actions
3. **Six Standard Shortage Stages:** establishes water shortage levels to clearly identify and prepare for shortages
4. **Shortage Response Actions:** describes the response actions that may be implemented or considered for each stage to reduce gaps between supply and demand as well as minimize social and economic impacts to the community
5. **Communication Protocols:** describes communication protocols under each stage to ensure customers, the public, and government agencies are informed of shortage conditions and requirements
6. **Compliance and Enforcement:** defines compliance and enforcement actions available to administer demand reductions
7. **Legal Authority:** lists the legal documents that grant the City the authority to declare a water shortage and implement and enforce response actions
8. **Financial Consequences of WSCP Implementation:** describes the anticipated financial impact of implementing water shortage stages and identifies mitigation strategies to offset financial burdens
9. **Monitoring and Reporting:** summarizes the monitoring and reporting techniques to evaluate the effectiveness of shortage response actions and overall WSCP implementation, with results used to determine if additional shortage response actions should be activated or if efforts are successful and response actions should be reduced
10. **WSCP Refinement Procedures:** describes the factors that may trigger updates to the WSCP and outlines how to complete an update
11. **Special Water Features Distinctions:** identifies exemptions for ponds, lakes, fountains, pools, and spas, etc.
12. **Plan Adoption, Submittal, and Availability:** describes the process for the WSCP adoption, submittal, and availability after each revision

This WSCP was prepared in conjunction with the City's 2020 Urban Water Management Plan (UWMP) and is a standalone document that can be modified as needed. This document is compliant with the California Water Code (CWC) Section 10632 and incorporated guidance from the State of California Department of Water Resources (DWR) UWMP Guidebook.

Water purveyor planning for possible water supply shortages has become an increasingly important subject considering the drought conditions over the last several years. The City adopted its first WSCP in 1994 in response to the 1991 Assembly Bill 11X, which mandated all water purveyors with more than 3,000 connections develop a WSCP. The WSCP was revised as part of the 2005 UWMP and adopted by the City in 2008. The WSCP was further refined in 2016 during preparation of the 2015 UWMP and is being updated in 2021 as a standalone document, developed in parallel with the 2020 UWMP. The 2020 WSCP is still based on the original 1994 plan. The revisions are intended to meet new CWC requirements and streamline the plan's usefulness and enable the City to manage the necessary conservation measures to be enacted if a water shortage condition exists. The 2020 WSCP will be reviewed and adopted in conjunction with the 2020 UWMP.

The plan is intended to provide guidance, rather than absolute direction, for City action in response to water shortages and provide the City with options to responsibly manage water shortages.

## 1.2 Water Supply Reliability Analysis

This section is consistent with CWC Section 10632(a)(1) and describes the key findings of the water supply reliability analysis conducted pursuant to CWC Section 10635, which is presented in **Chapter 7** of the City's 2020 UWMP. As part of the 2020 UWMP, water suppliers must perform long-term (2025-2045) water service reliability assessment to evaluate reliability under normal, single dry year, and five-year consecutive dry year periods and a short-term (2021-2025) Drought Risk Assessment (DRA) to evaluate reliability under a five-year consecutive dry year period. Water supply reliability reflects the City's ability to meet the water needs of its customers with water supplies under varying conditions. The analysis considers plausible hydrological and regulatory variability, infrastructure capacity, climate conditions, and other factors that affect the City's water supply and demand.

The City's current water supply portfolio includes groundwater from the Kings Subbasin, surface water from the Central Valley Project Friant Division through a contract with the United States Bureau of Reclamation (USBR), and surface water from the Kings River through a contract with Fresno Irrigation District (FID), as well as recycled water produced at the Fresno-Clovis Regional Water Reclamation Facility and North Fresno Water Reclamation Facility. The City manages the surface water supplies and groundwater conjunctively such that surface water supplies are used more heavily for direct use and recharge during wet periods and groundwater is used more heavily during dry periods. Over the long term, the City aims to maximize recharge to store water for future use and help groundwater levels recover. Key issues that may create a shortage conditions include reduced surface water availability due to dry hydrologic conditions, reduction in groundwater due to contamination issues, or emergency conditions that reduce the City's water supply.

The water supply reliability analysis concluded that the City's supply portfolio is highly reliable and allows the City flexibility to use a majority of surface water when available in normal years and switch to a majority of groundwater in dry years, when surface water supplies are reduced.

The City is projected to meet potable demands with its existing supplies in all year types through conjunctive use of its groundwater and the City is projected to recharge water in most years to help store water for dry years.

## 1.3 Annual Water Supply and Demand Assessment

As established by CWC Section 10632.1, urban water suppliers must conduct an Annual Water Supply and Demand Assessment (Annual Assessment) and submit an Annual Water Shortage Assessment Report to DWR, with the first deadline July 1, 2022[1]. The Annual Assessment is an evaluation of the short-term outlook for supplies and demands for the current year and one projected single dry year conditions to determine whether the potential for a supply shortage exists and whether there is a need to trigger a WSCP shortage stage, appropriate response actions, compliance and enforcement actions, and communication protocols.

### 1.3.1 Key Data Inputs

Key data inputs and their sources for the Annual Assessments are summarized in **Table 1,** and described below**.**

**Table 1. Key Data Inputs for the Annual Assessment**

| KEY DATA INPUT | DESCRIPTION | SOURCE |
|---|---|---|
| Customer demands | Estimates current year unconstrained demand plus a modest growth factor | Customer billing data, 2020 UWMP projections, input from City staff |
| Recharge demands | Estimates current year recharge demand | Surface water allocations, historical recharge, groundwater levels |
| State mandates | Reflects State orders and mandatory compliance with water use efficiency standards | Executive orders from the governor, orders and policies from the State Water Resources Control Board, input from City staff, or other sources |
| Surface water allocation | Reflects the City's available surface water supplies for treatment, recharge, and potential exchanges and transfers | Initial allocations from USBR and FID, typically available in April |
| Groundwater conditions | Reflects status of groundwater conditions | Production data, static water levels, and input from City staff |
| Infrastructure capacity | Reflects production and distribution capacity due to a variety of factors, including human-caused or natural catastrophic events | Production data, well production capacity, wells impacted by contamination, surface water treatment facilities' capacity, distribution system constraints, input from City staff |

[1] For USBR contractors, the assessment is due by July 1 or within 14 days of receiving final USBR water allocation, whichever is later.

#### 1.3.1.1 Customer Demands

Upcoming year customer demands will be estimated based on the previous year's demand, with increases to address: (1) near-term projected growth of customers; (2) unconstrained water use if the previous year included any water use restrictions; and (3) potential water losses not accounted for in the previous year's demand.

#### 1.3.1.2 Recharge Demands

Upcoming year recharge demands will be estimated by (1) availability of surface water not used at the surface water treatment facilities (SWTFs) and (2) projected availability of recharge basins.

#### 1.3.1.3 State Mandates

The City has historically been required by the State to reduce demand regardless of supply reliability at the given time. As described previously, compliance with State mandates for water use efficiency can be declared during drought or in preparation for future droughts, such as in response to the governor's drought declarations in the 2012–2016 drought with subsequent Executive Order B-37-16 and related legislation for Making Conservation a California Way of Life. The City may consider State mandates and mandatory compliance with water use efficiency standards in determining water shortage levels.

#### 1.3.1.4 Surface Water

The City has contracts for surface water with USBR and FID. The available surface water is dependent on hydrology, and in dry years less surface water is available to the City. Final allocations from both USBR and FID are known in April of each year, following the rainy season. In April, the City works with FID to develop a delivery schedule of surface water supplies and submits it USBR. The surface water allocation and delivery schedule will determine the City's operation of its SWTFs for the year, recharge operations, and if it will engage in any exchanges or transfers of supplies. In dry years, when less surface water is available, the City will also plan for increased groundwater use to meet its demands.

#### 1.3.1.5 Groundwater Conditions

Groundwater level and production trends will be compiled and considered by the City staff, or with a hydrogeologist, based on the following actions:

- Plot static groundwater levels on hydrographs to determine trends.
- Plot historic and projected production data to determine trends.
- Compare historic and projected groundwater levels against production data for average and dry years.

#### 1.3.1.6 Infrastructure Capacity

Infrastructure capabilities and overall production will be analyzed to determine if a possible power outage or deficiency may occur or continue in the coming year due to a variety of factors, potentially including human-caused or natural catastrophic events. This analysis may include well replacement, evaluation of wells for possible contamination, SWTFs capacities, and other considerations.

## 1.3.2 Evaluation Criteria

Staff will use the key data inputs to develop and compare supply and demand projections to determine if water shortage actions may be necessary. A preliminary Annual Assessment template is included in **Attachment 1**. Note that supply projections will incorporate infrastructure constraints and an operational buffer factor of 10% will be added to the demand estimate to account for supply and demand projection uncertainties. The estimated amount of supply available versus the estimated demand will be compared with the water shortage condition triggers presented in **Table 2**. Various trigger conditions, which summarize specific evaluation criteria for each shortage level and can be used to determine a water shortage level, are described in the following sections. Triggers are based on current conditions, and the City will evaluate these triggers and modify them as needed.

A shortage emergency may be declared when it is demonstrated that conditions threaten the ability to provide water for public health, safety, and welfare of the community. Furthermore, compliance with State mandates for water use efficiency can be declared during drought or in preparation for future droughts, such as in response to the governor's drought declarations in the 2012–2016 drought with subsequent Executive Order B-37-16 and related legislation for "Making Conservation a California Way of Life".

Short-term and long-term supply shortages may be caused by constrained production capacity or natural or human-caused catastrophic emergencies, such as: power outages, winter storms, wildfires, earthquakes, structural failures, contamination, and bomb threats. These types of emergencies may limit the City's immediate ability to provide adequate water service to meet the requirements for human consumption, sanitation, and fire protection. Impacts of such emergencies vary in duration. Thus, consumption reduction measures and prohibitions may differ for short-term and long-term conditions or shortages.

## 1.3.3 Annual Assessment Procedures

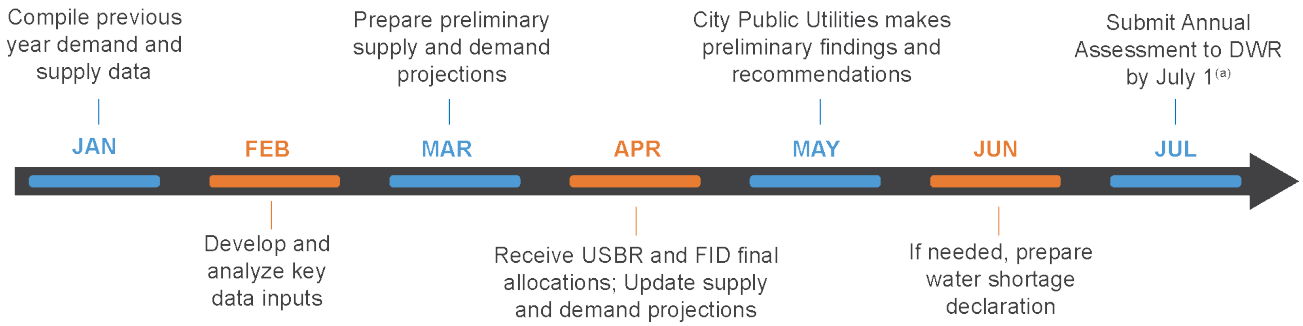
City staff will perform the Annual Assessment following initial allocations from USBR and initial projections for Kings River entitlements by FID, which is typically at the end of rainy season in April. The Annual Assessments are due to DWR by July 1 of each year[2] with the first Annual Assessment Report due to DWR by July 1, 2022. A preliminary annual assessment timeline is shown in **Figure 1.** The City may update the assessment after submission if key data inputs substantially change or other new information becomes available.

[2] For USBR contractors, the assessment is due by July 1 or within 14 days of receiving final USBR water allocation, whichever is later.

**Steps to conduct the Annual Assessment are as follows:**

1. Staff gathers the key inputs, compiles historical data, and analyzes potential supply and demand gaps.
2. Demand trends, water supply conditions, and production capacity are analyzed.
3. A hydrogeologist may be consulted to provide additional groundwater condition information.
4. City Public Utilities staff will review findings and, if necessary, determine a recommended level of conservation required at the implementation or termination of each stage that will then be brought to the City Manager or Mayor for approval.
5. The City Manager, or designee, will declare and implement the level of conservation required at the implementation or termination of each level, and the declaration shall remain in effect until the City Manager, or designee, so otherwise declares. If a conservation level declaration is made, the declaration shall be published at least once in a newspaper of general circulation.
6. The City will develop and/or implement appropriate communication protocols and applicable response actions.

**Figure 1. Annual Assessment Approximate Timeline**




[a] For USBR contractors, the assessment is due by July 1 or within 14 days of receiving final USBR water allocation, whichever is later.

# 1.4 Standard Water Shortage Levels

This section is consistent with CWC Section 10632(a)(2) and describes the City's water shortage levels. New to the 2020 UWMP, water suppliers must now consider six standard water shortage levels. Shortage levels indicate the gap between supply and demand compared to normal-year conditions. DWR standardized six shortage levels to provide a consistent regional and statewide approach to measure water supply shortage conditions. The six shortage levels correspond to 10%, 20%, 30%, 40%, 50%, and greater than 50% shortage in supplies compared to demands under normal conditions. However, a water supplier may use its own shortage levels if a crosswalk is included, relating its existing shortage levels to the six standard levels.

The City has elected to keep the previously established four water shortage stages from the 2016 WSCP and add a fifth stage to classify supply shortage greater than 50%. A crosswalk between the City's stages and DWR's standard levels is shown in **Figure 2**.

**Figure 2. Water Shortage Stages Crosswalk**

| City of Fresno Shortage Stage | Percent Shortage Range | Standard WSCP Level | Percent Shortage Level |
|---|---|---|---|
| 1 | 10% | 1 | 10% |
| 2 | 10 - 25% | 2 | 20% |
| 3 | 25 - 35% | 3 | 30% |
| 4 | 35 - 50% | 4 | 40% |
| 5 | >50% | 5 | 50% |
| | | 6 | >50% |

Although the water shortage stages are classified by the same percentages as the 2015 UWMP, the City has reevaluated the supply conditions and criteria to enter that stage to better reflect its supply portfolio in comparison to demand. **Table 2** lists the water shortage stages and the conditions that would trigger each stage. Any stage listed within the WSCP may be enacted by the City Manager, or designee, as deemed appropriate based on the water shortage condition.

**Table 2. Water Shortage Contingency Plan Levels (DWR 8-1)**

| SHORTAGE LEVEL | PERCENT SHORTAGE[a] | WATER SHORTAGE CONDITION |
|---|---|---|
| 0 | | No water shortage condition. Corresponds with year-round water use measures listed in Section 1.5.1 and demand reduction measures listed for "All" stages in Table 3. |
| 1 | 0-10% | Stage 1 may be triggered by any of the following conditions:<br>• The available water supplies for the next year are projected to be less than **100%** of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>• After having been in a Stage 2 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[b] or higher; or<br>• After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 2 | 10-25% | Stage 2 may be triggered by any of the following conditions:<br>• The available water supplies for the next year are projected to be less than **90%** of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>• After having been in a Stage 3 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[b] or higher; or<br>• After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 3 | 25-35% | Stage 3 may be triggered by any of the following conditions:<br>• The available water supplies for the next year are projected to be less than **75%** of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>• After having been in a Stage 4 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[b] or higher; or<br>• After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 4 | 35-50% | Stage 4 may be triggered by any of the following conditions:<br>• The available water supplies for the next year are projected to be less than **65%** of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment; or<br>• After having been in a Stage 5 classification from drought conditions, the upcoming water year USBR and FID allocations results in normal-dry water year type[b] or higher; or<br>• After having been in a higher classification as a result of emergency, original trigger for a previous higher-stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 5 | >50% | Stage 5 may be triggered by any of the following conditions:<br>• The available water supplies for the next year are projected to be less than **50%** of projected demand considering infrastructure constraints and an operational buffer. The available water supplies, infrastructure constraints, projected demand, and operational buffer will be estimated at least once per calendar year – and more often as appropriate - as part of the Annual Water Supply and Demand Assessment. Section 1.3 of the City's Water Shortage Contingency Plan describes the key data inputs, evaluation criteria, and procedures for the annual assessment. |

[a] Shortage levels indicate the gap between supply and demand compared to normal-year conditions. The Annual Assessment incorporates a 10% buffer on top of projected demands for conservative planning.

[b] Water year types were defined 2006 San Joaquin River Restoration Settlement Agreement for USBR allocations and characterized in Section 6.2 of the City's 2020 UWMP.

# 1.5 Shortage Response Actions

The Fresno Municipal Code (FMC) contains sections on water conservation that are to take place under normal water supply conditions. Regulations in place under normal water supply conditions encourage smart water use and help the City manage its water supply. Some of those regulations include year-round outdoor water schedules; turf type restrictions; turf irrigation methods; and prohibition of willful or negligent water wasting, flood irrigating, washing hardscape with potable water, and frequent draining of pools. Additional details of these regulations can be found in FMC Section 6-520(a) (**Attachment 2**). These restrictions are mandated year-round by the City and must be observed. In addition to the normal restrictions on water usage, the City developed shortage response actions to implement during a water shortage on the City level and consumer level in order to reduce demands that are described in **Section 1.5.2** and detailed in **Table 3**.

In the event of a potential water shortage, the City will evaluate the cause of the shortage to help inform which response actions should be implemented. Depending on the nature of the water shortage, the City can elect to implement one or several response actions to mitigate the shortage and reduce gaps between supply and demand. The City has identified actions that fall within the demand reduction, supply augmentation, operational changes, and additional mandatory restrictions, as stated by DWR. It should be noted that all prohibitions listed for Stage 1 will apply to Stage 2 and, likewise, all restrictions that apply to Stage 2 will apply to Stage 3 and so on, until Stage 5 is reached. Also, due to the City's diverse supply portfolio, Stage 1 imposes only voluntary consumer reductions, while Stages 2–5 all include mandatory reduction actions. If necessary, the City may adopt additional actions not listed here in extreme circumstances.

## 1.5.1 Year-Round Measures

FMC Section 6-520(a) lists actions that are prohibited at all times, whether or not there is a shortage condition and include:

- Use of potable water to irrigate or water outdoor landscaping in a manner that causes runoff.
- Keep, maintain, operate, or use any water connection, hose, faucet, hydrant, pipe, outlet, or plumbing fixture which is not tight and free from leakage.
- Willfully or negligently waste water as defined in FMC Section 6-501.
- Sprinkle or irrigate any yard, ground, premise, or vegetation except as set forth in the City's Outdoor Water Use Schedule.
- Sprinkle or irrigate any yard, ground, premise, or vegetation, unless watering device used is controlled by a shutoff device or a person is in immediate attendance of the hose or watering device.
- Prohibit use of potable water to wash sidewalks, walkways, driveways, parking lots, open ground, or other hard-surfaced areas, except where necessary for public health or safety.
- Use potable water in a fountain or other decorative water feature, except where the water is part of a recirculating system.
- Irrigation of ornamental turf on public street medians with potable water, except where the turf serves a community or neighborhood function, there is incidental irrigation by an irrigation system designed to irrigate trees, or the turf is irrigated with recycled water.

- Irrigating outdoor landscapes with potable water during and within 48 hours after measurable rain.
- Serve drinking water other than upon request in eating or drinking establishments, including but not limited to, restaurants, hotels, cafes, cafeterias, bars, or other public places where food or drink are served or purchased.
- Irrigate landscapes outside of newly constructed homes and buildings in a manner inconsistent with regulations or other requirements established by the California Building Standards Commission and the Department of Housing and Community Development.
- Automatically changing towels and linens in hotels and motels daily. Operators of hotels and motels shall provide guests the option of choosing not to have towels and linens laundered daily.
- Drain swimming pools more than once every three years, except as necessary to complete structural repairs or to comply with public health standards, as determined by the County Health Officer.
- Prohibit filling new or refurbished swimming pools without obtaining a pool fill permit from the City.
- Refill (top off) established swimming pools except during times when outdoor water use is allowed at the property address pursuant to the Outdoor Water Use Schedule

The City may update these year-round restrictions in the future as needed. For the latest permanent restrictions refer to FMC Section 6-520(a) (**Attachment 2**) and the latest WSCP Resolution (**Attachment 3**).

## 1.5.2 Demand Reduction

The City has identified a variety of demand reduction actions to offset supply shortages. Demand reduction measures are strategies intended to decrease water demand to close the gap between supply and demand. Demand reduction actions available to the City that may be considered during water shortage conditions are summarized in **Table 3**. Although it is difficult to estimate the volume of savings for each action, the City expects to meet required reductions through a combination of response actions in conjunction with outreach and communication efforts to the extent necessary to mitigate any impacts from a water shortage.

**Table 3. Demand Reduction Actions by City (DWR 8-2)**

| SHORTAGE LEVEL | DEMAND REDUCTION ACTIONS | HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP?[a] | ADDITIONAL EXPLANATION OR REFERENCE | PENALTY, CHARGE, OR OTHER ENFORCEMENT[b] |
|---|---|---|---|---|
| All | Expand Public Information Campaign | Not Applicable | Community outreach includes classroom presentations, outreach educational information, and water tours. Increase communication as drought stages increase. | Not Applicable |
| All | Improve Customer Billing | Not Applicable | Water bills show customer usage vs. average usage for the customer category. Increase customer notifications of high water use based on advanced metering infrastructure data as drought stages increase. | Not Applicable |
| All | Offer Water Use Surveys | Not Applicable | Use water leak surveys with all community members. | Not Applicable |
| All | Provide Rebates for Landscape Irrigation Efficiency | Not Applicable | The City offers rebates for micro-irrigation conversions, soil moisture sensors, smart irrigation controller, and rain sensors to improve efficiencies. | Not Applicable |
| All | Provide Rebates for Turf Replacement | Not Applicable | The City provides rebates for community members who wish to replace their turf with a drought-resistant garden. | Not Applicable |
| All | Provide Rebates on Plumbing Fixtures and Devices | Not Applicable | The City offers rebates on a variety of high-efficiency plumbing fixtures, such as washers, toilets, and urinals. | Not Applicable |
| All | Decrease Line Flushing | Not Applicable | The City uses NO-DES for regular pipe flushing to eliminate discharging water. | Not Applicable |
| All | Reduce System Water Loss | Not Applicable | The City has a comprehensive system water loss reduction program in place. Increase efforts to correct water system losses as drought stages increase. | Not Applicable |
| 1 | Decrease Line Flushing | 0 to 100% of shortage gap | For dead-end flushing where the NO-DES truck cannot be used, reduce normal flushing time. | Not Applicable |
| 1 | Increase Water Waste Patrols | 0 to 100% of shortage gap | Increase monitoring of AMI reporting and communication with customers; Conduct patrols based on public input. | Not Applicable |
| 1 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Voluntary limits:<br>Summer: three days/week<br>Winter: one day/week | No |
| 2 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Summer: three days/week<br>Winter: one day/week | Yes |
| 3 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Summer: two days/week<br>Winter: one day/week | Yes |
| 4 | Landscape — Limit landscape irrigation to specific times | 0 to 100% of shortage gap | Summer: one day/week<br>Winter: one day/week | Yes |
| 4 | Other — Prohibit use of potable water for construction and dust control | 0 to 100% of shortage gap | Prohibit use of potable water for construction, compaction, dust control, street or parking lot sweeping, and building washdowns where non-potable or recycled water is sufficient. | Yes |

| SHORTAGE LEVEL | DEMAND REDUCTION ACTIONS | HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP?[a] | ADDITIONAL EXPLANATION OR REFERENCE | PENALTY, CHARGE, OR OTHER ENFORCEMENT[b] |
|---|---|---|---|---|
| 4 | Other — Prohibit vehicle washing except at facilities using recycled or recirculating water | 0 to 100% of shortage gap | Prohibit washing cars, boats, trailers, aircraft, or other vehicles, except at commercial or fleet vehicle-washing facilities using water recycling equipment. | Yes |
| 4 | Pools and Spas - Require covers for pools and spas | 0 to 100% of shortage gap | Require covers for swimming pools when not in use. | No |
| 4 | Other | 0 to 100% of shortage gap | Prohibit use of potable water for sewer system maintenance or fire protection training without prior approval by the City manager. | Not Applicable |
| 4 | Other | 0 to 100% of shortage gap | Prohibit use of outdoor misters. | No |
| 5 | Landscape — Prohibit all landscape irrigation | 0 to 100% of shortage gap | Prohibit outdoor irrigation year-round. | Yes |
| 5 | Moratorium or Net Zero Demand Increase on New Connections | 0 to 100% of shortage gap | The City will temporarily limit or ban new water service connections within the service area. | Not Applicable |

[a] Reduction in the shortage gap is estimated and can vary significantly.
[b] Refer to Section 1.7 for Penalties for Water Wastage.

## 1.5.3 Supply Augmentation

Given the consistent supply of groundwater through pumping, the City has no immediate plan to augment supply. However, the City could purchase additional USBR or FID surface water, if available. Also, the Cities of Fresno and Clovis have an agreement for interconnection of their potable water systems to provide service during emergencies and other times of hardship in either community. Although these options are discretionary and quantifying their ability to reduce the shortage gap can vary significantly, they are readily available if needed, as indicated in **Table 4**.

**Table 4. Supply Augmentation & Other Actions (DWR 8-3R)**

| SHORTAGE LEVEL | SUPPLY AUGMENTATION METHODS AND OTHER ACTIONS BY WATER SUPPLIER | HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP? | ADDITIONAL EXPLANATION OR REFERENCE |
|---|---|---|---|
| 1 to 5 | Transfers | As Needed | Purchase or exchange available USBR or FID surface water |
| 1 to 5 | Other Purchases | As Needed | Interconnection with City of Clovis for use in emergencies |

## 1.5.4 Operational Changes

Operational changes to address a short-term water shortage may be implemented based on the severity of the reduction goal. The City can maximize its supply by implementing operational strategies and demand reduction measures. As part of the Annual Assessment process, the City will consider their operational procedures at the time of a shortage to identify changes that can be implemented to address water shortage on a short-term basis, including but not limited to:

- Utilization of a SWTF to treat pumped groundwater to offset lack of surface water supply
- Expansion of public information campaign to educate and inform customers of the water shortage emergency and required water savings
- Decrease line flushing to only on a compliant basis strictly using the currently operational NO DES truck
- Use water patrols and increase frequency of meter reading by recruiting staff from other departments if necessary
- Offer water use surveys
- Implementing or modifying drought rate structure or surcharge or water emergency tiered pricing, pursuant to the requirements of Proposition 218 and in accordance with California Law
- Prohibit any new permits for hydrant-construction or temporary construction meters.
- Monitoring construction meters and fire hydrant meters for efficient water use in the event that a meter identified wastes water.

- Moratorium on issuing any new building permit unless the: (a) Project is found by the City Manager, or designee, to be necessary for public health, safety. (b) Project will use recycled water for construction. (c) Project will not result in a net increase in non-recycled water use. (d) Project has adequate Conservation Offsets
- Suspending the consideration of annexation to its service area unless the annexation increases the water supply available more than the anticipated demands of the property to be annexed
- Reducing overhead in the short-term and mid-term by deferring non-critical Capital Improvement Plan projects and major maintenance expenditures, and in the long-term by adjusting operational and staffing levels and retail water rate structures to incorporate the reality of lower retail water sales than previously anticipated.
- Decrease in the level or, if need be, even a total interruption in the expenditures for the agency's facility replacement program. Non-critical replacement projects will have little or no impact on the agency or its customers and would only extend the master planned replacement schedule.

## 1.5.5 Emergency Response Plan

In addition to responding to drought conditions, the City's WSCP can be used to respond to emergency or catastrophic conditions that impact the availability of the City's water supplies, and/or the ability to deliver water within the City's service area. Potential events are listed below:

- Loss of surface water supply
- Loss of groundwater supply
- Area-wide electrical power failure
- Natural disaster — earthquake or flood

In the event of a supply interruption, there are several measures that could be taken that would mitigate the overall negative impacts of a water shortage. The following discussion indicates possible events and actions to maintain water service to the service area.

The City has an agreement with the City of Clovis that discusses an intertie system between the two cities that could provide service during emergencies and other times of hardship in either community. The agreement covers interconnections, including apportionment of capital costs, at two locations: Leonard Avenue at the Gould Canal alignment and Behymer Avenue at Willow Avenue. The Leonard interconnection was constructed and remains in place for emergency uses through manual operation. The agreement also provided for temporary deliveries from Fresno to northern Clovis through the Behymer connection through 2015. However, the Behymer interconnection has yet to be constructed.

The City also cooperates with the County of Fresno's Office of Emergency Services, and the WSCP is included in the County's Disaster Plan. The goal during any emergency scenario is to maintain water supply such that the health and safety of the community is protected.

In the event of contamination of either the surface or ground water supplies, the non-impacted water supply could be used more heavily or the intertie with the City of Clovis could be activated. Additionally, overall demand reduction and the use of other wells or treated surface water would help meet demands.

If a regional power outage were to occur, the City could use backup power generators to operate wells. This measure, in conjunction with demand reduction, could supply sufficient water for health and safety purposes. The City has more than 35 wells with backup power sources. The

City has budgeted for the installation of a backup generator for the Northeast Wastewater Reclamation Facility. The Southeast SWTF and T-3 SWTF are also equipped with backup power generators.

If a natural disaster occurs, in addition to the actions discussed above, the City will isolate any areas of the system that were compromised for emergency repairs and, potentially, use of the intertie with the City of Clovis. Implementing the WSCP could also occur to reduce demands.

For more information on actions during an emergency, refer to the City of Fresno's Risk and Resilience Assessment Report finalized in September 2020 (AARC Consultants, LLC, 2020) and the City of Fresno Emergency Response Plan finalized in March 2020 (AARC Consultants, LLC, 2020).

### 1.5.6 Seismic Risk Assessment and Mitigation Plan

Refer to Fresno County Multi-Jurisdictional Hazard Mitigation Plan implemented in May 2018, Annex E: City of Fresno attached in **Attachment 4**, for appropriate Seismic Risk Assessment and Mitigation Plan procedures.

### 1.5.7 Shortage Response Action Effectiveness

The City of Fresno has assessed its overall water reduction by evaluating the water usage trends that were discussed in SBX7-7 in conjunction with the American Water Works Association water loss calculator. See Chapters 5 and 4 of the 2020 UWMP, respectively, for additional information.

The overall decrease of water use per capita and compliance with the 2020 per capita water use target indicate that the reduction measures have been effective in the community. All of the City's customers are metered and the City will use these devices to monitor actual reductions in water use during enacted shortage levels compared to normal year conditions. This data allows the City to determine the effectiveness of the implemented shortage response actions. If reduction goals are not being met, the City Manager, or designee, can make the necessary decisions for corrective action to be taken.

## 1.6 Communication Protocols

The City's Department of Public Utilities (DPU) currently has a contract with JP Marketing to manage communication and outreach to the customers. The firm's services include strategic planning, creative concepts, public relations, marketing, promotion, research, advertising, media design, copywriting, event creation, and online services. The City also has a public information officer and communications team whose purpose is to communicate water shortage procedures or general utility information effectively and efficiently to the customers.

During normal supply conditions, the Water Division implements informational campaigns to customers that emphasize user-level changes in water use and overall mindfulness of water waste while promoting voluntary conservation. Over the past few years, DPU has increased use of social media to communicate with customers quickly and organically. The City uses Facebook, Twitter, and Instagram to promote water saving tips, notify of shortage conditions, and spotlight DPU employees to foster a sense of community centered around the water supply. The City strives to be proactive in communicating work strategy and conservation efforts with customers.

This WSCP includes a staged plan to communicate the declaration of a shortage stage, inform restrictions, and provide updates during a water shortage emergency. A summary of actions the City could potentially take during a specific shortage stage is outlined in **Table 5**.

**Table 5. Communication Protocol During Water Shortage Conditions**

| SHORTAGE STAGE | ACTION |
|---|---|
| 1 | Information posted on the City's website |
| 1 | Social media posts (Facebook, Twitter, Instagram, and Nextdoor) |
| 2 | Information included in utility bill inserts on a regular basis |
| 2 | Promotion of rebates and water conservation services |
| 2 | Letters, postcards, and flyers mailed to customers impacted by water use regulations |
| 2 | Targeted outreach and technical assistance to highest water users in each use class |
| 2 | Engage City councilmembers with resources to share with constituents |
| 3 | Increased paid advertising — print, online, radio, TV, streaming, social media, etc. |
| 3 | Messaging printed directly on utility bills |
| 3 | Press releases to local media (online and print newspapers, TV, radio, etc.) |
| 3 | Assembly and promotion of the speaker's bureau for water shortage presentations for neighborhood groups, gardening clubs, homeowners' associations, churches, senior centers, neighborhood associations, business associations, community groups, property management companies, etc. |
| 4 | Increased coordination with the local landscaping industry, including water shortage information in their newsletters, publications, and facilities; local wholesale and retail nurseries; and irrigation supply stores |
| 4 | Signage posted at nurseries and irrigation supply stores |
| 4 | Outreach materials and drought notices mailed to the hospitality industry, including restaurants and lodging |

Note: If a water shortage progresses through multiple stages all measures in the previous stage(s) are implemented in addition to current stage actions.

## 1.7 Compliance and Enforcement

The City has penalties for violation of the water use restrictions in **Table 3**. The City tracks customer usage through advanced metering infrastructure (AMI) in order to enforce water wastage during shortage conditions as detailed in **Section 1.10**. The fines are noted in **Table 6**. Penalties for water waste are based on FMC, Section 6-520(e).

**Table 6. Penalties for Water Wastage**

| INCIDENT MONTH[(a)] | PENALTY AND FINE |
|---|---|
| 1 | $0 – Issued a Notice of Water Waste |
| 2 | $25 |
| 3 | $50 |
| 4-12 | $100 |
| 6 | If a customer has more than six incident months of water wastage within a one-year period, the City may implement any or all of the following measures:<br>• Require the customer to get a landscape evaluation, lawn water audit, and water budget, as appropriate, in order to learn efficient water use. This work shall be completed at the customer's expense by landscape irrigation auditors certified by the Irrigation Association.<br>• Installation by the City of flow restrictors or termination of water service.<br>• Require a customer to repair any defects in their watering system within 14 days of notice by the City. |

Note:
[a] Number of incident months are based on a calendar year.

# 1.8 Legal Authorities

CWC Section 375 provides the City with the statutory authority to adopt and enforce water conservation restrictions, and CWC Sections 350 et seq. authorize the City to declare a water shortage emergency and impose water conservation measures when it is determined that the City may not be able to satisfy ordinary demands without depleting supplies to an insufficient level.

If necessary, the City will declare a water shortage emergency in accordance with CWC Chapter 3 (commencing with Section 350) of Division 1. Once having declared a water shortage, the City is provided with broad powers to implement and enforce regulations and restrictions for managing a water shortage. For example, CWC section 375(a) provides the following:

> *"Notwithstanding any other provision of the law, any public entity which supplies water at retail or wholesale for the benefit of persons within the service area or area of jurisdiction of the public entity may, by ordinance or resolution adopted by a majority of the members of the governing body after holding a public hearing upon notice and making appropriate findings of necessity for the adoption of a water conservation program, adopt and enforce a water conservation program to reduce the quantity of water used by those persons for the purpose of conserving the water supplies of the public entity."*

Water Code Section 375(a). CWC Section 375(b) grants the City with the authority to set prices to encourage water conservation.

Under California law, including CWC Chapter 3.3 and Chapter 3.5 of Division 1, Parts 2.55 and 2.6 of Division 6, Division 13, and Article X, Section 2 of the California Constitution, the City is authorized to implement the water shortage actions outlined in this WSCP. Prior to enacting a shortage level, the resolution providing the Council with authority to enact each level of the WSCP will be adopted. Resolutions to enact the WSCP can be adopted at any meeting of the City Council. The resolution providing the City Manager, or designee, with authority to enact each stage of the WSCP is included in **Attachment 6**.

The City shall also coordinate with any city or county within which it provides water supply services, as listed below, for the possible proclamation of a local emergency under California Government Code, California Emergency Services Act (Article 2, Section 8558).

## 1.9 Financial Consequences of WSCP

This section is in accordance with CWC Section 10632(a)(8) and describes the financial consequences of implementing the WSCP and potential mitigation strategies. The City anticipates reduced revenue while implementing the WSCP because of decreased water use by its customers and additional costs associated with implementing water use restrictions and associated reduction actions. The incurred cost may vary depending on the shortage stage and duration of the water shortage emergency. The cost of compliance may be tracked when a shortage is declared. The City may track the staff time and resources used to implement the WSCP, including reduced revenue, implementation and enforcement of shortage response actions, and communication and outreach efforts. Impacts of implementing the WSCP include:

- Impact of quantity of water sales on revenue
- Increased staff, salaries, and overtime required for implementing and enforcing restrictions
- Increased costs of new supplies, transfers, or other exchanges

In 2015, the mandatory conservation goal for the City was 28%, however the corresponding revenue reductions were less than 28% due to the City having a two-component water rate structure that includes the fixed “water meter service charge” for all service connections and a volumetric-based “water quantity charge.” Therefore, the reduction in revenues was affected by a lesser percentage than the overall total reduction in water use. In general, revenue impacts specified in the WSCP would be offset with a combination of the following:

- An increase in water commodity and service charges
- A reduction in annual operating expenses due to decreased demands
- Reserves currently earmarked for long range capital
- General tax fund revenues currently earmarked for future capital improvements

Methods to mitigate revenue/expenditure impacts are discussed in detail below.

### 1.9.1 Drought Rate Structures and Surcharges

At present, the City does not have in place a drought rate structure. The City plans to hire a rate consultant to review existing water rates and, if appropriate, develop new future water rates. As an additional task to this effort, the consultant will review, develop, and recommend a drought rate structure for the City’s consideration. With such a rate structure in place, should a water shortage take place, the City will be able to institute an alternate water rate structure that may

apply and change depending on the stage of drought that the community is experiencing. At this time, there are no details as to how the rate structure will be developed, but conceptually each of the five stages specified in the WSCP would have a water rate increase associated with it.

The use of this type of structure during a drought will minimize expenditure impacts that are incurred during a drought. The effects of the decrease in revenue due to the drought, with a corresponding increase in expenditure, will allow for the City to function without going into debt.

### 1.9.2 Use of Financial Reserves

The City of Fresno Water System maintains two reserve funding sources that can be used to meet a portion of the utility's revenue requirements during emergency or drought conditions. They are as follows:

- **Water Operating Reserves** – This is cash set aside in the Water Enterprise Fund that provides a "rainy day savings account" for unexpected cash flow shortages and large, unexpected expenses or losses. Normally, these reserves are not intended to be used to make up income shortfalls. However, in an emergency situation, they can be transferred to the Water Rate Stabilization Fund (see below) for transfer back to the Water Enterprise Fund to meet revenue requirements, including debt coverage ratios.
- **Water Rate Stabilization Fund** – Indentures from previous bond issuances required the establishment of the Water Rate Stabilization Fund. These funds can be drawn on to meet a portion of the utility's revenue requirements through unexpected low-revenue periods and may be applied to debt coverage ratio calculations to help avoid technical default of bond covenants and loan agreements.

In addition, the City maintains funding in the Emergency Reserve Fund for the purpose of meeting unforeseen emergencies (see Section 1212 of the City's Charter for more information). This funding may be used by an affirmative vote of at least five members of the City Council upon presentation of a statement declaring the reason for use of the funding. This funding would be used only if the Water System reserves were insufficient to meet revenue requirements.

### 1.9.3 Other Measures

If the funding mentioned above is not sufficient to compensate for loss of revenue during a water shortage, the City may temporarily suspend components of its operations and maintenance activities.

## 1.10 Monitoring and Reporting

As described in **Section 1.3**, the City will track its supplies and project demands annually as part of the Annual Water Supply and Demand Assessment, and, if conditions described in **Table 2** are projected, the City will enact its WSCP. Monitoring demands is essential to ensure the WSCP response actions are adequately meeting reductions and decreasing the supply/demand gap. This will help to analyze the effectiveness of the WSCP or identify the need to activate additional response actions.

The City currently has AMI technology to monitor customer water usage and uses its AMI system to automatically enforce demand reduction measures and restrictions. The AMI system is currently set up to monitor and enforce outdoor watering restrictions. The program monitors customer meter flows against an "excessive use" flowrate, which will vary based on the WSCP stage. The system flags customer meters exceeding the excessive use flowrate during a

day/time outside of permitted outdoor watering hours as excessive use and an incident of water waste. If a customer has one or more incidents of water waste during a month, the customer shall be issued a Notice of Water Waste and, if applicable, be charged fines and penalties. The City may expand this monitoring program in the future to monitor other uses beyond outdoor watering restrictions.

The City can also use the detailed water usage data to monitor customers' response and demand reduction due to restrictions for each stage in the WSCP. The many restrictions and prohibitions assigned to each stage in **Table 3** are inherently flexible so the City can implement certain the restrictions, monitor customer usage, and implement additional restrictions if the demand reductions are not sufficient to close the supply and demand gap. The City also intends to provide reporting to the State based on forthcoming regulations for monthly reporting of water production and other water uses, along with associated enforcement metrics.

## 1.11 WSCP Refinement Procedures

The City intends to use this WSCP as an adaptive management plan to respond to foreseeable and unforeseeable water shortages. The WSCP is used to provide guidance to the City's governing body and staff and the public by identifying response actions to allow for efficient management of any water shortage with predictability and accountability. To maintain a useful and efficient standard of practice in water shortage conditions, the requirements, criteria, and response actions need to be continually evaluated and improved on to make sure the WSCP provides the tools to maintain reliable supplies and reduce the impacts of supply shortages.

This 2020 WSCP accounts for the latest analysis of the City's robust supply portfolio in relation to demand and adjusted percentage reduction stages to reflect a more appropriate supply shortage that should trigger stages. This is a process that should be reevaluated annually and updated as necessary. Potential changes to the WSCP that would warrant an update include any changes to shortage level triggers, changes to the shortage level structure, and changes to the response actions. Any prospective changes to the WSCP would need to be presented at a public hearing; staff would obtain any comments and adopt the updated WSCP. The steps to formally amend the WSCP are discussed in **Section 1.13**.

Potential refinements will be documented and integrated into the next WSCP update. If new response actions are identified by staff or the public, these could be advertised as voluntary actions until they are formally adopted as mandatory.

## 1.12 Special Water Feature Distinction

CWC Section 10623 (b) requires that suppliers analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas, as defined in subdivision (a) of Section 115921 of the Health and Safety Code. As listed in **Table 3 and Section 1.5.1**, there are separate requirements for decorative water features — including decorative fountains, lakes, or ponds — and for pools and spas. The City has separate response actions, enforcement actions, and monitoring programs for both decorative water features and pools and spas. Non-pool or non-spa water features may use or be able to use recycled water, whereas pools and spas must use potable water for health and safety considerations. Limitations to pools and spas may require different considerations compared to non-pool or non-spa water features.

## 1.13 Plan Adoption, Submittal and Availability

This WSCP update was prepared in tandem with the 2020 UWMP. The City held a public hearing and adopted the 2020 WSCP on July 15, 2021. A copy of the published Notice of Public Hearing is included in **Attachment 5** and a copy of the adopting resolution is included in **Attachment 6**. Before the public hearing, notices were published notifying the public of the date and time of the hearing.

Once the 2020 WSCP has been adopted, a copy will be submitted to DWR, the State Library, and the County of Fresno. Also, a hard copy will be made available for public reference at the City of Fresno Department of Public Utilities office at City Hall (located at 2600 Fresno Street) and the Water Division office (located at 1910 E. University Avenue). Additionally, an electronic copy will be uploaded to the City of Fresno website[1] and made available for public reference.

Based on DWR's review of the WSCP, the City will make any amendments in its adopted WSCP, as required and directed by DWR. If the City revises its WSCP after the UWMP is approved by DWR, then an electronic copy of the revised WSCP will be submitted to DWR within 30 days of its adoption.

[1] www.fresno.gov/Government/DepartmentDirectory/PublicUtilities/Watermanagement/importantdocuments.htm

# References

AARC Consultants, LLC. (2020). *City of Fresno Department of Public Utilites Risk and Resilience Assessment for the America's Water Infrastructure Act 2018.* Fresno, California.

AARC Consultants, LLC. (2020). *City of Fresno Water Divsion All Hazards Emergency Response Plan.*

# Attachment 1
# Preliminary Annual Assessment Template

# DWR ASSESSMENT TABLE TEMPLATE - EXAMPLE VALUES FOR 2021 SHOWN

**City of Fresno**
**DWR Annual Water Supply and Demand Assessm**
**Supply and Demand Estimates**

**Current Year: <YEAR>**
**Updated: <DATE>**

| | Current Year | Following Year | |
|---|---|---|---|
| **Demand Use Type** | **2021** | **2022** | **Notes** |
| Single Family | 60,666 | 61,272 | 1% annual increase from 2020 |
| Multi-Family | 19,030 | 19,221 | 1% annual increase from 2020 |
| Commercial | 17,141 | 17,312 | 1% annual increase from 2020 |
| Industrial | 5,786 | 5,844 | 1% annual increase from 2020 |
| Landscape | 9,583 | 8,680 | 1% annual increase from 2020; Reduced by increased recycled water use |
| Other | 343 | 347 | 1% annual increase from 2020 |
| Losses | 9,664 | 9,760 | 1% annual increase from 2020 |
| Recycled Water | 1,912 | 2,911 | Estimates per 2020 UWMP Table 7-4 |
| **M&I Demand Subtotal** | **124,125** | **125,347** | |
| Operational Buffer (10%) | 12,410 | 12,530 | To account for supply and demand uncertainties |
| **M&I Demand Total** | **136,535** | **137,877** | |
| Groundwater Recharge | - | - | No recharge assumed due to low surface water supply availability |
| **Total Demand** | **136,535** | **137,877** | |

| **Supply** | **2021** | **2022** | |
|---|---|---|---|
| Groundwater, Sustainable Yield | 73,062 | 73,644 | Sustainable groundwater yield per 2020 UWMP Table 6-1 |
| Groundwater, Allocated from Storage | - | - | Groundwater in storage built up over time from recharge and reduced pumping; Not used since supply is greater than demand |
| USBR Contract Allocation | 17,612 | 19,025 | Current Year: USBR Allocation = 20% plus 5,612 AF of carryover<br>Following Year: Average of "Critical" year per 2020 UWMP Table 6-2 |
| FID Contract Allocation | 51,580 | 61,000 | Current Year: FID Kings River Allocation = 26%<br>Following Year: Average of "Critical" year per 2020 UWMP Table 6-3 |
| Recycled Water, RWRF | 1,802 | 2,801 | Estimates per 2020 UWMP Table 6-6 |
| Recycled Water, NFWRF | 110 | 110 | Estimates per 2020 UWMP Table 6-6 |
| **Total Supplies** | **144,166** | **156,580** | |

| **Supply vs. Demand** | **2021** | **2022** |
|---|---|---|
| Supply minus Demand (AF) | **7,631** | **18,703** |
| Supply divided by Demand (%) | **106%** | **114%** |

# WATER SHORTAGE STAGE TEMPLATE - EXAMPLE VALUES FOR 2021 SHOWN

**City of Fresno**
**DWR Annual Water Supply and Demand Assessment**
**Water Shortage Stage Comparison**

**Current Year: <YEAR>**
**Updated: <DATE>**

## 2021 Water Supplies (AFY)

| Supplies | Maximum Available Supplies | Projected Available Supplies |
|---|---|---|
| GW, Sustainable Yield | 73,062 | 73,062 |
| GW, from Storage | *Not Used* | |
| Surface Water | 176,055 | 69,192 |
| Recycled Water | 1,912 | 1,912 |
| **Total** | **251,029** | **144,166** |

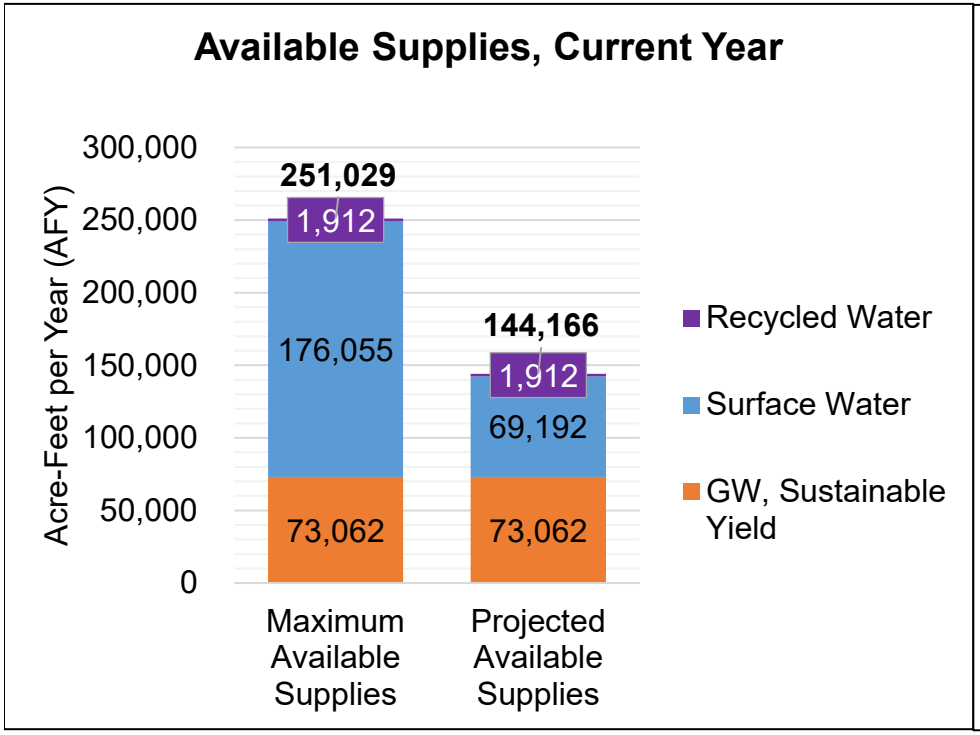
## 2021 Water Demands (AFY)

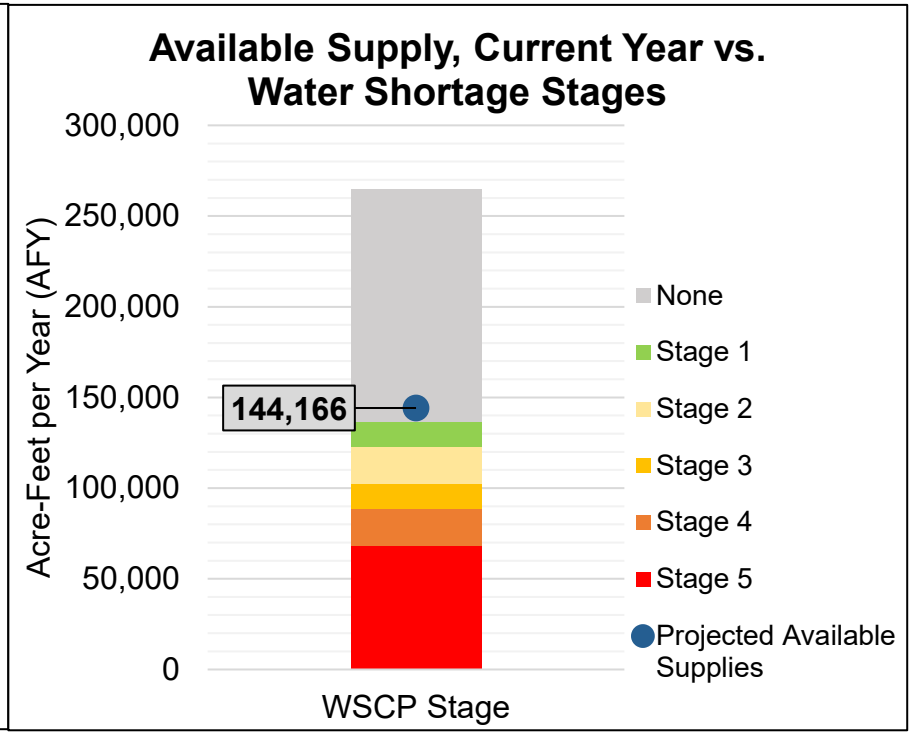
| Demand Type | Estimated Demands |
|---|---|
| M&I | 124,125 |
| Buffer | 12,410 |
| **Retail Subtotal** | **136,535** |
| Recharge | 0 |
| **Total** | **136,535** |

*Note: Refer to seperate Supply and Demand projections table for assumptions.*

## Water Shortage Stages

| WSCP Stage | Reduction Upper End | Reduction Lower End | (AFY) Upper End | (AFY) Lower End |
|---|---|---|---|---|
| None | | | | 136,500 |
| Stage 1 | 0% | 10% | 136,500 | 122,900 |
| Stage 2 | 10% | 25% | 122,900 | 102,400 |
| Stage 3 | 25% | 35% | 102,400 | 88,700 |
| Stage 4 | 35% | 50% | 88,700 | 68,300 |
| Stage 5 | | > 50% | 68,300 | |



# Attachment 2
# City of Fresno Municipal Code Chapter 6-520

SEC. 6-520. - WATER CONSERVATION.

(a) In the use of potable water supplied by the city, no customer shall do or permit any of the following:

(1) Use potable water to irrigate or water outdoor landscaping in a manner that causes runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots or structures,

(2) Keep, maintain, operate, or use any water connection, hose, faucet, hydrant, pipe, outlet, or plumbing fixture which is not tight and free from leakage,

(3) Willfully or negligently waste water,

(4) Flood any part of the premises of another,

(5) Sprinkle the premises of another so as to prevent the normal use thereof or unreasonably wet objects thereon which should not be subjected to a spray of water except as naturally caused by the elements or by action of the owner of the object,

(6) Sprinkle or irrigate any yard, ground, premise, or vegetation except as set forth in the City's Outdoor Water Use Schedule,

(i) Annual Exemptions. The following properties may submit an application for a one-year exemption to the Outdoor Water Use Schedule in effect at the time of the application:

a. Properties with multiple addresses, and

b. Properties with turfed or landscaped areas of two acres or larger, and

c. Properties without street addresses.

The owners of such properties shall submit a proposed modified Outdoor Water Use Schedule in writing to the Director or designee for approval or modification. The Director may approve a modified Outdoor Water Use Schedule for with more frequent watering or different watering days than allowed by the Outdoor Water Use Schedule in effect at the time the application for an exemption is submitted for consideration. If the Director determines the proposed exemption will adversely impact system water pressures in the service area, the proposed exemption will be denied. All Annual Exemptions approved by the Director shall automatically expire on December 31 of each year, and the property owners must re-apply for an exemption to the Outdoor Water Use Schedule.

(ii) Short-term Exemptions. The following properties may submit an application for an exemption from the Outdoor Water Use Schedule for a specific time period not to exceed one month.

a. Properties with new lawns not yet established.

b. Properties seeking to use water for a bona fide use, such as solar panel cleaning or other use necessary for health or preservation of property.

The owners of such properties shall submit a proposed modified Outdoor Water Use Schedule in writing to the Director or designee for approval or modification no less than 48 hours before the proposed non-compliant water usage. The Director may approve a modified Outdoor Water Use Schedule that may provide for more frequent outdoor water use or different outdoor water use days than allowed by the Outdoor Water Use Schedule in effect at the time the application for an exemption is submitted for consideration. If the Director determines the proposed exemption will adversely impact system water pressures in the service area, the proposed exemption will be denied. All Short-term Exemptions approved by the Director shall automatically expire on the date set forth on the Short-Term Exemption permit.

(7) Sprinkle or irrigate any yard, ground, premise, or vegetation unless the watering device used is controlled by an shut-off device, or a person is in immediate attendance of the hose or watering device,

(8) Wash any privately owned motor vehicle, trailer, or boat except from a bucket or in a commercial car wash, provided a hose equipped with a shut-off nozzle may be used for a quick rinse without causing water to flow onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots, or structures,

(9) Wash or rinse with a hose or watering device any sidewalk, driveway, parking area, tennis court, patio, or any other exterior paved area, except for public health and safety reasons at public gathering places, or

(10) Use potable water in a fountain or other decorative water feature, except where the water is part of a recirculating system.

(11) Irrigate ornamental turf on public street medians with potable water, except where:

(i) The turf serves a community or neighborhood function, including but not limited to, recreational uses and civic or community events;

(ii) The turf is irrigated incidentally by an irrigation system primarily intended to irrigate trees;

(iii) The turf is irrigated with recycled water.

This prohibition does not include trees and shrubs on public medians, which may be irrigated.

(12) Irrigate outdoor landscapes with potable water during and within 48 hours after measurable rainfall.

(13) Serve drinking water other than upon request in eating or drinking establishments, including but not limited to, restaurants, hotels, cafes, cafeterias, bars, or other public places where food or drink are served or purchased.

(14) Irrigate landscapes outside of newly constructed homes and buildings in a manner inconsistent with regulations or other requirements established by the California Building Standards Commission and the Department of Housing and Community Development.

(15) Automatically change towels and linens in hotels and motels daily. Operators of hotels and motels shall provide guests the option of choosing not to have towels and linens laundered daily. The hotel or motel shall prominently display notice of this option in each guestroom using clear and easily understood language.

(16) Drain swimming pools more than once every three years, except as necessary to complete structural repairs or to comply with public health standards, as determined by the County Health Officer. Residents with private swimming pools shall file a written application for a permit with the City of Fresno Water Division at least 48 hours prior to draining the pool. Any customer whose swimming pool is drained by order of the Department of Health for failure to maintain it properly will also be issued a notice of violation of the City of Fresno Municipal Code. The draining of pools for reasons of health and safety hazards as determined by the City of Fresno Water Division and/or the Department of Health is permitted. The application shall include the results of a pool water test conducted by an independent testing organization which shows a cyanuric acid level above 100 parts per million, total dissolved solids over 2,500 parts per million, or calcium over 450 parts per million, or stating the nature and duration of repairs to be made and the date on which the pool will be drained.

(17) Fill newly constructed or refurbished swimming pools without a pool fill permit from the City of Fresno Water Division.

(18) Refill (top off) established swimming pools except during times when outdoor water use is allowed at the property address pursuant to the Outdoor Water Use Schedule.

(b) Notwithstanding the foregoing, drip irrigation of community and residential fruit and vegetable gardens and fruit tr permitted any day of the week; for this subsection, "drip irrigation system" means a non-spray, low-pressure, and lc volume irrigation system in good working order utilizing emission devices with a flow rate of less than four gallons p hour, designed to slowly apply small volumes of water at or near the root zone of plants, when used primarily for ir of fruit and vegetable gardens and fruit trees; should any city water customer be cited for excessive water use, the customer may contact the Water Division and request an exemption from the Outdoor Water Use Schedule for a hc community garden that is irrigated with a drip irrigation system. Upon being contacted, the Water Division will sche visit to the subject property to inspect the garden and the drip irrigation system used to irrigate the garden. The Wa Division shall grant an exemption for home or community garden with the following conditions:

(1) The property must limit water use to an amount equal to, or less than, the average monthly water use for the single-family residential customer class. The monthly average water use for the single-family residential customer class is printed on monthly utility bills issued by the City.

(2) The drip irrigation system must be in good working order with no leaks, line breaks, or other deficiencies that will contribute to water waste. Exemptions shall be withheld until corrective action is taken to address system deficiencies.

(3) The drip irrigation system must be used primarily for the home or community garden, and not for other landscape on the property- Exemptions shall be withheld until the drip irrigation system for the home or community garden can be isolated from other landscape on the property.

(4) No flood irrigation will be allowed with the drip irrigation system, and water must remain on the subject property with no runoff to sidewalks, driveways, pavements, or adjacent properties.

(5) The home and community garden exemption is provided exclusively for drip irrigation systems only, and will not be allowed for other types of irrigation systems.

(6) This exemption shall only apply to properties ¼ acre or smaller. For properties greater than ¼ acre, the property owner may apply to the Director or designee for an exemption.

(c) Lawn sprinkling systems shall be properly designed, installed, maintained, and operated to prevent waste of water.

(d) Repealed.

(e) The provisions of this section are conditions of service.

(1) Each incident of Excessive Use as defined in section 6-501, or use of water inconsistent with the provisions of this section, is an incident of water waste.

(2) If a customer has one or more incidents of water waste during a month, as observed by City staff or as recorded by the City's water meter reading system, the customer shall be issued a Notice of Water Waste and, if applicable, charged a fine as set forth in the Master Fee Schedule. Such fines shall be added to the customer's monthly utility bill and shall be due and payable with that utility bill and subject to the FMC 6-106, Late Payment of Municipal Service Bills.

(3) Incident counts for water waste shall be monitored, recorded, documented and enforced on a monthly basis during the calendar year for individual customers, and the incident counts shall be reset January 1 of each year.

(4) If a customer performs or permits incidents of water waste more than six consecutive months, the water service to the customer may be terminated unless in the opinion of the Director such termination would result in an unreasonable risk to the health and safety of persons. If water service is terminated for

successive incident of water waste, the water service may only be restored upon execution of an agreement with the customer to adhere to the conditions of service described in this section.

(5) If a customer objects to a fine imposed for an incident of water waste pursuant to this section, the following appeal process may be used.

Step 1.

(a) Within thirty days of issuance of the utility bill including the fine, the customer may contact the Water Conservation Program to appeal an incident of water waste resulting in a fine with the staff person who initiated the enforcement measure. The staff person shall gather the facts about the incident.

(b) The customer may provide staff with evidence there was no incident of water waste, or of a bona fide reason for the incident of water waste, including evidence of a water leak, or another reasonable justification for the water use, within ten business days of the customer's first communication with the Water Conservation Program regarding the alleged incident of water waste.

(c) Within ten business days of the initiation of an appeal, staff shall provide the customer with documentation demonstrating the incident of water waste, if applicable.

(d) The staff will provide the facts and evidence related to the appeal to the Water Conservation Program Supervisor, who will determine whether to rescind the enforcement measure. The Water Conservation Program Supervisor will provide a written decision to the customer within fifteen business days of the customer's appeal, or receiving any applicable evidence from the customer, whichever comes later.

Step 2. If the customer is not satisfied with the decision of the Water Conservation Program Supervisor, they may appeal to the Director or designee within ten business days of the date of the Water Conservation Program Supervisor's decision. The Director or designee shall review the appeal and any evidence the customer previously submitted, and provide a written decision within thirty days of receiving the appeal.

Step 3. If the customer is not satisfied with the decision of the Director of Public Utilities, the customer may appeal to the City's Administrative Hearing Officer in the manner provided in Chapter 1, Article 4 of this code. Such decision shall be final.

(Orig. Ord. 4481; Am. Ord. 6486, 1964; Am. Ord. 73-120, § 6, eff. 8-16-73; Am. Ord. 77-99, § 1, eff. 9-23-77; Am. Ord. 78-74, §§ 1, 2, eff. 5-26-78; Am. Ord. 80-115, § 149, eff. 8-8-80; Am. Ord. 89-48, §§ 1, 2, eff. 4-18-89; Am. Ord. 89-77, § 1, eff. 6-7-89; Am. Ord. 89-102, § 1, eff. 9-22-89; Am. Ord. 90-72, § 1, eff. 8-24-90; Am. Ord. 90-97, § 1, eff. 10-12-90; Am. Ord. 91-104, § 1, eff. 10-18-91; Am. Ord. 91-112, § 1, eff. 11-22-91; Am. Ord. 93-14, § 1, eff. 2-23-93; Am. Ord. 93-20, § 2, eff. 4-30-93; Am. Ord. 2015-13, § 1, eff. 5-21-15; Am. Ord. 2015-29, § 1, eff. 8-27-15; Am. Ord. 2017-56, § 3, eff. 11-19-17; Am. Ord. 2018-45, § 1, eff. 8-10-18; Am. Ord. 2019-011, § 3, eff. 5-31-19).

**Editor's note—** The provisions in subsection 6-520(e) regarding the enforcement program for incidents of water waste are effective January 1, 2018.

# Attachment 3
# Water Shortage Resolution

RESOLUTION NO. 2019-073

A RESOLUTION OF THE COUNCIL OF THE CITY OF FRESNO, CALIFORNIA, TO AMEND THE WATER SHORTAGE CONTINGENCY PLAN

WHEREAS, the Urban Water Management Planning Act requires the City of Fresno (City) to describe its water conservation measures within its Water Shortage Contingency Plan (WSCP);

WHEREAS, the City adopted its current WSCP on June 23, 2016, as part of the City's 2015 Urban Water Management Plan (UWMP);

WHEREAS, the City Council adopted amendments to the WSCP on October 12, 2017;

WHEREAS, in response to water conservation mandates from the State of California and to provide flexibility to its customers, the City has prepared further amendments to the WSCP to update water conservation requirements and watering restrictions in different water conservation stages in the City of Fresno.

NOW THEREFORE, BE IT RESOLVED by the Council of the City of Fresno as follows:

1. The City hereby adopts the amended Water Shortage Contingency Plan, as attached in Tables 1-3 of Exhibit A herein.

2. Resolution 2018-253 shall be repealed on the effective date of this Resolution.

* * * * * * * * * * * * * * *



Date Adopted: 4/11/2019
Date Approved: 4/16/2019
Effective Date: 4/16/2019

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, YVONNE SPENCE, MMC CRM, City Clerk of the City of Fresno, certify that the foregoing resolution was adopted by the Council of the City of Fresno, at a regular meeting held on the 11th day of April, 2019.

AYES : Arias, Bredefeld, Chavez, Esparza, Soria, Caprioglio
NOES : None
ABSENT : None
ABSTAIN : None

Mayor Approval: April 16th, 2019
Mayor Approval/No Return: N/A, 2019
Mayor Veto: N/A, 2019
Council Override Vote: N/A, 2019

YVONNE SPENCE, MMC CRM
City Clerk

By: Yvonne Spence
Deputy

APPROVED AS TO FORM:
DOUGLAS T. SLOAN
City Attorney

By: Amanda Freeman 04/18/19
Amanda B Freeman Date
Senior Deputy City Attorney

Attachment:
Exhibit A – Revised Water Shortage Contingency Plan, Tables 1-3

# EXHIBIT A

## Revised Water Shortage Contingency Plan

## Table 1: Stages of Water Shortage Contingency Plan (WSCP)

| Stage | Percent Supply Reduction | Water Supply Condition |
|---|---|---|
| 1 | 10% | Stage 1 of the Water Shortage Contingency Plan may be triggered by any of the following conditions:<br>• In the second of two consecutive years, the volume of surface water available to the City through USBR and FID is projected to be less than the long-term average and the reduction in supply, averaged over the consecutive years, is equal to 10% or greater, or<br>• Groundwater contamination conditions exists (DDW required the City to shut down wells) or a large-scale infrastructure failure occurs that results in a 10% loss in water production capacity, or<br>• Localized groundwater cones of depression develop exceeding historic low water levels and, to avoid possible litigation with responsible parties of point source contaminant plumes, the City must shut down existing wells that result in a 10% loss in groundwater production capacity, or<br>• A combination of the above mentioned circumstances or a disaster reduced the City's overall water supply or production capabilities by 10% or more.<br>• After having been in a Stage 2 classification, the following water year results in a declaration by the jurisdictional authority in determining entitlements for the respective surface water supply of normal or above normal water deliveries; or the original trigger for a previous higher stage classification has been rectified to a point that is consistent with the above conditions for this stage. |
| 2 | 10 - 25% | Stage 2 of the Water Shortage Contingency Plan may be triggered by any of the following conditions:<br>• In the third of three consecutive years, the projected volume of surface water available to the City through USBR or FID is less than the long term average and the reduction in supply, averaged over the three consecutive years equals 10% or greater, or<br>• The volume of surface water available to the City through FID is reduced by 25% of the long-term average, or<br>• The volume of surface water available to the City through USBR is reduced by 25% of the long-term average, or<br>• One-year change in average groundwater level in 30 key City wells exceeds 3 feet or two-year change in average groundwater level in 30 key City wells exceeds 6 feet and exceeds historic low groundwater levels, or<br>• Groundwater contamination condition exists (DDW requires the City to shut down wells) or a large-scale infrastructure failure occurs that results in a 25% loss in water production capacity, or<br>• A combination of the above mentioned circumstances or disaster reduces the City's overall water supply or production capabilities |

| Stage | Percent Supply Reduction | Water Supply Condition |
|---|---|---|
| | | by 25% or more.<br>• After having been in a Stage 3 classification, the following water year results in a declaration by the jurisdictional authority in determining entitlements for the respective surface water supply of normal or above normal water deliveries on the Friant-Kern system; or the original trigger for a previous higher stage classification has been rectified to a point consistent with the above conditions for this stage. |
| 3 | 25 to 35% | Stage 3 of the Water Shortage Contingency Plan may be triggered by any of the following conditions:<br>• In the fourth of four consecutive years, the projected volume of surface water available to the City through USBR or FID is less than the long term average and the reduction in supply, averaged over the four consecutive years equals 10% or greater, or<br>• The volume of surface water available to the City through FID is reduced by 35% of the long-term average, or<br>• The volume of surface water available to the City through USBR is reduced by 35% of the long-term average, or<br>• One-year change in average groundwater level in 30 key City wells exceeds 5 feet or two-year change in average groundwater level in 30 key City wells exceeds 10 feet and exceeds historic low groundwater levels, or<br>• Groundwater contamination condition exists (DDW requires the City to shut down wells) or a large-scale infrastructure failure occurs that results in a 35% loss in water production capacity, or<br>• A combination of the above mentioned circumstances or disaster reduces the City's overall water supply or production capabilities by 35% or more.<br>• After having been in a Stage 4 classification, the following water year results in a declaration by the jurisdictional authority in determining entitlements for the respective surface water supply of normal or above normal water deliveries on the Friant-Kern system; or the original trigger for a previous higher stage classification has been rectified to a point that is consistent with the above conditions for this stage. |

| Stage | Percent Supply Reduction | Water Supply Condition |
|---|---|---|
| 4 | 35 - 50% | Stage 4 of the Water Shortage Contingency Plan may be triggered by any of the following conditions:<br>• In the fifth of five consecutive years, the projected volume of surface water available to the City through USBR or FID is less than the long term average and the reduction in supply, averaged over the five consecutive years equals 10% or greater, or<br>• The volume of surface water available to the City through FID is reduced by 50% of the long-term average, or<br>• The volume of surface water available to the City through USBR is reduced by 50% of the long-term average, or<br>• One-year change in average groundwater level in 30 key wells exceeds 7.5 feet or two-year change in average groundwater level in 30 key City wells exceeds 12 feet and exceeds historic low groundwater levels, or<br>• Groundwater contamination condition exists (DDW requires the City to shut down wells) or a large-scale infrastructure failure occurs that results in a 50% loss in water production capacity, or<br>• A combination of the above mentioned circumstances or disaster reduces the City's overall water supply or production capabilities by 50% or more. |

## Table 2: Restrictions and Prohibitions on End Uses

| (#) | Stage | Restrictions and Prohibitions | Additional Explanation or Reference | Penalty, Charge or Other Enforcement |
|---|---|---|---|---|
| a | 1-4 | Landscape – Limit landscape irrigation to specific times (Outdoor Water Use Schedule) | See Outdoor Water Use Schedule, Table 2a. | Yes<br>See Table 3 |
| b | 1-3 | Other | Prohibit car washing except with a bucket only (a hose equipped with a shut off nozzle may be used for a quick rinse) | Yes<br>See Table 3 |
| c | 1-4 | Other – Prohibit use of potable water for washing hard surfaces | Prohibit use of potable water to wash sidewalks, walkways, driveways, parking lots, open ground or other hard surfaced areas except where necessary for public health or safety | Yes<br>See Table 3 |
| d | 1-4 | Landscape – Prohibit certain types of landscape irrigation | Prohibit irrigating outdoor landscapes with potable water during and within 48 hours after measurable rainfall | Yes<br>See Table 3 |
| e | 1-4 | Landscape – Prohibit certain types of landscape irrigation | Sprinkle or irrigate any yard, ground, premise, or vegetation unless the watering device used is controlled by an automatic shut-off device, or a person is in immediate attendance of the hose or watering device | Yes<br>See Table 3 |
| f | 1-4 | Landscape – Prohibit certain types of landscape irrigation | Prohibit using potable water to irrigate or water outdoor landscaping in a manner that causes runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots or structures | Yes<br>See Table 3 |
| g | 1-4 | Landscape – Prohibit certain types of landscape irrigation | Prohibit irrigation of ornamental turf on public street medians with potable water, except where the turf serves a community or neighborhood function, it's irrigated incidentally by an irrigation systems designed to irrigate trees, or the turf is irrigated with recycled water | Yes<br>See Table 3 |

| | | | | |
|---|---|---|---|---|
| h | 4 | Other | Prohibit car washing | Yes<br>See Table 3 |
| i | 1-4 | Other – Restaurants may only serve water upon request | No restaurant, hotel, café, cafeteria, or other public place where food is sold is served or offered for sale, shall serve drinking water to any customer unless expressly requested | Yes<br>See Table 3 |
| j | 1-4 | Landscape – Prohibit certain types of landscape irrigation | Irrigate landscapes outside of newly constructed homes and buildings in a manner inconsistent with regulations or other requirements established by the California Building Standards Commission and the Department of Housing and Community Development | Yes<br>See Table 3 |
| k | 1-4 | Water Features – Restrict water use for decorative water features, such as fountains | Prohibit use of potable water to clean, fill or maintain decorative fountains, lakes, or ponds unless such water is reclaimed | Yes<br>See Table 3 |
| l | 4 | Other – Prohibit use of potable water for construction and dust control | Prohibit use of potable water for construction, compaction, dust control, street or parking lot sweeping, building wash down where non-potable or recycled water is sufficient | Yes<br>See Table 3 |
| m | 1-4 | Other – Prohibit automatic linen service in hotels and motels | Prohibit automatically changing towels and linens in hotels and motels daily. Operators of hotels and motels shall provide guests the option of choosing not to have towels and linens laundered daily | Yes<br>See Table 3 |
| n | 4 | Other | Prohibit use of potable water for sewer system maintenance or fire protection training without prior approval by the City Manager | No |
| o | 4 | Other – Customers must repair leaks, breaks, and malfunctions in a timely manner | Prohibit allowing potable water to escape from breaks within the customer's plumbing system for more than twenty-four (24) hours after the customer is notified or discovers the break | Yes<br>See Table 3 |

| | | | | |
|---|---|---|---|---|
| p | 4 | Other – Prohibit vehicle washing except at facilities using recycled or recirculating water | Prohibit washings cars, boats, trailers, aircraft, or other vehicles except to wash such vehicles at commercial or fleet vehicle washing facilities using water recycling equipment | Yes<br>See Table 3 |
| q | 1-4 | Swimming Pools – Prohibit draining swimming pools more than once every three years | Prohibit draining swimming pools more than once every three years, except as necessary to complete structural repairs or to comply with public health standards, as determined by the County Health Officer | Yes<br>See Table 3 |
| r | 1-4 | Swimming Pools – Limit filling new or refurbished pools by requiring a pool fill permit | Prohibit filling new or refurbished swimming pools without obtaining a pool fill permit from the City | Yes<br>See Table 3 |
| s | 1-4 | Swimming Pools – limit filling (topping off) established pools to times and days permitted by the Outdoor Water Use Schedule | Prohibit filling (topping off) swimming pools during times when outdoor irrigation is allowed according to the Outdoor Water Use Schedule | Yes<br>See Table 3 |
| t | 4 | Pools and Spas – Require covers for pools and spas | Require covers for swimming pools when not in use | No |
| u | 4 | Other | Prohibit Use of Outdoor Misters | No |

**Table 2a: Outdoor Water Use Schedule**

| Stage | Summer (April 1 – October 31) | Summer Outdoor Water Use days | Winter (November 1 – March 31) | Winter Outdoor Water Use days | Outdoor Water Use Times |
|---|---|---|---|---|---|
| 1 | 3 days/week recommended | Even addresses: Wednesday, Friday, Sunday<br><br>Odd addresses: Tuesday, Thursday, Saturday | 1 day/week recommended | Even addresses: Sunday<br><br>Odd addresses: Saturday | Outdoor Water Use allowed 12:00 AM – 9:59 AM & 6:00 PM – 11:59 PM<br><br>Outdoor Water Use is prohibited all days 10:00 AM – 6:00 PM |
| 2 | 3 days/week | Even addresses: Wednesday, Friday, Sunday<br><br>Odd addresses: Tuesday, Thursday, Saturday | 1 day/week | Even addresses: Sunday<br><br>Odd addresses: Saturday | |
| 3 | 2 days/week | Even: Wednesday and Sunday<br><br>Odd: Tuesday and Saturday | 1 day/week | Even addresses: Sunday<br><br>Odd addresses: Saturday | |
| 4 | 1 day/week | Even addresses: Sunday<br><br>Odd addresses: Saturday | No outdoor water use | | |

**Table 3: Penalties for Incidents of Water Waste**

| Incident Month | Incident Fine | Enforcement Schedule |
|---|---|---|
| 1 | $0 | The first month an incident of water waste is recorded during the calendar year, the City shall issue a Notice of Water Waste to the customer for the incident observed by City staff or as recorded directly by the City's water meter reading system. |
| 2 | $25 | The second month an incident of water waste is recorded is recorded for a customer during the calendar year, the City shall assess a fine of $25 to the customer, and the fine shall be applied to the customer's monthly utility bill. |
| 3 | $50 | The third month an incident of water waste is recorded for a customer during the calendar year, the City shall assess a fine of $50 to the customer, and the fine shall be applied to the customer's monthly utility bill. |
| 4 | $100 | The fourth month an incident of water waste is recorded for a customer during the calendar year, the City shall assess a fine of $100 to the customer, and the fine shall be applied to the customer's monthly utility bill. |
| 5 -12 | $100 | For the fifth month an incident of water waste is recorded during the calendar year, and every month thereafter for the remainder of the calendar year during which an incident of water waste is recorded, the City shall assess a fine of $100 to the customer, and the fine shall be applied to the customer's monthly utility bill. |
| After 6 | N/A | If a customer has more than six consecutive months of documented water waste incidents, the water service to the customer may be restricted or terminated unless in the opinion of the Director such restriction or termination would result in an unreasonable risk to the health and safety of persons. If water service is terminated for excessive violations of the water waste provisions as defined herein, the water service may only be restored upon execution of an agreement with the customer to adhere to the conditions of service described in this section. |

*April 12, 2019*

Council Adoption: 4/11/19
Mayor Approval:
Mayor Veto:
Override Request:

TO: MAYOR LEE BRAND

FROM: YVONNE SPENCE, MMC
City Clerk

SUBJECT: TRANSMITTAL OF COUNCIL ACTION FOR APPROVAL OR VETO

At the City Council meeting of 4/11/19, Council adopted the attached Resolution No. 2019-073, entitled **Amending the City of Fresno Water Shortage Contingency Plan.** Item No. 3-B (3), File ID19-1472, by the following vote:

| | | |
|---|---|---|
| Ayes | : | Arias, Bredefeld, Caprioglio, Chavez, Esparza, Soria |
| Noes | : | None |
| Absent | : | None |
| Abstain | : | None |

Please indicate either your formal approval or veto by completing the following sections and executing and dating your action. Please file the completed memo with the Clerk's office on or before April 22, 2019. In computing the ten day period required by Charter, the first day has been excluded and the tenth day has been included unless the 10th day is a Saturday, Sunday, or holiday, in which case it has also been excluded. Failure to file this memo with the Clerk's office within the required time limit shall constitute approval of the ordinance, resolution or action, and it shall take effect without the Mayor's signed approval

**********

Thank you.

**APPROVED/NO RETURN:** _____

**VETOED** for the following reasons: (Written objections are required by Charter; attach additional sheets if necessary.)

_____

_____

_____
Lee Brand, Mayor

Date: 4-16-19

**COUNCIL OVERRIDE ACTION:**

Date: _____

Ayes :
Noes :
Absent :
Abstain :

CITY OF FRESNO
CITY CLERK'S OFFICE
2019 APR 17 P 1:57

RECEIVED

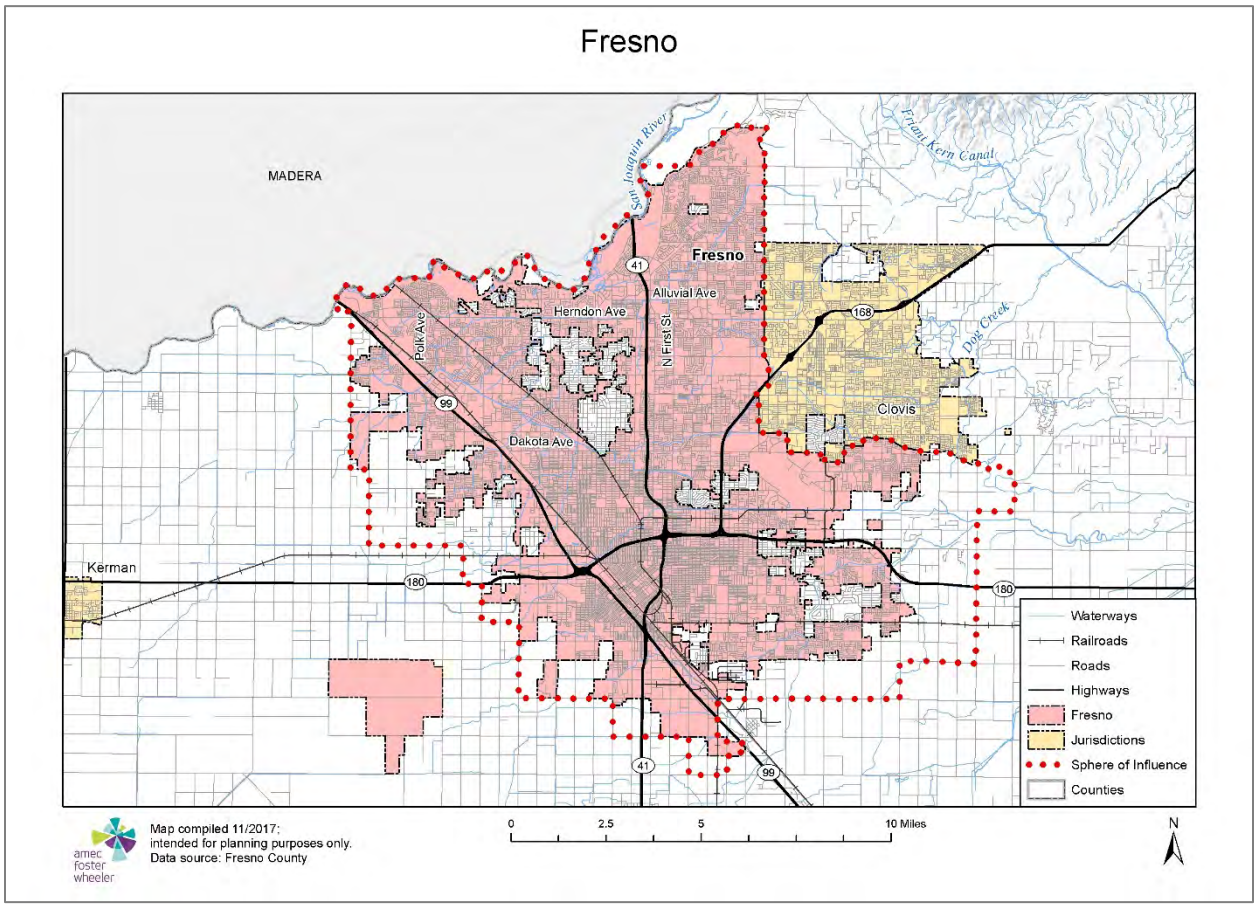
# Attachment 4
# Fresno County Multi-Jurisdictional Hazard Mitigation Plan, Annex E: City of Fresno

Reference the complete Fresno County Multi-Jurisdictional Hazard Mitigation Plan online:
https://www.fresno.gov/darm/wp-content/uploads/sites/10/2020/12/FresnoCountyHMPFinal.pdf

## E.1 Community Profile

Figure E.1 displays a map and the location within Fresno County of the City of Fresno and its Sphere of Influence.

**Figure E.1: The City of Fresno**




## E.1.1 Geography and Climate

The City of Fresno and its Sphere of Influence encompass a 100,400-acre area in central Fresno County. Over the past decade, the City has expanded into the northern, northwestern, and eastern reaches of its Sphere of Influence. Except for the deep channel of the San Joaquin River at the northern boundary of the City, Fresno's topography is generally level and slopes gently to the southwest. The upper San Joaquin River lies at the City's northerly boundary and has carved a deep channel, confining the river between steep bluffs that range from 20 to approximately 100 feet in height.

Fresno has a Mediterranean climate, averaging over 262 sunny days per year and little or no measurable precipitation from June through September. Annual rainfall typically totals 12-14 inches in episodic events lasting up to a few days at most. Fresno's prevailing winds are typically light and from the northwest.

Storms with strong weather disturbances (lightning and very agitated winds) may occur from autumn months through the spring, with the strength of the storm dependent upon temperature gradients between moving weather fronts.

Winter mornings in December and January approach freezing but only rarely reach as low as, or below, 32ºF; winter daytime high temperatures almost always approach or exceed 40ºF. Snowfall is an extremely rare and transient phenomenon; the last recorded snowfall in Fresno was ½ inch on December 20, 1998. The Tule fog, a thick ground fog that settles in the San Joaquin Valley from late fall through early spring, is the leading cause of weather-related accidents in California. In addition to causing visibility issues, "black ice" from precipitated fog may temporarily affect some roadways and bridges during the winter.

Summer daytime peak temperatures are high in Fresno. Some heat waves last over a week with daytime highs well over 100ºF and issuance of health advisories. Summer evenings provide for some cooling of 10-15ºF with the early morning daybreak hours cooling by 20-30ºF, depending on humidity (low humidity allows for more radiant cooling).

Geography and climate combine to create a general accumulation of air pollutants in the San Joaquin Valley (and in the City of Fresno) that occasionally result in unhealthy air quality conditions. Air quality problems are exacerbated by dust storms, human activities (e.g., vehicle emissions and fireplace and wood stove use), atmospheric photochemical processes, and forest fires from local and regional fires. The City has chronically failed to attain some of the national and state ambient air quality standards, but due to the efforts of the California Air Resources Board and the regional San Joaquin Valley Unified Air Pollution Control District, progress toward attainment of ozone (oxidant) and particulate matter standards is being made. Carbon monoxide standards were deemed to have been attained in the 1990s.

## E.1.2 History

Development of what today is the City of Fresno began in 1871, when the Central Pacific Railroad chose the Fresno Station for its San Joaquin Valley rail line. The City soon became the County seat and the shipping and distribution hub for the region's agricultural industry. An economic boom across California in the 1880s helped transform Fresno from a village to a city, and helped drive its incorporation in 1885. Today, the City of Fresno is the center of trade, commerce, finance, and transportation for the San Joaquin Valley.

## E.1.3 Economy

The most comprehensive economic data available for the City of Fresno comes from the U.S. Census Bureau by way of the American Community Survey (ACS). Select estimates of economic characteristics for the City of Fresno are shown in Table E.1.

**Table E.1: City of Fresno's Economic Characteristics, 2015**

| Characteristic | City of Fresno |
|---|---|
| Families below Poverty Level | 24.4% |
| All People below Poverty Level | 29.8% |
| Median Family Income | $45,806 |
| Median Household Income | $41,531 |
| Per Capita Income | $19,465 |
| Population in Labor Force | 231,332 |
| Population Employed* | 198,113 |
| Unemployment | 14.3% |

Source: U.S. Census Bureau American Community Survey 2011-2015 5-Year Estimates, www.census.gov/
*Excludes armed forces

Tables E.2 and E.3 show how the City of Fresno's labor force breaks down by occupation and industry based on 5-year estimates from the 2015 American Community Survey.

**Table E.2: City of Fresno's Employment by Occupation, 2015**

| Occupation | # Employed | % Employed |
|---|---|---|
| Management, Business, Science and Arts Occupations | 57,374 | 29.0 |
| *Management, Business, and Financial Occupations* | *(20,767)* | *(10.5)* |
| *Computer, Engineering, and Science Occupations* | *(6,018)* | *(3.0)* |
| *Education, Legal, Community Service, Arts, and Media Occupations* | *(20,262)* | *(10.2)* |
| *Healthcare Practitioner and Technical Occupations* | *(10,327)* | *(5.2)* |
| Sales and Office Occupations | 49,752 | 25.1 |
| Service Occupations | 41,528 | 21.0 |
| Production, Transportation, and Material Moving Occupations | 26,738 | 13.5 |
| Natural Resources, Construction, and Maintenance Occupations | 22,721 | 11.5 |
| **Total** | **198,113** | **100.00** |

Source: U.S. Census Bureau American Community Survey 2011-2015 5-Year Estimates, www.census.gov/

**Table E.3: City of Fresno's Employment by Industry, 2015**

| Industry | # Employed | % Employed |
|---|---|---|
| Educational Services, and Health Care, and Social Assistance | 48,557 | 24.5 |
| Retail Trade | 23,337 | 11.8 |
| Arts, Entertainment, and Recreation, and Accommodation, and Food Services | 20,643 | 10.4 |
| Professional, Scientific, and Management, and Administrative and Waste Management Services | 16,742 | 8.5 |
| Manufacturing | 14,869 | 7.5 |

| Industry | # Employed | % Employed |
|---|---|---|
| Public Administration | 12,030 | 6.1 |
| Finance and Insurance, and Real Estate and Rental and Leasing | 10,875 | 5.5 |
| Other Services, Except Public Administration | 10,710 | 5.4 |
| Construction | 10,586 | 5.3 |
| Agriculture, Forestry, Fishing and Hunting, and Mining | 10,446 | 5.3 |
| Transportation and Warehousing, and Utilities | 9,476 | 4.8 |
| Wholesale Trade | 7,158 | 3.6 |
| Information | 2,684 | 1.4 |
| **Total** | **198,113** | **100.00** |

Source: U.S. Census Bureau American Community Survey 2011-2015 5-Year Estimates, www.census.gov/

With the depressed real estate and construction market and economic recession toward the end of the 2000-2010 decade, unemployment rates increased to a peak of 18.0 percent in 2010. Since then, the unemployment rate has steadily decreased. The most recent annual data from the State of California Employment Development Department indicates that in 2016 there were 238,400 people in the City of Fresno labor force. Of these, 214,000 were employed; 24,400 were not. The unemployment rate was 10.2 percent.

## E.1.4 Population

According to the California Department of Finance, Fresno's population was estimated to be 520,778 in 2016. Select demographic and social characteristics for the City from the U.S. Census Bureau's 2015 American Community Survey 5-year estimates are shown in Table E.4.

**Table E.4: City of Fresno's Demographic and Social Characteristics, 2015***

| Characteristic | City of Fresno |
|---|---|
| **Gender/Age** | |
| Male | 49.2% |
| Female | 50.8% |
| Median age | 30.0 |
| Under 5 years | 8.9% |
| Under 18 years | 29.5% |
| 65 years and over | 9.9% |
| **Race/Ethnicity**** | |
| White | 52.2% |
| Asian | 13.0% |
| Black or African American | 7.9% |
| American Indian/Alaska Native | 1.1% |
| Hispanic or Latino (of any race) | 48.5% |
| **Education** | |
| High school graduate or higher | 75.2% |
| **Disability Status** | |
| Population 5 years and over | 11.75% |

Source: U.S. Census Bureau American Community Survey 2011-2015 5-Year Estimates, www.census.gov/
*Based on a 2015 estimated population of 510,451
**Of the 95.4% reporting one race

For information about how some of these demographics affect social vulnerability and how they compare to other Fresno County jurisdictions, California, and the United States, see "Social Vulnerability" in Section 4.3.1 Fresno County Vulnerability and Assets at Risk of the main plan. A more in-depth look at the population of the City of Fresno, including the City's special needs populations, is available in the City of Fresno General Plan 2015-2023 Housing Element commissioned by the City of Fresno Development and Resource Management Department and prepared by MIG, Inc (available at www.fresno.gov/housingelement).

## E.2 Hazard Identification and Summary

The City of Fresno's planning team identified the hazards that affect the City and summarized their frequency of occurrence, spatial extent, potential magnitude, and significance specific to Fresno (see Table E.5). In the context of the plan's planning area, there are no hazards unique to Fresno.

**Table E.5: City of Fresno—Hazard Summaries**

| Hazard | Geographic Extent | Probability of Future Occurrences | Magnitude/ Severity | Significance |
|---|---|---|---|---|
| Agricultural Hazards | Limited | Highly Likely | Critical | Low |
| Avalanche | N/A | N/A | N/A | N/A |
| Dam Failure | Significant | Unlikely | Limited | Medium |
| Drought | Significant | Likely | Critical | High |
| Earthquake | Extensive | Occasional | Critical | Medium |
| Flood/Levee Failure | Significant | Occasional | Critical | High |
| Hazardous Materials Incident | Significant | Likely | Critical | High |
| Human Health Hazards: | | | | |
| Epidemic/Pandemic | Extensive | Occasional | Critical | Medium |
| West Nile Virus | Limited | Highly Likely | Negligible | Low |
| Landslide | Limited | Unlikely | Negligible | Low |
| Severe Weather | | | | |
| Extreme Cold/Freeze | Significant | Occasional | Negligible | Low |
| Extreme Heat | Extensive | Highly Likely | Limited | Medium |
| Fog | Extensive | Likely | Limited | Medium |
| Heavy Rain/Thunderstorm/ Hail/Lightning | Extensive | Highly Likely | Limited | Low |
| Tornado | Extensive | Occasional | Negligible | Low |
| Windstorm | Extensive | Likely | Limited | Medium |
| Winter Storm | Extensive | Highly Likely | Negligible | Low |
| Soil Hazards: | | | | |
| Erosion | No Data | Likely | No Data | Low |
| Expansive Soils | No Data | Occasional | No Data | Low |
| Land Subsidence | Limited | Occasional | No Data | Low |
| Volcano | Extensive | Unlikely | Negligible | Low |
| Wildfire | Extensive | Highly Likely | Critical | Medium |

**Geographic Extent**
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

**Magnitude/Severity**
Catastrophic—More than 50 percent of property severely damaged; shutdown of facilities for more than 30 days; and/or multiple deaths

| | |
|---|---|
| **Probability of Future Occurrences**<br>Highly Likely: Near 100% chance of occurrence in next year, or happens every year.<br>Likely: Between 10 and 100% chance of occurrence in next year, or has a recurrence interval of 10 years or less.<br>Occasional: Between 1 and 10% chance of occurrence in the next year, or has a recurrence interval of 11 to 100 years.<br>Unlikely: Less than 1% chance of occurrence in next 100 years, or has a recurrence interval of greater than every 100 years. | Critical—25-50 percent of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries and/or illnesses result in permanent disability<br>Limited—10-25 percent of property severely damaged; shutdown of facilities for more than a week; and/or injuries/illnesses treatable do not result in permanent disability<br>Negligible—Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid<br><br>**Significance**<br>Low: minimal potential impact<br>Medium: moderate potential impact<br>High: widespread potential impact |

# E.3 Vulnerability Assessment

The intent of this section is to assess the City of Fresno's vulnerability separate from that of the planning area as a whole, which has already been assessed in Section 4.3 Vulnerability Assessment in the main plan. This vulnerability assessment analyzes the population, property, and other assets at risk to hazards ranked of medium or high significance that may vary from other parts of the planning area.

The information to support the hazard identification and risk assessment for this Annex was collected through a Data Collection Guide, which was distributed to each participating municipality or special district to complete during the original outreach process in 2009. Information collected was analyzed and summarized in order to identify and rank all the hazards that could impact anywhere within the County, as well as to rank the hazards and identify related vulnerabilities unique to each jurisdiction. In addition, the City of Fresno's HMPC team members were asked to validate the matrix that was originally scored in 2009 based on the experience and perspective of each planning team member relative to the City of Fresno.

Each participating jurisdiction was in support of the main hazard summary identified in the base plan (See Table 4.1). However, the hazard summary rankings for each jurisdictional annex may vary slightly due to specific hazard risk and vulnerabilities unique to that jurisdiction (See Table E.5). Identifying these differences helps the reader to differentiate the jurisdiction's risk and vulnerabilities from that of the overall County.

Note: The hazard "Significance" reflects overall ranking for each hazard, and is based on the City of Fresno's HMPC member input from the Data Collection Guide and the risk assessment developed during the planning process (see Chapter 4 of the base plan), which included a more detailed qualitative analysis with best available data.

The hazard summaries in Table E.5 reflect the hazards that could potentially affect the City. Those of Medium or High significance for the City of Fresno are identified below. The discussion of vulnerability for each of the following hazards is located in Section E.3.2 Estimating Potential

Losses. Based on this analysis, the priority hazards (High Significance) for mitigation include drought, flood/levee failure, and hazardous materials incidents.

- dam failure
- drought
- earthquake
- epidemic/pandemic
- extreme heat
- flood/levee failure
- fog
- hazardous materials incidents
- wildfire
- windstorm

## Other Hazards

Hazards assigned a Significance rating of Low and which do not differ significantly from the County ranking (e.g., Low vs. High) are not addressed further in this plan, and are not assessed individually for specific vulnerabilities in this section. In the City of Fresno, those hazards ranked Low are as follows:

- agricultural hazards*
- human health hazards: West Nile Virus
- landslide
- severe weather: heavy rain/thunderstorm/hail/lightning, tornado
- soil hazards
- volcano
- extreme cold
- winter storm

**Note on Agricultural Hazards*:** Agricultural hazards are ranked Low in the City of Fresno than for the County overall (ranked High) because very little land in the City is used for agricultural purposes.

Additionally, the City's Committee members decided to rate several hazards as Not Applicable (N/A) to the planning area due to a lack of exposure, vulnerability, and no probability of occurrence. **Avalanche** is considered Not Applicable (N/A) to the City of Fresno.

## E.3.1 Assets at Risk

This section considers Fresno's assets at risk, including values at risk; critical facilities and infrastructure; historic, cultural, and natural resources; economic assets; and growth and development trends.

### Values at Risk

The following data on property exposure is derived from the Fresno County 2017 Parcel and Assessor data. This data should only be used as a guideline to overall values in the City as the

information has some limitations. The most significant limitation is created by Proposition 13. Instead of adjusting property values annually, the values are not adjusted or assessed at fair market value until a property transfer occurs. As a result, overall value information is likely low and does not reflect current market value of properties. It is also important to note that in the event of a disaster it is generally the value of the infrastructure or improvements to the land that is of concern or at risk. Generally, the land itself is not a loss. Table E.6 shows the 2017 values at risk broken down by property type for the City of Fresno.

**Table E.6: 2017 Property Exposure for the City of Fresno by Property Type**

| Property Type | Parcel Count | Building Count | Improved Value | Content Value | Total Value |
|---|---|---|---|---|---|
| Agricultural | 76 | 53 | $2,887,304 | $2,887,304 | $5,774,608 |
| Commercial | 6,110 | 24,004 | $5,471,778,084 | $5,471,778,084 | $10,943,556,168 |
| Exempt | 1,012 | 3,881 | $0 | $0 | $0 |
| Industrial | 2,575 | 5,630 | $1,420,216,900 | $2,130,325,350 | $3,550,542,250 |
| Multi-Residential | 5,793 | 52,504 | $2,416,885,833 | $1,208,442,917 | $3,625,328,750 |
| Open Space | 1 | 1 | $150,882 | $150,882 | $301,764 |
| Residential | 113,468 | 117,771 | $15,122,142,902 | $7,561,071,451 | $22,683,214,353 |
| Unknown | 2 | 2 | $530,082 | $530,082 | $1,060,164 |
| **Total** | **129,037** | **203,846** | **$24,434,591,987** | **$16,375,186,070** | **$40,809,778,057** |

Source: Fresno County 2017 Parcel and Assessor data

Since the 2009 Plan, the City of Fresno has experienced notable increases in agricultural, commercial, and residential properties and property values at risk. Compared to improved values from the Fresno County Assessor's Office's 2007 Certified Roll Values, agricultural improved value has increased by 254.2 percent, commercial improved value has increased by 299.8 percent and total residential improved value has increased by 265.8 percent. Part of this dramatic increase in exposure of commercial and residential properties can be attributed to annexations of previously unincorporated County land that have occurred within the last decade.

## Critical Facilities and Infrastructure

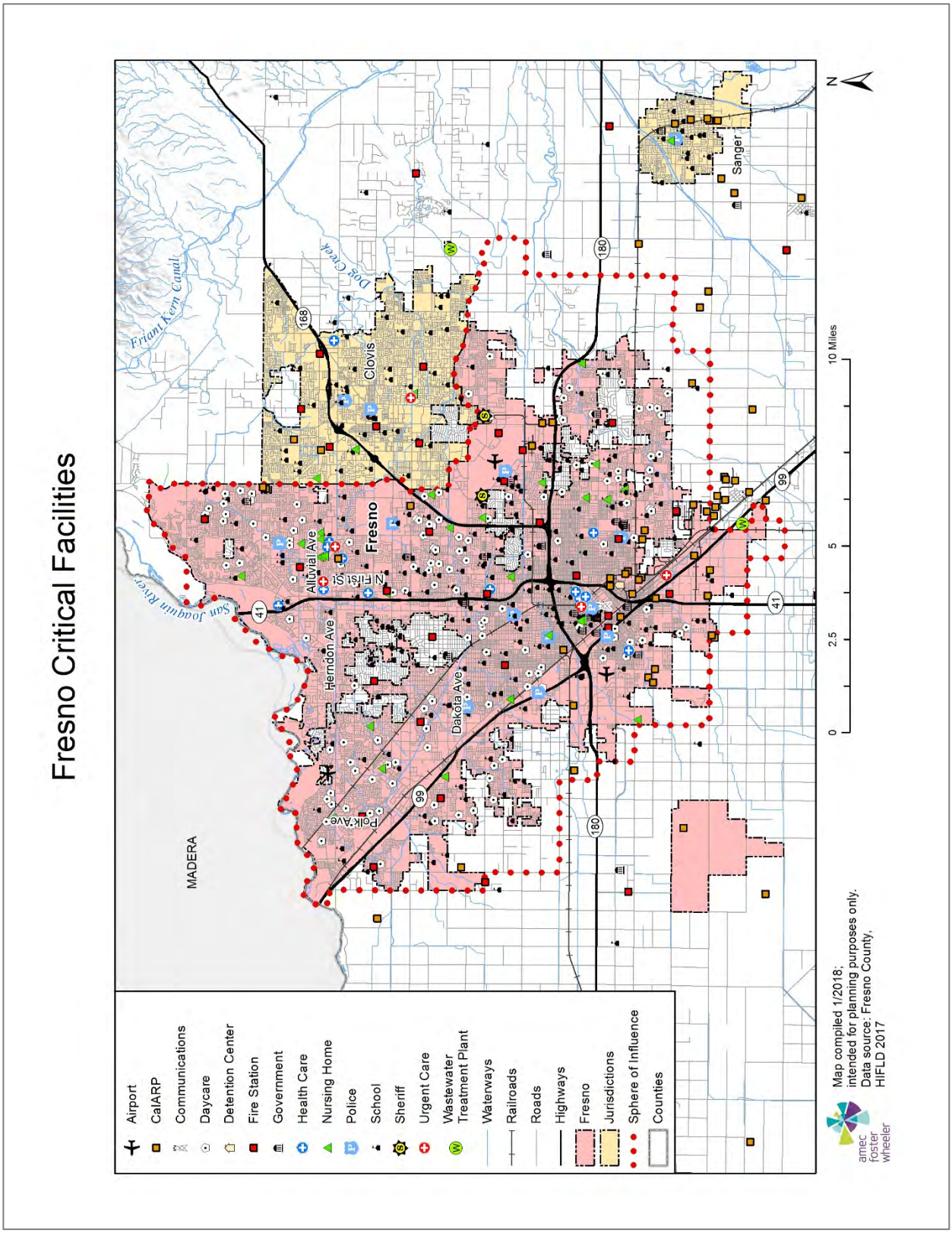
A critical facility may be defined as one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. An inventory of critical facilities in the City of Fresno from Fresno County GIS is provided in Table E.7 and mapped in Figure E.2.

## Table E.7: City of Fresno's Critical Facilities

| Critical Facility Type | Number |
|---|---|
| Airport | 3 |
| Behavioral Health | 4 |
| CalARP | 28 |
| Colleges & Universities | 14 |
| Communications | 1 |
| County Government | 4 |
| Courthouse | 1 |
| Daycare | 155 |
| Department of Agriculture | 2 |
| Department of Public Health | 4 |
| Department of Public Works | 1 |
| Department of Social Services | 9 |
| Detention Center | 4 |
| District Attorney | 2 |
| Fire Station | 21 |
| General Services | 3 |
| Health Care | 12 |
| Nursing Home | 27 |
| Police | 10 |
| School | 183 |
| Sheriff | 3 |
| Supplemental College | 4 |
| Urgent Care | 4 |
| **Total** | **499** |

Source: Fresno County, HIFLD 2017

## Figure E.2: City of Fresno's Critical Facilities



The list of specific critical facilities and community assets is maintained by the City of Fresno Police Department. The Fresno Urban Area Critical Infrastructure List is considered confidential and may be accessed through the Fresno Police Department Homeland Security Division.

## Historic, Cultural, and Natural Resources

### *Historic and Cultural Sites*

The Cultural Resource Facility located on the California State University, Bakersfield campus maintains a database, maps, and descriptive surveys of prehistoric sites in the Fresno area. Details of the locations are kept confidential due to the risk of theft or vandalism of artifacts. The general location of these sites is along the San Joaquin River and its bluffs, where permanent Native American settlements were established near a permanent water supply and seasonal salmon fishery.

The City of Fresno maintains a local official register of historic resources (available from the historic preservation officer in the City's Planning and Development Department). There are approximately 284 properties on the register. Twenty-one of the properties were demolished or destroyed by fire after being placed on the list, and three other properties have been relocated to sites outside the City of Fresno. The local register includes 31 properties that are on the National Register of Historic Places (see Table E.8).

**Table E.8: City of Fresno's Properties on the National Register of Historic Places**

| Property Name | Address | Date Listed |
|---|---|---|
| Azteca Theater | 836-840 F Street | 4/21/2017 |
| Bank of Italy | 1015 Fulton Mall | 10/29/1982 |
| Brix, H. H., Mansion | 2844 Fresno Street | 9/15/1983 |
| Einstein House | 1600 M Street | 1/31/1978 |
| Forestiere Underground Gardens | 5021 W. Shaw Avenue | 10/28/1977 |
| Fresno Bee Building | 1555 Van Ness Avenue | 11/1/1982 |
| Fresno Brewing Company Office and Warehouse | 100 M Street | 1/5/1984 |
| Fresno County Hall of Records | 2281 Tulare Street | 12/22/2011 |
| Fresno Memorial Auditorium | 2425 Fresno Street | 5/10/1994 |
| Fresno Republican Printery Building | 2130 Kern Street | 1/2/1979 |
| Fresno Sanitary Landfill | West and Jensen Avenues | 8/7/2001 |
| Holy Trinity Armenian Apostolic Church | 2226 Ventura Street | 7/31/1986 |
| Hotel Californian | 851 Van Ness Avenue | 4/21/2004 |
| Kearney, M. Theo, Park and Mansion | 7160 Kearney Boulevard | 3/13/1975 |
| Kindler, Paul, House | 1520 E. Olive Avenue | 10/29/1982 |
| Maulbridge Apartments | 2344 Tulare Street | 5/6/1982 |
| Meux House | 1007 R Street | 1/13/1975 |
| Old Administration Building, Fresno City College | 1101 University Avenue | 5/1/1974 |
| Old Fresno Water Tower | 2444 Fresno Street | 10/14/1971 |
| Pantages, Alexander, Theater | 1400 Fulton Street | 2/23/1978 |
| Physicians Building | 2607 Fresno Street | 11/20/1978 |

| Property Name | Address | Date Listed |
|---|---|---|
| Rehorn House | 1050 S Street | 1/8/1982 |
| Romain, Frank, House | 2055 San Joaquin Street | 1/11/1982 |
| San Joaquin Light & Power Corporation Building | 1401 Fulton Street | 1/3/2006 |
| Santa Fe Hotel | 935 Santa Fe Avenue | 3/14/1991 |
| Santa Fe Passenger Depot | 2650 Tulare Street | 11/7/1976 |
| Southern Pacific Passenger Depot | 1033 H Street | 3/21/1978 |
| Tower Theatre | 1201 N. Wishon Avenue | 9/24/1992 |
| Twining Laboratories | 2527 Fresno Street | 3/26/1991 |
| Warehouse Row | 722, 744, and 764 P Street | 3/24/1978 |
| YWCA Building | 1660 M Street | 9/21/1978 |

Source: National Register of Historic Places, www.nps.gov/nr/

Other historic resources in the City of Fresno include the following historic districts:

- The Porter Tract Historic District (45 homes)
- The Chandler Field/Fresno Municipal Airport Historic District (four historic structures)
- The Wilson Island Historic District (78 homes)
- The Huntington Boulevard Historic Districts (81 homes)

As comprehensive as the City's register may be, it does not include all properties in the City with potential historic or cultural significance. The list is continually being expanded as sites are discovered through routine analysis of proposed development areas and through proposed new listings of historic districts. The pool of potentially historic properties also changes through time, since federal law provides for a 50-year retrospective review, which now encompasses the post-World War II building boom era. Ten properties that were recommended for the City's register but were denied inclusion by the Fresno City Council are still recognized for their historic/cultural significance (heritage properties), which is taken into account when any actions are undertaken on them pursuant to provisions of the California Environmental Quality Act. (Three of these properties have been since been demolished.)

While a detailed assessment of seismic and flood risks for the listed properties in Fresno is currently beyond the available staff resources of the City's Historic Preservation Office, it can be generally assumed that most of the structures have not been seismically reinforced and that their masonry is vulnerable to strong ground shaking.

While many of the structures are in Fresno's old downtown and were built when this area was largely within the 100-year floodplain of the Fresno Stream Group, efforts by the Fresno Metropolitan Flood Control District in conjunction with the U.S. Army Corps of Engineers and the City of Fresno have provided for flood detention structures and ponding basins that have greatly reduced the size and extent of the floodplain in the downtown, helping to preserve these historic resources.

### *Natural Resource Areas*

#### San Joaquin River Corridor

While the City maintains many community and neighborhood parks, its natural resources are primarily along the San Joaquin River. Owing to the year-round presence of water, the river bottom and bluffs host the richest aquatic and riparian forest biota in the City. It is in this area where migratory waterfowl and federally and state-listed endangered wildlife are most likely be encountered. These species include the valley elderberry longhorn beetle, the giant garter snake, and the American bald eagle (recently recommended for delisting from the National Endangered Species list).

Over past decades, land in the river corridor has been purchased and aggregated by state agencies (Department of Fish and Game, San Joaquin River Conservancy), by nonprofit groups (San Joaquin River Parkway Trust, Fresno Sportsmen's Club), and by the City and County (the City's Woodward Park and Milburn Unit, the County's Lost Lake Park). The ultimate goal of the San Joaquin River Conservancy Plan is to fashion a regional parkway with continuity of wildlife corridors and to manage it for joint recreational, habitat conservation, and floodplain protection uses.

Due to its location, this natural resource area is flood-prone. In some areas, this risk has been increased due to removal of massive amounts of sand and gravel (from mining), which lowered the ground surface over past decades. While the native riparian plants and animals have largely evolved with coping mechanisms for periodic severe flooding, any developed recreation facilities would be at risk. The face of the bluff is also very vulnerable to wildfire because of its vegetative overgrowth and nearly vertical slopes. Fire prevention efforts are difficult here because the soils are too unstable for vegetative removal projects or for irrigation that would keep the plants well-watered.

#### Vernal Pool Areas

In the northerly parts of the City, outside the river corridor, certain clay soils have the capacity to form impermeable hardpans and layers that do not allow rapid percolation of rainwater. During the rainy season, shallow vernal pools form that are populated by a host of specialized plants and animals. Many species associated with vernal pools are federally and state-listed species (e.g., the California tiger salamander, various types of fairy shrimp crustaceans, orcutt grass, button celery species, meadowfoam, and owl clover). Vernal pools are also heavily utilized by nonlisted species, such as migratory waterfowl, rodents, furbearing predators, and raptors that prey on other animals.

Wildfire is not considered a major risk to these natural communities, because they evolved with dry season fires as a common occurrence (the plants have very resistant seeds and the crustaceans and amphibians go into protected parts of their life cycles such as deep dormancy). Human encroachment through agriculture and land development is the greatest risk to vernal pool areas. If the clay layers are disrupted by "deep ripping" plowing, water cannot accumulate on the surface and the pools will not form. If the land is subjected to year-round irrigation, specially adapted

vernal pool species will be out-competed by other species. Conversion of land to urban development with structures, paving, lawns, pets, and people will destroy vernal pool natural communities.

## Economic Assets

The City of Fresno's economic sector includes both private and public entities that have been compiled into clusters in order to identify key economic assets. These ten clusters, known as the Regional Job Initiative (RJI) clusters, are Advanced Manufacturing, Clean Energy, Construction, Food Processing, Healthcare, Info Processing (Call Centers, Logistics, and Distribution), Software Development, Tourism, and Water Technology. Among these clusters are major employers like Saint Agnes, Pelco, Gottschalks, and Ruiz Foods that both boost Fresno's economic growth and provide employment opportunities.

If a disaster struck the City, it could have a severe impact on Fresno's economic assets. Sectors of greatest concern include all the RJI clusters, but in particular Food Processing, which includes the agricultural industry, and Healthcare.

## Growth and Development Trends

The City of Fresno is growing at a rapid pace. Its expansion from incorporation in 1885 to the present day (August 2017) is illustrated in Figure E.3. Even more growth is anticipated in the years to come, based on current trends.

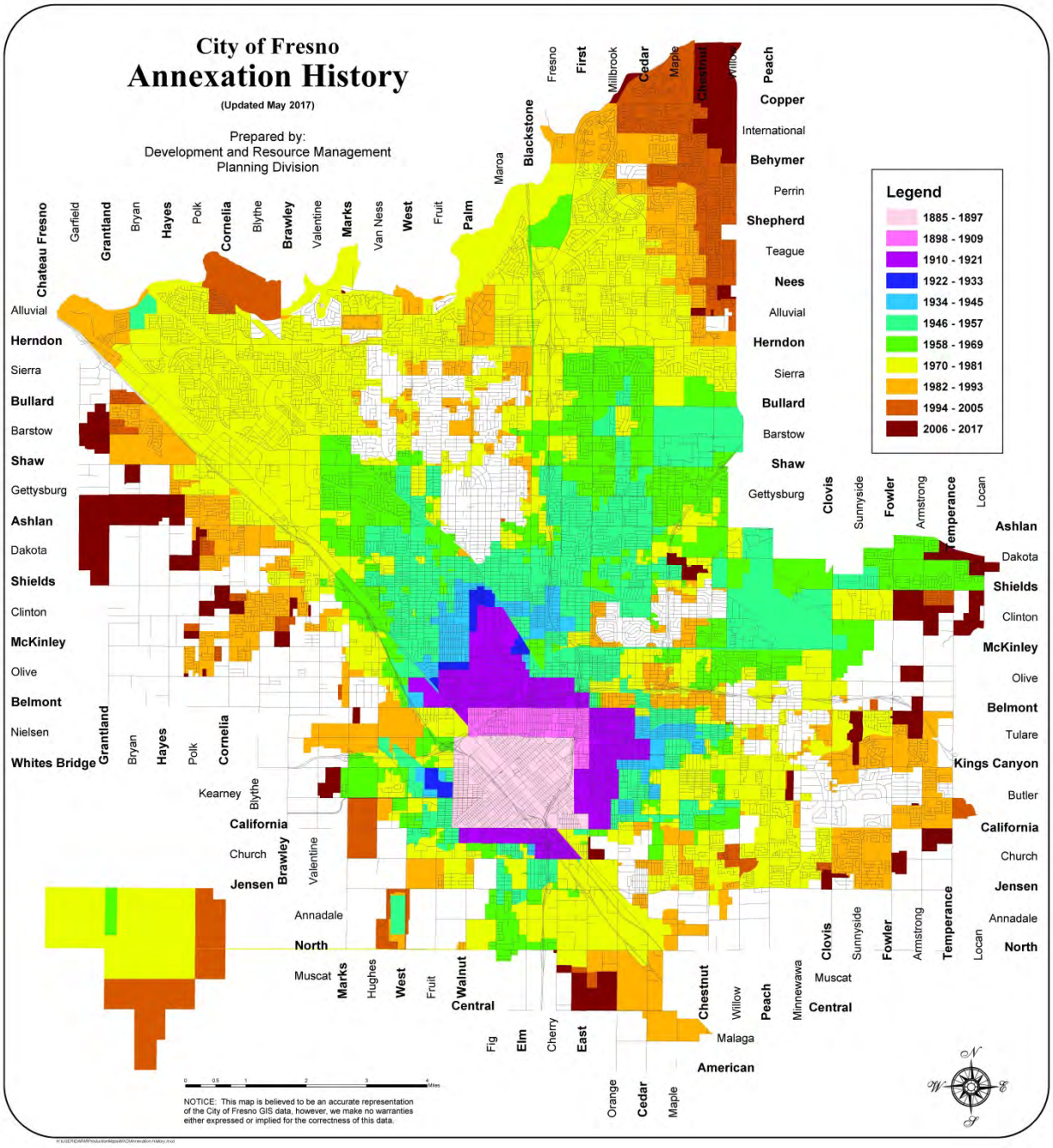
Table E.9 illustrates how the City has grown in terms of population and number of housing units between 2011 and 2017 alone.

**Table E.9: City of Fresno's Change in Population and Housing Units, 2011-2017**

| 2011 Population | 2017 Population Estimate | Estimated Percent Change 2011-2017 | 2011 # of Housing Units | 2017 Estimated # of Housing Units | Estimated Percent Change 2011-2017 |
|---|---|---|---|---|---|
| 498,664 | 525,832 | +5,49 | 172,171 | 178,819 | +3.86 |

Source: California Department of Finance, www.dof.ca.gov/Forecasting

## Figure E.3: City of Fresno's Annexation History




Source: City of Fresno Development Department. This map is believed to be an accurate representation of the City of Fresno GIS data, however, we make no warranties either expressed or implied for the correctness of this data.

By December 31, 2035 (the "Horizon" year of the most recent Fresno General Plan), it is estimated that 771,000 people will reside in the Fresno Metropolitan Area (which would include County islands and areas inside the City's Sphere of Influence but not yet annexed). This figure of 771,000 would be 64 percent of the projected 2035 Fresno County population of 1,201,416 (State of California Department of Finance population projections).

As of August of 2017, the City of Fresno comprised 115.3 square miles of annexed (incorporated) land within its 161.8-square mile Sphere of Influence. Development had reached the natural and political northerly boundary of the City, the San Joaquin River, and began expanding to the west and southeast through conversion of rural residential and agricultural land. Within the Sphere of Influence, there continued to be "County islands" and partially urbanized fringe areas. An urban unification annexation program may reduce the numbers and sizes of these enclaves in the coming decade.

The Fresno General Plan made a concerted effort to revitalize the City's downtown by balancing new growth areas to geographically recenter the downtown. With construction of a major sewer trunk along the Grantland Avenue alignment and proposed construction of new wastewater and water treatment plants in the southeastern area, the City's future growth is expected to concentrate primarily to the west and southeast.

The Fresno Metropolitan Flood Control District (FMFCD) has commenced major flood control facility construction on Fancher Creek in the eastern portion of the City's Sphere of Influence. Since the Fresno General Plan was completed in December 2014, the FMFCD will compile technical studies and update its master service plan in conjunction with the City's land use plan for this new growth area.

The Fresno General Plan also directed that new development be more compact and that single-family residential densities be higher than the City's traditional 4± dwelling units/acre pattern for subdivisions. The recently adopted Fulton Corridor Specific Plan and Downtown Neighborhoods Community Plan and other plan amendments and projects in process (and proposed in the future) feature smaller lots, multi-story housing, multi-family units, and reduced setbacks.

Unless the cost of manufactured housing units would provide a substantial savings over site-built homes, it is not expected that the proportion of manufactured housing in the City of Fresno will greatly increase. It is possible that there will be some increase as producers of these units create models with appropriate roof pitches and other features to meet the City's design review standards.

More information about the City of Fresno's growth and current housing stock is available in the City of Fresno General Plan 2015-2023 Housing Element commissioned by the City of Fresno Development and Resource Management Department and prepared by MIG, Inc (available at www.fresno.gov/housingelement). More general information on growth and development in Fresno County as a whole can be found in "Growth and Development Trends" in Section 4.3.1 Fresno County Vulnerability and Assets at Risk of the main plan.

## E.3.2 Estimating Potential Losses

Note: This section details vulnerability to specific hazards, where quantifiable, and/or where (through HMPC member input) it differs from that of the overall County.

Table E.6 above shows Fresno's exposure to hazards in terms of number and value of structures. Fresno County's parcel and assessor data was used to calculate the improved value of parcels. The most vulnerable structures are those in the floodplain (especially those that have been flooded in the past), unreinforced masonry buildings, and buildings built prior to the introduction of modern day building codes. No further information on vulnerable structures is available. Impacts of past events and vulnerability to specific hazards are further discussed below (see Section 4.1 Hazard Identification for more detailed information about these hazards and their impacts on Fresno County).

### Agricultural Hazards

Agricultural hazards are ranked with a Low significance in the City of Fresno; lower than for the County overall (ranked High) because very little land in the City is used for agricultural purposes. Agricultural losses due to hazard events have greater economic impact on the small communities and rural areas of the County than on the City of Fresno. However, ornamental and garden plants in the City, and pets and incidental livestock kept within City limits, may become involved in any countywide responses to crop pests or infectious agents, because these urban plants and animals provide reservoirs for the diseases and crop pests that threaten the County's agriculture.

### Dam Failure

The National Inventory of Dams lists five dams located in the City of Fresno, including the Redbank Creek Detention basin, Fancher Creek Detention, Friant Millerton Road Embankment A, Redbank, and Friant Dike 3.

### Drought

Annual rainfall in the City of Fresno is typically 12-14 inches. This makes the region vulnerable to episodic drought and to chronic drawdown of aquifer levels (the U.S. Environmental Protection Agency has designated the groundwater below Fresno as a sole source aquifer). Water in this aquifer has historically flowed through permeable strata from north and northeast toward the south and west, but the aquifer has been so affected by drawdown that a "cone of depression" has been created, reversing the historic flow directions (the "groundwater gradient") in portions of west and south Fresno.

In the last 10 years the City of Fresno has made strides to reduce dependence on groundwater by setting a course to implement water plans, which include the Urban Water Management Plan, Recycled Water Waster Plan, and the recently adopted Water Capital Program. A surface water treatment plant is currently under construction in Southeast Fresno and should be completed by 2018. When operational, the plant will maximize use of Fresno's surface water allocations during

normal years and allow the City to reduce overuse of groundwater. Recycled water use will also grow in Fresno with the new recycled water mains now being constructed. The City has plans to use 25,000 acre-feet per year of recycled water for irrigating open spaces, parks, street medians and golf courses.

## Earthquake

The seismic hazard in the City of Fresno is low relative to California coastal and mountain communities and is lower than in the Sierra and western areas of Fresno County. There are no known earthquake faults underlying Fresno, and the City has never been the epicenter of a known seismic event. However, Fresno is considered to have a moderate risk of earthquake damage due to the presence of major fault systems to the west, south, and east and due to Fresno's large population and number of buildings, critical facilities, and infrastructure and other development that could be vulnerable to more severe ground shaking.

Historically, Fresno has sustained very little damage from major earthquakes occurring on California's major faults: the Owens Valley earthquake of 1872 toppled an unreinforced masonry (brick) church steeple. More recent major earthquakes in the past four decades (with epicenters near Coalinga and the Bay Area) have resulted in perceptible tall building swaying in Fresno, minor injuries (attributable to shelved items falling), and slight damage (e.g., minor cracked plaster, etc.). To date, no soil liquefaction has been observed in Fresno from any seismic event.

The most serious impacts of an earthquake in Fresno would probably arise from damage to large dams in the Sierra Nevada on the upper reaches of the San Joaquin River very close to active Long Valley Caldera-related faults. Should either of the two most easterly (and largest) dams in this area be severely damaged or breached, the resulting sequential dam failures could cause floodwaters to overtop Friant Dam northeast of the City. While the dam failure inundation map for Friant shows that most of the flooded area would be expected in the northwest part of town (where the confining river bluffs are not as high), there are some residences and important infrastructure in the river channel itself that would be inundated and gravely damaged (or destroyed), including highway bridges and the inlet of the Friant-Kern Canal, which supplies Bureau of Reclamation surface water to the Fresno area and to other communities in the southern San Joaquin Valley.

## Epidemic/Pandemic

Fresno's population includes many residents who have limited access to health care, with causes related to low household income levels, lack of insurance coverage, a limited number of primary health care facilities and acute care beds, a low ratio of public health and medical professionals to population, and language barriers. Highly communicable diseases tend to affect a large percentage of the City, perhaps due to large household size and the mobility of the population. If a highly communicable disease outbreak occurred that caused serious or life-threatening illness for most infected persons, health care and other public service systems would experience disruption or breakdown and would require outside intervention with resources from other communities, the state, or the federal government.

### Extreme Cold/Freeze

Freeze events occur occasionally in Fresno, but impacts are greater to the agriculture industry in the County than to the City. In January 2007, overnight minimum temperatures fell below freezing between January 6 and 10. The event led to a presidential disaster declaration due to the estimated $710 million in agricultural damage in the Central and South Valley. The 2007 event occurred in another eight-year interval after the devastating citrus freezes of 1998 and 1990. The event caused frozen pipes in Fresno but little other property damage. The City also has a plan for freezing temperature events and opens warming centers. These centers are primarily geared toward the homeless population.

### Extreme Heat

Fresno uses a local version of the California State Plan for Extreme Heat. This plan was used during the extreme heat event during the summer of 2006 and worked well. The City operates cooling centers, which are primarily geared toward the homeless. Public notification for extreme heat events is conducted through the Public Affairs office in coordination with Fresno County.

### Expansive Soils

These types of soils occur in northern Fresno in the far northeastern portions of its Sphere of Influence (in the "Copper River" area). Expansive clay soils can cause cavitation over time and require special construction standards for foundations.

### Flood

As noted in the preceding section, there is some flood risk to the City from San Joaquin River major dam failure inundation, but the more common flood risk, repetitively experienced in Fresno, is that of shallow "sheet" flooding from major precipitation events. Except for the San Joaquin River, streams in the Fresno-Clovis Metropolitan Area originate in the Sierra foothills to the east and extend into the valley floor west of State Route 99 by way of dual-use irrigation and storm runoff channels and disperse into numerous smaller irrigation canals. Overflow from these canals and urban stormwater from intense precipitation events is sent back to the San Joaquin River or to farmland southwest of Fresno via spillway channels.

In the City of Fresno, these canals and channels are under control of the Fresno Irrigation District, an independent public agency, but their use during storm events is shared by another independent district, the Fresno Metropolitan Flood Control District (FMFCD). The FMFCD was created to develop flood control facilities to prevent further repetitive losses created by the Fresno Stream Group and to provide an urban drainage network. This District is responsible for administering a Storm Drainage and Flood Control Master Plan. The City's municipal code supports these efforts by including a Drainage Fee Ordinance to ensure that grading and development comply with the FMFCD's Master Plan and standards and provide proportionate shares of storm drain and ponding basin infrastructure.

The City of Fresno's Floodplain Ordinance further coordinates and supports FMFCD efforts. This ordinance and the Fresno General Plan Safety Element policies require conformance to FEMA floodplain management policies and to those of California's Central Valley Flood Prevention Board (which regulates the designated floodway along the San Joaquin River channel). Still, in areas not completely developed to urban standards, areas where the urban drainage network is not yet completed, and in some County "island" areas (land within the City that the County has authority over), stormwater drainage facilities may not prevent localized shallow flooding during intense runoff events.

According to FEMA's 2016 Flood Insurance Study (FIS), the following major canals and ditches run through the City:

- **Central Canal** flows southwest through the southeastern part of the City of Fresno.
- **Dry Creek Canal** begins at the confluence of Mill Ditch and Herndon Canal, just downstream of North Millbrook Avenue, and flows southwest through the southwestern portion of the City.
- **Fancher Creek Canal** flows southwest along the eastern corporate limits of the City of Fresno and joins Central Canal at the southeast corner of the City.
- **Herndon Canal** begins at the confluence of Mill Ditch and Dry Creek Canal. It flows west through the center of the City of Fresno, then flows northwest through the northwestern part of the City.
- **Mill Ditch** flows west along East McKinley Avenue to its confluence with Herndon and Dry Creek Canals.

The FIS details the City of Fresno's flood history as follows:

In February 1884, flood flows from streams of the Fresno-Clovis group inundated the business section of the City of Fresno. Frequent flooding was a problem in the City throughout the 1880. Suburban areas of the City were flooded in spring 1920; the downtown area was inundated in 1923; flooding occurred in the Fig Garden area in 1936; and parts of the City, especially in the northeast section, were flooded in March 1938. Since the 1938 flood, which had an estimated discharge of 2,700 cubic feet per second (cfs) on Dry Creek at the Big Dry Creek Dam site, high flows occurred on that stream in December 1955 (3,800 cfs), January 1969 (5,700 cfs), and February 1969 (4,500 cfs). During December 1955, approximately 500 acres of agricultural and suburban land were flooded by overflow from irrigation canals, and damage, mostly to public facilities, totaled approximately $50,000. The largest and most damaging flood period was January and February 1969, when the combined discharges of Dry, Dog, Redbank, Fancher, and Mud Creeks flooded an estimated 14,500 acres and caused almost $4.7 million in damage. Most of the flooding was in the eastern and northeastern parts of the City. It occurred because many of the streams in the Fresno-Clovis group discharged floodwater into various irrigation canals, causing them to overflow.

### *Values at Risk*

Following the methodology described in Section 4.3.2 Vulnerability of Fresno County to Specific Hazards, a flood map for the City of Fresno was created (see Figure E.4). Tables E.10 and E.11 summarize the values at risk in the City's 100-year and 500-year floodplain, respectively. These tables also detail loss estimates for each flood.

## Figure E.4: City of Fresno's 100- and 500-Year Floodplains

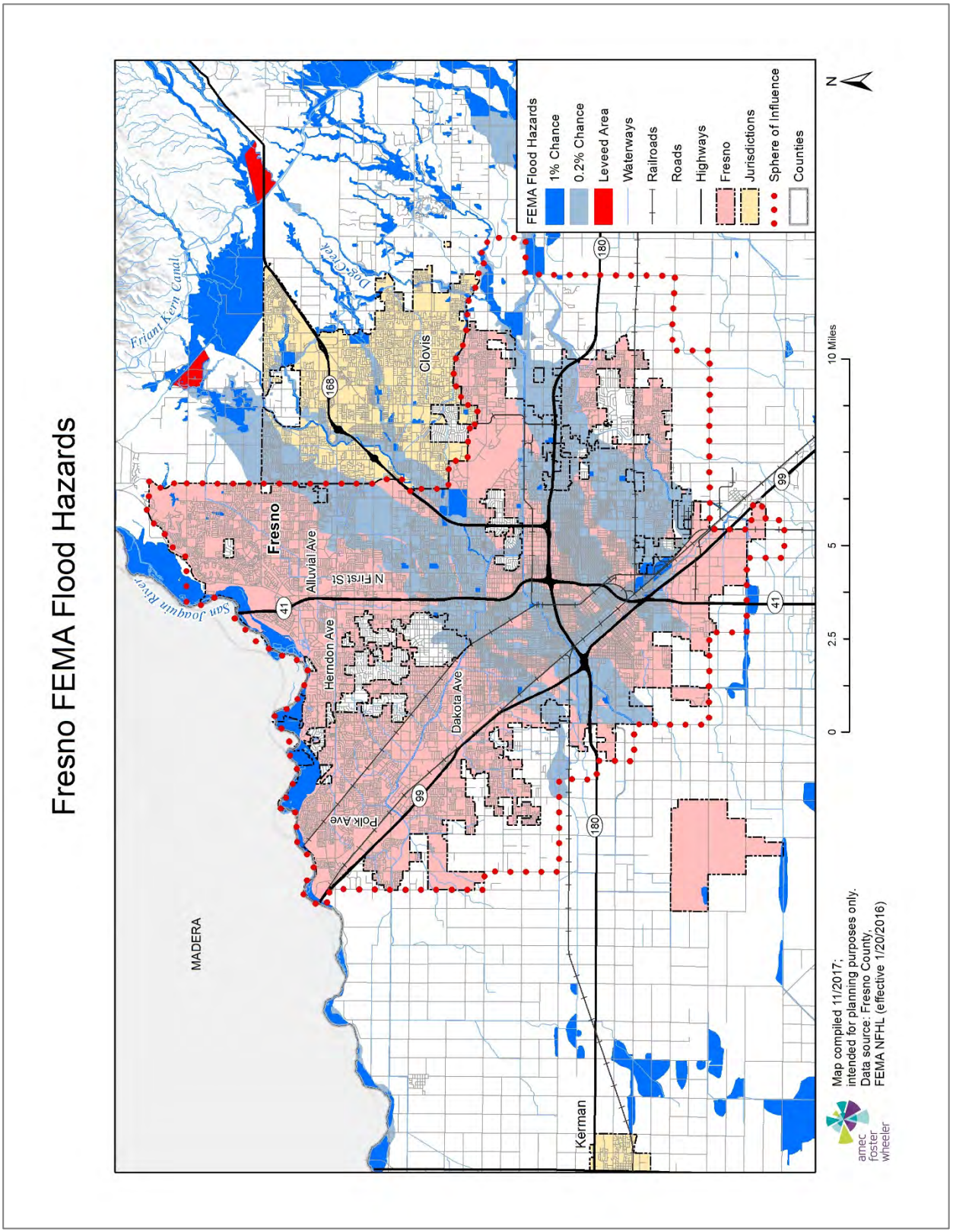


**Table E.10: City of Fresno's FEMA 1% Annual Chance Flood Hazard by Property Type**

| Property Type | Parcel Count | Building Count | Improved Value | Content Value | Total Value | Loss Estimate |
|---|---|---|---|---|---|---|
| Agricultural | 1 | 0 | $60,933 | $60,933 | $121,866 | $30,467 |
| Commercial | 23 | 210 | $6,222,246 | $6,222,246 | $12,444,492 | $3,111,123 |
| Exempt | 29 | 35 | $0 | $0 | $0 | $0 |
| Industrial | 70 | 107 | $30,681,072 | $46,021,608 | $76,702,680 | $19,175,670 |
| Multi-Residential | 11 | 84 | $2,529,983 | $1,264,992 | $3,794,975 | $948,744 |
| Residential | 97 | 120 | $23,269,875 | $11,634,938 | $34,904,813 | $8,726,203 |
| **Total** | **231** | **556** | **$62,764,109** | **$65,204,716** | **$127,968,825** | **$31,992,206** |

Sources: Fresno County 2017 Parcel and Assessor data; FEMA 2009 FIRM

**Table E.11: City of Fresno's FEMA 0.2% Annual Chance Flood Hazard by Property Type**

| Property Type | Parcel Count | Building Count | Improved Value | Content Value | Total Value | Loss Estimate |
|---|---|---|---|---|---|---|
| Agricultural | 29 | 29 | $746,974 | $746,974 | $1,493,948 | $373,487 |
| Commercial | 2,814 | 9,030 | $1,574,492,657 | $1,574,492,657 | $3,148,985,314 | $787,246,329 |
| Exempt | 381 | 1,404 | $0 | $0 | $0 | $0 |
| Industrial | 745 | 1,435 | $309,126,790 | $463,690,185 | $772,816,975 | $193,204,244 |
| Multi-Residential | 2,299 | 20,013 | $797,001,401 | $398,500,701 | $1,195,502,102 | $298,875,525 |
| Residential | 31,581 | 32,817 | $2,677,387,750 | $2,677,387,750 | $5,354,775,500 | $1,338,693,875 |
| **Total** | **37,849** | **64,728** | **$5,358,755,572** | **$5,114,818,267** | **$10,473,573,839** | **$2,618,393,460** |

Sources: Fresno County 2017 Parcel and Assessor data; FEMA 2009 FIRM

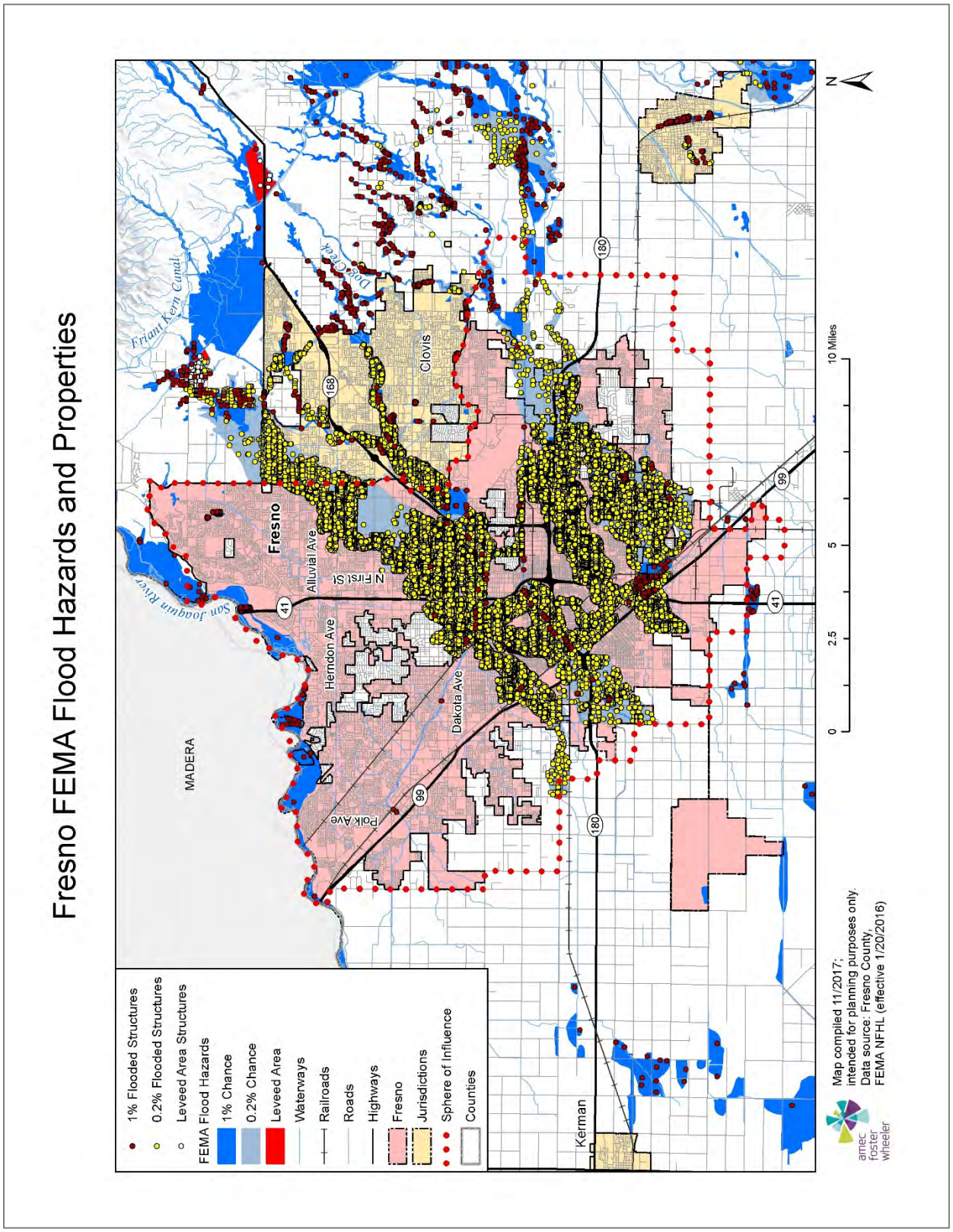
Based on this analysis, the City of Fresno has significant assets at risk to the 100-year and greater floods. There are 231 improved parcels within the 100-year floodplain for a total value of roughly $128 million, including building and content value. An additional 37,849 improved parcels valued at roughly $10.5 billion fall within the 500-year floodplain.

Applying the 25 percent damage factor as described in Section 4.3.2, there is a 1 percent chance in any given year of a 100-year flood causing roughly $32.0 million in damage in the City of Fresno and a 0.2 percent chance in any given year of a 500-year flood causing roughly $2.65 billion in damage (combined damage from both floods).

Properties at risk to flooding are shown in relation to the mapped floodplains in Figure E.5.

**Limitations:** This model may include structures in the floodplains that are elevated at or above the level of the base-flood elevation, which will likely mitigate flood damage. Also, the assessed values are well below the actual market values. Thus, the actual value of assets at risk may be significantly higher than those included herein.

**Figure E.5: City of Fresno's Properties at Risk in the 100- and 500-Year Floodplains**



In addition to the 100-year and 500-year floodplains mapped by FEMA, the California Department of Water Resources maintains Best Available Maps (BAM) which include the floodplains in the Sacramento and San Joaquin River Basins, based on a study performed in 2002 by the U.S. Army Corps of Engineers (USACE). Though limited to the San Joaquin River as a flood source and thus not as comprehensive as the FEMA FIRM, the USACE study shows additional differentiation in flood risk by modeling the 200-year floodplain (the flood with a 0.5 percent annual chance of occurring). Table E.12 summarizes the values at risk by property type within the 200-year floodplain and loss estimates to the 200-year storm using the same methodology described above.

**Table E.12: City of Fresno's FEMA 0.5% Annual Chance Flood Hazard by Property Type**

| Property Type | Parcel Count | Building Count | Improved Value | Content Value | Total Value | Loss Estimate |
|---|---|---|---|---|---|---|
| Agricultural | 1 | 0 | $60,933 | $60,933 | $121,866 | $30,467 |
| Commercial | 3 | 139 | $4,322,495 | $4,322,495 | $8,644,990 | $2,161,248 |
| Exempt | 5 | 5 | $0 | $0 | $0 | $0 |
| Residential | 18 | 19 | $12,103,507 | $6,051,754 | $18,155,261 | $4,538,815 |
| **Total** | **27** | **163** | **$16,486,935** | **$10,435,182** | **$26,922,117** | **$6,730,529** |

Sources: Fresno County 2017 Parcel and Assessor data; CA DWR BAM; USACE

Based on this analysis, there are 27 parcels within the 200-year floodplain valued at nearly $10.5 million. Applying the 25 percent damage factor, there is a 0.5 percent annual chance of a 200-year flood causing $6.73 million in damage in the City of Fresno.

### *Insurance Coverage, Claims Paid, and Repetitive Losses*

The City of Fresno joined the National Flood Insurance Program (NFIP) on December 1, 1982. In addition to providing insurance for properties at risk of flooding, the program collects and publishes statistics on flood-related losses in participating jurisdictions.

NFIP insurance data for the City of Fresno indicates that as of March 30, 2017, there were 323 flood insurance policies in force in the City with $99,316,700 in coverage. This coverage represents a decline of nearly 200 policies over the last decade. Of the 323 policies, 277 were residential (267 for single-family homes) and 46 were nonresidential. 56 of the policies were in A zones (including A01-30, AE, AO, and AH), and the remaining 267 policies were in B, C, and X zones. Policies in B, C, and X zones have increased slightly over the past decade, while policies in the 100-year floodplain have dramatically declined.

There have been 81 historical claims for flood losses totaling $765,183; 73 were for residential properties; 37 were in A zones and 36 were in B, C, or X zones; and 54 were pre-FIRM structures (17 of the 19 post-FIRM structures with reported losses were in a B, C, or X zone). According to the FEMA Community Information System accessed 9/17/2018 there was one Repetitive Loss and no Severe Repetitive Loss properties located in the jurisdiction.

### *Population at Risk*

Using parcel data from the County, the digital flood insurance rate map, population at risk was calculated for the 100-year and 500-year floods based on the number of residential properties at risk and the U.S. Census Bureau 2016 estimate for the average number of persons per household (3.17). The following are at risk to flooding in the City of Fresno:

- 100-year flood—342 people
- 500-year flood—107,400 people
- **Total flood**—107,742 people

### *Critical Facilities at Risk*

Critical facilities are those community components that are most needed to withstand the impacts of disaster as previously described. Table E.13 lists the critical facilities in the City's 100- and 500-year floodplains.

**Table E.13: Critical Facilities in the 100- and 500-Year Floodplains: City of Fresno**

| Critical Facility Type | 100-Year Floodplain | 500-Year Floodplain |
|---|---|---|
| Airport | - | 1 |
| Behavioral Health | - | 1 |
| CalARP | 1 | 12 |
| Colleges & Universities | - | 5 |
| Communications | - | 1 |
| County Government | - | 2 |
| Daycare | - | 52 |
| Department of Agriculture | - | 2 |
| Department of Public Health | - | 2 |
| Department of Social Services | - | 6 |
| District Attorney | - | 1 |
| Fire Station | - | 7 |
| General Services | - | 3 |
| Health Care | - | 1 |
| Nursing Home | - | 12 |
| Police | - | 5 |
| School | - | 68 |
| Urgent Care | - | 2 |
| **Total** | **1** | **183** |

Source: Fresno County, HIFLD 2017

## Hazardous Materials Incident

The following are the primary concerns for the City of Fresno related to hazardous materials release:

- Train derailments

- Kinder-Morgan pipeline
- Chevron petroleum pipelines
- Storage facilities

There are 28 CalARP hazardous materials facilities located in the City of Fresno. As detailed in Table E.14, there are 62 critical facilities located within a half mile of a CalARP facility.

**Table E.14: Critical Facilities within ½ mile of CalARP Facility: City of Fresno**

| Critical Facility Type | Count |
|---|---|
| Colleges & Universities | 1 |
| Communications | 1 |
| County Government | 4 |
| Courthouse | 1 |
| Daycare | 11 |
| Department of Public Health | 2 |
| Department of Social Services | 4 |
| Detention Center | 4 |
| District Attorney | 2 |
| Fire Station | 4 |
| Health Care | 3 |
| Nursing Home | 4 |
| Police | 1 |
| School | 17 |
| Sheriff | 1 |
| Supplemental College | 1 |
| Urgent Care | 1 |
| **Total** | **62** |

Source: Fresno County, HIFLD 2017

For more information on this hazard please refer to the main plan, Section 4.

## Severe Weather: Fog

The risk and vulnerability factors for fog in the City is not unique from the County at large. Please refer to the main plan's discussion of the fog hazard in section 4.

## Severe Weather: Windstorm

Fresno's prevailing winds are typically light and from the northwest. High wind conditions are occasionally created by strong weather fronts. Occasionally, there are funnel clouds of low intensity. Past structural damage has been light, infrequent, and very limited in geographic extent. Injuries have been extremely rare. Most of this damage has occurred secondary to large trees being blown over. The City's design wind load, the level of wind force that new structures are required to be engineered to withstand, is 70 mph.

## Soil Hazards: Land Subsidence

Despite long-term over-drafting of groundwater that has lowered the static water table under Fresno by as much as 100 feet over the past century, ground level subsidence has not been noted in the vicinity of the City (this is probably due to the geologic strata underlying the City, which features layers of clay and hardpan interleaved with sand and gravel layers).

## Wildfire

Similar to many areas of the County, Fresno has high temperatures in the summer with low rainfall creating fire hazard conditions. There is some wildfire risk in the San Joaquin River Bluff area in northern Fresno due to vegetation and steep slopes.

Following the methodology described in Section 4.3.2 Vulnerability of Fresno County to Specific Hazards, a wildfire map for the City of Fresno was created (see Figure E.6). An analysis was performed using GIS software to determine where populations, values at risk, and critical facilities are located within wildfire threat zones. Table E.15 shows the values at risk in the moderate wildfire threat zone (there are no values at risk in the high or very high threat zones). There are not any critical facilities in wildfire threat zones in the City of Fresno.

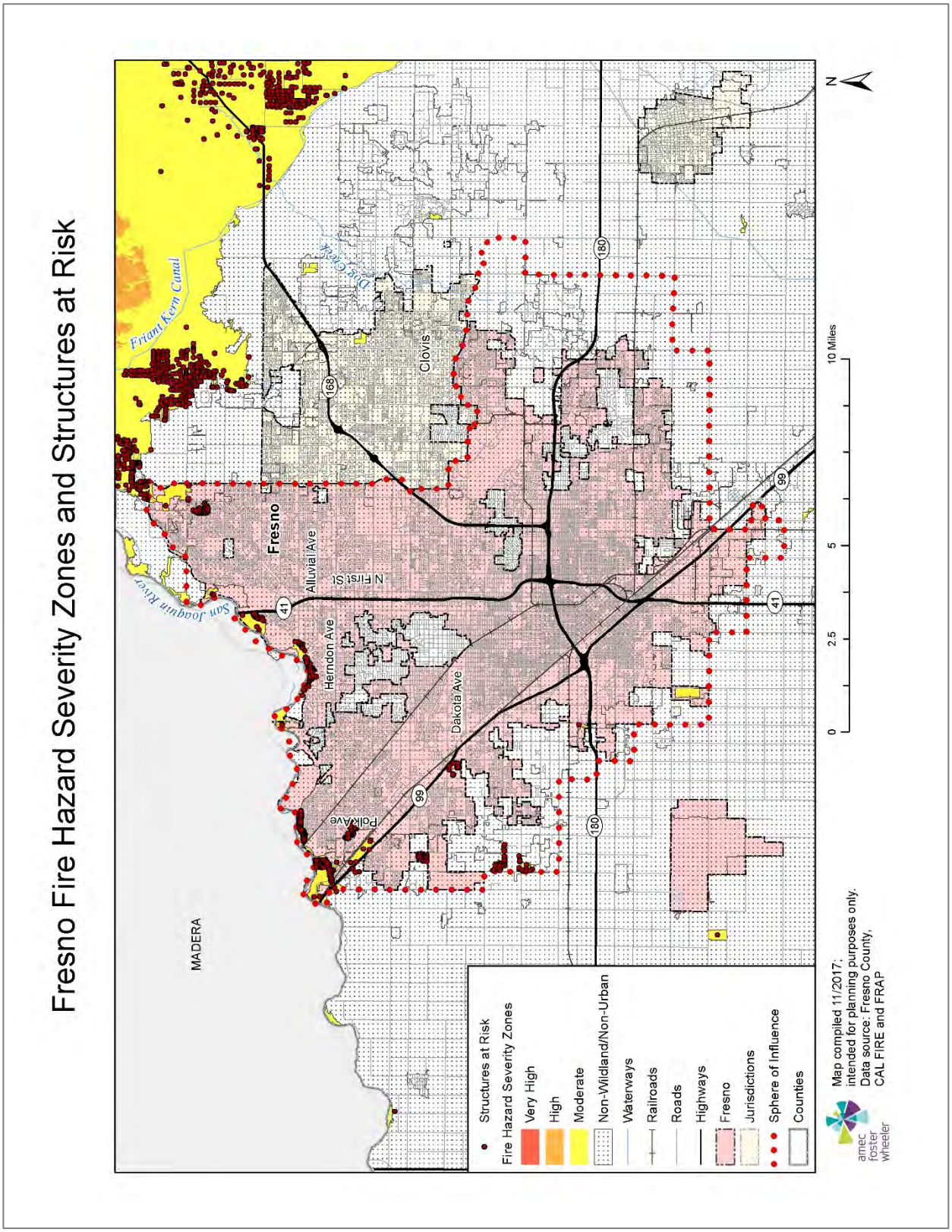
**Table E.15: Values at Risk to Wildfire (Moderate Threat) in the City of Fresno**

| Property Type | Parcel Count | Building Count | Improved Value | Content Value | Total Value |
|---|---|---|---|---|---|
| Agricultural | 1 | 0 | $60,933 | $60,933 | $121,866 |
| Commercial | 13 | 36 | $24,379,836 | $24,379,836 | $48,759,672 |
| Exempt | 12 | 13 | $0 | $0 | $0 |
| Industrial | 4 | 4 | $2,105,480 | $3,158,220 | $5,263,700 |
| Multi-Residential | 1 | 16 | $255,200 | $127,600 | $382,800 |
| Residential | 772 | 779 | $180,172,709 | $90,086,355 | $270,259,064 |
| **Total** | **803** | **848** | **$206,974,158** | **$117,812,944** | **$324,787,102** |

Sources: Fresno County 2017 Parcel and Assessor data

Based on this analysis, the City of Fresno's moderate wildfire threat affects 2,450 people and 803 improved parcels valued at roughly $324,787,102. Almost all of the parcels at risk are in the San Joaquin River corridor, where development is very restricted due to flood risk and bluff instability. Other parcels are in industrial areas along the western edge of the City, where the City's weed abatement ordinances (requiring vegetation control by April) would reduce the wildfire risk.

**Figure E.6: City of Fresno's Wildfire Threat**



# E.4 Capability Assessment

Capabilities are the programs and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. This capabilities assessment is divided into five sections: regulatory mitigation capabilities, administrative and technical mitigation capabilities, fiscal mitigation capabilities, mitigation outreach and partnerships, and other mitigation efforts.

To develop this capability assessment, the jurisdictional planning representatives used a matrix of common mitigation activities to inventory which of these policies or programs were in place. The team then supplemented this inventory by reviewing additional existing policies, regulations, plans, and programs to determine if they contributed to reducing hazard-related losses.

During the plan update process, this inventory was reviewed by the jurisdictional planning representatives and Amec Foster Wheeler consultant team staff to update information where applicable and note ways in which these capabilities have improved or expanded. Additionally, in summarizing current capabilities and identifying gaps, the jurisdictional planning representatives also considered their ability to expand or improve upon existing policies and programs as potential new mitigation strategies. The City of Fresno's updated capabilities are summarized below.

## E.4.1 Regulatory Mitigation Capabilities

Table E.16 lists regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Fresno.

**Table E.16: City of Fresno's Regulatory Mitigation Capabilities**

| Regulatory Tool | Yes/No | Comments |
|---|---|---|
| General Plan | Yes | The Fresno General Plan has a Noise and Safety Element with policies for wildland fire hazards, seismic/geologic hazards, storm drainage and flood control, hazardous materials, airport safety, and emergency response |
| Zoning Ordinance | Yes | Fresno Municipal Code Chapter 15; Zoning Ordinance has requirements related to health and safety (e.g., dwelling unit density controls, building setbacks for fire protection, masonry walls along major streets) |
| Subdivision Ordinance | Yes | Fresno Municipal Code Chapter 15 requires multiple points of access for ingress/egress, fire protection provisions, etc. |
| Development Permit (formerly Site Plan Review) requirements | Yes | Required for all nonresidential development projects and multi-family projects over two units; required for duplexes in some zone districts; plot plan review required for even single-family residential construction |
| Growth Management Ordinance | Yes | Fresno Municipal Code Chapter 12 provides for extension of urban infrastructure and services including sewer treatment, water supply, and fire protection |
| Floodplain Ordinance | Yes | Fresno Municipal Code Chapter 13 (local building codes) includes the Flood Damage Prevention Ordinance |
| Other special purpose ordinance (stormwater, water conservation, wildfire) | Yes | - Within the Zoning Ordinance, there is a Bluff Preservation Overlay district with requirements for soil stability analysis and setbacks from the San Joaquin bluff edge |

| Regulatory Tool | Yes/No | Comments |
|---|---|---|
| | | - Pretreatment Ordinance and environmental control program for wastewater system to prevent and abate any hazardous material releases |
| Building Code | Yes | Version: 2016 California Building Code with a few City modifications: fire sprinkler ordinance, swimming pool ordinance, and security ordinance |
| Fire Department ISO Rating | Yes | Rating: 3 |
| Erosion or Sediment Control Program | Yes | The Bluff Preservation Ordinance, as well as grading plan review and stormwater pollution prevention plans, which are required for all development projects through project conditions and CEQA review |
| Stormwater Management Program | Yes | In conjunction with Cal-EPA, Regional Water Quality Control Board, and Fresno Metropolitan Flood Control District |
| Capital Improvements Plan | Yes | Public Works Department and Department of Public Utilities formulate and administer these plans |
| Economic Development Plan | Yes | Fresno Redevelopment Agency and Economic Development Division of the Planning and Development Department |
| Local Emergency Operations Plan | Yes | Ratified by City Council in 2005 and last updated in 2015 |
| Flood Insurance Study or other engineering study for streams | Yes | FEMA Flood Insurance Study, 2005 |

## Fresno General Plan (Adopted December 18, 2014)

The Fresno General Plan is a blueprint of how the City anticipates directing and managing growth while minimizing potential impacts for existing and future generations. It provides long-range planning strategies for the continued development, enhancement, and revitalization of the Fresno Metropolitan Area. The plan goals are the guiding principles and provide the framework for the objectives and policies that can be found in the plan elements. The following general plan goals directly or indirectly mitigate hazards identified in this plan:

- **Goal 9**—Promote a city of healthy communities and improve quality of life in established neighborhoods.
  - *Emphasize supporting established neighborhoods in Fresno with safe, well maintained, and accessible streets, public utilities, education and job training, proximity to jobs, retail services, health care, affordable housing, youth development opportunities, open space and parks, transportation options, and opportunities for home grown businesses.*
- **Goal 12**— Resolve existing public infrastructure and service deficiencies, make full use of existing infrastructure, and invest in improvements to increase competitiveness and promote economic growth.
  - *Emphasize the fair and necessary costs of maintaining sustainable water, sewer, streets, and other public infrastructure and service systems in rates, fees, financing and public investments to implement the General Plan. Adequately address accumulated deferred maintenance, aging infrastructure, risks to service continuity, desired standards of service to meet quality-of-life goals, and required infrastructure to support growth, economic competitiveness and business development.*
- **Goal 16**— Protect and improve public health and safety.

Some of the elements of the General Plan also contain objectives and policies relevant to protecting human health and safety (e.g., supporting objectives and policies in the Public Utilities and Services Element direct that amendments to construction and fire codes to reduce the level of risk to life and property from fire commensurate with the City's fire suppression capabilities and that fire and police services be provided). Because the Noise and Safety Element is the portion of the General Plan most relevant to hazard mitigation, select objectives and policies are extracted and included below.

### *The Noise and Safety Element*

The Noise and Safety Element seeks to reduce deaths, injuries, illnesses, damage to property, and economic and social dislocation that could result from hazards. Of specific relevance to this plan, it addresses seismic and geologic conditions, flooding, hazardous materials, and emergency response.

## Seismic and Geologic Hazards

| **NS-2. Objective: Minimize risks of property damage and personal injury posed by geologic and seismic risks.** |
|---|
| **NS-2-a. Policy**: Seismic Protection. Ensure seismic protection is incorporated into new and existing construction, consistent with the Fresno Municipal Code. |
| **NS-2-b. Policy**: Soil Analysis Requirement. Identify areas with potential geologic and/or soils hazards, and require development in these areas to conduct a soil analysis and mitigation plan by a registered civil engineer (or engineering geologist specializing in soil geology) prior to allowing on-site drainage or disposal for wastewater, stormwater runoff, or swimming pool/spa water. |
| **NS-2-c. Policy**: Landfill Areas. Require proposed land uses on or near landfill areas to be designed and maintained to comply with California Code of Regulations, Title 27, Section 21190, Post Closure Land Use. |
| **NS-2-d. Policy**: Bluff Preservation Overlay Zone. Per the requirements of the Bluff Preservation Overlay Zone District and Policy POSS-7-f (Chapter 5, Parks and Open Space), the following standards shall be applicable for property located within the Bluff Preservation zone:<br>• Require proposed development within 300 feet of the toe of the San Joaquin River bluffs to undertake an engineering soils investigation and evaluation report that demonstrates that the site is sufficiently stable to support the proposed development, or provide mitigations to provide sufficient stability; and<br>• Establish a minimum setback of 30 feet from the San Joaquin River bluff edge for all buildings, structures, decks, pools and spas (which may be above or below grade), fencing, lighting, steps, etc.<br>o An applicant may request to reduce the minimum setback to 20 feet from the bluff edge if it can be demonstrated, to the satisfaction of the City's Building Official and the Planning Director, that the proposed building, structure, deck, pool and/or spas (which may be above or below grade), fencing, steps, etc., will meet the objectives of the Bluff Preservation Overlay Ordinance. In no case shall the setback be reduced to less than 20 feet. |

## Flooding Hazards

| **NS-3. Objective: Minimize the risks to property, life, and the environment due to flooding and stormwater runoff hazards.** |
|---|
| **NS-3-a. Policy**: Stormwater Drainage and Flood Control Master Plan. Support the full implementation of the FMFCD Storm Drainage and Flood Control Master Plan, the completion of planned flood control and drainage system facilities, and the continued maintenance of stormwater and flood water retention and conveyance facilities and capacities. Work with the FMFCD to make sure that its Storm Drainage and Flood Control Master Plan is consistent with the General Plan. |

| |
|---|
| **NS-3-b. Policy**: Curb and Gutter Installation. Coordinate with Fresno Metropolitan Flood Control District (FMFCD) to install curbing, gutters, and other drainage facilities with priority to existing neighborhoods with the greatest deficiencies and consistent with the Storm Drainage and Flood Control Master Plan. |
| **NS-3-c. Policy**: Dual Use Facilities. Support multiple uses of flood control and drainage facilities as follows:<br>• Use, wherever practical, FMFCD facilities for groundwater management and recharge; and<br>• Promote recreational development of ponding basin facilities located within or near residential areas, compatible with the stormwater and groundwater recharge functions. |
| **NS-3-d. Policy**: Landscaped Buffer. City will support the development of FMFCD ponding basins including the landscaping and irrigation for the top one third of the side sloped areas consistent with the FMFCD Basin Design Criteria. |
| **NS-3-e. Policy**: Pollutants. Work with FMFCD to prevent and reduce the existence of urban stormwater pollutants pursuant to the requirements of the National Pollution Discharge Elimination Systems Act. |
| **NS-3-f. Policy**: Flooding Emergency Response Plans. Work with responsible agencies to update emergency dam failure inundation plans, evacuation plans and other emergency response plans for designated flood-prone areas, including the San Joaquin river bottom. |
| **NS-3-g. Policy**: Essential Facilities Siting Outside of Floodplains. Avoid siting emergency response and essential public facilities, such as fire and police stations, within a 100-year floodplain, unless it can be demonstrated that the facility can be safely operated and accessed during flood events. |
| **NS-3-h. Policy**: Runoff Controls. Implement grading regulations and related development policies that protect area residents from flooding caused by urban runoff produced from events that exceed the capacity of the Storm Drainage and Flood Control Master Plan system of facilities. Place all structures and/or flood-proofing in a manner that does not cause floodwaters to be diverted onto adjacent property, increase flood hazards to other property, or otherwise adversely affect other property. |
| **NS-3-i. Policy**: New Development Must Mitigate Impact. Require new development to not significantly impact the existing storm drainage and flood control system by imposing conditions of approval as project mitigation, as authorized by law. As part of this process, closely coordinate and consult with the FMFCD to identify appropriate conditions that will result in mitigation acceptable and preferred by FMFCD for each project.<br>*Commentary: The City recognizes the expertise and significant role of the FMFCD, and will give the highest deference to its recommendations for mitigation measures, consistent with applicable law.* |
| **NS-3-j. Policy**: National Flood Insurance Program. Continue to participate in the National Flood Insurance Program (NFIP) by ensuring compliance with applicable requirements. Review NFIP maps periodically to determine if areas subject to flooding have been added or removed and make adjustments to the Land Use Diagram Figure LU-1. |
| **NS-3-k. Policy**: 100-Year Floodplain Policy. Require developers of residential subdivisions to preserve those portions of development sites as open space that may be subject to 100-year flood events, unless the flood hazard can be substantially mitigated by development project design. |
| **NS-3-l. Policy**: 200-Year Floodplain Protection. Promote flood control measures that maintain natural conditions within the 200-year floodplain of rivers and streams and, to the extent possible, combine flood control, recreation, water quality, and open space functions. Discourage construction of permanent improvements that would be adversely affected by periodic floods within the 200-year floodplain, particularly in the San Joaquin river bottom. |
| **NS-3-m. Policy**: Flood Risk Public Awareness. Continue public awareness programs to inform the general public and potentially affected property owners of flood hazards and potential dam failure inundation. Remind households and businesses located in flood-prone areas of opportunities to purchase flood insurance. |
| **NS-3-n. Policy**: Precipitation Changes. Work with FMFCD to evaluate the planned and existing stormwater conveyance system in light of possible changes to precipitation patterns in the future. |

## Hazardous Materials

| **NS-4. Objective: Minimize the risk of loss of life, injury, serious illness, and damage to property resulting from the use, transport, treatment, and disposal of hazardous materials and hazardous wastes.** |
|---|
| **NS-4-a. Policy**: Processing and Storage. Require safe processing and storage of hazardous materials, consistent with the California Building Code and the Uniform Fire Code, as adopted by the City. |
| **NS-4-b. Policy**: Coordination. Maintain a close liaison with the Fresno County Environmental Health Department, Cal-EPA Division of Toxics, and the State Office of Emergency Services to assist in developing and maintaining |

| |
|---|
| hazardous material business plans, inventory statements, risk management prevention plans, and contingency/emergency response action plans. |
| **NS-4-c. Policy**: Soil and Groundwater Contamination Reports. Require an investigation of potential soil or groundwater contamination whenever justified by past site uses. Require appropriate mitigation as a condition of project approval in the event soil or groundwater contamination is identified or could be encountered during site development. |
| **NS-4-d. Policy**: Site Identification. Continue to aid federal, State, and County agencies in the identification and mapping of waste disposal sites (including abandoned waste sites), and to assist in the survey of the kinds, amounts, and locations of hazardous wastes. |
| **NS-4-e. Policy**: Compliance with County Program. Require that the production, use, storage, disposal, and transport of hazardous materials conform to the standards and procedures established by the County Division of Environmental Health. Require compliance with the County's Hazardous Waste Generator Program, including the submittal and implementation of a Hazardous Materials Business Plan, when applicable. |
| **NS-4-f. Policy**: Hazardous Materials Facilities. Require facilities that handle hazardous materials or hazardous wastes to be designed, constructed, and operated in accordance with applicable hazardous materials and waste management laws and regulations. |
| **NS-4-g. Policy**: Hazmat Response. Include policies and procedures appropriate to hazardous materials in the City's disaster and emergency response preparedness and planning, coordinating with implementation of Fresno County's Hazardous Materials Incident Response Plan. |
| **NS-4-h. Policy**: Household Collection. Continue to support and assist with Fresno County's special household hazardous waste collection activities, to reduce the amount of this material being improperly discarded. |
| **NS-4-i. Policy**: Public Information. Continue to assist in providing information to the public on hazardous materials. |

## Emergency Response

| **NS-6. Objective: Foster an efficient and coordinated response to emergencies and natural disasters.** |
|---|
| **NS-6-a. Policy**: County Multi-Jurisdiction Hazard Mitigation Plan. Adopt and implement the Fresno County Multi-Jurisdiction Hazard Mitigation Plan and City of Fresno Local Hazard Mitigation Plan Annex.<br>*Commentary: The federal Disaster Mitigation Act of 2000 requires that cities, counties, and special districts have a Local Hazard Mitigation Plan to be eligible to receive FEMA hazard mitigation funds. Cities and counties can adopt and use all or part of a regional multi-jurisdictional plan, such as the one prepared by Fresno County, in lieu of preparing all or part of a Local Hazard Mitigation Plan.* |
| **NS-6-b. Policy**: Disaster Response Coordination. Maintain coordination with other local, State, and Federal agencies to provide coordinated disaster response. |
| **NS-6-c. Policy**: Emergency Operations Plan. Update the City's Emergency Operations Plan periodically, using a whole community approach which integrates considerations for People with access and functional needs in all aspects of planning. |
| **NS-6-d. Policy**: Evacuation Planning. Maintain an emergency evacuation plan in consultation with the Police and Fire Departments and other emergency service providers, which shows potential evacuation routes and a list of emergency shelters to be used in case of catastrophic emergencies.<br>Commentary: The evacuation plan will be flexible in order to consider many scenarios and multiple modes of transportation beyond private automobiles. It will provide special provisions for disadvantaged populations, such as those with physical disabilities or those with low or very low incomes, and for areas with fewer resources through neighborhood emergency preparedness programs. |
| **NS-6-e. Policy**: Critical Use Facilities. Ensure critical use facilities (e.g. City Hall, police and fire stations, schools, hospitals, public assembly facilities, transportation services) and other structures that are important to protecting health and safety in the community remain operational during an emergency.<br>• Site and design these facilities to minimize their exposure and susceptibility to flooding, seismic and geological effects, fire, and explosions.<br>• Work with the owners and operators of critical use facilities to ensure they can provide alternate sources of electricity, water, and sewerage in the event that regular utilities are interrupted in a disaster. |
| **NS-6-f. Policy**: Emergency Vehicle Access. Require adequate access for emergency vehicles in all new development, including adequate widths, turning radii, hard standing areas, and vertical clearance. |

**NS-6-g. Policy**: Emergency Preparedness Public Awareness Programs. Continue to conduct programs to inform the general public, including people with access and functional needs, of the City's emergency preparedness and disaster response procedures.

## Fresno Flood Plain Ordinance

The City of Fresno's Flood Plain Ordinance was revised in the late 1990s and formally adopted by the Fresno City Council on September 20, 2005. (In late 2007, the Fresno Municipal Code was republished with its chapters somewhat reorganized. There was no change in the text of the Flood Plain Ordinance at that time, but due to the reorganization of its content, its most recent adoption effective date is January 17, 2008.) The Fresno Flood Plain Ordinance is Article 6 of Chapter 11 of the Fresno Municipal Code.

The purpose of this ordinance is to promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

- Protect human life and health;
- Minimize expenditure of public money for costly flood control projects;
- Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- Minimize prolonged business interruptions;
- Minimize damage to public facilities and utilities such as water and gas mains; electric, telephone, and sewer lines; and streets and bridges located in areas of special flood hazard;
- Help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future blighted areas caused by flood damage;
- Ensure that potential buyers are notified that property is in an area of flood hazard; and
- Ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

In order to accomplish its purposes, the ordinance includes the following methods and provisions:

- Restrict or prohibit uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or flood heights or velocities
- Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction
- Control filling, grading, dredging, and other development which may increase flood damage
- Prevent or regulate the construction of flood barriers which will unnaturally divert flood water or which may increase flood hazards in other areas
- Control the alteration of natural flood plains, stream channels, and natural protective barriers, which help accommodate or channel floodwaters

This ordinance applies to all areas of special flood hazards within the jurisdiction of the City as identified by FEMA's Flood Insurance Study for Fresno County, California and incorporated areas dated September 30, 2005, with accompanying Flood Insurance Rate Maps, and all subsequent amendments and/or revisions. It appoints the building official to administer, implement, and enforce the ordinance by granting or denying development permits in accord with its provisions.

This ordinance includes the following standards of construction related to special flood hazard areas:

- Anchoring
- Construction materials and methods
- Elevation and floodproofing
- Residential construction
- Nonresidential construction
- Flood venting
- Standards for utilities
- Standards for subdivisions
- Standards for manufactured homes
- Standards for recreational vehicles
- Floodways
- Standards for storage of materials and equipment

In conjunction with Fresno's Drainage Fee Ordinance (Fresno Municipal Code Chapter 12, Article 19), which requires local grading and development to conform to the Fresno Metropolitan Flood Control District Master Drainage Plan and to provide proportionate shares of drainage infrastructure, the Fresno Flood Plain Ordinance and its preceding Flood Damage Prevention Ordinance have reduced flood damage losses in the City.

## National Flood Insurance Program/Community Rating System

The City of Fresno joined the National Flood Insurance Program (NFIP) on December 1, 1982. It has been a member of the Community Rating System (CRS) since October 1, 1992. The City's Floodplain Administrator duties are assigned to the building official. The Building and Safety Division of the Planning and Development Department works to improve the City's CRS rating, which determines the price paid for flood insurance policies issued in the jurisdiction. The rating is based on detailed biannual audits conducted by FEMA and/or a designee agency (currently, the California Department of Water Resources). The primary means of improving and maintaining a good CRS rating is through administration of the Fresno Flood Plain Ordinance. As part of its efforts to improve its community rating, the City of Fresno has hosted periodic FEMA Region IX NFIP/CRS training.

The City's current CRS rating from October 2016 is Class 8, which reflects the loss of two class levels in the most recent audit.

## San Joaquin River Bluff Preservation Ordinance, 1980

After an interagency San Joaquin River Reconnaissance Plan was completed in the late 1970s, the City of Fresno adopted the San Joaquin River Bluff Specific Plan to preserve this important open space and habitat feature and to safeguard the bluff face, which is the most unstable geologic feature in the City. The San Joaquin River Bluff Specific Plan was later subsumed by the 1988 Bullard Community Plan, which carried forward protective policies for this area of Fresno.

The regulation of land use, development, and grading in this portion of Fresno is ongoing pursuant to the Bluff Preservation Ordinance. This ordinance, part of the City's zoning regulations, delineates an overlay zone district along the river bluff (the Bluff Preservation Overlay District), established allowable and prohibited land uses, and set forth conditions and requirements for using or modifying property in the district. The regulations of the district are deemed to be necessary for the preservation of the special qualities of the bluffs and for the protection of the health, safety, and general welfare of owners and users of property in the area.

The Bluff Preservation Ordinance is administered by the Fresno Development and Resource Management Department through its special permit process and grading plan checks. Anyone applying for a building permit is required to submit a site plan review with accompanying soil investigation and evaluation report (prepared by an appropriately licensed professional engineer or registered geologist). The Department's Code Enforcement Division also conducts periodic surveillance of bluff properties for grading and construction done without permits and institutes abatement actions when these conditions are discovered.

## Hazardous Material Incident Safeguards

The Fresno Fire Department works with Fresno County Environmental Health to review hazardous material business plans that detail flammable, explosive, toxic, and otherwise hazardous materials used by businesses in the City. The Fire Department has its own permitting requirement for liquid and gaseous fuel tanks to ensure that they are installed and maintained safely. The City's Hazardous Materials Response Unit (housed in a City fire station) maintains the capability to quickly characterize material releases and spills, to evaluate risks to life and property, and to implement appropriate controls and evacuation measures.

## Fire Prevention Policy

The City of Fresno has some of the most progressive and effective fire prevention policies and regulations in the nation relating to water supply (fire flow) required for development, ingress and egress from developed buildings and subdivisions, on-site automatic fire suppression systems (sprinkler and on-site private hydrants), building addressing to facilitate rapid emergency response, marking of unsafe buildings (those older structures with hazardous conditions or a lack of water supply), and instant aid/mutual aid with adjacent fire departments belonging to Fresno County special districts and the City of Clovis.

In addition to its extensive network of well-trained and well-equipped firefighting stations, the Fresno Fire Department has a Fire Prevention Bureau, under supervision of the City's fire marshal, to administer regulations adopted and referenced by the Fresno Municipal Code Chapter 6, Article 5 relating to fire prevention. The Fire Prevention Bureau carries out these responsibilities by conducting routine inspections of all public and commercial buildings, performing detailed development permit and construction plan checks, and investigating arson.

Another component of the City's overall fire protection program is the administration of its public nuisance ordinances to require properties to be kept clean and free of flammable debris and to annually abate weeds and overgrown vegetation before these materials can dry out in the spring to pose a wildfire hazard (Fresno Municipal Code Chapter 10, Article 6 relating to public nuisance abatement). The Planning and Development Department Code Enforcement Division and Department of Public Utilities Community Sanitation Division coordinate their efforts to enforce the nuisance abatement regulations and provide cleanup services when property owners do not take care of matters themselves.

### City of Fresno Emergency Operations Plan, 2015, Updated 2015

The City of Fresno Emergency Operations Plan (EOP) addresses the planned response to extraordinary emergency situations associated with natural disasters, technological incidents, excessive heat/cold, power outages, and national security emergencies in or affecting the City of Fresno. The Plan, which was updated in 2015, does the following:

- Establishes the emergency management organization required to mitigate any significant emergency or disaster affecting the City of Fresno.
- Identifies the policies, responsibilities, and procedures required to protect the health and safety of City communities, public and private property, and the environment from natural or technological disasters.
- Establishes the operational concepts and procedures associated with initial response operations to emergencies, the extended response operations, and the recovery process.

The EOP is designed to establish the framework for implementation of the California Standardized Emergency Management System/National Incident Management System for the City of Fresno, which is located within the California Governor's Office of Emergency Services' Mutual Aid Region V. It is intended to facilitate multi-agency and multi-jurisdictional coordination, particularly between the City of Fresno and the Fresno County Operational Area, including special districts and state agencies, in emergency operations. This plan will be used in conjunction with the Fresno County EOP and the State of California Emergency Plan. The plan is designed to guide the reader or user through each phase of an emergency: preparedness, response, recovery, and mitigation.

### Other Plans and Policies

Other hazard mitigation-related policies and plans in place in and observed by the City of Fresno include the following:

- California Code of Regulations Title 23 administrative law for development and use of land in designated floodway areas along the San Joaquin River administered by the Central Valley Flood Protection Board, staffed by the California Department of Water Resources.
- Standards for constructing and maintaining drainage basins and ponds to prevent mosquito breeding and to provide for mosquito control district access for inspection and abatement activities (jointly promulgated by the Planning and Development Department and Public Works Department in fall of 2005).
- Dam failure inundation plans prepared and administered by the U.S. Bureau of Reclamation, the U.S. Army Corps of Engineers, Fresno Metropolitan Flood Control District, Southern California Edison, and Pacific Gas and Electric Company.
- The California Environmental Quality Act, overseen by the Fresno City Attorney's Office and administered by several City departments, requires consideration of health and safety impacts as they may relate to projects, which are defined as any action that may result in a change in the physical environment and that would include public facilities, and private development, and even adoption/amendment of land use plans and ordinances. An analysis of every project is conducted by the appropriate City department (the Development and Resource Management Department does the bulk of these analyses). Inquiries regarding project sites and features are distributed to departments and outside agencies that may have knowledge of, or which may regulate, aspects of the proposed project. The information obtained from these requests for comment and from other staff research is compiled into an informational document for decision-makers and the public. The information is also used to develop a list of mitigation actions to reduce or abate potential adverse impacts of the project. For those projects which may involve federal funds or require federal approvals, a parallel National Environmental Policy Act assessment is also prepared by the City.
- The Development and Resource Management Department administers regulations in the California Building Code and in Uniform Electrical, Plumbing, and Mechanical Codes as those codes are modified through adoption by the state and City. Plan check and inspection activities of the Department ensure structural soundness and compliance with seismic and other regulations.

## E.4.2 Administrative/Technical Mitigation Capabilities

Table E.17 identifies the personnel responsible for activities related to mitigation and loss prevention in Fresno.

**Table E.17: City of Fresno's Administrative and Technical Mitigation Capabilities**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/engineer with knowledge of land development/land management practices | Yes | Planning and Development Department (planners), Department of Public Utilities (engineers), Public Works Department (engineers), Fresno Metropolitan Flood Control District (engineers) |
| Engineer/professional trained in construction practices related to buildings and/or infrastructure | Yes | Planning and Development Department (engineers), Department of Public Utilities (engineers), Public Works Department (engineers), Fresno Metropolitan Flood Control District (engineers) |
| Planner/engineer/scientist with an understanding of natural hazards | Yes | Planning and Development Department (planners and engineers), Department of Public Utilities (engineers), Public Works Department (engineers), Fresno Metropolitan Flood Control District (engineers) |
| Personnel skilled in GIS | Yes | Planning and Development Department, Department of Public Utilities, Public Works Department, Information Services Department |
| Full time building official | Yes | Planning and Development Department |
| Floodplain administrator | Yes | Planning and Development Department |
| Emergency manager | Yes | Fresno Fire Department |
| Grant writer | Yes | Planning and Development Department, Police Department, Public Works Department, Fire Department |
| Other personnel | Yes | California registered geologist (Department of Public Utilities), California registered environmental health specialist (Planning and Development Department), licensed water and wastewater treatment operators |
| Warning systems/services (Reverse 9-11, outdoor warning signals) | Yes | State Emergency Alert System is coordinated by emergency management team through the National Weather Service |
| Other | Yes | Emergency notification of San Joaquin River bottom residents in conjunction with the U.S. Bureau of Reclamation and Fresno County |

## E.4.3 Fiscal Mitigation Capabilities

Table E.18 identifies financial tools or resources that the City could potentially use to help fund mitigation activities.

**Table E.18: City of Fresno's Fiscal Mitigation Capabilities**

| Financial Resources | Accessible/Eligible to Use (Yes/No) | Comments |
|---|---|---|
| Community Development Block Grants | Yes | Geographically restricted to designated portions of Fresno based on area income |
| Capital improvements project funding | Yes | Budgeted out of utility fees and often related to issuance of bonds; City also obtains grants, shares of state gas tax and sales taxes, ballot measure tax revenue, etc. |
| Authority to levy taxes for specific purposes | Yes | Subject to California Proposition 218 restrictions on new and increased assessments |
| Authority to levy fees and fines, and to recover costs through lien processes, for nuisance abatement | Yes | Subject to an appeal process that involves administrative law judges retained by the City |
| Fees for water, sewer, gas, or electric services | Yes | Water, sewer, solid waste, code enforcement (cleanup) |

| Financial Resources | Accessible/Eligible to Use (Yes/No) | Comments |
|---|---|---|
| Impact fees for new development | Yes | Master Fee Schedule as originally chartered under the City's Urban Growth Management Ordinance |
| Incur debt through general obligation bonds | Yes | Would need vote of the taxpayers to enact. |
| Incur debt through special tax bonds | Yes | Special Assessment Districts that issue debt and incur the debt but the City only administers |
| Incur debt through private activities | Yes | The City has the capability of doing them and have in the past |
| Withhold spending or public infrastructure investment in hazard prone areas | Yes | The Department of Public Utilities retains jurisdiction over water and sewer services and determines its appropriate service areas with risk to facilities being one of the factors leading to a decision not to extend services to River bottom properties |

## E.4.4 Mitigation Outreach and Partnerships

The Fresno Department of Public Utilities, in conjunction with other agencies, provides water conservation and stormwater quality protection public information programs. The Fire Department provides personal preparedness outreach for heat and freeze emergencies and shelter-in-place information for hazardous materials emergencies. Additionally, the City has developed public service announcements for smoke detector battery life, canal safety, and fireworks safety.

The City's Joint Information System disseminates information in Spanish, and the City can obtain translation services for other languages when necessary. A Joint Information Center plan is an annex to the City of Fresno Emergency Operations Plan and provides comprehensive guidance for early warning notification in all languages and specifically the Americans with Disabilities Act (ADA) community.

Preparedness Exercises afford the opportunity to include the City of Fresno ADA Committee. Members of the committee and volunteers from the ADA community role play for realistic first responder training.

## E.4.5 Other Mitigation Efforts

- The City is a certified StormReady community through the National Weather Service.
- The Fire Department, Police Department, and Solid Waste Division are nationally accredited.
- The City has installed security systems for the wastewater treatment facility and for its surface water treatment plant. Generators are installed in critical groundwater pumping stations and these facilities are secured.

## E.4.6 Opportunities for Enhancement

Based on the capabilities assessment, the City of Fresno has several existing mechanisms in place that already help to mitigate hazards. In addition to these existing capabilities, there are also opportunities for the City to expand or improve on these policies and programs to further protect

the community. Future improvements may include providing training for staff members related to hazards or hazard mitigation grant funding in partnership with the County and Cal OES. Additional training opportunities will help to inform City staff members on how best to integrate hazard information and mitigation projects into their departments. Continuing to train City staff on mitigation and the hazards that pose a risk to the City of Fresno will lead to more informed staff members who can better communicate this information to the public. In addition, the City could work to improve the CRS rating through additional floodplain management program enhancements. This could further lower the cost of flood insurance for residents.

# E.5 Mitigation Strategy

## E.5.1 Mitigation Goals and Objectives

The City of Fresno adopts the hazard mitigation goals and objectives developed by the HMPC and described in Chapter 5 Mitigation Strategy.

### Incorporation into Existing Planning Mechanisms

The information contained within this plan, including results from the Vulnerability Assessment, and the Mitigation Strategy will be used by the City to help inform updates and the development of local plans, programs and policies. The Public Works Department may utilize the hazard information when implementing Capital Improvement projects and the Planning and Development Department may utilize the hazard information when reviewing a site plan or other type of development applications. The City will also incorporate this LHMP into the Safety Element of their General Plan, as recommended by Assembly Bill (AB) 2140.

As noted in Chapter 7 Plan Implementation, the HMPC representatives from Fresno will report on efforts to integrate the hazard mitigation plan into local plans, programs and policies and will report on these efforts at the annual HMPC plan review meeting.

### Continued Compliance with the National Flood Insurance Program

In addition to the mitigation actions identified herein the City will continue to comply with the National Flood Insurance Program as specified in General Plan Policy NS-3-j: *"National Flood Insurance Program. Continue to participate in the National Flood Insurance Program (NFIP) by ensuring compliance with applicable requirements."*

## E.5.2 Completed 2009 Mitigation Actions

The City of Fresno did not complete any of the mitigation actions identified in the 2009 plan. However, implementation is in progress for several of these actions and will be continued as part of the mitigation strategy for this plan update.

## E.5.3 Mitigation Actions

The planning team for the City of Fresno identified and prioritized the following mitigation actions based on the risk assessment. Background information as well as information on how each action will be implemented and administered, such as ideas for implementation, responsible office, partners, potential funding, estimated cost, and schedule are also included.

In addition to implementing the mitigation actions below the City of Fresno will be participating in the county-wide, multi-jurisdictional action of developing and conducting a multi-hazard seasonal public awareness program. The county-wide project will be led by the County in

partnership with all municipalities and special districts. The City agrees to help disseminate information on hazards provided by the County. More information on the action can be found in the base plan Chapter 5 Mitigation Strategy (see Section 5.3.3 Multi-Jurisdictional Mitigation Actions, Action #1. Develop and Conduct a Multi-Hazard Seasonal Public Awareness Program).

### *1. Establish Post-Disaster Action Plan for City Continuity of Operations Plan*

**Hazard(s) Addressed:** Multi-Hazard: dam failure, earthquake, flood, severe weather, wildfire, hazardous materials

**Issue/Background:** Establish a post-disaster action plan to be part of the City of Fresno Continuity of Operations Plan (COOP) that will include the following elements:

- Procedures for public information
- Post-disaster damage assessment
- Grant writing
- Code enforcement
- Redundant operations

The plan will also include annexes from local businesses and large employers to improve economic and employment recovery. The plan will also identify a mechanism for the City to help businesses without COOPs develop a COOP to be incorporated, as an annex, into the City's Emergency Operations Plan.

**Other Alternatives**: No action

**Responsible Office**: City of Fresno Emergency Preparedness Officer

**Priority (High, Medium, Low)**: High

**Cost Estimate**: $150,000

**Potential Funding**: Local funds, grants

**Benefits (Avoided Losses)**: This will improve response/recovery during an event through pre-planning. A City COOP and local business COOPs will reduce the impact of a disaster to the local economy and employment.

**Schedule:** Long term

**Status**: 2009 project, implementation in progress

### *2. Improve the City's Capabilities for Sheltering Animals in a Disaster*

**Hazard(s) Addressed**: Multi-Hazard: dam failure, earthquake, flood, severe weather, wildfire, hazardous materials

**Issue/Background**: During a disaster, not only do people need to be rescued, but their pets do also. Hurricane Katrina showed the nation that shelters do not typically allow pets, so pets may be left behind when their owners evacuate. The care of the animals left behind falls to local animal shelters. Currently, the SPCA Animal Shelter does not have the supplies to handle a large scale animal emergency. The City has approximately 18,000 licensed dogs. If a disaster occurred, they would only be able to house a small percentage of them. Overcrowding of animals usually causes diseases and loss of animal life. Purchasing new cages would alleviate some of the overcrowding created by a disaster.

**Other Alternatives**: Ask other agencies for supplies, if they have them available.

**Responsible Office**: City of Fresno Emergency Preparedness Officer

**Priority (High, Medium, Low)**: High

**Cost Estimate**: $50,000

**Potential Funding**: General fund

**Benefits (Avoided Losses)**: This will cut down on the spread of disease and animal loss during an emergency or disaster.

**Schedule:** Short term

**Status**: 2009 project, implementation in progress

### *3. Train and Certify City Inspectors to Conduct Post-Disaster Damage Assessment*

**Hazard(s) Addressed:** Multi-Hazard: dam failure, earthquake, flood, severe weather, wildfire, hazardous materials

**Issue/Background**: City inspectors play a vital role in post-disaster building assessment and damage assessment. Pre-training and certification is vital in response and recovery to reduce loss of life, relocate populations, and ensure the rebuilding of local economies.

**Other Alternatives**: No action

**Responsible Office**: City of Fresno Emergency Preparedness Officer and Planning and Development Department

**Priority (High, Medium, Low)**: High

**Cost Estimate**: $250,000

**Potential Funding**: Grants

**Benefits (Avoided Losses)**: This will improve response/recovery during an event through pre-training and certification of individuals responsible for performing assessment of structures and facilities impacted by disasters. Certification will also allow qualified staff to mobilize with the State of California Office of Emergency Services (Region 5) Urban Search and Rescue Task Force.

**Schedule:** Long term

**Status**: 2009 project, implementation not yet started

### *4. Implement a Flood Awareness Program for the Public*

**Hazard(s) Addressed:** Flood

**Issue/Background**: The City needs a program to educate flood-prone property owners along the San Joaquin River and in frequent annual flooding areas about the flood threat and how best to prepare, mitigate, and insure their properties.

**Other Alternatives**: No action

**Responsible Office**: City of Fresno Emergency Preparedness Officer and Planning and Development Department

**Priority (High, Medium, Low)**: Medium

**Cost Estimate**: $15,000/year

**Potential Funding**: General fund, grants

**Benefits (Avoided Losses)**: This will prevent the loss of human life and economic and property losses.

**Schedule**: Long term

**Status**: 2009 project, implementation not yet started

### *5. Southwest Fresno – Recycled Water Distribution System Construction*

**Hazard(s) Addressed:** Drought

**Issue/Background**: In 2009, the State of California adopted a recycled water policy establishing a mandate to increase the use of recycled water in California by 200,000 acre-feet per year by 2020 and an additional 300,000 acre-feet per year by 2030. The Recycled Water Master Plan prepared by the City of Fresno, Department of Public Utilities (DPU), identifies opportunities to assist with compliance of this law by reducing groundwater pumping and replacing groundwater with recycled water for non-potable purposes (i.e. outdoor irrigation, dust control, fountains, etc.). On April 11, 2013, the Council adopted the Recycled Water Master Plan and associated environmental documents.

In 2017, the DPU commissioned a 5 MGD Tertiary Treatment Facility at the Fresno-Clovis Regional Wastewater Treatment Facility. DPU is currently constructing a Recycled Water Distribution System in Southwest Fresno to deliver recycled water to parks, cemeteries, schools, agricultural uses, etc., to offset potable water irrigation demands. This will help mitigate drought by enabling the use of recycled water for certain uses instead of tapping potable water supplies.

**Other Alternatives**: DPU has a Water Shortage Contingency Plan (WSCP) which was updated in the City of Fresno's 2015 Urban Water Management Plan to manage water shortages including drought conditions. The WSCP consists of four stages allowing the City to ultimately reduce its water demand to a level commensurate with the water supplies available to a maximum reduction of 50 percent.

**Responsible Office**: City of Fresno Department of Public Utilities

**Priority (High, Medium, Low)**: High

**Cost Estimate**: $75,000,000

**Potential Funding**: California State Water Resources Control Board – Clean Water State Revolving Fund

**Benefits (Avoided Losses)**: Reduced ground water pumping by using recycled water for non-potable purposes.

**Schedule:** Ongoing with completion in 2019

**Status**: New project

### *6. Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation*

**Hazard(s) Addressed:** Drought

**Issue/Background:** The Kings subbasin underlays the City of Fresno and like many groundwater basins throughout the State, this subbasin is in overdraft condition with underground aquifers adversely impacted by overuse. Such impacts include significant decline in water storage and water levels, degradation of water quality, and land subsidence resulting in the permanent loss of storage capacity. The Sustainable Groundwater Management Act (SGMA) provides for the establishment of local Groundwater Sustainability Agencies (GSAs) to manage groundwater sustainability within groundwater subbasins defined by the California Department of Water Resources (DWR). The City of Fresno has become a joint power authority of the North Kings Groundwater Sustainability Agency, other members of the Agency include the County of Fresno, City of Kerman, City of Clovis, Biola Community Services District, Garfield Water District and International Water District. As a member of the North Kings GSA, the City of Fresno is required to participate in the development and implementation, no later than January 31, 2020, of a

Groundwater Sustainability Plan (GSP) to ensure a sustainable yield of groundwater, without causing undesirable results. Failure to comply with that requirement could result in the State asserting its power to manage local groundwater resources. Participation in the North Kings GSA and the implementation of a GSP will allow the City to maintain sustainable groundwater supplies while providing insurance against periods of long-term drought, a high significance hazard for the City of Fresno.

**Other Alternatives**: None, compliance required by law, failure to meet requirements will result in State intervention and oversight.

**Responsible Office**: City Engineer and North Kings GSA

**Priority (High, Medium, Low):** High

**Cost Estimate:** Varies by GSA for preparation of the required GSP. Further expenses are anticipated to be accrued for the planning and construction of groundwater recharge projects.

**Potential Funding**: Property owner assessments along with grant funding opportunities from the State.

**Benefits (Avoided Losses):** Preparation and implementation of the GSP by the respective GSAs will result in the management of groundwater in a manner that is sustainable and avoids undesirable results as defined by the California State Department of Water Resources.

**Schedule:** GSAs must complete and submit the required GSP to DWR by January 31, 2020, which is to be fully implemented and result in sustainability of the groundwater basin, with no undesirable effects, by the year 2040.

**Status:** New project in 2018

# Attachment 5
# Notice of Public Hearing

Notice of Public Hearing

City of Fresno

Draft 2020 Urban Water Management Plan,

Draft 2020 Water Shortage Contingency Plan, &

Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed"

The City of Fresno (City) will hold a public hearing at 10:05 A.M. on Thursday, July 15, 2021, at the City Council Chambers at the City Hall located at 2600 Fresno Street to receive public comments on the City's Draft 2020 Urban Water Management Plan (2020 UWMP), the City's Draft 2020 Water Shortage Contingency Plan (2020 WSCP), and a Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed" (Addendum). The Draft 2020 UWMP addresses current and projected water supply availability and reliability and provides a comparison with current and projected water demands through the year 2045. The Draft 2020 WSCP details the City's potential actions in response to a severe water shortage or water supply emergency. Sections 1.3, 1.4, 1.5, and 1.8 of the Draft 2020 WSCP were revised from a version of the document that was previously released on Monday, July 28, 2021. The Draft Addendum discusses the City's reduced reliance on the Sacramento-San Joaquin River Delta surface water.

Interested citizens are invited to make public comments on the three documents at the public hearing. Services of an interpreter and additional accommodations such as assistive listening devices can be made available. Requests for accommodations should be made more than five working days but no later than 48 hours prior to the scheduled hearing. Please contact Mr. Peter Maraccini at 559-621-1603 or Peter.Maraccini@Fresno.gov.

The three documents will be made available for public review starting July 1, 2021. Physical copies of the three documents can be found at the following Fresno County Libraries: Central Library (2420 Mariposa St.), Woodward Park Regional Library (944 E Perrin Ave.), Betty Rodriguez Regional Library (3040 N Cedar Ave.), and Sunnyside Regional Library (5566 E Kings Canyon Rd.). Electronic copies of the three documents are available online at https://www.fresno.gov/publicutilities/about-dpu/plans-reports-resources/. Documents can be provided in alternate formats upon request.

Comments may be submitted by calling Utilities Planning & Engineering at 559-621-1603, by writing to Mr. Peter Maraccini, Utilities Planning & Engineering Division, 2101 G Street

Bldg. A, Fresno, CA 93706, or by emailing at Peter.Maraccini@Fresno.gov. All written comments must be received no later than July 14, 2021, at 11:59 P.M.

# Attachment 6
# Resolution Approving the WSCP

RESOLUTION NO. 2021-197

A RESOLUTION OF THE COUNCIL OF THE CITY OF FRESNO, CALIFORNIA, TO ADOPT THE 2020 WATER SHORTAGE CONTINGENCY PLAN AND AUTHORIZE THE CITY MANAGER TO DECLARE THE APPROPRIATE WATER CONSERVATION STAGES AND IMPLEMENT THE ASSOCIATED SHORTAGE RESPONSE ACTIONS

WHEREAS, the Urban Water Management Planning Act, codified at California Water Code Sections 10610, et seq., requires every urban water supplier to prepare and adopt an Urban Water Management Plan (UWMP) and update said plan at least once every five years; and

WHEREAS, Water Code Section 10632 requires every urban water supplier to prepare and adopt a Water Shortage Contingency Plan (WSCP) as part of its UWMP; and

WHEREAS, the WSCP details intended City actions to respond to water shortages; and

WHEREAS, as an urban water supplier, the City of Fresno has prepared a WSCP that complies with the requirements of the Urban Water Management Planning Act; and

WHEREAS, the City consulted with, and requested comments from, regional water related agencies such as the County of Fresno, Fresno Irrigation District, the City of Clovis, etc., as required by Water Code Section 10641; and

WHEREAS, prior to the public hearing on July 15, 2021, the City made the draft 2020 WSCP available for public inspection and placed copies for public review at the following Fresno County Libraries: Central Library, Woodward Park Regional Library,



Date Adopted: 07/15/2021
Date Approved: 07/19/2021
Effective Date: 07/19/2021

Betty Rodriguez Regional Library, and Sunnyside Regional Library, as well as making electronic copies available to agencies and the public, as required by Water Code Section 10642; and

WHEREAS, on July 1, 2021, and July 8, 2021, respectively, the City published notices on the City Clerk's website and in the Fresno Bee that on July 15, 2021 at 10:05 a.m. a public hearing regarding the draft 2020 WSCP would be held in Council Chambers at which time public comment on the plan would be received, as required by Water Code Section 10642; and

WHEREAS, on July 15, 2021, at 10:05 a.m. the public hearing was conducted in Council Chambers at which the public was provided the opportunity to comment on the 2020 WSCP.

NOW, THEREFORE, BE IT RESOLVED BY THE Council of the City of Fresno as follows:

1. The City hereby adopts the 2020 Water Shortage Contingency Plan.

2. The City Manager, or designee, is hereby authorized and directed to file the City of Fresno 2020 Water Shortage Contingency Plan with the California Department of Water Resources, the California State Library, and the County of Fresno within 30 days after adoption.

3. The City Manager, or designee, is hereby authorized to declare the appropriate Water Conservation Stages outlined in the 2020 Water Shortage Contingency Plan and implement the associated shortage response actions specified for the appropriate Water Conservation Stage in the Water Shortage Contingency Plan.

* * * * * * * * * * * * * * *

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, BRIANA PARRA, Interim City Clerk of the City of Fresno, certify that the foregoing resolution was adopted by the Council of the City of Fresno, at a regular meeting held on the 15th day of July, 2021.

AYES :Arias, Esparza, Karbassi, Maxwell, Chavez
NOES :None
ABSENT :Bredefeld, Soria
ABSTAIN :None

Mayor Approval: July 19th, 2021
Mayor Approval/No Return: N/A, 2021
Mayor Veto: N/A, 2021
Council Override Veto: N/A, 2021

BRIANA PARRA, CMC
Interim City Clerk

BY: Briana Parra 7/20/2021
Deputy Date

APPROVED AS TO FORM:
DOUGLAS T. SLOAN
City Attorney

BY: 7/20/21
Jennifer M. Quintanilla Date
Senior Deputy

*July 19, 2021*

Council Adoption: 07/15/2021
Mayor Approval:
Mayor Veto:
Override Request:

TO: MAYOR JERRY DYER

FROM BRIANA PARRA, CMC
Interim City Clerk

SUBJECT: TRANSMITTAL OF COUNCIL ACTION FOR APPROVAL OR VETO

At the City Council meeting of July 15, 2021, Council adopted the attached Resolution No. 2021-197, entitled ***RESOLUTION – **Adopting 2020 Water Shortage Contingency Plan and authorizing the City Manager to declare the appropriate water conservation stages and implement the associated shortage response actions (Subject to Mayor's veto).** Item 10:05 A.M. (4), File ID21-22925, by the following vote:

| | | |
|---|---|---|
| Ayes | : | Arias, Esparza, Karbassi, Maxwell, Chavez |
| Noes | : | None |
| Absent | : | Bredefeld, Soria |
| Abstain | : | None |

Please indicate either your formal approval or veto by completing the following sections and executing and dating your action. Please file the completed memo with the Clerk's office on or before July 29, 2021. In computing the ten day period required by Charter, the first day has been excluded and the tenth day has been included unless the 10th day is a Saturday, Sunday, or holiday, in which case it has also been excluded. Failure to file this memo with the Clerk's office within the required time limit shall constitute approval of the ordinance, resolution or action, and it shall take effect without the Mayor's signed approval.

**APPROVED /** **NO RETURN:** _____

**VETOED** for the following reasons: (Written objections are required by Charter; attach additional sheets if necessary.)

_____

_____

_____ Date: 7/19/2021

Jerry Dyer, Mayor

**COUNCIL OVERRIDE ACTION:** Date: _____

| | | |
|---|---|---|
| Ayes | : | |
| Noes | : | |
| Absent | : | |
| Abstain | : | |

RECEIVED
2021 JUL 19 P 4:52
CITY OF FRESNO
CITY CLERK'S OFFICE

# K

# Outreach Events

| 2015 Outreach Events | | |
|---|---|---|
| Date | Name of Event | Description |
| Jan | "Creating a Water-wise Landscape: Seven Steps to Follow our Climate" | Landscape Workshop by Susan Stiltz as SPEAKER for City employees at City Hall 2600 Fresno St 93721.Distribute literature E. Social media: sent email with flier to City employees. Contact: Melany Felton. LITERATURE |
| Jan | Fresno Chinese New Year Parade | Outreach booth providing water saving info & rebate information |
| March | Spring Festival - Clovis Botanical Garden | Outreach booth providing water saving info & rebate information |
| April | Home Depot - Riverpark Kid's Day Spring Event | Hands on activity for kids, drought tolerant plants planting, literature for adults |
| April | America's Party for the Planet | Outreach booth providing water saving info & rebate information |
| April | Sequoia Middle School Outdoor Club | Outreach booth providing water saving info & rebate information |
| May | Spring Fling - Master Gardener | Provided literature for event held at Garden of the Sun |
| May | Madden Library Water-wise Plant Exchange event | Water wise garden speaker, materials handed out |
| May | Water-Wise Plant Exchange | Large community event collaborating with several agencies to share water-wise plants & information, hands on activities |
| June | Kids Water Camp | Large one day event, hands on activites, educational for kids 3rd grade (all elementary schools invited to participate) |
| July | Fresno Home Remodeling & Decorating Show | Fresno Fairgrounds 3 day event. Outreach booth with visual displays & information |
| Sept | Carnaval Children's Festival | Mosqueda Center Outreach booth, providing water saving information & rebates |
| Sept | Fresno State partnership | Susan Hawksworth extended education. Began planning for Feb classes with landscape specialists |
| Oct | Clovis Botanical Plant Sale & Fair | Outreach booth providing water saving info & rebate information |
| Nov | Fresno Fall Improvement Show | Inspiration Park Grand opening |
| Nov | Inspiration Park Grand opening | Outreach booth providing water saving info & rebate information |

| 2016 Outreach Events | | |
|---|---|---|
| March | Fresno Home & Garden Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |

| | | |
|---|---|---|
| March | Spring Into Your Garden | Outreach booth providing water saving info & rebate information. Visual displays |
| April | Water Planet Day | Outreach booth providing water saving info & rebate information. Visual displays |
| April | 8th Annual Water-Wise Plant Exchange | Large community event collaborating with several agencies to share water-wise plants & information, hands on activities |
| May | Senior Spring Fling @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information. Visual displays |
| July | Fresno Remodeling & Decorating Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |
| Sept | Carnaval @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information. Visual displays |
| Oct | Clovis Botanical Plant Sale & Fair | Outreach booth providing water saving info & rebate information. Visual displays |
| Nov | Fresno Fall Home Improvement Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |
| Dec | Fresno Neighborhood Revitalization | Work with FNR team to reach customers in lower income areas about City services. Orchard St. & Grant Ave |

| 2017 Outreach Events | | |
|---|---|---|
| Jan | Hmong New Year | Outreach booth providing water saving info & rebate information. Hmong translator & printed materials in Hmong |
| Feb | Fresno Neighborhood Revitalization | Work with FNR team to reach customers in lower income areas about City services. Hildago Elementary 3550 E Thomas 93702 |
| March | Fresno Home & Garden Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |
| March | Fresno Neighborhood Revitalization | Work with FNR team to reach customers in lower income areas about City services. Leavenworth Elementary School, 4420 E Thomas |

| | | |
|---|---|---|
| April | Fresno Neighborhood Revitalization | Work with FNR team to reach customers in lower income areas about City services. Webster Elementary School, 2600 E Tyler 93701 |
| April | 9th Annual Water-Wise Plant Exchange | Large community event collaborating with several agencies to share water-wise plants & information, hands on activities |
| April | Senior Spring Fling @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information |
| May | Fresno Neighborhood Revitalization | Work with FNR team to reach customers in lower income areas about City services. Slater Elementary school 4472 N Emerson 93705 |
| July | Fresno Remodeling & Decorating Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |
| Sept | Carnaval @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information |
| Oct | Clovis Botanical Plant Sale & Fair | Outreach booth providing water saving info & rebate information. Visual displays |
| Oct | Make A Difference Day @ Chukchansi Park | Outreach booth providing water saving info & rebate information. Visual displays |
| Nov | Fresno Fall Home Improvement Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 day event |

| 2018 Outreach Events | | |
|---|---|---|
| March | Fresno Home & Garden Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 day event |
| March | Spring Into Your Garden Festival | Outreach booth providing water saving info & rebate information. Visual displays |
| April | 10th Annual Water Wise Plant Exchange | Large community event collaborating with several agencies to share water-wise plants & information, hands on activities |
| May | Senior Spring Fling @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information |
| July | Fresno Remodeling & Decorating Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |

| | | |
|---|---|---|
| Sept | Carnaval @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information. Visual Display |
| Sept | Central California Women's Conference | Outreach booth providing water saving info & rebate information. Visual Display |
| Oct | Clovis Botanical Plant Sale & Fair | Outreach booth providing water saving info & rebate information. Visual Display |
| Nov | Fresno Fall Home Improvement Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 day event |

| 2019 Outreach Events | | |
|---|---|---|
| March | Fresno Home & Garden Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 day event |
| March | Spring Into Your Garden Festival | Outreach booth providing water saving info & rebate information. Visual displays |
| April | Outreach booth @ Manchester Mall | Outreach booth providing water saving info & rebate information. Visual displays |
| April | Party for the Planet @ Chaffee Zoo | Outreach booth providing water saving info & rebate information. Visual displays |
| May | Senior Spring Fling @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information. Visual displays |
| May | 11th Annual Water Wise Plant Exchange | Large community event collaborating with several agencies to share water-wise plants & information, hands on activities |
| July | Fresno Remodeling & Decorating Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 days |
| Sept | Carnaval @ Mosqueda Community Center | Outreach booth providing water saving info & rebate information. Visual displays |
| Oct | Clovis Botanical Plant Sale & Fair | Outreach booth providing water saving info & rebate information. Visual displays |
| Nov | Fresno Fall Home Improvement Show | Outreach booth providing water saving info & rebate information. Visual displays. 3 day event |

| 2020 Outreach Events |
|---|
| All Outreach Suspended |

# L

# Notification Letters

City of FRESNO

**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Shay Bakman
Bakman Water Company
PO Box 7965
Fresno, CA 93747

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Bakman:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Scott Redelfs
City of Clovis Public Utilities
155 N. Sunnyside Ave
Clovis, CA 93611

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Redelfs:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

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Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Bill Stretch
Fresno Irrigation District
2907 South Maple Ave
Fresno, CA 93725

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Stretch:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

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Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of FRESNO

**Department of Public Utilities**

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2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Peter Sanchez
Fresno Metropolitan Flood Control District
5469 East Olive Ave
Fresno, CA 93727

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Sanchez:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

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Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Steven White
Fresno County Public Works
2220 Tulare St, 6th Floor
Fresno, CA 93721

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. White:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

We invite your agency's participation in the City's preparation of the 2020 UWMP and WSCP. A draft of the updated 2020 UWMP will be made available for public review and a public hearing will be scheduled for mid-June 2021 to hear public comments, discuss and consider adoption of the 2020 UWMP and WSCP. The City will notify you when the draft documents are released and of the date, time, and location of the subsequent public hearing.

Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Jason Phillips
Friant Water Authority
4969 E. McKinley Ave, Suite 201
Fresno, CA 93727

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Phillips:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

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Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

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2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Nick Keller
Garfield Water District
PO Box 337
Clovis, CA 93613

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Keller:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

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Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

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2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Moises Ortiz
Malaga County Water District
3580 South Frank Street
Fresno, CA 93725-2511

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Ortiz:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

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Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of FRESNO

**Department of Public Utilities**

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559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Kassy D. Chauhan, PE
North Kings Groundwater Sustainability Agency
2907 S. Maple Avenue
Fresno, CA 93725

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mrs. Chauhan:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

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Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of FRESNO

**Department of Public Utilities**

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Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Jason Franklin
Pinedale County Water District
480 West Birch Ave
Pinedale, CA 93650

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Franklin:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

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Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

City of
FRESNO
**Department of Public Utilities**

Utilities Planning & Engineering
2101 G Street, Bldg. A
Fresno, California 93706
559-621-8600 – FAX 559-498-4126
www.fresno.gov

March 16, 2021

ELECTRONIC MAIL and sent USPS

Michael P. Jackson, PE
United States Bureau of Reclamation South-Central California Area Office
1243 N Street
Fresno, CA 93721-1813

**SUBJECT**: NOTICE OF PREPARATION FOR CITY OF FRESNO 2020 URBAN WATER MANAGEMENT PLAN AND WATER SHORTAGE CONTINGENCY PLAN

Dear Mr. Jackson:

In accordance with the Urban Water Management Planning Act (California Water Code Sections 10610 to 10656), the City of Fresno (City) is required to update its Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP) to meet the California Department of Water Resources (DWR) requirements for a 2020 UWMP and WSCP.

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Until that time, if you would like more information regarding the City's 2020 UWMP and WSCP, please contact Mr. Peter Maraccini by telephone at 559-621-1603 or by email at Peter.Maraccini@Fresno.gov.

Sincerely,

Brock D. Buche, PE, PLS
Assistant Director

Notice of Public Hearing

City of Fresno

Draft 2020 Urban Water Management Plan,

Draft 2020 Water Shortage Contingency Plan, &

Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed"

The City of Fresno (City) will hold a public hearing at 10:05 A.M. on Thursday, July 15, 2021, at the City Council Chambers at the City Hall located at 2600 Fresno Street to receive public comments on the City's Draft 2020 Urban Water Management Plan (2020 UWMP), the City's Draft 2020 Water Shortage Contingency Plan (2020 WSCP), and a Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed" (Addendum). The Draft 2020 UWMP addresses current and projected water supply availability and reliability and provides a comparison with current and projected water demands through the year 2045. The Draft 2020 WSCP details the City's potential actions in response to a severe water shortage or water supply emergency. Sections 1.3, 1.4, 1.5, and 1.8 of the Draft 2020 WSCP were revised from a version of the document that was previously released on Monday, July 28, 2021. The Draft Addendum discusses the City's reduced reliance on the Sacramento-San Joaquin River Delta surface water.

Interested citizens are invited to make public comments on the three documents at the public hearing. Services of an interpreter and additional accommodations such as assistive listening devices can be made available. Requests for accommodations should be made more than five working days but no later than 48 hours prior to the scheduled hearing. Please contact Mr. Peter Maraccini at 559-621-1603 or Peter.Maraccini@Fresno.gov.

The three documents will be made available for public review starting July 1, 2021. Physical copies of the three documents can be found at the following Fresno County Libraries: Central Library (2420 Mariposa St.), Woodward Park Regional Library (944 E Perrin Ave.), Betty Rodriguez Regional Library (3040 N Cedar Ave.), and Sunnyside Regional Library (5566 E Kings Canyon Rd.). Electronic copies of the three documents are available online at https://www.fresno.gov/publicutilities/about-dpu/plans-reports-resources/. Documents can be provided in alternate formats upon request.

Comments may be submitted by calling Utilities Planning & Engineering at 559-621-1603, by writing to Mr. Peter Maraccini, Utilities Planning & Engineering Division, 2101 G Street Bldg. A, Fresno, CA 93706, or by emailing at Peter.Maraccini@Fresno.gov. All written comments must be received no later than July 14, 2021, at 11:59 P.M.

McClatchy

Beaufort Gazette
Belleville News-Democrat
Bellingham Herald
Bradenton Herald
Centre Daily Times
Charlotte Observer
Columbus Ledger-Enquirer
Fresno Bee
The Herald - Rock Hill
Herald Sun - Durham
Idaho Statesman
Island Packet
Kansas City Star
Lexington Herald-Leader
Merced Sun-Star
Miami Herald
el Nuevo Herald - Miami
Modesto Bee
Raleigh News & Observer
The Olympian
Sacramento Bee
Fort Worth Star-Telegram
The State - Columbia
Sun Herald - Biloxi
Sun News - Myrtle Beach
The News Tribune Tacoma
The Telegraph - Macon
San Luis Obispo Tribune
Tri-City Herald
Wichita Eagle

# AFFIDAVIT OF PUBLICATION

| Account # | Order Number | Identification | Order PO | Amount | Cols | Depth |
|---|---|---|---|---|---|---|
| 59161 | 92995 | Print Legal Ad - IPL0030763 | | $861.84 | 2 | 5.31 |

**Attention:** City of

City of Fresno Dept. Public Utilities
2101 G Street Bldg A
Fresno, CA 93706

PUBLIC NOTICE

**Notice of Public Hearing**

**City of Fresno**
Draft 2020 Urban Water Management Plan,

Draft 2020 Water Shortage Contingency Plan, &

Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed"

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IPL0030763
Jul 1 2021

## COUNTY OF DALLAS
## STATE OF TEXAS

The undersigned states:

McClatchy Newspapers in and on all dates herein stated was a corporation, and the owner and publisher of The Fresno Bee.
The Fresno Bee is a daily newspaper of general circulation now published, and on all-the-dates herein stated was published in the City of Fresno, County of Fresno, and has been adjudged a newspaper of general circulation by the Superior Court of the County of Fresno, State of California, under the date of November 28, 1994, Action No. 520058-9.
The undersigned is and on all dates herein mentioned was a citizen of the United States, over the age of twenty-one years, and is the principal clerk of the printer and publisher of said newspaper; and that the notice, a copy of which is hereto annexed, marked Exhibit A, hereby made a part hereof, was published in The Fresno Bee in each issue thereof (in type not smaller than nonpareil), on the following dates.

No. of Insertions: 1

Beginning Issue of: 07/01/2021

Ending Issue of: 07/01/2021

Isabel Capps

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

Dated: 07/01/2021

Amanda Grisham

Notary Public in and for the state of Texas, residing in Dallas County

AMANDA DAWN GRISHAM
My Notary ID # 132031326
Expires May 30, 2023

**Extra charge for lost or duplicate affidavits.**
**Legal document please do not destroy!**

McClatchy

Beaufort Gazette
Belleville News-Democrat
Bellingham Herald
Bradenton Herald
Centre Daily Times
Charlotte Observer
Columbus Ledger-Enquirer
Fresno Bee
The Herald - Rock Hill
Herald Sun - Durham
Idaho Statesman
Island Packet
Kansas City Star
Lexington Herald-Leader
Merced Sun-Star
Miami Herald
el Nuevo Herald - Miami
Modesto Bee
Raleigh News & Observer
The Olympian
Sacramento Bee
Fort Worth Star-Telegram
The State - Columbia
Sun Herald - Biloxi
Sun News - Myrtle Beach
The News Tribune Tacoma
The Telegraph - Macon
San Luis Obispo Tribune
Tri-City Herald
Wichita Eagle

# AFFIDAVIT OF PUBLICATION

| Account # | Order Number | Identification | Order PO | Amount | Cols | Depth |
|---|---|---|---|---|---|---|
| 59161 | 95606 | Print Legal Ad - IPL0031437 | | $861.84 | 2 | 53 L |

**Attention:** City of

City of Fresno Dept. Public Utilities
2101 G Street Bldg A
Fresno, CA 93706

PUBLIC NOTICE

**Notice of Public Hearing**

**City of Fresno**
Draft 2020 Urban Water Management Plan,

Draft 2020 Water Shortage Contingency Plan, &

Draft Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed"

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Interested citizens are invited to make public comments on the three documents at the public hearing. Services of an interpreter and additional accommodations such as assistive listening devices can be made available. Requests for accommodations should be made more than five working days but no later than 48 hours prior to the scheduled hearing. Please contact Mr. Peter Maraccini at 559-621-1603 or **Peter.Maraccini@Fresno.gov**.

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IPL0031437
Jul 8 2021

## COUNTY OF DALLAS
## STATE OF TEXAS

The undersigned states:

McClatchy Newspapers in and on all dates herein stated was a corporation, and the owner and publisher of The Fresno Bee.
The Fresno Bee is a daily newspaper of general circulation now published, and on all-the-dates herein stated was published in the City of Fresno, County of Fresno, and has been adjudged a newspaper of general circulation by the Superior Court of the County of Fresno, State of California, under the date of November 28, 1994, Action No. 520058-9.
The undersigned is and on all dates herein mentioned was a citizen of the United States, over the age of twenty-one years, and is the principal clerk of the printer and publisher of said newspaper; and that the notice, a copy of which is hereto annexed, marked Exhibit A, hereby made a part hereof, was published in The Fresno Bee in each issue thereof (in type not smaller than nonpareil), on the following dates.

No. of Insertions: 1

Beginning Issue of: 07/08/2021

Ending Issue of: 07/08/2021

Isabel Capps

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

Dated: 07/08/2021

Amanda Grisham

Notary Public in and for the state of Texas, residing in Dallas County

AMANDA DAWN GRISHAM
My Notary ID # 132031326
Expires May 30, 2023

**Extra charge for lost or duplicate affidavits.**
**Legal document please do not destroy!**

# M

# Adopting Resolutions

RESOLUTION NO. 2021-196

A RESOLUTION OF THE COUNCIL OF THE CITY OF FRESNO, CALIFORNIA, TO ADOPT THE 2020 URBAN WATER MANAGEMENT PLAN

WHEREAS, the Urban Water Management Planning Act, codified at California Water Code Sections 10610, et seq., requires every urban water supplier to prepare and adopt an Urban Water Management Plan (UWMP) and update said plan at least once every five years; and

WHEREAS, the City adopted its current UWMP on June 23, 2016; and

WHEREAS, the requirements of an UWMP are to generally: (1) assess current and projected water supplies, (2) evaluate water demand and customer types, (3) evaluate reliability of water supplies, (4) compare demand and supply projections for a 20-year period, and (5) detail response actions in the event of a water shortage; and

WHEREAS, as an urban water supplier, the City of Fresno has prepared the UWMP to comply with the requirements of the Urban Water Management Planning Act; and

WHEREAS, the City consulted with, and requested comments from, regional water related agencies such as the County of Fresno, Fresno Irrigation District, the City of Clovis, etc., as required by Water Code Section 10641; and

WHEREAS, prior to the public hearing on July 15, 2021, the City made the draft 2020 UWMP available for public inspection and placed copies for public review at the following Fresno County Libraries: Central Library, Woodward Park Regional Library, Betty Rodriguez Regional Library, and Sunnyside Regional Library, as well as making



Date Adopted: 07/15/2021
Date Approved: 07/19/2021
Effective Date: 07/19/2021

electronic copies available to agencies and the public, as required by Water Code Section 10642; and

WHEREAS, on July 1, 2021, and July 8, 2021, respectively, the City published notices on the City Clerk's website and in the Fresno Bee that on July 15, 2021 at 10:05 a.m. a public hearing regarding the draft 2020 UWMP would be held in Council Chambers at which public comment on the plan would be received, as required by Water Code Section 10642; and

WHEREAS, on July 15, 2021, at 10:05 a.m. the public hearing was conducted in Council Chambers at which the public was provided the opportunity to comment on the 2020 UWMP.

NOW, THEREFORE, BE IT RESOLVED BY THE Council of the City of Fresno as follows:

1. The City hereby adopts the 2020 Urban Water Management Plan.

2. The City Manager, or designee, is hereby authorized and directed to file the City of Fresno 2020 Urban Water Management Plan with the California Department of Water Resources, the California State Library, and the County of Fresno within 30 days after adoption.

* * * * * * * * * * * * * * *

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, BRIANA PARRA, Interim City Clerk of the City of Fresno, certify that the foregoing resolution was adopted by the Council of the City of Fresno, at a regular meeting held on the 15th day of July, 2021.

AYES :Arias, Esparza, Karbassi, Maxwell, Chavez
NOES :None
ABSENT :Bredefeld, Soria
ABSTAIN :None

Mayor Approval: July 19th, 2021
Mayor Approval/No Return: N/A, 2021
Mayor Veto: N/A, 2021
Council Override Veto: N/A, 2021

BRIANA PARRA, CMC
Interim City Clerk

BY: Briana Parra 7/20/2021
Deputy Date

APPROVED AS TO FORM:
DOUGLAS T. SLOAN
City Attorney

BY: 7/20/21
Jennifer M. Quintanilla Date
Senior Deputy

*July 19, 2021*

Council Adoption: 07/15/2021
Mayor Approval:
Mayor Veto:
Override Request:

TO: MAYOR JERRY DYER

FROM BRIANA PARRA, CMC
Interim City Clerk

SUBJECT: TRANSMITTAL OF COUNCIL ACTION FOR APPROVAL OR VETO

At the City Council meeting of July 15, 2021, Council adopted the attached Resolution No. 2021-196, entitled ***RESOLUTION – Adopting 2020 Urban Water Management Plan (Subject to Mayor's veto).** Item 10:05 A.M. (3), File ID21-22925, by the following vote:

| | | |
|---|---|---|
| Ayes | : | Arias, Esparza, Karbassi, Maxwell, Chavez |
| Noes | : | None |
| Absent | : | Bredefeld, Soria |
| Abstain | : | None |

Please indicate either your formal approval or veto by completing the following sections and executing and dating your action. Please file the completed memo with the Clerk's office on or before July 29, 2021. In computing the ten day period required by Charter, the first day has been excluded and the tenth day has been included unless the 10th day is a Saturday, Sunday, or holiday, in which case it has also been excluded. Failure to file this memo with the Clerk's office within the required time limit shall constitute approval of the ordinance, resolution or action, and it shall take effect without the Mayor's signed approval.

**APPROVED /** **NO RETURN:** _____

**VETOED** for the following reasons: (Written objections are required by Charter; attach additional sheets if necessary.)

_____

_____

_____ Date: 7/19/2021

Jerry Dyer, Mayor

**COUNCIL OVERRIDE ACTION:** Date: _____

| | | |
|---|---|---|
| Ayes | : | |
| Noes | : | |
| Absent | : | |
| Abstain | : | |

RECEIVED
2021 JUL 19 P 4:52
CITY OF FRESNO
CITY CLERK'S OFFICE

RESOLUTION NO. 2021-197

A RESOLUTION OF THE COUNCIL OF THE CITY OF FRESNO, CALIFORNIA, TO ADOPT THE 2020 WATER SHORTAGE CONTINGENCY PLAN AND AUTHORIZE THE CITY MANAGER TO DECLARE THE APPROPRIATE WATER CONSERVATION STAGES AND IMPLEMENT THE ASSOCIATED SHORTAGE RESPONSE ACTIONS

WHEREAS, the Urban Water Management Planning Act, codified at California Water Code Sections 10610, et seq., requires every urban water supplier to prepare and adopt an Urban Water Management Plan (UWMP) and update said plan at least once every five years; and

WHEREAS, Water Code Section 10632 requires every urban water supplier to prepare and adopt a Water Shortage Contingency Plan (WSCP) as part of its UWMP; and

WHEREAS, the WSCP details intended City actions to respond to water shortages; and

WHEREAS, as an urban water supplier, the City of Fresno has prepared a WSCP that complies with the requirements of the Urban Water Management Planning Act; and

WHEREAS, the City consulted with, and requested comments from, regional water related agencies such as the County of Fresno, Fresno Irrigation District, the City of Clovis, etc., as required by Water Code Section 10641; and

WHEREAS, prior to the public hearing on July 15, 2021, the City made the draft 2020 WSCP available for public inspection and placed copies for public review at the following Fresno County Libraries: Central Library, Woodward Park Regional Library,



Date Adopted: 07/15/2021
Date Approved: 07/19/2021
Effective Date: 07/19/2021

Betty Rodriguez Regional Library, and Sunnyside Regional Library, as well as making electronic copies available to agencies and the public, as required by Water Code Section 10642; and

WHEREAS, on July 1, 2021, and July 8, 2021, respectively, the City published notices on the City Clerk's website and in the Fresno Bee that on July 15, 2021 at 10:05 a.m. a public hearing regarding the draft 2020 WSCP would be held in Council Chambers at which time public comment on the plan would be received, as required by Water Code Section 10642; and

WHEREAS, on July 15, 2021, at 10:05 a.m. the public hearing was conducted in Council Chambers at which the public was provided the opportunity to comment on the 2020 WSCP.

NOW, THEREFORE, BE IT RESOLVED BY THE Council of the City of Fresno as follows:

1. The City hereby adopts the 2020 Water Shortage Contingency Plan.

2. The City Manager, or designee, is hereby authorized and directed to file the City of Fresno 2020 Water Shortage Contingency Plan with the California Department of Water Resources, the California State Library, and the County of Fresno within 30 days after adoption.

3. The City Manager, or designee, is hereby authorized to declare the appropriate Water Conservation Stages outlined in the 2020 Water Shortage Contingency Plan and implement the associated shortage response actions specified for the appropriate Water Conservation Stage in the Water Shortage Contingency Plan.

* * * * * * * * * * * * * * *

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, BRIANA PARRA, Interim City Clerk of the City of Fresno, certify that the foregoing resolution was adopted by the Council of the City of Fresno, at a regular meeting held on the 15th day of July, 2021.

AYES :Arias, Esparza, Karbassi, Maxwell, Chavez
NOES :None
ABSENT :Bredefeld, Soria
ABSTAIN :None

Mayor Approval: July 19th, 2021
Mayor Approval/No Return: N/A, 2021
Mayor Veto: N/A, 2021
Council Override Veto: N/A, 2021

BRIANA PARRA, CMC
Interim City Clerk

BY: Briana Parra 7/20/2021
Deputy Date

APPROVED AS TO FORM:
DOUGLAS T. SLOAN
City Attorney

BY: 7/20/21
Jennifer M. Quintanilla Date
Senior Deputy

*July 19, 2021*

Council Adoption: 07/15/2021
Mayor Approval:
Mayor Veto:
Override Request:

TO: MAYOR JERRY DYER

FROM BRIANA PARRA, CMC
Interim City Clerk

SUBJECT: TRANSMITTAL OF COUNCIL ACTION FOR APPROVAL OR VETO

At the City Council meeting of July 15, 2021, Council adopted the attached Resolution No. 2021-197, entitled ***RESOLUTION – **Adopting 2020 Water Shortage Contingency Plan and authorizing the City Manager to declare the appropriate water conservation stages and implement the associated shortage response actions (Subject to Mayor's veto).** Item 10:05 A.M. (4), File ID21-22925, by the following vote:

| | | |
|---|---|---|
| Ayes | : | Arias, Esparza, Karbassi, Maxwell, Chavez |
| Noes | : | None |
| Absent | : | Bredefeld, Soria |
| Abstain | : | None |

Please indicate either your formal approval or veto by completing the following sections and executing and dating your action. Please file the completed memo with the Clerk's office on or before July 29, 2021. In computing the ten day period required by Charter, the first day has been excluded and the tenth day has been included unless the 10th day is a Saturday, Sunday, or holiday, in which case it has also been excluded. Failure to file this memo with the Clerk's office within the required time limit shall constitute approval of the ordinance, resolution or action, and it shall take effect without the Mayor's signed approval.

**APPROVED /** **NO RETURN:** _____

**VETOED** for the following reasons: (Written objections are required by Charter; attach additional sheets if necessary.)

_____

_____

_____ Date: 7/19/2021

Jerry Dyer, Mayor

**COUNCIL OVERRIDE ACTION:** Date: _____

| | | |
|---|---|---|
| Ayes | : | |
| Noes | : | |
| Absent | : | |
| Abstain | : | |

RECEIVED
2021 JUL 19 P 4:52
CITY OF FRESNO
CITY CLERK'S OFFICE

RESOLUTION NO. 2021-198

A RESOLUTION OF THE COUNCIL OF THE CITY OF FRESNO, CALIFORNIA, TO ADOPT APPENDIX L - ADDENDUM TO THE CITY OF FRESNO'S 2015 URBAN WATER MANAGEMENT PLAN

WHEREAS, the City of Fresno (City) contracts with the United States Bureau of Reclamation (USBR) Central Valley Project (CVP) Friant Division for an annual supply of 60,000 acre-feet of Class 1 surface water; and,

WHEREAS, the CVP was developed through an agreement with the Exchange Contractors that have historic pre-1914 San Joaquin River water rights; and,

WHEREAS, the Exchange Contractors receive water from the Sacramento-San Joaquin River Delta (Delta) in exchange for the CVP Friant Division water; and,

WHEREAS, during times of severe drought when the Exchange Contractors don't receive their full allocations from the Delta, the Exchange Contractors can call on their historic pre-1914 San Joaquin River water rights to fulfill their allocations, which reduces CVP Friant Division allocations to the City; and,

WHEREAS, due to the indirect connection of the City's Class 1 surface water allocation from the CVP Friant Division to the Exchange Contractors allocation from the Delta, the City is required to demonstrate consistency with the Delta Plan established via the Sacramento-San Joaquin Delta Reform Act of 2009; and,

WHEREAS, Delta Plan Policy WR P1 requires urban water suppliers to demonstrate reduced Delta reliance in the 2015 and 2020 Urban Water Management Plans (UWMPs); and,

WHEREAS, the City's 2015 UWMP did not include information regarding Delta



Date Adopted: 07/15/2021
Date Approved: 07/19/2021
Effective Date: 07/19/2021

Plan Policy WR P1, Reduce Reliance on the Delta Through Improved Regional Water Self -Reliance; and

WHEREAS, the City prepared the 2015 UWMP following the Department of Water Resources (DWR) UWMP Guidebook 2015, which made such reporting optional; and,

WHEREAS, the DWR UWMP Guidebook 2020 instructs urban water suppliers to amend 2015 UWMP with reporting on reduced Delta reliance if not already included; and,

WHEREAS, the City has prepared Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed" that follows the instructions of the DWR UWMP Guidebook 2020, fulfills the requirements of the Delta Plan Policy WR P1, and complies with the requirements of the Urban Water Management Planning Act; and,

WHEREAS, the City desires to amend its 2015 UWMP to incorporate Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed;" and

WHEREAS, prior to the public hearing on July 15, 2021, the City made the draft Appendix L – Addendum to the 2015 UWMP available for public inspection and placed copies for public review at the following Fresno County Libraries: Central Library, Woodward Park Regional Library, Betty Rodriguez Regional Library, and Sunnyside Regional Library, as well as making electronic copies available to agencies and the public, as required by Water Code Section 10642; and

WHEREAS, on July 1, 2021 and July 8, 2021, respectively, the City published notices on the City Clerk's website and in the Fresno Bee that on July 15, 2021 at 10:05 a.m. a public hearing regarding the draft Appendix L – Addendum to the 2015 UWMP would be held in Council Chambers at which time public comment on the draft Addendum would be received, as required by Water Code Section 10642; and,

WHEREAS, on July 15, 2021, at 10:05 a.m. the public hearing was conducted in Council Chambers at which the public was provided the opportunity to comment on the draft Appendix L Addendum to the 2015 UWMP.

NOW, THEREFORE, BE IT RESOLVED BY THE Council of the City of Fresno as follows:

1. The City hereby adopts Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed."

2. The City Manager, or designee, is hereby authorized and directed to file Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan, "Quantifying Regional Self Reliance and Reduced Reliance on Water Supplies from the Delta Watershed" with the California Department of Water Resources, the California State Library, and the County of Fresno within 30 days after adoption.

* * * * * * * * * * * * * * *

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, BRIANA PARRA, Interim City Clerk of the City of Fresno, certify that the foregoing resolution was adopted by the Council of the City of Fresno, at a regular meeting held on the 15th day of July, 2021.

AYES :Arias, Esparza, Karbassi, Maxwell, Chavez
NOES :None
ABSENT :Bredefeld, Soria
ABSTAIN :None

Mayor Approval: July 19th, 2021
Mayor Approval/No Return: N/A, 2021
Mayor Veto: N/A, 2021
Council Override Veto: N/A, 2021

BRIANA PARRA, CMC
Interim City Clerk

BY: Briana Parra 7/20/2021
Deputy Date

APPROVED AS TO FORM:
DOUGLAS T. SLOAN
City Attorney

BY: 7/20/21
Jennifer M. Quintanilla Date
Senior Deputy

*July 19, 2021*

Council Adoption: 07/15/2021
Mayor Approval:
Mayor Veto:
Override Request:

TO: MAYOR JERRY DYER

FROM BRIANA PARRA, CMC
Interim City Clerk

SUBJECT: TRANSMITTAL OF COUNCIL ACTION FOR APPROVAL OR VETO

At the City Council meeting of July 15, 2021, Council adopted the attached Resolution No. 2021-198, entitled ***RESOLUTION – Adopting Appendix L – Addendum to the City of Fresno's 2015 Urban Water Management Plan (Subject to Mayor's veto). Item 10:05 A.M. (5), File ID21-22925, by the following vote:

| | | |
|---|---|---|
| Ayes | : | Arias, Esparza, Karbassi, Maxwell, Chavez |
| Noes | : | None |
| Absent | : | Bredefeld, Soria |
| Abstain | : | None |

Please indicate either your formal approval or veto by completing the following sections and executing and dating your action. Please file the completed memo with the Clerk's office on or before July 29, 2021. In computing the ten day period required by Charter, the first day has been excluded and the tenth day has been included unless the 10th day is a Saturday, Sunday, or holiday, in which case it has also been excluded. Failure to file this memo with the Clerk's office within the required time limit shall constitute approval of the ordinance, resolution or action, and it shall take effect without the Mayor's signed approval.

**APPROVED** / **NO RETURN:** _____

**VETOED** for the following reasons: (Written objections are required by Charter; attach additional sheets if necessary.)

_____

_____

_____ Date: 7/19/2021

Jerry Dyer, Mayor

**COUNCIL OVERRIDE ACTION:** Date: _____

| | | |
|---|---|---|
| Ayes | : | |
| Noes | : | |
| Absent | : | |
| Abstain | : | |

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# Southeast Development Area (SEDA)
# Specific Plan
# Recycled Water Technical Study

***April 26th, 2023***

*Prepared for:*

City of FRESNO

*City of Fresno, California*

*Prepared by:*

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# CHAPTER 1
# INTRODUCTION

## 1.1 Project Description and Background

The City of Fresno (City) is preparing a Specific Plan and Program Environmental Impact Report (PEIR) for the Southeast Development Area (SEDA). The SEDA Specific Plan Area (Plan Area), previously known as the Southeast Growth Area (SEGA), is an approximately 9,000-acre area in the southeast portion of the City that is formally designated as a growth area in the City of Fresno General Plan (General Plan). The Plan Area is generally bound by the Gould Canal to the north, McCall and Highland Avenues to the east, Jenson and North Avenues to the south, and Locan, Temperance, and Minnewawa Avenues to the west; see Figure 1.1 for the Plan Area's location.

SEDA was approved for incorporation into the City by the Local Agency Formation Commission (LAFCo) in 2006, with a number of qualifying provisions, of which included the preparation of a Specific Plan and associated environmental documents before the land could be annexed to the City. Located in Growth Area II, SEDA was planned for development after other infill initiatives from the City's other planning efforts. This is reflected in the City's General Plan buildout conditions, which included only one-third of SEDA's residential capacity (approximately 15,000 dwelling units of a total 45,0000 capacity) to accommodate Fresno's 2035 projected population; it was assumed that the remaining 30,000 units would not be developed until after 2035.

The proposed project is a Specific Plan for SEDA that would accommodate for increased density and accelerated housing production throughout the Plan Area. As part of the City's General Plan, SEDA was designated with specific land use categories matching those of other areas within the City, and only considered one-third of the Plan Area's residential capacity. The Specific Plan presents alternative land use categories for the Plan Area, and seeks to propose how the Plan Area will develop over time to complete buildout conditions with these newly-defined land use categories and to full capacity.

As part of the Specific Plan process, a PEIR needs to be developed to evaluate the impacts associated with the proposed improvements to the Plan Area, and what, if any, mitigation measures are necessary to account for such impacts. This technical report will focus on the impacts of the SEDA Specific Plan on recycled water supply, infrastructure, and demand for incorporation into the PEIR.

## 1.2 Summary of Analysis

The City's General Plan assigned various land use categories to each parcel located within the SEDA Specific Plan Area. Each land use category has a set of characteristics assigned to it with respect to a specific utility demand. The SEDA Specific Plan proposes new land use categories for each parcel within the Plan Area, which changes the demand of each user type for each distinct utility. The change in categories will result in modified areas for each type, leading to changes in the demand of each utility.

Typical infrastructure analysis for the Plan Area involves utilizing the land use data from the General Plan to determine a utility demand/production rate, and comparing the results to similarly calculated demand/production rates determined from the revised land use categories proposed in the Specific Plan. This comparison is then used in conjunction with existing and proposed infrastructure in the Plan Area to determine if further analysis and improvements are necessary to meet this future demand.

Recycled water is not yet utilized in the Plan Area. It has been assumed that all land use classifications will utilize domestic water for recycled water-approved uses (e.g. irrigation) until a source is readily available, at which time the City will need to update their Recycled Water Planning Documents, including the Recycled Water Master Plan (December 2010). This technical report will discuss the potential uses of recycled water in the Plan Area, as well as establish the possible improvements as indicated in the Recycled Water planning documents; the proposed SEDA Specific Plan offers an opportunity to integrate recycled water use into the associated improvements with buildout of the City's recycled water system. For uses in which recycled water is allowed, the domestic water distribution system should be installed with materials that meet recycled water regulations to promote optimum utilization of recycled water within the Plan Area once a source is available.

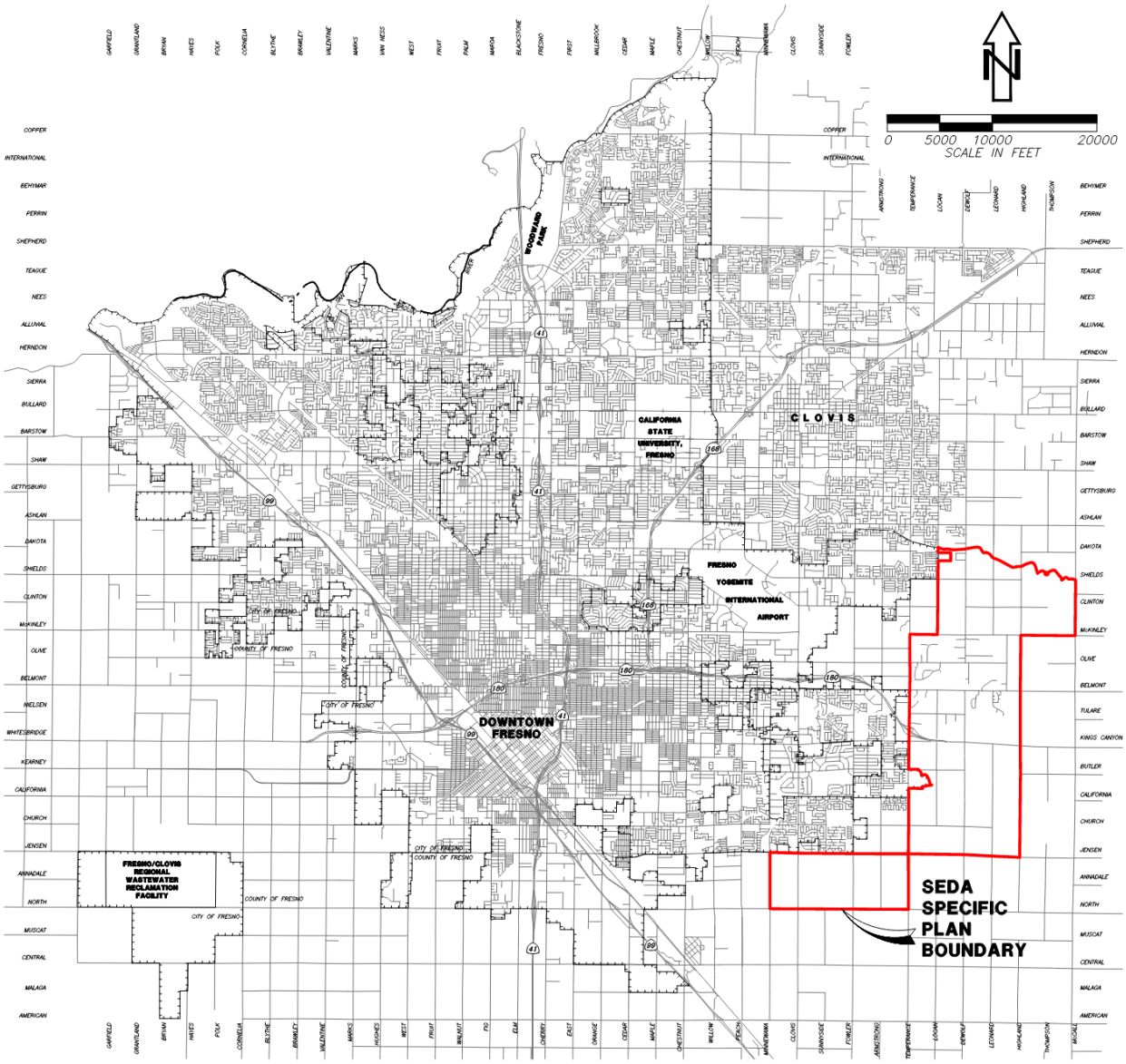



**Figure 1.1 SEDA Specific Plan Location**

# CHAPTER 2
# REGULATORY FRAMEWORK

## 2.1 General

The State of California promulgates and enforces statutes and regulations for the use of recycled water. The City of Fresno has established a Recycled Water Ordinance, as well as Rules and Regulations of Recycled Water Use. All recycled water use must comply with the requirements of the State and City statutes, rules and regulations, and ordinances, in addition to all federally established regulations. Many agencies also reference other helpful resources such as the American Water Works Association (AWWA) publications, "Guidelines for the On-site Retrofit of Facilities Using Disinfected Tertiary Recycled water," "Guidelines for Distribution of Non-Potable Water," "Planning for the Distribution of Reclaimed Water," and California WateReuse publication "Recycled Water Urban Irrigation User's Manual" for the installation and use of recycled water irrigation systems. Major regulatory documents that detail requirements for recycled water systems also include Title 17, "Public Health," and Title 22, "Social Security," of the California Code of Regulations (CCR).

There are a number of federal, state, and local regulations that encourage and direct the use of recycled water. Several regulations related to water conservation are discussed in this section due to their proximity to recycled water, in that recycled water can be used as a viable option in many instances to help conserve and reduce dependance on potable water. The use of recycled water can also affect surface and groundwater quality, and thus a number of regulatory policies/documents are discussed in the following sections to support proper management of the City's recycled water system.

## 2.2 Federal Regulations

Federal Safe Drinking Water Act[1]

The Federal Safe Drinking Water Act (SDWA) was established to protect the quality of drinking water in the United States. This law focuses on all waters actually or potentially designed for drinking, whether from above- or below-ground sources. The SDWA authorizes the Environmental Protection Agency (EPA) to establish national health-based minimum standards for drinking water to protect the public from naturally-occurring and man-made contaminants that may be found in drinking water. These standards, known as the National Primary Drinking Water Regulations, set enforceable maximum contaminant levels for specific contaminants in drinking water, as well as required methods of treatment to remove said contaminants. The SDWA applies to all public water systems in the United States, except for private wells serving less than 25 people. State drinking water programs provide direct oversight of these water systems to ensure compliance with the SDWA; in California's case, the Division of Drinking Water (DDW) within the State Water Resources Control Board (SWRCB) regulates public water systems.

## 2.3 State Regulations

California Porter-Cologne Water Quality Control Act[2]

The Porter-Cologne Water Quality Control Act is the principal law governing water quality in California, for both above- and below-ground supplies. This act designated the SWRCB as the

[1] Federal Safe Drinking Water Act, 42 U.S.C. §300f et seq. (1974).
[2] California Porter-Cologne Water Quality Act, California Water Code Div. 7 §13000 et seq. (1969)

statewide water quality planning agency, and gave authority to nine Regional Water Quality Control Boards (RWQCB) to oversee water quality on a day-to-day basis at both the local and regional levels. RWQCBs develop Regional Water Quality Plans (Basin Plans), regulate all pollutant or nuisance discharges that may affect either surface water or groundwater, and implement said water quality plans. The Central Valley RWQCB oversees the Fresno area.

California Urban Water Management Planning Act

The Urban Water Management Planning Act updated the California Water Code (§10610-10656 and 10608) to include a requirement that all urban water suppliers within California prepare and adopt an Urban Water Management Plan (UWMP) and update it every five years. This applies to suppliers that provide either 3,000 acre-feet of water annually, or who serve more than 3,000 customers. UWMPs support suppliers' long-term resource planning to ensure that adequate water supplies are available to meet existing and future water demands. The Act is intended to encourage and support water conservation efforts, and ensure efficient use of available water supplies. UWMPs must assess the reliability of water sources over a 20-year planning time period, describe demand management measures and water shortage contingency plans, planning for single and multiple dry water years, and discuss the use and planned use of recycled water.

Senate Bills 610 and 221[3]

Senate Bill (SB) 610 and SB 221 amended state law in 2002 to ensure better coordination between local water supply and land use decisions, and to confirm that there is an adequate water supply for new developments. These two companion measures require authorities to demonstrate that adequate and reliable 20-year water supplies are available for any new development, as well as existing water users. SB 610 requires the preparation of UWMPs and Water Supply Assessments (WSA) for larger development projects or land use plans that are subject to California Environmental Quality Act (CEQA) provisions. SB 221 covers approvals of subdivision maps with more than 500 units, and prohibits a land use agency from approving a subdivision map of more than 500 units without a letter of verification that sufficient and reliable water is available.

Sustainable Groundwater Management Act of 2014 (SGMA)[4]

The Sustainable Groundwater Management Act (SGMA) includes a three-bill legislative package composed of Assembly Bill (AB) 1739, SB 1168, and SB 1319. SGMA requires local agencies to form Groundwater Sustainability Agencies (GSAs) for high and medium priority basins, and develop and implement Groundwater Sustainability Plans (GSPs) to avoid and mitigate overdraft of groundwater within 20 years. SGMA places the authority of groundwater management with local agencies; it establishes a definition of sustainable groundwater management, establishes a framework for local agencies to develop plans and implement strategies to sustainably manage groundwater resources, prioritizes basins with the greatest problems, and sets a 20-year timeline for implementation.

State Updated Model Water Efficient Landscape Ordinance (AB 1881) (2015)[5]

The Model Water Efficient Landscape Ordinance (MWELO) is a state regulation designed to prevent water from being wasted on irrigated landscapes. Created in 1993, the MWELO was updated in 2015 by Executive Order EO B-29-15. Land use authorities (Cities and Counties) must ensure MWELO compliance on development projects with landscaped areas of 500 square feet or more. This applies to residential, commercial, industrial and institutional projects that require a permit, plan check, or design review. The California DWR provides technical assistance in helping

[3] SB 610 Water Supply Planning, Chapter 643, Statutes of 2001, Costa; SB 221 Land Use: Water Supplies, Chapter 642, Statutes of 2001, Kuehl.
[4] Sustainable Groundwater Management Act (SGMA), California Water Code Div. 6, Part 2.74 §10720-10737.8 (2014).
[5] Model Water Efficient Landscape Ordinance (MWELO), Title 23 CCR, Div. 2, Chap. 2.7 §490 et seq.

Land Use Authorities adhere to the ordinance. The Fresno Municipal Code includes local ordinances that are required to reduce water consumption and conserve water.

State Mandated Water Reductions[6]

On January 18, 2022, as a result of drought conditions in California, the California SWRCB adopted Emergency Regulation Requirements for water conservation. The Governor previously urged Californians to reduce water usage in 2021 by 15%, however actual reduction was only about 6%. Thus, the SWRCB has enacted emergency regulations that will remain in effect for one year unless the SWRCB acts to end, modify, or readopt it. These regulations were readopted in December 2022 for another year. The regulations prohibit certain wasteful water use practices statewide, and encourage Californians to monitor their water usage more closely. Emergency Regulation Requirements prohibit using potable water for:

- Outdoor watering that lets water run onto sidewalks and other areas (except incidental runoff)
- Washing vehicles without an automatic shutoff nozzle
- Washing hard surfaces, like driveways and sidewalks, that don't absorb water
- Street cleaning or construction site preparation
- Filling decorative fountains, lakes, or ponds
- Outdoor watering within 48 hours after it rains at least 1/4 inch of rainfall
- Watering ornamental turf on public medians

An additional emergency water conservation regulation was enacted in June 2022 that prohibits the use of potable water to water decorative grass in commercial, industrial, and institutional areas including common areas of homeowners' associations.[7] The regulation also requires urban water suppliers to implement all demand-reduction actions under "Level 2" of their Water Shortage Contingency Plans, which are actions meant to address a 10% to 20% water shortage. Additionally, urban water suppliers are required to fast-track their submissions of supply and demand assessments to plan for potential extended dry conditions. "Level 2" actions vary for each water supplier, but often include things like increasing communication about the importance of water conservation, limiting outdoor irrigation to certain days or hours, increasing patrolling to identify water waste, and enforcing water-use prohibitions.

CALGreen Building Code[8]

The California Building Standards Commission adopted the nation's first green building standards in 2008. The standards code (Part 11, Title 24 CCR, known as "CALGreen") was adopted to apply to the planning, design, operation, construction, use, and occupancy of every newly constructed building or structure, unless otherwise indicated in the CCR, throughout California. CALGreen established planning and design standards for sustainable site development including water conservation. CALGreen provisions became effective on January 1, 2011. The purpose of the CALGreen provisions is to improve public health, safety, and general welfare by enhancing the design and construction of buildings through the use of concepts having reduced negative impact or positive environmental impact and encouraging sustainable construction practices.

California Plumbing Code[9]

The California Plumbing Code (Part 5, Title 24 CCR) serves to prevent disorder in the industry and to consolidate plumbing codes utilized by local jurisdictions to reduce confusion and conflicts

[6] State Water Resources Control Board Resolution No. 2022-0002, "To Adopt an Emergency Regulation to Supplement Voluntary Water Conservation," 2022.
[7] State Water Resources Control Board Resolution No. 2022-0018, "To Adopt an Emergency Regulation to Reduce Water Demand and Improve Water Conservation." 2022.
[8] California Green Building Standards Code (CALGreen), Title 24 CCR Part 11.
[9] California Plumbing Code, Title 24 CCR Part 5.

among varying practices. The Plumbing Code covers water fixtures, potable and non-potable water systems, and recycled water systems, among other topics. Recycled water supply and distribution facilities shall comply with all applicable provisions of the current edition of the California Plumbing Code.

State Water Resources Control Board Water Quality Control Policy for Recycled Water[10]

The SWRCB adopted their Water Quality Control Policy for Recycled Water on December 11, 2018, and it became effective on April 8, 2019. The policy was adopted to encourage the safe use of recycled water from wastewater sources that implement state and federal water quality laws and protects public health and the environment. It is designed to provide direction to the State and regional water quality control boards when issuing permits for recycled water projects; it describes the circumstances under which permittees may enroll under statewide water reclamation requirements for recycled water use or choose an alternate permitting mechanism. The intent of the policy is to expedite the permitting of recycled water projects in a manner that implements state and federal water quality laws while allowing the regional water boards to focus their resources on projects that require substantial regulatory review due to unique site-specific conditions.

Title 22, California Code of Regulations

Title 22 "Social Security," of the California Code of Regulations (CCR) contains a number of requirements and regulations for the production, distribution, and use of recycled water. Recycled water intended for non-potable reuse can be used in many ways depending on the level of treatment. Such uses include irrigation (parks, schools, roadway medians, etc.), cooling, impoundments, toilets, industrial processes, decorative fountains, structural firefighting, commercial laundries, etc. Areas that utilize recycled water must meet certain use area requirements included in Title 22, including proper marking of recycled water improvements and appropriate cross-connection facilities. Title 22 also includes provisions for dual use sites, and required reporting and monitoring for all use cases. Any sites utilizing recycled water are required to meet all regulations and requirements of Title 22 of the CCR.

## 2.4 Local Regulations

Fresno General Plan[11]

The City's General Plan contains the following goals, policies, and objectives relevant to the provision of recycled water service and facilities (Table 2.1):

**Table 2.1 City of Fresno General Plan Objectives and Policies Relevant to Recycled Water Supply**

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| Policy PU-7-d | **Wastewater Recycling.** Pursue the development of a recycled water system and the expansion of beneficial wastewater recycling opportunities, including a timely technical, practicable, and institutional evaluation of treatment, facility siting, and water exchange elements. |
| Policy RC-6-d | **Recycled Water.** Prepare, adopt, and implement a City of Fresno Recycled Water Master Plan |

[10] "Water Quality Control Policy for Recycled Water," State Water Resources Control Board California Environmental Protection Agency. Adopted December 11, 2018. Effective April 8, 2019.
[11] City of Fresno, "Fresno General Plan," December 18, 2014.

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| Objective PU-8 | Manage and develop the City's water facilities on a strategic timeline basis that recognizes the long life cycle of the assets and the duration of the resources, to ensure a safe, economical, and reliable water supply for existing customers and planned urban development and economic diversification. |
| Policy PU-8-a | **Forecast Need.** Use available and innovative tools, such as computerized flow modeling to determine system capacity, as necessary to forecast demand on water production and distribution systems by urban development, and to determine appropriate facility needs. |
| Policy PU-8-c | **Conditions of Approval.** Set appropriate conditions of approval for each new development proposal to ensure that the necessary potable water production and supply facilities and water resources are in place prior to occupancy. |
| Policy PU-8-g | **Review Project Impact on Supply.** Mitigate the effects of development and capital improvement projects on the long-range water budget to ensure an adequate water supply for current and future uses. |

Fresno Municipal Code – Model Water Efficient Landscape Ordinance (MWELO)

As stated, MWELO requires local agencies to implement water efficiency measures as part of its review of landscaping plans. Local agencies can either adopt the MWELO or incorporate provisions of the ordinance into its own code requirements for landscaping. Section 11 of Chapter 11, "Building Permits and Regulations," and Section 23 of Chapter 15, "Citywide Development Code," of the City Municipal Code, include requirements for landscape design and incorporates the requirements of the California MWELO, among other state codes and regulations.

City of Fresno Recycled Water Ordinance[12]

The City adopted a Recycled Water Ordinance concurrently with its Recycled Water Master Plan to require the use of recycled water by existing and future potential users in areas where recycled water is available. It regulates the use and distribution of recycled water in a manner that complies with any and all applicable federal, state, and local standards.

City of Fresno Rules and Regulations of Recycled Water Use[13]

The City published the Rules and Regulations of Recycled Water Use to govern the design, construction, and use of recycled water within the City. The Rules and Regulations aim to provide customers with the necessary information needed to comply with relevant codes, laws, statutes, and regulations concerning the use of recycled water. The Rules and Regulations are prepared and administered by the Department of Public Utilities Wastewater Management Division, and apply to all customers and distributors of recycled water.

City of Fresno Metropolitan Water Resources Management Plan – Phase 2 Development and Evaluation of Future Water Supply Plan (January 2011)[14]

The City of Fresno's Metropolitan Water Resources Management Plan (Metro Plan) was prepared to document the existing conditions of the City's water system, and facilitate future water resources decisions and facilities improvements. Phase 1 consists of a baseline system characterization, Phase 2 consists of the development and evaluation of future water supplies, and Phase 3 consists of implementation of the management plan. Chapter 7 of Phase 2 discusses

[12] Bill No. B-18, Ordinance No. 2021-026 "An Ordinance of the City of Fresno, California, Amending Chapter 6, Article 9, of the Fresno Municipal Code, the Recycled Water Ordinance." Adopted 06/17/2021. Approved 06/21/2021. Effective 07/22/2021.
[13] City of Fresno Department of Public Utilities, "Rules and Regulations of Recycled Water Use."
[14] City of Fresno, "Metropolitan Water Resources Management Plan, Phase 2 Development and Evaluation of Future Water Supply Plan," January 2011.

the City's anticipated future use of recycled water, and includes a list of proposed objectives, goals, and policies related to recycled water, including the following:

Recycled Water Objectives

- Increase the use of recycled water to help offset existing/future potable water demands; and
- Maximize the use of available recycled water recharge exchange supply from the FID Agreement.

Recycled Water Goals

- Provide 25,000 af/yr of recycled water by 2025 for landscape irrigation and other non-potable water uses to offset potable water demands.

Recycled Water Policies

- Require new developments City-wide to install "purple pipe" for recycled water use on parks, common areas, roadway medians, etc.;
- Look for opportunities to install purple pipe near existing landscaped area (e.g., parks, sports fields) (i.e., "piggyback" on other pipeline installation/replacement projects);
- Work with FID and/or others to develop an agreement to better use the percolated treated effluent from the wastewater treatment plant;
- Further develop partnerships with FID, Clovis, and others to maximize available water resources;
- Allow new development to create "new" supplies by participation in the implementation of recycled water facilities and projects;
- Adopt and implement the Recycled Water Master Plan; and
- Provide additional staff and program-specific financial resources required to implement, manage and maintain the recycled water use program.

At the time of preparation of this study, an update to the Metro Plan is being developed by the City. This update is revising the proposed improvements to the City's future recycled water infrastructure, including that for the SEDA Specific Plan Area.

<u>City of Fresno Standard Specifications and Plans</u>

The City maintains its own set of standard Specifications and Plans to be followed when designing and constructing City projects. Those related to the supply, distribution and use of recycled water include, but are not limited to:

- Standard Specifications
  - Section 33 – Recycled Water Facilities Design Criteria
  - Section 34 – Recycled Water Facilities
- Standard Plans
  - Plans RW-1 through RW-26

**CHAPTER 3**
**EXISTING CONDITIONS**

## 3.1 Plan Area Recycled Water Infrastructure

Recycled water, an important water source for the City of Fresno in conserving potable water supplies, is not yet utilized in the Plan Area. However, there are existing recycled water facilities throughout the City that would contribute to the future delivery of recycled water to the Plan Area.

## 3.2 City Of Fresno Recycled Water Infrastructure

### 3.2.1 Recycled Water Sources

There are a number of facilities that the City owns, operates, and utilizes for the collection and treatment of wastewater and distribution of recycled water. See Figure 3.1 for the locations of the following facilities.

Fresno-Clovis Regional Wastewater Reclamation Facility

In partnership with the City of Clovis, the City of Fresno owns and operates the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) located near the intersection of Jensen and Cornelia Avenues in southwest Fresno. The RWRF receives and treats the majority of domestic, commercial, and industrial wastewater generated within the Cities of Fresno and Clovis, as well as some unincorporated areas of Fresno County. The RWRF is currently operated by the City, who holds responsibility for ensuring regulatory compliance with Waste Discharge Requirements (WDRs), and the Central Valley RWQCB Order No. 5-01-254, "Waste Discharge Requirements for Cities of Fresno and Clovis Wastewater Treatment Facility, Fresno County."

The RWRF has a rated capacity of 88 million gallons per day (MGD), but the average annual flow is approximately 80 MGD[15]. The RWRF produces undisinfected secondary-treated wastewater and disinfected tertiary-treated wastewater. The undisinfected secondary-treated wastewater is disposed into on-site disposal ponds and conveyed to farmers for restricted irrigation of non-food crops on agricultural land on surrounding properties. The disinfected tertiary-treated wastewater is delivered through a network of pipelines to various recycled water use areas around the City, mainly for irrigation of landscaping at sites including but not limited to parks, median landscape strips, and cemeteries. The RWRF also owns and operates a number of reclamation wells that extract water from on-site percolation ponds, and discharges that water into Fresno Irrigation District (FID) canals for irrigation use of farmland downstream of the RWRF.

North Fresno Wastewater Reclamation Facility

The City owns and operates the North Fresno Wastewater Reclamation Facility (NFWRF) located in northeast Fresno on the north side of Copper Avenue between Cedar and Maple Avenues. This facility receives and treats wastewater generated within a small area of the City generally bound by Copper, Friant, and Willow Avenues, including wastewater generated from Copper River Ranch. The NFWRF is a tertiary level treatment facility, and the treated wastewater is mainly used for irrigation of the Copper River Country Club and Golf Course. The permitted capacity of the plant is 0.71 MGD average monthly flow and 1.07 MGD maximum daily flow[16].

[15] "Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF)." https://www.fresno.gov/publicutilities/facilities-infrastructure/fresno-clovis-regional-wastewater-reclamation-facility-rwrf/.
[16] "North Fresno Wastewater Treatment Facility (NFWTF)." https://www.fresno.gov/publicutilities/facilities-infrastructure/north-fresno-wastewater-treatment-facility-nfwtf/.

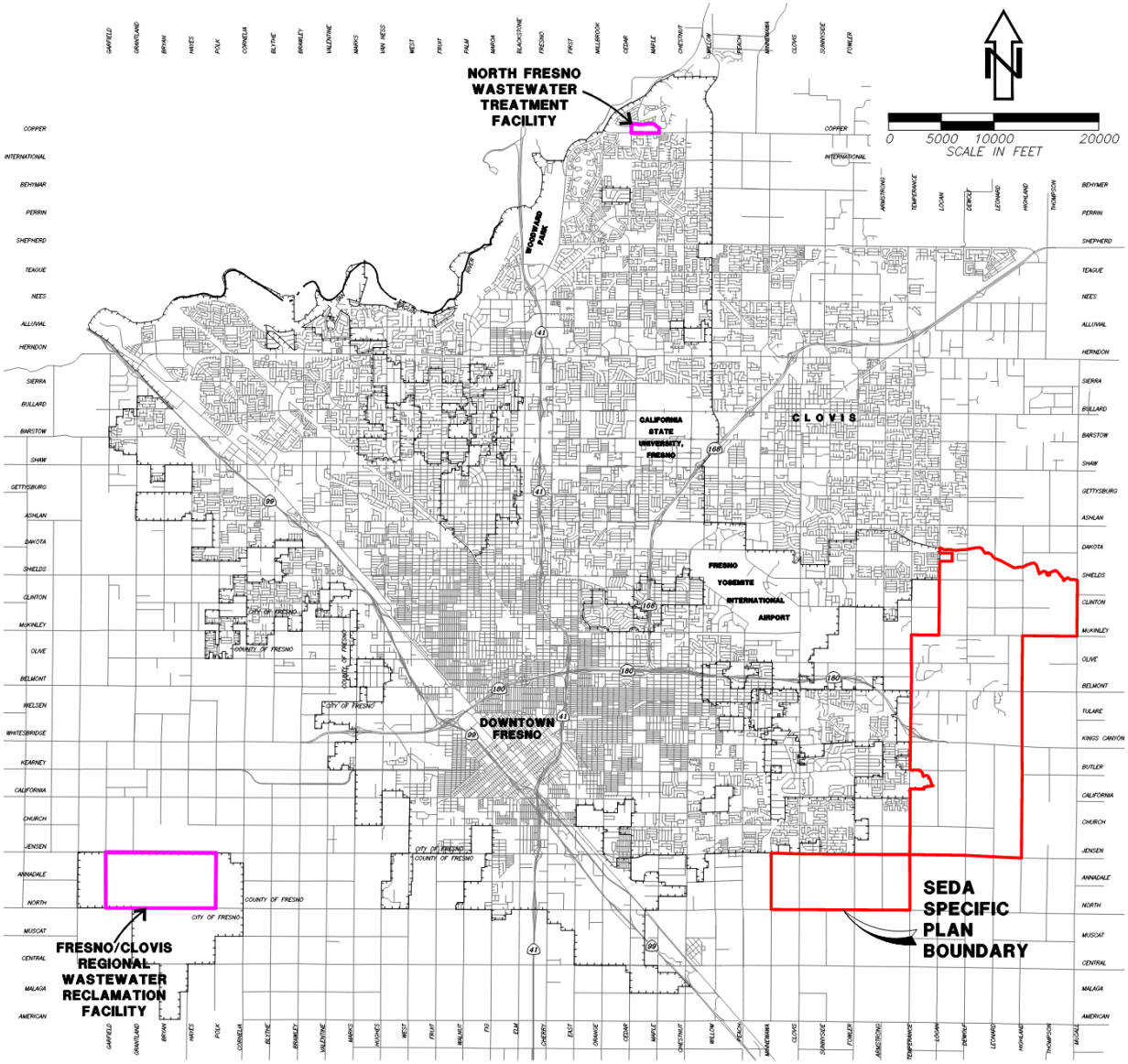



**Figure 3.1 City of Fresno Existing Recycled Water Sources**

### 3.2.2 Recycled Water Infrastructure

Since the adoption of the City's Recycled Water Master Plan in 2010, a number of recycled water facilities have been constructed and are currently in service throughout the Fresno area. As mentioned in Section 3.2.1, the Fresno-Clovis RWRF has been upgraded to produce disinfected tertiary-treated wastewater. Thus, segments of the recycled water distribution system outlined in the Recycled Water Master Plan have been designed and constructed over the last several years, mainly within the Southwest Quadrant of the distribution system, as well as some small portions of the Northeast and Northwest systems. Pipeline sizes range from 6 inches to 54 inches with several users actively utilizing recycled water for irrigation. Figure 3.2 shows an overview of the existing recycled water distribution system.

These existing facilities represent a portion of the future recycled water system; Chapter 4 will discuss the proposed master plan facilities, and how they may affect recycled water availability in the Plan Area. Recycled water is not yet utilized in the Plan Area, and the implications of this will be expanded upon in later chapters of this report.

### 3.2.3 Agency Use of Recycled Water

Fresno Irrigation District (FID)

There are extraction wells on-site at the Fresno-Clovis RWRF that extract percolated groundwater and deliver this water to FID through their own facilities for irrigation within FID's service area. This is completed via an agreement between the City and FID for the exchange of water. In 1974, the City and FID entered an agreement to establish this system of on-site extraction wells at the RWRF for groundwater reclamation and piping to convey this groundwater to FID facilities for irrigation. The extracted groundwater is discharged into FID canals during growing season, and often blended with other surface waters to be used for agricultural irrigation on the western side of FID's service area. The agreement stipulates the following:

- The City must discharge a minimum of 100,000 ac-ft of extracted groundwater to FID during any ten-year period.
- The City may discharge a maximum of 30,000 ac-ft of extracted groundwater to FID in any given year.
- For every ac-ft of extracted groundwater the City discharges to FID, the City is entitled to receive 0.46 ac-ft of surface water from FID.
- Any increase in the discharge of extracted groundwater to FID beyond that stipulated in the 1974 agreement is subject to FID approval.
- The City cannot extract groundwater from beneath the RWRF in volumes that will cause the groundwater level to drop below levels observed in the previous year.

The City also entered a separate cooperative agreement with FID in 1976 to use FID's distribution system to satisfy their respective water rights, and to work together to protect and preserve the groundwater basin. It also stipulates that the City will retain treated effluent within the boundaries of FID unless written approval to do otherwise is obtained. The City currently owns, operates and maintains the facilities that extract and deliver the water to the FID system up to the point of delivery, and FID owns, operates and maintains all parts of their delivery system beyond the point of delivery.

The Recycled Water Master Plan recommends expansion of the agricultural exchange via increased delivery of extracted groundwater and/or the addition of delivery of tertiary-treated recycled water to expand the agricultural exchange limit beyond the currently established limit of 30,000 AFY. To do so, the original agreements with FID would need to be modified, and additional infrastructure to accommodate increased volumes of extracted groundwater would need to be constructed.

Increased demand of recycled water for the Plan Area may affect the amount of groundwater that can be delivered to the FID, and thus these agreements and facilities will need to be revisited and revised as necessary upon further development of the Plan Area.

Fresno Metropolitan Flood Control District (FMFCD)

The Recycled Water Master Plan recommends implementing Groundwater Replenishment Reuse Projects (GRRPs) in the southwest, northwest, and southeast portions of the City. The Recycled Water Master Plan identifies a number of potential GRRP sites that are generally located near FMFCD basins; this is because storm runoff or surface water in the FMFCD system could be used for groundwater recharge on its own, or be used as diluent water for GRRPs if tertiary-treated recycled water is used. If development of GRRPs affects FMFCD basins or facilities, the City would need to enter into agreements with FMFCD. This will need to be done if GRRPs are planned in the Plan Area further into development.

### 3.2.4 Recycled Water Use and Demand

The primary use of recycled water in Fresno is irrigation. The undisinfected secondary treated wastewater produced by the Fresno-Clovis RWRF is used to irrigate non-food crops in the areas adjacent to the facility and is discharged to on-site basins for percolation to the aquifer and subsequent extraction for use by FID customers for irrigation. The disinfected tertiary treated wastewater produced by the RWRF is used to irrigate landscape for users served by the City's recycled water distribution system. The disinfected tertiary treated wastewater produced by the NFWRF is used to irrigate the nearby Copper River golf course.

Recycled water use has varied over the last few years due to fluctuations in recycled water use and the number of customers utilizing recycled water services. Per the 2020 UWMP, total recycled water use in 2020 was 4,757 AF (3,845 AF of undisinfected secondary treated wastewater for non-food crop irrigation, 858 AF of disinfected tertiary treated wastewater from the Fresno-Clovis RWRF, and 54 AF of disinfected tertiary treated wastewater from the NFWRF), with an average from 2015 to 2020 of 6,568 AFY.[17]

Undisinfected secondary treated wastewater reuse is projected to continue to be used to irrigate non-food crops adjacent to the RWRF for the foreseeable future. It is predicted that disinfected tertiary treated wastewater use will increase as the City's recycled water distribution system continues to be built out and the number of customers increases. The use of recycled water for the Copper River golf course is assumed to remain constant through buildout of the City's General Plan. Per the 2020 UWMP, recycled water use is projected to be 14,220 AFY in any given year from 2025 through buildout of the City's General Plan, comprised of 7,900 AF of secondary undisinfected recycled water for use as agricultural irrigation, and 6,320 AF of tertiary treated recycled water to be used for landscape irrigation and limited agricultural irrigation (5,800 AF for landscape irrigation excluding golf courses, 410 AF for limited agricultural irrigation, and 110 AF for golf course irrigation).[18] As noted in the UWMP, recycled water for agricultural irrigation does not offset the City's potable water demands, and as such, is excluded from projected recycled water. Thus, the total projected recycled water available to offset potable water demands is 5,910 AF (5,800 AF for landscape irrigation excluding golf courses, and 110 AF for golf course irrigation).

[17] Water Systems Consulting, Inc. 2021. City of Fresno Urban Water Management Plan. July.
[18] Water Systems Consulting, Inc. 2021. City of Fresno Urban Water Management Plan. July.

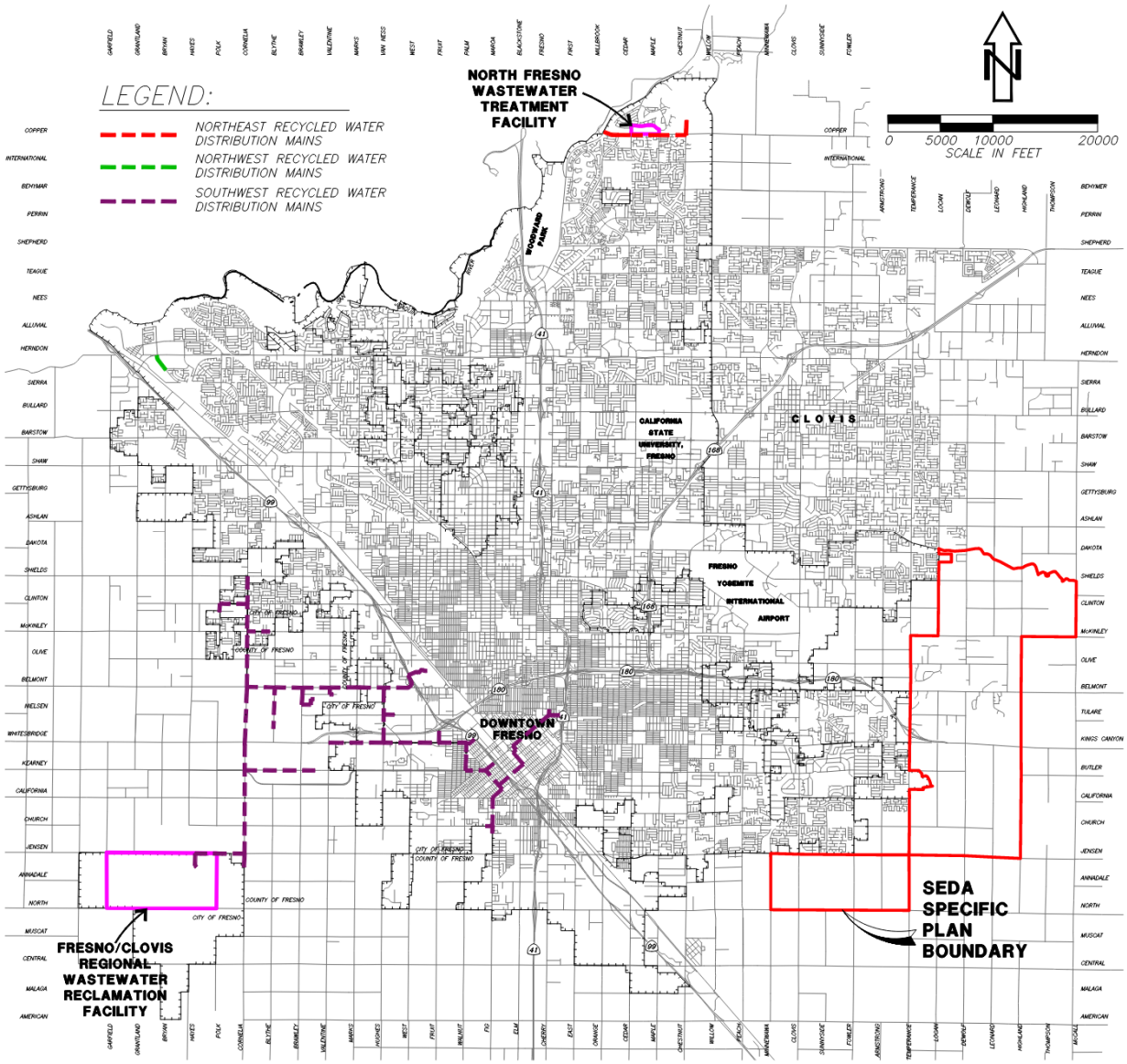



**Figure 3.2 Existing Recycled Water Distribution System**

# CHAPTER 4
# FUTURE RECYCLED WATER INFRASTRUCTURE

## 4.1 General

The City's General Plan examines the benefits of utilizing recycled water throughout the City, and discusses the proposed recycled water distribution system as a whole. The Recycled Water Master Plan (December 2010) and the subsequent Engineering Report (September 2015) discuss specific proposed infrastructure for the City's recycled water distribution system.

## 4.2 General Plan Improvements

The General Plan states that recycled water can afford the City a significant level of resource and financial savings when used for non-potable purposes. These include agricultural and landscaping irrigation, industrial processes, toilet flushing, and replenishing ground water basins (i.e. ground water recharge). The wastewater collected throughout the City can be treated and utilized for any one of the previously established uses.

At the time of the adoption of the General Plan, little of the recycled water distribution system had been designed or constructed, and recycled water being produced was only to an undisinfected secondary treatment level. Thus, a majority of the recycled water produced by the RWRF was limited in use to the irrigation of non-food agricultural land in proximity to the facility, and percolation into the aquifer through storage ponds and the eventual pumping and use by FID as irrigation water via FID facilities. The NFWRF was also in operation and supplied irrigation water to the Copper River Development.

The General Plan states that the City did not have the infrastructure in place to route recycled water from the RWRF to existing or new developments, and thus the Recycled Water Master Plan would need to be developed to recommend specific improvements to establish such a distribution system.

## 4.3 Master Plan Improvements

Recycled Water Master Plan (December 2010)

The Recycled Water Master Plan included in Appendix B, discusses various alternatives for the City's recycled water distribution system, and divides the system into four quadrants – Northeast, Northwest, Southeast, and Southwest. The Recycled Water Master Plan specifically discusses SEDA (referred to as SEGA), in terms of proposed recycled water supply for the Plan Area. The Recycled Water Master Plan proposes to construct a satellite recycled water facility (scalping plant) within SEDA, with two possible locations having been considered through various studies. The Master Planned capacity would be either 12 or 15 MGD. However, the evaluation of recycled water uses within SEDA was not covered in the Recycled Water Master Plan since it was believed that SEDA growth would be much slower than envisioned in the General Plan, and thus the capacity of a future recycled water facility was unknown.

The Recycled Water Master Plan focuses on four potential use categories for recycled water: urban reuse (including irrigation and industrial use), agricultural reuse, groundwater recharge, and fisheries enhancement.

- Urban reuse includes irrigation of landscaping at sites such as school yards, parks, cemeteries, golf courses, highway medians, and Home Owners Associations (HOAs), as well as industrial uses.

- Agricultural reuse incudes the direct delivery of both undisinfected secondary and disinfected tertiary treated wastewater, delivering recycled water to the FID via their canal facilities, and delivery of recycled water to other interested parties for agricultural use.
- Groundwater recharge affords the City an opportunity to directly augment the City's potable water supply and provide a use for recycled water during winter. The process involves siting and sizing potential recharge basins, and delivering recycled water to be stored in these basins to percolate down to the groundwater aquifers.
- Fisheries enhancement would involve supplementing water released by the United States Bureau of Reclamation (USBR) to maintain fish flows in the San Joaquin River with recycled water; however, the amount of water required for such activities greatly outpaces recycled water production, and this option was deemed impractical and not pursued further.

Two alternatives for recycled water supply and distribution systems were presented in the Master Plan, both with proposed improvements that provided a path to conveying recycled water to the Plan Area. The first alternative was outlined with the idea that the Fresno-Clovis RWRF would be the main source of recycled water for the City, and would supply recycled water to all four quadrants of the recycled water distribution system via numerous pipelines and pump stations. The second alternative assumed a number of satellite recycled water facilities would be built around the City to assist in providing recycled water supplies, thereby alleviating the Fresno-Clovis RWRF of the requirement to supply the entire system.

The Southeast Quadrant includes southeast Fresno and the Plan Area. Alternative 1 of the Master Plan included backbone piping that stops short of the Plan Area. Alternative 2 included backbone piping leading to a proposed satellite recycled water facility (scalping plant) within the limits of the Plan Area. The City is still analyzing the two alternative as presented in the Recycled Water Master Plan as well as other options for the use of recycled water in the Plan Area. The construction of a satellite recycled water facility (scalping plant) within SEDA would allow the area to be self-sustaining, and provide a path for wastewater collection and treatment that would directly benefit the Plan Area. Refer to the Recycled Water Master Plan for details on the proposed recycled water infrastructure.

Per the Recycled Water Master Plan, urban reuse provides the City with the best opportunity to implement recycled water projects that directly offset potable water and are highly visible to the community. However, urban reuse is much more distribution system-intensive than other alternatives like groundwater recharge since potential recycled water users are spread out around the City. The Recycled Water Master Plan recommended aligning the distribution system to serve large water users first to ensure efficient use of the recycled water supply. Smaller users can then be connected to the main distribution system at a later time.

The Recycled Water Master Plan includes assumptions of recycled water capacities and demands for each quadrant of the distribution system based on whether they were supplied via the RWRF or satellite RWFs (Alternative 1 vs Alternative 2, respectively). The Southeast Quadrant was projected to have a treatment capacity of 2.8/5.1 MGD (2.8 MGD without residential or commercial reuse/5.8 MGD with residential and commercial reuse) for Alternative 1 and 3.0 MGD for Alternative 2, and a demand of 995/1,820 AFY (acre feet per year) for Alternative 1 and 951 AFY for Alternative 2. It should be noted that the Master Plan Alternative 1 does not include any delivery of recycled water to the SEDA area, and thus the demands presented are not accurate for planning purposes of the Plan Area. Alternative 2 includes the proposed satellite RWF (scalping plant) potentially located within SEDA boundaries, and thus could be used in estimating demands. However, the timeline for recycled water development within the Plan Area has not been fully developed, and thus updates to the Recycled Water Master Plan are required to determine the extent to which recycled water would be available to SEDA users.

Engineering Report for the Production, Distribution and Use of Recycled Water (September 2015)

The Engineering Report for the Production, Distribution and Use of Recycled Water (included in Appendix C) serves as an update to the Recycled Water Master Plan and discusses further proposed improvements based on the City's plan for a recycled water distribution system, including the tertiary treatment equipment currently in operation.

The Engineering Report focuses on updating the Recycled Water Master Plan with data and information on the disinfected tertiary treatment process at the Fresno-Clovis RWRF, and establishes phases for its expansion – Phase I is the initial facility, which has a production capacity of 5 MGD; subsequent Phase 2 and 3 expansions are planned to provide an additional 10 MGD and 15 MGD of capacity, respectively, resulting in a final capacity of 30 MGD. With this came the establishment of a recycled water distribution system to convey the recycled water to users throughout the City. The engineering report recommends Alternative 2, which includes a pipeline connecting the Southeast quadrant with the recycled water system, as well as a satellite RWF (scalping plant) within the Plan Area. However, the City is still analyzing prospective options for recycled water system alignments.

The Engineering Report estimates that Phase 1 users will mainly be in the urban reuse category, as established in the Recycled Water Master Plan. The types of urban recycled water uses recommended generally include landscape irrigation and industrial uses. Some examples include:

- Parks
- Golf course and country clubs
- Homeowners Association common areas
- Cemeteries
- Airports
- State highway rights-of-way
- Schools and college campuses
- Municipal facilities such as courthouses and city halls
- Water feature impoundments such as Lake Van Ness and Woodward Lake
- Fairgrounds

Some examples of industrial uses include:

- Heating and cooling
- Industrial laundries
- Commercial vehicle washing
- Dust control
- Fire protection
- Sanitary, such as toilet flushing at industrial sites
- Process water (except for food processes)
- Cleanup/wash down water (except for food processes)
- Boiler feed

The City's Recycled Water Ordinance requires recycled water use under certain conditions, where recycled water is available, as summarized below:

a) The City may require all customers who connect to the potable water system to use recycled water for all approved uses, including but not limited to dual plumbing for commercial buildings and single family residential irrigation.
b) Existing commercial properties, existing industrial properties, existing apartments and condominiums, and all homeowners associations are required to use recycled water for landscape irrigation.

c) New commercial projects, new industrial projects, new institutional and governmental projects, and new apartments and condominiums are required to be dual plumbed to provide for internal use of recycled water, and are required to use recycled water for landscape irrigation.
d) New single family residential home projects are required to provide for landscape irrigation with recycled water.

All properties within a Recycled Water Project Area, as is defined in the Recycled Water Ordinance, that host land uses for which recycled water is recommended by the Recycled Water Master Plan, or is required by the Ordinance, are potential recycled water use areas, and the owners or tenants of such properties are potential recycled water users.

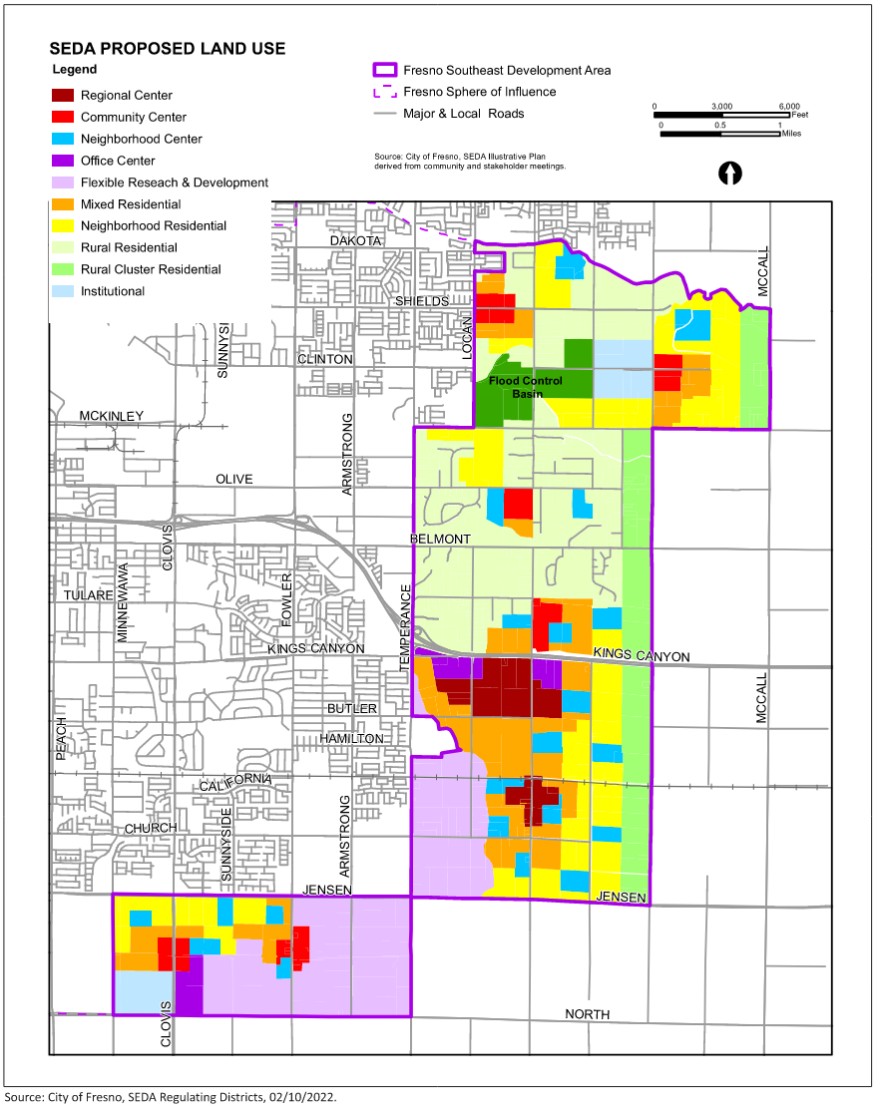
City of Fresno Metropolitan Water Resources Management Plan – Phase 2 Development and Evaluation of Future Water Supply Plan (January 2011)

Phase 2 of the City's Metro Plan for water resources includes a chapter devoted to future recycled water infrastructure (Chapter 7. Future Recycled Water). The Metro Plan discussed current recycled water use and future recycled water use, and includes data on estimated recycled water demands. The Metro Plan estimated that the SEDA Specific Plan area would utilize approximately 5,100 AFY of recycled water – about 18% of the total 2025 projected water demand for the SEDA area (27,800 AFY). These demands were determined with previous land use classifications for the SEDA area, and will thus need to be updated for those land uses being utilized in this Specific Plan. This will be discussed further in Chapter 5. The Metro Plan is also in the process of being updated by the City, and any analysis will need to be revised in accordance with any recommendations included in the revised Metro Plan.

# CHAPTER 5
# SPECIFIC PLAN RECYCLED WATER INFRASTRUCTURE

## 5.1 General

The SEDA Specific Plan area has been reevaluated with revised land use classifications – see Figure 5.1 for the chosen alternative for land use classifications. Of these land uses, there will be several that will be able to utilize recycled water for urban or agricultural reuse, as well as groundwater recharge. The Plan Area presents a unique opportunity to develop the recycled water distribution system along with the area-wide development, allowing recycled water use to be engrained into the Plan Area. However, recycled water is not yet utilized in the Plan Area, and the Recycled Water planning documents (Master Plan, Engineering Report, General Plan) do not account for the development of a recycled water distribution system within the Plan Area until after the planned development of the City's growth areas.




Source: City of Fresno, SEDA Regulating Districts, 02/10/2022.

**Figure 5.1 SEDA Proposed Land Use[19]**

[19] Southeast Development Area Specific Plan Notice of Preparation, First Carbon Solutions. 02/2022.

## 5.2 Plan Area Land Uses

The land use classifications for the Plan Area have been developed to be unique for the Specific Plan, and differ from those of the City's General Plan. Many land uses are similar to those of the General Plan, but have been tailored for use in the Specific Plan.

Land uses that would be eligible for recycled water use generally include any with green spaces, landscaping, industrial or agricultural processes. The SEDA Specific Plan document includes information for all specific plan land uses; several promote mixed-use facilities, which may allow recycled water to be utilized in many more ways than original plans would have allotted. Land uses that have landscaping, parks, educational facilities, industrial facilities, or open spaces would all be able to utilize recycled water for irrigation. The Specific Plan includes designated community agricultural and gardening areas, which may also be eligible for recycled water use.

In accordance with the SEDA Specific Plan Draft Policy Document, there will be a large significance placed on open spaces, including parks and other green spaces interspersed throughout its mixed-use centers and neighborhoods. There will also be a focus on community farming and agriculture, especially along buffer zones on the east side of the Plan Area. A system of pedestrian/bicycle trails is planned throughout the area as well. All of these land uses will be eligible to utilize recycled water, mainly for irrigation.

## 5.3 Plan Area Improvements

Improvements within the Plan Area will be required to facilitate the use of recycled water. Since the recycled water distribution system has not yet been planned for the area, it has been assumed that all land uses that would be eligible for recycled water use will utilize potable water until the recycled water supply and distribution system are available. However, these potable water facilities should be installed in accordance with all recycled water regulations and requirements so as to allow a seamless transition to recycled water. This includes installing purple pipe, purple valve boxes, purple irrigation facilities, and maintaining required clearances with other adjacent utilities.

If the Plan Area is expected to be supplied with recycled water from the Fresno-Clovis RWRF, significant infrastructure will be needed to convey the water from the facility to the Plan Area at a usable flow and pressure. Piping of various sizes and booster pump stations will be required, among other improvements. If a satellite RWF (scalping plant) is planned, then the infrastructure required would mainly consist of a distribution system of pipelines to convey the recycled water to the users, as well as a pipeline to convey solids to the Fresno-Clovis RWRF. Consideration would need to be given to recycled water storage facilities when assessing the demand versus the supply of recycled water produced.

## 5.4 Projected Baseline Demand

A baseline analysis of the Plan Area was completed to understand a preliminary recycled water demand based solely on estimated area of open space presented in the Specific Plan buildout plan, and only accounting for recycled water that may be used for irrigation of said open space. According to the plan, each land use classification will encompass some percentage of open space, or "Park Acres." These are as follows:

**Table 5.1 SEDA Land Use Classifications – Park Acres**

| SEDA Land Use Classification | Land Use Acres | Park Acres Percentage | Park Acres |
|---|---|---|---|
| Regional Center | 310 | 10% | 31 |
| Community Center | 290 | 10% | 29 |
| Neighborhood Center | 520 | 10% | 52 |
| Mixed Residential | 1,090 | 10% | 109 |
| Neighborhood Residential | 1,520 | 10% | 152 |
| Rural Residential | 2,160 | 0% | 0 |
| Rural Cluster | 810 | 0% | 0 |
| Institutional | 280 | 5% | 14 |
| Office Center | 160 | 5% | 8 |
| Flexible R&D | 1,380 | 5% | 69 |

The total minimum park acres in the Plan Area equals 464 acres. Utilizing precipitation data obtained from the Western Regional Climate Center for Fresno[20], preliminary irrigation calculations were completed to determine the Estimated Total Water Use (ETWU) of the park acres in the Plan Area. Assuming the landscaping would be warm-season turf, and irrigation would mainly be applied via overhead spray/rotors, an annual ETWU with rainfall included of approximately 283 ac-ft (0.3 MGD) was found for the Plan Area (without rainfall yields an ETWU of 1,572 ac-ft, or 1.4 MGD). This represents the minimum required recycled water demand for the park acres included in each of the land use classifications, and does not account for any designated open spaces, agricultural areas, or other miscellaneous potential recycled water uses. This has also been completed without knowledge about the available supply of recycled water for the Plan Area, and demands will need to be reassessed once a supply is available. A summary of the calculations completed can be seen in Appendix A.

This demand is not a clear indication of how much recycled water the Plan Area will actually use. Updates to the Recycled Water Master Plan will be required to fully develop the recycled water distribution system for the Plan Area. Determinations of potential recycled water users will need to be made in order to accurately estimate the anticipated recycled water demand.

[20] Western Regional Climate Center. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca3257. 2022.

**CHAPTER 6**
**IMPACTS AND MITIGATIONS**

## 6.1 SEDA Planning

Improvements within the Plan Area will require modifications to master planned recycled water facilities and infrastructure.

A draft policy document has been completed for the SEDA Specific Plan (March 2022), which includes updated policies for the Plan Area, and proposed improvements to meet the chosen alternative for development of the area. Included among these are policies directly related to recycled water use in the Plan Area. Refer to the SEDA Specific Plan policy document for details on policies related to recycled water.

## 6.2 Impacts of Significance

The proposed Specific Plan would result in a significant impact if it would:

1. Require or result in the construction of new water or wastewater treatment facilities or expansion of baseline facilities, the construction of which could cause significant environmental effects.

   Recycled water may be a significant contributor to the Plan Area's water supply system. The principal impact of providing recycled water is the overall water supply rather than direct shortages for end users. This is because the ability exists to trade off and supplement recycled water supply from other sources. The recycled water planning documents do not delve into detailed plans for improvements for the Plan Area. Recycled water is not currently utilized in the Plan Area, and there are no portions of the recycled water distribution system that have been constructed within the area. Thus, any proposed recycled water use would necessitate the expansion of the existing recycled water system, the installation of new recycled water pipelines, and potentially new treatment and storage facilities so as to provide sufficient recycled water at buildout conditions.

   However, the lack of planning document details and existing recycled water supply in the Plan Area makes it difficult to assess the necessary mitigation measures to accommodate the impacts of new facilities. Continued evaluation of available capacity and construction of improvements is required. Construction and operation of potential improvements could result in project-specific impacts that are not currently known because said facilities have not yet been designed or planned. Once further environmental evaluations have occurred and further planning is completed, potential impacts would be considered significant without any mitigations. Impacts related to the construction of new recycled water treatment facilities or expansion of baseline facilities would be less than significant with mitigations. At the time discretionary projects are submitted, the City shall require project-specific environmental evaluations for the expansion of recycled water facilities be completed prior to project approval.

2. Have insufficient recycled water supplies available to serve the proposed Plan from baseline entitlements and resources, and require new or expanded entitlements.

   Recycled water supply shortage impacts would be significant in both real impacts and the cost of non-compliance with regulatory requirements and proposed policies. The proposed Specific Plan would result in an increase in density between the Fresno General Plan and the SEDA Specific Plan, which would modify the generation of wastewater. Since the availability of recycled water is directly related to the generation of wastewater, any

change in wastewater production may affect recycled water availability. There are impacts associated with insufficient recycled water, including utilizing more potable water for non-potable uses.

The Master EIR (MEIR) prepared for the City of Fresno included several mitigation measures for increasing wastewater treatment capacities for the City of Fresno that are applicable to this plan. These include:

- MEIR Mitigation Measure USS-1: the City shall develop and implement a wastewater master plan update.
- MEIR Mitigation Measure USS-3: Prior to exceeding existing wastewater treatment capacity, the City shall evaluate the wastewater system and shall not approve additional development that contributes wastewater to the wastewater treatment facility that could exceed capacity until additional capacity is provided...

It is also not known how many users will exist in the Plan Area, and what the actual demand will be for recycled water. Continued development of the Recycled Water Master Plan and the recycled water distribution system is required to fully understand the needs of the Plan Area. With continued development and implementation of proposed improvements that will enhance the reliability and availability of recycled water in the Plan Area, impacts with mitigation would be less than significant.

## 6.3 Conclusions

The Plan Area currently does not utilize recycled water, however the SEDA Specific Plan presents the City with an opportunity to expand its recycled water system and increase the viability of recycled water to improve surface and groundwater conservation.

For the purposes of the Specific Plan, it has been assumed that since no recycled water supply exists in the Plan Area, and the distribution system has not been outlined in the City's recycled water planning documents, all land use classifications within the Plan Area will utilize potable water for use cases in which recycled water is allowed, with the stipulation that these systems install facilities that meet recycled water standards and regulations to ensure future conversion to recycled water will not require extensive improvements or revisions to the systems.

City recycled water planning documents, including but not limited to the Recycled Water Master Plan and the City Metro Plan, will need to be updated to account for the development of the SEDA, and account for the policies and revisions present in the Specific Plan.

Mitigations for SEDA from the General Plan to the SEDA Specific Plan include:

a) Develop additional water conservation measures in accordance with the City Metro Plan.
b) Implement recycled water objectives, goals, and policies as described in Chapter 7 of the City Metro Plan.
c) Develop an update to the Recycled Water Master Plan.
d) Develop an update to the Recycled Water Distribution System.
e) Develop recommendations and design and construct wastewater treatment facilities, recycled water supply, distribution, and storage facilities for the Plan Area.
f) Develop list of potential users in the Plan Area to estimate actual recycled water demand.

# Appendix A

Preliminary Irrigation Calculations

Evapotranspiration Calculations

| Fresno ETo data[1] | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.9 | 1.7 | 3.3 | 4.8 | 6.7 | 7.8 | 8.4 | 7.1 | 5.2 | 3.2 | 1.4 | 0.6 | 51.1 |
| Average Rainfall (WRCC) (in) [2] | 2.09 | 1.90 | 1.89 | 1.03 | 0.36 | 0.16 | 0.01 | 0.01 | 0.15 | 0.53 | 1.13 | 1.64 | 10.90 |
| Effective Rainfall (25% per AB 1881) | 0.52 | 0.48 | 0.47 | 0.26 | 0.09 | 0.04 | 0.00 | 0.00 | 0.04 | 0.13 | 0.28 | 0.41 | 2.73 |
| Adjusted Eto | 0.38 | 1.23 | 2.83 | 4.54 | 6.61 | 7.76 | 8.40 | 7.10 | 5.16 | 3.07 | 1.12 | 0.19 | 48.38 |

[1] Appendix A - Reference Evapotranspiration (ETo) Table, MWELO
[2] Western Regional Climate Center

Estimated Total Water Use (ETWU) = (ETo) x (0.62) x (K) x (PA) / (IE)

SEDA Plan Area (PA) – 464 acres
Landscape Factor (K): 0.60 (Warm-Season Turf)
Irrigation Efficiency (IE): 0.75 (Overhead Spray/Rotor)

| SEDA Plan Area | Jan | Feb | Mar | Apr | May | Jun | Jul |
|---|---|---|---|---|---|---|---|
| ETWU without rainfall (gal) | 9,022,565 | 17,042,623 | 33,082,740 | 48,120,349 | 67,167,987 | 78,195,567 | 84,210,610 |
| ETWU without rainfall (acre-ft) | 27.69 | 52.30 | 101.53 | 147.68 | 206.13 | 239.97 | 258.43 |
| ETWU with rainfall (gal) | 3,784,465 | 19,047,638 | 18,947,387 | 10,325,825 | 3,609,026 | 1,604,012 | 100,251 |
| ETWU with rainfall (acre-ft) | **11.6** | **58.5** | **58.1** | **31.7** | **11.1** | **4.9** | **0.3** |

| SEDA Plan Area | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|
| ETWU without rainfall (gal) | 71,178,016 | 52,130,378 | 32,080,232 | 14,035,102 | 6,015,044 | 512,281,212 |
| ETWU without rainfall (acre-ft) | 218.44 | 159.98 | 98.45 | 43.07 | 18.46 | 1572.13 |
| ETWU with rainfall (gal) | 100,251 | 1,503,761 | 5,313,288 | 11,328,332 | 16,441,119 | 92,105,355 |
| ETWU with rainfall (acre-ft) | **0.3** | **4.6** | **16.3** | **34.8** | **50.5** | **282.66** |

Annual without rainfall (MGD) = [1,572.13 ac-ft x (325,851 gal / 1 ac-ft)] x (1 year / 365 days) / $10^6$ = 1.4 MGD

Annual with rainfall (MGD) = [282.66 ac-ft x (325,851 gal / 1 ac-ft)] x (1 year / 365 days) / $10^6$ = 0.3 MGD

# Appendix B

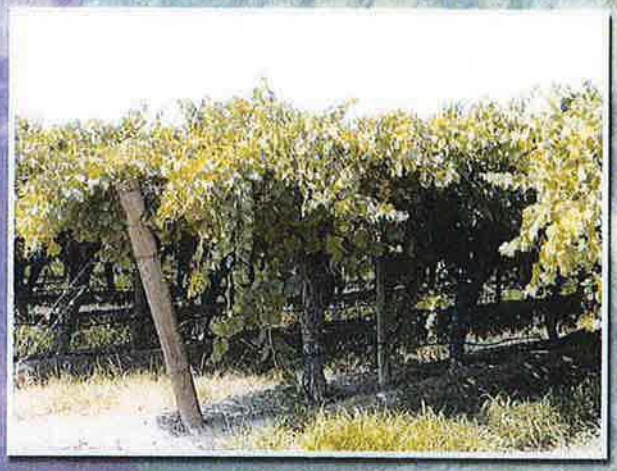
City of Fresno Recycled Water Master Plan

Exhibit A

City of
FRESNO
DEPARTMENT OF PUBLIC UTILITIES

DPU
WATER
COMMUNITY SANITATION
SOLID WASTE MANAGEMENT
WASTEWATER MANAGEMENT
SEWER MAINTENANCE

*Providing Life's Essential Services*



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# City of Fresno
# Recycled Water Master Plan

December 2010

carollo
*Engineers...Working Wonders With Water®*

# City of Fresno

## RECYCLED WATER MASTER PLAN

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CITY OF FRESNO
INCORPORATED OCT. 12, 1885

# RECYCLED WATER MASTER PLAN

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## 1.1 INTRODUCTION

In 2009, the State of California adopted a Recycled Water Policy establishing a mandate to increase the use of recycled water in California by 200,000 acre-feet per year by 2020 and by an additional 300,000 acre-feet per year by 2030. In support of these goals, the City has embarked on a Recycled Water Master Plan (Master Plan). The Master Plan is intended to serve as a basis to support the City's decision making process in selecting recycled water projects. The expansion of the recycled water system will enable the City to offset potable water use, enhance the sustainability of the water supply, and lessen the burden on the wastewater treatment plant percolation ponds that are currently used for effluent discharge.

The City is required by the Central Valley Regional Water Quality Control Board (RWQCB) to evaluate the quality of the groundwater beneath the percolation ponds. Constituents of concern are salts, nitrogen, and metals (arsenic and manganese) that are mobilized from the alluvium under reducing conditions created by effluent percolation. Reducing the hydraulic and constituent loading burden on the percolation ponds by implementing a significant reuse program would lower the concentrations of these constituents in the groundwater.

This chapter summarizes the purpose of the Master Plan, related facilities and institutional agreements, prior studies and the types of reuse that will be considered as part of this Master Plan. Many of the reuse options considered could offset existing uses of the City's potable supplies and some selected private wells. Other options could exchange the recycled water with other agencies for potable water credit. Groundwater recharge with recycled water could indirectly supplement potable water supplies.

Therefore, the intent of the Master Plan is to plan and implement a phased recycled water treatment and distribution system that:

- Protects and improves groundwater quality by reducing the use of percolation ponds that currently handle effluent discharge;
- Increases the use of recycled water through urban reuse, groundwater recharge and agricultural reuse to help meet the increasing need water demands in the region;
- Expands the recycled water system in order to enable the City to offset potable water use, thereby enhancing the sustainability of the water supply;
- Puts into practice a recycled water plan and ordinance that supports implementing reuse in the City for existing and future users.

The Master Plan examines urban reuse, agricultural reuse, groundwater recharge, and institutional exchanges of recycled water for potable water. Potential annual recycled water

deliveries were calculated and then used to determine the cost-effectiveness of implementing various recycled water alternatives. The Master Plan also considered diversification as an important strategy for the City to maintain a reliable wastewater disposal and reuse system.

Concurrently to this Master Planning effort, a Recycled Water Ordinance is being developed to require use by existing and future water users, including commercial, residential, and industrial properties.

## 1.2 BACKGROUND

This section reviews the existing wastewater treatment facilities, existing recycled water use, the related agreements pertaining to wastewater treatment and discharge, and past and ongoing studies and reports relevant to the Master Plan.

### 1.2.1 Existing Facilities and Recycled Water Use

#### 1.2.1.1 Fresno/Clovis Regional Wastewater Reclamation Facilities

The Regional Wastewater Reclamation Facilities (RWRF) serve the cities of Fresno and Clovis; the Pinedale Water District and Pinedale Utilities District, both of which are within the city limits of Fresno; and some areas within Fresno County not within the city limits of Fresno or Clovis. The RWRF treats domestic, commercial, and industrial wastewater from this service area. The RWRF has a rated capacity of 88 million gallons per day (mgd), but the annual average daily flows are approximately 70 mgd (80,000 AFY). The City of Clovis owns 9.3 mgd treatment capacity, while the City of Fresno owns the rest. The City of Fresno is responsible for day-to-day operations at the RWRF, and is the responsible entity for ensuring regulatory compliance with the RWRF's Waste Discharge Requirements (WDRs).The location of the RWRF is shown on Figure 1.1.

The RWRF is an activated sludge facility producing undisinfected secondary effluent. The majority of the wastewater treated at the RWRF is discharged to percolation ponds. Approximately ten percent of the total secondary undisinfected effluent flow is delivered directly to neighboring farmland for restricted irrigation of feed/fodder and fiber crops. Approximately 19 to 43 percent of the RWRF percolated effluent is extracted and delivered to Fresno Irrigation District (FID). The unused percolated effluent remains in the groundwater basin where it migrates laterally to the southwest. The remaining percolated effluent could be extracted for other non-potable beneficial uses.

#### 1.2.1.2 Existing Recycled Water Use at RWRF

The City provides farmers with undisinfected secondary effluent for restricted irrigation of nonfood crops on agricultural land on-site and off-site the RWRF. On-site reclamation refers to parcels near the RWRF that are owned by the City and leased to farmers. Off-site reclamation refers to irrigation on privately owned agricultural land. The City holds the

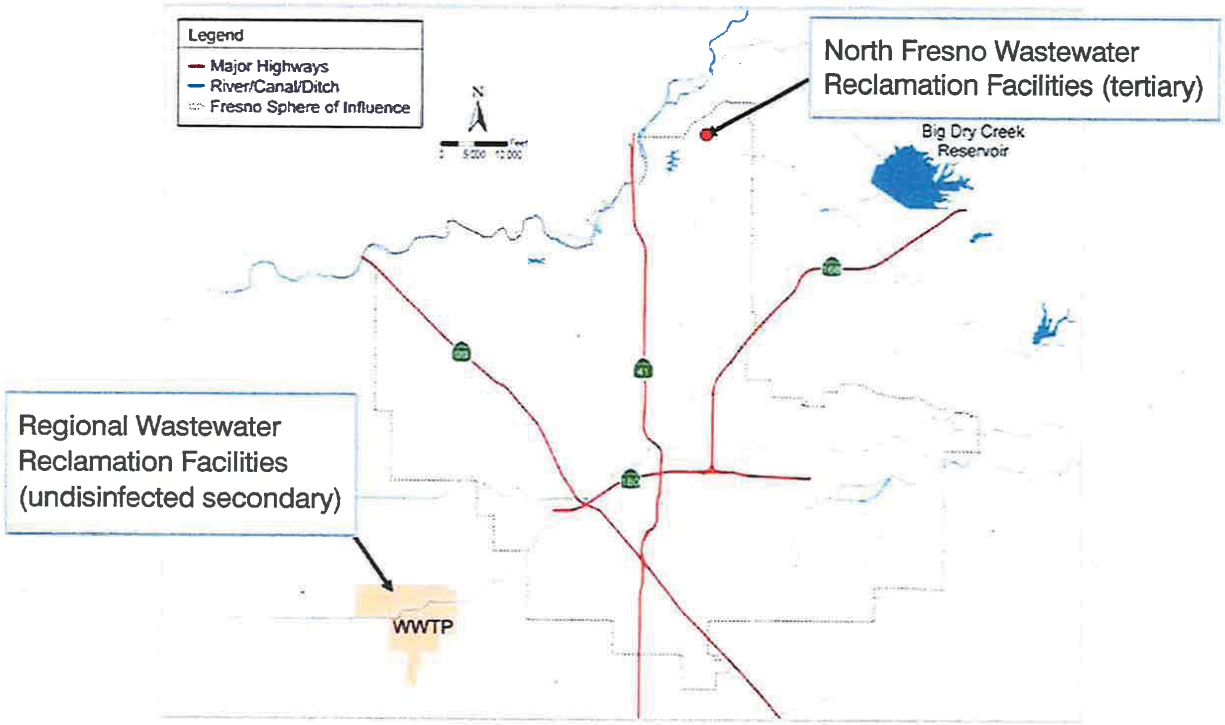


**Figure 1.1**
**RWRF AND NORTH FRESNO WRF LOCATIONS**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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WDRs for the individual farmers who lease the property owned by the City. The landowners hold the WDRs for irrigation on private land. Figure 1.2 shows the areas irrigated with RWRF effluent. As shown in Table 1.1, the combined on-site and off-site agricultural discharge is about 6,000 to 10,000 AF/year, or approximately 10 percent of the total plant flow.

The following is a list of on-site farmers receiving restricted-use recycled water from the RWRF as of December 2009:

- Quist Dairy, six parcels with a total of 458 acres
- Daniel Souza, one parcel totaling 158 acres
- Stephen England, two parcels totaling 285 acres

The following is a list of off-site farmers receiving restricted-use recycled water from the RWRF as of December 2009:

- Alfred Coelho with 520 acres
- Daniel Souza with 786 acres
- Golden State Vintners with 800 acres

Recycled water is made available to the farmers at no charge. Farmers are typically required to install and operate at their expense the necessary pumps and pipelines to transport the recycled water to their own land. On some occasions, the City has provided pipeline and pumping facilities.

FID has historically received between 15,000 and 34,000 AFY of extracted groundwater (percolated effluent). This water is delivered to FID canals and then conveyed to downstream local farmers. Historic recycled water usage and delivery of extracted groundwater is shown in Table 1.1.

#### 1.2.1.3 North Fresno Wastewater Reclamation Facility

The North Fresno Wastewater Reclamation Facility (North Fresno WRF) was recently constructed to serve the residential and commercial development and golf course in a portion of northeast Fresno. It was constructed with sequencing batch reactor (SBR) technology for secondary treatment, cloth media filtration for tertiary treatment, and sodium hypochlorite for disinfection. The permitted capacity of the plant is 0.71 mgd average monthly flow and 1.07 mgd maximum daily flow. The location of the North Fresno WRF is shown on Figure 1.1.

Recycled water in excess of turf demands can be dechlorinated and discharged to a nearby percolation basin, which is owned by the Fresno Metropolitan Flood Control District.

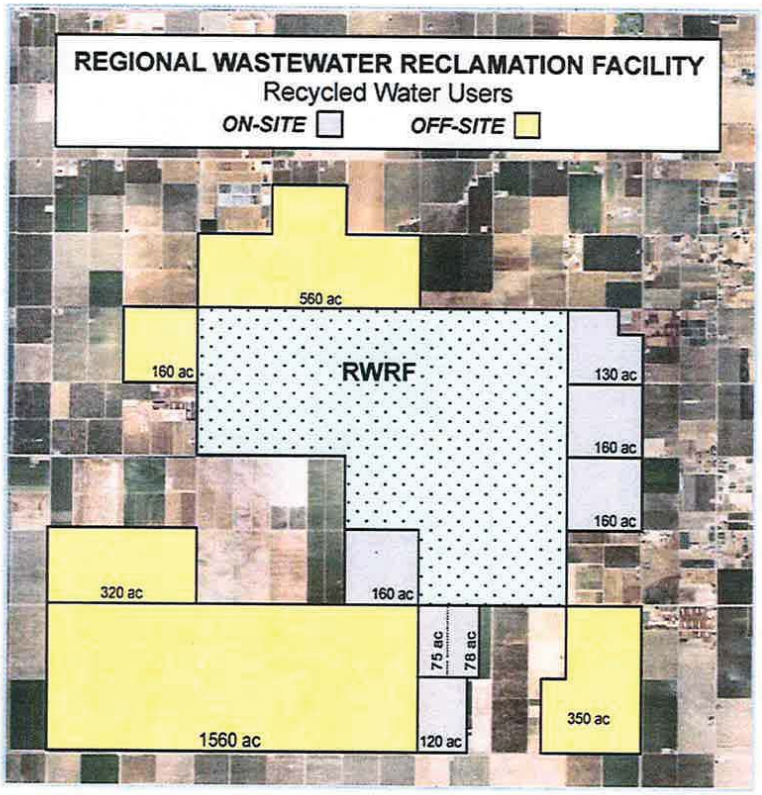


**Figure 1.2**
**FARMLAND IRRIGATED WITH RWRF EFFLUENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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| Table 1.1 | Existing Recycled Water Usage at the RWRF<br>Recycled Water Master Plan<br>City of Fresno | | | | |
|---|---|---|---|---|---|
| Year | Plant Influent Acre Feet | Effluent Direct Use To Farmers Acre Feet | Extracted Groundwater Discharge to FID Canals Acre Feet | Total Recycled Acre Feet | Percentage Recycled (%) |
| 2000 | 76,197 | 3,798 | 15,633 | 19,431 | 26% |
| 2001 | 76,236 | 4,972 | 26,824 | 31,796 | 42% |
| 2002 | 78,078 | 6,756 | 28,902 | 35,658 | 46% |
| 2003 | 78,504 | 6,715 | 33,958 | 40,673 | 52% |
| 2004 | 79,452 | 9,103 | 32,324 | 41,427 | 52% |
| 2005 | 78,894 | 8,509 | 25,022 | 33,531 | 43% |
| 2006 | 80,801 | 7,405 | 17,479 | 24,884 | 31% |
| 2007 | 78,009 | 10,935 | 27,532 | 38,467 | 49% |
| 2008 | 77,301 | 10,918 | 23,215 | 34,133 | 44% |

### 1.2.2 Interagency Agreements

#### 1.2.2.1 City of Clovis

On March 3, 1977, the City entered into a joint powers agreement (JPA) with the City of Clovis. The JPA and subsequent agreements provide the following purpose for the joint capacity use, and capacity rights ownership:

- Designates the City of Fresno as the entity responsible for day to day management, operation, and maintenance of the collection system and treatment facilities.
- Establishes capital and operating cost basis.
- Allocates collection system capacity.
- Allows Clovis to acquire additional flow capacity in future sewers and treatment facilities as needed, based on paying a pro-rated share of the cost of such facilities.

The City of Clovis does participate in paying for capital projects for effluent disposal facilities (percolation ponds and associated pipelines and canals, etc.). This includes paying for effluent recycling facilities (pumps, pipelines, canals, etc.) and the groundwater extraction well system. City of Clovis pays a pro rata share of both operations and maintenance (O&M) and capital expenditures using formulas set forth in the JPA. The formulas use either an actual flow percent or a capacity share percent to determine the pro rata share of costs to Clovis.

#### 1.2.2.2 Fresno Irrigation District

In 1974 the City entered into an exchange agreement with FID to establish a groundwater reclamation system consisting of on-site extraction wells and piping that delivers groundwater to FID's Dry Creek and Houghton Canals. The extracted water typically mixes with a variable amount of surface water prior to use on crops, including fodder, fiber, and food for human consumption (e.g., almonds, beans, peaches, raisins, and wine grapes, etc.). The extracted groundwater is discharged to the canals during the growing season for agricultural use on the western side of FID's service area. Each canal can convey up to the 200 cubic feet per second. To date there are no regulatory restrictions on the use of extracted groundwater.

The 1974 agreement between the City and FID stipulates the following:

- City must discharge a minimum of 100,000 AF of extracted groundwater to FID during any ten-year period.
- City may discharge a maximum of 30,000 AF of extracted groundwater to FID in a given year.
- For every acre-foot of extracted groundwater the City discharges to FID, the City is entitled to receive 0.46 AF of surface water from FID.

The City has not historically used its full entitlement of surface water from this FID agreement due to lack of demand and adequate facilities (recharge basins or water treatment facilities).

Any increase in the discharge of extracted groundwater to FID beyond that stipulated in the 1974 agreement is subject to FID approval. The agreement also stipulates the City cannot extract the filtered effluent from beneath the RWRF in volumes that will cause the groundwater level to drop below levels observed in the previous year.

The City and FID have a separate cooperative agreement, dated 1976, that provides for the agencies to use FID's distribution system to satisfy their respective water supply rights, and to work together to protect and preserve the groundwater basin. The agreement also stipulates that the City will retain its treated effluent within the boundaries of FID unless written consent is obtained.

#### 1.2.2.3 Central Valley Energy Center

The City and Central Valley Energy Center (CVEC) entered into an agreement effective August 27, 2001 which allow CVEC to purchase recycled water. Recycled water would be provided primarily from new reclamation wells built specifically for the CVEC project. The facility has not been constructed, and it is not known when the project will be implemented. The terms of the agreement extend to the year 2061. All costs associated with new wells and pipeline facilities necessary for the conveyance would be the responsibility of CVEC.

The maximum allowable quantity of recycled water from the existing and new wells combined is limited to a maximum 7,000 AF/year.

### 1.2.3 Ongoing and Previous Reports and Studies

The following is a summary of the reports and studies that are ongoing, or have previously been completed, and pertain to the Master Plan.

#### 1.2.4.1 2025 General Plan

The City's General Plan and EIR, adopted in November 2002, provide long-range planning for development over the next two decades. It includes community and specific plans that address growth and infill in different areas of the City. The General Plan identified two growth areas, the North Growth Area and the Southeast Growth Area. The North Growth Area has since been developed and is served by the North Fresno Wastewater Reclamation Facility. The General Plan also established objectives and policies to encourage development/revitalization of the Centre City area and to promote densification through formation of Intensity Corridors. Highway 41 has been designated an Intensity Corridor.

The population and growth projections in the General Plan were based upon the robust growth at the time the Plan was developed. Because of the recent housing market decline, development has slowed significantly. In addition, based on discussions with the Planning and Development Department, the City's new focus for growth is densification and in-fill. Therefore, the General Plan will be revisited in the coming years. It is likely that as the General Plan changes, planning scenarios for the use of the Recycled Water Master Plan will also need to be updated.

#### 1.2.4.2 SEGA Plan and Satellite Treatment Study

Incorporation of the Southeast Growth Area (SEGA) into the City was a major goal of the 2025 General Plan. To accommodate future growth, the City considered building a satellite recycled water facility (SRWF) in SEGA. Two reports were prepared, the 2001 "Satellite Wastewater Treatment Plant Study" and the 2006 "Satellite Plant Study Update." Two possible locations for the satellite plant were identified in this general area. Based on an analysis of the service areas, the capacities would be either 12 mgd or 15 mgd. In addition to distributing the recycled water to various users mentioned above, effluent flows would also be discharged to the FID canals for unrestricted agricultural irrigation reuse. During the winter months flows would be discharged to percolation ponds or irrigation canals.

The original intent of the City is that SEGA would be self-sustaining with respect to water and wastewater. The City has a separate specific plan under development to further define the SEGA development and the use of recycled water within SEGA. Therefore, evaluation of recycled water uses within the SEGA area was beyond the scope of this Master Plan. With the decline in development and the redirection of the General Plan, it is likely that

SEGA will develop at a much slower rate than envisioned in the 2025 General Plan. Due to the uncertainty in SEGA's development, the site and capacity of a future recycled water facility in this area is unknown (see Figure 1.3).

#### 1.2.3.1 Best Practicable Treatment and Control Comprehensive Evaluation

The City's Waste Discharge Requirements (WDR 5-01-0136) requires that the RWRF identify waste constituents that threaten to degrade the groundwater, and complete a technical evaluation with recommendations for how these constituents will be treated or controlled in the discharge via a "Best Practicable Treatment and Control (BPTC) Comprehensive Evaluation" report. The BPTC was submitted to the RWQCB in December 2009 and addressed the six COCs that were identified in "Final List of Constituents of Concern for Best Practicable Treatment and Control" (Carollo Engineers) submitted in January 2007. The six COCs were:

- Arsenic
- Manganese
- Total Dissolved Solids (TDS).
- Electrical Conductivity (EC).
- Sodium.
- Total Nitrogen.

A major recommendation of the evaluation for each COC was to reduce hydraulic and COC loading into the percolation ponds by direct effluent recycling. This Recycled Water Master Plan provides an alternative use for the RWRF's effluent.

## 1.3 TYPES OF REUSE

This section describes the types of reuse considered in this Master Plan. The categories of reuse are urban irrigation, groundwater recharge, agricultural irrigation and fisheries enhancement.

### 1.3.1 Urban Reuse

Urban reuse is composed of the following demands for recycled water:

- Irrigation of public and private landscaped areas.
- Industrial uses (heating, cooling, industrial laundries, and other approved uses).
- Dual plumbing for toilet flushing in condominiums and institutional buildings.
- Ornamental lakes or fountains.

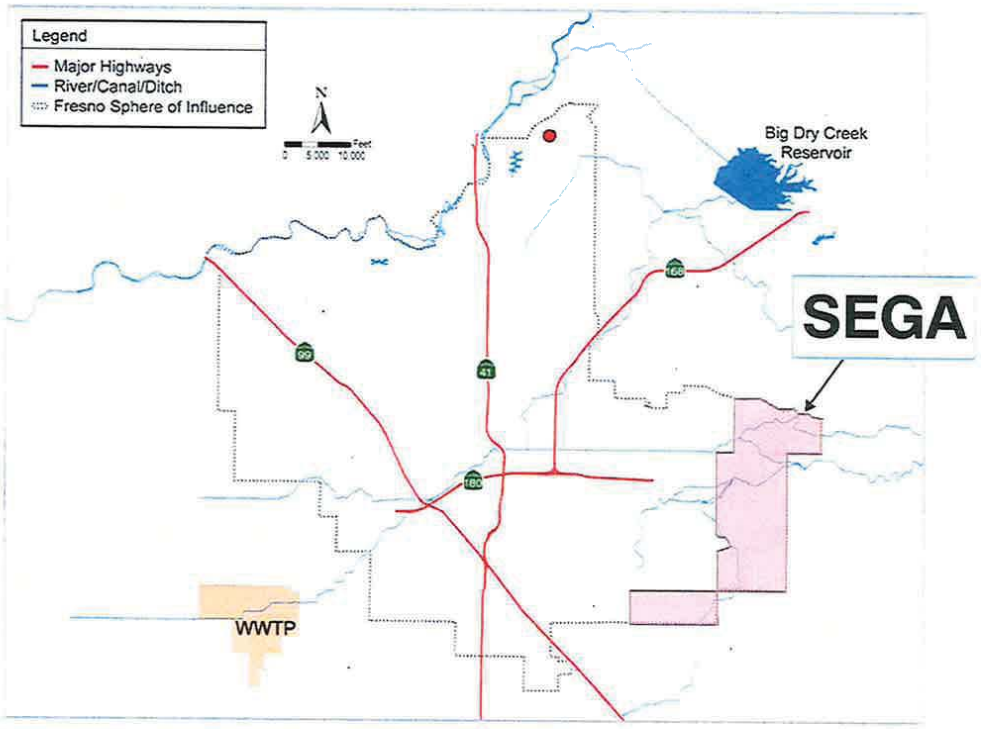


**Figure 1.3**
**LOCATION OF SOUTHEAST GROWTH AREA (SEGA)**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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Although these are all possible uses for recycled water, some are easier to implement than others. Installation of a recycled water distribution system ("purple pipe") can be expensive, especially through a fully developed area, and potential demands need to be sufficiently large to warrant it.

#### 1.3.1.1 Irrigation

Irrigation reuse is the largest potential existing potable offset. In general, golf courses are the largest application for irrigation reuse, followed by parks, schools, cemeteries and large water features. Highway median irrigation can also be a significant use in some areas, depending on the land area. Irrigation of new development areas is considered to the limited extent possible given the redirection of the General Plan discussed above.

The Recycled Water Ordinance will require use of recycled water by existing and future irrigation users including commercial, institutional and governmental properties, apartment and condominiums, single family residences, home owners associations (HOA), and open spaces.

#### 1.3.1.2 Dual Plumbing

Dual plumbing poses a real opportunity for potable offset recycled water use in new facilities, and the concept is gaining wider public acceptance. Due to the difficulty and expense to dual plumb existing buildings, this has not been included as a significant use in the Master Plan. However, the proposed Recycled Water Ordinance does require dual plumbing in new nonresidential construction, new apartments and condominiums, and in apartments and condominiums that undergo significant remodeling and the remodel cost exceeds 30 percent of the property value.

#### 1.3.1.3 Industrial

Although the City has many industrial users, only a few of them have large uses that can be offset with recycled water. Most of the industries in Fresno are food processors, and for public health reasons or public perception, recycled water is generally not used in food processing operations. The viable industrial uses consist mainly of industrial laundries or heating/cooling demands for large buildings. The Recycled Water Ordinance will require use of recycled water by existing and future industrial users.

### 1.3.2 Groundwater Recharge

Groundwater recharge is the augmentation of potable groundwater supplies with recycled water. Recharge can be performed via spreading (or "recharge") basins or direct injection. The state's draft Groundwater Recharge Reuse Regulations require reverse osmosis and advanced oxidation for direct injection. Due to the very high costs for these treatment requirements, this Master Plan only considered spreading basins for groundwater recharge.

Groundwater recharge is a desirable use since it can occur year-round, whereas irrigation demand is seasonal. Treatment facilities that produce high quality recycled water during the summer months for irrigation may also serve groundwater reuse recharge projects (GRRPs) during the winter.

Recharge potential is limited by land available for basins and the ability to obtain an adequate supply of diluent water. Diluent water is the water used to dilute the recycled water in the GRRP. It can be surface water, storm water, or groundwater. The draft regulations require a 4:1 blend of diluent water with recycled water for surface spreading recharge projects.

Due to the permitting process, as discussed in Chapter 2, implementation of GRRPs takes longer to implement. For this reason, GRRPs may not be implemented immediately, but may play an important role in the long term strategy for water supply and reuse implementation in Fresno. Potential sites for recharge basins are identified, as well as the issues and steps needed to implement groundwater recharge.

### 1.3.3 Agricultural Reuse

Agricultural irrigation represents the largest potential for beneficial reuse because the RWRF is surrounded by agricultural lands. As noted earlier, the City currently applies undisinfected secondary effluent to agricultural lands for restricted use. Depending on the crop, this type of use does not require additional wastewater treatment. The City could possibly expand its use of recycled water by delivering either secondary or tertiary treated water directly to local farmers.

Agricultural users in the vicinity use FID water and their own groundwater wells, not the City's potable supply. To derive a potable offset or "new supply" benefit from an agricultural reuse program, an agreement where the City exchanges recycled water for surface water would be needed.

As discussed under Section 1.2, the City has an existing exchange agreement with FID. The City has the option of reentering into negotiations with FID to increase deliveries of the extracted water to FID canals, or to deliver tertiary recycled water to the FID for unrestricted reuse. If a new exchange agreement is negotiated, both water and recycled water facilities would need to be constructed: Additional facilities may be needed to deliver larger recycled water flows from the RWRF to FID's canals. Additional facilities may be needed within the city to convey and treat FID's surface water for potable use, or to recharge it to the groundwater aquifer. The City has master planned the expansion of the northeast water treatment plant and construction of another southeast water treatment plant.

Agricultural exchange agreements with other water and irrigation districts are also possible. Any agreement would consist of exchanging recycled water for surface water. Additional conveyance facilities would be needed to deliver recycled water beyond the boundaries of

FID and additional water facilities would be required to accept and use a new surface water supply. This would be subject to FID consent, as discussed in Section 1.2.

### 1.3.4 Fisheries Enhancement Exchange

The US Bureau of Reclamation (USBR) is required by a court order to release sufficient water from the Friant Dam to maintain fish flows downstream in the San Joaquin River. An institutional exchange agreement may be possible whereby the City could deliver recycled water to supplement fish flows in exchange for a smaller amount of surface water to augment potable supplies. Since this alternative involves surface water discharge, the City would be required to obtain an NPDES permit.

## 1.4 RECYCLED WATER MASTER PLAN ORGANIZATION

The remainder of the Master Plan further develops the background, site-specific factors in the City and potential project alternatives for implementing recycled water projects in Fresno. The organization of the Master Plan is as follows:

- Chapter 2 – Regulatory and Water Quality Issues
- Chapter 3 –Potential Recycled Water Demands
- Chapter 4 – Project Alternatives
- Chapter 5 – Summary and Recommendations

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# REGULATORY AND WATER QUALITY REQUIREMENTS

## 2.1 INTRODUCTION

The purpose of this chapter is to identify existing and proposed state and regional regulatory requirements governing recycled water use in the City of Fresno. This chapter also analyzes the suitability of the RWRF effluent for irrigation.

## 2.2 CURRENT RECYCLED WATER REGULATIONS

The State Water Resources Control Board (SWRCB), the Regional Water Quality Control Boards (RWQCBs), and the California Department of Public Health (CDPH) have regulatory authority over projects using recycled water. The primary regulation governing recycled water use is the California Code of Regulations, Title 22.

### 2.2.1 California Code of Requirements - Title 22

Title 22 requirements are established and administered by the CDPH. Title 22 defines four types of recycled water uses based on the treatment process used, and the effluent total coliform bacteria, and turbidity levels. The CDPH has established the permitted uses for these four types of recycled water quality as summarized in Table 2.1. Title 22 also establishes approved uses of recycled water for industrial use, as shown in Table 2.2.

**Table 2.1 Summary of Approved Title 22 Uses of Recycled Water for Irrigation**
**Recycled Water Master Plan**
**City of Fresno**

| Treatment Level | Approved Uses | Total Coliform (median) |
|---|---|---|
| Disinfected Tertiary | Spray Irrigation of Food Crops | 2.2 / 100 ml |
| | Landscape Irrigation(1) | |
| | Unrestricted Recreational Impoundment | |
| Disinfected Secondary 2.2 | Surface Irrigation of Food Crops | 2.2 / 100 ml |
| | Restricted Recreational Impoundment | |
| | Surface Irrigation of Orchards, Vineyards | |
| Disinfected Secondary 23 | Pasture for Milking Animals | 23 / 100 ml |
| | Landscape Irrigation(2) | |
| | Landscape Impoundment | |
| Undisinfected Secondary | Fodder, Fiber and Seed Crops | N/A |

Notes:
(1) Includes unrestricted access golf courses, parks, playgrounds, school yards, and other landscaped areas with similar access.
(2) Includes restricted access golf courses, cemeteries, freeway landscapes, and landscapes with similar public access.

| Table 2.2 | Summary of Approved Title 22 Industrial Recycled Water Uses<br>Recycled Water Master Plan<br>City of Fresno | |
|---|---|---|
| **Supply for Cooling and Air Conditioning:** | | |
| Industrial or commercial cooling or air-conditioning involving cooling tower, evaporative condenser, or spraying that creates mist | | |
| Industrial or commercial cooling or air-conditioning not involving cooling tower, evaporative condenser, or spraying that creates mist | | |
| **Other Allowed Uses:** | | |
| Flushing toilets and urinals | | Structural fire fighting |
| Priming drain traps | | Non-structural fire fighting |
| Industrial process water that may contact workers | | Industrial process water that will not come into contact with workers |
| Industrial boiler feed water | | Mixing concrete |
| Decorative fountains | | Flushing sanitary sewers |
| Commercial laundries | | Soil compaction |
| Consolidation of backfill material around potable water pipelines | | Artificial snow making for commercial outdoor use |
| Dust control on roads and streets | | Cleaning roads, sidewalks, and outdoor work areas |
| Commercial car washes, not heating the water, excluding the general public from washing processes | | |

### 2.2.2 Recycled Water State Policy

Recycled water projects have historically been difficult to permit. The SWRCB recognized that a burdensome and inconsistent permitting process can impede the implementation of recycled water projects. As a result, the SWRCB adopted a Recycled Water Policy (RW Policy) in 2009 to establish more uniform requirements for water recycling throughout the State, and to streamline the permit application process in most instances.

The RW Policy includes a mandate that the State increase the use of recycled water over 2002 levels by at least 200,000 acre feet per year (AFY) by 2020, and by an additional 300,000 AFY by 2030. The RW Policy also includes goals for stormwater reuse, conservation and potable water offsets by recycled water. The onus for achieving these mandates and goals is placed both on recycled water purveyors and potential users.

Absent unusual circumstances, the RW Policy states that recycled water irrigation projects that meet CDPH Title 22 requirements and other State or Local regulations be issued permits by Regional Boards within 120 days. These streamlined projects will not be required to include a groundwater monitoring component.

The RW Policy requires development of salt/nutrient management plans for every basin in California. These plans are to be adopted as Basin Plan amendments by 2015. These management plans will be developed by local stakeholders and funded by the regulated community. The City is participating in the Central Valley Salinity Alternatives for Long Term Sustainability (CV SALTS) group, which is made up of stakeholders who are leading this effort in the Central Valley.

The findings of the salt/nutrient management plans will govern whether anti-degradation analyses are necessary for specific projects. While the plans are in the process of being drafted, anti-degradation analyses will be required for recycling projects where the discharge is more than 10 percent of the basin's available assimilative capacity for one project, or 20 percent for multiple projects. The RW Policy does not address the CDPH draft regulations for groundwater recharge.

The RW Policy specifies that a Blue-Ribbon Advisory Panel be convened to guide future actions with respect to Compounds of Emerging Concern (CECs). If any regulations arise from new knowledge of risks associated CECs, then projects will be given compliance schedules.

### 2.2.3 Groundwater Recharge Regulations

CDPH issued Draft Groundwater Recharge Reuse Regulations in 2008. A summary of the draft regulations is provided in this section, and a copy of the full draft regulations is included in Appendix A. Final regulations are not expected in the near future.

The draft regulations for a groundwater recharge reuse project (GRRP) include requirements in the following areas:

- Method of recharge
- Level of treatment
- Contribution of recycled water
- Retention time
- Water Quality

Regulations are established for the two methods of groundwater recharge, surface spreading or injection of recycled water into a groundwater aquifer. The level of treatment required depends on the method of recharge selected. For either method, the recycled water at a minimum shall be disinfected and filtered to meet tertiary treatment standards as defined by Title 22.

The draft regulations require that only a fraction of the water recharged through spreading basins may consist of recycled water. The remaining fraction must be diluent water from another source. The requirements for initial recycled water contribution for the different methods of recharge and level of treatment are listed in Table 2.3.

| Table 2.3 Initial Recycled Water Contribution (RWC) for Different Types of GRRPs<br>Recycled Water Master Plan<br>City of Fresno | |
|---|---|
| **Type of GRRP** | **Initial RWC** |
| Subsurface injection with Reverse Osmosis (RO) and advanced oxidation | 50 percent |
| Subsurface injection without RO and advanced oxidation | Not permitted |
| Surface spreading with RO and advanced oxidation | 50 percent |
| Surface spreading without RO | 20 percent |

The diluent water contribution is calculated as a 60-month rolling average. Therefore, diluent water can be banked in anticipation of, or made up after, a dry year. Sources for diluent water can include surface water, storm water or groundwater.

The draft recharge regulations dictate the retention time between recharge site and the nearest drinking water well, as measured by tracer studies. For each GRRP, the recycled water shall be retained underground for a minimum of six months to control pathogenic microorganisms.

The recycled water quality for a GRRP must meet the standards set by the CDPH and are reviewed and permitted on a site-specific, project-by-project basis. The concentration of total nitrogen in a new GRRP must either be less than 5 milligrams per liter (mg/L) measured in the treated effluent above ground, or 10 mg/L measured in the groundwater. The total organic carbon (TOC) limit in the filtered effluent must be less than 16 mg/L, and the limit in the groundwater is 2.5 mg/L for the initial recycled water contribution of 20 percent.

GRRPs must be monitored for regulated chemicals, including organic and inorganic chemicals, radionuclides, disinfection byproducts, lead and copper to ensure compliance with Title 22 maximum contaminant levels (MCLs). Monitoring is also required for a set of unregulated chemicals, priority toxic pollutants and other chemicals that the CDPH specifies, which may include pharmaceuticals, endocrine disruptors and other indicators of municipal waste.

CDPH will only consider an application to implement a recharge project if the Agency managing the treatment facility has in place a pretreatment and source control program. Additionally, before a GRRP is permitted, the Agency must have a plan for an alternative drinking water source in case the GRRP violates California drinking water standards or is degraded so that it is no longer is a safe source of drinking water. A list of steps necessary for the approval of a GRRP is provided in Appendix B.

### 2.2.4 Updates to the 2010 California Plumbing Code

The California Plumbing Code was recently updated to relax the restrictive rules for installing dual plumbing for indoor recycled water use, as well as for gray water. These changes pertain to Chapter 16 of Title 24, Part 5, of the California Code of Regulations.

The code revisions for recycled water were approved by the Building Standards Commission and will be part of the 2010 Code. The new rules remove some of the restrictions on the installation of recycled water pipe in buildings. The major features of the new dual plumbing rules are:

- Recycled water pipe can now run in the same wall/ceiling cavity as potable pipe.
- The labeling requirements for purple pipe are relaxed.
- The annual inspection is a visible inspection, followed by a cross-connection test if there's reason to believe a cross-connection exists, rather than an automatic cross-connection test each year.

## 2.3 FUTURE REGULATORY CONSIDERATIONS

Future regulatory concerns for the use of recycled water consist of the potential regulation of endocrine disrupting chemicals and other compounds of emerging concern (CECs). The State Recycled Water Policy highlights CECs as a potential issue for recycled water. A discussion of the current status of these emerging pollutants is provided below.

### 2.3.1 Microconstituents

In recent years there have been heightened scientific awareness and public debate over potential impacts that may result from exposure to microconstituents, some of which are endocrine disrupting compounds (EDCs). Humans, fish, and wildlife species could potentially be affected by sufficient environmental exposure to EDCs.

In 1996, new legislation required that the U.S. EPA "determine whether certain substances may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen or other such endocrine effect." In response, the EPA developed the Endocrine Disrupter Screening and Testing Advisory Committee. This effort to develop a robust test to identify EDCs is ongoing, and its results may lead to increased monitoring and limits on CECs in recycled water in the future.

Based on the current state of knowledge and the low levels of microconstituents in surface waters, it is likely to be many years before any such standards are promulgated. Nonetheless, in December 2009, the EPA took the first step in the regulation of microconstituents in water by putting 13 of these compounds on their Contaminant Candidate List. These compounds will be tested in the future to determine whether drinking

water criteria are necessary. If in the future these compounds are given human health criteria, they will be given limits in GRRPs.

While there are no current regulations regarding these constituents in recycled water, the State Recycled Water Policy convened a Blue Ribbon Panel to advise regulators as to the best way to proceed with monitoring for EDCs and other CECs. In June, 2010, the Blue Ribbon Panel released its recommendations for monitoring CECs in recycled water. The Panel recommends immediately monitoring for caffeine, 17-beta estradiol (a sex hormone) and triclosan (the active ingredient in antimicrobial soaps). In November 2010, the SWRCB will decide how to incorporate them into future permits. It will be important to continue to track research and regulations related to microconstituents in recycled water.

## 2.4 WATER QUALITY REQUIREMENTS

Water quality parameters such as salinity, nitrogen and metals can affect the acceptability of recycled water by users. This section reviews recommended water quality levels for reuse and compares these to the RWRF effluent.

### 2.4.1 General Irrigation Use Guidelines

The successful long-term use of recycled water for landscape and agricultural irrigation depends more on rainfall, leaching, soil drainage, irrigation water management, salt tolerance of plants, and soil management practices than upon water quality itself.

The Fresno RWRF effluent and extraction well monitoring results for 2008 were reviewed for key irrigation water quality parameters. Table 2.4 shows the RWRF effluent and extracted water quality compared to water quality guidelines for irrigation. Based on existing data, the degree of use restriction for irrigation parameters ranges from none to moderate; therefore the RWRF's effluent and extracted quality is appropriate for irrigation. However, if effluent is used for groundwater recharge, it will require nitrification and denitrification to meet the total nitrogen requirements.

Table 2.5 summarizes the concentrations of trace elements in the RWRF effluent and extracted well water. None of these constituents are at sufficiently high concentrations to be of concern as a water quality issue for agriculture or urban irrigation.

### 2.4.2 Water Quality for Industry

Industrial reuse applications approved by Title 22 and listed in Table 2.2 include applications such as cooling towers, ash sluicing, commercial vehicle washing, laundry facilities, dust control, fire protection, and waste dilution. In addition, petroleum refineries, chemical plants, and metal working facilities have recycled water uses beyond cooling purposes.

| Table 2.4 | Site Specific Salinity Objectives for Dominant Crops<br>Recycled Water Master Plan<br>City of Fresno | | | | | | |
|---|---|---|---|---|---|---|---|
| **Constituent** | **EC, dS/m** | **TDS, mg/L** | **Chloride, mg/L** | **Sodium, mg/L** | **Boron, mg/L** | **Sodium Adsorption Ratio** | **Total Nitrogen, mg/L** |
| Average RWRF Effluent Concentration | 0.79 | 430 | 77 | 82 | 0.2 | 3.2 | 17 |
| Average Extraction Well Concentration | 0.85 | 525 | 87 | 84 | 0.2 | 2.5 | 2.6 |
| General Guidelines[1] | 0.7 - 3.0 | 450 - 2000 | 70 - 355 | >70 | 1.0 - 2.0 | 3 - 9 | Agronomic Rates |
| Site-Specific Limits for AGR[2] | 1.4 | 766 | 175 | 161 | 1.0 | N/A | Agronomic Rates |
| Most Sensitive Crops | Almonds and Grapes | | Almonds | | Unknown | | |

Notes:
(1) For Slight to Moderate Restrictions on use. Source: Ayers and Westcot 1984.
(2) Source: Grattan and Isidoro-Ramirez, 2005.

| Table 2.5 | Recommended Maximum Concentrations of Trace Elements for Agricultural Use<br>Recycled Water Master Plan<br>City of Fresno | | |
|---|---|---|---|
| **Element** | **Recommended Limit (mg/L)[1]** | **Average Effluent Concentration (mg/L)** | **Average Extraction Well Concentration (mg/L)** |
| Aluminum | 5.0 | 0.026 | <0.02 |
| Arsenic | 0.10 | 0.001 | 0.017 |
| Cadmium | 0.01 | 0.0008 | 0.0002 |
| Chromium | 0.10 | 0.0017 | 0.0008 |
| Copper | 0.20 | 0.006 | 0.003 |
| Iron | 5.0 | 0.4 | 0.09 |
| Manganese | 0.20[2] | 0.036 | *1.0* |
| Nickel | 0.20 | 0.0028 | 0.015 |
| Lead | 5.0 | 0.0004 | 0.0003 |
| Selenium | 0.02 | 0.001 | 0.002 |
| Zinc | 2.0 | 0.04 | 0.006 |

Notes:
(1) Source: Ayers and Westcot, 1984
(2) Usually only toxic to plants in acidic soils

Parameters of concern for industrial reuse include calcium, magnesium, and hardness. As the concentrations of these parameters are similar in the RWRF effluent and in the City's potable water supplies, recycled water is considered suitable for industrial applications. For laundry facilities water must be nonstaining. Generally, this means that the water should be low in iron, manganese and color. The City would therefore need to verify that the constituents present do not stain. Commercial laundries are listed as potential recycled water users by the EPA (Guidelines for Water Reuse, US EPA, 2004).

## 2.5 REGULATIONS FOR DISCHARGE TO THE SAN JOAQUIN RIVER

If discharge to the San Joaquin river was part of a recycled water program, for example, as part of a fisheries enhancement program, an NPDES permit would be required. The North Fresno WRF already has an NPDES permit (CA0085189) , whose requirements indicate what would be required in a future NPDES permit. In general, permit limits for river discharge would be more extensive and restrictive than limits for urban or agricultural irrigation reuse.

Average month effluent limitations for the existing North Fresno WRF NPDES permit include:

- BOD – 10 mg/L
- TSS – 10 mg/L
- Total nitrogen – 10 mg/L (including 2 mg/L as ammonia and 8 mg/L as nitrate)

Additionally, the City would need to monitor and meet limits for colifom, electrical conductivity, chlorine residual and toxicity.

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# POTENTIAL RECYCLED WATER DEMANDS

## 3.1 INTRODUCTION

As discussed in Chapter 1, there are four types of reuse considered in this master plan: urban reuse (including irrigation and industrial uses), agricultural reuse, groundwater recharge and fisheries enhancement. This Chapter focuses on identifying and quantifying potential demand for the reuse opportunities and describes the overall approach used to evaluate the options. The discussion herein provides the basis for the selection and grouping of users into the project alternatives that are identified in Chapter 4.

## 3.2 URBAN REUSE OPPORTUNITIES

The types of urban recycled uses identified include urban irrigation (i.e., school yards, parks, cemeteries, golf courses, highway medians, Home Owners Associations (HOAs)) and industrial uses. Residential uses were also considered. This section describes how potential urban reuse customers (or users) were identified.

### 3.2.1 Recycled Water Ordinance

In order to implement the Recycled Water Program, the City needs to develop and adopt a "Recycled Water Ordinance." The purpose of the ordinance is to establish water recycling policy and criteria for its use within the Sphere of Influence. In general, the Ordinance will accomplish the following:

- Establish Administrative Authority
- Establish approved uses of recycled water
- Define areas of potential eligibility for recycled water service
- Specify mandatory and voluntary uses of recycled water, depending on user classifications
- Require installation of transmission and distribution infrastructure
- Encourage the use of voluntary retrofits for existing users that may not be addressed in the ordinance
- Require the City of Fresno to prepare Rules and Regulations
- Provide enforcement and severability clauses

The City needs to prepare "Rules and Regulations Governing the Distribution and Use of Recycled Water" that will be consistent with the Ordinance. The Rules and Regulations will govern the design, construction, and use of both the distribution system, to be operated by the City, and on-site recycled water systems to be operated by the users. The Wastewater

Management Division of the Department of Public Utilities will have the authority to enforce the Rules and Regulations by virtue of the Recycled Water Ordinance. The Wastewater Management Division will provide all operation, oversight, and administration of the Rules and Regulations for the end use of recycled water. In general, the Rules and Regulations document will include the following elements:

- Responsibilities for the City, Users, and Use Area Supervisors
- Requirements for the design, installation, and inspection of the distribution systems and on-site recycled water systems
- Application procedures and the City approval process
- Operation, Maintenance, and Management responsibilities for Users and the City
- Cross connection control test procedures
- Employee training requirements
- Prohibitions and Enforcement

### 3.2.2 Quadrants

Since the City is spread out over such a large area (105 square miles), the study area was divided into quadrants to facilitate the configuration of project alternatives, as illustrated in Figure 3.1. Potential users will typically be grouped by quadrants and served by recycled water produced either in that quadrant via the addition of satellite treatment or by a pipeline from the RWRF.

### 3.2.3 Existing Potential Urban Recycled Water Users

Of the existing urban water users, approximately 300 potential non-residential recycled water customers were identified by reviewing city GIS data for parks, schools, golf courses, and cemeteries. The customers were refined using multiple sources including previous reports, discussions with City staff, City water meter records and GIS mapping. In addition, large residential users were identified by identifying areas in the City with large lots and using GIS data and aerials to estimate potential irrigation demands.

#### 3.2.3.1 Non-Residential Urban Irrigation Reuse

Potential recycled water demand at school yards, parks, cemeteries, and golf courses, was estimated based on the irrigable area obtained from GIS data and aerial maps. The estimated percentage of irrigable areas for different types of land uses are listed in Appendix C. The expected landscape irrigation requirements were calculated using climatological data for the Fresno area.

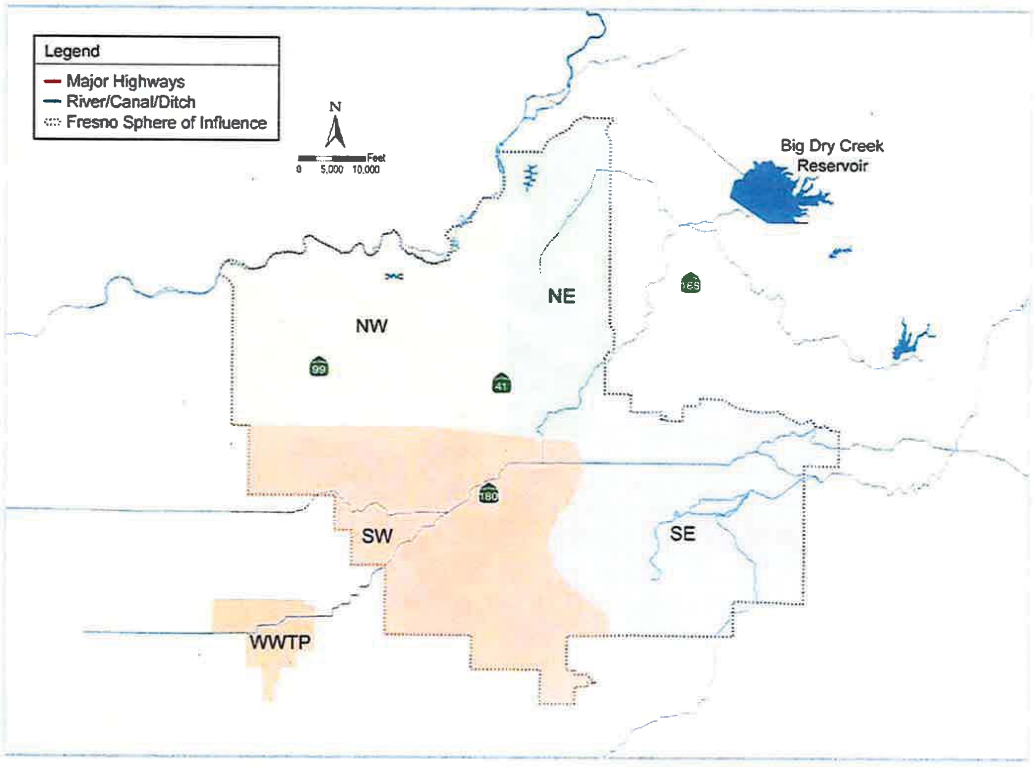


**Figure 3.1**
**MAP OF QUADRANTS FOR**
**RECYCLED WATER PROJECT ALTERNATIVES**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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The City is in the process of implementing a water meter program for residential users. The City already meters non-residential users, however, although total water use data is available for many customers, metered water use data is not specifically broken out for irrigation uses. Therefore, landscape irrigation reuse requirements were calculated based on evapotranspiration and rainfall data. Calculated irrigation requirements were also used to estimate peak month demand, peak day demand, and peak hour demand for distribution system sizing considerations.

The amount of irrigation required for the potential irrigation customers is directly dependent on precipitation quantities in the region. The amount of precipitation, evapotranspiration, and irrigation required for the potential irrigation customers are listed in Table 3.1. The reference evapotranspiration was obtained from the California Irrigation Management Information System (CIMIS) evapotranspiration zoning map. To calculate the landscape evapotranspiration, the landscaped area crop coefficient was estimated using information contained in the Guide to Estimating Irrigation Water Needs of Landscape Plantings in California (2000) by the California Department of Water Resources. Based on interviews with local golf course superintendents, the main irrigable species used for landscaping in Fresno is warm-season turfgrass. It is assumed that parks, schools and cemeteries also use warm season turf grass (including varieties such as bermuda grass, bahia grass, buffalo grass, etc.), which is the "typical" type of grass used in areas with hot summers.

As can be seen in Table 3.1, the net annual average landscape irrigation requirement in the study area is approximately 32 inches (or 2.7 feet) per year. Based on data from CIMIS, the irrigation season is roughly March through October, a period of 245 days. Landscape irrigation demand peaks in the month of July, which is estimated to be 6.3 inches, or 20 percent of the annual total.

The recycled water system storage, pumping, and pipeline sizing requirements are based on the maximum day demand. The maximum day peaking factor represents the average day of the maximum month demand. The peak hour demand takes into account variations in demand over a 24-hour period. Urban irrigation of large areas (such as golf courses) commonly occurs at night over an 8-hour period; therefore the peak hour demand is generally 3 times larger than the maximum day demand.

To quantify total recycled water demand, peaking factors are used to calculate the average day, maximum day, maximum month and peak hour demands as follows:

- Average day flow = 1.0
- Maximum month to average day flow = 2.4 (based on climatological data)
- Maximum day to average day flow = 3.1 (30 percent higher than maximum month)
- Peak hour to average day flow = 9.3 (based on an 8-hr/d irrigation period)

| Table 3.1 | Average Annual Landscape Irrigation Requirements<br>Recycled Water Master Plan<br>City of Fresno | | | |
|---|---|---|---|---|
| Month | Landscape Area Irrigation Required[1] (Inches) | Average Rainfall[2] (Inches) | Net Irrigation Requirement[3] (Inches) | Percent of Annual Net Irrigation Requirement[4] (%) |
| January | 0.72 | 2.11 | 0.0 | 0% |
| February | 1.26 | 1.90 | 0.0 | 0% |
| March | 1.98 | 1.87 | 0.1 | 0% |
| ***April*** | ***3.06*** | ***1.01*** | ***2.8*** | ***9%*** |
| ***May*** | ***3.96*** | ***0.37*** | ***4.9*** | ***15%*** |
| ***June*** | ***4.68*** | ***0.14*** | ***6.1*** | ***19%*** |
| ***July*** | ***4.68*** | ***0.01*** | ***6.3*** | ***20%*** |
| ***August*** | ***4.14*** | ***0.01*** | ***5.6*** | ***17%*** |
| ***September*** | ***3.24*** | ***0.16*** | ***4.2*** | ***13%*** |
| ***October*** | ***2.16*** | ***0.51*** | ***2.2*** | ***7%*** |
| November | 1.08 | 1.14 | 0.0 | 0% |
| December | 0.54 | 1.58 | 0.0 | 0% |
| **Total** | **31.50** | **10.81** | **32.2** | **100%** |
| | | | **2.7 feet** | |

Notes:

(1) Landscaped area irrigation required was obtained using the reference evapotranspiration from the California Irrigation Management Information System ET Zone Map. According to Water Use Classification of Landscape Species (WUCOLS) reference map, the City of Fresno is located in Zone 12. Irrigation requirements are calculated as $ET_L = K_L * ET_o$ Where: $ET_L$ = Evapotranspiration of landscaped areas (in inches), $K_L$ = Landscaped area crop coefficient, $ET_o$ = Reference evapotranspiration (in inches).The ET values are adjusted for the landscape irrigation coefficient $K_L$, where $K_L = K_s * K_{mc} * K_d$ which accounts for the species, microclimate and vegetation density. These factors were estimated to be 0.6, 1, and 1, respectively.

(2) Source: Fresno Station #042357 Data from the Western Regional Climate Center Precipitation Gauges, 1948-2008; ***Bold italics in table represent irrigation season.***

(3) [Evapotranspiration - Rainfall] *1.15/0.85. Where 0.85 = 85% Irrigation Factor (Average value from Carlos and Guitjens, University of Nevada) and 1.15 = 15% Leaching Fraction (Average value from Ayers and Westcot, "Water Quality for Agriculture", Food and Agriculture Organization of the United Nations).

(4) Current month net irrigation requirement divided by total net irrigation requirement.

Treatment facility capacity was based on maximum day demand, and distribution system sizing was based on a combination of maximum day and peak hour demand, depending on whether storage is available near users. While this approach is conservative for pipe sizing, and pipeline sizes can be reduced if storage near users is identified, it allows capacity in the pipeline for serving potential new or unidentified users along the pipe route.

A full list of all the non-residential urban irrigation sites identified, the estimated irrigable acreage, and the estimated average annual water demand is included in Appendix C. In total over 12,000 acre feet per year (AFY) of potential urban irrigation demand was identified for irrigation of parks, schools, cemeteries and golf courses. These users are located throughout the City, and average pipeline costs to serve smaller users are approximately $1.2 million per mile. Therefore, serving the largest users will drive the development of the distribution system alignments.

#### 3.2.3.2 Residential and Commercial Irrigation Reuse

There are limited examples of residential recycled water irrigation projects in California. One example is the El Dorado Irrigation District where the Serrano planned community installed recycled water during the initial construction of the development for the purpose of irrigating residential irrigation in front and back yards. Another example is Irvine Ranch Water District where a few hundred estate-sized residential lots use recycled water for front and backyard irrigation. In general, backyard irrigation is less desirable than front yard irrigation because of the lack of access for any maintenance concerns.

Implementation of recycled water for densely developed existing residential or commercial areas would be difficult due to the amount of roadway or private land that must be disturbed for a minimal demand at each turnout. Typically, only front yards are served for residential irrigation, so that the City doesn't need to maintain a lateral that traverses to the back of the homeowner's property. If the City wishes to serve residential and commercial users, the average demand is approximately 25 AFY per mile of pipe (assuming an average of 5 percent irrigable area in commercial areas and 20 percent irrigable areas in residential areas of 5 lots per acre and less).

It will be less expensive and will cause less disturbance to the community to install purple pipe in new residential areas compared to existing residential areas. However, there are a few existing residential areas, such as the Fig Garden Community, where there are large lot sizes and dirt shoulders where installing purple pipe for irrigation would yield a greater return in recycled water supplied per mile of pipe installed than other more densely developed areas.

Toilet flushing is another possible use for recycled water in new multi-unit developments. The demand for toilet flushing ranges from 11 to 43 AFY per mile of pipe for a 10 to 40 unit complex.

### 3.2.3.3 Industrial Reuse

Industrial users with high water use were identified by the City's water billing records. As part of the industrial pretreatment program, industries are required to report different types of water use to the City. Using these records, it is possible to estimate the potential recycled water demand. Based on Title 22 approved uses, the following types of industrial water use in Fresno can be served by recycled water:

- Sanitary (i.e., restrooms) - for toilet flushing at industrial sites
- Process water except for food processors
- Cleanup/wash down except for food processors
- Boiler Feed
- Cooling
- Irrigation

Title 22 does not allow the use of recycled water in food processing facilities where food can come into contact with the water. However, some of the non-food processing water uses listed above can also be served with recycled water at industries that process food. Assuming that all the above allowable uses are served with recycled water, as shown in Table 3.2, the potential recycled water demand for industries is 2,595 AFY. The Recycled Water Ordinance encourages existing industries to recondition their facilities to use recycled water.

Unlike irrigation reuse which peaks during the summer and drops to zero in the winter, the non-irrigation and non-food processing types of uses identified for industrial reuse vary throughout the year, but are expected to have a steadier demand with lower seasonal peaks.

### 3.2.3.4 Caltrans (Highway median irrigation)

The Caltrans median irrigation system is made up of individual points of connection with the City's water distribution system, and is not internally interconnected. Each point of connection can irrigate an area up to three quarters of a mile in each direction.

| Table 3.2 Potential Industrial Users Recycled Water Demand<br>Recycled Water Master Plan<br>City of Fresno | | |
|---|---|---|
| **Name of Industry** | **Type of Industry and Major Use (for Recycled Water)** | **Existing Water Use (AFY)** |
| Ameripride | Laundry – Wash water | 126 |
| Angelica Textile Services | Laundry– Wash water | 125 |
| Aramark | Laundry– Wash water | 160 |
| Beef Packers | Food Processor – Boiler/Cooling | 62 |
| California Dairies (Danish Creamery) | Food Processor – Toilet Flushing/Boiler/Cooling | 632 |
| Cellulo Co. | Filter Manufacturer – Process | 167 |
| Cornnuts Inc. | Food Processor – Boiler | 8 |
| Darling International | Food Processor – Cooling | 68 |
| Foster Farms Belgravia | Food Processor - Toilet Flushing/Cooling | 147 |
| Foster Farms Dairy | Food Processor – Boiler/ Cooling | 50 |
| Foster Farms Poultry | Food Processor – Toilet Flushing/Boiler/Cooling | 131 |
| Fresno Community Hospital | Hospital – Cooling and Irrigation | 108 |
| Kraft Foods (Capri Sun) | Food Processor – Boiling/Cooling | 171 |
| Lyons Magnus | Food Processor – Boiler/Cooling | 23 |
| Mission Linen | Laundry– Wash water/Toilet Flushing | 78 |
| Pacific Choice Brands | Food Processor – Boiler/Cooling | 99 |
| Pepsi-Cola Bottling | Food Processor - Toilet Flushing/Boiler/Cooling | 20 |
| Producer's Dairy | Food Processor - Toilet Flushing/Boiler/Cooling | 16 |
| Prudential Overall Supply | Laundry – Wash water | 43 |
| Saint Agnes Hospital (2006) | Hospital – Cooling/Irrigation | 42 |
| University Medical Ctr. | Hospital – Cooling | 51 |
| Veterans Administration Hospital | Hospital – Cooling/Irrigation | 88 |
| Wawona Frozen Foods (Fresno) | Food Processor – Boiler/Cooling | 44 |
| Zacky Turkey | Food Processor – Boiler/Cooling | 136 |
| | **Total** | **2,595** |

There are few freeway crossings, so in most cases a single point of connection only irrigates one side of the freeway. Caltrans' total water annual water use for 2008 and 2009, as billed by the City, is approximately 800 AFY. While it may not be feasible to run purple pipe to every Caltrans connection, individual points of connection can represent significant water use – up to 20 AFY each.

Many of the newer and improved highways are using plant-specific sprinklers and are no longer irrigating with long sweeping big gun sprinklers that spray water over a large area. This type of irrigation system is being phased out due to water waste and runoff issues. As landscaped areas along the freeways are upgraded, they will use much less water. That being said, highway medians remain a key targeted recycled water user in this Master Plan.

### 3.2.4 Recycled Water for Future Development

The City's General Plan and EIR, adopted in November 2002, provide long-range planning for development over the next two decades. It includes community and specific plans that address growth and infill in different areas of the City. The General Plan identified two growth areas, the North Growth Area and the Southeast Growth Area. The North Growth Area has since been developed and is served by the North Fresno Wastewater Reclamation Facility. The General Plan also established objectives and policies to encourage development/revitalization of the Centre City area and to promote densification through formation of "Intensity Corridors". The area on either side of Highway 41 has been designated an "Intensity Corridor."

The population and growth projections in the General Plan were based upon the robust growth at the time the Plan was developed. Because of the recent housing market decline, development has slowed significantly. In addition, based on discussions with the Planning and Development Department, the City's new focus for growth is densification and in-fill. Therefore, the General Plan will be revisited in the coming years. It is likely that as the General Plan changes, planning scenarios for the Recycled Water Master Plan will also need to be updated.

The revised General Plan's focus on densification may result in the decrease of irrigable green space for future developments. However, there will be increased opportunities to implement reuse for dual plumbing inside new buildings. In general, the City intends for recycled water to be an integral component of future development. The draft Ordinance requires use of recycled water for irrigation of landscape in common areas and front yards for new developments. The Ordinance also requires dual plumbing for new apartments and condominiums.

Incorporation of the Southeast Growth Area (SEGA) into the City was a major goal of the 2025 General Plan. The original intent of the City was that SEGA would be self-sustaining with respect to water and wastewater and the City intended to build a satellite recycled water facility for SEGA. The City intends to have a separate specific plan under

development to further define the SEGA development and the use of recycled water within SEGA. The SEGA specific plan was put on hold during the duration of this master planning process. Therefore, evaluation of recycled water uses within the SEGA area is beyond the scope of the Recycled Water Master Plan (Master Plan). However, opportunities to utilize a satellite facility for users in the southeast quadrant outside of SEGA will be considered in the Master Plan. With the decline in development and the redirection of the General Plan, it is likely that SEGA will develop at a much slower rate than envisioned in the 2025 General Plan.

Due to the uncertainties surrounding the location and timing of future developments, it is difficult to quantify potential reuse demands for serving these future users. In general estimated demands for future residential development range from 13 AFY per mile of pipeline for high-density residential development (apartment buildings) to 35 AFY per mile for low-density residential development (2 homes per acre). For indoor dual plumbing in condominiums and apartments, demand can range up to 43 AFY per mile for a forty-unit building. Distribution systems are sized so that they can accommodate future growth, so delivering recycled water to new developments will be part of future growth and infill projects.

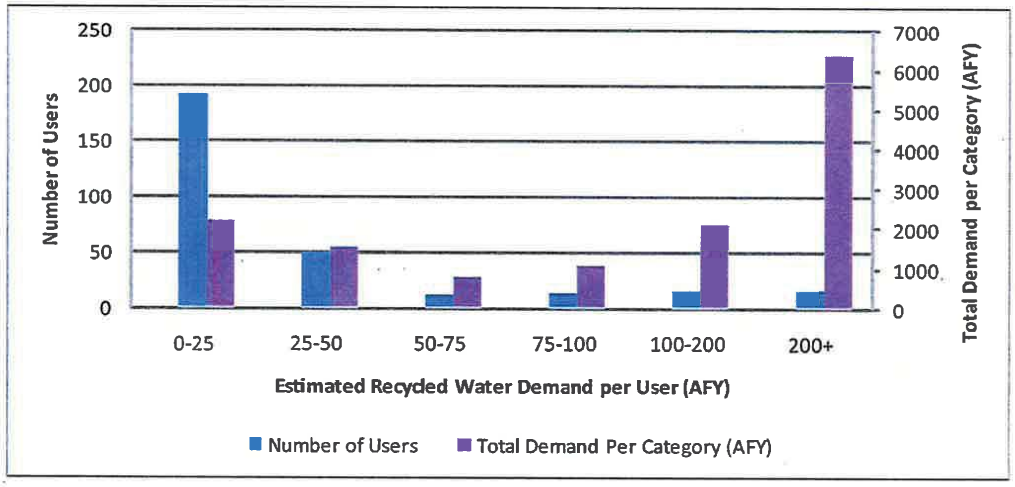
Future service to the Hwy 41 intensity corridor is included in this Master Plan. Based on a combination of dual plumbed mid- and high-rise development with 10 percent irrigable green space, the estimated demand for an 8-mile stretch along this corridor is approximately 300 AFY.

Areas within the City, primarily in the southwest and southeast quadrants, that are currently being used for agricultural are zoned for future residential development. Pipelines that go through these areas will be sized to deliver water to future residences at a rate of 35 AFY per mile. In the meantime, recycled water can be made available to any willing agricultural users that are along the pipeline alignment.

### 3.2.5 Distribution of Recycled Water to Urban Customers

Urban reuse provides an opportunity to implement recycled water projects that directly offset potable water and are highly visible to the community. However, urban reuse is more distribution system-intensive than other alternatives such as groundwater recharge and agricultural reuse, since landscape irrigation and industrial users are spread out across the City. While all irrigation and allowable industrial users are potential recycled water customers, aligning the distribution system to first serve large users, provides the most "bang for the buck" in pipeline construction.

The majority of the estimated demand is among existing large water users. Figure 3.2 shows the distribution of estimated use volumes among the potential users. As seen, the largest demand comes from eleven users with an individual demand exceeding 200




This graph illustrates that the "biggest bang for the buck" in distributing recycled water for urban reuse is to serve users of more than 200AFY.

**Figure 3.2**
**DISTRIBUTION OF NUMBER OF RECYCLED WATER USERS AND TOTAL RECYCLED WATER DEMAND**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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AFY each. These larger users are generally land-intensive parks, cemeteries and golf courses that are located around the outskirts of the City. These 11 large volume users account for approximately 60 percent of the total estimated irrigation demand (or 8,000 AFY). The City will maximize the initial use of recycled water at the lowest cost by designing a recycled water distribution system to primarily serve these potential customers. The use of recycled water can be further maximized by connecting smaller nearby users to the distribution system connecting the large users. Additional smaller users can then be connected in the future, since they will have little impact on the sizing of the distribution system or treatment facilities.

In addition to large users, recycled water will be delivered to high profile, demonstration sites, such as City Hall. Recycled water will also be provided in the future to new "green" development where recycled water would be used for landscape irrigation and indoor dual plumbing.

## 3.3 AGRICULTURAL REUSE

Fresno is fortunate in that agricultural reuse provides a significant opportunity for recycled water use with relatively low capital, regulatory and operational investment. There are five types of opportunities for direct agricultural reuse considered in this Master Plan:

- Expansion of direct deliveries of undisinfected secondary effluent to farmers
- Direct deliveries of tertiary treated effluent for unrestricted reuse to farmers
- Expansion of the existing practice of delivering extracted percolated effluent to Fresno Irrigation District (FID) via canal system
- Delivery of tertiary treated effluent for unrestricted reuse to FID via canal system
- Delivery of tertiary treated effluent for unrestricted reuse to another agency via pipeline

Based on the existing RWRF flow (approximately 80,000 AFY) and existing reuse volumes (approximately 35,000 AFY of direct secondary effluent reuse and extracted percolate delivered to FID), up to 45,000 AFY of additional effluent could be used for other purposes. The existing agreement with FID prevents the RWRF from taking any action that would lower the groundwater in the vicinity of the RWRF below the previous year's levels. While the amount of diversion or extraction allowable without affecting groundwater levels has not been studied, it is assumed that the full flow of the RWRF is available for beneficial reuse since there is currently a groundwater mound beneath the RWRF.

### 3.3.1 Direct Delivery of Undisinfected Secondary Effluent via Pipeline

The RWRF currently delivers approximately 10,000 AFY of undisinfected secondary effluent to nearby growers of non-food crops. RWRF staff performed a preliminary evaluation of expanding the direct reuse system to nearby growers willing to accept recycled water (shown in Figure 3.3). Corn for animal feed is allowed under Title 22 to be irrigated with undisinfected secondary effluent. Between the two identified corn-growing farms, an additional 1,400 acres could be served with undisinfected secondary effluent, provided that piping was available to convey the water. Corn uses approximately 3 feet of water per acre per year, so the 1,400 acres translates to a recycled water demand of 4,200 AFY. Expanding direct delivery of secondary effluent recycled water to nearby farmers relieves the hydraulic loading on the RWRF percolation ponds and meets the City's goal to increase recycling.

### 3.3.2 Direct Delivery of Tertiary Effluent to Growers via Pipeline

In addition to expanding the existing secondary reuse system, the City could upgrade its treatment facilities and deliver tertiary water to individual farmers for unrestricted reuse.

Serving the users directly would require installing a new distribution system to serve individual users. Farmers in the area are already served by an extensive canal system managed and owned by FID. Based on the City's direction, this alternative was not considered further in this Master Plan for large scale implementation of reuse to local farmers, as it would be more cost effective to utilize the existing canal system. However, individual growers could be served with turnouts from the urban reuse distribution system. Demands have been estimated at 450 to 900 AFY per mile of pipeline, assuming 1/8 to 1/4 mile of land could be irrigated on either side of a pipeline.

### 3.3.3 Expand Existing Practice of Delivering Extracted Percolate to FID Canals

Between 2000 and 2008, the RWRF extracted up to 34,000 AFY of percolated effluent from extraction wells and delivered this water to FID canals for use by downstream agricultural users (See Table 1.1 in Chapter 1). This alternative would expand on this existing practice to increase pumping from the groundwater beneath the percolation ponds for delivery to FID.

The City is surrounded by agricultural areas that are served by FID. FID maintains 800 miles of canals and provides water to 150,000 acres of farmland. A list of growers in the area immediately adjacent to the RWRF (Township 14, Range 19) was obtained from the County so that agricultural water demands could be estimated. Table 3.3 shows the annual demand of crops commonly grown near the RWRF. An average annual irrigation demand of 3.2 feet was calculated by taking an area-weighted average of the demands of all the crops.

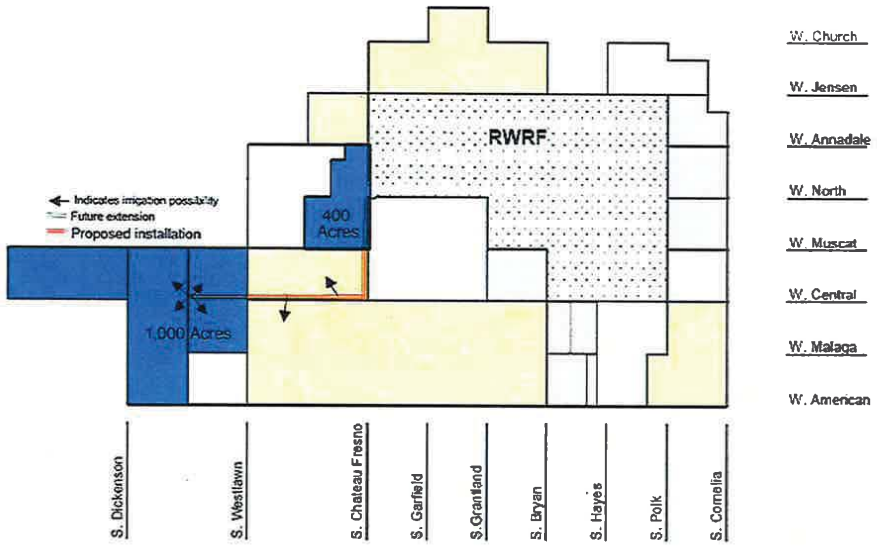


**Figure 3.3**
**POTENTIAL EXPANSION OF**
**DIRECT REUSE DELIVERY SYSTEM**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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Figure 3.4 shows the FID canal system in the vicinity of the RWRF. The City currently provides extracted water in the Houghton and Dry Creek canals near the RWRF. Depending on the alternative considered and the location of new treatment systems and pipelines, additional supply of recycled water can be delivered to various canals within the

**Table 3.3 Irrigation Demands of Crops Prevalent Near the RWRF**
**Recycled Water Master Plan**
**City of Fresno**

| Crop | Annual Irrigation Demand (feet) |
|---|---|
| Alfalfa | 4.5 |
| Citrus | 3.0 |
| Corn | 3.0 |
| Orchard | 3.9 |
| Other(1) | 2.7 |
| Pasture | 4.6 |
| Small Grain | 1.4 |
| Vineyard | 2.7 |

Note:
(1) "Other" is an estimate for crops that do not fall into the listed categories.

FID system. The City's current extraction wells and pipeline system for delivery to each of these canals cannot accommodate more flow; therefore new infrastructure would be required.

Preliminary discussions with FID have indicated that if the appropriate contracts and agreements were in place, they would be willing to operate their canals continuously to convey recycled water away from the RWRF to agricultural users or recharge basins. Further discussions with FID to better define canal capacity would be necessary prior to implementing this alternative.

In the past, pumping extracted groundwater from below the percolation ponds for use in agricultural irrigation has not been regulated. Due to concerns that this existing practice may be regulated differently in the future, research is being started to demonstrate the effectiveness of soil-aquifer treatment (SAT). The research is expected to show that SAT (of unfiltered and undisinfected wastewater) produces high quality water that is equivalent to Title 22 requirements for unrestricted reuse.

Agricultural reuse by sending either extracted percolate or tertiary water to FID canals presents an opportunity to exchange surface water for the recycled water. The existing agreement with FID would need to be renegotiated to allow increased deliveries. The City has not historically used its full entitlement of surface water from the existing FID agreement due to lack of demand and adequate facilities (recharge basins or water

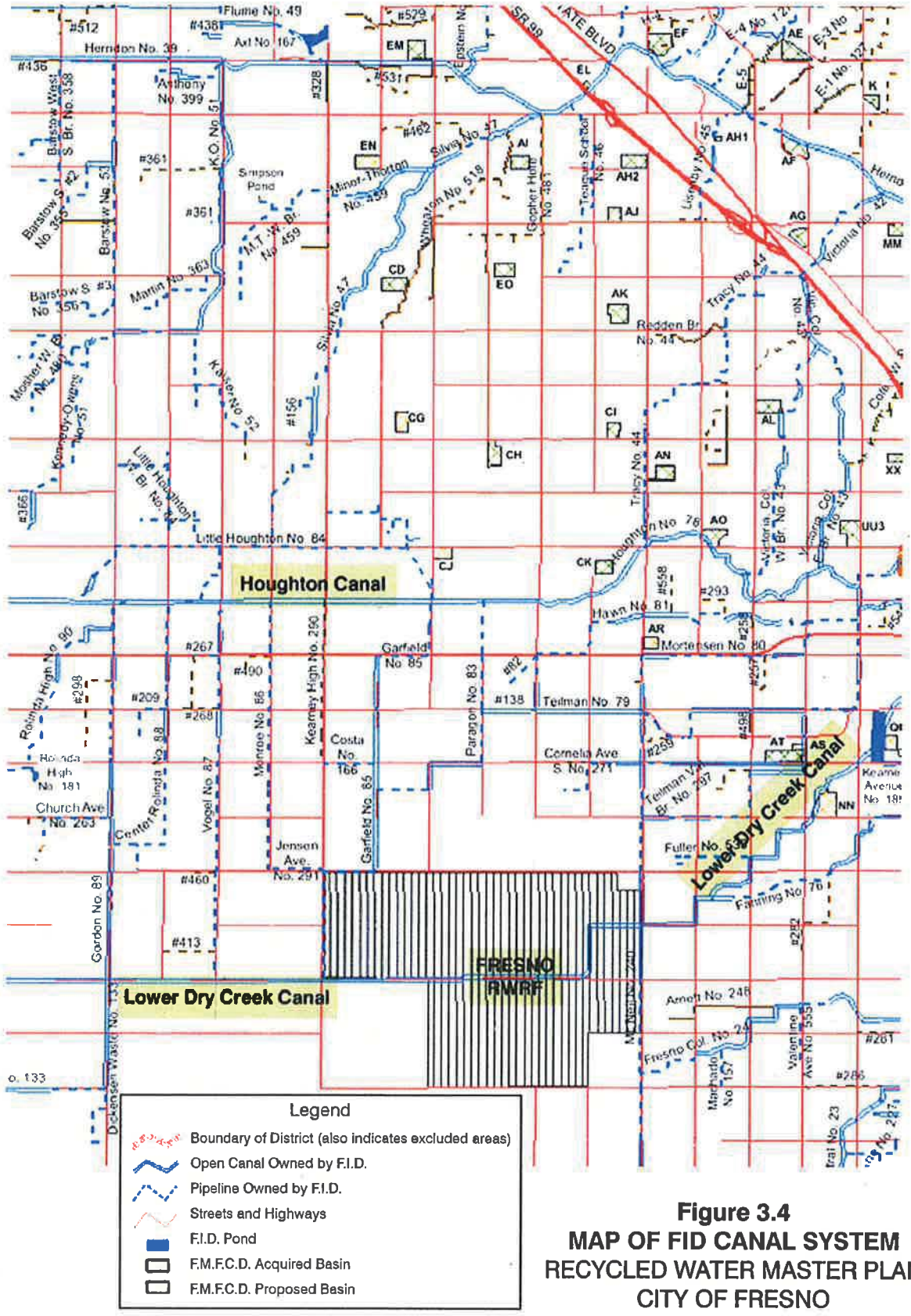


**Figure 3.4**
**MAP OF FID CANAL SYSTEM**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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treatment facilities). Additional facilities would be needed within the city to convey and treat FID's surface water for potable use, or to recharge it to the groundwater aquifer. The City has master planned the expansion of the northeast water treatment plant and construction of another southeast water treatment plant. As the City faces dwindling water supplies and decreasing groundwater levels, the surface water exchange will become more critical to its overall water portfolio.

### 3.3.4 Delivery of Tertiary Effluent to FID Canals

Instead of delivering extracted groundwater to FID canals, tertiary treated recycled water could be delivered directly to the canals. This alternative would require the RWRF to upgrade to tertiary treatment. The City would also need to renegotiate its agreement with FID to allow this type of delivery. This alternative would be more expensive than delivery of extracted percolated effluent (due to the additional treatment), while providing the same volume of water. However, this alternative is considered in the Master Plan in case the Regional Water Quality Control Board (RWQCB) does not recognize the percolation and extraction as equivalent to tertiary treatment in the future. Again, in order to take advantage of any new exchange agreement, additional facilities would be needed to convey and treat FID's surface water for potable use, or to recharge it to the groundwater aquifer.

### 3.3.5 Delivery of Recycled Water to Other Agencies via Pipeline

Delivery to other agencies, or irrigation districts, would likely require the RWRF to upgrade to tertiary treatment. In addition, the City would need to renegotiate its agreement with FID to convey recycled water outside FID's boundaries. This alternative was explored in the 1996 RWRF Master Plan, and the relevant section of that study is included in Appendix D. As this alternative has many institutional and political challenges, it will not be further explored as part of this Master Plan. However, in the interest of providing a diverse portfolio of options, the City should consider evaluating opportunities for potable water exchanges with other agencies in the future.

## 3.4 GROUNDWATER RECHARGE OPPORTUNITIES

Groundwater reuse recharge projects (GRRPs) are an opportunity to directly augment the City's potable supply, and provide a use for recycled water during the winter. Fresno's residents are already familiar with surface water recharge facilities scattered throughout the City, so the public is more likely to accept groundwater recharge than other cities unfamiliar with the concept.

Fresno's groundwater recharge potential depends on the ability to site basins in areas that have high percolation, the availability of diluent water and the travel time of percolated recycled to drinking water wells. As discussed in the regulatory section (Chapter 2), recharge basins must have six-months of hydraulic separation from the point of recharge to the nearest drinking water well. This separation requirement limits the ability to site

recharge facilities in the more developed parts of the City. Most likely, recharge facilities will be sited in the less developed areas of Fresno where there are fewer drinking water wells.

### 3.4.1 Diluent Water Sources

As discussed in Chapter 2, recharge regulations require that recycled water be blended with diluent water at a 1:4 ratio for surface spreading of tertiary recycled water. There are typically two sources of water that can be used for the diluent water: stormwater and raw (untreated) surface water. Fresno is fortunate to have several possible sources of diluent water: surface water from the US Bureau of Reclamation (USBR), Kings River entitlements for being inside FID boundaries, as well as stormwater managed by the Fresno Metropolitan Flood Control District (FMFCD). FMFCD operates recharge basins throughout the City for the purpose of recharging raw surface water and stormwater.

In discussions with FMFCD staff, they have indicated their willingness to work with City staff to provide diluent water in exchange for new recharge basins that would provide additional capacity for stormwater storage. Ideally, they prefer not to comingle recycled water in their stormwater basins in order to separate maintenance and operation issues between the two agencies and to simplify permitting issues. Stormwater would primarily be available as diluent water during the winter months. Surface water could theoretically be provided year-round for use as diluent water.

### 3.4.2 GRRP Basin Siting and Sizing

If stormwater water is to be used as diluent water, the best place to site the GRRP basins is adjacent to FMFCD basins or conveyance facilities. This way, stormwater can easily be conveyed into the recycled water recharge basins. If surface water is used as diluent water, then the water would be supplied from FID canals directly into the GRRP basins and the basins would best be sited near the canals.

The City is also considering the construction of "super-recharge basins" to increase the capacity to recharge surface water. If these basins are constructed, a portion of the recharge water could be made up of recycled water, provided there is adequate (6 months) travel time to the nearest drinking water well. Tentative locations of these super-recharge basins are shown in Figure 3.5.

The size of the GRRP basins will likely be driven by the availability of land (rather than the area needed to percolate the available recycled water) as the City is well developed in many parts of town. Basin sizing will also be driven by the volume and timing of delivery of diluent water, as there is four times more volume of diluent water required for blending than there is recycled water recharged. If diluent water is provided by FMFCD, then it will only be available during the winter, which is likely the same time that excess recycled water will be available for recharge (i.e., during the non-irrigation season). In this situation, the basin would need to be large enough to accommodate water from both sources at the same time. The amount of recycled water that can be percolated in a given area is maximized if

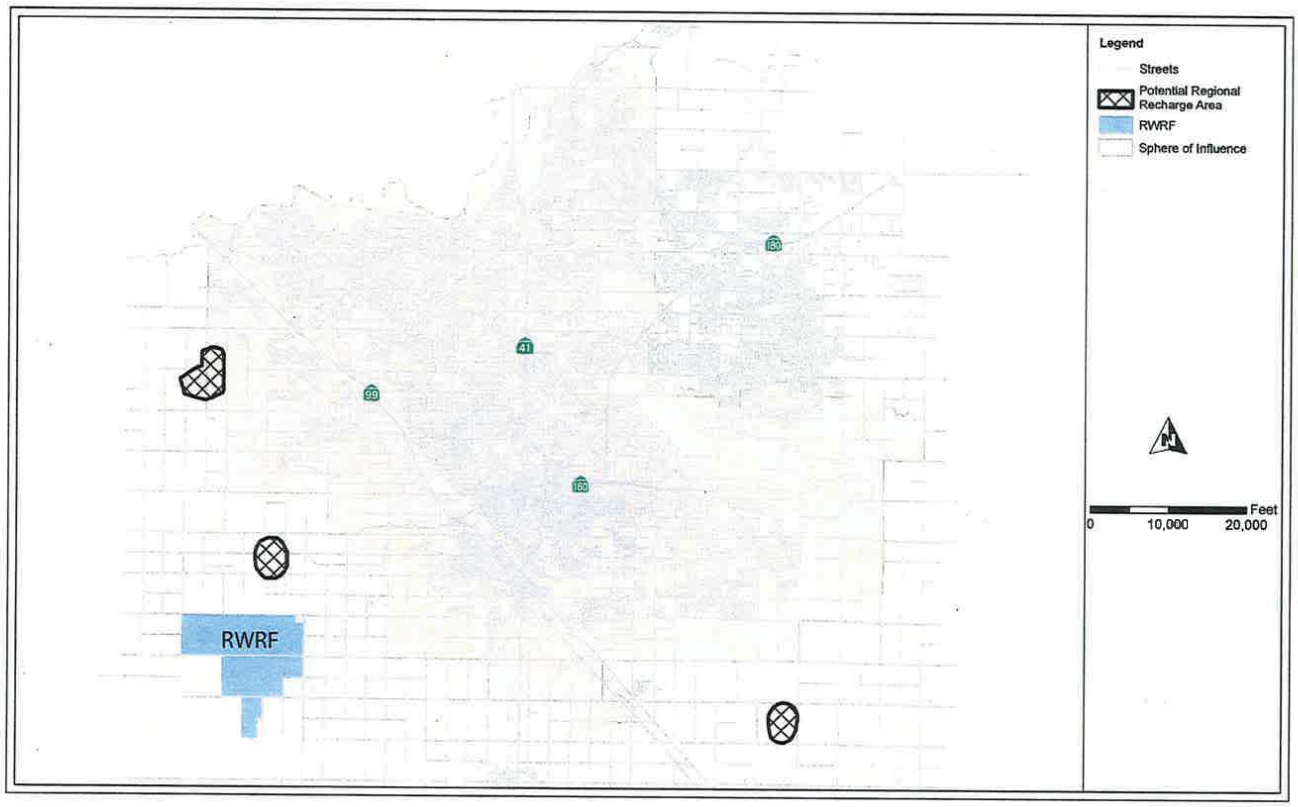


**Figure 3.5**
**TENTATIVE LOCATIONS OF SUPER-RECHARGE BASINS**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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diluent water is provided during a different time of year, or in an adjacent basin, so that the recycled water does not have to compete for basin capacity with the diluent water.

Percolation rates have been measured in FMFCD basins varying from 1.2 to 4.8 inches/day. Similar percolation rates would be expected in future GRRP basins. These percolation rates result in a recharge capacity of 33,000 to 130,000 gallons/acre/day (0.1 to 0.4 acre feet/acre/day) while the basin is in use. Percolation rates are highest on the west side of town, where it is also easiest to supply recycled water from the RWRF, and where fortunately there is an abundance of undeveloped land available. Including super-recharge basins, a total of approximately 2,450 acres of land have been preliminarily identified as possible sites for recharge basins. If all the identified sites were implemented, approximately 31,850 AFY of recycled water could be recharged (using an average percolation rate of 2.4 inch/day).

## 3.5 FISHERIES ENHANCEMENT EXCHANGE OPPORTUNITIES

The USBR is required by a 2006 Federal Court settlement to release sufficient water from the Friant Dam to maintain fish flows downstream in the San Joaquin River. One reuse alternative identified early in this Master Plan was the potential use of recycled water for stream flow enhancement.

In discussions with the USBR, agency representatives indicate that the amount of recycled water that could be supplied is a tiny fraction of the volume that is needed for fish flow maintenance in the river. The amount of water required to enhance San Joaquin River, 500,000 AFY, is significantly more than the City's entire potential recycled water supply, which is less than 80,000 AFY. The USBR staff also expressed concerns that the water quality and the temperature of the recycled water may be not being appropriate for the fisheries. Additionally, the USBR requires the water mostly in the spring when there is a high demand for recycled water for irrigation uses.

As a result of all this, discussions with the USBR were not pursued further, since fisheries enhancement exchange did not appear to be viable.

CITY OF FRESNO INCORPORATED OCT. 12, 1885



# PROJECT ALTERNATIVES

## 4.1 INTRODUCTION

Presented in this chapter is the development of the various recycled water uses (urban, agricultural and groundwater recharge) into project alternatives to be carried forward for further analysis. The project alternatives were configured to maximize the delivery of recycled water to each quadrant of the City, and to provide adequate cost and implementation information for moving forward with a recommended recycled water program.

## 4.2 SUMMARY OF PROJECT ALTERNATIVES

Project alternatives were developed for each type of water reuse including urban irrigation and industrial reuse, groundwater recharge, and agricultural reuse alternatives. Components of the project alternatives included: regional treatment or satellite treatment, distribution system, collection system flow diversions for satellite treatment, and influent and effluent storage.

### 4.2.1 Urban Alternatives

The City was divided into quadrants to develop the configuration of urban reuse project alternatives. Potential users were identified in each quadrant. Alternatives were then developed by grouping users in each quadrant and determining how they could be served. There were two treatment (recycled water production) alternatives considered when serving urban users: Alternative 1) delivering recycled water from the RWRF; and Alternative 2) delivering recycled water from Satellite Recycled Water Facilities (SRWFs) located in the vicinity of the uses. The designation of Alternative 1 or 2 were applied to recycled water use in each of the quadrants: the Southwest, Northwest, Northeast and Southeast. The project alternatives are summarized in Table 4.1. The total estimated demand that could be served by each alternative is also listed in Table 4.1, along with treatment flows. Alternatives in the same quadrant do not necessarily have the same demand, as different alignments allow serving different users.

Potential users were grouped into alternatives based on volume of demand and location. The larger users with demands over 100 AFY dictated the proposed pipeline alignments. In general these large users, such as golf courses, cemeteries and parks are located on the edges of town. Serving these larger users created a "backbone" distribution system around the City with spurs into the more densely developed areas to pick up additional users. The identified larger users and their demands are shown in Figure 4.1 along with the proposed backbone distribution system. Groundwater recharge opportunities could also be served by

| Table 4.1 Summary of Urban Reuse Project Alternatives<br>Recycled Water Master Plan<br>City of Fresno | | | | |
|---|---|---|---|---|
| **Quadrant/ Alternative** | **Demand AFY[1]** | **Treatment Capacity at RWRF (mgd)[1,2]** | **Treatment Capacity at SRWF (mgd)[2]** | **Comments** |
| SW - 1 | 4,140/5255 | 5.5/8.1 | - | Served entirely from the RWRF |
| SW - 2 | 4,340 | 1.4 | 4.1 | Served partially from the RWRF and partially from a SRWF at either Fruit & Church or south of Roeding Park |
| NW - 1 | 1,951/3,733 | 5.3/10.4 | - | Served entirely from the RWRF |
| NW - 2 | 1,709 | - | 4.7 | Served from a new SRWF at Herndon and Hayes |
| NE - 1 | 2,720/3,568 | 3.7/6.1 | 1.07 | Served partially from the RWRF and partially from the North Fresno WRF |
| NE - 2 | 508 | - | 1.07 | Served entirely from the North Fresno WRF |
| NE - 3.A | 263 | - | 0.7 | Served from a new SRWF on CSUF campus |
| NE - 3.B | 4,900 | - | 4.0 | Served from a new SRWF at Granite Park |
| SE - 1 | 995/1,820 | 2.8/5.1 | - | Served entirely from the RWRF |
| SE - 2 | 951 | - | 3.0 | Served from a new SRWF near at the fairgrounds, or a nearby park in SEGA |

Notes:
(1) Where numbers are presented as x/y, x is the demand or flow without residential and commercial reuse, and y is the number including residential and commercial reuse. Demands do not include potential for groundwater recharge.
(2) Treatment flows based on maximum day demand of potential urban irrigation and industrial reuse customers.

this distribution system during off-irrigation periods. Groundwater recharge basins could be filled in the winter when urban irrigation demands are minimal.

The backbone distribution system alignments shown in Figure 4.1 were selected based on consideration of the following elements: available right-of-way, utility conflicts, traffic volumes, highway and railroad crossings, jurisdictional agencies and special circumstances.

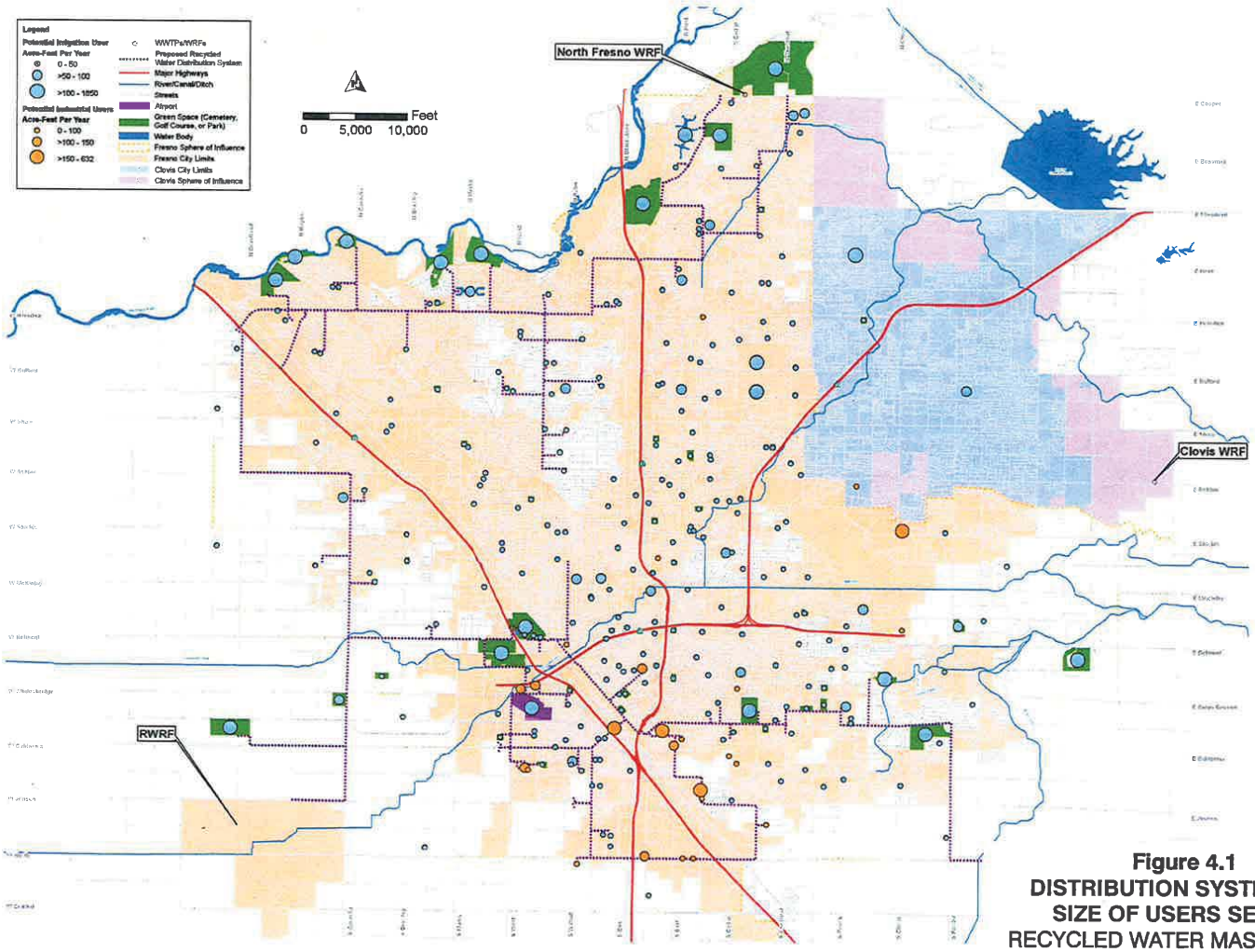


**Figure 4.1**
**DISTRIBUTION SYSTEM AND SIZE OF USERS SERVED**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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Although the distribution system was aligned to primarily serve larger users, for Alternative 1 (served from the RWRF) it was sized to accommodate smaller existing and future users as well. For the most part, significant numbers of smaller users cannot be served in Alternative 2 (served from SRWFs) since flows would not be sufficient to serve these smaller users. The additional users served under Alternative 1 include: 1) existing residential and commercial areas, and 2) future residential and commercial areas identified in the latest General Plan. Summarized in Table 4.2 are the potential demands for existing and future residential and commercial areas if all users within a mile of distribution pipeline are served with recycled water for irrigation. It was assumed for residential areas that only front yards would be irrigated with recycled water. Also shown in Table 4.2 are the assumptions of the demands to be served for the purposes of developing cost estimates.

**Table 4.2 Potential Irrigation Demand for Existing and Future Residential[1] and Commercial Users within 1 Mile of Distribution System Recycled Water Master Plan City of Fresno**

| Quadrant | Northeast | Northwest | Southeast[2] | Southwest | Total |
|---|---|---|---|---|---|
| **Water use if all identified users served (AFY)** | | | | | |
| Existing | 1552 | 2628 | 1212 | 580 | **5968** |
| Future | 288 | 1876 | 876 | 2500 | **5544** |
| **Assumption of demand to be served (AFY)** | | | | | |
| Existing (1/2 of users) | 776 | 1314 | 606 | 290 | **2984** |
| Future (1/4 of users) | 72 | 469 | 219 | 625 | **1386** |
| **Distribution system (miles)[3]** | | | | | |
| Existing (1/2 of users) | 31 | 54 | 23 | 15 | **123** |
| Future (1/4 of users) | 4 | 19 | 9 | 23 | **55** |

Notes:
(1) For residential densities up to 5 lots per acre.
(2) Does not include future demands in SEGA planning area.
(3) Distribution system length was estimated by using a ratio of the total length of City's 8-inch potable water system to the total City land area and multiplying this ratio by the area of commercial and residential areas proposed to be served by recycled water.

Once the "back bone" of the distribution system is established for larger recycled water users under Alternative 1, the City has the flexibility to extend laterals up existing residential streets and through commercial areas to serve the smaller users. Since it is not likely that all users will be served, in an effort to not oversize the treatment and distribution system, it was assumed that half of the identified existing residential (with densities up to 5 lots per acre) and commercial users would be served. Specific areas and developments for residential irrigation will be identified in the future. Pipeline cost for serving existing residential and commercial users was estimated to be $700,000/mile, including turnouts to individual users. The average demand for existing residential and commercial users served per mile was estimated to be 25 AFY/mile.

As discussed in earlier chapters, the City's General Plan is in the process of being updated and based on discussions with the planning department there will be a renewed focus on densification in the City. As a result, outlying areas that are adjacent to the proposed distribution system may not be developed as previously identified in the existing General Plan. Therefore, it was assumed that future development demands will be far less (assumed one quarter) of the potential area identified in the General Plan within one mile of the distribution system. It is anticipated that the costs for serving recycled water to future development will be borne by the developer (based on the proposed "Purple Pipe Ordinance").

The existing General Plan also identifies a future high-rise and mid-rise intensification corridor along Highway 41. It was assumed that this corridor would be served with recycled water for toilet flushing. This would offset an additional 200 AFY beyond the demands listed in Table 4.2. Existing and future users are shown in Figures 4.2 and 4.3.

### 4.2.2 Agricultural Alternatives

There were three agricultural reuse alternatives carried forward for further development in this Master Plan. They were: AG 1 - expanding the existing system to deliver additional undisinfected secondary effluent to local users; AG 2 - expanding deliveries of extracted percolated effluent to FID; and AG 3 - upgrading to tertiary treatment and delivering recycled water to growers for unrestricted reuse. These alternatives are summarized in Table 4.3.

**Table 4.3 Summary of Agricultural Reuse Project Alternatives Recycled Water Master Plan City of Fresno**

| Quadrant/ Alternative | Demand AFY | Tertiary Treatment Capacity at RWRF (mgd) | Comments |
|---|---|---|---|
| AG - 1 | 4,200 | - | No additional treatment is necessary |
| AG - 2 | 20,000 | - | No additional treatment necessary, but additional facilities for extraction and delivery is required. |
| AG - 3 | 20,000 | 27(1) | Assuming increased extraction of percolate for unrestricted reuse is not permittable by RWQCB. New tertiary facilities required. |

Note:
(1) Based on estimated peak day demand.

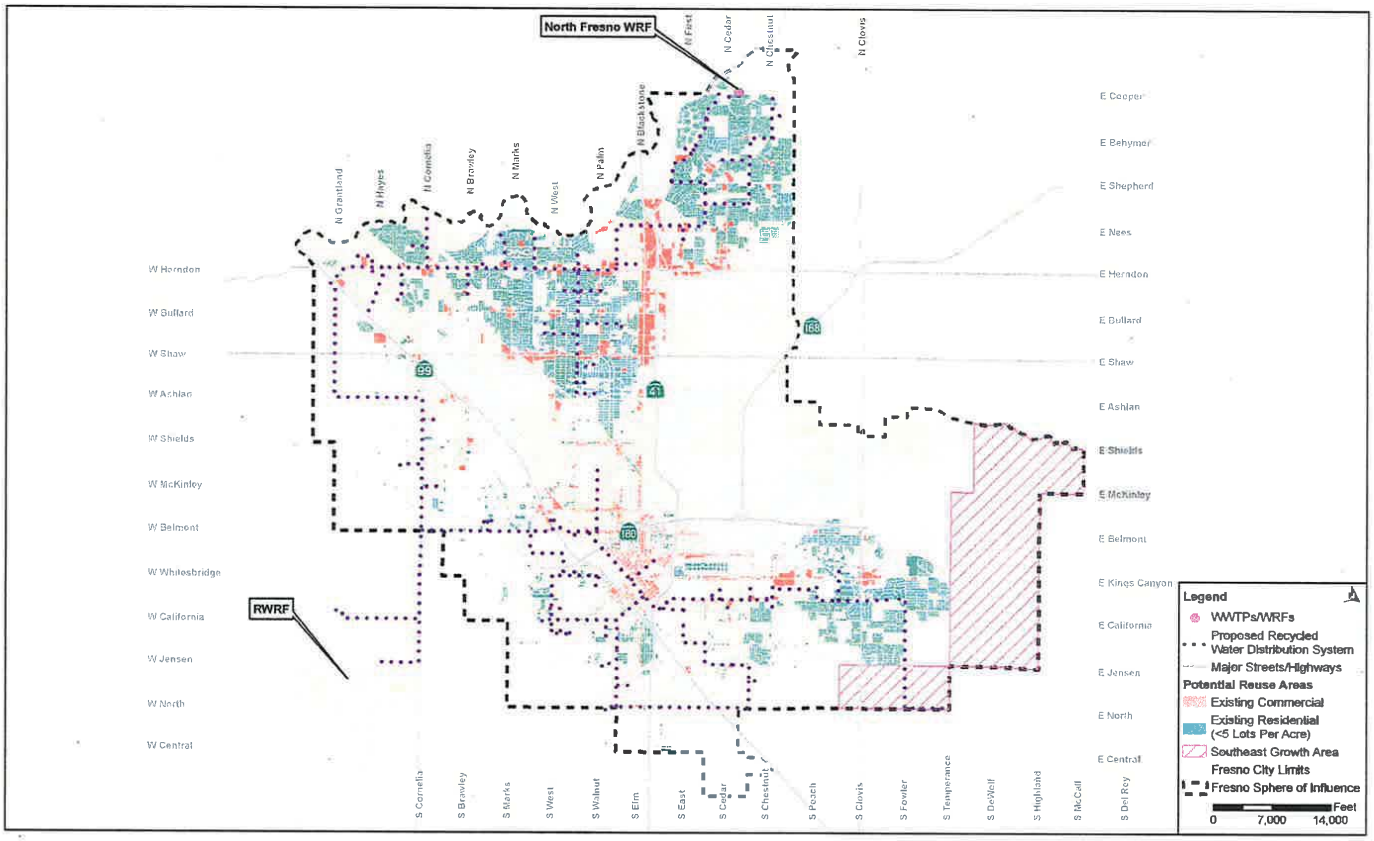


**Figure 4.2**
**EXISTING RESIDENTIAL AND COMMERCIAL DEVELOPMENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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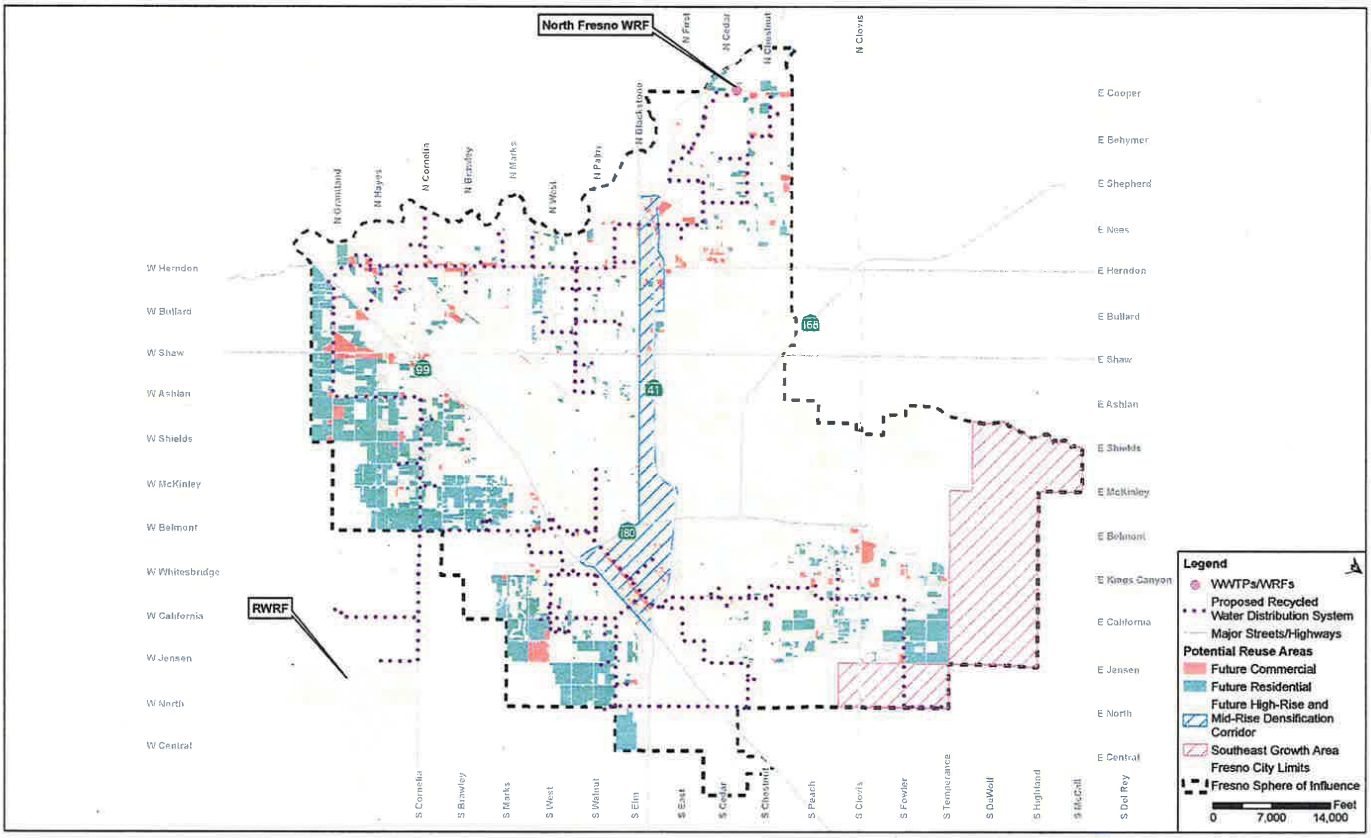


**Figure 4.3**
**FUTURE RESIDENTIAL AND COMMERCIAL DEVELOPMENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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The agricultural alternatives presented were generally developed assuming separate pipeline systems for urban users and agricultural users. However, in those instances where potential agricultural customers can be served directly from the urban distribution system, they will be.

### 4.2.3 Groundwater Recharge Reuse Projects (GRRPs)

Groundwater recharge with recycled water presents a significant opportunity for the City to both implement reuse and improve regional water supplies. For these reason, GRRPs are a critical component of the City's Recycled Water Master Plan. The City already utilizes the strategy of recharging surface water and stormwater to recharge the groundwater basin. Including the addition of recycled water to recharge the groundwater basin is a natural extension of this existing strategy. Additional recharge basins will also better leverage the City's ability to recharge existing and future surface water supplies.

In general, GRRPs would be implemented in coordination with the urban reuse alternatives. Treatment requirements for recharge utilizing spreading basins are similar to urban reuse, except that GRRPs require reduction of total nitrogen through nitrification/denitrification.

The urban recycled water distribution system would be utilized to deliver recycled water to the GRRP basins primarily during the winter months when there is little to no urban irrigation demand. For this reason GRRPs are an ideal complement to an urban reuse system to provide year-round reuse and effluent diversification. Diluent water required for GRRPs (as described in Chapter 2) can be provided from surface water or stormwater at any time water is available.

There are challenges to implementing GRRPs including: 1) finding a site with space and adequate detention time to the nearest potable well, 2) identifying and managing diluent water sources, and 3) meeting the conditions required for permitting a GRRP.

The City is developed and has limited open areas of land available for siting recharge basins, with the exception of the outer edges of town, particularly to the west. The City's extensive network of drinking water wells throughout town also complicates the siting of recharge basins, as a six month "travel time" is required between any GRRP basin and the nearest potable well. As part of this Master Plan effort, a reconnaissance-level investigation was conducted to identify potential GRRP sites. The investigation focused on areas of undeveloped lands adjacent to FID canals and/or to existing FMFCD basins, for greater ease of delivering diluent water to the GRRP. A discussion of potential GRRP basin sites is provided in Section 4.5. Once a GRRP site is selected, permitting studies will be required, including tracer studies to demonstrate adequate hydraulic distance between the GRRP basin and the nearest drinking water well.

It is the recommendation of this Master Plan that the City begin acquiring land as soon as possible, develop recharge basins, and begin use of these basins to recharge surface water while the permitting studies are being conducted for approval to recharge recycled water.

## 4.3 URBAN ALTERNATIVE 1 – RECYCLED WATER SERVED BY RWRF

Urban Alternative 1 utilizes the RWRF to produce and distribute recycled water throughout the City. Figure 4.4 shows an overview of this alternative, including the pipe segments that are considered the system "backbone" and laterals that would serve individual users. The system requirements for serving each individual quadrant of the City are discussed further on in this chapter.

### 4.3.1 Treatment

Recycled water for urban reuse from the RWRF (or a SWRF) must meet tertiary Title 22 standards, as described in Chapter 2. At the RWRF this will require construction of filtration and disinfection facilities since secondary treatment is already provided. Additionally, projects that include a GRRP component would require nitrification and denitrification (NdN) to less than 10 mg/l total nitrogen. The facilities needed for NdN are discussed in Section 4.5 - Groundwater Recharge.

Alternatives for filtration for the RWRF include cloth filters, media filters or microfilters. Alternatives for disinfection at the RWRF include ultraviolet light (UV) and ozone. Chlorine was not considered a viable disinfectant alternative due to concerns of forming regulated disinfection by products, such as trihalomethanes. However, it is recommended that chlorine be used to maintain a residual in the distribution system for urban reuse, although it is not required. A range of treatment train costs were developed with media filtration paired with UV for a lower cost option, and membranes paired with ozone for a higher cost option. There is adequate room onsite for either of these treatment trains. For the purposes of cost estimates, media filtration + UV was considered the most probable treatment train.

The existing secondary treatment facilities at the RWRF are comprised of sides A, B and C. All three plants are activated sludge processes, with Plant A being the oldest (constructed in the 1970s) and Plant C being the newest (construction completed in 2009). The facilities include aeration basins and secondary clarifiers. Both the B and C plants were designed with the capability to provide nutrient removal. Figure 4.5 shows a potential location for tertiary and disinfection facilities that would draw from any of the secondary treatment trains at the RWRF.

#### 4.3.1.1 Expanding Treatment at the North Fresno WRF

The North Fresno WRF currently serves users in the northeast quadrant of the City and is permitted (ORDER NO. R5-2006-0090-01; NPDES NO. CA0085189) for a discharge of 0.71 million gallons per day (mgd) average monthly flow and 1.07 mgd maximum daily flow. The plant is designed and permitted to produce a denitrified tertiary disinfected effluent with sequencing batch reactors (SBRs), disc filtration, and chlorination. The recycled water demand in the northeast quadrant exceeds the permitted capacity of the North Fresno WRF. Therefore, options to increase the capacity were evaluated.

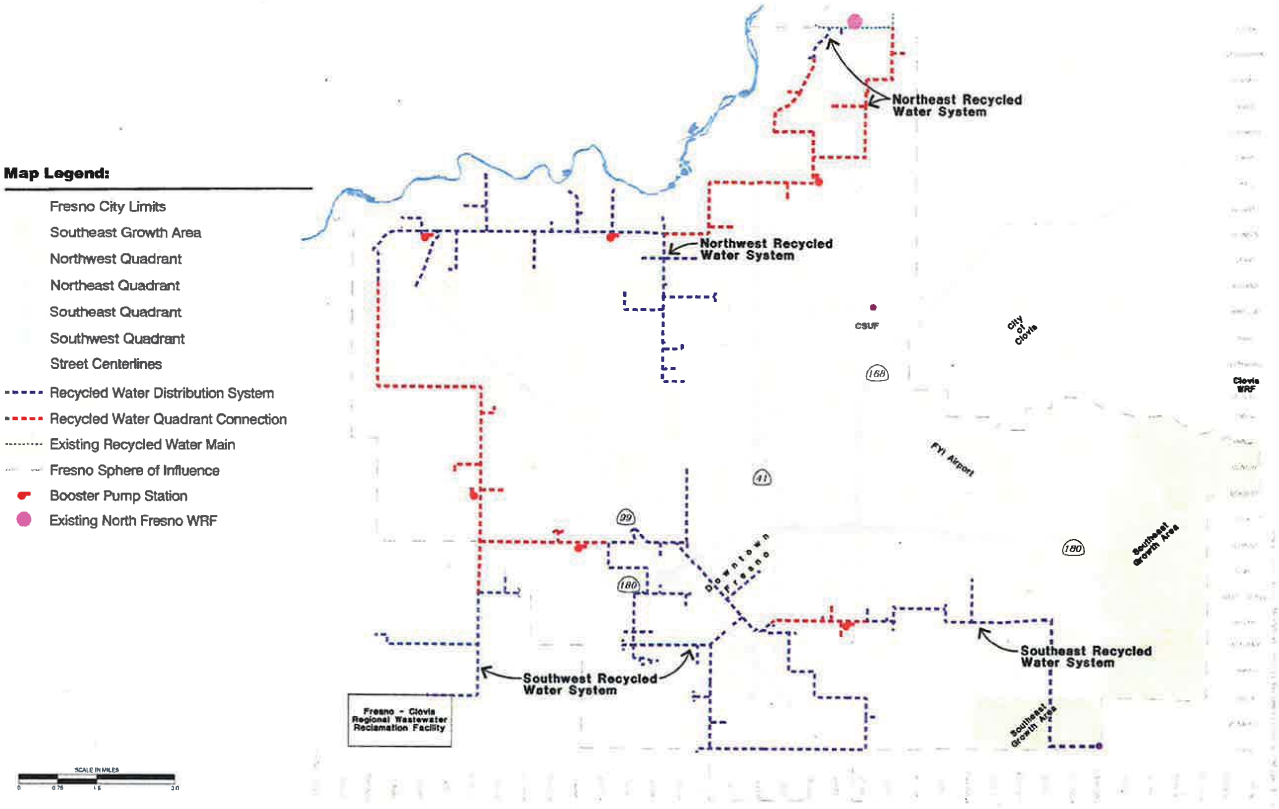


**Figure 4.4**
**OVERVIEW OF ALTERNATIVE 1 DISTRIBUTION SYSTEM**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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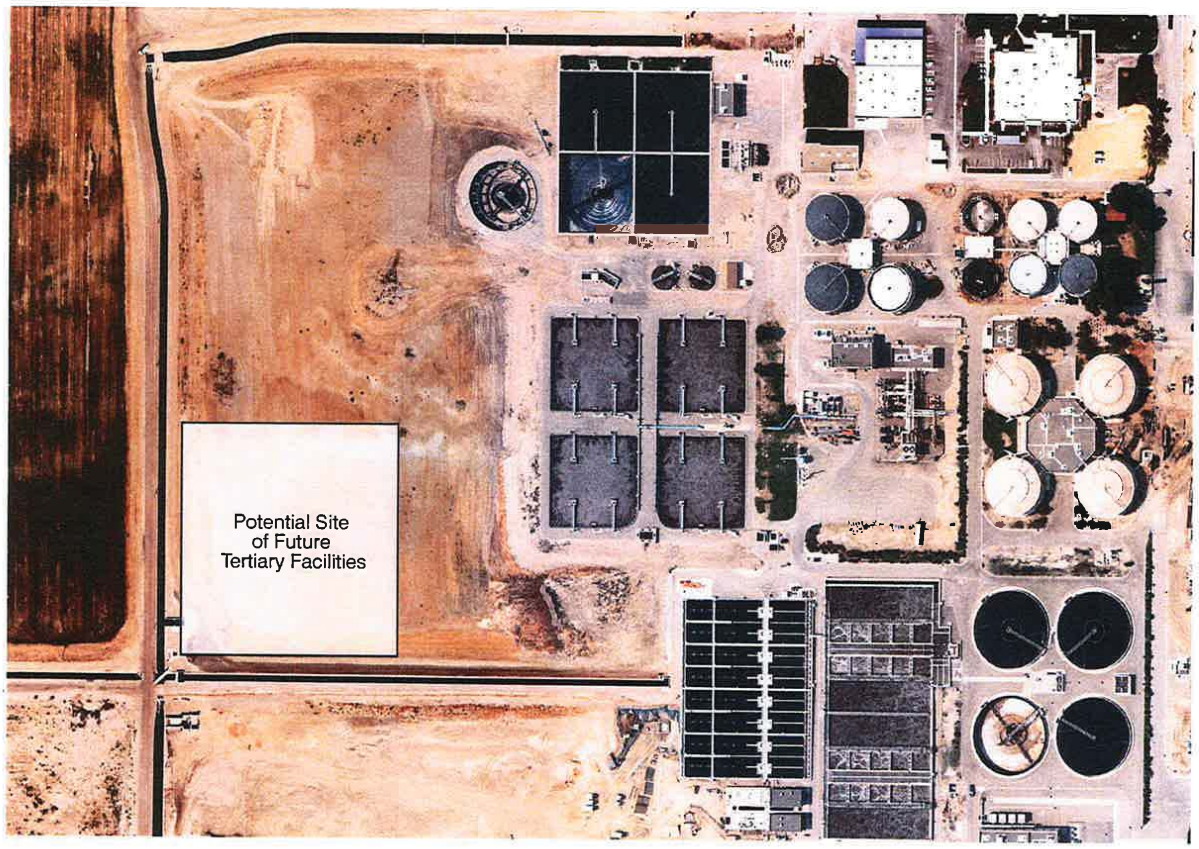


**Figure 4.5**
**A-SIDE/B-SIDE TERTIARY**
**FACILITIES SITE**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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In order to expand the average monthly treatment capacity to 1.07 mgd, the following facilities would be needed at the North Fresno WRF:

- A second channel grinder and screen at the headworks to match the current equipment.
- Two new SBR basins and associated mixers, decanters, piping, and pumps. (The basins would be built adjacent to SBR units on the north side of the SBR structure.)
- Two new aeration blowers (space is provided for the future blowers adjacent to the existing blowers.)
- An additional post-secondary equalization pump
- Two more filter discs within each package filtration tank.
- Two more effluent irrigation pumps in the existing pump station.
- All other ancillary equipment (piping, electrical, instrumentation, chemical feed, etc.) to make a complete system.

The above improvements assume the following:

- The existing influent lift pumps have adequate capacity to pump the increased flows.
- Peak flows greater than 1.07 mgd can be diverted away from the plant at the influent lift station, and sent to the RWRF.
- The standby generator is adequate for the additional equipment and their loads.

This analysis also assumed the chlorination system, which does not function well, would be replaced as the primary disinfectant with a UV or ozone system to minimize disinfection byproduct formation. Chlorine would likely still be used to maintain a residual in the distribution system for urban reuse, although it is not required.

### 4.3.2 Storage

Recycled water system storage is a key component of recycled water systems because of the difference in collection system flows, treatment capacity and distribution system demands. Adequate storage addresses the inconsistency of these flows/volumes to allow facilities to be optimally sized to convey and treat average flows as opposed to peak flows.

**Influent storage** of peak flows is required in cases were minimum sewer flows are below treatment plant capacity. Influent storage would not be required for tertiary facilities at the RWRF since the potential recycled water demands for urban reuse are much smaller than the RWRF's influent capacity.

**Effluent storage** can provide reliability for when treatment processes are down or can serve peak flow demands above the treatment capacity. Effluent storage needs could be provided by constructing dedicated recycled water storage tanks or by converting one of the existing RWRF percolation ponds to a storage pond with compacted clay or membrane

liner. In either case, the RWRF site is a good location for storage due to the large amounts of available land. Additional storage facilities would also be provided in the distribution system on City-owned land where possible. This distribution system storage would allow flexibility to serve additional users without oversizing the distribution system. It is typical for recycled water distribution systems to have one maximum day of storage, which gives the system the flexibility to deliver peak day demand.

### 4.3.3 Southwest Alternative (SW1)

Users in the Southwest Quadrant would be served by recycled water generated at the RWRF. The users and distribution systems for this alternative are illustrated in Figure 4.6. Major users in this quadrant are City and County parks, cemeteries, schools, Highway 180, industrial users, and existing and future residential and commercial development. Recycled water for indoor dual plumbing in the Highway 41 mid- and high-rise intensification corridor would be supplied in the future as part of this alternative.

Treatment flows required for SW1 are 5.5 mgd for the identified large urban users, or up to 8.1 mgd if existing and future residential and commercial irrigation is implemented. These flows represent the combined maximum day demand for the users identified in this quadrant. As mentioned previously, because the capacity of the RWRF is greater than the recycled water demand of the system, influent storage would not be required.

The irrigation customers or industries in the Southwest quadrant do not have onsite storage, therefore effluent storage at the RWRF site or distribution system storage would need to be provided. Approximately one day at maximum month demand, or 8.1 million gallons (MG) of total storage would be required.

### 4.3.4 Northwest Alternative (NW1)

Alternative NW1 would extend the SW quadrant backbone pipeline north to serve users in the northwest quadrant. The distribution system would connect to major golf courses, schools, parks in the area, Highway 99 median landscaped areas, and existing and future residential and commercial development. Shown on Figure 4.7 are the users' locations and potential distribution system routes.

For NW1, all flows would be treated at the RWRF and no influent storage would be required. The recycled water demand identified for this quadrant was 5.3 mgd to serve large urban users, or up to 10.4 mgd if existing and future residential and commercial irrigation is implemented.

The golf courses identified as potential recycled water customers in the northwest region have onsite storage in the form of ponds. An additional 6.9 MG would need to be added to provide one day of storage for other users. The storage facilities would be divided between the RWRF and a new facility on City owned land near Herndon and Hayes.

**Distribution System Summary**

| | Length of Pipe | Recycled Water Delivered* |
|---|---|---|
| Pipeline No. 1 | 13.15 mi | 1,423 acre ft / yr |
| Pipeline No. 2 | 2.17 mi | 368 acre ft / yr |
| Pipeline No. 3 | 1.44 mi | 95 acre ft / yr |
| Pipeline No. 4 | 4.78 mi | 1,129 acre ft / yr |
| Pipeline No. 5 | 3.08 mi | 362 acre ft / yr |
| Pipeline No. 6 | 2.63 mi | 194 acre ft / yr |
| Pipeline No. 7 | 3.28 mi | 131 acre ft / yr |
| Pipeline No. 8 | 2.96 mi | 140 acre ft / yr |
| Pipeline No. 9 | 2.79 mi | 283 acre ft / yr |
| Total: | 36.28 mi | 4,125 acre ft / yr |

*No agricultural or future demand included in calculations.

**Map Legend:**

- Airports
- Cemeteries
- Fresno City Limits
- Parks & Golf Courses
- Schools
- Water Bodies & Ponds
- Heavy Industrial User
- Light Industrial User
- Fresno Sphere of Influence
- Street Centerlines

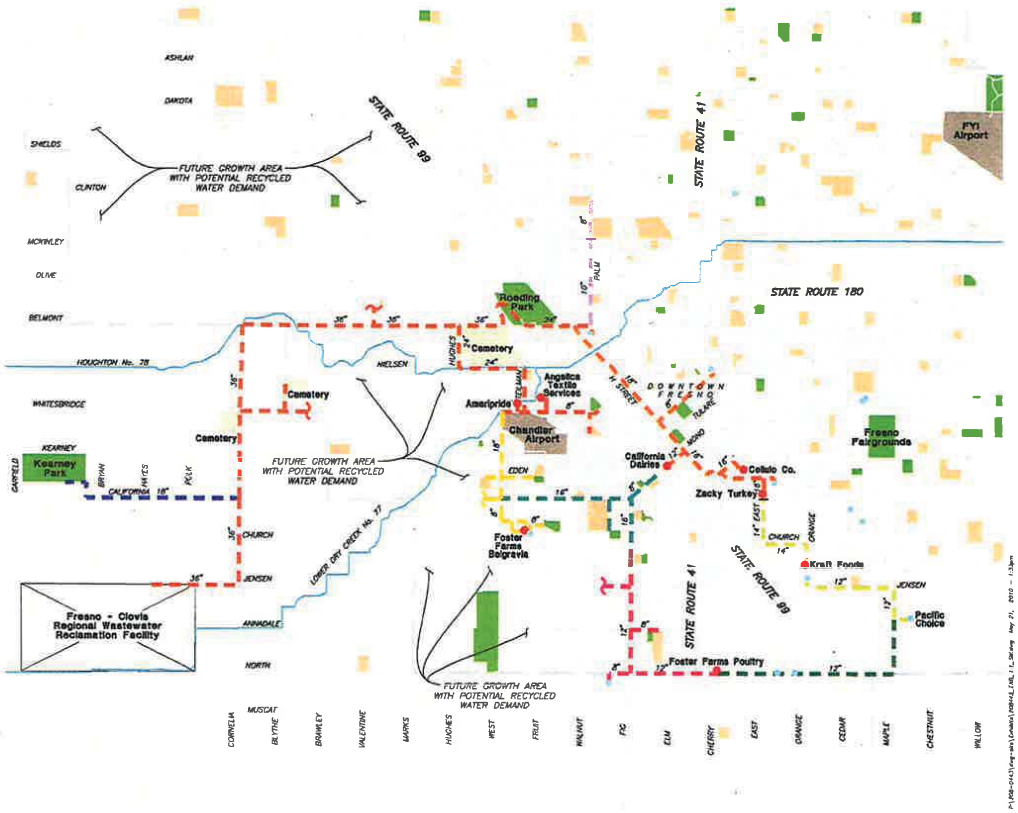


**Figure 4.6**
**SOUTHWEST PROJECT ALTERNATIVE 1**
**DISTRIBUTION SYSTEM ALIGNMENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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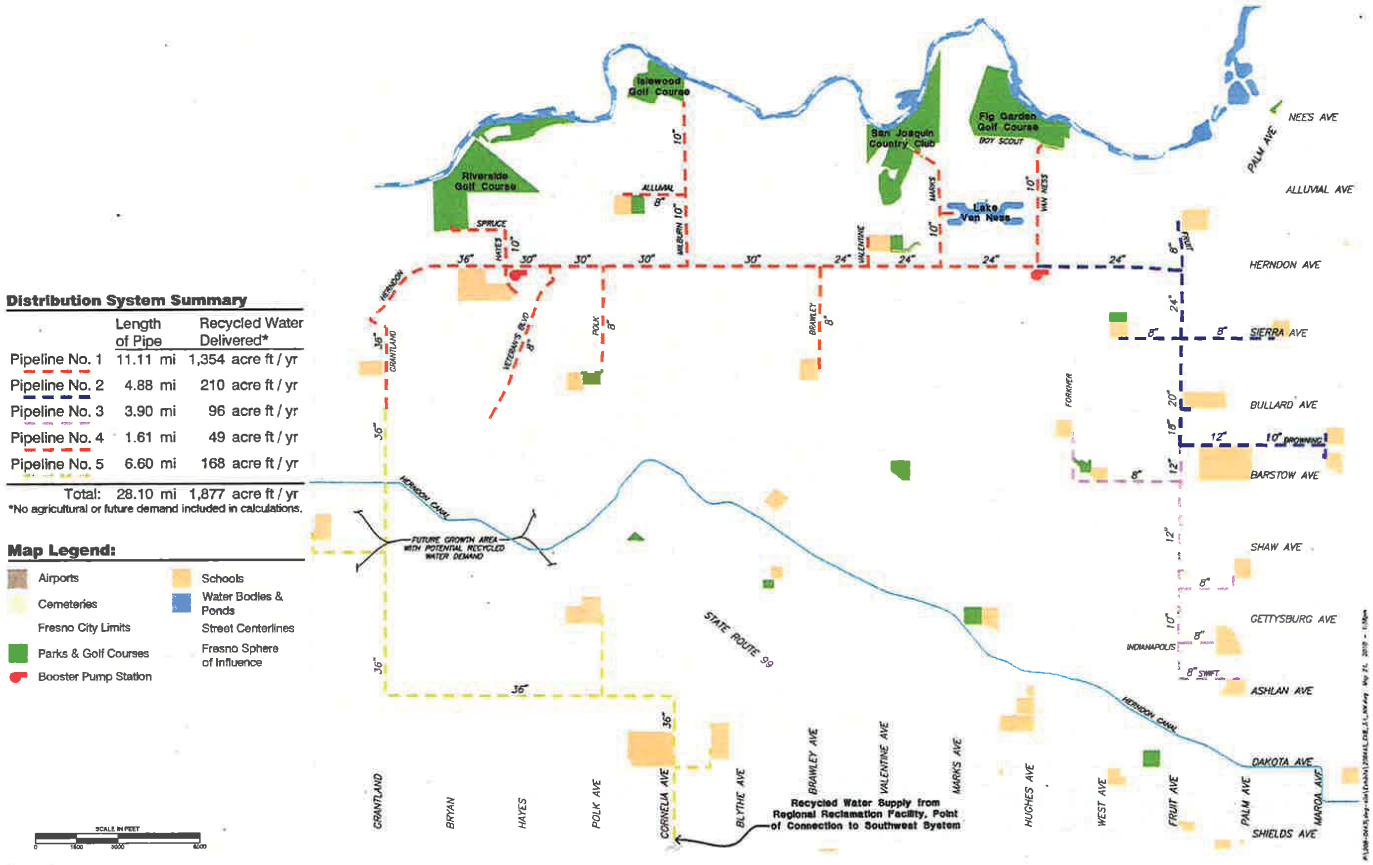


**Figure 4.7**
**NORTHWEST PROJECT ALTERNATIVE 1**
**DISTRIBUTION SYSTEM ALIGNMENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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### 4.3.5 Northeast Alternative (NE1)

Alternative NE 1 would be a hybrid alternative that includes serving the NE quadrant from both the RWRF and the North Fresno WRF to supply larger users including Woodward Park, Highway 41 irrigated areas, golf courses, local schools, and existing and future residential and commercial development. Shown on Figures 4.8 are the users' locations and potential distribution system routes for this alternative.

The existing North Fresno WRF would be expanded from its existing permitted average monthly capacity of 0.71 mgd to an average monthly capacity of 1.07 mgd by expanding the existing SBR and disc filter treatment technologies. To increase the flows at the North Fresno WRF, sewer lift station #6 would be rerouted to direct more wastewater to the North Fresno WRF to increase its recycled water production capacity. It was assumed that existing storage facilities at the North Fresno WRF would be used, so no additional storage for influent or effluent would be required at that facility.

The RWRF would provide additional treatment of 3.7 mgd for the larger urban users not served by the North Fresno WRF, or up to 6.1 mgd if existing and future residential and commercial irrigation users are served. The backbone pipeline from the RWRF would be extended from the northwest quadrant east of Highway 41. Approximately 6.1 MG of additional effluent storage would be required in the northeast quadrant for the area served from the RWRF.

A backbone pipeline was initially proposed to extend down Herndon Avenue, from Palm Avenue to Cedar Avenue and south to serve the CSUF campus. This alternative was discarded due to dependency on the entire backbone pipeline, and length of time required to implement.

### 4.3.6 Southeast Alternative (SE1)

SE1 would extend the backbone pipeline from the Southwest Quadrant to serve users in the southeast. The distribution system would serve nearby parks, schools, Fresno Pacific University, the Sunnyside Golf Course, irrigated areas on Highways 41 and 99, and existing and future residential and commercial development. As discussed in Chapter 1, while SE 1 includes potential future users in the southeast quadrant of the City service area, it does not include recycled water delivery to the future SEGA development. The proposed SE distribution system is illustrated on Figure 4.9. The backbone piping system in the southeast quadrant was not extended to the north as all the identified larger users, such as Airways Golf Course and Palm Lakes Golf Course, have been abandoned or are no longer in use.

For SE 1, flows would be treated at the RWRF, so no influent storage would be required. The RWRF would provide additional treatment of 2.8 mgd for larger urban users, or up to 5.1 mgd if existing and future residential and commercial irrigation are served. These flows would be in addition to the demands in the other quadrants.

**Distribution System Summary**

| | Length of Pipe | Recycled Water Delivered* |
|---|---|---|
| Existing Recycled Water Pipeline | 1.75 mi | 508 acre ft / yr |
| Pipeline No. 1 | 14.42 mi | 2,212 acre ft / yr |
| Total: | 16.17 mi | 2,720 acre ft / yr |

*No agricultural or future demand included in calculations.

**Legend:**

- Fresno City Limits
- Water Bodies & Ponds
- Parks & Golf Courses
- Schools
- Street Centerlines
- Fresno Sphere of Influence
- New Sewer Force Main
- North Fresno Water Reclamation Facility
- Booster Pump Station
- Sewer Lift Stations

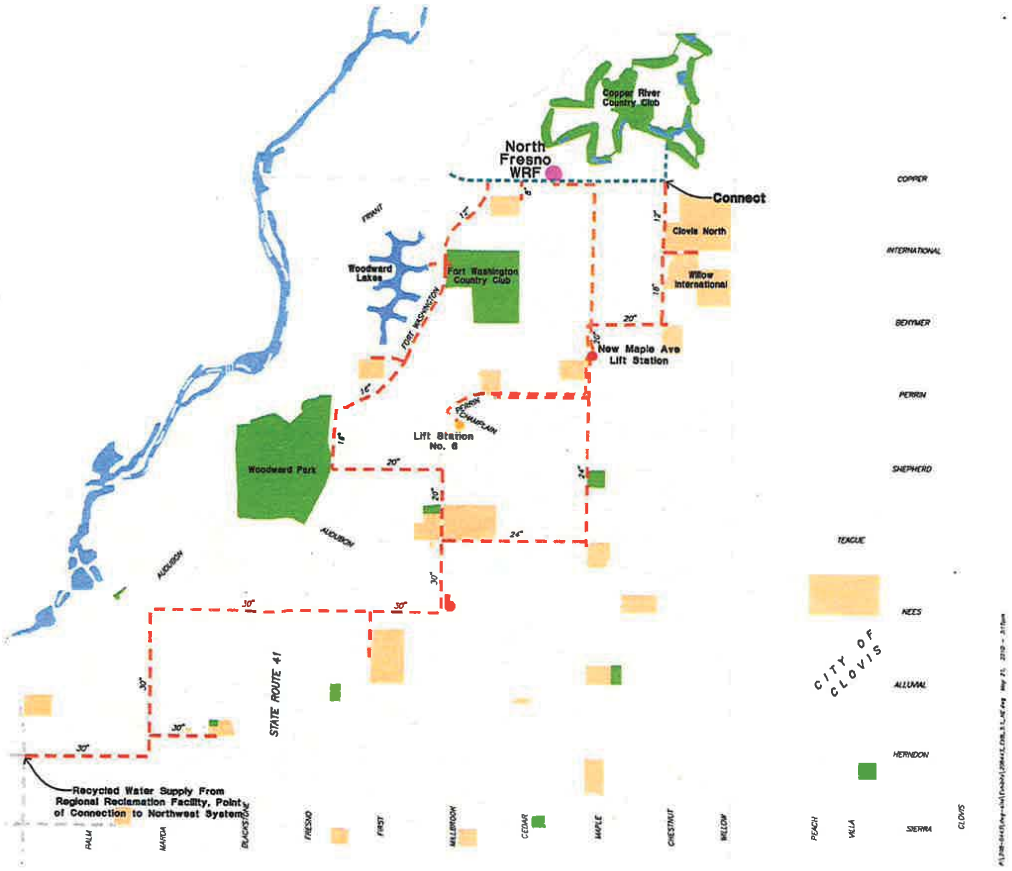


**Figure 4.8**
**NORTHEAST PROJECT ALTERNATIVE 1**
**DISTRIBUTION SYSTEM ALIGNMENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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**Distribution System Summary**

| | Length of Pipe | Recycled Water Delivered* |
|---|---|---|
| Pipeline No. 1 | 3.24 mi | 554 acre ft / yr |
| Pipeline No. 2 | 1.26 mi | 330 acre ft / yr |
| Pipeline No. 3 | 0.86 mi | 111 acre ft / yr |
| Total: | 7.35 mi | 995 acre ft / yr |

*No agricultural or future demand included in calculations.

**Map Legend:**

- Fresno City Limits
- Parks & Golf Courses
- Schools
- Southeast Growth Area
- Street Centerlines
- Booster Pump Station
- Clovis Water Reclamation Facility
- Heavy Industrial User
- Existing Recycled Water Pipeline
- Fresno Sphere of Influence

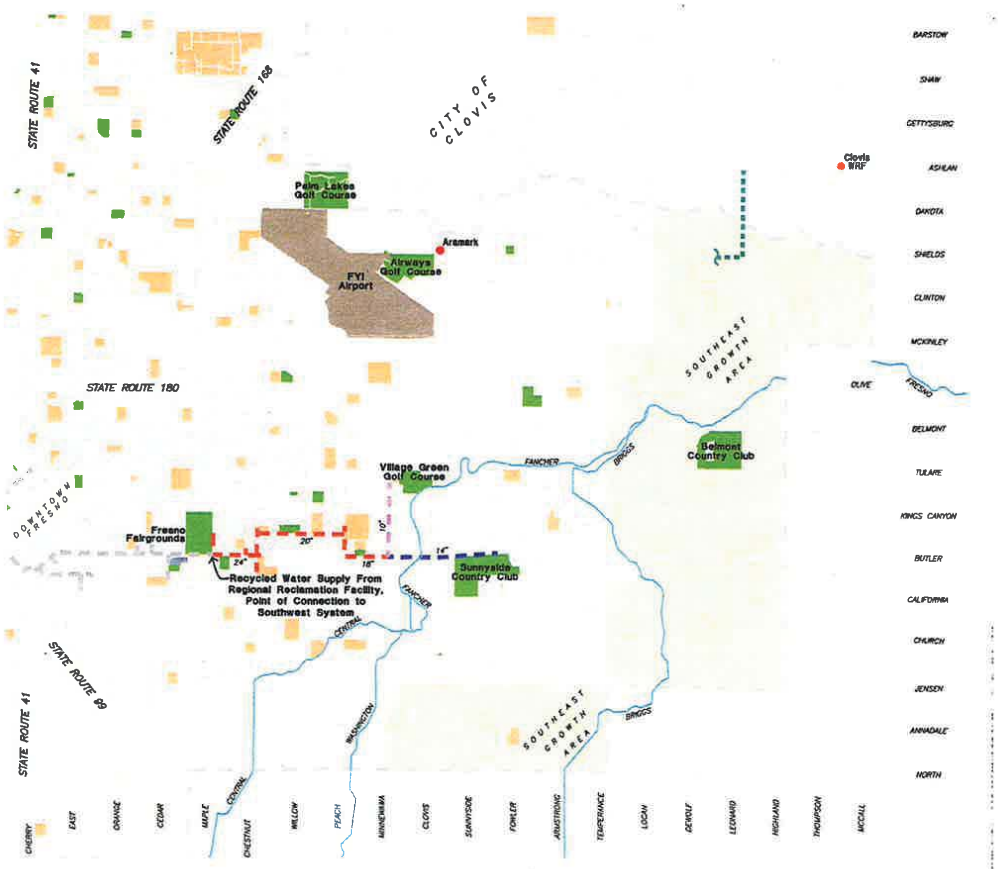


**Figure 4.9**
**SOUTHEAST PROJECT ALTERNATIVE 1**
**DISTRIBUTION SYSTEM ALIGNMENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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To serve the SE demands, approximately one day of effluent storage (approximately 5.1 MG) would be needed. This storage could be divided up between storage at the RWRF and distribution system storage on other City owned lands in the SE quadrant.

### 4.3.7 Costs for Urban Alternative 1 – Served by the RWRF

Conceptual level cost estimates for project alternatives served from the RWRF are presented in Table 4.4. These costs are construction costs which include an appropriate planning level contingencies for treatment facilities and the distribution system. Costs are presented in January 2010 dollars (ENR 8660).

**Table 4.4 Cost Estimates for Urban Alternatives 1 Served from RWRF (in Millions)[1] Recycled Water Master Plan City of Fresno**

| | | Distribution System | | | Treatment [2] | Storage [3] | |
|---|---|---|---|---|---|---|---|
| | Alternative | Backbone | Spurs | Total | | | Total |
| Capital Costs ($M) | SW1 | 22 | 27 | 49 | 12 | 7 | 68 |
| | NW1 | 37 | 13 | 50 | 9 | 6 | 65 |
| | NE1 | 24 | 12 | 40[4] | 11 | 5 | 56 |
| | SE1 | 13 | 4 | 17 | 6 | 4 | 27 |
| O&M Costs ($M/yr) | SW1 | - | - | 0.3 | 0.4 | 0.2 | 0.9 |
| | NW1 | - | - | 0.2 | 0.3 | 0.2 | 0.7 |
| | NE1 | - | - | 0.2 | 0.7 | 0.2 | 1.1 |
| | SE1 | - | - | 0.1 | 0.2 | 0.2 | 0.5 |

Notes:
(1) All costs presented in January 2010 dollars (ENR 8660).
(2) Low cost alternative is presented here, and is media filtration + UV. High cost alternative is microfiltration + ozone and is included in Appendix F. Treatment costs include feed pump station. Costs do not include treating flows for residential and commercial irrigation.
(3) Assuming half the storage is provided by a new facility on City-owned property outside of the RWRF land.
(4) Includes $4M to reroute lift station 6 and increase flow at North Fresno WRF.

Costs are based on the following assumptions:

- Except for the North Fresno WRF, costs are based on serving the City from the RWRF
- Distribution costs build on each other. For example, NW 1 assumes that the SW 1 distribution system and treatment facilities are already in place
- NW 1 and NE 1 are consecutive phases of the distribution system that are served from the SW 1 pipeline
- SE 1 also builds on the SW 1 distribution system but does not include service to SEGA

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- Feed pump station is included in treatment cost estimate, and recycled water delivery pump station is included in distribution system pump station cost estimate.
- Storage costs at sites other than the RWRF are based on welded steel tanks. Costs do not include land acquisition.
- More detailed cost information is provided in Appendix F.

## 4.4 URBAN ALTERNATIVE 2 - SERVED BY SRWF

As an alternative to serving all users from the RWRF, Alternative 2 serves urban users through a combination of satellite facilities (or SRWFs), and tertiary treatment at the RWRF. Where possible, facilities will be sited on land already owned by the City to minimize land acquisition costs (approximately $45,000 per acre).An overview of the distribution system for Alternative 2 is shown in Figure 4.10. Figure 4.10 shows both the distribution system "backbone" and the spurs that will deliver recycled water to individual users.

Because sewer flows are lower in outlying areas compared to influent flows at the RWRF, fewer users can be served from the SRWFs. In general, there is insufficient flow to serve significant numbers of residential and commercial areas if larger users are prioritized. Because of these lower sewer flows, a SRWF in the southeast quadrant would be the only system that could potentially also serve residential and commercial irrigation users.

### 4.4.1 Treatment for SRWFs

Tertiary treatment at the RWRF was discussed under Alternative 1 (Section 4.3). In contrast to the RWRF options where only filtration and disinfection are required, for SWRFs new treatment plants are required. New SWRFs would include preliminary treatment (screening and grit removal), primary treatment, secondary treatment, disinfection, odor control, a distribution system pump station, and operations building. Other requirements would include: architecture/landscaping, standby power, SCADA (Supervisory Control and Data Acquisition) and site work/yard piping. It is proposed that solids from these satellite plants would be sent to the RWRF for treatment. As a result, the SRWFs would not provide solids treatment. Sewer flows beyond the capacity of the SRWFs would be sent to the RWRF. Also if the SRWF is not operated year round, sewer flows would be conveyed to the RWRF during non-operational periods.

Considerations for selection of treatment processes for SRWFs include:

- Selection of technologies with a small footprint to best fit into developed residential neighborhoods
- Use of alternative disinfection (other than chlorine - with the exception of providing a residual for the distribution system).
- Use of modular systems that allow future expansion.
- Selection of tertiary treatment that meets Title 22 standards.

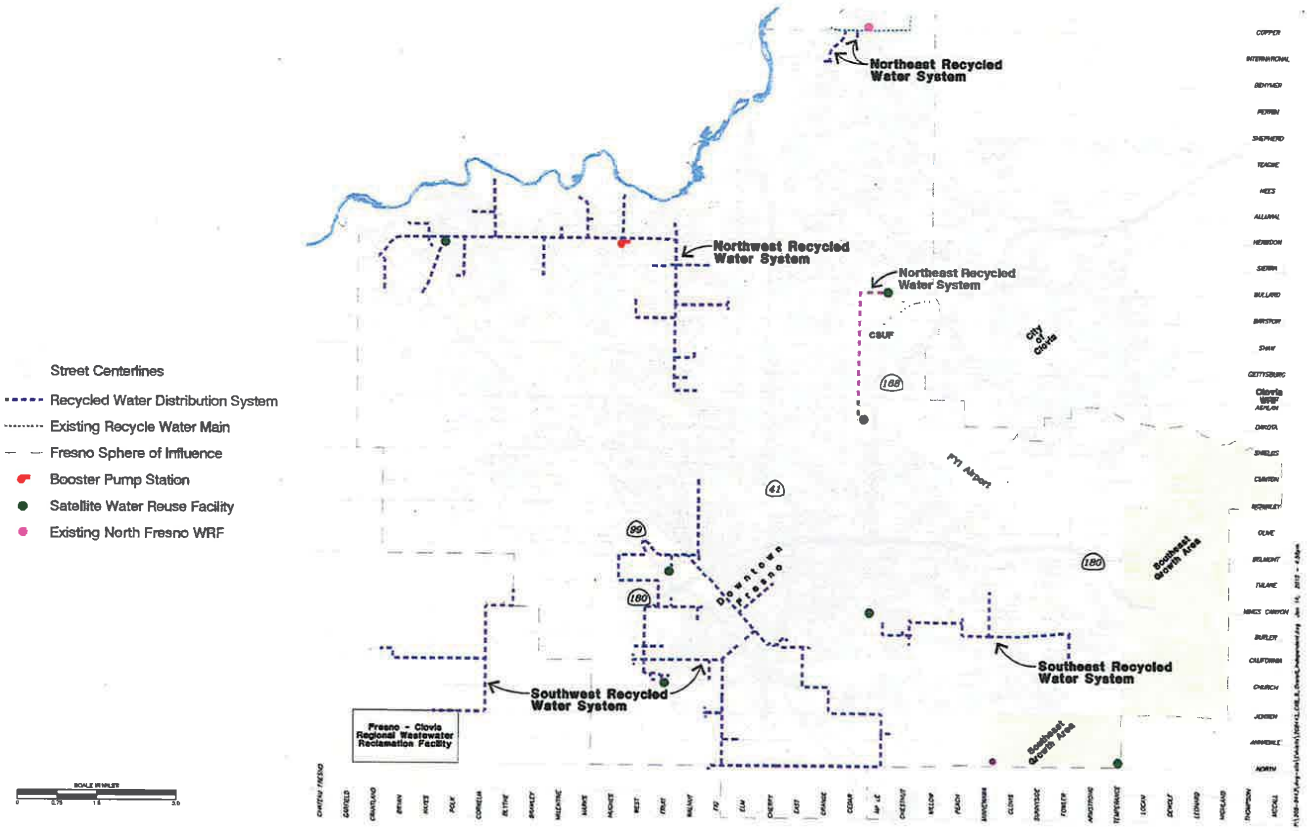


**Figure 4.10**
**OVERVIEW OF ALTERNATIVE 2 DISTRIBUTION SYSTEM**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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- Use of nitrification and denitrification for potential groundwater recharge.
- Bypass of the SRWF when sewer flows exceed storage and treatment capacity.
- Storage and discharge back to the sewers of treated flows in excess of recycled water demand.

Using these criteria, a range of treatment trains was developed. A nitrifying/denitrifying (NdN) activated sludge process followed by media filtration and UV was selected as the lowest cost alternative, and a membrane bioreactor (MBR) followed by ozone was selected as the highest cost alternative. The MBR/ozone alternative produces a higher quality effluent that may be more suitable for meeting future regulations, but both alternatives produce tertiary water that meets current regulations. MBR treatment provides both secondary and tertiary treatment. The MBR alternative has significantly smaller footprint that would provide more flexibility for siting the plant in residential areas.

Treatment trains were selected for cost estimates of SWRF as follows:

- Where there is sufficient space to build an activated sludge facility, the most likely treatment train was considered to be activated sludge + media filtration + UV.
- Where space is constrained, the most likely treatment train was considered to be MBR + UV.

The improvements needed to expand the North Fresno WRF were discussed in Section 4.3.1.

#### 4.4.1.1 Footprint for SRWFs

Footprint could be a major consideration when selecting treatment processes for SRWFs. While MBR facilities are more expensive than conventional wastewater treatment plants, they are often chosen for satellite facilities in urban areas due to their small footprint. If the footprint is small enough, it is desirable to minimize neighborhood impacts by building the facility below grade or in a contained building. While activated sludge with NdN is the lower-cost alternative for SRWF technology, it is more difficult to site and more difficult to contain because of its larger footprint.

Table 4.5 lists the area requirements for the two different technologies with respect to the different SRWF alternatives. These footprint requirements are planning level estimates. Actual area requirements will depend on the final site layout. Alternatives NE1 and NE2 utilize the existing North Fresno WRF site, and therefore, are not shown in Table 4.5.

### 4.4.2 Storage

Flow considerations for SRWFs include balancing variable sewer flows and recycled water demand; flow required for minimum recycled water flow conveyance; flow equalization to maintain biological processes; solids disposal; and effluent disposal during wet weather.

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| Table 4.5 Space Requirements for SRWFs Recycled Water Master Plan City of Fresno | | | |
|---|---|---|---|
| Alternative | Capacity (mgd) | MBR footprint (acres)[1] | Activated Sludge with NdN footprint (acres)[2] |
| SW 2 | 4.1 | 2.2 | 8.1 |
| NW 2 | 4.7 | 1.9 | 6.8 |
| NE 3.A | 0.7 | 1.0 | 1.6 |
| NE 3.B | 4.0 | 2.2 | 8.1 |
| SE 2 | 3.0 | 1.7 | 6.0 |

Notes:
(1) Includes headworks, MBR, UV chamber, odor control facility, blower building, effluent pump station, electrical building, control building, influent storage, effluent storage.
(2) Includes headworks, primary clarifier, activated sludge with NdN, secondary clarifier, microfilters, UV chamber, odor control facility, blower building, effluent pump station, electrical building, control building, influent storage and effluent storage.

#### 4.4.2.1 Flow Diversion from the Collection System

All of the alternatives with SRWFs involve scalping flow from the existing collection system. SRWFs must be carefully located to ensure that they have access to an existing sewer trunk with sufficient flow to supply recycled water demands of the users. In addition to meeting the recycled water demands, adequate flow must be maintained in the sewer to provide a scour velocity and to convey solids generated at the SRWF back to the RWRF. Alternatively solids from the SRWF could be trucked to the RWRF. Calculations for storage requirements at SRWFs were based on preliminary flow monitoring data and sewer models. Flow monitoring in the collection system near potential extraction points is currently ongoing to ascertain that there are sufficient flows in the collection system for scalping the desired recycled water flows.

The flow scalping for the alternative NE3.B will possibly have multiple benefits, including a relief from sewer surcharging in the Orange Avenue trunk sewer system. There will be avoided cost benefits from the future sewer improvements required along this trunk to prevent surcharging. The proposed alternative has the ability to scalp up to 4.0 mgd.

#### 4.4.2.2 Influent Flow and Storage at SRWFs

For project alternatives SW 2, NW 2 and NE 3, estimated minimum sewer flows were less than the planned capacity for the SRWFs. Therefore, influent storage at the SRWFs or up-sizing the treatment plant and increased effluent storage would be necessary to maximize reuse. Influent storage is the preferred of these two options because it allows the SRWF to operate at capacity at night and serve the identified users. Figure 4.11 conceptually illustrates this SWRF operational concept.

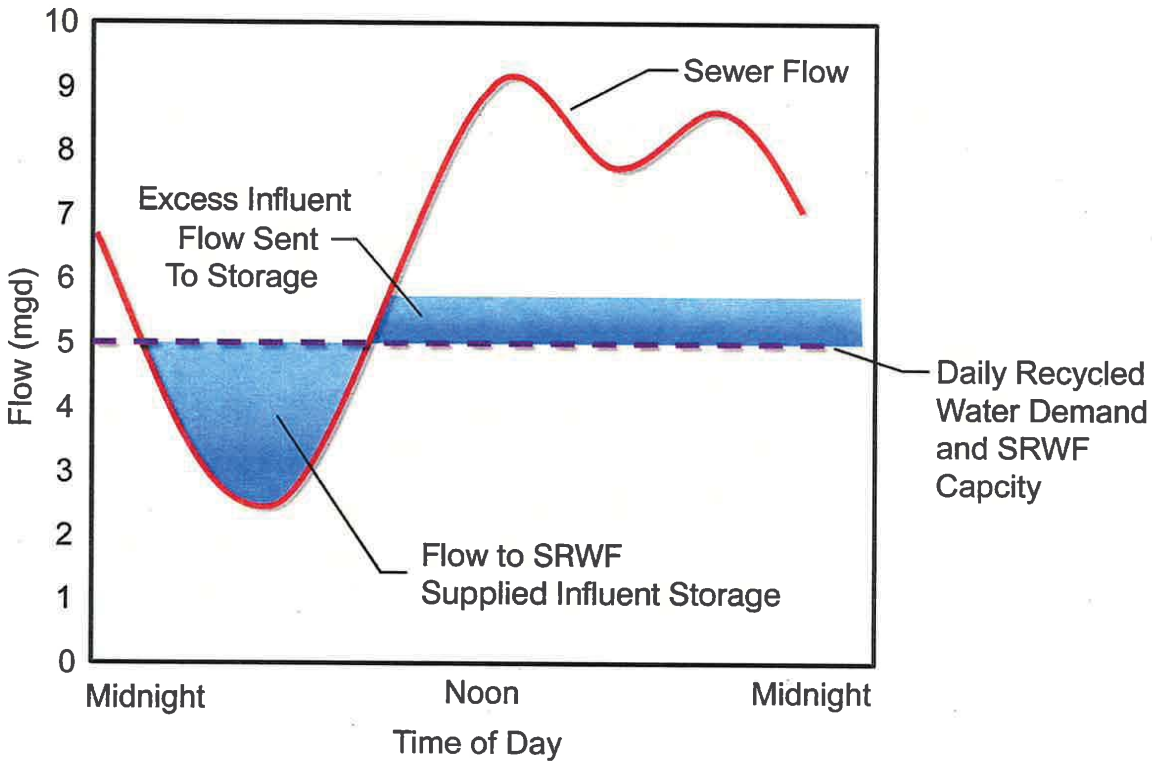


**Figure 4.11**
**INFLUENT STORAGE TO MAXIMIZE REUSE AT SRWFs**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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Influent storage has the risk of producing odors and likely additional maintenance (regular cleaning). Any influent storage at a satellite facility would need to be covered to reduce impacts to adjacent neighbors. Sewer flows in each of the potential SWRF locations are being verified by ongoing flow monitoring, which will be used to determine storage requirements.

#### 4.4.2.3 Effluent Flow and Storage at SRWFs

Typically, recycled water demand for irrigation is highest during times when wastewater flows are lowest (i.e., night-time hours). Therefore effluent storage is required to balance out the supply and demand. For the purpose of estimating effluent storage needs, it was assumed that recycled water would be produced constantly throughout the day, and used by irrigation users for eight hours/day during the night. Similarly it was assumed that industrial users would require recycled water for eight hours/day during the day. Some potential recycled water users have onsite storage that would reduce the storage needs at the SRWFs. It is typical for recycled water distribution systems to have one maximum day of storage, which gives the system the flexibility to deliver peak day demand.

During wet weather periods, the recycled water produced at the SRWF would exceed the recycled water demand. Alternate effluent disposal would be required during these periods. Disposal alternatives include discharge to the trunk sewer for re-treatment at the RWRF, groundwater recharge, discharge to the Fresno Irrigation District (FID) irrigation canals, or a combination of the same. Another alternative would be for the SRWF to be operated only during the irrigation season, in which case the plant would be required to be started up and reconditioned prior to the irrigation season each year.

### 4.4.3 Southwest Alternative (SW2)

Users in the Southwest Quadrant would be served by satellite facilities located either south of Roeding Park or at a parcel that is owned by the City at the intersection of Fruit Ave. and Church Ave. Larger users for this alternative are similar to users identified for SW1 and include parks, cemeteries, schools, industries, highway medians, City Hall and other government building, and redevelopment uses in the downtown area. The users and distribution systems for this alternative are illustrated on Figure 4.12.

SW2 requires a portion of the flow to be treated at the RWRF, and the remainder of flow to be treated at a SRWF. The total potential demand served in this quadrant is 4,340 AFY.

As illustrated in Figure 4.9, influent storage is required at SRWFs where minimum daily sewer flows are lower than the average daily flow to the treatment facility. Based on flow monitoring date, it is estimated that the daily minimum sewer flow is 3.0 mgd near the site south of Roeding Park, and 4.2 mgd near the Fruit Ave and Church Ave site, whereas the SWRF capacity would be 4.1 mgd in either location (based on the maximum day demand of identified users). Influent storage of approximately 370,000 gallons would be required for a SRWF south of Roeding Park, and no storage would be required for a SWRF at Fruit Ave.

**Distribution System Summary**

| | Length of Pipe | Recycled Water Delivered* |
|---|---|---|
| Pipeline No. 1 | 3.84 mi | 145 acre ft / yr |
| Pipeline No. 2 | 2.17 mi | 368 acre ft / yr |
| Sub-total: | 6.01 mi | 513 acre ft / yr |
| Pipeline No. 3 | 5.49 mi | 1,277 acre ft / yr |
| Pipeline No. 4 | 1.44 mi | 95 acre ft / yr |
| Pipeline No. 5 | 4.78 mi | 1,129 acre ft / yr |
| Pipeline No. 6 | 3.08 mi | 362 acre ft / yr |
| Pipeline No. 7 | 2.63 mi | 194 acre ft / yr |
| Pipeline No. 8 | 3.28 mi | 131 acre ft / yr |
| Pipeline No. 9 | 2.96 mi | 155 acre ft / yr |
| Pipeline No. 10 | 2.79 mi | 283 acre ft / yr |
| Sub-total: | 26.45 mi | 3,626 acre ft / yr |
| Total: | 32.46 mi | 4,139 acre ft / yr |

*No agricultural or future demand included in calculations.

**Map Legend:**

- Airports
- Cemeteries
- Fresno City Limits
- Parks & Golf Courses
- Schools
- New Satellite Recycled Water Facility
- Heavy Industrial User
- Light Industrial User
- Street Centerlines
- Fresno Sphere of Influence

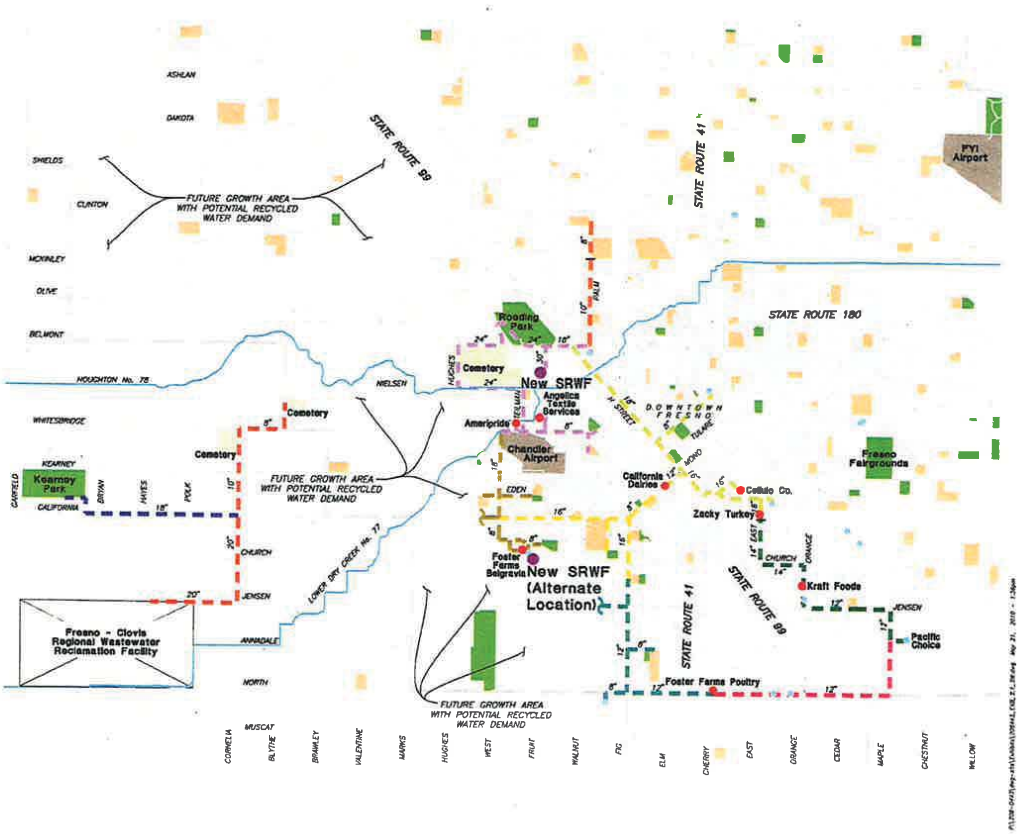


**Figure 4.12**
**SOUTHWEST PROJECT ALTERNATIVE 2**
**DISTRIBUTION SYSTEM ALIGNMENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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and Church Ave. (since minimum sewer flows at that location are larger than the flows required at the SRWF). Sewer flow curves from monitoring data are presented in Appendix F.

Similar to SW1, a maximum day flow of 5.5 MG of effluent storage would be required for SW 2 to serve the identified larger urban users. 4.1 MG of new storage would need to be constructed in proximity to the distribution system served by the SWRF at either the site south of Roeding Park, or at the site at Fruit Ave. and Church Ave. The remaining 1.4 MG could be stored at the RWRF.

The City owns the site at Fruit and Church Ave., however, this site is not large enough for a satellite facility to treat the 4.1 mgd. Therefore, either more land (approximately 0.7 acres for an MBR facility) would need to be acquired, or the facility could be constructed underground in a "stacked" treatment configuration, which would greatly increase construction costs. Approximately 17.4 acres of land would need to be purchased if a SWRF was built at the site near Roeding park.

### 4.4.4 Northwest Alternative (NW2)

NW2 would serve the northwest quadrant from a new satellite facility, which could be located on a city-owned parcel to the southwest of Herndon Ave and Hayes Ave. The users served would be similar to NW 1, consisting of golf courses, parks and schools. Due to the lack of adequate sewer flows, no future or existing residential and commercial users would be served. Figure 4.13 shows the users' locations and potential distribution system routes for NW2.

Flows for NW2 would be treated at a SRWF sized for 4.7. This flow is less than flows identified for NW1 because for NW1 additional recycled water uses would be served by the backbone pipeline from the RWRF extending from the Southwest quadrant.

The peak day urban demand for the SWRF is 4.7 mgd, however, the daily minimum sewer flow near the proposed SRWF is only 2.7 mgd. As a result, influent storage of approximately 670,000 gallons would be required to run the SWRF at a steady rate. Sewer flow curves from monitoring data are presented in Appendix E.

The golf courses in the northwest region all have onsite storage in the form of ponds. Approximately one day of storage for users other than the golf courses, approximately 1.2 MG, would need to be supplied.

Since the City already owns the site at Herndon Ave and Hayes Ave, no additional land would be acquired for NW2. The site is approximately 16 acres, and although some of that area would be used for a new road alignment in the future, it would be adequate for either treatment alternative. However, if for aesthetic purposes the City wished to build a subsurface facility, the MBR process with its smaller footprint would be a more attractive alternative.

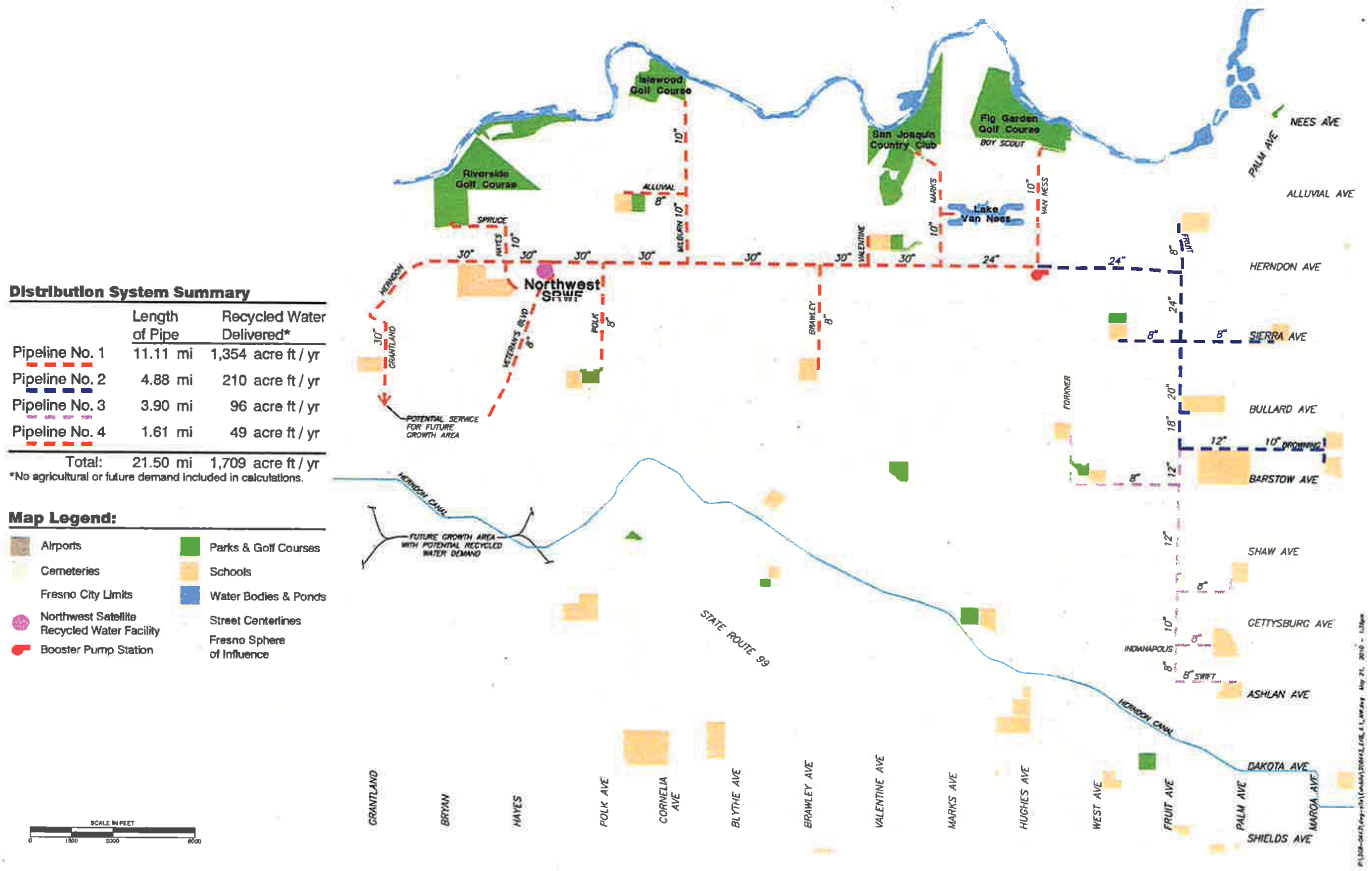


**Figure 4.13**
**NORTHWEST PROJECT ALTERNATIVE 2**
**DISTRIBUTION SYSTEM ALIGNMENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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### 4.4.5 Northeast Alternatives (NE2 and NE3)

The two northeast alternatives served from SRWFs are NE2, where users are served by the North Fresno WRF which would be expanded to its full capacity; and NE3, where users in the central Fresno region would be served by one of two possible SRWFs.

The Northeast Quadrant is unique because of the existing North Fresno WRF. However, this existing facility was originally sized to serve the Copper River development and is now under consideration to serve as the primary SRWF for that quadrant of the City. A major limiting factor to this, however, is that the majority of influent supply for this quadrant is downgradient of the existing plant. Alternative NE2 would require rerouting flow from downgradient sewers. However, even with this rerouting of NE quadrant flow, the potential demand for this quadrant is higher than the potential volume of wastewater flow generated. As a result, not all potential users in the northeast quadrant would be served by the North Fresno WRF. Figure 4.14 shows the users' locations and potential distribution system routes for each alternative.

#### 4.4.5.1 NE 2

Alternative NE 2 is similar to NE 1, except that fewer users can be served because the quadrant is served by the NFWRF as opposed to a backbone pipeline extension from the RWRF. The North Fresno WRF would be expanded to an average monthly capacity of 1.07 mgd. Sewer lift station 6 (located at Perrin and Chaplain) would be rerouted to supply the North Fresno WRF with sufficient flow to operate at 1.07 mgd.

Similar to NE 1, no additional influent or effluent storage would be required for this quadrant. No land acquisition would be necessary for this alternative, since new facilities would be on North Fresno WRF lands.

#### 4.4.5.2 NE 3

For NE3, there are two alternatives to serve the areas around CSUF. The alternatives are independent of NE1 and NE2. In this alternative, a SRWF would be constructed at either the CSUF's campus (as a demonstration reuse project) or on the Granite Park site to serve nearby users and CSUF.

##### 4.4.5.2.1 *NE 3.a*

The flow for the NE3 SRWF would be 0.7 mgd, which represents the maximum influent flow that can be supplied by the nearby sewer. Minimum sewer flows in this area are significantly reduced when school is not is session (summer and holidays), and as a result, approximately half a day's influent storage (or 350,000 gallons) would be necessary to maintain minimum flows through the SRWF. The campus has a one million gallon water storage tank for irrigation uses that could potentially be used for recycled water storage. Therefore distribution system storage may not be needed. It was also assumed that the project would also utilize the existing irrigation system onsite.

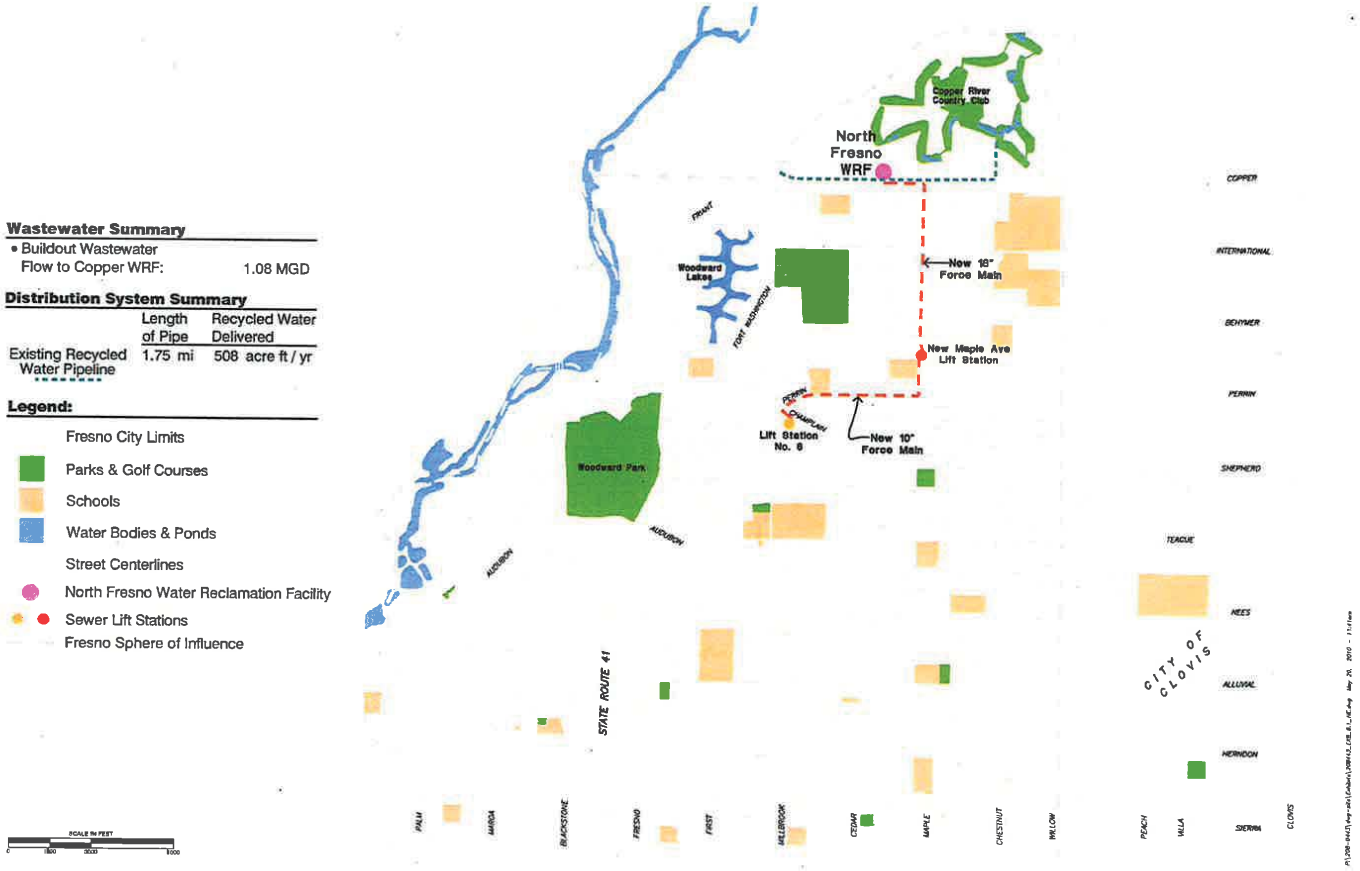


**Figure 4.14**
**NORTHEAST PROJECT ALTERNATIVE 2**
**DISTRIBUTION SYSTEM ALIGNMENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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No land acquisition would be necessary for this alternative, since the SWRF would be constructed on CSUF property.

#### 4.4.5.2.2 *NE 3.B*

Alternative NE3.B, constructed on City owned property at Granite Park, will serve the central area recycled water users including the CSUF campus and its agricultural areas. This SRWF will treat up to 4 mgd of sewer flow which represents the available flow in the Orange Avenue trunk line. Although there is no recent flow monitoring data for the Orange Avenue trunk line in this area, it is anticipated up to one million gallons of influent storage may be required to stabilize the treatment process during low flow periods. Based on estimated demand for recycled water in the central area, up to two million gallons of recycled water storage, (or half days storage) is anticipated. The distribution system supporting this SRWF will service surrounding parks, Freeway 168 landscaping and schools and the CSUF campus and agricultural areas. No land acquisition would be needed for this alternative.

### 4.4.6 Southeast Alternative (SE2)

Alternative SE 2 would serve the southeast quadrant from a new satellite facility, which could be located at the Fresno Fairgrounds (if the County is willing to cooperate with the project), at a City-owned park, or in the SEGA area on land owned by the City. The users served would be similar to SE 1, including golf courses, parks, schools, Fresno Pacific University, as well as some residential and commercial users. Figure 4.15 shows the users' locations and potential distribution system routes for each alternative, along with the potential locations of the SRWF.

For SE 2, flows are treated at a SRWF sized for 3.0 mgd. Because sewer flows in this quadrant are in excess of the demands of larger users, approximately 140 AFY of residential and commercial demand could also be served.

Based on recent flow monitoring results, the daily minimum sewer flow in the southeast quadrant is estimated to be 3.2 mgd near the proposed SRWF, not including future flows from the SEGA development. Therefore, no influent storage would be necessary for SE2. Approximately one day, or 2.6 MG, of effluent storage would be required as part of this alternative.

Since the SWRF and storage facilities would be built near the Fresno Fairgrounds, at a City-owned park, or in SEGA on land owned by the City, no land would be acquired. An activated sludge facility would occupy approximately 5.6 acres and a MBR would occupy 1.7 acres. Therefore, an MBR facility would be more feasible for small sites or developed areas such as the fairgrounds or a park. If the SRWF was built within SEGA, then a less expensive, more land intensive treatment technology could be used to serve the identified existing users, and expanded as future growth occurs in the SEGA area. Unlike the other

**Distribution System Summary**

| | Length of Pipe | Recycled Water Delivered* |
|---|---|---|
| Pipeline No. 1 | 3.24 mi | 488 acre ft / yr |
| Pipeline No. 2 | 1.26 mi | 330 acre ft / yr |
| Pipeline No. 3 | 0.86 mi | 111 acre ft / yr |
| Pipeline No. 4 | 3.73 mi | 22 acre ft / yr |
| Total: | 9.09 mi | 951 acre ft / yr |

*No agricultural or future demand included in calculations.

**Map Legend:**

- Fresno City Limits
- Parks & Golf Courses
- Schools
- Southeast Growth Area
- Street Centerlines
- Fresno Sphere of Influence
- New Satellite Recycled Water Facility
- Clovis Water Reclamation Facility
- Heavy Industrial User
- Existing Recycled Water Pipeline

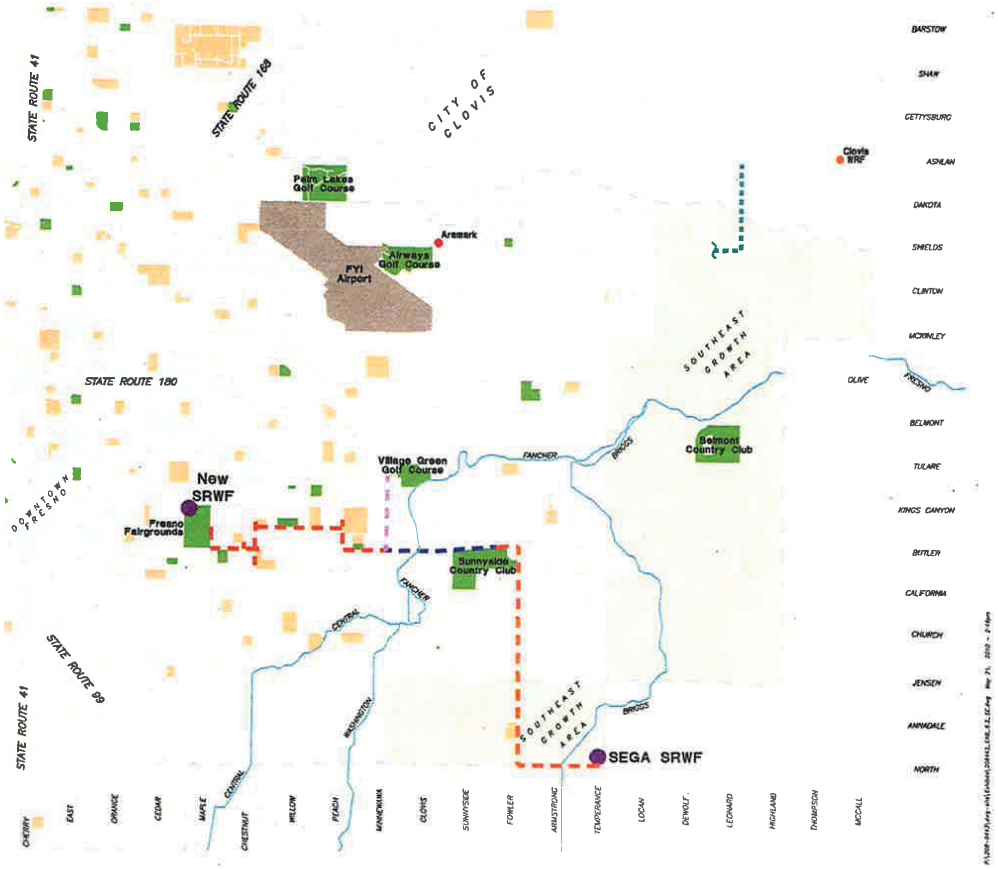


**Figure 4.15**
**SOUTHEAST PROJECT ALTERNATIVE 2**
**DISTRIBUTION SYSTEM ALIGNMENT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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quadrant SWRF alternatives, the SE quadrant alternative should consider future regional land development plans such as SEGA in its identification of the plant location, capacity, and technology for the proposed SWRF identified as part of this Master Plan.

### 4.4.7 Costs for Urban Alternative 2 – Served by SRWFs

A conceptual cost estimate for Southeast project alternatives is presented in Table 4.6. These costs are construction costs and include a 30 percent planning level contingency for treatment facilities and 25 percent for distribution system. Treatment costs are based on the most probably treatment trains, as presented in section 4.4.1. Costs are presented in January 2010 dollars (ENR 8660).

Costs are based on the following assumptions:

- Recycled water would serve the City from new SRWFs.
- Each quadrant is independent and SRWFs and distribution systems can be implemented in any order.
- Treatment costs are presented as a range from low to high costs which represent different treatment trains (Note 1 in Table 4.6).
- Feed pump station is included in treatment cost estimate, and recycled water delivery pump station is included in distribution system pump station cost estimate.
- Storage Costs are based on welded steel tanks.
- More detailed cost estimate information is provided in Appendix F.

## 4.5 GROUNDWATER RECHARGE PROJECT ALTERNATIVES

Groundwater Reuse Recharge Projects (GRRPs), provide a significant opportunity for improving the City's long term sustainable water supply. However, due to a lengthy permitting process, GRRPs will likely be phased in over time to supplement urban reuse projects. The reuse demand (and potable water offset) that can be achieved by implementing GRRPs would be above and beyond the estimated urban irrigation and industrial demand, and is dependent on the land area secured for recharge (discussed in Chapter 3).

Specific GRRP basin sites have not yet been identified. However, it is likely that GRRPs would be operated during the rainy season when there is little recycled water demand. This would take advantage of the distribution system and treatment capacity that would be constructed for urban reuse during the irrigation season while providing a winter discharge option. Therefore, GRRPs would not require significant specific capital investment for treatment or distribution of recycled water. Urban reuse and groundwater recharge reuse would utilize the same distribution system to the extent possible. Although the treatment

**Table 4.6 Cost Estimates for Alternative 2 Served by SWRF (in Millions)**
**Recycled Water Master Plan**
**City of Fresno**

| | Alternative | Distribution System | | | Treatment[2] | Storage | Land Acquisition | Total |
|---|---|---|---|---|---|---|---|---|
| | | Backbone | Spurs | Total | | | | |
| **Capital Costs ($M)** | SW2 | 25 | 11 | 36 | 37-50 | 7 | Up to 0.8 | 81-94 |
| | NW2 | 16 | 9 | 25 | 35-51 | 3 | Up to 0.04 | 63-79 |
| | NE2 | -[3] | 1 | 5[4] | 5[5] | -[6] | - | 10 |
| | NE3.A | -[3] | 2 | 2 | 23[7] | -[6] | - | 25 |
| | NE3.B | -[3] | 6 | 6 | 35-50 | 4 | - | 45-60 |
| | SE2 | 3 | 3 | 6 | 26-36 | 4 | - | 36-46 |
| **O&M Costs ($M/yr)** | SW2 | - | - | 0.2 | 0.9-1.7 | 0.2 | | 1.3-2.1 |
| | NW2 | - | - | 0.1 | 0.7-1.6 | 0.1 | | 0.9-1.8 |
| | NE2 | - | - | 0.06 | 0.5 | -[6] | | 0.6 |
| | NE3.A | - | - | 0.03 | 0.2-0.3[7] | -[6] | | 0.2-0.3 |
| | NE3.B | - | - | 0.05 | 0.7-1.6 | 0.2 | | 0.95-1.85 |
| | SE2 | - | - | 0.05 | 0.5-1.0 | 0.2 | | 0.7-1.2 |

Notes:
(1) All costs presented in January 2010 dollars (ENR 8660)
(2) High- and low-cost treatment alternatives are presented. Low cost alternative is activation sludge with NdN +media filtration + UV. High cost alternative is MBR + UV.
(3) Distribution system to small to have a segment considered a "backbone".
(4) Distribution system includes $4M for rerouting sewer lift station # 6 to North Fresno WRF.
(5) Includes expanding North Fresno WRF and replacing disinfection facilities with UV.
(6) Storage is provided in existing facilities.
(7) Only MBR+ UV was considered for CSUF SRWF

processes would require different operation with higher operating costs to meet the higher level of treatment required (e.g. nitrogen removal).

Approximately four times as much diluent water as recycled water is required by the DPH for GRRP operation. There are a couple of options for sources of diluent water required for a GRRP: surface water from FID or the US Bureau of Reclamation, and/or stormwater from the Fresno Metropolitan Flood Control District (FMFCD). Where possible, GRRP basins will be located adjacent to FMFCD basins or FID canals, so infrastructure to deliver diluent water would be minimal. The required 6 month travel time between the GRRP and nearest drinking water well also affects the siting of the GRRP basins. Land for potential GRRPs has been identified based on a brief review of empty lands adjacent to FID canals and flood control district facilities, in areas were soils are known to be generally suitable for recharge. These areas are mainly in the northwest and southwest quadrants.

### 4.5.1 Treatment

Recycled water from either the RWRF or a SWRF must meet Title 22 standards, including filtration and disinfection, as described in Chapter 2. Additionally, projects that include a GRRP component require nitrification/denitrification (NdN) to reduce total nitrogen to less than 10 mg/l. At the RWRF, this means changing the operational parameters of the existing secondary processes to achieve NdN in addition to providing filtration and disinfection.

Nitrogen removal at the RWRF for GRRPs can theoretically be achieved without construction of expensive end-of-pipe nitrification and denitrification filters by modifying existing secondary processes. Although the operation of the secondary treatment facilities is not currently aimed at nitrogen removal, significant removal is already being achieved.

The A Side treatment train at the RWRF has the capability of partially removing nitrogen through operation in simultaneous nitrification-denitrification (Sinn) mode. It will be difficult to implement a more advanced biological nitrogen removal process since this older activated sludge system was not originally designed for this purpose, and therefore lacks the operational flexibility required to reduce nitrogen concentration.

The best opportunity for providing NdN through operational changes is to use the newer activated sludge facilities in Plant B or C. Both the B and C facilities were designed with the flexibility to be operated in a variety of advanced biological nutrient removal processes and were designed to achieve 10 mg/L total effluent nitrogen.

Plant B consists of four aeration basin (Nos. 5 through 8) and eight secondary clarifier (Nos. 6 through 13). The rated capacity is 38 mgd during the summer (9.5 mgd per aeration basin) and 33 mgd during the winter (8.25 mgd per aeration basin). Aeration basin No. 5 was designed to be able to run in a NdN mode, separate from the rest of the basins. This basin could be dedicated to providing denitrified effluent for groundwater recharge (up to

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9.5 mgd) with relatively modest changes to piping and the addition of a stop plate in the effluent channel.

Plant C consists of two aeration basin (Nos. 9 through 10) and four secondary clarifier (Nos. 14 through 17). The rated capacity is 19 mgd during the summer (9.5 mgd per aeration basin) and 17 mgd during the winter (8. 5 mgd per aeration basin). If the groundwater recharge demand exceeds the capacity of aeration basin No. 5, then the entire Plant C could be used to provide up to 19 mgd for groundwater recharge. Piping would be required to convey the Plant C effluent to the filtration facilities.

If groundwater recharge demand exceeded the Plant C 19 mgd capacity, the entire Plant B could be operated in NdN mode for a capacity of up to 38 mgd. The operation of any of the existing facilities in NdN mode will require an increase in operating costs for the additional air required.

### 4.5.2 Southwest GRRP Basins

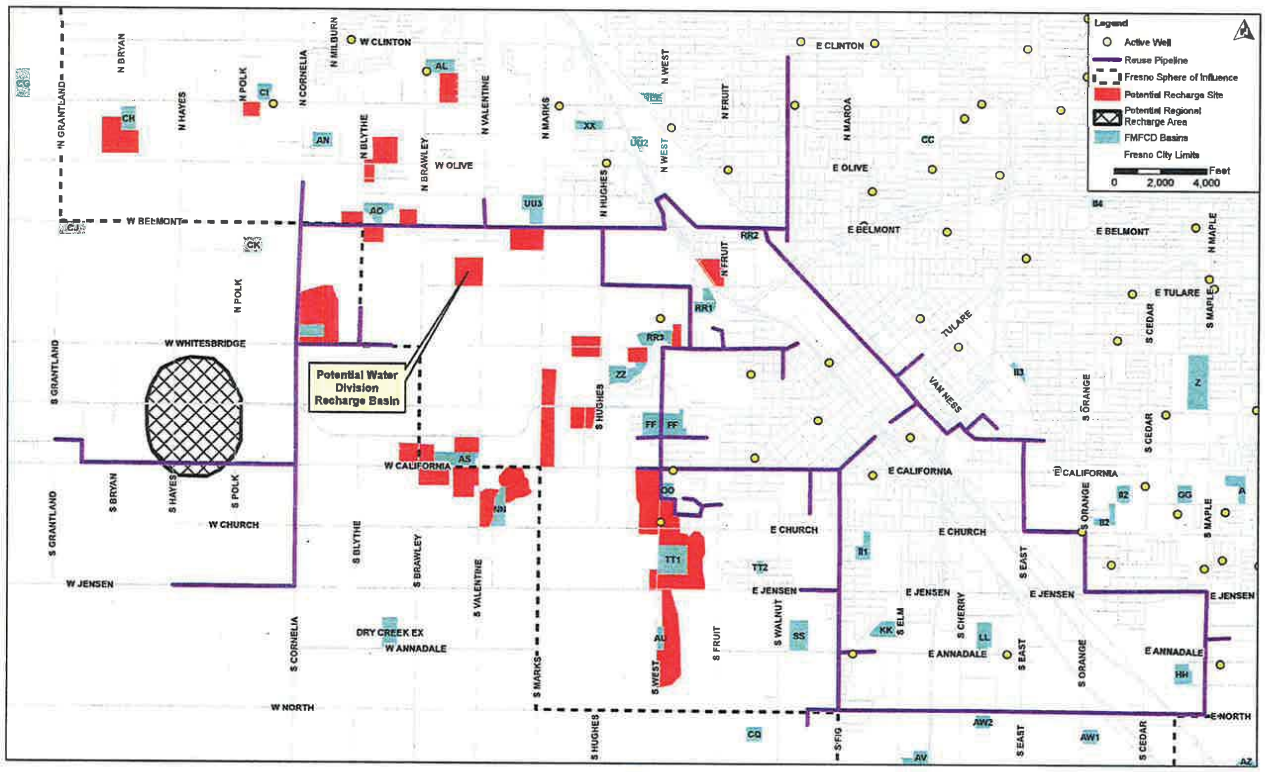
Potential future GRRP basin sites were located through a preliminary identification of empty parcels adjacent to existing flood control basins or near FID supply channels. These potential sites, as well as possible future super-recharge basin sites (identified by the City water division as areas for potential future recharge of surface water) that could receive recycled water in the southwest quadrant are shown in Figure 4.16.

There are 839 acres of land identified for potential recharge in the SW quadrant (not including super-recharge basins), or 1,244 acres including the super-recharge basins. Based on FMFCD data, recharge rates are estimated to be 1.2 to 4.8 inches/day. Using an intermediate value of 2.4 inches/day, and assuming the diluent water is delivered at the same time that recharge is occurring, the potential for recycled water recharge is conservatively estimated to be 13 AFY/acre. Therefore, if all sites identified in the SW quadrant were developed into GRRPs, 10,900 AFY of recycled water could be recharged without the super-recharge basins, or 16,180 AFY with the super-recharge basins.

### 4.5.3 Northwest GRRP Basins

The potential locations for GRRP recharge basins in the Northwest Quadrant, as well as that of a possible future super-recharge basins that could receive recycled water, are shown in Figure 4.17.

There are 303 acres of land identified for potential recharge in the NW quadrant, not including super-recharge basins, or 883 acres including the super-recharge basins. Using the estimated potential for recycled water recharge of 13 AFY/acre, if all sites identified in the NW quadrant were developed into GRRPs, 3,940 AFY recycled water could be recharged without the super-recharge basins, or 11,480 AFY with the super-recharge basins.




Alternative 1 Pipeline Alignments

**Figure 4.16**
**POTENTIAL FUTURE GRRP BASINS, SOUTHWEST QUADRANT**
RECYCLED WATER MASTER PLAN
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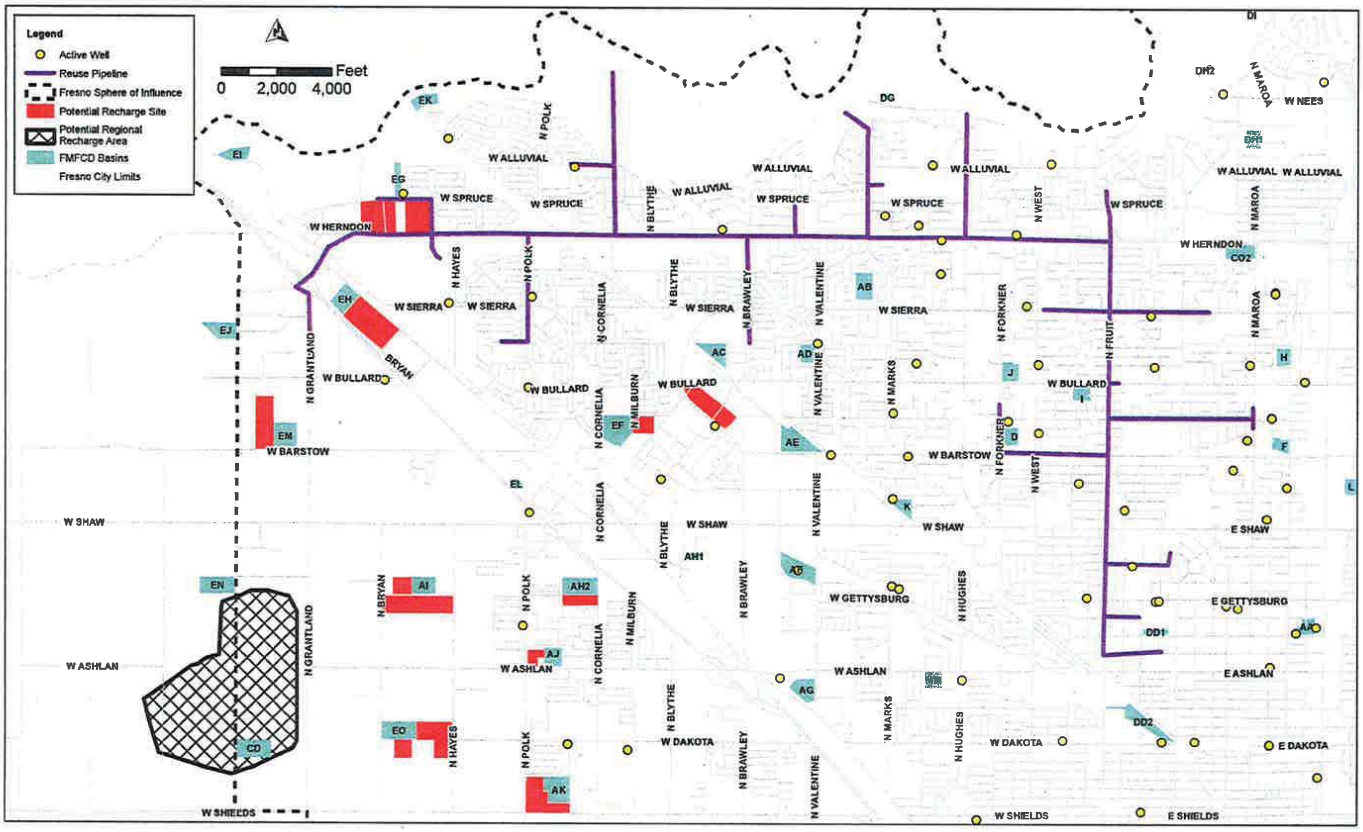


Alternative 1 Pipeline Alignments

**Figure 4.17**
**POTENTIAL FUTURE GRRP BASINS, NORTHWEST QUADRANT**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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### 4.5.4 Northeast and Southeast GRRP Basins

The NE quadrant is densely developed. As a result of this, no viable recharge sites were identified in this quadrant.

The City currently recharges surface water at Leaky Acres in the southeast quadrant. The ability to add recycled water to Leaky Acres was considered and dismissed as there are drinking water wells located within a 6-month travel time of the Leaky Acres site. Therefore, hydraulic detention time between recycled water recharge and the nearest well could not be met without abandoning the highly productive existing wells. The City has identified one 320 acre potential future super-recharge basin southeast of the City limits. This basin could also potentially recharge recycled water. Using the estimated potential for recycled water recharge of 13 AFY/acre, 4,160 AFY of recycled water could be recharged at this site.

Many of the undeveloped areas surrounding the southeast quadrant of town have soils that are not amenable to percolation, which leads to difficulty in locating a recharge basin in this quadrant. Additionally, there are known contaminant plumes in the SE quadrant that must be avoided. As a result, other than the super-recharge basin, groundwater recharge was not identified as part of the southeast reuse alternatives, although further investigation may be warranted..

### 4.5.5 Costs of GRRP

A conceptual cost estimate of a typical 20-acre GRRP basin is presented in Table 4.7. Land acquisition costs assume a land value of $45,000/acre. This value was obtained by gathering the 2009/10 assessed land and improvement values of several of the proposed basin and determining the 90$^{th}$ percentile value. Therefore, using $45,000/acre is a conservative land value estimate. Basin construction costs include an appropriate planning level contingency and are presented in January 2010 dollars (ENR 8660).

**Table 4.7 Project Cost Estimate for Example 20-acre Recharge Basin Recycled Water Master Plan City of Fresno**

| Element | Capital Cost ($M) | O&M Cost ($/yr) |
|---|---|---|
| Basin | 1.5 | 25,000 |
| Land Acquisition | 0.9 | - |
| **Total** | **$2.4** | **$25,000** |

Note:

(1) Assuming basins are excavated to a depth of three feet, with berm height of six feet. This allows a water depth of seven feet with two feet of freeboard. Excess dirt would be hauled to the RWRF. Unit costs for excavation and hauling were verified with FMFCD.

If all 1,142 acres of identified GRRP basins (not including the super-recharge basins) were developed as part of the City's Recycled Water Program (this would be equivalent to fifty seven (57) 20-acre basins), the construction cost is estimated to be $137 million.

## 4.6 AGRICULTURAL ALTERNATIVES

There were three alternatives carried forward to increase water reuse for agricultural irrigation. They were:

- AG 1 - Expand the existing system to deliver additional undisinfected secondary effluent to growers of non-food crops.
- AG 2 - Expand deliveries of extracted percolated effluent to FID.
- AG 3 - Upgrade to tertiary treatment and directly deliver recycled water for unrestricted reuse.

These alternatives could each be implemented in addition to the urban reuse alternatives discussed earlier. All of these alternatives involve supplying recycled water from the RWRF, (rather than SRWFs), since only the RWRF is expected to have excess flow above the demands of urban users during the summer time.

### 4.6.1 Direct Delivery of Undisinfected Secondary Effluent (AG 1)

The RWRF currently delivers approximately 10,000 AFY of undisinfected secondary effluent to nearby growers of non-food crops. City staff conducted a preliminary evaluation of the potential to expand the direct reuse system to new growers in the vicinity of the RWRF able to accept recycled water. Two farms with 1,400 acres, representing an additional 4,200 AF of demand, could be served with undisinfected secondary effluent, provided that piping was available to convey the water. While this alternative would not provide an exchange benefit, it would provide diversification of the City's reuse and effluent management systems and would reduce the hydraulic loading on the percolation ponds. Figure 4.18 shows a conceptual schematic of this alternative.

Increasing deliveries of undisinfected secondary effluent to growers would not require additional treatment or storage, however, a new pipeline to convey recycled water to growers would be necessary.

### 4.6.2 Delivery of Extracted Percolate to FID (AG 2)

The RWRF currently pumps approximately 30,000 AFY of percolated effluent from extraction wells to FID canals. This alternative would require increasing pumping from the groundwater beneath the percolation ponds from 30,000 AFY to 50,000 AFY, depending on the level of reuse that is agreed upon. This increase in extracted percolate being delivered to FID canals would require the existing agreement with FID to be negotiated to include provisions for increased deliveries to the FID canals. To take advantage of any exchange agreement with FID of recycled water for raw surface water, additional facilities may be

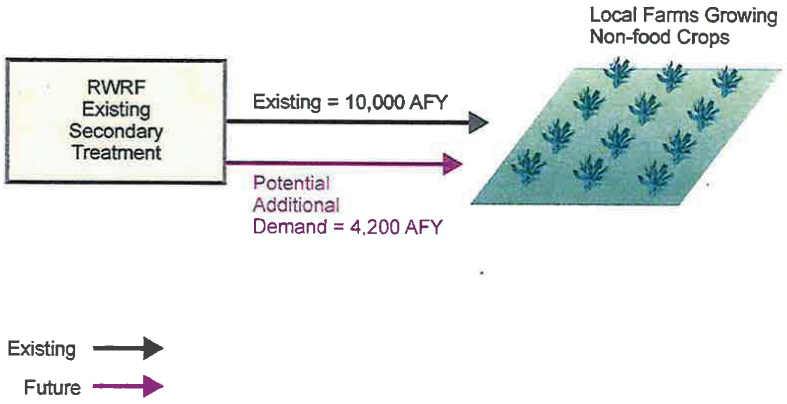


**Figure 4.18**
**DIRECT DELIVERY OF**
**UNDISINFECTED SECONDARY EFFLUENT (AG 1)**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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needed within the city to convey and treat FID's surface water for potable use, or to recharge it to the groundwater aquifer. A conceptual schematic of this alternative is shown in Figure 4.19.

FID's irrigation season is typically a six-month period between March and August, but can vary from year to year based on rainfall . During the irrigation season, flow rates in FID canals and pipelines are typically lowest during the months of March and April and then peak during the months of June and July. Lower Dry Creek, the Houghton and Herndon Canals have large flow capacity and could provide recycled water to agricultural users downstream of the points of discharge. The City of Fresno currently discharges extracted percolated effluent to both Lower Dry Creek and Houghton Canal.

Expanding the delivery of extracted percolate to the canals would require a number of improvements at the RWRF. A series of new wells would be required to increase extraction pumping. Over the last ten years, the City reused (through direct delivery or extraction) between 25,000 and 40,000 AFY. Based on an effluent flow of 80,000 AFY, between 40,000 to 55,000 AFY may be available for additional reuse. For the purposes of determining facility needs and costs, it was assumed an additional extraction of 20,000 AFY would occur over a nine month period for delivery of extracted percolated effluent. Approximately 12 new wells, each with a capacity of about 1,400 gpm, would be needed. These wells would need to be carefully located to limit impacts on groundwater quality, and to limit extraction of low-quality groundwater. In addition to new wells at the RWRF, a pipeline would be required to convey the additional flows.

### 4.6.3 Delivery of Tertiary Effluent (AG 3)

This alternative provides treatment for direct delivery of unrestricted reuse water to agricultural users instead of using extracted water. The City would need to upgrade to tertiary treatment at the RWRF for this alternative. While the City could invest in an agricultural distribution system to take the tertiary treated water directly to individual users, a comprehensive agricultural distribution system already exists with the FID canal system and could continue to be utilized for delivery of tertiary treated water.

Delivery to FID also has the advantage of potentially exchanging recycled water for surface water. In order to use the FID canal system for delivery of recycled water, the City would need to renegotiate its agreement with FID to allow delivery of tertiary treated effluent directly to the canals (without percolation and extraction). Also to take advantage of any exchange agreement with FID of recycled water for raw surface water, additional facilities may be needed within the city to convey and treat FID's surface water for potable use, or to recharge it to the groundwater aquifer.

For tertiary effluent deliveries to FID canals, new tertiary treatment facilities, a new pump station and a new recycled water pipeline would be required. The pump station would be located near the tertiary facilities at the RWRF, and the pipeline would extend from the

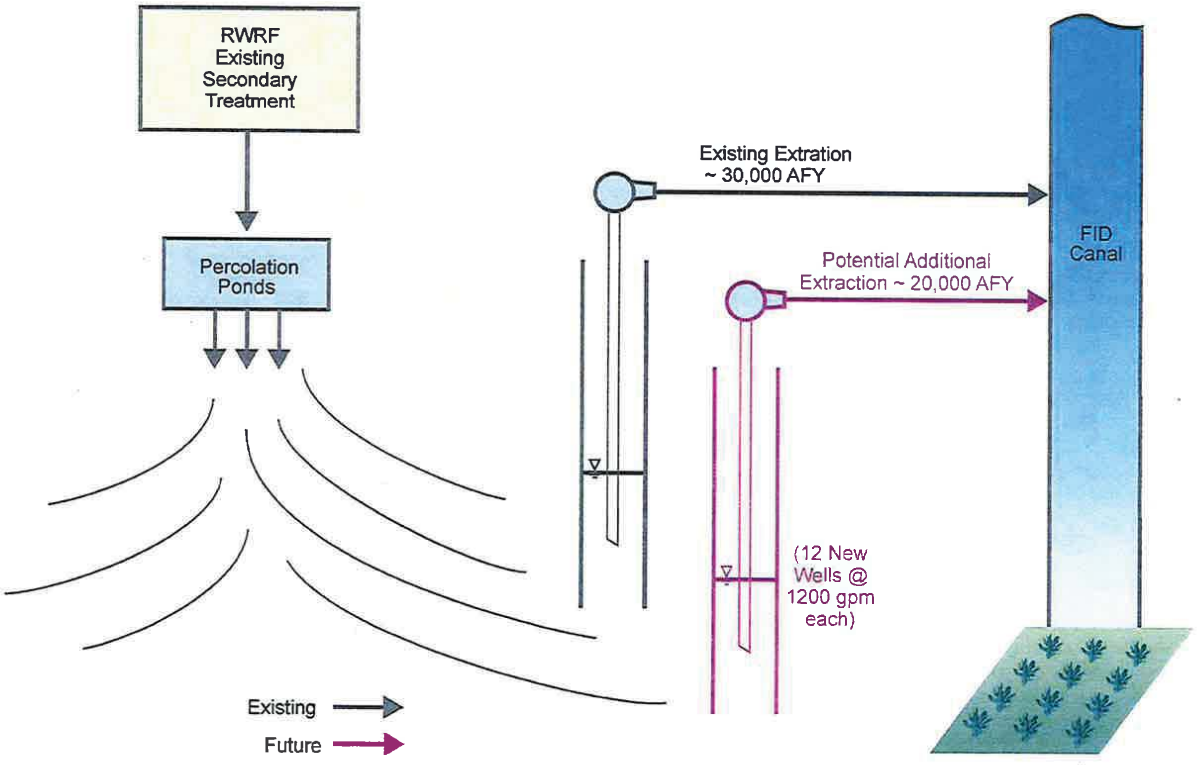


**Figure 4.19**
**DELIVERY OF EXTRACTED PERCOLATE TO FID (AG 2)**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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pump station to each canal. A conceptual schematic of this alternative is shown in Figure 4.20.

The City could invest in developing their own agricultural distribution system to serve tertiary treated recycled water directly to potential users, however it is less likely that the City could get an exchange of recycled water for surface water as individual farmers typically do not possess surface water rights.

This alternative is more expensive than increased pumping of percolated effluent to the FID canal system (AG 2). The two alternatives (AG 2 and AG 3) provide the same amount of additional reuse (approximately 20,000 AFY in the near term), at the same conveyance cost, but AG 3 incurs additional capital and O&M costs associated with construction and operation of a tertiary WWTP. However, it was carried forward in the Master Plan in case the RWQCB does not recognize percolation as equivalent to tertiary treatment in the future (see Chapter 3).

### 4.6.4 Costs Estimates

A conceptual cost estimate for the agricultural project alternatives is presented in Table 4.8. These costs are project costs which include construction costs (with an appropriate planning level contingency) plus a 20 percent factor for engineering, legal and administration costs. Costs are presented in January 2010 dollars (ENR 8660).

**Table 4.8 Cost Estimates for Agricultural Project Alternatives**
**Recycled Water Master Plan**
**City of Fresno**

| | Alternative | Distribution System | Treatment | Storage | Total |
|---|---|---|---|---|---|
| **Capital Costs ($M)** | AG 1 | 6 | - | - | 6 |
| | AG 2[1] | 18[2] | - | - | 18 |
| | AG 3[1] | 13 | 28[3] | - | 41 |
| **O&M Costs ($/yr)** | AG 1 | 0.06 | - | - | 0.06 |
| | AG 2 | 0.6 | - | - | 0.6 |
| | AG 3 | 0.3 | 1.1[3] | - | 1.4 |

Notes:
(1) Assuming 20,000 AFY agricultural reuse program (above current practices).
(2) Distribution system costs include new extraction wells (based on costs from City of existing extraction wells)
(3) Treatment train is assumed to be media filtration + UV.

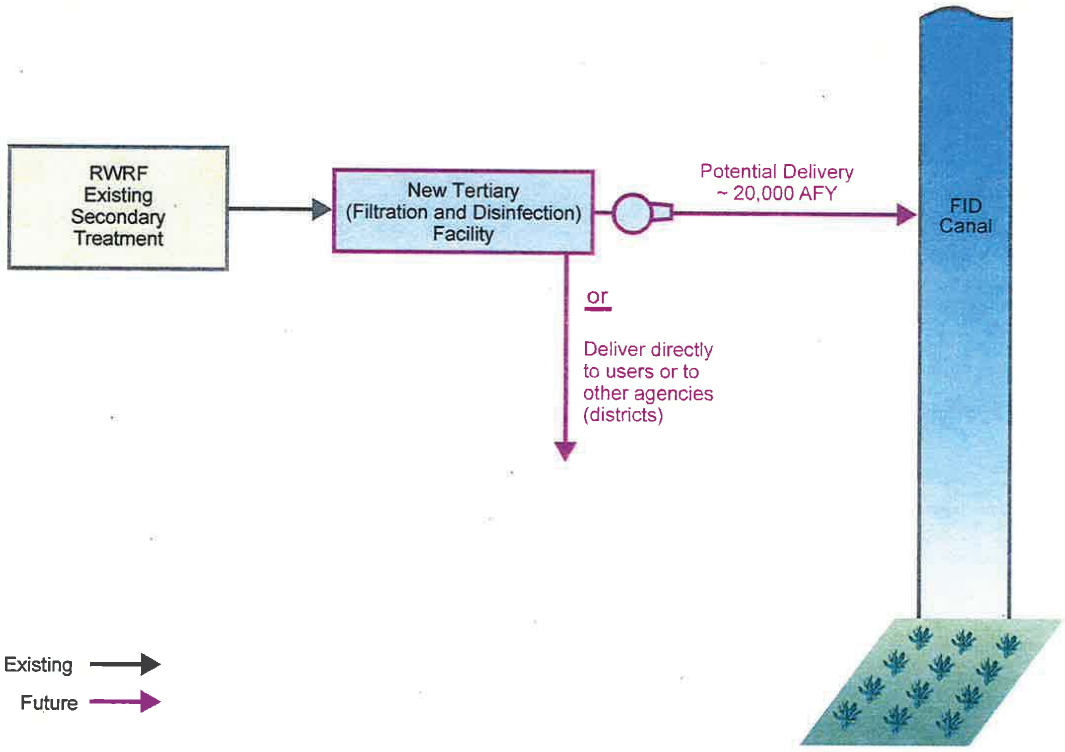


**Figure 4.20**
**DELIVERY OF TERTIARY EFFLUENT TO FID (AG 3)**
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CITY OF FRESNO

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Costs are based on the following assumptions:

- AG 1 is independent of AG 2 and AG 3.
- Only one of either AG 2 or AG 3 would be implemented.
- Distribution system costs for AG 1 include piping secondary effluent directly to farmers, and do not include connections to existing irrigation systems.
- Distribution system costs for AG 2 include installing and operating new extraction wells and piping tertiary disinfected effluent to Dry Creek and Houghton Canals.
- Distribution system costs for AG 3 include piping tertiary disinfected effluent to Dry Creek and Houghton Canals.
- Feed pump station is included in treatment cost estimate.
- More detailed information is provided in Appendix F.

## 4.7 SUMMARY OF COSTS FOR PROJECT ALTERNATIVES

Table 4.9 presents a summary of the cost information provided in this Chapter. More detailed information about the estimates is provided in Appendix F.

The costs presented in Table 4.9 for the satellite treatment alternatives (Urban Alternative 2) do not reflect the difficulty in siting these types of facilities. The higher cost shown for Alternative 2 represent a more compact and covered treatment train (MBRs) and would likely be required for mitigation of neighbor impacts if siting (area requirements) is an issue.

### 4.7.1 Cost Model

A spreadsheet cost model was prepared using the costs presented in this chapter for each of the pipeline segments identified. The model allows for selection of pipe segments in creation of a "project". The output is the cost for the selected distribution system and treatment needed to provide flow for the existing large users along the selected pipe segments. This tool was developed for the purpose of CIP planning and can be used by the City to help prioritize implementation of the recycled water distribution system. Figure 4.21 shows a screen capture of the cost model spreadsheet.

**Table 4.9 Summary of Costs for Project Alternatives**
**Recycled Water Master Plan**
**City of Fresno**

| Alternative | Demand (AFY) | Capital Costs ($M) | | | | | O&M Costs ($M/yr) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Distribution System | Treatment | Storage | Land Acquisition[1] | Total | Distribution | Treatment | Storage | Total |
| **Urban Alternative 1 (RWRF)** | | | | | | | | | | |
| SW 1 | 4,140 | 49 | 12[2] | 7 | - | 68 | 0.3 | 0.4 | 0.2 | 0.9 |
| NW 1 | 1,951 | 50 | 9[2] | 6 | - | 65 | 0.2 | 0.3 | 0.2 | 0.7 |
| NE 1 | 2,720 | 40 | 11[2,3] | 5 | - | 56 | 0.2 | 0.7 | 0.2 | 1.1 |
| SE 1 | 995 | 17 | 6[2] | 4 | - | 27 | 0.1 | 0.2 | 0.2 | 0.5 |
| Existing residential and commercial users[4] | 2,984 | 86 | 10[2] | -[6] | - | 96 | 0.4 | 0.3 | - | 0.7 |
| Future Residential and commercial users[4] | 1,586 | -[6] | 6[2] | -[6] | - | 6 | - | 0.2 | - | 0.2 |
| **Urban Alternative 2 (SRWF)** | | | | | | | | | | |
| SW 2 | 4,140 | 36 | 37-50[2,7,8] | 7 | Up to 0.8 | 81-94 | 0.2 | 0.9-1.7 | 0.2 | 1.3-2.1 |
| NW 2 | 1,709 | 25 | 35-51[2] | 3 | Up to 0.04 | 63-79 | 0.1 | 0.7-1.6 | 0.1 | 0.9-1.8 |
| NE 2 | 508 | 5[2] | 5[3] | - | - | 10 | 0.06 | 0.5 | - | 0.6 |
| NE 3.A | 263 | 2 | 23[9] | - | - | 25 | 0.03 | 0.2-0.3 | - | 0.2-0.3 |
| NE 3.B | 4,900 | 6 | 35-50 | 4 | - | 45-60 | 0.05 | 0.7-1.6 | 0.2 | 0.95-1.85 |
| SE 2 | 951 | 6 | 26-36[7] | 4 | - | 36-46 | 0.05 | 0.5-1.0 | 0.2 | 0.7-1.2 |
| **Groundwater Reuse Recharge** | | | | | | | | | | |
| 20 acre basin | 260 | - | - | 1.5 | 0.9 | 2.4 | - | - | 0.03 | 0.03 |
| **Agricultural Alternatives** | | | | | | | | | | |
| AG 1 | 4,200 | 6 | - | - | - | 6 | 0.06 | - | - | 0.06 |
| AG 2 | 20,000 | 18[10,11] | - | - | - | 18 | 0.6 | - | - | 0.6 |
| AG 3 | 20,000 | 13[11] | 28[2] | - | - | 41 | 0.3 | 1.1 | - | 1.4 |

Notes:
(1) Land acquisitions costs depend on the treatment technology used, and are $45,000 per acre.
(2) Treatment train for RWRF is media filtration + UV. Costs are additive and assume that prerequisite system has already been constructed. (For example, NW 2 assumes that SW 2 already exists)
(3) NE1 includes treatment at the RWRF and the North Fresno WRF.
(4) For serving residential and commercial users, it is assumed that distribution piping backbone, storage facilities, and initial treatment facilities are already in place. Costs include adding 120 miles of distribution laterals and expanding tertiary treatment and disinfection at the RWRF. Future users include indoor dual plumbing along Hwy 41 mid- and high-rise intensification corridor.
(5) Storage for residential/commercial use is accounted for as part of Urban Alternative 1 (SW 1, NW 1, NE 1 and SE 1)
(6) It is assumed that developers will carry the cost for purple pipe for future growth and infill, and build laterals off of existing distribution system.
(7) Low cost alternative for SRWF treatment is activation sludge with NdN +media filtration + UV. High cost alternative for SRWF treatment is MBR + UV.
(8) SW 2 includes treatment at the RWRF and at a new SRWF.
(9) Only MBR was considered for secondary treatment.
(10) Costs include 12 new extraction wells and pumps.
(11) Costs include piping to Dry Creek and Houghton Canals.



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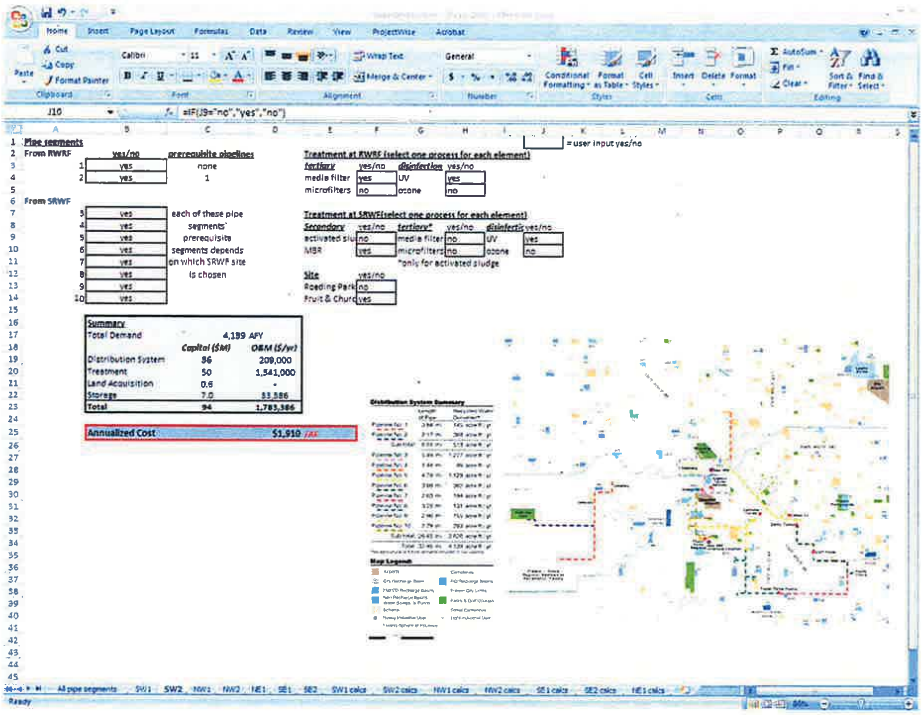

**Figure 4.21**
**COST ESTIMATING TOOL**
**FOR PIPE SEGMENTS**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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Chapter 5

# SUMMARY AND RECOMMENDATIONS

## 5.1 INTRODUCTION

The City of Fresno (City) has embarked on a Recycled Water Master Plan (Master Plan) to serve as a basis to support the City's decision-making process in selecting recycled water projects. The expansion of the recycled water system will enable the City to lessen the burden on the wastewater treatment plant percolation ponds that are currently used for effluent discharge, offset potable water use, and enhance the sustainability of the water supply.

The City currently treats nearly 80,000 AFY of wastewater at the Regional Wastewater Reclamation Facilities (RWRF). Some of this water is directly recycled, but most of it is percolated into the ground via percolation ponds at the RWRF. The City and Fresno Irrigation District (FID) have an agreement whereby the City is contracted to extract 30,000 AFY of percolated effluent for delivery to FID canals for use downstream by local farmers. The remaining effluent is available for other beneficial uses.

The City is required by the Central Valley Regional Water Quality Control Board (RWQCB) to evaluate the quality of the groundwater beneath the percolation ponds. Reducing the hydraulic and constituent loading burden on the percolation ponds by implementing a significant reuse program would minimize salt and nitrogen loading and metals mobilization in the alluvium, lowering the concentrations of these constituents in the groundwater.

In 2009, the State of California adopted a Recycled Water Policy establishing a mandate to increase the use of recycled water in California by 200,000 acre-feet per year by 2020 and by an additional 300,000 acre-feet per year by 2030. The City's expansion of recycled water use is in support of these state-wide goals.

The City relies heavily on groundwater for potable supply. As identified by ongoing water planning efforts, the City needs to diversify its water supply portfolio for long- term sustainability of its water supply. The use of recycled water for non-potable water uses will help meet a significant part of the City's existing and future water supply demands.

Therefore, the intent of the Master Plan is to plan and implement a phased recycled water treatment and distribution system that:

- Protect and improve groundwater quality by reducing the use of percolation ponds currently used as part of the RWRF effluent disposal process;
- Increases the use of recycled water through urban reuse, groundwater recharge and agricultural reuse to help meet State's objectives to increase recycled water use and to meet the increasing water demands in the region;
- Expand the recycled water system to enable the City to offset potable water use, thereby enhancing the sustainability of the water supply;

- Puts into practice a recycled water plan and ordinance that will support implementation of recycled water use in the City for existing and future users.

## 5.2 SUMMARY OF FINDINGS

The findings presented herein reflect the detailed materials presented in Chapters 1 through 4 of this Master Plan. This chapter presents the recommended projects and project phasing. Factors considered in selection and phasing of project alternatives included:

- Project costs
- Implementation issues and timing
- Institutional considerations such as permitting and environmental review

The City has several key opportunities for implementing reuse, namely:

- Urban reuse
- Unrestricted agricultural reuse/exchange
- Groundwater recharge

Urban reuse provides an opportunity for near-term implementation of recycled water projects and would offset existing uses of the City's potable supplies and some private wells. Unrestricted agricultural reuse and exchange with FID are also near-term opportunities that would provide the City with credit for additional potable water supply. Groundwater recharge with recycled water is a longer-term program that would supplement potable water supplies and provide a barrier to prevent groundwater migration away from the City. A summary of the potential volumes of reuse identified for each type of use is shown in Table 5.1. A schematic of the recommended master plan recycled water elements is shown in Figure 5.1.

**Table 5.1 Summary of Potential Reuse Volumes**
**Recycled Water Master Plan**
**City of Fresno**

| | Recycled Water Use (AFY) |
|---|---|
| Urban Irrigation and Industrial Reuse by Existing Large Users | 14,700 |
| Irrigation of Existing and Future Commercial and Residential Users | >4,000 |
| Groundwater Reuse Recharge | Up to 31,000[(1)] |
| Expand Direct Agricultural Reuse with Secondary Effluent | 4,200 |
| Expand delivery to FID for Agricultural Reuse | >20,000[(2)] |
| Total | >69,000 |

Notes:
(1) Recycled water for groundwater reuse recharge will be limited by the land available for recharge basins and the availability of diluent water.
(2) Delivery of recycled water to FID is unlimited by potential demand, rather it will be limited by remaining available supply once urban reuse and GRRPs are fully implemented.

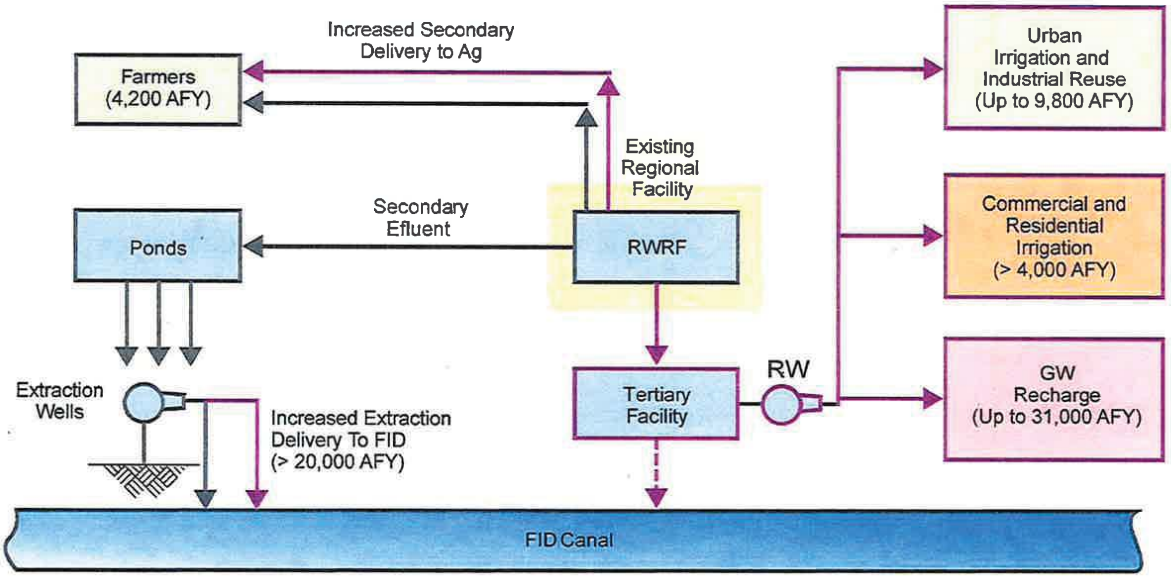


**Figure 5.1**
**SUMMARY OF RECOMMENDED ALTERNATIVES AND POTENTIAL REUSE VOLUMES**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

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### 5.2.1 Urban Reuse Opportunities

Urban reuse provides an opportunity to implement recycled water projects that directly offset potable water and are highly visible to the community. Urban reuse, however, requires the most intensive distribution system since users are spread out across the City. The recycled water distribution system alignments shown in Chapter 4 were selected based on prioritizing delivery to customers with an estimated demand of 100 AFY or more. These larger users are generally land-intensive parks, cemeteries and golf courses that are located around the outskirts of the City. Smaller users and future development areas were also identified to be served directly off the main distribution pipelines or from "laterals" off the main distribution system pipelines. The proposed distribution system forms a ring around the City, with laterals towards the City center that can be used to serve future infill development. If all the users identified by this strategy are served, the potential urban reuse opportunity for existing large users is over 9,000 AFY. If lateral are constructed to serve existing and future residential and commercial users, more than an additional 4,000 AFY can be served.

There were two major alternatives considered for serving urban users:

1. Delivery of recycled water from at the RWRF, or
2. Delivery of recycled water from at Satellite Recycled Water Facilities (SRWFs) located in each quadrant of the city (near the users).

The advantages and disadvantages of each tertiary treatment siting alternative are presented in Table 5.2. In general, treatment and delivery of recycled water from SRWFs is more expensive than treatment and delivery from the RWRF (particularly where small footprint technologies are required for siting in a densely developed community). Satellite facilities are more likely to generate community opposition due to treatment facilities being constructed in residential areas.

It is the recommendation of this Master Plan to proceed with the first concept, serving customers from the RWRF, for the following reasons:

- Less costly
- Less operationally challenging (North Fresno WRF has been a considerable challenge)
- Less dependant on flows in separate sewer sheds
- Eliminates solids handling concerns (don't have to transport solids away from satellite locations)
- Eliminates need for influent storage
- Minimizes community disruption both during construction and operation

| Table 5.2 | Comparison of Regional versus Satellite Treatment and Delivery<br>Recycled Water Master Plan<br>City of Fresno | |
|---|---|---|
| | **Advantages** | **Disadvantages** |
| Regional Treatment and Delivery | • Centralized operations<br>• Existing plant site requires little effort for siting<br>• Greater ability to serve residential/commercial users due to access to greater flows | • Long pipelines required to deliver throughout the City<br>• Multiple booster pump stations and recycled water storage facilities required |
| Satellite Treatment and Delivery | • Treatment close to point of use reduces piping<br>• Recycles at the point of use and achieves localized groundwater basin benefits | • Multiple treatment plants to site and construct<br>• Potential neighborhood resistance and land use impacts associated with satellite plant site<br>• Less ability to serve residential and commercial users due to lower sewer flows<br>• Potential for odor impacts due to need to provide influent storage<br>• SRWFs are more expensive where low-footprint technologies such as MBR must be implemented to accommodate limited land area |

- Utilizes treatment site property already available (is consistent with current land uses)
- Provides more flexibility for meeting diurnal flows (greater capacity to meet daily peaks without storage

### 5.2.2 Agricultural Reuse and Exchange Opportunities

Agricultural reuse provides the largest opportunity for recycled water use (in terms of volume), since demand is nearly unlimited. The benefit of potable water offset, however, can only be achieved if FID (or another agency) is willing to increase its recycled water use and trade recycled water for substituted surface water. Whether the City can realize this benefit depends on negotiations with FID, and the City having adequate facilities to take advantage of the surface water made available through the exchange.

### 5.2.3 Groundwater Reuse Recharge Opportunities

Groundwater recharge is an opportunity to directly augment the City's potable supply, and provide a use for recycled water during the winter. Groundwater recharge locations will be influenced by the City's ability to identify and purchase sites for recharge basins that have

six-months of hydraulic separation from drinking water wells. At this time, the west side of the City, closest to the RWRF, appears best to serve recharge opportunities as there are sites available with soils that are conducive to recharge, and there are relatively few wells located nearby. A source of diluent water would be required (at a contribution ratio of 4:1 diluent to recycled water). Diluent water sources include US Bureau of Reclamation (USBR) surface water, FID surface water, or stormwater provided by Fresno Metropolitan Flood Control District (FMFCD). Percolation rates are highest on the west side of town, where it is also cheapest to supply water from the RWRF.

At least 2,450 acres of land were identified through a preliminary site survey as possible sites for recharge basins. If all sites were implemented and an average percolation rate of 2.4 inches/day was assumed (based on experience of FMFCD), approximately 31,850 AFY of recycled water could be percolated. This recharge volume would need to be confirmed with future evaluation of 1) potential available percolations sites; 2) measured percolation rates for those sites; and 3) availability of adequate diluents water volumes.

## 5.3 COST BENEFIT ANALYSIS

An economic analysis was conducted to explore the environmental, social and economic benefits that may accrue to the City and potential users from implementing a recycled water program. Although recycled water is often more expensive than some traditional options for providing water, recycled water provides some benefits that these other alternatives do not. Therefore, it is important to go beyond cost comparisons by also considering how the benefits of reuse compare to its cost. To do this, a clear distinction must be made between financial and economic analysis:

- A financial analysis of water reuse is based solely on the cash flows of expenses and revenues in and out of the agency
- An economic analysis provides a benefit/cost perspective by considering a broader view of the value of the reclaimed water.

By focusing solely on revenues, a financial analysis provides an overly narrow perspective of the "value" of the waters provided. For example, a financial analysis does not include benefits to the environment and social costs avoided when reuse enables a community to forgo developing alternative water supply options. Therefore, it is important to consider the benefits and costs of each option, rather than considering only costs.

Stratus Consulting was hired for this economic evaluation using a triple bottom line (TBL) approach looks at relevant options and explores how the benefits and costs compare to each other, providing a method of evaluating financial, social and environmental impacts of the project. Table 5.3 summarizes the result of the analysis, including monetized and qualitative benefits, and the stakeholders that accrue those benefits. This table shows that monetized benefits for the project are estimated to outweigh the monetized costs when a 2.5% real discount rate is used. Net monetized benefits are estimated to be $9.4 million,

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**Table 5.3 BCA Overview – Using 2.5% Real Discount Rate (millions, 2010 USD)**
**Recycled Water Master Plan**
**City of Fresno**

| Benefit or Cost Category | Present Value | Stakeholder Accruing Cost or Benefit |
|---|---|---|
| **Costs – Total** | | |
| Capital and O&M costs(1) | 335.8 | City of Fresno |
| **Monetized Benefits** | | |
| Avoided alternative water supply costs | 77.4 | City of Fresno |
| Avoided water quality treatment costs | 252.5 | City of Fresno |
| Avoided agricultural water supply costs | 1.7 | Farmers |
| Avoided fertilizer costs for agriculture | 8.9 | Farmers |
| Avoided fertilizer costs for urban irrigation | 4.7 | Urban irrigators |
| Total monetizable benefits | 345.2 | |
| **Qualitative Benefits and Costs** | **Relative Magnitude*** | |
| Long-term gain in wildlife habitat | ++ | Public |
| Demonstration of "green" water use ethic | + | City of Fresno |
| Improved diversification of water supply portfolio | + | City of Fresno |
| Public perception of recycled water | – | Public |
| Short-term construction impacts | – | Public |
| **Total Net Benefits (Monetizable Benefits – Costs)** | **9.4** | |

All values in millions of dollars.
Assume 2.5% real discount rate and 30-year analysis period.
(1) Costs are based on Alternative 1 costs (not including residential and commercial users) and construction of half the identified areas for groundwater recharge.
O&M = operations and maintenance.
* Magnitude of likely effect on net benefits:
++ = Likely to increase net benefits significantly.
+ = Likely to increase net benefits relative to quantified estimates.
U = Uncertain effect on net benefits relative to quantified estimates.
– = Likely to decrease net benefits.
– – = Likely to decrease benefits significantly.

and total net benefits are believed to be much higher than that when non-monetized benefits and costs are considered. A report detailing the assumptions of the evaluation is in Appendix G.

Major benefits of a recycled water program include avoided costs of alternative water supply, avoided water quality improvements (to reduce salinity at the RWRF for existing percolation ponds), avoided agricultural water supply costs, and avoided fertilizer costs. Other benefits that were not easy to quantify include a gain in bird habitat by creating

groundwater recharge areas, promoting a "green," and improved diversification of the water supply.

## 5.4 PROJECT RECOMMENDATIONS

### 5.4.1 Conclusions of Technical Advisory Group

One of the key components for the development of this recycled water Master Plan was to build upon lessons learned by other agencies that have successfully implemented recycled water programs. To accomplish this, a Technical Advisory Group (TAG) was formed to provide input as to "lessons learned" and implementation considerations from other programs. The TAG for this project included:

- Dave Requa – Dublin San Ramon Services District
- James Crook – California Department of Public Health (retired)
- Bob Jaques – Monterey Regional Water Pollution Control Agency (retired)
- Ron Young – Elsinore Valley Municipal Water District
- Robin Saunders – Water and Sewer Utilities, City of Santa Clara (retired)

In August, 2009, members of the TAG convened at the RWRF to discuss options and opportunities for the City of Fresno. The preliminary recycled water demands and use types were presented. The conclusion of the TAG was that agricultural irrigation represented the greatest opportunity for beneficial reuse, with the least amount of regulatory hurdles, process technology or distribution system investment. It was also recognized that this reuse alternative depended on new exchange agreements with FID to optimize the full water supply benefit (i.e. gain agreement for additional raw water in exchange for recycled water).

Other conclusions of the TAG were:

- Regulators and potential users should be involved in project planning.
- Future projects can be funded with fees on development.
- Consideration should be given to a flat charge for recycled water to provide incentive for recycled water use.
- Going to a higher-than-necessary level of treatment helps with public perception of the projects.
- Public outreach should start early.

All the discussion and comments provided by the TAG during the August 2009 meeting are summarized in a meeting memorandum included Appendix H.

### 5.4.2 Urban Alternatives

As discussed in Section 5.2.1, production and distribution of recycled water from the RWRF offers many advantages over the satellite recycled water facilities. The following are recommendations for implementation of recycled water for existing large users in each quadrant. These recommendations are also summarized in Table 5.4: Pipeline segments are identified in the figures in Chapter 4 along with the demands to be served from each segment.

- ***Southwest*** – The construction of the recycled water distribution system in the Southwest quadrant would begin with the pipeline segments 1 and 2 (Figure 4.6). These two segments mostly serve primarily irrigation customers and some industrial users for a total demand of approximately 1,800 AFY. Pipelines to high-priority visible sites such as City Hall (pipeline 4) and the proposed redevelopment "intensity corridor" in the downtown area should also be implemented in an early phase. Pipeline 1 also sets the stage for expansion into the northwest quadrant.

  The remainder of the southwest pipelines largely deliver recycled water to potential industrial users. After an outreach effort to determine willingness to participate in the recycled water program, the City should choose additional pipe segments to serve industries who wish to participate in the program.

  ***Northwest*** – The majority of pipeline segments in the northwest quadrant can be constructed following the construction of the first segments of the southwest quadrant system. Although the majority of the water use in the quadrant is served by pipeline segment 1 north of Herndon Avenue, building the additional pipelines south from Herndon Avenue will facilitate future expansion of the recycled water distribution system to serve infill development and the proposed "intensity corridors" along Highway 41.

- ***Northeast*** –The distribution pipeline from the Northwest Quadrant should be extended to serve users in the Northeast Quadrant as this allows serving a significantly greater reuse demand (Figure 4.8). It is also recommended that sewer flows in the northeast quadrant be diverted from downstream of the North Fresno WRF to supplement flows to that plant and improve its operability and service capabilities.

  Implementing the 0.7 mgd satellite facility at CSUF does not appear practical at this time due to the high cost and small demand for landscape irrigation associated with this alternative.

  Constructing a SRWF at Granite Park will be a more serviceable solution to serve the CSUF campus and agricultural area and the central area. The additional sewer flows in the Orange Avenue trunk will provide greater capacity and allow more reuse possibilities. The distribution system is separate from the backbone pipeline and can be implemented in any phase pending appropriate funding.

| Table 5.4 Recommendations for Urban Reuse<br>Recycled Water Master Plan<br>City of Fresno | | | | |
|---|---|---|---|---|
| **City Quadrant** | **Pipe Segments and Lengths** | **Major Users Served** | **Demand, AFY** | **Treatment Facilities Required, mgd** |
| Southwest | Pipe segments 1 and 2 – 15.32 miles | • Roeding Park<br>• Kearney Park<br>• 3 cemeteries<br>• Chandler Airport<br>• 3 industries (laundries)<br>• Highway 180 and 99<br>• 3 schools | 1,800 | 2.4 |
| | Spur to City Center (part of pipe segment 4) – 2.5 miles | • City Hall/courthouse<br>• Grizzlies stadium<br>• 1 hospital | 170 | 0.2 |
| | Pipe segment 3 – 1.44 miles | • 3 schools | 95 | 0.1 |
| | Industrial users as possible (pipe segments 5 to 9 and remainder of 4) – 17.0 miles | • 14 industries<br>• 7 parks<br>• 10 schools | 2,100 | 2.8 |
| Northwest | All identified pipe segments – 28.1 miles | • Golf Courses: Riverside Golf Course, Islewood Golf Course, San Joaquin Country Club, Fig Garden Golf Course<br>• Lake Van Ness<br>• Highway 99<br>• 24 schools<br>• 4 parks | 1,900 | 5.3 |
| Northeast | All identified pipe segments - 16.17 miles | • Woodward Park,<br>• Fort Washington Country Club<br>• Woodward Lake<br>• 14 schools<br>• 2 parks | 2,720 | 3.9 |
| | Pipe segment for Granite Park and CSUF – 3 miles | • Granite Park<br>• CSUF<br>• Schools<br>• Parks | 4,900 | 4.0 |
| Southeast | All identified pipe segments - 7.35 miles | • Fairgrounds,<br>• Fresno Pacific University<br>• Sunnyside Country Club<br>• Village Green Golf Course<br>• 9 schools<br>• 4 parks | 995 | 2.8 |
| Total Demand | | | 9,780 | |

- ***Southeast*** – It is recommended that the pipeline from the southwest quadrant be extended eastwardly into the southeast quadrant to serve recycled water customers there (Figure 4.9). If the General Plan allocates growth in SEGA within the time frame of this Master Plan, then the City should consider building a SRWF in the westerly portion of the SEGA area that would link up with and extend the southeast distribution system. Siting a SRWF in SEGA would allow the City considerable flexibility in choosing a lower-cost treatment process, and land could be set aside to expand the facility in the future when sewer flows and potential recycled water demand increase due to growth. A SRWF in SEGA would also allow the area to be self-sustaining with respect to water management.

Providing recycled water to existing and future residential and commercial customers will be implemented following the adoption of the recycled water ordinance. New developments will be required to implement recycled water. Existing residential areas and home owners associations will be encouraged to use recycled water, but the implementation will likely take more time due to the education and outreach required. Once the "back bone" of the distribution system is established for the larger recycled water users, the City will have the flexibility to extend laterals up existing residential streets and through commercial areas to serve these users.

### 5.4.3 Agricultural Alternatives

Consistent with the TAG discussions, it is recommended that the City expand delivery of undisinfected secondary effluent to willing farmers adjacent to the RWRF. Delivery of undisinfected secondary effluent would help reduce the burden on the percolation ponds in the short term and requires minimal permitting and investment in infrastructure. Implementation of the reuse alternative would provide up to 4,200 AFY of recycled water supply.

The second agricultural alternative that should be considered is an agricultural exchange with FID. An agricultural exchange with FID would consist of delivery of either increased delivery of extracted percolate water or tertiary water from the RWRF in order to gain the full water supply benefit from an exchange with agricultural users, the City could begin negotiations with FID to establish the details of an updated (revised) exchange agreement. If negotiations are successful, the City could expand deliveries of extracted percolated effluent to FID (beyond the current limitation of 30,000 AFY). Little to no additional treatment would be required for this option. If the RWQCB for some reason revised its current policy of allowing extracted percolated effluent deliveries to FID canals, the plant effluent would have to be filtered and disinfected prior to delivery for unrestricted agricultural reuse.

For a successful potable water exchange agreement with FID, the City would need to have adequate recharge or treatment facilities to take advantage of the raw water "exchange". Additional facilities would be needed within the city to convey and treat FID's surface water

for potable use, or to recharge it to the groundwater aquifer. The City has master planned the expansion of the northeast water treatment plant and construction of another southeast water treatment plant for this purpose.

### 5.4.4 Groundwater Reuse Recharge Alternatives

It is recommended that groundwater recharge be implemented in the southwest, northwest and southeast quadrants of the City to the extent practical. The first step is to acquire lands for recharge and develop basins that can accept diluent water. These facilities could then be used immediately to take advantage of the City's allotted volume of FID and USBR water (or FMFCD water), even before recharge with recycled water begins. There should be continued coordination with the water division on the potential to recharge recycled water in the super recharge basins as they are developed.

### 5.4.5 Treatment, Management, and Administration of Recycled Water Program

It is recommended that the Wastewater Management Division of the Department of Public Utilities manage the recycled water system and provide the following services:

- treatment and compliance with Waste Discharge Requirements
- operation
- maintenance
- monitoring and inspection of customer connections
- distribution and sales
- billing and administration

The Wastewater Management Division operates and manages the Regional Wastewater Reclamation Facilities (RWRF). The RWRF will produce the majority of the recycled water that will be distributed city-wide. RWRF staff also operates and maintain the North Fresno WRF and oversee its recycling program. Staff will also operate and maintain any other future satellite plants that may be constructed to implement the recycling program.

Distribution and sales of recycled water should be assigned to the Wastewater Management Division. The costs for the current level of treatment (undisinfected secondary) are covered by the Wastewater Management Division's enterprise fund. This enterprise fund is also funding the RWRF's tertiary treatment upgrades and the recycled water distribution facilities. The Division invoices customers for sewer service. Rates will be set to cover capital and annual expenses. Planned sewer rate increases are intended to support the recycled water project. Billings for the use of recycled water could be administered by the Wastewater Division's current industrial billing group and charges included through the city's existing utility billing system.

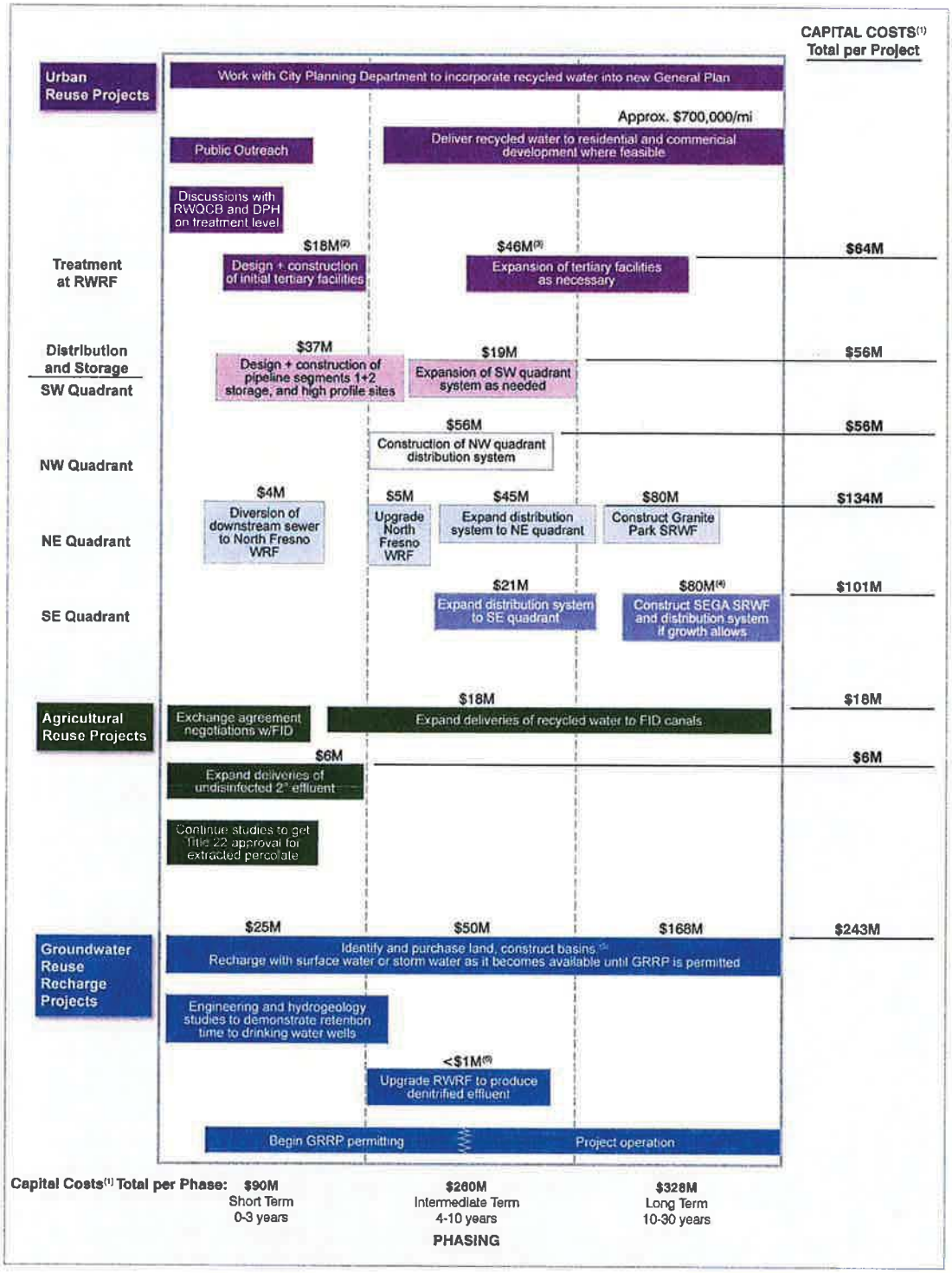
Other considerations that support the above recommendations to consolidate all elements of the recycled water program into the Wastewater Management Division are:

- The Division has a full time reclamation coordinator on staff to oversee implementation, distribution, and sales;
- The Division provides professionals skilled in other services similar to those needed to carry out the program. Customer connections, customer service, and O&M can be assimilated by the Division's staff and crews;
- The Division has developed a set of construction standards for recycled water service connections. Conformance to standards and construction oversight can be assimilated by the Division's staff and crews.
- The Division is responsible for complying with and carrying out the provisions of Waste Discharge Requirements for both the RWRF and the North Fresno WRF;
- The Division will be responsible for future WDRs for possible future satellite plants;
- The Division will be responsible for future Water Reclamation Requirements for the recycling program as well as issuing and administering permits for individual users;
- The Division provides a certified laboratory for water quality analyses of the recycled water;
- The Division is responsible for public outreach and education to promote the program.

## 5.5 PHASING RECOMMENDATIONS

Included in the section are the phasing recommendations for the recommended alternatives. A schedule for the recommended alternatives was developed based on three implementation periods: 1) short-term (zero to three years); 2) intermediate-term (four to ten years); and 3) long-term (10 to 30 years).

The phasing of the elements of the recommended project alternatives along with the associated costs are presented in Figure 5.2. Figure 5.3 shows a map of the phased pipeline construction for delivery to urban users, including the order in which the pipelines would be installed.




Notes:

(1) Costs are construction costs and are exclusive of design or administrative/legal costs, negotiations and agreements with other agencies, and costs for hydrology studies.

(2) Assume media filters and UV disinfection, 8-mgd initial facilities sized to serve SW segments 1 and 2 and NW quadrant.

(3) Expanded to 32-mgd (assuming tertiary treatment not needed for agricultural reuse).

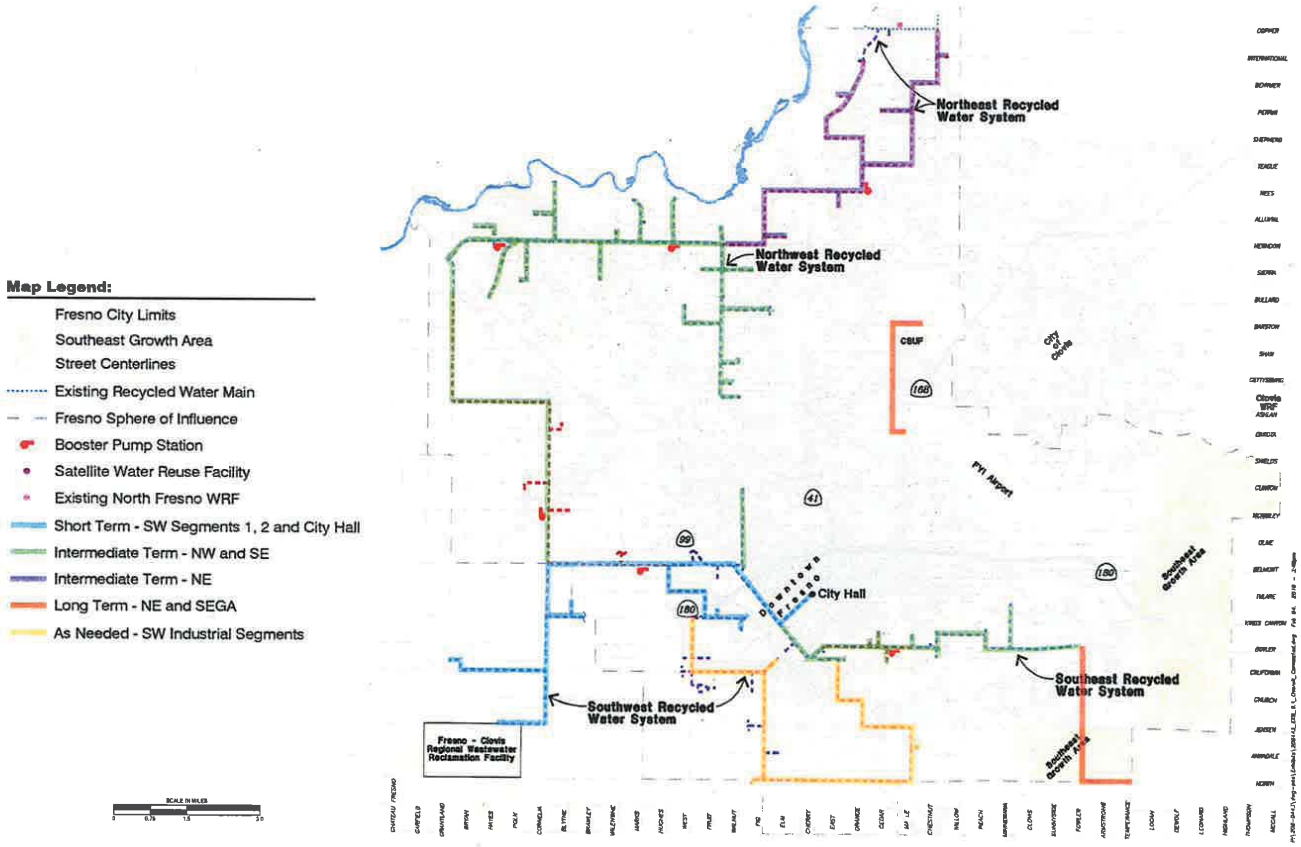
(4) Assuming a 15-mgd activated sludge w/NdN facility, no pipeline costs included. See 2006 Satellite Plant Study Update.

(5) Basin acquisition and construction rate of 70 acres/yr.

(6) Minimal cost since facilities were designed to nitrify/denitrify.

**Figure 5.2**
**RECYCLED WATER PROJECT PHASING AND CAPITAL PROGRAM**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

fr410f1-8230.ai




Note:
Distribution is primarily to serve urban users.
GRRP opportunities will be served from urban distribution system.
System does not accommodate agricultural reuse of exchange projects.

**Figure 5.3**
**SCHEMATIC OF DISTRIBUTION SYSTEM PHASING**
RECYCLED WATER MASTER PLAN
CITY OF FRESNO

fr410f2-8230.ai

### 5.5.1 Short-Term – 0 to 3 Years

The following project elements are recommended to be implemented in the short term:

***Urban Reuse Projects***

- Adopt program level environmental impact report (EIR) for city recycled water program.
- Adopt recycled water ordinance and rules and regulations to encourage and/or require existing and new users to use recycled water.
- Plan, design and begin construction for three parallel short-term projects.
  - Add tertiary facilities to RWRF
  - Segments 1 and 2 of southwest quadrant distribution system
  - Increase sewer diversion to NFWRF to provide adequate supply for reuse in northeast quadrant
- Irrigate freeways in the vicinity of the Highway 180/99 interchange from pipe segment 1.
- Continue public outreach and education for public and potential users to increase community acceptance of recycled water for irrigation and industrial use.
- Pipeline to high-profile areas such as City Hall. Begin an industrial outreach program to bring industries into the recycled water program, and build additional pipeline segments to serve these industries.
- Tertiary/disinfection facilities should be sized for the short-term projects at 8 million gallons per day (mgd) with a modular approach for future expansion in 4-mgd increments.
- Work with City Planning and Water Division to coordinate efforts for implementing recycled water in the General Plan Update and ongoing water planning documents. .

### 5.5.2 Agricultural Reuse/Exchange Projects

- Expand deliveries of undisinfected secondary to effluent willing local farmers for restricted use.
- Conduct negotiations with FID on exchange agreement to increase raw water deliveries to City recharge sites.
- Continue studies and discussions with the DPH to obtain approval for extracted percolated effluent as equivalent to Title 22 recycled water.

***Groundwater Reuse Recharge Projects***

- Identify and purchase land, which in the short term will be used to percolate raw water from FID (under the current agreement).

- Retain the services of a hydrogeologist to help select sites for GRRPs.
- Begin studies necessary for the permitting process and public hearings.
- Begin tracer studies to determine potential basins' hydraulic retention time to drinking water wells.
- Identify diluent water sources.

### 5.5.3 Intermediate-Term – 4 to 10 Years

The following project elements are recommended to be implemented in the intermediate term:

***Urban Reuse Projects***

- Expand the recycled water distribution system into the northwest quadrant and southeast quadrant, followed by the northeast quadrant. Begin building laterals for residential and commercial users where feasible.
- Expand the recycled water distribution system to new users in the southwest quadrant.
- Continue to work with City Planning and Water Division for delivery of recycled water to infill growth where feasible.
- Expand the RWRF's tertiary facilities in 4 mgd increments as necessary to serve additional users.

***Agricultural Reuse/Exchange Projects***

- If negotiations with FID for raw water exchange are successful and DPH and RWQCB allows the continued practice of percolated water extractions, expand deliveries of extracted percolate to FID canals.
- Deliver tertiary disinfected water to FID canals if feasible.

***Groundwater Reuse Recharge Projects***

- Continue to recharge surface water in the new basins until the recharge project is permitted.
- Continue GRRP permitting and begin project operation.
- Continue to acquire more land for more basins as opportunities arise.

### 5.5.4 Long-Term – 10 to 30 Years

The following project elements are to be implemented in the long term:

***Urban Reuse Projects***

- Construct a new SRWF at Granite Park.
- If SEGA is to be developed during this time frame, construct a new SRWF in SEGA.
- Continue to expand the recycled water distribution system to deliver recycled water to residential and commercial development where feasible.

***Agricultural Reuse/Exchange Projects***

- Continue deliveries and exchange with FID.

***Groundwater Reuse Recharge Projects***

- Continue to operate and expand the City's GRRP system.

# APPENDIX A – CDPH DRAFT REGULATIONS

CITY OF FRESNO
INCORPORATED OCT. 12, 1885

*This draft reflects the California Department of Public Health (CDPH) Drinking Water Program's current thinking on the regulation of recharge of groundwater with recycled municipal wastewater.*

*Any comments you have on this draft can be emailed to Jeff Stone at Jeffrey.Stone@cdph.ca.gov and Mike McKibben at Michael.McKibben@cdph.ca.gov .*

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# Title 22, CALIFORNIA CODE OF REGULATIONS

## *DIVISION 4. ENVIRONMENTAL HEALTH*

### *CHAPTER 3. RECYCLING CRITERIA*

***August 5, 2008***

## *ARTICLE 1. DEFINITIONS*

### Section 60301.080. 24-hour Composite Sample.

"24-hour composite sample" means an aggregate sample derived from no fewer than eight discrete samples collected at equal time intervals or collected proportional to the flow rate over the compositing period. The aggregate sample shall reflect the average source water quality covering the composite of sample period.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

### Section 60301.190. Diluent Water.

"Diluent water" means water used to dilute recycled municipal wastewater in a groundwater recharge reuse project.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

### Section 60301.370. Groundwater.

"Groundwater" means water below the land surface in the saturated zone.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

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## Section 60301.390. Groundwater Recharge Reuse Project (GRRP)

"Groundwater Recharge Reuse Project (GRRP)" means a project that uses recycled municipal wastewater, has been planned and is operated for the purpose of recharging a groundwater basin designated in the Water Quality Control Plan [defined in Water Code section 13050(j)] for use as a source of domestic water supply, and has been identified as a GRRP by the RWQCB.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Sections 13520, 13521, and 13050(j), Water Code.

## Section 60301.670. Project Sponsor.

"Project sponsor" means any agency that receives water recycling requirements for a GRRP from a RWQCB and is, in whole or part, responsible for the GRRP meeting the requirements of this Chapter.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60301.680. Public Water System.

"Public Water System" has the same meaning as defined in section 116275(h) of the Health and Safety Code.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 116275(h), Health and Safety Code.

## Section 60301.685. Recharge Water.

"Recharge Water" means either recycled municipal wastewater or the combination of recycled municipal wastewater and diluent water that is applied at a GRRP facility.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 116275(h), Health and Safety Code.

## Section 60301.690. Recycled Municipal Wastewater.

"Recycled Municipal Wastewater" means the effluent from the treatment of a wastewater of municipal origin, suitable for a direct beneficial use or a controlled use.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13050, Water Code.

## Section 60301.705. Recycled Water Contribution (RWC).

"Recycled water contribution (RWC)" means the quantity of recycled municipal wastewater applied at the GRRP, divided by the sum of the recycled municipal wastewater applied at the GRRP and diluent water meeting the requirements of section 60320.035.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60301.770. RWQCB.

"RWQCB" means Regional Water Quality Control Board.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60301.780. Saturated Zone.

"Saturated zone" means an underground region in which all interstices in, between, and below natural geologic materials are filled with water, with the uppermost surface of the saturated zone being the water table.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60301.810. Spreading Area.

"Spreading area" means a natural or constructed impoundment with a depth equal to or less than its widest surface dimension used by a GRRP to recharge a groundwater basin with recharge water infiltrating and percolating through an otherwise (i.e. without the presence of recharge water) unsaturated zone.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60301.840. Subsurface Application.

"Subsurface Application" means the controlled application of recharge water to a groundwater basin by a means other than surface application.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60301.850. Surface Application.

"Surface Application" means the controlled application of recharge water to a spreading area resulting in the recharge of a groundwater basin.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60301.860. Total Nitrogen.

"Total nitrogen" means the sum of concentrations of nitrogen in ammonia, nitrite, nitrate, and organic nitrogen-containing compounds, expressed as nitrogen.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60301.870. Total Organic Carbon (TOC).

"Total organic carbon (TOC)" means the concentration of organic carbon present in water that is able to be oxidized to carbon dioxide.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60301.910. Unsaturated Zone.

"Unsaturated Zone" means the volume between the land surface and the saturated zone.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

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## ARTICLE 5.1. GROUNDWATER RECHARGE

~~**Section 60320. Groundwater Recharge.**~~

~~(a) Reclaimed water used for groundwater recharge of domestic water supply aquifers by surface spreading shall be at all times of a quality that fully protects public health. The State Department of Health Services' recommendations to the Regional Water Quality Control Boards for proposed groundwater recharge projects and for expansion of existing projects will be made on an individual case basis where the use of reclaimed water involves a potential risk to public health.~~

~~(b) The State Department of Health Services' recommendations will be based on all relevant aspects of each project, including the following factors: treatment provided; effluent quality and quantity; spreading area operations; soil characteristics; hydrogeology; residence time; and distance to withdrawal.~~

~~(c) The State Department of Health Services will hold a public hearing prior to making the final determination regarding the public health aspects of each groundwater recharge project. Final recommendations will be submitted to the Regional Water Quality Control Board in an expeditious manner.~~

Note: ~~Authority cited: Section 208, Health and Safety Code; and Section 13521, Water Code. Reference: Sections 13520 and 13521, Water Code.~~

## Section 60320. General Requirements.[1]

(a) Recycled municipal wastewater used for a GRRP shall be from a wastewater management agency that:

(1) administers an industrial pretreatment and pollutant source control program;

(2) implements and maintains a source control program that includes at a minimum:

(A) an assessment of the fate of Department-specified contaminants through the wastewater and recycled municipal wastewater treatment systems,

(B) contaminant source investigations and contaminant monitoring that focus on Department-specified contaminants,

(C) an outreach program to industrial, commercial, and residential communities within the sewage collection agency's service area for the purpose of managing and minimizing the discharge of contaminants of concern at the source, and

(D) an up-to-date inventory of contaminants discharged into the wastewater collection system so that new contaminants of concern can be readily evaluated.

(3) is compliant with the effluent limits established in the RWQCB permit for the GRRP.

[1] The Department is considering the inclusion of a provision for operator certification and/or training.

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(b) Prior to operation of a new GRRP, or during the first year of operation after [*insert effective date*] for an existing GRRP, the GRRP shall have a Department approved plan that provides an alternative source of domestic water supply, or a Department approved treatment mechanism, to any user of a producing drinking water source that, as a result of the GRRP;

(1) violates California drinking water standards,

(2) has been degraded to the degree that it is no longer a safe source of drinking water, or

(3) receives water that fails to meet subsection 60320.010(c)..

(c) A public hearing for a GRRP shall be held prior to the Department's submittal of its recommendations for the GRRP's initial permit to the RWQCB and any time an increase in maximum RWC has been proposed but not addressed in a prior public hearing. Prior to a public hearing, the project sponsor shall provide the Department, for review and approval, the information the project sponsor intends to present at the hearing and on the Internet. Following the Department's approval of the information, the project sponsor shall place the information on the Internet and in a repository that provides at least thirty days of public access to the information prior to the public hearing.

(d) Prior to placing the information required pursuant to subsection (c) in a repository, the GRRP shall:

(1) Notify the public of the following;

(A) the location and hours of operation of the repository,

(B) the Internet address where the information may be viewed,

(C) the purpose of the repository and public hearing,

(D) the manner in which the public can provide comments, and

(E) the date, time, and location of the public hearing.

(2) At a minimum, notify the first downgradient potable water well owner and well owners whose drinking water source is within 10 years from the GRRP based on groundwater flow directions and velocities.

(e) Unless directed otherwise by the Department, the public notification made pursuant to subsection (d)(2) shall be by direct mail and the notification made pursuant to (d)(1) shall be by one or more of the following methods delivered in a manner to reach persons whose source of drinking water may be impacted by the GRRP:

(1) Local newspaper(s) publication;

(2) Mailed or direct delivery of a newsletter;

(3) Conspicuously placed statement in water bills; or

(4) Television and/or radio.

(f) Prior to operation, a new GRRP shall have an Operations Plan submitted to and approved by the Department. An existing GRRP shall maintain, and make available to the Department or RWQCB for review when requested, an

Operations Plan. An Operations Plan shall describe the operations, maintenance, and monitoring necessary for the GRRP to meet the requirements of this chapter. The project sponsor shall be responsible for ensuring that the Operations Plan is, at all times, representative of the current operations, maintenance, and monitoring of the GRRP.

(g) Prior to operating a new GRRP, the project sponsor shall collect at least two samples from each monitoring well approved pursuant to section 60320.070. The samples shall be representative of water in each aquifer, taking into consideration seasonal variations, and be analyzed for the constituents and characteristics in sections 60320.020, 60320.030, 60320.045 and 60320.47.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.005 Alternatives.

(a) A GRRP may use an alternative to a requirement in this chapter if the GRRP has:

(1) demonstrated to the Department that the proposed alternative would assure at least the same level of protection to public health;

(2) received written approval from the Department prior to implementation of the alternative; and

(3) conducted a public hearing, disseminated information to the public, and received public comments, pursuant to subsections 60320(c) and (d), on the proposed alternative.

(b) Surface application GRRPs that provide reverse osmosis treatment as well as subsequent advanced oxidation treatment to the entire recycled municipal wastewater may apply to the Department for less frequent monitoring than that required in sections **XXXX**[2]. The advanced oxidation treatment shall provide, at minimum, a level of treatment equivalent to a 1.2 log N-nitrosodimethylamine (NDMA) reduction and a 0.5 log 1,4-dioxane reduction.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.007 Laboratory Analyses.

(a) Analyses for contaminants having primary or secondary MCLs shall be performed by laboratories approved to perform such analyses by the Department utilizing Department-approved drinking water methods and,

[2] The applicable reduced monitoring is under discussion.

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(b) Analyses for constituents other than those having primary or secondary MCLs shall be described in the GRRP's Operations Plan prepared pursuant to subsection 60320(f).

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.010. Control of Pathogenic Microorganisms.

(a) For each GRRP, the wastewater to be used as recycled municipal wastewater shall be treated to meet the following:

(1) The definition of filtered wastewater, pursuant to section 60301.320[3]; and

(2) The definition of disinfected tertiary recycled water, pursuant to section 60301.230[3].

(b) If the recycled municipal wastewater being used for surface or subsurface application has not been treated to meet the criteria in sections 60301.230 and 60301.320, pursuant to section 60321 (Sampling and Analysis), the GRRP shall:

(1) Suspend surface or subsurface application of the recycled municipal wastewater until the criteria are met; and

(2) Inform the Department and the RWQCB in the next quarterly report submitted pursuant to section 60321[3].

(c) For each GRRP, the recycled municipal wastewater shall be retained underground for a minimum of six months prior to extraction for use as a drinking water supply.

(d) To demonstrate that the minimum retention time in subsection (c) has been met, prior to the end of the third month of operation (including prior to initial operation), under hydraulic conditions representative of normal GRRP operations the GRRP shall initiate a tracer study utilizing an added tracer (e.g. sulfur hexafluoride). Based the time for two percent of the tracer concentration to arrive at its endpoint from the GRRP location ($T_2$), the results of the tracer study shall provide evidence of;

(1) A minimum retention time of six months, with the nearest downgradient drinking water well as the endpoint or,

(2) A minimum retention time of three months, with the monitoring well sited pursuant to paragraph 60320.070(a)(1) as the endpoint.

(e) If the retention time to nearest downgradient drinking water well is less than twelve months based on the extrapolation of the results of the tracer study performed pursuant to paragraph (d)(2), the GRRP shall monitor the tracer, with

[3] Refers to existing regulations not shown in this document.

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the nearest downgradient drinking water well as the endpoint, until compliance with paragraph (d)(1) has been demonstrated.

(f) Until a GRRP has demonstrated compliance with subsection (c) pursuant to subsection (d), i.e. for the purpose of siting a GRRP location during project planning, each GRRP shall be located at a distance from drinking water supply wells that ensures that one of the estimated retention times in Table 60320.010-A is met, as indicated by the corresponding method used to determine the estimated retention times.

**Table 60320.010-A**

| **Method used to estimate the retention time to the nearest downgradient drinking water well** | **Minimum Estimated Retention Time** |
|---|---|
| Tracer study utilizing an intrinsic tracer based on $T_{10}$ (i.e. the time for 10% of tracer concentration to reach the endpoint) conducted under hydraulic conditions representative of normal GRRP operations. | 9 months |
| Numerical modeling (i.e. calibrated finite element or finite difference models using verified computer codes such as Modflow, Feflow, Sutra, Femwater, etc.) | 12 months |
| Analytical modeling (i.e. Using existing equations such as Darcy's Law to estimate groundwater flow conditions based on simplifying aquifer assumptions) | 24 months |

(g) A method used to establish the retention times in subsections (d) or (f) shall be approved by the Department.

(h) A GRRP shall provide the Department and RWQCB a map of the GRRP site at a scale of 1:24,000 or larger (1 inch equals 2,000 feet or 1 inch equals less than 2,000 feet) or, if necessary, a site sketch at a scale providing more detail, that clearly indicates;

(A) The location and boundaries of the GRRP,

(B) The boundary representing the six-month retention time required in paragraph (c) as determined in paragraph (d) or (f), whichever is most recent, and

(C) The location of all drinking water supply wells and monitoring wells within three years of the GRRP based on groundwater flow directions and velocities expected under GRRP operating conditions.

(i) The Department may require the GRRP to demonstrate that the underground retention times required in this section are being met if changes in

hydrogeological or climatic conditions have occurred since the most recent demonstration.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.020. Control of Nitrogen Compounds.

To demonstrate control of the nitrogen compounds in the recycled municipal wastewater, the project sponsor shall meet the requirements of one of the methods in subsections (a), (b), or (c). Method 3, described in subsection (c), may only be utilized by a GRRP that has been in operation for a minimum of twenty years. (These requirements are summarized in a table at the end of this document, see ENDNOTE 7)

(a) Method 1:

(1) Each week, at least three days apart as specified in the GRRP's Operation Plan, two samples (grab or 24-hour composite) representative of the recycled municipal wastewater or recharge water applied throughout the spreading area or subsurface application area shall be collected. Samples may be collected before or after surface or subsurface application.

(2) Samples collected pursuant to subsection (a)(1) shall be analyzed for total nitrogen, with the laboratory being required to complete each analysis within 72 hours and have the result reported to the project sponsor within the same 72 hours if the result of any single sample exceeds 5 mg/L.

(A) If the average of two consecutive samples exceeds 5 mg/L total nitrogen, the cause shall be investigated, appropriate actions to reduce the total nitrogen levels shall be taken, and the Department and the RWQCB shall be notified within 48 hours of the GRRP being notified by the laboratory.

(B) If the average of all samples collected during any consecutive four weeks exceeds 5 mg/L, the surface or subsurface application of recycled municipal wastewater shall be suspended. Surface or subsurface application shall not resume until appropriate corrective actions are made and two consecutive total nitrogen samples are less than 5 mg/L.

(b) Method 2:

(1) At a frequency approved by the Department and specified in the operations plan prepared pursuant to section 60320(f):

(A) samples shall be collected and analyzed for dissolved oxygen (DO) in the groundwater that has been blended with the recharge water and;

(B) samples (grab or 24-hour composite) representative of the recycled municipal wastewater or recharge water shall be collected and analyzed for nitrate, nitrite, ammonia, organic nitrogen, DO, and BOD.

(2) The GRRP shall ensure that the laboratory completes each analysis in (b)(1) within 72 hours (one week for BOD) and report the result(s) to the project sponsor within the same 72 hours (one week for BOD) if:

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(A) the total nitrogen exceeds 10 mg/L, or

(B) the concentration of any constituent exceeds the respective limit identified in the engineering report and approved by the Department.

(3) If the average of two consecutive samples exceeds 10 mg/L total nitrogen or a limit identified in the engineering report for another constituent, the cause shall be investigated, appropriate actions to meet the limit(s) shall be taken, the Department and the RWQCB shall be notified within 24 hours of the GRRP being notified by the laboratory, and surface or subsurface application of recycled municipal wastewater shall be suspended until an average of two consecutive samples meets the limit(s).

(c) Method 3:

(1) In the engineering report prepared pursuant to section 60323, evidence shall be provided that:

(A) it is possible to track the movement of recharge water from the GRRP surface or subsurface application facility to downgradient potable water wells located within 20 years of the GRRP based on groundwater flow directions and velocities,

(B) the most recent year's total nitrogen levels in the recycled municipal wastewater is not greater than the most recent 10 years of historical data, and

(C) surface or subsurface application has not resulted in, and would not result in, an exceedance of the nitrate or nitrite MCLs at any downgradient potable water wells located within 20 years of the GRRP based on groundwater flow directions and velocities. At a minimum, the evidence shall consist of at least the most recent 10 years of historical data, and shall demonstrate that no potable water well, as a result of the operation of the GRRP:

1. exceeded the nitrate or nitrite MCLs or
2. has had a trend of increasing concentrations of nitrate or nitrite that would lead to a nitrate or nitrite MCL exceedance utilizing the GRRP's current operations.

(2) At the frequency specified in the operations plan prepared pursuant to subsection 60320(f), two grab samples of groundwater at each sampling location downgradient of the GRRP's surface or subsurface application facility shall be collected and analyzed for nitrite and nitrate. The GRRP shall ensure that the laboratory completes each analysis within 72 hours and shall report any result exceeding the nitrate or nitrite MCL to the project sponsor within the same 72 hours.

(A) If the average of two consecutive samples exceeds an MCL at any sampling location, the Department and RWQCB shall be notified and, unless the GRRP demonstrates to the Department and RWQCB that the groundwater no longer exceeds the MCL, the surface or subsurface application of recycled municipal wastewater shall be suspended.

(d) The GRRP may apply for reduced total nitrogen or nitrate/nitrite monitoring frequencies if all results for the previous two years did not exceed;

(1) 5 mg/L total nitrogen and one-half the nitrate and nitrite MCL for Method 1, or

(2) 10 mg/L total nitrogen and one-half the nitrate and nitrite MCL for Method 2.

(e) If a GRRP implementing reduced monitoring pursuant to subsection (d) exceeds the total nitrogen, nitrate, or nitrite concentrations in (d)(1) or (d)(2), the GRRP shall revert to the monitoring frequencies for total nitrogen, nitrate, and nitrite prior to the frequency being reduced.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.030. Control of Regulated Chemicals and Physical Characteristics.

(a) Each calendar quarter, as specified in the GRRP's operations plan, the GRRP shall collect grab samples representative of the applied recycled municipal wastewater and have the samples analyzed for the contaminants listed below.

(1) The inorganic chemicals in Table 64431-A, except for nitrogen compounds;

(2) The radionuclide chemicals in Tables 64442 and 64443;

(3) The organic chemicals in Table 64444-A;

(4) The disinfection byproducts in Table 64533-A; and

(5) Lead and copper.

(b) Recharge water may be monitored in lieu of recycled municipal wastewater to satisfy the monitoring requirements in paragraph (a)(4) if the fraction of recycled municipal waste water in the recharge water is equal to or greater than the average fraction for the quarter. If the fraction of recycled municipal waste water in the recharge water being monitored is less than the average fraction applied for the quarter, the reported value shall be adjusted to account for any dilution.

(c) Each year, the GRRP shall collect at least one representative grab sample of the recycled municipal wastewater and have the sample(s) analyzed for the secondary drinking water constituents in Tables 64449-A and 64449-B.

(d) If a result of the monitoring performed pursuant to subsection (a) exceeds a contaminant's MCL or action level (for lead and copper), the GRRP shall collect another sample and have it analyzed for the contaminant as confirmation within 72 hours.

(1) For a contaminant whose compliance with its MCL is not based on a running annual average (see Endnote 1), if the average of the initial and confirmation sample exceeds the contaminant's MCL, or the confirmation sample

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is not collected and analyzed pursuant to this subsection, the GRRP shall notify the Department and RWQCB within 24 hours and initiate weekly monitoring until four consecutive weekly results are below the contaminant's MCL.

(A) If the running four-week average exceeds the acute contaminant's MCL, the GRRP shall notify the Department and RWQCB within 24 hours and, if directed by the Department or RWQCB, suspend application of the recycled municipal wastewater.

(2) For a contaminant whose compliance with its MCL is based on a running annual average, if the average of the initial and confirmation sample exceeds the contaminant's MCL or action level, or a confirmation sample is not collected and analyzed pursuant to this subsection, the GRRP shall initiate weekly monitoring for the contaminant until the running four-week average no longer exceeds the contaminant's MCL or action level.

(A) If the running four-week average exceeds the contaminant's MCL or action level, the GRRP shall describe the reason(s) for the exceedance and provide a schedule for completion of corrective actions in the next quarterly report submitted to RWQCB pursuant to section 60321, with a copy provided to the Department.

(B) If the running four-week average exceeds the contaminant's MCL or action level for sixteen weeks, the GRRP shall notify the Department and RWQCB within 24 hours and, if directed by the Department or RWQCB, suspend application of the recycled municipal wastewater.

(e) With the exception of color, if an annual result of the monitoring performed pursuant to (c) exceeds a constituent's secondary MCL in Table 64449-A or the upper limit in Table 64449-B, the GRRP shall initiate quarterly monitoring of the municipal wastewater for the constituent and, if the running annual average of quarterly results exceeds a constituent's secondary MCL or upper limit, describe the reason(s) for the exceedance and any corrective actions taken in the next quarterly report submitted to RWQCB pursuant to section 60321, with a copy provided to the Department. The annual monitoring in (c) may resume if the running annual average of quarterly results does not exceed a constituent's secondary MCL or upper limit.

(f) If four consecutive quarterly results for asbestos are below the detection limit for asbestos, monitoring for asbestos may be reduced to one sample every three years. Quarterly monitoring shall resume if asbestos is detected.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.035. Diluent Water Requirements.

To be credited with diluent water to be used in calculating an RWC to meet the requirements of section 60320.041, the GRRP shall comply with the requirements of this section. For diluent water that is a Department approved

drinking water source, the GRRP is exempt from subsections (a) and (b). The GRRP shall:

(a) Monitor the diluent water quarterly for nitrate and nitrite and, within 72 hours of being informed by the laboratory of a nitrate or nitrite result exceeding an MCL, collect a confirmation sample. If the average of the two samples is greater than an MCL;

(1) notify the Department and the RWQCB within 48 hours of receiving the confirmation sample result,

(2) investigate the cause(s) and implement corrective actions, and

(3) each week, collect and analyze two grab samples at least three days apart as specified in an operations plan. If the average of the results for a two-week period exceeds the MCL, surface or subsurface application of the diluent water shall not be used in the calculation of RWC until corrective actions are made. Quarterly monitoring may resume if four consecutive results are below the MCL.

(b) Conduct a source water evaluation per California-Nevada Section of American Water Works Association watershed sanitary survey handbook, or other Department approved evaluation, of the diluent water for Department review and approval that includes, but is not limited to:

(1) a description of the source of the diluent water,
(2) delineation of the origin and extent of the diluent water,
(3) the susceptibility of the diluent water to contamination,
(4) the identification of known or potential contaminants, and
(5) an inventory of the potential sources of diluent water contamination.

(c) Implement a Department-approved water quality monitoring plan for the purpose of demonstrating that the diluent water meets Department specified primary MCLs and notification levels based on the source water evaluation performed in (b). The plan shall also include:

(1) Monitoring of any constituents listed in section 62320.047, based on the source water evaluation performed in (b), and;

(2) Actions to be taken in the event of non-compliance with a primary MCL or failing to meet a notification level.

(d) Develop a method for accurately determining the volume of diluent water to be credited, including consideration of any temporal variations, and demonstrate that the diluent water will be applied in a manner such that temporal variations in the diluent water volume will not lead to an exceedance of the maximum RWC. The method shall be submitted to the Department for review and approval and be conducted at the frequency specified in the engineering report prepared pursuant to section 60323.

(e) For credit not to exceed 60 months prior to the operation of the GRRP:

(1) demonstrate that the diluent water has met the nitrate and nitrite MCLs and the water quality requirements in sections 60320.030 and 60320.047(a)(1)(A),

(2) provide evidence that the quantity of diluent water has been accurately determined and was distributed such that the proposed or permitted maximum RWC will not be exceeded, and

(3) conduct a source water evaluation of the diluent water pursuant to subsection (c).

(f) In the operations plan prepared pursuant to 60320(f), include a description of:

(1) How the diluent water will be distributed in a manner that ensures that the maximum RWC will not be exceeded during normal operations; and

(2) The actions to be taken in the event the diluent water is curtailed or is no longer available.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.041. Recycled Water Contribution (RWC) Requirements

(a) Each month, for each surface or subsurface application facility used for replenishing a groundwater basin, the GRRP shall calculate its running monthly average (RMA) RWC based on the total volume of the recycled municipal wastewater and diluent water for the preceding 60 calendar months. For GRRPs in operation less than 60 months, calculation of the RMA RWC shall commence after 30 months of operation, based on the total volume of the recycled municipal wastewater and diluent water for the preceding months.

(b) The GRRP's RMA RWC, as determined in (a), shall not exceed the maximum RWC specified by the Department.

(c) The initial maximum RWC will be based on the Department's review of the engineering report and information obtained as a result of the public hearing, but shall not exceed;

(1) 0.50 for subsurface application GRRPs;

(2) 0.50 for surface application GRRPs that provide reverse osmosis treatment as well as subsequent advanced oxidation treatment to the entire recycled municipal wastewater, if the advanced oxidation[4] treatment provides, at minimum, a level of treatment equivalent to a 1.2 log NDMA reduction and a 0.5 log 1,4-dioxane reduction or;

(3) 0.20 for surface application GRRPs not meeting the criteria in paragraph (2).

[4] The requirement for advanced oxidation for all subsurface application GRRPs is under discussion.

(d) A GRRP may increase its maximum RWC, provided that:

(1) the increase has been approved by the Department and RWQCB,

(2) for the previous 52 consecutive weeks, the TOC 20-week running average, as monitored pursuant to section 62320.045, has not exceeded the following:

$$TOC_{max} = \frac{0.5 mg/L}{RWC_{proposed}},$$

Where,
$RWC_{proposed}$ is the proposed maximum RWC

(3) the GRRP has received a permit from the RWQCB that allows operation of the GRRP at the increased maximum RWC, and

(4) the GRRP meets the requirements in subsections (e) and (f).

(e) Prior to operating a GRRP in any of the RWC ranges in Table 60320.041 exceeding the GRRP's initial RWC, the GRRP shall meet the corresponding requirements in Table 60320.041-A or B sequentially, beginning with the range of the approved initial maximum RWC. The approval in subsection (d)(1) will be based on the Department's and the RWQCB's review of the information submitted pursuant to the corresponding RWC range in Table 60320.041-A or B and the GRRP's history of compliance with this chapter.

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**Table 60320.041-A**
**Surface Application Projects**

| **GRRP RWC Operating Range Requirements**<br>For Operating Ranges A through E, where<br>A = 0.00 ≤ RWC < 0.20<br>B = 0.20 ≤ RWC < 0.35<br>C = 0.35 ≤ RWC < 0.50<br>D = 0.50 ≤ RWC < 0.75<br>E = 0.75 ≤ RWC ≤ 1.00 | **RWC Operating Range** | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| 1. Provide documentation that a groundwater monitoring well located between the GRRP and a drinking water well has received recharge water from the GRRP for at least six months such that the fraction of the GRRP's recycled municipal wastewater in the monitoring well equals a value of at least 0.5 multiplied by $RWC_{proposed}$. | | ✓ | ✓ | ✓ | ✓ |
| 2. The groundwater impacted by a GRRP from a monitoring well and a drinking water well meets all drinking water standards and the requirements of section 60320.020 (Control of Nitrogen Compounds). | | ✓ | ✓ | ✓ | ✓ |
| 3. Provide a proposal to the Department prepared and signed by an engineer licensed in California with at least three years experience in wastewater treatment and public water supply. The proposal shall include: | ✓ | ✓ | ✓ | ✓ | ✓ |
| A. GRRP operations, monitoring, and compliance data; | ✓ | ✓ | ✓ | ✓ | ✓ |
| B. Evidence that a groundwater monitoring well located between the GRRP and a drinking water well has received recharge water from the GRRP for at least one year such that the fraction of the GRRP's recycled municipal wastewater in the monitoring well equals a value of at least 0.8 multiplied by $RWC_{maximum}$.; | | ✓ | ✓ | ✓ | ✓ |
| C. Validation of appropriate construction and siting of monitoring wells pursuant to section 60320.070. | ✓ | ✓ | ✓ | ✓ | ✓ |
| D. A scientific peer review by an independent advisory panel that includes, as a minimum, a toxicologist, a registered engineering geologist or hydrogeologist, an engineer licensed in California with at least three years experience in wastewater treatment and public water supply., a microbiologist, and a chemist. | | | | ✓ | ✓ |
| E. Submittal of an updated engineering report and operations plan. | | ✓ | ✓ | ✓ | ✓ |
| 4. At a minimum, for that portion of the recycled municipal wastewater stream needing additional treatment to meet the TOC limit in section 60320.045, provide reverse osmosis[5] | ✓ | ✓ | ✓ | ✓ | ✓ |

[5] Performance criteria for reverse osmosis treatment is under discussion.

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| | | | | | |
|---|---|---|---|---|---|
| treatment as well as subsequent advanced oxidation treatment. The advanced oxidation treatment[6] shall provide, at minimum, a level of treatment equivalent to a 1.2 log NDMA reduction and a 0.5 log 1.4-dioxane reduction, whether NDMA or 1,4-Dioxane are present or not. | | | | | |

**Table 60320.041-B**
**Subsurface Application Projects**

| **GRRP RWC Operating Range Requirements**<br>For Operating Ranges A through C, where<br>A = 0.00 ≤ RWC < 0.50<br>B = 0.50 ≤ RWC < 0.75<br>C = 0.75 ≤ RWC ≤ 1.00 | **RWC Operating Range** | | |
|---|---|---|---|
| | A | B | C |
| 1. Provide documentation that a groundwater monitoring well located between the GRRP and a drinking water well has received recharge water from the GRRP for at least six months such that the fraction of the GRRP's recycled municipal wastewater in the monitoring well equals a value of at least 0.5 multiplied by $RWC_{proposed}$. | | ✓ | ✓ |
| 2. The groundwater impacted by a GRRP from a monitoring well and a drinking water well meets all drinking water standards and the requirements of section 60320.020 (Control of Nitrogen Compounds). | | ✓ | ✓ |
| 3. Provide a proposal to the Department prepared and signed by an engineer licensed in California with at least three years experience in wastewater treatment and public water supply.. The proposal shall include: | ✓ | ✓ | ✓ |
| A. GRRP operations, monitoring, and compliance data; | ✓ | ✓ | ✓ |
| B. Evidence that a groundwater monitoring well located between the GRRP and a drinking water well has received recharge water from the GRRP for at least one year such that the fraction of the GRRP's recycled municipal wastewater in the monitoring well equals a value of at least 0.8 multiplied by $RWC_{maximum}$.; | | ✓ | ✓ |
| C. Validation of appropriate construction and siting of monitoring wells pursuant to section 60320.070. | ✓ | ✓ | ✓ |
| D. A scientific peer review by an independent advisory panel that includes, as a minimum, a toxicologist, a registered engineering geologist or hydrogeologist, an engineer licensed in California with at least three years experience in wastewater treatment and public water supply., a microbiologist, and a chemist. | | ✓ | ✓ |
| E. Submittal of an updated engineering report and operations plan. | | ✓ | ✓ |
| 4. For the entire recycled municipal wastewater stream, provide | ✓ | ✓ | ✓ |

| | | | |
|---|---|---|---|
| reverse osmosis treatment as well as subsequent advanced oxidation treatment[6]. The advanced oxidation treatment shall provide, at minimum, a level of treatment equivalent to a 1.2 log NDMA reduction and a 0.5 log 1.4-dioxane reduction. | | | |

(f) If the RMA RWC exceeds its maximum RWC, the GRRP shall:

a. Notify the Department and RWQCB in writing within 7 days of exceedance and,

b. Within 60 days, implement corrective action(s) and submit a report to the Department and RWQCB describing the reason(s) for the exceedance and the corrective action(s) taken to avoid future exceedances.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.045. Total Organic Carbon Requirements

(a) For each surface or subsurface application facility used for replenishing a groundwater basin, the GRRP shall monitor TOC as follows:

(1) For filtered wastewater, unless subsequently treated with reverse osmosis, two 24-hour composite samples a week, taken at least three days apart. Based on the Department's review of the previous 12 months' results, with approval from the Department, monitoring may be reduced to one 24-hour composite sample each week, and

(2) For recycled municipal wastewater, at least one 24-hour composite sample each week prior to recharge, or

(3) For surface application, at least one sample each week in a manner yielding TOC values representative of the recycled municipal wastewater TOC after infiltration and percolation, and not influenced by diluent water, native groundwater, or other source of dilution as determined by:

(A) measuring undiluted percolating recycled municipal wastewater,

(B) measuring diluted percolating recycled municipal wastewater and adjusting the value for the diluent water effect, or

(C) using recharge demonstration studies to develop a soil treatment factor that can be applied weekly to recycled municipal wastewater measurements leaving the treatment plant.

(b) Grab samples may be taken in lieu of the 24-hour composite samples required in subsection (a) if:

(1) the GRRP demonstrates that a grab sample is representative of the water quality throughout a 24-hour period, or

(2) the entire recycled municipal wastewater stream has been treated by reverse osmosis.

[6] The requirement for advanced oxidation for **all** subsurface application GRRPs is under discussion.

(c) Analytical results of the monitoring performed pursuant to subsection (a) shall not exceed the following TOC limits:

(1) For filtered wastewater, 16 mg/L, based on:

(A) two consecutive samples and

(B) the average of the last four results and,

(2) For recycled municipal wastewater or recharge water, with the running monthly average (RMA) RWC determined pursuant to section 60320.041(a),

$$TOC_{max} = \frac{0.5 mg/L}{RWC}$$ , based on:

(A) a 20-week running average of all TOC results and

(B) the average of the last four results.

(d) The $TOC_{max}$ limit specified in subsection (c)(2) may be increased if:

(1) The increased $TOC_{max}$ limit is approved by the Department and RWQCB,

(2) The GRRP has been in operation for the most recent ten consecutive years,

(3) The project sponsor submits a proposal to the Department prepared and signed by an engineer licensed in California and experienced in the fields of wastewater treatment and public water supply. The proposal shall include the following, based on the most recent ten consecutive years of operation:

(A) GRRP operations, monitoring, and compliance data;

(B) Evidence that the GRRP has a history of compliance with the requirements of their RWQCB permit;

(C) Evidence that the water collected at all downgradient drinking water wells and monitoring wells impacted by the GRRP has met all the primary drinking water standards for the parameters specified pursuant to section 60320.070(b)(2);

(D) Analytical or treatment studies requested by the Department to make the determination in subsection (C);

(E) Validation of appropriate construction and siting of monitoring wells pursuant to section 60320.070;

(F) A study defining the water quality changes, including organic carbon characterization, as a result of the impact of the GRRP;

(4) The GRRP has performed a health effects evaluation that assesses the health risks to consumers of water impacted by the GRRP, including any anticipated water quality changes resulting from the proposed increased $TOC_{max}$ limit. The evaluation shall include the following:

(A) An exposure assessment that characterizes the quality of the water consumed and the quantity of contaminants and constituents consumed.

(B) All available human epidemiologic studies of the population that has consumed water impacted by the GRRP.

(C) The results of laboratory animal studies and health risk assessments available in peer-reviewed literature pertaining to water impacted by the GRRP and anticipated water quality changes resulting from the proposed increased $TOC_{max}$, including studies or assessments where extrapolation of data may be relevant.

(D) A health risk assessment of the potential individual and cumulative effects of the regulated contaminants described in section 62320.030 and the constituents monitored pursuant to subsections 60320.047(a) and (c), in a manner that includes;

(1) lifetime risks of cancer and

(2) risks of non-cancer effects.

(E) A report detailing comments, questions, concerns, and conclusions of a review by an independent scientific peer review advisory panel that includes, as a minimum, a toxicologist, an epidemiologist, an engineering geologist or hydrogeologist registered in California, an engineer licensed in California with at least three years of experience in wastewater treatment and public water supply, a microbiologist, and a chemist.

(e) If the GRRP exceeds the limit in (c)(1)(A), (c)(2)(A), or its approved increased $TOC_{max}$ limit obtained pursuant to subsection (d) based on a 20-week running average, the GRRP shall:

(1) immediately suspend the addition of recycled municipal wastewater until at least two consecutive results, 3 days apart, are less than the limit,

(2) notify the Department and RWQCB within 7 days of suspension,

*(3)* revert back to the semi-weekly monitoring in (a)(1), if the GRRP had been approved for reduced monitoring, and

(4) within 60 days, submit a report to the Department and RWQCB describing the reasons for the exceedance and the corrective actions to avoid future exceedances. At a minimum, the corrective actions shall include:

(A) a reduction of RWC sufficient to comply with the limit, and/or

(B) the treatment of the filtered wastewater with reverse osmosis.

(f) If the GRRP exceeds the limit in (c)(1)(B), (c)(2)(B), or its approved increased $TOC_{max}$ limit obtained pursuant to subsection (d) based on the last four results, the GRRP shall, within 60 days, submit a report to the Department and RWQCB describing the reasons for the exceedance and the corrective actions taken to avoid future exceedances.

(g) To use one or more wastewater constituents in lieu of TOC, approval from the Department shall be obtained. At a minimum, the constituent(s) used in lieu of TOC shall (see Endnote 6):

(1) Be quantifiable in the wastewater, recycled municipal wastewater, groundwater, and throughout the treatment processes,

(2) Have identifiable treatment performance standards as protective of public health as the TOC standards in this Chapter.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.047. Additional Constituent Monitoring

(a) Each quarter, the GRRP shall sample and analyze the recycled municipal wastewater and the downgradient monitoring wells specified by the Department for the following (see Endnote 2):

(1) Priority Toxic Pollutants [chemicals listed in the Water Quality Standards, Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California, and 40 CFR Part 131, Federal Register 65(97), May 18, 2000, p. 31682] specified by the Department, based on the Department's review of the GRRP's engineering report;

(2) Chemicals with state notification levels that the Department has specified (see Endnote 3), based on a review of the GRRP engineering report and the affected groundwater basin(s); and

(3) Chemicals that the Department has specified (See Endnote 4), based on a review of the GRRP's engineering report, the affected groundwater basin(s), and the results of the assessment performed pursuant to subparagraph 60320(a)(2)(A).

(b) The GRRP may reduce monitoring for the constituents in (a) to once each year following Department approval based on the Department's review of the results of the monitoring in (a).

(c) Annually, the GRRP shall monitor the recycled municipal wastewater for constituents indicating the presence of municipal wastewater, as specified by the Department (See Endnote 5) based on the following:

(1) a review of the GRRP's engineering report,

(2) the contaminant list developed pursuant to section 60320(a)(2)(D),

(3) the affected groundwater basin(s),

(4) a constituent's ability to characterize the presence of pharmaceuticals, endocrine disrupting chemicals, personal care products, and other indicators of the presence of municipal wastewater, and

(5) the availability of a test method for a constituent.

(d) A constituent detected as a result of monitoring conducted pursuant to this section shall be reported to the Department and RWQCB no later than the quarter following the quarter in which the results are received by the GRRP.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.065. Operation Optimization.

(a) During the first year of operation for new GRRP's, or during the first year of operation after the effective date of this section for existing GRRP's, and at all times thereafter, all treatment processes shall be operated in a manner providing optimal reduction of all contaminants including:

(1) microbial contaminants,

(2) regulated contaminants identified in section 60320.030 and the nitrogen compounds in section 60320.020, and

(3) nonregulated contaminants identified in section 60320.047.

(b) Within six months of optimizing treatment processes pursuant to (a) and anytime thereafter operations are optimized resulting in a change in operation, each GRRP shall update their operations plan to include such changes in operational procedures and submit the operations plan to the Department for review.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.070. Monitoring Between a GRRP and Downgradient Drinking Water Supply Wells.

(a) Prior to operating a GRRP, each GRRP shall site and construct monitoring wells, as follows:

(1) At a location where the GRRP's recharge water has been retained in the saturated zone for 1-3 months but will take at least three months before reaching the nearest domestic water supply well,

(2) At an additional point or points between the surface or subsurface application facility and the nearest downgradient domestic water supply well, and

(3) Such that samples can be obtained independently from each aquifer that will receive water that was recharged by the GRRP.

(b) Monitoring shall be conducted as follows:

(1) Two samples prior to GRRP operation and at least one sample each quarter thereafter, shall be collected at each monitoring well;

(2) Each sample shall be analyzed for TOC, total nitrogen, nitrate, nitrite, the constituents in tables 64449-A and B of section 64449, total coliform bacteria, and any water quality constituents specified by the Department based on the results of the recycled municipal wastewater monitoring conducted pursuant to this chapter; and

(c) Analytical results of monitoring performed pursuant to paragraph (b) shall be reported to the Department and the RWQCB by the GRRP, as follows:

(1) For all chemical analyses completed in a calendar month, the GRRP shall ensure the laboratory submits results no later than the end of the following month using the Electronic Deliverable Format as defined in the Electronic

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Deliverable Format (EDF) Version 1.2i Guidelines & Restrictions dated April 2001 and Data Dictionary dated April 2001.

(2) For any results exceeding an MCL or at anytime coliform bacteria are present, within 48 hours of receiving the results.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

## Section 60320.090. Annual and Five-Year Reporting.

(a) By the date specified in the GRRP's RWQCB permit, the project sponsor shall provide a report to the RWQCB and the Department. Public water systems having downgradient sources potentially affected by the GRRP shall be notified by direct mail of the availability of the report. The report shall be prepared by an engineer licensed in California and experienced in the fields of wastewater treatment and public water supply. The report shall include the following:

(1) A summary of compliance with the applicable monitoring requirements and criteria of this Chapter for the previous calendar year;

(2) For any violations of this Chapter during the previous calendar year;

(A) the date, duration, and nature of the violation

(B) a summary of any corrective actions and/or suspensions of surface or subsurface application of recycled municipal wastewater resulting from a violation

(C) if uncorrected, a schedule for and summary of all remedial actions

(3) Any detections of monitored constituents and any observed trends in the monitoring wells, as well as diluent water supplies,

(4) Information pertaining to the vertical and horizontal migration of the recharge water plume,

(5) A description of any changes in the operation of any unit processes or facilities,

(6) A description of any anticipated changes, along with an evaluation of the expected impact of the changes on subsequent unit processes, and

(7) The estimated quantity and quality of the recycled municipal wastewater and diluent water to be utilized for the next twelve months.

(b) Every five years from the date of the initial approval the engineering report required pursuant to section 60323, the project sponsor shall update the report to address any project changes and submit the report to the RWQCB and the Department. The update shall include, but not be limited to:

(1) Anticipated RWC increases, a description of how the RWC requirements in section 60320.041 will be met, and the expected impact the increase will have on the GRRP's ability to meet the requirements of this Chapter,

(2) Evidence that the minimum retention time requirement in subsection 60320.010(c) has been met, and

(3) A description of any inconsistencies between previous groundwater model predictions and the observed and/or measured values, as well as a description of how subsequent predictions will be accurately determined.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

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# ARTICLE 7. ENGINEERING REPORT AND OPERATIONAL REQUIREMENTS

## Section 60323[7]. Engineering Report

(a) No person shall produce or supply ~~reclaimed water~~recycled municipal wastewater for direct reuse from a ~~proposed~~ water reclamation plant ~~unless he files an~~ without a Department approved engineering report.

(b) The report shall be prepared by a properly qualified engineer ~~registered~~ licensed in California and experienced in the field of wastewater treatment, and shall contain a description of the design of the proposed reclamation system. The report shall clearly indicate the means for compliance with these regulations and any other features specified by the regulatory agency.

(c) The report shall contain a contingency plan which will assure that no untreated or inadequately treated wastewater will be delivered to the use area.

NOTE: Authority cited: Section 100275, Health and Safety Code and Section 13521, Water Code. Reference: Section 13520, Water Code.

[7] Section 60320 is an existing section. The text reflects the proposed amendments.

## Endnotes for Draft Groundwater Recharge Reuse Regulations

These Endnotes accompany the draft recharge regulations currently being developed by the California Department of Public Health's Drinking Water Program, *but are not expected to be part of the proposed regulatory package*. The draft recharge regulations address the supplementation of groundwater by surface or subsurface application of treated municipal wastewater prior to eventual extraction via drinking water wells for potable use.

The latest draft is here:

http://www.cdph.ca.gov/healthinfo/environhealth/water/Pages/Waterrecycling.aspx

### ENDNOTE 1.

### §60320.030. Control of Regulated Chemicals and Physical Characteristics

Examples of contaminants whose MCL compliance is not based on a running annual average include; nitrate, nitrite, and perchlorate.

### ENDNOTE 2.

### §60320.047. Additional Constituent Monitoring

### Analytical Methods for Unregulated Chemicals

Subsection (a) states that the GRRP shall conduct the following and report any detections.

Some of the chemicals will have analytical methods that are available. Some may not.

CDPH views the use of drinking water methods as most appropriate, since they are generally more sensitive than wastewater methods. However, this may not always be possible, since there may be characteristics of the wastewater (e.g., high total dissolved solids) that may make the use of drinking water methods difficult.

GRRPs should select methods for non-regulated chemicals according to the following approach.

1. Use CDPH-approved drinking water methods, when available.

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2. Use CDPH-recommended methods for chemicals if no CDPH-approved drinking water method is available (e.g., 1,2,3-TCP).

3. If there is no CDPH-recommended drinking water method for a chemical, and more than a single EPA-approved method is available, consult with CDPH to determine the appropriate EPA-approved method.

4. If there is no EPA-approved method for a chemical, and more than one method is available from the scientific literature (e.g., peer-reviewed journals), consult with CDPH to determine an appropriate method.

5. If no approved method is available for a specific chemical, the GRRP's laboratory may develop or use its own methods and should provide the analytical methods to CDPH for review.

6. If the only method available for a chemical is for wastewater analysis (e.g., a chemical listed as a priority pollutant only), sample and analyze for that chemical in the treated wastewater immediately prior to reverse osmosis treatment to increase the likelihood of detection. Use this approach until the GRRP's laboratory develops a method for the chemical in drinking water, or until a CDPH-approved or -recommended or EPA-approved drinking water method is available.

7. If no method is available for a specific contaminant, as may be the case for certain endocrine disrupting chemicals, pharmaceuticals, personal care products, or other chemicals indicating the presence of wastewater (see Endnote 5), the GRRP should propose an alternative contaminant that might be used as an indicator or surrogate for the contaminant of interest, or an alternate sampling program that addresses the contaminant of concern, or the category of the contaminant of concern.

**ENDNOTE 3.**

**§60320.047. Additional Constituent Monitoring**

**Selected chemicals with CDPH notification levels for possible analysis.**

Paragraph (a)(2) refers to chemicals with state notification levels that CDPH has specified. These chemicals are selected from CDPH's chemicals with notification levels; chemicals already included in analysis required under other subsections are not included here.

These chemicals have either been detected at least once in drinking water supplies over the past few years, or if not detected, they are of interest for some specific reason [e.g., formaldehyde is of interest because in may be a byproduct

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of certain treatment processes]. These would likely include boron, chlorate, 1,4-dioxane, formaldehyde, N-nitrosodimethylamine (NDMA), 1,2,3-trichloropropane, and vanadium.

**ENDNOTE 4.**

**§60320.047. Additional Constituent Monitoring**

**Additional chemicals for analysis**

Paragraph (a)(3) refers to other chemicals that CDPH has specified. These chemicals would likely include: chromium-6, diazinon, and nitrosamines for which US EPA has developed analytical methods.

**ENDNOTE 5.**

**§60320.047. Additional Constituent Monitoring**

**Pharmaceuticals, endocrine disruptors, and other wastewater indicator chemicals**

Subsection (c) refers to pharmaceuticals, endocrine disruptors and other indicators of the presence of municipal wastewater as specified by CDPH.

CDPH is interested in collecting information that relates to the presence of the listed categories of contaminants in municipal wastewater that may be found in recycled municipal wastewater.

The specific contaminants targeted for monitoring will likely vary among GRRPs, depending on their individual engineering reports and characteristics of their groundwater basins, as well as the GRRP's efforts that have been taken to address the presence of endocrine disrupting chemicals, pharmaceuticals, and personal care products in recycled municipal wastewater, and its efforts to assure that their presence in recycled municipal wastewater is at levels that are protective of the public health.

Monitoring for these chemicals—or categories of chemicals—is a diligent way of assessing and verifying recycled municipal wastewater quality characteristics, which can be useful in addressing issues of public perception about the safety of recharge projects.

Further, should there be positive findings of these types of chemicals, the recharge agency and CDPH can give the result due consideration as to whether it is of concern or not. Just what such consideration might entail would depend on

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what is known and what is not known about the particular chemical, including its potential health effects at the given concentration, the source of the chemical, as well as possible means of better control to limit its presence, treatment strategies if necessary, and other appropriate actions.
Such monitoring is not for compliance purposes, but for informational use only.

If a GRRP has additional reports for its own project using prior data that address the types of chemicals discussed in this Endnote, or reports for its own project addressing the effectiveness of the treatment processes in limiting the release of endocrine disruptors, pharmaceuticals, or personal care chemicals into recharge water, those reports should be made available to CDPH to assist in developing an approach that would build upon or supplement the already available information.

A GRRP that has little monitoring information should plan on collecting more analytical data related to endocrine disrupting chemicals, pharmaceuticals, personal care products and other chemicals that are indicators of wastewater in its recharge water.

A GRRP that can demonstrate a history of sampling, analysis, and related research—as well as an on-going program of monitoring and research—on endocrine disrupting chemicals, pharmaceuticals and personal care products, or appropriate indicator or surrogate chemicals in its recharge water will likely be encouraged to continue its research efforts, and likely have no contaminants specified by CDPH for analysis under this section.

GRRPs will not be required to conduct an ongoing monitoring program for contaminants under this section, unless good indicator or surrogate chemicals can be identified through this monitoring, and analytical methods are available to perform that monitoring.

Depending on the results of analyses and other information discussed above, required monitoring may be of short duration (e.g., twice a year for two or three years). If good indicator or surrogate chemicals with available analytical methods can be identified, requirements for their monitoring will be considered. This notwithstanding, CDPH recommends an ongoing monitoring program to address public concerns about the presence in wastewater about these types of chemicals.

A monitoring program could include sampling and analysis for representatives of these categories of contaminants (including surrogates or specific chemicals indicators):

- Hormones. CDPH at this time does not recommend specific chemicals. However, GRRPs should investigate chemicals that could represent either female or male hormones, or surrogates that could represent both.

• "Industrial" endocrine disruptors: CDPH at this time does not recommend specific chemicals. However, GRRPs should investigate chemicals such as bisphenol A, nonylphenol and nonylphenol polyethoxylates, octylphenol and octylphenol polyethoxylates, and polybrominated diphenyl ethers, or surrogates that could represent one or more industrial endocrine disruptors.

• Pharmaceuticals: CDPH at this time does not recommend specific chemicals. However, GRRPs should investigate chemicals such as acetaminophen, amoxicillin, azithromycin, carbamazepine, ciprofloxacin, dilantin, gemfibrozil, ibuprofen, lipitor, meprobamate, sulfamethoxazole, trimethoprin, and salicylic acid, or surrogates that could represent one or more pharmaceuticals.

• Personal Care Products: CDPH at this time does not recommend specific chemicals. However, GRRPs should investigate chemicals such triclosan and DEET, or surrogates that could represent one or more personal care products.

• Other chemicals that may suggest the presence of wastewater: CDPH at this time does not recommend specific chemicals. However, GRRPs should investigate chemicals such as caffeine, iodinated contrast media, fire retardants such as TCEP, or surrogates that could represent one or more chemicals that suggest the presence of wastewater.

There are no drinking water standards for the contaminants listed above and no standards are anticipated. In addition, analytical methods may not be widely available (See Endnote 2).

**ENDNOTE 6.**

**Alternatives to Using TOC**

The current draft proposes that GRRPs interested in using an alternative wastewater constituent or constituents in lieu of TOC must demonstrate that the alternative proposed is quantifiable in the wastewater, recycled municipal wastewater, groundwater, and throughout the treatment processes. Further, the alternative must have identifiable treatment performance standards and an overall demonstration that it provides the same level of public health protection as the TOC requirement.

A GRRP that can demonstrate a history of sampling, analysis, and related research to support the use of alternatives should provide this information to CDPH when proposing an alternative.

One alternative that has been suggested to CDPH for consideration is the use of Biodegradable Dissolved Organic Carbon (BDOC) in concert with specific chemical indicators to assure proper removal of unregulated wastewater-derived organics for surface application projects. In this case, indicators are defined as individual compounds occurring at quantifiable levels that can represent certain physical, chemical and biological characteristics that are relevant to fate and transport during treatment (where treatment includes wastewater and soil aquifer treatment (SAT)). BDOC is a measure of dissolved biodegradable organic matter that is consumed or otherwise altered by indigenous bacterial populations. The use of BDOC by measuring differential (delta) TOC (i.e., the differences between recycled municipal wastewater TOC and before and after transport through the soil column) and specific chemical indicators may be able to serve as a surrogate for the absence of biodegradable organic compounds that are not derived from humic (i.e., soil) substances.

The use of BDOC/indicators would likely consist of a number of elements, including the following:

1. For each project, prior to start-up,

    A. The GRRP will select a set of indicator compounds for approval by CDPH that can be reliably measured by approved laboratory methods in recycled municipal wastewater and groundwater that also reflect good and poor removal via SAT. For purposes of this section, "good" is >90 percent, and "poor" is <25 percent removal.

    B. The GRRP will identify the laboratory or laboratories that will be used for BDOC analyses and the federal or state approved or recommended methods that will be used for those analyses. If no approved or recommended method is available for determining BDOC, the GRRP's laboratory may develop or use its own methods and should provide the analytical methods to CDPH for review. Those methods may be used until federal or state approved or recommended methods are available. Where multiple analytical methods exist, the more sensitive method should be used (i.e., that which can measure indicator compounds at a lower concentration).

    C. The GRRP will validate the presence of the proposed indicators in the recycled municipal wastewater, and would also collect baseline data from the project's monitoring wells. The selected indicators and baseline data will be presented in the GRRP's Engineering Report.

    D. The GRRP will establish baseline information on BDOC and TOC in recycled municipal wastewater and groundwater monitoring wells.

The GRRP will also characterize expected SAT performance by conducting batch soil column tests with recycled municipal wastewater and measuring BDOC and delta TOC. This information will be provided in the GRRP's Engineering Report.

2. During start-up, the GRRP, through frequent monitoring and analysis, will validate the expected BDOC performance, delta TOC, and indicator removal performance. If BDOC performs as expected, the delta TOC can serve as the routine parameter that is monitored to validate that the expected biodegradation is occurring, along with the selected indicators, provided that the GRRP also monitors TOC consistent with the regulations for a specific time period established by CDPH and designated in its permit.

3. During routine operation, the GRRP would use delta TOC and the indicators to validate performance of the project. In parallel, the GRRP will also monitor TOC consistent with the regulations for a specific time period established by CDPH, and designated in its permit. This will enable the GRRP to demonstrate the suitability of its alternative approach.

4. The RWC will initially be set at 20%, or some other value, as determined in its permit. The GRRP may be allowed to increase the RWC up to 50% in a phased manner over time (such as five years) as long as BDOC and indicator performance are the same as the performance observed at the 20% or initial RWC. At each increased step, the GRRP will also monitor TOC consistent with the regulations for a specific time period established by CDPH, and designated in its permit.

5. If the BDOC in any monitoring well associated with the GRRP or the indicators begin to perform differently than as observed during startup or previous monitoring events, then a GRRP would have to evaluate its project for the cause and adjust the RWC downward. The GRRP will also monitor TOC consistent with the regulations.

6. As part of the proposal to CDPH, the GRRP will convene an expert panel to provide feedback to CDPH on the proposed approach and, if the proposal is accepted, to meet periodically to provide feedback on its performance and adequacy of BDOC monitoring.

7. Indicator compounds selected will be re-evaluated by the expert panel and by CDPH for continued relevance by the GRRP annually.

## ENDNOTE 7. Table summarizing text of Section 60320.020 (Control of Nitrogen Compounds)*

| | Method 1 | Method 2 | Method 3 |
|---|---|---|---|
| Compliance point and monitoring | • Anywhere representative of recycled municipal wastewater or recharge water (i.e. including in or above the mound)<br>• Samples analyzed for total nitrogen<br>• Reduced monitoring available | • Anywhere representative of recycled municipal wastewater or recharge water. (i.e. prior to surface or subsurface application or from within a mound or vadose zone prior to reaching the GW table)<br>• Samples analyzed for total nitrogen, nitrate, nitrite, ammonia, organic nitrogen, DO, and BOD<br>• A groundwater sample analyzed for DO<br>• Reduced monitoring available | • Only for projects in operation for ≥ 20 years<br>• Groundwater downgradient of the recharge area<br>• Samples analyzed for nitrate and nitrite |
| Standard(s) | • 5 mg/L total N as an average | • 10 mg/L total nitrogen and<br>• Limits established in the engineering report for other constituents | MCLs for nitrate and nitrite |
| Frequency of sampling | 2 per week | As established by CDPH and specified in the operations plan | • Specified in the engineering report and operations plan.<br>• Relatively frequent monitoring at locations between the recharge area and downgradient domestic wells is required. |
| Consequence of failure | • Investigate, correct, and notify if the average of two consecutive samples >5 mg/L<br>• Suspend application of recycled municipal wastewater if the 4-week average of all samples >5 mg/L | • Investigate, correct, and notify if the average of two consecutive samples >10 mg/L total nitrogen standard or exceeds standard for other constituents<br>• Suspend surface and subsurface application of recycled municipal wastewater until the average of two consecutive samples meets all limits | • Notify the Department and RWQCB if > MCLs<br>• Suspend surface and subsurface application unless demonstrated that the groundwater no longer exceeds the MCLs. |
| Rationale | Method 1 relies on such a low limit for the total N in the recycled municipal wastewater that the chance that the $NO_2$ or $NO_3$ MCL could be exceeded is minute. | Method 2 relies on:<br>1. A low enough limit for the total N in the recycled municipal wastewater that the chance that a $NO_2$ or $NO_3$ MCL could be exceeded is low, combined with<br>2. A set of limits determined for a specific GRRP and explained in the Engineering Report for nitrite, organic nitrogen and/or ammonia necessary to limit oxidation to $NO_2$ or $NO_3$, and a set of minimum levels for an excess DO over BOD requirement in the recycled municipal wastewater and/or a DO requirement in the groundwater as necessary to prevent reduction of $NO_3$ to $NO_2$ | Method 3 relies on:<br>1. A demonstration that historic recharge with water containing comparable levels of nitrogen has not caused a problem,<br>2. Evidence that recharge water can be tracked and monitored throughout the flow path, and<br>3. Monitoring to show that the MCLs for $NO_2$ and $NO_3$ are met in the groundwater. |

*Note: This table provides a *summary* of the regulatory requirements and is not intended to be comprehensive.



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# APPENDIX B – GRRP APPROVAL STEPS

From Jim Crooke

**Potable Reuse Project Sequence of events for Approval**

Prepare Engineering Report (details of proposed project)

Submit Engineering Report to CDPH, RWQCB, and County Health Agency for review

CDPH, RWQCB, and County Health agency review Engineering Report and request changes, additional information, etc.

CDPH accepts Engineering Report (usually after revisions by the project proponent)

Notice of Public Hearing released at least 30 days before scheduled hearing date

CDPH person is hearing officer at public hearing

Proponent prepares document for CDPH signature that includes a Summary of Public Hearing, Findings of Fact, and Conditions

- Findings of Fact includes all necessary details of proposed project

- Conditions include specific CDPH regulatory requirements for project that conform to draft groundwater recharge regulations

CDPH approves Summary of Public Hearing, Findings of Fact, and Conditions (usually after several revisions)

CDPH sends a letter to the RWQCB stating that the project complies with all CDPH requirements and recommends that the RWQCB incorporate all of the Findings of Fact and Conditions (which are appended to the letter) into the proponent's waste discharge requirements

RWQCB approves Findings of Fact and includes them in the proponent's permit

Total time if starting from scratch is at least 1 year (likely longer, e.g., 2 years) not counting a demonstration study of proposed treatment train, which is not required but is recommended

jc: 072909

# APPENDIX C – FRESNO POTENTIAL CUSTOMERS

Potential Recycled Water Irrigation Customers

| Customer Name | Water Zone | Customer Type | Customer ID | Parcel Acres | Estimated Irrigable Acres [1] | Estimated Irrigation Usage [2] (AFY) | Max Month Demand [3] (AFY) | Max Day Demand [4] (AFY) | Peak Hour Demand [5] (AFY) |
|---|---|---|---|---|---|---|---|---|---|
| **Clovis Quadrant** | | | | | | | | | |
| Clovis | Clovis | School | C-1 | 49.74 | 29.84 | 80.15 | 191 | 246.5 | 745.6 |
| Buchanan | Clovis | School | C-2 | 87.14 | 52.29 | 140.42 | 335 | 435.4 | 1306.3 |
| Cemetery | Clovis | Cemetery | C-3 | 9.10 | 8.64 | 23.21 | 55 | 72.0 | 216.0 |
| **Northeast Quadrant** | | | | | | | | | |
| Carter G. Woodson Public Charter School | Northeast | School | NE-3 | 1.30 | 0.78 | 2.10 | 5 | 6.5 | 19.5 |
| Fresno Prep Academy | Northeast | School | NE-12 | 4.17 | 2.50 | 6.72 | 16 | 20.8 | 62.5 |
| Willow International Center | Northeast | School | | 66.79 | 40.08 | 107.63 | 257 | 333.7 | 1001.2 |
| Copper River Country Club | Northeast | Golf Course | NE-49 | 720.13 | 684.13 | 1837.28 | 4,382 | 5697.2 | 17091.7 |
| Fort Washington Country Club | Northeast | Golf Course | NE-48 | 130.36 | 123.85 | 332.60 | 793 | 1031.4 | 3094.1 |
| Woodward Lakes | Northeast | Lake | NE-50 | 48.14 | 48.14 | 129.28 | 308 | 400.9 | 1202.7 |
| Belcher | Northeast | Park | NE-56 | 5.49 | 5.21 | 14.00 | 33 | 43.4 | 130.2 |
| Cary | Northeast | Park | NE-62 | 8.80 | 8.36 | 22.44 | 54 | 69.6 | 208.8 |
| East Rotary | Northeast | Park | NE-53 | 4.19 | 3.98 | 10.68 | 25 | 33.1 | 99.4 |
| Einstein | Northeast | Park | NE-59 | 7.88 | 7.49 | 20.10 | 48 | 62.3 | 187.0 |
| El Dorado | Northeast | Park | NE-57 | 5.63 | 5.35 | 14.36 | 34 | 44.5 | 133.6 |
| Kaiser | Northeast | Park | NE-54 | 4.70 | 0.71 | 1.89 | 5 | 5.9 | 17.6 |
| Keith Tice | Northeast | Park | NE-52 | 4.06 | 0.61 | 1.64 | 4 | 5.1 | 15.2 |
| Large | Northeast | Park | NE-58 | 6.05 | 5.75 | 15.44 | 37 | 47.9 | 143.7 |
| Layne | Northeast | Park | NE-61 | 8.66 | 8.23 | 22.10 | 53 | 68.5 | 205.6 |
| Manchester | Northeast | Park | NE-63 | 9.49 | 9.02 | 12.11 | 29 | 37.5 | 112.6 |
| Robinson | Northeast | Park | NE-55 | 4.77 | 4.53 | 12.17 | 29 | 37.7 | 113.2 |
| Rotary West | Northeast | Park | NE-64 | 14.23 | 13.52 | 36.30 | 87 | 112.6 | 337.7 |
| University | Northeast | Park | NE-51 | 2.37 | 2.25 | 6.05 | 14 | 18.8 | 56.3 |
| Vinland | Northeast | Park | NE-60 | 8.09 | 7.68 | 20.63 | 49 | 64.0 | 191.9 |
| Woodward Regional | Northeast | Park | NE-65 | 285.71 | 271.42 | 728.92 | 1,739 | 2260.3 | 6781.0 |
| Calvary Chapel Christian | Northeast | School | NE-9 | 2.66 | 1.60 | 4.29 | 10 | 13.3 | 39.9 |
| Carden School of Fresno | Northeast | School | NE-40 | 19.60 | 11.76 | 31.58 | 75 | 97.9 | 293.8 |
| Central Valley Christian Academy | Northeast | School | NE-14 | 6.15 | 3.69 | 9.91 | 24 | 30.7 | 92.2 |
| First Church Christian Academy | Northeast | School | NE-11 | 3.27 | 1.96 | 5.28 | 13 | 16.4 | 49.1 |
| Fresno Christian Schools | Northeast | School | NE-8 | 2.24 | 1.34 | 3.60 | 9 | 11.2 | 33.5 |
| La Petite Academy | Northeast | School | NE-5 | 0.71 | 0.43 | 1.15 | 3 | 3.6 | 10.7 |
| Mountain View Christian | Northeast | School | NE-13 | 4.59 | 2.75 | 7.39 | 18 | 22.9 | 68.8 |
| Northpointe Christian Leadership Academy | Northeast | School | NE-36 | 18.04 | 10.82 | 29.07 | 69 | 90.1 | 270.4 |
| Reaching Potentials Educational Institute | Northeast | School | NE-2 | 0.22 | 0.13 | 0.36 | 1 | 1.1 | 3.3 |
| Sierra View Christian Academy | Northeast | School | NE-1 | 0.17 | 0.10 | 0.27 | 1 | 0.8 | 2.5 |
| Truth Tabernacle Christian | Northeast | School | NE-10 | 2.88 | 1.73 | 4.65 | 11 | 14.4 | 43.2 |
| Ahwahnee Middle School | Northeast | School | NE-34 | 16.67 | 10.00 | 26.86 | 64 | 83.3 | 249.8 |
| Centennial Elementary School | Northeast | School | NE-15 | 7.80 | 4.68 | 12.57 | 30 | 39.0 | 116.9 |
| Clovis North | Northeast | School | | 38.15 | 22.89 | 61.47 | 147 | 190.6 | 571.8 |
| Clovis North - Middle School | Northeast | School | | 58.67 | 35.20 | 94.54 | 226 | 293.2 | 879.5 |
| Clovis West High School | Northeast | School | NE-44 | 56.41 | 33.85 | 90.90 | 217 | 281.9 | 845.6 |
| Copper Hills Elementary School | Northeast | School | NE-31 | 16.38 | 9.83 | 26.39 | 63 | 81.8 | 245.5 |
| Eaton Elementary School | Northeast | School | NE-21 | 9.02 | 5.41 | 14.54 | 35 | 45.1 | 135.3 |
| Erma Duncan Polytechnical High School | Northeast | School | NE-35 | 16.98 | 10.19 | 27.36 | 65 | 84.9 | 254.6 |
| Fort Washington Elementary School | Northeast | School | NE-37 | 18.35 | 11.01 | 29.57 | 71 | 91.7 | 275.1 |
| Herbert Hoover High School | Northeast | School | NE-43 | 46.60 | 27.96 | 75.09 | 179 | 232.9 | 698.6 |
| Holland Elementary School | Northeast | School | NE-20 | 8.70 | 5.22 | 14.03 | 33 | 43.5 | 130.5 |
| James S. Fugman Elementary School | Northeast | School | NE-33 | 16.50 | 9.90 | 26.58 | 63 | 82.4 | 247.3 |
| Kastner Intermediate School | Northeast | School | NE-38 | 18.67 | 11.20 | 30.09 | 72 | 93.3 | 279.9 |
| Liberty Elementary School | Northeast | School | NE-29 | 14.99 | 8.99 | 24.16 | 58 | 74.9 | 224.7 |
| Lincoln Elementary School | Northeast | School | NE-41 | 34.71 | 20.83 | 55.93 | 133 | 173.4 | 520.3 |
| Manchester Gate | Northeast | School | NE-16 | 8.03 | 4.82 | 12.95 | 31 | 40.1 | 120.4 |
| Maple Creek Elementary School | Northeast | School | NE-30 | 15.94 | 9.57 | 25.69 | 61 | 79.7 | 239.0 |
| McCardle Elementary School | Northeast | School | NE-18 | 8.33 | 5.00 | 13.43 | 32 | 41.6 | 124.9 |
| Mountain View Elementary School | Northeast | School | NE-28 | 14.55 | 8.73 | 23.45 | 56 | 72.7 | 218.1 |
| Pyle Elementary School | Northeast | School | NE-22 | 9.08 | 5.45 | 14.63 | 35 | 45.4 | 136.1 |
| Riverview Elementary School | Northeast | School | NE-32 | 16.49 | 9.89 | 26.56 | 63 | 82.4 | 247.1 |
| Robinson Elementary School | Northeast | School | NE-23 | 9.21 | 5.53 | 14.84 | 35 | 46.0 | 138.0 |
| Thomas Elementary School | Northeast | School | NE-19 | 8.68 | 5.21 | 13.99 | 33 | 43.4 | 130.1 |
| Tioga Middle School | Northeast | School | NE-39 | 19.06 | 11.43 | 30.70 | 73 | 95.2 | 285.6 |
| Valley Oak Elementary School | Northeast | School | NE-27 | 14.01 | 8.41 | 22.57 | 54 | 70.0 | 210.0 |
| Viking Elementary School | Northeast | School | NE-26 | 10.91 | 6.55 | 17.59 | 42 | 54.5 | 163.6 |
| Vinland Elementary School | Northeast | School | NE-24 | 9.27 | 5.56 | 14.93 | 36 | 46.3 | 138.9 |
| Wolters Elementary School | Northeast | School | NE-25 | 9.89 | 5.94 | 15.94 | 38 | 49.4 | 148.3 |
| Ashlan Park Christian School | Northeast | School | NE-7 | 2.17 | 1.30 | 3.49 | 8 | 10.8 | 32.5 |
| Fresno Christian School | Northeast | School | NE-4 | 2.12 | 0.32 | 0.86 | 2 | 2.7 | 8.0 |
| Fresno Montesori School | Northeast | School | NE-17 | 8.19 | 4.92 | 13.20 | 31 | 40.9 | 122.8 |
| **Northwest Quadrant** | | | | | | | | | |
| Crescent View Charter High School | Northwest | School | NW-39 | 27.61 | 16.56 | 44.48 | 106 | 137.9 | 413.8 |
| KIPP Academy Fresno | Northwest | School | NW-3 | 0.70 | 0.42 | 1.13 | 3 | 3.5 | 10.5 |
| Valley Preparatory Academy | Northwest | School | NW-6 | 2.22 | 1.33 | 3.58 | 9 | 11.1 | 33.3 |
| Fig Garden Golf Course | Northwest | Golf Course | NW-44 | 133.26 | 126.59 | 339.98 | 811 | 1054.2 | 3162.7 |
| Islewood Golf Course | Northwest | Golf Course | NW-42 | 48.91 | 46.47 | 124.79 | 298 | 387.0 | 1160.9 |
| San Joaquin Country Club | Northwest | Golf Course | NW-43 | 127.80 | 121.41 | 326.05 | 778 | 1011.1 | 3033.2 |
| Lake Van Ness | Northwest | Lake | NW-45 | 28.83 | 28.83 | 77.43 | 185 | 240.1 | 720.3 |
| Dante-Alluvial | Northwest | Park | NW-54 | 6.82 | 6.48 | 17.40 | 42 | 54.0 | 161.9 |
| Dog | Northwest | Park | NW-50 | 2.37 | 2.25 | 6.04 | 14 | 18.7 | 56.2 |
| Forkner | Northwest | Park | NW-55 | 7.03 | 6.67 | 17.92 | 43 | 55.6 | 166.7 |
| Grannys' | Northwest | Park | NW-46 | 1.08 | 1.03 | 2.76 | 7 | 8.5 | 25.6 |
| Highway City | Northwest | Park | NW-49 | 2.03 | 1.92 | 5.17 | 12 | 16.0 | 48.1 |
| Holman | Northwest | Park | NW-52 | 4.58 | 4.35 | 11.67 | 28 | 36.2 | 108.6 |
| Lions | Northwest | Park | NW-57 | 8.56 | 8.13 | 21.84 | 52 | 67.7 | 203.2 |
| Logan | Northwest | Park | NW-58 | 9.02 | 8.57 | 23.01 | 55 | 71.4 | 214.1 |
| Oso de Oro | Northwest | Park | NW-51 | 3.99 | 3.79 | 10.18 | 24 | 31.6 | 94.7 |
| Pinedale | Northwest | Park | NW-48 | 1.64 | 1.56 | 4.18 | 10 | 13.0 | 38.9 |
| Quigley | Northwest | Park | NW-56 | 8.22 | 7.81 | 20.97 | 50 | 65.0 | 195.1 |
| Riverbottom | Northwest | Park | NW-59 | 41.79 | 39.70 | 106.61 | 254 | 330.6 | 991.8 |
| Riverpark | Northwest | Park | NW-60 | 123.02 | 116.87 | 313.86 | 749 | 973.3 | 2919.8 |
| Spano | Northwest | Park | NW-47 | 1.12 | 1.07 | 2.87 | 7 | 8.9 | 26.7 |
| Stallion | Northwest | Park | NW-53 | 5.68 | 5.40 | 14.49 | 35 | 44.9 | 134.8 |
| Fairmont Preschool and Kindergarten | Northwest | School | NW-1 | 0.36 | 0.21 | 0.57 | 1 | 1.8 | 5.3 |
| Pathfinders Institute | Northwest | School | NW-7 | 3.85 | 2.31 | 6.21 | 15 | 19.3 | 57.8 |
| Souls Harbor Christian Academy | Northwest | School | NW-2 | 0.44 | 0.26 | 0.71 | 2 | 2.2 | 6.6 |
| St. Anthony | Northwest | School | NW-15 | 8.69 | 5.22 | 25.16 | 58 | 57.8 | 57.8 |
| World Harvest Christian Academy | Northwest | School | NW-29 | 13.50 | 8.10 | 21.75 | 52 | 67.4 | 202.3 |
| Baird Middle School | Northwest | School | NW-19 | 9.39 | 5.63 | 15.13 | 36 | 46.9 | 140.8 |
| Bullard High School | Northwest | School | NW-41 | 48.41 | 29.05 | 78.00 | 186 | 241.9 | 725.7 |
| Bullard Talent Project | Northwest | School | NW-21 | 9.62 | 5.77 | 15.51 | 37 | 48.1 | 144.3 |
| Central High East Campus | Northwest | School | NW-40 | 46.95 | 28.17 | 75.65 | 180 | 234.6 | 703.8 |

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|---|---|---|---|---|---|---|---|---|---|
| Cooper Middle School | Northwest | School | NW-32 | 16.54 | 9.92 | 26.65 | 64 | 82.6 | 247.9 |
| Del Mar Elementary School | Northwest | School | NW-13 | 8.37 | 5.02 | 13.48 | 32 | 41.8 | 125.4 |
| Figarden Elementary School | Northwest | School | NW-28 | 12.15 | 7.29 | 19.58 | 47 | 60.7 | 182.2 |
| Florence E. Rata | Northwest | School | NW-10 | 6.66 | 3.99 | 10.73 | 26 | 33.3 | 99.6 |
| Forkner Elementary School | Northwest | School | NW-25 | 10.60 | 6.36 | 17.08 | 41 | 52.9 | 158.8 |
| Fort Miller Middle School | Northwest | School | NW-34 | 17.81 | 10.69 | 28.70 | 68 | 89.0 | 267.0 |
| Gibson Elementary School | Northwest | School | NW-9 | 6.28 | 3.77 | 10.13 | 24 | 31.4 | 94.2 |
| Herndon-Barstow Elementary School | Northwest | School | NW-27 | 11.24 | 6.75 | 18.12 | 43 | 56.2 | 168.5 |
| John Steinbeck Elementary School | Northwest | School | NW-36 | 19.31 | 11.58 | 31.11 | 74 | 96.5 | 289.4 |
| Kratt Elementary School | Northwest | School | NW-16 | 8.78 | 5.27 | 14.14 | 34 | 43.8 | 131.5 |
| Lawless Elementary School | Northwest | School | NW-17 | 8.80 | 5.28 | 14.18 | 34 | 44.0 | 131.9 |
| Malloch Elementary School | Northwest | School | NW-12 | 8.27 | 4.96 | 13.32 | 32 | 41.3 | 123.9 |
| Nelson Elementary School | Northwest | School | NW-33 | 16.71 | 10.02 | 26.92 | 64 | 83.5 | 250.4 |
| New Horizon High School | Northwest | School | NW-4 | 1.62 | 0.97 | 2.61 | 6 | 8.1 | 24.3 |
| Norman Liddell Elementary School | Northwest | School | NW-22 | 9.67 | 5.80 | 15.59 | 37 | 48.3 | 145.0 |
| Phoenix Elementary Academy Community D | Northwest | School | NW-5 | 1.81 | 1.08 | 2.91 | 7 | 9.0 | 27.1 |
| Pinedale Elementary School | Northwest | School | NW-24 | 10.50 | 6.30 | 16.92 | 40 | 52.5 | 157.4 |
| Powers-Ginsburg Elementary School | Northwest | School | NW-26 | 10.62 | 6.37 | 17.12 | 41 | 53.1 | 159.3 |
| Rio Vista Middle School | Northwest | School | NW-38 | 27.13 | 16.28 | 43.72 | 104 | 135.6 | 406.7 |
| River Bluff Elementary School | Northwest | School | NW-30 | 13.85 | 8.31 | 22.31 | 53 | 69.2 | 207.5 |
| Roeding Elementary School | Northwest | School | NW-11 | 7.63 | 4.58 | 12.29 | 29 | 38.1 | 114.4 |
| Slater Elementary School | Northwest | School | NW-23 | 10.24 | 6.15 | 16.50 | 39 | 51.2 | 153.5 |
| Starr Elementary School | Northwest | School | NW-20 | 9.51 | 5.71 | 15.33 | 37 | 47.5 | 142.6 |
| Teague Elementary School | Northwest | School | NW-37 | 24.31 | 14.58 | 39.17 | 93 | 121.5 | 364.4 |
| Tenaya Middle School | Northwest | School | NW-31 | 15.28 | 9.17 | 24.63 | 59 | 76.4 | 229.1 |
| Wawona Middle School | Northwest | School | NW-35 | 18.28 | 10.97 | 29.46 | 70 | 91.3 | 274.0 |
| William Saroyan Elementary School | Northwest | School | NW-18 | 8.94 | 5.36 | 14.40 | 34 | 44.7 | 134.0 |
| Wilson Elementary School | Northwest | School | NW-14 | 8.54 | 5.12 | 13.76 | 33 | 42.7 | 128.0 |
| Northwest Elementary School | Northwest | School | NW-8 | 5.93 | 3.56 | 9.55 | 23 | 29.6 | 88.9 |
| **Southeast Quadrant** | | | | | | | | | |
| FYI Airport | Southeast | Airport | SE-36 | 842.54 | 210.63 | 565.68 | 1,349 | 1754.1 | 5262.3 |
| Sierra Charter School | Southeast | School | SE-4 | 1.73 | 1.04 | 2.79 | 7 | 8.6 | 25.9 |
| Belmont Country Club | Southeast | Golf Course | SE-39 | 109.36 | 103.89 | 279.01 | 666 | 865.2 | 2595.6 |
| Hanks Par 3 Golf Course | Southeast | Golf Course | SE-37 | 24.48 | 23.26 | 62.47 | 149 | 193.7 | 581.1 |
| Sunnyside Country Club | Southeast | Golf Course | SE-40 | 136.65 | 129.82 | 348.65 | 832 | 1081.1 | 3243.4 |
| Village Green Golf Course | Southeast | Golf Course | SE-38 | 45.99 | 43.69 | 117.33 | 280 | 363.8 | 1091.5 |
| Airways | Southeast | Park | SE-52 | 101.29 | 96.23 | 258.43 | 616 | 801.4 | 2404.1 |
| Carroza | Southeast | Park | SE-46 | 8.59 | 8.16 | 21.92 | 52 | 68.0 | 203.9 |
| East Fresno Boys/Girls Club | Southeast | Park | SE-43 | 4.39 | 4.17 | 11.21 | 27 | 34.8 | 104.3 |
| Elks Club | Southeast | Park | SE-50 | 17.01 | 16.16 | 43.41 | 104 | 134.6 | 403.8 |
| Fresno Fairgrounds | Southeast | Park | SE-51 | 93.03 | 88.38 | 237.36 | 566 | 736.0 | 2208.1 |
| Melody | Southeast | Park | SE-45 | 4.82 | 4.58 | 12.31 | 29 | 38.2 | 114.5 |
| Mosqueda | Southeast | Park | SE-48 | 10.13 | 9.62 | 25.84 | 62 | 80.1 | 240.4 |
| Oso de Oro II | Southeast | Park | SE-47 | 9.41 | 8.94 | 24.01 | 57 | 74.4 | 223.3 |
| Palm Lakes | Southeast | Park | SE-53 | 132.30 | 125.68 | 337.53 | 805 | 1046.6 | 3139.9 |
| Park | Southeast | Park | SE-41 | 0.43 | 0.41 | 1.11 | 3 | 3.4 | 10.3 |
| Pilibos | Southeast | Park | SE-49 | 12.86 | 12.22 | 32.82 | 78 | 101.6 | 305.3 |
| Sunnyside | Southeast | Park | SE-44 | 4.71 | 4.47 | 12.02 | 29 | 37.3 | 111.8 |
| Willow-Balch | Southeast | Park | SE-42 | 1.48 | 1.40 | 3.77 | 9 | 11.7 | 35.1 |
| Campus Christian Academy | Southeast | School | SE-1 | 0.36 | 0.22 | 0.58 | 1 | 1.8 | 5.4 |
| Cornerstone Christian | Southeast | School | SE-5 | 2.20 | 1.32 | 3.55 | 8 | 11.0 | 33.0 |
| Fresno Adventist Academy | Southeast | School | SE-34 | 39.54 | 23.73 | 63.72 | 152 | 197.6 | 592.8 |
| Fresno Sunnyside Christian Academy, Isp | Southeast | School | SE-2 | 0.87 | 0.52 | 1.41 | 3 | 4.4 | 13.1 |
| St. Helen | Southeast | School | SE-5 | 7.13 | 4.28 | 11.48 | 27 | 35.6 | 106.8 |
| Fresno Pacific University | Southeast | School | SE-3 | 22.98 | 13.79 | 37.02 | 88 | 114.8 | 344.4 |
| Ayer Elementary School | Southeast | School | SE-15 | 9.26 | 5.56 | 14.92 | 36 | 46.3 | 138.8 |
| Aynesworth Elementary School | Southeast | School | SE-10 | 7.90 | 4.74 | 12.73 | 30 | 39.5 | 118.5 |
| Burroughs Elementary School | Southeast | School | SE-9 | 7.82 | 4.69 | 12.60 | 30 | 39.1 | 117.2 |
| Cambridge Continuation High School | Southeast | School | SE-6 | 4.10 | 2.46 | 6.60 | 16 | 20.5 | 61.4 |
| David L. Greenberg Elementary School | Southeast | School | SE-28 | 17.35 | 10.41 | 27.95 | 67 | 86.7 | 260.0 |
| Easterby Elementary School | Southeast | School | SE-12 | 8.28 | 4.97 | 13.35 | 32 | 41.4 | 124.2 |
| Edith B. Storey Elementary School | Southeast | School | SE-29 | 17.66 | 10.60 | 28.45 | 68 | 88.2 | 264.7 |
| Elizabeth Terronez Middle School | Southeast | School | SE-32 | 24.96 | 14.98 | 40.22 | 96 | 124.7 | 374.2 |
| Ericson Elementary School | Southeast | School | SE-11 | 8.19 | 4.91 | 13.20 | 31 | 40.9 | 122.8 |
| Ewing Elementary School | Southeast | School | SE-14 | 8.87 | 5.32 | 14.29 | 34 | 44.3 | 133.0 |
| Ezekiel Balderas Elementary School | Southeast | School | SE-19 | 10.59 | 6.35 | 17.07 | 41 | 52.9 | 158.8 |
| Fancher Creek Elementary School | Southeast | School | SE-25 | 15.62 | 9.37 | 25.17 | 60 | 78.0 | 234.1 |
| Fresno County Court | Southeast | School | SE-16 | 9.28 | 5.57 | 14.95 | 36 | 46.3 | 139.0 |
| Irwin O. Addicot Elementary School | Southeast | School | SE-24 | 14.20 | 8.52 | 22.88 | 55 | 70.9 | 212.8 |
| John S. Wash Elementary School | Southeast | School | SE-23 | 14.20 | 8.52 | 22.88 | 55 | 70.9 | 212.8 |
| Kings Canyon Middle School | Southeast | School | SE-31 | 18.36 | 11.02 | 29.58 | 71 | 91.7 | 275.2 |
| Lane Elementary School | Southeast | School | SE-13 | 8.35 | 5.01 | 13.46 | 32 | 41.7 | 125.2 |
| Lone Star Elementary School | Southeast | School | SE-22 | 13.41 | 8.05 | 21.61 | 52 | 67.0 | 201.0 |
| Molly S. Bakman Elementary School | Southeast | School | SE-20 | 11.19 | 6.71 | 18.03 | 43 | 55.9 | 167.7 |
| Roosevelt High School | Southeast | School | SE-33 | 34.56 | 20.73 | 55.68 | 133 | 172.7 | 518.0 |
| Scandinavian Middle School | Southeast | School | SE-18 | 10.36 | 6.21 | 16.69 | 40 | 51.7 | 155.2 |
| Sequoia Middle School | Southeast | School | SE-27 | 16.86 | 10.11 | 27.16 | 65 | 84.2 | 252.7 |
| Sunnyside High School | Southeast | School | SE-35 | 49.83 | 29.90 | 80.29 | 192 | 249.0 | 747.0 |
| Temperance-Kutner Elementary School | Southeast | School | SE-21 | 13.00 | 7.80 | 20.94 | 50 | 64.9 | 194.8 |
| Turner Elementary School | Southeast | School | SE-17 | 10.00 | 6.00 | 16.11 | 38 | 50.0 | 149.9 |
| Academy for New Americans | Southeast | School | SE-30 | 17.79 | 10.67 | 28.66 | 68 | 88.9 | 266.6 |
| **Southwest Quadrant** | | | | | | | | | |
| Chandler Airport | Southwest | Airport | SW-68 | 155.24 | 38.81 | 104.23 | 249 | 323.2 | 969.6 |
| Cemetery | Southwest | Cemetery | SW-71 | 197.92 | 188.03 | 504.96 | 1,204 | 1565.8 | 4697.5 |
| Cemetery | Southwest | Cemetery | SW-69 | 18.27 | 17.35 | 46.61 | 111 | 144.5 | 433.6 |
| Cemetery | Southwest | Cemetery | SW-70 | 38.65 | 36.71 | 98.60 | 235 | 305.8 | 917.3 |
| Edison-Bethune Charter Academy | Southwest | School | SW-43 | 9.38 | 5.63 | 15.11 | 36 | 46.9 | 140.6 |
| New Millenium Charter School | Southwest | School | SW-7 | 0.47 | 0.28 | 0.76 | 2 | 2.4 | 7.1 |
| Sunset Elementary School | Southwest | School | SW-45 | 9.67 | 5.80 | 15.58 | 37 | 48.3 | 144.9 |
| W.E.B. Dubois Public Charter School | Southwest | School | SW-23 | 5.31 | 3.19 | 8.55 | 20 | 26.5 | 79.6 |
| Bigby-Villa | Southwest | Park | SW-83 | 2.41 | 2.29 | 6.14 | 15 | 19.0 | 57.1 |
| Carver | Southwest | Park | SW-87 | 4.62 | 4.39 | 11.78 | 28 | 36.5 | 109.6 |
| Chandler | Southwest | Park | SW-82 | 1.98 | 1.88 | 5.05 | 12 | 15.7 | 47.0 |
| Courthouse Park | Southwest | Park | SW-99 | 13.94 | 13.24 | 35.55 | 85 | 110.2 | 330.7 |
| Dickey | Southwest | Park | SW-81 | 1.94 | 1.84 | 4.95 | 12 | 15.4 | 46.1 |
| Fink-White | Southwest | Park | SW-94 | 8.89 | 8.44 | 22.67 | 54 | 70.3 | 210.9 |
| Frank H. Ball | Southwest | Park | SW-84 | 2.95 | 2.80 | 7.52 | 18 | 23.3 | 69.9 |
| Fresno Metropolitan Museum | Southwest | Park | SW-76 | 0.16 | 0.15 | 0.42 | 1 | 1.3 | 3.9 |
| Grizzlies Stadium | Southwest | Park | SW-98 | 10.87 | 10.32 | 27.73 | 66 | 86.0 | 257.9 |
| Hinton | Southwest | Park | SW-90 | 6.03 | 5.73 | 15.38 | 37 | 47.7 | 143.1 |
| Hobart | Southwest | Park | SW-79 | 0.64 | 0.61 | 1.64 | 4 | 5.1 | 15.2 |
| Holmes | Southwest | Park | SW-95 | 9.19 | 8.73 | 23.44 | 56 | 72.7 | 218.0 |
| Hyde | Southwest | Park | SW-97 | 10.82 | 10.28 | 27.61 | 66 | 85.6 | 256.8 |
| Ivy | Southwest | Park | SW-88 | 4.69 | 4.46 | 11.97 | 29 | 37.1 | 111.3 |
| Kearney Park | Southwest | Park | SW-102 | 144.14 | 136.93 | 367.74 | 877 | 1140.3 | 3421.0 |

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|---|---|---|---|---|---|---|---|---|---|
| Lafayette | Southwest | Park | SW-86 | 4.49 | 4.27 | 11.47 | 27 | 35.6 | 106.7 |
| Meux | Southwest | Park | SW-75 | 0.13 | 0.12 | 0.33 | 1 | 1.0 | 3.1 |
| Nelsen | Southwest | Park | SW-85 | 3.67 | 3.67 | 9.87 | 24 | 30.6 | 91.8 |
| Park | Southwest | Park | SW-77 | 0.28 | 0.26 | 0.71 | 2 | 2.2 | 6.6 |
| Park | Southwest | Park | SW-73 | 0.04 | 0.04 | 0.10 | 0 | 0.3 | 0.9 |
| Park | Southwest | Park | SW-72 | 0.03 | 0.03 | 0.08 | 0 | 0.2 | 0.7 |
| Park | Southwest | Park | SW-74 | 0.04 | 0.04 | 0.11 | 0 | 0.3 | 1.0 |
| Pride | Southwest | Park | SW-78 | 0.32 | 0.30 | 0.81 | 2 | 2.5 | 7.6 |
| Radio | Southwest | Park | SW-91 | 7.32 | 6.95 | 18.66 | 45 | 57.9 | 173.6 |
| Roeding Regional | Southwest | Park | SW-101 | 138.83 | 131.89 | 354.20 | 845 | 1098.3 | 3295.0 |
| Romain | Southwest | Park | SW-93 | 7.88 | 7.49 | 20.11 | 48 | 62.4 | 187.1 |
| San Pablo Family | Southwest | Park | SW-80 | 0.96 | 0.91 | 2.46 | 6 | 7.6 | 22.9 |
| Sunset | Southwest | Park | SW-96 | 9.82 | 9.33 | 25.05 | 60 | 77.7 | 233.0 |
| Victoria-West | Southwest | Park | SW-92 | 7.35 | 6.99 | 18.76 | 45 | 58.2 | 174.6 |
| Wills | Southwest | Park | SW-89 | 5.70 | 5.41 | 14.54 | 35 | 45.1 | 135.2 |
| Roeding Regional | Southwest | Park - Water | SW-103 | 6.10 | 0.00 | 0.00 | 0 | 0.0 | 0.0 |
| Armenian Community School of Fresno | Southwest | School | SW-13 | 1.36 | 0.82 | 2.19 | 5 | 6.8 | 20.4 |
| Faith Baptist Academy | Southwest | School | SW-5 | 0.32 | 0.19 | 0.51 | 1 | 1.6 | 4.8 |
| Koinonia Christian | Southwest | School | SW-6 | 0.44 | 0.26 | 0.70 | 2 | 2.2 | 6.6 |
| Our Lady of Victory | Southwest | School | SW-16 | 4.00 | 2.40 | 6.44 | 15 | 20.0 | 59.9 |
| Sacred Heart | Southwest | School | SW-30 | 7.22 | 4.33 | 11.64 | 28 | 36.1 | 108.3 |
| San Joaquin Memorial High School | Southwest | School | SW-32 | 41.03 | 24.62 | 66.12 | 158 | 205.0 | 615.1 |
| FRESNO CITY COLLEGE | Southwest | School | SW-1 | 51.21 | 30.73 | 82.52 | 197 | 255.9 | 767.7 |
| Addams Elementary School | Southwest | School | SW-37 | 8.38 | 5.03 | 13.51 | 32 | 41.9 | 125.7 |
| Akira Yokomi Elementary School | Southwest | School | SW-27 | 6.50 | 3.90 | 10.48 | 25 | 32.5 | 97.5 |
| Ann B. Leavenworth | Southwest | School | SW-50 | 10.71 | 6.43 | 17.26 | 41 | 53.5 | 160.5 |
| Birney Elementary School | Southwest | School | SW-38 | 8.43 | 5.06 | 13.59 | 32 | 42.1 | 126.4 |
| Calwa Elementary School | Southwest | School | SW-40 | 8.45 | 5.07 | 13.61 | 32 | 42.2 | 126.6 |
| Carver Academy | Southwest | School | SW-39 | 8.43 | 5.06 | 13.59 | 32 | 42.1 | 126.4 |
| Central Unified Alternative/Opportunity | Southwest | School | SW-17 | 4.50 | 2.70 | 7.25 | 17 | 22.5 | 67.4 |
| Columbia Elementary School | Southwest | School | SW-36 | 8.29 | 4.97 | 13.35 | 32 | 41.4 | 124.2 |
| Dailey Elementary School | Southwest | School | SW-18 | 4.59 | 2.75 | 7.40 | 18 | 22.9 | 68.8 |
| Dewolf West High School | Southwest | School | SW-19 | 4.68 | 2.81 | 7.54 | 18 | 23.4 | 70.1 |
| Edison Computech | Southwest | School | SW-61 | 18.81 | 11.29 | 30.31 | 72 | 94.0 | 282.0 |
| Edison High School | Southwest | School | SW-66 | 36.13 | 21.68 | 58.22 | 139 | 180.5 | 541.6 |
| El Capitan Middle School | Southwest | School | SW-59 | 17.28 | 10.37 | 27.85 | 66 | 86.3 | 259.0 |
| Fremont Elementary School | Southwest | School | SW-31 | 7.75 | 4.65 | 12.50 | 30 | 38.7 | 116.2 |
| Fresno County Community | Southwest | School | SW-22 | 5.31 | 3.18 | 8.55 | 20 | 26.5 | 79.6 |
| Fresno County Special Education | Southwest | School | SW-10 | 0.72 | 0.43 | 1.16 | 3 | 3.6 | 10.8 |
| Fresno High School | Southwest | School | SW-65 | 33.99 | 20.39 | 54.76 | 131 | 169.8 | 509.5 |
| Fulton Special Education | Southwest | School | SW-42 | 9.34 | 5.61 | 15.05 | 36 | 46.7 | 140.1 |
| Hamilton Elementary School | Southwest | School | SW-58 | 16.82 | 10.09 | 27.10 | 65 | 84.0 | 252.1 |
| Heaton Elementary School | Southwest | School | SW-25 | 6.43 | 3.86 | 10.36 | 25 | 32.1 | 96.4 |
| Homan Elementary School | Southwest | School | SW-34 | 7.99 | 4.79 | 12.87 | 31 | 39.9 | 119.7 |
| J. E. Young Academic Center | Southwest | School | SW-9 | 0.64 | 0.38 | 1.03 | 2 | 3.2 | 9.6 |
| Jackson Elementary School | Southwest | School | SW-14 | 3.25 | 1.95 | 5.24 | 12 | 16.2 | 48.7 |
| James K. Polk Elementary School | Southwest | School | SW-63 | 19.09 | 11.45 | 30.76 | 73 | 95.4 | 286.2 |
| Jefferson Elementary School | Southwest | School | SW-29 | 6.65 | 3.99 | 10.72 | 26 | 33.2 | 99.7 |
| King Elementary School | Southwest | School | SW-51 | 10.94 | 6.56 | 17.62 | 42 | 54.6 | 163.9 |
| Kirk Elementary School | Southwest | School | SW-3 | 5.19 | 3.12 | 8.37 | 20 | 25.9 | 77.8 |
| Lincoln Elementary School | Southwest | School | | 6.48 | 3.89 | 10.44 | 25 | 32.4 | 97.1 |
| Lowell Elementary School | Southwest | School | SW-24 | 5.32 | 3.19 | 8.58 | 20 | 26.6 | 79.8 |
| Madison Elementary School | Southwest | School | SW-60 | 18.13 | 10.88 | 29.22 | 70 | 90.6 | 271.8 |
| Mayfair Elementary School | Southwest | School | SW-28 | 6.62 | 3.97 | 10.67 | 25 | 33.1 | 99.3 |
| McKinley Elementary School | Southwest | School | SW-47 | 10.01 | 6.01 | 16.14 | 38 | 50.0 | 150.1 |
| McLane High School | Southwest | School | SW-41 | 8.49 | 5.10 | 13.68 | 33 | 42.4 | 127.3 |
| Miguel Hidalgo Elementary School | Southwest | School | SW-52 | 11.03 | 6.62 | 17.77 | 42 | 55.1 | 165.3 |
| Muir Elementary School | Southwest | School | SW-35 | 8.14 | 4.89 | 13.12 | 31 | 40.7 | 122.1 |
| Norseman Elementary School | Southwest | School | SW-54 | 12.40 | 7.44 | 19.99 | 48 | 62.0 | 185.9 |
| Orange Center Elementary | Southwest | School | SW-48 | 10.04 | 6.02 | 16.17 | 39 | 50.1 | 150.4 |
| Roosevelt Elementary School | Southwest | School | SW-53 | 11.63 | 6.98 | 18.74 | 45 | 58.1 | 174.3 |
| Rowell Elementary School | Southwest | School | SW-44 | 9.40 | 5.64 | 15.14 | 36 | 46.9 | 140.8 |
| Susan B. Anthony Elementary School | Southwest | School | SW-46 | 9.85 | 5.91 | 15.88 | 38 | 49.2 | 147.7 |
| Tehipite Middle School | Southwest | School | SW-62 | 19.08 | 11.45 | 30.75 | 73 | 95.3 | 286.0 |
| Webster Elementary School | Southwest | School | SW-21 | 5.10 | 3.06 | 8.22 | 20 | 25.5 | 76.4 |
| West Fresno Elementary School | Southwest | School | SW-57 | 16.46 | 9.87 | 26.52 | 63 | 82.2 | 246.7 |
| West Fresno Middle School | Southwest | School | SW-49 | 10.63 | 6.38 | 17.12 | 41 | 53.1 | 159.3 |
| West Park Elementary School | Southwest | School | SW-55 | 14.17 | 8.50 | 22.82 | 54 | 70.8 | 212.3 |
| Winchell Elementary School | Southwest | School | SW-33 | 7.85 | 4.71 | 12.66 | 30 | 39.2 | 117.7 |
| Wishon Elementary School | Southwest | School | SW-67 | 37.83 | 22.70 | 60.96 | 145 | 189.0 | 567.1 |
| Yosemite Middle School | Southwest | School | SW-4 | 15.71 | 9.42 | 25.31 | 60 | 78.5 | 235.5 |
| Armenian Community School | Southwest | School | SW-12 | 1.29 | 0.77 | 2.08 | 5 | 6.4 | 19.3 |
| Fresno Valley High School | Southwest | School | SW-20 | 4.87 | 2.92 | 7.85 | 19 | 24.3 | 73.0 |
| St. Therese School | Southwest | School | SW-8 | 0.50 | 0.30 | 0.81 | 2 | 2.5 | 7.6 |
| TOTAL | | | | | | 12,859 | 30,671 | 39,855 | 119,448 |

**Irrigation Factors**

| | |
|---|---|
| Airport | 25% |
| Cemetery | 95% |
| Golf Course/Country Club | 90% |
| Lake | 100% |
| Park | 95% |
| Park - Water | 0% |
| School | 60% |

| | |
|---|---|
| Peak Day Peaking Factor | 30% |

Notes:
(1) Irrigable acreage is estimated by multiplying parcel acreage by the irrigation factor. This is an adjustment for unirrigated parcel area.
(2) Estimated irrigation usage has been calculated by multiplying the irrigable area by the average irrigation requirement for the Fresno area.
(3) The maximum month irrigation has been calculated by multiplying the average irrigation requirement by the maximum month irrigation requirement (July = 20 percent of annual demand).
(4) Maximum day irrigation demand is assumed to 30 percent larger than the maximum month demand.
(5) The peak hour demand has been estimated assuming an eight hour irrigation period.

**Removed Customers**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Calif State Univ Fresno Sports Complex | Northeast<br>Southwest | School<br>Park | NE-47 | 264.26<br>141.10 | 158.55<br>141.10 | 425.81<br>378.93 | 1,016<br>904 | 1320.4<br>1175.0 | 3961.2<br>3525.1 |

# APPENDIX D – 1996 RWRF MASTER PLAN – AGRICULTURAL EXCHANGE EVALUATION

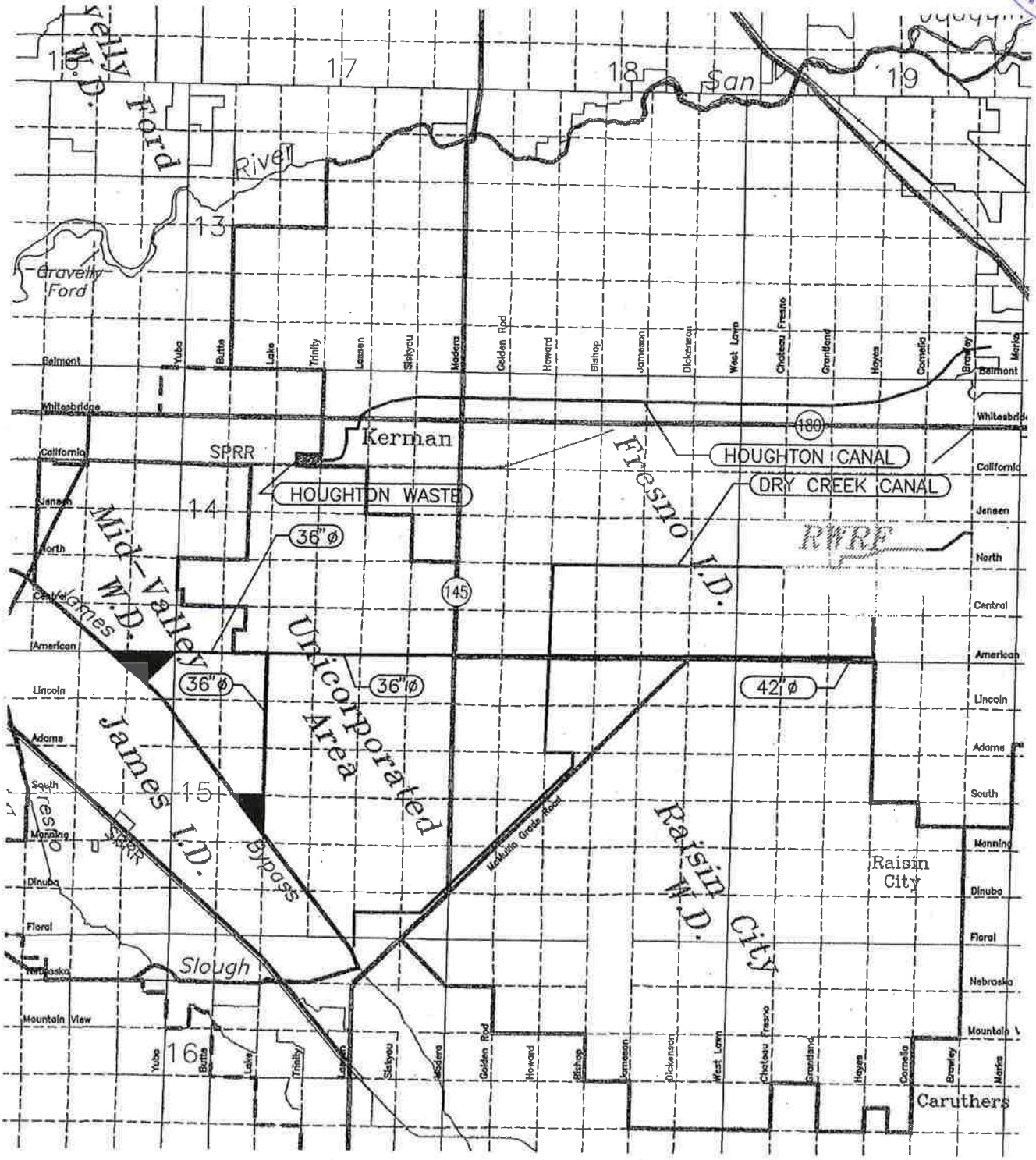
### Raisin City Water District

In January 1995, Raisin City Water District (RCWD) submitted a proposal to take delivery of secondary undisinfected effluent from the RWRF. Meetings with the RCWD Board of Directors (Spring 1996) confirmed that RCWD is interested in negotiating an agreement with the City based on the original proposal. This proposal includes year round delivery of approximately 45 mgd through pipelines to disposal ponds located in RCWD. Turnouts from the pipelines would also be provided for direct irrigation.

**Technical Elements.** The RCWD proposal for 45 mgd of RWRF effluent includes an estimated 48,000 ft of pipeline and three 320 acre disposal ponds (total 960 acres assuming a conservative percolation rate of 2 in/day). The pipe sizes required range from 66 inches to 42 inches in diameter. The three pond sites are not located on adjacent property, therefore the pipe size requirements are reduced after each turnout to a pond. Review of the regional topography indicates that the effluent can be delivered to the ponds by gravity flow. This would be confirmed in final design.

**Institutional Elements.** The RCWD Board of Directors has expressed strong commitment to the proposed project, primarily because the effluent provides a reliable source of water for agricultural use. This project would increase effluent reuse and provide incidental groundwater recharge in a water-short area. Incidental percolation would help to off-set the declining groundwater parts of the District. The District currently relies solely on groundwater for agricultural use.

This project requires a transfer of agricultural land for use as disposal ponds. The proposed locations of the off-site ponds is approximately six to seven miles south of the RWRF, as shown in Figure 4. Approximately one-half of the proposed pond locations is currently planted with vineyards and orchards; the other half is planted with seasonal crops. However, the RCWD Board expects that adequate land is available through willing sellers in the event the proposed locations are not available.




LEGEND:

——— DISTRIBUTION TO MVWD

RWRF—PLANT BOUNDARIES

ALL SHADED AREAS—POTENTIAL POND LOCATIONS

**Figure 4**
**PROPOSED MVWD REUSE/DISPOSAL PROJECT**
Fresno Clovis Wastewater Facilities
Master Plan Report

If implemented this project may require mitigation to FID because delivery of effluent to RCWD would occur outside the FID boundary. As noted above, additional hydrogeologic studies and are necessary to determine to what extent, if any, mitigation would be required. The studies must identify the potential benefit of incidental percolation from the disposal operation in RCWD. The incidental percolation should help to offset the declining groundwater levels in the vicinity of RCWD (i.e., flatten the groundwater gradient), thereby reducing the amount of localized incidental groundwater flow out of FID toward RCWD.

The construction of additional disposal ponds is necessary to meet existing and future flow conditions at the plant, and therefore should not be viewed as a "growth inducing project". Moreover, there is a regulatory directive to expand the disposal capacity. The transfer of agricultural land to disposal lands will result in some lost agricultural production; however, the lost agricultural production may be offset by improving area-wide groundwater elevations through incidental percolation.

**Cost.** The estimated total project cost for the pipeline and land for the three ponds is approximately $37 million (assuming no costs for mitigation). This cost includes approximately $13.6 million for pipelines; $2.4 million for land; $9.6 million for pond construction, and; engineering costs and contingency allowance.

Based discussion the RCWD Board of Directors, it is anticipated that RCWD could share in the costs up to approximately $0.2 - 0.24 million/year. This equates to an assessment of roughly $4 to $5/acre. Total costs to the City would be approximately $3.7 million/yr, or approximately $67/acre-foot. These costs represent the expected maximum project costs. It may be possible to reduce total costs to the City to approximately $25/acre-foot. Cost savings could be realized by reduced land requirements for percolation (e.g., 4 in/day percolation rate), reduced costs for pipeline construction, or economy of scale/shared costs for a joint project with other irrigation districts (ref. J. Boren RCWD September 1996).

### Mid-Valley Water District

In January 1995, Mid-Valley Water District (MVWD) submitted a proposal to take delivery of secondary undisinfected effluent from the RWRF. Meetings with the MVWD Board of Directors (Spring 1996) confirmed interest in negotiating an agreement with the City based on the original proposal, which includes year round delivery of 15 mgd through pipelines to disposal ponds. Turnouts from the pipelines would also be provided for direct irrigation.

**Technical Elements.** The MVWD proposal for approximately 15 mgd of RWRF effluent includes approximately 79,000 feet of pipe for delivery to a 300 acre reservoir. The pipe sizes required range from 36 to 42 inches. Review of the regional topography indicates that the effluent can be delivered to the ponds by gravity flow.

**Institutional Elements.** The proposed locations of the off-site ponds is approximately fifteen miles west- southwest of the RWRF, as shown in Figure 5. The proposed sites were identified by the MVWD as potentially available for pond construction.

Conversations with MVWD indicate willingness to proceed with the proposal. The farmers within the district consider this to be a beneficial project because of the potential for direct use as well as the incidental percolation. MVWD currently has no surface water rights and relies solely on groundwater pumping.

Potential institutional issues include FID mitigation and the transfer of agricultural land to disposal ponds, as described above.

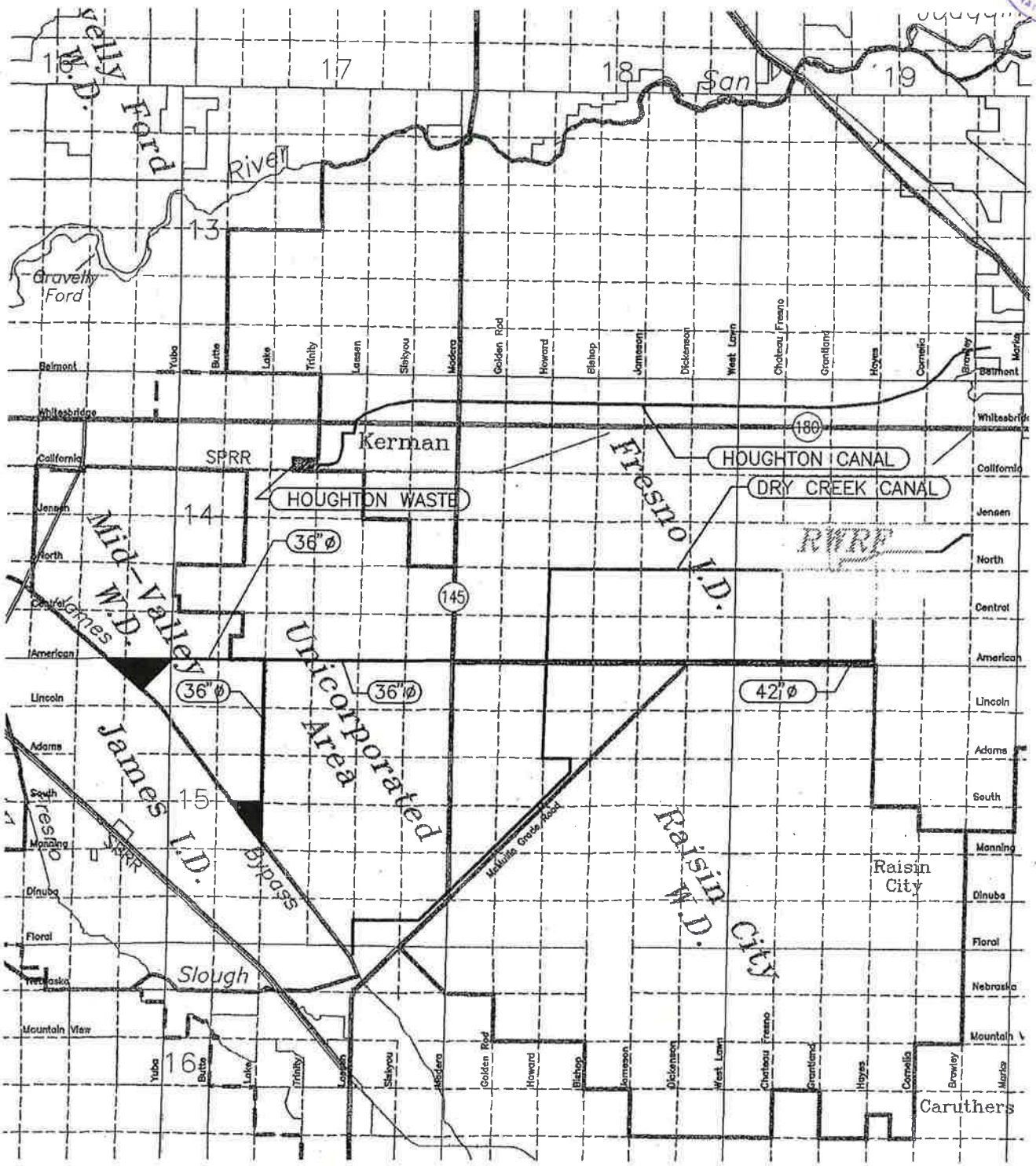
**Cost.** The estimated total project cost is $28.1 million (assuming no mitigation). This cost includes $15.8 million for pipeline; $0.6 million for land; $3.0 million for pond construction, and; cost allowances for engineering and contingencies.

Based discussion the MVWD Board of Directors, MVWD could share in the costs up to approximately $0.05 to 0.06 million/year. This equates to an assessment of roughly $4 to $5 per acre. Total costs to the City would be approximately $2.6 million/yr, or approximately $152/acre-foot. As noted above for RCWD, this estimate represents the expected maximum cost to the City. It may be possible to reduce total costs to the city to approximately $50/acre-foot (assuming no economy of scale or shared costs for a joint project with other irrigation districts). Like RCWD, total project costs could also be reduced if less land is required for percolation or if pipeline costs can be reduced.

#### James and Tranquillity Irrigation Districts

James Irrigation District (JID) and Tranquillity Irrigation District (TID) are located approximately 15 miles south-southwest of the RWRF. Both districts receive surface water through contracts with the U.S. Bureau of Reclamation. JID currently operates groundwater extraction wells along McMullen Grade Road (on the border of RCWD and an unincorporated area) and pumps water into Dry Creek Canal. The water flows from Dry Creek to the James Bypass which distributes water throughout JID. JID's canals are interconnected with TIDs distribution system. The two districts have the ability to share water resources and have expressed willingness to enter in a joint venture.

JID is currently coordinating a recharge project with the Kings River Conservation District (KRCD) to build 80 acres of basins in the southwest corner of the unincorporated area (in the northwest corner of Section 35, T15S, R17E). Seasonal flood flow from the Kings River would be diverted to these ponds, approximately one out of every four years. The original intent was that the basins would be farmed the other four years, however, JID is considering a revision of the plan to make the basins a joint project between JID and TID and the City of Fresno, so that secondary




LEGEND:

——— DISTRIBUTION TO MVWD

RWRF–PLANT BOUNDARIES

ALL SHADED AREAS–POTENTIAL POND LOCATIONS

**Figure 5**
**PROPOSED MVWD**
**REUSE/DISPOSAL PROJECT**
Fresno-Clovis Wastewater Facilities
Master Plan Report

undisinfected effluent could be diverted to the basins during the non-flood years. A separate project for disposal of effluent only could also be developed.

**Technical Elements.** JID has indicated interest in extracting 35,000 ac-ft/yr of effluent and TID indicated interest in extracting 14,000 ac-ft/yr of effluent. These annual extractions rates are roughly equivalent to 45 mgd average annual flow. The districts would be extracting at a greater rate primarily during the summer months, but flow to the basins from the RWRF would remain relatively steady year round at about 45 mgd.

Between 430 and 1,670 acres of ponds would be required for reuse/disposal of 45 mgd of effluent flow, based on percolation rates of 4 in/day and 1 in/day respectively. The soils in the area are sandy so a minimum percolation rate of 2 in/day could be obtained with proper management with regular rehabilitation. For this percolation rate a minimum of 830 acres of ponds would be required. Assuming additional land required for roads and berms is equivalent to 15 percent of the pond acreage, a total of approximately 1,000 acres is needed (approximately equal to one and a half square miles).

Delivery to the basins by gravity would require approximately 79,000 feet of pipeline ranging from 60 to 66-inch diameter. This would be confirmed in final design.

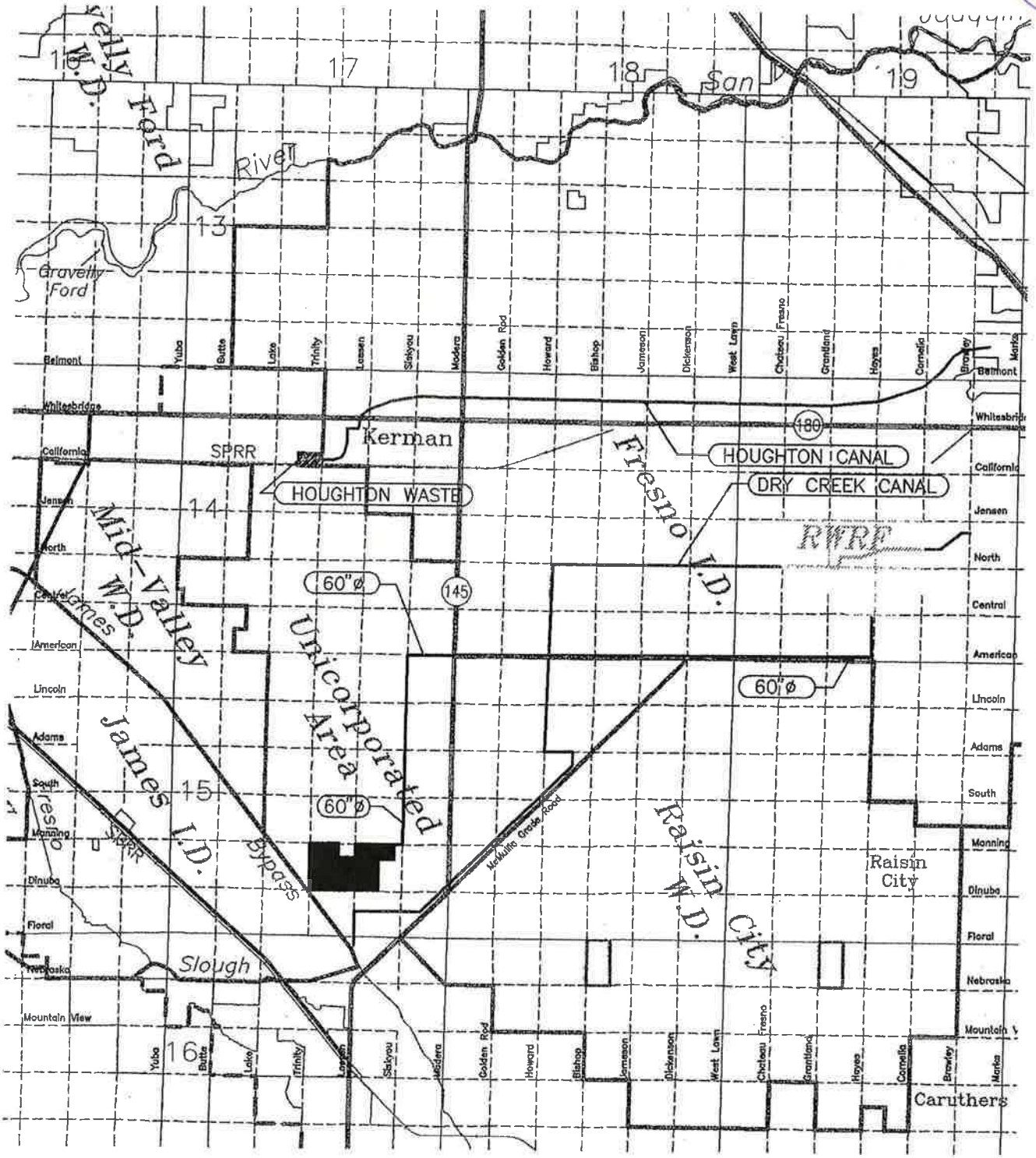
**Institutional Elements.** JID and TID have indicated a willingness to proceed with the proposal. The farmers within the district consider this to be a beneficial project because of the potential for improving the regional groundwater levels through incidental percolation. Groundwater in the unincorporated area has historically been overdrafted.

Acreage near and around the JID proposed recharge site are currently farmed primarily in seasonal alfalfa and grains. Proposed pond locations which are currently farmed with seasonal crops are shown in Figure 6. These locations are adjacent to the planned recharge basin, and are also in proximity to a possible pipeline route. The current owners have not yet been approached to determine their willingness to sell.

Potential institutional issues include FID mitigation and the transfer of agricultural land to disposal ponds, as described above.

**Cost.** The estimated total project cost is $51.8 million. This cost includes $23.7 million for pipeline; $2 million for land; $10 million for pond construction, and; cost allowances for engineering and contingencies.

JID/TID have indicated a willingness to share in costs for this project. Assuming a share in the costs up to approximately $0.15 to 0.18 million/year (assessment of roughly $4 to $5 per acre),




LEGEND:

DISTRIBUTION TO JID/TID
RWRF-PLANT BOUNDARIES

ALL SHADED AREAS-POTENTIAL POND LOCATIONS

**Figure 6**
**PROPOSED JID/TID**
**REUSE/DISPOSAL PROJECT**
Fresno-Clovis Wastewater Facilities
Master Plan Report

the total costs to the City would be approximately $4.8 million/yr, or approximately $91/acre-foot. As noted for RCWD and MVWD, this represents the expected maximum project cost.

# APPENDIX E – SEWER FLOW CURVES FROM MONITORING DATA

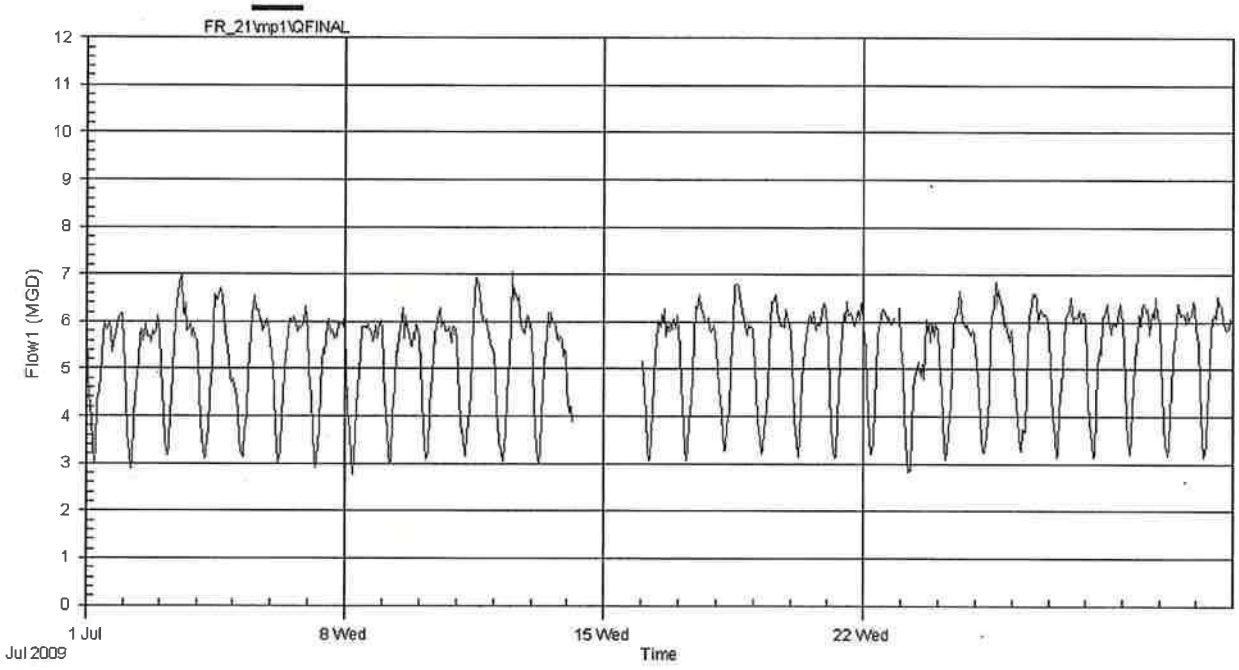
City of Fresno - SOUTHWEST QUADRANT, DOUNSTREAM OF ROEDING PARK
Sewer Monitoring Station No.21
N. Fruit Ave. 990 feet n/o W. Nielsen Ave.
Pipe Height: 40.5"
Pipe Dimensions: 40.5" x 41.5"

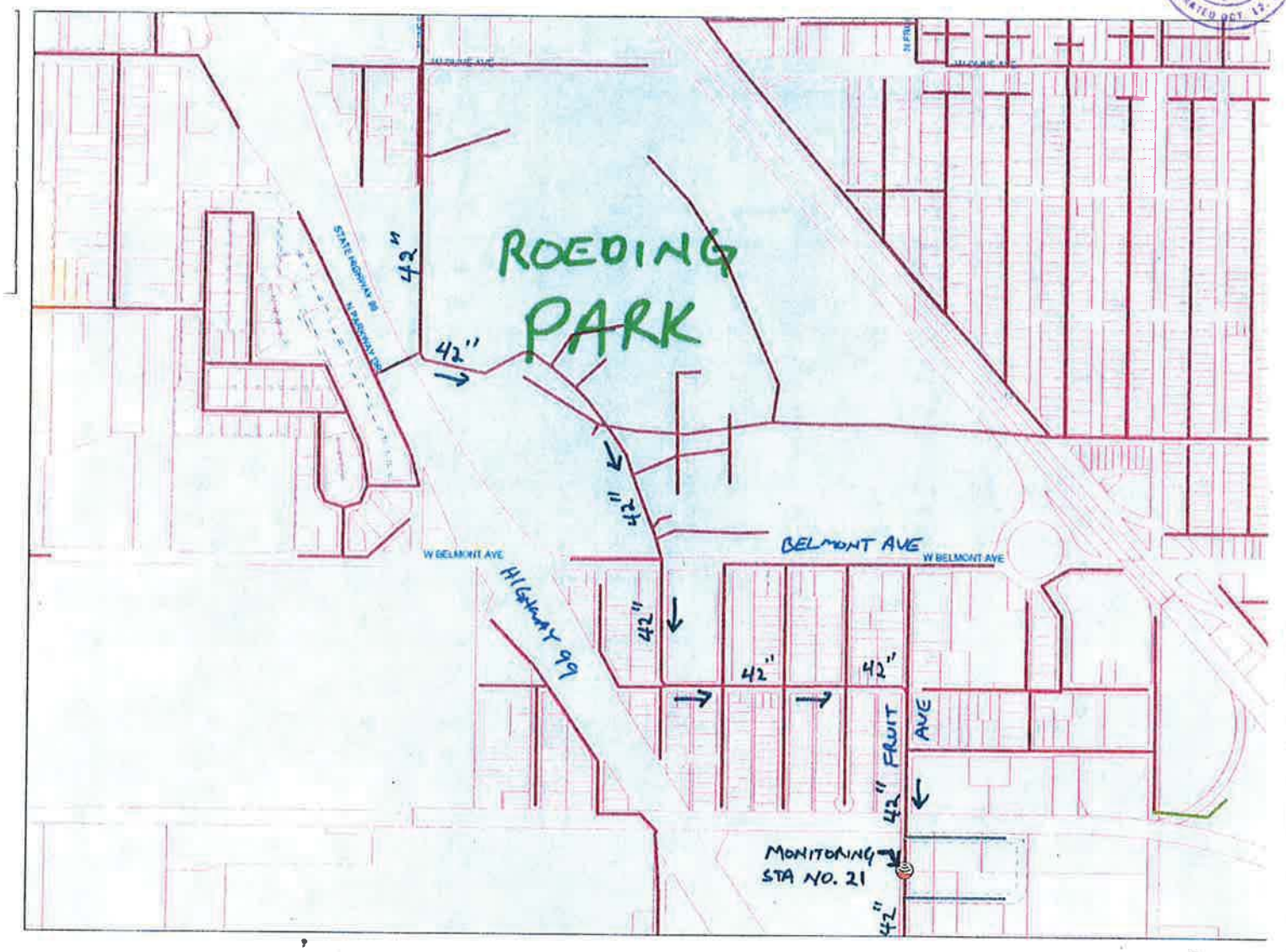
FR21\mp1\QFINAL (MGD - Total MG)

| Date | Time | Min. | Time | Max. | Average | Total | Rain |
|---|---|---|---|---|---|---|---|
| 07/01/09 | 6:00 | 2.892 | 23:00 | 6.319 | 5.168 | 5.168 | 0.00 |
| 07/02/09 | 5:45 | 2.756 | 23:00 | 6.366 | 5.050 | 5.050 | 0.00 |
| 07/03/09 | 6:00 | 3.061 | 14:00 | 7.272 | 5.391 | 5.391 | 0.00 |
| 07/04/09 | 5:30 | 2.880 | 14:45 | 6.984 | 5.137 | 5.137 | 0.00 |
| 07/05/09 | 6:15 | 3.046 | 14:00 | 6.746 | 5.127 | 5.127 | 0.00 |
| 07/06/09 | 5:45 | 2.843 | 22:45 | 6.793 | 5.209 | 5.209 | 0.00 |
| 07/07/09 | 5:45 | 2.865 | 23:00 | 6.365 | 5.106 | 5.106 | 0.00 |
| 07/08/09 | 5:45 | 2.653 | 12:30 | 6.290 | 5.110 | 5.110 | 0.00 |
| 07/09/09 | 6:15 | 2.834 | 13:15 | 6.453 | 5.127 | 5.127 | 0.00 |
| 07/10/09 | 4:45 | 2.747 | 13:45 | 6.520 | 5.196 | 5.196 | 0.00 |
| 07/11/09 | 5:30 | 2.985 | 13:00 | 7.141 | 5.234 | 5.234 | 0.00 |
| 07/12/09 | 6:45 | 2.890 | 12:00 | 7.456 | 5.235 | 5.235 | 0.00 |
| 07/13/09 | 5:30 | 2.703 | 11:00 | 6.607 | 5.098 | 5.098 | 0.00 |
| 07/14/09 | 3:15 | 3.797 | 0:15 | 4.707 | 4.225 | 0.616 | 0.00 |
| 07/15/09 | | | | | | – | 0.00 |
| 07/16/09 | 6:15 | 2.863 | 23:15 | 6.421 | 5.237 | 4.965 | 0.00 |
| 07/17/09 | 5:15 | 2.889 | 13:45 | 6.749 | 5.312 | 5.312 | 0.00 |
| 07/18/09 | 6:15 | 3.025 | 12:45 | 7.102 | 5.350 | 5.350 | 0.00 |
| 07/19/09 | 6:15 | 3.009 | 14:30 | 7.007 | 5.268 | 5.268 | 0.00 |
| 07/20/09 | 5:15 | 2.875 | 23:15 | 6.769 | 5.364 | 5.364 | 0.00 |
| 07/21/09 | 5:30 | 3.053 | 22:45 | 6.647 | 5.378 | 5.378 | 0.00 |
| 07/22/09 | 5:15 | 3.087 | 23:15 | 6.650 | 5.355 | 4.797 | 0.00 |
| 07/23/09 | 6:00 | 2.723 | 16:45 | 6.168 | 4.867 | 4.867 | 0.00 |
| 07/24/09 | 5:45 | 2.961 | 14:30 | 6.831 | 5.295 | 5.295 | 0.00 |
| 07/25/09 | 6:15 | 3.041 | 13:45 | 7.090 | 5.293 | 5.293 | 0.00 |
| 07/26/09 | 6:15 | 3.163 | 13:00 | 7.006 | 5.353 | 5.353 | 0.00 |
| 07/27/09 | 5:00 | 3.007 | 14:15 | 6.628 | 5.368 | 5.368 | 0.00 |
| 07/28/09 | 6:15 | 3.036 | 14:00 | 6.784 | 5.339 | 5.339 | 0.00 |
| 07/29/09 | 5:15 | 3.057 | 22:00 | 6.700 | 5.428 | 5.428 | 0.00 |
| 07/30/09 | 6:00 | 3.058 | 22:45 | 6.673 | 5.396 | 5.396 | 0.00 |
| 07/31/09 | 5:15 | 2.860 | 14:45 | 6.689 | 5.378 | 5.378 | 0.00 |
| ReportAvg | | 2.955 | | 6.664 | 5.213 | | |
| ReportTotal | | | | | | 151.955 | 0.000 |

ADS Environmental Services

Pipe Height: 40.50






SCALE 1 : 9,958

1,000 2,000 3,000

FEET

N

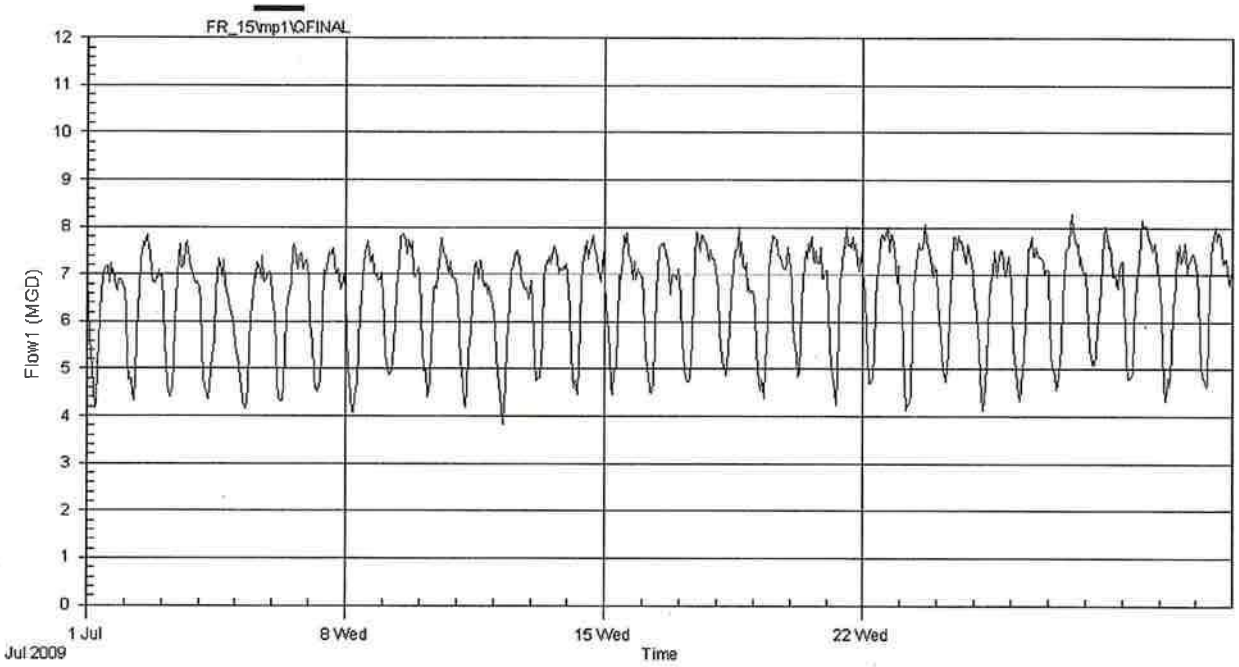
City of Fresno - SOUTHWEST QUADRANT - UPSTREAM OF FRUIT & CHURCH SITE
Sewer Monitoring Station No.15
428 W. California Ave
Pipe Height: 48.00"
Pipe Dimensions: 48.00" x 48.00"

FR_15\mp1\QFINAL (MGD - Total MG)

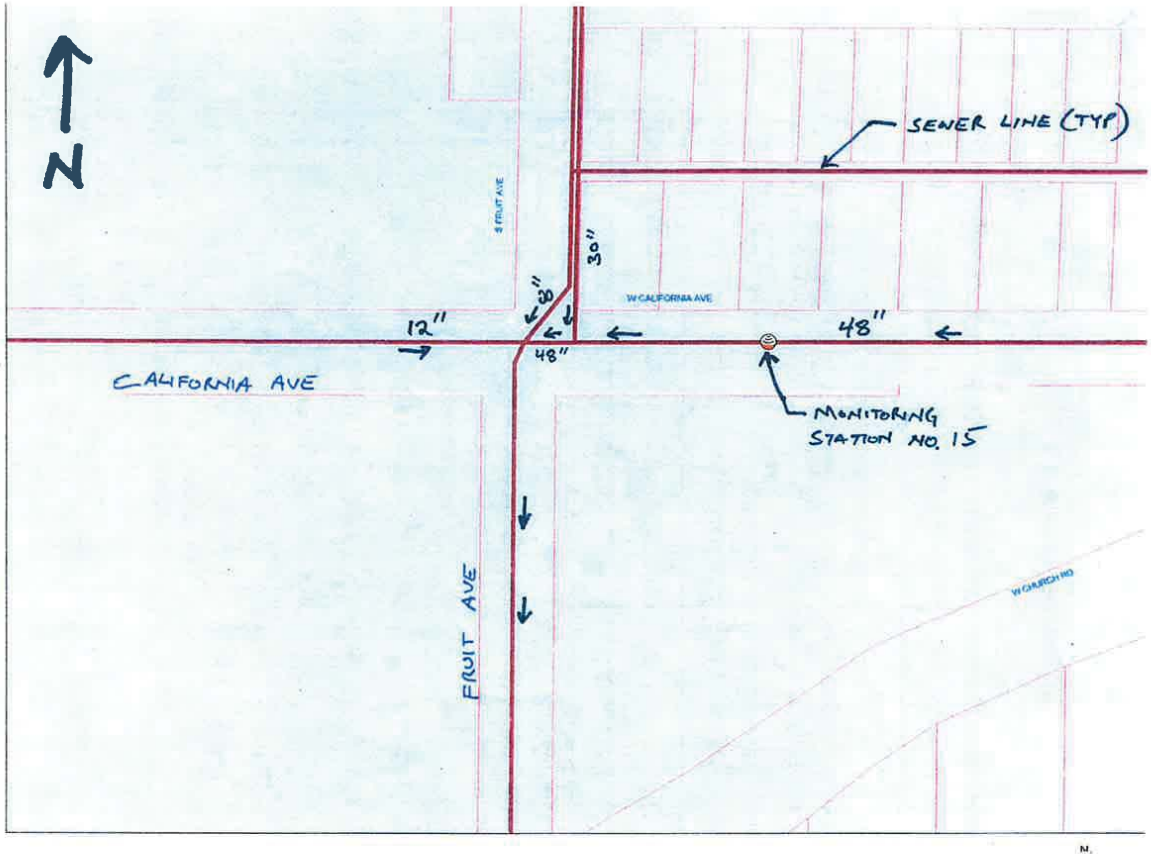
| Date | Time | Min. | Time | Max. | Average | Total | Rain |
|---|---|---|---|---|---|---|---|
| 07/01/09 | 5:45 | 3.877 | 13:00 | 7.438 | 6.331 | 6.331 | 0.00 |
| 07/02/09 | 6:00 | 4.066 | 14:45 | 7.998 | 6.468 | 6.468 | 0.00 |
| 07/03/09 | 5:15 | 4.130 | 12:45 | 7.915 | 6.425 | 6.425 | 0.00 |
| 07/04/09 | 7:45 | 4.081 | 14:15 | 7.610 | 6.010 | 6.010 | 0.00 |
| 07/05/09 | 7:00 | 4.057 | 17:00 | 7.663 | 6.048 | 6.048 | 0.00 |
| 07/06/09 | 6:15 | 4.039 | 14:30 | 7.965 | 6.372 | 6.372 | 0.00 |
| 07/07/09 | 6:45 | 4.283 | 16:30 | 8.016 | 6.390 | 6.390 | 0.00 |
| 07/08/09 | 5:30 | 3.750 | 14:00 | 7.842 | 6.284 | 6.284 | 0.00 |
| 07/09/09 | 6:00 | 4.768 | 14:15 | 8.041 | 6.636 | 6.636 | 0.00 |
| 07/10/09 | 5:15 | 4.241 | 14:30 | 7.817 | 6.446 | 6.446 | 0.00 |
| 07/11/09 | 6:30 | 4.115 | 16:30 | 7.637 | 6.214 | 6.214 | 0.00 |
| 07/12/09 | 6:30 | 3.540 | 14:30 | 7.759 | 6.132 | 6.132 | 0.00 |
| 07/13/09 | 4:30 | 4.397 | 14:45 | 7.834 | 6.586 | 6.586 | 0.00 |
| 07/14/09 | 6:15 | 4.219 | 16:00 | 7.991 | 6.619 | 6.619 | 0.00 |
| 07/15/09 | 5:15 | 4.410 | 14:00 | 8.296 | 6.588 | 6.588 | 0.00 |
| 07/16/09 | 5:30 | 4.325 | 15:15 | 8.084 | 6.483 | 6.483 | 0.00 |
| 07/17/09 | 5:45 | 4.646 | 15:15 | 8.337 | 6.706 | 6.706 | 0.00 |
| 07/18/09 | 6:00 | 4.442 | 14:00 | 8.113 | 6.569 | 6.569 | 0.00 |
| 07/19/09 | 7:15 | 4.145 | 15:30 | 8.154 | 6.517 | 6.517 | 0.00 |
| 07/20/09 | 5:30 | 4.424 | 17:45 | 8.048 | 6.787 | 6.787 | 0.00 |
| 07/21/09 | 6:00 | 4.087 | 13:15 | 8.206 | 6.696 | 6.696 | 0.00 |
| 07/22/09 | 6:00 | 4.272 | 15:30 | 8.410 | 6.829 | 6.829 | 0.00 |
| 07/23/09 | 4:15 | 3.816 | 16:30 | 8.270 | 6.530 | 6.530 | 0.00 |
| 07/24/09 | 5:30 | 4.469 | 14:00 | 8.012 | 6.761 | 6.761 | 0.00 |
| 07/25/09 | 6:30 | 3.900 | 13:30 | 7.814 | 6.384 | 6.384 | 0.00 |
| 07/26/09 | 5:45 | 4.142 | 13:15 | 8.114 | 6.491 | 6.491 | 0.00 |
| 07/27/09 | 5:30 | 4.159 | 16:00 | 8.469 | 6.669 | 6.669 | 0.00 |
| 07/28/09 | 6:45 | 4.687 | 12:00 | 8.094 | 6.671 | 6.671 | 0.00 |
| 07/29/09 | 7:00 | 4.198 | 13:30 | 8.666 | 6.809 | 6.809 | 0.00 |
| 07/30/09 | 4:45 | 3.923 | 11:45 | 7.929 | 6.500 | 6.500 | 0.00 |
| 07/31/09 | 6:30 | 4.418 | 16:00 | 8.254 | 6.693 | 6.693 | 0.00 |
| ReportAvg | | 4.194 | | 8.026 | 6.505 | | |
| ReportTotal | | | | | | 201.644 | 0.000 |

ADS Environmental Services

Pipe Height: 48.00



Sewer
PublicWorks
Public Utilities Easments
Parcels
Parcels
City Limits
Fresno County



City of Fresno - NORTHWEST QUADRANT
Sewer Monitoring Station No.2
Intersection of Herndon and Blythe Ave.
Pipe Height: 45.25"
Pipe Dimensions: 44.75" X 45.13"

FR_02\mp1\QFINAL (MGD - Total MG)

| Date | Time | Min. | Time | Max. | Average | Total | Rain |
|---|---|---|---|---|---|---|---|
| 07/01/09 | 6:45 | 2.525 | 12:15 | 9.821 | 6.824 | 6.824 | 0.00 |
| 07/02/09 | 6:30 | 2.683 | 12:15 | 9.909 | 6.787 | 6.787 | 0.00 |
| 07/03/09 | 7:15 | 2.537 | 15:00 | 10.130 | 6.727 | 6.727 | 0.00 |
| 07/04/09 | 7:30 | 2.473 | 14:45 | 10.120 | 6.352 | 6.352 | 0.00 |
| 07/05/09 | 7:15 | 2.473 | 15:45 | 10.080 | 6.391 | 6.391 | 0.00 |
| 07/06/09 | 6:30 | 2.511 | 13:15 | 9.578 | 6.816 | 6.816 | 0.00 |
| 07/07/09 | 7:00 | 2.427 | 12:00 | 9.557 | 6.726 | 6.726 | 0.00 |
| 07/08/09 | 7:15 | 2.571 | 12:15 | 9.788 | 6.816 | 6.816 | 0.00 |
| 07/09/09 | 6:45 | 2.596 | 12:30 | 9.740 | 6.734 | 6.734 | 0.00 |
| 07/10/09 | 6:45 | 2.474 | 13:00 | 10.140 | 6.778 | 6.778 | 0.00 |
| 07/11/09 | 7:15 | 2.435 | 13:30 | 10.330 | 6.791 | 6.791 | 0.00 |
| 07/12/09 | 7:30 | 2.249 | 13:45 | 9.914 | 6.501 | 6.501 | 0.00 |
| 07/13/09 | 7:15 | 2.332 | 12:45 | 9.878 | 6.757 | 6.757 | 0.00 |
| 07/14/09 | 7:15 | 2.742 | 11:15 | 9.545 | 6.719 | 6.719 | 0.00 |
| 07/15/09 | 7:15 | 2.796 | 12:15 | 9.727 | 6.685 | 6.685 | 0.00 |
| 07/16/09 | 6:45 | 2.595 | 11:45 | 9.759 | 6.763 | 6.763 | 0.00 |
| 07/17/09 | 6:45 | 2.815 | 12:45 | 10.220 | 6.829 | 6.829 | 0.00 |
| 07/18/09 | 7:15 | 2.540 | 14:00 | 10.100 | 6.671 | 6.671 | 0.00 |
| 07/19/09 | 7:45 | 2.361 | 13:45 | 9.992 | 6.575 | 6.575 | 0.00 |
| 07/20/09 | 7:15 | 2.598 | 11:30 | 9.954 | 6.874 | 6.874 | 0.00 |
| 07/21/09 | 7:15 | 2.820 | 11:30 | 9.716 | 6.868 | 6.868 | 0.00 |
| 07/22/09 | 6:00 | 2.884 | 11:30 | 9.777 | 6.862 | 6.862 | 0.00 |
| 07/23/09 | 7:00 | 3.230 | 11:45 | 9.599 | 6.938 | 6.938 | 0.00 |
| 07/24/09 | 7:00 | 2.921 | 12:15 | 9.762 | 6.906 | 6.906 | 0.00 |
| 07/25/09 | 7:30 | 2.600 | 16:15 | 10.140 | 6.780 | 6.780 | 0.00 |
| 07/26/09 | 7:45 | 2.655 | 14:00 | 10.090 | 6.740 | 6.740 | 0.00 |
| 07/27/09 | 6:15 | 2.873 | 11:45 | 9.915 | 6.993 | 6.993 | 0.00 |
| 07/28/09 | 7:00 | 2.945 | 12:00 | 9.764 | 7.003 | 7.003 | 0.00 |
| 07/29/09 | 5:30 | 3.221 | 12:00 | 9.689 | 7.122 | 7.122 | 0.00 |
| 07/30/09 | 7:45 | 3.037 | 12:00 | 9.749 | 7.143 | 7.143 | 0.00 |
| 07/31/09 | 6:00 | 3.114 | 12:45 | 9.949 | 7.085 | 7.085 | 0.00 |
| ReportAvg | | 2.678 | | 9.885 | 6.792 | | |
| ReportTotal | | | | | | 210.556 | 0.000 |

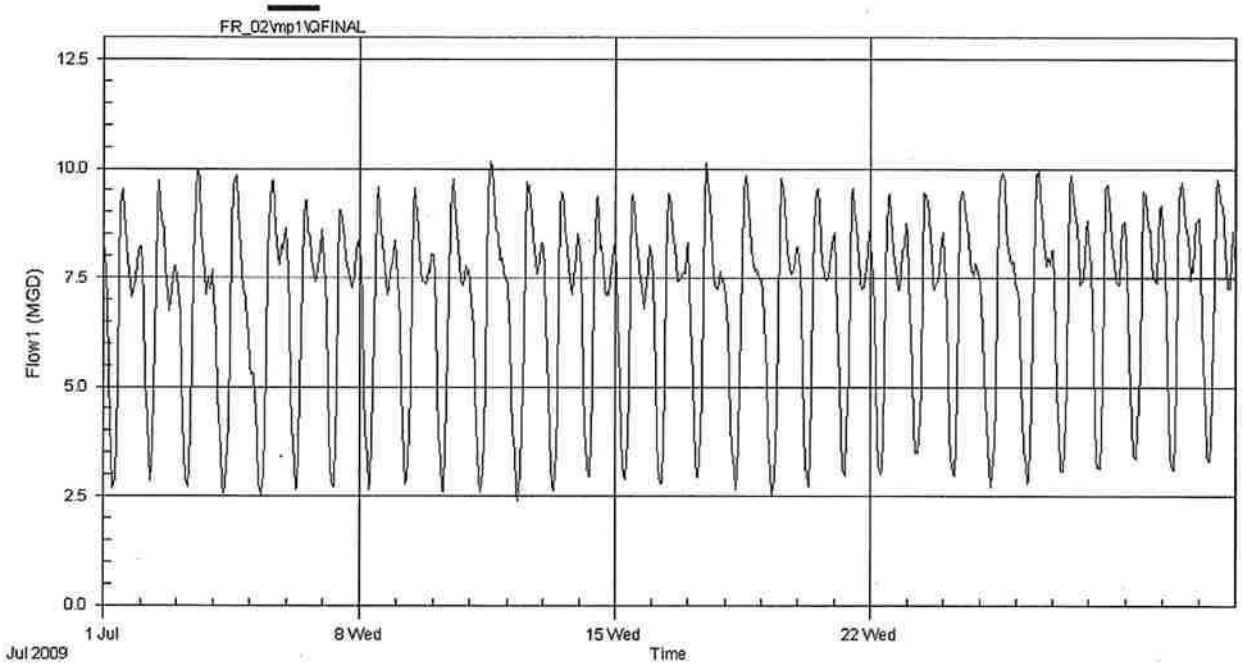
# ADS Environmental Services

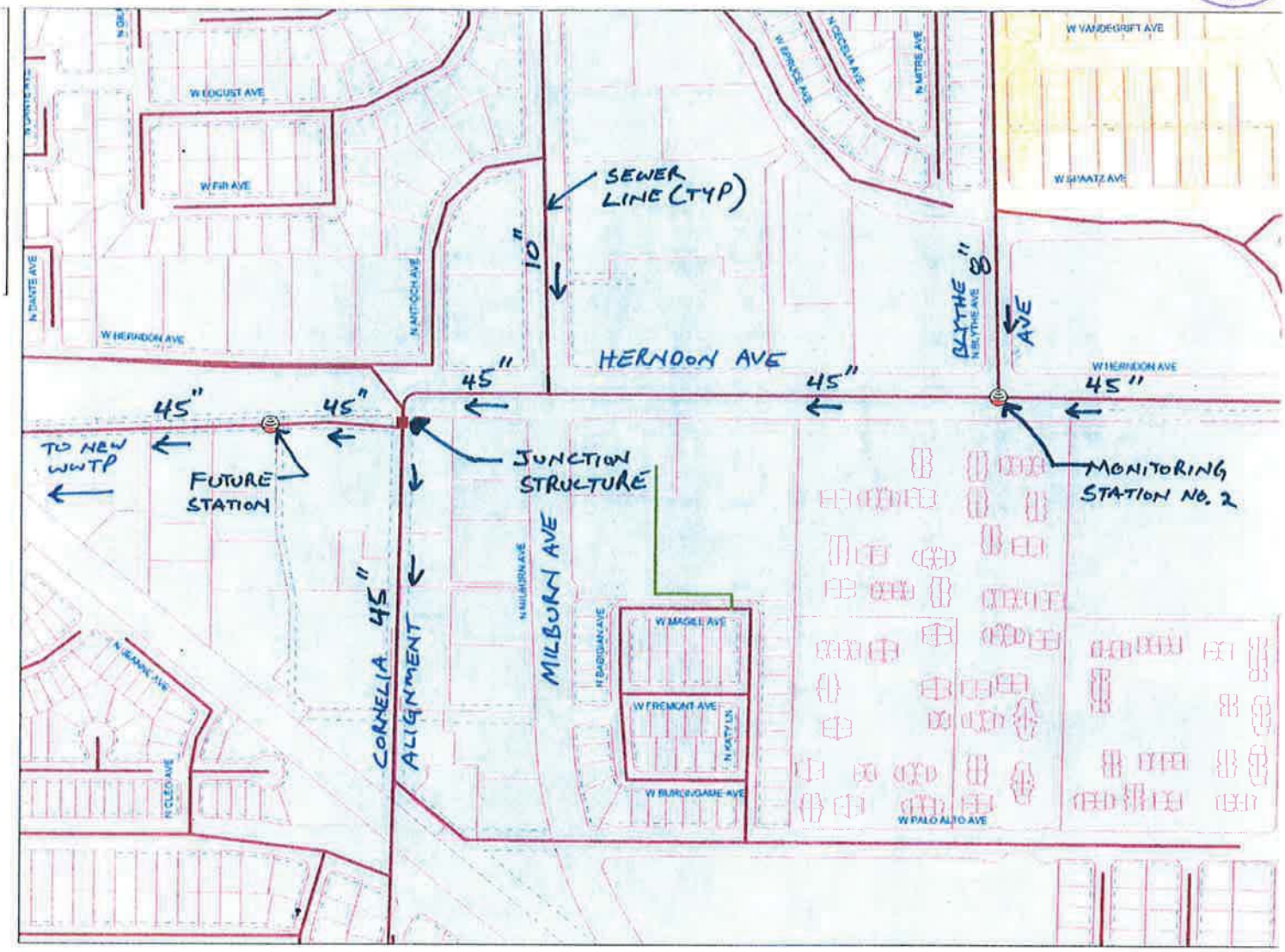
Pipe Dimensions: 44.75" X 45.13"

Intersection of Herndon and Blythe Ave.

Fresno, CA

Pipe Height: 44.75






SCALE 1 : 5,532

500 1,000 1,500

FEET

City of Fresno - SOUTHEAST QUADRANT
Sewer Monitoring Station No.9
Intersection of Chestnut and Madison
Pipe Height: 38.88"
Pipe Dimensions: 38.88" X 38.88"

FR_09\mp1\QFINAL (MGD - Total MG)

| Date | Time | Min. | Time | Max. | Average | Total | Rain |
|---|---|---|---|---|---|---|---|
| 07/01/06 | 3:30 | 3.096 | 11:30 | 8.063 | 5.911 | 5.911 | 0.00 |
| 07/02/06 | 2:45 | 2.817 | 10:30 | 7.815 | 5.776 | 5.776 | 0.00 |
| 07/03/06 | 3:00 | 2.969 | 12:00 | 8.150 | 6.177 | 6.177 | 0.00 |
| 07/04/06 | 3:30 | 2.915 | 12:00 | 8.574 | 5.845 | 5.845 | 0.00 |
| 07/05/06 | 2:45 | 3.002 | 11:15 | 7.969 | 6.252 | 6.252 | 0.00 |
| 07/06/06 | 3:00 | 2.938 | 13:00 | 8.050 | 6.280 | 6.280 | 0.00 |
| 07/07/06 | 3:00 | 2.851 | 10:00 | 8.009 | 6.197 | 6.197 | 0.00 |
| 07/08/06 | 2:45 | 3.212 | 11:00 | 8.539 | 6.033 | 6.033 | 0.00 |
| 07/09/06 | 5:00 | 3.043 | 10:00 | 7.781 | 5.923 | 5.923 | 0.00 |
| 07/10/06 | 3:30 | 3.120 | 11:45 | 8.327 | 6.448 | 6.448 | 0.00 |
| 07/11/06 | 3:45 | 3.287 | 11:00 | 8.030 | 6.439 | 6.439 | 0.00 |
| 07/12/06 | 3:15 | 3.126 | 12:30 | 7.927 | 6.298 | 6.298 | 0.00 |
| 07/13/06 | 3:15 | 3.028 | 11:15 | 8.000 | 6.335 | 6.335 | 0.00 |
| 07/14/06 | 3:15 | 3.137 | 10:45 | 8.407 | 6.352 | 6.352 | 0.00 |
| 07/15/06 | 3:15 | 3.193 | 11:45 | 8.125 | 5.981 | 5.981 | 0.00 |
| 07/16/06 | 3:15 | 3.144 | 10:15 | 8.035 | 6.018 | 6.018 | 0.00 |
| 07/17/06 | 3:15 | 3.272 | 11:00 | 8.312 | 6.452 | 6.452 | 0.00 |
| 07/18/06 | 3:15 | 3.379 | 12:30 | 8.281 | 6.446 | 6.446 | 0.00 |
| 07/19/06 | 3:15 | 3.160 | 10:00 | 8.186 | 6.419 | 6.419 | 0.00 |
| 07/20/06 | 3:30 | 3.257 | 9:15 | 8.000 | 6.398 | 6.398 | 0.00 |
| 07/21/06 | 3:00 | 3.142 | 12:00 | 8.406 | 6.336 | 6.336 | 0.00 |
| 07/22/06 | 4:00 | 3.347 | 11:00 | 8.209 | 6.079 | 6.079 | 0.00 |
| 07/23/06 | 4:15 | 3.194 | 10:15 | 7.998 | 6.039 | 6.039 | 0.00 |
| 07/24/06 | 4:00 | 3.195 | 11:00 | 8.364 | 6.495 | 6.495 | 0.00 |
| 07/25/06 | 3:00 | 3.363 | 10:15 | 8.459 | 6.593 | 6.593 | 0.00 |
| 07/26/06 | 3:15 | 3.378 | 11:45 | 8.150 | 6.446 | 6.446 | 0.00 |
| 07/27/06 | 3:15 | 3.241 | 11:00 | 8.330 | 6.498 | 6.498 | 0.00 |
| 07/28/06 | 3:15 | 3.467 | 10:30 | 8.373 | 6.455 | 6.455 | 0.00 |
| 07/29/06 | 3:30 | 3.313 | 11:00 | 8.449 | 6.143 | 6.143 | 0.00 |
| 07/30/06 | 3:45 | 3.188 | 11:30 | 8.111 | 6.083 | 6.083 | 0.00 |
| 07/31/06 | 3:30 | 3.119 | 12:30 | 8.619 | 6.477 | 6.477 | 0.00 |
| ReportAvg | | 3.158 | | 8.195 | 6.246 | | |
| ReportTotal | | | | | | 193.624 | 0.00 |

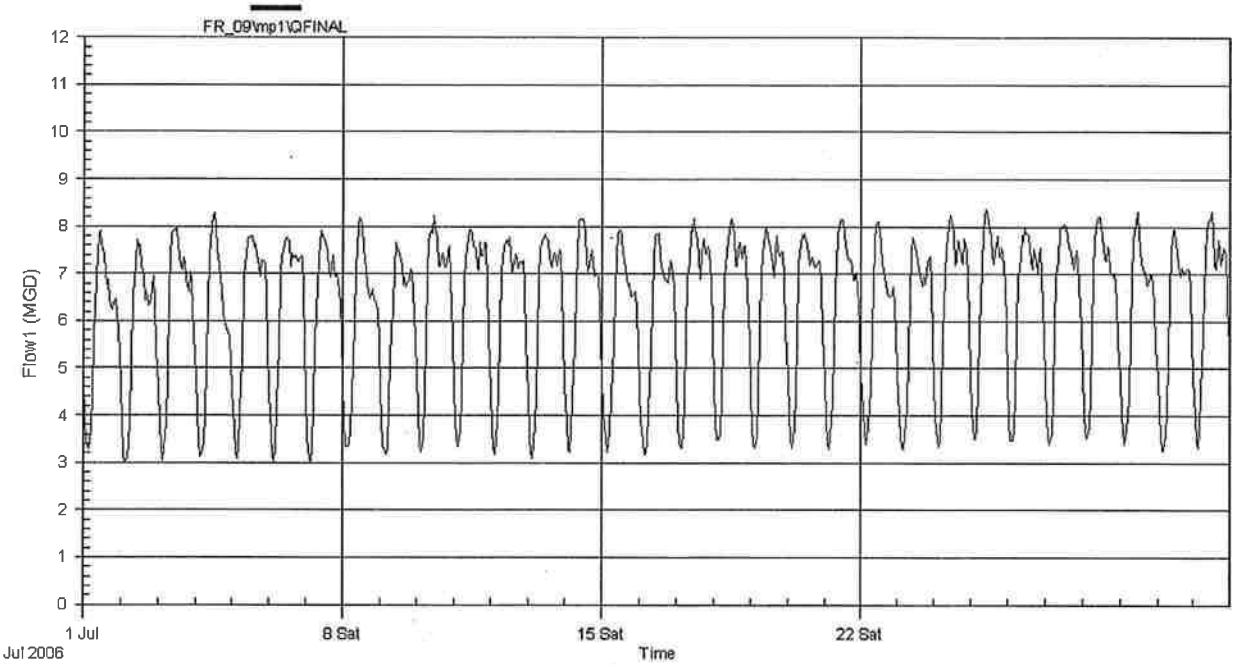
CITY OF FRESNO
INCORPORATED OCT. 12, 1885

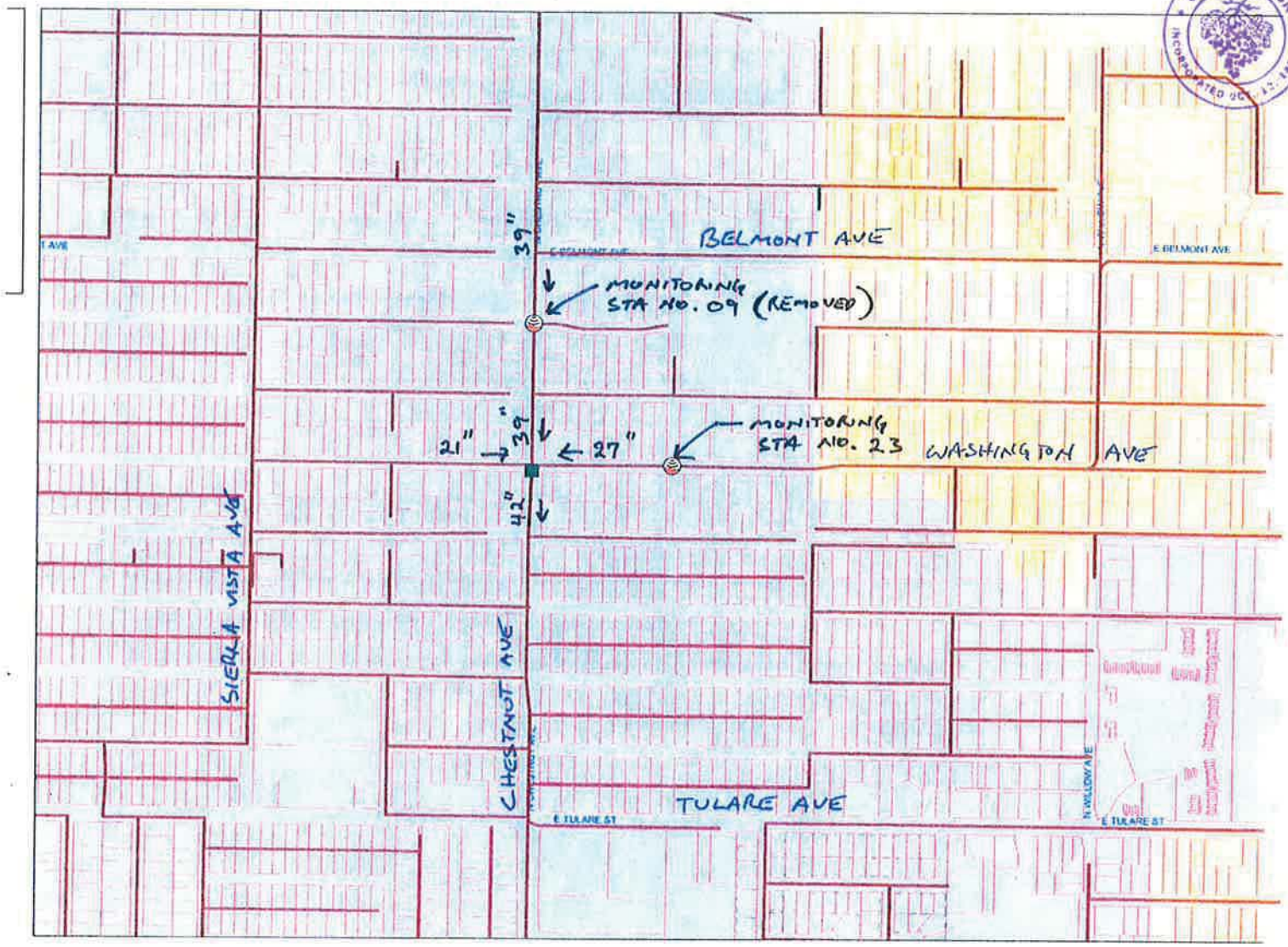
# ADS Environmental Services

Pipe Dimensions: 38.88" X 38.88"

Intersection of Chestnut and Madison

Fresno, CA
Pipe Height: 38.88






SCALE 1 : 8,843

500 1,000 1,500

FEET

N

# APPENDIX F – BASIS OF COST MEMORANDUM

## 1.0 PURPOSE

The purpose of this memorandum is to describe the methodology and assumptions used in developing the Recycled Water Master Plan (RWMP) basis of cost estimate. Cost estimates developed for the RWMP were planning level estimates and utilized for capital planning of future recycled water projects and for estimating the potential impact of those projects on sewer rates.

## 2.0 PROJECT DESCRIPTION

The RWMP project alternatives consist of water recycling facilities (treatment modifications at the RWRF and/or satellite treatment facilities), and a recycled water distribution system to serve large and small users in the four quadrants of the City (SW, NW, NE, and SE). The project is located within the Sphere of Influence (SOI) of the City of Fresno, including "county islands" and other incorporated areas of Fresno County. The project is anticipated to be constructed in phases and will include modular treatment facilities or satellite treatment plants with an initial total capacity of 8 MGD, expandable to 32 MGD; approximately 500,000 lineal feet of 8-inch through 60-inch pipelines; six booster pump stations; four distribution system storage tanks of 1.0 to 1.5 million gallons each; and customer turnouts.

## 3.0 METHODOLOGY

The level of accuracy that can be expected for any cost estimate is directly proportional to the level of engineering effort completed. For the RWMP quantity take-offs were performed based on conceptual site plans for the treatment plant alternatives and for distribution system alignment corridors. Construction cost estimates were developed using historical costs from recent Carollo and BCF projects, proprietary cost curves, and vendor quoted information. Past construction cost estimates were adjusted to January 2010 costs for Fresno California using the ENR Construction Cost Index (CCI). The current "location factor" for the City of Fresno is 1.072.

Cost estimates included for the RWMP included:

- Capital cost (costs for construction of facilities)
- Project costs (capital costs plus contingency for engineering, administration and legal associated with implementation of the project)
- O&M costs (annual operating and maintenance costs of proposed projects)

Capital costs included a design contingency appropriate for this planning level of detail and have an accuracy of -30 percent to +50 percent (AACE International Recommended Practices and Standards, No. 18R-97). Because there was more uncertainty associated with the processes and facilities of the treatment alternatives, a 30 percent design contingency was given to the treatment facilities estimates. A 25 percent design contingency was given to the distribution system facilities because more information was available about the cost of pipeline construction in main corridors throughout the City. Costs are in January 2010 dollars (ENR 8660).

Project costs included a placeholder contingency of 20 percent of the capital costs to account for project implementation costs such as design, environmental review, and permitting, legal, administration and construction management.

The following table summarizes the direct cost multipliers used to develop the RWMP cost estimates.

**Table 1 Cost Estimate Direct Cost Multipliers**
**Recycled Water Master Plan**
**City of Fresno**

| Multiplier | Percent |
|---|---|
| Construction costs adjusted to 2010 | ENR 8660 |
| Location factor for Fresno California | 1.072 |
| Planning level design contingency for treatment facilities | 30 |
| Planning level design contingency for distribution system facilities | 25 |
| Engineering, Legal and Administration | 20 |

O&M costs were estimated based on historical unit O&M costs of the City's wastewater system operation including costs for power, labor, chemicals, and replacement materials. Table 2 summarizes the unit costs used to develop the recycled water system annual O&M costs.

| Table 2 | Estimated O&M Unit Costs<br>Recycled Water Master Plan<br>City of Fresno | |
|---|---|---|
| Power | | $0.20/kWh |
| Labor | | $50/hr |
| Chemicals | | |
| • | Citric Acid | $0.50 lb |
| • | Sodium Hypochlorite | $0.12/lb |
| • | Alum | $0.10/lb |
| • | Polymer | $1.60/lb |
| Replacement Materials | | 5%/yr |

# 4.0 ASSUMPTIONS

## 4.1 Treatment Plants

Treatment plant cost estimates were developed for each of the treatment alternatives: Alternative 1, delivery of recycled water from the RWRF, and Alternative 2, delivery of recycled water from satellite treatment plants located in the vicinity of users in each quadrant of the City. In addition, costs were developed for expanding treatment at the North Fresno WRF, which is a project that is independent of the main treatment alternative selected. The following assumptions were used to develop facilities costs for construction of recycled water facilities at the RWRF.

1. Media filtration, UV disinfection, and chlorine or chloramines for distribution system disinfection.
2. Secondary processes already exist with A-side and B-side secondary treatment trains.
3. Nitrification/denitrification step was not included because it is possible that future NdN required for potential GRRPs could be achieved though operational changes at the RWRF.
4. Media filtration and disinfection costs were estimated based on recent bid tabs and vendor quotes.

The following assumptions were used to develop facilities costs for construction of satellite recycled water facilities:

1. The total capacity of satellite treatment plants is limited by sewer flows in outlying areas (fewer users can be served from SWRFs).

2. Full primary, secondary and tertiary treatment processes are required.
3. Nitrification/denitrification step was included to meet requirements of future GRRPs.
4. Solids from SWRFs would be sent to the RWRF for treatment.
5. A range of treatment alternatives were considered:
   a. Activated sludge process followed by media filtration and UV (lower cost).
   b. Membrane bioreactor (MBR) followed by ozone or UV (higher cost)
6. Satellite plants would be located on City owned property. Footprint for AS process was estimated to be between 6 to 8 acres. Footprint for MBR process was estimated to be about two acres.
7. MBR costs were estimated based on cost curves developed from bid tabs (see Figure 1 below).
8. Costs for AS process with NdN were scared from SEGA 2006 Satellite study update.

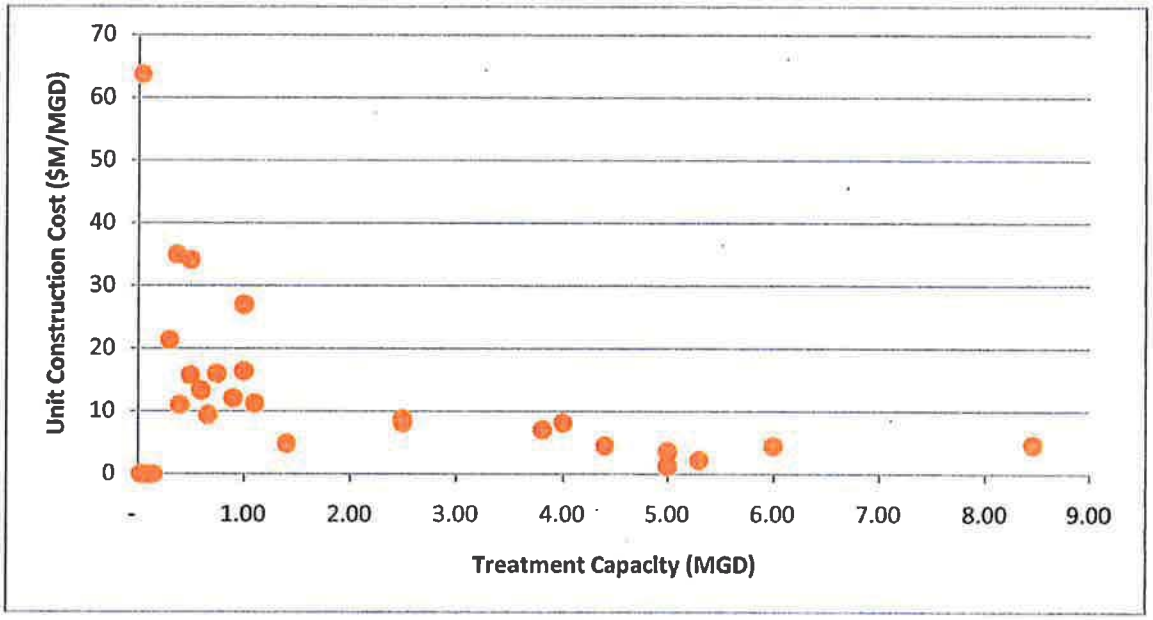



**FIGURE 1**
**MBR SATELLITE TREATMENT PLANT COST CURVE**
**RECYCLED WATER MASTER PLAN**
**CITY OF FRESNO**

The following assumptions were used to develop facilities costs for expansion of the North Fresno WRF:

1. Capacity of the NRWRD would be expanded from 0.71 MGD average dry weather flow to 1.08 MGD average dry weather flow.
2. SBR process will be maintained.
3. Existing chlorination system will be replaced with UV or ozone.

4. Media filtration and disinfection costs were estimated based on recent bid tabs and vendor quotes.

### 4.2 Pipelines

The following assumptions were used to develop the distribution system pipeline cost estimates:

1. Open cut installation with a trench section reflecting vertical trench sections.
2. Identification of existing utilities and consideration of alternative construction methods in some locations to avoid interface of existing utilities.
3. Native material will be used as trench backfill.

## 5.0 COST ESTIMATES

The cost estimates herein are based on our perception of current conditions in the project location. The estimates reflect our professional opinion of accurate planning level costs at this time and will be subject to change as the project matures in the future design phases.

Estimates of facilities were grouped into two alternatives (of which the second alternative has two options) that included:

- Alternative 1 – Treatment at RWRF
- Alternative 2 – Treatment at SWRF utilizing MBR with Ozone and UV (high costs)
- Alternative 3 – Treatment at SWRF utilizing Activated Sludge with UV (low costs)

From these alternatives, total capital costs were calculated for the distribution system (including pump stations), treatment plant, and storage. Capital costs were then "normalized" to $/MGD costs for comparison of alternatives. Shown in Table 3 is a summary of the cost estimates for alternatives identified in the Recycled Water Master Plan.

Table 3 Summary of Construction Cost Estimates for the Master Plan Project Alternatives
Recycled Water Master Plan
**City of Fresno**

| Alternative | Length (mi) | Delivery (AFY) | Distr. Sys. Costs ($M) | Treatment capacity | Treatment Costs ($M) [1] | $/gallon - Treatment | Storage volume (MG) [2,3] | Storage Costs ($M) | $/gallon - Storage | Total Capital Costs ($M) | $/MGD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SW-1 | 36.28 | 4,125 | 48.7 | 5.5 | 12 | 2.15 | 0/8.1 | 7 | 0.86 | 68 | 12.3 |
| NW-1 | 28.1 | 1,877 | 49.8 | 5.3 | 9 | 1.70 | 0/6.9 | 6 | 0.87 | 65 | 12.2 |
| NE-1 | 16.17 | 2,720 | 39.6 | 4.8 | 11 | 2.29 | 0/6.1 | 5 | 0.82 | 56 | 11.6 |
| SE-1 | 7.35 | 995 | 16.6 | 2.8 | 6 | 2.14 | 0/5.1 | 4 | 0.78 | 27 | 9.5 |
| total | 87.9 | 9,717 | 155 | 18.4 | 38 | | | 22 | | 215 | |

**Alternative 2 Costs (with MBR)**

| Alternative | Length (mi) | Delivery (AFY) | Distr. Sys. Costs ($M) | Treatment capacity | Treatment Costs ($M) [4] | $/gallon - Treatment | Storage volume (MG) [2] | Storage Costs ($M) | $/gallon - Storage | Total Capital Costs ($M) | $/MGD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SW-2 [5] | 32.46 | 4,139 | 36.3 | 5.5 | 50 | 9.09 | 0.4/4.1 | 7 | 1.56 | 93 | 17.0 |
| NW-2 | 21.5 | 1,709 | 24.8 | 4.7 | 51 | 10.85 | 0.7/1.2 | 3 | 1.58 | 79 | 16.8 |
| NE-2 [6] | 1.75 | 508 | 4.3 | 1.08 | 5 | 4.63 | 0/0 | 0 | - | 9 | 8.6 |
| NE-3 | 3 | 4,900 | 6.1 | 4 | 47 | 11.75 | 2-Jan | 4 | 2.11 | 57 | 14.3 |
| SE-2 | 9.09 | 951 | 5.4 | 3 | 36 | 12.00 | 0/2.6 | 4 | 1.54 | 45 | 15.1 |
| total | 67.8 | 12,207 | 76.9 | 18.28 | 189 | | | 18 | | 284 | |

**Alternative 2 Costs (with activated sludge)**

| Alternative | Length (mi) | Delivery (AFY) | Distr. Sys. Costs ($M) | Treatment capacity | Treatment Costs ($M) [7] | $/gallon - Treatment | Storage volume (MG) [2] | Storage Costs ($M) | $/gallon - Storage | Total Capital Costs ($M) | $/MGD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SW-2 [5] | 32.46 | 4,139 | 36.3 | 5.5 | 37 | 6.73 | 0.4/4.1 | 7 | 1.56 | 80 | 14.6 |
| NW-2 | 21.5 | 1,709 | 24.8 | 4.7 | 35 | 7.45 | 0.7/1.2 | 3 | 1.58 | 63 | 13.4 |
| NE-2 [8] | 1.75 | 508 | 4.3 | 1.08 | 5 | 4.63 | 0/0 | 0 | - | 9 | 8.6 |
| SE-2 | 9.09 | 951 | 5.4 | 3 | 26 | 8.67 | 0/2.6 | 4 | 1.54 | 35 | 11.8 |
| total | 64.8 | 7,307 | 70.8 | 14.28 | 103 | | | 14 | | 188 | |

(1) Alternative 1 treatment costs assume media filtration + UV; include feed pump station
(2) Influent storage/effluent storage
(3) Half of effluent storage provided at RWRF in existing basins
(4) Alternative 2 treatment costs assume MBR + UV; include feed pump station
(5) Partially served from the RWRF and partially served from a new SRWF
(6) Expansion of North Fresno WRF to 1.08 mgd w/ SBR and UV
(7) Alternative 2 treatment costs assume Activated Sludge (with NdN) + UV (include feed pump station)
(8) Includes pipeline from RWRF and expansion of North Fresno WRF to 1.08 mgd w/ SBR and UV

pw:\Documents\Client\CA\Fresno\8230A00\Data\Task 08\Cost Summary.xlsx

# APPENDIX G – BENEFIT – COST ANALYSIS

# City of Fresno Recycled Water System Expansion Economic Analysis

*Prepared by:*

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PO Box 4059
Boulder, CO 80306-4059
303-381-8000

*Under subcontract to:*

Carollo Engineers

*Contact:*

James L. Henderson

July 30, 2010

# City of Fresno Recycled Water System Expansion Economic Analysis

This chapter contains an economic analysis of the expansion of the City of Fresno's (the City's) recycled water system, as detailed in the City of Fresno Recycled Water Master Plan, and explores the potential types of environmental, social, and economic benefits that may accrue to the City, agricultural water users in the Fresno Irrigation District (FID), urban irrigation users in Fresno, and the general public.

The analysis starts with an introduction to economic analysis of recycled water projects, and in particular, the Triple Bottom Line (TBL) form of the benefit-cost analysis (BCA). This is followed by a short project summary, followed by a discussion of defining the baseline for the analysis and other assumptions made to set up the analysis. Project costs are then summarized, followed by a detailed discussion of project benefits. After discussion of additional social costs, a section containing sensitivity analysis is included at the end of the analysis. The effect of alternate assumptions regarding the appropriate discount rate and other key assumptions is explored in that section. This is followed by a summary of analysis conclusions.

## 1. Introduction

Although recycled water is often more expensive than some traditional options for providing water, recycled water provides some benefits that these other alternatives do not. Therefore, it is important to go beyond cost comparisons by also considering how the benefits of reuse compare to its cost. To do this, a clear distinction must be made between financial and economic analysis:

1. A financial analysis of water reuse is based solely on the cash flows of expenses and revenues in and out of the agency

2. An economic analysis provides a benefit/cost perspective by considering a broader view of the value of the reclaimed water.

By focusing solely on revenues, a financial analysis provides an overly narrow perspective of the "value" of the waters provided. For example, a financial analysis does not include benefits to the environment and social costs avoided when reuse enables a community to forgo developing alternative water supply options. Therefore, it is important to consider the benefits and costs of each option, rather than considering only costs.

Water and wastewater programs are typically evaluated using cost-effectiveness (C-E) analysis. Using a C-E analysis, the least expensive alternative is identified for obtaining a specific outcome. This assumes that the level of benefits from the various options is identical and the only important distinction is cost. In contrast, the BCA looks at relevant options and explores how the benefits and costs compare to each other, providing a method of evaluating the full social and environmental impacts of the project. The BCA approach helps identify if an objective is worth pursuing and/or which options provide the greatest net benefit to society. The TBL approach used below is a variant of the BCA approach.

The TBL is a planning tool that helps agencies track their progress toward promoting sustainability and is a streamlined version of a social BCA. Benefits and costs identified in the economic analysis are categorized into one of three bottom lines, which consist of:

1. A **financial** bottom line that reflects the cash flow accounting stance of the agency. In addition to any revenues from deliveries of water to new customers, this category often includes any financial benefits in terms of avoided costs and cost offsets due to avoiding other water resource management options. This might include avoiding development of an alternative water supply, or upgrading a wastewater treatment system to protect water quality.

2. The **social** impacts that reflect impacts on societal values. Social benefits take numerous forms, including adherence to a widely shared "environmental ethic" for recycling and the use of "green" approaches to local resource management challenges. This can also include increasing water supply reliability, thereby promoting societal security.

3. The **environmental** impacts that reflect effects on the natural environment. Environmental benefits can include many of the ecological services and environmental values enjoyed by the public. This can range from the value of wetland habitat and the potential wildlife values associated with it, to the avoided degradation of water quality in water bodies that receive wastewater.

## 2. Project Summary

The recommendation of the Recycled Water Master Plan is to expand distribution of recycled water from the Regional Wastewater Reclamation Facilities (RWRF). The City currently produces nearly 80,000 acre-feet of wastewater per year at the RWRF. The City and FID have an agreement whereby the City extracts 30,000 acre-feet per year (AFY) of percolated effluent for delivery to FID canals for use by local farmers. The majority of the remaining effluent is available for other beneficial uses.

The overall goal of expanded recycled water use in Fresno is to offset the City's potable water use, enhance the sustainability of the water supply, and lessen the burden on the wastewater treatment plant percolation ponds that are currently used for effluent discharge. Recommended reuse opportunities include urban reuse, agricultural reuse, and groundwater recharge. If all the users identified for urban reuse are served, the potential urban reuse opportunity for existing larger users is over 9,800 AFY. Serving existing and future residential and commercial users would result in additional use of over 4,300 AFY. The potential amount of agricultural reuse is approximately 24,200 AFY, including 4,200 AFY in expansion of undisinfected secondary delivery to farmers adjacent to the RWRF, and 20,000 AFY of expansion of pumping for delivery to FID over the next 30 years. However, agricultural reuse will not generate potable offsets for the City unless FID is willing to trade recycled water for surface water to augment the City's potable supply. This outcome is dependent on negotiations between FID and the City. And, groundwater recharge is recommended to the extent practical in the northwest, southwest and southeast quadrants of the City.

It was assumed for analysis purposes that the project would start in the year 2011, and span 30 years until 2040. Potential phasing of the project is divided into short term (0-3 years), medium term (4-10 years), and long term (greater than 10 years). This phasing was roughly interpreted for economic analysis purposes, and start years were assigned to specific parts of the project based on the master plan recommendations.

Table 1 summarizes the result of the BCA, including monetized and qualitative benefits, and the stakeholders that accrue those benefits. This table shows that monetized benefits for the project are estimated to outweigh the monetized costs when a 2.5% real discount rate is used. Net monetized benefits are estimated to be $9.4 million, and total net benefits are believed to be much higher than that when non-monetized benefits and costs are considered. The costs and benefits shown in this table are discussed in detail in Sections 4 and 5.

**Table 1. BCA Overview – Using 2.5% Real Discount Rate (millions, 2010 USD)**

| Benefit or Cost Category | Present Value | Stakeholder Accruing Cost or Benefit |
|---|---|---|
| **Costs – Total** | | |
| Capital and O&M costs | 335.8 | City of Fresno |
| **Monetized Benefits** | | |
| Avoided alternative water supply costs | 77.4 | City of Fresno |
| Avoided water quality treatment costs | 252.5 | City of Fresno |
| Avoided agricultural water supply costs | 1.7 | Farmers |
| Avoided fertilizer costs for agriculture | 8.9 | Farmers |
| Avoided fertilizer costs for urban irrigation | 4.7 | Urban irrigators |
| Total monetizable benefits | 345.2 | |

| Qualitative Benefits and Costs | Relative Magnitude* | |
|---|---|---|
| Long-term gain in wildlife habitat | ++ | Public |
| Demonstration of "green" water use ethic | + | City of Fresno |
| Improved diversification of water supply portfolio | + | City of Fresno |
| Public perception of recycled water | – | Public |
| Short-term construction impacts | – | Public |
| **Total Net Benefits (Monetizable Benefits – Costs)** | 9.4 | |

All values in millions of dollars.
Assume 2.5% real discount rate and 30-year analysis period.
O&M = operations and maintenance.
* Magnitude of likely effect on net benefits:
++ = Likely to increase net benefits significantly.
+ = Likely to increase net benefits relative to quantified estimates.
U = Uncertain effect on net benefits relative to quantified estimates.
– = Likely to decrease net benefits.
– – = Likely to decrease benefits significantly.

# 3. Defining the Baseline and Setting Up the Analysis

## 3.1 Baseline Definition

The baseline for a project reflects the actions or the conditions that are expected in the future if the proposed project is not undertaken. The baseline not only needs to account for current conditions, but also to reflect changes that are likely to occur over time in the absence of the investment in the project. Defining the baseline is especially important because some benefits of the project will follow directly from the definition of the without-project baseline. One benefit may be the result of avoiding alternate projects to supply the amount of water that will be supplied by the project. Another benefit may come from improving the quality of groundwater supplies.

For this project, there are both water quantity and water quality aspects to the without-project baseline. The main driver from a water quality standpoint is that the City is required by the Central Valley Regional Water Quality Control Board (RWQCB) to improve the quality of the groundwater beneath the percolation ponds. Reducing the hydraulic and constituent loading burden on the percolation ponds by implementing a significant reuse program would lower the concentrations of these constituents in the groundwater. The six major pollutants identified were arsenic, manganese, total dissolved solids (TDS), electrical conductivity (EC), sodium, and total nitrogen. Without the proposed project, the City will not be able to follow one of the major recommendations in the "Best Practicable Treatment and Control (BPTC) Comprehensive Evaluation" submitted to the RWQCB in December 2009, which is to reduce the hydraulic and contaminant of concern loading into the percolation ponds by direct effluent recycling. In that case, the City would have to consider other ways to remove the contaminants of concern, including installing a reverse osmosis (RO) plant to treat a similar amount of water as would reliably be removed via the proposed reuse project.

From a water quantity standpoint, the City is planning for recycled water use to help meet growing overall demands for City-supplied water. Without the proposed project, the City would have to seek alternative supplies, mostly from projects that are in various stages of planning and some of which do not yet exist, including local groundwater banks or the proposed Temperance Flat Reservoir on the San Joaquin River. Using more groundwater to meet projected demands is not considered an option because of the City's goal to enhance the long-term sustainability of the City's water supply. This includes reducing groundwater use to be aligned with annual recharge rates in order to stop groundwater level declines that are expected to increase into the future if the current amount of groundwater use is projected into the future.

## 3.2 Choice of Discount Rate and Analysis Period

Several standard assumptions were made to frame this analysis. The economic analysis is performed in real dollars, meaning that benefit and cost values are shown to change over time only if they are projected to increase or decrease at a rate different from the expected rate of inflation (3%). A real discount rate of 2.5% was used in the analysis, based on a general cost of capital for water utilities of around 5.5%. The real discount rate can roughly be calculated by subtracting the expected rate of inflation (3%) from the nominal cost of capital (5.5%). The

analysis period was set to 30 years in order to match the average expected life of the assets to be installed with the project, and the analysis period set in the Recycled Water Master Plan.

# 4. Costs

The present value costs of the proposed recycled water project were determined based on the planned timing for development and implementation of the individual alternatives, as outlined in the master plan recommendations. Costs are included for development of urban and agricultural reuse opportunities, as well as for groundwater recharge.

Table 2 presents the present value capital and O&M costs associated with each of the preferred recycled water alternatives. Cost estimates were determined based on a real discount rate of 2.5% over a 30-year project time period. As shown in Table 2, project costs are expected to total $320 million in present value. Detail on expected project costs is explained in the section on project alternatives in the Recycled Water Master Plan.

**Table 2. Present Value Costs* for Proposed Reuse Alternatives (millions, 2010 USD)**

| | Capital Costs | O&M Costs | Total Costs |
|---|---|---|---|
| **Low Cost Scenario** | | | |
| Urban reuse alternatives (Alternative 1 existing larger users) | $208.6 | $45.4 | $254.0 |
| Agricultural reuse alternatives (Alternatives AG1 and AG2) | $17.8 | $11.9 | $29.7 |
| Groundwater recharge (assuming 50% of identified basins are constructed) | $45.7 | $6.4 | $52.1 |
| Total | $272.1 | $63.7 | $335.8 |

* Present value costs are calculated by assuming timing of expenditures over the 30-year project life and discounting costs to present value using a real discount rate. Therefore, present value costs will differ slightly compared to the costs upon which they are based that are shown in the master plan.

# 5. Benefits

## 5.1 Financial Benefits

### Avoided alternative water supply costs

The City is counting on adding recycled water to its portfolio of water supplies starting in 2020 in order to meet projected demand while maintaining more sustainable groundwater withdrawal amounts. Without the projected recycled water supply, the City would not meet the deficit with groundwater withdrawals. Instead, the City would need to develop other potential supply sources that are in various stages of conceptual development at present. Those sources include local water banks to store flood releases on the San Joaquin or Kings River, or the proposed Temperance Flat Reservoir on the San Joaquin River.

It is unclear how the City would participate in water banks it does not directly develop, such as FID's Waldron Pond. No information was available on detailed plans for Fresno's development of water banks, possibly with other jurisdictions. It is uncertain therefore how reliable the supply that might be available to Fresno from a water bank would be, or what the cost will be.

The U.S. Bureau of Reclamation (the Bureau) published an analysis of the proposed Temperance Flat project (U.S. Bureau of Reclamation and California Department of Water Resources, 2008). The preferred option is estimated to cost $3.35 billion, and would provide between 112,000 and 180,000 AFY. The Bureau calculated an annualized cost for this project of $169 million, based on a 100-year amortization time period and a 4.875% interest rate. Simply dividing the annual cost by the annual yield results in water costing roughly $950 to $1,500 per AF per year. The analysis does not clearly specify the share of water yield that will go to municipal and industrial (M&I) use as opposed to agricultural use, nor does it provide the details behind the Bureau's benefits calculations. Analysis by Peter Gleick of the Pacific Institute roughly calculates that the Bureau is assigning a value of $850 per acre foot (AF) to M&I benefits from the project (Gleick, 2009). Analysis by an economist reviewing the Bureau's study calculates an implied value of alternative supplies of over $600 per AF (Michael, 2009). A value of $600 per AF also has generally been mentioned as the willingness to pay for Los Angeles to acquire available supplies from the area (Subcommittee on Water and Power, 2005). We use $600 per AF as a conservative cost of fully developing a project, with a realization that a project such as Temperance Flat would result in much higher costs. However, if a project already developed by another entity would allow Fresno to store excess water, then the cost per AF could be lower.

For this study, the $600 per AF estimate is applied only to the cost to replace the recycled water scheduled for urban use, because this is the portion of recycled water supply that can be relied upon to create a potable water offset. This results in $2.5 million in avoided cost in the intermediate term of the project, jumping to $5.8 million per year as more urban uses are switched to recycled water. The total present value of water supply development costs to serve urban uses that are avoided by recycled water use is $82.5 million over the 30-year project life.

**Avoided water quality treatment costs**

The City is required by the RWQCB to improve the quality of the groundwater beneath the percolation ponds. Constituents of concern are salts, nitrogen, and metals (arsenic and manganese) that are mobilized from the alluvium by effluent percolation. Reducing the hydraulic and constituent loading burden on the percolation ponds by implementing a significant reuse program would reduce the concentrations of these constituents in the groundwater.

Under the recommended approach for recycled water development, urban reuse would be combined with agricultural reuse and groundwater recharge to expand the use of effluent produced. To the extent that the produced effluent would otherwise have been discharged at the RWRF evaporation ponds, then the constituent and hydrologic loading burden at the ponds will be reduced and the concentrations of these constituents in the groundwater will be reduced.

One way to understand the value of the recycled water program in reducing constituent loading at the RWRF is to consider other possible methods to reduce constituent loading. One possibility that has been explored specifically for reducing concentrations of salts (as measured either by

TDS or by sodium) discharged at the RWRF is the use of a RO plant. The alternatives that have been explored include a 10% removal of TDS, a 10% sodium removal, and a 25% sodium removal. Alternative methods for removal include a pellet reactor system and a brine concentrator.

Under the recommended approach in the Recycled Water Master Plan, urban reuse from larger users alone would remove up to 9,800 AFY from disposal at the RWRF treatment ponds. This volume matches the volume of water that would be treated via RO under the 10% TDS removal target. While serving existing and future residential and commercial users as well as agricultural users may further reduce discharge of constituents at the RWRF ponds, depending on the location of recycled water use production, this urban reuse amount is used as a conservative illustration of the cost to otherwise remove constituents of concern.

Capital costs for the 10% TDS removal alternative range from $180.0 million for the pellet reactor option to $170.2 million for the brine concentrator, after updating to January 2010 dollars (costs updated from September 2007 original estimate using the Construction Cost Index from the Engineering News Record). O&M costs range from $6.3 million per year for the pellet reactor option to $33.6 million per year for the brine concentrator option.

These costs include the brine disposal cost of $45 per ton to remove the brine from evaporation ponds. The brine concentrator option has the advantage of lesser brine production, but at the expense of higher O&M costs. In terms of present value costs of the 30-year analysis time period, the cost of the pellet reactor is significantly lower than the brine concentrator option. Assuming a real discount rate of 2.5%, the total present value cost of the pellet reactor over the 30-year project life is $278 million (vs. $738 million for the brine concentrator).

## 5.2 Social Benefits

### Reduced agricultural irrigation costs

Farmers that switch to the use of recycled water as their primary source of irrigation water will realize substantial cost savings. Recycled water will provide farmers with a reliable supply of water throughout the irrigation season. Farmers that use recycled water will benefit from avoiding costs associated with groundwater pumping in dry years (i.e., in years where surface water supplies from FID are unavailable later in the irrigation season).

After paying a per-acre assessment fee, farmers are allowed to irrigate fully until FID water supplies become unavailable. The irrigation season in Fresno typically runs from March 1 to August 31. The point in the year at which FID water supplies are no longer available depends on the level of Kings River runoff. For example, in a year where Kings River runoff is at 40% of normal, surface water irrigation supplies may be cut off in July. Farmers pay the same per-acre fee at the beginning of each season, regardless of how long surface water is available. In 2010, this charge ranged from approximately $29 to $47 per acre per year, depending on the type of water service.

In years when runoff is below normal (i.e., years when surface supplies become unavailable prior to the end of the irrigation season), most farmers will switch to a secondary source of water

(i.e., groundwater). Groundwater is much more expensive than surface water, and is estimated to cost about $25 to $35 per AF of water (including pumping). Farmers pay their own costs to pump groundwater, in addition to the assessment fee.

To estimate benefits to farmers, we determined the frequency of shortages (i.e., years when Kings River runoff is below normal) in recent years, as well as the average shortage amount during those years (percent below normal). Data back to 1980 show a shortage in 18 of the past 30 years, or a 60% probability of shortage. The average delivery amount in years with below normal deliveries compared to the long-term average normal delivery over the past 100 years was 61%. We used these two measurements to determine an annual average shortage amount of 23% (1 minus the sum of 60% of years at 61% delivery and 40% of years at 100% delivery), meaning that on average, farmers will need to supplement 23% of their irrigation supplies with groundwater. Based on the estimated average cost of $30 per AF for groundwater irrigation, the benefit from avoided supplemental groundwater pumping is estimated to be about $6.97 per acre per year.

Over the next 30 years, when taking into account the timing and implementation of the agricultural alternatives, the total present value of the annual avoided costs amounts to approximately $1.7 million, assuming a real discount rate of 2.5%.

**Avoided fertilizer costs for urban reuse**

This project also will allow for reduced fertilizer use for municipal irrigation users such as parks, schools, and golf courses that are expected to take recycled water. Nutrients available in recycled water will allow municipal irrigation users to reduce fertilizer treatment applied to the soil. Urban use of recycled water is expected to total up to 9,800 AFY for existing larger users such as golf courses, parks and schools that would typically use lawn fertilizers.

Although exact offset of fertilizer use from use of recycled water is difficult to estimate due to daily and seasonal nutrient variations in the recycled water, an estimate is available from the potential fertilizer value of recycled water produced from the Irvine Ranch Water District. This value is used to calculate the potential benefits from the offset of fertilizer use from this project. Using a fertilizer price index for the United States from the Food and Agriculture Organization of the United Nations (FAO), and after adjusting for existing data on the nitrogen, potassium, and phosphorus values of recycled water produced at the Fresno RWRF, the value of offset fertilizer use per AF of water applied is $36.56, when updated to 2010 dollars (updated from Asano, 1981). When multiplied by the amount of recycled water to be delivered from this project for urban irrigation for larger users (9,800 AFY), the total avoided fertilizer cost is approximately $358,000 per year. Assuming a 2.5% real discount rate, the present value of this benefit over the assumed 30-year life of the project is approximately $4.7 million.

**Avoided fertilizer costs for agricultural reuse**

This project will allow for reduced fertilizer use for agricultural users expected to take recycled water. Recycled water contains substantial amounts of nitrogen, phosphorus, and potassium (Kopec et al., 1993). Nutrients available in recycled water will allow agricultural users to reduce

fertilizer treatment applied to the soil. Agricultural use of recycled water is expected to total up to 24,200 acre-feet by the end of the project.

Although the exact offset of fertilizer use from the use of recycled water is difficult to estimate due to daily and seasonal nutrient variations in the recycled water, an estimate is available from the potential fertilizer value of recycled water produced from the Irvine Ranch Water District. This value is used to calculate the potential benefit from the offset of fertilizer use from this project. Using a fertilizer price index for the United States from the FAO, and after adjusting for existing data on the nitrogen, potassium, and phosphorus values of recycled water produced at the Fresno RWRF, the value of offset fertilizer use per AF of water applied is $36.56, when updated to 2010 dollars (updated from Asano, 1981). When multiplied by the amount of recycled water to be delivered from this project for agricultural irrigation (up to 24,200 AFY when the project is fully developed), the total avoided fertilizer cost is approximately $884,000 per year. Assuming a 2.5% real discount rate, the present value of this benefit over the assumed 30-year life of the project is approximately $8.9 million.

**Demonstration of commitment to "green" water use ethic**

In many parts of the United States, there is a growing trend among individuals, local governments, and businesses to promote environmental stewardship and sustainability. The City is committed to being a leader in promoting sustainable water management. Using reclaimed water instead of potable water for irrigation is one way to help demonstrate environmental leadership. By posting the reclaimed water sign ("We're using water wisely by irrigating with reclaimed water"), the City's "green" image would be portrayed to all public park and golf course visitors and other individuals passing these sites.

This benefit cannot be monetized with the information available. However, this benefit was determined to potentially have a positive effect on the net benefits of the project if it could be monetized (a qualitative benefit rating of +).

**Improved diversification of water supply portfolio**

Adding a significant expansion of reclaimed water to the City's supplies will help diversify the City's supply portfolio. A major advantage of using reclaimed water is its relative insensitivity to droughts. Adding a drought-independent and locally controlled source of water can add important value, especially when other supplies in the portfolio have yields that are highly correlated with drought cycles.

This benefit cannot be monetized with the information available. However, this benefit was determined to potentially have a positive effect on the net benefits of the project if it could be monetized (a qualitative benefit rating of +).

## 5.3 Environmental Benefits

**Long-term gain in wildlife habitat**

RWRF is currently one of the most popular birding sites in the region. According to the eBird web site run by Cornell University, 75 different bird species were counted at the RWRF in 2009. The most frequently seen species include the northern shoveler (with a high count of 2,435 individual species at one time), the least sandpiper (high count of 1,500 individuals), and the American coot (high count of 1,100 individuals). Other species that visit the site in large numbers are the ruddy duck, bufflehead, eared grebe, American pipit, cliff swallow, tree swallow, and the long-billed dowitcher. According to the Fresno Audubon Society web site, RWRF is also one of the best places in Fresno County to spot burrowing owls, a California Species of Special Concern (eBird, 2010).

The northwest, southwest and southeast urban reuse alternatives include the development of Groundwater Recharge Reuse Projects (GRRPs). Due to the lengthy permitting processes involved with implementation, GRRPs will likely be phased in over time. These GRRPs are expected to provide wildlife habitat similar to the disposal ponds at the RWRF. As the project is implemented, the total number of acres at the RWRF is expected to decrease as less wastewater is disposed there, but this loss in acreage is expected to be more than made up for by the gain in acreage from the GRRPs.

Groundwater recharge is planned for implementation in the southwest and northwest quadrants. In the southwest quadrant, 839 acres of land have been identified for potential recharge. This does not include areas identified for superrecharge basins. The superrecharge basins could potentially add an additional 405 acres, for 1,244 acres total. In the northwest quadrant, 303 acres of land have been identified for potential recharge, not including superrecharge basins. Including the superrecharge basins, the total potential recharge area amounts to 883 acres for the northwest quadrant. In the southeast a superrecharge basin has been identified with 320 acres. In total for the three quadrants, this amounts to about 1,142 acres of pond/recharge area, or 2,447 total acres with the superrecharge basins. However, it is likely that many of these sites will be found to be unsuitable or not easily acquired. Therefore, the total recharge pond area is likely to be significantly less. The costs assumed for groundwater recharge in this analysis are based on developing half of the additional acres identified for recharge. This implies the addition of 571 acres over the 30-year time period (839 acres + 303 acres, divided by 2). This does not count any acres developed in superrecharge basins, which would be developed by the Water Division.

Although overall acres of pond habitat will increase, pond acreage at the RWRF will decrease due to lower levels of discharge from the treatment facility. Table 3 shows the expected decrease in pond acreage at RWRF as a result of the proposed project at full implementation. It is not clear how the timing of these reductions will be phased. The acreage shown here assumes a future scenario of full development of urban irrigation and agricultural recycled water use as recommended in the master plan over the 30-year planning period, and half of potential total recharge acres identified in the plan.

Thus, the additional pond acreage provided under the GRRPs is expected to offset the reduction in acreage at the RWRF by at least 200 acres. Assuming the GRRP ponds provide similar habitat to those at RWRF, the overall project will result in net benefits. However, there may be temporary negative impacts if the loss of acreage at RWRF starts occurring before the GRRPs are implemented.

**Table 3. Projected Change in Wastewater Disposal Pond Area at the RWRF By Month* (values in acres, unless otherwise noted)**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current ponding area | 1,107 | 1,233 | 1,160 | 794 | 934 | 973 | 942 | 1,063 | 974 | 1,076 | 1,211 | 1,260 |
| Estimated pond area with project | 915 | 980 | 897 | 603 | 682 | 635 | 561 | 704 | 732 | 961 | 962 | 1,021 |
| **Change in Acres** | 192 | 253 | 263 | 191 | 252 | 338 | 381 | 359 | 242 | 115 | 249 | 239 |
| **Percent Change** | -17% | -21% | -23% | -24% | -27% | -35% | -40% | -34% | -25% | -11% | -21% | -19% |

* Based on assumed future scenario of full development of urban irrigation and agricultural recycled water use as recommended in the master plan over the 30-year planning period, and half of potential total recharge acres.

This benefit cannot be monetized with the information available. However, this benefit was determined to potentially have a significantly positive effect due to increased habitat potential on the net benefits of the project if it could be monetized (a qualitative benefit rating of ++).

# 6. Additional Social Costs

### Public perception of recycled water

Public perception of recycled water use by municipal users may be negative, in some settings and with some members of the public. A key concern for use of reclaimed water in irrigation of public areas is the potential presence of pathogenic microorganisms in the influent wastewater. However, ensuring that the wastewater and recycled water treatment systems are effective and reliable, and controlling the extent of human exposure to reclaimed water, can minimize health risks (Asano, 2001). The treated wastewater standard for unrestricted irrigation of public spaces includes a bacterial concentration of less than 2.2 Most Probable Number (MPN) total coliform per 100 milliliters. This critical parameter for the effluent is currently and will continue to be monitored daily at the RWRF.

This cost of potential negative public perceptions cannot be monetized with the information available. However, it was determined to potentially have a negative effect on the net benefits of the project if monetized (a qualitative benefit rating of –).

### Short-term construction impacts

Short-term construction impacts are expected with the proposed project. Any adverse effects have been determined to be temporary or mitigated.

This cost was not monetized, however, it was determined to potentially have a negative effect on the net benefits of the project if it could be monetized (a qualitative benefit rating of –).

# 7. Sensitivity Analysis

## 7.1 Discount Rate

The net benefits for the project are not very sensitive to the choice of discount rate. The effect of using a 6% real discount rate instead of a 2.5% real discount rate on the analysis for the proposed project can be seen in Table 4. Rules for recent analyses for Integrated Regional Water Management implementation grants from the State of California have stipulated the use of a 6% real discount rate. This choice of discount rate means that costs and benefits incurred in the early project years are relatively much more highly valued than when the cost of capital for water and wastewater utilities and the prevailing rate of inflation are used to calculate a real discount rate. However, due to the relatively even spread of both project benefits and costs over the 30-year analysis period, use of the 6% discount rate only reduces the present value of net benefits to $4.0 million, down from the $9.4 million value derived with a 2.5% discount rate.

**Table 4. BCA Overview – Sensitivity Analysis When Using 6.0% Real Discount Rate (rather than 2.5%) (millions, 2010 USD)**

| Benefit or Cost Category | Present Value | Stakeholder Accruing Cost or Benefit |
|---|---|---|
| **Costs – Total** | | |
| Capital and O&M costs | 247.7 | City of Fresno |
| **Monetized Benefits** | | |
| Avoided water supply costs | 42.2 | City of Fresno |
| Avoided water quality treatment costs | 201.2 | City of Fresno |
| Avoided agricultural water supply costs | 0.9 | Farmers |
| Avoided fertilizer costs for agriculture | 4.9 | Farmers |
| Avoided fertilizer costs for urban irrigation | 2.6 | Urban irrigators |
| Total monetizable benefits | 251.7 | |

| Qualitative Benefits and Costs | Relative Magnitude* | |
|---|---|---|
| Long-term gain in wildlife habitat | ++ | Public |
| Demonstration of "green" water use ethic | + | City of Fresno |
| Improved diversification of water supply portfolio | + | City of Fresno |
| Public perception of recycled water | – | Public |
| Short-term construction impacts | – | Public |
| **Total Net Benefits (Monetizable Benefits – Costs)** | 4.0 | |

All values in millions of dollars.
Assume 6.0% real discount rate and 30-year analysis period.
* Magnitude of likely effect on net benefits:
++ = Likely to increase net benefits significantly.
+ = Likely to increase net benefits relative to quantified estimates.
U = Uncertain effect on net benefits relative to quantified estimates.
– = Likely to decrease net benefits.
– – = Likely to decrease benefits significantly.
Sum of benefit values do not exactly equal the total shown for monetizable benefits due to rounding.

### 7.2 Cost of Alternative Water Supplies

A key assumption is the cost of alternative water supplies that would be needed if not for the recycled water supply that will provide potable water offsets. A value of $600 per AF was used in this analysis as a best estimate of the cost of alternative water supplies. Exploration of the sensitivity of the net benefits from the project to the assumption of cost of alternative water supplies shows that the project continues to have positive net benefits until the cost of alternative water supplies is lowered to $527 per AF, assuming a 2.5% discount rate.

On the other end of the spectrum of alternate water supply costs, the high end of the cost per AF cost range for the proposed Temperance Flat Reservoir is approximately $1,500 per AF. If the value of alternate supplies is set to $1,500 per AF for this analysis, the net benefits from the project rise to $125.4 million, assuming a 2.5% discount rate.

## 8. Conclusions

The expansion of the City recycled water system will provide recycled water to offset some of the City's potable water use, enhance the sustainability of the water supply, and lessen the burden on the wastewater treatment plant percolation ponds that are currently used for effluent discharge.

The net benefits (benefits minus the costs) from the project are $9.4 million, when analyzed using a 2.5% discount rate, and the benefits for the project are approximately 103% of the costs. The largest benefit category is the avoided cost of reducing the hydraulic and constituent loading burden on the percolation ponds at the RWRF by another means besides implementing a significant reuse program to reduce the concentrations of these constituents in the groundwater. The alternate method investigated here for removing those pollutants is construction of a RO plant. The analysis concentrated only on the relief of constituent loading burden that would be provided by urban reuse for larger users, or approximately 9,800 AFY. Avoiding construction and operation of this RO plant would provide a present value of approximately $252 million in benefit from avoided capital and O&M costs during the 30-year analysis period.

The recycled water used for irrigation also is a significant source of water supply for Fresno. Without that water supply, the City would need to find an alternate water source. Using more groundwater is not an option, and Fresno will be making full use of its surface water supplies by 2020. So, the alternative is water banking facilities that are not yet developed or for which Fresno does not have agreements to store water, or other water supply projects that are very uncertain in their cost and potential yield for Fresno. A value of approximately $600 per AF is assumed based on recent analyses of alternative supplies. If the value of offset urban irrigation for larger users alone is counted, the value of avoided alternative water supply totals $77.4 million over the 30-year analysis period in present value. If the costs of alternative supplies is greater than $600 per AF, then the sensitivity analyses reveal that the net benefits of the reuse program would increase significantly.

Additional monetized benefits from recycled water use include avoided agricultural water supply costs, and avoided fertilizer costs for both agricultural and urban irrigation users, due to nutrients

contained in the recycled water. These benefits, over the 30-year analysis period, total approximately $15.3 million in present value.

There are important benefit values that could not be monetized as well. Development of groundwater recharge basins over time is expected to result in a large net gain of ponding area that is a benefit to a wide variety of birds and other wildlife. In addition, use of recycled water allows the City to demonstrate a commitment to environmental stewardship and sustainability. And, the addition of recycled water to the water supply portfolio adds a supply that is not sensitive to droughts, and can better allow the City to cope with drought periods affecting its other supplies. These non-monetized benefits are expected to outweigh the non-monetized costs of short-term construction impacts, and the public perception of recycled water as having a public health risk. This accounting in favor of non-monetized benefits could add significant additional value to the monetized net benefits from the project, if they could be valued monetarily.

Sensitivity analysis showed that the result for the economic assessment was not sensitive to the choice of discount rate. When a 6% real discount rate is used, which is consistent with recent practice for analyzing grant applications for Integrated Regional Water Management implementation grants from the State of California, the net benefits for the project become only somewhat less positive – benefits are greater than costs for the project by $4.0 million with the 6% real discount rate, instead of $9.4 million with the 2.5% real discount rate.

Another key assumption explored with sensitivity analysis was the cost of alternative water supplies, which was assumed to be $600 per AF. Sensitivity analysis shows that the value of the monetized benefits for the project still cover the project costs until the cost of alternative water supplies is lowered to $527 per AF.

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# APPENDIX H – TAG MEETING MINUTES

CITY OF FRESNO
INCORPORATED OCT. 12, 1885

Carollo
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# CONFERENCE MEMORANDUM

| | | | |
|---|---|---|---|
| **Project:** | Fresno Recycled Water Master Plan | **Conf. Date:** | August 5, 2009 |
| **Client:** | City of Fresno | **Issue Date:** | August 7, 2009 |
| **Location:** | Fresno RWRF | | |
| **Attendees:** | City: Steve Hogg, Reace Fisher, Rick Staggs, Kevin Norgaard, Brock Buche<br>TAC members: Ron Young, Dave Requa, Jim Crook, Robin Saunders, Bob Jaques | Carollo: Lou Carella, Lydia Holmes, Penny Carlo, Tracy Clinton, Lorien Fono<br>BCF: Karl Kienow, Luis Gonzalez<br>Jeffery/Scott: David Bogdanov | |
| **Purpose:** | Visioning Workshop | | |
| **Distribution:** | Attendees, Steve Swanback, Jamel Demir | **File:** | 8230A.00 |

**Discussion:**
**The following is our understanding of the subject matter covered in this conference. If this differs with your understanding, please notify us.**

## Introduction

Purpose of the meeting is to identify implementation issues associated with developing a 25,000 acre-feet per year (AFY) potable offset with recycled water.

Steve - have opportunity to add new supply - not just offset, but need at least 25k AFY for offset
Priorities:

- Make sure we can make offset goal
- Make sure that we're making best use of water resources, best and highest uses
- Loking to relieve burden on perc ponds and other effluent management issues
- Doing the "green" thing,

Steve - Dept of Public Utilities is responsible for solid waste, water, wastewater and others. Easier because city is both producer and purveyor. City council is extremely supportive of recycled water. Formed water subcommittee made up of 3/7 council people to look at water issues. Good timing for getting projects done. Citizen advisory committees not yet used for recycled water. Found citizen committees to be effective tools on other issues. Anticipate for recycled water. Awareness of water resources is really heightened right now. Makes for prime environment to implement projects.

Brock - 13% surface water only includes treated water, not recharge water. Contract with USBR for 60k AFY and FID 105k AFY for recharge water.

Steve - currently recycling 30-35k AFY total of which 20-30k AFY is from extracted water from below the percolation ponds and 8-10 AFY is direct reuse of undisinfected secondary effluent, piped directly to users. Each off-site use has own WDR. Existing reuse doesn't count toward offset goal. Tulare Lake Basin Plan has goal of 100% reclamation, and goal is reflected in WDR.

Wetlands development has been discussed in Southwest. Audobon Society is active doing bird counts and regularly out at ponds. Recently added island in pond for bird habitat. Stream flow enhancement is not considered reuse but wetlands might be.

Dave asks Jim: are they at risk for more permitting for incidental recharge. Jim: as time goes on, perc ponds will need to meet more restrictive regulations. Steve:CDPH has required City to do SAT study do demonstrate 5-log removal.

Steve: There has been discharge here since 1891. In 1912 ,talked about doing extraction and putting in SJ river. In mid-40s, built 1st primary treatment w/ 600 acres of ponds. In 60s added secondary and 600 more acres of ponds. In 70s, capacity was 54 MGD. In 80s went to current capacity and 1700 acres of ponds.

FID agreements mean that district needs to approve removing percolate from their boundaries. FID may argue that even direct delivery is their purview. Only one user has agreement outside of FID, and FID made City pay them a portion of the proceeds. Technically the agreement has expired and runs on a year-to -year basis, and City can get out. Assimilative capacity beneath perc ponds is approx 45 mgd. FID argues they have more jurisdiction than the City thinks. City thinks they could go directly to landowner. FID complains they don't have enough water, but the city doesn't think so. FID delivers cheap water- $35/af (Federal water is $110/AF). There's no additional use within FID - area is saturated with active crops. Have higher priority on water from the Kings River than downstream irrigation districts.

Ron: There's a concern that if City hasn't exercised water rights from FID, they may lose them.

City of Clovis argues that because they have capacity ownership of facility, they argue that they own portion of effluent. Clovis' water supply is not as reliable as Fresno's . They wanted 10% of 0.46 afy exchange water ratio and FID gave it to them last year. Steve agrees with Ron that Clovis has a reasonable claim.

Steve discussed importance of harmonizing EIRs for different plans (Regional Water Master Plan, Metro Plan and SEGA development plan). SEGA final plan and EIR due in fall 2010.

City delivers all water in the City. FID only delivers irrigation water. FID believes that they are the ones with the water right to water they convey to the City.

Brock: There's a regional groundwater master plan that the City partnered on with FID and others.

**Recycling Opportunities**

***Irrigation Reuse***

Dave: Did "back-to-school nights" to help sell projects to the public - for school reuse. Ron: went to school board meetings - showed then how to save money with reuse.

Ron: EID got ordinance to dual plumb front and backyards. Its doable but it's a stretch. Its probably better to do commercially or by HOA managed areas. City would probably work with HOAs. Robin: Implement in parks and public areas first, then go to HOAs.

Bob: Pebble Beach Golf Course ran into problems because of site-specific conditions made

them more sensitive to TDS. Need to check with users as to their specific water quality needs.

Steve: having a hard time selling community that they don't need water softeners.

Dave: why can't scalping plant be turned on and off? (Because there are issues with biological processes)

Use of General permit for landscaping reuse - may not to be able to use permit because of multiple uses. Robin said they had different permits for different uses and each industrial user, but that may be specific to RB2.

Costing strategies - Ron: maybe charge the same amount as what is being charged now for potable water, especially if connection fees are paying for new infrastructure. Need to look at whole picture of city finances (40 year lifecycle cost), not just little picture of the project. In Elsnore, they have recycled water line item in budget. Dave says they charge the same for all kinds of water.

Rick: EC at Copper River is much lower than RWRF (300 micromhos/cm). This could indicate that effluent from north scalping plants is better for turf irrigation.

Haven't yet started outreach to sell recycled water to the community. Need to start now. Different pressures on different groups will help them accept recycled water. Jim wrote a WaterReuse Foundation report on using recycled water in schoolyard playgrounds. For Redwood City, it was a public relations failure - because they didn't get public input from the beginning.

Dave got developer to pay for project - both for dual plumbing and connection fees. Dave: had big new area where they required dual plumbing - but also got federal money to do retrofits. Tracy: Many schools already have separate systems for irrigation and internal use. Robin: once had to replumb a cemetery because there were hose bibs all over the place.

***Industrial Use***
Group agreed we should screen out washdown water for food processors.

No one thinks that industrial laundries use is a problem, but no one can identify an existing industrial laundries that uses recycled water.

Ron: industrial users are going to decided on a owner-by-owner basis, depending on benefit. Many laundries and car washes treat water internally. In Irvine had carpet dyer who really wanted recycled water and loved it because it was half the price.

Robin: Cement comes out stronger with recycled water.

Bob: algae would be a problem with open storage.

Cooling towers are major use.
Need to start talking to users to see their willingness and water quality needs.

***Groundwater Recharge***
Existing stormwater basins are managed by different agency (flood control district). Brock: need 800 AF of additional recharge facilities for surface water recharge. FID canals are used in

the winter to remove flood water from the City. Would need separate distribution system to convey wastewater to recharge basins in the winter. City is not fully using their entitlements because they don't have the infrastructure to do so.

Would need to prove buffer distances. Jim: the type of tracer study will lead to different buffer zones. New regulations are not expected anytime soon, especially not an adopted regulations.

Brock: 300 feet from nearest well seems way too low, even has problem with 900 feet. Wants to caution that this could be a larger problem. In the summer, the zone of influence of wells is 1800 feet. Penny: could shut down a well if necessary for a really good reuse site.

Brock: need to have 80% of wells operation at any given time to meet peak day demands. In future as move to more surface supply will still use groundwater system as a backup plan in extreme drought situation.

Penny: also need to consider plumes - don't want to make contamination move due to recharge

Jim: Probably want to do tracer studies before you start projects. Base design on theory, then come back and prove it. This was successful at Inland Empire, Orange County and West Basin. There are also issues with showing TOC reduction. Need to show that you meet all standards (including drinking water standards) at the bottom of the vadose zone. Inland Empire did this by putting in lysimeters.

Jim provided sequence of necessary steps to get a recharge project approved (separate handout). Will probably take a couple years to get a permit. One year at best.

At Inland Empire and Orange County, there was no public opposition to recharge projects, and probably West Basin. However, there have been problems in San Diego, the San Fernando Valley and also DSRSD. Probably going to put in a project in LA.

Dave: Get RWQCB to participate in all DPH meetings.

**Agricultural Exchange**

City of Fresno is 25% of FID land area.

There's a TMDL for EC in the SJ River.

To use canals as distribution system, need to look at conveyance capacity as well as where the canals go.

Steve: There's opportunity to negotiate for delivering water outside of FID. Only reason to go to unincorporated area is if current disposal operation becomes infeasible, since there is no opportunity for potable exchange.

There are some interconnects between FID and Consolidated Irrigation District.

It's possible that future regulations will be on what's at end of the pipe before percolation, so there would be no benefit to percolation.

There is significantly more capacity to extract percolate.

Can do undisinfected secondary on wine grapes, but not table grapes or raisins.

May expand delivery to Souza (farmer). Is there opportunity to get more water from FID for this? Ron: Could make a deal to get their water rights (eg. Pay for their assessment). Brock: This could be a good long-term new supply.

Corn and alfalfa are great crops because they uptake nitrogen. Need to confirm water use with Mohammad.

Bob: No real public perception issues since most local crops can't be bought in grocery. Most growers wanted to know what the technical issues are for irrigation operations and agronomic rates. Most engineers underestimate clogging problems in spray and drip irrigation due to algae. County health officials can add more requirements on top of Title 22. Signage was a requirement. Concern about farm workers. Needed to do farmworker health study, and there was no difference between before and after recycled water project. Steve: so far county public health hasn't been problem. Had to make sure farmers educate workers on the fact that it's not potable.

Jim: Are there any root crops in the area? Steve: Not immediately adjacent. Penny: Sensitive edible crops are about 1% of land around here.

Bob: why are they growing low value crops? Kevin: to support dairy farmers, because of soil conditions.

Steve: generally rotate between corn and alfalfa

Exchange contractors on the west side of the valley may be interested in getting effluent for opportunities for exchange.

***Fisheries/Environmental Enhancement***

There's water in Friant Dam that is required to be released. They could release less water from the dam, if City could supply some recycled water.

Robin: Water temperature could be an issue, like in San Jose/Coyote Creek.

Steve: Depends on where flow needs to enter the river. NE plant is overcommitted. Could use canal system to divert water to river.

There's also possibility for new wetlands in the north along the river. This wouldn't be an offset, but an additional disposal opportunity. Would also require an NPDES permit.

Discharge location is important. Could convey water through Houghton or Herndon canal.

**Opportunities by Region**

***Southwest***

Concept of locating additional treatment facilities at existing regional plant and running pipeline along Cornelia Corridor to parks/cemeteries, use old winery waste line (replace with pipe

bursting) to take water to industrial users. Provide water to Ag users in vicinity. Could use either extracted percolate or provide tertiary treatment to secondary effluent.

Location of treatment facilities shown on ppt designated for a pole barn - need to move west (A side)

Jim - Use of extracted percolate - DPH would likely want disinfection for multiple barriers
Robin - tried to do no residual - had regrowth
Jim - Santa Ana River - need to disinfect after extraction
Steve H - don't have enough data to make DPH happy, but getting 5 log removal
Jim - talked to Rich Haberman at DPH - agrees not enough info to not add disinfection

Fresno sports complex - old landfill and superfund site - using groundwater remediation for irrigation. Don't assume any reuse potential

Cornelia Corridor - may be able to pick up the irrigation of large yards in area
Crossing of 99 a problem
Some subdivisions already conditioned for reuse - Steve H to get info on which areas

Jensen line - old brick sewer has been abandoned. Goes into middle of SW area

Dave - issues of regrowth in the system. Large pipes an issue if low flow. More than 5 days retention becomes a problem. DSRSD did a gradual rate increase - started out 20 % below water costs and then increased rates over time.

Potential for new AG in this area? Canals are already getting extracted water in this area. Clovis is actually paying FID to discharge to their canals.

Planned recharge area for Metro Plan - actually a depression in the GW in SW area (northeast of plant) due to overpumping.

Tracy - issue that industries can go away.

Ron - Has the City thought about buying more Ag land to do own reuse/growing?
Bob - plant surrounded by Ag - why go all over town with pipelines when could do an Ag program?
Steve H - need to continue to look at Ag - not sure can get the offset needed.
Bob - need to find out now. Most viable program.
Dave - need to have a backup program to compare.

Ron - what happens when water goes out of Ag and into Urban growth?
Brock - if density is low then demands increase because landscape irrigation is water intensive. Until get water meters - can't really determine.

***Northwest***
Sewer in area of proposed scalping plant (Grantline and Herndon) about 42 inch or greater.
City owned land, adjacent to Herndon Canal for siting facility and maybe recharge - 17 acres.
Outfalls from Herndon Canal to SJ River if wanted
Could irrigate golf courses, schools…
Proposed recharge facility for water proposed west of 99 (from Metro Plan). Potential to combine with wastewater.

Commercial project proposed in Herndon and 99 area - conditioned with purple pipe. Not constructed yet.
Van Ness lakes - man made lakes - water feature - not really used for contact.
Ron: At Lake Elsnore - put all effluent in lake - 5k out of 40k. RWQCB doesn't have any bacterial issues - TMDL issues for nitrogen and P. Terminal lake used for full body contact. In summertime is green - but people fish, swim and waterski.

***Northeast***
Potential to redirect some wastewater from forcemains to North Fresno WRF
WRF expandable to 2.5 mgd. Maybe more if use different technology (MBR)
Could irrigate golf courses, Woodward Park, potential Ag north of Woodward Lake, wetlands restoration
Potential additional scalping plant at Woodward Park?
Good location for GW recharge
Flood control basin at Chestnut and Sheppard

***Southeast***
Dave - make developer put in the scalping plant.
Steve - Yes, we will make them pay for it but we want to have control over the treatment plant after our experience with the Copper River plant.

Brock - SEGA proposing multiple scalping plants - not in areas shown here from previous study
Luis - Plant locations next to FID canals for Ag water reuse. Clovis also discharges into one of the canals - need to check capacity.

Satellite locations don't have to be situated where identified in 2006 study.

Brock - planned recharge area for water - some difficulty in even developing GW drinking wells in the SE area. Will know more soon.

SEGA - planned development for 105,000 people - big opportunity for residential reuse, dual plumbing in commercial buildings, recharge. Calthorpe and EDAW planned water features.

Jim - in Florida takes about 5 houses to develop enough wastewater for irrigating one yard.

**Wrap-up - key issues to consider from each TAC member**

Bob - put together task force of regulators and users (chairman was in charge of health so that after he was satisfied, everything went smoothly). Agricultural reuse seems most promising. Need to work out with FID agreement about what kind of offset they can get. Doesn't see why City has to deal with FID if we deliver water directly to them and they'll stop pumping groundwater. (Kevin - most growers are far away from where we need the groundwater. Brock: can't put drinking water wells in Ag land). Need to evaluate impacts if city puts all eggs in Ag basket. Doesn't see any stumbling blocks. Ag reuse seems to be immediately located (next to plant) and lowest level of treatment.

Ron - Needs to have an overarching blue ribbon panel. Representatives from all major stakeholders (citizens, regulators, elected, FID) to be included in panel. Get prior overarching buy-in and policy / goal statement. This needs to come before engineering. Also need to develop water balance. Need to let gravity do the work. Economics are most important. If the

land costs are cheap enough, then can impose fees on top of that for development. Can't raise the fees so high you can't sell houses. Treatment issue is real - makes best sales pitch.

Dave - Agree about task force, but keep regulators as separate group. Get newspapers on board. Figure out what you're trying to sell. Make a paradigm choice. Cheaper to go to Ag than to add in a billion dollars of irrigation pipeline. Should not shortchange self of treatment quality now, since it's a major part of the public perception issue. In terms of concerns about overuse - using recycled water is the same as using potable water wisely.

Jim - Agree with advisory panel concept because of credibility. Need to narrow alternatives. Agree that Ag may be easiest solutions. None of industrial users have been contacted, so first need to ask them what their needs and willingness are. Keep regulatory agencies in the loop. Some in CDPH think that Title 22 isn't stringent enough for irrigation. Recognize that short-term decisions have long-term consequences. Need to seriously consider undisinfected effluent in perc ponds. Also examine whether other uses are better than recharge due to the regulatory burdens. Remember that when building satellite plants there needs to be enough remaining flow to take solids away to main plant. Recommends applying disinfection before putting in the ground. Need credible experts - not paid consultants - to deal with public outrage.

Robin - Did project w/o task forces, but thinks its necessary for recharge. If you're just doing irrigation, Redwood City is an example of outreach going wrong. Robin started smaller with parks and medians. Later, as projects are developed, people felt that they had a choice about whether to take recycled water. Get horticultural experts onboard. Need to get control over water waste in Fresno. Really need to put meters in this town. Should also have separate irrigation meters to track water use and eventually retrofit. Pricing - for commercial/industrial, maybe have fixed price for irrigation water rather than price per quantity for potable. Must make it cheaper for recycled than potable. Doesn't require cultural change in irrigation practices. Put the sign up early even though recycled water isn't yet there, so if people complain initially, you can tell them it's not there yet.

Dave Requa will send notes on mandatory requirements.

**Prepared By:**

Lorien Fono

LF:LF

# Appendix C

Engineering Report for the Production, Distribution and Use of Recycled Water

**CITY OF FRESNO, CALIFORNIA**
**DEPARTMENT OF PUBLIC UTILITIES**
**WASTEWATER MANAGEMENT DIVISION**

# ENGINEERING REPORT FOR THE PRODUCTION, DISTRIBUTION AND USE OF RECYCLED WATER

**SEPTEMBER 18, 2015**

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Appendix B Rules and Regulations
Appendix C Recycled Water User Agreement
Appendix D TTDF Design Report
Appendix E Standard Specifications and Drawings for Recycled Water Facilities

## LIST OF RELEVANT INTERNET-ACCESSIBLE DOCUMENTS

**Construction Plans for Recycled Water Transmission Main Project SW1A**
https://dl.dropboxusercontent.com/u/79172/215138_RWTM_SW1A_Plans.pdf

**Construction Plans for Recycled Water Transmission Main Project SW1B**
https://dl.dropboxusercontent.com/u/79172/215138_RWTM_SW1B_Plans.pdf

**Industrial Pretreatment Program**
https://dl.dropboxusercontent.com/u/79172/Industrial%20Pretreatment%20Program%202009.pdf

**Recycled Water Master Plan**
http://www.fresno.gov/NR/rdonlyres/7B22E4E4-29CF-4C10-B3BE-F32C141CBB4B/0/RecycledWaterMasterPlan2013.pdf

**Recycled Water Ordinance**
http://www.fresno.gov/NR/rdonlyres/7AB20689-3E0B-4C1C-A01B-67BF9D0B8305/0/RecycledWaterOrdinance.pdf

**Recycled Water-Related Statutes**
http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Documents/Lawbook/RWstatutes2014-05-01a.pdf

**Recycled Water-Related Regulations**
http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/RWregulations_20150716.pdf

**Recycled Water User Map for Initial Contacts**
https://dl.dropboxusercontent.com/u/79172/Fresno%20RecWat%20User%20Map.pdf

**TTDF Design Report**
https://dl.dropboxusercontent.com/u/79172/TTDF%20Schematic%20Design%20Final%20Tech%20Memo.pdf

**TTDF Construction Drawings**
https://dl.dropboxusercontent.com/u/79172/TTDF%20Conformed%20Plans.pdf

**TTDF Construction Specifications Volume I**
https://dl.dropboxusercontent.com/u/79172/TTDF%20Conformed%20Specs%20Vol1.pdf

**TTDF Construction Specifications Volume II**
https://dl.dropboxusercontent.com/u/79172/TTDF%20Conformed%20Specs%20Vol2.pdf

**TTDF Construction Specifications Volume III**
https://dl.dropboxusercontent.com/u/79172/TTDF%20Conformed%20Specs%20Vol3.pdf

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AFY | Acre-Feet per Year |
| BOD | Biochemical Oxygen Demand |
| CRWQCB | California Regional Water Quality Control Board, Central Valley Region |
| CFS | Cubic Feet per Second |
| Clovis ST/WRF | Clovis Sewage Treatment / Water Reuse Facility |
| FID | Fresno Irrigation District |
| FMFCD | Fresno Metropolitan Flood Control District |
| FSE | Fine Screen Effluent |
| GFD | Gallons per Square Foot per Day |
| GPM | Gallons per Minute |
| GRRP | Groundwater Replenishment Reuse Projects |
| KVA | Kilovolt-Amp |
| KW | Kilowatt |
| MGD | Million Gallons per Day |
| MVA | Megavolt-Amp |
| MW | Megawatt |
| NFWRF | North Fresno Wastewater Reclamation Facility |
| OIS | Operator Interface Station |
| PGE | Pacific Gas & Electric Company |
| RAS | Return Activated Sludge |
| RWPA | Recycled Water Project Area |
| RWRF | Fresno / Clovis Regional Wastewater Reclamation Facility |
| RWTM | Recycled Water Transmission Main |
| SCADA | Supervisory Control and Data Acquisition |
| TSS | Total Suspended Solids |
| TTDF | Tertiary Treatment and Disinfection Facility |
| TTRW | Tertiary Treated Recycled Water |
| UV | Ultra-Violet |
| WAS | Waste Activated Sludge |
| WDRs | Waste Discharge Requirements |

**DEFINITIONS**

**1974 Agreement:** The 1974 agreement between the City of Fresno and FID to establish a groundwater reclamation system consisting of on-site extraction wells at the RWRF and piping that delivers extracted groundwater to FID's Dry Creek and Houghton Canals.

**1976 Agreement:** The 1976 agreement between the City of Fresno and FID that provides for the agencies to use FID's distribution system to satisfy their respective water supply rights, and to work together to protect and preserve the groundwater basin.

**Guidelines:** The California Department of Water Resources March 2001 “Guidelines for the Preparation of an Engineering Report for the Production, Distribution, and Use of Recycled Water”

**Master Plan:** The City of Fresno's 2010 "Recycled Water Master Plan"

**Metro Plan Update:** The City of Fresno's 2011 "Metropolitan Water Resources Management Plan Update, Phase 2"

**Recycled Water Ordinance:** The City of Fresno Recycled Water Ordinance, adopted July 17, 2014 as Ordinance 2014-32

**Rules and Regulations:** The City of Fresno "Rules and Regulations of Recycled Water Use"

**TTDF Design Report:** "Tertiary Treatment and Disinfection Facility Technical Memorandum", August 2011

**TTDF Construction Plans:** "Drawings for the Construction of Tertiary Treatment and Disinfection Facility - Phase I", Conformed Drawings, September 19, 2013

**TTDF Construction Specifications:** "Fresno-Clovis Regional Wastewater Reclamation Facility, Tertiary Treatment And Disinfection Facility, Specifications", Conformed, Volumes I - III, September 2013,

**Waste Discharge Requirements:** California Regional Water Quality Control Board, Central Valley Region, "Order No. 5-01-254, Waste Discharge Requirements for Cities of Fresno and Clovis Wastewater Treatment Facility, Fresno County", 19 October 2001

## 1.0 INTRODUCTION

The City of Fresno is located in the County of Fresno, in California's Central Valley, approximately 220 miles north of Los Angeles and 180 miles south of Sacramento. In partnership with the City of Clovis, the City owns and operates the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF), which receives and treats the majority of wastewater generated within the Cities of Fresno and Clovis and some unincorporated areas of Fresno County. The RWRF site is located in the area generally bounded by Jensen, Chateau Fresno, Central, and Cornelia Avenues, and its on-site Administration Office building is located at Lat 36°42'14.63" N, Long 119°53'33.50" W. The RWRF is currently operated under California Regional Water Quality Control Board, Central Valley Region, "Order No. 5-01-254, Waste Discharge Requirements for Cities of Fresno and Clovis Wastewater Treatment Facility, Fresno County", dated 19 October 2001 (Waste Discharge Requirements).

The City also owns and operates the North Fresno Wastewater Reclamation Facility (NFWRF), which receives and treats wastewater generated within a small area of the City generally bounded by Copper, Friant, and Willow Avenues. The NFWRF is located on the north side of Copper Avenue, between Cedar and Maple Avenues, at Lat 36°53'46.35" N, Long 119°45'8.01" W. Recycled water produced by the NFWRF is used for irrigation of a golf course at Copper River Country Club, which is situated within the area served by the NFWRF.

The City of Clovis owns the Clovis Sewage Treatment / Water Reuse Facility (Clovis ST/WRF), which is operated under contract by CH2M Hill. The Clovis ST/WRF is located at the northeast corner of Ashlan and Loma Vista Avenues, at Lat 36°47'39.77" N, Long 119°36'50.71" W. The Clovis ST/WRF receives and treats wastewater generated within certain areas of the City of Clovis that are not tributary to the RWRF, and currently has an average daily flow capacity of 2.8 MGD. Recycled water produced by the Clovis ST/WRF is used for landscape irrigation in certain areas of the City of Clovis, and for agricultural irrigation via limited elements of the Fresno Irrigation District distribution system.

Figure 1-1 provides a location map showing the approximate locations of the RWRF, NFWRF and Clovis ST/WRF facilities.

The City of Fresno's 2011 Metropolitan Water Resources Management Plan Update (Metro Plan Update), Phase 2, recommended that the City incorporate tertiary-treated recycled water into its future water supply portfolio to meet non-potable demands in new development areas and existing parts of the City, to offset potable water demands. The Metro Plan Update called for the use of up to 25,000 AFY, approximately equivalent to an average of 22.3 MGD, of tertiary-treated recycled water by 2025. The City's 2010 Recycled Water Master Plan (Master Plan), although completed prior to the Metro Plan Update, Phase 2, incorporated the same Metro Plan Update recommendation taken from a draft edition, as a minimum. The Recycled Water Master Plan implementation recommendations included the construction of a tertiary-treated recycled water production facility at the RWRF, and a network of recycled water transmission and distribution pipelines to convey recycled water to use areas.

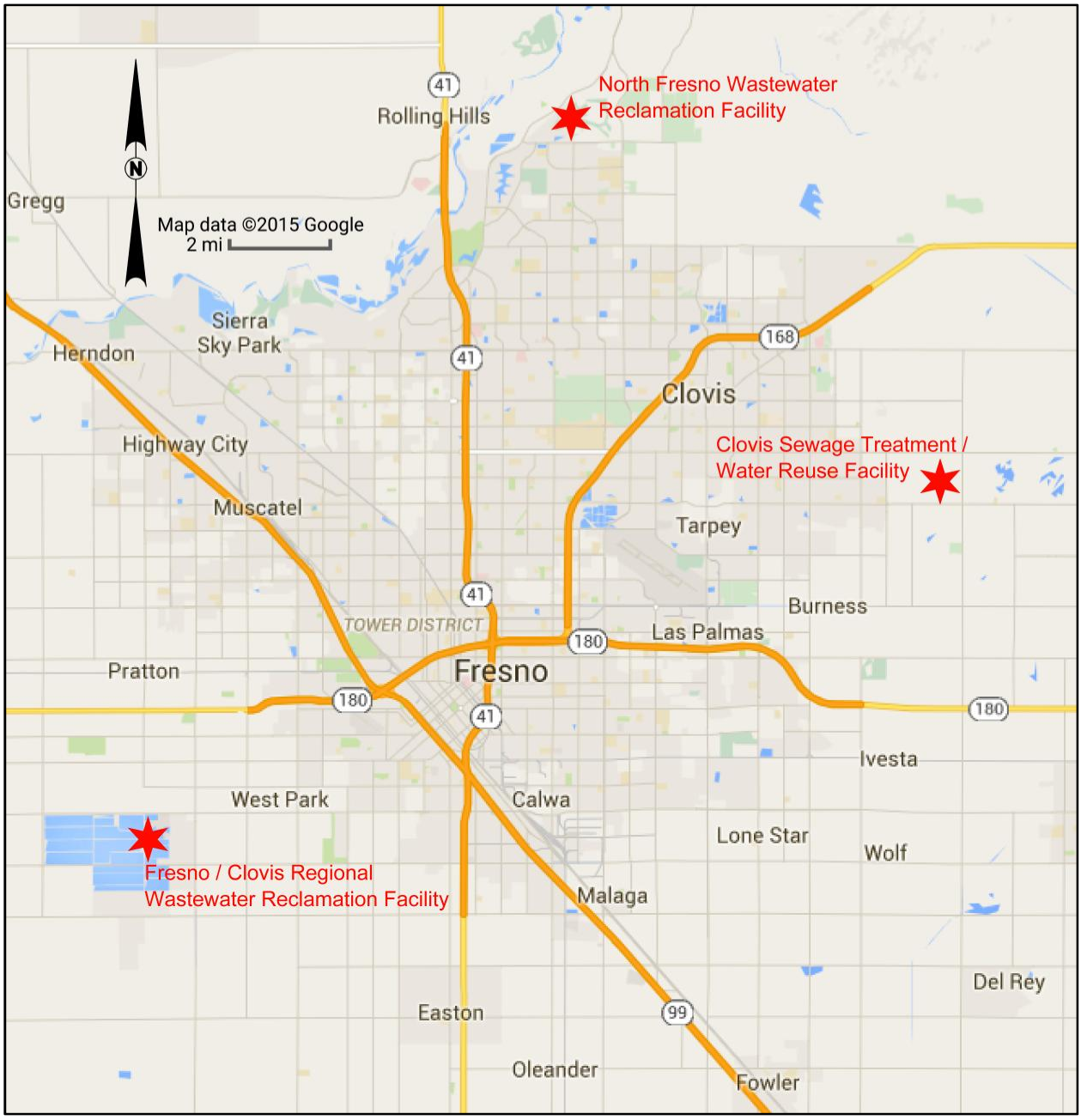


**FIGURE 1-1**
**LOCATION MAP**

The City of Fresno is currently constructing a Tertiary Treatment and Disinfection Facility (TTDF) at the RWRF. It will be a Phase 1 facility having an initial recycled water production capacity of 5 MGD. Subsequent Phase 2 and Phase 3 expansions are planned to provide additional capacity of 10 MGD and 15 MGD, respectively, to result in a Phase 3 capacity of 30 MGD. The TTDF will receive primary effluent from one of the existing RWRF treatment trains, and will produce disinfected tertiary-treated recycled water. A recycled water transmission and distribution pipeline network is planned to convey recycled

water from the TTDF to recycled water use areas in the City of Fresno. Figure 1-2 provides an overview of the planned distribution system, taken from the Master Plan.

As generally described in the Master Plan, the City's objectives for its planning and development of a recycled water production and distribution system are:

- Protect and improve groundwater quality by reducing the use of the RWRF percolation ponds that are currently used for effluent disposal.
- Increase the use of recycled water through urban reuse, groundwater recharge and agricultural reuse to help meet increasing water demands in the region.
- Offset potable water use, enhancing the sustainability of the City's water supply.

This Engineering Report for the Production, Distribution, and Use of Recycled Water describes the City of Fresno's planned recycled water production and distribution facilities, and describes how those facilities and the planned uses of recycled water will comply with the State of California Water Recycling Criteria, which are contained in Sections 60301 through 60355, inclusive, of the California Code of Regulations, Title 22, Division 4. The format and content of this report conform to the March 2001 "Guidelines for the Preparation of an Engineering Report for the Production, Distribution, and Use of Recycled Water" (Guidelines).

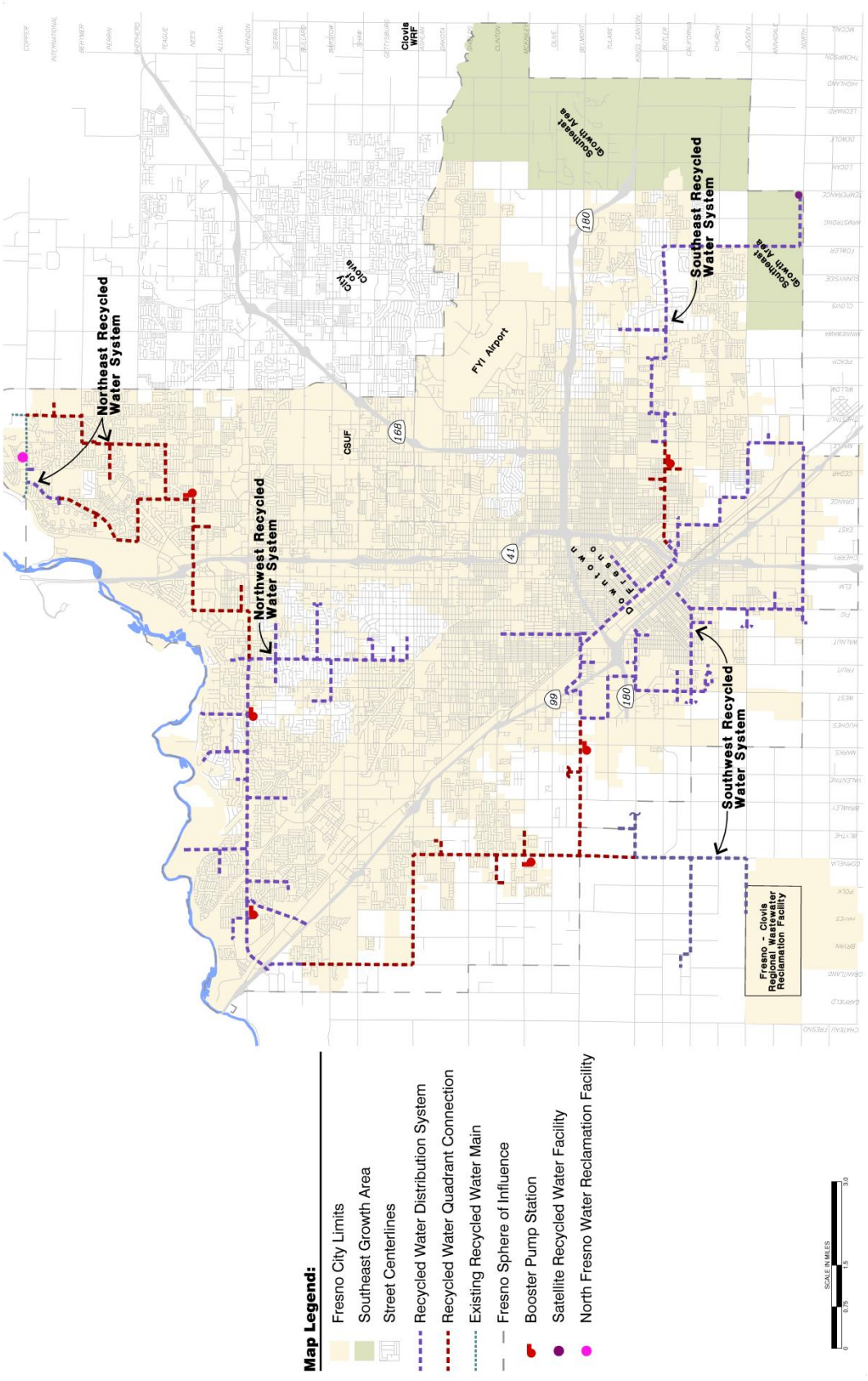


**FIGURE 1-2**
**OVERVIEW OF PLANNED DISTRIBUTION SYSTEM**

## 2.0 RECYCLED WATER PROJECT

### 2.1 General

The City of Fresno, Department of Public Utilities, Wastewater Management Division, is the lead agency and project sponsor for this project, and is ultimately responsible for the design, construction, operation and maintenance of the recycled water production and distribution facilities. Although the City of Fresno owns and operates the RWRF, in partnership with the City of Clovis, the City of Clovis has no ownership in or responsibility for the City of Fresno's planned recycled water production and distribution facilities.

Other agencies that have, or could potentially have, an interest in the City's production, distribution and use of recycled water are Fresno Irrigation District (FID) and Fresno Metropolitan Flood Control District (FMFCD).

#### 2.1.1 Fresno Irrigation District

In 1974, the City entered into an exchange agreement (1974 Agreement) with Fresno Irrigation District (FID) to establish a groundwater reclamation system consisting of on-site extraction wells at the RWRF and piping that delivers extracted groundwater to FID's Dry Creek and Houghton Canals. The extracted ground water typically mixes with a variable amount of surface water prior to use on crops, including fodder, fiber, and food for human consumption (e.g., almonds, beans, peaches, raisins, and wine grapes, etc.). The extracted groundwater is discharged to the canals during the growing season for agricultural use on the western side of FID's service area. Each canal can convey up to 200 cubic feet per second (CFS). There are currently no regulatory restrictions on the use of extracted groundwater.

The 1974 Agreement stipulates the following:

- The City must discharge a minimum of 100,000 AF of extracted groundwater to FID during any ten-year period.
- The City may discharge a maximum of 30,000 AF of extracted groundwater to FID in any given year.
- For every acre-foot of extracted groundwater the City discharges to FID, the City is entitled to receive 0.46 acre-foot of surface water from FID.
- Any increase in the discharge of extracted groundwater to FID beyond that stipulated in the 1974 agreement is subject to FID approval.
- The City cannot extract groundwater from beneath the RWRF in volumes that will cause the groundwater level to drop below levels observed in the previous year.

The City has not historically used its full entitlement of surface water under the 1974 Agreement due to lack of demand and adequate facilities, such as groundwater recharge basins or surface water treatment facilities.

The City and FID also entered into a separate cooperative agreement dated 1976 (1976 Agreement), that provides for the agencies to use FID's distribution system to satisfy their respective water supply rights, and to work together to protect and preserve the groundwater basin. The 1976 Agreement also stipulates that the City will retain its treated effluent within the boundaries of FID unless written consent to do otherwise is obtained.

The City currently owns, operates and maintains the facilities that deliver extracted groundwater to the FID system, up to the point of delivery. FID currently owns, operates and maintains all elements of the FID system that distribute the extracted water, beyond the point of delivery. There are currently no plans to change responsibility for ownership, operation and maintenance of the respective facilities.

Relative to agricultural alternatives that involve FID, the Master Plan recommends expansion of agricultural exchange via increased delivery of extracted groundwater, and / or the addition of delivery of tertiary-treated recycled water, to expand such agricultural exchange beyond the current limitation of 30,000 AFY. Expansion beyond the current limitation, and / or the addition of tertiary-treated recycled water to the agricultural exchange program, would require modification of the 1974 Agreement. The City and FID are not yet working to modify the 1974 Agreement. Neither the TTDF currently under construction, nor the planned recycled water transmission and distribution pipeline network, include elements that are specifically intended to expand the agricultural exchange program beyond the current limitation, or provide for the addition of tertiary-treated recycled water to the program.

#### 2.1.2 Fresno Metropolitan Flood Control District

The Master Plan recommends that Groundwater Replenishment Reuse Projects (GRRPs) be implemented to the extent practical in the southwest, northwest and southeast quadrants of the City. The Master Plan identifies numerous potential GRRP sites that are generally situated near or adjacent to FMFCD basin sites, since storm water runoff or surface water in the FMFCD system could be used for groundwater recharge on its own, and could also serve as diluent water for the GRRPs if tertiary-treated recycled water is used in the GRRPs. The Master Plan also identifies three tentative locations for regional groundwater recharge areas, or "super-recharge basins".

If development of any of the GRRPs affects FMFCD basins or other facilities, the City would have to enter into related agreements with FMFCD, whether or not the GRRP incorporates the use of tertiary-treated recycled water. The City and FMFCD are not yet working to develop such agreements. Neither the TTDF currently under construction, nor the planned recycled water transmission and distribution pipeline network, include elements that are specifically intended to supply TTRW to potential GRRP sites.

### 2.2 Rules and Regulations

The City of Fresno Recycled Water Ordinance was adopted July 17, 2014 as Ordinance 2014-32, and it is appended to this report as Appendix A. The Recycled Water Ordinance specifies that the City will establish Recycled Water Rules and Regulations to govern the operation of the City's recycled water system and the use of recycled water, and to implement the policies and requirements of the Recycled Water Ordinance, the California Code of Regulations Titles 17 and 22; and other State and local rules

and regulations related to the use of recycled water. The Rules and Regulations have been prepared by the City, and they are appended as Appendix B.

The City will ensure that all parties involved in the distribution and use of its recycled water perform their activities in accordance with the Rules and Regulations, which have been developed by the City's Public Utilities Department (Public Utilities). The following documents support the Rules and Regulations:

- This Engineering Report
- TTDF Engineering Report
- Recycled Water Ordinance
- Recycled Water User Agreements

The Rules and Regulations cover design, construction, operation and maintenance for recycled water distribution systems and use areas, together with control measures to be implemented for use areas. They include a cross-connection control program, and provisions for inspection by City personnel. The Rules and Regulations are intended to meet or exceed all of the requirements of applicable State statutes and regulations, including but not limited to those compiled in the 25 June 2015 edition of the State Water Resources Control Board "*Recycled Water-Related Statutes and Regulations",* which was formerly referred to as "The Purple Book".

The Recycled Water Ordinance specifies that the Director of the City of Fresno Department of Public Utilities (Director), and / or City employees to whom such responsibility is delegated by the Director, shall administer, implement, and enforce the provisions of the ordinance. The Director also bears responsibility for enforcement of the Rules and Regulations. As of the date of this report, Thomas C. Esqueda is the Director of the City of Fresno Department of Public Utilities.

## 2.3 Producer, Distributor and Users of Recycled Water

### 2.3.1 Producer and Distributor

The City of Fresno, Department of Public Utilities, Wastewater Management Division, is the lead agency and project sponsor for this project, and is ultimately responsible for the design, construction, operation and maintenance of the recycled water production and distribution facilities. Although the City of Fresno owns and operates the RWRF in partnership with the City of Clovis, the City of Clovis has no ownership in or responsibility for the City of Fresno's planned recycled water production and distribution facilities. The City of Fresno will be the sole producer and distributor of recycled water.

### 2.3.2 Recycled Water Users

The Master Plan contains recommendations for three different categories of recycled water use opportunities, namely: Urban Reuse Opportunities, Agricultural Reuse and Exchange Opportunities, and Groundwater Reuse Recharge Opportunities.

As described earlier in this report, the City and FID are not yet working to modify the 1974 Agreement. Neither the TTDF currently under construction, nor the planned recycled water transmission and distribution pipeline network, include elements that are specifically intended to expand the agricultural exchange program beyond the current limitation, or provide for the addition of TTRW to the program. With respect to the use of TTRW, agricultural reuse and exchange involving FID is considered a long term opportunity, and it is not currently planned as a Phase 1 recycled water use.

GRRP opportunities are also considered long term recycled water use opportunities, and are not currently planned as a Phase 1 recycled water use.

The urban reuse opportunities recommended by the Master Plan are considered to be both near term and long term recycled water use opportunities, and it is expected that most or all of the Phase 1 recycled water uses will be in the urban reuse category. Urban reuse provides an opportunity to implement recycled water projects that directly offset potable water use and are highly visible to the community. The types of urban recycled water uses recommended in the Master Plan generally include landscape irrigation and industrial uses. Some examples of the types of users for which recycled water landscape irrigation is planned are listed below.

- Parks
- Golf courses and country clubs
- Homeowners association common areas
- Cemeteries
- Airports
- State highway rights-of-way
- Schools and college campuses
- Municipal facilities such as courthouses and city hall
- Water feature impoundments such as Lake Van Ness and Woodward Lake
- Fairgrounds

Similarly, some examples of industrial uses for which recycled water use is planned are given in the following bulleted list.

- Heating and cooling
- Industrial laundries
- Commercial vehicle washing
- Dust control
- Fire protection
- Sanitary, such as toilet flushing at industrial sites
- Process water (except for food processors)

- Cleanup/wash down water (except for food processors)
- Boiler Feed

The Recycled Water Ordinance requires recycled water use under certain circumstances, where recycled water service is available, as summarized in the following paragraphs.

a) The City may require all customers who connect to the potable water system to use recycled water for all approved uses, including but not limited to dual plumbing for commercial buildings and single family residential irrigation.
b) Existing commercial properties, existing industrial properties, existing apartments and condominiums, and all homeowners associations are required to use recycled water for landscape irrigation.
c) New commercial projects, new industrial projects, new institutional and governmental projects, and new apartments and condominiums are required to be dual plumbed to provide for internal use of recycled water, and are required to use recycled water for landscape irrigation.
d) New single family residential home projects are required to provide for landscape irrigation with recycled water.

All properties within the Recycled Water Project Area (RWPA), as it is defined in the Recycled Water Ordinance, that host land uses for which recycled water use is recommended by the Master Plan, or is required by the Recycled Water Ordinance, are potential recycled water use areas, and the owners or tenants of such properties are potential recycled water users.

The Rules and Regulations require that no recycled water shall be used on any property or use area not owned or controlled by the City unless a non-transferrable User Agreement has been executed between the City and the recycled water user. User Agreements will contain contractually binding terms requiring conformance with the Rules and Regulations and all applicable local, state and federal regulations, including Title 17 and 22 of the California Code of Regulations. Users will be responsible for constructing and maintaining their own on-site recycled water systems for their use area. Appendix C contains a user agreement template that will serve as the foundation for the individual User Agreements for each recycled water user.

The City of Fresno has begun making initial contacts with potential recycled water users to advise them of the forthcoming availability of recycled water, and to begin making necessary arrangements for them to become recycled water users. Initial contacts are being made with potential users sited within one-half mile of the planned recycled water transmission main system. Figure 2-1 is a highly reduced scale map graphically identifying the target area for initial contacts, and the locations of potential recycled water use areas. A full scale version of the map may be viewed at the URL address provided in the List Of Relevant Internet-Accessible Documents.

The City of Fresno also plans to install recycled water hydrants along the recycled water transmission main system. The recycled water hydrants could be used to provide TTRW for fire suppression activities, and for construction water uses such as dust control and moisture conditioning for soil compaction.

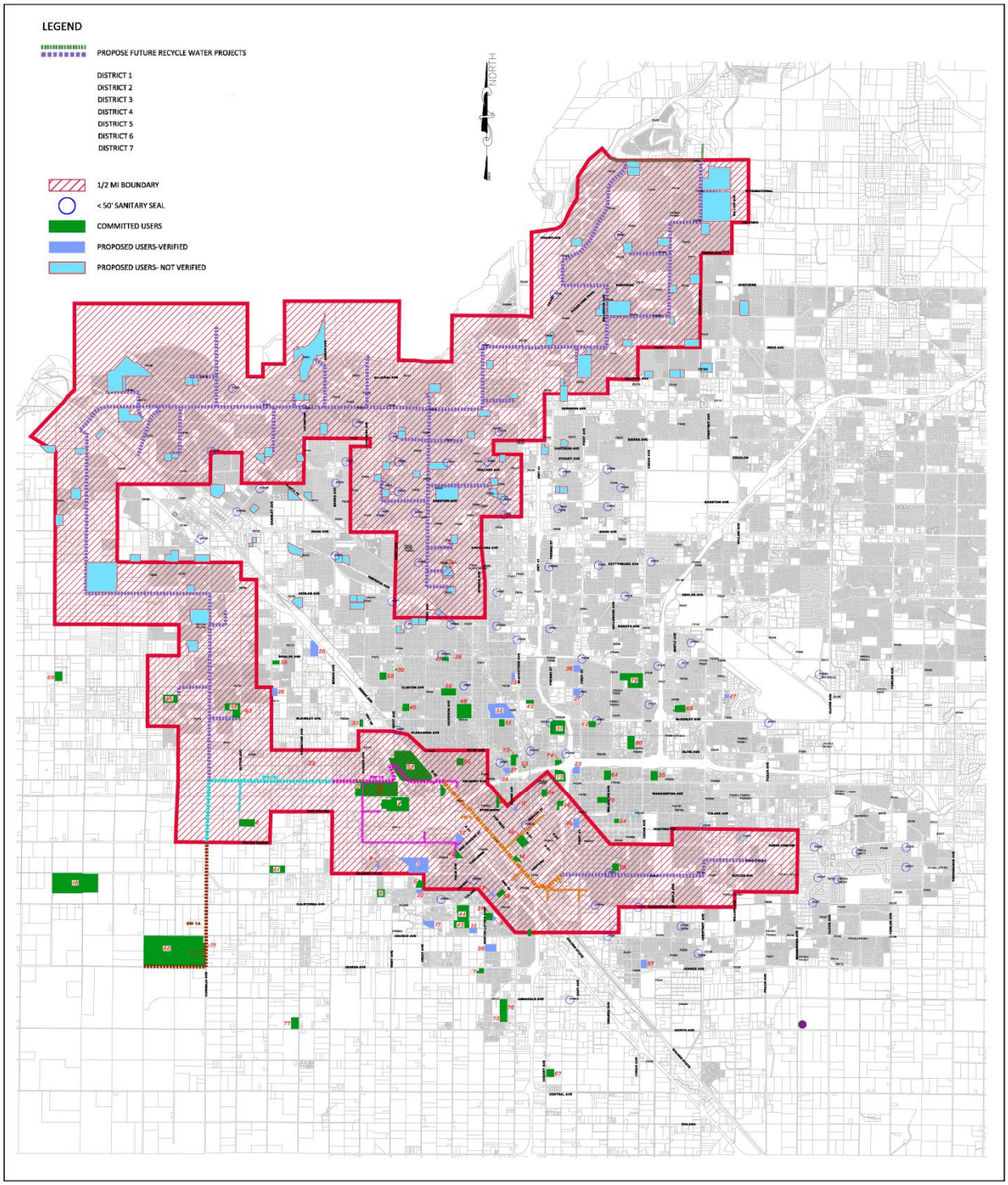


**FIGURE 2-1**
**RECYCLED WATER USER MAP FOR INITIAL CONTACTS**

### 2.4 Raw Wastewater

The raw wastewater entering the RWRF, for the last 12-month period ending 30 June 2015, has been characterized by the wastewater chemistry shown in Table 2-1, based on an analysis of data provided by the City. The data provided by the City consisted of laboratory analysis results for 24-hour composite samples.

**TABLE 2-1**
**WASTEWATER CHARACTERISTICS**
**JULY 1 2014 THROUGH JUNE 30 2015**

| Property | Minimum | Maximum | Median | 95th Percentile |
|---|---|---|---|---|
| Biochemical Oxygen Demand (BOD, mg/l) | 219 | 598 | 336 | 450 |
| Total Suspended Solids (TSS, mg/l) | 182 | 546 | 294 | 368 |
| Electrical Conductivity (EC, µmhos/cm) | 778 | 1369 | 1051 | 1236 |
| Ammonia Nitrogen (NH3-N, mg/l) | 21 | 52 | 32 | 38 |
| Total Dissolved Solids (TDS, mg/l) | 430 | 964 | 605 | 779 |
| Total Volatile Dissolved Solids (TVDS, mg/l) | 108 | 448 | 192 | 285 |

The wastewater entering the RWRF is ordinary municipal wastewater generated within the majority of the wastewater collection system service areas of the Cities of Fresno and Clovis. The City of Fresno reports that wastewater generated by 46 industrial customers in calendar year 2014 accounted for the flow, BOD and TSS proportions, relative to the total flow received at the RWRF, shown in Table 2-2.

**TABLE 2-2**
**INDUSTRIAL CUSTOMER CONTRIBUTIONS**
**JANUARY 1 2014 THROUGH DECEMBER 31 2014**

| Property | Total RWRF | Industrial Contribution | Industrial Percentage |
|---|---|---|---|
| Wastewater Flow (Million Gallons) | 21,537 | 2,946 | 13.68% |
| Biochemical Oxygen Demand (BOD, Pounds) | 62,489,056 | 21,655,376 | 34.65% |
| Total Suspended Solids (TSS, Pounds) | 54,152,862 | 10,378,756 | 19.17% |

The City has developed and rigorously implements an Industrial Pretreatment Program, as required by the Clean Water Act of 1977 (PL 95-217). The program sets forth uniform requirements for the discharge of certain industrial wastewater flows into the wastewater collection system and the RWRF, and enables the City as operator of the RWRF to comply with applicable local, state and federal laws relative to industrial wastewaters. The objectives of the program are to:

- Prevent the introduction of pollutants which will interfere with the operation of the RWRF, including interference with the use or disposal of municipal sludge.
- Prevent the introduction of pollutants which will pass through into the RWRF treatment facilities or otherwise be incompatible with the treatment facilities.
- Improve opportunities to recycle and reclaim wastewater and related sludges.
- Provide for equitable distribution of the cost of the Pretreatment Program among users.

The City of Fresno Industrial Pretreatment Program may be viewed at the URL address provided in the List Of Relevant Internet-Accessible Documents.

## 2.5 Treatment Processes

### 2.5.1 Existing RWRF Facilities

The existing RWRF is currently rated for an annual monthly average daily discharge flow of 80 MGD and a maximum monthly average daily discharge flow of 88 MGD. The annual monthly average daily discharge flow is currently reported to be approximately 60 MGD.

Wastewater is received at the RWRF headworks, which includes an influent pump station, bar screens, grit removal tanks, and grit processing equipment. After the preliminary treatment at the headworks, the wastewater is provided with primary treatment by six clarifiers. The primary effluent from these clarifiers is distributed to three secondary treatment trains, referred to as Trains A, B and C. Figure 2-2 provides a schematic illustration of the three RWRF treatment trains.

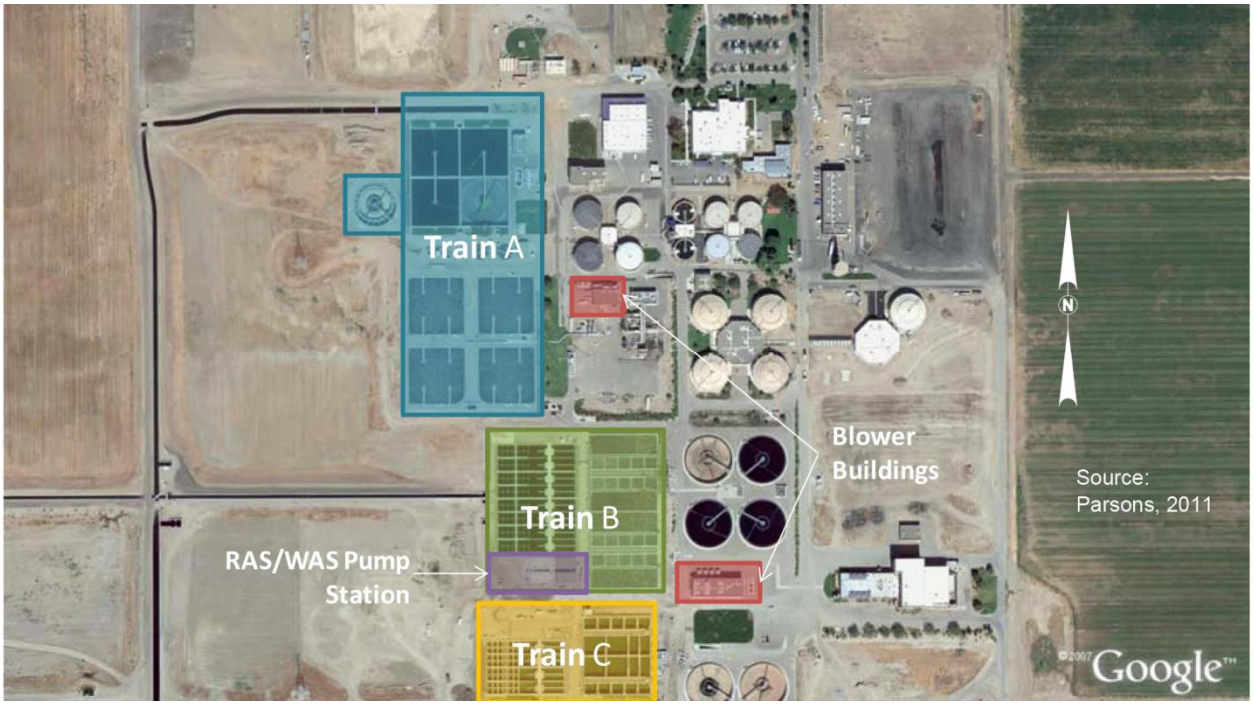


**FIGURE 2-2**
**EXISTING RWRF TREATMENT TRAINS**

Train A is the oldest of the three treatment trains, and it reportedly has several operational and maintenance issues as identified in the TTDF Engineering Report. Train B is the next oldest of the three treatment trains, and it consists of four rectangular aeration basins and eight rectangular secondary clarifiers. Train C is the newest of the three treatments trains. It consists of two rectangular aeration basins and four rectangular secondary clarifiers. The undisinfected secondary effluent from the RWRF

treatment trains flows into two canals on the site, by which it is conveyed to the RWRF percolation basins.

### 2.5.2 New TTDF Facilities

Primary effluent destined for treatment at the new TTDF will be diverted from Train C at a point immediately upstream of the Train C aeration basins by connection to an existing pipe stub in the primary effluent piping. The primary effluent will be treated by fine screening at a new fine screen facility situated near the point of diversion. Fine screen effluent (FSE) will be conveyed to the TTDF by a gravity flow FSE pipeline that crosses one of the secondary effluent canals (Canal B) in an inverted siphon configuration.

The TTDF will receive and treat the FSE and produce TTRW using membrane bioreactor (MBR) processes. The TTDF will be all new construction, with bioreactors (pre-aeration basins), membrane tanks and a blower building all having common walls to minimize concrete and piping costs. In the course of the treatment process, flow will progress through two parallel bioreactors that provide both anoxic and oxic zones, and then through the membrane cassette facilities in the membrane tanks. Membrane permeate will be disinfected by an in-pipe ultra-violet (UV) disinfection system to produce TTRW, meeting Title 22 recycled water quality criteria. Train A Aeration Basin No. 4 will be converted to provide covered recycled water storage.

The initial phase of the TTDF will have a constant flow capacity of 5 MGD, but will be laid out so as to provide for future expansion to have an ultimate design capacity of 30 MGD.

The existing 24 inch diameter aeration air line serving Train A Aeration Basin No. 4 will be used and extended to deliver process air to the bioreactors. Electrical power for the TTDF will be supplied from an existing 12 kV electrical building, located east of the Train A secondary clarifiers, through existing and new extended conduits.

Figure 2-3 provides a TTDF schematic site plan, and Figure 2-4 provides a TTDF schematic line diagram, both taken from the TTDF Design Report.

The most significant key elements of manufactured components of the TTDF are the fine screen equipment, the MBR membranes, and the UV disinfection system. The fine screen equipment will be ROTAMAT Rotary Drum Fine Screens RPPS-PRO, Model RPPS-PRO 1600/2, manufacture by Huber Technology. The MBR membrane facilities will be LEAPmbr, incorporating ZeeWeed hollow fiber membranes, manufactured by GE Water & Process Technologies. The UV disinfection systems will be TrojanUVFit Model 72AL75 UV disinfection system, manufactured by Trojan Technologies.

Chemicals that will be routinely used at the TTDF include sodium hypochlorite (12.5% solution) and citric acid (50% solution) for MBR maintenance and recovery cleans. The chemicals will be stored at an outdoor 30' by 20' containment area that consists of a concrete slab with perimeter containment walls 1' 2" high. Sodium hypochlorite will be stored in two 250 gallon totes, and citric acid will be stored in one 250 gallon tote. The totes will be supported on individual steel tote support frames. Chemical

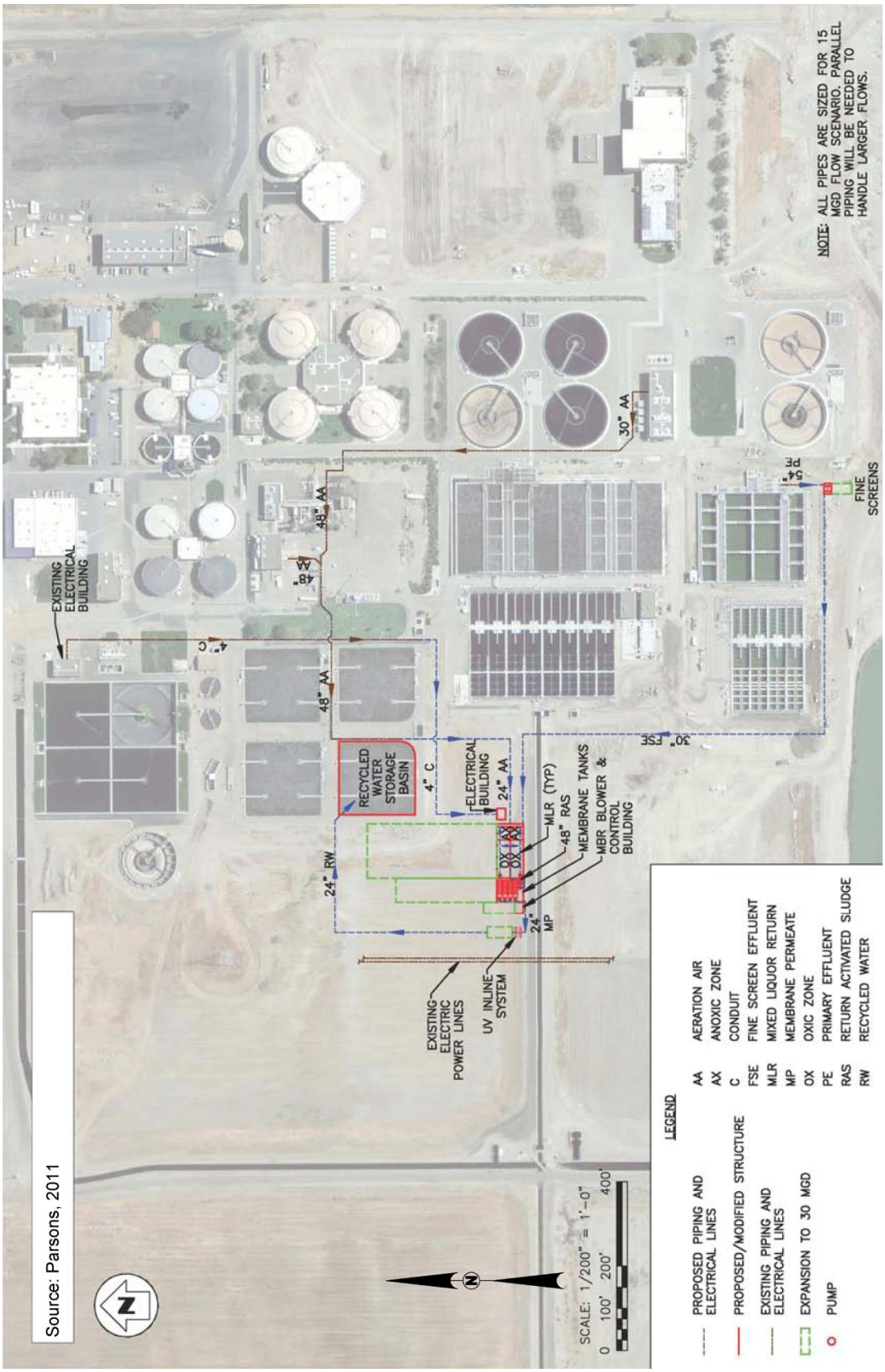


**FIGURE 2-3**
**TTDF SCHEMATIC SITE PLAN**

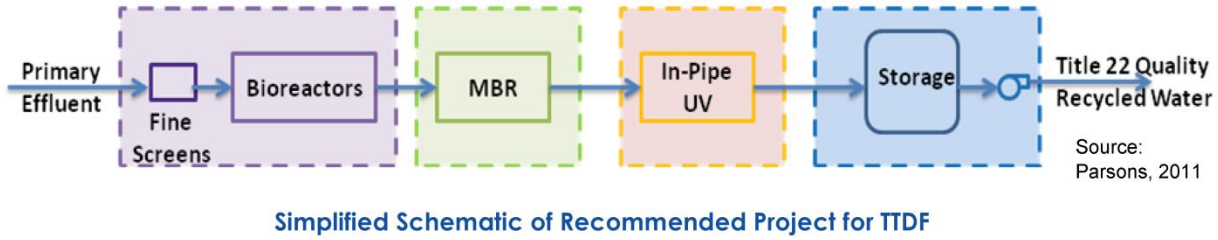


**FIGURE 2-4**
**TTDF SCHEMATIC LINE DIAGRAM**

metering pumps sited within the containment areas will inject the chemicals into the backpulse pumps discharge header for MBR maintenance and recovery cleans. It is estimated that annual chemical consumption will be 4,000 gallons per year for sodium hypochlorite, and 750 gallons per year for citric acid. The TTDF Design Report, Section 16 - Recommended Project Description in particular, provides a description of the TTDF, including a detailed list of major process equipment and planned chemical use. The TTDF Design Report is included as Appendix D, and may be viewed at the URL address provided in the List Of Relevant Internet-Accessible Documents. TTDF Construction Drawings may also be viewed at the URL address provided in the List Of Relevant Internet-Accessible Documents.

### 2.5.3 Operation and Maintenance Manuals

Under the provisions of the construction contract for the TTDF, the construction contractor is responsible for obtaining from the various vendors and suppliers and providing the operation and maintenance (O&M) manuals for all of the key elements of the TTDF. The TTDF design engineer, Parsons Corporation (Parsons) will prepare an overall Process O&M Manual for the TTDF, which will incorporate all of the O&M documentation and will be produced in an electronic format that will be accessible and usable online by computer and other electronic devices, such as iPads and similar tablets.

In a separate but related effort, Carollo Engineers (Carollo), under a contract with the City is assembling all of the existing O&M manuals for the RWRF, exclusive of the TTDF. The existing O&M manuals currently exist only in printed hard copy form. Carollo will combine the existing documentation in an electronic format that will provide similar online accessibility as for the Parsons Process O&M Manual for the TTDF. Although the Parsons Process O&M Manual for the TTDF and the Carollo combined O&M manual for the RWRF will be separate electronic documents, they will both be accessible for plant operators via the same secure online portal.

## 2.6 Plant Reliability Features

The TTDF Design Report, Section 15 - Selected MBR Alternatives Analysis, and Section 16 - Recommended Project Description in particular, provides a description of the key elements of the TTDF process equipment and their reliability features. The following paragraphs provide a summary of process equipment reliability features described in the TTDF Design Report.

### 2.6.1 Fine Screens

Fine screens will be in-channel perforated-plate drum screens. Two fine screens will be installed with one of the units as standby, thereby providing a fully redundant standby primary treatment unit process. Each screen would be capable of handling 5 MGD of flow to provide redundancy. The units will be installed in concrete channels equipped with isolation gates to allow for maintenance without interfering with fine screen and TTDF operation. Each fine screen will be equipped with an integrated washer/compactor for cleaning and concentrating the screenings prior to disposal off site.

The fine screens will be provided with alarms to indicate high differential water level (between upstream and downstream surfaces), high upstream water level, motor overload, low oil level, and emergency stop actuated conditions.

### 2.6.2 Bioreactors (Pre-Aeration Basins)

Two bioreactors will be constructed, each having a flow capacity of 5 MGD to provide system redundancy, thereby providing multiple biological treatment units capable of producing oxidized wastewater with one unit not in operation. Each bioreactor will be divided into several anoxic and oxic zones, with the first quarter of each bioreactor dedicated to the anoxic zone. Baffles would be placed in the bioreactors to separate the anoxic and oxic zones to minimize back-mixing as the flow passes through in a plug flow regime. Additional baffling would be used to divide each anoxic and oxic zone into 3 compartments to minimize back-mixing. The plug flow conditions increase the efficiency of biological treatment, optimizing carbonaceous matter removal, nitrification and denitrification. Submersible mixers will provide mixing in the anoxic zones. One submersible mixer will be provided in each anoxic zone compartment, for a total of six mixers, with one additional mixer provided as a shelf spare.

### 2.6.3 Aeration System

Air will be introduced into the oxic zones in the bioreactors through fine bubble diffusers. Aeration will be tapered so that approximately 70% of the oxygen is provided in the first half of the oxic zone to satisfy the high oxygen demand. The required air will be supplied to the oxic zones by the existing RWRF blowers. The blowers are of single-stage centrifugal type and have enough capacity to serve the biological needs of the MBR process as well as the remaining plant. There are five duty blowers with one standby blower. The existing 24 inch diameter air pipeline of RWRF Train A Aeration Basin No. 4 will be used and extended to supply air to the bioreactors, since that basin will be de-commissioned and converted to provide recycled water storage.

### 2.6.4 Mixed Liquor Return and Sludge Recirculation Pumps

Two recirculation lines will be provided in the MBR system, namely the mixed liquor return and sludge recirculation lines. The mixed liquor return system transfers mixed liquor from the tail end of the oxic zone back to the head of the anoxic zone at an adjustable rate up to four times the average flow. This

system transfers nitrates resulting from nitrification back to the anoxic zone for denitrification as the oxygen molecules associated with nitrates are used by the biomass. The sludge recirculation system transfers sludge from the membrane tanks to the head of the oxic zone, also at an adjustable rate up to four times the average flow. The recirculation system prevents the solids concentration in the membrane tanks from increasing excessively and plugging the membranes, as permeate is removed from the mixed liquor. Excess sludge will be wasted from the MBR system from the sludge recirculation line.

There will be two duty pumps with one shelf spare pump for the mixed liquor return pumps, one duty pump with one standby pump for the sludge recirculation pumps, and one duty pump with one standby pump for the waste activated sludge (WAS) pumps.

### 2.6.5 MBR Membrane System

The MBR membrane system will consist of four independent MBR tanks, with each tank containing six installed hollow fiber membrane cassettes with spare room for installation of an additional cassette. The system will be configured to allow isolation of a tank for maintenance and cleaning. Permeate pumps would draw the MBR membrane system effluent through the membranes, directing it to the TTDF disinfection system.

The total membrane surface area for the four tanks is 417,360 square feet, which provides for a treatment capacity of 5.0 MGD for the design flux rate of 12 gallons/square foot/day (GFD), and for the maximum flux rate of 16 GFD when one tank is out of service. The MBR membrane system facilities will include alarms to signal the production of TTDF effluent that does not meet the quality requirements for disinfected TTRW. The MBR membrane system thus provides alarm systems and multiple MBR tank units capable of treating the entire flow with one unit not in operation.

Key mechanical elements of the MBR membrane system include air scouring blowers, permeate pumps, backpulse pumps, and instrument air compressors. There will be two duty blowers and one standby blower for the air scouring blowers. There will be four duty pumps and one shelf spare pump for the permeate pumps. There will be one duty pump and one standby pump for the backpulse pump. And finally, there will one duty air compressor and one standby air compressor for the instrument air compressor.

### 2.6.6 Disinfection

Membrane permeate will be disinfected by an in-pipe ultra-violet (UV) disinfection system to produce TTRW, meeting Title 22 recycled water quality criteria. The UV disinfection systems will be TrojanUVFit Model 72AL75 UV disinfection system, manufactured by Trojan Technologies. There will be four reactor trains, with each train having two reactors. Three of the UV disinfection trains will be in service at any given time, with the fourth train being on standby. Each reactor will have a flow treatment capacity of 1.0 MGD, providing an in-service total treatment capacity of 6.0 MGD for the design flow of 5.0 MGD. The standby train with its two standby reactors will provide 2.0 MGD of standby capacity. The UV

disinfection system provides multiple UV disinfection units capable of treating the entire flow with one unit out of service, and also provides two standby units.

### 2.6.7 Alarm Provisions

The TTDF will include a new Supervisory Control and Data Acquisition (SCADA) system with an Operator Interface Station (OIS) in the Control Building. The TTDF will also include many alarm systems that will communicate with facility operators via the SCADA OIS. The OIS will include alarm management screens to display process and control system alarms.

The contents of the alarm management screen will be arranged in a tabular fashion, and entries in the alarm table will be color coded following the same color conventions as used in the existing RWRF SCADA system. The following information, as applicable, will be conveyed in the alarm table: date and time of the alarm, database point designation, type of alarm, value, PLC number and alarm description. The alarm management screen will provide a means for acknowledging alarms either individually or by page or globally.

If audible alarms are enabled at the intended site, a means will be provided for silencing audible alarms which is at all times accessible or visible to the operator. At physical locations where there is more than one OIS, the operator will not be required to silence the alarm on more than one OIS.

Alarms are categorized by four types listed in order of priority from highest to lowest.

a) Major alarm is the highest priority. A major alarm is caused by an abnormal process or equipment condition. A condition which is potentially dangerous to personnel or equipment or violates public health regulatory limits is classified as a major alarm. A major alarm is usually characterized as being a High-High alarm, hardwired alarm, or remote safety shutdown alarm.
b) Minor alarm is the next highest priority. A minor alarm is caused by an abnormal process or equipment condition. A condition which is not considered mission critical is classified as a minor alarm. A minor alarm may be a precursor to a major alarm.
c) Event alarm is the next to lowest priority. An event alarm is generated by operator action such as changing the control mode.
d) Informational alarm is the lowest priority. An informational alarm provides a means of conveying important process information to the operator. Informational alarms usually take the form of messages.

Table 2-3 provides a very brief summary of alarms that will be provided for key elements of the TTDF process equipment. It is based on information contained in Section 13370 – Programmable Controllers and Panel Instruments in the TTDF Construction Specifications.

**TABLE 2-3**
**ALARM PROVISIONS FOR SELECTED KEY ELEMENTS**
**OF THE TTDF PROCESS EQUIPMENT**

| Process Equipment Item | Alarm Description |
|---|---|
| Fine Screens | Common Alarm |
| Fine Screens | High Differential Level |
| Fine Screens | High Upstream Level |
| Fine Screens | Emergency Stop Actuated |
| Fine Screens | Grease Pump No. 1 Reservoir Low Level |
| Aeration Basins | RAS Influent Valve Fail |
| Aeration Basins | Influent Channel Agitation Air Valve Fail |
| Aeration Basins | ML Channel Agitation Air Valve Fail |
| Aeration Basins | Anoxic Mixer Fail |
| Aeration Basins | Anoxic Mixer High Winding Temperature |
| Aeration Basins | Anoxic Mixer Seal Leak |
| Aeration Basins | Oxic Zone Aeration Valve Fail |
| Aeration Basins | Mixed Liquor Pump Fail |
| Membrane Basins | Agitation Air Valve Fail |
| Membrane Basins | Membrane Basin Low Level |
| Membrane Basins | Membrane Basin Low-Low Level |
| Membrane Basins | Infeed Slide Gate Fail |
| Membrane Pump Gallery | Permeate Pump Fail |
| Membrane Pump Gallery | Permeate Pump High Winding Temperature |
| Membrane Pump Gallery | Backpulse Pump Fail |
| Membrane Pump Gallery | Backpulse Pump High Winding Temperature |
| Membrane Pump Gallery | Backpulse Pumps High Discharge Pressure |
| Membrane Pump Gallery | Sump Pump Common Alarm |
| Membrane Pump Gallery | Sump Pump Seal Leak |
| Membrane Pump Gallery | Sump High-High Level |
| Membrane Pump Gallery | Floor High Level |
| Permeate Collector | Permeate Collector Low Level |
| Permeate Collector | Permeate Collector Low-Low Level |
| Permeate Collector | Permeate Collector High Turbidity |
| RAS Pump Station | RAS Pump Fail |
| RAS Pump Station | RAS Pump High Winding Temperature |
| RAS Pump Station | RAS Pump High Discharge Pressure |
| RAS Pump Station | RAS Pump Station Low-Low Level |
| WAS Pump Station | WAS Pump Fail |
| WAS Pump Station | WAS Pump High Winding Temperature |
| WAS Pump Station | WAS Pump Seal Leak |
| WAS Pump Station | WAS Pump Station Low-Low Level |
| UV Train | Discharge Valve Fail |
| UV Reactor | High Water Temperature |
| UV Reactor | Low UV Intensity |
| UV Reactor | Ground Fault |

| TABLE 2-3<br>ALARM PROVISIONS FOR SELECTED KEY ELEMENTS<br>OF THE TTDF PROCESS EQUIPMENT | |
|---|---|
| **Process Equipment Item** | **Alarm Description** |
| UV Reactor | Low Priority Alarm |
| UV Reactor | High Priority Alarm |
| UV Reactor | Critical Instrument Failure |
| UV Reactor | UV Dose Failure |
| Drain Pump Station | Drain Pump Fail |
| Drain Pump Station | Drain Pump High Winding Temperature |
| Drain Pump Station | Drain Pump Seal Leak |
| Drain Pump Station | Drain Pump Station Low Level |
| Drain Pump Station | Drain Pump Station High Level |
| Valve Vault | Valve Vault Sump Pump Common Alarm |
| Valve Vault | Valve Vault Sump High-High Level |

### 2.6.8 Facility Hours and Staffing

As for the existing RWRF facilities, the TTDF facilities will be staffed around the clock, 24 hours every day, by certified plant operators. All alarm indicators will be received by plant operators in the facility Control Building via the SCADA system and its OIS interfaces. The Control Building is continuously staffed by RWRF personnel.

### 2.6.9 Electrical Power Supply

The primary source of electrical power supply for the RWRF, provided by Pacific Gas & Electric Company (PGE) is one 70 KV high voltage power line supplying power via one City-owned 10 MVA power transformer with a secondary voltage of 12 KV. The secondary side of the transformer is connected to two main circuit breakers for the main 12 KV service switchgear, which is equipped with a normally open tie circuit breaker. This switchgear is rated at 12 KV, 2000A, 500 MVA short circuit capacity with Bus “A” and Bus “B” separated by the normally open tie circuit breaker.

A backup source of electrical power supply from PGE exists in the form of a 12 KV line that provides a capacity of 5 MVA for emergency use. This backup line originates at a different PGE substation than the primary source line, and it is considered highly unlikely that both sources would be out of service at the same time. This backup line is tied to the main 12KV service switchgear through a normally open circuit breaker with a "Kirk Key" trapped key interlock, operated manually.

The RWRF also has three backup generators, one of which is a propane fired system that generates 25 KW. The other two backup generators are diesel fired systems that produce 350 KW and 1600 KW, respectively. The total power generation capacity of these three backup generators is thus 1975 KW, or 1975 KVA. Combined with the backup PGE line, this results in a total backup power supply capacity of 6975 KVA.

The RWRF also has a natural gas fired turbine generator that can produce up to 9.25 MW, equivalent to 9250 KVA. This generator system is not currently configured to provide power to the overall RWRF electrical system, and so it is not available as a near-term backup source of electrical power for the RWRF and the TTDF. However, the City is working to implement the necessary improvements to allow this generator to serve as a backup source of electrical power.

The City reports that the RWRF summer peak electrical power demand is approximately 6500 KVA, and that the estimated peak power demand for the TTDF is approximately 1250 KVA, for a combined total of 7750 KVA. It is evident that the primary power supply provides sufficient capacity for the anticipated combined demand of the RWRF and the TTDF. However, until the natural gas fired turbine generator can be configured to serve as a general service backup generator, the backup power supply capacity of 6975 KVA does not provide sufficient electrical power for the combined demands of the RWRF and the TTDF. The City reports that until such time as the natural gas fired turbine generator can be configured to serve as a general service backup generator, plant operators will shut down non-essential electrical loads facility-wide if necessary for temporary operation under emergency backup power supply conditions.

### 2.7 Supplemental Water Supply

The City will operate the TTDF and manage its recycled water users such that the recycled water supply can meet recycled water demand at all times. However, if the TTDF becomes unable to produce sufficient recycled water on a short-term basis to meet recycled water demand, supplemental water may be required to meet the recycled water user needs.

Supplemental water could be provided by the following sources.

1) Stored Recycled Water. The covered recycled water storage basin, a converted RWRF Train A aeration basin, will provide 2.7 million gallons of recycled water storage, or approximately 54% of one day's recycled water production capacity of the TTDF. Stored recycled water may be used to provide continued recycled water service for limited periods in the event of a short-term emergency situation resulting in TTDF inability to produce TTRW.

2) Raw Water. Raw water consists of untreated surface water provided by FID. Raw water would not be introduced into and conveyed by the recycled water distribution system, but would be delivered by other conveyance systems, generally the FID pipeline and canal system and private irrigation water pipelines. Thus, utility of this source of supplemental water would be limited to those users who have access to such other systems, and would be subject to supply availability.

3) Potable Water Distribution System. The City's potable water distribution system could serve as a temporary source of supplemental water for recycled water users. This would require an approved temporary disconnection from the City's recycled water distribution system, followed by the establishment of an approved temporary connection to the City's potable water distribution system.

4) Private Wells. Some recycled water users will have onsite private wells that have been or are being used for irrigation water supply and/or potable water supply, and could be relied on as a temporary source of supplemental water. As for potable water, the use of this supplemental source would require an approved temporary disconnection from the City's recycled water distribution system, followed by the establishment of an approved temporary connection to the private well system.

5) Reclamation Wells. In the future, the City hopes to be able to use groundwater produced from aquifers beneath the RWRF percolation ponds, disinfected if necessary, as a supplemental water source for the recycled water system. The City estimates that it will be at least two years from the date of this report before the use of this groundwater as a supplemental water supply could be implemented Water quality testing to verify suitability of the groundwater would be done prior to approval of such use, and necessary infrastructure would have to be constructed.

The only supplemental water source of those listed above that has potentially lower general quality than the recycled water itself is the raw (untreated) surface water. In cases where raw water is used as a supplemental source, the City will confirm with the affected users that the raw water quality is adequate for their particular application, which is ordinarily expected to be the case.

Since most recycled water users will have formerly relied on raw water, potable water, or private wells for the same uses for which recycled water is subsequently used, it is expected that the supply and delivery infrastructure for those supplemental water supply sources would generally be adequate for those same uses on a temporary basis.

Cross-connection of any recycled water distribution system, whether the City's recycled water distribution system or any individual user's on-site recycled water system, with any potable water distribution system is prohibited, even as a supplemental water source in the event of a shutdown or failure at the TTDF. The Rules and Regulations contain specific requirements for disconnecting on-site recycled water systems from the recycled water distribution system before making a temporary connection to a potable water distribution system.

### 2.8 Monitoring and Reporting

The Waste Discharge Requirements (WDRs) for the RWRF include a Monitoring and Reporting Program (MRP) that specifies required monitoring and reporting for RWRF operations. Primary effluent destined for treatment at the new TTDF will be diverted from RWRF Train C at a point immediately upstream of the Train C aeration basins by connection to an existing pipe stub in the primary effluent piping. The diversion point is downstream of the RWRF headworks, and therefore downstream of the influent composite sampling location designated in the WDRs. Influent monitoring and reporting for the TTDF will therefore be done as an integral part of the influent monitoring and reporting done for the RWRF under the provisions of the MRP.

Monitoring and reporting for disinfected TTRW produced by the TTDF will also be done as specified in the MRP for effluent discharge monitoring. This will involve the introduction of a new effluent composite sampling location at the TTDF discharge, in addition to those currently designated in the WDRs. The new sampling location must be established with concurrence of CRWQCB staff, and a description of the new sampling location must be submitted to the Board and attached to the WDRs.

In addition to the effluent discharge monitoring and reporting required by the WDRs, disinfected TTRW will also be tested for total coliform bacteria and turbidity, as required by Title 22 CCR Section 60321.

The disinfected TTRW will be sampled at least once daily for total coliform bacteria. The samples will be taken from the disinfected TTRW at the new designated effluent composite sampling location, and will be analyzed by the RWRF laboratory.

Disinfected TTRW will also be continuously sampled for turbidity using a continuous turbidity meter and recorder at the new effluent composite sampling location. In the event of failure of the continuous turbidity meter and recorder, grab samples taken at the same location at a minimum frequency of 1.2-hours may be substituted for a period of up to 24-hours.

All monitoring results will be reported as specified in the WDRs, including the additional total coliform bacteria and turbidity monitoring for the TTDF.

### 2.9 Contingency Plan

For the purposes of this report, "off-spec effluent" is TTDF effluent that does not meet the quality requirements for disinfected TTRW, or partially treated or untreated wastewater that somehow passes through the TTDF. In the event of any circumstance that could result, or does result, in the discharge of off-spec effluent from the TTDF, effluent pumping from the TTDF permeate pumps to the covered recycled water storage basin would be halted, so as to preserve the quality of stored TTRW so that it may be used to provide continued recycled water service while the cause of the problem is investigated and remedied.

In the event that off-spec effluent is delivered into the covered recycled water storage basin, pumping from the recycled water pump station would be halted, so as to prevent the introduction of off-spec effluent into the recycled water distribution system. Provided that the off-spec effluent in storage is of an equivalent or higher quality than the undisinfected secondary effluent produced by the RWRF, the off-spec effluent would be pumped or allowed to overflow via the overflow pipeline to Canal B, which is part of the canal system that delivers undisinfected secondary effluent from the RWRF treatment facilities to the percolation basins. The TTDF facilities will include a dedicated pipeline for pumped conveyance of off-spec effluent under such conditions.

If off-spec effluent in the covered recycled water storage basin is not of an equivalent or higher quality than the undisinfected secondary effluent produced by the RWRF, the off-spec effluent would be pumped from the storage basin via temporary pipelines and returned to the primary effluent stream of

RWRF Train C. The recycled water storage basin would be flushed clean and disinfected prior to returning the basin to normal recycled water storage duty.

Since the supply of primary effluent for treatment by the TTDF is a diversion from the primary effluent stream of RWRF Train C, the supply can be stopped by simply stopping the diversion. This can be done by operation of a pneumatically operated valve located in a valve vault adjacent to the fine screens. When the diversion is stopped, the primary effluent that would otherwise be diverted to and treated by the TTDF is instead retained and treated in RWRF Train C.

## 3.0 TRANSMISSION AND DISTRIBUTION SYSTEMS

Chapter 1 of this report provides a brief description of the Master Plan, and its recommendations for recycled water production, transmission and distribution facilities that are now in the early stages of implementation. Figure 1-2 provides an overview of the planned distribution system, taken from the Master Plan. The initial phase of implementation of the planned distribution system includes the design and construction of certain elements of the recycled water transmission mains referred to as the Southwest Quadrant, together with a related recycled water booster pump station. Figure 3-1 shows the Southwest Quadrant recycled water transmission main and booster pump station projects.

The City is expected to soon award a construction contract for the Southwest Quadrant Project SW1A, and is currently soliciting bid proposals for the construction of Project SW1B. The construction plans for Projects SW1A and SW1B may be viewed at the URL addresses provided in the List Of Relevant Internet-Accessible Documents.

Projects SW1C, SW1D, SW4, and SWPS1 are currently under engineering design, at various levels of design completion. The City reportedly is planning to soon issue a Request for Qualifications for engineering design of the Northwest Quadrant and Northeast Quadrant recycled water transmission mains.

The hydraulic design for the recycled water transmission main system is based on a minimum operating pressure of 40 PSI, and a maximum pressure variation between low operating pressure and high operating pressure of 20 PSI.

Pipe materials for the recycled water transmission mains will be cement mortar lined and coated steel pipe (CMLCSP) or cement mortar lined and tape coated steel pipe with a mortar rock shield (CMLTCSP) for pipes 24 inches and larger in diameter. Pipes smaller than 24 inches in diameter will be poly-vinyl chloride pipe (PVC) or ductile iron pipe (DIP).

The City of Fresno has developed and adopted Standard Specifications and Standard Drawings for recycled water facilities. The Standard Specifications include construction specifications as well as design criteria. The Standard Specifications and Standard Drawings are appended to this report as Appendix E. The Standard Specifications and Standard Drawings apply to all construction of recycled water facilities within the City of Fresno.

With respect to pipe materials, the Standard Specifications and Standard Drawings currently include provisions for PVC and DIP pipe materials. The City of Fresno is also in the process of developing additional standard specification and standard drawing content to include the CMLCSP and CMLTCSP pipe materials, which is expected to be added to the Standard Specifications and Standard Drawings after it is adopted by the City.

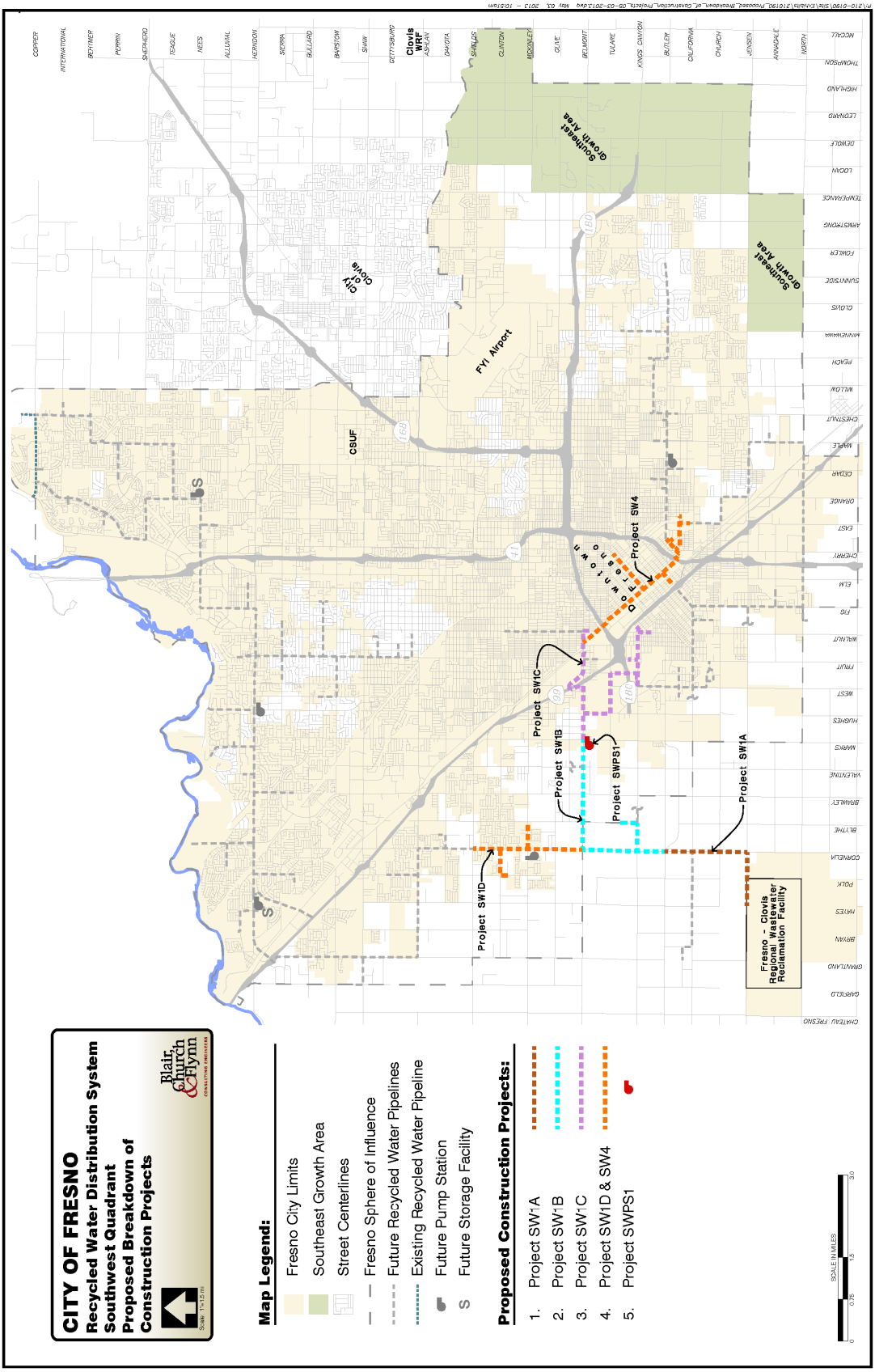


**FIGURE 3-1**
**SOUTHWEST QUADRANT RECYCLED WATER TRANSMISSION MAIN PROJECTS**

## 4.0 RECYCLED WATER USE AREAS

Subchapter 2.3 of this report provides a brief discussion of planned and/or required recycled water uses, restated in part here for the reader's ease of reference. All properties within the Recycled Water Project Area (RWPA), as it is defined in the Recycled Water Ordinance, that host land uses for which recycled water use is recommended by the Master Plan, or is required by the Recycled Water Ordinance, are potential recycled water use areas, and the owners or tenants of such properties are potential recycled water users.

The Rules and Regulations require that no recycled water shall be used on any property or use area not owned or controlled by the City unless a non-transferrable User Agreement has been executed between the City and the recycled water user. User Agreements will contain contractually binding terms requiring conformance with the Rules and Regulations and all applicable local, state and federal regulations, including Title 17 and 22 of the California Code of Regulations. Users will be responsible for constructing and maintaining their own on-site recycled water systems for their use area. Appendix C contains a user agreement template that will serve as the foundation for the individual User Agreements for each recycled water user.

The City of Fresno has begun making initial contacts with potential recycled water users to advise them of the forthcoming availability of recycled water, and to begin making necessary arrangements for them to become recycled water users. Initial contacts are being made with potential users sited within one-half mile of the planned recycled water transmission main system. Figure 2-1 is a highly reduced scale map graphically identifying the target area for initial contacts, and the locations of potential recycled water use areas. A full scale version of the map may be viewed at the URL address provided in the List Of Relevant Internet-Accessible Documents.

The City is in the process of retaining a recycled water use area consultant (RWUA Consultant) that will work with potential recycled water users and the City to set up recycled water use areas in conformance with the Recycled Water Ordinance, the Rules and Regulations, the Recycled Water User Agreement, and all applicable local, state and federal regulations. The City will pay the cost of the RWUA Consultant. The recycled water user will be responsible for implementing all onsite improvements, beyond the point of connection to the City's recycled water service, that may be necessary to retrofit or equip the use area for recycled water use. The recycled water user will also be responsible for elimination of any cross connections discovered in the course of the cross connection control survey.

Each recycled water user must designate a Recycled Water Site Supervisor to be responsible for the onsite recycled water system at each use area under their control. The Recycled Water Site Supervisor is required to be responsible for proper installation, operation, and maintenance of the recycled water system, compliance with the Rules and Regulations, prevention of potential hazards, and preservation of the onsite recycled water system plans in “as built” form. Additional specific responsibilities of the Recycled Water Site Supervisor are provided in the Rules and Regulations.

Upon completion of the RWTM facilities that will deliver TTRW to the Roeding Park area, the City plans to implement recycled water use at Roeding Park, including Chaffee Zoo and Rotary Storyland and

Playland, as the first of the City's own recycled water use areas. A feasibility study has been conducted, and the City is currently making arrangements to retain an engineering and landscape architecture consultant for the design of improvements necessary to retrofit or equip the use area for recycled water use.

# APPENDIX A
# RECYCLED WATER ORDINANCE

ORDINANCE NO. _____

AN ORDINANCE OF THE CITY OF FRESNO, CALIFORNIA, ADDING ARTICLE 9 OF CHAPTER 6 OF THE FRESNO MUNICIPAL CODE RELATING TO THE USE OF RECYCLED WATER FOR PLUMBING AND LANDSCAPE IRRIGATION

WHEREAS, the people of the State of California have a primary interest in the development of facilities to reuse water containing waste to supplement existing surface and underground water supplies and to assist in meeting the future water requirements of the State (California Water Code, Section 13510);

WHEREAS, conservation of all available water resources requires the maximum reuse of wastewater for beneficial uses of water (Water Code Section 461);

WHEREAS, continued use of potable water for irrigation of greenbelt areas and other non-potable uses may be an unreasonable use of such water where recycled water is available;

WHEREAS, the State Water Resources Control Board adopted Resolution No. 2009-0011, which intends to establish requirements to increase the use of recycled water in California;

WHEREAS, the State Water Resources Control Board adopted an Order, which creates General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water (General Permit); and

WHEREAS, the City of Fresno Urban Water Management Plan (Resolution No. 2008-207, August 19, 2008) identifies the City's need to develop 25,000 acre-feet per

year of recycled water by 2025 to offset potable water use in order to help meet future water supply needs for the Fresno Metropolitan area;

THE COUNCIL OF THE CITY OF FRESNO DOES ORDAIN AS FOLLOWS:

SECTION 1. Article 9 is added to Chapter 6 of the Fresno Municipal Code to read:

## ARTICLE 9

## RECYCLED WATER ORDINANCE


| | | |
|---|---|---|
| Section | 6-901. | Title. |
| | 6-902. | Purpose and Intent. |
| | 6-903. | Definitions. |
| | 6-904. | Administration. |
| | 6-905. | User Agreement. |
| | 6-906. | Application Process for User Agreement. |
| | 6-907. | Recycled Water Service Eligibility. |
| | 6-908. | Requirements to Use Recycled Water. |
| | 6-909. | Voluntary Use Inside and Outside of the Recycled Water Project Area. |
| | 6-911. | Construction and Dust Control Activities. |
| | 6-913. | Sanctions. |
| | 6-915. | Conflicting Provisions. |


SECTION 6-901. TITLE. This section shall be known as the "Recycled Water Ordinance" of the City of Fresno and may be so cited.

SECTION 6-902. PURPOSE AND INTENT. The purpose and intent is to provide recycled water to all service areas in the City identified in the Recycled Water Master Plan (Plan) (currently under development) and subsequent additions, revisions or updates of the Plan. It is the intent of the City that existing owners of property and future development, identified in the Master Plan as being potential users within areas designated for recycled water use, qualify for a recycled water use agreement from the City in accordance with this Recycled Water Ordinance.

It is also the intent of the City that such recycled water be used in a manner and for types of uses that are in compliance with any and all applicable Federal, State and local statues, ordinances, regulations and other requirements.

SECTION 6-903 DEFINITIONS.

(a) "Approved use" means the uses defined by State law as being approved for use of tertiary treated recycled water.

(b) "Cross-connection" means any unapproved and/or unprotected connection between a potable water system and a nonpotable system. No cross connections are allowed between recycled water and potable water systems.

(c) "Customer", "Consumer", or "User" means a person or entity having a connection to the recycled water system or potable water system owned and operated by the City.

(d) "Dual plumbed system" means a system that utilizes separate piping systems for recycled water and potable water within a facility and where the recycled water is used for either of the following:

a. To serve plumbing outlets (excluding fire suppression systems) within a building, or

b. Outdoor landscaping irrigation at individual residences.

(e) "On-site recycled water system" means facilities under the control of the owner, normally downstream of the recycled water meter.

(f) "Potable water" means water which conforms to the Federal, State and local standards for human consumption.

(g) "Recycled water" means non-potable tertiary treated water which, as a result of treatment of wastewater, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource.

(h) "Recycled water distribution system" means recycled water pipelines, transmission mains, pump stations, storage reservoirs, and appurtenances acquired or constructed and owned by the City, and used for the conveyance of recycled water between the wastewater treatment plant and the recycled water service connections.

(i) "Recycled water project area" means those geographical areas identified in the Fresno Recycled Water Master Plan and designated by the City to which the City will provide recycled water service where it is expected to be available. Customers within the Recycled Water Project Area are eligible for recycled water service for approved uses when it becomes available.

(j) "Recycled water service connection" means the point of connection (POC) of the user/customer's recycled water line with the recycled water service line of the City, which shall normally be the downstream end of the recycled water meter tailpiece.

(k) "Rules and regulations" means the Rules and Regulations for Recycled Water Use and Distribution within the City of Fresno.

(l) "Use area" means an area of recycled water use with defined boundaries. A use area may contain one or more facilities.

SECTION 6-904. ADMINISTRATION. The Director of the Department of Public Utilities (Director) shall administer, implement, and enforce the provisions of this section. Any powers granted to or duties imposed upon the Director may be delegated by the Director to persons in the employ of the City.

The Director will develop and enforce rules and regulations necessary to the administration of this section. The Director may amend such rules and regulations from time to time as conditions require. These rules and regulations shall be consistent with the general policy established herein by the City.

SECTION 6-905. USER AGREEMENT. Recycled water shall not be delivered, used, or discharged upon any property or use area not owned or controlled by the City unless a user agreement has been established.

The City will issue to each recycled water customer a user agreement for each site or combination of sites, which grants permission to use recycled water and requires the customer to use recycled water in accordance with the rules, regulations and standards of the City's Recycled Water Rules and Regulations and all applicable State and local rules and regulations, including Titles 17 and 22 of the California Code of Regulations (CCR), as may be amended from time to time.

SECTION 6-906. APPLICATION PROCESS FOR USER AGREEMENT. Applicants shall file applications for recycled water use with the Department of Public Utilities. The application shall contain such information as required by the

Department of Public Utilities. The application shall be reviewed for conformance with the requirements in this section, the Recycled Water Master Plan and all other applicable statutes. Upon determination that a property shall be served with recycled water, or adoption of a condition for development approval requiring use of recycled water, and approval of the application, the owner of the property may become a user by entering into a user agreement that complies with the regulations and such other requirements deemed necessary by the Department of Public Utilities.

SECTION 6-907. RECYCLED WATER SERVICE ELIGIBILITY. All areas served by potable water service within the Recycled Water Project Area are eligible for recycled water service connections for approved uses when recycled water becomes available.

However, the Director, or his or her designee, may determine that currently, connection to the recycled water system is not economically or operationally feasible because of distance from an available recycled water source or other such condition as the Director, or his or her designee, deems appropriate. This determination can change as the system is expanded or revised in the future and will be considered at that time.

SECTION 6-908. REQUIREMENT TO USE RECYCLED WATER. The City reserves the right to require all customers who connect (or desire to connect) to the City potable water system on or after January 1, 2015 to use recycled water in-lieu of potable water for all approved uses, including, but not

limited to, dual plumbing requirements for commercial buildings and single family residential irrigation.

Upon application by a developer, owner or water customer for a tentative map, subdivision map, land use permit, or other development project, the Director shall review the Master Plan and make a preliminary determination whether the current or proposed use of the subject property require it to be served with recycled water or to include facilities designed to accommodate the use of recycled water in the future, due to its location within an existing or proposed Recycled Water Project Area. Based upon such determination, an agreement for such use may be required as a condition of approval of any such application, in addition to any other conditions of approval or service.

a. Requirement for Commercial Properties in Recycled Water Project Area.

Existing Commercial: Existing commercial properties in the Recycled Water Project Area are required to use recycled water for landscape irrigation. Owners of existing commercial properties shall connect to the recycled water system or must provide a feasibility study to apply for an exception to this Recycled Water Ordinance.

New Commercial: Projects involving new commercial subdivision of land for which a tentative map or parcel map is required and are located within the Recycled Water Project Area, shall be conditioned to be dual plumbed to provide for the internal use of recycled water and to provide for the use of recycled water for landscape irrigation. The point of connection to the recycled water distribution

system shall be coordinated between the customer and the City. The Director will determine requirements for recycled water plumbing. These requirements and the use of recycled water will become conditions of approval.

b. Requirement for Industrial Projects in the Recycled Water Project Area.

Existing Industrial: Existing industrial properties in the Recycled Water Project Area are required to use recycled water for landscaping. Owners of existing industrial properties shall connect to the recycled water system or must provide a feasibility study to apply for an exception to this Recycled Water Ordinance.

New Industrial: New industrial projects which require a City permit and which are located within the Recycled Water Project Area are required to provide dual plumbing for internal uses of recycled water and to provide for the use of recycled water for landscape irrigation. Such projects must also provide a feasibility study analyzing the possibility of using recycled water for industrial processes and cooling. The Director will determine requirements for recycled water plumbing. The feasibility study and, if applicable, any City requirements for the use of recycled water will become conditions of approval.

c. Requirement for Institutional and Governmental Use in the Recycled Water Project Area.

New Institutional and Governmental Projects: New institutional and governmental projects which are located within the Recycled Water Project Area are required to be dual plumbed to provide for the internal use of recycled water

and to provide for the use of recycled water for landscape irrigation. The Director will determine requirements for recycled water plumbing. These requirements and the use of recycled water will become conditions of approval.

d. Requirement for Residential Uses in the Recycled Water Project Area.

New Apartments and Condominiums: Apartment and Condominium projects involving new commercial subdivisions of land for which a tentative map or parcel map is required and are located within the Recycled Water Project Area, shall be conditioned to be dual plumbed to provide for the internal use of recycled water and to provide for the use of recycled water for landscape irrigation in common areas. The point of connection to the recycled water distribution system shall be coordinated between the customer and the City. The Director will determine requirements for recycled water plumbing. These requirements and the use of recycled water will become conditions of approval.

New Single Family Residential Homes: Single family residential home projects involving new residential subdivisions of land for which a tentative map or parcel map is required and are located within the Recycled Water Project Area, shall be conditioned to provide for landscape irrigation with recycled water. The point of connection to the recycled water distribution system shall be coordinated between the customer and the City. These requirements and the use of recycled water will become conditions of approval.

Existing Apartments and Condominiums: Existing apartment and condominiums are required to use recycled water for landscape irrigation in

common areas. Owners of existing apartment and condominium properties shall connect to the recycled water system or must provide a feasibility study to apply for an exception to this Recycled Water Ordinance.

Home Owner Associations: Home Owner Associations are required to use recycled water for landscape irrigation in common areas. Home Owner Associations shall connect to the recycled water system or must provide a feasibility study to apply for an exception to this Recycled Water Ordinance.

SECTION 6-909. VOLUNTARY USE INSIDE AND OUTSIDE OF THE RECYCLED WATER PROJECT AREA.

a. Existing Commercial Properties in the Recycled Water Project Area.

Existing Commercial Properties: Existing commercial properties that are in the Recycled Water Project Area shall consider using recycled water for internal dual plumbing, internal cooling towers and evaporative coolers.

b. Commercial Properties Outside of the Recycled Water Project Area.

New and Remodeled Commercial Properties: New and remodeled commercial properties that are located outside of the Recycled Water Project Area shall consider the feasibility of providing for internal dual plumbing and providing for the use of recycled water for landscape irrigation, as recycled water may be extended beyond the Recycled Water Project Area.

c. Existing Industrial Properties in the Recycled Water Project Area.

Existing Industrial Properties: Existing industrial properties in the Recycled Water Project Area shall consider the feasibility of using recycled water for internal dual plumbing.

d. Existing and New Institutional and Governmental Use.

Existing Institutional and Governmental Properties: Existing institutional and governmental properties in the Recycled Water Project Area shall consider the feasibility of using recycled water for internal dual plumbing and landscape irrigation.

New Institutional and Governmental Properties Outside of Recycled Water Project Area: New institutional and governmental properties that are located outside of the Recycled Water Project Area shall consider the feasibility of using recycled water for internal dual plumbing and landscape irrigation, as recycled water is expected to be extended beyond the Recycled Water Project Area.

e. Residential Uses Outside of Recycled Water Project Area

Remodeled Apartments and Condominiums: Remodeled apartment and condominium properties shall consider the feasibility of dual plumbing to provide for the internal use of recycled water and using recycled water for landscape irrigation in common areas.

Existing Apartments and Condominiums: Existing apartment and condominiums shall consider the feasibility of using recycled water for landscape irrigation in common areas.

Home Owner Associations: Home Owner Associations are encouraged to consider the feasibility of using recycled water for landscape irrigation in common areas.

These statements apply to residential uses outside of the Recycled Water Project Area as recycled water may be extended beyond the current Recycled Water Project Area.

f. Industrial Projects; Inside and Outside of Recycled Water Project Area.

All existing and new industrial projects shall consider the feasibility of providing for the use of recycled water for industrial processes and cooling and dual plumbing.

SECTION 6-910. EXISTING POTABLE WATER SERVICE: VOLUNTARY RETROFITS. Existing potable water customers in the Recycled Water Project Area may be provided with the opportunity by the City to retrofit their system to accept recycled water, such as existing commercial properties and existing institutional and governmental properties.

SECTION 6-911. CONSTRUCTION AND DUST CONTROL ACTIVITIES. Any person applying for a construction permit for a project that includes dust control activities is required to use recycled water for those activities within the Recycled Water Project Area.

SECTION 6-912. RECYCLED WATER RULES AND REGULATIONS. The City will at all times have Recycled Water Rules and Regulations which will be prepared, maintained and updated by the Director, or his or her designee.

The purpose of the Recycled Water Rules and Regulations is to detail the requirements of the City's recycled water system, namely: this section; the California Code of Regulations Titles 17 and 22; and other State and local rules and regulations related to the use of recycled water as they may be adopted or changed from time to time.

SECTION 6-913. SANCTIONS. Any owner and or operator who violates this Recycled Water Ordinance may, for each day of violation, or portion thereof, be subject to penalties in accordance with Chapter 1, Article 3 of the City Municipal Code.

SECTION 6-914. ENFORCEMENT. Any person, firm, corporation, association, or agency found to be violating any provisions of this section or the terms and conditions of the user agreement, permit or any applicable Federal, State, County, or City statute, regulation, resolution, ordinance or other requirement may be subject to termination of the recycled water service without notice.

SECTION 9-915. CONFLICTING PROVISIONS. In the event of any conflict, between the provisions of the most current version of the Uniform Plumbing Code, and the provisions of this Section, the provisions of this Section shall apply.

SECTION 9-916. SEVERABILITY. If any section, subsection, provision or part of this Recycled Water Ordinance, or its application to any person or circumstance, is held to be unconstitutional or otherwise invalid, the remainder of this Recycled Water Ordinance, and the application of such provision to other

person or circumstances, shall not be affected thereby and shall remain in full force and effect and, to that end, the provisions of this Recycled Water Ordinance are severable.

SECTION 2. This ordinance shall become effective and in full force and effect at 12:01 a.m. on the thirty-first day after its final passage.

* * * * * * * * * * * * * * *

STATE OF CALIFORNIA )
COUNTY OF FRESNO ) ss.
CITY OF FRESNO )

I, YVONNE SPENCE, City Clerk of the City of Fresno, certify that the foregoing ordinance was adopted by the Council of the City of Fresno, at a regular meeting held on the _____ day of _____, 2014.

AYES :
NOES :
ABSENT :
ABSTAIN :

Mayor Approval: _____, 2014
Mayor Approval/No Return: _____, 2014
Mayor Veto: _____, 2014
Council Override Vote: _____, 2014

YVONNE SPENCE, CMC
City Clerk

BY:_____
Deputy

APPROVED AS TO FORM:
CITY ATTORNEY'S OFFICE

BY:_____
Brandon M. Collet, Deputy Date

BMC:prn [64611prn/ord] 05-19-14

# APPENDIX B
# RULES AND REGULATIONS

# Rules and Regulations of Recycled Water Use

DEPARTMENT OF
PUBLIC UTILITIES
*Providing Life's Essential Services*

Wastewater Management Division
5607 W. Jensen Ave
Fresno, CA 93706

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# 1. Introduction

The City of Fresno owns and operates a Recycled Water Distribution System (Distribution System) providing Recycled Water for approved uses to Recycled Water Customers (Customer) within the Recycled Water Project Area. This document contains the City of Fresno's Rules and Regulations governing the design, construction and use of Recycled Water (Rules and Regulations). These Rules and Regulations aim to provide Customers with necessary information to comply with relevant codes, laws, statutes and regulations concerning the use of Recycled Water.

## 1.1. Authority and Sources

The Rules and Regulations are prepared and administered by the Department of Public Utilities Wastewater Management Division, and may be updated from time to time. The Rules and Regulations apply to all Customers and distributors of Recycled Water and shall govern the design, construction and use of both the Distribution System operated by the City and On-Site Recycled Water Systems operated by Customers. Since codes, laws, statutes and regulations can change without prior approval or knowledge, the City of Fresno does not assume any liability for errors in this document. It is the responsibility of the Customer to check with the City of Fresno before initiating any changes to their On-Site Recycled Water System. It is the intent of these Rules and Regulations to be consistent with the following criteria:

(a) California Code of Regulations, Title 22, Division 4, Chapter 3 (Water Recycling Criteria).

(b) California Code of Regulations, Title 17, Division 1, Chapter 5 Group 4, Article 1and 2 (General and Protection of Water System).

(c) The State Water Resources Control Board (SWRCB) and its Division of Drinking Water (DDW) Guidelines for Use of Recycled Water, and Guidelines for Use of Recycled Water for Construction Purposes.

(d) American Water Works Association (AWWA) California/Nevada section, Guidelines for the Distribution of Non-Potable Water and Guidelines for Retrofitting to Recycled Water or alternate measures that are acceptable to the DDW.

(e) Applicable regulations by the Regional Water Quality Control Board (RWQCB).

(f) City of Fresno Municipal Code, Chapter 6, Article 3, Sewage and Water Disposal and Article 9, Recycled Water Ordinance.

Interested parties may contact the Wastewater Management Division for copies of documents referenced in these Rules and Regulations.

## 1.2. Scope and Severability

If any section, subsection, clause or phrase of these Rules and Regulations is determined to be invalid, the remaining portions of these Rules and Regulations shall remain in effect. If there is any conflict between the provisions of these Rules and Regulations and the provisions of any of the referenced documents, the most stringent guidelines will control.

### 1.3 Planning for Recycled Water Use

The Rules and Regulations outlined in this document provide Recycled Water Customers with information for design, installation, operation and maintenance of an On-Site Recycled Water System. This section provides general information about the City of Fresno's Recycled Water program.

Eligibility to Use Recycled Water.

(a) The Department of Public Utilities shall review the Recycled Water Master Plan and make a preliminary determination whether the current or proposed use of the property requires service with Recycled Water, or facilities designed to accommodate the use of Recycled Water in the future. This determination is based in part on the property's location within the existing or proposed Recycled Water Project Area.[1]

(b) The City of Fresno's Recycled Water Ordinance requires all new construction, existing and future commercial/ industrial facilities to use Recycled Water for landscape irrigation, if available in the Recycled Water Project Area.

(c) Existing sites using Potable Water for irrigation may convert to Recycled Water with approval of the City.

(d) All Recycled Water systems shall be metered separately from the Potable Water supply and must have no Cross Connection to the Potable Water supply.

### 1.4. Protection of Public Health and the Environment

The use of Recycled Water shall not result in contamination or pollution of any surface water body nor create a hazard that is injurious to public health. The City of Fresno, Fresno County Department of Health, and the DDW may take measures to ensure that a Customer's On-Site Recycled Water System adequately protects public health and the environment. Conditions which may lead to unacceptable public health and environmental hazards include, but are not limited, to:

(a) Cross connections with the potable system or any other water system;

(b) Improper tagging, marking or signage;

(c) Unapproved uses of Recycled Water; and

(d) Recycled Water runoff to a surface water body.

### 1.5. Approved Uses of Recycled Water

Tertiary disinfected Recycled Water may be used for landscape and agricultural irrigation, impoundments, commercial laundries, cooling towers and other Approved Uses as identified in Title 22, Division 4, Chapter 3, Article 3 Recycled Water Criteria. Moreover, statutes delineating permissible uses of Recycled Water at locations such as

[1] Fresno Municipal Code, Chapter 6, Article 9, Section 6-908

cemeteries and car washes are identified in the Health and Safety Code, Division 8, Part 1, Chapter 4.5 and the Water Code Division 6, Part 2.12 § 10950 – § 10953, respectively.

### 1.6. Violation of Rules and Regulations

The City may terminate Recycled Water service to a Customer who uses, transports, or stores Recycled Water in violation of these Rules and Regulations. No Customer will create or threaten to create conditions of pollution, contamination, and nuisance or violate discharge requirements prescribed by the RWQCB. Enforcement actions may be initiated against any Customer resulting in potential termination of Recycled Water service. In addition, no person at any time shall tamper with City property except to shut off water to protect public health or prevent damage to property or the environment. Only authorized City personnel may operate City facilities.

The City shall investigate all reports of non-compliance with any provision of these Rules and Regulations and/or the User Agreement to determine the validity and seriousness of the violation. Determinations regarding the seriousness will be based upon the violation's magnitude and duration; effect on public health, the environment, City property or assets, or the operation of the Distribution System; effect on the City's compliance with the Rules and Regulations of the regulatory agencies with which it must in turn comply; and the history and good faith of the Customer.

### 1.7. Notice of Violation

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Unless the violation is an emergency, as determined by the City, the Customer will receive a written notice of violation describing:

(a) The nature of the violation;
(b) Requirements for submittal of a corrective action plan;
(c) A reasonable time limit for the satisfactory mitigation of the violation; and
(d) A date for a follow-up inspection.

The Customer may file a notice of appeal within 15 calendar days after notice of violation is received, following the guidelines for filing a notice of appeal and the City shall implement duty of enforcement procedures as defined in Fresno Municipal Code, Chapter 1, Article 4.

For emergencies that result in cross connection of recycled water with potable water, refer to Part 10. Cross Connection, Section 10.3 Emergency Preparedness and Section 10.4 Emergency Cross Connection Procedures.

### 1.8. User Agreements

Recycled Water shall not be delivered, used, or discharged upon any property or Use Area not owned or controlled by the City unless a non-transferrable User Agreement has been executed between the City and Customer permitting the Customer to receive Recycled Water service.

The site-specific User Agreement will identify the Recycled Water's Use Area, an estimate of the quantity (including seasonal schedule) of Recycled Water to be used, and permitted uses of Recycled Water. User Agreements delineate contractually binding terms associated with these Rules and Regulations. Once executed, the User

Agreement permits use of Recycled Water in accordance with the terms of the User Agreement, these Rules and Regulations, and all applicable local, State and federal regulations, including Title 17 and 22 of the California Code of Regulations, as may be amended from time to time. If an On-Site Recycled Water System is found to be in violation of a City of Fresno Ordinance, the corresponding User Agreement and/or these Rules and Regulations, the City shall implement provisions of Section 1.7. of these Rules and Regulations.

### 1.8.1. User Agreement Renewal

Upon expiration of the existing User Agreement, customer shall enter into a new agreement for continuation of recycled water services. The new agreement may have additional regulatory requirements, costs, or rates not specified on the original agreement. In the case of change of property ownership and if the new owner desires to continue the recycled water service, a new Recycled Water User Agreement with the new owner will be processed reflecting changes in regulatory requirements, costs or rates not previously specified, if any.

### 1.9. Conditions Precluding Delivery of Recycled Water

The City has sole discretion and flexibility in scheduling, distributing and prioritizing Recycled Water deliveries, particularly under conditions of insufficient recycled water supply, maintenance of City's treatment or distribution systems, acts of a third party, or order of a Regulatory Agency.

## 2. Definitions

Whenever the following terms (or pronouns are used in their place) occur in these Rules and Regulations, they will be identified with capitalized initials and their meaning shall be interpreted as follows:

"**Air Gap**" is a physical separation from the free-flowing discharge end of a water supply pipeline and an open or non-pressure receiving vessel. It is generally regarded as the most protective method of backflow prevention. An approved air gap must be at least twice the diameter of the water supply pipeline, measured vertically from the flood rim of the Customer's receiving vessel to the supply pipe from the service connection. In no case shall the air-gap separation be less than one inch.

"**Applicant**" is a potential user requesting Recycled Water services from the City.

"**Approved Uses**" means uses defined by California Code of Regulations, Title 22, Division 4 Environmental Health, Chapter 3 Water Recycling Criteria, Article 3 Uses of Recycled Water.

"**As-Built**" means engineering drawings that depict completed facilities, as constructed or modified.

"**Backflow**" is a condition that results in the flow of water, mixtures or substances into a potable water system from a source other than an approved water supply.

"**City**" means City of Fresno, California.

"**Contamination**" means an impairment of the City's potable water quality resulting from the introduction of sewage, industrial fluids, waste liquids, compounds or other materials

to a degree which creates an actual hazard to public health through poisoning or spread of disease.

"**Cross Connection**" is the unprotected and/or unapproved actual or potential connection between a potable and non-potable water supply. By-pass arrangements, jumper connections, removable sections, swivel or changeover devices through which backflow could occur, shall be considered to be Cross Connections.

"**Cross Connection Control Specialist**" is an individual trained in cross-connection control, establishment of a procedure or system for testing backflow preventers, and maintenance of records of locations, tests, and repairs of backflow preventers.

"**Customer**", "Consumer" or "User" means a person or entity who is the contracted recipient of Recycled Water services owned and operated by the City of Fresno.

**Division of Drinking Water** ("**DDW**") is a division of the State Water Resources Control Board, formerly California Department of Public Health (CDPH).

"**Dual Plumbing**" means a system that utilizes separate piping systems for Recycled Water and potable water within a facility and where the Recycled Water is used for either of the following: (a) to serve plumbing outlets (excluding fire suppression systems) within buildings or (b) outdoor landscaping irrigation at individual residences.

"**Easement**" means a recorded document in which the land owner gives the City permanent rights to construct and maintain Recycled Water mains and/or facilities across private property.

"**Impoundment**" is a lined structure or a body of water with a lined structure containing Recycled Water, which is used for aesthetic, recreational or irrigation purposes.

"**On-Site Recycled Water System**" means facilities under the control of the property owner, extending from the Recycled Water service connection to the Use Area being serviced with Recycled Water. This includes any on-site distribution plumbing, irrigation systems, industrial processes, impoundments or other approved facilities.

"**Overspray**" means the spray of Recycled Water outside the irrigation area.

"**Pantone**" A color standard system referenced in the American Water Works Association California-Nevada Section Guidelines for Distribution of non-potable water.

"**Ponding**" means the unauthorized retention of Recycled Water in a Use Area for a period following the cessation of approved Recycled Water use activity.

"**Potable Water**" means water which meets the federal, state and local standards for human consumption and is approved for human consumption.

"**Record Drawings**" are the Customer's plans and specifications for the proposed Use Area required by the City's application for Recycled Water Service.

"**Recycled Water**" means non-potable tertiary disinfected water, which as a result of treatment of wastewater is suitable for a direct beneficial use or controlled use that would otherwise not occur, and is therefore considered a valuable resource.

"**Recycled Water Distribution System**" means Recycled Water pipelines, transmission mains, pump stations, storage reservoirs, and appurtenances acquired, constructed and owned by the City and used for the conveyance of Recycled Water between the wastewater treatment plant and the Recycled Water service connections.

"**Recycled Water Project Area**" means those geographical areas identified in the City's Recycled Water Master Plan where the City expects Recycled Water service to be available. Customers within the Recycled Water Project Area are eligible for Recycled Water service for approved uses when it becomes available.

"**Recycled Water Service Connection**" means the point of connection (POC) of the Customer's Recycled Water line with the Recycled Water service line of the City, which shall normally be the downstream end of the Recycled Water meter tailpiece.

"**Recycled Water Site Supervisor**" or "Site Supervisor" is the Customer's liaison with the City regarding Recycled Water matters. This person must have the authority to enforce these Rules and Regulations, be responsible for the operation and maintenance of the On-Site Recycled Water System, must prevent potential violations and submit a Use Area Monitoring Report.

"**Reduced Pressure Principle Backflow Prevention Device**" is a type of backflow prevention device, usually installed near a water meter, which prevents backflow by a combination of two check valves, an automatically operated differential relief valve between the two check valves and a tightly closing shut-off valve on each side of the check valve assembly.

"**Regulatory Agency**" refers to those public agencies legally constituted to protect public health and water quality, and whose rules govern the use of Recycled Water, such as DDW, RWQCB and the Fresno County Department of Public Health.

"**Rules and Regulations**" means the Rules and Regulations for Recycled Water use, distribution and transport within the City of Fresno.

"**Runoff**" means Recycled Water that drains outside the approved Use Area.

"**RWQCB**" means Regional Water Quality Control Board, a subdivision of the State Water Resources Control Board.

"**RWRF**", Fresno-Clovis Regional Wastewater Reclamation Facility.

"**SWRCB**", State Water Resources Control Board

"**Use Area**" means an area of Recycled Water use with defined boundaries. A Use Area may contain one or more facilities.

"**Water Recycling Criteria**" - the State of California's set of requirements for the implementation of Recycled Water programs as detailed in the California Code of Regulations, Title 22, Division 4, Chapter 3.

## 3. General City Responsibilities

The City shall be responsible for all aspects of the treatment, distribution system and quality of Recycled Water. City responsibilities shall include:

(a) Observe and permit installation, connection, and disconnection of Recycled Water service, including, piping, valves and other appurtenances required to connect the City's Recycled Water Distribution System to an On-Site Recycled Water System. The service includes a Recycled Water Meter(s) to measure Recycled Water consumption at the Use Area.

(b) ). Ensure users follow the City of Fresno Public Works Standard Specifications, Section 33, Recycled Water Facilities Design Criteria and Section 34, Recycled Water Facilities. [2]

(c) Manage and supervise remergency and non-emergency conversions from a Recycled Water supply at a Use Area back to a Potable Water system and viceversa. This can happen if delivery of recycled water is precluded for reasons beyond the reasonable control of the City including, but not limited to insufficient recycled water supply, maintenance of City's treatment or distribution systems, acts of a third party, or an order from a Regulatory Agency..

(d) Conduct the initial and final inspections of the Use Area as part of the Customer's process for utilizing recycled water.

(e) Monitor the Customer's Recycled Water management practices.

(f) Collect fees from Customers Recycled Water use and related services, as designated in the Master Fee Schedule, when such fees are developed.

(g) Agents of the City, RWQCB, or DDW may enter and inspect the Use Area during reasonable hours, upon providing credentials and with 24 hours advance notice or such notice as required by law, for the purposes of verifying that Customer is complying with these Rules and Regulations and to protect public health and the environment.

(h) The City shall not be responsible for abatement of Cross Connections within a Customer's premises.

## 4. General Customer Responsibilities

Recycled Water Customers must comply with and enforce all aspects of these Rules and Regulations upon accepting Recycled Water service and finalizing the User Agreement. Customer responsibilities include but are not limited to the following:

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[2] City of Fresno Public Works Standard Specifications, Addendum No. 4, Resolution No.70-36, Sections 33. Updated version approved January 2013.

(a) Understanding that all Approved Uses of Recycled Water for the permitted Use Area are exclusively for non-potable uses as identified in Title 22, Division 4, Chapter 3, Article 3. Water Recycling Criteria

(b) Obtaining all permits necessary to install, operate and maintain the On-Site Recycled Water System.

(c) Granting the City an easement for construction of the Recycled Water Service Connection if the City decides to make provisions for delivery of Recycled Water to the proposed Use Area.

(d) Paying for, furnishing, installing, operating and maintaining all facilities necessary for conveyance of Recycled Water from the point of connection (beginning at a flow control valve adjacent to, and following the water meter assembly) to the On-Site Recycled Water System, in a manner consistent with these Rules and Regulations and without harming or damaging any person or property.

(e) Identifying and labeling all facilities associated with the On-Site Recycled Water System according to the type of water in each system.

(f) Paying to install, connect and/or disconnect from the Recycled Water Service Connection in a manner ensuring no Recycled Water enters the Potable Water system.

(g) Paying for, and furnishing, all necessary modifications to the On-Site Recycled Water System such as sprinkler changes, quick-coupler modifications or installations, modifications to prevent unauthorized discharges and additional requirements related to new or expanded systems (see Section 6).

(h) Providing the City a written notification, in a timely manner, specifying any material change or proposed change in the character of the use of Recycled Water.

(i) Ensuring all materials used in operating and maintaining the On-Site Recycled Water System are approved/recommended for Recycled Water use.

(j) Adhering to Use Area management practices as described in Section 7.

(k) Submitting an Annual Self Inspection Report (Exhibit B); arranging and paying for a third party Cross Connection inspection once every four years using the Cross Connection Control Test Procedures outlined in Exhibit C.

(l) Designating a Recycled Water Site Supervisor who is responsible for the On-Site Recycled Water System at each Use Area under their control (see Section 5).

## 5. Site Supervisor Responsibilities

The Recycled Water Site Supervisor is responsible for the On-Site Recycled Water System at each Use Area under their control. The Site Supervisor is responsible for proper installation, operation, and maintenance of the irrigation system; compliance with

these Rules and Regulations, prevention of potential hazards and preservation of the Recycled Water distribution system plans in “as built” form. Specific responsibilities include but are not limited to the following:

(a) Avoiding Cross Connections when installing, operating and maintaining pipelines, equipment and appurtenances associated with On-Site Recycled Water Systems.

(b) Attending all Cross Connection tests.

(c) Knowing and understanding the provisions of Title 17 and the Water Recycling Criteria relating to the safe use of Recycled Water; understanding basic concepts of backflow and Cross Connection prevention, system testing and related emergency procedures.

(d) Maintaining a copy of these Rules and Regulations, irrigation system layout map and a Recycled Water system operations manual at the Use Area. These documents shall be available to operating personnel at all times.

(e) Ensuring Recycled Water signs are fully legible and displayed at all irrigation sites, particularly areas with greater visibility and public use.

(f) Training Use Area personnel on the Approved Uses of Recycled Water.

(g) Providing the City with updated contact information of the supervisor and/or a designee to ensure operational and maintenance issues receive prompt attention.

(h) Conducting a required annual self-inspection of the Use Area and submitting a monitoring report to the City (see Appendix A).

(i) Coordinating a Cross Connection test by a third party every four years and ensuring the City receives documentation following the test.

(j) Establishing and maintaining a record of all inspections, modifications, maintenance, employee trainings, permit documents, and communications with the City and other Regulatory Agencies.

(k) Reporting all violations and emergencies to the appropriate Regulatory Agency.

### 5.1. Changing the Recycled Water Site Supervisor

The Customer must immediately notify the City of any personnel changes relating to the Recycled Water Site Supervisor position. In the event of any change, the new Site Supervisor must attend a Recycled Water Site Supervisor Certification Workshop within 90 days of the position change. Failure to attend this workshop may result in termination of Recycled Water service.

### 5.2. Recycled Water Site Supervisor Training

The Site Supervisor must attend a Supervisor Certification Workshop as recommended by the DDW and provided by the City, within the first 120 days of receiving Recycled

Water service. Failure to attend the Site Supervisor Certification Workshop may result in the termination of Recycled Water service.

## 6. Facility Requirements

This section specifies the Rules and Regulations governing the design, installation and inspection of new and existing Recycled Water irrigation systems. Additionally, this section also covers the required Rules and Regulations governing design requirements at the service connection and on-site requirements for piping depth, separation requirements, vertical separation at crossings, pipe class specifications and depth of cover consistent with Title 22, Division 4, Chapter 16, Article 4 § 64572.

### 6.1. Design Requirements at the Service Connection

Each Recycled Water Service Connection will be equipped with a valve on both sides of, and adjacent to, the meter assembly. The valve on the inlet side of the meter assembly will be owned and maintained by the City and shall be used by the City to control the water supply through the meter assembly. The valve on the outlet side of the meter assembly will be owned and maintained by the Customer and shall be used by the Customer to control the flow of Recycled Water to the Use Area. City ownership and maintenance responsibilities of the service connection include the meter assembly and terminate at, and does not include, the valve on the Customer's side of the meter assembly.

(a) Air gap

If conveyance of Recycled Water is carried out with existing plumbing, Potable Water service will be disconnected from the On-Site Recycled Water System and an above-ground air gap will be installed. The air gap will be spaced so that a Reduced Pressure Principle Backflow Prevention Device may be installed by the City in the future.

(b) Future Connections

In the event of potential Recycled Water service interruption or failure, Customers may connect the On-Site Recycled Water System to the previous Potable Water supply provided that (a) Recycled Water supply is disconnected from the On-Site Recycled Water System and (b) a Potable Water service point is configured to allow for future connections.

### 6.2. Required Temporary Connection to Potable Water Service

Each On-Site Recycled Water System must pass a Cross Connection test prior to receiving Recycled Water. To facilitate this, the On-Site facility must be supplied with water via a temporary supply pipe to an on-site Potable Water system up to and during the Cross Connection test. After passing the test, the temporary supply connection must be removed and the system connected to the Recycled Water meter. On-Site Recycled Water Systems with no Potable Water within the Use Area, such as some streetscapes and medians, do not need to conduct a Cross Connection test and therefore do not need a temporary Potable Water source.

### 6.3. Conversion of Facilities

(a) Conversion from Potable to Recycled Water Use

No existing Potable Water facility shall be converted to, or incorporated into, a Recycled Water facility without proper testing and approval by the City. With the exception of pipe identification and pipe separation, On-site Recycled Water Systems for which the existing buried piping system is converted from Potable Water to Recycled Water must meet the same requirements as new facilities. However, any new buried piping added to existing piping at a converted Use Area must meet the identification and separation requirements for new systems. In addition, any existing piping uncovered for any reason during construction must be marked according to new pipe identification requirements to the extent feasible. Prior to the conversion of an existing Potable Water system to Recycled Water use, the Customer shall, at a minimum, submit Record Drawings and a report outlining the measures necessary to bring the system into full compliance to the City for review and approval.

(b) Conversion from Recycled to Potable Water Use

If the City determines it is necessary to convert Recycled Water facilities to Potable Water use, it shall be the responsibility of the Customer, at the Customer's cost and expense, to implement the following, as determined by the City:

(i) Notify DDW of the intention to return to Potable Water use.

(ii) Arrange to have the City disconnect and plug the Use Area Recycled Water Service Connection in a manner approved by the City.

(iii) Shock the On-site Recycled Water System to be converted with 50 ppm of chlorine for 24 hours.

(iv) Measure the chlorine residual after 24 hours. If a residual greater than 25 ppm is maintained, then continue to the next step. If the residual is below 25 ppm, then re-chlorinate by returning to the previous step until the chlorine residual can be maintained above 25 ppm.

(v) Flush the On-site Recycled Water System with Potable Water and perform a standard bacteriological test. The final test results must be acceptable to the City before supplying the former On-site Recycled Water System with Potable Water.

(vi) Install and test approved backflow prevention assemblies on all Potable Water meter connections as required by Cross Connection requirements.

(vii) Remove all Recycled Water quick-couplers.

(viii) Notify all Use Area personnel of the change.

(ix) Remove all Recycled Water warning labels/signs from the On-site Recycled Water System and the Use Area.

(x) Notify DDW both prior to and upon completion of conversion back to Potable Water.

### 6.4. Recycled Water Piping Requirements

Construction of Recycled Water mains, facilities and appurtenances within the Recycled Water Project Area shall comply with design requirements as identified in the City's Standard Specifications.[3] The specifications also include identification requirements for piping, valve boxes, quick couplers, sprinkler heads, signage boards and specifications for pipe sizing, depth, materials, identification tags and service assemblies. The "California Waterworks Standards" set forth minimum separation requirements for Recycled Water and water main lines. Refer to Title 22 California Code of Regulations § 64572 for specific horizontal and vertical separation distances between potable and recycled water lines.

## 7. On-Site Recycled Water Systems

The following requirements shall be met for new On-Site Recycled Water System facilities. Before Recycled Water is delivered to a Use Area, the site shall be assessed and retrofitted, as necessary, by the Customer in order to meet the requirements of this subsection. Customers shall furnish, install, operate, and maintain all On-site Recycled Water Systems and appurtenances necessary to convey water from the valve immediately following the meter assembly to the approved Use Area in a manner that does not harm or damage any person or property. Refer to Sections 5 and 6 for general City and Customer responsibilities regarding On-Site Recycled Water Systems. Plans, specifications and drawings of On-Site Recycled Water Systems shall be submitted to and approved by the City prior to construction.

### 7.1. Signage

All Use Areas that are accessible to the public shall be posted with conspicuous signs, not smaller than 4 inches by 8 inches in area and showing an international symbol for Non-Potable Water. The lettering on the signs must be a minimum of ½ inch in height and must be back or white on a purple background (See figure 1 for an acceptable symbol). The signs must read "Recycled Water—Do Not Drink" in English, Spanish ("Agua Reciclada—No Beber") or any additional language that may be needed to reach the population or workers in the area using recycled water The User will be responsible for posting signs in all Use Areas visible to the public (such as site entrances), and at all valves, control boxes, and similar features. Use Areas that are prone to vandalism may place Recycled Water signage at higher elevations to avoid tagging, theft, and property damage.

Recycled Water signage may also be posted at any points where after-market clip-on purple rings are used for head identification of pop-up sprinklers, rotary sprinklers and shrub riser sprinklers.

### 7.2. Irrigation Requirements

Operation of all On-Site Recycled Water Systems shall comply with the Use Area irrigation requirements defined in Title 22 Code of Regulations, Division 4, Chapter 3, Article 4, § 60310.

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[3] City of Fresno Public Works Standard Specifications, Addendum No. 4, Resolution No.70-36, Sections 33 and 34. Updated version approved January 2013.

## 8. Department of Transportation

In cooperation with the City, the California Department of Transportation (Caltrans) shall permit the City to place transmission lines for Recycled Water in freeway rights-of-way to promote the beneficial use of Recycled Water so long as transmission does not unreasonably interfere with use of the freeway or unreasonably increase any hazard to vehicles on the freeway. Caltrans shall require the use of Recycled Water for irrigation of freeway landscaping as identified in Streets and Highways Code, Division 1, Chapter 1, Article 1, § 92.3.

## 9. Recycled Water Fill Stations

Residential and commercial Customers may collect bulk supply of recycled water at City-designated areas to offset potable water uses by agreeing to the terms and conditions of the user agreement for fill station Customers (Exhibit E). Residential Customers may collect up to 300 gallons per load and commercial users may collect 300 gallons or more per load.

## 10. Cross Connection

**IMPORTANT: No physical connection shall be made or allowed between any Recycled Water system and any potable water system.**

### 10.1. General City Responsibilities

(a) The City shall implement a Cross Connection control program as required by all provisions of Title 17, Division 1, Chapter 5, Group 4, Article 1, § 7584.

(b) The Cross Connection control program may be implemented directly by the City or by means of a contract with the local health agency, or with another agency approved by the health agency.

(c) The Cross Connection control program shall include the provision of at least one Cross Connection Control Specialist trained in cross-connection control to carry out the cross-connection program, the establishment of a procedure or system for testing backflow preventers, and the maintenance of records of locations, tests, and repairs of backflow preventers.

(d) The City is not responsible for abatement of Cross Connections which may exist within a Customer's Use Area.

(e) The City shall evaluate the degree of potential health hazard to the public water supply that may be created as a result of special conditions existing in a Use Area as identified in Title 17, Division 1, Chapter 5, Group 4, Article 1, § 7585.

### 10.2. General Customer Responsibilities

(a) The Customer must pass a Cross Connection test before connecting the On-Site Recycled Water System to the Distribution System at any Use Area that uses both recycled and potable water.

(b) The following elements are required for a Cross Connection test. See Exhibit C for specific Cross Connection Testing Procedure.

(i) The Customer must notify the City at least 48 hours prior to the test so that a City representative is present.

(ii) The test must be done once every four years under the supervision of the City and performed by an AWWA-certified Cross Connection Control Specialist.

(iii) The Recycled Water Site Supervisor must be present at the test.

(iv) A written report documenting test results must be submitted by the Cross Connection Control Specialist to the Recycled Water Site Supervisor and the City following test completion.

### 10.3. Emergency Preparedness

In case of earthquake, flood, fire, major freeze, nearby construction, or other incident that could damage the Recycled Water or Potable Water systems, the Site Supervisor must inspect all Potable Water systems and the On-site Recycled Water System for damage as soon as it is safe to do so. If either system appears damaged, both systems should be shut off at their points of connection. The Site Supervisor must immediately contact the City for further instruction.

To prevent contamination, damage, or a public health hazard, the Customer may make emergency modifications or repairs without the prior approval of the City. As soon as possible after the modification, but within 24 hours, the Customer must notify the City of the emergency modifications and file a written report within three days.

### 10.4. Emergency Cross Connection Procedures

In the event that a Cross Connection occurs or is identified, the following emergency Cross Connection response plan shall be implemented:

(a) The Customer must notify the City by telephone immediately. This notification must be followed by a written notice within 24 hours that includes an explanation of the nature of the Cross Connection, date and time discovered, and the contact information of the person reporting the Cross Connection if different from the Recycled Water Site Supervisor.

(b) The City will notify DDW and other Regulatory Agencies, as appropriate, of the reported Cross Connection.

(c) Customer must immediately shut down the Recycled Water supply to the On-site Recycled Water System.

(d) Customer must keep Potable Water systems pressurized and post “Contaminated Water – Do Not Drink or Apply to Food” signs at all Potable Water fixtures and outlets.

(e) Customer must provide bottled water for employees until the Potable Water system is deemed safe to drink.

(f) After DDW has provided final approval, the City will reestablish the Recycled Water service and inform the Customer to remove "Contaminated Water – Do Not Drink or Apply to Food" signage at Potable Water fixtures and outlets.

## 11. Backflow Prevention

Customers shall be responsible for ensuring that all Potable Water services into Use Areas are fitted with a Reduced Pressure Principal Backflow Prevention Device if one does not already exist. The backflow prevention device must be located as close as practical to the downstream side of every Potable Water meter. Backflow prevention devices must be properly maintained and tested by the User at least annually. Backflow protection is usually not necessary on Recycled Water irrigation systems as Recycled Water is non-potable. However, the City may require certain sites to install backflow prevention devices at the service connection if it is determined that a potential on-site backflow hazard exists; this protects the quality of Recycled Water in the Distribution System. Examples include:

(a) Irrigation systems that are installed with direct injection chemical fertilizer capability; and
(b) Irrigation sites where Recycled Water impoundment may cause a backflow hazard.

Refer to Title 17, Division 1, Chapter 5, Group 4, Article 2, § 7601 - § 7605 for requirements on construction and type of backflow preventers, feasible locations, and type of protection required.

## 12. Obtaining Recycled Water Service

### 12.1. Request for Service

Potential customers requesting recycled water service shall contact the Department of Public Utilities who will determine if the customer's proposed area is in an area where Recycled Water is or will be available. If in the area where Recycled Water is or will be available, Customer will be provided an "Application for the use of Recycled Water" form (Exhibit A) which should be filled out and returned to the City for process. Prior to receiving Recycled Water service, any proposed use of Recycled Water not listed on Title 22, Uses of Recycled Water, will be required to be approved by DDW.

### 12.2. Proposed Site Assessment and Inspection

Upon receipt of Application and before the On-Site Recycled Water System is connected to the Distribution System, the proposed Use Area will be inspected and an assessment will be made by the City for locations of potential Ponding, Runoff, Overspray, and other concerns. The City will indicate how the On-site Recycled Water System needs be designed in order to address potential violations of these Rules and Regulations.

### 12.3. Design Approval

Prior to constructing or modifying On-Site Recycled Water Systems, draft Record Drawings prepared by the Customer must be approved by the City. The Customer must meet all applicable design requirements for the Use Area to comply with these Rules and Regulations. The Customer shall submit to the City plans for the On-Site Recycled Water System utilizing City Standard format. No work shall begin by the Customer until plans and necessary permits have been approved and issued by the City.

### 12.5. Acceptance Inspection

(a) Construction Inspection. The City will inspect Use Areas undergoing construction to incorporate On-Site Recycled Water Systems and appurtenances in conformance with the approved Record Drawings and applicable regulations. It is the responsibility of the Customer to notify the City of all planning and construction phases so that inspections can be scheduled.

(b) Cross Connection Test. Any Use Area where both Recycled and Potable Water are present shall pass a Cross Connection test prior to connecting the On-Site Recycled Water System to the Distribution System. Refer to section 11 and Appendix B for all Cross Connection requirements.

(c) Final Inspection and Approval to Receive Recycled Water. The City will perform a final inspection to ensure all requirements have been met prior to establishing Recycled Water service. This inspection may be coordinated with the Cross Connection test. The inspector will check to see that the proper equipment was used and that all required tags, labels, and signs are in place. The City must grant final approval before Recycled Water may be supplied to the Use Area. Final approval will be granted when construction has been completed in accordance with approved Record Drawings, all Cross Connection tests have been performed, a final on-site inspection has been conducted, and all requirements have been met satisfactorily. After the User Agreement is finalized by the City and all applicable fees have been paid, the City will finalize the installation of the service connection with the service meter assembly. Upon request, DDW will be provided with a copy of all test and inspection reports as well as notification that Recycled Water service has started. For the lifetime of the On-site Recycled Water System, the City will periodically inspect the Use Area to ensure compliance with all applicable Rules and Regulations.

### 12.6. Coverage Test

Customers are responsible for minimizing Overspray, Runoff, and Ponding from their On-site Recycled Water System. The City will conduct an inspection of the On-site Recycled Water System; the Customer must contact the City to schedule a coverage test walk-through of the system. The Recycled Water Site Supervisor must be in attendance. All modifications to the system are the responsibility of the Customer, and the Customer must pay all costs associated with such modifications.

### 12.7. Metering

All Recycled Water use shall be metered, and all Recycled Water used on any Use Area where a meter is installed must pass through said meter. Users shall be held responsible, and charged, for all Recycled Water passing through the meter(s), unless otherwise specified by the City.

### 12.8. Record Drawings

**Customers must provide Record Drawings of the On-Site Recycled Water System to the City within 90 days of receiving Recycled Water. Record Drawings must indicate any and all changes in the work involving departures from the original contract drawings, including those involving both constant pressure and intermittent-pressure lines and appurtenances. Changes must be approved by the City before the Customer implements the changes in the construction contract. Exhibit D provides a list of required information when submitting Record Drawings12.9. Fees and Charges**

The Customer shall pay all fees and charges for the use of recycled water and other related charges based upon the actual use of recycled water by the Customer, in the amount designated in the City's Master Fee Schedule when such a fee is developed.

### 12.10. Disputed Recycled Water Bills

Any dispute over the accuracy of a Recycled Water bills shall be governed byFresno Municipal Code (FMC) Article 1 – Billing and Collection Procedures for Municipal Utility Services, Section 6-104 (h)

### 12.11. Non-Registering Recycled Water Meter

When a meter is found to be out of order, the charge for Recycled Water will be governed FMC Article 1 – Billing and Collection Procedures for Municipal Utility Services, Section 6-104 (j)

## 13. Service Termination

### 13.1. Turn-off at User's Request

A Customer may request that service be discontinued, either temporarily or permanently, by giving at least 30 days' advance notice to the City. The User assumes full responsibility for all meter and usage charges incurred from the effective date of service until User notifies the City to discontinue service.

### 13.2. Turn-off by the City

The City may discontinue a Customer's service for any of the following reasons:

(a) Non-Payment of Bills. Service may be discontinued for nonpayment of any water charges by a User, subject to the terms of the User Agreement.

(b) Non-Compliance. Service may be discontinued for non-compliance with the terms and conditions of the User Agreement or these Rules and Regulations, as specified in the User Agreement.

(c) Water Quality. Service may be discontinued if, at any point in the City's Distribution System, the Recycled Water does not meet the quality requirements of the City or a Regulatory Agency. Service would, in such case, be restored at such time as Recycled Water again meets the quality requirements or at such time as the City supplements the Recycled Water system with water from other sources.

(d) Non-Compliance with Regulations. Service may be suspended or terminated in the manner provided herein at any time the Customer's operations do not conform to these Rules and Regulations as determined by the City in its sole discretion. Where safety of water supply or public health is endangered, or Regulatory Agency regulations have been violated, service may be suspended immediately without notice. Otherwise, all defects noted shall be corrected within the period of time specified by the City.

(e) Waste of Water. In order to protect against serious and negligent waste or misuse of Recycled Water, the City may provide notice of such waste and suspend service if such wasteful practices are not remedied after notice to such effect has been given to the Customer.

(f) Unauthorized Use of Recycled Water. When the City has discovered an unauthorized use, the service may be suspended without notice.

### 13.3. Re-Establishment of Service

The City shall have the right to refuse to re-establish service following termination of service for violation of these Rules and Regulations or the terms of a User Agreement. If a Customer desires to re-establish service following the termination of Recycled Water service, the City may renew the original User Agreement, with modified terms and conditions to achieve compliance with these Rules and Regulations or terms of the User Agreement. . Any restoration of recycled water service to the Use Area that is desired by the Customer shall be the responsibility of the Customer and shall be at no cost to the City.

## Exhibit A

## APPLICATION FOR USE OF RECYCLED WATER

1. Customer Name:
2. Address:
3. Use Area Property Manager:
4. Property Manager Email:
5. Property Manager Telephone number:
6. Name of Recycled Water Site Supervisor:
7. Recycled Water Site Supervisor Telephone number:
8. Complete the following information for the Use Area:

    Use Area APN:
    Use Area Address:
    Total Irrigated Area (Acres):
    Estimated Recycled Water Demand:
    Method of irrigation:
    Type of plant material present:
    Type of Recycled Water use: ☐Landscape Irrigation
    ☐Agricultural Irrigation
    ☐Impoundments
    ☐Other:
    Public access to the Use Area is: ☐Unrestricted ☐Restricted
    Number of outdoor drinking fountains in the Use Area:
    Number of outdoor eating areas in the Use Area:
    Number of domestic wells in the Use Area:
    Number of impoundments in the Use Area (if any, briefly describe):

For City of Fresno Use Only:

9. Check list of items required for obtaining Recycled Water service:

    ☐ The Customer and the City have determined that the Use Area is eligible to be served with Recycled Water.

- ☐ The Customer has submitted Exhibit A – Application for the Use of Recycled Water. Application received on:
- ☐ The City has reviewed the application.
- ☐ The City has assessed the Customer's on-site irrigation system and provided a description of required improvements. Assessment performed on:
- ☐ The City has approved the plans and retrofit/construction schedule prior to retrofit/construction.
- ☐ The Customer has constructed/retrofitted the On-Site Recycled Water System.
- ☐ The City has reimbursed the Customer for required improvements as recommended by the on-site assessment.
- ☐ The Customer has submitted "as-built" drawings to the City for record, including all remaining information requested by Exhibit B.
- ☐ The City has performed the final on-site inspection and approval, as specified in Exhibit C.
- ☐ The Customer has signed a Recycled Water User Agreement.
- ☐ The City initiates Recycled Water service. Date:
- ☐ The City confirms service to DDW.
- ☐ The City documents Recycled Water Site Supervisor training.

10. Description of on-site assessment and required improvements:

## Exhibit B

## USE AREA MONITORING REPORT

City of FRESNO

**Department of Public Utilities**

Wastewater Management Division
5607 W. Jensen Ave
Fresno, CA 93706-9458
559-621-5100—FAX 559-498-1700
www.fresno.gov

### PART 1 - ANNUAL INSPECTION

1. **Site Name**:

2. **Site Address**:

3. Indicate regular hours of irrigation system operation:
   **From**: Choose an item. **To**: Choose an item.

*If you answer yes to any question from 4 to 11 list the corrective action in each case.*

4. Is there evidence of runoff Recycled Water from the site? Show affected area(s) on a sketch. Fax sketch to (559) 498-1700, Attn: Reclamation Coordinator.

   ☐**Yes** ☐**No**
   **Corrective Action**:

5. Is odor of wastewater origin emanating from the irrigation site? If present, indicate apparent sources, characterization, and direction of travel.

   ☐**Yes** ☐**No**
   **Corrective Action**:

6. Is there evidence of ponding of Recycled Water, and evidence of mosquitoes breeding within the irrigation area due to ponding?

   ☐**Yes** ☐**No**
   **Corrective Action**:

7. Are warning signs, tags, stickers and above-ground pipe markings properly posted to to inform the public that Recycled Water is being used for irrigation, which is not suitable for drinking?

☐**Yes** ☐**No**
**Corrective Action**:

8. Is there evidence of plugged, broken, or otherwise faulty drip irrigation system emitters, valves, or sprinklers?

   ☐**Yes** ☐**No**
   **If yes, indicate which apply**:

   ☐Pop-up repair Date: Click here to enter a date.
   ☐Rotor repair Date: Click here to enter a date.
   ☐Nozzle replacement Date: Click here to enter a date.
   ☐Lateral repair Date: Click here to enter a date.
   ☐Main-line repair Date: Click here to enter a date.
   ☐Quick coupler repair Date: Click here to enter a date.
   ☐Other Date: Click here to enter a date.

9. Are the irrigation controls working properly?

   ☐**Yes** ☐**No**
   **Corrective Action**:

10. Is there evidence of direct spraying of Recycled Water on drinking water fountains, passing vehicles, buildings, and food facilities?

    ☐**Yes** ☐**No**
    **Corrective Action**:

11. Has there been any construction or have there been any modifications done on the property within the last six months? If yes, please explain.

    ☐**Yes** ☐**No**
    **Explanation**:

## PART II - RECYCLED WATER SITE SUPERVISOR SIGN OFF

I, _____, certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, and accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and/or disconnection of Recycled Water service."

☐ By checking this box, I have read and agree to the statement above.

Name of Recycled Water Site Supervisor:

Date: Click here to enter a date.

## PART III – CHANGE OF ON-SITE SUPERVISOR, OWNERSHIP OR MANAGEMENT

If the on-site supervisor, property ownership or management has changed since the last inspection, fill out the following change of information:

**New Owner/Management**:

**Address**:
*Street Name*

**City**: **State**: **Zip**:

**Email**: **Phone**:

---

**New On-Site Supervisor**:

**Address**:
*Street Name*

**City**: **State**: **Zip**:

**Email**: **Phone**:

## PART IV – SAVE, PRINT AND SUBMIT

Save, Print and Submit form:

Attn: Reclamation Coordinator
Fresno-Clovis Regional Reclamation Facility
5607 W. Jensen Ave
Fresno, CA 93706

Or fax to: (559) 498-1700, Attn: Reclamation Coordinator

# Exhibit C
## CROSS CONNECTION TEST PROCEDURE

The following is the required methodology for conducting Cross Connection control tests in Use Areas having both Recycled Water and Potable Water service. An AWWA-certified Cross Connection Control Specialist must perform the test using equipment dedicated for use with Recycled Water. Backflow testing equipment used for Recycled Water must not be reused on Potable Water systems.

**Cross Connection Control Test Part 1**

The Potable Water system shall be activated and pressurized. The On-Site Recycled Water System shall be shut down at its point of connection to the Distribution System and depressurized – this is usually done by manually bleeding a control valve or quick-coupling valve located in the lowest elevation of the On-Site Recycled Water System.

(a) The Cross Connection Control Specialist will specify the amount of time that the Potable Water system shall remain pressurized while the On-Site Recycled Water System is depressurized. The size and complexity of the Potable Water and On-Site Recycled Water System will determine the minimum amount of time the On-Site Recycled Water System is to remain depressurized.

(b) All On-Site Recycled Water System control valves, quick-coupling valves, irrigation systems and impoundment inlets shall be tested and surveyed for flow. If the On-Site Recycled Water System is shut down at its point of connection to the Distribution System, then continuous flow from any part of the On-Site Recycled Water System indicates a Cross Connection.

(c) All water fixtures using Potable Water (hose bibs, faucets, drinking fountains, urinals, decorative fountains) shall be tested and surveyed for flow. No flow from Potable Water outlets indicates that it may be connected to the On-Site Recycled Water System and therefore constitutes a Cross Connection to be remedied.

(d) Use Areas where no Cross Connections have been identified may proceed to part 2 of this test. If any Cross Connections are discovered, they must be disconnected and the Use Area must be re-inspected by an AWWA-certified Cross Connection Specialist per these procedures, beginning with Part 1 of the Cross Connection Control Test.

**Cross Connection Control Test Part 2**

(a) The Potable Water system shall be shut down at its point of connection (usually the City-controlled valve immediately preceding the meter assembly) and depressurized. For multistory buildings, the Cross Connection Control Specialist will determine the amount of pressure to be reduced and monitored with a gauge installed at a low point of elevation in the Potable Water System.

(b) The On-Site Recycled Water System shall then be activated and pressurized.

(c) The Cross Connection Control Specialist shall specify the minimum amount of time to pressurize the On-Site Recycled Water System while the Potable Water system is depressurized (or in the case of multistory buildings remains in a state of reduced pressure). The minimum amount of time the Potable Water system is

to remain depressurized shall be determined by the Cross Connection Control Specialist.

(d) All water fixtures using Potable Water (hose bibs, faucets, drinking fountains, urinals, decorative fountains) shall be tested and surveyed for flow. If the Potable Water System has been shut down at its point of connection, then continuous flow from any part of the Potable Water system indicates a Cross Connection. Potable Water fixtures in multistory buildings may be inspected in combination with a pressure gauge, or the pressure gauge may be used instead of testing all fixtures. If the Potable Water system has truly been shut down at its point of connection, an increase in pressure viewed at the gauge over a period of time specified by the Cross Connection Control Specialist indicates a Cross Connection with the Recycled Water System.

(e) All On-Site Recycled Water System control valves, quick-coupling valves, and any other approved Use Area facilities (such as supply lines to impoundments) shall be tested and surveyed for flow. No flow from any On-Site Recycled Water System control valve, quick-coupling valve or Recycled Water fixture indicates a likely connection with the Potable Water system, and therefore constitutes a Cross Connection to be remedied.

(f) If no Cross Connections are identified, then the Potable Water system shall be re-pressurized. If any Cross Connections are discovered, the On-Site Recycled Water System must be re-inspected by a Cross Connection Control Specialist according to these procedures, beginning with part 1 of the Cross Connection Control Test.

(g) The Cross Connection Control Specialist performing the foregoing tests must report the results and return it to the Department of Public Utilities, Wastewater Management Division.

## Exhibit D

## REQUIRED INFORMATION FOR RECORD DRAWINGS

Customers shall submit draft Record Drawings during the process for obtaining Recycled Water service and then provide final as-built Record Drawings upon completion of all modifications to the On-Site Recycled Water System(s) and Potable Water System(s). Applicants shall submit drawings of each Use Area on 8½" x 11", 11" x 17" or 24" x 36" sheets of paper which shall include a signature line for the Department of Public Utilities approval.

**Sheet 1**

☐ Location and vicinity map including surrounding land use and adjacent streets demarking the Recycled Water Use Area.

**Sheet 2**

☐ Specific Potable Water irrigation use areas (if applicable).
☐ Location of Potable Water main lines, ancillary lines, gate valves, controllers, drinking fountains, and supply facility.
☐ Location and size of Potable Water service connections.
☐ Location and size of existing and future Recycled Water service connections.
☐ Location of all On-Site Recycled Water System distribution lines, gate valves, master valves, pressure regulating valves, and other associated facilities. Exception: Although it may not be possible to show the location of all water pipelines for existing irrigation systems converting to Recycled Water, all locations where future Recycled Water piping must be separated from the Potable water piping must be clearly indicated on the plans.
☐ Location of any other piping network piping, gate valves, strainers, controllers, and supply facilities, specifically all backflow prevention devices for Potable Water systems.
☐ Where applicable, indicate that the separation between Potable and Recycled Water lines meets minimum requirements. Also show sleeving and other cross-connection prevention measures where applicable.
☐ Areas of public access on the Use Area.
☐ Location of domestic wells on or within 100 ft. of the Use Area.
☐ Location of any lakes, ponds, reservoirs, or other impoundments located within the Use Area or within 100 feet of the Use Area, and indicate the type of water source.
☐ Location of Recycled Water signage on the Use Area.
☐ Location of foundations, buildings, structures, and public facilities with either Recycled or Potable Water service. Public facilities include, but are not limited to

drinking fountains, outdoor eating areas, restrooms, snack bars, swimming pools,
wading pools, decorative fountains and showers. Include the pipelines feeding all
of these facilities.

☐ Any other features known or considered to be important to the on-site use of Recycled Water.

☐ Depiction of any other applicable On-Site Recycled Water System components
as required by the Rules and Regulations.

☐ Include the Standard Notes specified by the City.

**<u>Sheet 3</u> (if applicable)**

☐ Construction details of any domestic well within 100 feet of the Use Area.

# Exhibit E
# FILL STATION APPLICATION FORM

City of FRESNO
**Department of Public Utilities**

Wastewater Management Division
5607 W. Jensen Ave
Fresno, CA 93706-9458
559-621-5100—FAX 559-498-1700
www.fresno.gov

WATER & CONSERVATION • SOLID WASTE & RECYCLING • WASTEWATER & RECLAMATION
DPU
DEPARTMENT OF PUBLIC UTILITIES
Providing Life's Essential Services

## Recycled Water Use Application and Agreement for Fill Station Customers

**Customer Information**:

**Customer Name**:

**Customer Street Address**:

**City**:

**Zip Code**:

**Customer Phone**:

**Your Water Provider**:

**Phone**:

**Email**:

**Type of Customer**: Residential (up to 300 gallons per load)
Commercial (300 gallons and more per load)

## Vehicle Information

Please provide the following information for all vehicles collecting recycled water:

**1. Vehicle A** License Plate Number:

Does Vehicle A have valid insurance and registration?

What is the automobile insurance expiration date for Vehicle A?

**2. Vehicle B** License Plate Number:

Does Vehicle B have valid insurance and registration?

What is the automobile insurance expiration date for Vehicle B?

**3. Vehicle C** License Plate Number:

Does Vehicle C have valid insurance and registration?

What is the automobile insurance expiration date for Vehicle C?

## Recycled Water Use Information

**From the list below, select all applicable uses of Recycled water:**

☐ Dust control

☐ Irrigation of trees, landscaping and gardens

☐ Vehicle Washing

☐ Soil compaction

☐ Washing of hard surfaces such as paths, walls, windows

☐ Other:

**Specify the street address, City and zip code where recycled water will be used:**

Location A:

Location B:

Location C:

## Frequently Asked Questions about Recycled Water

**1. What is the Recycled Water Fill Station Program?**

The “Recycled Water Fill Station” program is a pilot initiative to provide recycled water from the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) for commercial and residential Customers to offset the use of drinking water for non-drinking uses.

**2. What is recycled water and is it safe?**

Recycled water is wastewater which as a result of treatment and disinfection is suitable for a beneficial use and is therefore considered a valuable resource. The ultra violet disinfection process uses high energy ultraviolet light to inactivate pathogens and other microorganisms. It must meet strict standards of the Division of Drinking Water (DDW)

**3. What can I use recycled water for?**

Recycled water can be used for watering trees, lawns and gardens. It can also be used for dust control, soil compaction, washing vehicles and hard surfaces such as paths, walls and windows.

**4. What is recycled water <u>NOT</u> suitable for?**

It is not suitable for drinking, cooking or use in the kitchen, bathing or showering, filling swimming pools or spas, children's water toys and connecting it to the household domestic (drinking water) plumbing or irrigation system.

**5. Do water use restrictions (conservation) apply to recycled water?**

No. Water use restrictions do not apply to recycled water. However, it is a valuable resource and should not be wasted.

**6. How much will recycled water cost me?**

The Customer shall pay all fees and charges for the use of recycled water and other related charges based upon the actual use of recycled water by the Customer in an amount to be designated in the City's Master Fee Schedule.

**7. How much recycled water can I pick up at a time?**

Commercial Customers may collect 300 gallons or more per load and residential Customers may collect up to 300 gallons per load. **The City of Fresno is not liable for any damages to you or your vehicle(s) due to your participation in the recycled water fill station program.**

**8. Where and when can I use the Recycled Water Fill Station?**

Designated areas for recycled water fill stations will be approved by the City's Director of Public Utilities.

## Rules and Regulations of Recycled Water Use

**1.** **DO NOT DRINK** recycled water.

**2.** Recycled water **shall not** be put into any piping or storage facility that has any connection to an on-site drinking water supply.

**3.** Commercial distributor's vehicles used for bulk collection, transportation and distribution of recycled water must have containers with capabilities of 300 gallons or greater.

**4.** Designated vehicles must have water tight valves and fittings, must not leak, and tanks must be cleaned of contaminants prior to use.

**5.** Hauling vehicles may be self-propelled or towed vehicles having an attached water tank, with or without pumps, hoses and accessory equipment for filling or distribution of recycled water. Use of convertible trucks, dump trucks, or flat-bed trucks with detachable tanks is allowed if the tanks are securely attached.

**6.** Vehicles without a tank or detached tank are not approved for collecting recycled water.

**7.** A truck or tank that has contained material from a septic tank or cesspool shall not be used to convey recycled water.

**8.** Customers are required to label both sides of their water tanks with the words "**Recycled Water/Do not drink**" in letters of at least 4 inches in height. Labeling must be permanently attached to or painted on the vehicle and must be fully legible and visible at all times.

**9.** Recycled water shall be used and/or applied promptly. No storage of recycled water on-site at a residential property.

**10.** Recycled water shall not be discharged to the street gutter or storm drain system. If you have leftover recycled water and want to dispose of it, either discharge it to a landscaped area or to the sanitary sewer system via an on-site cleanout.

**11.** After handling recycled water, remember to apply hand sanitizer or wash hands with soap and drinking water, especially before eating or smoking.

**12.** The City may conduct site visits to ensure your proper use of recycled water and to ensure the health and safety of your family and the public.

### Procedure to Obtain Recycled Water

**1.** Read and understand the conditions of this Use Application/Agreement. Download and save the form to your Desktop. Type in your responses, Save, Print, and mail a signed form to the following address:

Attn: Reclamation Coordinator
Fresno Clovis Regional Wastewater Reclamation Facility
5607 W. Jensen Ave
Fresno, CA 93706

A hard copy of the form can be mailed to you by calling (559) 621-5134.

**2.** Approved applicants will receive a brief one-on-one training on use requirements of recycled water. Customers will be provided a badge to access the gate into the fill station site and activate the water supply. A City representative will direct participating Customers to the fill station located inside the RWRF.

**3.** The badge holder is the primary party held accountable for accessing the fill station site. If the badge is misplaced or damaged, the primary badge holder shall pay $25.00 to the Wastewater Management Division for a new badge.

**4.** All water tanks and containers are required to be labeled with the words "**Non-potable water/Do not drink**".

**5.** Access to the commercial and residential recycled water fill station is based on a first-come basis.

**6.** Haulers must ensure that tanks are sealed and secured for transport prior to leaving the facility.

## Certification Statement/Signature Section

☐ By checking this box, myself, and if applicable, my organization's officers, owners, personnel, employees, agents, contractors, invitees or volunteers agree to hold harmless the City of Fresno from any and all claims, lawsuits, demands, liability, monetary loss, property damage and/or injury arising out of our organization's connection with the collection, transportation and distribution of recycled water.

☐ By checking this box, I assert that the information provided in this application is true and accurate to the best of my knowledge, and represent that I have read, understand, and agree to comply with the City's Rules and Regulations for recycled water. Failure to comply with the conditions of this agreement may lead to termination of this agreement and the ability to obtain recycled water from the commercial/residential fill station.

**Name**:

**Customer's Signature**

**Date**

**Figure 1**

**NON-POTABLE DO NOT DRINK ACCEPTABLE FIGURE**

# APPENDIX C
# RECYCLED WATER USER AGREEMENT

**AGREEMENT**
**CITY OF FRESNO, CALIFORNIA**
**RECYCLED WATER SERVICES**

THIS AGREEMENT is made and entered into effective the [Day of the month, e.g., 1st] day of Choose an item. [Year], by and between the CITY OF FRESNO, a California municipal corporation (hereinafter referred to as "CITY", and [Customer's Name], [Legal identity], located at [address] (hereinafter referred to as "CUSTOMER").

## RECITALS

WHEREAS, CITY produces and distributes recycled water of satisfactory quality for use in irrigating landscaped areas and impoundment areas with unrestricted public access; and

WHEREAS, CUSTOMER owns and operates certain landscaped areas and/or impoundment areas that CUSTOMER desires to irrigate/supply with recycled water distributed by CITY; and

WHEREAS, CITY and CUSTOMER will conserve potable water by using recycled water for agricultural or landscape irrigation and/or impoundment water supply; and

WHEREAS, CUSTOMER acknowledges that this Agreement is subject to the requirements of Fresno Municipal Code Section Chapter 6, Article 9, Recycled Water Ordinance; and

WHEREAS, this Agreement will be administered for CITY by its Director of Public Utilities (hereinafter referred to as "Administrator") or his/her designee.

## AGREEMENT

NOW, THEREFORE, in consideration of the foregoing and of the covenants, conditions, and premises, hereinafter contained to be kept by the respective parties, it is mutually agreed as follows:

1. Term of Agreement. This Agreement shall be effective from the date first set forth above ("Effective date") and shall continue in full force and effect through [Day of the month, e.g., 1st] day of Choose an item., [Year], subject to any earlier termination in accordance with this Agreement.

2. Recycled Water Use Area. CUSTOMER shall use recycled water supplied by CITY on approximately [Number of acres] acres within the permitted use area. The location of the use area is described in the attached Exhibit A as submitted with the "Application for the Use of Recycled Water". CITY understands that the CUSTOMER has the right to add or subtract from the total use area as operations plans dictate, provided that all potential use areas are disclosed in this Agreement.

3. City Ordinance. CUSTOMER has read and agrees to the terms stated in CITY Ordinance 2014-32 (hereinafter, "Recycled Water Ordinance"), attached as Exhibit D and incorporated herein.

4. Rules and Regulations. CUSTOMER has read and agrees to the terms of the CITY's Recycled Water Use Rules and Regulations governing the use, distribution and transport of recycled water (hereinafter, "CITY's Rules and Regulations"), which are attached as Exhibit E and incorporated herein.

5. No Representation Regarding Water Service, Pressure, or Volume for any Portion of the Recycled Water Pipeline. CITY does not make any representation, warranty or guarantee of any kind or nature and hereby specifically disclaims any kind of representation, warranty or guarantee that any portion of the recycled water system described or the recycled water system as a whole will yield any specific volume of water or provide any specific water pressure to CUSTOMER under static or demand scenarios or for any use by CUSTOMER and its tenants, lessees, purchasers, successors or assigns. CUSTOMER assumes full responsibility for the adequacy of volume of water and water pressure beyond the Point of Connection ("POC") as defined in the CITY's Rules and Regulations.

6. Maintenance and Repair. CUSTOMER shall be responsible for operation, maintenance, repair, and replacement of all portions of the recycled water system beyond the POC. Under no circumstances shall CITY be required or accountable to maintain, repair or replace CUSTOMER's recycled water system unless and until CITY may, at its sole discretion and option, accept dedication of the water system, or any portion thereof in increments or otherwise, at some future date. CUSTOMER's obligation to maintain, repair and replace its recycled water system shall include, without limitation, any operation and maintenance, repair, replacement or modification of the recycled water system as may be required by CITY. Should CUSTOMER fail to operate, maintain, repair and replace its portion of recycled water pipeline as needed for proper operation of the public portions of the recycled water pipeline, the CITY shall have the right, but not the obligation, to stop providing water.

7. Priorities for Delivery of Recycled Water.

(a) The CITY reserves the right to control and schedule recycled water distribution as necessary to maintain an acceptable working pressure; protect public health; construct, maintain and operate other CITY facilities; and manage availability of recycled water supply.

(b) Delivery of recycled water may at times be precluded for reasons beyond the reasonable control of the CITY including, but not limited to insufficient recycled water supply, maintenance of CITY's treatment or distribution systems, acts of a third party, or order of a regulatory agency.

(c) If recycled water supply is interrupted for any reason, including but not limited to those outlined in (b), first priority for recycled water service shall be given to potable water rate payers of the CITY to meet all anticipated municipal needs of the CITY.

(d) If recycled water delivery is interrupted for more than 48 hours, the CITY may connect the CUSTOMER'S back-up water supply. If the CUSTOMER does not have a backup supply and was originally connected to the CITY potable water system, CITY may reconnect CUSTOMER'S on-site recycled water system to the CITY potable water system subject to the terms of the Rules and Regulations. The CUSTOMER agrees to return to recycled water use as soon as the CITY is able to resume recycled water delivery. CUSTOMER shall pay for the full cost of water used from the alternate supply.

8. Receipt and Application of Recycled Water.

(a) CUSTOMER agrees to use recycled water for uses stated in Exhibit A of this Agreement, as submitted on the "Application for the Use of Recycled Water," except for portions of the use area where application of recycled water may be prohibited by any law, statute, rule, regulations or guidelines governing the use of recycled water.

(b) CUSTOMER understands that the CITY will inspect and assess the use area before the On-Site Recycled Water System is connected to the Distribution System. The CITY will indicate how the On-site Recycled Water System needs be designed in order to minimize/eliminate potential violations of the Rules and Regulations. Furthermore, CUSTOMER understands that this Agreement shall become valid upon passing a Final On-Site Inspection by the CITY (Exhibit -C).

(c) CUSTOMER agrees that any agreement it may have with a third party for the management of the use area shall not in any way relieve CUSTOMER of the requirements, terms and conditions of this Agreement. CUSTOMER shall be responsible to the CITY for the safe use of recycled water by CUSTOMER and any third party.

(d) The CITY shall not be liable for any damage related to CUSTOMER's recycled water infrastructure, use, and distribution, including damage resulting from inadequate capacity, defective plumbing, broken or faulty services, or any conditions beyond the control of the CITY. Furthermore, CUSTOMER accepts such conditions of pressure, as provided by the distribution system at the location of its service connection, and holds the CITY harmless from any and all liability, damage, losses, costs, fees or expenses, arising from low pressure or high pressure conditions, or from interruptions of service.

(e) CUSTOMER understands and accounts for the nutrient contribution of recycled water when irrigating crops, green spaces, freeway medians, parks, school yards and cemeteries. CUSTOMER agrees that the CITY will not be liable for damage to vegetation resulting from the application of recycled water.

9. Recycled Water Use Requirements. CUSTOMER agrees to abide by all use requirements identified in the CITY's Rules and Regulations, the Recycled Water Ordinance, California Code of Regulations Title 17 and 22 relating to the use of recycled water, and all laws, statutes or guidelines governing recycled water use. Approved uses of recycled water for the CUSTOMER's use area shall be limited to those described in Exhibit A of this Agreement and as specified on the "Application for the Use of Recycled Water".

10. Recycled Water Site Supervisor. CUSTOMER shall designate an individual as its Recycled Water Site Supervisor ("Site Supervisor"), who shall be the CUSTOMER's coordinator and direct liaison with the CITY regarding recycled water matters. CUSTOMER agrees that the Site Supervisor shall be responsible for all duties identified in CITY's Rules and Regulations. The Site Supervisor is required to attend a certification course provided by the City on the accepted uses and regulatory restrictions for the use of Recycled Water. The Site Supervisor is also responsible for training operators or recycled water in the Use Area.

11. On-Site Recycled Water System Modifications. CUSTOMER understands and agrees that any modifications to its On-Site Recycled Water System, as defined in the Recycled Water Ordinance, must comply with the CITY's Rules and Regulations relating to recycled water and failure to do may result in termination of recycled water service.

12. Notification of Public. CUSTOMER shall provide adequate notification, as required by the Division of Drinking Water (DDW) to employees and the general public that recycled water is being applied within the designated use area.

13.

Record Drawings. Upon completion of all modifications to CUSTOMER'S on-site recycled water system and potable water system, CUSTOMER shall provide the CITY with record drawings containing specific information as identified in Exhibit B of this agreement.

14. Fees and Charges. CUSTOMER shall pay all fees and charges for the use of recycled water and other related charges based upon the actual use of recycled water by the CUSTOMER, in an amount designated in the CITY's Master Fee Schedule when such a fee is developed. The CITY shall provide recycled water at no cost until June 30, 2019. As an incentive, CUSTOMERS may receive a one-time reimbursement of up to $5,000 at the sole discretion of the Director of Public Utilities or his or her designee for on-site improvements needed to utilize recycled water.

15. Indemnification. To the furthest extent allowed by law, CUSTOMER shall indemnify, hold harmless and defend CITY and each of its officers, officials, employees, agents and volunteers from any and all loss, liability, fines, penalties, forfeitures, costs and damages (whether in contract, tort or strict liability, including but not limited to personal injury, death at any time, and property damage) incurred by CITY, CUSTOMER or any other person, and from any and all claims, demands, liabilities, damages and actions in law or equity (including attorney's fees and litigation expenses), arising or alleged to have arisen directly or indirectly out of the performance of this Agreement and the performance of any or all work to be done in and upon the street rights-of-way or within CUSTOMER's property boundary, and premises adjacent thereto, pursuant to this Agreement, or arising or alleged to have arisen directly or indirectly in any way related to the construction, installation and operation of the recycled water supply pipeline or its appurtenances by anyone occupying any portion of CUSTOMER's property including, without limitation, any such claims, causes of action, damages, liabilities, fees, costs, expenses, and attorney fees arising from water quality compliance, a lack of volume of water, inadequate fire flow, lack of water pressure in, from or delivered to the recycled water supply pipeline, or lack of flow capacity in the recycled water supply pipeline. CUSTOMER's obligations under the preceding sentence shall apply regardless of whether CITY or any of its officers, officials, boards, employees, agents or volunteers are passively negligent, but shall not apply to any loss, liability, fines, penalties, forfeitures, costs or damages caused by the active or sole negligence, or the willful misconduct, of CITY or any of its officers, officials, employees, agents or volunteers.

16. General Terms.

(a) Governing Law and Venue. This Agreement shall be governed by, and construed and enforced in accordance with the laws of the State of California, and venue for purposes of filing any action regarding the enforcement or interpretation of this Agreement shall be Fresno County, California.

(b) Severability. The provisions of this Agreement are severable. The invalidity or unenforceability of any one provision in this Agreement shall not affect the other provisions.

(c) Binding. Once this Agreement is signed by all parties, it shall be binding upon all parties and each parties' respective heirs, successors, lessees, sub lessees, assigns, transferees, agents, servants, employees and representatives.

(d) No Third Party Beneficiaries. The rights, interests, duties and obligations defined within this Agreement are intended for the specific parties hereto as identified in the preamble of this Agreement. Notwithstanding anything stated to the contrary in this Agreement, it is not intended that any rights or interests in this Agreement benefit or flow to the interest of any third parties.

(e) Extent of Agreement. Each party acknowledges that they have

read and fully understand the contents of this Agreement. This Agreement represents the entire and integrated agreement between the parties with respect to the subject matter hereof and supersedes all prior negotiations, representations or agreements, either written or oral.

17. Monitoring and Reporting. CUSTOMER agrees to comply with the monitoring and reporting requirements as identified in the CITY's Rules and Regulations.

18. Headings. The section headings in the Agreement are for convenience and reference only and shall not be construed or held in any way to explain, modify or add to the interpretation or meaning of the provisions of this Agreement.

19. Exhibits. Each exhibit and attachment referenced in this Agreement is, by the reference, incorporated into and made part of this Agreement.

20. Notices. Any notice required or intended to be given to either party under the terms of this Agreement shall be in writing and shall be deemed to be duly given if delivered personally, transmitted by facsimile followed by phone confirmation of receipt, or sent by United States registered or certified mail, with postage prepaid, return receipt requested, addressed to the party to which notice is to be given at the party's address set forth on the signature page of this Agreement.

21. Attorney's Fees. If a party is required to commence any proceeding or legal action to enforce or interpret any term, covenant or condition of this MOU, the prevailing party in such proceeding or action shall be entitled to recover from the other party its/their reasonable attorney's fees and legal expenses.

22. Termination. Upon any breach of this Agreement by CUSTOMER, CITY may (a) exercise any right, remedy (in contract, law or equity), or privilege which may be available to it under applicable laws of the State of California or any other applicable law; (b) proceed by appropriate court action to enforce the terms of the Agreement and/or recover all direct, indirect, consequential, economic, and incidental damages for the breach of the Agreement.

The CITY may terminate this Agreement immediately following any of the reasons listed in Section 13.2 of the CITY's Rules and Regulations for recycled water use.

IN WITNESS WHEREOF, the parties have executed this Agreement at Fresno, California, the day and year first above written.

| | |
|---|---|
| [Name of Company]<br>[legal entity]<br>By: _____<br><br>Name: _____<br>(Type or print written signature.) | CITY OF FRESNO,<br>a California municipal corporation<br><br>By: _____<br>Thomas C. Esqueda, Director<br>Department of Public Utilities<br><br>Dated: _____ |

| | |
|---|---|
| Addresses: | |
| CUSTOMER: | CITY: |
| [Company Name] | City of Fresno |
| Attention: | Attention: Conrad Braganza |
| [Title] | Wastewater Reclamation Coordinator |
| [Street Address] | 5607 W. Jensen Ave. |
| [City, State, Zip Code] | Fresno, CA 93706 |
| Phone: | Phone: (559) 621-5134 |
| Fax: | Fax: (559) 498-1700 |

Attachments:

1. Exhibit A – Application for the Use of Recycled Water
2. Exhibit B – Required Information for Record Drawings
3. Exhibit C – Final On-Site Inspection and Approval
4. Exhibit D – Recycled Water Ordinance
5. Exhibit E – CITY's Recycled Water Use Rules and Regulations

**Exhibit A**
**APPLICATION FOR THE USE OF RECYCLED WATER**

1. Customer Name:

2. Address:

3. Use Area Property Manager:

4. Property Manager Email:

5. Property Manager Telephone number:

6. Name of Recycled Water Site Supervisor:

7. Recycled Water Site Supervisor Telephone number:

8. Complete the following information for the Use Area:

   Use Area APN:
   Use Area Address:
   Total Irrigated Area (Acres):
   Estimated Recycled Water Demand:
   Method of irrigation:
   Type of plant material present:
   Type of Recycled Water use: ☐Landscape Irrigation
   ☐Agricultural Irrigation
   ☐Impoundments
   ☐Other:
   Public access to the Use Area is: ☐Unrestricted ☐Restricted
   Number of outdoor drinking fountains in the Use Area:
   Number of outdoor eating areas in the Use Area:
   Number of domestic wells in the Use Area:
   Number of impoundments in the Use Area (if any, briefly describe):

For City of Fresno Use Only:

9. Check list of items required for obtaining Recycled Water service:

   ☐ The Customer and the City have determined that the Use Area is eligible to be served with Recycled Water.
   ☐ The Customer has submitted Exhibit A – Application for the Use of Recycled Water. Application received on:
   ☐ The City has reviewed the application.

- ☐ The City has assessed the Customer's on-site irrigation system and provided a description of required improvements.
  Assessment performed on:
- ☐ The City has approved the plans and retrofit/construction schedule prior to retrofit/construction.
- ☐ The Customer has constructed/retrofitted the On-Site Recycled Water System.
- ☐ The City has reimbursed the Customer for required improvements as recommended by the on-site assessment.
- ☐ The Customer has submitted "as-built" drawings to the City for record, including all remaining information requested by Exhibit B.
- ☐ The City has performed the final on-site inspection and approval, as specified in Exhibit C.
- ☐ The Customer has signed a Recycled Water User Agreement.
- ☐ The City initiates Recycled Water service. Date:
- ☐ The City confirms service to DDW.
- ☐ The City documents Recycled Water Site Supervisor training.

10. Description of on-site assessment and required improvements:

## Exhibit B

## REQUIRED INFORMATION FOR RECORD DRAWING

Customers shall submit draft Record Drawings during the process for obtaining Recycled Water service and then provide final as-built Record Drawings upon completion of all modifications to the On-Site Recycled Water System(s) and Potable Water System(s). Applicants shall submit drawings of each Use Area on 8½" x 11", 11" x 17" or 24" x 36" sheets of paper which shall include a signature line for the Department of Public Utilities approval.

**Sheet 1**

☐ Location and vicinity map including surrounding land use and adjacent streets demarking the Recycled Water Use Area.

**Sheet 2**

☐ Specific Potable Water irrigation use areas (if applicable).
☐ Location of Potable Water main lines, ancillary lines, gate valves, controllers, drinking fountains, and supply facility.
☐ Location and size of Potable Water service connections.
☐ Location and size of existing and future Recycled Water service connections.
☐ Location of all On-Site Recycled Water System distribution lines, gate valves, master valves, pressure regulating valves, and other associated facilities. Exception: Although it may not be possible to show the location of all water pipelines for existing irrigation systems converting to Recycled Water, all locations where future Recycled Water piping must be separated from the Potable water piping must be clearly indicated on the plans.
☐ Location of any other piping network piping, gate valves, strainers, controllers, and supply facilities, specifically all backflow prevention devices for Potable Water systems.
☐ Where applicable, indicate that the separation between Potable and Recycled Water lines meets minimum requirements. Also show sleeving and other cross-connection prevention measures where applicable.
☐ Areas of public access on the Use Area.
☐ Location of domestic wells on or within 100 ft. of the Use Area.
☐ Location of any lakes, ponds, reservoirs, or other impoundments located within the Use Area or within 100 feet of the Use Area, and indicate the type of water source.
☐ Location of Recycled Water signage on the Use Area.
☐ Location of foundations, buildings, structures, and public facilities with either Recycled or Potable Water service. Public facilities include, but are not limited to drinking fountains, outdoor eating areas, restrooms, snack bars, swimming pools, wading pools, decorative fountains and showers. Include the pipelines feeding all

of these facilities.

☐ Any other features known or considered to be important to the on-site use of Recycled Water.

☐ Depiction of any other applicable On-Site Recycled Water System components as required by the Rules and Regulations.

☐ Include the Standard Notes specified by the City.

**<u>Sheet 3</u> (if applicable)**

☐ Construction details of any domestic well within 100 feet of the Use Area.

## Exhibit C

## FINAL ON-SITE INSPECTION AND APPROVAL

1. Customer Name:

2. Complete the following information for the Use Area:

   Use Area APN:

   Use Area Address:

   Requested date of service:

   Recycled Water service initiated on (TBD):

   Number of service connections:

   Specify the back-up water supply source:

   Has the Cross Connection Test been waived?[1] ☐Yes ☐No

   Date of Cross Connection Test:

   Briefly describe any upgrades to the Use Area:

   How many domestic wells are present within 50 ft. of the Use Area or within 100 ft. of any impoundment?

   Describe the level and method of backflow protection at the Use Area:

   Is Recycled Water signage displayed in visible and public areas? ☐Yes ☐No

   Special requirements and conditions:

3. **Final Inspection by the City**:

   I have inspected the On-Site Recycled Water System(s) governed by this User Agreement and attest that the construction and operation of this system are in accordance with the City's Rules and Regulations governing recycled water use.

   Inspector Name:

   Inspector Signature: _____

   Date:

[1] Customers may request a waiver of the Cross Connection test if no potable water piping is present in the Use Area.

## Exhibit D

## RECYCLED WATER ORDINANCE

## Exhibit E

## RECYCLED WATER RULES AND REGULATIONS

# APPENDIX D
# TTDF DESIGN REPORT

City of Fresno

Fresno-Clovis Regional Wastewater Reclamation Facility

# Tertiary Treatment and Disinfection Facility Technical Memorandum

## (Part One—Schematic Design Phase)

August 2011

PARSONS

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# EXECUTIVE SUMMARY

## BACKGROUND

### New Water Source – Recycled Water

The City of Fresno (City) has embarked on development of a new water source – recycled water, to offset potable water use and improve ground water quality. The City prepared a Recycled Water Master Plan (July 2010) to assess potential uses and demand for recycled water.

The City's ultimate goal is to recycle 25,000 acre feet/year or more of recycled water by 2025. The recycled water goal includes direct non-potable use of State of California Title 22 quality recycled water for landscape irrigation as well as for groundwater recharge. The City anticipated that the project would be developed in three logical phases and decided to construct a 5 to 10 mgd first phase Tertiary Treatment and Disinfection Facility (TTDF) at their Fresno-Clovis Regional Water Reclamation Facility (RWRF).

During the master planning efforts, although the City had decided on the approximate capacity of the TTDF, the tertiary treatment technology, system layout and location of the facilities were not finalized. These tasks have been performed as part of the pre-design and are summarized in this technical memorandum (TM). Therefore, this pre-design TM, in addition to developing the design basis, focuses on evaluation and selection of a filtration technology out of eight (8) proven California Department of Public Health (CDPH) approved technologies, a disinfection technology between UV irradiation and ozonation, and a recycled water storage system from several options.

### Nitrogen Removal and Effluent Electrical Conductivity (EC)

The RWRF's discharge currently has a limit for electrical conductivity (EC) of 500 micro mhos/cm + EC of the source water. Meeting this limit is a challenge and may require various measures including source water treatment or replacement, expensive systems to remove salts in wastewater, industrial source control and/or public education on waste minimization. The various alternatives presented, including Membrane Bio Reactor (MBR), may not be effective removing all salts from the final effluent. However, MBR technology could help reduce EC levels through its reliable nitrification/denitrification (NDN) capability. Parsons estimates that effluent EC can be reduced by about 150 micro mhos/cm through NDN in the MBR permeate, as ammonia is converted to nitrogen gas and escapes into the atmosphere.

During the past few years, the RWRF has experienced a reduction of the effluent EC through an incidental NDN process that reduced ammonia to nitrogen gas. The reduction in the effluent was estimated between 8% to 9.5% of the total EC influent, enough to maintain compliance with the Waste Discharge Requirements (WDR) discharge limit.

North Fresno Wastewater Reclamation Facility, operated by the City, was issued a WDR/NPDES permit on December 10, 2009 by the Central Valley Regional Water Quality Control Board (RWQCB) with a Total Nitrogen (TN) limit of 10 mg/L for the recycled water used for golf course irrigation. It is expected that the proposed TTDF at the RWRF will also have a similar TN limit for irrigation water. This means that it will be short sighted to design the TTDF with no consideration for nitrogen removal.

### Aging Train A Infrastructure

Train A facilities, reportedly, are old, of obsolete design and are difficult to operate and maintain. Further, nitrogen removal cannot be achieved reliably with the current configuration of the aeration basins in Train A. Discussions with the City's operations staff indicated that the ceramic disc diffusers installed in the aerations basins need replacement/cleaning and it may not be possible to restore them to their original state due to their age. Further, the aeration pipe grids that connect the diffusers are old and unique to the type of diffusers currently installed. The secondary clarifiers in Train A are in need of central column and scraper mechanism replacement. Based on the above extensive repair/replacement needs related to Train A infrastructure coupled with the long age of the equipment, it appears that replacement of Train A facilities in the near future would be a prudent measure, if the intention is to continue to use Train A for the long term.

## MBR - A Clear Choice for Holistic Solution

Considering the regulatory requirements discussed earlier and long age of Train A facilities, a decision was made to consider the MBR process as a potential alternative to conventional tertiary filtration technologies. The MBR system followed by ultraviolet disinfection offers a multi faceted solution and provides the following four key benefits.

- Excellent Filtration – Produces the highest quality recycled water with effluent turbidity consistently less than 0.2 NTU. The MBR permeate is superior in quality compared to effluent from any conventional tertiary filtration process and exceeds Title 22 standards for recycled water.
- Simultaneous Nitrification and Denitrification (NDN) – Provides effluent that meets the expected permit limits, specifically Total Nitrogen (TN) of less than 10 mg/L, without significant infrastructure addition.
- Reduction in EC – Due to its NDN capability, a measurable reduction in EC can be achieved by using MBR process.
- Future Capacity Replacement – Provides a means for reliable, phased capacity replacement of aging infrastructure at Train A, with one of the most advanced and state-of-the-art membrane filtration technologies that will consistently and reliably meet current and future discharge regulations. This would avoid substantial costs associated with replacing and/or upgrading of Train A facilities in the near future, if tertiary filters were used in lieu of an MBR system.

Based on the above considerations, MBR will be more cost effective compared to conventional filtration systems, when considering its ability to produce high quality effluent with nitrogen removal and avoided cost of future upgrades/replacement of Train A facilities for nitrogen removal.

The scope of this TM evolved around the City's recycled water goals and associated electrical power supply options. Although a major part of this TM focuses on evaluation and selection of a conventional filtration technology, Sections following Workshop No.1 (Sections 8 through 13) compare conventional tertiary filtration systems with MBR system.

During Workshop No. 2 (Section 14), the decision was made in favor of MBR process due to the key benefits discussed above. Therefore, the last Section (Section 15) of this TM, which serves as a standalone section with MBR as the system of choice, has been printed on color paper to differentiate it from the rest of the report.

The proposed TTDF needs to become an integral part of the RWRF for its operation, reliability and compliance with the near term and future regulatory requirements. Further, the SCADA system of the proposed TTDF should fully integrate with the existing RWRF SCADA system for smooth and reliable operation.

## COMMUNICATION AND DECISION WORKSHOPS

Since the inception of this project, Parsons maintained regular interaction and discussions with the City's staff throughout the development of this TM. The feedback received from the City's staff helped Parsons immensely to understand the plant's operational and maintenance constraints as well as City's preferences and to incorporate them into the TM. Two full-day technical Workshops were conducted at the RWRF to review and discuss the progress of this TM development. The first Workshop was held on 11/4/2010 while the second one was conducted on 2/3/2011.

Sections 3 through 7 present the work completed prior to Workshop No.1. This includes a comparison of eight conventional filtration system alternatives, three disinfection system alternatives/variations, and three storage alternatives. Features of operation, pros and cons, reliability, expandability to 30 mgd, capital, O&M and life cycle costs were compared and discussed. Section 8 summarizes the discussions and decisions made during Workshop No.1.

The following are the key collective decisions made during Workshop No.1.

1. Nova filtration system will be the preferred conventional filtration technology, if filtration is considered over MBR process.
2. In-pipe UV disinfection will be used for all alternatives
3. Depending on the physical configuration of the alternative, either pre-stressed concrete tanks or converted Train A aeration basins will be used as storage tanks for recycled water.

4. Due to aging infrastructure at Train A, only Train A will be considered for retrofitting into MBR system.

Moving forward, three Plans were identified for further development.

- Plan A – Conversion of Train A facilities into a 12 mgd MBR with 1.23 peaking factor. This plan includes conversion of one secondary clarifier into aeration basin for MBR; building new tank(s) to house membranes; constructing new housing for in-pipe UV reactors and conversion of one aeration basin into recycled water storage
- Plan B – 5 mgd constant flow conventional filtration (Nova disc filter) system for Train B. This plan includes feed from Canal B at a constant flow rate, Nova disk filters for filtration, construction of new housing for in-pipe UV reactors, and building new pre-stressed concrete tank (5 MG) for recycled water storage
- Plan C – 12 mgd constant flow conventional filtration (Nova disk filter) system for Train B.

These Plans are discussed in detail in Sections 9, 10 and 11. Section 11 presents a comparison of Plan A with Plan C. Section 12 describes the power source options for TTDF with both conventional filtration and MBR system for a 12 mgd facility expandable to an ultimate capacity of 30 mgd. The Section includes a duct bank and cable routing plan for the two alternative systems. These routing plans were developed after a thorough review of the Plant's record drawings and in close coordination with City's electrical engineers. Utilization of existing conduits was maximized to the extent possible in both the alternatives.

During Workshop No. 2, in addition to the option of converting Train A facilities into MBR, the City expressed their interest to explore the option of having MBR designed and built as a separate stand-alone system with all new structures.

As a result of the discussion during Workshop No.2, the following two MBR alternatives are selected over the conventional tertiary filtration alternatives for further development and City's review and final decision.

1. Converting Train A into MBR – (5 mgd constant flow; no peaking factor) – This is similar to Plan A as discussed in Section 9 of this report, except that the capacity will be 5 mgd constant flow instead of 12 mgd with peaking factor.
2. Constructing a separate standalone MBR system with all new tanks – (5 mgd constant flow; no peaking factor)

Sections 14 and 15 summarize the latest developments, subsequent to Workshop No.2. Section 14 sets the stage for a new project direction provided by the City during Workshop No.2. and steers the discussion into Section 15, which compares the two MBR alternatives noted above. Figures 15-1 and 15-2 present the preliminary layouts for the two alternatives.

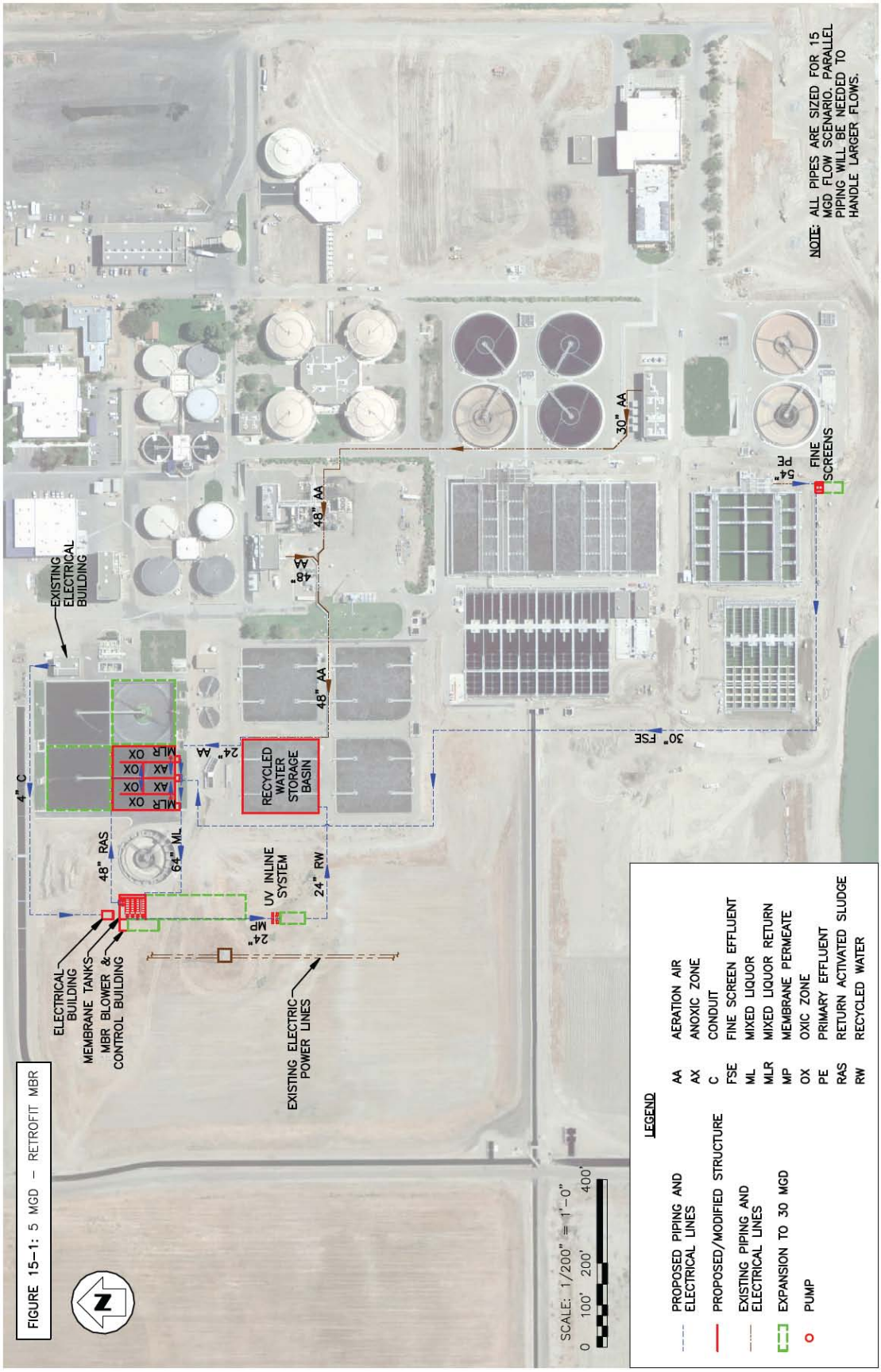


FIGURE 15-1: 5 MGD – RETROFIT MBR

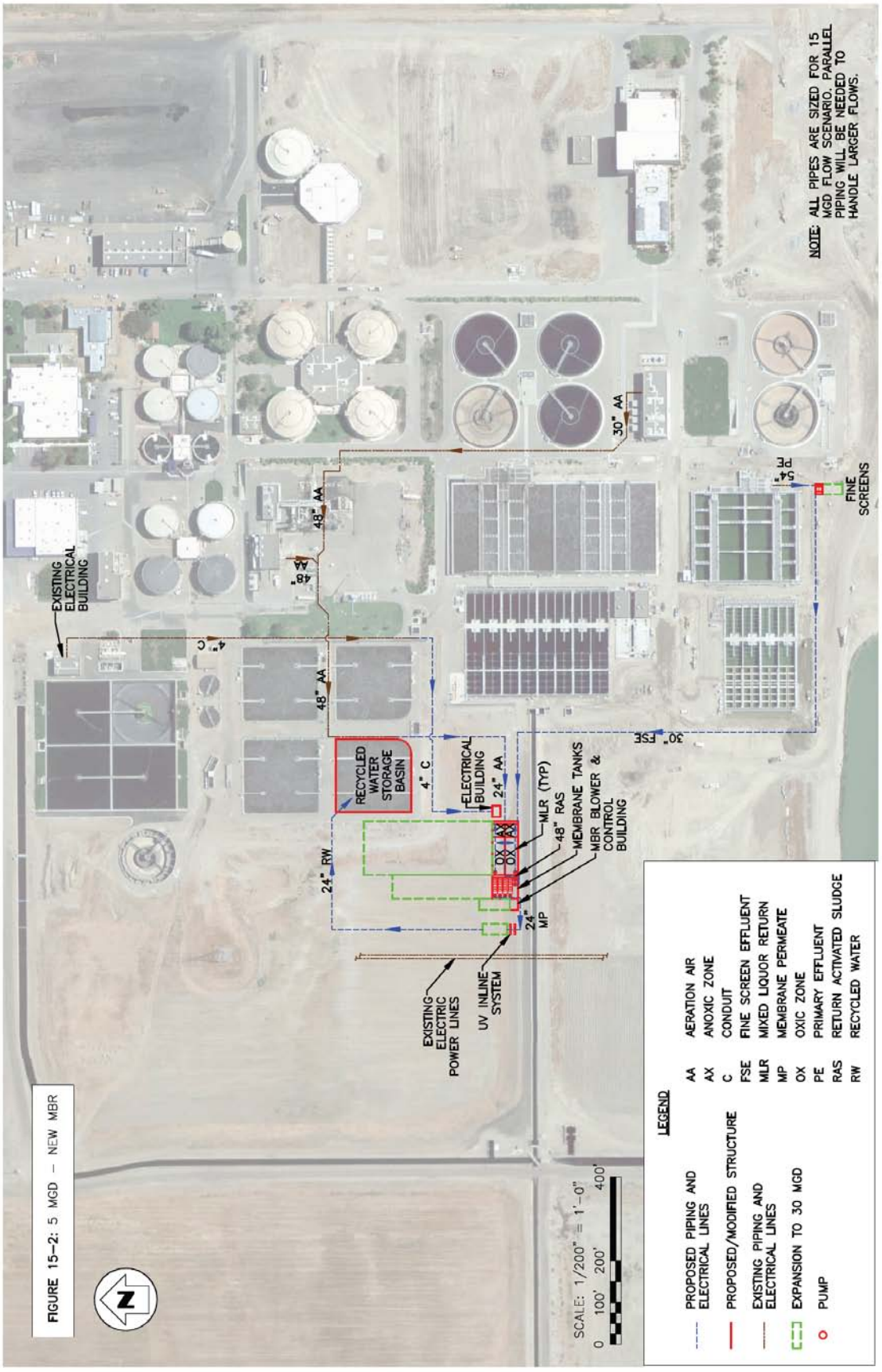


**FIGURE 15-2:** 5 MGD – NEW MBR

## IN-PIPE UV FOR DISINFECTION

During Workshop No.1, the City chose in-pipe UV disinfection as opposed to an open channel UV system. One of the major drivers was the positive feedback received from the staff at neighboring Clovis Water Reuse Facility in operating and maintaining their in-pipe UV system. Therefore, for the purpose of this TM, 1-mgd capacity in-pipe UV reactors were considered. The 1 MGD rating for each reactor is based upon high quality membrane permeate feed such as from the MBR system. Four reactor trains (3 operating + one standby) will be required to disinfect 5 mgd of flow and each train will accommodate two reactors. There are several larger in-pipe reactors currently available from other manufacturers that may be more economical for the present project and will be evaluated during detailed design.

## CONVERSION OF AERATION BASIN (TRAIN A) FOR RECYCLED WATER STORAGE

It was determined that the aeration basins at Train A, with sloping walls could be retrofitted into recycled water storage tanks. According to the City's staff, at least one of the units in Train A is typically out of service and hence conversion of one aeration basin into recycled water storage tank will not negatively impact the current plant operations. Further, due to the proximity of the proposed MBR facilities to Train A, conversion of one of the aeration basins into a storage tank would be a prudent choice.

## PRELIMINARY COSTS

Preliminary costs were developed for two alternatives described earlier - retrofitting the existing facilities in Train A for aeration basins of MBR system or using completely new structures for this purpose. The costs estimated are according to Class 4 level per AACE (Association for the Advancement of Cost Engineering) guidelines. At this point in the design process, these costs are preliminary and should be used only for comparative purposes. The costs were estimated using several resources. Quotes from the manufacturers, information available from similar projects performed by Parsons, including construction in the Central Valley, were used to determine these costs.

### Avoided Cost of Future Upgrades/Replacement of Train A

As disused earlier, a credit could be given to compensate for the cost of replacing and upgrading Train A in the near future, which would occur under conventional filtration alternatives but not under MBR alternatives. To estimate this credit, $3-$4 per gal of wastewater treated was used as the cost basis, which would translate into $15-$20 million of avoided future capital investment for a 5 mgd system. For the purposes of cost comparison, $18 million is considered as avoided capital replacement cost. Note that the estimated avoided cost is based on constructing new basins to remove nitrogen but without new aeration blowers.

**Table ES-1: MBR Alternatives Capital Cost (5 mgd) [a]**

| Parameter | Capital Cost ($ Million) | |
|---|---|---|
| | Retrofit MBR | New MBR |
| MBR Equipment and Structures Cost | 8.4 | 8.7 |
| MBR Total Capital Cost [b] | 24.5 | 24.4 |
| UV Disinfection Total Capital Cost [b] | 5.3 | 5.3 |
| Storage (Aeration Basin No. 3 or 4) Total Capital Cost [b] | 3.1 | 3.1 |
| **Total Capital Cost** | **32.9** | **32.8** |
| Train A Capacity Replacement (Avoided Cost) [c] | (18) | (18) |
| **Net Effective Capital Cost** | **14.9** | **14.8** |

[a] For detailed cost analysis see Appendix A.
[b] Including installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013)
[c] Near future replacement cost of Train A facilities equivalent to 5 mgd capacity

## DISCUSSION AND CONCLUSION

It is evident from the data presented in Table ES-1 above that the two MBR alternatives compared are very close to each other from a cost standpoint. The capital cost difference between the two alternatives is insignificant and is within the margin of error of our estimates. The concrete savings realized by retrofitting existing structures is balanced by less extensive piping required by using new structures.

However, using all new structures offers a more flexible and compact design. By properly planning the new facilities, they can be built in a monolithic construction with common walls, which would make it easier to build and more efficient to operate. The future expansion of tertiary facilities would follow the same compact pattern. Also, the design would not need to be tailored based on the constraints of existing facilities, but based on the best design practices. For example, deeper new aeration basins compared to the retrofitted basins would allow for a more efficient aeration system.

Further, a separate standalone MBR system will be easier to construct and will also provide some redundant treatment facilities associated with that particular train in the interim and for several years until the City decides to totally decommission that train due to its obsolescence.

Based on the above discussion, Parsons recommends using all new structures for constructing the MBR system, as it would be a more prudent and reliable approach to achieve filtration, nitrogen removal and future capacity replacement for Train A.

# SECTION 1 - INTRODUCTION AND OBJECTIVE

## 1.1 BACKGROUND

The City of Fresno (City) mainly relies on groundwater as the primary drinking water resource where the groundwater level is approximately 300 feet below ground surface. To conserve valuable drinking water resources, the City plans to use tertiary treated recycled water for landscape irrigation as well as for commercial and industrial uses. Also the City plans to maximize the recharge of groundwater with high quality recycled water. The City's goal is to recycle 25,000 acre feet/year or more of recycled water by 2025. Therefore, the City is embarking upon new projects to design and construct a tertiary treatment and disinfection facility (TTDF) at the City of Fresno-Clovis Regional Water Reclamation Facility (RWRF) and new recycled water distribution system including pipelines, pump stations and storage reservoirs. The new recycled water distribution system will deliver disinfected tertiary recycled water to potential recycled water use sites according to the City's Recycled Water Master Plan that is currently being prepared.

The size of the new TTDF will have an initial capacity of 5 to 10 million gallons a day (mgd) in response to the immediate recycled water demand identified in the Recycled Water Master Plan; however it will ultimately expand to 30 mgd over the years to accommodate more users. The City's initial plan was to expand the TTDF in phases: the first phase (Phase I) would have a capacity of 5 mgd, the second phase (Phase II) would have a capacity of 10 mgd for a total of 15 mgd, and the third phase (Phase III) would have a capacity of 15 mgd for a total of 30 mgd. The City is now considering a Phase I capacity of 5 to 10 mgd, depending on the system selection and associated economics. If the Phase I is constructed for a capacity greater than 5 mgd, the capacity of subsequent phases will be adjusted accordingly. A phased expansion approach is prudent for several reasons:

- Recycled water demand will be low initially, but will increase over the years.
- It will minimize initial capital outlay.
- This approach takes advantage of emerging technologies in the area of recycled water production as new technologies emerge and are developed and optimized over the years, e.g., ultraviolet (UV) disinfection, ozonation, membrane filtration and so forth.
- Public acceptance of recycled water and hence the demand for that water will increase over the years.

The proposed TTDF needs to become an integral part of the RWRF for its operation, reliability and compliance with the near term and future regulatory requirements. Train A, the oldest treatment train at RWRF, is dated and has operational issues and therefore is a candidate for replacement in the near future with a more reliable and state-of-the-art treatment system. Furhter, the SCADA system of the proposed TTDF should fully integrate with the existing RWRF SCADA system for smooth and reliable operation.

## 1.2 SCOPE AND OBJECTIVES

Key objectives of this project include:

- Design and construct the first phase of the TTDF to match the demand of 5 to 10 mgd.
- Consider proven, cost effective and state-of-the-art technologies for upgradability and expandability in the future to a capacity of 30 mgd.
- Develop phased site master plan for ultimate 30 mgd capacity.
- Design treatment facilities that meet Title 22 irrigation and groundwater recharge requirements and could be retrofitted in the future to meet more stringent effluent quality requirements, if needed, in a cost effective manner, such as nitrogen removal.
- Consider facilities that present desired flexibility and redundancy as required for California Department of Public Health (CDPH) Title 22 criteria.
- Design facilities which are easier to operate.
- Consider full integration of TTDF control system (SCADA, etc.,) with the existing facilities at RWRF's control system.

More specifically, the following eight types of commonly used filters will be evaluated for tertiary filtration:

- Dual media gravity filters
- Deep bed mono-media gravity filters
- Continuous backwash filters
- Traveling bridge filters
- Fuzzy Filters™
- Cloth media disk filters
- Nova Ultrascreen® filters
- Microfilters

In addition to the alternatives above, membrane bioreactors (MBR), which replace secondary clarifiers and provide filtration at the same time, will also be evaluated.

The filtered effluent in all cases will be disinfected to meet the State of California Title 22 requirements for unrestricted reuse. Both UV disinfection and ozone will be evaluated for this purpose. Disinfection by gaseous or liquid chlorine (NaOCl) was not considered at the suggestion of the City, due to extensive operation and maintenance requirements associated with chlorine storage, handling and pumping and due to its potential to form toxic disinfection by products (DBP). A storage tank, 5 million gallons (MG) capacity, will be provided for storage of the final effluent/recycled water before it can be pumped though the recycled water distribution system.

# SECTION 2 - EXISITNG RELEVANT TREATMENT FACILITIES

## 2.1 EXISTING FACILITIES AT THE CITY OF FRESNO CLOVIS REGIONAL WATER RECLAMATION FACILITY (RWRF)

The existing RWRF located at 5607 W. Jenson Avenue in Fresno, is designed for a capacity of 80 mgd average annual flow while the current plant flow is about 64 mgd. The wastewater entering the plant is received at the headworks, which includes an influent pump station, bar screens, grit removal tanks, and grit processing equipment. After the preliminary treatment at the headworks, the wastewater is provided with primary treatment by six clarifiers. The primary effluent from these clarifiers is distributed to three trains of secondary treatment facilities (Trains A, B and C). See Figure 2-1 below.

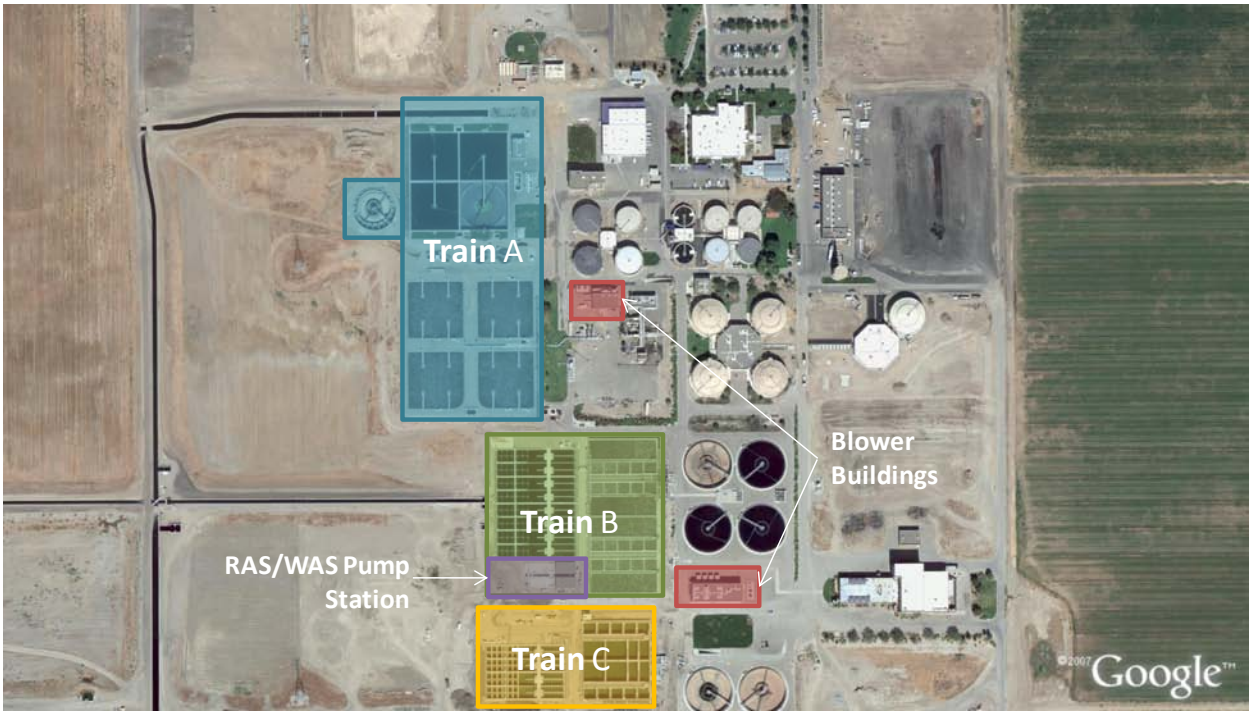


**Figure 2-1: Relevant Facilities**

Train A is the oldest one. It consists of four square aeration basins and four square secondary clarifiers. Train A has several operational and maintenance issues as summarized in Section 14 of this TM. Train B is the next oldest one. It consists of four rectangular aeration basins and eight rectangular secondary clarifiers. This train is located between trains A and C. Train C is the newest train. It consists of two rectangular aeration basins and four rectangular secondary clarifiers. The effluent from the plant flows into two canals on the site and finally from there to percolation ponds. The RWRF is in compliance with all the current regulatory requirements, except for Electrical Conductivity (EC) and occasionally other constituents such as chlorides, manganese and arsenic. Relevant design information for the three trains is provided in Table 2-1 with a brief schematic shown in Figure 2-2.

**Table 2-1: Existing Relevant Facilities - Major Design Information[1]**

| Parameter | Units | Train A | Train B | Train C | Total |
|---|---|---|---|---|---|
| Rated Average Flow[2] | mgd | - | - | - | 80 |
| Rated Max Month Flow[2] | mgd | - | - | - | 88 |
| Aeration Basins, Blowers, and Air Supply System | | | | | |
| Number | - | 4 | 4 | 2 | 10 |
| Volume, Each | MG | 2.7 | 2.6 | 2.7 | 26.6 |
| Side Water Depth (SWD) | ft | 16 | 17 | 17 | - |
| Mixed Liquor Suspended Solids (MLSS) | mg/L | 2,500 - 3,000 | 2,500 - 3,000 | 2,500 - 3,000 | - |
| Solids Retention Time (SRT) | days | 4 - 5 | 4 - 5 | 4 - 5 | - |
| Blower Type | - | Single-stage centrifugal (Turblex) | | | - |
| Blower No. | - | 6 (Located in Two Buildings) | | | - |
| Bower Capacity, Each | scfm | 27,000 | | | 162,000 |
| Diffuser Type | - | Ceramic Dome | Ceramic Plate | Membrane | - |
| Secondary Clarifiers | | | | | |
| Number | - | 4[3] | 8 | 4 | 16[3] |
| Volume, Each | MG | 2.36 | 0.93 | 0.93 | 20.6 |
| SWD | ft | 14 | 13 | 13 | - |

[1]Values obtained from 2006 conformed drawings. SRT was obtained from Water Environment & Technology (WE&T) paper, June 2009
[2]Per Waste Discharge Report (WDR) Order No. 5-01-254 - See Appendix C)

[3]Train A circular secondary clarifier (clarifier no.5) is not included.

Even though the current discharge permit only requires Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) removal (40 mg/L BOD and 40 mg/L TSS in the effluent), the operations staff has been able to achieve some nitrification and denitrification by dissolved oxygen (DO) control at strategic locations and maintaining a higher (4-5 days) SRT in the aeration basins.[1]

[1]"How Low is Too Low?" Schuyler, Ronald G et.al., WE&T Journal, June 2009

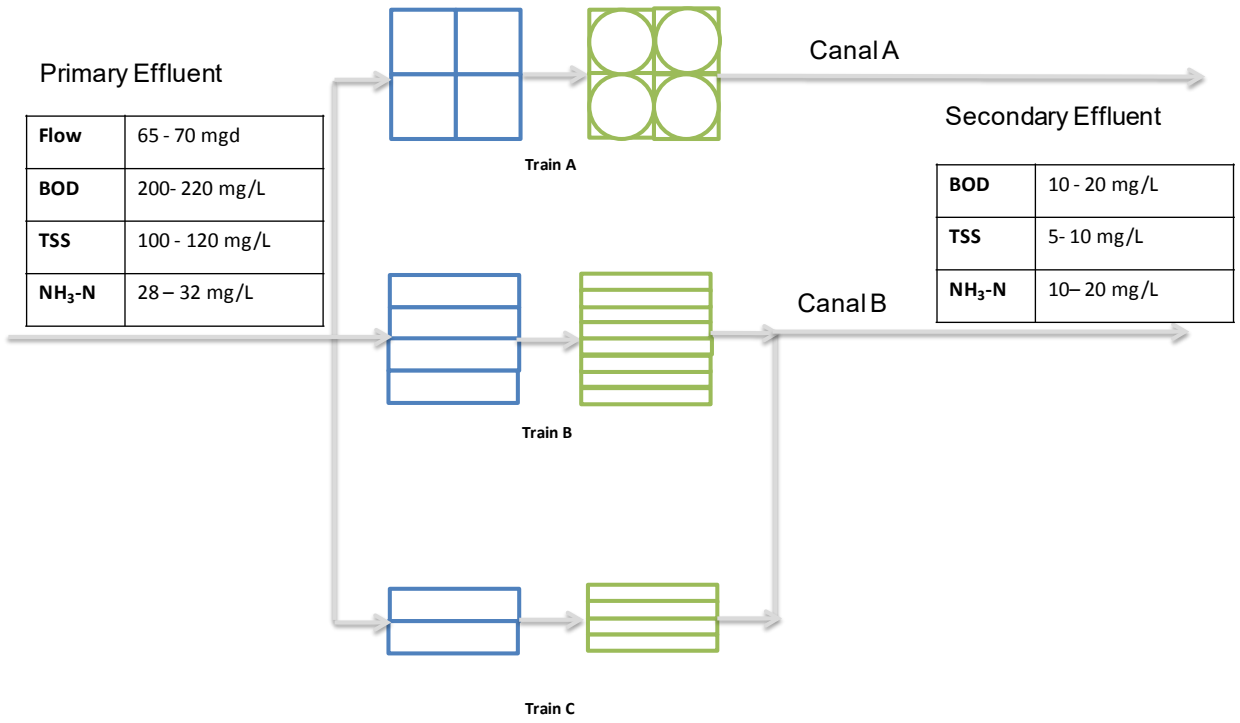


**Figure 2-2: Existing Relevant Facilities - Current Operation**

Train A, as pointed out above, is the oldest and is of obsolete design. The aeration basins are square shaped with sloping side walls. The mixed liquor is difficult to mix and aerate, the design is inefficient and does not allow plug flow regime (nearly essential to achieve high efficiency in a biological reactor), and operation and maintenance is less than optimum with sloping "gunited" walls. Further, based on Parsons' discussions with City's operations staff, Train A has immediate need for significant repairs/replacements (See Section 14 for details).

Trains B and C, however, are of newer construction and are well designed and operated. They have concrete walls and employ plug flow in reactors. The associated secondary clarifiers are also of proper design in terms of detention time, surface settling rates and other important criteria.

Therefore, the City believes and Parsons concurs, that in the current TTDF project, if any existing facilities should be upgraded and/or modified for reuse, they should be of Train A.

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# PRE-WORKSHOP NO.1 ANALYSIS (SECTION 3 - SECTION 7)

# SECTION 3 - PLANNED TERTIARY TREATMENT AND DISINFECTION FACILITY (TTDF)

## 3.1 GENERAL

As described in the previous Sections of this Technical Memorandum (TM), the City plans to construct a 5 to 10 mgd TTDF at the RWRF under first phase. This facility will consist of a 5 to 10 mgd filter feed pump station, a new conventional filtration system, a disinfection system, and a 5 million gallon (MG) storage tank along with post-chlorination and recycled water distribution pump station. The recycled water treated at the TTDF will be used for unrestricted landscape irrigation. The City, in the future, may also use the recycled water for ground water recharge, which requires removal of nitrogen to comply with the CDPH guidelines for recycled water recharge. The TTDF will be located in an open area north of Canal "B." During the Schematic Design Phase, a preliminary layout of 5 to 10 mgd TTDF expandable to ultimate capacity of 30 mgd will be prepared. Figure 3-1 below shows the planned TTDF in the overall RWRF treatment scheme. A simplified schematic of the TTDF and its unit processes is shown in Figure 3-2.

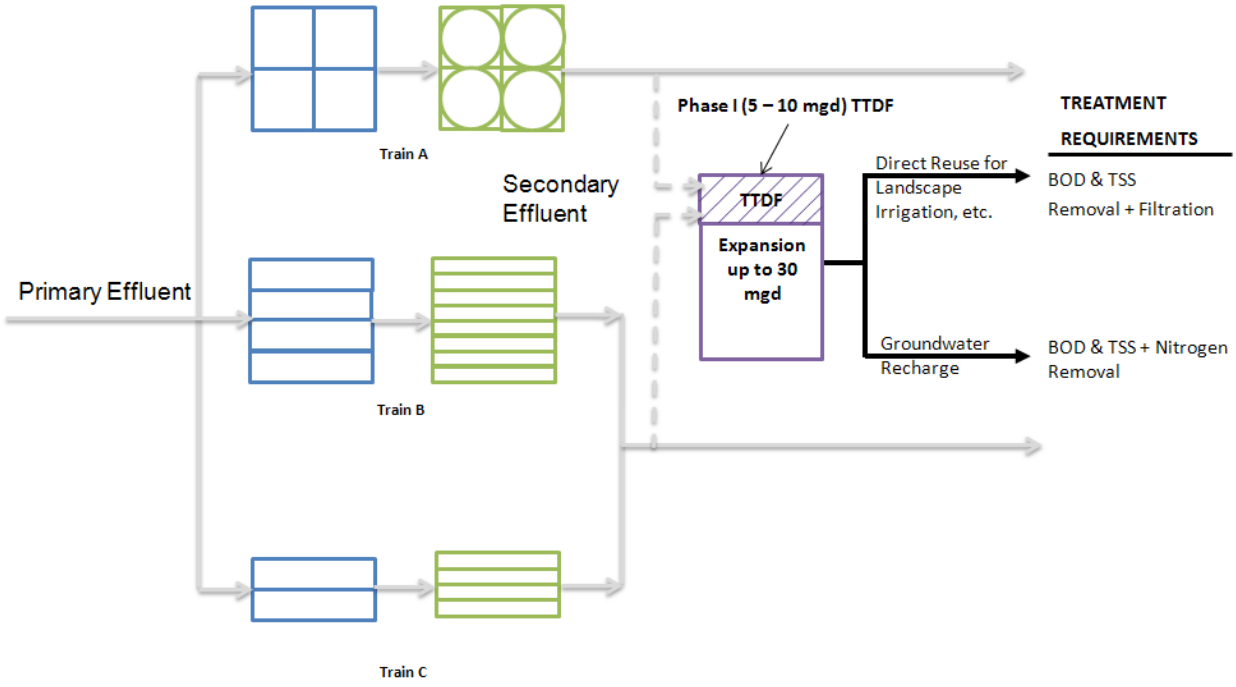


**Figure 3-1: Planned TTDF**

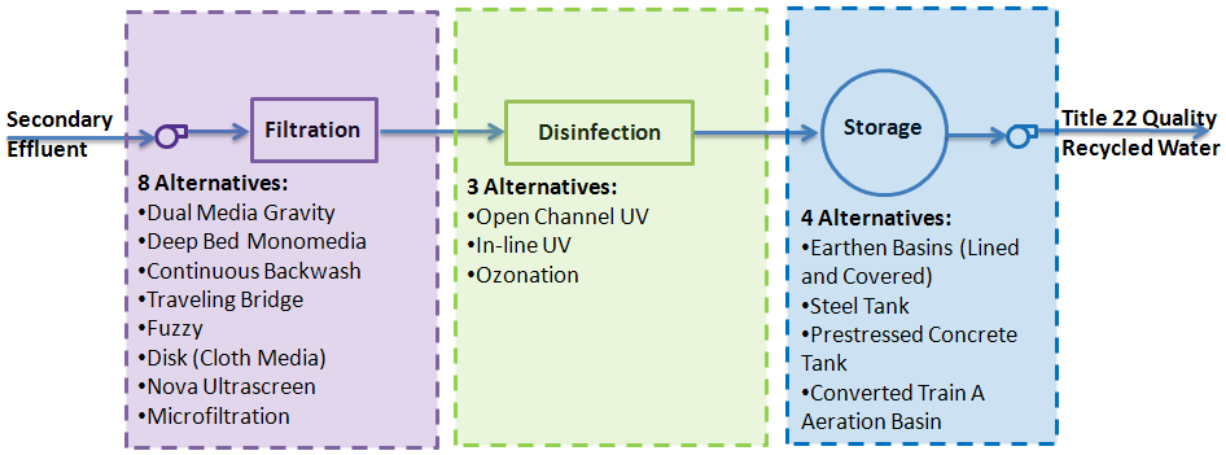


**Figure 3-2: Simplified Schematic of the TTDF**

A detailed analysis of the alternative technologies considered for evaluation for filtration, disinfection and storage systems is presented in Sections 4, 5 and 6, respectively, of this TM.

## 3.2 FILTER FEED PUMP STATION

A new filter feed pump station will be located adjacent to the existing effluent junction box to feed the secondary effluent to the proposed filters. The pump station will be sized to accommodate a total of four (4) vertical turbine pumps: two (one duty and one standby) will be installed for 5 mgd capacity and two more will be installed for next 10 mgd expansion of the TTDF. Space will be left for expansion of the pump station to 30 mgd.

## 3.3 FILTRATION

The following eight CDPH approved conventional filtration technologies will be evaluated to select the preferred filtration technology:

- Dual Media Gravity Filters
- Deep Bed Monomedia Filters
- Continuous Backwash Filters
- Traveling Bridge Filters
- Fuzzy Filters
- Disk (Cloth Media) Filters
- NOVA Ultrascreen Filters
- Microfiltration

In addition to the alternatives above, MBR, which replaces secondary clarifiers and provides filtration at the same time, will also be evaluated as an alternative to conventional filtration.

## 3.4 DISINFECTION

To select the most viable technology for the TTDF, proven disinfection technologies including

UV radiation (open channel and in-pipe) and ozonation will be evaluated. Only low-pressure high-intensity UV lamps will be considered for both open channel and in-pipe UV disinfection. Ozonation alternative will only consider the use of liquid oxygen for ozone generation. Section 5 of this TM provides a detailed analysis of disinfection system alternatives.

## 3.5 STORAGE

The proposed TTDF will include a 5 MG recycled water storage tank. The storage tank will have a recycled water distribution pump station. The following four alternatives for the storage tank construction will be evaluated to select the most viable alternative:

- Earthen Basins (lined and covered)
- Steel Tank
- Concrete Tank
- Conversion of an existing aeration basin from train A (capacity will be limited to 2.7 MG) – only for MBR option

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# SECTION 4 - FILTRATION SYSTEM ALTERNATIVES ANALYSIS

## 4.1 BACKGROUND

As noted in Section 1, the City's goal is to produce 25,000 acre-ft/year of recycled water by 2025. This Section of the TM presents the eight filtration alternatives that were evaluated for the TTDF.

As described earlier, the existing facilities at the RWRF are designed to treat an average wastewater flow of 80 mgd. The existing RWRF produces secondary effluent that is well within the permitted BOD and TSS limits, as indicated in Table 4-1 below.

**Table 4-1: Secondary Effluent Permitted Quality and Currently Achieved Quality**

| Parameter | Units | WDR Permit Limit[1] (Monthly Average) | Currently Achieving |
|---|---|---|---|
| **$BOD_5$** | mg/L | 40 | 10 - 20 |
| **TSS** | mg/L | 40 | 5 - 10 |

[1]WDR Order No. 5-01-254 (See Appendix C)

To comply with CDPH standards for unrestricted reuse (Title 22) of wastewater effluent, the secondary effluent must be coagulated (although this requirement can be waived - see below), filtered, and disinfected. By removing a majority of the suspended solids and turbidity, filtration enhances the effectiveness of the downstream disinfection process.

Per Title 22 standards, when media filtration is used, the filtered effluent turbidity must not exceed a daily average of 2 Nephelometric Turbidity Units (NTU), 5 NTU more than 5% of the time within a 24 hour period, and 10 NTU at any time. These turbidity maxima were developed based on the Pomona Virus Study conducted by the County Sanitation Districts of Los Angeles County (CSDLAC, 1977), which correlated the turbidity values with successful disinfection as measured by total coliforms (less than 2.2 per 100 ml for Title 22 tertiary effluent) and viruses. When membrane filtration is used, the filtered effluent turbidity must not exceed 0.2 NTU more than 5% of the time within a 24 hour period, and 0.5 NTU at any time. Table 4-2 below summarizes Title 22 tertiary effluent criteria.

**Table 4-2: Tertiary Effluent (Title 22) Criteria**

| Parameter | Units | Value |
|---|---|---|
| **Turbidity for Media Filtration** | NTU | ≤2 Daily Average, ≤5 95% of the time within a 24 hour period, ≤10 at all times |
| **Turbidity for Membrane Filtration** | NTU | ≤0.2 NTU 95% of the time within a 24 hour period, ≤0.5 NTU at all times |
| **Filter Loading Rate** | $gpm/ft^2$ | 2 – 30 |

Title 22 standards state that coagulation may be waived if the filter effluent does not exceed 2 NTU, the filter influent is continuously measured, the filter influent turbidity does not exceed 5 NTU, and automatically activated chemical addition or diversion facilities are provided in the event filter influent turbidity exceeds 5 NTU. The current secondary effluent quality data suggests that the RWRF meets the filter influent criteria for waiving the coagulation requirement. To enhance reliability and provide a prudent design, automatically actuated coagulation will be provided in the event filter influent turbidity exceeds 5 NTU.

There are several CDPH approved filtration technologies which generally fall into the following eight categories:

- Dual media gravity filters
- Deep bed monomedia filters
- Continuous backwash filters
- Traveling bridge filters
- Fuzzy filters
- Cloth media filters
- Nova Ultrascreen filters
- Microfilters

Each of these categories of filters has a specific maximum allowable filtration rate approved by the CDPH. The approved rates are based on pilot tests conducted (typically by an independent testing agency) on these filters using secondary effluent from an actual wastewater treatment plant and measurement and verification of performance in these tests.

Operational reliability is an important criterion for recycled water systems and there are several options for meeting Title 22 reliability requirements, including (reproduced from California Code of Regulations, Title 22, Chapter 3, Article 10, Section 60351) :

- Alarm and multiple filter units capable of treating the entire flow with one unit not in operation.
- Alarm, short-term retention or disposal provisions and standby replacement equipment.
- Alarm and long-term storage or disposal provisions.
- Automatically actuated long-term storage or disposal provisions.
- Alarm and standby filtration unit process.

For the purposes of filtration system alternative analysis in this TM, multiple filter units capable of treating the entire flow with one unit not in operation were considered. However, it should be noted that the RWRF does currently have long term disposal provisions under its existing WDR Order No. 5-01-254.

This TM presents the features of operation, advantages and disadvantages, design criteria, preliminary layout drawings, and preliminary construction, O&M, and 20 year life-cycle cost estimates for each of the eight filtration technologies. The evaluations consider a filtration capacity of 5 mgd constant flow (enough to satisfy near-term recycled water demand identified in the City's Recycled Water Master Plan).

## 4.2 FILTRATION SYSTEM ALTERNATIVES

### 4.2.1 Dual Media Gravity Filters

**Features of Operation**

Dual media filters are custom designed filters employing anthracite (typically 18-inches depth) and sand (typically 12-inches depth) media. The anthracite medium layer is above the sand medium layer. The sand medium is supported by a layer of gravel (in order to prevent plugging of underdrain nozzles/orifices and to distribute the backwash water evenly across the filter) which, in turn, is supported by the filter underdrain system. Many underdrain systems, however, are now capable of supporting the media directly, without the need of a gravel layer. Solids are removed by a variety of mechanisms including straining, sedimentation, impaction, interception, and adhesion (removal mechanisms that are common to all granular media depth filters). Figure 4-1 below presents a simplified schematic of a granular media depth filter.

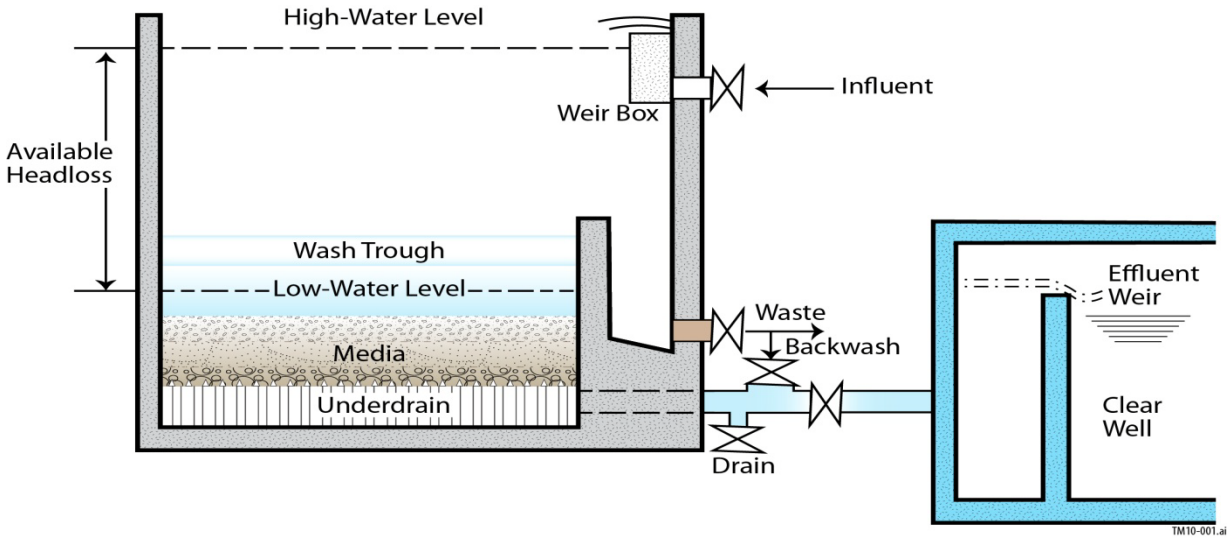


**Figure 4-1: Simplified Schematic of a Granular Media Depth Filter**

Over time, the solids accumulate within the voids of the filter bed, increasing the headloss across the filter. After the headloss exceeds a certain allowable level or after the filtered turbidity exceeds the allowable level, the filter must be backwashed in order to remove the accumulated solids. In the majority of operating filtration systems, headloss is used as the criteria for backwashing. The backwashing sequence in these filters is automatic and programmable so that backwashing occurs first with air only (approximately 3 minutes, but to be preselected), then air and water (approximately 5 minutes, but to be preselected), and then water only (approximately 10 minutes, but to be preselected). Two backwash pumps (one duty and one standby) and two air scour blowers (one duty and one standby), sized for backwashing one filter cell at a time, are provided. The backwash velocity is enough to fluidize the bed while avoiding media loss. In other words, the backwash velocity is controlled such that height of the fluidized bed does not exceed the level of the wash trough. The backwash waste is collected in the wash trough and is sent to a backwash waste storage tank. From the backwash waste

storage tank, the backwash waste is pumped at a controlled rate back to the headworks via return pumps. The length of a filter run (i.e. the time between filter cell backwashes) is conservatively 24 hours; however, the length of a filter run will depend upon the filter influent quality. Influent with higher turbidity would require more frequent backwashes and vice versa. The typical headloss through the filter is 2 (clean bed) - 10 (dirty bed) feet. The backwash waste production rate varies depending upon the filter influent quality, typically ranging between 5 - 15% of the filter influent flow rate.

Advantages and disadvantages of dual media gravity filters are summarized in Table 4-3 and the design criteria are summarized in Table 4-4. A preliminary layout for the dual media gravity filters at the TTDF is presented in Figure 4-2. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter cell is planned for the 5 mgd and 15 mgd systems and two redundant filter cells are planned for the 30 mgd system. Preliminary construction, O&M, and 20 year life-cycle cost estimates for dual media filters are presented in Table 4-5.

## Advantages and Disadvantages

**Table 4-3: Dual Media Filter Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Dual media filters are proven, with many long-operating installations. | Backwashes produce a large, instantaneous flow of backwash waste - which requires storage. The backwash waste storage tank is large (sized for two backwashes), adding to capital costs. |
| Dual media filters are, by virtue of their ample storage capacity, less susceptible to upsets and breakthrough than other filtration technologies that do not employ depth filtration. | Backwashing requires that a filter cell be taken off-line. |
| Dual media filters are non-proprietary (both in terms of design and materials e.g. media) and can be competitively bid. | Concrete and piping requirements are high. |
| | Expansion of the filter requires the construction of additional filter cells. |
| | Operating issues, such as loss of media and destratification of media, will occur over time. |
| | Chlorine dosing is recommended for algae control. |

## Design Criteria

**Table 4-4: Dual Media Filter Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Flow, mgd** | 5 |
| **CDPH Approved Filtration Rate, gpm/ft$^2$** | 5 |
| **Number of Filter Cells** | 4 |
| **Dimensions of Each Cell, Length (ft) x Width (ft) x Depth (ft)** | 16 x 16 x 15.5 |
| **Total Filtration Area, ft$^2$** | 1,024 |
| **Filtration Rate with One Filter Backwashing, gpm/ft$^2$** | 4.5 |
| | |
| **Backwash** | |
| **Type** | Air-water (Air, Air & Water, Water) |
| **Rate, Air and Water Cycle** | |
| **Air, scfm/ft$^2$** | 3 to 5 |
| **Water, gpm/ft$^2$** | 8 to 9 |
| **Rate, Water Cycle Only, gpm/ft$^2$** | 16 to 18 |
| **Underdrain Type** | False Bottom with Nozzles or Underdrain Blocks |
| **Backwash Waste Storage Tank Capacity** | 2 Backwashes |
| | |
| **Headloss Through Filter, ft (Operating)** | 10 |

## Preliminary Layout

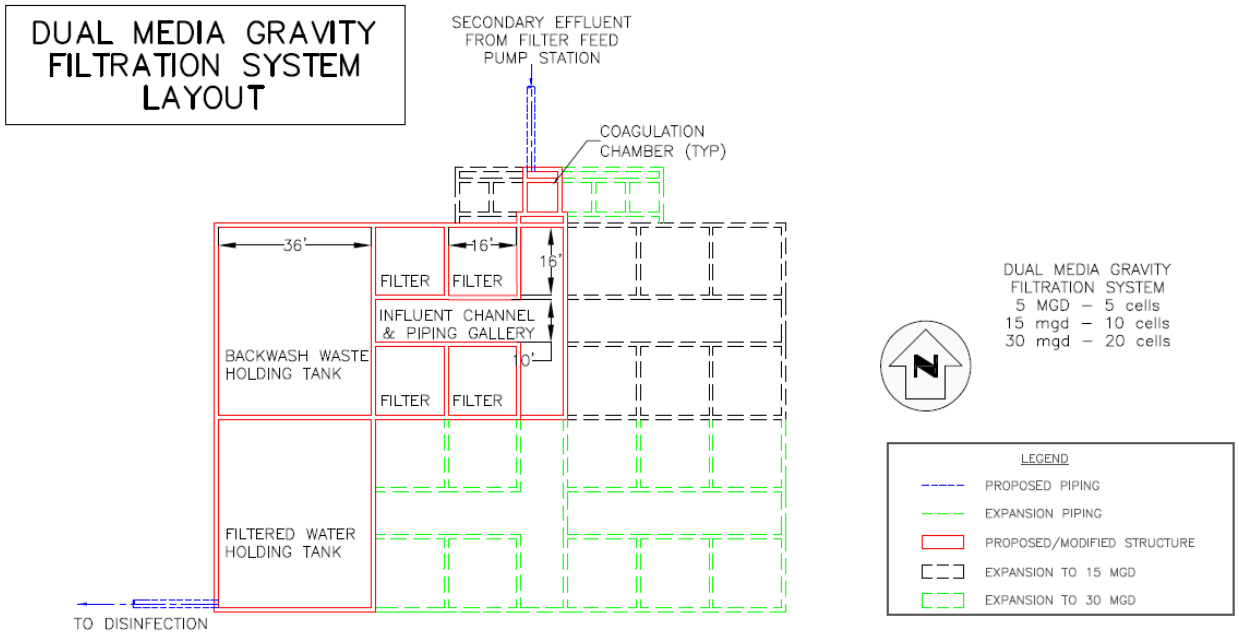


**Figure 4-2: Preliminary Layout of 5 mgd Dual Media Filter, with Future Footprint for Phased Expansion to 30 mgd**

### Cost Summary

**Table 4-5: Dual Media Filter Cost Summary (5 mgd Constant Flow)**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 1,600,000 |
| **Total Capital Cost**[a] | 4,300,000 |
| **Total Annual O&M Cost**[b] | 90,000 |
| **20-Year Life Cycle Cost** [c] | 5,900,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

## 4.2.2 Deep Bed Monomedia Filters

### Features of Operation

The features of operation for deep bed monomedia filters are essentially identical to dual media gravity filters, with the only major difference being the media - deep bed monomedia filters employ a single medium (typically anthracite with a depth of 48-inches). The length of a filter run, the operating headloss across the filter bed, and the backwash waste production rate for deep bed monomedia filters are essentially the same as for dual media gravity filters (refer to Section 4.2.1).

Advantages and disadvantages of deep bed monomedia filters are summarized in Table 4-6 and the design criteria are summarized in Table 4-7. A preliminary layout for the deep bed monomedia filters at the TTDF is presented in Figure 4-3. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter cell is planned for the 5 mgd and 15 mgd systems and two redundant filter cells are planned for the 30 mgd system. Preliminary construction, O&M, and 20 year life-cycle cost estimates for deep bed monomedia filters are presented in Table 4-8 below.

## Advantages and Disadvantages

**Table 4-6: Deep Bed Monomedia Filter Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Deep bed monomedia filters are proven, with many long-operating installations. | Backwashes produce a large, instantaneous flow of backwash waste - which requires storage. The backwash waste storage tank is large (sized for two backwashes), adding to capital costs. |
| Deep bed monomedia filters are, by virtue of their ample storage capacity, less susceptible to upsets and breakthrough than other filtration technologies, including dual media gravity filters. | Backwashing requires that a filter cell be taken off-line. |
| Deep bed monomedia filters are non-proprietary (both in terms of design and materials e.g. media) and can be competitively bid. | Concrete and piping requirements are high. |
| Deep bed monomedia filters use a single medium, avoiding the problems with destratification of media experienced with multimedia filters. | Expansion of the filter requires the construction of additional filter cells. |
| | Operating issues, such as loss of media, occur over time. |
| | Chlorine dosing is recommended for algae control. |

## Design Criteria

**Table 4-7: Deep Bed Monomedia Filter Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Flow, mgd** | 5 |
| **CDPH Approved Filtration Rate, gpm/ft$^2$** | 5 |
| **Number of Filter Cells** | 4 |
| **Dimensions of Each Cell, Length (ft) x Width (ft) x Depth (ft)** | 16 x 16 x 17 |
| **Total Filtration Area, ft$^2$** | 1,024 |
| **Filtration Rate with One Filter Backwashing, gpm/ft$^2$** | 4.5 |
| **Backwash** | |
| **Type** | Air-water (Air, Air & Water, Water) |
| **Rate, Air and Water Cycle** | |
| **Air, scfm/ft$^2$** | 3 to 5 |
| **Water, gpm/ft$^2$** | 8 to 9 |
| **Rate, Water Cycle Only, gpm/ft$^2$** | 16 to 18 |
| **Underdrain Type** | False Bottom with Nozzles or Underdrain Blocks |
| **Backwash Waste Storage Tank Capacity** | 2 Backwashes |
| **Headloss Through Filter, ft (Operating)** | 10 |

## Preliminary Layout

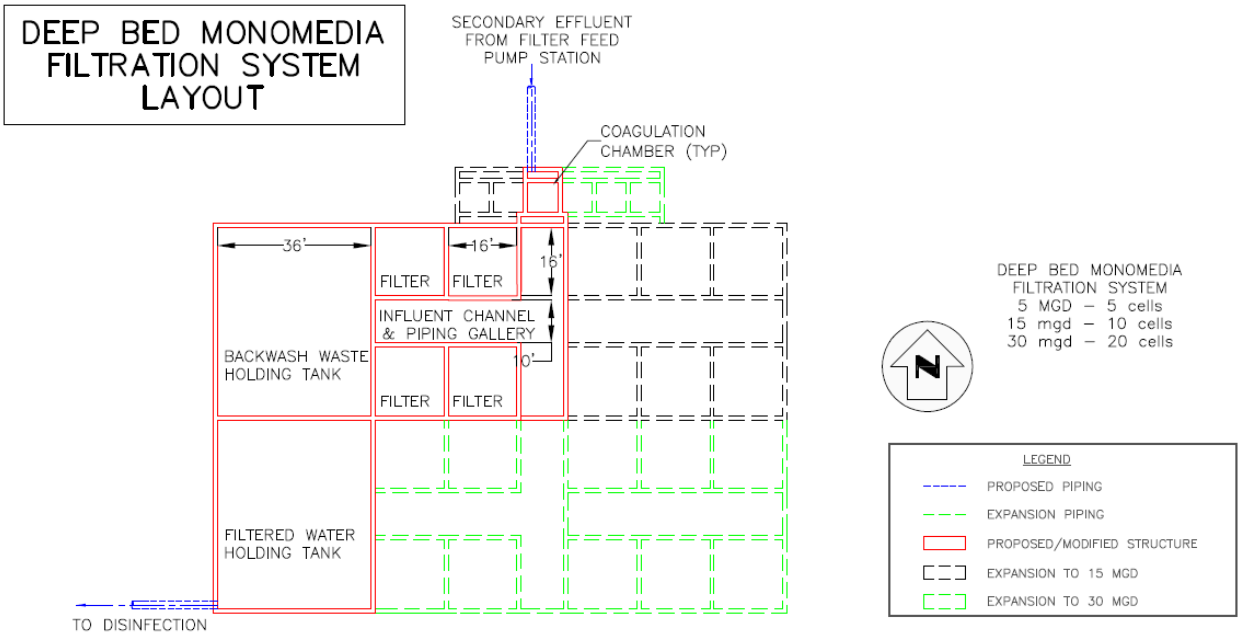


**Figure 4-3: Preliminary Layout of 5 mgd Deep Bed Monomedia Filter, with Future Footprint for Phased Expansion to 30 mgd**

## Cost Summary

**Table 4-8: Deep Bed Monomedia Filter Cost Summary (5 mgd Constant Flow)**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 1,600,000 |
| **Total Capital Cost**[a] | 4,400,000 |
| **Total Annual O&M Cost**[b] | 90,000 |
| **20-Year Life Cycle Cost** [c] | 6,000,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

### 4.2.3 Continuous Backwash Filters

**Features of Operation**

Continuous backwash filters, marketed under various names such as DynaSand, SuperSand, and TechnaSand, are deep bed granular media filters that are similar to the granular media filters discussed above in that solids are removed by straining, sedimentation, impaction, interception, and adhesion. However, there are a several major differences: the filter bed is continuously backwashed via an airlift pump and the filter operates as an up-flow filter rather than a down-flow filter. The filters are supplied in modules, either as packaged units (for low flow applications) or for installation in concrete basins (for high flow applications). Due to the continuous filter bed cleaning system, this type of filter requires a low operating head (about 3 feet). It also produces a continuous low rate of waste backwash flow to eliminate the need for flow equalization of the waste backwash before return to the main treatment plant. The backwash waste production rate is approximately 5% of the filter influent flow rate.

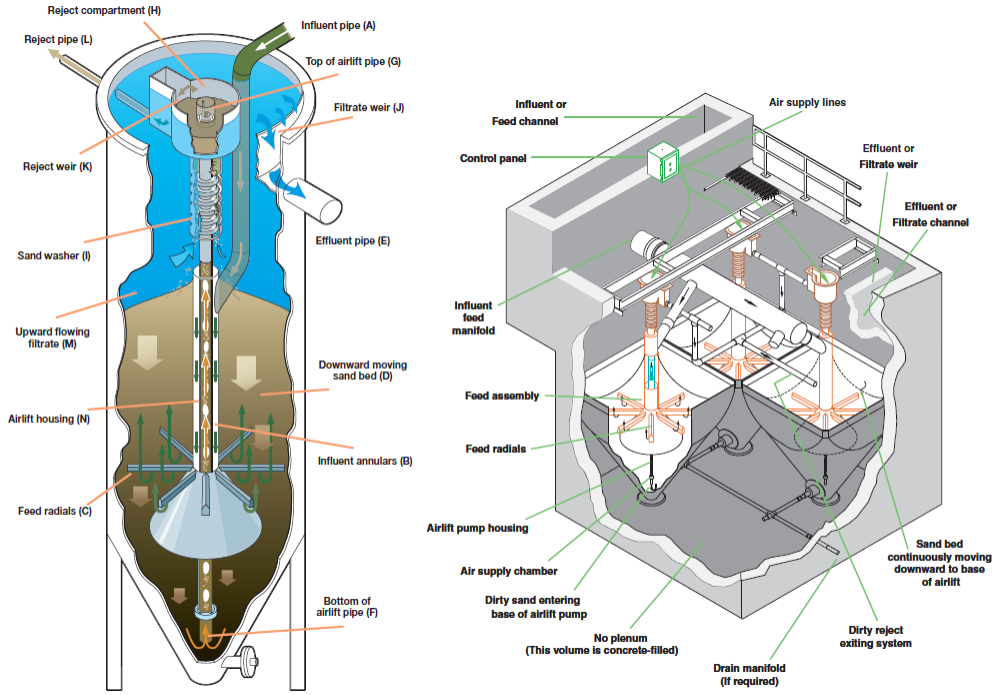


**Figure 4-4: Continuous Backwash Filter (Figure from DynaSand®)**

As shown in Figure 4-4 above, sand containing captured solids is drawn though an airlift pipe and into a reject compartment. The sand is scoured within the airlift pipe, cleaning the sand before it is collected in the reject compartment. The scoured solids, which are less dense than the sand media, flow over the reject weir and into the reject pipe. The clean sand then returns to the filter bed though a sand washer, in which any remaining solids are removed and carried back into the reject compartment by a small amount of filtrate. Figure 4-4 above shows filter cells arranged in 2 x 2 configuration. For the TTDF, a 4 x 1 module configuration is planned.

Advantages and disadvantages of continuous backwash filters are summarized in Table 4-9 and the design criteria are summarized in the Table 4-10. A preliminary layout for the continuous backwash filters at the TTDF is presented in Figure 4-5. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter cell is planned for the 5 mgd and 15 mgd systems and two redundant filter cells are planned for the 30 mgd system. Preliminary construction, O&M, and 20 year life-cycle cost estimates are presented in Table 4-11.

## Advantages and Disadvantages

**Table 4-9: Continuous Backwash Filter Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Continuous backwash filters are proven, with many long-operating installations. | The design of continuous backwash filters is proprietary. |
| Continuous backwash filters are, by virtue of their ample storage capacity, less susceptible to upsets and breakthrough than other filtration technologies that do not employ depth filtration. | Expansion of the filter requires the construction of additional filter cells. |
| Continuous backwash filters have no moving parts. The only mechanical component of this type of filter is an air compressor to produce the air needed for the airlift pumps. | Air flow must be precisely controlled in order to prevent the loss of media. |
| Continuous backwashing eliminates the need for taking a filter off-line for cleaning, storing backwash water and filtered water, and backwash waste return pumps. | Internal parts of the filter cannot be accessed for maintenance without taking the filter offline and removing the media. |

## Design Criteria

**Table 4-10: Continuous Backwash Filter Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Flow, mgd** | 5 |
| **CDPH Approved Filtration Rate, gpm/ft$^2$** | 5 |
| **Number of Filter Cells** | 5 |
| **Dimensions of Each Cell, Length (ft) x Width (ft) x Depth (ft)** | 28.3 x 7.1 x 16.2 |
| **Total Filtration Area, ft$^2$** | 1,000 |
| **Filtration Rate with One Filter Backwashing, gpm/ft$^2$** | 4.3 |
| **Backwash** | |
| **Type** | Air |
| **Rate, Air** | |
| **Air, scfm per module (scfm per ft$^2$)** | 2 - 3 (>150) |
| **Headloss Through Filter, ft (Operating)** | 3 |

## Preliminary Layout

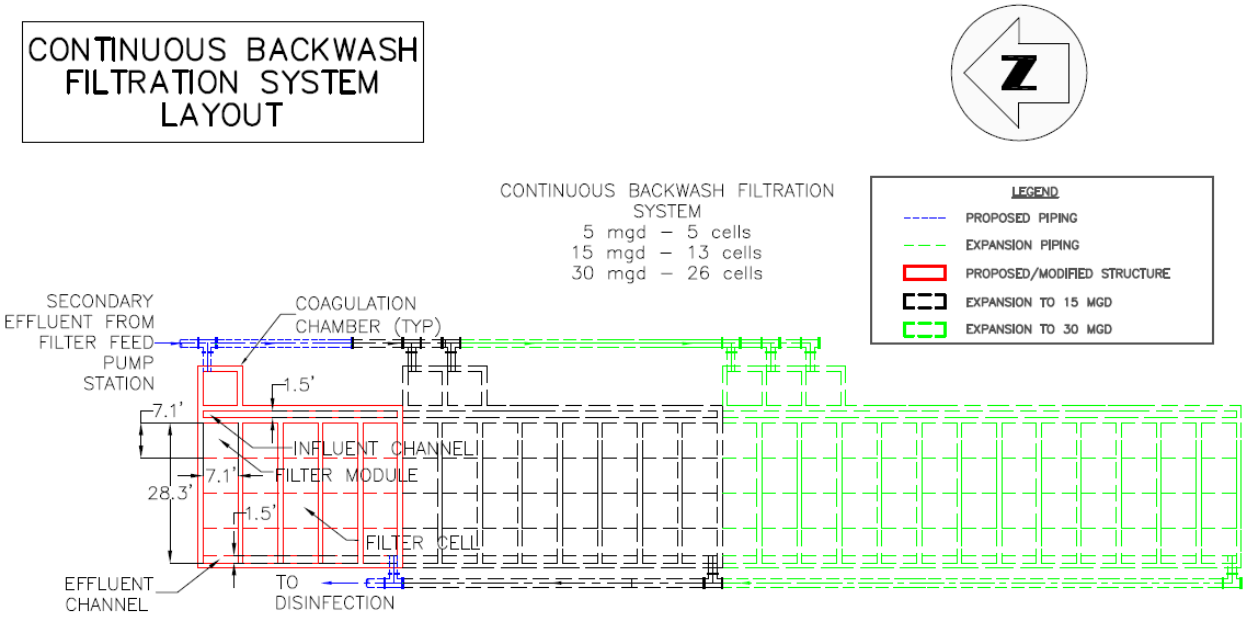


**Figure 4-5: Preliminary Layout of 5 mgd Continuous Backwash Filter, with Future Footprint for Phased Expansion to 30 mgd**

## Cost Summary

**Table 4-11: Continuous Backwash Filter Cost Summary (5 mgd Constant Flow)**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 1,300,000 |
| **Total Capital Cost**[a] | 3,800,000 |
| **Total Annual O&M Cost**[b] | 105,000 |
| **20-Year Life Cycle Cost** [c] | 5,600,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

### 4.2.4 Traveling Bridge Filters

**Features of Operation**

Traveling bridge filters, marketed under various names such as ABW, AquaABF, and Gravisand, are shallow bed (typically 11-inches) granular media filters that are installed in a segmented bed arrangement. The backwash system is suspended from a bridge that moves across the bed. A pump takes filtered water from the effluent channel and directs it back into a segment of the filter bed, forcing the water back up through the filter bed, dislodging the particles removed from the wastewater. A second pump, attached to a hood that covers the segment being backwashed, draws the waste backwash water into the hood and discharges it into a trough for return to the head of the treatment plant.

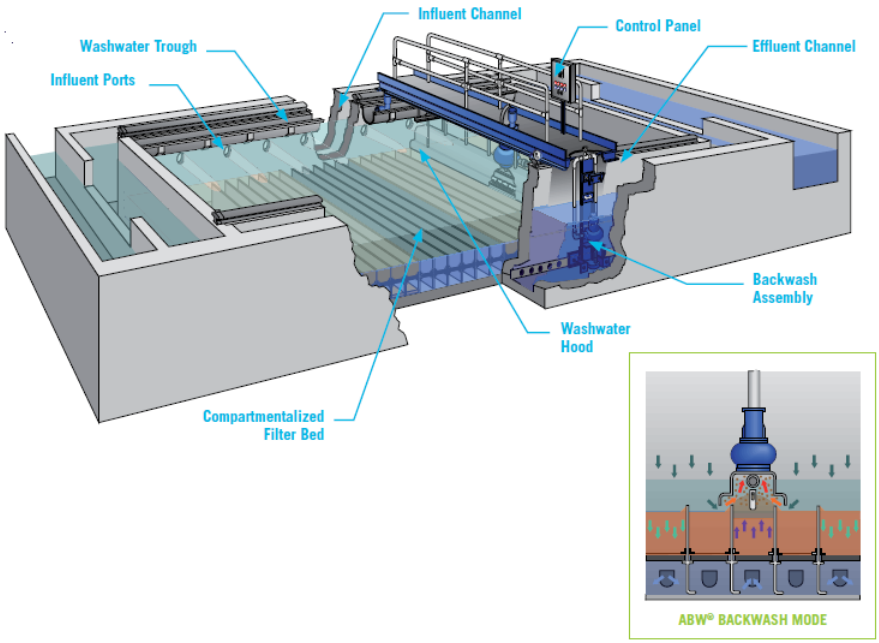


**Figure 4-6: Traveling Bridge Filter (Figure from ABW®)**

As with other filtration technologies, the backwash frequency and backwash waste production rate vary depending upon the filter influent quality; however, typically each filter is backwashed three times per day and the backwash waste production rate is typically 1 - 2% of the filter influent flow rate. The operating headloss across the filer is low, typically 2 - 12 inches of water. Typically, backwashing is initiated when a predetermined headloss across the filter bed is exceeded although the operator can choose to initiate backwashing after the filter effluent turbidity exceeds a predetermined set point.

Advantages and disadvantages of traveling bridge filters are summarized in Table 4-12 and design criteria are summarized in the Table 4-13. A preliminary layout for the traveling bridge filters at the TTDF is presented in Figure 4-7. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter cell is planned for the 5 mgd, 15 mgd, and

30 mgd systems. Preliminary construction, O&M, and 20 year life-cycle cost estimates for traveling bridge filters are presented in Table 4-14.

### Advantages and Disadvantages

**Table 4-12: Traveling Bridge Filter Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Traveling bridge filters are proven, with many long-operating installations. | The design of traveling bridge filters is proprietary. |
| The backwashing arrangement eliminates the need for taking a filter out-of-service for cleaning. | The CDPH approved filtration rate is low (≤2 gpm/ft$^2$), resulting in a large footprint. |
| Filter feed pump pressure requirements are lower due to the shallow filter bed depth. | Expansion of the filter requires the construction of additional filter cells. |
| | The backwash system bridge has many moving parts. |
| | The depth of the filter bed is shallow and the filter is more susceptible to upsets and breakthrough than deep bed filters. |

### Design Criteria

**Table 4-13: Traveling Bridge Filter Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Flow, mgd** | 5 |
| **CDPH Approved Filtration Rate, gpm/ft$^2$** | 2 |
| **Number of Filter Cells** | 2 |
| **Dimensions of Each Cell, Length (ft) x Width (ft) x Depth (ft)** | 110 x 16 x 6.25 |
| **Total Filtration Area, ft$^2$** | 3,520 |
| **Filtration Rate with One Filter Offline, gpm/ft$^2$** | 1.97 |
| | |
| **Headloss Through Filter, ft (Operating)** | 1 |

## Preliminary Layout

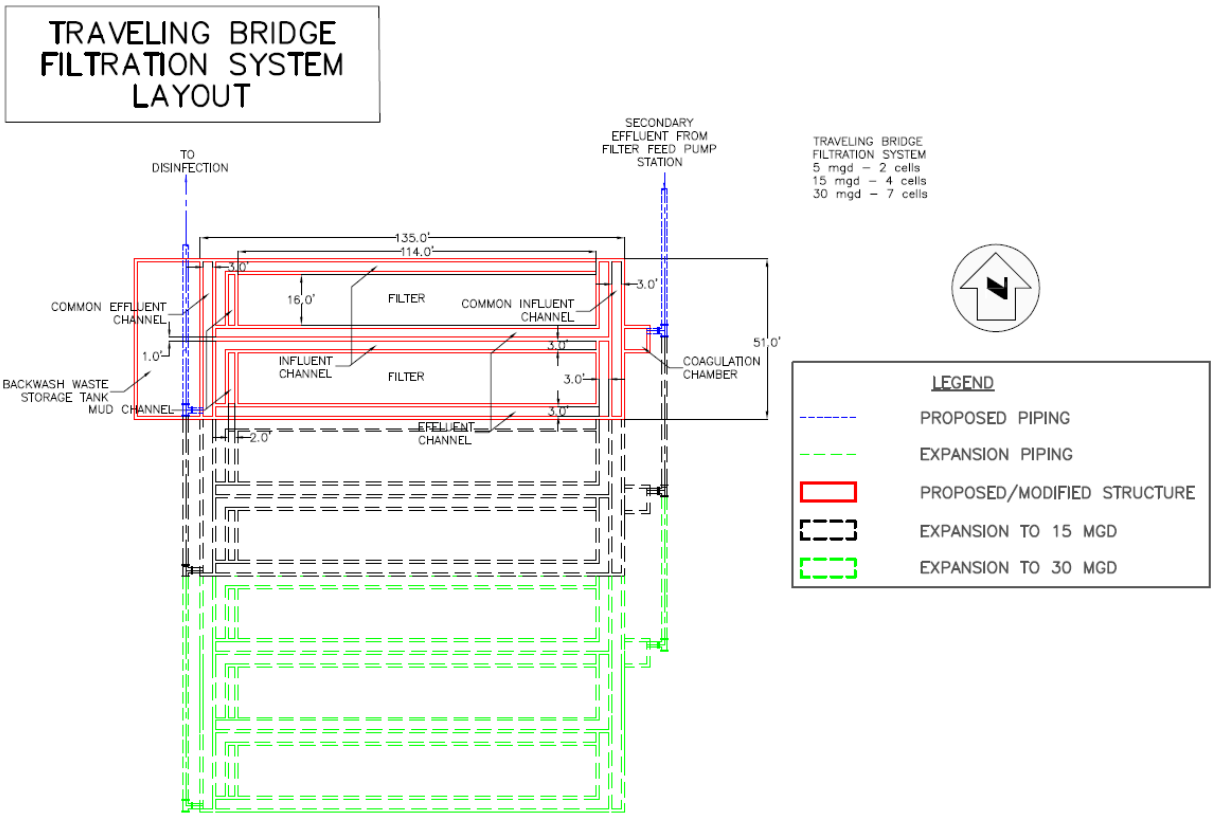


**Figure 4-7: Preliminary Layout of 5 mgd Traveling Bridge Filter, with Future Footprint for Phased Expansion to 30 mgd**

## Cost Summary

**Table 4-14: Traveling Bridge Filter Cost Summary (5 mgd Constant Flow)**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 1,800,000 |
| **Total Capital Cost**[a] | 4,800,000 |
| **Total Annual O&M Cost**[b] | 80,000 |
| **20-Year Life Cycle Cost** [c] | 6,200,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

### 4.2.5 Fuzzy Filters

**Features of Operation**

Fuzzy filter is a proprietary filtration technology from Schreiber, LLC utilizing media consisting of highly porous (~90%) 1.25-inch diameter synthetic fiber spheres. The media is compressible, which allows the properties of the filter bed (including bed depth and porosity) to be controlled by the operator in response to changes in filter influent quality, amount of solids accumulated in the filter bed, and desired effluent quality. The high porosity allows the filter to be operated at a filtration rate well in excess of conventional incompressible granular media filters (30 gpm/ft2 as opposed to 5 gpm/ft2), which translates to a very compact footprint. The filters are supplied as modular, packaged units.

**Figure 4-8: Fuzzy Filter (Figure from Schreiber, LLC)**

The media is retained between two perforated plates as shown in Figure 4-8, of which the top plate is adjustable. During the "Filtration Cycle", the influent is filtered in an up-flow configuration - it is introduced at the bottom of the filter and withdrawn at the top of the filter. When the headloss across the filter reaches a predetermined set point or when the effluent turbidity exceeds a predetermined set point, the filter enters into the "Wash Cycle." Typically, backwashing is initiated every 24 hours or after the headloss across the filter exceeds a predetermined set point, whichever occurs sooner. In the "Wash Cycle," the adjustable plate automatically rises and the filter media is expanded using the flow velocity of filter influent water. "Washing air" is then introduced to scour the media and remove the captured solids. The dirty wash water is withdrawn from the top of the filter and returned to the plant. Before the filter is brought back into service, the adjustable plate comes back to its original position and the filter is flushed to waste ("Flush Cycle") for approximately one minute. The entire backwash cycle takes about 30 minutes. The backwash waste production rate is approximately 1 - 5% of the influent filter flow rate, depending upon the filter influent quality.

Advantages and disadvantages of fuzzy filters are summarized in Table 4-15 and the design criteria are summarized in the Table 4-16. A preliminary layout for the fuzzy filters at the TTDF is presented in Figure 4-9. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter unit is planned for the 5 mgd, 15 mgd, and 30 mgd systems.

Preliminary construction, O&M, and 20 year life-cycle cost estimates for fuzzy filters are presented in Table 4-17 below.

### Advantages and Disadvantages

**Table 4-15: Fuzzy Filter Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| The CDPH approved filtration rate for Fuzzy Filters is high (≤30 gpm/ft$^2$), resulting in a compact footprint. | Fuzzy filters are proprietary and would need to be sole sourced from Schreiber, LLC. |
| The properties of the bed (porosity, depth, etc.) are adjustable and, thus, the filter is able to handle variations in influent quality. | The media is proprietary and media replacement is expensive. |
| Filters are supplied as easy to install skid mounted, packaged units. | There are only small (less than 1 mgd filtration capacity) installations in California. |
| | The history and number of Title 22 installations is limited. |
| | Backwashing requires the shutdown of the entire filter unit. |

### Design Criteria

**Table 4-16: Fuzzy Filter Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Flow, mgd** | 5 |
| **CDPH Approved Filtration Rate, gpm/ft$^2$** | 30 |
| **Number of Filter Units** | 3 |
| **Dimensions of Each Filter Bed, Length (ft) x Width (ft)** | 7 x 7 |
| **Total Filtration Area, ft$^2$** | 147 |
| **Filtration Rate with One Filter Backwashing, gpm/ft$^2$** | 35.4 |
| | |
| **Headloss Through Filter, ft (Operating)** | 4 |

## Preliminary Layout

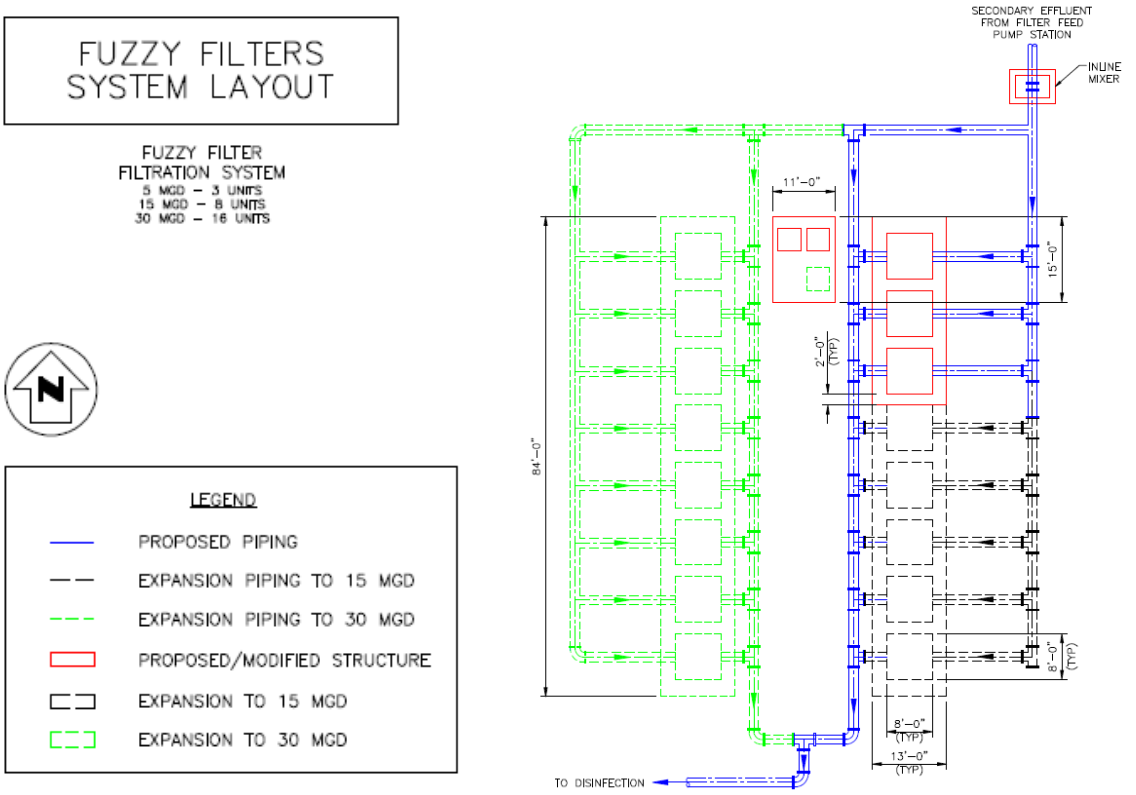


**Figure 4-9: Preliminary Layout of 5 mgd Fuzzy Filter, with Future Footprint for Phased Expansion to 30 mgd**

## Cost Summary

**Table 4-17: Fuzzy Filter Cost Summary(5 mgd Constant Flow)**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 1,350,000 |
| **Total Capital Cost**[a] | 4,100,000 |
| **Total Annual O&M Cost**[b] | 110,000 |
| **20-Year Life Cycle Cost** [c] | 6,000,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

### 4.2.6 Cloth Media Filters

**Features of Operation**

Cloth media filters are type of filters consisting of segmented disks of synthetic media. Unlike in deep bed granular media filtration, cloth media filters remove solids primarily by straining and, while the media does have depth, the "filter bed" is essentially two-dimensional. There are many proprietary products that fall into this category, including: AquaDisk from Aqua Aerobics, Hydrotech from Veolia, and Forty X from Siemens. Aqua Aerobics also supplies AquaDiamond, which operates on the same principles as AquaDisk; however, it is primarily used as a retrofit to traveling bridge filters.

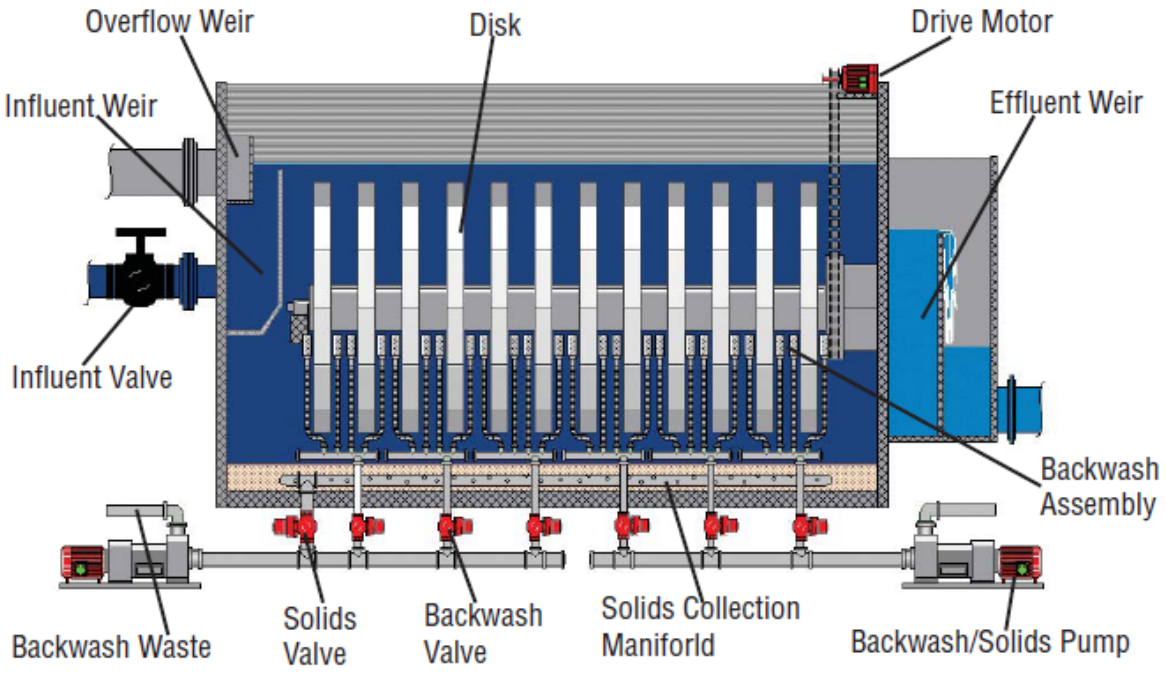


**Figure 4-10: Cloth Media Filter (Figure from Aqua-Aerobic)**

Depending upon the specific manufacturer, cloth media filters operate in both "inside-out" (filter influent is introduced within the center shaft of the disks, flows through the disk media, and filtered water is collected in the basin) and "outside-in" (filter influent is introduced in the basin, flows through the disk media, and filtered water is collected in the center shaft of the disks as shown in Figure 4-10) configurations. The description that follows describes a cloth media filter with an "out-to-in" configuration, such as AquaDisk. Inlet wastewater enters the basin, completely submerging the cloth media. Liquid passes through the cloth media. The filtered liquid enters the internal portion of the disk and is discharged through the center shaft. As the filter cloth collects solids on the outer surface, headloss across the media gradually increases and water level inside the tank rises to a set point elevation. At this point, the backwash cleaning system initiates backwash operation and cleans a set of two discs while the other discs in the tank continue filtration. During backwash, the disks undergoing backwash are rotated and a vacuum pump cleans the disk media. Influent will continue to be processed

during the backwash cleaning cycle, allowing for continuous filtration. Heavier solids are allowed to settle to the bottom portion of the filter tank. These solids are then pumped on an intermittent basis. All components of the system are constructed from corrosion resistant materials designed for continuous operation.

The backwash waste production rate varies depending upon filter influent quality, but typically ranges from 5 - 10% of the filter influent flow rate. The number of backwashes per day also varies widely depending upon influent water quality. Typically, disks are backwashed every 30 to 40 minutes and the backwash duration for one 12 disk unit is 12 minutes.

Advantages and disadvantages of cloth media filters are summarized in Table 4-18 and the design criteria are summarized in the Table 4-19. A preliminary layout for the cloth media filters at the TTDF is presented in Figure 4-11. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter unit is planned for the 5 mgd, 15 mgd, and 30 mgd systems and that the structure that is planned for the 5 mgd system is sufficient for housing disks with a filtration capacity of up to 9 mgd. Preliminary construction, O&M, and 20 year life-cycle cost estimates for cloth media filters are presented in Table 4-20.

### Advantages and Disadvantages

**Table 4-18: Cloth Media Filter Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Filtration capacity can be increased without adding tanks. The cloth media filter considered for the TTDF is expandable to 9 mgd with just the addition of disks. | The design of cloth media filters is proprietary. |
| There are no moving parts during filtration. | The media for cloth media filters is proprietary and relatively expensive. |
| There is no downtime during backwashing (only a set of two disks are backwashed at a time). | There are pronounced spikes in effluent turbidity for ~5 minutes following backwash - more so than in conventional deep bed granular media filters. |
| Backwash volume requirements are low. | |
| The footprint is relatively small (since the disks allow for a high filter surface area per $ft^2$ of physical footprint). | |
| There is a good customer base in California with many Title 22 installations. | |
| The headloss across the filter is low. | |
| Media replacement is simple. | |

## Design Criteria

**Table 4-19: Cloth Media Filter Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Flow, mgd** | 5 |
| **CDPH Approved Filtration Rate, gpm/ft$^2$** | 6 |
| **Number of Filter Units** | 3 |
| **Number of Disks per Unit** | 8 |
| **Total Filtration Area, ft$^2$** | 1291 |
| **Filtration Rate with One Filter Offline, gpm/ft$^2$** | 4.0 |
| | |
| **Headloss Through Filter, ft (Operating)** | 3 |

## Preliminary Layout

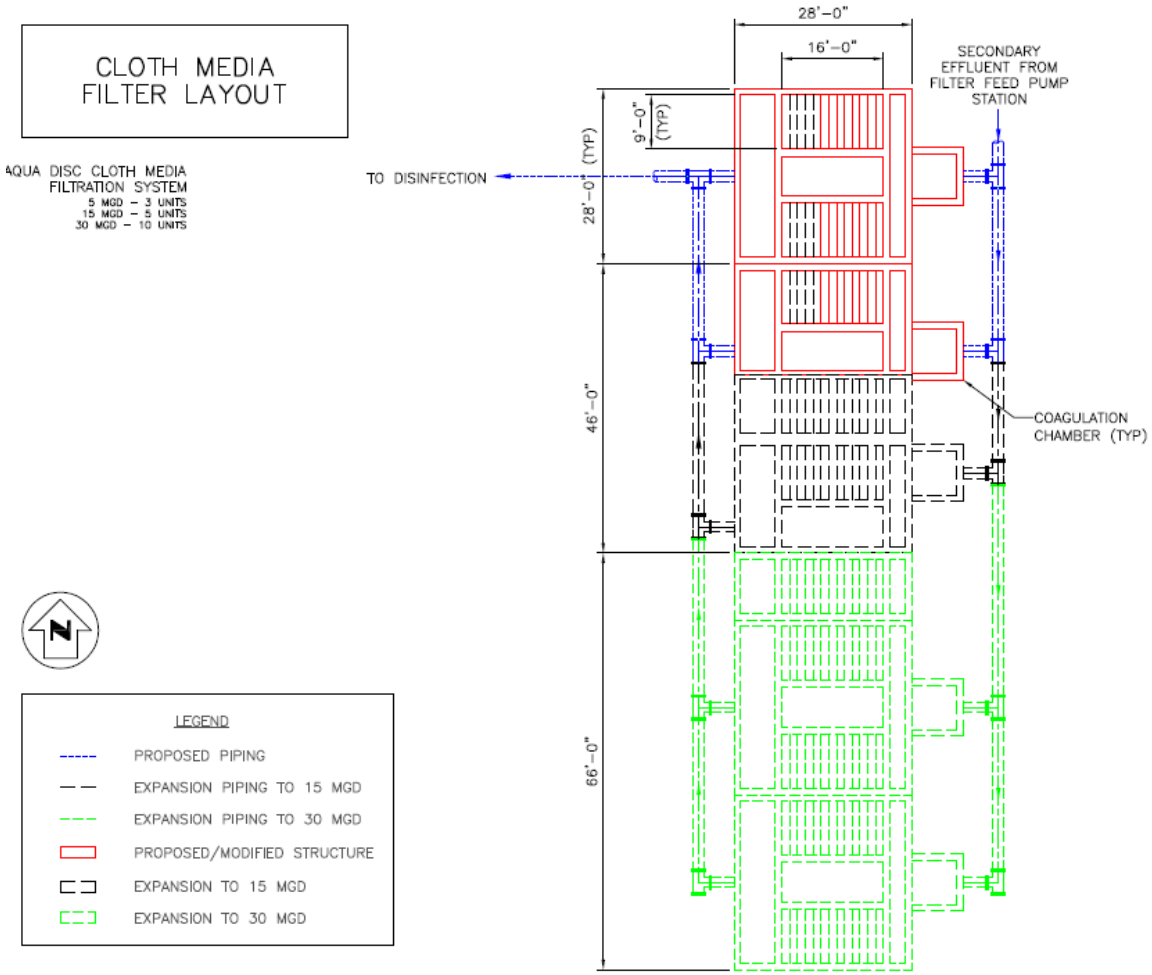


**Figure 4-11: Preliminary Layout of 5 mgd Cloth Media Filter, with Future Footprint for Phased Expansion to 30 mgd**

### Cost Summary

**Table 4-20: Cloth Media Filter Cost Summary (5 mgd Constant Flow[d])**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 1,400,000 |
| **Total Capital Cost** [a] | 4,100,000 |
| **Total Annual O&M Cost** [b] | 90,000 |
| **20-Year Life Cycle Cost** [c] | 5,700,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.
[d]Concrete structure is capable of housing additional disks with a filtration capacity of 4 mgd i.e. the concrete structure is designed for a total filtration capacity of 9 mgd.

## 4.2.7 Nova Ultrascreen Filters

### Features of Operation

The Nova Ultrascreen® filter is a proprietary filter from Nova Water Technologies that, like cloth media filters, utilizes segmented disks for filtration. The key difference between Nova Ultrascreen filters and cloth media filters is the filtration media - Nova Ultrascreen filters use precision woven stainless steel micronic screen mesh with precise perforation sizes depending upon the application. The media has no depth and the mechanism of solids removal is exclusively straining (i.e. operates as a surface filter). The filter operates in an “inside-out” configuration - the filter influent is directed to the inside of the disks, flows through the stainless steel mesh, and is collected in a clear well (see Figure 4-12 below). Nova Ultrascreen filters are supplied as modular, fully enclosed, packaged units constructed in full stainless steel.

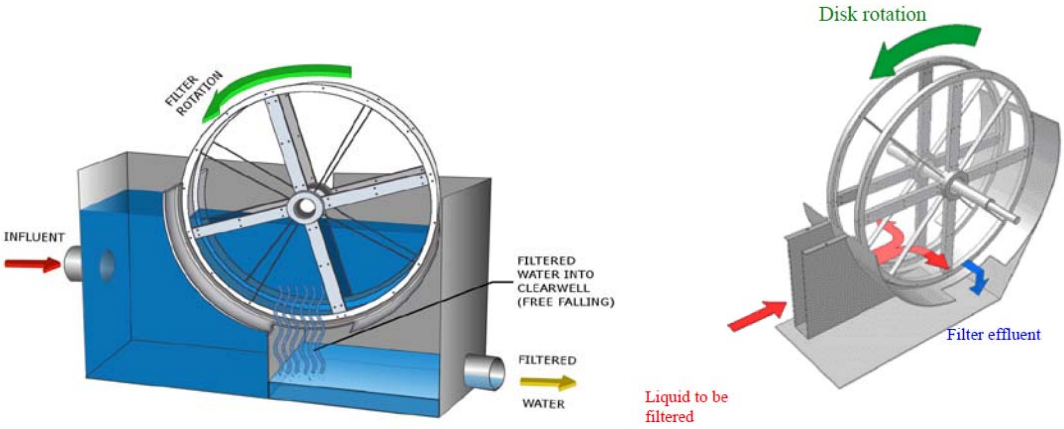


**Figure 4-12: Nova Ultrascreen Filter (Figure from Nova Water Technologies)**

The other major difference when compared to cloth media disc filters is that here the disks rotate continually during filtration in order to achieve "dynamic tangential filtration," a phenomenon that the supplier claims increases solids rejection and limits the build-up of solids on the screen. By continuously rotating the disks during filtration, the angle of approach taken by a particle will be less than $90^{o}$, making the projected area of perforations in the media smaller than their rated size. Per the manufacturer, these filters are able to remove a target particle size of 10 microns with a mesh opening size of 20 microns due to "dynamic tangential filtration".

Nova Ultrascreen discs are partially submerged as shown in Figure 12. The backwash is initiated in a manner similar to cloth media disc filters upon the water level in the basin reaching a preset elevation. However, unlike the cloth media filters, the backwash is carried out via a set of backwash arms installed on both sides of the discs and fitted with nozzles. Per the manufacturer, the disks undergo "pulsed backwashing", which is a short burst of backwashes lasting 10-15 sec and occur quite frequently throughout the day. The number of backwashes per day varies widely depending on the quality of the influent. The filtration cycle continues during the backwash as the discs continually rotate. Upper half of the discs that are above the water level are backwashed while the lower half of the discs continue filtration. The backwash waste production rate also varies depending upon filter influent quality, but is typically less than 1% of the filter influent flow rate.

Advantages and disadvantages of Nova Ultrascreen filters are summarized in Table 4-21 and the design criteria are summarized in the Table 4-22. A preliminary layout for the Nova Ultrascreen filters at the TTDF is presented in Figure 4-13. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter unit is planned for the 5 mgd, 15 mgd, and 30 mgd systems. Preliminary construction, O&M, and 20 year life-cycle cost estimates for Nova Ultrascreen filters are presented in Table 4-23.

## Advantages and Disadvantages

**Table 4-21: Nova Ultrascreen Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| The CDPH approved filtration rate for the Nova Ultrascreen filter is 16 gpm/ft$^2$, provided that the filter is coupled with a disinfection process that achieves a 5-log polio virus removal. | Nova Ultrascreen filters are proprietary and would need to be sole sourced from Nova Water Technologies. |
| Supplied as modular, packaged units that are easy to install. | The disks are continuously rotating, which could present reliability issues. |
| The filter occupies a small footprint. | Limited history of installations in operation (less than one year). |
| The media replacement is less frequent than for other non-granular media filters. | There are no operating municipal installations in California. All municipal installations are on the East Coast (total of eight installations, of which four are in Florida). |
| The disk rotation speed is variable, allowing the operator to adjust the speed based on the filter influent quality or the desired filtered water quality. | |
| The headloss across the filter is low. | |
| Effluent turbidity is relatively constant, even after a backwash. | |

## Design Criteria

**Table 4-22: Nova Ultrascreen Filter Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Flow, mgd** | 5 |
| **CDPH Approved Filtration Rate, gpm/ft$^2$** | 16 |
| **Number of Filter Units** | 2 |
| **Number of Disks per Unit** | 10 |
| **Total Filtration Area, ft$^2$** | 444 |
| **Filtration Rate with One Filter Offline, gpm/ft$^2$** | 15.6 |
| | |
| **Headloss Through Filter, ft (Operating)** | 2.5 |

## Preliminary Layout

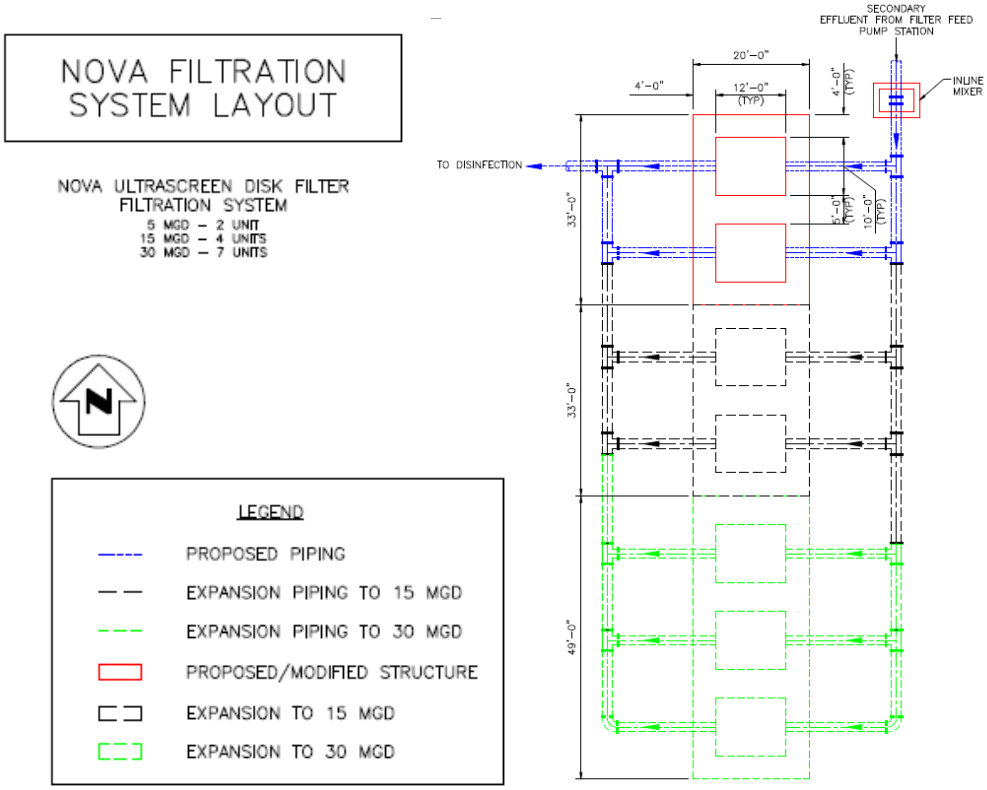


**Figure 4-13: Preliminary Layout of 5 mgd Nova Ultrascreen Filter, with Future Footprint for Phased Expansion to 30 mgd**

## Cost Summary

**Table 4-23: Nova Ultrascreen Filter Cost Summary (5 mgd Constant Flow)**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 1,200,000 |
| **Total Capital Cost**[a] | 3,500,000 |
| **Total Annual O&M Cost**[b] | 100,000 |
| **20-Year Life Cycle Cost** [c] | 5,300,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

### 4.2.8 Microfilters

**Features of Operation**

Microfilters use membrane filtration to separate micron-sized particles from the filter influent water. Like the Nova Ultrascreen, the solids removal mechanism used is straining - however, the membrane pore sizes are much smaller, typically close to 0.1 microns. The membrane material varies depending upon the supplier, but is usually natural or synthetic polymers. For example, Pall's Microza LGV microfilters are made of PVDF (polyvinylidene fluoride) membranes.

Microfilters can be arranged in horizontal or vertical configuration, depending on the influent quality and manufacturer. Microfilter modules are arranged in racks and are pre-engineered to suit various flow rates.

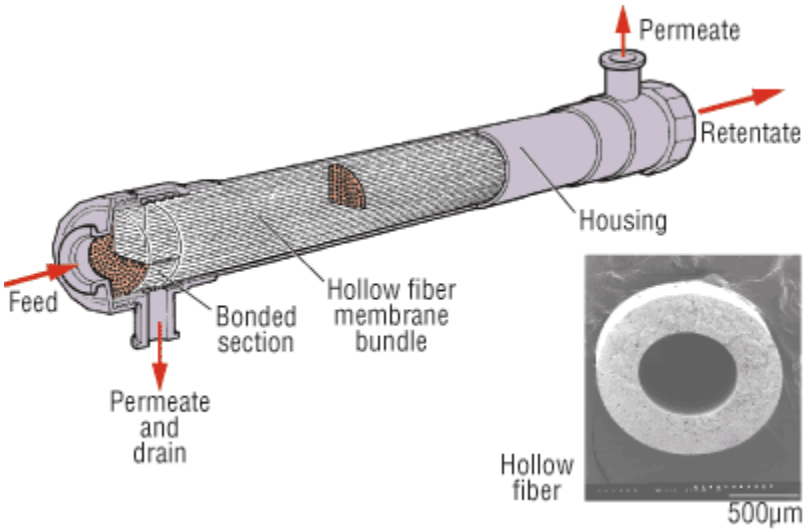


**Figure 4-14: Microfilter Cross Section**

Due to the small membrane pore sizes, the majority of solids and even some viruses are rejected and the quality of permeate produced is much higher than the quality of filtered water produced with media filtration technologies discussed earlier. Due to the high solids removal efficiency, the downstream disinfection efficiency is enhanced. If UV disinfection is used, the NWRI guidelines allow for a smaller UV system resulting in significant capital and operating cost savings when operating on microfilter permeate.

Advantages and disadvantages of microfilters are summarized in Table 4-24 and the design criteria are summarized in the Table 4-25. A preliminary layout for microfilters at the TTDF is presented in Figure 4-15. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Peliminary construction, O&M, and 20 year life-cycle cost estimates for microfilters are presented in Table 4-26.

## Advantages and Disadvantages

**Table 4-24: Microfilter Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Microfilters produce recycled water exceeding Title 22 requirements. | Microfilters have a higher capital cost when compared to media filters. |
| Microfilters remove most viruses, giardia, and crypto. | The influent pumping requirements increase the O&M costs when compared to media filters. |
| Available in modular, skid mounted units - lowering installation costs. | Membrane replacement is relatively expensive. |
| When coupled with a downstream UV disinfection system, substantial cost savings can be realized when compared to media filtration coupled with UV disinfection. | Microfilters are more O&M intensive than conventional media filters. |

## Design Criteria

**Table 4-25: Microfilter Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Flow, mgd** | 5 |
| **Flux Rate, gpd/ft$^2$** | Not regulated[1] |
| **Feed pressure, psi** | 20-30 |

[1] Flux rates are not regulated for Title 22 recycled water applications. The microfilter membranes used for Title 22 applications are similar to the ones approved for drinking water filtration applications, where the approved flux rates range from 75 – 120 gpd/sq.ft, depending on the manufacturer. However, based on current installations for Title 22 applications, the operating flux rates range from 30-50 gpd/sq.ft.

## Preliminary Layout

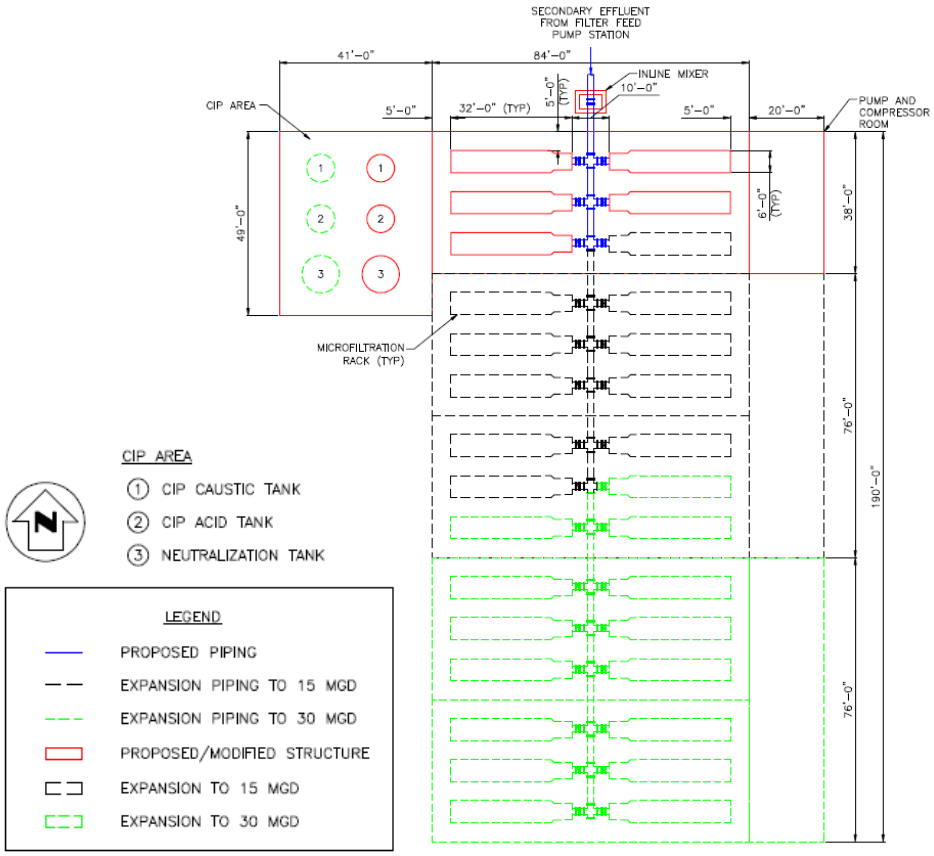


**Figure 4-15: Preliminary Layout of 5 mgd Microfiltration System, with Future Footprint for Phased Expansion to 30 mgd**

## Cost Summary

**Table 4-26: Microfilter Cost Summary (5 mgd Constant Flow)**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 3,500,000 |
| **Total Capital Cost** [a] | 10,700,000 |
| **Capital Cost Credit for UV Disinfection** [b] | (2,000,000) |
| **Net Total Capital Cost** | 8,700,000 |
| **Total Annual O&M Cost** [c] | 400,000 |
| **Annual O&M Cost Credit for UV Disinfection** | (100,000) |
| **Net Total Annual O&M Cost** | 300,000 |
| **20-Year Life Cycle Cost** [d] | 14,200,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Credit due to higher UVT and lower UV dosage for microfilter permeate.
[c]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[d]At a 5% discount rate and a 4% escalation rate.

## 4.3 SUMMARY OF COSTS

Table 4-27 presents a summary of the construction, O&M, and 20-year life-cycle cost estimates for each of the eight filtration technologies evaluated. As can be seen below, Nova Ultrascreen filters are the lowest both in terms of capital cost (~$300,000 less than continuous backwash filters, the next lowest cost alternative) and 20-year life-cycle cost (~$400,000 less than cloth media filters, the next lowest cost alternative). See Appendix A for preliminary cost estimates.

**Table 4-27: Summary of Costs of Each 5 mgd Constant Flow Filtration Alternative**

| Technology | Capital Cost ($ Millions) | O&M Cost ($ Thousands) | 20-Year Life Cycle Cost ($ Millions) |
|---|---|---|---|
| **Dual Media Gravity Filters** | 4.3 | 90 | 5.9 |
| **Deep Bed Monomedia Filters** | 4.4 | 90 | 6.0 |
| **Continuous Backwash Filters** | 3.8 | 105 | 5.6 |
| **Travelling Bridge Filters** | 4.8 | 80 | 6.2 |
| **Fuzzy Filters** | 4.1 | 110 | 6.0 |
| **Cloth Media Filters[1]** | 4.1 | 90 | 5.7 |
| **Nova Ultrascreen Filters** | 3.5 | 100 | 5.3 |
| **Microfilters[2]** | 8.7 | 300 | 14.2 |

[1]Concrete structure is designed for a filtration capacity of up to 9 mgd.
[2] Includes UV system credit.

# SECTION 5 - DISINFECTION SYSTEM ALTERNATIVES ANALYSIS

## 5.1 BACKGROUND

Currently the RWRF does not disinfect the secondary treated effluent. The secondary effluent is discharged to percolation ponds through effluent canals A and B. As described earlier in this TM, in order to upgrade the discharge to California Title 22 standards for unrestricted reuse, the City has decided to construct a TTDF, which consists of filtration, disinfection and storage. This Section of the TM evaluates three alternatives for disinfection at the TTDF.

The two disinfection technologies evaluated are:

1. Ultraviolet (UV) Disinfection
    a. Open Channel UV Disinfection
    b. In-pipe UV Disinfection

2. Ozone Disinfection

The UV disinfection system considers low pressure, high intensity lamps, which are the result of progressive research and energy conservation measures over the years. The use of low pressure high intensity lamps results in a compact and more efficient UV disinfection system. Ozone disinfection, which is still considered an emerging technology for wastewater disinfection, considers generation of ozone from liquid oxygen. Ozone can also be generated from air, which however, may be cost prohibitive for a large plant such as TTDF.

## 5.2 UV DISINFECTION

UV disinfection utilizes ultra-violet portion of the light spectrum to render disease causing pathogens inactive. The UV lamps can be placed in several banks, in series, in an open channel system or may be placed inside a vessel (pipe) for an inline UV system. The design of UV system highly depends on the quality of water being disinfected. The UV system design criteria for tertiary-filter (media based) treated recycled water are more stringent than membrane treated recycled water, primarily due to the fact that the higher turbidity of former creates a shielding effect on pathogens thus reducing the effectiveness of UV light. According to National Water Research Institute (NWRI), May 2003 guidelines, the minimum UV transmittance for media filter effluent and membrane effluent shall be 55% and 65% at 254 nm, respectively. The minimum UV dose required for media filter effluent and membrane effluent are 100 mJ/cm2 and 80 mJ/cm2, respectively, under maximum flow. Besides the above criteria, end of lamp life and fouling factors are used in the design of UV system. The former addresses the loss in the output of UV lamps as they age and the latter compensates for the fouling of lamp sleeve. The values of these factors differ from manufacturer to manufacturer as approved by CDPH. To comply with CDPH standards for unrestricted reuse (Title 22) of wastewater effluent, the City will need to provide tertiary treatment (filtration) to reduce the effluent suspended solids to a

turbidity level less than 2 NTU in case of media filtration and less than 0.2 NTU for membrane filtration prior to final disinfection. By removing a majority of the solids, the effectiveness of the downstream disinfection process is enhanced.

### 5.2.1 UV Design Criteria

According to NWRI guidelines, the UV disinfection system for TTDF should include the following two parameters and should be designed according to Table 5-1:

1. The UV system should be capable of 5 – log polio virus inactivation and total coliform not to exceed 2.2 MPN/ 100 ML
2. The UV system should include one standby bank per train or a separate standby train must be provided.

**Table 5-1: UV Disinfection Design Criteria**

| Parameter | Units | Media Filtration | Membrane Filtration |
|---|---|---|---|
| **Capacity** | mgd | 5 | 5 |
| **UV Transmittance** | UVT | 55% | 65% |
| **Design Dose (Maximum daily design flow of 5 mgd)** | mJ/cm2 | 100 | 80 |

## 5.3 UV OPEN CHANNEL EQUIPMENT AND STRUCTURE

### Features of Operation

In an open channel disinfection system, the UV lamps are placed in modules and several modules make up for a bank. These banks may be placed in series in a channel to provide required disinfection (refer to Figure 5-1). For the TTDF, two identical parallel channels will be constructed to house UV banks; the channels will be located north of the effluent canal B. The channels will initially house 3 banks each to accommodate 5 mgd filtered water flow through the facility. The channels will be designed to have extra room for adding more banks in the future to disinfect up to a total of 10 mgd flow in the same structure as shown in Figure 5-2. The design characteristics of the UV channels are shown in Table 3. Each UV channel will have a level control gate / weir at the discharge end to ensure the UV lamps are submerged consistently. The disinfected water will be either conveyed by gravity or pumped into storage for distribution.

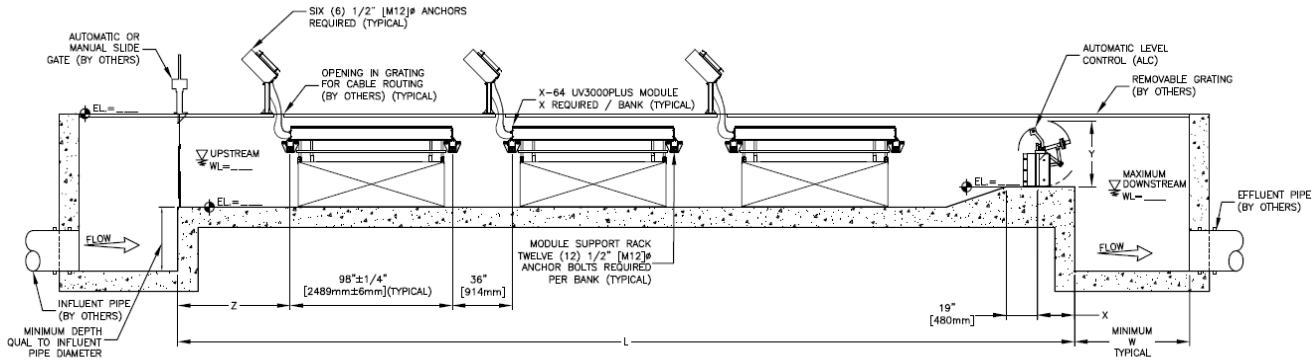


**Figure 5-1: Simplified Schematic of a UV-Open Channel System**

## Advantages and Disadvantages

Advantages and Disadvantages are included in Table 5-2

**Table 5-2: UV Disinfection Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Modular design - UV banks may be added to the same channel to increase capacity | Canopy/building may be required to protect the electronic ballasts from direct sunlight |
| Lamps are arranged in modules - each module can be taken out for maintenance without taking the bank offline. | Mechanical components like mechanical wiping system require more maintenance |
| Low head loss | Future compliance with EDC's and NDMA is expensive as it requires increasing the UV dose to 6-7 times by upgrading the facility by employing reverse osmosis and or increasing the number of UV banks. |
| Less process instrumentation and controls required when compared to other technologies considered for the project | |
| Extensive experience in wastewater disinfection | |

## Open Channel UV Design Characteristics

Key design criteria for open channel UV system are listed in Table 5-3 below.

**Table 5-3: Design Characteristics of Open Channel UV System for Design Flow of 5 mgd**

| Parameter | Units | Design Value |
|---|---|---|
| **Type of UV system** | - | Low Pressure, High Intensity |
| **Number of Channels** | - | 2 |
| **Length of channel** | ft | 62 |
| **Width of Channel** | ft | 4 |
| **Depth of Channel** | ft | 5.2 |
| **Total Number of Banks** | - | 6 (4 Duty, 2 Redundant) |
| **Total Number UV lamps** | - | 528 (including redundancy) |
| **Disinfection Capacity per Bank** | mgd | 1.25 |

## Preliminary Layout

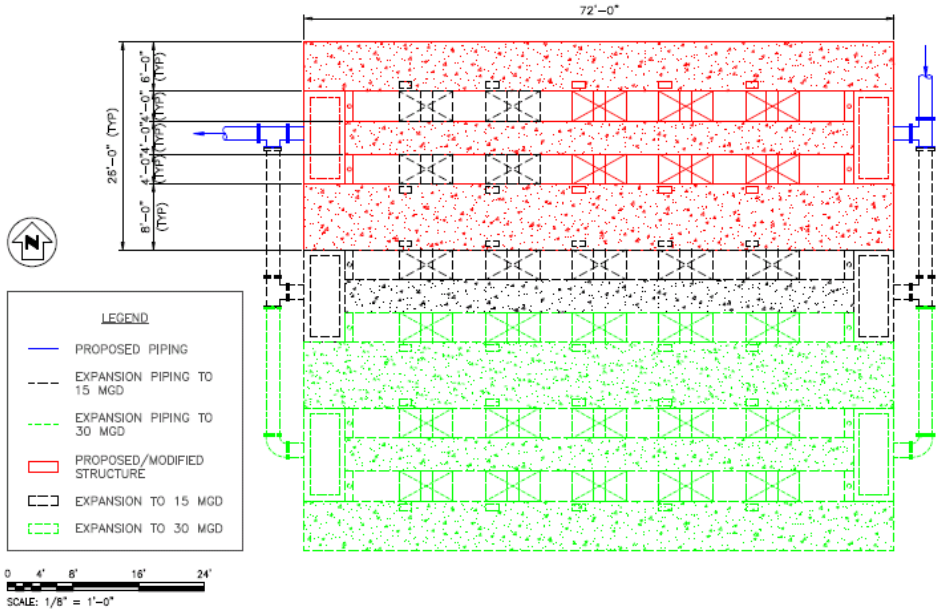


**Figure 5-2: Preliminary Layout of 5 mgd UV Open Channel Disinfection System, with Future Footprint for Phased Expansion to 30 mgd**

### 5.3.1 Expandability

The UV system layout is presented in Figure 5-2 above planned for 5 mgd, expandable to 15 mgd and ultimately to 30 mgd capacity. The initial expansion to 15 mgd shall be accomplished by providing additional banks (two banks each) in the existing two channels and constructing an additional identical channel with same number of banks. The ultimate 30 mgd expansion will require construction of three additional identical channels and populating them with equal number of banks.

### 5.3.2 Capital, O&M and Life Cycle Costs

The capital cost includes cost for 5 mgd UV equipment, concrete structure, canopy, distribution pipes and a building required to house the ballasts. Table 5-4 below presents preliminary capital, O&M and 20 year life cycle costs.

**Table 5-4: Open Channel UV System Following Media Filtration Cost Summary (5 mgd Constant Flow[d])**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 1,450,000 |
| **Total Capital Cost** [a] | 4,500,000 |
| **Total Annual O&M Cost** [b] | 230,000 |
| **20-Year Life Cycle Cost** [c] | 8,700,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to mid point of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

[d]Concrete structure designed to house additional banks with a disinfection capacity of 5 mgd for a total disinfection capacity of 10 mgd.

## 5.4 UV IN-PIPE EQUIPMENT AND STRUCTURE

**Features of Operation**

UV in-pipe system consists of UV lamps that are housed in a stainless steel reactor. Each reactor has an inlet and an outlet and the flow can be controlled via a flow meter and a control valve. This system requires more instrumentation and control than the open channel UV systems. The capacity of each reactor considered (for workshop no. 1) is approximately 2.30 mgd for filtered water. For 5 mgd system four reactors (3 Duty + 1 Standby) would be necessary to reliably disinfect the required flow as shown in Figure 4. The reactors can be arranged in series or

parallel depending on the manufacturer, site constraints and capacity of the facility. Several trains can be installed parallel to each other to provide require disinfection capacity.

Based upon Parsons' discussions with the in-pipe UV disinfection system manufacturers and CDPH, we understand that in-pipe UV disinfection systems are validated but are not approved for Title 22 unrestricted water reuse. It is our understanding that CDPH approves in-pipe UV disinfection systems on a case-by-case basis, only after a wastewater facility has installed the particular system under consideration.

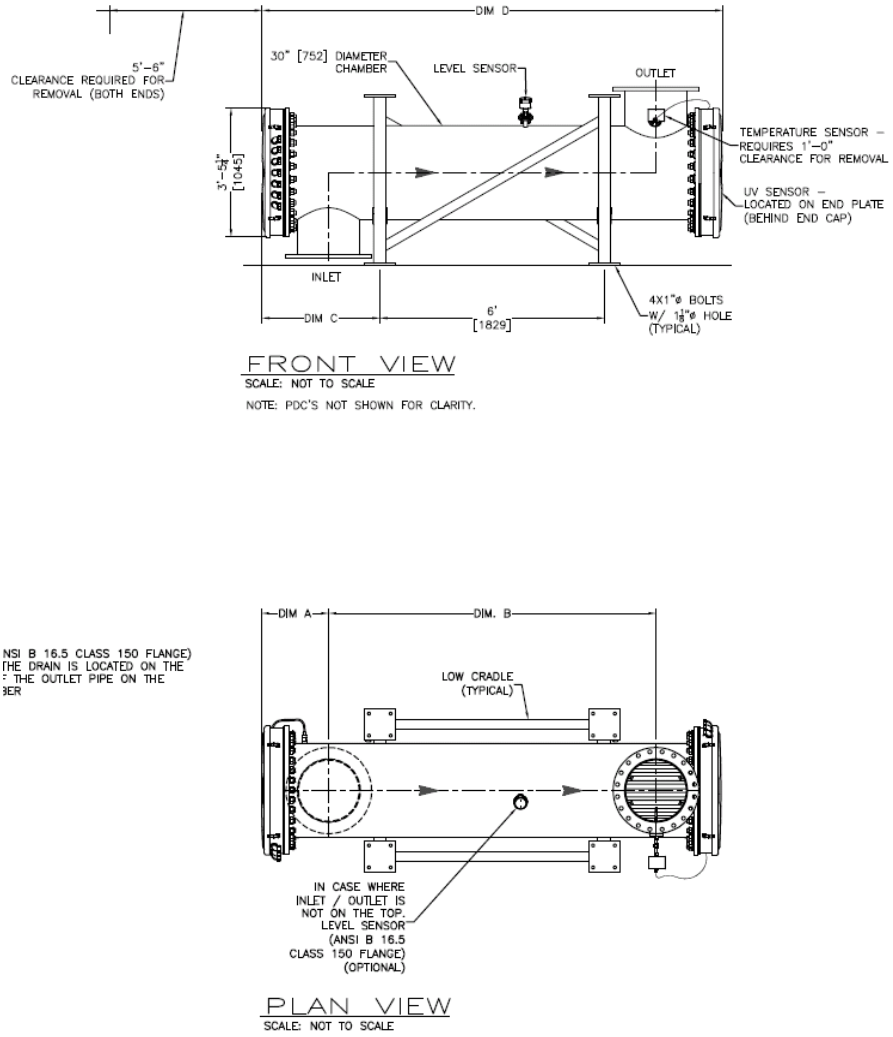


**Figure 5-3: Simplified Schematic of an In-pipe UV Disinfection System**

## Advantages and Disadvantages

Table 5-5 below shows advantages and disadvantages for In-pipe UV disinfection system.

**Table 5-5: In-pipe UV Disinfection System Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Modular design – UV inline system reactors are modular and can be places parallel or in series depending on design capacity | Lamps are enclosed in the reactor and it needs to be taken off line for servicing |
| Ease of expandability | More modulating valves required to control flow |
| Less civil and site work is required compared to other disinfection technologies considered in the project. | More process instrumentation and control required |
| Little to no site excavation required | CDPH approves the system on a case by case basis; CDPH has not given any blanket approved for inline systems. |
| Lamps are serviceable from the reactor end | |

## In-pipe UV Design Characteristics

Key design criteria for in-pipe UV system are listed in Table 5-6 below.

**Table 5-6: Design Characteristics of In-pipe UV System for Design Flow of 5 mgd**

| Parameter | Units | Design Value |
|---|---|---|
| **Type of UV system** | - | Low Pressure, High Intensity |
| **Number of Reactors** | - | 4 |
| **Length of Reactor** | ft | 13 |
| **Total number of lamps in each Reactor** | - | 144 |
| **Total Number UV lamps** | - | 576 (including redundancy) |
| **Disinfection Capacity per Reactor** | mgd | 2.3 |

## Preliminary Layout

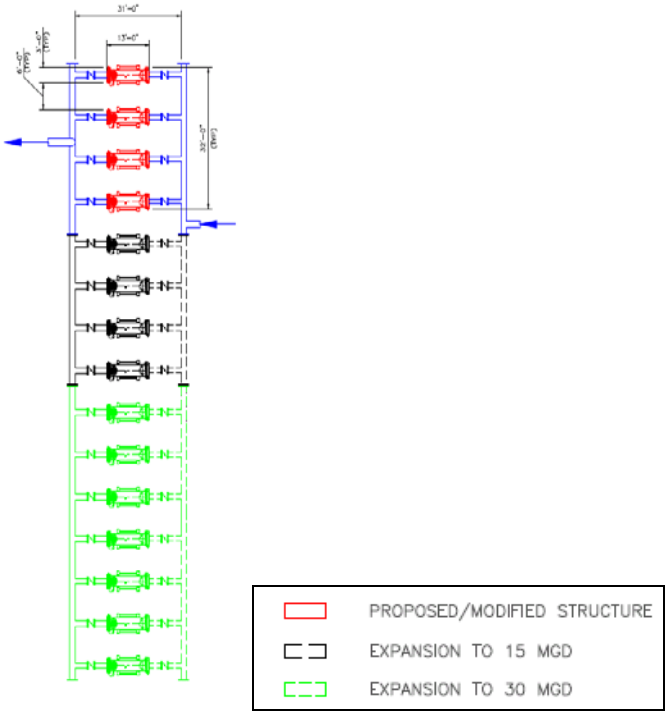


**Figure 5-4: In-pipe UV Disinfection System**

### 5.4.1 Expandability

The initial 5 to 15 mgd expansion of the facility will be accomplished by adding 4 additional reactors of the same capacity. Similarly expansion to 30 mgd will be accomplished by adding 7 additional reactors. However several automatic actuated control valves and flow meters will be required to ensure proper flow distribution and control to each reactor. This will lead to higher instrumentation and control costs and operational complexity compared to open channel UV system.

### 5.4.2 Capital, O&M and Life Cycle Costs

The capital cost includes cost for 5 mgd inline UV equipment, concrete pad, canopy, distribution pipes and a building required to house the ballasts. Table 5-7 below presents preliminary capital, O&M and 20 year life cycle costs.

**Table 5-7: In-pipe UV Disinfection System following Media Filtration Cost Summary (5 mgd Constant Flow)**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 1,460,000 |
| **Total Capital Cost** [a] | 4,800,000 |
| **Total Annual O&M Cost** [b] | 230,000 |
| **20-Year Life Cycle Cost** [c] | 8,900,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

## 5.5 OZONE DISINFECTION

### Features of Operation

Ozone is a much stronger disinfectant than chlorine, UV and other common disinfectants. Unlike chlorine (or sodium hypochlorite) which diffuses through the cell wall of the microorganisms and disinfects, ozone oxidizes the cell wall causing the microbes to disintegrate. Ozone is a very strong oxidizing agent with 1.5 times the oxidizing potential of chlorine.

Ozone is produced from either air or oxygen. Typically, the concentration of ozone is about 3 % (maximum) when produced by air versus 10% when produced using oxygen. Therefore ozone generation using air could be cost prohibitory for smaller installations. For purposes of this evaluation, ozone generation system using liquid oxygen is considered. The system is designed for a dose of 10mg/L with a contact time of 15 minutes to be conservative and to keep a factor of safety for the system. Pilot testing is highly recommended to establish a design dose and contact time for ozone disinfection of recycled water specific to TTDF, which is an additional cost to the project.

### Ozone Disinfection Equipments and Structure

Ozone disinfection system comprises a liquid oxygen tank that provides liquid oxygen to ozone generators via ambient vaporizers (used to eliminate moisture). Nitrogen gas is introduced in the ozone generators as a catalyst. The ozone is produced by several dielectrics in the generators and is introduced into the filtered water via coarse bubble diffusers in a contact basin. Excess ozone is collected and destroyed in the ozone destruct system as shown in

schematic Figure 5-5. A preliminary layout for ozone disinfection system is included as Figure 5-6.

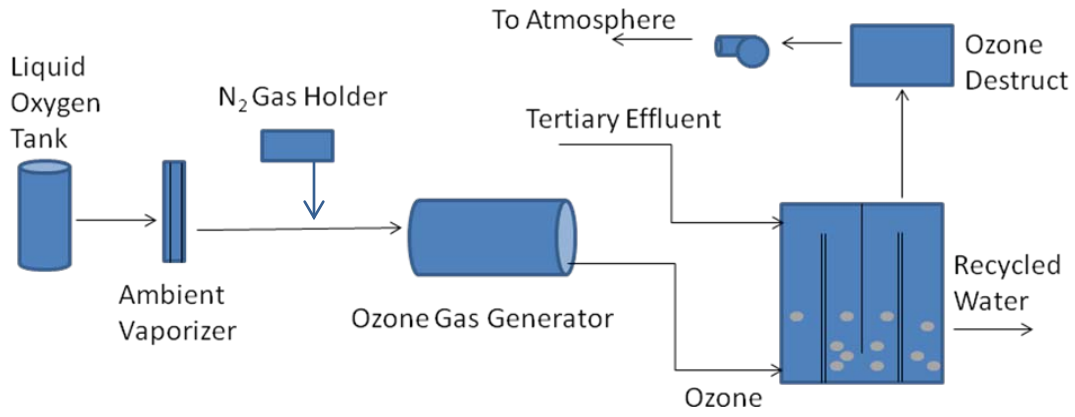


**Figure 5-5: Schematic of Ozone Generation**

## Advantages and Disadvantages

Table 5-8 includes advantages and disadvantages for Ozone disinfection system.

**Table 5-8: Ozone Disinfection System Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Skid mounted system | Dose and contact time are critical and must be decided carefully |
| Less civil and site work required for the equipment | Regular liquid oxygen supply is required |
| Compact design | Second and third phase expansion will require larger units than the one proposed for initial installation |
| More economical for future removal of Endocrine Disruptive Chemicals and NDMA etc. | More process instrumentation and controls required |
| | Extensive mechanical equipment required for the system |
| | High power consumption |
| | Limited experience in wastewater disinfection |

### Ozone Disinfection Equipments and Structure

The ozone disinfection system design criteria are summarized in the Table 5-9 below.

**Table 5-9: Design Characteristics of Ozone Disinfection System for Design Flow of 5 mgd**

| Parameter | Units | Design Value |
|---|---|---|
| **Ozone Dose** | mg/L | 10 |
| **Contact Time** | Minutes | 15 |

### Preliminary Layout

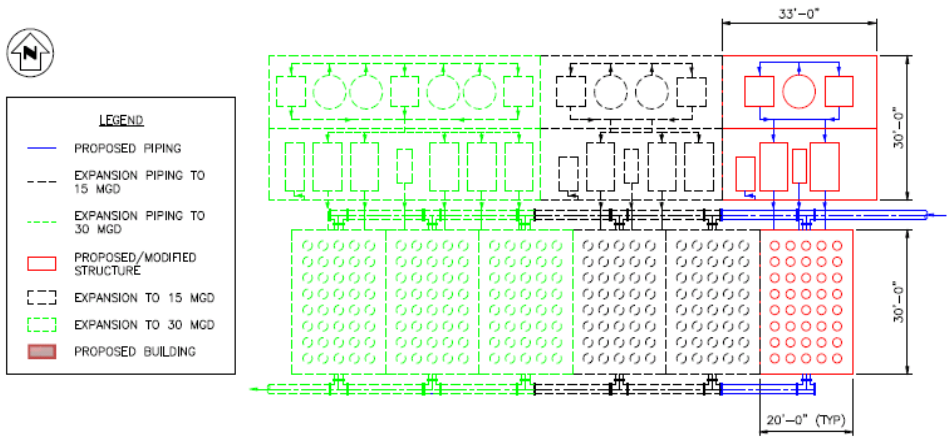


**Figure 5-6: Ozone Disinfection System**

#### 5.5.1 Expandability

The Ozone system is skid mounted but may not be expandable as easily as UV disinfection systems. Increasing the capacity of the system may be accomplished by including more reactors of the same size or larger Ozone reactors and larger contact basins which need to be carefully designed. Alternatively, the larger Ozone Generators may be installed initially and similar Ozone generators may be added depending on the capacity of expansion.

#### 5.5.2 Capital, O&M and Life Cycle Costs

The capital cost for the ozone disinfection system includes 5 mgd ozone equipment, concrete pad, distribution pipes and building required to house ozone reactors. Table 5-10 below presents preliminary capital, O&M and 20 year life cycle costs.

**Table 5-10: Ozone Disinfection System Cost Summary (5 mgd Constant Flow)**

| Parameter | Cost ($) |
|---|---|
| **Equipment and Structures Cost** | 2,200,000 |
| **Total Capital Cost** [a] | 6,600,000 |
| **Total Annual O&M Cost** [b] | 450,000 |
| **20-Year Life Cycle Cost** [c] | 14,800,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

## 5.6 SUMMARY OF COSTS

**Table 5-11: Summary of Costs for Disinfection System Alternatives (5 mgd Constant Flow)**

| Technology | Capital Cost ($ Millions) | O&M Cost ($ Thousands) | 20-Year Life Cycle Cost ($ Millions) |
|---|---|---|---|
| **UV – Open Channel**[1] | 4.5 | 230 | 8.7 |
| **UV – In-pipe** | 4.8 | 230 | 8.9 |
| **Ozone** | 6.6 | 450 | 14.8 |

[1]Concrete structure designed to house banks with a total disinfection capacity of 10 mgd.

# SECTION 6 - STORAGE SYSTEM ALTERNATIVES ANALYSIS

## 6.1 BACKGROUND

As pointed out in Section 1, the City's goal is to produce 25,000 acre-ft/year of recycled water by 2025. This TM will present the four storage alternatives that were evaluated for the TTDF.

The following four storage alternatives were considered:

- Earthen basins, lined and covered
- Steel tank
- Pre-stressed concrete tank
- Conversion of Train A aeration basin into a storage reservoir

The last option (the conversion of a Train A aeration basin into a storage tank) is only an option if the City decides to select MBR alternative. A detailed discussion of the MBR option is presented in Section 7.

## 6.2 STORAGE ALTERNATIVES

### 6.2.1 Earthen Basins, Lined and Covered

**Description**

Earthen basins are constructed by excavating and forming earthen berms with the excavated soil, resulting in basins that are partially above grade and partially below grade. In order to function as a storage reservoir, the basins must be lined (to prevent loss of recycled water via percolation) and covered (to prevent the loss of recycled water via evaporation and the contamination of recycled water). While there are many options for lining and covering earthen basins, the use of gunite lining and a hypalon membrane cover have been considered in the evaluation of this alternative. Gunite lining is proven, cost effective, easy to install, and has been used by the City in the past. Hypalon membrane covers, while more expensive than polypropylene or high density polyethylene (HDPE) membrane covers, are of a superior quality, and come with a standard 30-year material warranty.

Advantages and disadvantages of earthen basins are summarized in Table 6-1 and the design criteria are summarized in Table 6-2. A preliminary layout for the earthen basins at the TTDF is presented in Figure 6-1. Preliminary construction, O&M, and 20 year life-cycle cost estimates for the planned earthen storage basins at the TTDF are presented in Table 6-3. The typical life of storage structures is at least 50 years; however, a 20 year life-cycle cost analysis is presented for consistency.

## Advantages and Disadvantages

**Table 6-1: Earthen Basins Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Lined and covered earthen basins are typically less expensive than steel tanks or concrete tanks. | Periodic maintenance and replacement of floating membrane covers are required. |
| Earthen basins are easily constructed. | Membrane covers need to be removed to access the basin internals for maintenance. |
| Permits recycled water from the treatment system to flow by gravity into the storage | Leak detection is difficult. |
| Partitions within the basin allow for taking one cell offline for maintenance while keeping the others in operation. | Floating covers are prone to vandalism. |
| | Less conducive to water circulation, which may impact water quality. |

## Design Criteria

**Table 6-2: Earthen Basins Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Capacity, MG** | 5 |
| **Number of Basins** | 2 |
| **Dimensions of Each Basin, Length (ft) x Width (ft) x Depth (ft) (Free Board (ft))** | 255 x 180 x 10 (3) |
| **Side Wall Slope (H:V)** | 3:1 |
| **Number of Distribution Pumps** | 2 (1 duty + 1 standby) |
| **Distribution Pump Capacity, Each** | 3,500 gpm |
| **Distribution Pump Discharge Head** | 230 feet |
| **Distribution Pump Motor hp, Each** | 300 hp |

## Preliminary Layout

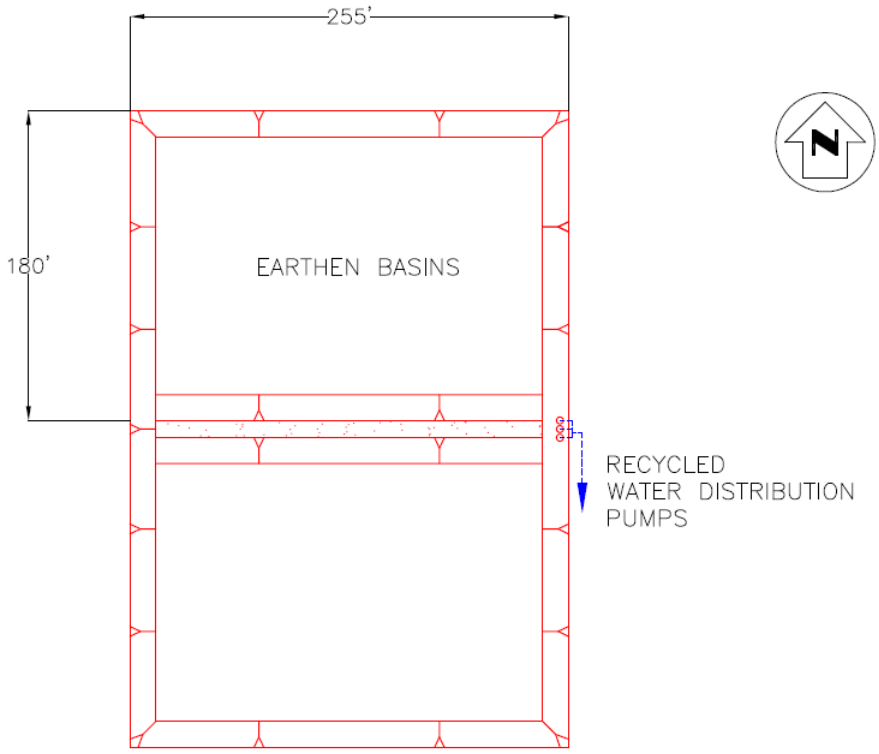


**Figure 6-1: Preliminary Layout of 5 MG Earthen Basins**

## Cost Summary

**Table 6-3: Earthen Basins and Recycled Water Pump Station Cost Summary**

| Parameter | Cost ($) |
|---|---|
| **Total Capital Cost**[a] | 4,000,000 |
| **Total Annual O&M Cost**[b] | 310,000 |
| **20 Year Life-Cycle-Cost**[c] | 9,600,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power for distribution pumps and general maintenance. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

### 6.2.2 Steel Tank

#### Description

A single welded steel storage tank with a welded steel roof and a concrete ring wall foundation has been considered in the evaluation of this alternative. Advantages and disadvantages of steel tanks are summarized in Table 6-4 and the design criteria are summarized in Table 6-5. A preliminary layout for the steel tank at the TTDF is presented in Figure 6-2. Preliminary construction, O&M, and 50 year life-cycle cost estimates for the planned steel storage tank at the TTDF are presented in Table 6-6.

#### Advantages and Disadvantages

**Table 6-4: Steel Tank Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Steel storage tanks are typically less expensive than concrete storage tanks. | Since steel storage tanks are installed above grade, pumping to the steel storage tank will be required - adding to O&M costs. |
| Circular shape promotes water circulation, improving water quality. | Steel storage tanks require maintenance (e.g. painting of the interior surface) and typically have lower lifetimes when compared to concrete tanks. |
| Leakage can be readily detected. | Cathodic protection is required to prevent corrosion. |
| | When maintenance is required, entire tank needs to be taken out of service. |

#### Design Criteria

**Table 6-5: Steel Tank Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Capacity, MG** | 5 |
| **Number of Tanks** | 1 |
| **Dimensions of Tank, Diameter (ft) x Depth (ft) (Free Board (ft))** | 210 x 24 (4) |
| **Number of Feed Pumps** | 2 (1 duty + 1 standby) |
| **Feed Pump Capacity, Each** | 3,500 gpm |
| **Feed Pump Discharge Head** | 20 feet |
| **Feed Pump Motor hp, Each** | 30 hp |
| **Number of Distribution Pumps** | 2 (1 duty + 1 standby) |
| **Distribution Pump Capacity, Each** | 3,500 gpm |
| **Distribution Pump Discharge Head** | 230 feet |
| **Distribution Pump Motor hp, Each** | 300 hp |

### Preliminary Layout

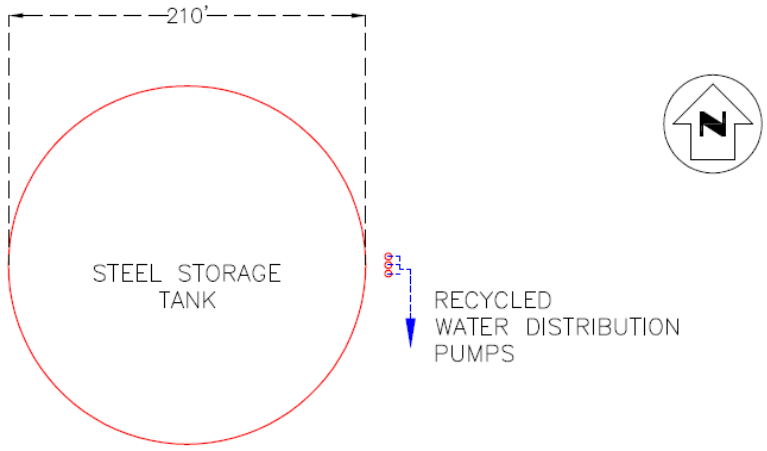


**Figure 6-2: Preliminary Layout of 5 MG Steel Tank**

### Cost Summary

**Table 6-6: Steel Tank and Recycled Water Pump Station Cost Summary**

| Parameter | Cost ($) |
|---|---|
| **Total Capital Cost**[a] | 6,400,000 |
| **Total Annual O&M Cost**[b] | 370,000 |
| **20 Year Life-Cycle-Cost**[c] | 13,100,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power for feed and distribution pumps and general maintenance. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

## 6.2.3 Prestressed Concrete Tank

### Description

A single partially buried, strand-wrapped circular prestressed concrete storage tank has been considered in the evaluation of this alternative. Advantages and disadvantages of prestressed concrete tanks are summarized in Table 6-7 and the design criteria are summarized in Table 6-8. A preliminary layout for the prestressed concrete tank at the TTDF is presented in Figure 6-3. Preliminary construction, O&M, and 50 year life-cycle cost estimates for the planned prestressed concrete storage tank are presented in Table 6-9.

## Advantages and Disadvantages

**Table 6-7: Prestressed Concrete Tank Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| Prestressed concrete storage tanks are lower maintenance than both steel tanks or lined and covered earthen basins. | Prestressed concrete storage tanks are typically more expensive than both steel tanks and lined and covered earthen basins. |
| Prestressed concrete storage tanks have a longer life than steel tanks or lined and covered earthen basins. | Leak detection for partially buried tank is difficult - an observation vault is required for leak detection. |
| Circular shape promotes water circulation, improving water quality. | Piping and tank repairs are more costly due to buried depth. |

## Design Criteria

**Table 6-8: Prestressed Concrete Tank Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Capacity, MG** | 5 |
| **Number of Tanks** | 1 |
| **Dimensions of Tank, Diameter (ft) x Depth (ft) (Free Board (ft))** | 178 x 30 (2) |
| **Number of Distribution Pumps** | 2 (1 duty + 1 standby) |
| **Distribution Pump Capacity, Each** | 3,500 gpm |
| **Distribution Pump Discharge Head** | 230 feet |
| **Distribution Pump Motor hp, Each** | 300 hp |

## Preliminary Layout

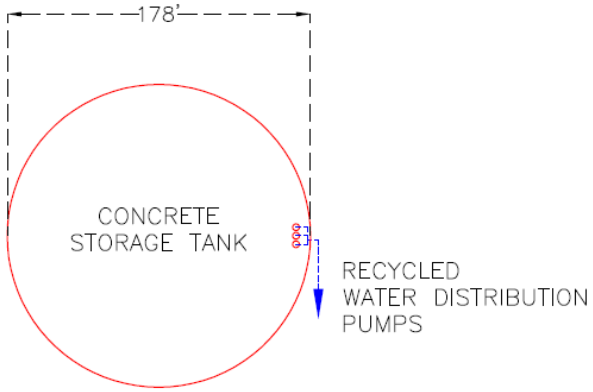


**Figure 6-3: Preliminary Layout of 5 MG Prestressed Concrete Tank**

### Cost Summary

**Table 6-9: Prestressed Concrete Tank and Recycled Water Pump Station Cost Summary**

| Parameter | Cost ($) |
|---|---|
| **Total Capital Cost**[a] | 7,500,000 |
| **Total Annual O&M Cost**[b] | 290,000 |
| **20 Year Life-Cycle-Cost**[c] | 12,700,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power for distribution pumps and general maintenance. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

## 6.2.3 Conversion of Train A Aeration Basin

### Description

The conversion of a Train A aeration basin into a storage tank requires the removal of all mechanical internals including aeration piping (with diffusers) and the old mechanical aerators (with the associated supports and platforms). In addition, the converted aeration basin requires modifications to support a cover, including a supporting curb around the perimeter of the basins and support columns within the basin. Due to the long life and minimal maintenance associated with aluminum covers, a flat aluminum cover has been considered in the evaluation of this alternative.

Advantages and disadvantages of using a converted Train A aeration basin as a recycled water storage tank are summarized in Table 6-10. The design criteria for this alternative are summarized in Table 6-11. A preliminary layout of the converted Train A aeration basin is presented in Figure 6-4. Preliminary construction, O&M, and 50 year life-cycle cost estimates for the conversion of a Train A aeration basin are presented in Table 6-6.

### Advantages and Disadvantages

**Table 6-10: Conversion of Train A Aeration Basin Advantages and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| This alternative uses an existing structure, reducing costs and minimizing footprint. | The conversion of a Train A aeration basin is only feasible if a MBR is used. |
| | Due to conversion of existing aeration basin, the storage capacity is limited to about 2.7 MG. |

## Design Criteria

**Table 6-11: Conversion of Train A Aeration Basin Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Capacity, MG** | 2.7 |
| **Number of Tanks** | 1 |
| **Dimensions of Tank, Length (ft) x Width (ft) x Side Water Depth (ft)** | 170 x 170 x 16 |
| **Number of Distribution Pumps** | 2 (1 duty + 1 standby) |
| **Distribution Pump Capacity, Each** | 3,500 gpm |
| **Distribution Pump Discharge Head** | 230 feet |
| **Distribution Pump Motor hp, Each** | 300 hp |

## Preliminary Layout

**Figure 6-4: Train A Aeration Basin Converted to Storage Basin**

### Cost Summary

**Table 6-12: Conversion of Train A Aeration Basin and Recycled Water Pump Station Cost Summary (2.7 MG Storage Capcity)**

| Parameter | Cost ($) |
|---|---|
| **Total Capital Cost**[a] | 2,900,000 |
| **Total Annual O&M Cost**[b] | 290,000 |
| **20 Year Life-Cycle-Cost**[c] | 8,100,000 |

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power for distribution pumps and general maintenance. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

## 6.3 SUMMARY OF COSTS

Table 6-13 presents a summary of the construction, O&M, and 20 year life-cycle cost estimates for each of the four storage alternatives evaluated. As shown in the Table, excluding the option of converting a Train A aeration basin into a storage tank (only an option if MBR option is selected), earthen basins are the lowest cost both in terms of capital cost (~$2,400,000 less than a steel tank, the next lowest cost alternative) and 20 year life-cycle cost (~$3,100,000 less than a prestressed concrete tank, the next lowest cost alternative).

**Table 6-13: Summary of Cost for Each Storage and Distribution Pump Station Alternative**

| Alternative | Storage Capacity (MG) | Capital Cost ($ Millions) | O&M Cost ($ Thousands) | 20 Year Life Cycle Cost ($ Millions) |
|---|---|---|---|---|
| **Earthen Basins, Lined and Covered** | 5.0 | 4.0 | 310 | 9.6 |
| **Steel Tank** | 5.0 | 6.4 | 370 | 13.1 |
| **Prestressed Concrete Tank** | 5.0 | 7.5 | 290 | 12.7 |
| **Train A Aeration Basin Conversion** | 2.7 | 2.9 | 290 | 8.1 |

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# SECTION 7 – MEMBRANE BIOREACTOR (MBR) OPTION

## 7.1 BACKGROUND

As an alternative to tertiary filters, which were discussed in Section 4, MBR system can be used to produce Title 22 recycled water. This section first describes the MBR technical concept and how its different components are tied together and later briefly discusses the MBR alternatives considered prior to Workshop No. 1. A detailed analysis of the selected alternative will be presented in Section 9. Refer to Section 9 for information regarding the design criteria and specifications of equipment.

## 7.2 TECHNICAL CONCEPT

The MBR is a multi-purpose process providing secondary treatment for organic and nitrogen removal, and using membrane filters to separate the mixed liquor solids from the wastewater. The membranes take the place of the clarifiers and tertiary filters of the conventional treatment plant. By removing the secondary clarifiers from the mainstream through the plant, problems controlling the settling characteristics of the solids, as measured by Sludge Volume Index (SVI) are eliminated. This allows the aeration basin (bioreactor) mixed liquor to be increased in concentration by almost three times the usual levels, i.e. from 3,500 mg/L to 10,000 mg/L, reducing the volume of aeration basin required to less than one-half that of the conventional treatment process.

The MBR process dates back 50 years. In the last ten years, the process has been applied in numerous installations of increasing size. Several plants today have design capacities in excess of 10 mgd, with larger facilities in design and construction. The worldwide application of the process over the last ten years has taken it from an emerging technology to one that is regarded as proven based on its long term consistent performance at numerous plants.

The general concept of the MBR is similar to that of conventional treatment, except it takes advantage of the latest in membrane technology to minimize the footprint of the secondary and tertiary treatment facilities and to enhance the performance of the plant to produce an effluent of exceptional quality.

To consistently achieve NDN, i.e. to meet a Total Inorganic Nitrogen (TIN) level of 10 mg/L in the effluent, a treatment plant should be designed to reliably produce an effluent TIN level in the range of 5 to 8 mg/L. This can be accomplished by upgrading the treatment to provide biological nutrient removal (BNR). Further, addition of membranes will result in an effluent containing low levels of organics (BOD), solids (TSS) and nitrogen allowing for effective disinfection so that the final effluent complies with water quality standards for unrestricted reuse.

The current plant uses conventional activated sludge consisting of aeration basins followed by clarification to significantly reduce the level of BOD and TSS in the effluent and to achieve partial NDN. The City has a significant investment in the process and with some modifications it

can be converted into a BNR facility to provide full secondary treatment.

Figure 7-1 shows a schematic of the overall liquid treatment train. This section of the TM will focus on the technical concepts of the fine screening, bioreactor and membrane portions of the plant.

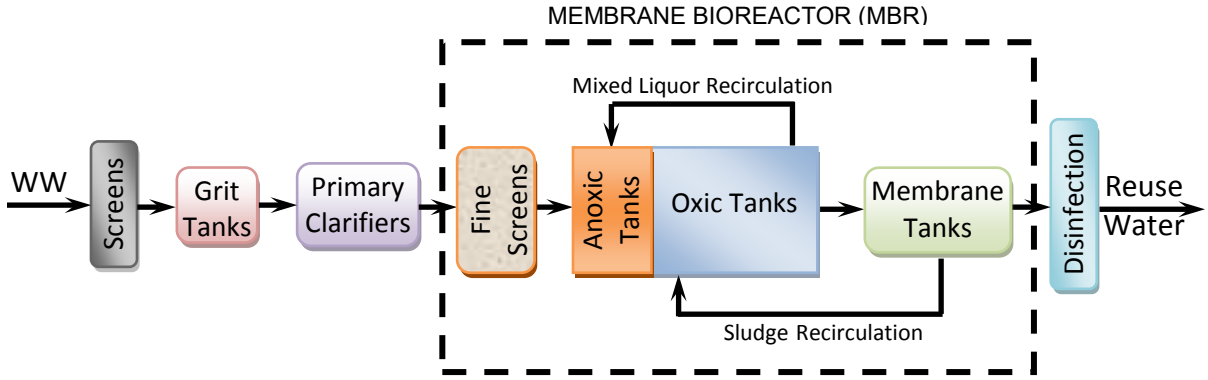



**Figure 7-1: Membrane Bioreactor (MBR) Consisting of Activated Sludge Bioreactor and Membrane Filtration**

### 7.2.1 Fine Screening

Hair, stringy material and other deleterious matter passing through the preliminary treatment (coarse bar racks and grit tanks) and primary settling tanks can damage the MBR membranes. To protect the membranes, ultra-fine screens are installed ahead of the MBR system on the primary effluent flow stream. Openings through the screens are in the range of 1 to 3-mm in size. The screens are of the band or drum type comprised of a series of perforated plates. The screen cleaning operation is automatically controlled based on differential level or time. These types of screens have been found to be the most efficient for removal of fine material. The screens are equipped with washing systems to clean odorous organic material from the screenings and return it back to the flow stream for treatment. The washed screenings are compacted to reduce the water content and volume prior to hauling off-site for disposal.

### 7.2.2 Secondary Treatment – Bioreactor (Aeration Basin)

The bioreactor portion of the MBR process is very similar to that in the conventional activated sludge system. The aeration basin will be divided into anoxic and oxic zones for denitrification, organic removal and nitrification. Primary effluent will enter the anoxic zones where it will be mixed with mixed liquor recirculated from the oxic zones. However, because of the high level of dissolved oxygen in the sludge return from the membrane chambers, this recycled sludge will be returned to the start of the oxic zones.

The anoxic zones are equipped with mixers to maintain the mixed liquor biomass in suspension without introducing ambient air (oxygen). This promotes the scavenging of oxygen from the

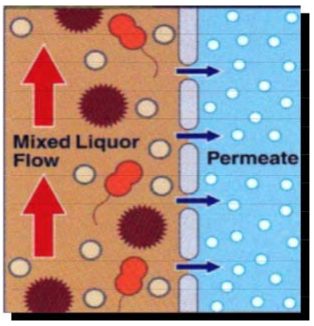
nitrates present in the recirculated sludge and exhausting of the resultant nitrogen gas, which reduces the nitrogen content in the wastewater. The oxic zones are equipped with fine bubble diffusers to create an oxygen rich environment for the biomass.

The most significant difference between conventional activated sludge and the bioreactor portion of an MBR system is the ability to raise the mixed liquor concentration in the bioreactor from a conventional 3,500 mg/L to 10,000 mg/L, resulting in a reduction in the tankage volume required to provide an equal level of secondary treatment.

A consequence of the higher mixed liquor concentration is that the oxygen transfer efficiency is slightly lower (i.e. lower alpha), reducing the overall efficiency of the aeration system and increasing the aeration energy. This difference may add 10 to 15% to the amount of air required in the oxic zones of an MBR system. However, the oxygen contained in the membrane chamber's recycled sludge will typically balance the extra air/oxygen required in the aeration basins.

### 7.2.3 Tertiary Treatment - Membrane Filtration

Membrane technology started in the water treatment field, and has been successfully used in water treatment plants for more than 20 years. Membrane filtration can consistently reduce the level of solids and contaminants in the effluent to below detection limits. Though membranes are an effective physical barrier, straining out many contaminants, further treatment through a disinfection process is necessary to remove the remaining contaminants. This provides a "dual-barrier" to enhance the safety of the final effluent, complying with CDPH requirements for unrestricted reuse of the plant effluent.




Operating experience of several membrane manufacturers have shown that the membranes are consistently capable of producing an effluent essentially approaching non-detectable levels of organics, solids and pathogens. The clarity of the membrane effluent is significantly superior to that produced by traditional filtration processes. The high quality effluent is ideal for reuse applications and public acceptance.

In the MBR process, the membranes can be located externally from the mixed liquor tanks in tubes, but typically are submerged in tanks in direct contact with the mixed liquor and function as the clarification and filtration steps. Externally installed membranes are configured in pressure vessels with pumps transferring flow from the bioreactors to the vessels. In submerged membrane applications, pressure differential across the membranes in the form of a vacuum is provided using either the hydraulic grade (gravity) or a filtrate pump suction to siphon liquid (permeate) through the membrane material. In all cases, permeate or membrane effluent, passes through the membrane material leaving the solids behind for recirculation back to the bioreactors.

Unlike a media type tertiary filter, in an MBR system, the membranes are not backwashed, but rather, the solids are air scoured from the membrane surface and recycled back to the

activated sludge bioreactor. The main waste from an MBR system is the waste activated sludge (WAS), similar to the WAS currently pulled from the secondary clarifiers.

Chemical cleanings of the membranes, performed using a clean-in-place (CIP) system, is dependent on the feed water quality and membrane manufacturer; thus, the frequency of cleaning can range from once or twice a week to three or four times a year. Extensive cleaning of the membranes beyond this routine cleaning is required approximately once or twice per year.

There are two types of membranes commonly used in an MBR system; hollow-fiber and flat-sheet. Both membrane types are able to reliably produce high quality water and therefore, the choice of membranes will be mostly a matter of capital and operational costs evaluated on a life cycle cost basis. Hollow-fiber membranes can be installed in a smaller footprint. Flat-sheet membranes require more area, but a lower operating differential pressure across the membranes (transmembrane pressure, TMP), and reportedly (per manufacturers) have a higher maximum flow capacity (flux rate).

Because both membrane types are a viable alternative for application at the Fresno TTDF, it is recommended that pre-selection be undertaken during the early stages of detailed design to select a membrane manufacturer and facilitate the design of the MBR system specific to that manufacturer.

## 7.3 LOCATION AND CAPACITY OF MBR

Two locations were considered for MBR system: Train A and Train B (Figures 7-2 through 7-5):

- Train A:
    - Convert one of the secondary clarifiers to aeration basin of MBR (due to age of structure and sloping walls of the existing aeration basins in Train A, it was decided not to use them for this purpose)
    - Construct the membrane tanks in vicinity of secondary clarifiers
- Train B:
    - Use aeration basin No. 5 as the aeration basin of MBR
    - Modify secondary clarifier No. 6 to accommodate membrane tanks

Two flow rates were considered for analysis: 5 and 10 mgd. Primary effluent will be pumped to fine screens and then will flow by gravity to aeration basin and then membrane tanks. The flow for 5 mgd scenario is constant, while the flow for 10 mgd scenario includes a peaking factor of 1.23. For both flows, nitrogen removal (NDN) is included in the design.

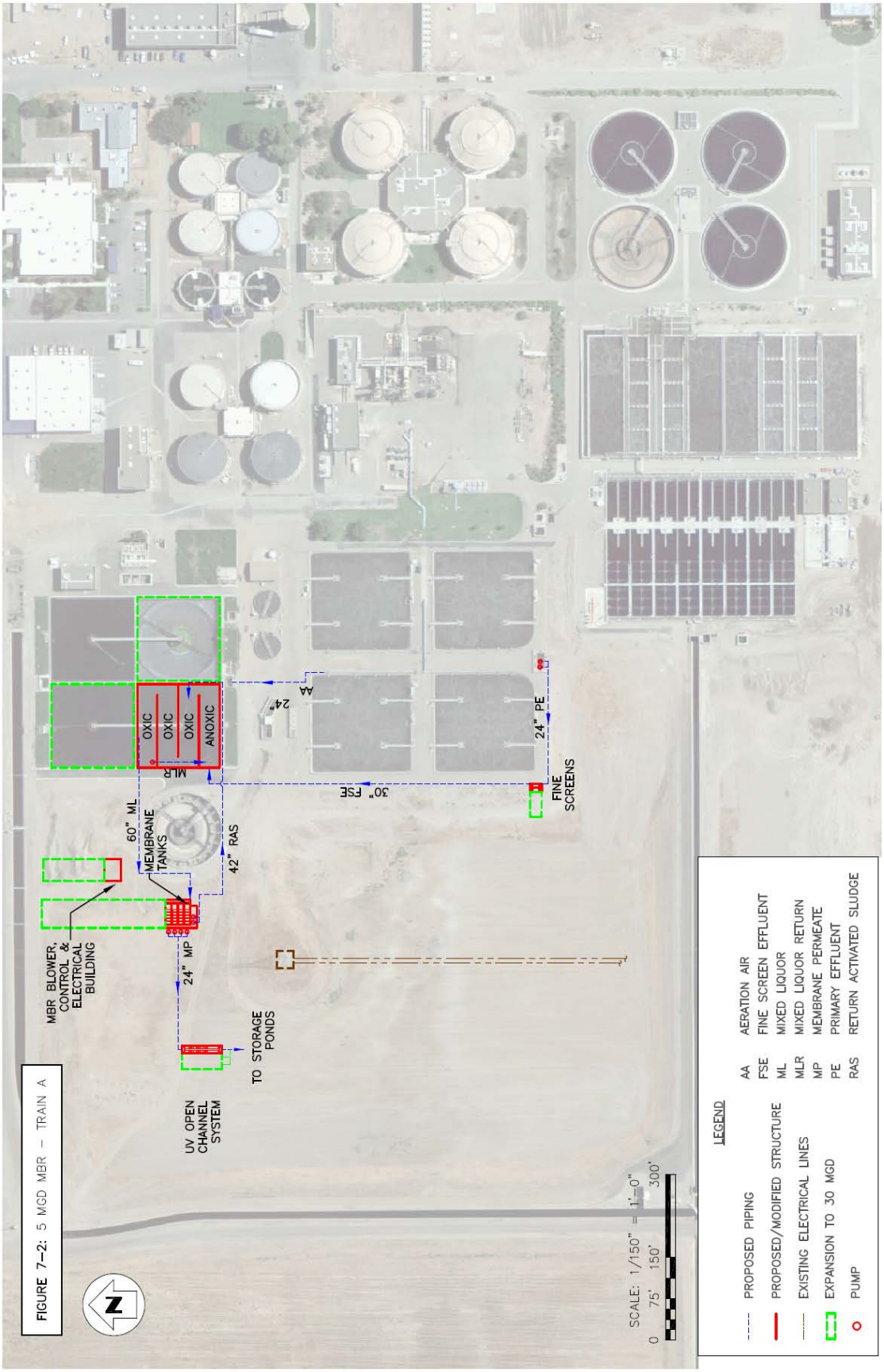



FIGURE 7-2: 5 MGD MBR – TRAIN A

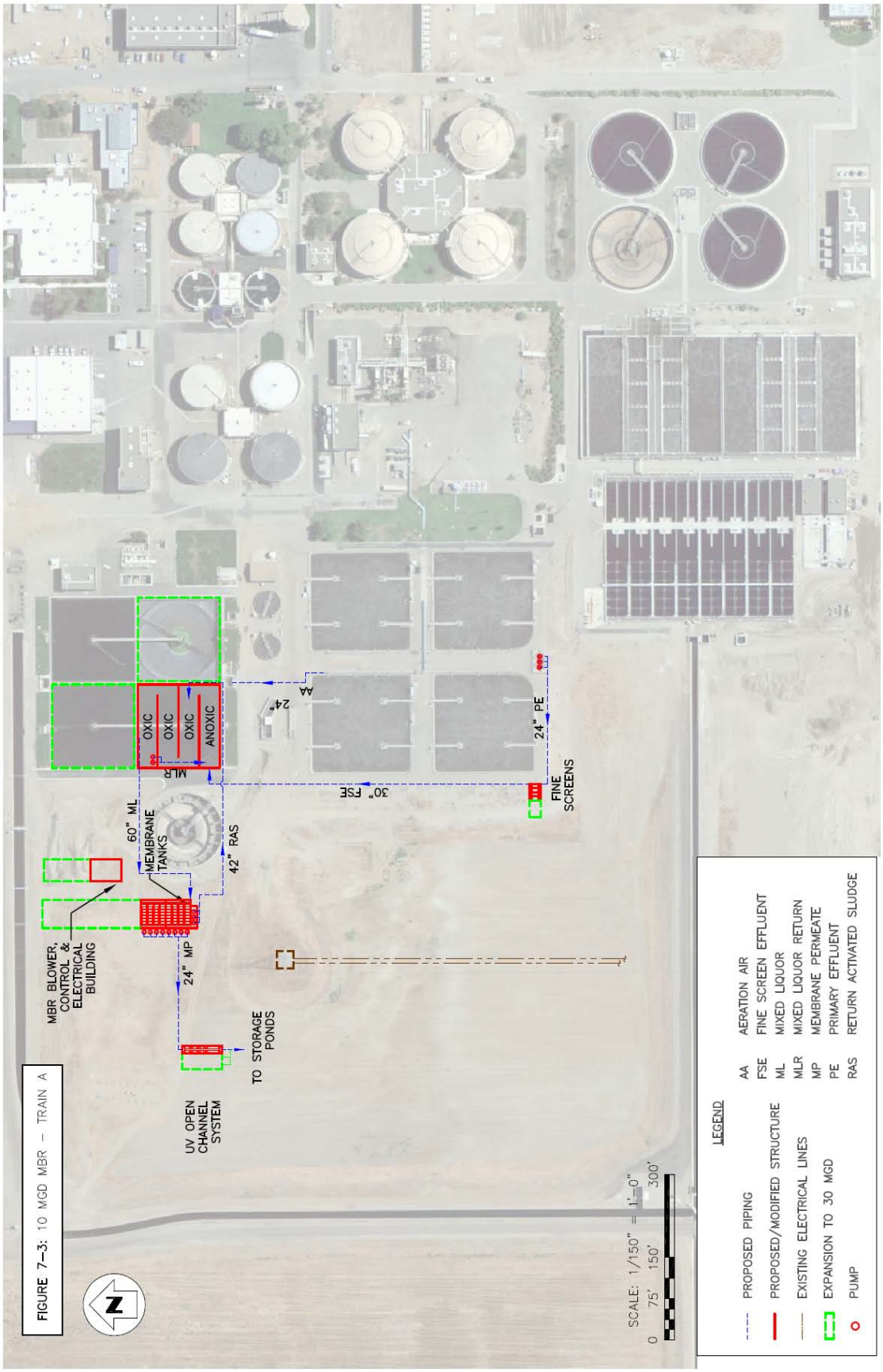



FIGURE 7–3: 10 MGD MBR – TRAIN A

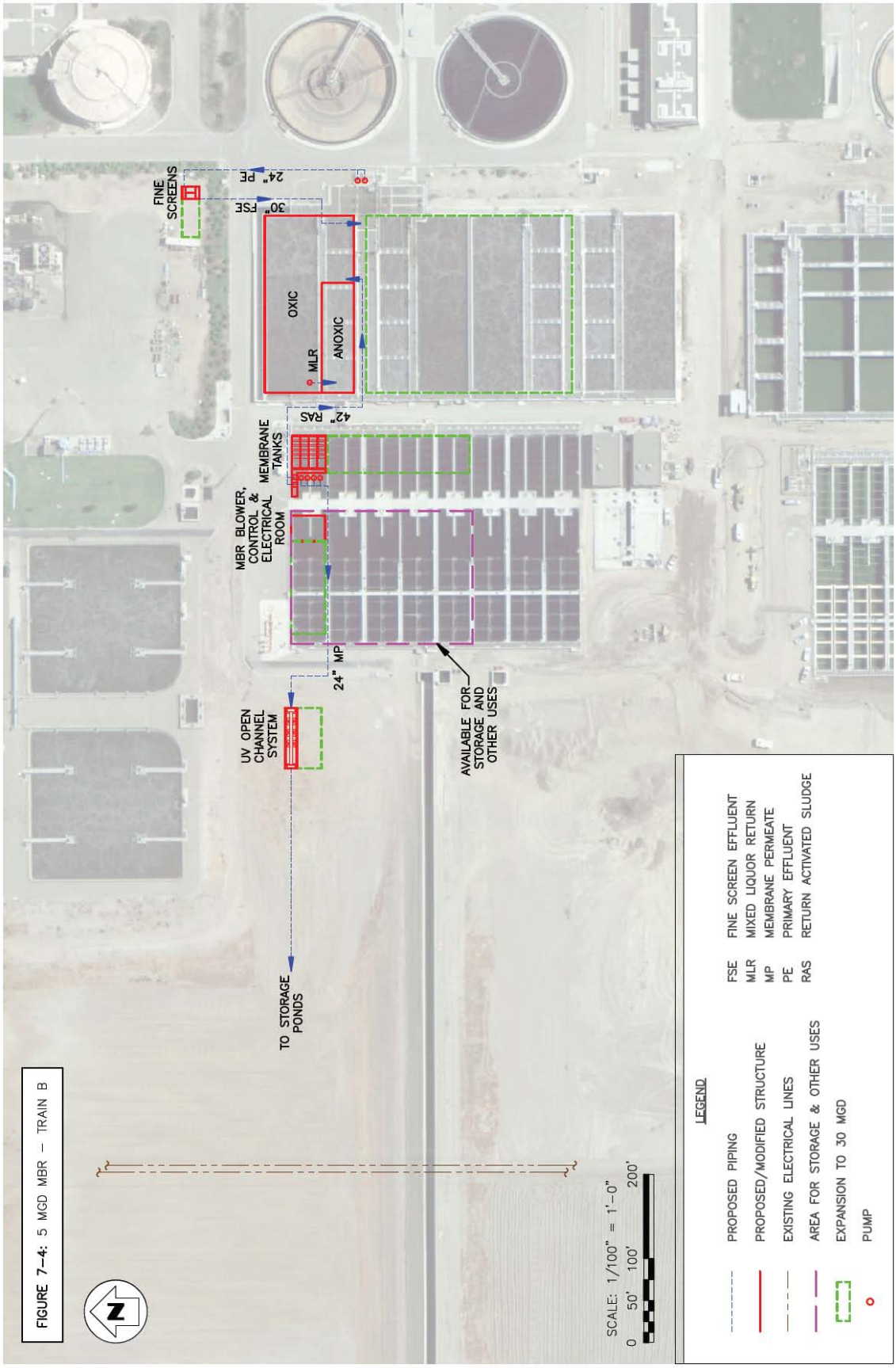



**FIGURE 7-4:** 5 MGD MBR – TRAIN B

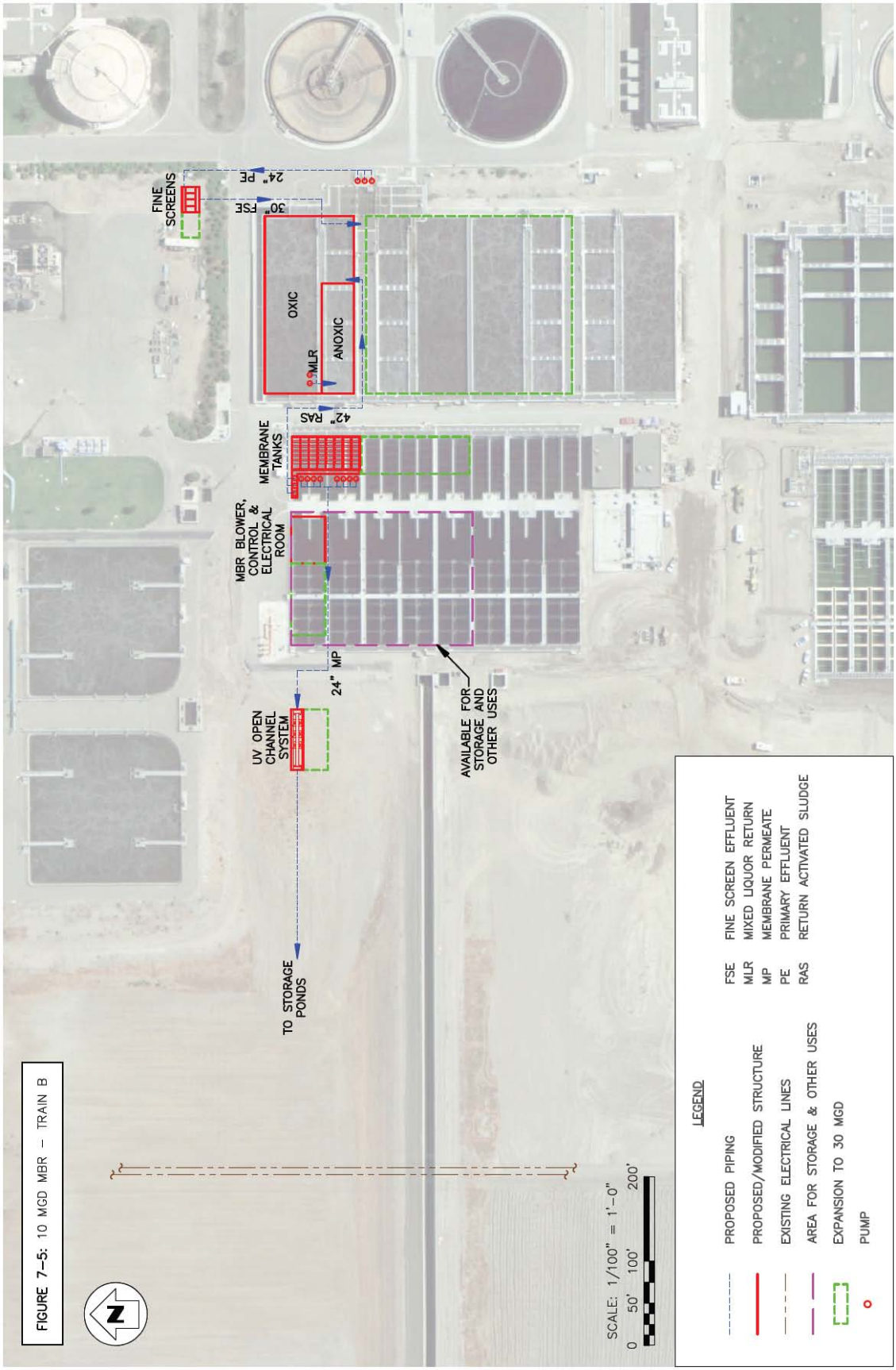



**FIGURE 7–5:** 10 MGD MBR – TRAIN B

## 7.4 COSTS

The capital costs for Train A and Train B (5 and 10 mgd) are shown in Tables 7-1 and 7-2, respectively. A credit for conventional NDN is included. This is the investment the City would need to make on secondary treatment system, if the plant had to be upgraded to NDN process using conventional tertiary filters rather than MBR. As can be seen, using Train A for MBR would result in higher cost. This is due to the extensive modifications needed in Train A.

**Table 7-1: MBR Capital Cost – Train A [a]**

| Parameter | Capital Cost ($ Million) | |
|---|---|---|
| **Flow** | **5 mgd** | **10 mgd** |
| Equipment and Structures Cost | 7.0 | 12.1 |
| Total Capital Cost [b] | 20.2 | 34.9 |
| Credit for Conventional NDN [b,c] | (0) | (8.2) |
| **Total Capital Cost Including NDN Credit** | **20.2** | **26.7** |

[a] UV credit not included.
[b] Including installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013)
[c] NDN credit based on constructing additional facilities (one aeration basin and installing new equipment such as mixed liquor recycle pumps) if the City were to choose conventional filters instead of MBR and were required to achieve NDN in the conventional secondary treatment process.

**Table 7-2: MBR Capital Cost – Train B [a]**

| Parameter | Capital Cost ($ Million) | |
|---|---|---|
| **Flow** | **5 mgd** | **10 mgd** |
| Equipment and Structures Cost | 5.9 | 10.9 |
| Total Capital Cost [b] | 17.0 | 31.5 |
| Credit for Conventional NDN [b,c] | (0) | (8.2) |
| **Total Capital Cost Including NDN Credit** | **17.0** | **23.3** |

[a] UV credit not included.
[b] Including installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013)
[c] NDN credit based on constructing additional facilities (one aeration basin and installing new equipment such as mixed liquor recycle pumps) if the City were to choose conventional filters instead of MBR and were required to achieve NDN in the conventional secondary treatment process.

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# SECTION 8 – SUMMARY OF WORKSHOP NO.1

## 8.1 BACKGROUND

A Workshop was conducted with the City on November 4, 2010 to present and discuss various system alternatives for filtration, disinfection and storage systems for the proposed TTDF. These alternatives are discussed in detail in Sections 4, 5 and 6, respectively, of this TM. This Section of the TM summarizes the discussion carried out at the Workshop and highlights the important decisions made for subsequent work.

## 8.2 FILTRATION SYSTEM ALTERNATIVES ANALYSIS

Eight filtration technologies were analyzed and summarized during the Workshop. The technologies discussed were:

1. Dual media gravity filters
2. Deep bed mono media filters
3. Continuous backwash filters
4. Traveling bridge filters
5. Fuzzy filters
6. Cloth media filters
7. Nova Ultrascreen filter
8. Microfilters

The Workshop presentations & discussions included the following:

1. Introduction and filter history
2. Photos and cross-sections
3. Features of operation
4. Pros and Cons
5. Title 22 design criteria including reliability
6. Preliminary layout for 5 mgd expandable to 15 mgd and ultimately to 30 mgd.
7. Capital, O&M and life cycle cost analysis

*Based on the discussions, the City indicated their preference for cloth media filters and Nova Ultrascreen filters. The City expressed their concern about possibility of air-borne dust contaminating the recycled water and directed that all filtration units be covered. City requested that revised cost estimates be prepared for the two preferred filtration technologies including a building to house cloth media filters and a canopy for Nova Ultrascreen filters. Subsequently, the City asked Parsons to consider a building for Nova filters as well. The City also asked Parsons to inquire Nova about potential effluent turbidity spikes following backwash with Nova filters. Parsons will revise the cost estimates and will contact Nova to inquire about the potential effluent spike problems immediately following the backwash.*

### 8.2.1 Subsequent Developments

Following the Workshop, Parsons submitted revised cost estimates to the City for cloth media filters and Nova Ultrascreen filters. Table 8-1 presents a summary of revised costs for the two systems (including CMU buildings to house each type of filters) for 5 mgd constant flow rate.

**Table 8-1: Revised Cost Summary for Cloth Media and Nova Ultrascreen Filters (5 mgd Constant Flow)**

| Parameter | Cloth Media Filters[e] ($) | Nova Ultrascreen Filters ($) |
|---|---|---|
| Equipment and Structures Cost[a] | 1,870,000 | 1,325,000 |
| Total Capital Cost[b] | 5,000,000 | 3,800,000 |
| Total Annual O&M Cost[c] | 90,000 | 100,000 |
| 20 Year Life Cycle Cost[d] | 6,700,000 | 5,650,000 |

[a] Includes CMU building to house the filters.

[b] Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[c] Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[d] At a 5% discount rate and a 4% escalation rate.

[e] Concrete structure designed for a total filtration capacity of 9 mgd.

Per City's request, Parsons contacted Nova to inquire about possible effluent turbidity spikes immediately following backwash operation. Staff at Nova clarified that Nova filters do not experience the effluent turbidity spikes, unlike cloth media filters, immediately following backwash. They attribute this to what they call "pulse backwashing". Nova filter discs go through much frequent backwash cycles; one backwash every 6-10 minutes each lasting for about 10-15 sec. This "pulse backwashing" not only eliminates effluent turbidity spikes but the volume of backwash is significantly less (less than 1% of feed water volume) when compared to cloth media filters. Nova also claims that due to the fact that Nova filter discs use a filter medium (precision woven SS mesh) which provides fine pore size control, their filtration system does not depend on cake filtration as is the case with cloth media filters. To substantiate their claim against effluent turbidity spikes following backwash, Nova supplied an evaluation report for Orange County South Regional Water Reclamation Facility – Sand Lake Road in Florida, where cloth media filters and Nova filters were tested side-by-side. The report supports Nova's claim that their filters do not experience effluent turbidity spikes as in the case of cloth media filters. This report is attached in Appendix C. The graphs presented in pages 5 and 6 of the report clearly document relatively constant effluent turbidity from Nova filters when compared to distinct spikes in effluent turbidity after every backwash in case of cloth media filters.

*Based on the above analysis and fact finding, City selected Nova Ultrascreen filters as their system of choice for filtration for comparison against MBR system. Parsons would like to highlight the Nova's lack of experience in meeting Title 22 regulations in California. Nova Ultrascreen® filters have a long history (~10 years) of use in overseas installations; however, the history of use in the US on municipal wastewater is limited. There are currently no installations in California and the longest operating municipal wastewater installation in the US has been in operation for less than one year (in Orange Park, FL) and has a rated capacity of 3.0 mgd. If the City should consider this filtration system, Parsons strongly recommends a minimum of two (2) site visits to operating installations by Parsons and City staff to gain first-hand knowledge of the performance and operation of Nova filters before finalizing this choice.*

*In addition, disc filters in general, require the upstream biological treatment system to have a minimum SRT of 5 days prior to filtration (including Nova Ultrascreen filters) for consistent effluent quality. Without such a high SRT, the extra cellular enzymes secreted by the microorganisms will potentially plug the fine pores on the disk media. If the existing biological system does not provide an SRT of at least 5 days, modifications to the pertinent secondary treatment facilities' operations will be required.*

## 8.3 DISINFECTION SYSTEM ALTERNATIVES ANALYSIS

Three disinfection technologies were analyzed and summarized during the Workshop. The technologies discussed were:

1. Open channel UV Disinfection
2. In-pipe UV Disinfection
3. Ozone Disinfection

Each disinfection technology was discussed in detail and consisted of the following:

1. Introduction
2. Photos and cross-sections
3. Features of operation
4. Pros and Cons
5. Title 22 design criteria including reliability
6. Preliminary layout for 5 mgd expandable to 15 mgd and ultimately to 30 mgd.
7. Capital, O&M and life cycle cost analysis

*Based on the discussions, the City expressed their preference for in-pipe UV disinfection system similar to neighbouring Clovis Water Reuse Facility. At the Clovis facility, the City noted the operator's positive experience with operating and maintaining the in-pipe UV system. The City asked Parsons to revise the cost estimates to include 1.0 mgd capacity UV reactors instead of 2.3 mgd capacity reactors considered earlier by Parsons. City also wanted the cost estimate to include a canopy for in-pipe UV reactors. Table 8-2 presents a summary of the revised cost estimates for the 1 mgd in-pipe UV system compared to the 2.3 mgd in-pipe UV system. Final*

*selection of the UV system will be made during detailed design and will be based on competitive bidding between 1 mgd reactors and lager size reactors (2.3 mgd and others, as applicable).*

**Table 8-2: Revised Cost Summary for In-pipe UV Disinfection Following Meida Filtration (5 mgd Constant Flow)**

| Parameter | 2.3 mgd Reactors ($) | 1 mgd Reactors ($) |
|---|---|---|
| Equipment and Structures Cost | 1,460,000 | 2,000,000 |
| Total Capital Cost[a] | 4,800,000 | 6,500,000 |
| Total Annual O&M Cost[b] | 230,000 | 230,000 |
| 20 Year Life Cycle Cost[c] | 8,900,000 | 10,600,000 |

[a] Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b] Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c] At a 5% discount rate and a 4% escalation rate.

## 8.4 STORAGE AND PUMPING SYSTEM ALTERNATIVES ANALYSIS

Three storage alternatives were analyzed and summarized during the Workshop. The alternatives discussed were:

1. Earthen basins (lined and covered)
2. Steel tanks
3. Pre-stressed concrete tanks
4. Converted Train A Aeration Basin

The pros and cons of each alternative along with capital, O&M and life cycle costs were discussed during the Workshop.

*If modifications to Train A are required as part of the proposed treatment system (as in case of MBR alternative), then converting an aeration basin (Train A) into storage will be the preferred choice for the City. On the other hand, if a new storage tank needs to be constructed (for conventional filtration alternative), the City prefers pre-stressed concrete tanks due to their low maintenance cost, avoided costs for pumping the recycled water to the storage tanks (as in case of a steel tank) and aesthetics.*

## 8.5 MEMBRANE BIO-REACTOR (MBR) OPTION

Parsons presented MBR system as an alternative to conventional filtration. The advantages with MBR include the ability to remove nitrogen, producing higher quality effluent exceeding Title 22 standards, utilizing existing basins, and enhancing the existing treatment capacity without addition of tanks and lowering the cost of downstream UV system.

*The presentation included analysis of MBR system in Train A versus Train B. City likes the idea of utilizing Train A infrastructure (aeration basins and clarifiers), which reportedly are at the end of their useful life. In contrast, Train B is a newer and well operated system, which the City prefers not to make any modification to at this time. City directed Parsons to use exclusively Train A for MBR system analysis.*

*Parsons presented an MBR system that made the best use of existing infrastructure at Train A. Pre-aeration for MBR comes from modifying one of the four existing square secondary clarifiers. The City suggested Parsons to utilize the currently decommissioned secondary clarifier no. 5 to install membrane cassettes. In-pipe UV reactor system will be used for disinfection as in case of filtration alternatives. Parsons proposed the idea of converting one of the existing four square aeration basins (app. 2.7 MG each) into a recycled water storage tank; the City concurred with this recommendation.*

*City requested Parsons to evaluate the option of using a portion of the air from the existing aeration blowers for membrane air scouring. Parsons has addressed this issue in Section 9 of this TM.*

## 8.6 THREE PLANS (PLANS A, B AND C)

At the end of the Workshop, City decided to have three Plans to be developed in further detail and to be included as part of this TM. The three Plans are called A, B and C, which are described below.

### PLAN A (12 mgd MBR)

1. This MBR alternative will be based on Train A with 12 mgd average dry weather flow (maximum capacity of each basin to provide nitrification & denitrification) and 14.76 mgd peak dry weather flow (12 mgd times 1.23 peaking factor). The MBR alternative with 5 mgd average constant flow will only be discussed but not evaluated, since it involves de-rating of Train A (also Train B) capacity significantly.

2. This plan will include conversion of a Train A clarifier (one only) into pre-aeration basins preceding the membrane tanks.

3. This plan will evaluate conversion of clarifier no. 5 (circular) into membrane tanks versus construction of separate membrane tanks.

4. In-pipe ultraviolet (UV) is the preferred process for disinfection and will be designed and used as the basis for cost estimates for the same flows as above. Based on discussion at the Workshop, 1-mgd UV reactors will be used as the basis for the construction cost estimate. A canopy to cover the UV reactors will also be considered.

5. One aeration basin at Train A will be converted into a recycled water storage facility (about 2.7 MG).

### PLAN B (5 mgd Filtration)

1. Plan B will incorporate a 5 mgd constant flow filtration system. Both Nova and Disk filter systems will be evaluated. Revised cost estimates including a canopy for the Nova filters and a building for the Disk filters will be submitted to the City. Furthermore, Parsons will contact Nova to investigate the issue of potential turbidity spikes in filtrate immediately after backwash. The cloth media disk filter system has reflected this phenomenon, although it is not of much concern since the effluent quality is mandated based on averages. Nova is preferred subject to resolution of this issue.

2. This plan will take 5 mgd of constant flow from the effluent junction box downstream of Train B for filtration and disinfection. There is no nitrification-denitrification (NDN) requirement right now for this flow. However, it may be required in the future, so leave space for any future facilities needed for this to be accomplished.

3. In-pipe UV is the preferred process for disinfection (a system using 1-mgd reactors with canopy).

4. Storage will be accomplished with a partially buried 5 MG pre-stressed concrete tank.

### PLAN C (12 mgd Filtration)

1. Plan C will incorporate a 12-mgd constant flow filtration system. Here again, the flow will be taken from the effluent junction box downstream of Train B. There is no nitrification-denitrification (NDN) requirement right now for this flow. However, it may be required in the future, so leave space for any future facilities needed for this to be accomplished.

2. Nova and Disk filters will be evaluated as for Plan B. Nova is preferred subject to the resolution of the effluent quality issue as in Plan B.

3. In-pipe UV as for Plans A and B is the preferred process for disinfection (a system using 1-mgd reactors with canopy).

4. Storage will be accomplished with a partially buried 5 MG pre-stressed concrete tank.

## 8.7 POWER SUPPLY OPTIONS FOR TTDF

Per the scope of work, Parsons was to evaluate the feasibility of feeding the proposed TTDF facilities from an existing switchgear at RAS/WAS pump station located adjacent to the secondary clarifiers in train B. However, during the Workshop the City indicated that, for MBR system, it may be better to take the power feed from either four existing transformers or a 12kV switchgear located east of secondary clarifier no.1 in Train A. Parsons' evaluation of various options of power supply for TTDF are presented under Section 12 of this TM.

## 8.8 EFFLUENT ELECTRICAL CONDUCTIVITY (EC)

The City staff brought up an important issue that needs to be considered for design of the TTDF. The RWRF's discharge currently has a limit for electrical conductivity (EC) of 500 micro mhos/cm + EC of the source water. Meeting this limit is a challenge and may require various measures including source water treatment or replacement, expensive systems to remove salts in wastewater, industrial source control and/or public education on waste minimization. The various alternatives presented, including MBR, may not be effective removing all salts from the final effluent. However, MBR technology could help reduce EC levels through its nitrification/denitrification (NDN) abilities. Parsons estimates that effluent EC can be reduced by about 150 micro mhos/cm through NDN, as ammonia is converted to nitrogen gas and escapes into the atmosphere.

During the past few years, the RWRF has experienced a reduction of the effluent EC through an incidental NDN process that reduced ammonia to nitrogen gas. The reduction in the effluent was estimated between 8% to 9.5% of the total EC influent, enough to maintain compliance with the Waste Discharge Requirements (WDR) discharge limit.

## 8.9 OTHER KEY DECISIONS MADE

Aside from the discussion above, the following are the other key decisions made during the Workshop.

1. Site preparation (filling and compacting the percolation basins to grade) will be performed by the City.
2. All facilities (for Plans A, B and C) will be located north of Canal B.

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# SECTION 9 – PLAN A: MBR, UV DISINFECTION AND STORAGE SCHEME (12 MGD CAPACITY)

## 9.1 BACKGROUND

Per Workshop No. 1 (Section 8 of this TM), Plan A which incorporates an MBR system, disinfection, and storage is discussed under this Section. The technical concept of MBR system was discussed in Section 7. During Workshop No.1, several key decisions were made regarding the analysis of Plan A, as mentioned briefly below:

- Design the system to achieve organics as well as nitrogen removal (NDN). This is to maximize the benefits which can be obtained from MBR considering the possible future effluent nitrogen requirements.
- Use the existing facilities of Train A – and not of Train B – to build Plan A scheme. Train A is the oldest amongst the three existing Trains, is obsolete in design, and is the best candidate for modifications and conversion to MBR.
- Due to age and sloping walls of the aeration basins in Train A, do not consider conversion of any of these basins to MBR bioreactor. This will be very expensive for retrofitting and/or very inefficient. Instead, use one of the secondary clarifiers in this Train for such purpose.
- In Train A, the rated capacity of each existing aeration basin and associated clarifiers is 8 mgd. Therefore, do not consider 5 mgd design flow as the basis for analysis because this would result in significantly de-rating the exiting train. Instead, use the maximum capacity that each aeration basin (in this case converted secondary clarifier) can handle to achieve NDN.
- UV Inline System (1 mgd capacity) will be used for disinfection of MBR permeate. Final selection of the UV system will be made during detailed design and will be based on competitive bidding between 1 mgd reactors and lager size reactors (2.3 mgd and others, as applicable).
- One of the aeration basins in Train A will be used to store the recycled water (approximate capacity of 2.7 MG).

Based on the above items, MBR system as discussed later in the section will be located in Train A and designed for maximum capacity that one converted secondary clarifier can handle.

## 9.2 DESIGN DEVELOPMENT

This Section of the TM takes the technical concepts discussed above and develops the mainstream treatment system: i.e. membrane bioreactor (MBR), to upgrade a portion of the RWRF from a carbonaceous BOD removal facility to a simultaneous nitrification and denitrification (nitrogen removal) Title 22 water reclamation facility capable of producing a high

quality, low nitrogen effluent. Primary effluent is treated through an MBR system, providing oxidation, nitrification-denitrification and solids separation in a single process.

Primary effluent will be first pumped through fine screens and will then flow into the bioreactor (aeration basin) and then into the membrane tanks. The membrane permeate will be pumped to the UV system for disinfection prior to transfer into the storage basin. Two alternative locations are considered for membrane tanks – 1) conversion of secondary clarifier 5 2) a separate membrane tank. Figures 9-1 and 9-2 show the overall layouts for the MBR system for these two options. Detailed analysis of each option is presented later on in this document.

### 9.2.1 Capacity Analysis

As mentioned above and agreed upon during Workshop No.1, one of the secondary clarifiers in train A will be converted to the aeration basin associated with MBR. The capacity of the MBR system will be determined based on the amount of flow that the converted secondary clarifier can handle to achieve NDN. The basin will be compartmentalized to incorporate anoxic and oxic zones. The design criteria in Table 9-1 were developed as the basis for capacity analysis.

**Table 9-1: Design Criteria for Capacity Analysis of MBR Aeration Basin to Achieve NDN**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Flow Peaking Factor | - | 1.23 | Peak:Average ratio |
| Primary Effluent | - | - | Max month values |
| BOD | mg/L | 224 | 70% of raw wastewater |
| TSS | mg/L | 120 | 40% of raw wastewater |
| TKN | mg/L | 30 | 65% of raw wastewater |
| MLSS | mg/L | 10,000 | |
| SRT (Minimum) | days | 6 | Oxic zone |
| Anoxic:Oxic Zone Ratio (Minimum) | - | 0.3 | |
| Total Volume of Basin | MG | 2.3 | One secondary clarifier |
| Maximum Oxygen Uptake Rate | mg/L-hr | 135 | For peak flow |

Based on the above design criteria, the average flow that a converted secondary clarifier in Train A can handle was determined to be 12 mgd, corresponding to a peak flow of 14.76 mgd. These values were used to size the other equipment and structures associated with the MBR system.

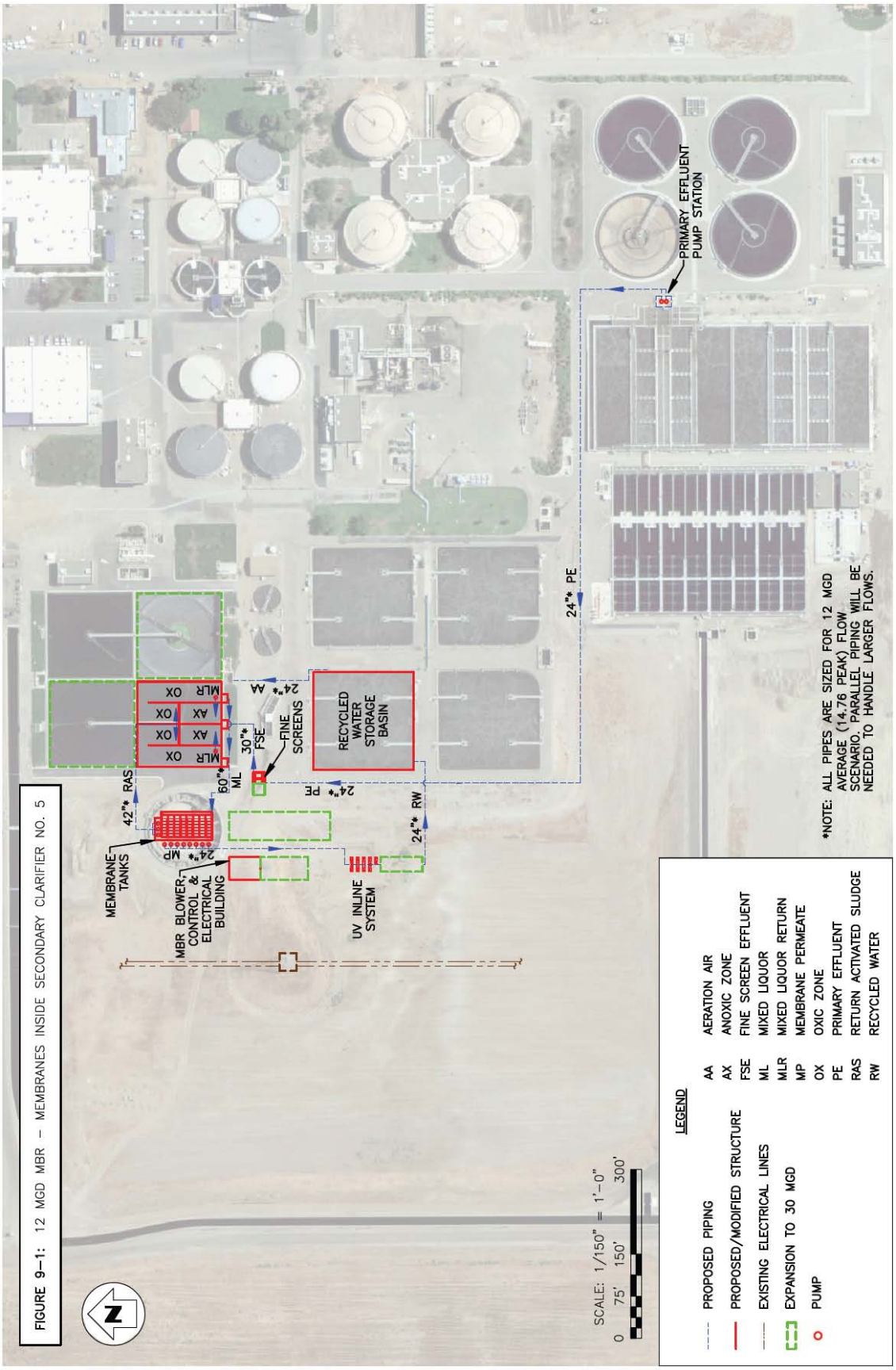


**FIGURE 9–1:** 12 MGD MBR – MEMBRANES INSIDE SECONDARY CLARIFIER NO. 5

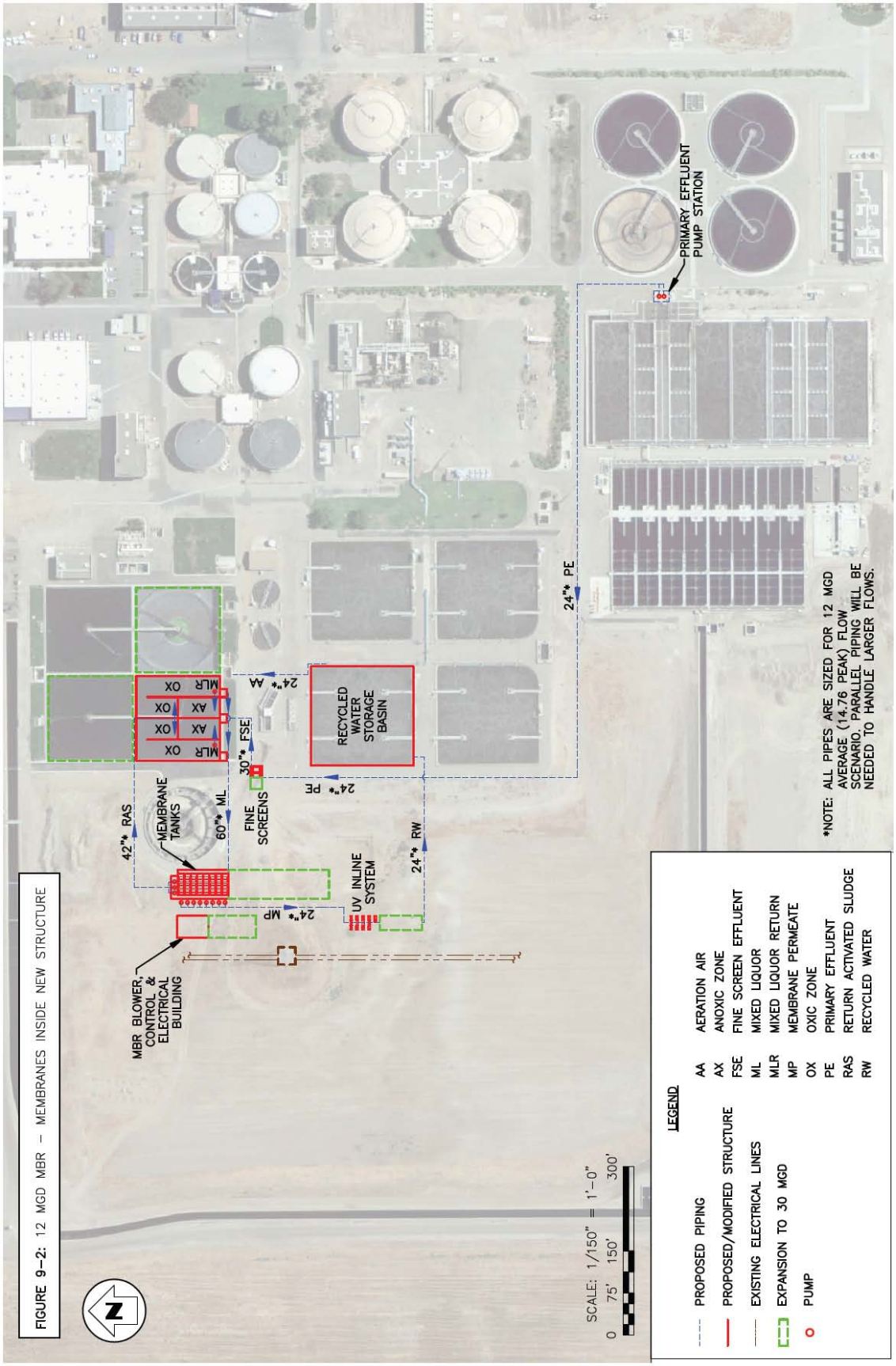


**FIGURE 9–2:** 12 MGD MBR – MEMBRANES INSIDE NEW STRUCTURE

### 9.2.2 Primary Effluent Pumps

The existing aeration basin distribution structure located on the east side of Train B will be modified to house the primary effluent pumps. These pumps will pump the desired flow from the distribution structure to fine screens. Table 9-2 shows the design characteristics for the pumps.

**Table 9-2: Primary Effluent Pumps Design Characteristics**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Type | | | Vertical propeller |
| Number | - | 2 (1+1) | |
| Capacity, Each | gpm | 10,300 | Wet weather peak will not be handled in MBR |
| TDH | ft | 20 | |
| Horsepower | hp | 100 | |
| Drive | | | Variable speed |

### 9.2.3 Fine Screens

There are different types of fine screens which could be used in an MBR facility; in-channel rotary drum screen, internally-fed rotary drum screen, and band screen. The first type, i.e. **in-channel rotary drum**, consists of an inclined screen basket, placed within a channel, and is equipped with an integrated auger for dewatering/compaction of collected screenings. The second type, i.e. **internally-fed rotary drum**, is a skid-mounted unit. The screen basket is installed in a horizontal configuration. Wastewater is fed into the unit, flows over the weirs and free falls into the screen basket. The screenings need to be handled by a separate dewatering unit. This type of screen requires more available head due to the free-fall condition. The third type, i.e. **band screen**, consists of several perforated plates joined together similar to a conveyor belt. The unit is installed vertically in a channel. Wastewater is fed into the center of the unit and flows across the plates out of the unit. There have been performance issues associated with this type of screen in the past during operation. The product, however, has reportedly been improved over the past few years.

The in-channel rotary drum screen was selected for consideration in this technical memorandum due to its apparent simplicity. By way of illustration, collection and dewatering of screenings are accomplished in a single unit as noted above. A dispenser holding a roll of plastic tubes is mounted at the discharge of the screenings dewatering auger such that the plant operator can pull down a portion of the plastic tube to form a bag to receive the screenings, thus containing the odor of the screenings in the bag and avoiding nuisances like flies or other insects. Nonetheless, it is Parsons' intent that if the MBR alternative is selected, all three types of fine screens will be evaluated for their reliability and cost-effectiveness, as well as odor control requirements and ease of screenings removal during the detail design. The best screens will be provided accordingly.

As shown on Figures 9-2 and 9-3, the fine screens will be located southwest of secondary clarifier No. 4 of Train A. Two fine screens would be installed with one of the units as standby. Each screen would be capable of handling the peak flow of 14.76 mgd. The units would be installed in concrete channels equipped with isolation gates to allow for maintenance without interfering with the plant's operation. Each fine screen would be equipped with an integrated washer/compactor for cleaning and concentrating the screenings prior to disposal off site.

The design characteristics for the fine screens and washer/compactors are shown in Table 9-3.

**Table 9-3: Design Characteristics of Fine Screens and Washer/Compactors**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Screens | | | |
| Type | - | - | In-channel perforated-plate drum |
| Number | - | 2 (1+1) | |
| Capacity, Each | mgd | 14.9 | |
| Effective Opening Size | mm | 2 | |
| Channel Width | ft | 8.5 | Width at screen |
| Screenings Handling | | | |
| Type | - | - | Washer, dewatering, compactor unit |
| Number | - | 2 (1+1) | Integrated with screens |
| Motor Power, Each | hp | 3 | Also powers screen basket |

### 9.2.4 Bioreactors and Associated Equipment

This subsection describes the structures and equipment located downstream of fine screens and upstream of membrane tanks.

***Bioreactor (Aeration Basin):***

As mentioned above, one of the secondary clarifiers of Train A (clarifier No. 4) will be converted to aeration basin. To provide redundancy, the clarifier will be retrofitted to accommodate two bioreactors, each divided into anoxic and oxic zones, with the first quarter of each bioreactor dedicated to the anoxic zone. Baffles would be placed in the bioreactors to separate the anoxic and oxic zones to minimize back-mixing as the flow passes through in a plug flow regime. Additional baffling would be used to divide each anoxic and oxic zone into 3 compartments, again to minimize back-mixing. The plug flow conditions increase the efficiency of biological treatment, optimizing carbonaceous matter removal, nitrification and denitrification. Submersible mixers would be used to provide mixing in the anoxic zones. Table 9-4 provides the design characteristics of the bioreactors.

**Table 9-4: Bioreactors Design Characteristics**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Bioreactors | | | |
| Number (In Parallel) | - | 2 | Converted secondary clarifier No. 4 |
| Volume, Each | MG | 1.15 | |
| Anoxic Zone | | | |
| Number per Bioreactor | - | 1 | |
| Dimensions of Zone (L x W x SWD), Each | ft x ft x ft | 75 x 37 x 14 | |
| Number of Compartments per Zone | - | 3 | Equal volume (in series) |
| Oxic Zone | | | |
| Number per Basin | - | 1 | |
| Dimensions of Zone (L x W x SWD), Each | ft x ft x ft | 225 x 37 x 14 | |
| Number of Compartments per Zone | - | 3 | Equal volume (in series) |
| Anoxic Zone Mixers | | | |
| Type | | | Submersible |
| Number per Compartment | - | 1 | |
| Total Number | - | 7 (6+1) | One shelf spare |
| Horsepower, Each | hp | 4 | |

***Aeration System:***

The air will be transferred to the oxic zones in the bioreactors through fine bubble diffusers. Either EPDM Membrane disks or more efficient aerator strips (e.g. AEROSTRIPTM), would be used to provide aeration. The aeration would be tapered so that approximately 70% of the oxygen is provided in the first half of the oxic zone to satisfy the high oxygen demand as the substrate enters the oxic zone.

The required air will be supplied to the oxic zones by the existing blowers. These blowers are of single-stage centrifugal type and have enough capacity to serve the biological needs of the MBR process as well as the remaining plant. The existing 24 inch air pipeline of aeration basin No. 3 will be used and extended to supply the air to the bioreactors. As discussed in Section 6, aeration basin No. 3 will no longer be in service and will be used as recycled water storage in the future.

The design characteristics for the aeration system are presented in Table 9-5.

**Table 9-5: Aeration System Design Characteristics**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Diffusers | | | |
| Type | | | Fine bubble, membrane (EPDM) disk or strip type |
| Aeration Pattern | | | Tapered along bioreactor length |
| Process Air Blowers | | | |
| Type | | | Single-stage centrifugal |
| Number | - | 6 (5+1) | Existing blowers |
| Capacity, Each | scfm | 27,000 | |
| Discharge Pressure | psig | 7.8 or 8.5 | 4 units at 7.8 and 2 units at 8.5 |
| Horsepower | hp | 1,500 | |

***Mixed Liquor Return and Sludge Recirculation Pumps:***

Two recirculation lines are provided in the MBR system; mixed liquor return and sludge recirculation. The mixed liquor return system transfers mixed liquor from the tail end of the oxic zone back to the head of the anoxic zone at a rate up to four times the average flow. This system transfers nitrates resulting from nitrification back to the anoxic zone for denitrification as the oxygen molecules associated with nitrates are used by the biomass.

The sludge recirculation system transfers sludge from the membrane tanks to the head of the oxic zone at a rate also up to four times the average flow. The recirculation system prevents the solids concentration in the membrane tanks from increasing excessively as permeate is removed from the mixed liquor. This sludge is highly oxygenated and provides a portion of the process oxygen needed for BOD removal and nitrification.

Sludge will be wasted from the MBR system from the membrane tanks. New pumps will be installed for this purpose.

The design characteristics for the recirculation and waste pumps are presented in Table 9-6.

**Table 9-6: Sludge Pumping Systems Design Characteristics**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Mixed Liquor Return Pumps | | | Returning flow from oxic zone to anoxic zone |
| Type | | | Axial propeller |
| Number | - | 3 (2+1) | One shelf spare |
| Capacity, Each | gpm | 16,700 | |
| TDH | ft | 3 | |
| Horsepower | hp | 30 | |
| Drive | | | Variable speed |
| Sludge Recirculation Pumps | | | Returning flow from membrane tanks to oxic zone |
| Type | | | Vertical propeller |
| Number | - | 3 (2+1) | |
| Capacity, Each | gpm | 16,700 | |
| TDH | ft | 20 | |
| Horsepower | hp | 150 | |
| Drive | | | Variable speed |
| WAS Pumps | | | |
| Type | | | Centrifugal |
| Number | - | 2 (1+1) | |
| Capacity, Each | gpm | 1,000 | |
| TDH | ft | 20 | |
| Horsepower | hp | 7.5 | |
| Drive | | | Variable speed |

### 9.2.5 Membranes

The membranes will be installed in 8 independent tanks. Two options were considered for the location of membranes; inside secondary clarifier No. 5 (Figure 9-2) and in a completely new structure (Figure 9-3). In the first option, the existing secondary clarifier No. 5 would be modified by removing the mechanisms and raising the bottom to house the membrane tanks. In the second option, the membrane tanks will be constructed east of secondary clarifier No. 5.

For the purpose of this Section, hollow-fiber membranes were considered. The following design criteria were developed as the basis for sizing the membranes:

- Minimum wastewater temperature of 16°C.
- Maximum flux rate of 14 gfd at average flow (all membrane tanks in service).
- Maximum flux rate of 20 gfd at peak flow (one membrane tank out of service).

Eight membrane tanks, each housing 6 membrane cassettes plus space for a future cassette, would have enough capacity to handle 12 mgd of flow. The tankage would be configured to allow isolation of a tank for maintenance and cleaning.

Permeate pumps will draw the MBR effluent through the membranes, directing it to the disinfection system. A building would house new air scouring blowers and membrane control and electrical system. The building would be located adjacent to the membrane structure.

As an alternative to installing new air scouring blowers, the existing single-stage blowers could be used for membrane scouring and also to provide the process air with proper piping and valves to address the different pressure requirements at membrane tanks and bioreactors. Although this approach is technically feasible, based on Parsons' experience, this would complicate the operation of the plant and result in inefficient long term operation. Dedicating one or two of the single-stage blowers to air scouring is not recommended as the maximum required scour air for the 12-mgd plant is only about half of the capacity of each blower. Using these blowers would require them to operate at half the full rated capacity and will result in an inefficient operation of the blowers. Therefore, separate air scour blowers are recommended.

Table 9-7 summarizes the design characteristics of the MBR membrane system.

**Table 9-7: MBR Membrane System Design Characteristics**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Tanks | | | |
| Number | - | 8 | |
| Cassettes per Tank | | | |
| Number of Installed | - | 6 | |
| Space for Future | - | 1 | |
| Total Membrane Surface Area | $ft^2$ | 852,480 | |
| Air Scouring Blowers | | | |
| Type | | | High-speed turbo |
| Number | - | 3 (2+1) | |
| Capacity, Each | scfm | 7,900 | |
| Discharge Pressure | psi | 5 | |
| Horsepower, Each | hp | 250 | |
| Drive | | | Variable speed |

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Permeate Pumps | | | |
| Type | | | Horizontal end suction |
| Number | - | 9 (8+1) | One shelf spare |
| Capacity, Each | gpm | 1,700 | |
| TDH | ft | 25 | |
| Horsepower, Each | hp | 20 | |
| Drive | | | Variable speed |
| Backpulse Pumps | | | |
| Type | | | Horizontal end suction |
| Number | - | 2 (1+1) | |
| Capacity, Each | gpm | 1,480 | |
| TDH | ft | 25 | |
| Horsepower, Each | hp | 30 | |
| Drive | | | Variable speed |
| Instrument Air Compressors | | | If Plant air not available |
| Number | - | 2 (1+1) | |
| Horsepower, Each | hp | 15 | |
| Chemical Cleaning | | | |
| Sodium Hypochlorite | | | 12.5% Solution |
| Frequency | | | |
| Recovery | Yearly | 2 | Per tank |
| Maintenance | Weekly | 1 | Per tank |
| Annual Consumption | gal | 7,900 | |
| Citric Acid | | | 50% Solution |
| Frequency | Yearly | 1-2 | Part of Recovery Clean |
| Annual Consumption | gal | 1,500 | |

## 9.3 DISINFECTION

During Workshop No.1, as is the case with Plans B and C, the City directed Parsons to consider in-pipe UV disinfection for Plan A. It was also decided during the workshop that smaller (1 MGD capacity) reactors be considered for preliminary design and cost estimates. The 1 MGD rating for each reactor is based upon high quality membrane permeate feed such as from the MBR system. Nine reactor trains (8 operating + one standby) will be required to disinfect 12 mgd average flow (12 x 1.23 = 14.7 peak flow) and each train will accommodate two reactors. Table 9-8 presents the design criteria for the in-pipe UV disinfection system. There are several larger in-pipe reactors currently available from other manufacturers that may be more economical for

the present project and may be considered later during detailed design.

**Table 9-8: In-pipe UV Disinfection Design Characteristics**

| Parameter | Criteria |
|---|---|
| Design Flow (Average), mgd | 12 |
| Peaking Factor | 1.23 |
| Type of UV System | In-pipe, Low Pressure, High Intensity |
| Number of Reactors | 18 (8 trains + 1 standby) each train has 2 reactors |
| Flow Capacity per Reactor, mgd | 1.0 |
| Length of Reactor (ft) | 8 |
| Number of Lamps per Reactor | 40 |
| Total Number of Lamps Provided | 720 |

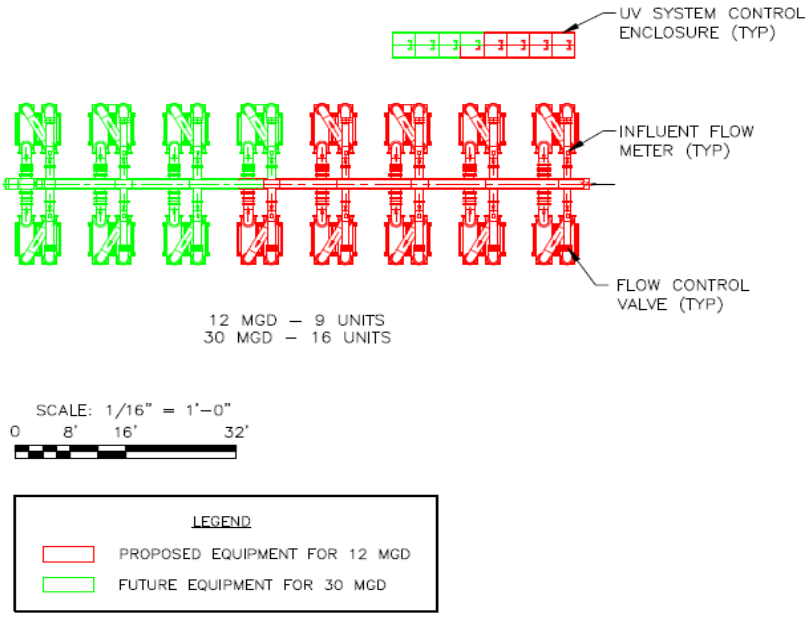


**Figure 9-3: In-pipe UV Disinfection System Preliminary Layout**

## 9.4 CONSTRUCTABILITY AND EXPANSION

It is critical that the treatment plant operation not be impacted by the construction activities. The plant must, at all times, be capable of performing at the level required to achieve the water quality standards set by its permit.

The major new construction associated with the MBR system will be the fine screens, bioreactors, membrane structure, and blower building. In case of fine screens, membrane structure, and blower building, construction will be performed in areas that are not associated with the present operation of the plant. This would allow the construction of these facilities to take place independent of the current operation. In case of bioreactors, modifications of one of the secondary clarifiers should not impact the plant operation as one of the square clarifiers is currently not being used. Minor construction activities, as necessary, can be performed

during periods of low flow to avoid negative impacts on the plant performance. Finally, sequencing of construction will be necessary when making connections to existing piping and the plant electrical and control systems; these constraints will be carefully developed and specified in the contract documents.

The ultimate capacity of the Fresno TTDF is planned to reach an average flow of 30 mgd. Additional fine screens, bioreactors, membrane tanks, and blowers will be needed to handle the ultimate capacity. As shown in Figures 9-2 and 9-3, space has been provided for the above equipment/structures, adjacent to the proposed facilities, to accommodate the future expansion.

## 9.5 PRELIMINARY COSTS

Preliminary costs are developed for two scenarios. The only difference between two scenarios is the location of the membranes; inside the secondary clarifier No. 5 and outside the clarifier in a completely new structure. At this point in the design process, these costs are preliminary and should be used only for comparative purposes.

The costs are estimated using several resources. The quotes from the manufacturers, information available from the similar projects performed by Parsons, and also our own experience, including construction in the Central Valley, were used to determine the costs.

The capital costs for the two scenarios are shown in Table 9-9. For both scenarios, a credit for conventional NDN is included. This is the investment the City would need to make on secondary treatment system, if the plant had to be upgraded to NDN process using conventional tertiary filters rather than MBR. As can be seen, locating the membranes inside the secondary clarifier No. 5 would result in $0.5 million additional cost to the City. This is mainly due to the substantial modifications required to the clarifier before it can accommodate the membranes.

**Table 9-9: Plan A Capital Cost (12 mgd) [a]**

| Parameter | Capital Cost ($ Million) | |
|---|---|---|
| | Membranes Inside Secondary Clarifier No. 5 | Membranes in New Structure |
| MBR Equipment and Structures Cost | 15.5 | 15.1 |
| MBR Total Capital Cost [b] | 44.2 | 43.7 |
| Credit for Conventional NDN [b,c] | (8.9) | (8.9) |
| MBR Total Capital Cost Including NDN Credit | 35.3 | 34.8 |
| UV Disinfection Total Capital Cost [b] | 12.9 | 12.9 |
| Storage (Aeration Basin No.3) Total Capital Cost [b] | 3.1 | 3.1 |
| **Plan A Total Capital Cost** | **51.3** | **50.8** |

[a] For detailed cost analysis see Appendix A.
[b] Including installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013)
[c] NDN credit based on constructing additional facilities (one aeration basin and installing new equipment such as mixed liquor recycle pumps) if the City were to choose conventional filters instead of MBR and were required to achieve NDN in the conventional secondary treatment process.

An evaluation of the operation and maintenance (O&M) cost was also performed (Table 9-10). As was the case for capital cost, credit is given for operation of secondary treatment of a conventional NDN plant. The O&M cost for both scenarios is the same.

**Table 9-10: Plan A O&M Cost (12 mgd) [a]**

| Parameter | O&M Cost ($) |
|---|---|
| MBR Total Annual O&M Cost [b,c] | 1,834,000 |
| Credit for Conventional NDN [b,c] | (670,000) |
| MBR Total Annual O&M Cost Including NDN Credit | 1,164,000 |
| UV Disinfection Total Annual O&M Cost [c] | 271,000 |
| Recycled Water Storage and Distribution Pumping Annual O&M Cost | 680,000 |
| Plan A Total Annual O&M Cost | 2,115,000 |

[a] For detailed cost analysis see Appendix A.
[b] Including power and chemicals consumption, membrane/diffusers replacement, general maintenance, and labor.
[c] Assuming power usage rate of 14¢ per kWh.

Using the estimated capital and O&M costs, a 20-year life cycle cost analysis was performed. The results are shown in Table 9-11. The option of housing the membranes in new structure is presented in Table 9-11 as the Plan A Life-Cycle Cost.

**Table 9-11: Plan A Life-Cycle Cost (12 mgd)**

| Parameter | Capital Cost ($ Millions) | O&M Cost ($ Thousands) | 20-Year Life Cycle Cost ($ Millions) |
|---|---|---|---|
| **MBR System** | 34.8[1] | 1,165[1] | 55.9 |
| **Disinfection (In-pipe UV)** | 12.9 | 270 | 17.8 |
| **Storage (Aeration Basin No.3) and Distribution Pumping** | 3.1 | 680 | 15.4[2] |
| **TOTAL** | 50.8 | 2,115 | 89.1 |

[1]Includes credit for conventional NDN
[2]Although the life of the storage structure is 50 years, a 20 year life cycle cost is presented for consistency.

## 9.6 ADVANTAGES AND DISADVANTAGES OF PLAN A VERSUS PLANS C

Section 11 of this TM summarizes the advantages and disadvantages of Plan A versus Plan C. Both Plans A and C are of 12 mgd capacity, while Plan B is 5 mgd in capacity and therefore will not be used to compare against Plan A.

Subsequent to Workshop No.2 (Section 14), The City further refined the MBR alternative(s), which are discussed in detail in Section 15 of this TM.

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# SECTION 10 - PLANS B AND C: NOVA FILTRATION, UV DISINFECTION AND STORAGE SCHEMES

## 10.1 BACKGROUND

Per Workshop No.1 (Section 8 of this TM), Plans B and C, which include Nova ultrascreen filter, are discussed under this Section.

Several key decisions regarding filtration schemes were made during Workshop No.1, which are summarized below.

- Nova ultrascreen filters will be used for both Plans B and C as filtration system of choice.
- UV Inline System (1 mgd capacity) will be used for disinfection of filtered effluent. Final selection of the UV system will be made during detailed design and will be based on competitive bidding between 1 mgd reactors and lager size reactors (2.3 mgd and others, as applicable).
- A pre-stressed concrete tank (5 MG capacity) will be used to store the recycled water.
- Plan B will have a treatment capacity of 5 mgd (constant flow – no peaking factor) with provisions for phased expansion to 30 mgd of ultimate capacity.
- Plan C will have a treatment capacity of 12 mgd (constant flow – no peaking factor) with provisions for phased expansion to 30 mgd of ultimate capacity.

Figure 10-1 below presents the schematic for Plans B and C.

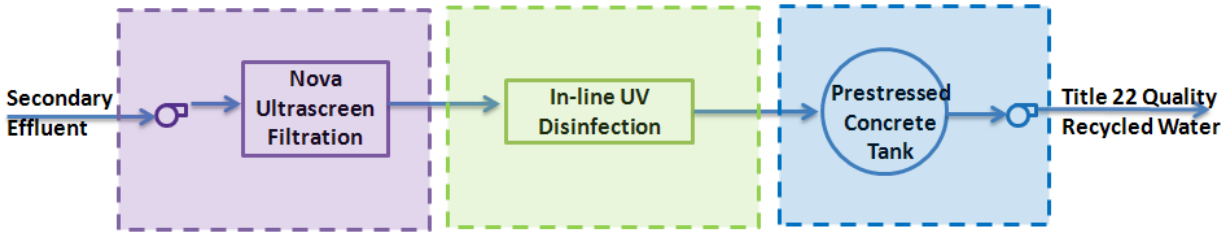


**Figure 10-1: Selected Filtration, Disinfection, and Storage Scheme**

## 10.2 EVALUATION OF CONVENTIONAL FILTRATION PLANS (PLAN B AND PLAN C)

### 10.2.1 Plan B (5 mgd Capacity)

Under this scheme, the TTDF will be fed from distribution canal "B" from which secondary effluent can be withdrawn at a constant rate of 5 mgd, even during periods of low influent flow. Considering this, the TTDF under Plan B will have a capacity of 5 mgd of constant flow (i.e. no flow peaking factor considered).

The design criteria for Plan B are summarized in Table 10-1 and the preliminary construction, O&M, and life-cycle cost estimates for Plan B are presented in Table 10-2. Note that, as per the

decision made during Workshop No. 1, 1 mgd capacity in-pipe UV reactors are considered; however, due to the lower quality of filtered water produced with conventional filtration, an in-pipe UV reactor rated at 1 mgd when treating high quality membrane permeate is de-rated to 0.55 mgd when treating conventional filtrate. Figures 10-2 and 10-3 present the preliminary layout drawings for the Nova Ultrascreen filters and the in-pipe UV disinfection system, respectively. The layout drawings show the facilities for initial capacity of 5 mgd (i.e. the equipment required for Plan B) as well as for phased expansions to 15 mgd and 30 mgd.

**Table 10-1: Plan B Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Flow, mgd** | 5 (constant flow) |
| **Filtration – Nova Ultrascreen** | |
| **CDPH Approved Filtration Rate, gpm/ft$^2$** | 16 |
| **Number of Filter Units** | 2 |
| **Number of Disks per Unit** | 10 |
| **Total Filtration Area, ft$^2$** | 444 |
| **Filtration Rate with One Filter Offline, gpm/ft$^2$** | 15.6 |
| **Headloss Through Filter, ft (Operating)** | 2 - 2.5 |
| **Disinfection – Inline UV** | |
| **Type of UV System** | In-pipe, Low Pressure, High Intensity |
| **Number of Reactors** | 12 (5 trains + 1 standby) each train has 2 reactors |
| **Flow Capacity per Reactor, mgd** | 0.55 |
| **Length of Reactor (ft)** | 8 |
| **Number of Lamps per Reactor** | 40 |
| **Total Number of Lamps Provided** | 480 |
| **Storage – Prestressed Concrete Tank** | |
| **Design Capacity, mg** | 5 |
| **Number of Tanks** | 1 |
| **Dimensions of Tank, Diameter (ft) x Side Water Depth (ft)** | 178 x 28 |

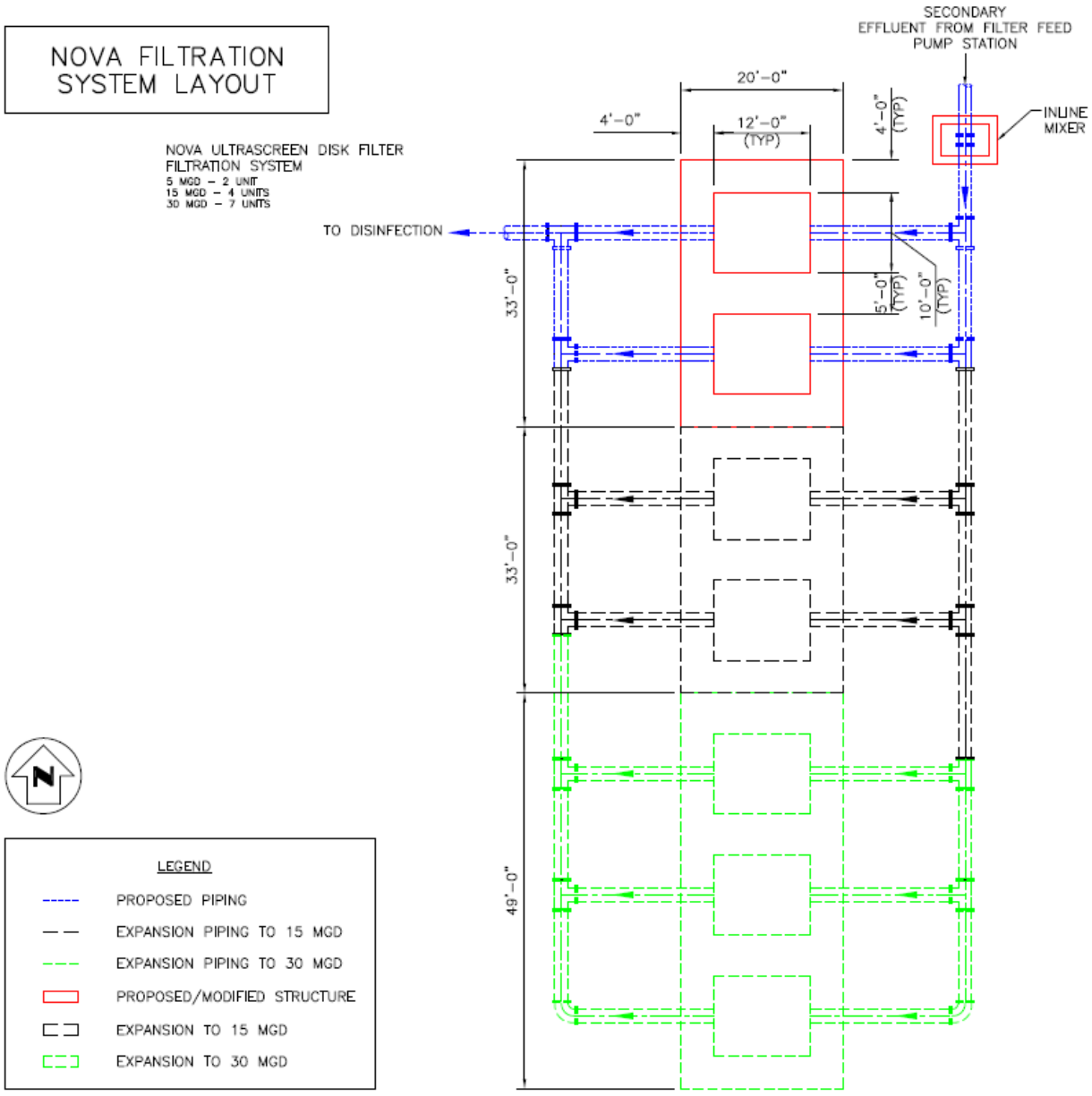


**Figure 10-2: Plan B Nova Ultrascreen Filter Preliminary Layout**

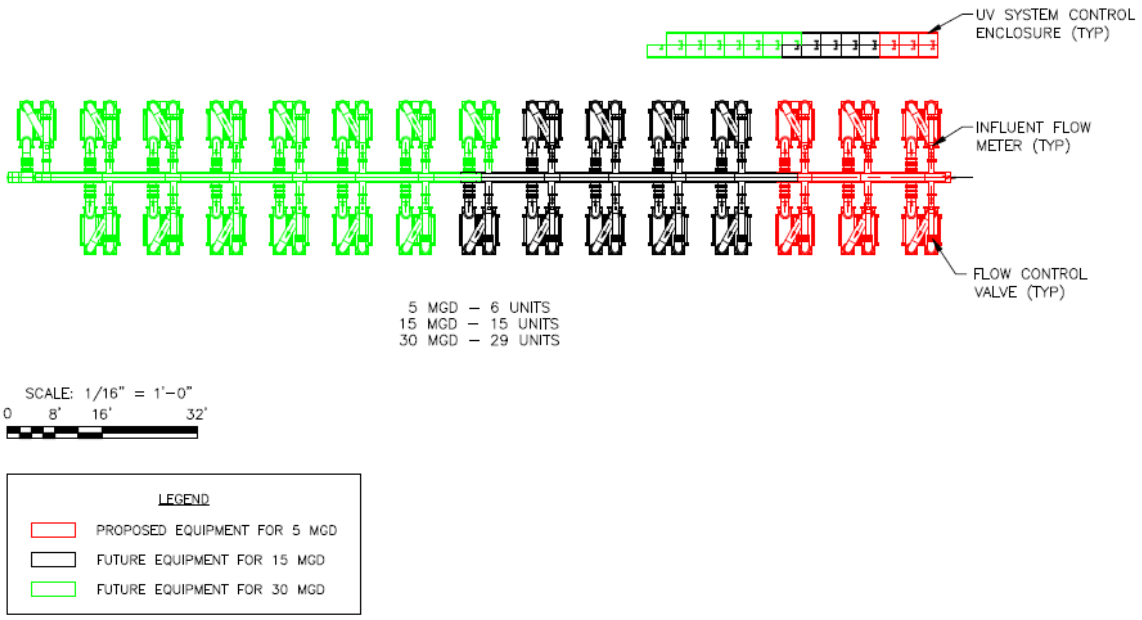


**Figure 10-3: Plan B UV Disinfection System Preliminary Layout**

**Table 10-2: Plan B (5 mgd Capacity) Preliminary Cost Summary**

| Parameter | Capital Cost ($ Millions) | O&M Cost ($ Thousands) | 20-Year Life Cycle Cost ($ Millions) |
|---|---|---|---|
| **Filters (Nova Ultrascreen)** | 4.2 | 100 | 6.0 |
| **Disinfection (In-pipe UV)** | 6.5 | 230 | 10.6 |
| **Storage (5 MG Circular Prestressed Concrete Tank) and Distribution Pumping** | 7.5 | 290 | 12.7[1] |
| **TOTAL** | 18.2 | 620 | 29.3 |

[1]Although the life of the storage structure is 50 years, a 20 year life cycle cost is presented for consistency.

### 10.2.2 Plan C (12 mgd Capcity)

The TTDF under Plan C is similar to Plan B discussed above, except that it has a capacity of 12 mgd of constant flow (i.e. no flow peaking factor considered). As discussed in Section 10, Plan A, which incorporates an MBR system in place of conventional filtration, has a capacity of 12 mgd. In order to compare the use of a MBR system to the use of conventional tertiary filtration, the design criteria, preliminary layout drawings, and preliminary construction, O&M, and life-cycle cost estimates for Plan C have been developed.

The design criteria for Plan C are summarized in the Table 10-3 and the preliminary construction, O&M, and life-cycle cost estimates are presented in Table 10-4. Figures 10-4 and 10-5 present the preliminary layout drawings for the Nova Ultrascreen filter and the in-pipe UV

disinfection system, respectively. Note that the Nova Ultrascreen units proposed for Plan C (16 disk units) are larger than the units proposed for Plan B (10 disk units). The layout drawings show the initial capacity of 12 mgd as well as the expansion to 30 mgd.

**Table 10-3: Plan C Design Criteria**

| Parameter | Criteria |
|---|---|
| **Design Flow, mgd** | 12 (constant flow) |
| **Filtration** | |
| **CDPH Approved Filtration Rate, gpm/ft$^2$** | 16 |
| **Number of Filter Units** | 3 |
| **Number of Disks per Unit** | 16 |
| **Total Filtration Area, ft$^2$** | 1,056 |
| **Filtration Rate with One Filter Offline, gpm/ft$^2$** | 11.8 |
| **Headloss Through Filter, ft (Operating)** | 2 - 2.5 |
| **Disinfection** | |
| **Type of UV System** | In-pipe, Low Pressure, High Intensity |
| **Number of Reactors** | 24 (11 trains + 1 standby) each train has 2 reactors |
| **Flow Capacity per Reactor, mgd** | 0.55 |
| **Length of Reactor (ft)** | 8 |
| **Number of Lamps per Reactor** | 40 |
| **Total Number of Lamps Provided** | 960 |
| **Storage** | |
| **Design Capacity, mg** | 5 |
| **Number of Tanks** | 1 |
| **Dimensions of Tank, Diameter (ft) x Side Water Depth (ft)** | 178 x 28 |

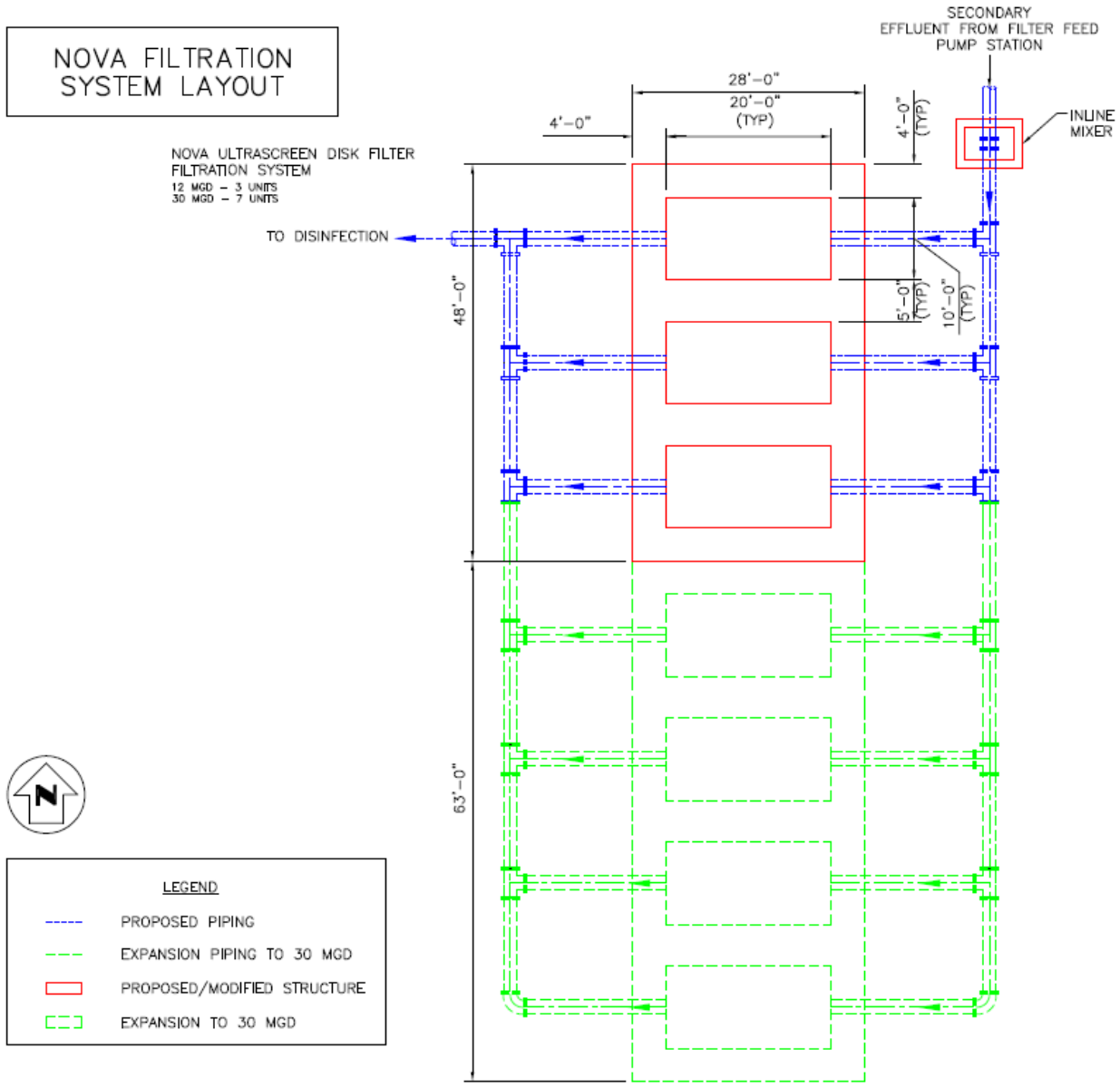


**Figure 10-4: Plan C Nova Ultrascreen Filter Preliminary Layout**

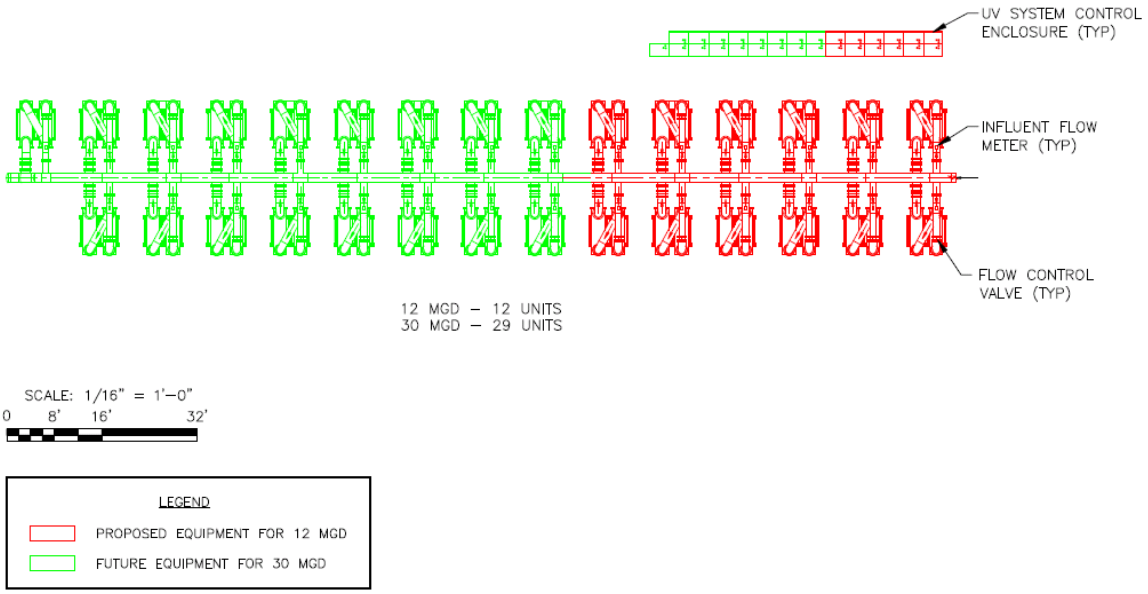


**Figure 10-5: Plan C UV Disinfection System Preliminary Layout**

**Table 10-4: Plan C (12 mgd Capacity) Preliminary Cost Summary**

| Parameter | Capital Cost ($ Millions) | O&M Cost ($ Thousands) | 20-Year Life Cycle Cost ($ Millions) |
|---|---|---|---|
| **Filters (Nova Ultrascreen)** | 7.3 | 155 | 10.1 |
| **Disinfection (In-pipe UV)** | 13.5 | 465 | 21.9 |
| **Storage (5 MG Circular Prestressed Concrete Tank) and 12 mgd Distribution Pumping** | 7.7 | 680 | 19.9[1] |
| **TOTAL** | 28.5 | 1,300 | 51.9 |

[1]Although the life of the storage structure is 50 years, a 20 year life cycle cost is presented for consistency.

## 10.3 ADVANTAGES AND DISADVANTAGES OF PLAN A VERSUS PLANS C

Section 11 of this TM summarizes the advantages and disadvantages of Plan A versus Plan C. Both Plans A and C are of 12 mgd capacity, while Plan B is 5 mgd in capacity and therefore will not be used to compare against Plan A.

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# SECTION 11 – COMPARISON OF MBR SYSTEM WITH NOVA FILTRATION SYSTEM (PLAN A VS. PLAN C)

## 11.1 BACKGROUND

In this section, the Plan A (described in Section 9) and Plan C (described in Section 10) will be compared. The advantages and disadvantages of each Plan are presented along with preliminary construction, O&M, and life-cycle cost estimates of each Plan.

Under Plan A, the TTDF will produce an average of 12 mgd of denitrified Title 22 quality effluent and will be designed to handle peak flows of up to 14.76 mgd. The use of existing Train A facilities will be maximized: a secondary clarifier will be converted into a bioreactor for achieving organic and nitrogen (NDN) removal, a new structure will house the membranes, and Aeration Basin No. 3 will be converted into a recycled water storage tank. The option of housing the membranes in a new structure as opposed to inside secondary clarifier No. 5 is considered for Plan C due to lower cost (refer to Section 9). Under Plan C, the TTDF will produce 12 mgd of Title 22 quality effluent without a flow peaking factor. The TTDF feed water will be withdrawn from distribution Canal B at a constant rate of 12 mgd. No modifications to the upstream biological treatment facilities will be made - thus, the recycled water produced under Plan C will contain nitrogen in the form of ammonia, nitrates, and nitrites at concentrations approximately equal to current secondary effluent concentrations.

## 11.2 COMPARISON OF PLAN A AND PLAN C

The major difference between Plan A and Plan C is the means of filtration: Plan A will utilize membrane filtration (MBR) while Plan C utilizes media filtration (Nova Ultrascreen). This section will primarily focus on the benefits and drawbacks of these technologies.

The difference in filtration technology allows Plan A to achieve nitrogen removal without additional tanks, use an existing aeration basin for recycled water storage, and achieve disinfection meeting NWRI guidelines with a smaller UV disinfection system. These benefits are reflected in the preliminary Plan A construction, O&M, and life-cycle cost estimate.

### 11.2.1 Ease of Expandability

Figures 11-1 and 11-2 below show the preliminary layout drawings for Plan A and Plan C, respectively. The preliminary layout drawings show the footprint for a 12 mgd TTDF (in red) and the future footprint for a 30 mgd TTDF (in green).

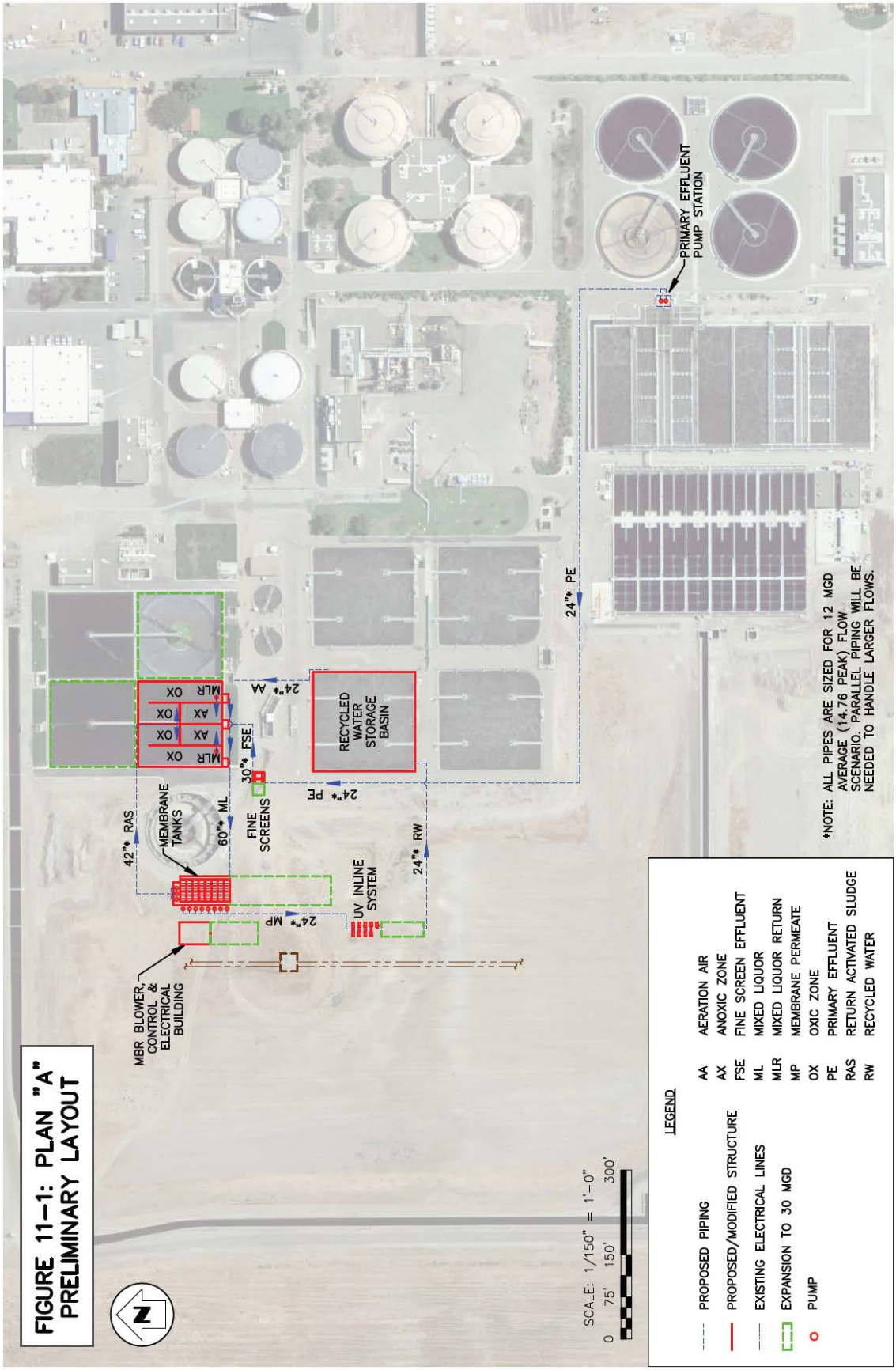
FIGURE 11-1: PLAN "A" PRELIMINARY LAYOUT
PRIMARY EFFLUENT PUMP STATION
24"* PE
RECYCLED WATER STORAGE BASIN
24"* AA
30"* FSE
24"* PE
MEMBRANE TANKS
42"* RAS
60"* ML
FINE SCREENS
UV INLINE SYSTEM
24"* RW
24"* MP
MBR BLOWER, CONTROL & ELECTRICAL BUILDING
MLR
OX
AX
*NOTE: ALL PIPES ARE SIZED FOR 12 MGD AVERAGE (14.76 PEAK) FLOW SCENARIO. PARALLEL PIPING WILL BE NEEDED TO HANDLE LARGER FLOWS.
SCALE: 1/150" = 1'-0"
0 75' 150' 300'
LEGEND
PROPOSED PIPING
PROPOSED/MODIFIED STRUCTURE
EXISTING ELECTRICAL LINES
EXPANSION TO 30 MGD
PUMP
AA AERATION AIR
AX ANOXIC ZONE
FSE FINE SCREEN EFFLUENT
ML MIXED LIQUOR
MLR MIXED LIQUOR RETURN
MP MEMBRANE PERMEATE
OX OXIC ZONE
PE PRIMARY EFFLUENT
RAS RETURN ACTIVATED SLUDGE
RW RECYCLED WATER

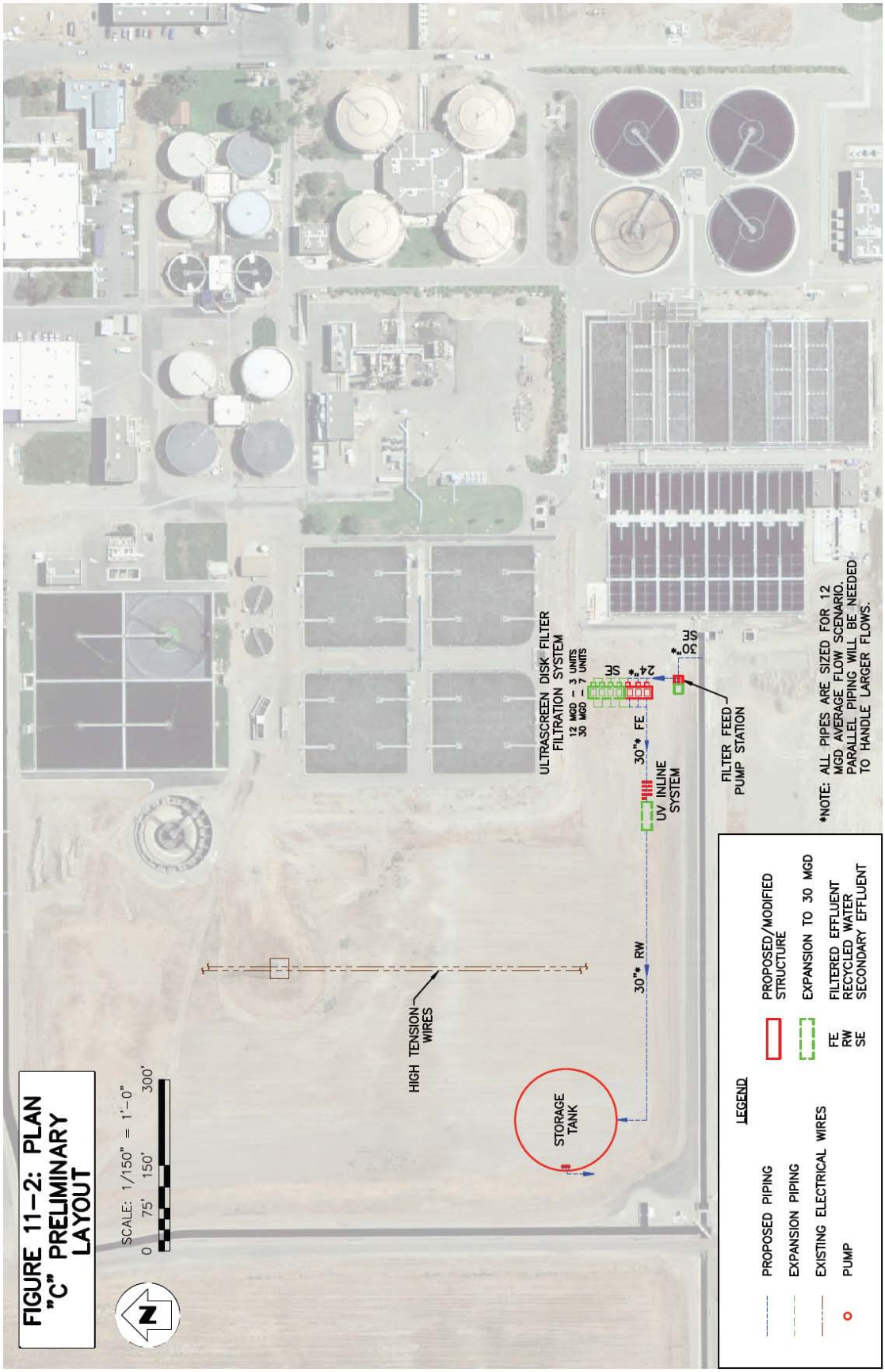
FIGURE 11–2: PLAN "C" PRELIMINARY LAYOUT
SCALE: 1/150" = 1'–0"
0 75' 150' 300'
N
HIGH TENSION WIRES
STORAGE TANK
30"ø RW
30"ø FE
UV INLINE SYSTEM
ULTRASCREEN DISK FILTER FILTRATION SYSTEM
12 MGD – 3 UNITS
30 MGD – 7 UNITS
SE
24"ø*
SE
30"ø*
FILTER FEED PUMP STATION
*NOTE: ALL PIPES ARE SIZED FOR 12 MGD AVERAGE FLOW SCENARIO. PARALLEL PIPING WILL BE NEEDED TO HANDLE LARGER FLOWS.
LEGEND
PROPOSED PIPING
EXPANSION PIPING
EXISTING ELECTRICAL WIRES
PUMP
PROPOSED/MODIFIED STRUCTURE
EXPANSION TO 30 MGD
FE FILTERED EFFLUENT
RW RECYCLED WATER
SE SECONDARY EFFLUENT

Under Plan C, additional facilities will need to be constructed in order to increase the TTDF capacity to 30 mgd; however, the expansion would be straightforward. Nova Ultrascreen filters are supplied as prefabricated, packaged units ready for "plug and play" installation. The site work will consist of the extension of the concrete equipment pad and an equipment canopy or a building.

Under Plan A, two additional secondary clarifiers will need to be converted to bioreactors and a new structure will need to be constructed to house the additional membrane modules required for increasing the TTDF capacity to 30 mgd. Even though new structures do not need to be built for the additional bioreactor capacity required, the existing secondary clarifiers will need to be modified and therefore the construction sequencing for the expansion of Plan A will be more complex than for the expansion of Plan C.

### 11.2.2 Reliability

Both Plan A and Plan C will be provided with features to ensure adequate reliability. As discussed in Section 4, the TTDF under Plan C will be designed with multiple Nova Ultrascreen filter units capable of treating the entire flow with one unit not in operation.

The TTDF under Plan A will be provided with eight independent membrane tanks, each with six membrane cassettes. Sufficient membrane area will be provided to allow for redundancy.

### 11.2.3 Constructability

Plan A maximizes the use of existing Train A facilities. The use of existing facilities will not impact the sequence of construction due to the fact that at least one of the units in Train A is typically out of service and construction can be performed on one unit at a time. The constructability of Plan C is slightly easier since no modifications of existing facilities are planned. The secondary effluent will simply be withdrawn from distribution Canal B and fed to the new TTDF.

It is our understanding that a minimum SRT of 5 days in the upstream biological treatment system is required prior to filtration with disk filters (including Nova Ultrascreen filters) for consistent effluent quality. If the existing biological system does not provide an SRT of at least 5 days, modifications to the pertinent secondary treatment facilities' operation will be required.

### 11.2.4 Simplicity of Operation

The treatment systems used in both Plan A and Plan C will be automated; however, since the MBR is a biological process as well as a filtration process, the operation of Plan A facilities will likely be somewhat more complex. However, trained and experienced City staff should be able to operate and maintain both the systems with similar ease.

### 11.2.5 History of Use

Nova Ultrascreen filters have a long history (~10 years) of use in overseas installations; however, the history of use in the US on municipal wastewater is limited. There are currently

no installations in California and the longest operating municipal wastewater installation in the US has been in operation for less than one year (in Orange Park, FL) and has a rated capacity of 3.0 mgd. If this filtration system is selected, site visits to a minimum of two operating installations is recommended to obtain firsthand knowledge of their performance and operation.

There are numerous MBR installations at municipal wastewater treatment plants producing water for recycle/reuse purposes and the history of use is well documented.

### 11.2.6 Environmental Impacts, Including Public Perception and Acceptance

While both Plan A and Plan C are capable of producing an effluent that meets the requirement for unrestricted reuse water as set forth by the Department of Public Health, Plan A far exceeds the requirements for unrestricted reuse water. In addition to conventional uses of reuse water, MBR treated water has been used by industry for cooling water applications because of its high quality as a feed to additional treatment units, such as reverse osmosis, ahead of manufacturing processes. MBR effluent is also being used as the feed water to advanced water treatment in indirect potable water systems.

In terms of environmental impacts such as energy efficiency, however, Plan A is more energy intensive - even when considering the credit of reduced UV disinfection power consumption. The estimated incremental power consumption for Plan A over Plan C is approximately 4,425 MWh per year (considering the power consumption credit for achieving nitrogen removal). This is primarily due to the power consumed by the air scour blowers and the sludge recirculation pumps.

### 11.2.7 Staffing Requirements

Plan A involving membrane system, requires relatively more operator attention due to the fact that periodic chemical cleaning and backwashing of membranes is required. Additionally more sophisticated controls are involved requiring skilled operators to run the system. Comparatively, Plan C is simpler to operate. For the purposes of this TM, we have estimated 1 FTE for Plan A. For Plan C the required hours are half of that of Plan A.

### 11.2.8 Preliminary Capital, O&M, and Life-Cycle Costs

Table 11-1 below presents preliminary capital, O&M, and life-cycle cost estimates for Plan A and Plan C.

**Table 11-1: Comparison of Plan A and Plan C Preliminary Capital, O&M, and Life-Cycle Costs**

| Parameter | Capital Cost ($ Millions) | O&M Cost ($ Thousands) | 20 Year Life-Cycle Cost ($ Millions) |
|---|---|---|---|
| **MBR (Train A)[1]** | 34.8 | 1,165 | 55.9 |
| **Disinfection (In-line UV)** | 12.9 | 270 | 17.8 |
| **Storage (Converted Train A Aeration Basin) and Distribution Pumping** | 3.1 | 680 | 15.4[2] |
| **Total Plan A Cost** | **50.8** | **2,115** | **89.1** |
| | | | |
| **Filters (Nova Ultrascreen)** | 7.3 | 155 | 10.1 |
| **Disinfection (In-line UV)** | 13.5 | 465 | 21.9 |
| **Storage (Circular, Prestressed Concrete Storage Tank) and Distribution Pumping** | 7.7 | 680 | 19.9[2] |
| **Total Plan C Cost** | **28.5** | **1,300** | **51.9** |

[1]Includes credit of $8.9 million capital cost and $670,400 O&M cost for conventional NDN.
[2]Although the life of the storage structure is 50 years, a 20 year life cycle cost is presented for consistency.

**Table 11-2: Comparison of Plan A and Plan C Non-Economic Features**

| Parameter | Plan A | Plan C |
|---|---|---|
| **Ease of Expandability** | Good | Good |
| **Reliability** | Good | Good |
| **Constructability** | Good | Good |
| **Simplicity of Operation** | Average | Good |
| **History of Use** | Good | Average |
| **Environmental Impacts, Including Public Perception and Acceptance** | Excellent | Average |
| **Staffing Requirements** | Good | Good |

Per the above cost data, Plan C is far more economical than Plan A, approximately $22.3 million lower than Plan A in capital costs and approximately $815,000 lower than Plan A in O&M costs. However, per Table 11-2 above, Plan A does provide several non-economic advantages over Plan C that need to be considered in decision making. For more information on comparison of MBR system with conventional filtration system and key drivers for decision making, refer to Section 14. The results of this analysis including preliminary cost data were presented to the City during Workshop No. 2 (Section 14). Refer to Section 15 for an evaluation of further modified MBR alternatives.

# SECTION 12 – EVALUATION OF POWER SUPPLY OPTIONS FOR TTDF

## 12.1 BACKGROUND

Per the contracted scope of work, an evaluation needs to be done to determine the feasibility of feeding the new loads of proposed TTDF from low voltage switchgear "R/W-SWG1" in the RAS/WAS Electrical Building. A draft version of this Section was submitted to the City in December 2010 as a part of the draft TM, which included evaluation of two power source options:

a. Utilizing low voltage switchgear "R/W-SWG1" in the RAS/WAS Electrical Building as the power source (per contract)

b. Utilizing the 4.16 KV medium voltage switchgear "BL-MVS3" at the Blower Building No.2 Electrical Room

Subsequent to the submission of a draft version of this TM, Parsons' electrical engineer met with the City's staff at the RWRF on January 20, 2011 to understand the facility's electrical system and to review the "as-built" electrical drawings. During the meeting, estimated electrical loads associated with a 12 MGD TTDF for both conventional filtration and MBR systems were discussed. The City's staff expressed keen interest in planning the electrical infrastructure for an ultimate future flow of 30 mgd.

The following electrical loads (operating) were estimated for each alternative.

| | |
|---|---|
| Conventional Filtration System | - 12 mgd - 1,311 HP |
| | - 30 mgd – 3,307 HP |
| MBR System | - 12 mgd – 2,272 HP |
| | - 30 mgd – 5,617 HP |

Detailed break-up of the loads are attached as Exhibit 1 at the end of this Section. Based on these estimated loads and discussions with the City's staff, it was determined that the two power source options, existing low voltage switchgear "R/W-SWG1" in the RAS/WAS pump station electrical building and existing 4.16 KV Switchgear "BL-MVS3", presented in the draft TM are no longer feasible. The estimated loads are deemed to be too large for the existing infrastructure at the two power sources.

During the meeting, the City's staff noted that there are four "under-utilized" electrical transformers, TD, TE, TF and TG, located near Train A aeration basins and preference should be given to maximize the use of existing infrastructure. In addition, the existing 12 KV Subservice Switchgear "12-MS2" was identified as another potential power source. This 12 KV switchgear has available spare power circuit breakers and are of adequate capacity to serve the estimated power loads for both conventional filtration and MBR alternatives.

## 12.2 EXISTING ELECTRICAL INFRASTRUCTURE

Currently, Pacific Gas and Electric Company (PG & E) is supplying power to the RWRF with one (1) 70 KV high voltage power line via one (1) 10 MVA power transformer (City owned) with secondary voltage of 12 KV. The secondary side of the transformer is connected to two (2) main circuit breakers 53-BKR-CMA and 53-BKR-CMB of Main 12 KV Service Switchgear,12-MS1. Switchgear 12-MS1 is equipped with a normally open (NO) tie circuit breaker, 53-BKR-CMT. This switchgear is rated at 12 KV, 2000A, 500 MVA short circuit capacity with Bus "A" and Bus "B" separated by the NO tie circuit breaker.

In addition, there is a 12 KV back-up line from PG&E that has a capacity of 5 MVA for emergency use. This back-up line is tied to the Switchgear 12-MVS1 thru 29-BKR-201Circuit Breaker. This breaker is normally open with kirk key interlock and is operated manually.

From the Switchgear 12-MVS1, feeder circuit breakers and cables feed several electrical Substations /Electrical Buildings throughout the facility. Feeder circuit breakers 29-BKR-103 and 29-BKR-203 and corresponding two feeder cables connect the 12 KV service to Subservice Switchgear 12-MS2.

For future expansion of the TTDF to 30 MGD capacity, it is anticipated that the City will rely on the cooling fans equipped on the existing 10 MVA step-down transformer to increase the capacity by up to 12% to meet the additional load. Per the City's staff, the facility's established summer peak demand is about 6500 KVA.

## 12.3 EVALUATION OF THE POWER SOURCES FOR CONVENTIONAL FILTRATION AND MBR SYSTEMS

As discussed earlier in this Section, the following two power source options will be discussed in detail.

A. 12 MGD Conventional Filtration System Expandable to 30 MGD Capacity

B. 12 MGD MBR System Expandable to 30 MGD Capacity

   1. Option 1 – Power from Swithgear 12-MS2 using spare circuit breakers and new duct banks

   2. Option 2 – Power from Swithgear 12-MS2 using existing circuit breakers and extending existing duct banks via transformers TG and TF.

### A. 12 MGD Conventional Filtration System Expandable to 30 MGD Capacity

The proposed TTDF with conventional filtration and in-pipe disinfection will utilize the existing two (2) 12 KV circuit breakers 60-BKR-104 and 60-BKR-204 that are currently feeding existing transformers "TG" and "TF". The two transformers, per City's staff, are currently "under-utilized" with minimal to no load and therefore can be disconnected. The existing # 2 15 KV Class cables will be removed as they are inadequate to carry the estimated loads of TTDF. The

existing 4" conduits will be used to route the new # 3/0 15 KV Class cables to 12 MGD TTDF. The TTDF will have a 15 KV Class Switchboard with a 600A main isolation switch and two (2) 600A fused disconnect feeder switches. Each feeder switch will feed one step-down transformer. The first feeder switch will feed the 12 MGD facility step-down transformer and the other will feed the second step-down transformer for the future loads up to an additional 18 MGD to make the total capacity of 30 MGD. The secondary sides of the two (2) step-down transformers will be tied to a double ended 480 V Switchboard/MCC with a normally open (NO) tie circuit breaker. The 15 KV Class Switchboard and the transformers will be located outdoor in NEMA 3R enclosures.

The feeder cable length from the Subservice Switchgear 12-MS2 to the TTDF is approximately 1600 feet. Approximately 550 feet of two (2) new 4" conduit duct banks from the existing EMH-6 to the TTDF switchboard/transformer pad will be required. Refer to Sketch No. 1 and 2 for the single line diagrams of the proposed electrical system.

### B. 12 MGD MBR System Expandable to 30 MGD Capacity

The proposed MBR and in-pipe disinfection Facility will have similar features like the conventional TTDF discussed above, with same size conduits but with larger step-down transformers, and larger feeder cables.

**Option 1 -** This option utilizes the existing two spare circuit breakers in Switchgear 12-MS2 as well as (2) 4" spare conduits on the north side of the Switchgear Building and extending them to the MBR Facility site. This route requires approximately 1,300 feet of cables from the power source to the MBR Facility. Refer to Sketch No. 3 and 4 for the single line diagrams.

**Option 2 -** The second option utilizes the existing circuit breakers 60-BKR-104 and 60-BKR-204 as well as existing conduits from the 12 KV Subservice Switchgear Building to the existing Transformers "TF" and "TG". As stated earlier, these transformers are under-utilized and can be disconnected. The existing # 2 - 15KV Class cables will be removed and the 4" conduits will be extended towards the West and up North to the MBR Facility transformer pad. The approximate length of the 1-4" conduit trench is about 1800 feet and the length of 2-4" conduit trench is about 600 feet. The approximate feeder cable length from the power source using the 4"conduit for transformer "TG" to the MBR Facility is about 2500 feet. For the feeder cables using the conduit for the Transformer "TF" to the MBR Facility is about 2200 feet. Refer to Sketch No. 5 and 6 for the single line diagrams.

## 12.4 LIST OF SINGLE LINE DIAGRAMS

The following sketches were developed as part of this technical memorandum and are enclosed in Appendix B for reference.

1. Sketch No. 1, Single Line Diagram - 12 MGD Conventional Filtration System

2. Sketch No. 2 , Single Line Diagram – Up to 30 MGD Conventional Filtration System

3. Sketch No. 3, Single Line Diagram – 12 MGD MBR System (Option 1)
4. Sketch No. 4, Single Line Diagram – Up to 30 MGD MBR System (Option1)
5. Sketch No. 5, Single Line Diagram – 12 MGD MBR System (Option 2)
6. Sketch No. 6, Single Line Diagram – Up to 30 MGD MBR System (Option2)
7. Dwg. E-1, City of Fresno Plant No. 1 – Site Plan Primary Distribution (Marked-up to show proposed TTDF)

## 12.5 FURTHER MODIFICATIONS

Subsequent to Workshop No.2 (See Section 14), further modifications to MBR system alternatives were made, which required certain revisions to the power source options discussed in this Section. These revisions are summarized under Section 15 of this TM.

## EXHIBIT 1

## ESTIMATED ELECTRICAL LOADS

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**Table 12-1: Proposed TTDF (MBR) Electrical Loads (30 MGD)**

| Process Area | Description | Connected Load (HP) | Duty Load (HP) |
|---|---|---|---|
| MBR System | Primary Effluent Pumps | 375 | 250 |
| MBR System | Fine Screens | 12 | 9 |
| MBR System | Anoxic Mixers | 72 | 72 |
| MBR System | Mixed Liquor Return Pumps | 180 | 180 |
| MBR System | Sludge Recirculation Pumps | 900 | 750 |
| MBR System | WAS Pumps | 22.5 | 15 |
| MBR System | Air Scouring Blowers | 1,500 | 1,250 |
| MBR System | Permeate Pumps | 400 | 400 |
| MBR System | Backpulse Pumps | 60 | 30 |
| MBR System | Instruments Air Compressors | 30 | 15 |
| Disinfection | UV Lamp Ballasts | 680 | 646 |
| Distribution | Distribution Pumps | 2,400 | 2,000 |
| | **Total (HP)** | **6,631.5** | **5,617** |

***Assume 1 KVA = 1 HP**

Primary Effluent Pumps: 2+1; 125 hp each (12,800 gpm at 23' TDH)

Fine Screens: 3+1; 3 hp each

Anoxic Mixers: 18; 4 hp each

Mixed Liquor Return Pumps: 6; 30 hp each (13,900 gpm at 3-4' TDH)

Sludge Recirculation Pumps: 5+1; 150 hp each (16,700 gpm at 20' TDH)

WAS Pumps: 2+1; 7.5 hp each (1,000 gpm at 20' TDH)

Air Scouring Blowers: 5+1; 250 hp each (7,900 scfm at 5 psi)

Permeate Pumps: 20; 20 hp each (1,700 gpm at 25' TDH)

Backpulse Pumps: 1+1; 30 hp each (1,480 gpm at 25' TDH)

Instruments Air Compressors: 1+1; 15 hp each

UV Lamps: 19 Duty Trains + 1 Standby Train; 34 hp per Train

Distribution Pumps: 5 + 1; 400 hp each (4,200 gpm at 230' TDH)

**Table 12-2: Proposed TTDF (MBR) Electrical Loads (12 MGD)**

| Process Area | Description | Connected Load (HP) | Duty Load (HP) |
|---|---|---|---|
| MBR System | Primary Effluent Pumps | 200 | 100 |
| MBR System | Fine Screens | 6 | 3 |
| MBR System | Anoxic Mixers | 24 | 24 |
| MBR System | Mixed Liquor Return Pumps | 60 | 60 |
| MBR System | Sludge Recirculation Pumps | 450 | 300 |
| MBR System | WAS Pumps | 15 | 7.5 |
| MBR System | Air Scouring Blowers | 750 | 500 |
| MBR System | Permeate Pumps | 160 | 160 |
| MBR System | Backpulse Pumps | 60 | 30 |
| MBR System | Instruments Air Compressors | 30 | 15 |
| Disinfection | UV Lamp Ballasts | 306 | 272 |
| Distribution | Distribution Pumps | 1,200 | 800 |
| | **Total (HP)** | **3,261** | **2,271.5** |

***Assume 1 KVA = 1 HP**

Primary Effluent Pumps: 1+1; 100 hp each (10,300 gpm at 20' TDH)

Fine Screens: 1+1; 3 hp each

Anoxic Mixers: 6; 4 hp each

Mixed Liquor Return Pumps: 2; 30 hp each (16,700 gpm at 3' TDH)

Sludge Recirculation Pumps: 2+1; 150 hp each (16,700 gpm at 20' TDH)

WAS Pumps: 1+1; 7.5 hp each (1,000 gpm at 20' TDH)

Air Scouring Blowers: 2+1; 250 hp each (7,900 scfm at 5 psi)

Permeate Pumps: 8; 20 hp each (1,700 gpm at 25' TDH)

Backpulse Pumps: 1+1; 30 hp each (1,480 gpm at 25' TDH)

Instruments Air Compressors: 1+1; 15 hp each

UV Lamps: 8 Duty Trains + 1 Standby Train ; 34 hp per Train

Distribution Pumps: 2 + 1; 400 hp each (4,200 gpm at 230' TDH)

**Table 12-3 : Proposed TTDF (Tertiary Filtration) Electrical Loads (30 MGD)**

| Process Area | Description | Connected Load (HP) | Duty Load (HP) |
|---|---|---|---|
| Tertiary Filtration | Filter Feed Pumps | 240 | 200 |
| Tertiary Filtration | Coagulant Dosing Pumps | 1.0 | 0.75 |
| Tertiary Filtration | Backwash Pumps | 52.5 | 52.5 |
| Tertiary Filtration | Washwater Return Pumps | 80 | 60 |
| Tertiary Filtration | Filter Drive | 42 | 42 |
| Disinfection | UV Lamp Ballasts | 986 | 952 |
| Distribution | Distribution Pumps | 2,400 | 2,000 |
| | **Total (HP)** | **3,801.5** | **3,307.25** |

***Assume 1 KVA = 1 HP**

Filter Feed Pumps - 5 + 1; 40 hp each (4,200 gpm at 20' TDH)

Coagulant Dosing Pumps - 3 + 1 at 0.25 hp

Backwash Pumps – 7; 7.5 hp each

Washwater Return Pumps - 3 + 1; 20 hp each (2,000 gpm at 20' TDH)

Filter Drive – 7; 6 hp each

UV Lamps – 28 duty Trains + 1 standby Train; 34 hp per Train

Distribution Pumps - 5 + 1; 400 hp each (4,200 gpm at 230' TDH)

**Table 12-4: Proposed TTDF (Tertiary Filtration) Electrical Loads (12 MGD)**

| Process Area | Description | Connected Load (HP) | Duty Load (HP) |
|---|---|---|---|
| Tertiary Filtration | Filter Feed Pumps | 120 | 80 |
| Tertiary Filtration | Coagulant Dosing Pumps | 0.75 | 0.5 |
| Tertiary Filtration | Backwash Pumps | 22.5 | 22.5 |
| Tertiary Filtration | Washwater Return Pumps | 40 | 20 |
| Tertiary Filtration | Filter Drive | 18 | 18 |
| Disinfection | UV Lamp Ballasts | 405 | 370 |
| Distribution | Distribution Pumps | 1,200 | 800 |
| | **Total (HP)** | **1,806.25** | **1,311** |

***Assume 1 KVA = 1 HP**

Filter Feed Pumps - 2 + 1; 40 hp each (4,200 gpm at 20' TDH)

Coagulant Dosing Pumps - 2 + 1 at 0.25 hp

Backwash Pumps – 3; 7.5 hp each

Washwater Return Pumps - 1 + 1; 20 hp each (2,000 gpm at 20' TDH)

Filter Drive – 3; 6 hp each

UV Lamps – 11 duty Trains + 1 standby Train; 34 hp per Train

Distribution Pumps - 2 + 1; 400 hp each (4,200 gpm at 230' TDH)

# SECTION 13 – INTEGRATION OF TTDF CONTROLS WITH EXISTING SCADA SYSTEM

## 13.1 BACKGROUND

This Section of the TM describes the present condition and expansion philosophy of the Supervisory Control and Data Acquisition (SCADA) system and Instrumentation at the RWRF. The expanded SCADA and Instrumentation, which will be consistent with the existing design, will be able to handle the control and communication requirements of the proposed TTDF.

## 13.2 EXISTING SCADA AND INSTRUMENTATION

Parsons reviewed the existing SCADA block diagram (refer to Carollo Engineers Dwg. 0N04, Rev. 1, dated 6/23/06). The existing SCADA consists of two independent communication networks: Modbus Plus and Remote I/O. Each loop uses different communication media that includes shielded twisted pair cables and coaxial cables, respectively. Fiber optic cables are used for communications between buildings.

The existing SCADA consists of several Programmable Logic Controllers (PLCs) and Operator Interface Stations (OISs) located throughout the plant. Each PLC system on the plantwide network operates in a redundant processor configuration. The fiber optic communication modules are also configured with redundancy.

## 13.3 DISCUSSION

Parsons will design SCADA and instrumentation systems to match and be compatible with the existing SCADA. A new PLC control panel will be provided in a redundant processor configuration with an uninterruptible power supply (UPS). The PLC panel will be located in a new Electrical and Control Building located close to the proposed TTDF. The PLC will be linked to the existing PLCs and OISs by fiber optic cables routed to the existing RAS/WAS Pump Station Electrical Room and will communicate via Modbus Plus. The PLC control panel will also be linked to the vendor-supplied PLC control panels by digital data communication cables. Under Plan A, the PLC control panel will be linked to the new Membrane Bioreactor system and Inline Ultraviolet Disinfection system control panels. Under Plans B and C, the PLC control panel will be linked to the new Nova Ultrascreen Filtration system and Inline Ultraviolet Disinfection system control panels.

A new OIS will be provided in the new Electrical and Control Building. The new OIS will be configured with graphics and symbols to match the existing OISs. Parsons will incorporate the new process areas into the new OIS, which will be accessible at the existing SCADA OISs. New SCADA screens will be added to monitor and control the new process areas. Parsons will conduct further investigation of the existing SCADA hardware and software during Design Development Phase.

The above discussion assumes that the existing Modbus Plus network has the capacity to handle the additional data transfers required by the new PLC and OIS. However, there is a concern that the network may be near or at its maximum capacity and that the additional nodes will overload the network. Further investigation of the Modbus Plus network is required to determine its capabilities. Plants of this size are usually designed with or have converted to Ethernet communications, which has a much larger bandwidth (i.e. handles more data) and communicates at higher speeds (i.e. 100 Mbits/s compared to 2 Mbits/s maximum) than Modbus Plus communications. Parsons will further investigate the existing network during Design Development Phase.

A new Closed-Circuit Television (CCTV) camera will also be provided in the TTDF. The camera, control receiver, and Ethernet encoder will match the existing CCTV equipment. The new camera will be tied into the plant's existing CCTV equipment.

For the proposed TTDF, Parsons will specify field instruments after consultation with the RWRF plant personnel and/or will match existing instruments to achieve instrument standardization throughout the plant. This criterion is intended to minimize spare parts inventory and improve operator familiarity with similar equipment. Instrument data sheets will be prepared to specify the same brand and model numbers already in use at the RWRF, as much as possible.

# SECTION 14 – SUMMARY OF WORKSHOP NO.2 AND NEW PROJECT DIRECTION

## 14.1 BACKGROUND

A second Workshop (Workshop No.2) was conducted with the City on February 3, 2011 to present and discuss the comparison of Plan A with Plan C, as detailed under Section 11. The discussions included pros and cons of MBR system compared to conventional filtration system. This Section summarizes the discussion carried out at the Workshop and highlights the important decisions made for subsequent work.

## 14.2 DISCUSSION AND KEY DECISIONS

During the Workshop No.2, very crucial plant operating and maintenance issues were discussed in detail with the City's operations staff and the following key considerations were identified:

1. Train A facilities, reportedly, are old, of obsolete design and are difficult to operate and maintain. Further, nitrogen removal cannot be achieved reliably with the current configuration of the aeration basins in Train A. Discussions with the City's operations staff indicated that the ceramic disc diffusers installed in the aerations basins need replacement/cleaning and it may not be possible to restore them to their original state due to their age. The aeration pipe grids that connect the diffusers are old and unique to the type of diffusers currently installed. Further, the secondary clarifiers in Train A are in need of central column and scraper mechanism replacement. Based on the above described extensive repair/replacement needs related to Train A infrastructure coupled with the long age of the equipment, it appears that replacement of Train A facilities in the near future would be a prudent measure, If the intention is to continue to use Train A for the long term.

2. North Fresno Wastewater Reclamation Facility, operated by the City, was issued a WDR/NPDES permit on December 10, 2009 by the Central Valley Regional Water Quality Control Board (RWQCB) with a Total Nitrogen (TN) limit of 10 mg/L for the recycled water used for golf course irrigation. It is expected that the proposed TTDF at the RWRF will also have a similar TN limit for irrigation water. This means that it will be short sighted to design the TTDF with no consideration for nitrogen removal.

3. In this report, all the options involving conventional filtration systems are designed to produce Title 22 recycled water without nitrogen removal. However, as discussed above, if nitrogen removal becomes a requirement per the anticipated WDR/NPDES permit for the TTDF, additional aeration basins and secondary clarifiers will be required to provide enough Solids Retention Time (SRT) in the system for consistent and reliable nitrogen removal. On the other hand, the MBR alternative will not only produce effluent exceeding Title 22 criteria, but will achieve nitrogen removal without additional basins.

Based on the above discussion, it is evident that the MBR system alternative for TTDF has a clear advantage over the conventional filtration system alternatives. By converting Train A facilities into MBR (See Plan A), not only will the system be capable of producing effluent meeting all permit limitations, but also will avoid the future replacement and upgrading cost of Train A for nitrogen removal. This means that constructing an MBR system will, in effect, be an equivalent capacity replacement for Train A. Therefore, MBR will be more cost effective compared to conventional filtration systems, when considering both its ability to produce high quality effluent with nitrogen removal and the avoided cost of future upgrades/replacement of Train A facilities for nitrogen removal.

Moving forward, both Parsons and the City collectively decided to pursue MBR as the technology of choice for TTDF. In addition to the option of converting Train A facilities into MBR, the City expressed their interest to explore the option of having MBR designed and built as a separate stand-alone system with all new structures.

## 14.2 NEW PROJECT DIRECTION – POST WORKSHOP NO.1 AND WORKSHOP NO.2

The City asked Parsons to develop and compare the following two MBR alternatives for their review and final selection.

1. Converting Train A into MBR – (5 mgd constant flow; no peaking factor) – This is similar to Plan A as discussed in Section 9 of this report, except that the capacity will be 5 mgd constant flow instead of 12 mgd with peaking factor.

2. Constructing a separate standalone MBR system with all new tanks – (5 mgd constant flow; no peaking factor)

A new final section (Section No. 15) is added to this report to discuss and compare the two selected MBR system alternatives.

# POST-WORKSHOP NO.2 ANALYSIS (SECTION 15 - SECTION 16)

# SECTION 15 – SELECTED MBR ALTERNATIVES ANALYSIS

## 15.1 BACKGROUND

Workshop No. 2 was held on February 3, 2011 and was attended by the City's and Parsons' staff. Tertiary filters, MBR, and electrical feed alternatives were discussed and several key decisions were made with respect to the tertiary treatment systems as summarized below:

- MBR alternative offers several advantages over the conventional filtration alternatives, which include higher quality recycled water and nitrogen removal. Also, as Train A is reportedly approaching the end of its useful life (see Section 14), implementation of an MBR system could be tied with Train A phase out. This would avoid substantial costs associated with replacing and/or upgrading of Train A facilities in the near future, if tertiary filters were used. Therefore, MBR will be more cost effective compared to conventional filtration systems, when considering both its ability to produce high quality effluent with nitrogen removal and the avoided cost of future upgrades/replacement of Train A facilities for nitrogen removal. Based on the discussions, it was decided to pursue the MBR alternative as the system of choice for filtration, nitrogen removal and future capacity replacement for Train A.

- The MBR system should be designed to handle 5 mgd of constant flow. The influent pipeline should be capable of conveying 15 mgd of flow, with a parallel pipeline added in the future when the demand for recycled water increases beyond 15 mgd.

- The location of the MBR system should be evaluated considering a completely new structure for the system versus retrofitting the existing Train A structure for this purpose. In the case of using a new structure, the MBR system would be located north of Canal B. In the case of using existing Train A facilities, an existing secondary clarifier would be retrofitted into aeration basins and a new tank(s) would be constructed to house the membranes.

This Section develops and compares the two MBR system alternatives mentioned above.

## 15.2 DESIGN DEVELOPMENT

This subsection describes the design of MBR system for two different alternatives; 1) retrofitting existing Train A facilities, 2) using completely new structures.

### 15.2.1 Layout – 5 mgd Constant Flow – Retrofitting Train A Facilities into MBR

In this alternative, secondary clarifier No. 4 (Train A) would be modified and converted into the pre-aeration bioreactors of MBR system (Figure 15-1). Primary effluent would be taken from the existing stub at Train C and delivered by gravity to bioreactors. The gravity pipeline would be routed underneath Canal B as an inverted siphon. Fine screens would be located at the upstream side of this gravity line (near Train C) to minimize solids accumulation within the pipe. Following the pre-aeration bioreactors, the flow would be conveyed to the membrane tanks

located west of secondary clarifier No. 5. The MBR blower building would be located west of membrane tanks. Space is allowed for expansion to 30 mgd. The existing 24 inch diameter air line serving aeration basin No. 3 (Train A) would be used and extended to deliver process air to bioreactors. In-pipe UV system will be used to disinfect the MBR permeate to achieve Title 22 recycled water quality. Aeration basin No. 3 would be used for storage of the recycled water. The power for the MBR system would be supplied from the 12 kV electrical building, located east of Train A secondary clarifiers, through new conduits. See Subsection 15.5 for electrical details.

### 15.2.2 Layout – 5 mgd Constant Flow – MBR with All New Construction

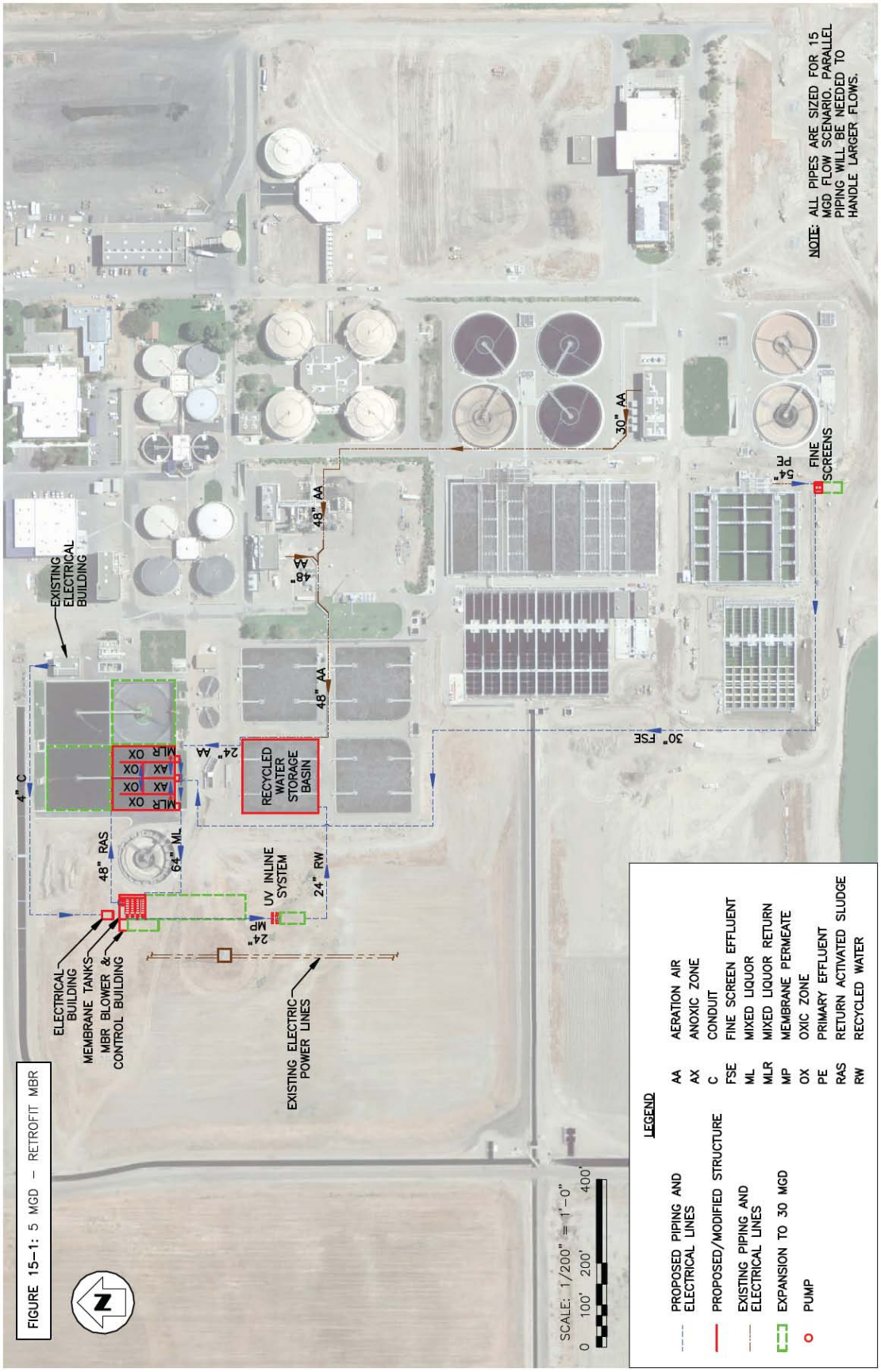
The structures for MBR system would be located north of Canal B as shown in Figure 15-2. Primary effluent would be taken from the existing stub at Train C and delivered by gravity to pre-aeration Bioreactors. The gravity pipeline will be routed underneath Canal B as an inverted siphon. Fine screens would be located at the upstream side of this gravity line (near Train C) to minimize solids accumulation within the pipe. Bioreactors, membrane tanks, and blower building would have common walls to minimize the concrete and piping costs. Space is allowed for expansion to 30 mgd. The existing 24 inch diameter air line serving aeration basin No. 4 (Train A) would be used and extended to deliver process air to bioreactors. In-pipe UV system will be used to disinfect the MBR permeate to achieve Title 22 recycled water quality. Aeration basin No. 4 would be used for storage of the recycled water. The power for the MBR system would be supplied from the 12 kV electrical building, located east of Train A secondary clarifiers, through existing and new conduits. See Subsection 15.5 for electrical details.

### 15.2.3 Capacity Analysis

Process analysis was performed to determine the volume of aeration basins required to handle 5 mgd of flow and to achieve NDN. The basins would be compartmentalized to incorporate several anoxic and oxic zones. The design criteria in Table 15-1 were developed as the basis for capacity analysis.

**Table 15-1: Design Criteria for Capacity Analysis of MBR Aeration Basin to Achieve NDN**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Flow Peaking Factor | - | 1 | Peak:Average ratio |
| Primary Effluent | - | - | Max month values |
| BOD | mg/L | 224 | 70% of raw wastewater |
| TSS | mg/L | 120 | 40% of raw wastewater |
| TKN | mg/L | 30 | 65% of raw wastewater |
| MLSS | mg/L | 10,000 | |
| SRT (Minimum) | days | 6 | Oxic zone |
| Anoxic:Oxic Zone Ratio (Minimum) | - | 0.3 | |
| Maximum Oxygen Uptake Rate | mg/L-hr | 128 | |


NOTE: ALL PIPES ARE SIZED FOR 15 MGD FLOW SCENARIO. PARALLEL PIPING WILL BE NEEDED TO HANDLE LARGER FLOWS.
FINE SCREENS
54" PE
30" AA
48" AA
24" AA
48" AA
EXISTING ELECTRICAL BUILDING
RECYCLED WATER STORAGE BASIN
30" FSE
4" C
MLR OX
AX OX
AX OX
MLR OX
48" RAS
64" ML
UV INLINE SYSTEM
24" RW
24" MP
ELECTRICAL BUILDING
MEMBRANE TANKS
MBR BLOWER & CONTROL BUILDING
EXISTING ELECTRIC POWER LINES
SCALE: 1/200" = 1'-0"
0 100' 200' 400'
LEGEND
PROPOSED PIPING AND ELECTRICAL LINES
PROPOSED/MODIFIED STRUCTURE
EXISTING PIPING AND ELECTRICAL LINES
EXPANSION TO 30 MGD
PUMP
AA AERATION AIR
AX ANOXIC ZONE
C CONDUIT
FSE FINE SCREEN EFFLUENT
ML MIXED LIQUOR
MLR MIXED LIQUOR RETURN
MP MEMBRANE PERMEATE
OX OXIC ZONE
PE PRIMARY EFFLUENT
RAS RETURN ACTIVATED SLUDGE
RW RECYCLED WATER
FIGURE 15-1: 5 MGD – RETROFIT MBR

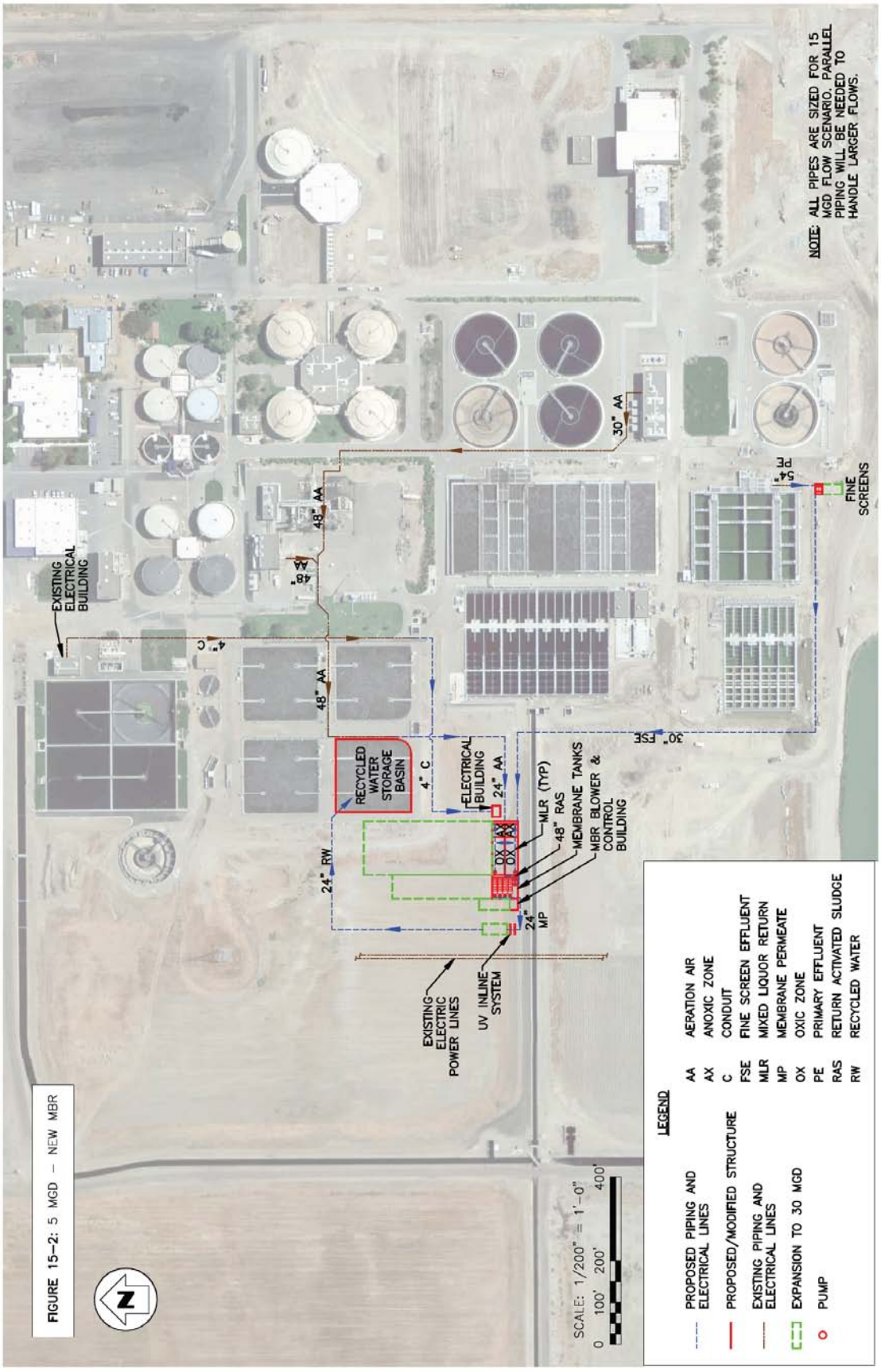



FIGURE 15-2: 5 MGD – NEW MBR

### 15.2.4 Fine Screens

The flow (i.e. primary effluent) would be conveyed by gravity to fine screens located southeast of aeration basins of Train C (Figures 15-1 and 15-2). Two fine screens would be installed with one of the units as standby. Each screen would be capable of handling 5 mgd of flow to provide prudent redundancy. The units would be installed in concrete channels equipped with isolation gates to allow for maintenance without interfering with the plant's operation. Each fine screen would be equipped with an integrated washer/compactor for cleaning and concentrating the screenings prior to disposal off site.

The design characteristics for the fine screens and washer/compactors are shown in Table 15-2.

**Table 15-2: Design Characteristics of Fine Screens and Washer/Compactors**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Screens | | | |
| Type | - | - | In-channel perforated-plate drum |
| Number | - | 2 (1+1) | |
| Capacity, Each | mgd | 5 | |
| Effective Opening Size | mm | 2 | |
| Channel Width | ft | 5.3 | Width at screen |
| Screenings Handling | | | |
| Type | - | - | Washer, dewatering, compactor unit |
| Number | - | 2 (1+1) | Integrated with screens |
| Motor Power, Each | hp | 2 | Also powers screen basket |

### 15.2.5 Bioreactors and Associated Equipment

This subsection describes the structures and equipment located downstream of fine screens and upstream of membrane tanks.

***Bioreactor (Pre-Aeration Basin):***

Depending on the MBR alternative considered, the bioreactors (pre- aeration basins) would be provided by retrofitting the secondary clarifier No. 4 or by using a new structure. To provide redundancy, two bioreactors would be designed, each divided into several anoxic and oxic zones, with the first quarter of each bioreactor dedicated to the anoxic zone. Baffles would be placed in the bioreactors to separate the anoxic and oxic zones to minimize back-mixing as the flow passes through in a plug flow regime. Additional baffling would be used to divide each anoxic and oxic zone into 3 compartments, again to minimize back-mixing. The plug flow conditions increase the efficiency of biological treatment, optimizing carbonaceous matter removal, nitrification and denitrification. Submersible mixers would be used to provide mixing in the anoxic zones. Table 15-3 provides the design characteristics of the bioreactors. As can be seen in the Table, volume of bioreactors is larger for the first alternative (Retrofit MBR). This is

due to the fact that an existing structure (secondary clarifier No. 4) is being used and the volume available in this structure is more than what is actually needed to handle 5 mgd of flow.

**Table 15-3: Bioreactors Design Characteristics**

| Item | Units | Design Value | | Remarks |
|---|---|---|---|---|
| | | Retrofit MBR | New MBR | |
| Bioreactors | | | | |
| Number (In Parallel) | - | 2 | 2 | |
| Volume, Each | MG | 1.0 | 0.42 | |
| Anoxic Zone | | | | |
| Number per Bioreactor | - | 1 | 1 | |
| Dimensions of Zone (L x W x SWD), Each | ft x ft x ft | 75 x 37.5 x 12 | 27.5 x 30 x 17 | |
| Number of Compartments per Zone | - | 3 | 3 | Equal volume (in series) |
| Oxic Zone | | | | |
| Number per Basin | - | 1 | 1 | |
| Dimensions of Zone (L x W x SWD), Each | ft x ft x ft | 225 x 37.5 x 12 | 82.5 x 30 x 17 | |
| Number of Compartments per Zone | - | 3 | 3 | Equal volume (in series) |
| Anoxic Zone Mixers | | | | |
| Type | | | | Submersible |
| Number per Compartment | - | 1 | 1 | |
| Total Number | - | 7 (6+1) | 7 (6+1) | One shelf spare |
| Horsepower, Each | hp | 4 | 4 | |

### *Aeration System:*

The air would be transferred to the oxic zones in the bioreactors through fine bubble diffusers. Either EPDM Membrane disks or more efficient aerator strips (e.g. AEROSTRIP™), would be used to provide aeration. The aeration would be tapered so that approximately 70% of the oxygen is provided in the first half of the oxic zone to satisfy the high oxygen demand as the substrate enters the oxic zone.

The required air would be supplied to the oxic zones by the existing blowers. These blowers are of single-stage centrifugal type and have enough capacity to serve the biological needs of the MBR process as well as the remaining plant. The existing 24 inch diameter air pipeline of aeration basin No. 3 (Retrofit MBR Alternative) or aeration basin No. 4 (New MBR Alternative) would be used and extended to supply the air to the bioreactors. Aeration basin No. 3 (Retrofit-MBR Alternative) or aeration basin No. 4 (New-MBR Alternative) would no longer be in service and would be used as recycled water storage in the future.

The design characteristics for the aeration system are presented in Table 15-4.

**Table 15-4: Aeration System Design Characteristics**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Diffusers | | | |
| Type | | | Fine bubble, membrane (EPDM) disk or strip type |
| Aeration Pattern | | | Tapered along bioreactor length |
| Process Air Blowers | | | |
| Type | | | Single-stage centrifugal |
| Number | - | 6 (5+1) | Existing blowers |
| Capacity, Each | scfm | 27,000 | |
| Discharge Pressure | psig | 7.8 or 8.5 | 4 units at 7.8 and 2 units at 8.5 |
| Horsepower, Each | hp | 1,500 | |

***Mixed Liquor Return and Sludge Recirculation Pumps:***

Two recirculation lines will be provided in the MBR system: mixed liquor return and sludge recirculation. The mixed liquor return system transfers mixed liquor from the tail end of the oxic zone back to the head of the anoxic zone at a rate up to four times (adjustable) the average flow. This system transfers nitrates resulting from nitrification back to the anoxic zone for denitrification as the oxygen molecules associated with nitrates are used by the biomass.

The sludge recirculation system transfers sludge from the membrane tanks to the head of the oxic zone at a rate also up to four times (adjustable) the average flow. The recirculation system prevents the solids concentration in the membrane tanks from increasing excessively and thus plugging the membranes, as permeate is removed from the mixed liquor. This sludge is highly oxygenated and provides a portion of the process oxygen needed for BOD removal and nitrification. Sludge would be wasted from the MBR system from the sludge recirculation line. New pumps would be installed for this purpose.

The design characteristics for the recirculation and WAS pumps are presented in Table 15-5.

**Table 15-5: Sludge Pumping Systems Design Characteristics**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Mixed Liquor Return Pumps | | | Returning flow from oxic zone to anoxic zone |
| Type | | | Axial propeller |
| Number | - | 3 (2+1) | One shelf spare |
| Capacity, Each | gpm | 7,000 | |
| TDH | ft | 3 | |
| Horsepower | hp | 15 | |

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Drive | | | Variable speed |
| Sludge Recirculation Pumps | | | Returning flow from membrane tanks to oxic zone |
| Type | | | Vertical propeller |
| Number | - | 2 (1+1) | |
| Capacity, Each | gpm | 14,000 | |
| TDH | ft | 20 | |
| Horsepower | hp | 125 | |
| Drive | | | Variable speed |
| WAS Pumps | | | |
| Type | | | Centrifugal |
| Number | - | 2 (1+1) | |
| Capacity, Each | gpm | 450 | |
| TDH | ft | 20 | |
| Horsepower | hp | 5 | |
| Drive | | | Variable speed |

### 15.2.6 Membranes

The membranes would be installed in 4 new independent tanks. For the purpose of this Section, hollow-fiber membranes were considered. The following design criteria were developed as the basis for sizing the membranes:

- Minimum wastewater temperature of 16$^{o}$C.
- Maximum flux rate of 12 gfd (all membrane tanks in service).
- Maximum flux rate of 16 gfd (one membrane tank out of service).

Four membrane tanks, each housing 6 membrane cassettes plus space for a future cassette, would have enough capacity to handle 5 mgd of flow. The tankage would be configured to allow isolation of a tank for maintenance and cleaning.

Permeate pumps would draw the MBR effluent through the membranes, directing it to the disinfection system. A building would house new air scouring blowers and membrane control and electrical system. The building would be located adjacent to the membrane structure.

Table 15-6 summarizes the design characteristics of the MBR membrane system.

**Table 15-6: MBR Membrane System Design Characteristics**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Tanks | | | |
| Number | - | 4 | |
| Cassettes per Tank | | | |
| Number Installed | - | 6 | |
| Space for Future | - | 1 | |
| Total Membrane Surface Area | ft2 | 417,360 | |
| Air Scouring Blowers | | | |
| Type | | | High-speed turbo |
| Number | - | 3 (2+1) | |
| Capacity, Each | scfm | 3,950 | |
| Discharge Pressure | psi | 5 | |
| Horsepower, Each | hp | 125 | |
| Drive | | | Variable speed |
| Permeate Pumps | | | |
| Type | | | Horizontal end suction |
| Number | - | 5 (4+1) | One shelf spare |
| Capacity, Each | gpm | 1,350 | |
| TDH | ft | 25 | |
| Horsepower, Each | hp | 20 | |
| Drive | | | Variable speed |
| Backpulse Pumps | | | |
| Type | | | Horizontal end suction |
| Number | - | 2 (1+1) | |
| Capacity, Each | gpm | 1,480 | |
| TDH | ft | 25 | |
| Horsepower, Each | hp | 30 | |
| Drive | | | Variable speed |
| Instrument Air Compressors | | | If Plant air not available |
| Number | - | 2 (1+1) | |
| Horsepower, Each | hp | 15 | |
| Chemical Cleaning | | | |
| Sodium Hypochlorite | | | 12.5% Solution |
| Frequency | | | |
| Recovery | Yearly | 2 | Per tank |
| Maintenance | Weekly | 1 | Per tank |
| Annual Consumption | gal | 4,000 | |
| Citric Acid | | | 50% Solution |
| Frequency | Yearly | 1-2 | Part of Recovery Clean |
| Annual Consumption | gal | 750 | |

## 15.3 DISINFECTION

During Workshop No.1, the City chose in-pipe UV disinfection as opposed to an open channel UV system. One of the major drivers was the positive feedback received from the staff at neighboring Clovis Water Reuse Facility in operating and maintaining their in-pipe UV system. Therefore, for the purpose of this TM, 1-mgd capacity in-pipe UV reactors were considered. The 1 MGD rating for each reactor is based upon high quality membrane permeate feed such as from the MBR system. Four reactor trains (3 operating + one standby) will be required to disinfect 5 mgd of flow and each train will accommodate two reactors. Table 15-7 and Figure 15-3 show the design criteria and preliminary layout for the in-pipe UV disinfection system, respectively. There are several larger in-pipe reactors currently available from other manufacturers that may be more economical for the present project and will be evaluated during detailed design.

**Table 15-7: In-pipe UV Disinfection Design Characteristics**

| Parameter | Criteria |
|---|---|
| Design Flow, mgd | 5 |
| Type of UV System | In-pipe, Low Pressure, High Intensity |
| Number of Reactors | 8 (3 trains + 1 standby) each train has 2 reactors |
| Flow Capacity per Reactor, mgd | 1.0 |
| Length of Reactor (ft) | 8 |
| Number of Lamps per Reactor | 40 |
| Total Number of Lamps Provided | 320 |

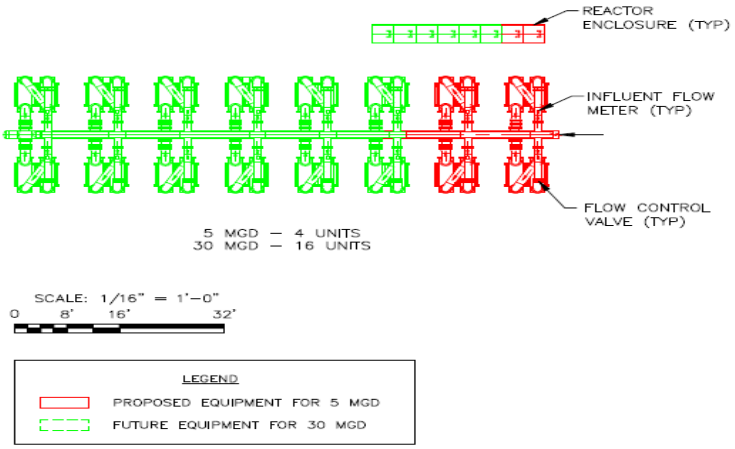



**Figure 15-3: In-pipe UV Disinfection System Preliminary Layout**

## 15.4 PRELIMINARY COSTS

Preliminary costs were developed for two alternatives: retrofitting the existing facilities in Train A for aeration basins of MBR system or using a completely new structure for this purpose. The costs estimated are according to Class 4 level per AACE (Association for the Advancement of Cost Engineering) guidelines. At this point in the design process, these costs are preliminary and should be used only for comparative purposes.

The costs were estimated using several resources. Quotes from the manufacturers, information available from similar projects performed by Parsons, including construction in the Central Valley, were used to determine these costs.

The capital costs for the two alternatives are shown in Table 15-8. For both alternatives, the credit for conventional NDN is negligible. This is the investment the City would need to make on a secondary treatment system, if the plant had to be upgraded to an NDN process using conventional tertiary filters rather than MBR. As the existing secondary systems for both Train B and Train C are designed and constructed with future NDN in mind, the aerations basins provide required SRT to achieve NDN and only require installation of new mixed liquor recycle pumps, the cost of which is deemed insignificant for comparison purposes. As indicated in Table 15-8, there is little cost difference between the two alternatives. Retrofitting the existing structure would result in less concrete cost but in higher piping cost.

### 15.4.1 Avoided Cost of Future Upgrades/Replacement of Train A

As discussed earlier, a credit could be given to compensate for the cost of replacing and upgrading Train A in the near future, which would occur under conventional filtration alternatives but not under MBR alternatives. To estimate this credit, $3-$4 per gal of wastewater treated was used as cost basis, which would translate into $15-$20 million of avoided future capital investment for a 5 mgd system. For the purposes of cost comparison in this Section, $18 million is considered as avoided capital replacement cost. Note that the estimated avoided cost is based on constructing new basins to remove nitrogen but without new aeration blowers.

**Table 15-8: MBR Alternatives Capital Cost (5 mgd) [a]**

| Parameter | Capital Cost ($ Million) | |
|---|---|---|
| | Retrofit MBR | New MBR |
| MBR Equipment and Structures Cost | 8.4 | 8.7 |
| MBR Total Capital Cost [b] | 24.5 | 24.4 |
| Credit for Conventional NDN [b,c] | (0) | (0) |
| MBR Total Capital Cost Including NDN Credit | 24.5 | 24.4 |
| UV Disinfection Total Capital Cost [b] | 5.3 | 5.3 |
| Storage (Aeration Basin No.3 or 4) Total Capital Cost [b] | 3.1 | 3.1 |
| **Total Capital Cost** | **32.9** | **32.8** |
| Train A Capacity Replacement (Avoided Cost) [d] | (18) | (18) |
| **Net Effective Capital Cost** | **14.9** | **14.8** |

[a] For detailed cost analysis see Appendix A.
[b] Including installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013)
[c] NDN credit is insignificant (only involves installation of minor new equipment such as mixed liquor recycle pumps). NDN credit is based on the premise that if the City were to choose conventional filters instead of MBR and were required to achieve NDN in the conventional secondary treatment process.
[d] Near future replacement cost of Train A facilities equivalent to 5 mgd capacity

An evaluation of the operation and maintenance (O&M) costs was also performed (Table 15-9). The O&M cost difference between the two alternatives is insignificant and hence assumed to be the same. Credit is given to MBR system for avoided cost of operation and maintenance of a secondary treatment system to achieve NDN.

**Table 15-9: MBR Alternatives O&M Cost (5 mgd) [a]**

| Parameter | O&M Cost ($) |
|---|---|
| MBR Total Annual O&M Cost [b,c] | 833,000 |
| Credit for Conventional NDN [b,c,d] | (280,000) |
| MBR Total Annual O&M Cost Including NDN Credit | 553,000 |
| UV Disinfection Total Annual O&M Cost [c,d] | 150,000 |
| Recycled Water Storage and Distribution Pumping Annual O&M Cost [d] | 283,000 |
| Total Annual O&M Cost | 986,000 |

[a] For detailed cost analysis see Appendix A.
[b] Including power and chemicals consumption, membrane/diffusers replacement, general maintenance, and labor.
[c] Assuming power usage rate of 14¢ per kWh.
[d] Proportioned using 12 mgd costs developed in previous Sections.

Using the estimated capital and O&M costs, a 20-year life cycle cost analysis was performed. The results are shown in Table 15-10.

**Table 15-10: MBR Alternatives Life-Cycle Cost (5 mgd)**

| Alternative | Parameter | Capital Cost ($ Millions) | O&M Cost ($ Thousands) | 20-Year Life Cycle Cost ($ Millions) |
|---|---|---|---|---|
| **RETROFIT TRAIN A INTO MBR** | MBR System | 24.5 | 553[1] | 34.5 |
| | Disinfection (In-pipe UV) | 5.3 | 150 | 8.0 |
| | Storage (Aeration Basin No.3) and Distribution Pumping | 3.1 | 283 | 8.2[2] |
| | **TOTAL** | **32.9** | **986** | **50.7** |
| | **Train A Capacity Replacement Cost** | **(18)** | | |
| | **Net Effective Capital Cost** | **14.9** | | |
| **NEW MBR** | MBR System | 24.4[1] | 553[1] | 34.4 |
| | Disinfection (In-pipe UV) | 5.3 | 150 | 8.0 |
| | Storage (Aeration Basin No.4) and Distribution Pumping | 3.1 | 283 | 8.2[2] |
| | **TOTAL** | **32.8** | **986** | **50.6** |
| | **Train A Capacity Replacement Cost** | **(18)** | | |
| | **Net Effective Capital Cost** | **14.8** | | |

[1]Includes credit for conventional NDN
[2]Although the life of the storage structure is 50 years, a 20 year life cycle cost is presented for consistency.

## 15.5 REVISIONS TO POWER SOURCE OPTIONS

The power source options for TTDF for both conventional filtration and MBR alternative are described under Section 12 of this report. Single line diagram illustrating the proposed electrical system along with proposed electrical duct bank and cable routing plans are developed and enclosed as part of Section 12. The following revisions are made to the electrical strategy due to the new location for MBR.

### A. 5 mgd Constant Flow – MBR with All New construction

For this option, feed will be drawn from existing Sub Service Switchgear "12KV-MS2" building. Two (2) existing circuit breakers 60-BKR-104 and 60-BKR-204 will be utilized to provide a double ended feed to the new indoor type 12 KV switchgear. This new switchgear will be provided with two (2) main circuit breakers, a normally open (NO) tie circuit breaker, two (2) feeder circuit breakers and extra space for two (2) additional circuit breakers for future expansion. All the 480 V Motor Control Centers are also indoor type. The new 12 KV switchgear and all the 480V Motor Control Centers will be housed in a building close to the MBR structure. The step-down transformers, however, are all outdoor type and will be located on an open concrete pad close to the new electrical building. Refer to Sketch No. 7 for a single line diagram showing the proposed system. Two (2) existing – 4"C conduits on the north-south electrical duct bank will be utilized up to Manhole EMH-6. From Manhole EMH-6, two (2) new -4"C conduits will be installed down to the new 12 KV switchgear Electrical Building. Refer to revised drawing E-1 (Rev.1) for electrical conduits and cable routes for this option.

### B. 5 mgd Constant Flow – Retrofitting Train A Facilities into MBR

The proposed power source for this option is already discussed in detail in Section 12. The arrangement and type of equipment used will be similar to the option described above. The conduits and cable routes will utilize the two (2)-4"C spare conduits at Manhole EMH-2 on the north side of the Sub Service Switchgear "12KV-MS2" building. These conduits will be extended west and then south to the proposed location of the new electrical building. Refer to revised drawing E-1 (Rev.1) for electrical conduits and cable routes for this option.

## 15.6 DISCUSSION

It is evident from the data presented in Table 15-10 above, that the two MBR alternatives compared are very close to each other from a cost standpoint. The capital cost difference between the two alternatives is insignificant and is within the margin of error of our estimates. The concrete savings realized by retrofitting existing structures are balanced by less extensive piping required by using new structures.

However, using all new structures offers a more flexible and compact design. By properly planning the new facilities, they can be built in a monolithic construction with common walls, which would make it easier to build and more efficient to operate. The future expansion of tertiary facilities would follow the same compact pattern. Also, the design would not need to be tailored based on the constraints of existing facilities, but based on the best design

practices. For example, deeper new aeration basins compared to the retrofitted basins would allow for a more efficient aeration system.

Further, a separate standalone MBR system will be easier to construct and will also provide some redundant treatment facilities associated with that particular train in the interim and for several years until the City decides to totally decommission that train due to its obsolescence.

## 15.7 CONCLUSION

Based on the above discussion, Parsons recommends using all new structures for constructing the MBR system, as it would be a more prudent and reliable approach to achieve filtration, nitrogen removal and future capacity replacement for Train A.

# SECTION 16 – RECOMMENDED PROJECT DESCRIPTION

This Section provides a brief description of the recommended project for TTDF at RWRF. The location and selection of technology for TTDF was thoroughly evaluated considering a variety of factors as presented in this TM and summarized in Section 15. A simplified schematic of the project is presented in Figure 16-1 below.

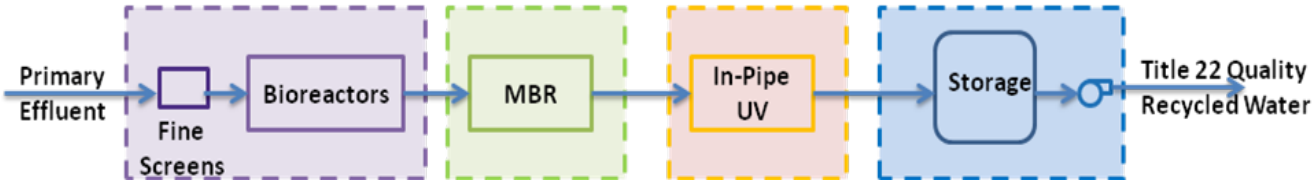



**Figure 16-1: Simplified Schematic of Recommended Project for TTDF**

## 16.1 Summary of Recommended Project

The TTDF will have a design capacity of 5 mgd (constant flow) and the facilities would be located on a "green field" site north of Canal B as shown in Figure 16-2. Primary effluent would be taken from the existing stub at Train C and delivered by gravity to pre-aeration bioreactors. The gravity pipeline will be routed underneath Canal B as an inverted siphon. Fine screens would be located at the upstream side of this gravity line (near Train C) to minimize solids accumulation within the pipeline. Bioreactors, membranes tanks, and blower building would have common walls to minimize the concrete and piping costs. In-pipe UV system will be used to disinfect the MBR permeate to achieve Title 22 recycled water quality. Aeration basin No. 4 would be used for storage of the recycled water. The facility will be laid out for ultimate design capacity of 30 mgd. The existing 24 inch diameter air line serving aeration basin No. 4 (Train A) would be used and extended to deliver process air to bioreactors. The power for this project would be supplied from the 12 kV electrical building, located east of Train A secondary clarifiers, through existing and new (extended) conduits.

## 16.2 Design Criteria

The design criteria in Table 16-1 were developed as the basis for the recommended project for TTDF.

**Table 16-1: Design Criteria for TTDF**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Design Flow Rate | mgd | 5 | |
| Flow Peaking Factor | - | 1 | Peak:Average ratio |
| Primary Effluent | - | - | Max month values |
| BOD | mg/L | 224 | 70% of raw wastewater |
| TSS | mg/L | 120 | 40% of raw wastewater |
| TKN | mg/L | 30 | 65% of raw wastewater |
| MLSS | mg/L | 10,000 | |
| SRT (Minimum) | days | 6 | Oxic zone |
| Anoxic:Oxic Zone Ratio (Minimum) | - | 0.3 | |
| Maximum Oxygen Uptake Rate | mg/L-hr | 128 | |

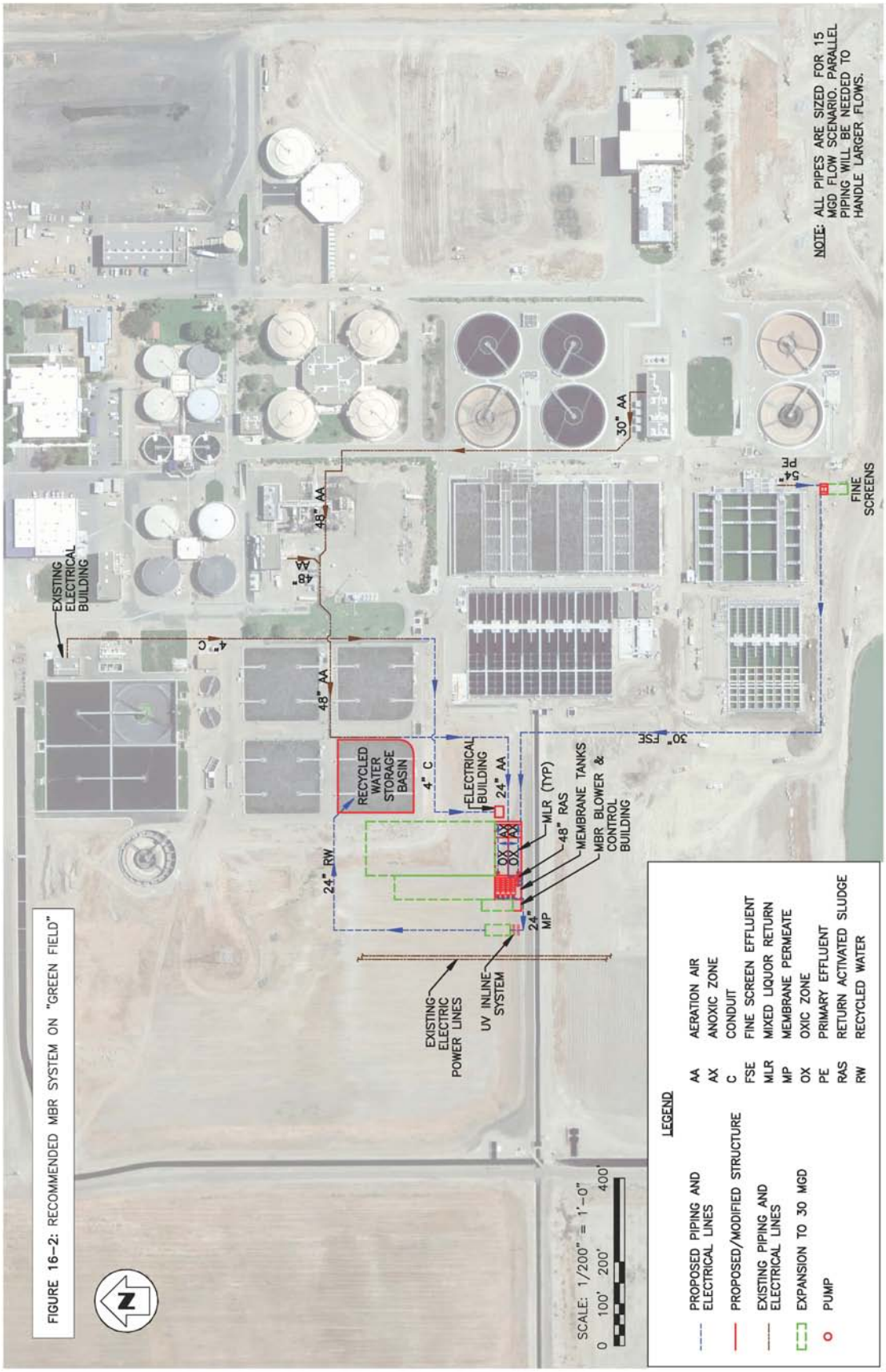



FIGURE 16–2: RECOMMENDED MBR SYSTEM ON "GREEN FIELD"

## 16.3 Process Equipment List

A list of major processes and equipment is presented in Table 16-2 below. An appropriate level of redundancy is incorporated into the process design and equipment sizing for reliable operation and maintenance of the TTDF.

**Table 16-2: List of Major Process Equipment**

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Screens | | | |
| Type | - | - | In-channel perforated-plate drum |
| Number | - | 2 (1+1) | One duty, one standby |
| Capacity, Each | mgd | 5 | |
| Bioreactors | | | |
| Number (In Parallel) | | 2 | Anoxic and oxic zones in each |
| Volume, Each | MG | 0.42 | |
| Diffusers | | | |
| Type | | | Fine bubble, membrane (EPDM) disk or strip type |
| Aeration Pattern | | | Tapered along bioreactor length |
| Process Air Blowers | | | |
| Type | | | Single-stage centrifugal |
| Number | - | 6 (5+1) | Existing blowers |
| Capacity, Each | scfm | 27,000 | |
| Discharge Pressure | psig | 7.8 or 8.5 | 4 units at 7.8 and 2 units at 8.5 |
| Horsepower, Each | hp | 1,500 | |
| Mixed Liquor Return Pumps | | | Returning flow from oxic zone to anoxic zone |
| Type | | | Axial propeller |
| Number | - | 3 (2+1) | Two duty, one shelf spare |
| Capacity, Each | gpm | 7,000 | |
| TDH | ft | 3 | |
| Horsepower | hp | 15 | |
| Drive | | | Variable speed |
| Sludge Recirculation Pumps | | | Returning flow from membrane tanks to oxic zone |
| Type | | | Vertical propeller |
| Number | - | 2 (1+1) | One duty, one standby |
| Capacity, Each | gpm | 14,000 | |
| TDH | ft | 20 | |
| Horsepower | hp | 125 | |
| Drive | | | Variable speed |
| WAS Pumps | | | |
| Type | | | Centrifugal |

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Number | - | 2 (1+1) | One duty, one standby |
| Capacity, Each | gpm | 450 | |
| TDH | ft | 20 | |
| Horsepower | hp | 5 | |
| Drive | | | Variable speed |
| Membrane Tanks | | | |
| Number | - | 4 | |
| Cassettes per Tank | | | |
| Number Installed | - | 6 | |
| Space for Future | - | 1 | |
| Total Membrane Surface Area | ft2 | 417,360 | |
| Air Scouring Blowers | | | |
| Type | | | High-speed turbo |
| Number | - | 3 (2+1) | Two duty, one standby |
| Capacity, Each | scfm | 3,950 | |
| Discharge Pressure | psi | 5 | |
| Horsepower, Each | hp | 125 | |
| Drive | | | Variable speed |
| Permeate Pumps | | | |
| Type | | | Horizontal end suction |
| Number | - | 5 (4+1) | Four duty, one shelf spare |
| Capacity, Each | gpm | 1,350 | |
| TDH | ft | 25 | |
| Horsepower, Each | hp | 20 | |
| Drive | | | Variable speed |
| Backpulse Pumps | | | |
| Type | | | Horizontal end suction |
| Number | - | 2 (1+1) | One duty, one standby |
| Capacity, Each | gpm | 1,480 | |
| TDH | ft | 25 | |
| Horsepower, Each | hp | 30 | |
| Drive | | | Variable speed |
| Instrument Air Compressors | | | If Plant air not available |
| Number | - | 2 (1+1) | One duty, one standby |
| Horsepower, Each | hp | 15 | |
| Chemical Cleaning | | | |
| Sodium Hypochlorite | | | 12.5% Solution |
| Frequency | | | |
| Recovery | Yearly | 2 | Per tank |
| Maintenance | Weekly | 1 | Per tank |

| Item | Units | Design Value | Remarks |
|---|---|---|---|
| Annual Consumption | gal | 4,000 | |
| Citric Acid | | | 50% Solution |
| Frequency | Yearly | 1-2 | Part of Recovery Clean |
| Annual Consumption | gal | 750 | |
| UV System | | | |
| Design Flow | mgd | 5 | |
| Type of UV System | | | In-pipe, Low Pressure, High Intensity |
| Number of Trains | | 4 (3+1) | Three duty, one standby |
| Number of Reactors | | 8 (6+2) | Six duty, two standby |
| Flow Capacity per Reactor | mgd | 1.0 | |
| Length of Reactor | ft | 8 | |
| Number of Lamps per Reactor | | 40 | |
| Total Number of Lamps Provided | | 320 | |

## 16.4 Preliminary Costs

Preliminary costs were developed according to Class 4 level per AACE (Association for the Advancement of Cost Engineering) guidelines. Using the estimated capital and O&M costs, a 20-year life cycle cost analysis was performed. The results are shown in Table 16-3.

**Table 16-3: MBR System Life-Cycle Cost (5 mgd)**

| Parameter | Capital Cost ($ Millions) | O&M Cost ($ Thousands) | 20-Year Life Cycle Cost ($ Millions) |
|---|---|---|---|
| MBR System | 24.4 | 553 | 34.4 |
| Disinfection (In-pipe UV) | 5.3 | 150 | 8.0 |
| Storage (Aeration Basin No.4) and Distribution Pumping | 3.1 | 283 | 8.2 |
| **TOTAL** | **32.8** | **986** | **50.6** |
| **Train A Capacity Replacement Cost** | **(18)** | | |
| **Net Effective Capital Cost** | **14.8** | | |

## 16.5 Power Source

For the proposed TTDF on a "green field" site, power feed will be drawn from existing Sub Service Switchgear "12KV-MS2" building. Two (2) existing circuit breakers 60-BKR-104 and 60-BKR-204 will be utilized to provide a double ended feed to the new indoor type 12 KV switchgear. This new switchgear will be provided with two (2) main circuit breakers, a normally open (NO) tie circuit breaker, two (2) feeder circuit breakers and extra space for two (2) additional circuit breakers for future expansion. All new 480 V Motor Control Centers are also indoor type. The new 12 KV switchgear and all the 480V Motor Control Centers will be housed

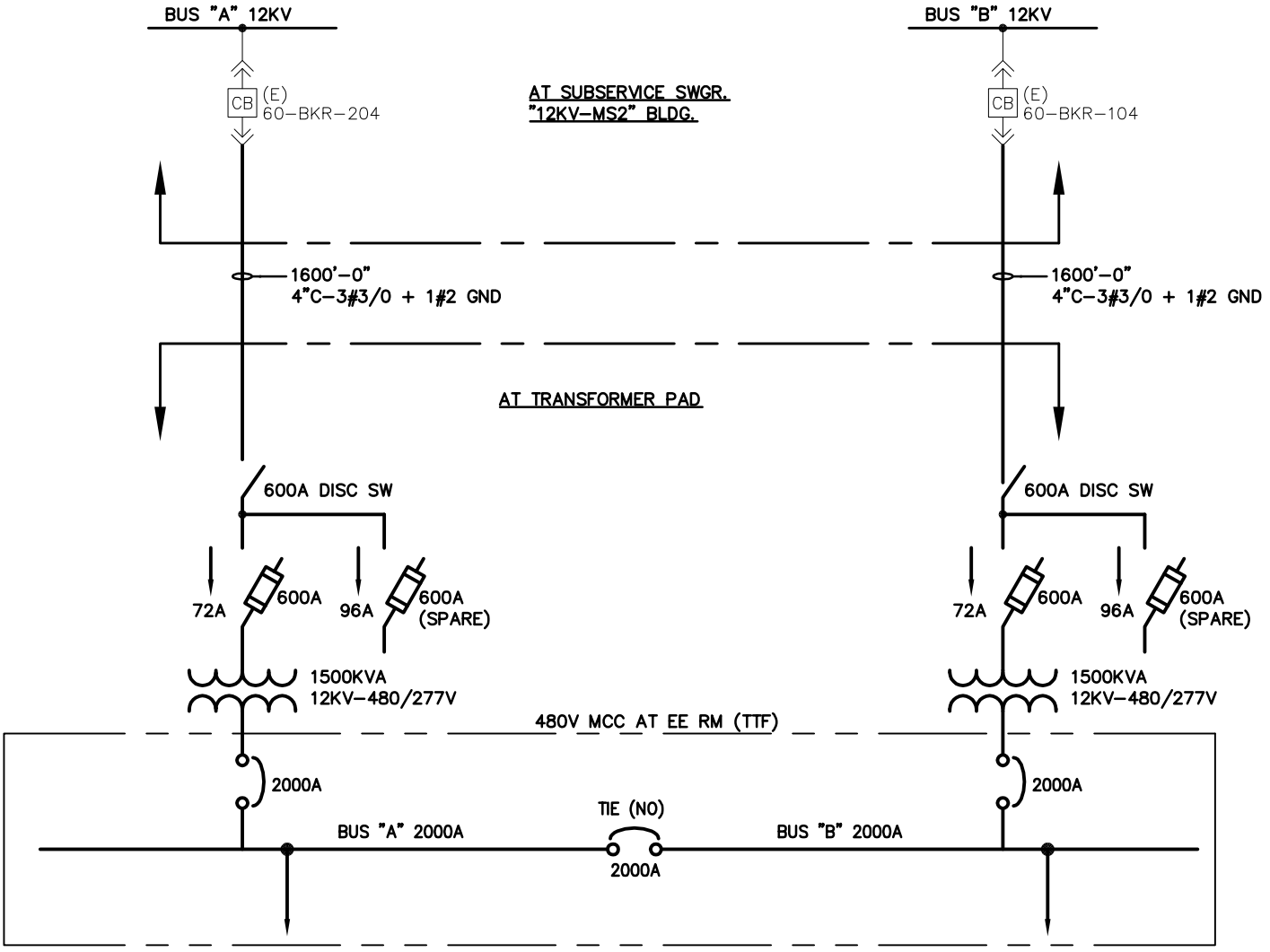
in a building close to the MBR structure. The step-down transformers, however, are all outdoor type and will be located on an open concrete pad close to the new electrical building. Two (2) existing – 4"C conduits on the north-south electrical duct bank will be utilized up to Manhole EMH-6. From Manhole EMH-6, two (2) new -4"C conduits will be installed down to the new 12 KV switchgear Electrical Building.

# APPENDIX A

## PRELIMINARY CONSTRUCTION AND O&M COST ESTIMATES

# APPENDIX B

## REFERENCE DRAWINGS

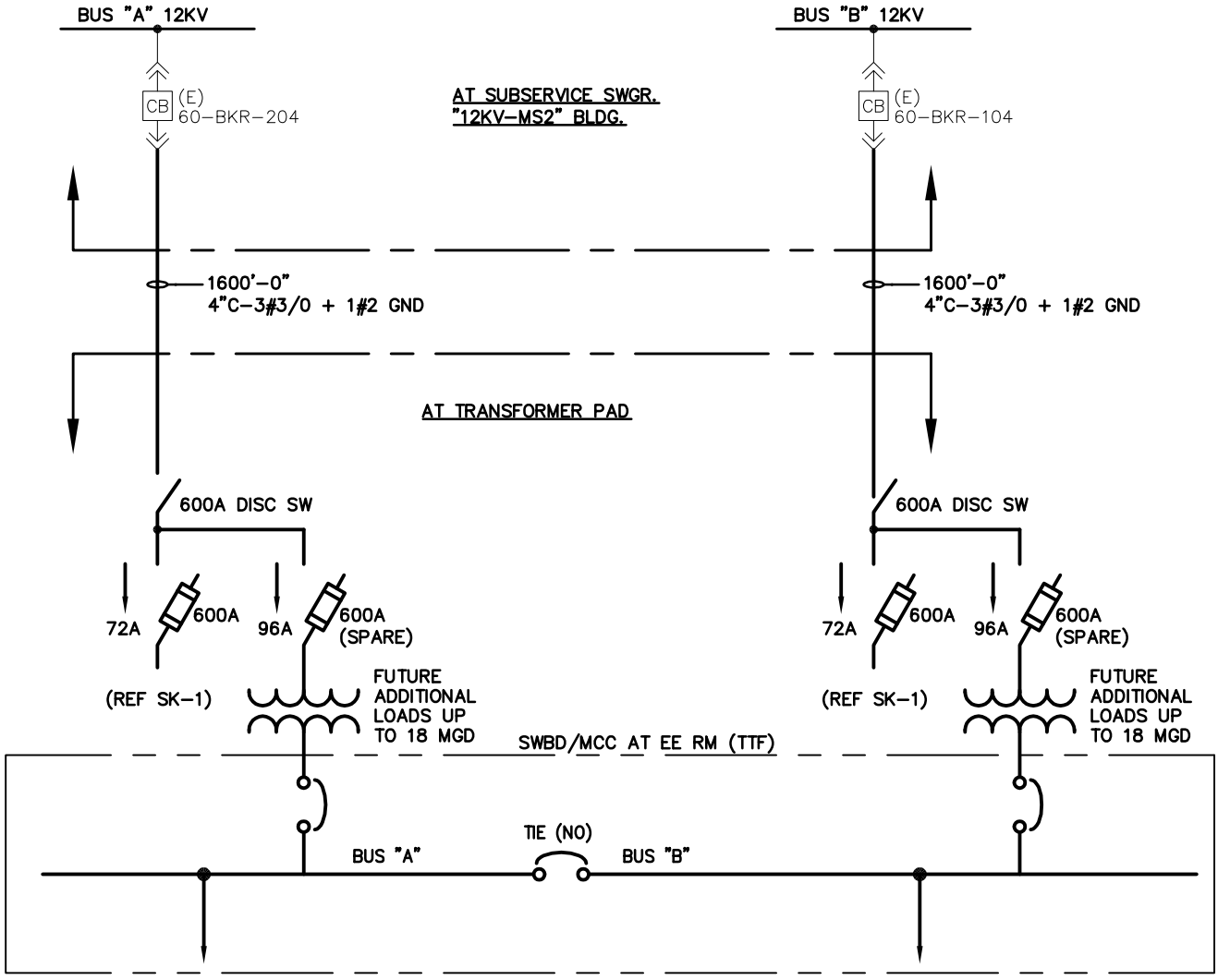



CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

# SINGLE LINE DIAGRAM
# TTDF - 12 MGD CONVENTIONAL FILTRATION SYSTEM

# SK-1

DESIGN BY: E. GATDULA
SCALE: NONE | DATE: 02/01/2011

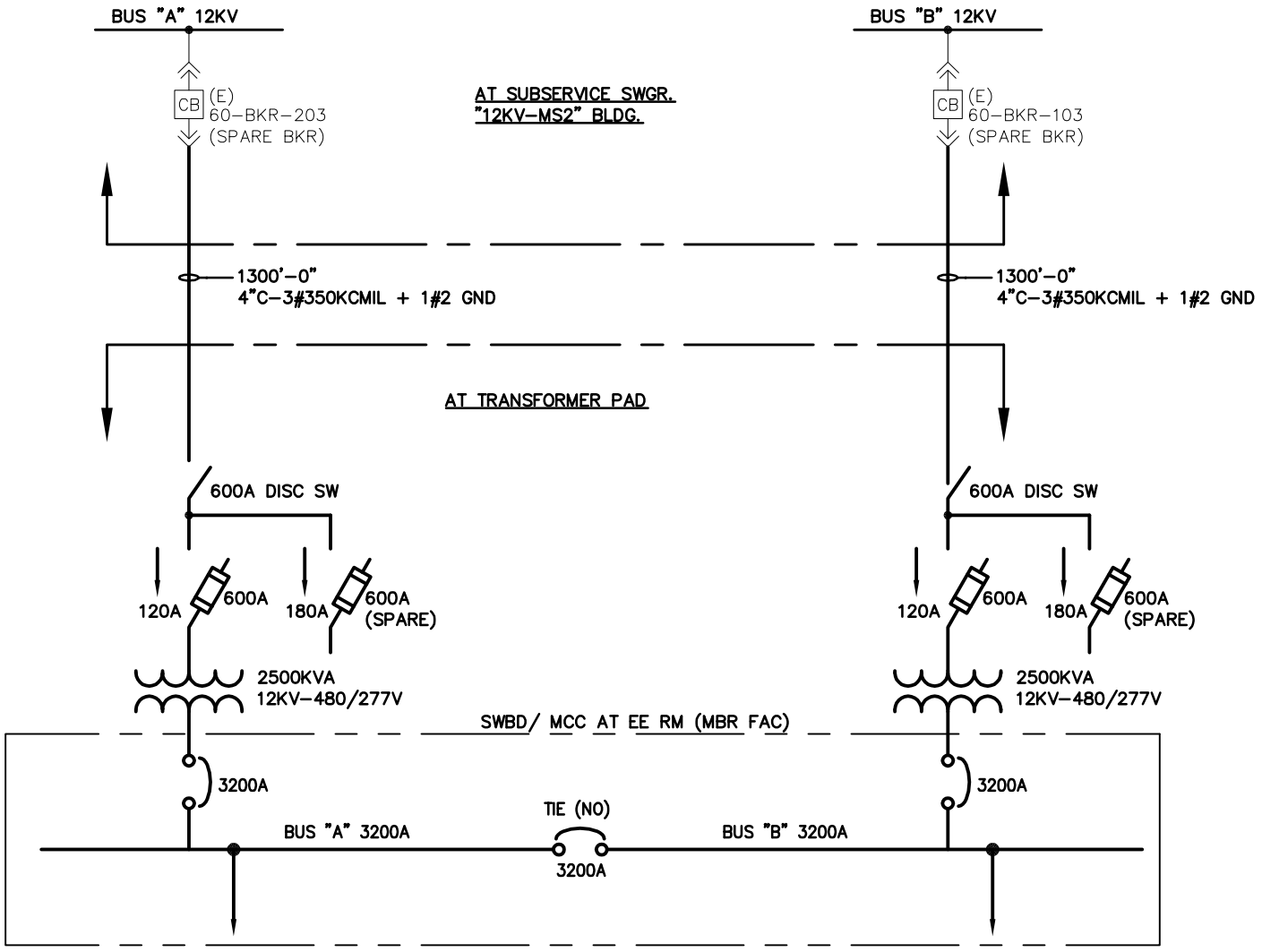



CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

# SINGLE LINE DIAGRAM
# TTDF - UP TO 30 MGD CONVENTIONAL FILTRATION SYSTEM

SK-2

DESIGN BY: E. GATDULA
SCALE: NONE | DATE: 02/01/2011

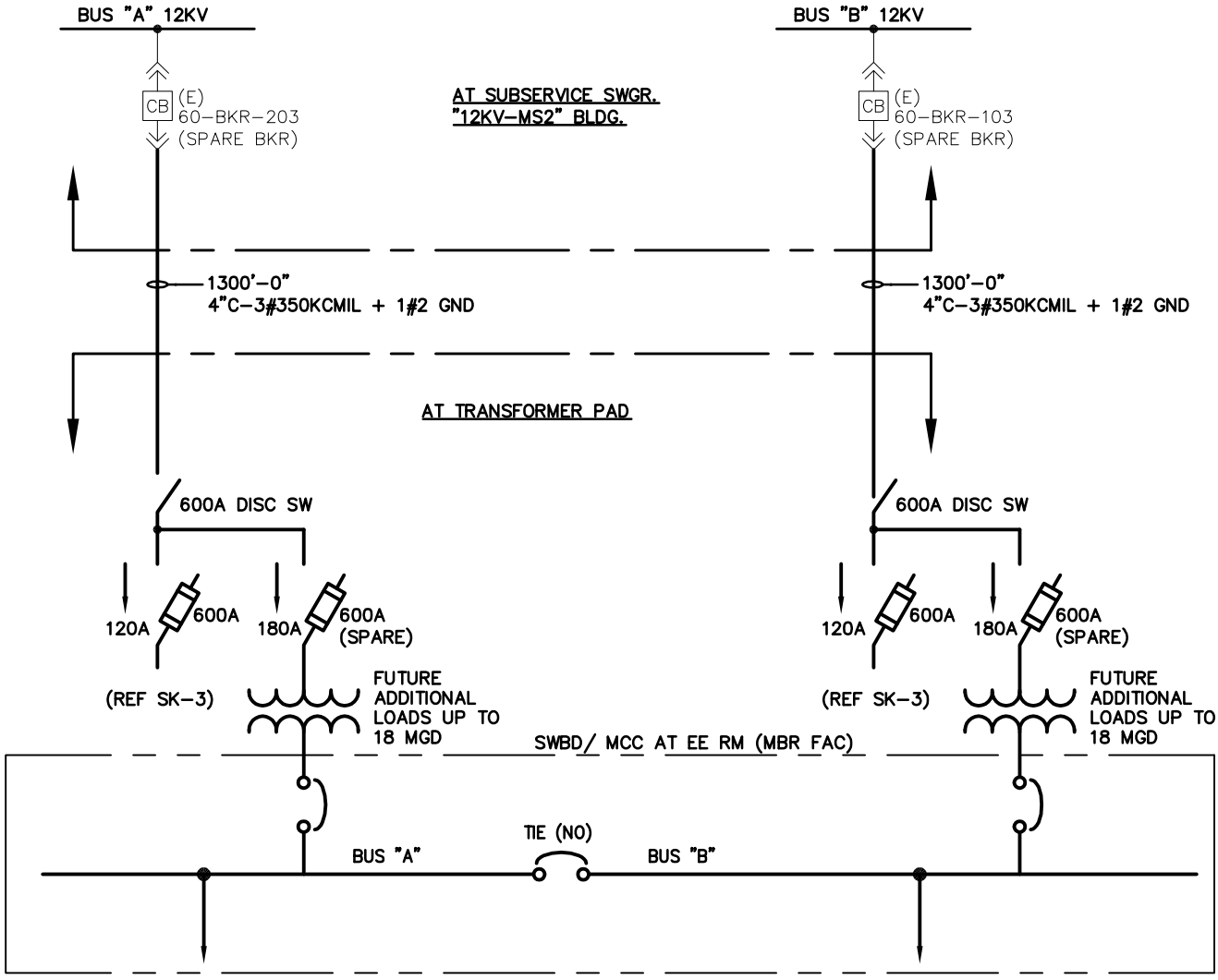



CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

# SINGLE LINE DIAGRAM
# TTDF - 12 MGD MBR SYSTEM
# OPTION 1 (SPARE BREAKERS - NEW 4" CONDUITS)

SK-3

DESIGN BY: E. GATDULA
SCALE: NONE | DATE: 02/01/2011

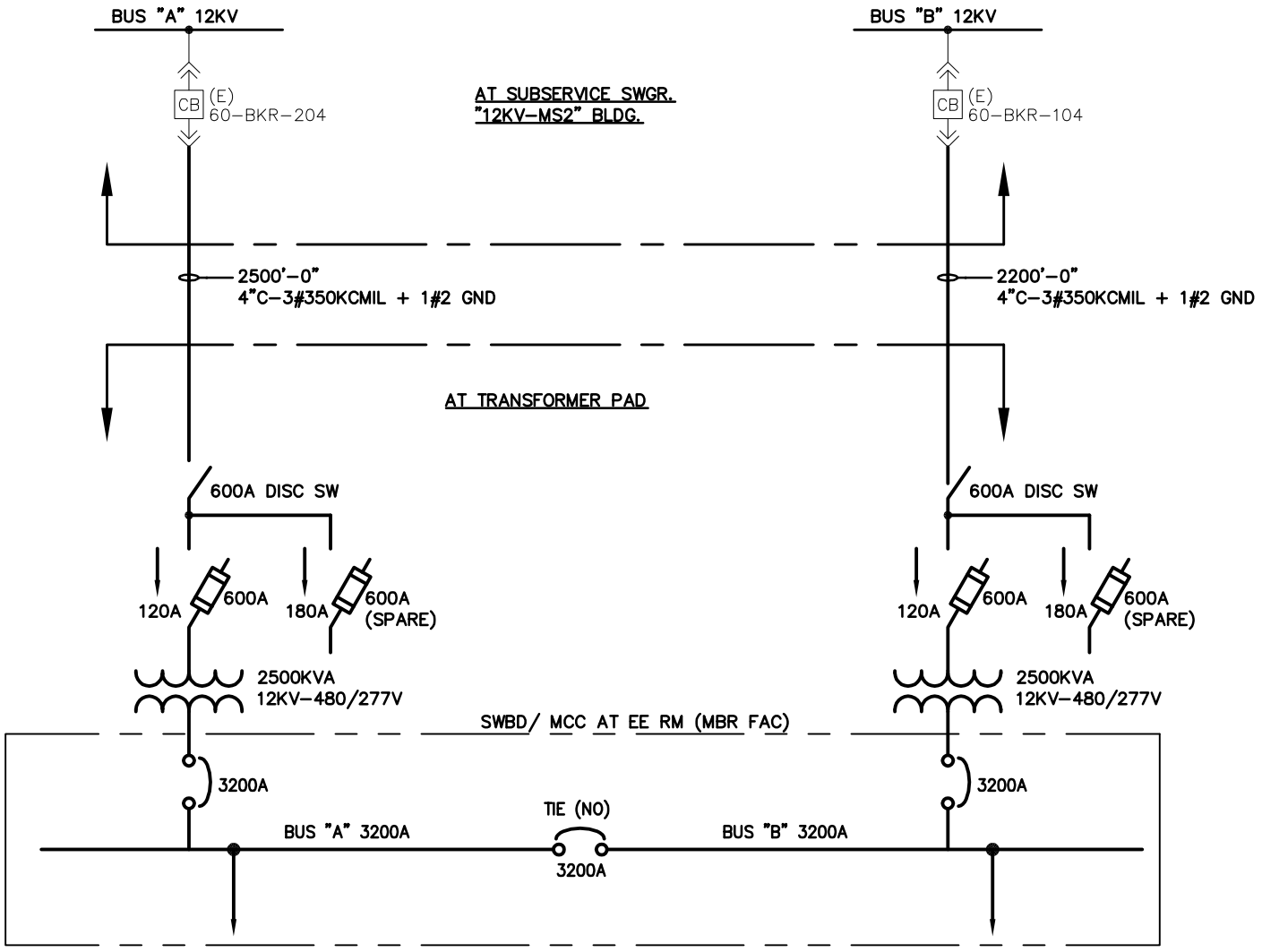



CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

# SINGLE LINE DIAGRAM
# TTDF - UP TO 30 MGD MBR SYSTEM
# OPTION 1 (SPARE BREAKERS - NEW 4" CONDUITS)

# SK-4

DESIGN BY: E. GATDULA
SCALE: NONE | DATE: 02/01/2011

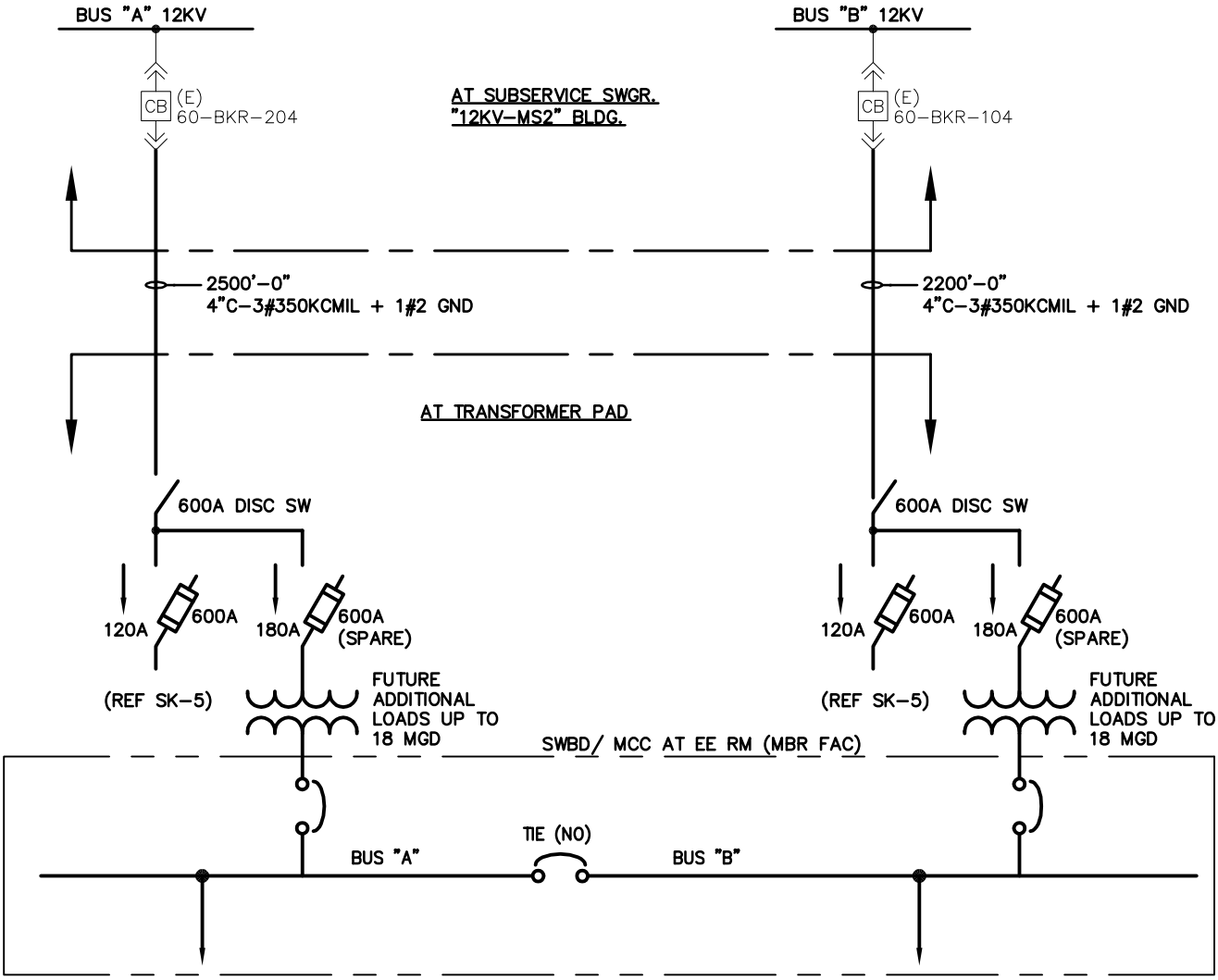



CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

# SINGLE LINE DIAGRAM
# TTDF - 12 MGD MBR SYSTEM
# OPTION 2 (EXIST. BREAKERS - EXIST./ NEW 4" CONDUITS)

SK-5

DESIGN BY: E. GATDULA
SCALE: NONE | DATE: 02/01/2011

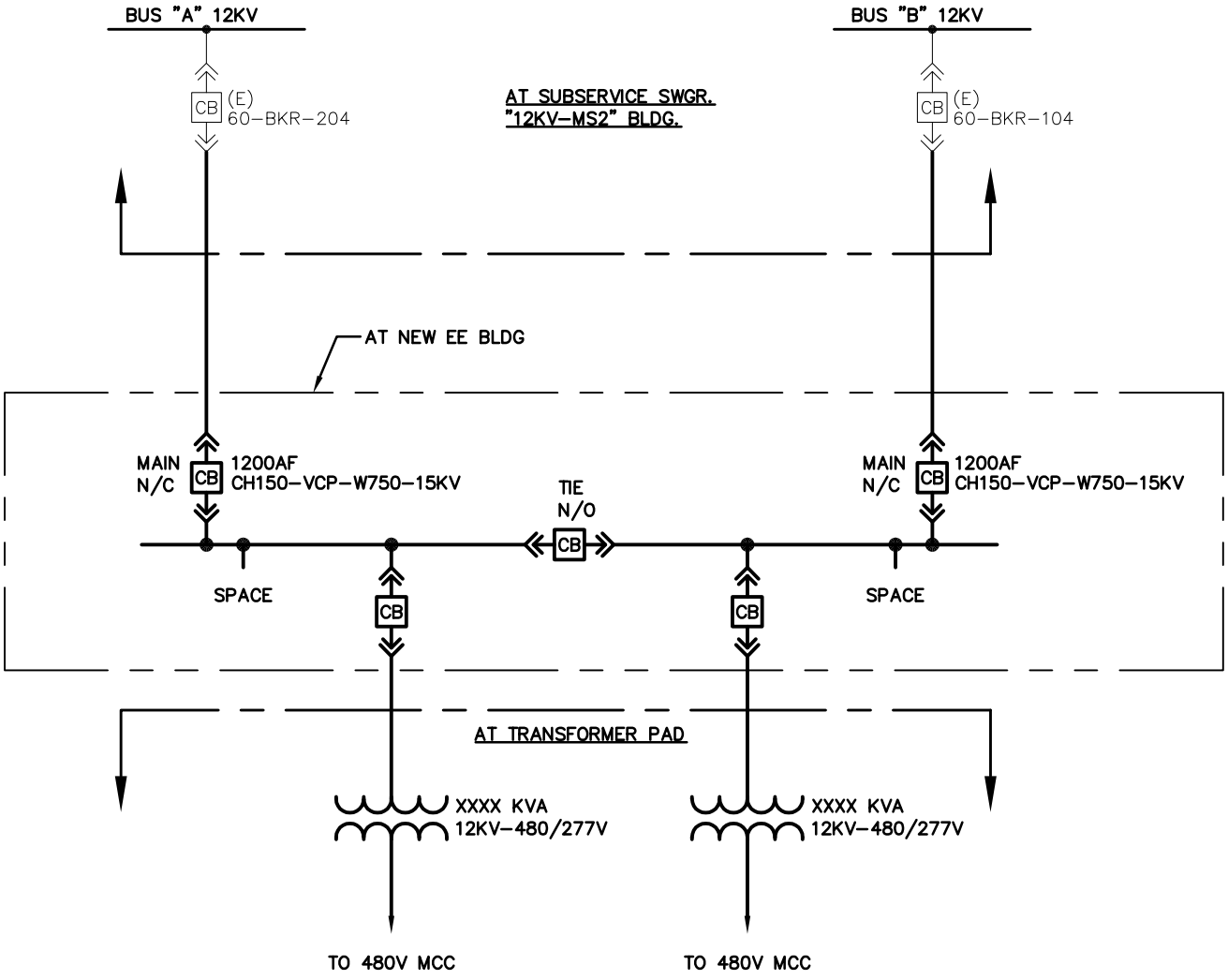



CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

# SINGLE LINE DIAGRAM
# TTDF - UP TO 30 MGD MBR SYSTEM
# OPTION 2 (EXIST. BREAKERS - EXIST./ NEW 4" CONDUITS)

# SK-6

DESIGN BY: E. GATDULA
SCALE: NONE | DATE: 02/01/2011

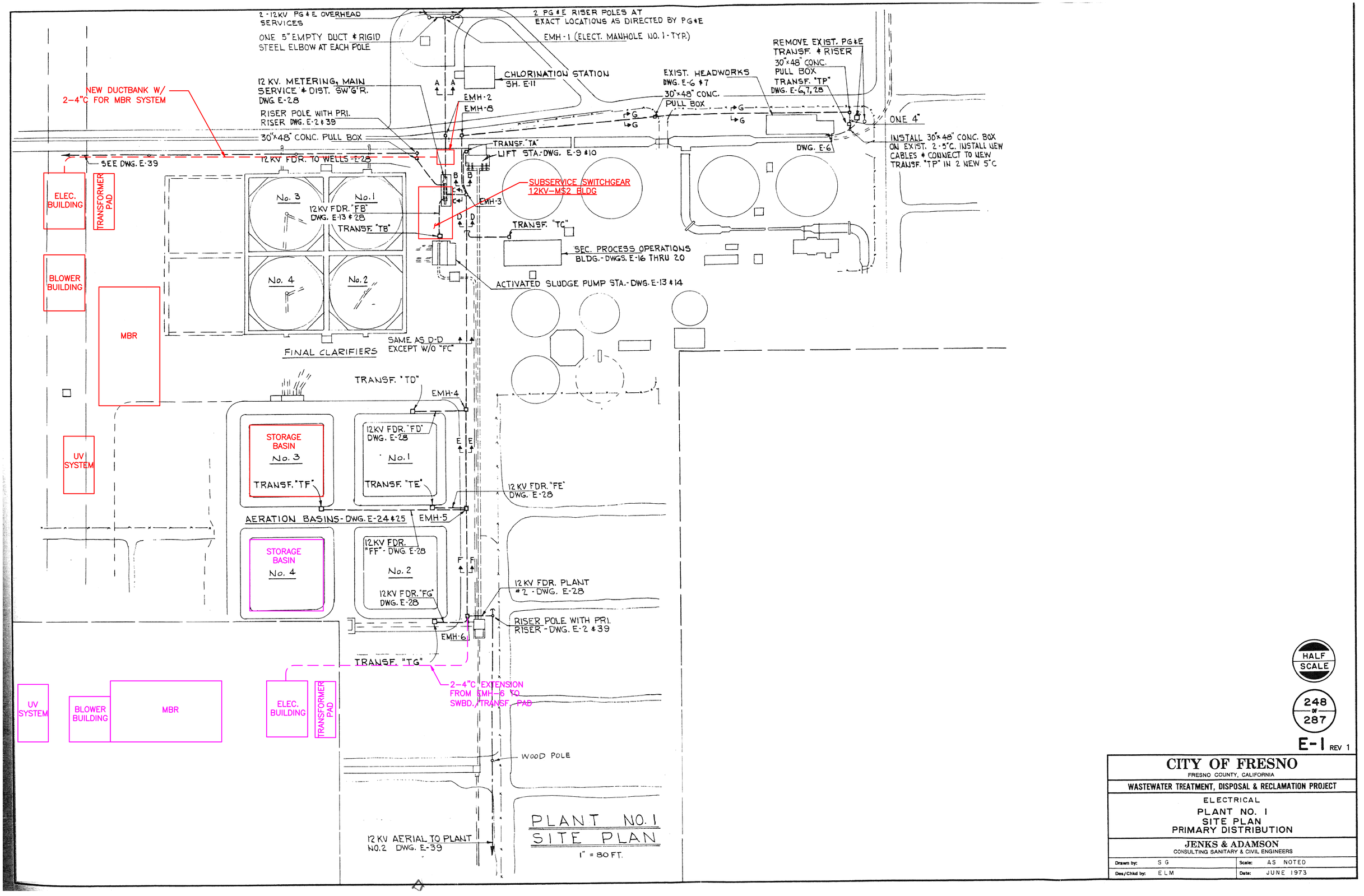



CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

# SINGLE LINE DIAGRAM
# TTDF - 5 MGD MBR SYSTEM
# PREFERRED ELECTRICAL EQUIPMENT ARRANGEMENT

SK-7

DESIGN BY: E. GATDULA
SCALE: NONE | DATE: 02/25/2011




HALF SCALE

248 OF 287

E-1 REV 1

# CITY OF FRESNO

FRESNO COUNTY, CALIFORNIA

WASTEWATER TREATMENT, DISPOSAL & RECLAMATION PROJECT

ELECTRICAL

PLANT NO. 1
SITE PLAN
PRIMARY DISTRIBUTION

JENKS & ADAMSON
CONSULTING SANITARY & CIVIL ENGINEERS

| | | | |
|---|---|---|---|
| Drawn by: | S G | Scale: | AS NOTED |
| Des/Chkd by: | E L M | Date: | JUNE 1973 |

# APPENDIX C

## REFERENCE DOCUMENTS

# WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

RESOLUTION NO. R5-2002-0254-A01
AMENDING WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254
FOR
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

WHEREAS, the California Regional Water Quality Control Board, Central Valley Region, (hereafter Board) adopted Waste Discharge Requirements Order No. 5-01-254 for the Cities of Fresno and Clovis at its regularly scheduled public meeting on 19 October 2001; and

WHEREAS, Order No. 5-01-254 references the Cities of Fresno and Clovis as Discharger and the City of Fresno as Operator; and

WHEREAS, Order No. 5-01-254 requires that the Discharger comply with all pretreatment requirements contained in Title 40, Code of Federal Regulations (CFR), Part 403, including implementing the necessary legal authorities; and

WHEREAS, when Order No. 5-01-254 was adopted, legal adequacy review of the Operator's pretreatment program was still pending; and

WHEREAS, the legal adequacy review was completed and a 21 November 2001 letter from Board staff to the Operator identifies revisions that are necessary for the ordinance and the interjurisdictional agreements contained in the Operator's pretreatment program to comply with the federal pretreatment regulations set forth in 40 CFR Part 403; and

WHEREAS, although the Discharger has been made aware of the required revisions, the process of effecting the revisions will take some time; and

WHEREAS, the action to amend Waste Discharge Requirements Order No. 5-01-254 for this existing facility is exempt from the provisions of the California Environmental Quality Act in accordance with Title 14, California Code of Regulations, Section 15301; and

WHEREAS, the Board has notified the Discharger, interested agencies, and persons of its intent to amend waste discharge requirements for the Discharger and has provided them with an opportunity for public hearing and an opportunity to submit their views and recommendations; and

WHEREAS, the Board, in a public meeting, heard and considered all comments pertaining to this action; therefore be it

RESOLVED, that the Board hereby amends Waste Discharge Requirements Order No. 5-01-254 as follows:

RESOLUTION NO. R5-2002-0254-A01
AMENDING WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-245
FOR CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

## REVISED FINDING

1. On Page 5, in Finding No. 20, delete last sentence and replace with "Pretreatment program review identified certain revisions to the City of Fresno's Municipal Code and interjurisdictional agreements that are necessary for the pretreatment program to contain the legal authorities required for compliance with the federal pretreatment regulations set forth in 40 CFR 403. The required revisions are set forth in a 21 November 2001 letter from Board staff to the Operator, and it is reasonable that a schedule be established (Provision H.35) for completion of the required revisions. The Operator's current pretreatment program, with revisions and updates submitted by the Operator on 5 April 2001, shall remain in effect and is approved conditional upon completion of the required revisions to the program in accordance with the time schedule set forth herein."

## NEW PROVISION

2. On Page 35, add a new Provision H.35 that states: "The Operator shall, no later than **15 January 2003**, submit sufficient documentation to demonstrate that its ordinance and interjurisdictional agreements contained in its pretreatment program contain adequate legal authorities to implement and enforce the pretreatment requirements in compliance with 40 CFR 403."

I, GARY M. CARLTON, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, Central Valley Region, on 1 March 2002.

_____
GARY M. CARLTON, Executive Officer

BLH:fmc

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. 5-01-254

WASTE DISCHARGE REQUIREMENTS
FOR
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

The California Regional Water Quality Control Board, Central Valley Region, (hereafter Board) finds that:

1. The Fresno-Clovis Metropolitan Regional Wastewater Reclamation Facility is a wastewater treatment facility (WWTF) that serves the cities of Fresno and Clovis; the Pinedale Water District and Pinedale Utilities District, both of which are within the city limits of Fresno; and some areas within Fresno County not within the city limits of Fresno or Clovis. The City of Clovis owns 9.5 percent of the WWTF's treatment capacity, while the City of Fresno owns the rest. The cities of Fresno and Clovis are referred to as Discharger. The City of Fresno is responsible for day-to-day WWTF operations, and is referred to as Operator. The WWTF is on property owned by the City of Fresno and covers 3,290 acres in Sections 20, 21, 22, 27, and 33, of T14S, R19E, MDB&M, as shown in Attachment A, which is part of this Order.

2. The WWTF features two separate wastewater treatment plants. Plant 1 is an activated sludge treatment plant that includes headworks, primary and secondary clarifiers, aeration basins, and anaerobic digesters (see Attachment B). The Discharger recently expanded Plant 1 to increase its nominal treatment capacity from 68 million gallons per day (mgd) to 88 mgd. Plant 2 is a 6-mgd-capacity trickling filter treatment plant that includes primary and secondary clarifiers (see Attachment C). Plant 2 is remotely located from Plant 1 and is currently not utilized. Also included within the 3,290-acre WWTF property are 1,660 acres of effluent disposal ponds; a 145-acre winery stillage disposal site (Stillage Site), portions of which have been in service since 1974; and about 600 acres of farmland on which WWTF effluent is recycled by local growers under lease agreements with the Operator.

3. Waste Discharge Requirements (WDRs) Order No. 96-054, adopted by the Board 23 February 1996, prescribes requirements for an average dry weather flow discharge of 68 mgd from Plant 1 and of 6 mgd from Plant 2 (when in operation). Order No. 96-054 also regulates the 145-acre Stillage Site generally in accordance with guidelines for land disposal of stillage waste from wineries (Stillage Guidelines) adopted by the Board in 1983. Prior to 1996, WDRs Order No. 74-10 regulated the discharge of stillage to a 95-acre portion of the Stillage Site.

4. Cease and Desist (C&D) Order No. 96-055, adopted by the Board 23 February 1996, directed the Discharger to achieve compliance with its WDRs by implementing specific short-term and long-term tasks and measures. Tasks included a study regarding the expansion of WWTF treatment and disposal pond capacity and the possibility of reclaiming substantially all wastewater. Measures included salinity control and compliance with an effluent salinity limitation. The Operator has

implemented salinity source control, upgraded the WWTF to accommodate current and projected wastewater flow through 2008, increased disposal capacity, and submitted a study describing the feasibility of expanded water recycling operations. On 19 October 2001, the Board adopted Order No. 5-01-241 rescinding C&D Order No. 96-055.

5. The Operator submitted a Report of Waste Discharge, dated 31 December 1996, in support of a 20-mgd increase in Plant 1 treatment and disposal capacity (i.e., to 88 mgd) and a 30 percent increase over current permitted flow of 72 mgd (i.e., to 94 mgd). The Discharger projects the added capacity should be sufficient until 2008.

6. Currently, average and maximum daily discharge flows are 68 mgd (on an annual basis) and 72 mgd (on a maximum monthly average basis), respectively. Discharger monitoring reports from 2000 characterize the WWTF effluent and municipal source water as follows:

| Constituent | Units | Average | Minimum | Maximum |
|---|---|---|---|---|
| Effluent 5-day biochemical oxygen demand ($BOD_5$) | mg/L | 26 | 8 | 53 |
| Total dissolved solids (TDS) | mg/L | | | |
| Source water | | 240 | 220 | 250 |
| Effluent | | 440 | 340 | 500 |
| Conductivity at 25°C (EC) | µmhos/cm | | | |
| Source water | | 350 | -- | -- |
| Effluent | | 780 | 690 | 870 |
| Effluent Chloride | mg/L | 72 | 60 | 107 |
| Effluent Sodium | mg/L | 81 | 74 | 100 |
| Effluent bicarbonate alkalinity (as $CaCO_3$) | mg/L | 208 | 164 | 255 |

7. The Discharger frequently adds ferric chloride to the influent prior to primary clarification. While this enhances pretreatment for organic and solids removal and control of hydrogen sulfide, it does increase the discharge's chloride and EC concentration. From 1 January 1999 through 4 April 2001, the discharge's monthly average chloride concentration ranged from 59 to 87 mg/L, averaged 70 mg/L, and had a 95% confidence level of 82 mg/L. Similarly, for this same period, the discharge's monthly EC concentration ranged from 594 to 924 µmhos/cm, averaged 757 µmhos/cm, and had a 95% confidence level of 842 µmhos/cm.

## EFFLUENT DISPOSAL AND REUSE

8. At the current average daily discharge flow of 68 mgd, the WWTF discharges about 76,000 acre-feet per year (af/yr). Of this amount, about 4,000 af/yr of effluent is recycled directly, an amount that represents about only five percent of the WWTF's current annual discharge flow. Dedicated pumps and piping carry the effluent to reclamation areas for irrigation of crops such as alfalfa, cotton, silage corn, and wine grapes. Current and proposed on-site water recycling is by local farmers (hereafter Users) under lease agreements on 766 acres within the WWTF property (hereafter reclamation area). Off-site water recycling is by growers under separate water

reclamation requirements. Of the 72,000 af/yr discharged to the 1,660 acres of disposal ponds, about 63,400 af/yr (88 percent) percolates to groundwater and 8,600 af/yr (12 percent) is lost through evaporation.

9. The Discharger's practice of disposing of most discharge flow by percolation has, over the years, created an extensive groundwater mound under the WWTF disposal ponds (hereafter effluent mound). The effluent mound appears to be about 10-feet high, ranges in depth from 25 to 60 feet below ground surface (bgs), extends well beyond the perimeter of the WWTF property, and affects groundwater contours throughout a 25-square-mile area.

10. The Fresno Irrigation District (FID) covers 245,000 acres in central Fresno County, extends from Pine Flat Dam along the Kings River to the Kerman area, and includes the Fresno-Clovis metropolitan area.

11. In 1974, the City of Fresno entered into an agreement with FID to establish a groundwater reclamation system consisting of onsite extraction wells and piping that delivers groundwater to FID's Dry Creek and Houghton Canals during the growing season for agricultural use on the western side of FID. Both canals can each convey up to about 200 cubic feet per second. The 1974 agreement between FID and the Operator currently stipulates, in part, that the Operator may discharge a maximum of 30,000 af/yr of extracted groundwater to FID canals. To date, there are no restrictions on the use of extracted groundwater discharged to FID canals.

12. In 1975, the Operator installed 21 reclamation wells within the WWTF property. The amount of water extracted ranges between 10,000 af/yr (minimum) to 30,000 af/yr (maximum), an amount equivalent to 12 to 37 percent of the WWTF's current annual discharge flow. As of 30 April 2001, all 21 reclamation wells were operational. The estimated delivery capacity is in excess of 30,000 af/yr. With the exception of several newly-installed "Flowpath™" reclamation wells, the Operator's reclamation wells extract groundwater from depths exceeding 200 feet bgs, which is 140 to 175 feet below the top of the effluent mound. The Operator pumps from these depths rather than those associated with the effluent mound reportedly due to shallow zone's low specific yields. The Flowpath ™ wells, installed in the fall of 2000, extract from depths ranging from 80 to 240 feet bgs. The Operator periodically monitors the quality of groundwater extracted from the reclamation wells for TDS, EC, sodium, chloride, nitrogen compounds, and general minerals. The chloride concentration in extracted groundwater is comparable to WWTF effluent and not to groundwater extracted from the WWTF's background monitoring wells. Consequently, the reclamation well network, while drawing from depths below the top elevation of the effluent mound, is effectively extracting percolated effluent and not regional groundwater. Water quality data from October 2000 for groundwater extracted from three Flowpath ™ reclamation wells indicate the following average concentrations in mg/L: chloride (79), dissolved iron (0.19), dissolved manganese (1.24), total nitrogen (< 2), sodium (76), TDS (490), and total organic carbon (5).

13. The Operator normally delivers between 15,000 and 20,000 af/yr to FID canals with its current reclamation well network. For the Operator to deliver in excess of 30,000 af/yr to FID canals, the Operator would have to add more reclamation wells. Any increase in the discharge of extracted groundwater beyond that specified in the 1974 agreement is subject to FID approval.

14. The Discharger submitted a technical report, *Fresno-Clovis Regional Wastewater Reclamation Facilities Master Plan Summary Report* (Master Plan), dated November 1996, pursuant, in part, to C&D Order No. 96-055. The Master Plan describes several near- and long-term options for off-site effluent reuse/disposal to meet the Discharger's disposal needs through 2020. The Master Plan further describes the institutional and structural elements of each option, including its financial analysis and multi-year implementation schedule.

15. The Master Plan recommends the following effluent disposal and reuse projects: (a) adding about 270 acres of on-site disposal ponds, (b) maximizing the discharge to FID canals from of its existing reclamation well network, and (c) implementing a reuse project that would recycle an amount equivalent of the annual WWTF discharge flow. At the full capacity of 80 mgd, the annual discharge flow is about 90,000 af/yr, which far exceeds the discharge of any municipal sewage treatment facility in the San Joaquin Valley. The Discharger has increased its on-site disposal pond acreage and has continued to explore opportunities for the direct reuse of effluent. The City currently is constructing pipelines that will provide effluent for the irrigation of an additional 630 acres of reclamation area. The City also has a project under way to increase the capacity of the existing reclamation well network.

16. Calpine Corporation (hereafter Calpine) is planning to construct a new gas-fired turbine in Fresno County (Central Valley Energy Center, hereafter referred to as CVEC). Calpine proposes to pump approximately 7,000 af/yr from the Operator's reclamation wells to provide cooling tower and industrial process water for the CVEC. Once extracted, the recycled water will be dosed with sodium hypochlorite prior to introduction into a 20.5 mile, 30-inch diameter pipeline, which will terminate into two 1.5 million gallon storage tanks at the CVEC site.

17. In addition to its Kings River entitlement, FID and the Operator have signed contracts to purchase up to 135,000 af/yr of surface water from the Friant Division of the Central Valley Project, operated by the U.S. Bureau of Reclamation (Bureau). The contract between FID, the Operator, and the Bureau is up for renewal, which may change the terms and conditions of the 1974 agreement between FID and the Operator. Until the contract renewal is consummated, the economic value of WWTF effluent as a source of agricultural supply is uncertain. This economic uncertainty influences the Discharger's scheduling for implementing a large-scale effluent reuse project.

**PRETREATMENT**

18. Fifty-six significant industrial users discharge waste into the WWTF collection system, including 14 users from the metal finishing categories, according to data submitted by the Operator in February 2001. Other industrial users discharging into the WWTF include soft drink bottlers, meat packers, food processors (fruit, vegetable, grain, nuts, and seeds), dairy and poultry products processors, plastic manufacturers, wineries, and several linen and industrial laundries.

19. Pretreatment effluent standards established pursuant to section 307 of the Federal Clean Water Act (CWA) and amendments thereto are applicable to the discharge.

20. The Discharger originally developed a pretreatment program in conformance with 40 CFR 403. The Board approved the program on 17 June 1984. The Operator has subsequently submitted a revised pretreatment program (dated 6 June 1996), also in conformance with 40 CFR 403, which updates its original submission to bring it in line with current practices. The Operator updated its pretreatment program in 2001, in part, to reflect its latest municipal code and enforcement response plan, incorporate WWTF upgrades, and describe modifications in sampling procedures. The Board is reviewing the revised pretreatment program for completeness and adequacy.

21. A pretreatment compliance inspection conducted in June 1999 indicated that all elements of the Discharger's pretreatment program comply with the federal pretreatment regulations in 40 CFR 403.

## SLUDGE MANAGEMENT AND BIOSOLIDS DISPOSAL

22. Pursuant to section 13274 of the California Water Code, the State Water Resources Control Board adopted on 17 August 2000 Water Quality Order No. 2000-10-DWQ, *General Waste Discharge Requirements for the Discharge of Biosolids to Land for use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities* (hereafter General Biosolids Order).

23. The WWTF produced 12,800 dry tons of sludge in 1999, or an average of 35 tons/day. Dissolved air flotation and gravity belt units thicken sludge, anaerobic digesters stabilize it, and belt filter presses dewater it.

24. Prior to 1993, the Operator pumped digested sludge to 62 acres of sludge drying beds consisting of unlined open earthen basins. The Operator has since constructed additional treatment facilities on the majority of the 62-acre site of the old sludge beds, with a small portion converted into effluent disposal ponds.

25. The Operator previously stockpiled over 75,000 cubic yards of biosolids that had been originally classified as "hazardous" waste due to its concentrations of lead and cadmium. In September 1994, the Discharger submitted a technical report, *Work Plan To Collect and Analyze Sludge Samples*. In July 1997, the California Department of Toxic Substances re-evaluated the biosolids and re-classified it as nonhazardous. During the fall of 1998, the Operator transported the stockpiled biosolids to the Fresno Sanitary Landfill as part of the landfill's final closure project. From September 1998 through January 1999, the Operator diverted 25 percent of the biosolids previously produced at the WWTF to the Fresno Sanitary Landfill as part of its final closure project.

26. In August 1997, the Discharger entered into a contract with McCarthy Farms (MFF) to haul nonhazardous WWTF biosolids to MFF's land application site near Corcoran or to MFF's composting site in Lost Hills operated by San Joaquin Composting, Inc. These sites are regulated by waste discharge requirements adopted by the Board. In April 1999, the Operator certified that WWTF biosolids met the requirements for Class B biosolids and implemented a direct land application program in conjunction with MFF in Corcoran.

## HYDROLOGY, SOILS AND GROUNDWATER

27. The WWTF lies within the Fresno Hydrologic Area (No. 551.30), which is within the Kings River Basin, as depicted on interagency hydrologic maps prepared by the California Department of Water Resources (DWR) in August 1986. The WWTF is not within a 100-year floodplain, and all storm water runoff is reportedly contained on-site. Incidental on-site runoff (e.g., runoff along the canal banks) drains into Dry Creek Canal, which flows through the WWTF property.

28. Dry Creek Canal originates in the City of Fresno and flows seasonally downstream of the WWTF. Houghton Canal flows seasonally downstream of the WWTF and originates at a junction with Dry Creek Canal in the City of Fresno. Dry Creek Canal has an undetermined terminus southwest of the WWTF. Houghton Canal has an undetermined terminus west of the WWTF.

29. Areal soils consist of unconsolidated alluvial deposits of interbedded layers of sand, gravel, silt, sandy clay, clay and localized cobble zones. Soils in the upper five feet of the Stillage Site are described as well-sorted sands with good permeability (i.e., 0.7 to 1.0 in/hr) and therefore suitable for rapid infiltration of stillage waste.

30. The WWTF is in a semiarid region. Average annual precipitation and evapotranspiration are about 11 inches and 62 inches, according to information published by DWR.

31. Areal groundwater comprises the north portion of an essentially closed groundwater basin (Tulare Lake Basin) and flows southwesterly under unconfined conditions from the foothills east of Fresno westward to a northwest-trending line through Kerman and Raisin City. West of that line, groundwater occurs under both unconfined and semiconfined conditions. Extensive groundwater pumpage near the cities of Fresno and Raisin City have caused local changes in groundwater flow direction.

32. Groundwater in the WWTF vicinity occurs in an unconfined aquifer at depths ranging from 30 to 60 feet below ground surface (bgs). The Operator has delineated two zones of groundwater quality within the unconfined aquifer: a shallow zone consisting of the upper 50 feet of the aquifer and a lower zone, the top of which is about 200 feet below the water table.

33. The Operator monitors area groundwater via a groundwater monitoring well network currently comprised of 22 wells in the WWTF vicinity. In August 1996, the Operator proposed constructing additional groundwater monitoring wells along the WWTF perimeter to further characterize groundwater quality further and to assess potential groundwater impacts pursuant to Monitoring and Reporting Program No. 96-054. The Operator has not constructed the additional proposed groundwater monitoring wells.

34. Background or upgradient groundwater quality is highly variable due to the presence of dairies and other land uses that impact water quality. The Discharger currently monitors upgradient water quality in three wells, two monitoring wells (MW-10A and MW-10B) approximately 10,000 feet north of the WWTF property's north boundary and one domestic well (I) approximately 9,000 feet east of the WWTF's property's northeast corner. Of the two monitoring wells, MW-10A monitors the shallow zone and MW-10B, the deeper zone.

35. Upgradient or background groundwater is of high quality and meets all primary and secondary maximum contaminant levels for drinking water, according to the Operator's report, *Technical Memorandum No. 1-Update of Groundwater Quality Conditions* (April 1999). High quality groundwater conditions are generally associated with areas characterized by the absence of dairies or other localized sources of waste discharges.

36. Compared to background groundwater quality, groundwater passing under the WWTF contains elevated concentrations of TDS, EC, sodium, chloride, total phosphorus, and bicarbonate alkalinity. WWTF operations that have degraded groundwater for those constituents include stillage disposal and effluent disposal operations and the past use of sludge-drying beds. Groundwater within and surrounding the WWTF property has been degraded by other activities (e.g., past and existing dairy operations, a closed landfill), which over the years have created localized areas of groundwater degradation (hereafter referred to as "hot spots"). The Discharger's current groundwater monitoring well network is not adequate to distinguish groundwater impacts that are exclusively attributable to WWTF operations or to waste constituents originating from identified hot spots.

37. As indicated in Finding No. 8, evaporative losses account for about 12 percent of the current discharge flow to the disposal ponds. Evaporative losses will decrease to about 10 percent of the proposed increased discharge flow of 80 mgd, and result in an increase in the concentrations of waste constituents in effluent percolating to groundwater by about 10 percent. Therefore, groundwater underlying disposal ponds in areas unaffected by other waste discharges can be expected to contain salt constituents (e.g., chloride, EC, and TDS) in concentrations about 10 percent greater than that in WWTF effluent. A similar concentration increase can be expected for sodium provided there is no attenuation of sodium in the soil profile. The concentrating effect of evaporation appears to diminish as percolating effluent blends with regional groundwater, as indicated by the lower concentrations of chloride, TDS, and sodium in groundwater extracted in the recently-installed Flowpath ™ reclamation wells (as described in Finding No. 12).

38. As indicated in Finding No. 12, recent monitoring of groundwater extracted from the newly-installed Flowpath ™ reclamation wells has revealed very low concentrations of nitrogen and elevated concentrations of dissolved manganese (almost 25 times the drinking water standard of 0.05 mg/L). In contrast, monitoring of shallow groundwater has revealed nitrate-nitrogen concentrations approaching and even exceeding the drinking water standard of 10 mg/L and very low dissolved manganese concentrations.

## STILLAGE SITE

39. The Operator's 145-acre stillage disposal site, or Stillage Site, consists of a 95-acre site (SS-1), 95 acres of which have been in service since 1974, and a 50-acre site (SS-2) in service since December 1998 (see Attachment A). Stillage waste is generated from the distillation of wine in continuous stills and pot stills (infrequently used) for the production of distilled spirits. Stillage waste is conveyed year-round to the Stillage Site by a dedicated pipeline.

40. Prior to 1974, four wineries discharged a maximum of 1.1 mgd of stillage waste to the Operator's sanitary sewer system. This practice resulted in nuisance conditions and other problems at the domestic wastewater treatment plant's infiltration beds. In 1974, the Operator began discharging up to 1.07 mgd of stillage via dedicated pipelines to the 95-acre SS-1 under the terms and conditions of WDRs Order No. 74-10. The Stillage Site has been operated generally in accordance with the minimum requirements of Board-adopted Stillage Guidelines. The Operator has not, however, adjusted its stillage disposal operation to ensure that it is protective of groundwater quality, even when groundwater monitoring data revealed that it had degraded and continues to degrade groundwater quality (discussed below).

41. The Stillage Site is divided into long narrow checks, approximately 500 feet long by 100 feet wide, most of which are equipped with concrete inlet structures to prevent erosion. Stillage is discharged to individual checks until it reaches depths ranging from 2.5 to about 4 inches, depending on the time of year. Once applied, the stillage is allowed to dry from six days to several weeks until all that remains is a thin, dry layer (called leathers). Checks are ripped and disked to a depth of 18 to 24 inches prior to reapplication of stillage. Prior to 1996, leathers were disked into disposal area soils. In 1996, the Operator began removing leathers from checks to help reduce the nutrient build-up in disposal area soils. Scraped leathers are stockpiled on site and reportedly used as soil amendment on landscaped areas within the WWTF property.

42. Recent monitoring data characterizes the $BOD_5$ and nitrogen concentrations in stillage as averaging about 12,000 mg/L and 400 mg/L, respectively. About 90 percent of the $BOD_5$ is in the soluble form; nitrogen occurs predominantly in the organic form, expressed as total Kjeldahl nitrogen (TKN). Typically, the peak discharge season is from August through November, during which discharge flows average about 0.215 mgd. Off-season discharge flow averages about 0.15 mgd.

43. The Operator discharged a total of about 79 million gallons of stillage in 2000. Peak daily flows occurred in mid-June, and ranged from 1.1 to 1.27 mgd. At an average TKN concentration of 400 mg/L, this discharge to the entire 145 acres of the Stillage Site equates to a nitrogen load in excess of 1,800 lbs/acre/year.

44. The Operator began growing crops in the Stillage Site in 1996 to reduce residual nitrogen, as recommended by the Stillage Guidelines. Soil monitoring data collected by the Operator in 1992 indicate that the Operator's long-term stillage disposal operation has resulted in a massive accumulation of nitrogen in the upper two feet of disposal area soils (i.e., 21,300 lbs TKN/acre).

45. Order No. 96-054, Stillage Discharge Specification B.8, requires the Discharger to grow crops in the Stillage Site to assist in the removal of residual nitrogen from the soil. The Discharger is exempt from this requirement if it can demonstrate that its stillage disposal operation has been and can be accomplished without nitrogen control and without violating Groundwater Limitations. The Discharger was required to submit a report on measures to be implemented to provide for nutrient uptake in the Stillage Site, or justification why such measures are unnecessary, pursuant to Order No. 96-054, Provision G.7. The Operator submitted a report that describes (a) alternatives to current disposal practices (i.e., implementing pretreatment by anaerobic digestion or discharging

to a different site) and (b) plans to plant crops on portions of the Stillage Site and to monitor soils before and after cropping.

46. In 1996, the Operator conducted a field experiment in which it planted Sudan grass on 35 acres of SS-1, allowed the crop to mature, and harvested it twice. Before and after cropping, the Operator analyzed soil samples for various constituents, including TKN, ammonia, phosphorus, and calcium. After harvesting, the Operator found that while reductions of these constituents occurred as a result of the planting, the concentrations were still quite elevated compared to background levels. The Operator has yet to initiate systematic cropping and harvesting of portions of the SS.

47. Excessive application of stillage waste to land can overload the shallow soil profile, cause anaerobic soil conditions, retard the degradation, stabilization, transformation, and immobilization of waste constituents, and create objectionable odors that lead to public nuisance. Degradation of waste constituents within the soil profile increases the concentration of alkalinity in soil pore water. Anaerobic soil conditions can lead to the dissolution of soil minerals such as calcium and magnesium. Hydraulic overloading flushes waste constituents, their decomposition by-products, and dissolved minerals into the soil profile. If attenuation is inadequate, these compounds may be released at concentrations in excess of applicable water quality objectives or could reasonably be expected to affect beneficial uses underlying groundwater.

48. The Operator's decades-long stillage disposal operation has degraded groundwater beneath SS-1 to the degree that its beneficial uses as a domestic and agricultural supply are impaired. Data from a monitoring well in this area (MW-2) shows that the EC of groundwater passing under SS-1 consistently exceeds the recommended secondary maximum contaminant levels for drinking water of 900 µmhos/cm. Additional monitoring data shows groundwater degradation for TDS, total alkalinity, calcium, magnesium, and manganese.

49. Currently, the Stillage Site receives stillage waste year round from only one winery, Cribari Winery, which is owned and operated by Canandaigua Wine Company, a New York corporation. Canandaigua Wine Company intends to cease discharge of stillage waste to the Stillage Site by the end of fall 2003.

50. The Operator reports that Plant 1 lacks the treatment capacity to handle all of the stillage waste currently generated by the Cribari Winery.

## BASIN PLAN AND REGULATORY CONSIDERATIONS

51. The *Water Quality Control Plan for the Tulare Lake Basin, 2nd Edition,* (hereafter Basin Plan) designates beneficial uses, establishes water quality objectives, contains implementation plans and policies for protecting all waters of the Basin, and incorporates by reference plans and policies of the State Water Resources Control Board. These requirements implement the Basin Plan.

52. The Dry Creek and Houghton Canals carry irrigation deliveries from the Kings River and Friant Kern Canal, both waters of the United States. They also carry urban storm water runoff and surface waters from upgradient ephemeral streams. The Dry Creek and Houghton Canals are

valley floor waters. The designated beneficial uses of valley floor waters, according to the Basin Plan, are municipal and domestic, agricultural, industrial service, and industrial process supply; water contact and noncontact water recreation; warm freshwater, wildlife, and rare, threatened, or endangered species habitat; and groundwater recharge.

53. Historically, groundwater has been the sole source of municipal and domestic supply for the Fresno-Clovis metropolitan area, and for thousands of residents in surrounding rural areas. The Basin Plan designates the beneficial uses of groundwater in the vicinity of the WWTF and its discharges to land as municipal, agricultural, industrial service, and industrial process supply and water contact and noncontact water recreation.

54. In 1977, the United States Environmental Protection Agency (EPA) determined that the groundwater aquifer serving the Fresno-Clovis metropolitan area is a sole source of drinking water pursuant to section 1424 of the Safe Drinking Water Act.

55. Water in the Tulare Lake Basin is in short supply, requiring importation of surface waters from other parts of the State. The Basin Plan encourages reclamation on irrigated crops wherever feasible and indicates that evaporation of reclaimable wastewater is not an acceptable permanent disposal method where the opportunity exists to replace an existing use or proposed use of fresh water with recycled water. The Basin Plan further requires plans for new or expanded wastewater treatment facilities to include wastewater reclamation, or reasons why this is not possible.

56. Section 13050(h) of the California Water Code defines water quality objectives as ". . . the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention on nuisance within a specific area."

57. The Basin Plan establishes numerical and narrative water quality objectives for surface and groundwaters within the basin, and recognizes that water quality objectives are achieved primarily through the Board's adoption of waste discharge requirements and enforcement orders. Where numerical water quality objectives are listed, these are the limits necessary for the reasonable protection of beneficial uses of the water. Where compliance with narrative water quality objectives is required, the Board will, on a case-by-case basis, adopt numerical limitations in orders which will implement the narrative objectives to maintain existing and anticipated beneficial uses of waters in the subject area.

58. The Basin Plan identifies numerical water quality objectives for waters designated as municipal supply. These are the maximum contaminant levels (MCLs) specified in the following provisions of Title 22, California Code of Regulations: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of section 64431, Table 64444-A (Organic Chemicals) of section 64444, and Table 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of section 64449. The Basin Plan's incorporation of these provisions by reference is prospective, and includes future changes to the incorporated provisions as the changes take effect. The Basin Plan requires the application of objectives more stringent than MCLs as necessary to ensure that waters do not contain chemical constituents in concentrations that adversely affect beneficial uses, whether the use is domestic drinking water supply, agricultural supply, or some other use.

59. The Basin Plan contains narrative water quality objectives for chemical constituents in and toxicity of groundwater that address constituents in the discharge that are potentially harmful to beneficial uses. The toxicity objective requires that groundwater be maintained free of toxic substances in concentrations that produce detrimental physiological responses in plants or animals. The chemical constituent objective states groundwater shall not contain chemical constituents in concentrations that adversely affect beneficial uses. Guidelines for identifying the quality of irrigation water necessary to sustain various crops were compiled by Ayers and Westcot in 1985 *(Food and Agriculture Organization of the United Nations – Irrigation Drainage Paper No. 29).* The Basin Plan recognizes these Guidelines for providing relevant numerical criteria to evaluate compliance with the previously described narrative water quality objectives. The Guidelines are intended for use in estimating the potential hazards to crop production associated with long term use of the particular water being evaluated. The Guidelines divide water quality characteristics as having "No Problem – Increasing Problems – Severe Problems" based on large numbers of field studies and observations, and carefully controlled greenhouse and small plot research. In general, crops sensitive to sodium or chloride are most sensitive to foliar absorption from sprinkler applied water. Bicarbonate has been a problem when fruit crops or nursery crops are sprinkler irrigated during periods of very low humidity and high evaporation. The following table contains numerical criteria adapted from the Guidelines for protection of a range of crops under various circumstances, but the most stringent is not necessarily the concentration that assures no adverse affect on any nonagricultural beneficial use:

| Problem and Related Constituent | No Problem | Increasing Problem |
|---|---|---|
| Salinity of irrigation water (EC, µmhos/cm) | < 750 | 750 – 3,000 |
| Salinity of irrigation water (TDS, mg/L)* | < 450 | 450 – 1,800 |
| Specific Ion Toxicity | | |
| from ROOT absorption | | |
| Sodium (mg/L) | < 69 | 69 – 207 |
| Chloride (mg/L) | < 142 | 142 – 355 |
| Boron (mg/L) | < 0.5 | 0.5 – 2.0 |
| from FOLIAR absorption | | |
| Sodium (mg/L) | < 69 | > 69 |
| Chloride (mg/L) | < 106 | > 106 |
| Miscellaneous | | |
| $NH_4$-N (mg/L) (for sensitive crops) | < 5 | 5 – 30 |
| $NO_3$-N(mg/L) (for sensitive crops) | < 5 | 5 – 30 |
| $HCO_3$ (mg/L) (only with overhead sprinklers) | < 90 | 90 - 520 |
| pH | normal range = 6.5 – 8.4 | |

* Assumes an EC:TDS ratio of 0.6:1

60. The existing and anticipated beneficial uses of area groundwater for agricultural supply include irrigation of crops sensitive to salt and boron. According to the 1994 DWR land use map, irrigated crops within five miles of the WWTF consist of alfalfa, almonds, beans, corn, cotton, grain and hay, melons, peaches, plums, tomatoes, and vineyards. Based on climate, soil type, and water

quality, other crops sensitive to salt and boron might be capable of being grown in the area, and changing market conditions could drive a change in cropping patterns, but neither is expected to necessitate greater protection than crops already identified.

61. The Guidelines presents the maximum EC of irrigation water for various crops with respect to percent crop reductions (i.e., 0, 10, 25, and 50). The table below extracts irrigation water EC data (in µmhos/cm) for crops cultivated in the WWTF vicinity (as described in Finding No. 60). As indicated below, zero crop yield reductions are not evident when irrigating all but one crop (bean) with water having an EC of less than 1,000 µmhos/cm.

| Crop | 0% Reduction | 10% Reduction |
|---|---|---|
| Beans | 700 | 1,000 |
| Almonds | 1,000 | 1,400 |
| Plums | 1,000 | 1,400 |
| Vineyards | 1,000 | 1,700 |
| Corn (Sweet) | 1,100 | 1,700 |
| Peaches | 1,100 | 1,400 |
| Corn (Forage) | 1,200 | 2,100 |
| Alfalfa | 1,300 | 2,200 |
| Melon (Cantaloupe) | 1,500 | 2,400 |
| Tomatoes | 1,700 | 2,300 |
| Hay (Barley) | 4,000 | 4,900 |
| Cotton | 5,100 | 6,400 |

62. The Guidelines indicate that boron sensitive crops such as stone fruit and grapes may show injury when irrigated with water with boron ranging from 0.5 to 1.0 mg/L and reduced yield and vigor when irrigated with water with boron ranging from 1.0 to 2.0 mg/L. Bicarbonate has been a problem when fruit crops or nursery crops are sprinkler irrigated during periods of very low humidity and high evaporation.

63. To maintain the beneficial uses of flood irrigation of stone fruit, and sprinkler irrigation of vegetables and fruit, it is necessary that area groundwater have EC values of 1,000 µmhos/cm or less, and low concentrations of chloride, sodium, boron, and bicarbonate.

64. The average EC of WWTF effluent in 2000 was about 430 µmhos/cm above source water EC and the average bicarbonate of WWTF effluent in 2000 was 208 mg/L as $CaCO_3$ (as indicated in Finding No. 6). Despite the Discharger's implementation of an effective salinity source control program, however, the average sodium concentration of WWTF effluent (81 mg/L in 2000) exceeds the 69 mg/L recommended by the Guidelines for sodium sensitive crops (for either root or foliar absorption). Unless other means of sodium control are possible, irrigating at night is one method to mitigate potential adverse effects of sprinkler irrigation of sodium-sensitive crops with water containing elevated levels of sodium and of bicarbonate. Because the groundwater degradation from sodium can be mitigated by reasonable changes in irrigation management practices and because the Discharger has implemented best practicable source control for sodium and bicarbonate alkalinity (a matter that will require further documentation by means of studies

required herein), the consequent degradation from sodium and bicarbonate alkalinity for the time can be found at the present time to be consistent with Resolution No. 68-16.

65. As explained in the attached Information Sheet, this Order implements water quality objectives established as necessary to maintain the existing and anticipated beneficial uses of area groundwater for the production of stone fruit, grape, and other crops that are sensitive to salt (i.e., sodium and chloride), boron, or both. The numerical values reflect the highest tolerable level of quality necessary to sustain sprinkler application, as these are more restrictive than for flood irrigation. These objectives include EC (990 µmhos/cm), and the following expressed as mg/L: chloride (106), sodium (103), boron (0.7), and TDS (560). The Order's nitrogen limit of 10 mg/L is for total nitrogen because all forms of nitrogen can convert to nitrate in groundwater and the nitrate standard is 10 mg/L as nitrogen in drinking water. It is reasonable to conclude that a total nitrogen limit of 10 mg/L is adequately protective of existing and anticipated agricultural land uses. This Order implements a narrative groundwater limitation for taste and odor by prescribing a groundwater limitation of 0.5 mg/L for ammonia. This concentration is based on a European Union drinking water standard. Discharger monitoring data indicate that effluent ammonia concentrations typically exceed 5 mg/L. As such, there is reasonable potential for the discharge to cause violations of the narrative water quality limitation for taste. There are numerous domestic wells in the area encompassed by the groundwater mound created by percolating effluent. The groundwater ammonia limitation is protective of the beneficial uses of area groundwater for domestic supply.

66. California Department of Water Resources standards for the construction and destruction of groundwater wells (hereafter DWR Well Standards), as described in *California Well Standards Bulletin 74-90* (June 1991) and *Water Well Standards: State of California Bulletin 94-81* (December 1981), and any more stringent standards adopted by the Discharger or county pursuant to CWC section 13801, apply to all monitoring wells.

67. The discharge authorized herein and the treatment and storage facilities associated with the discharge of treated municipal wastewater, except for discharges of residual sludge and solid waste, are exempt from the requirements of Title 27, California Code of Regulations (CCR), section 20380 et seq. (hereafter Title 27). The exemption, pursuant to Title 27 CCR section 20090(a), is based on the following:

    a. The waste consists primarily of domestic sewage and treated effluent;

    b. The waste discharge requirements are consistent with water quality objectives; and

    c. The treatment and storage facilities described herein are associated with a municipal wastewater treatment plant.

68. The discharge of stillage waste authorized herein is exempt from the requirements of Title 27. The exemption, pursuant to section 20090(b), is based on the following:

    a. The Board is issuing these waste discharge requirements,

b. These waste discharge requirements implement the Basin Plan and allow discharge only in accordance with the Basin Plan, and

c. The wastewater is not hazardous waste and need not be managed according to Title 22, CCR, Division 4.5, Chapter 11, as a hazardous waste.

69. In the process of crop irrigation, evaporation and crop transpiration remove water from and result in accumulation of residual salts in the soil root zone. These salts would retard or inhibit plant growth except for a fraction of irrigation water applied to leach the harmful salt from the root zone. The leached salts eventually enter groundwater and concentrate above the uppermost layer of the uppermost aquifer. As this is the general condition throughout the agricultural Tulare Lake Basin, water supply wells for all beneficial uses typically are constructed to extract groundwater from below this level.

70. Infiltration from wastewater treatment and wastewater disposal ponds results in wastewater intersecting and accumulating on and in the uppermost layer of the uppermost groundwater until dispersed horizontally and vertically into the main mass of the aquifer. Compliance with the various water quality objectives necessary to protect present and future beneficial uses within the aquifer should be determined by water representative of the uppermost zones. Site-specific studies to determine the appropriate zones and geographical locations should be conducted by the Discharger subject to Executive Officer approval.

**TITLE 22**

71. Domestic wastewater contains pathogens harmful to humans that are typically measured by means of total and fecal coliform, as indicator organisms. The California Department of Health Services (DHS) has primary statewide responsibility for protecting public health. In 1977, DHS established statewide criteria in Title 22, California Code of Regulations (CCR), section 60301 et seq., (hereafter Title 22) for the use of recycled water and has developed guidelines for specific uses. Revisions of the water recycling criteria in Title 22 became effective on 2 December 2000. The revised Title 22 expands the range of allowable uses of recycled water, establishes criteria for these uses, and clarifies some of the ambiguity contained in the previous regulations.

72. The 1988 Memorandum of Agreement (MOA) between DHS and the State Water Resources Control Board on the use of recycled water establishes basic principles relative to the agencies and the regional boards. Under terms of the MOA, the Board implements Title 22 and DHS recommendations for the protection of public health. In addition, the MOA allocates primary areas of responsibility and authority between these agencies, and provides for methods and mechanisms necessary to assure ongoing, continuous future coordination of activities relative to the use of recycled water in California.

73. Title 22 requires recyclers of treated municipal wastewater to submit an engineering report detailing the use of recycled water, contingency plans, and safeguards. The Discharger submitted an engineering report to DHS pursuant to Title 22 for on-site water reclamation operations on

1 February 2001. The DHS commented on the Discharger's Title 22 Engineering Report by letter dated 22 March 2001. The Discharger is in the process of responding to these comments.

74. By letter dated 10 May 2001, DHS recommended that the Discharger expedite efforts to expand recycling and curtail discharge to groundwater. The DHS recommends that the Board require the Discharger to (a) assess the current status of all private and domestic wells that exist within the 25-square-mile area described in Finding No. 9, (b) monitor domestic supply wells within this area for contaminants to assure they are producing safe water for domestic use, and (c) conduct a comprehensive study to assess the fate and effects of the discharge on groundwater.

75. By letter dated 24 August 2001, DHS further recommended that the Board require the Discharger, in collaboration with FID, to (a) identify the types of crops grown in the area served by FID canals that receive groundwater extracted by the Operator's reclamation wells and (b) provide information on the dilution of the extracted groundwater with fresh water prior to irrigation application. If food crops are found to be grown in the subject area, DHS recommends the Discharger be required to evaluate the degree of filtration and virus removal provided. The DHS also recommended the Discharger provide continuous turbidity monitoring of representative reclamation wells for at least one year.

## DEGRADATION

76. State Water Resources Control Board (SWRCB) Resolution No. 68-16 (hereafter Resolution 68-16 or the "Antidegradation" Policy) requires the Board in regulating the discharge of waste to maintain high quality waters of the state until it is demonstrated that any change in quality will be consistent with maximum benefit to the people of the State, will not unreasonably affect beneficial uses, and will not result in water quality less than that described in the Board's policies (e.g., quality that exceeds water quality objectives).

77. The Basin Plan identifies the greatest long-term problem facing the entire Tulare Lake Basin as the increase in salinity in groundwater, which has accelerated due to the intensive use of soil and water resources by irrigated agriculture. The Basin Plan recognizes that degradation is unavoidable until a valley wide drain is constructed to carry salts out of the basin. Until the drain is available, the Basin Plan describes numerous salt management recommendations and requirements. The later includes the requirement that discharges to land from wastewater treatment facilities not have an EC greater than source water plus 500 μmhos/cm. Accordingly, the Basin Plan allows for salinity degradation and focuses on controlling the rate of increase.

78. The Board finds that some degradation of groundwater beneath the WWTF and reclamation and disposal areas is consistent with Resolution 68-16 provided that:

- the degradation is confined to a specified area
- the Discharger minimizes the degradation by fully implementing, regularly maintaining, and optimally operating best practicable treatment and control (BPTC) measures

- the degradation is limited to waste constituents typically encountered in municipal wastewater as specified in the groundwater limitations in this Order
- the degradation does not result in water quality less than that prescribed in the Basin Plan

79. Some degradation of groundwater by some of the typical waste constituents released with discharge from a municipal wastewater utility after effective source control, treatment, and control is consistent with maximum benefit to the people of California. The technology, energy, water recycling, and waste management advantages of municipal utility service for the Cities of Fresno and Clovis far exceed any benefits derived from a metropolitan area otherwise reliant on numerous concentrated individual wastewater systems, and the impact on water quality will be substantially less. When allowed, the degree of degradation allowed depends upon many factors (i.e., background water quality, the waste constituent, the beneficial uses and most stringent water quality objective, source control measures, waste constituent treatability).

80. The WWTF described in Finding No. 2 provides treatment and control of the discharge that incorporates:

- technology for secondary treatment of municipal wastewater
- biosolids handling and treatment for reuse
- constituent attenuation within the vadose zone
- concrete treatment structures
- recycling of wastewater on cropped properties
- a pretreatment program that includes effective salinity source control
- an active inflow and infiltration (I/I) rehabilitation program
- a capital recovery fund
- an operation and maintenance (O&M) manual
- staffing to assure proper operation and maintenance

81. Discharger practices that may not constitute BPTC as used in Resolution 68-16 include the reliance of effluent disposal by evaporation and percolation. The impact to area groundwater caused by this practice is mitigated to some degree by the Operator's discharge to FID canals of about 15,000 af/yr of groundwater extracted from a network of reclamation wells situated throughout the disposal pond area. However, as indicated in Finding No. 12, the concentrations of dissolved manganese in groundwater extracted from several reclamation wells exceed the water quality objective of 0.05 mg/L (as referenced in Finding No. 58). Neither WWTF effluent nor groundwater sampled from shallow monitoring wells exhibit such high dissolved manganese concentrations. Further, the Discharger's stillage disposal operation appears to have degraded and polluted groundwater underlying SS-1 (Finding No. 48). The existing impacts on groundwater and the appropriate level of degradation that complies with Resolution 68-16 has not been evaluated.

82. This Order, therefore, establishes schedules of tasks to evaluate BPTC for each treatment, storage, and disposal component of the WWTF and to characterize groundwater for all waste constituents.

83. This Order establishes groundwater limitations that will not unreasonably threaten present and anticipated beneficial uses or result in groundwater quality that exceeds water quality objectives set forth in the Basin Plan. This means that where the stringency of the limitations for the same waste constituent differs according to beneficial use, the most stringent applies as the governing limitation for that waste constituent. This Order contains tasks for assuring that BPTC and the highest water quality consistent with the maximum benefit to the people of the State will be achieved. Accordingly, the discharge is consistent with the antidegradation provisions of Resolution 68-16. Based on the results of the scheduled tasks, the Board may reopen this Order to reconsider groundwater limitations and other requirements to comply with Resolution 68-16.

## CEQA FINDINGS

84. The City of Fresno certified a final environmental impact report (EIR) dated 31 October 1995 for an expansion in WWTF treatment and disposal capacity in accordance with the California Environmental Quality Act (CEQA) (Public Resources Code section 21000 et seq.) and the State CEQA Guidelines. The expansion project includes (a) increasing Plant 1 treatment capacity to 80 mgd to accommodate urban growth in the Discharger's service area, (b) discontinuing use of Plant 2 to improve the WWTF's overall air emissions, reliability, and operations, and (c) constructing an additional 600 acres of infiltration basins (i.e., effluent disposal ponds) to provide disposal capacity for the increased flows and to comply with Board-prescribed pond freeboard requirements. The EIR estimates that, at full build out, the project would discharge an additional 11,200 af/yr of effluent to area groundwater. While the EIR states that the infiltration of effluent over the years has caused concentrations in groundwater of TDS, EC, and sodium to increase, the EIR states that the project would not affect public or private water supplies. The EIR identifies the project's impact on groundwater as temporary, as the City "shall commit to developing a plan for the reclamation of water infiltrated at the plant by 1997." The EIR further states that the City of Fresno "shall continue to develop and implement a reuse program for its treated wastewater to reduce the need for future infiltration basins. The EIR indicates the City "is also developing a reuse program for its treated wastewater to alleviate groundwater conditions under the treatment plant…[to]…mitigate the cumulative effects to water resources to a level of less than significant." The City's proposed mitigation measure must result in implementation of additional projects that recycle a total of at least 11,200 af/yr, but these projects have yet to be realized.

85. The project certified by the City of Fresno as described in the EIR differs from the project characterized in the Discharger's 31 December 1996 Report of Waste of Discharge (RWD). The RWD describes a project in which the City would increase Plant 1's treatment capacity to 88 mgd, continue use of Plant 2, and construct an additional 600 acres of disposal ponds. The increase in amount of effluent percolating from the project described in the RWD is nearly 25,000 af/yr, not the 11,200 af/yr identified in the EIR. Since submitting the RWD, the Discharger indicates that (a) it plans, as necessary, to treat some industrial flows in Plant 2 prior to full treatment in Plant 1; (b) the 80 mgd specified in the EIR represents the annual monthly average daily discharge flow; and (c) the EIR did not accurately reflect that Plant 1 would be designed, constructed, and operated

to treat a maximum monthly average daily discharge flow of 88 mgd. The additional 8 mgd short-term treatment capacity accommodates seasonal peaks from food-processing industries that generally occur in September.

86. As described in Finding No. 16, Calpine proposes to recycle up to 7,000 af/yr of effluent extracted by reclamation wells. If Calpine completes its project utilizing extracted effluent, the Discharger will still need to implement reuse projects for an additional 4,200 af/yr to accomplish its goal of reusing the 11,200 af/yr discharge flow to groundwater resulting from the WWTF expansion project.

87. The Board, as a responsible agency under CEQA, has reviewed the City's EIR for the project relative to impacts to groundwater quality and concurs that the increased percolation will have a significant effect on water quality by contributing to increases in salts and increasing the already dominant groundwater mound and affected geographic area. Further, the Board concurs that the City's mitigation measure of implementing reuse projects to offset the project's increase in flow (i.e., 11,200 af/yr) will mitigate the project's potential incremental impact, but observes that the measure has yet to be implemented. Given that the full increase will be reached in 2008, the stated commitment of the City to mitigate, and applicable reclamation policies, full mitigation by 2004 is not unreasonable. Regardless, the scale of the reuse program is not sufficient to mitigate the same adverse water quality impacts occurring from the pre-project discharge, which must be evaluated by the Board in accordance with Resolution No. 68-16. The following provisions mitigate or avoid the adverse impact of the project on water quality: (a) annual monthly average daily discharge flow is limited to 80 mgd and maximum monthly average daily discharge flow is limited to 88 mgd (WWTF Discharge Specification B.1); reuse projects must recycle 11,200 af/yr by 2004 (Provision H.15); (c) water quality of private domestic and agricultural wells within the influence of the discharge must be evaluated (Provision H.18); and treatment and control practices must be evaluated along with consequent degradation of groundwater for consistency with Resolution No. 68-16 (Provisions H.12, H13, and H14).

88. On 25 March 1998, the City of Fresno adopted a negative declaration (Environmental Assessment 98-03), in accordance with CEQA and State CEQA Guidelines for the discharge of stillage to the 50-acre stillage disposal site (SS-2) adjacent to the existing 95-acre stillage disposal site (SS-1). Mitigation measures 3 – 15 are identical to Stillage Discharge Specifications C.1 – C.13 from WDRs Order No. 96-054. The negative declaration does not adequately mitigate the potentially significant effect on groundwater from accumulation of nitrogen in stillage disposal area soils, nor adequately monitor the fate of waste constituents that percolate through the soil profile. The following provisions mitigate or avoid the adverse impact of the project on water quality: (a) planting and harvesting of crops will reduce the nitrogen content in soils (Stillage Disposal Specification D.1) and (b) vadose zone monitoring for waste constituents and their decomposition by-products will provide adequate monitoring (Monitoring and Reporting Program).

## GENERAL FINDINGS

89. Section 13263 of the CWC authorizes the Board to prescribe discharge requirements that implement the Basin Plan and other applicable plans and take into consideration other factors,

including the factors in CWC section 13241, which includes economic considerations. The State Water Resources Control Board, however, has held that a regional board need not specifically address section 13241 factors when implementing existing water quality objectives in waste discharge requirements because the factors were already considered in adopting water quality objectives. These waste discharge requirements implement adopted water quality objectives. Therefore, no additional analysis of the section 13241 factors is required.

90. Pursuant to CWC section 13263(g), discharge is a privilege, not a right, and adoption of this Order does not create a vested right to continue the discharge.

91. California Water Code (CWC) section 13267 authorizes the Board to require anyone who discharges waste that could affect the quality of water, as the Discharger does, to furnish, under penalty of perjury, technical and monitoring program reports.

92. The Board considered all the above and the supplemental information and details in the attached Information Sheet, which is incorporated by reference herein, in establishing the following conditions of discharge.

93. The Board has notified the Discharger and interested agencies and persons of its intent to prescribe waste discharge requirements for this discharge and has provided them with an opportunity for a public hearing and an opportunity to submit their written views and recommendations.

94. The Board, in a public meeting, heard and considered all comments pertaining to the discharge.

**IT IS HEREBY ORDERED** that Order No. 96-054 is rescinded and that, pursuant to CWC sections 13263 and 13267, the Cities of Fresno and Clovis, their agents, successors, and assigns, in order to meet the provisions contained in the Clean Water Act and Division 7 of the California Water Code and regulations adopted there under, shall comply with the following:

## A. Discharge Prohibitions

1. Discharge of wastes from the WWTF and of stillage from the Stillage Site to surface waters or surface water drainage courses is prohibited.

2. Discharge of waste classified as “hazardous” as defined in section 2521(a) of Title 23, CCR, section 2510 et seq., or “designated” as defined in section 13173 of the California Water Code, is prohibited.

3. Bypass or overflow of untreated or partially treated waste from the WWTF to disposal ponds, to reclamation areas, or to the Stillage Site, is prohibited.

4. By **31 December 2003** discharge of stillage to SS-1 is prohibited.

5. Discharge of stillage to areas within or beyond the WWTF property other than to the Stillage Site (as defined in Finding No. 39) without Board-adopted waste discharge requirements or waiver from said requirements is prohibited.
6. Discharge of effluent to areas outside of the WWTF property boundary without Board-adopted water reclamation requirements or waiver from said requirements is prohibited.

7. Grazing of animals producing milk for human consumption within areas irrigated with effluent is prohibited.

**B. WWTF Discharge Specifications**

1. The discharge flow from WWTF (i.e., the combined flow from Plant 1 and Plant 2 when in service and discharging directly to disposal ponds) shall not exceed:

   a. an annual monthly average daily discharge flow of 80 mgd; and

   b. a maximum monthly average daily discharge flow of 88 mgd.

2. The discharge from Plant 1 (including that from Plant 2 when in service and discharging directly to disposal ponds) shall not exceed the following limits:

| Constituent | Units | Monthly Average[1] | Daily Maximum |
|---|---|---|---|
| $BOD_5$[2] | mg/L | 40 | 80 |
| Total Suspended Solids (TSS) | mg/L | 40 | 80 |
| Settleable Solids | mL/L | 0.2 | 0.5 |

[1] Arithmetic mean of measurements made during the month
[2] Five-day, 20° Celsius biochemical oxygen demand

3. The arithmetic mean of $BOD_5$ and of total suspended solids in effluent samples collected over a monthly period shall not exceed 20 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period (80 percent removal).

4. The monthly average EC of the discharge, shall not exceed the flow-weighted average EC of the source water plus 500 µmhos/cm, or a maximum of 900 µmhos/cm, whichever is less. The flow-weighted average for the source water shall be a moving average for the most recent twelve months.

5. The discharge shall not have a pH less than 6.0 or greater than 9.0.

6. Objectionable odors shall not be perceivable beyond the limits of the WWTF property at an intensity that creates or threatens to create nuisance conditions.

7. Notwithstanding WWTF Discharge Specifications B.1 through B.6, no waste constituent shall be released or discharged, or placed where it will be released or discharged, in a concentration or in a mass that causes violation of Groundwater Limitations.

## C. Disposal Pond Specifications

1. The dissolved oxygen content in the upper zone (1 foot) of effluent in disposal ponds shall not be less than 1.0 mg/L.

2. Disposal ponds shall be managed to prevent breeding of mosquitoes. In particular:

   a. An erosion control program should assure that small coves and irregularities are not created around the perimeter of the water surface.

   b. Weeds shall be minimized through control of water depth, harvesting, or herbicides.

   c. Dead algae, vegetation, and debris shall not accumulate on the water surface.

   d. Vegetation management operations in areas in which nesting birds have been observed shall be carried out either before or after, but not during, the **1 April to 30 June** bird nesting season.

3. Public contact with effluent shall be precluded through such means as fences, signs, or acceptable alternatives. Signs shall be as shown in Attachment D, a part of this Order.

4. Disposal ponds shall have sufficient capacity to accommodate allowable discharge flow and design seasonal precipitation and ancillary inflow and infiltration, excluding effluent discharged as authorized by valid requirements to reclamation areas and to off-site effluent storage and disposal areas. Design seasonal precipitation shall be based on total annual precipitation using a return period of 100 years, distributed monthly in accordance with historical rainfall patterns. Freeboard shall never be less than two feet (measured vertically) or a lesser freeboard if certified in writing by a registered civil engineer as adequate to prevent overtopping, overflows, or levee failures.

5. On or about **15 November** of each year, available disposal pond storage capacity shall at least equal the volume necessary to comply with Disposal Pond Specification C.4.

## D. Stillage Discharge Specifications

1. **Effective immediately,** the Discharger shall commence regularly planting and harvesting crops in the Stillage Site to reduce the nitrogen content in stillage disposal area soils.

2. Objectionable odors originating from stillage disposal areas shall not be perceivable beyond the limits of the WWTF property boundary.

3. The maximum daily stillage discharge shall not exceed the following limits:

| Period of Year | Maximum Discharge (mgd) |
|---|---|
| 1 May to 30 Sep | 1.36 |
| 1 Oct to 30 Nov | 0.77 |
| 1 Dec to Apr 30 | 0.46 |

4. Stillage shall be discharged to land in long narrow checks or basins. The check or basin surface should be leveled within 0.1 foot per 100 feet and be free of potholes.

5. At the inlet of the checks, stillage shall be distributed using splash plates or other devices to prevent deep holes from forming.

6. The depth of applied stillage shall not exceed the following in any one application:

| Period of Year | Maximum Depth (inches) |
|---|---|
| 1 May to 30 Sep | 3.7 |
| 1 Oct to 30 Nov | 3.0 |
| 1 Dec to Apr 30 | 2.5 |

7. Standing stillage shall not be present 24 hours after application has ceased.

8. Checks receiving stillage applications shall be allowed to dry for at least the following period before re-application of waste:

| Period of Year | Drying Time (days) |
|---|---|
| 1 May to 30 Sep | 6 |
| 1 Oct to 30 Nov | 9 |
| 1 Dec to Apr 30 | 13 |

9. Land area used for disposal shall equal or exceed the following:

| Period of Year | Land Area (acres per 100,000 gpd of stillage waste) |
|---|---|
| 1 May to 30 Sep | 6 |
| 1 Oct to 30 Nov | 9 |
| 1 Dec to Apr 30 | 13 |

10. Once applied stillage has dried, the Discharger shall remove leathers prior to re-application. The Discharger shall store collected leathers in a manner that precludes infiltration of waste constituents into soils in a mass or concentration that will violate Groundwater Limitations. Further, the Discharger shall dispose of collected leathers not recycled as a soil amendment

in a manner that precludes infiltration of waste constituents into soils in a mass or concentration that will violate Groundwater Limitations.

11. The resulting effect of the stillage discharge on soil pH shall be such as not to exceed the buffering capacity of the soil profile.

12. Soil depth in the Stillage Site shall be 10 feet or greater above unbroken hardpan, groundwater, or impermeable soils. There shall be no unripped hardpan within the top 10 feet of the soil profile.

## E. Sludge Specifications

Sludge in this document means the solid, semisolid, and liquid residues removed during primary, secondary, or advanced wastewater treatment processes. Solid waste refers to grit and screening material generated during preliminary treatment. Residual sludge means sludge that will not be subject to further treatment at the WWTF. Biosolids refers to sludge that has undergone sufficient treatment and testing to qualify for reuse pursuant to federal and state regulations as a soil amendment for agriculture, silviculture, horticulture, and land reclamation.

1. Sludge and solid waste shall be removed from screens, sumps, ponds, clarifiers, etc. as needed to ensure optimal plant operation.

2. Treatment and storage of sludge generated by the WWTF and solids from the Operator's stillage disposal operation (i.e., leathers) shall be confined to the WWTF property and conducted in a manner that precludes infiltration of waste constituents into soils in a mass or concentration that will violate Groundwater Limitations.

3. Any storage of residual sludge, solid waste (including stillage leathers), and biosolids on property of the WWTF shall be temporary and controlled and contained in a manner that minimizes leachate formation and precludes infiltration of waste constituents into soils in a mass or concentration that will violate Groundwater Limitations.

4. Residual sludge, biosolids, and solid waste shall be disposed of in a manner approved by the Executive Officer and consistent with Title 27. Removal for further treatment, disposal, or reuse at sites (i.e., landfill, WWTF, composting site, soil amendment sites) operated in accordance with valid waste discharge requirements issued by a regional water quality control board will satisfy this specification.

5. Use of biosolids as a soil amendment shall comply with General Biosolids Order (State Water Resources Control Board Water Quality Order No. 2000-10-DWQ, *General Waste Discharge Requirements for the Discharge of Biosolids to Land for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities*). The Discharger must obtain a "Notice of Applicability" of the General Biosolids Order from the Executive Officer prior to discharge of biosolids to any site. Alternatively, use of biosolids

as a soil amendment shall comply with valid waste discharge requirements issued by a regional water quality control board.

6. Use and disposal of biosolids should comply with the self-implementing federal regulations of 40 CFR 503, which are subject to enforcement by the U.S. Environmental Protection Agency (EPA), not the Board. If during the life of this Order the State accepts primacy for implementation of 40 CFR 503, the Board may also initiate enforcement where appropriate.

**F. Reclamation Specifications**

The following specifications apply to reclamation areas under the control of the Discharger within the WWTF property boundary. Other reclamation sites are covered by separate waste reclamation requirements.

1. Recycled water (i.e., effluent) shall remain within the Discharger's on-site reclamation areas. Recycled water provided off-site shall only be provided to users that hold Board-adopted water reclamation requirements, or users who have obtained a waiver of reclamation requirements from the Board.

2. Use of recycled water shall be limited to flood irrigation of fodder, fiber, seed crops, and of crops such as wine grapes that undergo extensive commercial, physical, or chemical processing before human consumption, and shall comply with the provisions of Title 22.

3. The Discharger shall maintain the following setback distances from areas irrigated with recycled water:

| Setback Distance (feet) | To |
|---|---|
| 25 | Property Line |
| 30 | Public Roads |
| 50 | Drainage courses |
| 100 | Irrigation wells |
| 150 | Domestic wells |

4. No physical connection shall exist between recycled water piping and any domestic water supply or domestic well, or between recycled water piping and any irrigation well that does not have an air gap or reduced pressure principle device.

5. The perimeter of reclamation areas shall be graded to prevent ponding along public roads or other public areas.
6. Areas irrigated with recycled water shall be managed to prevent breeding of mosquitoes. More specifically:

    a. All applied irrigation water must infiltrate completely within a 48-hour period.

b. Ditches not serving as wildlife habitat should be maintained free of emergent, marginal, and floating vegetation.

c. Low-pressure and unpressurized pipelines and ditches accessible to mosquitoes shall not be used to store recycled water.

7. Recycled water shall be managed to minimize runoff onto adjacent properties not owned or controlled by the Discharger.

8. Recycled water shall be managed to minimize contact with workers.

9. If recycled water is used for construction purposes, it shall comply with the most current edition of *Guidelines for Use of Reclaimed Water for Construction Purposes*. Other uses of recycled water not specifically authorized herein shall be subject to the approval of the Executive Officer and shall comply with Title 22.

10. Public contact with recycled water shall be precluded through such means as fences or acceptable alternatives. Signs with proper wording (shown below) of a size no less than four inches high by eight inches wide shall be placed at all areas of public access and around the perimeter of all areas used for effluent disposal or conveyance to alert the public of the use of recycled water. All signs shall display an international symbol similar to that shown in Attachment D, a part of this Order, and present the following wording:

"RECYCLED WATER—DO NOT DRINK"

"AGUA DE DESPERDICIO RECLAMADA—POR FAVOR NO TOME"

11. Reclamation of WWTF effluent shall be at reasonable agronomic rates considering the crop, soil, climate, and irrigation management plan. The annual nutrient loading of reclamation areas, including the nutritive value of organic and chemical fertilizers and of the recycled water, shall not exceed the crop demand.

## G. Groundwater Limitations

Release of waste constituents from any storage, treatment, or disposal component associated with the WWTF shall not, in combination with other sources of the waste constituents, cause groundwater under and beyond the WWTF and discharge area(s) to exceed any of the following:

1. Constituent concentrations specified below or natural background concentration, whichever is greater:

a. Total coliform organisms of 2.2 MPN/100 mL.

b. Total nitrogen in excess of 10 mg/L.

c. For constituents identified in Title 22 (as described in Finding No. 58), the MCLs quantified therein.

2. Constituent concentrations listed below or natural background concentration, whichever is greater:

| Constituent | Units | Limitation |
|---|---|---|
| Boron | mg/L | 0.7 |
| Chloride | mg/L | 106 |
| EC | µmhos/cm | 990 |
| Sodium | mg/L | 103 |
| Total Dissolved Solids[1] | mg/L | 560 |

[1] A cumulative constituent comprised of dissolved matter consisting mainly of inorganic salts, small amounts of organic matter, and dissolved gases [e.g., ammonia, bicarbonate alkalinity, boron, calcium, chloride, copper, iron, magnesium, manganese, nitrate, phosphorus, potassium, sodium, silica, sulfate, total alkalinity]

3. Taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses, including but not limited to ammonia (as N) in excess of 0.5 mg/L, or natural background, whichever is greater.

4. Constituent concentrations identified as follows or natural background concentration, whichever is greater: toxic substances in concentrations that produce detrimental physiological responses in human, plant, or animal, or aquatic life; or chemical constituents and pesticides in concentrations that adversely affect beneficial uses.

## H. Provisions

1. For purposes of day-to-day communication regarding compliance with terms of this Order, the Board will communicate directly with the City of Fresno. Correspondence and notifications between the Board and City of Fresno shall be as if to or from all parties identified in Finding No. 1 as "Discharger."

2. The Discharger shall comply with the *Standard Provisions and Reporting Requirements for Waste Discharge Requirements*, dated 1 March 1991, which are attached hereto and by reference a part of this Order. This attachment and its individual paragraphs are commonly referenced as Standard Provision(s).

3. The Discharger shall comply with Monitoring and Reporting Program No. 5-01-254 that is part of this Order, and any revisions thereto as ordered by the Executive Officer.

4. The Discharger shall submit to the Board on or before each report due date the specified document or, if an action is specified, a written report detailing evidence of compliance with the date and task. If noncompliance is being reported, the reasons for such noncompliance shall be stated, plus an estimate of the date when the Discharger will be in compliance. The Discharger shall notify the Board by letter when it returns to compliance with the time schedule.

5. **By 15 April 2002**, the Discharger shall submit a technical report describing a work plan for monitoring its stillage disposal operation. The technical report shall at a minimum describe:

   a. The methods the Discharger will employ for determining the daily quantity of stillage discharge and the amount of acreage covered by the discharge on a daily basis.

   b. Alternatives for disposal should the Discharger be in threatened violation of any conditions of this Order.

   c. The location, depths, and number of soil sampling points.

   d. Vadose zone monitoring procedures, specifically:

      i) The location, depths, and number of vadose zone liquid sampling points.

      ii) The method for collecting samples of liquid percolating through the soil.

   The technical report must be prepared by a qualified professional such as a California registered civil engineer, agricultural engineer, or a certified soil scientist experienced in land treatment of food processing wastewater. The Discharger shall implement the Stillage Site monitoring program within **30 days** following Executive Officer approval of the technical report.

6. **By 15 April 2002**, the Discharger shall submit a sludge management plan that satisfies the information requirements of Attachment E, "Information Needs For Sludge Management Plan." A California registered civil engineer experienced in sludge disposal must prepare and certify the sludge management plan. Following written approval of the sludge management plan from the Executive Officer, this Provision shall be considered satisfied.

7. **By 15 July 2002**, the Discharger shall complete a hydrogeologic investigation within the area affected and potentially affected by the WWTF and submit a technical report to the Executive Officer. The technical report, which shall be prepared and professionally certified by a geologist registered to practice in California, shall describe the underlying geology, existing wells (active and otherwise), local well construction practices and standards, well restrictions, and hydrogeology. The report shall recommend representative monitoring zones of the uppermost aquifer with consideration given to the Discharger's existing data and provide a detailed evaluation of the existing monitoring well network. The recommendations shall be reviewed and approved as appropriate by the Executive Officer.

8. Within 210 days following Executive Officer approval of representative monitoring zones in accordance with **Provision H.7**, the Discharger shall submit a technical report proposing a modified groundwater monitoring network. The technical report shall consist of a Monitoring Well Installation Work Plan for a network that satisfies Attachment F, "Standard Monitoring Well Provisions for Waste Discharge Requirements." The network shall include one or more background wells and sufficient number of wells to evaluate performance of BPTC measures and to determine compliance with this Order's Groundwater Limitations. These include monitoring wells immediately downgradient of components that do or may release waste constituents to groundwater (e.g., disposal ponds, Stillage Site, former sludge drying bed area, biosolids storage areas). Every monitoring well shall comply with applicable Well Standards. Monitoring of wells constructed to yield representative samples from approved monitoring zones within the uppermost aquifer in accordance with this Order's Monitoring and Reporting Program shall comprise the representative zone monitoring program. Implementation of the Monitoring Well Installation Work Plan shall be subject to the prior approval of the Executive Officer.

9. The Discharger shall comply with the following compliance schedule in implementing the groundwater monitoring network approved by the Executive Officer in Provision H.8:

| Task | Compliance Date |
|---|---|
| a. Implement Monitoring Well Installation Work Plan | 180 days following Work Plan approval by Executive Officer |
| b. Complete Monitoring Well Installation | 120 days following Work Plan implementation |
| c. Commence Groundwater Monitoring | 30 days following completion of task 9.b |
| d. Submit Monitoring Well Installation Report of Results | 60 days following completion of task 9.b |
| e. Submit technical report that characterizes natural background water quality in approved representative monitoring zones for all monitored constituents | 365 days following completion of task 9.d |

Technical reports submitted pursuant to this Provision shall be prepared and certified by a California registered civil engineer or geologist, and are subject to Executive Officer approval.

10. Compliance with Groundwater Limitations will be evaluated based on the approved representative zone monitoring program following completion of Provision H.9, task e. Should the Discharger fail to comply with the schedule to characterize natural background groundwater quality at the approved monitoring zone(s) by the date specified in Provision H.9, task e, the Board shall not consider the lack of natural background characterization as sufficient defense to enforcement for violations of Groundwater Limitations G.1 through G.4.

11. **By 15 October 2002**, the Discharger shall submit a written work plan in the form of a technical report that sets forth a schedule for a systematic and comprehensive technical evaluation of each component of the WWTF's waste treatment and control to determine for each waste constituent best practicable treatment and control as used in Resolution 68-16. The technical report shall contain a preliminary evaluation of each component and propose a time schedule for completing the comprehensive technical evaluation. The technical report shall be prepared and certified by a California registered civil engineer. The schedule to complete all comprehensive technical evaluations shall be as short as practicable, and shall not exceed two years. Upon written determination of adequacy by the Executive Officer of the technical report, this Provision shall be considered satisfied.

12. **By two years from satisfaction of Provision H.11**, the written comprehensive technical evaluation shall be submitted with the Discharger's written recommendations for any WWTF modifications (e.g., component upgrade and retrofit) and/or operational modifications that are necessary to ensure BPTC. Comprehensive technical evaluations shall be prepared and certified by a California registered civil engineer. The proposed schedule for modifications shall be identified. The schedule shall be as short as practicable but in no case shall completion of the necessary improvement exceed four years past the Executive Officer's determination of the adequacy of the comprehensive technical evaluation submitted pursuant to this provision unless the schedule is reviewed and specifically approved by the Board. The adequacy of the component evaluation, recommended improvements, and schedule are subject to the Executive Officer's review and determination.

13. The groundwater limitations set forth in this Order are not final and not an entitlement. **By 15 June 2005**, the Discharger shall submit a technical report that proposes specific numeric groundwater limitations for each waste constituent that reflects full implementation of BPTC and compliance with the most stringent applicable water quality objectives for that waste constituent. The report shall describe how these were determined considering actual data from monitoring wells comprising the approved representative zone monitoring program, impact reductions through full implementation of BPTC, reasonable growth, the factors in Water Code section 13241, State Water Resources Control Board Resolution No. 68-16, the Basin Plan, etc. The most stringent applicable water quality objective shall be interpreted based on the Regional Board policy entitled Application of Water Quality Objectives on pages IV-21 through IV-23 of the Basin Plan. Where the stringency of a proposed water quality objective can vary according to land use, the Discharger must provide documentation from similar third party government authorities that there is no potential for the more sensitive land use to occur, and the reason, if it wishes the Board to consider a proposed water quality objective, that provides protection for only less sensitive uses. The Board will consider the documentation and recommendation for the governing water quality objective, and it is this accepted value that will establish the maximum permissible groundwater limitation the Board will consider in Phase 2 evaluation. The Discharger may, at its discretion, submit results of a validated groundwater model or other hydrogeologic information to support its proposal.

14. Upon completion of tasks set forth in Provisions H.12 and H.13, the Board shall consider the evidence provided and make a determination regarding (a) whether the Discharger has justified BPTC and (b) the appropriate final numeric groundwater limitations that comply with Resolution 68-16.

15. The Discharger shall expand its WWTF effluent reuse operation to recycle an additional 11,200 af/yr over that recycled currently (as described in Finding Nos. 8 and 12). This amount may include the 7,000 af/yr reuse project proposed by Calpine (described in Finding No. 16). The Discharger shall comply with the following time schedule in implementing additional reuse project(s):

| Task | Compliance Date |
|---|---|
| a. Submit technical report and implementation schedule | **15 October 2002** |
| b. Submit Title 22 Engineering Report to DHS | **90 days** following Executive Officer approval of Task 15.a |
| c. Comply with CEQA | **270 days** following completion of Task 15.b |
| d. Submit Report of Water Reclamation for additional reuse project(s) | **60 days** following completion of Task 15.c |
| e. Implement additional reuse project(s) | **110 days** following completion of Task 15.d |

Reports submitted pursuant to Tasks a, b, d of this Provision shall be prepared and certified by a California registered civil engineer.

16. **By 1 April 2002**, the Discharger, in collaboration with FID, shall submit a technical report that (a) identifies the types and acreages of crops in the FID service area that receives groundwater extracted from the Operator's reclamation wells and (b) provides information on the dilution of the extracted groundwater with fresh water prior to irrigation. The crop identification should provide information on fluctuations in cropping patters in the subject area. The dilution information should provide and interpret historic flow data of FID surface water deliveries to cropland receiving extracted groundwater for a range of water year types (e.g., drought, normal, and wet). The Discharger shall submit a copy of the technical report to DHS. Upon written approval of the Executive Officer of the technical report, this Provision shall be considered satisfied.

17. **By 15 February 2002,** the Discharger shall submit a technical report for Executive Officer approval that describes a work plan and implementation schedule for installing and operating continuous turbidity monitoring devices on representative reclamation wells for at least a one-year period. The Discharger shall submit a copy of the technical report to DHS. The Discharger shall implement continuous turbidity monitoring on approved representative

monitoring wells prior to the startup of reclamation well discharge in the spring 2002 irrigation season.

18. **By 15 July 2002**, the Discharger shall submit a technical report describing a work plan and implementation schedule for sampling a representative number of private domestic and agricultural wells in the 25-square-mile area surrounding and downgradient of the WWTF (as described in Finding No. 9). The technical report shall, at a minimum, include:

    a. A map depicting the location of all individual and agricultural wells in the subject area.

    b. A map depicting the land use within the subject area.

    c. A map and listing of individual and agricultural wells proposed for sampling, and a justification of why each well was selected for sampling.

    d. The driller's log for the selected wells.

    e. A proposed list of monitored constituents, including, at a minimum, the following: TDS, EC, general minerals (defined in the Monitoring and Reporting Program), nitrogen compounds (i.e., nitrate, nitrite, ammonia, organic nitrogen), total organic carbon, endocrine disrupting compounds, and pharmaceuticals.

    f. A thorough description of the sampling and testing protocol.

    A California registered civil engineer or geologist shall certify the technical report. The Discharger shall submit a copy of the technical report to DHS. Within **30 days** following Executive Officer written approval of the technical report, the Discharger shall commence sampling of approved domestic and agricultural wells and continue sampling in accordance with the approved work plan. Upon evaluation of submitted data, the Executive Officer may require the Discharger to sample additional wells.

19. **By 15 July 2002**, the Discharger shall submit a technical report describing a work plan and implementation schedule for an evaluation of the degree of soil treatment provided by the current recharge and extraction operation. The evaluation shall include, at a minimum, a determination of the level of filtration and virus removal treatment provided. A California registered civil engineer or geologist shall certify the technical report. The Discharger shall submit a copy of the technical report to DHS. Within **30 days** following Executive Officer written approval of the technical report, the Discharger shall implement the work plan. Within **120 days** following the work plan implementation, the Discharger shall submit a technical report describing the results of the evaluation. The Discharger shall submit a copy of the technical report to DHS. Following written acceptance of the technical report by the Executive Officer, this Provision will be considered satisfied.

20. **By 1 March 2002,** the Discharger shall submit a report for Executive Officer approval outlining EPA test methods and detection limits for priority pollutants listed in Title 40, Code of Federal Regulations, Part 131.

21. By **15 March 2002**, the Discharger shall submit a technical report that shows whether the disposal ponds have adequate capacity for the 100-year annual rainfall at design flow of 80 mgd. The technical report shall also include a nutrient balance that estimates the amount of nitrogen (tons and lbs/acre) that will percolate annually to groundwater underlying the disposal ponds at the design flow. A California registered civil engineer must oversee and certify the technical report. Following written approval of the technical report from the Executive Officer, this Provision shall be considered satisfied.

22. At least **90 days prior** to termination or expiration of any lease, contract, or agreement involving the Stillage Site, reclamation areas, or off-site reuse of effluent, used to justify the capacity authorized herein and assure compliance with this Order, the Discharger shall notify the Board in writing of the situation and of what measures have been taken or are being taken to assure full compliance with this Order.

23. The Discharger shall not allow pollutant-free wastewater to be discharged into the WWTF collection, treatment, and disposal systems in amounts that significantly diminish the system's capability to comply with this Order. Pollutant-free wastewater means stormwater (i.e., inflow), groundwater (i.e., infiltration), cooling waters, and condensates that are essentially free of pollutants.

24. The Discharger shall use best practicable treatment or control, including proper operation and maintenance, to comply with terms of this Order.

25. Each User of recycled water who is farming lands within the WWTF property should receive appropriate employee training to assure proper operation of recycling facilities, worker protection, and compliance with this Order. The Operator and Users shall each designate a Recycled Water Supervisor responsible for compliance with these waste discharge requirements. The Recycled Water Supervisor shall be responsible for the avoidance of cross-connections during the installation, operation and maintenance of the reclamation area's pipelines and equipment.

26. If the Board determines that waste constituents in the discharge have reasonable potential to cause or contribute to an exceedance of an objective for groundwater, this Order may be reopened for consideration of addition or revision of appropriate numerical effluent or groundwater limitations for the problem constituents.

27. The Discharger shall report to the Board any toxic chemical release data it reports to the State Emergency Response Commission within 15 days of reporting the data to the Commission pursuant to section 313 of the "Emergency Planning and Community Right to Know Act of 1986."

28. The Discharger shall comply with all pretreatment requirements contained in 40 CFR 403 and shall be subject to enforcement actions, penalties, fines, and other remedies by EPA or other appropriate parties, as provided in the CWA, as amended, and the CWA. The Discharger shall implement and enforce its approved Publicly-Owned Treatment Works (POTW) Pretreatment Program, which is hereby made an enforceable condition of these requirements. EPA may initiate enforcement action against an industrial user for noncompliance with applicable standards and requirements as provided in the CWA.

29. The Discharger shall enforce the requirements promulgated under Sections 307(b), (c), (d), and 402(b) of the CWA. The Discharger shall cause industrial users subject to federal categorical standards to achieve compliance no later than the date specified in those requirements or, in the case of a new industrial user, upon commencement of the discharge.

30. The Discharger shall perform the pretreatment functions required in 40 CFR 403, including, but not limited to:

    a. Implementing the necessary legal authorities as provided in 40 CFR 403.8(f)(1);

    b. Enforcing the pretreatment requirements under 40 CFR 403.5 and 403.6;

    c. Implementing the programmatic functions as provided in 40 CFR 403.8(f)(2);

    d. Providing the requisite funding and personnel to implement the pretreatment program as provided in 40 CFR 403.8(f)(3);

    e. Publishing a list of industrial users that were in significant noncompliance of applicable pretreatment requirements as required by 40 CFR 403.8(f)(2)(vii); and

    f. Conducting inspections in accordance with provisions of 40 CFR 403.8(f)(1)(v) and 403.8(f)(2)(v) and ensuring compliance with pretreatment standards and requirements by (1) assessing and collecting, when appropriate, civil penalties and civil administrative penalties in accordance with Government Code Sections 54740, 54740.5, and 54740.6, or (2) other equally effective means.

31. In the event of any change in control or ownership of land or waste discharge facilities described herein, the Discharger shall notify the succeeding owner or operator of the existence of this Order by letter, a copy of which shall be immediately forwarded to this office. To assume operation under this Order, the succeeding owner or operator must apply in writing to the Executive Officer requesting transfer of the Order. The request must contain the requesting entity's full legal name, the state of incorporation if a corporation, the name and address and telephone number of the persons responsible for contact with the Board, and a statement. The statement shall comply with the signatory paragraph of Standard Provision B.3 and state that the new owner or operator assumes full responsibility for compliance with this Order. Failure to submit the request shall be considered a discharge

without requirements, a violation of the California Water Code. Transfer shall be approved or disapproved by the Executive Officer.

32. The Discharger must comply with all conditions of this Order, including timely submittal of technical and monitoring reports as directed by the Executive Officer. Violations may result in enforcement action, including Board or court orders requiring corrective action or imposing civil monetary liability, or in revision or rescission of this Order.

33. A copy of this Order shall be kept at the discharge facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.

34. The Board will review this Order periodically and will revise requirements when necessary.

I, GARY M. CARLTON, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 19 October 2001.

_____
GARY M. CARLTON, Executive Officer

Order Attachments:
Monitoring and Reporting Program No.
A: Vicinity Map
B: Plant 1 Diagrammatic Layout
C: Plant 2 Diagrammatic Layout
D: Symbol For Recycle Water Signs
E: Information Needs for Sludge Management Plan
F: Standard Monitoring Well Provisions for Waste Discharge Requirements
G: Recommended Recycled Water Monitoring Form
Information Sheet
Standard Provisions (1 March 1991 version) (separate attachment to Discharger only)

BLH:jlk:fmc 10/19/01 AMENDED

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. 5-01-254

MONITORING AND REPORTING PROGRAM
FOR
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

This Monitoring and Reporting Program (MRP) is issued pursuant to Water Code Section 13267. The Discharger shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer. Sample station locations are depicted on Attachments B and C. Changes to sample location shall be established with concurrence of Board's staff, and a description of the revised stations shall be submitted to the Board and attached to this Order. All samples should be representative of the volume and nature of the discharge or matrix of material sampled. The time, date, and location of each sample shall be recorded on the sample chain of custody form.

## WWTF INFLUENT MONITORING

Samples shall be collected at the headworks and should be representative of the influent for the period sampled. Time and date of collection of samples shall be recorded. Influent monitoring shall include at least the following:

| Constituent | Units | Type of Sample | Sampling Frequency |
|---|---|---|---|
| Maximum Daily Flow | mgd | Continuous | Daily |
| Average Daily Flow | mgd | Continuous | Daily |
| Monthly Average Flow | mgd | Computed | Monthly |
| Annual Monthly Average Daily Flow[1] | mgd | Computed | Monthly |
| Settleable Solids | mL/L | Grab | 2/week[2] |
| pH | pH units | Continuous | Daily[4] |
| $BOD_5$[2] | mg/L | 24-hr Composite | 2/week[3] |
| Monthly Average $BOD_5$ | mg/L | Calculated | Monthly |
| Total Suspended Solids | mg/L | 24-hr Composite | 2/week[3] |
| Monthly Average TSS | mg/L | Calculated | Monthly |

1 Based on the previous twelve months
2 Five-day biochemical oxygen demand at 20ºC
3 Nonconsecutive days
4 Median value for 24-hour period

## WWTF DISCHARGE MONITORING

Effluent samples shall be collected just prior to discharge to the disposal ponds and should be representative of the volume and nature of the discharge. Time of collection of composite and grab samples shall be recorded. Effluent monitoring from Plant 1 (and from Plant 2 when in operation and discharging directly to disposal ponds) shall include at least the following:

| Constituent | Units | Type of Sample | Sampling Frequency[1] |
|---|---|---|---|
| pH | pH Units | Continuous | Daily[2] |
| Settleable Solids | mL/L | Grab | 2/Week[3] |
| $BOD_5$ | | | |
| Concentration | mg/L | 24-hr Composite | 2/Week[3] |
| Monthly Average | mg/L | Calculated | Monthly |
| Percent Removal | % | Calculated | Monthly |
| Total Suspended Solids | | | |
| Concentration | mg/L | 24-hr Composite | 2/Week[3] |
| Monthly Average | mg/L | Calculated | Monthly |
| Percent Removal | % | Calculated | Monthly |
| Total Dissolved Solids (TDS)[4] | mg/L | 24-hr Composite | Weekly[5] |
| EC[6] | µmhos/cm | 24-hr Composite | 2/Weekly |
| Chloride | mg/L | 24-hr Composite | 2/Week[3,5] |
| Ammonia Nitrogen (as $NH_3$-N) | mg/L | 24-hr Composite | Weekly |
| Nitrate Nitrogen (as $NO_3$-N) | mg/L | 24-hr Composite | Weekly |
| Nitrite Nitrogen (as $NO_2$-N) | mg/L | 24-hr Composite | Weekly |
| Total Kjeldahl Nitrogen (TKN) | mg/L | 24-hr Composite | Weekly |
| Total Nitrogen | mg/L | Calculated[7] | Weekly |
| General Minerals[8] | mg/L | 24-hr Composite | Quarterly[9] |
| Metals[10,11] | µg/L | 24-hr Composite | Semiannually[12] |
| Priority Pollutants[13] | µg/L | Grab | Semiannually[12,14] |

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1 If results of monitoring a pollutant appear to violate discharge specifications, but monitoring frequency is not sufficient to validate violation (e.g., the monthly mean for $BOD_5$), or indicate a violation and potential upset of the treatment process (e.g., less than minimum dissolved oxygen concentration), the frequency of sampling shall be increased to confirm the magnitude and duration of violation, if any, and aid in identification and resolution of the problem.

2 Median value for 24-hour period

3 Nonconsecutive days

4 TDS as referred to in this program shall be determined using EPA Method No. 160.1 for combined organic and inorganic TDS and EPA Method No. 160.4 for inorganic.

5 Concurrent with EC sampling (i.e., on the same day)

6 Conductivity at 25º

[7] Total Nitrogen as referred to in this program shall be calculated as : TKN + $NO_2$-N + $NO_3$-N
[8] General Minerals as referred to in this program shall include the constituents in the Analyte listed below.
[9] January, April, July, and October
[10] Metal analyses as referred to in this program shall include aluminum arsenic, barium, copper, cadmium, chromium, lead mercury, molybdenum, selenium, silver, zinc, and nickel.
[11] Samples shall pass through a 0.45 µm filter prior to analysis.
[12] April and October, coincident with general minerals analyses
[13] The Discharger must submit a report for approval by 1 March 2002 outlining EPA test methods and detection limits for priority pollutants listed in Title 40, Code of Federal Regulations, Part 131).
[14] Sampling to commence in April 2002

General Minerals Analyte List

| | | |
|---|---|---|
| Alkalinity (as $CaCO_3$), unfiltered | | Phosphorus, total dissolved (P) |
| Boron | Hardness (as $CaCO_3$), calculated | Potassium |
| Bicarbonate (as $CaCO_3$), unfiltered | Iron | Sodium |
| Calcium | Magnesium | Sulfate |
| Carbonate (as $CaCO_3$), unfiltered | Manganese | |

**Sample Collection and Preservation:** Any sample placed in an acid-preserved bottle must first be filtered through a 0.45 µm nominal pore size filter. If field filtering is not feasible, samples shall be collected in unpreserved containers and submitted to the laboratory within 24-hours with a request (on the chain-of-custody form) to filter immediately then preserve the sample.

## DISPOSAL POND MONITORING

Disposal pond monitoring shall include at least the following:

| Constituent/Parameter | Unit | Type of Sample | Sampling Frequency[1] |
|---|---|---|---|
| Dissolved Oxygen (DO) | mg/L | Grab[2] | As Required[3] |
| Temperature | °C | Grab | As Required[4] |
| Freeboard | feet[5] | Observation | |
| External Disposal Ponds | | | Daily |
| Internal Disposal Ponds | | | Weekly[6] |

[1] If results of monitoring appear to violate Disposal Pond Specifications, but monitoring frequency is not sufficient to validate violation or indicate a violation and potential upset of the treatment process (e.g., less than minimum dissolved oxygen concentration), the frequency of sampling shall be increased to confirm the magnitude and duration of violation, if any, and aid in identification and resolution of the problem.
[2] Samples shall be collected at a depth of one foot from each pond in use, opposite the inlet, and analyzed for DO. Samples shall be collected between 0700 and 0900 hours.
[3] If offensive odor detected by or brought to the attention of WWTF personnel, monitor affected pond(s) daily until dissolved oxygen > 1.0 mg/L. If DO results for any pond in use indicate noncompliance with Disposal Pond Specification C.1, the Discharger shall implement corrective measures as specified in the O&M manual and monitor said pond daily until its DO stabilizes above 1.0 mg/L.
[4] Concurrent with DO monitoring

[5] For freeboard measurements greater than 2 feet, estimate to nearest half foot. For freeboard measurements less than 2 feet, estimate to nearest quarter foot.
[6] At least once every seventh calendar day on nonconsecutive days

Markers (e.g., staff gages) shall be placed in disposal ponds adjacent to public roads, private properties, and surface waters. The markers shall have calibrations indicating the water level at design capacity and available operational freeboard. The Discharger shall inspect all disposal ponds daily to determine compliance with Disposal Pond Specification D.4, which requires freeboard of all disposal ponds to never be less than two feet (measured vertically). In addition, the Discharger shall inspect the condition of the disposal ponds in use daily and write visual observations of developing potential problems in a bound logbook. Notations shall include observations of whether weeds are developing in the water or along the bank, and their location; whether dead algae, vegetation, scum, or debris are accumulating on the disposal pond surface and their location; whether burrowing animals or insects are present; and the general color of effluent in the disposal pond. A summary of entries made in the log during each month shall be submitted along with the monitoring report the following month. The Discharger shall certify in each November monitoring report that it is in compliance with Disposal Pond Specification C.5.

## RECLAMATION OPERATION MONITORING

The type of crop(s) irrigated, amounts of water and/or reclaimed water applied to the crops(s) (in acre-feet) and amounts of sludge and chemical fertilizers (in pounds of nitrogen per acre) shall be measured and reported to the Board quarterly in accordance with the following schedule:

| Monitoring Period | Reports Due |
|---|---|
| January – March | 1 May |
| April – June | 1 August |
| July – September | 1 November |
| October – December | 1 February |

The Discharger shall utilize the form presented in Attachment G (or variation thereof subject to Board staff approval) for reporting the reclamation area monitoring data.

## STILLAGE DISCHARGE MONITORING

The areas of land utilized for stillage disposal shall be reported monthly. Additionally, a sampling station shall be established where a representative sample of the stillage can be obtained. Stillage discharge monitoring shall include at least the following:

| Constituent | Units | Type of Sample | Frequency |
|---|---|---|---|
| Flow | mgd | Measured | Daily |
| pH | pH units | Grab | Weekly |
| $BOD_5$, total | mg/L | Grab | Weekly |
| $BOD_5$, soluble | mg/L | Grab | Weekly |

| Constituent | Units | Type of Sample | Frequency |
|---|---|---|---|
| COD, total | mg/L | Grab | Weekly |
| COD, soluble | mg/L | Grab | Weekly |
| Total Suspended Solids | mg/L | Grab | Weekly |
| Volatile Suspended Solids | mg/L | Grab | Weekly |
| Total Kjeldahl Nitrogen (TKN) | mg/L | Grab | Weekly |
| Nitrate Nitrogen (as $NO_3$-N) | mg/L | Grab | Monthly[1] |
| Total Nitrogen | mg/L | Calculated | Monthly[1] |
| Total Phosphorus (P) | mg/L | Grab | Monthly[1] |
| Total Organic Carbon (TOC) | mg/L | Grab | Monthly[1] |
| Carbon/Nitrogen/Phosphorus ratio | --- | Calculated | Monthly[1] |
| EC | µmhos/cm | Grab | Monthly[1] |
| TDS | mg/L | Grab | April, October |

[1] Coincident with time of weekly sample

## STILLAGE SITE APPLICATION MONITORING

| Constituent | Units | Type of Sample | Frequency |
|---|---|---|---|
| Precipitation[1] | inches | Rain gauge | Daily |
| Flow | mgd | Measured | Daily |
| Area | acres | Measured | Daily |
| Drying Time[2] | days | Calculated | Per Application |
| $BOD_5$, maximum[3] | lbs/acre/day | Calculated | Monthly |
| $BOD_5$, average[4] | lbs/acre/ day | Calculated | Weekly |
| Total Kjeldahl Nitrogen (TKN)[5] | lbs/acre/day | Calculated | Monthly |

[1] On-site rain gauge, National Weather Service, or California Irrigation Management Information System

[2] Report per active application area

[3] Maximum daily $BOD_5$ loading rate shall be calculated using the total volume of stillage applied on the day of application, estimated daily application area, and a running average of the three most recent results of $BOD_5$, which shall also be reported along with supporting calculations.

[4] Average $BOD_5$ loading rate shall be calculated using the total volume of stillage applied on the day of application, the total application period (i.e., day of application and drying time), estimated application area on day of application, and a running average of the three most recent results of $BOD_5$, which shall also be reported along with supporting calculations.

[5] Loading rate for nitrogen shall be calculated using the daily applied load and the estimated daily application area.

## STILLAGE SITE SOILS MONITORING

The Discharger shall inspect and document the condition of the Stillage Site at least once a week. Notations should be made in a bound log book and include observations on whether ponding waste, soil clogging, odors, insects, or other potential nuisance conditions are present. The notations shall also document any corrective actions taken. A summary of entries made in the log during each month shall be submitted along with the monitoring report the following month.

The Discharger shall establish representative soil surface and soil profile monitoring locations within and outside the Stillage Site. There shall be at least one monitoring location per 20 acres. The samples shall be collected and analyzed for at least the following constituents:

| Constituent | Units | Sample[1] | Frequency |
|---|---|---|---|
| Soil pH | pH Units | Grab | Semiannually[2] |
| Total Alkalinity (as $CaCO_3$) | mg/kg | Grab | Semiannually[2] |
| Cation Exchange Capacity | meq/100 grams | Grab | Semiannually[2] |
| Total Phosphorus (P) | mg/kg | Grab | Semiannually[2] |
| Nitrate Nitrogen (as $NO_3$-N) | mg/kg | Grab | Semiannually[2] |
| Total Kjeldahl Nitrogen (TKN) | mg/kg | Grab | Semiannually[2] |
| Total Nitrogen | mg/kg | Calculated | Semiannually[2] |

[1] Samples shall be collected at 0.5, 1, 2, 3-foot depths.
[2] April and October

## STILLAGE SITE VADOSE ZONE MONITORING

The Discharger shall establish representative vadose monitoring locations in the Stillage Site in accordance with the approved work plan required by Provision H.5. The samples shall be collected and analyzed for at least the following constituents:

| Method | Constituent | Minimum Sample (mL) | Frequency |
|---|---|---|---|
| | pH | 5 | Twice/year[1] |
| | EC | 10 | Twice/year[1] |
| EPA 351.3 or 4500N-org | TKN | 20 | Twice/year[1] |
| EPA 300.0 | Nitrate | 20 | Twice/year[1] |
| | Phosphorus | | Twice/year[1] |
| | Sulfate | | Twice/year[1] |
| | Chloride | | Twice/year[1] |
| EPA 200.7 | Calcium | 5 | Twice/year[1] |
| | Iron | | Twice/year[1] |
| | Magnesium | | Twice/year[1] |
| | Manganese | | Twice/year[1] |
| | Potassium | | Twice/year[1] |

| Method | Constituent | Minimum Sample (mL) | Frequency |
|---|---|---|---|
| | Total Alkalinity | 20 | Twice/year[1] |
| EPA 310.1 | | | |
| EPA 415.1 | TOC | 150 | Twice/year[1] |

[1] In accordance with the vadose zone monitoring program described in the Discharger's approved work plan for monitoring its stillage disposal operation (Provision H.5).

## GROUNDWATER MONITORING

Prior to collecting samples, the monitoring well shall be adequately purged to remove water that has been standing within the well screen and casing that may not be chemically representative of formation water. Depending on the hydraulic conductivity of the geologic setting, the volume removed during purging is typically from 3 to 5 volumes of the standing water within the well casing and screen, or additionally the filter pack pore volume.

At least quarterly and concurrently with groundwater quality sampling, the Discharger shall in each well measure groundwater level and report the data as groundwater depth (in feet and hundredths) and as groundwater surface elevation (in feet and hundredths above mean sea level). The horizontal geodetic location for each monitoring well shall be provided where the point of beginning shall be described by the California State Plane Coordinate System, 1983 datum.

Samples shall be collected from approved monitoring wells and analyzed for the following constituents at the following frequency:

| Constituent | Units | Type of Sample | Frequency |
|---|---|---|---|
| Total Coliform Organisms | MPN/100 mL | Grab | Quarterly[1] |
| Total Organic Carbon (TOC) | mg/L | Grab | Quarterly[1] |
| Ammonia Nitrogen (as $NH_3$-N) | mg/L | Grab | Quarterly[1] |
| Nitrate Nitrogen (as $NO_3$-N) | mg/L | Grab | Quarterly[1] |
| Total Kjeldahl Nitrogen (TKN) | mg/L | Grab | Quarterly[1] |
| Total Organic Nitrogen (as N) | mg/L | Calculated | Quarterly[1] |
| EC | µmhos/cm | Grab | Quarterly[1] |
| Total dissolved solids (TDS) | mg/L | Grab | Quarterly[1] |
| General Minerals | mg/L | Grab | Quarterly[1] |
| Metals[2] | µg/L | Grab | Quarterly[1] |
| Dissolved Oxygen | mg/L | Grab | Quarterly[1] |
| Oxidation-Reduction Potential | mV | Grab | Quarterly[1] |

[1] January, April, July and October

[2] Samples shall pass through a 0.45 µm filter prior to analysis.

In reporting the results of the first sampling event pursuant to this MRP, the Discharger shall include a

detailed description of the procedures and techniques for: (a) sample collection, including purging techniques, sampling equipment, and decontamination of sampling equipment; (b) sample preservation and shipment; (c) analytical procedures; and (d) chain of custody control.

## EXTRACTED GROUNDWATER MONITORING

Prior to collecting samples, the reclamation well shall be adequately purged to remove water that has been standing within the well screen and casing that may not be chemically representative of formation water. Depending on the hydraulic conductivity of the geologic setting, the volume removed during purging is typically from 3 to 5 volumes of the standing water within the well casing and screen, or additionally the filter pack pore volume. Samples shall be collected from the reclamation wells and analyzed for the following constituents at the following frequency:

| Constituent / Parameter | Units | Type of Sample | Frequency |
|---|---|---|---|
| Flow | million gallons | metered | Monthly |
| | acre-feet | Calculated | Monthly |
| Total Coliform Organisms | MPN / 100 mL | Grab | Quarterly[1] |
| Total Dissolved Solids (TDS) | mg/L | Grab | Quarterly[1] |
| pH | pH Units | Grab | Quarterly[1] |
| EC | µmhos/cm | Grab | Quarterly[1] |
| Total Kjeldahl Nitrogen (TKN) | mg/L | Grab | Quarterly[1] |
| Ammonia Nitrogen (as $NH_3$-N) | mg/L | Grab | Quarterly[1] |
| Nitrate Nitrogen (as $NO_3$-N) | mg/L | Grab | Quarterly[1] |
| Total Nitrogen | mg/L | Calculated | Quarterly[1] |
| Total Phosphorus (P) | mg/L | Grab | Quarterly[1] |
| Chloride | mg/L | Grab | Quarterly[1] |
| General Minerals | mg/L | Grab | Semiannually[2] |
| Total Organic Carbon (TOC) | mg/L | Grab | Semiannually[2] |
| Metals[3] | µg/L | Grab | Semiannually[2] |

[1] January, April, July and October
[2] April and October, coincident with general minerals
[3] Samples shall pass through a 0.45 µm filter prior to preservation.

## PRETREATMENT MONITORING

The Discharger shall submit an annual report to the Board, with copies to the U.S. Environmental Protection Agency (EPA) Regional Administrator and the State Water Resources Control Board, describing the Discharger's pretreatment activities over the previous 12 months. In the event that the Discharger is not in compliance with any conditions or requirements of this Order, the Discharger shall include the reasons for the noncompliance and state how and when the Discharger shall comply with such conditions and requirements. This annual report shall be submitted by **28 February** and shall contain, but not be limited to item E.7 of *Standard Provisions and Reporting Requirements for Waste*

*Discharge Requirements*, dated 1 March 1991 (Standard Provisions).

Signed copies of the reports shall also be submitted to the EPA Regional Administrator and the State Board at the following addresses, or as advised in writing subsequent to adoption of this Order:

| | |
|---|---|
| Regional Administrator | Pretreatment Program Manager |
| U.S. EPA, Region 9 | Division of Water Quality |
| Water Management Division (W-5-2) | State Water Resources Control Board |
| 75 Hawthorne Street | P.O. Box 944213 |
| San Francisco, CA 94105 | Sacramento, CA 94244-2130 |

## BIOSOLIDS MONITORING

To monitor whether discharges to the WWTF are interfering with the treatment process or lessening biosolids quality, the Discharger shall collect monthly composite samples of sludge in accordance with EPA's *POTW Sludge Sampling And Analysis Guidance Document, August 1989*, *Test Methods for Evaluating Solid Waste, Physical Chemical Methods (SW-846)*. Monthly the Discharger shall submit a certification statement for biosolids classification, how the pathogen reduction and the vector reduction were met. Supporting documentation and analytical results must be submitted with the certification. The certification statement and report shall be submitted to the Executive Officer.

Biosolids monitoring shall include the following:

| Constituent[1] | Sampling Frequency[2] | Constituent[1] | Sampling Frequency[2] |
|---|---|---|---|
| pH | Monthly | Molybdenum | Monthly |
| Total Solids | Monthly | Nickel | Monthly |
| Total Nitrogen | Monthly | Selenium | Monthly |
| Nitrate Nitrogen (as $NO_3$-N) | Monthly | Silver | Monthly |
| Ammonia Nitrogen (as $NH_3$-N) | Monthly | Zinc | Monthly |
| Total Phosphorus (P) | Monthly | Fecal Coliform[3] | Monthly |
| Potassium | Monthly | Vector Reduction[3] | Monthly |
| Arsenic | Monthly | Salmonella[4] | Quarterly[5] |
| Cadmium | Monthly | Enteric Viruses[4] | Quarterly[5] |
| Chromium | Monthly | Helminth Ova[4] | Quarterly[5] |
| Cobalt | Monthly | Semi-Volatile Organics | Quarterly[5] |
| Copper | Monthly | Pesticides | Quarterly[5] |
| Lead | Monthly | PCBs | Quarterly[5] |
| Mercury | Monthly | | |

| Constituent[1] | Sampling Frequency[2] | Constituent[1] | Sampling Frequency[2] |
|---|---|---|---|

1 In metal analyses, ICAP may not be used for arsenic, mercury, and selenium.
2 The Discharger shall sample for these parameters at the specified frequency if biosolids are to be land-applied.
3 If biosolids are classified as Class B and land applied and do not meet 40 CFR 503 Alternatives for Processes to Significantly Reduce Pathogens (PSRP) or Processes to Further Reduce Pathogens (PFRP). Vector reduction as defined in 40 CFR 503.33(b)(1) through 503.33(b)(8).
4 If biosolids are classified as Class A.
5 January, April, July, and October

## WATER SUPPLY MONITORING

Discharger shall utilize its computerized database of the production from municipal wells supplying the cities of Fresno and Clovis. The chemical analysis shall be the most recent analysis in accordance with Title 22 requirements. The flow weighted average concentration shall be calculated and reported for each mineral listed in the following table. The electronic form of the data shall accompany the written calculations.

| Constituent[1] | Units | Reporting Frequency[2] |
|---|---|---|
| Total Dissolved Solids | mg/L | Quarterly[3] |
| EC | µmhos/cm | Quarterly[3] |

1 Constituents shall be reported as a flow-weighted average of all wells during the quarter.
2 Moving average shall include the most recent analysis for each well.
3 January, April, July, October.

## REPORTING

Monthly monitoring reports containing samples collected at frequencies of monthly or greater shall be submitted to the Board by the **1st day of the second month** following sampling. Quarterly reports shall be submitted to the Board by the **1st day of the second month** following the calendar quarter.
In reporting the monitoring data, the Discharger shall arrange the data in tabular form so that the date, the constituents, and the concentrations are readily discernible. The data shall be summarized in a manner that illustrates clearly whether the Discharger complies with waste discharge requirements, including calculation of all averages, etc. If any pollutant is monitored at the locations designated herein more frequently than is required by this Order, the results of such monitoring shall be included in the calculation and reporting of the values required in the discharge monitoring report form. Such increased frequency shall be indicated on the discharge monitoring report form. Monthly and quarterly monitoring reports shall discuss the compliance record for the reporting period. If violations have occurred, the report shall also discuss the corrective actions taken and planned to bring the discharge into full compliance with this Order.

The Discharger may also be requested to submit an annual report to the Board with tabular and graphical summaries of the monitoring data obtained during the previous year. Any such request shall be made in writing. The report shall discuss the corrective actions taken and planned to bring the discharge into full compliance with the waste discharge requirements.

By **1 February of each year**, the Discharger shall submit a written Annual Report to the Executive Officer containing the following:

1. The names, certificate grade and general responsibilities of persons operating and maintaining the wastewater treatment plant (Standard Provision E.1).

2. The names and telephone numbers of (a) persons to contact regarding plant emergency and routine situations and (b) persons designated as Recycled Water Supervisors.

3. A statement certifying when the flow meter and other monitoring instruments and devices were last calibrated, including identification of who performed the calibration (Standard Provision C.4).

4. A statement identifying whether the current operation and maintenance manual, and contingency plan, reflect the wastewater treatment plant as currently constructed and operated, and the dates when these documents were last reviewed for adequacy.

5. The results of an evaluation conducted pursuant to Standard Provision E.4 and a figure depicting monthly average discharge flow for the past five years.

6. A statement describing whether the disposal ponds have adequate capacity for a 100-year rainfall at a design flow of 80 mgd. The statement shall include a summary of disposal pond monitoring of percolation rates for the previous year. The summary shall describe the method(s) used to determine percolation rates and shall include for each disposal pond.

    a. Period during which percolation rate was determined (i.e., initial and final dates)

    b. Measured percolation rate and calculated percolation rate (adjusted for evaporation losses) in inches/day

7. The most recent Annual Water Supply Report for the City of Fresno.

8. A summary of onsite reclamation operations for the previous water year (i.e., from October through September). The summary shall discuss total monthly water application; total wastewater recycled annually; total nutrient loading annually from applied wastewater, biosolids, and chemical fertilizers; and total estimated amount of nutrients removed through crop harvest. In short, the summary shall present a mass balance relative to constituents of concern and hydraulic loading along with supporting data and calculations. The summary shall also include a tabulation and interpretation of analytical results of reclamation soil monitoring.

9. A summary of Stillage Site nitrogen control measures for the previous water year (i.e., from October through September). The summary shall discuss total monthly stillage application; total wastewater recycled annually (if applicable); total nutrient loading annually from applied stillage and wastewater (if applicable), and total estimated amount of nutrients removed through crop harvest. In short, the summary shall present a mass balance relative to constituents of concern and hydraulic and waste constituent loading along with supporting data and calculations. The summary shall include a tabulation and interpretation of analytical results of Stillage Site soil monitoring for the previous calendar year. The summary shall also present tabulated Stillage Site monitoring data for the previous calendar year on 3.5" computer diskettes (or submitted separately via e-mail), either in MS-DOS / ASCII format or in another file format acceptable to the Executive Officer (e.g., Microsoft Excel).

10. A summary of groundwater monitoring data for the previous calendar year. The summary shall include

    a. Hydrographs showing the groundwater elevation in each approved monitoring well for at least the previous five years. The hydrographs should show groundwater elevation with respect to the elevations of the top and bottom of the screened interval and be presented at a scale of values appropriate to show trends or variations in groundwater elevation.

    b. Graphs of the laboratory analytical data for all samples taken from each approved well (monitoring and reclamation) within at least the previous five calendar years (as data become available). Each such graph shall plot the concentration of one or more waste constituents over time for a given monitoring well, at a scale appropriate to show trends or variations in water quality. The graphs shall plot each datum, rather than plotting mean values. For any given evaluated constituent, the scale for the background plots shall be the same as that used to plot downgradient data. Separate graphs shall show hydrologic equipotential gradients and equal concentration gradients for evaluated constituents.

    c. All monitoring analytical data obtained during the previous four quarterly reporting periods, presented in tabular form, as well as 3.5" computer diskettes (or submitted separately via e-mail), either in MS-DOS / ASCII format or in another file format acceptable to the Executive Officer (e.g., Microsoft Excel).

    d. A comprehensive discussion of the compliance record, and the result of any corrective actions taken or planned that may be needed to bring the Discharger into full compliance with the waste discharge requirements.

11. A summary of groundwater extraction operations for the previous calendar year. This summary shall address the past year's groundwater extraction activities and extracted groundwater quality and shall contain all monitoring analytical data obtained during the previous four quarterly reporting periods, presented in tabular form, as well as 3.5" computer diskettes (or submitted separately via e-mail), either in MS-DOS / ASCII format or in another file format acceptable to the Executive Officer (e.g., Microsoft Excel).

12. A summary of biosolids monitoring, including

a. Annual sludge production in dry tons and percent solids.

b. A schematic diagram showing sludge handling facilities and solids flow diagram.

c. A description of disposal methods, including the following information related to the disposal methods used at the WWTF. If more than one method is used, include the percentage of annual sludge production disposed of by each method

i. For **landfill disposal**, include: (a) the Order numbers of WDRs that regulate the landfill(s) used, (b) the present classifications of the landfill(s) used, and (c) the names and locations of the facilities receiving sludge.

ii. For **land application**, include: (a) the locations of the site(s), (b) the Order numbers of any WDRs that regulate the site(s), (c) the application rate in lbs/acre/year (specify wet or dry), and (d) subsequent uses of the land.

iii. For **incineration**, include: (a) the names and location of the site(s) where sludge incineration occurs, (b) the Order numbers of WDRs that regulate the site(s), (c) the disposal method of ash, and (d) the names and locations of facilities receiving ash (if applicable).

iv. For **composting**, include: (a) the location of the site(s), and (b) the Order numbers of any WDRs that regulate the site(s).

The Annual Report shall discuss the compliance record for the reporting period. If violations have occurred, the report shall also discuss the corrective actions taken and planned to bring the discharge into full compliance with this Order. Reports submitted concerning WWTF performance must also be signed and certified by the chief plant operator. When reports contain laboratory analyses performed by the Discharger and the chief plant operator is not in the direct line of supervision of the laboratory, reports must also be signed and certified by the chief of the laboratory.

The Discharger shall implement this monitoring program on the first day of the month following adoption of this Order. All reports submitted in response to this Order shall comply with the signatory requirements in Standard Provision B.3.

Ordered by:_____
GARY M. CARLTON, Executive Officer

19 October 2001
(Date)

BLH:jlk:fmc:10/19/01 AMENDED

INFORMATION SHEET

ORDER NO. 5-01-254
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

The Fresno-Clovis Metropolitan Regional Wastewater Reclamation Facility is a wastewater treatment facility (WWTF) that serves the cities of Fresno and Clovis; the Pinedale Water District and Pinedale Utilities District, both of which are within the city limits of Fresno; and some areas within Fresno County not within the city limits of Fresno or Clovis. The cities of Fresno and Clovis are referred to as Discharger. The City of Fresno is responsible for day-to-day WWTF operations, and is referred to as Operator. The WWTF, on property owned by the Operator, originated in 1891 as a 40-acre "sewage farm" for raw sewage disposal. Beginning in 1924, the Operator began extracting groundwater from deep on-site irrigation wells to draw down the shallow water table caused by groundwater mounding under the WWTF disposal ponds[1].

The WWTF currently encompasses 3,290 acres and includes two separate treatment plants; 1,660 acres of disposal ponds; about 600 acres of reclamation area; 290 acres of wet-weather effluent disposal area: and a 145-acre wine stillage disposal area that currently serves Canandaigua Wine Company, a New York corporation. The Operator recently expanded the WWTF property by 480 acres and proposes to convert some of the newly acquired area to disposal ponds and to use the remainder for year-round water reclamation.

The Operator submitted a Report of Waste Discharge in 1996, to support a proposed increase in WWTF discharge flow from 74 to 94 million gallons per day (mgd). Plant 1 is now an 88-mgd-capacity activated sludge treatment plant that includes headworks and primary and secondary clarifiers. Plant 2, which is currently in stand-by mode, is a 6-mgd-capacity trickling filter plant that includes primary and secondary clarifiers. The WWTF currently treats about 68 mgd, or 24,800 million gallons annually (76,000 acre-feet).

The Operator's January 2001 Title 22 Engineering Report (hereafter Title 22 Report) describes the WWTF as follows:

> Influent is pumped from the collection system into the Headworks for screening, flow measurement, and grit removal. The flow from the Headworks is then divided equally among six primary clarifiers. The effluent from the clarifiers converges at the Primary Effluent Splitting Structure. The primary solids are pumped directly into anaerobic digesters. Currently nine are in service, two are being rehabilitated, and one is used as a feed storage structure for the Dewatering facility.
>
> The primary effluent is divided into two trains. The "B" side receives sixty-four percent of the flow and consists of four plug flow type aeration basins in parallel. Each basin consists of five influent cells followed by a large tank. The aeration effluent enters eight rectangular sedimentation basins, also in parallel, whose effluent flows to a network of percolation ponds via a canal system.

1 Loehr, R. C. et al. (1979). Land Application of Wastes. Volume I, Publisher, City.

> "A" side receives thirty-six percent of the primary effluent and consists of four complete mix aeration basins. This aeration effluent enters five final clarifiers.
>
> Solids from these secondary systems are thickened using a combination of five dissolved air floatation units and two gravity belt thickeners. The thickened secondary solids from each unit feed into a common header and the solids are distributed to the digesters.
>
> The feed digester (Digester #1) receives digested biosolids from all digesters on line. This is pumped to the dewatering facility, which contains seven belt filter presses. The dewatered solids are stored in a silo and then shipped by truck to an application site.

The WWTF has an average power demand of 6.3 megawatts (MW). The WWTF is supplied by two sources of power. Feeder A (10 MW) is the primary source of power; Feeder B (5 MW) is a standby source of power. The Operator's Title 22 Report indicates that a new substation adjacent to the WWTF and owned by the City of Fresno will provide the WWTF's power supply by May 2001. A second 12 KW supply feeds directly into the WWTF's switchgear from a separate substation, thereby assuring reliable power. Further, the WWTF has three standby engine generators onsite with capacities of 25 KW (propane), 350 KW (diesel), and 1,600 KW (diesel). The overall onsite standby capacities allows the WWTF to continue to operate process components during a power outage, including the primary treatment units, plus one of the large aeration blowers. The Operator has implemented a computerized maintenance program to monitor equipment data, preventive maintenance, and repairs. Instrumentation, electrical, and mechanical equipment are on a preventive maintenance program that regularly schedules calibration and service of the equipment. Equipment repairs are scheduled on the computerized maintenance program, and the repair data is entered into the computer. The data from the preventive maintenance and repairs has established equipment history to help in the scheduling of repairs with a minimum of equipment downtime and improved equipment reliability.

The Operator reports that 56 significant industrial users discharge waste into the WWTF collection system, including 14 users from the metal finishing categories. Other industrial users discharging into the WWTF include soft drink bottlers, meat packers, food processors, dairy and poultry products processors, plastic manufacturers, wineries, and several linen and industrial laundries. The Discharger originally developed a pretreatment program in conformance with 40 CFR 403. The Board approved the program on 17 June 1984. The Operator has subsequently submitted a revised pretreatment program (dated 6 June 1996), also in conformance with 40 CFR 403, which updates its original submission to bring it in line with current practices. The Operator updated its pretreatment program in 2001, in part, to reflect its latest municipal code and enforcement response plan, incorporate WWTF upgrades, and describe modifications in sampling procedures. Board staff is reviewing the revised pretreatment program for completeness and adequacy. Once the program is deemed complete, staff will submit for Board consideration a proposed Order approving the revised pretreatment program.

Sludge from the WWTF is thickened by dissolved air flotation and gravity belts, anaerobically digested, and dewatered by seven belt filter presses, three of which went on line in July 1993. Prior to 1993, digested sludge was pumped to 62 acres of open earthen basins beds that are no longer in service and the Operator has since constructed additional treatment facilities on the majority of the 62 acre site. Plant Wells 1001 and 1002, which are in proximity to these former drying beds, have high concentrations of TDS and nitrates.

The Operator previously stockpiled 100,000 cubic yards of dried sludge at the WWTF. Over 75,000 cubic yards of the stockpiled sludge was classified as "hazardous" waste due to the lead and cadmium concentrations present in it. In July1997, the California State Department of Toxic Substances reclassified the sludge as nonhazardous. The stockpiled sludge was transported to the Fresno Sanitary Landfill in 1998 as part of the landfill's final closure project.

**Effluent Disposal and Reclamation**

At the current annual average discharge flow of 68 mgd, the WWTF's annual discharge flow is 24,820 million gallons (or about 76,000 af). Of this amount, about 4,000 af/yr of effluent is recycled directly, an amount that represents about only five percent of the WWTF's current annual discharge flow. On-site effluent recycling effluent currently occurs on 528 acres within the WWTF property, an amount that will reportedly increase to 766 acres (hereafter reclamation area). Area farmers recycle effluent on site under lease agreements with the Operator, as summarized below:

| Field No. | Lessee | Acreage | Types of Crops | AF used in 1999 |
|---|---|---|---|---|
| 1 | Quist Dairy | 121 | Alfalfa, Silage, Cotton, Wheat | 175 |
| 6B | Dan Sousa | 160 | Wine Grapes, Silage, Alfalfa | 462 |
| 7B | Quist Dairy | 117 | Cotton, Alfalfa, Silage, Wheat | 51 |
| 7C | Quist Dairy | 130 | Cotton, Silage, Wheat | 12 |
| 8* | Quist Dairy | 238 | Cotton, Silage, Alfalfa, Wheat | 0 |
| | Total | 766 | Total | 700 |

*Field 8 currently does not have access to recycled water; however, the Operator anticipates that necessary improvements will be made to convey recycled water to the field by 2002.

Off-site effluent recycling currently occurs on 2,770 acres surrounding the WWTF property by growers under separate water reclamation requirements (WRRs), as summarized below:

| Field No. | WRRs Order No. | Reclaimer | Acreage | Types of Crops | AF used in 1999 |
|---|---|---|---|---|---|
| 2 | 94-370 | Al Coelho Jr. | 560 | Cotton, Wine Grapes, Alfalfa | 502 |
| 3 | 94-369 | Golden State Vintners | 1,560 | Wine Grapes | 1,528 |
| 6A | 94-372 | Joe Souza | 320 | Alfalfa, Silage, Wheat | 580 |
| 6C | 94-367 | Myrna Craviero (Dan Souza) | 130 | Alfalfa, Silage, Wheat | 299 |
| 7A | 94-371 | Quist Dairy (Alvin J. Quist) | 200 | Cotton, Alfalfa, Silage, Wheat | 135 |
| | | Total | 2,770 | Total | 3,044 |

As indicated above, about 3,700 af of effluent was directly recycled in 1999, an amount equivalent to less than five percent of current WWTF's annual discharge flow. Of the 72,000 af/yr discharged to the disposal ponds, about 63,400 af/yr (88 percent) percolates to groundwater and 8,600 af/yr (12 percent) is lost through evaporation (i.e., 62 in/yr evaporation from 1,660 acres of disposal ponds). Over the years,

the Operator's reliance on effluent disposal by percolation has created an extensive groundwater mound (approximately 10-feet high) that persists year-round, ranges in depth from 25 to 61 feet below ground surface (bgs), and extends well beyond the perimeter of the WWTF property. The mounded effluent appears to affect groundwater contours throughout the surrounding township.

The Operator owns and operates a network of 21 groundwater extraction wells on the WWTF property (hereafter reclamation wells). The reclamation wells extract from 150 to 200 feet below ground surface (bgs), operate about 10 months of the year, and discharge about 10 to 40 mgd (or about 15,300 af/yr) to the Houghton Canal and the Dry Creek Canal under an agreement with FID. Order No. 96-054 did not establish numerical or narrative effluent limits for the discharge from the groundwater extraction wells, require any monitoring of the flow or quality of the extracted groundwater, or impose any restrictions on the use of extracted groundwater.

The 1974 agreement between the Operator and FID currently stipulates, in part, that (a) the Operator must discharge into FID canals a minimum of 100,000 af of extracted groundwater during any ten year period; (b) the Operator may discharge a maximum of 30,000 af/yr of extracted groundwater to FID canals; (c) for every acre-foot of extracted groundwater the Operator discharges to FID canals, FID may deliver to the Operator 0.45 af of surface water up to a maximum of 7,600 af/yr. The Operator uses this surface water throughout the City of Fresno for aquifer recharge (i.e., by discharging to groundwater recharge basins situated within the metropolitan area). Most of the surface water delivered to Fresno's groundwater recharge basins is from the Friant Division of the Central Valley Project (CVP), operated by the U.S. Bureau of Reclamation (Bureau). The Operator and FID have signed contracts to purchase up to 135,000 af/yr of CVP surface water from the Bureau.

The Operator normally delivers between 15,000 and 20,000 af/yr to FID canals, an amount that is equivalent to 19 to 25 percent of the current annual discharge flow. Any increase in the discharge of extracted groundwater beyond that stipulated in the 1974 agreement is subject to FID approval.

The Discharger submitted a technical report, *Fresno-Clovis Regional Wastewater Reclamation Facilities Master Plan Summary Report* (Master Plan), dated November 1996, pursuant, in part, to C&D Order No. 96-055. The Master Plan describes a planning structure to maximize effluent reuse through land-based alternatives, primarily effluent reuse for agriculture. It documents options for off-site effluent reuse/disposal to meet the Discharger's disposal needs through 2020. The Master Plan presents financial impact analyses and multi-year implementation schedules for each option. These options include
(a) adding about 270 acres of on-site disposal ponds; (b) increasing the amount of groundwater extracted and discharged to FID's canals to 28,000 to 33,000 af/yr, which is about equal to the capacity of the existing on-site extraction wells; and (c) reclaiming effluent on lands outside of FID's service area through the development of a partnership among the Operator, FID, Raisin City Water District, Mid-Valley Water District, James Irrigation District, and Tranquillity Irrigation District. According to the Master Plan, negotiations for the reuse project will take up to 18 months to finalize and construction of the reuse project's infrastructure (e.g., pipelines) will take up to 36 months to complete. The Master Plan further indicates that FID may seek mitigation for delivery of effluent outside of the FID service area. The Discharger has increased its on-site disposal pond acreage, but has yet to implement the Master Plan's effluent reuse options.

Calpine Corporation (hereafter Calpine) is planning to construct a new gas-fired turbine in Fresno County (Central Valley Energy Center, hereafter referred to as CVEC). Calpine proposes to pump approximately 7,000 af/yr from the Operator's reclamation wells to provide cooling tower and industrial process water for the CVEC. Once extracted, the recycled water will be dosed with sodium hypochlorite prior to introduction into a 20.5 mile, 30-inch diameter pipeline, which will terminate into two 1.5 million gallon storage tanks at the CVEC site.

The California Department of Health Services (DHS) commented on the tentative WDRs circulated for public comment on 10 April 2001. Among the concerns expressed by DHS was that the Discharger has discharged and will continue to discharge a significant amount of wastewater to groundwater with minimal treatment and inadequate monitoring.

On 23 April 2001, DHS released for public review the first draft of regulations governing projects designed to use recycled water for the purpose of recharging by infiltration or injection of recycled water in a groundwater basin designated in a Water Quality Control Plan, as defined in CWC section 13050(j), for use as a source of domestic water supply. The draft regulations do not specify the hydraulic loading rate that constitutes groundwater recharge. The draft regulations proposed higher levels of treatment (e.g., nutrient removal, filtration) than is typically provided for domestic wastewater disposed of through percolation. The draft regulations also propose to control total nitrogen, regulated contaminants (i.e., those for which Title 22 establishes maximum contaminant levels) and physical characteristics and control of nonregulated contaminants such as total organic carbon (TOC). The draft regulations propose that recycled water rechargers monitor mounded groundwater for TOC, total nitrogen, and pharmaceuticals (e.g., endocrine disrupting chemicals).

In its 10 April 2001 letter, DHS recommends that the Discharger expedite efforts to expand its recycling efforts and curtail discharge to groundwater. In its regulation of this ongoing discharge, DHS recommends that the Board require the Discharger to (a) assess the current status of all private and domestic wells that exist within the 25-square-mile area described in Finding No. 9; (b) monitor domestic supply wells within this area for contaminants to assure they are producing safe water for domestic use and are not adversely impacted by the wastewater the Discharger has discharged to area groundwater; and (c) conduct a comprehensive study to assess the fate and effects of the past and current discharge on the groundwater basin. DHS further recommends that the Board require the Discharger to (a) identify the types of crops grown in the area served by FID canals that receive groundwater extracted by the Operator’s reclamation wells and (b) provide information on the dilution of the extracted groundwater with fresh water prior to irrigation application. If the crop identification reveals that food crops are grown in the subject area, DHS recommends that the Board require the Discharger to
undertake a timely evaluation of the degree of soil treatment provided by the current recharge and extraction operation and a determination of the level of filtration and virus removal treatment provided. DHS also recommends the Board require the Discharger to provide continuous turbidity monitoring of representative reclamation wells for at least one year.

**Stillage Guidelines**

Stillage is the waste material produced by the distillation of wine, pomace, or raisins for fortifying spirits and is the least readily disposal of all winery wastes. In the mid-1940s, the Wine Institute funded a study by Coast Laboratories on wine stillage composition. The study's 1946 report, *The Disposal of Winery Waste*, characterized conventional stillage as follows: (a) total solids content average 1.6 percent, about one-third of which is suspended solids, largely yeast; (b) pH range from 3.4 to 4.2; and (c) $BOD_5$ content average 12,500 mg/L.

In 1979, the Wine Institute funded Metcalf & Eddy engineers to survey existing practices of 16 seasonally discharging stillage disposal operations. The study's 1980 report, *Land Application of Stillage Waste: Odor Control and Environmental Effects* (hereafter the Wine Institute Study), summarized the results of this study and recommended guidelines for stillage disposal operations to minimize water quality effects and nuisance conditions.

Board Resolution No. 83-105 amended the Basin Plan to prescribe guidelines for the land disposal of stillage wastes from wineries. The guidelines reflect the recommendations of the Wine Institute Study and prescribe minimum operational procedures for two types of stillage disposal (i.e., rapid infiltration and slow infiltration). The maximum application rates and minimum drying times prescribed by the Stillage Guidelines for rapid infiltration are outlined in the following table:

| Period of Year | Depth of Stillage Application (inches) | Drying Time (days) | Minimum Land Requirement (acres per 100,000 gpd of stillage waste) |
|---|---|---|---|
| 1 Aug to 30 Sep | 3.7 | 6 | 7 |
| 1 Oct to 30 Nov | 3 | 9 | 12.3 |
| 1 Dec to 1 May | 2.5 | 13 | 20.6 |

The values below represent the organic load to land allowed by the Stillage Guidelines for rapid disposal systems. The values assume an average stillage $BOD_5$ concentration of 12,500 mg/L and reflect two different application time periods. The first is the organic load on the actual day of application, while the second is the organic load averaged over the entire application cycle (i.e., including drying days).

| Period of Year | Application gallons/acre | On day of application lbs/acre/day | $BOD_5$ Loading Averaged over entire application cycle lbs/acre/day |
|---|---|---|---|
| 1 Aug – 30 Sep | 100,000 | 10,500 | 1,500 |
| 1 Oct – 30 Nov | 81,000 | 8,500 | 850 |
| 1 Dec – 1 May | 68,000 | 7,000 | 500 |

Excessive application of stillage waste to land can overload the shallow soil profile, cause anaerobic soil conditions, retard the degradation, stabilization, transformation, and immobilization of waste

constituents, and create objectionable odors that lead to public nuisance. Degradation of organic matter within the soil profile increases the concentration of alkalinity in soil pore water. Anaerobic soil conditions can lead to the dissolution of soil minerals such as calcium and magnesium. Hydraulic overloading flushes waste constituents, the by-products of organic degradation, and dissolved minerals into the soil profile where they will continue to leach into and unreasonably degrade groundwater.

In applying food-processing wastewater to land for biological treatment, loadings of total suspended solids (TSS) typically range from 70 to 200 lbs/acre/day and loadings of $BOD_5$ should not exceed 100 lbs/acre/day to prevent the creation of nuisances, according to EPA's *Pollution Abatement in the Fruit and Vegetable Industry* (Publication No. 625/3-77-0007) (hereafter *Pollution Abatement*). In well-operated land treatment systems, wastewater application is typically followed by several days of rest, according to *Pollution Abatement*. This management practice maintains aerobic conditions in the soil profile. Slow-rate systems with $BOD_5$ loading rates that occasionally exceed 300 lbs/acre/day have successfully avoided odor problems by using adequate drying times between applications, according to *Natural Systems for Waste Management and Treatment*, by Sherwood C. Reed and others.

Organic loadings recommended by the Wine Institute Study and allowed by the Stillage Guidelines, while exceeding the loading rates recommended by *Pollution Abatement,* reflect longstanding disposal practices by stillage disposal operations that discharged on a seasonal basis (e.g., from August to November). The Wine Institute Study rationalized its recommended organic loadings by assuming that 80 percent of stillage $BOD_5$ is contained in suspended solids trapped on the surface leaving 20 percent in soluble compounds to infiltrate the soil profile. The resultant organic loading to the soil profile (as soluble $BOD_5$) calculated at 120 lb/acre/day over the course of the entire application cycle.

The Wine Institute Study also cites work by Jewell and Loehr[2, 3] to support organic loads in excess of that recommended by *Pollution Abatement*, especially for acclimated soils (i.e., those that had been receiving waste for a number of years). Jewell and Loehr monitored the oxygen uptake of bacteria in soils collected from a land application site that had received vegetable processing wastewater. The experiment utilized a Warburg respirator apparatus, which is typically used to determine the oxygen uptake of microbial cells in liquid samples (e.g., 20 to 40 ml). In extrapolating the results of laboratory oxygen uptake experiments to field conditions, Jewell and Loehr concluded that food-processing waste disposal sites with acclimated soils could consume oxygen at rates exceeding 600 lbs/acre/day. Additionally, Jewell and Loehr concluded that acclimated soils could accommodate organic loads (as chemical oxygen demand) of up to 16,000 lbs/acre/day without suffering prolonged oxygen depletion and nuisance from organic overloading. Key to the rapid degradation of organic wastes applied to land is adequate drying time. While Jewell and Loehr may have identified the oxygen transfer rate in small samples of acclimated soil, their application of these rates to field conditions was premature given the lack of field validation. Further, it appeared that Jewell and Loehr were unconcerned about what leached to groundwater since the waste application sites they examined demonstrated clear and unambiguous

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[2] Jewell, W. J. and R.C. Loehr (1975) Land Treatment of Food Processing Waste. Presented at the American Society of Agricultural Engineering. Winter Meeting. Chicago. Paper No. 75-2513.

[3] Jewell, W. J. et al. (1978) Limitations of Land Treatment of Wastes in the Vegetable Processing Industries. Cornell University.

evidence that groundwater had been degraded, not only for total dissolved solids but also for organics (as COD).

Stillage is very high in organic nitrogen content compared to other food-processing wastes. Organic nitrogen (as total Kjeldahl nitrogen, or TKN) is primarily retained in the upper two to three feet of the soil profile. Soil bacteria transform organic into inorganic nitrogen (i.e., ammonia, nitrites and nitrates). Nitrate and nitrite are highly soluble, not bound to the soil, and are readily leached through the vadose zone and into groundwater subsequent to the application of water to the soil.

The Wine Institute Study describes stillage disposal sites as having soil TKN concentrations in excess of 2,500 mg/kg, with concentrations decreasing substantially at depths below two feet and reducing further to background levels at depths of six feet. Groundwater data collected during the Wine Institute Study was minimal and inconclusive regarding nitrogen contamination from stillage disposal operations.

The Stillage Guidelines recommend that stillage application sites be planted with crops, *if necessary,* to assist in the removal of residual nitrogen concentrations from the soil during periods when it is not used for stillage disposal. At the time of the Wine Institute Study, stillage disposal operations were seasonal, whereas now wineries such as Canandaigua operate and discharge year-round. The Stillage Guidelines further recognize the need to impose more stringent disposal requirements as necessary to comply with water quality objectives. "If necessary" was intended to be predicated on monitoring the buildup of nitrogen in the soil, but has been largely ignored by the industry.

**Stillage Site**

The Operator owns and operates a 145-acre wine Stillage Site, which consists of a 95-acre portion (SS-1) in operation since 1974 and a 50-acre portion (SS-2) in service since 1998. SS-1 was regulated by Order No. 74-10 until 1996, when regulation of the stillage disposal operation was included in the WWTF's waste discharge requirements (Order No. 96-054). Currently, the Stillage Site receives stillage waste year round from only one winery, Canandaigua Wine Company, a New York corporation (hereafter Canandaigua).

Recent monitoring data (1996 through 1998) indicates that during the crush season (from August to November), the Operator discharges an average 0.21 mgd of stillage to the 145-acre disposal site (1.0 mgd daily maximum). During the rest of the year, the Operator discharges an average of 0.12 mgd (0.71 mgd daily maximum). The waste is discharged to land without any prior treatment. The Discharger reports that the stillage pipeline is in need of extensive maintenance repairs. The lease agreement between the Discharger and Canandaigua for its discharge of stillage to the Stillage Site expires in 2004. By fall 2003, Canandaigua plans to relocate its stillage operation to its Paul Masson winery in Madera County and cease discharge of stillage to the Stillage Site. The WWTF does not have the treatment capacity to accommodate Canandaigua's stillage discharge.

In 2000, the Stillage Site received about 79 million gallons of stillage. Peak daily flows occurred in mid-June and ranged from 1.1 to 1.27 mgd. The table below compares year 2000 total monthly stillage discharge flows to those recommended by the Stillage Guidelines and currently permitted for the original 95-acre SS-1:

| Month | Amount Discharged (mg) | Maximum Amount Allowed (mg)[1] |
|---|---|---|
| Jan | 6.732 | 14.26 |
| Feb | 6.504 | 12.88 |
| Mar | 5.874 | 14.26 |
| Apr | 3.668 | 13.8 |
| May | 6.14 | 42.16 |
| Jun | 16.91 | 40.8 |
| Jul | 1.113 | 42.16 |
| Aug | 6.771 | 42.16 |
| Sep | 9.857 | 40.8 |
| Oct | 7.665 | 23.87 |
| Nov | 7.534 | 23.1 |
| Dec | 0.64 | 23.87 |
| Total | 79.4 | 335 |

[1] Value assumes the discharge complies with all other relevant stillage discharge specifications (e.g., no standing stillage after 24 hours of application)

As indicated above, the Operator's stillage discharge in 2000, in terms of monthly discharge flow, is less than 25 percent of that permitted by the Stillage Guidelines for the original 95-acre SS-1 (assuming the discharge complied with all remaining discharge specifications). In 1998, the Operator reduced the waste loading to the original SS-1 by placing into service the new 50-acre stillage disposal area (SS-2).

The following table compares the water quality from MW-2 that is in the middle of SS-1 and MW-5 (5,400 feet from MW-2) that is in the vicinity of the WWTF disposal ponds. The data show that the Operator's long-term stillage disposal operation has degraded area groundwater as evidenced by elevated concentrations of TDS, alkalinity, calcium, magnesium, and manganese.

| Constituent | Units | MW-2 | MW-5 |
|---|---|---|---|
| Total Dissolved Solids | mg/L | 1,700 | 450 |
| Total Alkalinity (as $CaCO_3$) | mg/L | 1,600 | 260 |
| Calcium | mg/L | 300 | 46 |
| Magnesium | mg/L | 200 | 24 |
| Manganese | mg/L | 10 | 0.1 |

In February and March 1999, the Operator performed laboratory tests to determine the soluble and insoluble fractions of stillage $BOD_5$. Specifically, the Operator split six samples of stillage and analyzed one sample for total suspended solids and total $BOD_5$, centrifuged the other sample at 2000

revolutions per minute for 15 minutes, and analyzed the resulting liquid for suspended solids and $BOD_5$. The results indicate that almost 90 percent of stillage $BOD_5$ is in soluble form. These results imply that the actual organic loading from the land application of stillage may be appreciably higher than previously thought.

As described previously, the Wine Institute Study assumed that most $BOD_5$ would be retained in surface organic solids and that biological degradation processes would mineralize the majority of the nitrogen, which would be then be biologically converted to nitrogen gas. In reality, most $BOD_5$ in stillage applied to the Stillage Site is soluble and only a small fraction is in the retained organic solids. In July 1992, the Operator tested Stillage Site soils for TKN analysis. The samples were taken at the surface, one foot, and two feet below the surface at six sites. When groundwater monitoring well 2 (MW-2) was drilled in SS-1, the Operator collected soil samples at 5, 10, 15, 20, 25, 30, 35, 40, and 45 feet bgs, and analyzed them for TKN. The Operator found that the majority of TKN occurs within the upper two feet of SS-1 soils, as indicated below:

| Depth, ft | 0.5 | 1 | 2 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TKN, mg/kg | 5,225 | 2,468 | 460 | 114 | 213 | 161 | 101 | 89 | 88 | 55 | 72 | 65 |

The average TKN from 5 to 45 feet is 106 mg/kg. There was no measurable nitrate or nitrite in the soil samples. These findings correspond with the data in the 1980 Wine Institute Study. In the 1992 study, the average TKN concentration was 2,700 mg/kg in the upper two feet of soil in SS-1. Assuming a minimum soil weight of 90 $lbs/ft^3$, there are 21,300 lbs-TKN/acre in the upper two feet in SS-1. The Discharger applied 104,000 lbs TKN to the site in 1998 and 245,000 lbs TKN in 1999. In 1992, based upon the 1998 and 1999 rates of application, there were 9 to 20 years of nitrogen accumulation in the top two feet of soil. Since stillage has been discharged to the site since 1974, the data indicates minimal biodegradation of the applied TKN.

In Finding No. 13 of Order No. 96-054, the Board found that no crops had been grown in the disposal area to aid in nitrogen control. Provision G.7 of Order No. 96-054 required the Operator to "submit a written technical report and schedule on measures to be implemented to provide for nutrient uptake in the stillage disposal area or justify why it should not be necessary." In its report, *Schedule of Measures to be Implemented to Provide for Nutrient Uptake in the Stillage Disposal Area* (April 1998), the Discharger investigated the use of Sudan grass for nitrogen uptake from Stillage Site soils. While this report recommended that the Operator plant and harvest crops to reduce the large accumulation of nitrogen in Stillage Site soil, the Operator has not yet initiated systematic cropping and harvesting. The SS-2 area was added in 1998 but has not been planted crops to remove nitrogen. In the report, *Technical Memorandum No. 1, Update of Groundwater Quality Conditions* (April 1999), groundwater monitoring from MW-2 showed high concentrations of EC and TDS.

**Groundwater Monitoring and Evaluation**

Area soils are coarse, well sorted sands with good permeability (i.e., from 0.7 to 1.0 in/hr). Groundwater underlying the WWTF occurs in an unconfined aquifer at depths ranging from 31 to 60 below ground surface (bgs). Regional groundwater generally moves southwesterly, according to FID groundwater elevation contour maps.

The Operator has one background monitoring well upgradient of the WWTF site, but no downgradient wells off-site. Several of the on-site monitoring wells are adjacent to localized areas of groundwater degradation (hereafter hot spots) such as existing or historic confined animal facilities with plumes that mask the impacts of the discharge on area groundwater. Consequently, the impacts of the discharge upon the chemical characteristics of the regional aquifer are not well defined.

Since 1990, the Operator has been investigating potential impacts on groundwater quality associated with current and past discharges from the WWTF as well as discharges to the 145-acre Stillage Site. It has documented these investigations in the following reports:

- *Wastewater Treatment Facility, Phase I Investigation, Groundwater Impacts from Effluent Disposal*, June 1991;

- *Wastewater Treatment Facility, Phase II Investigation, Groundwater Impacts from Effluent Disposal*, February 1993;

- *Master Plan Report, Task 700, Technical Memorandum No. 3, Evaluation of Reclamation Operations and Recommended Groundwater Monitoring Program*, August 1996;

- *Update of Groundwater Quality Conditions, Vicinity of Fresno/Clovis Regional Wastewater Reclamation Facility*, July 1998; and

- *Technical Memorandum No. 1, Update of Groundwater Quality Condition*, April 1999.

The reports contain the following findings. The groundwater mound created by percolating WWTF effluent persists year-round and is less than 20 feet below the bottom of the percolation/disposal ponds. The Operator's extraction wells pull from the deep zone aquifer (approximately 200 feet) rather than the shallow zone that is associated with the percolation/disposal ponds (approximately 50 feet). This is reportedly due to low yields associated with pumping from the shallow zone. Groundwater extracted and discharged to FID canals recovers less than 36 percent of the percolated water. Percolated effluent has contributed to increases in constituents such as EC, TDS, sodium, chloride, manganese, and phosphorus and decreases in nitrate concentrations. Impaired groundwater quality is associated with localized on-site plant operations such as the Stillage Site and former dairy sites. Groundwater beneath the former sludge disposal area in the northeastern portion of the WWTF is characterized by high nitrate and EC concentrations. The off-site extent and impact of recharged effluent downgradient of the WWTF is unknown, although the resultant groundwater quality beyond the WWTF boundary is believed to be adequate for agricultural use.

The reports made the following recommendations. Groundwater extraction needs to be increased to provide increased groundwater/pond bottom separation and to control off-site migration of treated effluent and groundwater affected by on-site chemical sources. The groundwater monitoring network and program should be revised to provide for depth-specific monitoring on-site and off-site and to evaluate future wastewater management actions on water quality beneath and downgradient of the plant.

Chloride, a conservative ion, is known to pass through soil untransformed and relatively uninhibited by the sorption process and thereby is a reliable marker ion for comparing two liquid streams. Staff compiled data from self-monitoring reports for effluent chloride concentrations for the period of January 1997 through June 2000. The Discharger presented staff with mineral analyses collected from extraction wells for the period of January 1989 through June 1999. Staff calculated the mean, variance, and number of samples for each set of data. Staff used the standard normal deviate, z, to compare the mean chloride concentration in the effluent with the mean chloride concentration for the extraction wells. Based upon a calculated z = 1.42, staff concluded that the mean concentration of 74.5 (n=38) mg/L from the reclamation wells was not statistically significantly different from the mean concentration of 77.8 mg/L (n=210) in the effluent.

$$z = \frac{\overline{X_A} - \overline{X_B}}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}}$$

The Discharger has designated monitoring well 10A as the shallow zone and monitoring well 10B as the deep zone background water quality. The mean chloride concentration (16.1 mg/L) in the shallow zone was significantly greater (5.19 mg/L) than in the deep zone (z=21.6). The chloride concentration in the effluent and the composite chloride concentration in the extraction wells were significantly greater than in both MW-10A (z=27.6) and MW-10B (z=25.3).

Nitrate was measured in the effluent of reclamation well RW-15 from May 1993 through September 1996. A plot of the data showed an exponential decrease in the nitrate from 9.2 mg/L in May 1993 to a baseline value of 0.6 mg/L in May 1996. An analysis of RW-12 data presented similar results. Reclamation wells located in proximity to identified hot spots have significantly higher nitrogen concentrations than those with lower nitrogen application rates.

At the proposed discharge flow of 80 mgd (89,600 af/yr) and continued direct reuse of 4,000 af/yr, about 85,600 af/yr will be discharged to the 1,660 acres of disposal ponds, of which 8,600 af/yr (10 percent) will evaporate and 77,000 af/yr (90 percent) will percolate to groundwater. The concentration affect of evaporative losses will cause an 11 percent increase in concentrations of waste constituents in effluent percolating to groundwater. This is illustrated in the mass balance calculation below.

(85,600 af/yr) (100 mg/L) = (8,600 af/yr) (0 mg/L) + (77,000 af/yr) (X mg/L)

X = 111 mg/L, or 11 percent greater that the concentration discharged to the disposal ponds.

The table below shows the concentrations of salinity constituents in WWTF effluent, effluent percolating to groundwater, and in four monitoring wells situated in an area removed from dairies or other concentrated sources of waste discharges.

| | | | | Shallow groundwater | | Deeper groundwater | |
|---|---|---|---|---|---|---|---|
| Constituent | Units | Effluent to ponds[1] | Effluent to groundwater[2] | MW 13A[3] | MW 14A[3] | MW 13B[3] | MW 14B[3] |
| Chloride | mg/L | 72 | 80 | 70 | 78 | 70 | 82 |
| EC | µmhos/cm | 780 | 866 | 901 | 781 | 1,170 | 902 |
| Sodium | mg/L | 81 | 90 | 78 | 83 | 81 | 92 |
| TDS | mg/L | 440 | 488 | 566 | 460 | 742 | 575 |

[1] Average values based on 2000 monitoring data
[2] Estimated at 11% greater than concentration in effluent discharged to disposal ponds
[3] Average values based on quarterly monitoring data from April 2000 through May 2001

As indicated above, the concentrations of salinity constituents in groundwater comprised predominately of percolating effluent are comparable to that of WWTF effluent as it is concentrated due to the effect of evaporation.

Water quality data from October 2000 for groundwater extracted from three recently-installed Flowpath™ reclamation wells, which extract groundwater from depths of 80 to 240 feet bgs, indicate the following average concentrations in mg/L: chloride (79), dissolved iron (0.19), dissolved manganese (1.24), total nitrogen (< 2), sodium (76), TDS (490), and total organic carbon (5). With few exceptions (i.e., MW-14A, MW-14B, and MW-15A), manganese concentrations in groundwater extracted from the WWTF's
monitoring wells are typically less than the detection limit of 0.02 mg/L. In contrast, the average manganese concentration of 1.24 mg/L in groundwater extracted from the Flowpath™ wells is almost 25 times the drinking water standard of 0.05 mg/L.

A reasonable explanation for the low concentrations of nitrate and high concentrations of manganese and total organic carbon in groundwater extracted from reclamation wells is the microbial degradation of organic carbon in percolating effluent. Biological wastewater treatment is the process of dissimilation and assimilation whereby organic compounds are broken down (dissimilation) or incorporated into cell mass (assimilation). The biochemical oxidation of organic carbon compounds to carbon dioxide and water and the conversion of nitrogen to nitrate provide cells energy. These processes occur in an aqueous solution giving the byproducts of carbonic acid and nitric acid.

If effluent percolating to groundwater contains more organic carbon than can be oxidized by the residual oxygen in the effluent, the soil and groundwater beneath the ponds may be an anoxic or oxygen deficient environment. In an aqueous environment under anoxic conditions, nitrate and oxidized forms of manganese and iron substitute for oxygen as a terminal electron acceptor whereby nitrate is reduced to nitrogen and manganese and iron are transformed to reduced forms. The reduced forms of manganese

and iron have a higher solubility product, $K_{sp}$, and therefore become more soluble in water. This reduced form dissolves in water and migrates.

## Basin Plan

The *Water Quality Control Plan for the Tulare Lake Basin, Second Edition* (hereinafter Basin Plan) designates beneficial uses and contains water quality objectives for all waters of the Basin. Beneficial uses often determine the water quality objectives that apply to a water body. For example, waters designated as municipal and domestic supply must meet the maximum contaminant levels (MCLs) for drinking waters. The Basin Plan sets forth the applicable beneficial uses (industrial, agricultural, and domestic supply in this instance), procedure for application of water quality objectives, and the process for and factors to consider in allocating waste assimilation capacity. The Basin Plan incorporates plans and policies of the State Water Resources Control Board by reference.

The Houghton and Dry Creek Canals are Valley Floor Waters, according to the Basin Plan. The beneficial uses of Valley Floor Waters are identified in the Basin Plan as agricultural supply, aesthetics, and groundwater recharge. The beneficial uses of underlying ground water are domestic, industrial, and agricultural supply. Dry Creek Canal originates in the City of Fresno within the Tulare Lake Basin and flows seasonally downstream of the WWTF. Houghton Canal flows seasonally downstream of the WWTF and originates within the Tulare Lake Basin at a junction with Dry Creek Canal in the City of Fresno. For irrigation purposes, they carry surface waters from the Kings River and Friant Kern Canal, both waters of the United States. They also carry urban storm runoff and surface waters from upgradient ephemeral streams. Downstream of the WWTF, the known beneficial uses are agricultural supply, aesthetics, and groundwater recharge.

The Basin Plan indicates that degradation of groundwater in the Tulare Lake Basin by salts is unavoidable without a plan for removing the salts from the Basin. In the absence of a valley wide drain to carry salts out of the valley, the Basin Plan indicates that the only other solution is to manage the rate of degradation by minimizing the salt loads to groundwater. The Board implements this policy, in part, by prescribing effluent salinity limits in waste discharge requirements for all discharges to land in the Basin. The Basin Plan's discharge salinity limit consists of narrative and numerical limits:

> The incremental increase in salts from use and treatment must be controlled to the extent possible. The maximum EC shall not exceed the EC of the source water plus 500 µmhos/cm. When the source water is from more than one source, the EC shall be a weighted average of all sources.

The Basin Plan encourages reclamation and does not consider disposal by evaporation/percolation or discharge to surface waters a permanent disposal solution when the potential exists for reclamation. Further, the Basin Plan requires that project reports for new or expanded wastewater facilities shall include plans for wastewater reclamation or the reasons why this is not possible.

## Antidegradation

The antidegradation directives of section 13000 of the California Water Code require that waters of the State that are better in quality than established water quality objectives be maintained "consistent with

the maximum benefit to the people of the State." Waters can be of high quality for some constituents or beneficial uses and not others. Policies and procedures for complying with this directive are set forth in the Basin Plan (including by reference State Water Board Resolution No. 68-16, "Statement of Policy With Respect to Maintaining High Quality Waters in California," or "Antidegradation" Policy).

Resolution 68-16 is applied on a case-by-case, constituent-by-constituent basis in determining whether a certain degree of degradation can be justified. It is incumbent upon the Discharger to provide technical information for the Board to evaluate that fully characterizes:

- all waste constituents to be discharged, the background quality of the uppermost layer of the uppermost aquifer
- the background quality of other waters that may be affected
- the underlying hydrogeologic conditions
- waste treatment and control measures
- how treatment and control measures are justified as best practicable treatment and control
- the extent the discharge will impact the quality of each aquifer
- the expected degradation compared to water quality objectives

In allowing a discharge, the Board must comply with CWC section 13263 in setting appropriate conditions. The Board is required, relative to the groundwater that may be affected by the discharge, to implement the Basin Plan and consider the beneficial uses to be protected along with the water quality objectives essential for that purpose. The Board need not authorize the full utilization of the waste assimilation capacity of the groundwater (CWC 13263(b)) and must consider other waste discharges and factors that affect that capacity. The applicable beneficial uses (industrial, agricultural, and domestic supply in this instance), procedure for application of water quality objectives, and the process for and factors to consider in allocating waste assimilation capacity are set forth in the Basin Plan.

This discharge has been occurring for years. Previous conditions of discharge have specified that, except for EC, the discharge, in combination with other sources, shall not cause underlying groundwater to contain waste constituents in concentrations statistically greater than background quality. In the case of EC, the previous Order stipulated that the combined effect of the discharges shall not cause an incremental increase greater than 20 µmhos/cm in EC over the most recent five-year period. Certain waste constituents in municipal wastewater are not fully amenable to waste treatment and control and it is reasonable to expect some impact on groundwater. Some degradation for certain constituents is consistent with maximum benefit to the people of California because the technology, energy, water recycling, and waste management advantages of municipal utility service to the State far outweigh the environmental impact damage of a community that would otherwise be reliant on numerous concentrated individual wastewater systems. Economic prosperity of the Cities of Fresno and Clovis is of maximum benefit to the people of California, and therefore sufficient reason to accommodate increases in wastewater discharge provided terms of reasonable degradation are defined and met. The proposed Order authorizes some degradation consistent with the maximum benefit to the people of the State.

Groundwater monitoring data at this site is insufficient to establish the most appropriate receiving water limits. In addition, as explained elsewhere in this information sheet, certain aspects of waste treatment and control practices have not been and are unlikely to be justified as representative of BPTC. Reasonable time is necessary to gather specific information about the facility and the site to make informed, appropriate, long-term decisions. This proposed Order, therefore, establishes receiving water limitations to assure protection of the beneficial uses of waters of the State pending the completion of certain tasks and provides time schedules to complete specified tasks. The tasks provide that the Discharger is expected to identify, implement, and adhere to best practicable treatment and control as individual practices are reviewed and upgraded in this process. During this period, degradation may occur from certain constituents, but by interim conditions can never exceed water quality objectives (or background water quality should it exceed objectives) or cause nuisance.

Water quality objectives define the least stringent limits that could apply as water quality limitations for groundwater at this location, except where background quality unaffected by the discharge already exceeds the objective. The values below reflect water quality objectives that must be met to maintain specific beneficial uses of groundwater. Unless natural background for a constituent proves higher, the groundwater quality limit established in proposed Order is the most stringent of the values listed for the listed constituents.

| Constituent | Units | Value | Beneficial Use | Criteria or Justification |
|---|---|---|---|---|
| Ammonia | mg/L | 0.5 | MUN[1] | Taste and Odor[2] |
| Boron | mg/L | 0.7 | AGR[3] | Boron senstivity[4] |
| Chloride | mg/L | 106 | AGR[3] | Chloride sensitivity on certain crops irrigated via sprinklers[4] |
| | | 142 | AGR[3] | Chloride sensitivity on certain crops[4] |
| | | 250 | MUN[1] | Recommended Secondary MCL[5] |
| | | 500 | MUN[1] | Upper Secondary MCL[5] |
| Conductivity (EC) | µmhos/cm | 750 | AGR[3] | Salt sensitivity[4] |
| | | 900 | MUN[1] | Recommended Secondary MCL[5] |
| | | 1,600 | MUN[1] | Upper Secondary MCL[5] |
| Iron | mg/L | 0.3 | MUN[1] | Secondary MCL[6] |
| Manganese | mg/L | 0.05 | MUN[1] | Secondary MCL[6] |
| Nitrate as N | mg/L | 10 | MUN[1] | Primary MCL[7] |
| Nitrite as N | mg/L | 1 | MUN[1] | Primary MCL[7] |
| pH | pH Units | 6.5 to 8.5 | MUN | Secondary MCL[8] |
| Sodium | mg/L | 69 | AGR[3] | Sodium sensitivity on certain crops[4] |
| Total Coliform Organisms | MPN/100 mL | 2.2 | MUN[1] | Basin Plan |
| Total Dissolved Solids | mg/L | 450 | AGR[3] | Salt sensitivity[4] |

| Constituent | Units | Value | Beneficial Use | Criteria or Justification |
|---|---|---|---|---|
| | | 500 | MUN[1] | Recommended Secondary MCL[5] |
| | | 1,000 | MUN[1] | Recommended Upper MCL[5] |
| Total Trihalomethanes | µg/L | 100 | MUN[1] | MCL[9] |
| Chloroform | µg/L | 1.1 | MUN[1] | Narrative Toxicity Criteria[10] |
| Bromodichloromethane | µg/L | 0.27 | MUN[1] | Narrative Toxicity Criteria[10] |
| Dibromochloromethane | µg/L | 0.37 | MUN[1] | Narrative Toxicity Criteria[10] |
| Bromoform | µg/L | 4.3 | MUN[1] | Narrative Toxicity Criteria[10] |

See footnotes next page

[1] Municipal and domestic supply
[2] Council of the European Union, On the Quality of Water Intended for Human Consumption, Council Directive 98/83/EC (3 November 1998).
[3] Agricultural supply
[4] Ayers, R. S. and D. W. Westcot, Water Quality for Agriculture, Food and Agriculture Organization of the United Nations – Irrigation and Drainage Paper No. 29, Rev. 1, Rome (1985)
[5] Title 22, California Code of Regulations (CCR), section 64449, Table 64449-B
[6] Title 22, CCR, section 64449, Table 64449-A
[7] Title 22, CCR, section 64431, Table 64431-A
[8] United States Environmental Protection Agency
[9] Title 22, CCR, section 64439
[10] California Environmental Protection Agency, Office of Environmental Health Hazard Assessment Cancer Potency Factor as a Drinking Water Level, *California Environmental Protection Agency Toxicity Criteria Database*

Municipal wastewater contains numerous dissolved inorganic waste constituents (i.e., salts, minerals) that together comprise total dissolved solids (TDS). Each component constituent is not individually critical to any beneficial use. Constituents that are critical are individually listed. The cumulative impact from these other constituents, along with the cumulative affect of the constituents that are individually listed can be effectively controlled using TDS as a generic indicator parameter. Most dissolved inorganic substances in water are in the ionized form and so contribute to a solution's ability to carry an electrical current, or its "electrical conductivity" (EC). EC varies both with the number and type of ions the solution contains and is strongly temperature dependent. It is standard practice to report a solution's EC at 25° Celsius (this value is technically called "specific conductance"). Only ions can carry a current, however. Un-ionized species of weak acids or bases will not carry a current, nor will uncharged soluble organic materials, such as ethyl alcohol and glucose, even though these constituents comprise a portion of TDS. Although EC is affected by the nature of the various ions, their relative concentrations, and ionic strength of the water, EC measurements can give a practical estimate of the variations in a solution's dissolved mineral content. An empirical factor may be developed from simultaneous measurements of TDS and EC that allows for the rapid estimation of TDS from EC measurements.

**Treatment Technology and Control**

Given the character of municipal wastewater, secondary treatment technology is generally sufficient to control degradation of groundwater from decomposable organic constituents. Adding disinfection significantly reduces populations of pathogenic organisms, and reasonable soil infiltration rates and unsaturated soils can reduce them further. Total coliform, the indicator parameter for pathogenic organisms, should not be found in groundwater beneath a well-designed, well-operated facility. The Discharger indicates, however, that groundwater extracted from municipal wells occasionally contains detectable concentrations of coliform organisms.

Municipal wastewater typically contains nitrogen in concentrations greater than water quality objectives, which vary according to the form of nitrogen. Degradation by nitrogen can be controlled by an appropriate secondary treatment system (e.g., oxidation ditch), tertiary treatment for nitrogen reduction, and agronomic reuse on harvested crops. The effectiveness varies, but generally best practicable treatment and control should be able to control nitrogen degradation at a concentration well below the water quality objectives.

Waste constituents that are forms of salinity pass through the treatment process and soil profile and effective control of long-term affects relies upon effective source control and pretreatment measures. In the best of circumstances, long-term land discharge of treated municipal wastewater will degrade groundwater with salt (as measured by TDS and EC) and the individual components of salts (e.g., sodium, chloride). Not all TDS constituents pass through the treatment process and soil profile in the same manner or rate. Chloride tends to pass through both rapidly to groundwater. As chloride concentrations in most groundwaters in the region are much lower than in treated municipal wastewater, chloride is a useful indicator parameter for evaluating the extent to which effluent reaches groundwater.

Other indicator constituents for monitoring for groundwater degradation due to recharged effluent include total coliform bacteria, ammonia, total nitrogen, and total trihalomethanes (when the effluent is chlorinated). Chlorine disinfection of effluent causes formation of trihalomethanes, which are priority pollutants. Treatment to reduce these in wastewater generally has not been performed, and little is known at this point on the typical impact on groundwater. Total trihalomethanes (TTHMs) are chlorinated organic materials that are toxic at low concentrations. Common TTHMs include bromoform, bromodichloromethane, dibromochloromethane, and chloroform. While the State drinking water regulations (i.e., Title 22, CCR, section 64439) establish a maximum contaminant level for TTHMs of 100 µg/L, the actual concentrations at which THMs components are considered "toxic" to humans are much lower (e.g., chloroform's human health toxicity limit is 1.1 µg/L). The Basin Plan states that groundwaters "shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life associated with designated beneficial uses."

Boron is another TDS constituent that may occur in wastewater in concentrations greater than groundwater depending on the source water, to the extent residents use cleaning products containing boron, and whether any industrial dischargers utilize boron (e.g., glass production, cosmetics). Still other constituents in treated municipal waste that may pass through the treatment process and the soil

profile include recalcitrant organic compounds (e.g., ethylene glycol, or antifreeze), radionuclides, and pharmaceuticals. Hazardous compounds are not usually associated with domestic wastes and when present are reduced in the discharge to inconsequential concentrations through dilution with domestic waste, treatment, and the implementation of effective pretreatment programs.

A discharge of wastewater that overloads soils with nutrients and organics can result in anaerobic conditions in the soil profile, which in turn creates organic acids and decreases soil pH. Under conditions of low soil pH (i.e., below 5), iron and manganese compounds in the soil can solubilize and leach into groundwater. Discharge of residual sludge to land may also lead to increases in groundwater alkalinity and hardness to concentrations that impair the water's beneficial uses and contribute to an overall increase in TDS. Overloading soils with nutrients and organics is preventable and does not constitute BPTC as used in Resolution 68-16. Elevated concentrations in groundwater compared to percolating effluent of dissolved iron, dissolved manganese, alkalinity, and hardness are useful indicators to determine whether components of the WWTF with high-strength waste constituents, such as sludge handling facilities, are ineffective in containing waste.

**Title 27**

Title 27, CCR, section 20380 et seq. ("Title 27"), contains regulations to address certain discharges to land. Title 27 establishes a waste classification system, specifies siting and construction standards for full containment of classified waste, requires extensive monitoring of groundwater and the unsaturated zone for any indication of failure of containment, and specifies closure and post-closure maintenance requirements. Generally, no degradation of groundwater quality by any waste constituent is acceptable.

Discharges of domestic sewage and treated effluent can be treated and controlled to a degree that will not result in unreasonable degradation of groundwater. For this reason, they have been conditionally exempted from Title 27, except for residual sludge and solid waste generated as part of the treatment process [section 20090(a) of Title 27]. The condition requires that the discharge not result in violation of any water quality objective in groundwater.

Treatment and storage facilities for sludge that are part of the WWTF are considered exempt from Title 27 under section 20090(a), under the condition that the facilities not result in a violation of any water quality objective. However, residual sludge (for the purposes of the proposed order, sludge that will not be subjected to further treatment by the WWTF) is not exempt from Title 27. Solid waste (e.g., grit and screenings) that results from treatment of domestic sewage and industrial waste also is not exempt from Title 27. This residual sludge and solid waste are subject to the provisions of Title 27.

Accordingly, the municipal discharge of effluent and the operation of treatment or storage facilities associated with a municipal wastewater treatment plant can be allowed without requiring compliance with Title 27, but only if resulting degradation of groundwater is in accordance with the Basin Plan. This means, among other things, degradation of groundwater must be consistent with Resolution 68-16 and in no case greater than water quality objectives.

## PROPOSED ORDER TERMS AND CONDITIONS

### Discharge Specifications

As in other WDRs orders for municipal discharges recently adopted by the Board, the proposed Order implements a two-phased approach to setting final groundwater limitations. While the Board has determined that some degradation is in the public interest, it cannot yet determine how much due to incomplete data and evaluation of treatment and control measures. In Phase 1 of this 'implementation approach,' WDRs orders establish receiving water limitations that assure protection of the beneficial uses of groundwater pending the completion of certain tasks in accordance with a time schedule. In Phase 2, determination of site-specific groundwater limitations to be adopted in WDRs will depend upon the Board's evaluation of the results of the tasks. The numerical implementation of many Basin Plan narrative water quality objectives in Phase 1, in accord with the procedures prescribed in the Basin Plan, represents the threshold above which there will be adverse impacts on beneficial uses of groundwater (e.g., drinking water MCLs). Since the proposed Order implements existing water quality objectives, the Board is not required to undertake further consideration of the factors in Water Code section 13241, including economic considerations.

The discharge specifications prescribed in this Order for $BOD_5$, TSS, and EC, are based on the Basin Plan. The proposed Order carries over the effluent limitations for $BOD_5$, TSS, settleable solids, and EC from the previous Order. The Basin Plan requires municipal facilities discharging in excess of 1 mgd to provide removal of 80 percent or reduction to 40 mg/L, whichever is more restrictive, of both 5-day BOD and suspended solids. While the current Order prescribes a monthly average daily discharge limit of 40 mg/L for BOD and for TSS, it does not require 80 percent removal. The proposed Order's WWTF Discharge Specification B.3 implements the Basin Plan's 80 percent removal requirement. From January 2000 to September 2001, monthly average influent and effluent BOD and suspended solids concentrations indicate that percent removals range from 47 to 94 and average 86 for BOD and range from 64 to 97 and average 90 for suspended solids. The Discharger currently relies on groundwater recharge for effluent disposal. In 2000, the discharge's monthly average chloride concentration ranged from 59 to 87 mg/L, averaged 70 mg/L, and had a 95% confidence level of 82 mg/L. The Basin Plan establishes a maximum effluent chloride limit of 175 mg/L for discharges to areas that may recharge to good quality groundwater. The previous Order prescribed monthly average and daily maximum chloride discharge limitations of 175 and 205 mg/L, respectively. As discussed later, the proposed Order prescribes a groundwater chloride limitation of 106 mg/L to protect the existing and future beneficial uses of area groundwater. Rather than carrying over the previous Order's discharge chloride limitations, which, if approached, would result in exceedances of the proposed Order's groundwater chloride limitation, the proposed Order does not prescribe a discharge chloride limitation. The proposed Order requires the Discharger to conduct a study that establishes appropriate groundwater limitations based on the factual circumstances of the discharge. In lieu of continuing to impose an effluent chloride limitation that may not be protective of groundwater given the present information, Staff is recommending a limit be formulated and proposed for Board consideration after the Discharger completes its groundwater study. The discharge specifications regarding dissolved oxygen and freeboard are consistent with Board policy for the prevention of nuisance conditions, and are applied to all such facilities.

The proposed Order limits the use of recycled water to flood irrigation of fodder, fiber, seed crops, and of crops such as wine grapes that undergo extensive commercial, physical, or chemical processing before human consumption, and requires the Discharger to comply with the provisions of Title 22. To ensure compliance with Title 22 and Board reclamation policy, the proposed Order requires the Discharger to implement best management practices with respect to effluent reuse (e.g., to reuse effluent at reasonable agronomic rates considering the crop, soil, climate, and irrigation management plan). The setback distances prescribed in Reclamation Specification F.3 are carried over from the previous Order with one exception. While the previous Order required a setback distance of 100 feet for both irrigation and domestic wells, the proposed Order prescribes a setback distance of 150 feet for domestic wells in accordance with Title 22, section 60307(d).

The conditions for sludge, solid waste, and biosolids management proposed in the proposed Order are intended to assure that degradation resulting from the City's management of sludge is in accordance with the Basin Plan. The proposed Order requires that storage, use and disposal of biosolids comply with the self-implementing federal regulations of 40 CFR 503, which are subject to enforcement by the U.S. Environmental Protection Agency not the Board, and the Statewide General Order for the Discharge of Biosolids (Water Quality Order No. 2000-10-DWQ) (or any subsequent document which replaces Order No. 2000-10-DWQ).

In accordance with DHS recommendations described earlier, the proposed Order requires the Discharger to (a) assess the current status of all private and domestic wells that exist within the 25-square-mile area described in Finding No. 9, (b) monitor domestic supply wells within this area for contaminants, and (c) conduct a comprehensive study to assess the fate and effects of the past and current discharge on the groundwater basin. The proposed Order further requires the Discharger to (a) identify the types of crops grown in the area served by FID canals that receive groundwater extracted by the Operator's reclamation wells and (b) provide information on the dilution of the extracted groundwater with fresh water prior to irrigation application. Because it is likely that food crops are grown or could be grown in the subject
area, the proposed Order requires the Discharger to undertake a timely evaluation of the degree of soil treatment provided by the current recharge and extraction operation and a determination of the level of filtration and virus removal treatment provided.

Regarding the discharge of stillage to the Stillage Site, the proposed Order carries over the previous Order's specifications for stillage disposal, which were adapted from the Stillage Guidelines. While the Operator has been discharging stillage to SS-1 for decades, it only recently began discharging stillage to SS-2. The groundwater impacts from the Operator's long-term discharge of stillage appear to be limited to salinity constituents, although there is the potential for nitrate contamination due to the accumulation of organic nitrogen in SS-1 soils. In the event the stillage discharge causes or contributes to exceedances of water quality objectives, the proposed Order has a Provision that allows the Board to reopen the Order to consider adding or revising appropriate stillage discharge specifications or groundwater limitations for the problem constituents.

Canandaigua's discharge to the Stillage Site is scheduled to cease by fall 2003, and the WWTF does not have the capacity to treat the discharge. While the continued discharge of stillage during the next two years may further degrade area groundwater for salinity, Staff is recommending that the Board allow it

to it be continued in the manner previously permitted, provided the Board requires the Operator to commence regularly planting and harvesting crops in the Stillage Site and to store collected leathers in a manner that will violate Groundwater Limitations. Staff is also recommending that the Board require the Operator to provide more detailed monitoring data on its stillage disposal operation, including data on the quality of soil-pore water under the Stillage Site. The technical report required by Provision H.5 of the proposed Order includes a description of the manner in which the Discharger proposes to monitor the quality of soil pore water beneath the Stillage Site. Vadose zone liquid can be readily sampled via lysimeters. The proposed Order's Monitoring and Reporting Program identifies the minimum sample size required for listed monitored constituents. The benefits of acquiring soil pore water quality data through vadose zone monitoring justify the costs involved in lysimeter acquisition, installation, sample collection, and laboratory analysis. Analytical results from this effort will be instrumental in evaluating the efficacy of treatment provided by the soil profile within the Stillage Site. Analytical results collected after stillage disposal ceases by January 2004 will monitor the extent to which stillage waste constituents (or their decomposition byproducts) continue to leach through the soil profile, especially in the original 95-acre stillage disposal area (SS-1). As indicated in Finding No. 44, the long-term discharge of stillage to SS-1 has resulted in a massive accumulation of organic nitrogen in the upper two feet of the soil profile. Attenuation of this massive loading through cropping is expected to take numerous years. At such time when SS soil nitrogen content is comparable to background, the Discharger may request termination of vadose zone monitoring. Such a modification in the proposed Order's Monitoring and Reporting Program can be executed by the Executive Officer.

The proposed Order prescribes groundwater limitations that reflect numerical and narrative water quality objectives (WQOs) for groundwater established in the Basin Plan. The proposed Order requires the discharge not to cause or contribute to exceedances of the groundwater limitations. Designated beneficial uses of area groundwater include municipal (MUN) and agricultural (AGR) supply. The Basin Plan states that "[w]ater quality objectives apply to all waters within a surface or ground water resource for which beneficial uses have been designated, rather than at an intake, wellhead or other point of consumption." Groundwater WQOs include (1) chemical constituents (including pesticides and radioactivity), (3) salinity, (4) tastes and odors, and (5) toxicity. For groundwaters designated MUN, the Basin Plan establishes numerical WQOs for bacteria and chemical constituents. The latter consists of drinking water maximum contaminant levels (MCLs) in Title 22, sections 64431 (Inorganic Chemicals); 64431 (Fluoride); 64443 (Radioactivity) 64444 (Organic Chemicals); 64449 (Secondary MCLs – Consumer Acceptance Limits); and lead not to exceed 0.015 mg/L.

The total coliform organism limitation of 2.2 MPN/100 mL in Groundwater Limitation G.1.a is based on the Basin Plan's WQO (i.e., the concentration of TCO over any 7-day period shall be less than 2.2/100 mL). Groundwater Limitation G.1.b prescribes a value of 10 mg/L as total nitrogen to ensure that groundwater nitrate levels will remain at or below the Title 22 primary drinking water MCL for nitrate (45 mg/L as nitrate or 10 mg/L as N). The limitations for chemical constituents prescribed in Groundwater Limitation G.1.c reflect the Title 22 drinking water MCLs. Groundwater Limitation G.2 prescribes limits for boron, chloride, EC, sodium, and TDS to protect existing and future beneficial uses of area groundwater for agriculture. The majority of area agriculture water supply is currently delivered via flood irrigation. Accordingly, it may not be critical to maintain the low salt concentrations in agricultural supply required for sprinkler irrigation. Additionally, the Discharger has implemented best practicable control for salt constituents through its implementation of an effective salinity source control

program.

The proposed Order requires the Discharger to conduct a BPTC evaluation of the discharge (including source control, pretreatment, and treatment). Once it completes its BPTC evaluation, the Discharger may, at its discretion, propose for Board consideration site-specific, constituent-specific limits for salinity constituents (e.g., chloride, EC, sodium, and TDS). In the next Order regulating the discharge, the Board will evaluate the Discharger's justification of BPTC implementation and its proposed groundwater salinity limitations. It is possible upon further documentation that the resulting degradation from salt can be found consistent with Resolution 68-16. Monitoring data submitted to date for WWTF effluent and groundwater indicates that the discharge will not result in exceedances of the proposed Order's groundwater limitation for boron of 0.7 mg/L. Staff determined the groundwater limitations for the remaining constituents as follows. The proposed Order prescribes an effluent EC limit of 900 µmhos/cm. Currently, WWTF effluent averages less than 800 µmhos/cm. As described previously, the concentration effect of evaporative losses are such that the concentration of waste constituents in effluent percolating to groundwater is about 11 percent greater than that discharged to disposal ponds. It is reasonable to assume that the relative concentrations of chloride and sodium in WWTF effluent will remained unchanged as the effluent EC approaches the 900 µmhos/cm limitation. The table below summarizes the derivation of the proposed Order's groundwater limitations for chloride, EC, sodium, and TDS.

| Constituent | Units | Current discharge to disposal ponds[1] | Discharge to disposal ponds at maximum EC[2] | Discharge to groundwater at maximum EC[3] | Proposed Limitation |
|---|---|---|---|---|---|
| Chloride | mg/L | 72 | 832 | 91.3 | 106[4] |
| EC | µmhos/cm | 780 | 900 | 990 | 990 |
| Sodium | mg/L | 81 | 94[2] | 103 | 103 |
| TDS | mg/L | 440 | 507[5] | 557 | 560 |

[1] Average values based on 2000 monitoring data
[2] Assumes relative concentrations remain unchanged at higher EC concentration
[3] Estimated at 11% greater than concentration in effluent discharged to disposal ponds
[4] Reflects maximum chloride concentration for chloride-sensitive crops
[5] Assumes unchanged ratio of TDS:EC of 440:780 (i.e., TDS = 0.564 * EC)

The last two groundwater limitations reflect narrative WQOs contained in the Basin Plan. Groundwater Limitation G.3 implements the Basin Plan's WQO for taste and odor. The taste threshold for ammonia, a waste constituent in municipal wastewater, is 0.5 mg/L. The limitation of 0.5 mg/L for ammonia ensures that this waste constituent will not adversely affect the beneficial use of area groundwater for human consumption. Lastly, Groundwater Limitation G.4 implements the Basin Plan's WQO for toxicity.

**Monitoring Requirements**

Section 13267 of the CWC authorizes the Board to require monitoring and technical reports as necessary to investigate the impact of a waste discharge on waters of the state. In recent years there has been increased emphasis on obtaining all necessary information, assuring the information is timely as

well as representative and accurate, and thereby improving accountability of any discharger for meeting the conditions of discharge. Section 13268 of the CWC authorizes assessment civil administrative liability where appropriate.

The proposed Order prescribes monitoring of discharge $BOD_5$, TSS, pH, and EC. The monitoring of these constituents is necessary to check compliance with discharge specifications. The proposed Order also prescribes monitoring of discharge nitrogen (as nitrite, nitrate, TKN, and total nitrogen), quarterly monitoring of minerals, and semiannual monitoring of metals and priority pollutants for discharges from Plant 1 and Plant 2 (when in operation), and quarterly and annual monitoring of source water quality. Staff is recommending the Discharger monitor effluent for priority pollutants to evaluate whether there is reasonable potential for the discharge to cause toxicity in groundwater. The source water monitoring, at the request of the Operator, utilizes data compiled in the Operator's electronic database for DHS reporting requirements. This lessens the financial burden on the Operator and increases the likelihood that source water quality is adequately characterized. Monitoring by the Operator over the years has not revealed any significant radiological waste constituents in either WWTF effluent or area groundwater. As such, the proposed Order eliminates the monitoring of radiological constituents in the discharge and groundwater.

The previous Order required the Discharger to sample systematically a representative number of disposal ponds at least once every seventh calendar day for dissolved oxygen (DO) and freeboard. During the two-year period beginning 1 January 1998, the Operator measured pond DO 7,624 times and found the value to be less than 1.0 mg/L for only 14 separate occurrences for a frequency of 0.0018 (0.18%). Therefore, the proposed Order decreases the frequency of pond DO monitoring to an as-needed basis.

Monitoring available freeboard in disposal ponds is necessary for several reasons. It documents compliance Disposal Pond Specification C.4, which requires all ponds to have a minimum of two feet available freeboard. It provides data for detecting reductions in effluent infiltration rates, which may, in turn, signify the need for pond maintenance to restore design infiltration rates. It also provides data that may signify levee damage (i.e., a sudden drop in freeboard may signify leakage caused by burrowing animals). The proposed Order requires the Discharger to (1) inspect pond freeboard of all disposal ponds daily and document all instances of noncompliance with Disposal Pond Specification C.4, which requires all ponds to have a minimum of two feet available freeboard; (2) monitor pond freeboard daily in external disposal ponds; (3) monitor pond freeboard at least once every seventh calendar day in a internal disposal ponds.

The proposed Order prescribes monitoring of stillage waste, including flow, $BOD_5$ (total and soluble), COD (total and soluble), total organic carbon, total nitrogen (nitrate and TKN), phosphorus, TDS, and EC. The monitoring of these constituents is necessary to check compliance with stillage discharge specifications and to monitor constituents that have a potential impact upon groundwater or will potentially create nuisance conditions. Further, the proposed Order requires the Operator to provide detailed descriptions on the manner in which it conducts its stillage discharge operation, perform periodic monitoring of Stillage Site soils, monitor vadose zone water quality, and monitor the quantity and chemical characteristics of groundwater passing under the Stillage Site. This information will be used by the Board to evaluate similar stillage disposal operations elsewhere in the Central Valley Region.

The proposed Order requires the Discharger to collect composite samples of sludge when it is removed in accordance with EPA's *POTW SLUDGE SAMPLING AND ANALYSIS GUIDANCE DOCUMENT, AUGUST 1989,* and test for arsenic, cadmium, molybdenum, copper, lead, mercury, nickel, selenium, and zinc. The proposed Order requires the Discharger to submit an annual summary of sludge discharge operations.

The Title 27 zero leakage protection strategy relies heavily on extensive groundwater and unsaturated zone monitoring to increase a discharger's awareness of, and accountability for, compliance with the prescriptive and performance standards. With a high volume, concentrated, uncontained discharge to land, monitoring takes on even greater importance. The proposed Order includes monitoring of applied waste quality, application rates, and groundwater.

The proposed Order requires a monitoring well network that effectively measures the quality of groundwater that could be impacted by the discharge. The existing well network monitors the uppermost layer of the aquifer, and data indicate a number of problem areas that call into question some aspects of treatment and control. The proposed Order requires the Discharger to evaluate the uppermost aquifer for a representative zone against which groundwater limitations will be applied. Use of the existing network will continue for the purposes of monitoring the effects of the discharge on the uppermost layer of groundwater until an alternate network suitable for evaluating the effectiveness of BPTC and compliance with Groundwater Limitations is approved by the Executive Officer in accord with the process outlined in the proposed Order.

The proposed Order also requires monitoring of groundwater extracted by the reclamation wells. The proposed Order's groundwater monitoring requires quarterly sampling from identified monitoring wells for constituents in the discharge that may degrade groundwater quality and for which numerical limitations have been prescribed (e.g., nitrate, total nitrogen, chloride, sodium, etc.). Additional monitored constituents include total organic carbon, general minerals, metals, dissolved oxygen, and oxidation-reduction potential. The last two parameters, which can be readily obtained through the use of hand-held probes during the time of sample collection, provide information to evaluate the extent to which microbial degradation of organic matter has created anoxic or anaerobic conditions (i.e., conditions of very low or no dissolved oxygen). Factual evidence of organic overloading would include the presence of total organic carbon and soluble manganese in extracted groundwater along with very low or no dissolved oxygen and nitrate, and oxidation-reduction potentials corresponding to manganese reduction.

Consistent with the implementation approach taken in the proposed Order, evaluation of compliance with Groundwater Limitations cannot occur until the initiation of the approved representative zone monitoring program. The approved representative zones of the aquifer will be identified in the hydrogeologic investigation described in Provision H.7. Wells must be installed to measure the quality of water within these zones for comparison with Groundwater Limitations as part of the proposed Order. The proposed Order provides a schedule for proposing, then providing the monitoring network, for these representative zones. Until the network is installed and monitoring initiated, the Board cannot evaluate compliance with Groundwater Limitations.

In accordance with DHS recommendations described earlier, the proposed Order requires the Discharger to monitor a representative sample of domestic supply wells within the 25-square-mile area encompassed by the mound of percolated effluent. The collected data will be used to determine if these supply wells are producing safe water for domestic use. In addition, the proposed Order requires the Discharger to install continuous turbidity meters on representative reclamation wells and to collect continuous turbidity data for at least one year. Acquisition of turbidity data for groundwater extracted from the Operator's reclamation wells is essential in determining the quality of percolated effluent that the Operator discharges to FID canals for unrestricted use. To qualify as a "filtered" wastewater pursuant to Title 22, section 60301.320, the groundwater extracted from reclamation wells must not have a turbidity that exceeds an average of 2 NTU within a 24-hour period, 5 NTU more than 5 percent of the time within a 24-hour period, and 10 NTU at any time.

As described previously, the proposed Order requires the Discharger to provide detailed monitoring data on its stillage disposal operation, including water quality data for soil-pore water collected from lysimeters installed in Stillage Site soils.

## CEQA CONSIDERATIONS

The City of Fresno certified a final environmental impact report (EIR) dated 31 October 1995 for an expansion in WWTF treatment and disposal capacity in accordance with the California Environmental Quality Act (CEQA) (Public Resources Code section 21000 et seq.) and the State CEQA Guidelines. The expansion project includes (a) increasing Plant 1 treatment capacity to 80 mgd to accommodate urban growth in the Discharger's service area, (b) discontinuing use of Plant 2 to improve the WWTF's overall air emissions, reliability, and operations, and (c) constructing an additional 600 acres of infiltration basins (i.e., effluent disposal ponds) to provide disposal capacity for the increased flows and to comply with Board-prescribed pond freeboard requirements. The EIR estimates that, at full build out, the project would discharge an additional 11,200 af/yr of effluent to area groundwater. While the EIR states that the infiltration of effluent over the years has caused concentrations in groundwater of TDS, EC, and sodium to increase, the EIR states that the project would not affect public or private water supplies. The EIR identifies the project's impact on groundwater as temporary, as the City "shall commit to developing a plan for the reclamation of water infiltrated at the plant by 1997." The EIR promises that the City "shall continue to develop and implement a reuse program for its treated wastewater to reduce the need for future infiltration basins. The EIR further states that the City "is also developing a reuse program for its treated wastewater to alleviate groundwater conditions under the treatment plant…[to]…mitigate the cumulative effects to water resources to a level of less than significant."

The project certified by the City of Fresno as described in the EIR differs from the project characterized in the Discharger's 31 December 1996 Report of Waste of Discharge (RWD). The RWD describes a project that increases Plant 1's treatment capacity to 88 mgd, continues use of Plant 2, and adds 600 acres of disposal ponds. The increase in amount of effluent percolating from the project described in the RWD is nearly 25,000 af/yr, well over the 11,200 af/yr identified in the EIR. Since submitting the RWD, the Discharger indicates that (a) it plans to treat some industrial flows in Plant 2, as necessary, prior to their full treatment in Plant 1; (b) the 80 mgd specified in the EIR represents the annual monthly average daily discharge flow (i.e., the average of the monthly average daily discharge flow for the

calendar year); and (c) the EIR did not correctly reflect that the Plant 1 would be designed, constructed, and operated to treat a short-term maximum monthly average daily discharge flow of 88 mgd. The additional 8 mgd treatment capacity accommodates seasonal peaks from food-processing industries that generally occur in September.

This Order, in accordance with the terms of the certified EIR, limits treatment and disposal capacity to 80 mgd, and requires the Discharger to implement one or more reuse projects by spring 2004 to recycle an additional 4,200 acre-feet of treated wastewater in addition to that currently either directly or indirectly recycled or is proposed to be recycled by Calpine.

The Board has reviewed the City of Fresno's EIR for the WWTF expansion project and finds that any potential significant adverse impacts to water quality will be mitigated to insignificant levels or is acceptable due to overriding considerations provided the Discharger complies with the terms in the proposed Order. The proposed Order, in accordance with the terms of the City of Fresno's certified EIR, limits the WWTF's annual monthly average daily discharge flow to 80 mgd and its maximum monthly average daily discharge flow to 88 mgd. The proposed Order requires the Discharger to implement by 2004 one or more reuse projects to recycle at least 4,200 af/yr in order to render as temporary the WWTF expansion project's impacts to groundwater. It further requires the Discharger to evaluate, in consultation with DHS, the discharge's impact on area groundwater's use as a domestic and municipal supply.

On 25 March 1998, the City of Fresno adopted a negative declaration (Environmental Assessment 98-03), in accordance with CEQA and State CEQA Guidelines for the discharge of stillage to the 50-acre stillage disposal site (SS-2) adjacent to the existing 95-acre stillage disposal site (SS-1). Mitigation measures 3 – 15 are identical to Stillage Discharge Specifications C.1 – C.13 from WDRs Order No. 96-054. In its review of this document, the Board, as a responsible agency under CEQA, finds that it does not adequately mitigate the potentially significant adverse impact to groundwater due to the accumulation of nitrogen in stillage disposal area soils, nor does it monitor the fate of waste constituents as it percolates through the upper soil profile. This Order requires the Discharger to commence planting and harvesting crops in the Stillage Site to reduce the nitrogen content in stillage disposal area soils. It also requires the Discharger to implement vadose zone monitoring for waste constituents and their decomposition by-products.

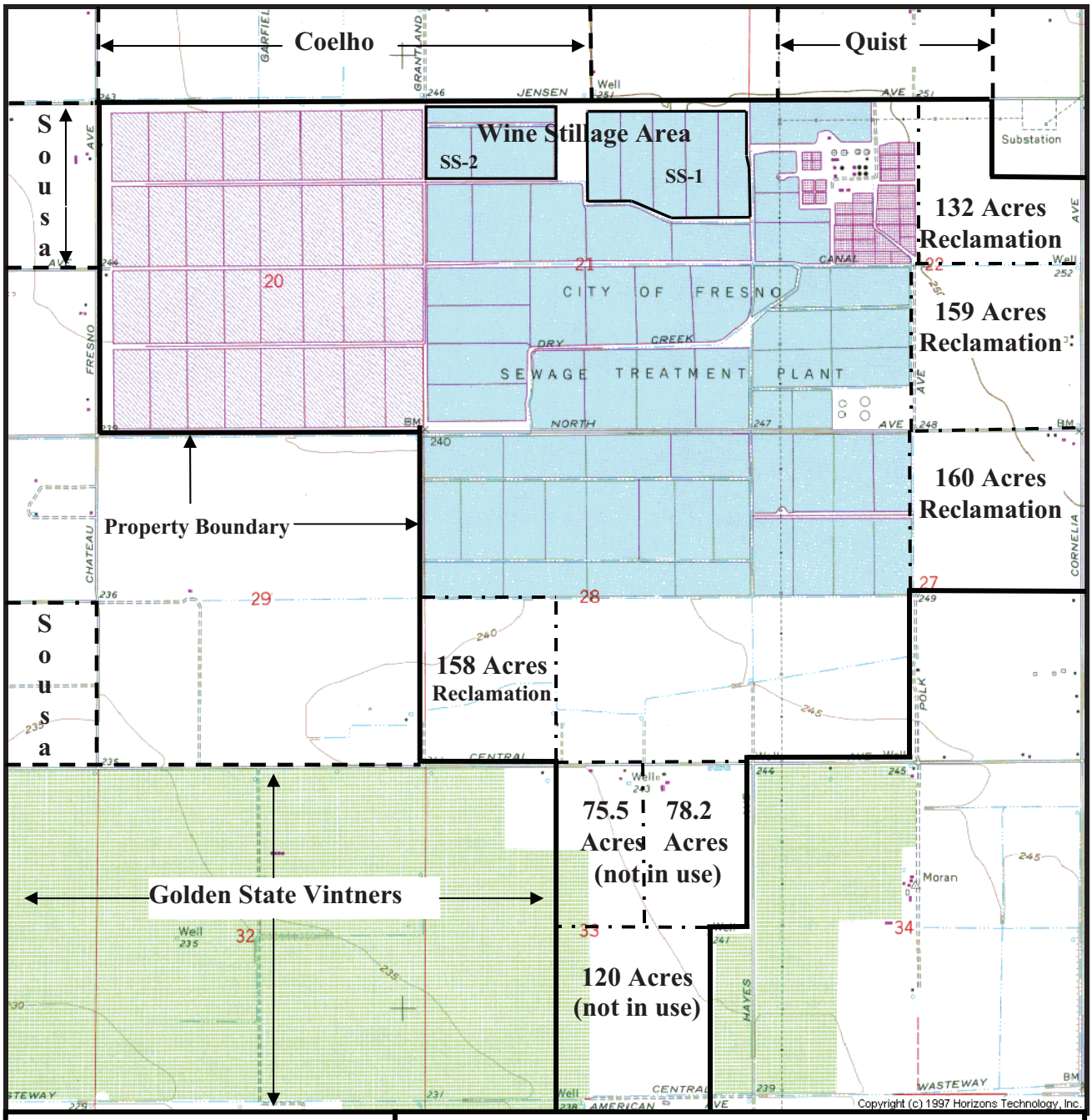
**Reopener**

The conditions of discharge in the proposed Order were developed based on currently available technical information and applicable water quality laws, regulations, policies, and plans, and are intended to assure conformance with them. However, information is presently insufficient to develop final effluent and groundwater limitations, so the proposed Order contains interim limitations. Additional information must be developed and documented by the Discharger as required by schedules set forth in the proposed Order. As this additional information is obtained, decisions will be made concerning the best means of assuring the highest water quality possible may that could involve substantial cost. It may be

appropriate to reopen the Order if applicable laws and regulations change, but the mere possibility that such laws and regulations may change is not sufficient basis for reopening the Order. The CWC requires that waste discharge requirements implement all applicable requirements.

Several other more likely reasons for reconsidering terms of the Order exist, and the Order may be opened for this purpose at the Board's discretion. For example, Board procedures require periodic review of the effectiveness of requirements at a frequency proportional to the threat the discharge has to water quality with update as appropriate. The Order will definitely be reopened for consideration of BPTC and establishing final numeric groundwater limitations. It is also conceivable that monitoring of compliance may identify a waste constituent, possibly a toxic waste constituent, that violates or threatens to violate groundwater limitations, establishing a need to consider an appropriate numeric effluent limit for that waste constituent.

BLH:jlk:10/19/01 AMENDED




1700 FT
(approximate)

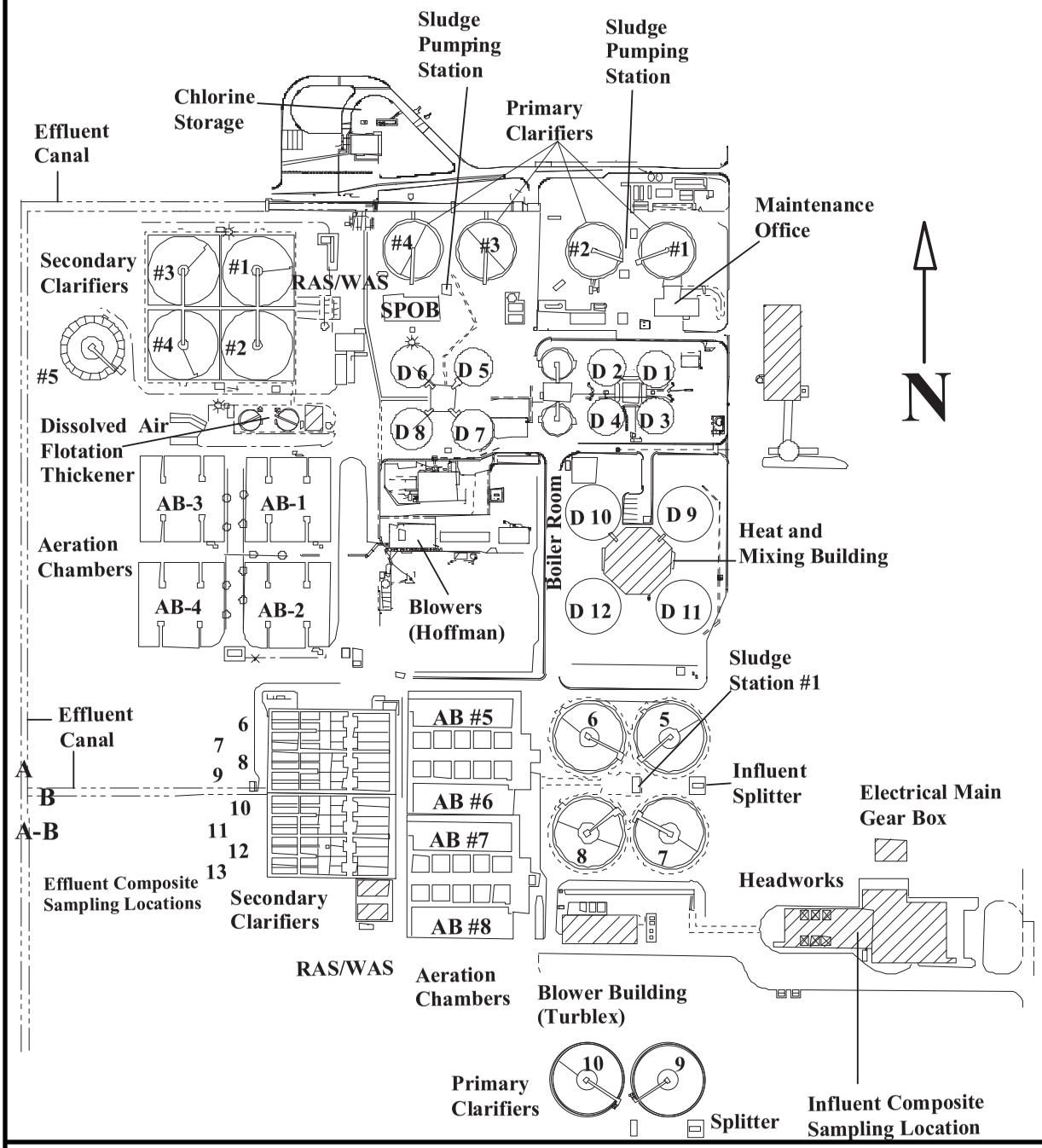
N

**Attachment A**

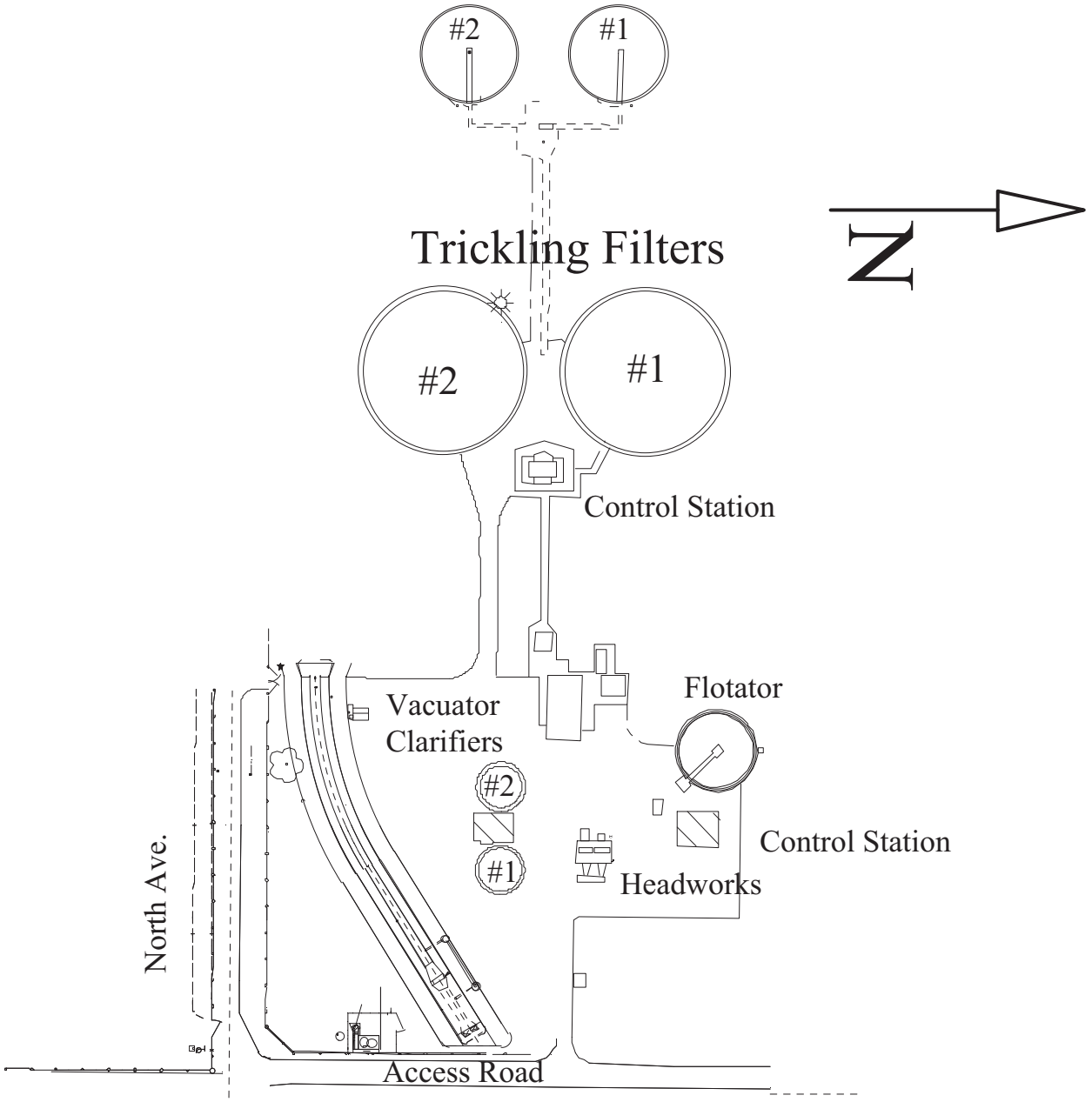
**Vicinity Map**

**WASTE DISCHARGE ORDER NO. 5-01-254**

**Cities of Fresno and Clovis**
**Wastewater Treatment Facility**
**Fresno County**
**Sections 20, 21, 22, 27, 28, and 33 of T14S R19E**
Fresno, CA USGS 15' Quadrangle




**ATTACHMENT B**
**PLANT 1 DIAGRAMMATIC LAYOUT**
**WASTE DISCHARGE REQUIREMENTS ORDER NO 5-01-254**
**CITIES OF FRESNO AND CLOVIS**
**WASTEWATER TREATMENT FACILITY**
**FRESNO COUNTY**




**ATTACHMENT C**
**PLANT 2 DIAGRAMMATIC LAYOUT**
**WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254**
**CITIES OF FRESNO AND CLOVIS**
**WASTEWATER TREATMENT FACILITY**
**FRESNO COUNTY**

**ATTACHMENT D**

Symbol for Recycle Water Signs
WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

TENTATIVE WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254
FOR
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

ATTACHMENT E
INFORMATION NEEDS FOR SLUDGE MANAGEMENT PLAN

A. Wastewater Treatment Facility (WWTF)

1. Describe treatment processes at the wastewater treatment facility.
2. List significant industrial users (SIUs) that discharge to the wastewater treatment facility and describe how SIUs affect sludge production, sludge handling, and biosolids disposal.
3. Indicate whether the WWTF has an adopted source control ordinance or a pretreatment program, and if the latter whether the program is approved by the Board.
4. Indicate whether WWTF accepts septage and, if so, describe septage handling operation facilities.
5. Provide a WWTF site map showing:
   a. existing sludge handling facilities (e.g., sludge drying beds and sludge storage areas)
   b. abandoned sludge handling facilities (if applicable)
   c. location of groundwater monitoring wells, if any, and groundwater gradient.

B. Sludge Production

1. Provide a schematic diagram showing solids flow and sludge handling operations; include, where applicable, supernatant flow and handling operations.
2. Specify the quantity of sludge expected to annually accumulate in each wastewater treatment process, how it is quantified, and the expected removal frequency.
3. For sludge handling facilities with sludge drying beds:
   a. Describe number and size of sludge drying beds.
   b. Describe sludge drying bed construction (e.g., liner, leachate collection system).
   c. If sludge drying beds are not lined, thoroughly describe measures taken to ensure that area groundwater is not adversely affected by sludge drying operations.
   d. Indicate the expected frequency with which sludge will be applied to and removed from sludge drying beds.
4. Describe how biosolids are transferred to onsite biosolids storage facility (if applicable). If biosolids are removed directly from sludge drying beds, provide a plan that indicates when during the year you expect to dispose of biosolids and explain that whoever is responsible for disposing of your biosolids will be able to remove and dispose it at this time.

C. Biosolids Characterization

1. Describe proposed sampling procedures by indicating number of samples, sample locations, and sample composition. For reference consult *POTW Sludge Sampling an Analysis Guidance Document*, published by the EPA Publication No. 833-B-89-100.
2. Describe the methods proposed to meet the necessary levels of pathogen reduction (i.e., Class A or B according to 40 CFR 503.32) for the proposed method of sludge disposal.
3. Describe the methods proposed to meet vector reduction requirements, in accordance with 40 CFR Part 503.33.

D. Biosolids Storage

1. If on-site biosolids storage is used,
   a. Describe:
      i. Size of biosolids storage area
      ii. How frequently it will be used (emergency basis only or routine use)
      iii. Typical storage duration
      iv. Leachate controls
      v. Erosion controls
      vi. Run-on/runoff controls
   b. Indicate measures that will be taken to ensure that area groundwater is not adversely affected by the biosolids storage facility.
   c. For biosolids storage facilities that contain biosolids between 1 October and 30 April, describe how facilities are designed and maintained to prevent washout or inundation from a storm or flood with a return frequency of 100 years.
   d. Provide a map of showing setback distances from (where applicable)
      i. Property lines
      ii. Domestic water supply wells
      iii. Non-Domestic water supply wells
      iv. Public roads and occupied onsite residences
      v. Surface waters, including wetlands, creeks, ponds, lakes, underground aqueducts, and marshes
      vi. Primary agricultural drainage ways
      vii. Occupied non-agricultural buildings and off-site residences
      viii. Primary tributary to a waterway or reservoir used for domestic water supply
      ix. Domestic surface water supply intake

E. Spill Response Plan

1. Emergency contacts and notification procedures
2. Personal protective equipment requirements
3. Response instructions for
   a. spill during biosolids transport
   b. storage facility failure
   c. when hazardous or other unauthorized material is found

F. Method of Disposal

1. Describe and provide the following information related to biosolids disposal method(s). If more than one method will be utilized, include the percentage of annual biosolids production expected to be disposed of by each method.

   a. Landfill Disposal

      i. Name(s) and location(s) of landfill(s).

      ii. Waste discharge requirements order numbers adopted by the Regional Board that regulate the landfill(s).

      iii. Present classification of the landfill(s).

      iv. Name and telephone number of the contact person at the landfill(s).

   b. Incineration

      i. Name(s) and location(s) of incineration site(s).

      ii. Waste discharge requirements order numbers adopted by the Regional Board that regulate the incineration site(s).

      iii. Method of disposal of ash from the incineration site(s).

      iv. Names and locations of facilities receiving ash from the incineration site(s), if applicable.

      v. Name and telephone number of the contact person at the incineration site(s).

   c. Composting

      i. Name(s) and location(s) of composting site(s).

      ii. Waste discharge requirements order numbers adopted by the Regional Board that regulate the composting site(s).

      iii. Name and telephone number of the contact person at the composting site(s).

   d. Land Application

i. Ownership of the site(s) where biosolids are applied.

ii. Assessor Parcel Numbers (APNs) of site(s) where biosolids are applied.

iii. Waste discharge requirements order numbers adopted by the Regional Board that regulate the biosolids application site(s).

TENTATIVE WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254
FOR
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

ATTACHMENT F
STANDARD MONITORING WELL PROVISIONS

Prior to installation of groundwater monitoring wells, the Discharger shall submit a workplan containing at least the information specified in this document. Wells may be installed after the executive officer's approval of the workplan. Upon installation of the monitoring wells, the Discharger shall submit a report of results, as described below. A registered geologist, certified engineering geologist, or civil engineer registered or certified by the State of California must sign all workplans and reports.

**Monitoring Well Installation Workplan**

A. General Information:
   Monitoring well locations and rationale
   Survey details
   Equipment decontamination procedures
   Health and safety plan
   Topographic map showing any existing monitoring wells, proposed wells, waste handling facilities, utilities, and other major physical and man-made features.

B. Drilling Details: describe drilling and logging methods

C. Monitoring Well Design:
   Casing diameter
   Borehole diameter
   Depth of surface seal
   Well construction materials
   Diagram of well construction
   Type of well cap
   Size of perforations and rationale
   Grain size of sand pack and rationale
   Thickness and position of bentonite seal and sand pack
   Depth of well, length and position of perforated interval

D. Well Development:
   Method of development to be used
   Method of determining when development is complete
   Method of development water disposal

E. Surveying Details: discuss how each well will be surveyed to a common reference point

F. Soil Sampling (if applicable):
   Cuttings disposal method

Analyses to be run and methods
Sample collection and preservation method
Intervals at which soil samples are to be collected
Number of soil samples to be analyzed and rationale
Location of soil samples and rationale
QA/QC procedures

G. Well Sampling:
Minimum time after development before sampling (48 hours)
Well purging method and amount of purge water
Sample collection and preservation method
QA/QC procedures

H. Water Level Measurement:
The elevation reference point at each monitoring well shall be within 0.01 foot. Ground surface elevation at each monitoring well shall be within 0.1 foot. Method and time of water level measurement shall be specified.

I. Proposed time schedule for work.

**Monitoring Well Installation Report of Results**

A. Well Construction:
Number and depth of wells drilled
Date(s) wells drilled
Description of drilling and construction
Approximate locations relative to facility site(s)
A well construction diagram for each well must be included in the report, and should contain the following details:
Total depth drilled
Depth of open hole (same as total depth drilled if no caving occurs)
Footage of hole collapsed
Length of slotted casing installed
Depth of bottom of casing
Depth to top of sand pack
Thickness of sand pack
Depth to top of bentonite seal
Thickness of bentonite seal
Thickness of concrete grout
Boring diameter
Casing diameter
Casing material
Size of perforations

Number of bags of sand
Well elevation at top of casing
Depth to ground water
Date of water level measurement
Monitoring well number
Date drilled
Location

B. Well Development:

Date(s) of development of each well
Method of development
Volume of water purged from well
How well development completion was determined
Method of effluent disposal
Field notes from well development should be included in report.

C. Well Surveying: provide reference elevations for each well and surveyor's notes

D. Water Sampling:

Date(s) of sampling
How well was purged
How many well volumes purged
Levels of temperature, EC, and pH at stabilization
Sample collection, handling, and preservation methods
Sample identification
Analytical methods used
Laboratory analytical data sheets
Water level elevation(s)
Groundwater contour map

E. Soil Sampling (if applicable):

Date(s) of sampling
Sample collection, handling, and preservation method
Sample identification
Analytical methods used
Laboratory analytical data sheets

# NOVA DISK FILTER EVALUATION AT ORANGE COUNTY SOUTH REGIONAL WATER RECLAMATION FACILITY – SAND LAKE ROAD

# DISK FILTER EVALUATION AT ORANGE COUNTY SOUTH REGIONAL WATER RECLAMATION FACILITY – SAND LAKE ROAD

NOVA WATER DISK FILTER MODEL 1001 - ULTRASCREEN

Introduction – Nova Water Technologies in conjunction with Carter and Verplanck received permission to test the Ultrascreen disk filter at the SLR water reclamation facility on secondary clarifier effluent. The objectives include a real time comparison with the existing Aqua Aerobic disk filters for multiple parameters and the ability to demonstrate compliance with the California State Department of Health Title-22 standards for public access reuse of reclaimed water from municipal sewage.

The comparison with the Aqua filters is being organized and overseen by managerial level county utility staff while the Title-22 documentation is being conducted by Carollo

Engineers from their Sarasota, FL office (Sean Poust) and being supported by Dr Keith Bourgeous from the Sacramento, CA office.

Background – The Ultrascreen disk filter is a product originally developed by Nuove Energie located in Vicenza, Italy. Nuove has been involved in liquid/solid separation process equipment for almost 20 years and has teamed with Nova Water for developing applications for the Ultrascreen filter in North America. Since teaming with Nova the Ultrascreen technology has been demonstrated with good results at more than a dozen wastewater facilities including the Orange County NW facility. The Ultrascreen disk filter is available in multiple capacities. The model 1001 represents the smallest standard production unit and has 17 square feet of filtration media.

The key difference in the filtration media used on the Ultrascreen versus the Aqua filter is the material and the weave configuration. The Ultrascreen uses a precision woven stainless steel mesh allowing for precise micron size adjustments for the specific process purpose. The Aqua filter can use several types of media from needle felt to nonwoven nylon or acrylic mounted on a woven backing.

Objectives – For the performance comparison between the Aqua filter and the Nova filter the following major parameters were proposed for data collection and review:

Flow to each filter measured as gpm per square foot of media. Both filters have flow meters installed. The Aqua filter is using a Panametrics brand unit. The Nova filter is using an Endress and Hauser brand mag meter.

Influent NTU which is the same to both filters as the Nova filter draws water from the Aqua feed trough. The influent NTU is being measured by a HACH brand continuous on line turbidimeter.

Effluent NTU measured at the filter discharge for both filters. Both filters are using HACH brand continuous on line turbidimeters.

Measure the volume of backwash reject water produced by both filters. The Aqua filter is using an ABB brand mag flow meter. The Nova filter is using a physical capture tank for reject collection that can hold more than 250 gallons. This can accommodate at least one full 24 hour period of reject collection. These values are being measured and recorded manually and supervised by Carollo Engineers weekly.

The final filter layout is shown below with feed and drain piping and a temporary observation platform. The building in the background houses the VFD’s for the filter drive, the filter feed pump and the backwash pump, the data recorder and the turbidimeter analyzers.

Data Collection – The influent flow rate to the Aqua filter is being recorded by the plant SCADA system. The influent flow to the Nova filter is being recorded by an ABB brand Videographic data recorder. Some typical graphs are included.

The influent turbidity for both filters is being recorded by the same data recorder.

The effluent turbidity for the Aqua filter is being recorded by the plant SCADA system and the ABB data recorder.

The Aqua reject flow meter is being read and recorded manually.

The Nova filter data is being recorded for influent feed gpm, influent NTU, effluent NTU, and backwash pump operating cycles. These are being recorded on the ABB data recorder.

Sample Collection – Samples are being collected by the county plant staff on an established schedule. The influent and effluent for both filters are sampled at approximately the same time and the samples are collected multiple times each day. The Carollo staff has also collected samples from both filters for additional analysis. The Carollo staff will continue collecting samples each Monday for the duration of the Title-22 protocol. The county staff is also collecting samples for Carollo to support the Title-22 collection.

Note: Nova Water staff has not collected any of the samples being analyzed by either party for either filter.

Sample Analysis and Results – The lab results from county collected samples will be tabulated and reviewed by county staff. To date Nova Water has not been informed as to any results.

The lab results from Carollo collected samples are being reviewed by Carollo and some of the data has been forwarded to Nova Water for our review. Some of the Carollo data is included in this progress report.

Test Protocol and Schedule – The testing calendar was originally targeted for a March to April time frame. Several factors prevented this from being accomplished. The main issues were electrical and instrumentation. The filter was reliably on line in May and Nova Water began a series of tests to determine possible loading rates, reject rates and particle capture capabilities. The nature of the secondary clarifier effluent suspended particles indicated the need for Nova to apply a filtration mesh with finer weave characteristics. Fortunately this is accomplished fairly easily with the Ultrascreen design but even so there was a lead time required to get the fabric and that caused some additional waiting time.

Once the new mesh was installed (20 micron) the Nova filter was tested again for establishing the basic parameters. Our original goal was to operate at a maximum hydraulic loading rate of 16 gpm per square foot. Both the original 25 micron mesh and the current 20 micron mesh have demonstrated they can meet this hydraulic throughput

For the purpose of data collection we have operated the Nova filter initially at 102 gpm average or 6 gpm/sq ft and 5 rpm rotation speed. During this time the Aqua filter was operated at approximately 3 gpm/sq ft.

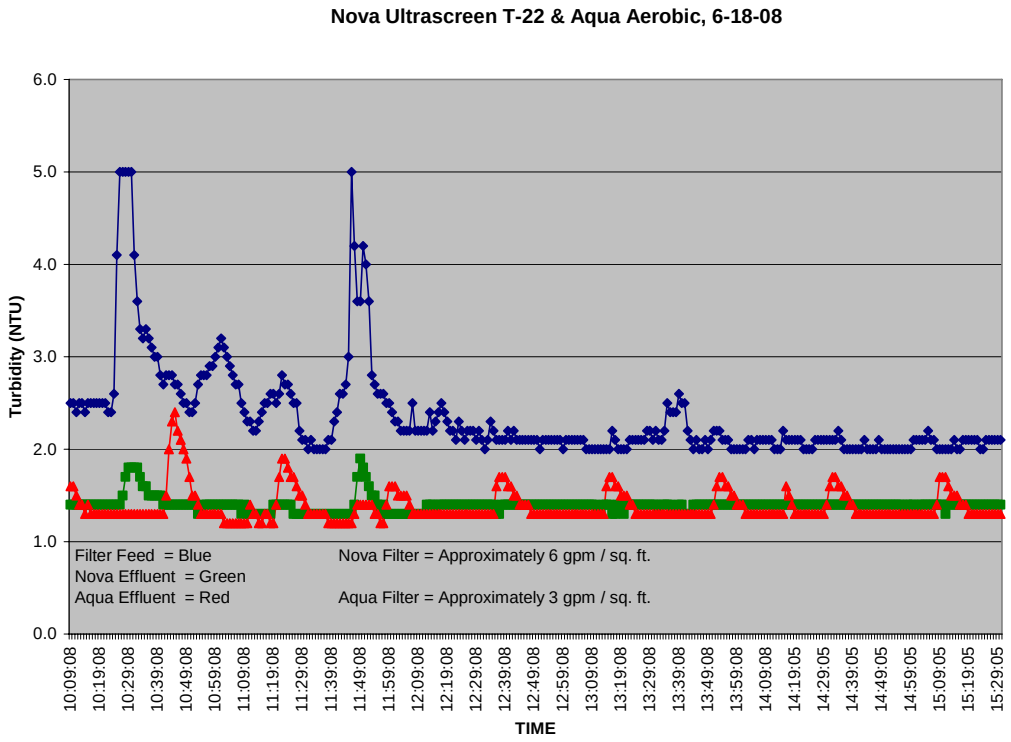
The second operating point for the Nova filter was 6 gpm/sq ft and 6 rpm rotation speed. The Aqua filter was operated at approximately 4 gpm/sq ft.

Moving forward into the coming weeks the Nova filter will be increased incrementally up to 16 gpm/sq ft and the Aqua filter is proposed to operate at up to 8 gpm/sq ft.

Observations – To date the filters have been operating well and each design is producing approximately equal results for effluent turbidity as expressed in NTU's. The Nova filter has so far demonstrated that it can operate at 6 gpm/sq ft continuously over a wide range of influent turbidity values and maintain effluent values of less than 2.0 NTU which is our target for the Title-22 criteria. The Aqua filter has also operated well at the 3-4 gpm/sq ft loading rates.

A typical data recording is shown in the graph below. Both filters are showing the expected responses to significant spikes in influent turbidity. Both filters are performing within expectations. The Nova filter has been able to handle the NTU spikes as effectively as the Aqua filter overall. For the data period covered the Nova filter is

operating at approximately double the hydraulic loading rate of the Aqua filter based on readings from the two influent flow meters.

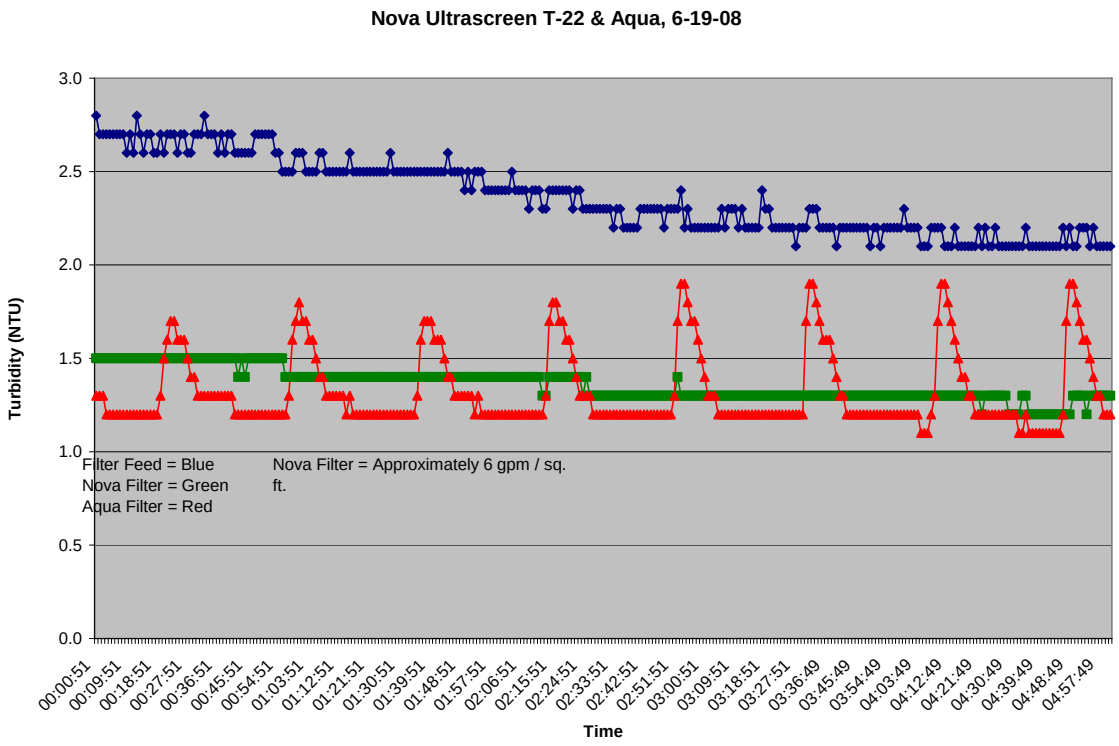



The Nova filter displays a relatively flat effluent turbidity trend when compared to the Aqua filter. The reason for this difference is the pulse wash nature of the Ultrascreen. The duration of backwash for the Ultrascreen is brief and the frequency is more often than the Aqua technology employs. The Ultrascreen uses a pressure washing concept where the Aqua filter is using a vacuum suction approach. Both concepts work and the Aqua backwash frequency can be noted on the chart as a brief increase in turbidity accompanies each of the backwash cycles.

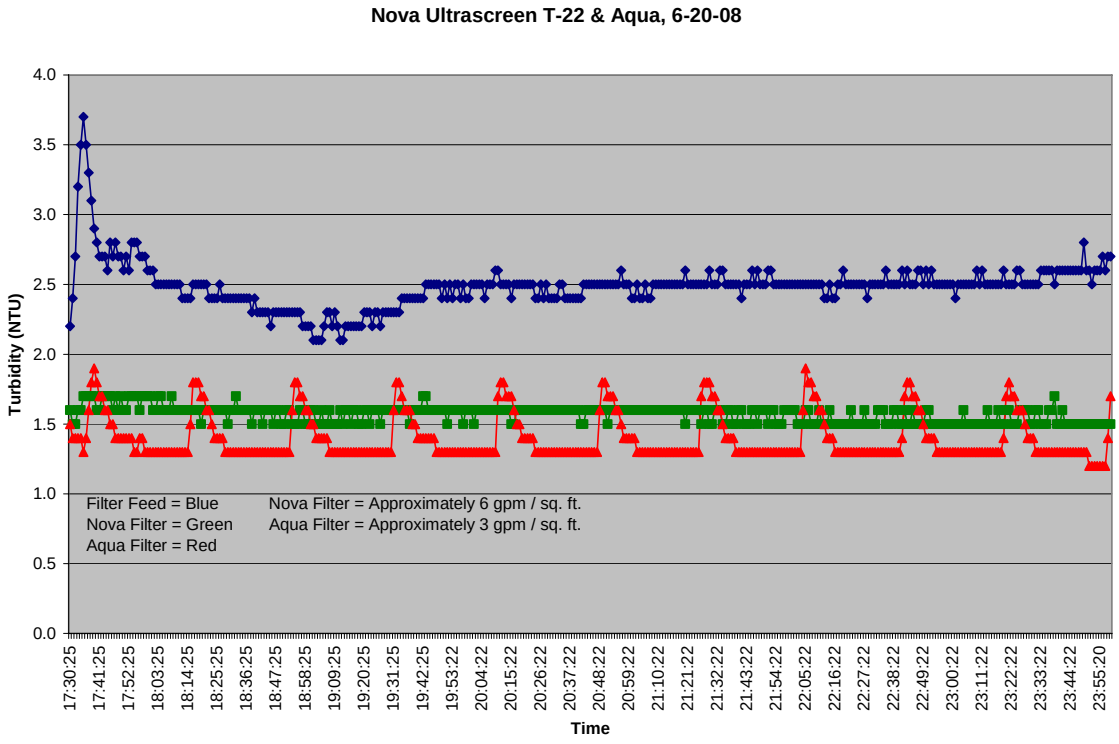
The backwash cycle for the Aqua filter is presently controlled by the filter water elevation above the disks (differential) versus the filter effluent elevation. The Nova filter is being operated at a consistent elevation for initiating the backwash cycle during the testing at SLR.

Note: It is also possible to operate the Nova filter using a PLC with programmed logic that can vary the desired backwash initiation elevation to optimize the filter operation for changing influent condition like flow and turbidity.

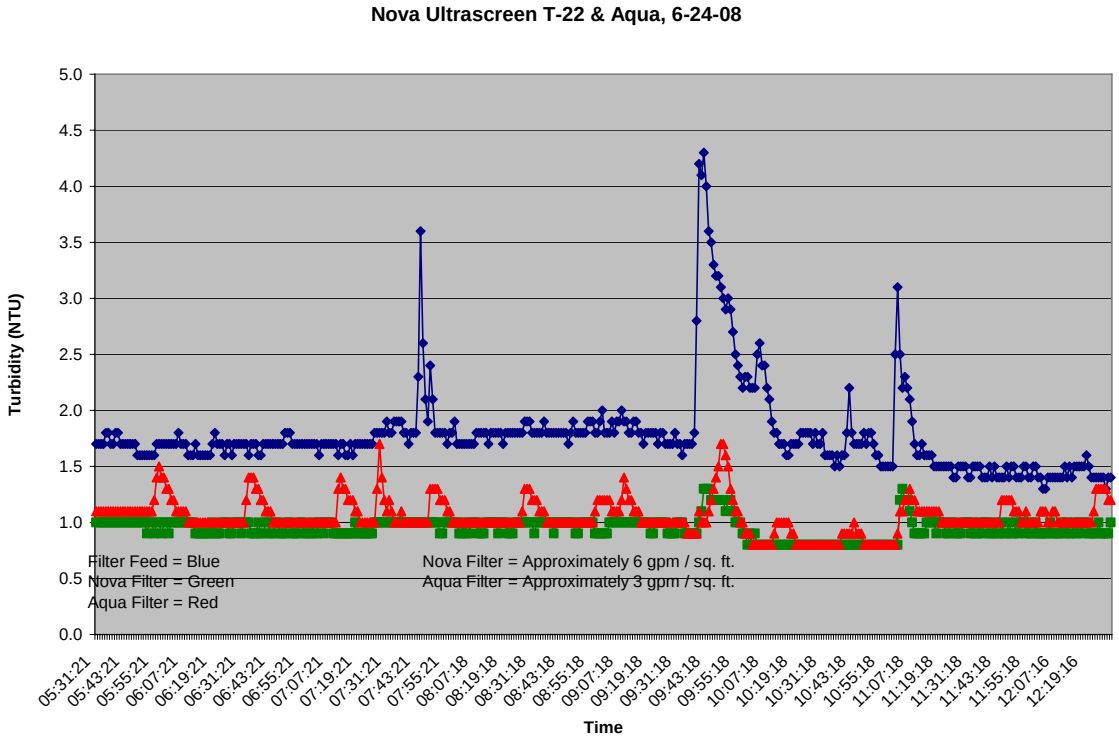
Additional turbidity graphic displays are shown below.




The Nova filter is producing a relatively flat NTU trend line even with variable influent.

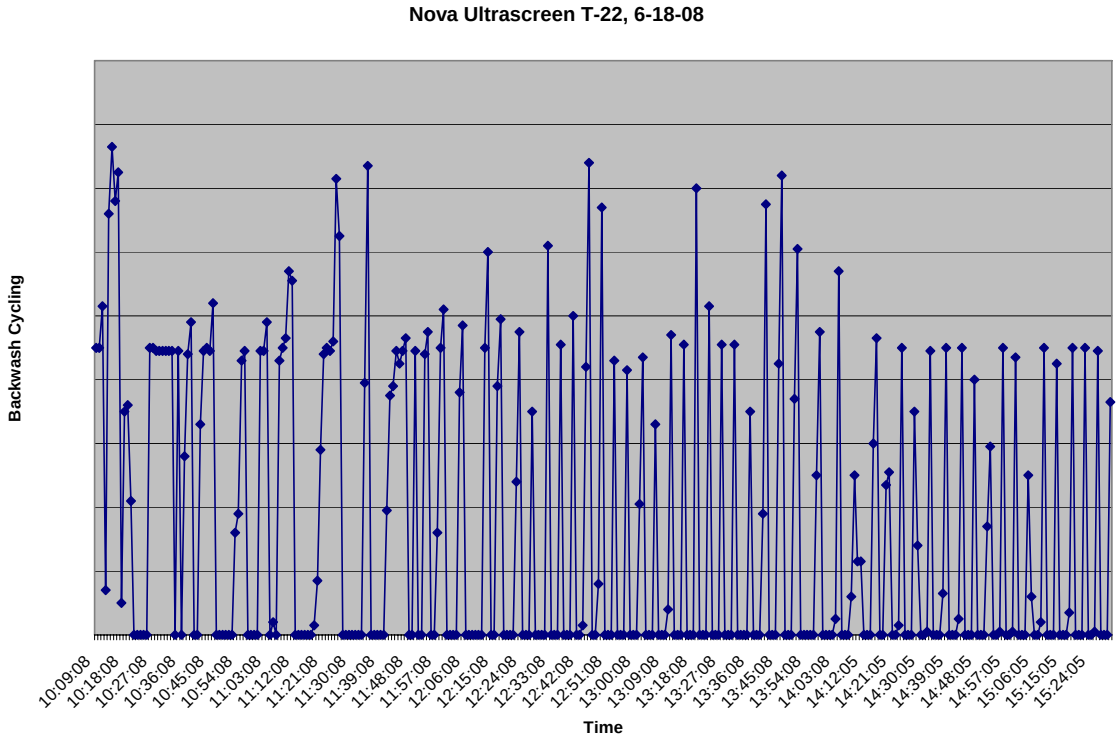



Both filters are producing effluent below the Title-22 threshold value of 2.0 NTU.




Both filters show response to influent turbidity spike on June 24th around 10 AM.

<u>Backwash and Reject</u> - The pulse backwash concept employed by the Nova filter takes advantage of three principles; media, pressure and elevation. Each is discussed below.



Media – The precision woven stainless steel media provides fine pore size control while presenting a shallow profile to the water being filtered. Particles rejected on the feed side of the media do not penetrate the mesh at any depth as is the design concept employed with cloth filtration. This allows the particles to be separated from the mesh easily when the time comes for backwashing.

Pressure – The original cloth filtration concepts using needle felt employed high pressure washing cycles for removing the captured particles. Once the particles are deeply embedded in the cloth fabric a substantial amount of volume and pressure is required to extract them

The Ultrascreen concept uses the opposite approach. The precision mesh maintains a dynamic film layer of rejected solids at the surface of the media and because there is no significant depth to the media particles are easily washed at low pressure from the outside to the inside using previously filtered water. At SLR we have demonstrated that wash pressures as low as 20 psig can be used for keeping the media clean at an acceptable level for extended periods of time.

Elevation – The Ultrascreen disks are in constant slow rotation during filtration cycles. The disks are approximately 50% submerged at the maximum normal operating liquid level. This allows the 50% of the disk above the water level elevation to be washed as it rotates above the filter feed well. The filter initiates a backwash cycle when the internal feed water elevation reaches a preset point. This allows the disks to be cleaned when they need to be without hindering the ongoing filtration of continuous influent flow.

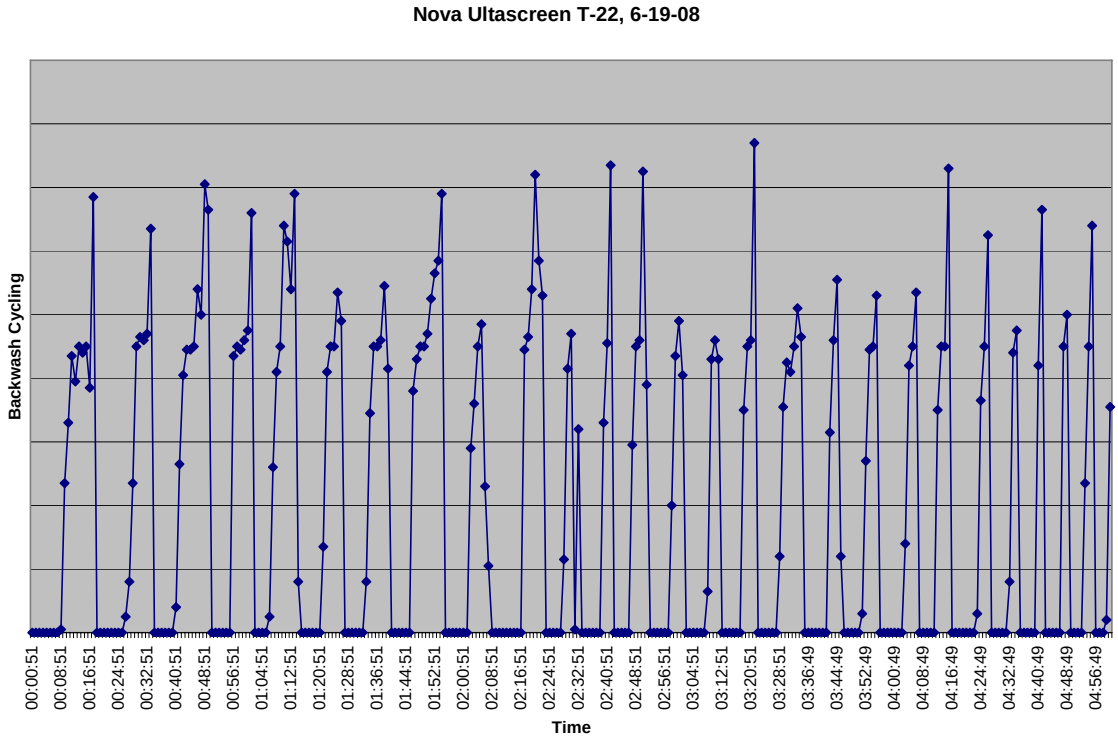
During times of low turbidity in the influent water the disks can operate for many minutes without requiring a backwash cycle. Eventually captured particles begin to coat the disk media and headloss increases. When the backwash elevation is reached the wash pump energizes and the disks are washed just long enough to return the headloss to normal. The wash pump shuts off and the process repeats itself.

The dirty water is caught in a simple collection trough and leaves the filter under gravity flow. The entire backwash cycle normally takes 10-15 seconds to complete. The time between backwash cycles is highly variable based on influent turbidity and TSS loading. The typical cycles at SLR have been 1.5 – 2.0 minutes so far.

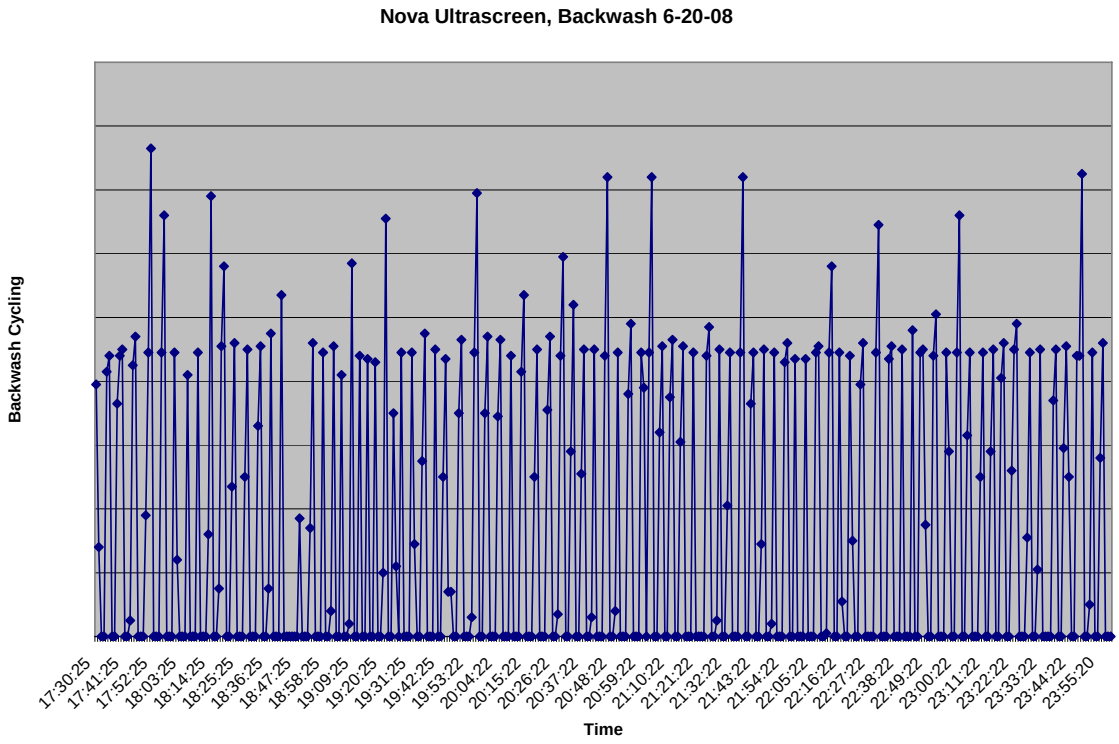
Reject – Using the pulse backwash approach the Nova filter has been able to produce reject rates that have been below one quarter of one percent to date. This is well below the reject rates of traditional cloth disk filters.

Note: On larger systems the individual backwash pumps would be replaced by a typical wash water pressure manifold that can feed wash water to all the filters in a given configuration. A simple solenoid controlled valve can operate at each filter to allow backwash water to flow when called for.

Additional backwash graphs and feed flow rate graphs are shown below.

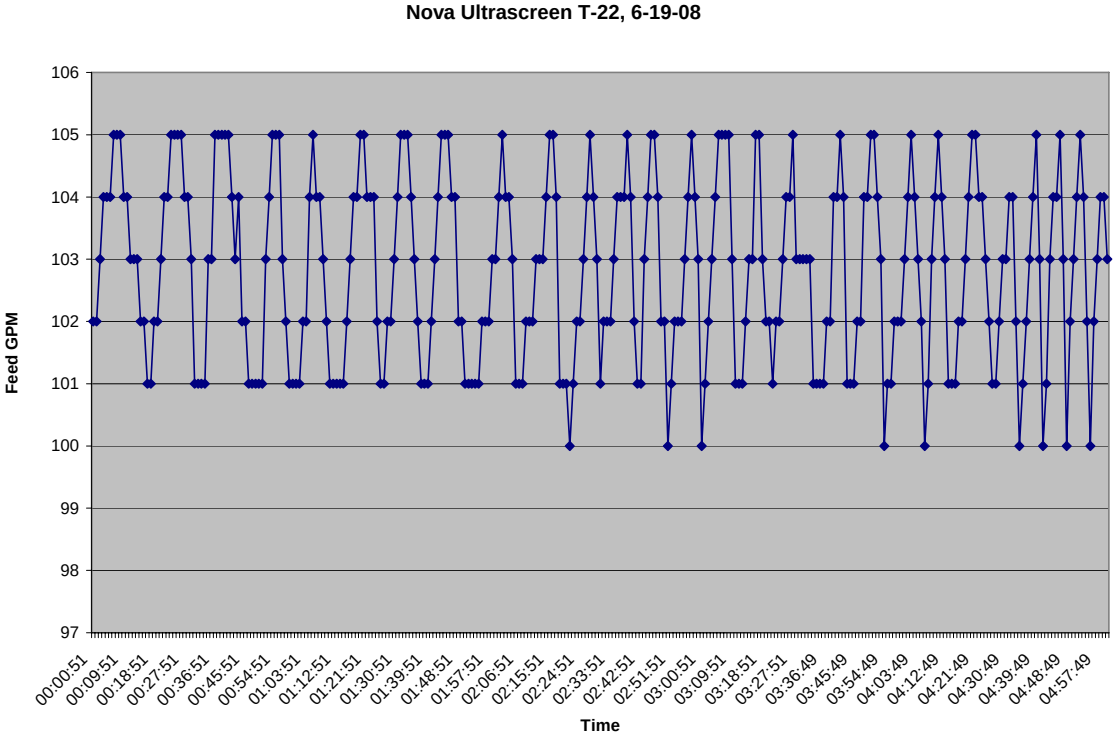



Typical pulse backwash cycles from June 19th.

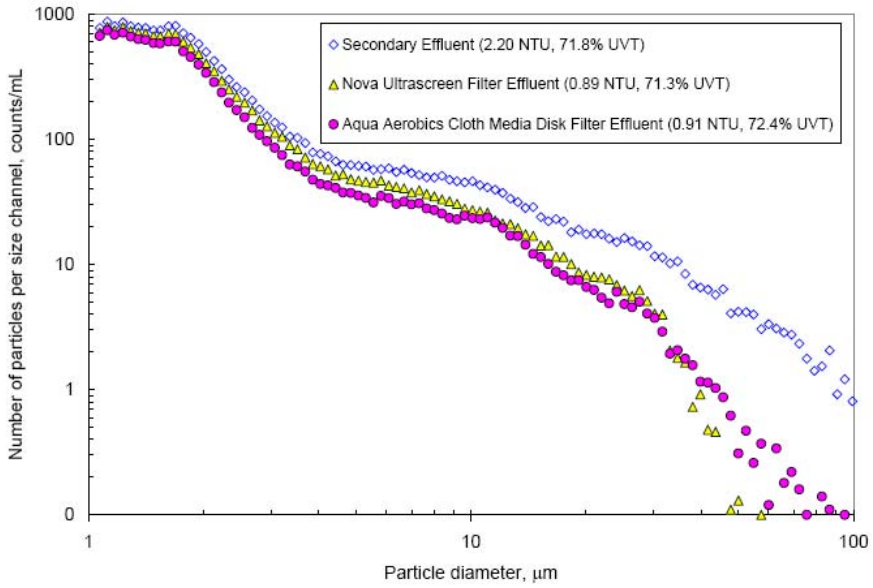



Typical pulse backwash cycles from June 20th.

The influent flow rate has also been data recorded. An example is below. The target flow rate is 102 gpm average for the Nova filter with 17 sq ft of filtration media for a hydraulic loading rate of 6 gpm/sq ft.




<u>Particle Counting and Size Distribution</u> - The Carollo testing is also looking at particle size removal and particle size distribution as part of their analytical work. Early test indications from samples suggest there is minimal difference between the cloth filter media and the stainless steel mesh performance in this regard. See the graph below.



In reviewing the graph show above it can be seen that the secondary clarifier is producing effluent with relatively low turbidity. The number of particles being removed by filtration in either filter is minimal until the 9-10 micron particle size range is reached. Both filters show approximately the same particle size distribution on particles smaller than about 9 microns and both filters show good removal of particles larger than 10 microns.

Summary - The significant difference in media selection appears to make little difference in the particle size distribution overall. The dynamic disk operation associated with the Nova filter is allowing the filter to operate at higher hydraulic loading and maintain approximately the same water quality as the cloth filter, 6 gpm/sq ft versus 3 gpm/sq ft for the first two weeks of testing.

The Nova filter so far has produced essentially equivalent turbidity performance compared to the cloth filter technology over a wide range of influent NTU values.

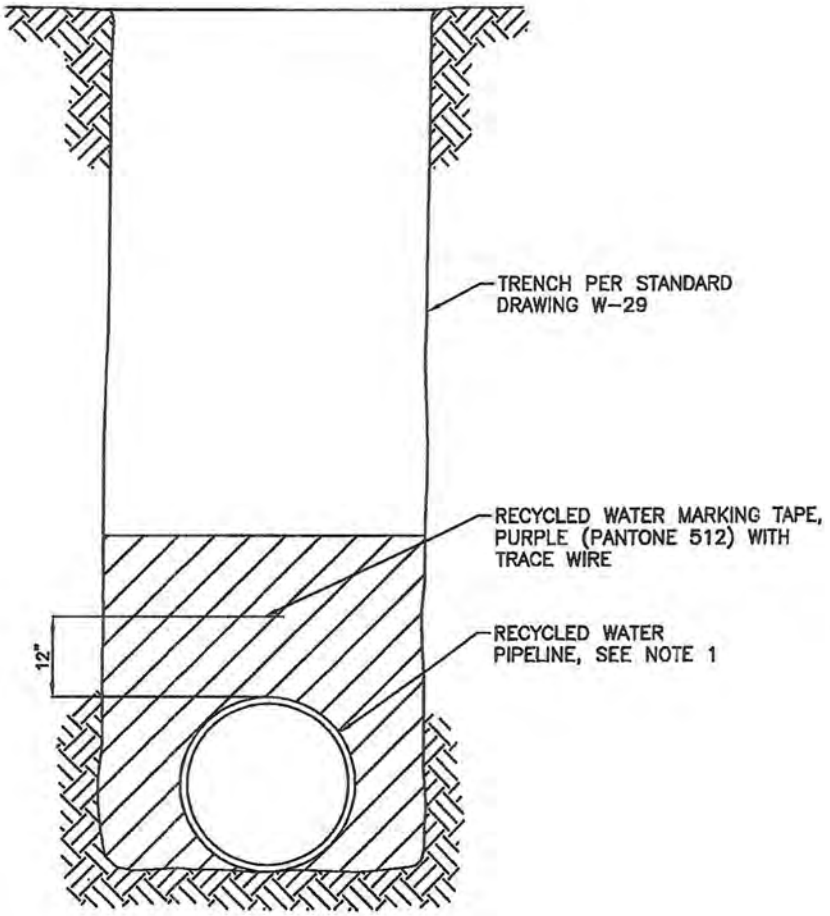
The Nova filter reject rate while operating at 6 gpm/sq ft has been measured in a separate collection vessel on multiple calibration runs and has been measured to be about one tenth of the reject rate of the cloth filter technology.

We also wish to thank Orange County for allowing us to be on site and utilizing their facility for this work.

# APPENDIX E
# STANDARD SPECIFICATIONS AND DRAWINGS FOR RECYCLED WATER FACILITIES

# RECYCLED WATER STANDARD DRAWINGS

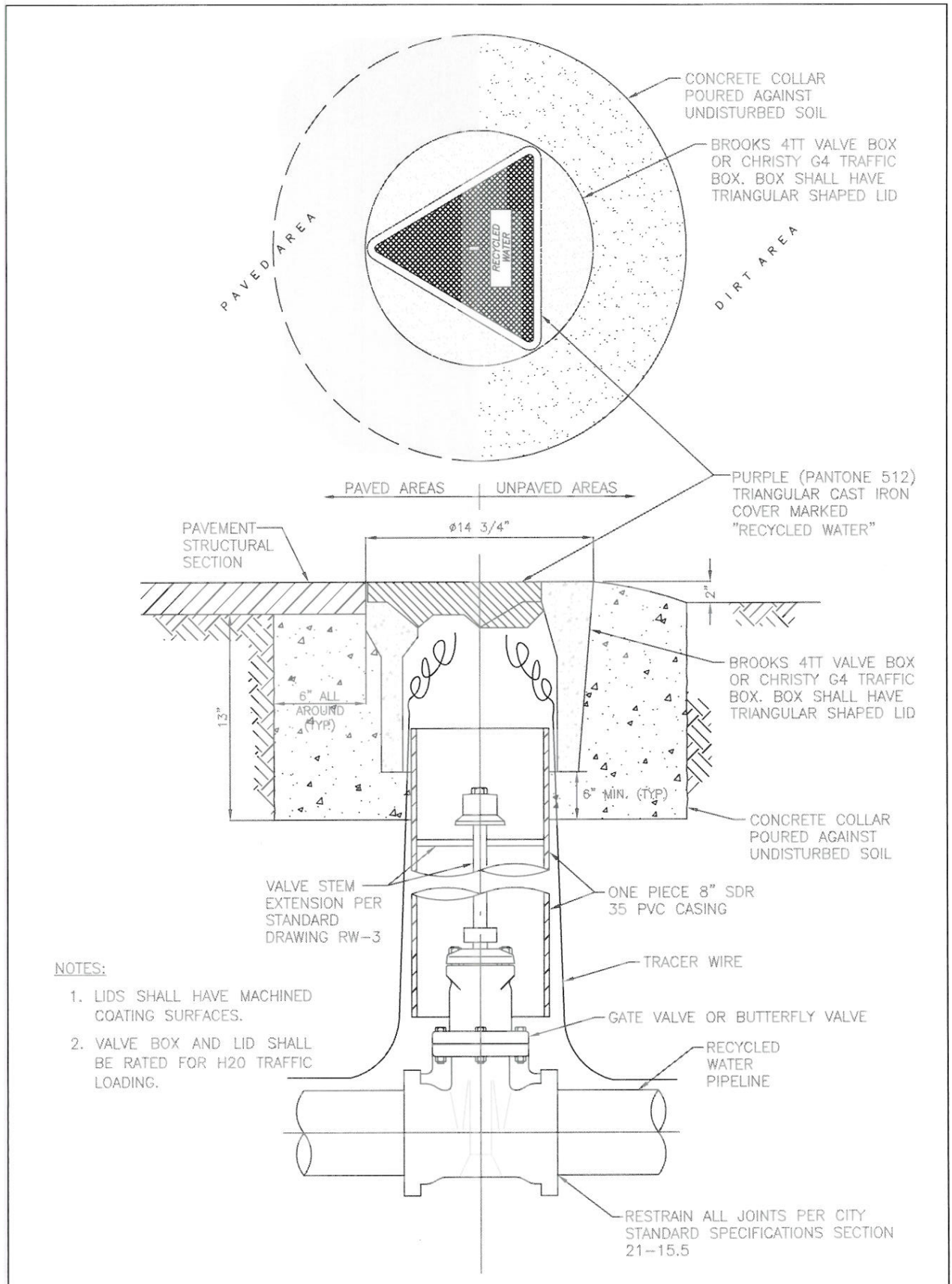
| NO. | TITLE OF DRAWING |
|---|---|
| ☐RW-1 | Recycled Water Main Identification |
| ☐RW-2 | Recycled Water Valve and valve Box |
| ☐RW-3 | Recycled Water Valve Stem Extension |
| ☐RW-4 | 1" Service Connection & Meter Box Installation |
| ☐RW-5 | 1-1/2" & 2" Service Connection & Meter Box Installation |
| ☐RW-6 | 4" Recycled Water Service |
| ☐RW-7 | Temporary 2" Recycled Water Blow-off |
| ☐RW-8 | Recycled Water Blow-off Assembly |
| ☐RW-9 | Recycled Water 1" or 2" Air Release/Vacuum Breaker Station |
| ☐RW-10 | Recycled Water 4" Air Release/Vacuum Breaker Station |
| ☐RW-11 | 1" or 2" Air Release/Vacuum Breaker Valve Enclosure |
| ☐RW-12 | Recycled Water Main Separation Requirements |
| ☐RW-13 | Recycled Water Irrigation Information Sign |
| ☐RW-14 | Recycled Water Remote Control Irrigation valve Identification |
| ☐RW-15 | Recycled Water Backflow Preventer Identification |
| ☐RW-16 | Recycled Water Irrigation Box Cover Markings |
| ☐RW-17 | Recycled Water Irrigation System Clock Marking |
| ☐RW-18 | General Recycled Water Identification Tag |
| ☐RW-19 | Recycled Water Landscape Irrigation Head Identification |
| ☐RW-20 | Quick Coupling Valve |
| ☐RW-21 | Cross Connection Control Test Station |
| ☐RW-22 | Temporary Potable Water Supply to On-site Recycled Water System |
| ☐RW-23 | Temporary Potable Water Supply to Recycled Water System |




NOTE:

1. RECYCLED WATER PIPELINES SHALL BE COLORED PURPLE (PANTONE 512) AND INTEGRALLY STAMPED "RECYCLED WATER – DO NOT DRINK" ON OPPOSITE SIDES OF THE PIPE. ALTERNATIVELY, NON-PVC RECYCLED WATER PIPELINES MAY BE MARKED WITH LETTERING ON PURPLE MARKING TAPE BEARING THE CONTINUOUS WORDING "RECYCLED WATER-DO NOT DRINK". THE MARKING TAPE SHALL BE A MINIMUM OF SIX INCHES WIDE AND SHALL BE SECURELY ATTACHED DIRECTLY TO THE TOP OF THE PIPELINE EVERY FIVE FEET.

| RECYCLED WATER MAIN IDENTIFICATION | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-1 |
|---|---|---|




NOTES:

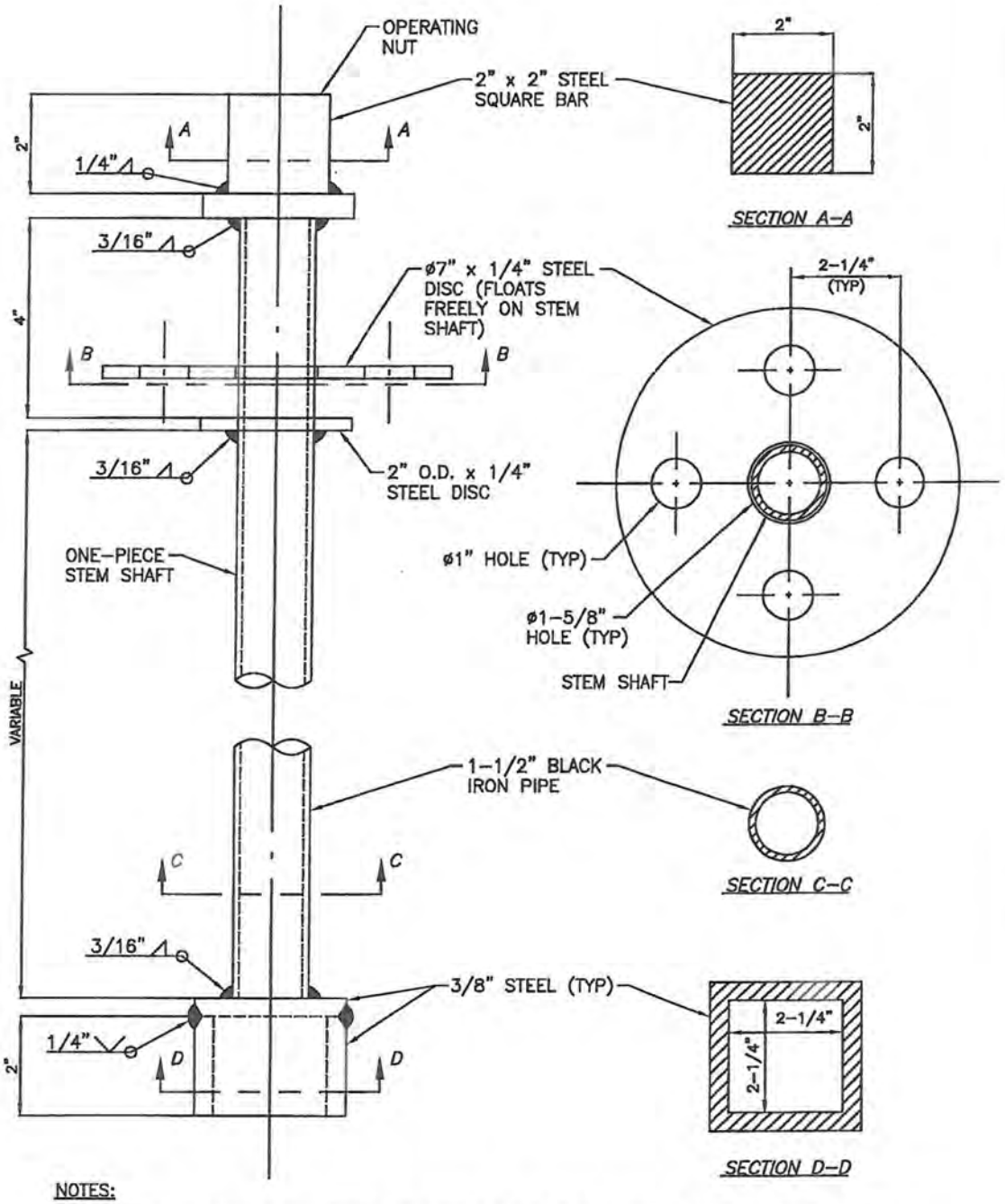
1. LIDS SHALL HAVE MACHINED COATING SURFACES.
2. VALVE BOX AND LID SHALL BE RATED FOR H20 TRAFFIC LOADING.

# RECYCLED WATER VALVE AND VALVE BOX

REF. & REV. AUGUST 2015

CITY OF FRESNO

RW-2




NOTES:

1. EXTENSION STEM SHAFT SHALL BE ROUND OR SQUARE STEEL TUBING OF ONE-PIECE DESIGN (NO PINNED CONNECTIONS OR COUPLINGS PERMITTED).
2. VALVES DEEPER THAN 5' REQUIRE A VALVE STEM EXTENSION.
3. EXTENSION STEMS SHALL NOT BE ATTACHED/BOLTED TO OPERATING NUT OF THE VALVE.
4. VALVE STEM EXTENSION SHALL BE HOT DIP GALVANIZED AFTER FABRICATION IS COMPLETE.

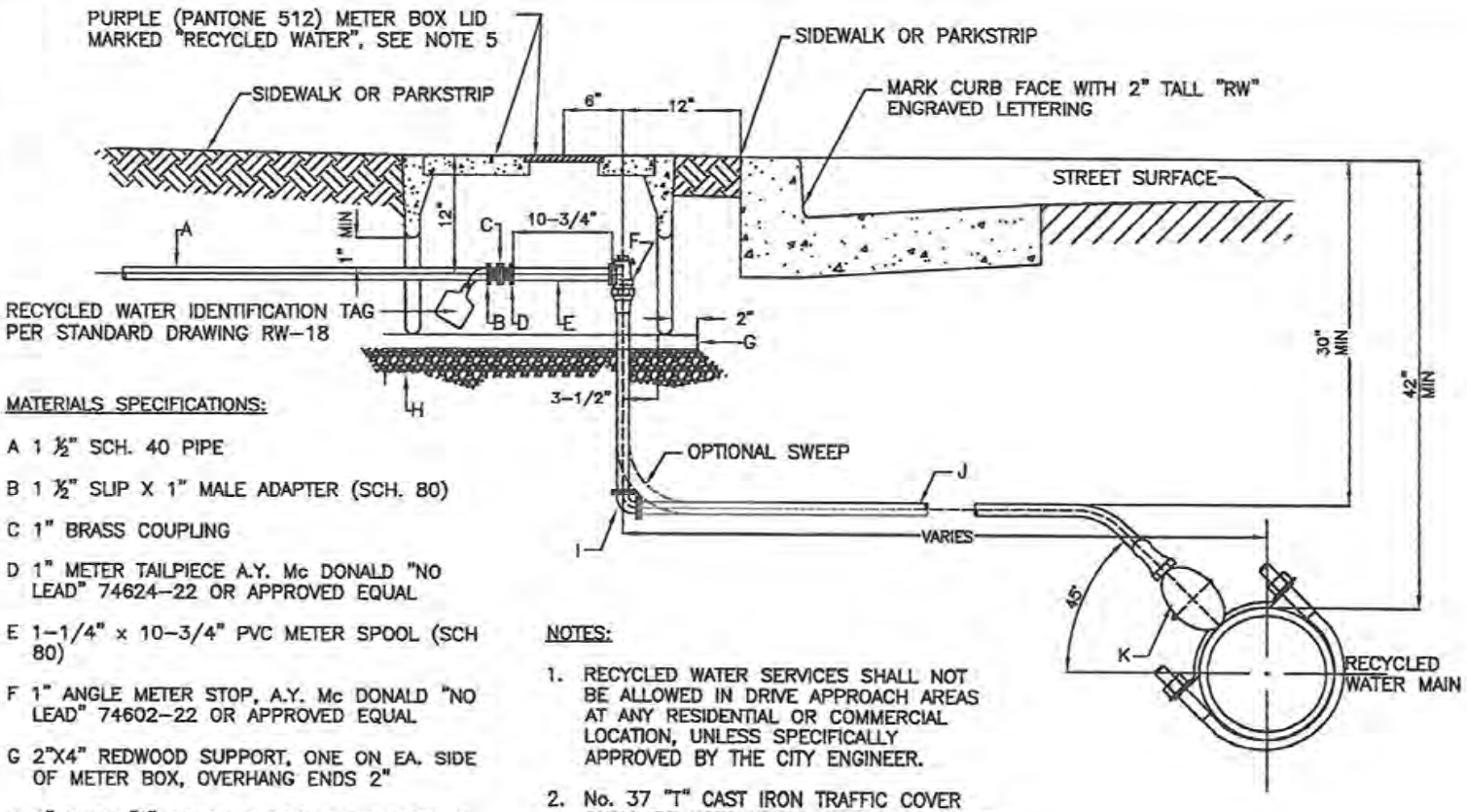
| RECYCLED WATER VALVE STEM EXTENSION | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-3 |
|---|---|---|

# 1" SERVICE CONNECTION & METER BOX INSTALLATION

REF. & REV. JUNE 2014

CITY OF FRESNO

RW-4




MATERIALS SPECIFICATIONS:

A 1 ½" SCH. 40 PIPE

B 1 ½" SLIP X 1" MALE ADAPTER (SCH. 80)

C 1" BRASS COUPLING

D 1" METER TAILPIECE A.Y. Mc DONALD "NO LEAD" 74624-22 OR APPROVED EQUAL

E 1-1/4" x 10-3/4" PVC METER SPOOL (SCH 80)

F 1" ANGLE METER STOP, A.Y. Mc DONALD "NO LEAD" 74602-22 OR APPROVED EQUAL

G 2"X4" REDWOOD SUPPORT, ONE ON EA. SIDE OF METER BOX, OVERHANG ENDS 2"

H 6" THICK ¾" CRUSHED ROCK WHEN BOX IS PLACED IN ALLEYS WITH TRASH PICK UP ONLY. ALL BOXES IN ALLEYS SHALL BE PLACED PARALLEL TO ALLEY

I COMP X COMP 90° ELL, A.Y. Mc DONALD "NO LEAD" 74761-22 OR APPROVED EQUAL

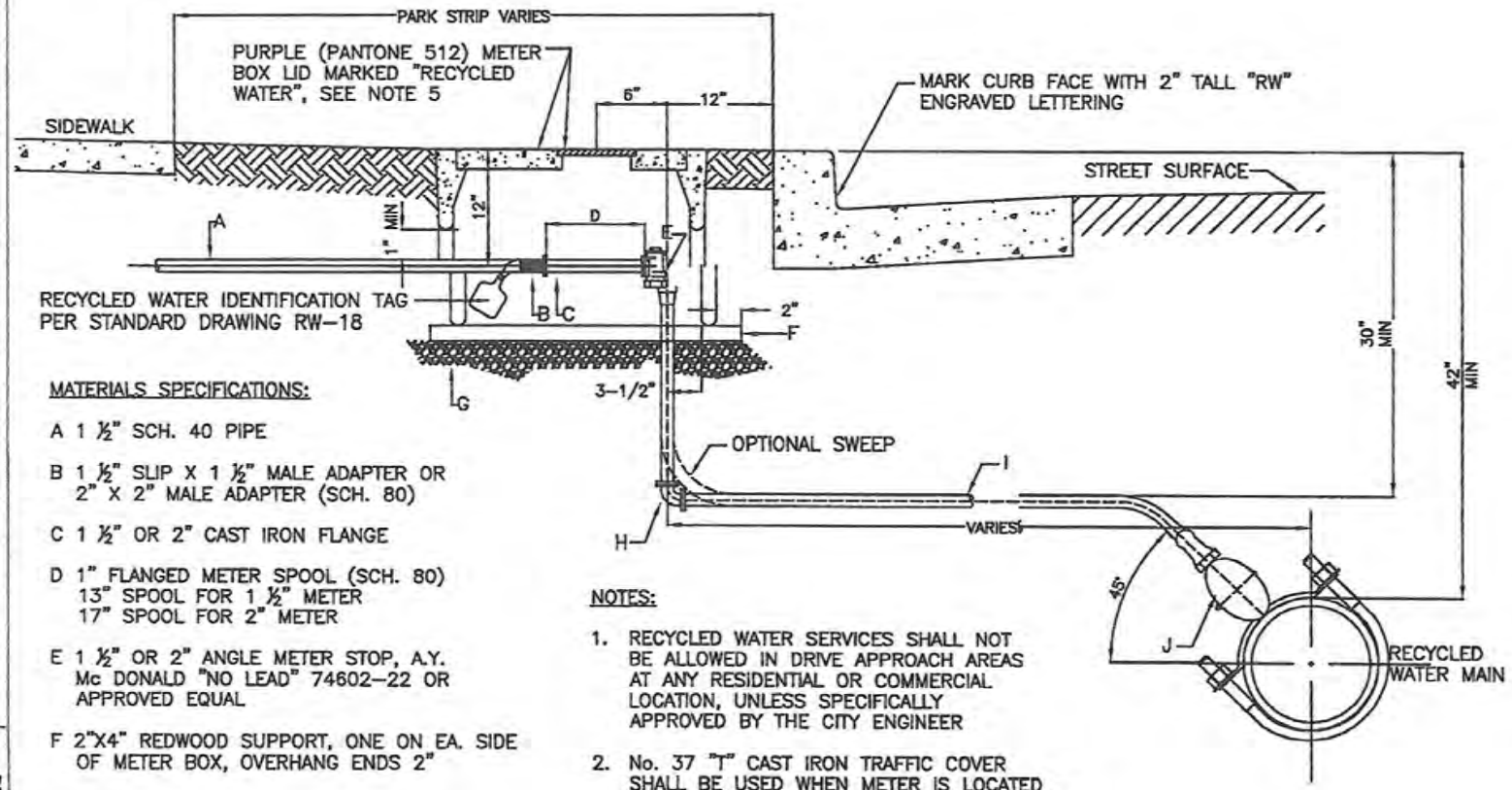
J TYPE "K" SOFT DRAWN COPPER TUBING CONTINUOUSLY WRAPPED IN PURPLE MARKING TAPE OR PURPLE (PANTONE 512) POLYETHYLENE CTS SDR-9 PE 3408, USE COMPRESSION JOINTS WITH STAILESS STEEL INSERT

K 1" CORPORATION STOP A.Y. Mc DONALD "NO LEAD" 74701-22 OR APPROVED EQUAL

NOTES:

1. RECYCLED WATER SERVICES SHALL NOT BE ALLOWED IN DRIVE APPROACH AREAS AT ANY RESIDENTIAL OR COMMERCIAL LOCATION, UNLESS SPECIFICALLY APPROVED BY THE CITY ENGINEER.
2. No. 37 "T" CAST IRON TRAFFIC COVER SHALL BE USED WHEN METER IS LOCATED IN ALLEYS OR DRIVE APPROACH AREAS, OR BEHIND ROLLED CURBS.
3. ALL COPPER FITTINGS SHALL BE CAMPAK COMPRESSION-TYPE.
4. FOR PVC RECYCLED WATER MAIN TAPS, SERVICE SADDLES WITH CIRCUMFERENTIAL TYPE BANDS SHAPED TO FIT THE ACTUAL O.D. OF THE PIPE AND HAVING A MINIMUM BEARING WIDTH OF 3" (1-1/2" PER BAND) SHALL BE USED. FOR DUCTILE AND CAST IRON MAINS USE BRONZE OR DUCTILE IRON SERVICE SADDLES, WITH BRONZE OR STAINLESS DOUBLE STRAPS.
5. METER BOX SHALL BE OLD CASTLE B16 OR N16 BOX WITH CAST-IN CORNER BRACKETS. USE ARMORCAST A6000489T-COF LID
6. RECYCLED WATER SERVICES SHALL BE LOCATED A MINIMUM OF 4' CLEAR OF POTABLE WATER SERVICES.

# 1-1/2" & 2" SERVICE CONNECTION & METER BOX INSTALLATION




MATERIALS SPECIFICATIONS:

A 1 ½" SCH. 40 PIPE

B 1 ½" SLIP X 1 ½" MALE ADAPTER OR 2" X 2" MALE ADAPTER (SCH. 80)

C 1 ½" OR 2" CAST IRON FLANGE

D 1" FLANGED METER SPOOL (SCH. 80)
13" SPOOL FOR 1 ½" METER
17" SPOOL FOR 2" METER

E 1 ½" OR 2" ANGLE METER STOP, A.Y. Mc DONALD "NO LEAD" 74602-22 OR APPROVED EQUAL

F 2"X4" REDWOOD SUPPORT, ONE ON EA. SIDE OF METER BOX, OVERHANG ENDS 2"

G 6" THICK ¾" CRUSHED ROCK WHEN BOX IS PLACED IN ALLEYS WITH TRASH PICK UP ONLY. ALL BOXES IN ALLEYS SHALL BE PLACED PARALLEL TO ALLEY

H COMP X COMP 90° ELL, A.Y. Mc DONALD "NO LEAD" 74761-22 OR APPROVED EQUAL

I TYPE "K" SOFT DRAWN COPPER TUBING CONTINUOUSLY WRAPPED IN PURPLE MARKING TAPE OR PURPLE (PANTONE 512) POLYETHYLENE CTS SDR-9 PE 3408, USE COMPRESSION JOINTS WITH STAINLESS STEEL INSERT

J 1" CORPORATION STOP A.Y. Mc DONALD "NO LEAD" 74701-22 OR APPROVED EQUAL

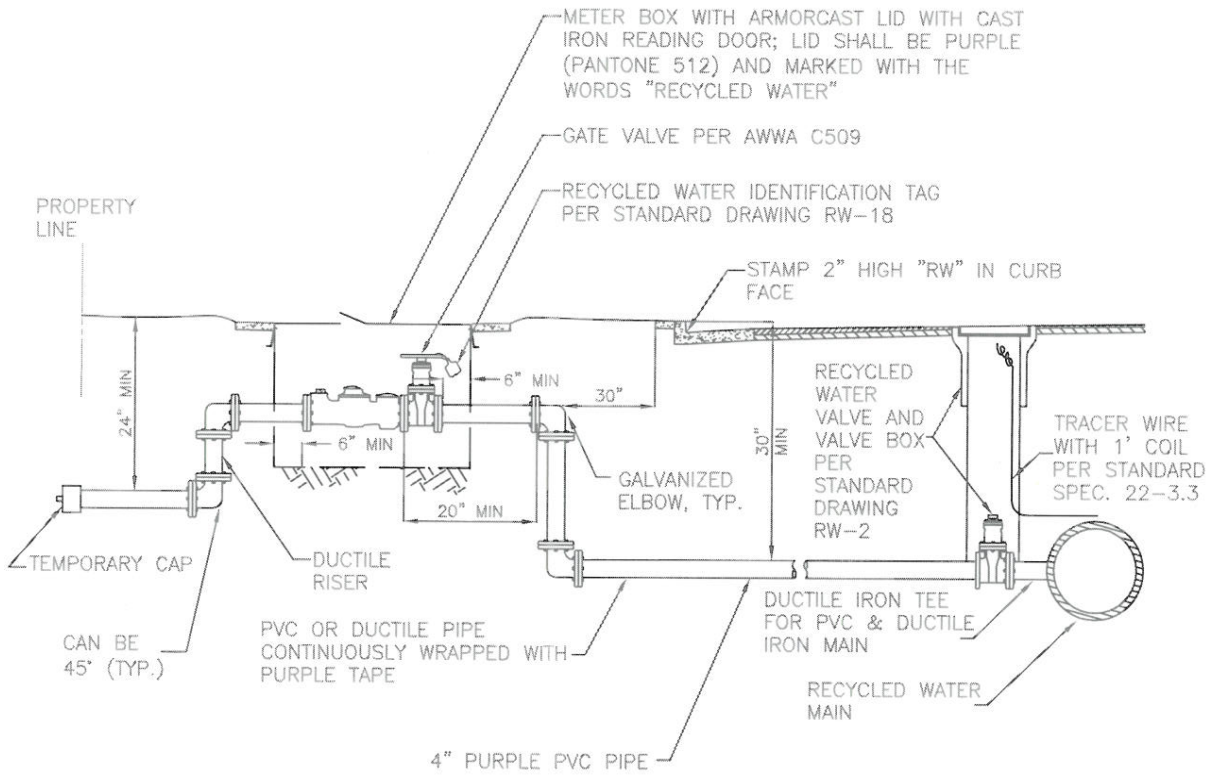
NOTES:

1. RECYCLED WATER SERVICES SHALL NOT BE ALLOWED IN DRIVE APPROACH AREAS AT ANY RESIDENTIAL OR COMMERCIAL LOCATION, UNLESS SPECIFICALLY APPROVED BY THE CITY ENGINEER
2. No. 37 "T" CAST IRON TRAFFIC COVER SHALL BE USED WHEN METER IS LOCATED IN ALLEYS OR DRIVE APPROACH AREAS, OR BEHIND ROLLED CURBS.
3. ALL COPPER FITTINGS SHALL BE CAMPAK COMPRESSION-TYPE.
4. POLYETHYLENE PIPE SHALL USE CAMPAK COMPRESSION-TYPE JOINTS WITH STAINLESS STEEL INSERT.
5. FOR 1½" SERVICE, METER BOX SHALL BE ARMORCAST OR APPROVED EQUAL. OLD CASTLE B30 BOX W/ CAST-IN CORNER BRACKETS ARMORCAST A6001969-COF LID FOR 1 ½" METER OR OLD CASTLE B36 BOX W/ CAST-IN CORNER BRACKETS & ARMORCAST A6001947T-COF LID FOR 2" METER.
6. FOR PVC RECYCLED WATER MAIN TAPS, SERVICE SADDLES WITH CIRCUMFERENTIAL TYPE BANDS SHAPED TO FIT THE ACTUAL O.D. OF THE PIPE AND HAVING A MINIMUM BEARING WIDTH OF 3" (1-1/2" PER BAND) SHALL BE USED. FOR DUCTILE AND CAST IRON MAINS USE BRONZE OR DUCTILE IRON SERVICE SADDLES, WITH BRONZE OR STAINLESS DOUBLE STRAPS.
7. RECYCLED WATER SERVICES SHALL BE LOCATED A MINIMUM OF 4' CLEAR OF POTABLE WATER SERVICES.

REF. & REV. JUNE 2014

CITY OF FRESNO

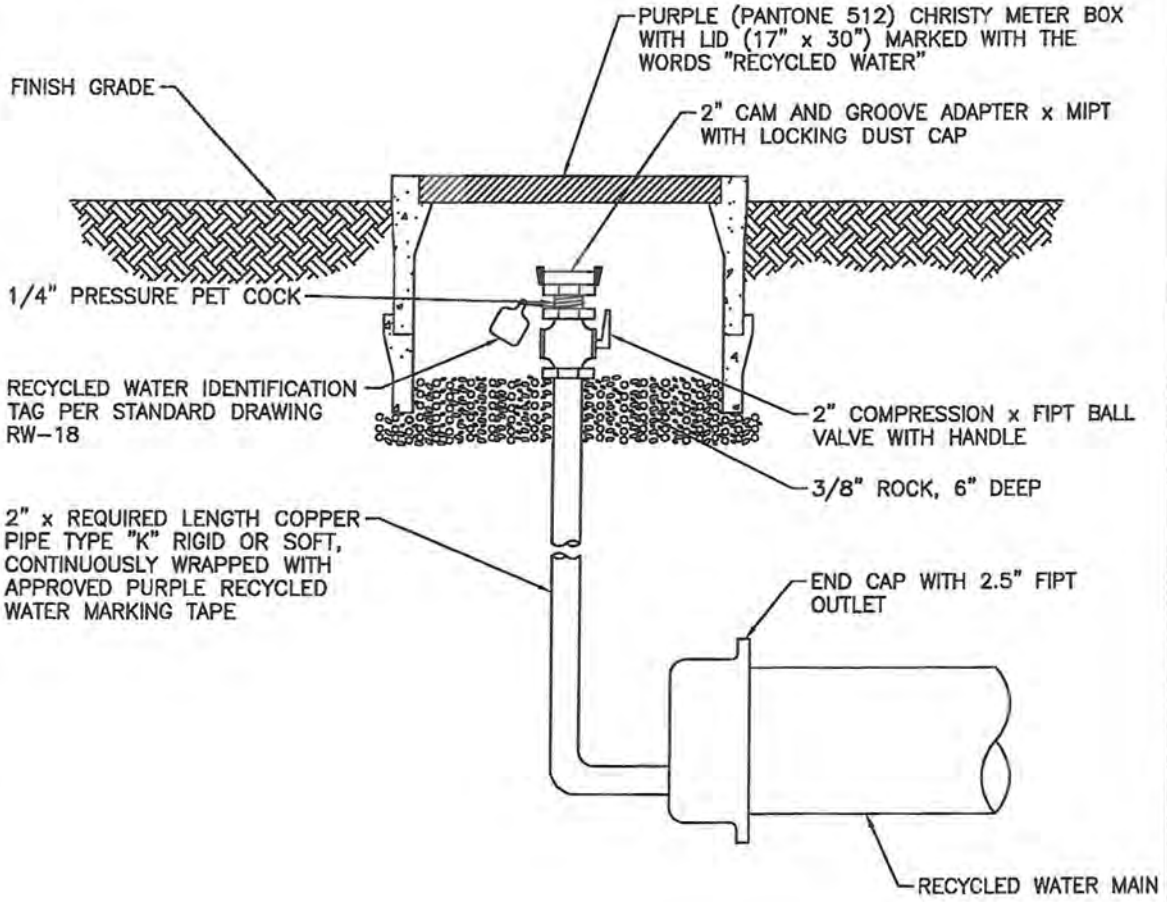
RW-5




NOTES:

1. RECYCLED WATER SERVICE AND METER BOX INSTALLATION SHALL BE INSPECTED AND APPROVED BY CITY PRIOR TO SIDEWALK INSTALLATION.
2. RECYCLED WATER SERVICES SHALL BE LOCATED A MINIMUM OF 4' CLEAR OF POTABLE WATER SERVICES.
3. ALL MATERIALS SHALL BE AS NOTED OR CITY-APPROVED EQUAL.
4. ALL METER BOXES IN DIRT OR LANDSCAPE AREAS SHALL BE SET IN A 6" CONCRETE SLAB MEASURING AT LEAST 1' BEYOND METER BOX ON ALL SIDES.
5. RESTRAIN ALL JOINTS PER CITY STANDARD SPECIFICATIONS SECTION 21-15.5
6. RECYCLED WATER SERVICES SHALL NOT BE ALLOWED IN DRIVEWAY APPROACH AREAS AT ANY RESIDENTIAL OR COMMERCIAL LOCATION.

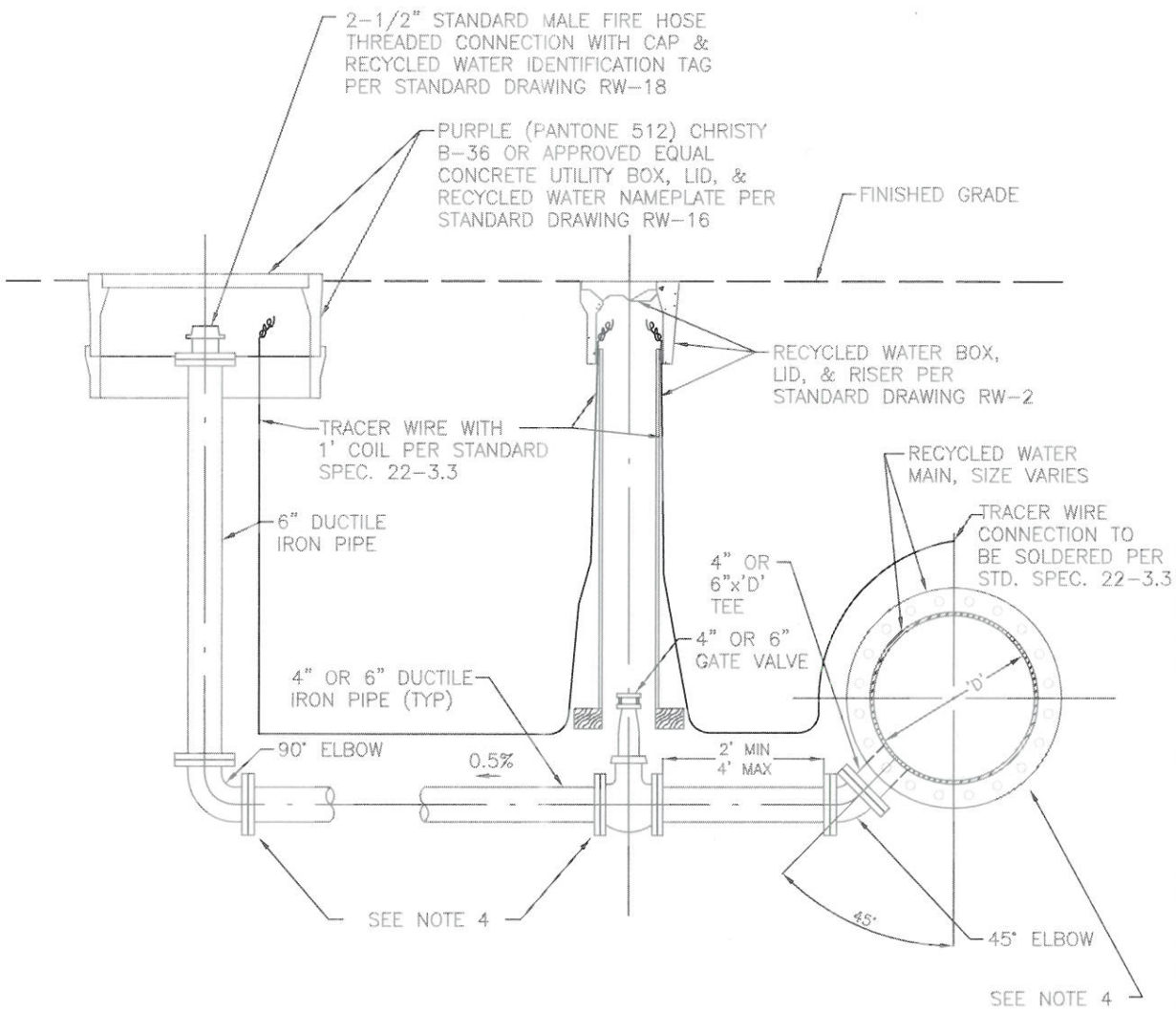
| 4" RECYCLED WATER SERVICE | REF. & REV. AUGUST 2015 | CITY OF FRESNO RW-6 |
|---|---|---|




NOTES:

1. SET TOP OF METER BOX 2" ABOVE FINISH GRADE.
2. THE CONSTRUCTION OF A TEMPORARY BLOW-OFF FOR THE USE OF TESTING AND FLUSHING OF NEW RECYCLED WATER MAINS ONLY.
3. RESTRAIN ALL JOINTS PER CITY STANDARD SPECIFICATIONS SECTION 21-15.5

| TEMPORARY 2" RECYCLED WATER BLOW-OFF | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-7 |
|---|---|---|




NOTES:

1. ALL FITTINGS SHALL BE SECURED WITH FLANGE CONNECTION, HARNESSES OR TIE-RODS AS APPLICABLE.
2. PLACE VALVES AND BLOW-OFFS OUTSIDE SIDEWALK AND DRIVEWAY AREAS.
3. ALL RISERS SHALL BE FLANGED, 6" DIAMETER.
4. RESTRAIN ALL JOINTS PER CITY STANDARD SPECIFICATIONS SECTION 21-15.5

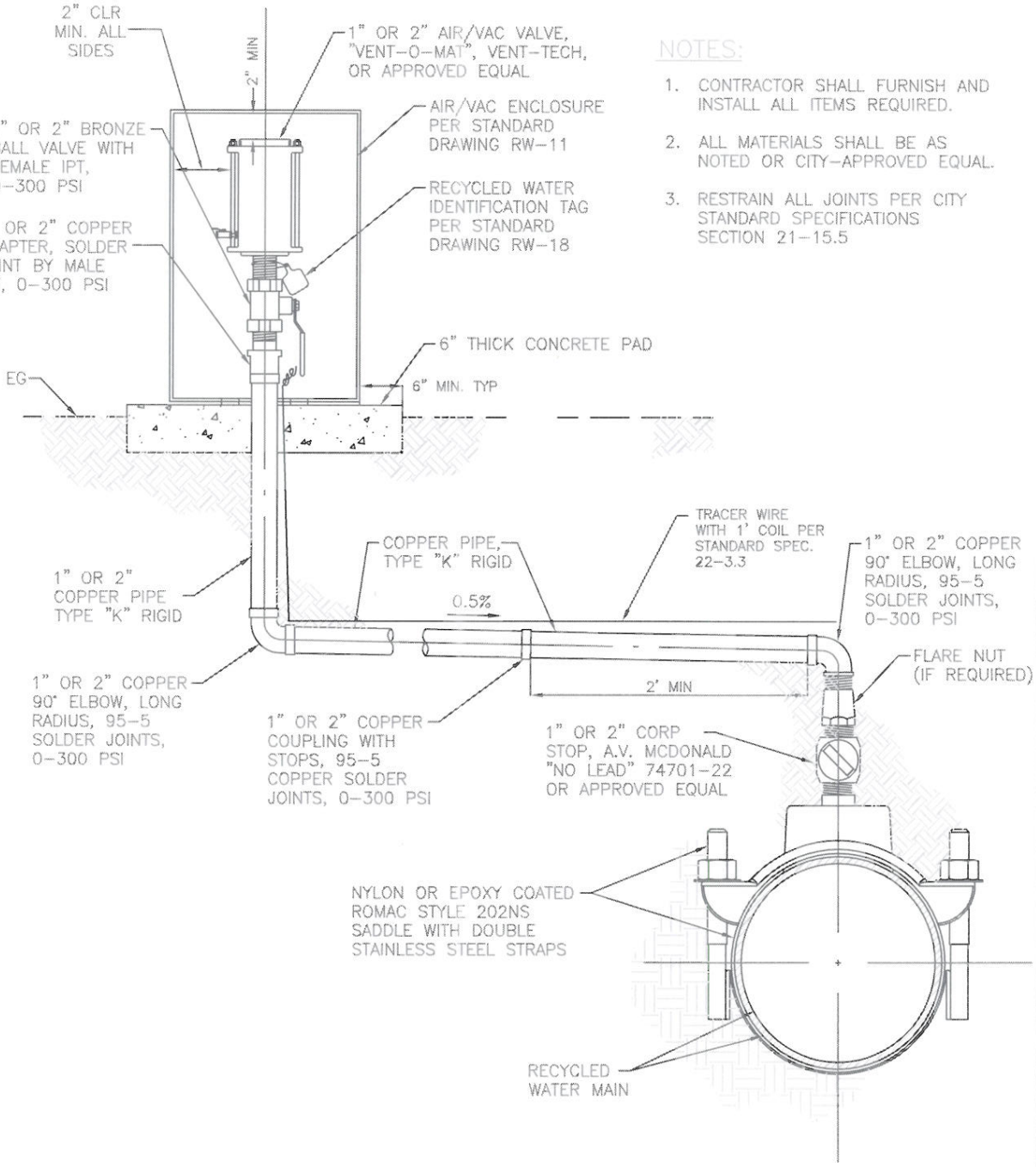
| BLOW-OFF PIPE SIZE SCHEDULE | |
|---|---|
| MAIN | BLOW-OFF |
| 6" | 4" |
| 8" | 4" |
| 10" | 4" |
| 12" | 6" |
| 14" | 6" |
| 16" | 6" |
| 18" | 6" |
| 24" | 6" |
| 30" | 6" |

# RECYCLED WATER BLOW-OFF ASSEMBLY

REF. & REV. AUGUST 2015

CITY OF FRESNO

RW-8




NOTES:

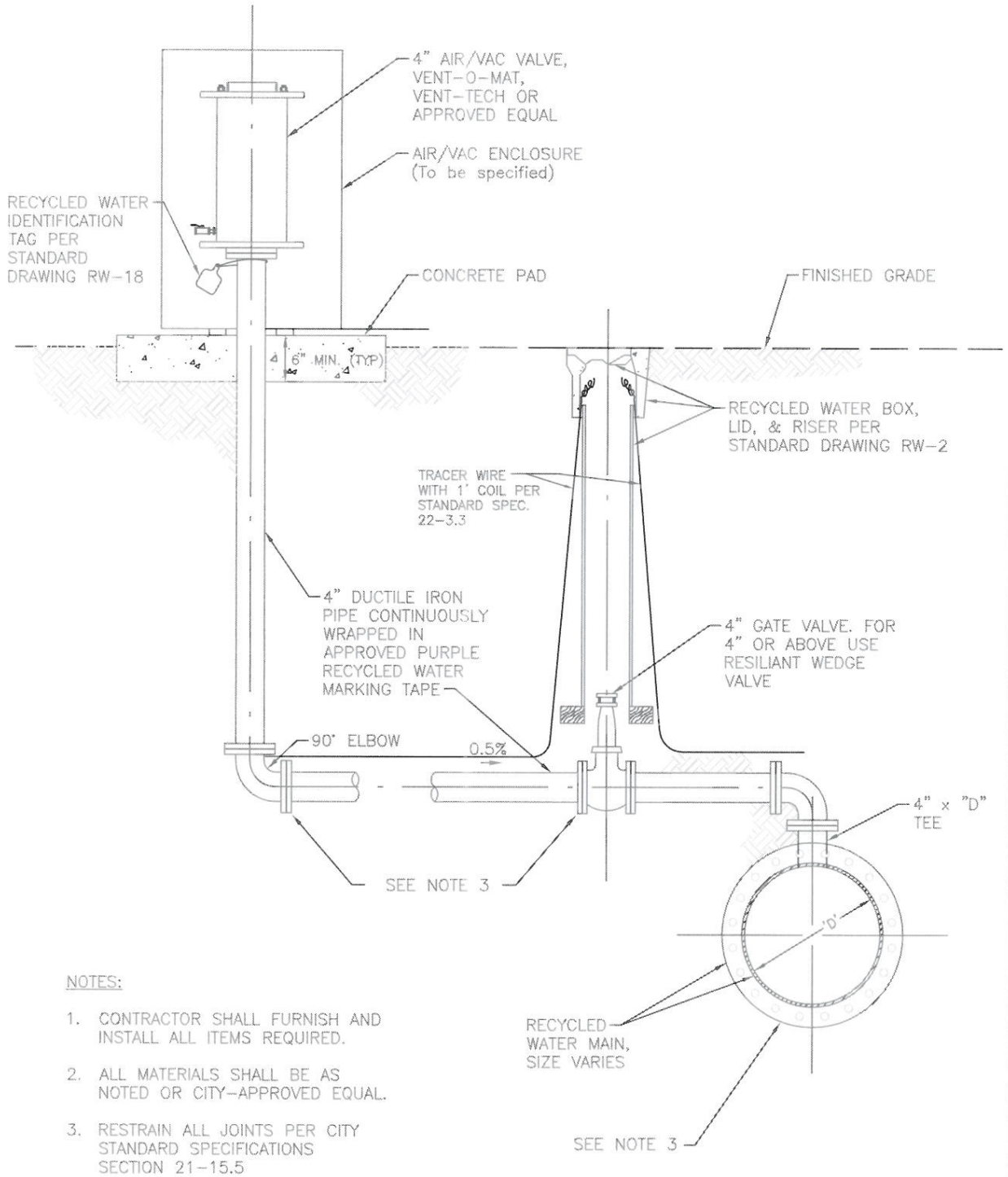
1. CONTRACTOR SHALL FURNISH AND INSTALL ALL ITEMS REQUIRED.
2. ALL MATERIALS SHALL BE AS NOTED OR CITY-APPROVED EQUAL.
3. RESTRAIN ALL JOINTS PER CITY STANDARD SPECIFICATIONS SECTION 21-15.5

# RECYCLED WATER 1" OR 2" AIR RELEASE/VACUUM BREAKER STATION

REF. & REV. AUGUST 2015

CITY OF FRESNO

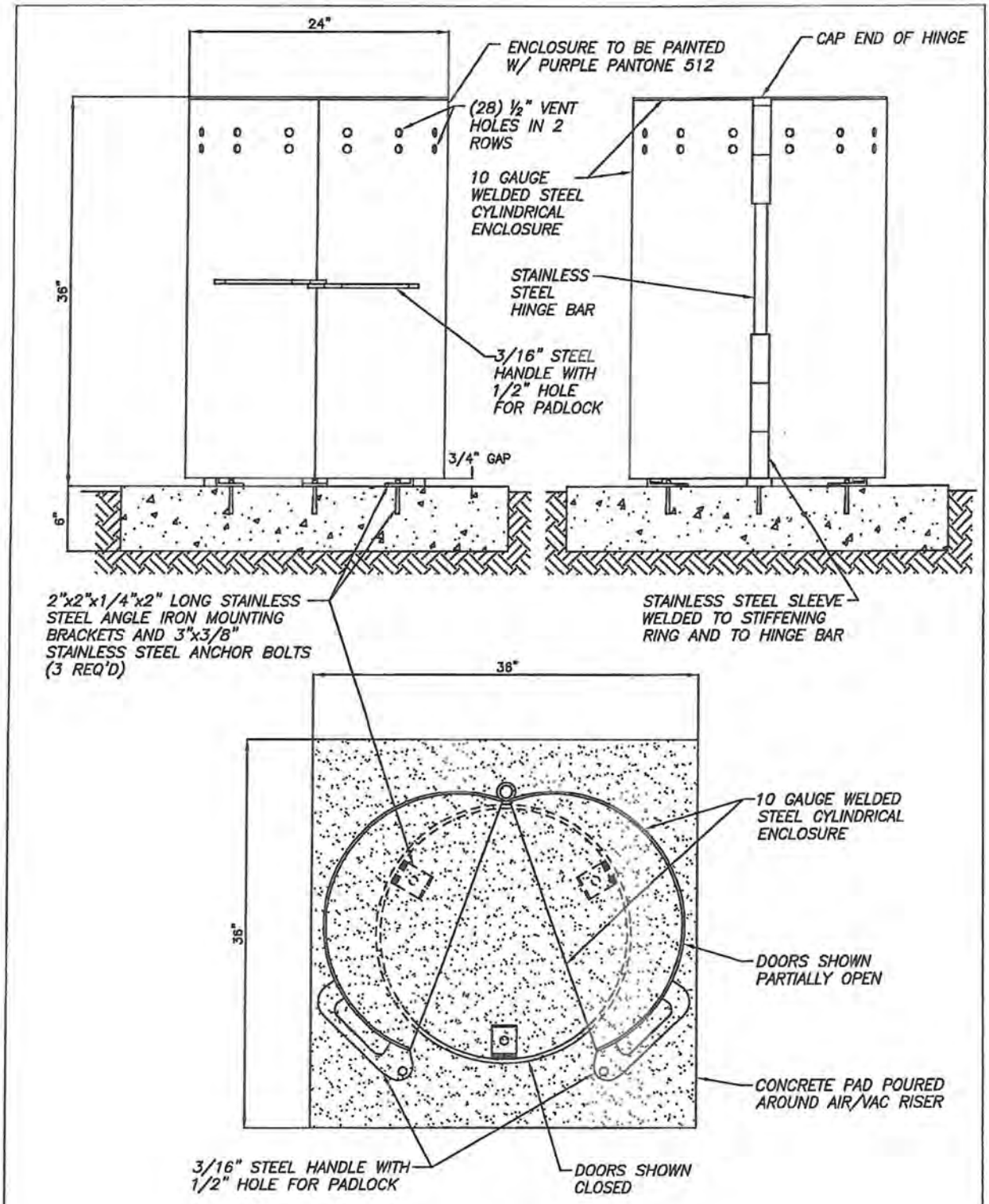
RW-9



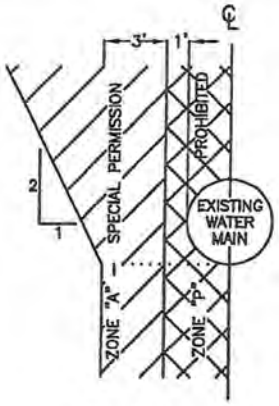

NOTES:

1. CONTRACTOR SHALL FURNISH AND INSTALL ALL ITEMS REQUIRED.
2. ALL MATERIALS SHALL BE AS NOTED OR CITY-APPROVED EQUAL.
3. RESTRAIN ALL JOINTS PER CITY STANDARD SPECIFICATIONS SECTION 21-15.5

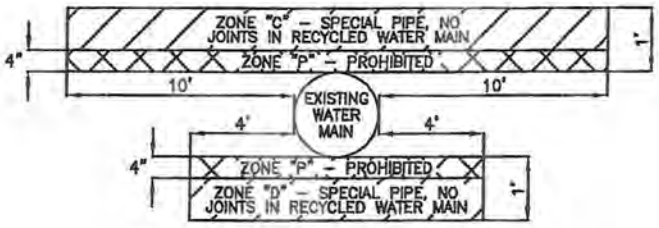
| RECYCLED WATER 4" AIR RELEASE/ VACUUM BREAKER STATION | REF. & REV. AUGUST 2015 | CITY OF FRESNO RW-10 |
|---|---|---|



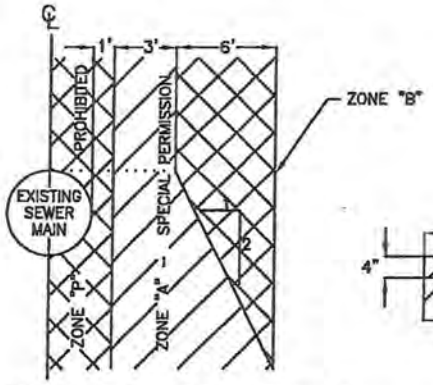

| 1" OR 2" AIR RELEASE/ VACUUM BREAKER VALVE ENCLOSURE | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-11 |
|---|---|---|



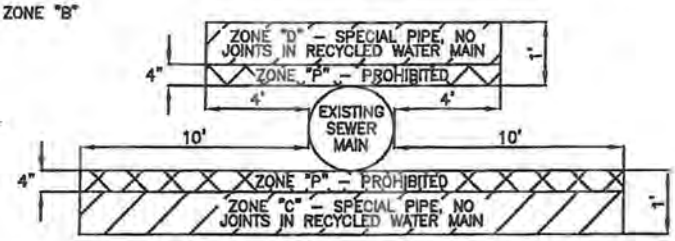

RECYCLED WATER MAIN PARALLEL TO POTABLE WATER MAINS




RECYCLED WATER MAIN CROSSING POTABLE WATER MAINS




RECYCLED WATER MAIN PARALLEL TO SEWER MAINS




RECYCLED WATER MAIN CROSSING SEWER MAINS

SPECIAL CONSTRUCTION REQUIRED FOR RECYCLED WATER

ZONE:

"A" NO RECYCLED WATER LINES PARALLEL TO WATER MAINS SHALL BE PERMITTED IN THIS ZONE WITHOUT PRIOR WRITTEN APPROVAL FROM COUNTY, CALIFORNIA DEPARTMENT OF PUBLIC HEALTH AND THE CITY.

"B" RECYCLED WATER MAIN SHALL BE CONSTRUCTED OF:
1. DUCTILE IRON PIPE WITH HOT DIP BITUMINOUS COATING.
2. DIPPED AND WRAPPED 1/4" THICK WELDED STEEL PIPE.
3. CLASS 305 PRESSURE RATED PLASTIC WATER PIPE (DR 14 PER AWWA C900) OR EQUIVALENT.
4. REINFORCED CONCRETE PRESSURE PIPE, STEEL CYLINDER TYPE, PER AWWA (C300 OR C302 OR C303).

"C" A RECYCLED WATER MAIN SHALL BE CONSTRUCTED OF:
1. DUCTILE IRON PIPE WITH HOT DIP BITUMINOUS COATING.
2. DIPPED AND WRAPPED 1/4" THICK WELDED STEEL PIPE.
3. CLASS 305 PRESSURE RATED PLASTIC WATER PIPE (DR 14 PER AWWA C900) OR EQUIVALENT.
4. REINFORCED CONCRETE PRESSURE PIPE, STEEL CYLINDER TYPE PER AWWA (C300 OR C302 OR C303).

"D" A RECYCLED WATER MAIN SHALL BE CONSTRUCTED OF:
1. DUCTILE IRON PIPE WITH HOT DIP BITUMINOUS COATING.
2. DIPPED AND WRAPPED 1/4" WELDED STEEL PIPE.
3. CLASS 200 PRESSURE RATED PLASTIC WATER PIPE (DR 14 PER AWWA C900) OR EQUIVALENT.
4. REINFORCED CONCRETE PRESSURE PIPE STEEL CYLINDER TYPE, PER AWWA (C300 OR C302 OR C303).

"P" NO RECYCLED WATER MAIN SHALL BE CONSTRUCTED

BASIC SEPARATION STANDARDS

1. SEPARATION DISTANCE SHALL BE MEASURED FROM THE NEAREST OUTSIDE EDGE OF PIPE.

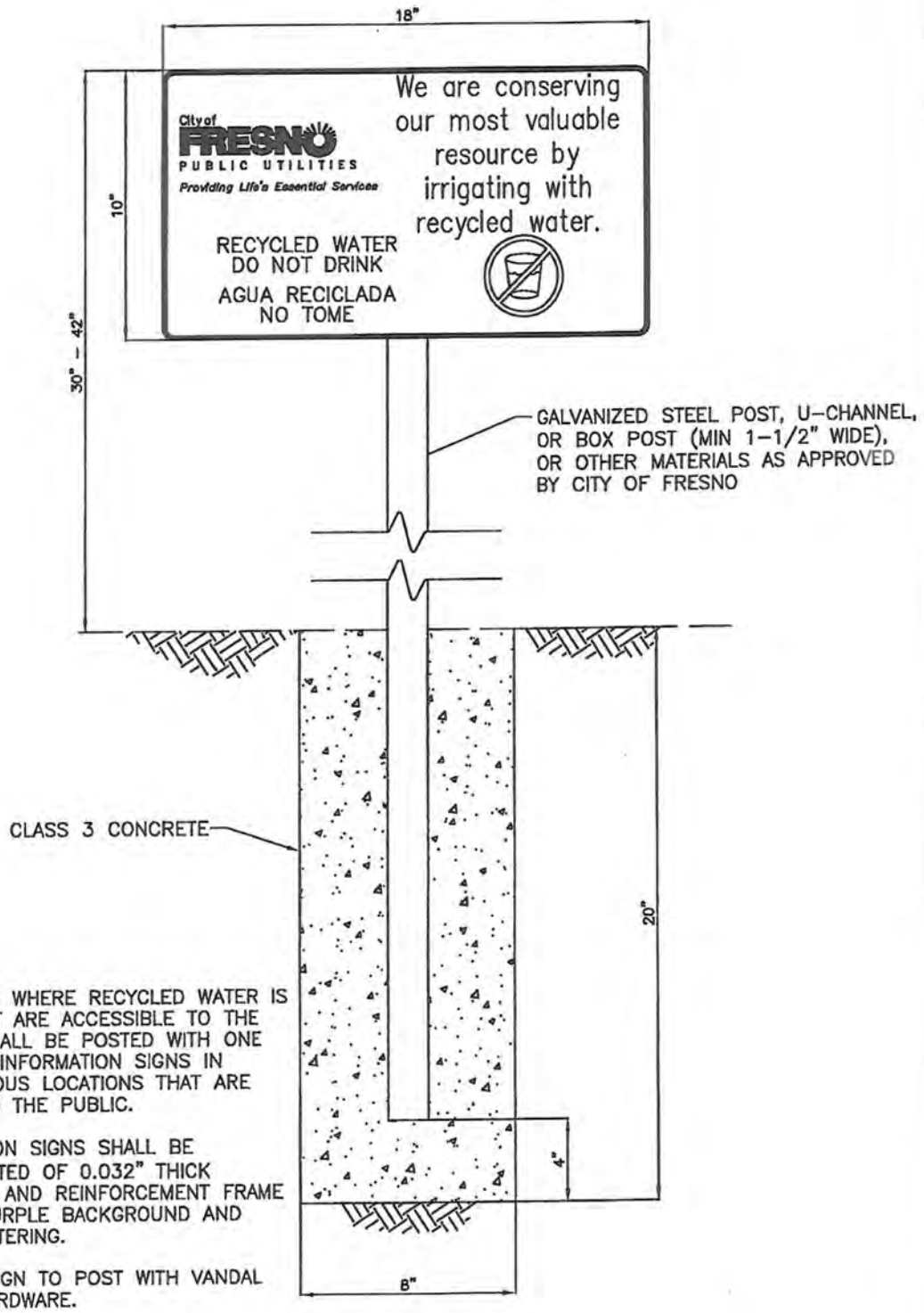
2. WATER MAINS AND SUPPLY LINES OF 24" DIAMETER OR GREATER MAY CREATE SPECIAL HAZARDS BECAUSE OF THE LARGE VOLUMES OF FLOW. INSTALLATIONS OF WATER MAINS AND SUPPLY LINES 24" DIAMETER OR LARGER MUST BE REVIEWED AND APPROVED BY THE HEALTH AGENCY AND CITY ENGINEER PRIOR TO CONSTRUCTION.

# RECYCLED WATER MAIN SEPARATION REQUIREMENTS

REF. & REV. JUNE 2014

CITY OF FRESNO

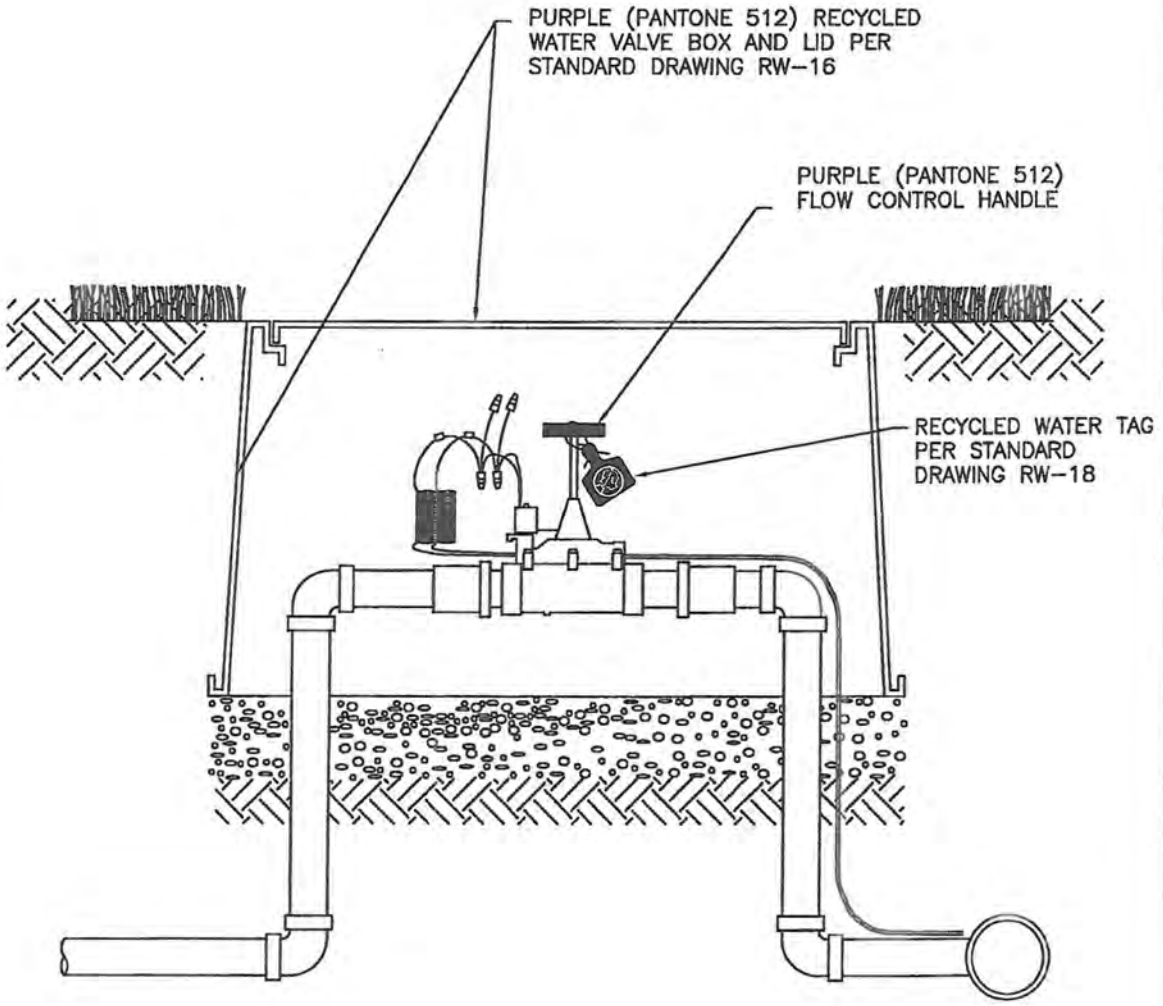
RW–12



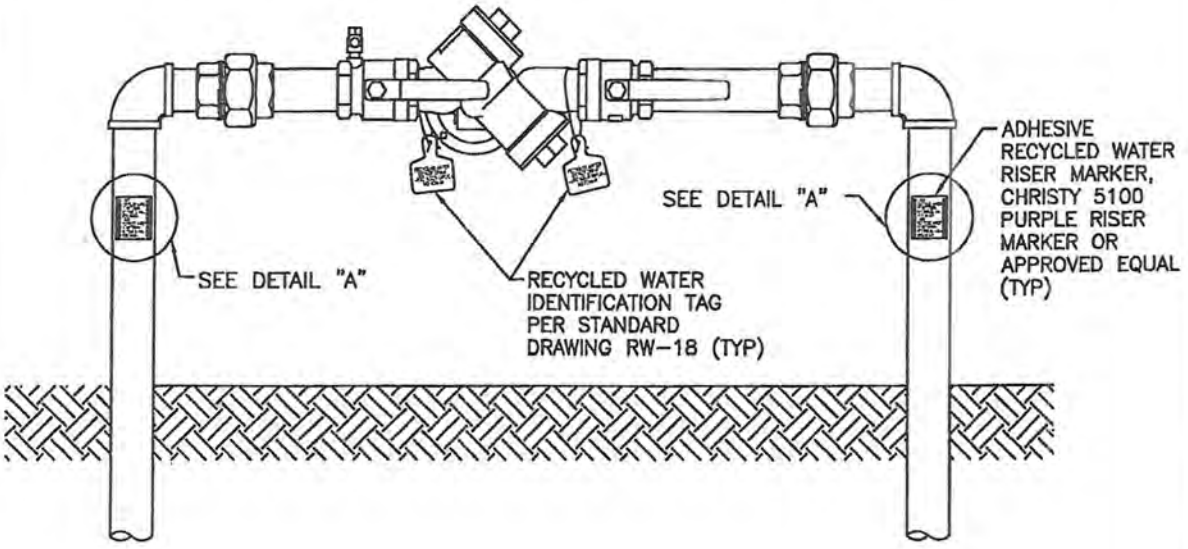

## NOTES:

1. ALL AREAS WHERE RECYCLED WATER IS USED THAT ARE ACCESSIBLE TO THE PUBLIC SHALL BE POSTED WITH ONE OR MORE INFORMATION SIGNS IN CONSPICUOUS LOCATIONS THAT ARE VISIBLE TO THE PUBLIC.
2. INFORMATION SIGNS SHALL BE CONSTRUCTED OF 0.032" THICK ALUMINUM AND REINFORCEMENT FRAME WITH A PURPLE BACKGROUND AND WHITE LETTERING.
3. SECURE SIGN TO POST WITH VANDAL PROOF HARDWARE.

| RECYCLED WATER IRRIGATION INFORMATION SIGN | REF. & REV. JUNE 2014 | CITY OF FRESNO RW–13 |
|---|---|---|




| RECYCLED WATER REMOTE CONTROL IRRIGATION VALVE IDENTIFICATION | REF. & REV. JUNE 2014 | CITY OF FRESNO RW–14 |
|---|---|---|



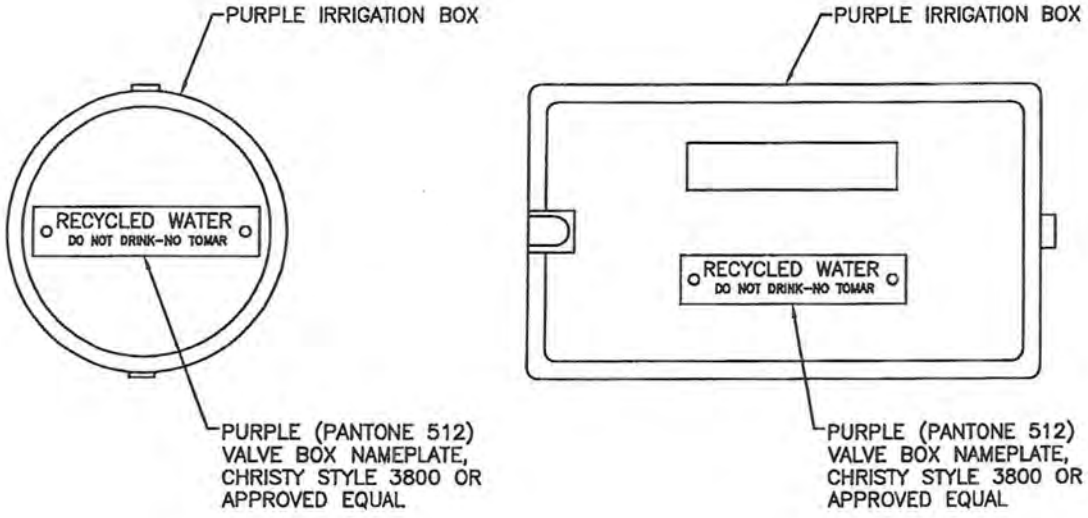
DETAIL "A"

# RECYCLED WATER BACKFLOW PREVENTER IDENTIFICATION

REF. & REV.
JUNE 2014

CITY OF FRESNO

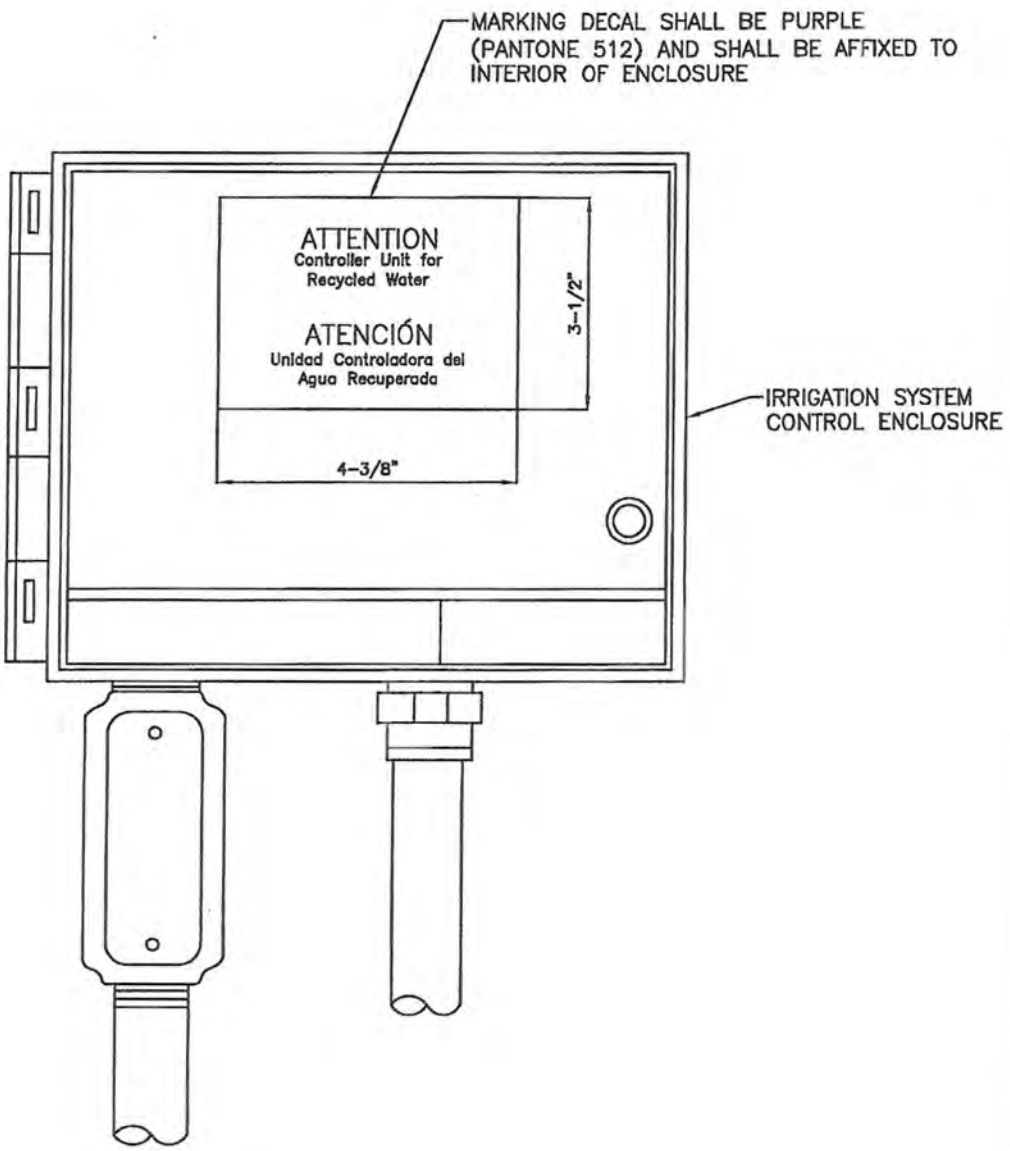
RW-15




NOTES:

1. ALL RECYCLED WATER IRRIGATION BOXES AND LIDS SHALL BE COLORED PURPLE (PANTONE 512).
2. NAMEPLATE SHALL BE 5.75" LONG AND 1.25" WIDE AND SHALL BE MANUFACTURED IN PURPLE, WITH A UV RESISTANT CO-POLYMER PLASTIC.
3. NAMEPLATE SHALL BE ATTACHED TO VALVE BOX WITH TWO TAMPER-PROOF RIVETS.

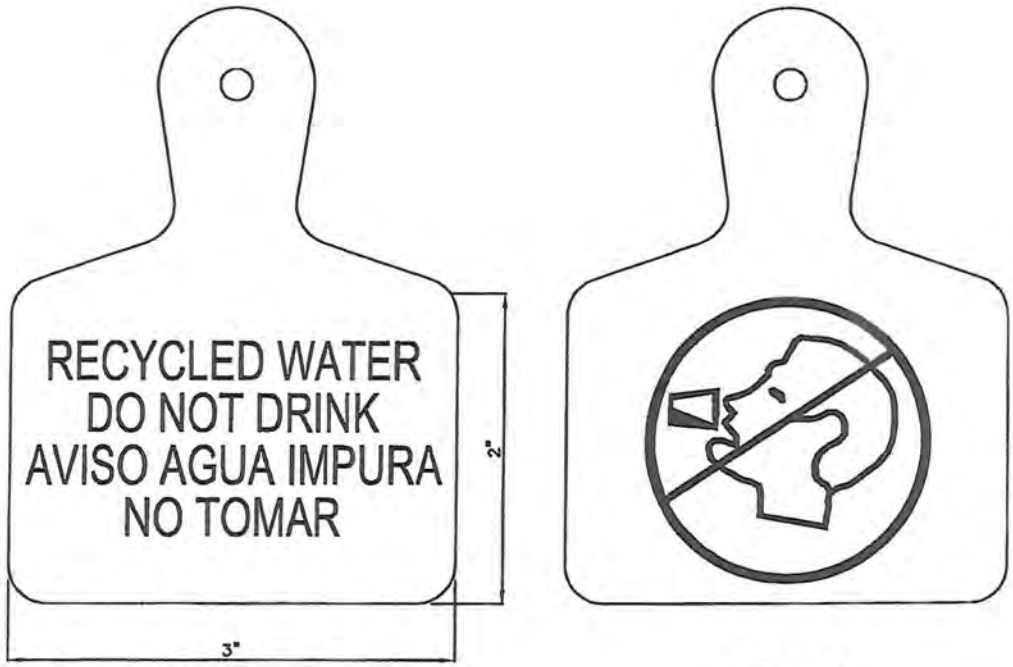
| RECYCLED WATER IRRIGATION BOX COVER MARKINGS | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-16 |
|---|---|---|




NOTES:

1. ALL RECYCLED WATER IRRIGATION CONTROL ENCLOSURES SHALL BE IDENTIFIED WITH A MARKING DECAL.
2. MARKING DECAL SHALL BE BACKED WITH A PERMANENT ACRYLIC ADHESIVE.
3. MARKING DECAL SHALL BE CHRISTY STYLE 4100, OR APPROVED EQUAL.

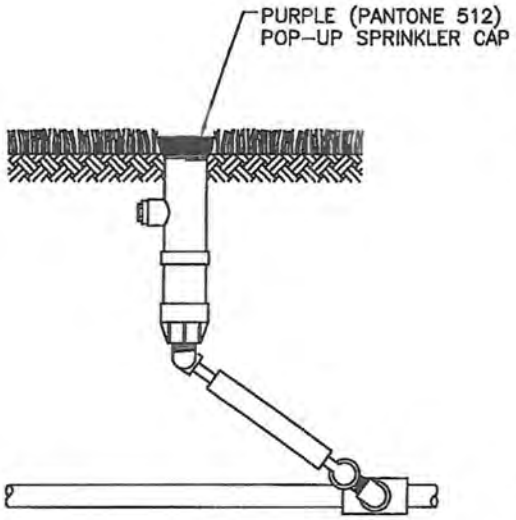
| RECYCLED WATER IRRIGATION SYSTEM CLOCK MARKING | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-17 |
|---|---|---|



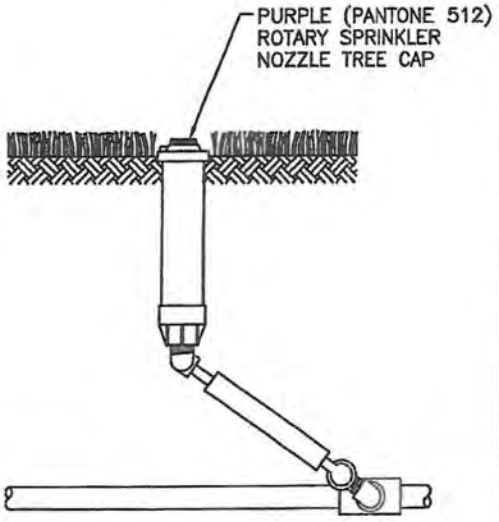

NOTES:

1. IDENTIFICATION TAGS SHALL INCORPORATE AN INTEGRAL ATTACHMENT NECK AND REINFORCED ATTACHMENT HOLE AND SHALL BE CAPABLE OF WITHSTANDING 180 LBS. OF PULL OUT RESISTANCE.
2. ALL LETTERING SHALL BE HOT-STAMPED IN BLACK AND APPROPRIATE FOR OUTDOOR USAGE.
3. IDENTIFICATION TAG COLOR SHALL BE PURPLE.
4. IDENTIFICATION TAG SHALL BE CHRISTY STYLE #007, OR APPROVED EQUAL.
5. IDENTIFICATION TAGS SHALL BE ATTACHED TO GATE VALVES, BALL VALVES, ANGLE STOPS, AND ALL OTHER VALVES IN RECYCLED WATER SERVICE.
6. ATTACH WITH UV RESISTANT ZIP TIES WITH A MINIMUM PULL STRENGTH OF 50 POUNDS.

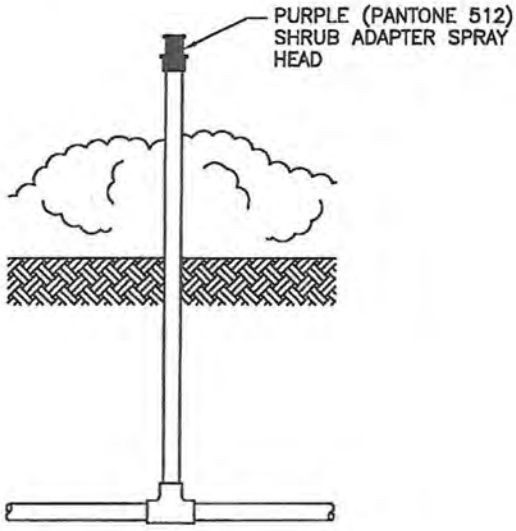
| GENERAL RECYCLED WATER IDENTIFICATION TAG | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-18 |
|---|---|---|




POP-UP SPRINKLER

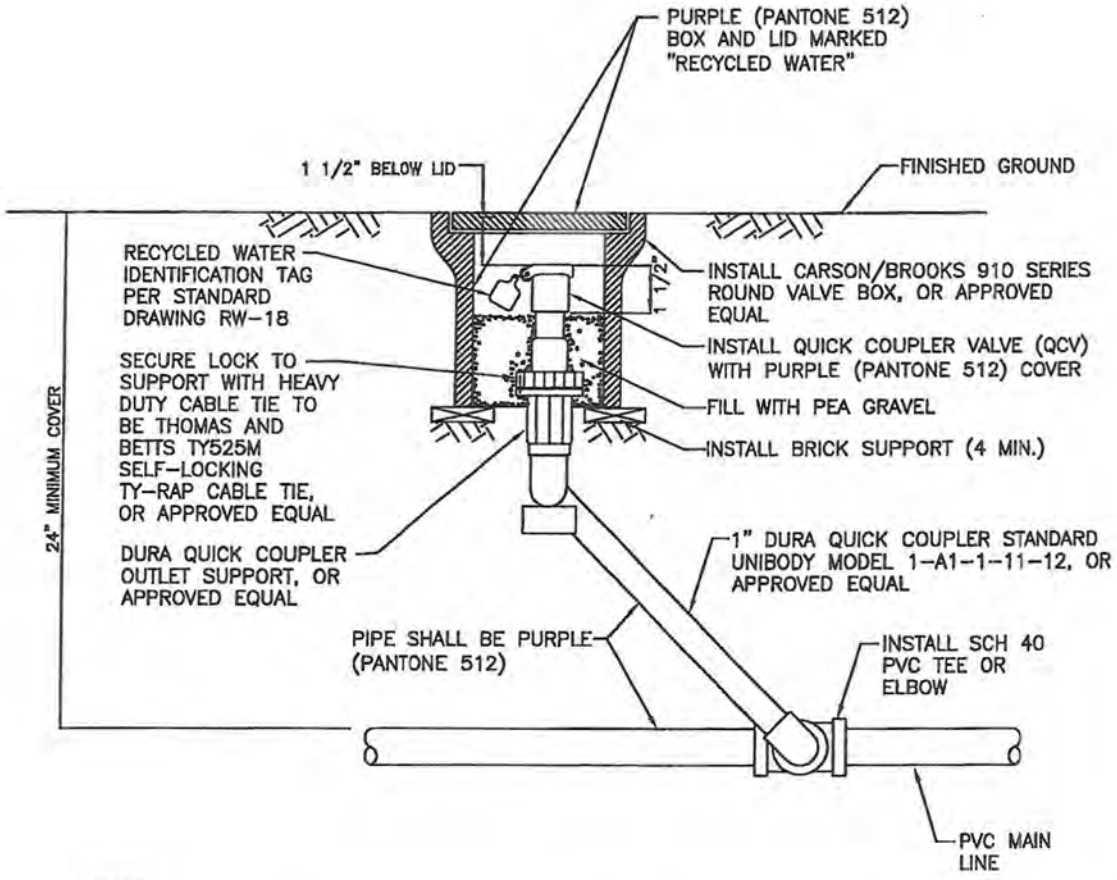



ROTARY SPRINKLER




SHRUB RISER SPRINKLER

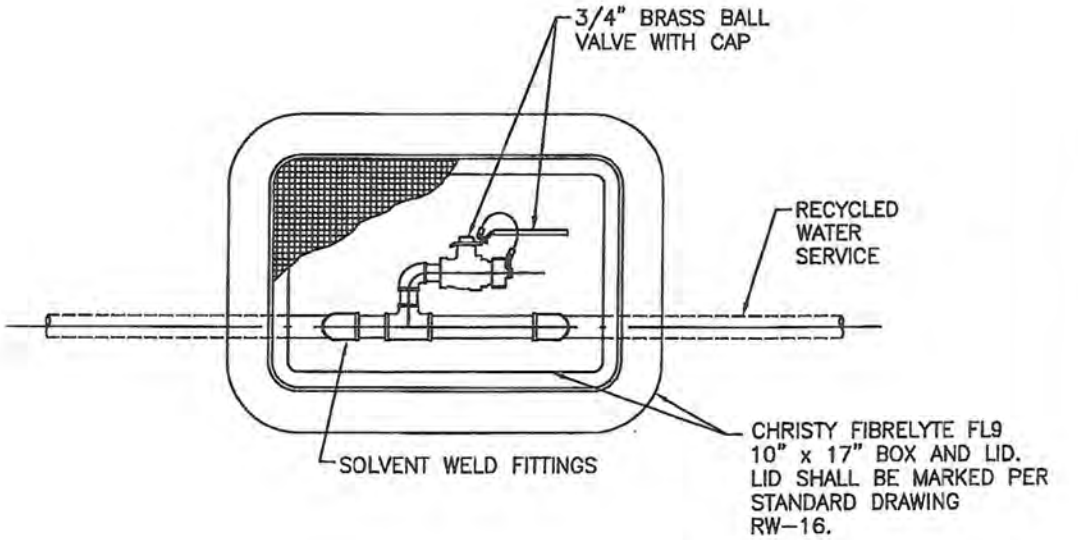
| RECYCLED WATER LANDSCAPE IRRIGATION HEAD IDENTIFICATION | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-19 |
|---|---|---|

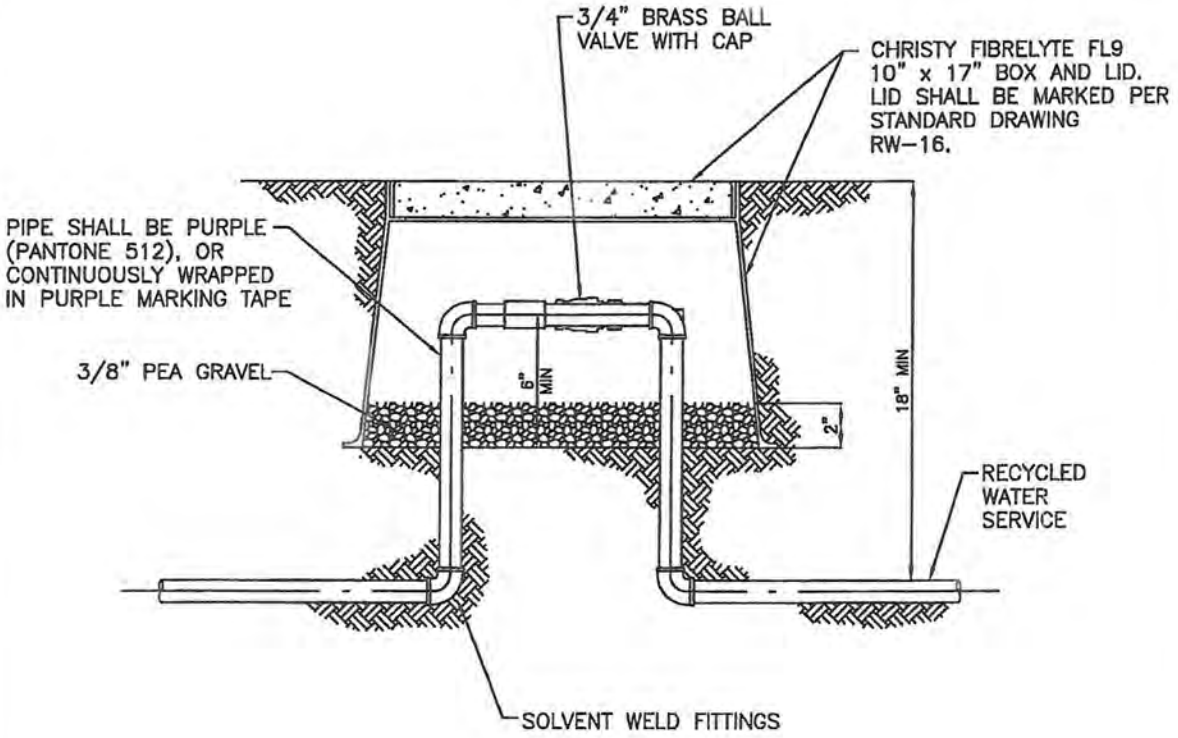



NOTES:

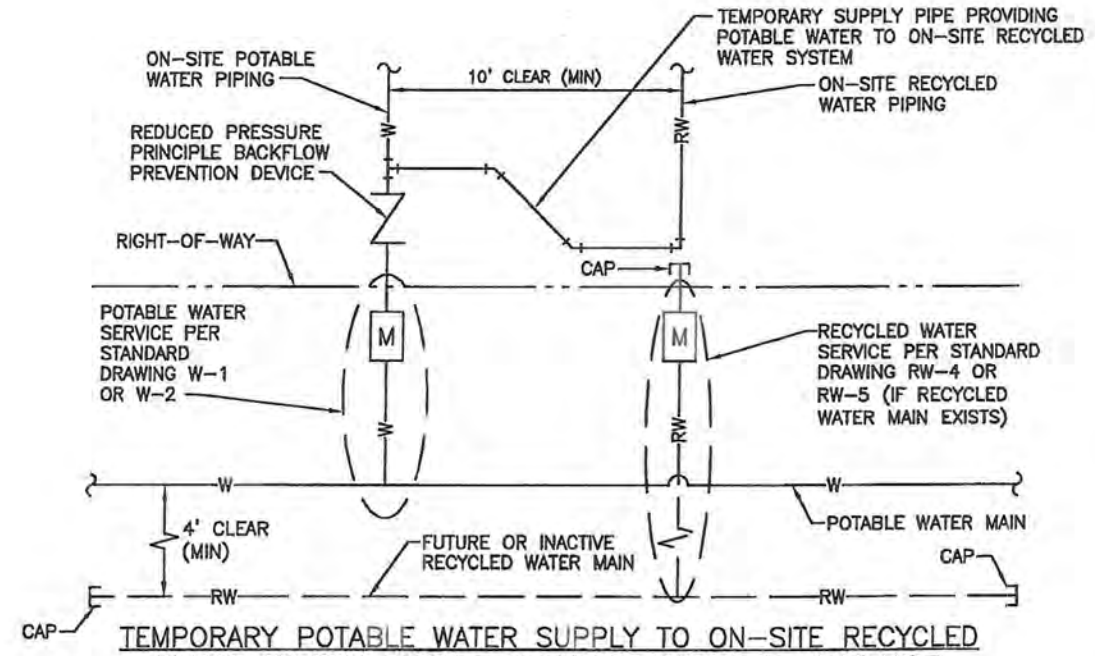
1. NEW-CONSTRUCTION – ALL QUICK COUPLING VALVES MUST HAVE NON-POTABLE LOCKING PURPLE THERMOPLASTIC RUBBER COVERS.
2. RETROFITS – REPLACE ALL EXISTING QUICK COUPLING VALVES WITH NON-POTABLE LOCKING PURPLE THERMOPLASTIC RUBBER COVERS.

| QUICK COUPLING VALVE | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-20 |
|---|---|---|



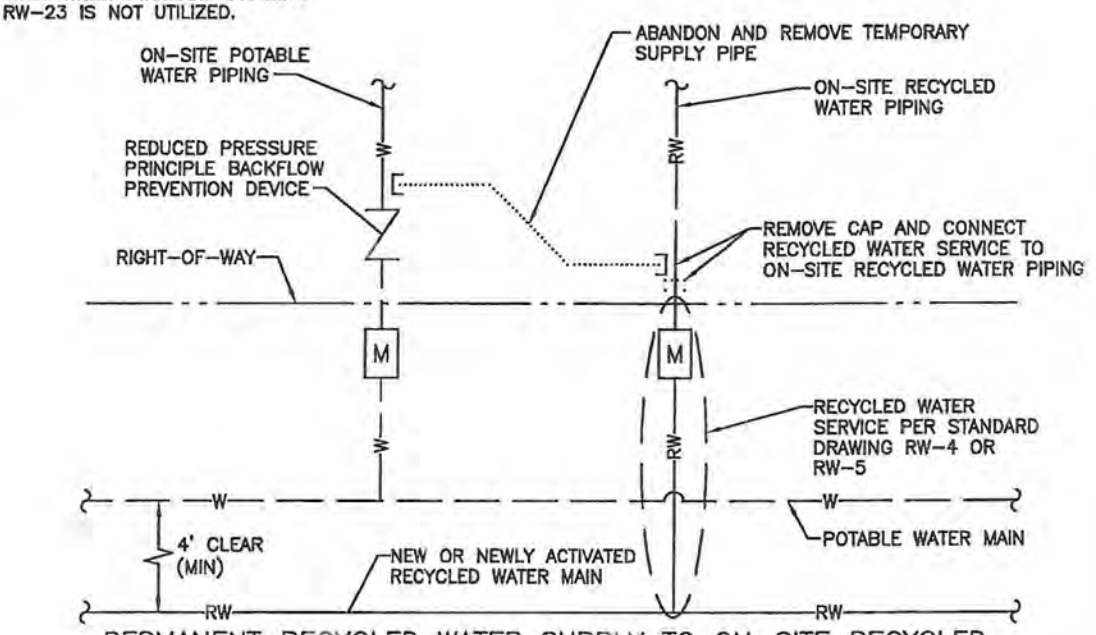

| CROSS CONNECTION CONTROL TEST STATION | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-21 |
|---|---|---|




TEMPORARY POTABLE WATER SUPPLY TO ON-SITE RECYCLED WATER SYSTEM BEFORE RECYCLED WATER IS AVAILABLE

NOTE:

THIS STANDARD DRAWING IS ONLY USED WHEN STANDARD DRAWING RW-23 IS NOT UTILIZED.




PERMANENT RECYCLED WATER SUPPLY TO ON-SITE RECYCLED WATER SYSTEM AFTER RECYCLED WATER IS AVAILABLE

| TEMPORARY POTABLE WATER SUPPLY TO ON-SITE RECYCLED WATER SYSTEM | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-22 |
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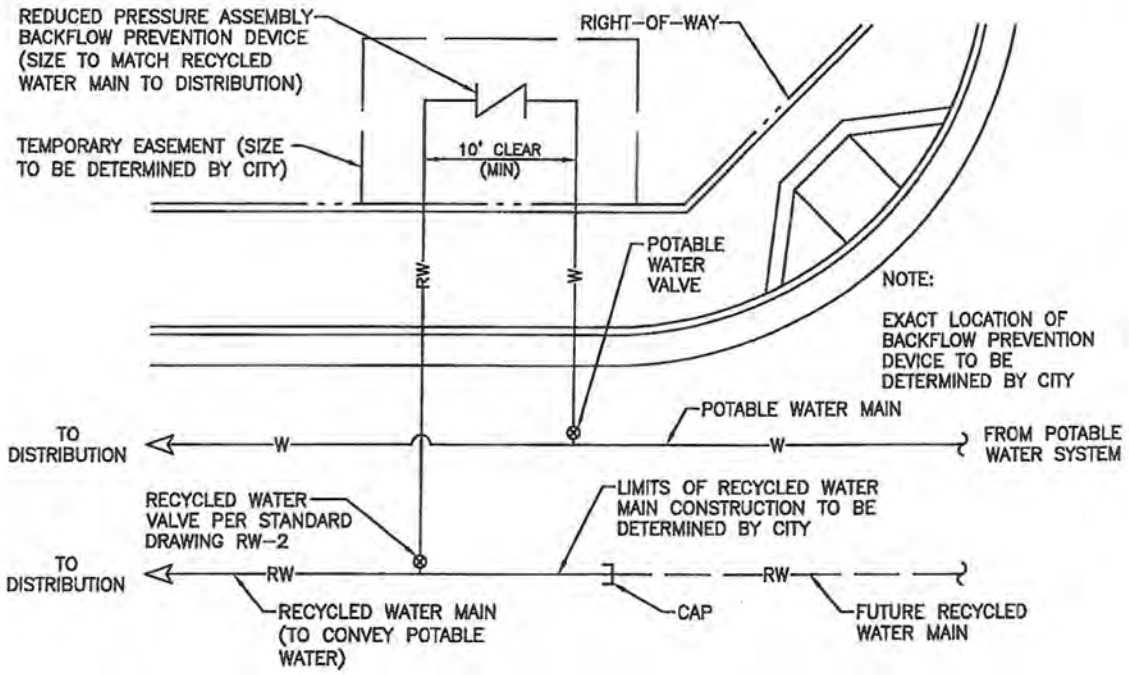
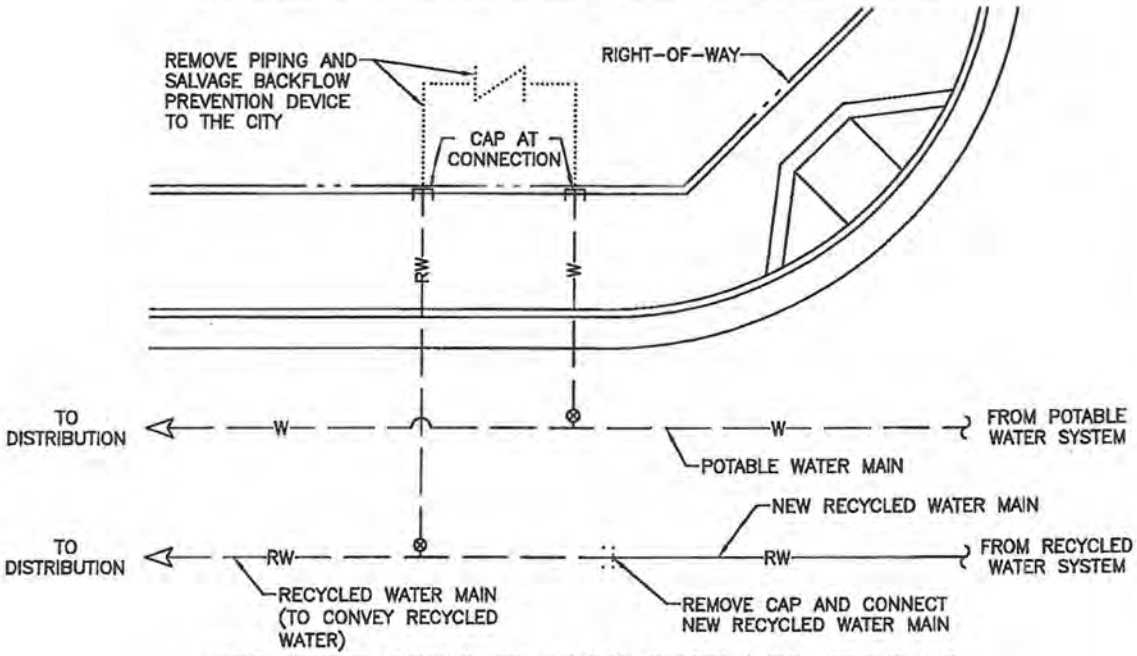



TEMPORARY POTABLE WATER SUPPLY TO RECYCLED WATER SYSTEM BEFORE RECYCLED WATER IS AVAILABLE




PERMANENT RECYCLED WATER SUPPLY TO RECYCLED WATER SYSTEM AFTER RECYCLED WATER IS AVAILABLE

| TEMPORARY POTABLE WATER SUPPLY TO RECYCLED WATER SYSTEM | REF. & REV. JUNE 2014 | CITY OF FRESNO RW-23 |
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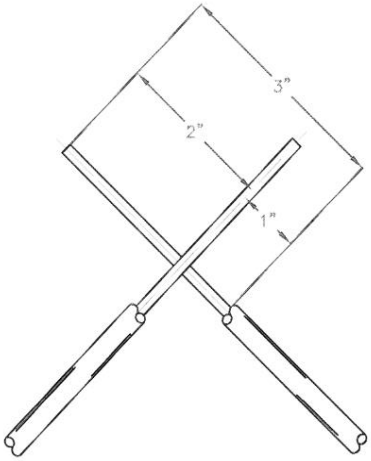
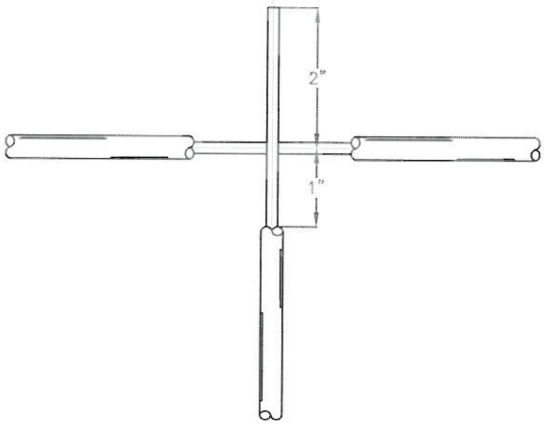
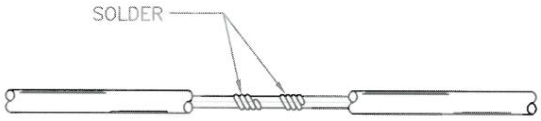
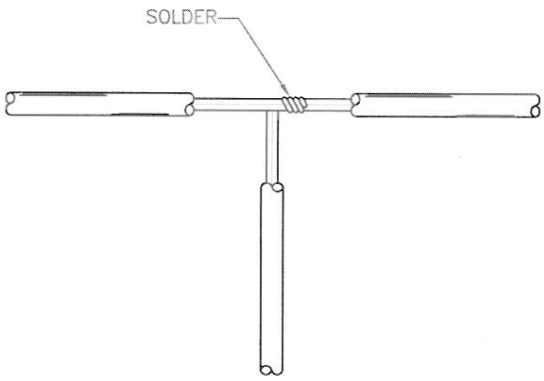
IN–LINE CONNECTION




BRANCH CONNECTION




NOTES:

1. STRIP THE INSULATION FROM THE WIRE AS SHOWN IN THE DRAWING, BUT DO NOT CUT THE COPPER WIRE.
2. LOOP THE WIRE ENDS A MINIMUM OF (4) TIMES FOR EACH WIRE OF THE CONNECTION.
3. USING A PROPANE TORCH, APPLY THE FLAME DIRECTLY TO THE JOINT (LOOPS) TO BE SOLDERED.
4. APPLY 62SN OR EQUIVALENT ROSIN CORE SOLDER TO THE SPLICE. SOLDER SHOULD FLOW INTO THE JOINT.
5. COVER ALL BARE COPPER WIRE WITH A WATERPROOF WRAP THAT IS APPROVED FOR UNDERGROUND CONNECTIONS. THE WRAP MUST EXTEND A MINIMUM OF TWO INCHES (2") BEYOND THE END OF THE STRIPPED WIRE.
6. ALL WIRE MUST BE 12 GAUGE COPPER WIRE.

# TRACER WIRE SPLICE CONNECTION DETAIL

REF. & REV.
AUGUST 2015

**CITY OF FRESNO**

RW–24

## SECTION 33 – RECYCLED WATER FACILITIES DESIGN CRITERIA

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## SECTION 33 – RECYCLED WATER FACILITIES DESIGN CRITERIA

## PART I - INTRODUCTION

### 33-1 DEFINITIONS

Unless the particular provision or context otherwise requires, the definitions and provisions contained in this Section 34 shall govern the construction, meaning and application of words and phrases used in the conditions in this Section 34. The definition of each word or phrase shall constitute, to the extent applicable, the definition of each word or phrase which is derivative from it, or from which it-is a derivative, as the case may be.

"Compression Joint"
A push-on joint that seals by means of the compression of a rubber ring or gasket between the pipe and a bell or coupling.

"Confined" In areas were the hydraulic grade line is above the soffit of the Storm Drain pipe, only watertight joints are allowed and shall comply with Section 61 of the State Standard Specifications.

"Easement" A recorded document in which the land owner gives the City permanent rights to construct and maintain recycled water mains and/or facilities across private property.

"Health Agency"
The State Department of Health Services, or the local health officer with respect to a small water system.

"Mechanical Joint"
A joint comprised of pipe spigot, a follower gland (ring), a mechanical joint gasket and the bell of an adjoining pipe, fitting or valve wherein the joint seal is accomplished by tightening a series of bolts and nuts that compress the gasket against the bell recess and the pipe spigot outside diameter.

"Non-potable Water"
Non-potable water is water that may contain objectionable pollution, contamination, minerals, or bacterial agents and is considered unsafe and/or unpalatable for drinking.

"Pantone" A color standard system referenced in the American Water Works Association California-Nevada Section Guidelines for Distribution of Nonpotable Water

"Pressure Class"

See definition for "Rated Working Water Pressure" below.

"Rated Working Water Pressure"
A pipe classification system based upon internal working pressure of fluid in the pipe, type of pipe material, and the thickness of the pipe wall.

"Recycled Water" and "Reclaimed Water"
Non-potable water that is the treated effluent from a wastewater treatment facility. The terms are identical and any reference to reclaimed water refers to recycled water and vice versa.

"Restrained Joints"
A non-standard or modified push-on or Mechanical Joint that is capable of preventing internal pressures or external forces from causing the joint to separate without the use of thrust blocks.

"Sleeve" A protective tube of steel with a wall thickness of not less than one fourth inch into which a pipe is inserted.

"Vertical Separation"
The difference in elevation between the outside bottom of the higher pipe and the outside top of the lower pipe.

"Water Supplier"
Any person who owns or operates a public water system.

## 33-2 OTHER REQUIREMENTS

Ordinances, requirements, and applicable standards of governmental agencies having jurisdiction within the area served by the Department of Public Utilities shall be observed in the design and construction of recycled water mains and facilities.

Such requirements include, but are not limited to, current revision of the following:

33-2.1 Standard Specifications for Public Works Construction, "latest edition, including all applicable supplements, prepared and promulgated by the California Chapter of the American Public Works Assn. and the Associated General Contractors of America."

33-2.2 State Health laws and regulations regulating the separation between water supply, recycled water and sewerage facilities.

33-2.3 State Uniform Plumbing code as adopted by the City of Fresno.

33-2.4 Road encroachment regulations of the City of Fresno, County, State of California, Fresno Irrigation District, and railroad permits where applicable.

33-2.5 American Water Works Association Standards

33-2.6 Titles 17 and 22 of the State Health and Safety Code regulating cross connection control and back-flow prevention and Chapter 6 of the City of Fresno Municipal Code, regulating cross connections for the City water system.

## PART II – GENERAL PROVISIONS

## 33-3 OTHER REQUIREMENTS

Ordinances, requirements, and applicable standards of governmental agencies having jurisdiction within the area served by the Department of Public Utilities shall be observed in the design and construction of recycled water mains and facilities.

Such requirements include, but are not limited to, current revision of the following:

### 33-3.1 Scope

The design and construction of recycled water mains, facilities and other appurtenances for the City shall comply with these City Standard Specifications, or permit requirements of various governing bodies, except where specific modifications have been approved by the Engineer, in writing. A tentative plan must be submitted for comment prior to final design. All final Plans submitted by the Developer shall be signed by a registered civil engineer and all Work shall be in accordance with good engineering practice.

### 33-3.2 Standard Criteria

The City Standard Specifications set forth the procedure for designing and preparing Plans and Specifications for recycled water mains, facilities and appurtenances to be built within the City's recycled water service area. These standards shall include the Specifications on design and installation of ductile iron pipe and polyvinyl chloride (PVC) pressure pipe.

Whenever potable water, recycled water and sanitary sewer plans are to be designed and installed under one project, said work shall be shown on the same construction plans. In this case the Developer's engineer shall supply the City the original vellum or mylar for the final record.

## 33-4 ENFORCEMENTS

Provisions of these design and construction standards shall be enforced by the Engineer.

# PART III – DESIGN CRITERIA

## 33-5 RECYCLED WATER MAIN PRESSURES, CAPACITIES, AND SIZES

### 33-5.1 Quantity of Recycled Water Flow

Recycled water needs shall be determined from maximum potential population and land use of the area to be served. For design purposes, the design recycled water flow shall equal the peak hour demand. In order to determine the design recycled water flow, the following criteria shall be used, unless otherwise approved by the Engineer.

### 33-5.2 Pressure

Recycled water mains shall be designed so that service pressures range between 45 and 60 psi.

### 33-5.3 Velocity

Recycled water mains shall be designed such that the mean velocity does not exceed five (5) feet per second under Maximum Daily Demand flow conditions.

### 33-5.4 Head Loss

Recycled water mains shall be designed to provide a mean head loss of not more than five (5) feet per thousand feet of pipe under Maximum Daily Demand flow.

### 33-5.5 Hazen-Williams "C"

Pipe analysis shall be performed by assuming a value of 110 for Hazen-Williams co-efficient "C".

### 33-5.6 Minimum Recycled Water Main Size

Recycled water mains shall have an inside diameter of six (6) inches or more. Four (4) inch mains may be permitted by the Engineer for cul-de-sacs that are 150 feet and shorter when the main serves less than five services.

## 33-6 LOCATION OF AIR RELEASE VALVE ASSEMBLIES

Air release valve assemblies shall be located at all points where air pockets may form and at locations shown and/or established by the Engineer.

## 33-7 LOCATION OF BLOW-OFF ASSEMBLIES

Blow-off assemblies shall be located at low points and dead ends, where sediment may collect. Design class shall be compatible with the pipeline working pressure.

## 33-8 RECYCLED WATER MAIN LOCATIONS

### 33-8.1 Recycled Water Main Location in Roads or Streets

The centerline of recycled water mains shall be located in public Streets in accordance with Drawing P-41, P-42 and RW-12 of City Standard Drawings. A minimum of four (4) feet of clearance must be maintained between parallel sewer and recycled water lines. Recycled water line locations shall be dimensioned from property line and centerline or section line of the street.

### 33-8.2 Curved Recycled Water Main Requirements

In curved streets the recycled water main shall not cross the center line, but shall follow the street curvature using join deflections or fittings or as shown on the drawings. Bending of PVC pipe barrels to accomplish horizontal and vertical curves is not permitted.

### 33-8.3 Joint Deflection for Curved Recycled Water Main

Deflection in joints of pipe shall be as limited by manufacturers recommendation.

### 33-8.4 Elbows

Elbow shall be placed at locations where coupling deflection would exceed the allowable, as limited by manufacturer's recommendation.

### 33-8.5 Recycled Water-Water-Sewer Separation

The provisions of State Health Codes shall be met in locating recycled water mains.

## 33-9 CRITERIA FOR THE SEPARATION

### 33-9.1 Basic Separation Standards

The "California Waterworks Standards" set forth the minimum separation requirements for recycled water and water main lines. These Standards, contained in Title 22 California Code of Regulations 64572 specify:

a) Parallel Construction:
The horizontal distance between pressure water mains, recycled water lines and sewer lines shall be at least 4 feet.

b) Perpendicular Construction (crossing):
Pressure water mains shall be at least one foot above sanitary sewer and recycled water lines where these lines must cross.

c) Separation distances specified in a) shall be measured from the nearest edges of the facilities.

d) Common Trench:
Water mains and recycled water lines must not be installed in the same trench. When water and recycled water mains are not adequately separated, the potential for contamination of the water main supply increases. Therefore, when adequate physical separation cannot be attained, an increase in the factor of safety shall be provided by increasing the structural integrity of both the pipe materials and joints.

### 33-9.2 Basic Separation Standards

Local conditions such as available space, limited slope, existing structure, etc., may create a situation where there is no alternative but to install water mains or recycled water lines at a distance less than required by the Basic Separation Standards. In such cases, alternative construction criteria may be allowed in very special circumstances. Detail shall be submitted to City Engineer and Health Agency for approval prior to construction.

Water mains and supply lines of 24" diameter or greater may create special hazards because of the large volumes of flow. Therefore, installations of water mains and supply lines 24 inches diameter or larger shall be reviewed and approved by the Health Agency and City Engineer prior to construction.

### 33-9.3 Special Provisions

The Basic Separation Standards are applicable under normal conditions for recycled lines and water distribution mains. More stringent requirements may be necessary if conditions, such as, high groundwater exist.

New recycled water mains and sewers shall be pressure tested where the conduits are located ten feet apart or less.

In the installation of recycled water or water mains, measures shall be taken to prevent or minimize disturbances of the existing line. Disturbance of the supporting base of this line could eventually result in failure of this existing pipe.

Special consideration shall be given to the selection of pipe materials if corrosive conditions are likely to exist. These conditions may be due to soil type and/or the nature of the fluid conveyed in the conduit.

## 33-10 ALTERNATE CRITERIA FOR CONSTRUCTION

When new water mains, new sanitary sewer mains, or other non-potable fluid-carrying pipeline are being installed in existing developed areas, local conditions (e.g., available space, limited slope, existing structures) may create a situation in which there is no alternative but to install water mains, sanitary sewer mains, or other non-potable pipelines at a distance less than that is required by the regulations (Section 64572). In such cases, through permit action, the Engineering Department may approve alternate construction criteria. The alternate approval is allowed under Title 22 California Code of Regulations, Section 64551(c).

## 33-11 PROCEDURE FOR WATER, RECYCLED WATER AND SEWER SYSTEM INSTALLATIONS IN SUBDIVISIONS

a. Installation of all sewer mains, laterals and manholes and backfill.

b. Installation of all recycled water mains, services and backfill.

c. Installation of all water mains, services and backfill

d. Compact all Sewer trenches.
   - d1. Make preliminary pressure test. (Optional)
   - d2. Locate and repair leaks, if any.
   - d3. Recompact if necessary.

e. Compact all recycled water trenches.
   - e1. Make preliminary pressure test. (Optional)
   - e2. Locate and repair leaks, if any.
   - e3. Recompact if necessary.

f. Compact all water trenches.
   - f1. Make preliminary pressure test. (Optional)
   - f2. Locate and repair leaks, if any.

f3. Recompact if necessary.

g. Items (d), (e) and (f) may be done simultaneously if conditions permit.

h. All trenches shall be identified. Contractor shall also locate and mark Sewer, Water and Recycled water service laterals on curb face when constructed.

i. Compaction tests on sewer, water and recycled water taken by City.

j. Final air test for sewer and pressure test for water and recycled water, providing all leaks are repaired all compaction tests have been approved.

k. Any failure of final tests would require Contractor to reinitiate sequence of work starting with Item (i).

l. The Department of Public Utilities will construct the wet tie to connect to the City's system. This will allow the Contractor to sterilize and flush the newly constructed system. There is often an associated charge for the construction of these wet ties.

m. Flushing recycled water mains shall not be allowed in Street area if it conflicts with sewer and water installations. Often done after compaction tests have passed. Water seeps into trenches and holds up Developer's paving while Street dries out.

n. If storm sewers are to be installed, they shall be constructed first, unless otherwise directed.

## 33-12 EASEMENTS

Non-metallic pipes may be allowed in Easements which are neither confined or interior Easements.

### 33-12.1 Easements

The minimum width of a recycled water facility Easement shall be approved by the Engineer.

### 33-12.2 Recycled Water Main Location in Easement

The recycled water main shall be located 5 feet north or west of the center line of the Easement except where otherwise approved by the Engineer.

### 33-12.3 Where Easements Follow Common Lot Lines

The full Easement width shall be on one lot, in such a manner that access to lines will not be obstructed by walls, trees, or permanent improvements. Where this requirement cannot be met without interfering with existing buildings, easements may straddle lot lines, but the recycled water line shall not be located on the lot lines.

### 33-12.4 Deeds for Easements

Deeds for Easements shall provide for restrictions of permanent construction within the Easement to provide ingress and egress for maintenance. A recent title report will be required prior to acceptance of the Easement.

### 33-12.5 Dedications

Dedications shall be in accordance with City standard practice.

(A) For subdivision tracts the owners of land included within the subdivision shall provide a bill of sale on a form provided by the City. This bill of sale shall be a part of the acceptance of the subdivision.

(B) For other than subdivision tracts, the following shall be conveyed to the City:

(1) A deed of Easement satisfactory to the City for the operation maintenance of the recycled water facilities shall be prepared by a registered engineer or land surveyor, on City Easement forms properly executed by the owners;

(2) A bill of sale to the City for the recycled water mains and appurtenances.

## 33-13 DEPTH OF RECYCLED WATER MAINS

### 33-13.1 Basic Requirements

Recycled water mains shall be installed at a depth which shall be in accordance with the applicable ordinances, regulating the separation between water supply and sewerage facilities.

### 33-13.2 Standard Depths

Minimum depth shall be 42 inches to top of pipe measured from Street or surface above the pipe. Where the natural ground above the pipeline trench

has been over-excavated and/or the pipeline is to be placed in the new embankment, embankment material shall be placed and compacted to an elevation of not less than 3 feet above the top of pipe prior to the trench excavation. Where 42 inches from top of curb cannot be maintained, pipe shall be installed with selected or imported bedding as approved by the Engineer or metallic pipe material shall be used.

### 33-13.3 Exceptions

Designs not in accordance with City Standard Drawing No. RW-12 shall be submitted to the Engineer for approval together with evidence that it complies with City Standard Drawing No. RW-12.

## 33-14 STRUCTURAL REQUIREMENTS

### 33-14.1 Buried Facilities

All structures and pipe placed underground shall be of sufficient strength to support with an adequate factor of safety the following applicable loads: the backfill, road surfacing, H-20 truck loading with impact, high loading to be specified by the Engineer or as required by permits for crossing State highways, railroad tracks, canals, and streams. Calculations showing factor of safety may be required by the Engineer.

### 33-14.2 Other Pipes and Structures

Recycled water lines designed to cross under other pipes or structures shall be protected from damage and shall be constructed in order not to endanger the other pipe or structure. Minimum clearance between outside of pipes or between pipes and other structures is 12 inches unless otherwise approved by the Engineer.

### 33-14.3 Flexible Joints

Flexible joints which will allow for differential settlements or other movement of recycled water pipe, facilities, adjacent pipe and adjacent structures shall be provided where recycled water lines enter encasements or other structures. Flexible joints shall be within three feet of such structures. Any deviations from these requirements shall require approval from the Engineer.

### 33-14.4 Thrust Blocks

The use of concrete thrust blocks may be required but will only be allowed when specifically approved in writing by the Engineer.

### 33-14.5 Mechanical Restrained Joints

Restrained Joint fittings shall be provided at all tees, crosses, reducers, bends, caps, plugs and valves such that the pipe is fully restrained in any one given direction.

These shall meet Uni-B-13 and ASTM F 1674-96 for PVC and be UL/FM approved through 12" for both ductile iron and PVC. The restraint mechanism shall consist of individually activated gripping surfaces to maximize restraint capability. Twist-off nuts, sized the same as the tee-head bolts, shall be used to ensure proper activating of restraining devices. The gland shall be manufactured of ductile iron conforming to ASTM A536-80. The retainer-gland shall have a pressure rating equal to that of the pipe on which it is used through 14" with a minimum safety factor of 2:1. See City Standard Drawings W-31, W-32, W-33, W-34, W-35, W-36 and W-37. Gland shall be Megalug by EBAA Iron, Inc., Uni-Flange by Ford Meter Box Co. Inc., or approved equal.

Push-on Restraint: When it is necessary to restrain push-on joints adjacent to restrained fittings, a harness restraint device shall be used. All harnesses shall have a pressure rating equal to that of the pipe on which it is used through 14". Harness assemblies including tie bolts shall be manufactured of ductile iron conforming to ASTM A536-80. Harness shall be manufactured by EBAA Iron, Inc., Ford Meter Box Co. Inc., or approved equal.

## 33-15 DESIGN CRITERIA FOR RECYCLED WATER METERS

The City shall determine the appropriate meter sizes and types, based on the building plumbing plans and the landscape sprinkler plans furnished by the Developer.

## PART IV – MATERIALS

## 33-16 REQUIREMENTS

Materials shall be chosen for their strength, durability and ease of maintenance, with due consideration for dead and live loads, beam strength and resistance to corrosion. Pipe joints shall be selected to provide sufficient flexibility to adjust to the residual conditions during and after construction.

## 33-17 PIPE MATERIALS

The following are acceptable materials for recycled water line construction:

### 33-17.1 Ductile Iron Pipe and Ductile Iron Fittings

Ductile iron pipe and associated fittings shall conform to the applicable sections of the City Standard Specifications.

(a) Fabrication

Ductile iron pipe shall be Pressure Class 350 ductile iron for sizes up to and including 12 inch and Pressure Class 250 ductile iron from 14 inch to 20 inch; complete with all accessories and conforming to ANSI/AWWA C151/A21.51, unless otherwise indicated on the construction plans. Ductile iron pipe shall be eighteen (18) foot laying lengths.

(b) Joints

Joining of ductile iron pipe shall be with elastomeric-gasket bell ends or couplings. The joints and rubber gaskets shall be in conformance with ANSI/AWWA C111/A21.11.

(c) Inspection and Testing

City at its discretion may inspect the plant facilities, materials, manufacture and testing of the pipe to be furnished by Contractor. Testing of the pipe to ensure compliance with these Specifications shall be made in accordance with applicable AWWA Standards latest edition. All cost incurred by City for witnessing the manufacture of the pipe and in obtaining test results shall be borne by Contractor furnishing the pipe.

(d) Affidavit of Compliance

City may elect to waive any of the above testing and inspection requirements in which event the Engineer may require the manufacturer to submit affidavits stating that all pipe has been manufactured and tested in accordance with this Specification.

(e) Fittings

All fittings for use with ductile iron pipe shall be ductile iron manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. All Mechanical Joint or push-on joint fittings shall be rated for 350 psi working pressure in sizes 4" through 24". Flange fittings shall be rated for 250 psi working pressure. Flange drilling pattern shall be in accordance with ANSI/AWWA C110/A21.10, or commonly referred to as a 125# drilling pattern.

In accordance with Section 4.3 of ANSI/AWWA C153/A21.53, fittings may be provided with a cement-mortar lining and asphalt

coating or fusion bonded epoxy inside and outside. Fusion bonded epoxy shall be in accordance with ANSI/AWWA C116/A21.16 and shall be applied to interior and exterior surfaces.

All tees and crosses shall have all flanged ends with the exception of blowoff, and pumping connections, which shall have flange by Mechanical Joint or push-on joint ends; reducers shall have flange by Mechanical Joint ends; elbows maybe either Mechanical Joint or flanged ends.

(f) Appurtenances

All appurtenances used in conjunction with the ductile iron pipe shall meet the City Standard Specifications.

(g) Lining and Coating

Unless otherwise approved, the internal surface shall be lined with a uniform thickness of cement mortar and then sealed with a thin asphaltic coating in accordance to AWWA C104.

(h) Encasement

The outside surface shall be protected with purple polyethylene encasement furnished and installed in accordance with AWWA C105.

(i) Marking/Identification

Ductile iron pipe shall be identified and marked in accordance to City Standard Drawing RW-1.

#### 33-17.1.1 Confined Easements

All confined easement construction shall be ductile iron.

### 33-17.2 Polyvinyl Chloride (PVC) Pressure Pipe

Polyvinyl chloride (PVC) pressure pipe shall conform to the applicable sections of the City Standard Specifications.

(a) Fabrication

Polyvinyl chloride pressure pipe shall be purple in color, or be installed in a purple sleeve marked "RECLAIMED WATER –DO

NOT DRINK" the entire length of the pipeline, shall conform to AWWA C-900 latest edition for 12" and smaller and AWWA C905 latest edition for 14" and larger, unless otherwise indicated on the construction Plans.

(b) Joints

Joining of PVC pipe shall be with elastomeric-gasket bell ends or couplings. The bell ends shall be an integral thickened bell end (IB) or an integral Sleeve-reinforced bell end. The bell end joints shall have a minimum wall thickness of the bell or Sleeve-reinforced bell equal, at all points, to the DR Requirements for the pipe. The minimum wall thickness in the ring groove and bell-entry sections shall equal or exceed the minimum wall thickness of the pipe barrel.

If bell ends are not part of the pipe, one PVC coupling, manufactured of the same material and by the same manufacturer as the pipe, shall be furnished with each length of pipe together with two (2) rubber rings. The coupling shall be designed to ensure a water-tight joint with the pipe. The coupling body and socket shall have a wall thickness equal to the pipe barrel thickness with which the coupling is to be used.

All rubber rings shall be furnished by the pipe manufacturer. These rubber rings (Elastomeric Gaskets) shall be manufactured to conform with the requirements of ASTM F-477.

(c) Hydrostatic Proof-test

Each length of pipe shall be proof-tested at two (2) times its rated Pressure Class for a minimum dwell of five (5) seconds, in accordance with AWWA C900 and C905.

(d) Inspection and Testing

The City, at its discretion, may inspect the plant facilities, materials, manufacture and testing of the pipe to be furnished by Contractor.

Testing of the pipe to ensure compliance with these Specifications shall be made in accordance with applicable AWWA Standards latest edition. All cost incurred by City for witnessing the manufacture of the pipe and in obtaining test results shall be borne by Contractor furnishing the pipe.

(e) Affidavit of Compliance

City may elect to waive any of the above testing and inspection requirements in which event the Engineer may require the manufacturer to submit affidavits stating that all pipe has been manufactured and tested in accordance with this Specification.

(f) Fittings

All fittings for use with Polyvinyl chloride pipe shall be ductile iron manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. All Mechanical Joint or push-on joint fittings shall be rated for 350 psi working pressure in sizes 4" through 24". Flange fittings shall be rated for 250 psi working pressure. Flange drilling pattern shall be in accordance with ANSI/AWWA C110/A21.10, or commonly referred to as a 125# drilling pattern. In accordance with Section 4.3 of ANSI/AWWA C153/A21.53, fittings may be provided with a cement-mortar lining and asphalt coating or fusion bonded epoxy inside and outside. Fusion bonded epoxy shall be in accordance with ANSI/AWWA C116/A21.16 and shall be applied to interior and exterior surfaces.

All tees and crosses shall have all flanged ends with the exception of blow-off, and pumping connections, which shall have flange by Mechanical Joint or push-on joint ends; reducers shall have flange by Mechanical Joint ends; elbows maybe either Mechanical Joint or flanged ends. A/C to C.I.O.D. (PVC adapter rings may not be used).

(g) Appurtenances

All appurtenances used in conjunction with PVC shall meet the City Standard Specifications.

(h) Detachable Ribbon or Tapes

Because PVC is non-conductive and subject to more damage if struck with excavation equipment, an identification marking tape shall be installed in accordance to City Standard Drawing No. RW-1.

## 33-18 VALVES

### 33-18.1 Butterfly Valves

(a) General

These Specifications designate the requirements for the manufacture and installation of butterfly valves. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the valves as shown on the Plans and herein specified.

(b) Materials and Workmanship

Butterfly valves shall be of the rubber-seated tight-closing type. They shall meet or exceed AWWA Standard C504 latest revision. All valves must use full AWWA C504 Class 150B valve shaft diameter, and full Class 150B underground-service-operator torque rating throughout entire travel. All valves shall be NSF approved. Valve body shall be high-strength cast iron ASTM A126 Class B with 18-8 Type 304 stainless steel body seat. Valve vane shall be high-strength cast iron ASTM A48 Class 40, having rubber seat mechanically secured with an integral 18-8 stainless steel clamp ring and 18-8 stainless steel self-locked screws.

Rubber seat shall be full-circle 360 degree seat not penetrated by the valve shaft. Valve shaft shall be one piece, extending full size through the entire valve. Valve shaft shall be 304 stainless steel. Packing shall be O-ring cartridge designed for permanent duty underground. All exposed cap screws and fasteners on the valve body and flanges shall be Ni-Cad steel or approved equal.

(c) Valve Operations

Valve operators shall be of the manual type. The operator shall be totally enclosed, self-locking worm gear or screw type, with adjustable stops to limit disc travel. The number of complete turns of the operator required to rotate this disc 90 degrees shall be approximately the same as an equivalent sized gate valve. All valve operators shall be fully gasketed, weather-proof and factory packed with grease. Operators shall be of the size required for opening and closing the valve against 150 psi water pressure, and shall have a torque rating of not less than shown in AWWA C-504, 1, Class 150-B. Operators for valves located above ground shall have disc-position indicators and a hand-wheel.

Should the difference between the operating nut and the valve cover exceed 50 inches, an extension mast shall be installed so that the operating nut will not exceed 50 inches from the valve cover or ground surface. Buried operators shall be worm gear or screw type and shall be threaded to accommodate a two inch operating nut, and shall include the operating nut, and a 3/4" hex head plated bolt for operating nut hold-down. All exposed fastenings shall be specifically designed and suitable for permanent buried service. Input shaft and thread for the operating nut shall be at a right angle to the operating shaft. The input shaft shall

extend vertically from the side when the valve is in the horizontal position.

Epoxy shall be applied to all surfaces of valve body and vane to an average minimum thickness of 5 mils, conforming to AWWA C 550 Standards. A primer shall be applied before the coating per the epoxy manufacturer's recommendations. The coating shall be applied to the entire valve body and vane before final assembly.

(d) Valve Ends

Valve ends shall be for Flanged Joint pipe and shall conform to ANSI CIII (AWWA A21.11-1972, Class 125) and drilled to ANSI B16.1 for cast iron flanges and flanged fittings, Class 125. Flanges shall be 125# ANSI. The butterfly valves shall be right closing Class 150-B designed for tight shut off with a maximum differential pressure across the disc of 200 psi. Valve shafts shall consist of a one-piece unit extending completely through the valve disc.

(e) Valve Boxes, Nuts and Bolts, Gaskets and Marker Posts shall conform to the provisions specified herein for gate valves.

(f) Marking/Identification

Install an identification tag in accordance to City Standard Drawing RW-18.

### 33-18.2 Gate Valves

(a) General

These Specifications designate the requirements for the manufacture and installation of gate valves. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the valves as shown on the Plans and herein specified.

(b) Materials and Workmanship

Gate valves shall be non-rising stem resilient seated type. Valves shall conform to the latest version of AWWA C-509. Valve bodies shall be ductile iron and wedges shall be fully rubber encapsulated.

The stem shall have two O-rings above the collar and one O-ring below the collar. Stem seals must be replaceable with the valve under pressure. The stem material shall be stainless steel [ANSI-420], low zinc bronze or manganese bronze. The waterway shall be full size. No

cavities or depressions are permitted in the seat area. Valve body and bonnet shall be electrostatically applied, fusion bonded, epoxy coated both inside and out by the valve manufacturer. The coating shall meet the requirements of AWWA C-550 and NSF 61 approved. All valve body and bonnets bolts and nuts shall be type 304 stainless steel.

All valves must be tested by hydrostatic pressure equal to the requirements in the AWWA C-509 specifications prior to shipment.

Tapping gate valve assemblies shall be used only in conjunction with tapping Sleeves and shall be furnished and installed by the Department of Public Utilities.

Nuts and bolts used for bolting flanged-end gate valves to pipeline flanges above ground, shall be hexagonal head machine bolts and hexagonal nuts conforming to ASTM A307, Grade B. All buried flanged-end gate valves shall be bolted to the pipe line flanges with Ni-Cad nuts and bolts or approved equal.

(c) Gaskets

Gaskets for flanged-end gate valves shall be right face 1/8".

(d) Valve Ends

Valves may be provided with Mechanical Joint ends, push-on joint ends, flanged ends, Mechanical Joint by flange ends or push-on joint by flange ends.

(e) Marking/Identification

Install an identification tag in accordance to City Standard Drawing RW-18.

## 33-19 APPURTENANCES

### 33-19.1 Blow-off Assemblies for Recycled Water Mains

(a) General

Blow-off assemblies shall be furnished and installed by the Contractor at the locations shown on the Plans. The Contractor shall furnish all labor, materials, tools and equipment necessary to furnish and install, complete and ready for operation, the assemblies as shown on the plans and herein specified. See City Standard Drawings RW-7 and RW-8.

(b) Materials, Fabrication and Installation

(1) Materials Shall be ductile iron and sized as designated on the City Standard Drawings. RW-7 and RW-8 or on the Plans.

(2) Valves Gate valves or butterfly valves for blow-off assemblies shall be as specified herein.

(3) Pipes and Fittings Shall be 6 inch or 8 inch ductile iron and shall conform with the standard for ductile iron pipe water main and fittings. Joints on the recycled water main side of the gate valves shall be flanged. Properly restrained MJ fittings are allowed downstream of the gate valve.

(4) Pipe Sleeves and Lids Shall be used per City Standard Drawing RW-2.

(5) Boxes and Lids Shall be per City Standard Drawings RW-7 and RW-8 or Engineer approved equivalent and marked "Recycled Water". Covers shall be seated flush with the surface of the natural ground or paved surface, such that they may not be damaged by, nor present an obstruction or rough surface to traffic.

**33-19.2 Air Release Valve Assemblies**

(a) General

Air release valve assemblies shall be furnished and installed by the Contractor at all points where air pockets may form and at the locations shown and/or established in the field by the Engineer. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the valve assemblies shown on the plans and herein specified. See City Standard Drawing No. RW-9, RW-10, and RW-11.

(b) Materials, Fabrication and Installation

Materials shall be in accordance with City Standard Drawings. The valve shall be a Vent-o-Mat RBX series, Vent- Tech or approved equal.

**33-19.3 Recycled Water Service Assemblies (2 inches and smaller)**

(a) General

Recycled water service assemblies shall be furnished and installed by the

Contractor at the locations shown on Plans or established in the field by the Developer. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the assemblies as shown on the Plans and herein specified. The Contractor shall perform the installation of the lot services in accordance with the City Standard Drawing Nos. RW-4 and RW-5. The Developer shall provide the City with a Plan showing the "As Built" location of all services.

(b) Materials, Fabrication and Installation

(1) Materials Shall be those designated on the City Standard Drawings RW-4 and RW-5

| Service Size | Corp. Stop | Service Pipe | Angle Meter Stop |
|---|---|---|---|
| 1" | 1" | 1" | 1" |
| 1 ½" | 1 ½" | 1 ½" | |
| 2" | 2" | 2" | |

(2) Pipe and Fittings Service pipe shall be Type K soft copper tubing, or Polyethylene CTS 200 psi SDR-9 PE 3408. Solder fittings shall be soldered with 95% tin / 5% lead or silver solder (pure).

(3) Saddles Service saddles shall be used for all 1", 1-1/2", and 2" taps made on ductile iron and PVC pipe. A circumferential type stainless steel band or bands shaped to fit the actual O.D. of the pipe shall be used. Double strap bands shall provide a minimum bearing width of 1-1/2 inches per band along the axis of the pipe. Single strap bands shall provide a minimum bearing width of 3 inches per band along the axis of the pipe. Saddles shall not have lugs that will cut into the pipe when the saddle is tightened. Saddles are to be Jones, Ford, Mueller or approved equal.

Multiple O.D. range saddles shall not be used.

(4) Service Taps In no case shall a service tap be made in a main closer than 18 inches to a bell coupling joint, or fitting. Service taps shall not be less than two feet apart. Service taps shall be located opposite the service locations so that the service laterals will be perpendicular to the Street centerline. Service tap locations varying more than two feet from the perpendicular must be approved by the Engineer prior to installation. Service taps shall be in accordance with City Standard Drawing Nos. RW-4 and RW-5. Where dissimilar metals are joined, a dielectric connection, approved by the Engineer shall be provided. Hole

size drilled in the pipe shall be the same size as the corporation stop. The cutting tool shall be muller cutting type (hole) cutter which will retain the coupon.

Tapping Sleeves and corporation stop valves shall be used for service connections of 2 inches and smaller. For ductile iron recycled water mains, double strap ductile iron service saddles must be used.

(5) Service Boxes

Service casing and covers and meter boxes and covers shall be furnished and installed by the Contractor as shown of City Standard Drawings RW-4 and RW-5. All service casings shall be complete and in place at the time of acceptance of the subdivision. All services shall be marked by an "RW" clearly visible on the curb face. Minimum size 1 ½" X 1 ½ " maximum 3" X 3".

(6) Curb Stops in Driveway

No services in driveway approaches allowed.

(7) Encasement and Identification

Due to the corrosive nature of soils, a protective polyethylene sleeve shall be installed over the copper service line on all sizes from 1" to 2". It must be purple in color, to immediately identify it as non-potable service, and shall encase the service line from the corp stop to the angle meter stop in one continuous piece. It shall be attached to both the corp and the angle meter stop by using PVC tape, duct tape, or other suitable adhesive tape.

## 33-19.4 Valve Service Casing and Lid

Valve Service Casing and Lid Shall conform with City Standard Drawing RW-2. Covers shall be seated flush with the surface of the natural ground or paved surface such that they may not be damaged by, or present an obstruction or rough surface to traffic. Covers shall have a 9 inch wide and 6 inch thick stabilizing concrete ring constructed when the valve is outside the pavement area. Covers must be painted purple by using Pantone 512.

## SECTION 34 – RECYCLED WATER FACILITIES

### 34-1 SCOPE

These City Standard Specifications are intended to describe the execution and workmanship to be used in construction of a recycled water system operated in the City of Fresno. It is presumed that the Developer or his/her engineer has prepared such general and special Specifications as are necessary to define the nature and location of the Work, contractual arrangements, payment for Work, and any other matters concerning the owner or his/her Contractor. All Street work permits shall be obtained and fees shall be paid by the Developer or Contractor.

### 34-2 GENERAL

#### 34-2.1 Quality Control of Materials

The quality control of materials shall conform to the applicable sections of the City Standard Specifications as published by the City of Fresno.

#### 34-2.2 Quality of Workmanship

All Work will be done by Persons experienced in the specific Work, under competent supervision and in a first class manner to the Engineer's complete satisfaction. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, the Engineer may require that before lowering the pipe into the trench a heavy tightly woven burlap bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. After placing a length of pipe in the trench and completing the jointing operation, in a method approved by the pipe manufacturer, the pipe shall be secured in place with approved backfill material placed under it. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer. This provision shall apply during any Work stoppage.

#### 34-2.3 Connections to Existing Facilities

Connections shall be performed by Wastewater Division personnel only. One week notice shall be given before any connection is to be made.

#### 34-2.4 Defective Work

Any defective materials or workmanship which becomes evident within one year after the City assumes responsibility for the completed Work shall be

replaced or repaired without cost to the City. Refusal of the Contractor to correct defective Work which is his/her responsibility will be considered just cause for excluding him/her from performing future Work to be connected to the City's system. Such exclusion does not impair the City's right to bring legal action to correct the deficiencies.

### 34-2.5 Construction Staking and "Record-Drawings"

Construction stakes will be set parallel to the recycled water main alignment at an offset distance and direction agreed upon with the Contractor but in no case shall construction stakes be offset more than 10 feet. Stakes will be set at no greater interval than 100 feet on straight alignments. For horizontally or vertically curved recycled water mains, the stake intervals shall be 25 feet. For all Street recycled water mains, regardless of alignment or slope, the Developer's engineers shall determine "Record-Drawings" elevations at the top of pipe centerline at each change in pipe grade and shall provide a written record of such elevations to the inspector. The Developer's engineer shall also provide "Record-Drawings" of all main line valve locations and all service stop locations.

## 34-3 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS INSTALLATION

### 34-3.1 Scope of Work

The Contractor performing the Work under this Specification shall furnish all labor tools and equipment, which are necessary to install, complete, and ready for operation, the PVC pressure pipe recycled water mains as herein specified and/or as indicated on the contract drawings.

### 34-3.2 Installation

Installation shall conform to Chapter 7, Installation, of AWWA Standard C605 and AWWA Manual M23. Bending of PVC pipe barrels to accomplish horizontal or vertical curves is not permitted.

### 34-3.3 Tracer Wire with Marking Tape

Tracer wire used with PVC **where called for on the Plans** shall be copper wire, Type TW, Size AWG #12 and shall be placed above the PVC recycled water main along with a recycled water marking tape, purple (pantone 512). The marking tape shall be a minimum of six inches wide and a minimum of 12" but no greater than 24" above the pipeline. See City Standard Drawing No.'s RW-1 and RW-24.

## 34-4 DUCTILE IRON PRESSURE PIPE AND FITTINGS INSTALLATION

### 34-4.1 Scope of Work

The Contractor performing the Work under this Specification shall furnish all labor tools and equipment, which are necessary to install, complete, and ready for operation, the ductile iron pressure pipe recycled water mains as herein specified and/or as indicated on the contract drawings.

### 34-4.2 Installation

Installation shall conform to AWWA C-600 and Installation of Ductile Iron Pipe and Fittings in AWWA Manual M41.

## 34-5 VALVE CASING AND LID INSTALLATION

When recycled water mains are installed, casings and lids in Street areas shall be installed in a lowered position below any sub-grade which may be removed or re-compacted.

When sub-grade is compacted and base material installed and completed, casing and lids shall be completed in accordance with City Standard Drawing Nos. RW-2, "Recycled Water Valve and Valve Box," and RW-16, " Recycled Water Irrigation Box Cover Markings".

Valves located in the sidewalk shall be marked with a 2" X 4" stake so that casings and lids may be brought to finished grade at the time concrete is poured.

Any excavation necessary for valve casing and lid work shall be thoroughly re-compacted to the satisfaction of the Engineer. All casings shall be installed in a vertical position. All valve operating nuts shall be free of any dirt or debris and all valves shall be checked to ensure that they are left in a wide open position.

**It shall be the responsibility of the Contractor to do this Work exactly as specified.**

## 34-6 EARTHWORK FOR DUCTILE IRON AND PVC PIPE INSTALLATION

### 34-6.1 Trench Excavation

The trench shall be constructed per City Standard Specifications, Section 16, City Standard Drawings P-48 and RW-1. Unless shown otherwise on the Plans a minimum cover of 3.5' is required for mains.

### 34-6.2 Trench Bottom

The trench bottom shall be true and even so that the barrel of the pipe will have soil support for its full length. Earth mounds can be used to support the pipe with the Engineer's approval and under his/her direction.

### 34-6.3 Bell Holes

Bell holes are required for push-on and mechanical joint pipe. While push-on joints require only a small depression beneath each bell to allow pipe to lay flat on the trench bottom, mechanical joints require additional space for operation of a ratchet wrench.

Minor excavations, which are necessary for removing the sling and for assembling the joints, shall be made in advance of the laying crew and filled after these operations are completed.

### 34-6.4 Trench Width

The trench must be wide enough to permit proper installation of the pipe with room for assembling joints and tamping backfill around the pipe. The trench must be at least 12 inches wider than the outside diameter of the pipe to allow for proper placement, tamping, and compaction of the initial backfill. Per the City Standard Specifications, Section 16, the width of the trench at the top of the pipe shall not be greater than 16 inches more than the outside diameter of the barrel of the pipe to be laid therein. These requirements may be modified by the Engineer or as shown on the Plans.

### 34-6.5 Rock or Hardpan Excavation

In rock or hardpan excavations it is necessary that the rock or hardpan be removed so that it will not be closer than 4 inches to the bottom and sides of the pipe for sizes up to 24 inches in diameter. This same practice shall be followed should the trench excavation pass through piles of abandoned masonry, large pieces of concrete or other debris. The pipe shall not be permitted to rest on masonry walls, piers, foundations or other unyielding, subterranean structures which may be encountered in the excavation.

### 34-6.6 Barricades and Safety

The Contractor shall follow all the requirements in Section 7-10.4 of the City Standard Specifications.

### 34-6.7 Shoring

In addition to, and consistent with public safety considerations, every precaution for safety must be provided for the workers at the Site. Shoring must comply with Cal-OSHA Standards.

## 34-7 BACKFILLING AND TAMPING

Backfilling usually follows pipe installation as closely as possible. This protects the pipe from falling materials, eliminates possibility of lifting the pipe due to flooding of open trench, and avoids shifting pipe out of line by cave-ins. The purpose of backfilling is not only to protect the pipe by covering it, but to provide firm, continuous support that will prevent the pipe from settling or resting on the couplings. The essentials of a first class backfilling job shall be as follows:

Provide continuous bedding or support by carefully consolidating approved material under pipe and couplings and between the run of pipe and the trench walls. Provide a cushion on top by hand - placing approved material to at least 12" over the pipe - the balance can then be backfilled by machine.

The first step in providing firm, continuous support for the pipeline is to tamp soil solidly under the pipe and couplings. Tamping can be done with tamping bars to consolidate the backfill material. Hand tamping is best accomplished with damp loamy earth or sand.

The initial backfill material used shall be slightly damp which will pack more solidly under the pipe. This initial backfill is always placed by hand. It shall be shoveled in evenly along both sides of the pipe, making a layer about 4" thick. Then the tamping bar is used to tamp this soil firmly under the pipe. If more than 4" of soil is shoveled in before tamping, the soil can bridge and fail to go under the pipe. Next, another 4" layer is shoveled in and tamped. This is repeated until the pipe is firmly bedded in compact soil up to the top of the pipe. Two 6 inch lifts are then used to achieve a 12 inch cover over the pipe. This completes what is called the "initial" backfill, the thoroughly tamped soil which provides a continuous supporting bed for the pipeline. Where clay soil or unstable soil is encountered, the pipe shall be enveloped in a minimum of four inches of sand - then the backfill completed to at least 12" above the pipe with selected material, then dry sand or other suitable materials shall be laid.

The balance of the backfill which is usually placed by machine, need not be as carefully selected as the initial material. Cleanup shall be in accordance with the City Standard Specifications.

## 34-8 TESTING AND STERILIZATION

### 34-8.1 General

The Specifications constituting this section designate the requirements for the procedure, materials, performance, and payment for testing and sterilization of recycled water mains and appurtenances intended for the conveyance of non-potable water under pressure.

Scope of Work The Contractor shall furnish all labor, material, tools, and equipment, including all chemicals, necessary to perform all operations required to complete the testing and sterilization as herein specified.

### 34-8.2 Field Testing

(a) Hydrostatic Pressure Test Hydrostatic Pressure test. After the pipe and all appurtenances have been laid and the backfill has been placed and compacted, a hydrostatic pressure test shall be conducted. A hydrostatic test shall be conducted on the entire pipeline for a period of 2 hours at a hydrostatic pressure of 200 psi for Class 200 pipe and 150 psi for Class 150 pipe. In locations where there is a combination of Class 200 and Class 150 pipe, the system testing pressure shall be 150 psi. All valves in the pipeline shall be in the open position during system testing.

(b) Preparation The line shall be filled with water at least 24 hours prior to testing. While filling and immediately prior to testing, all air shall be expelled from the pipeline. Where air valves or other suitable outlets are not available for introducing water or releasing air for test purposes, taps and fittings approved by the Engineer shall be installed and later securely plugged.

(c) Procedure The procedure shall follow those specified in the AWWA Standard C-600 Sec. 5.2 for ductile iron and C-605 Sec. 7.3 for PVC pipe. The pressure in the pipeline shall be pumped up to the specified test pressure. When the test pressure has been reached, the pumping shall be discontinued until the pressure in the line has dropped 5 psi, at which time the pressure shall again be pumped up to the specified test pressure. This procedure shall be repeated until the end of the test period. At the end of the test period, the

pressure shall be pumped up to the test pressure for the last time. The total quantity of water pumped to maintain pressure shall be measured and compared to the allowable.

(d) Leakage Shall not exceed the amount calculated, using AWWA Standard C-605 for PVC and C-600 for ductile iron.

### 34-8.3 Sterilization

Prior to pressure testing and prior to acceptance of Work, the entire pipeline including all valves, fitting, hydrants, service laterals, and other accessories shall be sterilized in accordance with AWWA C-601 latest revision. All mains shall be flushed with potable water after completion of construction and prior to disinfection. The Contractor shall provide a sufficient number of suitable outlets at the end(s) of the line(s) being sterilized in addition to those required by the Plans, to permit the main to be flushed with water at a velocity of at least 5.5 feet per second over its entire length. The outlets provided shall meet the requirements for fittings as specified for the type of main constructed. Temporary blow-offs may be installed during the sterilization and flushing to satisfy these requirements. Drainage facilities shall be constructed such that the water lines cannot be contaminated through the flushing outlet. After flushing, chlorine compound solution made with liquid chlorine, calcium hypochlorite in solution or sodium hypochlorite solution shall be water mixed and introduced into the mains to form a chlorine concentration of approximately 100 ppm or that which will provide a minimum residual of 50 ppm in all parts of the line after 24 hours have elapsed.

During the sterilization process all valves, hydrants and other accessories shall be operated. After chlorination, the water shall be flushed from the line at its extremities until the replacement water tests are equal chemically and bacteriologically to those of the permanent source of supply. The placing of chlorine capsules or tablets in pipe sections during the laying process will be considered as an acceptable method of sterilization. The chlorine water solutions shall be diluted to a chlorine concentration of not more than 100 ppm and not less than 50 ppm measured in the water lines. The Contractor shall keep adequate chlorine residual testing and indicating apparatus available on the site during the entire sterilization period.

After final flushing, the flushing fitting shall be plugged with devices intended for this purpose at the pressure class of the pipe. Where water main is coated, plugs and outlets shall be similarly coated. Bacteriologic samples of water for the specified bacteriologic test shall be taken from each end of the sterilized main (located downstream of the point of introduction of chlorine disinfectant and at other locations as determined necessary by the Engineer.) Additional samples shall be taken at intermediate points in such a manner that at least

one sample is taken for each 700 feet of main. Bacterial samples will be taken a minimum of 48 hours after the mains have been flushed of all chorine.

The Contractor shall dechlorinate disinfecting water and flushing water if required by the Plans

## 34-9 SIGNAGE

A sign reading "Recycled Water-Do Not Drink" in English and Spanish, shall be posted at all points where consumption of the water may be attractive to the public, in areas of public use that receive reclaimed water and at all valves, control boxes, and similar features in accordance with City Standard Drawing No RW-13 . This requirement may also apply to sprinkler heads when after-market clip-on purple rings are readily available in accordance with City Standard Drawing No RW-19.

## 34-10 ABANDONMENT

### 34-10.1 General

All existing non-potable waterlines or structures that are to be abandoned must be identified in the drawing. In general, abandoned lines that are in service will be replaced with a parallel line of equal or larger size, and the Engineer shall demonstrate in any case that the abandonment does not adversely affect the water system.

### 34-10.2 Recycled Water Lines

All non-potable water lines to be abandoned shall be entirely filled by pumping concrete into them. The pump mix shall be a mixture sufficiently workable for the purposes intended.

# Southeast Development Area (SEDA)
# Specific Plan
# Wastewater Technical Study

***April 26th, 2023***

*Prepared for:*

City of FRESNO

*City of Fresno, California*

*Prepared by:*


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# CHAPTER 1
# INTRODUCTION

## 1.1 Project Description and Background

The City of Fresno (City) is preparing a Specific Plan and Program Environmental Impact Report (PEIR) for the Southeast Development Area (SEDA). The SEDA Specific Plan Area (Plan Area), previously known as the Southeast Growth Area (SEGA), is an approximately 9,000-acre area in the southeast portion of the City of Fresno that is formally designated as a growth area in the City of Fresno General Plan (General Plan). The Plan Area is generally bound by the Gould Canal to the north, McCall and Highland Avenues to the east, Jensen and North Avenues to the south, and Locan, Temperance, and Minnewawa Avenues to the west; see Figure 1.1 for the Plan Area's location.

SEDA was approved for incorporation into the City by the Local Agency Formation Commission (LAFCo) in 2006, with a number of qualifying provisions, of which included the preparation of a Specific Plan and associated environmental documents before the land could be annexed to the City. Located in Growth Area II, SEDA was planned for development after other infill initiatives from the City's other planning efforts, and would be developed in phases. The General Plan established two levels of development – the General Plan Horizon and the General Plan Buildout. The General Plan Horizon is the level of development predicted to occur by the "Horizon Year," which was established as 2035, in accordance with the General Plan. General Plan Buildout is the level of development characterized by full occupancy of all developable sites in accordance with the General Plan; this was estimated to occur beyond 2035 (defined as past 2050).

As such, the General Plan defined development of SEDA under General Plan Horizon as a portion of the full buildout conditions – specifically, it assumed a residential development capacity of approximately 15,000 dwelling units, one third of the buildout capacity. Accordingly, the residential development capacity of SEDA under General Plan Buildout is approximately 45,000 dwelling units, and the General Plan assumed that the additional 30,000 dwelling units would not be developed until after 2035. However, though the General Plan was analyzed under the General Plan Horizon level, the associated MEIR (Master Environmental Impact Report) analyzed the environmental impacts of the General Plan under the buildout level for the Sphere of Influence (SOI), which encompasses other growth areas, including SEDA.

The Specific Plan for SEDA was developed for the buildout condition of the Plan Area of 45,000 dwelling units, and provides implementation mechanisms for development in the Plan Area that accommodate for increased density and accelerate housing production. As part of the City's General Plan, SEDA was designated with land use classifications as defined in the General Plan. The Specific Plan presents alternative land use classifications for SEDA, and seeks to propose how the Plan Area will develop over time to complete buildout conditions with these newly-defined land use categories.

As part of the Specific Plan process, a PEIR needs to be developed to evaluate the impacts associated with the proposed improvements to the Plan Area, and what, if any, mitigation measures are necessary to account for such impacts. This technical study will focus on the impacts of the SEDA Specific Plan on wastewater facilities and the wastewater collection and treatment system proposed for the Plan Area.

## 1.2 Summary of Analysis

The City's General Plan assigned land use classifications to areas located within the SEDA Specific Plan Area. Each land use classification has a set of characteristics assigned to it with respect to a specific utility demand that have been determined and/or calculated by various contributing parties. The SEDA Specific Plan proposes new land use classifications for the Plan Area that may change the area's characteristics as it relates to utilities, e.g., water demand, wastewater generation, or storm water runoff, when compared to the General Plan. Additionally, some land uses have revised areas, which further alters those characteristics.

Changes in land use can affect a wastewater collection system's ability to collect, convey, and treat wastewater generated by a city's residents. New development will require the construction of new wastewater collection facilities including sewer mains, manholes, pump stations, and treatment plants. The City of Fresno's Wastewater Collection System Master Plan Update (Wastewater Master Plan)[1] includes a number of proposed capital improvements to account for increased development based on the General Plan buildout conditions. The Wastewater Master Plan includes wastewater flow factors that were developed for each land use classification defined in the General Plan.

This technical study will focus on the analysis of wastewater production in the Plan Area, and how it may change based on Specific Plan development. The analysis to determine the change in wastewater flows involved comparing the total wastewater flow determined for the Plan Area under both the General Plan and Specific Plan land use cases.

At the time of preparation of this study, the City was developing wastewater flow factors for the new SEDA land use classifications. These factors were not available when completing the above stated analysis. Thus, a number of reasonable assumptions were made to correlate Specific Plan land uses with General Plan land uses in order to use the wastewater flow factors established in the Wastewater Master Plan for General Plan land uses.

This technical study focuses on specifically analyzing the change in wastewater generation between the General Plan and the Specific Plan for SEDA in order to assist with the development of mitigation measures as needed.

[1] City of Fresno, "Wastewater Collection System Master Plan Update," September 2015.

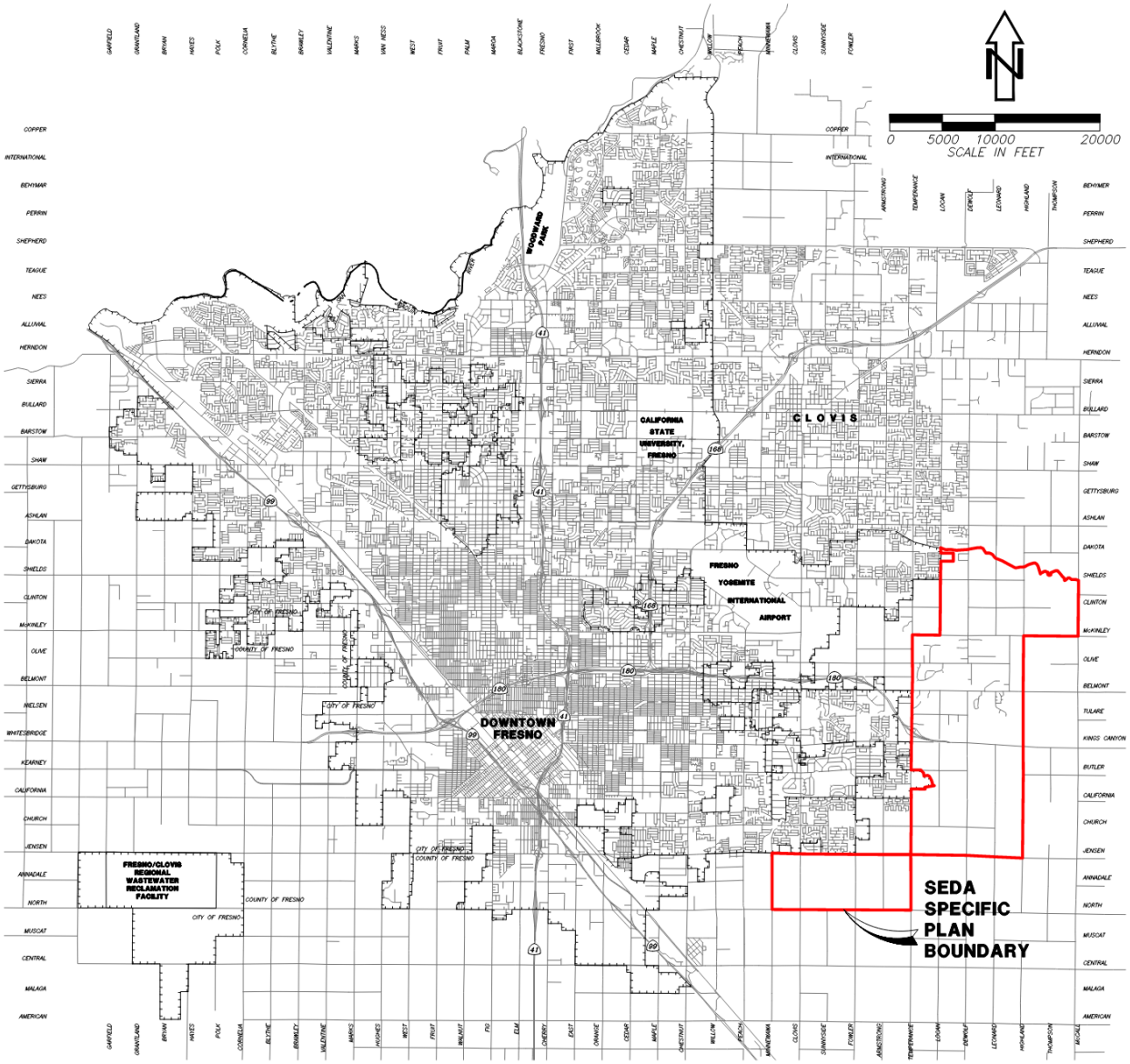



**Figure 1.1 SEDA Specific Plan Location**

# CHAPTER 2
# REGULATORY FRAMEWORK

## 2.1 General

The City of Fresno owns and operates the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) as well as the North Fresno Wastewater Reclamation Facility (NFWRF), and owns and maintains the wastewater collection system that serves Fresno and other participating agencies, including the County of Fresno, the City of Clovis, the Pinedale Public Utility District, and the Pinedale Water District. The area served by the City's wastewater collection system includes residential, commercial, and industrial uses. A majority of the City's wastewater is collected and conveyed to the RWRF for treatment, with a small portion being treated by the NFWRF. Wastewater service for Clovis is also provided by Fresno facilities and the RWRF, however a small portion of Clovis is served by their own wastewater treatment facility. The Wastewater Management Division (WMD) of the City's Department of Public Utilities is responsible for the collection, conveyance, treatment, and reclamation of wastewater generated by users in the Fresno-Clovis metropolitan area.

There are a number of federal, state, and local regulations that must be adhered to when planning wastewater facilities, many of which provide guidance and requirements for the handling and management of wastewater flows; several are discussed in the following sections.

## 2.2 Federal Regulations

Clean Water Act[2]

The Federal Water Pollution Control Act of 1972, commonly referred to as the Clean Water Act (CWA), regulates the discharge of pollutants into watersheds throughout the United States. It is the primary federal law regulating and governing water pollution, with the objective of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. The CWA establishes the basic structure for regulating discharges of pollutants in waters of the United States and regulating quality standards for surface waters. Under the CWA, the EPA has implemented pollution control programs, such as setting wastewater standards for industry, and developed national water quality criteria recommendations for pollutants in surface waters. The CWA provides assistance to publicly owned treatment works for the improvement of wastewater treatment and maintenance of wetlands.

National Pollutant Discharge Elimination System[3]

The National Pollutant Discharge Elimination System (NPDES) was established in the CWA to regulate industrial and municipal discharge into waters of the United States; this includes point-source municipal waste discharges and nonpoint-source storm water runoff. NPDES permits typically identify effluent and receiving water limits on allowable concentrations and/or mass emissions of pollutants contained in the discharge, prohibitions on discharges not specifically allowed under the permit, and provisions that describe required actions by the discharger, including industrial pretreatment, pollution prevention, self-monitoring, and other activities. The NPDES permitting program delegates authority to state governments for implementation through State Water Boards. Wastewater discharge is regulated under the NPDES permit program for

[2] Clean Water Act, 33 U.S.C. §1251 et seq. (1972).
[3] Environmental Protection Agency (EPA), National Pollutant Discharge Elimination System (NPDES), 1972.

direct discharges into receiving waters and by the National Pretreatment Program for indirect discharges to a sewage treatment plant.

## 2.3 State Regulations

State Water Resources Control Board

The State Water Resources Control Board (SWRCB) adopted a General Waste Discharge Requirement (Order No. 2006-0003) in 2006 for all publicly owned sanitary sewer collection systems in California with more than one mile of sewer pipe.[4] The order provides a statewide approach to managing and reducing sanitary sewer overflows (SSOs) by requiring public sewer system operators to take all feasible steps to control the volume of waste discharged into the system, and to develop a Sewer System Management Plan (SSMP). The General Waste Discharge Requirement also requires storm sewer overflows to be reported to the SWRCB.

The SWRCB delegates the authority to enforce these requirements to nine Regional Water Quality Control Boards (RWQCB) within their own regions. The Central Valley RWQCB issues and enforces NPDES permits in Fresno. Such permits allow the RWQCB to regulate where and how waste is disposed, including the discharge volume and effluent limits of the waste, and monitoring and reporting. Inspections of permitted discharges and monitoring permit compliance is also the responsibility of each RWQCB.

Sanitary District Act of 1923[5]

The Sanitary District Act of 1923 (California Health and Safety Code §6400 et seq.) authorized the formation of sanitation districts and enforces the districts to construct, operate, and maintain facilities for the collection, treatment, and disposal of wastewater. The act was amended in 1949 to allow the districts to also provide solid waste management and disposal services, including refuse transfer and resource recovery.

## 2.4 Local Regulations

Wastewater management in Fresno is mainly regulated by the Central Valley RWQCB. There are other local authorities, including the City's WMD, and various regulations and planning documents that assist the City in overseeing wastewater infrastructure management and planning.

Fresno General Plan[6]

The City's General Plan contains the following goals, policies, and objectives relevant to the provision of wastewater service and facilities (Table 2.1):

**Table 2.1 City of Fresno General Plan Objectives and Policies Relevant to Wastewater Facilities**

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| Objective PU-4 | Ensure provision of adequate trunk sewer and collector main capacities to serve existing and planned urban development, consistent with the Wastewater Master Plan. |

[4] State Water Resources Control Board, "Statewide General Waste Discharge Requirements for Sanitary Sewer Systems," Order No. 2006-0003-DWQ, May 2006.
[5] California Health and Safety Code, §6400 et seq. (1923).
[6] City of Fresno, "Fresno General Plan," December 18, 2014.

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| Policy PU-4-b | **New Trunk Facilities.** Pursue construction of new or replacement sewer trunk facilities or other alternatives consistent with the Wastewater Master Plan to accommodate the uses as envisioned in this General Plan. |
| Policy NS-4-c | **System Extension and Cost Recovery.** Pursue enlargement or extension of the sewage collection system where necessary to serve planned urban development, with the capital costs and benefits allocated equitably and fairly between the existing users and new users. |
| Objective PU-5 | Preserve groundwater quality and ensure that the health and safety of the entire Fresno community is not impaired by use of private, on-site disposal systems. |
| Policy PU-5-b | **Non-Regional Treatment.** Discourage, and when determined appropriate, oppose the use of private wastewater (septic) disposal systems, community wastewater disposal systems, or other non-regional sewage treatment and disposal systems within or adjacent to the Metropolitan Area if these types of wastewater treatment facilities would cause discharges that could result in groundwater degradation. |
| Policy PU-5-c | **Satellite Facilities.** Work with the Regional Water Quality Control Board to ensure that approval of any satellite treatment and reclamation facility proposal is consistent with governing statutes and regulations. |
| Objective PU-6 | Ensure the provision of adequate sewage treatment and disposal by utilizing the Fresno-Clovis Regional Wastewater Reclamation Facility as the primary facility, when economically feasible, for all existing and new development within the Metropolitan Area. |
| Policy PU-6-a | **Treatment Capacity and Cost Recovery.** Prepare for and consider the implementation of increased wastewater treatment and reclamation facility capacity in a timely manner to facilitate planned urban development within the Metropolitan Area consistent with this General Plan. Accommodate increase in flows and loadings from the existing community with the capital costs and benefits allocated equitably and fairly between existing users and new users, as authorized by law. |
| Policy PU-6-b | **Consider Capacity in Plan Amendments.** Monitor wastewater treatment plant flows and loadings to the extent feasible. Consider the effects on wastewater treatment capacity and availability of potable water when evaluating proposed General Plan amendment proposals, community plans, Specific Plans, neighborhood plans, and Concept Plans. |
| Objective PU-7 | Promote reduction in wastewater flows and develop facilities for beneficial reuse of reclaimed water and biosolids for management and distribution of treated wastewater. |
| Policy PU-7-a | **Reduce Wastewater.** Identify and consider implementing water conservation standards and other programs and policies to reduce wastewater flows. |
| Policy PU-7-b | **Reduce Stormwater Leakage.** Reduce storm water infiltration into the sewer collection system, where feasible, through a program of replacing old and deteriorated sewer collection pipeline; eliminating existing stormwater sewer cut-ins to the sanitary sewer system; and avoiding any new sewer cut-ins except when required to protect health and safety. |
| Policy PU-7-c | **Biosolid Disposal.** Investigate and consider implementing economically effective and environmentally beneficial methods of biosolids handling and disposal. |

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| Policy PU-7-d | **Wastewater Recycling.** Pursue the development of a recycled water system and the expansion of beneficial wastewater recycling opportunities, including a timely technical, practicable, and institutional evaluation of treatment, facility siting, and water exchange elements. |
| Policy PU-7-e | **Infiltration Basins.** Continue to rehabilitate existing infiltration basins, and if determined appropriate, pursue acquiring additional sites for infiltration basins, as needed. |
| Policy PU-7-f | **Food and Drink Industry.** Ensure adequate provision of facilities for the appropriate management of wastewater from wineries and food processing and beverage facilities, including conformance with Waste Discharge Requirements issued by the Regional Water Quality Control Board. |

City of Fresno Municipal Code[7]

Article 3, "Sewage and Water Disposal," of Chapter 6, "Municipal Services and Utilities," of the City of Fresno Municipal Code includes provisions regarding wastewater collection and discharge for the City. The purpose of the Sewage and Water Disposal Ordinance is to ensure the health, safety, and general welfare of citizens, and protect the water quality of water courses, water bodies, and groundwater in accordance with the CWA and the NPDES permitting program, and providing requirements for wastewater collection, conveyance, treatment, and disposal/recycling.

Sewer System Management Plan[8]

Under the Statewide General Wastewater Discharge Requirements for Sanitary Sewer Systems, the City was required to develop and maintain a Sewer System Management Plan (SSMP) to provide a mechanism to properly manage, operate, and maintain all parts of the sanitary sewer system with the goal of reducing and preventing SSOs, which include releases of untreated or partially treated wastewater resulting in public exposure, regardless of whether the wastewater reaches waters of the United States or not, or wastewater backups into buildings and onto private property that are caused by blockages in the City's portion of the sanitary sewer system. The City's first SSMP was approved in 2009, and several revisions have been issued since; the latest revision was approved in 2019.

The City's SSMP must:

- Establish the legal authority to prevent illicit discharges into its sanitary sewer system;
- Require that sewers and connections be properly designed and constructed;
- Ensure access for maintenance, inspection, or repairs for those portions of the lateral owned or maintained by the City;
- Limit the discharge of fats, oils, and grease and other debris that may cause blockages; and
- Enforce any violation of its sewer ordinances.

City of Fresno Standard Specifications and Plans

The City maintains its own set of standard Specifications and Plans to be followed when designing and constructing City projects. Those related to the collection and conveyance of wastewater include, but are not limited to:

[7] City of Fresno Municipal Code, Chapter 6, "Municipal Services and Utilities, Article 3, "Sewage and Water Disposal."
[8] City of Fresno, "Sewer System Management Plan," 2019.

- Standard Specifications
    - Section 17 – Sanitary Sewer Pipe and Appurtenances
- Standard Plans
    - Plans S-1 through S-13B

**CHAPTER 3**
**EXISTING CONDITIONS**

## 3.1 Wastewater Collection Infrastructure

### 3.1.1 General

The City of Fresno's wastewater collection system consists of approximately 1,500 miles of gravity sewer lines ranging from 8 inches to 84 inches in diameter, 15 active lift stations, 1.7 miles of force mains, 23,000+ manholes, and 54 junction structures. The area serviced by the City system includes residential, commercial, and industrial users.

### 3.1.2 Wastewater Collection

The wastewater collection system primarily conveys wastewater via gravity flow from the northeast to the southwest, ultimately to the Fresno-Clovis RWRF. The system consists of pipe of varying materials, with the majority being composed of either vitrified clay pipe (VCP) (56.2% of system piping) or polyvinyl chloride (PVC) pipe (30.8% of system piping).[9]

Wastewater collection begins at each user/land type, in which a house branch/service connects the user to the wastewater collection system. The house branches/services (typically 4 to 12 inches in size) will connect to a sewer lateral (collection pipelines, typically 13 to 33 inches in size), which conveys wastewater to a main or trunk sewer (typically 34 inches or larger in size). Main or trunk sewers collect wastewater from a number of services as they head toward the treatment plant. Manholes are placed within runs of sewer mains at regular intervals to facilitate access for maintenance of the mains, as well as at changes in direction of the sewer main. Lift stations may be located strategically throughout the system to provide the necessary lift when the natural alignment of a gravity pipeline becomes inefficient (e.g., too deep or insufficient slope).

The City has a number of monitoring stations that actively collect and log flow data for the wastewater system. Additionally, the City has many junction structures/special structures that can be used to control flow distribution between downstream sewers. See Figure 3.1 for an overview of the existing wastewater collection system.

### 3.1.3 Wastewater Treatment

In partnership with the City of Clovis, the City of Fresno owns and operates the Fresno-Clovis RWRF located near the intersection of Jensen and Cornelia Avenues in southwest Fresno. The RWRF receives and treats the majority of domestic, commercial, and industrial wastewater generated within the Cities of Fresno and Clovis, as well as some unincorporated areas of Fresno County. The RWRF is currently operated by the City, who holds responsibility for ensuring regulatory compliance with Waste Discharge Requirements (WDRs), and the Central Valley RWQCB Order No. 5-01-254, "Waste Discharge Requirements for Cities of Fresno and Clovis Wastewater Treatment Facility, Fresno County."

The RWRF has a rated capacity of 88 million gallons per day (MGD), but the average annual flow is approximately 80 MGD.[10] The RWRF produces undisinfected secondary-treated wastewater and disinfected tertiary-treated wastewater. The undisinfected secondary-treated wastewater is

[9] City of Fresno, "Wastewater Collection System Master Plan Update," September 2015.
[10] "Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF)." https://www.fresno.gov/publicutilities/facilities-infrastructure/fresno-clovis-regional-wastewater-reclamation-facility-rwrf/.

disposed into on-site disposal ponds and conveyed to farmers for restricted irrigation of non-food crops on agricultural land on surrounding properties. The disinfected tertiary-treated wastewater is delivered through a network of pipelines to various recycled water use areas around the City, mainly to be used for irrigation of landscaping at sites including but not limited to parks, median landscape strips, and cemeteries. The RWRF also owns and operates a number of reclamation wells that extract water from on-site percolation ponds, and discharge into Fresno Irrigation District (FID) canals for irrigation use of farmlands downstream of the RWRF.

The City also owns and operates the NFWRF located in northeast Fresno on the north side of Copper Avenue between Cedar and Maple Avenues. This facility receives and treats wastewater generated within a small area of the City generally bound by Copper, Friant, and Willow Avenues, including wastewater generated from Copper River Ranch. The NFWRF is a tertiary level treatment facility, and the treated wastewater is mainly used for irrigation of the Copper River Country Club and Golf Course. The permitted capacity of the plant is 0.71 MGD average monthly flow and 1.07 MGD maximum daily flow.[11]

The City treats wastewater via primary (removal of materials that will float or settle) and secondary (biological processes to remove suspended and dissolved solids) treatment, after which it is deposited into infiltration ponds to allow percolation through the soil, serving as another level of treatment. The City operates federally mandated industrial pretreatment programs to prevent the introduction of pollutants into publicly owned treatment works that could impact the collection infrastructure and pass through to receiving waters. Industries are also billed for sewer service depending on the amount of water used or effluent discharged and the strength of their wastewater measured as pounds of biochemical oxygen demand (BOD) and pounds of total suspended solids (TSS). Reducing the strength of their wastewater to reduce sewerage costs becomes an incentive for industries to improve the water quality of their wastewater effluent.

### 3.1.4 Wastewater Flow

Generally, wastewater consists of base wastewater flow and wet weather flow. Base wastewater flow is generated by routine water usage in the residential, commercial, business, and industrial sectors of the collection system. Wet weather flow includes storm water inflow, trench infiltration, and wet weather ground water infiltration. Base wastewater flow also includes dry weather groundwater infiltration, which is groundwater that enters the sewer system when the relative depth of the groundwater table is higher than the depth of the pipeline and defects exist in the pipe, such as cracks, misaligned joints, or breaks allowing infiltration into the system. In Fresno, the depth to groundwater table is significant, and therefore dry weather groundwater infiltration has little to no influence on the collection system. For wet weather flow, storm water inflow and trench infiltration comprise the term “Infiltration and Inflow,” also known as I/I. Wet weather flow can also be affected by groundwater infiltration in that the groundwater table elevation may rise during storm events. Though as mentioned, the depth to groundwater level is very large in Fresno, and thus has no noticeable effect on wastewater flow.

Base wastewater flows are diurnal in nature, taking on patterns of generation that depend on the type of use and hours of use. Commercial and industrial patterns typically have higher flows during business hours and lower flows at night, and weekend flow patterns may vary significantly when compared to weekday flows.

I/I affects all sewer systems. Infiltration occurs when storm water slowly seeps into the sewer system by percolating through the soil and entering through defects in the pipes, manholes, and

[11] “North Fresno Wastewater Treatment Facility (NFWTF).” https://www.fresno.gov/publicutilities/facilities-infrastructure/north-fresno-wastewater-treatment-facility-nfwtf/.

joints. Inflow occurs when storm water rapidly flows into the sewer system through more readily available entrances, such as storm drain cross connections, leaky manhole covers, illegal storm drain connections, and sewer cleanouts. I/I increases the flow volume and peak flows, and can cause overflows if the sewer system is operating at capacity at the time of I/I occurrence. Per the Wastewater Master Plan, though some areas experience higher rates of I/I, the City's wastewater collection system generally exhibits relatively low I/I as a whole.

### 3.1.5 Plan Area

Per the Wastewater Master Plan, the Plan Area is currently outside of the City's sewer service area, and there are little to no existing City wastewater facilities within the area. The City does not provide wastewater collection service to the Plan Area, except in small portions of developed areas; there are a few existing sewer mains that border the Plan Area. It is assumed that most of the Plan Area is unsewered and/or served by septic tank systems. In accordance with Section 6-303, "Sewer Connection Required," of the Fresno Municipal Code, all properties within the City's service area shall be connected to the City's sanitary sewer system if it is available, and all septic tank/cesspool systems shall be abandoned.[12]

A sewer system is considered "available" if a sewer main has been constructed and is available for use in a public street, alley, or right-of-way within 100 feet for the first unit plus 50 feet for each additional unit, to be measured along the public street, alley, or right-of-way from the nearest property line to the sewer main. Any existing development within the Plan Area currently served by a septic tank system will be required to connect to the future sewer mains constructed to serve the area within three years after the sewer system becomes available, and pay all associated fees.

[12] City of Fresno Municipal Code Chapter 6, "Municipal Services and Utilities," Article 3, "Sewage and Water Disposal," §6-303, "Sewer Connection Required."

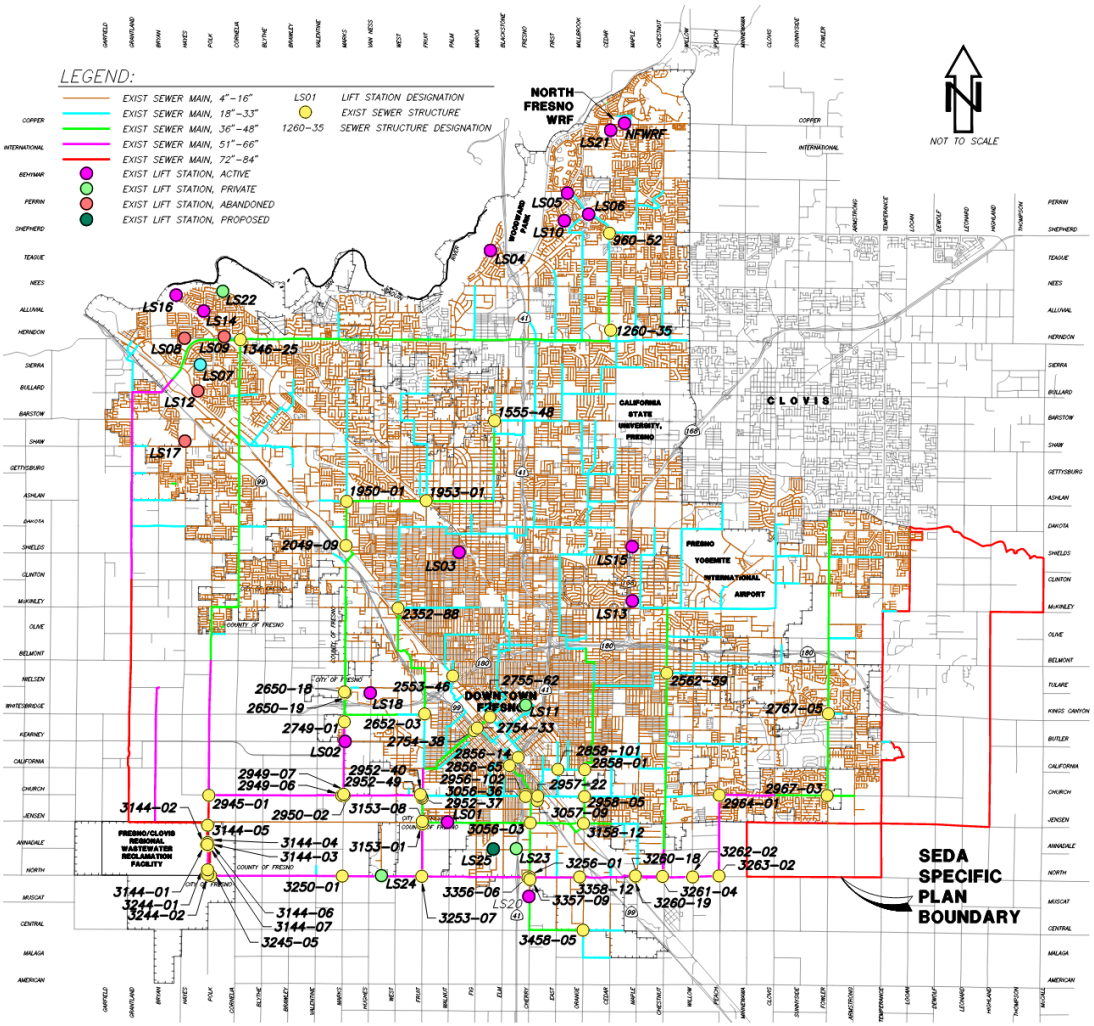



**Figure 3.1 Existing Fresno Wastewater Collection Facilities**

# CHAPTER 4
# FUTURE WASTEWATER INFRASTRUCTURE

## 4.1 General

Future wastewater facilities are included in the City's Wastewater Collection System Master Plan Update. The City's General Plan includes developmental policies for wastewater facilities for the City of Fresno, including growth areas such as SEDA.

## 4.2 General Plan Policies

The General Plan discusses aspects of the wastewater collection system as they pertain to development in Fresno. The City is designated as the Regional Sewer Agency for the Fresno-Clovis Metropolitan Area, and as mentioned, owns, operates, and maintains the wastewater collection system that serves Fresno and other participating agencies, as well as the Fresno-Clovis RWRF and the NFWRF. The wastewater treatment and reclamation system includes the collection and conveyance of wastewater, treatment of raw wastewater, and management of reclaimed water and biosolids. Aging infrastructure and the need to pursue more advanced levels of reclamation and reuse are factors in long term development/improvements in new growth areas and existing developments. See Table 2.1 for a summary of objectives and policies for wastewater included in the General Plan.

## 4.3 Master Plan Improvements

The most recent version of the Wastewater Master Plan is the Wastewater Collection System Master Plan Update (Wastewater Master Plan), completed in September 2015. The Wastewater Master Plan is intended to be the guiding document in planning and implementing sewer system improvements to accommodate future growth to buildout of the General Plan. The SEDA Plan Area is referred to as an "Area of Change" in the Wastewater Master Plan (specifically as a "New Growth Area"), and is characterized as a growth area that will contribute to an expansion of the service area and increased wastewater flows.[13]

The Wastewater Master Plan includes in depth analysis of the existing and projected wastewater flows of the City based on the General Plan development buildout conditions, and includes a number of proposed facilities to accommodate future development, including those for the Plan Area.

Per the Wastewater Master Plan, the peak wet weather flow (PWWF) is the highest observed hourly flow that occurs following the design storm event, and that the City's sewer and lift stations were evaluated based on their capacity to convey this flow, referred to synonymously as the "design flow." Analysis was also completed for the base wastewater flow. The Wastewater Master Plan indicates that the buildout base wastewater flow will be 129.9 MGD (million gallons per day), and that the PWWF will be 202.4 MGD. The peak dry weather flow (PDWF) was also calculated as 164.7 MGD at buildout. The base wastewater flow, also known as the average dry wastewater flow, will be used for analysis of the General Plan and Specific Plan wastewater capacities presented in this report. The RWRF has a buildout capacity of 88 MGD.

As mentioned, several new sewer pipelines were proposed to accommodate the projected wastewater flows. These consist of a number of proposed sewer mains and related facilities for

[13] City of Fresno, "Wastewater Collection System Master Plan Update," September 2015.

the Plan Area, including new trunk sewers, sewer mains, and sewer laterals throughout the SEDA Specific Plan Area, and a satellite treatment/scalping plant with a connection to existing sewer mains to convey wastewater solids to the Fresno-Clovis RWRF. See the Wastewater Master Plan for details on the proposed wastewater improvements within the Plan Area.

The proposed improvements for the Plan Area included in the Wastewater Master Plan were determined based on wastewater modeling and analysis of the General Plan buildout condition, which assumed full development of all developable sites within the General Plan boundary. The Wastewater Master Plan defined its study area boundary as the City's SOI as defined in the General Plan, which includes all land within the City limits (excluding the RWRF), County islands (unincorporated land surrounded by the city), and lands that are expected to be annexed by the City, which includes the land beyond the outer City limits on all sides. The Wastewater Master Plan study area was intended to include the existing City limits and development that could occur through buildout of the City's General Plan. The proposed improvements in the Plan Area were developed to accommodate future growth as identified by the hydraulic analysis completed as part of the Wastewater Master Plan.

The land use assumptions in the Wastewater Master Plan were based on the General Plan and projected future developments within the City's proposed growth boundary. The Wastewater Master Plan includes wastewater flow factors that were established based on the average wastewater flow generated for each existing land use type in Fresno, and calculated from the General Plan land use classifications in gpd/ac (gallons per day per acre). These factors were used to project the estimated wastewater flow through buildout of the City's General Plan boundary, and were used in the analysis of the Plan Area wastewater generation that will be covered in Chapter 5.

**CHAPTER 5**
**SPECIFIC PLAN WASTEWATER ANALYSIS**

## 5.1 General

The SEDA Specific Plan revised the General Plan buildout land use classifications to new SEDA-specific land use classifications – see Figure 5.1 for the General Plan Land Use Map of the Plan Area, and Figure 5.2 for the SEDA Specific Plan Land Use Map for the chosen alternative for the Plan Area. With changes in land use classifications, the Plan Area will need to be evaluated for impacts to the proposed wastewater collection system due to changes in wastewater generation.

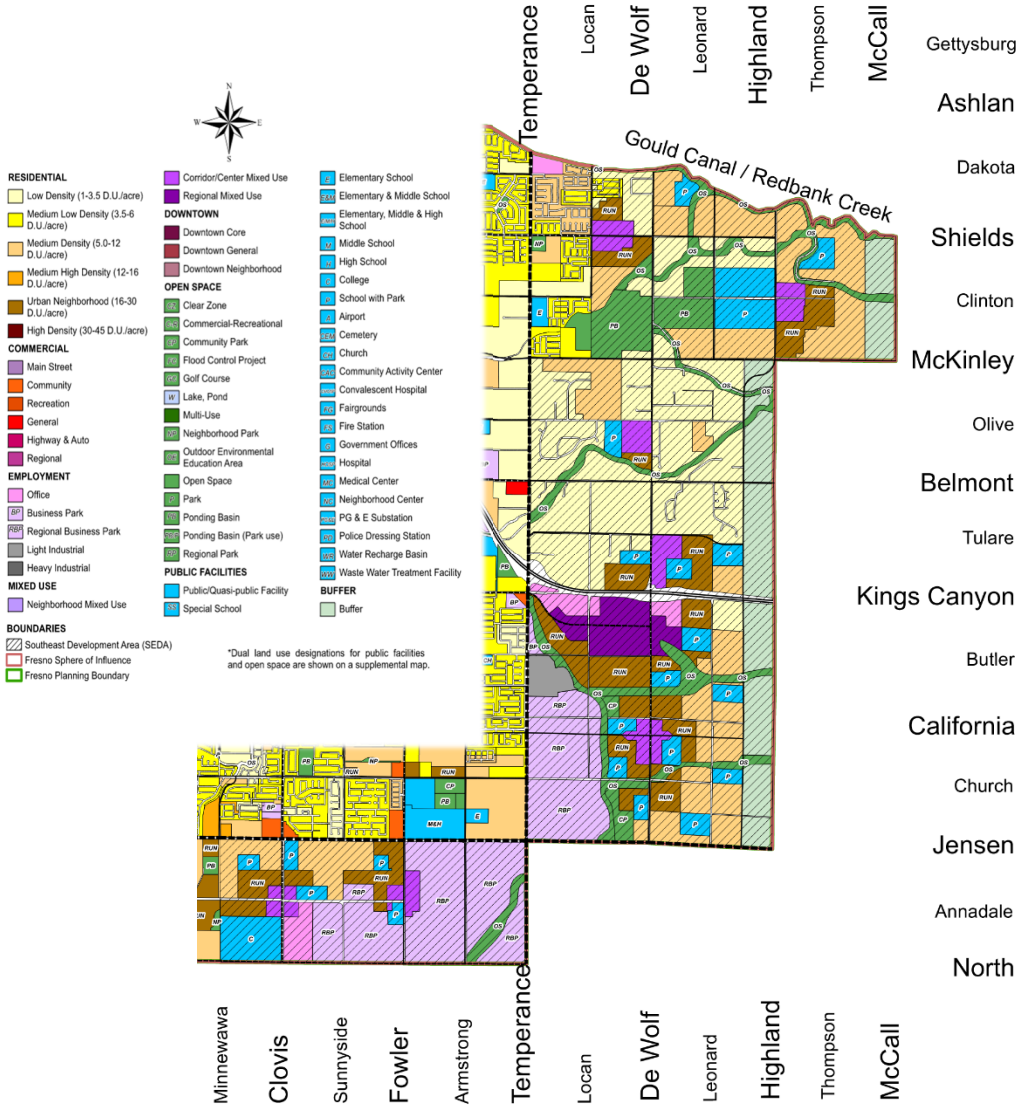
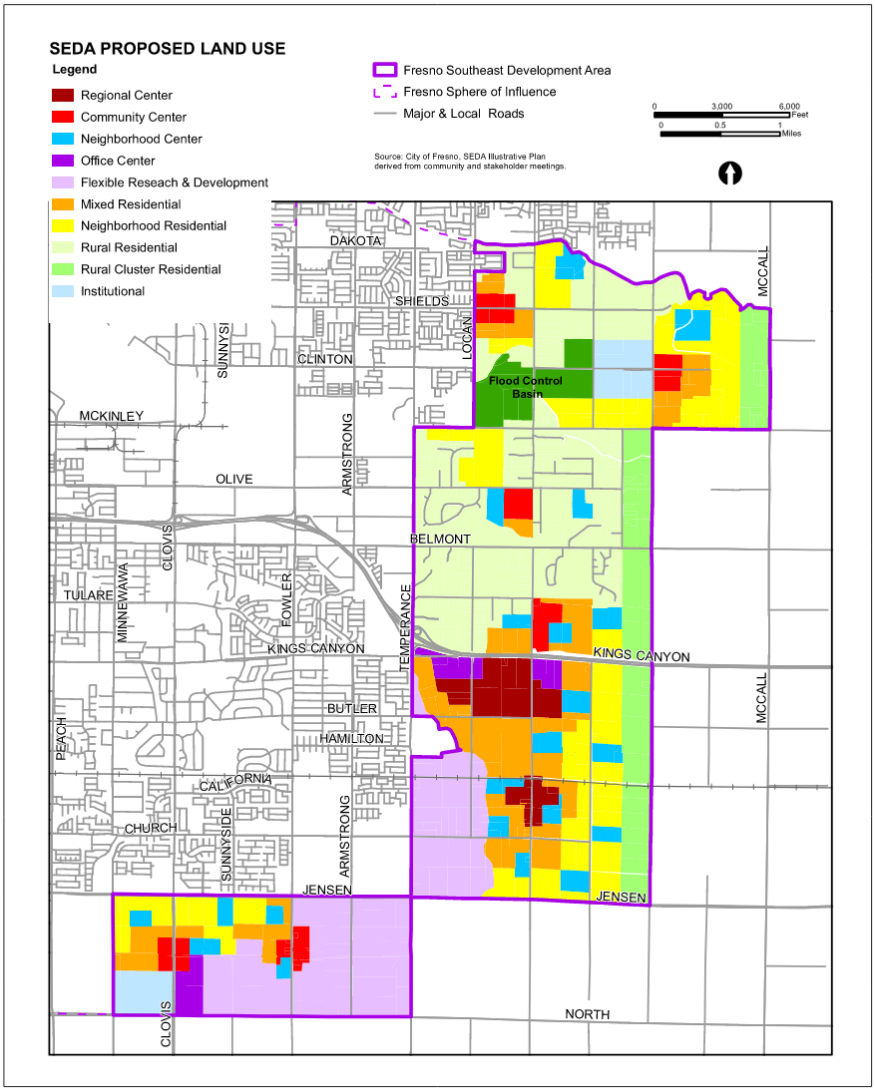



**Figure 5.1 General Plan Land Use Map for SEDA Plan Area**
Source: City of Fresno General Plan, Figure LU-1, December 2014, Figure Updated 3/2/2021




Source: City of Fresno, SEDA Regulating Districts, 02/10/2022.

**Figure 5.2 SEDA Proposed Land Use**
Source: Southeast Development Area Specific Plan Notice of Preparation,
First Carbon Solutions, 02/2022

## 5.2 Analysis Methodology

The technical analysis of the land use changes in the Plan Area was focused on comparing the change in wastewater flow generation from the General Plan Land Use case to the Specific Plan Land Use case to determine potential impacts to the wastewater collection system and to assist in the development of mitigation measures if necessary. General Plan land use classifications and Specific Plan land use classifications were provided by the City of Fresno Planning and Development Department in the form of GIS (Geographic Information System) and Shape files. GIS and Shape files were also obtained from the City of Fresno Department of Public Utilities for the existing sewer facilities in Fresno. The GIS and Shape files were georeferenced to the

California State Plane Coordinate System, Zone 4, Foot, NAD83 Datum for analysis. This allowed mapping of the land uses to pull information necessary to complete the analysis, including the area of each land use.

The SEDA Specific Plan does not use the same land use classifications as defined in the General Plan, and instead utilizes SEDA-specific land use classifications developed as part of the Specific Plan. At the time of the preparation of this technical study, the City was developing wastewater flow factors for the SEDA-specific land uses as was done for the General Plan land uses; these factors were unavailable during the completion of the analysis for this technical study. However, the SEDA-specific land uses are similar in nature to many of the General Plan land uses, and similarities can be drawn between the two land use categories. Thus, a number of reasonable assumptions were made to determine equivalent General Plan land uses for each SEDA-specific land use in order to utilize the wastewater flow factors for General Plan land uses previously established in the Wastewater Master Plan. See Table 5.1 for the equivalent General Plan land uses established for the SEDA-specific land uses.

The wastewater flow factors taken from the Wastewater Master Plan for each General Plan land use that were used in the analysis have been included in Table 5.2. The GIS files for the General and Specific Plan land uses were used to determine the total areas of each land use classification. The wastewater flow factors were then multiplied by the area of the corresponding land use classification to determine a total wastewater flow for the Plan Area based on the General Plan and the Specific Plan developments. The total wastewater produced by the Plan Area based on the General Plan case was compared to that of the Specific Plan case, resulting in the total change in wastewater generation for the Plan Area.

**Table 5.1 General Plan–SEDA Equivalent Land Use Classifications for Determination of Wastewater Flow Factors**

| SEDA Specific Plan Land Use Classifications[14] | Equivalent General Plan Land Use Classification[15] |
|---|---|
| Residential – Mixed Residential | Residential – Urban Neighborhood |
| Residential – Neighborhood Residential | Residential – Medium Density |
| Residential – Rural Residential | Residential – Low Density |
| Residential – Rural Cluster Residential | Residential – Low Density |
| Employment – Office Center | Employment – Office |
| Employment – Flexible Research & Development | Employment – Business Park/ Regional Business Park |
| Employment – Institutional | Public Facilities – College/School with Park |
| Mixed Use – Regional Center | Mixed Use – Regional Mixed Use |
| Mixed Use – Community Center | Mixed Use – Corridor/Center Mixed Use |
| Mixed Use – Neighborhood Center | Public Facilities – Neighborhood Center |
| Open Space – Flood Control Basin | Open Space – Ponding Basin |
| Other | Streets/Railroad/Canals/Etc. |

[14] City of Fresno, "Notice of Preparation of a Program Environmental Impact Report for the Southeast Development Area Specific Plan, Fresno, California," February 22, 2022.
[15] City of Fresno, "Fresno General Plan," December 18, 2014.

**Table 5.2 Wastewater Master Plan Wastewater Flow Coefficients[16]**

| Land Use Classification | Wastewater Flow Coefficient (gpd/ac) |
|---|---|
| Residential | |
| Low Density (1-3 DU/acre) | 600 |
| Medium Density (5-12 DU/acre) | 1,700 |
| Urban Neighborhood (16-30 DU/acre) | 3,500 |
| Employment | |
| Office | 1,000 |
| Business Park | 800 |
| Regional Business Park | 800 |
| Mixed Use | |
| Corridor/Center Mixed Use | 2,800 |
| Regional Mixed Use | 3,300 |
| Open Space | |
| Open Space | 0 |
| Community Park | 0 |
| Ponding Basin | 0 |
| Public Facilities | |
| Neighborhood Center | 1,000 |
| College | 700 |
| School with Park | 700 |
| Buffer | |
| Buffer (Ag) | 50 |
| Other | |
| Street, Rail, Canal, Etc. | 0 |

## 5.3 Analysis Results

The base wastewater flow for all land uses in the Plan Area was found for both the General Plan and the Specific Plan conditions. The total General Plan base wastewater flow was found to be 9.86 MGD, and the Specific Plan base wastewater flow was found to be 11.32 MGD, resulting in an increase of wastewater flow of approximately 1.46 MGD, or 15%. See Table 5.3 and Table 5.4 for the results of the analysis and a direct comparison of the General Plan and Specific Plan wastewater flows. See Appendix A for a more detailed version of the analysis.

There may be a number of reasons as to why the wastewater flow increased from the General Plan to the Specific Plan. One reason may be that the SEDA boundary increased from that shown in the General Plan, indicated by the increased area of total land uses. As shown in Table 5.4, the total area of the General Plan land uses is 8,253.76 acres, while the total area of the Specific Plan land uses is 8,325.57 acres – an increase of approximately 72 acres. This increase will lend itself to an increase in wastewater generation based on which land uses increased in area.

[16] City of Fresno, "Wastewater Collection System Master Plan Update," Table 5.5, "Future BWF Projections," September 2015.

Another contributor to increased wastewater flows is changes in land use classifications. For the most part, the land use classifications remained fairly similar in nature and category when transitioning from the General Plan to the Specific Plan. However, a few areas of land uses changed to different land uses that have larger wastewater flow factors; these include "Public Facilities – School with Park," "Buffer," and some low density residential areas. Per the SEDA Specific Plan land use map, all but one area defined as "School with Park" in the General Plan land use map changed to the SEDA "Neighborhood Center" land use. Similarly, the areas denoted as "Buffer" land use in the General Plan changed to "Rural Cluster Residential" in the SEDA Specific Plan. To a lesser extent, some of the "Low Density" residential areas in the General Plan were changed to residential land uses with higher densities in the Specific Plan. Each of these SEDA land uses have higher wastewater generation rates compared to the General Plan. These combined changes lead to cumulative increases in the wastewater generation of the Plan Area.

Finally, many SEDA land uses increased in area from their General Plan counterparts seemingly due to the elimination of the "Open Space" land uses included in the General Plan for the Plan Area, which totaled approximately 617 acres. As shown in Figure 5.1 and Table 5.3, "Open Space," and "Community Park," were removed from the Plan Area, and those areas were absorbed by adjacent land uses, including various residential, mixed use, and employment land uses. Open Space land uses have a wastewater flow factor of 0 gpd/ac per the Wastewater Master Plan; consequently, this means that 617 acres were added to other land uses with larger wastewater flow factors, thereby increasing the total wastewater production of the SEDA Plan Area when compared to the General Plan buildout condition.

**Table 5.3 Comparison of General Plan (GP) and Specific Plan (SP) Anticipated Wastewater Use per Land Use Classification**

| GP Land Use Classification | Wastewater Flow Factor (GPD/ac) | GP Area (ac) | GP Base Wastewater (MGD) | SP Equivalent Land Use Classification | Wastewater Flow Factor[1,2] (GPD/ac) | SP Area (ac) | SP Base Wastewater (MGD) |
|---|---|---|---|---|---|---|---|
| Residential - Low Density | 600 | 1,700.92 | 1.02 | Residential - Rural Residential | 600 | 2,037.69 | 1.22 |
| Residential - Medium Density | 1,700 | 1,473.32 | 2.50 | Residential - Neighborhood Residential | 1,700 | 1,434.91 | 2.44 |
| Residential - Urban Neighborhood | 3,500 | 891.47 | 3.12 | Residential - Mixed Residential | 3,500 | 1,026.26 | 3.59 |
| Employment - Office | 1,000 | 144.37 | 0.14 | Employment - Office Center | 1,000 | 154.47 | 0.15 |
| Employment - Business Park | 800 | 12.78 | 0.01 | Employment - Flexible Research and Development | 800 | 1,304.07 | 1.04 |
| Employment - Regional Business Park | 800 | 1,219.71 | 0.98 | | | | |
| Mixed Use - Corridor/Center Mixed Use | 2,800 | 315.41 | 0.88 | Mixed Used - Community Center | 2,800 | 273.88 | 0.77 |
| Mixed Use - Regional Mixed Use | 3,300 | 209.77 | 0.69 | Mixed Use - Regional Center | 3,300 | 291.71 | 0.96 |
| Open Space - Open Space | 0 | 569.53 | 0.00 | N/A | 0 | 0 | 0.00 |
| Open Space - Community Park | 0 | 47.46 | 0.00 | N/A | 0 | 0 | 0.00 |
| Open Space - Ponding Basin | 0 | 263.32 | 0.00 | Other - Flood Control Basin | 0 | 265.78 | 0.00 |
| Public Facilities - College | 700 | 116.26 | 0.08 | Employment - Institutional | 700 | 266.02 | 0.19 |
| Public Facilities - School with Park | 700 | 149.77 | 0.10 | | | | |
| Public Facilities - School with Park | 700 | 413.45 | 0.29 | Mixed Use - Neighborhood Center | 1,000[3] | 491.38 | 0.49 |
| Buffer - Buffer | 50 | 715.04 | 0.04 | Residential - Rural Cluster Residential | 600[4] | 766.47 | 0.46 |
| Other - Street/Rail/ Canal, etc. | 0 | 11.21 | 0.00 | Other | 0 | 12.94 | 0.00 |
| Totals | - | 8,253.76 | 9.86 | - | - | 8,325.57 | 11.32 |

[1] Wastewater flow factors obtained from Wastewater Master Plan, Table 5.5, "Future BWF Projections."

[2] See Table 5.1 for equivalent GP land use and associated wastewater flow factor used for SP analysis.

[3] Wastewater flow factor used for SP Neighborhood Center = GP Public Facilities – Neighborhood Center from Wastewater Master Plan

[4] Wastewater flow factor used for SP Rural Cluster Residential = GP Low Density Residential from Wastewater Master Plan

**Table 5.4 Summary of Difference between General Plan (GP) and Specific Plan (SP) Anticipated Wastewater Use**

| GP Land Use Classification | SP Equivalent Land Use Classification | Usage Δ (MGD) | Usage Δ (%) |
|---|---|---|---|
| Residential - Low Density | Residential - Rural Residential | 0.20 | 19.8% |
| Residential - Medium Density | Residential - Neighborhood Residential | -0.07 | -2.6% |
| Residential - Urban Neighborhood | Residential - Mixed Residential | 0.47 | 15.1% |
| Employment - Office | Employment - Office Center | 0.01 | 7.0% |
| Employment - Business Park | Employment - Flexible Research and Development | 0.06 | 5.8% |
| Employment - Regional Business Park | | | |
| Mixed Use -Corridor/Center Mixed Use | Mixed Used - Community Center | -0.12 | -13.2% |
| Mixed Use - Regional Mixed Use | Mixed Use - Regional Center | 0.27 | 39.1% |
| Open Space - Open Space | N/A | 0.00 | 0.0% |
| Open Space - Community Park | N/A | 0.00 | 0.0% |
| Open Space - Ponding Basin | Other - Flood Control Basin | 0.00 | 0.0% |
| Public Facilities - College | Employment - Institutional | 0.00 | 0.00% |
| Public Facilities - School with Park | | | |
| Public Facilities - School with Park | Mixed Use - Neighborhood Center | 0.20 | 69.8% |
| Buffer - Buffer | Residential - Rural Cluster Residential | 0.42 | 1,186.3% |
| Other - Street/Rail/ Canal, etc. | Other | 0.00 | 0.0% |
| Totals | - | 1.46 | 15% |

**CHAPTER 6**
**IMPACTS AND MITIGATION**

## 6.1 SEDA Planning

Improvements within the Plan Area will require modifications to master planned wastewater facilities and infrastructure to account for the increased wastewater flows resulting from the new development as part of the Specific Plan. A draft policy document has been completed for the SEDA Specific Plan (March 2022), which includes updated policies for the Plan Area, and proposed improvements to meet the chosen alternative for development of the area. Included among these are policies directly related to wastewater in the Plan Area[17]. Refer to the SEDA Specific Plan policy document for details on policies related to recycled water.

## 6.2 Impacts of Significance

The proposed Specific Plan would result in a significant impact if it would:

1. Exceed wastewater treatment requirements of the applicable RWQCB.

   The Specific Plan proposes a transfer of density from the General Plan conditions to the Specific Plan conditions which will modify the distribution of wastewater generation in the Plan Area from that originally planned. Generally, wastewater generation is predicted to increase as growth occurs, both in the General Plan and this Specific Plan. For the purposes of this analysis, it was assumed that development of the Plan Area would proceed as described in this study – from the General Plan to the Specific Plan land conditions. As described in the Draft EIR, this will result in new or reoccupied dwelling units and new or repurposed commercial/mixed use space within the Plan Area. Per the proposed Specific Plan, the Plan Area has capacity for 45,000 dwelling units and 5,580 acres of residential space, 1,120 acres of commercial/mixed use space, and 1,820 acres of office/employment space.[18]

   As shown in Table 5.3, there would be an increase in baseline wastewater generation of 1.46 MGD, or 15% when compared to the buildout General Plan conditions. The Plan Area is projected to produce an estimated 11.32 MGD at buildout with Specific Plan land uses compared to 9.86 MGD under the General Plan land uses. Given that the Wastewater Master Plan utilities were designed based on General Plan buildout conditions, a 15% increase would impact associated wastewater treatment requirements and waste discharge requirements, and the impacts would be significant without mitigation.

   The City would be required to increase wastewater treatment capacity and obtain revised and/or new waste discharge permits. The polices included in the General Plan and the Wastewater Master Plan would reduce the potential impacts associated with increased wastewater generation and treatment requirements, however these improvements will need to be reevaluated given the projected increase in wastewater generation in the Plan Area. The City shall evaluate the wastewater system at the time that discretionary projects are submitted for approval by the City, and the City shall not approve development that would contribute wastewater to the wastewater treatment system that would exceed

[17] City of Fresno, "Southeast Development Area Specific Plan Policy Draft," March 2022.

[18] City of Fresno, "Notice of Preparation of a Program Environmental Impact Report for the Southeast Development Area Specific Plan, Fresno, California," February 22, 2022.

capacity until additional capacity is provided. The City shall evaluate proposed wastewater treatment improvements provided in the City Wastewater Master Plan and General Plan for potential environmental impacts, and shall construct such improvements prior to exceedance of capacity to accommodate full buildout of the Specific Plan.

2. Require or result in the relocation or construction of new or expanded wastewater treatment facilities, the construction of which could cause significant environmental effects.

   As discussed in Impact 1 above, the implementation of the proposed Specific Plan will result in the need for expansion of the existing wastewater treatment facilities, and new wastewater collection and treatment facilities to serve future land uses in the Plan Area. Thus, development of the Plan Area could result in significant impacts to the existing wastewater collection and treatment system.

   Master planned wastewater treatment facilities and collection infrastructure that may accommodate future development associated with the Specific Plan include[19]:

   - Trunk sewers, sewer mains, sewer laterals, and a satellite treatment/scalping plant.
   - Expansion of Fresno-Clovis RWRF wastewater treatment capacity.
   - Increased size of planned wastewater collection facilities.

   As stated, the City will need to increase wastewater treatment capacity and obtain revised and/or new waste discharge permits to accommodate the impacts of the development of the Plan Area. Potential environmental impacts associated with construction of such improvements include but are not limited to: traffic, air emissions, noise, water quality, aesthetics, agricultural resources, biological resources, and cultural resources. The Specific Plan establishes mitigation measures for impacts in these areas associated with construction of expanded or new wastewater collection and treatment facilities. These may include traffic control/management plans to address traffic impacts during construction, various wastewater improvement/rehabilitation plans within the City to improve overall wastewater collection and treatment system conditions, and the reevaluation of wastewater master plan documents.

   The City shall evaluate the wastewater system at the time that discretionary projects are submitted for approval by the City, and the City shall not approve development that would contribute wastewater to the wastewater treatment system that would exceed capacity until additional capacity is provided. The City shall evaluate proposed wastewater treatment improvements provided in the City Wastewater Master Plan and General Plan for potential environmental impacts, and shall construct such improvements prior to exceedance of capacity to accommodate full buildout of the Specific Plan. Additionally, consistent with the Sewer System Management Plan, the City shall evaluate the wastewater collection system at the time that discretionary projects are submitted for approval by the City, and the City shall not approve development that would generate additional wastewater and exceed the capacity of a facility until additional capacity is provided. The City shall evaluate proposed wastewater collection improvements provided in the City Wastewater Master Plan and General Plan for potential environmental impacts, and shall construct such improvements prior to exceedance of capacity to accommodate full buildout of the Specific Plan. Without mitigation, the impacts would be significant.

[19] City of Fresno, "Wastewater Collection System Master Plan Update," September 2015.

3. Result in a determination by the wastewater treatment provider which serves or may serve the project that it has inadequate capacity to serve the project's projected demand in addition to the provider's existing commitments.

   The potential long-term impacts related to wastewater collection, treatment, and disposal requirements of the General Plan versus the Specific Plan differ by 15%, and would result in the need for additional wastewater collection and treatment facilities with significant impacts on the existing wastewater collection and treatment system. As mentioned in Impact 2, impacts would be less than significant if mitigation measures are enacted in the form of construction of master planned utilities, and a reevaluation of said planned facilities to ensure sufficient collection and treatment capacities exist.

## 6.3 Conclusions

City planning documents, including but not limited to the General Plan and the Wastewater Master Plan, will need to be updated to account for the development of the SEDA, and account for the policies and revisions present in the Specific Plan.

Mitigations for SEDA from the General Plan to the SEDA Specific Plan include:

a) Develop an update to the General Plan
b) Develop an update to the Wastewater Master Plan
c) Construct new wastewater collection infrastructure in the Plan Area
d) Expand existing wastewater treatment facilities
e) Construct new wastewater treatment facilities in the Plan Area
f) Obtain revised discharge permits from appropriate authorities

**Appendix A**

Supporting Calculations

| GP Land Use Classification | Abbrv. | Wastewater Flow Factor (GPD/ac) | GP Area (ac) | GP Base Wastewater (MGD) | SP Equivalent Land Use | Abbrv. | Wastewater Flow Factor (GPD/ac) | SP Area (ac) | SP Base Wastewater (MGD) | Usage Δ (MGD) | Usage Δ (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Residential - Low Density | RL | 600 | 1,700.92 | 1.02 | Residential - Rural Residential | RR | 600 | 2,037.69 | 1.22 | 0.20 | 19.8% |
| Residential - Medium Density | RM | 1,700 | 1,473.32 | 2.50 | Residential - Neighborhood Residential | NR | 1,700 | 1,434.91 | 2.44 | -0.07 | -2.6% |
| Residential - Urban Neighborhood | RUN | 3,500 | 891.47 | 3.12 | Residential - Mixed Residential | MR | 3,500 | 1,026.26 | 3.59 | 0.47 | 15.1% |
| Employment - Office | O | 1,000 | 144.37 | 0.14 | Employment - Office Center | OC | 1,000 | 154.47 | 0.15 | 0.01 | 7.0% |
| Employment - Business Park | BP | 800 | 12.78 | 0.01 | Employment - Flexible Research and Development | F | 800 | 1,304.07 | 1.04 | 0.06 | 5.8% |
| Employment - Regional Business Park | RBP | 800 | 1,219.71 | 0.98 | | | | | | | |
| Mixed Use - Corridor/Center Mixed Use | CMX | 2,800 | 315.41 | 0.88 | Mixed Used - Community Center | CC | 2,800 | 273.88 | 0.77 | -0.12 | -13.2% |
| Mixed Use - Regional Mixed Use | RMX | 3,300 | 209.77 | 0.69 | Mixed Use - Regional Center | RC | 3,300 | 291.71 | 0.96 | 0.27 | 39.1% |
| Open Space - Open Space | OS | 0 | 569.53 | 0.00 | N/A | N/A | 0 | 0 | 0.00 | 0.00 | 0.0% |
| Open Space - Community Park | CP | 0 | 47.46 | 0.00 | N/A | N/A | 0 | 0 | 0.00 | 0.00 | 0.0% |
| Open Space - Ponding Basin | PB | 0 | 263.32 | 0.00 | Other - Flood Control Basin | POF | 0 | 265.78 | 0.00 | 0.00 | 0.0% |
| Public Facilities - College | C | 7,00 | 116.26 | 0.08 | Employment - Institutional | I | 700 | 266.02 | 0.19 | 0.00 | 0.0% |
| Public Facilities - School with Park | P | 7,00 | 149.77 | 0.10 | | | | | | | |
| Public Facilities - School with Park | P | 7,00 | 413.45 | 0.29 | Mixed Use - Neighborhood Center | NC | 1,000 | 491.38 | 0.49 | 0.20 | 69.8% |
| Buffer - Buffer | BUFFER | 50 | 715.04 | 0.04 | Residential - Rural Cluster Residential | RCR | 600 | 766.47 | 0.46 | 0.42 | 1,186.3% |
| Other - Street/Rail/ Canal, etc. | N/A | 0 | 11.21 | 0.00 | Other | N/A | 0 | 12.94 | 0.00 | 0.00 | 0.0% |
| Totals | | | 8,253.76 | 9.86 | | | | 8,325.57 | 11.32 | 1.46 | 15% |

# Appendix B

City of Fresno Wastewater Collection System Master Plan Update

City of FRESNO
DEPARTMENT OF PUBLIC UTILITIES
WATER & CONSERVATION • WASTEWATER & RECLAMATION • SOLID WASTE & RECYCLING
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# WASTEWATER COLLECTION SYSTEM
# MASTER PLAN UPDATE

Final • September 2015

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# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

**City of Fresno**

**September 2015**

**FINAL**

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**September 18, 2015**

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**WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE**

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# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

This executive summary presents a brief background of the City of Fresno (City) wastewater collection system, the need for this master plan update, proposed improvements to mitigate existing system deficiencies, and proposed expansion projects. A summary of capital improvement project costs is included at the end of this chapter.

## ES.1 INTRODUCTION

The City was founded in 1872 by the Central Pacific Railroad Company and incorporated in 1885. The City has since grown to over 112 square miles with a population of just under a half million people in the incorporated area. Today, Fresno is the fifth largest city in the state of California. Centrally located, Fresno is the financial, industrial, trade, and commercial capital in the Central San Joaquin Valley. Figure ES.1 presents a location map of the City. The City is the hub of a region rich in heritage, resources, and people.

The City owns and operates the Fresno/Clovis Regional Wastewater Reclamation Facility (RWRF), as well as the smaller North Fresno Wastewater Reclamation Facility (NFWRF). The City owns and maintains a wastewater collection system that serves the City and the other participating agencies: the County of Fresno, the majority of the City of Clovis, the Pinedale Public Utility District, and the Pinedale County Water District.

## ES.2 STUDY AREA

The area served by the City is characterized by residential, commercial, and industrial uses within the City limits. While the City has a diverse economy, Fresno County is the nations' top-ranked agriculture-producing county. There are some agricultural lands within the metropolitan area that are interspersed on larger parcels along the fringe of urbanized area and in between parcels.

There are many open space areas within the City, including Woodward Park and Roeding Park which is home of the Fresno Chaffee Zoo. The main water bodies near the City are located on the outskirts of town. The San Joaquin River runs east and west just to the North of the City limits. The Kings River is about 12 miles east of the City limits and the City diverts water from the river for part of their water supply. The Sierra Nevada Mountains are located about 25 miles east of the City.

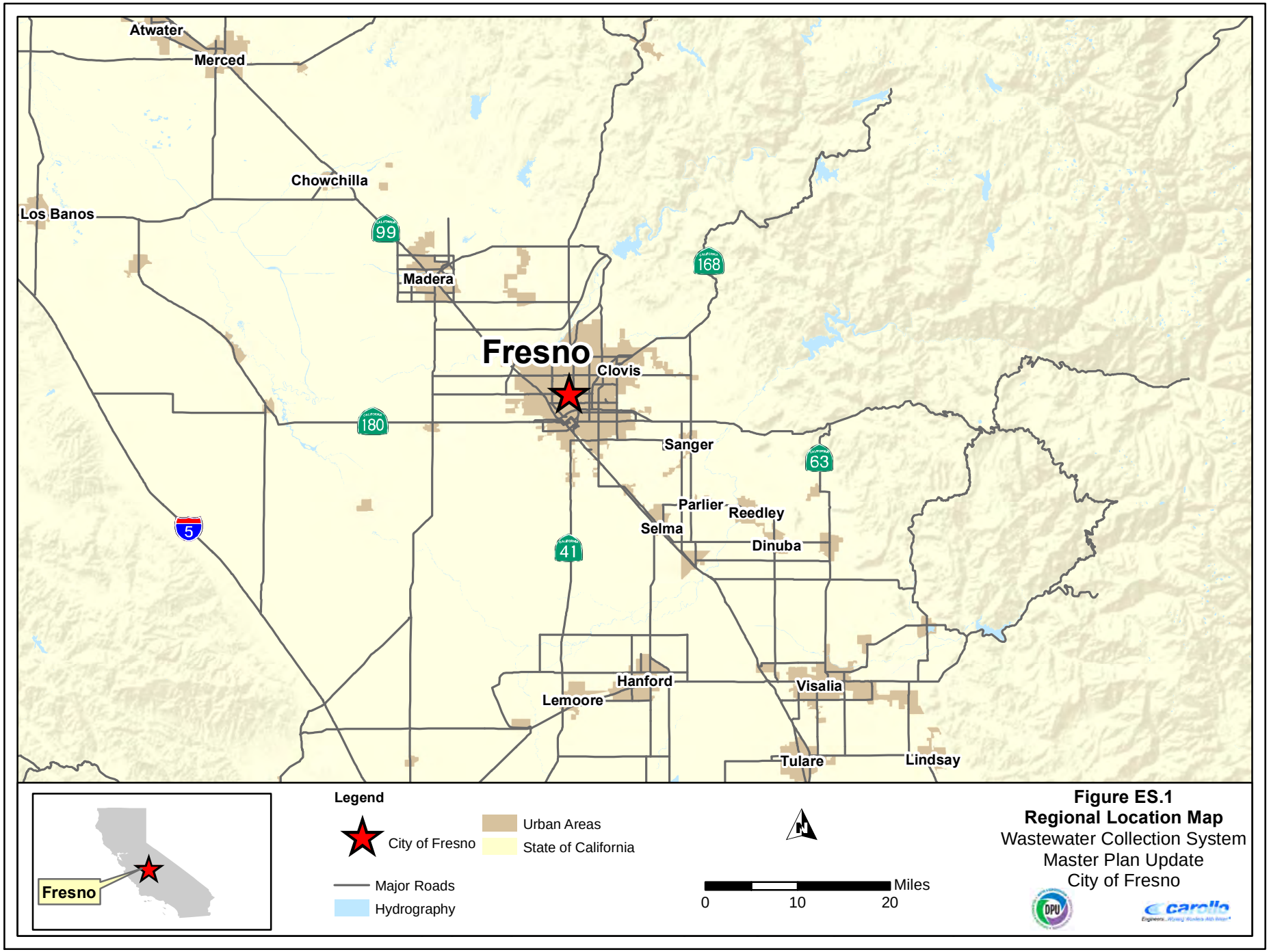


**Figure ES.1**
**Regional Location Map**
Wastewater Collection System
Master Plan Update
City of Fresno

There are four major highways that run through the City which include State Route 99, State Route 168, State Route 41, and State Route 180. State Route 99 connects the major cities in the central valley and runs north and south. State Route 168 heads east out of the City through Clovis and heads to the Sierras to the east. State Route 41 runs north and south which connects to Atascadero in the South and to Yosemite to the north. State Route 180 runs east and west which connects to Mendota to the west and to Kings Canyon National Park to the east.

The City's proposed Sphere of Influence (SOI), as defined in Fresno General Plan (General Plan) is the study area boundary for this Wastewater Collection System Master Plan Update (Master Plan). The Master Plan study area boundary and the SOI are synonymous and will be used interchangeably throughout this report. The Master Plan study area is intended to include the existing City limits and development that could occur through build out of the City's General Plan. The General Plan Buildout (Buildout) is defined as all developable sites will be fully occupied according to the General Plan.

## ES.3 SEWER SERVICE AREA

Figure ES.2 illustrates the City's current wastewater service area. The City manages and maintains more than 1,500 miles of gravity sewer lines up to 84-inches in diameter, 15 active lift stations, and associated force mains. Nearly all of the wastewater generated within the sewer service area is conveyed to the City's RWRF for treatment, with the exception of a small amount of flow that is treated at the City's NFWRF. In addition, the City of Clovis recently constructed its own wastewater treatment facility on the eastern edge of the Clovis City limits (near the intersection of Ashlan Avenue and McCall Avenue), which provides wastewater service for a portion of the City of Clovis. However, most of the flow generated within the City of Clovis is treated at the RWRF.

The land use assumptions in this Master Plan were based on the Fresno General Plan and projected future developments within the City's proposed growth boundary. Should future planning conditions change from the assumptions stated in this Master Plan (i.e., accelerated growth, more intense developments, etc.), revisions and adjustments to the Master Plan recommendations would be necessary.

## ES.4 WASTEWATER FLOWS

In general, wastewater consists of base wastewater flow (BWF) and wet weather flow (WWF). BWF is flow generated by routine water usage in the residential, commercial, business and industrial sectors of the collection system. WWF includes storm water inflow, trench infiltration, and wet weather ground water infiltration.

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave

Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave

NFWRF
LS05
LS06
LS10
LS04
LS16
LS14
LS12
LS03
LS15
LS13
LS18
LS02
LS01
LS20
RWRF

99
41
168
180

**Legend**

**Existing Wastewater Collection System**

- Lift Stations
- Special Structures

**Pipelines**

- 8" and Smaller
- 10" - 18"
- 20" - 36"
- Greater than 36"
- Streets
- Existing Sewer Service Area
- City Limits

N

0 10,000 20,000 Feet

**Figure ES.2**
**Wastewater Service Area**
Wastewater Collection System
Master Plan Update
City of Fresno

DPU

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Peak wet weather flow (PWWF) is the highest observed hourly flow that occurs following the design storm event. The City's sewers and lift stations were evaluated based on their capacity to convey the "design flow ("design flow" is synonymous to PWWF in this study).

A summary of the existing and build-out BWF and the PWWF is presented in Table ES.1. The City's BWF is projected to roughly double from 64.1 million gallons per day (mgd) to 129.9 mgd by build out, whereas the PWWF is projected to increase from 123.9 mgd to about 202.4 mgd by build out (an increase of approximately 63-percent). Therefore, the City's PWWF to BWF peaking factor is projected to decrease from roughly 1.93 to 1.56, which is relatively low for sanitary sewer collection systems.

**Table ES.1 Current and Projected Wastewater Flows**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Year | BWF[1] (mgd) | PDWF[2] (mgd) | PDWF Peaking Factor | PWWF[3] (mgd) | PWWF Peaking Factor |
|---|---|---|---|---|---|
| Existing | 64.1 | 88.5 | 1.38 | 123.9 | 1.93 |
| Build Out | 129.9 | 164.7 | 1.27 | 202.4 | 1.56 |

Notes:
(1) BWF = Base Wastewater Flow.
(2) PDWF = Peak Dry Weather Flow.
(3) PWWF = Peak Wet Weather Flow.

## ES.5 CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS

The capacity analysis identified areas in the sewer system where flow restrictions occur or where pipe capacity is insufficient to convey design flows. Sewers that lack sufficient capacity to convey design flows create bottlenecks in the collection system that can potentially cause sanitary sewer overflows (SSOs).

For the existing sewer collection system, the Peak Dry Weather Flow (PDWF) and PWWF were routed through the hydraulic model. In accordance with the established flow depth criteria for sewers during PDWF, pipelines where the maximum depth to full flow depth (d/D) ratio that exceeded 1.0 were flagged. Each pipeline with a maximum d/D in excess of 1.0 was reviewed on a case-by-case basis to determine if a capacity improvement project was warranted. Similarly, in accordance with the established flow depth criteria for sewers during PWWF, manholes where the maximum flow to full flow (q/Q) ratio that exceeded 1.15 were flagged. Each pipeline with a maximum q/Q in excess of 1.15 was reviewed on a case-by-case basis to determine if a capacity improvement project was warranted.

In general, the City's collection system has sufficient capacity to convey current PWWFs without exceeding the established flow depth criterion. However, there are a few areas

where capacity restrictions lead to flow depths that exceed allowable levels. Following the completion of the existing system analysis, improvement projects and alternatives were identified in order to mitigate existing system pipeline capacity deficiencies.

The build out system analysis was performed in a manner similar to the existing system analysis. The purpose of the build out system evaluation is to verify that the existing system improvements were appropriately sized to convey build out PWWFs, and to identify the locations of sewers that are adequately sized to convey existing PWWFs, but cannot convey build out PWWFs. Additionally, new trunk sewers were added to the hydraulic model and sized to service major growth areas beyond the current City sewer service area.

Figure ES.3 illustrates the improvements recommended to mitigate capacity deficiencies in the existing and future sewer collection system and improvements to accommodate future growth as identified by the hydraulic analysis. Details of each improvement are also provided in Table ES.2.

### ES.5.1 Project Prioritization

The majority of improvements listed in Table ES.2 are driven by future development, which consist of new sewers that serve future growth or improvements to existing facilities that are needed to serve future growth. When fully implemented, the capital projects will allow the conveyance of PWWFs to the RWRF during build out conditions.

Prioritizing the required capital improvements for the City's sewer system is an important aspect of this study. The improvement projects were prioritized based on the following factors:

- Upgrading existing facilities to mitigate current capacity deficiencies and to serve future users
- Building the new trunks necessary to serve future users

Improvements to existing facilities will provide sufficient capacity to mitigate existing issues and to convey increased flows resulting from future growth. Future development will require the construction of sewers to serve new users. The projects were grouped into the following phases:

- Phase 1: Years 2014 through 2015
- Phase 2: Years 2016 through 2020
- Phase 3: Years 2021 through 2025
- Phase 4: Years 2026 through 2030

Dickenson Ave
West Lawn Ave
Chateau Fresno Ave
Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave
Del Rey Ave
Bethel Ave
Academy Ave
Madsen Ave

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave
Central Ave
American Ave

NFWRF
LS05
LS06
LS04
LS10
LS16
LS14
LS12
LS03
LS15
LS13
LS18
LS02
LS01
LS20
RWRF

Direct Storm Drain Connections to be Removed

GALLO

99
41
168
180

## Legend

**Existing Wastewater Collection System**

- Lift Stations

**Pipelines**

- 8" and Smaller
- 10" and Larger

**Proposed Improvements**

- Existing System
- Future System
- Development
- Gallo Winery I/I Reduction Program
- Streets
- Sphere of Influence
- City Limits
- Existing Sewer Service Area

N

0 12,500 25,000 Feet

**Figure ES.3**
**Proposed Collection System Capacity Improvements**
Wastewater Collection System Master Plan Update
City of Fresno

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**Table ES.2 Capital Improvement Projects**
**Wastewater Collection System Master Plan**
**City of Fresno**

| Job No. | Project Type | Description / Limits | Existing Diameter (in) | New Diameter (in) | Rehab, Replace, or New | Length (ft) | Improvement Cost ($) | Capital Improvement Phasing | | | | Future User Benefit (%) | Reimbursement Category | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Phase 1 2015-2020 ($) | Phase 2 2021-2025 ($) | Phase 3 2026-2030 ($) | Phase 4 2031-2035 ($) | | Existing Improvements | Future Improvements |
| **Existing Improvements** | | | | | | | | | | | | | | |
| C1 | ravit | a o ve e et ee lacito e ve. a St. | 20 | **24** | Replace | 30 | 4120000 | 4120000 | | | | 7 | 383160 | 28840 |
| C1 | ravit | Street ro a o ve. to a Salle ve. | 20 | **24** | Replace | 1822 | 868000 | 868000 | | | | 7 | 807240 | 60760 |
| C2 | ravit | le ve e ro re er ve. to o a ve. | 24 | **27** | Replace | 31 | 430000 | 430000 | | | | 7 | 399200 | 30100 |
| C2 | ravit | le ve e ro 180 to oor a ve. | 24 | **27** | Replace | 2580 | 1580000 | | 1580000 | | | 14 | 1358800 | 221200 |
| C3 | ravit | le ve e Street ro oor a ve. to ol e St. | 27 | **30** | Replace | 1530 | 1148000 | | | 1148000 | | 1 | 2288880 | 218120 |
| C4 | ravit | Mo tere Street ro lto Street to Street | 6 | **10** | Replace | 1812 | 683000 | | | 683000 | | 0 | 683000 | |
| C5 | ravit | itt Street ro e t ra St. to oo ar ve. | 36 | **42** | Replace | 4717 | 3825000 | | | 3825000 | | 17 | 3174750 | 650250 |
| C5 | ravit | oo ar ve e ro itt St. to Ora e ve. | 36 | **42** | Replace | 62 | 733000 | | | 733000 | | 17 | 608390 | 124610 |
| C5C | ravit | Ora e ve e ro oo ar ve. to Cali or ia ve. | 36 | **42** | Replace | 693 | 778000 | | | 778000 | | 17 | 645740 | 132260 |
| C6 | ravit | Sa or ve e ro Pro cer air to Street | 6 | **8** | Replace | 30 | 32000 | | 32000 | | | 0 | 32000 | |
| | | | | | | | **Existing Improvement Totals** | **$ 1,710,000** | **$ 1,909,000** | **$ 7,167,000** | **$ -** | | **$ 9,319,860** | **$ 1,466,140** |
| **Build-Out Improvements** | | | | | | | | | | | | | | |
| C7 | ravit | ol e Street a e ve e ro Street to Merce St. | 27 | **30** | Replace | 1567 | 1228000 | | | | 1228000 | 100 | | 1228000 |
| C8 | ravit | ort ve e ro Pol ve. li e t to ir it ve. | | **60** | e | 20857 | 1615000 | | | | 1615000 | 100 | | 1615000 |
| C | ravit | ort ve e ro ir it ve. to Ora e ve. | 60 | **60** | Rea | 1514 | 1376000 | | | | 1376000 | 100 | | 1376000 |
| 1 | ravit | e era ce ve e ro ort ve. to e e ve. | | **48** | e | 5875 | 4805000 | | | | 4805000 | 100 | | 4805000 |
| 2 | ravit | e era ce ve e ro e e e ve. to lare St. | | **42** | e | 1352 | 1224000 | | | | 1224000 | 100 | | 1224000 |
| 3 | ravit | e era ce ve e ro lare St. to Olive ve. | | **36** | e | 487 | 508000 | | | | 508000 | 100 | | 508000 |
| 4 | ravit | e era ce Mc i le e ol ro Olive ve. to Siel ve. | | **30** | e | 1300 | 770000 | | | | 770000 | 100 | | 770000 |
| 5 | ravit | Siel ve. eo ar ve. ro e ol ve. to a ota ve. | | **27** | e | 4575 | 2837000 | | | | 2837000 | 100 | | 2837000 |
| 6 | ravit | e e e ve e ro e era ce ve. to e ol ve. | | **15** | e | 5228 | 2053000 | | | | 2053000 | 100 | | 2053000 |
| 6 | ravit | e e e ve e ro e ol ve. to eo ar ve. | | **12** | e | 2732 | 643000 | | | | 643000 | 100 | | 643000 |
| 7 | ravit | C rc ve e ro e era ce ve. to oca ve. | | **15** | e | 2552 | 1016000 | | | | 1016000 | 100 | | 1016000 |
| 7 | ravit | C rc ve e ro oca ve. to e ol ve. | | **12** | e | 2772 | 630000 | | | | 630000 | 100 | | 630000 |
| 7C | ravit | C rc ve e ro e ol ve. to eo ar ve. | | **8** | e | 2673 | 82000 | | | | 82000 | 100 | | 82000 |
| 8 | ravit | Cali or ia ve e ro e era ce ve to oca ve. | | **18** | e | 2676 | 1137000 | | | | 1137000 | 100 | | 1137000 |
| 8 | ravit | Cali or ia ve e ro oca ve. to e ol ve. | | **15** | e | 2670 | 1058000 | | | | 1058000 | 100 | | 1058000 |
| 8C | ravit | Cali or ia ve e ro e ol ve. to eo ar ve. | | **10** | e | 2617 | 870000 | | | | 870000 | 100 | | 870000 |
| | ravit | tler ve e ro e e era ce ve to oca ve. | | **18** | e | 2617 | 1115000 | | | | 1115000 | 100 | | 1115000 |
| | ravit | tler ve e ro oca ve. to e ol ve. | | **15** | e | 2611 | 1037000 | | | | 1037000 | 100 | | 1037000 |
| C | ravit | tler ve e ro e ol ve. to eo ar ve. | | **8** | e | 2778 | 862000 | | | | 862000 | 100 | | 862000 |
| 10 | ravit | lare Street ro e e era ce ve. to oca ve. | | **21** | e | 2730 | 1237000 | | | | 1237000 | 100 | | 1237000 |
| 10 | ravit | lare Street e ol ve e ro oca ve. to a rel ve. li e t | | **15** | e | 4035 | 1586000 | | | | 1586000 | 100 | | 1586000 |
| 10C | ravit | a rel ve e e li e t ro e ol ve. to eo ar ve. | | **8** | e | 2772 | 845000 | | | | 845000 | 100 | | 845000 |
| 10 | ravit | oca ve e el o t ve. ro lare St. to e ol ve. | | **12** | e | 4026 | 1738000 | | | | 1738000 | 100 | | 1738000 |
| 10 | ravit | el o t ve e ro e ol ve. to eo ar ve. | | **10** | e | 2554 | 851000 | | | | 851000 | 100 | | 851000 |
| 11 | ravit | Olive ve e ro e e era ce ve. to oca ve. | | **15** | e | 2671 | 1058000 | | | | 1058000 | 100 | | 1058000 |
| 11 | ravit | Olive ve e ro oca ve. to e ol ve. | | **12** | e | 2613 | 266000 | | | | 266000 | 100 | | 266000 |
| 11C | ravit | Olive ve e ro e ol ve. to eo ar ve. | | **8** | e | 2617 | 813000 | | | | 813000 | 100 | | 813000 |
| 12 | ravit | Mc i le ve e ro e ol ve. to eo ar ve. | | **21** | e | 2772 | 1237000 | | | | 1237000 | 100 | | 1237000 |
| 12 | ravit | Mc i le ve e ro eo ar ve. to o o ve. | | **18** | e | 5103 | 2157000 | | | | 2157000 | 100 | | 2157000 |
| 12C | ravit | o o ve e ro Mc i le ve. to Cli to ve. | | **15** | e | 2730 | 1807000 | | | | 1807000 | 100 | | 1807000 |
| 13 | ravit | Cli to ve e ro e ol ve. to eo ar ve. | | **10** | e | 2842 | 832000 | | | | 832000 | 100 | | 832000 |
| 14 | ravit | ort ve e ro Peac ve. to e era ce ve. | | **36** | e | 15787 | 11051000 | | | | 11051000 | 100 | | 11051000 |

**Table ES.2 Capital Improvement Projects**
**Wastewater Collection System Master Plan**
**City of Fresno**

| Job No. | Project Type | Description / Limits | | Existing Diameter (in) | New Diameter (in) | Rehab, Replace, or New | Length (ft) | Improvement Cost ($) | Capital Improvement Phasing | | | | Future User Benefit (%) | Reimbursement Category | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Phase 1 2015-2020 ($) | Phase 2 2021-2025 ($) | Phase 3 2026-2030 ($) | Phase 4 2031-2035 ($) | | Existing Improvements | Future Improvements |
| ??15 | ?ravit? | Mi??e? a? a ?ve??e | ?ro? ?ort? ?ve. to ???a?ale ?ve. | ? | 12 | ?e? | 2?730 | ? ?64?000 | | | | ? ?64?000 | 100? | ? ? | ? ?64?000 |
| ??16 | ?ravit? | S?????e ?ve??e | ?ro? ?ort? ?ve. to ???a?ale ?ve. | ? | 15 | ?e? | 2?611 | ? 10?037?000 | | | | ? 10?037?000 | 100? | ? ? | ? 10?037?000 |
| ??17 | ?ravit? | ?o? ler ?ve??e | ?ro? ?ort? ?ve. to ???a?ale ?ve. | ? | 10 | ?e? | 2?78? | ? ??22?000 | | | | ? ??22?000 | 100? | ? ? | ? ??22?000 |
| ??18 | ?ravit? | ?r? ?tro?? ?ve??e | ?ro? ?ort? ?ve. to ???a?ale ?ve. | ? | 8 | ?e? | 2?671 | ? 828?000 | | | | ? 828?000 | 100? | ? ? | ? 828?000 |
| ??1?? | ?ravit? | ?ale?ti?e ?ve??e | ?ro? C??rc? ?ve. to ?ear?e? ?ro?ta?e | ? | 12 | ?e? | 3??45 | ? 1?38?000 | | | | ? 1?38?000 | 100? | ? ? | ? 1?38?000 |
| ??1?? | ?ravit? | ?ale?ti?e ?ve??e | ?ro? ?ear?e? ?ro?ta?e to Ma?i?o? ?ve. | ? | 10 | ?e? | 1?312 | ? 444?000 | | | | ? 444?000 | 100? | ? ? | ? 444?000 |
| ??20 | ?ravit? | ?ra? le? ?ve??e | ?ro? C??rc? ?ve. to Ma?i?o? ?ve. | ? | 8 | ?e? | 5?303 | ? 1?630?000 | | | | ? 1?630?000 | 100? | ? ? | ? 1?630?000 |
| ??21? | ?ravit? | ? ?ite??ri??e ?ve??e | ?ro? Pol??ve. to ?l?t?e ?ve. | ? | 12 | ?e? | 5?271 | ? 1?851?000 | | | | ? 1?851?000 | 100? | ? ? | ? 1?851?000 |
| ??21? | ?ravit? | ? ?ite??ri??e??ra? le??ve??e | ?ro? ?l?t?e ?ve. to ?iel?e? ?ve. | ? | 10 | ?e? | 5?3?2 | ? 1?773?000 | | | | ? 1?773?000 | 100? | ? ? | ? 1?773?000 |
| ??22? | ?ravit? | ?el? o?t ?ve??e | ?ro? Pol??ve. to Cor?elia ?ve. | ? | 12 | ?e? | 2?716 | ? ?5?000 | | | | ? ?5?000 | 100? | ? ? | ? ?5?000 |
| ??22? | ?ravit? | ?el? o?t ?ve??e | ?ro? Cor?elia ?ve. to ?l?t?e ?ve. | ? | 10 | ?e? | 2?675 | ? 887?000 | | | | ? 887?000 | 100? | ? ? | ? 887?000 |
| ??22C | ?ravit? | ?el? o?t ?ve??e | ?ro? ?l?t?e ?ve. to ?ra? le??ve. | ? | 8 | ?e? | 2?640 | ? 81?000 | | | | ? 81?000 | 100? | ? ? | ? 81?000 |
| ??23? | ?ravit? | Olive ?ve??e | ?ro? Pol??ve. to ?l?t?e ?ve. | ? | 12 | ?e? | 5?260 | ? 1?847?000 | | | | ? 1?847?000 | 100? | ? ? | ? 1?847?000 |
| ??23? | ?ravit? | Olive ?ve??e | ?ro? ?l?t?e ?ve. to ?ra? le??ve. | ? | 8 | ?e? | 2?675 | ? 82?000 | | | | ? 82?000 | 100? | ? ? | ? 82?000 |
| ??24? | ?ravit? | Olive ?ve??e | ?ro? ?ra?tla?? ?ve. to ?r?a? ?ve. | ? | 12 | ?e? | 2?64? | ? ?37?000 | | | | ? ?37?000 | 100? | ? ? | ? ?37?000 |
| ??24? | ?ravit? | Olive ?ve??e | ?ro? ?r?a? ?ve. to ?a?e??ve. | ? | 10 | ?e? | 1?73 | ? 65?000 | | | | ? 65?000 | 100? | ? ? | ? 65?000 |
| ??25 | ?ravit? | Mc?i?le? ?ve??e | ?ro? ?ra?tla?? ?ve. to Ri??ve. | ? | 10 | ?e? | 3?603 | ? 1?1??000 | | | | ? 1?1??000 | 100? | ? ? | ? 1?1??000 |
| ??26? | ?ravit? | Cli?to? ?ve??e | ?ro? ?ra?tla?? ?ve. to ?r?a? ?ve. | ? | 12 | ?e? | 2?645 | ? ?36?000 | | | | ? ?36?000 | 100? | ? ? | ? ?36?000 |
| ??26? | ?ravit? | Cli?to? ?ve??e | ?ro? ?r?a? ?ve. to ?a?e??ve. | ? | 10 | ?e? | 2?5?2 | ? 862?000 | | | | ? 862?000 | 100? | ? ? | ? 862?000 |
| ??27? | ?ravit? | S?iel???ve??e | ?ro? ?ra?tla?? ?ve. to ?r?a? ?ve. | ? | 15 | ?e? | 2?627 | ? 1?042?000 | | | | ? 1?042?000 | 100? | ? ? | ? 1?042?000 |
| ??27? | ?ravit? | S?iel???ve??e | ?ro? ?r?a? ?ve. to ?a?e??ve. | ? | 12 | ?e? | 2?5?2 | ? ?1?000 | | | | ? ?1?000 | 100? | ? ? | ? ?1?000 |
| | | | | | | | **Build-Out Improvement Totals** | **$ 125,170,000** | **$ -** | **$ -** | **$ -** | **$ 125,170,000** | | **$ -** | **$ 125,170,000** |
| **New Facilities** | | | | | | | | | | | | | | | |
| ?C?? R??1 | ?reat? e?t | Ce?ar??a?ota?Scal?i?? Pla?t at ?aca?t ?iel? ?e?i?? ?ra?ite Par? | ? | ? | **6 mgd** | ?e? | ? | ? 51?106?000 | | ? 51?106?000 | | | 0? | ? 51?106?000 | ? ? |
| ?C?? R??2 | ?ravit? | ?a?ota??ro? ?reat? e?t ?acilit? to Mill?roo? ?ve. | ? | ? | **36** | ?e? | 4?042 | ? 2?833?000 | | ? 2?833?000 | | | 0? | ? 2?833?000 | ? ? |
| S??? | ?reat? e?t | ?e? ?era?ce?Scal?i?? Pla?t O? Cor?er o??e? ?era?ce a?? ?ort? ?ve. | ? | ? | **15 mgd** | ?e? | ? | ? 77?760?000 | | | | ? 77?760?000 | 100? | ? ? | ? 77?760?000 |
| | | | | | | | **New Facilities Totals** | **$ 131,699,000** | **$ -** | **$ 53,939,000** | **$ -** | **$ 77,760,000** | | **$ 53,939,000** | **$ 77,760,000** |
| **Lift Stations** | | | | | | | | | | | | | | | |
| ?SF1 | ?i?t Statio? | ? e?t o??e?e?e? a?? ? al??t ?ve??e? | ? | ? | ? | ? | ? | ? 15?000 | ? 15?000 | | | | | ? 15?000 | ? ? |
| ?SF2 | ?i?t Statio? | ?ear?e? ?o?levar? a?? Mar???ve??e | ? | ? | ? | ? | ? | ? 3??000 | ? 3??000 | | | | | ? 3??000 | ? ? |
| ?SF3 | ?i?t Statio? | ?ort? o?S?iel? a?? ? il?o? ?ve??e? | ? | ? | ? | ? | ? | ? 15?000 | ? 15?000 | | | | | ? 15?000 | ? ? |
| ?SF4 | ?i?t Statio? | Rivervie? ?rive a?? ?l????ve??e | ? | ? | ? | ? | ? | ? 200?000 | ? 200?000 | | | | | ? 200?000 | ? ? |
| ?SF5 | ?i?t Statio? | ?ort ? a??i??to? Roa? a?? C?a? ?lai? ?rive | ? | ? | ? | ? | ? | ? ?6?000 | ? ?6?000 | | | | | ? ?6?000 | ? ? |
| ?SF6 | ?i?t Statio? | So??ea?t o?Perri? ?ve??e a?? C?a? ?lai? ?rive | ? | ? | ? | ? | ? | ? 114?000 | ? 114?000 | | | | | ? 114?000 | ? ? |
| ?SF10 | ?i?t Statio? | Strat?or? a?? ? oo?la? ? ?rive? | ? | ? | ? | ? | ? | ? 4??000 | ? 4??000 | | | | | ? 4??000 | ? ? |
| ?SF11 | ?i?t Statio? | ?a?t o?Ce?ar a?? Co??er ?ve??e? | ? | ? | ? | ? | ? | ? 160?000 | ? 160?000 | | | | | ? 160?000 | ? ? |
| ?SF12 | ?i?t Statio? | Car?e?ie a?? ??llar? ?ve??e? | ? | ? | ? | ? | ? | ? ? | ? ? | | | | | ? ? | ? ? |
| ?SF13 | ?i?t Statio? | ?ort? o??ac??o? a?? ??iver?it? ?ve??e? | ? | ? | ? | ? | ? | ? 5??000 | ? 5??000 | | | | | ? 5??000 | ? ? |
| ?SF14 | ?i?t Statio? | ?a?t o?Car?e?ie a?? ?ll?vial ?ve??e? | ? | ? | ? | ? | ? | ? 70?000 | ? 70?000 | | | | | ? 70?000 | ? ? |
| ?SF15 | ?i?t Statio? | ?ort? o??? a?to? ?ve??e a?? ?o??tai? ? a? | ? | ? | ? | ? | ? | ? 128?000 | ? 128?000 | | | | | ? 128?000 | ? ? |
| ?SF16 | ?i?t Statio? | ?ort?? e?t o?Sa?ta ?e a?? ?l Pa?o ?ve??e? | ? | ? | ? | ? | ? | ? 72?000 | ? 72?000 | | | | | ? 72?000 | ? ? |
| ?SF18 | ?i?t Statio? | So?t? o?? iel?e? a?? ????e??ve??e? | ? | ? | ? | ? | ? | ? 82?000 | ? 82?000 | | | | | ? 82?000 | ? ? |
| ?SF20 | ?i?t Statio? | ?ort? o?C?err? a?? M???cat ?ve??e? | ? | ? | ? | ? | ? | ? 15?000 | ? 15?000 | | | | | ? 15?000 | ? ? |
| | | | | | | | **Lift Station Totals** | **$ 1,114,000** | **$ 1,114,000** | **$ -** | **$ -** | **$ -** | | **$ 1,114,000** | **$ -** |
| **Point Repairs** | | | | | | | | | | | | | | | |
| ?PPR?1 | Poi?t Re?air | 250 Priorit? Poi?t Re?air?a??eter? i?e? ??? Cit? o???re??o ?er?o??el | ?arie? | ?arie? | | Re?lace | ?arie? | ? 5?800?000 | ? 5?800?000 | | | | | ? 5?800?000 | ? ? |

**Table ES.2 Capital Improvement Projects**
**Wastewater Collection System Master Plan**
**City of Fresno**

| Job No. | Project Type | Description / Limits | Existing Diameter (in) | New Diameter (in) | Rehab, Replace, or New | Length (ft) | Improvement Cost ($) | Capital Improvement Phasing: Phase 1 2015-2020 ($) | Phase 2 2021-2025 ($) | Phase 3 2026-2030 ($) | Phase 4 2031-2035 ($) | Future User Benefit (%) | Reimbursement Category: Existing Improvements | Future Improvements |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PPR2 | Point Repair | 250 Priority Point Repair at Peter Pipe Cut off Repair Pipe Pipe | Varies | Varies | Replace | Varies | 5,800,000 | 5,800,000 | | | | | 5,800,000 | |
| PPR3 | Point Repair | 250 Priority Point Repair at Peter Pipe Cut off Repair Pipe Pipe | Varies | Varies | Replace | Varies | 5,800,000 | 5,800,000 | | | | | 5,800,000 | |
| PPR4 | Point Repair | 250 Priority Point Repair at Peter Pipe Cut off Repair Pipe Pipe | Varies | Varies | Replace | Varies | 5,800,000 | 5,800,000 | | | | | 5,800,000 | |
| PPR5 | Point Repair | 24 Priority Point Repair at Peter Pipe Cut off Repair Pipe Pipe | Varies | Varies | Replace | Varies | 5,777,000 | 5,777,000 | | | | | 5,777,000 | |
| | | | | | | **Point Repair Totals** | **$ 28,977,000** | **$ 28,977,000** | **$ -** | **$ -** | **$ -** | | **$ 28,977,000** | **$ -** |
| **Pipe Rehabilitation** | | | | | | | | | | | | | | |
| R1 | Rehabilitation | 16 in MOSR Pipe Pipe | Varies | Varies | Repair | Varies | 2,488,000 | 2,488,000 | | | | | 2,488,000 | |
| R1 | Rehabilitation | 18 in MOSR Pipe Pipe | Varies | Varies | Repair | Varies | 2,571,000 | 2,571,000 | | | | | 2,571,000 | |
| R1C | Rehabilitation | 23 in MOSR Pipe Pipe | Varies | Varies | Repair | Varies | 2,631,000 | 2,631,000 | | | | | 2,631,000 | |
| R2 | Rehabilitation | 2006 Master Plan Project RS03 | 24 | 24 | Repair | 3,118 | 1,126,000 | 1,126,000 | | | | | 1,126,000 | |
| R3 | Rehabilitation | 2006 Master Plan Project RS06 | 15 | 15 | Repair | 300 | 2,000 | 2,000 | | | | | 2,000 | |
| R4 | Rehabilitation | 2006 Master Plan Project R02 | 48 | 48 | Repair | 2,644 | 2,101,000 | 2,101,000 | | | | | 2,101,000 | |
| R5 | Rehabilitation | 2006 Master Plan Project R11 | 54 | 54 | Repair | 3,[illegible]2 | 3,561,000 | 3,561,000 | | | | | 3,561,000 | |
| | | | | | | **Pipe Rehabilitation Totals** | **$ 14,570,000** | **$ 14,570,000** | **$ -** | **$ -** | **$ -** | | **$ 14,570,000** | **$ -** |
| | | | | | | | | | | | | | | |
| | | | | | | **Capitol Improvement Projects Totals** | **$ 312,316,000** | **$ 46,371,000** | **$ 55,848,000** | **$ 7,167,000** | **$ 202,930,000** | | **$ 107,919,860** | **$ 204,396,140** |

The projects were phased based on the best available information for how the City will develop moving forward. The actual implementation of the improvements serving future users ultimately depends on growth. The priorities presented below are estimates, and changes in the City's planning assumptions or growth projections could increase or decrease the priority of each improvement.

## ES.6 REHABILITATION AND REPAIR PLAN

The purpose of the rehabilitation and repair (R&R) plan is to identify sewer infrastructure conditions that pose a current or future threat to regular sewer operations and restore the affected facilities to an acceptable state. Sewer system conditions change over time and require periodic examination to monitor deterioration and determine when rehabilitation efforts are warranted. When sewer condition assessment activities yield signs of significant deterioration, rehabilitation is recommended to prevent operational system failures.

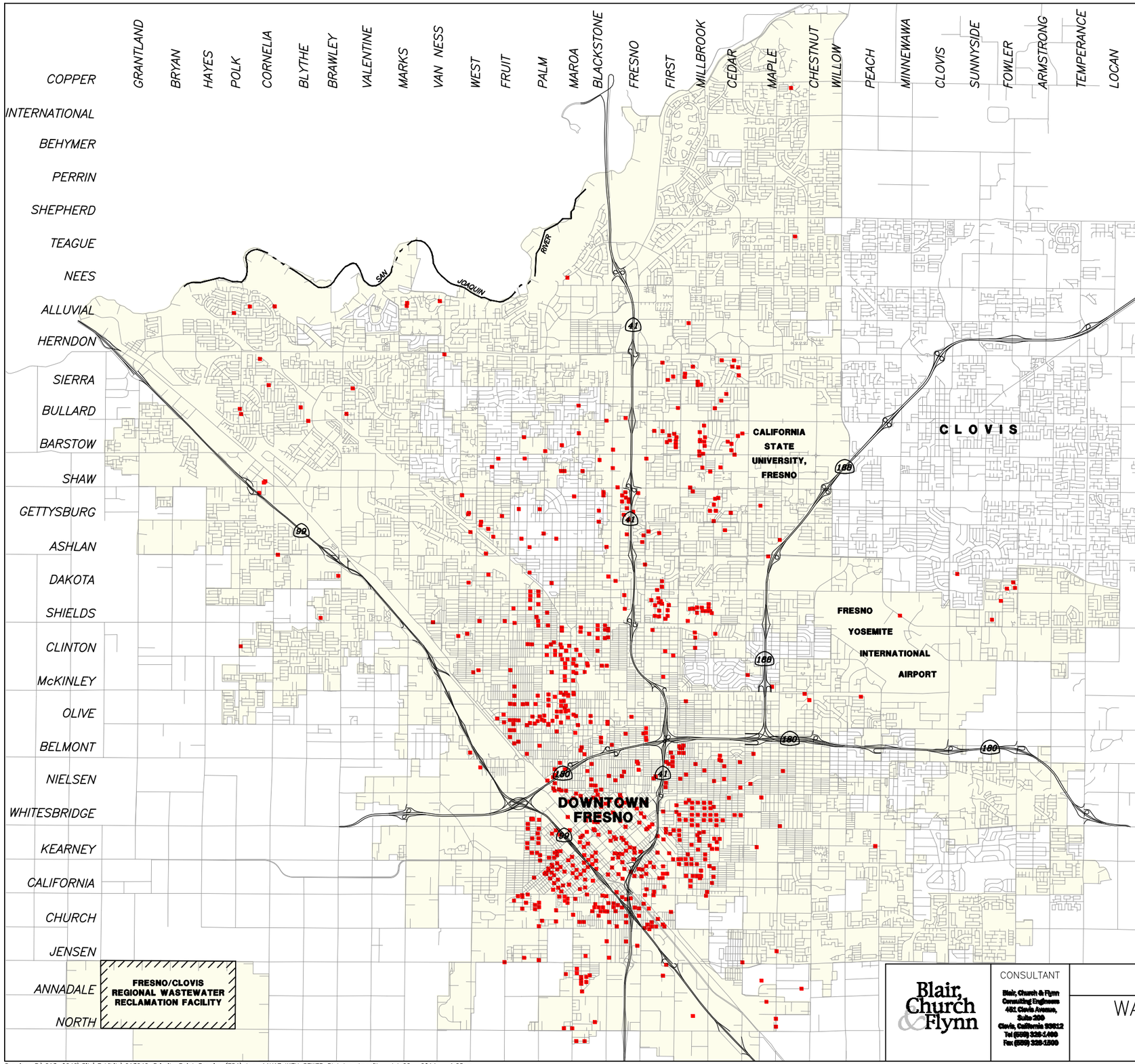
The City has developed and actively maintains a Geographic Information System (GIS) database of their sewer system. This GIS database includes detailed information that was used in the development of this R&R plan. City owned and operated truck mounted closed circuit television (CCTV) units have been used to collect video and condition assessment data for approximately 43 percent (690.5 miles) of the City's gravity sewer system. The City uses the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP©) evaluation protocols to rate the condition of each CCTV inspected sewer main.

Rehabilitation recommendations have been provided for previously recommended rehabilitation projects, high priority point repairs, high Modified Overall Structural Rating (MDRS) sewers, and sewer lift stations. Figures ES.4 through ES.6 represent the recommended rehabilitation improvements.

## ES.7 CAPITAL IMPROVEMENT PLAN

The cost estimates presented in the capital improvement plan (CIP) have been prepared for general master planning purposes and for guidance in project evaluation and implementation. Final costs of a project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors such as preliminary alignment generation, investigation of alternative routings, and detailed utility and topography surveys.

The capital improvement project costs are based on City bid results for wastewater projects, previous cost studies, interviews with local contractors and our project experience with similar wastewater infrastructure projects throughout the Central Valley. The costs have been adjusted to the Engineering News Record Construction Cost Index (ENRCCI) 20 City Average of 9,800 for June 2014.




## LEGEND

- PRIORITY POINT REPAIRS
- STREETS
- CITY LIMITS

**Priority Point Repairs**
**Wastewater Master Plan Update**
**City of Fresno**

| Priority Code | Code Description | Occurrences |
|---|---|---|
| B | Broken | 616 |
| BSV | Broken Soil Visible | 136 |
| BVV | Broken Void Visible | 139 |
| CH3 | Hinge Crack | 3 |
| CH4 | Hinge Crack | 2 |
| D | Deformed | 33 |
| FH3 | Hinge Fracture | 2 |
| FH4 | Hinge Fracture | 1 |
| H | Hole | 195 |
| HSV | Hole Soil Visible | 31 |
| HVV | Hole Void Visible | 28 |
| SMW | Missing Wall | 4 |
| SMWZ | Missing Wall, Surface Damage Not Evident | 6 |
| SRC | Reinforcement Corroded | 35 |
| SRCZ | Reinforcement Corroded, Surface Damage Not Evident | 1 |
| SRV | Reinforcement Visible | 6 |
| SRVC | Reinforcement Visible, Surface Damage Chemical | 1 |
| XP | Pipe Collapse | 10 |
| | **Priority Point Repair Total:** | **1249** |

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn

CONSULTANT
Blair, Church & Flynn
Consulting Engineers
451 Clovis Avenue,
Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

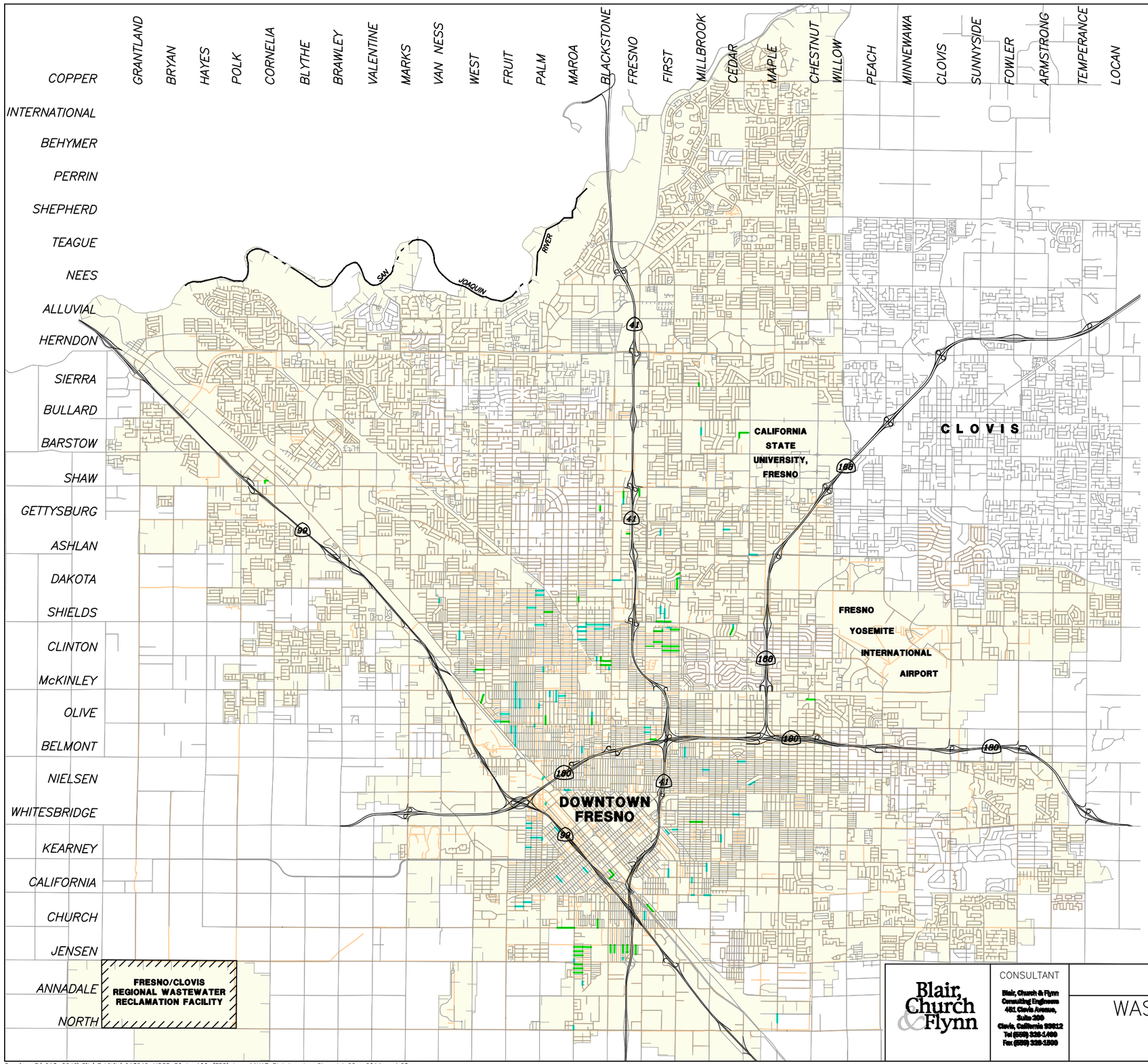
# CITY OF FRESNO

## WASTEWATER MASTER PLAN
## PRIORITY POINT REPAIRS
FIGURE ES.4

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1 OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_Priority Point Repairs (ES4).dwg; 11X17 WITH SEWER Plot by: dmagill Jul 22, 2014 - 1:25pm




## LEGEND

- SEVERE & CRITICAL MOSR SEWERS (MOSR ≥ 100)
- POOR MOSR SEWERS (50 ≤ MOSR < 100)
- OTHER EXISTING SEWERS
- STREETS
- CITY LIMITS

**MOSR Overview**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Sewer Condition | Range | Condition Occurrence | Percent of Inspected System |
|---|---|---|---|
| Severe | MOSR ≥ 200 | 53 | 0.43 |
| Critical | 100 ≤ MOSR < 200 | 33 | 0.27 |
| Poor | 50 ≤ MOSR < 100 | 84 | 0.68 |

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn

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Clovis, California 93612
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# CITY OF FRESNO

## WASTEWATER MASTER PLAN
## HIGH MOSR SEWERS
FIGURE ES.5

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR 50 to 100 (ES5).dwg; 11X17 Plot by: dmagill Jul 22, 2014 - 1:28pm

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDGE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNADALE
NORTH

GRANTLAND
BRYAN
HAYES
POLK
CORNELIA
BLYTHE
BRAWLEY
VALENTINE
MARKS
VAN NESS
WEST
FRUIT
PALM
MAROA
BLACKSTONE
FRESNO
FIRST
MILLBROOK
CEDAR
MAPLE
CHESTNUT
WILLOW
PEACH
MINNEWAWA
CLOVIS
SUNNYSIDE
FOWLER
ARMSTRONG
TEMPERANCE
LOCAN

SAN JOAQUIN RIVER

CALIFORNIA STATE UNIVERSITY, FRESNO

CLOVIS

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

FRESNO/CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY

99 41 168 180

## LEGEND

REHABILITATION PROJECTS

STREETS

CITY LIMITS

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Drawing: P:\213-0242\Site\Exhibits\213242_Improvement status (ES6).dwg; 11X17 Plot by: dmagill Jul 22, 2014 - 1:31pm

Blair, Church & Flynn

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# CITY OF FRESNO

## WASTEWATER MASTER PLAN
## PREVIOUS REHABILITATION PROJECTS NOT COMPLETED
FIGURE ES.6

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Cost estimates have been developed to help the City prepare budgeting and scheduling for these projects. The cost estimates included in this master plan are Class 5 estimates as defined by the Association for the Advancement of Cost Engineering (AACE) International publication entitled *Recommend Practice No. 56R-08*. Class 5 estimates are generally prepared on limited design information and subsequently have wide accuracy ranges. A typical Class 5 estimate for a civil engineering project may have an accuracy range as broad as -30 percent to +50 percent, or as narrow as -20 to +30 percent. Class 5 estimates are typically used for evaluation of resource needs, budgeting and capital planning.

The CIP scheduling assigns a fiscal year for each project as a target date for construction. The CIP scheduling was developed with consideration given to the following:

- Project Prioritization
- Anticipated City Growth Rates and Patterns
- Cost Distribution and Budgeting
- City of Fresno Direction

Short term projects are phased by year through the year 2020 and long-term projects are phased in five year increments beginning in 2020 through 2035.

Rehabilitation projects and capacity projects are given the highest priority needs are and are all scheduled as short term projects to be completed between 2015 and 2020. Each project is itemized by phase in Table ES.3.

The improvements proposed in this study either benefit existing users, or are required to service new development and future users. A summary of the existing and future user cost share for the proposed projects by phase is summarized in Table ES.3.

**Table ES.3 Summary of Capital Improvement Costs**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| | Implementation Phase | | | | |
|---|---|---|---|---|---|
| **Reimbursement Category** | **2015-20 ($, mill.)** | **2021-25 ($, mill.)** | **2026-30 ($, mill.)** | **2031-35 ($, mill.)** | **Total ($, mill.)** |
| Existing User | 46.3 | 55.6 | 6.1 | 0 | 108.0 |
| Future User | 0.1 | 0.2 | 1.1 | 202.9 | 204.3 |
| **Total** | **46.4** | **55.8** | **7.2** | **202.9** | **312.3** |

Notes:
(1) Costs are based on ENR CCI 20-City Average of 9,800 (June 2014).

# BACKGROUND

This chapter presents a brief summary of the sanitary sewer system service area, the need for this Wastewater Collection System Master Plan Update (Master Plan) and the objectives of the study. A list of abbreviations is also provided to assist the reader in understanding the information presented.

## 1.1 INTRODUCTION

The City of Fresno (City) was founded in 1872 by the Central Pacific Railroad Company and incorporated in 1885. The City has since grown to over 112 square miles with a population of just under a half million people in the incorporated area. Today, Fresno is the fifth largest city in the state of California. Centrally located, Fresno is the financial, industrial, trade, and commercial capital in the Central San Joaquin Valley. Figure 1.1 presents a location map of the City. The City is the hub of a region rich in heritage, resources, and people.

The City is the Regional Sewer Agency for the Fresno-Clovis Metropolitan Area (FCMA). The City owns and maintains a wastewater collection system that serves the City and the other participating agencies: the County of Fresno, the majority of the City of Clovis, the Pinedale Public Utility District, and the Pinedale County Water District. The City also owns and operates the Fresno/Clovis Regional Wastewater Reclamation Facility (RWRF), as well as the smaller North Fresno Wastewater Reclamation Facility (NFWRF) scalping plant.

## 1.2 SEWER SERVICE AREA

Figure 1.2 illustrates the City's current wastewater service area. The City manages and maintains more than 1,500 miles of gravity sewer lines up to 84-inches in diameter, 15 active lift stations, and associated force mains. Nearly all of the wastewater generated within the sewer service area is conveyed to the City's RWRF for treatment, with the exception of a small amount of flow that is treated at the City's NFWRF. In addition, the City of Clovis recently constructed its own wastewater treatment facility on the eastern edge of the Clovis City limits (near the intersection of Ashlan Avenue and McCall Avenue), which provides wastewater service for a portion of the City of Clovis. However, most of the flow generated within the City of Clovis is treated at the RWRF.

The land use assumptions in this Master Plan were based on the Fresno General Plan (General Plan) and projected future developments within the City's proposed growth boundary. Should future planning conditions change from the assumptions stated in this Master Plan (i.e., accelerated growth, more intense developments, etc.), revisions and adjustments to the Master Plan recommendations would be necessary.

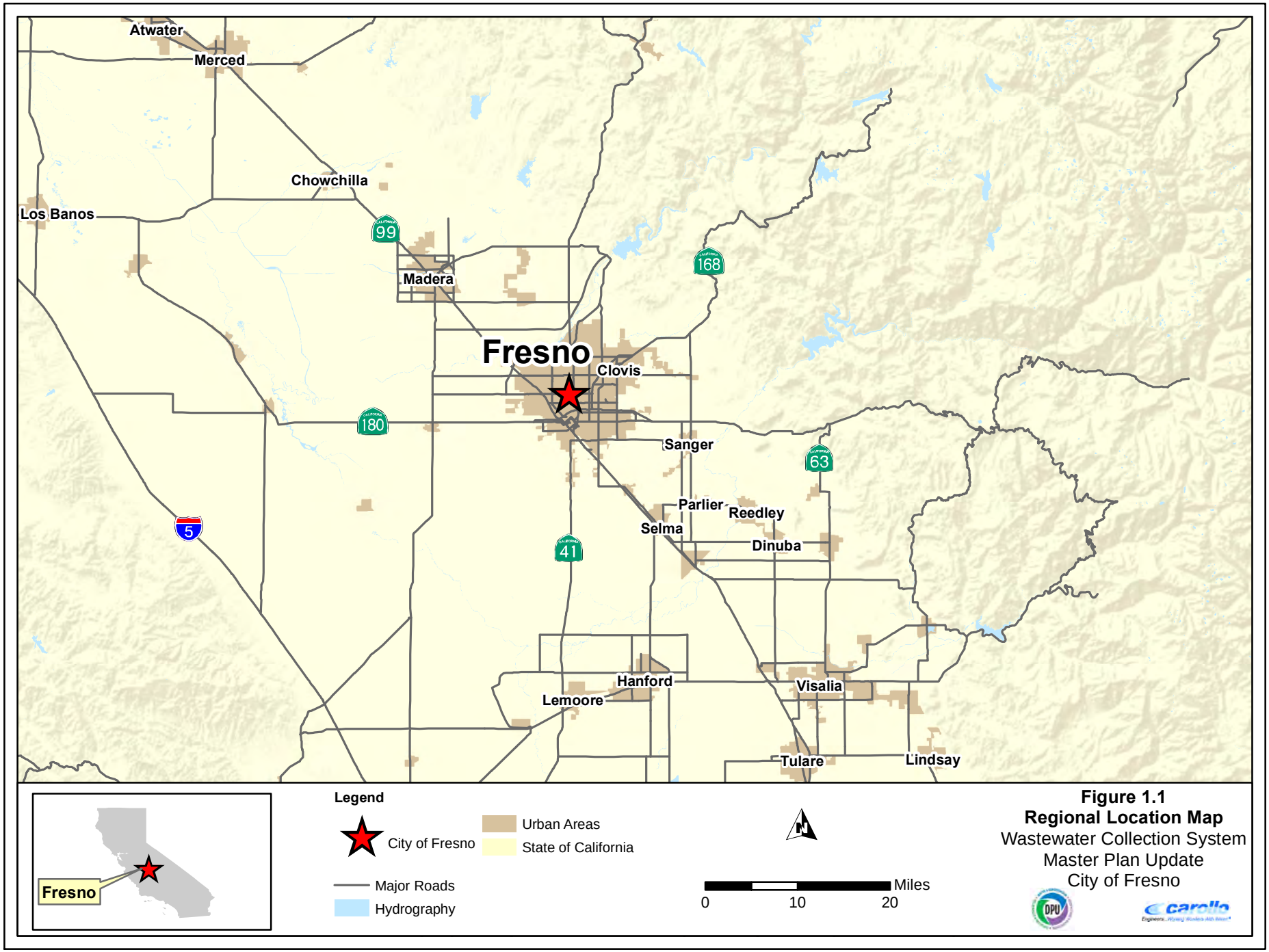


**Figure 1.1**
**Regional Location Map**
Wastewater Collection System
Master Plan Update
City of Fresno

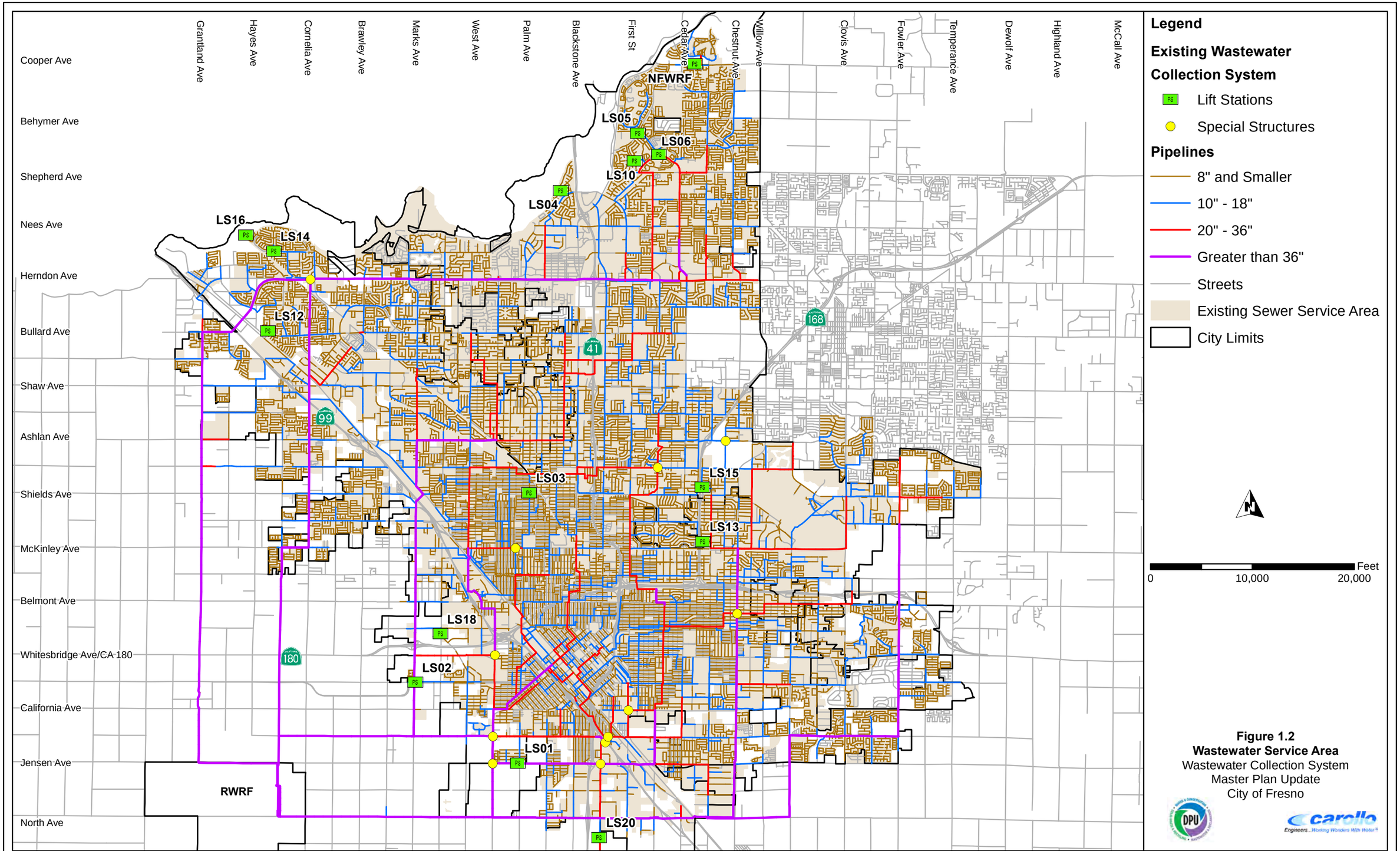


**Figure 1.2**
**Wastewater Service Area**
Wastewater Collection System
Master Plan Update
City of Fresno

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## 1.3 PREVIOUS MASTER PLAN

The City's previous Wastewater Collection System Master Plan was completed in 2004 by Brown and Caldwell with the assistance of Blair, Church, and Flynn Consulting Engineers (BC&F). The objective of the 2004 Master Plan was to develop a long-range planning document that would assist the City's staff with managing the collection system capital improvement program and update the impact and connection fees.

One component in this project was the development of a hydraulic model of the collection system and performing a hydraulic assessment for current and future conditions. The model allowed for identification of hydraulic deficiencies in the current collection system and new pipelines to serve new developments as well as development of a capital improvement program that included collection system projects identified during the hydraulic analysis and other projects already identified by the city.

## 1.4 SCOPE AND AUTHORIZATION

The purpose of this Master Plan is to update the 2004 Master Plan and to identify capacity deficiencies in the sanitary sewer system, develop feasible alternatives to correct these deficiencies, plan the infrastructure that will serve future development projected by the Fresno General Plan, and to develop a rehabilitation and repair plan for the City's wastewater collection system.

In July 2013, the City approved a professional service agreement with Carollo Engineers, Inc. (Carollo), to prepare this Master Plan Update for the wastewater collection system. The professional services agreement included the following main tasks:

- Task 1 – Project Management and Meetings
- Task 2 – Data Collection and Review
- Task 3 – Wastewater Flow Projections
- Task 4 – Model Review, Evaluation, and Calibration
- Task 5 – Planning Criteria Development
- Task 6 – Rehabilitation/Repair Plan
- Task 7 – System Evaluation and Capital Improvement Plan
- Task 8 – Master Plan Report Preparation

Carollo entered into a Subconsultant Agreement with BC&F to assist with the development of certain aspects of this Master Plan, including field reconnaissance, development of the rehabilitation and repair plan, and development of capital cost estimates.

## 1.5 REPORT ORGANIZATION

The Master Plan report contains seven chapters, followed by appendices that provide supporting documentation for the information presented in the report. The chapters are briefly described below:

**Chapter 1 - Introduction**. This chapter presents the need for this Master Plan and the objectives of the study. Lists of abbreviations and reference materials are also provided to assist the reader in understanding the information presented.

**Chapter 2 - Study Area Description**. This chapter presents a description of the study area, defines the planning horizon for this study, and summarizes the land use classifications.

**Chapter 3 - Flow Monitoring Program**. This chapter defines the typical components of wastewater in a collection system as they pertain to this Master Plan. The flow monitoring data and results from the flow monitoring program are summarized and discussed.

**Chapter 4 - Collection System Facilities and Hydraulic Model.** This chapter describes the update and calibration of the City's collection system hydraulic model. A description of the City's wastewater collection system, the existing hydraulic model, and an outline of the steps used to update the model are provided. A detailed summary of the hydraulic model calibration steps, standards, and results for both base wastewater flow (BWF) and wet weather flow (WWF) conditions is also provided.

**Chapter 5 - Planning Criteria and Design Flows**. The capacity of the City's wastewater collection system was evaluated based on the planning criteria defined in this chapter. The planning criteria address the collection system capacity, gravity sewer pipe slopes, and maximum allowable depth of flow within a sewer. This chapter also summarizes the existing and build out design flows.

**Chapter 6 - Capacity Evaluation and Proposed Improvements**. This chapter discusses the hydraulic evaluation of the sewer collection system and the proposed projects that correct capacity deficiencies and serve future users.

**Chapter 7 – Rehabilitation and Replacement Plan.** This Chapter describes the proposed rehabilitation and repair (R&R) plan for the City's wastewater collection system, and includes the objectives of the plan, the data used to develop the plan, and the evaluation of the City's collection system assets.

**Chapter 8 - Capital Improvement Plan**. This chapter presents the capital improvement projects, a summary of the capital costs, and a basic assessment of the possible financial impacts on the City. This chapter presents the recommended capital improvement plan (CIP) for the City collection system and a summary of the capital costs.

## 1.6 ACKNOWLEDGMENTS

Carollo and BC&F wish to acknowledge and thank Mr. Steve Hogg, Assistant Director, Department of Public Utilities; Mr. Kevin Norgaard, Supervising Professional Engineer, Department of Public Utilities; and Mr. Orlando Gonzalez, Engineer, Department of Public Utilities. Their cooperation and courtesy in obtaining a variety of necessary information were valuable components in completing and producing this report.

## 1.7 ABBREVIATIONS AND DEFINITIONS

To conserve space and to improve readability, the following abbreviations are used in this report.

| | |
|---|---|
| °F | Degrees Fahrenheit |
| General Plan | Fresno General Plan |
| AACE | Association for the Advancement of Cost Engineering |
| AAF | Average Annual Flow |
| ADWF | Average Dry Weather Flow |
| ADS | ADS Environmental Services |
| BCC | Baseline Construction Cost |
| BC&F | Flair, Church, and Flynn Consulting Engineers |
| BRT | Bus Rapid Transit |
| BWF | Base Wastewater Flow |
| Buildout | General Plan Buildout |
| Carollo | Carollo Engineers, Inc. |
| CCTV | Closed-Circuit Television |
| CIP | Capital Improvement Plan |
| CIPP | Cured-in-Place Pipe |
| City | City of Fresno |
| CSUF | California State University, Fresno |
| d/D | Flow Depth to Pipe Diameter Ratio |

| | |
|---|---|
| DWF | Dry Weather Flow |
| ENRCCI | Engineering News Record Construction Cost Index |
| EPS | Extended Period Simulation |
| FCMA | Fresno-Clovis Metropolitan Area |
| ft/s | Feet Per Second |
| $ft^2$ | Square Feet |
| GIS | Geographic Information System |
| gpd | Gallons Per Day |
| gpd/ac | Gallons Per Day Per Acre |
| gpm | Gallons Per Minute |
| GWI | Groundwater Infiltration |
| HDPE | High-Density Polyethylene |
| HGL | Hydraulic Grade Line |
| I/I | Infiltration and Inflow |
| JPA | Fresno-Clovis Regional Sewerage System Joint Powers Agreement |
| Master Plan | Wastewater Collection System Master Plan Update |
| mgd | Million Gallons Per Day |
| MGP | Master Group Polygons |
| MOSR | Modified Overall Structural Rating |
| MPG | Master Group Polygons |
| MSL | Mean Sea Level |
| n | Manning Friction Coefficient |
| NASSCO | National Association of Sewer Service Companies |
| NCFWRF | North Central Fresno Wastewater Reclamation Facility |
| NFWRF | North Fresno Wastewater Reclamation Facility |
| NOAA | National Oceanic and Atmospheric Administration |

| | |
|---|---|
| NRCS | Natural Resources Conservation Service |
| OSR | Overall Structural Rating |
| PACP© | Pipeline Assessment and Certification Program |
| PDWF | Peak Dry Weather Flow |
| PVC | Polyvinyl Chloride |
| PWWF | Peak Wet Weather Flow |
| q/Q | Peak Flow to Pipe Capacity Ratio |
| R&R | Rehabilitation and Repair |
| RDII | Rainfall Derived Infiltration and Inflow |
| ROW | Right Of Way |
| RWRF | Regional Water Reclamation Facility |
| SCADA | Supervisory Control and Data Acquisition |
| SEDA | Southeast Development Area |
| SIU | Significant Industrial Users |
| SOI | Sphere of Influence |
| SSO | Sanitary Sewer Overflow |
| SWMM | Stormwater Management Model |
| VCP | Vitrified Clay Pipe |
| WaPUG | Wastewater Planning Users Group |
| WWF | Wet Weather Flow |

## 1.8 REFERENCE MATERIAL

The following documents were referenced in the preparation of this Master Plan:

- *City of Fresno General Plan Update*, December 2014.
- *City of Fresno CCTV Inspection and Evaluation for Mid-Sized Concrete Sewers*, Final, Blair, Church & Flynn, July 2010.
- *City of Fresno Evaluation of Large Diameter Wastewater Collection System*, Final, Blair, Church & Flynn, 1992-1996.

- *City of Fresno Inspection and Evaluation of Concrete Sewers 12 Inches to 27 Inches in Diameter*, Final, Blair, Church & Flynn, July 2001.
- *City of Fresno Large Diameter Sewer Evaluation Update*, Final, Blair, Church & Flynn, January 2012.
- *City of Fresno North Avenue Trunk Sewer Evaluation*, Final, Blair, Church, and Flynn, 1990.
- *City of Fresno Permanent Flow Monitoring Data*, ADS, 2010-2012
- *City of Fresno Wastewater Collection System Master Plan,* Final, Brown and Caldwell, May 2006.

Chapter 2

# STUDY AREA DESCRIPTION

This chapter presents a description of the study area, defines the planning horizon for the study, and summarizes the land use classifications.

## 2.1 STUDY AREA

The area serviced by the City of Fresno (City) is characterized by residential, commercial, and industrial uses within the City limits. While the City has a diverse economy, Fresno County is the nations' top-ranked agriculture-producing county. There are some agricultural lands within the metropolitan area that are interspersed on larger parcels along the fringe of urbanized area and in between parcels.

There are many open space areas within the City, including Woodward Park and Roeding Park which is home of the Fresno Chaffee Zoo. The main water bodies near the City are located on the outskirts of town. The San Joaquin River runs east and west just to the North of the City limits. The Kings River is about 12 miles east of the City limits and the City diverts water from the river for part of their water supply. The Sierra Nevada Mountains are located about 25 miles east of the City.

There are four major highways that run through the City which include State Route 99, State Route 168, State Route 41, and State Route 180. State Route 99 connects the major cities in the central valley and runs north and south. State Route 168 heads east out of the City through Clovis and heads to the Sierras to the east. State Route 41 runs north and south which connects to Atascadero in the South and to Yosemite to the north. State Route 180 runs east and west which connects to Mendota to the west and to Kings Canyon National Park to the east.

The City's proposed Sphere of Influence (SOI), as defined in Fresno General Plan (General Plan) is the study area boundary for this Wastewater Collection System Master Plan Update (Master Plan). The Master Plan study area boundary and the SOI are synonymous and will be used interchangeably throughout this report. The SOI extends beyond the current sewer service area and is approximately 100,240 acres (156.6 square miles). This Master Plan is intended as the guiding document to plan and implement sewer system improvements to accommodate future growth to build out of the General Plan. Figure 2.1 shows the study area boundary and the current City limits.

## 2.2 PLANNING PERIOD

The Master Plan study area is intended to include the existing City limits and development that could occur through build out of the City's General Plan. Existing and build out land uses within the study area are discussed in this chapter.

Dickenson Ave
West Lawn Ave
Chateau Fresno Ave
Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave
Del Rey Ave
Bethel Ave
Academy Ave
Madsen Ave

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave
Central Ave
American Ave

99
41
168
180

RWRF

**Legend**

- Sphere of Influence
- City Limits

N

0 12,500 25,000 Feet

**Figure 2.1**
**Study Area**
Wastewater Collection System
Master Plan Update
City of Fresno

DPU

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## 2.3 CLIMATE

The City's study area is characterized by a semi-arid climate with mild, moderately wet winters and hot, dry summers. Table 2.1 summarizes the maximum and minimum monthly temperatures as well as the average monthly precipitation. January is the City's coldest and wettest month, with an average high temperature of 55.3 degrees Fahrenheit (°F), an average low temperature of 39.3°F, and 2.19 inches of precipitation. July is the City's hottest month, with an average high temperature of 98.7°F and an average low temperature of 68.1°F. Approximately 87 percent of the annual rainfall occurs between November and May, with an average annual rainfall of 10.73 inches.

**Table 2.1 Study Area Climate**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Month | Average Maximum Temperature (ºF) | Average Minimum Temperature (ºF) | Average Monthly Rainfall (inches) |
|---|---|---|---|
| January | 55.3 | 39.3 | 2.19 |
| February | 61.0 | 41.7 | 2.08 |
| March | 68.3 | 45.8 | 1.40 |
| April | 73.4 | 49.0 | 1.05 |
| May | 84.4 | 56.5 | 0.42 |
| June | 92.1 | 62.4 | 0.23 |
| July | 98.7 | 68.1 | 0.01 |
| August | 97.2 | 66.0 | 0.08 |
| September | 90.8 | 61.3 | 0.07 |
| October | 78.7 | 52.6 | 0.62 |
| November | 65.0 | 44.8 | 0.98 |
| December | 55.7 | 38.4 | 1.62 |
| **Annual** | **76.7** | **52.2** | **10.73** |

Notes:
(1) Source: Western Regional Climate Center, Fresno Yosemite International Airport, www.wrcc.dri.edu.

## 2.4 TOPOGRAPHY

The City is located in the center of San Joaquin Valley near the eastern fringe of the Sierra Nevada mountain range. The terrain is flat except for the bluffs near the San Joaquin River.

The majority of the City is relatively flat with an average elevation of approximately 335 feet above mean sea level (MSL). Figure 2.2 shows the general topography of the study area.

## 2.5 LAND USE

Land use information is an integral component in determining the amount of wastewater generated within the City. The type of land use in an area will affect the volume and characteristics of the wastewater generation. Therefore, adequately estimating the generation of wastewater from various land use types is important in sizing and maintaining effective sanitary sewer system facilities. Existing land use was utilized to develop the initial estimate of wastewater flows for current conditions. For future flow conditions, the City's General Plan land use was used.

An important tool for determining land use projections is the City's General Plan, which guides development within the study area and establishes long-range development policies. Land use assumptions used in this study area consistent with those for existing and proposed development as published in the General Plan.

### 2.5.1 Existing Wastewater Collection System Service Area Land Use

The City provides wastewater collection service to residents, businesses, and other institutions within its service area, which currently encompasses and area of approximately 61,200 acres or 95.7 square miles. It should be noted that the 95.7 square miles excludes areas within the City limits that are developed but are unsewered (e.g., areas served by septic tanks), land area within the City of Clovis, and undeveloped land outside of the current service area. It does however include some County islands that area not technically within the City limits (e.g., Pinedale). Figure 2.3 shows the City's existing land use within the current sewer service area. Table 2.2 summarizes the existing sewer service land area by existing land use designation.

The largest land use category is residential, which accounts for approximately 44 percent of the total current service area acreage. Commercial land uses make up approximately 6 percent of the total. Industrial designations comprise 7 percent of the service area. Public land uses account for approximately 8 percent of the service area. Other land uses, such as open space, roads, and vacant land account for the remaining 35 percent of the total service area.

### 2.5.2 Build Out Wastewater Service Area Land Use

At build out of the General Plan, the City will encompass approximately 100,240 acres (156.6 square miles). Build out is defined as complete development of the General Plan Boundary. Appendix A provides a description of the different land uses associated with the General Plan. The descriptions are excerpts from the General Plan. Figure 2.4 and Table 2.3 show the General Plan land uses.

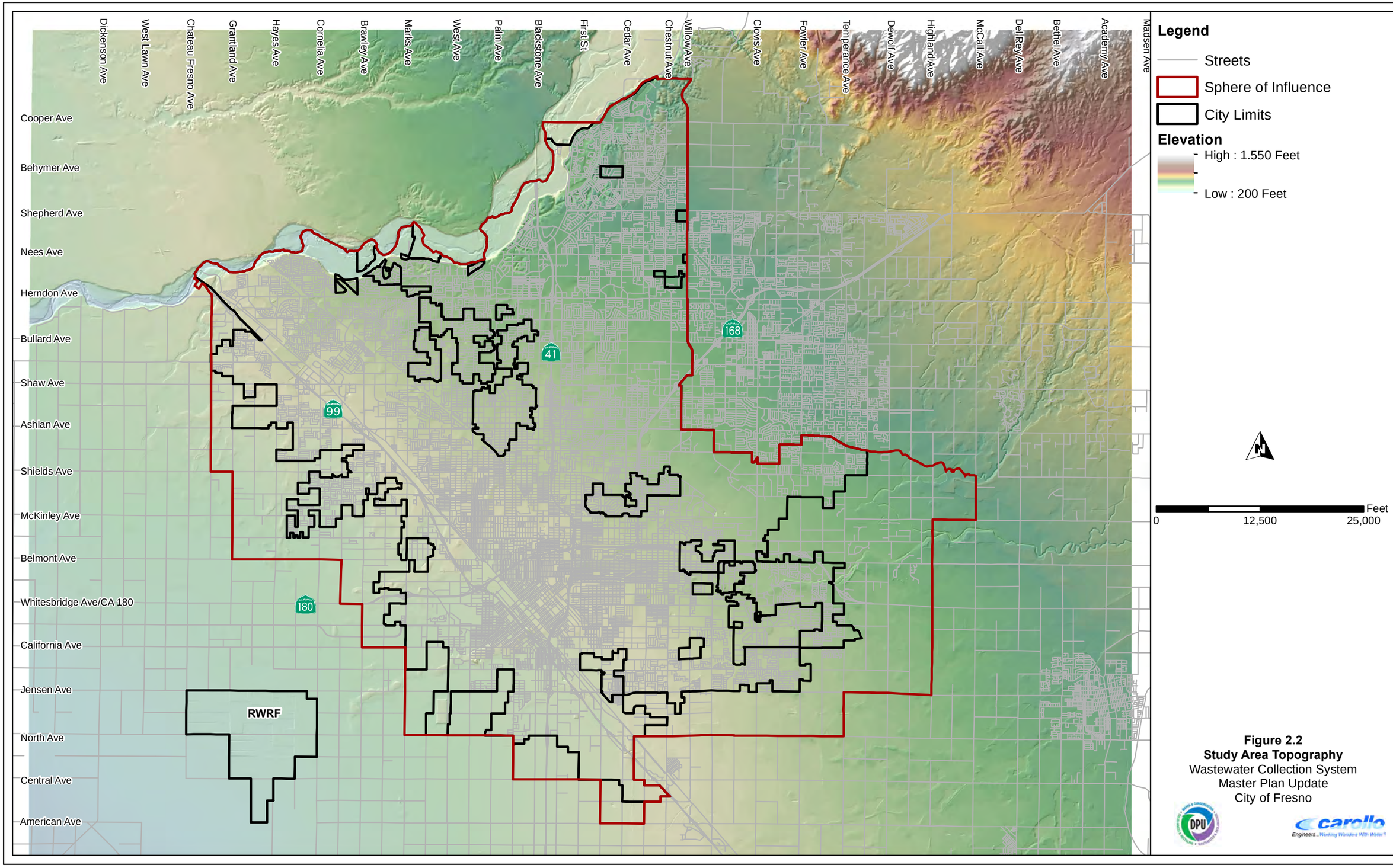


**Figure 2.2**
**Study Area Topography**
Wastewater Collection System
Master Plan Update
City of Fresno

DPU

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Dickenson Ave
West Lawn Ave
Chateau Fresno Ave
Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave
Del Rey Ave
Bethel Ave
Academy Ave
Madsen Ave

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave
Central Ave
American Ave

99
41
168
180

RWRF

## Legend

- Sphere of Influence
- City Limits
- Major Streets

### Existing Land Use

- Residential Rural
- Residential Low Density
- Residential Medium Low Density
- Residential Medium Density
- Residential Medium High Density
- Residential High Density
- Residential Mobile Home
- Commercial
- Industrial
- Public Facilities
- Open Space
- Vacant

N

0 12,500 25,000 Feet

**Figure 2.3**
**Existing Land Use**
Wastewater Collection System
Master Plan Update
City of Fresno

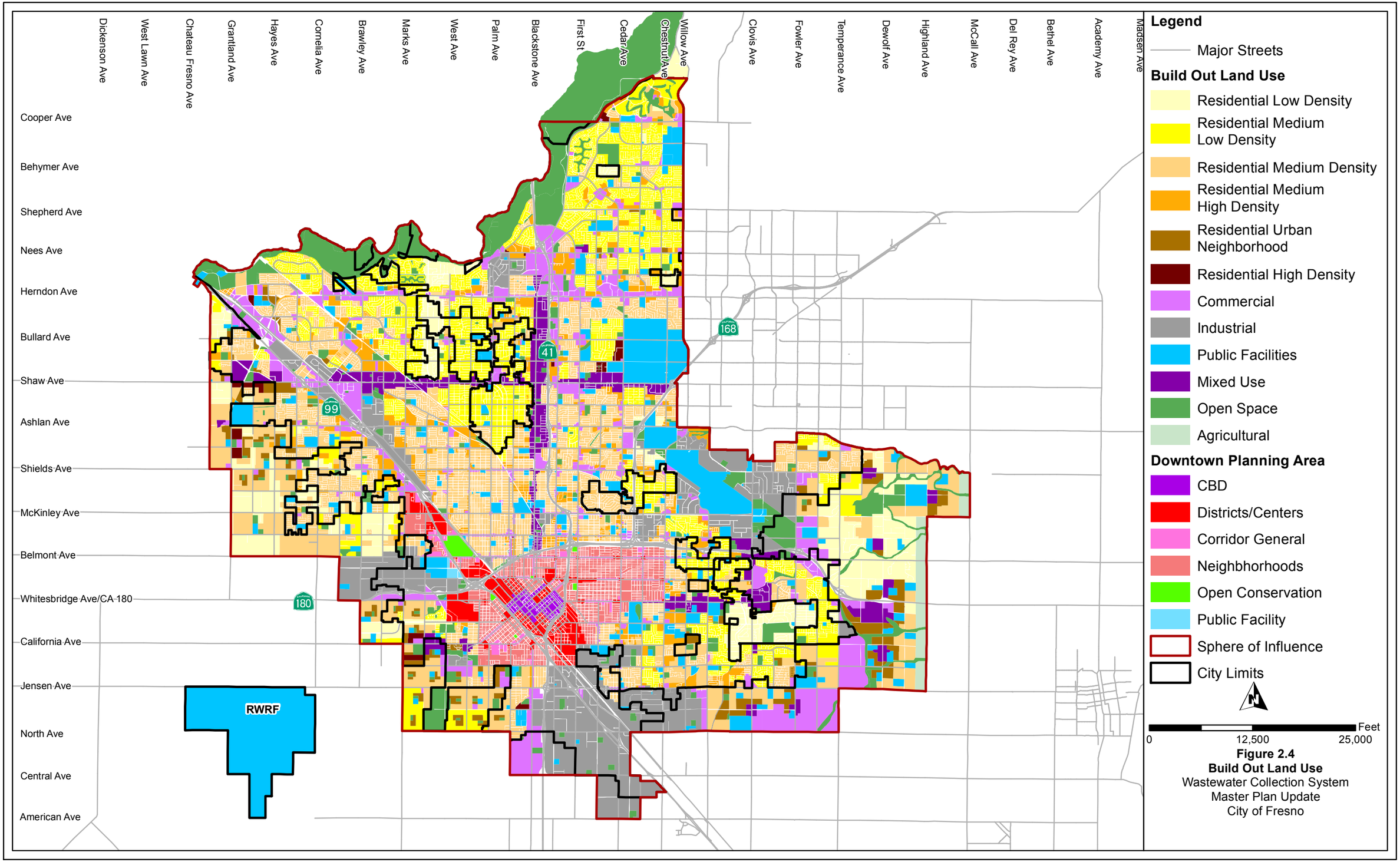


**Figure 2.4**
**Build Out Land Use**
Wastewater Collection System
Master Plan Update
City of Fresno

**Table 2.2 Existing Land Use**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Land Use Classification | Current Sewer Service Area Land Use | |
|---|---|---|
| | Land Use Area (acre) | Percent of Total (%) |
| **Residential** | | |
| Rural Density | 1,216 | 2.0% |
| Low Density (1-3 DU/acre) | 1,138 | 1.9% |
| Medium Low Density (3.5 -6 DU/acre) | 10,361 | 16.9% |
| Medium Density (5-12 DU/acre) | 11,143 | 18.2% |
| Medium High Density (12-16 DU/acre) | 2,039 | 3.3% |
| High Density (30-45 DU/acre) | 1,316 | 2.1% |
| **Subtotal** | **27,212** | **44.4%** |
| **Commercial** | | |
| Community | 604 | 1.0% |
| General Heavy | 1,054 | 1.7% |
| Neighborhood | 569 | 0.9% |
| Neighborhood Limited | 3 | 0.0% |
| Office | 1,057 | 1.7% |
| Professional Services Office | 100 | 0.2% |
| Regional | 218 | 0.4% |
| Recreational | 119 | 0.2% |
| Storage Limited | 44 | 0.1% |
| **Subtotal** | **3,768** | **6.2%** |
| **Public Facilities** | | |
| Airport | 1,065 | 1.7% |
| College | 151 | 0.2% |
| High school | 475 | 0.8% |
| Elementary School and High School | 141 | 0.2% |
| Middle School | 233 | 0.4% |
| Elementary School and Middle School | 188 | 0.3% |
| Elementary School | 735 | 1.2% |
| Special School | 42 | 0.1% |
| Cemetery | 165 | 0.3% |
| Church | 545 | 0.9% |
| Community Activity Center | 8 | 0.0% |
| Neighborhood Center | 5 | 0.0% |
| Convention Center | 17 | 0.0% |
| Fairgounds | 90 | 0.1% |
| Fire Station | 14 | 0.0% |
| Government Offices | 141 | 0.2% |
| County Court House Central Area | 14 | 0.0% |
| Hospital | 137 | 0.2% |
| Medical Center | 10 | 0.0% |
| Convalescent Hospital | 64 | 0.1% |
| Military | 60 | 0.1% |
| Mobile Home Park | 388 | 0.6% |
| Municipal Service Center | 37 | 0.1% |
| Post Office | 23 | 0.0% |
| Public Facility | 21 | 0.0% |
| Public/Quasi-Public Facility | 43 | 0.1% |
| Pump Station | 44 | 0.1% |
| **Subtotal** | **4,854** | **7.9%** |
| **Open Space** | | |
| Open Space | 60 | 0.1% |
| Recreational Use/Clear Zone | 16 | 0.0% |
| Ag | 233 | 0.4% |
| Canal | 38 | 0.1% |
| Community Park | 28 | 0.0% |
| Golf Course | 597 | 1.0% |
| Lake or Pond | 54 | 0.1% |
| Multi-Use | 101 | 0.2% |
| Neighborhood Park | 212 | 0.3% |
| Recreational Park | 59 | 0.1% |
| Recreational Use | 12 | 0.0% |
| Regional Park | 154 | 0.3% |
| Parking | 78 | 0.1% |
| Pg&e Substation | 117 | 0.2% |
| Ponding Basin | 407 | 0.7% |
| Ponding Basin/Park | 108 | 0.2% |
| **Subtotal** | **2,281** | **3.7%** |
| **Other** | | |
| Roads/ Canals/ Highways | 16,545 | 27.0% |
| Vacant | 2,303 | 3.8% |
| **Subtotal** | **18,848** | **30.8%** |
| **Industrial/Clovis** | | |
| Light Industrial | 2,979 | 4.9% |
| Heavy Industrial | 1,291 | 2.1% |
| **Subtotal** | **4,270** | **7.0%** |
| **Total** | | |
| **Total** | **61,234** | **100.0%** |

**Table 2.3 Build Out Land Use**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Land Use Type | Build Out Sewer Service Area Land Use | |
|---|---|---|
| | Land Use Area (acre) | Percent of Total (%) |
| **Residential** | | |
| Low Density (1-3 DU/acre) | 6,436 | 6.4% |
| Medium Low Density (3.5 -6 DU/acre) | 12,558 | 12.5% |
| Medium Density (5-12 DU/acre) | 17,977 | 17.9% |
| Medium High Density (12-16 DU/acre) | 3,743 | 3.7% |
| Urban Neighborhood (16-30 DU/acre) | 2,184 | 2.2% |
| High Density (30-45 DU/acre) | 371 | 0.4% |
| **Subtotal** | **43,269** | **43.2%** |
| **Commercial** | | |
| Main Street | 72 | 0.1% |
| Community | 1,363 | 1.4% |
| Recreation | 111 | 0.1% |
| General Heavy | 437 | 0.4% |
| Highway & Auto | 253 | 0.3% |
| Regional | 553 | 0.6% |
| Neighborhood | 0 | 0.0% |
| **Subtotal** | **2,790** | **2.8%** |
| **Employment** | | |
| Office | 1,426 | 1.4% |
| Professional Services Office | 1 | 0.0% |
| Business Park | 842 | 0.8% |
| Regional Business Park | 1,817 | 1.8% |
| Light Industrial | 4,847 | 4.8% |
| Heavy Industrial | 3,960 | 4.0% |
| **Subtotal** | **12,893** | **12.9%** |
| **Mixed Use** | | |
| Corridor/Center Mixed Use | 2,046 | 2.0% |
| Regional Mixed Use | 956 | 1.0% |
| Neighborhood Mixed Use | 131 | 0.1% |
| **Subtotal** | **3,133** | **3.1%** |
| **Open Space** | | |
| Recreational Use/Clear Zone | 8 | 0.0% |
| Recreational Use | 339 | 0.3% |
| Commercial-Recreational | 18 | 0.0% |
| Community Park | 105 | 0.1% |
| Golf Course | 985 | 1.0% |
| Lake, Pond | 86 | 0.1% |
| Multi-Use | 2,221 | 2.2% |
| Neighborhood Park | 228 | 0.2% |
| Open Space | 1,552 | 1.5% |
| Recreational Park | 222 | 0.2% |
| Ponding Basin | 1,244 | 1.2% |
| Ponding Basin (Park Use) | 102 | 0.1% |
| Regional Park | 561 | 0.6% |
| **Subtotal** | **7,670** | **7.7%** |
| **Public Facilities** | | |
| Public/Quasi-Public Facility | 596 | 0.6% |
| Public Facility | 321 | 0.3% |
| Special School | 635 | 0.6% |
| Elementary School | 1,071 | 1.1% |
| Elementary & Middle School | 62 | 0.1% |
| Elementary, Middle, & High School | 40 | 0.0% |
| Middle School | 290 | 0.3% |
| Junior High School | 34 | 0.0% |
| High School | 383 | 0.4% |
| College | 282 | 0.3% |
| Cal State University | 1,258 | 1.3% |
| Airport | 928 | 0.9% |
| Cemetary | 75 | 0.1% |
| Church | 149 | 0.1% |
| Community Activity Center | 9 | 0.0% |
| Convalescent Hospital | 7 | 0.0% |
| Fairgrounds | 116 | 0.1% |
| Fire Station | 20 | 0.0% |
| Hospital | 58 | 0.1% |
| Neighborhood Center | 5 | 0.0% |
| PG&E Substation | 141 | 0.1% |
| Police Dressing Station | 1 | 0.0% |
| Water Recharge Basin | 288 | 0.3% |
| **Subtotal** | **6,770** | **6.8%** |
| **Buffer** | | |
| Buffer (Ag) | 736 | 0.7% |
| **Subtotal** | **736** | **0.7%** |
| **Downtown** | | |
| Central Business District | 267 | 0.3% |
| Civic Center | 37 | 0.0% |
| Town Center | 55 | 0.1% |
| Neighborhood Center | 84 | 0.1% |
| Chinatown District | 29 | 0.0% |
| Cultural Arts District | 69 | 0.1% |
| Corridor General | 466 | 0.5% |
| Neighborhoods | 2,584 | 2.6% |
| Special Districts | 1,000 | 1.0% |
| Public Facility | 150 | 0.1% |
| Open Conservation | 178 | 0.2% |
| South Stadium District | 120 | 0.1% |
| **Subtotal** | **5,039** | **5.0%** |
| **Other** | | |
| Street, Rail, Canal, Etc. | 17,941 | 17.9% |
| **Subtotal** | **17,941** | **17.9%** |
| **Total** | | |
| **Total** | **100,240** | **100.0%** |

At build out, the largest land use category is residential, which accounts for approximately 43 percent of the total service area acreage. Commercial land uses make up approximately 3 percent of the total. Employment land uses make up approximately 13 percent, and mixed use areas account for roughly 3 percent of the service area. Public land uses account for approximately 7 percent of the service area. The downtown area, which consists of a mixture of land uses, accounts for 5 percent of the service area. Other land uses, such as open space, roads, and vacant land account for the remaining 26 percent of the total service area.

In general terms, the study area can be grouped into two mains categories in regards to future development/land use. These are “Areas of Stability” and “Areas of Change,” as summarized below:

- **Areas of Change:** For the purposes of this Master Plan, areas of change are defined as an area within the study area that will contribute to a net increase in wastewater flows into the collection system. These areas are further broken down subcategories, as described below:
  - Downtown: A major component of the General Plan is Downtown. The General Plan envisions a new focus on land use and design along major streets and in neighborhoods that support Downtown. This new focus includes proposals for increased density in Downtown itself and vibrant mixed-use centers that will emanate from Downtown (mixed use corridors are described below), extending the reach of and connections with Downtown in all directions.
  - Bus Rapid Transit (BRT) Corridors: The City believes that the BRT corridors proposed in the General Plan offer great opportunities for future growth in form of mixed-use development on sites that are now underutilized or vacant. These areas are assigned a mixed use land use designation, and are targeted for densification in the General Plan. The City provided Carollo with a Geographic Information System (GIS) shape file indicating which areas are targeted for redevelopment in the BRT corridors, as well as the Downtown area.
  - Infill: For the purposes of this Master Plan, infill is defined as development of existing vacant parcels that lie within the existing wastewater service area. Development of these vacant areas will increase wastewater flows within the existing collection system, and are therefore targeted as areas of change.
  - New Growth Areas: There are several planned growths areas within the study area. These areas primarily consist of the Southeast Development Area (SEDA), the West Growth Area, and the Southwest Growth Area. In addition, this Master Plan includes other areas that are within the current City limits, but are not currently developed or otherwise connected to the wastewater collection system (i.e., areas on septic systems), as these areas will also contribute to an expansion of the service area and increased wastewater flows.

- **Areas of Stability:** The remaining land use areas within the current sewer service area (not designated as areas of change) are defined as areas of stability for the purposes of this Master Plan. Wastewater flows associated with areas of stability are assumed to remain unchanged at build out of the General Plan.

Figure 2.5 identifies the “Areas of Stability” and “Areas of Change” within the City’s General Plan Boundary.

Dickenson Ave
West Lawn Ave
Chateau Fresno Ave
Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave
Del Rey Ave
Bethel Ave
Academy Ave
Madsen Ave

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave
Central Ave
American Ave

99
41
168
180

RWRF

**Legend**

- Streets
- Areas of Change
- Existing Sewer Service Area
- Sphere of Influence
- City Limits

N

0 12,500 25,000 Feet

**Figure 2.5**
**Areas of Stability and Areas of Change**
Wastewater Collection System
Master Plan Update
City of Fresno

DPU

carollo
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Chapter 3

# FLOW MONITORING PROGRAM

This chapter defines the typical components of wastewater in a collection system as they pertain to this Wastewater Collection System Master Plan Update (Master Plan). The flow monitoring data and results from the flow monitoring program are summarized and discussed.

## 3.1 PERMANENT FLOW MONITORING SITES AND TRIBUTARY AREAS

The City of Fresno (City) has an ongoing contract with ADS Environmental Services (ADS) to perform quarterly quality control on the City's permanent flow meters. The purpose of the City's permanent flow monitoring program monitors flows at specific locations in the collection system over an extended period of time. In general, the permanent flow monitors were located to capture flows from various sewer basins within the collection system, and to capture flows from the City of Clovis and a portion of the flow discharged from California State University, Fresno (CSUF). This section defines the typical components of wastewater in a collection system, and summarizes and discusses the flow monitoring data used as part of this study.

A total of 21 open channel flow meters are currently installed in the City's wastewater collection system at strategic locations. The meter sites were selected by the City to isolate flows in specific areas and subareas in the collection system, and to capture flows from the City of Clovis and Fresno State. The 21 flow monitoring locations, as well as the area tributary to each site, are shown on Figure 3.1. Table 3.1 lists the flow monitoring locations and the diameters for the sewers where the meters were installed. Figure 3.2 provides a schematic illustration of the flow monitoring locations.

## 3.2 WASTEWATER FLOW COMPONENTS

As a way to help the reader understand the wastewater flow components, this section describes and provides definitions of commonly used terminology in the wastewater collection system analysis and evaluations conducted as part of this project. In general, wastewater consists of base wastewater flow (BWF) and wet weather flow (WWF). BWF is flow generated by routine water usage in the residential, commercial, business and industrial sectors of the collection system.

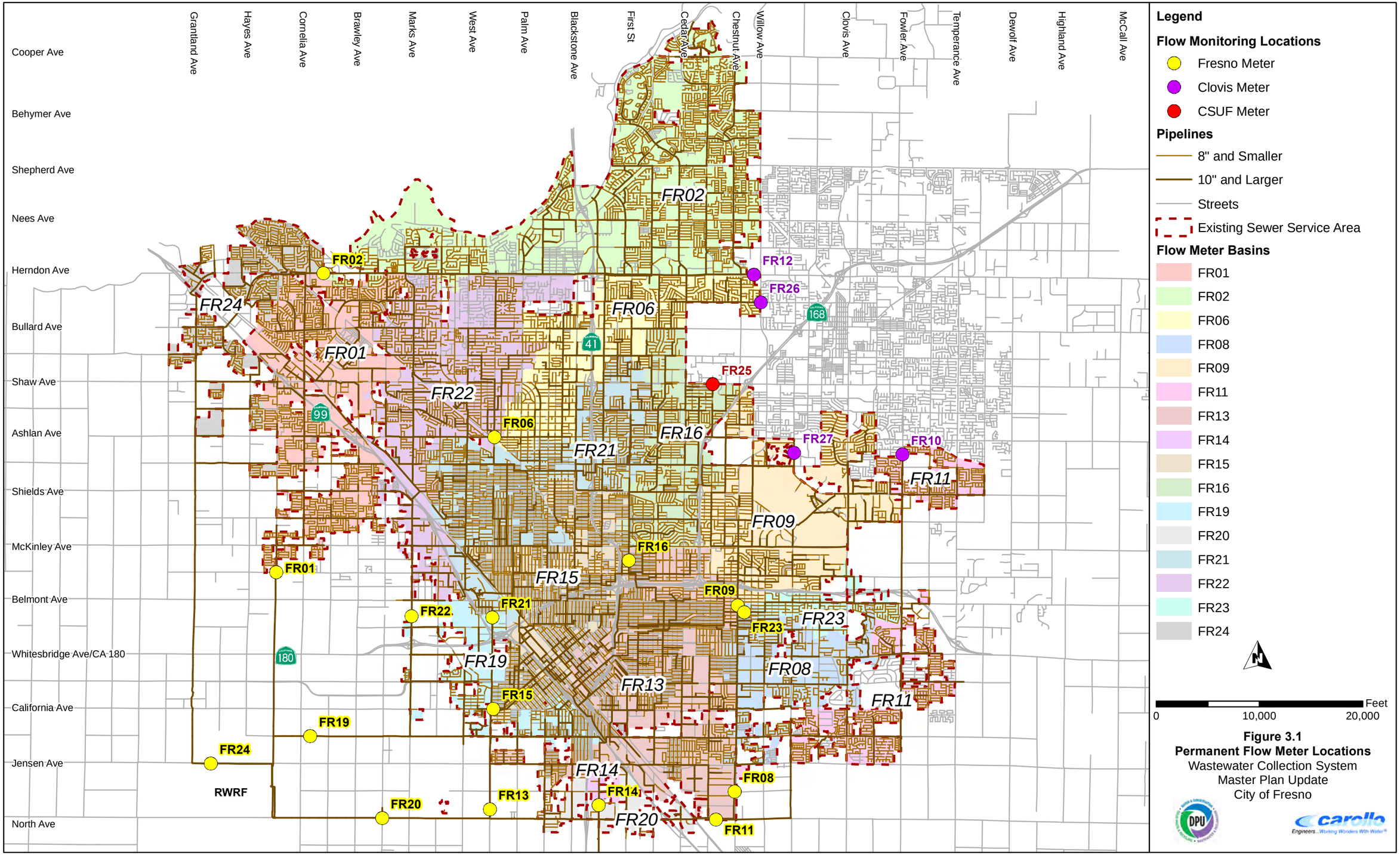
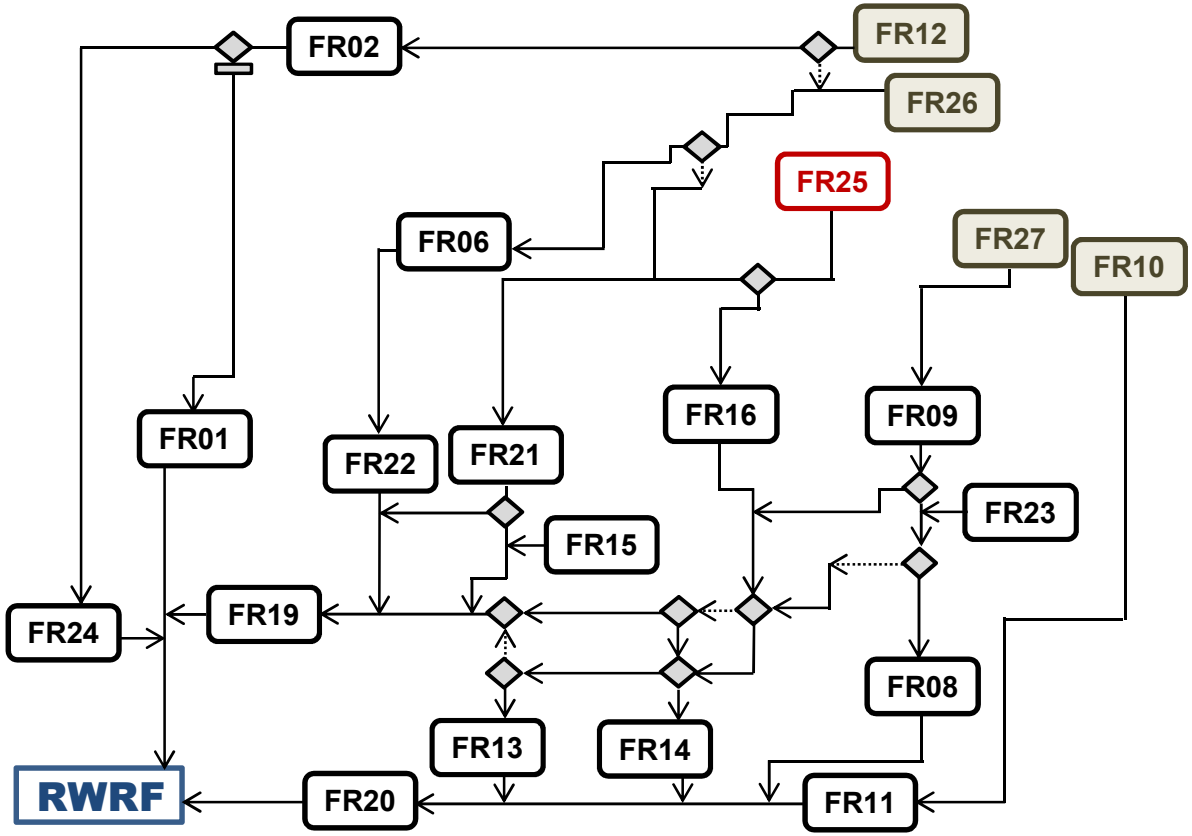



**Figure 3.1**
**Permanent Flow Meter Locations**
Wastewater Collection System
Master Plan Update
City of Fresno



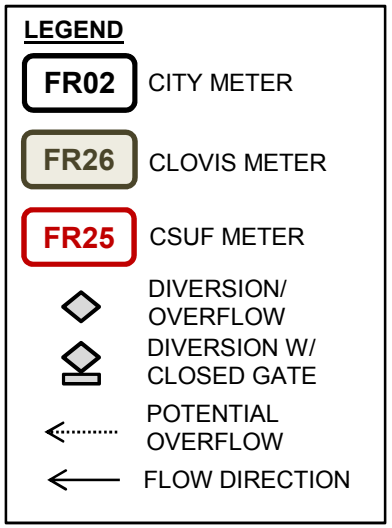




**Figure 3.2**
**Flow Monitoring Locations Schematic**
Wastewater Collection System Master Plan Update
City of Fresno

**Table 3.1 Flow Monitoring Locations**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Meter Site | Manhole ID | Pipe Diameter (in.) | Location | Notes |
|---|---|---|---|---|
| FR01 | 2345-01 | 45 | Polk Ave. & Olive Ave. | |
| FR02 | 1346-24 | 45 | Herndon Ave. & Blythe Ave. | |
| FR06 | 1953-02 | 36 | Ashlan Ave. & Fruit Ave. | |
| FR08 | 3261-05 | 48 | Chestnut Ave. & Annadale Ave. | |
| FR09 | 2561-09 | 39 | Chestnut Ave. & Madison Ave. | |
| FR10 | 1967-46 | 36 | Fowler Ave. near Sussex Way | Clovis |
| FR11 | 3361-01 | 66 | North Ave. & Maple Ave. | |
| FR12 | 1362-02 | 33 | Herndon Ave. & Willow Ave. | Clovis |
| FR13 | 3253-06 | 51 | Fruit Ave. & North Ave. | |
| FR14 | 3256-11 | 36 | Cherry Ave. & Edgar Ave. | |
| FR15 | 2853-86 | 48 | California Ave. & Fruit Ave. | |
| FR16 | 2357-34 | 30 | First St. & Floradora Ave. | |
| FR19 | 2946-02 | 66 | Church Ave. & Cornelia Ave. | |
| FR20 | 3249-01 | 66 | North Ave. & Prospect Ave. | |
| FR21 | 2552-36 | 42 | Fruit Ave. & Nielsen Ave. | |
| FR22 | 2550-07 | 45 | Marks Ave. & Nielsen Ave. | |
| FR23 | 2562-21 | 27 | Washington Ave. & Garden Ave. | |
| FR24 | 3042-07 | 72 | Jensen Ave. & Grantland Ave. | |
| FR25 | 1760-56 | 15 | Shaw Ave. & Maple Ave. | Fresno State, Maple |
| FR26 | 1362-45 | 12 | Sierra Ave. & Willow Ave. | Clovis |
| FR27 | 1963-09 | 27 | Peach Ave. & Pontiac Way | Clovis |

The other component of BWF is the contribution of dry weather groundwater infiltration (GWI) into the collection system. Dry weather GWI will enter the sewer system when the relative depth of the groundwater table is higher than the depth of the pipeline and when the susceptibility of the sanitary sewer pipe allows infiltration through defects such as cracks, misaligned joints, and broken pipelines. In the City specifically, the depth to the groundwater table is quite deep, and therefore there is little to no influence associated with dry weather GWI into the collection system.

WWF includes storm water inflow, trench infiltration, and wet weather GWI. The storm water inflow and trench infiltration comprise the WWF component termed infiltration and inflow (I/I). The response in the sewer system to rainfall is seen immediately (as with inflow) or within hours after the storm (as with infiltration).

The third element of WWF is GWI, which is not specific to a single rainfall event, but rather to the effects on the sewer system over the entire wet weather season. The depth of the groundwater table rising above the pipe invert elevation causes GWI. Sewer pipes within close proximity to a body of water can be greatly influenced by groundwater effects. As the groundwater table fluctuates over the wet weather season, this fluctuation is seen as a mounding effect in flow monitoring data. As previously mentioned, the depth to groundwater in Fresno is very deep, and so the effect of wet weather GWI is negligible. In fact, wastewater flows, on average, are lowest during the wet weather months in the City. Figure 3.3 illustrates the various flow components of wastewater in general, which are described in detail in the following sections.

### 3.2.1 Base Wastewater Flow

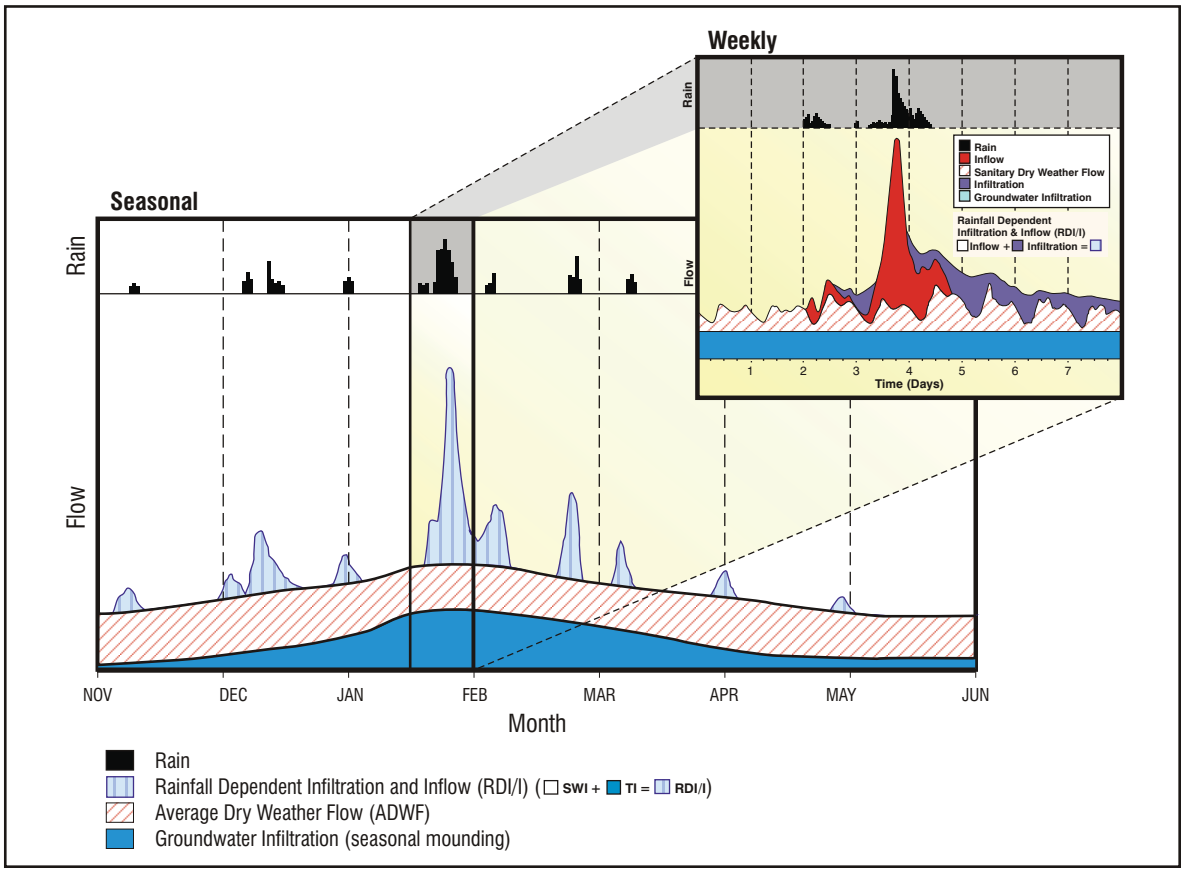
The BWF is the flow generated by the City's customers. The flow has a diurnal pattern that varies depending on the type of use. Commercial and industrial patterns, though they vary depending on the type of use, typically have more consistent higher flows during business hours and lower flows at night. Furthermore, the diurnal flow pattern experienced during a weekend may vary from the diurnal flow experienced during a weekday.

### 3.2.2 Average Annual Flow

The average annual flow (AAF) is the average flow that occurs on a daily basis throughout the year, including both periods of dry and wet weather conditions.

### 3.2.3 Average Dry Weather Flow

The Average Dry Weather Flow (ADWF) is the average flow that occurs on a daily basis during the dry weather season. The ADWF includes the BWF generated by the City's residential, commercial, and industrial users, plus the dry weather GWI component. For the City, the ADWF and the BWF are synonymous, because dry weather GWI is not a contributor to the City's collection system. Therefore, throughout the remainder of this Master Plan, the term BWF will be used in place of the term ADWF.



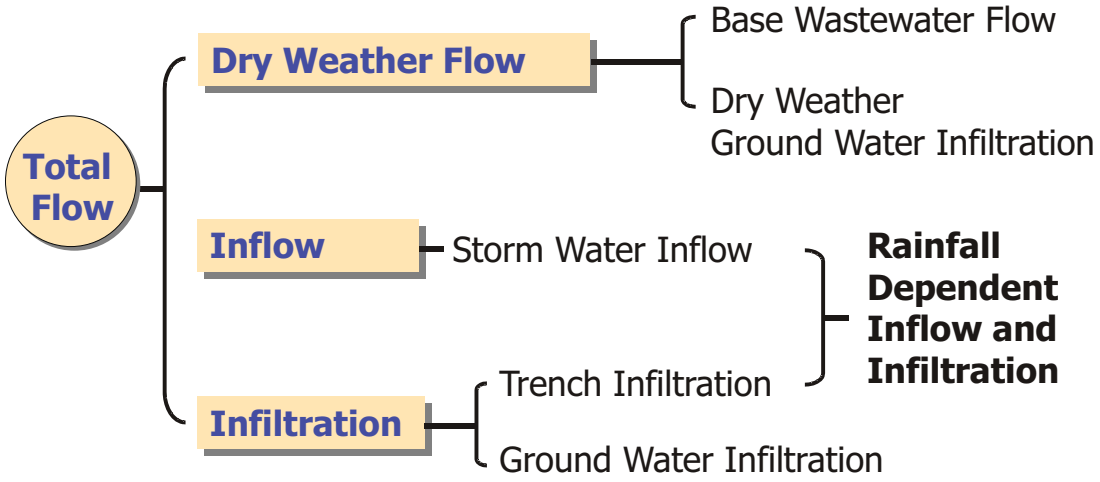




**Figure 3.3**
**Typical Wastewater Flow Components**
Wastewater Collection System Master Plan Update
City of Fresno

Note: This figure is not based on flow data specific to the City or this Master Plan

### 3.2.4 Infiltration and Inflow

All wastewater collection systems have some I/I, although the characteristics and severity vary by region and individual collection system. Some of the most common sources of I/I are shown on Figure 3.4. Infiltration is defined as storm water flows that enter the sewer system by percolating through the soil and then through defects in pipelines, manholes, and joints.

Examples of infiltration entry points are cracks in pipelines, misaligned joints, and root penetration. Inflow is defined as storm water that enters the sewer system via a storm drain cross connections, leaky manhole covers, or cleanouts. Examples of inflow entry points are roof drain and downspout connections, leaky manhole covers, and illegal storm drain connections.

The adverse effects of I/I entering the sewer system is that it increases both the flow volume and peak flows, as illustrated on Figure 3.5. If too much I/I enters the sewer system such that the sewer system is operating at or above its capacity, sanitary sewer overflows (SSOs) could occur. The City's wastewater collection system exhibits relatively low I/I contribution as a whole, although there are certain areas with relatively high rates of I/I.

### 3.2.5 Peak Dry Weather Flow

Peak dry weather flow (PDWF) is the highest observed hourly flow in the collection system during the dry weather season. In the case of the City, industrial flows increase significantly during the late summer months. The highest monthly flow rates at the RWRF are typically experienced in the months of August, September, and October. PDWF is used to evaluate the capacity of the collection system.

### 3.2.6 Peak Wet Weather Flow (Design Flow)

Peak wet weather flow (PWWF) is the highest observed flow that occurs following a design storm event. Wet weather I/I cause flows in the collection system to increase. PWWF is typically used for designing sewers and lift stations. Therefore, the PWWF and the "Design Flow" are synonymous and will be used interchangeably. As with PDWF, PWWF is also used to evaluate the capacity of the collection system.

## 3.3 FLOW MONITORING DATA SUMMARY

This section summarizes the data obtained and analyzed from the City's permanent flow monitoring program, including BWF data and wet weather flow data. Data collected from Meter FR06 is presented throughout this and other chapters as an example of the type of data collected from the flow monitoring program. Refer to Appendix B and Appendix C for additional data summaries and other information associated with the remaining meter sites.

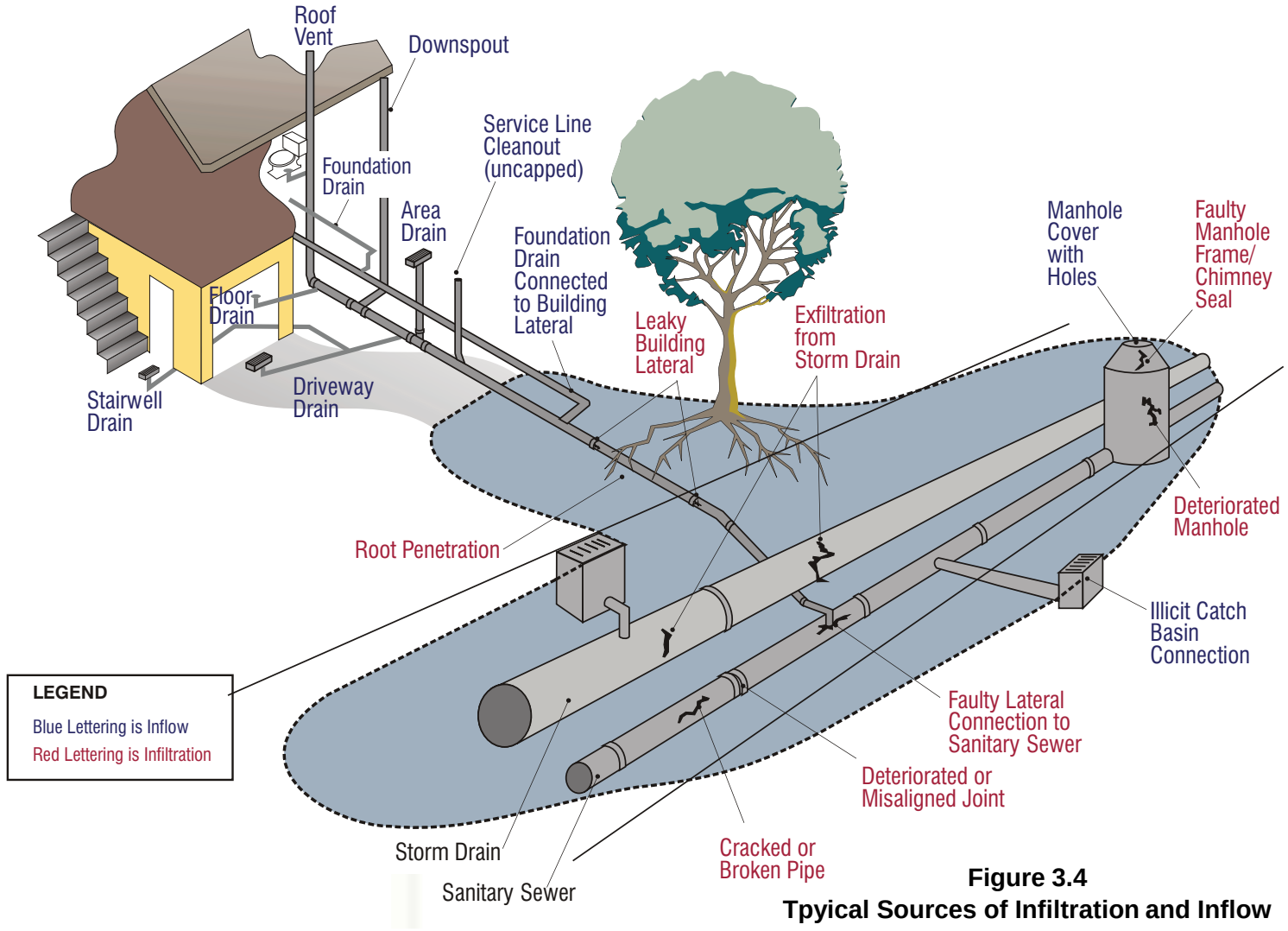



**Figure 3.4**
**Tpyical Sources of Infiltration and Inflow**
Wastewater Collection System Master Plan Update
City of Fresno

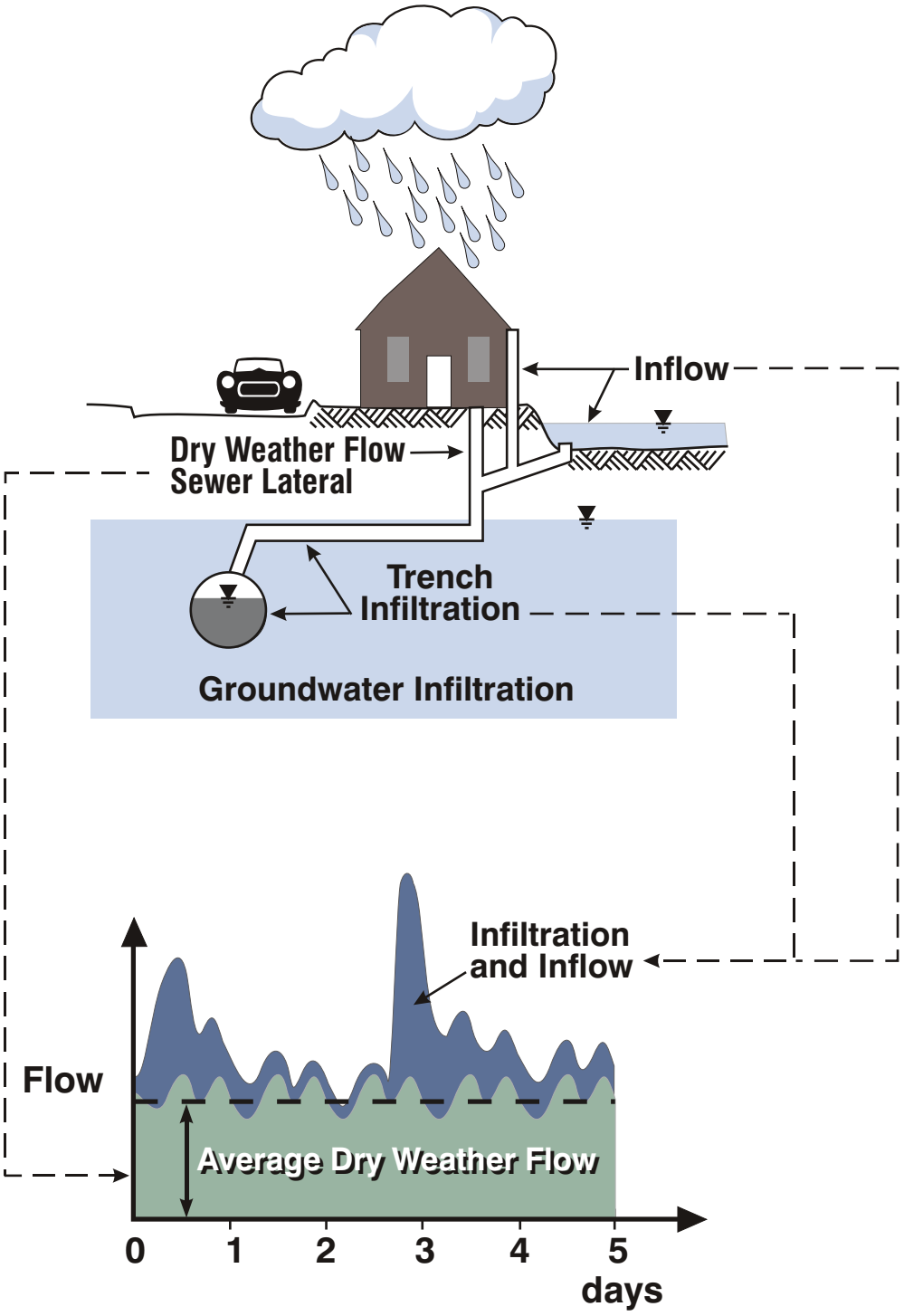



**Figure 3.5**
**Typical Effects of Infiltration and Inflow**
Wastewater Collection System Master Plan Update
City of Fresno

### 3.3.1 Base Wastewater Flow Data

The City's permanent flow meters collect depth and velocity data at 5-minute intervals. Characteristic dry weather 24 hour diurnal flow patterns for each site were developed for each meter based on data available during base flow periods (i.e., in the winter when there is no rainfall). This hourly flow data was then used to calibrate the hydraulic model for the observed dry weather flows during the flow monitoring period.

For Fresno, it was determined, based on a review of the available flow monitoring data and the monthly flows at the RWRF, that the month of January 2013 was the most appropriate time period to select for the determination of BWF at each flow meter. At a few sites, flow monitoring data were not available in January 2013. In these cases, January 2012 was used.

Hourly patterns for weekday and weekend flows vary and are separated to better understand dry weather flow. Carollo used the data from days in January 2013 that were least affected by rainfall to estimate the weekday and weekend dry weather flows. In addition, Carollo prepared estimates for the average weekday and weekend levels and velocities at each site, which are used in BWF calibration. Figure 3.6 illustrates a typical variation of weekday and weekend flow in the City, which is based on the data collection from Meter FR06. Similar graphics associated with the remaining sites are included in Appendix B. Table 3.2 summarizes the BWF at each meter.

### 3.3.2 Industrial Flow Data

The City has several large significant industrial users (SIUs). Some users have dedicated flow meters, and flow records were available on a monthly basis. For other SIUs, the City provided average flow estimates. A summary of the average flows associated with each SIU is provided in Appendix D.

### 3.3.3 Rainfall Data

Available rainfall data for the Fresno area were reviewed to identify significant rainfall events that have occurred in recent years. Based on a review of this data, as well as the available flow monitoring data, it was determined that the most significant rainfall events that have occurred in recent years occurred from March 20-21, 2011, and April 11-13, 2012.

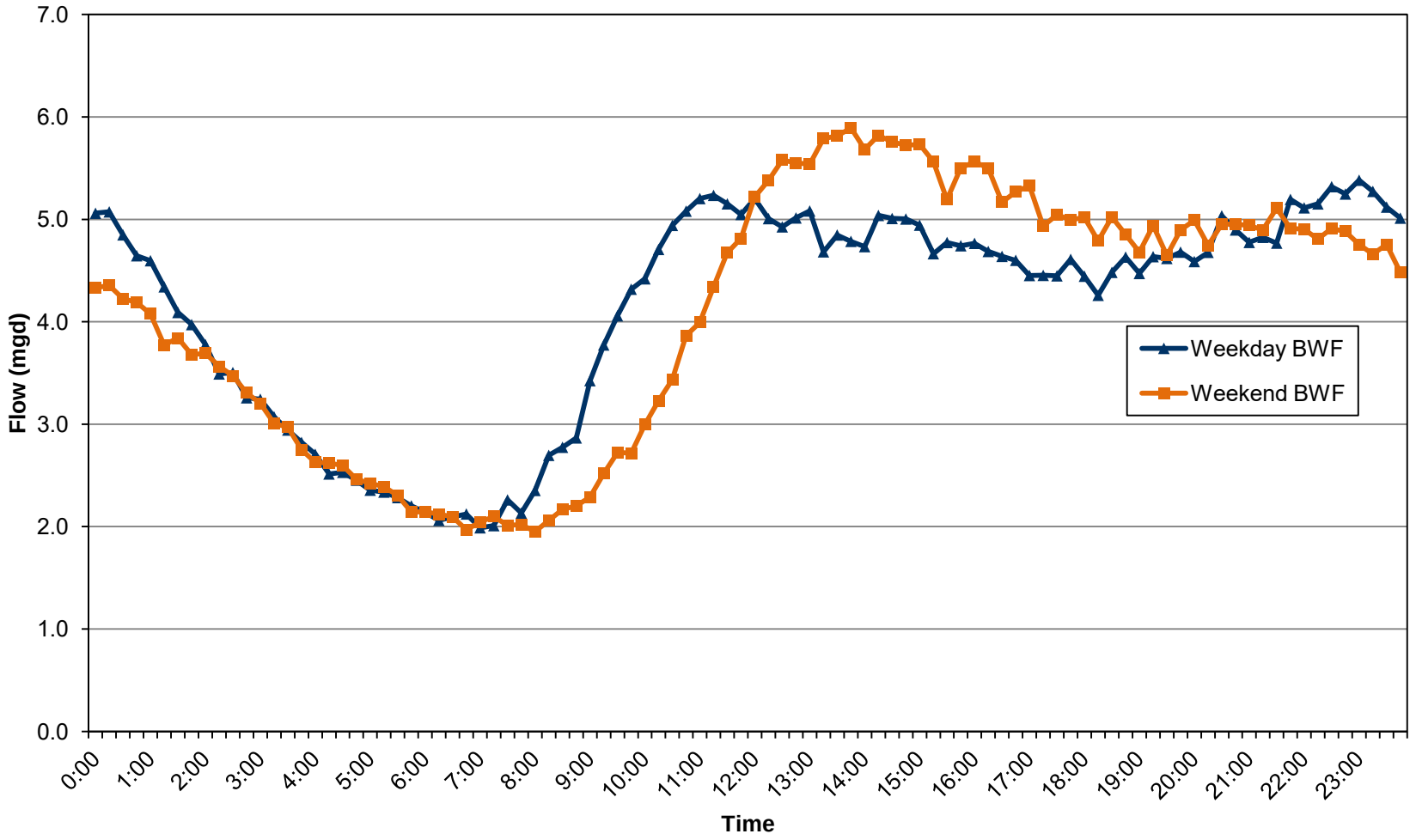



**Figure 3.6**

**Example Weekday vs. Weekend Flow Variation (Meter FR06)**

Wastewater Collection System Master Plan Update

**Table 3.2 Base Wastewater Flow Summary**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Meter Site | Weekday BWF (mgd) | Weekend BWF (mgd) | Overall BWF (mgd) | Weekend/ Weekday Ratio |
|---|---|---|---|---|
| FR01 | 3.70 | 3.70 | 3.76 | 1.05 |
| FR02 | 8.05 | 7.73 | 8.07 | 1.01 |
| FR06 | 4.13 | 4.13 | 4.12 | 0.99 |
| FR08 | 7.66 | 7.67 | 7.51 | 0.93 |
| FR09 | 5.03 | 4.86 | 4.92 | 0.93 |
| FR10 | 1.49 | 1.46 | 1.49 | 1.00 |
| FR11 | 3.58 | 3.61 | 3.55 | 0.97 |
| FR12 | 1.58 | 1.58 | 1.58 | 1.01 |
| FR13 | 8.53 | 8.33 | 8.36 | 0.93 |
| FR14 | 4.06 | 4.02 | 4.05 | 0.99 |
| FR15 | 6.19 | 6.07 | 6.12 | 0.96 |
| FR16 | 3.72 | 3.70 | 3.72 | 1.00 |
| FR19 | 23.15 | 23.07 | 22.51 | 0.90 |
| FR20 | 29.85 | 26.96 | 28.94 | 0.89 |
| FR21 | 4.40 | 4.45 | 4.42 | 1.01 |
| FR22 | 7.46 | 7.47 | 7.51 | 1.02 |
| FR23 | 1.25 | 1.26 | 1.11 | 0.61 |
| FR24 | 8.12 | 8.99 | 8.15 | 1.01 |
| FR25 | 0.08 | 0.08 | 0.08 | 0.96 |
| FR26 | 0.19 | 0.19 | 0.19 | 1.03 |
| FR27 | 1.90 | 1.90 | 1.91 | 1.02 |

### 3.3.4 Wet Weather Flow Data

The flow monitoring data was also evaluated to determine how the collection system responds to wet weather events. As mentioned above, the most significant rainfall events in recent years occurred in March 2011 and April 2012. There was limited flow monitoring data available for March 2011, but most of the City's flow meters had valid data for the April 2012. For this reason, the April 2012 storm was used for model calibration, and the March 2011 storm was used to validate the I/I parameters developed as part of the April 2012 WWF calibration.

Figure 3.7 shows an example of the wet weather response at Meter FR06 during the April 2012 storm. Figure 3.7 illustrates the volume of I/I that entered the system from the collection system upstream of Site FR06. The light blue area is the base sanitary flow while the gray area is the measured flow from the flow monitoring period. As can be seen in the figure, discernible amounts of I/I do enter the system during wet weather events.

The metric typically used to quantify the severity of the system's I/I is the R-value. The R-value is defined as the percentage of rainfall volume that makes it into the collection system as I/I. Table 3.3 summarizes the calibrated R-values for each flow monitoring basin. As shown in Table 3.3, the R-Values vary from 0.2-percent in basin FR02 to 1.45 percent in Basin 20. In general, an R-Value of 5 percent or more is usually considered indicative of a significant I/I response. It should be noted that Basin 23 exhibited an R-Value in excess of 5 percent. Based on a review of available data, it appears that the majority of I/I contributions in this basin are associated with the Gallo property (see Section 1.5.4 for more information).

The R-Value for each basin is determined by isolating I/I associated with individual flow monitoring basins (i.e., excluding flow rates from upstream flow monitors) and calculating the ratio of the volume of water that enters the system as I/I versus the volume of rainfall that fell over the flow monitoring basin tributary area.

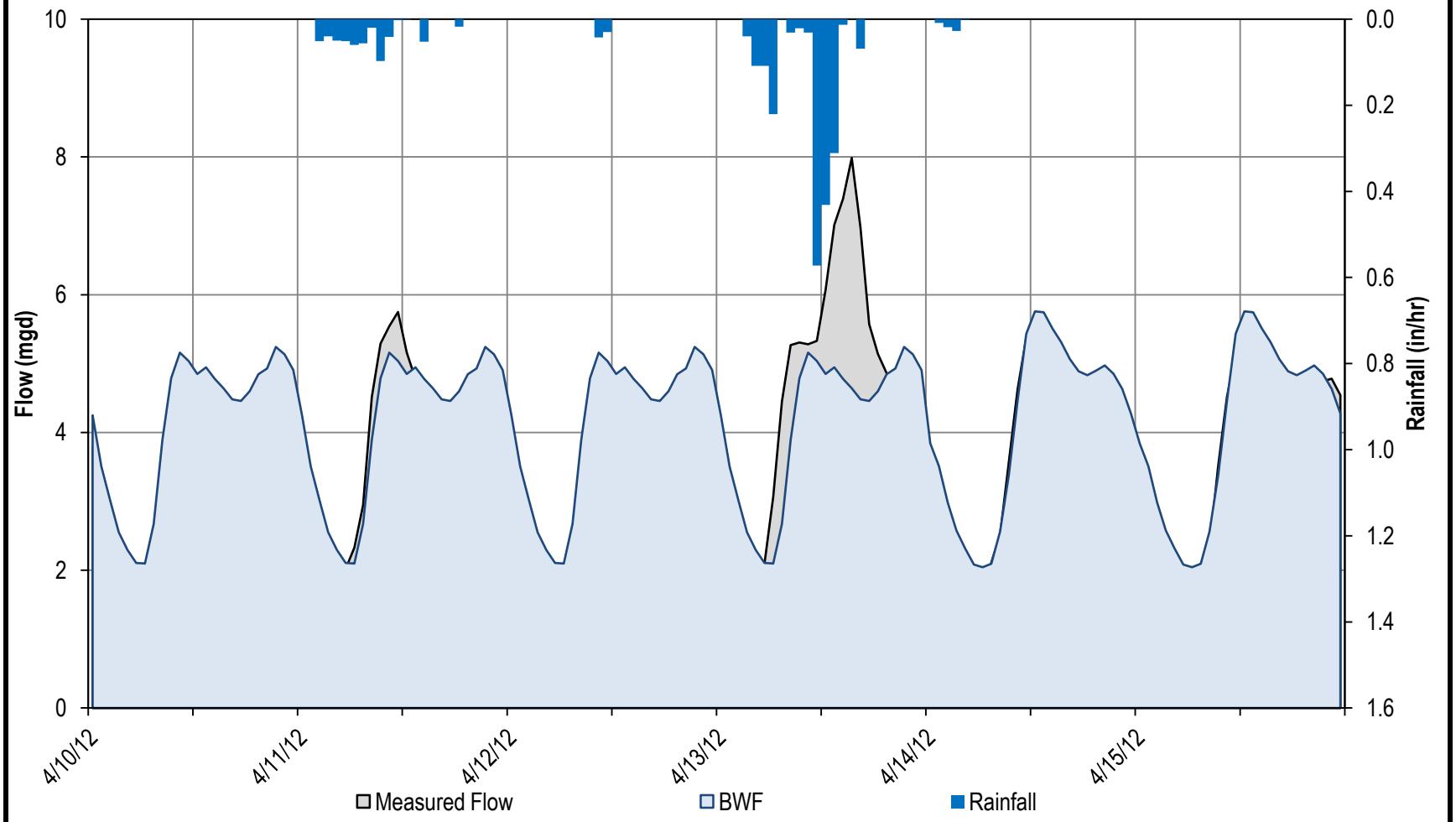



**Figure 3.7**

**Example WWF Response (Meter FR06)**

Wastewater Collection System Master Plan Update

City of Fresno

**Table 3.3 R-Value Summary**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Meter Basin | R-Value (%) |
|---|---|
| FR01 | 0.40 |
| FR02 | 0.20 |
| FR06 | 0.41 |
| FR08 | 1.30 |
| FR09 | 1.20 |
| FR10 | Note(1) |
| FR11 | 1.00 |
| FR12 | Note(1) |
| FR13 | 1.30 |
| FR14 | 1.30 |
| FR15 | 1.20 |
| FR16 | 0.88 |
| FR19 | 0.25 |
| FR20 | 1.45 |
| FR21 | 0.80 |
| FR22 | 0.65 |
| FR23(1) | 0.75 |
| Gallo Property, Basin 23 | 75 |
| FR24 | 0.80 |
| FR25 | 0.75 |
| FR26 | Note(1) |
| FR27 | Note(1) |

Notes:

(1) Tributary areas associated with the City of Clovis are not known. Therefore, R-values are not presented in this document.

(2) R-value presented excludes the Gallo Property, which is estimated to have an R-value of roughly 75 percent.

# COLLECTION SYSTEM FACILITIES AND HYDRAULIC MODEL

This Chapter describes the update and calibration of the City of Fresno's (City's) collection system hydraulic model. A description of the City's wastewater collection system, the existing hydraulic model, and an outline of the steps used to update the model are provided. A detailed summary of the hydraulic model calibration steps, standards, and results for both base wastewater flow (BWF) and wet weather flow (WWF) conditions is also provided.

## 4.1 COLLECTION SYSTEM FACILITIES

The City's collection system consists of gravity sewers, lift stations, associated force mains, and several special structures/flow diversions that collect and convey wastewater to the Fresno/Clovis Regional Wastewater Reclamation Facility (RWRF), which is located on Jenson Avenue just west of Cornelia Avenue. In addition, the City operates the North Fresno Wastewater Reclamation Facilities (NFWRF) satellite plant, which serves the Copper River Ranch development, and provides recycled water via irrigation to the Copper River Country Club golf course.

Figure 4.1 presents the City's collection system, and the current wastewater service area. The collection system conveys wastewater primarily by gravity flow, generally from the northeast to the southwest, and ultimately to the RWRF. In addition to customers within City limits, the RWRF also serves a majority of flow generated within the City of Clovis, as well as unincorporated County islands within the City. The City of Clovis has four connections to the City collection system. The maximum discharge at each connection is defined by the Fresno-Clovis Regional Sewerage System Joint Powers Agreement (JPA), dated March 3, 1977.

The City's wastewater collection system has roughly 23,000 manholes, 15 lift stations, 1.7 miles of force mains, and 1,500 miles of gravity sewer pipes (excluding abandoned/out of service and private facilities).

### 4.1.1 Gravity Collection System

The City's existing sanitary sewer collection system is comprised of over 1,500 miles of gravity collection system pipe up to 84-inches in diameter, and over 23,000 manholes. Table 4.1 presents a summary by diameter of the known sewers in the collection system. This table excludes abandoned and private sewers, as well as sewers associated with the City of Clovis collection system.

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave

Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave

NFWRF
RWRF
LS01
LS02
LS03
LS04
LS05
LS06
LS10
LS12
LS13
LS14
LS15
LS16
LS18
LS20
1346-25
1961-01
2058-06
2253-15
2561-21
2652-03
2858-101
2952-49
2957-22
3057-07
3153-01
3056-03

99
180
41
168

## Legend

**Existing Wastewater Collection System**

- Lift Stations
- Special Structures

**Pipelines**

- 8" and Smaller
- 10" - 18"
- 20" - 36"
- Greater than 36"
- Streets
- Existing Sewer Service Area
- City Limits

Feet
0 10,000 20,000

**Figure 4.1**
**Existing Wastewater Collection System**
Wastewater Collection System
Master Plan Update
City of Fresno

DPU
carollo
Engineers...Working Wonders With Water®

As shown in Table 4.1, approximately 72-percent of the system is 8-inches in diameter and smaller, with the majority (46.6-percent) being 8-inches in diameter.

**Table 4.1 Collection System Gravity Pipeline Summary**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Diameter (inches) | Length[(1),(2)] (miles) | Percent of System (by length) | Diameter (inches) | Length[(1),(2)] (miles) | Percent of System (by length) |
|---|---|---|---|---|---|
| 4 | 0.02 | 0.0 | 33 | 5.1 | 0.3 |
| 6 | 386.7 | 25.7 | 36 | 9.4 | 0.6 |
| 8 | 702.1 | 46.6 | 39 | 8.2 | 0.5 |
| 10 | 104.2 | 6.9 | 40 | 0.7 | 0.0 |
| 12 | 71.1 | 4.7 | 42 | 7.3 | 0.5 |
| 14 | 2.3 | 0.2 | 45 | 13.7 | 0.9 |
| 15 | 41.9 | 2.8 | 46 | 0.0 | 0.0 |
| 16 | 2.8 | 0.2 | 48 | 10.2 | 0.7 |
| 18 | 39.5 | 2.6 | 51 | 3.5 | 0.2 |
| 20 | 2.6 | 0.2 | 54 | 2.9 | 0.2 |
| 21 | 16.0 | 1.1 | 57 | 1.1 | 0.1 |
| 22 | 1.1 | 0.1 | 60 | 9.1 | 0.6 |
| 24 | 21.0 | 1.4 | 66 | 11.2 | 0.7 |
| 27 | 11.0 | 0.7 | 72 | 6.6 | 0.4 |
| 30 | 13.5 | 0.9 | 84 | 1.4 | 0.1 |
| | | | **Total (miles)** | **1,506** | **100** |

Notes:
(1) Source: City of Fresno GIS database
(2) Totals exclude abandoned and private facilities

Table 4.2 summarizes the gravity collection system by pipe material. As shown in Table 4.2, the majority of the collection system (56-percent) consists of vitrified clay pipe (VCP), and roughly one-third of the collection system (30.8-percent) consists of polyvinyl chloride (PVC) pipe.

**Table 4.2 Collection System Gravity Pipeline Material Summary**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Material | Abbreviation | Length[(1),(2)] (miles) | Percent of System (by length) |
|---|---|---|---|
| Asbestos Cement Pipe | ACP | 6.2 | 0.4 |
| Armco Plastic Truss | APT | 5.7 | 0.4 |
| Closed Profile PVC | CCP | 1.1 | 0.1 |
| Cast Iron Pipe | CIP | 6.3 | 0.4 |
| Ductile Iron Pipe | DIP | 4.6 | 0.3 |
| Fiberglass Reinforced Plastic | FRP | 0.01 | 0.0 |
| Polyvinyl Chloride Pipe | PVC | 464.5 | 30.8 |
| Reinforced Concrete Lined Pipe | RCL | 20.2 | 1.3 |
| Reinforced Concrete Pipe | RCP | 95.0 | 6.3 |
| Standard Concrete Pipe | SCP | 56.0 | 3.7 |
| Truss Pipe | TRS | 0.2 | 0.0 |
| Vitrified Clay Pipe | VCP | 846.2 | 56.2 |
| **Total** | **--** | **1,506.2** | **100.0** |

Notes:
(1) Source: City of Fresno GIS database
(2) Totals exclude abandoned and private facilities
(3) Approximately 68.9 miles of pipe have been rehabilitated using a CIPP liner, or 4.6 percent of the system.

Table 4.3 summarizes the gravity collection system by installation year. As shown on Table 4.3, approximately 16-percent of the collection system was originally installed before 1950. Roughly 48-percent of the system was installed between 1950 and 1980 (26-percent of the system was installed in the 1970's), and the remaining 36-percent of the system was installed since 1980.

**Table 4.3 Collection System Gravity Pipeline Installation Year Summary**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Years | Length[(1),(2)] (miles) | Percent of System (by length) |
|---|---|---|
| Unknown | 0.1 | 0.0 |
| Pre 1900 | 8.8 | 0.6 |
| 1900-1910 | 7.4 | 0.5 |
| 1911-1920 | 55.9 | 3.7 |
| 1921-1930 | 29.0 | 1.9 |
| 1931-1940 | 25.8 | 1.7 |
| 1941-1950 | 106.5 | 7.1 |
| 1951-1960 | 163.1 | 10.8 |
| 1961-1970 | 179.6 | 11.9 |
| 1971-1980 | 385.7 | 25.6 |
| 1981-1990 | 153.0 | 10.2 |
| 1991-2000 | 196.7 | 13.1 |
| 2001-2010 | 185.2 | 12.3 |
| 2011-2013 | 9.4 | 0.6 |
| **Total** | **1,506.2** | **100.0** |

Notes:
(1) Source: City of Fresno GIS database
(2) Totals exclude abandoned and private facilities

### 4.1.2 Lift Stations

The City operates and maintains 15 active wastewater lift stations throughout the City (excluding private and abandoned lift stations). Figure 4.1 shows the location of each lift station. Table 4.4 summarizes the available design data for each f the City's active lift stations.

### 4.1.3 Special Structures/Field Reconnaissance

The City's collection system includes several important flow diversions, which split average and peak wastewater flows between sewer basins. The City's previous Collection System Master Plan provided a description of many of the flow diversions. In most cases, these descriptions were deemed sufficient for the purposes of this Master Plan. Supplemental field reconnaissance was also performed by Blair, Church, and Flynn (BC&F) and City staff at seven sites selected by Carollo (Figure 4.2). The sites selected for field reconnaissance

were determined to be complex or otherwise important enough to warrant further investigation. As part of the field reconnaissance, BC&F provided rim elevations, invert elevations, rough estimates for flow splits between outlet pipes, general observations, and photographs for each site (with the exception of the Dakota and Millbrook Structure, which was visually inspected by Carollo Engineers (Carollo)/City staff only).

**Table 4.4 Wastewater Lift Station Summary**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Name | Location | No. of Pumps | Capacity (per pump) | | Firm Capacity (mgd) |
|---|---|---|---|---|---|
| | | | (gpm) | (mgd) | |
| LS01 | Jensen and Walnut Avenues | 2 | 750 | 1.080 | 1.080 |
| LS02 | Marks Avenue and Kearney Boulevard | 2 | 450 | 0.648 | 0.648 |
| LS03 | Wilson Avenue north of Shields Avenue | 2 | 250 | 0.360 | 0.360 |
| LS04 | Riverview Drive and Del Mar Avenue | 2 | 186 | 0.272 | 0.272 |
| LS05 | Fort Washington Road and Champlain Drive | 2 | 515 | 0.742 | 0.742 |
| LS06 | Champlain Drive and Perrin Avenue | 2 | 1545 | 2.220 | 2.220 |
| LS10 | Stratford Drive and Woodlawn Drive | 2 | 260 | 0.374 | 0.374 |
| LS12 | Bullard and Carnegie Avenues | 2 | 200 | 0.288 | 0.288 |
| LS13 | Jackson and University Avenues | 2 | 190 | 0.272 | 0.272 |
| LS14 | Alluvial and Carnegie Avenues | 2 | 400 | 0.576 | 0.576 |
| LS15 | Hayston Avenue and Fountain Way | 2 | 400 | 0.576 | 0.576 |
| LS16 | Santa Fe and Bluff Avenues | 2 | 175 | 0.252 | 0.252 |
| LS18 | Hughes and Nielson Avenues | 2 | 670 | 0.959 | 0.959 |
| LS20 | Cherry Avenue south of North Avenue | 2 | 670 | 0.959 | 0.959 |
| NFWRF | North Fresno WRF | 2 | 440 | 0.639 | 0.639 |

Notes:
(1) Source: Data provided by City Staff.

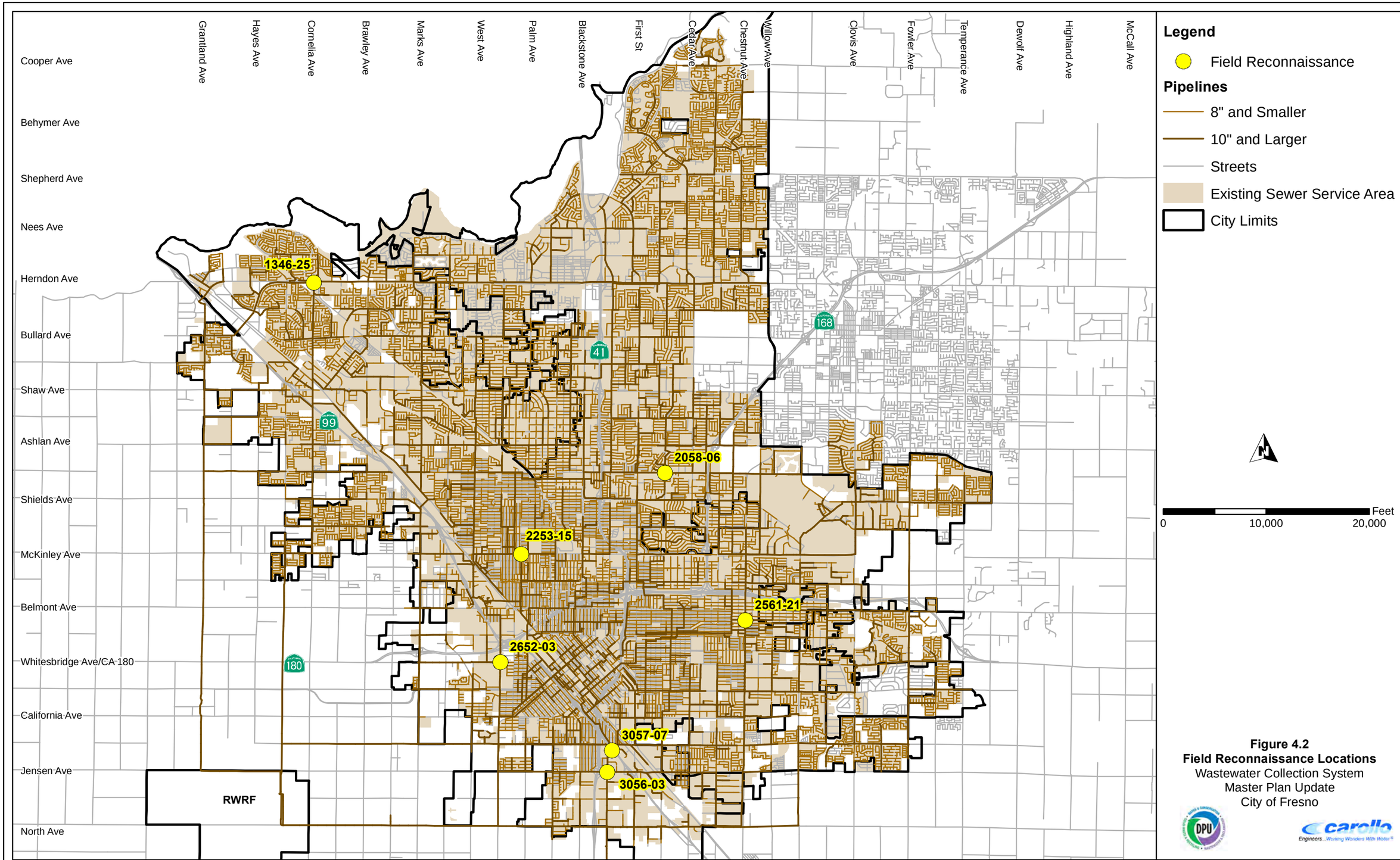



**Figure 4.2**
**Field Reconnaissance Locations**
Wastewater Collection System
Master Plan Update
City of Fresno

Table 4.5 provides a summary of the major diversions within the collection system, and identifies which of the structures were investigated as part of this Master Plan Update. Appendix E provides detailed survey data, sketches, and photographs from the site reconnaissance performed by BC&F.

During the base wastewater flow calibration process (see Section 3.4), it was discovered that there was a flow discrepancy in the model for Flow Meters FM16 and FM21. Further investigation revealed that the most likely source of the flow discrepancy was the junction structure located at the intersection of Dakota Avenue and Millbrook Avenue. For this reason, Carollo and City staff performed a site visit at one additional manhole to supplement the field reconnaissance activities performed by BC&F, as described below:

- **MH 2058-06, Dakota and Millbrook:** During the base wastewater flow calibration process (see Section 4.3.3), it was discovered that there was a flow discrepancy in the model for Flow Meters FM16 and FM21. Further investigation revealed that the most likely source of the flow discrepancy was the junction structure located at the intersection of Dakota Avenue and Millbrook Avenue. The previous Collection System Master Plan indicated that flows into this structure are split roughly 50/50 between a 21-inch diameter sewer that flows south into Basin 16 and a 21-inch sewer that flows west into Basin 21. However, Carollo determined that during base flow conditions, the majority of flow in this structure is routed to the 21-inch pipeline flowing south to Meter FM16. In order to confirm this, Carollo arranged with City staff to perform an additional site investigation of this structure. At the site investigation, it was discovered that a concrete wall has been installed on the 21-inch pipeline flowing to the west, approximately to the halfway depth of the pipe. Therefore, at this structure, low flows are conveyed south. Once flows reach a flow depth to pipe diameter ratio (d/D) of roughly 0.5, flows are split between both pipelines. At the time of the site visit (about 9:30 AM), it was estimated that approximately 10 to 20-percent of the flow into the structure was observed to be diverted west into Basin 21. The majority of the remaining flow continued south to Meter FM16, which was consistent with the flow monitoring data.

  A custom flow inflow/outflow diversion curve of this structure was developed using $H_2$OMAP SWMM and input into $H_2$OMAP Sewer. Because $H_2$OMAP SWMM features a more accurate routing engine than $H_2$OMAP Sewer, it was determined that a curve generated from $H_2$OMAP SWMM would be the most appropriate method of simulating this structure. Figure 4.3 shows the custom diversion curve that was developed for this structure. Furthermore, the pipelines downstream of this structure are known capacity issues, and therefore it is critical to simulate the flow splits at this location as accurately as possible.

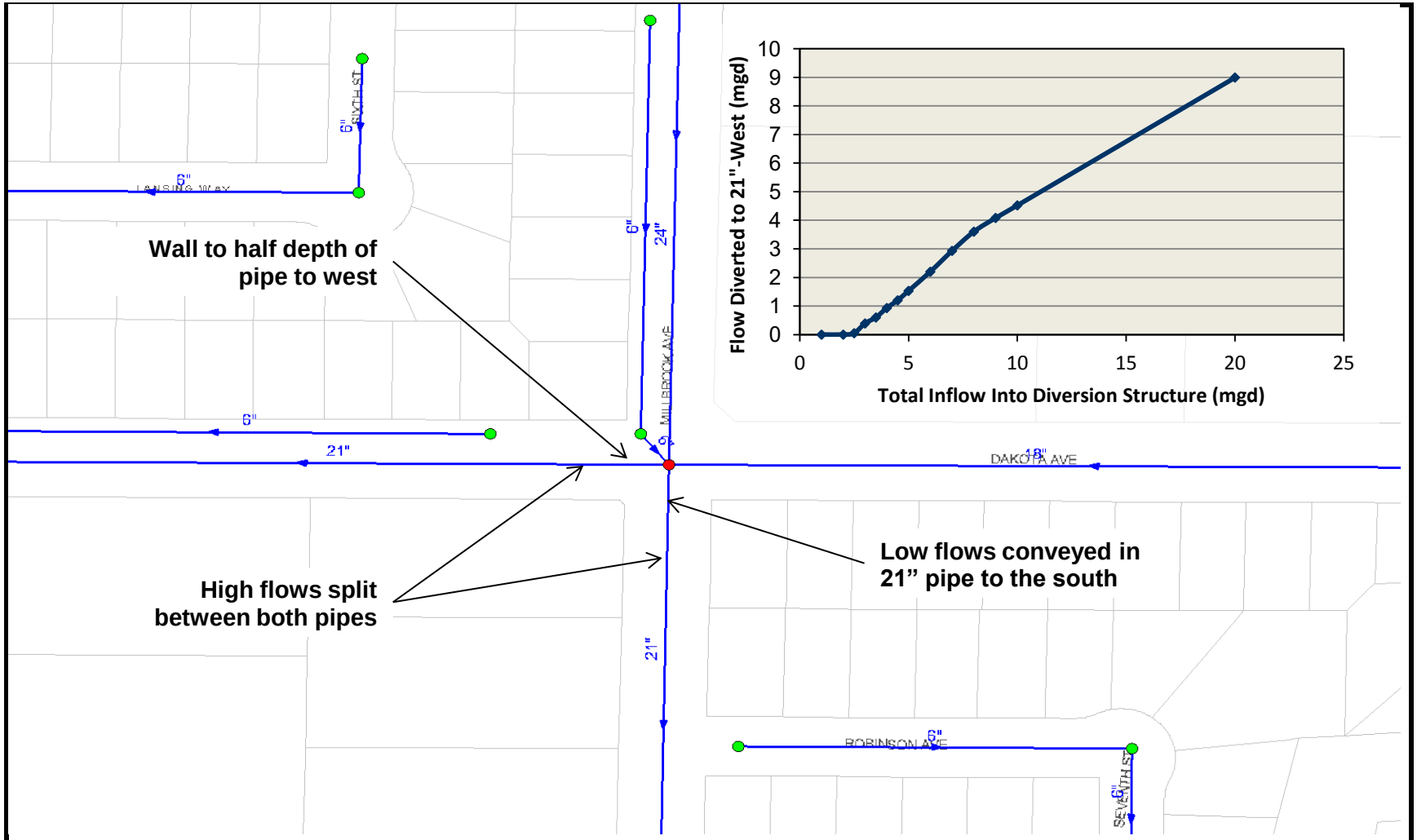



**Figure 4.3**
**Dakota/Millbrook Diversion Curve**
Wastewater Collection System Master Plan Update
City of Fresno

**Table 4.5 Special Structures**
**Wastewater Collection System Master Plan**
**City of Fresno**

| Manhole ID | Location | Model ID | Structure Type | Flow Description | Reconn. Performed |
|---|---|---|---|---|---|
| 2858-101 | California Ave. and East Ave. | 37421 | This structure consists of a 60-inch standard manhole design with frame and cover, and channelized base. | Under average day conditions, all flow diverts east to the 30-inch pipe with an upstream invert elevation of 275.7 feet However, once the hydraulic grade line reaches 276.5 feet flow will split south to the 21-inch pipe. | |
| 2952-49 | Church Ave. and Fruit Ave. | 39583 | This structure is a cast-in-place, reinforced concrete structure with a channelized bottom, and the manhole risers are made of brick with cast iron covers. | Flow enters the structure from the east via two new 30-inch pipes. Currently, flow also enters from a 48-inch pipe from the south. Flow exits the structure through an existing 48-inch pipe to the west. The structure had options for installing 2"x12"x4'-4" redwood board gates on the 48- inch pipe exiting the structure; however, due to a blow-out in 2002 flow is no longer prohibited from exiting the structure and continuing westerly in Church Avenue. The structure was repaired in 2003, but the gate was not reinstated. A new gate will need to be constructed such that the flow can be diverted to the south in the 48-inch Fruit Avenue pipeline to North Avenue as originally conceived. | |
| 3153-01 | Jenson Ave. and Fruit Ave. | 40580 | This structure was constructed with reinforced, cast-in-place concrete. The structure has one 24"x 60" access manhole. | Currently, wastewater entering the structure from the north and east flows south in Fruit Avenue. The north and east are 48-inch pipelines and south is a 51-inch pipeline. There are channels provided to install a gate in this junction structure to block flow from going south to North Avenue, thus forcing flows north to West Church Avenue; however, gates are not currently installed. Therefore, no gates were modeled. | |
| 3153-09 | Jenson Ave. and Fruit Ave. | | The structure has a standard manhole design with frame and cover for access. | Flow enters the structure from the easterly 48-inch pipeline and currently is diverted south to a 51-inch pipeline in South Fruit Avenue. Having since been plugged and abandoned, this structure was originally constructed with a 48-inch pipeline and radius bend to the north directing flow from West Jensen Avenue north in South Fruit Avenue to West Church Avenue. A 48-inch pipeline was also constructed with a radius bend to the south that allows flow from East Jensen Avenue to travel south in South Fruit Avenue when the gate described above for the structure at manhole 3153-01 is not in place. As mentioned above, this gate is currently not installed and flow is directed south in South Fruit Avenue to West North Avenue. | |
| 3506-03 | Jenson Ave. and Cherry Ave. | 39753 | This structure was constructed with reinforced, cast-inplace concrete. The structure has two 24"x 50" access manholes. | Flow entering the structure from the north and east is split to the south and west, respectively. The north and south pipelines are 48-inch pipes and the pipelines in the east and west directions are both 36-inch pipes. An existing manhole is located just outside the junction on the east and the 48-inch pipe passes through this manhole before entering the junction structure. There are notches provided to install gates in this junction structure for the east 48-inch pipe and the south 36-inch pipe; however, gates are not installed. Under average day conditions, approximately two-thirds of the wastewater flows west and the remaining one-third flows south. | X |
| 3057-07 | Highway 99 and South of Church Ave. | 39851 | This structure was constructed with reinforced, cast-in-place concrete. The structure has two 24"x 50" access manholes. | Flow enters the junction structure through a 6'x 3' single box sewer from the east. Currently, flow exits the structure to northwest and west by a 34" x 54" elliptical sewer and a 36-inch pipe, respectively. Under average day conditions, flow splits approximately in half between the two exiting pipes. There are notches provided to install gates in this junction structure for the northwest elliptical pipe and the west 36-inch pipe. However, gates are not currently in place. | X |
| 2652-03 | Whitesbridge Rd. at Fruit Ave. | 33197 | This structure was constructed with reinforced, cast-in-place concrete. | Flow enters the structure through a 42-inch pipe from the north and is split approximately in half between to the south and southwest into a 42-inch pipe and a 33-inch pipe respectively. | X |
| 2957-22 | Taylor Ave. and Church Ave. | 39841 | The structure was constructed with reinforced, cast-in-place concrete. | Flow enters the structure from the east via existing 27-inch and 30-inch pipes. Currently, flow exits the structure to the west through a 34" x 53" elliptical sewer pipe. The elliptical sewer pipe curves at a radius of 30 feet to the south into an existing manhole where a 6-inch pipe from the northwest connects. Flow is not split at this structure; the elliptical pipe and radius of this pipe are a unique feature of this collection system and is considered a special structure. | |
| 1346-25 | Herndon Ave. and Milburn Ave. | 7780 | The structure was constructed with reinforced, cast-in-place concrete. The interior concrete surfaces, except the floor of the structure, are lined with PVC. | Flow enters the junction structure from the north via an existing 45-inch pipe. The flow can be split to the southwest and south to 45-inch pipes. Flow is controlled using two 45" x 45" fabricated, stainless steel slide gates. A 24-inch PVC air jumper connects the junction structure with a manhole located to the west of the structure. Currently, the south slide gate is closed forcing all flow to the southwest into the Grantland Trunk. | X |
| 1961-01 | Ashlan Ave. and Sierra Vista Ave. | 18338 | Unknown | Currently, flow enters the structure from the north via a 12-inch pipe and splits approximately in half to the west and south into a 12-inch and a 15-inch pipe, respectively. | |
| 2253-15 | McKinley Ave. and Harrison Ave. | 25677 | This structure consists of a standard manhole design with frame and cover, and channelized base. | Under average day conditions, all the flow diverts west to the 21-inch pipe with an upstream invert elevation of 282.8 feet However, once the hydraulic grade line reaches 283.7 feet (0.8 ft depth) flow will split south to the 12-inch pipe. | X |
| 2058-06 | Dakota Ave. and Milbrook Ave. | 19985 | This structure is a cast-in-place, reinforced concrete structure with a a 42" diameter manhole cover. | Flow enters the structure from the north and east via a 24-inch and 18-inch pipe, respectively. Currently, flow is split approximately in half to the south and west through two 21-inch pipes. | X |
| 2561-21 | Chestnut Ave. and Washington Ave. | 32321 | The structure was constructed with reinforced, cast-in-place concrete. | Flow enters the structure from the north via a 42-inch pipe and can exit south and west into a 42-inch and 21-inch pipe, respectively. The majority of flow exits south in the 42-inch. Roughly a thrid of the flow is estimated to be conveyed in the 21-inch sewer. | X |

## 4.2 HYDRAULIC MODEL UPDATE

A sewer collection system model is a simplified representation of the real sewer system. Sewer system models can assess the conveyance capacity for a collection system. In addition, sewer system models can perform "what if" scenarios to assess the impacts of future developments and land use changes. The City's collection system hydraulic model was constructed by City staff using a multi-step process utilizing data from a variety of sources.

As part of this Wastewater Collection System Master Plan Update (Master Plan Update) project, Carollo reviewed the existing hydraulic model, and updated/expanded upon certain aspects of the model. This section summarizes the hydraulic model review and update process.

### 4.2.1 Existing Hydraulic Model

The City's existing hydraulic model was built in-house using the City's current geographic information system (GIS) database. The hydraulic model was built using the $H_2$OMAP Sewer hydraulic modeling software package, developed by Innovyze (formerly MWH Soft). $H_2$OMAP Sewer tracks the movement of wastewater flowing through the network over an extended period of time under varying wastewater loading and operating conditions. The extended period simulation (EPS) model implemented in $H_2$OMAP Sewer is a quasi-dynamic model and is predicated on solving a simplified form of the full 1D Saint-Venant equations neglecting local acceleration. It provides seamless database and GIS interfacing and outputs features for presentations and reports.

The City's existing $H_2$OMAP Sewer model is an "all-pipe" model. In other words, the model includes all of the City's active wastewater collection system sewer mains, trunks, interceptors, and lift stations. Not included in the City's wastewater collection system hydraulic model are the City of Clovis collection system facilities, as well as other private collection system facilities (usually within County islands or other large facilities, such as the California State University Fresno (CSUF) campus or Pinedale).

The existing hydraulic model does include base wastewater loads (flows). However, these loads were reallocated and revised as part of the model update process.

### 4.2.2 Elements of the Hydraulic Model

The following provides a brief overview of the major elements of the City's hydraulic model and the required input parameters associated with each:

- **Loading Manholes**: Sewer manholes, cleanouts, as well as other locations where pipe sizes change or where pipelines intersect are represented by loading manholes in the hydraulic model. Required inputs for loading manholes include diameter, rim elevation, and wastewater loads (dry and wet weather). Loading manholes are also

used to represent locations where flows are split or diverted between two or more downstream links.

- **Chamber Manholes**: Chamber manholes connects pumps and force mains in the hydraulic model. The only required input parameter for a chamber manhole is elevation.
- **Gravity Mains**: Gravity sewers are represented as gravity mains in the hydraulic model. Input parameters for pipes include length, friction factor (i.e., Manning's n for gravity mains, Hazen Williams C for force mains), invert elevations, diameter, and a flow split type and percentage/curve (if the pipeline is directly downstream of an overflow/flow diversion).
- **Force Mains**: Force mains represent pressure sewers in the model. Required input parameters are diameter, invert elevations, length, and friction factor (i.e., Hazen Williams C).
- **Wet Wells**: Required input parameters for wet wells include invert elevation, wet well depth, cross section type (e.g., circular or variable area) and wet well cross section (e.g., diameter).
- **Pumps**: Pumps are included in the hydraulic model as links. Input parameters for pumps include type (fixed capacity, design point, or exponential 3 point curve), pump capacity/head information, and operational controls (on/off set points).
- **Outlets**: Outlets represent areas where flow leaves the system. For sewer system modeling, an outfall typically represents the connection to the influent pump station at a wastewater treatment plant.
- **Curves**: Curves represent a number of items in the hydraulic model, including rainfall hyetographs, flow split curves, and other miscellaneous items.
- **Inflows**: The following are the two types of wastewater flow sources that can be injected into individual model junctions:
  - Loads. Loads simulate base sanitary wastewater flows and represent the average flow. The base flows are multiplied by a pattern that varies the flow temporally. The base flow diurnal patterns are adjusted during the dry weather calibration process.
  - Stormwater Flows. Rainfall Derived Infiltration and Inflows (RDII) are applied in the model by assigning a unit hydrograph and a corresponding tributary area to a given loading manhole. The unit hydrographs consists of several parameters that are used to adjust the volume of RDII that enters the system at a given location. These parameters are adjusted during the wet weather calibration process.

### 4.2.3 General Model Review

In the early stages of the Master Plan Update project, Carollo worked closely with City Staff to gain an understanding of how the model was created. The model was then reviewed

against industry standards, to identify discrepancies, and to determine which aspects of the model could be improved upon.

The model review process consisted of several steps, as described below:

- **Step 1**: The first step involved in the model review process was to verify that the model data (i.e., inverts, diameters, etc.) were input correctly and that the flow direction, size, and layout of the modeled pipelines were logical. Additionally, the modeled lift stations were also checked to verify that they operated correctly.
- **Step 2**: Review which model nodes were associated with each significant industrial user (SIU) to verify that the flows associated each SIU are injected at the appropriate location in the model. For certain larger SIUs (e.g., Foster Farms, Beef Packers, Gallo), the industrial customer was contacted directly, as necessary, to verify their discharge point into the collection system and to obtain supplemental data.
- **Step 3**: Review pipeline connectivity to determine, in a general sense, how flows are routed through collection system basins, and to identify the locations of potential overflows.
- **Step 4**: Review the model/GIS facilities database to determine which portions of the existing City limits are currently served and which are not currently connected to the wastewater collection system.
- **Step 5**: Review the City's existing "master group polygons" (MGPs), which are used by the hydraulic model to allocate flows from specific parcels within the system to specific model nodes.
- **Step 6**: Review existing baseline wastewater flows in the existing hydraulic model to determine the need to develop new wastewater flow factors and reallocate the model.
- **Step 7**: Review other miscellaneous model parameters.

In general, the City's hydraulic model was constructed well and there were very few discrepancies with the physical configuration and invert elevations of the collection system facilities. However, there were some enhancements that were performed to the hydraulic model, which are summarized in the following sections.

### 4.2.4 Model Wastewater Loads

Determining the quantity of base wastewater flows generated by a municipality and how they are distributed throughout the collection system is a critical component of the hydraulic modeling process. Based on a review of the City's historical flow monitoring data (see Chapter 3) over the last few years, it was determined that the City's existing hydraulic model tended to overestimate wastewater flows into the collection system, in some cases by a significant amount. For this reason, it was determined that the model should be reallocated using revised wastewater flow factors.

Various techniques can be used to assign wastewater flows to individual model junctions, depending on the type of data that is available. Adequate estimates of the volume of

wastewater are important in maintaining and sizing sewer system facilities, both for present and future conditions. Baseline wastewater loads were allocated (assigned to specific nodes) in the hydraulic model based on land use data provided by the City and revised wastewater flow factors developed for each land use type (these are described in detail in Chapter 3). The flow coefficients and land use data provides a means to transform a specific land use category into a BWF, as described below:

- **Step 1**: The City's service area was broken up into individual loading polygons. The City's MGPs were used as the City's loading polygons. Each loading polygon represents the geographic area that contributes flows into a single model node (i.e., trunk system manhole). In an all pipe model, a loading polygon could be as small as a few parcels, or could encompass a particular subdivision or grouping of lots.

  In the case of the City, the MGPs were developed to allocate BWFs to "large diameter" pipes only (i.e., 10" and larger), and updating the MGPs to reassign individual loading polygons to small diameter pipes was beyond the scope of this Master Plan. For this reason, although the City's model is an "all pipe" model, there are only loads allocated to large diameter pipes. The City has indicated that it plans to revise the MGPs in house, at which point the model should be updated and reallocated, either in-house, or with the assistance or guidance of an outside consultant.

- **Step 2**: The loads were calculated for each loading polygon using the hydraulic model's "load allocator" tool by multiplying the appropriate flow coefficient by the land use acreage. Load = Land Use Area (ac) x Wastewater Flow Factor (gpd/ac) x conversion factor (mgd/gpd).

- **Step 3**: Once the load allocator tool assigns BWFs into the hydraulic model, the total flows were reviewed by type (i.e., residential vs. non-residential) to confirm that the load allocator functioned correctly.

- **Step 4**: The allocated loads were adjusted as necessary during the BWF calibration process (see Section 4.3.3) to closely match the actual BWFs recorded from the City's permanent flow monitoring data.

### 4.2.5 Model Scenarios

The City's existing hydraulic model contained only one scenario (the "BASE" scenario). As part of any master planning project, multiple scenarios are used to simulate different flow conditions, for both current flow conditions and future flow conditions. As part of the model update process, additional model scenarios were added. There are three model calibration scenarios, which usually are not modified by the end user after model calibration is complete. In addition, there are two "evaluation" scenarios for both existing and build out flow conditions. These are the peak dry weather flow (PDWF) condition, and the peak wet weather flow (PWWF) condition. These scenarios are used to identify system deficiencies and to develop capacity improvement projects, and can be used by the City in the future to

run several “what if” scenarios, such as the impact of new developments or land use changes.

### 4.2.6 Miscellaneous Model Updates

Several other additions/modifications were made to the hydraulic model as part of the model update process, including:

- Information fields were created in the model to identify which flow monitor a group of collection system facilities are associated with (e.g., FR01, FR02, etc.), and database queries/query sets were created for each flow monitoring basin.
- Custom diurnal patterns for each flow monitoring basin were created based on the flow data collected from the City’s permanent flow monitoring data. The custom diurnal patterns include both weekday and weekend flow conditions.
- Diurnal patterns for the City’s significant industrial users (SIU)s were updated based on available data to include both weekday and weekend flow conditions. For the build out scenario, SIU’s were modeled at their maximum permit capacity.
- Diurnal patterns for certain other large facilities (e.g., hospitals) were developed and applied based on typical hourly use patterns.
- Due to the limitations of the $H_2$OMAP Sewer hydraulic modeling package, the hydraulic grade line (HGL) calculations for flow diversions where an overflow pipe is significantly higher than the rim of the main downstream pipeline are inaccurate. An example of this condition is shown on Figure 4.4. Therefore, where an overflow pipeline was significantly higher than the rim of the main pipeline, and it was apparent that no flow would be diverted to the overflow pipeline, the overflow pipeline was deactivated in the model, similar to how loops have been deactivated in the existing hydraulic model. A selection set “Deactivated Overflows” was created to keep track of these the deactivated diversions. No pipelines were deactivated in the model that were deemed to be hydraulically significant. Should the City wish to include the inactivated pipelines, as well as the loops that had been previously deactivated, the City should consider converting to the $H_2$OMAP SWMM or InfoSWMM hydraulic modeling software platform.

## 4.3 MODEL CALIBRATION

Hydraulic models are built off the best available information regarding the physical attributes and operational conditions of the collection system, most of which are known to a reasonable level of confidence. Even so, there are a number of parameters that are not directly known and cannot be directly measured. For this reason, these parameters must be assumed initially based on typical values and engineering judgment. Every collection system is unique. For this reason, industry standard of care dictates that a model be validated to ensure that the assumptions built into the model are accurate. This validation process is commonly referred to as calibration.

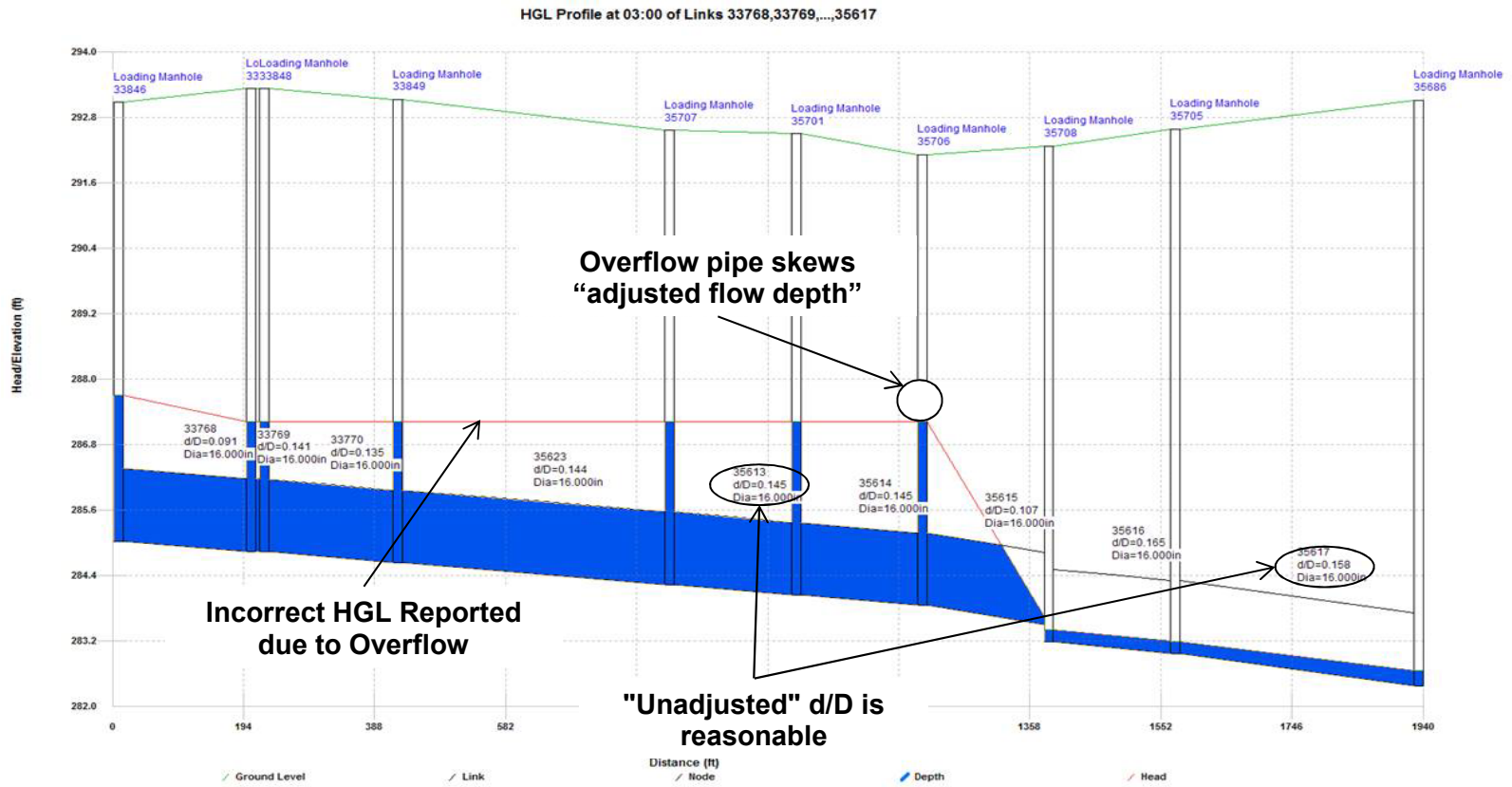



**Figure 4.4**
**Example HGL Limitations for Overflow Pipelines in $H_2OMAP$ Sewer**
Wastewater Collection System Master Plan Update

The calibration process must be undertaken in any modeling effort. Having an appropriately calibrated model is necessary to provide confidence in all project team members and stakeholders that the results produced by the model are as accurate as possible and defensible.

A model cannot be considered calibrated unless it accurately represents flow conditions that have actually occurred, preferably in the very recent past. This dictates that the model include an "existing" model scenario, which represents the configuration and flow conditions that are currently experienced. Only after the model has been shown to accurately simulate these flow conditions can it be used to simulate hypothetical conditions, such as a design storm event or a build out flow condition.

The intended purpose of the model will dictate how the model is constructed and should be calibrated. For Fresno, flow conditions observed in the flow monitoring data and at the RWRF have demonstrated that it is necessary to calibrate to both dry weather and wet weather flow conditions. Model calibration of the City's collection system hydraulic model consisted of three main parts, a macro calibration, a base flow calibration, and wet weather flow calibration.

### 4.3.1 Calibration Standards

The hydraulic model was calibrated in accordance with international modeling standards. The Wastewater Planning Users Group (WaPUG), a section of the Chartered Institution of Water and Environmental Management, has established generally agreed upon principles for model verification. The base flow and wet weather calibration focused on meeting the recommendations on model verification contained in the "Code of Practice for the Hydraulic Modeling of Sewer Systems," published by the WaPUG (WaPUG 2002), as summarized below:

- **Base Wastewater Flow Calibration Standards**: Base flow calibration should be carried out for two base flow days and the modeled flows and depths should be compared to the field measured flows and depths. Both the modeled and field measured flow hydrographs should closely follow each other in both shape and magnitude.

  In addition to the shape, the flow hydrographs should also meet the following criteria as a general guide:

  – The timing of flow peaks and troughs should be within one hour.

  – The peak flow rate should be within the range of ±10 percent

  – The volume of flow (or the average rate of flow) should be within the range of ±10 percent. If applicable, care should be taken to exclude periods of missing or inaccurate data.

- **Wet Weather Calibration Standards**: The model simulated flows and depths should be compared to the field measured flows and depths. The flow hydrographs should

closely follow each other in both shape and magnitude, until the flow has substantially returned to dry weather flow rates.

In addition to the shape, the flow hydrographs should also meet the following criteria as a general guide:

– The timing of the peaks and troughs should be similar with regard to the duration of the events.

– The peak flow rates at significant peaks should be in the range of +25 percent to 15 percent and should be generally similar throughout.

– The volume of flow (or the average flow rate) should be within the range of +20 percent to -10 percent.

### 4.3.2 Macro Calibration

The initial calibration process consisted of a macro calibration. Initially, Carollo ran the model under existing BWF conditions and necessary adjustments were made to produce reasonable system flows. Such adjustments include modifications of pipeline connectivity, inverts, facility characteristics, and lift station characteristics.

### 4.3.3 Base Wastewater Flow Calibration

The BWF calibration process consists of several elements, as outlined below:

- **Divide the system into areas tributary to each flow meter**. The first step in the calibration process was to divide the City into flow meter tributary areas. Twenty-one tributary areas were created, one for each flow meter from the permanant flow monitoring program. A map showing the locations of each flow monitoring site and their associated tributary area are provided in Chapter 3 along with a schematic of the flow meters.
- **Define flow volumes within each area**. The next step was to define the flow volumes within each area, which was accomplished in the flow allocation step.
- **Create diurnal patterns to match the temporal distribution of flow**. A diurnal curve is a pattern of hourly multipliers that are applied to the base flow to simulate the variation in flow that occurs throughout the day. In order to match the flows throughout the week, a seven day diurnal pattern was established for each flow meter. The diurnal patterns were initially developed based on the flow monitoring data and adjusted as part of the calibration process until the model simulated flows closely matched the field measured flows. Figure 4.5 shows the calibrated weekday and weekend diurnal patterns for the area tributary to Site FR06. Similar diurnal curves were developed for each of the meters and its tributary area. These additional curves are available in Appendix B.

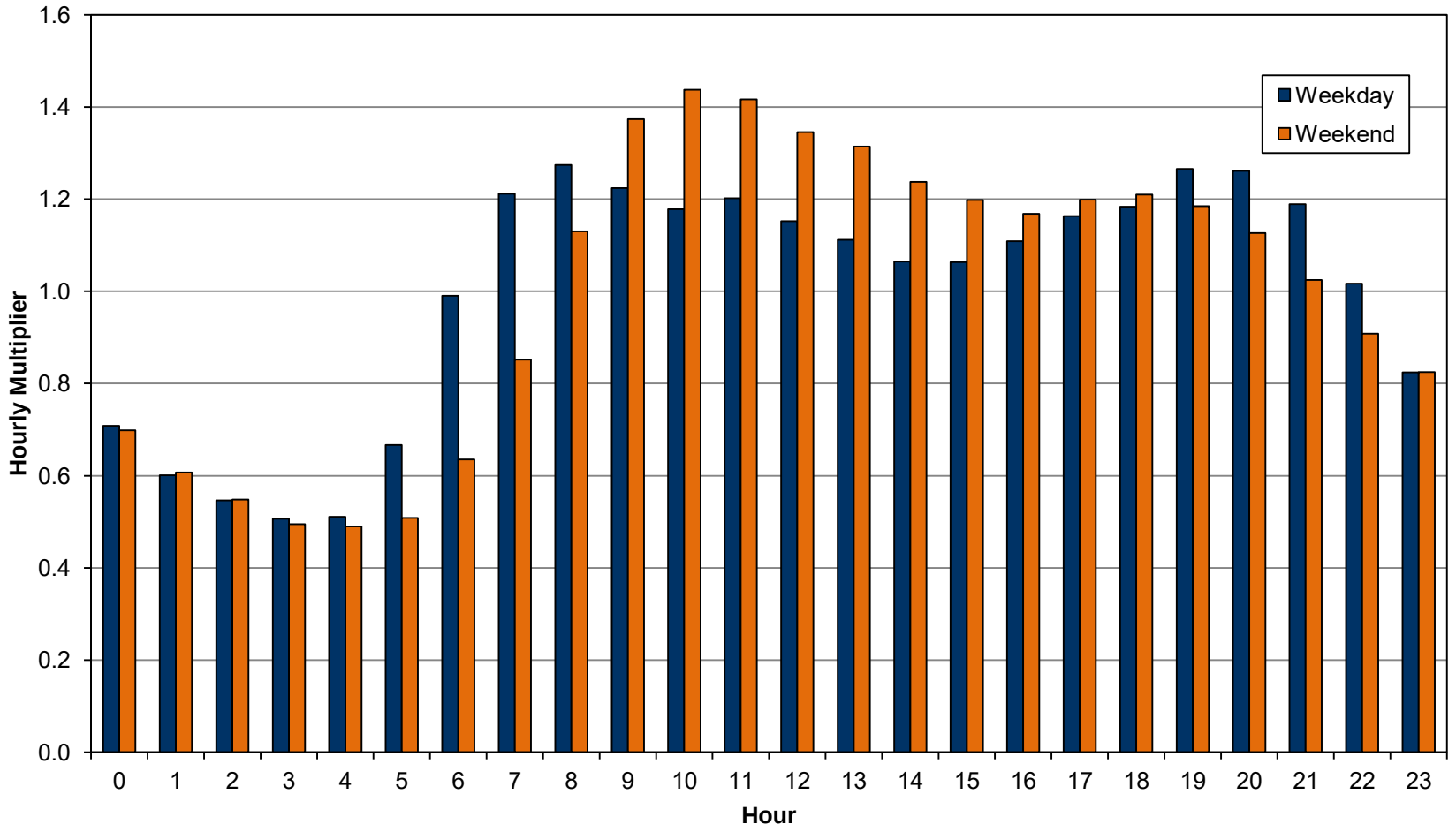



**Figure 4.5**

**Example Diurnal Patterns (Meter FR06)**
Wastewater Collection System Master Plan Update
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- **Adjust model variables to match field measured velocity and flow depths**. Once the model simulated flows acceptably matched the field measured flows, the model simulated velocity and flow depth were compared to the field measured velocity and flow depth. Adjustments were made to various model parameters until the modeled and measured velocity and depth closely matched one another. The primary varied parameters for this process are pipeline roughness (Manning's n) and sediment build up in the pipe, although other parameters can also be adjusted as calibration results are generated.

  Manning's roughness coefficients, or n values, have industry accepted ranges based on a number of variables. Roughness coefficients increase over time depending on the construction methods, installation quality, system maintenance, and other environmental factors. There can be certain factors within the City's collection system that can result in roughness coefficients which differ from the typical range. For example, pipeline bellies, joint misalignment, cracks, and debris (e.g., root intrusion, etc.) lead to increased turbulence in a pipe, as well as the apparent Manning's n factor.

  If the model is unable to reasonably match the field measured flow depth and velocity without leaving the acceptable range of Manning's roughness coefficients, further investigation is conducted to help determine the cause of the discrepancy. Some issues that could cause such a discrepancy can include errors in the slope or diameter of a pipeline, downstream blockages, pipeline sags, and, in some cases, influences from downstream lift station operations. This method was not needed on any of the City's current flow metering points to match flows.

Table 4.6 provides a summary of the BWF calibration using the average and daily peak flow results for both weekday and weekend conditions. As shown in Table 4.6, with the exception of Meter FR24 (which was only very slightly above 10-percent), the model simulated average and peak flows for both weekday and weekend BWF were all within 10-percent. The flow monitoring data associated with meter FR24 was limited and somewhat questionable, so a percent error of only slightly greater than 10-percent was deemed acceptable for this meter.

Appendix B contains a detailed BWF calibration summary sheet for each of the 21 meter sites. Each calibration sheet provides plots that compare the model simulated and field measured flow, velocity, and level data for both weekday and weekend conditions. An example of the dry weather calibration for Site FR06 is shown on Figure 4.6. As shown on Figure 4.6 and in Appendix B, there is excellent overall correlation of the field measured data to the model output results.

### 4.3.4 Wet Weather Flow Calibration

The WWF calibration enables the hydraulic model to accurately simulate I/I entering the collection system during a large storm. As outlined below, the WWF calibration process consists of several elements:

**Table 4.6 BWF Calibration Summary**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| | | Weekday Base Wastewater Flow | | | | | | | | | | | | Weekend Base Wastewater Flow | | | | | | | | | | Base Wastewater Flow[4] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Measured Data[1] | | | | Modeled Data[2] | | | | Percent Error[3] | | | | Measured Data[1] | | | | Modeled Data[2] | | | | Percent Error[3] | | | | | | |
| Meter Number | Pipe Diameter (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (%) | Peak Flow (%) | Avg. Velocity (%) | Avg. Level (%) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (%) | Peak Flow (%) | Avg. Velocity (%) | Avg. Level (%) | Measured BWF (mgd) | Modeled BWF (mgd) | Percent Difference (%) |
| FR01 | 45 | 3.701 | 5.507 | 3.36 | 9.3 | 3.704 | 5.212 | 3.06 | 10.0 | 0.1% | -5.4% | -8.9% | 7.1% | 3.904 | 5.939 | 3.39 | 9.5 | 3.927 | 5.766 | 3.09 | 10.2 | 0.6% | -2.9% | -8.7% | 7.3% | 3.759 | 3.768 | 0.2% |
| FR02 | 45 | 8.049 | 10.996 | 3.52 | 15.9 | 7.726 | 10.331 | 3.59 | 15.1 | -4.0% | -6.0% | 2.0% | -4.5% | 8.135 | 12.465 | 3.51 | 15.9 | 7.777 | 11.659 | 3.57 | 15.1 | -4.4% | -6.5% | 1.7% | -4.9% | 8.074 | 7.741 | -4.1% |
| FR06 | 36 | 4.132 | 5.207 | 2.59 | 14.2 | 4.131 | 5.050 | 2.57 | 13.6 | 0.0% | -3.0% | -0.7% | -4.0% | 4.089 | 5.758 | 2.54 | 14.2 | 4.118 | 5.630 | 2.56 | 13.5 | 0.7% | -2.2% | 1.1% | -4.7% | 4.120 | 4.128 | 0.2% |
| FR08 | 48 | 7.661 | 9.894 | 4.59 | 12.3 | 7.672 | 10.070 | 4.24 | 13.0 | 0.2% | 1.8% | -7.7% | 5.9% | 7.131 | 9.883 | 4.52 | 11.7 | 7.336 | 10.727 | 4.16 | 12.6 | 2.9% | 8.5% | -7.8% | 8.1% | 7.509 | 7.576 | 0.9% |
| FR09 | 39 | 5.025 | 6.285 | 3.41 | 12.8 | 4.860 | 6.020 | 3.23 | 12.4 | -3.3% | -4.2% | -5.4% | -2.8% | 4.673 | 6.466 | 3.31 | 12.3 | 4.556 | 6.325 | 3.16 | 12.0 | -2.5% | -2.2% | -4.5% | -2.8% | 4.925 | 4.773 | -3.1% |
| FR10 | 0 | 1.491 | 2.750 | 1.16 | 10.4 | 1.464 | 2.697 | 1.19 | 10.3 | -1.8% | -1.9% | 2.3% | -1.4% | 1.496 | 3.201 | 1.11 | 10.0 | 1.469 | 3.103 | 1.15 | 10.0 | -1.8% | -3.1% | 3.4% | -0.7% | 1.492 | 1.465 | -1.8% |
| FR11 | 66 | 3.582 | 5.199 | 2.23 | 10.3 | 3.609 | 4.851 | 2.16 | 10.8 | 0.8% | -6.7% | -3.3% | 4.3% | 3.483 | 5.471 | 2.24 | 10.0 | 3.665 | 5.539 | 2.16 | 10.7 | 5.2% | 1.2% | -3.7% | 7.0% | 3.554 | 3.625 | 2.0% |
| FR12 | 33 | 1.578 | 2.513 | 1.89 | 8.6 | 1.579 | 2.502 | 1.93 | 8.5 | 0.0% | -0.4% | 1.9% | -1.6% | 1.590 | 2.673 | 1.84 | 8.7 | 1.592 | 2.671 | 1.91 | 8.4 | 0.1% | -0.1% | 3.9% | -2.9% | 1.582 | 1.582 | 0.0% |
| FR13 | 51 | 8.526 | 10.118 | 3.29 | 15.8 | 8.329 | 9.611 | 3.31 | 16.2 | -2.3% | -5.0% | 0.6% | 2.3% | 7.951 | 10.072 | 3.24 | 15.2 | 7.902 | 9.556 | 3.26 | 15.7 | -0.6% | -5.1% | 0.6% | 3.6% | 8.362 | 8.207 | -1.9% |
| FR14 | 36 | 4.058 | 4.998 | 2.40 | 14.4 | 4.022 | 4.819 | 2.25 | 14.8 | -0.9% | -3.6% | -6.1% | 2.9% | 4.017 | 5.367 | 2.39 | 14.3 | 3.762 | 4.806 | 2.21 | 14.2 | -6.3% | -10.4% | -7.8% | -0.1% | 4.046 | 3.948 | -2.4% |
| FR15 | 48 | 6.194 | 7.184 | 2.19 | 18.2 | 6.071 | 6.949 | 2.25 | 17.5 | -2.0% | -3.3% | 2.7% | -3.5% | 5.939 | 7.337 | 2.17 | 17.7 | 5.850 | 7.075 | 2.22 | 17.2 | -1.5% | -3.6% | 2.5% | -3.1% | 6.121 | 6.008 | -1.9% |
| FR16 | 30 | 3.724 | 4.692 | 3.34 | 11.5 | 3.702 | 4.463 | 3.26 | 11.5 | -0.6% | -4.9% | -2.5% | 0.3% | 3.708 | 5.104 | 3.32 | 11.5 | 3.667 | 4.664 | 3.24 | 11.4 | -1.1% | -8.6% | -2.3% | -0.5% | 3.720 | 3.692 | -0.7% |
| FR19 | 66 | 23.147 | 27.598 | 4.52 | 24.1 | 23.071 | 27.048 | 4.89 | 22.7 | -0.3% | -2.0% | 8.2% | -5.8% | 20.907 | 26.800 | 4.35 | 22.8 | 22.057 | 28.163 | 4.81 | 22.1 | 5.5% | 5.1% | 10.6% | -3.2% | 22.507 | 22.781 | 1.2% |
| FR20 | 66 | 29.854 | 34.806 | 4.60 | 28.6 | 26.961 | 31.643 | 4.71 | 26.2 | -9.7% | -9.1% | 2.3% | -8.3% | 26.650 | 34.503 | 4.48 | 26.6 | 25.500 | 31.954 | 4.62 | 25.4 | -4.3% | -7.4% | 3.1% | -4.6% | 28.939 | 26.544 | -8.3% |
| FR21 | 42 | 4.403 | 5.596 | 2.11 | 15.3 | 4.451 | 5.716 | 2.11 | 15.4 | 1.1% | 2.1% | 0.0% | 0.9% | 4.454 | 6.167 | 2.10 | 15.4 | 4.541 | 6.199 | 2.11 | 15.6 | 1.9% | 0.5% | 0.7% | 0.7% | 4.418 | 4.477 | 1.3% |
| FR22 | 45 | 7.461 | 9.611 | 2.90 | 17.5 | 7.471 | 9.230 | 2.88 | 17.5 | 0.1% | -4.0% | -0.8% | 0.0% | 7.615 | 10.754 | 2.90 | 17.6 | 7.650 | 10.427 | 2.88 | 17.6 | 0.5% | -3.0% | -0.5% | 0.1% | 7.505 | 7.522 | 0.2% |
| FR23 | 27 | 1.251 | 1.638 | 2.08 | 7.5 | 1.262 | 1.521 | 2.20 | 7.4 | 0.9% | -7.2% | 5.5% | -1.5% | 0.762 | 1.032 | 1.94 | 5.5 | 0.827 | 1.469 | 1.93 | 5.9 | 8.5% | 42.4% | -0.6% | 7.6% | 1.111 | 1.138 | 2.4% |
| FR24 | 72 | 8.120 | 10.599 | 2.60 | 16.1 | 8.987 | 11.826 | 2.63 | 17.3 | 10.7% | 11.6% | 0.9% | 7.5% | 8.216 | 11.913 | 2.61 | 16.1 | 9.103 | 13.093 | 2.63 | 17.3 | 10.8% | 9.9% | 0.8% | 7.5% | 8.147 | 9.021 | 10.7% |
| FR25 | 15 | 0.082 | 0.121 | 1.11 | 2.1 | 0.082 | 0.121 | 1.12 | 2.1 | 0.1% | 0.1% | 1.1% | 1.0% | 0.079 | 0.134 | 1.12 | 2.0 | 0.079 | 0.134 | 1.10 | 2.1 | 0.2% | -0.1% | -2.0% | 3.0% | 0.081 | 0.081 | 0.1% |
| FR26 | 0 | 0.190 | 0.311 | 0.92 | 4.9 | 0.192 | 0.308 | 0.91 | 5.1 | 1.4% | -1.0% | -1.1% | 2.6% | 0.195 | 0.321 | 0.93 | 5.0 | 0.198 | 0.322 | 0.91 | 5.1 | 1.3% | 0.4% | -1.9% | 3.3% | 0.191 | 0.194 | 1.3% |
| FR27 | 27 | 1.900 | 2.558 | 1.82 | 12.1 | 1.900 | 2.546 | 1.86 | 11.1 | 0.0% | -0.5% | 2.6% | -8.4% | 1.935 | 2.786 | 1.86 | 12.1 | 1.935 | 2.783 | 1.86 | 11.2 | 0.0% | -0.1% | 0.1% | -7.4% | 1.910 | 1.910 | 0.0% |

Notes:

1. Source: City of Fresno Permanent Flow Monitoring Data
2. Average flow, level, and velocity are calculated from weekday/weekend dry weather flow monitoring data. Maximum flow values are hourly peaks corresponding to either weekend or weekday confitions, as appropriate.
3. Percent Difference = (Modeled - Measured)/Measured*100.
4. Base Wastewater Flow = (5*Weekday Base Wastewater Flow + 2*Weekend Base Wastewater Flow)/7

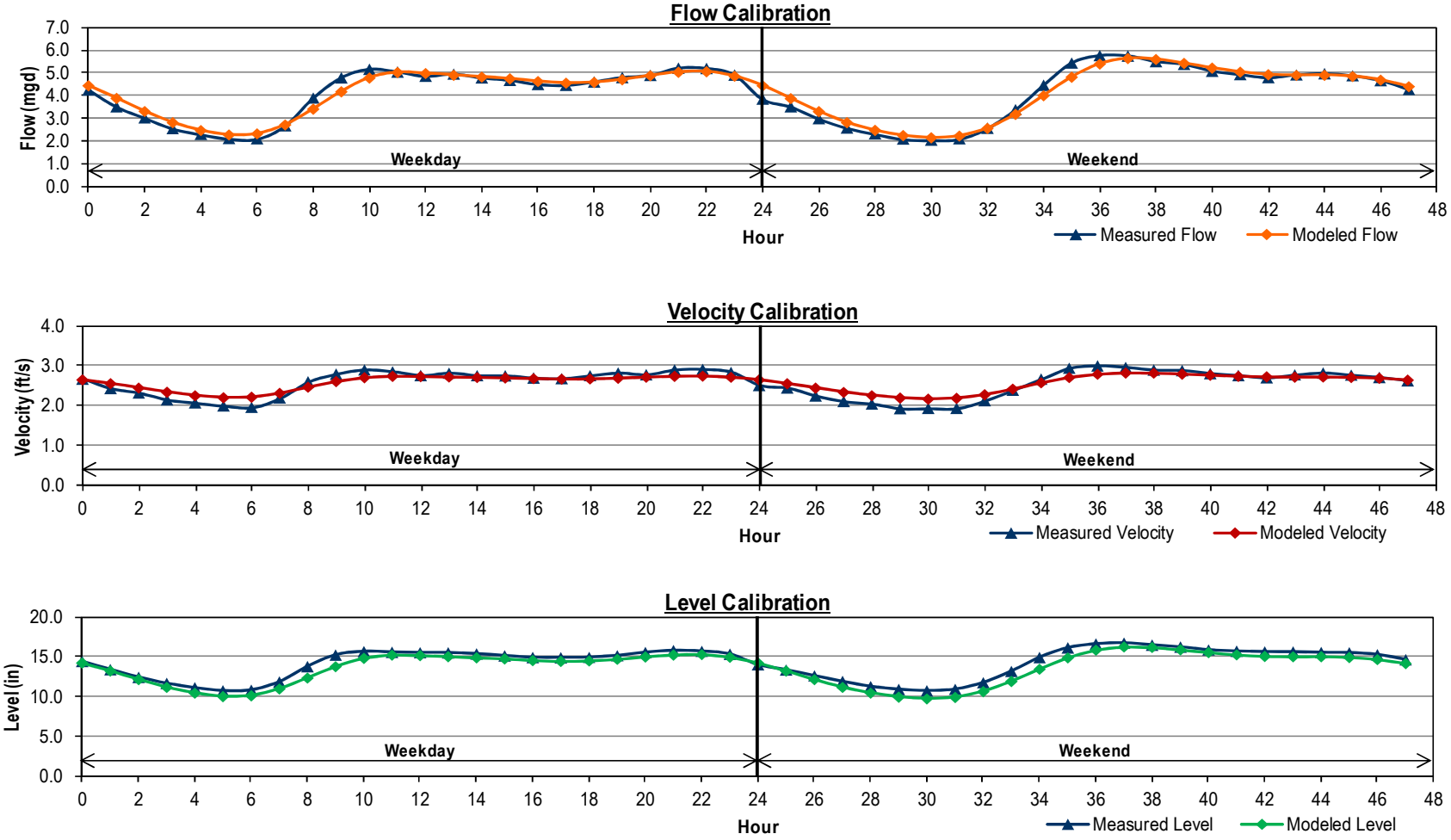


**Figure 4.6**

**Example BWF Calibration (Meter FR06)**
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- **Identify calibration rainfall events**. The WWF calibration process consists of running model simulations of historic rainfall events based on data from the City's permanent flow monitoring program. The goal of any wet weather flow monitoring program is to capture and characterize a system's response to a significant rainfall event, preferably during wet antecedent moisture conditions. In the case of the City, although there is permanent flow monitoring data available, there were significant data gaps in recent years, and so selection of a calibration rainfall event was limited to periods of time in which sufficient data were available.

  The selection of a particular calibration storm or group of storms is based on a review of the flow and rainfall data. In the case of the City, the most significant event in recent years with sufficient data availability to perform an adequate WWF calibration occurred in April 2012, and therefore this storm was used as the basis for WWF calibration. As a validation of the April 2012 WWF calibration, the model was validated to a series of rainfall events that occurred in March 2011 for sites where data was available, and to the hourly influent flow data at the RWRF.

  In order to run a model simulation for the both of these rainfall events, the hourly rainfall data were input into the model for these events. Each flow monitoring tributary area, or basin, was assigned a specific rainfall hyetograph, which was calculated for each basin based on available historic rainfall data.

- **Define RDII tributary areas**. For the WWF calibration, RDII flows are superimposed on top of the BWF. RDII inflows consist of both a unit hydrograph and the total area that is tributary to the model node. The RDII tributary areas were calculated in GIS using the City's loading polygons (MGPs), excluding any large vacant, open space, or other areas in the system which are not expected to contribute to I/I into the collection system. The tributary area provides a means to transform hourly rainfall depth from the rainfall hyetographs into a rainfall volume. The rainfall volume is transformed into actual RDII flows using the unit hydrograph, as described in the next step.

- **Create I/I parameter database and modify to match field measured flows**. The main step in the WWF calibration process involves creating custom unit hydrographs for each flow monitoring tributary area using the "RTK Method," which is widely used in collection system master planning. Using the RTK Method, the RDII unit hydrograph is the summation of three separate triangular hydrographs (short term, medium term, and long term), which are each defined by three parameters: R, T, and K. R represents the fraction of rainfall over the sewer shed that enters the collection system; T represents the time to peak of the hydrograph; and K represents the ratio of time to recession to the time to peak. Therefore, there are a total of nine separate variables associated with each unit hydrograph. Figure 4.7 shows the shape of an example unit hydrograph.

  The hydrographs utilize the R-Values (percent of rainfall that enters the collection system) calculated for each basin to simulate I/I. The nine variables in each unit hydrograph were initially set based on engineering judgment and then adjusted until the model simulated flows (both peak flows and average flows) matched closely with the field measured flows.

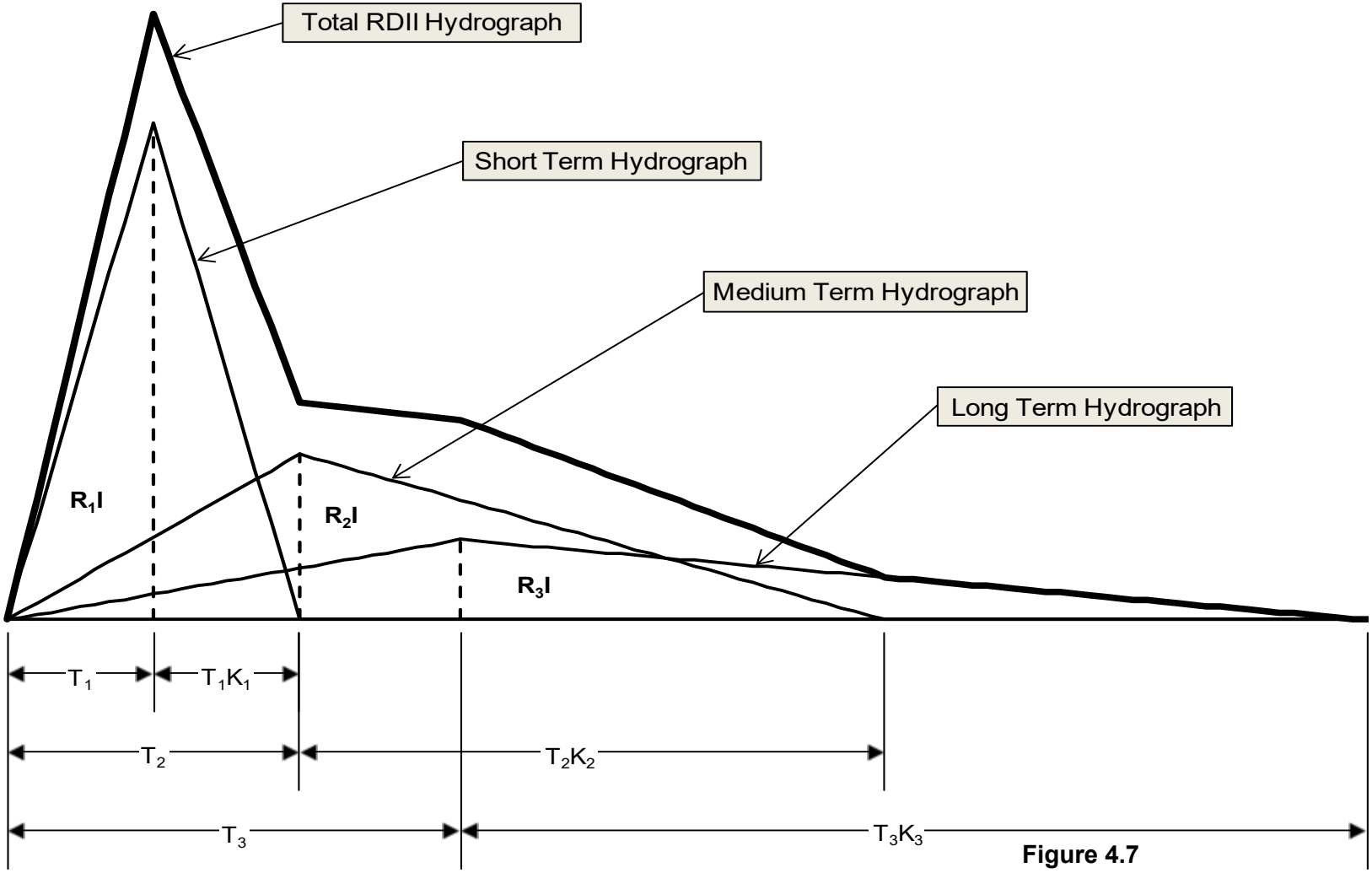


**Figure 4.7**

**Example RDII Unit Hydrograph**
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City of Fresno

As with the dry weather calibration, the wet weather calibration process compared the meter data with the model output. Comparisons were made for average and peak flows as well as the temporal distribution of flow until flows returned to their baseline levels. According to the WaPUG, a hydraulic model is generally considered to be satisfactorily calibrated to WWF conditions if the modeled peak flows are within +25 percent to -15 percent of the field measured data, and if the average modeled flows are within +20 percent to -10 percent of the field measured data.

- **Refine model variables to match field measured velocity and flow depths**. After the model was considered to be satisfactorily calibrated for wet weather flows, the model simulated velocities and flow depths were checked against the field measured velocities and flow depths during the calibration storms. Refinements were made to the various model parameters so that the modeled and measured velocity and depth closely matched one another. If any adjustments were made to Manning's n-values or other parameters, the BWF calibration was rechecked as well to make sure that the flow depth and velocities still matched well under BWF conditions.

Appendix C contains a detailed wet weather flow calibration summary sheet for each of the 21 meter sites. Each calibration sheet provides plots that compare the model simulated and field measured flow, velocity, and level data for the calibration storms. An example of the wet weather calibration for Site FR06 is shown on Figure 4.8. Table 4.7 provides a summary of the wet weather flow calibration using the average and peak flow results. Additionally, Figure 4.9 and Figure 4.10 show a comparison of the modeled and measured flows at the RWRF influent pump station for the April 2012 and March 2011 storms, respectively.

It should be noted that there is a considerable amount of I/I contributed into the collection system in Basin 23 (see Figure 4.11). This basin is relatively small and receives a significant amount of flow from Gallo, an SIU.

For this reason, flow data from Gallo was obtained for the April 2012 storm event. Based on a review of this data, it was confirmed that the majority of the observed I/I flow from Basin 23 appears to be associated with the Gallo property (see Appendix C). Furthermore, the amount of flow observed in Basin 23 during the April 2012 storm event would suggest that under PWWF conditions, there will be significant capacity deficiencies cause immediately downstream of Gallo. For this reason, it is recommended that the City investigate the cause of the excessive rates of I/I associated with the Gallo property, and work with Gallo to identify possible solutions to address the issue.

As shown on Table 4.7, the model simulated average and peak flows at all meter sites were within the acceptable tolerances for at least two of the three calibration storms, and therefore the model was considered calibrated and ready to use for capacity analysis purposes.

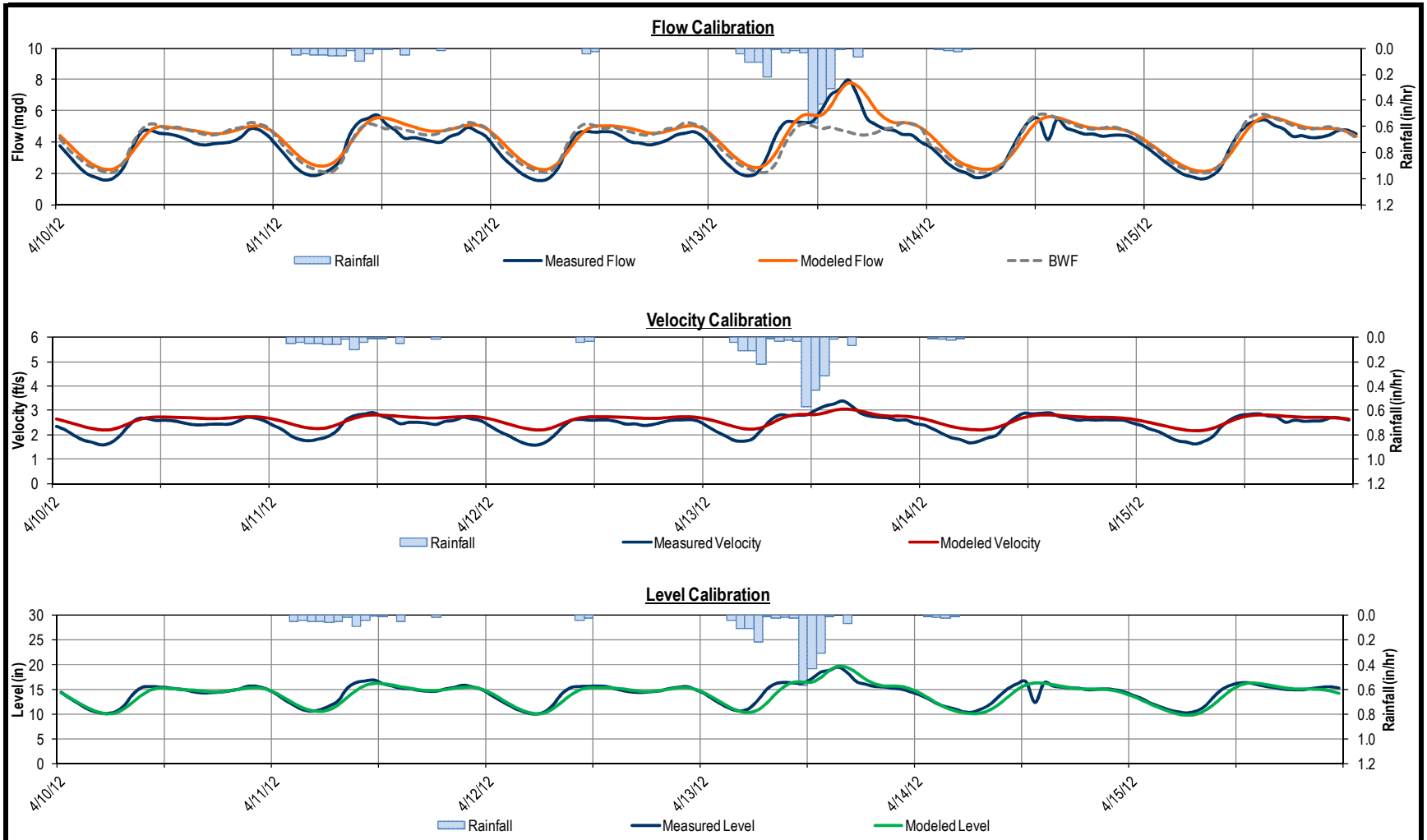


**Figure 4.8**
**Example WWF Calibration (Meter FR06)**
Wastewater Collection System Master Plan Update
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**Table 4.7 WWF Calibration Sumnmary**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| | | April 13-14, 2012 Storm Event | | | | | | | | | | | | March 20-21, 2011 Storm Event | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Measured Data[1] | | | | Modeled Data[2] | | | | Percent Error[3] | | | | Measured Data[1] | | | | Modeled Data[2] | | | | Percent Error[3] | | | |
| Meter Number | Pipe Diameter (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (%) | Peak Flow (%) | Avg. Velocity (%) | Avg. Level (%) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (%) | Peak Flow (%) | Avg. Velocity (%) | Avg. Level (%) |
| FR01 | 45 | 3.60 | 5.50 | 3.40 | 9.07 | 4.08 | 5.81 | 3.14 | 10.46 | 13.2% | 5.5% | -7.6% | 15.4% | 4.14 | 6.64 | 3.52 | 9.69 | 4.28 | 6.44 | 3.19 | 10.72 | 3.4% | -3.0% | -9.6% | 10.7% |
| FR02 | 45 | 8.86 | 12.72 | 3.58 | 16.78 | 8.64 | 13.32 | 3.67 | 15.98 | -2.5% | 4.8% | 2.6% | -4.7% | 8.02 | 13.11 | 3.22 | 16.67 | 8.51 | 13.68 | 3.67 | 15.89 | 6.1% | 4.4% | 13.8% | -4.7% |
| FR06 | 36 | 4.24 | 7.99 | 2.52 | 14.58 | 4.57 | 7.80 | 2.63 | 14.33 | 7.8% | -2.3% | 4.5% | -1.7% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR08 | 48 | Note 4 | Note 4 | Note 4 | Note 4 | 9.47 | 15.58 | 4.46 | 14.35 | Note 4 | Note 4 | Note 4 | Note 4 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR09 | 39 | -- | -- | -- | -- | 5.73 | 9.77 | 3.36 | 13.48 | n/a | n/a | n/a | n/a | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR10 | 0 | 1.33 | 2.98 | 1.19 | 8.22 | 1.68 | 3.26 | 1.23 | 10.99 | 26.1% | 9.1% | 2.9% | 33.7% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR11 | 66 | -- | -- | -- | -- | 4.16 | 6.22 | 2.24 | 11.45 | n/a | n/a | n/a | n/a | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR12 | 33 | 1.79 | 4.58 | 1.89 | 9.28 | 2.07 | 4.65 | 2.06 | 9.64 | 15.6% | 1.5% | 8.7% | 3.8% | 2.11 | 3.82 | 1.95 | 10.32 | 2.09 | 3.85 | 2.08 | 9.75 | -0.9% | 0.6% | 6.6% | -5.5% |
| FR13 | 51 | -- | -- | -- | -- | 9.28 | 14.37 | 3.40 | 17.04 | n/a | n/a | n/a | n/a | 10.26 | 14.43 | 3.54 | 17.09 | 9.62 | 12.90 | 3.44 | 17.40 | -6.3% | -10.6% | -2.7% | 1.8% |
| FR14 | 36 | 4.36 | 6.79 | 2.11 | 16.88 | 4.64 | 7.90 | 2.32 | 15.98 | 6.4% | 16.3% | 9.7% | -5.3% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR15 | 48 | 6.33 | 8.27 | 2.14 | 18.79 | 6.57 | 9.51 | 2.29 | 18.25 | 3.7% | 14.9% | 6.8% | -2.9% | 7.57 | 11.22 | 2.36 | 19.89 | 7.03 | 9.87 | 2.33 | 18.94 | -7.2% | -12.0% | -1.4% | -4.8% |
| FR16 | 30 | 4.13 | 6.43 | 3.29 | 12.56 | 4.17 | 7.46 | 3.35 | 12.23 | 0.8% | 16.0% | 1.9% | -2.7% | 3.91 | 6.18 | 3.18 | 12.24 | 4.24 | 5.87 | 3.37 | 12.37 | 8.3% | -4.9% | 6.0% | 1.1% |
| FR19 | 66 | 22.98 | 34.12 | 5.46 | 20.79 | 25.38 | 37.23 | 4.99 | 23.80 | 10.4% | 9.1% | -8.6% | 14.5% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR20 | 66 | Note 4 | Note 4 | Note 4 | Note 4 | 31.07 | 47.74 | 4.86 | 28.24 | Note 4 | Note 4 | Note 4 | Note 4 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR21 | 42 | 5.49 | 9.33 | 2.13 | 17.91 | 5.24 | 9.03 | 2.18 | 16.76 | -4.5% | -3.3% | 2.5% | -6.4% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR22 | 45 | 8.46 | 12.88 | 3.02 | 18.56 | 8.55 | 13.45 | 2.96 | 18.74 | 1.1% | 4.5% | -1.7% | 0.9% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR23 | 27 | 1.46 | 5.03 | 2.01 | 8.22 | 1.73 | 4.52 | 2.29 | 8.37 | 18.6% | -10.0% | 14.0% | 1.8% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR24 | 72 | Note 4 | Note 4 | Note 4 | Note 4 | 10.32 | 15.57 | 2.72 | 18.42 | Note 4 | Note 4 | Note 4 | Note 4 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR25 | 15 | 0.12 | 0.32 | 1.26 | 2.48 | 0.11 | 0.33 | 1.22 | 2.48 | -3.4% | 3.5% | -3.1% | -0.1% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR26 | 0 | 0.22 | 0.67 | 0.93 | 5.28 | 0.25 | 0.66 | 0.95 | 5.91 | 14.8% | -1.5% | 2.0% | 11.9% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FR27 | 27 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

Notes:
1. Source: City of Fresno Permanent Flow Monitoring Data
2. Average flow, level, and velocity are calculated from weekday/weekend dry weather flow monitoring data.
3. Base Wastewater Flow = (5*Weekday Base Wastewater Flow + 2*Weekend Base Wastewater Flow)/7
4. "--" indicates that data were not available. "Note 4" indicates that data were available, but with data gaps.

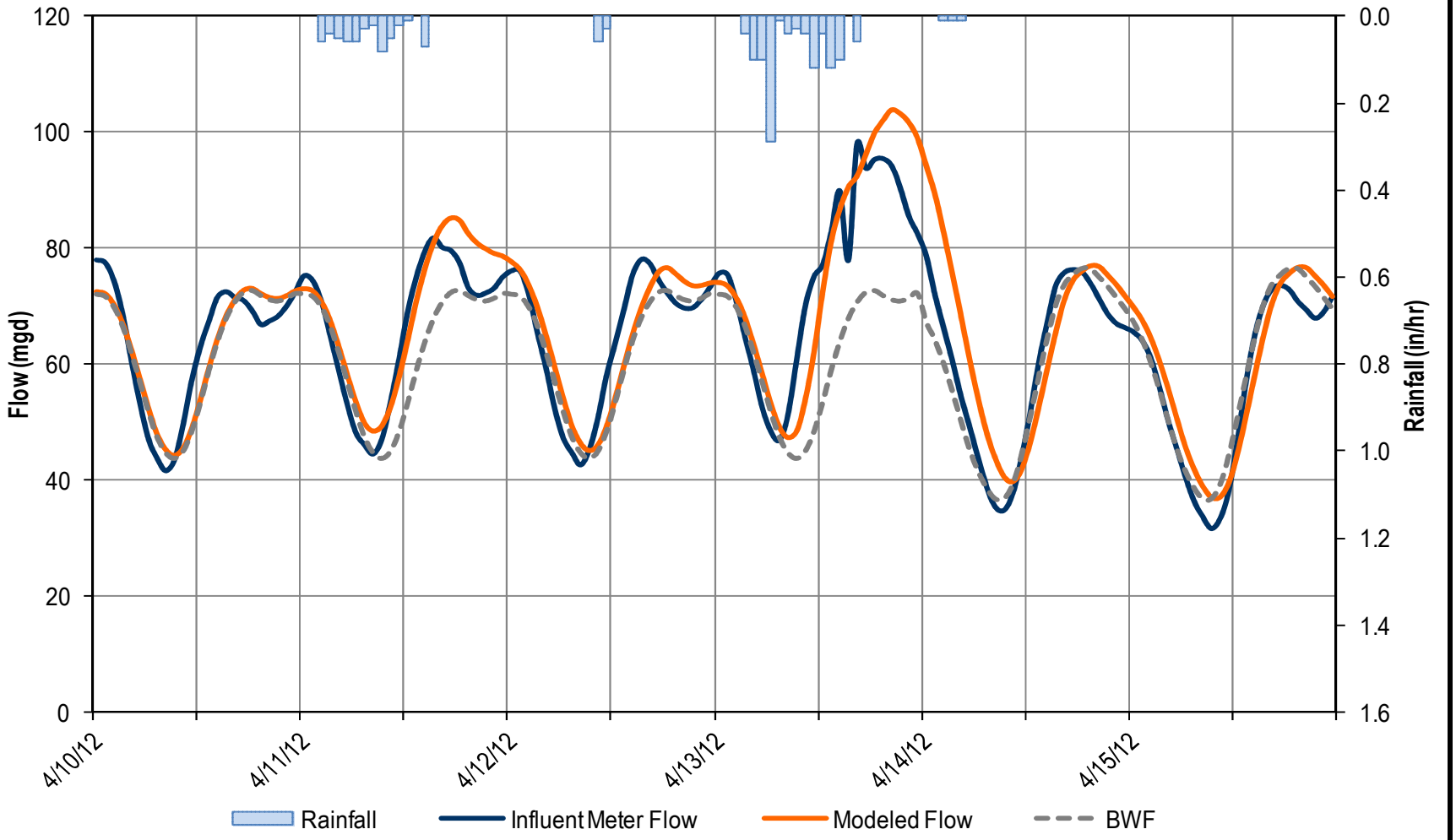



**Figure 4.9**
**RWRF WWF Calibration (April 2012)**
Wastewater Collection System Master Plan Update
City of Fresno

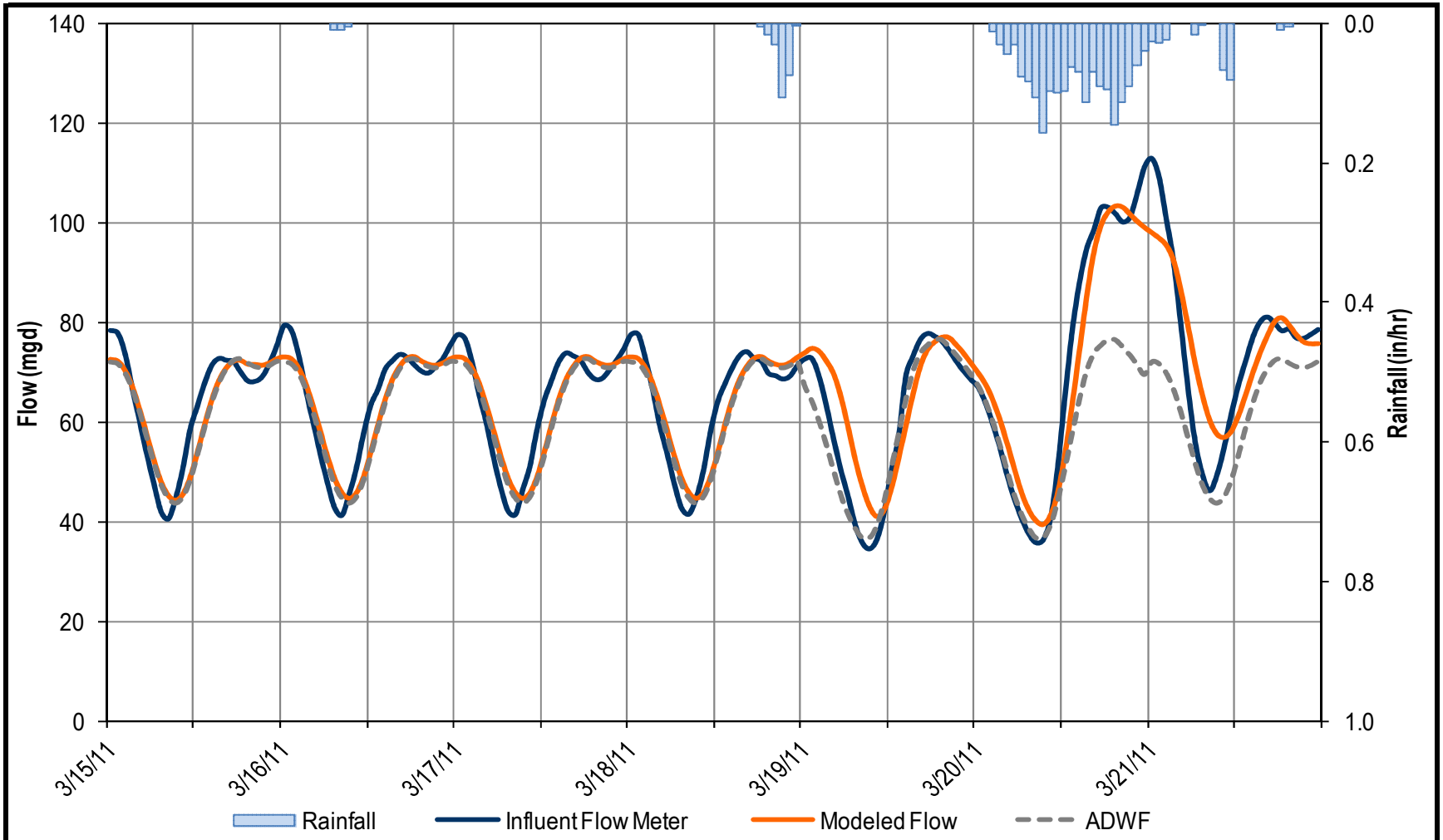



**Figure 4.10**

**RWRF WWF Calibration (March 2011)**
Wastewater Collection System Master Plan Update
City of Fresno

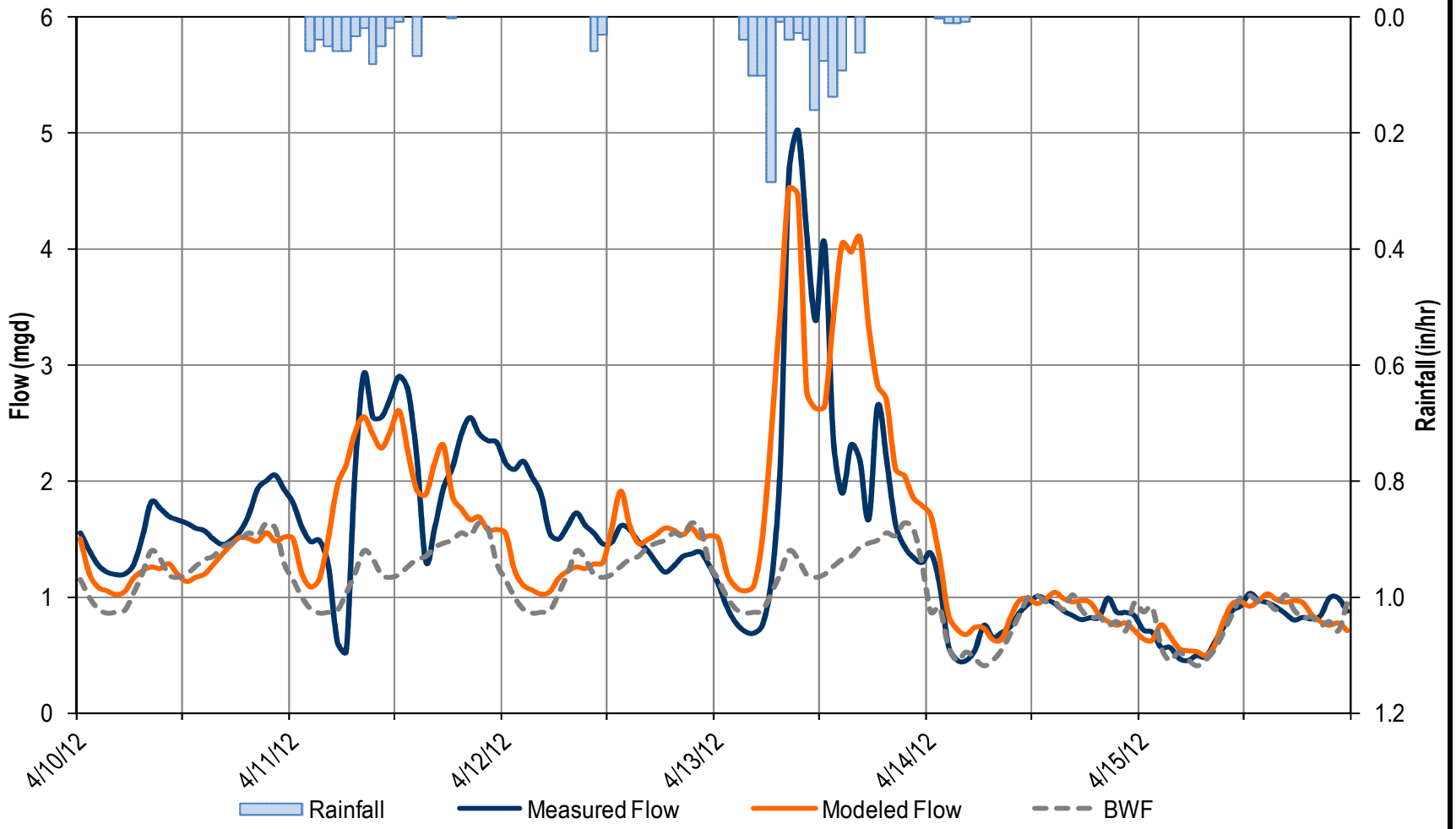



**Figure 4.11**
**WWF Calibration for Meter 23**
Wastewater Collection System Master Plan Update
City of Fresno

### 4.3.5 Model Calibration Summary

As documented in this section, there is excellent agreement between the field measured and hydraulic model simulated flows, depths, and velocities under both BWF and WWF conditions, and meets the generally accepted standards used to determine the adequacy of model calibration, according to the WaPUG. For this reason, the model is considered calibrated.

Chapter 5

# PLANNING CRITERIA AND DESIGN FLOWS

The capacity of the City of Fresno's (City's) wastewater collection system was evaluated based on the planning criteria defined in this chapter. The planning criteria address the collection system capacity, gravity sewer pipe slopes, and maximum allowable depth of flow within a sewer. This chapter also summarizes the existing and build out design flows.

## 5.1 GRAVITY SEWERS

Gravity sewer pipe capacities are dependent on many factors. The factors include roughness of the pipe, the chosen maximum allowable depth of flow downstream, and limiting velocity and slope. The following sections describe the factors that account for the determination of existing and future pipeline capacities in the City's collection system.

### 5.1.1 Manning Coefficient (n)

The manning coefficient 'n' is a friction coefficient that varies with respect to pipe material, size of pipe, depth of flow, smoothness of joints, root intrusion, and other factors. For sewer pipes, the manning coefficient typically ranges between 0.011 and 0.017, with 0.013 being a representative value used for system planning purposes. For this study, the existing manning's coefficients provided in the hydraulic model were used, and then refined as necessary during model calibration to accurately simulated field measured levels and velocities.

### 5.1.2 Peak Flow Criteria

The primary criteria used to identify capacity deficient sewers or to size new sewer improvements are the maximum flow depth to pipe diameter ratio (d/D), as well as the peak flow to pipe capacity ratio (q/Q). The d/D value is defined as the depth of flow (d) in a pipe during peak (design) flow conditions divided by the pipe's diameter (D). The q/Q is defined as the maximum flow rate in a pipe (q) divided by the maximum flow capacity of the pipe (Q). Based on Carollo Engineers, Inc's (Carollo's) experience, City staff input, and industry standards, the following criteria were used:

- **Flow Depth for Existing Sewers.** Peak flow criteria for existing sanitary sewers are established based on a number of factors, including the acceptable risk tolerance of the utility, local standards and codes, and other factors. Using a conservative criterion for evaluating existing sewers may lead to unnecessary replacement of existing pipelines. Conversely, lenient criteria could increase the risk of sanitary sewer overflows (SSOs). Ultimately, the maximum allowable peak flow criteria should be established to be as cost effective as possible while at the same time reducing the risk of SSOs to the greatest extent possible.

For Fresno, it was decided that a maximum q/Q ratio of 1.15 would be used to identify capacity deficient sewers. In other words, a pipeline was considered capacity deficient if the peak flow is 15-percent over capacity.

- **Flow Depth for New Sewers.** When designing sewer pipelines, it is common practice to adopt variable flow depth criteria for various pipe sizes. Design d/D ratios typically range from 0.5 to 0.92, with the lower values typically used for smaller pipes, which may experience flow peaks greater than design flow or blockages from debris, paper, or rags. Table 5.1 summarizes the criteria for the evaluation of existing sewers and for sizing new trunk lines. For pipelines less than 12-inches in diameter the max d/D value is 0.5 or 50 percent of the pipeline depth. Pipelines 12- to 18-inches in diameter, the max d/D is 0.67, and for pipelines larger than 18-inches in diameter the maximum d/D value is 0.75.

**Table 5.1 Maximum Flow Depth Criteria**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| **Maximum Flow Depth for Existing Sewers** | |
|---|---|
| Peak Wet Weather Flow: | Maximum q/Q = 1.15 |
| **Maximum d/D for New Sewers** | |
| Pipe Diameter (inches) | Maximum d/D Ratio (during Peak Flows) |
| Less than 12 | 0.50 |
| 12 to 18 | 0.67 |
| Larger than 18 | 0.75 |

### 5.1.3 Design Velocities and Minimum Slopes

In order to minimize the settlement of sewage solids, it is standard practice in the design of gravity sewers to specify that a minimum velocity of two feet per second (ft/s) be maintained when the pipeline is half-full. At this velocity, the sewer flow will typically provide self cleaning for the pipe. Due to hydraulics of a circular conduit, velocity of half-full flow in pipes approaches the velocity of nearly full flow in pipes.

Table 5.2 lists the recommended minimum slopes and their corresponding maximum flows for maintaining self-cleaning velocities (equal to or greater than two ft/s) when the pipe is flowing at its maximum depth (d/D ratio).

| Table 5.2 Minimum Slope for New Pipes<br>Wastewater Collection System Master Plan Update<br>City of Fresno | | | |
|---|---|---|---|
| Pipe Diameter (inches) | Minimum Slope[1][2] (feet/feet) | Calculated Flow at Maximum d/D[2][3] | |
| | | d/D | Maximum Flow (mgd) |
| 6 | 0.0050 | 0.50 | 0.127 |
| 8 | 0.0033 | 0.50 | 0.226 |
| 10 | 0.0025 | 0.50 | 0.353 |
| 12 | 0.0019 | 0.67 | 0.796 |
| 15 | 0.0014 | 0.67 | 1.24 |
| 18 | 0.0011 | 0.67 | 1.79 |
| 21 | 0.0009 | 0.75 | 2.84 |
| 24 | 0.0008 | 0.75 | 3.70 |
| 27 | 0.0007 | 0.75 | 4.68 |
| 30 | 0.0006 | 0.75 | 5.79 |
| 36 | 0.0006 | 0.75 | 9.65 |
| 42 | 0.0006 | 0.75 | 14.56 |

Notes:
(1) Recommended minimum slope for flows at a velocity greater than or equal to 2 ft/s.
(2) Manning's n = 0.013
(3) Calculated flow is determined using the minimum slope and maximum allowable d/D from Table 3.1.

### 5.1.4 Changes in Pipe Size

When a smaller sewer joins a large one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation. For planning purposes and designing new pipes, and in the absence of field data, sewer crowns are typically matched at the manholes.

## 5.2 LIFT STATIONS AND FORCE MAINS

Industry standard practice is to require that sewage lift stations have sufficient capacity to pump the Peak Dry Weather Flow (PDWF) and Peak Wet Weather Flow (PWWF) (whichever is greater) with the largest pump out of service (firm capacity).

Force main piping should be sized to provide a minimum velocity of 3 ft/s at the design flow rate of the lift station and no more than 8 ft/s. For the determination of head loss, the Hazen

Williams Equation is used with a C-factor of 110. These factors are typical for sewer system master planning purposes.

## 5.3 DESIGN FLOWS

This section summarizes the historic flows measured at the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) and presents the calculation of the design flows used to model the existing and future sewer collection system.

### 5.3.1 Historic RWRF Flows

In addition to the flow monitoring data (summarized in Chapter 3), this project reviewed historical influent flow data at the RWRF from 2008 to 2012 to help establish wastewater flow criteria.

Flow data from January 2008 through December 2012 are summarized in Table 5.3. Table 5.3 lists the average flow at the RWRF for each month from 2007 through 2012. In addition, Table 5.3 summarizes the annual average flow (i.e., the average day flow) and the base wastewater flow (BWF) for each of those years. Flows at the plant have declined since 2008, due to economic conditions, and possibly increased water conservation. Therefore, based on a review of the historical flow data at the RWRF, the years 2010 through 2012 were determined to be the most appropriate time period to define the "existing" flow condition. As shown in Table 5.3, the annual average flow ranged from 63.2 million gallons per day (mgd) in 2012 to 68.8 mgd in 2008, with a three-year average of 64.7 mgd. The BWF (defined as the average flow during the months of November through July) ranged from 62.6 mgd in 2012 to 68.1 mgd in 2008, with a three year average of 64.1 mgd. For this study, the existing BWF was defined as the three year BWF, which is equal to 64.1 mgd.

### 5.3.2 Wastewater Unit Flow Factors

In order to develop wastewater flow projections and allocate future flows to the collection system, relationships between land use and wastewater generation were developed. These relationships, called wastewater flow factors are established based on the average wastewater flow generated for each existing land use type. The land use flow coefficients were established to project the estimated BWF through build out of the City's general plan boundary.

Unit flow factors provide a means to estimate flow per acre for each land use category. Wastewater unit flow factors are expressed in gallons per day per acre (gpd/ac), applied to land use acreage for calculating average day flow generated from a particular land use. A unit flow factor was developed for each of the City's existing land use classifications. The resulting flow was entered in the sewer system hydraulic model.

**Table 5.3 Historical RWRF Flows**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Month | RWRF Influent Flow[(1)] (mgd) | | | | | 5-Year Average (2008-2012) | 3-Year Average (2010-2012) |
|---|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2010 | 2011 | 2012 | | |
| January | 70.0 | 66.2 | 62.9 | 65.9 | 62.4 | 65.5 | 63.7 |
| February | 67.4 | 66.8 | 64.8 | 65.1 | 64.1 | 65.6 | 64.7 |
| March | 66.0 | 65.3 | 64.7 | 64.2 | 62.1 | 64.5 | 63.7 |
| April | 66.8 | 65.1 | 66.1 | 63.1 | 62.0 | 64.6 | 63.7 |
| May | 67.5 | 65.5 | 64.8 | 63.3 | 62.2 | 64.7 | 63.4 |
| June | 68.7 | 66.5 | 65.3 | 64.3 | 63.1 | 65.6 | 64.2 |
| July | 69.7 | 65.6 | 65.7 | 63.5 | 62.8 | 65.5 | 64.0 |
| August | 70.7 | 66.0 | 67.5 | 65.3 | 65.3 | 67.0 | 66.0 |
| September | 71.6 | 66.9 | 68.9 | 66.5 | 64.6 | 67.7 | 66.6 |
| October | 70.9 | 67.3 | 68.7 | 65.9 | 64.9 | 67.5 | 66.5 |
| November | 68.7 | 64.2 | 67.8 | 64.8 | 62.5 | 65.6 | 65.0 |
| December | 67.6 | 64.0 | 68.7 | 62.8 | 61.8 | 65.0 | 64.4 |
| **Average Annual Flow** | **68.8** | **65.8** | **66.3** | **64.6** | **63.2** | **65.7** | **64.7** |
| **BWF (Nov.-July)** | **68.1** | **65.5** | **65.6** | **64.1** | **62.6** | **65.2** | **64.1** |
| **Minimum Month Flow** | **66.0** | **64.0** | **62.9** | **62.8** | **61.8** | **63.5** | **62.5** |
| **Maximum Month Flow** | **71.6** | **67.3** | **68.9** | **66.5** | **65.3** | **67.9** | **66.9** |

Notes:
(1) Source: City influent metering records.

Flow factors for residential areas typically range between 250 to 4,000 gallons per day per acre (gpd/ac), and commercial and industrial areas may range from 600 to 3,000 gpd/ac or higher. Open space land uses were assumed to generate negligible amounts of sewage flow. The factors were developed using the following procedure:

- Average flows for each flow metering tributary area were derived from the flow monitoring data (see Chapter 3).
- Flows associated with each of the City's existing significant industrial users (SIU)s were identified based on meter data provided by the City. A summary of the average flows associated with each SIU is provided in Appendix D. Each SIU was assigned to the appropriate flow metering tributary area and its average flows were subtracted

from the average flows measured during the flow monitoring period. Flows associated with the SIUs were input into the model as “point loads”.

- Using Geographic Information Systems (GIS), the acres for each existing land use type contained in each flow monitoring tributary area were calculated, excluding the SIU areas and vacant areas. According to City staff, the City’s vacant land shape file was is out of date. For this reason, Carollo examined and revised the City’s vacant land use database by comparing the vacant land shape file against a recent aerial photograph.
- Preliminary flow factors for each land use type are estimated based on the approximate number of dwelling units per acre, the assumed per capita wastewater generation rates, and the typical number of people per dwelling unit for each land use type.
- The flow factors for each flow metering tributary were then adjusted up or down (balanced) so that the calculated average flows from each tributary match what was measured from the flow monitoring data.
- Once the flow factors for each of the flowmeter tributary areas were balanced, the weighted average of the coefficients for each existing land use type was calculated based on the acreage contribution from each metering tributary area.

The calibrated wastewater flow factors developed for existing land uses are summarized in Table 5.4. A wastewater flow balance was performed to test the accuracy of the flow factor estimates. As with most cities throughout California, residential land use makes up the majority of developed land and wastewater flow. For Fresno, residential customers within the City proper (excluding Clovis) make up approximately 63 percent of the current flow (40.2 million gallons per day [mgd]). Additionally, Fresno’s industrial sector also makes up a significant portion of the City’s current flow. Industrial customers account for 17 percent of the current BWF (11.3 mgd) and a greater percentage in the summer months when industrial flows increase. The City of Clovis flows currently account for 8 percent of the existing flow (5.1 mgd), although the City of Clovis is entitled to discharge up to roughly 8.9 mgd. Commercial customers account for roughly 6 percent of the current flow (3.8 mgd), and other land uses, such as public land use areas, account for the remaining 5 percent of current flow (3.4 mgd).

**Table 5.4 Wastewater Flow Balance**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Land Use Classification | Current Sewer Service Area and Existing Land Use | | |
|---|---|---|---|
| | Wastewater Flow Factor (gpd/ac) | Land Use Area (acre) | Base Wastewater Flow (gpd) |
| **Residential** | | | |
| Rural Density | 250 | 1,216 | 0.30 |
| Low Density (1-3 DU/acre) | 600 | 1,138 | 0.68 |
| Medium Low Density (3.5 -6 DU/acre) | 900 | 10,361 | 9.33 |
| Medium Density (5-12 DU/acre) | 1,700 | 11,143 | 18.94 |
| Medium High Density (12-16 DU/acre) | 2,800 | 2,039 | 5.71 |
| High Density (30-45 DU/acre) | 4,000 | 1,316 | 5.26 |
| **Subtotal** | | **27,212** | **40.2** |
| **Commercial** | | | |
| Community | 800 | 604 | 0.48 |
| General Heavy | 950 | 1,054 | 1.00 |
| Neighborhood | 1,660 | 569 | 1.06 |
| Neighborhood Limited | 1,410 | 3 | 0.94 |
| Office | 1,000 | 1,057 | 0.00 |
| Professional Services Office | 800 | 100 | 0.08 |
| Regional | 800 | 218 | 0.17 |
| Recreational | 600 | 119 | 0.07 |
| Storage Limited | 0 | 44 | 0.00 |
| **Subtotal** | | **3,768** | **3.8** |
| **Public Facilities** | | | |
| Airport | 300 | 1,065 | 0.32 |
| College | 0 | 151 | 0.00 |
| High school | 700 | 475 | 0.33 |
| Elementary School and High School | 700 | 141 | 0.10 |
| Middle School | 700 | 233 | 0.16 |
| Elementary School and Middle School | 700 | 188 | 0.13 |
| Elementary School | 700 | 735 | 0.51 |
| Special School | 700 | 42 | 0.03 |
| Cemetery | 0 | 165 | 0.00 |
| Church | 500 | 545 | 0.27 |
| Community Activity Center | 850 | 8 | 0.01 |
| Neighborhood Center | 1,000 | 5 | 0.00 |
| Convention Center | 850 | 17 | 0.01 |
| Fairgounds | 500 | 90 | 0.04 |
| Fire Station | 850 | 14 | 0.01 |
| Government Offices | 1,000 | 141 | 0.14 |
| County Court House Central Area | 1,500 | 14 | 0.02 |
| Hospital | 4,000 | 137 | 0.55 |
| Medical Center | 3,000 | 10 | 0.03 |
| Convalescent Hospital | 3,000 | 64 | 0.19 |
| Military | 850 | 60 | 0.05 |
| Mobile Home Park | 500 | 388 | 0.19 |
| Municipal Service Center | 1,300 | 37 | 0.05 |
| Post Office | 1,200 | 23 | 0.03 |
| Public Facility | 1,200 | 21 | 0.03 |
| Public/Quasi-Public Facility | 850 | 43 | 0.04 |
| Pump Station | 0 | 44 | 0.00 |
| **Subtotal** | | **4,854** | **3.3** |
| **Open Space** | | | |
| Open Space | 0 | 60 | 0.00 |
| Recreational Use/Clear Zone | 0 | 16 | 0.00 |
| Ag | 0 | 233 | 0.00 |
| Canal | 0 | 38 | 0.00 |
| Community Park | 0 | 28 | 0.00 |
| Golf Course | 150 | 597 | 0.09 |
| Lake or Pond | 0 | 54 | 0.00 |
| Multi-Use | 0 | 101 | 0.00 |
| Neighborhood Park | 0 | 212 | 0.00 |
| Recreational Park | 0 | 59 | 0.00 |
| Recreational Use | 0 | 12 | 0.00 |
| Regional Park | 0 | 154 | 0.00 |
| Parking | 0 | 78 | 0.00 |
| Pg&e Substation | 500 | 117 | 0.06 |
| Ponding Basin | 0 | 407 | 0.00 |
| Ponding Basin/Park | 0 | 108 | 0.00 |
| **Subtotal** | | **2,281** | **0.1** |
| **Other** | | | |
| Roads/ Canals/ Highways | | 16,545 | 0.00 |
| Vacant | 0 | 2,303 | 0.00 |
| **Subtotal** | | **18,848** | **0.0** |
| **Industrial/Clovis** | | | |
| Light Industrial | 620 | 2,979 | 1.85 |
| Heavy Industrial | 1,160 | 1,291 | 1.50 |
| Metered Industrial Users | - | - | 7.95 |
| City of Clovis | - | - | 5.12 |
| **Subtotal** | | **4,270** | **16.4** |
| **Total** | | | |
| **Total** | **--** | **61,234** | **63.9** |

### 5.3.3 Existing and Projected Base Wastewater Flow

Developing an accurate estimate of the future quantity of wastewater generated at build out of the collections system is an important step in maintaining and sizing sewer system facilities, for both existing conditions and future developments. In general, the future BWF for build out of the study area was determined by multiplying the wastewater flow factors by the projected land use acreage.

As noted in Chapter 2, the City's General Plan land use can be broken down into "Areas of Change" and "Areas of Stability." Areas of Change are generally defined as areas that contribute to a net increase in wastewater flow in the future, and include densification areas (i.e., Downtown, and densification corridors), infill areas (i.e., development of vacant parcels), and new growth areas (i.e., expansion of the wastewater service area). Wastewater flows associated with the "Areas of Change" were estimated to be 71.8 mgd, which was estimated by multiplying the appropriate wastewater unit flow factor by the land use acreage identified in Table 5.5.

Areas of Stability include the remaining land use areas within the existing sewer service area. The existing BWF associated with these "Areas of Stability" is estimated to be approximately 46.6 mgd, which includes 8.2 mgd of flow from the existing metered industrial customers, but not including the City of Clovis. City of Clovis flows at build out were assumed to be equal to their maximum permit capacity, as well as 3 mgd of additional flow associated with the future Leonard Trunk. In total, the City of Clovis wastewater flows are assumed to be 11.9 mgd at build out.

As shown in Table 5.5, the build out BWF is projected to be approximately 129.9 mgd.

### 5.3.4 Existing and Project PDWF

The PDWF is the highest hourly flow that occurs during dry weather conditions. In Fresno, the PDWF condition occurs in the late summer when industry is discharging at its maximum rate. Based on a review of the historical RWRF flow data (see Table 5.3), the highest monthly flow rate at the RWRF between 2010 and 2012 was 68.9 mgd (September 2010). The existing PDWF was derived throughout the system based on the hydraulic modeling results. For the PDWF model run, model flows were increased for each SIU based on the maximum monthly flow for each user (see Appendix C), and the remaining flows were scaled up to match 68.9 mgd (daily average flow). In addition, for the PDWF scenario, the City of Clovis flows were set to their maximum permitted discharge rates. From the modeling results, the existing PDWF is estimated to be 88.5 mgd. The build out PDWF was generated using this approach. At build out, the PDWF is estimated to increase to 164.7 mgd.

**Table 5.5 Future BWF Projections**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Land Use Type | Wastewater Flow Coefficient (gpd/ac) | Land Use Area Totals | | | | BWF by Land Use Type | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Current Service Area | | New Growth Areas (acres) | Total (acres) | Current Service Area | | New Growth Areas (mgd) | Total (mgd) |
| | | Infill (acres) | Redevelopment (acres) | | | Infill (mgd) | Redevelopment (mgd) | | |
| **Residential** | | | | | | | | | |
| Low Density (1-3 DU/acre) | 600 | 75 | 0 | 5,089 | 5,164 | 0.0 | 0.0 | 3.1 | **3.1** |
| Medium Low Density (3.5 -6 DU/acre) | 900 | 191 | 4 | 2,226 | 2,421 | 0.2 | 0.0 | 2.0 | **2.2** |
| Medium Density (5-12 DU/acre) | 1,700 | 264 | 29 | 6,990 | 7,282 | 0.4 | 0.0 | 11.9 | **12.4** |
| Medium High Density (12-16 DU/acre) | 2,800 | 89 | 16 | 531 | 636 | 0.2 | 0.0 | 1.5 | **1.8** |
| Urban Neighborhood (16-30 DU/acre) | 3,500 | 63 | 121 | 2,001 | 2,184 | 0.2 | 0.4 | 7.0 | **7.6** |
| High Density (30-45 DU/acre) | 4,000 | 9 | 20 | 252 | 281 | 0.0 | 0.1 | 1.0 | **1.1** |
| **Commercial** | | | | | | | | | |
| Main Street | 800 | 4 | 67 | 0 | 72 | 0.0 | 0.1 | 0.0 | **0.1** |
| Community | 800 | 106 | 507 | 436 | 1,050 | 0.1 | 0.4 | 0.3 | **0.8** |
| Recreation | 500 | 0 | 0 | 8 | 8 | 0.0 | 0.0 | 0.0 | **0.0** |
| General | 950 | 73 | 0 | 75 | 147 | 0.1 | 0.0 | 0.1 | **0.1** |
| Highway and Auto | 950 | 31 | 50 | 169 | 250 | 0.0 | 0.0 | 0.2 | **0.2** |
| Regional | 800 | 8 | 136 | 186 | 331 | 0.0 | 0.1 | 0.1 | **0.3** |
| **Employment** | | | | | | | | | |
| Office | 1,000 | 217 | 5 | 226 | 448 | 0.2 | 0.0 | 0.2 | **0.4** |
| Business Park | 800 | 12 | 63 | 743 | 817 | 0.0 | 0.1 | 0.6 | **0.7** |
| Regional Business Park | 800 | 28 | 126 | 1,662 | 1,817 | 0.0 | 0.1 | 1.3 | **1.5** |
| Light Industrial | 620 | 362 | 2 | 1,781 | 2,145 | 0.2 | 0.0 | 1.1 | **1.3** |
| Heavy Industrial | 5,000 | 148 | 7 | 2,368 | 2,522 | 0.7 | 0.0 | 11.8 | **12.6** |
| **Mixed Use** | | | | | | | | | |
| Corridor/Center Mixed Use | 2,800 | 78 | 1,139 | 829 | 2,046 | 0.2 | 3.2 | 2.3 | **5.7** |
| Regional Mixed Use | 3,300 | 19 | 613 | 321 | 952 | 0.1 | 2.0 | 1.1 | **3.1** |
| Neighborhood Mixed Use | 2,300 | 3 | 112 | 15 | 131 | 0.0 | 0.3 | 0.0 | **0.3** |
| **Open Space** | | | | | | | | | |
| Clear Zone | 0 | 2 | 0 | 4 | 7 | 0.0 | 0.0 | 0.0 | **0.0** |
| Commercial-Recreational | 0 | 1 | 0 | 0 | 1 | 0.0 | 0.0 | 0.0 | **0.0** |
| Community Park | 0 | 0 | 0 | 40 | 41 | 0.0 | 0.0 | 0.0 | **0.0** |
| Flood Control Project | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Golf Course | 150 | 8 | 0 | 418 | 426 | 0.0 | 0.0 | 0.1 | **0.1** |
| Lake, Pond | 0 | 0 | 0 | 32 | 32 | 0.0 | 0.0 | 0.0 | **0.0** |
| Multi-Use | 0 | 46 | 0 | 2,053 | 2,098 | 0.0 | 0.0 | 0.0 | **0.0** |
| Neighborhood Park | 0 | 17 | 0 | 61 | 79 | 0.0 | 0.0 | 0.0 | **0.0** |
| Outdoor Environmental Education Area | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Open Space | 0 | 0 | 0 | 339 | 339 | 0.0 | 0.0 | 0.0 | **0.0** |
| Park | 0 | 11 | 12 | 1,441 | 1,464 | 0.0 | 0.0 | 0.0 | **0.0** |
| Ponding Basin | 0 | 0 | 0 | 894 | 894 | 0.0 | 0.0 | 0.0 | **0.0** |
| Ponding Basin (Park Use) | 0 | 0 | 15 | 0 | 15 | 0.0 | 0.0 | 0.0 | **0.0** |
| Regional Park | 0 | 44 | 43 | 642 | 729 | 0.0 | 0.0 | 0.0 | **0.0** |
| **Public Facilities** | | | | | | | | | |
| Public/Quasi-Public Facility | 850 | 47 | 88 | 535 | 670 | 0.0 | 0.1 | 0.5 | **0.6** |
| Special School | 700 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Elementary School | 700 | 4 | 12 | 236 | 252 | 0.0 | 0.0 | 0.2 | **0.2** |
| Elementary & Middle School | 700 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Elementary, Middle, & High School | 700 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Middle School | 700 | 0 | 17 | 115 | 132 | 0.0 | 0.0 | 0.1 | **0.1** |
| High School | 700 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| College | 700 | 8 | 0 | 0 | 8 | 0.0 | 0.0 | 0.0 | **0.0** |
| School with Park | 700 | 0 | 0 | 596 | 596 | 0.0 | 0.0 | 0.4 | **0.4** |
| Airport | 300 | 0 | 0 | 86 | 86 | 0.0 | 0.0 | 0.0 | **0.0** |
| Cemetary | 0 | 0 | 0 | 61 | 61 | 0.0 | 0.0 | 0.0 | **0.0** |
| Church | 500 | 12 | 24 | 22 | 58 | 0.0 | 0.0 | 0.0 | **0.0** |
| Community Activity Center | 850 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Convalescent Hospital | 3,000 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Fairgrounds | 500 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Fire Station | 850 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Government Offices | 1,000 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Hospital | 4,000 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Medical Center | 3,000 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Neighborhood Center | 1,000 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| PG&E Substation | 500 | 0 | 0 | 34 | 34 | 0.0 | 0.0 | 0.0 | **0.0** |
| Police Dressing Station | 1,200 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Water Recharge Basin | 0 | 0 | 0 | 288 | 288 | 0.0 | 0.0 | 0.0 | **0.0** |
| Wastewater Treatment Facility | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | **0.0** |
| **Buffer** | | | | | | | | | |
| Buffer (Ag) | 50 | 0 | 0 | 736 | 736 | 0.0 | 0.0 | 0.0 | **0.0** |
| **Downtown** | | | | | | | | | |
| Central Business District | 7,900 | 23 | 244 | 0 | 267 | 0.2 | 1.9 | 0.0 | **2.1** |
| Civic Center | 4,000 | 0 | 37 | 0 | 37 | 0.0 | 0.1 | 0.0 | **0.1** |
| Town Center | 5,200 | 1 | 54 | 0 | 55 | 0.0 | 0.3 | 0.0 | **0.3** |
| Neighborhood Center | 3,200 | 11 | 72 | 0 | 84 | 0.0 | 0.2 | 0.0 | **0.3** |
| Chinatown District | 4,800 | 5 | 24 | 0 | 29 | 0.0 | 0.1 | 0.0 | **0.1** |
| Cultural Arts District | 1,000 | 13 | 56 | 0 | 69 | 0.0 | 0.1 | 0.0 | **0.1** |
| Corridor General | 3,400 | 24 | 442 | 0 | 466 | 0.1 | 1.5 | 0.0 | **1.6** |
| Downtown Neighborhoods | 2,800 | 101 | 2,482 | 0 | 2,584 | 0.3 | 7.0 | 0.0 | **7.2** |
| Special Districts | 2,000 | 82 | 815 | 0 | 897 | 0.2 | 1.6 | 0.0 | **1.8** |
| Public Facility | 1,200 | 0 | 150 | 0 | 150 | 0.0 | 0.2 | 0.0 | **0.2** |
| Open Conservation | 0 | 0 | 178 | 0 | 178 | 0.0 | 0.0 | 0.0 | **0.0** |
| South Stadium District | 6,900 | 16 | 99 | 0 | 115 | 0.1 | 0.7 | 0.0 | **0.8** |
| **Other** | | | | | | | | | |
| Street, Rail, Canal, Etc. | 0 | 41 | 2,035 | 3,070 | 5,146 | 0.0 | 0.0 | 0.0 | **0.0** |
| **Total Infill, Redevelopment Areas, and Growth Areas** | | | | | | | | | |
| Total | -- | 2,299 | 9,919 | 37,614 | 49,832 | 3.8 | 20.7 | 47.0 | **71.5** |

| **Grand Total BWF at Build Out** | |
|---|---|
| Existing BWF from SIUs, mgd: | 8.2 |
| City of Clovis (Max Permit + 3 mgd in Leonard Trunk), mgd: | 11.9 |
| BWF from Existing "Areas of Stability", mgd: | 38.4 |
| BWF from Infill, Redevelopment, and Growth Areas, mgd: | 71.5 |
| **Grand Total BWF at Build Out:** | **129.9** |

### 5.3.5 Design Storm

Design storms are rainfall events used to analyze the performance of a collection system under extreme wet weather events. The first step in the development of the design storm is to define its recurrence interval and rainfall duration. The recurrence interval is based on the probability that a given rainfall event will occur or be exceeded in any given year. For example, a “100-year storm” means there is a 1 in 100 chance that a storm as large or larger than this event will occur at a specific location in any year.

Duration is the length of time in which the rainfall occurs. It is an industry standard in California to use the 10-year, 24-hour design storm for analyzing wastewater collection system performance during PWWF conditions. For this reason, this study defines the design storm as a 10-year, 24-hour rainfall event. The 10-year, 24-hour design storm volume is available from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, which revealed that a 10-year storm would have a total volume of 2.06-inches.

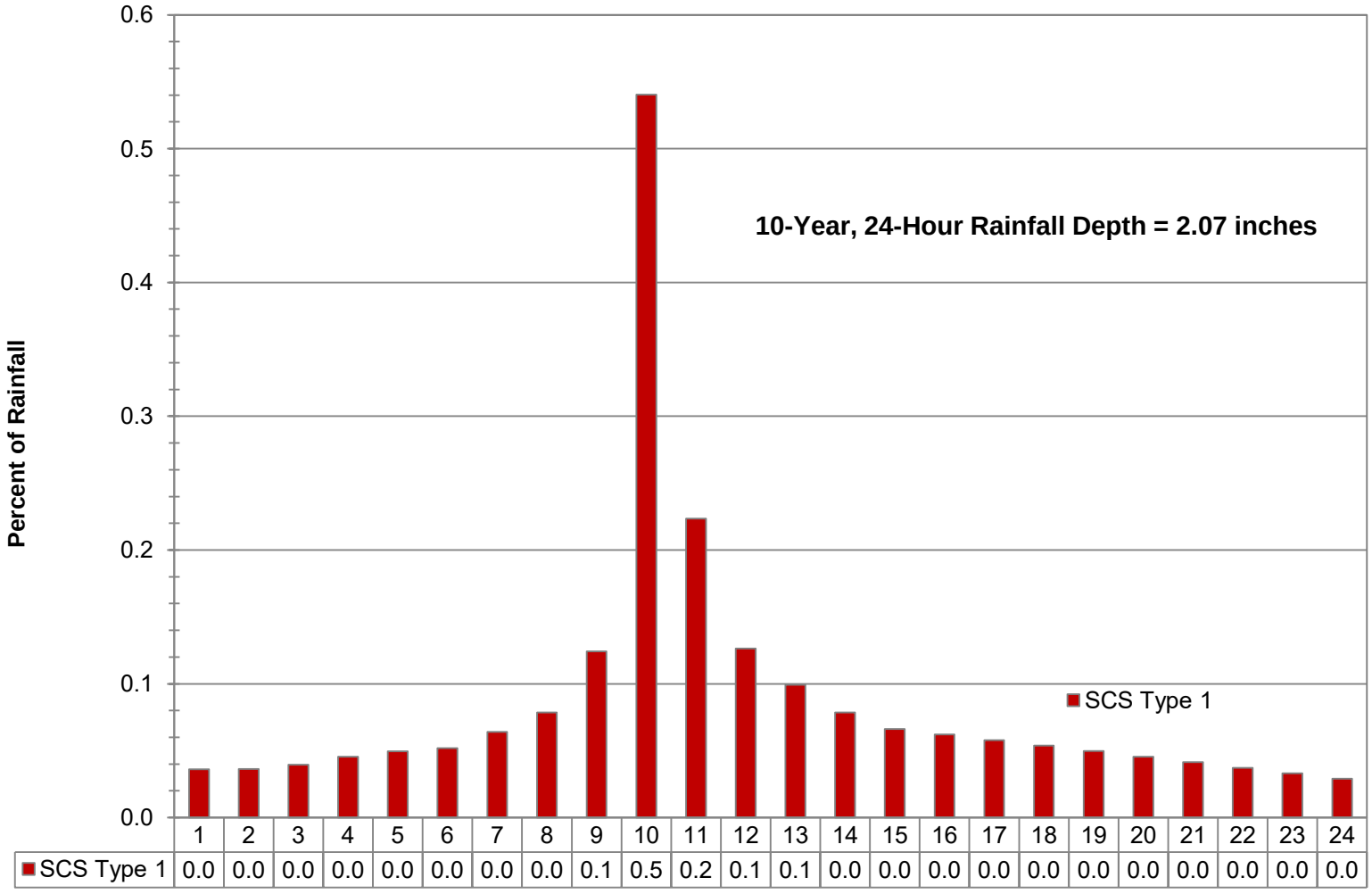
Once the design storm recurrence interval, duration, and associated rainfall volume have been determined, the next step in defining the design storm is to distribute the total rainfall over duration of the storm. To accomplish this, an industry standard synthetic rainfall distribution (SCS Type 1, developed by the Natural Resource Conservation Service [NRCS]) was used. Figure 5.1 shows the 10-year, 24-hour design storm.

### 5.3.6 Existing and Projected Peak Wet Weather Flow

The PWWF is the highest observed hourly flow that occurs following the design storm event. Wet weather infiltration and inflow (I/I), which occurs during and after rainfall events, increases flows in the collection system. PWWF is typically used for designing sewers and lift stations. The City’s sewers and lift stations were evaluated based on their capacity to convey the PWWF.

The existing PWWF was derived throughout the system based on the hydraulic modeling results. This was accomplished by routing the 10-year, 24-hour design storm through the hydraulic model, which was calibrated to both dry weather and wet weather conditions. Detailed information regarding the calibration of the City’s hydraulic model is provided in Chapter 4.

Similar to the existing PWWF, the build out PWWF was derived by routing a 10-year, 24 hour design storm through the hydraulic model. Peak I/I rates for future growth areas (e.g., vacant areas within the existing service area, growth areas outside of the current service area, etc.) were developed based on a peak I/I rate of 370 gpd/ac, based on the peak I/I rates experienced in Basin 2, which is considered the most representative area for new growth within the City.




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCS Type 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.5 | 0.2 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

**Figure 5.1**
**10-Year, 24-Hour Design Storm**
Wastewater Collection System Master Plan Update
City of Fresno

Table 5.6 presents a summary of the existing and build out BWF. In addition to the build out BWF, Table 5.6 includes the existing and build out peak dry weather flow (PDWF) and peak wet weather flow (PWWF). As shown in Table 5.6, the City's BWF is projected to roughly double from 64.1 mgd to 129.9 mgd by build out. The PDWF is projected to increase from 88.5 mgd to about 164.7 mgd (an increase of approximately 86-percent), and the PWWF is projected to increase from 123.9 mgd to about 202.4 mgd by build out (an increase of approximately 63 percent). Overall, the City's PWWF to ADWF peaking factor is projected to decrease from roughly 1.93 to 1.56, which is typical for sanitary sewer collection systems. Newer sewers tend to have less I/I response than older areas of the system, primarily due to better construction methods. Furthermore, flow attenuation also tends to dampen out flow peaks as collection systems expand. In addition, a significant portion of the future increase in wastewater flows at the City is associated with densification, which would not include a corresponding increase in I/I.

**Table 5.6 Current and Projected Wastewater Flows**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Year | BWF(1) (mgd) | PDWF(2) (mgd) | PDWF Peaking Factor | PWWF(3) (mgd) | PWWF Peaking Factor |
|---|---|---|---|---|---|
| Existing | 64.1 | 88.5 | 1.38 | 123.9 | 1.93 |
| Build Out | 129.9 | 164.7 | 1.27 | 202.4 | 1.56 |

Notes:
(1) BWF = Base Wastewater Flow.
(2) PDWF = Peak Dry Weather Flow
(3) PWWF = Peak Wet Weather Flow.

# CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS

This chapter discusses the hydraulic evaluation of the sewer collection system and the proposed projects that correct capacity deficiencies and serve future users.

## 6.1 CAPACITY EVALUATION

This section summarizes the results of the capacity evaluation of the City of Fresno's (City's) wastewater collection system, which includes a gravity pipeline capacity evaluation, as well as a lift station capacity evaluation. The evaluation considers both current and projected peak dry weather flow (PDWF) and peak wet weather flow (PWWF) conditions.

### 6.1.1 Gravity Collection System Evaluation

Following the dry and wet weather flow calibration, which is summarized in detail in Chapter 4, a capacity analysis of the existing and future collection system was performed. The capacity analysis entailed identifying areas in the sewer system where flow restrictions occur or where pipe capacity is insufficient to convey PDWFs or PWWFs. Sewers that lack sufficient capacity to convey these flows create bottlenecks in the collection system that can potentially cause sanitary sewer overflows (SSOs). The sewer system was evaluated based on planning criteria presented in Chapter 5.

Per staff's request, it is recommended that each identified project be further investigated using temporary flow monitoring during the preliminary design phase of the project. This will not only further define the extent of the determined deficiency, but also allows the designer to have a better understanding of potential bypass flows which will help mitigate problems during the construction phase.

This section discusses the locations of current and projected hydraulic deficiencies resulting from flows exceeding the maximum flow depth criteria.

- PDWF Analysis:
  - Existing System. For the existing sewer collection system, the PDWF was routed through the hydraulic model. In accordance with the established flow depth criteria for existing sewers, pipelines where the maximum depth to full flow depth (d/D) ratio that exceeded 1.0 were flagged. Each pipeline with a maximum d/D in excess of 1.0 was reviewed on a case-by-case basis to determine if a capacity improvement project was warranted. Some pipelines with very shallow or flats slopes may exceed the 1.0 d/D threshold but only cause minor surcharging. Each of these cases was evaluated to determine the risk of SSO, and some pipeline reaches with slight surcharging were allowed. The locations of the capacity deficient pipelines for current PDWF conditions are shown on Figure 6.1 in red.

Dickenson Ave
West Lawn Ave
Chateau Fresno Ave
Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave
Del Rey Ave
Bethel Ave
Academy Ave
Madsen Ave

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave
Central Ave
American Ave

NFWRF
LS05
LS06
LS04
LS10
LS16
LS14
LS12
LS03
LS15
LS13
LS18
LS02
LS01
LS20
RWRF
99
41
168
180
Direct Storm Drain Connections to be Removed
GALLO

## Legend

**Existing Wastewater Collection System**

- Lift Stations

**Pipelines**

- 8" and Smaller
- 10" and Larger

**Proposed Improvements**

- Existing System
- Future System
- Development
- Gallo Winery I/I Reduction Program
- Streets
- Sphere of Influence
- City Limits
- Existing Sewer Service Area

N

0 12,500 25,000 Feet

**Figure 6.1**
**Proposed Collection System Capacity Improvements**
Wastewater Collection System Master Plan Update
City of Fresno

DPU

carollo
Engineers...Working Wonders With Water®

- Build Out System. The build out system analysis was performed in a manner similar to the existing system analysis. The purpose of the build out system evaluation is to verify that the existing system improvements were appropriately sized to convey build out PDWFs, and to identify the locations of sewers that are adequately sized to convey existing PDWFs, but cannot convey build out PWWFs. At the time of this Master Plan, there are no known planned future industrial users that will add significant PDWFs to the collection system causing system deficiencies. Should new industrial loads increase in the future, a project-by-project analysis is recommended to assure the collection system has adequate capacity.

- **PWWF Analysis:**
  - Existing System. For the existing sewer collection system, the PWWF was routed through the hydraulic model. In accordance with the established flow depth criteria for existing sewers, manholes where the maximum flow to full flow (q/Q) ratio that exceeded 1.15 were flagged. Each pipeline with a maximum q/Q in excess of 1.15 was reviewed on a case-by-case basis to determine if a capacity improvement project was warranted. As with the PDWF analysis, some pipelines with very shallow or flats slopes may exceed the 1.15 q/Q threshold but only cause minor surcharging. In these cases, these pipelines were removed from the list of deficiencies.

    In general, the City's collection system has sufficient capacity to convey current PWWFs without exceeding the established q/Q ratio. However, there are a few areas where wet weather capacity restrictions are present and required mitigation. The location of these capacity deficient pipelines for current PWWF conditions are shown on Figure 6.1 in red.

    Following the completion of the existing system analysis, improvement projects and alternatives were identified in order to mitigate existing system pipeline capacity deficiencies. The recommended improvement projects are discussed in greater detail in Section 6.2 and project specific detail sheets will be provided in Appendix F. In accordance with the established planning criteria, new sewer pipelines were sized such that the maximum flow depth to pipe diameter ratio (d/D) did not exceed the values summarized in Chapter 5. In other words, flows in recommended improvements were not allowed to surcharge during PWWF conditions.
  - Build Out System. The build out system analysis was performed in a manner similar to the existing system analysis. The purpose of the build out system evaluation is to verify that the existing system improvements were appropriately sized to convey build out PWWFs, and to identify the locations of sewers that are adequately sized to convey existing PWWFs, but cannot convey build out PWWFs. Additionally, new trunk sewers were added to the hydraulic model and sized to service major growth areas beyond the current City sewer service area.

At build out, the City's wastewater flows are expected to increase substantially. As such, there are some areas of the existing collection system that cannot convey the build out PWWF within the established q/Q ratio. These pipelines are shown on Figure 6.1 in orange. The locations of new trunk sewers to service future growth are also shown in green.

### 6.1.2 Lift Station Evaluation

The City's hydraulic model includes 15 lift stations that service the major trunk system (typically pipes 10-inches and larger sewers) and smaller developments (less than 10-inch diameter). The hydraulic model does not have flows routed to a majority of these lift stations. However, the lift stations that do have flows allocated to them were determined to have sufficient capacity to convey the existing and future PWWF.

It is recommended that the capacity evaluation be updated when flows allocations within the hydraulic modeling software have been modified such that the capacity of the additional lift station can be evaluated. In addition, the City does not currently collect supervisory control and data acquisition (SCADA) data for their lift stations. Were feasible, it is recommended that upgrades be performed to allow for proper flow monitoring data acquisition, which will help confirm lift station capacity and monitor lift station performance.

## 6.2 COLLECTION SYSTEM IMPROVEMENTS

Figure 6.1 illustrates the proposed sewer improvements required to correct existing deficiencies and to serve future users. Detail maps for each of the proposed improvements are provided in Chapter 8 for clarity. Table 6.1 provides more detail of each improvement. Both Figure 6.1 and Table 6.1 should be used together to locate the proposed improvement and to gain details of the improvement (length, diameter, street location, etc.). The improvement identification number links the figure and table. The improvements summarized in Table 6.1 use a cross-referenced number system. The columns used in Table 6.1 refer to the following:

- **Improvement ID**: Assigned unique identifier associated with each improvement project. This is an alphanumeric number that starts with one letter indicating the type of improvement C = Capacity, D = Development, NCFWRF = North Central Fresno Wastewater Reclamation Facility, SEDA = Southeast Development Area Treatment Facility, and each continues with a number indicating different projects.
- **Type of improvement**: Pipelines, lift stations, force mains, and jacked steel casings.
- **Street Description**: Street in which the improvement is proposed.
- **Limits**: Description of the beginning and end of a proposed pipeline project.
- **Existing Size**: This is the size of the existing pipeline/facility. It represents the diameter of the existing pipelines (inches), and the total capacity of lift stations (million gallons per day [mgd]).

- **Proposed Size**: This is the size of the proposed improvement. It represents the diameter of the proposed pipelines (inches), and the total capacity of lift stations or plants (mgd). Additionally, for jacked steel casings, the size of the casing as well as the carrier pipe are indicated (inches).
- **Replace/New**: Indicates whether the proposed improvement is a replacement pipeline, parallel pipeline, or a new facility.
- **Length**: Estimated length of the proposed improvement (in feet). It should be noted that the length estimates do not account for re-routing the alignment to avoid unknown conditions.

When an increase to capacity is required, existing sewers can be upgraded or a parallel relief sewer can be constructed. For the purposes of this study, unless otherwise stated, we assumed that a capacity deficient sewer would be upgraded to a larger diameter. The upgraded pipeline generally followed the same slope as the existing pipeline, with the exception where survey data revealed negative or flat slopes in an existing alignment.

In essence, there are two alternatives for every trunk sewer project, but the decision to replace or construct a parallel sewer should be made during the preliminary design phase.

During the preliminary design phase, the existing sewer should be inspected by closed circuit television (CCTV) to determine its structural condition. If severely deteriorated, the existing sewer should be upgraded using a replacement pipe. If moderately deteriorated, slip lining or cured-in-place pipe lining can rehabilitate the existing sewer.

The proposed improvements that will serve future users are sized for build-out conditions. As the City continues to grow, it is recommended that the proposed pipeline diameters be constructed so that the facilities have sufficient capacity for build out conditions. Building a smaller interim project with the plans of upsizing in the future to account for further growth is not recommended due to the extended useful life of the improvements proposed herein. The proposed pipe diameter represents the ultimate diameter for build out conditions.

### 6.2.1 Existing versus Future Improvement

An existing deficiency is one where the existing facility's capacity is insufficient to meet the planning criteria (e.g., pipeline upgrades required to prevent severe surcharging during the design wet weather event) for existing users. If a project was proposed to correct an existing deficiency exclusively, then existing users were assigned 100 percent of the project's benefit, and therefore, 100 percent of the costs.

**Table 6.1 Proposed Collection System Improvements**
**Collection System Master Plan**
**City of Fresno**

| Project Description | | | | | Project Size | | | | Project Phasing | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Improv. ID | Type of Improv. | Description/Street | Description/Limits | Detail Sheet No. (Appendix xx) | Existing Size (in.) | Proposed Size (in) | Replace/ New | Length (ft) | Phase 1 (2014-2020) | Phase 2 (2020-2025) | Phase 3 (2025-2030) | Phase 4 (2030-2035) |
| **Existing Improvements** | | | | | | | | | | | | |
| C-1A | Gravity | Hammond Avenue | Between Blackstone Ave. and Abby St. | 1 | 20 | **24** | Replace | 390 | x | | | |
| C-1B | Gravity | Abby Street | From Hammond Ave. to La Salle Ave. | 2 | 20 | **24** | Replace | 1,619 | x | | | |
| C-2A | Gravity | Glenn Avenue | From Brewer Ave. to Thomas Ave. | 3 | 24 | **27** | Replace | 390 | x | | | |
| C-2B | Gravity | Glenn Avenue | From HWY 180 to Voorman Ave. | 4 | 24 | **27** | Replace | 2,594 | | x | | |
| C-3 | Gravity | Glenn Avenue / N Street | From Voorman Ave. to Tuolumne St. | 5 | 27 | **30** | Replace | 1,343 | | | x | |
| C-4 | Gravity | Monterey Avenue | From Fulton Street to N Street | 6 | 6 | **10** | Replace | 1,820 | | | x | |
| C-5A | Gravity | Eighth Street | From Ventura Ave. to Woodward Ave. | 7 | 36 | **42** | Replace | 4,752 | | | x | |
| C-5B | Gravity | Woodward Avenue | From Eigth St. to Orange Ave. | 8 | 36 | **42** | Replace | 597 | | | x | |
| C-5C | Gravity | Orange Avenue | From Woodward Ave. to California Ave. | 9 | 36 | **42** | Replace | 707 | | | x | |
| C-6 | Gravity | Safford Avenue | From Producers Dairy to H Street | 10 | 6 | **8** | Replace | 930 | | x | | |
| **Build-Out Improvements** | | | | | | | | | | | | |
| C-7 | Gravity | Tuolumne Street/ Van Ness Avenue | From N Street to Merced Ave. | 11 | 27 | **30** | Replace | 1,680 | | | | x |
| C-8 | Gravity | North Avenue | From Polk Ave. to Fruit Ave. | 12 | - | **60** | New | 20,855 | | | | x |
| C-9 | Gravity | North Avenue | From Fruit Ave. to HWY 99 | 13 | 60 | **60** | Rehab | 15,533 | | | | x |
| D-1 | Gravity | Temperance Avenue | From North Ave. to Jensen Ave. | - | - | **48** | New | 5,873 | | | | x |
| D-2 | Gravity | Temperance Avenue | From Jensen Ave. to Tulare St. | - | - | **42** | New | 13,350 | | | | x |
| D-3 | Gravity | Temperance Avenue | From Tulare St. to Olive Ave. | - | - | **36** | New | 4,987 | | | | x |
| D-4 | Gravity | Temperance/McKinley/DeWolf | From Olive Ave. to Shields | - | - | **30** | New | 13,299 | | | | x |
| D-5 | Gravity | Shields Ave./Leonard Ave. | From DeWolf Ave. to Leonard Ave. | - | - | **27** | New | 4,575 | | | | x |
| D-6A | Gravity | Jensen Avenue | From Temperance Ave. to DeWolf | - | - | **15** | New | 5,227 | | | | x |
| D-6B | Gravity | Jensen Avenue | From DeWolf Ave. to Leonard Ave. | - | - | **12** | New | 2,732 | | | | x |
| D-7A | Gravity | Church Avenue | From Temperance Ave. to Locan Ave. | - | - | **15** | New | 2,552 | | | | x |
| D-7B | Gravity | Church Avenue | From Locan Ave. to DeWolf Ave. | - | - | **12** | New | 2,729 | | | | x |
| D-7C | Gravity | Church Avenue | From DeWolf Ave. to Leonard Ave. | - | - | **8** | New | 2,673 | | | | x |
| D-8A | Gravity | Locans Avenue | From Temperance Ave to Locan Ave. | - | - | **18** | New | 2,676 | | | | x |
| D-8B | Gravity | Locans Avenue | From Locan Ave. to DeWolf Ave. | - | - | **15** | New | 2,670 | | | | x |
| D-8C | Gravity | Locans Avenue | From DeWolf Ave. to Leonard Ave. | - | - | **10** | New | 2,492 | | | | x |
| D-9A | Gravity | Butler Avenue | From Temperance Ave to Locan Ave. | - | - | **18** | New | 2,617 | | | | x |
| D-9B | Gravity | Butler Avenue | From Locan Ave. to DeWolf Ave. | - | - | **15** | New | 2,611 | | | | x |
| D-9C | Gravity | Butler Avenue | From DeWolf Ave. to Leonard Ave. | - | - | **8** | New | 2,849 | | | | x |
| D-10A | Gravity | Tulare Street | From Temperance Ave. to Locan Ave. | - | - | **21** | New | 2,730 | | | | x |
| D-10B | Gravity | Tulare Street/DeWolf Avenue | From Locan Ave. to DeWolf Ave. | - | - | **15** | New | 4,034 | | | | x |
| D-10C | Gravity | Laurel Avenue | From DeWolf Ave. to Leonard Ave. | - | - | **8** | New | 2,729 | | | | x |
| D-10D | Gravity | Locan Ave/ Belmont Ave. | From Tulare St. to DeWolf Ave. | - | - | **12** | New | 4,926 | | | | x |
| D-10E | Gravity | Belmont Avenue | From DeWolf Ave. to Leonard Ave. | - | - | **10** | New | 2,554 | | | | x |
| D-11A | Gravity | Olive Avenue | From Temperance Ave. to Locan Ave. | - | - | **15** | New | 2,671 | | | | x |
| D-11B | Gravity | Olive Avenue | From Locan Ave. to DeWolf Ave. | - | - | **12** | New | 2,613 | | | | x |
| D-11C | Gravity | Olive Avenue | From DeWolf Ave. to Leonard Ave. | - | - | **8** | New | 2,617 | | | | x |
| D-12A | Gravity | McKinley Avenue | From DeWolf Ave. to Leonard Ave. | - | - | **21** | New | 2,729 | | | | x |
| D-12B | Gravity | McKinley Avenue | From Leonard Ave. to Thompson Ave. | - | - | **18** | New | 5,103 | | | | x |
| D-12C | Gravity | Thompson Avenue | From McKinley Ave. to Clinton Ave. | - | - | **15** | New | 2,730 | | | | x |
| D-13 | Gravity | Clinton Avenue | From DeWolf Ave. to Leonard Ave. | - | - | **10** | New | 2,492 | | | | x |

**Table 6.1 Proposed Collection System Improvements**
**Collection System Master Plan**
**City of Fresno**

| Project Description | | | | | Project Size | | | | Project Phasing | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Improv. ID | Type of Improv. | Description/Street | Description/Limits | Detail Sheet No. (Appendix xx) | Existing Size (in.) | Proposed Size (in) | Replace/ New | Length (ft) | Phase 1 (2014-2020) | Phase 2 (2020-2025) | Phase 3 (2025-2030) | Phase 4 (2030-2035) |
| D-14 | Gravity | North Avenue | From Peach Ave. to Temperance Ave. | - | - | **36** | New | 15,787 | | | | x |
| D-15 | Gravity | Minnewawa | From North Ave. to Annadale Ave. | - | - | **12** | New | 2,729 | | | | x |
| D-16 | Gravity | Sunnyside Avenue | From North Ave. to Annadale Ave. | - | - | **15** | New | 2,610 | | | | x |
| D-17 | Gravity | Fowler Avenue | From North Ave. to Annadale Ave. | - | - | **10** | New | 2,789 | | | | x |
| D-18 | Gravity | Armstrong Avenue | From North Ave. to Annadale Ave. | - | - | **8** | New | 2,671 | | | | x |
| D-19A | Gravity | Valentine Avenue | From Church Ave. to Kearney Frontage | - | - | **12** | New | 3,976 | | | | x |
| D-19B | Gravity | Valentine Avenue | From Kearney Frontage to Madison Ave. | - | - | **10** | New | 1,312 | | | | x |
| D-20 | Gravity | Brawley Avenue | From Church Ave. to Madison Ave. | - | - | **8** | New | 5,415 | | | | x |
| D-21A | Gravity | Whitesbridge Avenue | From Polk Ave. to Blythe Ave. | - | - | **12** | New | 5,336 | | | | x |
| D-21B | Gravity | Whitesbridge/Brawley Avenue | From Blythe Ave. to Nelsen Ave. | - | - | **10** | New | 5,392 | | | | x |
| D-22A | Gravity | Belmont Avenue | From Polk Ave. to Cornelia Ave. | - | - | **12** | New | 2,734 | | | | x |
| D-22B | Gravity | Belmont Avenue | From Cornelia Ave. to Blythe Ave. | - | - | **10** | New | 2,675 | | | | x |
| D-22C | Gravity | Belmont Avenue | From Blythe Ave. to Brawley Ave. | - | - | **8** | New | 2,640 | | | | x |
| D-23A | Gravity | Olive Avenue | From Polk Ave. to Blythe Ave. | - | - | **12** | New | 5,343 | | | | x |
| D-23B | Gravity | Olive Avenue | From Blythe Ave. to Brawley Ave. | - | - | **8** | New | 2,675 | | | | x |
| D-24A | Gravity | Olive Avenue | From Grantland Ave. to Bryan Ave. | - | - | **12** | New | 2,769 | | | | x |
| D-24B | Gravity | Olive Avenue | From Bryan Ave. to Hayes Ave. | - | - | **10** | New | 1,973 | | | | x |
| D-25 | Gravity | McKinley Avenue | From Grantland Ave. to Ring Ave. | - | - | **10** | New | 3,748 | | | | x |
| D-26A | Gravity | Clinton Avenue | From Grantland Ave. to Bryan Ave. | - | - | **12** | New | 2,621 | | | | x |
| D-26B | Gravity | Clinton Avenue | From Bryan Ave. to Hayes Ave. | - | - | **10** | New | 2,592 | | | | x |
| D-27A | Gravity | Shields Avenue | From Grantland Ave. to Bryan Ave. | - | - | **15** | New | 2,775 | | | | x |
| D-27B | Gravity | Shields Avenue | From Bryan Ave. to Hayes Ave. | - | - | **12** | New | 2,592 | | | | x |
| **New Facilities** | | | | | | | | | | | | |
| NCFWRF-1 | Treatment | Cedar/Dakota | Reclamation Facility at Vacant Field Behind Granite Park | - | - | **3 mgd** | New | - | x | | | |
| NCFWRF-2 | Gravity | Dakota | From Treatment Facility to Millbrook Ave. | - | - | **36** | New | 4,042 | x | | | |
| SEGA | Treatment | Temperance | Reclamation Facility on Corner of Temperance and North Ave. | - | - | **12 mgd** | New | - | | | | x |

Many of the Master Plan improvements will serve future users, even when an improvement calls for the upgrade of an existing facility. In these cases, an existing sewer or lift station may have sufficient capacity to convey current PWWFs, but as growth continues and more users are added to the system, the increased flow results in capacity deficiencies. These projects, as well as new trunk sewers to extend wastewater collection system service to future growth areas, are future improvements. Future users were assigned 100 percent of the future project's benefit and 100 percent of the costs.

In some cases, a project is needed to correct an existing capacity deficiency, but is sized to accommodate additional flows from future development. In these cases, the hydraulic modeling results were used to determine the cost breakdown between existing and future users based on the ratio of existing and build out average dry weather flows. More information on the breakdown in cost split between existing and future users and whether a proposed improvement is intended to correct an existing deficiency, to serve a future user, or both, is provided in Chapter 8.

### 6.2.2 Existing System Improvements

For the majority of the City, the existing wastewater collection system contains sufficient capacity to convey the PDWF and PWWF without exceeding the capacity criteria discussed Chapter 5. There are a few exceptions where existing sewers will need to be replaced by larger diameter sewers, or parallel sewers will need to be constructed to bypass flow around hydraulically deficient sewers. These projects are discussed in this section and details for each are provided in Chapter 8. Detail sheets for individual projects are provided in Appendix F.

- **Project 1 – Hammond Avenue and Abby Street Sewers (C-1A and C-1B)**. This project consists of replacing approximately 2,000 feet of existing 20-inch diameter sewer on Hammond Avenue and Abby Street from Blackstone Avenue to La Salle Avenue with a new 24-inch diameter sewer. This project is required to mitigate surcharged conditions for existing PWWFs. It is recommended that the City perform a flow-monitoring program to confirm the capacity deficiency in this pipeline prior to construction. If the flow-monitoring program determines that the I/I for this pipeline is significantly lower, then this project could possibly be avoided. However, due to the age of this pipeline (over 100 years old) it is recommended that the City develop a program for flow monitoring and inspection in the near future.
- **Project 2 – Glenn Avenue Sewers (C-2A and C-2B)**. This project consists of replacing the existing 24-inch diameter sewer on Glenn Avenue, from Brewer Avenue to Voorman Avenue with a new 27-inch diameter sewer. This project is required to mitigate surcharged conditions on the Glenn Avenue sewer for existing PWWFs. It is recommended that the City perform a flow-monitoring program to confirm the capacity deficiency in this pipeline prior to construction. If the flow-monitoring program determines that the I/I for this pipeline is significantly lower, then this project could

possibly be avoided. However, due to the age of this pipeline (over 100 years old) it is recommended that the City develop a program for flow monitoring and inspection in the near future.

- **Project 3 – Glenn Avenue Sewer (C-3)**. This project is required to mitigate existing capacity deficiencies due to PWWF in the 27-inch diameter gravity sewer immediately downstream of Project C-2. The replacement 30-inch sewer extends from Voorman Avenue to Tuolumne Street. It is recommended that the City perform a flow-monitoring program to confirm the capacity deficiency in this pipeline prior to construction. If the flow-monitoring program determines that the I/I for this pipeline is significantly lower, then this project could possibly be avoided. However, due to the age of this pipeline (over 100 years old) it is recommended that the City develop a program for flow monitoring and inspection in the near future.
- **Project 4 – Monterey Avenue Sewer (C-4)**. This project mitigates existing capacity deficiencies in the sewer immediately downstream of two medium sized industrial users. The existing 6-inch sewer is capacity deficient during PDWF caused by the two large industrial users directly upstream. This project consists of replacing approximately 1,800 feet of 6-inch diameter pipeline with a new 10-inch diameter sewer on Monterey Avenue from Fulton Street to N Street.
- **Project 5 – Orange Avenue Trunk Sewers (C-5A, C-5B, and C-5C)**. The Orange Avenue trunk is a main sewer artery that conveys flows from the City of Clovis, California State University Fresno (CSUF), and a large area of the central section of the City. This project mitigates existing capacity deficiencies during PWWF. This project consists of replacing approximately 6,050 feet of 36-inch diameter pipeline with a new 42-inch diameter sewer on Eighth Street, Woodward Avenue, and Orange Avenue from Ventura Street to California Avenue.
- **Project 6 – Safford Avenue Sewer (C-6)**. The Safford Avenue project consists of replacing approximately 930 feet of existing 6-inch diameter sewer from Producers Dairy to H Street with a new 8-inch diameter sewer. This project is required to mitigate surcharged conditions for existing PDWFs due to the flows from Producers Dairy.

### 6.2.3 Build Out System Improvements

The following discussion summarizes the new trunk sewers that will serve future users, as well as the locations of existing pipelines that would need to be replaced in order to accommodate build out PWWFs. The locations of the new trunk sewers are conceptual and are likely to change during the design phase. The locations shown are possible alignments based on available information and are intended to assist in the development of probable construction costs. No investigation into the feasibility of these alignments has been conducted. However, an attempt was made to place new trunk sewer alignments within existing streets or other feasible pipeline alignments.

- **Project 7 – Tuolumne Street and Van Ness Avenue Sewers (C-7).** . Under current PWWF conditions, the existing 27-inch diameter sewers on Tuolumne Street and Van Ness Avenue from N Street to Merced Avenue experience surcharging. However, the surcharged conditions did not exceed the allowable flow depth criteria and therefore no improvement is required for current PWWFs.

  At build out, however, there is a capacity increase seen in this sewer due to redevelopment areas and requires the existing 27-inch sewer to be replaced with a 30-inch sewer.

- **Project 8 – North Avenue Trunk (C-8 and C-9)**. As determined in the previous 2006 Master Plan, the North Avenue trunk is capacity deficient under current PWWF conditions and the existing 66-inch diameter sewers on North Avenue experience surcharging. However, the surcharged conditions did not exceed the allowable flow depth criteria and therefore no improvement is required for existing PWWFs.

  However, at build out, a significant increase in flow from new industrial land uses as well as redevelopment causes significant surcharging throughout the North Avenue trunk. The flows exceed the flow depth criteria and create a condition that requires an improvement project.

  This proposed improvement project is broken up into two portions. The fist project (C-8) entails constructing a new 60-inch diameter sewer parallel to the existing 66-inch diameter sewer on North Avenue that will tie into the existing 60-inch diameter at Polk Avenue and extend to a new flow diversion structure at Fruit Avenue. The second project (C-9) will require the rehabilitation of the existing abandoned 60-inch diameter sewer on North Avenue from Fruit Avenue to Highway 99.

- **Project 10 – SEDA North Trunk Sewers (D-1 through D-13)**. In order to serve the planned growth areas in the Southeast Development Area (SEDA), it is recommended that a new sewer be constructed from 8-inch diameter up to 48-inch diameter. The main 48-inch diameter trunk sewer will extend up Temperance Avenue from the proposed SEDA scalping facility near the intersection of North Avenue and Temperance Avenue. The trunk sewer will extend from the scalping facility sequentially reducing in diameter to the 27-inch diameter sewer at the upstream City of Clovis connection near Leonard Avenue and Shields Avenue. Laterals from the main Temperance trunk are sized from 8-inch, 10-inch, 12-inch, and 15-inch diameter to serve new developments.

- **Project 11 – SEDA South Sewers (D-14 through D-18)**. Similar to project 10, this project involves development improvements stemming from the SEDA. It is recommended that a 24-inch diameter trunk sewer be constructed in North Avenue from Peach Avenue to Armstrong Avenue. This pipeline is sized to convey the PWWF and solids from the SEDA facility and to serve the new developments planned for this area. Arterial laterals from the North Avenue trunk main sized from 8-inch, 10-inch,

12-inch, and 15-inch diameter sewers will be connected to serve planned developments.

- **Project 12 – West Fresno Development Sewers (D-19 through D-27)**. There are a number of planned developments in west Fresno within the existing sphere of influence. This project provides new 8-inch to 15-inch diameter sewers to serve these new planned development areas.
- **Project 13 – North Central Fresno Wastewater Reclamation Facility (NCFWRF-1 and NCFWRF -2)**. The 2010 Fresno Recycled Water Master Plan has identified an alternative to provide recycled water to potential users in the central portion of the City. In this alternative, a satellite treatment facility would be constructed at the CSUF campus (as a demonstration reuse project) or on a parcel of land currently owned by the City at the intersection of Cedar Avenue and Dakota Avenue(Granite Park). The proposed treatment facility would treat 2-4 mgd average daily flow and alleviate a number of deficient pipelines downstream of the diversion. However, if the treatment facility is not constructed to intercept wastewater flows, further investigations is needed to investigate the capacity deficiencies in the Orange Avenue Trunk system.
- **Project 14 – Southeast Development Area Reclamation Facility (SEDA)**. Staff has planned for a satellite treatment facility in the southeast portion of the City near North Avenue and Temperance Avenue. This treatment plant would treat all the flow from the new development pipelines in Project 10 and treat between 12-15 mgd average daily flows. If the treatment facility is not constructed and development projects begin to be built, further analysis on the existing downstream pipelines in North Avenue is needed to determine if wastewater capacity is available.
- **Project 15 – Gallo Direct Storm Drain**. During the PWWF analysis, it was determined that a number of pipelines downstream of the Gallo winery facility are experiencing very high peak flows during storm events. After discussion with staff, it was confirmed that Gallo has a direct storm drain connection to the sewer system. It is recommended that this direct connection be removed to eliminate the PWWF surcharging currently present in the downstream pipelines. If the storm drain connection cannot be performed, further analysis shall be performed to determine the required additional capacity for downstream pipelines.

### 6.2.4 Project Prioritization

The majority of the improvements listed in Table 6.1 are driven by future development, which consist of new sewers that serve future growth or improvements to existing facilities that are needed to serve future growth. When fully implemented, the capital projects will allow the conveyance of PWWFs to the RWRF and satellite plants during build out conditions.

Prioritizing the required capital improvements for the City's sewer system is an important aspect of this study. The improvement projects were prioritized based on the following factors:

- Upgrading existing facilities to mitigate current capacity deficiencies and to serve future users
- Building the new trunks necessary to serve future users

Improvements to existing facilities will provide sufficient capacity to mitigate existing issues and to convey increased flows resulting from future growth. Future development will require the construction of sewers to serve new users. The projects were grouped into the following phases:

- Phase 1: Years 2014 through 2015
- Phase 2: Years 2016 through 2020
- Phase 3: Years 2021 through 2025
- Phase 4: Years 2026 through 2030

The projects were phased based on the best available information for how the City will develop moving forward. The actual implementation of the improvements serving future users ultimately depends on growth. The priorities presented in Table 6.1 are estimates, and changes in the City's planning assumptions or growth projections could increase or decrease the priority of each improvement.

# REHABILITATION AND REPAIR PLAN

This Chapter describes the proposed rehabilitation and repair (R&R) plan for the City of Fresno (City) wastewater collection system. This chapter also includes the objectives of the plan, the data used to develop the plan, and the evaluation of the City's collection system assets.

## 7.1 BACKGROUND AND OBJECTIVES

The purpose of the R&R plan is to identify sewer infrastructure conditions that pose a current or future threat to regular sewer operations and restore the affected facilities to an acceptable state. Sewer system conditions change over time and require periodic examination to monitor deterioration and determine when rehabilitation efforts are warranted. When sewer condition assessment activities yield signs of significant deterioration, rehabilitation is recommended to prevent operational system failures. Rehabilitation may include removing and replacing the existing infrastructure, installing a new liner in deteriorated sewer mains, or individual point repairs. Sewer systems also experience blockages for various reasons and require routine maintenance for problem areas. The routine maintenance of sewer systems is crucial and includes cleaning, root removal, obstruction elimination, and other efforts as needed. This rehabilitation and repair plan provides tools for the orderly and timely implementation of rehabilitation projects that will extend the useful life and strengthen the condition of the City's current wastewater collection system.

## 7.2 COLLECTION SYSTEM ASSET DATA

### 7.2.1 Collection System GIS Data

The City has developed and actively maintains a Geographic Information System (GIS) database of their sewer system. This GIS database includes detailed information that was used in the development of this R&R plan. For gravity sewers, key facility attributes available in the GIS data include pipe size, pipe material, installation year, upstream and downstream manhole ID's, pipe slope, pipeline alignment, and past rehabilitation information.

### 7.2.2 CCTV Inspection Data

City owned and operated truck mounted closed circuit television (CCTV) units have been used to collect video and condition assessment data for approximately 43 percent (690.5 miles) of the City's gravity sewer system. The City uses the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) evaluation protocols to rate the condition of each CCTV inspected sewer main. Figure 7.1 shows inspected and non-inspected sewers as of December 2012.

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDGE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNADALE
NORTH

GRANTLAND
BRYAN
HAYES
POLK
CORNELIA
BLYTHE
BRAWLEY
VALENTINE
MARKS
VAN NESS
WEST
FRUIT
PALM
MAROA
BLACKSTONE
FRESNO
FIRST
MILLBROOK
CEDAR
MAPLE
CHESTNUT
WILLOW
PEACH
MINNEWAWA
CLOVIS
SUNNYSIDE
FOWLER
ARMSTRONG
TEMPERANCE
LOGAN

RIVER

CALIFORNIA STATE UNIVERSITY, FRESNO

CLOVIS

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

99
41
180
90

FRESNO/CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY

## LEGEND

- SEWER EVALUATED WITH CCTV
- SEWER NOT EVALUATED WITH CCTV
- CITY LIMITS

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn
CONSULTING ENGINEERS

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Fax (559) 326-1500

# CITY OF FRESNO

## WASTEWATER MASTER PLAN
## EVALUATED VS UNEVALUATED SEWER SEGMENTS
FIGURE 7.1

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_Sewers Evaluated.dwg; 11X17 Plot by: mgraham Jul 11, 2014 - 4:51pm

Approximately 57 percent (916 miles) of the City's gravity sewers have not received an initial CCTV inspection. Table 7.1 summarizes the total length of sewer, by pipe diameter, that has been inspected to date by the City. As shown in Table 7.1, sewers that are 6-inch and 8-inch have the highest percent of completed CCTV inspection. Small sewers have relatively low wastewater flows, which is accommodating to the CCTV inspection process. For sewers larger than 30-inches there is little or no CCTV inspection completed, likely due to the challenges in bypassing the high wastewater flows typical for these large diameter sewer mains.

**Table 7.1 CCTV Inspection Summary by Pipe Diameter**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Pipe Diameter (in) | Inspected Length (miles) | Total Pipeline Length (miles) | Percent Inspected to Date (%) |
|---|---|---|---|
| 3 | - | 0.0 | 0.0 |
| 4 | - | 0.9 | 0.0 |
| 6 | 209.9 | 409.1 | 51.3 |
| 8 | 371.6 | 742.4 | 50.1 |
| 10 | 43.1 | 110.2 | 39.1 |
| 12 | 26.8 | 79.6 | 33.7 |
| 14 | 0.9 | 7.9 | 11.9 |
| 15 | 17.1 | 43.3 | 39.5 |
| 16 | 0.9 | 3.2 | 27.4 |
| 18 | 7.9 | 40.0 | 19.7 |
| 20 | 0.8 | 2.9 | 28.8 |
| 21 | 1.4 | 16.5 | 8.4 |
| 22 | 0.6 | 1.3 | 48.0 |
| 24 | 1.7 | 21.2 | 8.1 |
| 27 | 3.4 | 11.2 | 30.2 |
| 30 | 2.7 | 14.5 | 18.5 |
| 33 | 0.1 | 6.0 | 1.8 |
| 36 | 0.1 | 11.1 | 0.6 |
| 39 | 0.6 | 8.2 | 7.4 |

**Table 7.1 CCTV Inspection Summary by Pipe Diameter**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Pipe Diameter (in) | Inspected Length (miles) | Total Pipeline Length (miles) | Percent Inspected to Date (%) |
|---|---|---|---|
| 40 | - | 0.7 | 0.0 |
| 42 | - | 7.6 | 0.0 |
| 45 | 0.2 | 13.7 | 1.4 |
| 46 | - | 0.3 | 0.0 |
| 48 | 0.6 | 10.2 | 6.2 |
| 51 | - | 3.5 | 0.0 |
| 54 | - | 5.5 | 0.0 |
| 57 | - | 1.1 | 0.0 |
| 60 | - | 15.4 | 0.0 |
| 66 | - | 11.1 | 0.0 |
| 72 | - | 6.6 | 0.0 |
| 84 | - | 1.4 | 0.0 |
| **Total** | **690.5** | **1,606.5** | **43.0** |

Table 7.2 summarizes the total length of sewers, by material type, within the City that have been inspected. As shown in Table 7.2, cast iron, polyvinyl chloride (PVC), vitrified clay and asbestos cement sewers have the greatest percent of completed CCTV inspections. These pipe materials are generally used for small diameter sewers, which are easier to CCTV than the mid-sized and large diameter sewers.

The PACP standards enable an objective evaluation of the condition of gravity sewers based on a standard and consistent coding system. The Pipeline Assessment and Certification Program (PACP©) coding system allows the user to code structural defects, operational and maintenance (O&M) defects, and construction features/defects. Structural defects are assigned a structural grade that ranges from 1 (minor defect) to 5 (most significant defect). O&M and construction defects are also assigned a grade that ranges from 1 (minor defect) to 5 (most significant defect).

| Table 7.2 CCTV Inspection Summary by Pipe Material<br>Wastewater Collection System Master Plan Update<br>City of Fresno | | | |
|---|---|---|---|
| **Pipe Material** | **Inspected Pipeline Length (miles)** | **Total Pipeline Length (miles)** | **Percent Inspected to Date (%)** |
| Asbestos Cement | 2.6 | 6.3 | 41.6 |
| Cast Iron | 4.1 | 6.4 | 64.1 |
| Concrete | 19.1 | 64.4 | 29.7 |
| Concrete Cylinder | | 1.1 | 0.0 |
| Ductile Iron | 1.3 | 4.7 | 28.2 |
| Fiberglass | | 9.6 | 0.0 |
| PVC | 314.8 | 503.4 | 62.5 |
| Reinforced Concrete | 8.7 | 123.7 | 7.1 |
| Truss | 0.2 | 6.2 | 3.2 |
| Vitrified Clay | 334.1 | 880.8 | 37.9 |
| Not Identified | 5.5 | 0.0 | N/A |
| **Total** | **690.5** | **1,606.5** | **43.0** |

The PACP condition grading system uses more than one method to rate the condition of each pipe segment, including a rating that considers the total number of defects within a pipe segment (Overall Rating) and a rating that only considers the most severe defects within a pipe segment (Quick Rating). Appendix G provides a short guidance document that summarizes the PACP rating system.

### 7.2.3 Previous Reports

Previous evaluations of the City's system have been conducted and described in the following documents:

- *North Avenue Trunk Sewer Evaluation;* Final, Blair, Church, & Flynn, 1990.
- *Evaluation of Large Diameter Wastewater Collection System;* Final, Blair, Church, & Flynn, 1992-1996.
- *Inspection and Evaluation of Concrete Sewers 12-inches to 27-inches in Diameter;* Final, Blair, Church, & Flynn, July 2001.
- *Wastewater Collection System Master Plan*, Final; Brown and Caldwell, May 2006.
- *CCTV Inspection and Evaluation for Mid-Sized Concrete Sewers;* Final, Blair, Church, & Flynn, July 2010.

- *Large Diameter Sewer Evaluation Update;* Final, Blair, Church, & Flynn, January 2012.

These reports identified substantial rehabilitation work for mid-sized and large diameter concrete sewers. Most of the rehabilitation work identified in the previous reports has been completed or is in some stage of design or construction Recommended rehabilitation and repair projects that have not been completed are described in Section 7.3.2.3.

### 7.2.4 Lift Station Visual Inspection

The sewer system includes 15 submersible-type sewer lift stations, which are owned, operated, and maintained by the City. Figure 4.1 includes the location of each lift station and Table 4.4 identifies their pumping capacities. The lift stations are generally situated on relatively small sites and consist of either duplex or triplex submersible pumps housed in circular wet wells. A limited on-site review of each lift station site was conducted on October 10, 2013 by Blair, Church, & Flynn Consulting Engineers (BC&F) Staff to help identify lift station infrastructure in need of repair or rehabilitation. Wet well, valve vault, and discharge manhole inspections consisted of an above-grade visual observation aided by illumination tools. Available City staff was interviewed on site regarding lift station operation and maintenance.

## 7.3 COLLECTION SYSTEM ASSET EVALUATION

This section summarizes the criteria used to identify pipelines in need of R&R and the results of the asset evaluation.

### 7.3.1 Rehabilitation Project Selection Criteria

The priorities for project selection for the R&R Plan begin with sewer segments that are in the most severe state followed by successively less severe sewer mains.

#### 7.3.1.1 High Priority Point Repair Criteria

There are locations within the City's sewer system where significant structural defects in sewer mains exist. The City has selected the PACP structural defect codes that should be considered for high priority repairs, and are shown in Table 7.3. Sewer mains that were coded with a high priority structural defect code are designated in this report for high priority repair projects.

**Table 7.3 High Priority PACP Structural Defects Codes**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Group | Descriptor | Modifier | Code | Structural Grade |
|---|---|---|---|---|
| Crack (C) | Hinge (CH3) | - | CH3 | 5 |
| Crack (C) | Hinge (CH4) | - | CH3 | 5 |
| Fracture (F) | Hinge (H3) | - | FH3 | 5 |
| Fracture (F) | Hinge (H4) | - | FH3 | 5 |
| Pipe Failures (Silent) | Broken (B) | - | B | 3,4,5 |
| Pipe Failures (Silent) | Broken (B) | Soil Visible (SV) | BSV | 5 |
| Pipe Failures (Silent) | Broken (B) | Void Visible (VV) | BVV | 5 |
| Pipe Failures (Silent) | Hole (H) | - | H | 3,4,5 |
| Pipe Failures (Silent) | Hole (H) | Soil Visible (SV) | HSV | 5 |
| Pipe Failures (Silent) | Hole (H) | Void Visible (VV) | HVV | 5 |
| Collapse (X) | Pipe (P) | - | XP | 5 |
| Deformed | (Pipe) | - | D | 4,5 |
| Surface Damage Chemical (S) | Reinforcement Visible (RV) | C | SRVC | 5 |
| Surface Damage Chemical (S) | Reinforcement Corroded (RC) | C | SRCC | 5 |
| Surface Damage Chemical (S) | Missing Wall (MW) | C | SMWC | 5 |
| Surface Damage Mechanical (M) | Reinforcement Visible (RV) | M | SRVM | 5 |
| Surface Damage Mechanical (M) | Reinforcement Corroded (RC) | M | SRCM | 5 |
| Surface Damage Mechanical (M) | Missing Wall (MW) | M | SMWM | 5 |
| Surface Damage Not Evident (Z) | Reinforcement Visible (RV) | Z | SRVZ | 5 |
| Surface Damage Not Evident (Z) | Reinforcement Corroded (RC) | Z | SRCZ | 5 |
| Surface Damage Not Evident (Z) | Missing Wall (MW) | Z | SMWZ | 5 |

#### 7.3.1.2 Modified Overall Structural Rating

The PACP coding system includes an overall structural rating (OSR) that represents a weighted total of all defects coded for each sewer segment. The number of occurrences of

each pipe code is multiplied by the pipe defect grade (1 though 5) to calculate the overall structural rating of the pipe segment.

Per City staff direction, the OSR was modified to eliminate contributions from defect Grades 1 and 2 (minor and minor-moderate defects), resulting in a Modified Overall Structural Rating (MOSR) that was used for the purpose of this Master Plan. Minor and minor to moderate grades were omitted from the overall scores to prevent artificially high scores being created by less significant defects.

The MOSR information in Table 7.4 was developed to provide tools for the categorization of each sewer segment by priority and sorting based on sewer conditions. Analysis of the current City of Fresno sewer system showed MOSR scores varying from 0 to 630. The MOSR range criterion was determined from review of CCTV data that was made available for each inspected sewer segment. General review of the CCTV videos provided insight about the actual sewer conditions of the MOSR sewers and an appropriate range was developed for each condition. The critical and severe conditions were chosen to be rehabilitated as part of the recommended projects within this master plan. Further rehabilitation projects may continue with sewer segments that received a poor rating after the severe and critical sewers are rehabilitated.

**Table 7.4 MOSR Overview**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Sewer Condition | Range |
|---|---|
| Severe | MOSR ≥ 200 |
| Critical | 100 ≤ MOSR < 200 |
| Poor | 50 ≤ MOSR < 100 |
| Moderate | 25 ≤ MOSR < 50 |
| Average | 0 ≤ MOSR < 25 |

#### 7.3.1.3 Previously Recommended Rehabilitation Projects

Rehabilitation projects recommended in previous reports that have yet to be completed are included as rehabilitation projects in this Master Plan. Section 7.3.2.3 includes a detailed description of these projects.

### 7.3.2 Evaluation Results

A summary of the evaluation results is presented within this section.

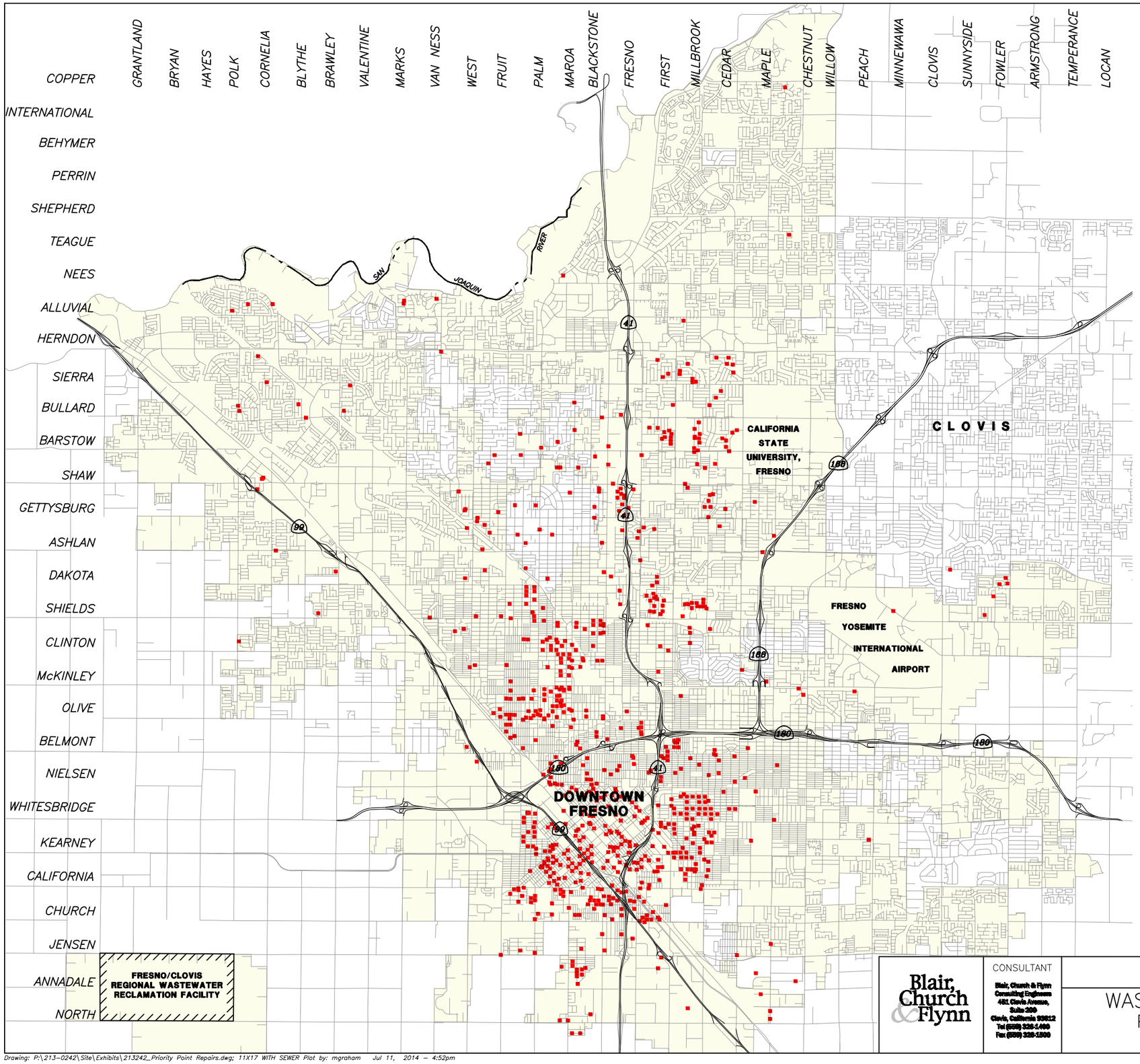
#### 7.3.2.1 High Priority Point Repairs

Sewer main defects requiring high priority point repairs exist at 1,249 locations. Table 7.5 includes the priority codes together with the number of occurrence per code.

**Table 7.5 Point Repairs**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Priority Code | Code Description | Occurrences |
|---|---|---|
| B | Broken | 616 |
| BSV | Broken Soil Visible | 136 |
| BVV | Broken Void Visible | 139 |
| CH3 | Hinge Crack | 3 |
| CH4 | Hinge Crack | 2 |
| D | Deformed | 33 |
| FH3 | Hinge Fracture | 2 |
| FH4 | Hinge Fracture | 1 |
| H | Hole | 195 |
| HSV | Hole Soil Visible | 31 |
| HVV | Hole Void Visible | 28 |
| SMW | Missing Wall | 4 |
| SMWZ | Missing Wall, Surface Damage Not Evident | 6 |
| SRC | Reinforcement Corroded | 35 |
| SRCZ | Reinforcement Corroded, Surface Damage Not Evident | 1 |
| SRV | Reinforcement Visible | 6 |
| SRVC | Reinforcement Visible, Surface Damage Chemical | 1 |
| XP | Pipe Collapse | 10 |
| | **Point Repair Total:** | **1,249** |

Figure 7.2 shows high priority repair locations. Appendix H provides a summary list of the significant sewer main defects described above and includes information on the type of pipe defect, pipe size, pipe material, upstream and downstream manhole identification numbers, street name and sewer plat area. An initial order of work for the point repairs is also included in Appendix H. The City should review available data and new data as it becomes available and adjust the order of work as necessary.




## LEGEND

- PRIORITY POINT REPAIRS
- STREETS
- CITY LIMITS

**Priority Point Repairs**
**Wastewater Master Plan Update**
**City of Fresno**

| Priority Code | Code Description | Occurrences |
|---|---|---|
| | ro e | 616 |
| S | ro e Soil i le | 136 |
| | ro e oi i le | 13 |
| C 3 | i e Crac | 3 |
| C 4 | i e Crac | 2 |
| | e or e | 33 |
| 3 | i e ract re | 2 |
| 4 | i e ract re | 1 |
| | ole | 1 5 |
| S | ole Soil i le | 31 |
| | ole oi i le | 28 |
| SM | Mi all | 4 |
| SM | Mi all S ace a a e ot vi e t | 6 |
| SRC | Rei orce e t Corro e | 35 |
| SRC | Rei orce e t Corro e S ace a a e ot vi e t | 1 |
| SR | Rei orce e t i le | 6 |
| SR C | Rei orce e t i le S ace a a e C e ical | 1 |
| P | Pi e Colla e | 10 |
| | **Priority Point Repair Total:** | **1249** |

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

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# CITY OF FRESNO

## WASTEWATER MASTER PLAN
## PRIORITY POINT REPAIRS
FIGURE 7.2

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1 OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_Priority Point Repairs.dwg; 11X17 WITH SEWER Plot by: mgraham Jul 11, 2014 - 4:52pm

#### 7.3.2.2 Modified Overall Structural Rating

Sewer mains with a MOSR greater than or equal to 100 meet the criteria developed for rehabilitation. Rehabilitation is expected to be a cured-in-place pipe (CIPP) liner as described in Section 7.4.1.2. A total of 86 pipe segments were identified as having a MOSR greater than 100.

Figure 7.3 shows pipe segments with a high MOSR that are recommended for rehabilitation. Appendix BCF-3 includes each sewer segment MOSR, pipe size, pipe material, upstream and downstream manhole identification numbers, street name and sewer plat area for proposed rehabilitation projects.

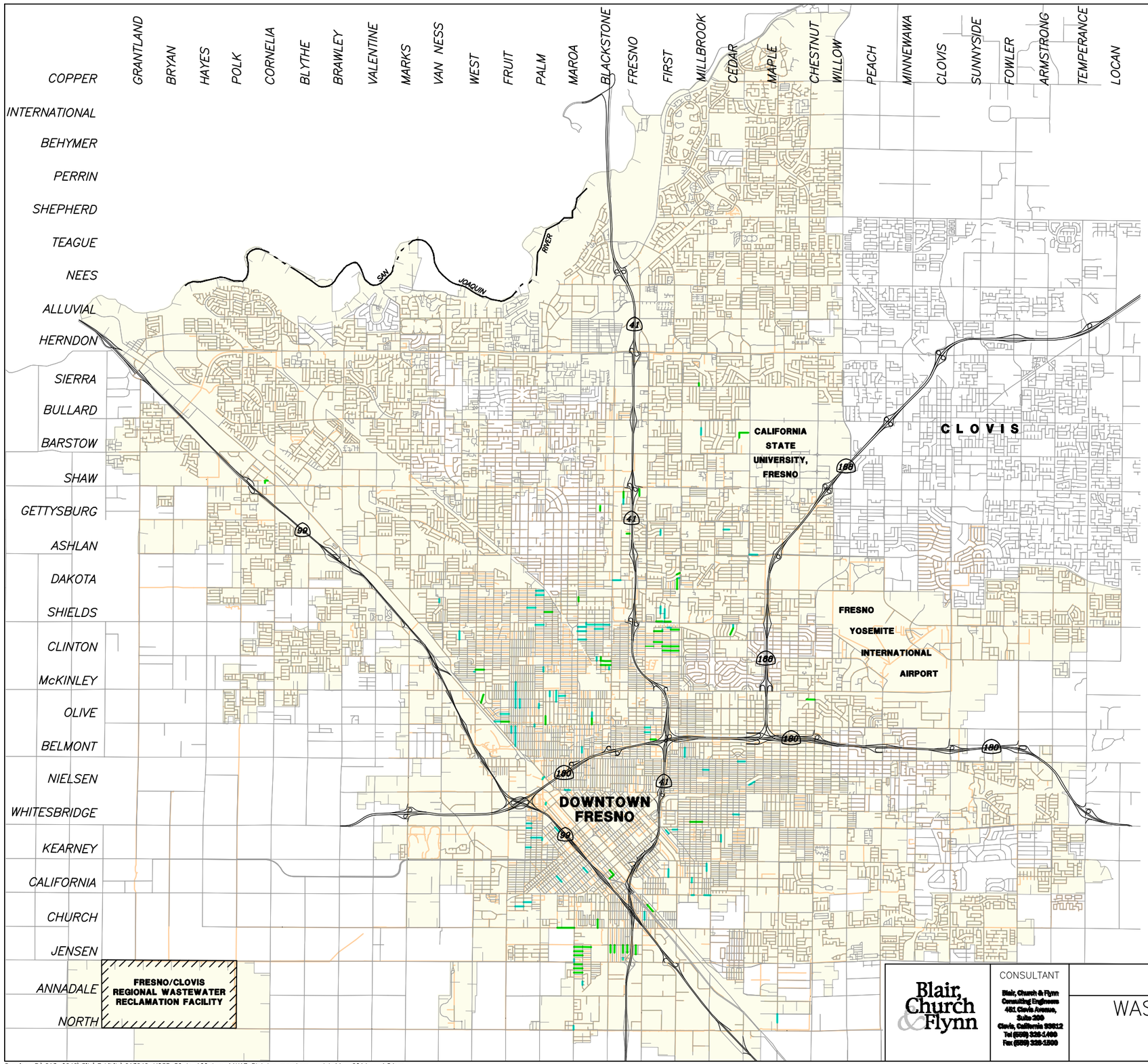
As shown in Table 7.6, only 0.7 percent of the sewers that have been inspected received a MOSR in the severe to critical range, and 2.5 percent of the system received a MOSR in the poor to moderate range. The vast majority (96.9 percent) received an average MOSR rating. It should be noted that as older portions of the city are inspected, the percent of the system with a MOSR greater than 25 will likely increase.

**Table 7.6 MOSR Overview**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Sewer Condition | Range | Condition Occurrence | Percent of Inspected System |
|---|---|---|---|
| Severe | MOSR ≥ 200 | 53 | 0.43 |
| Critical | 100 ≤ MOSR < 200 | 33 | 0.27 |
| Poor | 50 ≤ MOSR < 100 | 84 | 0.68 |
| Moderate | 25 ≤ MOSR < 50 | 219 | 1.77 |
| Average | 0 ≤ MOSR < 25 | 12,010 | 96.85 |

#### 7.3.2.3 Previously Recommend Rehabilitation Projects

Five rehabilitation projects identified in the 2006 Wastewater Master Plan remain uncompleted. The rehabilitation projects are identified in the 2006 Wastewater Master Plan as Projects RL11, RS06B, RL02, RS03A and RS04A are summarized in Table 7.7. The project locations can be seen on Figure 7.4.




## LEGEND

- SEVERE & CRITICAL MOSR SEWERS (MOSR ≥ 100)
- POOR MOSR SEWERS (50 ≤ MOSR < 100)
- OTHER EXISTING SEWERS
- STREETS
- CITY LIMITS

**MOSR Overview**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Sewer Condition | Range | Condition Occurrence | Percent of Inspected System |
|---|---|---|---|
| Severe | MOSR ≥ 200 | 53 | 0.43 |
| Critical | 100 ≤ MOSR < 200 | 33 | 0.27 |
| Poor | 50 ≤ MOSR < 100 | 84 | 0.68 |

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

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CITY OF FRESNO

WASTEWATER MASTER PLAN
HIGH MOSR SEWERS
FIGURE 7.3

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR 50 to 100.dwg; 11X17 Plot by: mgraham Jul 11, 2014 - 4:54pm

GRANTLAND
BRYAN
HAYES
POLK
CORNELIA
BLYTHE
BRAWLEY
VALENTINE
MARKS
VAN NESS
WEST
FRUIT
PALM
MAROA
BLACKSTONE
FRESNO
FIRST
MILLBROOK
CEDAR
MAPLE
CHESTNUT
WILLOW
PEACH
MINNEWAWA
CLOVIS
SUNNYSIDE
FOWLER
ARMSTRONG
TEMPERANCE
LOCAN

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDGE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNADALE
NORTH

SAN JOAQUIN RIVER

CALIFORNIA STATE UNIVERSITY, FRESNO

C L O V I S

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

FRESNO/CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY

## LEGEND

- REHABILITATION PROJECTS
- CAPACITY PROJECTS
- ACTION RECOMMENDED PER THE 2010 MID-SIZED CONCRETE SEWER REPORT
- STREETS
- CITY LIMITS

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

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# CITY OF FRESNO

## WASTEWATER MASTER PLAN
## PROJECTS FROM PREVIOUS REPORTS
FIGURE 7.4

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_Improvement status.dwg; 11X17 Plot by: mgraham Jul 11, 2014 - 4:55pm

| Table 7.7 Previously Recommend Rehabilitation Projects Wastewater Collection System Master Plan Update City of Fresno | | | |
|---|---|---|---|
| **2006 Master Plan Project Designation** | **Pipe Size (inches)** | **Rehabilitation Length (feet)** | **Type of Rehabilitation** |
| RS03A | 24 | 3,118 | CIPP Liner |
| RS04A | 18-21 | 4,341 | CIPP Liner |
| RS06B | 15 | 300 | CIPP Liner |
| RL02 | 48 | 2,644 | CIPP Liner |
| RL11 | 48-54 | 3,992 | CIPP Liner |

#### 7.3.2.4 Sewer Lift Station Survey Results

The City's lift stations were inspected to document existing conditions and make recommendations for rehabilitation. The findings from the inspection are summarized in Table 7.8 for all surveyed locations. Existing liners or coatings were observed to be in some level of distress at all but four of the lift stations inspected and will require liner/coating repair or removal and replacement. Complications with failing liners getting caught in the wet well pumps has been a maintenance issue and can potentially cause damage to the current infrastructure. Lack of liner/coating integrity can allow corrosion and deterioration of substrate materials. During the rehabilitation process, quick connect locations for bypass pumping will be available for some locations on the upstream and downstream side of the wet wells as seen in the available data.

## 7.4 RECOMMENDED REHABILITATION/REPAIR PLAN

This section summarizes the proposed R&R plan for the City, including a description of the highest priority projects in the "Primary Recommendations" section, and the lower priority projects in the "Secondary Recommendations" section.

All of the proposed projects included in the recommended R&R plan were developed for general master planning purposes based on the best available information provided by the City. For all proposed sewer system rehabilitation and repair projects, the City or its design consultant should conduct a careful review of available or new CCTV video inspection data to verify that there is a defect requiring mitigation and to establish a detailed scope of the remedial work prior to construction.

**Table 7.8 Lift Station Condition Survey Results**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Lift Station | Existing Liner | New Liner or Rehabilitate Existing Liner Required | Dedicated Upstream Bypass Quick Connection | Dedicated Downstream Bypass Quick Connection | Adequate Site Lighting | History of Odor Control Complaints | Approximate Wet Well Area ($ft^2$) |
|---|---|---|---|---|---|---|---|
| LS-01 | Y | N | N | N | Y | N | 428 |
| LS-02 | Y | N | N | N | Y | N | 226 |
| LS-03 | Y | N | Y | N | N | N | 214 |
| LS-04 | N | Y | Y | N | Y | N | 754 |
| LS-05 | N | Y | N | N | Y | N | 892 |
| LS-06 | Y | Y | Y | Y | Y | N | 892 |
| LS-10 | N | Y | N | N | Y | N | 339 |
| LS-11 | Y | Y | N | N | N | N | 352 |
| LS-12 | Y | N | Y | N | Y | N | 434 |
| LS-13 | Y | Y | N | N | N | N | 310 |
| LS-14 | Y | Y | N | N | Y | N | 434 |
| LS-15 | Y | Y | Y | N | N | N | 343 |
| LS-16 | Y | Y | N | Y | Y | N | 452 |
| LS-18 | Y | Y | N | Y | Y | N | 561 |
| LS-20 | Y | Y | N | N | N | N | 855 |

Notes:
Y = Yes; N = No

### 7.4.1 Primary Recommendations

#### 7.4.1.1 High Priority Point Repairs

Sewer system defects requiring high priority point repairs, as described in Sections 7.3.1.1 and 7.3.2.1, pose a threat to the sewer system operations and should be the first projects undertaken by the City. The high priority repairs are generally expected to consist of excavation via conventional open cut methods to gain access to the area of defective pipe, removal and replacement of a small section of pipe, followed by trench backfill and resurfacing. For pipe segments that have several significant point defects in proximity to each other, it may be prudent to install a CIPP liner in lieu of removal and replacement of multiple sections of pipe.

High priority repairs described in Sections 7.3.2 and 7.3.3 should be repaired as outlined in Chapter 8.

#### 7.4.1.2 Sewer Rehabilitation - High MOSR

Sewer mains with a MOSR greater than or equal to 100 should be rehabilitated in order of severity. It is anticipated that the pipe segment rehabilitation would be accomplished with a CIPP liner, but other options such as a slip liner or a high-density polyethylene (HDPE) solid wall pipe liner may be considered.

Sewer rehabilitation using a CIPP liner consists of installing a fabric tube that is impregnated with a thermosetting resin, either by hydrostatic inversion methods or by pulling it into the host pipe and expanding it under hydrostatic head, followed by thermal curing. For pipe diameters less than 12-inches, an air inversion process may be used in lieu of a hydrostatic inversion. The air inversion process is faster and more cost effective. No insertion pit excavation is required under most circumstances, and service connection reinstatement may be done by remote internal methods.

CIPP liner installation is usually a completely trenchless process, requiring no excavation. However, open cut excavation is sometimes required in localized areas for placement of temporary wastewater bypass pipelines, for manhole construction if the project includes it, or for repair of localized sewer defects.

Sewer mains with a high MOSR as described in Sections 7.3.1.2 and 7.3.2.2 should be rehabilitated as outlined in Chapter 8.

#### 7.4.1.3 Previously Identified Rehabilitation Projects

Sewers previously identified as requiring rehabilitation as described in Section 7.3.2.3 should be rehabilitated.

### 7.4.2 Secondary Recommendations

#### 7.4.2.1 Sewer Lift Station Rehabilitation

For all lift stations other than Lift Stations Nos. 1, 2, 3 and 12, lift station facilities should be rehabilitated by repair or removal and replacement of distressed liners and coatings. Where necessary, as indicated in Table 7.9, lift station rehabilitation should include lighting improvements to provide adequate lift station lighting. Lift Station No. 11 is in failing condition and requires replacement of the entire lift station.

**Table 7.9 Proposed Lift Station Improvements Wastewater Collection System Master Plan City of Fresno**

| Lift Station | Existing Wet Well Coating | Failure of Existing Coating | Apply New Wet Well Coating | Install Site Lighting |
|---|---|---|---|---|
| LS-01 | Y | N | N | Y |
| LS-02 | Y | N | Y | Y |
| LS-03 | Y | N | N | N |
| LS-04 | N | N/A | Y | Y |
| LS-05 | N | N/A | Y | Y |
| LS-06 | Y | Y | Y | Y |
| LS-10 | N | N/A | Y | Y |
| LS-11 | Y | Y | N/A | N |
| LS-12 | Y | N/A | N | Y |
| LS-13 | Y | Y | Y | N |
| LS-14 | Y | Y | Y | Y |
| LS-15 | Y | Y | Y | N |
| LS-16 | Y | Y | Y | Y |
| LS-18 | Y | Y | Y | Y |
| LS-20 | Y | N | N | N |

Notes:
Y = Yes; N = No; N/A = Not Applicable

#### 7.4.2.2 Unlined Sewer Pipe

Certain pipe materials once commonly used in sanitary sewer systems, such as asbestos cement pipe (ACP), reinforced concrete pipe (RCP), standard (non-reinforced) concrete pipe (SCP), and cast iron pipe (CIP), are susceptible to sulfide-related corrosion, often referred to as microbially-induced corrosion (MIC), if they are not otherwise protected against MIC. MIC can ultimately result in complete pipe wall penetration and sewer collapse, particularly in partly full pipes where wastewater chemistry is conducive to MIC

processes. The rate at which MIC occurs can be highly variable, ranging from none at all where the sewer environment is not conducive to MIC processes, to very rapid in an aggressive sewer environment.

Existing sewers where MIC has resulted in a MOSR greater than 100 are included under the corresponding recommendations of this report. Wherever other sewers exist that are susceptible to MIC, the sewer condition should be carefully evaluated during regular or special sewer inspection efforts to determine the extent to which MIC processes are affecting sewer conditions, and the extent to which sewer rehabilitation may be required to halt MIC processes and preserve sewer main integrity. In general, whenever MIC results in an MOSR greater than 100, the affected sewer should be rehabilitated or replaced.

#### 7.4.2.3 Low MOSR

Low MOSR sewers shall be evaluated on a case by case basis by City personnel to determine the correct action necessary. Sewers that have a “poor” rating in Table 7.4 should be evaluated for rehabilitation following the completion of all primary recommendations.

### 7.4.3 Prioritization and Scheduling

The sewer system rehabilitation work should generally be prioritized such that the most critical defective areas can be addressed first. The scheduling recommendations were derived from the available PACP records provided by the City, on-site inspections and previous reports. Scheduling for the priority repairs and rehabilitation can be seen in Table 7.10 by the appropriate fiscal years. Projects are further divided into phases which are detailed in Chapter 8.

**Table 7.10 Rehabilitation Project Prioritization**
**Wastewater Collection System Master Plan**
**City of Fresno**

| Priority | Project | Fiscal Year |
|---|---|---|
| 1 | High Priority Point Repairs | 2015-2020 |
| 2 | Rehabilitation of Sewer with High MOSR | 2015-2020 |
| 3 | Previously Recommend Rehab Projects | 2015-2020 |
| 4 | Sewer Lift Station Rehabilitation | 2015-2020 |

### 7.4.4 Recommended Sewer Inspection Plan

#### 7.4.4.1 Background

Approximately 57 percent (916.0 miles) of the City’s sewers have not been inspected via CCTV and evaluated using the PACP coding system. These areas are shown on Figure 7.1. To properly assess a sewer system, an initial baseline inspection is required. The baseline inspection together with subsequent inspections enables users to monitor the

changing conditions of each sewer segment. Areas of the sewer systems that have not been inspected should be a high priority and scheduled for video inspection.

The City currently owns three CCTV trucks which are dedicated to sewer system inspections. The current target productivity rate for all three trucks is 60,300 feet per month which is roughly 0.71 percent of the entire system. At this rate, it would take approximately 11 years to survey the entire system. This target requires that all three trucks be in working order and the appropriate staff be available to operate the equipment. The City also has secured funds to purchase an additional CCTV truck that will be dedicated to sewer system inspections. The purchase of this new CCTV truck is imminent. Once the additional truck is secured the City's productivity rate for four trucks would be 80,400 feet per month, which is roughly 0.95 percent of the entire system.

Prior to CCTV inspection, sewer pipelines should be cleaned of debris to provide a relatively clear path for the tractor mounted camera and potentially uncover any underlying defects. Two cleaning trucks specifically dedicated to aid sewer man inspections are dispatched with the CCTV trucks.

Sewer main inspections can be used to estimate the amount of time needed before pipeline rehabilitation or replacement is required. This can only be accomplished by observing and monitoring the changes between successive inspections. The majority of uninspected pipelines are near the end of their design life or currently exceeding that period. Some of these pipes are probably already in a deteriorated condition and may require immediate maintenance, rehabilitation, repair or replacement.

#### 7.4.4.2 Sewer Inspection: Phase 1 Scheduling

Scheduling for the inspection of sewers is divided into two phases. Phase 1 includes scheduling of work to inspect all sewers that have not had an initial PACP coding system inspection. Once Phase 1 inspections are completed, sewer inspection work should be in accordance with the Phase 2 scheduling. Figure 7.5 includes the limits of uninspected sewers and distinguishes sewers that are susceptible to corrosion from sewers that are not susceptible to corrosion.

For Phase 1 inspections, sewers that are susceptible to corrosions should be inspected first. Sewers that are not susceptible to corrosion should be given second priority in the schedule. Table 7.11 summarizes the length of sewers that have not been inspected. Based on the City's expected productivity rate of 80,400 feet per month, the time to complete an initial inspection of sewers that are susceptible to corrosion and not susceptible to corrosion is 0.54 and 4.47 years, respectively.

GRANTLAND
BRYAN
HAYES
POLK
CORNELIA
BLYTHE
BRAWLEY
VALENTINE
MARKS
VAN NESS
WEST
FRUIT
PALM
MAROA
BLACKSTONE
FRESNO
FIRST
MILLBROOK
CEDAR
MAPLE
CHESTNUT
WILLOW
PEACH
MINNEWAWA
CLOVIS
SUNNYSIDE
FOWLER
ARMSTRONG
TEMPERANCE
LOGAN

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDGE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNANDALE
NORTH

CALIFORNIA STATE UNIVERSITY, FRESNO

CLOVIS

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

FRESNO/CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY

41
99
180
168
190

## LEGEND

- UNINSPECTED SEWER PIPE SUSCEPTIBLE TO CORROSION
- UNINSPECTED SEWER PIPES NOT SUSCEPTIBLE TO CORROSION
- STREETS
- CITY LIMITS

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

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# CITY OF FRESNO

## WASTEWATER MASTER PLAN
## UNINSPECTED CORROSION POTENTIAL
FIGURE 7.5

DR. BY JRS
CH. BY MDG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_UninspectedCorrosionSusceptible.DWG; 11x17 Plot by: mgraham Jul 11, 2014 - 4:56pm

| Table 7.11 Phase 1 Sewer Inspection Schedule<br>Wastewater Collection System Master Plan<br>City of Fresno | | |
|---|---|---|
| **Sewer Description** | **Length (miles)** | **Time to Complete[1] (Years)** |
| Susceptible to Corrosion, Not Inspected | 98.9 | 0.54 |
| Not Susceptible to Corrosion, Not Inspected | 817.1 | 4.47 |
| **Total** | **916.0** | **5.01** |

Notes:
(1) Based on an inspection rate of 80,400 feet per month.

#### 7.4.4.3 Sewer Inspection: Phase 2 Scheduling

The second phase includes scheduling to provide subsequent inspection of all sewers and should be in accordance with Table 7.12.

Sewer systems shall also be inspected based upon their MOSR as show in Table 7.12. Elevated MOSR sections shall be monitored to observe existing problems and changing conditions. If a CCTV inspection reveals a section of pipe that has an MOSR greater than 100, the section of pipe should be rehabilitated. Figure 7.6 represents the recommended sewer inspection phasing.

| Table 7.12 Inspection Frequency<br>Wastewater Collection System Master Plan<br>City of Fresno | |
|---|---|
| **Sewer Description** | **Maximum Inspection Frequency Interval (Years)** |
| Pipe Materials Susceptible to Corrosion | 5 |
| Sewers with a MOSR between 50 and 100 | 5 |
| Pipe Materials Not Susceptible to Corrosion | 10 |

GRANTLAND
BRYAN
HAYES
POLK
CORNELIA
BLYTHE
BRAWLEY
VALENTINE
MARKS
VAN NESS
WEST
FRUIT
PALM
MAROA
BLACKSTONE
FRESNO
FIRST
MILLBROOK
CEDAR
MAPLE
CHESTNUT
WILLOW
PEACH
MINNEWAWA
CLOVIS
SUNNYSIDE
FOWLER
ARMSTRONG
TEMPERANCE
LOCAN

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNADALE
NORTH

CALIFORNIA STATE UNIVERSITY, FRESNO

C L O V I S

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

WASTEWATER TREATMENT PLANT

41 99 168 180

## LEGEND

- PIPES SUSCEPTIBLE TO CORROSION
- PIPES NOT SUSCEPTIBLE TO CORROSION
- POOR MOSR SEWERS (50 ≤ MOSR < 100)
- STREETS
- CITY LIMITS

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn

CONSULTANT
Blair, Church & Flynn
Consulting Engineers
481 Clovis Avenue, Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

# CITY OF FRESNO

## WASTEWATER MASTER PLAN
## INSPECTION FREQUENCY
FIGURE 7.6

DR. BY JRS
CH. BY MDG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_PipeCorrosion.dwg; 11x17 Plot by: mgraham Jul 22, 2014 - 10:07am

# CAPITAL IMPROVEMENT PLAN

This chapter describes the development of the Capital Improvement Plan (CIP). This CIP is a comprehensive plan that incorporates recommended improvements identified in Chapters 6 and 7 of this report.

## 8.1 CAPITAL IMPROVEMENT PROJECT COSTS

The capital improvement project costs are based on City of Fresno (City) bid results for wastewater projects, previous cost studies, interviews with local contractors and our project experience with similar wastewater infrastructure projects throughout the Central Valley. The costs have been adjusted to the Engineering News Record Construction Cost Index 20 City Average of 9,800 for June 2014.

## 8.2 COST ESTIMATING ACCURACY

Cost estimates have been developed to help the City prepare budgeting and scheduling for these projects. The cost estimates included in this master plan are Class 5 estimates as defined by the Association for the Advancement of Cost Engineering (AACE) International publication entitled *Recommend Practice No. 56R-08*. Class 5 estimates are generally prepared on limited design information and subsequently have wide accuracy ranges. A typical Class 5 estimate for a civil engineering project may have an accuracy range as broad as -30 percent to +50 percent, or as narrow as -20 percent to +30 percent. Class 5 estimates are typically used for evaluation of resource needs, budgeting and capital planning.

## 8.3 CONSTRUCTION UNIT COSTS

The construction unit costs for sewer infrastructure projects are based on a normal bidding environment and normal construction schedules. Costs for new projects and rehabilitation projects are included.

### 8.3.1 Rehabilitation Unit Costs

One goal in developing unit costs for pipe rehabilitation was to develop “loaded” unit costs which, when applied to the key elements of the capital improvement projects, would result in an estimated project cost inclusive of all necessary associated incidental and ancillary work. Recent City bid tabulations for sewer rehabilitation projects were primarily used to develop rehabilitation unit costs.

#### 8.3.1.1 Point Repairs

Point repairs costs include temporary wastewater handling, traffic control, excavation, removal and replacement of up to 15 feet of sewer pipe, backfill, video inspection of repaired line, and surface restoration. Nearly all defects requiring point repairs occur on sewer mains ranging in size from 6 to 15 inches. Between August 2013 and March 2014, the City completed 4 point repair projects for pipe sizes ranging from 4-to 12-inches. The cost for the point repair projects ranged from $15,250 to $16,650 with an average cost of approximately $16,000. Based on these results it appears that the pipe size has little effect on the cost of point repairs for small to medium sized sewer mains. As a result, a cost of $16,000 per point repair is used for point repairs on pipe sizes ranging from 6 to 15 inches.

#### 8.3.1.2 Sewer Main Rehabilitation

For sewer mains with moderate defects throughout, rehabilitation of the entire sewer main is necessary. Sewer main rehabilitation is commonly accomplished via the installation of an internal liner. Sewer main rehabilitation costs are based on cured-in-place pipe (CIPP) liner methods, which is the most common type of liner used for City projects. Bid summaries for 17 recent City CIPP sewer rehabilitation projects, for sewers ranging in size from 6- to 45-inches in diameter, were used to help develop unit costs. See Table 8.1 for estimated sewer main rehabilitation unit costs.

**Table 8.1 Cured-in-Place Pipe Rehabilitation Unit Costs**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Item No. | Item Description | Cost Per Foot ($) |
|---|---|---|
| 1 | 6" CIPP Sewer Rehabilitation | 100 |
| 2 | 8" CIPP Sewer Rehabilitation | 113 |
| 3 | 10" CIPP Sewer Rehabilitation | 126 |
| 5 | 12" CIPP Sewer Rehabilitation | 140 |
| 6 | 15" CIPP Sewer Rehabilitation | 160 |
| 7 | 18" CIPP Sewer Rehabilitation | 180 |
| 8 | 21" CIPP Sewer Rehabilitation | 200 |
| 9 | 24" CIPP Sewer Rehabilitation | 220 |
| 10 | 27" CIPP Sewer Rehabilitation | 240 |
| 11 | 30" CIPP Sewer Rehabilitation | 260 |
| 12 | 36" CIPP Sewer Rehabilitation | 300 |
| 13 | 42" CIPP Sewer Rehabilitation | 400 |
| 14 | 45" CIPP Sewer Rehabilitation | 470 |

#### 8.3.1.3 Lift Station Rehabilitation

Lift Station rehabilitation includes removal and replacement of failed existing wet well coatings or application of wet well coatings to uncoated wet wells. Recent construction cost data for wet well rehabilitation is not available but interviews with two coating contractors were conducted to help determine construction costs. Wet well rehabilitation costs include bypass pumping, interior wet well surface preparation, coating application, and non destructive testing. Estimated wet well rehabilitation unit costs are summarized in Table 8.2.

**Table 8.2 Lift Station Rehabilitation Unit Costs**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Item No. | Item Description | Cost per square foot ($) |
|---|---|---|
| 1 | Removal of Existing Liner | 25 |
| 2 | Install New Liner | 40 |
| 3 | Bypass Pumping | Site Specific |

### 8.3.2 New or Replacement Unit Costs

Unit costs for new or replacement infrastructure are “loaded” unit costs which, when applied to the key elements of the capital improvement projects, would result in an estimated project cost inclusive of all necessary associated incidental and ancillary work. Recent City bid tabulations for new sewer construction projects were primarily used to develop unit costs.

#### 8.3.2.1 New or Replacement Sewer Mains

New or replacement sewer mains range in size from 8- to 60-inches. Bid summaries for 7 recent City new or replacement sewer main projects for sewers ranging in size from 8- to 72-inches in diameter were used to help develop unit costs. See Table 8.3 for estimated sewer main installation unit costs.

**Table 8.3 Pipe Construction Unit Costs**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Item No. | Item Description | Cost per Foot ($) |
|---|---|---|
| 1 | 6" PVC Sewer Pipe | 185 |
| 2 | 8" PVC Sewer Pipe | 195 |
| 3 | 10" PVC Sewer Pipe | 210 |
| 5 | 12" PVC Sewer Pipe | 225 |

| Table 8.3 Pipe Construction Unit Costs<br>Wastewater Collection System Master Plan Update<br>City of Fresno | | |
|---|---|---|
| **Item No.** | **Item Description** | **Cost per Foot ($)** |
| 6 | 15" PVC Sewer Pipe | 245 |
| 7 | 18" PVC Sewer Pipe | 265 |
| 8 | 21" PVC Sewer Pipe | 285 |
| 9 | 24" PVC Sewer Pipe | 305 |
| 10 | 27" PVC Sewer Pipe | 335 |
| 11 | 30" PVC Sewer Pipe | 370 |
| 12 | 36" PVC Sewer Pipe | 440 |
| 13 | 42" PVC Lined RCP Sewer Pipe | 485 |
| 14 | 48" PVC Lined RCP Sewer Pipe | 530 |
| 15 | 54" PVC Lined RCP Sewer Pipe | 570 |
| 16 | 60" PVC Lined RCP Sewer Pipe | 615 |
| 17 | 66" PVC Lined RCP Sewer Pipe | 655 |

#### 8.3.2.2 Lift Station Replacement

As described in Chapter 7, Lift Station No. 11 is slated for a complete removal and replacement. A unit cost of $110,000 was used for the lift station based on a recently constructed lift station of comparable size and complexity.

## 8.4 PROJECT COSTS AND CONTINGENCIES

### 8.4.1 Baseline Construction Costs

Baseline construction costs were developed for all rehabilitation and replacement/new projects. The baseline construction costs for each type of project were developed according to the methods described below.

*Rehabilitation Projects:*

1. Point Repairs: Determined by multiplying the unit cost by the number of point repairs.
2. Sewer Main Rehabilitation: Determined by multiplying the pipeline length by the CIPP liner unit costs.
3. Pump Station Wet Well Coating (Remove and Replace): Determined by multiplying the wet well interior area by the unit cost for coating removal and replacement together with the unit costs for bypass pumping.

4. Pump Station Wet Well Coating (Bare Concrete): Determined by multiplying the wet well interior area by the unit cost for wet well coating together with the unit costs for bypass pumping.

*New or Replacement Projects:*

1. New or Replacement Pipeline: Determined by multiplying the pipeline length by the unit costs for new or replacement pipe.
2. Replacement Lift Station: Determined by using the unit cost described in Section 8.3.2.2.

### 8.4.2 Construction Costs Contingency

Development of the recommended wastewater construction projects is limited to a master planning level of detail. As such, a 25 percent contingency has been added to all construction project costs to help account for unknown conditions, fluctuations in material prices, changes in the bidding climate and unexpected changes to the scope of the projects.

## 8.5 CAPITAL IMPROVEMENT COSTS

### 8.5.1 Capital Improvement Cost Summary

The Capital Improvement Cost is the total estimated cost for each project and includes the baseline construction costs (BCC), contingency, engineering, and management costs. The composition of the baseline construction cost is detailed in Section 8.4.1 of this report. Contingencies are calculated as 25 percent of the baseline construction cost to help account for unknown or changed conditions. The engineering portion of the estimate is 10 percent of the BCC and includes all services normally required to produce construction documents and provide engineering support during bidding and construction phases. This includes the production of plans, specifications, and construction support for each project. Management is the final portion of the Capital Improvement Cost and is calculated at 10 percent of the BCC. Management costs encompass all administrative expenditures, legal fees, financing, and environmental documents required for construction. The summation of all these components covers the total cost for each project.

### 8.5.2 Capital Improvement Implementation

The CIP Scheduling assigns a fiscal year for each project as a target date for construction. The CIP scheduling was developed with consideration given to the following:

- Project Prioritization
- Anticipated City Growth Rates and Patterns
- Cost Distribution and Budgeting

- City Direction

Short term projects are phased by year through the year 2020 and long-term projects are phased in five year increments beginning in 2020 through 2035.

Rehabilitation projects and capacity projects are given the highest priority needs are and are all scheduled as short term projects to be completed between 2015 and 2020. Each project is itemized by phase in Table 8.5. Appendix J includes a large format figure showing all CIP projects. Appendix F includes detailed project summary sheets for CIP projects scheduled to be completed between 2015 and 2020.

## 8.6 EXISTING VERSUS FUTURE USER COST SHARE

The CIP includes projects that will benefit existing users and future users. An initial estimate of the project benefit for existing and future users is included in Table 8.4.

**Table 8.4 Summary of Capital Improvement Costs**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| | Implementation Phase | | | | |
|---|---|---|---|---|---|
| **Reimbursement Category** | **2015-20 ($, mill.)** | **2021-25 ($, mill.)** | **2026-30 ($, mill.)** | **2031-35 ($, mill.)** | **Total ($, mill.)** |
| Existing User | 46.3 | 55.6 | 6.1 | 0 | 108.0 |
| Future User | 0.1 | 0.2 | 1.1 | 202.9 | 204.3 |
| **Total** | **46.4** | **55.8** | **7.2** | **202.9** | **312.3** |

Notes:
(1) Costs are based on ENR CCI 20-City Average of 9,800 (June 2014).

**Table 8.5 Capital Improvement Projects**
**Wastewater Collection System Master Plan**
**City of Fresno**

| Job No. | Project Type | Description / Limits | | Existing Diameter (in) | New Diameter (in) | Rehab, Replace, or New | Length (ft) | Improvement Cost ($) | Capital Improvement Phasing | | | | Future User Benefit (%) | Reimbursement Category | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Phase 1 2015-2020 ($) | Phase 2 2021-2025 ($) | Phase 3 2026-2030 ($) | Phase 4 2031-2035 ($) | | Existing Improvements | Future Improvements |
| **Existing Improvements** | | | | | | | | | | | | | | | |
| C-1A | Gravity | Hammond Avenue | Between Blackstone Ave. and Abby St. | 20 | **24** | Replace | 390 | $ 412,000 | $ 412,000 | | | | 7% | $ 383,160 | $ 28,840 |
| C-1B | Gravity | Abby Street | From Hammond Ave. to La Salle Ave. | 20 | **24** | Replace | 1,322 | $ 868,000 | $ 868,000 | | | | 7% | $ 807,240 | $ 60,760 |
| C-2A | Gravity | Glenn Avenue | From Bremer Ave. to Thomas Ave. | 24 | **27** | Replace | 391 | $ 430,000 | $ 430,000 | | | | 7% | $ 399,900 | $ 30,100 |
| C-2B | Gravity | Glenn Avenue | From HWY 180 to Voorman Ave. | 24 | **27** | Replace | 2,580 | $ 1,580,000 | | $ 1,580,000 | | | 14% | $ 1,358,800 | $ 221,200 |
| C-3 | Gravity | Glenn Avenue / N Street | From Voorman Ave. to Tuolumne St. | 27 | **30** | Replace | 1,530 | $ 1,148,000 | | | $ 1,148,000 | | 19% | $ 929,880 | $ 218,120 |
| C-4 | Gravity | Monterey Street | From Fulton Street to N Street | 6 | **10** | Replace | 1,812 | $ 683,000 | | | $ 683,000 | | 0% | $ 683,000 | $ - |
| C-5A | Gravity | Eighth Street | From Ventura St. to Woodward Ave. | 36 | **42** | Replace | 4,717 | $ 3,825,000 | | | $ 3,825,000 | | 17% | $ 3,174,750 | $ 650,250 |
| C-5B | Gravity | Woodward Avenue | From Eighth St. to Orange Ave. | 36 | **42** | Replace | 629 | $ 733,000 | | | $ 733,000 | | 17% | $ 608,390 | $ 124,610 |
| C-5C | Gravity | Orange Avenue | From Woodward Ave. to California Ave. | 36 | **42** | Replace | 693 | $ 778,000 | | | $ 778,000 | | 17% | $ 645,740 | $ 132,260 |
| C-6 | Gravity | Safford Avenue | From Producers Dairy to H Street | 6 | **8** | Replace | 930 | $ 329,000 | | $ 329,000 | | | 0% | $ 329,000 | $ - |
| | | | | | | | **Existing Improvement Totals** | **$ 10,786,000** | **$ 1,710,000** | **$ 1,909,000** | **$ 7,167,000** | **$ -** | | **$ 9,319,860** | **$ 1,466,140** |
| **Build-Out Improvements** | | | | | | | | | | | | | | | |
| C-7 | Gravity | Tuolumne Street/ Van Ness Avenue | From N Street to Merced St. | 27 | **30** | Replace | 1,679 | $ 1,228,000 | | | | $ 1,228,000 | 100% | $ - | $ 1,228,000 |
| C-8 | Gravity | North Avenue | From Polk Ave. Alignment to Fruit Ave. | - | **60** | New | 20,857 | $ 19,615,000 | | | | $ 19,615,000 | 100% | $ - | $ 19,615,000 |
| C-9 | Gravity | North Avenue | From Fruit Ave. to Orange Ave. | 60 | **60** | Rehab | 15,514 | $ 15,376,000 | | | | $ 15,376,000 | 100% | $ - | $ 15,376,000 |
| D-1 | Gravity | Temperance Avenue | From North Ave. to Jensen Ave. | - | **48** | New | 5,875 | $ 4,805,000 | | | | $ 4,805,000 | 100% | $ - | $ 4,805,000 |
| D-2 | Gravity | Temperance Avenue | From Jensen Ave. to Tulare St. | - | **42** | New | 13,352 | $ 10,224,000 | | | | $ 10,224,000 | 100% | $ - | $ 10,224,000 |
| D-3 | Gravity | Temperance Avenue | From Tulare St. to Olive Ave. | - | **36** | New | 4,987 | $ 3,508,000 | | | | $ 3,508,000 | 100% | $ - | $ 3,508,000 |
| D-4 | Gravity | Temperance/McKinley/DeWolf | From Olive Ave. to Shields Ave. | - | **30** | New | 13,300 | $ 7,970,000 | | | | $ 7,970,000 | 100% | $ - | $ 7,970,000 |
| D-5 | Gravity | Shields Ave./Leonard Ave. | From DeWolf Ave. to Dakota Ave. | - | **27** | New | 4,575 | $ 2,397,000 | | | | $ 2,397,000 | 100% | $ - | $ 2,397,000 |
| D-6A | Gravity | Jensen Avenue | From Temperance Ave. to DeWolf Ave. | - | **15** | New | 5,228 | $ 2,053,000 | | | | $ 2,053,000 | 100% | $ - | $ 2,053,000 |
| D-6B | Gravity | Jensen Avenue | From DeWolf Ave. to Leonard Ave. | - | **12** | New | 2,732 | $ 964,000 | | | | $ 964,000 | 100% | $ - | $ 964,000 |
| D-7A | Gravity | Church Avenue | From Temperance Ave. to Locan Ave. | - | **15** | New | 2,552 | $ 1,016,000 | | | | $ 1,016,000 | 100% | $ - | $ 1,016,000 |
| D-7B | Gravity | Church Avenue | From Locan Ave. to DeWolf Ave. | - | **12** | New | 2,729 | $ 963,000 | | | | $ 963,000 | 100% | $ - | $ 963,000 |
| D-7C | Gravity | Church Avenue | From DeWolf Ave. to Leonard Ave. | - | **8** | New | 2,673 | $ 829,000 | | | | $ 829,000 | 100% | $ - | $ 829,000 |
| D-8A | Gravity | California Avenue | From Temperance Ave to Locan Ave. | - | **18** | New | 2,676 | $ 1,137,000 | | | | $ 1,137,000 | 100% | $ - | $ 1,137,000 |
| D-8B | Gravity | California Avenue | From Locan Ave. to DeWolf Ave. | - | **15** | New | 2,670 | $ 1,058,000 | | | | $ 1,058,000 | 100% | $ - | $ 1,058,000 |
| D-8C | Gravity | California Avenue | From DeWolf Ave. to Leonard Ave. | - | **10** | New | 2,617 | $ 870,000 | | | | $ 870,000 | 100% | $ - | $ 870,000 |
| D-9A | Gravity | Butler Avenue | From Temperance Ave to Locan Ave. | - | **18** | New | 2,617 | $ 1,115,000 | | | | $ 1,115,000 | 100% | $ - | $ 1,115,000 |
| D-9B | Gravity | Butler Avenue | From Locan Ave. to DeWolf Ave. | - | **15** | New | 2,611 | $ 1,037,000 | | | | $ 1,037,000 | 100% | $ - | $ 1,037,000 |
| D-9C | Gravity | Butler Avenue | From DeWolf Ave. to Leonard Ave. | - | **8** | New | 2,789 | $ 862,000 | | | | $ 862,000 | 100% | $ - | $ 862,000 |
| D-10A | Gravity | Tulare Street | From Temperance Ave. to Locan Ave. | - | **21** | New | 2,730 | $ 1,237,000 | | | | $ 1,237,000 | 100% | $ - | $ 1,237,000 |
| D-10B | Gravity | Tulare Street/DeWolf Avenue | From Locan Ave. to Laurel Ave. Alignment | - | **15** | New | 4,035 | $ 1,586,000 | | | | $ 1,586,000 | 100% | $ - | $ 1,586,000 |
| D-10C | Gravity | Laurel Avenue Alignment | From DeWolf Ave. to Leonard Ave. | - | **8** | New | 2,729 | $ 845,000 | | | | $ 845,000 | 100% | $ - | $ 845,000 |
| D-10D | Gravity | Locan Ave/ Belmont Ave. | From Tulare St. to DeWolf Ave. | - | **12** | New | 4,926 | $ 1,738,000 | | | | $ 1,738,000 | 100% | $ - | $ 1,738,000 |
| D-10E | Gravity | Belmont Avenue | From DeWolf Ave. to Leonard Ave. | - | **10** | New | 2,554 | $ 851,000 | | | | $ 851,000 | 100% | $ - | $ 851,000 |
| D-11A | Gravity | Olive Avenue | From Temperance Ave. to Locan Ave. | - | **15** | New | 2,671 | $ 1,058,000 | | | | $ 1,058,000 | 100% | $ - | $ 1,058,000 |
| D-11B | Gravity | Olive Avenue | From Locan Ave. to DeWolf Ave. | - | **12** | New | 2,613 | $ 926,000 | | | | $ 926,000 | 100% | $ - | $ 926,000 |
| D-11C | Gravity | Olive Avenue | From DeWolf Ave. to Leonard Ave. | - | **8** | New | 2,617 | $ 813,000 | | | | $ 813,000 | 100% | $ - | $ 813,000 |
| D-12A | Gravity | McKinley Avenue | From DeWolf Ave. to Leonard Ave. | - | **21** | New | 2,729 | $ 1,237,000 | | | | $ 1,237,000 | 100% | $ - | $ 1,237,000 |
| D-12B | Gravity | McKinley Avenue | From Leonard Ave. to Thompson Ave. | - | **18** | New | 5,103 | $ 2,157,000 | | | | $ 2,157,000 | 100% | $ - | $ 2,157,000 |
| D-12C | Gravity | Thompson Avenue | From McKinley Ave. to Clinton Ave. | - | **15** | New | 2,730 | $ 1,079,000 | | | | $ 1,079,000 | 100% | $ - | $ 1,079,000 |
| D-13 | Gravity | Clinton Avenue | From DeWolf Ave. to Leonard Ave. | - | **10** | New | 2,492 | $ 832,000 | | | | $ 832,000 | 100% | $ - | $ 832,000 |
| D-14 | Gravity | North Avenue | From Peach Ave. to Temperance Ave. | - | **36** | New | 15,787 | $ 11,051,000 | | | | $ 11,051,000 | 100% | $ - | $ 11,051,000 |

**Table 8.5 Capital Improvement Projects**
**Wastewater Collection System Master Plan**
**City of Fresno**

| Job No. | Project Type | Description / Limits | | Existing Diameter (in) | New Diameter (in) | Rehab, Replace, or New | Length (ft) | Improvement Cost ($) | Capital Improvement Phasing: Phase 1 2015-2020 ($) | Phase 2 2021-2025 ($) | Phase 3 2026-2030 ($) | Phase 4 2031-2035 ($) | Future User Benefit (%) | Reimbursement Category: Existing Improvements | Reimbursement Category: Future Improvements |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D-15 | Gravity | Minnewawa Avenue | From North Ave. to Annadale Ave. | - | **12** | New | 2,730 | $ 964,000 | | | | $ 964,000 | 100% | $ - | $ 964,000 |
| D-16 | Gravity | Sunnyside Avenue | From North Ave. to Annadale Ave. | - | **15** | New | 2,611 | $ 1,037,000 | | | | $ 1,037,000 | 100% | $ - | $ 1,037,000 |
| D-17 | Gravity | Fowler Avenue | From North Ave. to Annadale Ave. | - | **10** | New | 2,789 | $ 922,000 | | | | $ 922,000 | 100% | $ - | $ 922,000 |
| D-18 | Gravity | Armstrong Avenue | From North Ave. to Annadale Ave. | - | **8** | New | 2,671 | $ 828,000 | | | | $ 828,000 | 100% | $ - | $ 828,000 |
| D-19A | Gravity | Valentine Avenue | From Church Ave. to Kearney Frontage | - | **12** | New | 3,945 | $ 1,389,000 | | | | $ 1,389,000 | 100% | $ - | $ 1,389,000 |
| D-19B | Gravity | Valentine Avenue | From Kearney Frontage to Madison Ave. | - | **10** | New | 1,312 | $ 444,000 | | | | $ 444,000 | 100% | $ - | $ 444,000 |
| D-20 | Gravity | Brawley Avenue | From Church Ave. to Madison Ave. | - | **8** | New | 5,303 | $ 1,630,000 | | | | $ 1,630,000 | 100% | $ - | $ 1,630,000 |
| D-21A | Gravity | Whitesbridge Avenue | From Polk Ave. to Blythe Ave. | - | **12** | New | 5,271 | $ 1,851,000 | | | | $ 1,851,000 | 100% | $ - | $ 1,851,000 |
| D-21B | Gravity | Whitesbridge/Brawley Avenue | From Blythe Ave. to Nielsen Ave. | - | **10** | New | 5,392 | $ 1,773,000 | | | | $ 1,773,000 | 100% | $ - | $ 1,773,000 |
| D-22A | Gravity | Belmont Avenue | From Polk Ave. to Cornelia Ave. | - | **12** | New | 2,716 | $ 959,000 | | | | $ 959,000 | 100% | $ - | $ 959,000 |
| D-22B | Gravity | Belmont Avenue | From Cornelia Ave. to Blythe Ave. | - | **10** | New | 2,675 | $ 887,000 | | | | $ 887,000 | 100% | $ - | $ 887,000 |
| D-22C | Gravity | Belmont Avenue | From Blythe Ave. to Brawley Ave. | - | **8** | New | 2,640 | $ 819,000 | | | | $ 819,000 | 100% | $ - | $ 819,000 |
| D-23A | Gravity | Olive Avenue | From Polk Ave. to Blythe Ave. | - | **12** | New | 5,260 | $ 1,847,000 | | | | $ 1,847,000 | 100% | $ - | $ 1,847,000 |
| D-23B | Gravity | Olive Avenue | From Blythe Ave. to Brawley Ave. | - | **8** | New | 2,675 | $ 829,000 | | | | $ 829,000 | 100% | $ - | $ 829,000 |
| D-24A | Gravity | Olive Avenue | From Grantland Ave. to Bryan Ave. | - | **12** | New | 2,649 | $ 937,000 | | | | $ 937,000 | 100% | $ - | $ 937,000 |
| D-24B | Gravity | Olive Avenue | From Bryan Ave. to Hayes Ave. | - | **10** | New | 1973 | $ 659,000 | | | | $ 659,000 | 100% | $ - | $ 659,000 |
| D-25 | Gravity | McKinley Avenue | From Grantland Ave. to Ring Ave. | - | **10** | New | 3,603 | $ 1,199,000 | | | | $ 1,199,000 | 100% | $ - | $ 1,199,000 |
| D-26A | Gravity | Clinton Avenue | From Grantland Ave. to Bryan Ave. | - | **12** | New | 2,645 | $ 936,000 | | | | $ 936,000 | 100% | $ - | $ 936,000 |
| D-26B | Gravity | Clinton Avenue | From Bryan Ave. to Hayes Ave. | - | **10** | New | 2,592 | $ 862,000 | | | | $ 862,000 | 100% | $ - | $ 862,000 |
| D-27A | Gravity | Shields Avenue | From Grantland Ave. to Bryan Ave. | - | **15** | New | 2,627 | $ 1,042,000 | | | | $ 1,042,000 | 100% | $ - | $ 1,042,000 |
| D-27B | Gravity | Shields Avenue | From Bryan Ave. to Hayes Ave. | - | **12** | New | 2,592 | $ 919,000 | | | | $ 919,000 | 100% | $ - | $ 919,000 |
| | | | | | | | **Build-Out Improvement Totals** | **$ 125,170,000** | **$ -** | **$ -** | **$ -** | **$ 125,170,000** | | **$ -** | **$ 125,170,000** |
| **New Facilities** | | | | | | | | | | | | | | | |
| NCFWRF-1 | Treatment | Cedar/Dakota, Scalping Plant at Vacant Field Behind Granite Park | | - | **6 mgd** | New | - | $ 51,106,000 | | $ 51,106,000 | | | 0% | $ 51,106,000 | $ - |
| NCFWRF-2 | Gravity | Dakota, From Treatment Facility to Millbrook Ave. | | - | **36** | New | 4,042 | $ 2,833,000 | | $ 2,833,000 | | | 0% | $ 2,833,000 | $ - |
| SEGA | Treatment | Temperance, Scalping Plant On Corner of Temperance and North Ave. | | - | **15 mgd** | New | - | $ 77,760,000 | | | | $ 77,760,000 | 100% | $ - | $ 77,760,000 |
| | | | | | | | **New Facilities Totals** | **$ 131,699,000** | **$ -** | **$ 53,939,000** | **$ -** | **$ 77,760,000** | | **$ 53,939,000** | **$ 77,760,000** |
| **Lift Stations** | | | | | | | | | | | | | | | |
| LS-1 | Lift Station | West of Jensen and Walnut Avenues | | - | - | - | - | $ 15,000 | $ 15,000 | | | | | $ 15,000 | $ - |
| LS-2 | Lift Station | Kearney Boulevard and Marks Avenue | | - | - | - | - | $ 39,000 | $ 39,000 | | | | | $ 39,000 | $ - |
| LS-3 | Lift Station | North of Shield and Wilson Avenues | | - | - | - | - | $ 15,000 | $ 15,000 | | | | | $ 15,000 | $ - |
| LS-4 | Lift Station | Riverview Drive and Bluff Avenue | | - | - | - | - | $ 200,000 | $ 200,000 | | | | | $ 200,000 | $ - |
| LS-5 | Lift Station | Fort Washington Road and Champlain Drive | | - | - | - | - | $ 96,000 | $ 96,000 | | | | | $ 96,000 | $ - |
| LS-6 | Lift Station | Southeast of Perrin Avenue and Champlain Drive | | - | - | - | - | $ 114,000 | $ 114,000 | | | | | $ 114,000 | $ - |
| LS-10 | Lift Station | Stratford and Woodlawn Drives | | - | - | - | - | $ 49,000 | $ 49,000 | | | | | $ 49,000 | $ - |
| LS-11 | Lift Station | East of Cedar and Copper Avenues | | - | - | - | - | $ 160,000 | $ 160,000 | | | | | $ 160,000 | $ - |
| LS-12 | Lift Station | Carnegie and Bullard Avenues | | - | - | - | - | $ - | $ - | | | | | $ - | $ - |
| LS-13 | Lift Station | North of Jackson and University Avenues | | - | - | - | - | $ 59,000 | $ 59,000 | | | | | $ 59,000 | $ - |
| LS-14 | Lift Station | East of Carnegie and Alluvial Avenues | | - | - | - | - | $ 70,000 | $ 70,000 | | | | | $ 70,000 | $ - |
| LS-15 | Lift Station | North of Haston Avenue and Fountain Way | | - | - | - | - | $ 128,000 | $ 128,000 | | | | | $ 128,000 | $ - |
| LS-16 | Lift Station | Northwest of Santa Fe and El Paso Avenues | | - | - | - | - | $ 72,000 | $ 72,000 | | | | | $ 72,000 | $ - |
| LS-18 | Lift Station | South of Nielsen and Hughes Avenues | | - | - | - | - | $ 82,000 | $ 82,000 | | | | | $ 82,000 | $ - |
| LS-20 | Lift Station | North of Cherry and Muscat Avenues | | - | - | - | - | $ 15,000 | $ 15,000 | | | | | $ 15,000 | $ - |
| | | | | | | | **Lift Station Totals** | **$ 1,114,000** | **$ 1,114,000** | **$ -** | **$ -** | **$ -** | | **$ 1,114,000** | **$ -** |
| **Point Repairs** | | | | | | | | | | | | | | | |
| HPPR-1 | Point Repair | 250 Priority Point Repairs as determined by City of Fresno personnel | | Varies | Varies | Replace | Varies | $ 5,800,000 | $ 5,800,000 | | | | | $ 5,800,000 | $ - |

**Table 8.5 Capital Improvement Projects**
**Wastewater Collection System Master Plan**
**City of Fresno**

| Job No. | Project Type | Description / Limits | Existing Diameter (in) | New Diameter (in) | Rehab, Replace, or New | Length (ft) | Improvement Cost ($) | Capital Improvement Phasing | | | | Future User Benefit (%) | Reimbursement Category | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Phase 1 2015-2020 ($) | Phase 2 2021-2025 ($) | Phase 3 2026-2030 ($) | Phase 4 2031-2035 ($) | | Existing Improvements | Future Improvements |
| HPPR-2 | Point Repair | 250 Priority Point Repairs as determined by City of Fresno personnel | Varies | Varies | Replace | Varies | $ 5,800,000 | $ 5,800,000 | | | | | $ 5,800,000 | $ - |
| HPPR-3 | Point Repair | 250 Priority Point Repairs as determined by City of Fresno personnel | Varies | Varies | Replace | Varies | $ 5,800,000 | $ 5,800,000 | | | | | $ 5,800,000 | $ - |
| HPPR-4 | Point Repair | 250 Priority Point Repairs as determined by City of Fresno personnel | Varies | Varies | Replace | Varies | $ 5,800,000 | $ 5,800,000 | | | | | $ 5,800,000 | $ - |
| HPPR-5 | Point Repair | 249 Priority Point Repairs as determined by City of Fresno personnel | Varies | Varies | Replace | Varies | $ 5,777,000 | $ 5,777,000 | | | | | $ 5,777,000 | $ - |
| | | | | | | **Point Repair Totals** | **$ 28,977,000** | **$ 28,977,000** | **$ -** | **$ -** | **$ -** | | **$ 28,977,000** | **$ -** |
| **Pipe Rehabilitation** | | | | | | | | | | | | | | |
| R-1A | Rehabilitation | 16 high MOSR segments | Varies | Varies | Rehab | Varies | $ 2,488,000 | $ 2,488,000 | | | | | $ 2,488,000 | $ - |
| R-1B | Rehabilitation | 18 high MOSR segments | Varies | Varies | Rehab | Varies | $ 2,571,000 | $ 2,571,000 | | | | | $ 2,571,000 | $ - |
| R-1C | Rehabilitation | 23 high MOSR segments | Varies | Varies | Rehab | Varies | $ 2,631,000 | $ 2,631,000 | | | | | $ 2,631,000 | $ - |
| R-2 | Rehabilitation | 2006 Master Plan Project RS03A | 24 | 24 | Rehab | 3,118 | $ 1,126,000 | $ 1,126,000 | | | | | $ 1,126,000 | $ - |
| R-3 | Rehabilitation | 2006 Master Plan Project RS06B | 15 | 15 | Rehab | 300 | $ 92,000 | $ 92,000 | | | | | $ 92,000 | $ - |
| R-4 | Rehabilitation | 2006 Master Plan Project RL02 | 48 | 48 | Rehab | 2,644 | $ 2,101,000 | $ 2,101,000 | | | | | $ 2,101,000 | $ - |
| R-5 | Rehabilitation | 2006 Master Plan Project RL11 | 54 | 54 | Rehab | 3,992 | $ 3,561,000 | $ 3,561,000 | | | | | $ 3,561,000 | $ - |
| | | | | | | **Pipe Rehabilitation Totals** | **$ 14,570,000** | **$ 14,570,000** | **$ -** | **$ -** | **$ -** | | **$ 14,570,000** | **$ -** |
| | | | | | | | | | | | | | | |
| | | | | | | **Capitol Improvement Projects Totals** | **$ 312,316,000** | **$ 46,371,000** | **$ 55,848,000** | **$ 7,167,000** | **$ 202,930,000** | | **$ 107,919,860** | **$ 204,396,140** |

# APPENDIX A – GENERAL PLAN LAND USE DESCRIPTIONS

- *Walls and fences that separate related uses or isolate neighborhoods;*
- *Over reliance on cul-de-sacs and dead end streets that cut off access within neighborhoods;*
- *Disconnected bike and pedestrian paths;*
- *Wide streets that lack pedestrian support, such as sidewalks, median strips, and a landscaped strip that separates pedestrians from the street;*
- *Street front parking lots that separate pedestrian from commercial operations;*
- *Retail centers that are exclusively auto-oriented;*
- *Transit stops that are not easily accessible from an individual's starting point and destination; and*
- *Long blocks that discourage walking.*

UF-14-b **Local Street Connectivity.** Design local roadways to connect throughout neighborhoods and large private developments with adjacent major roadways and pathways of existing adjacent development. Create access for pedestrians and bicycles where a local street must dead end or be designed as a cul-de-sac to adjoining uses that provide services, shopping, and connecting pathways for access to the greater community area.

UF-14-c **Block Length.** Create development standards that provide desired and maximum block lengths in residential, retail, and mixed-use districts in order to enhance walkability.

***Commentary:*** *When preparing such standards the City should assess the desirability of varying maximum block length requirements between single family residential, multi-family residential, mixed use, and commercial districts.*

## 3.5 LAND USE

The following sections provide the General Plan's required land use information with use classifications, maximum densities and intensities on Figure LU-1: Fresno General Plan Land Use Diagram.

The City has reviewed those areas covered by the General Plan that are subject to flooding identified by flood plain mapping prepared by the Federal Emergency Management Agency (FEMA), which can be found at Figure NS-7: Floodplains. The City

will annually review those areas covered by the Plan as set out in the Implementation Element.

## Land Use Diagram

The Land Use Diagram is the City's master designation of land uses for Fresno including the City's SOI. The Land Use Diagram includes the Downtown Planning Area, shown in an inset, and its designations are anticipated to be further refined and implemented through specific and community plans, such as the proposed FCSP and the DNCP. Land use designations for the Downtown Planning Area are generalized to facilitate implementation by providing some flexibility for the detailed plans.

## Dual Designations

All new parks, open space, and public facilities (such as school sites) carry dual land use designations, so that if that facility is not needed, private and public development consistent with zoning and development standards may be approved. These dual land use designations are shown in Figure LU-2: Dual Designation.

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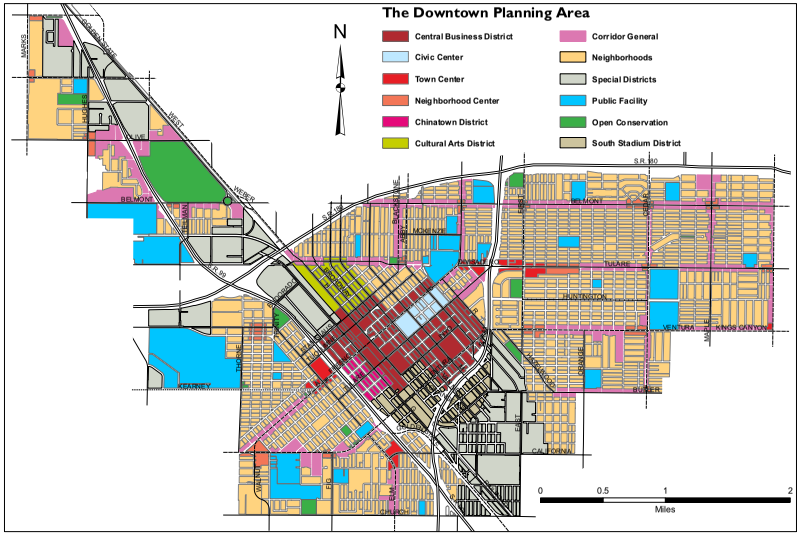
# City of Fresno General Plan Land Use and Circulation Map

| PLAN ADOPTION | |
|---|---|
| Resolution Number | Date |
| 2014 - 226 | 18-Dec-14 |
| 2014 - 227 | 18-Dec-14 |
| **PLAN AMMENDMENTS** | |
| Resolution Number | Date |
| 2015 - 133 | 16-Jul-15 |
| 2016 - 21 | 4-Feb-16 |
| 2016 - 23 | 4-Feb-16 |




(Proposed downtown land use and circulation classifications are anticipated to be further refined through specific and community plans such as the proposed Fulton Corridor Specific Plan and the Downtown Neighbohoods Community Plan.)

## LEGEND

**RESIDENTIAL**
- Low Density (1-3.5 D.U./acre)
- Medium Low Density (3.5-6 D.U./acre)
- Medium Density (5.0-12 D.U./acre)
- Medium High Density (12-16 D.U./acre)
- Urban Neighborhood (16-30 D.U./acre)
- High Density (30-45 D.U./acre)

**COMMERCIAL**
- Main Street
- Community
- Recreation
- General
- Highway & Auto
- Regional

**EMPLOYMENT**
- Office
- Business Park
- Regional Business Park
- Light Industrial
- Heavy Industrial

**MIXED USE**
- Corridor/Center Mixed Use
- Regional Mixed Use
- Neighborhood Mixed Use

**OPEN SPACE**
- Clear Zone
- Commercial-Recreational
- Community Park
- Flood Control Project
- Golf Course
- Lake, Pond
- Multi-Use
- Neighborhood Park
- Outdoor Environmental Education Area
- Open Space
- Park
- Ponding Basin
- Ponding Basin (Park use)
- Regional Park

**PUBLIC FACILITIES**
- Public/Quasi-public Facility
- Special School
- Elementary School
- Elementary & Middle School
- Elementary, Middle & High School
- Middle School
- High School
- College
- School with Park
- Airport
- Cemetery
- Church
- Community Activity Center
- Convalescent Hospital
- Fairgrounds
- Fire Station
- Government Offices
- Hospital
- Medical Center
- Neighborhood Center
- PG & E Substation
- Police Dressing Station
- Water Recharge Basin
- Waste Water Treatment Facility

**BUFFER**
- Buffer

**BOUNDARIES**
- Existing Fresno Sphere of Influence
- Fresno Planning Boundary
- Downtown Neighborhoods
- Southeast Development Area (SEDA)

Date: 2/29/2016

**Circulation Legend**

| | | |
|---|---|---|
| Freeway | Super Arterial | Scenic Drive |
| Expressway | Arterial | Collector |
| Scenic Expressway | Scenic Arterial | Scenic Collector |

0 0.5 1 2 3 4 5 Miles

Dual land use designations for public facilities and open space are shown on a supplemental map.

This map is believed to be an accurate representation of the City of Fresno GIS data. However, we make no warranties either expressed or implied for the correctness of this data.

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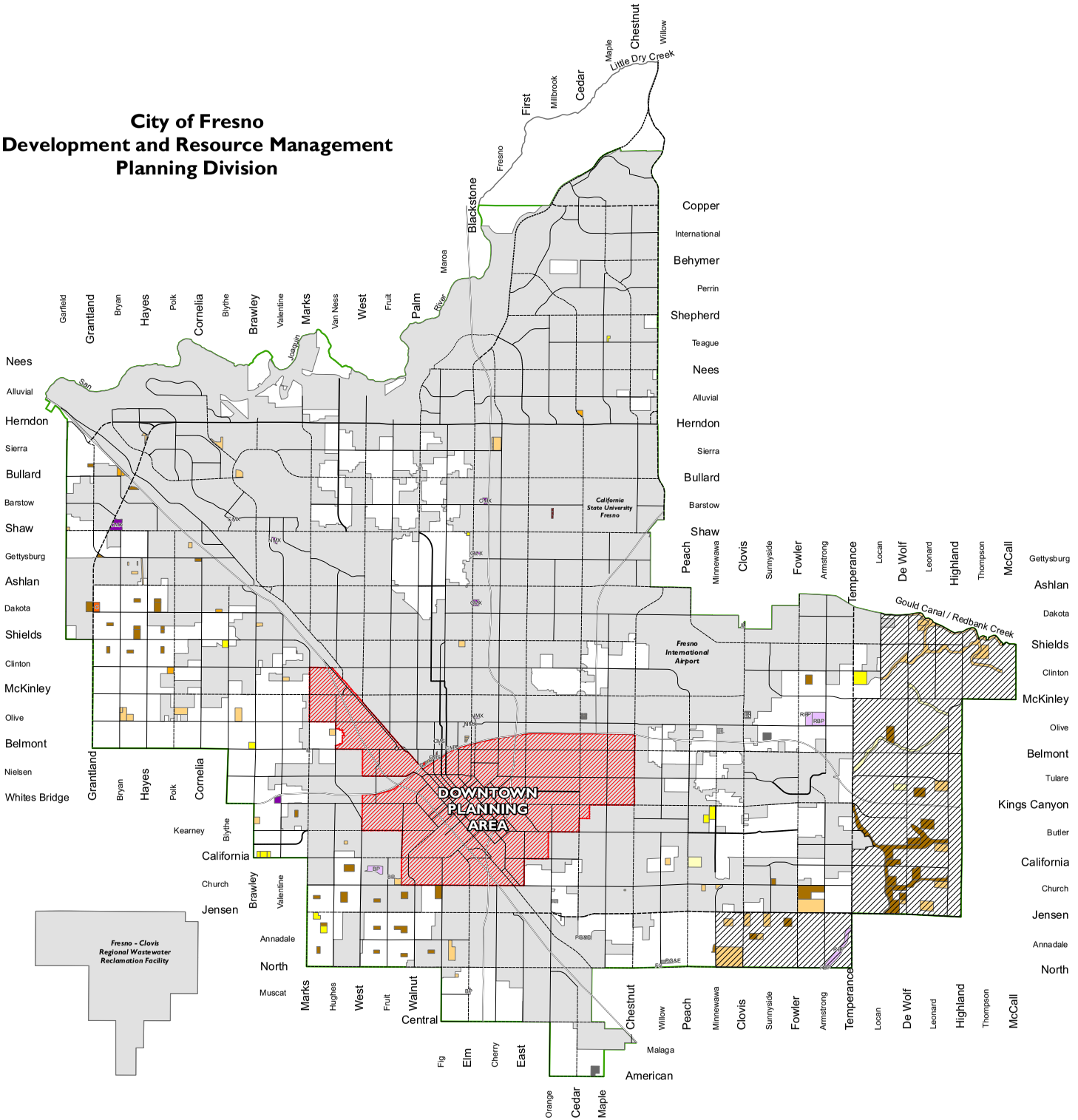
# City of Fresno
# Development and Resource Management
# Planning Division




## Figure LU - 2:
## Dual Designation Diagram

**Residential**
- Low Desnisty (1-3.5 D. U./Acre)
- Medium Low Desnisty (3.5-6 D. U./Acre)
- Medium Desnisty (5-12 D. U./Acre)
- Medium High Desnisty (12-16 D. U./Acre)
- Urban Neighborhood (16-30 D. U./Acre)
- High Density (30-45 D. U./Acre)

**Commercial**
- C Community
- M Main Street
- G General

**Employment**
- Office
- BP Business Park
- RBP Regional Business Park
- Light Industrial
- Heavy Industrial

**Mixed Use**
- CMX Corridor/Center Mixed Use
- RMX Regional Mixed Use
- NMX Neighborhood Mixed Use

## Boundaries
- Fresno Planning Boundary
- Existing Sphere of Influence
- City Limit
- Downtown Neighborhoods
- Southeast Development Area (SEDA)

*Date: 1/4/2016*

**Circulation Legend**

| | | |
|---|---|---|
| Freeway | Super Arterial | Scenic Drive |
| Expressway | Arterial | Collector |
| Scenic Expressway | Scenic Arterial | Scenic Collector |
| Ramp | | |

0 1 2 4 6 Miles

N

Note: All planned land uses for future parks, open space, ponding basins, schools (e.g. special, elementary, middle, high, and colleges) and schools with parks carry dual planned land use designations so that if that facility is not needed private and public development consistent with zoning and development standards may be approved. This map shows the additional land use designations.

Source: City of Fresno, DARM Dept., Planned Land Use, 2015.

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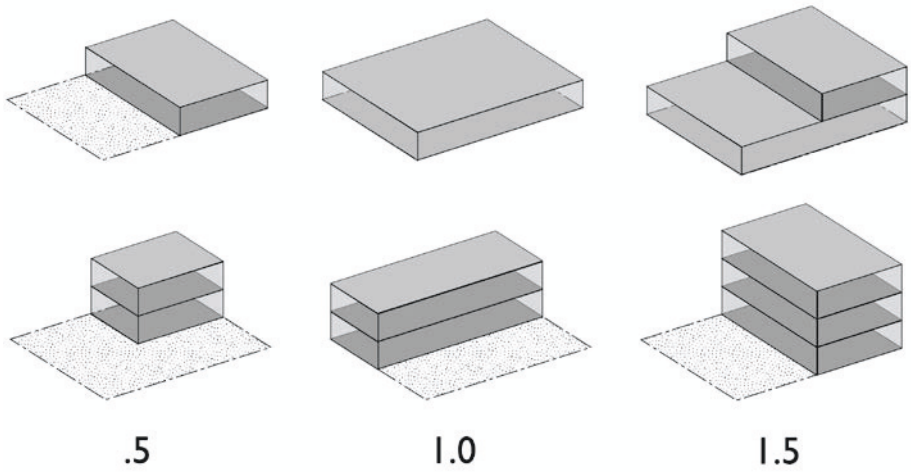
## Density and Intensity

The General Plan calculates density on net acreage, defined as the land area of a lot remaining after dedication of all areas for major streets, schools, regional trails, certified wetlands or floodplains, and land underneath electric transmission lines. For residential uses, the density and intensity standards are expressed as the number of housing units per net acre. For non-residential uses, a measure known as Floor Area Ratio (FAR) is specified. FAR is defined as the permitted ratio of gross floor area to site area. It is a measure of building bulk that controls both visual prominence and traffic generation, as shown in the diagram below.




The citywide density and intensity standards, established in Table 3-1, are intended to establish minimum and maximum densities per net acre allowed in each General Plan land use category, exclusive of the Downtown Planning Area. Minimum and maximum densities, intensities, and required land use mixes will be more precisely defined within the Development Code for purposes of determining the consistency of a proposed zone district and a property development entitlement with an applicable land use designation.

Minimum lot/parcel sizes (and corresponding lot frontage minimums and other lot design requirements) will be defined in the Development Code for each zone district. The Development Code will also provide procedures and criteria for preparing and implementing "planned development" for a given area to allow for limited reconfiguration of the planned land uses for that area and variations from base zoning district development standard, while maintaining the equivalent densities, intensities and mix of uses. Finally, the General Plan land use designation may provide overlap in the defined densities, intensities and land uses described for various land uses.

## TABLE 3-1: CITYWIDE STANDARDS FOR DENSITY AND DEVELOPMENT INTENSITY

| Land Use | Minimum to Maximum Residential Density (du/net acre)[1,2,3] | Maximum Floor Area Ratio |
|---|---|---|
| Buffer | Max = 0.05 (1 unit per 20 net acres) | - |
| **Residential** | | |
| Low Density | Min = 1 unit per 5 acres<br>Max = 3.5 units per acre | - |
| Medium Low Density | Min = 3.5 units per acre<br>Max = 6 units per acre | - |
| Medium Density | Min = 5 units per acre<br>Max = 12 units per acre | - |
| Medium High Density | Min = 12 units per acre<br>Max = 16 units per acre | - |
| Urban Neighborhood Density | Min = 16 units per acre<br>Max = 30 units per acre | - |
| High Density | Min = 30 units per acre<br>Max = 45 units per acre | - |
| **Commercial** | | |
| Main Street | | 1.0 |
| Community | | 1.0 |
| Recreation | | 0.5 |
| General | | 2.0 |
| Highway & Auto | | 0.75 |
| Regional | | 1.0 |
| **Mixed-Use** | | |
| Neighborhood Mixed-Use | Min = 12 units per acre<br>Max = 16 units per acre | 1.5 |
| Corridor/Center Mixed-Use | Min = 16 units per acre<br>Max = 30 units per acre | 1.5 |
| Regional Mixed-Use | Min = 30 units per acre<br>Max = 45 units per acre | 2.0 |
| **Employment** | | |
| Office | - | 2.0 |
| Business Park | - | 1.0 |
| Regional Business Park | - | 1.0 |
| Light Industrial | - | 1.5 |
| Heavy Industrial | - | 1.5 |

1. Based on Net Acreage.
2. Residential density refers to the ratio of residential dwelling units per acre (43,560 square feet) of land which is calculated by dividing the number of existing or proposed residential dwelling units by the land area of the property designated for, or proposed for development with, a residential use. The residential land area includes property upon which the residential and ancillary structures are located, together with yards and other private or common open spaces, and includes vehicle access drives and parking areas together with public and private roadways. The residential land area does not include major streets or State Routes designated by Figure MT-1: General Plan Circulation Diagram, and does not include schools or regional trails.
3. Additional density may be allowed for affordable housing or provision of community benefits (pursuant to California Government Code Sections 65915 – 65918, as may be amended).

Table 3-2 provides density and intensity standards specific to the Downtown Planning Area.

| TABLE 3-2: DOWNTOWN PLANNING AREA STANDARDS FOR DENSITY AND DEVELOPMENT INTENSITY | | |
|---|---|---|
| Land Use | Maximum Residential Density (du/net acre)[1,2] | Maximum Floor Area Ratio |
| Central Business District (CBD) | 60 units per acre[3] | 7.5 |
| Civic Center | - | 5.0 |
| Town Center | 45 units per acre | 4.0 |
| Neighborhood Center | 30 units per acre | 2.0 |
| Chinatown District | 45 units per acre | 3.0 |
| Cultural Arts District | | |
| Corridor General | 30 units per acre | 2.5 |
| Neighborhoods | 16 units per acre | - |
| Special Districts[4] | - | 2.5 |
| Public Facility | - | - |
| Open Conservation | - | - |
| South Stadium District | 60 units per acre | 5.0 |

1. Based on Net Acreage.
2. Additional density may be allowed for affordable housing or provision of community benefits (pursuant to California Government Code Sections 65915 – 65918, as may be amended).
3. Maximum density in CBD provided for capacity analysis and is considered an average for the district. Industrial projects may be allowed to exceed this density.
4. Additional FAR may be granted for hospitals and related uses, up to 5.0.

## Land Use Classifications

These land use classifications cover the entire Planning Area, with the exception of the Downtown Planning Area. The land use classifications for the Downtown Planning Area are described later in this element.

### Residential

Residential land uses provide for a wide range of neighborhoods and housing types.

#### LOW DENSITY

This designation is intended to provide for large lot residential development. Low Density residential allows one to 3.5 housing units per acre. The resulting land use pattern is large lot residential in nature, such as rural residential, ranchettes, or estate homes.

#### MEDIUM LOW DENSITY

The Medium Low Density designation is intended to provide for single family detached housing with densities of 3.5 to 6 units per acre.

#### MEDIUM DENSITY

Medium Density residential covers developments of 5 to 12 units per acre and is intended for areas with predominantly single-family residential development, but can

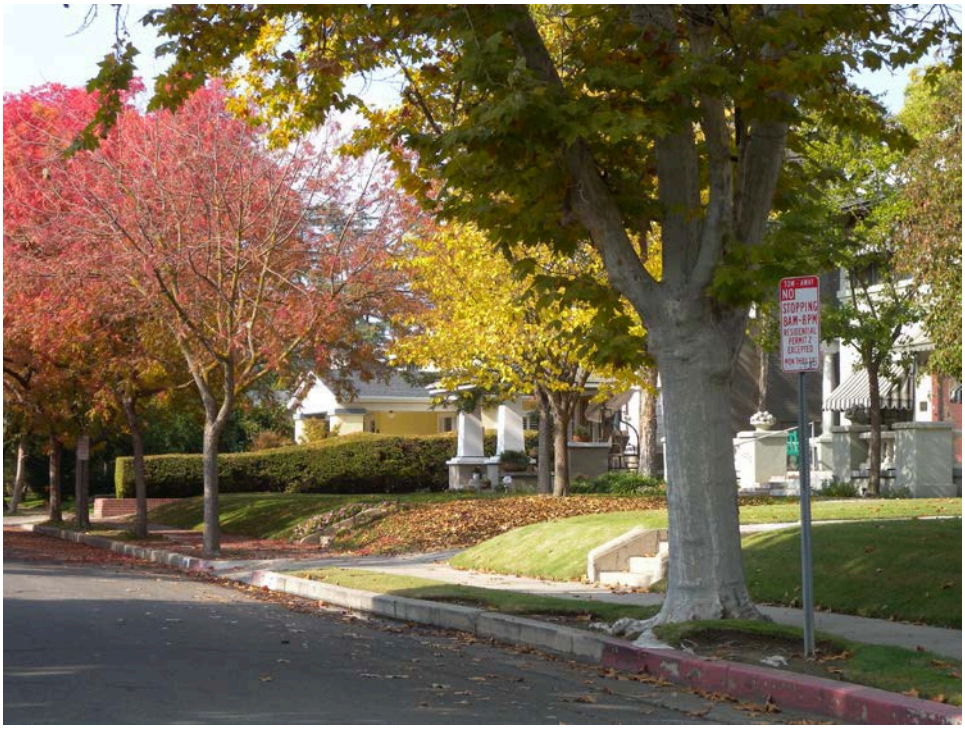
also accommodate a mix of housing types, including small-lot starter homes, zero-lot-line developments, duplexes, and townhouses. Much of the City's established neighborhoods fall within this designation.

### MEDIUM HIGH

Medium High Density residential is intended for neighborhoods with a mix of single-family residences, townhomes, garden apartments, and multi-family units intended to support a fine-grain, pedestrian scale. This land use accommodates densities from 12 to 16 units per acre overall.

### URBAN NEIGHBORHOOD

Urban Neighborhood residential covers densities from 16 to 30 units per acre, which will require multi-family dwellings but still allows for a mix of housing types including single-family houses. This land use is intended to provide for a compact community that includes community facilities and walkable access to parkland and commercial services; it also supports efficient, frequent transit service. Urban Neighborhood is designated for targeted areas with complementary land uses adjacently located.




*An example of Fresno's established residential neighborhoods, with wide streets, sidewalks, and large trees.*

### HIGH DENSITY

High Density residential is intended to accommodate attached homes, two- to four-plexes, and apartment buildings, and it will be supported by walkable access to frequent transit, retail and services, and community facilities such as parks and schools. High Density allows for 30 to 45 units per acre.

## Commercial

Commercial land use designations allow a wide range of retail and service establishments intended to serve local and regional needs.

### MAIN STREET

Main Street Commercial encourages a traditional Main Street character with active storefronts, outdoor seating and pedestrian-oriented design. This designation promotes primarily one to two story retail uses. It also preserves small-scale, fine-grain character in neighborhoods where single-family residential and townhomes are predominant. The maximum FAR is 1.0.

### COMMUNITY

Community Commercial is intended for commercial development that primarily serves local needs such as convenience shopping and small offices. Many of the city's current commercial districts fall into this designation. Specific uses allowed include medium-scale retail, office, civic and entertainment uses, supermarkets, drug stores and supporting uses. The maximum FAR is 1.0.

### RECREATION

The Recreation designation is intended for areas of private commercial recreation uses, such as bowling alleys and golf driving ranges. The maximum FAR is 0.5.

### GENERAL

The General Commercial designation is intended for a range of retail and service uses that are not appropriate in other areas because of higher volumes of vehicle traffic and potential adverse impacts on other uses. Development such as strip malls fall into this designation. Examples of allowable uses include: building materials, storage facilities with active storefronts, equipment rental, wholesale businesses, and specialized retail not normally found in shopping centers. The maximum FAR is 2.0.

### HIGHWAY & AUTO

The Highway & Auto designation is intended for limited areas near State Route 99 to accommodate uses that depend on or are supported by freeway access but do not generate a large volume of traffic. Hotels, restaurants, and auto malls are typical land uses. The maximum FAR is 0.75.

### REGIONAL

The Regional Commercial designation is intended to meet local and regional retail demand, such as large-scale retail, office, civic and entertainment uses; shopping malls, with large format or "big-box" retail allowed; and supporting uses such as gas stations, and hotels. Buildings typically have relatively large footprints. Development and design standards will create a pedestrian orientation within centers and along major corridors. The maximum FAR is 1.0.

## Employment

### OFFICE

The Office designation is intended for administrative, financial, business, professional, medical, and public offices. This designation is mainly intended to apply to existing office uses on smaller lots, generally located on arterial roadways. This designation is also considered compatible with existing residential neighborhoods given the smaller level of noise and traffic generated compared to commercial uses. Retail uses would be limited to business services, food services, and convenience goods for those who work in the area. The maximum FAR is 2.0.

### BUSINESS PARK

The Business Park designation provides for office/business parks in campus-like settings that are well suited for large offices or multi-tenant buildings. This designation is intended to accommodate and allow for the expansion of small businesses. Given its proximity to residential uses, only limited outdoor storage will be permitted, while adequate landscaping is imperative to minimize the visual impacts. Typical land uses include research and development, laboratories, administrative and general offices, medical offices and clinics, professional offices, prototype manufacturing, testing, repairing, packaging, and printing. No free-standing retail is permitted, except for small uses serving businesses and employees. The maximum FAR is 1.0.

### REGIONAL BUSINESS PARK

The Regional Business Park designation is intended for large or campus-like office and technology development that includes office, research and development, manufacturing, and other large-scale, professional uses, with limited and properly screened outdoor storage. Permitted uses include incubator-research facilities, prototype manufacturing,

testing, repairing, packaging, and printing, as well as offices and research facilities. Small-scale retail and service uses serving local employees and visitors are permitted as secondary uses. The maximum FAR is 1.0.

### LIGHT INDUSTRIAL

The Light Industrial designation accommodates a diverse range of light industrial uses, including limited manufacturing and processing, research and development, fabrication, utility equipment and service yards, wholesaling, warehousing, and distribution activities. Small-scale retail and ancillary office uses are also permitted. Light Industrial areas may serve as buffers between Heavy Industrial and other land uses and otherwise are generally located in areas with good transportation access, such as along railroads and State Routes. The maximum FAR is 1.5.

### HEAVY INDUSTRIAL

The Heavy Industrial designation accommodates the broadest range of industrial uses including manufacturing, assembly, wholesaling, distribution, and storage activities that are essential to the development of a balanced economic base. Small-scale commercial services and ancillary office uses are also permitted. The maximum FAR is 1.5.

## Mixed-Use[5]

Mixed-use designations are based on commercial uses and also require a residential or upper-floor office component.

### NEIGHBORHOOD MIXED-USE

This designation allows a minimum of 50 percent residential uses and provides for mixed-use districts of local-serving, pedestrian-oriented commercial development, such as convenience shopping and professional offices in two- to three-story buildings. Development is expected to include ground-floor neighborhood retails uses and upper-level housing or offices, with a mix of small lot single family houses, townhomes, and multi-family dwelling units on side streets, in a horizontal or vertical mixed-use orientation. The built form will have a scale and character that is consistent with pedestrian-orientation, to attract and promote a walk-in clientele, with small lots and frequent roadway and pedestrian connections permitting convenient access from residences to commercial space. Automobile-oriented uses are not permitted.

[5] The General Plan is long-term in nature, and recognizes the importance of providing for an orderly evolution of existing, legal non-conforming uses during the planning period in a manner that acknowledges their current economic contributions while providing for a transition into conforming uses consistent with applicable land use designations.

Residential densities range between 12 and 16 units per acre and the maximum FAR is 1.5.

### CORRIDOR/CENTER MIXED-USE

The Corridor/Center Mixed-Use designation is higher intensity than Neighborhood Mixed-Use, and is intended to allow for horizontal and vertical mixed-use development in multiple story buildings along key circulation corridors where height and density can be easily accommodated. Ground-floor retail and upper-floor residential or offices are the primary uses, with personal and business services and public and institutional space as supportive uses. Development will facilitate the transformation of existing transportation corridors into vibrant, highly walkable areas with broad, pedestrian-friendly sidewalks, trees, landscaping, and local-serving uses with new buildings that step down in relationship to the scale and character of adjacent neighborhoods. This designation will largely apply along major roadways, at targeted locations between regional Activity Centers. Residential densities range between 16 and 30 units per acre with a minimum 40 percent residential uses, and the maximum FAR is 1.5.

### REGIONAL MIXED-USE

The Regional Mixed-Use land use designation is intended to accommodate mixed-use development in urban-scale buildings and retail establishments that serve residents and businesses of the region at large. Medium-scale retail, residential, office, civic and entertainment uses, and shopping malls (with large format or "big-box" retail) are allowed, as are supporting uses such as gas stations and hotels in mixed-use or single use buildings. Design standards will support a pedestrian orientation within centers and along major corridors, with parking on the side or rear in general, but automobile-oriented uses also will be accommodated on identified streets and frontages. Residential densities range between 30 and 45 units per acre with a minimum 30 percent residential uses, and the maximum FAR is 2.0.

## Open Space

The Open Space designations (Parks and Recreational Facilities; Other Public Open Space) apply to open space areas that are not parks or trails, such as riparian corridors, the clear zone around Fresno-Yosemite International Airport, and the San Joaquin River bottom, which is primarily designated as open space even though it includes a limited number of existing homes.

## Public Facilities

This designation applies to public facilities, such as City Hall, county buildings, schools, colleges, the municipal airports, and hospitals. It also includes public facilities, such as fire and police stations, City-operated recycling centers, sewage treatment plants, neighborhood, community and regional parks, recreational centers, and golf courses.

Finally, it applies to multi-purpose trails that serve both regional and neighborhood needs.

### Buffer

This designation is intended to separate urban uses from long-term agricultural uses in order to preserve long-term viable agricultural areas and intensive farming operations adjoining but outside the Planning Area. The Buffer designation will serve to prevent urban residential and related uses from developing near agricultural operations and infringing on full operation of important farmland. A variety of uses are compatible with the purpose of the Buffer, which will be defined in detail in the Development Code. General categories include environmental habitats; water conveyance, retention and recharge; preservation and preparation of gravel resources for beneficial uses related to permanent water resource facilities; limited agriculture and necessary supportive uses, such as agricultural processing, excluding animal processing or uses that have the potential to create nuisances; and residential uses with 20 acres of land required per residence.

## Downtown Land Use Classifications

These land use classifications are specific only to the Downtown Planning Area portion of the Planning Area, as depicted in the inset to Figure LU-1: General Plan Land Use Diagram. It is anticipated the land use classifications may be further refined in community or Specific Plans, such as the proposed DNCP and FCSP. The following are general descriptions of the Land Use classifications within the Downtown Planning Area.

### Central Business District

The Central Business District (CBD) is the cultural, civic, shopping, and transit center of Fresno and the region. This designation is applied to areas of the Downtown Planning Area bounded by Stanislaus Street, the Union Pacific tracks, Inyo Street, and the alley between Van Ness Avenue and L Street. New buildings will be at least 2 to 15 stories in height and located at or near the sidewalk. Buildings will be occupied with ground floor commercial, retail, multi-family housing, and office activity to support active streetscapes and walking. Upper floors and the floor area behind storefronts will accommodate a wide variety of office, civic, lodging, housing, or additional commercial uses.

### Civic Center

The Civic Center is intended for civic and office uses, including numerous public buildings containing City, County, State, and federal uses. This land use designation is applied to properties currently fronting Mariposa Street, the south side of Fresno Street, and the north side of Tulare Street between Van Ness Avenue and Q Street.

New buildings will be block-scale, up to 10 stories in height, and set back from the sidewalk along a continuous build-to line to maintain a formal alignment and arrangement of building frontages. Upper stories will be expressed in volumes that enhance and support the civic presence of buildings along these streets. A full range of civic and office uses, including ground floor retail, are envisioned to support active streetscapes and walking. Upper floors will have office and civic uses.

## Chinatown District

The Chinatown District designation is applied to the areas bounded by the Union Pacific Railroad tracks, State Route 99, Stanislaus Street, and Inyo Street. Chinatown's close proximity to State Route 99 and Downtown Core create the unique opportunity to introduce buildings and uses that serve both the region and the surrounding neighborhoods. F Street is preserved and developed as Chinatown's "Main Street." New buildings will be block-scale, up to three stories in height and located at the sidewalk to activate the street with pedestrian-oriented commercial activity. Most upper stories will be expressed in single volumes to enhance the small scale of this urban neighborhood and historic main street. Ground floor uses will include commercial, retail, civic, or office uses to support active streetscapes and walking. Upper floors and the space behind storefronts will have offices, housing, or additional commercial uses.

## Cultural Arts District

This designation is applied to the area immediately north of the CBD bounded by Divisadero Street to the north, Van Ness Avenue to the east, Stanislaus Street to the south and Union Pacific railroad tracks to the west. This designation is intended to spur the area's transformation by encouraging mixed-use buildings comprised primarily of small-scale retail, office, industrial, and multi-family residential uses. New buildings will be block scale, up to five stories tall, and located at or near the sidewalk to generate an active public realm and support walking. Buildings will have ground floor retail, live-work, and uses such as art galleries on key streets.

## South Stadium / South Van Ness

This designation is applied to the areas immediately to south of the Central Business District, including the Monterey and Los Angeles Street areas. It is intended for small-scale retail, office, and industrial uses. New buildings will be block-scale, with non-industrial buildings up to five stories in height, and located at or near the sidewalk to generate an active public realm. Secondary streets and upper floors will have residential and office uses. Industrial buildings may have larger footprints and may be up to two stories tall.

## Town Center

The Town Center designation is applied to nodes at major intersections along major roadway corridors. It is intended for medium-scale retail, housing, office, civic, and entertainment uses that serve several neighborhoods. New buildings will be block-scale, up to five stories in height and located at or near the sidewalk to generate focused and active, commercial activity along corridors. Most upper stories will be expressed in single volumes along the corridor and in multiple volumes with significant setbacks when adjacent to neighborhoods. Ground floor uses will include commercial, retail, and office uses to support active streetscapes and walking. Upper floors and the floor area behind storefronts will have office, civic, residential, or additional commercial uses.

## Neighborhood Center

The Neighborhood Center designation is applied to nodes at secondary intersections and along corridors and is comprised of primarily small-scale neighborhood uses such as retail, office, civic, entertainment, and housing. New buildings will be block and house-scale, up to three stories in height, completely compatible in scale with adjacent single-family houses, and located at or near the sidewalk to generate pedestrian activity. Upper stories will be expressed in volumes compatible with adjacent houses. Buildings will have ground floor commercial, retail, and office uses to support active streetscapes and walking. Upper floors and the floor area behind shop fronts will have office, civic, residential or additional commercial uses.

*Neighborhood Centers support surrounding neighborhoods with a mix of uses, including retail, office, civic, housing, and entertainment.*

## Corridor General

This designation is applied to areas fronting on corridors including Belmont Avenue, Kings Canyon Road, Blackstone Avenue, Abby Street, and North Fresno Street. It is intended for moderate intensity housing and neighborhood services, while also accommodating automobile-oriented commercial uses. New buildings will be block-scale and house-scale, up to three stories in height, and located at or near the sidewalk to generate more pedestrian activity. Buildings will vary in size and type, but be compatible in massing and scale with adjacent buildings. Most upper stories will be expressed in single volumes along the corridor and in multiple volumes with significant setbacks when adjacent to neighborhoods. Living rooms, dining rooms, and other formal rooms will face the street. Ground floor uses will include housing, as well as commercial, retail and office uses. Upper floors will be for housing, office, or additional commercial uses.

## Neighborhood (General, General Preservation, General Revitalization, Edge)

The Neighborhood designations are applied to areas outside of the Downtown CBD. These areas include the Lowell neighborhood; much of the southwest and southeast neighborhoods; the L Street area and the Huntington Boulevard area east of Downtown Core; the Jefferson Neighborhood; areas south of Elm and B Streets in southwest; several southeast neighborhoods adjacent to State Route 180; and areas west of State Route 99, including the Jane Addams area. New buildings will be house-scale, up to two stories in height, and some buildings may be up to two and one-half stories. All buildings will set back from the sidewalk to provide a buffer between the sidewalk and the dwellings. Living rooms, dining rooms, and other formal rooms will face and activate the street. Other house-scale buildings are compatible in these neighborhoods when scaled and massed in relation to the predominant single-family houses. Buildings will be occupied with residential uses, limited live/work uses, and home occupation activity.

## Special Districts

The Special Districts designation is applied to areas that are best suited for a variety of moderate to intense industrial and manufacturing activity. These areas are comprised primarily of large and varied building sizes with substantial activity from large cargo vehicles. New buildings will be block-scale, up to eighteen stories in height (hospitals), and located with a portion, or all, of their frontage at or near the sidewalk. Ground floor activity will range from industrial and manufacturing uses and outdoor assembly to offices. Included in the Special Districts designation are General Industrial (1 & 2); Fresno Chandler Executive Airport between Kearney Boulevard, and Thorne Avenue and Whitesbridge Road; and Downtown Hospital that includes the hospital campus and

surrounding streets with Diana Street / railroad tracks on the west and south, McKenzie Avenue on the north and Fresno Street on the east and south.

### Open Conservation

This designation is intended to provide for permanent open spaces, and does not include neighborhood and community parks and recreational center. This applies only to parcels zoned Open Conservation (FMC 12-204) prior to the adoption of the DNCP.

## General Plan and Zoning Consistency

Table 3-3 summarizes the proposed zoning districts that will contain detailed development guidelines and regulations for the land uses in the General Plan.

TABLE 3-3: GENERAL PLAN LAND USE DESIGNATIONS AND ZONING DISTRICTS CONSISTENCY

| General Plan Land Use Designation | Development Code Zoning District | |
|---|---|---|
| Buffer | B | Buffer |
| **Residential** | | |
| Low Density | RE | Residential Estate |
| | RS-1 | Residential Single Family, Extremely Low Density |
| | RS-2 | Residential Single Family, Very Low Density |
| | RS-3 | Residential Single Family, Low Density |
| Medium Low Density | RS-4 | Residential Single Family, Medium Low Density |
| Medium Density | RS-5 | Residential Single Family, Medium Density |
| Medium High Density | RM-MH | Mobile Home Park |
| | RM-1 | Residential Multi-Family, Medium High Density |
| Urban Neighborhood | RM-2 | Residential Multi-Family, Urban Neighborhood |
| High Density | RM-3 | Residential Multi-Family, High Density |
| **Mixed-Use** | | |
| Neighborhood | NMX | Neighborhood Mixed Use |
| Corridor/Center | CMX | Corridor/Center Mixed Use |
| Regional | RMX | Regional Mixed Use |
| **Commercial** | | |
| Main Street | CMS | Commercial - Main Street |
| Community | CC | Commercial - Community |
| Regional | CR | Commercial - Regional |
| General | CG | Commercial - General |
| Highway and Auto | CH | Commercial - Highway and Auto |
| Recreation | CRC | Commercial - Recreation |

| | | |
|---|---|---|
| **Employment** | | |
| Office | O | Office |
| Business Park | BP | Business Park |
| Regional Business Park | RBP | Regional Business Park |
| Light Industrial | IL | Light Industrial |
| Heavy Industrial | IH | Heavy Industrial |
| **Other** | | |
| Open Space | OS | Open Space |
| | PR | Parks and Recreation |
| Public Facilities | PI | Public and Institutional |
| **Downtown Planning Area Anticipated Zoning Districts** | | |
| Central Business District | DTC | Downtown Core |
| | DTG | Downtown General |
| Civic Center | DTG | Downtown General |
| Town Center | DTN | Downtown Neighborhood |
| Chinatown | | |
| Cultural Arts | | |
| South Stadium | | |
| Neighborhood Center | NMX | Neighborhood Mixed Use |
| Corridor General | | |
| Neighborhoods | RS-5 | Residential Single Family, Medium Density |
| | RS-4 | Residential Single Family, Medium Low Density |
| Special Districts | IL | Light Industrial |
| Public Facility | PI | Public and Institutional |
| Open Conservation | OS | Open Space |
| | PR | Parks and Recreation |

## Local Plans

The City has adopted a number of plans that apply to defined areas throughout Fresno. Under the City's Local Planning and Procedures Ordinance (LPPO), Specific and Community Plans prevail when inconsistent with the General Plan. As a practical matter, this means full implementation of the General Plan may require certain Specific or Community plans to be either repealed or amended to allow consistency. As part of this process, policies and portions from certain plans have been considered in developing the General Plan, essentially resulting in a consolidation and update of planning documents through this repeal and amendment of plans. See Implementing Policy D-7-a for the list of plans being amended or repealed.

## Annexation

As specified by Policy LU-1-g, this General Plan promotes the principle that the SOI not be expanded. The one exception to SOI expansion is to allow for the siting of a

maintenance yard proximate to and south of the SOI boundary associated with the California High Speed Train project.

## Regional Cooperation

Fresno is part of an eight-county region, each with its own Metropolitan Planning Organization. Collectively, they have approved the San Joaquin Valley Blueprint along with the Smart Growth principles listed below, which have been integrated into the General Plan. The adopted San Joaquin Valley Blueprint 12 Smart Growth principles:

1. Create a range of housing opportunities and choices;
2. Create walkable neighborhoods;
3. Encourage community and stakeholder collaboration;
4. Foster distinctive, attractive communities with a strong sense of place;
5. Make development decisions predictable, fair, and cost-effective;
6. Mix land uses;
7. Preserve open space, farmland, natural beauty, and critical environmental areas;
8. Provide a variety of transportation choices;
9. Strengthen and direct development towards existing communities;
10. Take advantage of compact building design;
11. Enhance the economic vitality of the region; and
12. Support actions that encourage environmental resource management.

The City of Fresno is also partnering with 13 of the other 15 federally defined Urbanized Areas in the San Joaquin Valley as part of the Smart Valley Places network, to plan and implement smart growth, livability, and sustainability through revised land use and transportation systems in the respective cities within all the Urbanized Areas in the eight-county Valley region. The City of Fresno also seeks to develop a regional cooperative planning and development strategy with all the city, county, and special district jurisdictions in Fresno, Madera, Tulare, and Kings counties in order to better achieve increased air quality, lower greenhouse gas emissions, farmland preservation, water and energy conservation, increased regional transportation infrastructure and economic development, and sustainable fiscal resource and mutual quality-of-life goals in the region.

# APPENDIX B – BASE WASTEWATER FLOW CALIBRATION

**Table 1 Base Wastewater Flow Calibration Results**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| | | Weekday Base Wastewater Flow | | | | | | | | | | | | Weekend Base Wastewater Flow | | | | | | | | | | Base Wastewater Flow[4] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Measured Data[1] | | | | Modeled Data[2] | | | | Percent Error[3] | | | | Measured Data[1] | | | | Modeled Data[2] | | | | Percent Error[3] | | | | | | |
| Meter Number | Pipe Diameter (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (%) | Peak Flow (%) | Avg. Velocity (%) | Avg. Level (%) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (%) | Peak Flow (%) | Avg. Velocity (%) | Avg. Level (%) | Measured BWF (mgd) | Modeled BWF (mgd) | Percent Difference (%) |
| FR01 | 45 | 3.701 | 5.507 | 3.36 | 9.3 | 3.704 | 5.212 | 3.06 | 10.0 | 0.1% | -5.4% | -8.9% | 7.1% | 3.904 | 5.939 | 3.39 | 9.5 | 3.927 | 5.766 | 3.09 | 10.2 | 0.6% | -2.9% | -8.7% | 7.3% | 3.759 | 3.768 | 0.2% |
| FR02 | 45 | 8.049 | 10.996 | 3.52 | 15.9 | 7.726 | 10.331 | 3.59 | 15.1 | -4.0% | -6.0% | 2.0% | -4.5% | 8.135 | 12.465 | 3.51 | 15.9 | 7.777 | 11.659 | 3.57 | 15.1 | -4.4% | -6.5% | 1.7% | -4.9% | 8.074 | 7.741 | -4.1% |
| FR06 | 36 | 4.132 | 5.207 | 2.59 | 14.2 | 4.131 | 5.050 | 2.57 | 13.6 | 0.0% | -3.0% | -0.7% | -4.0% | 4.089 | 5.758 | 2.54 | 14.2 | 4.118 | 5.630 | 2.56 | 13.5 | 0.7% | -2.2% | 1.1% | -4.7% | 4.120 | 4.128 | 0.2% |
| FR08 | 48 | 7.661 | 9.894 | 4.59 | 12.3 | 7.672 | 10.070 | 4.24 | 13.0 | 0.2% | 1.8% | -7.7% | 5.9% | 7.131 | 9.883 | 4.52 | 11.7 | 7.336 | 10.727 | 4.16 | 12.6 | 2.9% | 8.5% | -7.8% | 8.1% | 7.509 | 7.576 | 0.9% |
| FR09 | 39 | 5.025 | 6.285 | 3.41 | 12.8 | 4.860 | 6.020 | 3.23 | 12.4 | -3.3% | -4.2% | -5.4% | -2.8% | 4.673 | 6.466 | 3.31 | 12.3 | 4.556 | 6.325 | 3.16 | 12.0 | -2.5% | -2.2% | -4.5% | -2.8% | 4.925 | 4.773 | -3.1% |
| FR10 | 0 | 1.491 | 2.750 | 1.16 | 10.4 | 1.464 | 2.697 | 1.19 | 10.3 | -1.8% | -1.9% | 2.3% | -1.4% | 1.496 | 3.201 | 1.11 | 10.0 | 1.469 | 3.103 | 1.15 | 10.0 | -1.8% | -3.1% | 3.4% | -0.7% | 1.492 | 1.465 | -1.8% |
| FR11 | 66 | 3.582 | 5.199 | 2.23 | 10.3 | 3.609 | 4.851 | 2.16 | 10.8 | 0.8% | -6.7% | -3.3% | 4.3% | 3.483 | 5.471 | 2.24 | 10.0 | 3.665 | 5.539 | 2.16 | 10.7 | 5.2% | 1.2% | -3.7% | 7.0% | 3.554 | 3.625 | 2.0% |
| FR12 | 33 | 1.578 | 2.513 | 1.89 | 8.6 | 1.579 | 2.502 | 1.93 | 8.5 | 0.0% | -0.4% | 1.9% | -1.6% | 1.590 | 2.673 | 1.84 | 8.7 | 1.592 | 2.671 | 1.91 | 8.4 | 0.1% | -0.1% | 3.9% | -2.9% | 1.582 | 1.582 | 0.0% |
| FR13 | 51 | 8.526 | 10.118 | 3.29 | 15.8 | 8.329 | 9.611 | 3.31 | 16.2 | -2.3% | -5.0% | 0.6% | 2.3% | 7.951 | 10.072 | 3.24 | 15.2 | 7.902 | 9.556 | 3.26 | 15.7 | -0.6% | -5.1% | 0.6% | 3.6% | 8.362 | 8.207 | -1.9% |
| FR14 | 36 | 4.058 | 4.998 | 2.40 | 14.4 | 4.022 | 4.819 | 2.25 | 14.8 | -0.9% | -3.6% | -6.1% | 2.9% | 4.017 | 5.367 | 2.39 | 14.3 | 3.762 | 4.806 | 2.21 | 14.2 | -6.3% | -10.4% | -7.8% | -0.1% | 4.046 | 3.948 | -2.4% |
| FR15 | 48 | 6.194 | 7.184 | 2.19 | 18.2 | 6.071 | 6.949 | 2.25 | 17.5 | -2.0% | -3.3% | 2.7% | -3.5% | 5.939 | 7.337 | 2.17 | 17.7 | 5.850 | 7.075 | 2.22 | 17.2 | -1.5% | -3.6% | 2.5% | -3.1% | 6.121 | 6.008 | -1.9% |
| FR16 | 30 | 3.724 | 4.692 | 3.34 | 11.5 | 3.702 | 4.463 | 3.26 | 11.5 | -0.6% | -4.9% | -2.5% | 0.3% | 3.708 | 5.104 | 3.32 | 11.5 | 3.667 | 4.664 | 3.24 | 11.4 | -1.1% | -8.6% | -2.3% | -0.5% | 3.720 | 3.692 | -0.7% |
| FR19 | 66 | 23.147 | 27.598 | 4.52 | 24.1 | 23.071 | 27.048 | 4.89 | 22.7 | -0.3% | -2.0% | 8.2% | -5.8% | 20.907 | 26.800 | 4.35 | 22.8 | 22.057 | 28.163 | 4.81 | 22.1 | 5.5% | 5.1% | 10.6% | -3.2% | 22.507 | 22.781 | 1.2% |
| FR20 | 66 | 29.854 | 34.806 | 4.60 | 28.6 | 26.961 | 31.643 | 4.71 | 26.2 | -9.7% | -9.1% | 2.3% | -8.3% | 26.650 | 34.503 | 4.48 | 26.6 | 25.500 | 31.954 | 4.62 | 25.4 | -4.3% | -7.4% | 3.1% | -4.6% | 28.939 | 26.544 | -8.3% |
| FR21 | 42 | 4.403 | 5.596 | 2.11 | 15.3 | 4.451 | 5.716 | 2.11 | 15.4 | 1.1% | 2.1% | 0.0% | 0.9% | 4.454 | 6.167 | 2.10 | 15.4 | 4.541 | 6.199 | 2.11 | 15.6 | 1.9% | 0.5% | 0.7% | 0.7% | 4.418 | 4.477 | 1.3% |
| FR22 | 45 | 7.461 | 9.611 | 2.90 | 17.5 | 7.471 | 9.230 | 2.88 | 17.5 | 0.1% | -4.0% | -0.8% | 0.0% | 7.615 | 10.754 | 2.90 | 17.6 | 7.650 | 10.427 | 2.88 | 17.6 | 0.5% | -3.0% | -0.5% | 0.1% | 7.505 | 7.522 | 0.2% |
| FR23 | 27 | 1.251 | 1.638 | 2.08 | 7.5 | 1.262 | 1.521 | 2.20 | 7.4 | 0.9% | -7.2% | 5.5% | -1.5% | 0.762 | 1.032 | 1.94 | 5.5 | 0.827 | 1.469 | 1.93 | 5.9 | 8.5% | 42.4% | -0.6% | 7.6% | 1.111 | 1.138 | 2.4% |
| FR24 | 72 | 8.120 | 10.599 | 2.60 | 16.1 | 8.987 | 11.826 | 2.63 | 17.3 | 10.7% | 11.6% | 0.9% | 7.5% | 8.216 | 11.913 | 2.61 | 16.1 | 9.103 | 13.093 | 2.63 | 17.3 | 10.8% | 9.9% | 0.8% | 7.5% | 8.147 | 9.021 | 10.7% |
| FR25 | 15 | 0.082 | 0.121 | 1.11 | 2.1 | 0.082 | 0.121 | 1.12 | 2.1 | 0.1% | 0.1% | 1.1% | 1.0% | 0.079 | 0.134 | 1.12 | 2.0 | 0.079 | 0.134 | 1.10 | 2.1 | 0.2% | -0.1% | -2.0% | 3.0% | 0.081 | 0.081 | 0.1% |
| FR26 | 0 | 0.190 | 0.311 | 0.92 | 4.9 | 0.192 | 0.308 | 0.91 | 5.1 | 1.4% | -1.0% | -1.1% | 2.6% | 0.195 | 0.321 | 0.93 | 5.0 | 0.198 | 0.322 | 0.91 | 5.1 | 1.3% | 0.4% | -1.9% | 3.3% | 0.191 | 0.194 | 1.3% |
| FR27 | 27 | 1.900 | 2.558 | 1.82 | 12.1 | 1.900 | 2.546 | 1.86 | 11.1 | 0.0% | -0.5% | 2.6% | -8.4% | 1.935 | 2.786 | 1.86 | 12.1 | 1.935 | 2.783 | 1.86 | 11.2 | 0.0% | -0.1% | 0.1% | -7.4% | 1.910 | 1.910 | 0.0% |

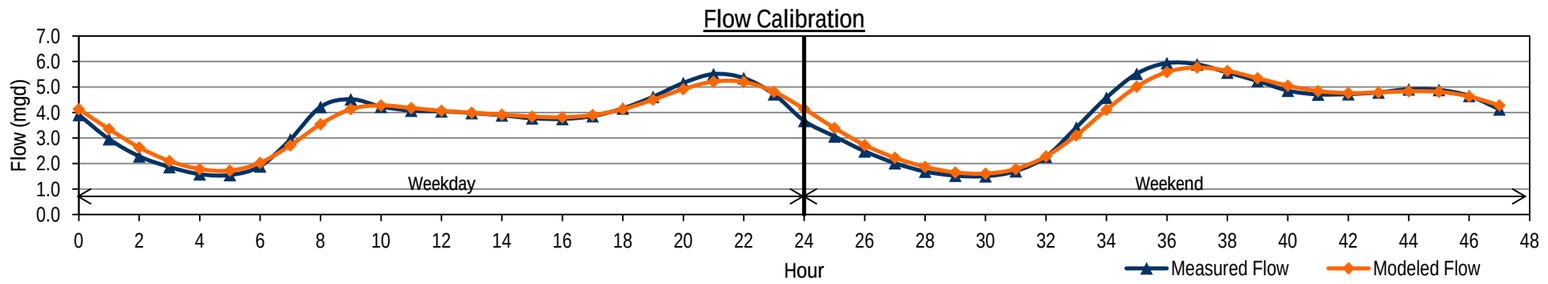
Notes:
1. Source: City of Fresno Permanent Flow Monitoring Data
2. Average flow, level, and velocity are calculated from weekday/weekend dry weather flow monitoring data. Maximum flow values are hourly peaks corresponding to either weekend or weekday confitions, as appropriate.
3. Percent Difference = (Modeled - Measured)/Measured*100.
4. Base Wastewater Flow = (5*Weekday Base Wastewater Flow + 2*Weekend Base Wastewater Flow)/7

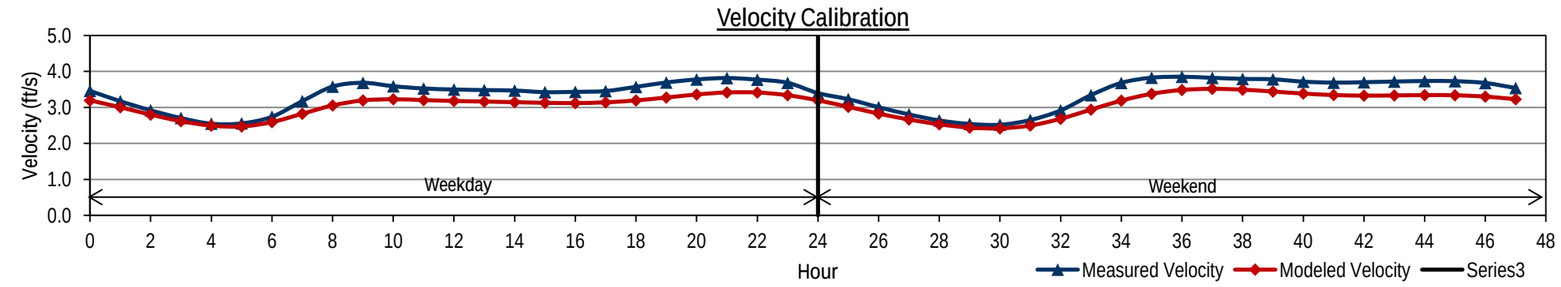
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR01 BASE WASTEWATER FLOW CALIBRATION

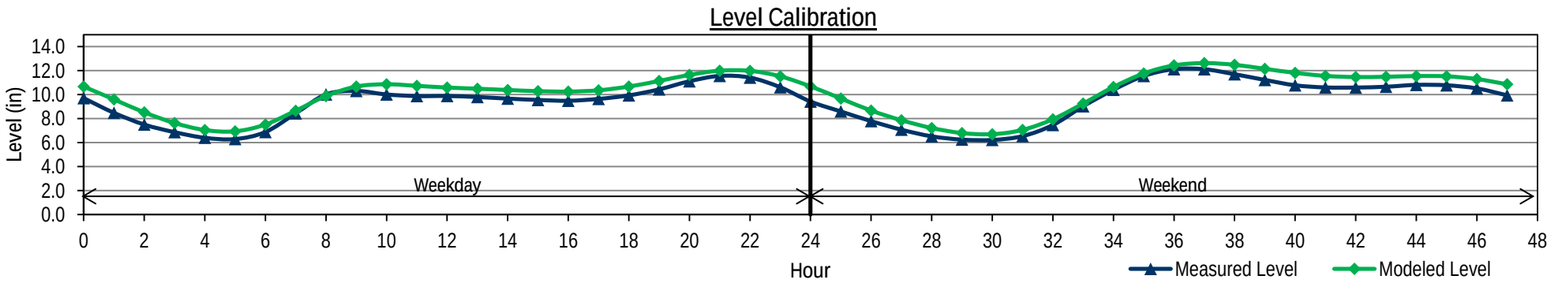
| | Hour | Measured Data Flow (mgd) | Measured Data Level (in) | Measured Data Velocity (ft/s) | Modeled Data Flow (mgd) | Modeled Data Level (in) | Modeled Data Velocity (ft/s) | Diurnal Calibrated Diurnal |
|---|---|---|---|---|---|---|---|---|
| Weekday | 0 | 3.908 | 9.7 | 3.46 | 4.134 | 10.7 | 3.19 | 0.61 |
| | 1 | 2.958 | 8.5 | 3.17 | 3.350 | 9.6 | 3.00 | 0.49 |
| | 2 | 2.282 | 7.5 | 2.92 | 2.629 | 8.5 | 2.80 | 0.42 |
| | 3 | 1.863 | 6.9 | 2.71 | 2.096 | 7.6 | 2.62 | 0.41 |
| | 4 | 1.581 | 6.4 | 2.55 | 1.783 | 7.0 | 2.49 | 0.50 |
| | 5 | 1.549 | 6.3 | 2.56 | 1.724 | 6.9 | 2.47 | 0.78 |
| | 6 | 1.892 | 6.9 | 2.74 | 2.027 | 7.5 | 2.59 | 1.12 |
| | 7 | 2.945 | 8.4 | 3.18 | 2.710 | 8.7 | 2.82 | 1.20 |
| | 8 | 4.222 | 10.0 | 3.58 | 3.543 | 9.9 | 3.05 | 1.13 |
| | 9 | 4.522 | 10.3 | 3.68 | 4.134 | 10.7 | 3.19 | 1.08 |
| | 10 | 4.230 | 10.0 | 3.59 | 4.280 | 10.9 | 3.23 | 1.08 |
| | 11 | 4.075 | 9.9 | 3.53 | 4.177 | 10.7 | 3.20 | 1.06 |
| | 12 | 4.047 | 9.9 | 3.50 | 4.069 | 10.6 | 3.18 | 1.03 |
| | 13 | 3.981 | 9.8 | 3.48 | 3.995 | 10.5 | 3.16 | 1.00 |
| | 14 | 3.890 | 9.7 | 3.47 | 3.916 | 10.4 | 3.14 | 1.00 |
| | 15 | 3.773 | 9.6 | 3.42 | 3.841 | 10.3 | 3.13 | 1.03 |
| | 16 | 3.747 | 9.5 | 3.43 | 3.815 | 10.2 | 3.12 | 1.11 |
| | 17 | 3.860 | 9.6 | 3.45 | 3.900 | 10.4 | 3.14 | 1.23 |
| | 18 | 4.161 | 9.9 | 3.57 | 4.132 | 10.7 | 3.19 | 1.37 |
| | 19 | 4.616 | 10.4 | 3.69 | 4.502 | 11.1 | 3.27 | 1.47 |
| | 20 | 5.158 | 11.1 | 3.78 | 4.918 | 11.6 | 3.36 | 1.42 |
| | 21 | 5.507 | 11.6 | 3.81 | 5.212 | 12.0 | 3.41 | 1.26 |
| | 22 | 5.351 | 11.4 | 3.77 | 5.202 | 12.0 | 3.41 | 1.04 |
| | 23 | 4.718 | 10.6 | 3.68 | 4.815 | 11.5 | 3.34 | 0.79 |
| Weekend | 24 | 3.672 | 9.4 | 3.40 | 4.141 | 10.7 | 3.19 | 0.66 |
| | 25 | 3.063 | 8.6 | 3.23 | 3.393 | 9.7 | 3.01 | 0.54 |
| | 26 | 2.480 | 7.8 | 3.01 | 2.722 | 8.7 | 2.83 | 0.45 |
| | 27 | 2.014 | 7.1 | 2.81 | 2.227 | 7.9 | 2.66 | 0.40 |
| | 28 | 1.684 | 6.5 | 2.64 | 1.869 | 7.2 | 2.53 | 0.40 |
| | 29 | 1.524 | 6.3 | 2.54 | 1.651 | 6.8 | 2.44 | 0.45 |
| | 30 | 1.502 | 6.2 | 2.52 | 1.605 | 6.7 | 2.42 | 0.60 |
| | 31 | 1.700 | 6.6 | 2.65 | 1.786 | 7.1 | 2.50 | 0.91 |
| | 32 | 2.267 | 7.5 | 2.92 | 2.281 | 7.9 | 2.68 | 1.22 |
| | 33 | 3.409 | 9.0 | 3.34 | 3.102 | 9.3 | 2.94 | 1.47 |
| | 34 | 4.582 | 10.4 | 3.68 | 4.109 | 10.6 | 3.19 | 1.58 |
| | 35 | 5.522 | 11.6 | 3.82 | 5.013 | 11.8 | 3.38 | 1.57 |
| | 36 | 5.939 | 12.1 | 3.85 | 5.589 | 12.4 | 3.48 | 1.48 |
| | 37 | 5.889 | 12.1 | 3.82 | 5.766 | 12.6 | 3.51 | 1.39 |
| | 38 | 5.568 | 11.7 | 3.79 | 5.634 | 12.5 | 3.49 | 1.29 |
| | 39 | 5.235 | 11.2 | 3.78 | 5.347 | 12.1 | 3.44 | 1.25 |
| | 40 | 4.858 | 10.8 | 3.72 | 5.053 | 11.8 | 3.38 | 1.26 |
| | 41 | 4.709 | 10.6 | 3.69 | 4.842 | 11.6 | 3.34 | 1.27 |
| | 42 | 4.721 | 10.6 | 3.70 | 4.763 | 11.5 | 3.33 | 1.31 |
| | 43 | 4.788 | 10.7 | 3.72 | 4.787 | 11.5 | 3.33 | 1.30 |
| | 44 | 4.911 | 10.8 | 3.73 | 4.834 | 11.5 | 3.34 | 1.24 |
| | 45 | 4.887 | 10.8 | 3.73 | 4.813 | 11.5 | 3.34 | 1.10 |
| | 46 | 4.654 | 10.5 | 3.68 | 4.632 | 11.3 | 3.30 | 0.98 |
| | 47 | 4.126 | 9.9 | 3.54 | 4.281 | 10.9 | 3.23 | 0.82 |
| Average | | | | | | | | |
| | Weekday | 3.701 | 9.3 | 3.36 | 3.704 | 10.0 | 3.06 | 0.98 |
| | Weekend | 3.904 | 9.5 | 3.39 | 3.927 | 10.2 | 3.09 | 1.04 |
| | BWF[1] | 3.759 | 9.4 | 3.37 | 3.768 | 10.1 | 3.07 | 1.00 |
| % Error | | | | | | | | |
| | Weekday | | | | 0.1% | 7.1% | -8.9% | |
| | Weekend | | | | 0.6% | 7.3% | -8.7% | |

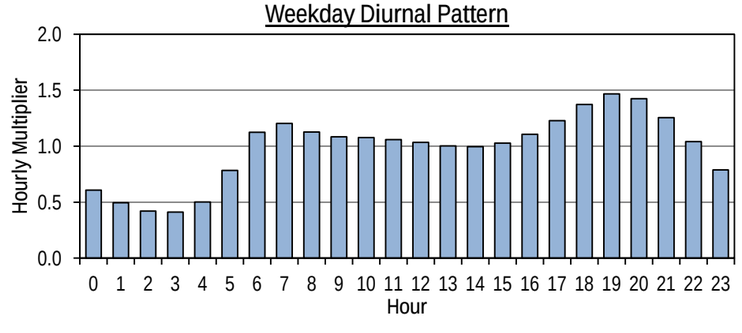
Note:

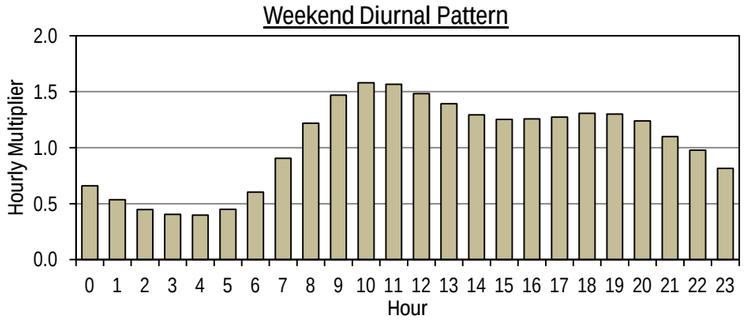
1. BWF = (5xWeekday Average + 2xWeekend Average)/7



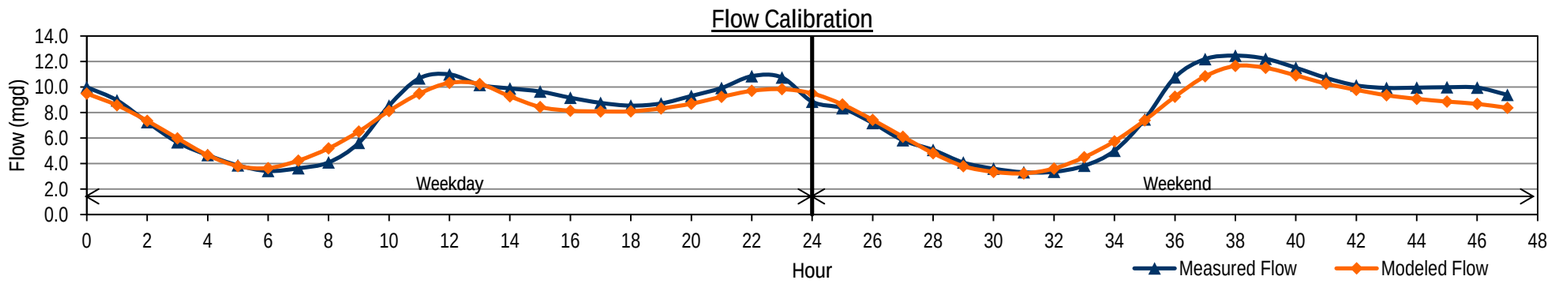



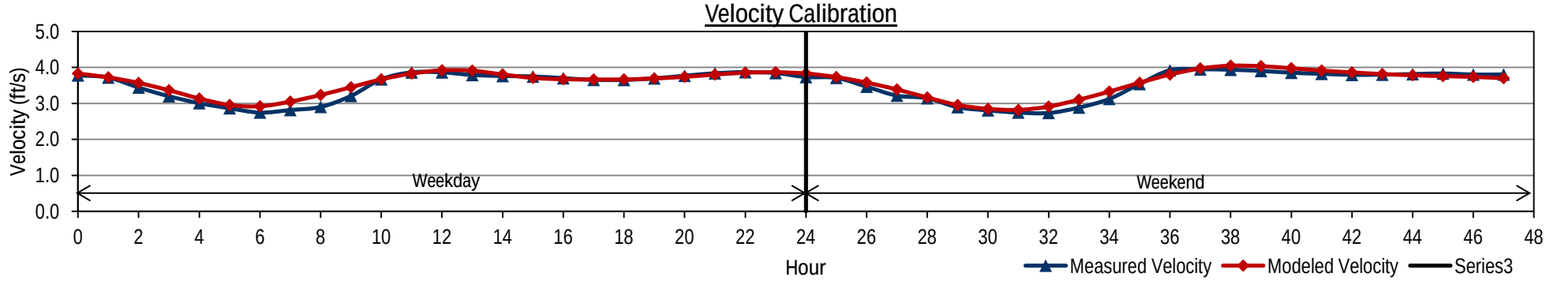
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR02 BASE WASTEWATER FLOW CALIBRATION

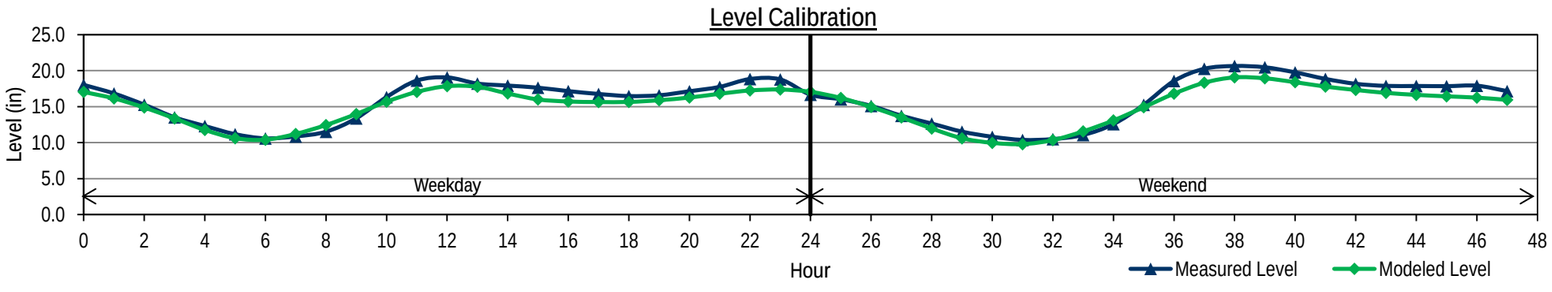
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 9.994 | 18.0 | 3.78 | 9.489 | 17.0 | 3.83 | 0.34 |
| | 1 | 8.962 | 16.8 | 3.72 | 8.573 | 16.1 | 3.73 | 0.33 |
| | 2 | 7.253 | 15.3 | 3.44 | 7.353 | 14.9 | 3.57 | 0.32 |
| | 3 | 5.672 | 13.5 | 3.20 | 5.977 | 13.4 | 3.37 | 0.36 |
| | 4 | 4.670 | 12.3 | 3.01 | 4.657 | 11.8 | 3.14 | 0.48 |
| | 5 | 3.865 | 11.2 | 2.87 | 3.800 | 10.6 | 2.96 | 0.92 |
| | 6 | 3.425 | 10.6 | 2.75 | 3.642 | 10.4 | 2.92 | 1.79 |
| | 7 | 3.639 | 10.8 | 2.82 | 4.231 | 11.2 | 3.05 | 1.89 |
| | 8 | 4.097 | 11.5 | 2.90 | 5.191 | 12.4 | 3.24 | 1.46 |
| | 9 | 5.629 | 13.4 | 3.21 | 6.512 | 14.0 | 3.45 | 1.13 |
| | 10 | 8.545 | 16.3 | 3.67 | 8.123 | 15.7 | 3.67 | 1.04 |
| | 11 | 10.685 | 18.6 | 3.86 | 9.487 | 17.0 | 3.83 | 1.05 |
| | 12 | 10.996 | 19.1 | 3.86 | 10.331 | 17.8 | 3.92 | 1.02 |
| | 13 | 10.170 | 18.2 | 3.79 | 10.241 | 17.8 | 3.91 | 0.99 |
| | 14 | 9.894 | 17.9 | 3.76 | 9.272 | 16.8 | 3.81 | 0.98 |
| | 15 | 9.652 | 17.6 | 3.75 | 8.434 | 16.0 | 3.71 | 1.03 |
| | 16 | 9.166 | 17.1 | 3.70 | 8.145 | 15.7 | 3.67 | 1.12 |
| | 17 | 8.763 | 16.8 | 3.65 | 8.085 | 15.6 | 3.67 | 1.33 |
| | 18 | 8.547 | 16.5 | 3.65 | 8.095 | 15.6 | 3.67 | 1.50 |
| | 19 | 8.718 | 16.6 | 3.70 | 8.325 | 15.9 | 3.70 | 1.55 |
| | 20 | 9.305 | 17.1 | 3.77 | 8.692 | 16.3 | 3.74 | 1.31 |
| | 21 | 9.930 | 17.7 | 3.84 | 9.233 | 16.8 | 3.80 | 1.01 |
| | 22 | 10.856 | 18.8 | 3.87 | 9.706 | 17.2 | 3.85 | 0.73 |
| | 23 | 10.753 | 18.8 | 3.84 | 9.837 | 17.4 | 3.87 | 0.52 |
| Weekend | 24 | 8.855 | 16.6 | 3.73 | 9.500 | 17.1 | 3.83 | 0.46 |
| | 25 | 8.345 | 16.0 | 3.71 | 8.637 | 16.2 | 3.73 | 0.34 |
| | 26 | 7.183 | 15.1 | 3.47 | 7.428 | 15.0 | 3.58 | 0.33 |
| | 27 | 5.834 | 13.7 | 3.22 | 6.103 | 13.5 | 3.39 | 0.33 |
| | 28 | 5.075 | 12.6 | 3.15 | 4.809 | 12.0 | 3.17 | 0.34 |
| | 29 | 4.089 | 11.5 | 2.90 | 3.792 | 10.6 | 2.96 | 0.44 |
| | 30 | 3.607 | 10.8 | 2.81 | 3.345 | 10.0 | 2.85 | 0.69 |
| | 31 | 3.324 | 10.4 | 2.75 | 3.227 | 9.8 | 2.82 | 1.17 |
| | 32 | 3.361 | 10.5 | 2.74 | 3.606 | 10.3 | 2.91 | 1.86 |
| | 33 | 3.834 | 11.1 | 2.89 | 4.497 | 11.6 | 3.10 | 1.91 |
| | 34 | 5.008 | 12.6 | 3.13 | 5.741 | 13.1 | 3.33 | 1.71 |
| | 35 | 7.467 | 15.2 | 3.54 | 7.388 | 14.9 | 3.58 | 1.46 |
| | 36 | 10.763 | 18.6 | 3.92 | 9.242 | 16.8 | 3.80 | 1.31 |
| | 37 | 12.197 | 20.3 | 3.95 | 10.846 | 18.3 | 3.97 | 1.20 |
| | 38 | 12.465 | 20.6 | 3.93 | 11.659 | 19.1 | 4.05 | 1.12 |
| | 39 | 12.224 | 20.5 | 3.90 | 11.510 | 18.9 | 4.04 | 1.12 |
| | 40 | 11.518 | 19.8 | 3.85 | 10.919 | 18.4 | 3.98 | 1.16 |
| | 41 | 10.722 | 18.8 | 3.82 | 10.270 | 17.8 | 3.91 | 1.20 |
| | 42 | 10.133 | 18.2 | 3.79 | 9.781 | 17.3 | 3.86 | 1.21 |
| | 43 | 9.934 | 17.9 | 3.80 | 9.357 | 16.9 | 3.82 | 1.12 |
| | 44 | 9.956 | 17.9 | 3.81 | 9.075 | 16.6 | 3.78 | 0.99 |
| | 45 | 9.989 | 17.8 | 3.83 | 8.860 | 16.4 | 3.76 | 0.88 |
| | 46 | 9.960 | 17.9 | 3.80 | 8.680 | 16.2 | 3.74 | 0.68 |
| | 47 | 9.393 | 17.1 | 3.80 | 8.372 | 15.9 | 3.70 | 0.51 |
| Average | | | | | | | | |
| Weekday | | 8.049 | 15.9 | 3.52 | 7.726 | 15.1 | 3.59 | 1.01 |
| Weekend | | 8.135 | 15.9 | 3.51 | 7.777 | 15.1 | 3.57 | 0.98 |
| ADWF[1] | | 8.074 | 15.9 | 3.51 | 7.741 | 15.1 | 3.58 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | -4.0% | -4.5% | 2.0% | |
| Weekend | | | | | -4.4% | -4.9% | 1.7% | |

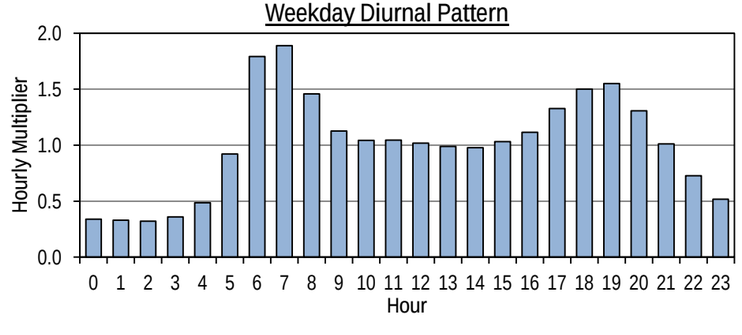
Note:

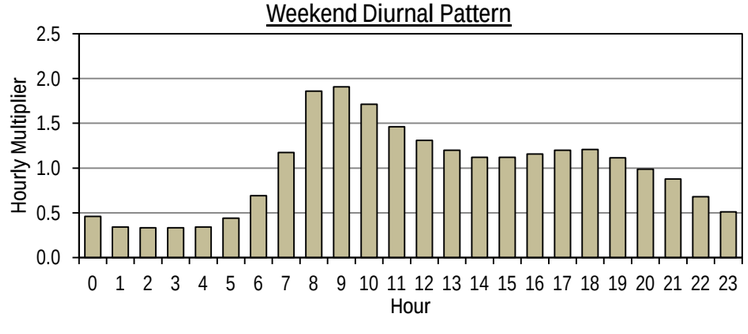
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



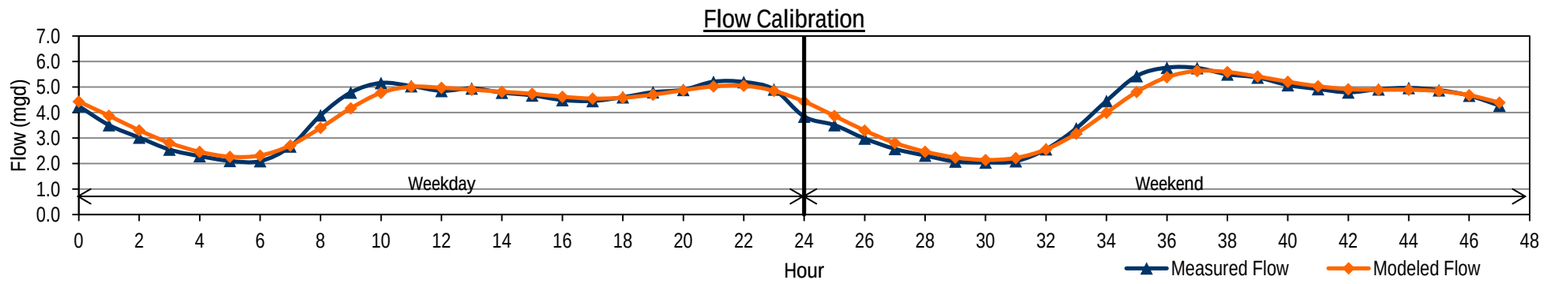



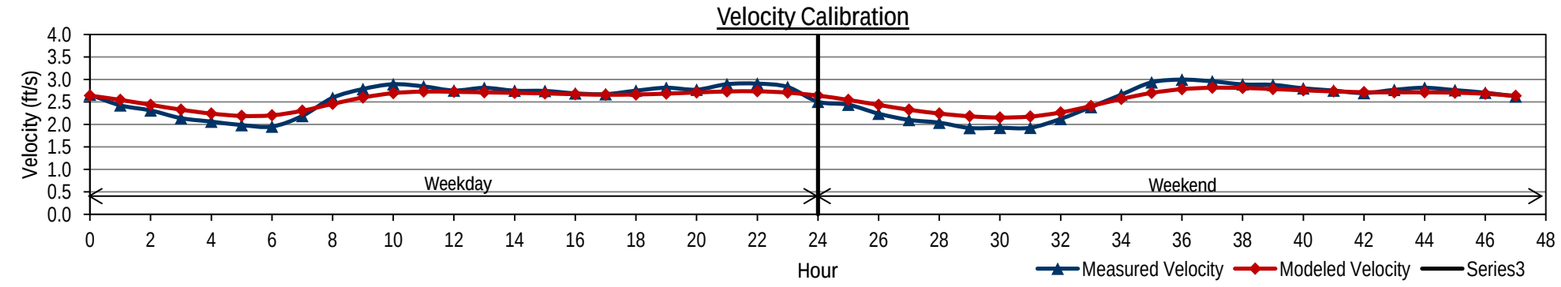



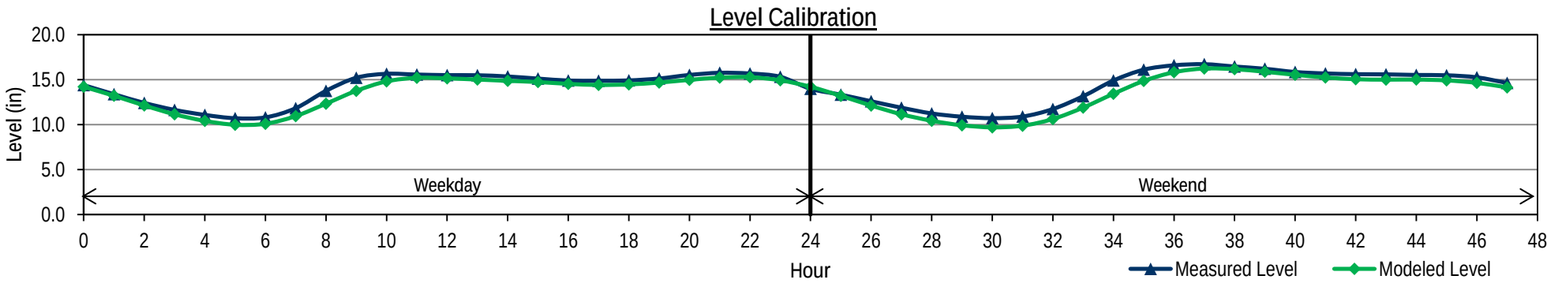
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR06 BASE WASTEWATER FLOW CALIBRATION

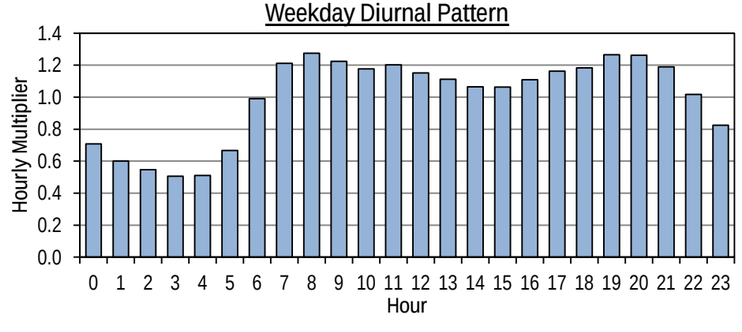
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 4.250 | 14.4 | 2.66 | 4.429 | 14.2 | 2.64 | 0.71 |
| | 1 | 3.507 | 13.4 | 2.42 | 3.873 | 13.2 | 2.55 | 0.60 |
| | 2 | 3.020 | 12.4 | 2.31 | 3.300 | 12.1 | 2.44 | 0.55 |
| | 3 | 2.551 | 11.6 | 2.14 | 2.807 | 11.1 | 2.33 | 0.51 |
| | 4 | 2.294 | 11.1 | 2.06 | 2.458 | 10.4 | 2.24 | 0.51 |
| | 5 | 2.105 | 10.7 | 1.99 | 2.264 | 10.0 | 2.19 | 0.67 |
| | 6 | 2.097 | 10.8 | 1.95 | 2.312 | 10.1 | 2.20 | 0.99 |
| | 7 | 2.672 | 11.8 | 2.19 | 2.705 | 10.9 | 2.31 | 1.21 |
| | 8 | 3.894 | 13.8 | 2.59 | 3.399 | 12.3 | 2.46 | 1.27 |
| | 9 | 4.787 | 15.2 | 2.79 | 4.167 | 13.8 | 2.60 | 1.22 |
| | 10 | 5.159 | 15.7 | 2.89 | 4.774 | 14.8 | 2.70 | 1.18 |
| | 11 | 5.038 | 15.6 | 2.85 | 5.012 | 15.2 | 2.73 | 1.20 |
| | 12 | 4.849 | 15.5 | 2.75 | 4.971 | 15.1 | 2.73 | 1.15 |
| | 13 | 4.946 | 15.5 | 2.81 | 4.896 | 15.0 | 2.71 | 1.11 |
| | 14 | 4.781 | 15.4 | 2.75 | 4.813 | 14.9 | 2.70 | 1.06 |
| | 15 | 4.673 | 15.1 | 2.75 | 4.736 | 14.7 | 2.69 | 1.06 |
| | 16 | 4.490 | 14.9 | 2.69 | 4.618 | 14.5 | 2.67 | 1.11 |
| | 17 | 4.454 | 14.9 | 2.67 | 4.546 | 14.4 | 2.66 | 1.16 |
| | 18 | 4.601 | 14.9 | 2.75 | 4.578 | 14.5 | 2.67 | 1.18 |
| | 19 | 4.799 | 15.1 | 2.82 | 4.699 | 14.7 | 2.69 | 1.27 |
| | 20 | 4.890 | 15.5 | 2.77 | 4.874 | 15.0 | 2.71 | 1.26 |
| | 21 | 5.207 | 15.8 | 2.89 | 5.024 | 15.2 | 2.73 | 1.19 |
| | 22 | 5.197 | 15.7 | 2.91 | 5.050 | 15.3 | 2.74 | 1.02 |
| | 23 | 4.906 | 15.3 | 2.83 | 4.849 | 14.9 | 2.71 | 0.82 |
| Weekend | 24 | 3.842 | 14.0 | 2.50 | 4.428 | 14.2 | 2.64 | 0.70 |
| | 25 | 3.508 | 13.3 | 2.44 | 3.867 | 13.2 | 2.55 | 0.61 |
| | 26 | 2.983 | 12.6 | 2.24 | 3.292 | 12.1 | 2.44 | 0.55 |
| | 27 | 2.576 | 11.9 | 2.10 | 2.804 | 11.1 | 2.33 | 0.49 |
| | 28 | 2.316 | 11.2 | 2.04 | 2.463 | 10.4 | 2.24 | 0.49 |
| | 29 | 2.083 | 10.9 | 1.92 | 2.235 | 9.9 | 2.18 | 0.51 |
| | 30 | 2.044 | 10.7 | 1.93 | 2.138 | 9.7 | 2.16 | 0.64 |
| | 31 | 2.095 | 10.9 | 1.93 | 2.216 | 9.9 | 2.18 | 0.85 |
| | 32 | 2.562 | 11.7 | 2.12 | 2.552 | 10.6 | 2.27 | 1.13 |
| | 33 | 3.380 | 13.2 | 2.39 | 3.171 | 11.9 | 2.41 | 1.37 |
| | 34 | 4.454 | 14.9 | 2.66 | 3.991 | 13.4 | 2.57 | 1.44 |
| | 35 | 5.432 | 16.1 | 2.94 | 4.806 | 14.9 | 2.70 | 1.42 |
| | 36 | 5.758 | 16.6 | 3.00 | 5.386 | 15.8 | 2.78 | 1.35 |
| | 37 | 5.745 | 16.7 | 2.96 | 5.630 | 16.2 | 2.82 | 1.31 |
| | 38 | 5.496 | 16.5 | 2.89 | 5.588 | 16.2 | 2.81 | 1.24 |
| | 39 | 5.374 | 16.2 | 2.88 | 5.414 | 15.9 | 2.79 | 1.20 |
| | 40 | 5.077 | 15.9 | 2.80 | 5.207 | 15.5 | 2.76 | 1.17 |
| | 41 | 4.921 | 15.7 | 2.75 | 5.032 | 15.2 | 2.73 | 1.20 |
| | 42 | 4.791 | 15.6 | 2.70 | 4.914 | 15.0 | 2.72 | 1.21 |
| | 43 | 4.911 | 15.6 | 2.77 | 4.889 | 15.0 | 2.71 | 1.18 |
| | 44 | 4.965 | 15.5 | 2.82 | 4.894 | 15.0 | 2.71 | 1.13 |
| | 45 | 4.876 | 15.5 | 2.76 | 4.840 | 14.9 | 2.71 | 1.02 |
| | 46 | 4.664 | 15.3 | 2.71 | 4.680 | 14.6 | 2.68 | 0.91 |
| | 47 | 4.274 | 14.6 | 2.62 | 4.390 | 14.1 | 2.64 | 0.82 |
| Average | | | | | | | | |
| Weekday | | 4.132 | 14.2 | 2.59 | 4.131 | 13.6 | 2.57 | 1.00 |
| Weekend | | 4.089 | 14.2 | 2.54 | 4.118 | 13.5 | 2.56 | 1.00 |
| ADWF[1] | | 4.120 | 14.2 | 2.58 | 4.128 | 13.6 | 2.57 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | 0.0% | -4.0% | -0.7% | |
| Weekend | | | | | 0.7% | -4.7% | 1.1% | |

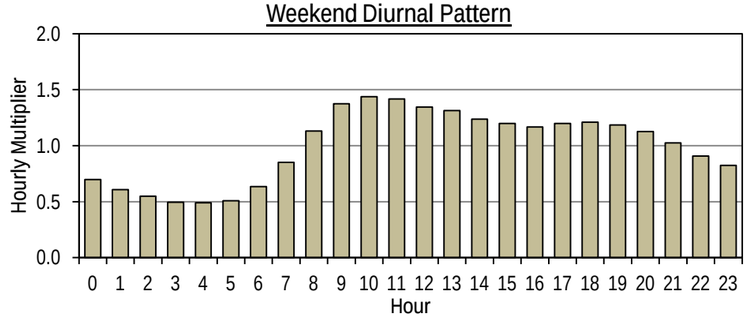
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



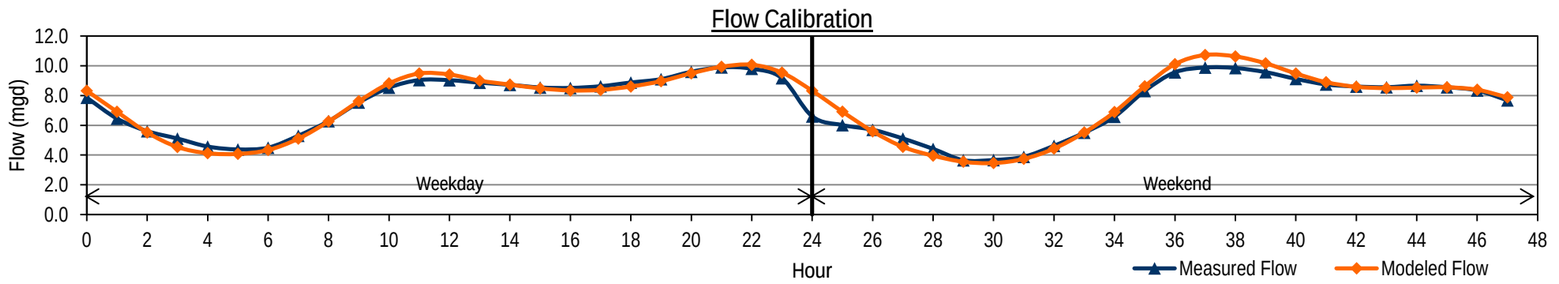



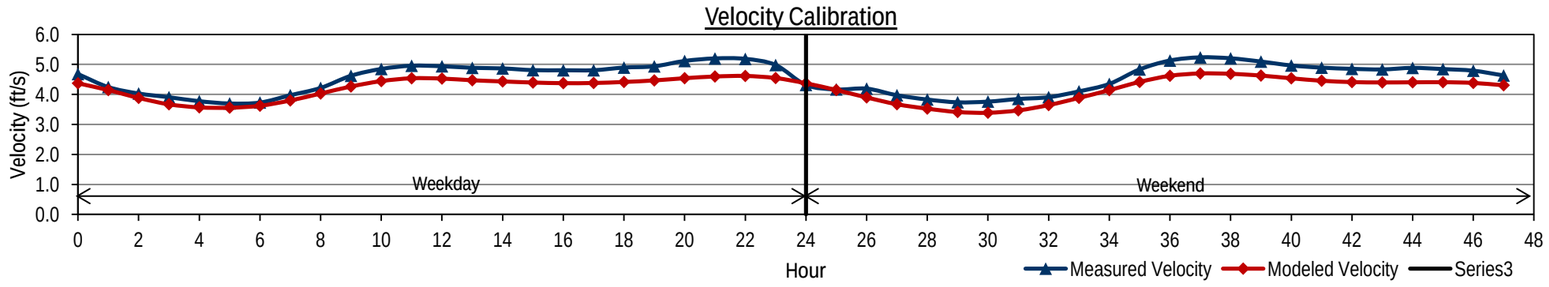
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR08 BASE WASTEWATER FLOW CALIBRATION

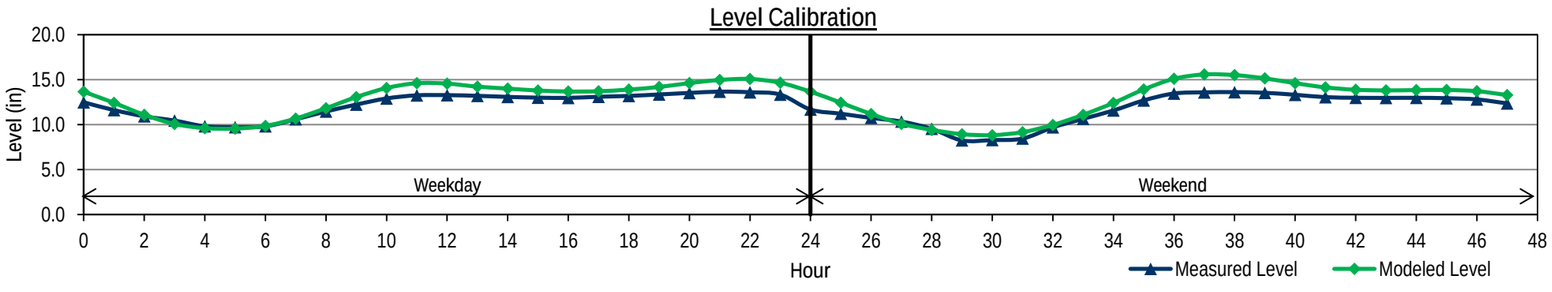
| | Hour | Measured Data Flow (mgd) | Measured Data Level (in) | Measured Data Velocity (ft/s) | Modeled Data Flow (mgd) | Modeled Data Level (in) | Modeled Data Velocity (ft/s) | Diurnal Calibrated Diurnal |
|---|---|---|---|---|---|---|---|---|
| Weekday | 0 | 7.854 | 12.5 | 4.68 | 8.322 | 13.7 | 4.37 | 0.23 |
| | 1 | 6.447 | 11.6 | 4.25 | 6.911 | 12.4 | 4.15 | 0.15 |
| | 2 | 5.604 | 10.9 | 4.03 | 5.519 | 11.1 | 3.88 | 0.27 |
| | 3 | 5.106 | 10.5 | 3.91 | 4.546 | 10.1 | 3.67 | 0.37 |
| | 4 | 4.567 | 9.8 | 3.78 | 4.130 | 9.6 | 3.57 | 0.48 |
| | 5 | 4.376 | 9.7 | 3.70 | 4.085 | 9.6 | 3.56 | 0.63 |
| | 6 | 4.494 | 9.8 | 3.73 | 4.347 | 9.9 | 3.62 | 0.97 |
| | 7 | 5.296 | 10.6 | 3.97 | 5.108 | 10.7 | 3.80 | 1.25 |
| | 8 | 6.277 | 11.5 | 4.22 | 6.265 | 11.8 | 4.03 | 1.50 |
| | 9 | 7.532 | 12.2 | 4.62 | 7.620 | 13.1 | 4.26 | 1.56 |
| | 10 | 8.531 | 12.9 | 4.85 | 8.817 | 14.1 | 4.44 | 1.39 |
| | 11 | 9.041 | 13.2 | 4.95 | 9.485 | 14.6 | 4.54 | 1.19 |
| | 12 | 9.030 | 13.3 | 4.94 | 9.414 | 14.6 | 4.53 | 1.13 |
| | 13 | 8.864 | 13.2 | 4.89 | 9.000 | 14.2 | 4.47 | 1.04 |
| | 14 | 8.720 | 13.1 | 4.87 | 8.736 | 14.0 | 4.43 | 0.94 |
| | 15 | 8.540 | 13.0 | 4.81 | 8.484 | 13.8 | 4.40 | 0.94 |
| | 16 | 8.510 | 13.0 | 4.81 | 8.344 | 13.7 | 4.38 | 1.01 |
| | 17 | 8.624 | 13.1 | 4.81 | 8.381 | 13.7 | 4.38 | 1.16 |
| | 18 | 8.875 | 13.2 | 4.89 | 8.608 | 13.9 | 4.42 | 1.27 |
| | 19 | 9.101 | 13.3 | 4.94 | 8.967 | 14.2 | 4.47 | 1.44 |
| | 20 | 9.598 | 13.5 | 5.11 | 9.497 | 14.6 | 4.54 | 1.54 |
| | 21 | 9.894 | 13.7 | 5.20 | 9.934 | 15.0 | 4.60 | 1.41 |
| | 22 | 9.801 | 13.6 | 5.18 | 10.070 | 15.1 | 4.62 | 1.11 |
| | 23 | 9.168 | 13.3 | 4.98 | 9.543 | 14.7 | 4.55 | 0.55 |
| Weekend | 24 | 6.597 | 11.7 | 4.32 | 8.322 | 13.7 | 4.37 | 0.23 |
| | 25 | 6.011 | 11.2 | 4.17 | 6.917 | 12.4 | 4.15 | 0.20 |
| | 26 | 5.697 | 10.7 | 4.19 | 5.596 | 11.2 | 3.90 | 0.32 |
| | 27 | 5.109 | 10.3 | 3.97 | 4.556 | 10.1 | 3.67 | 0.43 |
| | 28 | 4.411 | 9.5 | 3.83 | 3.965 | 9.4 | 3.53 | 0.33 |
| | 29 | 3.651 | 8.3 | 3.74 | 3.556 | 8.9 | 3.42 | 0.47 |
| | 30 | 3.663 | 8.3 | 3.76 | 3.469 | 8.8 | 3.39 | 0.64 |
| | 31 | 3.881 | 8.5 | 3.85 | 3.749 | 9.2 | 3.47 | 1.02 |
| | 32 | 4.620 | 9.7 | 3.91 | 4.440 | 10.0 | 3.65 | 1.36 |
| | 33 | 5.502 | 10.7 | 4.10 | 5.518 | 11.1 | 3.88 | 1.60 |
| | 34 | 6.573 | 11.6 | 4.35 | 6.894 | 12.4 | 4.14 | 1.97 |
| | 35 | 8.307 | 12.7 | 4.83 | 8.620 | 13.9 | 4.42 | 2.07 |
| | 36 | 9.560 | 13.5 | 5.13 | 10.111 | 15.1 | 4.62 | 1.85 |
| | 37 | 9.883 | 13.6 | 5.23 | 10.727 | 15.6 | 4.70 | 1.61 |
| | 38 | 9.850 | 13.6 | 5.20 | 10.629 | 15.5 | 4.69 | 1.38 |
| | 39 | 9.572 | 13.5 | 5.09 | 10.165 | 15.1 | 4.63 | 1.20 |
| | 40 | 9.119 | 13.3 | 4.96 | 9.482 | 14.6 | 4.54 | 1.12 |
| | 41 | 8.746 | 13.0 | 4.89 | 8.898 | 14.1 | 4.46 | 1.12 |
| | 42 | 8.605 | 13.0 | 4.85 | 8.588 | 13.9 | 4.41 | 1.14 |
| | 43 | 8.558 | 13.0 | 4.83 | 8.500 | 13.8 | 4.40 | 1.25 |
| | 44 | 8.662 | 13.0 | 4.88 | 8.536 | 13.8 | 4.40 | 1.23 |
| | 45 | 8.555 | 12.9 | 4.84 | 8.555 | 13.8 | 4.41 | 1.19 |
| | 46 | 8.343 | 12.8 | 4.79 | 8.393 | 13.7 | 4.38 | 0.94 |
| | 47 | 7.678 | 12.4 | 4.63 | 7.884 | 13.3 | 4.31 | 0.52 |
| Average | | | | | | | | |
| | Weekday | 7.661 | 12.3 | 4.59 | 7.672 | 13.0 | 4.24 | 0.98 |
| | Weekend | 7.131 | 11.7 | 4.52 | 7.336 | 12.6 | 4.16 | 1.05 |
| | ADWF[1] | 7.509 | 12.1 | 4.57 | 7.576 | 12.9 | 4.22 | 1.00 |
| % Error | | | | | | | | |
| | Weekday | | | | 0.2% | 5.9% | -7.7% | |
| | Weekend | | | | 2.9% | 8.1% | -7.8% | |

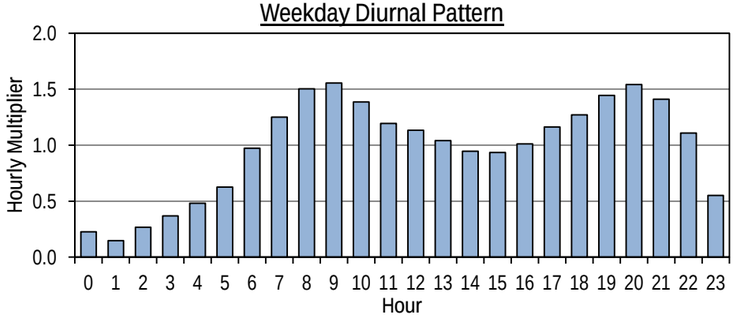
Note:

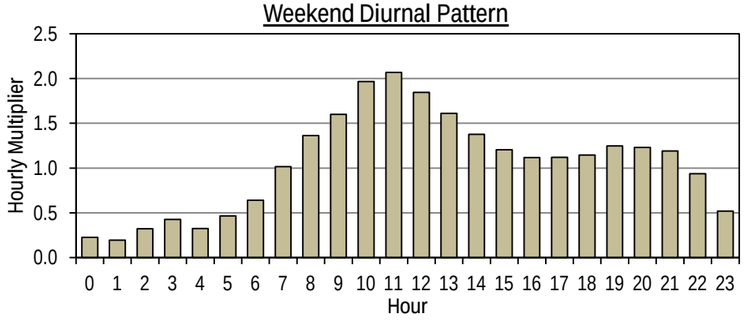
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



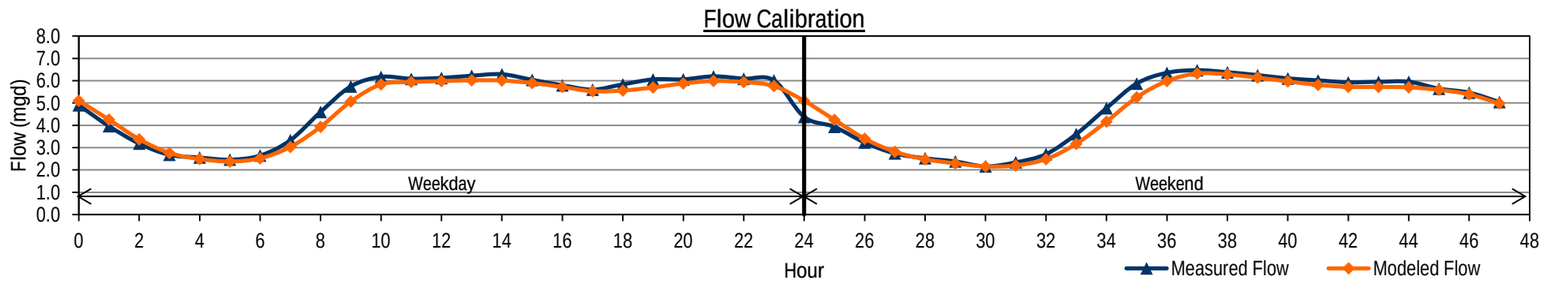



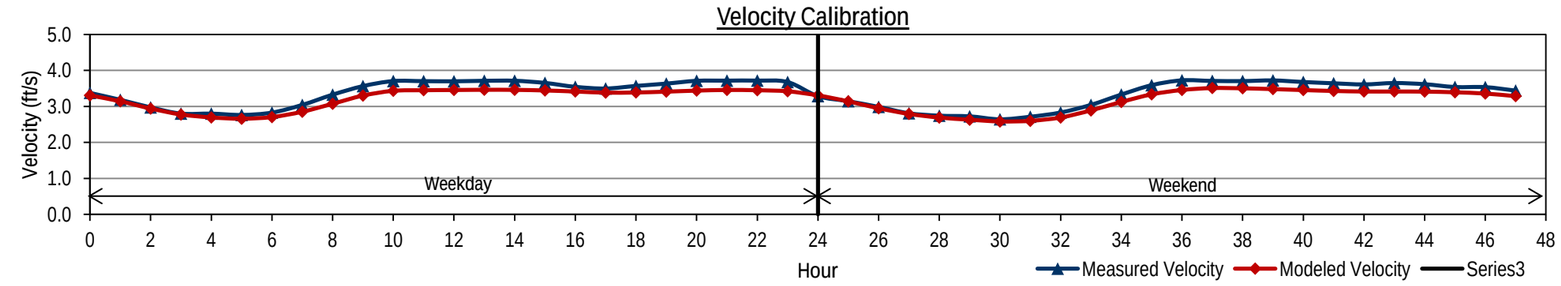
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR09 BASE WASTEWATER FLOW CALIBRATION

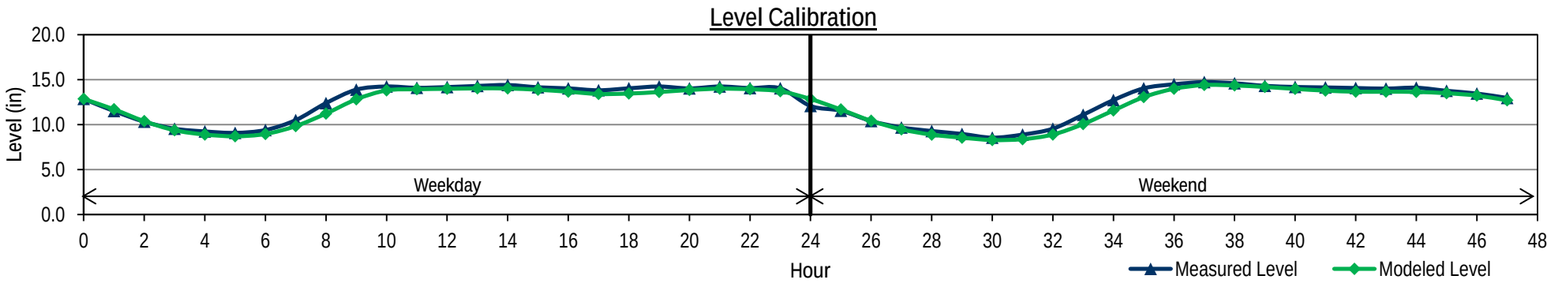
| | Hour | Measured Data Flow (mgd) | Measured Data Level (in) | Measured Data Velocity (ft/s) | Modeled Data Flow (mgd) | Modeled Data Level (in) | Modeled Data Velocity (ft/s) | Diurnal Calibrated Diurnal |
|---|---|---|---|---|---|---|---|---|
| Weekday | 0 | 4.899 | 12.9 | 3.38 | 5.098 | 12.9 | 3.31 | 0.66 |
| | 1 | 3.962 | 11.5 | 3.19 | 4.255 | 11.7 | 3.14 | 0.52 |
| | 2 | 3.182 | 10.3 | 2.97 | 3.371 | 10.4 | 2.94 | 0.46 |
| | 3 | 2.679 | 9.5 | 2.80 | 2.757 | 9.4 | 2.78 | 0.48 |
| | 4 | 2.559 | 9.2 | 2.80 | 2.485 | 8.9 | 2.69 | 0.49 |
| | 5 | 2.465 | 9.1 | 2.76 | 2.374 | 8.7 | 2.66 | 0.56 |
| | 6 | 2.647 | 9.4 | 2.83 | 2.518 | 9.0 | 2.70 | 0.77 |
| | 7 | 3.335 | 10.5 | 3.04 | 3.028 | 9.8 | 2.85 | 1.12 |
| | 8 | 4.599 | 12.4 | 3.33 | 3.930 | 11.2 | 3.07 | 1.33 |
| | 9 | 5.742 | 13.9 | 3.57 | 5.068 | 12.8 | 3.30 | 1.32 |
| | 10 | 6.168 | 14.2 | 3.71 | 5.834 | 13.8 | 3.43 | 1.26 |
| | 11 | 6.082 | 14.1 | 3.70 | 5.944 | 13.9 | 3.45 | 1.25 |
| | 12 | 6.121 | 14.2 | 3.70 | 5.981 | 14.0 | 3.46 | 1.26 |
| | 13 | 6.220 | 14.3 | 3.71 | 6.020 | 14.0 | 3.46 | 1.30 |
| | 14 | 6.285 | 14.4 | 3.71 | 6.008 | 14.0 | 3.46 | 1.22 |
| | 15 | 6.035 | 14.2 | 3.65 | 5.896 | 13.9 | 3.44 | 1.15 |
| | 16 | 5.792 | 14.0 | 3.55 | 5.720 | 13.7 | 3.42 | 1.12 |
| | 17 | 5.599 | 13.8 | 3.50 | 5.528 | 13.4 | 3.38 | 1.22 |
| | 18 | 5.832 | 14.0 | 3.57 | 5.559 | 13.5 | 3.39 | 1.29 |
| | 19 | 6.055 | 14.2 | 3.64 | 5.697 | 13.6 | 3.41 | 1.25 |
| | 20 | 6.057 | 14.0 | 3.71 | 5.876 | 13.9 | 3.44 | 1.26 |
| | 21 | 6.191 | 14.2 | 3.72 | 5.987 | 14.0 | 3.46 | 1.22 |
| | 22 | 6.087 | 14.1 | 3.72 | 5.937 | 13.9 | 3.45 | 1.20 |
| | 23 | 6.010 | 14.0 | 3.68 | 5.759 | 13.7 | 3.42 | 0.88 |
| Weekend | 24 | 4.375 | 12.1 | 3.29 | 5.094 | 12.9 | 3.31 | 0.65 |
| | 25 | 3.933 | 11.5 | 3.15 | 4.245 | 11.7 | 3.14 | 0.53 |
| | 26 | 3.230 | 10.4 | 2.99 | 3.398 | 10.4 | 2.95 | 0.46 |
| | 27 | 2.742 | 9.7 | 2.81 | 2.812 | 9.5 | 2.79 | 0.47 |
| | 28 | 2.524 | 9.3 | 2.74 | 2.473 | 8.9 | 2.69 | 0.47 |
| | 29 | 2.383 | 9.0 | 2.73 | 2.291 | 8.6 | 2.63 | 0.43 |
| | 30 | 2.162 | 8.6 | 2.64 | 2.150 | 8.3 | 2.58 | 0.52 |
| | 31 | 2.344 | 8.9 | 2.71 | 2.198 | 8.4 | 2.60 | 0.64 |
| | 32 | 2.711 | 9.6 | 2.83 | 2.481 | 8.9 | 2.69 | 0.89 |
| | 33 | 3.606 | 11.1 | 3.04 | 3.167 | 10.1 | 2.89 | 1.17 |
| | 34 | 4.767 | 12.7 | 3.33 | 4.164 | 11.6 | 3.12 | 1.36 |
| | 35 | 5.870 | 14.0 | 3.59 | 5.254 | 13.1 | 3.34 | 1.37 |
| | 36 | 6.349 | 14.5 | 3.73 | 5.983 | 14.0 | 3.46 | 1.30 |
| | 37 | 6.466 | 14.7 | 3.71 | 6.325 | 14.4 | 3.51 | 1.24 |
| | 38 | 6.377 | 14.6 | 3.71 | 6.281 | 14.4 | 3.50 | 1.19 |
| | 39 | 6.246 | 14.3 | 3.72 | 6.139 | 14.2 | 3.48 | 1.17 |
| | 40 | 6.099 | 14.2 | 3.68 | 5.969 | 14.0 | 3.46 | 1.19 |
| | 41 | 6.012 | 14.1 | 3.64 | 5.812 | 13.8 | 3.43 | 1.20 |
| | 42 | 5.925 | 14.1 | 3.61 | 5.724 | 13.7 | 3.42 | 1.22 |
| | 43 | 5.947 | 14.0 | 3.65 | 5.721 | 13.7 | 3.42 | 1.23 |
| | 44 | 5.950 | 14.1 | 3.62 | 5.702 | 13.6 | 3.41 | 1.11 |
| | 45 | 5.639 | 13.8 | 3.54 | 5.590 | 13.5 | 3.39 | 1.06 |
| | 46 | 5.463 | 13.5 | 3.54 | 5.387 | 13.2 | 3.36 | 0.95 |
| | 47 | 5.044 | 13.0 | 3.44 | 4.982 | 12.7 | 3.29 | 0.69 |
| Average | | | | | | | | |
| Weekday | | 5.025 | 12.8 | 3.41 | 4.860 | 12.4 | 3.23 | 1.02 |
| Weekend | | 4.673 | 12.3 | 3.31 | 4.556 | 12.0 | 3.16 | 0.94 |
| ADWF[1] | | 4.925 | 12.6 | 3.38 | 4.773 | 12.3 | 3.21 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | -3.3% | -2.8% | -5.4% | |
| Weekend | | | | | -2.5% | -2.8% | -4.5% | |

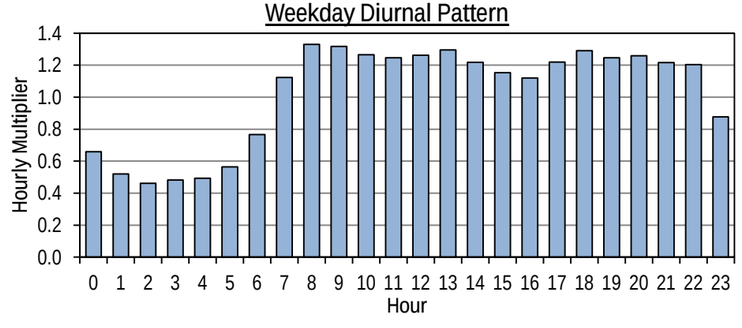
Note:

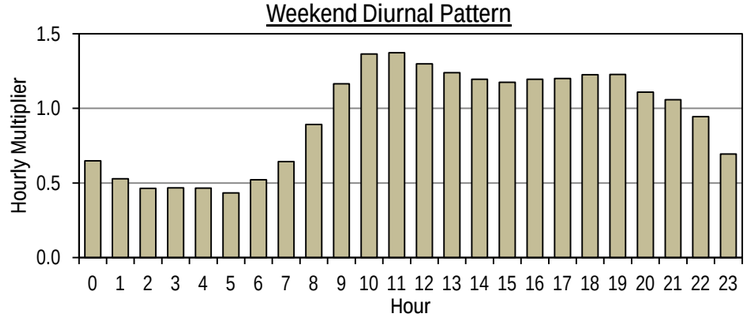
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



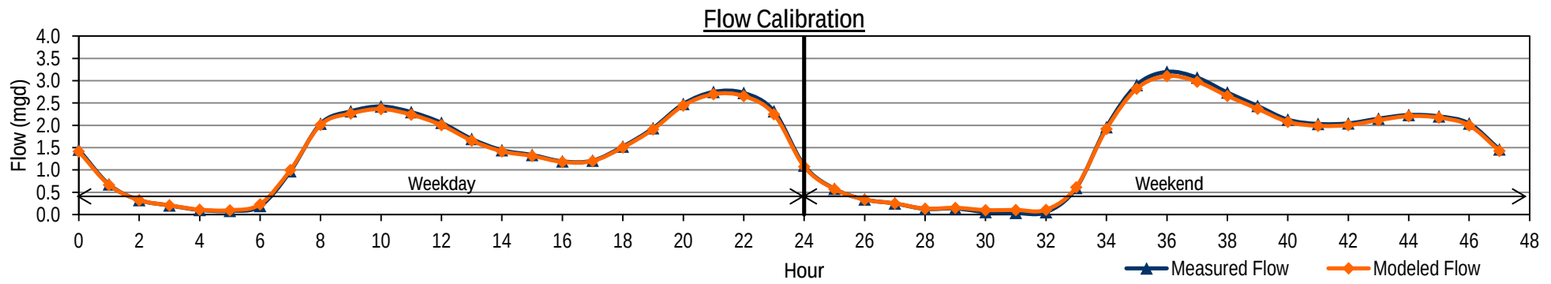



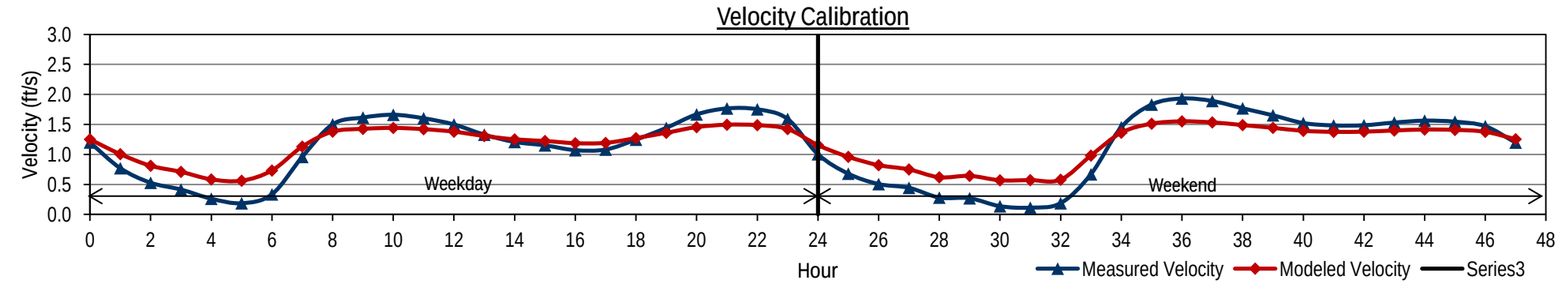
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR10 BASE WASTEWATER FLOW CALIBRATION

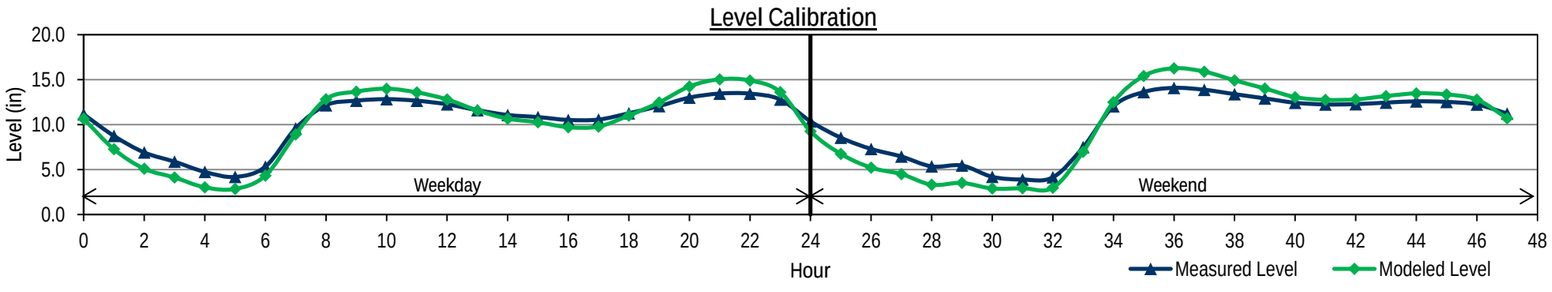
| | Hour | Measured Data Flow (mgd) | Measured Data Level (in) | Measured Data Velocity (ft/s) | Modeled Data Flow (mgd) | Modeled Data Level (in) | Modeled Data Velocity (ft/s) | Diurnal Calibrated Diurnal |
|---|---|---|---|---|---|---|---|---|
| Weekday | 0 | 1.456 | 11.1 | 1.20 | 1.415 | 10.7 | 1.25 | 0.98 |
| | 1 | 0.678 | 8.8 | 0.77 | 0.663 | 7.3 | 1.00 | 0.45 |
| | 2 | 0.326 | 6.9 | 0.53 | 0.321 | 5.1 | 0.81 | 0.22 |
| | 3 | 0.206 | 5.9 | 0.41 | 0.205 | 4.1 | 0.71 | 0.14 |
| | 4 | 0.105 | 4.8 | 0.26 | 0.108 | 3.0 | 0.58 | 0.07 |
| | 5 | 0.084 | 4.2 | 0.19 | 0.095 | 2.9 | 0.56 | 0.06 |
| | 6 | 0.193 | 5.3 | 0.33 | 0.228 | 4.3 | 0.73 | 0.13 |
| | 7 | 0.972 | 9.6 | 0.96 | 0.997 | 8.9 | 1.13 | 0.65 |
| | 8 | 2.038 | 12.2 | 1.50 | 2.010 | 12.8 | 1.38 | 1.37 |
| | 9 | 2.317 | 12.7 | 1.61 | 2.264 | 13.7 | 1.43 | 1.55 |
| | 10 | 2.425 | 12.8 | 1.66 | 2.364 | 14.0 | 1.44 | 1.63 |
| | 11 | 2.298 | 12.7 | 1.60 | 2.238 | 13.6 | 1.42 | 1.54 |
| | 12 | 2.058 | 12.3 | 1.50 | 2.004 | 12.8 | 1.38 | 1.38 |
| | 13 | 1.696 | 11.6 | 1.33 | 1.656 | 11.6 | 1.31 | 1.14 |
| | 14 | 1.444 | 11.1 | 1.21 | 1.415 | 10.7 | 1.25 | 0.97 |
| | 15 | 1.337 | 10.8 | 1.15 | 1.313 | 10.3 | 1.22 | 0.90 |
| | 16 | 1.194 | 10.5 | 1.07 | 1.178 | 9.7 | 1.19 | 0.80 |
| | 17 | 1.210 | 10.6 | 1.08 | 1.197 | 9.8 | 1.19 | 0.81 |
| | 18 | 1.526 | 11.3 | 1.25 | 1.503 | 11.0 | 1.27 | 1.02 |
| | 19 | 1.937 | 12.1 | 1.44 | 1.908 | 12.5 | 1.36 | 1.30 |
| | 20 | 2.481 | 13.0 | 1.67 | 2.442 | 14.2 | 1.45 | 1.66 |
| | 21 | 2.750 | 13.4 | 1.77 | 2.697 | 15.0 | 1.49 | 1.84 |
| | 22 | 2.728 | 13.4 | 1.75 | 2.655 | 14.9 | 1.49 | 1.83 |
| | 23 | 2.317 | 12.8 | 1.59 | 2.248 | 13.6 | 1.42 | 1.55 |
| Weekend | 24 | 1.100 | 10.4 | 1.00 | 1.072 | 9.3 | 1.15 | 0.74 |
| | 25 | 0.578 | 8.5 | 0.68 | 0.568 | 6.7 | 0.96 | 0.39 |
| | 26 | 0.341 | 7.3 | 0.51 | 0.335 | 5.2 | 0.82 | 0.23 |
| | 27 | 0.250 | 6.5 | 0.44 | 0.247 | 4.5 | 0.75 | 0.17 |
| | 28 | 0.129 | 5.4 | 0.28 | 0.131 | 3.3 | 0.62 | 0.09 |
| | 29 | 0.139 | 5.5 | 0.27 | 0.148 | 3.5 | 0.64 | 0.09 |
| | 30 | 0.058 | 4.2 | 0.14 | 0.098 | 2.9 | 0.57 | 0.04 |
| | 31 | 0.039 | 3.9 | 0.11 | 0.101 | 2.9 | 0.57 | 0.03 |
| | 32 | 0.055 | 4.2 | 0.19 | 0.105 | 3.0 | 0.58 | 0.04 |
| | 33 | 0.596 | 7.5 | 0.67 | 0.611 | 7.0 | 0.98 | 0.40 |
| | 34 | 1.960 | 12.0 | 1.45 | 1.918 | 12.5 | 1.36 | 1.31 |
| | 35 | 2.904 | 13.6 | 1.83 | 2.820 | 15.4 | 1.51 | 1.95 |
| | 36 | 3.201 | 14.1 | 1.93 | 3.103 | 16.2 | 1.55 | 2.15 |
| | 37 | 3.070 | 13.9 | 1.89 | 2.977 | 15.9 | 1.53 | 2.06 |
| | 38 | 2.737 | 13.4 | 1.77 | 2.658 | 14.9 | 1.49 | 1.83 |
| | 39 | 2.437 | 12.9 | 1.65 | 2.370 | 14.0 | 1.44 | 1.63 |
| | 40 | 2.129 | 12.4 | 1.52 | 2.077 | 13.0 | 1.39 | 1.43 |
| | 41 | 2.033 | 12.2 | 1.48 | 1.988 | 12.7 | 1.38 | 1.36 |
| | 42 | 2.045 | 12.3 | 1.49 | 2.004 | 12.8 | 1.38 | 1.37 |
| | 43 | 2.152 | 12.4 | 1.53 | 2.114 | 13.2 | 1.40 | 1.44 |
| | 44 | 2.233 | 12.6 | 1.56 | 2.204 | 13.5 | 1.41 | 1.50 |
| | 45 | 2.202 | 12.5 | 1.55 | 2.171 | 13.3 | 1.41 | 1.48 |
| | 46 | 2.042 | 12.2 | 1.47 | 1.997 | 12.8 | 1.38 | 1.37 |
| | 47 | 1.462 | 11.2 | 1.20 | 1.427 | 10.7 | 1.25 | 0.98 |
| Average | | | | | | | | |
| Weekday | | 1.491 | 10.4 | 1.16 | 1.464 | 10.3 | 1.19 | 1.00 |
| Weekend | | 1.496 | 10.0 | 1.11 | 1.469 | 10.0 | 1.15 | 1.00 |
| ADWF[1] | | 1.492 | 10.3 | 1.15 | 1.465 | 10.2 | 1.17 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | -1.8% | -1.4% | 2.3% | |
| Weekend | | | | | -1.8% | -0.7% | 3.4% | |

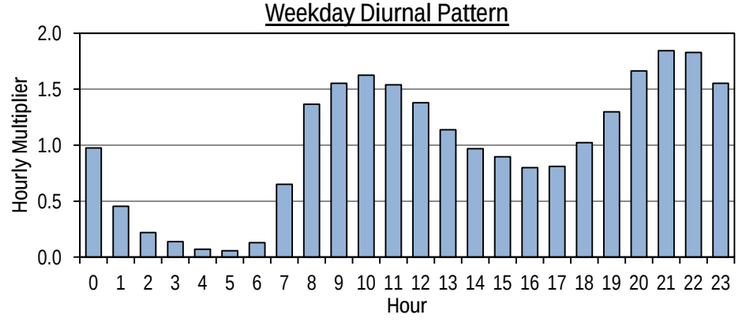
Note:

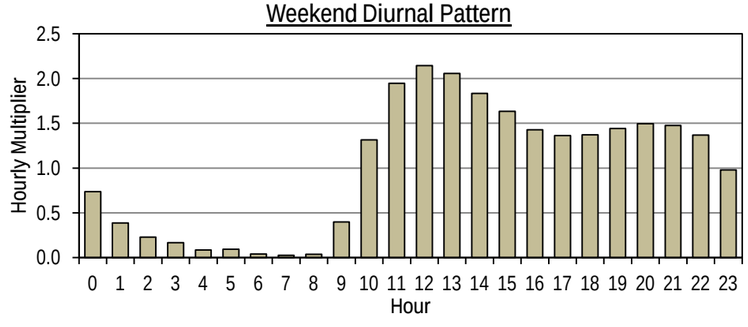
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



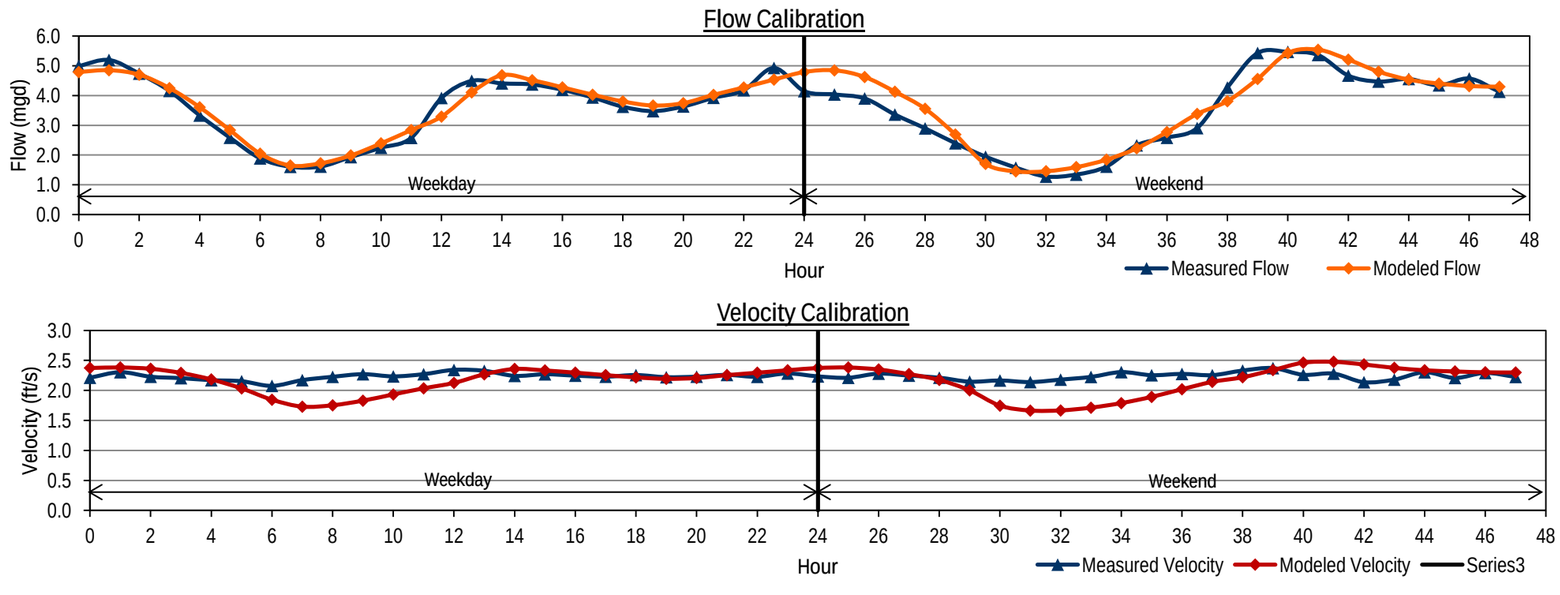



**CITY OF FRESNO**
**WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE**
**FLOW MONITORING SITE FR11 BASE WASTEWATER FLOW CALIBRATION**

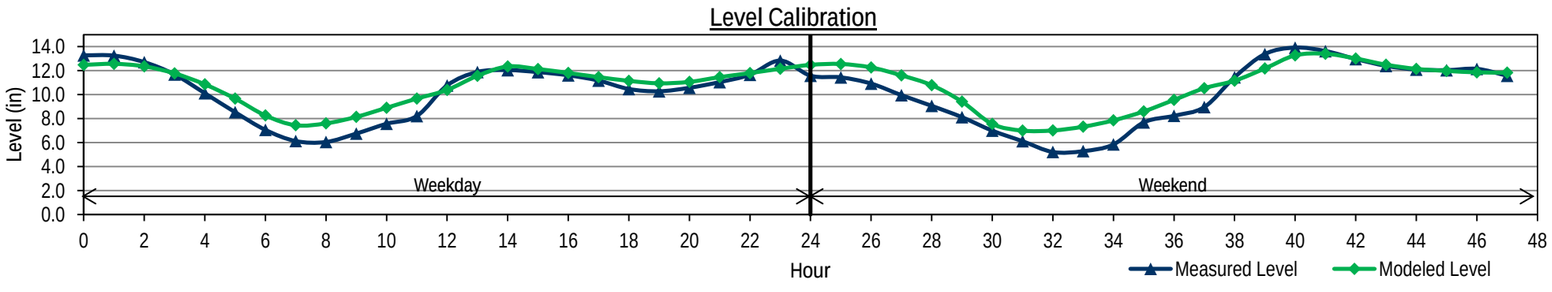
| | Hour | Measured Data Flow (mgd) | Measured Data Level (in) | Measured Data Velocity (ft/s) | Modeled Data Flow (mgd) | Modeled Data Level (in) | Modeled Data Velocity (ft/s) | Diurnal Calibrated Diurnal |
|---|---|---|---|---|---|---|---|---|
| Weekday | 0 | 4.997 | 13.3 | 2.21 | 4.790 | 12.5 | 2.37 | 0.33 |
| | 1 | 5.199 | 13.2 | 2.30 | 4.851 | 12.6 | 2.38 | 0.21 |
| | 2 | 4.738 | 12.7 | 2.23 | 4.700 | 12.4 | 2.36 | 0.28 |
| | 3 | 4.157 | 11.7 | 2.20 | 4.249 | 11.8 | 2.29 | 0.47 |
| | 4 | 3.330 | 10.1 | 2.17 | 3.607 | 10.9 | 2.18 | 0.61 |
| | 5 | 2.583 | 8.5 | 2.15 | 2.839 | 9.7 | 2.03 | 0.84 |
| | 6 | 1.889 | 7.1 | 2.08 | 2.047 | 8.3 | 1.84 | 1.04 |
| | 7 | 1.605 | 6.1 | 2.17 | 1.650 | 7.5 | 1.73 | 1.20 |
| | 8 | 1.612 | 6.1 | 2.23 | 1.725 | 7.6 | 1.75 | 1.75 |
| | 9 | 1.932 | 6.8 | 2.27 | 1.989 | 8.1 | 1.83 | 1.60 |
| | 10 | 2.244 | 7.6 | 2.23 | 2.394 | 8.9 | 1.93 | 1.12 |
| | 11 | 2.578 | 8.2 | 2.27 | 2.841 | 9.7 | 2.03 | 0.98 |
| | 12 | 3.920 | 10.8 | 2.34 | 3.292 | 10.4 | 2.13 | 0.87 |
| | 13 | 4.496 | 11.9 | 2.33 | 4.106 | 11.6 | 2.27 | 0.81 |
| | 14 | 4.410 | 12.0 | 2.24 | 4.683 | 12.3 | 2.36 | 0.79 |
| | 15 | 4.374 | 11.9 | 2.27 | 4.516 | 12.1 | 2.33 | 0.88 |
| | 16 | 4.195 | 11.6 | 2.25 | 4.275 | 11.8 | 2.30 | 1.08 |
| | 17 | 3.937 | 11.2 | 2.23 | 4.028 | 11.5 | 2.26 | 1.31 |
| | 18 | 3.625 | 10.5 | 2.26 | 3.802 | 11.1 | 2.22 | 1.50 |
| | 19 | 3.477 | 10.3 | 2.22 | 3.664 | 10.9 | 2.19 | 1.86 |
| | 20 | 3.634 | 10.6 | 2.23 | 3.744 | 11.1 | 2.21 | 1.72 |
| | 21 | 3.926 | 11.0 | 2.26 | 4.023 | 11.5 | 2.26 | 1.60 |
| | 22 | 4.181 | 11.7 | 2.23 | 4.271 | 11.8 | 2.30 | 1.10 |
| | 23 | 4.929 | 12.8 | 2.28 | 4.536 | 12.2 | 2.34 | 0.70 |
| Weekend | 24 | 4.149 | 11.6 | 2.23 | 4.790 | 12.5 | 2.37 | 0.09 |
| | 25 | 4.037 | 11.4 | 2.21 | 4.846 | 12.6 | 2.38 | 0.16 |
| | 26 | 3.904 | 10.9 | 2.28 | 4.623 | 12.3 | 2.35 | 0.46 |
| | 27 | 3.362 | 10.0 | 2.25 | 4.129 | 11.6 | 2.27 | 0.49 |
| | 28 | 2.897 | 9.1 | 2.21 | 3.556 | 10.8 | 2.17 | 0.42 |
| | 29 | 2.396 | 8.1 | 2.15 | 2.691 | 9.4 | 2.00 | 0.50 |
| | 30 | 1.944 | 7.0 | 2.17 | 1.703 | 7.6 | 1.75 | 0.68 |
| | 31 | 1.576 | 6.1 | 2.14 | 1.453 | 7.0 | 1.66 | 1.06 |
| | 32 | 1.275 | 5.2 | 2.18 | 1.457 | 7.0 | 1.67 | 1.21 |
| | 33 | 1.341 | 5.3 | 2.22 | 1.596 | 7.3 | 1.71 | 1.37 |
| | 34 | 1.611 | 5.9 | 2.30 | 1.846 | 7.9 | 1.79 | 2.04 |
| | 35 | 2.327 | 7.7 | 2.25 | 2.228 | 8.6 | 1.89 | 2.28 |
| | 36 | 2.581 | 8.2 | 2.27 | 2.773 | 9.6 | 2.02 | 1.65 |
| | 37 | 2.907 | 9.0 | 2.25 | 3.383 | 10.5 | 2.14 | 1.19 |
| | 38 | 4.270 | 11.4 | 2.33 | 3.810 | 11.2 | 2.22 | 0.73 |
| | 39 | 5.432 | 13.4 | 2.37 | 4.557 | 12.2 | 2.34 | 0.72 |
| | 40 | 5.471 | 13.9 | 2.26 | 5.428 | 13.3 | 2.46 | 0.94 |
| | 41 | 5.366 | 13.6 | 2.28 | 5.539 | 13.4 | 2.48 | 0.98 |
| | 42 | 4.673 | 13.0 | 2.14 | 5.207 | 13.0 | 2.43 | 1.24 |
| | 43 | 4.472 | 12.4 | 2.18 | 4.803 | 12.5 | 2.38 | 1.04 |
| | 44 | 4.558 | 12.1 | 2.30 | 4.534 | 12.1 | 2.34 | 1.26 |
| | 45 | 4.345 | 12.0 | 2.21 | 4.403 | 12.0 | 2.32 | 0.97 |
| | 46 | 4.574 | 12.1 | 2.29 | 4.317 | 11.9 | 2.30 | 0.65 |
| | 47 | 4.129 | 11.6 | 2.22 | 4.297 | 11.8 | 2.30 | 0.26 |
| Average | | | | | | | | |
| | Weekday | 3.582 | 10.3 | 2.23 | 3.609 | 10.8 | 2.16 | 1.03 |
| | Weekend | 3.483 | 10.0 | 2.24 | 3.665 | 10.7 | 2.16 | 0.93 |
| | ADWF[1] | 3.554 | 10.2 | 2.24 | 3.625 | 10.8 | 2.16 | 1.00 |
| % Error | | | | | | | | |
| | Weekday | | | | 0.8% | 4.3% | -3.3% | |
| | Weekend | | | | 5.2% | 7.0% | -3.7% | |

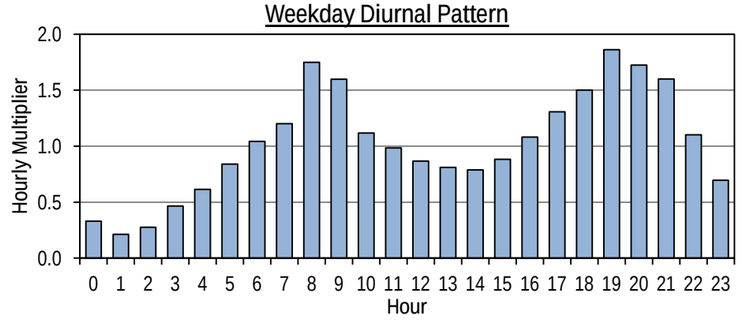
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7

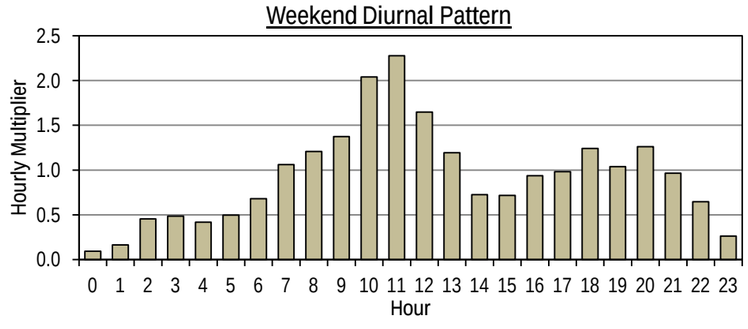








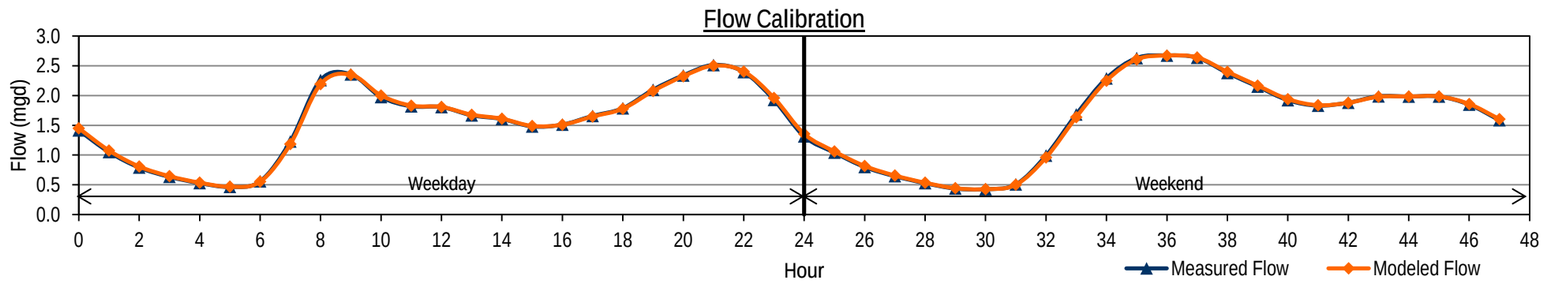



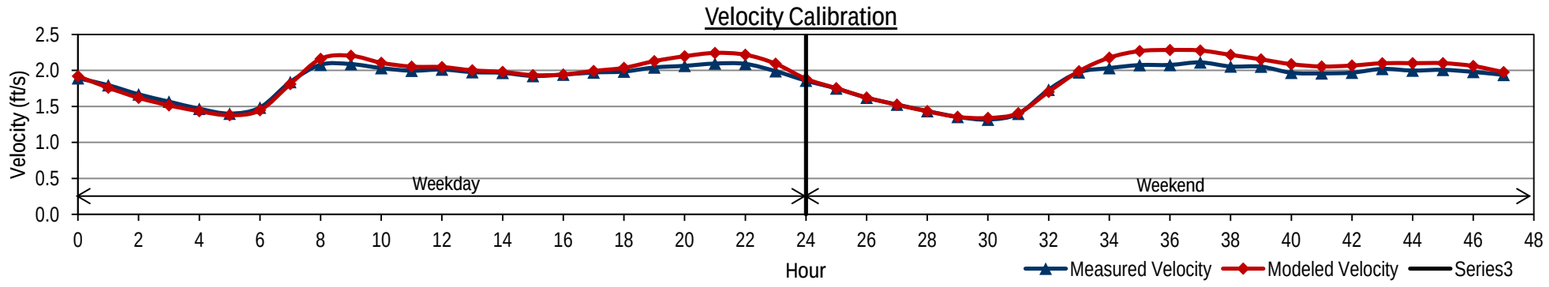



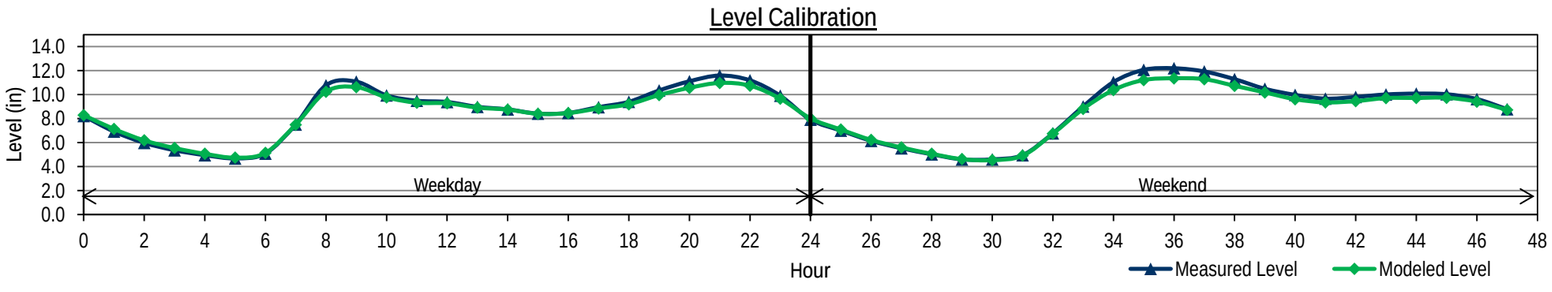
**CITY OF FRESNO**
**WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE**
**FLOW MONITORING SITE FR12 BASE WASTEWATER FLOW CALIBRATION**

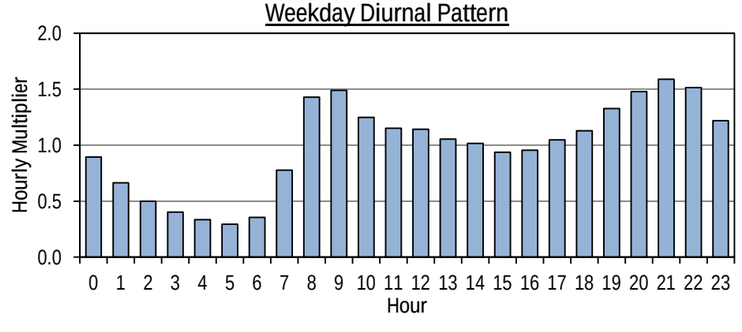
| | Hour | Measured Data Flow (mgd) | Measured Data Level (in) | Measured Data Velocity (ft/s) | Modeled Data Flow (mgd) | Modeled Data Level (in) | Modeled Data Velocity (ft/s) | Diurnal Calibrated Diurnal |
|---|---|---|---|---|---|---|---|---|
| Weekday | 0 | 1.415 | 8.2 | 1.89 | 1.450 | 8.3 | 1.92 | 0.89 |
| | 1 | 1.051 | 6.9 | 1.80 | 1.076 | 7.1 | 1.76 | 0.66 |
| | 2 | 0.791 | 6.0 | 1.67 | 0.808 | 6.2 | 1.62 | 0.50 |
| | 3 | 0.635 | 5.4 | 1.57 | 0.646 | 5.6 | 1.52 | 0.40 |
| | 4 | 0.530 | 5.0 | 1.47 | 0.537 | 5.1 | 1.43 | 0.33 |
| | 5 | 0.466 | 4.7 | 1.40 | 0.469 | 4.8 | 1.38 | 0.29 |
| | 6 | 0.559 | 5.1 | 1.48 | 0.554 | 5.1 | 1.45 | 0.35 |
| | 7 | 1.229 | 7.5 | 1.84 | 1.185 | 7.5 | 1.81 | 0.78 |
| | 8 | 2.260 | 10.8 | 2.08 | 2.192 | 10.2 | 2.16 | 1.43 |
| | 9 | 2.356 | 11.1 | 2.09 | 2.351 | 10.6 | 2.20 | 1.49 |
| | 10 | 1.975 | 9.9 | 2.03 | 2.001 | 9.8 | 2.11 | 1.25 |
| | 11 | 1.819 | 9.5 | 2.00 | 1.830 | 9.3 | 2.05 | 1.15 |
| | 12 | 1.807 | 9.4 | 2.01 | 1.809 | 9.3 | 2.05 | 1.14 |
| | 13 | 1.667 | 9.0 | 1.98 | 1.677 | 8.9 | 2.00 | 1.05 |
| | 14 | 1.606 | 8.8 | 1.97 | 1.611 | 8.7 | 1.98 | 1.02 |
| | 15 | 1.481 | 8.4 | 1.92 | 1.489 | 8.4 | 1.93 | 0.94 |
| | 16 | 1.512 | 8.5 | 1.94 | 1.510 | 8.5 | 1.94 | 0.96 |
| | 17 | 1.658 | 9.0 | 1.97 | 1.648 | 8.8 | 1.99 | 1.05 |
| | 18 | 1.786 | 9.4 | 1.98 | 1.778 | 9.2 | 2.04 | 1.13 |
| | 19 | 2.098 | 10.3 | 2.04 | 2.077 | 10.0 | 2.13 | 1.33 |
| | 20 | 2.338 | 11.1 | 2.06 | 2.324 | 10.6 | 2.20 | 1.48 |
| | 21 | 2.513 | 11.6 | 2.10 | 2.502 | 11.0 | 2.24 | 1.59 |
| | 22 | 2.395 | 11.2 | 2.09 | 2.403 | 10.7 | 2.22 | 1.51 |
| | 23 | 1.928 | 9.9 | 1.99 | 1.960 | 9.7 | 2.09 | 1.22 |
| Weekend | 24 | 1.315 | 7.9 | 1.86 | 1.356 | 8.0 | 1.88 | 0.83 |
| | 25 | 1.042 | 7.0 | 1.75 | 1.061 | 7.1 | 1.75 | 0.66 |
| | 26 | 0.800 | 6.1 | 1.62 | 0.817 | 6.2 | 1.62 | 0.51 |
| | 27 | 0.646 | 5.5 | 1.53 | 0.657 | 5.6 | 1.52 | 0.41 |
| | 28 | 0.529 | 5.0 | 1.44 | 0.536 | 5.1 | 1.43 | 0.33 |
| | 29 | 0.438 | 4.6 | 1.35 | 0.444 | 4.6 | 1.36 | 0.28 |
| | 30 | 0.427 | 4.6 | 1.32 | 0.428 | 4.5 | 1.34 | 0.27 |
| | 31 | 0.507 | 5.0 | 1.40 | 0.502 | 4.9 | 1.41 | 0.32 |
| | 32 | 0.992 | 6.8 | 1.73 | 0.960 | 6.7 | 1.70 | 0.63 |
| | 33 | 1.683 | 9.0 | 1.97 | 1.637 | 8.8 | 1.99 | 1.06 |
| | 34 | 2.289 | 11.0 | 2.03 | 2.249 | 10.4 | 2.18 | 1.45 |
| | 35 | 2.630 | 12.1 | 2.07 | 2.608 | 11.2 | 2.27 | 1.66 |
| | 36 | 2.673 | 12.2 | 2.08 | 2.671 | 11.4 | 2.28 | 1.69 |
| | 37 | 2.636 | 11.9 | 2.11 | 2.640 | 11.3 | 2.28 | 1.67 |
| | 38 | 2.380 | 11.3 | 2.06 | 2.398 | 10.7 | 2.22 | 1.50 |
| | 39 | 2.152 | 10.5 | 2.05 | 2.167 | 10.2 | 2.15 | 1.36 |
| | 40 | 1.923 | 10.0 | 1.97 | 1.939 | 9.6 | 2.09 | 1.22 |
| | 41 | 1.830 | 9.7 | 1.96 | 1.837 | 9.3 | 2.05 | 1.16 |
| | 42 | 1.880 | 9.8 | 1.97 | 1.878 | 9.5 | 2.07 | 1.19 |
| | 43 | 1.987 | 10.0 | 2.02 | 1.980 | 9.7 | 2.10 | 1.26 |
| | 44 | 1.984 | 10.1 | 2.00 | 1.984 | 9.7 | 2.10 | 1.25 |
| | 45 | 1.985 | 10.0 | 2.01 | 1.985 | 9.7 | 2.10 | 1.25 |
| | 46 | 1.848 | 9.6 | 1.98 | 1.858 | 9.4 | 2.06 | 1.17 |
| | 47 | 1.587 | 8.8 | 1.94 | 1.604 | 8.7 | 1.98 | 1.00 |
| Average | | | | | | | | |
| | Weekday | 1.578 | 8.6 | 1.89 | 1.579 | 8.5 | 1.93 | 1.00 |
| | Weekend | 1.590 | 8.7 | 1.84 | 1.592 | 8.4 | 1.91 | 1.01 |
| | ADWF[1] | 1.582 | 8.6 | 1.88 | 1.582 | 8.5 | 1.92 | 1.00 |
| % Error | | | | | | | | |
| | Weekday | | | | 0.0% | -1.6% | 1.9% | |
| | Weekend | | | | 0.1% | -2.9% | 3.9% | |

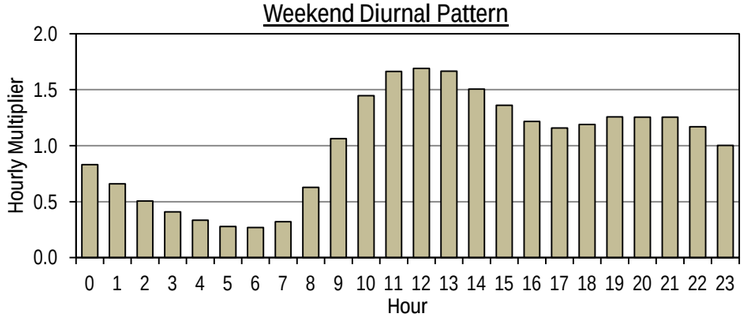
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



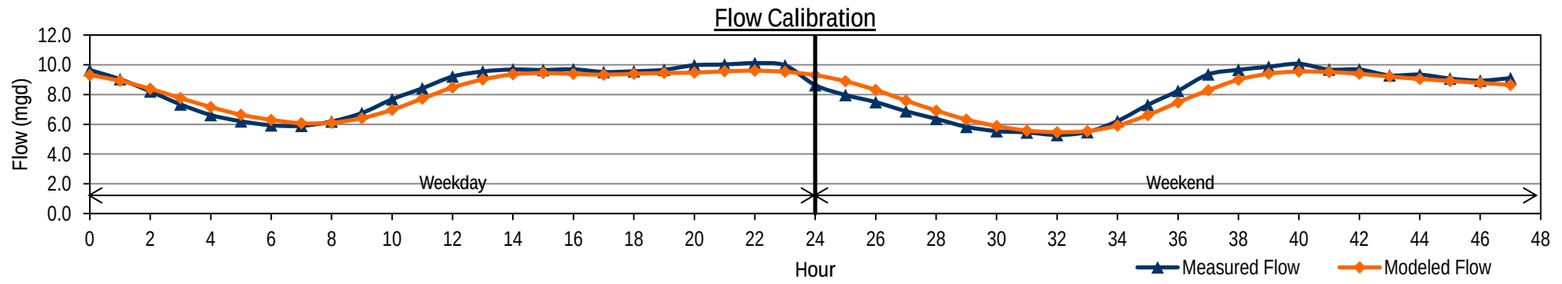



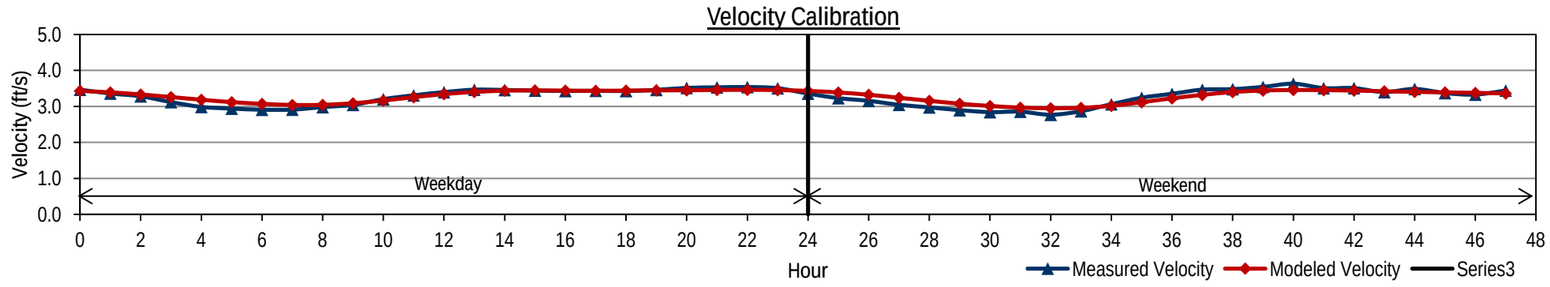



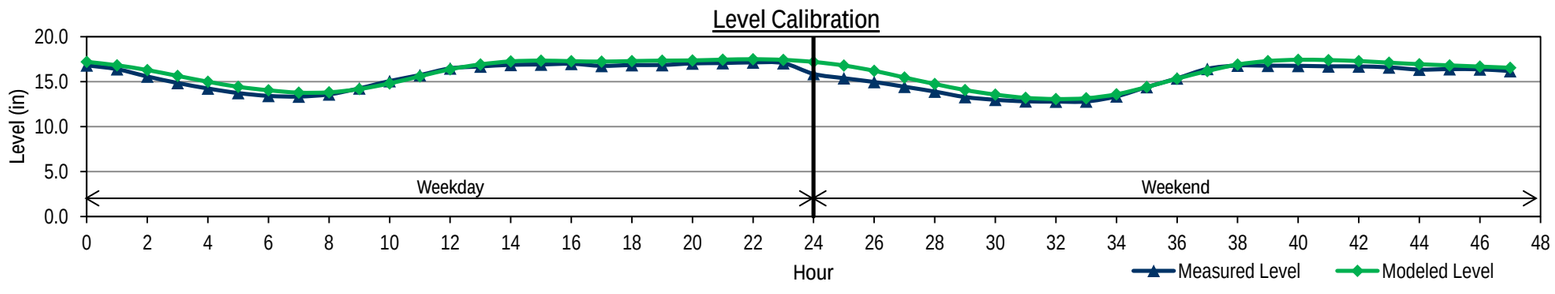
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR13 BASE WASTEWATER FLOW CALIBRATION

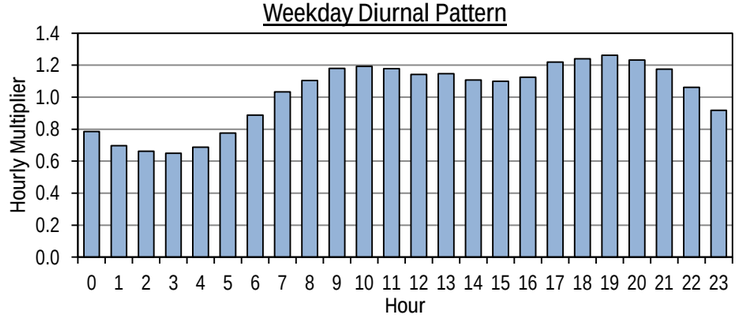
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 9.655 | 16.8 | 3.46 | 9.313 | 17.2 | 3.43 | 0.79 |
| | 1 | 9.037 | 16.4 | 3.36 | 8.931 | 16.8 | 3.39 | 0.70 |
| | 2 | 8.211 | 15.6 | 3.28 | 8.392 | 16.3 | 3.33 | 0.66 |
| | 3 | 7.339 | 14.8 | 3.12 | 7.765 | 15.6 | 3.26 | 0.65 |
| | 4 | 6.626 | 14.2 | 2.98 | 7.159 | 15.0 | 3.18 | 0.69 |
| | 5 | 6.203 | 13.7 | 2.94 | 6.644 | 14.4 | 3.12 | 0.78 |
| | 6 | 5.934 | 13.4 | 2.91 | 6.297 | 14.0 | 3.07 | 0.89 |
| | 7 | 5.898 | 13.3 | 2.91 | 6.071 | 13.8 | 3.04 | 1.03 |
| | 8 | 6.191 | 13.6 | 2.98 | 6.101 | 13.8 | 3.04 | 1.10 |
| | 9 | 6.758 | 14.2 | 3.04 | 6.411 | 14.2 | 3.09 | 1.18 |
| | 10 | 7.684 | 15.1 | 3.20 | 6.976 | 14.8 | 3.16 | 1.19 |
| | 11 | 8.423 | 15.7 | 3.31 | 7.727 | 15.6 | 3.25 | 1.18 |
| | 12 | 9.214 | 16.5 | 3.40 | 8.480 | 16.4 | 3.34 | 1.14 |
| | 13 | 9.555 | 16.7 | 3.46 | 9.020 | 16.9 | 3.40 | 1.15 |
| | 14 | 9.691 | 16.9 | 3.46 | 9.367 | 17.2 | 3.43 | 1.11 |
| | 15 | 9.656 | 16.9 | 3.44 | 9.454 | 17.3 | 3.44 | 1.10 |
| | 16 | 9.704 | 17.0 | 3.43 | 9.392 | 17.3 | 3.44 | 1.13 |
| | 17 | 9.524 | 16.7 | 3.43 | 9.339 | 17.2 | 3.43 | 1.22 |
| | 18 | 9.572 | 16.8 | 3.43 | 9.405 | 17.3 | 3.44 | 1.24 |
| | 19 | 9.671 | 16.8 | 3.46 | 9.456 | 17.3 | 3.44 | 1.26 |
| | 20 | 9.977 | 17.0 | 3.51 | 9.479 | 17.4 | 3.45 | 1.23 |
| | 21 | 10.028 | 17.1 | 3.53 | 9.572 | 17.4 | 3.45 | 1.18 |
| | 22 | 10.118 | 17.1 | 3.54 | 9.611 | 17.5 | 3.46 | 1.06 |
| | 23 | 9.964 | 17.0 | 3.51 | 9.537 | 17.4 | 3.45 | 0.92 |
| Weekend | 24 | 8.636 | 15.8 | 3.35 | 9.309 | 17.2 | 3.43 | 0.69 |
| | 25 | 7.971 | 15.4 | 3.23 | 8.901 | 16.8 | 3.39 | 0.64 |
| | 26 | 7.494 | 15.0 | 3.15 | 8.313 | 16.2 | 3.32 | 0.60 |
| | 27 | 6.880 | 14.4 | 3.04 | 7.596 | 15.5 | 3.24 | 0.60 |
| | 28 | 6.369 | 13.9 | 2.97 | 6.921 | 14.7 | 3.15 | 0.64 |
| | 29 | 5.830 | 13.3 | 2.89 | 6.319 | 14.1 | 3.07 | 0.64 |
| | 30 | 5.540 | 13.0 | 2.84 | 5.882 | 13.6 | 3.01 | 0.70 |
| | 31 | 5.452 | 12.8 | 2.85 | 5.576 | 13.2 | 2.96 | 0.84 |
| | 32 | 5.281 | 12.8 | 2.77 | 5.468 | 13.1 | 2.95 | 1.01 |
| | 33 | 5.478 | 12.8 | 2.87 | 5.538 | 13.2 | 2.96 | 1.12 |
| | 34 | 6.219 | 13.4 | 3.06 | 5.915 | 13.6 | 3.01 | 1.27 |
| | 35 | 7.302 | 14.4 | 3.24 | 6.617 | 14.4 | 3.11 | 1.24 |
| | 36 | 8.251 | 15.4 | 3.35 | 7.475 | 15.3 | 3.22 | 1.22 |
| | 37 | 9.359 | 16.4 | 3.46 | 8.291 | 16.2 | 3.32 | 1.22 |
| | 38 | 9.667 | 16.8 | 3.48 | 9.004 | 16.9 | 3.40 | 1.13 |
| | 39 | 9.874 | 16.8 | 3.54 | 9.409 | 17.3 | 3.44 | 1.13 |
| | 40 | 10.072 | 16.7 | 3.63 | 9.556 | 17.4 | 3.45 | 1.07 |
| | 41 | 9.687 | 16.7 | 3.51 | 9.521 | 17.4 | 3.45 | 1.10 |
| | 42 | 9.691 | 16.7 | 3.51 | 9.404 | 17.3 | 3.44 | 1.06 |
| | 43 | 9.295 | 16.6 | 3.40 | 9.216 | 17.1 | 3.42 | 1.04 |
| | 44 | 9.345 | 16.3 | 3.48 | 9.052 | 16.9 | 3.40 | 1.09 |
| | 45 | 9.083 | 16.4 | 3.37 | 8.919 | 16.8 | 3.39 | 0.96 |
| | 46 | 8.943 | 16.4 | 3.33 | 8.787 | 16.7 | 3.37 | 0.83 |
| | 47 | 9.107 | 16.2 | 3.44 | 8.652 | 16.5 | 3.36 | 0.77 |
| Average | | | | | | | | |
| | Weekday | 8.526 | 15.8 | 3.29 | 8.329 | 16.2 | 3.31 | 1.02 |
| | Weekend | 7.951 | 15.2 | 3.24 | 7.902 | 15.7 | 3.26 | 0.94 |
| | ADWF[1] | 8.362 | 15.6 | 3.28 | 8.207 | 16.0 | 3.30 | 1.00 |
| % Error | | | | | | | | |
| | Weekday | | | | -2.3% | 2.3% | 0.6% | |
| | Weekend | | | | -0.6% | 3.6% | 0.6% | |

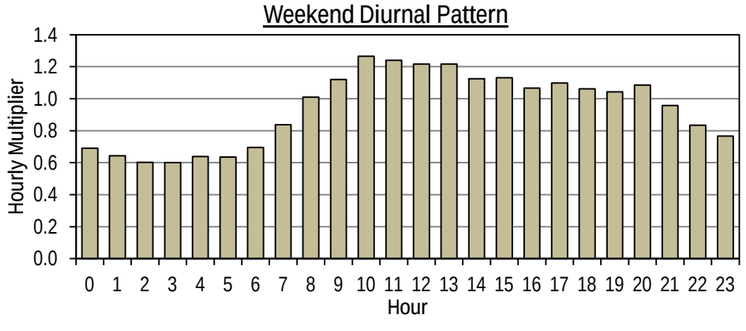
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



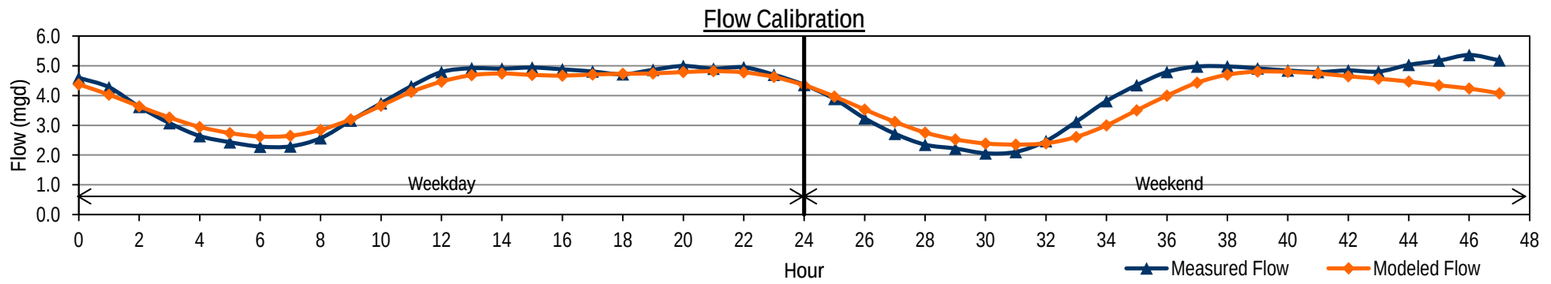



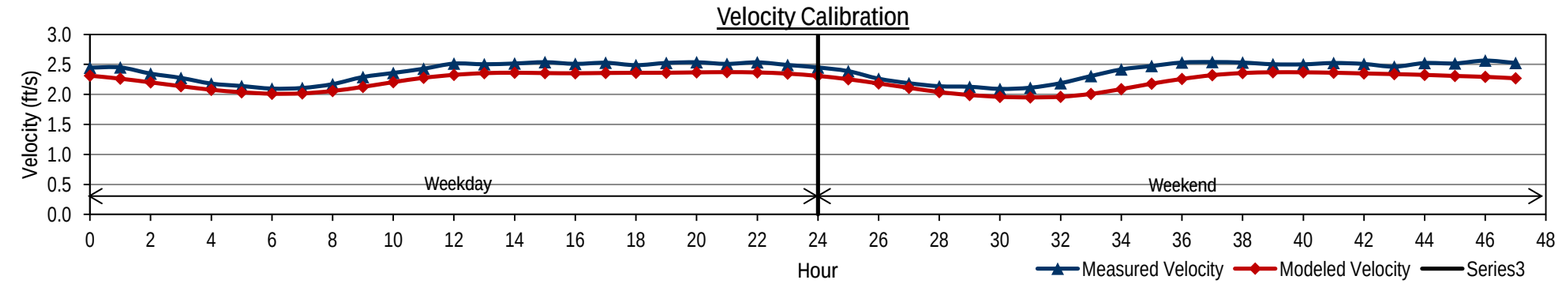



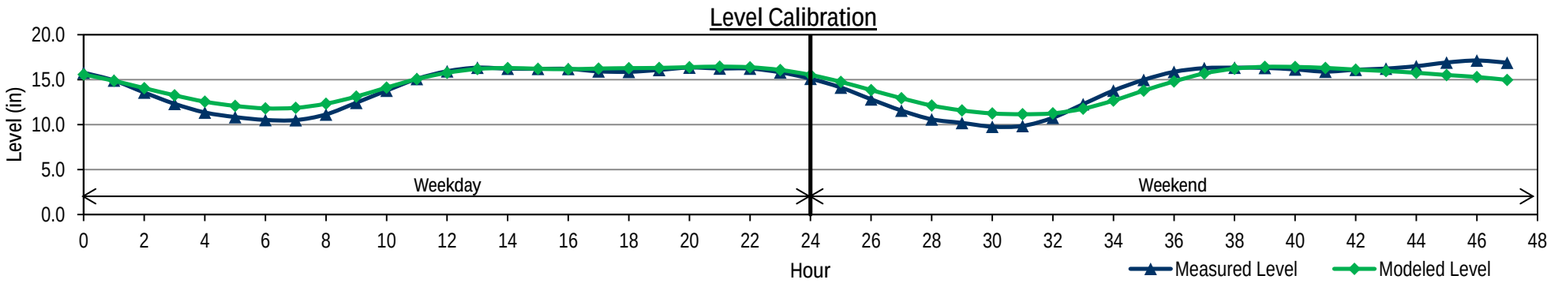
**CITY OF FRESNO**
**WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE**
**FLOW MONITORING SITE FR14 BASE WASTEWATER FLOW CALIBRATION**

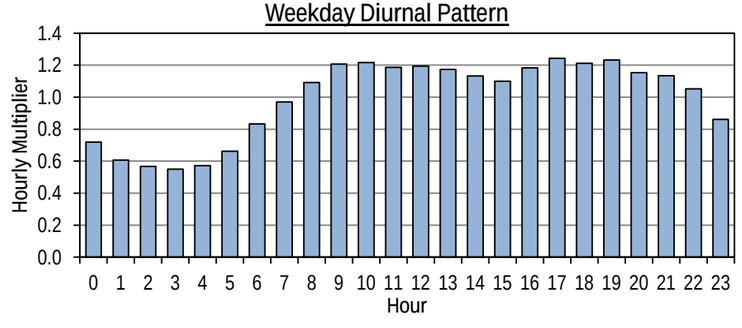
| | Hour | Measured Data Flow (mgd) | Measured Data Level (in) | Measured Data Velocity (ft/s) | Modeled Data Flow (mgd) | Modeled Data Level (in) | Modeled Data Velocity (ft/s) | Diurnal Calibrated Diurnal |
|---|---|---|---|---|---|---|---|---|
| Weekday | 0 | 4.599 | 15.8 | 2.45 | 4.376 | 15.6 | 2.31 | 0.72 |
| | 1 | 4.281 | 14.9 | 2.45 | 4.029 | 14.9 | 2.26 | 0.61 |
| | 2 | 3.620 | 13.6 | 2.35 | 3.635 | 14.1 | 2.20 | 0.57 |
| | 3 | 3.074 | 12.3 | 2.28 | 3.261 | 13.3 | 2.14 | 0.55 |
| | 4 | 2.639 | 11.3 | 2.18 | 2.943 | 12.6 | 2.08 | 0.57 |
| | 5 | 2.429 | 10.8 | 2.14 | 2.738 | 12.1 | 2.04 | 0.66 |
| | 6 | 2.282 | 10.5 | 2.10 | 2.620 | 11.8 | 2.01 | 0.83 |
| | 7 | 2.290 | 10.5 | 2.11 | 2.646 | 11.9 | 2.02 | 0.97 |
| | 8 | 2.566 | 11.1 | 2.17 | 2.844 | 12.3 | 2.06 | 1.09 |
| | 9 | 3.159 | 12.4 | 2.29 | 3.197 | 13.1 | 2.12 | 1.21 |
| | 10 | 3.743 | 13.8 | 2.36 | 3.658 | 14.1 | 2.20 | 1.22 |
| | 11 | 4.316 | 15.1 | 2.43 | 4.122 | 15.1 | 2.28 | 1.19 |
| | 12 | 4.793 | 15.9 | 2.51 | 4.468 | 15.8 | 2.33 | 1.20 |
| | 13 | 4.921 | 16.3 | 2.50 | 4.686 | 16.2 | 2.35 | 1.17 |
| | 14 | 4.906 | 16.2 | 2.52 | 4.741 | 16.3 | 2.36 | 1.13 |
| | 15 | 4.943 | 16.2 | 2.54 | 4.694 | 16.2 | 2.36 | 1.10 |
| | 16 | 4.884 | 16.2 | 2.51 | 4.669 | 16.2 | 2.35 | 1.18 |
| | 17 | 4.812 | 15.9 | 2.53 | 4.707 | 16.2 | 2.36 | 1.24 |
| | 18 | 4.717 | 15.9 | 2.49 | 4.732 | 16.3 | 2.36 | 1.21 |
| | 19 | 4.868 | 16.1 | 2.53 | 4.744 | 16.3 | 2.36 | 1.23 |
| | 20 | 4.998 | 16.3 | 2.54 | 4.790 | 16.4 | 2.37 | 1.15 |
| | 21 | 4.905 | 16.2 | 2.51 | 4.819 | 16.4 | 2.37 | 1.14 |
| | 22 | 4.953 | 16.2 | 2.54 | 4.780 | 16.4 | 2.37 | 1.05 |
| | 23 | 4.701 | 15.8 | 2.49 | 4.626 | 16.1 | 2.35 | 0.86 |
| Weekend | 24 | 4.359 | 15.1 | 2.45 | 4.348 | 15.5 | 2.31 | 0.59 |
| | 25 | 3.889 | 14.1 | 2.39 | 3.967 | 14.7 | 2.25 | 0.52 |
| | 26 | 3.235 | 12.8 | 2.26 | 3.529 | 13.8 | 2.18 | 0.52 |
| | 27 | 2.716 | 11.6 | 2.19 | 3.114 | 12.9 | 2.11 | 0.50 |
| | 28 | 2.347 | 10.6 | 2.14 | 2.754 | 12.1 | 2.04 | 0.55 |
| | 29 | 2.218 | 10.2 | 2.13 | 2.524 | 11.6 | 1.99 | 0.69 |
| | 30 | 2.056 | 9.8 | 2.09 | 2.386 | 11.2 | 1.96 | 0.91 |
| | 31 | 2.103 | 9.8 | 2.11 | 2.350 | 11.2 | 1.95 | 1.12 |
| | 32 | 2.470 | 10.8 | 2.19 | 2.393 | 11.3 | 1.96 | 1.23 |
| | 33 | 3.119 | 12.3 | 2.31 | 2.607 | 11.8 | 2.01 | 1.31 |
| | 34 | 3.815 | 13.8 | 2.42 | 2.997 | 12.7 | 2.09 | 1.30 |
| | 35 | 4.351 | 15.0 | 2.47 | 3.503 | 13.8 | 2.18 | 1.24 |
| | 36 | 4.795 | 15.9 | 2.53 | 3.995 | 14.8 | 2.26 | 1.18 |
| | 37 | 4.977 | 16.3 | 2.54 | 4.433 | 15.7 | 2.32 | 1.14 |
| | 38 | 4.983 | 16.3 | 2.53 | 4.701 | 16.2 | 2.36 | 1.13 |
| | 39 | 4.915 | 16.3 | 2.50 | 4.806 | 16.4 | 2.37 | 1.17 |
| | 40 | 4.845 | 16.1 | 2.50 | 4.798 | 16.4 | 2.37 | 1.17 |
| | 41 | 4.794 | 15.9 | 2.52 | 4.743 | 16.3 | 2.36 | 1.28 |
| | 42 | 4.847 | 16.1 | 2.51 | 4.648 | 16.1 | 2.35 | 1.34 |
| | 43 | 4.808 | 16.2 | 2.46 | 4.566 | 15.9 | 2.34 | 1.42 |
| | 44 | 5.034 | 16.5 | 2.52 | 4.471 | 15.8 | 2.33 | 1.36 |
| | 45 | 5.175 | 16.9 | 2.52 | 4.343 | 15.5 | 2.31 | 1.05 |
| | 46 | 5.367 | 17.1 | 2.57 | 4.237 | 15.3 | 2.29 | 0.91 |
| | 47 | 5.186 | 16.9 | 2.53 | 4.073 | 15.0 | 2.27 | 0.72 |
| Average | | | | | | | | |
| Weekday | | 4.058 | 14.4 | 2.40 | 4.022 | 14.8 | 2.25 | 0.99 |
| Weekend | | 4.017 | 14.3 | 2.39 | 3.762 | 14.2 | 2.21 | 1.01 |
| ADWF[1] | | 4.046 | 14.4 | 2.39 | 3.948 | 14.6 | 2.24 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | -0.9% | 2.9% | -6.1% | |
| Weekend | | | | | -6.3% | -0.1% | -7.8% | |

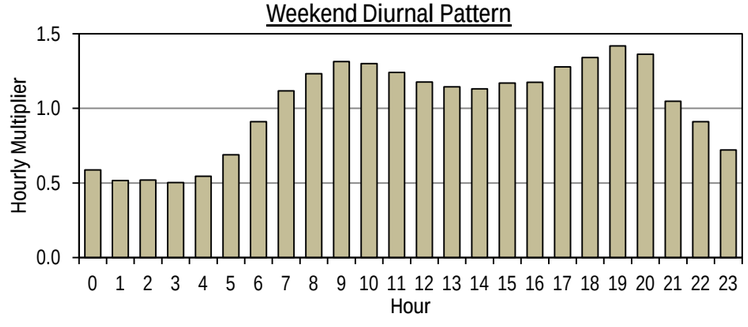
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



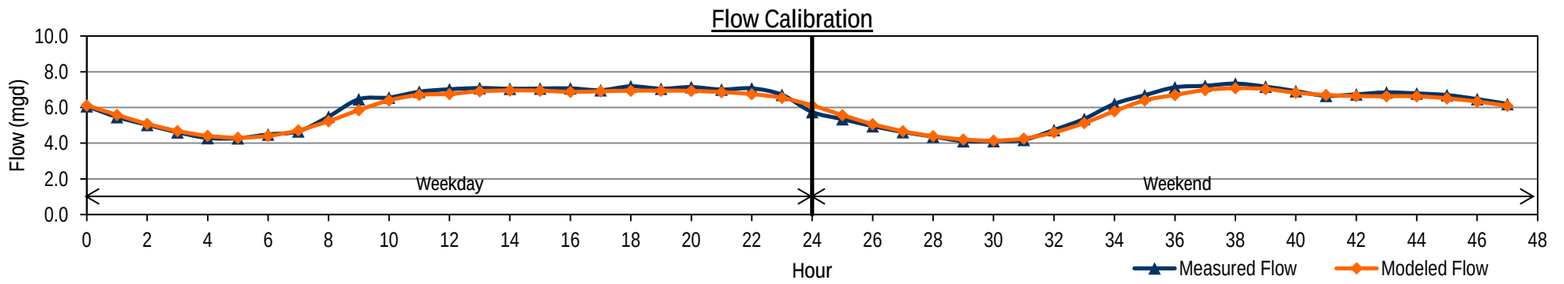



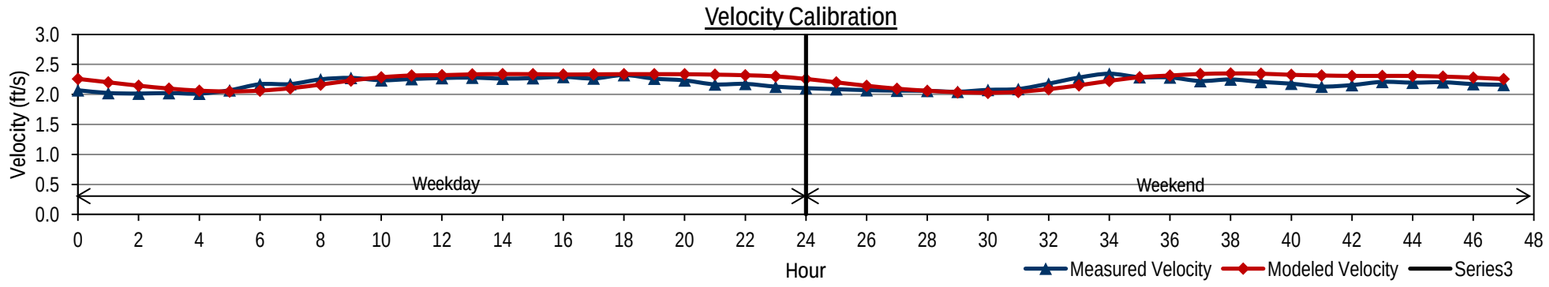



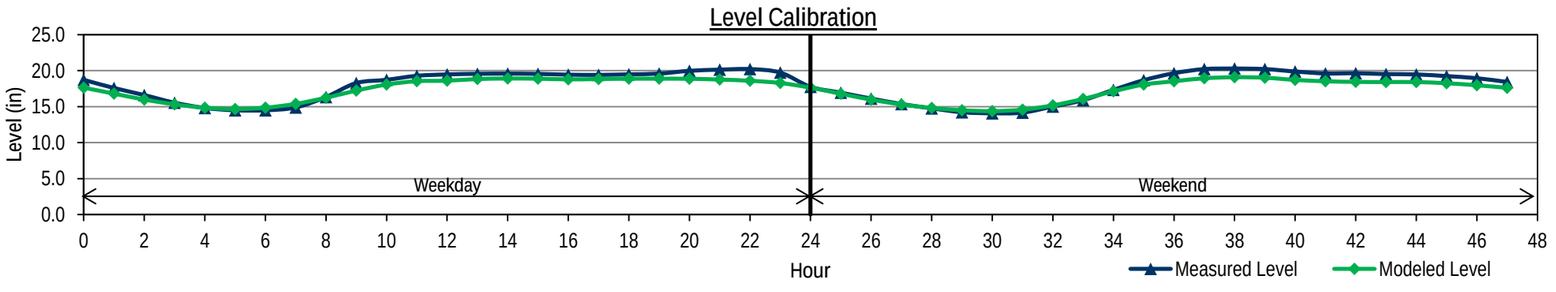
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR15 BASE WASTEWATER FLOW CALIBRATION

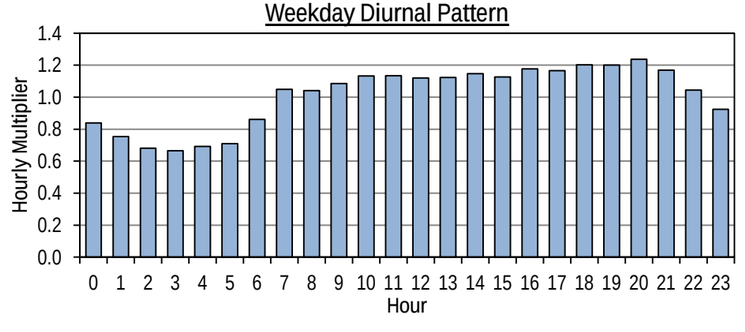
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 6.069 | 18.7 | 2.07 | 6.112 | 17.6 | 2.26 | 0.84 |
| | 1 | 5.461 | 17.6 | 2.02 | 5.580 | 16.8 | 2.20 | 0.75 |
| | 2 | 5.022 | 16.6 | 2.01 | 5.077 | 16.0 | 2.14 | 0.68 |
| | 3 | 4.608 | 15.5 | 2.02 | 4.679 | 15.3 | 2.10 | 0.67 |
| | 4 | 4.286 | 14.8 | 2.01 | 4.407 | 14.8 | 2.06 | 0.69 |
| | 5 | 4.275 | 14.5 | 2.07 | 4.304 | 14.7 | 2.05 | 0.71 |
| | 6 | 4.484 | 14.5 | 2.17 | 4.409 | 14.9 | 2.06 | 0.86 |
| | 7 | 4.660 | 14.9 | 2.17 | 4.716 | 15.4 | 2.10 | 1.05 |
| | 8 | 5.485 | 16.3 | 2.25 | 5.228 | 16.2 | 2.16 | 1.04 |
| | 9 | 6.460 | 18.3 | 2.28 | 5.847 | 17.2 | 2.23 | 1.09 |
| | 10 | 6.555 | 18.7 | 2.24 | 6.392 | 18.1 | 2.29 | 1.13 |
| | 11 | 6.882 | 19.3 | 2.26 | 6.701 | 18.5 | 2.32 | 1.13 |
| | 12 | 7.020 | 19.5 | 2.27 | 6.752 | 18.6 | 2.32 | 1.12 |
| | 13 | 7.087 | 19.6 | 2.28 | 6.902 | 18.8 | 2.33 | 1.12 |
| | 14 | 7.048 | 19.6 | 2.26 | 6.949 | 18.9 | 2.34 | 1.15 |
| | 15 | 7.059 | 19.6 | 2.27 | 6.937 | 18.9 | 2.34 | 1.13 |
| | 16 | 7.070 | 19.4 | 2.29 | 6.871 | 18.8 | 2.33 | 1.18 |
| | 17 | 6.968 | 19.4 | 2.27 | 6.904 | 18.8 | 2.33 | 1.17 |
| | 18 | 7.184 | 19.5 | 2.32 | 6.937 | 18.9 | 2.34 | 1.20 |
| | 19 | 7.051 | 19.6 | 2.26 | 6.935 | 18.9 | 2.34 | 1.20 |
| | 20 | 7.141 | 20.0 | 2.23 | 6.928 | 18.9 | 2.34 | 1.24 |
| | 21 | 7.004 | 20.1 | 2.17 | 6.853 | 18.8 | 2.33 | 1.17 |
| | 22 | 7.070 | 20.2 | 2.18 | 6.744 | 18.6 | 2.32 | 1.04 |
| | 23 | 6.707 | 19.7 | 2.13 | 6.538 | 18.3 | 2.30 | 0.92 |
| Weekend | 24 | 5.742 | 17.8 | 2.10 | 6.108 | 17.6 | 2.26 | 0.82 |
| | 25 | 5.344 | 16.9 | 2.09 | 5.568 | 16.8 | 2.20 | 0.75 |
| | 26 | 4.951 | 16.1 | 2.07 | 5.063 | 16.0 | 2.14 | 0.69 |
| | 27 | 4.621 | 15.4 | 2.06 | 4.668 | 15.3 | 2.09 | 0.62 |
| | 28 | 4.365 | 14.8 | 2.06 | 4.390 | 14.8 | 2.06 | 0.61 |
| | 29 | 4.111 | 14.2 | 2.04 | 4.205 | 14.5 | 2.03 | 0.61 |
| | 30 | 4.117 | 14.1 | 2.08 | 4.139 | 14.4 | 2.03 | 0.70 |
| | 31 | 4.184 | 14.2 | 2.09 | 4.255 | 14.6 | 2.04 | 0.82 |
| | 32 | 4.735 | 15.0 | 2.18 | 4.599 | 15.2 | 2.09 | 0.98 |
| | 33 | 5.358 | 15.9 | 2.28 | 5.122 | 16.1 | 2.15 | 1.07 |
| | 34 | 6.201 | 17.3 | 2.34 | 5.788 | 17.1 | 2.22 | 1.19 |
| | 35 | 6.685 | 18.7 | 2.29 | 6.393 | 18.1 | 2.29 | 1.20 |
| | 36 | 7.129 | 19.6 | 2.28 | 6.695 | 18.5 | 2.31 | 1.23 |
| | 37 | 7.214 | 20.2 | 2.22 | 6.973 | 18.9 | 2.34 | 1.19 |
| | 38 | 7.337 | 20.3 | 2.25 | 7.075 | 19.1 | 2.35 | 1.15 |
| | 39 | 7.168 | 20.2 | 2.21 | 7.027 | 19.0 | 2.35 | 1.09 |
| | 40 | 6.916 | 19.9 | 2.18 | 6.822 | 18.7 | 2.33 | 1.11 |
| | 41 | 6.651 | 19.6 | 2.13 | 6.698 | 18.5 | 2.32 | 1.14 |
| | 42 | 6.734 | 19.6 | 2.16 | 6.634 | 18.4 | 2.31 | 1.14 |
| | 43 | 6.844 | 19.5 | 2.21 | 6.625 | 18.4 | 2.31 | 1.14 |
| | 44 | 6.785 | 19.5 | 2.20 | 6.622 | 18.4 | 2.31 | 1.11 |
| | 45 | 6.694 | 19.2 | 2.20 | 6.507 | 18.3 | 2.30 | 1.06 |
| | 46 | 6.468 | 18.9 | 2.17 | 6.327 | 18.0 | 2.28 | 0.97 |
| | 47 | 6.194 | 18.4 | 2.16 | 6.091 | 17.6 | 2.26 | 0.90 |
| Average | | | | | | | | |
| Weekday | | 6.194 | 18.2 | 2.19 | 6.071 | 17.5 | 2.25 | 1.01 |
| Weekend | | 5.939 | 17.7 | 2.17 | 5.850 | 17.2 | 2.22 | 0.97 |
| ADWF[1] | | 6.121 | 18.0 | 2.18 | 6.008 | 17.4 | 2.24 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | -2.0% | -3.5% | 2.7% | |
| Weekend | | | | | -1.5% | -3.1% | 2.5% | |

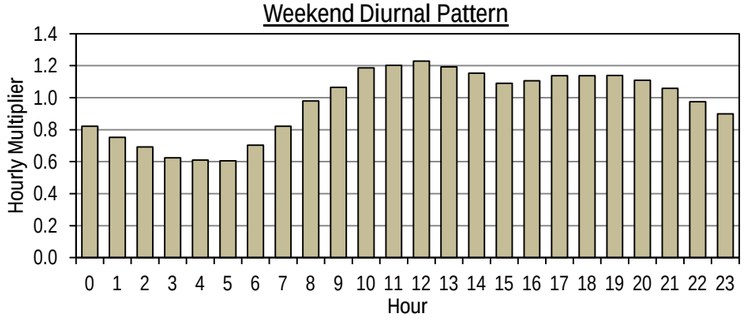
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



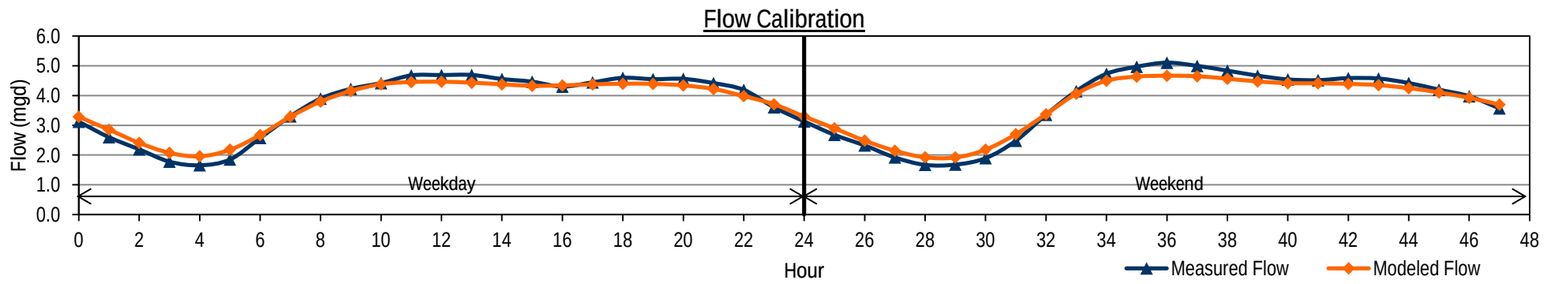



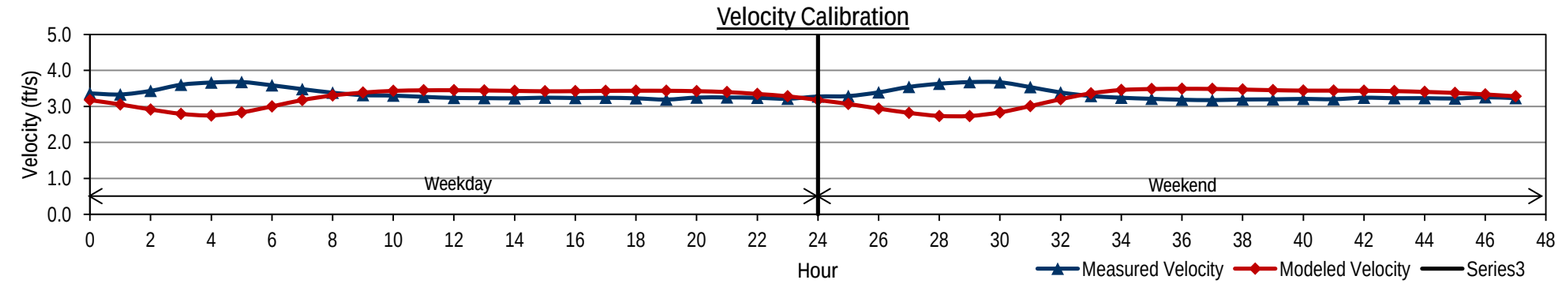



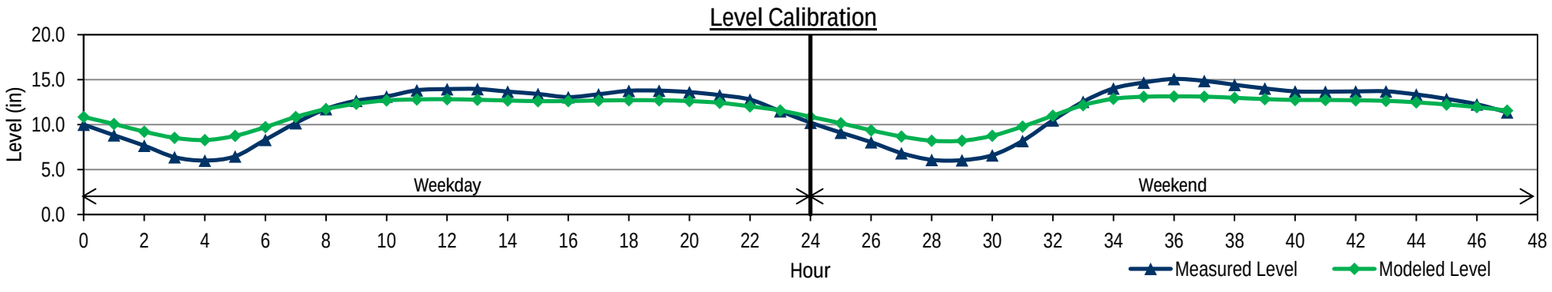
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR16 BASE WASTEWATER FLOW CALIBRATION

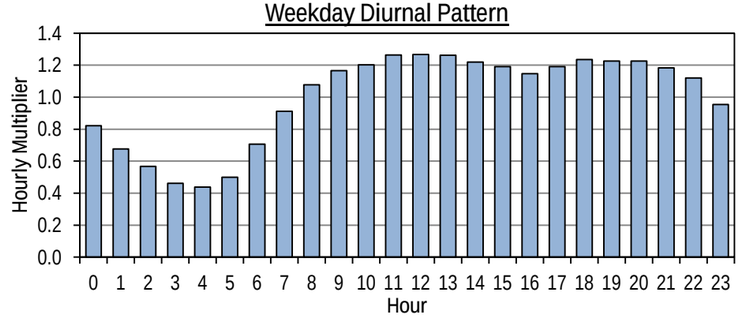
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 3.122 | 10.0 | 3.37 | 3.284 | 10.8 | 3.18 | 0.82 |
| | 1 | 2.601 | 8.8 | 3.33 | 2.853 | 10.1 | 3.06 | 0.68 |
| | 2 | 2.193 | 7.7 | 3.43 | 2.410 | 9.2 | 2.91 | 0.57 |
| | 3 | 1.781 | 6.4 | 3.60 | 2.076 | 8.5 | 2.79 | 0.46 |
| | 4 | 1.660 | 6.0 | 3.67 | 1.960 | 8.3 | 2.75 | 0.44 |
| | 5 | 1.853 | 6.5 | 3.68 | 2.181 | 8.7 | 2.83 | 0.50 |
| | 6 | 2.577 | 8.3 | 3.59 | 2.673 | 9.7 | 3.00 | 0.71 |
| | 7 | 3.304 | 10.2 | 3.48 | 3.288 | 10.8 | 3.18 | 0.91 |
| | 8 | 3.897 | 11.7 | 3.38 | 3.797 | 11.7 | 3.31 | 1.08 |
| | 9 | 4.225 | 12.6 | 3.32 | 4.153 | 12.3 | 3.39 | 1.17 |
| | 10 | 4.420 | 13.1 | 3.30 | 4.379 | 12.7 | 3.43 | 1.20 |
| | 11 | 4.677 | 13.8 | 3.27 | 4.452 | 12.8 | 3.45 | 1.26 |
| | 12 | 4.688 | 13.9 | 3.24 | 4.463 | 12.8 | 3.45 | 1.27 |
| | 13 | 4.692 | 14.0 | 3.23 | 4.430 | 12.8 | 3.45 | 1.26 |
| | 14 | 4.555 | 13.7 | 3.23 | 4.376 | 12.7 | 3.43 | 1.22 |
| | 15 | 4.466 | 13.4 | 3.25 | 4.326 | 12.6 | 3.42 | 1.19 |
| | 16 | 4.301 | 13.0 | 3.24 | 4.339 | 12.6 | 3.43 | 1.15 |
| | 17 | 4.445 | 13.4 | 3.24 | 4.374 | 12.7 | 3.43 | 1.19 |
| | 18 | 4.595 | 13.7 | 3.23 | 4.396 | 12.7 | 3.44 | 1.24 |
| | 19 | 4.551 | 13.8 | 3.19 | 4.391 | 12.7 | 3.44 | 1.23 |
| | 20 | 4.560 | 13.6 | 3.25 | 4.339 | 12.6 | 3.43 | 1.23 |
| | 21 | 4.419 | 13.3 | 3.25 | 4.220 | 12.4 | 3.40 | 1.18 |
| | 22 | 4.191 | 12.8 | 3.24 | 3.980 | 12.0 | 3.35 | 1.12 |
| | 23 | 3.607 | 11.5 | 3.22 | 3.707 | 11.6 | 3.28 | 0.95 |
| Weekend | 24 | 3.131 | 10.2 | 3.28 | 3.294 | 10.9 | 3.18 | 0.82 |
| | 25 | 2.682 | 9.1 | 3.29 | 2.900 | 10.2 | 3.07 | 0.70 |
| | 26 | 2.325 | 8.0 | 3.39 | 2.486 | 9.4 | 2.94 | 0.60 |
| | 27 | 1.923 | 6.8 | 3.54 | 2.146 | 8.7 | 2.82 | 0.50 |
| | 28 | 1.674 | 6.1 | 3.63 | 1.926 | 8.2 | 2.73 | 0.44 |
| | 29 | 1.682 | 6.0 | 3.68 | 1.922 | 8.2 | 2.73 | 0.45 |
| | 30 | 1.898 | 6.6 | 3.67 | 2.183 | 8.8 | 2.83 | 0.51 |
| | 31 | 2.482 | 8.2 | 3.54 | 2.702 | 9.8 | 3.01 | 0.68 |
| | 32 | 3.354 | 10.5 | 3.39 | 3.372 | 11.0 | 3.20 | 0.93 |
| | 33 | 4.148 | 12.5 | 3.29 | 4.059 | 12.2 | 3.37 | 1.15 |
| | 34 | 4.731 | 14.0 | 3.24 | 4.497 | 12.9 | 3.46 | 1.31 |
| | 35 | 4.968 | 14.7 | 3.21 | 4.634 | 13.1 | 3.49 | 1.37 |
| | 36 | 5.104 | 15.1 | 3.19 | 4.664 | 13.1 | 3.49 | 1.40 |
| | 37 | 4.997 | 14.9 | 3.18 | 4.646 | 13.1 | 3.49 | 1.36 |
| | 38 | 4.836 | 14.4 | 3.20 | 4.564 | 13.0 | 3.47 | 1.30 |
| | 39 | 4.668 | 14.0 | 3.20 | 4.471 | 12.8 | 3.45 | 1.25 |
| | 40 | 4.542 | 13.7 | 3.21 | 4.414 | 12.7 | 3.44 | 1.22 |
| | 41 | 4.517 | 13.7 | 3.20 | 4.411 | 12.7 | 3.44 | 1.21 |
| | 42 | 4.586 | 13.7 | 3.24 | 4.391 | 12.7 | 3.44 | 1.23 |
| | 43 | 4.572 | 13.7 | 3.23 | 4.349 | 12.6 | 3.43 | 1.23 |
| | 44 | 4.422 | 13.3 | 3.23 | 4.247 | 12.5 | 3.41 | 1.18 |
| | 45 | 4.198 | 12.9 | 3.22 | 4.104 | 12.2 | 3.38 | 1.12 |
| | 46 | 3.978 | 12.3 | 3.26 | 3.924 | 11.9 | 3.34 | 1.05 |
| | 47 | 3.572 | 11.4 | 3.23 | 3.697 | 11.6 | 3.28 | 0.94 |
| Average | | | | | | | | |
| Weekday | | 3.724 | 11.5 | 3.34 | 3.702 | 11.5 | 3.26 | 1.00 |
| Weekend | | 3.708 | 11.5 | 3.32 | 3.667 | 11.4 | 3.24 | 1.00 |
| ADWF[1] | | 3.720 | 11.5 | 3.34 | 3.692 | 11.5 | 3.26 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | -0.6% | 0.3% | -2.5% | |
| Weekend | | | | | -1.1% | -0.5% | -2.3% | |

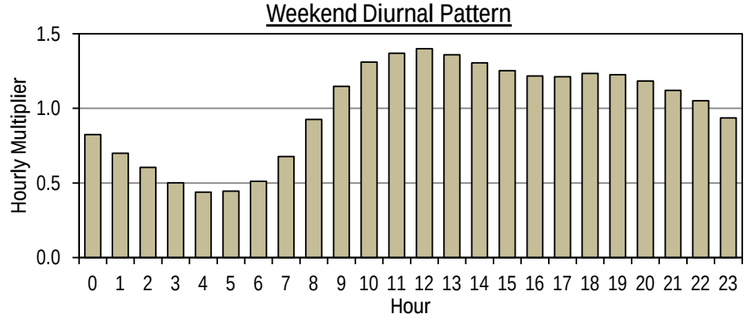
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



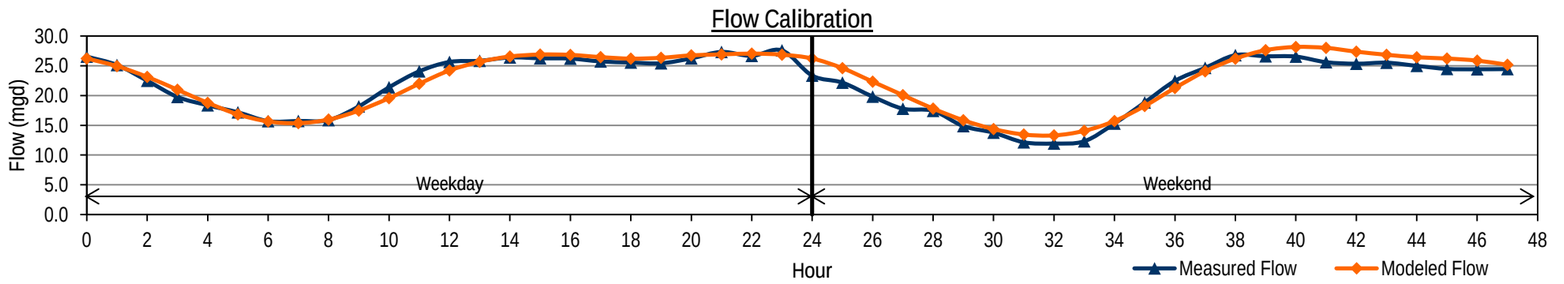



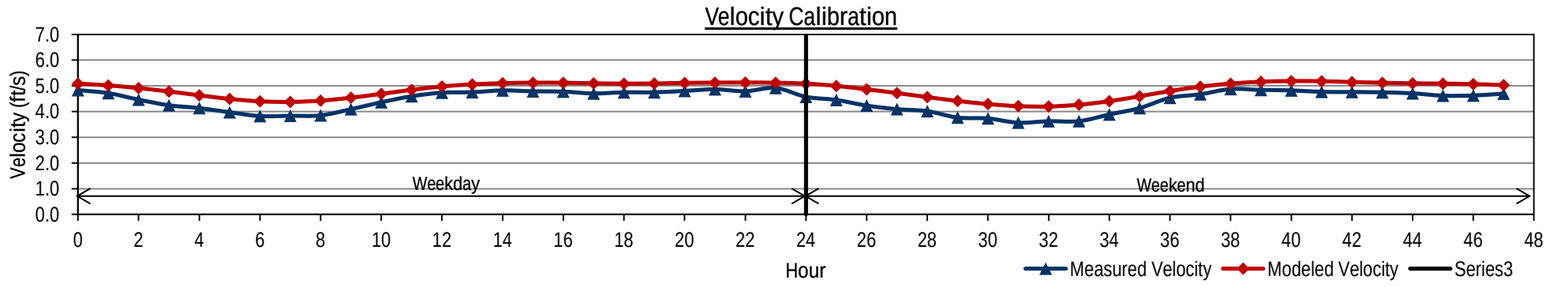



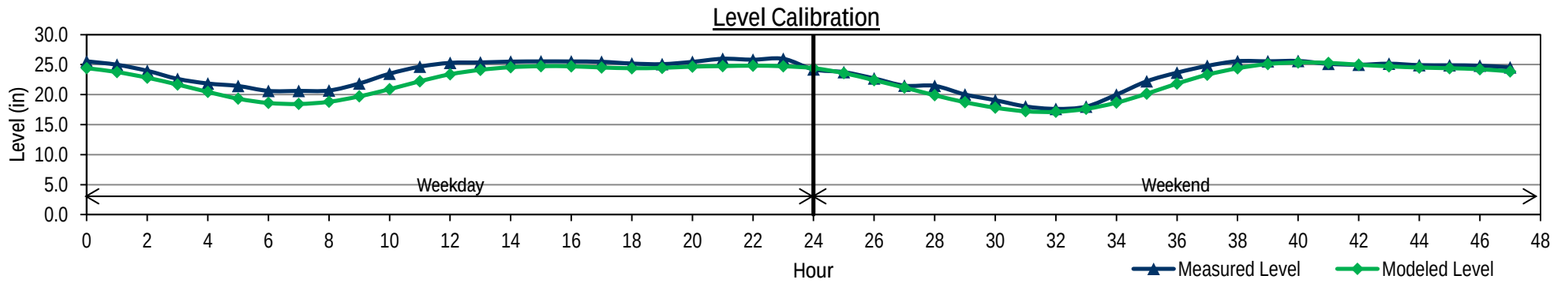
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR19 BASE WASTEWATER FLOW CALIBRATION

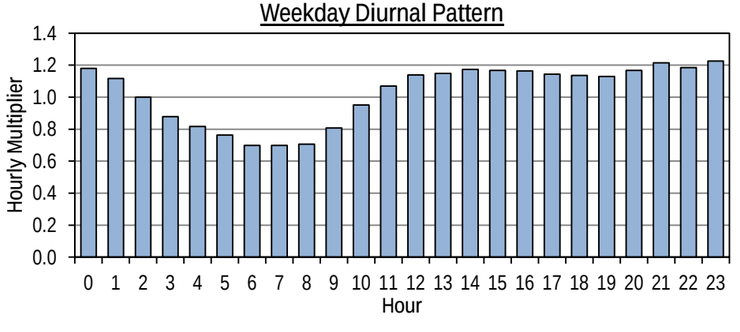
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 26.554 | 25.6 | 4.83 | 26.229 | 24.4 | 5.08 | 1.18 |
| | 1 | 25.140 | 25.0 | 4.72 | 24.946 | 23.8 | 5.01 | 1.12 |
| | 2 | 22.494 | 24.0 | 4.46 | 23.137 | 22.8 | 4.91 | 1.00 |
| | 3 | 19.773 | 22.6 | 4.25 | 20.978 | 21.7 | 4.78 | 0.88 |
| | 4 | 18.374 | 21.9 | 4.14 | 18.777 | 20.5 | 4.63 | 0.82 |
| | 5 | 17.191 | 21.4 | 3.97 | 16.837 | 19.3 | 4.49 | 0.76 |
| | 6 | 15.704 | 20.6 | 3.83 | 15.652 | 18.6 | 4.40 | 0.70 |
| | 7 | 15.738 | 20.6 | 3.84 | 15.371 | 18.5 | 4.38 | 0.70 |
| | 8 | 15.882 | 20.7 | 3.85 | 15.968 | 18.8 | 4.42 | 0.71 |
| | 9 | 18.189 | 21.9 | 4.09 | 17.474 | 19.7 | 4.54 | 0.81 |
| | 10 | 21.393 | 23.5 | 4.36 | 19.565 | 20.9 | 4.69 | 0.95 |
| | 11 | 24.081 | 24.7 | 4.59 | 21.992 | 22.2 | 4.84 | 1.07 |
| | 12 | 25.653 | 25.3 | 4.73 | 24.218 | 23.4 | 4.97 | 1.14 |
| | 13 | 25.849 | 25.4 | 4.75 | 25.671 | 24.1 | 5.05 | 1.15 |
| | 14 | 26.413 | 25.5 | 4.82 | 26.561 | 24.6 | 5.10 | 1.17 |
| | 15 | 26.271 | 25.5 | 4.79 | 26.894 | 24.7 | 5.12 | 1.17 |
| | 16 | 26.219 | 25.5 | 4.78 | 26.834 | 24.7 | 5.12 | 1.16 |
| | 17 | 25.742 | 25.5 | 4.70 | 26.462 | 24.5 | 5.10 | 1.14 |
| | 18 | 25.563 | 25.2 | 4.75 | 26.205 | 24.4 | 5.08 | 1.14 |
| | 19 | 25.434 | 25.1 | 4.75 | 26.348 | 24.5 | 5.09 | 1.13 |
| | 20 | 26.261 | 25.5 | 4.80 | 26.757 | 24.7 | 5.11 | 1.17 |
| | 21 | 27.339 | 26.0 | 4.87 | 26.915 | 24.7 | 5.12 | 1.21 |
| | 22 | 26.677 | 25.8 | 4.79 | 27.048 | 24.8 | 5.13 | 1.19 |
| | 23 | 27.598 | 26.0 | 4.92 | 26.869 | 24.7 | 5.12 | 1.23 |
| Weekend | 24 | 23.356 | 24.2 | 4.57 | 26.229 | 24.4 | 5.08 | 1.04 |
| | 25 | 22.179 | 23.8 | 4.45 | 24.606 | 23.6 | 4.99 | 0.99 |
| | 26 | 19.829 | 22.7 | 4.23 | 22.338 | 22.4 | 4.86 | 0.88 |
| | 27 | 17.797 | 21.5 | 4.09 | 20.068 | 21.2 | 4.72 | 0.79 |
| | 28 | 17.435 | 21.5 | 4.02 | 17.807 | 19.9 | 4.56 | 0.77 |
| | 29 | 14.872 | 20.0 | 3.77 | 15.855 | 18.7 | 4.41 | 0.66 |
| | 30 | 13.771 | 19.1 | 3.73 | 14.370 | 17.8 | 4.29 | 0.61 |
| | 31 | 12.152 | 18.0 | 3.57 | 13.455 | 17.2 | 4.21 | 0.54 |
| | 32 | 11.944 | 17.6 | 3.63 | 13.305 | 17.1 | 4.20 | 0.53 |
| | 33 | 12.324 | 18.0 | 3.63 | 14.069 | 17.6 | 4.27 | 0.55 |
| | 34 | 15.301 | 20.0 | 3.89 | 15.716 | 18.7 | 4.40 | 0.68 |
| | 35 | 18.845 | 22.2 | 4.14 | 18.247 | 20.2 | 4.59 | 0.84 |
| | 36 | 22.468 | 23.7 | 4.53 | 21.273 | 21.8 | 4.80 | 1.00 |
| | 37 | 24.664 | 24.8 | 4.67 | 24.077 | 23.3 | 4.97 | 1.10 |
| | 38 | 26.800 | 25.6 | 4.88 | 26.202 | 24.4 | 5.08 | 1.19 |
| | 39 | 26.613 | 25.6 | 4.84 | 27.629 | 25.1 | 5.16 | 1.18 |
| | 40 | 26.558 | 25.6 | 4.82 | 28.163 | 25.4 | 5.18 | 1.18 |
| | 41 | 25.614 | 25.1 | 4.77 | 28.015 | 25.3 | 5.18 | 1.14 |
| | 42 | 25.359 | 25.0 | 4.76 | 27.377 | 25.0 | 5.14 | 1.13 |
| | 43 | 25.528 | 25.2 | 4.75 | 26.854 | 24.7 | 5.12 | 1.13 |
| | 44 | 24.999 | 24.9 | 4.71 | 26.438 | 24.5 | 5.09 | 1.11 |
| | 45 | 24.482 | 24.9 | 4.62 | 26.224 | 24.4 | 5.08 | 1.09 |
| | 46 | 24.425 | 24.8 | 4.62 | 25.873 | 24.2 | 5.06 | 1.09 |
| | 47 | 24.459 | 24.6 | 4.70 | 25.173 | 23.9 | 5.03 | 1.09 |
| Average | | | | | | | | |
| Weekday | | 23.147 | 24.1 | 4.52 | 23.071 | 22.7 | 4.89 | 1.03 |
| Weekend | | 20.907 | 22.8 | 4.35 | 22.057 | 22.1 | 4.81 | 0.93 |
| ADWF[1] | | 22.507 | 23.8 | 4.47 | 22.781 | 22.5 | 4.86 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | -0.3% | -5.8% | 8.2% | |
| Weekend | | | | | 5.5% | -3.2% | 10.6% | |

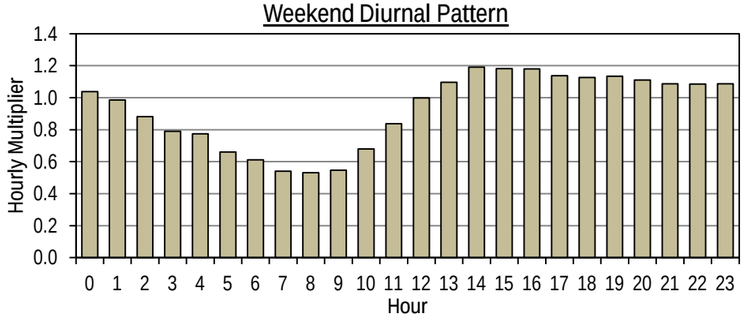
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



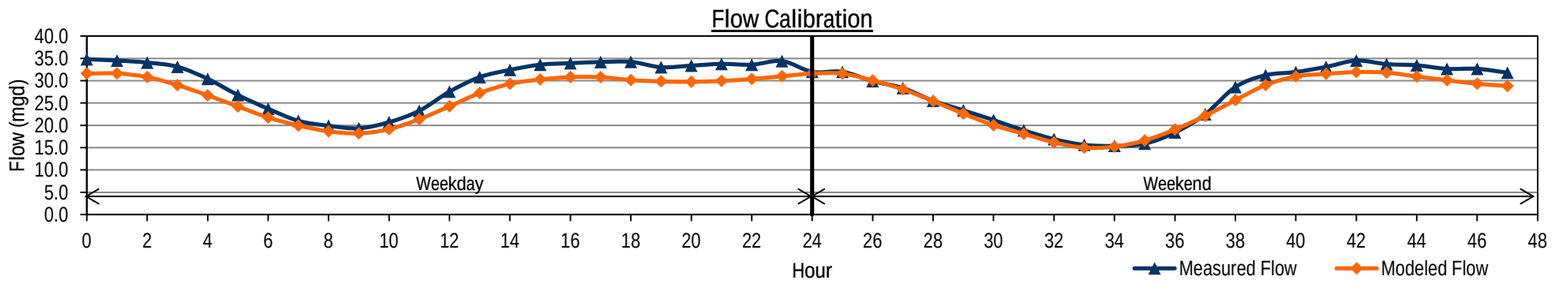



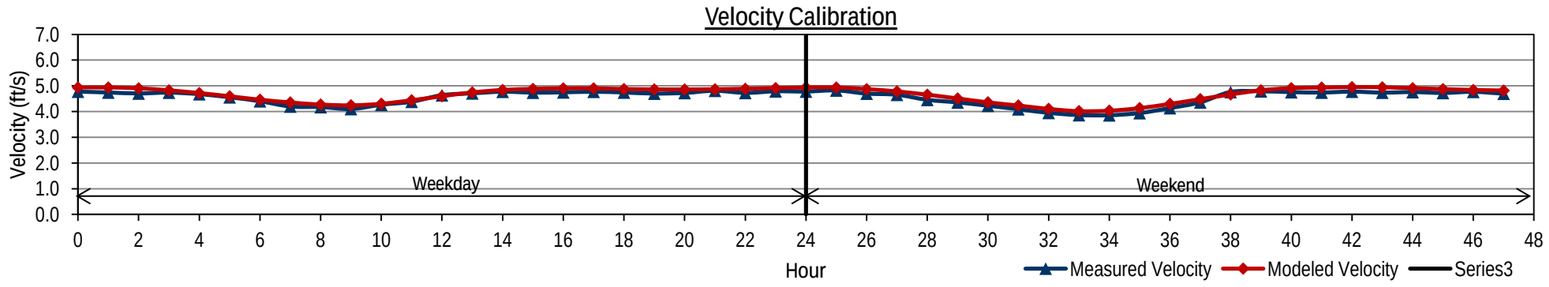



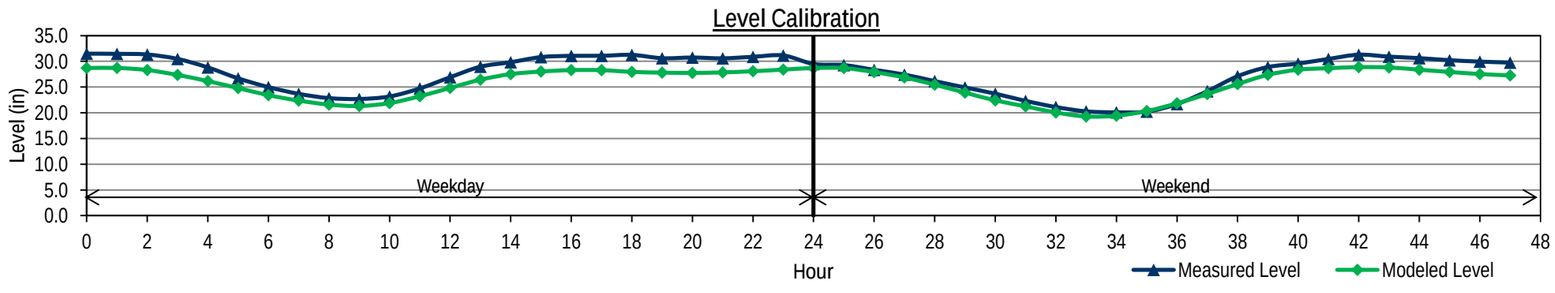
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR20 BASE WASTEWATER FLOW CALIBRATION

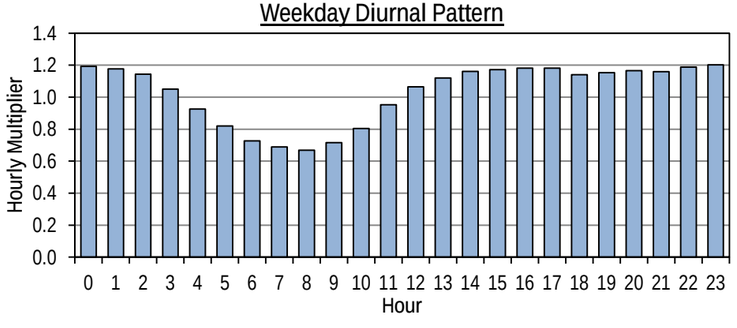
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 34.806 | 31.5 | 4.77 | 31.625 | 28.7 | 4.93 | 1.19 |
| | 1 | 34.508 | 31.5 | 4.74 | 31.643 | 28.7 | 4.94 | 1.18 |
| | 2 | 34.059 | 31.3 | 4.70 | 30.832 | 28.3 | 4.90 | 1.14 |
| | 3 | 33.114 | 30.5 | 4.73 | 29.012 | 27.4 | 4.82 | 1.05 |
| | 4 | 30.411 | 28.8 | 4.67 | 26.722 | 26.2 | 4.72 | 0.93 |
| | 5 | 26.794 | 26.7 | 4.55 | 24.224 | 24.8 | 4.59 | 0.82 |
| | 6 | 23.721 | 25.0 | 4.40 | 21.763 | 23.4 | 4.46 | 0.73 |
| | 7 | 21.021 | 23.7 | 4.19 | 19.963 | 22.4 | 4.35 | 0.69 |
| | 8 | 19.923 | 22.8 | 4.17 | 18.658 | 21.6 | 4.27 | 0.67 |
| | 9 | 19.350 | 22.7 | 4.10 | 18.205 | 21.3 | 4.24 | 0.72 |
| | 10 | 20.724 | 23.2 | 4.26 | 19.138 | 21.9 | 4.30 | 0.80 |
| | 11 | 23.265 | 24.7 | 4.38 | 21.390 | 23.2 | 4.44 | 0.95 |
| | 12 | 27.552 | 26.9 | 4.63 | 24.274 | 24.8 | 4.60 | 1.06 |
| | 13 | 30.797 | 29.0 | 4.71 | 27.249 | 26.4 | 4.74 | 1.12 |
| | 14 | 32.418 | 29.8 | 4.77 | 29.310 | 27.5 | 4.84 | 1.16 |
| | 15 | 33.584 | 30.8 | 4.73 | 30.287 | 28.0 | 4.88 | 1.17 |
| | 16 | 33.924 | 31.1 | 4.74 | 30.816 | 28.3 | 4.90 | 1.18 |
| | 17 | 34.184 | 31.1 | 4.77 | 30.803 | 28.3 | 4.90 | 1.18 |
| | 18 | 34.222 | 31.2 | 4.74 | 30.151 | 27.9 | 4.87 | 1.14 |
| | 19 | 33.023 | 30.6 | 4.70 | 29.859 | 27.8 | 4.86 | 1.15 |
| | 20 | 33.372 | 30.7 | 4.72 | 29.765 | 27.8 | 4.86 | 1.17 |
| | 21 | 33.764 | 30.6 | 4.81 | 29.963 | 27.9 | 4.86 | 1.16 |
| | 22 | 33.580 | 30.9 | 4.72 | 30.402 | 28.1 | 4.88 | 1.19 |
| | 23 | 34.393 | 31.1 | 4.78 | 31.015 | 28.4 | 4.91 | 1.20 |
| Weekend | 24 | 31.997 | 29.5 | 4.78 | 31.625 | 28.7 | 4.93 | 1.11 |
| | 25 | 31.994 | 29.3 | 4.82 | 31.603 | 28.7 | 4.93 | 1.03 |
| | 26 | 29.908 | 28.3 | 4.70 | 30.071 | 27.9 | 4.87 | 0.98 |
| | 27 | 28.352 | 27.4 | 4.65 | 28.073 | 26.9 | 4.78 | 0.88 |
| | 28 | 25.504 | 26.2 | 4.45 | 25.440 | 25.5 | 4.65 | 0.81 |
| | 29 | 23.368 | 24.9 | 4.35 | 22.630 | 23.9 | 4.51 | 0.73 |
| | 30 | 21.197 | 23.7 | 4.22 | 20.016 | 22.4 | 4.36 | 0.65 |
| | 31 | 18.890 | 22.3 | 4.09 | 18.098 | 21.3 | 4.24 | 0.58 |
| | 32 | 16.918 | 21.1 | 3.95 | 16.189 | 20.1 | 4.11 | 0.54 |
| | 33 | 15.644 | 20.3 | 3.86 | 14.991 | 19.3 | 4.02 | 0.53 |
| | 34 | 15.409 | 20.1 | 3.85 | 15.231 | 19.4 | 4.04 | 0.55 |
| | 35 | 15.909 | 20.2 | 3.94 | 16.616 | 20.3 | 4.14 | 0.64 |
| | 36 | 18.412 | 21.7 | 4.13 | 19.062 | 21.8 | 4.30 | 0.78 |
| | 37 | 22.476 | 24.2 | 4.36 | 22.141 | 23.6 | 4.48 | 0.99 |
| | 38 | 28.577 | 27.1 | 4.76 | 25.657 | 25.6 | 4.67 | 1.08 |
| | 39 | 31.231 | 28.9 | 4.79 | 29.048 | 27.4 | 4.82 | 1.10 |
| | 40 | 31.945 | 29.6 | 4.75 | 30.978 | 28.4 | 4.91 | 1.14 |
| | 41 | 33.095 | 30.5 | 4.74 | 31.547 | 28.7 | 4.93 | 1.19 |
| | 42 | 34.503 | 31.3 | 4.77 | 31.954 | 28.9 | 4.95 | 1.16 |
| | 43 | 33.711 | 30.9 | 4.73 | 31.826 | 28.8 | 4.94 | 1.16 |
| | 44 | 33.451 | 30.6 | 4.75 | 30.956 | 28.4 | 4.91 | 1.13 |
| | 45 | 32.656 | 30.2 | 4.72 | 30.112 | 27.9 | 4.87 | 1.13 |
| | 46 | 32.661 | 29.9 | 4.76 | 29.330 | 27.5 | 4.84 | 1.10 |
| | 47 | 31.803 | 29.7 | 4.69 | 28.816 | 27.3 | 4.81 | 1.11 |
| Average | | | | | | | | |
| Weekday | | 29.854 | 28.6 | 4.60 | 26.961 | 26.2 | 4.71 | 1.03 |
| Weekend | | 26.650 | 26.6 | 4.48 | 25.500 | 25.4 | 4.62 | 0.92 |
| ADWF[1] | | 28.939 | 28.0 | 4.57 | 26.544 | 26.0 | 4.69 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | -9.7% | -8.3% | 2.3% | |
| Weekend | | | | | -4.3% | -4.6% | 3.1% | |

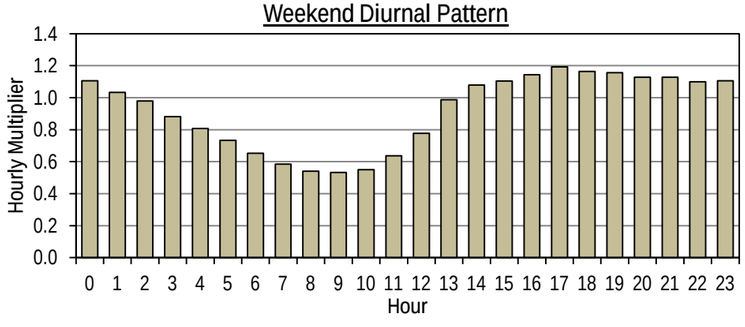
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



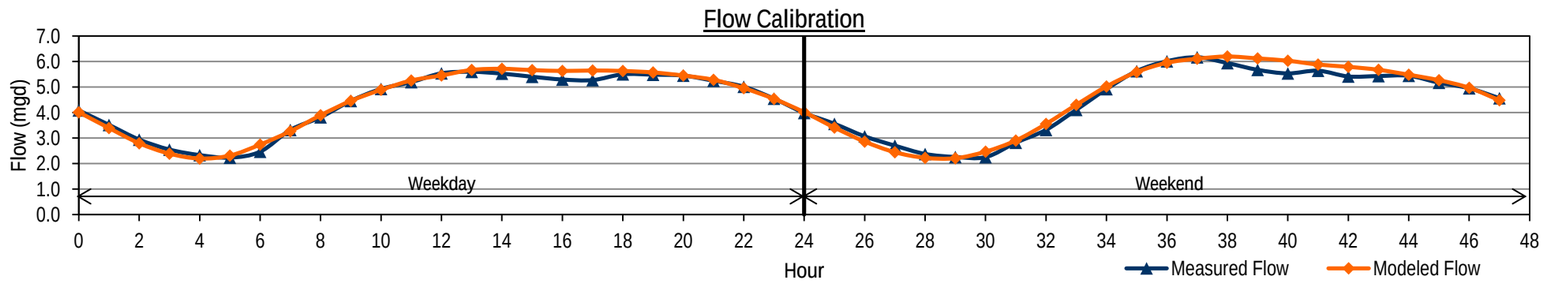



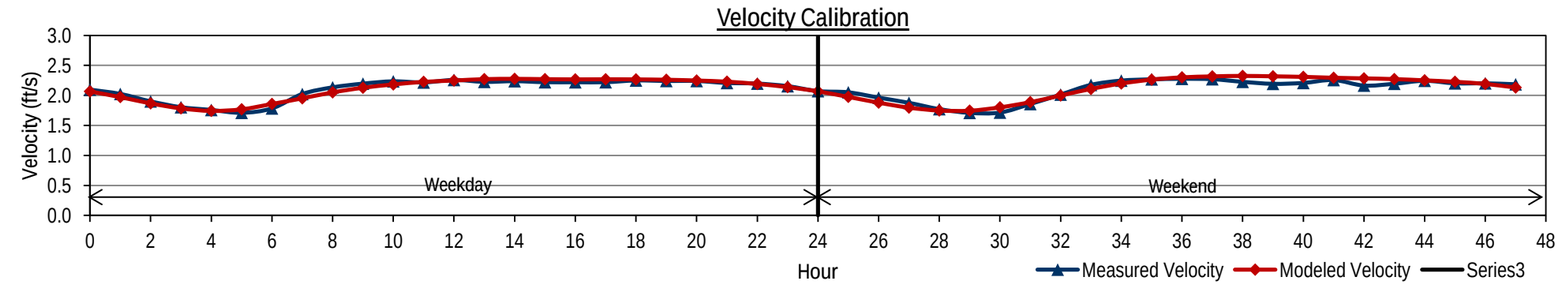
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR21 BASE WASTEWATER FLOW CALIBRATION

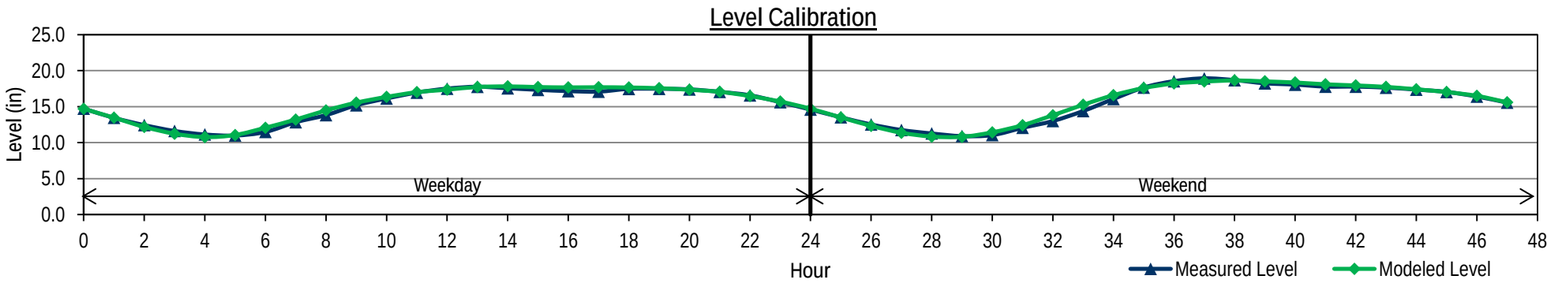
| | Hour | Measured Data Flow (mgd) | Measured Data Level (in) | Measured Data Velocity (ft/s) | Modeled Data Flow (mgd) | Modeled Data Level (in) | Modeled Data Velocity (ft/s) | Diurnal Calibrated Diurnal |
|---|---|---|---|---|---|---|---|---|
| Weekday | 0 | 4.083 | 14.7 | 2.10 | 4.012 | 14.7 | 2.07 | 0.53 |
| | 1 | 3.514 | 13.5 | 2.02 | 3.392 | 13.5 | 1.97 | 0.48 |
| | 2 | 2.936 | 12.4 | 1.90 | 2.794 | 12.2 | 1.87 | 0.46 |
| | 3 | 2.545 | 11.6 | 1.80 | 2.387 | 11.2 | 1.79 | 0.53 |
| | 4 | 2.330 | 11.1 | 1.76 | 2.196 | 10.8 | 1.74 | 0.76 |
| | 5 | 2.229 | 11.0 | 1.71 | 2.312 | 11.1 | 1.77 | 0.88 |
| | 6 | 2.463 | 11.5 | 1.78 | 2.743 | 12.1 | 1.86 | 1.04 |
| | 7 | 3.317 | 12.8 | 2.02 | 3.266 | 13.2 | 1.95 | 1.15 |
| | 8 | 3.815 | 13.8 | 2.13 | 3.895 | 14.5 | 2.05 | 1.22 |
| | 9 | 4.455 | 15.2 | 2.20 | 4.458 | 15.6 | 2.13 | 1.30 |
| | 10 | 4.926 | 16.1 | 2.23 | 4.893 | 16.4 | 2.18 | 1.29 |
| | 11 | 5.194 | 16.9 | 2.22 | 5.257 | 17.0 | 2.23 | 1.27 |
| | 12 | 5.539 | 17.5 | 2.26 | 5.456 | 17.4 | 2.25 | 1.24 |
| | 13 | 5.596 | 17.8 | 2.23 | 5.672 | 17.7 | 2.27 | 1.20 |
| | 14 | 5.526 | 17.5 | 2.24 | 5.716 | 17.8 | 2.28 | 1.19 |
| | 15 | 5.402 | 17.3 | 2.22 | 5.665 | 17.7 | 2.27 | 1.25 |
| | 16 | 5.294 | 17.1 | 2.22 | 5.632 | 17.7 | 2.27 | 1.25 |
| | 17 | 5.272 | 17.1 | 2.22 | 5.649 | 17.7 | 2.27 | 1.24 |
| | 18 | 5.500 | 17.5 | 2.25 | 5.631 | 17.7 | 2.27 | 1.18 |
| | 19 | 5.484 | 17.5 | 2.24 | 5.573 | 17.6 | 2.26 | 1.12 |
| | 20 | 5.448 | 17.4 | 2.24 | 5.452 | 17.4 | 2.25 | 1.00 |
| | 21 | 5.246 | 17.0 | 2.21 | 5.284 | 17.1 | 2.23 | 0.89 |
| | 22 | 5.012 | 16.6 | 2.20 | 4.957 | 16.5 | 2.19 | 0.76 |
| | 23 | 4.544 | 15.6 | 2.15 | 4.537 | 15.7 | 2.14 | 0.62 |
| Weekend | 24 | 3.984 | 14.6 | 2.07 | 4.014 | 14.7 | 2.07 | 0.57 |
| | 25 | 3.557 | 13.5 | 2.05 | 3.411 | 13.5 | 1.98 | 0.49 |
| | 26 | 3.066 | 12.5 | 1.96 | 2.860 | 12.3 | 1.88 | 0.47 |
| | 27 | 2.700 | 11.8 | 1.88 | 2.443 | 11.4 | 1.80 | 0.48 |
| | 28 | 2.374 | 11.3 | 1.77 | 2.224 | 10.8 | 1.75 | 0.64 |
| | 29 | 2.256 | 10.9 | 1.71 | 2.208 | 10.8 | 1.75 | 0.77 |
| | 30 | 2.250 | 11.1 | 1.71 | 2.466 | 11.4 | 1.80 | 0.96 |
| | 31 | 2.816 | 12.1 | 1.86 | 2.902 | 12.4 | 1.89 | 1.16 |
| | 32 | 3.319 | 13.0 | 2.01 | 3.554 | 13.8 | 2.00 | 1.34 |
| | 33 | 4.105 | 14.4 | 2.18 | 4.303 | 15.3 | 2.11 | 1.42 |
| | 34 | 4.919 | 16.1 | 2.25 | 5.022 | 16.6 | 2.20 | 1.46 |
| | 35 | 5.624 | 17.6 | 2.27 | 5.589 | 17.6 | 2.26 | 1.39 |
| | 36 | 6.011 | 18.5 | 2.28 | 5.953 | 18.2 | 2.30 | 1.31 |
| | 37 | 6.167 | 18.9 | 2.27 | 6.112 | 18.5 | 2.32 | 1.27 |
| | 38 | 5.940 | 18.7 | 2.23 | 6.199 | 18.6 | 2.33 | 1.30 |
| | 39 | 5.675 | 18.2 | 2.19 | 6.123 | 18.5 | 2.32 | 1.24 |
| | 40 | 5.534 | 18.0 | 2.21 | 6.033 | 18.4 | 2.31 | 1.24 |
| | 41 | 5.641 | 17.8 | 2.26 | 5.883 | 18.1 | 2.29 | 1.24 |
| | 42 | 5.414 | 17.8 | 2.16 | 5.794 | 18.0 | 2.28 | 1.17 |
| | 43 | 5.431 | 17.6 | 2.19 | 5.677 | 17.7 | 2.27 | 1.11 |
| | 44 | 5.442 | 17.4 | 2.24 | 5.484 | 17.4 | 2.25 | 1.02 |
| | 45 | 5.169 | 17.0 | 2.20 | 5.269 | 17.0 | 2.23 | 0.87 |
| | 46 | 4.952 | 16.4 | 2.20 | 4.971 | 16.5 | 2.19 | 0.77 |
| | 47 | 4.563 | 15.6 | 2.19 | 4.483 | 15.6 | 2.13 | 0.65 |
| Average | | | | | | | | |
| | Weekday | 4.403 | 15.3 | 2.11 | 4.451 | 15.4 | 2.11 | 0.99 |
| | Weekend | 4.454 | 15.4 | 2.10 | 4.541 | 15.6 | 2.11 | 1.01 |
| | ADWF[1] | 4.418 | 15.3 | 2.10 | 4.477 | 15.5 | 2.11 | 1.00 |
| % Error | | | | | | | | |
| | Weekday | | | | 1.1% | 0.9% | 0.0% | |
| | Weekend | | | | 1.9% | 0.7% | 0.7% | |

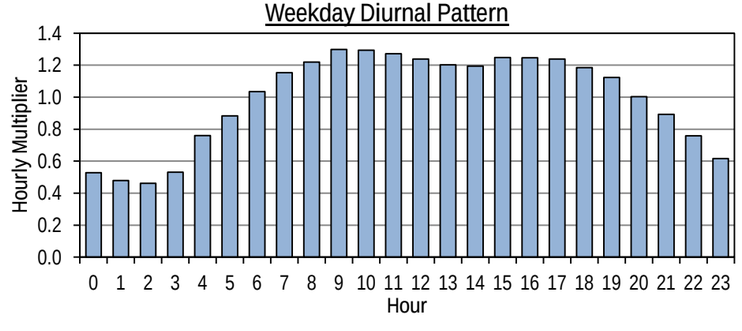
Note:

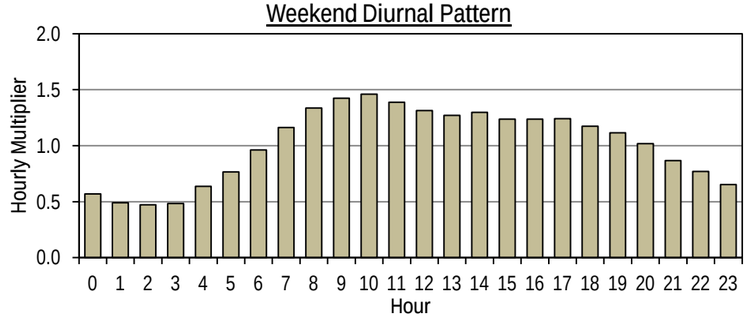
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



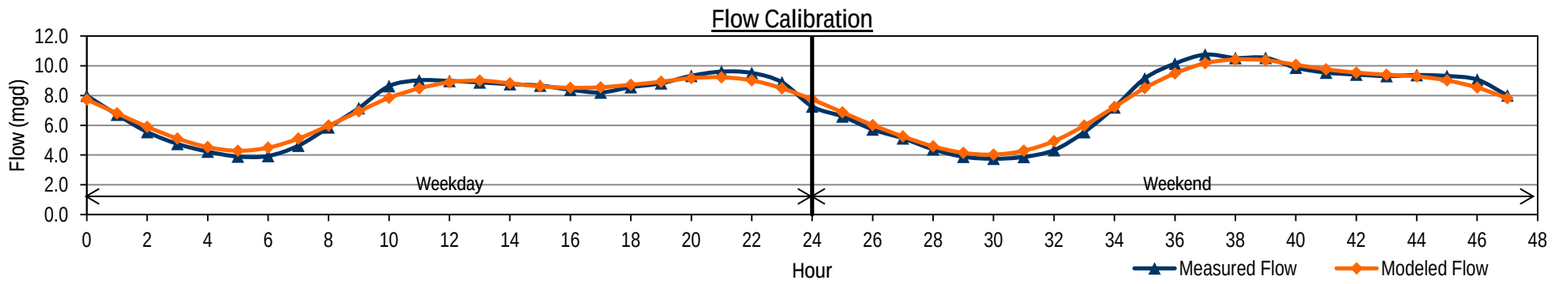



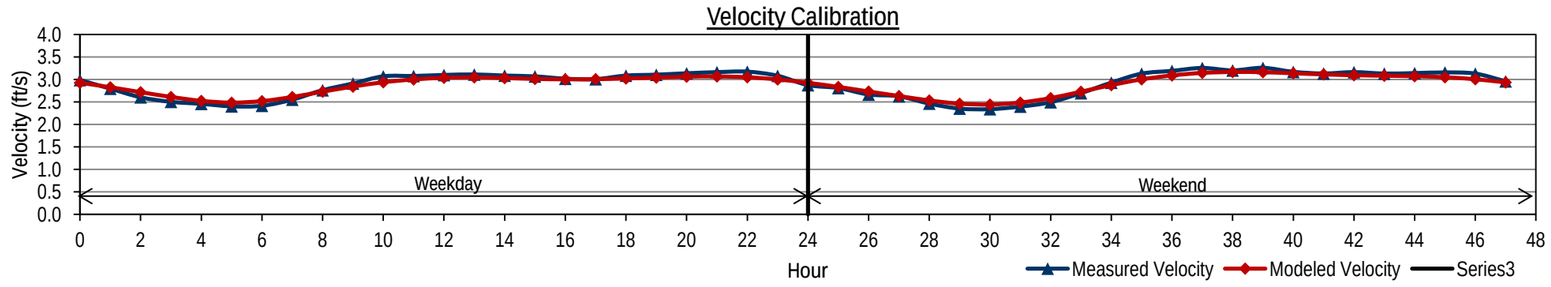



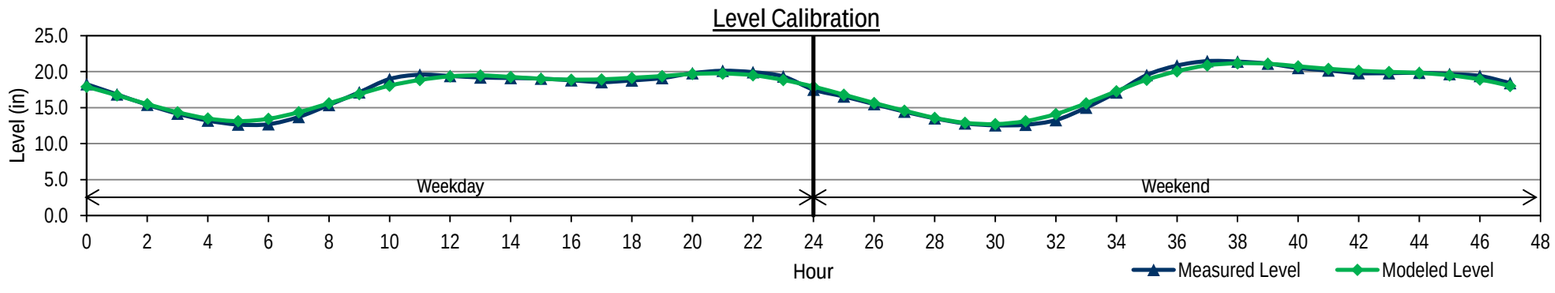
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR22 BASE WASTEWATER FLOW CALIBRATION

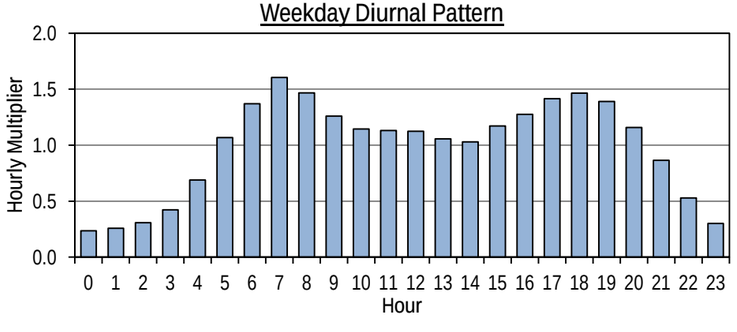
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 7.998 | 18.3 | 2.98 | 7.734 | 17.9 | 2.92 | 0.24 |
| | 1 | 6.717 | 16.8 | 2.79 | 6.812 | 16.7 | 2.83 | 0.26 |
| | 2 | 5.552 | 15.4 | 2.60 | 5.903 | 15.5 | 2.72 | 0.31 |
| | 3 | 4.752 | 14.2 | 2.50 | 5.115 | 14.4 | 2.61 | 0.42 |
| | 4 | 4.235 | 13.2 | 2.46 | 4.540 | 13.5 | 2.52 | 0.69 |
| | 5 | 3.902 | 12.7 | 2.40 | 4.293 | 13.1 | 2.48 | 1.07 |
| | 6 | 3.939 | 12.7 | 2.41 | 4.503 | 13.4 | 2.52 | 1.37 |
| | 7 | 4.632 | 13.7 | 2.55 | 5.112 | 14.4 | 2.61 | 1.60 |
| | 8 | 5.863 | 15.4 | 2.76 | 5.987 | 15.6 | 2.73 | 1.47 |
| | 9 | 7.159 | 17.1 | 2.91 | 6.941 | 16.9 | 2.84 | 1.26 |
| | 10 | 8.638 | 19.0 | 3.07 | 7.851 | 18.0 | 2.94 | 1.15 |
| | 11 | 9.026 | 19.6 | 3.07 | 8.489 | 18.8 | 3.00 | 1.13 |
| | 12 | 8.983 | 19.4 | 3.10 | 8.895 | 19.3 | 3.04 | 1.12 |
| | 13 | 8.886 | 19.2 | 3.11 | 9.010 | 19.5 | 3.05 | 1.06 |
| | 14 | 8.770 | 19.1 | 3.08 | 8.826 | 19.2 | 3.03 | 1.03 |
| | 15 | 8.671 | 19.0 | 3.07 | 8.621 | 19.0 | 3.01 | 1.17 |
| | 16 | 8.391 | 18.8 | 3.01 | 8.525 | 18.9 | 3.00 | 1.28 |
| | 17 | 8.209 | 18.5 | 3.00 | 8.558 | 18.9 | 3.00 | 1.41 |
| | 18 | 8.568 | 18.8 | 3.08 | 8.728 | 19.1 | 3.02 | 1.46 |
| | 19 | 8.825 | 19.1 | 3.10 | 8.932 | 19.4 | 3.04 | 1.39 |
| | 20 | 9.330 | 19.8 | 3.13 | 9.175 | 19.7 | 3.06 | 1.16 |
| | 21 | 9.611 | 20.1 | 3.16 | 9.230 | 19.7 | 3.07 | 0.86 |
| | 22 | 9.521 | 19.9 | 3.17 | 9.024 | 19.5 | 3.05 | 0.53 |
| | 23 | 8.892 | 19.3 | 3.08 | 8.491 | 18.8 | 3.00 | 0.30 |
| Weekend | 24 | 7.268 | 17.5 | 2.87 | 7.740 | 17.9 | 2.92 | 0.35 |
| | 25 | 6.599 | 16.6 | 2.81 | 6.877 | 16.8 | 2.83 | 0.31 |
| | 26 | 5.723 | 15.5 | 2.66 | 6.017 | 15.6 | 2.73 | 0.30 |
| | 27 | 5.125 | 14.5 | 2.62 | 5.258 | 14.6 | 2.63 | 0.36 |
| | 28 | 4.388 | 13.5 | 2.46 | 4.593 | 13.6 | 2.53 | 0.46 |
| | 29 | 3.886 | 12.8 | 2.35 | 4.154 | 12.9 | 2.46 | 0.64 |
| | 30 | 3.755 | 12.6 | 2.34 | 4.038 | 12.7 | 2.44 | 1.00 |
| | 31 | 3.876 | 12.6 | 2.40 | 4.299 | 13.1 | 2.48 | 1.42 |
| | 32 | 4.333 | 13.3 | 2.49 | 4.939 | 14.1 | 2.58 | 1.83 |
| | 33 | 5.546 | 15.0 | 2.69 | 5.984 | 15.6 | 2.73 | 1.88 |
| | 34 | 7.207 | 17.1 | 2.93 | 7.240 | 17.3 | 2.87 | 1.80 |
| | 35 | 9.146 | 19.5 | 3.13 | 8.509 | 18.9 | 3.00 | 1.54 |
| | 36 | 10.149 | 20.8 | 3.19 | 9.490 | 20.0 | 3.09 | 1.46 |
| | 37 | 10.754 | 21.5 | 3.25 | 10.178 | 20.9 | 3.14 | 1.27 |
| | 38 | 10.529 | 21.4 | 3.20 | 10.427 | 21.1 | 3.16 | 1.22 |
| | 39 | 10.540 | 21.1 | 3.25 | 10.379 | 21.1 | 3.16 | 1.24 |
| | 40 | 9.876 | 20.5 | 3.17 | 10.070 | 20.7 | 3.14 | 1.27 |
| | 41 | 9.545 | 20.2 | 3.13 | 9.767 | 20.4 | 3.11 | 1.32 |
| | 42 | 9.413 | 19.8 | 3.16 | 9.545 | 20.1 | 3.09 | 1.32 |
| | 43 | 9.313 | 19.8 | 3.13 | 9.406 | 19.9 | 3.08 | 1.24 |
| | 44 | 9.381 | 19.8 | 3.14 | 9.291 | 19.8 | 3.07 | 0.93 |
| | 45 | 9.319 | 19.7 | 3.15 | 9.022 | 19.5 | 3.05 | 0.64 |
| | 46 | 9.074 | 19.4 | 3.13 | 8.544 | 18.9 | 3.00 | 0.49 |
| | 47 | 8.010 | 18.4 | 2.96 | 7.821 | 18.0 | 2.93 | 0.35 |
| Average | | | | | | | | |
| Weekday | | 7.461 | 17.5 | 2.90 | 7.471 | 17.5 | 2.88 | 0.99 |
| Weekend | | 7.615 | 17.6 | 2.90 | 7.650 | 17.6 | 2.88 | 1.03 |
| ADWF[1] | | 7.505 | 17.5 | 2.90 | 7.522 | 17.5 | 2.88 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | 0.1% | 0.0% | -0.8% | |
| Weekend | | | | | 0.5% | 0.1% | -0.5% | |

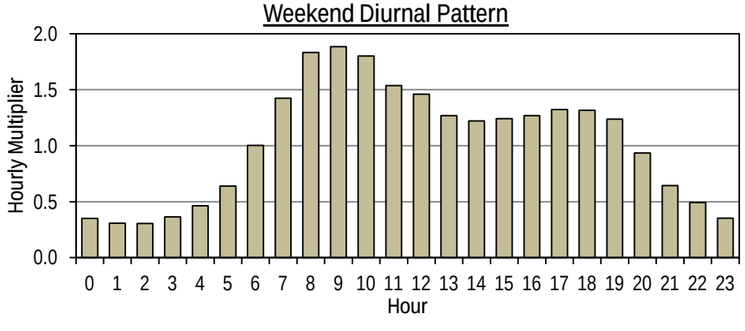
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



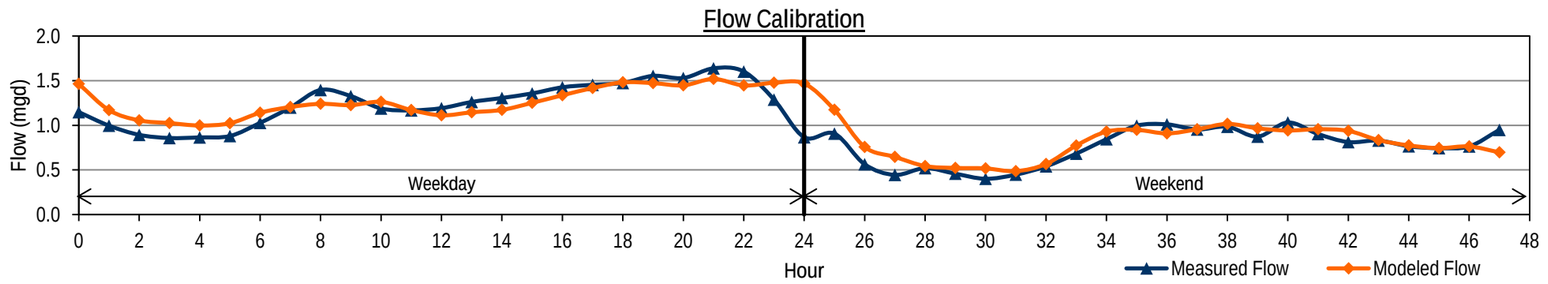



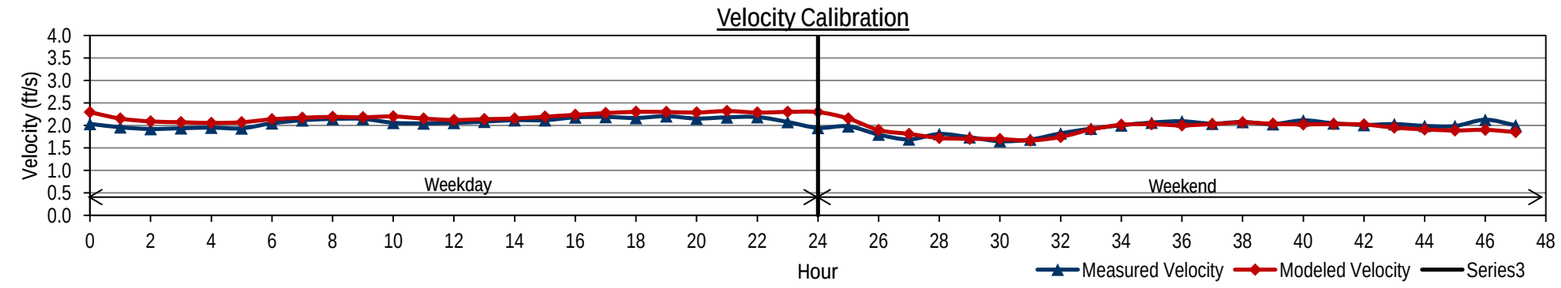



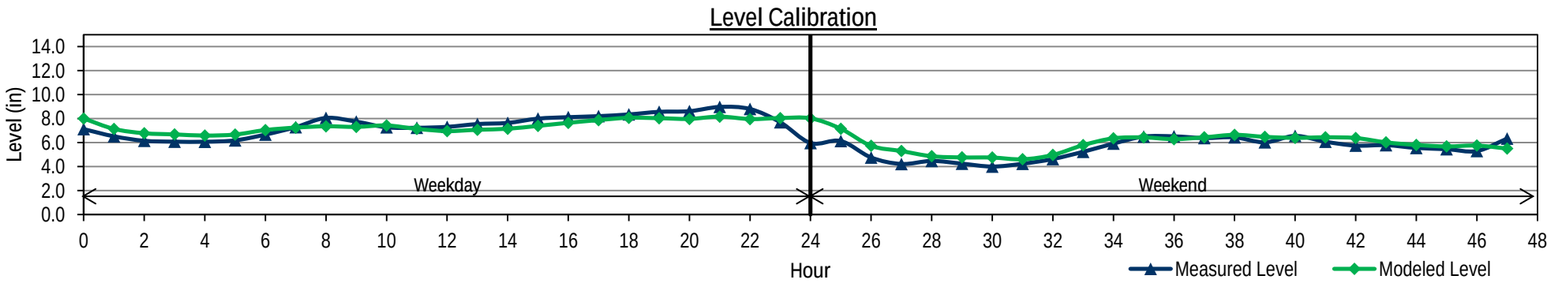
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR23 BASE WASTEWATER FLOW CALIBRATION

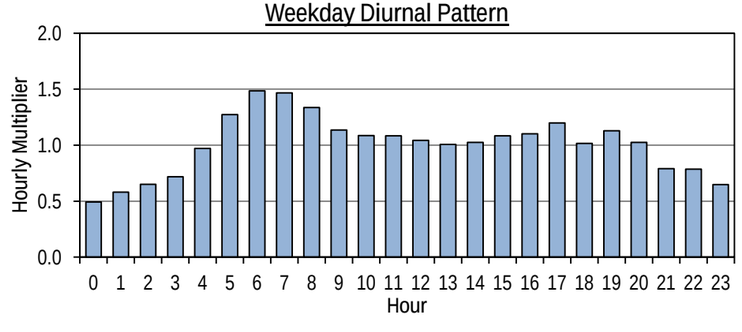
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 1.148 | 7.1 | 2.03 | 1.465 | 8.0 | 2.30 | 0.49 |
| | 1 | 0.996 | 6.5 | 1.96 | 1.171 | 7.1 | 2.15 | 0.58 |
| | 2 | 0.893 | 6.2 | 1.92 | 1.056 | 6.8 | 2.09 | 0.65 |
| | 3 | 0.858 | 6.1 | 1.94 | 1.026 | 6.7 | 2.07 | 0.72 |
| | 4 | 0.864 | 6.1 | 1.95 | 0.999 | 6.6 | 2.06 | 0.97 |
| | 5 | 0.880 | 6.2 | 1.93 | 1.024 | 6.7 | 2.07 | 1.27 |
| | 6 | 1.028 | 6.7 | 2.05 | 1.142 | 7.0 | 2.14 | 1.48 |
| | 7 | 1.199 | 7.3 | 2.11 | 1.206 | 7.2 | 2.17 | 1.47 |
| | 8 | 1.396 | 8.1 | 2.14 | 1.242 | 7.4 | 2.19 | 1.34 |
| | 9 | 1.327 | 7.8 | 2.14 | 1.227 | 7.3 | 2.18 | 1.14 |
| | 10 | 1.189 | 7.3 | 2.06 | 1.264 | 7.4 | 2.20 | 1.09 |
| | 11 | 1.167 | 7.2 | 2.04 | 1.172 | 7.1 | 2.15 | 1.08 |
| | 12 | 1.192 | 7.3 | 2.06 | 1.113 | 7.0 | 2.12 | 1.04 |
| | 13 | 1.262 | 7.6 | 2.08 | 1.147 | 7.1 | 2.14 | 1.01 |
| | 14 | 1.306 | 7.6 | 2.12 | 1.174 | 7.2 | 2.16 | 1.03 |
| | 15 | 1.357 | 8.0 | 2.12 | 1.253 | 7.4 | 2.20 | 1.08 |
| | 16 | 1.426 | 8.1 | 2.18 | 1.338 | 7.6 | 2.24 | 1.10 |
| | 17 | 1.454 | 8.2 | 2.19 | 1.419 | 7.9 | 2.28 | 1.20 |
| | 18 | 1.474 | 8.4 | 2.16 | 1.483 | 8.1 | 2.30 | 1.02 |
| | 19 | 1.553 | 8.6 | 2.20 | 1.474 | 8.0 | 2.30 | 1.13 |
| | 20 | 1.529 | 8.6 | 2.15 | 1.449 | 8.0 | 2.29 | 1.03 |
| | 21 | 1.638 | 9.0 | 2.18 | 1.521 | 8.2 | 2.32 | 0.79 |
| | 22 | 1.602 | 8.8 | 2.18 | 1.448 | 8.0 | 2.29 | 0.79 |
| | 23 | 1.288 | 7.7 | 2.08 | 1.478 | 8.0 | 2.30 | 0.65 |
| Weekend | 24 | 0.866 | 6.0 | 1.95 | 1.469 | 8.0 | 2.30 | 0.57 |
| | 25 | 0.907 | 6.1 | 1.98 | 1.175 | 7.2 | 2.16 | 0.72 |
| | 26 | 0.564 | 4.8 | 1.80 | 0.758 | 5.7 | 1.90 | 0.56 |
| | 27 | 0.445 | 4.2 | 1.69 | 0.647 | 5.3 | 1.81 | 0.55 |
| | 28 | 0.520 | 4.5 | 1.81 | 0.544 | 4.9 | 1.72 | 0.61 |
| | 29 | 0.458 | 4.2 | 1.74 | 0.523 | 4.8 | 1.70 | 0.59 |
| | 30 | 0.401 | 4.0 | 1.65 | 0.518 | 4.8 | 1.70 | 0.57 |
| | 31 | 0.448 | 4.2 | 1.69 | 0.487 | 4.6 | 1.67 | 0.91 |
| | 32 | 0.541 | 4.6 | 1.82 | 0.567 | 5.0 | 1.74 | 1.33 |
| | 33 | 0.683 | 5.2 | 1.93 | 0.774 | 5.8 | 1.91 | 1.50 |
| | 34 | 0.844 | 5.9 | 2.00 | 0.930 | 6.4 | 2.02 | 1.36 |
| | 35 | 0.996 | 6.5 | 2.06 | 0.950 | 6.4 | 2.03 | 1.26 |
| | 36 | 1.011 | 6.5 | 2.09 | 0.910 | 6.3 | 2.00 | 1.46 |
| | 37 | 0.953 | 6.4 | 2.04 | 0.956 | 6.4 | 2.03 | 1.40 |
| | 38 | 0.984 | 6.4 | 2.08 | 1.017 | 6.6 | 2.07 | 1.30 |
| | 39 | 0.873 | 6.0 | 2.03 | 0.967 | 6.5 | 2.04 | 1.24 |
| | 40 | 1.032 | 6.6 | 2.11 | 0.943 | 6.4 | 2.02 | 1.36 |
| | 41 | 0.903 | 6.1 | 2.05 | 0.957 | 6.4 | 2.03 | 1.08 |
| | 42 | 0.812 | 5.8 | 2.01 | 0.939 | 6.4 | 2.02 | 1.08 |
| | 43 | 0.829 | 5.8 | 2.03 | 0.835 | 6.0 | 1.95 | 0.87 |
| | 44 | 0.765 | 5.6 | 1.99 | 0.776 | 5.8 | 1.91 | 1.04 |
| | 45 | 0.744 | 5.5 | 1.99 | 0.745 | 5.7 | 1.89 | 1.02 |
| | 46 | 0.764 | 5.3 | 2.12 | 0.764 | 5.8 | 1.90 | 0.88 |
| | 47 | 0.949 | 6.3 | 2.00 | 0.698 | 5.5 | 1.85 | 0.40 |
| Average | | | | | | | | |
| Weekday | | 1.251 | 7.5 | 2.08 | 1.262 | 7.4 | 2.20 | 1.01 |
| Weekend | | 0.762 | 5.5 | 1.94 | 0.827 | 5.9 | 1.93 | 0.99 |
| ADWF[1] | | 1.111 | 6.9 | 2.04 | 1.138 | 7.0 | 2.12 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | 0.9% | -1.5% | 5.5% | |
| Weekend | | | | | 8.5% | 7.6% | -0.6% | |

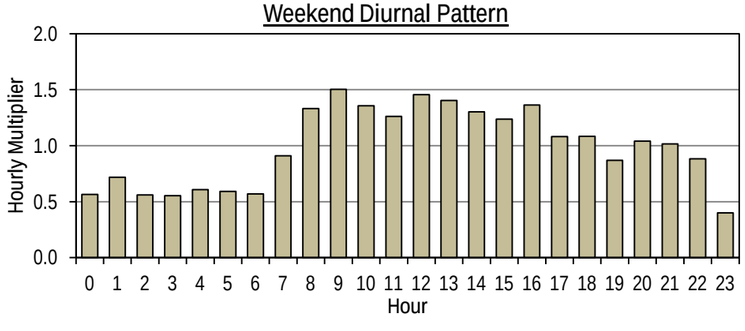
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



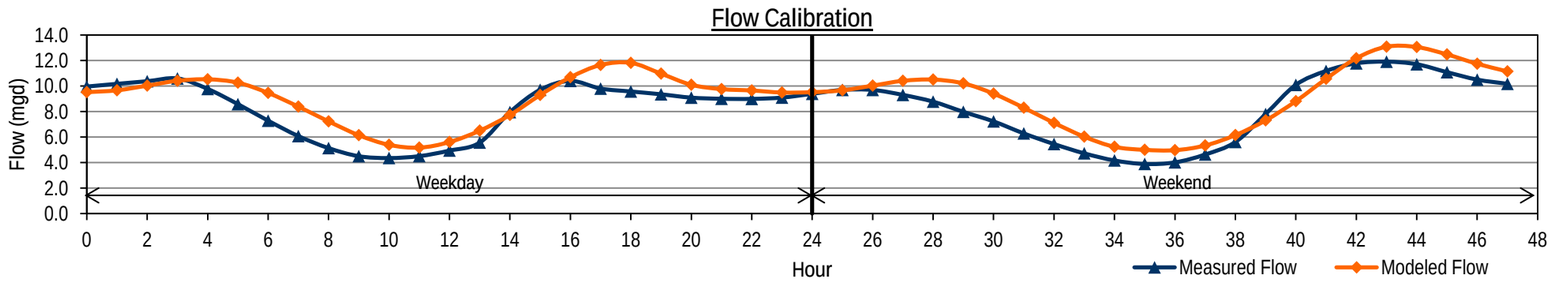



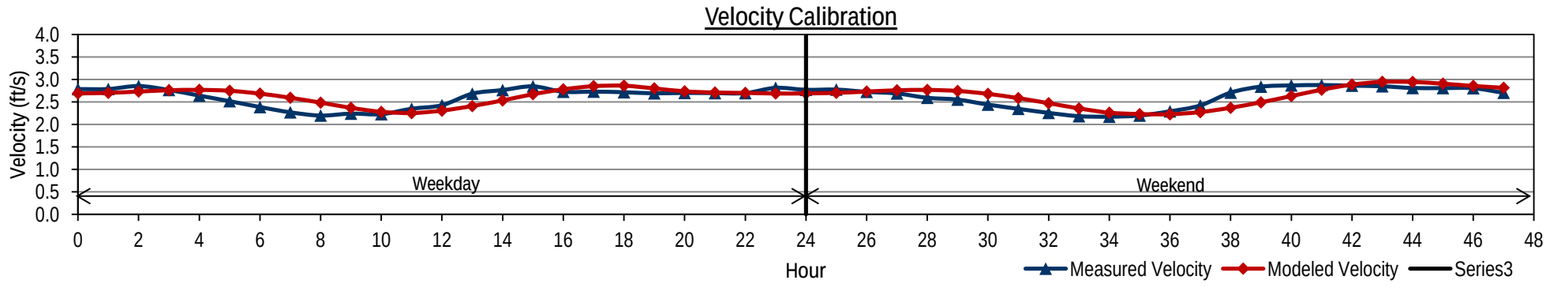



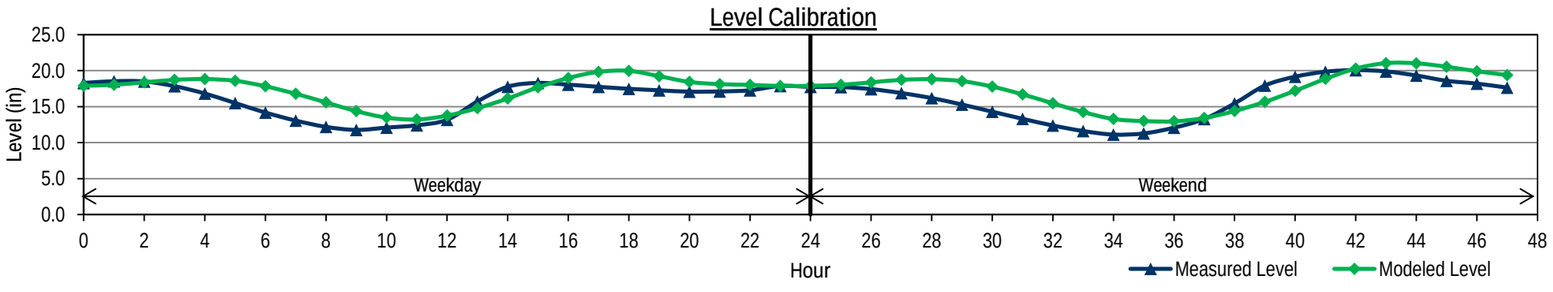
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR24 BASE WASTEWATER FLOW CALIBRATION

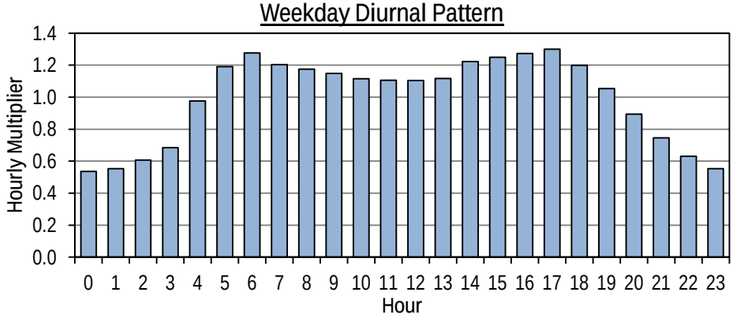
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 9.962 | 18.3 | 2.79 | 9.529 | 17.9 | 2.69 | 0.54 |
| | 1 | 10.176 | 18.5 | 2.79 | 9.673 | 18.0 | 2.70 | 0.55 |
| | 2 | 10.381 | 18.5 | 2.85 | 10.041 | 18.4 | 2.73 | 0.61 |
| | 3 | 10.599 | 17.8 | 2.77 | 10.424 | 18.7 | 2.76 | 0.68 |
| | 4 | 9.775 | 16.8 | 2.64 | 10.537 | 18.8 | 2.77 | 0.98 |
| | 5 | 8.583 | 15.5 | 2.52 | 10.273 | 18.6 | 2.75 | 1.19 |
| | 6 | 7.285 | 14.2 | 2.39 | 9.469 | 17.8 | 2.68 | 1.28 |
| | 7 | 6.080 | 13.1 | 2.27 | 8.397 | 16.8 | 2.59 | 1.20 |
| | 8 | 5.139 | 12.2 | 2.20 | 7.237 | 15.6 | 2.48 | 1.18 |
| | 9 | 4.504 | 11.8 | 2.24 | 6.154 | 14.4 | 2.37 | 1.15 |
| | 10 | 4.360 | 12.1 | 2.23 | 5.399 | 13.5 | 2.28 | 1.12 |
| | 11 | 4.511 | 12.4 | 2.35 | 5.181 | 13.2 | 2.25 | 1.11 |
| | 12 | 4.945 | 13.2 | 2.43 | 5.619 | 13.8 | 2.31 | 1.10 |
| | 13 | 5.571 | 15.7 | 2.68 | 6.512 | 14.8 | 2.41 | 1.12 |
| | 14 | 7.958 | 17.8 | 2.76 | 7.740 | 16.1 | 2.53 | 1.22 |
| | 15 | 9.709 | 18.3 | 2.85 | 9.306 | 17.7 | 2.67 | 1.25 |
| | 16 | 10.407 | 18.0 | 2.73 | 10.700 | 19.0 | 2.78 | 1.27 |
| | 17 | 9.803 | 17.7 | 2.73 | 11.660 | 19.8 | 2.85 | 1.30 |
| | 18 | 9.576 | 17.5 | 2.72 | 11.826 | 20.0 | 2.86 | 1.20 |
| | 19 | 9.356 | 17.3 | 2.69 | 10.982 | 19.2 | 2.80 | 1.05 |
| | 20 | 9.093 | 17.1 | 2.70 | 10.107 | 18.4 | 2.74 | 0.89 |
| | 21 | 9.006 | 17.1 | 2.70 | 9.769 | 18.1 | 2.71 | 0.75 |
| | 22 | 8.995 | 17.3 | 2.70 | 9.661 | 18.0 | 2.70 | 0.63 |
| | 23 | 9.098 | 17.9 | 2.81 | 9.501 | 17.9 | 2.69 | 0.55 |
| Weekend | 24 | 9.394 | 17.7 | 2.77 | 9.529 | 17.9 | 2.69 | 0.51 |
| | 25 | 9.700 | 17.7 | 2.78 | 9.673 | 18.0 | 2.70 | 0.48 |
| | 26 | 9.699 | 17.4 | 2.72 | 10.041 | 18.4 | 2.73 | 0.49 |
| | 27 | 9.309 | 16.9 | 2.69 | 10.419 | 18.7 | 2.76 | 0.57 |
| | 28 | 8.780 | 16.2 | 2.59 | 10.516 | 18.8 | 2.77 | 0.69 |
| | 29 | 7.983 | 15.3 | 2.55 | 10.220 | 18.5 | 2.74 | 0.96 |
| | 30 | 7.232 | 14.3 | 2.44 | 9.412 | 17.8 | 2.68 | 1.24 |
| | 31 | 6.290 | 13.3 | 2.35 | 8.308 | 16.7 | 2.58 | 1.37 |
| | 32 | 5.458 | 12.4 | 2.26 | 7.121 | 15.5 | 2.47 | 1.45 |
| | 33 | 4.729 | 11.6 | 2.18 | 6.038 | 14.3 | 2.35 | 1.46 |
| | 34 | 4.171 | 11.1 | 2.17 | 5.245 | 13.3 | 2.26 | 1.44 |
| | 35 | 3.896 | 11.3 | 2.20 | 5.007 | 13.0 | 2.23 | 1.36 |
| | 36 | 4.021 | 12.1 | 2.29 | 4.980 | 13.0 | 2.22 | 1.29 |
| | 37 | 4.637 | 13.3 | 2.42 | 5.348 | 13.4 | 2.27 | 1.25 |
| | 38 | 5.618 | 15.4 | 2.71 | 6.163 | 14.4 | 2.37 | 1.15 |
| | 39 | 7.805 | 17.9 | 2.84 | 7.314 | 15.7 | 2.49 | 1.19 |
| | 40 | 10.093 | 19.1 | 2.87 | 8.820 | 17.2 | 2.63 | 1.19 |
| | 41 | 11.185 | 19.8 | 2.88 | 10.574 | 18.9 | 2.77 | 1.14 |
| | 42 | 11.784 | 20.1 | 2.86 | 12.187 | 20.3 | 2.89 | 1.08 |
| | 43 | 11.913 | 19.9 | 2.85 | 13.093 | 21.0 | 2.95 | 0.98 |
| | 44 | 11.711 | 19.3 | 2.81 | 13.069 | 21.0 | 2.94 | 0.89 |
| | 45 | 11.090 | 18.6 | 2.81 | 12.490 | 20.5 | 2.91 | 0.77 |
| | 46 | 10.506 | 18.2 | 2.81 | 11.755 | 19.9 | 2.86 | 0.67 |
| | 47 | 10.177 | 17.6 | 2.70 | 11.158 | 19.4 | 2.81 | 0.58 |
| Average | | | | | | | | |
| Weekday | | 8.120 | 16.1 | 2.60 | 8.987 | 17.3 | 2.63 | 1.00 |
| Weekend | | 8.216 | 16.1 | 2.61 | 9.103 | 17.3 | 2.63 | 1.01 |
| ADWF[1] | | 8.147 | 16.1 | 2.61 | 9.021 | 17.3 | 2.63 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | 10.7% | 7.5% | 0.9% | |
| Weekend | | | | | 10.8% | 7.5% | 0.8% | |

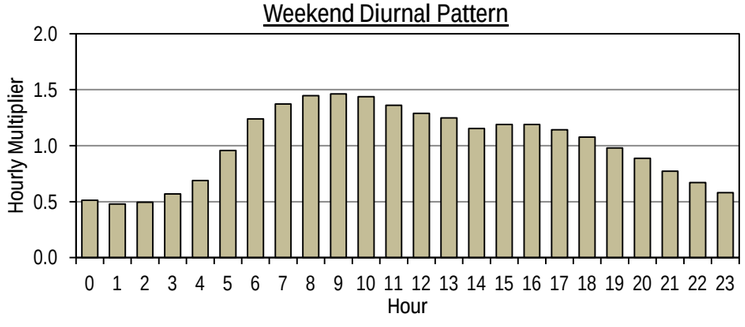
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



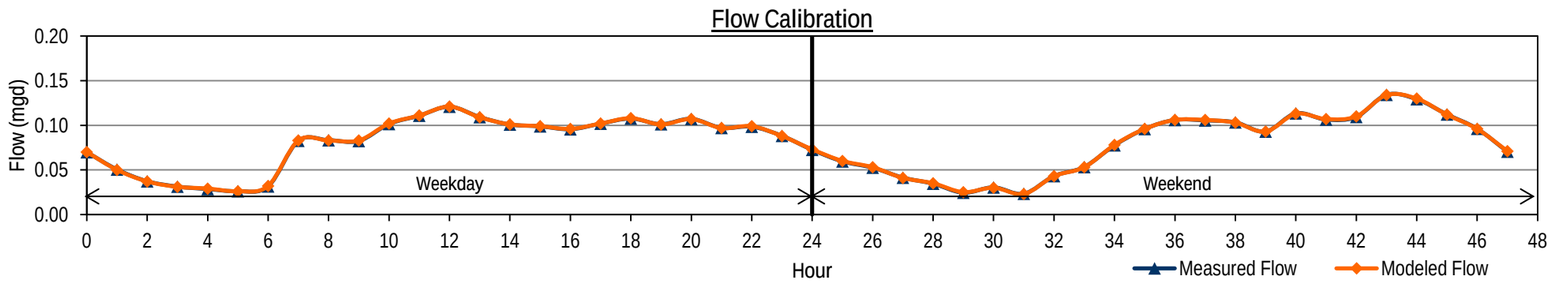



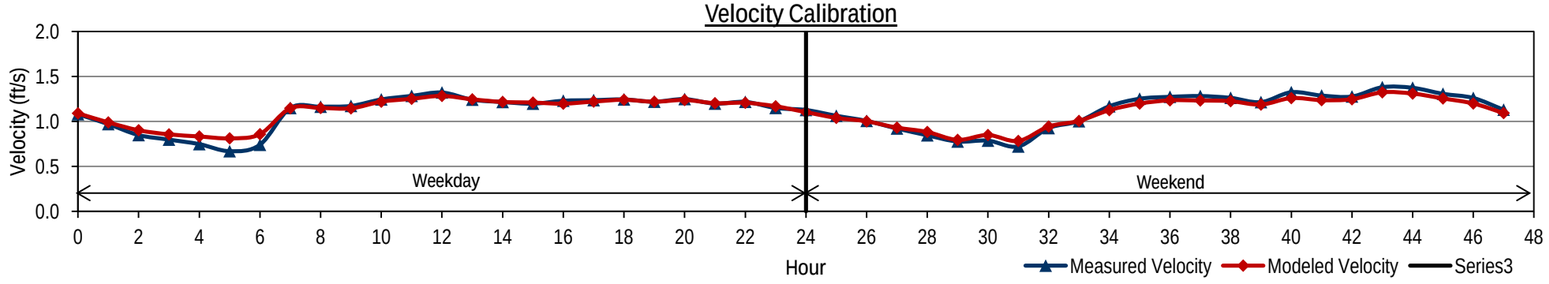



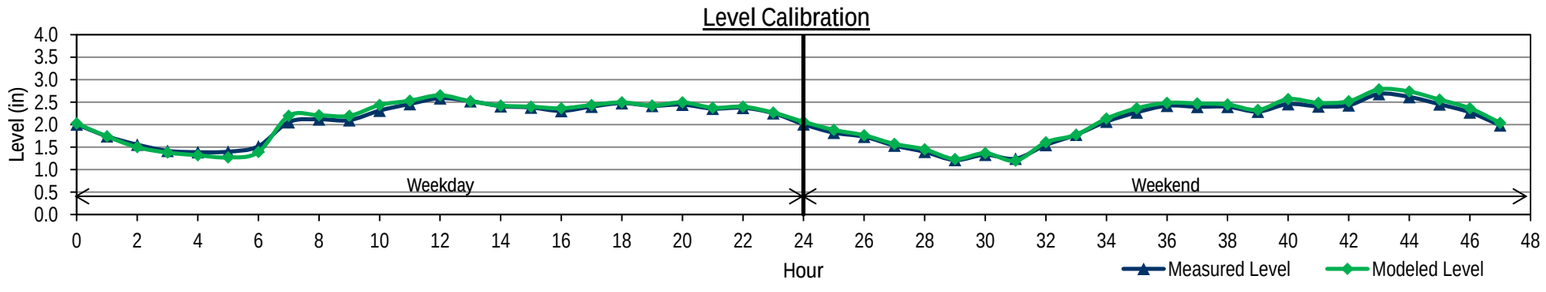
**CITY OF FRESNO**
**WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE**
**FLOW MONITORING SITE FR25 BASE WASTEWATER FLOW CALIBRATION**

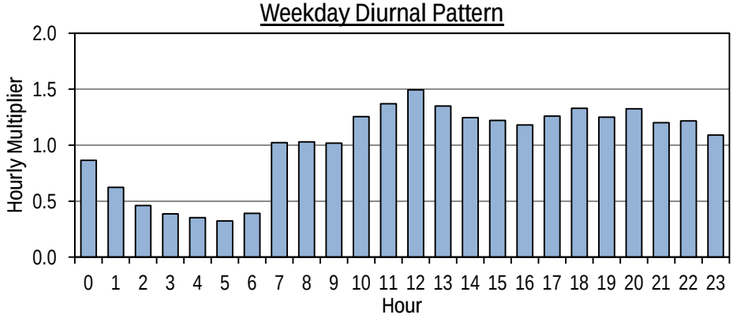
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 0.070 | 2.0 | 1.08 | 0.070 | 2.0 | 1.09 | 0.86 |
| | 1 | 0.050 | 1.7 | 0.97 | 0.050 | 1.7 | 0.99 | 0.62 |
| | 2 | 0.037 | 1.6 | 0.85 | 0.037 | 1.5 | 0.90 | 0.46 |
| | 3 | 0.031 | 1.4 | 0.80 | 0.031 | 1.4 | 0.86 | 0.39 |
| | 4 | 0.029 | 1.4 | 0.75 | 0.029 | 1.3 | 0.83 | 0.35 |
| | 5 | 0.026 | 1.4 | 0.67 | 0.026 | 1.3 | 0.81 | 0.32 |
| | 6 | 0.032 | 1.5 | 0.74 | 0.032 | 1.4 | 0.86 | 0.39 |
| | 7 | 0.083 | 2.1 | 1.15 | 0.083 | 2.2 | 1.15 | 1.02 |
| | 8 | 0.083 | 2.1 | 1.16 | 0.083 | 2.2 | 1.15 | 1.03 |
| | 9 | 0.082 | 2.1 | 1.17 | 0.083 | 2.2 | 1.15 | 1.02 |
| | 10 | 0.102 | 2.3 | 1.25 | 0.102 | 2.4 | 1.22 | 1.25 |
| | 11 | 0.111 | 2.5 | 1.28 | 0.111 | 2.5 | 1.25 | 1.37 |
| | 12 | 0.121 | 2.6 | 1.32 | 0.121 | 2.7 | 1.28 | 1.49 |
| | 13 | 0.109 | 2.5 | 1.24 | 0.109 | 2.5 | 1.25 | 1.35 |
| | 14 | 0.101 | 2.4 | 1.22 | 0.101 | 2.4 | 1.22 | 1.25 |
| | 15 | 0.099 | 2.4 | 1.20 | 0.099 | 2.4 | 1.21 | 1.22 |
| | 16 | 0.096 | 2.3 | 1.23 | 0.096 | 2.4 | 1.20 | 1.18 |
| | 17 | 0.102 | 2.4 | 1.24 | 0.102 | 2.4 | 1.22 | 1.26 |
| | 18 | 0.108 | 2.5 | 1.25 | 0.108 | 2.5 | 1.24 | 1.33 |
| | 19 | 0.101 | 2.4 | 1.22 | 0.101 | 2.4 | 1.22 | 1.25 |
| | 20 | 0.107 | 2.4 | 1.25 | 0.107 | 2.5 | 1.24 | 1.33 |
| | 21 | 0.097 | 2.4 | 1.20 | 0.097 | 2.4 | 1.20 | 1.20 |
| | 22 | 0.098 | 2.4 | 1.22 | 0.099 | 2.4 | 1.21 | 1.22 |
| | 23 | 0.088 | 2.3 | 1.15 | 0.088 | 2.3 | 1.17 | 1.09 |
| Weekend | 24 | 0.073 | 2.0 | 1.13 | 0.073 | 2.1 | 1.10 | 0.90 |
| | 25 | 0.060 | 1.8 | 1.06 | 0.060 | 1.9 | 1.04 | 0.74 |
| | 26 | 0.053 | 1.7 | 1.01 | 0.053 | 1.8 | 1.00 | 0.65 |
| | 27 | 0.041 | 1.5 | 0.92 | 0.041 | 1.6 | 0.93 | 0.51 |
| | 28 | 0.035 | 1.4 | 0.85 | 0.035 | 1.5 | 0.88 | 0.43 |
| | 29 | 0.025 | 1.2 | 0.78 | 0.025 | 1.2 | 0.80 | 0.30 |
| | 30 | 0.030 | 1.3 | 0.79 | 0.030 | 1.4 | 0.85 | 0.38 |
| | 31 | 0.023 | 1.2 | 0.72 | 0.023 | 1.2 | 0.78 | 0.29 |
| | 32 | 0.043 | 1.5 | 0.93 | 0.043 | 1.6 | 0.94 | 0.53 |
| | 33 | 0.053 | 1.8 | 1.00 | 0.053 | 1.8 | 1.01 | 0.66 |
| | 34 | 0.078 | 2.1 | 1.17 | 0.078 | 2.1 | 1.13 | 0.96 |
| | 35 | 0.096 | 2.3 | 1.25 | 0.096 | 2.4 | 1.20 | 1.19 |
| | 36 | 0.106 | 2.4 | 1.27 | 0.106 | 2.5 | 1.23 | 1.31 |
| | 37 | 0.106 | 2.4 | 1.28 | 0.106 | 2.5 | 1.23 | 1.30 |
| | 38 | 0.103 | 2.4 | 1.26 | 0.103 | 2.4 | 1.23 | 1.28 |
| | 39 | 0.093 | 2.3 | 1.22 | 0.093 | 2.3 | 1.19 | 1.15 |
| | 40 | 0.113 | 2.5 | 1.33 | 0.113 | 2.6 | 1.26 | 1.40 |
| | 41 | 0.106 | 2.4 | 1.29 | 0.107 | 2.5 | 1.24 | 1.32 |
| | 42 | 0.109 | 2.4 | 1.28 | 0.110 | 2.5 | 1.25 | 1.35 |
| | 43 | 0.134 | 2.7 | 1.38 | 0.134 | 2.8 | 1.32 | 1.66 |
| | 44 | 0.129 | 2.6 | 1.37 | 0.130 | 2.7 | 1.31 | 1.60 |
| | 45 | 0.112 | 2.5 | 1.31 | 0.112 | 2.6 | 1.26 | 1.39 |
| | 46 | 0.096 | 2.3 | 1.26 | 0.096 | 2.4 | 1.20 | 1.19 |
| | 47 | 0.071 | 2.0 | 1.13 | 0.071 | 2.0 | 1.09 | 0.87 |
| Average | | | | | | | | |
| Weekday | | 0.082 | 2.1 | 1.11 | 0.082 | 2.1 | 1.12 | 1.01 |
| Weekend | | 0.079 | 2.0 | 1.12 | 0.079 | 2.1 | 1.10 | 0.97 |
| ADWF[1] | | 0.081 | 2.1 | 1.11 | 0.081 | 2.1 | 1.12 | 1.00 |
| % Error | | | | | | | | |
| Weekday | | | | | 0.1% | 1.0% | 1.1% | |
| Weekend | | | | | 0.2% | 3.0% | -2.0% | |

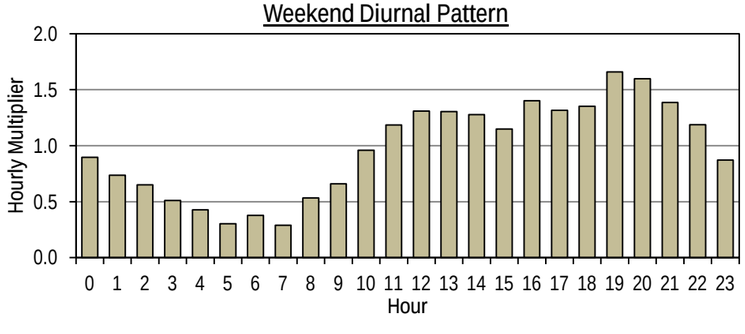
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



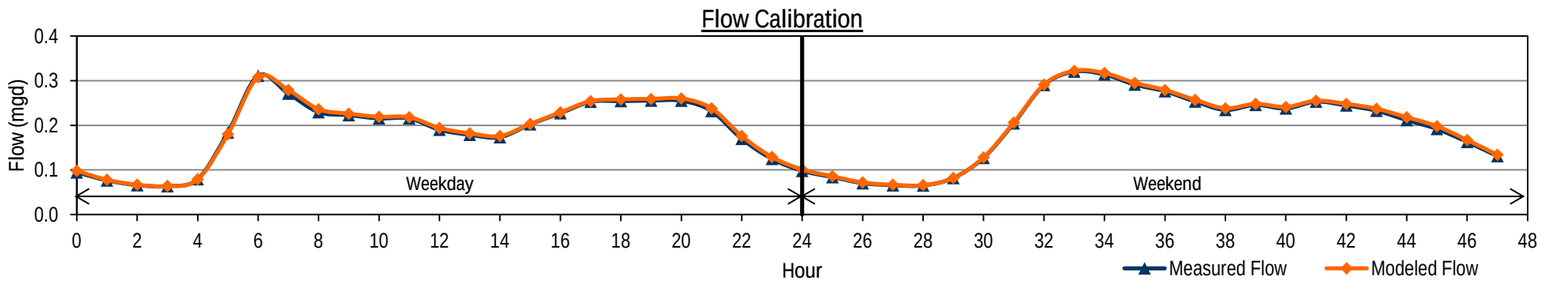



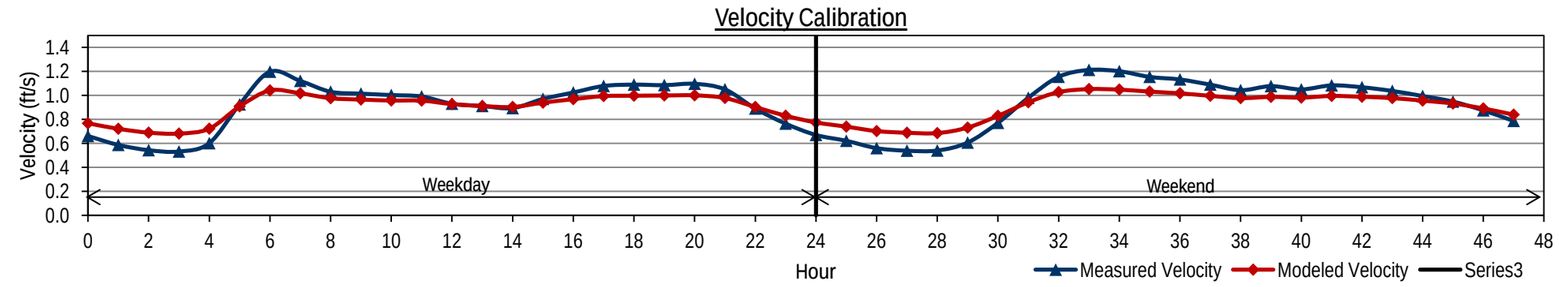



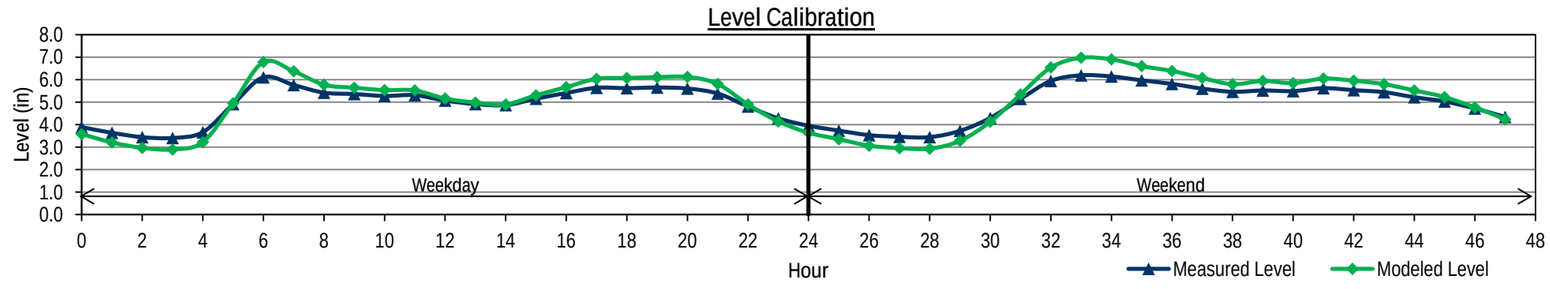
**CITY OF FRESNO**
**WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE**
**FLOW MONITORING SITE FR26 BASE WASTEWATER FLOW CALIBRATION**

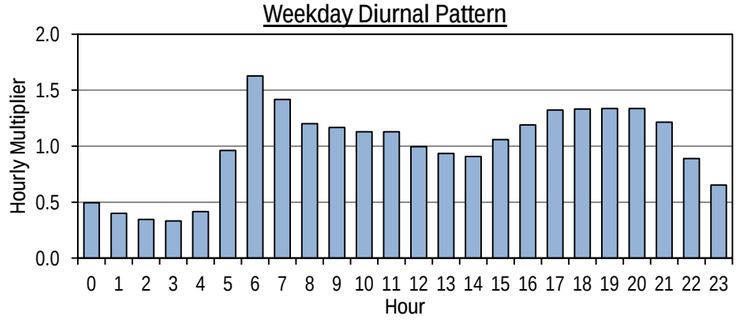
| | Hour | Measured Data Flow (mgd) | Measured Data Level (in) | Measured Data Velocity (ft/s) | Modeled Data Flow (mgd) | Modeled Data Level (in) | Modeled Data Velocity (ft/s) | Diurnal Calibrated Diurnal |
|---|---|---|---|---|---|---|---|---|
| Weekday | 0 | 0.095 | 3.9 | 0.66 | 0.098 | 3.6 | 0.77 | 0.49 |
| | 1 | 0.077 | 3.6 | 0.59 | 0.078 | 3.2 | 0.72 | 0.40 |
| | 2 | 0.066 | 3.4 | 0.54 | 0.067 | 3.0 | 0.69 | 0.34 |
| | 3 | 0.064 | 3.4 | 0.53 | 0.064 | 2.9 | 0.68 | 0.33 |
| | 4 | 0.079 | 3.7 | 0.60 | 0.079 | 3.2 | 0.72 | 0.42 |
| | 5 | 0.184 | 4.9 | 0.93 | 0.180 | 4.9 | 0.91 | 0.96 |
| | 6 | 0.311 | 6.1 | 1.20 | 0.308 | 6.8 | 1.04 | 1.63 |
| | 7 | 0.271 | 5.8 | 1.12 | 0.279 | 6.4 | 1.02 | 1.42 |
| | 8 | 0.230 | 5.4 | 1.03 | 0.236 | 5.8 | 0.98 | 1.20 |
| | 9 | 0.223 | 5.4 | 1.02 | 0.226 | 5.6 | 0.97 | 1.17 |
| | 10 | 0.216 | 5.3 | 1.00 | 0.219 | 5.5 | 0.96 | 1.13 |
| | 11 | 0.216 | 5.3 | 0.99 | 0.218 | 5.5 | 0.96 | 1.13 |
| | 12 | 0.190 | 5.1 | 0.93 | 0.194 | 5.2 | 0.93 | 0.99 |
| | 13 | 0.179 | 4.9 | 0.91 | 0.182 | 5.0 | 0.91 | 0.94 |
| | 14 | 0.174 | 4.9 | 0.90 | 0.176 | 4.9 | 0.90 | 0.91 |
| | 15 | 0.203 | 5.2 | 0.97 | 0.203 | 5.3 | 0.94 | 1.06 |
| | 16 | 0.227 | 5.4 | 1.03 | 0.229 | 5.7 | 0.97 | 1.19 |
| | 17 | 0.253 | 5.6 | 1.08 | 0.254 | 6.0 | 1.00 | 1.32 |
| | 18 | 0.255 | 5.6 | 1.09 | 0.258 | 6.1 | 1.00 | 1.33 |
| | 19 | 0.256 | 5.6 | 1.09 | 0.259 | 6.1 | 1.00 | 1.34 |
| | 20 | 0.255 | 5.6 | 1.10 | 0.260 | 6.1 | 1.00 | 1.34 |
| | 21 | 0.232 | 5.4 | 1.05 | 0.238 | 5.8 | 0.98 | 1.21 |
| | 22 | 0.170 | 4.8 | 0.89 | 0.176 | 4.9 | 0.90 | 0.89 |
| | 23 | 0.125 | 4.3 | 0.77 | 0.129 | 4.1 | 0.83 | 0.65 |
| Weekend | 24 | 0.098 | 4.0 | 0.67 | 0.101 | 3.6 | 0.78 | 0.51 |
| | 25 | 0.084 | 3.7 | 0.62 | 0.086 | 3.3 | 0.74 | 0.44 |
| | 26 | 0.070 | 3.5 | 0.56 | 0.072 | 3.1 | 0.70 | 0.37 |
| | 27 | 0.066 | 3.5 | 0.54 | 0.067 | 3.0 | 0.69 | 0.34 |
| | 28 | 0.065 | 3.4 | 0.54 | 0.066 | 2.9 | 0.69 | 0.34 |
| | 29 | 0.082 | 3.7 | 0.61 | 0.082 | 3.3 | 0.73 | 0.43 |
| | 30 | 0.127 | 4.3 | 0.77 | 0.128 | 4.1 | 0.83 | 0.66 |
| | 31 | 0.205 | 5.1 | 0.98 | 0.206 | 5.3 | 0.94 | 1.07 |
| | 32 | 0.291 | 5.9 | 1.16 | 0.291 | 6.5 | 1.03 | 1.52 |
| | 33 | 0.321 | 6.2 | 1.21 | 0.322 | 7.0 | 1.05 | 1.68 |
| | 34 | 0.314 | 6.1 | 1.20 | 0.317 | 6.9 | 1.05 | 1.64 |
| | 35 | 0.292 | 6.0 | 1.16 | 0.295 | 6.6 | 1.03 | 1.52 |
| | 36 | 0.277 | 5.8 | 1.13 | 0.279 | 6.4 | 1.02 | 1.45 |
| | 37 | 0.254 | 5.6 | 1.09 | 0.257 | 6.1 | 1.00 | 1.33 |
| | 38 | 0.235 | 5.5 | 1.04 | 0.238 | 5.8 | 0.98 | 1.23 |
| | 39 | 0.246 | 5.5 | 1.08 | 0.248 | 5.9 | 0.99 | 1.29 |
| | 40 | 0.238 | 5.5 | 1.05 | 0.241 | 5.8 | 0.98 | 1.24 |
| | 41 | 0.253 | 5.6 | 1.08 | 0.255 | 6.0 | 1.00 | 1.32 |
| | 42 | 0.245 | 5.5 | 1.07 | 0.248 | 6.0 | 0.99 | 1.28 |
| | 43 | 0.233 | 5.4 | 1.04 | 0.237 | 5.8 | 0.98 | 1.22 |
| | 44 | 0.212 | 5.2 | 1.00 | 0.218 | 5.5 | 0.96 | 1.11 |
| | 45 | 0.192 | 5.0 | 0.95 | 0.198 | 5.2 | 0.93 | 1.00 |
| | 46 | 0.163 | 4.7 | 0.88 | 0.167 | 4.8 | 0.89 | 0.85 |
| | 47 | 0.131 | 4.3 | 0.79 | 0.134 | 4.2 | 0.84 | 0.69 |
| Average | | | | | | | | |
| | Weekday | 0.190 | 4.9 | 0.92 | 0.192 | 5.1 | 0.91 | 0.99 |
| | Weekend | 0.195 | 5.0 | 0.93 | 0.198 | 5.1 | 0.91 | 1.02 |
| | ADWF[1] | 0.191 | 4.9 | 0.92 | 0.194 | 5.1 | 0.91 | 1.00 |
| % Error | | | | | | | | |
| | Weekday | | | | 1.4% | 2.6% | -1.1% | |
| | Weekend | | | | 1.3% | 3.3% | -1.9% | |

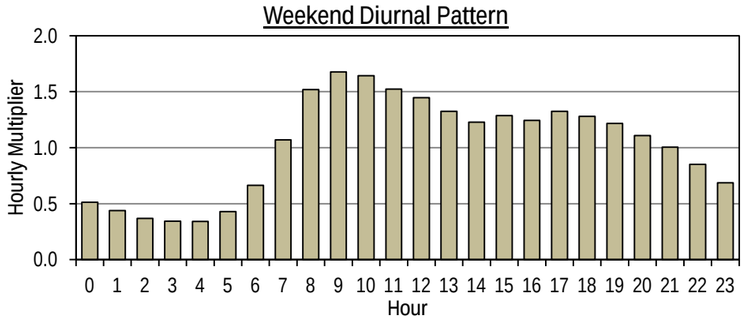
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



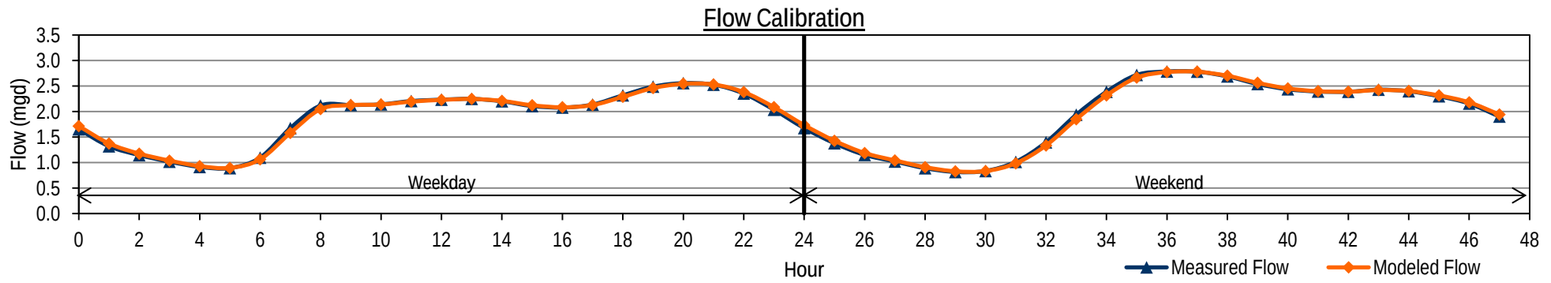



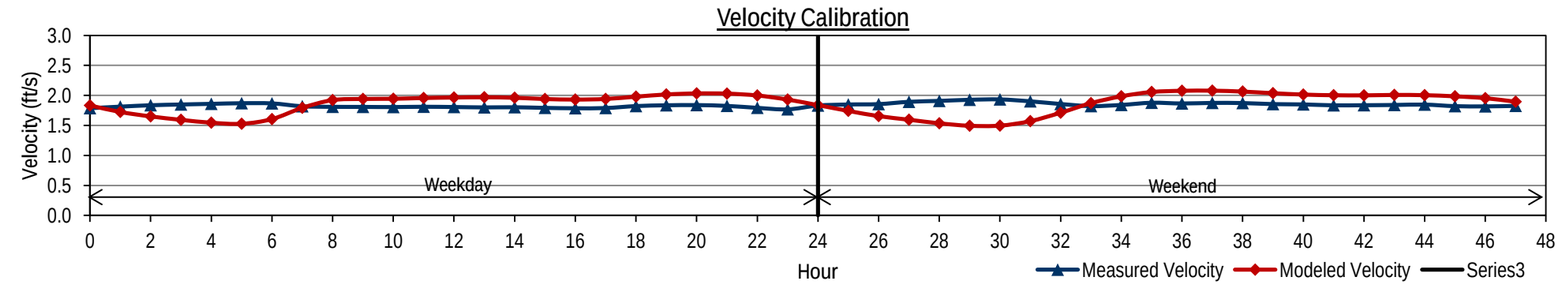
# CITY OF FRESNO
# WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
# FLOW MONITORING SITE FR27 BASE WASTEWATER FLOW CALIBRATION

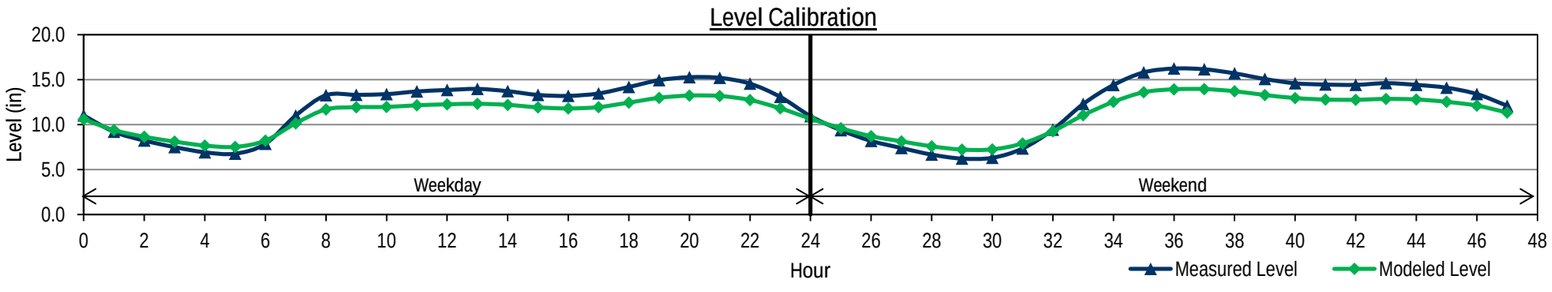
| | | Measured Data | | | Modeled Data | | | Diurnal |
|---|---|---|---|---|---|---|---|---|
| | Hour | Flow (mgd) | Level (in) | Velocity (ft/s) | Flow (mgd) | Level (in) | Velocity (ft/s) | Calibrated Diurnal |
| Weekday | 0 | 1.653 | 11.0 | 1.79 | 1.715 | 10.6 | 1.83 | 0.87 |
| | 1 | 1.319 | 9.2 | 1.81 | 1.373 | 9.4 | 1.73 | 0.69 |
| | 2 | 1.146 | 8.2 | 1.84 | 1.174 | 8.7 | 1.65 | 0.60 |
| | 3 | 1.017 | 7.5 | 1.85 | 1.037 | 8.1 | 1.59 | 0.53 |
| | 4 | 0.914 | 6.9 | 1.86 | 0.929 | 7.7 | 1.55 | 0.48 |
| | 5 | 0.891 | 6.8 | 1.87 | 0.894 | 7.5 | 1.53 | 0.47 |
| | 6 | 1.096 | 7.9 | 1.87 | 1.063 | 8.2 | 1.61 | 0.57 |
| | 7 | 1.675 | 11.0 | 1.82 | 1.582 | 10.1 | 1.79 | 0.88 |
| | 8 | 2.119 | 13.3 | 1.81 | 2.049 | 11.7 | 1.92 | 1.11 |
| | 9 | 2.128 | 13.3 | 1.81 | 2.127 | 11.9 | 1.94 | 1.11 |
| | 10 | 2.142 | 13.4 | 1.81 | 2.139 | 12.0 | 1.95 | 1.12 |
| | 11 | 2.207 | 13.7 | 1.81 | 2.196 | 12.1 | 1.96 | 1.16 |
| | 12 | 2.234 | 13.9 | 1.81 | 2.230 | 12.3 | 1.97 | 1.17 |
| | 13 | 2.249 | 14.0 | 1.80 | 2.248 | 12.3 | 1.97 | 1.18 |
| | 14 | 2.202 | 13.7 | 1.80 | 2.210 | 12.2 | 1.96 | 1.15 |
| | 15 | 2.108 | 13.3 | 1.79 | 2.124 | 11.9 | 1.94 | 1.10 |
| | 16 | 2.079 | 13.2 | 1.79 | 2.085 | 11.8 | 1.93 | 1.09 |
| | 17 | 2.138 | 13.5 | 1.79 | 2.128 | 11.9 | 1.94 | 1.12 |
| | 18 | 2.319 | 14.2 | 1.82 | 2.290 | 12.4 | 1.98 | 1.21 |
| | 19 | 2.490 | 14.9 | 1.84 | 2.462 | 13.0 | 2.02 | 1.30 |
| | 20 | 2.558 | 15.3 | 1.84 | 2.546 | 13.2 | 2.03 | 1.34 |
| | 21 | 2.527 | 15.2 | 1.83 | 2.532 | 13.2 | 2.03 | 1.32 |
| | 22 | 2.354 | 14.6 | 1.79 | 2.383 | 12.7 | 2.00 | 1.23 |
| | 23 | 2.036 | 13.1 | 1.77 | 2.087 | 11.8 | 1.93 | 1.07 |
| Weekend | 24 | 1.676 | 11.0 | 1.83 | 1.734 | 10.7 | 1.84 | 0.88 |
| | 25 | 1.379 | 9.4 | 1.85 | 1.427 | 9.6 | 1.74 | 0.72 |
| | 26 | 1.150 | 8.2 | 1.86 | 1.186 | 8.7 | 1.66 | 0.60 |
| | 27 | 1.020 | 7.4 | 1.89 | 1.041 | 8.1 | 1.60 | 0.53 |
| | 28 | 0.889 | 6.7 | 1.91 | 0.909 | 7.6 | 1.54 | 0.47 |
| | 29 | 0.815 | 6.2 | 1.93 | 0.827 | 7.2 | 1.50 | 0.43 |
| | 30 | 0.834 | 6.3 | 1.93 | 0.832 | 7.2 | 1.50 | 0.44 |
| | 31 | 1.014 | 7.4 | 1.90 | 0.985 | 7.9 | 1.57 | 0.53 |
| | 32 | 1.397 | 9.5 | 1.86 | 1.335 | 9.3 | 1.71 | 0.73 |
| | 33 | 1.938 | 12.3 | 1.82 | 1.850 | 11.0 | 1.87 | 1.01 |
| | 34 | 2.389 | 14.4 | 1.84 | 2.317 | 12.5 | 1.99 | 1.25 |
| | 35 | 2.719 | 15.8 | 1.88 | 2.667 | 13.6 | 2.06 | 1.42 |
| | 36 | 2.786 | 16.2 | 1.87 | 2.776 | 13.9 | 2.08 | 1.46 |
| | 37 | 2.784 | 16.2 | 1.88 | 2.783 | 13.9 | 2.08 | 1.46 |
| | 38 | 2.690 | 15.7 | 1.87 | 2.704 | 13.7 | 2.07 | 1.41 |
| | 39 | 2.541 | 15.1 | 1.86 | 2.564 | 13.3 | 2.04 | 1.33 |
| | 40 | 2.438 | 14.6 | 1.85 | 2.454 | 12.9 | 2.02 | 1.28 |
| | 41 | 2.394 | 14.5 | 1.84 | 2.400 | 12.8 | 2.00 | 1.25 |
| | 42 | 2.389 | 14.4 | 1.84 | 2.390 | 12.8 | 2.00 | 1.25 |
| | 43 | 2.430 | 14.6 | 1.84 | 2.423 | 12.9 | 2.01 | 1.27 |
| | 44 | 2.399 | 14.4 | 1.85 | 2.404 | 12.8 | 2.01 | 1.26 |
| | 45 | 2.301 | 14.1 | 1.82 | 2.317 | 12.5 | 1.99 | 1.20 |
| | 46 | 2.158 | 13.4 | 1.82 | 2.181 | 12.1 | 1.96 | 1.13 |
| | 47 | 1.903 | 12.1 | 1.83 | 1.943 | 11.3 | 1.90 | 1.00 |
| Average | | | | | | | | |
| | Weekday | 1.900 | 12.1 | 1.82 | 1.900 | 11.1 | 1.86 | 0.99 |
| | Weekend | 1.935 | 12.1 | 1.86 | 1.935 | 11.2 | 1.86 | 1.01 |
| | ADWF[1] | 1.910 | 12.1 | 1.83 | 1.910 | 11.1 | 1.86 | 1.00 |
| % Error | | | | | | | | |
| | Weekday | | | | 0.0% | -8.4% | 2.6% | |
| | Weekend | | | | 0.0% | -7.4% | 0.1% | |

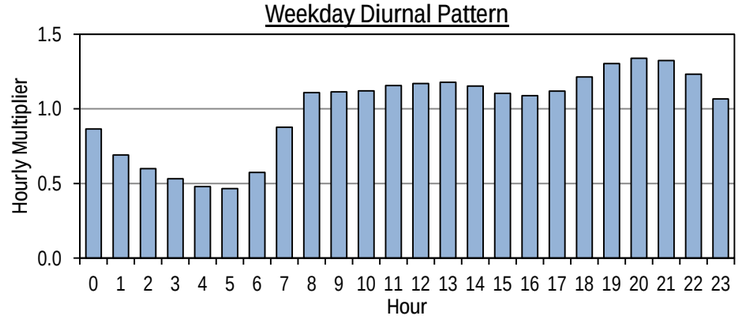
Note:

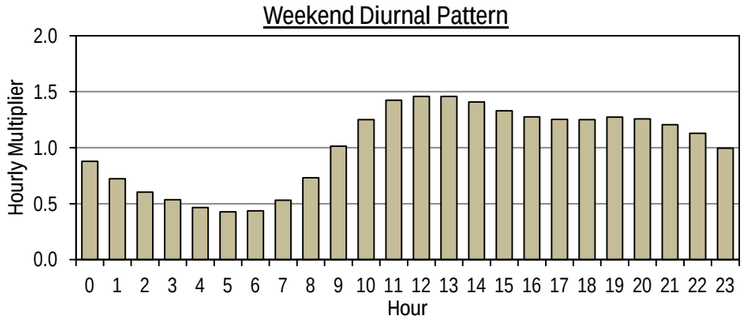
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7



# APPENDIX C – WET WEATHER FLOW CALIBRATION

**Table 2 Wet Weather Calibration Summary - April 2012 Storm Event**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

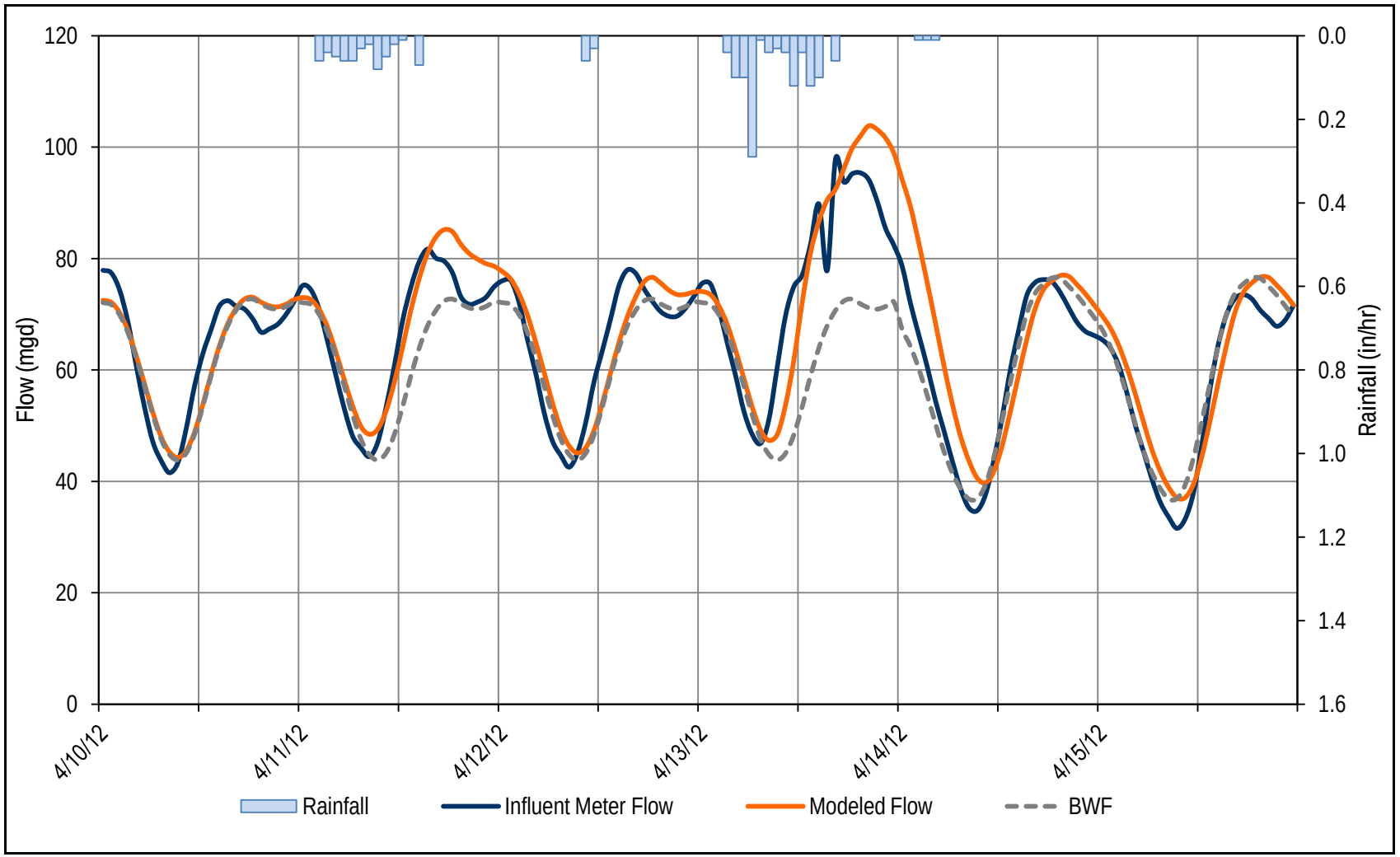
| Meter Number | April 13-14, 2012 Storm Event | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Measured Data[1] | | | | Modeled Data[2] | | | | Percent Error[3] | | | |
| | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (%) | Peak Flow (%) | Avg. Velocity (%) | Avg. Level (%) |
| FR01 | 3.603 | 5.501 | 3.40 | 9.1 | 4.080 | 5.806 | 3.14 | 10.5 | 13.2% | 5.5% | -7.6% | 15.4% |
| FR02 | 8.864 | 12.715 | 3.58 | 16.8 | 8.642 | 13.321 | 3.67 | 16.0 | -2.5% | 4.8% | 2.6% | -4.7% |
| FR06 | 4.241 | 7.986 | 2.52 | 14.6 | 4.572 | 7.804 | 2.63 | 14.3 | 7.8% | -2.3% | 4.5% | -1.7% |
| FR08 | Note 4 | Note 4 | Note 4 | Note 4 | 9.466 | 15.576 | 4.46 | 14.4 | Note 4 | Note 4 | Note 4 | Note 4 |
| FR10 | 1.332 | 2.985 | 1.19 | 8.2 | 1.680 | 3.255 | 1.23 | 11.0 | *26.1%* | 9.1% | 2.9% | *33.7%* |
| FR12 | 1.790 | 4.581 | 1.89 | 9.3 | 2.070 | 4.647 | 2.06 | 9.6 | 15.6% | 1.5% | 8.7% | 3.8% |
| FR14 | 4.363 | 6.793 | 2.11 | 16.9 | 4.641 | 7.900 | 2.32 | 16.0 | 6.4% | 16.3% | 9.7% | -5.3% |
| FR15 | 6.330 | 8.273 | 2.14 | 18.8 | 6.565 | 9.505 | 2.29 | 18.2 | 3.7% | 14.9% | 6.8% | -2.9% |
| FR16 | 4.135 | 6.434 | 3.29 | 12.6 | 4.168 | 7.464 | 3.35 | 12.2 | 0.8% | 16.0% | 1.9% | -2.7% |
| FR19 | 22.983 | 34.118 | 5.46 | 20.8 | 25.384 | 37.234 | 4.99 | 23.8 | 10.4% | 9.1% | -8.6% | 14.5% |
| FR20 | Note 4 | Note 4 | Note 4 | Note 4 | 31.073 | 47.739 | 4.86 | 28.2 | Note 4 | Note 4 | Note 4 | Note 4 |
| FR21 | 5.485 | 9.333 | 2.13 | 17.9 | 5.241 | 9.025 | 2.18 | 16.8 | -4.5% | -3.3% | 2.5% | -6.4% |
| FR22 | 8.456 | 12.878 | 3.02 | 18.6 | 8.547 | 13.454 | 2.96 | 18.7 | 1.1% | 4.5% | -1.7% | 0.9% |
| FR23 | 1.455 | 5.026 | 2.01 | 8.2 | 1.726 | 4.522 | 2.29 | 8.4 | 18.6% | -10.0% | 14.0% | 1.8% |
| FR24 | Note 4 | Note 4 | Note 4 | Note 4 | 10.316 | 15.570 | 2.72 | 18.4 | Note 4 | Note 4 | Note 4 | Note 4 |
| FR25 | 0.117 | 0.318 | 1.26 | 2.5 | 0.113 | 0.329 | 1.22 | 2.5 | -3.4% | 3.5% | -3.1% | -0.1% |
| FR26 | 0.216 | 0.669 | 0.93 | 5.3 | 0.248 | 0.659 | 0.95 | 5.9 | 14.8% | -1.5% | 2.0% | 11.9% |

Notes:
1. Source: City of Fresno Permanent Flow Monitoring Data
2. Average flows are calculated from flow monitoring data. Maximum flow values are hourly peaks.
3. Percent Difference = (Modeled - Measured)/Measured*100.
4. Meters FR08, FR20, and FR24 have data gaps or questionable data quality, and therefore percent error comparisons are not appropriate for these meters.

CITY OF FRESNO

WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

RWRF WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

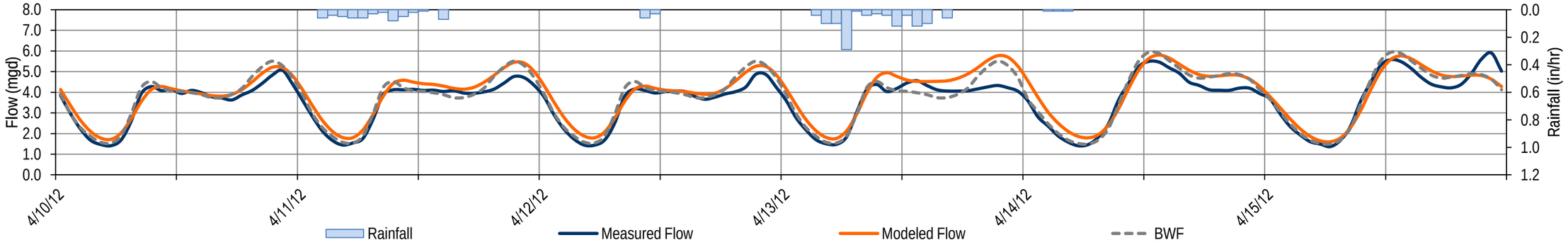


CITY OF FRESNO

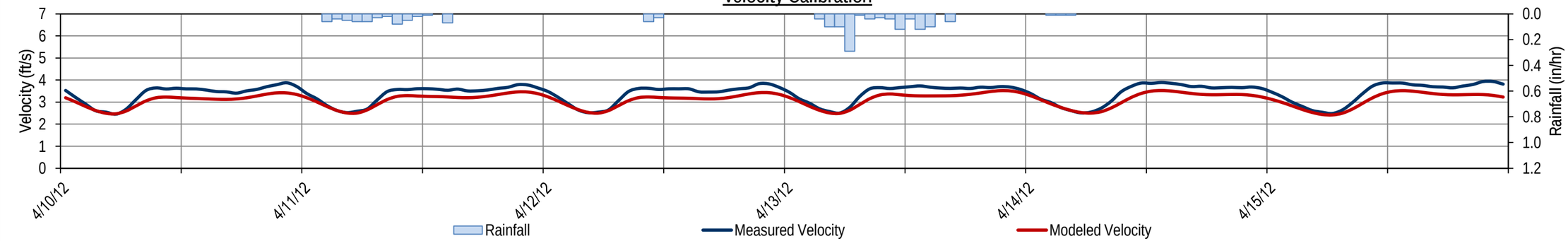
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR01 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

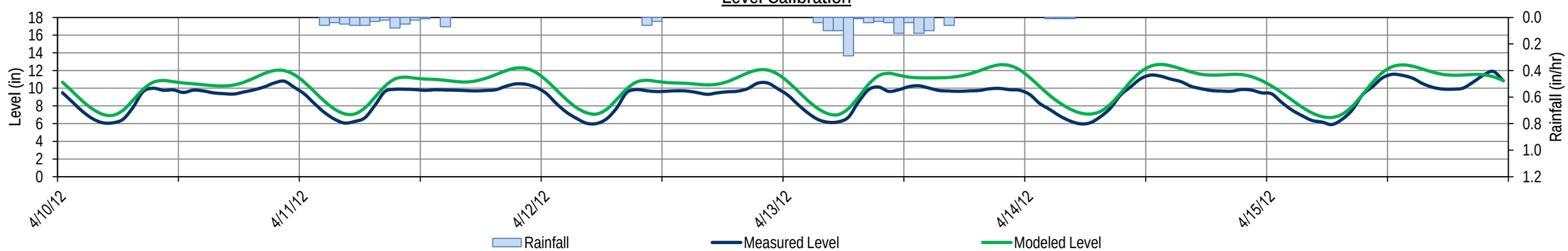
## Flow Calibration




## Velocity Calibration




## Level Calibration

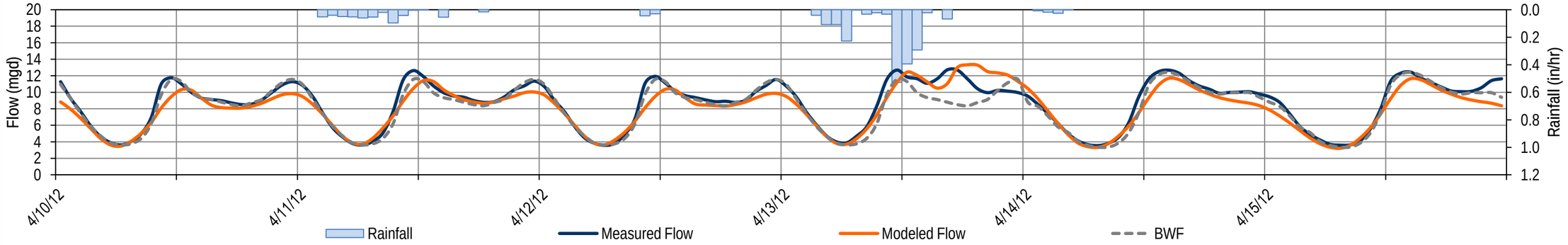


**CITY OF FRESNO**

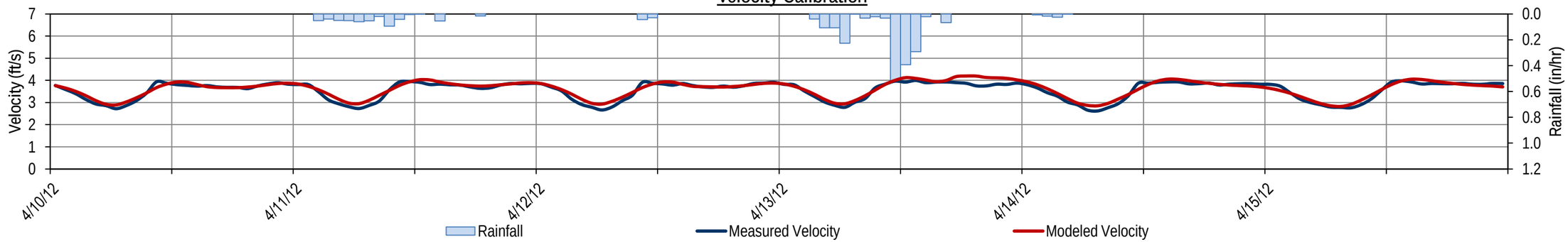
**WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE**

**FLOW MONITORING SITE FR02 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)**

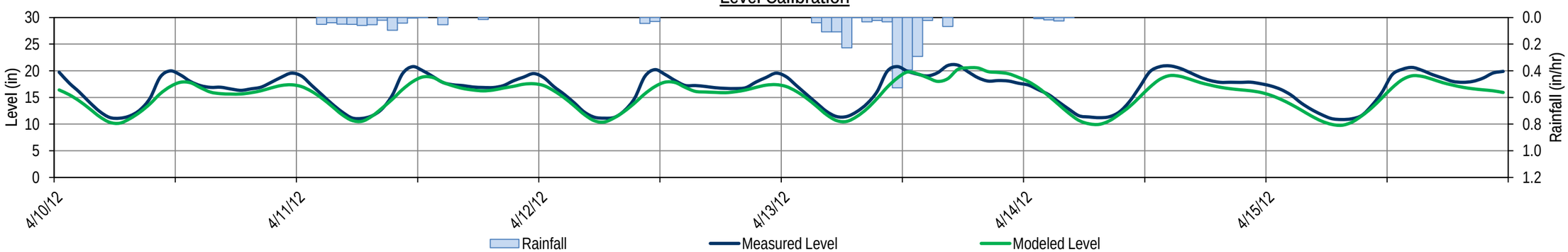
## Flow Calibration




## Velocity Calibration




## Level Calibration

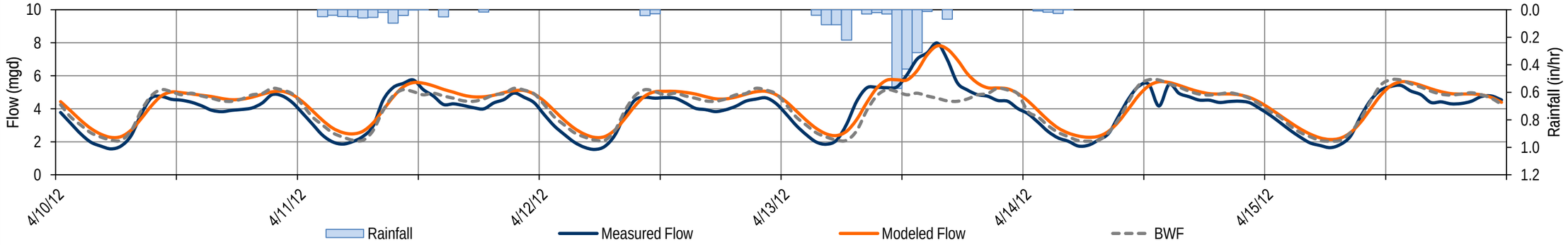


CITY OF FRESNO

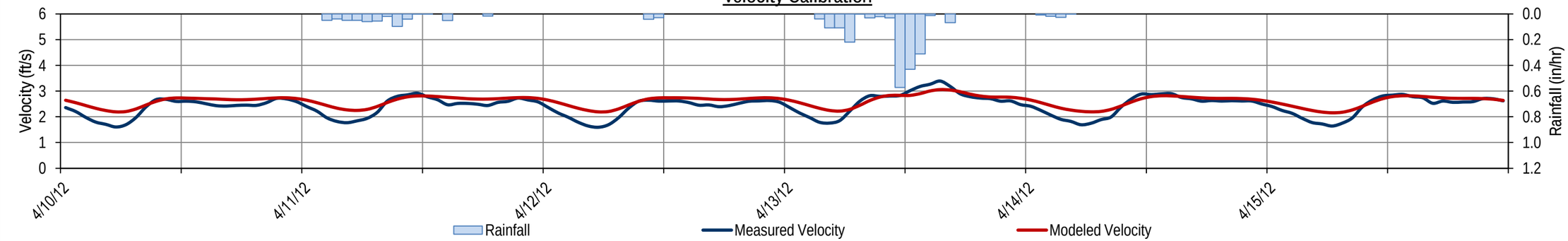
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR06 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

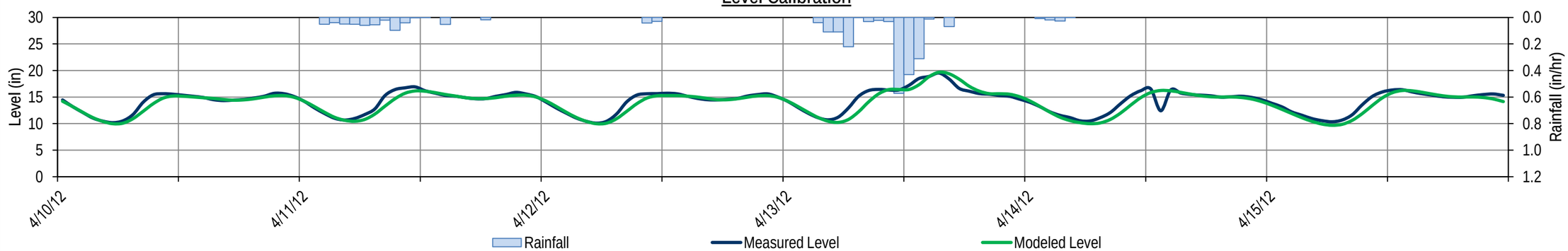
## Flow Calibration




## Velocity Calibration




## Level Calibration

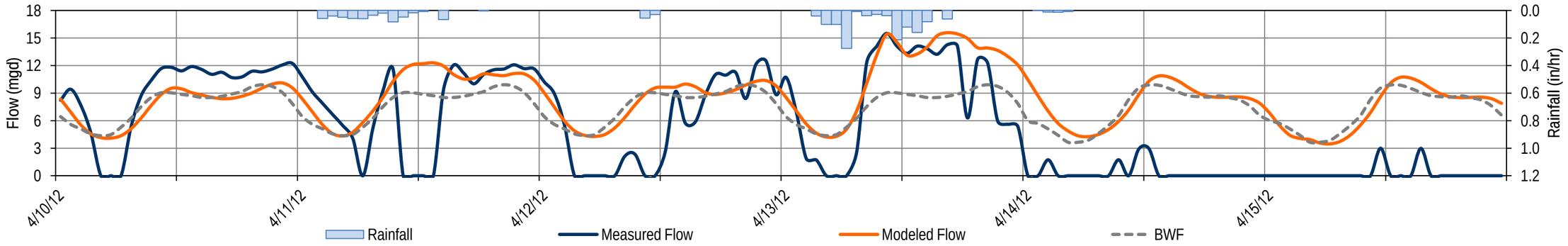


CITY OF FRESNO

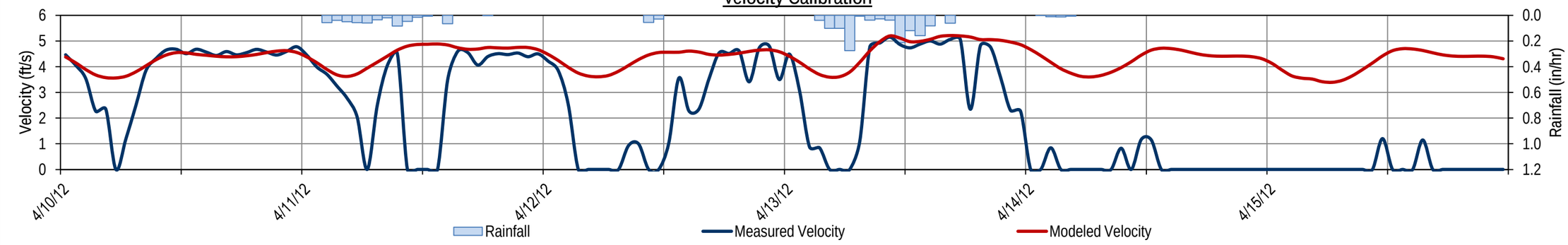
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR08 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

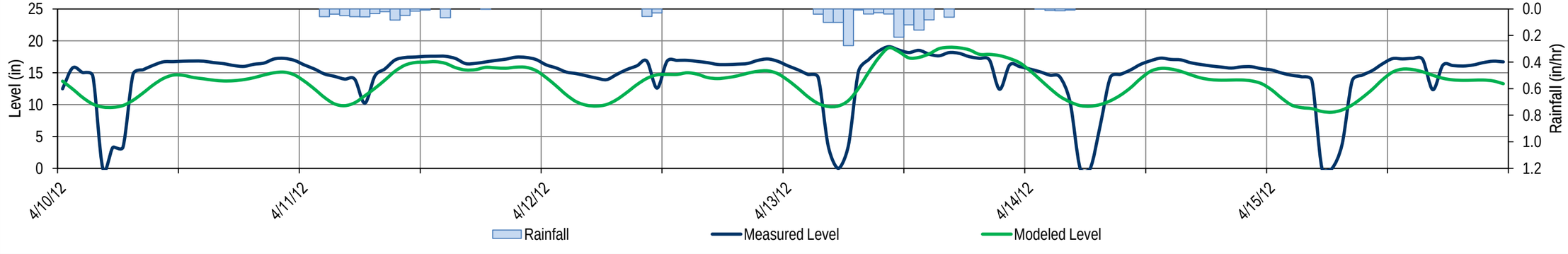
## Flow Calibration




## Velocity Calibration




## Level Calibration

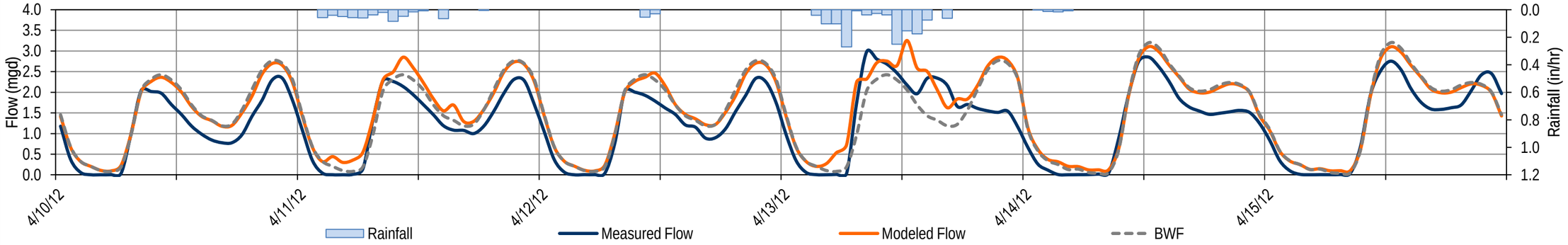


**CITY OF FRESNO**

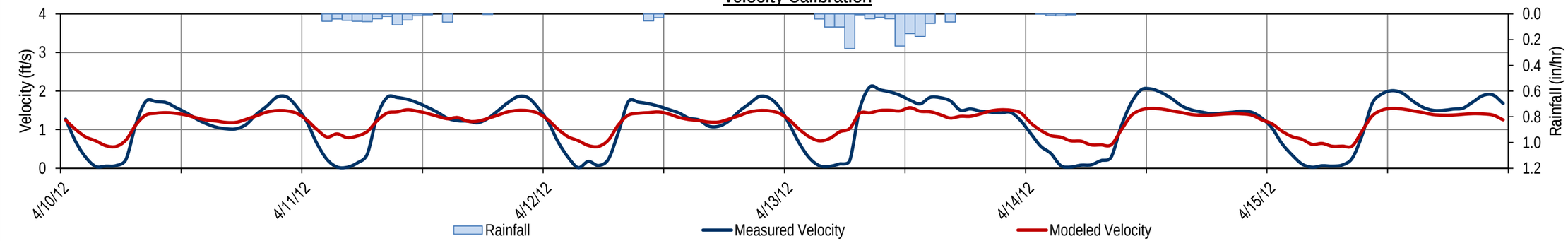
**WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE**

**FLOW MONITORING SITE FR10 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)**

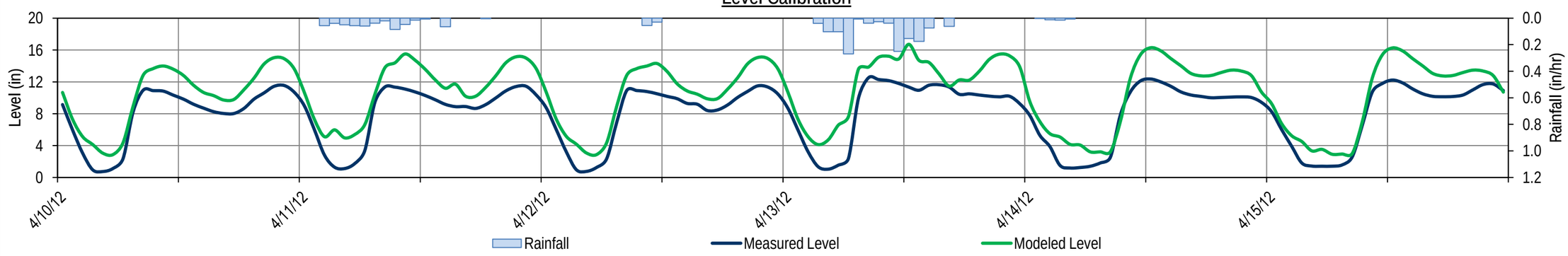
## Flow Calibration




## Velocity Calibration




## Level Calibration

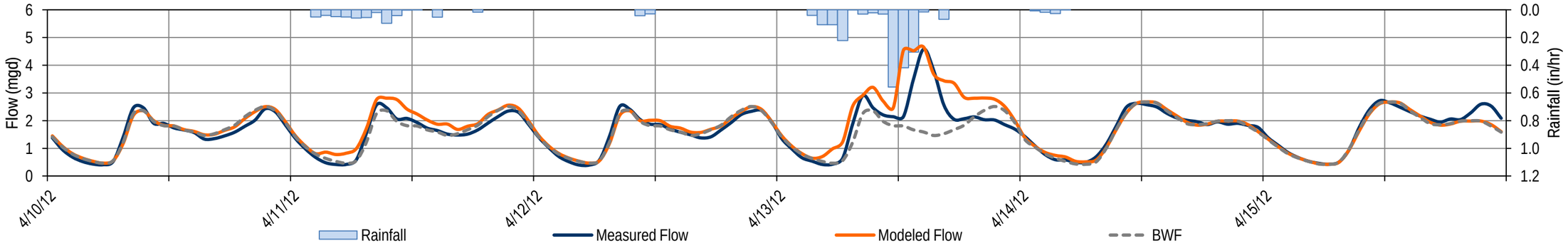


CITY OF FRESNO

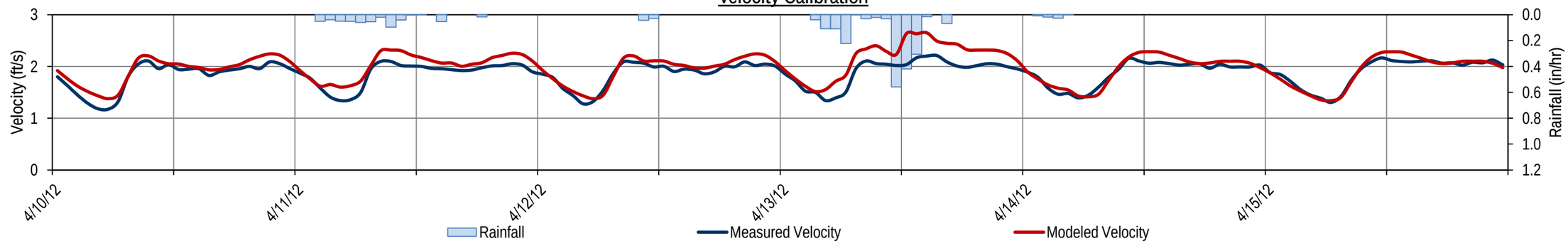
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR12 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

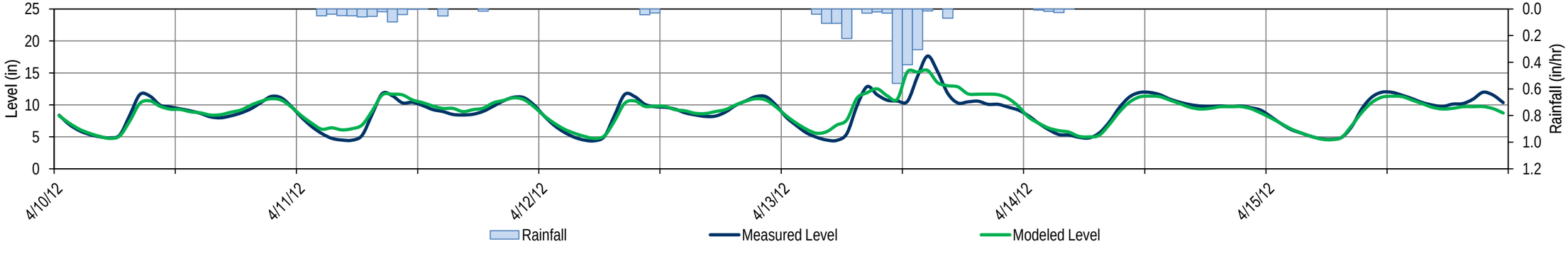
## Flow Calibration




## Velocity Calibration




## Level Calibration

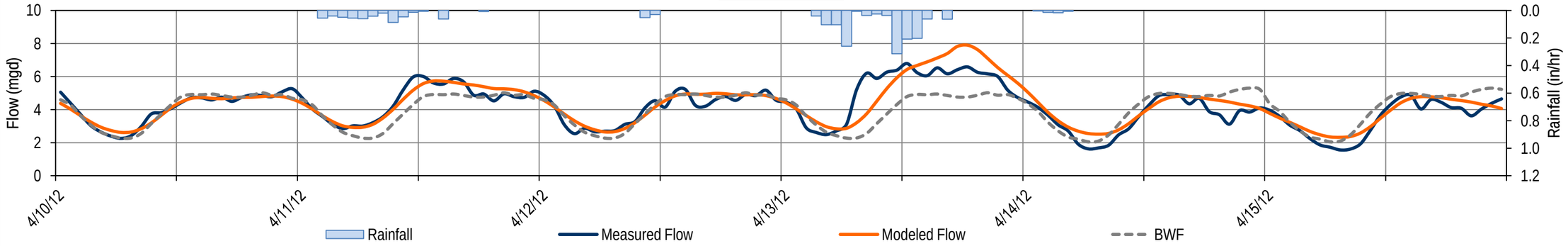


CITY OF FRESNO

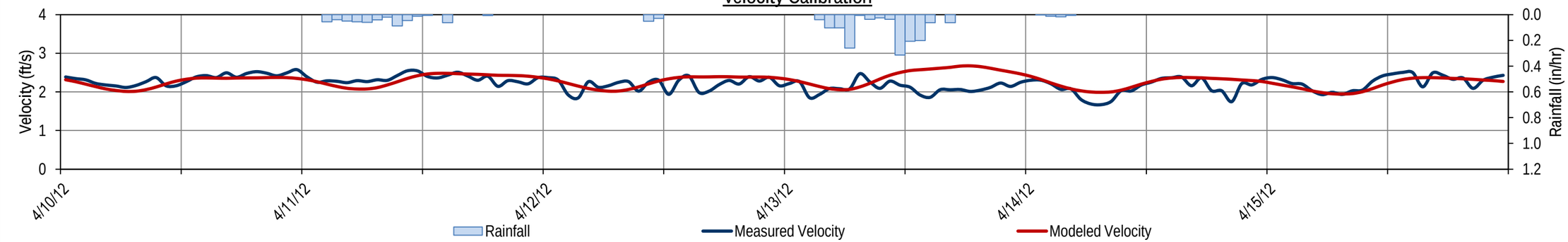
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR14 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

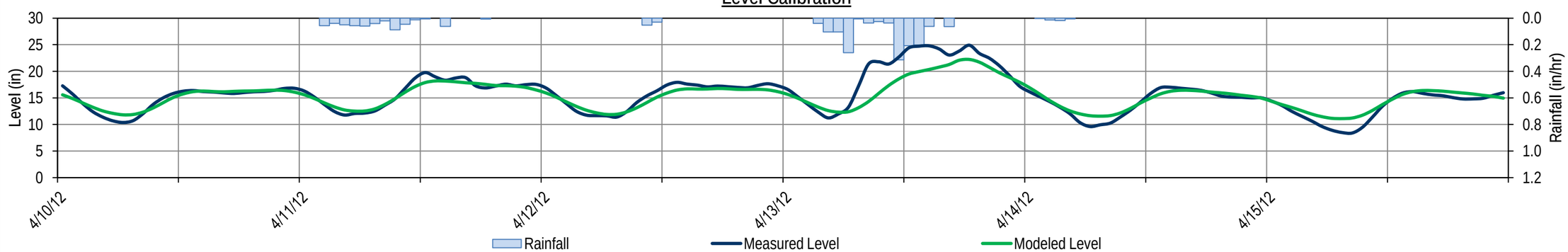
## Flow Calibration




## Velocity Calibration




## Level Calibration

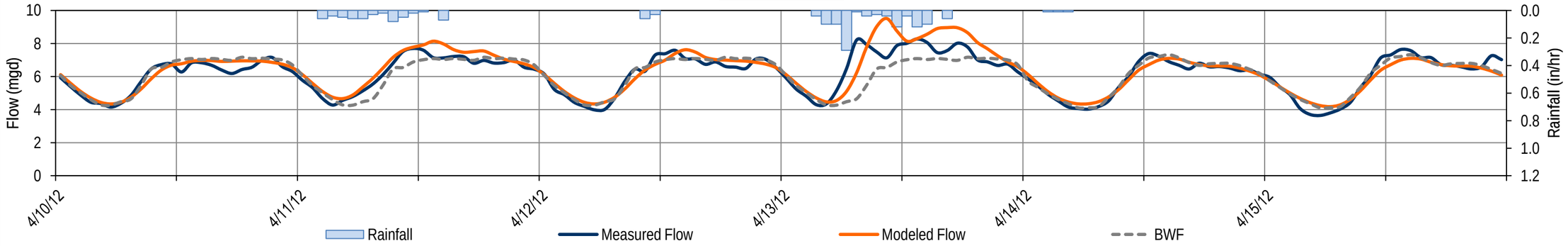


CITY OF FRESNO

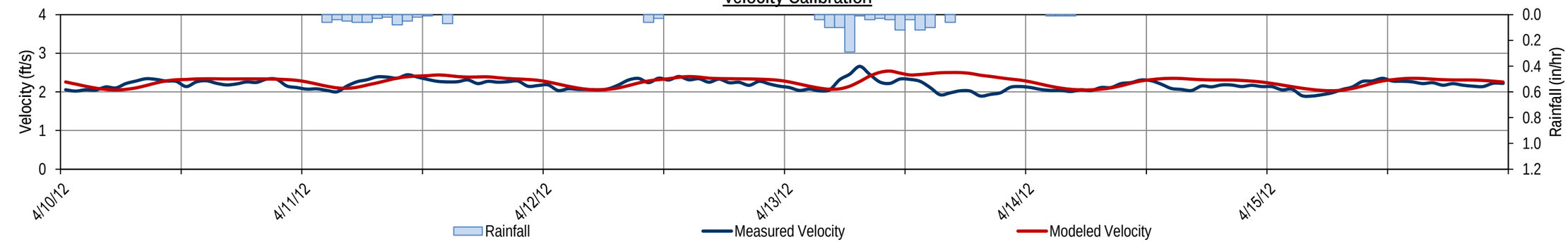
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR15 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

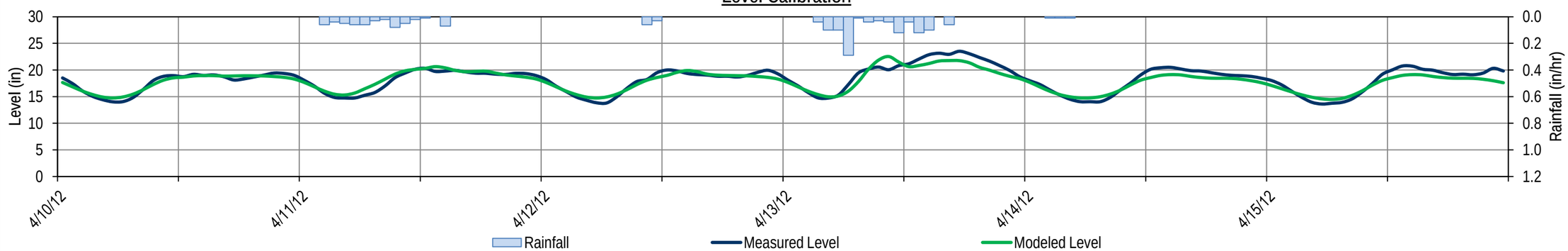
## Flow Calibration




## Velocity Calibration




## Level Calibration

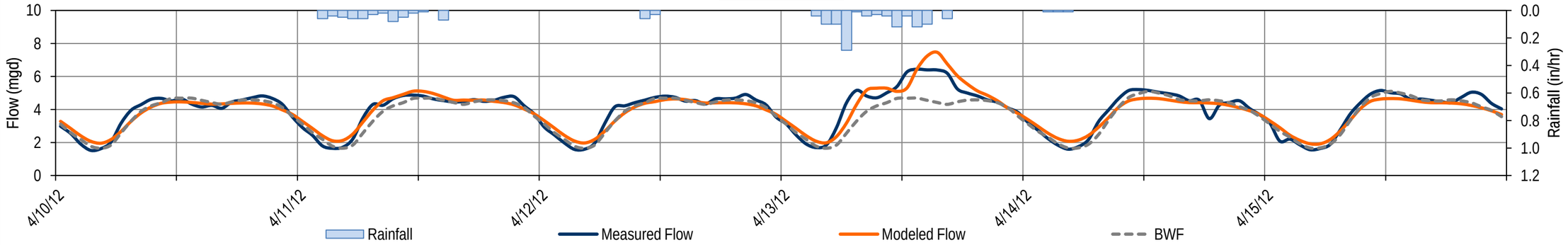


CITY OF FRESNO

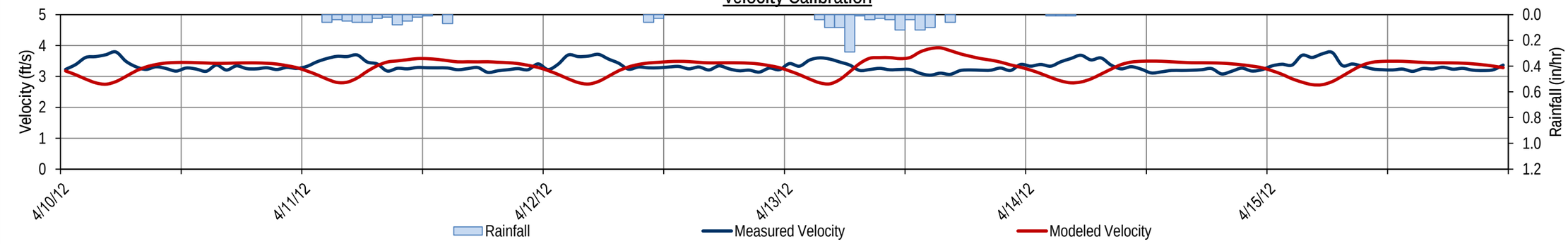
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR16 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

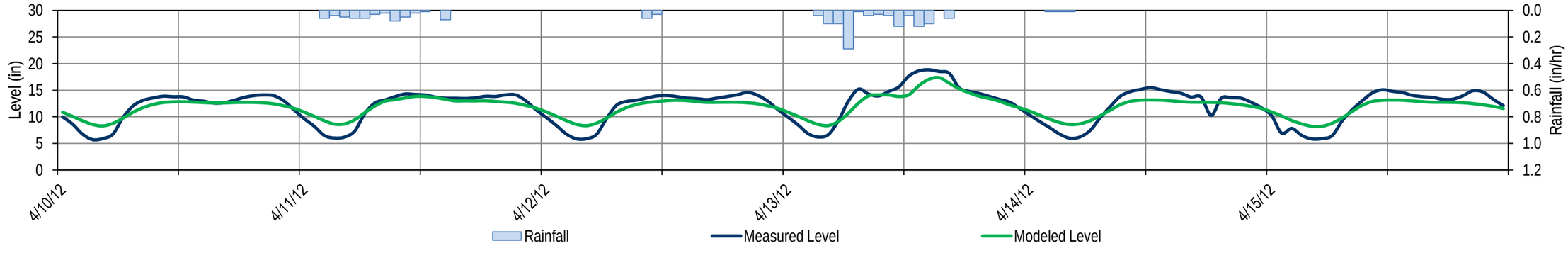
## Flow Calibration




## Velocity Calibration




## Level Calibration

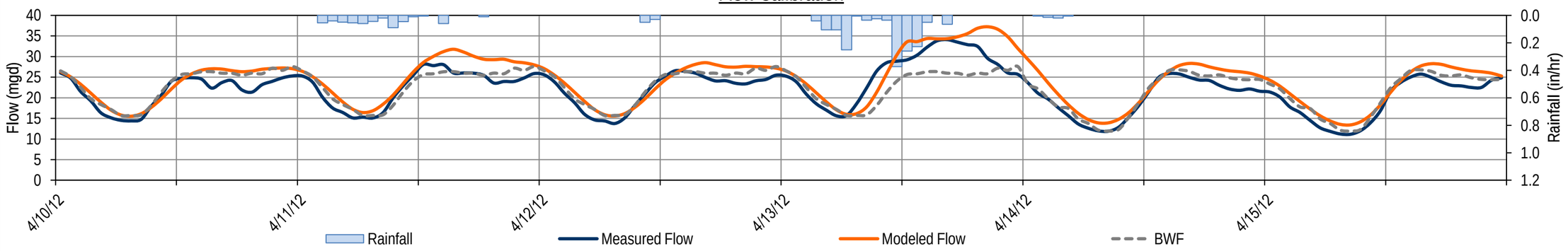


**CITY OF FRESNO**

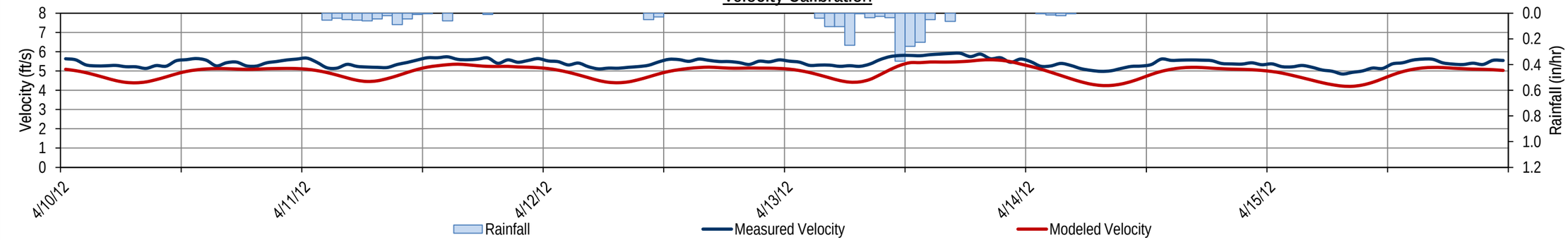
**WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE**

**FLOW MONITORING SITE FR19 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)**

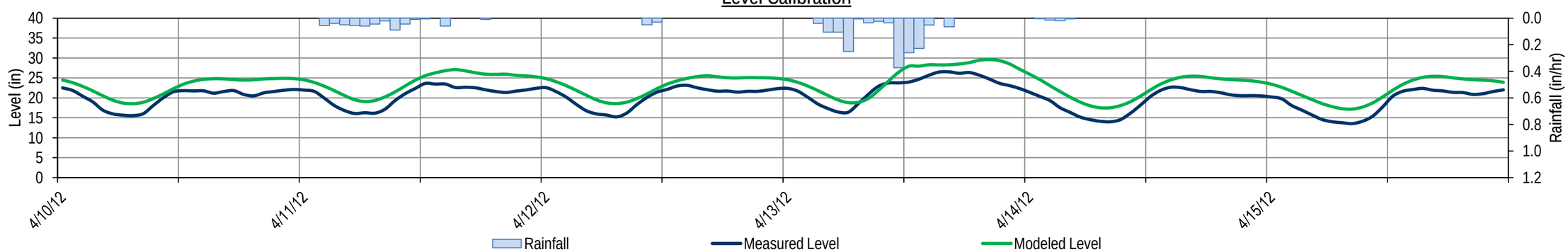
## Flow Calibration




## Velocity Calibration




## Level Calibration

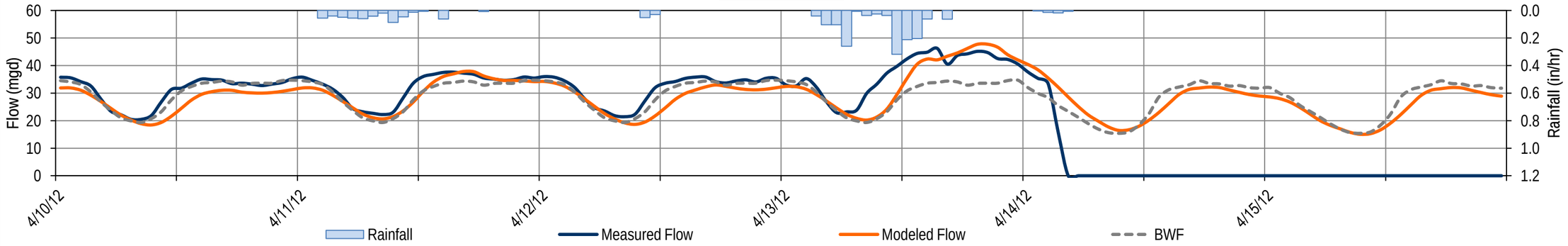


**CITY OF FRESNO**

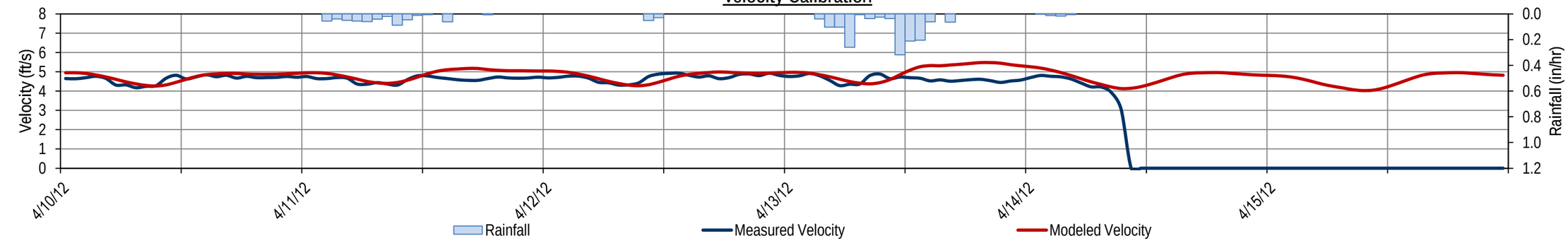
**WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE**

**FLOW MONITORING SITE FR20 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)**

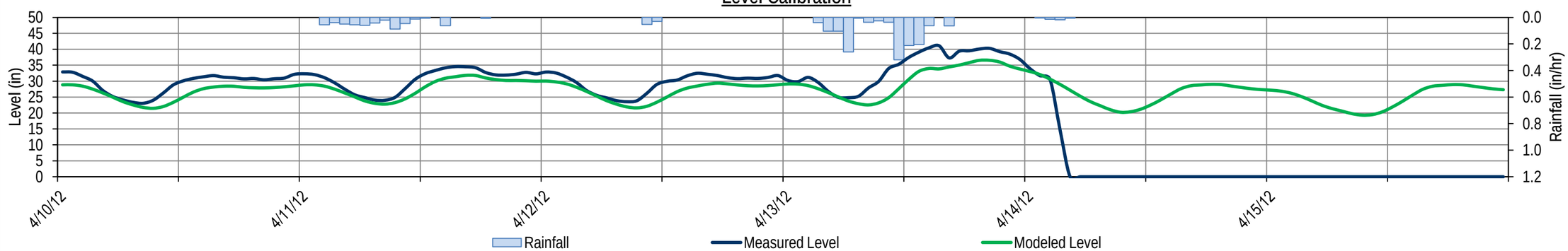
## Flow Calibration




## Velocity Calibration




## Level Calibration

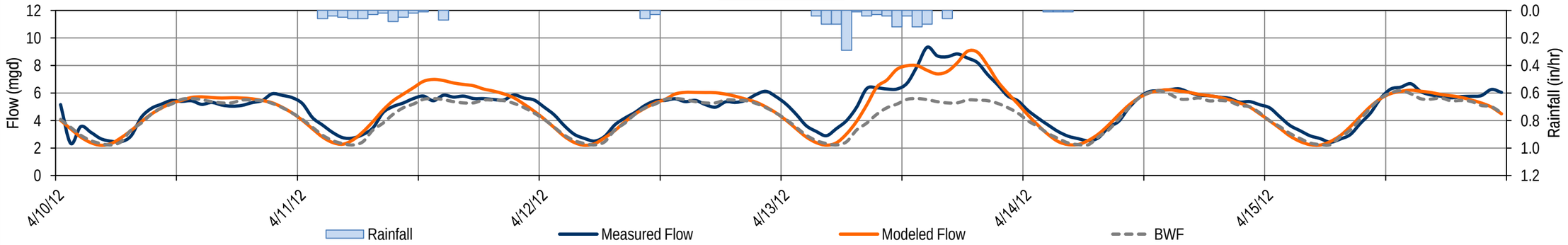


CITY OF FRESNO

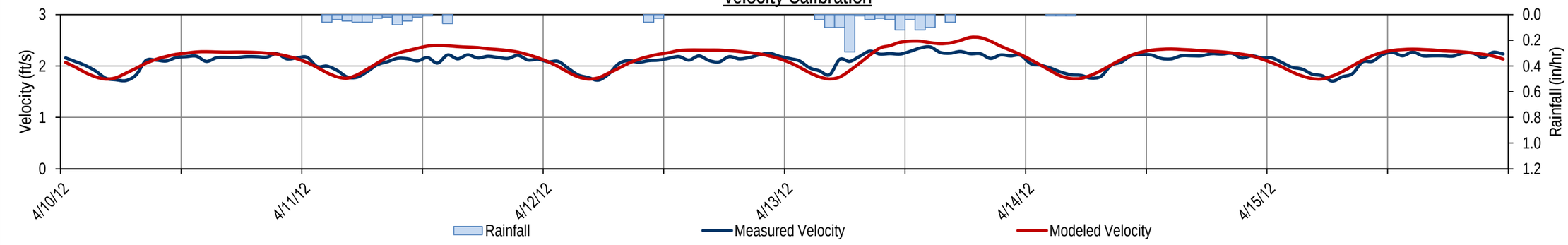
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR21 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

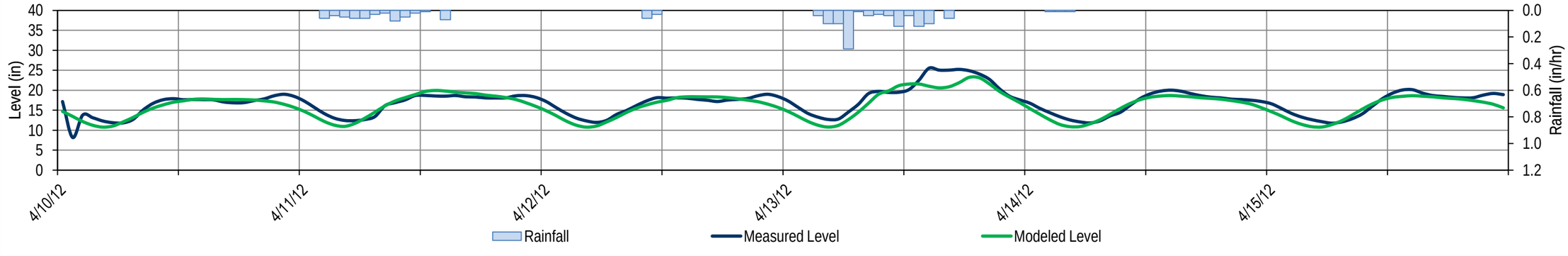
## Flow Calibration




## Velocity Calibration




## Level Calibration

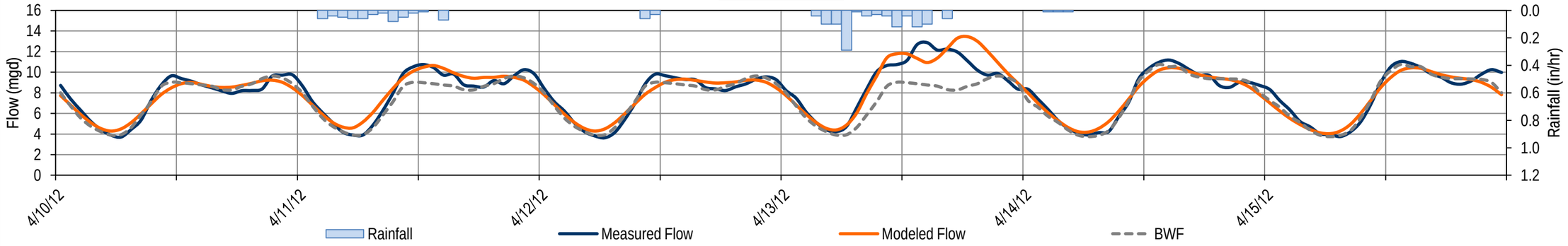


CITY OF FRESNO

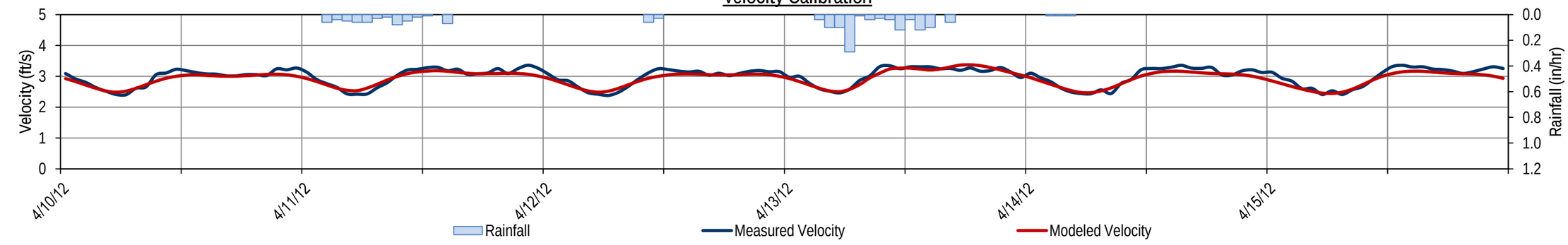
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR22 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

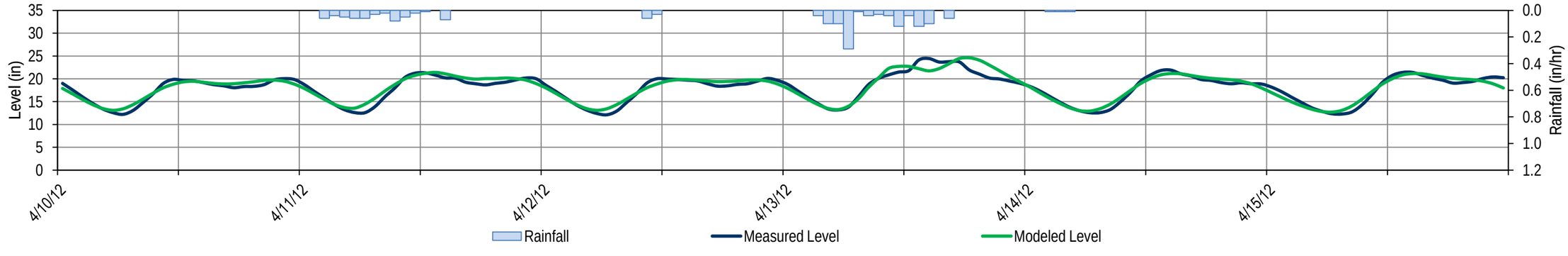
## Flow Calibration




## Velocity Calibration




## Level Calibration

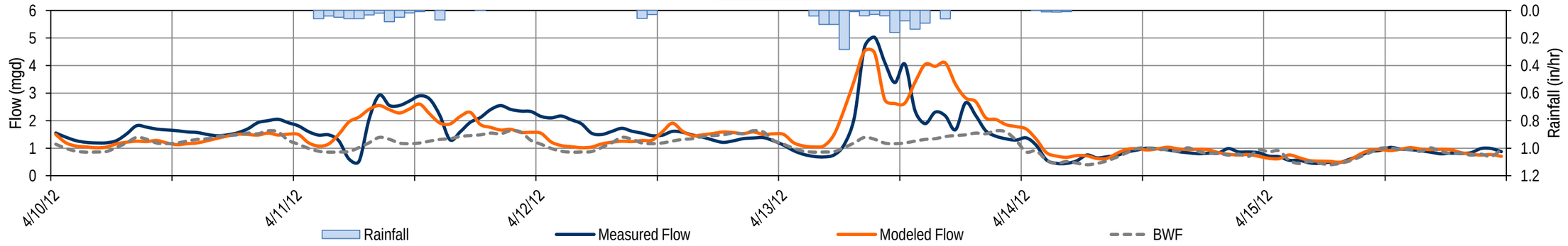


CITY OF FRESNO

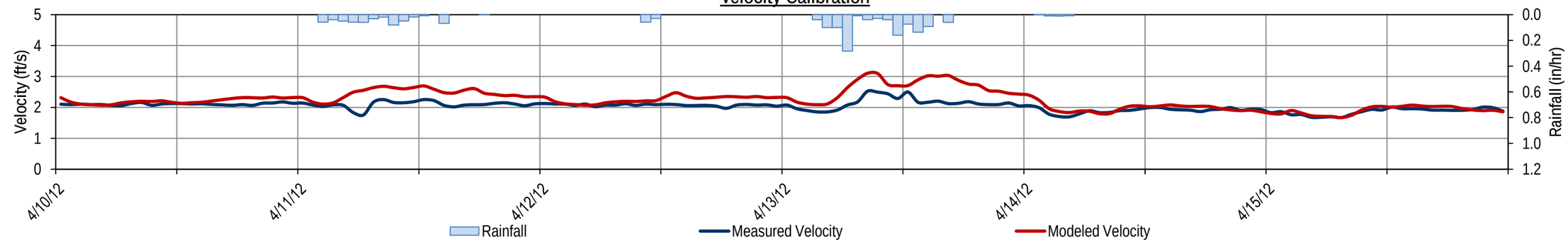
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR23 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

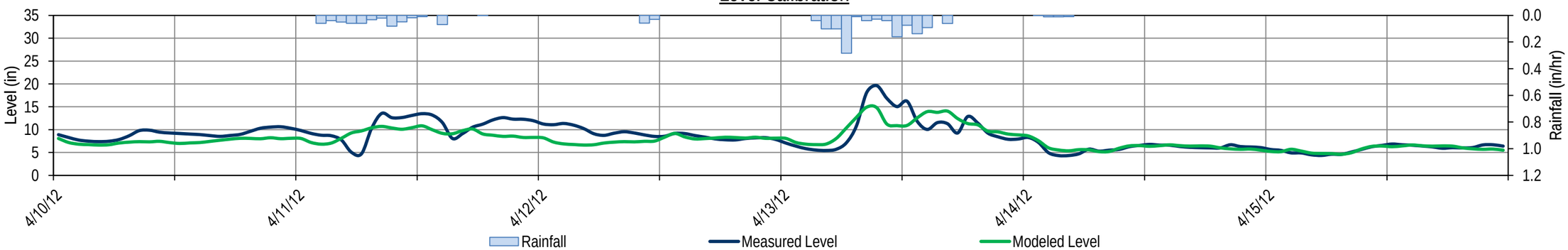
## Flow Calibration




## Velocity Calibration




## Level Calibration

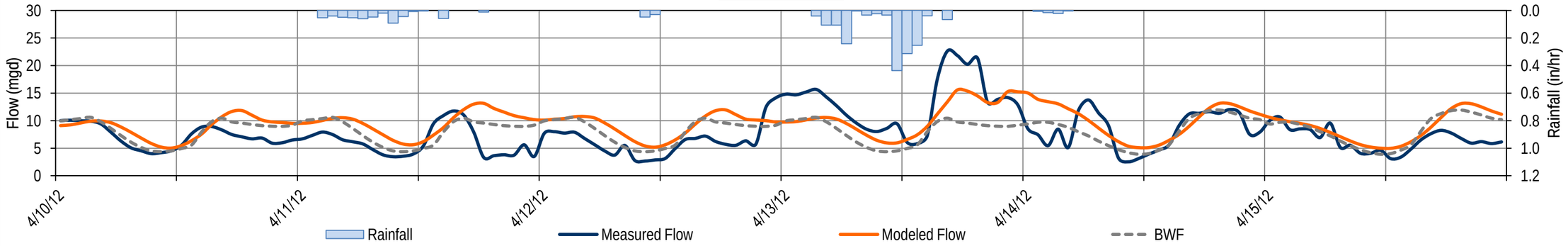


CITY OF FRESNO

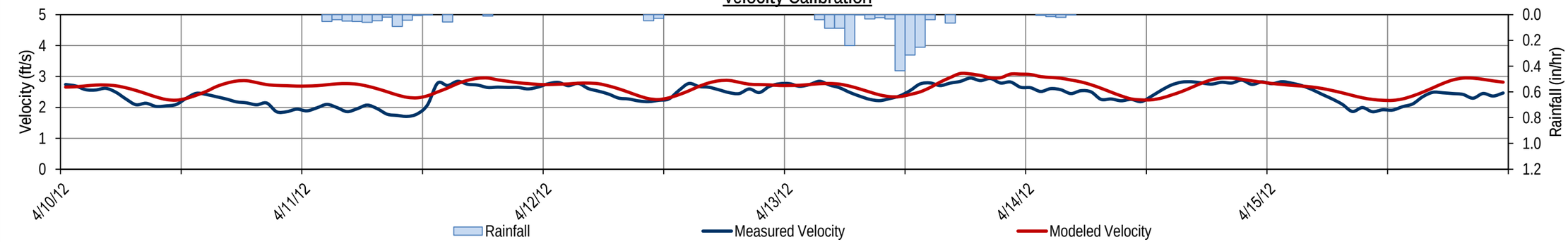
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR24 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

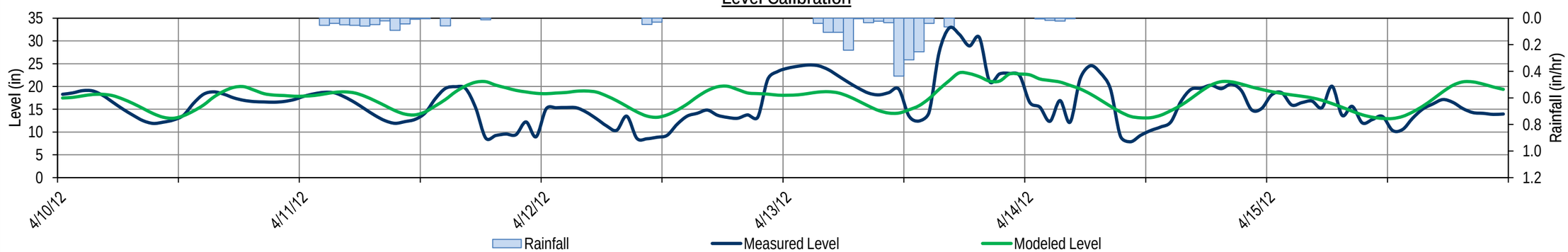
## Flow Calibration




## Velocity Calibration




## Level Calibration

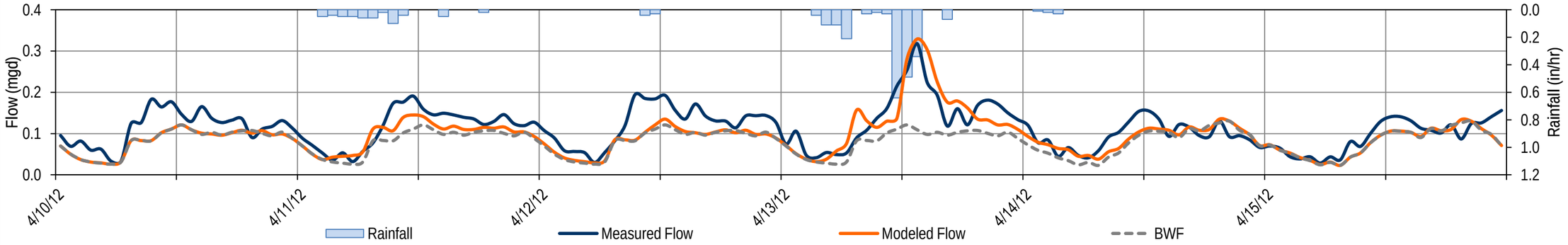


CITY OF FRESNO

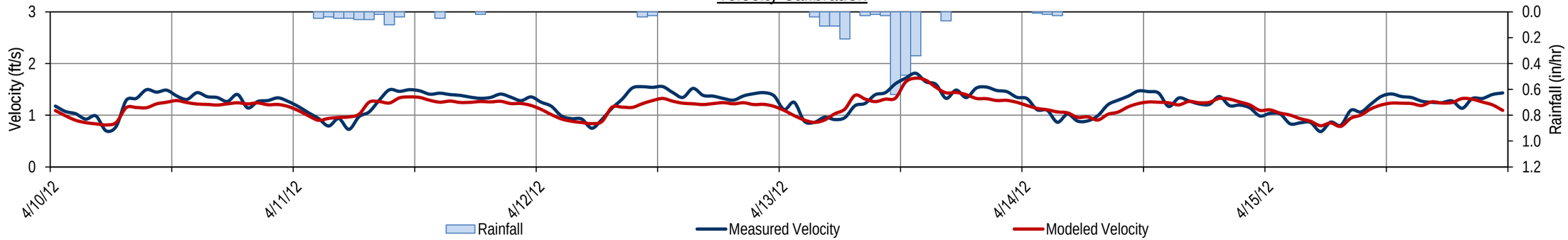
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR25 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

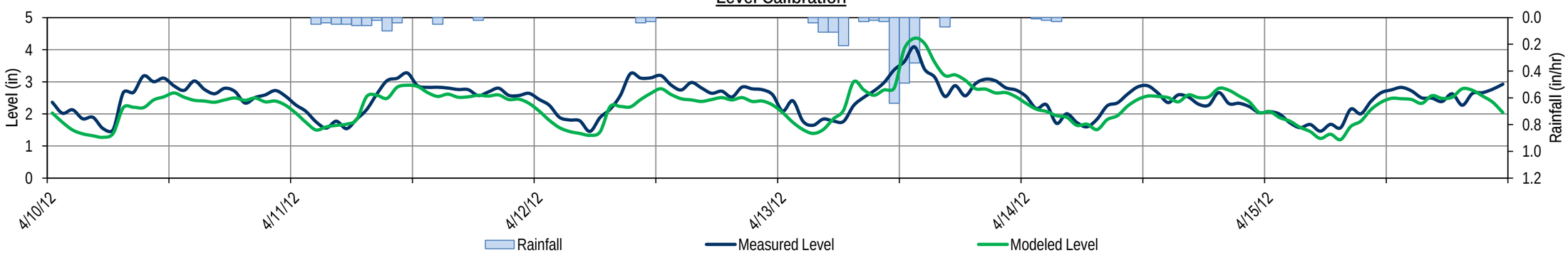
## Flow Calibration




## Velocity Calibration




## Level Calibration

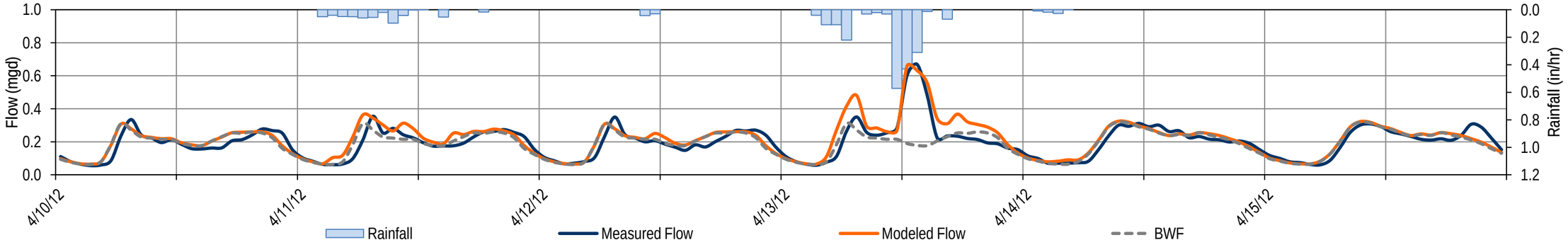


CITY OF FRESNO

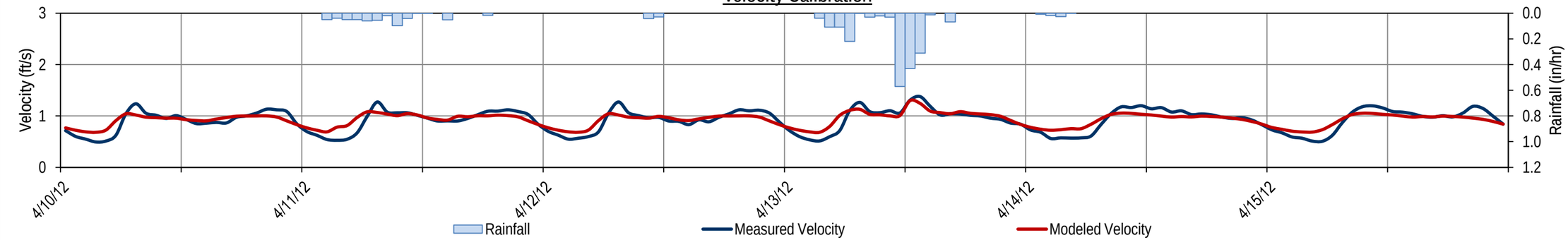
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR26 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

## Flow Calibration




## Velocity Calibration




## Level Calibration

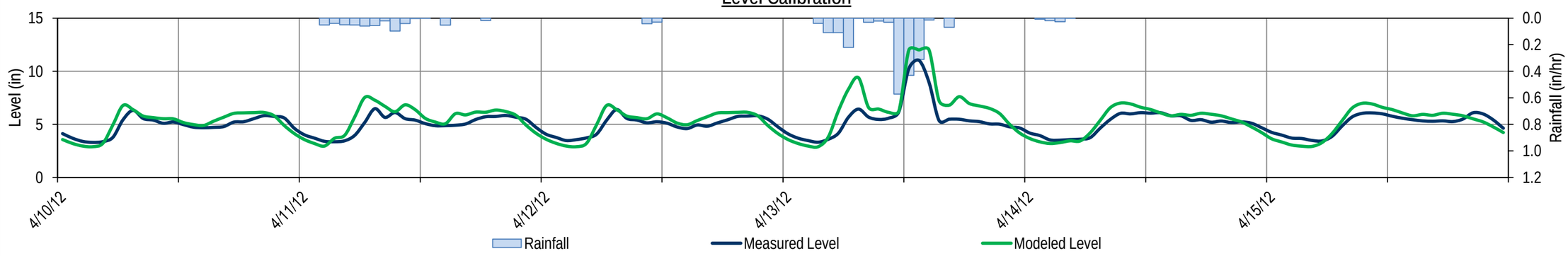


**Table 1 Wet Weather Calibration Summary - March 2011 Storm Event**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| Meter Number | March 20-21, 2011 Storm Event | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Measured Data[1] | | | | Modeled Data[2] | | | | Percent Error[3] | | | |
| | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (mgd) | Peak Flow (mgd) | Avg. Velocity (ft/s) | Avg. Level (in) | Avg. Flow (%) | Peak Flow (%) | Avg. Velocity (%) | Avg. Level (%) |
| FR01 | 4.142 | 6.641 | 3.52 | 9.7 | 4.282 | 6.444 | 3.19 | 10.7 | 3.4% | -3.0% | -9.6% | 10.7% |
| FR02 | 8.019 | 13.113 | 3.22 | 16.7 | 8.512 | 13.684 | 3.67 | 15.9 | 6.1% | 4.4% | 13.8% | -4.7% |
| FR12 | 2.106 | 3.823 | 1.95 | 10.3 | 2.088 | 3.845 | 2.08 | 9.7 | -0.9% | 0.6% | 6.6% | -5.5% |
| FR13 | 10.263 | 14.428 | 3.54 | 17.1 | 9.615 | 12.896 | 3.44 | 17.4 | -6.3% | -10.6% | -2.7% | 1.8% |
| FR15 | 7.574 | 11.218 | 2.36 | 19.9 | 7.030 | 9.866 | 2.33 | 18.9 | -7.2% | -12.0% | -1.4% | -4.8% |
| FR16 | 3.910 | 6.178 | 3.18 | 12.2 | 4.236 | 5.873 | 3.37 | 12.4 | 8.3% | -4.9% | 6.0% | 1.1% |

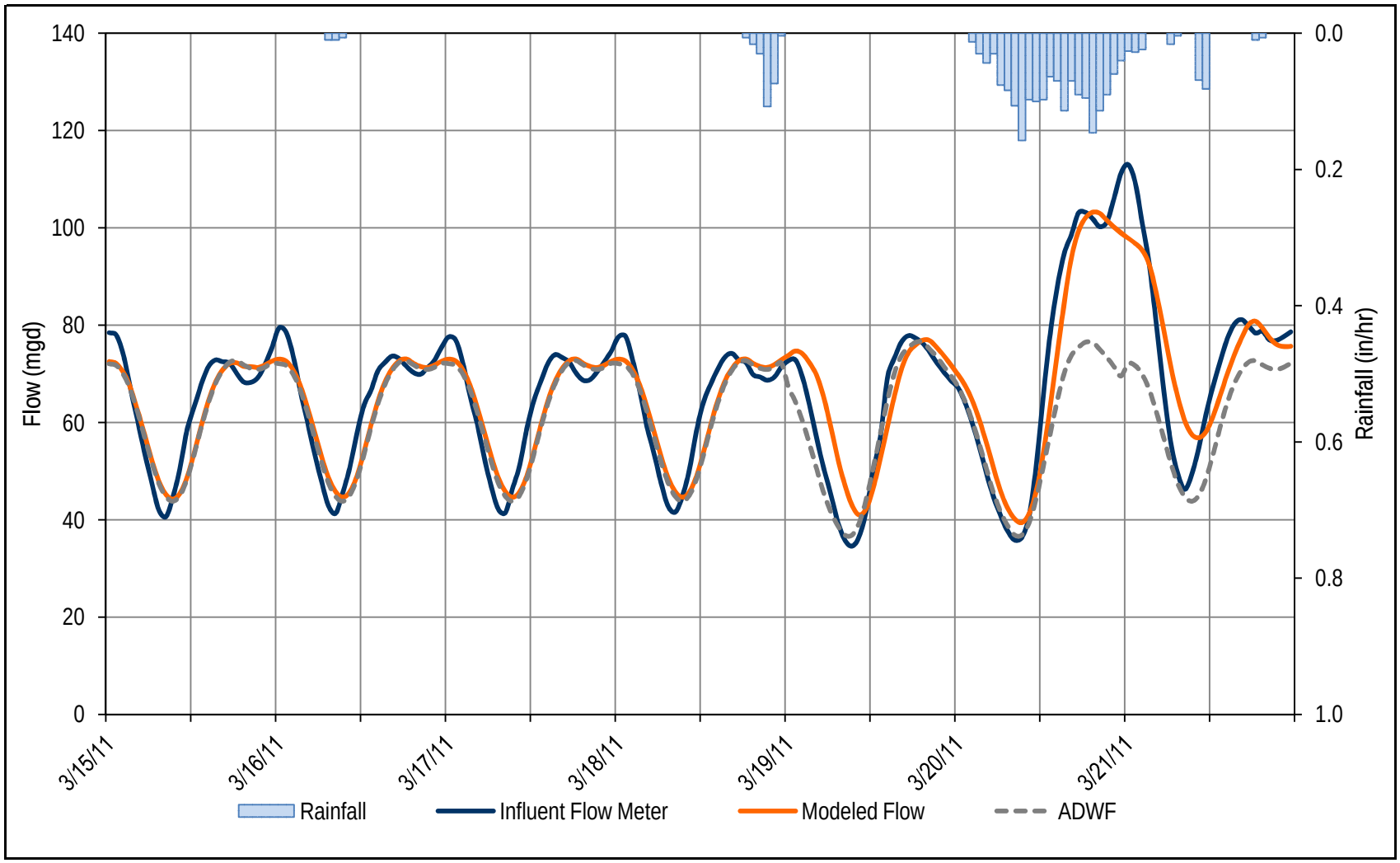
Notes:

1. Source: City of Fresno Permanent Flow Monitoring Data
2. Average flows are calculated from flow monitoring data. Maximum flow values are hourly peaks.
3. Percent Difference = (Modeled - Measured)/Measured*100.

CITY OF FRESNO

WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

RWRF WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

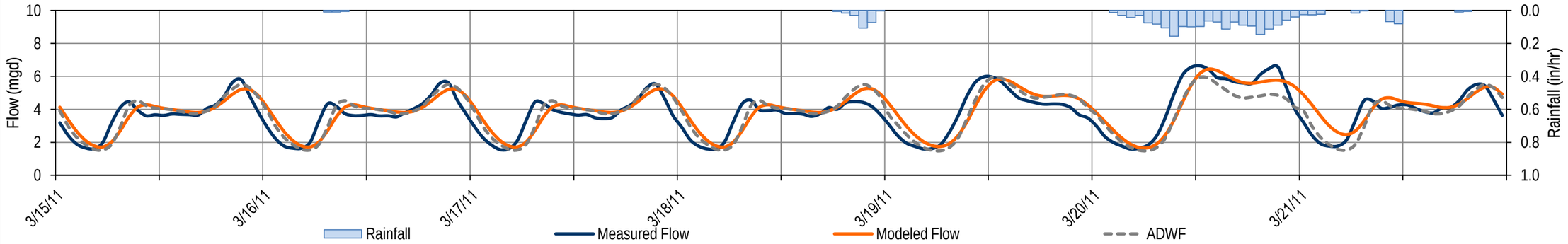


CITY OF FRESNO

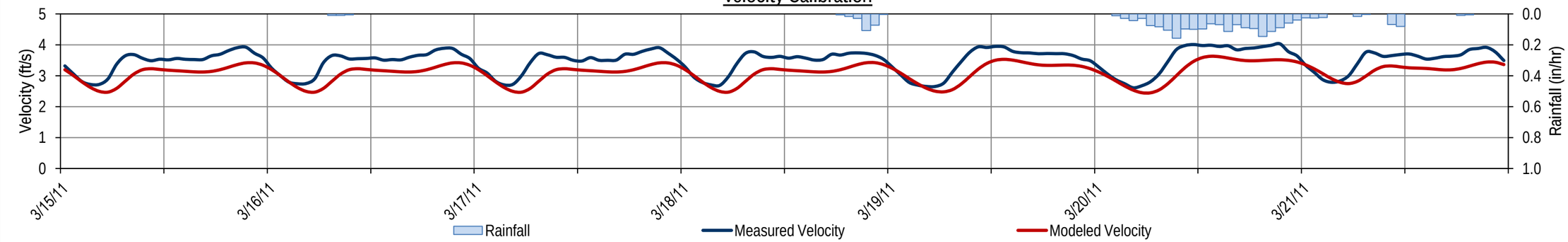
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR01 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

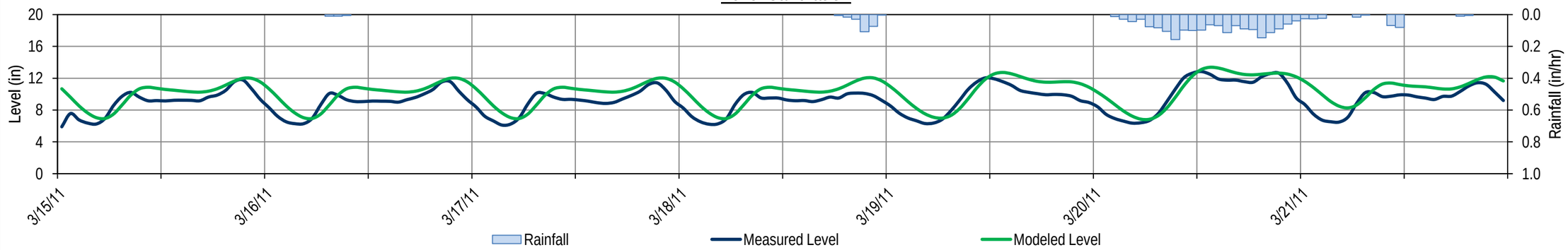
## Flow Calibration




## Velocity Calibration




## Level Calibration

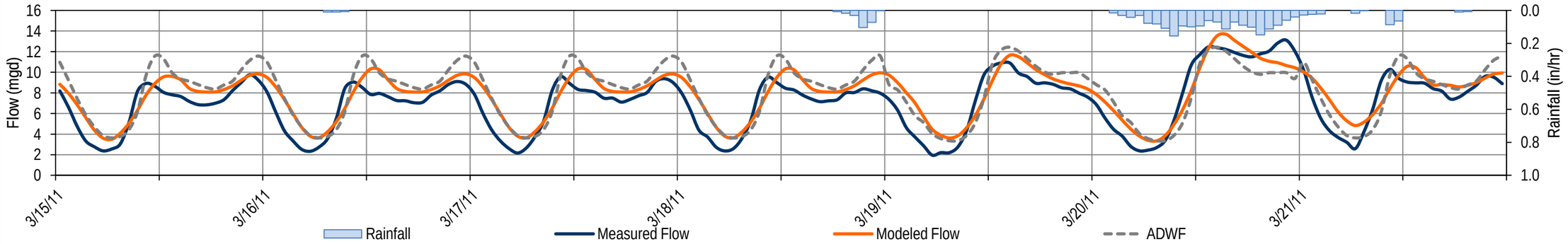


CITY OF FRESNO

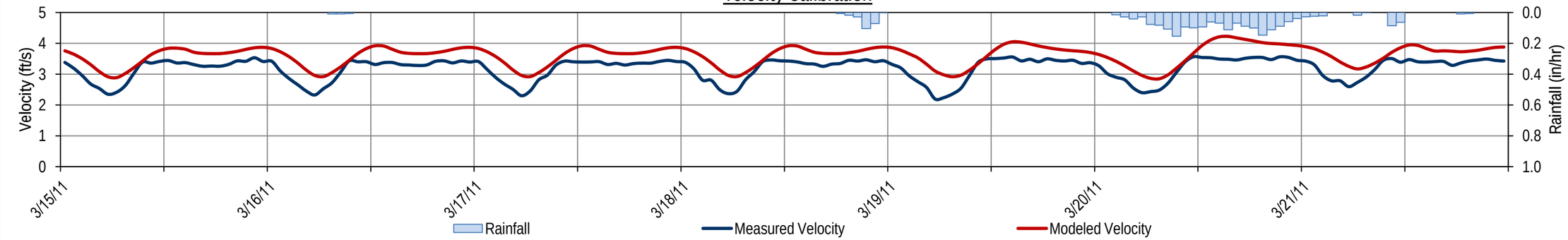
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR02 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

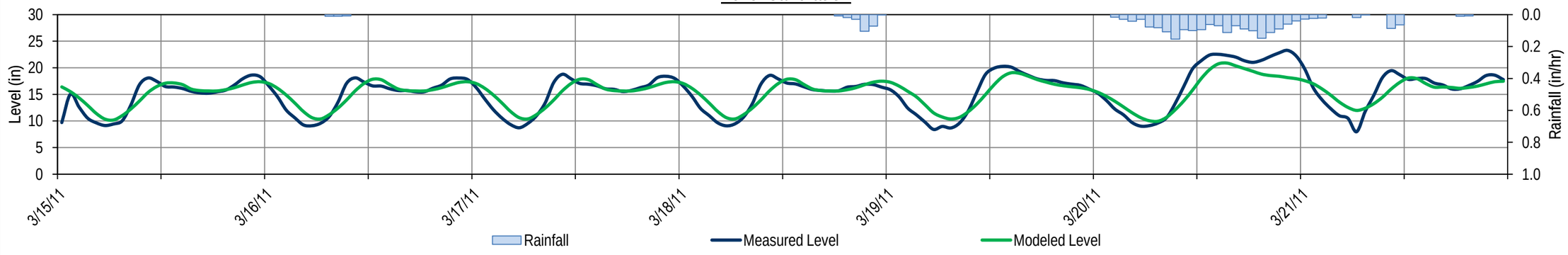
## Flow Calibration




## Velocity Calibration




## Level Calibration

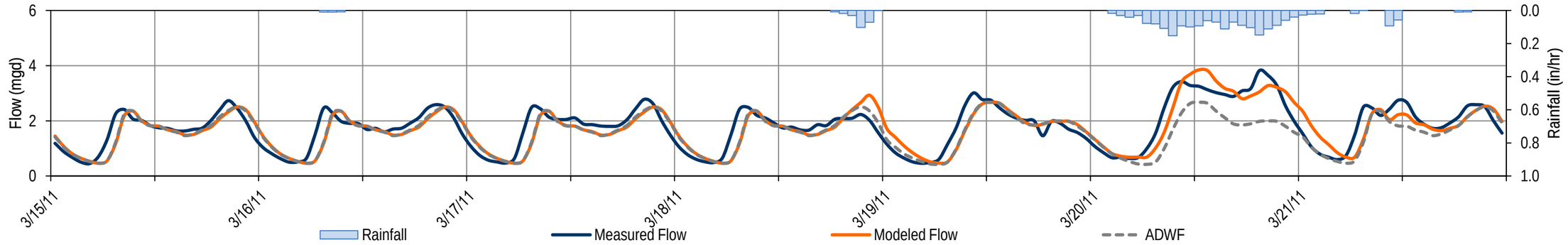


CITY OF FRESNO

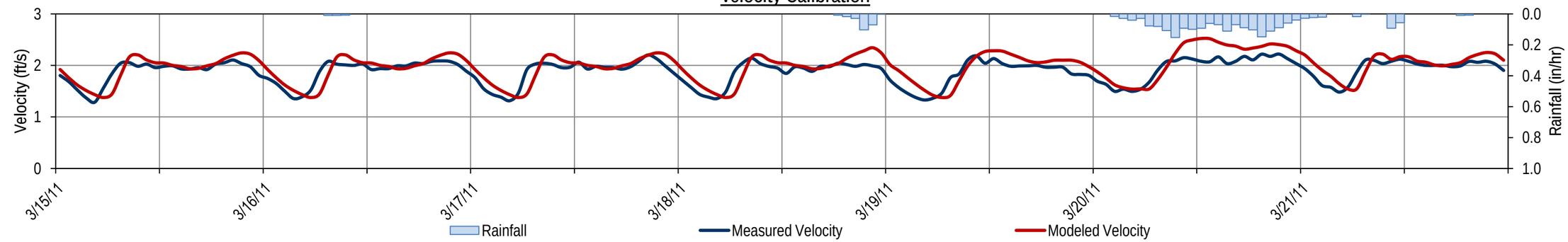
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR12 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

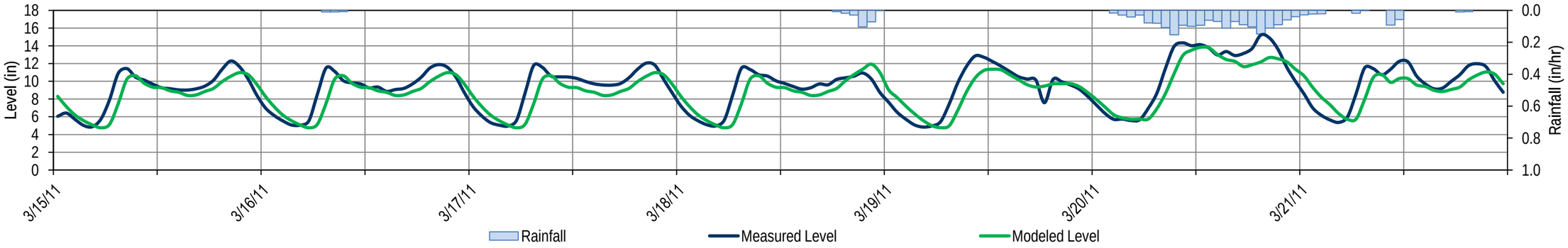
## Flow Calibration




## Velocity Calibration




## Level Calibration

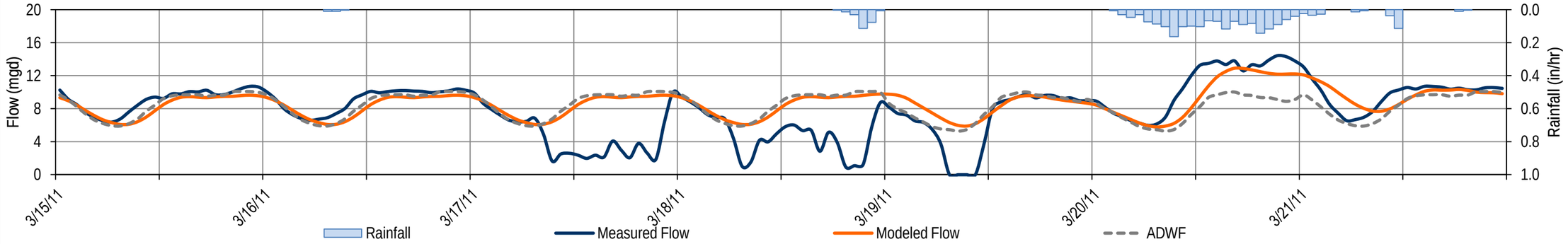


CITY OF FRESNO

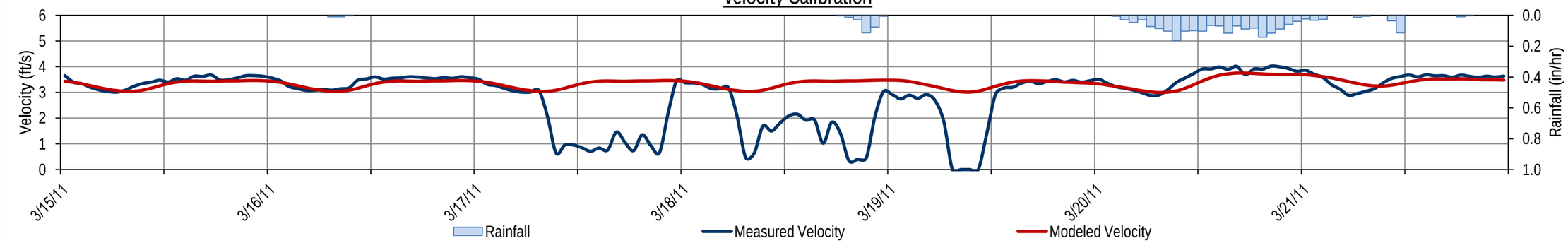
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR13 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

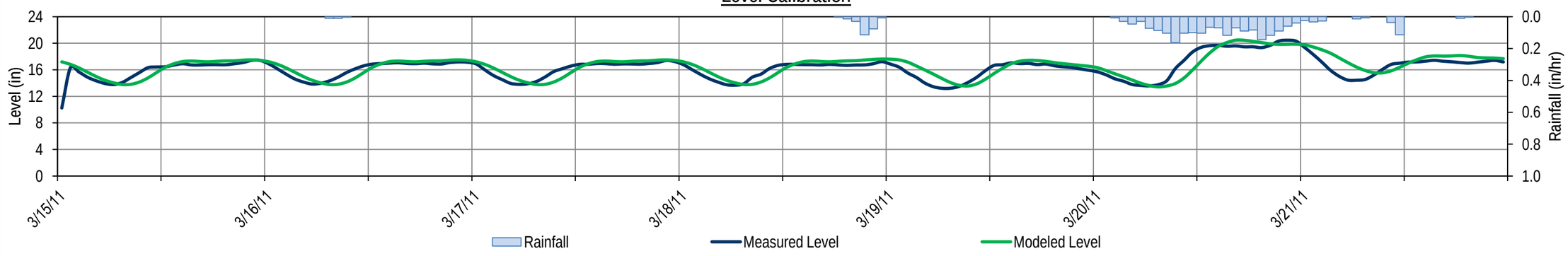
## Flow Calibration




## Velocity Calibration




## Level Calibration

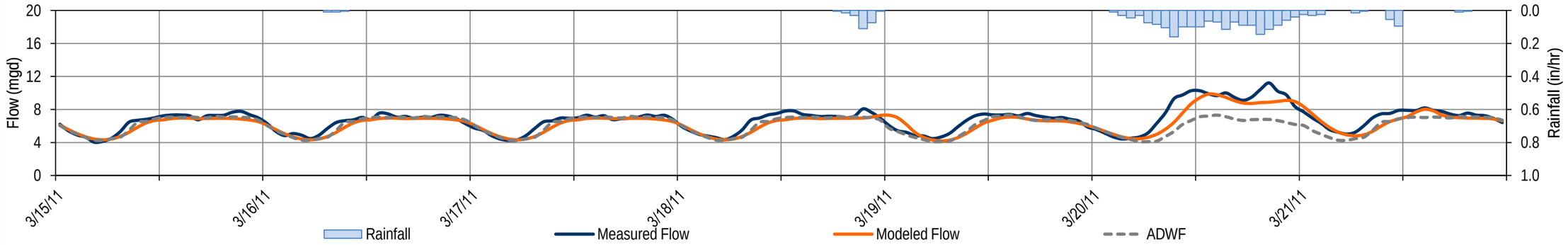


CITY OF FRESNO

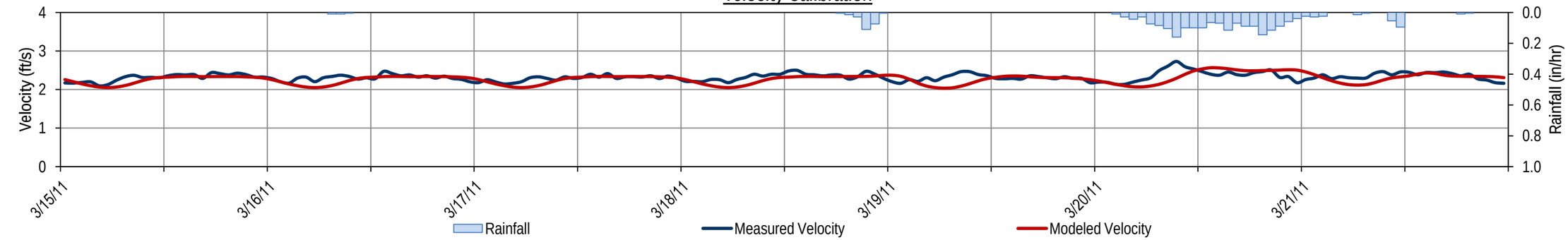
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR15 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

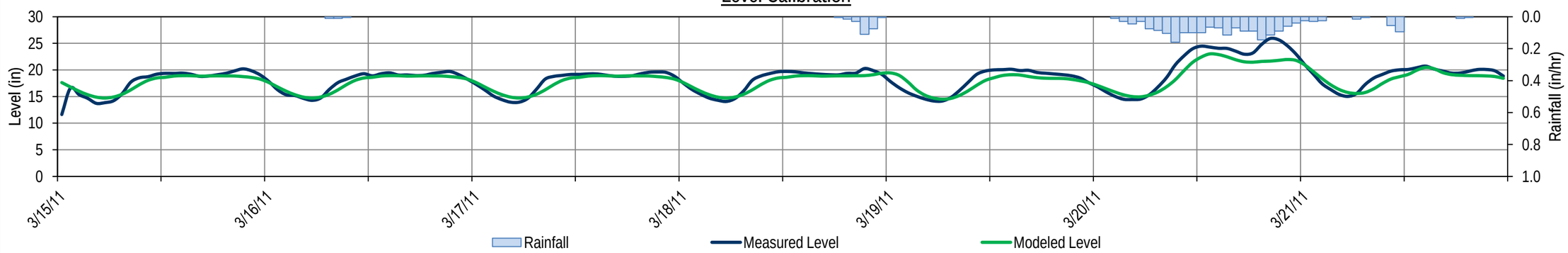
## Flow Calibration




## Velocity Calibration




## Level Calibration

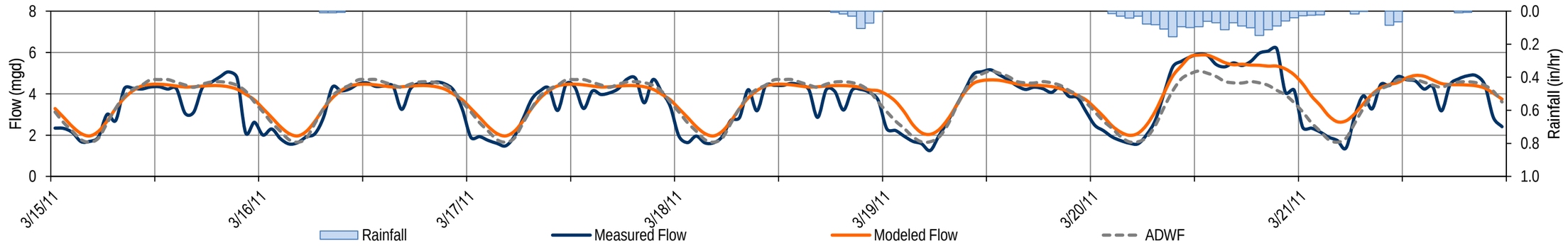


CITY OF FRESNO

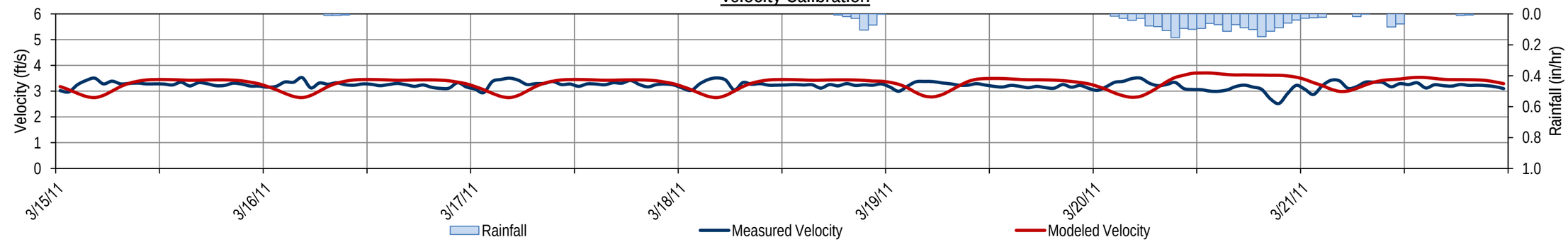
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR16 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

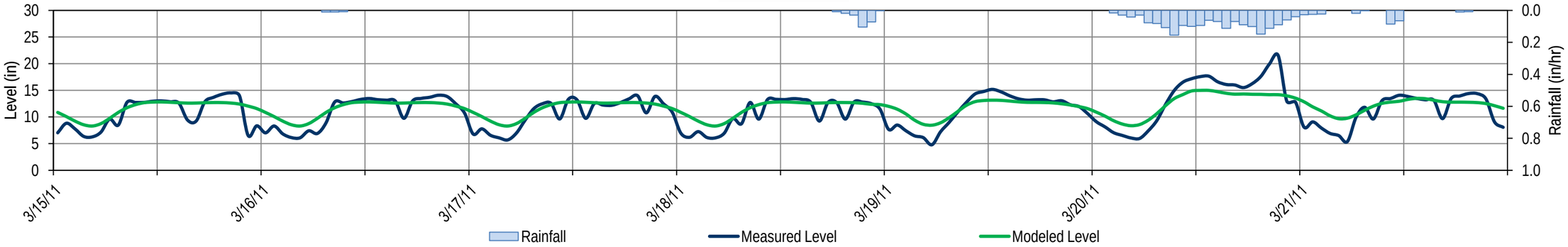
## Flow Calibration




## Velocity Calibration




## Level Calibration



# APPENDIX D – SIGNIFICANT INDUSTRIAL USER FLOW DATA

**Available Monthly SIU Discharge Data**
**Wastewater Collection System Master Plan Update**
**City of Fresno**

| | | Assumed Model Flows | | Actual Monthly Flow, where Available (gpd) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Model Flow | Model Flow | 2011 | | | | | | | | | | | | 2012 | | | | | | | | | | | | 2013 | | | | | |
| Name | Address | BWF (mgd) | PDWF (mgd) | Jan-11 | Feb-11 | Mar-11 | Apr-11 | May-11 | Jun-11 | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Apr-12 | May-12 | Jun-12 | Jul-12 | Aug-12 | Sep-12 | Oct-12 | Nov-12 | Dec-12 | Jan-13 | Feb-13 | Mar-13 | Apr-13 | May-13 | Jun-13 | Jul-13 | Aug-13 |
| Ameripride | 1050 W Whitesbridge | 0.086 | 0.114 | 81,731 | 82,704 | 91,630 | 110,430 | 87,591 | 81,183 | 95,420 | 88,488 | 68,816 | 77,617 | 94,423 | 113,123 | 107,887 | 65,026 | 65,699 | 67,445 | 29,471 | 72,556 | 91,854 | 75,199 | 86,494 | 100,830 | 113,846 | 110,679 | 85,596 | 68,442 | 52,659 | 67,021 | 51,562 | 43,608 | | |
| Angelica | 422 S Fruit | 0.091 | 0.116 | 116,139 | 72,506 | 54,928 | 61,286 | 57,172 | 66,348 | 79,413 | 81,906 | 69,365 | 80,211 | 67,869 | 75,598 | 88,364 | 67,096 | 61,112 | 62,907 | 64,627 | 68,841 | 94,348 | 77,144 | 104,944 | 84,424 | 116,065 | 73,379 | 91,106 | 73,354 | 66,447 | 98,911 | 73,279 | 74,975 | | |
| Aramark | 3333 N Sabre Dr | 0.110 | 0.160 | 117,985 | 113,945 | 112,225 | 131,897 | 111,776 | 122,497 | 159,922 | 155,035 | 130,825 | 125,839 | 145,935 | 150,223 | 154,487 | 135,488 | 131,847 | 129,828 | 121,001 | 123,096 | 145,561 | 112,001 | 155,808 | 121,425 | 147,855 | 116,663 | 110,230 | 114,220 | 119,680 | 142,319 | 116,887 | 111,976 | | |
| Beef Packers | 3115 S Fig | 0.659 | 1.009 | 1,009,476 | 777,033 | 753,161 | 803,925 | 682,475 | 873,066 | 802,031 | 896,303 | 699,006 | 768,096 | 740,196 | 853,543 | 865,137 | 673,175 | 708,431 | 691,302 | 731,369 | 888,026 | 663,700 | 815,270 | 765,603 | 714,440 | 881,842 | 683,772 | 658,589 | 638,867 | 868,603 | 630,838 | 678,660 | 851,773 | | |
| Breckenridge, Durbin | 1828 E Hedges Ave | 0.020 | 0.020 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cal Dairies 15" | 755 F St | 0.787 | 1.216 | 896,653 | 700,745 | 757,494 | 890,644 | 742,515 | 895,206 | 815,320 | 906,052 | 671,056 | 733,589 | 736,531 | 960,208 | 1,101,629 | 882,640 | 914,355 | 910,939 | 1,182,613 | 1,215,650 | 1,006,160 | 918,444 | 647,967 | 573,317 | 780,114 | 654,575 | 787,469 | 823,997 | 1,087,692 | 865,212 | 901,490 | 1,382,030 | 946,370 | |
| Cellulo | 81 M St | 0.076 | 0.152 | 95,306 | 67,198 | 98,676 | 72,648 | 144,721 | 100,058 | 54,029 | 82,430 | 130,250 | 73,229 | 59,937 | 88,439 | 72,076 | 87,993 | 107,297 | 115,712 | 85,716 | 100,801 | 117,922 | 95,882 | 93,536 | 125,938 | 152,255 | 92,702 | 75,827 | 106,222 | 115,317 | 106,359 | 116,278 | | | |
| Clovis Connection | Ashlan and Peach | 1.910 | 1.910 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clovis Connection | Fowler and Sussex | 1.434 | 1.434 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clovis Connection | Herndon and Willow | 1.582 | 1.582 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clovis Connection | Sierra and Willow | 0.191 | 0.191 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Community Hospital | 202 N Valeria St | 0.226 | 0.226 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ConAgra | 5626 E Shields | 0.017 | 0.017 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Costco Wholesale | 4500 W Shaw Ave | 0.011 | 0.011 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Costco Wholesale #657 | 7100 N Abby St | 0.014 | 0.014 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CSUF Cedar | 5241 N Maple Ave | 0.150 | 0.150 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CSUF Maple | 5241 N Maple Ave | 0.081 | 0.140 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Darling | 995 W Belgravia | 0.068 | 0.086 | 86,269 | 79,193 | 77,119 | 76,570 | 61,012 | 75,448 | 64,677 | 75,623 | 57,970 | 67,170 | 67,220 | 80,211 | 85,172 | 66,447 | 65,026 | 69,888 | 63,381 | 79,288 | 60,638 | 68,143 | 62,209 | 62,882 | 77,792 | 67,569 | 67,968 | 62,682 | 91,081 | 73,678 | 69,439 | 84,000 | | |
| E&J Gallo Winery (A) | 5610 E Olive | 0.145 | 0.328 | 205,326 | 133,610 | 327,799 | 147,830 | 62,059 | 195,477 | 129,903 | 106,191 | 60,463 | 98,886 | 6,308 | 42,112 | 159,773 | 73,030 | 166,405 | 151,719 | 199,093 | 233,925 | 122,173 | 128,531 | 76,121 | 169,472 | 192,660 | 96,517 | 144,813 | 104,047 | 55,950 | 100,905 | 31,989 | 78,540 | | |
| E&J Gallo Winery (FATS) | 5610 E Olive | 0.154 | 1.348 | 375,097 | 749,478 | 384,622 | 848,407 | 446,855 | 641,086 | 515,048 | 645,491 | 1,002,470 | 1,334,233 | 1,347,672 | 820,357 | 318,872 | 570,874 | 398,534 | 341,562 | 909,468 | 461,666 | 440,896 | 720,698 | 955,221 | 1,152,344 | 1,102,178 | 671,978 | 154,836 | 409,256 | 846,088 | 330,067 | 499,465 | 494,403 | | |
| Foster Farms (Front) | 900 W Belgravia | 0.022 | 0.056 | 40,916 | 40,467 | 38,796 | 38,746 | 38,173 | 32,264 | 48,022 | 38,572 | 34,009 | 33,111 | 35,630 | 46,376 | 25,781 | 21,966 | 24,360 | 32,812 | 29,471 | 41,040 | 50,590 | 38,622 | 56,399 | 36,727 | 56,349 | 48,520 | 22,191 | 21,019 | 21,094 | 30,294 | 32,388 | 22,490 | | |
| Foster Farms (Pretreat) | 900 W Belgravia | 1.326 | 1.861 | 1,343,857 | 1,249,035 | 1,332,562 | 1,422,497 | 1,251,254 | 1,331,839 | 1,860,825 | 1,632,759 | 1,404,395 | 1,322,167 | 1,236,045 | 1,599,623 | 1,641,810 | 1,357,819 | 1,315,931 | 1,458,575 | 1,399,234 | 1,392,776 | 1,832,650 | 1,411,102 | 1,731,869 | 1,341,812 | 1,686,466 | 1,278,606 | 1,326,304 | 1,398,660 | 1,318,175 | 1,661,258 | 1,323,860 | 1,318,300 | | |
| Foster Farms Poultry | 2960 S Cherry | 1.492 | 1.951 | 1,712,995 | 969,558 | 1,293,167 | 1,290,325 | 1,246,791 | 1,364,078 | 1,691,677 | 1,735,036 | 1,550,429 | 1,299,675 | 1,525,970 | 1,741,469 | 1,749,173 | 1,568,132 | 1,618,921 | 1,639,092 | 1,446,831 | 1,327,401 | 1,726,758 | 1,368,242 | 1,682,776 | 1,511,110 | 1,951,058 | 1,433,866 | 1,492,410 | 1,386,094 | 1,263,372 | 1,637,322 | 1,328,697 | 1,251,703 | | |
| Fresno Bee | 1626 E St | 0.044 | 0.052 | 16,281 | 11,100 | 29,347 | 17,503 | 24,360 | 8,303 | 7,954 | 9,624 | 7,879 | 11,270 | 16,905 | 39,220 | 52,235 | 24,185 | 17,902 | 19,099 | 16,556 | 12,492 | 7,879 | 9,574 | 8,901 | 10,472 | 22,490 | 33,311 | 44,057 | 32,713 | 60,937 | 24,809 | 28,823 | 11,494 | | |
| Fruit Fillings | 2531 E Edgar | 0.016 | 0.023 | 15,209 | 14,486 | 14,885 | 18,501 | 13,364 | 13,838 | 18,949 | 20,071 | 17,054 | 16,207 | 19,623 | 19,573 | 18,426 | 16,207 | 16,032 | 15,234 | 16,356 | 15,583 | 13,663 | 15,359 | 21,218 | 14,312 | 23,288 | 16,456 | 16,207 | 17,628 | 15,808 | 20,021 | 15,509 | 19,822 | | |
| Kaiser Permanente Inc | 7300 N Fresno St | 0.066 | 0.066 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Kraft-Capri Sun | 2494 S Orange | 0.079 | 0.137 | 126,836 | 104,577 | 111,427 | 118,533 | 112,724 | 136,660 | 126,985 | 136,136 | 104,321 | 120,902 | 117,361 | 103,423 | 111,552 | 91,032 | 126,337 | 90,259 | 97,988 | 121,326 | 89,087 | 133,717 | 99,010 | 93,600 | 105,368 | 52,161 | 78,615 | 93,375 | 143,766 | 95,769 | 109,632 | 131,473 | 86,195 | 108,011 |
| Kraft-Cornnuts | 4343 E Florence | 0.186 | 0.312 | 124,318 | 100,793 | 187,125 | 209,664 | 137,881 | 166,430 | 199,517 | 163,488 | 197,372 | 124,118 | 120,403 | 148,578 | 193,632 | 166,505 | 219,239 | 186,651 | 232,254 | 236,941 | 312,415 | 195,303 | 226,644 | 129,254 | 170,818 | 182,886 | 185,654 | 143,766 | 175,506 | 155,409 | 122,223 | 146,508 | 214,526 | |
| La Tapatia | 104 E Belmont | 0.017 | 0.027 | 14,935 | 11,619 | 20,246 | | 17,503 | 16,057 | 19,672 | 18,650 | 24,135 | 18,326 | 19,523 | 19,947 | 21,094 | 15,035 | 13,663 | 11,395 | 18,999 | 20,296 | 27,452 | 20,171 | 26,778 | 25,831 | 25,407 | 24,285 | 17,578 | 18,875 | 18,226 | 30,942 | | | | |
| La Tapatia B | 94 E Belmont | 0.034 | 0.050 | 15,907 | 12,417 | 9,151 | 7,281 | 2,743 | 28,349 | 27,925 | 43,833 | 30,942 | 26,112 | 16,655 | 49,817 | 44,481 | 42,087 | 30,818 | 26,055 | 29,770 | 35,206 | 45,952 | 34,009 | 28,798 | 30,618 | 30,992 | 41,190 | 34,458 | 31,067 | 21,193 | 23,163 | | | | |
| LiDestri | 568 S Temperance | 0.205 | 0.326 | 236,617 | 240,688 | 227,217 | 178,523 | 219,737 | 249,707 | 217,319 | 303,663 | 195,926 | 183,484 | 282,345 | 277,807 | 205,176 | 201,935 | 216,571 | 168,649 | 247,239 | 326,452 | 202,533 | 323,510 | 267,634 | 257,836 | 283,642 | 224,500 | | | | | | | | |
| Louie, Jay | 471 S Teilman Ave | 0.016 | 0.016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lyons PLT 1 | 1634 S Second St | 0.109 | 0.204 | 89,361 | 126,136 | 217,618 | 282,569 | 347,122 | 391,927 | 358,292 | 556,063 | 276,411 | 191,064 | 187,923 | 223,178 | 177,027 | 211,659 | 229,486 | 270,901 | 378,588 | 436,583 | 392,501 | 610,767 | 317,775 | 194,330 | 255,791 | 188,147 | 114,120 | | | | | | | |
| Lyons PLT 1 | 1635 S Second St | 0.109 | 0.204 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lyons PLT 1 | 1636 S Second St | 0.109 | 0.204 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mission Linen | 2555 S Orange | 0.020 | 0.055 | 20,296 | 21,717 | 22,664 | 26,729 | 33,386 | 45,927 | 49,418 | 47,573 | 55,452 | 42,960 | 41,115 | 41,140 | 44,606 | 30,319 | 21,742 | 16,855 | 18,127 | 35,630 | 52,061 | 36,901 | 44,182 | 35,879 | 35,954 | 35,680 | 20,445 | 13,913 | 10,946 | 6,183 | 34,533 | 28,025 | 36,577 | 29,247 |
| New World Pasta | 2704 S Maple | 0.015 | 0.027 | 20,021 | 9,700 | 22,567 | 16,381 | 26,679 | 2,194 | 27,452 | 4,114 | 6,009 | 5,061 | 3,715 | 3,316 | 3,590 | 4,712 | 7,081 | 7,729 | 5,560 | 8,427 | 16,456 | 13,838 | 25,058 | 17,005 | 21,667 | 18,575 | 15,409 | 11,370 | 11,395 | 21,044 | 22,964 | 18,775 | 20,545 | 13,813 |
| Pacific Choice | 4667 E Date | 0.096 | 0.230 | 112,375 | 54,978 | 166,555 | 154,936 | 119,630 | 167,826 | 229,611 | 202,957 | 203,431 | 187,000 | 193,782 | 147,705 | 121,849 | 64,054 | 91,555 | 75,199 | 105,717 | 119,481 | 166,181 | 111,477 | 211,160 | 177,575 | 158,003 | 108,734 | 95,644 | 57,421 | 91,206 | 97,065 | | | | |
| PepsiCo | 1150 E North | 0.126 | 0.277 | 123,993 | 131,847 | 163,014 | 173,312 | 208,343 | 196,674 | 250,231 | 201,536 | 181,789 | 152,991 | 149,824 | 180,717 | 157,404 | 138,679 | 144,937 | 150,797 | 162,815 | 204,852 | 277,458 | 226,370 | 203,082 | 171,417 | 171,716 | 115,741 | 126,487 | 139,053 | 181,839 | | | | | |
| Producers Dairy | 144 E Belmont | 0.244 | 0.256 | 220,560 | 220,111 | 227,442 | 240,208 | 212,158 | 199,118 | 227,716 | 199,093 | 245,893 | 207,321 | 209,739 | 245,219 | 244,870 | 198,569 | 202,932 | 177,974 | 253,348 | 210,562 | 255,666 | | | | | | | | | | | | | |
| Producers Dairy | 144 E Belmont | 0.220 | 0.220 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Prudential | 1260 E North | 0.017 | 0.028 | 27,676 | 24,709 | 24,509 | 17,204 | 13,564 | 23,188 | 15,658 | 17,304 | 13,439 | 13,963 | 14,860 | 16,730 | 17,603 | 15,683 | 12,591 | 13,763 | 15,085 | 14,212 | 16,207 | 12,342 | 17,329 | 21,368 | 25,083 | | | | | | | | | |
| Rich Products | 320 O St | 0.022 | 0.039 | 32,048 | 38,746 | 22,864 | 18,476 | 15,858 | 37,575 | 30,020 | 35,879 | 28,428 | 22,964 | 8,502 | 4,438 | 21,542 | 15,159 | 13,813 | 13,713 | 27,402 | 26,554 | 25,307 | 27,402 | 22,615 | 19,398 | | | | | | | | | | |
| San Joaquin Fig | 3564 N Hazel | 0.012 | 0.012 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SJV Concentrate | 5631 E Olive | 0.013 | 0.013 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| St Agnes Hospital | 1303 E Herndon Ave | 0.274 | 0.274 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| VA Medical Ctr 134 | 2615 E Clinton Ave | 0.090 | 0.090 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Valley Fig | 2028 S Third | 0.045 | 0.201 | 91,406 | 45,867 | 53,158 | 59,865 | 49,567 | 56,200 | 76,795 | 127,359 | 86,544 | 71,235 | 62,358 | 127,260 | 105,742 | 200,564 | 46,925 | 71,459 | 95,195 | 99,334 | 70,312 | 60,339 | 46,376 | 74,975 | 114,643 | 55,826 | 44,855 | 58,494 | | | | | | |
| Wawona Fresno | 2202 S Cedar | 0.076 | 0.280 | 0 | 0 | 0 | 0 | 0 | 103,000 | 103,000 | 228,414 | 234,473 | 183,310 | 75,149 | | | | | | | 51,138 | 57,421 | 280,126 | 188,720 | | | | | | | | | | |
| Westlake | | 0.000 | 0.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Yosemite | 3330 E Church | 0.019 | 0.049 | 19,523 | 27,393 | 35,380 | 44,157 | 27,851 | 22,989 | 25,806 | 31,217 | 18,351 | 22,141 | 28,948 | 27,402 | 34,433 | 26,030 | 30,344 | 26,579 | 38,123 | 48,795 | 46,251 | 46,900 | 30,244 | 28,623 | 38,572 | 20,620 | 18,974 | 21,019 | 34,583 | 28,723 | 30,967 | 30,194 | 31,815 | |
| Zacky Packing | 2950 E California | 0.113 | 0.210 | 125,067 | 102,326 | 103,573 | 116,788 | 107,911 | 138,330 | 123,021 | 138,131 | 120,927 | 127,933 | 117,635 | 115,042 | 135,263 | 182,736 | 113,621 | 114,344 | 131,922 | 205,201 | 149,176 | 209,590 | 158,925 | 157,304 | 184,931 | 139,178 | 112,998 | 67,968 | 155,360 | | | | | |
| Zacky Turkey | 2222 S East | 0.396 | 0.816 | 355,200 | 287,933 | 290,099 | 441,071 | 444,312 | 527,365 | 475,504 | 517,092 | 362,306 | 448,725 | 623,832 | 423,343 | 375,197 | 411,101 | 566,336 | 455,707 | 601,168 | 659,088 | 574,863 | 689,531 | 629,492 | 684,595 | 815,844 | 440,871 | 396,265 | 396,639 | 555,639 | 378,338 | | | | |

# APPENDIX E – FIELD RECONNAISSANCE DATA

Structure Information

| Location | Manhole ID | Model ID | Time of Survey |
|---|---|---|---|
| Herndon Ave and Milburn Ave | 1346-25 | 7780 | 11:30 AM |

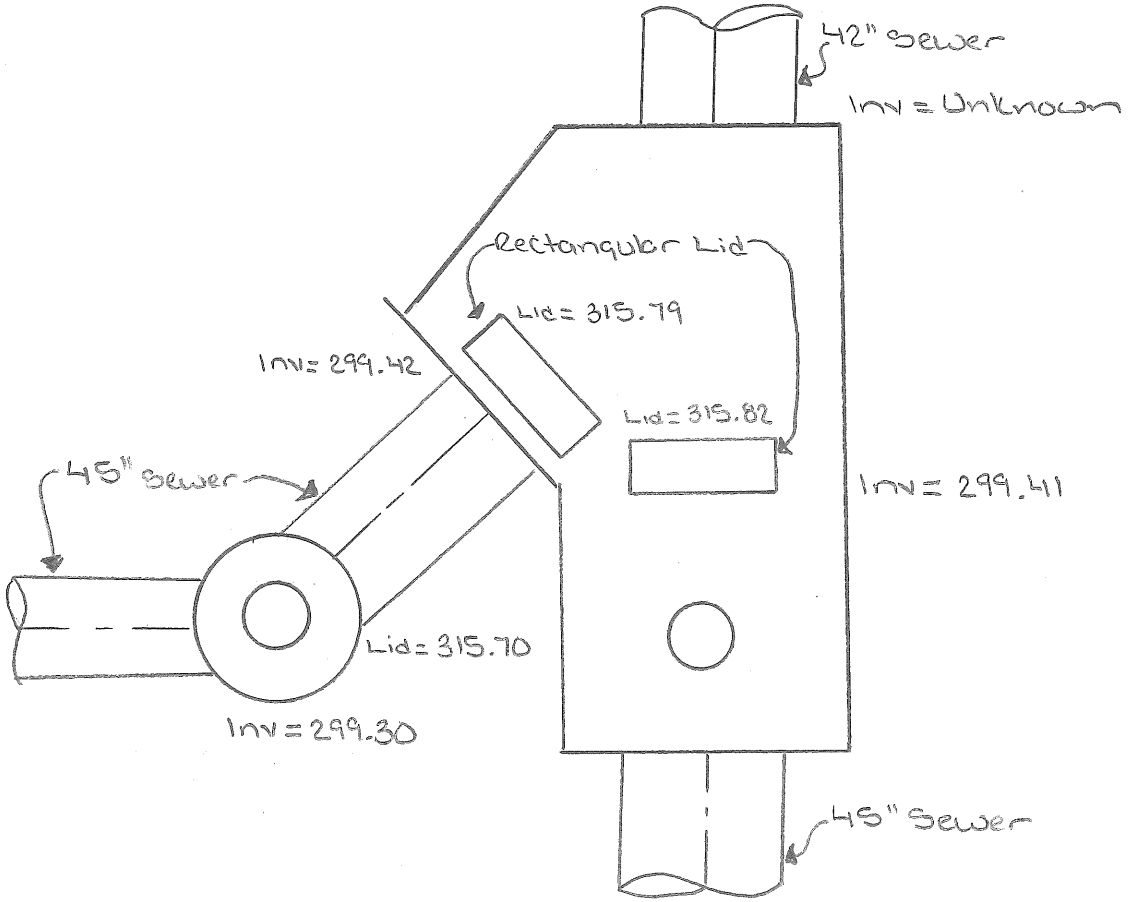
| Rim and Invert Data | Elevation |
|---|---|
| North Rectangular Lid (avg 4 corners) | 315.79 |
| Southwest FL | 299.42 |
| East Rectangular Lid (avg 4 corners) | 315.82 |
| South FL | 299.41 |
| North FL | Unknown |
| West MH Rim | 315.70 |
| Northeast and West FL | 299.30 |

| Depth of Flow (estimated) | |
|---|---|
| West | 50% |
| South | No flow to south, slide gate closed |
| Inlet Pipe | Could not be determined |

| Flow to Each Outlet Pipe (estimated) | |
|---|---|
| West | 100% |
| South | 0% |

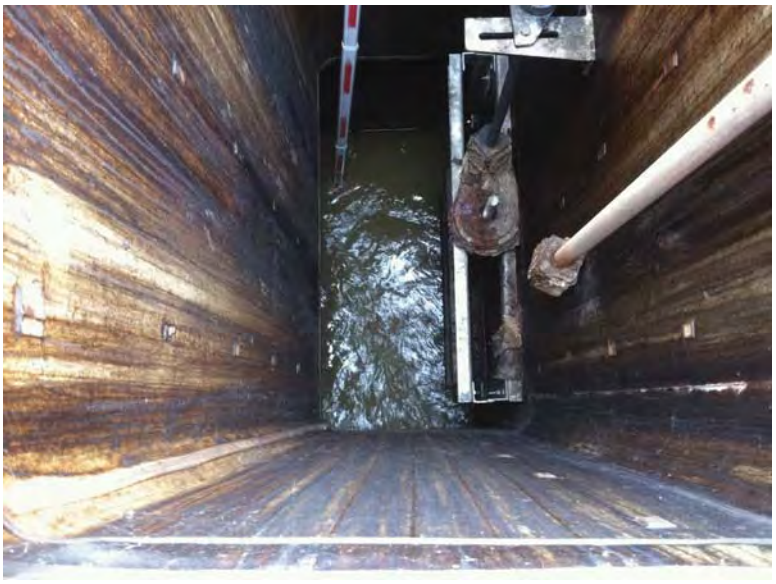
General Observations

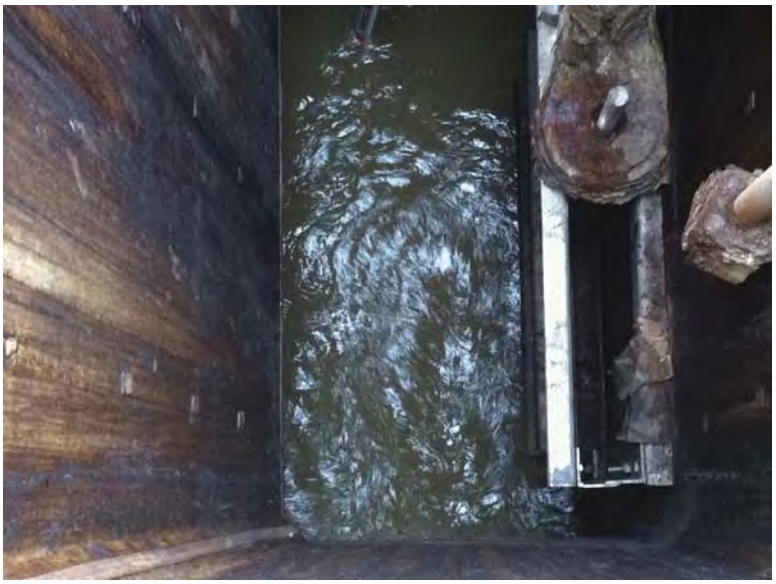
Wastewater was swirling around inside junction structure, all flow goes to west as the slide gate to the south is closed. Invert for the inlet pipe could not be determined due to the location of the structure lids.



MH 1346-25 Herndon and Milburn

MH 1346-25 Herndon and Milburn





MH 1346-25 Herndon and Milburn

MH 1346-25 Herndon and Milburn

MH 1346-25 Herndon and Milburn

MH 1346-25 Herndon and Milburn

Structure Information

| Location | Manhole ID | Model ID | Time of Survey |
|---|---|---|---|
| McKinley Ave and Harrison Ave | 2253-15 | 25677 | 11:00 AM |

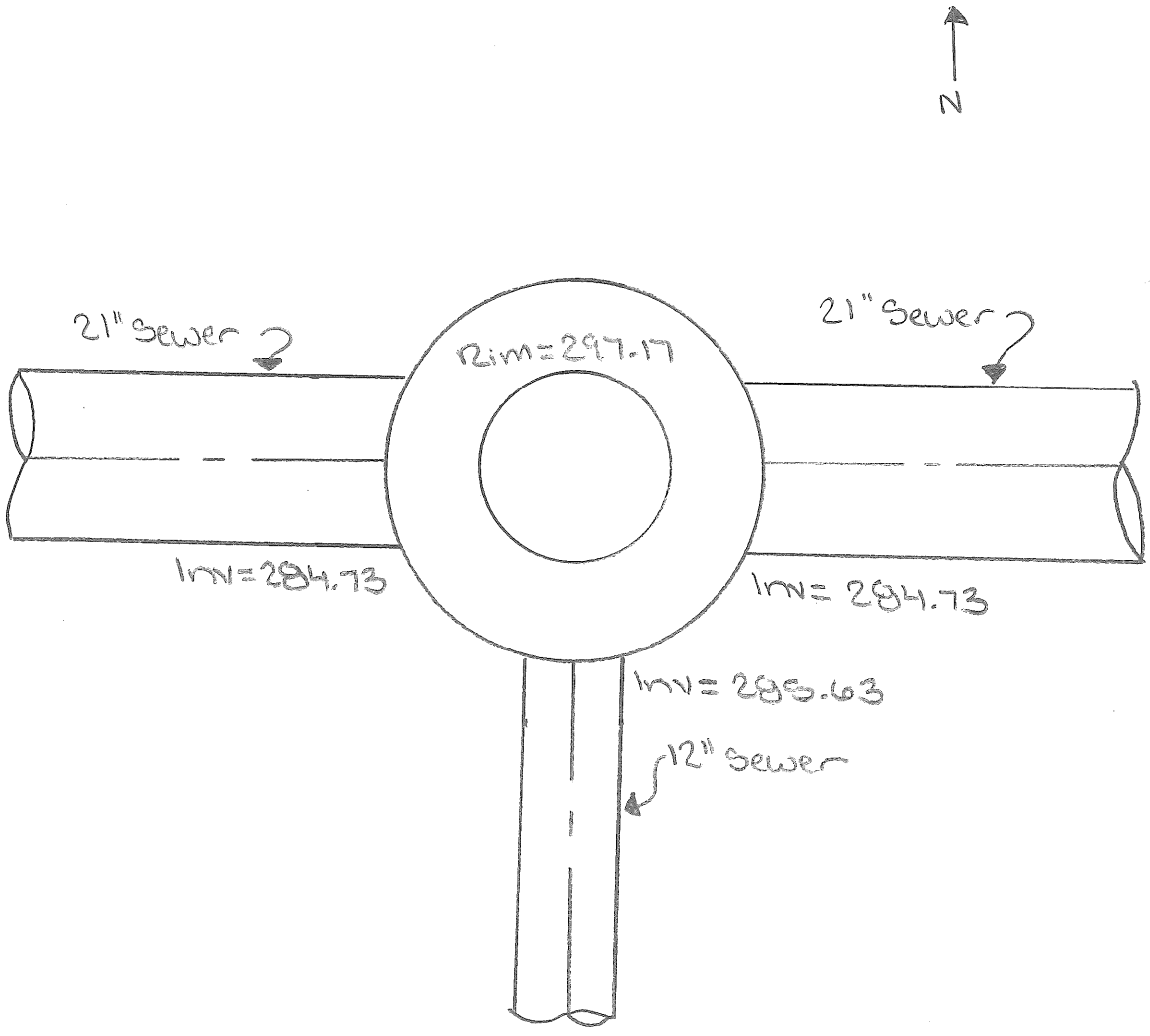
| Rim and Invert Data | Elevation |
|---|---|
| Rim | 297.17 |
| East and West FL | 284.73 |
| South FL | 285.63 |

| Depth of Flow (estimated) | |
|---|---|
| East and West | 30% to 50% |

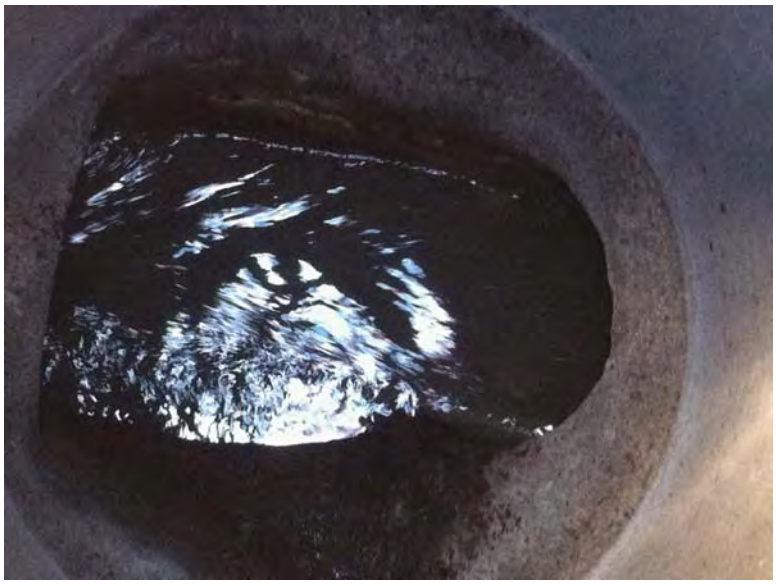
| Flow to Each Outlet Pipe (estimated) | |
|---|---|
| West (only outlet) | 100% |

General Observations

No flow entering from southerly pipe into manhole, all flow to west. Obstruction in pipe included a storm drain valve which the City removed while we were on-site.



MH 2253-15 McKinley and Harrison



MH 2253-15 McKinley and Harrison

Structure Information

| Location | Manhole ID | Model ID | Time of Survey |
|---|---|---|---|
| Chestnut Ave and Washington Ave | 2561-21 | 32321 | 8:45 AM |

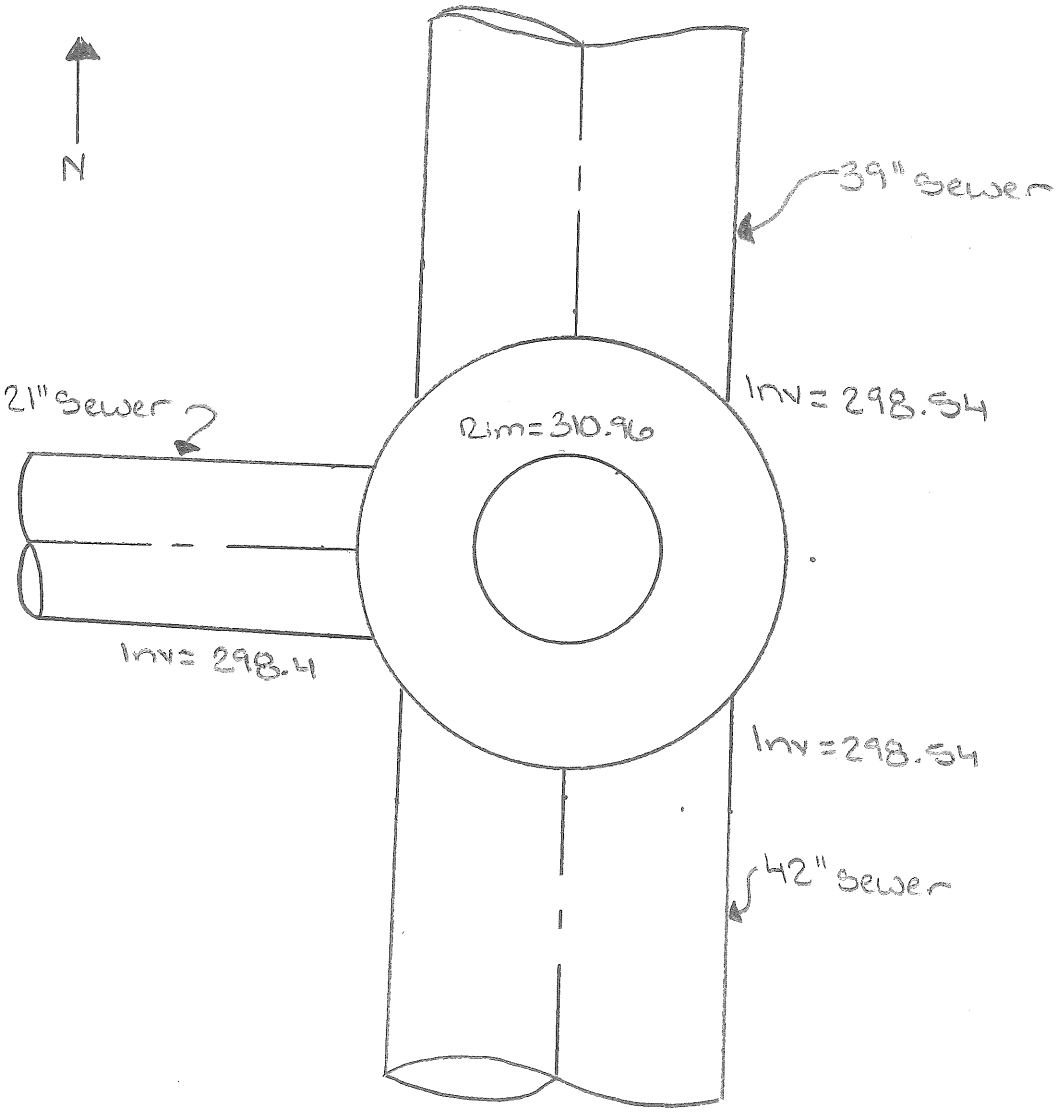
| Rim and Invert Data | Elevation |
|---|---|
| Rim | 310.96 |
| North and South FL | 298.54 |
| West FL | 298.41 |

| Depth of Flow (estimated) | |
|---|---|
| South and West | 50% |

| Flow to Each Outlet Pipe (estimated) | |
|---|---|
| South | 70% |
| West | 30% |

General Observations

Flow through manhole was moving swiftly through pipe.



MH 2561-21 Chestnut and Washington

MH 2561-21 Chestnut and Washington

Structure Information

| Location | Manhole ID | Model ID | Time of Survey |
|---|---|---|---|
| Chestnut Ave and Washington Ave | 2562-59 | N/A | 8:45 AM |

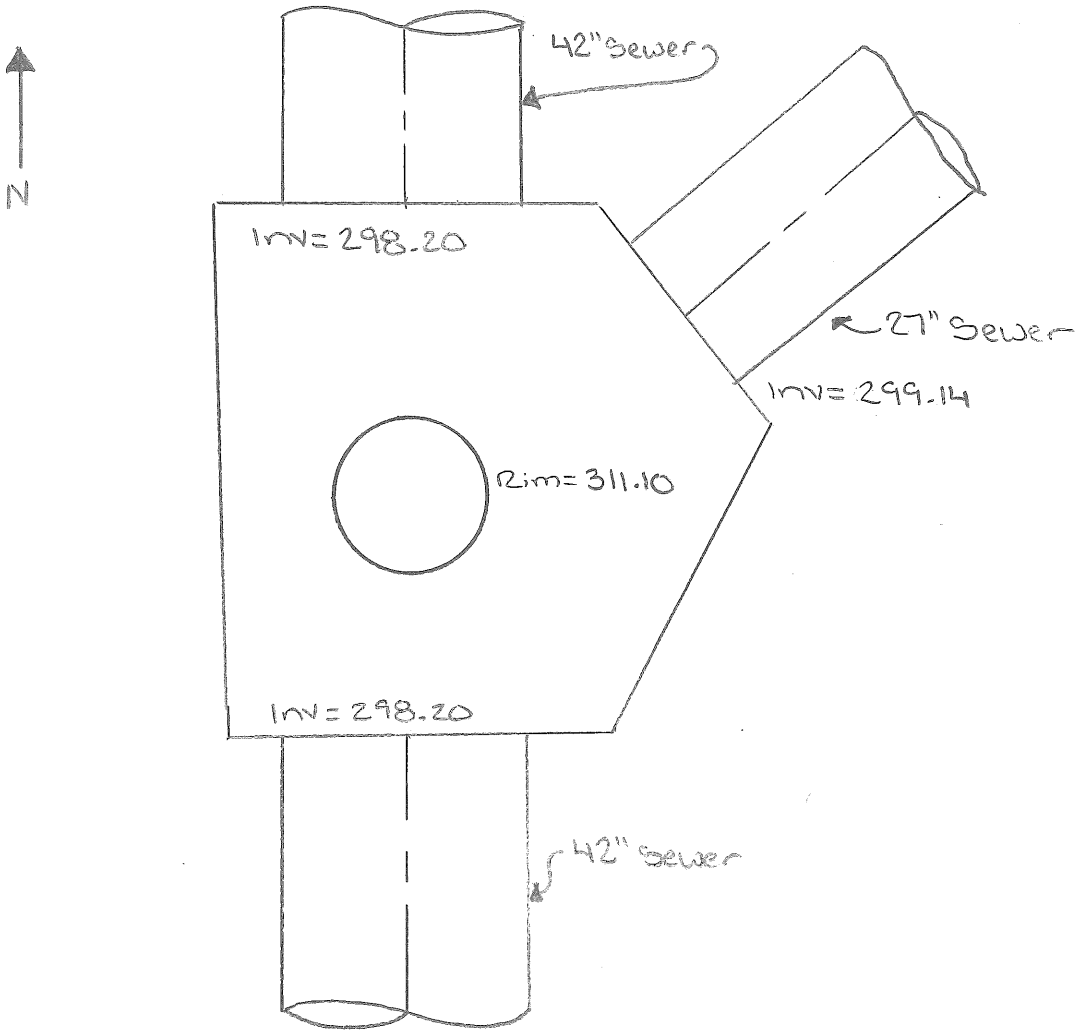
| Rim and Invert Data | Elevation |
|---|---|
| Rim | 311.10 |
| North and South FL | 298.20 |
| East FL | 299.14 |

| Depth of Flow (estimated) | |
|---|---|
| North, South and Northeast | 50% |

| Flow to Each Outlet Pipe (estimated) | |
|---|---|
| South (only outlet) | 100% |

General Observations

Flow through manhole was moving swiftly through pipe.



MH 2562-59 Chestnut and Washington

MH 2562-59 Chestnut and Washington

Structure Information

| Location | Manhole ID | Model ID | Time of Survey |
|---|---|---|---|
| Whitesbridge Ave and Fruit Ave | 2652-03 | 33197 | 8:00 AM |

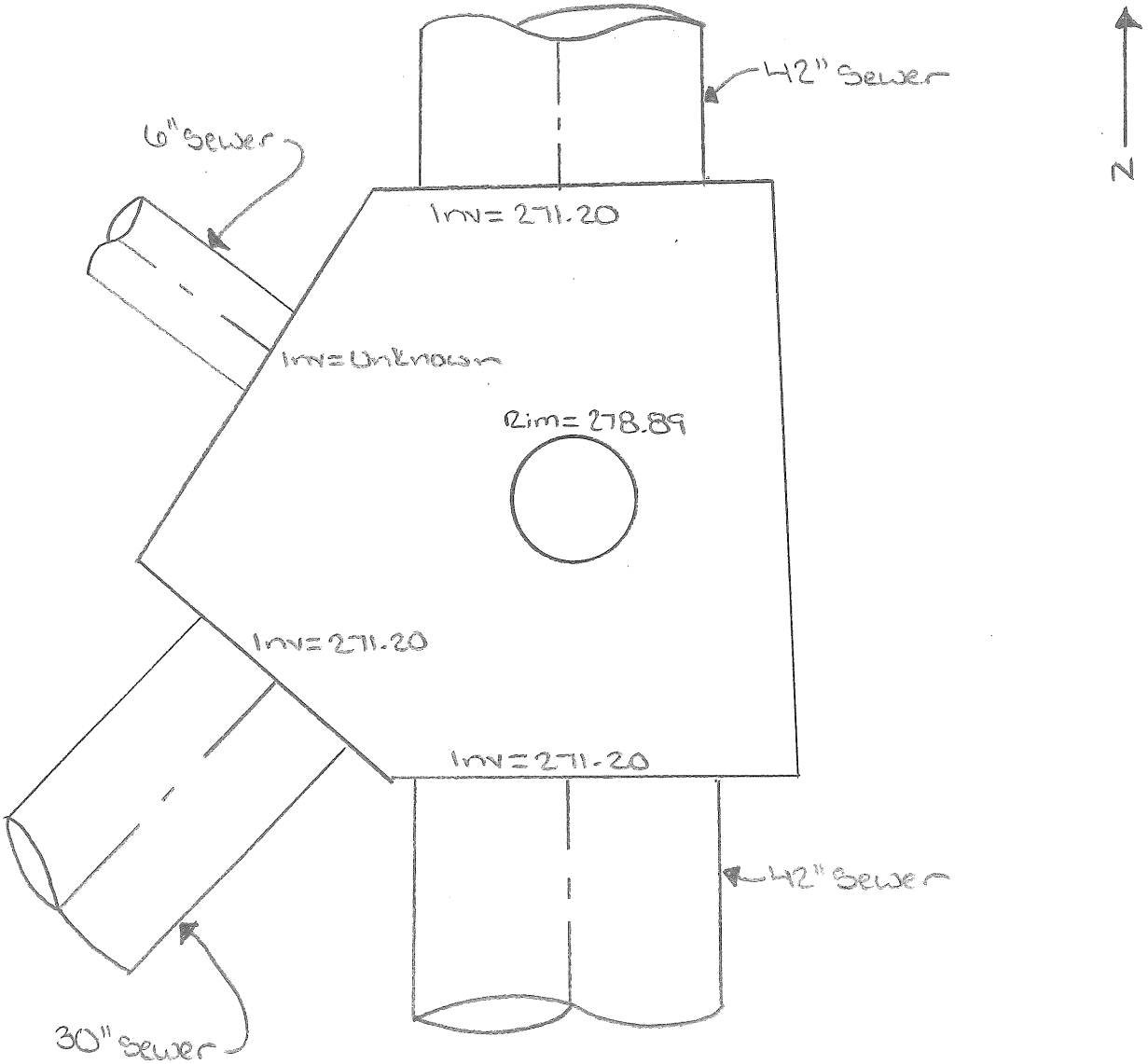
| Rim and Invert Data | Elevation |
|---|---|
| Rim | 278.89 |
| North, South and Southwest FL | 271.20 |
| Northwest FL | Unknown |

| Depth of Flow (estimated) | |
|---|---|
| North and South | 30% |

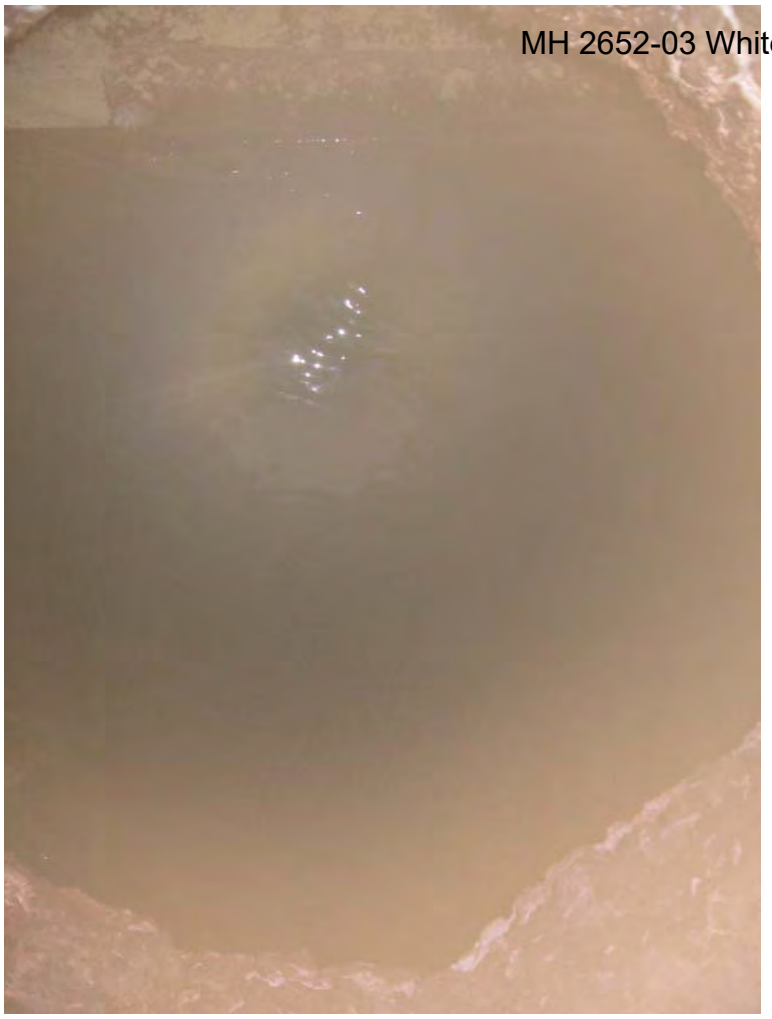
| Flow to Each Outlet Pipe (estimated) | |
|---|---|
| South | 50% |
| Southwest | 50% |

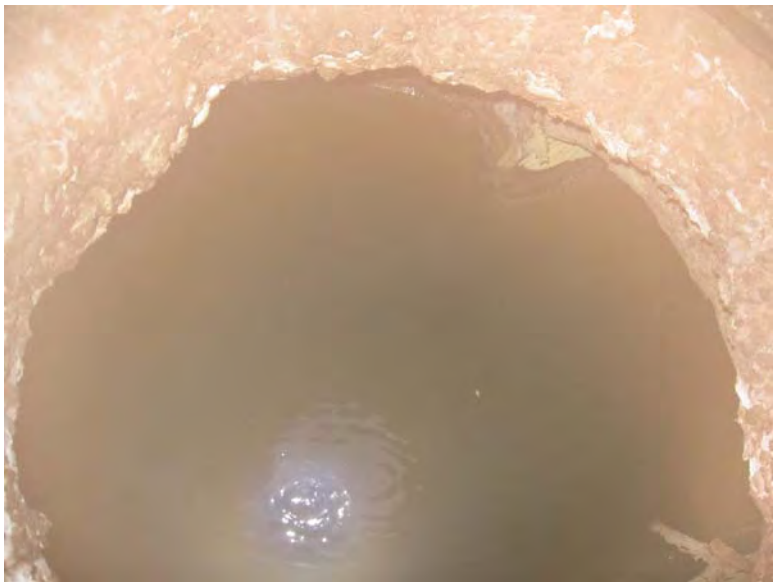
General Observations

Could not observe inlet pipe from northwest although View Fresno indicates there is a pipe from the northwest.



MH 2652-03 Whitesbridge and Fruit





Structure Information

| Location | Manhole ID | Model ID | Time of Survey |
|---|---|---|---|
| Jensen Ave and Cherry Ave | 3056-03 | 39753 | 9:45 AM |

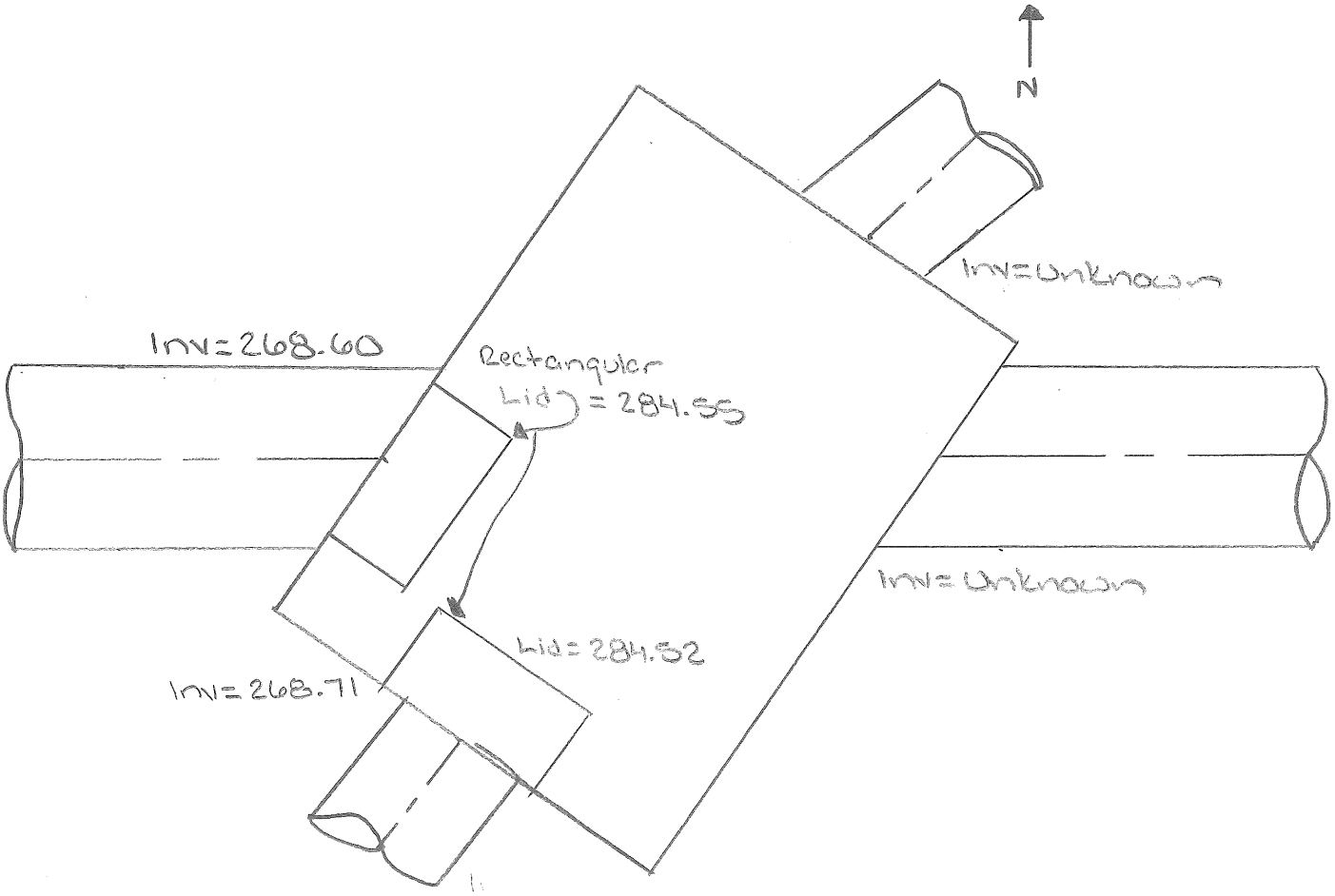
| Rim and Invert Data | Elevation |
|---|---|
| North Rectangular Lid (avg 4 corners) | 284.55 |
| South Rectangular Lid (avg 4 corners) | 284.52 |
| West FL | 268.60 |
| South FL | 268.71 |
| Northeast FL | Unknown |
| East FL | Unknown |

| Depth of Flow (estimated) | |
|---|---|
| West | 50% |
| South | 50% |
| Inlet Pipes | Could not be determined |

| Flow to Each Outlet Pipe (estimated) | |
|---|---|
| West | 50% |
| South | 50% |

General Observations

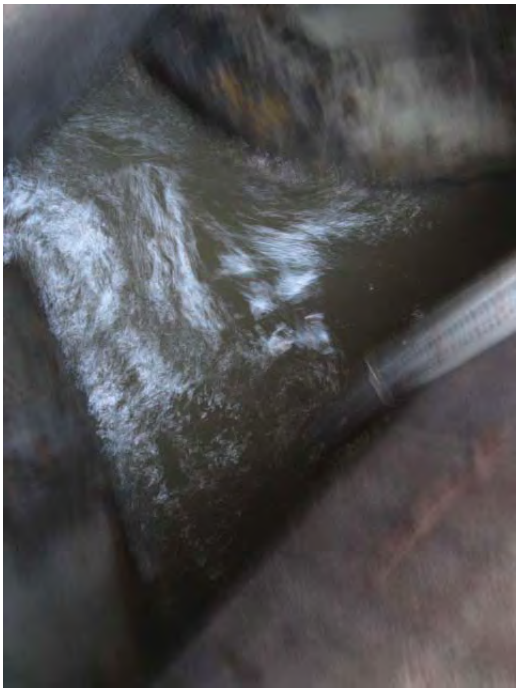
Inlet flowlines could not be determined due to location of junction structure steel lids. Debris in the structure included an abandoned air line for confined entry.



MH 3056-03 Jensen and Cherry

MH 3056-03 Jensen and Cherry

MH 3056-03 Jensen and Cherry



MH 3056-03 Jensen and Cherry

Structure Information

| Location | Manhole ID | Model ID | Time of Survey |
|---|---|---|---|
| Cherry Ave s/o Church Ave | 3057-07 | 39851 | 7:00 AM |

| Rim and Invert Data | Elevation |
|---|---|
| North Rectangular Lid (avg 4 corners) | 282.97 |
| South Rectangular Lid (avg 4 corners) | 283.07 |
| Northwest FL | 270.74 |
| West FL | 270.69 |
| East FL | Unknown |

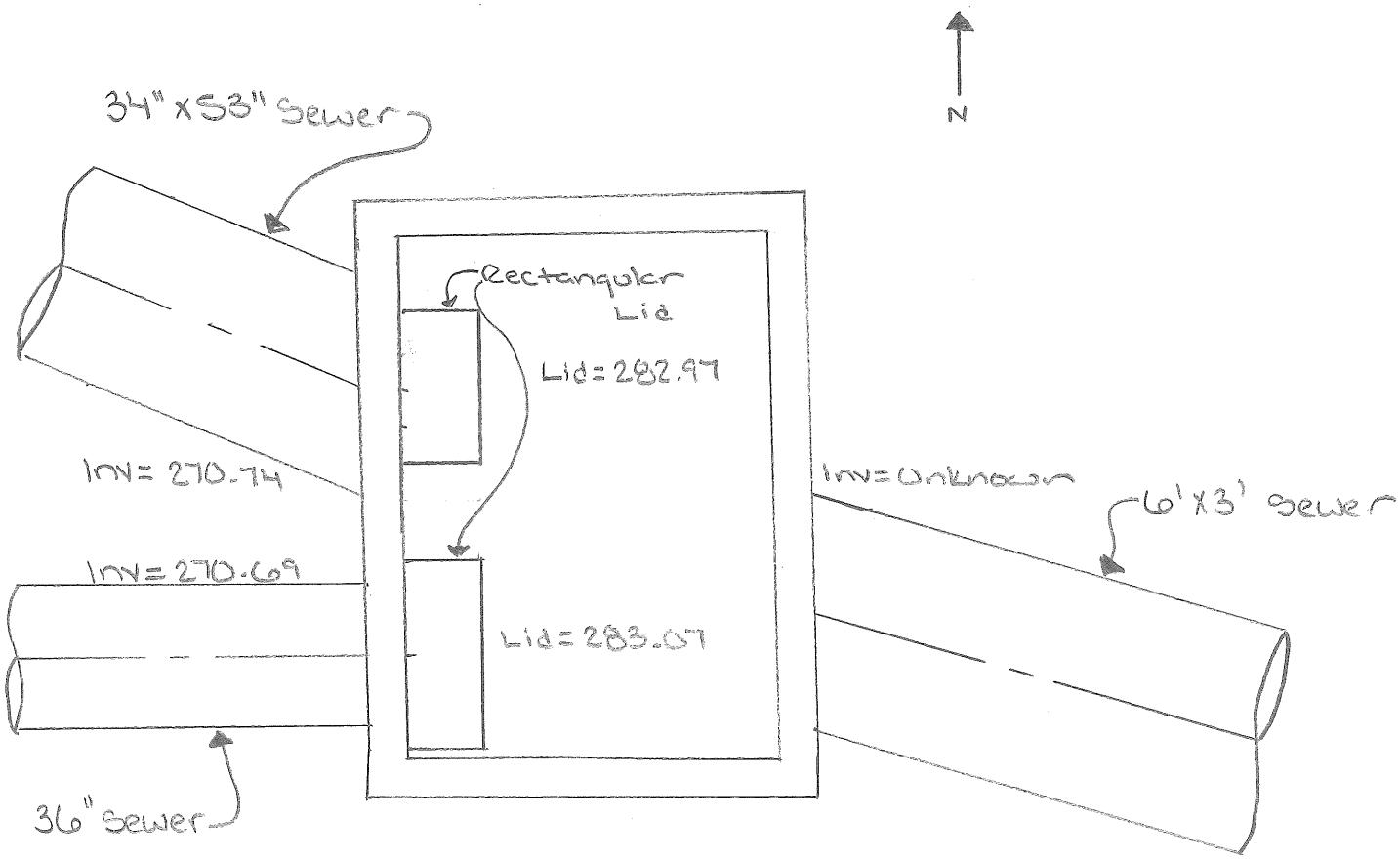
Depth of Flow (estimated)

Could not be determined due to buildup of debris and grease within outlet pipes

| Flow to Each Outlet Pipe (estimated) | |
|---|---|
| Northwest | 60% |
| West | 40% |

General Observations

A lot of debris and grease buildup within outlet pipes near westerly face of junction structure. Slots for redwood boards are present but no boards were in place. Flowline and photos of inlet pipe could not be observed due to location of lids to structure and angle to inlet pipe.



MH 3057-07 Cherry Near Church

# MH 3057-07 Cherry Near Church

# MH 3057-07 Cherry Near Church

# MH 3057-07 Cherry Near Church

# MH 3057-07 Cherry Near Church

# APPENDIX F – BCF-PROJECT DATA SHEETS

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

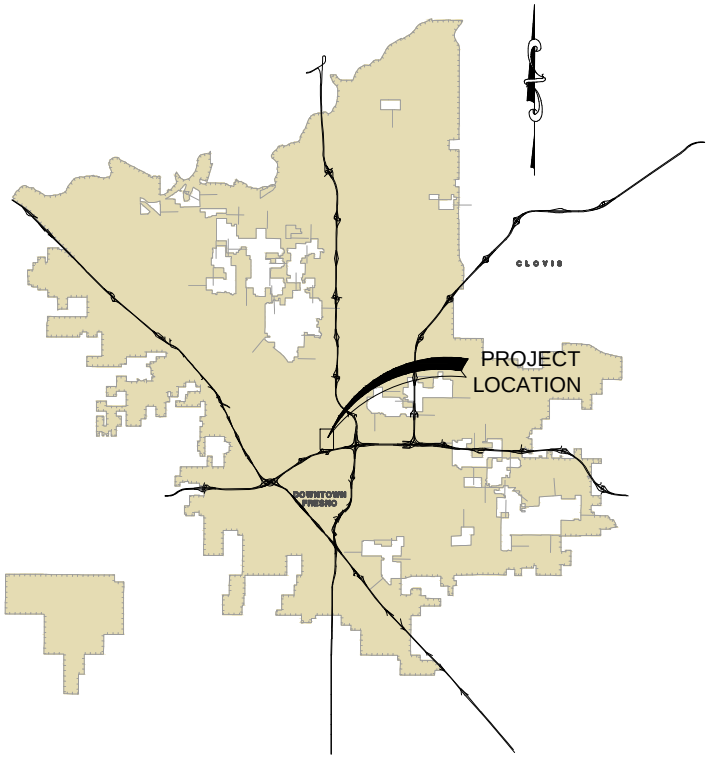
**Project:** C-1A

**Sewer Plat No.** 2356, 2456

**Implementation Phase** Phase 1 (2015-2020)

**Project Purpose:** Replacement of Existing Sewer Facilities

**Project Location:** Hammond Avenue between Blackstone Avenue and Abby Street




**Project Vicinity Map**
**Not to Scale**

**Approximate Project Quantities:**
Proposed Diameter: 24"

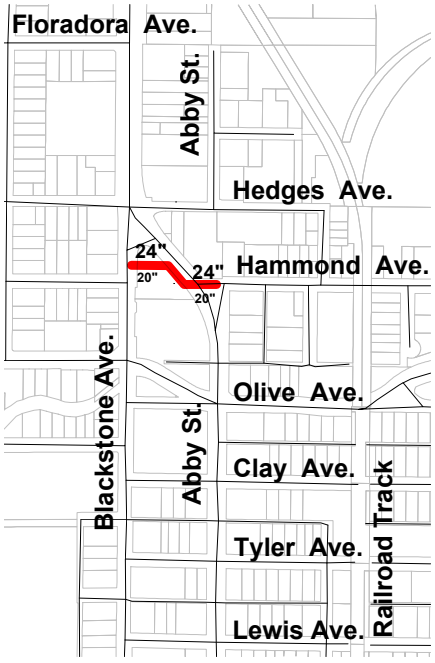
**Project Conditions:**
2-Lane Streets
Commercial Setting

**Project Benefit:**
Existing Customers: 93%
Future Development: 7%

**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $284,000.00 |
| Estimated Contingencies Cost: | $71,000.00 |
| Estimated Management and Engineering Cost: | $57,000.00 |
| Total Estimated Project Cost: | $412,000.00 |

ENR CCI = 9,835 (20 City Average, July 2014)




**Project Location Map**
**1" = 800'**

**Legend:**

- Project Sewer
- Street
- 24" Proposed Pipe Diameter
- 20" Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-1A)ECA-1-REP
Plot by: dmagill Jul 11, 2014 - 3:51pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

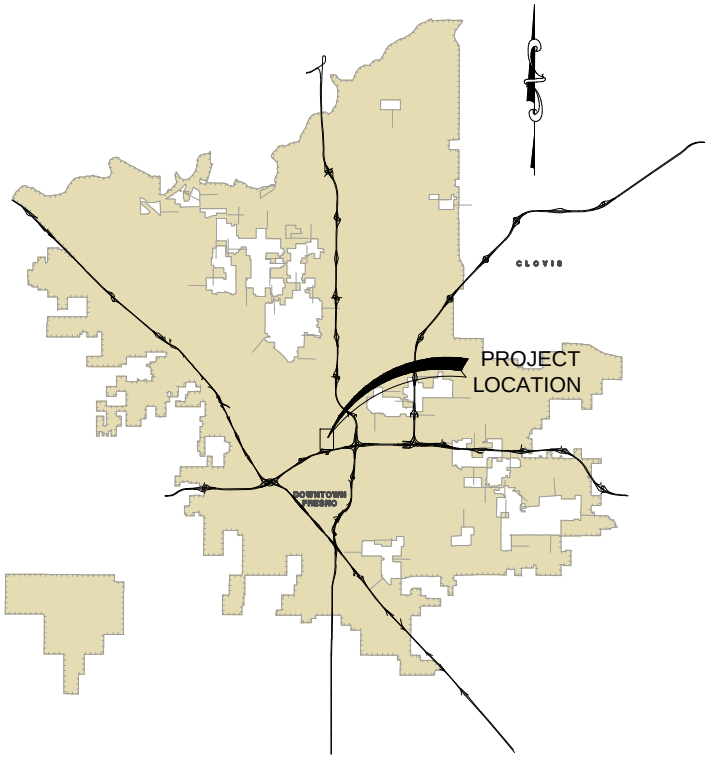
**Project:** C-1B

**Sewer Plat No.** 2356, 2456

**Implementation Phase** Phase 1 (2015-2020)

**Project Purpose:** Replacement of Existing Sewer Facilities

**Project Location:** Abby Street between Hammond Avenue and La Salle Avenue Alignment




**Project Vicinity Map**
**Not to Scale**

**Approximate Project Quantities:**
Proposed Diameter: 24"

**Project Conditions:**
2-Lane Streets
Commercial Setting

**Project Benefit:**
Existing Customers: 93%
Future Development: 7%

**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $598,000.00 |
| Estimated Contingencies Cost: | $150,000.00 |
| Estimated Management and Engineering Cost: | $120,000.00 |
| Total Estimated Project Cost: | $868,000.00 |

ENR CCI = 9,835x (20 City Average, July 2014)

**Project Location Map**
**1" = 800'**

**Legend:**

- Project Sewer
- Street
- 24" Proposed Pipe Diameter
- 20" Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-1B)ECA-1-REP
Plot by: dmagill Jul 11, 2014 - 3:52pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

| | |
|---|---|
| **Project:** | **C-2A** |
| **Sewer Plat No.** | **2455, 2555** |
| **Implementation Phase** | **Phase 1 (2015-2020)** |
| **Project Purpose:** | Replacement of Existing Sewer Facilities |
| **Project Location:** | Glenn Avenue between Bremer and Thomas Avenues |

**Approximate Project Quantities:**
Proposed Diameter: 27"

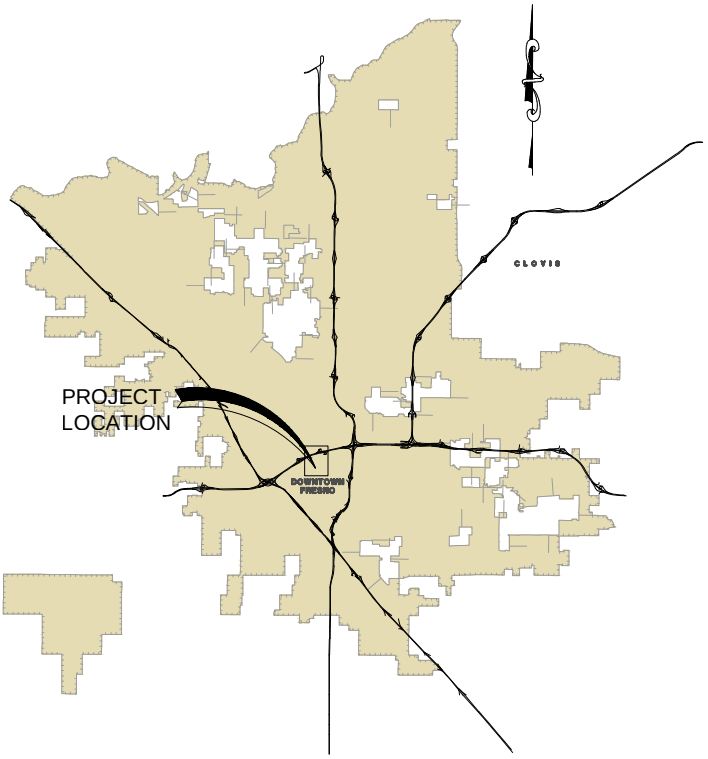
**Project Conditions:**
2-Lane Streets
Residential Setting

**Project Benefit:**
Existing Customers: 93%
Future Development: 7%

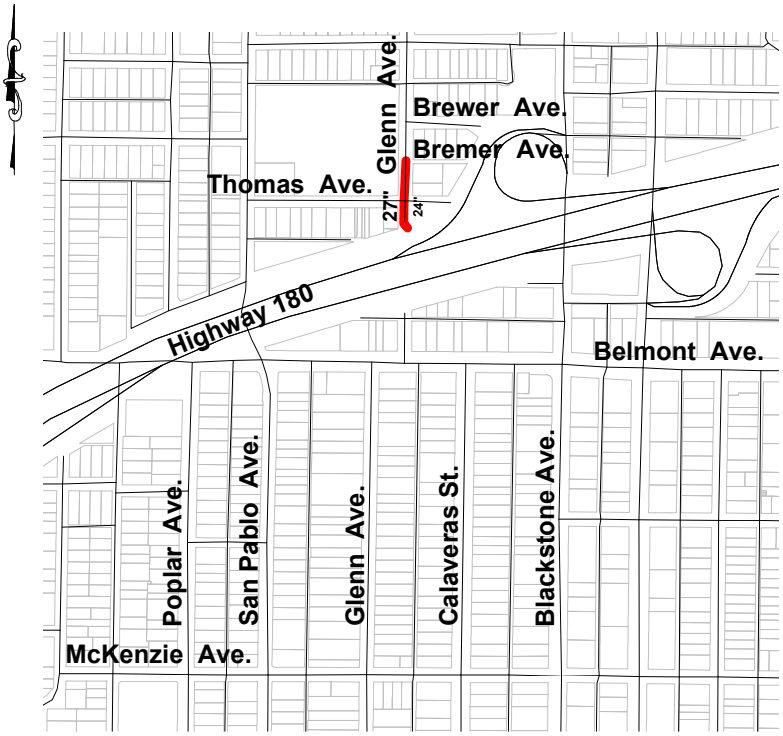
**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $297,000.00 |
| Estimated Contingencies Cost: | $74,000.00 |
| Estimated Management and Engineering Cost: | $59,000.00 |
| Total Estimated Project Cost: | $430,000.00 |

ENR CCI = 9,835 (20 City Average, July 2014)




**Project Vicinity Map**
**Not to Scale**




**Project Location Map**
**1" = 800'**

**Legend:**

| | |
|---|---|
| | **Project Sewer** |
| | **Street** |
| 27" | **Proposed Pipe Diameter** |
| 24" | **Existing Pipe Diameter** |

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-2A)ECA-2-REP
Plot by: dmagill Jul 11, 2014 - 3:54pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

carollo

Blair, Church & Flynn

**Project:** C-2B

**Sewer Plat No.** 2455, 2555

**Implementation Phase** Phase 1 (2015-2020)

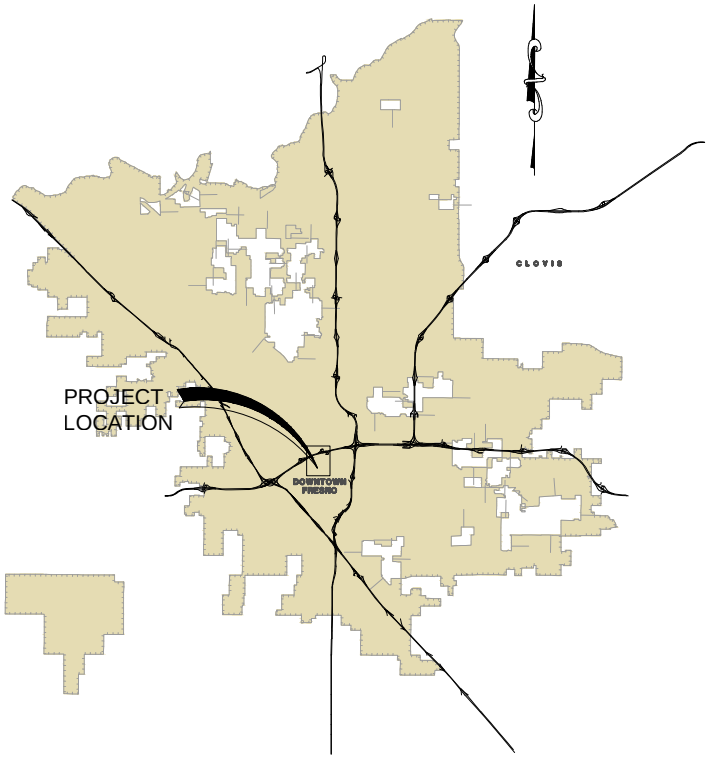
**Project Purpose:** Replacement of Existing Sewer Facilities

**Project Location:** Glenn Avenue from Highway 180 to Voorman Avenue

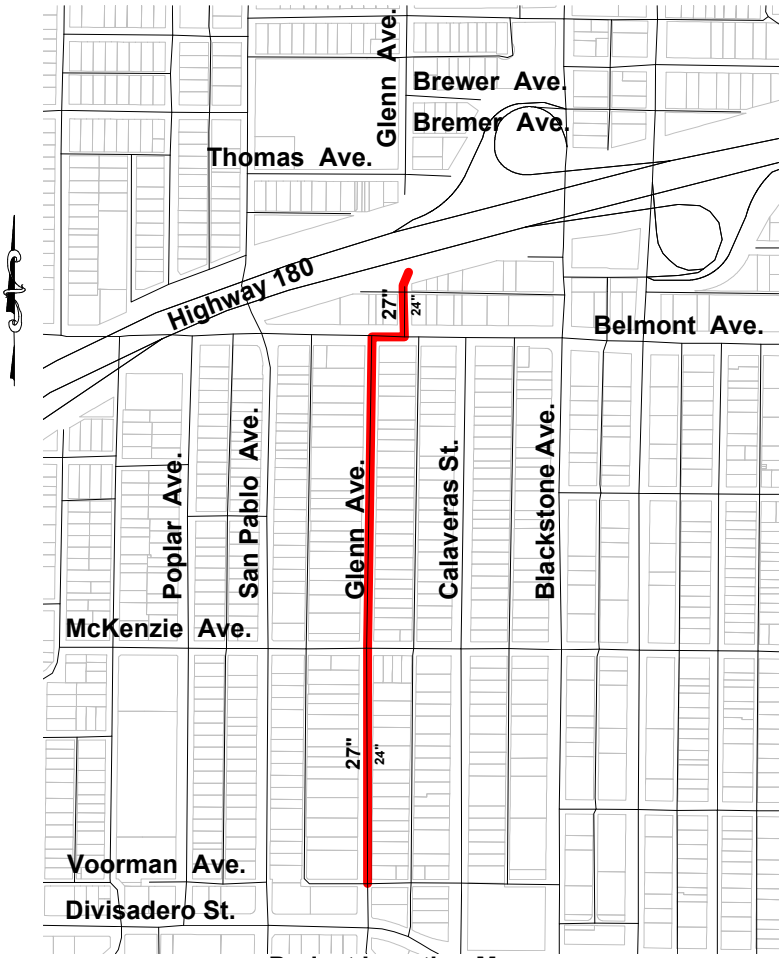
**Approximate Project Quantities:**
Proposed Diameter: 27"

**Project Conditions:**
2-Lane Streets
Residential Setting

**Project Benefit:**
Existing Customers: 86%
Future Development: 14%




**Project Vicinity Map**
**Not to Scale**




**Project Location Map**
**1" = 800'**

**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $1,090,000.00 |
| Estimated Contingencies Cost: | $272,000.00 |
| Estimated Management and Engineering Cost: | $218,000.00 |
| Total Estimated Project Cost: | $1,580,000.00 |

ENR CCI = 9,835 (20 City Average, July 2014)

**Legend:**

- **Project Sewer**
- **Street**
- 27" **Proposed Pipe Diameter**
- 24" **Existing Pipe Diameter**

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-2B)ECA-2-REP
Plot by: dmagill Jul 11, 2014 - 3:55pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

**Project:** C-3

**Sewer Plat No.** 2555, 2655

**Implementation Phase** Phase 2 (2021-2025)

**Project Purpose:** Replacement of Existing Sewer Facilities

**Project Location:** Glenn Avenue and N Street between Voorman Avenue and Tuolumne Street

**Approximate Project Quantities:**
Proposed Diameter: 30"

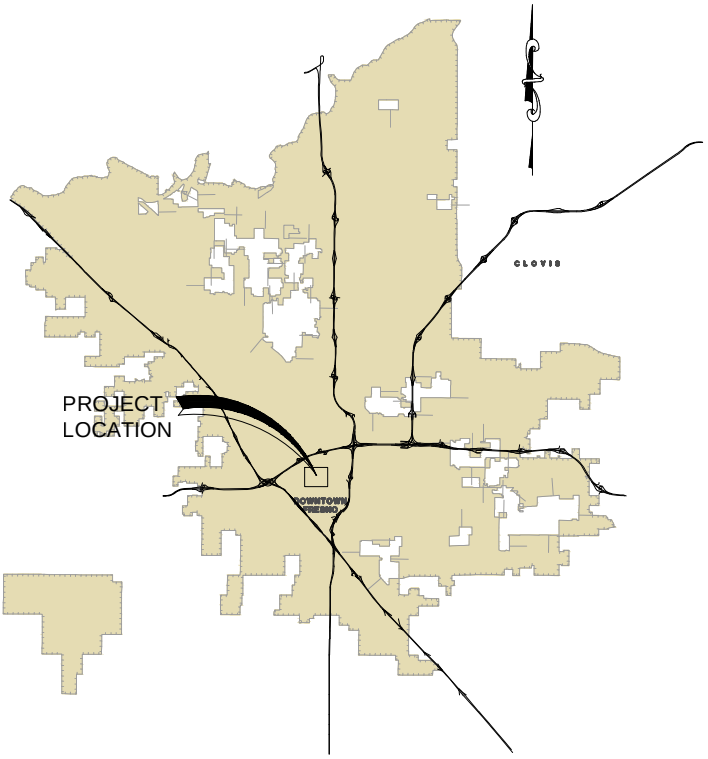
**Project Conditions:**
2-Lane Streets
Residential Setting

**Project Benefit:**
Existing Customers: 81%
Future Development: 19%

**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $792,000.00 |
| Estimated Contingencies Cost: | $198,000.00 |
| Estimated Management and Engineering Cost: | $158,000.00 |
| Total Estimated Project Cost: | $1,148,000.00 |

ENR CCI = 9,835 (20 City Average, July 2014)




**Project Vicinity Map**
**Not to Scale**

**Project Location Map**
**1" = 800'**

**Legend:**

- Project Sewer
- Street
- 30" Proposed Pipe Diameter
- 27" Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-3)ECA-3-REP.d
Plot by: dmagill Jul 11, 2014 - 3:55pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

**Project:** C-4

**Sewer Plat No.** 2757, 2856, 2857

**Implementation Phase** Phase 3 (2026-2030)

**Project Purpose:** Replacement of Existing Sewer Facilities

**Project Location:** Monterey Street between N Street Fulton Streets

**Approximate Project Quantities:**
Proposed Diameter: 10"

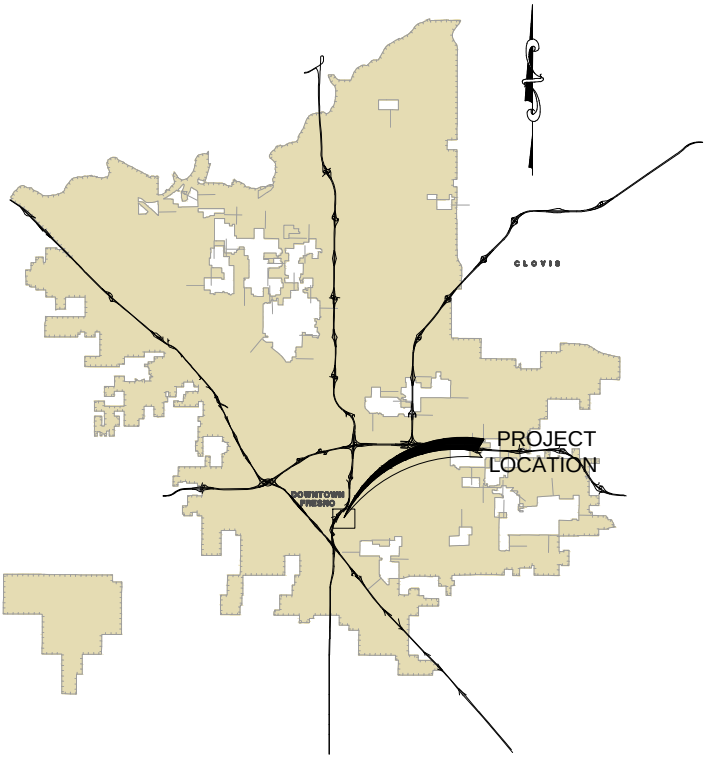
**Project Conditions:**
2-Lane Streets
Residential Setting

**Project Benefit:**
Existing Customers: 100%
Future Development: 0%

**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $471,000.00 |
| Estimated Contingencies Cost: | $118,000.00 |
| Estimated Management and Engineering Cost: | $94,000.00 |
| Total Estimated Project Cost: | $683,000.00 |

ENR CCI = 9,835 (20 City Average, July 2014)




**Project Vicinity Map**
**Not to Scale**

**Project Location Map**
**1" = 800'**

**Legend:**

- Project Sewer
- Street
- 10" Proposed Pipe Diameter
- 8" Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-4)ECA-5-REP.d
Plot by: dmagill Jul 11, 2014 - 3:56pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

carollo

Blair, Church & Flynn

**Project:** C-5A

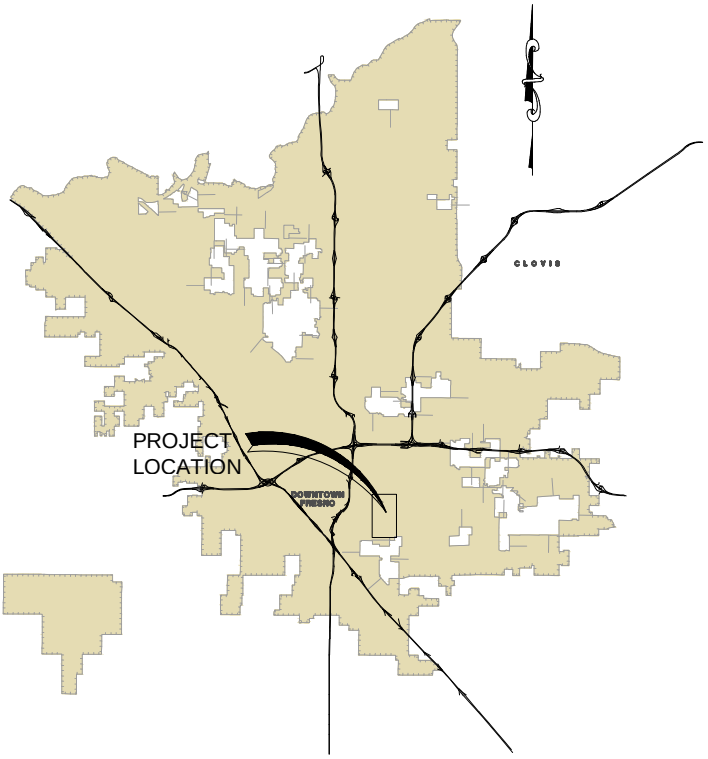
**Sewer Plat No.** 2759, 2859

**Implementation Phase** Phase 4 (2031-2035)

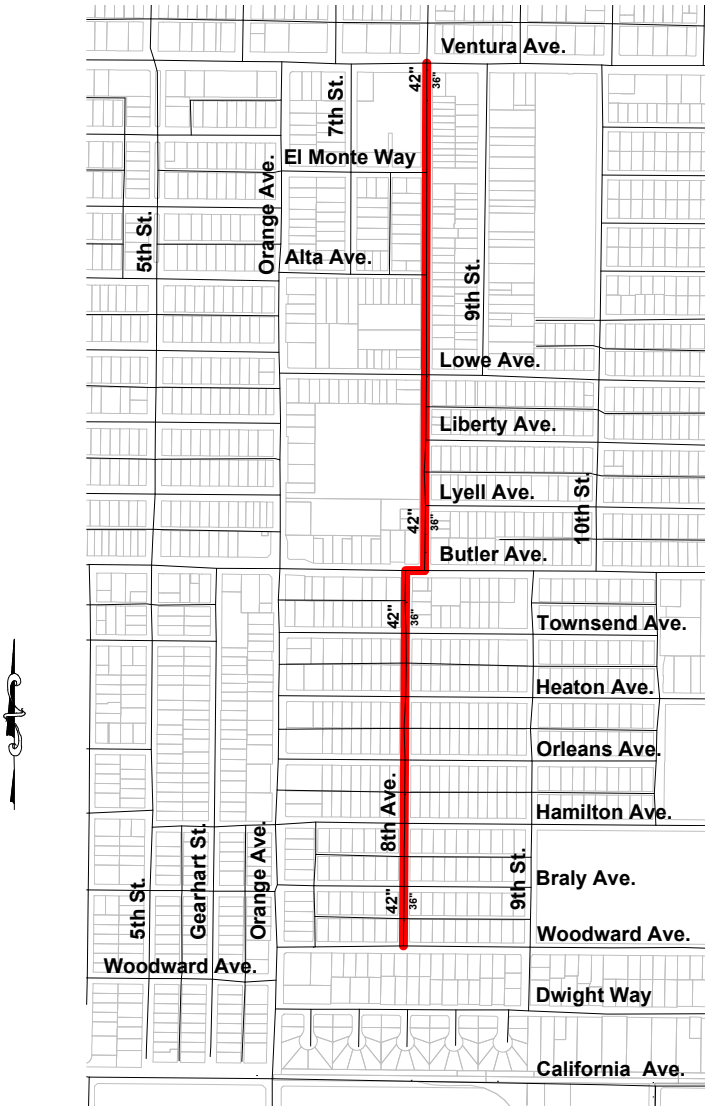
**Project Purpose:** Replacement of Existing Sewer Facilities

**Project Location:** Eighth Street between Ventura Street and Woodward Avenue

**Approximate Project Quantities:**
Proposed Diameter: 42"




**Project Vicinity Map**
**Not to Scale**




**Project Location Map**
**1" = 1,000'**

**Project Conditions:**
2-Lane Streets
Residential Setting

**Project Benefit:**
Existing Customers: 83%
Future Development: 17%

**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $2,638,000.00 |
| Estimated Contingencies Cost: | $659,000.00 |
| Estimated Management and Engineering Cost: | $528,000.00 |
| Total Estimated Project Cost: | $3,825,000.00 |

ENR CCI = 9,835 (20 City Average, July 2014)

**Legend:**

- **Project Sewer**
- **Street**
- 42" **Proposed Pipe Diameter**
- 36" **Existing Pipe Diameter**

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-5A)ECA-4-REP
Plot by: dmagill Jul 11, 2014 - 3:57pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

carollo

Blair, Church & Flynn

**Project:** C-5B

**Sewer Plat No.** 2759, 2859

**Implementation Phase** Phase 4 (2031-2035)

**Project Purpose:** Replacement of Existing Sewer Facilities

**Project Location:** Woodward Avenue between Eighth and Orange Avenues

**Approximate Project Quantities:**
Proposed Diameter: 42"

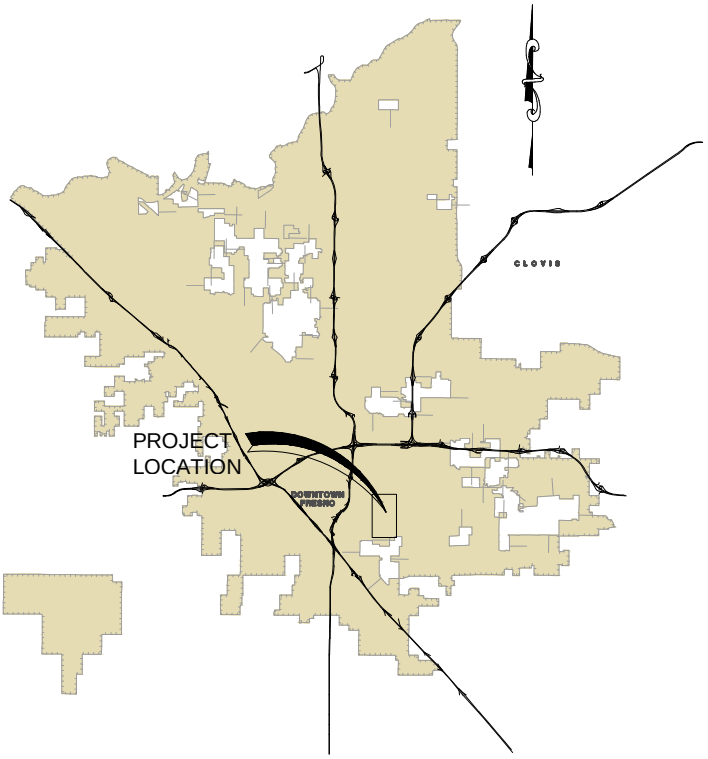
**Project Conditions:**
2-Lane Streets
Residential Setting

**Project Benefit:**
Existing Customers: 83%
Future Development: 17%

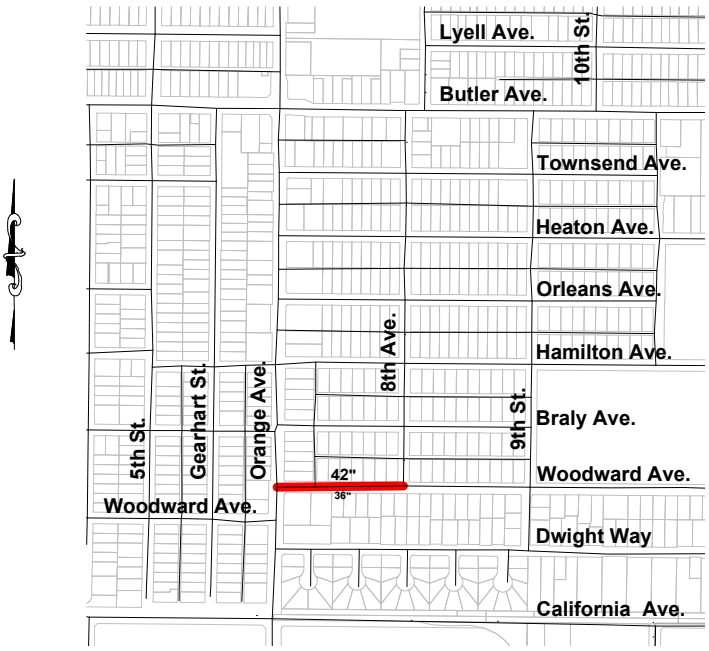
**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $506,000.00 |
| Estimated Contingencies Cost: | $126,000.00 |
| Estimated Management and Engineering Cost: | $101,000.00 |
| Total Estimated Project Cost: | $733,000.00 |

ENR CCI = 9,835 (20 City Average, July 2014)




**Project Vicinity Map**
**Not to Scale**




**Project Location Map**
**1" = 1,000'**

**Legend:**

| | |
|---|---|
| | Project Sewer |
| | Street |
| 42" | Proposed Pipe Diameter |
| 36" | Existing Pipe Diameter |

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-5B)ECA-4-REP
Plot by: dmagill Jul 11, 2014 - 3:58pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

**Project:** C-5C

**Sewer Plat No.** 2759, 2859

**Implementation Phase** Phase 4 (2031-2035)

**Project Purpose:** Replacement of Existing Sewer Facilities

**Project Location:** Orange Avenue between Woodward and California Avenues

**Approximate Project Quantities:**
Proposed Diameter: 42"

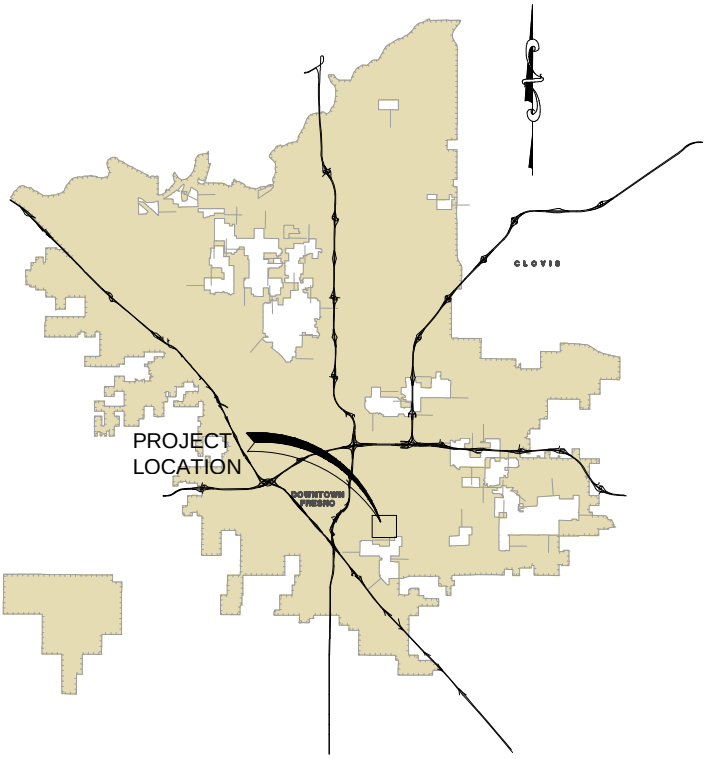
**Project Conditions:**
2-Lane Streets
Residential Setting

**Project Benefit:**
Existing Customers: 83%
Future Development: 17%

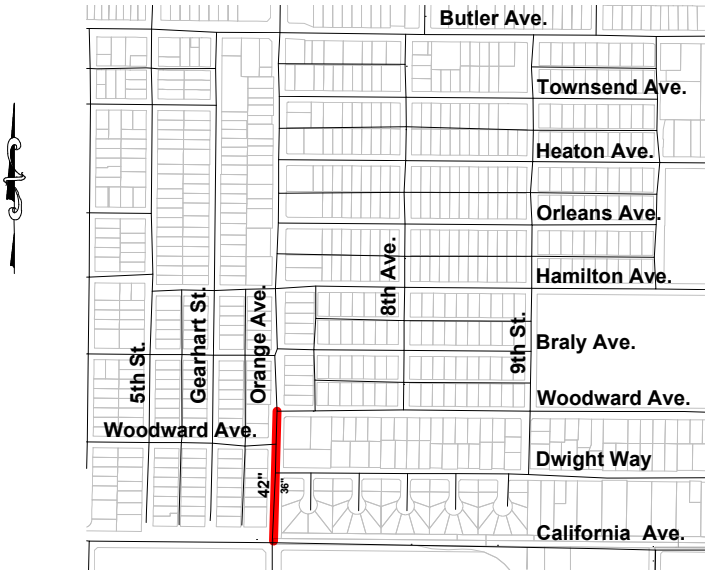
**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $537,000.00 |
| Estimated Contingencies Cost: | $134,000.00 |
| Estimated Management and Engineering Cost: | $107,000.00 |
| Total Estimated Project Cost: | $778,000.00 |

ENR CCI = 9,835 (20 City Average, July 2014)




**Project Vicinity Map**
**Not to Scale**




**Project Location Map**
**1" = 1,000'**

**Legend:**

| | |
|---|---|
| | Project Sewer |
| | Street |
| 42" | Proposed Pipe Diameter |
| 36" | Existing Pipe Diameter |

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-5C)ECA-4-REP
Plot by: dmagill Jul 11, 2014 - 3:59pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

**Project:** C-6

**Sewer Plat No.** 2553

**Implementation Phase** Phase 4 (2031-2035)

**Project Purpose:** Replacement of Existing Sewer Facilities

**Project Location:** Alley between Producers Dairy and H Street

**Approximate Project Quantities:**
Proposed Diameter: 8"

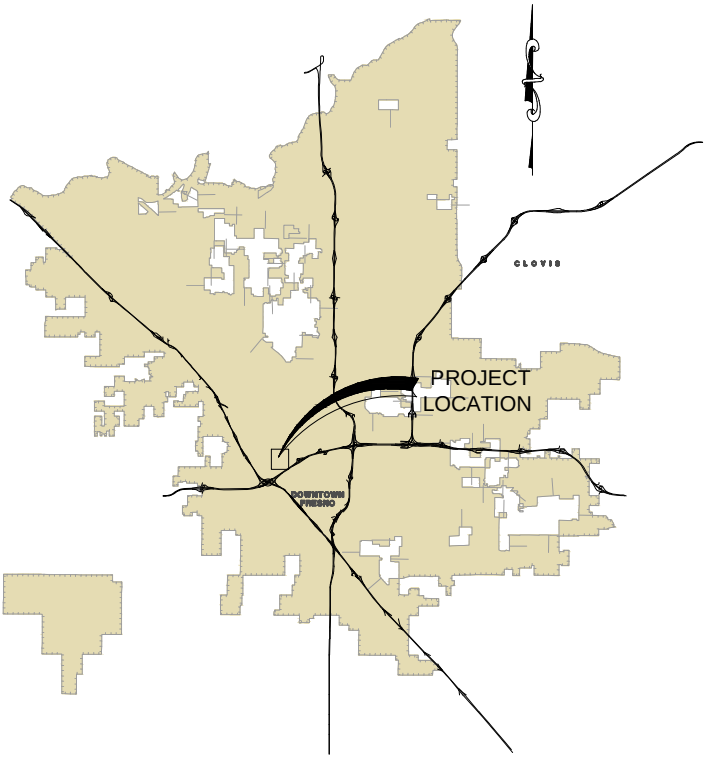
**Project Conditions:**
2-Lane Streets
Commercial Setting

**Project Benefit:**
Existing Customers: 100%
Future Development: 0%

**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $227,000.00 |
| Estimated Contingencies Cost: | $57,000.00 |
| Estimated Management and Engineering Cost: | $45,000.00 |
| Total Estimated Project Cost: | $329,000.00 |

ENR CCI = 9,835 (20 City Average, July 2014)




**Project Vicinity Map**
**Not to Scale**

**Project Location Map**
**1" = 800'**

**Legend:**

| | |
|---|---|
| | Project Sewer |
| | Street |
| 8" | Proposed Pipe Diameter |
| 6" | Existing Pipe Diameter |

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-6)ECA-6-REP.d
Plot by: dmagill Jul 11, 2014 - 4:00pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

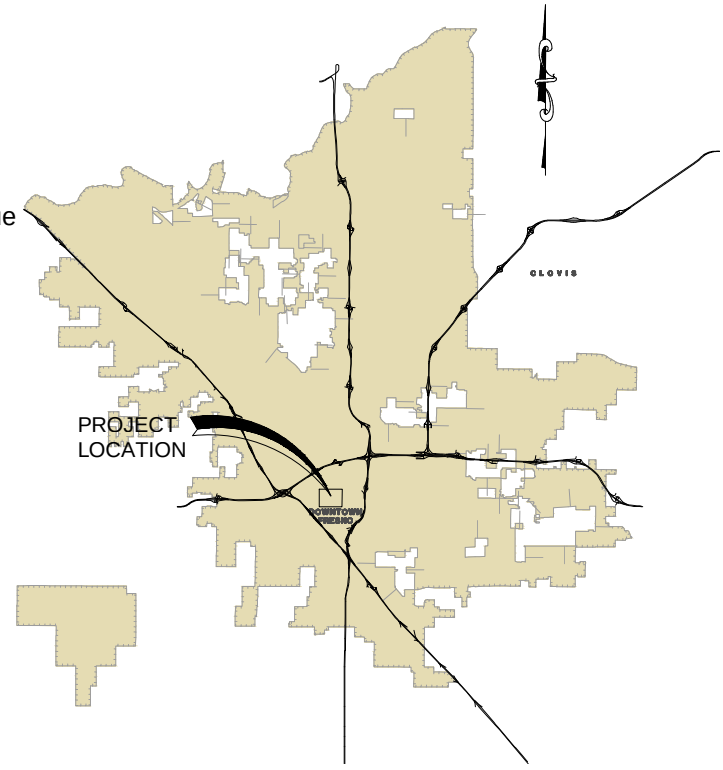
**Project:** C-7

**Sewer Plat No.** 2655

**Implementation Phase** Phase 4 (2031-2035)

**Project Purpose:** Replacement of Existing Sewer Facilities

**Project Location:** Tuolumne Street and Van Ness Avenue between N and Merced Streets




**Project Vicinity Map**
**Not to Scale**

**Approximate Project Quantities:**
Proposed Diameter: 30"

**Project Conditions:**
2-Lane Streets
Commercial Setting

**Project Benefit:**
Existing Customers: 0%
Future Development: 100%

**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $847,000.00 |
| Estimated Contingencies Cost: | $212,000.00 |
| Estimated Management and Engineering Cost: | $169,000.00 |
| Total Estimated Project Cost: | $1,228,000.00 |

ENR CCI = 9,835 (20 City Average, July 2014)

**Project Location Map**
**1" = 800'**

**Legend:**

| | |
|---|---|
| | Project Sewer |
| | Street |
| 30" | Proposed Pipe Diameter |
| 27" | Existing Pipe Diameter |

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-7)FCA-1-REP.d
Plot by: dmagill Jul 11, 2014 - 4:01pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

**Project:** C-8

**Sewer Plat No.** 3245, 3246, 3247, 3248, 3249, 3250, 3251, 3252

**Implementation Phase** Phase 4 (2031-2035)

**Project Purpose:** Relief Line for Existing Sewer Facilities

**Project Location:** North Avenue between Polk Avenue Alignment and Fruit Avenue

**Approximate Project Quantities:**
Proposed Diameter: 60"

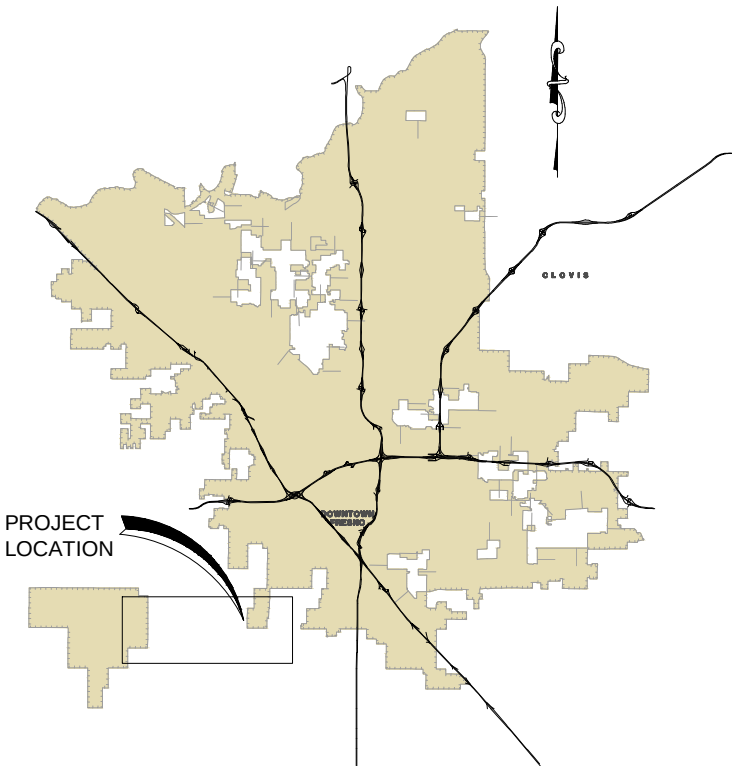
**Project Conditions:**
2-Lane Streets
Rural Setting

**Project Benefit:**
Existing Customers: 0%
Future Development: 100%

**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $13,527,000.00 |
| Estimated Contingencies Cost: | $3,382,000.00 |
| Estimated Management and Engineering Cost: | $,2706,000.00 |
| Total Estimated Project Cost: | $19,615,000.00 |

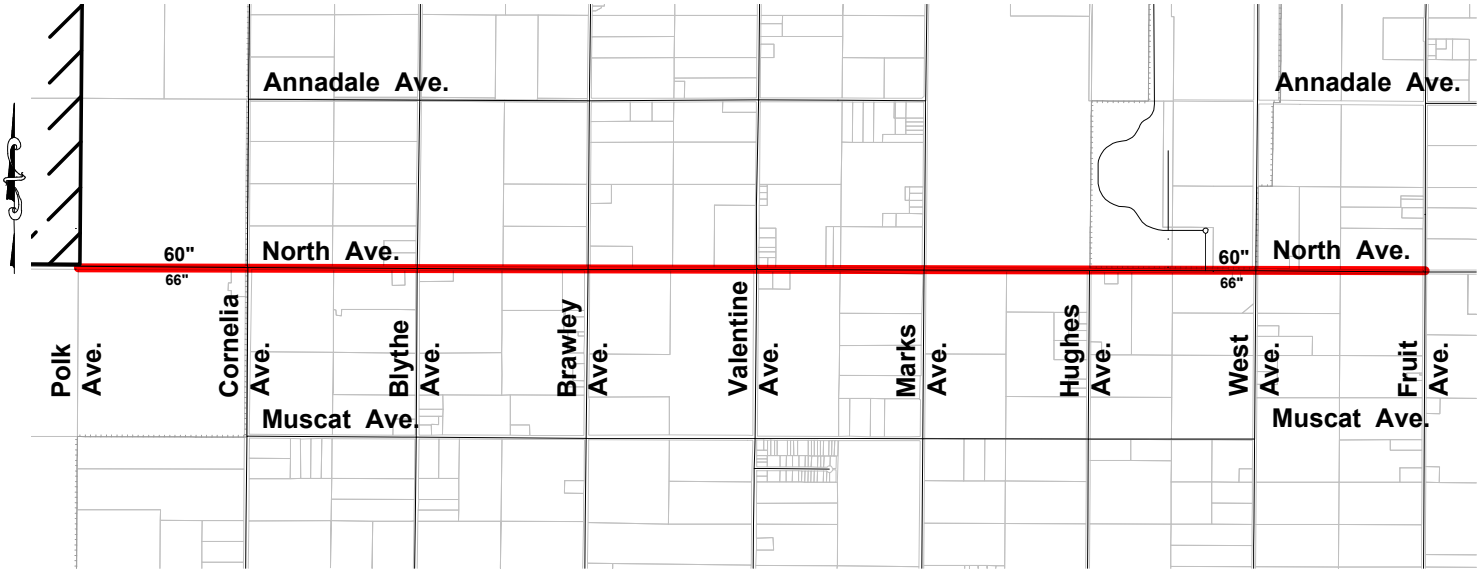
ENR CCI = 9,835 (20 City Average, July 2014)




**Project Vicinity Map**
**Not to Scale**

**Legend:**

- **Project Sewer**
- **Street**
- 60" **Proposed Pipe Diameter**
- 66" **Existing Pipe Diameter**




**Project Location Map**
**1" = 3,000'**

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-8)FCA-2-REL
Plot by: dmagill Jul 11, 2014 - 4:01pm

# City of Fresno
# Wastewater Collection System Master Plan Update
# CAPITAL IMPROVEMENT PLAN
# PROJECT SHEET

**Project:** C-9

**Sewer Plat No.** 3253, 3254, 3255, 3256 3257, 3258

**Implementation Phase** Phase 4 (2031-2035)

**Project Purpose:** Rehabilitate Line for Existing Sewer Facilities

**Project Location:** North Avenue between Fruit and Orange Avenues

**Approximate Project Quantities:**
Proposed Diameter: 60"

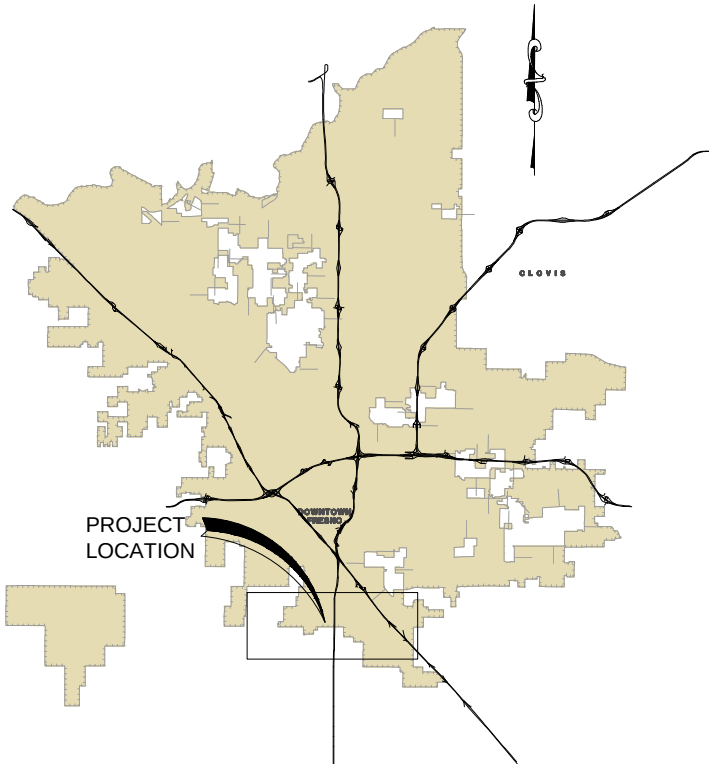
**Project Conditions:**
2-Lane Streets
Rural Setting

**Project Benefit:**
Existing Customers: 0%
Future Development: 100%

**Estimated Project Costs:**

| | |
|---|---|
| Estimated Construction Cost: | $10,604,000.00 |
| Estimated Contingencies Cost: | $2,651,000.00 |
| Estimated Management and Engineering Cost: | $2,121,000.00 |
| Total Estimated Project Cost: | $15,376,000.00 |

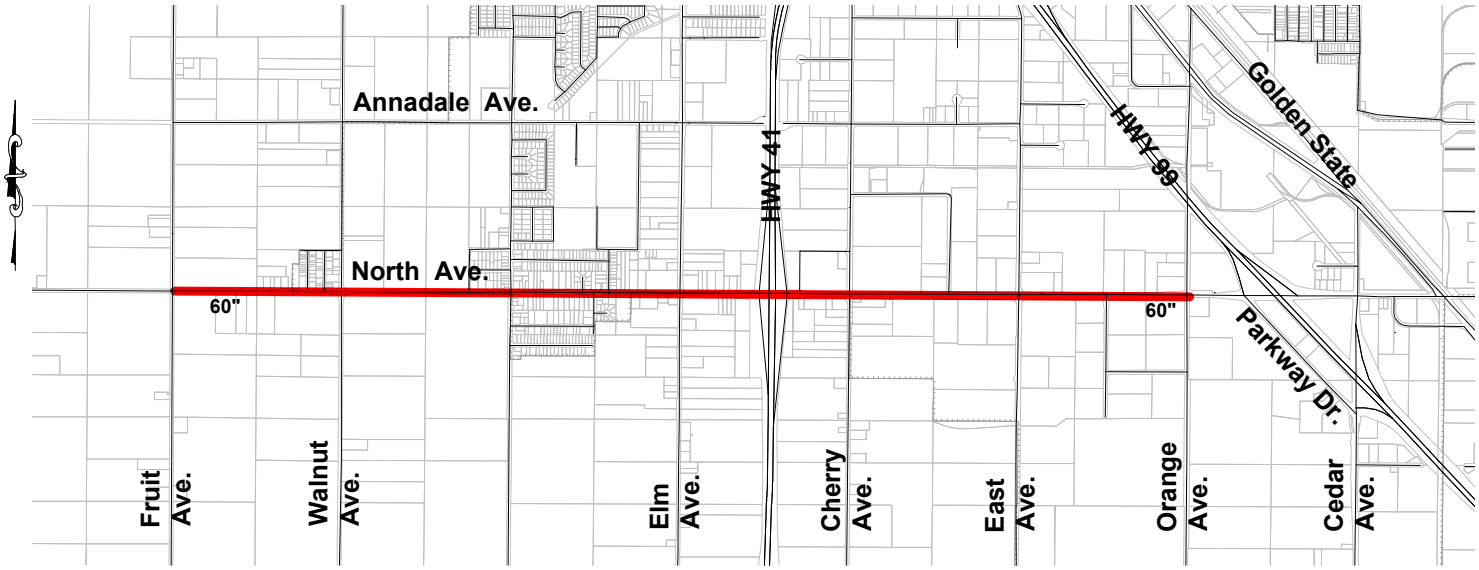
ENR CCI = 9,835 (20 City Average, July 2014)




**Project Vicinity Map**
**Not to Scale**

**Legend:**

**Project Sewer**
**Street**
60" **Proposed Pipe Diameter**




**Project Location Map**
**1" = 3,000'**

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-9)FCA-3-REH
Plot by: dmagill Jul 11, 2014 - 4:02pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** B

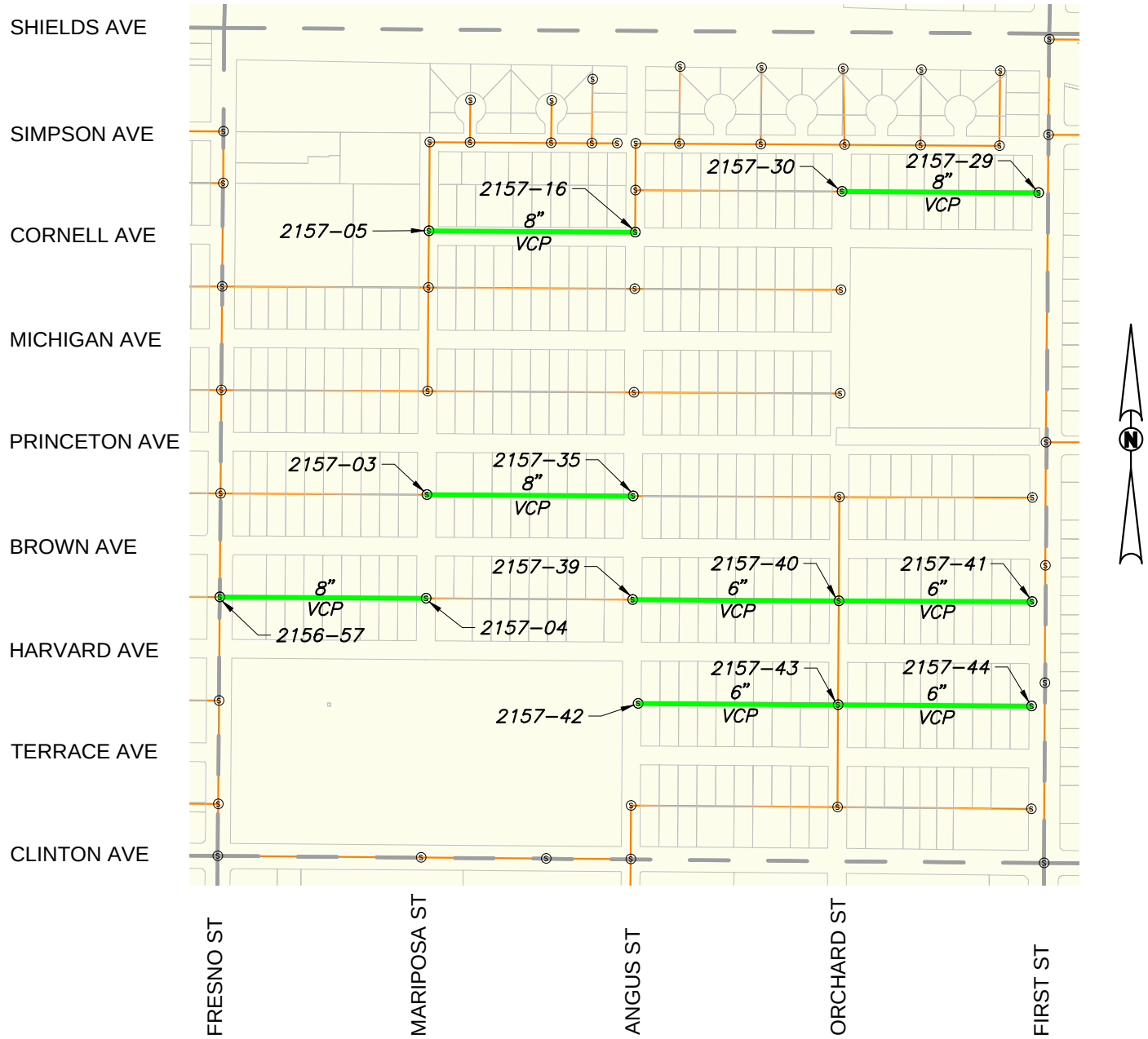
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2157**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 2,603 LF |
| 6" | 2,530 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2157 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:39pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

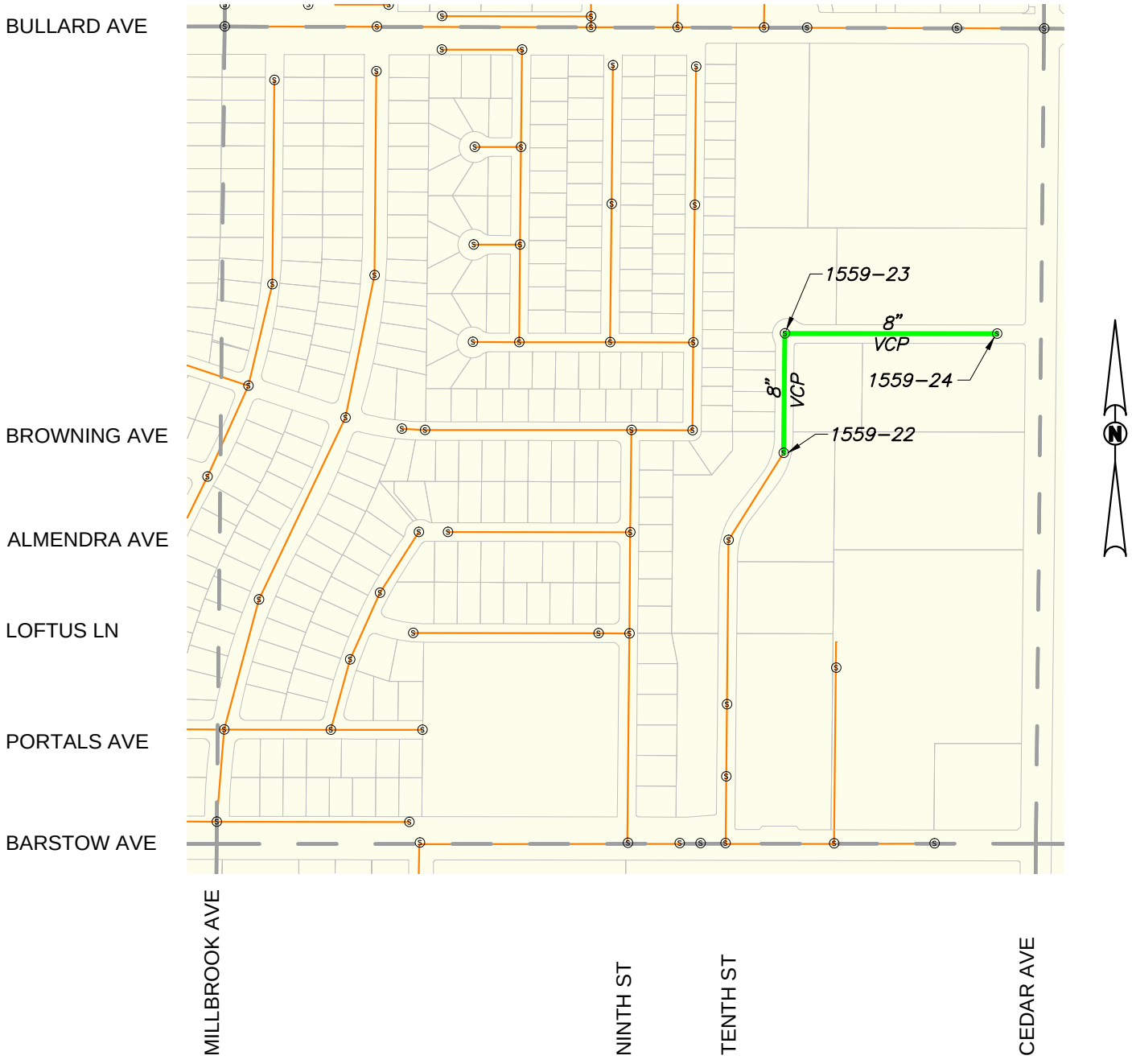
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 1559**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 1,074 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1559 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:39pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 1358**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**
6" 200 LF

**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1358 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:39pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

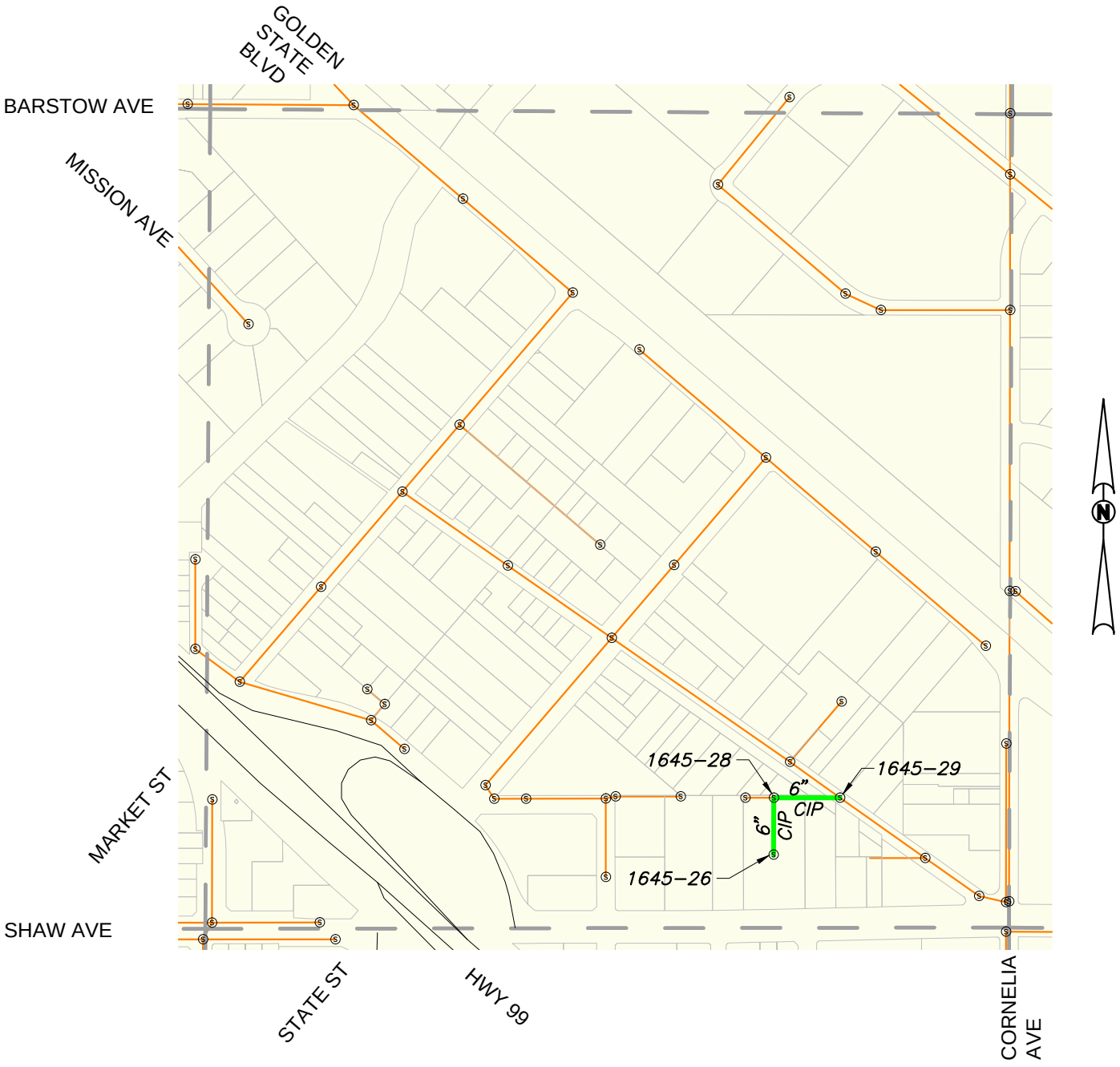
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 1645**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 6" | 100 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| CIP — Cast In Place | 1358-23 — Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1645 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:39pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** B

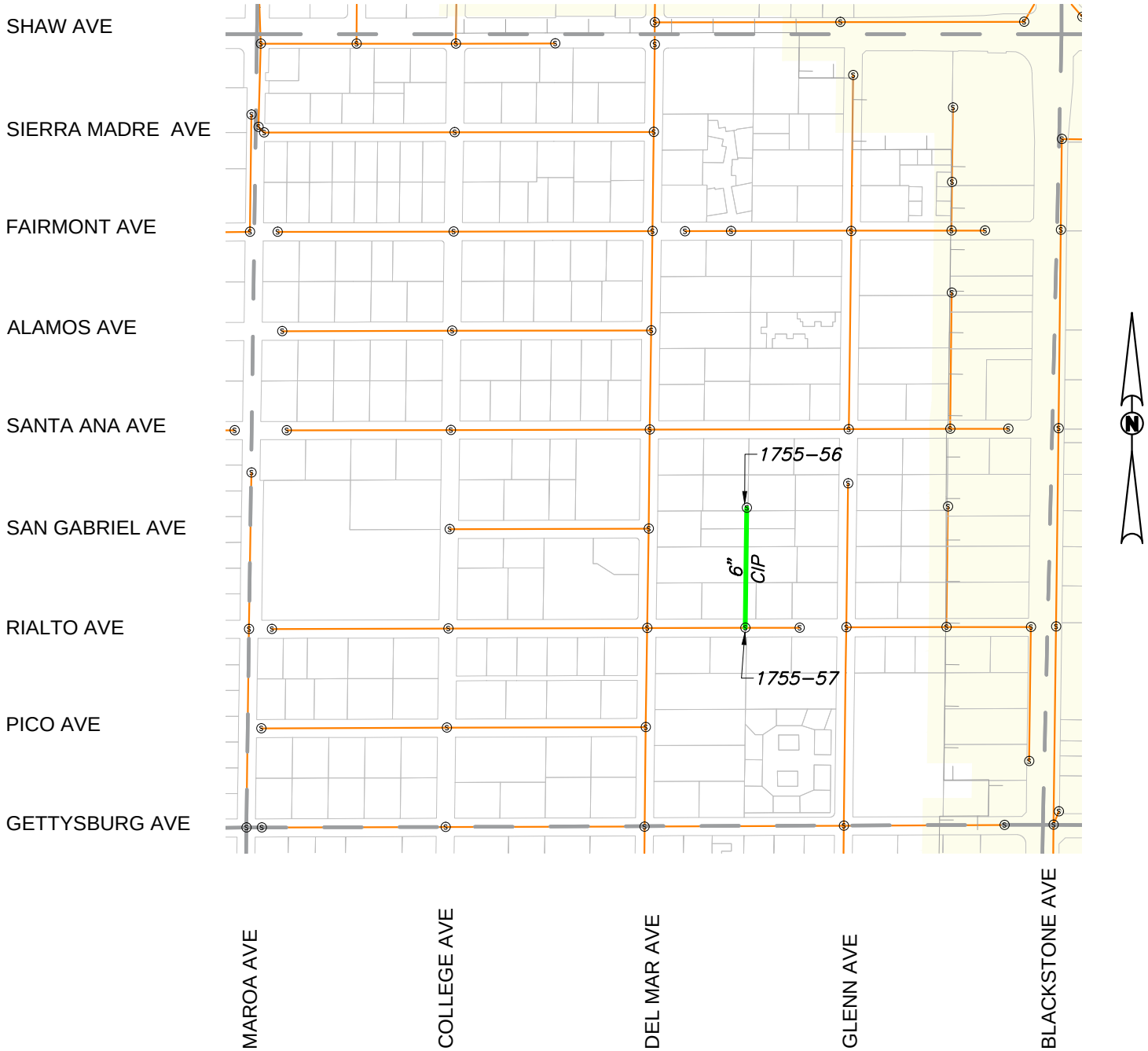
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 1755**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 6" | 398 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| CIP — Cast In Place | 1358–23 — Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1755 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:40pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** B

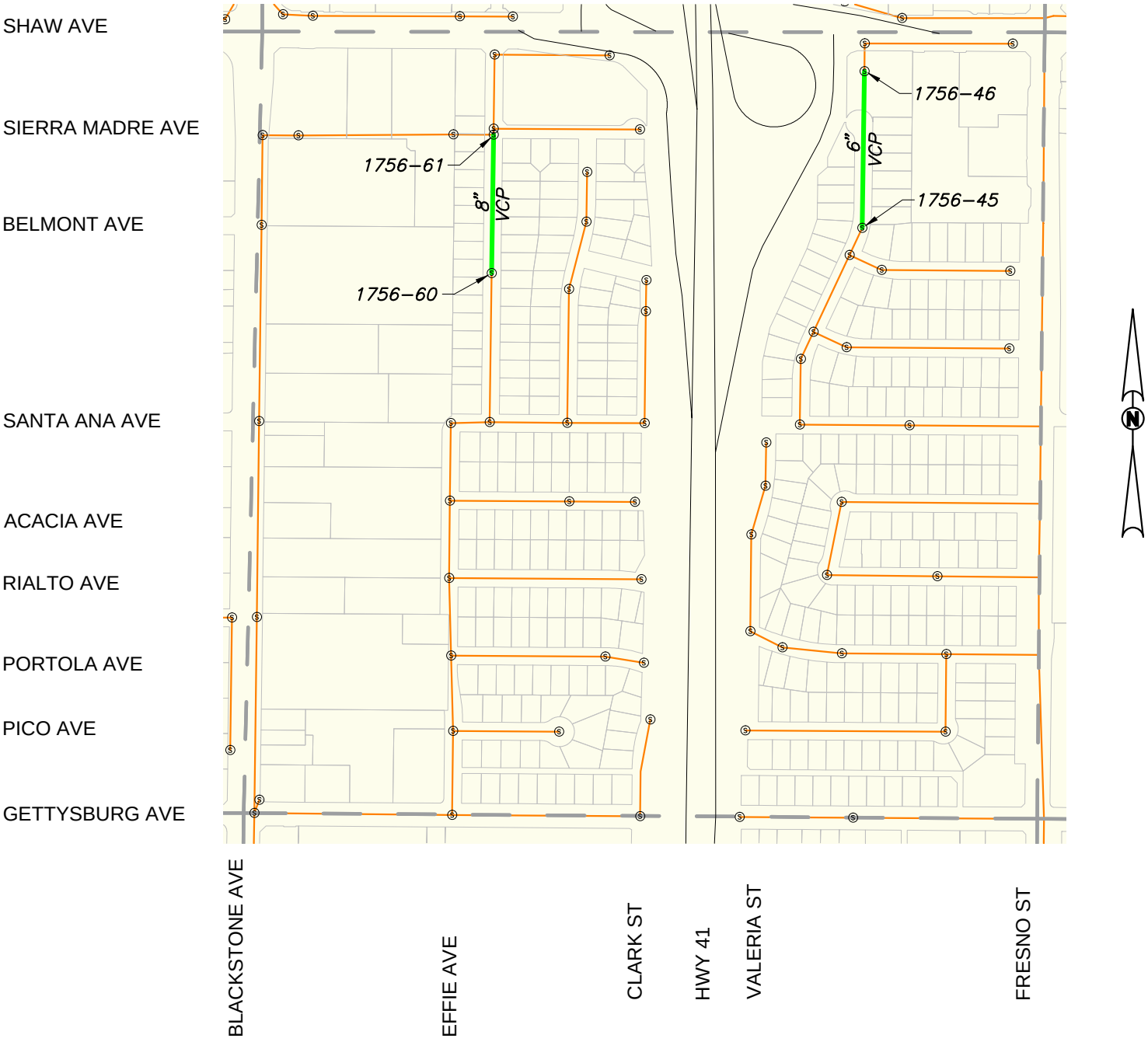
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 1756**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 464 LF |
| 6" | 525 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358-23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1756 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:40pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

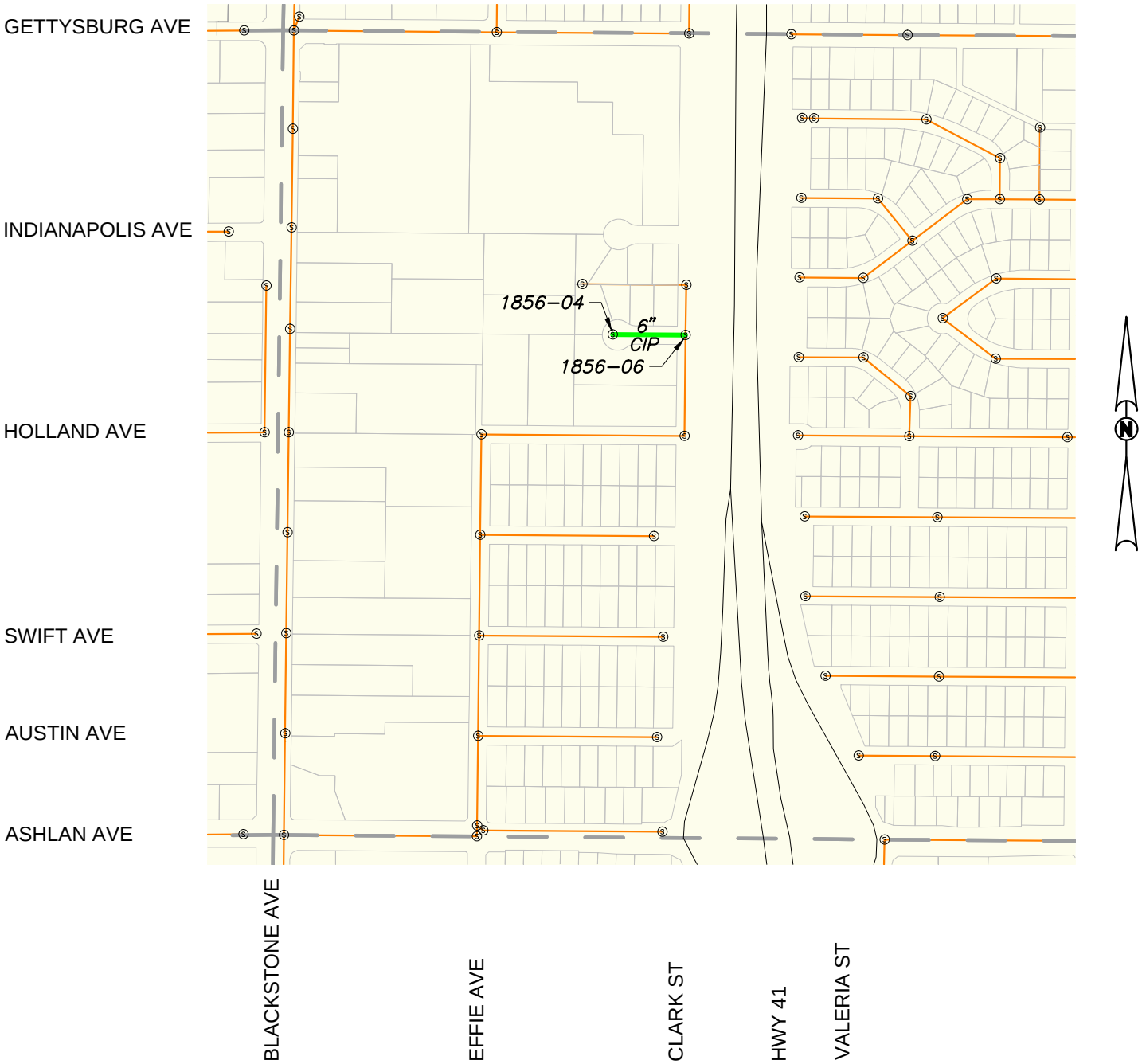
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 1856**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 6" | 239 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| CIP — Cast In Place | 1358-23 — Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1856 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:40pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** A

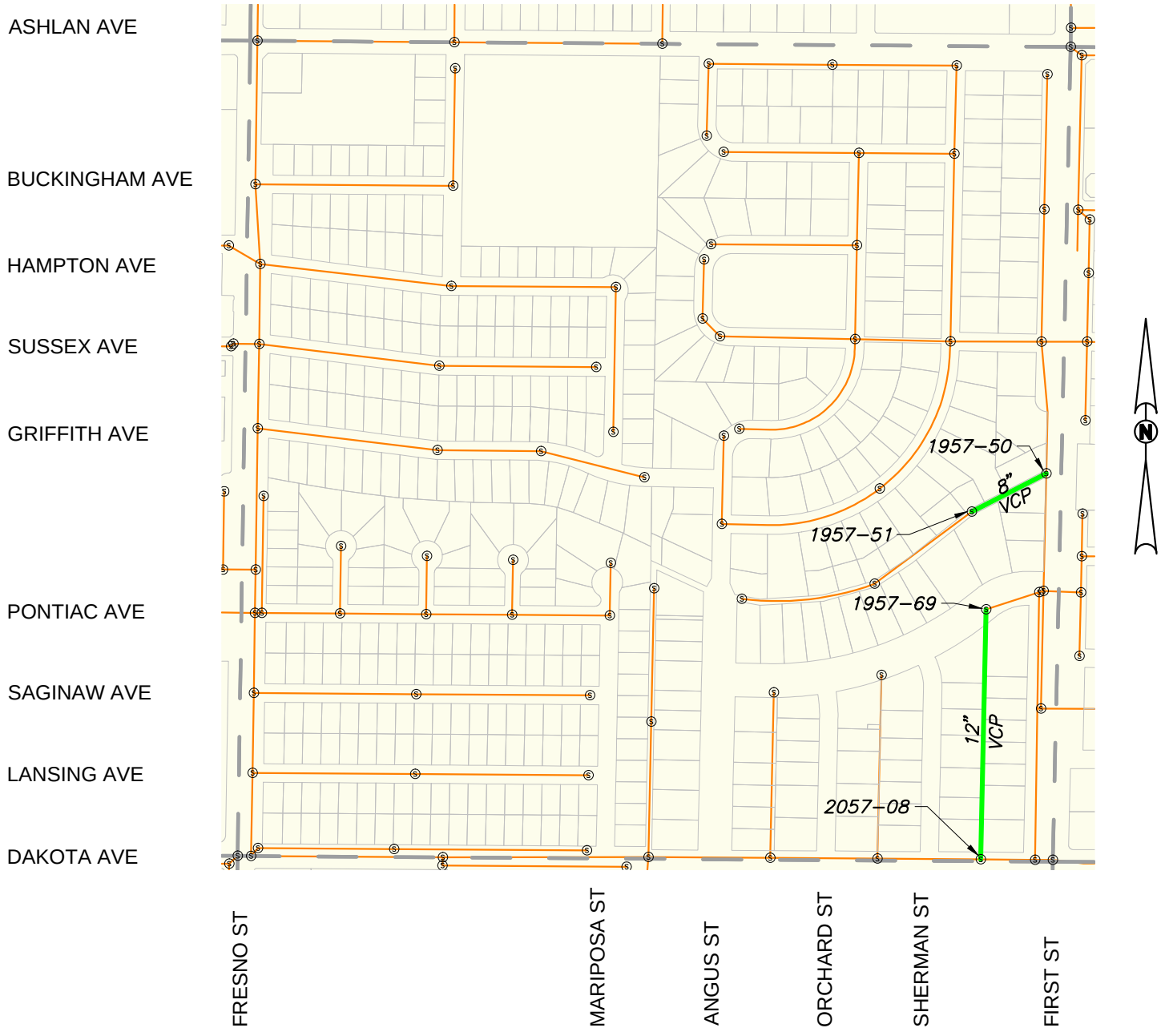
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 1957**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 12" | 813 LF |
| 8" | 272 LF |




**Legend**

| | | | |
|---|---|---|---|
| | Rehabilitation Required | | Plat Boundary |
| | Other Sewers | | City Limits |
| | Parcel Boundary | Ⓢ | Sewer Manhole |
| VCP | Vitrified Clay Pipe | 1358–23 | Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1957 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:40pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

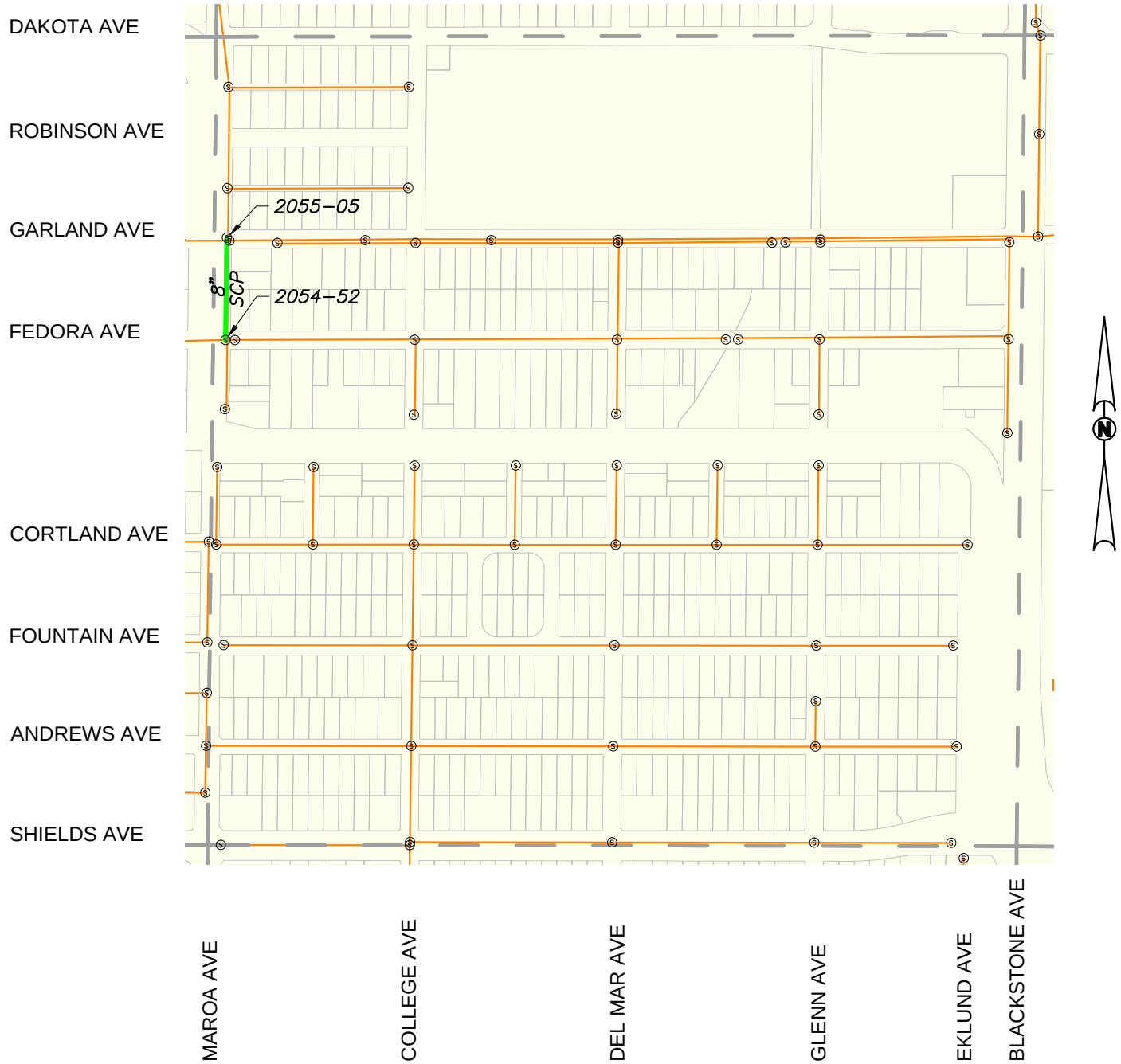
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2055**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 335 LF |




**Legend**

| | | | |
|---|---|---|---|
| Rehabilitation Required | | Plat Boundary | |
| Other Sewers | | City Limits | |
| Parcel Boundary | Ⓢ | Sewer Manhole | |
| SCP | Standard Concrete Pipe | 1358-23 | Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2055 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:40pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

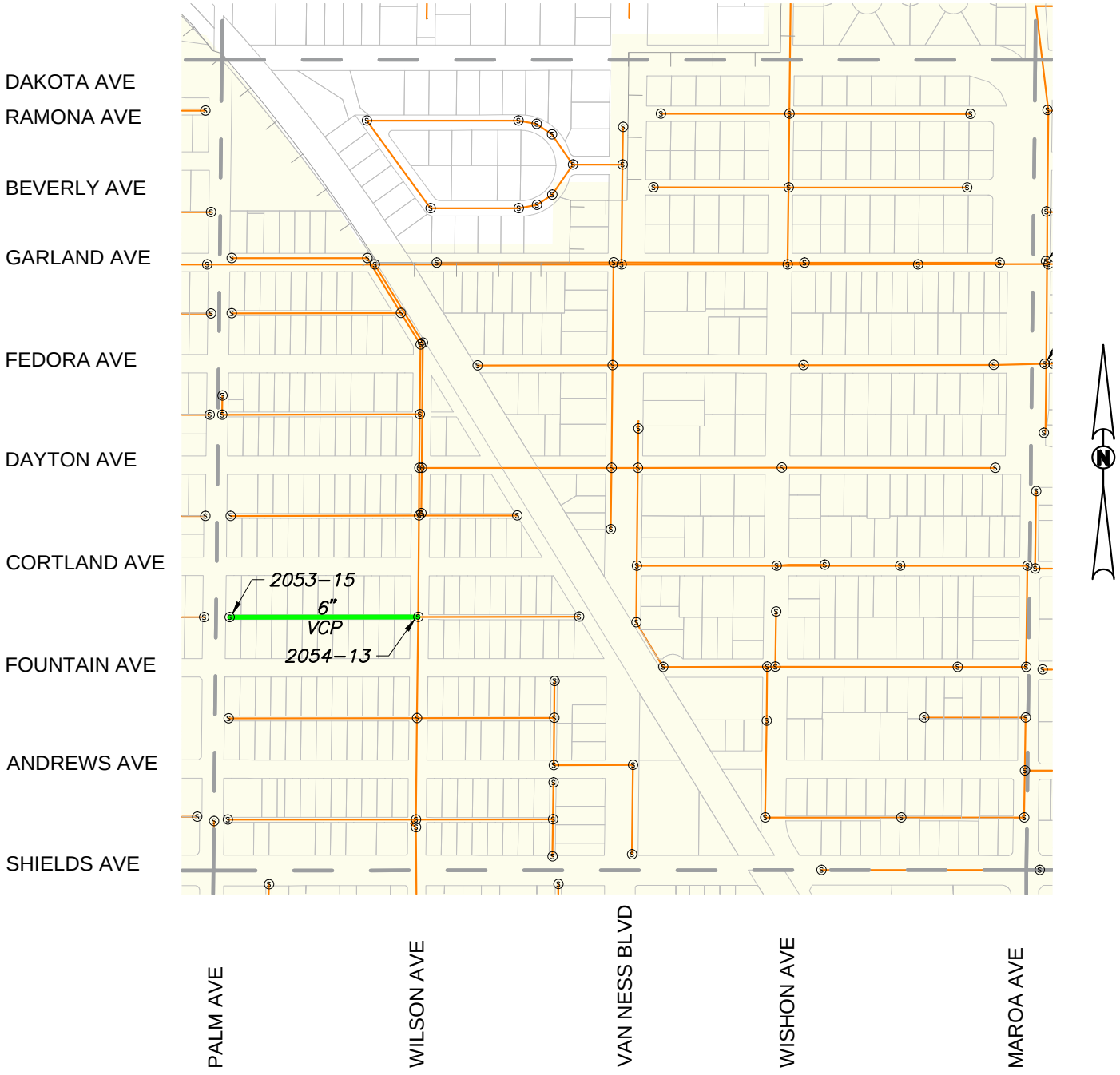
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2054**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 6" | 615 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2054 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:40pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

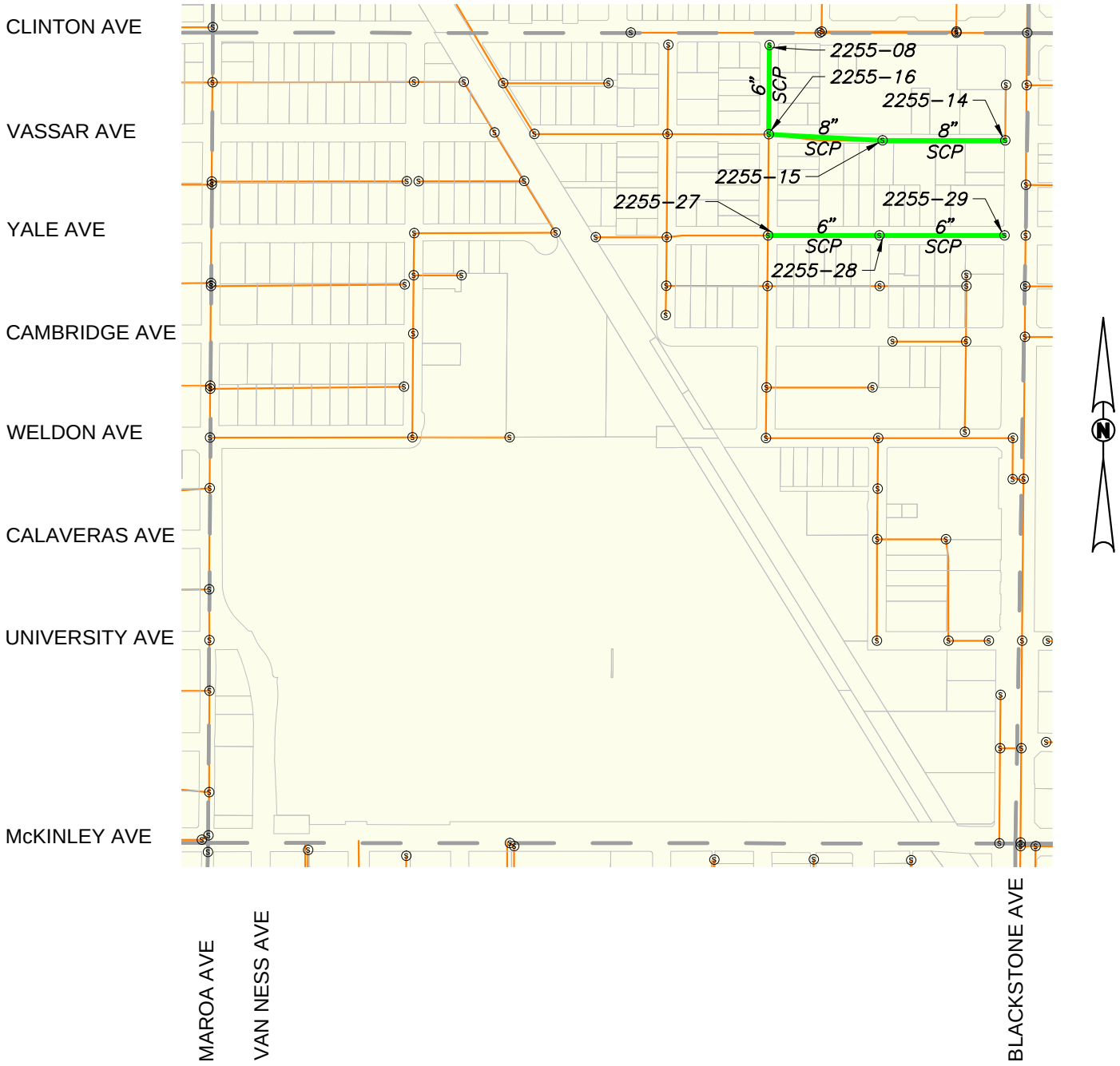
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2255**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 771 LF |
| 6" | 1,061 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2255 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:41pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** A

**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2057**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 12" | 953 LF |

**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2057 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:41pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

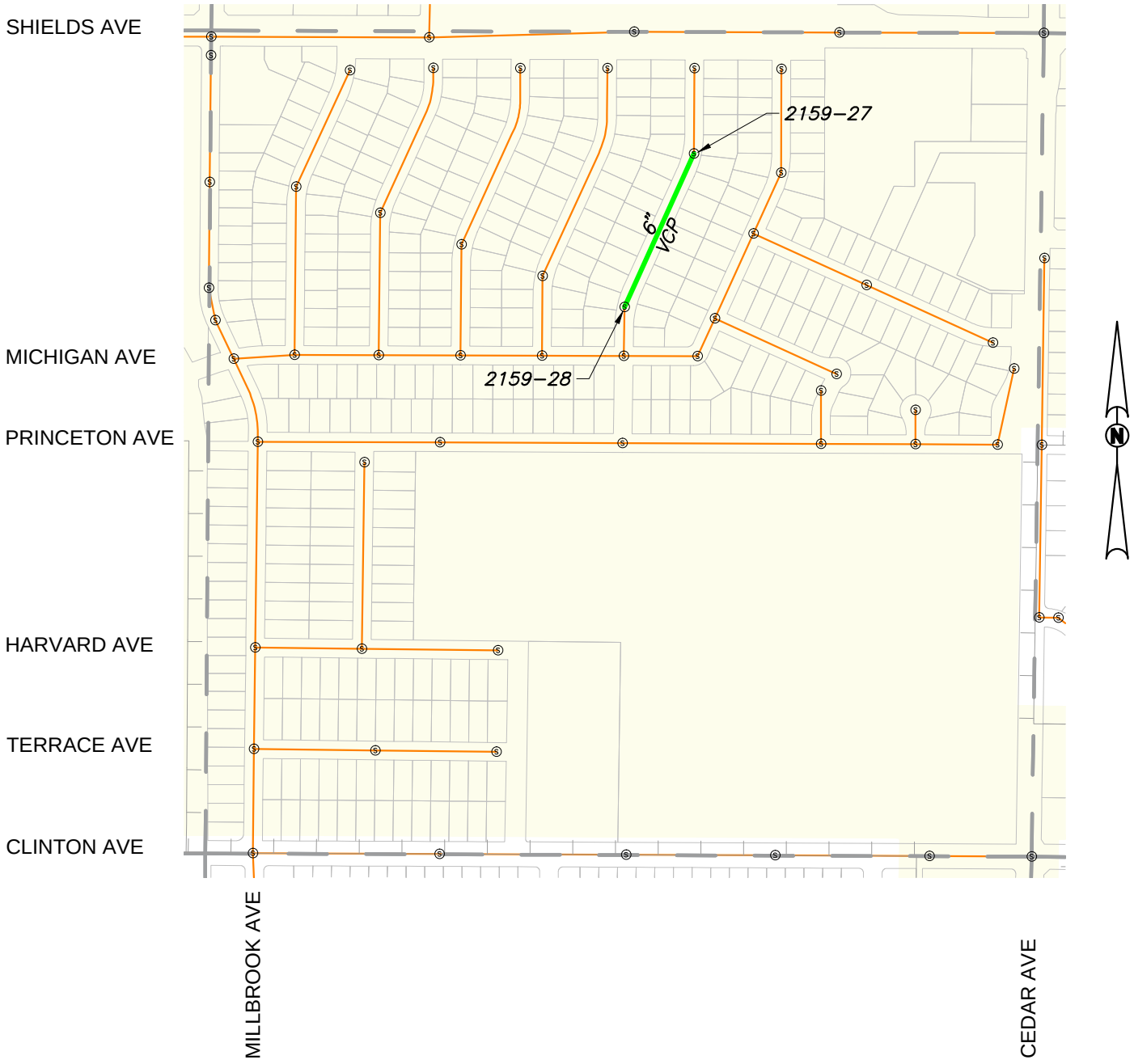
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2159**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 6" | 543 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2159 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:41pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

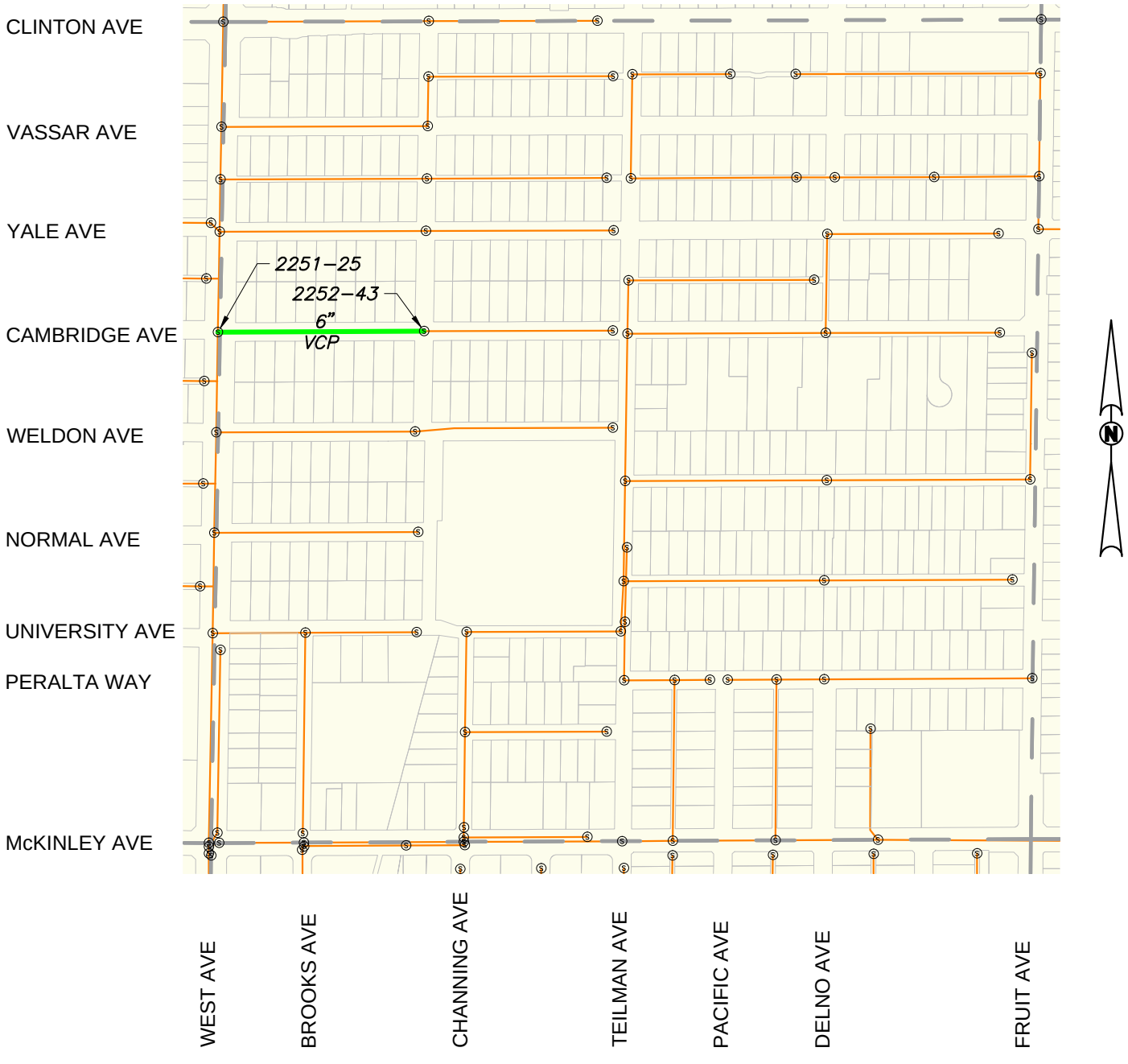
**Project Phase:** C

**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2252**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**
6" 668 LF




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2252 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:41pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** B

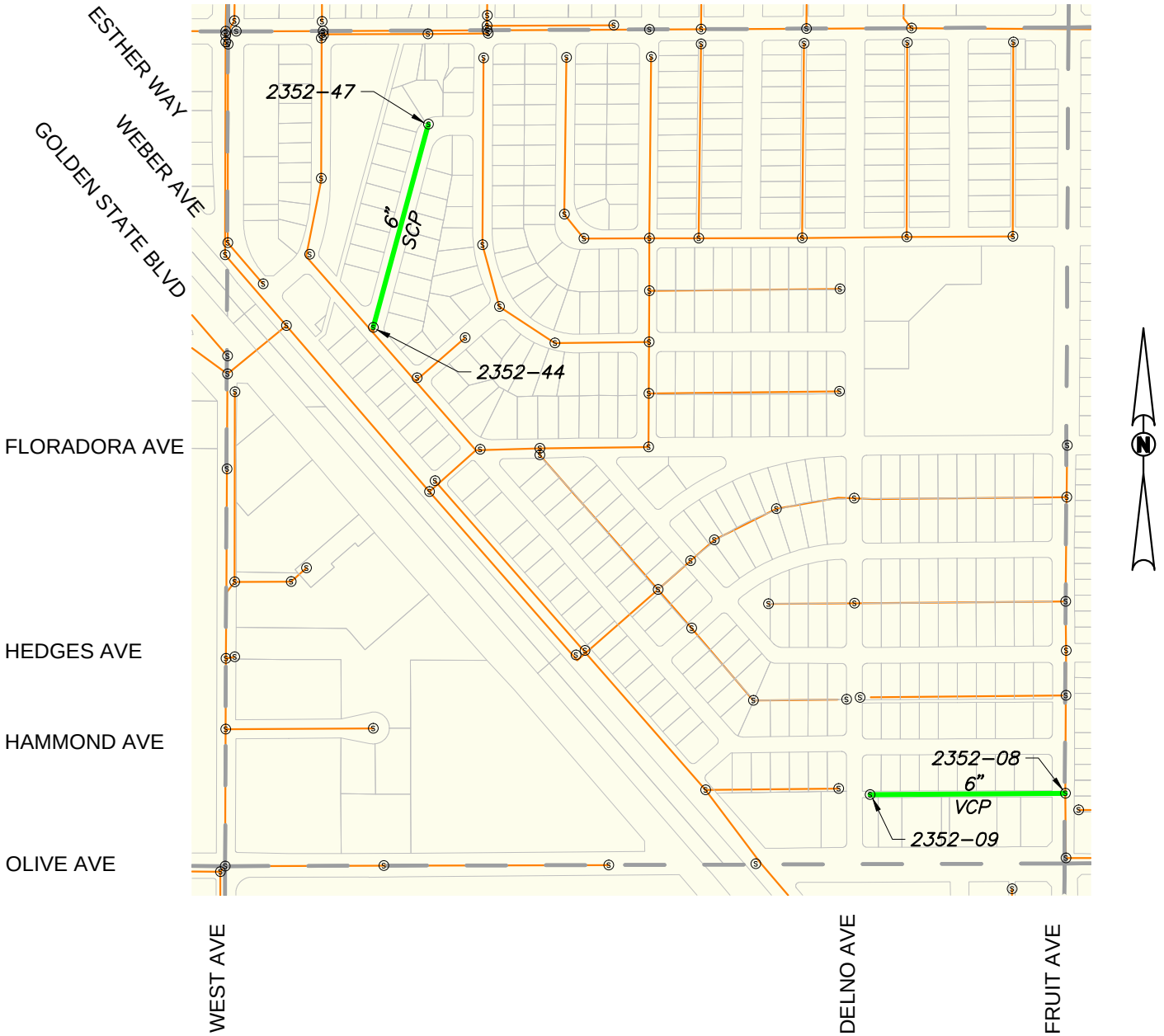
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2352**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 6" | 1,281 LF |




**Legend**

| | | | |
|---|---|---|---|
| | Rehabilitation Required | | Plat Boundary |
| | Other Sewers | | City Limits |
| | Parcel Boundary | Ⓢ | Sewer Manhole |
| SCP | Standard Concrete Pipe | 1358–23 | Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2352 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:41pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

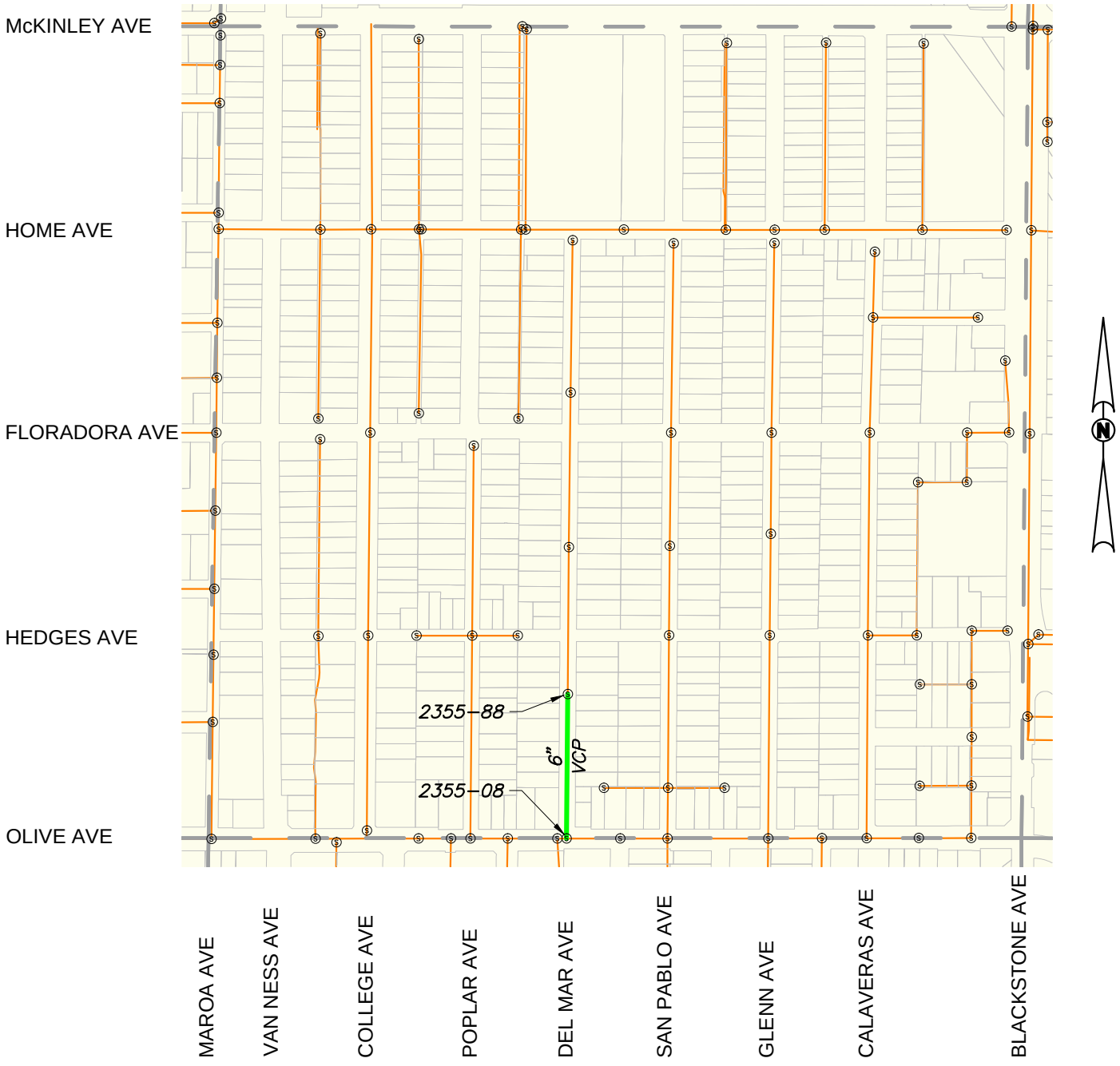
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2355**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 6" | 471 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP — Vitrified Clay Pipe | 1358-23 — Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2355 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:41pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

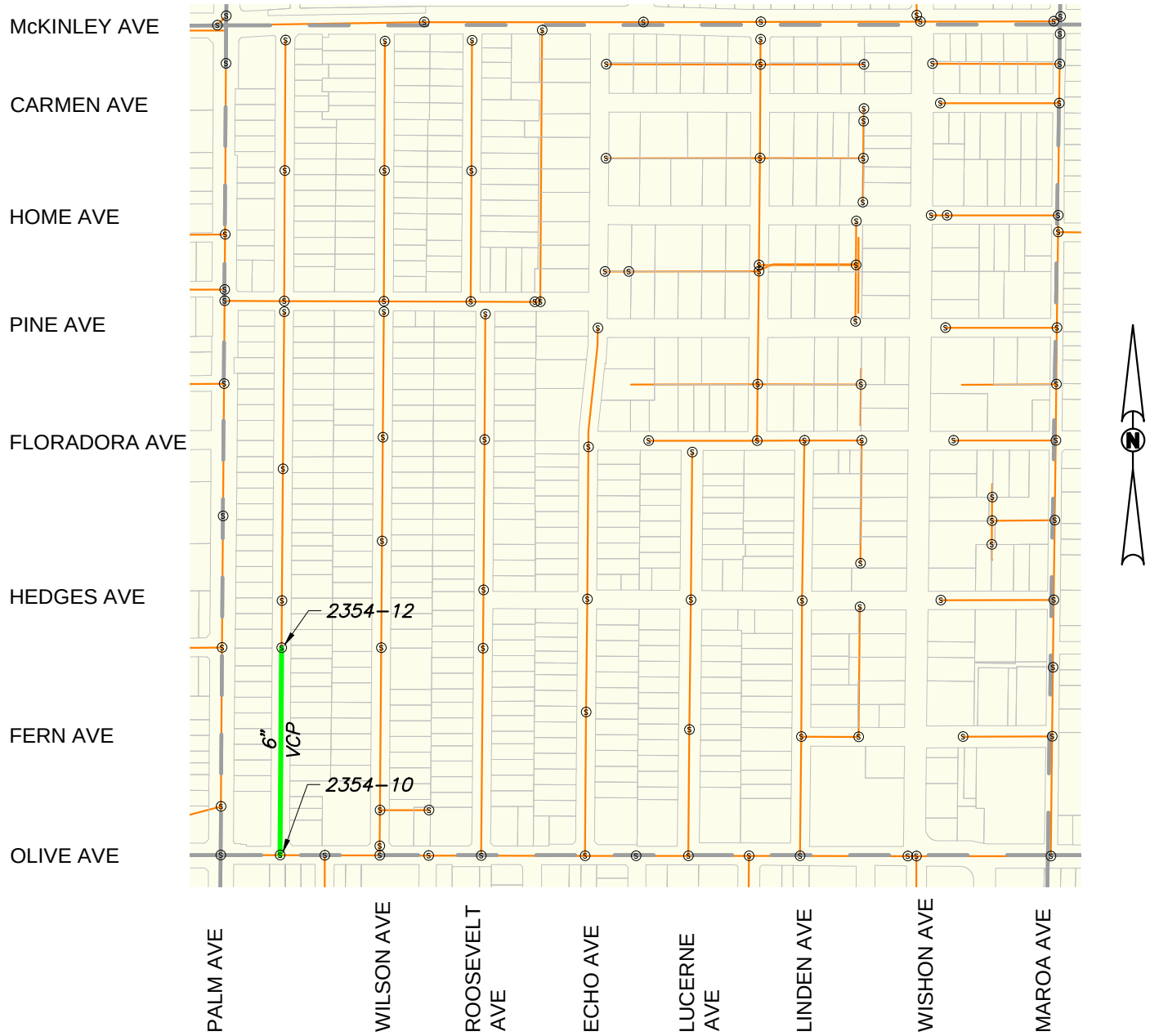
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2354**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 6" | 661 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358-23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2354 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** A

**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2361**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 637 LF |

**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| CIP — Cast In Place | 1358–23 — Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2361 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** A

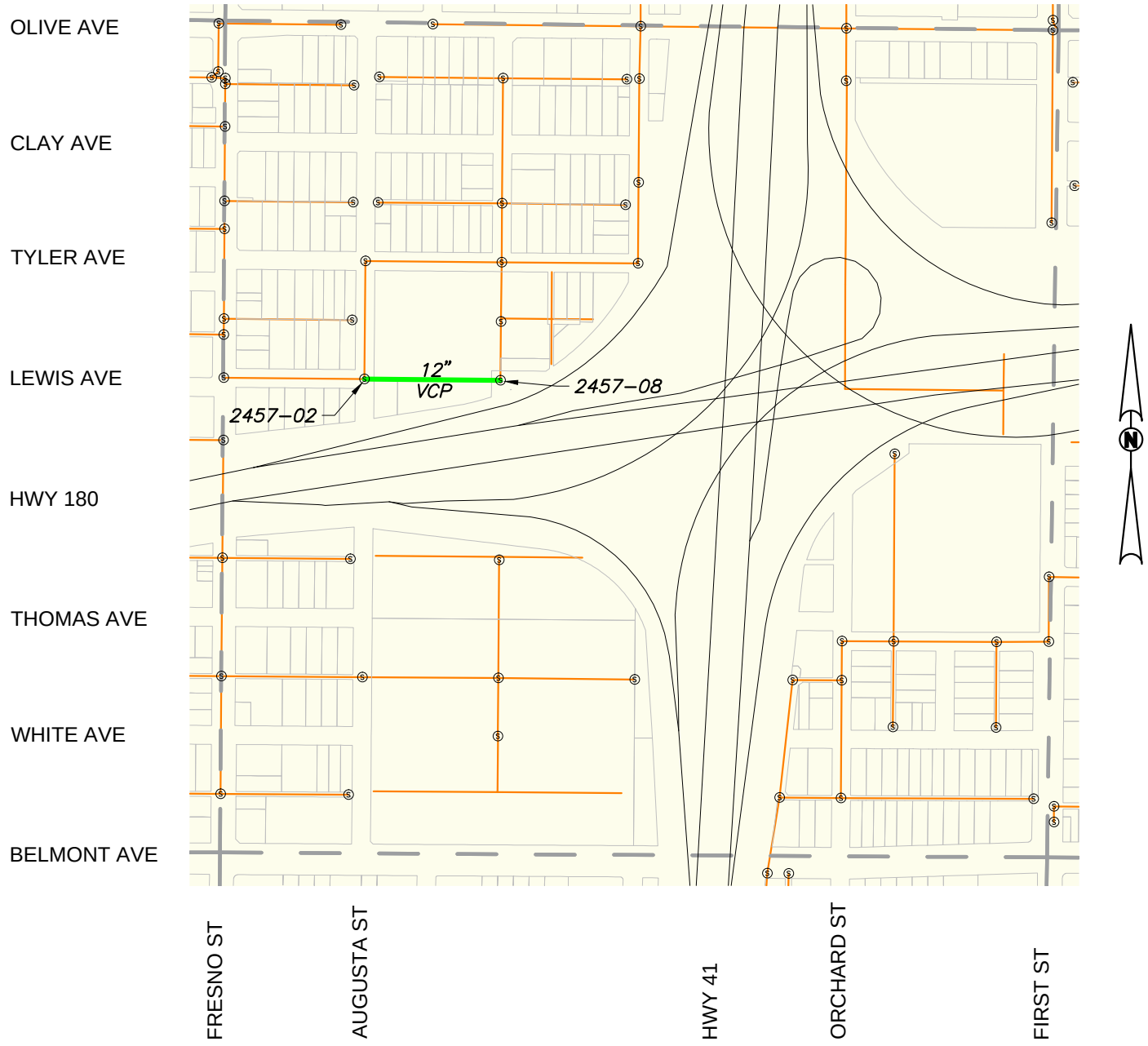
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2457**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 12" | 435 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358-23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2457 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** A

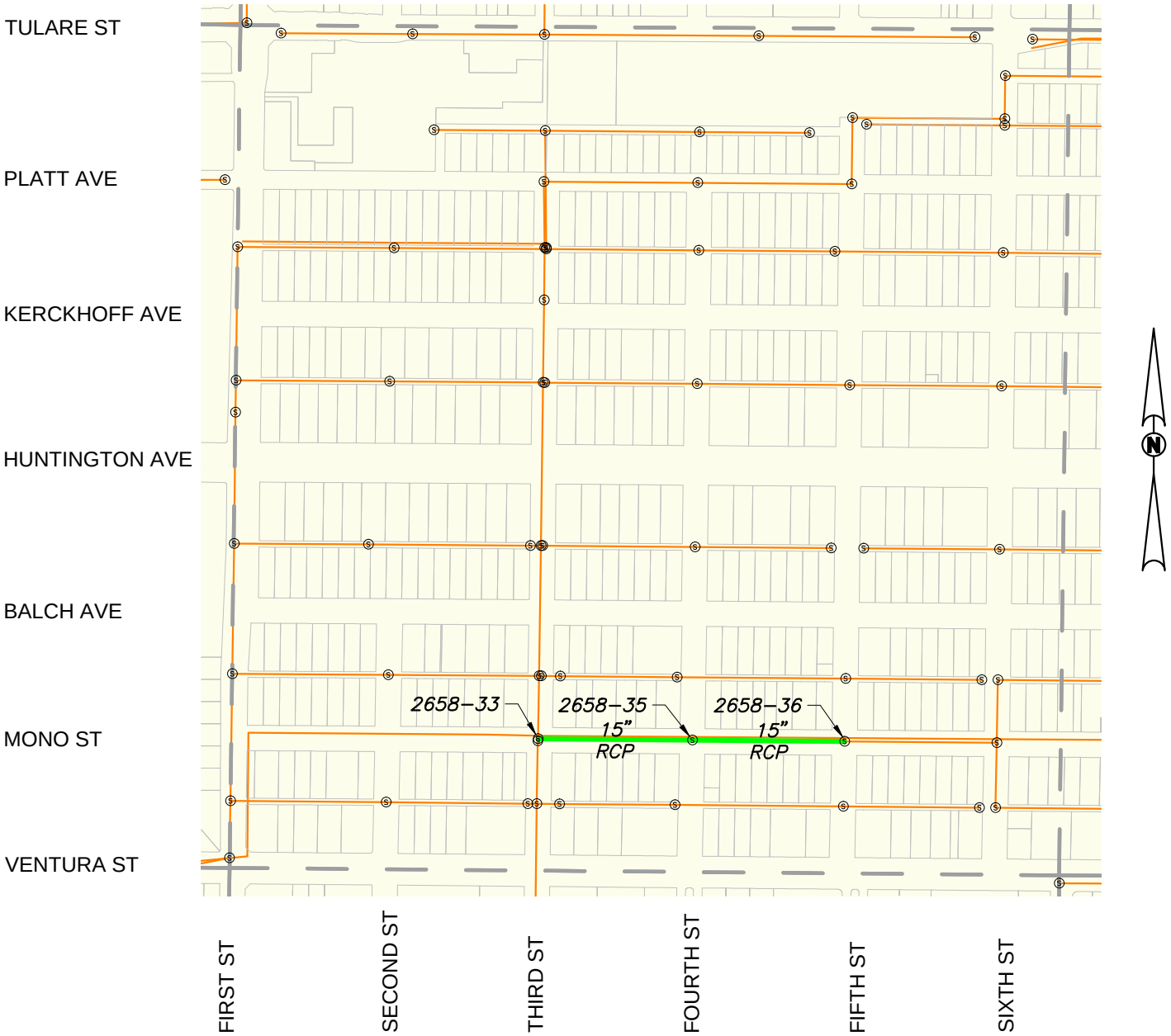
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2658**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 15" | 967 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| RCP — Reinforced Concrete Pipe | 1358-23 — Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2658 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** A

**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2856**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 18" | 925 LF |

**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2856 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:42pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** A

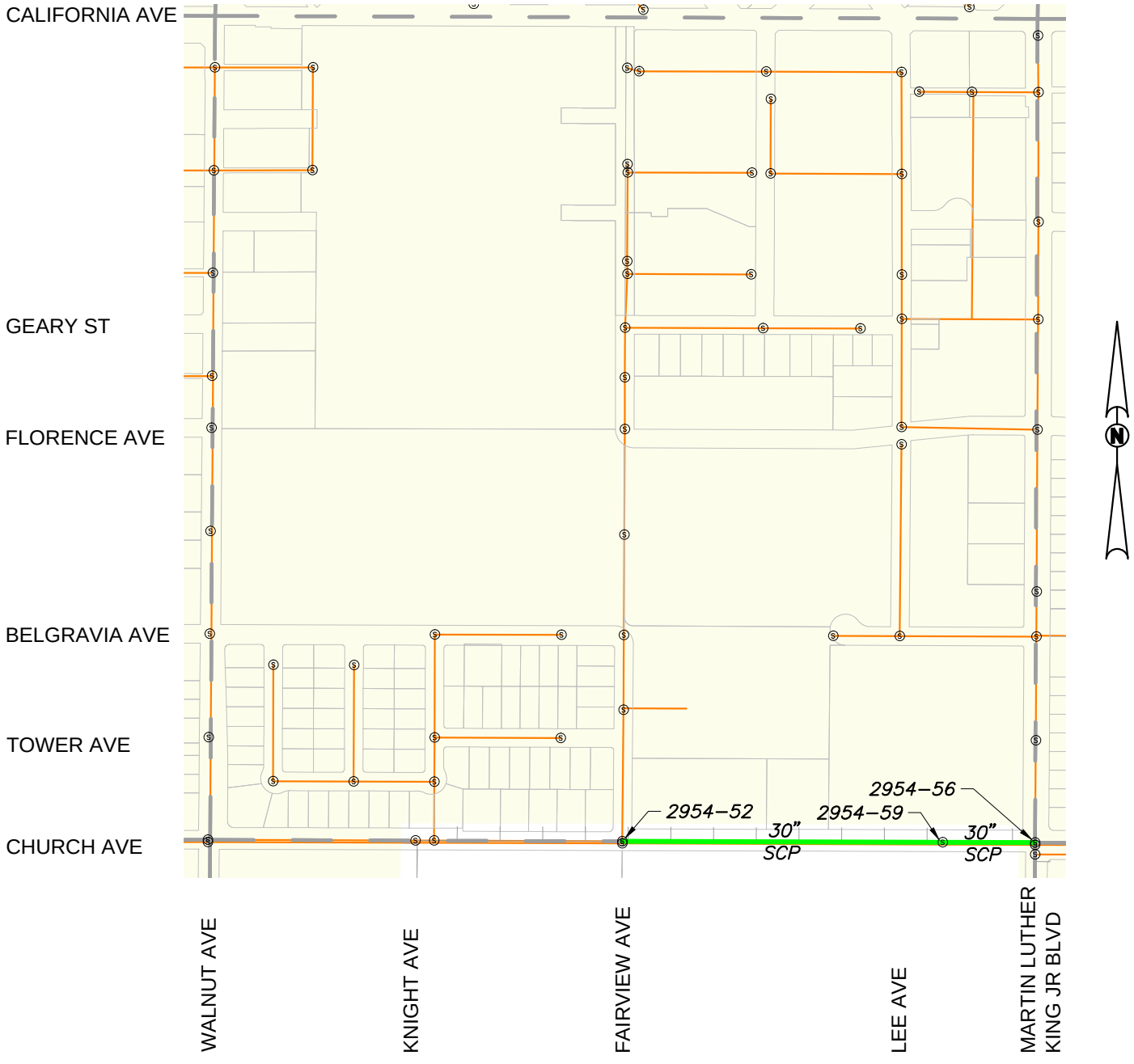
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2954**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 30" | 1,329 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| SCP Standard Concrete Pipe | 1358-23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2954 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

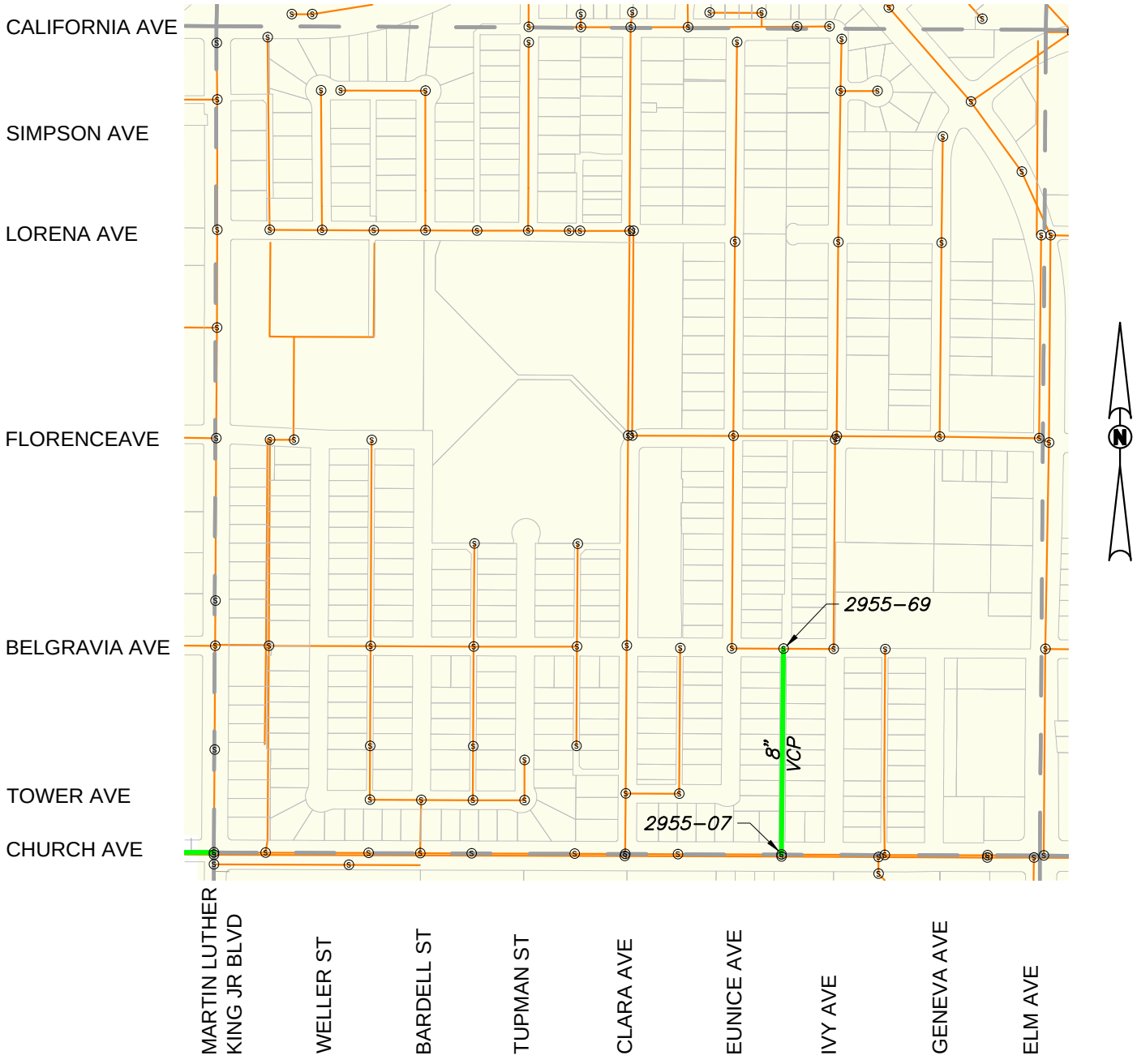
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2955**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 661 LF |




**Legend**

| | | | |
|---|---|---|---|
| | Rehabilitation Required | | Plat Boundary |
| | Other Sewers | | City Limits |
| | Parcel Boundary | Ⓢ | Sewer Manhole |
| VCP | Vitrified Clay Pipe | 1358-23 | Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2955 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** B

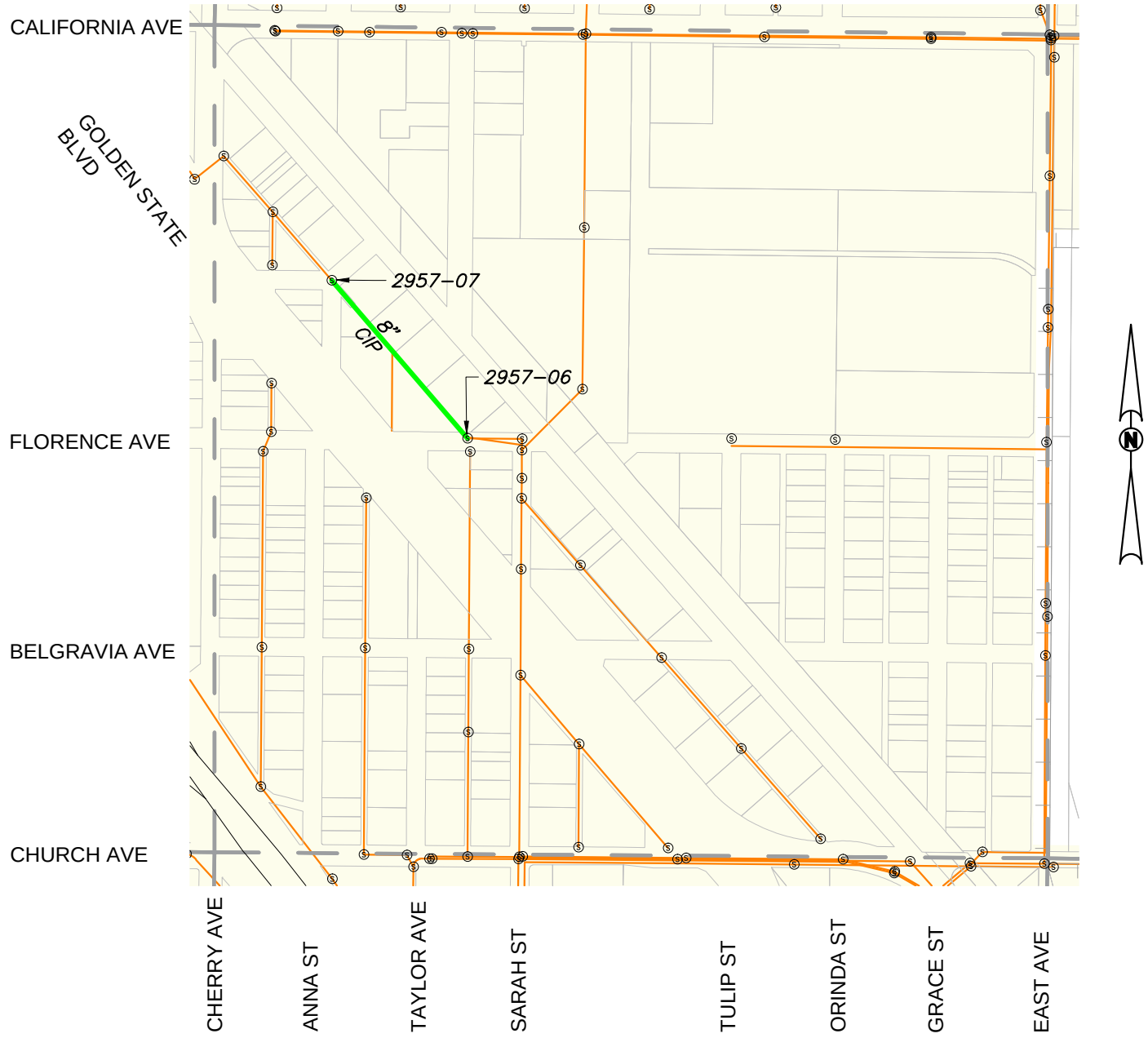
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 2957**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 665 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| CIP — Cast In Place | 1358–23 — Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2957 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:43pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** B

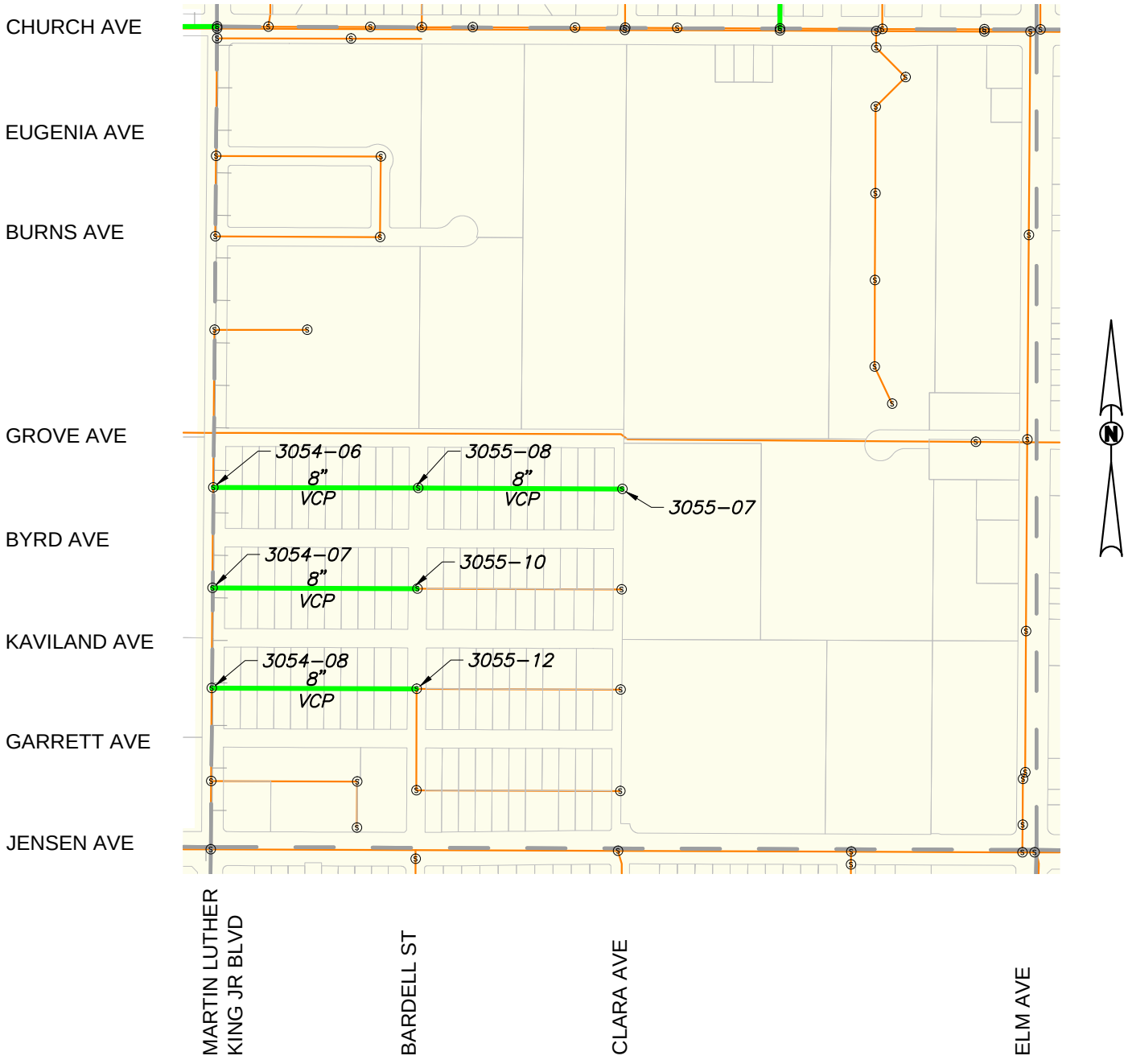
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 3055**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 1,991 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP — Vitrified Clay Pipe | 1358–23 — Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 3055 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:43pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** C

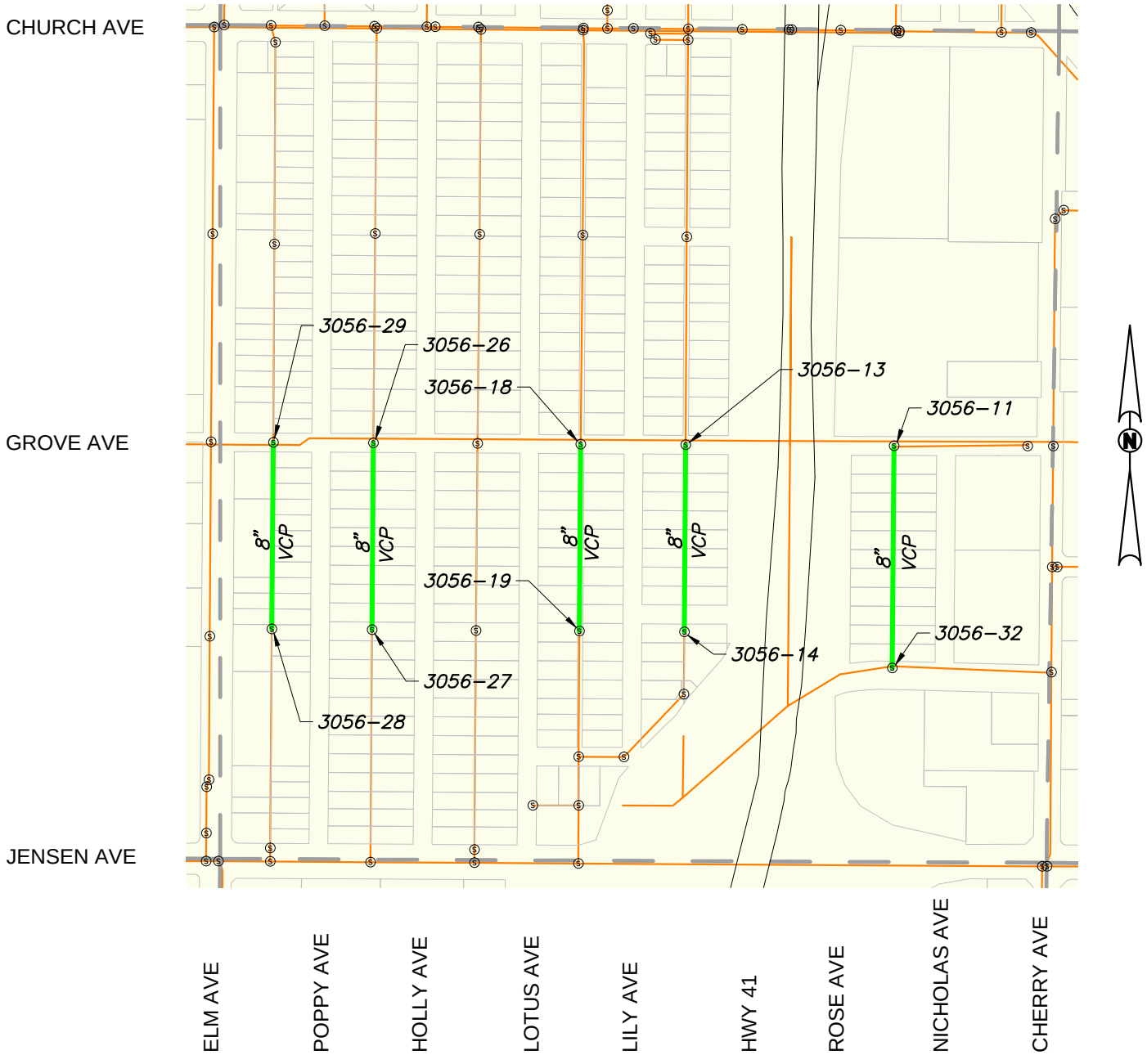
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 3056**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 3,087 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 3056 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:43pm

# City of Fresno
# Wastewater Collection System Master Plan
# CAPITAL IMPROVEMENT PLAN
# HIGH MOSR SEWER REPAIRS

**Project Phase:** A

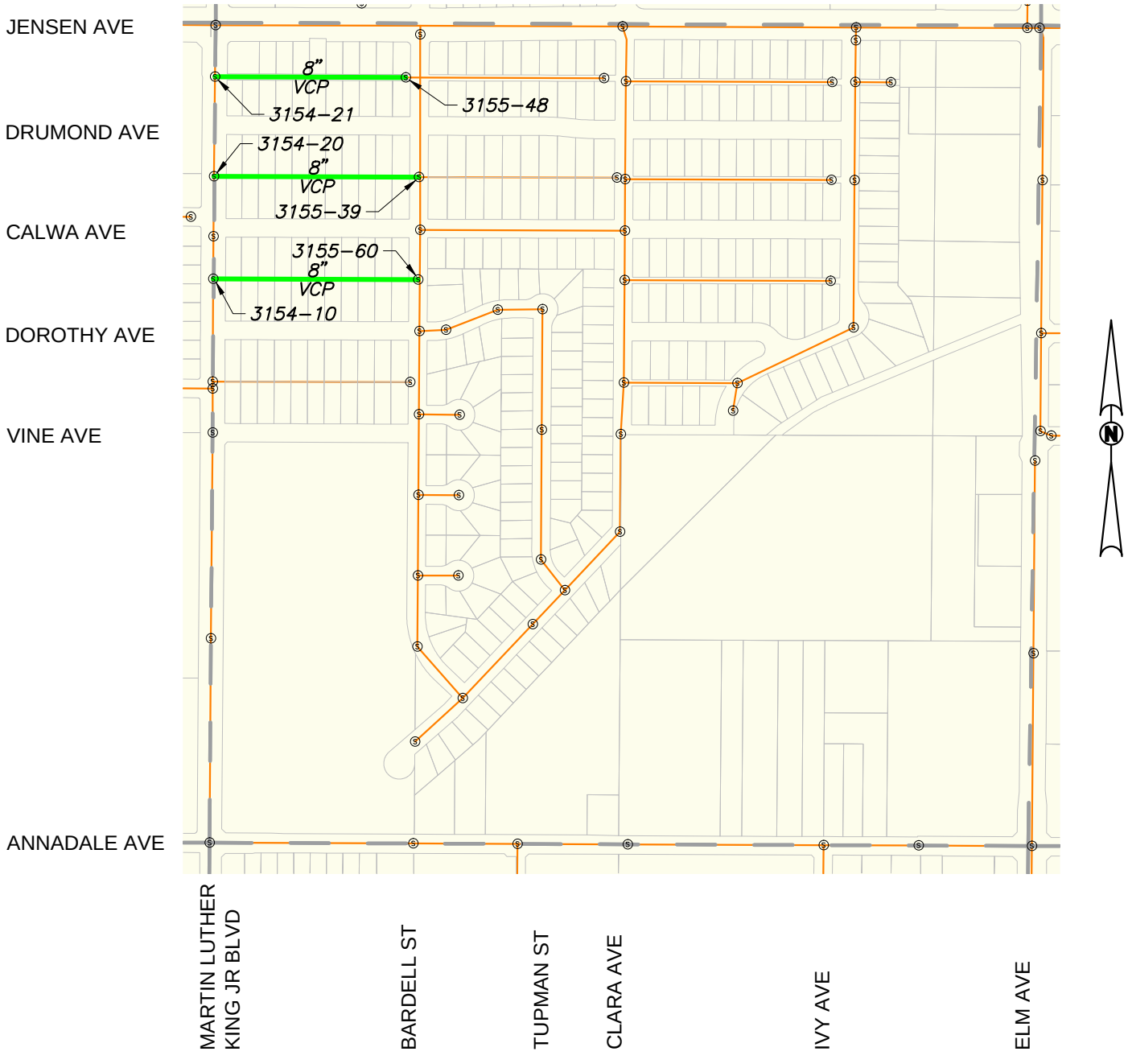
**Project Purpose:** Rehabilitation of Existing Sewer Facilities

**Plat Area: 3155**

**Reccomendation:** Install Cured-In-Place (CIPP) Liner

**Pipe Diameter Quantities:**

| | |
|---|---|
| 8" | 1,945 LF |




**Legend**

| | |
|---|---|
| Rehabilitation Required | Plat Boundary |
| Other Sewers | City Limits |
| Parcel Boundary | Sewer Manhole |
| VCP Vitrified Clay Pipe | 1358–23 Sewer Manhole Number |

0 100 250 500 1000
SCALE IN FEET

**PRELIMINARY**

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 3155 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:43pm

# APPENDIX G –BCF-PACP RATING SYSTEM

# PACP© Condition Grading System

The Pipeline Assessment and Certification Program (PACP) developed by NASSCO provides a mechanism for creating reliable descriptions of pipe conditions. NASSCO has also developed a system based on the PACP codes to assign a condition rating to pipelines. Requirements of the grading system were as follows:

1. Like the PACP, the grading system should be direct and objective.
2. Provide the ability to qualitatively identify differences in pipe condition between one inspection and subsequent inspections, and to prioritize based on the significance of the defects different pipe segments.

Many other approaches to sewer pipe grading have been used in the United States as well as in other parts of the World. These approaches generally use some type of defect grading that is then used to calculate an overall pipe rating.

It is problematic to develop a single pipe segment rating that fully describes all of the important aspects of a pipe. Therefore the PACP Condition Grading System uses more than one method of rating pipe segment condition including a rating that considers the number of total defects within the pipe segment and a rating that considers the most severe defects within the pipe segment.

The PACP Condition Grading System only considers internal pipe conditions obtained from TV inspection. While other factors such as pipe material, depth, soils, and surface conditions also affect pipe survivability, those factors have not been included in the PACP Condition Grading System. The PACP Condition Grading System should be used only as a tool for screening pipe segment inspections, allowing the User to quickly determine which pipe segments have significant defects. It is expected that as the PACP further develops the PACP Condition Grading System will expand to include other factors.

The PACP Condition Grading System provides condition ratings for Structural Defects and Operation and Maintenance Defects.

## Approach

Using the PACP Code Matrix, Each PACP defect code is assigned a condition grade of from 1 to 5. Grades are assigned based on the significance of the defect, extent of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damage, percentage of flow capacity restriction, or the amount of wall loss due to deterioration.

The PACP Condition Grading System alone is inadequate for determining if a pipe segment should be rehabilitated or replaced. Many other factors in addition to the internal condition of the segment should be considered. The fact that a segment has significant Grade 4 or Grade 5 defects does not necessarily mean the pipe segment should be immediately rehabilitated. Recent experience by PACP Users has shown that pipe segments with serious defects such as hinge failures may remain largely unchanged for many decades if no deterioration factors such as surcharging, roots, or groundwater are present.

What is needed is improved estimates of remaining life or mean time before failure that are based on close monitoring of pipe segments over time. Once we know how much change occurs in pipe segments we can better understand the relationship between defects, deterioration factors, and pipe segment life expectancy. PACP continues to be an excellent tool for benchmarking pipe condition between one inspection and subsequent inspections of the same pipe.

Grades are assigned for two categories, Structural, and O&M defects.
Grades are as follows;
**5** - Most significant defect grade
**4** – Significant
**3** – Moderate defect grade
**2** – Minor to Moderate
**1** –Minor defect grade

The PACP Condition Grading System results are entirely dependent on the quality of the PACP defect coding. Errors in the coding will directly result in errors in the Grading. All utilities, engineers, and contractors should make sure the data they are using was coded by experienced technicians who have successfully demonstrated their competence through a formal or informal apprenticeship program. PACP data from inexperienced technicians should be checked and corrected as needed. Errors found in coding should be corrected and the errors brought to the attention of the technician.


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## Grading of Continuous Defects

The PACP continuous defect feature is used to denote where long portions of a sewer pipe are affected by the same defect, without the User having to repetitively enter point defects. However to develop a grade for the pipe segment, a mechanism is needed to translate a continuous defect into an equivalent number of point defects.

The equivalent number (quantity) of "uninterrupted" and "joint repeating" continuous defects is calculated by dividing the length of the continuous defect by 5. Example, a 6-meter long continuous defect, grade 3, should equate to four Grade 3 defects. Fractions are rounded to the nearest whole number.

## Pipe Ratings

The pipe rating is based on the number of occurrences for each condition grade. Ratings are calculated separately for **Structural Defects** and **O&M Defects**. Several ways of expressing pipe segment condition are used by the PACP Condition Grading System as follows.

**Segment Grade Scores** - Each pipe segment will have a Segment Grade Score for each of the five grades. The number of occurrences of each pipe grade is multiplied by the pipe grade to calculate the segment grade score. Example, six Grade 5 defects would be 6 times 5 and equates to a Segment Grade 5 Score of 30. If a pipe segment had no defects of a particular grade, then the Segment Grade Score for that grade would be 0.

**Overall Pipe Rating** –The five Segment Grade Scores are added together to calculate the **Overall Pipe Rating. Structural Pipe Ratings** are calculated using only Structural Defect grades, while **O&M Pipe Ratings** are calculated using only O&M Defect grades.


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**PACP Quick Rating** – The PACP Quick Rating is a shorthand way of expressing the number of occurrences for the two highest severity grades. The PACP Quick Rating is a four character score as follows:

1. The first character is the highest severity grade occurring along the pipe length.
2. The second character is the total number of occurrences of the highest severity grade. If the total number exceeds 9, then alphabetic characters are used as follows- 10 to 14 – A; 15 to 19 – B; 20 to 24 – C; etc.
3. The third character is the next highest severity grade occurring along the pipe length.
4. The fourth character is the total number of the second highest severity grade occurrences, derived as in item 2 above.

*For Example*

4B27

This immediately shows that no grade 5 defects or grade 3 defects, however 15 to 19 grade 4 defects and seven grade 2 defects were found.

*Another Example*

3224

Two grade 3 defects and four grade 2 defects, however no grade 5 or grade 4 defects were found.

If a pipe segment only has defects of one grade, the first two characters are the grade and the quantity of defects, and the last two characters are 00 (denoting no other defect grades). A pipe segment with no defects would have a Quick Score of 0000 (all zeros).

The PACP Quick Rating provides the ability to summarize the number and severity of defects found within a pipe segment. As with the Pipe Rating, Quick Structural Ratings


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are calculated using only Structural Defect Grades, and Quick O&M Ratings are calculated using only O&M Defect Grades.

The Quick Rating is an excellent screening tool to determine which pipe segments require closer scrutiny. If a pipe has not defects greater than Grade 1 or 2, then the pipe segment probably does not need any further investigation.

**Pipe Ratings Index** – This is an indicator of the distribution of defect severity. The Pipe Ratings Index is calculated by dividing the Pipe Rating by the number of defects. For example, the Structural Pipe Ratings Index would be the Structural Pipe Rating divided by the number of structural defects. Pipe Ratings Indexes are calculated for Structural, O&M, and Overall. A pipe segment with a Pipe Rating of zero (0) would have a Pipe Rating Index of zero (0).

**Summary**

The following procedures are used to calculate pipe segment ratings using the PACP Condition Grading System:

1. Determine the number of occurrences for each condition grade within the pipe segment. Calculate separately for Structural Defect Grades and O&M Defect Grades.
2. Calculate the Segment Grade Score by multiplying the number of occurrences by the respective grade 1 through 5. Calculate the Structural Segment Grade Score and the O&M Segment Grade Score separately, and then add together for the Overall Segment Grade Score.
3. Calculate the Pipe Rating for the pipe segment by adding the Segment Grade Scores. Add all five Structural Segment Grade Scores for the Structural Pipe Rating, and add all five O&M Segment Grade Scores for the O&M Pipe Rating. Add all five Overall Segment Grade Scores for the Overall Pipe Rating.
4. Determine the PACP Quick Rating by calculating the number of occurrences of the two highest severity grades.



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5. Calculate the Pipe Ratings Index by dividing the Pipe Rating by the number of defects. If the pipe has no defects, the Pipe Ratings Index is zero.
6. Verify the PACP defect data used in accurate. The grading is a direct calculation from the defect data, and coding errors will be reflected in grading errors.


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# NASSCO PACP Condition Grading System
## Code Matrix

| Family | Group | Descriptor | Modifier | Code | Structural Grade | O&M Grade |
|---|---|---|---|---|---|---|
| Structural | Crack (C) | Circumferential ( C) | | CC | 1 | |
| | | Longitudinal (L) | | CL | 2 | |
| | | Multiple (M) | | CM | 3 | |
| | | Hinge (CH2) | | CH2 | 4 | |
| | | Hinge (CH3) | | CH3 | 5 | |
| | | Hinge (CH4) | | CH4 | 5 | |
| | | Spiral (S) | | CS | 2 | |
| Structural | Fracture (F) | Circumferential ( C) | | FC | 2 | |
| | | Longitudinal (L) | | FL | 3 | |
| | | Multiple (M) | | FM | 4 | |
| | | Hinge (H2) | | FH2 | 4 | |
| | | Hinge (H3) | | FH3 | 5 | |
| | | Hinge (H4) | | FH4 | 5 | |
| | | Spiral (S) | | FS | 3 | |
| Structural | Pipe Failures (Silent) | Broken (B) | | B | 1 clock pos - 3, 2 clock pos - 4, >=3 clock pos - 5 | |
| | | Broken (B) | Soil Visible (SV) | BSV | 5 | |
| | | Broken (B) | Void Visible (V V) | BVV | 5 | |
| | | Hole (H) | | H | 1 clock pos - 3, 2 clock pos - 4, >= 3 clock pos - 5 | |
| | | Hole (H) | Soil Visible (SV) | HSV | 5 | |
| | | Hole (H) | Void Visible (V V) | HVV | 5 | |
| Structural | Collapse (X) | Pipe (P) | | XP | 5 | |
| | | Brick (B) | | XB | 5 | |
| Structural | Deformed (D) | (Pipe) | | D | <=10% - 4,>10% - 5 | |
| | | (Brick) | Horizontally (H) | DH | 5 | |
| | | (Brick) | Vertically (V) | DV | 5 | |
| Structural | Joint (J) | Offset (displaced) (O) | Med (M) | JOM | 1 | |
| | | | Large (L) | JOL | 2 | |
| | | Separated (open) (S) | Med (M) | JSM | 1 | |
| | | | Large (L) | JSL | 2 | |
| | | Angular (A) | Med (M) | JAM | 1 | |
| | | | Large (L) | JAL | 2 | |
| Structural | Surface Damage Chemical (S) | Roughness Increased (RI) | C | SRIC | 1 | |
| | | Surface Spalling (SS) | C | SSSC | 2 | |
| | | Aggregate Visible (AV) | C | SAVC | 3 | |
| | | Aggregate Projecting (AP) | C | SAPC | 3 | |
| | | Aggregate Missing (AM) | C | SAMC | 4 | |



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# NASSCO PACP Condition Grading System
## Code Matrix

| Family | Group | Descriptor | Modifier | Code | Structural Grade | O&M Grade |
|---|---|---|---|---|---|---|
| | | Reinforcement Visible (RV) | C | SRVC | 5 | |
| | | Reinforcement Projecting (RP) | C | SRPC | 3 | |
| | | Reinforcement Corroded (RC) | C | SRCC | 5 | |
| | | Missing Wall (MW) | C | SMWC | 5 | |
| | | Other (Z) | C | SZC | | |
| Structural | Surface Damage Mechanical (M) | Roughness Increased (RI) | M | SRIM | 1 | |
| | | Surface Spalling (SS) | M | SSSM | 2 | |
| | | Aggregate Visible (AV) | M | SAVM | 3 | |
| | | Aggregate Projecting (AP) | M | SAPM | 3 | |
| | | Aggregate Missing (AM) | M | SAMM | 4 | |
| | | Reinforcement Visible (RV) | M | SRVM | 5 | |
| | | Reinforcement Projecting (RP) | M | SRPM | 3 | |
| | | Reinforcement Corroded (RC) | M | SRCM | 5 | |
| | | Missing Wall (MW) | M | SMWM | 5 | |
| | | Other (Z) | M | SZM | N/A | |
| Structural | Surface Damage Not Evident (Z) | Roughness Increased (RI) | Z | SRIZ | 1 | |
| | | Surface Spalling (SS) | Z | SSSZ | 2 | |
| | | Aggregate Visible (AV) | Z | SAVZ | 3 | |
| | | Aggregate Projecting (AP) | Z | SAPZ | 3 | |
| | | Aggregate Missing (AM) | Z | SAMZ | 4 | |
| | | Reinforcement Visible (RV) | Z | SRVZ | 5 | |
| | | Reinforcement Projecting (RP) | Z | SRPZ | 3 | |
| | | Reinforcement Corroded (RC) | Z | SRCZ | 5 | |
| | | Missing Wall (MW) | Z | SMWZ | 5 | |
| | | Other (Z) | Z | SZZ | N/A | |
| Structural | Surface Damage (Metal Pipes) | Corrosion (CP) | | SCP | 3 | |
| Structural | Lining Features (LF) | Detached (D) | | LFD | 3 | |
| | | Defective End (DE) | | LFDE | 3 | |
| | | Blistered (B) | | LFB | 3 | |
| | | Service Cut Shifted (CS) | | LFCS | 3 | |
| | | Abandoned Connection (AC) | | LFAC | | |
| | | Overcut Service (OC) | | LFOC | 3 | |
| | | Undercut Service (UC) | | LFUC | 3 | |
| | | Buckled (BK) | | LFBK | 3 | |
| | | Annular Space (AS) | | LFAS | 3 | |
| | | Bulges (BU) | | LFBU | 3 | |
| | | Discoloration (DC) | | LFDC | 3 | |
| | | Delamination (DL) | | LFDL | 3 | |
| | | Pinholes (PH) | | LFPH | 3 | |
| | | Resin Slug (RS) | | LFRS | 3 | |
| | | Wrinkled (W) | | LFW | 3 | |
| | | Other (Z) | | LFZ | N/A | |
| Structural | Weld Failure (WF) | Circumfrential ( C) | | WFC | 2 | |
| | | Longitudinal (L) | | WFL | 2 | |



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# NASSCO PACP Condition Grading System
## Code Matrix

| Family | Group | Descriptor | Modifier | Code | Structural Grade | O&M Grade |
|---|---|---|---|---|---|---|
| | | Multiple (M) | | WFM | 3 | |
| | | Spiral (S) | | WFS | 2 | |
| Structural | Point Repair (RP) | Localized Pipeliner (L) | | RPL | | |
| | | Localized Pipeliner (L) | Defective (D) | RPLD | 4 | |
| | | Patch Repair (P) | | RPP | | |
| | | Patch Repair (P) | Defective (D) | RPPD | 4 | |
| | | Pipe Replaced ( R) | | RPR | | |
| | | Pipe Replaced ( R) | Defective (D) | RPRD | 4 | |
| | | Other (Z) | | RPZ | | |
| | | Other (Z) | Defective (D) | RPZD | | |
| Structural | Brickwork (Silent) | Displaced (DB) | | DB | 3 | |
| | | Missing (MB) | | MB | 4 | |
| | | Dropped Invert (DI) | | DI | 5 | |
| | | Missing Mortar | Small | MMS | 2 | |
| | | | Medium | MMM | 3 | |
| | | | Large | MML | 3 | |
| O&M | Deposits (D) | Deposits Attached (DA) | Encrustation (E) | DAE | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Grease (G) | DAGS | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Ragging ( R) | DAR | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Other (Z) | DAZ | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Deposits Settled (DS) | Hard/Compacted ( C) | DSC | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Fine silt/sand (F) | DSF | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Gravel (G) | DSGV | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Other (Z) | DSZ | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Deposits Ingress (DN) | Fine silt/sand (F) | DNF | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Gravel (GV) | DNGV | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |



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# NASSCO PACP Condition Grading System
## Code Matrix

| Family | Group | Descriptor | Modifier | Code | Structural Grade | O&M Grade |
|---|---|---|---|---|---|---|
| | | | Other (Z) | DNZ | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | | | | |
| | | | | | | |
| O&M | Roots (R) | Fine (F) | Barrel (B) | RFB | | 2 |
| | | | Lateral (L) | RFL | | 1 |
| | | | Connecfion ( C) | RFC | | 1 |
| | Roots (R) at a Joint | | N/A | RFJ | in software with a J | 1 |
| | | Tap (T) | Barrel (B) | RTB | | 3 |
| | | | Lateral (L) | RTL | | 2 |
| | | | Connecfion ( C) | RTC | | 2 |
| | Roots (R) at a Joint | | N/A | RTJ | | 2 |
| | | Medium (M) | Barrel (B) | RMB | | 4 |
| | | | Lateral (L) | RML | | 3 |
| | | | Connecfion ( C) | RMC | | 3 |
| | Roots (R) at a Joint | | N/A | RMJ | | 3 |
| | | Ball (B) | Barrel (B) | RBB | | 5 |
| | | | Lateral (L) | RBL | | 4 |
| | | | Connecfion ( C) | RBC | | 4 |
| | Roots (R) at a Joint | | N/A | RBJ | | 4 |
| O&M | Infiltration (I) | Weeper (W) | | IW | | 2 |
| | | Dripper (D) | | ID | | 3 |
| | | Runner ( R) | | IR | | 4 |
| | | Gusher (G) | | IG | | 5 |
| | | Stain (S) | | IS | | |
| | | | | | | |
| O&M | Obstacles/Obstructions (OB) | Brick or Masonry (B) | | OBB | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Pipe Material in Invert (M) | | OBM | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Object Intruding Thru Wall (I) | | OBI | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Object Wedged in Joint (J) | | OBJ | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Object Thru Connection (C ) | | OBC | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | External Pipe or Cable In Sewer (P) | | OBP | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Built Into Structure (S) | | OBS | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |



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# NASSCO PACP Condition Grading System
## Code Matrix

| Family | Group | Descriptor | Modifier | Code | Structural Grade | O&M Grade |
|---|---|---|---|---|---|---|
| | | Construction Debris (N) | | OBN | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Rocks (R) | | OBR | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Other Objects (Z) | | OBZ | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| O&M | Vermin (V) | Rat (R) | | VR | | 2 |
| | | Cockroach (C) | | VC | | 1 |
| | | Other (Z) | | VZ | | 1 |
| O&M | Grout Test and Seal (G) | Grout Test Pass (GTP) | | | | |
| | | | Joint (J) | GTPJ | | |
| | | | Lateral (L) | GTPL | | |
| | | Grout Test Fail (GTF) | | | | |
| | | | Joint (J) | GTFJ | | |
| | | | Lateral (L) | GTFL | | |
| | | Grout Test Unable to Test (GTU) | | | | |
| | | | Joint (J) | GTUJ | | |
| | | | Lateral (L) | GTUL | | |
| | | Grout at a Location (not a joint) (GRT) | | GRT | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Construction Features | Tap (T) | Factory Made (F) | | TF | | |
| | | | Capped ( C) | TFC | | |
| | | | Abandoned (B) | TFB | | |
| | | | Defective (D) | TFD | | 2 |
| | | | Intruding (I) | TFI | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Activity (A) | TFA | | |
| | | Break-In/Hammer (B) | | TB | | |
| | | | Capped ( C) | TBC | | 2 |
| | | | Abandoned (B) | TBB | | |
| | | | Defective (D) | TBD | | 3 |
| | | | Intruding (I) | TBI | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Activity (A) | TBA | | |
| | | Saddle (S) | | TS | | |
| | | | Capped (C) | TSC | | |
| | | | Abandoned (B) | TSB | | |



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# NASSCO PACP Condition Grading System
## Code Matrix

| Family | Group | Descriptor | Modifier | Code | Structural Grade | O&M Grade |
|---|---|---|---|---|---|---|
| | | | Defective (D) | TSD | | 2 |
| | | | Intruding (I) | TSI | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Activity (A) | TSA | | |
| | | Rehabilitated (R) | | TR | | |
| | | | Defective (D) | TRD | | 2 |
| | | | Intruding (I) | TRI | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | | | | |
| Construction Features | Intruding Seal Material (IS) | | | IS | | |
| | | Sealing Ring (SR) | | ISSR | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Hanging (H) | ISSRH | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | Broken (B) | ISSRB | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Loose, Poorly Fitting (SRL) | | ISSRL | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Grout (GT) | | ISGT | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | Other (Z) | | ISZ | | <=10% - 2, <=20% - 3, <=30% - 4, >30% - 5 |
| | | | | | | |
| Construction Features | Line (L) | Left (L) | | LL | | <=10 Deg - 1, <=20 Deg 2, >20 Deg - 4 |
| | | Left/Up (LU) | | LLU | | <=10 Deg - 1, <=20 Deg 2, >20 Deg - 4 |
| | | Left/Down (LD) | | LLD | | <=10 Deg - 1, <=20 Deg 2, >20 Deg - 4 |
| | | Right (R) | | LR | | <=10 Deg - 1, <=20 Deg 2, >20 Deg - 4 |



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# NASSCO PACP Condition Grading System
## Code Matrix

| Family | Group | Descriptor | Modifier | Code | Structural Grade | O&M Grade |
|---|---|---|---|---|---|---|
| | | Right/Up (RU) | | LRU | | <=10 Deg - 1, <=20 Deg 2, >20 Deg - 4 |
| | | Right/Down (RD) | | LRD | | <=10 Deg - 1, <=20 Deg 2, >20 Deg - 4 |
| | | Up (U) | | LU | | <=10 Deg - 1, <=20 Deg 2, >20 Deg - 4 |
| | | Down (D) | | LD | | <=10 Deg - 1, <=20 Deg 2, >20 Deg - 4 |
| Construction | Access Points (A) | | | | | |
| | | Cleanout (CO) | | ACO | | |
| | | | Mainline (M) | ACOM | | |
| | | | Property (P) | ACOP | | |
| | | | House (H) | ACOH | | |
| | | Discharge Point (DP) | | ADP | | |
| | | Junction Box (JB) | | AJB | | |
| | | Meter (M) | | AM | | |
| | | Manhole (MH) | | AMH | | |
| | | Other Special Chamber (OC) | | AOC | | |
| | | Tee Connection (TC) | | ATC | | |
| | | WW Access Device (WA) | | AWA | | |
| | | Wet Well (WW) | | AWW | | |
| | | Catch Basin (CB) | | ACB | | |
| | | End of Pipe (EP) | | AEP | | |
| | | | | | | |
| | | | | | | |
| Other | Miscellaneous (M) | Camera Underwater (CU) | | MCU | | 4 |
| | | Dimension/Diam/Shape Change (SC) | | MSC | | |
| | | General Observation (GO) | | MGO | | |
| | | General Photograph (GP) | | MGP | | |
| | | Material Change (MC) | | MMC | | |
| | | Lining Change (LC) | | MLC | | |
| | | Pipe Joint Length Change (JL) | | MJL | | |
| | | Survey Abandoned (SA) | | MSA | | |
| | | Water Level (WL) | | MWL | | |
| | | | Sag (S) | MWLS | <=30% - 2, <=50% - 3, >50% - 4 | |
| | | Water Mark (WM) | | MWM | | >=50% 4, >=75% 5 |
| | | Dye Test (Y) | | MY | | |
| | | | Visible (V) | MYV | | 5 |
| | | | Not Visible (N) | MYN | | 3 |



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# APPENDIX H – BCF-POINT REPAIRS

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

**DRAFT**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 1 | 533 W AUDUBON | 1054-02 | 1054-01 | 8 | Polyvinyl Chloride | 605 | 5 | HVV |
| 2 | 5622 W ATHENS AVE | 1145-12 | 1145-09 | 8 | Polyvinyl Chloride | 247 | 4 | D |
| 3 | 7653 N ELLENDALE AVE | 1145-43 | 1145-42 | 6 | Polyvinyl Chloride | 339 | 13 | D |
| 4 | 7653 N ELLENDALE AVE | 1145-43 | 1145-42 | 6 | Polyvinyl Chloride | 339 | 13 | D |
| 5 | 7653 N ELLENDALE AVE | 1145-43 | 1145-42 | 6 | Polyvinyl Chloride | 339 | 13 | D |
| 6 | 4897 W BLUFF AVE | 1146-13 | 1146-12 | 8 | Polyvinyl Chloride | 194 | 4 | D |
| 7 | 2865 W DECATUR AVE | 1150-25 | 1150-24 | 8 | Asbestos Cement Pipe | 141 | 9 | H |
| 8 | 2865 W DECATUR AVE | 1150-25 | 1150-24 | 8 | Asbestos Cement Pipe | 141 | 9 | H |
| 9 | 2865 W DECATUR AVE | 1150-25 | 1150-24 | 8 | Asbestos Cement Pipe | 141 | 9 | H |
| 10 | 7581 N MONTE AVE | 1150-33 | 1150-25 | 8 | Asbestos Cement Pipe | 315 | 8 | HSV |
| 11 | 2483 W BLUFF AVE | 1151-06 | 1151-07 | 8 | Vitrified Clay Pipe | 280 | 5 | B |
| 12 | 7341 N BOND ST | 1258-23 | 1258-24 | 6 | Vitrified Clay Pipe | 374 | 5 | B |
| 13 | 6716 N DANTE AVE | 1345-60 | 1345-61 | 6 | Polyvinyl Chloride | 153 | 8 | D |
| 14 | 6716 N DANTE AVE | 1345-60 | 1345-61 | 6 | Polyvinyl Chloride | 153 | 8 | D |
| 15 | 6776 N VAN NESS BLVD | 1350-03 | 1350-02 | 8 | Vitrified Clay Pipe | 272 | 5 | BVV |
| 16 | 570 E MAGILL AVE | 1357-15 | 1357-16 | 8 | Vitrified Clay Pipe | 140 | 5 | BVV |
| 17 | 705 E PAUL AVE | 1357-39 | 1357-44 | 8 | Vitrified Clay Pipe | 528 | 18 | B |
| 18 | 705 E PAUL AVE | 1357-39 | 1357-44 | 8 | Vitrified Clay Pipe | 528 | 18 | B |
| 19 | 705 E PAUL AVE | 1357-39 | 1357-44 | 8 | Vitrified Clay Pipe | 528 | 18 | D |
| 20 | 637 E PAUL VE | 1357-42 | 1357-43 | 8 | Vitrified Clay Pipe | 282 | 13 | B |
| 21 | 637 E PAUL VE | 1357-42 | 1357-43 | 8 | Vitrified Clay Pipe | 282 | 13 | D |
| 22 | 1155 E FREMONT AVE | 1358-12 | 1358-13 | 8 | Vitrified Clay Pipe | 50 | 5 | B |
| 23 | 6510 N FOURTH ST | 1358-21 | 1358-22 | 6 | Vitrified Clay Pipe | 337 | 5 | B |
| 24 | 6414 N FOURTH ST | 1358-23 | 1358-22 | 6 | Vitrified Clay Pipe | 200 | 104 | B |
| 25 | 6414 N FOURTH ST | 1358-23 | 1358-22 | 6 | Vitrified Clay Pipe | 200 | 104 | H |
| 26 | 1023 E WATHEN AVE | 1358-30 | 1357-54 | 8 | Vitrified Clay Pipe | 400 | 5 | BVV |
| 27 | 1019 E LOS ALTOS AVE | 1358-32 | 1357-56 | 8 | Vitrified Clay Pipe | 450 | 8 | B |
| 28 | 6410 N FLORA AVE | 1358-37 | 1358-47 | 8 | Vitrified Clay Pipe | 405 | 16 | B |
| 29 | 6410 N FLORA AVE | 1358-37 | 1358-47 | 8 | Vitrified Clay Pipe | 405 | 16 | B |
| 30 | 1674 E MAGILL AVE | 1359-06 | 1359-08 | 8 | Vitrified Clay Pipe | 500 | 17 | B |
| 31 | 1580 E MAGILL AVE | 1359-09 | 1359-11 | 8 | Vitrified Clay Pipe | 631 | 8 | XP |
| 32 | 1612 E PALO ALTO AVE | 1359-17 | 1359-19 | 8 | Vitrified Clay Pipe | 289 | 5 | B |
| 33 | 1660 E PALO ALTO AVE | 1359-22 | 1359-23 | 8 | Vitrified Clay Pipe | 142 | 5 | B |
| 34 | 1663 E LOS ALTOS AVE | 1359-52 | 1359-72 | 8 | Vitrified Clay Pipe | 630 | 5 | B |
| 35 | 6057 N POLK AVE | 1444-03 | 1444-02 | 8 | Polyvinyl Chloride | 156 | 5 | B |
| 36 | 5509 W STUART AVE | 1444-08 | 1444-10 | 6 | Polyvinyl Chloride | 75 | 4 | D |
| 37 | 6399 N CLEO AVE | 1445-13 | 1445-14 | 6 | Polyvinyl Chloride | 413 | 5 | D |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 38 | 6178 N MITRE AVE | 1446-02 | 1446-03 | 6 | Polyvinyl Chloride | 520 | 5 | B |
| 39 | 6068 N GENTRY AVE | 1448-04 | 1448-02 | 8 | Vitrified Clay Pipe | 134 | 4 | D |
| 40 | 3645 W ATWATER AVE | 1448-56 | 1448-90 | 6 | Polyvinyl Chloride | 400 | 5 | H |
| 41 | 122 E BULLARD AVE | 1456-01 | 1456-02 | 6 | Cast Iron | 450 | 5 | SRC |
| 42 | 781 E STUART AVE | 1457-64 | 1457-63 | 8 | Vitrified Clay Pipe | 450 | 10 | B |
| 43 | 781 E STUART AVE | 1457-64 | 1457-63 | 8 | Vitrified Clay Pipe | 450 | 10 | BVV |
| 44 | 1411 E ESCALON AVE | 1458-24 | 1458-36 | 12 | Vitrified Clay Pipe | 663 | 5 | BVV |
| 45 | 6307 N EIGHTH ST | 1459-04 | 1459-05 | 6 | Vitrified Clay Pipe | 142 | 10 | B |
| 46 | 6307 N EIGHTH ST | 1459-04 | 1459-05 | 6 | Vitrified Clay Pipe | 142 | 10 | B |
| 47 | 1449 E SAMPLE AVE | 1459-10 | 1459-11 | 6 | Vitrified Clay Pipe | 475 | 5 | B |
| 48 | 4433 W BULLARD AVE | 1547-25 | 1546-13 | 12 | Polyvinyl Chloride | 604 | 5 | BSV |
| 49 | 5610 N ARTHUR AVE | 1553-16 | 1553-17 | 8 | Vitrified Clay Pipe | 318 | 5 | BSV |
| 50 | 5424 N PALM AVE | 1553-21 | 1553-01 | 8 | Vitrified Clay Pipe | 489 | 5 | BVV |
| 51 | 590 W ROBINWOOD LN | 1554-31 | 1554-11 | 6 | Vitrified Clay Pipe | 368 | 5 | B |
| 52 | 5680 N MAROA AVE | 1554-44 | 1554-21 | 10 | Vitrified Clay Pipe | 656 | 15 | B |
| 53 | 5680 N MAROA AVE | 1554-44 | 1554-21 | 10 | Vitrified Clay Pipe | 656 | 15 | B |
| 54 | 5680 N MAROA AVE | 1554-44 | 1554-21 | 10 | Vitrified Clay Pipe | 656 | 15 | BSV |
| 55 | 5422 N BLACKSTONE AVE | 1555-28 | 1555-01 | 10 | Vitrified Clay Pipe | 610 | 5 | B |
| 56 | 50 W BULLARD AVE | 1555-41 | 1555-42 | 12 | Vitrified Clay Pipe | 327 | 5 | BVV |
| 57 | 715 E ROBINWOOD LN | 1557-12 | 1557-13 | 6 | Vitrified Clay Pipe | 469 | 23 | B |
| 58 | 715 E ROBINWOOD LN | 1557-12 | 1557-13 | 6 | Vitrified Clay Pipe | 469 | 23 | B |
| 59 | 715 E ROBINWOOD LN | 1557-12 | 1557-13 | 6 | Vitrified Clay Pipe | 469 | 23 | B |
| 60 | 715 E ROBINWOOD LN | 1557-12 | 1557-13 | 6 | Vitrified Clay Pipe | 469 | 23 | B |
| 61 | 19 E WRENWOOD LN | 1557-18 | 1557-17 | 6 | Vitrified Clay Pipe | 469 | 12 | B |
| 62 | 5563 N FIRST ST | 1557-19 | 1557-20 | 6 | Vitrified Clay Pipe | 469 | 11 | B |
| 63 | 653 E DOVEWOOD LN | 1557-20 | 1557-21 | 8 | Vitrified Clay Pipe | 469 | 5 | B |
| 64 | 5521 N CALLISCH ST | 1557-21 | 1557-16 | 8 | Vitrified Clay Pipe | 260 | 5 | H |
| 65 | 739 E BROWING AVE | 1557-31 | 1557-30 | 6 | Vitrified Clay Pipe | 376 | 10 | B |
| 66 | 739 E BROWING AVE | 1557-31 | 1557-30 | 6 | Vitrified Clay Pipe | 376 | 10 | B |
| 67 | 713 E ROBERTS AVE | 1557-33 | 1557-35 | 8 | Vitrified Clay Pipe | 269 | 10 | BVV |
| 68 | 713 E ROBERTS AVE | 1557-33 | 1557-35 | 8 | Vitrified Clay Pipe | 269 | 10 | BVV |
| 69 | 677 E ROBERTS AVE | 1557-36 | 1557-29 | 10 | Vitrified Clay Pipe | 260 | 5 | B |
| 70 | 585 E ROBERTS AVE | 1557-43 | 1557-38 | 8 | Vitrified Clay Pipe | 490 | 5 | B |
| 71 | 5671 N AUGUSTA ST | 1557-57 | 1557-56 | 6 | Vitrified Clay Pipe | 260 | 5 | BSV |
| 72 | 1236 E BARSTOW AVE | 1558-12 | 1558-13 | 6 | Vitrified Clay Pipe | 443 | 8 | B |
| 73 | 1295 E LOFTUS LN | 1558-20 | 1558-19 | 8 | Vitrified Clay Pipe | 210 | 5 | B |
| 74 | 1255 E ALMENDRA DR | 1558-27 | 1558-28 | 8 | Vitrified Clay Pipe | 316 | 15 | BVV |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 75 | 5543 N BOND ST | 1558-29 | 1558-30 | 12 | Vitrified Clay Pipe | 135 | 8 | BVV |
| 76 | 5411 N BOND ST | 1558-31 | 1558-06 | 12 | Vitrified Clay Pipe | 500 | 8 | B |
| 77 | 5581 N BOND ST | 1558-32 | 1558-29 | 12 | Vitrified Clay Pipe | 130 | 5 | B |
| 78 | 1267 E BULLARD AVE | 1558-36 | 1558-37 | 6 | Vitrified Clay Pipe | 511 | 27 | B |
| 79 | 1267 E BULLARD AVE | 1558-36 | 1558-37 | 6 | Vitrified Clay Pipe | 511 | 27 | B |
| 80 | 1267 E BULLARD AVE | 1558-36 | 1558-37 | 6 | Vitrified Clay Pipe | 511 | 27 | B |
| 81 | 1267 E BULLARD AVE | 1558-36 | 1558-37 | 6 | Vitrified Clay Pipe | 511 | 27 | B |
| 82 | 5616 N FOURTH ST | 1558-39 | 1558-38 | 8 | Vitrified Clay Pipe | 165 | 9 | BVV |
| 83 | 5627 N BOND ST | 1558-60 | 1558-34 | 8 | Vitrified Clay Pipe | 528 | 55 | B |
| 84 | 5627 N BOND ST | 1558-60 | 1558-34 | 8 | Vitrified Clay Pipe | 528 | 55 | CH3 |
| 85 | 5627 N BOND ST | 1558-60 | 1558-34 | 8 | Vitrified Clay Pipe | 528 | 55 | FH3 |
| 86 | 5420 N NINTH ST | 1559-03 | 1559-44 | 10 | Vitrified Clay Pipe | 150 | 8 | B |
| 87 | 5494 N NINTH ST | 1559-14 | 1559-04 | 10 | Vitrified Clay Pipe | 683 | 5 | H |
| 88 | 1535 E ALMENDRA DR | 1559-15 | 1559-16 | 6 | Vitrified Clay Pipe | 590 | 5 | B |
| 89 | 1568 E LOFTUS LN | 1559-16 | 1559-14 | 10 | Vitrified Clay Pipe | 590 | 15 | B |
| 90 | 1568 E LOFTUS LN | 1559-16 | 1559-14 | 10 | Vitrified Clay Pipe | 590 | 15 | B |
| 91 | 1568 E LOFTUS LN | 1559-16 | 1559-14 | 10 | Vitrified Clay Pipe | 590 | 15 | B |
| 92 | 6537  N TENTH ST | 1559-23 | 1559-22 | 8 | Vitrified Clay Pipe | 387 | 103 | CH3 |
| 93 | 5645 N TENTH ST | 1559-24 | 1559-23 | 8 | Vitrified Clay Pipe | 687 | 135 | B |
| 94 | 5645 N TENTH ST | 1559-24 | 1559-23 | 8 | Vitrified Clay Pipe | 687 | 135 | B |
| 95 | 5645 N TENTH ST | 1559-24 | 1559-23 | 8 | Vitrified Clay Pipe | 687 | 135 | CH3 |
| 96 | 5106 W SHAW AVE | 1645-26 | 1645-28 | 6 | Cast Iron | 185 | 165 | SRC |
| 97 | 5106 W SHAW AVE | 1645-26 | 1645-28 | 6 | Cast Iron | 185 | 165 | SRC |
| 98 | 5106 W SHAW AVE | 1645-26 | 1645-28 | 6 | Cast Iron | 185 | 165 | SRC |
| 99 | 5123 W MISSION AVE | 1645-28 | 1645-29 | 6 | Cast Iron | 212 | 165 | SRC |
| 100 | 5123 W MISSION AVE | 1645-28 | 1645-29 | 6 | Cast Iron | 212 | 165 | SRC |
| 101 | 1529 W SAN MADELE AVE | 1652-05 | 1652-06 | 8 | Vitrified Clay Pipe | 657 | 8 | B |
| 102 | 1621 W SAN BRUNO AVE | 1652-16 | 1652-17 | 8 | Vitrified Clay Pipe | 319 | 5 | B |
| 103 | W SAN MADELE AVE | 1653-08 | 1653-09 | 8 | Vitrified Clay Pipe | 490 | 5 | B |
| 104 | 594 W SAN JOSE AVE | 1654-14 | 1654-48 | 8 | Vitrified Clay Pipe | 312 | 5 | BSV |
| 105 | 5212 N MAROA AVE | 1654-17 | 1655-16 | 12 | Vitrified Clay Pipe | 659 | 5 | B |
| 106 | 594 W SAN JOSE AVE | 1654-48 | 1654-15 | 8 | Vitrified Clay Pipe | 207 | 5 | B |
| 107 | 5365 N SAN PABLO AVE | 1655-33 | 1655-53 | 8 | Vitrified Clay Pipe | 327 | 5 | B |
| 108 | 5262 N BLACKSTONE AVE | 1655-51 | 1655-41 | 6 | Vitrified Clay Pipe | 470 | 13 | B |
| 109 | 5262 N BLACKSTONE AVE | 1655-51 | 1655-41 | 6 | Vitrified Clay Pipe | 470 | 13 | BSV |
| 110 | 5321 N FRESNO ST | 1656-09 | 1556-03 | 10 | Vitrified Clay Pipe | 656 | 5 | BSV |
| 111 | 50 E SHAW AVE | 1656-16 | 1656-17 | 8 | Vitrified Clay Pipe | 493 | 29 | HVV |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 112 | 1255 E BARSTOW AVE | 1658-15 | 1658-14 | 8 | Vitrified Clay Pipe | 494 | 20 | BSV |
| 113 | 1257 E BRUNO AVE | 1658-18 | 1658-22 | 8 | Vitrified Clay Pipe | 280 | 17 | B |
| 114 | 1365 E BULLDOG LN | 1658-29 | 1658-30 | 8 | Vitrified Clay Pipe | 705 | 32 | B |
| 115 | 5240 N SIXTH ST | 1659-03 | 1659-04 | 8 | Vitrified Clay Pipe | 332 | 5 | B |
| 116 | 4915 N DALE AVE | 1745-21 | 1745-23 | 8 | Cast Iron | 484 | 5 | SRC |
| 117 | 4915 N DALE AVE | 1745-21 | 1745-23 | 8 | Cast Iron | 484 | 5 | SRC |
| 118 | 4915 N CRYSTAL AVE | 1751-28 | 1751-29 | 8 | Cast Iron | 195 | 0 | SRC |
| 119 | 4707 N WARREN AVE | 1751-43 | 1751-46 | 10 | Vitrified Clay Pipe | 190 | 5 | B |
| 120 | 4717 N WARREN AVE | 1751-45 | 1751-46 | 8 | Vitrified Clay Pipe | 52 | 8 | BSV |
| 121 | 1221 W GETTYSBURG AVE | 1752-26 | 1751-50 | 8 | Vitrified Clay Pipe | 623 | 14 | BSV |
| 122 | 4660 N DELNO AVE | 1752-52 | 1752-54 | 6 | Vitrified Clay Pipe | 241 | 5 | B |
| 123 | 235 SANTA ANA AVE | 1753-06 | 1753-07 | 8 | Vitrified Clay Pipe | 658 | 5 | B |
| 124 | 4710 N SAFFORD AVE | 1753-35 | 1753-36 | 8 | Vitrified Clay Pipe | 654 | 8 | B |
| 125 | 4919 N MAROA AVE | 1754-42 | 1754-43 | 8 | Vitrified Clay Pipe | 578 | 3 | H |
| 126 | 4589 N GLENN AVE | 1755-28 | 1755-27 | 12 | Vitrified Clay Pipe | 655 | 5 | BSV |
| 127 | 4911 N GLENN AVE | 1755-38 | SN17550001 | 8 | Vitrified Clay Pipe | 368 | 10 | B |
| 128 | 4911 N GLENN AVE | 1755-38 | SN17550001 | 8 | Vitrified Clay Pipe | 368 | 10 | B |
| 129 | 4911 N GLENN AVE | 1755-38 | 1755-43 | 8 | Vitrified Clay Pipe | 518 | 13 | BSV |
| 130 | 4911 N GLENN AVE | 1755-38 | 1755-43 | 8 | Vitrified Clay Pipe | 518 | 13 | CH4 |
| 131 | 4748 N SAN PABLO AVE | 1755-56 | 1755-57 | 6 | Cast Iron | 398 | 380 | SRC |
| 132 | 4748 N SAN PABLO AVE | 1755-56 | 1755-57 | 6 | Cast Iron | 398 | 380 | SRC |
| 133 | 2004 E PORTOLA AVE | 1756-10 | 1756-08 | 6 | Vitrified Clay Pipe | 516 | 25 | B |
| 134 | 2004 E PORTOLA AVE | 1756-10 | 1756-08 | 6 | Vitrified Clay Pipe | 516 | 25 | BSV |
| 135 | 4609 N CLARK ST | 1756-11 | 1756-04 | 6 | Vitrified Clay Pipe | 327 | 9 | B |
| 136 | 4710 N VALERIA ST | 1756-19 | 1756-18 | 8 | Vitrified Clay Pipe | 3297 | 5 | BSV |
| 137 | 2044 E ACACIA AVE | 1756-38 | 1756-70 | 6 | Vitrified Clay Pipe | 220 | 10 | B |
| 138 | 2044 E ACACIA AVE | 1756-38 | 1756-70 | 6 | Vitrified Clay Pipe | 220 | 10 | B |
| 139 | 4947 N THESTA ST | 1756-46 | 1756-45 | 6 | Vitrified Clay Pipe | 525 | 116 | B |
| 140 | 4947 N THESTA ST | 1756-46 | 1756-45 | 6 | Vitrified Clay Pipe | 525 | 116 | BVV |
| 141 | 4944 N DIANA ST | 1756-54 | 1756-63 | 6 | Vitrified Clay Pipe | 490 | 21 | B |
| 142 | 4944 N DIANA ST | 1756-54 | 1756-63 | 6 | Vitrified Clay Pipe | 490 | 21 | B |
| 143 | 4865 N DIANA ST | 1756-56 | 1756-57 | 6 | Vitrified Clay Pipe | 232 | 14 | B |
| 144 | 4863 N DOON WAY | 1756-58 | 1756-59 | 6 | Vitrified Clay Pipe | 105 | 5 | BSV |
| 145 | 4863 N DOON WAY | 1756-58 | 1756-33 | 6 | Vitrified Clay Pipe | 480 | 17 | B |
| 146 | 1914 E SANTA ANA AVE | 1756-60 | 1756-35 | 8 | Vitrified Clay Pipe | 500 | 96 | B |
| 147 | 1914 E SANTA ANA AVE | 1756-60 | 1756-35 | 8 | Vitrified Clay Pipe | 500 | 96 | B |
| 148 | 1914 E SANTA ANA AVE | 1756-60 | 1756-35 | 8 | Vitrified Clay Pipe | 500 | 96 | BSV |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 149 | 4946 N EFFIE ST | 1756-61 | 1756-60 | 8 | Vitrified Clay Pipe | 464 | 156 | B |
| 150 | 4946 N EFFIE ST | 1756-61 | 1756-60 | 8 | Vitrified Clay Pipe | 464 | 156 | B |
| 151 | 4605 N MILLBROOK AVE | 1758-04 | 1758-01 | 18 | Reinforced Concrete Pipe | 67 | 5 | HSV |
| 152 | 3602 E RIALTO AVE | 1758-43 | 1758-44 | 6 | Vitrified Clay Pipe | 459 | 11 | B |
| 153 | 4715 N FIFTH ST | 1758-44 | 1758-42 | 6 | Vitrified Clay Pipe | 450 | 5 | B |
| 154 | 4847 N SIXTH ST | 1758-48 | 1758-46 | 8 | Vitrified Clay Pipe | 385 | 8 | B |
| 155 | 3305 E SIERRA MADRE AVE | 1758-61 | 1758-60 | 8 | Vitrified Clay Pipe | 659 | 16 | B |
| 156 | 1110 E SHAW AVE | 1758-67 | 1758-68 | 8 | Cast Iron | 393 | 5 | SRC |
| 157 | 1110 E SHAW AVE | 1758-67 | 1758-68 | 8 | Cast Iron | 393 | 5 | SRC |
| 158 | 3889 E RIALTO AVE | 1759-27 | 1759-28 | 8 | Vitrified Clay Pipe | 280 | 5 | B |
| 159 | 3633 E FAIRMONT AVE | 1759-41 | 1759-42 | 6 | Vitrified Clay Pipe | 130 | 8 | B |
| 160 | 3542 E FAIRMONT AVE | 1759-42 | 1758-53 | 8 | Vitrified Clay Pipe | 489 | 27 | B |
| 161 | 4450 E SANTA ANNA AVE | 1760-32 | 1760-59 | 15 | Vitrified Clay Pipe | 655 | 5 | B |
| 162 | 2720 TULARE ST | 2656-62 | 2657-35 | 6 | Vitrified Clay Pipe | 521 | 23 | B |
| 163 | 2720 TULARE ST | 2656-62 | 2657-35 | 6 | Vitrified Clay Pipe | 521 | 23 | B |
| 164 | 2720 TULARE ST | 2656-62 | 2657-35 | 6 | Vitrified Clay Pipe | 521 | 23 | H |
| 165 | 2720 TULARE ST | 2656-62 | 2657-35 | 6 | Vitrified Clay Pipe | 521 | 23 | H |
| 166 | 4790 W ASHLAN AVE | 1846-06 | 1846-07 | 12 | Polyvinyl Chloride | 660 | 5 | HSV |
| 167 | 4475 W ILA AVE | 1851-57 | 1851-58 | 6 | Vitrified Clay Pipe | 83 | 3 | H |
| 168 | 1019 W SWIFT AVE | 1852-11 | 1852-12 | 6 | Vitrified Clay Pipe | 360 | 5 | B |
| 169 | 4410 N TEILMAN AVE | 1852-40 | 1852-28 | 6 | Vitrified Clay Pipe | 655 | 5 | B |
| 170 | 4546 N WEST AVE | 1852-51 | 1851-67 | 6 | Vitrified Clay Pipe | 561 | 5 | B |
| 171 | 1046 W INDIANAPOLIS AVE | 1852-52 | 1852-35 | 6 | Vitrified Clay Pipe | 498 | 5 | HSV |
| 172 | 131 W HOLLAND AVE | 1853-11 | 1853-10 | 6 | Vitrified Clay Pipe | 480 | 5 | B |
| 173 | 12 E SWIFT AVE | 1853-22 | 1853-18 | 6 | Vitrified Clay Pipe | 453 | 5 | B |
| 174 | HOLLAND & PALM INTERSECTION | 1853-29 | 1853-28 | 6 | Vitrified Clay Pipe | 510 | 5 | BVV |
| 175 | 530 E HOLLAND AVE | 1854-11 | 1854-12 | 8 | Vitrified Clay Pipe | 666 | 5 | B |
| 176 | 4285 N BLACKSTONE AVE | 1855-32 | 1855-31 | 8 | Vitrified Clay Pipe | 597 | 5 | H |
| 177 | 2033 E ASHCROFT AVE | 1856-04 | 1856-06 | 6 | Cast Iron | 233 | 200 | SRC |
| 178 | 2033 E ASHCROFT AVE | 1856-04 | 1856-06 | 6 | Cast Iron | 233 | 200 | SRC |
| 179 | 4429 N FRESNO ST | 1856-40 | 1856-42 | 6 | Vitrified Clay Pipe | 341 | 5 | B |
| 180 | 2432 E RICHERT AVE | 1856-45 | 1856-44 | 6 | Vitrified Clay Pipe | 527 | 28 | B |
| 181 | 470 N FRESNO ST | 1857-11 | 1856-36 | 6 | Vitrified Clay Pipe | 364 | 29 | B |
| 182 | 470 N FRESNO ST | 1857-11 | 1856-36 | 6 | Vitrified Clay Pipe | 364 | 29 | CH4 |
| 183 | 4455 N AUGUSTA ST | 1857-17 | 1857-26 | 6 | Vitrified Clay Pipe | 400 | 79 | B |
| 184 | 4455 N AUGUSTA ST | 1857-17 | 1857-26 | 6 | Vitrified Clay Pipe | 400 | 79 | B |
| 185 | 3823 E DONNER AVE | 1859-05 | 1859-04 | 6 | Vitrified Clay Pipe | 450 | 96 | H |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 186 | 3823 E DONNER AVE | 1859-05 | 1859-04 | 6 | Vitrified Clay Pipe | 450 | 96 | HSV |
| 187 | 3823 E DONNER AVE | 1859-05 | 1859-04 | 6 | Vitrified Clay Pipe | 450 | 96 | HSV |
| 188 | 3823 E DONNER AVE | 1859-05 | 1859-04 | 6 | Vitrified Clay Pipe | 450 | 96 | HVV |
| 189 | 3823 E DONNER AVE | 1859-05 | 1859-04 | 6 | Vitrified Clay Pipe | 450 | 96 | HVV |
| 190 | 4410 N MERIDIAN AVE | 1860-43 | 1860-51 | 8 | Vitrified Clay Pipe | 221 | 5 | BSV |
| 191 | 4133 W SAGINAW WAY | 1947-04 | 1947-05 | 6 | Polyvinyl Chloride | 470 | 11 | D |
| 192 | 3884 N MANOR AVE | 1951-49 | 1951-51 | 6 | Vitrified Clay Pipe | 500 | 43 | B |
| 193 | 3884 N MANOR AVE | 1951-49 | 1951-51 | 6 | Vitrified Clay Pipe | 500 | 43 | B |
| 194 | 3884 N MANOR AVE | 1951-49 | 1951-51 | 6 | Vitrified Clay Pipe | 500 | 43 | B |
| 195 | 3884 N MANOR AVE | 1951-49 | 1951-51 | 6 | Vitrified Clay Pipe | 500 | 43 | B |
| 196 | 3884 N MANOR AVE | 1951-49 | 1951-51 | 6 | Vitrified Clay Pipe | 500 | 43 | B |
| 197 | 934 W PONTIAC WAY | 1952-11 | 1952-09 | 6 | Vitrified Clay Pipe | 633 | 17 | H |
| 198 | 934 W PONTIAC WAY | 1952-11 | 1952-09 | 6 | Vitrified Clay Pipe | 633 | 17 | H |
| 199 | 934 W PONTIAC WAY | 1952-11 | 1952-09 | 6 | Vitrified Clay Pipe | 633 | 17 | H |
| 200 | 934 W PONTIAC WAY | 1952-11 | 1952-09 | 6 | Vitrified Clay Pipe | 633 | 17 | H |
| 201 | 934 W PONTIAC WAY | 1952-11 | 1952-09 | 6 | Vitrified Clay Pipe | 633 | 17 | HSV |
| 202 | 36 E GRIFFITH WAY | 1953-18 | 1953-17 | 8 | Vitrified Clay Pipe | 486 | 5 | B |
| 203 | 3862 N WILSON AVE | 1954-50 | 1954-54 | 8 | Vitrified Clay Pipe | 330 | 15 | B |
| 204 | 3862 N WILSON AVE | 1954-50 | 1954-54 | 8 | Vitrified Clay Pipe | 330 | 15 | BVV |
| 205 | 3862 N WILSON AVE | 1954-50 | 1954-54 | 8 | Vitrified Clay Pipe | 330 | 15 | BVV |
| 206 | 3927 N BLACKSTONE AVE | 1955-31 | 1955-38 | 8 | Cast Iron | 662 | 0 | SRC |
| 207 | 2516 E HAMPTON WAY | 1956-41 | 1956-08 | 6 | Vitrified Clay Pipe | 119 | 5 | B |
| 208 | 1837 E SAGINAW WAY | 1956-43 | 1956-42 | 6 | Vitrified Clay Pipe | 599 | 51 | B |
| 209 | 1837 E SAGINAW WAY | 1956-43 | 1956-42 | 6 | Vitrified Clay Pipe | 599 | 51 | B |
| 210 | 1837 E SAGINAW WAY | 1956-43 | 1956-42 | 6 | Vitrified Clay Pipe | 599 | 51 | B |
| 211 | 1837 E SAGINAW WAY | 1956-43 | 1956-42 | 6 | Vitrified Clay Pipe | 599 | 51 | BSV |
| 212 | 3902 N MARIPOSA ST | 1957-54 | 1957-66 | 8 | Vitrified Clay Pipe | 433 | 41 | B |
| 213 | 3822 N MARIPOSA ST | 1957-66 | 2057-05 | 8 | Vitrified Clay Pipe | 440 | 16 | B |
| 214 | 4530 E ASHLAN AVE | 1960-03 | 1960-02 | 15 | Polyvinyl Chloride | 640 | 5 | B |
| 215 | 3445 CLOVIS AVE | 1966-61 | 1966-29 | 6 | Vitrified Clay Pipe | 250 | 5 | HVV |
| 216 | 3845 N SHIRLEY AVE | 1967-04 | 1967-05 | 8 | Vitrified Clay Pipe | 281 | 10 | B |
| 217 | 3845 N SHIRLEY AVE | 1967-04 | 1967-05 | 8 | Vitrified Clay Pipe | 281 | 10 | BSV |
| 218 | 5936 E LANSING WAY | 1967-12 | 1967-13 | 8 | Vitrified Clay Pipe | 192 | 5 | BSV |
| 219 | 5971 E PONTIAC WAY | 1967-43 | 1967-44 | 8 | Vitrified Clay Pipe | 151 | 5 | B |
| 220 | 4245 W. ANDREWS AVE | 2047-40 | 2047-41 | 6 | Polyvinyl Chloride | 405 | 10 | D |
| 221 | 4245 W ANDREWS AVE | 2047-40 | 2047-41 | 6 | Polyvinyl Chloride | 405 | 10 | D |
| 222 | 2244 W SHIELDS AVE | 2050-38 | 2050-30 | 6 | Vitrified Clay Pipe | 260 | 5 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 223 | 3216 N WEST AVE | 2052-01 | 2051-15 | 6 | Vitrified Clay Pipe | 682 | 5 | XP |
| 224 | 536 W SHIELDS AVE | 2052-05 | 2052-06 | 8 | Vitrified Clay Pipe | 643 | 16 | BSV |
| 225 | 536 W SHIELDS AVE | 2052-05 | 2052-06 | 8 | Vitrified Clay Pipe | 643 | 16 | BSV |
| 226 | 54 E DAKOTA AVE | 2053-04 | 2053-03 | 8 | Concrete Pipe | 654 | 12 | BVV |
| 227 | 3758 N PALM AVE | 2053-05 | 2053-04 | 6 | Vitrified Clay Pipe | 598 | 53 | B |
| 228 | 3758 N PALM AVE | 2053-05 | 2053-04 | 6 | Vitrified Clay Pipe | 598 | 53 | B |
| 229 | 3758 N PALM AVE | 2053-05 | 2053-04 | 6 | Vitrified Clay Pipe | 598 | 53 | B |
| 230 | 3758 N PALM AVE | 2053-05 | 2053-04 | 6 | Vitrified Clay Pipe | 598 | 53 | BSV |
| 231 | 3717 N PALM AVE | 2053-06 | 2053-28 | 6 | Vitrified Clay Pipe | 628 | 77 | H |
| 232 | 3621 N PALM AVE | 2053-10 | 2053-36 | 8 | Concrete Pipe | 627 | 11 | B |
| 233 | 307 E FOUNTAIN | 2053-15 | 2054-13 | 6 | Vitrified Clay Pipe | 612 | 134 | B |
| 234 | 307 E FOUNTAIN | 2053-15 | 2054-13 | 6 | Vitrified Clay Pipe | 612 | 134 | B |
| 235 | 307 E FOUNTAIN | 2053-15 | 2054-13 | 6 | Vitrified Clay Pipe | 612 | 134 | B |
| 236 | 307 E FOUNTAIN | 2053-15 | 2054-13 | 6 | Vitrified Clay Pipe | 612 | 134 | H |
| 237 | 307 E FOUNTAIN | 2053-15 | 2054-13 | 6 | Vitrified Clay Pipe | 612 | 134 | H |
| 238 | 307 E FOUNTAIN | 2053-15 | 2054-13 | 6 | Vitrified Clay Pipe | 612 | 134 | H |
| 239 | 307 E FOUNTAIN | 2053-15 | 2054-13 | 6 | Vitrified Clay Pipe | 612 | 134 | H |
| 240 | 3219 N PALM AVE | 2053-17 | 2053-51 | 6 | Vitrified Clay Pipe | 602 | 31 | B |
| 241 | 350 W SHIELDS AVE | 2053-22 | 2053-23 | 6 | Vitrified Clay Pipe | 232 | 23 | B |
| 242 | 350 W SHIELDS AVE | 2053-22 | 2053-23 | 6 | Vitrified Clay Pipe | 232 | 23 | B |
| 243 | 95 E GARLAND AVE | 2053-28 | 2053-26 | 6 | Vitrified Clay Pipe | 675 | 34 | H |
| 244 | 93 E FEDORA AVE | 2053-30 | 2053-31 | 6 | Vitrified Clay Pipe | 655 | 31 | B |
| 245 | 93 E FEDORA AVE | 2053-30 | 2053-31 | 6 | Vitrified Clay Pipe | 655 | 31 | BVV |
| 246 | 305 W DAYTON AVE | 2053-37 | 2053-38 | 8 | Concrete Pipe | 621 | 16 | H |
| 247 | 305 W DAYTON AVE | 2053-37 | 2053-38 | 8 | Concrete Pipe | 621 | 16 | H |
| 248 | 43 E CORTLAND AVE | 2053-41 | 2053-40 | 6 | Vitrified Clay Pipe | 655 | 51 | B |
| 249 | 135 E ANDREWS AVE | 2053-45 | 2053-46 | 6 | Vitrified Clay Pipe | 454 | 22 | H |
| 250 | 3797 N EFFIE ST | 2056-01 | 2056-58 | 6 | Vitrified Clay Pipe | 715 | 43 | B |
| 251 | 3797 N EFFIE ST | 2056-01 | 2056-58 | 6 | Vitrified Clay Pipe | 715 | 43 | B |
| 252 | 3797 N EFFIE ST | 2056-01 | 2056-58 | 6 | Vitrified Clay Pipe | 715 | 43 | BVV |
| 253 | 3605 N EFFIE ST | 2056-47 | 2056-45 | 8 | Vitrified Clay Pipe | 90 | 8 | XP |
| 254 | 2704 E DAKOTA AVE | 2057-04 | 2057-02 | 6 | Vitrified Clay Pipe | 598 | 20 | XP |
| 255 | 3686 N AGUSTA ST | 2057-39 | 2057-38 | 6 | Vitrified Clay Pipe | 281 | 17 | B |
| 256 | 2840 E GARLAND | 2057-44 | 2057-43 | 6 | Vitrified Clay Pipe | 496 | 8 | B |
| 257 | 3554 N MARIPOSA ST | 2057-46 | 2057-47 | 6 | Vitrified Clay Pipe | 265 | 27 | H |
| 258 | 3334 N MARIPOSA ST | 2057-48 | 2057-49 | 6 | Vitrified Clay Pipe | 437 | 24 | B |
| 259 | 3320 N ANGUS ST | 2057-51 | 2057-50 | 6 | Vitrified Clay Pipe | 356 | 36 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 260 | 3536 N ANGUS ST | 2057-52 | 2057-51 | 6 | Vitrified Clay Pipe | 561 | 53 | B |
| 261 | 2818 E FEDORA AVE | 2057-55 | 2057-54 | 6 | Vitrified Clay Pipe | 148 | 15 | B |
| 262 | 2818 E FEDORA AVE | 2057-55 | 2057-54 | 6 | Vitrified Clay Pipe | 148 | 15 | B |
| 263 | 2818 E FEDORA AVE | 2057-55 | 2057-54 | 6 | Vitrified Clay Pipe | 148 | 15 | B |
| 264 | 2904 E FEDORA AVE | 2057-56 | 2057-55 | 6 | Vitrified Clay Pipe | 353 | 8 | B |
| 265 | 3267 N ORCHARD ST | 2057-58 | 2057-60 | 6 | Vitrified Clay Pipe | 383 | 17 | B |
| 266 | 3553 N ORCHARD ST | 2057-60 | 2057-61 | 6 | Vitrified Clay Pipe | 455 | 41 | B |
| 267 | 3553 N ORCHARD ST | 2057-60 | 2057-61 | 6 | Vitrified Clay Pipe | 455 | 41 | B |
| 268 | 3407 N ORCHARD ST | 2057-61 | 2057-62 | 6 | Vitrified Clay Pipe | 443 | 45 | B |
| 269 | 3403 N ORCHARD ST | 2057-62 | 2057-63 | 6 | Vitrified Clay Pipe | 329 | 33 | B |
| 270 | 3662 N ANGUS ST | 2057-70 | 2057-55 | 6 | Vitrified Clay Pipe | 286 | 10 | B |
| 271 | 3662 N ANGUS ST | 2057-70 | 2057-55 | 6 | Vitrified Clay Pipe | 286 | 10 | B |
| 272 | 3443 N MILLBROOK AVE | 2058-16 | 2058-15 | 6 | Vitrified Clay Pipe | 308 | 11 | B |
| 273 | 3452 N THIRD ST | 2058-26 | 2058-29 | 6 | Vitrified Clay Pipe | 357 | 5 | B |
| 274 | 3201 E SHIELDS AVE | 2058-31 | 2058-23 | 8 | Vitrified Clay Pipe | 481 | 12 | B |
| 275 | 3614 N VIRGINIA AVE | 2058-34 | 2058-35 | 6 | Vitrified Clay Pipe | 378 | 8 | B |
| 276 | 3427 E CORTLAND AVE | 2058-43 | 2058-44 | 6 | Vitrified Clay Pipe | 552 | 5 | BSV |
| 277 | 3445 N BOND ST | 2058-45 | 2058-44 | 6 | Vitrified Clay Pipe | 275 | 22 | B |
| 278 | 3445 N BOND ST | 2058-45 | 2058-44 | 6 | Vitrified Clay Pipe | 275 | 22 | B |
| 279 | 3445 N BOND ST | 2058-45 | 2058-44 | 6 | Vitrified Clay Pipe | 275 | 22 | B |
| 280 | 3442 N FOURTH ST | 2058-51 | 2058-52 | 6 | Vitrified Clay Pipe | 292 | 11 | B |
| 281 | 3446 N FIFTH ST | 2058-52 | 2058-54 | 6 | Vitrified Clay Pipe | 292 | 13 | B |
| 282 | 3446 N FIFTH ST | 2058-52 | 2058-54 | 6 | Vitrified Clay Pipe | 292 | 13 | B |
| 283 | 3111 N SIXTH ST | 2058-54 | 2058-15 | 6 | Vitrified Clay Pipe | 275 | 5 | B |
| 284 | 3442 E DAYTON AVE | 2058-56 | 2058-57 | 6 | Vitrified Clay Pipe | 558 | 26 | H |
| 285 | 3524 E DAYTON AVE | 2058-57 | 2058-14 | 6 | Vitrified Clay Pipe | 492 | 13 | B |
| 286 | 3524 E DAYTON AVE | 2058-57 | 2058-14 | 6 | Vitrified Clay Pipe | 492 | 13 | B |
| 287 | 3542 E REDLANDS AVE | 2058-59 | 2058-12 | 6 | Vitrified Clay Pipe | 492 | 18 | B |
| 288 | 3542 E REDLANDS AVE | 2058-59 | 2058-12 | 6 | Vitrified Clay Pipe | 492 | 18 | BVV |
| 289 | 5348 E AIRWAYS BLVD | 2064-05 | 2064-06 | 8 | Polyvinyl Chloride | 660 | 5 | H |
| 290 | 5884 E RAMONA WAY | 2067-16 | 2067-64 | 8 | Cast Iron | 307 | 0 | SRC |
| 291 | 5849 E ANDREWS AVE | 2067-44 | 2067-45 | 6 | Vitrified Clay Pipe | 473 | 5 | H |
| 292 | 2625 N ELLENDALE AVE | 2145-05 | 2145-03 | 8 | Polyvinyl Chloride | 205 | 5 | XP |
| 293 | 2850 N CRYSTAL AVE | 2151-16 | 2151-17 | 8 | Vitrified Clay Pipe | 663 | 70 | B |
| 294 | 1538 W MICHIGAN AVE | 2151-34 | 2151-33 | 6 | Vitrified Clay Pipe | 575 | 49 | B |
| 295 | 3110 N HARRISON AVE | 2153-02 | 2153-14 | 8 | Vitrified Clay Pipe | 656 | 57 | B |
| 296 | 2743 N FARRIS AVE | 2153-44 | 2153-29 | 6 | Vitrified Clay Pipe | 600 | 20 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 297 | 2743 N FARRIS AVE | 2153-44 | 2153-29 | 6 | Vitrified Clay Pipe | 600 | 20 | H |
| 298 | 2731 N HARRISON AVE | 2153-46 | 2153-30 | 6 | Vitrified Clay Pipe | 646 | 5 | B |
| 299 | 305 E CLINTON AVE | 2153-57 | 2154-83 | 6 | Vitrified Clay Pipe | 617 | 19 | B |
| 300 | 305 E CLINTON AVE | 2153-57 | 2154-83 | 6 | Vitrified Clay Pipe | 617 | 19 | D |
| 301 | 304 E BROWN AVE | 2153-62 | 2154-59 | 6 | Vitrified Clay Pipe | 635 | 11 | BSV |
| 302 | 3117 N WILSON AVE | 2154-02 | 2154-03 | 6 | Vitrified Clay Pipe | 484 | 18 | B |
| 303 | 628 E SIMPSON AVE | 2154-08 | 2154-17 | 6 | Vitrified Clay Pipe | 90 | 5 | B |
| 304 | 1036 E SIMPSON AVE | 2154-104 | 2155-01 | 8 | Vitrified Clay Pipe | 638 | 56 | B |
| 305 | 1036 E SIMPSON AVE | 2154-104 | 2155-01 | 8 | Vitrified Clay Pipe | 638 | 56 | B |
| 306 | 529 E TERRACE AVE | 2154-107 | 2154-71 | 6 | Vitrified Clay Pipe | 661 | 46 | BSV |
| 307 | 2426 N VAN NESS BLVD | 2154-108 | 2154-83 | 6 | Vitrified Clay Pipe | 663 | 14 | BVV |
| 308 | 629 E CORNELL AVE | 2154-18 | 2154-24 | 6 | Vitrified Clay Pipe | 165 | 11 | B |
| 309 | 505 E BROWN AVE | 2154-44 | 2154-59 | 10 | Vitrified Clay Pipe | 326 | 20 | B |
| 310 | 505 E BROWN AVE | 2154-44 | 2154-59 | 10 | Vitrified Clay Pipe | 326 | 20 | BSV |
| 311 | 527 E BROWN AVE | 2154-46 | 2154-44 | 6 | Vitrified Clay Pipe | 479 | 9 | B |
| 312 | 527 E BROWN AVE | 2154-46 | 2154-44 | 6 | Vitrified Clay Pipe | 479 | 9 | B |
| 313 | 2640 N VAN NESS AVE | 2154-50 | 2154-48 | 6 | Vitrified Clay Pipe | 177 | 5 | B |
| 314 | 625 E HARVARD AVE | 2154-63 | 2154-62 | 6 | Vitrified Clay Pipe | 121 | 5 | HSV |
| 315 | 2611 N WISHON AVE | 2154-64 | 2154-65 | 6 | Vitrified Clay Pipe | 121 | 19 | BSV |
| 316 | 2611 N WISHON AVE | 2154-64 | 2154-65 | 6 | Vitrified Clay Pipe | 121 | 19 | HVV |
| 317 | 2611 N WISHON AVE | 2154-64 | 2154-65 | 6 | Vitrified Clay Pipe | 121 | 19 | XP |
| 318 | 2644 N MAROA AVE | 2154-69 | 2154-90 | 8 | Vitrified Clay Pipe | 166 | 16 | B |
| 319 | 745 E TERRACE AVE | 2154-75 | 2154-73 | 6 | Vitrified Clay Pipe | 678 | 5 | B |
| 320 | 2426 N VAN NESS BLVD | 2154-85 | 2154-108 | 6 | Vitrified Clay Pipe | 193 | 15 | HSV |
| 321 | 1044 E CORNELL AVE | 2154-94 | 2155-14 | 8 | Vitrified Clay Pipe | 682 | 72 | B |
| 322 | 1044 E CORNELL AVE | 2154-94 | 2155-14 | 8 | Vitrified Clay Pipe | 682 | 72 | H |
| 323 | 1044 E CORNELL AVE | 2154-94 | 2155-14 | 8 | Vitrified Clay Pipe | 682 | 72 | H |
| 324 | 1323 E SIMPSON AVE | 2155-04 | 2155-03 | 6 | Vitrified Clay Pipe | 661 | 76 | BVV |
| 325 | 1323 E SIMPSON AVE | 2155-04 | 2155-03 | 6 | Vitrified Clay Pipe | 661 | 76 | H |
| 326 | 1545 E SIMPSON AVE | 2155-05 | 2155-04 | 6 | Vitrified Clay Pipe | 489 | 79 | B |
| 327 | 1545 E SIMPSON AVE | 2155-05 | 2155-04 | 6 | Vitrified Clay Pipe | 489 | 79 | B |
| 328 | 1405 E CORNELL AVE | 2155-10 | 2155-09 | 6 | Vitrified Clay Pipe | 661 | 54 | H |
| 329 | 1405 E CORNELL AVE | 2155-10 | 2155-09 | 6 | Vitrified Clay Pipe | 661 | 54 | H |
| 330 | 3006 N GLENN AVE | 2155-11 | 2155-10 | 6 | Vitrified Clay Pipe | 488 | 33 | B |
| 331 | 3006 N GLENN AVE | 2155-11 | 2155-10 | 6 | Vitrified Clay Pipe | 488 | 33 | BSV |
| 332 | 1624 E SIMPSON AVE | 2155-12 | 2155-11 | 6 | Vitrified Clay Pipe | 125 | 12 | BSV |
| 333 | 3003 N BLACKSTONE AVE | 2155-13 | 2155-11 | 6 | Vitrified Clay Pipe | 125 | 9 | B |

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 334 | 1243 E MICHIGAN AVE | 2155-16 | 2155-15 | 8 | Vitrified Clay Pipe | 661 | 47 | B |
| 335 | 1337 E PRINCTON AVE | 2155-24 | 2155-23 | 6 | Vitrified Clay Pipe | 661 | 44 | B |
| 336 | 2809 N BLACKSTONE AVE | 2155-25 | 2155-24 | 8 | Vitrified Clay Pipe | 488 | 45 | B |
| 337 | 1620 N MICHIGAN AVE | 2155-26 | 2155-25 | 6 | Vitrified Clay Pipe | 125 | 24 | B |
| 338 | 1145 E TERRACE AVE | 2155-45 | 2155-46 | 6 | Concrete Pipe | 661 | 7 | H |
| 339 | 910 E TERRACE AVE | 2155-50 | 2154-92 | 6 | Vitrified Clay Pipe | 588 | 16 | BVV |
| 340 | 3004 N MARIPOSA ST | 2157-06 | 2157-05 | 8 | Vitrified Clay Pipe | 284 | 33 | BVV |
| 341 | 2514 N ANGUS ST | 2157-42 | 2157-43 | 6 | Concrete Pipe | 638 | 170 | H |
| 342 | 2415 N FIRST ST | 2157-47 | 2157-46 | 6 | Concrete Pipe | 617 | 20 | H |
| 343 | 3426 E SIMPSON AVE | 2158-03 | 2158-04 | 6 | Vitrified Clay Pipe | 690 | 21 | B |
| 344 | 3426 E SIMPSON AVE | 2158-03 | 2158-04 | 6 | Vitrified Clay Pipe | 690 | 21 | B |
| 345 | 3426 E SIMPSON AVE | 2158-03 | 2158-04 | 6 | Vitrified Clay Pipe | 690 | 21 | B |
| 346 | 2836 N BOND AVE | 2158-11 | 2158-10 | 6 | Vitrified Clay Pipe | 217 | 5 | B |
| 347 | 3401 E HARVARD AVE | 2158-31 | 2158-38 | 8 | Vitrified Clay Pipe | 280 | 11 | BVV |
| 348 | 3012 N SEVENTH ST | 2159-16 | 2159-01 | 6 | Vitrified Clay Pipe | 541 | 40 | B |
| 349 | 3012 N SEVENTH ST | 2159-16 | 2159-01 | 6 | Vitrified Clay Pipe | 541 | 40 | BVV |
| 350 | 2030 N WEST AVE | 2252-43 | 2251-25 | 6 | Vitrified Clay Pipe | 668 | 218 | BVV |
| 351 | 438 W WELDON AVE | 2253-41 | 2253-51 | 8 | Vitrified Clay Pipe | 647 | 18 | B |
| 352 | 1749 N ARTHUR AVE | 2253-81 | 2253-78 | 6 | Vitrified Clay Pipe | 632 | 78 | B |
| 353 | 1749 N ARTHUR AVE | 2253-81 | 2253-78 | 6 | Vitrified Clay Pipe | 632 | 78 | B |
| 354 | 622 E CLINTON AVE | 2254-06 | 2254-05 | 6 | Vitrified Clay Pipe | 441 | 12 | BSV |
| 355 | 740 E CLINTON AVE | 2254-07 | 2254-06 | 6 | Vitrified Clay Pipe | 400 | 15 | HVV |
| 356 | 2325 N MAROA AVE | 2254-08 | 2254-11 | 6 | Vitrified Clay Pipe | 409 | 24 | HSV |
| 357 | 2325 N MAROA AVE | 2254-08 | 2254-11 | 6 | Vitrified Clay Pipe | 409 | 24 | HVV |
| 358 | 2325 N MAROA AVE | 2254-08 | 2254-11 | 6 | Vitrified Clay Pipe | 409 | 24 | HVV |
| 359 | 904 E YALE AVE | 2254-13 | 2254-23 | 8 | Vitrified Clay Pipe | 320 | 14 | B |
| 360 | 805 E YALE AVE | 2254-14 | 2254-13 | 6 | Vitrified Clay Pipe | 455 | 36 | B |
| 361 | 805 E YALE AVE | 2254-14 | 2254-13 | 6 | Vitrified Clay Pipe | 455 | 36 | B |
| 362 | 805 E YALE AVE | 2254-14 | 2254-13 | 6 | Vitrified Clay Pipe | 455 | 36 | B |
| 363 | 2220 N VAN NESS BLVD | 2254-15 | 2254-14 | 6 | Vitrified Clay Pipe | 815 | 35 | B |
| 364 | 2220 N VAN NESS BLVD | 2254-15 | 2254-14 | 6 | Vitrified Clay Pipe | 815 | 35 | B |
| 365 | 2220 N VAN NESS BLVD | 2254-15 | 2254-14 | 6 | Vitrified Clay Pipe | 815 | 35 | B |
| 366 | 2220 N VAN NESS BLVD | 2254-15 | 2254-14 | 6 | Vitrified Clay Pipe | 815 | 35 | HVV |
| 367 | 2124 N VAN NESS BLVD | 2254-21 | 2254-22 | 6 | Vitrified Clay Pipe | 838 | 40 | B |
| 368 | 901 E WELDON AVE | 2254-26 | 2255-01 | 8 | Vitrified Clay Pipe | 158 | 11 | BSV |
| 369 | 850 E CAMBRIDGE AVE | 2254-27 | 2254-25 | 6 | Vitrified Clay Pipe | 434 | 5 | B |
| 370 | 2019 N WILSON AVE | 2254-33 | 2254-34 | 6 | Vitrified Clay Pipe | 165 | 12 | H |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 371 | 2019 N WILSON AVE | 2254-33 | 2254-34 | 6 | Vitrified Clay Pipe | 165 | 12 | H |
| 372 | 1922 N ECHO AVE | 2254-38 | 2254-39 | 6 | Vitrified Clay Pipe | 859 | 24 | B |
| 373 | N WISHON AVE | 2254-42 | 2254-41 | 6 | Vitrified Clay Pipe | 454 | 5 | H |
| 374 | 1808 N WISHON AVE | 2254-42 | 2254-41 | 6 | Vitrified Clay Pipe | 454 | 5 | HVV |
| 375 | 1814 N ECHO AVE | 2254-44 | 2254-42 | 6 | Vitrified Clay Pipe | 851 | 33 | B |
| 376 | 1814 N ECHO AVE | 2254-44 | 2254-42 | 6 | Vitrified Clay Pipe | 851 | 33 | B |
| 377 | 1814 N ECHO AVE | 2254-44 | 2254-42 | 6 | Vitrified Clay Pipe | 851 | 33 | HSV |
| 378 | 1138 E VASSAR AVE | 2255-21 | 2255-22 | 6 | Vitrified Clay Pipe | 344 | 9 | D |
| 379 | 1138 E YALE AVE | 2255-25 | 2255-23 | 6 | Vitrified Clay Pipe | 465 | 5 | BVV |
| 380 | 1522 E YALE AVE | 2255-28 | 2255-27 | 6 | Concrete Pipe | 364 | 215 | B |
| 381 | 1610 E YALE AVE | 2255-29 | 2255-28 | 6 | Concrete Pipe | 417 | 320 | HVV |
| 382 | 2104 N COLLEGE AVE | 2255-41 | 2255-59 | 6 | Vitrified Clay Pipe | 333 | 20 | B |
| 383 | 2104 N COLLEGE AVE | 2255-41 | 2255-59 | 6 | Vitrified Clay Pipe | 333 | 20 | B |
| 384 | 2104 N COLLEGE AVE | 2255-41 | 2255-59 | 6 | Vitrified Clay Pipe | 333 | 20 | B |
| 385 | 2104 N COLLEGE AVE | 2255-41 | 2255-59 | 6 | Vitrified Clay Pipe | 333 | 20 | B |
| 386 | 2929 E NORMAL AVE | 2257-27 | 2257-28 | 8 | Cast Iron | 395 | 5 | SRC |
| 387 | 4556 E UNIVERSITY AVE | 2260-09 | 2260-25 | 6 | Cast Iron | 350 | 10 | BSV |
| 388 | 4556 E UNIVERSITY AVE | 2260-09 | 2260-25 | 6 | Cast Iron | 350 | 10 | BVV |
| 389 | 4556 E UNIVERSITY AVE | 2260-09 | 2260-25 | 6 | Cast Iron | 350 | 10 | SRC |
| 390 | 4207 E WELDON | 2260-38 | 2259-32 | 8 | Vitrified Clay Pipe | 296 | 10 | H |
| 391 | 4207 E WELDON | 2260-38 | 2259-32 | 8 | Vitrified Clay Pipe | 296 | 10 | H |
| 392 | 537 W HAMMOND AVE | 2352-09 | 2352-08 | 6 | Vitrified Clay Pipe | 617 | 104 | B |
| 393 | 537 W HAMMOND AVE | 2352-09 | 2352-08 | 6 | Vitrified Clay Pipe | 617 | 104 | B |
| 394 | 734 W HAMMOND AVE | 2352-14 | 2352-71 | 8 | Polyvinyl Chloride | 266 | 19 | B |
| 395 | 734 W HAMMOND AVE | 2352-14 | 2352-71 | 8 | Polyvinyl Chloride | 266 | 19 | H |
| 396 | 1225 N VAGEDES AVE | 2352-17 | 2352-07 | 6 | Vitrified Clay Pipe | 460 | 9 | HSV |
| 397 | 1315 N FRUIT AVE | 2352-20 | 2352-19 | 6 | Vitrified Clay Pipe | 667 | 58 | B |
| 398 | 1315 N FRUIT AVE | 2352-20 | 2352-19 | 6 | Vitrified Clay Pipe | 667 | 58 | BVV |
| 399 | 1315 N FRUIT AVE | 2352-20 | 2352-19 | 6 | Vitrified Clay Pipe | 667 | 58 | D |
| 400 | 1315 N FRUIT AVE | 2352-20 | 2352-19 | 6 | Vitrified Clay Pipe | 667 | 58 | D |
| 401 | 43 W OLIVE AVE | 2353-05 | 2353-04 | 8 | Vitrified Clay Pipe | 331 | 8 | B |
| 402 | 1228 N VAGEDES AVE | 2353-09 | 2353-07 | 6 | Vitrified Clay Pipe | 120 | 5 | BSV |
| 403 | 1224 N FARRIS AVE | 2353-23 | 2353-22 | 6 | Vitrified Clay Pipe | 137 | 15 | BVV |
| 404 | 1208 N HARRISON AVE | 2353-26 | 2353-24 | 6 | Vitrified Clay Pipe | 230 | 5 | B |
| 405 | 244 E HEDGES AVE | 2353-30 | 2353-28 | 14 | Vitrified Clay Pipe | 506 | 20 | HSV |
| 406 | 1284 N SAFFORD AVE | 2353-31 | 2353-30 | 6 | Vitrified Clay Pipe | 331 | 8 | BVV |
| 407 | 1219 N SAFFORD AVE | 2353-32 | 2353-02 | 6 | Vitrified Clay Pipe | 615 | 36 | H |

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 408 | 1295 N HARRISON AVE | 2353-36 | 2353-34 | 6 | Vitrified Clay Pipe | 174 | 5 | H |
| 409 | 222 W OLIVE AVE | 2353-41 | 2353-15 | 6 | Vitrified Clay Pipe | 501 | 32 | B |
| 410 | 222 W OLIVE AVE | 2353-41 | 2353-15 | 6 | Vitrified Clay Pipe | 501 | 32 | B |
| 411 | 222 W OLIVE AVE | 2353-41 | 2353-15 | 6 | Vitrified Clay Pipe | 501 | 32 | B |
| 412 | 222 W OLIVE AVE | 2353-41 | 2353-15 | 6 | Vitrified Clay Pipe | 501 | 32 | D |
| 413 | 316 W OLIVE AVE | 2353-42 | 2353-12 | 6 | Vitrified Clay Pipe | 460 | 8 | B |
| 414 | 144 E HOME AVE | 2353-61 | 2353-49 | 6 | Vitrified Clay Pipe | 641 | 9 | HVV |
| 415 | 1407 N FARRIS AVE | 2353-65 | 2353-52 | 6 | Vitrified Clay Pipe | 570 | 44 | H |
| 416 | 1407 N THORNE AVE | 2353-67 | 2353-46 | 6 | Vitrified Clay Pipe | 704 | 28 | B |
| 417 | 1407 N THORNE AVE | 2353-67 | 2353-46 | 6 | Vitrified Clay Pipe | 704 | 28 | B |
| 418 | 1405 N ARTHUR AVE | 2353-69 | 2353-44 | 6 | Vitrified Clay Pipe | 704 | 65 | B |
| 419 | 1405 N VAGEDES AVE | 2353-70 | 2353-43 | 6 | Vitrified Clay Pipe | 570 | 5 | HVV |
| 420 | 1507 N ARTHUR AVE | 2353-73 | 2353-69 | 6 | Vitrified Clay Pipe | 604 | 70 | B |
| 421 | 1532 N SAFFORD AVE | 2353-76 | 2353-60 | 6 | Vitrified Clay Pipe | 621 | 8 | B |
| 422 | 405 E OLIVE AVE | 2354-11 | 2354-91 | 6 | Vitrified Clay Pipe | 115 | 13 | B |
| 423 | 405 E OLIVE AVE | 2354-11 | 2354-91 | 6 | Vitrified Clay Pipe | 115 | 13 | XP |
| 424 | 1218 N FERGER AVE | 2354-12 | 2354-10 | 6 | Vitrified Clay Pipe | 662 | 144 | H |
| 425 | 437 E OLIVE AVE | 2354-14 | 2354-07 | 6 | Vitrified Clay Pipe | 395 | 14 | BSV |
| 426 | 645 E OLIVE AVE | 2354-16 | 2354-04 | 6 | Vitrified Clay Pipe | 405 | 22 | B |
| 427 | 645 E OLIVE AVE | 2354-16 | 2354-04 | 6 | Vitrified Clay Pipe | 405 | 22 | B |
| 428 | 858 E HEDGES AVE | 2354-21 | 2354-96 | 12 | Vitrified Clay Pipe | 215 | 8 | B |
| 429 | 1320 N WISHON AVE | 2354-22 | 2354-21 | 6 | Vitrified Clay Pipe | 360 | 31 | B |
| 430 | 1320 N WISHON AVE | 2354-22 | 2354-21 | 6 | Vitrified Clay Pipe | 360 | 31 | H |
| 431 | 733 E FERN AVE | 2354-23 | 2354-18 | 6 | Vitrified Clay Pipe | 414 | 26 | H |
| 432 | 1320 N ECHO AVE | 2354-26 | 2354-15 | 6 | Vitrified Clay Pipe | 355 | 20 | H |
| 433 | 1319 N FERGER AVE | 2354-29 | 2354-12 | 6 | Vitrified Clay Pipe | 150 | 14 | BSV |
| 434 | 1350 N ECHO AVE | 2354-33 | 2354-26 | 6 | Vitrified Clay Pipe | 490 | 29 | B |
| 435 | 645 W HEDGES AVE | 2354-35 | 2354-25 | 6 | Vitrified Clay Pipe | 475 | 23 | BSV |
| 436 | 1360 N LINDEN AVE | 2354-36 | 2354-39 | 6 | Vitrified Clay Pipe | 390 | 33 | B |
| 437 | 1360 N LINDEN AVE | 2354-36 | 2354-39 | 6 | Vitrified Clay Pipe | 390 | 33 | H |
| 438 | 1360 N LINDEN AVE | 2354-36 | 2354-39 | 6 | Vitrified Clay Pipe | 390 | 33 | H |
| 439 | 1394 N LINDEN AVE | 2354-37 | 2354-38 | 6 | Vitrified Clay Pipe | 150 | 16 | B |
| 440 | 1394 N LINDEN AVE | 2354-37 | 2354-38 | 6 | Vitrified Clay Pipe | 150 | 16 | B |
| 441 | 1394 N LINDEN AVE | 2354-38 | 2354-24 | 8 | Vitrified Clay Pipe | 509 | 15 | B |
| 442 | 748 E PINE AVE | 2354-46 | 2354-47 | 6 | Vitrified Clay Pipe | 329 | 8 | BSV |
| 443 | 1460 N WILSON AVE | 2354-53 | 2354-31 | 6 | Vitrified Clay Pipe | 400 | 17 | B |
| 444 | 655 E PINE AVE | 2354-58 | 2354-60 | 6 | Vitrified Clay Pipe | 414 | 40 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 445 | 655 E PINE AVE | 2354-58 | 2354-60 | 6 | Vitrified Clay Pipe | 414 | 40 | H |
| 446 | 655 E PINE AVE | 2354-58 | 2354-60 | 6 | Vitrified Clay Pipe | 414 | 40 | H |
| 447 | 655 E PINE AVE | 2354-58 | 2354-60 | 6 | Vitrified Clay Pipe | 414 | 40 | H |
| 448 | 655 E PINE AVE | 2354-58 | 2354-60 | 6 | Vitrified Clay Pipe | 414 | 40 | H |
| 449 | 655 E PINE AVE | 2354-58 | 2354-60 | 6 | Vitrified Clay Pipe | 414 | 40 | H |
| 450 | 701 E PINE AVE | 2354-59 | 2354-60 | 8 | Vitrified Clay Pipe | 20 | 8 | BSV |
| 451 | 742 E CARMEN AVE | 2354-71 | 2354-70 | 6 | Vitrified Clay Pipe | 120 | 9 | H |
| 452 | 742 E CARMEN AVE | 2354-72 | 2354-71 | 6 | Vitrified Clay Pipe | 40 | 15 | H |
| 453 | 1460 N WILSON AVE | 2354-76 | 2354-52 | 6 | Vitrified Clay Pipe | 415 | 11 | BSV |
| 454 | 1550 N WILSON AVE | 2354-79 | 2354-76 | 6 | Vitrified Clay Pipe | 415 | 51 | H |
| 455 | 1549 N ECHO AVE | 2354-81 | 2354-92 | 6 | Vitrified Clay Pipe | 864 | 57 | B |
| 456 | 1549 N ECHO AVE | 2354-81 | 2354-92 | 6 | Vitrified Clay Pipe | 864 | 57 | B |
| 457 | 1549 N ECHO AVE | 2354-81 | 2354-92 | 6 | Vitrified Clay Pipe | 864 | 57 | B |
| 458 | 1549 N ECHO AVE | 2354-81 | 2354-92 | 6 | Vitrified Clay Pipe | 864 | 57 | H |
| 459 | 641 E CARMEN AVE | 2354-82 | 2354-84 | 6 | Vitrified Clay Pipe | 489 | 8 | HVV |
| 460 | 708 E CARMEN AVE | 2354-84 | 2354-73 | 8 | Vitrified Clay Pipe | 300 | 13 | B |
| 461 | 708 E CARMEN AVE | 2354-84 | 2354-73 | 8 | Vitrified Clay Pipe | 300 | 13 | BSV |
| 462 | 743 E CARMEN AVE | 2354-85 | 2354-84 | 6 | Vitrified Clay Pipe | 328 | 5 | H |
| 463 | 855 E CARMEN AVE | 2354-86 | 2354-88 | 6 | Vitrified Clay Pipe | 403 | 8 | BVV |
| 464 | 822 E CARMEN AVE | 2354-90 | 2354-89 | 6 | Vitrified Clay Pipe | 378 | 24 | B |
| 465 | 405 E OLIVE AVE | 2354-91 | 2354-09 | 6 | Vitrified Clay Pipe | 30 | 17 | B |
| 466 | 405 E OLIVE AVE | 2354-91 | 2354-09 | 6 | Vitrified Clay Pipe | 30 | 17 | XP |
| 467 | 1002 E OLIVE AVE | 2355-15 | 2354-01 | 12 | Vitrified Clay Pipe | 338 | 38 | B |
| 468 | 1229 N BLACKSTONE AVE | 2355-24 | 2355-25 | 8 | Cast Iron | 166 | 5 | SRC |
| 469 | 1229 N BLACKSTONE AVE | 2355-24 | 2355-25 | 8 | Cast Iron | 166 | 5 | SRC |
| 470 | 1649 E OLIVE AVE | 2355-25 | 2355-01 | 8 | Cast Iron | 186 | 35 | SRC |
| 471 | 1649 E OLIVE AVE | 2355-25 | 2355-01 | 8 | Cast Iron | 186 | 35 | SRC |
| 472 | 1302 N DEL MAR AVE | 2355-67 | 2355-88 | 6 | Vitrified Clay Pipe | 479 | 62 | B |
| 473 | 1302 N DEL MAR AVE | 2355-67 | 2355-88 | 6 | Vitrified Clay Pipe | 479 | 62 | B |
| 474 | 1302 N DEL MAR AVE | 2355-67 | 2355-88 | 6 | Vitrified Clay Pipe | 479 | 62 | B |
| 475 | 1305 E OLIVE AVE | 2355-88 | 2355-08 | 6 | Vitrified Clay Pipe | 471 | 155 | B |
| 476 | 1305 E OLIVE AVE | 2355-88 | 2355-08 | 6 | Vitrified Clay Pipe | 471 | 155 | B |
| 477 | 1305 E OLIVE AVE | 2355-88 | 2355-08 | 6 | Vitrified Clay Pipe | 471 | 155 | HVV |
| 478 | 1295 N THESTA ST | 2356-20 | 2356-24 | 6 | Vitrified Clay Pipe | 570 | 9 | B |
| 479 | 3237 E PINE AVE | 2358-62 | 2358-39 | 6 | Vitrified Clay Pipe | 199 | 9 | BVV |
| 480 | 1501 N CHESTNUT AVE | 2361-29 | 2362-76 | 8 | Cast Iron | 635 | 510 | SRC |
| 481 | 1501 N CHESTNUT AVE | 2361-29 | 2362-76 | 8 | Cast Iron | 635 | 510 | SRC |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 482 | 4734 E CARMEN AVE | 2361-33 | 2361-32 | 8 | Vitrified Clay Pipe | 427 | 8 | B |
| 483 | 5096 E CARMEN AVE | 2363-76 | 2363-77 | 8 | Vitrified Clay Pipe | 440 | 28 | BSV |
| 484 | 1444 W WHITE AVE | 2451-23 | 2451-24 | 8 | Vitrified Clay Pipe | 220 | 10 | HSV |
| 485 | 1444 W WHITE AVE | 2451-23 | 2451-24 | 8 | Vitrified Clay Pipe | 220 | 10 | HSV |
| 486 | 1005 N VAGEDES AVE | 2452-16 | 2452-17 | 6 | Vitrified Clay Pipe | 505 | 50 | B |
| 487 | 1005 N VAGEDES AVE | 2452-16 | 2452-17 | 6 | Vitrified Clay Pipe | 505 | 50 | BVV |
| 488 | 915 N VAGEDES AVE | 2452-17 | 2453-56 | 6 | Vitrified Clay Pipe | 551 | 44 | B |
| 489 | 915 N VAGEDES AVE | 2452-17 | 2453-56 | 6 | Vitrified Clay Pipe | 551 | 44 | H |
| 490 | 915 N VAGEDES AVE | 2452-17 | 2453-56 | 6 | Vitrified Clay Pipe | 551 | 44 | H |
| 491 | 1105 N ARTHUR AVE | 2453-01 | 2453-02 | 6 | Vitrified Clay Pipe | 505 | 53 | B |
| 492 | 1105 N ARTHUR AVE | 2453-01 | 2453-02 | 6 | Vitrified Clay Pipe | 505 | 53 | BVV |
| 493 | 1105 N ARTHUR AVE | 2453-01 | 2453-02 | 6 | Vitrified Clay Pipe | 505 | 53 | BVV |
| 494 | 1105 N ARTHUR AVE | 2453-01 | 2453-02 | 6 | Vitrified Clay Pipe | 505 | 53 | BVV |
| 495 | 715 N WEBER AVE | 2453-03 | 2453-04 | 6 | Vitrified Clay Pipe | 514 | 86 | B |
| 496 | 715 N WEBER AVE | 2453-03 | 2453-04 | 6 | Vitrified Clay Pipe | 514 | 86 | B |
| 497 | 715 N WEBER AVE | 2453-03 | 2453-04 | 6 | Vitrified Clay Pipe | 514 | 86 | B |
| 498 | 715 N WEBER AVE | 2453-03 | 2453-04 | 6 | Vitrified Clay Pipe | 514 | 86 | HVV |
| 499 | 905 N ADOLINE AVE | 2453-08 | 2453-07 | 6 | Vitrified Clay Pipe | 455 | 10 | B |
| 500 | 905 N ADOLINE AVE | 2453-08 | 2453-07 | 6 | Vitrified Clay Pipe | 455 | 10 | BVV |
| 501 | 217 E THOMAS AVE | 2453-43 | 2453-44 | 6 | Vitrified Clay Pipe | 585 | 48 | BSV |
| 502 | 217 E THOMAS AVE | 2453-43 | 2453-44 | 6 | Vitrified Clay Pipe | 585 | 48 | BVV |
| 503 | 217 E THOMAS AVE | 2453-43 | 2453-44 | 6 | Vitrified Clay Pipe | 585 | 48 | BVV |
| 504 | 517 N FARRIS AVE | 2453-49 | 2453-50 | 6 | Vitrified Clay Pipe | 466 | 19 | H |
| 505 | 1003 N ECHO AVE | 2454-11 | 2454-12 | 6 | Vitrified Clay Pipe | 320 | 28 | B |
| 506 | 1030 N FULTON | 2455-02 | 2455-03 | 6 | Cast Iron | 474 | 0 | SRC |
| 507 | 733 N COLLEGE AVE | 2455-09 | 2455-08 | 8 | Vitrified Clay Pipe | 437 | 52 | B |
| 508 | 733 N COLLEGE AVE | 2455-09 | 2455-08 | 8 | Vitrified Clay Pipe | 437 | 52 | H |
| 509 | 545 PARK AVE | 2455-20 | 2555-82 | 6 | Cast Iron | 732 | 32 | H |
| 510 | 545 PARK AVE | 2455-20 | 2555-82 | 6 | Cast Iron | 732 | 32 | H |
| 511 | 545 PARK AVE | 2455-20 | 2555-82 | 6 | Cast Iron | 732 | 32 | H |
| 512 | 545 PARK AVE | 2455-20 | 2555-82 | 6 | Cast Iron | 732 | 32 | H |
| 513 | 545 PARK AVE | 2455-20 | 2555-82 | 6 | Cast Iron | 732 | 32 | H |
| 514 | 545 PARK AVE | 2455-20 | 2555-82 | 6 | Cast Iron | 732 | 32 | H |
| 515 | 914 N GLENN AVE | 2455-53 | 2455-45 | 8 | Vitrified Clay Pipe | 336 | 23 | B |
| 516 | 1506 E LA SALLE AVE | 2455-61 | 2455-53 | 8 | Vitrified Clay Pipe | 329 | 14 | B |
| 517 | 733 N COLLEGE | 2455-89 | 2455-09 | 6 | Vitrified Clay Pipe | 156 | 5 | HSV |
| 518 | 2011 E TYLER AVE | 2456-60 | 2456-59 | 6 | Vitrified Clay Pipe | 476 | 37 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 519 | 2011 E TYLER AVE | 2456-60 | 2456-59 | 6 | Vitrified Clay Pipe | 476 | 37 | BSV |
| 520 | 1004 N FRESNO ST | 2456-65 | 2456-56 | 10 | Concrete Pipe | 92 | 15 | B |
| 521 | 1721 E HARVEY AVE | 2456-70 | 2456-26 | 6 | Vitrified Clay Pipe | 210 | 13 | BVV |
| 522 | 1721 E HARVEY AVE | 2456-70 | 2456-26 | 6 | Vitrified Clay Pipe | 210 | 13 | HSV |
| 523 | 2558 E LEWIS AVE | 2457-02 | 2456-55 | 12 | Concrete Pipe | 449 | 290 | B |
| 524 | 2558 E LEWIS AVE | 2457-02 | 2456-55 | 12 | Concrete Pipe | 449 | 290 | B |
| 525 | 3027 E WHITE AVE | 2457-25 | 2457-19 | 6 | Vitrified Clay Pipe | 272 | 5 | H |
| 526 | 1100 N FRESNO ST | 2457-35 | 2457-01 | 6 | Vitrified Clay Pipe | 409 | 62 | BSV |
| 527 | 1100 N FRESNO ST | 2457-35 | 2457-01 | 6 | Vitrified Clay Pipe | 409 | 62 | BSV |
| 528 | 1011 N AUGUSTA ST | 2457-36 | 2456-65 | 6 | Vitrified Clay Pipe | 409 | 55 | B |
| 529 | 1011 N AUGUSTA ST | 2457-36 | 2456-65 | 6 | Vitrified Clay Pipe | 409 | 55 | BSV |
| 530 | 1011 N AUGUSTA ST | 2457-36 | 2456-65 | 6 | Vitrified Clay Pipe | 409 | 55 | BSV |
| 531 | 918 N FRESNO ST | 2457-38 | 2456-53 | 6 | Vitrified Clay Pipe | 409 | 13 | B |
| 532 | 3099 E BELMONT AVE | 2457-48 | 2457-23 | 6 | Vitrified Clay Pipe | 618 | 5 | BSV |
| 533 | 3236 E HARVEY AVE | 2458-52 | 2458-54 | 6 | Vitrified Clay Pipe | 425 | 24 | BVV |
| 534 | 3236 E HARVEY AVE | 2458-52 | 2458-54 | 6 | Vitrified Clay Pipe | 425 | 24 | H |
| 535 | 3209 E THOMAS AVE | 2458-54 | 2458-60 | 8 | Vitrified Clay Pipe | 180 | 21 | B |
| 536 | 3167 E BELMONT AVE | 2458-56 | 2458-54 | 8 | Vitrified Clay Pipe | 730 | 66 | B |
| 537 | 3167 E BELMONT AVE | 2458-56 | 2458-54 | 8 | Vitrified Clay Pipe | 730 | 66 | BSV |
| 538 | 3167 E BELMONT AVE | 2458-56 | 2458-54 | 8 | Vitrified Clay Pipe | 730 | 66 | BVV |
| 539 | 3167 E BELMONT AVE | 2458-56 | 2458-54 | 8 | Vitrified Clay Pipe | 730 | 66 | BVV |
| 540 | 667 N SECOND ST | 2458-60 | 2458-59 | 8 | Vitrified Clay Pipe | 150 | 32 | BVV |
| 541 | 3123 E BELMONT AVE | 2458-65 | 2458-59 | 6 | Vitrified Clay Pipe | 730 | 41 | B |
| 542 | 3117 E THOMAS AVE | 2458-76 | 2458-59 | 6 | Vitrified Clay Pipe | 425 | 27 | BVV |
| 543 | 3778 E WHITE AVE | 2459-60 | 2459-61 | 8 | Vitrified Clay Pipe | 400 | 5 | B |
| 544 | 4345 E WHITE AVE | 2460-25 | 2460-27 | 8 | Vitrified Clay Pipe | 330 | 5 | B |
| 545 | 1144 W FRANKLIN AVE | 2552-05 | 2552-04 | 8 | Vitrified Clay Pipe | 308 | 16 | BSV |
| 546 | 1144 W FRANKLIN AVE | 2552-05 | 2552-04 | 8 | Vitrified Clay Pipe | 308 | 16 | BSV |
| 547 | 620 E BELMONT AVE | 2554-25 | 2554-05 | 6 | Vitrified Clay Pipe | 626 | 13 | B |
| 548 | 512 E FRANKLIN AVE | 2554-36 | 2554-27 | 8 | Vitrified Clay Pipe | 406 | 16 | B |
| 549 | 512 E FRANKLIN AVE | 2554-36 | 2554-27 | 8 | Vitrified Clay Pipe | 406 | 16 | B |
| 550 | 202 N H ST | 2554-41 | 2554-40 | 6 | Vitrified Clay Pipe | 24 | 13 | B |
| 551 | 202 N H ST | 2554-41 | 2554-40 | 6 | Vitrified Clay Pipe | 24 | 13 | BSV |
| 552 | 279 N ECHO AVE | 2554-43 | 2554-92 | 6 | Vitrified Clay Pipe | 140 | 20 | H |
| 553 | 164 N ROOSEVELT AVE | 2554-45 | 2554-46 | 6 | Vitrified Clay Pipe | 211 | 8 | B |
| 554 | 108 N H ST | 2554-49 | 2554-47 | 6 | Polyvinyl Chloride | 233 | 34 | B |
| 555 | 108 N H ST | 2554-49 | 2554-47 | 6 | Polyvinyl Chloride | 233 | 34 | BSV |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 556 | 108 N H ST | 2554-49 | 2554-47 | 6 | Polyvinyl Chloride | 233 | 34 | HSV |
| 557 | 730 E FRANKLIN AVE | 2554-53 | 2554-55 | 6 | Vitrified Clay Pipe | 223 | 31 | B |
| 558 | 730 E FRANKLIN AVE | 2554-53 | 2554-55 | 6 | Vitrified Clay Pipe | 223 | 31 | B |
| 559 | 730 E FRANKLIN AVE | 2554-53 | 2554-55 | 6 | Vitrified Clay Pipe | 223 | 31 | BSV |
| 560 | 730 E FRANKLIN AVE | 2554-53 | 2554-55 | 6 | Vitrified Clay Pipe | 223 | 31 | BVV |
| 561 | 2121 H ST | 2554-74 | 2554-73 | 10 | Vitrified Clay Pipe | 315 | 17 | B |
| 562 | 2121 H ST | 2554-74 | 2554-73 | 10 | Vitrified Clay Pipe | 315 | 17 | B |
| 563 | 607 E DIVISADERO ST | 2554-78 | 2554-75 | 6 | Vitrified Clay Pipe | 340 | 46 | BSV |
| 564 | 607 E DIVISADERO ST | 2554-78 | 2554-75 | 6 | Vitrified Clay Pipe | 340 | 46 | BVV |
| 565 | 742 E VOORMAN AVE | 2554-79 | 2554-78 | 6 | Vitrified Clay Pipe | 405 | 59 | B |
| 566 | 742 E VOORMAN AVE | 2554-79 | 2554-78 | 6 | Vitrified Clay Pipe | 405 | 59 | B |
| 567 | 742 E VOORMAN AVE | 2554-79 | 2554-78 | 6 | Vitrified Clay Pipe | 405 | 59 | BVV |
| 568 | 607 E DIVISADERO ST | 2554-88 | 2554-75 | 12 | Vitrified Clay Pipe | 178 | 9 | BSV |
| 569 | 205 N H ST | 2554-90 | 2553-49 | 8 | Vitrified Clay Pipe | 671 | 18 | BSV |
| 570 | 1330 E BELMONT AVE | 2555-11 | 2555-28 | 6 | Vitrified Clay Pipe | 635 | 5 | B |
| 571 | 1224 E FRANKLIN AVE | 2555-21 | 2555-26 | 8 | Cast Iron | 750 | 0 | SRC |
| 572 | 252 N POPLAR AVE | 2555-37 | 2555-48 | 6 | Vitrified Clay Pipe | 435 | 29 | H |
| 573 | 158 N POPLAR AVE | 2555-48 | 2555-54 | 6 | Vitrified Clay Pipe | 490 | 12 | H |
| 574 | 214 N SAN PABLO | 2555-57 | 2555-56 | 6 | Vitrified Clay Pipe | 435 | 19 | B |
| 575 | 214 N SAN PABLO | 2555-57 | 2555-56 | 6 | Vitrified Clay Pipe | 435 | 19 | B |
| 576 | 214 N SAN PABLO | 2555-57 | 2555-56 | 6 | Vitrified Clay Pipe | 435 | 19 | BVV |
| 577 | 1537 E VOORMAN AVE | 2555-66 | 2555-59 | 6 | Vitrified Clay Pipe | 180 | 14 | B |
| 578 | 16 N SAN PABLO AVE | 2555-70 | 2555-67 | 8 | Vitrified Clay Pipe | 424 | 18 | B |
| 579 | 297 N BLACKSTONE AVE | 2556-01 | 2555-40 | 15 | Vitrified Clay Pipe | 375 | 5 | B |
| 580 | 215 N EFFIE ST | 2556-11 | 2556-09 | 8 | Vitrified Clay Pipe | 630 | 8 | B |
| 581 | 385 N CLARK ST | 2556-19 | 2556-20 | 8 | Vitrified Clay Pipe | 653 | 8 | XP |
| 582 | 275 N DIANA ST | 2556-20 | 2556-15 | 15 | Vitrified Clay Pipe | 330 | 10 | B |
| 583 | 2329 E GRANT AVE | 2556-45 | 2556-46 | 6 | Vitrified Clay Pipe | 266 | 41 | B |
| 584 | 2329 E GRANT AVE | 2556-45 | 2556-46 | 6 | Vitrified Clay Pipe | 266 | 41 | BSV |
| 585 | 2329 E GRANT AVE | 2556-45 | 2556-46 | 6 | Vitrified Clay Pipe | 266 | 41 | BSV |
| 586 | 2329 E GRANT AVE | 2556-45 | 2556-46 | 6 | Vitrified Clay Pipe | 266 | 41 | HSV |
| 587 | 2329 E GRANT AVE | 2556-45 | 2556-46 | 6 | Vitrified Clay Pipe | 266 | 41 | HSV |
| 588 | 451 N HOWARD ST | 2556-46 | 2556-47 | 6 | Vitrified Clay Pipe | 156 | 30 | BVV |
| 589 | 384 N THESTA ST | 2556-99 | 2556-44 | 8 | Vitrified Clay Pipe | 630 | 15 | B |
| 590 | 384 N THESTA ST | 2556-99 | 2556-44 | 8 | Vitrified Clay Pipe | 630 | 15 | B |
| 591 | 384 N THESTA ST | 2556-99 | 2556-44 | 8 | Vitrified Clay Pipe | 630 | 15 | B |
| 592 | 2734 N MCKENZIE AVE | 2557-16 | 2557-15 | 10 | Vitrified Clay Pipe | 331 | 5 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 593 | 270 N MARIPOSA ST | 2557-20 | 2557-15 | 8 | Vitrified Clay Pipe | 320 | 19 | B |
| 594 | 270 N MARIPOSA ST | 2557-20 | 2557-15 | 8 | Vitrified Clay Pipe | 320 | 19 | BSV |
| 595 | 2988 E BELMONT AVE | 2557-26 | 2557-27 | 6 | Vitrified Clay Pipe | 273 | 33 | B |
| 596 | 2988 E BELMONT AVE | 2557-26 | 2557-27 | 6 | Vitrified Clay Pipe | 273 | 33 | B |
| 597 | 2988 E BELMONT AVE | 2557-26 | 2557-27 | 6 | Vitrified Clay Pipe | 273 | 33 | H |
| 598 | 450 N ORCHARD ST | 2557-30 | 2557-31 | 8 | Vitrified Clay Pipe | 330 | 5 | B |
| 599 | 3017 E MADISON AVE | 2557-33 | 2557-30 | 6 | Vitrified Clay Pipe | 615 | 26 | B |
| 600 | 3017 E MADISON AVE | 2557-33 | 2557-30 | 6 | Vitrified Clay Pipe | 615 | 26 | B |
| 601 | 3017 E MADISON AVE | 2557-33 | 2557-30 | 6 | Vitrified Clay Pipe | 615 | 26 | B |
| 602 | 3017 E MADISON AVE | 2557-33 | 2557-30 | 6 | Vitrified Clay Pipe | 615 | 26 | H |
| 603 | 3037 E GRANT AVE | 2557-34 | 2557-31 | 6 | Vitrified Clay Pipe | 614 | 40 | B |
| 604 | 3037 E GRANT AVE | 2557-34 | 2557-31 | 6 | Vitrified Clay Pipe | 614 | 40 | B |
| 605 | 3037 E GRANT AVE | 2557-34 | 2557-31 | 6 | Vitrified Clay Pipe | 614 | 40 | B |
| 606 | 3037 E GRANT AVE | 2557-34 | 2557-31 | 6 | Vitrified Clay Pipe | 614 | 40 | B |
| 607 | 3037 E GRANT AVE | 2557-34 | 2557-31 | 6 | Vitrified Clay Pipe | 614 | 40 | BSV |
| 608 | 221 N ORCHARD ST | 2557-49 | 2557-50 | 6 | Vitrified Clay Pipe | 302 | 13 | B |
| 609 | 221 N ORCHARD ST | 2557-49 | 2557-50 | 6 | Vitrified Clay Pipe | 302 | 13 | B |
| 610 | 137  N ORCHARD ST | 2557-52 | 2557-51 | 6 | Vitrified Clay Pipe | 368 | 43 | H |
| 611 | 137  N ORCHARD ST | 2557-52 | 2557-51 | 6 | Vitrified Clay Pipe | 368 | 43 | H |
| 612 | 137  N ORCHARD ST | 2557-52 | 2557-51 | 6 | Vitrified Clay Pipe | 368 | 43 | H |
| 613 | 137  N ORCHARD ST | 2557-52 | 2557-51 | 6 | Vitrified Clay Pipe | 368 | 43 | H |
| 614 | 137  N ORCHARD ST | 2557-52 | 2557-51 | 6 | Vitrified Clay Pipe | 368 | 43 | H |
| 615 | 137  N ORCHARD ST | 2557-52 | 2557-51 | 6 | Vitrified Clay Pipe | 368 | 43 | H |
| 616 | 137  N ORCHARD ST | 2557-52 | 2557-51 | 6 | Vitrified Clay Pipe | 368 | 43 | H |
| 617 | 137  N ORCHARD ST | 2557-52 | 2557-51 | 6 | Vitrified Clay Pipe | 368 | 43 | H |
| 618 | 3402 E MADISON AVE | 2558-10 | 2558-16 | 8 | Vitrified Clay Pipe | 329 | 5 | H |
| 619 | 364 N FIFTH ST | 2558-24 | 2558-23 | 6 | Vitrified Clay Pipe | 441 | 87 | BSV |
| 620 | 364 N FIFTH ST | 2558-24 | 2558-23 | 6 | Vitrified Clay Pipe | 441 | 87 | BVV |
| 621 | 364 N FIFTH ST | 2558-24 | 2558-23 | 6 | Vitrified Clay Pipe | 441 | 87 | H |
| 622 | 364 N FIFTH ST | 2558-24 | 2558-23 | 6 | Vitrified Clay Pipe | 441 | 87 | H |
| 623 | 310 N SECOND ST | 2558-26 | 2558-27 | 6 | Vitrified Clay Pipe | 479 | 5 | HSV |
| 624 | 258 N FIRST ST | 2558-31 | 2558-32 | 6 | Vitrified Clay Pipe | 417 | 18 | H |
| 625 | 258 N FIRST ST | 2558-31 | 2558-32 | 6 | Vitrified Clay Pipe | 417 | 18 | HSV |
| 626 | 258 N FIRST ST | 2558-31 | 2558-32 | 6 | Vitrified Clay Pipe | 417 | 18 | HSV |
| 627 | 258 N FIRST ST | 2558-31 | 2558-32 | 6 | Vitrified Clay Pipe | 417 | 18 | HSV |
| 628 | 3666 E NEVADA AVE | 2559-14 | 2559-18 | 8 | Vitrified Clay Pipe | 330 | 20 | B |
| 629 | 3666 E NEVADA AVE | 2559-14 | 2559-18 | 8 | Vitrified Clay Pipe | 330 | 20 | BVV |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 630 | 5965 E SHIELDS AVE | 2559-15 | 2559-16 | 6 | Vitrified Clay Pipe | 590 | 8 | B |
| 631 | 3746 E BELMONT AVE | 2559-52 | 2559-54 | 30 | Concrete Pipe | 322 | 152 | SRV |
| 632 | 3746 E BELMONT AVE | 2559-52 | 2559-54 | 30 | Concrete Pipe | 322 | 152 | SRV |
| 633 | 3770 E BELMONT AVE | 2559-54 | 2559-90 | 30 | Concrete Pipe | 127 | 184 | SRV |
| 634 | 3770 E BELMONT AVE | 2559-54 | 2559-90 | 30 | Concrete Pipe | 127 | 184 | SRV |
| 635 | 3770 E BELMONT AVE | 2559-54 | 2559-90 | 30 | Concrete Pipe | 127 | 184 | SRV |
| 636 | 4128 E BELMONT AVE | 2559-62 | 2559-64 | 8 | Vitrified Clay Pipe | 560 | 52 | B |
| 637 | 4128 E BELMONT AVE | 2559-62 | 2559-64 | 8 | Vitrified Clay Pipe | 560 | 52 | HVV |
| 638 | 411 N NINTH ST | 2559-67 | 2559-05 | 6 | Vitrified Clay Pipe | 491 | 20 | BSV |
| 639 | 160 N ELEVENTH ST | 2559-85 | 2559-86 | 12 | Vitrified Clay Pipe | 664 | 21 | B |
| 640 | 4321 E ILLINOIS AVE | 2560-39 | 2560-40 | 6 | Vitrified Clay Pipe | 497 | 90 | B |
| 641 | 4321 E ILLINOIS AVE | 2560-39 | 2560-40 | 6 | Vitrified Clay Pipe | 497 | 90 | B |
| 642 | 4321 E ILLINOIS AVE | 2560-39 | 2560-40 | 6 | Vitrified Clay Pipe | 497 | 90 | B |
| 643 | 4321 E ILLINOIS AVE | 2560-39 | 2560-40 | 6 | Vitrified Clay Pipe | 497 | 90 | B |
| 644 | 370 N MAPLE AVE | 2561-25 | 2560-17 | 6 | Vitrified Clay Pipe | 660 | 13 | H |
| 645 | 370 N MAPLE AVE | 2561-25 | 2560-17 | 6 | Vitrified Clay Pipe | 660 | 13 | HSV |
| 646 | 370 N MAPLE AVE | 2561-25 | 2560-17 | 6 | Vitrified Clay Pipe | 660 | 13 | HVV |
| 647 | 530 S TRINITY ST | 2653-111 | 2653-87 | 6 | Vitrified Clay Pipe | 91 | 14 | B |
| 648 | 530 S TRINITY ST | 2653-111 | 2653-87 | 6 | Vitrified Clay Pipe | 91 | 14 | H |
| 649 | 624 S PLUMAS ST | 2653-73 | 2653-90 | 6 | Vitrified Clay Pipe | 391 | 52 | B |
| 650 | 624 S PLUMAS ST | 2653-73 | 2653-90 | 6 | Vitrified Clay Pipe | 391 | 52 | BSV |
| 651 | 127 E ONEIL AVE | 2653-94 | 2653-95 | 6 | Vitrified Clay Pipe | 110 | 5 | BSV |
| 652 | 127 E ONEIL AVE | 2653-95 | 2653-74 | 6 | Vitrified Clay Pipe | 159 | 8 | B |
| 653 | 127 E ONEIL AVE | 2653-96 | SN26530004 | 6 | Vitrified Clay Pipe | 90 | 5 | BVV |
| 654 | 1762 G ST | 2654-30 | 2654-29 | 10 | Vitrified Clay Pipe | 580 | 5 | B |
| 655 | 1332 N ST | 2655-02 | 2655-01 | 6 | Vitrified Clay Pipe | 440 | 24 | BSV |
| 656 | 1630 VAN NESS AVE | 2655-10 | 2655-16 | 6 | Vitrified Clay Pipe | 479 | 32 | B |
| 657 | 1630 VAN NESS AVE | 2655-10 | 2655-16 | 6 | Vitrified Clay Pipe | 479 | 32 | BVV |
| 658 | 1630 VAN NESS AVE | 2655-10 | 2655-16 | 6 | Vitrified Clay Pipe | 479 | 32 | H |
| 659 | 1630 VAN NESS AVE | 2655-10 | 2655-16 | 6 | Vitrified Clay Pipe | 479 | 32 | SRCZ |
| 660 | 1650 L ST | 2655-11 | 2655-15 | 6 | Vitrified Clay Pipe | 388 | 9 | HVV |
| 661 | 1402 BROADWAY | 2655-40 | 2655-21 | 6 | Vitrified Clay Pipe | 375 | 18 | B |
| 662 | 1402 BROADWAY | 2655-40 | 2655-21 | 6 | Vitrified Clay Pipe | 375 | 18 | B |
| 663 | 1402 BROADWAY | 2655-40 | 2655-21 | 6 | Vitrified Clay Pipe | 375 | 18 | BSV |
| 664 | 1315 VAN NESS AVE | 2655-41 | 2655-57 | 27 | Concrete Pipe | 481 | 5 | H |
| 665 | 2305 STANISLAUS ST | 2655-49 | 2655-13 | 6 | Vitrified Clay Pipe | 429 | 40 | HVV |
| 666 | 2310 STANISLAUS ST | 2655-50 | 2655-72 | 6 | Vitrified Clay Pipe | 423 | 24 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 667 | 2310 STANISLAUS ST | 2655-50 | 2655-72 | 6 | Vitrified Clay Pipe | 423 | 24 | BVV |
| 668 | 2222 STANISLAUS ST | 2655-51 | 2655-27 | 6 | Vitrified Clay Pipe | 425 | 9 | B |
| 669 | 1428 H ST | 2655-56 | 2655-71 | 8 | Vitrified Clay Pipe | 433 | 23 | H |
| 670 | 1428 H ST | 2655-56 | 2655-71 | 8 | Vitrified Clay Pipe | 433 | 23 | H |
| 671 | 1428 H ST | 2655-56 | 2655-71 | 8 | Vitrified Clay Pipe | 433 | 23 | H |
| 672 | 1428 H ST | 2655-56 | 2655-71 | 8 | Vitrified Clay Pipe | 433 | 23 | H |
| 673 | 1911 MERCED ST | 2655-64 | 2655-63 | 8 | Vitrified Clay Pipe | 411 | 19 | B |
| 674 | 1432 E DIVISADERO ST | 2655-66 | 2655-13 | 6 | Vitrified Clay Pipe | 385 | 37 | BSV |
| 675 | 1432 E DIVISADERO ST | 2655-66 | 2655-13 | 6 | Vitrified Clay Pipe | 385 | 37 | HVV |
| 676 | 946 E DIVISADERO ST | 2655-73 | 2554-81 | 6 | Vitrified Clay Pipe | 153 | 5 | B |
| 677 | 2619 MERCED ST | 2656-06 | 2656-04 | 6 | Vitrified Clay Pipe | 430 | 12 | BSV |
| 678 | 2505 MERCED ST | 2656-07 | 2656-03 | 6 | Vitrified Clay Pipe | 432 | 39 | B |
| 679 | 2505 MERCED ST | 2656-07 | 2656-03 | 6 | Vitrified Clay Pipe | 432 | 39 | B |
| 680 | 2505 MERCED ST | 2656-07 | 2656-03 | 6 | Vitrified Clay Pipe | 432 | 39 | BVV |
| 681 | 2520 MERCED ST | 2656-08 | 2656-09 | 6 | Vitrified Clay Pipe | 421 | 12 | BVV |
| 682 | 1230 M ST | 2656-14 | 2656-63 | 6 | Vitrified Clay Pipe | 409 | 5 | H |
| 683 | 2314 MARIPOSA MALL | 2656-18 | 2656-17 | 6 | Vitrified Clay Pipe | 200 | 5 | H |
| 684 | 908 M ST | 2656-19 | 2756-47 | 6 | Vitrified Clay Pipe | 524 | 9 | B |
| 685 | 908 M ST | 2656-19 | 2756-47 | 6 | Vitrified Clay Pipe | 524 | 10 | B |
| 686 | 908 M ST | 2656-19 | 2756-47 | 6 | Vitrified Clay Pipe | 524 | 10 | B |
| 687 | 2606 KERN ST | 2656-41 | 2656-40 | 6 | Vitrified Clay Pipe | 376 | 44 | BVV |
| 688 | 2950 MARIPOSA ST | 2656-47 | 2657-06 | 6 | Vitrified Clay Pipe | 438 | 12 | H |
| 689 | 2727 TULARE ST | 2656-49 | 2656-62 | 6 | Vitrified Clay Pipe | 485 | 9 | D |
| 690 | 2727 TULARE ST | 2656-49 | 2656-62 | 6 | Vitrified Clay Pipe | 485 | 9 | H |
| 691 | 2621 FRESNO ST | 2656-54 | 2656-55 | 6 | Vitrified Clay Pipe | 424 | 16 | H |
| 692 | 2621 FRESNO ST | 2656-54 | 2656-55 | 6 | Vitrified Clay Pipe | 424 | 16 | H |
| 693 | 2006 E DIVISADERO | 2656-57 | 2656-04 | 8 | Vitrified Clay Pipe | 232 | 10 | H |
| 694 | 2006 E DIVISADERO | 2656-57 | 2656-04 | 8 | Vitrified Clay Pipe | 232 | 10 | HVV |
| 695 | 2448 STANISLAUS ST | 2656-64 | 2656-01 | 6 | Vitrified Clay Pipe | 428 | 18 | B |
| 696 | 2448 STANISLAUS ST | 2656-64 | 2656-01 | 6 | Vitrified Clay Pipe | 428 | 18 | B |
| 697 | 2448 STANISLAUS ST | 2656-64 | 2656-01 | 6 | Vitrified Clay Pipe | 428 | 18 | B |
| 698 | 2920 E HUNTINGTON BLVD | 2657-20 | 2657-67 | 12 | Vitrified Clay Pipe | 325 | 11 | H |
| 699 | 3103 KERCKHOFF AVE | 2657-31 | 2657-32 | 14 | Vitrified Clay Pipe | 420 | 10 | D |
| 700 | 430 S FIRST ST | 2657-33 | 2657-34 | 14 | Vitrified Clay Pipe | 414 | 5 | B |
| 701 | 2730 TULARE ST | 2657-64 | 2657-35 | 6 | Vitrified Clay Pipe | 250 | 8 | B |
| 702 | 900 SANTA FE AVE | 2657-65 | 2757-01 | 8 | Vitrified Clay Pipe | 384 | 30 | BVV |
| 703 | 900 SANTA FE AVE | 2657-65 | 2757-01 | 8 | Vitrified Clay Pipe | 384 | 30 | BVV |

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 704 | 900 SANTA FE AVE | 2657-65 | 2757-01 | 8 | Vitrified Clay Pipe | 384 | 30 | H |
| 705 | 900 SANTA FE AVE | 2657-65 | 2757-01 | 8 | Vitrified Clay Pipe | 384 | 30 | H |
| 706 | 710 R ST | 2657-68 | 2657-65 | 8 | Vitrified Clay Pipe | 191 | 5 | B |
| 707 | 3303 E PLATT AVE | 2658-02 | 2658-12 | 12 | Vitrified Clay Pipe | 368 | 28 | H |
| 708 | 3025 E KERCKHOFF AVE | 2658-13 | 2658-50 | 6 | Vitrified Clay Pipe | 479 | 18 | B |
| 709 | 3025 E KERCKHOFF AVE | 2658-13 | 2658-50 | 6 | Vitrified Clay Pipe | 479 | 18 | D |
| 710 | 3327 KERCKHOFF AVE | 2658-14 | 2658-13 | 6 | Vitrified Clay Pipe | 479 | 32 | B |
| 711 | 3403 E KERCKHOFF AVE | 2658-15 | 2658-14 | 6 | Vitrified Clay Pipe | 428 | 13 | B |
| 712 | 3561 E KERCKHOFF AVE | 2658-16 | 2658-15 | 6 | Vitrified Clay Pipe | 530 | 5 | BSV |
| 713 | 3362 E KERCKHOFF AVE | 2658-19 | 2658-53 | 10 | Vitrified Clay Pipe | 479 | 28 | B |
| 714 | 3555 E HUNTINGTON BLVD | 2658-21 | 2658-20 | 10 | Vitrified Clay Pipe | 479 | 30 | H |
| 715 | 3363 E BALCH AVE | 2658-24 | 2658-23 | 6 | Vitrified Clay Pipe | 479 | 11 | D |
| 716 | 3463 E BALCH AVE | 2658-25 | 2658-24 | 6 | Vitrified Clay Pipe | 428 | 20 | B |
| 717 | 3463 E BALCH AVE | 2658-25 | 2658-24 | 6 | Vitrified Clay Pipe | 428 | 20 | B |
| 718 | 3561 E BALCH AVE | 2658-26 | 2658-70 | 6 | Vitrified Clay Pipe | 428 | 22 | B |
| 719 | 3561 E BALCH AVE | 2658-26 | 2658-70 | 6 | Vitrified Clay Pipe | 428 | 22 | BSV |
| 720 | 3561 E BALCH AVE | 2658-26 | 2658-70 | 6 | Vitrified Clay Pipe | 428 | 22 | H |
| 721 | 528 S FIFTH ST | 2658-27 | 2658-29 | 6 | Vitrified Clay Pipe | 428 | 8 | H |
| 722 | 3302 BALCH AVE | 2658-30 | 2658-31 | 6 | Vitrified Clay Pipe | 368 | 28 | B |
| 723 | 3302 BALCH AVE | 2658-30 | 2658-31 | 6 | Vitrified Clay Pipe | 368 | 28 | BVV |
| 724 | 532 S SECOND ST | 2658-32 | 2658-73 | 6 | Vitrified Clay Pipe | 474 | 14 | B |
| 725 | 623 S FOURTH ST | 2658-40 | 2658-41 | 6 | Vitrified Clay Pipe | 530 | 24 | B |
| 726 | 623 S FOURTH ST | 2658-40 | 2658-41 | 6 | Vitrified Clay Pipe | 530 | 24 | B |
| 727 | 3360 E MONO ST | 2658-41 | 2658-42 | 6 | Vitrified Clay Pipe | 363 | 46 | BVV |
| 728 | 3360 E MONO ST | 2658-41 | 2658-42 | 6 | Vitrified Clay Pipe | 363 | 46 | BVV |
| 729 | 3130 E HUNTINGTON BLVD | 2658-51 | 2657-34 | 6 | Vitrified Clay Pipe | 420 | 43 | B |
| 730 | 3130 E HUNTINGTON BLVD | 2658-51 | 2657-34 | 6 | Vitrified Clay Pipe | 420 | 43 | B |
| 731 | 3653 E BALCH AVE | 2658-70 | 2659-22 | 6 | Vitrified Clay Pipe | 479 | 5 | B |
| 732 | 543 S FIRST ST | 2658-73 | 2657-36 | 6 | Vitrified Clay Pipe | 489 | 41 | D |
| 733 | 3911 E PLATT AVE | 2659-06 | 2659-05 | 6 | Vitrified Clay Pipe | 459 | 5 | HSV |
| 734 | 3669 E KERCKHOFF AVE | 2659-09 | 2658-16 | 6 | Vitrified Clay Pipe | 428 | 13 | B |
| 735 | 3669 E KERCKHOFF AVE | 2659-09 | 2658-16 | 6 | Vitrified Clay Pipe | 428 | 13 | BSV |
| 736 | 3655 E HUNTINGTON BLVD | 2659-15 | 2658-21 | 10 | Vitrified Clay Pipe | 479 | 25 | B |
| 737 | 3655 E HUNTINGTON BLVD | 2659-15 | 2658-21 | 10 | Vitrified Clay Pipe | 479 | 25 | B |
| 738 | 3655 E HUNTINGTON BLVD | 2659-15 | 2658-21 | 10 | Vitrified Clay Pipe | 479 | 25 | H |
| 739 | 3753 E BALCH AVE | 2659-23 | 2659-22 | 6 | Vitrified Clay Pipe | 430 | 5 | B |
| 740 | 4055 E BALCH AVE | 2659-26 | 2659-25 | 6 | Vitrified Clay Pipe | 459 | 54 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 741 | 4055 E BALCH AVE | 2659-26 | 2659-25 | 6 | Vitrified Clay Pipe | 459 | 54 | BSV |
| 742 | 4167 BALCH AVE | 2659-27 | 2659-26 | 6 | Vitrified Clay Pipe | 479 | 41 | B |
| 743 | 4167 BALCH AVE | 2659-27 | 2659-26 | 6 | Vitrified Clay Pipe | 479 | 41 | B |
| 744 | 4167 BALCH AVE | 2659-27 | 2659-26 | 6 | Vitrified Clay Pipe | 479 | 41 | BSV |
| 745 | 3659 E MONO ST | 2659-33 | 2658-28 | 8 | Vitrified Clay Pipe | 480 | 28 | B |
| 746 | 522 EIGHTH ST | 2659-34 | 2659-33 | 8 | Vitrified Clay Pipe | 480 | 27 | H |
| 747 | 521 EIGHTH ST | 2659-35 | 2659-34 | 8 | Vitrified Clay Pipe | 480 | 21 | H |
| 748 | 3751 E VENTURA ST | 2659-43 | 2659-45 | 8 | Vitrified Clay Pipe | 480 | 35 | B |
| 749 | 3751 E VENTURA ST | 2659-43 | 2659-45 | 8 | Vitrified Clay Pipe | 480 | 35 | BVV |
| 750 | 3751 E VENTURA ST | 2659-43 | 2659-45 | 8 | Vitrified Clay Pipe | 480 | 35 | BVV |
| 751 | 3751 E VENTURA ST | 2659-43 | 2659-45 | 8 | Vitrified Clay Pipe | 480 | 35 | BVV |
| 752 | 3660  E KERCKHOFF AVE | 2659-83 | 2659-15 | 8 | Vitrified Clay Pipe | 210 | 8 | H |
| 753 | 205 S BARTON AVE | 2660-01 | 2560-58 | 6 | Vitrified Clay Pipe | 485 | 29 | B |
| 754 | 205 S BARTON AVE | 2660-01 | 2560-58 | 6 | Vitrified Clay Pipe | 485 | 29 | BVV |
| 755 | 4608 E MONO ST | 2661-28 | 2660-24 | 6 | Vitrified Clay Pipe | 279 | 5 | B |
| 756 | 47 E AMADOR ST | 2753-11 | 2753-12 | 6 | Vitrified Clay Pipe | 380 | 55 | BSV |
| 757 | 47 E AMADOR ST | 2753-11 | 2753-12 | 6 | Vitrified Clay Pipe | 380 | 55 | BSV |
| 758 | 217 E AMADOR ST | 2753-14 | 2753-15 | 6 | Vitrified Clay Pipe | 380 | 28 | BVV |
| 759 | 823 S MODOC ST | 2753-16 | 2753-55 | 6 | Vitrified Clay Pipe | 430 | 5 | B |
| 760 | 129 E SAN JOAQUIN ST | 2753-21 | 2753-20 | 6 | Vitrified Clay Pipe | 380 | 73 | B |
| 761 | 129 E SAN JOAQUIN ST | 2753-21 | 2753-20 | 6 | Vitrified Clay Pipe | 380 | 73 | BSV |
| 762 | 129 E SAN JOAQUIN ST | 2753-21 | 2753-20 | 6 | Vitrified Clay Pipe | 380 | 73 | BSV |
| 763 | 129 E SAN JOAQUIN ST | 2753-21 | 2753-20 | 6 | Vitrified Clay Pipe | 380 | 73 | BVV |
| 764 | 223 E SAN JOAQUIN ST | 2753-22 | 2753-23 | 6 | Vitrified Clay Pipe | 375 | 56 | B |
| 765 | 53 E STANISLAUS ST | 2753-27 | 2753-28 | 6 | Vitrified Clay Pipe | 380 | 21 | FH3 |
| 766 | 219 E STANISLAUS ST | 2753-30 | 2753-32 | 6 | Vitrified Clay Pipe | 368 | 14 | BSV |
| 767 | 219 E STANISLAUS ST | 2753-30 | 2753-32 | 6 | Vitrified Clay Pipe | 368 | 14 | BVV |
| 768 | 51 E TUOLUMNE ST | 2753-38 | 2753-37 | 6 | Vitrified Clay Pipe | 380 | 74 | B |
| 769 | 51 E TUOLUMNE ST | 2753-38 | 2753-37 | 6 | Vitrified Clay Pipe | 380 | 74 | B |
| 770 | 51 E TUOLUMNE ST | 2753-38 | 2753-37 | 6 | Vitrified Clay Pipe | 380 | 74 | BSV |
| 771 | 51 E TUOLUMNE ST | 2753-38 | 2753-37 | 6 | Vitrified Clay Pipe | 380 | 74 | BSV |
| 772 | 51 E TUOLUMNE ST | 2753-38 | 2753-37 | 6 | Vitrified Clay Pipe | 380 | 74 | BSV |
| 773 | 101 E OLEANDER AVE | 2753-41 | 2753-40 | 6 | Vitrified Clay Pipe | 380 | 47 | BSV |
| 774 | 231 E OLEANDER AVE | 2753-42 | 2753-41 | 6 | Vitrified Clay Pipe | 430 | 49 | BSV |
| 775 | 231 E OLEANDER AVE | 2753-42 | 2753-41 | 6 | Vitrified Clay Pipe | 430 | 49 | BSV |
| 776 | 1244 S TRINITY ST | 2753-43 | 2753-44 | 16 | Vitrified Clay Pipe | 379 | 11 | HSV |
| 777 | 304 E KEARNEY BLVD | 2753-44 | 2853-78 | 16 | Vitrified Clay Pipe | 443 | 5 | B |

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 778 | 1622 C ST | 2754-02 | 2754-09 | 6 | Vitrified Clay Pipe | 484 | 56 | B |
| 779 | 1622 C ST | 2754-02 | 2754-09 | 6 | Vitrified Clay Pipe | 484 | 56 | BSV |
| 780 | 1622 C ST | 2754-02 | 2754-09 | 6 | Vitrified Clay Pipe | 484 | 56 | BVV |
| 781 | 1107 CALAVERAS ST | 2754-04 | 2754-08 | 6 | Vitrified Clay Pipe | 484 | 22 | FH4 |
| 782 | 1211 STANISLAUS ST | 2754-10 | 2754-09 | 6 | Vitrified Clay Pipe | 428 | 46 | B |
| 783 | 1211 STANISLAUS ST | 2754-10 | 2754-09 | 6 | Vitrified Clay Pipe | 428 | 46 | BSV |
| 784 | 1211 STANISLAUS ST | 2754-10 | 2754-09 | 6 | Vitrified Clay Pipe | 428 | 46 | BVV |
| 785 | 1444 STANISLAUS ST | 2754-26 | 2754-20 | 10 | Vitrified Clay Pipe | 434 | 11 | BVV |
| 786 | 1018 TUOLUMNE ST | 2754-49 | 2754-50 | 6 | Vitrified Clay Pipe | 423 | 31 | B |
| 787 | 1018 TUOLUMNE ST | 2754-49 | 2754-50 | 6 | Vitrified Clay Pipe | 423 | 31 | B |
| 788 | 1215 S SNOW AVE | 2754-52 | 2754-55 | 6 | Vitrified Clay Pipe | 375 | 36 | B |
| 789 | 1215 S SNOW AVE | 2754-52 | 2754-55 | 6 | Vitrified Clay Pipe | 375 | 36 | B |
| 790 | 1215 S SNOW AVE | 2754-52 | 2754-55 | 6 | Vitrified Clay Pipe | 375 | 36 | B |
| 791 | 1215 S SNOW AVE | 2754-52 | 2754-55 | 6 | Vitrified Clay Pipe | 375 | 36 | BSV |
| 792 | 457 E KEARNEY BLVD | 2754-53 | 2754-54 | 6 | Vitrified Clay Pipe | 380 | 11 | B |
| 793 | 505 E KEARNEY BLVD | 2754-54 | 2754-55 | 6 | Vitrified Clay Pipe | 425 | 14 | B |
| 794 | 1116 B ST | 2754-65 | 2754-64 | 6 | Vitrified Clay Pipe | 440 | 17 | BVV |
| 795 | 552 E TUOLUMNE ST | 2754-72 | 2754-71 | 12 | Vitrified Clay Pipe | 724 | 5 | H |
| 796 | 543 E OLEANDER AVE | 2754-75 | 2754-52 | 6 | Vitrified Clay Pipe | 380 | 29 | B |
| 797 | 543 E OLEANDER AVE | 2754-75 | 2754-52 | 6 | Vitrified Clay Pipe | 380 | 29 | BSV |
| 798 | 543 E OLEANDER AVE | 2754-75 | 2754-52 | 6 | Vitrified Clay Pipe | 380 | 29 | BVV |
| 799 | 1344 TULARE ST | 2755-09 | 2755-11 | 6 | Vitrified Clay Pipe | 528 | 16 | B |
| 800 | 1344 TULARE ST | 2755-09 | 2755-11 | 6 | Vitrified Clay Pipe | 528 | 16 | BVV |
| 801 | 1023 E ST | 2755-12 | 2755-11 | 6 | Vitrified Clay Pipe | 454 | 33 | B |
| 802 | 1023 E ST | 2755-12 | 2755-11 | 6 | Vitrified Clay Pipe | 454 | 33 | B |
| 803 | 1023 E ST | 2755-12 | 2755-11 | 6 | Vitrified Clay Pipe | 454 | 33 | HSV |
| 804 | 1417 KERN ST | 2755-20 | 2755-21 | 12 | Vitrified Clay Pipe | 480 | 8 | H |
| 805 | 1420 FRESNO ST | 2755-23 | 2755-24 | 6 | Vitrified Clay Pipe | 388 | 16 | B |
| 806 | 1420 FRESNO ST | 2755-23 | 2755-24 | 6 | Vitrified Clay Pipe | 388 | 16 | BSV |
| 807 | 1441 FRESNO ST | 2755-25 | 2755-02 | 6 | Vitrified Clay Pipe | 496 | 5 | HVV |
| 808 | 1445 FRESNO ST | 2755-30 | 2755-27 | 18 | Vitrified Clay Pipe | 200 | 10 | SMWZ |
| 809 | 1445 FRESNO ST | 2755-30 | 2755-27 | 18 | Vitrified Clay Pipe | 200 | 10 | SMWZ |
| 810 | 1136 F ST | 2755-33 | 2755-32 | 8 | Vitrified Clay Pipe | 477 | 23 | B |
| 811 | 1136 F ST | 2755-33 | 2755-32 | 8 | Vitrified Clay Pipe | 477 | 23 | B |
| 812 | 1136 F ST | 2755-33 | 2755-32 | 8 | Vitrified Clay Pipe | 477 | 23 | B |
| 813 | 1136 F ST | 2755-33 | 2755-32 | 8 | Vitrified Clay Pipe | 477 | 23 | BVV |
| 814 | 1136 F ST | 2755-33 | 2755-32 | 8 | Vitrified Clay Pipe | 477 | 12 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 815 | 1136 F ST | 2755-33 | 2755-32 | 8 | Vitrified Clay Pipe | 477 | 12 | D |
| 816 | 921 CHINA ALLEY | 2755-38 | 2755-36 | 8 | Vitrified Clay Pipe | 430 | 9 | BVV |
| 817 | 1257 G ST | 2755-47 | 2755-30 | 18 | Vitrified Clay Pipe | 190 | 15 | SMWZ |
| 818 | 1257 G ST | 2755-47 | 2755-30 | 18 | Vitrified Clay Pipe | 190 | 15 | SMWZ |
| 819 | 1257 G ST | 2755-47 | 2755-30 | 18 | Vitrified Clay Pipe | 190 | 15 | SMWZ |
| 820 | 1266 G ST | 2755-68 | 2755-47 | 18 | Vitrified Clay Pipe | 690 | 21 | SMW |
| 821 | 1266 G ST | 2755-68 | 2755-47 | 18 | Vitrified Clay Pipe | 690 | 21 | SMW |
| 822 | 1266 G ST | 2755-68 | 2755-47 | 18 | Vitrified Clay Pipe | 690 | 21 | SMW |
| 823 | 1920 TULARE ST | 2755-73 | 2756-05 | 10 | Vitrified Clay Pipe | 425 | 5 | H |
| 824 | 1821 FRESNO ST | 2755-79 | 2755-80 | 6 | Vitrified Clay Pipe | 241 | 5 | B |
| 825 | 1821 FRESNO ST | 2755-80 | 2755-67 | 8 | Vitrified Clay Pipe | 10 | 5 | BSV |
| 826 | 1901 MARIPOSA ST | 2755-81 | 2755-59 | 6 | Vitrified Clay Pipe | 430 | 34 | B |
| 827 | 1901 MARIPOSA ST | 2755-81 | 2755-59 | 6 | Vitrified Clay Pipe | 430 | 34 | BSV |
| 828 | 1901 MARIPOSA ST | 2755-81 | 2755-59 | 6 | Vitrified Clay Pipe | 430 | 34 | BVV |
| 829 | 1901 MARIPOSA ST | 2755-81 | 2755-59 | 6 | Vitrified Clay Pipe | 430 | 34 | BVV |
| 830 | 1010 FULTON MALL | 2756-01 | 2755-74 | 10 | Vitrified Clay Pipe | 414 | 16 | B |
| 831 | 740 H ST | 2756-08 | 2756-13 | 6 | Vitrified Clay Pipe | 439 | 23 | BSV |
| 832 | 740 H ST | 2756-08 | 2756-13 | 6 | Vitrified Clay Pipe | 439 | 23 | H |
| 833 | 740 H ST | 2756-08 | 2756-13 | 6 | Vitrified Clay Pipe | 439 | 23 | H |
| 834 | 648 N BROADWAY | 2756-12 | 2756-13 | 12 | Polyvinyl Chloride | 400 | 15 | H |
| 835 | 735 H ST | 2756-14 | 2756-84 | 10 | Vitrified Clay Pipe | 371 | 9 | BSV |
| 836 | 635 BROADWAY | 2756-15 | 2756-13 | 6 | Vitrified Clay Pipe | 432 | 8 | B |
| 837 | 626 N BROADWAY | 2756-16 | 2756-12 | 6 | Vitrified Clay Pipe | 429 | 5 | BSV |
| 838 | 458 FULTON ST | 2756-19 | 2756-20 | 6 | Vitrified Clay Pipe | 277 | 8 | BVV |
| 839 | 2033 VENTURA ST | 2756-22 | 2756-11 | 8 | Vitrified Clay Pipe | 429 | 10 | H |
| 840 | 2033 VENTURA ST | 2756-22 | 2756-11 | 8 | Vitrified Clay Pipe | 429 | 10 | H |
| 841 | 2126 VENTURA ST | 2756-27 | 2756-26 | 6 | Vitrified Clay Pipe | 399 | 5 | H |
| 842 | 2126 VENTURA ST | 2756-27 | 2756-26 | 6 | Vitrified Clay Pipe | 399 | 8 | H |
| 843 | 2126 INYO ST | 2756-29 | 2756-28 | 6 | Vitrified Clay Pipe | 427 | 39 | B |
| 844 | 2126 INYO ST | 2756-29 | 2756-28 | 6 | Vitrified Clay Pipe | 427 | 39 | H |
| 845 | 2126 INYO ST | 2756-29 | 2756-28 | 6 | Vitrified Clay Pipe | 427 | 39 | H |
| 846 | 2126 INYO ST | 2756-29 | 2756-28 | 6 | Vitrified Clay Pipe | 427 | 39 | H |
| 847 | 2126 INYO ST | 2756-29 | 2756-28 | 6 | Vitrified Clay Pipe | 427 | 39 | H |
| 848 | 2134 KERN ST | 2756-30 | 2756-98 | 6 | Vitrified Clay Pipe | 50 | 19 | B |
| 849 | 2134 KERN ST | 2756-30 | 2756-98 | 6 | Vitrified Clay Pipe | 50 | 19 | B |
| 850 | 2228 SANTA CLARA ST | 2756-38 | 2756-39 | 6 | Vitrified Clay Pipe | 110 | 5 | B |
| 851 | 2130 VENTURA ST | 2756-41 | 2756-73 | 16 | Vitrified Clay Pipe | 382 | 5 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 852 | 654 VAN NESS AVE | 2756-48 | 2756-28 | 6 | Vitrified Clay Pipe | 430 | 23 | BSV |
| 853 | 654 VAN NESS AVE | 2756-48 | 2756-28 | 6 | Vitrified Clay Pipe | 430 | 23 | H |
| 854 | 2027 KERN ST | 2756-71 | 2756-03 | 8 | Vitrified Clay Pipe | 110 | 32 | B |
| 855 | 2027 KERN ST | 2756-71 | 2756-02 | 8 | Vitrified Clay Pipe | 110 | 8 | B |
| 856 | 2134 KERN ST | 2756-98 | 2756-31 | 6 | Vitrified Clay Pipe | 371 | 5 | BSV |
| 857 | 900 SANTA FE AVE | 2757-01 | 2757-02 | 8 | Vitrified Clay Pipe | 20 | 11 | BSV |
| 858 | 900 SANTA FE AVE | 2757-02 | 2757-97 | 8 | Vitrified Clay Pipe | 201 | 34 | B |
| 859 | 900 SANTA FE AVE | 2757-02 | 2757-97 | 8 | Vitrified Clay Pipe | 201 | 34 | B |
| 860 | 900 SANTA FE AVE | 2757-02 | 2757-97 | 8 | Vitrified Clay Pipe | 201 | 34 | BVV |
| 861 | 900 SANTA FE AVE | 2757-02 | 2757-97 | 8 | Vitrified Clay Pipe | 201 | 34 | BVV |
| 862 | 900 SANTA FE AVE | 2757-02 | 2757-97 | 8 | Vitrified Clay Pipe | 201 | 34 | H |
| 863 | 825 S TOPEKA AVE | 2757-04 | 2757-10 | 8 | Vitrified Clay Pipe | 375 | 26 | BSV |
| 864 | 825 S TOPEKA AVE | 2757-04 | 2757-10 | 8 | Vitrified Clay Pipe | 375 | 26 | H |
| 865 | 305 O ST | 2757-21 | 2757-31 | 8 | Vitrified Clay Pipe | 311 | 10 | H |
| 866 | 305 O ST | 2757-21 | 2757-31 | 8 | Vitrified Clay Pipe | 311 | 10 | H |
| 867 | 235 SANTE FE AVE | 2757-44 | 2757-45 | 10 | Vitrified Clay Pipe | 266 | 10 | B |
| 868 | 235 SANTE FE AVE | 2757-44 | 2757-45 | 10 | Vitrified Clay Pipe | 266 | 10 | BVV |
| 869 | 3095 E BUTLER | 2757-47 | 2757-48 | 10 | Vitrified Clay Pipe | 350 | 19 | BVV |
| 870 | 3095 E BUTLER | 2757-47 | 2757-48 | 10 | Vitrified Clay Pipe | 350 | 19 | BVV |
| 871 | 3095 E BUTLER | 2757-47 | 2757-48 | 10 | Vitrified Clay Pipe | 350 | 19 | BVV |
| 872 | 3259 E BUTLER AVE | 2757-52 | 2758-11 | 6 | Vitrified Clay Pipe | 431 | 36 | B |
| 873 | 3259 E BUTLER AVE | 2757-52 | 2758-11 | 6 | Vitrified Clay Pipe | 431 | 36 | B |
| 874 | 3259 E BUTLER AVE | 2757-52 | 2758-11 | 6 | Vitrified Clay Pipe | 431 | 36 | BVV |
| 875 | 3203 E BUTLER AVE | 2757-54 | 2757-52 | 6 | Vitrified Clay Pipe | 305 | 40 | B |
| 876 | 3203 E BUTLER AVE | 2757-54 | 2757-52 | 6 | Vitrified Clay Pipe | 305 | 40 | BVV |
| 877 | 1236 S PARALLEL AVE | 2757-55 | 2757-51 | 12 | Concrete Pipe | 341 | 8 | BSV |
| 878 | 3114 E VENTURA ST | 2757-70 | 2757-71 | 6 | Vitrified Clay Pipe | 492 | 37 | H |
| 879 | 724 S ORANGE AVE | 2757-71 | 2757-72 | 6 | Vitrified Clay Pipe | 355 | 61 | B |
| 880 | 2970 E VENTURA ST | 2757-73 | 2757-63 | 10 | Vitrified Clay Pipe | 242 | 17 | B |
| 881 | 778 S HAZELWOOD BLVD | 2757-75 | 2757-74 | 8 | Vitrified Clay Pipe | 158 | 8 | H |
| 882 | 3135 E MONTECITO AVE | 2757-78 | 2757-77 | 6 | Vitrified Clay Pipe | 492 | 15 | BVV |
| 883 | 925 S FIRST ST | 2757-80 | 2757-79 | 6 | Vitrified Clay Pipe | 430 | 11 | B |
| 884 | 935 TOPEKA AVE | 2757-92 | 2757-90 | 8 | Vitrified Clay Pipe | 326 | 24 | B |
| 885 | 728 S HAZELWOOD BLVD | 2757-95 | 2757-103 | 6 | Vitrified Clay Pipe | 326 | 50 | B |
| 886 | 728 S HAZELWOOD BLVD | 2757-95 | 2757-103 | 6 | Vitrified Clay Pipe | 326 | 50 | B |
| 887 | 728 S HAZELWOOD BLVD | 2757-95 | 2757-103 | 6 | Vitrified Clay Pipe | 326 | 50 | H |
| 888 | 728 S HAZELWOOD BLVD | 2757-95 | 2757-103 | 6 | Vitrified Clay Pipe | 326 | 50 | H |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 889 | 728 S HAZELWOOD BLVD | 2757-95 | 2757-103 | 6 | Vitrified Clay Pipe | 326 | 50 | HSV |
| 890 | 728 S HAZELWOOD BLVD | 2757-95 | 2757-103 | 6 | Vitrified Clay Pipe | 326 | 50 | HVV |
| 891 | 728 S HAZELWOOD BLVD | 2757-95 | 2757-103 | 6 | Vitrified Clay Pipe | 326 | 50 | HVV |
| 892 | 728 S HAZELWOOD BLVD | 2757-95 | 2757-103 | 6 | Vitrified Clay Pipe | 326 | 50 | SMWZ |
| 893 | 1259 S HAZELWOOD BLVD | 2758-09 | 2758-10 | 6 | Vitrified Clay Pipe | 105 | 5 | BVV |
| 894 | 1309 S THIRD ST | 2758-14 | 2758-11 | 6 | Vitrified Clay Pipe | 486 | 18 | B |
| 895 | 1034 S FOURTH ST | 2758-17 | 2758-06 | 6 | Vitrified Clay Pipe | 485 | 30 | B |
| 896 | 1034 S FOURTH ST | 2758-17 | 2758-06 | 6 | Vitrified Clay Pipe | 485 | 30 | B |
| 897 | 1034 S FOURTH ST | 2758-17 | 2758-06 | 6 | Vitrified Clay Pipe | 485 | 30 | B |
| 898 | 1034 S FOURTH ST | 2758-17 | 2758-06 | 6 | Vitrified Clay Pipe | 485 | 30 | BVV |
| 899 | 833 S FOURTH ST | 2758-23 | 2758-31 | 6 | Vitrified Clay Pipe | 297 | 22 | B |
| 900 | 833 S FOURTH ST | 2758-23 | 2758-31 | 6 | Vitrified Clay Pipe | 297 | 22 | B |
| 901 | 833 S FOURTH ST | 2758-23 | 2758-31 | 6 | Vitrified Clay Pipe | 297 | 22 | BSV |
| 902 | 833 S FOURTH ST | 2758-23 | 2758-31 | 6 | Vitrified Clay Pipe | 297 | 22 | D |
| 903 | 3445 E EL MONTE WAY | 2758-29 | 2758-31 | 6 | Vitrified Clay Pipe | 373 | 5 | B |
| 904 | 3438 E MONTECITO AVE | 2758-33 | 2758-32 | 6 | Vitrified Clay Pipe | 187 | 10 | B |
| 905 | 3438 E MONTECITO AVE | 2758-33 | 2758-32 | 6 | Vitrified Clay Pipe | 187 | 10 | B |
| 906 | 3445 E ALTA AVE | 2758-34 | 2758-33 | 6 | Vitrified Clay Pipe | 100 | 5 | BSV |
| 907 | 3522 E EL MONTE WAY | 2758-41 | 2758-40 | 6 | Vitrified Clay Pipe | 242 | 28 | BVV |
| 908 | 1134 S FIFTH ST | 2758-51 | 2758-16 | 6 | Vitrified Clay Pipe | 519 | 9 | H |
| 909 | 3588 E ALTA AVE | 2758-53 | 2758-47 | 6 | Vitrified Clay Pipe | 522 | 33 | B |
| 910 | 3588 E ALTA AVE | 2758-53 | 2758-47 | 6 | Vitrified Clay Pipe | 522 | 33 | B |
| 911 | 3585 E LYELL AVE | 2758-55 | 2758-56 | 6 | Vitrified Clay Pipe | 606 | 43 | H |
| 912 | 3585 E LYELL AVE | 2758-55 | 2758-56 | 6 | Vitrified Clay Pipe | 606 | 43 | H |
| 913 | 1354 S ORANGE AVE | 2758-60 | 2758-62 | 6 | Vitrified Clay Pipe | 604 | 20 | B |
| 914 | 3701 E ALTA AVE | 2759-02 | 2759-03 | 6 | Vitrified Clay Pipe | 531 | 34 | B |
| 915 | 3701 E ALTA AVE | 2759-02 | 2759-03 | 6 | Vitrified Clay Pipe | 531 | 34 | B |
| 916 | 3701 E ALTA AVE | 2759-02 | 2759-03 | 6 | Vitrified Clay Pipe | 531 | 34 | H |
| 917 | 3750 E EL MONTE WAY | 2759-10 | 2759-12 | 6 | Vitrified Clay Pipe | 531 | 97 | B |
| 918 | 3750 E EL MONTE WAY | 2759-10 | 2759-12 | 6 | Vitrified Clay Pipe | 531 | 97 | B |
| 919 | 3750 E EL MONTE WAY | 2759-10 | 2759-12 | 6 | Vitrified Clay Pipe | 531 | 97 | B |
| 920 | 3750 E EL MONTE WAY | 2759-10 | 2759-12 | 6 | Vitrified Clay Pipe | 531 | 97 | B |
| 921 | 3750 E EL MONTE WAY | 2759-10 | 2759-12 | 6 | Vitrified Clay Pipe | 531 | 97 | BSV |
| 922 | 3750 E EL MONTE WAY | 2759-10 | 2759-12 | 6 | Vitrified Clay Pipe | 531 | 97 | BVV |
| 923 | 3733 E ALTA AVE | 2759-11 | 2759-03 | 6 | Vitrified Clay Pipe | 380 | 21 | BSV |
| 924 | 1104 S EIGHTH ST | 2759-15 | 2759-16 | 6 | Vitrified Clay Pipe | 377 | 18 | B |
| 925 | 1104 S EIGHTH ST | 2759-15 | 2759-16 | 6 | Vitrified Clay Pipe | 377 | 18 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 926 | 1104 S EIGHTH ST | 2759-15 | 2759-16 | 6 | Vitrified Clay Pipe | 377 | 18 | BVV |
| 927 | 1133 S ORANGE AVE | 2759-16 | 2758-53 | 6 | Vitrified Clay Pipe | 378 | 21 | D |
| 928 | 1040 S CHANCE AVE | 2760-13 | 2760-14 | 12 | Vitrified Clay Pipe | 244 | 5 | XP |
| 929 | 1034 S PEACH AVE | 2763-14 | 2763-20 | 8 | Vitrified Clay Pipe | 679 | 36 | BSV |
| 930 | 1034 S PEACH AVE | 2763-14 | 2763-20 | 8 | Vitrified Clay Pipe | 679 | 36 | BVV |
| 931 | 154 E EDEN AVE | 2853-33 | 2853-35 | 30 | Concrete Pipe | 24 | 5 | B |
| 932 | 661 E CALIFORNIA AVE | 2854-02 | 2854-18 | 6 | Vitrified Clay Pipe | 388 | 18 | B |
| 933 | 661 E CALIFORNIA AVE | 2854-02 | 2854-18 | 6 | Vitrified Clay Pipe | 388 | 18 | B |
| 934 | 941 KLETTE AVE | 2854-07 | 2854-08 | 6 | Vitrified Clay Pipe | 425 | 17 | B |
| 935 | 941 KLETTE AVE | 2854-07 | 2854-08 | 6 | Vitrified Clay Pipe | 425 | 17 | BVV |
| 936 | 527 FRESNO ST | 2854-13 | 2854-14 | 6 | Vitrified Clay Pipe | 202 | 17 | B |
| 937 | 527 FRESNO ST | 2854-13 | 2854-14 | 6 | Vitrified Clay Pipe | 202 | 17 | BVV |
| 938 | 1138 KLETTE AVE | 2854-16 | 2854-15 | 6 | Vitrified Clay Pipe | 350 | 30 | BSV |
| 939 | 1052 KLETTE AVE | 2854-17 | 2854-16 | 6 | Vitrified Clay Pipe | 600 | 36 | B |
| 940 | 1052 KLETTE AVE | 2854-17 | 2854-16 | 6 | Vitrified Clay Pipe | 600 | 36 | B |
| 941 | 928 KLETTE AVE | 2854-18 | 2854-17 | 6 | Vitrified Clay Pipe | 354 | 13 | B |
| 942 | 617 KERN ST | 2854-19 | 2854-20 | 6 | Vitrified Clay Pipe | 609 | 8 | BSV |
| 943 | 1060 WATERMAN AVE | 2854-20 | 2854-21 | 6 | Vitrified Clay Pipe | 578 | 60 | B |
| 944 | 1060 WATERMAN AVE | 2854-20 | 2854-21 | 6 | Vitrified Clay Pipe | 578 | 60 | B |
| 945 | 1060 WATERMAN AVE | 2854-20 | 2854-21 | 6 | Vitrified Clay Pipe | 578 | 60 | B |
| 946 | 1060 WATERMAN AVE | 2854-20 | 2854-21 | 6 | Vitrified Clay Pipe | 578 | 60 | B |
| 947 | 1060 WATERMAN AVE | 2854-20 | 2854-21 | 6 | Vitrified Clay Pipe | 578 | 60 | B |
| 948 | 1060 WATERMAN AVE | 2854-20 | 2854-21 | 6 | Vitrified Clay Pipe | 578 | 60 | B |
| 949 | 1140 WATERMAN AVE | 2854-21 | 2854-22 | 6 | Vitrified Clay Pipe | 350 | 42 | BSV |
| 950 | 1140 WATERMAN AVE | 2854-22 | 2854-23 | 6 | Vitrified Clay Pipe | 188 | 20 | B |
| 951 | 1240 WATERMAN AVE | 2854-25 | 2854-24 | 6 | Vitrified Clay Pipe | 250 | 20 | B |
| 952 | 1240 WATERMAN AVE | 2854-25 | 2854-24 | 6 | Vitrified Clay Pipe | 250 | 20 | H |
| 953 | 1234 POTTLE AVE | 2854-30 | 2854-29 | 6 | Vitrified Clay Pipe | 295 | 17 | B |
| 954 | 1234 POTTLE AVE | 2854-30 | 2854-29 | 6 | Vitrified Clay Pipe | 295 | 17 | H |
| 955 | 800 POTTLE AVE | 2854-36 | 2854-35 | 6 | Vitrified Clay Pipe | 480 | 5 | BVV |
| 956 | 1053 MAYOR AVE | 2854-40 | 2854-41 | 6 | Vitrified Clay Pipe | 535 | 21 | BVV |
| 957 | 1138 COLLINS AVE | 2854-41 | 2854-42 | 6 | Vitrified Clay Pipe | 428 | 16 | B |
| 958 | 1210 COLLINS AVE | 2854-43 | 2854-42 | 6 | Vitrified Clay Pipe | 347 | 11 | B |
| 959 | 917 A ST | 2854-48 | 2854-47 | 10 | Vitrified Clay Pipe | 480 | 5 | B |
| 960 | 1032 TULARE ST | 2854-54 | 2854-49 | 6 | Vitrified Clay Pipe | 435 | 23 | B |
| 961 | 1032 TULARE ST | 2854-54 | 2854-49 | 6 | Vitrified Clay Pipe | 435 | 23 | B |
| 962 | 1032 TULARE ST | 2854-54 | 2854-49 | 6 | Vitrified Clay Pipe | 435 | 23 | B |

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 963 | 1032 TULARE ST | 2854-54 | 2854-49 | 6 | Vitrified Clay Pipe | 435 | 23 | BVV |
| 964 | 1136 A ST | 2854-55 | 2754-67 | 6 | Vitrified Clay Pipe | 440 | 5 | B |
| 965 | 371 B ST | 2855-02 | 2955-52 | 8 | Vitrified Clay Pipe | 402 | 9 | BVV |
| 966 | 320 B ST | 2855-03 | 2955-52 | 8 | Vitrified Clay Pipe | 392 | 5 | BSV |
| 967 | 2103 S TUPMAN ST | 2855-07 | 2855-86 | 10 | Vitrified Clay Pipe | 166 | 5 | B |
| 968 | 664 MAYOR AVE | 2855-36 | 2855-30 | 8 | Vitrified Clay Pipe | 429 | 37 | H |
| 969 | 915 INYO ST | 2855-39 | 2854-48 | 6 | Vitrified Clay Pipe | 430 | 35 | B |
| 970 | 915 INYO ST | 2855-39 | 2854-48 | 6 | Vitrified Clay Pipe | 430 | 35 | BVV |
| 971 | 764 A ST | 2855-40 | 2855-41 | 6 | Vitrified Clay Pipe | 483 | 9 | B |
| 972 | 554 B ST | 2855-42 | 2855-28 | 6 | Vitrified Clay Pipe | 431 | 17 | B |
| 973 | 1124 KERN ST | 2855-45 | 2855-90 | 6 | Vitrified Clay Pipe | 433 | 62 | B |
| 974 | 1124 KERN ST | 2855-45 | 2855-90 | 6 | Vitrified Clay Pipe | 433 | 62 | B |
| 975 | 1124 KERN ST | 2855-45 | 2855-90 | 6 | Vitrified Clay Pipe | 433 | 62 | BVV |
| 976 | 1124 KERN ST | 2855-45 | 2855-90 | 6 | Vitrified Clay Pipe | 433 | 62 | BVV |
| 977 | 1124 KERN ST | 2855-45 | 2855-90 | 6 | Vitrified Clay Pipe | 433 | 62 | BVV |
| 978 | 912 B ST | 2855-45 | 2855-90 | 6 | Vitrified Clay Pipe | 480 | 15 | B |
| 979 | 811 B ST | 2855-46 | 2855-47 | 6 | Vitrified Clay Pipe | 434 | 12 | B |
| 980 | 920 A ST | 2855-47 | 2854-49 | 6 | Vitrified Clay Pipe | 479 | 18 | BSV |
| 981 | 1257 KERN ST | 2855-50 | 2755-08 | 6 | Vitrified Clay Pipe | 420 | 9 | B |
| 982 | 1224 KERN ST | 2855-51 | 2855-50 | 6 | Vitrified Clay Pipe | 487 | 5 | B |
| 983 | 1320 KERN ST | 2855-56 | 2755-09 | 6 | Vitrified Clay Pipe | 380 | 8 | B |
| 984 | 761 E ST | 2855-57 | 2855-58 | 6 | Vitrified Clay Pipe | 375 | 11 | B |
| 985 | 506 E ST | 2855-64 | 2855-63 | 8 | Vitrified Clay Pipe | 538 | 5 | B |
| 986 | 1424 KERN ST | 2855-67 | 2755-19 | 6 | Vitrified Clay Pipe | 423 | 19 | B |
| 987 | 1424 KERN ST | 2855-67 | 2755-19 | 6 | Vitrified Clay Pipe | 423 | 19 | BSV |
| 988 | 750 MONO ST | 2855-82 | 2855-33 | 6 | Vitrified Clay Pipe | 450 | 5 | B |
| 989 | 1424 KERN ST | 2855-84 | 2855-85 | 10 | Vitrified Clay Pipe | 430 | 5 | B |
| 990 | 2539 E WOODWARD AVE | 2856-04 | 2857-16 | 14 | Vitrified Clay Pipe | 407 | 9 | H |
| 991 | 1320 MONTEREY ST | 2856-08 | 2856-62 | 6 | Vitrified Clay Pipe | 391 | 44 | H |
| 992 | 1320 MONTEREY ST | 2856-08 | 2856-62 | 6 | Vitrified Clay Pipe | 391 | 44 | H |
| 993 | 1320 MONTEREY ST | 2856-08 | 2856-62 | 6 | Vitrified Clay Pipe | 391 | 44 | H |
| 994 | 1320 MONTEREY ST | 2856-08 | 2856-62 | 6 | Vitrified Clay Pipe | 391 | 44 | H |
| 995 | 1320 MONTEREY ST | 2856-08 | 2856-62 | 6 | Vitrified Clay Pipe | 391 | 44 | H |
| 996 | 1320 MONTEREY ST | 2856-08 | 2856-62 | 6 | Vitrified Clay Pipe | 391 | 44 | H |
| 997 | 1320 MONTEREY ST | 2856-08 | 2856-62 | 6 | Vitrified Clay Pipe | 391 | 44 | H |
| 998 | 1320 MONTEREY ST | 2856-08 | 2856-62 | 6 | Vitrified Clay Pipe | 391 | 44 | H |
| 999 | 214 BROADWAY | 2856-19 | 2856-20 | 6 | Vitrified Clay Pipe | 325 | 22 | BVV |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 1000 | 214 BROADWAY | 2856-19 | 2856-20 | 6 | Vitrified Clay Pipe | 325 | 22 | H |
| 1001 | 1820 MONTERY ST | 2856-21 | 2856-71 | 6 | Vitrified Clay Pipe | 372 | 13 | B |
| 1002 | 253 FULTON ST | 2856-28 | 2856-25 | 8 | Vitrified Clay Pipe | 401 | 33 | B |
| 1003 | 1820 SAN BENITO ST | 2856-39 | 2856-23 | 6 | Vitrified Clay Pipe | 402 | 11 | BSV |
| 1004 | 564 F ST | 2856-50 | 2855-69 | 18 | Vitrified Clay Pipe | 392 | 5 | BVV |
| 1005 | 401 H ST | 2856-53 | 2856-42 | 10 | Vitrified Clay Pipe | 478 | 5 | BSV |
| 1006 | 1804 VENTURA ST | 2856-55 | 2756-15 | 6 | Vitrified Clay Pipe | 536 | 39 | B |
| 1007 | 1804 VENTURA ST | 2856-55 | 2756-15 | 6 | Vitrified Clay Pipe | 536 | 39 | BSV |
| 1008 | 1804 VENTURA ST | 2856-55 | 2756-15 | 6 | Vitrified Clay Pipe | 536 | 39 | BSV |
| 1009 | 1804 VENTURA ST | 2856-55 | 2756-15 | 6 | Vitrified Clay Pipe | 536 | 39 | HSV |
| 1010 | 241 H ST | 2856-79 | 2856-80 | 10 | Vitrified Clay Pipe | 481 | 10 | BVV |
| 1011 | 241 H ST | 2856-79 | 2856-80 | 10 | Vitrified Clay Pipe | 481 | 10 | BVV |
| 1012 | 310 G ST | 2856-80 | 2856-67 | 10 | Vitrified Clay Pipe | 476 | 19 | B |
| 1013 | 310 G ST | 2856-80 | 2856-67 | 10 | Vitrified Clay Pipe | 476 | 19 | BSV |
| 1014 | 2105 S VAN NESS AVE | 2857-03 | 2857-05 | 8 | Vitrified Clay Pipe | 460 | 23 | B |
| 1015 | 1923 S MARY ST | 2857-20 | 2857-11 | 6 | Vitrified Clay Pipe | 439 | 14 | B |
| 1016 | 2933 E HAMILTON | 2857-27 | 2857-28 | 8 | Vitrified Clay Pipe | 75 | 21 | H |
| 1017 | 2748 E HAMILTON | 2857-28 | 2857-30 | 8 | Vitrified Clay Pipe | 400 | 38 | B |
| 1018 | 2748 E HAMILTON | 2857-28 | 2857-30 | 8 | Vitrified Clay Pipe | 400 | 38 | B |
| 1019 | 2748 E HAMILTON | 2857-28 | 2857-30 | 8 | Vitrified Clay Pipe | 400 | 38 | B |
| 1020 | 2748 E HAMILTON | 2857-28 | 2857-30 | 8 | Vitrified Clay Pipe | 400 | 38 | B |
| 1021 | 2748 E HAMILTON | 2857-28 | 2857-30 | 8 | Vitrified Clay Pipe | 400 | 38 | B |
| 1022 | 2748 E HAMILTON | 2857-28 | 2857-30 | 8 | Vitrified Clay Pipe | 400 | 38 | HSV |
| 1023 | 120 FULTON ST | 2857-37 | 2857-48 | 6 | Vitrified Clay Pipe | 418 | 13 | H |
| 1024 | 2250 LOS ANGELES ST | 2857-38 | 2857-40 | 6 | Vitrified Clay Pipe | 469 | 10 | B |
| 1025 | 2250 LOS ANGELES ST | 2857-38 | 2857-40 | 6 | Vitrified Clay Pipe | 469 | 10 | H |
| 1026 | 210 VAN NESS AVE | 2857-39 | 2856-31 | 6 | Vitrified Clay Pipe | 418 | 5 | H |
| 1027 | 2202 MONTEREY ST | 2857-40 | 2757-26 | 6 | Vitrified Clay Pipe | 418 | 5 | H |
| 1028 | 2910 E HEATON AVE | 2857-41 | 2857-27 | 8 | Vitrified Clay Pipe | 640 | 33 | B |
| 1029 | 100 M ST | 2857-42 | 2857-41 | 8 | Vitrified Clay Pipe | 487 | 21 | B |
| 1030 | 100 M ST | 2857-42 | 2857-41 | 8 | Vitrified Clay Pipe | 487 | 21 | B |
| 1031 | 100 M ST | 2857-42 | 2857-41 | 8 | Vitrified Clay Pipe | 487 | 21 | B |
| 1032 | 1780 S PEARL ST | 2857-43 | 2857-24 | 6 | Vitrified Clay Pipe | 197 | 60 | B |
| 1033 | 1780 S PEARL ST | 2857-43 | 2857-24 | 6 | Vitrified Clay Pipe | 197 | 60 | H |
| 1034 | 1780 S PEARL ST | 2857-43 | 2857-24 | 6 | Vitrified Clay Pipe | 197 | 60 | H |
| 1035 | 1780 S PEARL ST | 2857-43 | 2857-24 | 6 | Vitrified Clay Pipe | 197 | 60 | H |
| 1036 | 1780 S PEARL ST | 2857-43 | 2857-24 | 6 | Vitrified Clay Pipe | 197 | 60 | H |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 1037 | 1780 S PEARL ST | 2857-43 | 2857-24 | 6 | Vitrified Clay Pipe | 197 | 60 | H |
| 1038 | 1780 S PEARL ST | 2857-43 | 2857-24 | 6 | Vitrified Clay Pipe | 197 | 60 | H |
| 1039 | 1780 S PEARL ST | 2857-43 | 2857-24 | 6 | Vitrified Clay Pipe | 197 | 60 | H |
| 1040 | 1780 S PEARL ST | 2857-43 | 2857-24 | 6 | Vitrified Clay Pipe | 197 | 60 | H |
| 1041 | 2730 E WOODWARD AVE | 2857-46 | 2857-14 | 8 | Vitrified Clay Pipe | 380 | 5 | B |
| 1042 | 202 FULTON ST | 2857-48 | 2856-29 | 6 | Vitrified Clay Pipe | 483 | 15 | B |
| 1043 | 202 FULTON ST | 2857-48 | 2856-29 | 6 | Vitrified Clay Pipe | 483 | 15 | B |
| 1044 | 202 FULTON ST | 2857-48 | 2856-29 | 6 | Vitrified Clay Pipe | 483 | 15 | H |
| 1045 | 2060 S GEARHART ST | 2858-02 | 2858-04 | 8 | Vitrified Clay Pipe | 496 | 58 | B |
| 1046 | 2008 ORANGE AVE | 2858-03 | 2858-19 | 8 | Vitrified Clay Pipe | 420 | 8 | B |
| 1047 | 1919 S THIRD ST | 2858-26 | 2858-14 | 6 | Cast Iron | 433 | 0 | SRC |
| 1048 | 3321 E BRALY AVE | 2858-31 | 2858-27 | 6 | Cast Iron | 355 | 90 | SRC |
| 1049 | 3321 E BRALY AVE | 2858-31 | 2858-27 | 6 | Cast Iron | 355 | 90 | SRC |
| 1050 | 1808 S FIFTH ST | 2858-37 | 2858-34 | 8 | Vitrified Clay Pipe | 146 | 17 | B |
| 1051 | 3230 E ORLEANS AVE | 2858-49 | 2858-43 | 6 | Cast Iron | 335 | 5 | SRC |
| 1052 | 3230 E ORLEANS AVE | 2858-49 | 2858-43 | 6 | Cast Iron | 335 | 5 | SRC |
| 1053 | 1736 S HAZELWOOD BLVD | 2858-52 | 2858-39 | 6 | Vitrified Clay Pipe | 335 | 26 | B |
| 1054 | 1728 S FOURTH ST | 2858-53 | 2858-38 | 6 | Vitrified Clay Pipe | 335 | 8 | BSV |
| 1055 | 1742 S FIFTH ST | 2858-54 | 2858-37 | 6 | Vitrified Clay Pipe | 335 | 21 | D |
| 1056 | 1725 S FIFTH ST | 2858-55 | 2858-36 | 6 | Vitrified Clay Pipe | 363 | 21 | B |
| 1057 | 1429 S ORANGE AVE | 2858-59 | 2858-58 | 6 | Vitrified Clay Pipe | 329 | 16 | BVV |
| 1058 | 1627 S FIFTH ST | 2858-62 | 2858-55 | 6 | Vitrified Clay Pipe | 521 | 48 | B |
| 1059 | 1627 S FIFTH ST | 2858-62 | 2858-55 | 6 | Vitrified Clay Pipe | 521 | 48 | B |
| 1060 | 1627 S FIFTH ST | 2858-62 | 2858-55 | 6 | Vitrified Clay Pipe | 521 | 48 | BVV |
| 1061 | 1627 S FIFTH ST | 2858-62 | 2858-55 | 6 | Vitrified Clay Pipe | 521 | 48 | H |
| 1062 | 1640 S FIFTH ST | 2858-63 | 2858-54 | 6 | Vitrified Clay Pipe | 520 | 5 | B |
| 1063 | 1435 S FOURTH ST | 2858-65 | 2858-68 | 6 | Vitrified Clay Pipe | 387 | 12 | H |
| 1064 | 3356 E BUTLER AVE | 2858-68 | 2858-72 | 6 | Vitrified Clay Pipe | 465 | 12 | B |
| 1065 | 3241 E TOWNSEND AVE | 2858-74 | 2858-72 | 6 | Vitrified Clay Pipe | 320 | 29 | B |
| 1066 | 3241 E TOWNSEND AVE | 2858-74 | 2858-72 | 6 | Vitrified Clay Pipe | 320 | 29 | BVV |
| 1067 | 3125 E TOWNSEND AVE | 2858-83 | 2858-80 | 6 | Vitrified Clay Pipe | 280 | 37 | B |
| 1068 | 3125 E TOWNSEND AVE | 2858-83 | 2858-80 | 6 | Vitrified Clay Pipe | 280 | 37 | B |
| 1069 | 3125 E TOWNSEND AVE | 2858-83 | 2858-80 | 6 | Vitrified Clay Pipe | 280 | 37 | BVV |
| 1070 | 3633 E BRALY AVE | 2859-27 | 2859-17 | 8 | Vitrified Clay Pipe | 324 | 8 | B |
| 1071 | 1727 S ORANGE AVE | 2859-30 | 2858-87 | 6 | Vitrified Clay Pipe | 615 | 17 | BVV |
| 1072 | 3747 E HEATON AVE | 2859-40 | 2858-58 | 6 | Vitrified Clay Pipe | 640 | 16 | B |
| 1073 | 3747 E HEATON AVE | 2859-40 | 2858-58 | 6 | Vitrified Clay Pipe | 640 | 16 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 1074 | 54 E CALIFORNIA AVE | 2953-12 | 2953-11 | 6 | Vitrified Clay Pipe | 362 | 30 | B |
| 1075 | 54 E CALIFORNIA AVE | 2953-12 | 2953-11 | 6 | Vitrified Clay Pipe | 362 | 30 | B |
| 1076 | 54 E CALIFORNIA AVE | 2953-12 | 2953-11 | 6 | Vitrified Clay Pipe | 362 | 30 | BSV |
| 1077 | 216 W ATCHISON ST | 2953-13 | 2953-14 | 8 | Vitrified Clay Pipe | 628 | 34 | BSV |
| 1078 | 216 W ATCHISON ST | 2953-13 | 2953-14 | 8 | Vitrified Clay Pipe | 628 | 34 | BVV |
| 1079 | 9 W ATCHISON ST | 2953-14 | 2953-15 | 8 | Vitrified Clay Pipe | 97 | 8 | B |
| 1080 | 9 W ATCHISON ST | 2953-20 | 2953-15 | 8 | Concrete Pipe | 257 | 8 | B |
| 1081 | 241 W ATCHISON ST | 2953-23 | 2953-18 | 8 | Vitrified Clay Pipe | 330 | 5 | B |
| 1082 | 56 E LORENA ST | 2953-26 | 2953-25 | 6 | Vitrified Clay Pipe | 582 | 51 | B |
| 1083 | 56 E LORENA ST | 2953-26 | 2953-25 | 6 | Vitrified Clay Pipe | 582 | 51 | B |
| 1084 | 2220 S WALNUT AVE | 2953-28 | 2953-30 | 8 | Vitrified Clay Pipe | 330 | 8 | BVV |
| 1085 | 2220 S WALNUT AVE | 2953-29 | 2953-30 | 6 | Vitrified Clay Pipe | 658 | 8 | BVV |
| 1086 | 2220 S WALNUT AVE | 2953-30 | 2953-42 | 8 | Vitrified Clay Pipe | 332 | 11 | B |
| 1087 | 2887 S THORNE AVE | 2953-39 | 2953-33 | 8 | Vitrified Clay Pipe | 256 | 19 | B |
| 1088 | 2887 S THORNE AVE | 2953-39 | 2953-33 | 8 | Vitrified Clay Pipe | 256 | 19 | B |
| 1089 | 2280 S WALNUT AVE | 2953-41 | 2953-42 | 6 | Vitrified Clay Pipe | 659 | 18 | B |
| 1090 | 2280 S WALNUT AVE | 2953-41 | 2953-42 | 6 | Vitrified Clay Pipe | 659 | 18 | B |
| 1091 | 2280 S WALNUT AVE | 2953-41 | 2953-42 | 6 | Vitrified Clay Pipe | 659 | 18 | BVV |
| 1092 | 2131 S FAIVIEW AVE | 2954-04 | 2954-05 | 6 | Vitrified Clay Pipe | 410 | 11 | B |
| 1093 | 2166 S LEE AVE | 2954-05 | 2954-06 | 6 | Vitrified Clay Pipe | 437 | 18 | BVV |
| 1094 | 2139 S LEE AVE | 2954-06 | 2954-14 | 8 | Vitrified Clay Pipe | 329 | 13 | B |
| 1095 | 2139 S LEE AVE | 2954-06 | 2954-14 | 8 | Vitrified Clay Pipe | 329 | 13 | B |
| 1096 | 855 E LORENA AVE | 2954-14 | 2954-24 | 8 | Vitrified Clay Pipe | 327 | 9 | B |
| 1097 | 2163 S MAUD AVE | 2954-16 | 2954-14 | 6 | Vitrified Clay Pipe | 423 | 24 | B |
| 1098 | 608 E GEARY ST | 2954-32 | 2954-33 | 6 | Vitrified Clay Pipe | 166 | 10 | B |
| 1099 | 608 E GEARY ST | 2954-32 | 2954-33 | 6 | Vitrified Clay Pipe | 166 | 10 | SMW |
| 1100 | 2218 S MARTIN LUTHER | 2954-36 | 2954-38 | 10 | Vitrified Clay Pipe | 521 | 25 | B |
| 1101 | 2385 S FAIRVIEW AVE | 2954-61 | 2954-45 | 8 | Vitrified Clay Pipe | 241 | 16 | BVV |
| 1102 | 2390 S WALNUT AVE | 2954-63 | 2953-09 | 10 | Vitrified Clay Pipe | 330 | 5 | B |
| 1103 | 2338 S WALNUT AVE | 2954-64 | 2954-47 | 10 | Vitrified Clay Pipe | 331 | 14 | BSV |
| 1104 | 2374 S BARDELL ST | 2955-18 | 2955-19 | 6 | Vitrified Clay Pipe | 320 | 8 | B |
| 1105 | 2372 S TUPMAN ST | 2955-25 | 2955-26 | 8 | Concrete Pipe | 320 | 11 | B |
| 1106 | 2105 S MARTIN LUTHER | 2955-28 | 2955-29 | 6 | Vitrified Clay Pipe | 619 | 37 | B |
| 1107 | 2105 S MARTIN LUTHER | 2955-28 | 2955-29 | 6 | Vitrified Clay Pipe | 619 | 37 | B |
| 1108 | 1311 E FLORENCE AVE | 2955-44 | 2955-47 | 10 | Vitrified Clay Pipe | 325 | 21 | B |
| 1109 | 1311 E FLORENCE AVE | 2955-44 | 2955-47 | 10 | Vitrified Clay Pipe | 325 | 21 | B |
| 1110 | 2225 S EUNICE AVE | 2955-46 | 2955-47 | 6 | Vitrified Clay Pipe | 523 | 38 | B |

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 1111 | 2225 S EUNICE AVE | 2955-46 | 2955-47 | 6 | Vitrified Clay Pipe | 523 | 38 | H |
| 1112 | 2206 S IVY AVE | 2955-49 | 2955-50 | 6 | Vitrified Clay Pipe | 622 | 21 | B |
| 1113 | 1551 E FLORENCE AVE | 2955-50 | 2955-55 | 10 | Vitrified Clay Pipe | 331 | 14 | BVV |
| 1114 | 2324 S IVY AVE | 2955-51 | 2955-70 | 6 | Vitrified Clay Pipe | 681 | 33 | B |
| 1115 | 2292 S GENEVA AVE | 2955-54 | 2955-55 | 6 | Vitrified Clay Pipe | 621 | 45 | BSV |
| 1116 | 2292 S GENEVA AVE | 2955-54 | 2955-55 | 6 | Vitrified Clay Pipe | 621 | 45 | H |
| 1117 | 1636 E FLORENCE AVE | 2955-55 | 2955-56 | 10 | Vitrified Clay Pipe | 307 | 27 | B |
| 1118 | 1636 E FLORENCE AVE | 2955-55 | 2955-56 | 10 | Vitrified Clay Pipe | 307 | 27 | B |
| 1119 | 1636 E FLORENCE AVE | 2955-55 | 2955-56 | 10 | Vitrified Clay Pipe | 307 | 27 | H |
| 1120 | 2290 S ELM AVE | 2955-56 | 2955-57 | 10 | Vitrified Clay Pipe | 30 | 5 | B |
| 1121 | 1329 E FLORENCE AVE | 2955-75 | 2955-44 | 8 | Vitrified Clay Pipe | 657 | 13 | B |
| 1122 | 2370 S KIRK ST | 2956-21 | 2956-22 | 6 | Vitrified Clay Pipe | 305 | 8 | B |
| 1123 | 2385 S HOLLY AVE | 2956-27 | 2956-28 | 6 | Vitrified Clay Pipe | 132 | 10 | B |
| 1124 | 2385 S HOLLY AVE | 2956-27 | 2956-28 | 6 | Vitrified Clay Pipe | 132 | 10 | B |
| 1125 | 235 S ELM AVE | 2956-32 | 2956-72 | 6 | Vitrified Clay Pipe | 165 | 13 | B |
| 1126 | 235 S ELM AVE | 2956-32 | 2956-72 | 6 | Vitrified Clay Pipe | 165 | 13 | BSV |
| 1127 | 2365 S ELM AVE | 2956-33 | 2956-32 | 6 | Vitrified Clay Pipe | 318 | 16 | H |
| 1128 | 1824 E CALIFORNIA AVE | 2956-35 | 2956-46 | 6 | Vitrified Clay Pipe | 586 | 29 | B |
| 1129 | 1824 E CALIFORNIA AVE | 2956-35 | 2956-46 | 6 | Vitrified Clay Pipe | 586 | 29 | B |
| 1130 | 2195 S ELM AVE | 2956-36 | 2955-58 | 8 | Vitrified Clay Pipe | 168 | 9 | B |
| 1131 | 2233 S HOLLY AVE | 2956-43 | 2956-40 | 6 | Vitrified Clay Pipe | 320 | 20 | B |
| 1132 | 2229 S POPPY AVE | 2956-46 | 2956-37 | 6 | Vitrified Clay Pipe | 627 | 16 | B |
| 1133 | 2285 S HOLLY AVE | 2956-47 | 2956-46 | 6 | Vitrified Clay Pipe | 305 | 32 | BSV |
| 1134 | 2285 S HOLLY AVE | 2956-47 | 2956-46 | 6 | Vitrified Clay Pipe | 305 | 32 | HVV |
| 1135 | 2316 S KIRK ST | 2956-54 | 2956-21 | 6 | Vitrified Clay Pipe | 664 | 33 | B |
| 1136 | 2316 S KIRK ST | 2956-54 | 2956-21 | 6 | Vitrified Clay Pipe | 664 | 33 | H |
| 1137 | 2250 E CALIFORNIA AVE | 2956-56 | 2956-57 | 6 | Vitrified Clay Pipe | 167 | 5 | BVV |
| 1138 | 2590 E CHURCH AVE | 2956-62 | 2957-01 | 36 | Reinforced Concrete Pipe | 374 | 10 | B |
| 1139 | 2590 E CHURCH AVE | 2956-62 | 2957-01 | 36 | Reinforced Concrete Pipe | 374 | 10 | SRV |
| 1140 | 2301 E FLORENCE AVE | 2956-64 | 2956-63 | 6 | Vitrified Clay Pipe | 663 | 8 | B |
| 1141 | 2224 S CHERRY AVE | 2956-66 | 2956-67 | 6 | Vitrified Clay Pipe | 545 | 28 | B |
| 1142 | 2224 S CHERRY AVE | 2956-66 | 2956-67 | 6 | Vitrified Clay Pipe | 545 | 28 | H |
| 1143 | 2328 S CHERRY AVE | 2956-67 | 2956-61 | 6 | Vitrified Clay Pipe | 615 | 21 | H |
| 1144 | 2167 S G ST | 2956-79 | 2956-78 | 6 | Vitrified Clay Pipe | 165 | 9 | B |
| 1145 | 2167 S G ST | 2956-79 | 2956-78 | 6 | Vitrified Clay Pipe | 165 | 9 | H |
| 1146 | 2111 S LOTUS AVE | 2956-80 | 2956-82 | 6 | Vitrified Clay Pipe | 325 | 24 | BVV |
| 1147 | 2111 S LOTUS AVE | 2956-80 | 2956-82 | 6 | Vitrified Clay Pipe | 325 | 24 | H |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 1148 | 2161 S LILY AVE | 2956-81 | 2956-84 | 6 | Vitrified Clay Pipe | 600 | 20 | B |
| 1149 | 2256 S RAILROAD | 2957-07 | 2957-06 | 8 | Cast Iron | 658 | 384 | B |
| 1150 | 2256 S RAILROAD | 2957-07 | 2957-06 | 8 | Cast Iron | 658 | 384 | B |
| 1151 | 2384 SARAH ST | 2957-12 | 2957-53 | 8 | Vitrified Clay Pipe | 265 | 16 | B |
| 1152 | 2384 SARAH ST | 2957-12 | 2957-53 | 8 | Vitrified Clay Pipe | 265 | 16 | H |
| 1153 | 2336 S RAILROAD AVE | 2957-15 | 2957-14 | 6 | Vitrified Clay Pipe | 393 | 27 | B |
| 1154 | 2336 S RAILROAD AVE | 2957-15 | 2957-14 | 6 | Vitrified Clay Pipe | 393 | 27 | BVV |
| 1155 | 2336 S RAILROAD AVE | 2957-15 | 2957-14 | 6 | Vitrified Clay Pipe | 393 | 27 | BVV |
| 1156 | 2356 S RAILROAD AVE | 2957-16 | 2957-15 | 6 | Vitrified Clay Pipe | 771 | 22 | H |
| 1157 | 2356 S RAILROAD AVE | 2957-16 | 2957-102 | 6 | Vitrified Clay Pipe | 383 | 15 | B |
| 1158 | 2356 S RAILROAD AVE | 2957-16 | 2957-102 | 6 | Vitrified Clay Pipe | 383 | 15 | B |
| 1159 | 2356 S RAILROAD AVE | 2957-16 | 2957-102 | 6 | Vitrified Clay Pipe | 383 | 15 | H |
| 1160 | 2643 E CHURCH AVE | 2957-18 | 2957-19 | 6 | Vitrified Clay Pipe | 660 | 21 | B |
| 1161 | 2643 E CHURCH AVE | 2957-18 | 2957-19 | 6 | Vitrified Clay Pipe | 660 | 21 | B |
| 1162 | 2643 E CHURCH AVE | 2957-20 | 2957-21 | 8 | Vitrified Clay Pipe | 53 | 5 | BSV |
| 1163 | 2811 E CHURCH AVE | 2957-28 | 2957-27 | 6 | Vitrified Clay Pipe | 329 | 29 | BSV |
| 1164 | 2811 E CHURCH AVE | 2957-28 | 2957-27 | 6 | Vitrified Clay Pipe | 329 | 29 | BVV |
| 1165 | 2811 E CHURCH AVE | 2957-28 | 2957-27 | 6 | Vitrified Clay Pipe | 329 | 29 | BVV |
| 1166 | 2303 S ORINDA ST | 2957-38 | 2957-36 | 10 | Vitrified Clay Pipe | 672 | 34 | B |
| 1167 | 2500 E CALIFORNIA AVE | 2957-40 | 2957-41 | 8 | Vitrified Clay Pipe | 250 | 36 | B |
| 1168 | 2500 E CALIFORNIA AVE | 2957-40 | 2957-41 | 8 | Vitrified Clay Pipe | 250 | 36 | B |
| 1169 | 2384 SARAH ST | 2957-53 | 2957-23 | 6 | Vitrified Clay Pipe | 397 | 16 | BSV |
| 1170 | 2384 SARAH ST | 2957-53 | 2957-23 | 6 | Vitrified Clay Pipe | 397 | 16 | H |
| 1171 | 89 E GARRETT AVE | 3053-19 | 3053-18 | 6 | Vitrified Clay Pipe | 388 | 5 | B |
| 1172 | 2581 S WALNUT AVE | 3053-28 | 3153-05 | 12 | Vitrified Clay Pipe | 360 | 8 | B |
| 1173 | 1222 E KAVILAND AVE | 3055-11 | 3055-12 | 8 | Concrete Pipe | 551 | 5 | B |
| 1174 | 2498 S ELM AVE | 3055-18 | 3055-17 | 8 | Vitrified Clay Pipe | 660 | 5 | B |
| 1175 | 2424 E GROVE AVE | 3056-10 | 3056-11 | 6 | Vitrified Clay Pipe | 444 | 21 | B |
| 1176 | 2424 E GROVE AVE | 3056-10 | 3056-11 | 6 | Vitrified Clay Pipe | 444 | 21 | B |
| 1177 | 2424 E GROVE AVE | 3056-10 | 3056-11 | 6 | Vitrified Clay Pipe | 444 | 21 | B |
| 1178 | 2495 S LILY AVE | 3056-13 | 3056-12 | 8 | Vitrified Clay Pipe | 663 | 9 | B |
| 1179 | 2953 S ELM AVE | 3056-28 | 3056-01 | 8 | Concrete Pipe | 676 | 13 | BVV |
| 1180 | 2953 S ELM AVE | 3056-28 | 3056-01 | 8 | Concrete Pipe | 676 | 13 | BVV |
| 1181 | 2592 S CEDAR AVE | 3059-10 | 3159-24 | 8 | Vitrified Clay Pipe | 207 | 5 | B |
| 1182 | 2536 S MAPLE AVE | 3061-10 | 3061-11 | 6 | Polyvinyl Chloride | 388 | 4 | D |
| 1183 | 2594 S HABITAT AVE | 3153-01 | 3153-08 | 48 | Concrete Pipe | 87 | 8 | SRC |
| 1184 | 2658 S LEE AVE | 3154-07 | 3154-06 | 8 | Vitrified Clay Pipe | 555 | 10 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 1185 | 2658 S LEE AVE | 3154-07 | 3154-06 | 8 | Vitrified Clay Pipe | 555 | 10 | B |
| 1186 | 2750 S BARDELL ST | 3155-12 | 3155-13 | 8 | Vitrified Clay Pipe | 209 | 5 | B |
| 1187 | 2734 S TUPMAN ST | 3155-17 | 3155-30 | 8 | Vitrified Clay Pipe | 420 | 38 | B |
| 1188 | 2734 S TUPMAN ST | 3155-17 | 3155-30 | 8 | Vitrified Clay Pipe | 420 | 38 | B |
| 1189 | 2734 S TUPMAN ST | 3155-17 | 3155-30 | 8 | Vitrified Clay Pipe | 420 | 38 | B |
| 1190 | 2734 S TUPMAN ST | 3155-17 | 3155-30 | 8 | Vitrified Clay Pipe | 420 | 38 | BSV |
| 1191 | 2727 S BARDELL ST | 3155-19 | 3155-21 | 8 | Vitrified Clay Pipe | 260 | 56 | B |
| 1192 | 2727 S BARDELL ST | 3155-19 | 3155-21 | 8 | Vitrified Clay Pipe | 260 | 56 | B |
| 1193 | 2727 S BARDELL ST | 3155-19 | 3155-21 | 8 | Vitrified Clay Pipe | 260 | 56 | B |
| 1194 | 2727 S BARDELL ST | 3155-19 | 3155-21 | 8 | Vitrified Clay Pipe | 260 | 56 | B |
| 1195 | 2697 S BARDELL ST | 3155-21 | 3155-23 | 8 | Vitrified Clay Pipe | 260 | 19 | B |
| 1196 | 2677 S BARDELL ST | 3155-23 | 3155-26 | 8 | Vitrified Clay Pipe | 270 | 22 | B |
| 1197 | 2677 S BARDELL ST | 3155-23 | 3155-26 | 8 | Vitrified Clay Pipe | 270 | 22 | B |
| 1198 | 2677 S BARDELL ST | 3155-23 | 3155-26 | 8 | Vitrified Clay Pipe | 270 | 22 | B |
| 1199 | 2672 S TUPMAN ST | 3155-30 | 3155-29 | 8 | Vitrified Clay Pipe | 390 | 39 | B |
| 1200 | 2672 S TUPMAN ST | 3155-30 | 3155-29 | 8 | Vitrified Clay Pipe | 390 | 39 | B |
| 1201 | 2672 S TUPMAN ST | 3155-30 | 3155-29 | 8 | Vitrified Clay Pipe | 390 | 39 | B |
| 1202 | 2672 S TUPMAN ST | 3155-30 | 3155-29 | 8 | Vitrified Clay Pipe | 390 | 39 | BVV |
| 1203 | 1307 E DOROTHY AVE | 3155-32 | 3155-36 | 8 | Vitrified Clay Pipe | 165 | 16 | BVV |
| 1204 | 1004 E DRUMMOND AVE | 3155-39 | 3154-20 | 8 | Vitrified Clay Pipe | 664 | 371 | HVV |
| 1205 | 1046 E CALWA AVE | 3155-60 | 3154-10 | 8 | Vitrified Clay Pipe | 664 | 326 | B |
| 1206 | 2627 S EAST AVE | 3157-08 | 3157-09 | 10 | Vitrified Clay Pipe | 222 | 5 | BVV |
| 1207 | 2734 S TUPMAN ST | 3157-17 | 3157-23 | 8 | Vitrified Clay Pipe | 420 | 20 | B |
| 1208 | 2734 S TUPMAN ST | 3157-17 | 3157-23 | 8 | Vitrified Clay Pipe | 420 | 20 | B |
| 1209 | 2696 S MAPLE AVE | 3160-17 | 3160-10 | 12 | Vitrified Clay Pipe | 350 | 5 | BSV |
| 1210 | 4771 E DATE AVE | 3161-01 | 3161-08 | 8 | Vitrified Clay Pipe | 535 | 5 | B |
| 1211 | 2991 LEE AVE | 3254-09 | 3254-12 | 6 | Vitrified Clay Pipe | 316 | 5 | B |
| 1212 | 3052 S MARTIN LUTHER | 3254-11 | 3254-13 | 15 | Reinforced Concrete Pipe | 331 | 75 | BSV |
| 1213 | 3052 S MARTIN LUTHER | 3254-11 | 3254-13 | 15 | Reinforced Concrete Pipe | 331 | 75 | BVV |
| 1214 | 3052 S MARTIN LUTHER | 3254-11 | 3254-13 | 15 | Reinforced Concrete Pipe | 331 | 75 | SRVC |
| 1215 | 1664 E CHESTER AVE | 3255-15 | 3255-14 | 8 | Vitrified Clay Pipe | 458 | 5 | BSV |
| 1216 | 3187 E COMMERCE AVE | 3258-03 | 3258-08 | 8 | Vitrified Clay Pipe | 625 | 5 | H |
| 1217 | 2907 S MAPLE AVE | 3260-04 | 3260-14 | 10 | Vitrified Clay Pipe | 570 | 35 | B |
| 1218 | 2907 S MAPLE AVE | 3260-04 | 3260-14 | 10 | Vitrified Clay Pipe | 570 | 35 | B |
| 1219 | 2907 S MAPLE AVE | 3260-04 | 3260-14 | 10 | Vitrified Clay Pipe | 570 | 35 | BSV |
| 1220 | 4525 E COMMERCE AVE | 3260-09 | 3260-10 | 8 | Vitrified Clay Pipe | 500 | 8 | B |
| 1221 | 2907 S MAPLE AVE | 3260-14 | 3260-13 | 10 | Vitrified Clay Pipe | 660 | 54 | B |

**BCF-2 POINT REPAIRS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH PRIORITY POINT REPAIRS**

| No. | Street | Upstream MH | Downstream MH | Diameter (in) | Material | Total Length (ft) | MOSR | Priority Code |
|---|---|---|---|---|---|---|---|---|
| 1222 | 2907 S MAPLE AVE | 3260-14 | 3260-13 | 10 | Vitrified Clay Pipe | 660 | 54 | B |
| 1223 | 2907 S MAPLE AVE | 3260-14 | 3260-13 | 10 | Vitrified Clay Pipe | 660 | 54 | B |
| 1224 | 2907 S MAPLE AVE | 3260-14 | 3260-13 | 10 | Vitrified Clay Pipe | 660 | 54 | B |
| 1225 | 2907 S MAPLE AVE | 3260-14 | 3260-13 | 10 | Vitrified Clay Pipe | 660 | 54 | B |
| 1226 | 313 W ROY AVE | 3355-08 | 3355-02 | 8 | Vitrified Clay Pipe | 640 | 5 | B |
| 1227 | 207 W ROY AVE | 3355-10 | 3355-08 | 8 | Vitrified Clay Pipe | 660 | 5 | BSV |
| 1228 | 10882 N. WOODROW AVE | 561-44 | 561-43 | 8 | Polyvinyl Chloride | 184 | 5 | D |
| 1229 | 2303 E. WARICK | 961-26 | 961-27 | 6 | Polyvinyl Chloride | 413 | 4 | D |
| 1230 | 419 W ESCALON AVE | SN14540003 | 1454-11 | 8 | Vitrified Clay Pipe | 75 | 5 | B |
| 1231 | 4909 N GLENN AVE | SN17550001 | 1755-43 | 8 | Vitrified Clay Pipe | 200 | 5 | BSV |
| 1232 | 1303 W CAMBRIDGE AVE | SN22510002 | 2251-26 | 8 | Cast Iron | 71 | 65 | SRC |
| 1233 | 1303 W CAMBRIDGE AVE | SN22510002 | 2251-26 | 8 | Cast Iron | 71 | 65 | SRC |
| 1234 | 1426 N ECHO AVE | SN23540004 | 2354-47 | 6 | Vitrified Clay Pipe | 400 | 13 | BVV |
| 1235 | 1426 N ECHO AVE | SN23540004 | 2354-47 | 6 | Vitrified Clay Pipe | 400 | 13 | H |
| 1236 | 1840 BROADWAY | SN26540003 | 2654-32 | 6 | Vitrified Clay Pipe | 428 | 22 | H |
| 1237 | 1840 BROADWAY | SN26540003 | 2654-32 | 6 | Vitrified Clay Pipe | 428 | 22 | H |
| 1238 | 1840 BROADWAY | SN26540003 | 2654-32 | 6 | Vitrified Clay Pipe | 428 | 22 | H |
| 1239 | 1840 BROADWAY | SN26540003 | 2654-32 | 6 | Vitrified Clay Pipe | 428 | 22 | H |
| 1240 | 1861 AMADOR ST | SN26540004 | 2654-11 | 6 | Vitrified Clay Pipe | 428 | 26 | B |
| 1241 | 1861 AMADOR ST | SN26540004 | 2654-11 | 6 | Vitrified Clay Pipe | 428 | 26 | D |
| 1242 | 1254 FULTON MALL | SN26550002 | SN26550003 | 30 | Vitrified Clay Pipe | 400 | 5 | B |
| 1243 | 517 FRESNO ST | SN28540006 | 2854-13 | 6 | Vitrified Clay Pipe | 150 | 10 | B |
| 1244 | 517 FRESNO ST | SN28540006 | 2854-13 | 6 | Vitrified Clay Pipe | 150 | 10 | BVV |
| 1245 | 517 FRESNO ST | SN28540007 | 2854-13 | 6 | Vitrified Clay Pipe | 150 | 5 | BVV |
| 1246 | 1232 WATERMAN AVE | SN28540010 | 2854-24 | 6 | Vitrified Clay Pipe | 150 | 5 | B |
| 1247 | 1226 POTTLE AVE | SN28540012 | 2854-30 | 6 | Vitrified Clay Pipe | 150 | 5 | H |
| 1248 | 1137 COLLINS AVE | SN28540014 | 2854-32 | 6 | Vitrified Clay Pipe | 150 | 10 | BSV |
| 1249 | 1137 COLLINS AVE | SN28540014 | 2854-32 | 6 | Vitrified Clay Pipe | 150 | 10 | BSV |

# APPENDIX I – BCF-MOSR SEWER SEGMENTS

**BCF-3 MOSR SEWER SEGMENTS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH MOSR REHABILITATION SECTIONS**

**DRAFT**

| CIPP Liner Rehabilitation Phase A | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | Street | Plat Number | Upstream MH | Downstream MH | Pipe Diameter (in) | Material | Total Length (ft) | MOSR | $/ft | Price |
| 1 | 810 E BELGRAVIA AVE | 2954 | 2954-59 | 2954-52 | 30 | Concrete Segments | 1038 | 600 | 260 | $431,000 |
| 2 | 871 E CHURCH AVE | 2954 | 2954-56 | 2954-59 | 30 | Concrete Segments | 294 | 138 | 260 | $143,000 |
| 3 | 505 F ST | 2856 | 2855-70 | 2856-64 | 18 | Vitrified Clay Pipe | 475 | 288 | 180 | $155,000 |
| 4 | 506 E ST | 2856 | 2855-63 | 2855-62 | 18 | Vitrified Clay Pipe | 230 | 129 | 180 | $ 94,000 |
| 5 | 1430 SANTA CLARA ST | 2856 | 2856-64 | 2855-63 | 18 | Vitrified Clay Pipe | 218 | 123 | 180 | $ 91,000 |
| 6 | 3370 E MONO ST | 2658 | 2658-35 | 2658-33 | 15 | Reinforced Concrete Pipe | 479 | 376 | 160 | $143,000 |
| 7 | 3408 E MONO ST | 2658 | 2658-36 | 2658-35 | 15 | Reinforced Concrete Pipe | 479 | 116 | 160 | $143,000 |
| 8 | 860 N AUGUSTA AVE | 2457 | 2457-08 | 2457-02 | 12 | Standard Concrete Pipe | 435 | 352 | 140 | $121,000 |
| 9 | 2841 E SHIELDS AVE | 2057 | 2057-26 | 2057-27 | 12 | Vitrified Clay Pipe | 473 | 272 | 140 | $128,000 |
| 10 | 2997 E SHIELDS AVE | 2057 | 2057-24 | 2057-25 | 12 | Standard Concrete Pipe | 473 | 267 | 140 | $128,000 |
| 11 | 3074 E SAGINAW WAY | 1957 | 1957-69 | 2057-08 | 12 | Vitrified Clay Pipe | 812 | 477 | 140 | $212,000 |
| 12 | 3995 N FIRST ST | 1957 | 1957-51 | 1957-50 | 8 | Vitrified Clay Pipe | 272 | 141 | 113 | $ 79,000 |
| 13 | 1501 N CHESTNUT AVE | 2361 | 2361-29 | 2362-76 | 8 | Cast Iron | 635 | 510 | 113 | $153,000 |
| 14 | 1004 E DRUMMOND AVE | 3155 | 3155-39 | 3154-20 | 8 | Vitrified Clay Pipe | 664 | 371 | 113 | $158,000 |
| 15 | 1002 E JENSEN AVE | 3155 | 3155-48 | 3154-21 | 8 | Standard Concrete Pipe | 619 | 348 | 113 | $151,000 |
| 16 | 1046 E CALWA AVE | 3155 | 3155-60 | 3154-10 | 8 | Vitrified Clay Pipe | 664 | 326 | 113 | $158,000 |

Phase A Total = $ 2,488,000

**BCF-3 MOSR SEWER SEGMENTS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH MOSR REHABILITATION SECTIONS**

**DRAFT**

| CIPP Liner Rehabilitation Phase B | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | Street | Plat Number | Upstream MH | Downstream MH | Pipe Diameter (in) | Material | Total Length (ft) | MOSR | $/ft | Price |
| 17 | 1206 E GROVE AVE | 3055 | 3055-07 | 3055-08 | 8 | Standard Concrete Pipe | 660 | 351 | 113 | $157,000 |
| 18 | 945 E KAVILAND AVE | 3055 | 3055-10 | 3054-07 | 8 | Standard Concrete Pipe | 664 | 333 | 113 | $158,000 |
| 19 | 1047 E BYRD AVE | 3055 | 3055-08 | 3054-06 | 8 | Concrete Segments | 664 | 259 | 113 | $158,000 |
| 20 | 952 E KAVILAND AVE | 3055 | 3055-12 | 3054-08 | 8 | Standard Concrete Pipe | 664 | 144 | 113 | $158,000 |
| 21 | 2256 S RAILROAD | 2957 | 2957-07 | 2957-06 | 8 | Cast Iron | 658 | 384 | 113 | $157,000 |
| 22 | 2943 N MARIPOSA ST | 2157 | 2157-16 | 2157-05 | 8 | Concrete Segments | 659 | 380 | 113 | $157,000 |
| 23 | 2602 N FRESNO ST | 2157 | 2157-04 | 2156-57 | 8 | Standard Concrete Pipe | 659 | 363 | 113 | $157,000 |
| 24 | 3013 E CORNELL AVE | 2157 | 2157-29 | 2157-30 | 8 | Standard Concrete Pipe | 628 | 222 | 113 | $152,000 |
| 25 | 2707 E BROWN AVE | 2157 | 2157-35 | 2157-03 | 8 | Standard Concrete Pipe | 658 | 126 | 113 | $157,000 |
| 26 | 4946 N EFFIE ST | 1756 | 1756-61 | 1756-60 | 8 | Vitrified Clay Pipe | 464 | 156 | 113 | $109,000 |
| 27 | 2515 N FIRST ST | 2157 | 2157-44 | 2157-43 | 6 | Standard Concrete Pipe | 620 | 366 | 100 | $140,000 |
| 28 | 2619 N FIRST ST | 2157 | 2157-41 | 2157-40 | 6 | Standard Concrete Pipe | 617 | 337 | 100 | $139,000 |
| 29 | 2907 E HARVARD AVE | 2157 | 2157-39 | 2157-40 | 6 | Vitrified Clay Pipe | 659 | 318 | 100 | $145,000 |
| 30 | 2514 N ANGUS ST | 2157 | 2157-42 | 2157-43 | 6 | Standard Concrete Pipe | 638 | 170 | 100 | $142,000 |
| 31 | 1540 N GERALDINE WAY | 2352 | 2352-47 | 2352-44 | 6 | Concrete Segments | 665 | 436 | 100 | $146,000 |
| 32 | 537 W HAMMOND AVE | 2352 | 2352-09 | 2352-08 | 6 | Vitrified Clay Pipe | 617 | 104 | 100 | $139,000 |
| 33 | 4947 N THESTA ST | 1756 | 1756-46 | 1756-45 | 6 | Vitrified Clay Pipe | 525 | 116 | 100 | $109,000 |
| 34 | 4748 N SAN PABLO AVE | 1755 | 1755-56 | 1755-57 | 6 | Cast Iron | 398 | 380 | 100 | $ 91,000 |

Phase B Total = $ 2,571,000

**BCF-3 MOSR SEWER SEGMENTS**
**CITY OF FRESNO WASTEWATER MASTER PLAN**
**HIGH MOSR REHABILITATION SECTIONS**

**DRAFT**

| CIPP Liner Rehabilitation Phase C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | Street | Plat Number | Upstream MH | Downstream MH | Pipe Diameter (in) | Material | Total Length (ft) | MOSR | $/ft | Price |
| 35 | 1782 E GROVE AVE | 3056 | 3056-29 | 3056-28 | 8 | Standard Concrete Pipe | 659 | 346 | 113 | $157,000 |
| 36 | 2504 S KIRK ST | 3056 | 3056-13 | 3056-14 | 8 | Standard Concrete Pipe | 624 | 315 | 113 | $152,000 |
| 37 | 2504 S HOLLY AVE | 3056 | 3056-26 | 3056-27 | 8 | Standard Concrete Pipe | 630 | 261 | 113 | $153,000 |
| 38 | 2504 S NICHOLAS AVE | 3056 | 3056-11 | 3056-32 | 8 | Concrete Segments | 678 | 201 | 113 | $160,000 |
| 39 | 2582 S LILY AVE | 3056 | 3056-18 | 3056-19 | 8 | Vitrified Clay Pipe | 630 | 114 | 113 | $153,000 |
| 40 | 1421 E CHURCH AVE | 2955 | 2955-69 | 2955-07 | 8 | Concrete Segments | 664 | 162 | 113 | $158,000 |
| 41 | 1503 E VASSAR AVE | 2255 | 2255-14 | 2255-15 | 8 | Standard Concrete Pipe | 402 | 231 | 113 | $ 99,000 |
| 42 | 2242 N GLENN AVE | 2255 | 2255-15 | 2255-16 | 8 | Standard Concrete Pipe | 372 | 225 | 113 | $ 94,000 |
| 43 | 3672 N MAROA AVE | 2055 | 2055-05 | 2054-52 | 8 | Concrete Segments | 336 | 189 | 113 | $ 89,000 |
| 44 | 6537 N TENTH ST | 1559 | 1559-23 | 1559-22 | 8 | Vitrified Clay Pipe | 387 | 103 | 113 | $ 97,000 |
| 45 | 5645 N TENTH ST | 1559 | 1559-24 | 1559-23 | 8 | Vitrified Clay Pipe | 687 | 135 | 113 | $162,000 |
| 46 | 1305 E OLIVE AVE | 2355 | 2355-88 | 2355-08 | 6 | Vitrified Clay Pipe | 471 | 155 | 100 | $101,000 |
| 47 | 1218 N FERGER AVE | 2354 | 2354-12 | 2354-10 | 6 | Vitrified Clay Pipe | 662 | 144 | 100 | $146,000 |
| 48 | 1610 E YALE AVE | 2255 | 2255-29 | 2255-28 | 6 | Standard Concrete Pipe | 417 | 320 | 100 | $ 94,000 |
| 49 | 1522 E YALE AVE | 2255 | 2255-28 | 2255-27 | 6 | Standard Concrete Pipe | 364 | 215 | 100 | $ 86,000 |
| 50 | 1508 E CLINTON AVE | 2255 | 2255-08 | 2255-16 | 6 | Standard Concrete Pipe | 290 | 176 | 100 | $ 76,000 |
| 51 | 2030 N WEST AVE | 2252 | 2252-43 | 2251-25 | 6 | Vitrified Clay Pipe | 668 | 218 | 100 | $147,000 |
| 52 | 3104 N NINTH ST | 2159 | 2159-27 | 2159-28 | 6 | Vitrified Clay Pipe | 542 | 203 | 100 | $111,000 |
| 53 | 307 E FOUNTAIN | 2054 | 2053-15 | 2054-13 | 6 | Vitrified Clay Pipe | 612 | 134 | 100 | $139,000 |
| 54 | 2033 E ASHCROFT AVE | 1856 | 1856-04 | 1856-06 | 6 | Cast Iron | 233 | 200 | 100 | $ 68,000 |
| 55 | 5123 W MISSION AVE | 1645 | 1645-28 | 1645-29 | 6 | Cast Iron | 212 | 165 | 100 | $ 65,000 |
| 56 | 5106 W SHAW AVE | 1645 | 1645-26 | 1645-28 | 6 | Cast Iron | 185 | 165 | 100 | $ 61,000 |
| 57 | 6414 N FOURTH ST | 1358 | 1358-23 | 1358-22 | 6 | Vitrified Clay Pipe | 200 | 104 | 100 | $ 63,000 |

Phase C Total = $ 2,631,000

# APPENDIX J – BCF-CIP PROJECT MAP

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDGE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNANDALE
NORTH
MUSCAT
CENTRAL

GARFIELD GRANTLAND BRYAN HAYES POLK CORNELIA BLYTHE BRAWLEY VALENTINE MARKS VAN NESS WEST FRUIT PALM MAROA BLACKSTONE FRESNO FIRST MILLBROOK CEDAR MAPLE CHESTNUT WILLOW PEACH MINNEWAWA CLOVIS SUNNYSIDE FOWLER ARMSTRONG TEMPERANCE LOGAN DEWOLF LEONARD HIGHLAND THOMPSON McCALL

SAN JOAQUIN RIVER

LS-4 LS-5 LS-6 LS-10 LS-16 LS-14 LS-12 LS-18 LS-2 LS-11 LS-1 LS-3 LS-15 LS-13 LS-20

R-01A R-01B R-01C

C-1A C-1B C-2A C-2B C-3 C-4 C-5A C-5B C-5C C-6 C-7 C-8 C-9

D-1 D-2 D-3 D-4 D-5 D-6A D-6B D-7A D-7B D-7C D-8A D-8B D-8C D-9A D-9B D-9C D-10A D-10B D-10C D-10D D-10E D-11A D-11B D-11C D-12A D-12B D-12C D-13 D-14A D-14B D-14C D-14D D-15 D-16 D-17 D-18 D-19A D-19B D-20 D-21A D-21B D-22A D-22B D-22C D-23A D-23B D-24A D-24B D-25 D-26A D-26B D-27A D-27B

GPSP GPSP-PIPE SEGA

CALIFORNIA STATE UNIVERSITY, FRESNO

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

FRESNO/CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY

99 41 180

HERNDON MARKS CORNELIA GRANTLAND ORANGE CHESTNUT FOWLER LEONARD NORTH AVENUE

## LEGEND

- REHABILITATION/REPAIR PROJECTS (R-X)
- DEVELOPMENT/GROWTH PROJECTS (D-X)
- CAPACITY PROJECTS (C-X)
- OTHER EXISTING SEWER ≥ 27"
- OTHER EXISTING SEWER
- SEWER SERVICE AREA BOUNDARIES
- CITY LIMITS
- LIFT STATION REHABILITATION PROJECT (LS-X)
- PROPOSED TREATMENT FACILITY

NOTE: PRIORITY POINT REPAIR LOCATIONS NOT SHOWN, SEE CHAPTER 7 FOR LOCATIONS

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CITY OF FRESNO

WASTEWATER COLLECTION SYSTEM MASTER PLAN
FIGURE 1
CAPITAL IMPROVEMENT PROJECTS

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CH. BY: LMG
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# Southeast Development Area (SEDA)
# Specific Plan
# Storm Drain Technical Study

## *DRAFT*

***June 10th, 2022***

*Prepared for:*

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# CHAPTER 1
# INTRODUCTION

## 1.1 Project Description and Background

The City of Fresno (City) is preparing a Specific Plan and Program Environmental Impact Report (PEIR) for the Southeast Development Area (SEDA). The SEDA Specific Plan Area (Plan Area), previously known as the Southeast Growth Area (SEGA), is an approximately 9,000-acre area in the southeast portion of the City of Fresno that was formally designated as a growth area in the 2025 Fresno General Plan. The Plan Area is generally bound by the Gould Canal to the north, McCall and Highland Avenues to the east, Jenson and North Avenues to the south, and Locan, Temperance, and Minnewawa Avenues to the west; see Figure 1.1 for the Plan Area's location.

SEDA was approved for incorporation into the City by the Local Agency Formation Commission (LAFCo) in 2006, with a number of qualifying provisions, of which included the preparation of a Specific Plan and associated environmental documents before the land could be annexed to the City. Located in Growth Area II, SEDA was planned for development after other infill initiatives from the City's other planning efforts, and would be developed in phases. The General Plan established two levels of development – the General Plan Horizon and the General Plan Buildout. The General Plan Horizon is the level of development predicted to occur by the "Horizon Year," which was established as 2035, in accordance with the General Plan. General Plan Buildout is the level of development characterized by full occupancy of all developable sites in accordance with the General Plan; this is estimated to occur beyond 2035 (defined as past 2050).

As such, the General Plan defined development of SEDA under General Plan Horizon as a portion of the full buildout conditions – specifically, it assumes a residential development capacity of approximately 15,000 dwelling units. Accordingly, the residential development capacity of SEDA under General Plan Buildout is approximately 45,000 dwelling units, and the General Plan assumed that the additional 30,000 dwelling units would not be developed until after 2035. However, though the General Plan was analyzed under the General Plan Horizon level, the associated MEIR (Master Environmental Impact Report) analyzed the environmental impacts of the General Plan under the buildout level of the Sphere of Influence (SOI), which encompasses other growth areas, including SEDA.

The Specific Plan for SEDA provides implementation mechanisms for development in the Plan Area that accommodate for increased density and accelerate housing production. As part of the City's General Plan, SEDA was designated with land use classifications as defined in the General Plan. The Specific Plan presents alternative land use classifications for SEDA, and seeks to propose how the Plan Area will develop over time to complete buildout conditions with these newly-defined land use categories.

As part of the Specific Plan process, a PEIR needs to be developed to evaluate the impacts associated with the proposed improvements to the Plan Area, and what, if any, mitigation measures are necessary to account for such impacts. This technical report will focus on the impacts of the SEDA Specific Plan on storm drain facilities and the drainage capacity of the Plan Area.

## 1.2 Summary of Analysis

The City's General Plan assigned land use classifications to areas located within the SEDA Specific Plan Area. Each land use classification has a set of characteristics assigned to it with respect to a specific utility demand that have been determined and/or calculated by various

contributing parties. The SEDA Specific Plan proposes new land use classifications for the Plan Area that are different than the General Plan classifications that may change the area's characteristics as it relates to utilities, e.g., water demand, wastewater generation, or storm water runoff, when compared to the General Plan. Additionally, some land uses may change in area, further altering those characteristics.

In the case of storm drain utilities, each land use classification as defined in both the General Plan and the SEDA Specific Plan possesses varying degrees of drainage. An area's runoff rate and volume are heavily affected by the amount of impervious surfaces within the area. Imperviousness is directly related to the type of land use, and can either positively or negatively affect an areas drainage capabilities with a change in impervious surfaces. A common characteristic that can define an area's imperviousness, i.e. its ability to handle drainage during storm events, is its Equivalent Area, also known as the CA value. An area's CA value is the product of a unique runoff coefficient (C) and its area (A). Runoff coefficients vary based on land use depending on a perceived level of imperviousness, i.e., areas with higher levels of impervious surfaces (e.g. shopping centers) will have higher runoff coefficients than those with less impervious surfaces (e.g. rural residential areas).

Changes in land use can affect the runoff rate and volume of areas depending on whether the change increases or decreases equivalent areas; these changes will impact drainage collection and disposal facilities. Typical drainage collection facilities include inlets, manholes, pipelines, and outfall structures, and disposal facilities are usually recharge or retention/detention basins, pump stations, and canals. Land use changes that increase runoff rates and volumes will have a negative impact on collection and disposal facilities. Increased equivalent areas result in increased peak runoff rates, which can increase head loss in collection system piping and reduce the system's ability to convey peak runoff rates from inlets to basins, leading to possible flooding at the inlet and manhole locations. Basins are also impacted by increased runoff rates and volumes because basins are typically designed to withhold a specific volume of runoff, and any increase could lead to flooding. Conversely, land use changes that decrease runoff rates and volumes will have positive impacts on the collection and disposal system by reducing the peak runoff rate and the volume of runoff collected by inlets and basins.

The City's storm drain system is managed, owned, and operated by the Fresno Metropolitan Flood Control District (FMFCD). The FMFCD has developed a Storm Drainage Master Plan (SDMP) that divides the City into various drainage areas. Each area facilitates the drainage of all parcels within the area via a system of collection and disposal facilities. The Plan Area includes six (6) proposed drainage areas, and two (2) existing drainage areas designed by FMFCD; each area has a designated basin for disposal, and a system of proposed collection facilities.

The Specific Plan is proposing a change in land use classifications within SEDA from those originally defined within the City's 2025 General Plan. Land use classifications and areas are changing for several parcels, which is going to impact the equivalent area of each drainage area within the Plan Area. This technical study is limited to analyzing change in equivalent area of each drainage area between the General Plan land use case and the SEDA Specific Plan land use case, and determining if the proposed improvements will be sufficient to accommodate the revised runoff flows and volumes. The equivalent areas for each land use within the proposed drainage areas were calculated using the General Plan land use classifications, and subsequently compared to equivalent areas obtained using the Specific Plan land use classifications to evaluate the impact caused from a change in runoff characteristics.

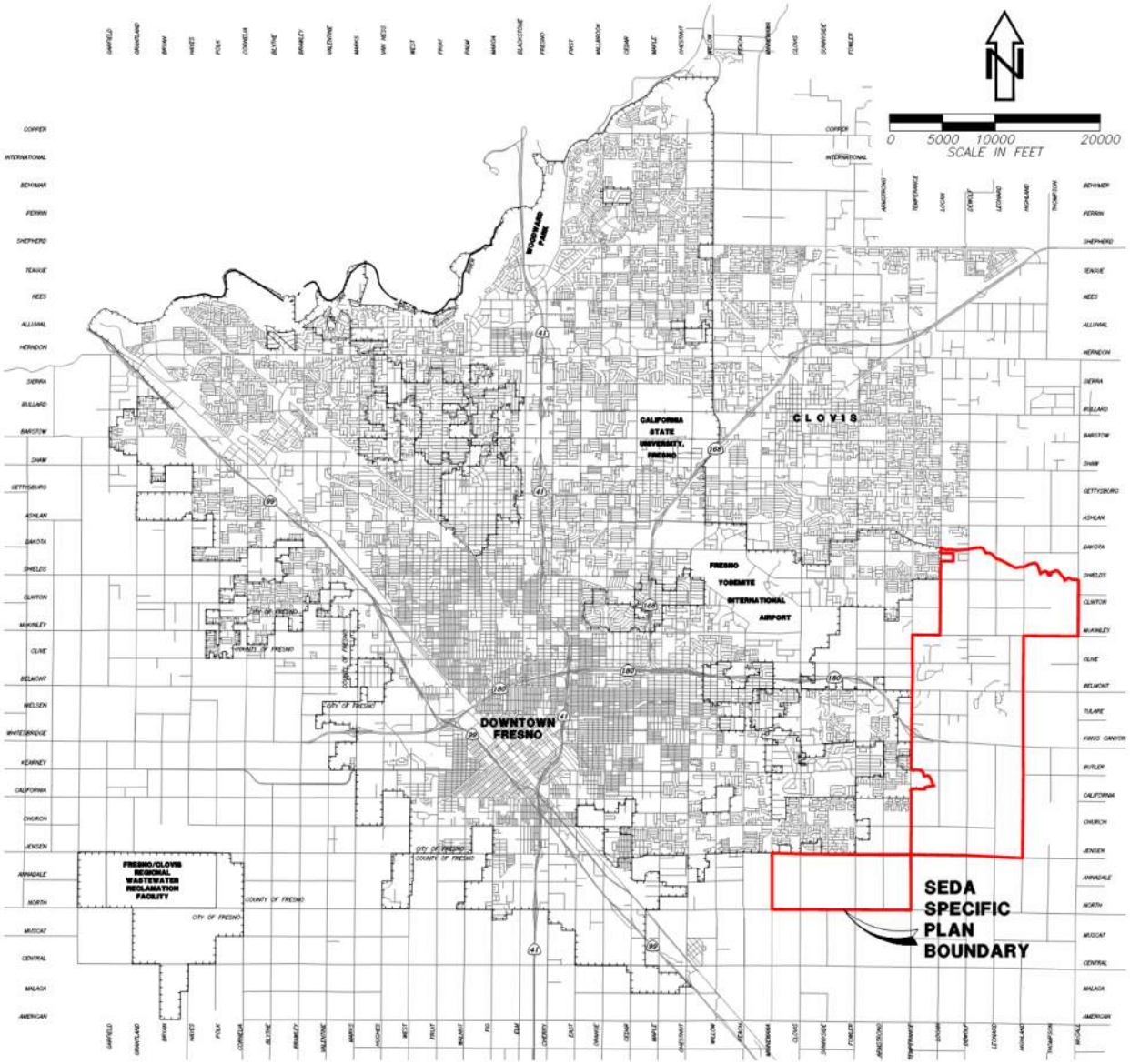



**Figure 1.1 SEDA Specific Plan Location**

**CHAPTER 2**
**REGULATORY FRAMEWORK**

## 2.1 General

The FMFCD manages stormwater runoff collection and disposal within the Plan Area and the Fresno/Clovis metropolitan area in general. The FMFCD provides flood control within an approximately 400 square mile watershed in Fresno County, generally located between the Kings River and San Joaquin River, and extending up into the Sierra Nevada foothills. FMFCD also provides urban storm drainage, groundwater recharge, and recreation spaced in the Fresno/Clovis metropolitan area, as well as Clean Water Act pollution prevention compliance assistance.

The District's flood control program consists of a system of major facilities and operations that control flows from a number of low-elevation streams that drain a portion of the west slope of the Sierra Nevada between the San Joaquin and Kings Rivers. The system is comprised of numerous flood control facilities including various dams and reservoirs, as well as many related streams and channels. The FMFCD is responsible for flood control and stormwater planning and management; the District Services Plan (DSP) provides comprehensive policies and implementation actions for flood control, rural streams management, local storm water drainage, stormwater quality management, water conservation, recreation, and related wildlife management.[1] The FMFCD coordinates with cities and the County of Fresno via a framework provided in the Storm Drainage and Flood Control Master Plan, which is prepared by the District as a specific element within the general plan of each agency. The Master Plan identifies urban and rural drainage area boundaries, computes runoff flows based on planned land use, identifies facility size and location, establishes street grades necessary to accomplish drainage of the runoff from the point of origin to the nearest collector facility, and identifies natural channels requiring preservation.

The FMFCD is responsible for reviewing all land use proposals for drainage and flood control needs and impacts, including evaluation of the proximity of development to floodplains, the need for the application of floodplain management requirements, the acceptability of proposed floodplain modifications' compliance with and implementation of the Master Plan, and the identification of stormwater quality best management practices.

In addition to the standards and requirements set forth by the FMFCD, a number of other federal, state, and local regulations must be adhered to when planning storm drain facilities. The management of surface water quality is regulated by a number of policies, which are also discussed in the following sections.

## 2.2 Federal Regulations

Clean Water Act[2]

The Federal Water Pollution Control Act of 1972, commonly referred to as the Clean Water Act (CWA), regulates the discharge of pollutants into watersheds throughout the United States. It is the primary federal law regulating and governing water pollution, with the objective of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. The CWA establishes the basic structure for regulating discharges if pollutants in waters of the United States and regulating quality standards for surface waters. Under the CWA., the EPA has implemented

[1] Fresno Metropolitan flood Control District, "2016 District Services Plan," 2016.
[2] Clean Water Act, 33 U.S.C. §1251 et seq. (1972).

pollution control programs, such as setting wastewater standards for industry, and developed national water quality criteria recommendations for pollutants in surface waters. The CWA makes it unlawful to discharge any pollutant from a point source into navigable waters, unless a permit was obtained via the National Pollutant Discharge Elimination System (NPDES).

National Pollutant Discharge Elimination System[3]

The National Pollutant Discharge Elimination System (NPDES) was established in the CWA to regulate point sources that discharge pollutants into waters of the United States; this includes stormwater runoff from a Municipal Separate Storm Sewer System (MS4) to surface waters. Stormwater runoff often carries pollutants, such as oil, pesticides, herbicides, trash, bacteria and heavy metals, which are some of the leading causes of water quality impairments. Storm water discharge is regulated under the NPDES permit for direct discharge into receiving waters and by the National Pretreatment Program for indirect discharge into sewage treatment plants. The NPDES permitting program delegates authority to state governments for implementation through State Water Boards. NPDES permits generally identify effluent and receiving water limits on allowable concentrations and/or mass emissions of pollutants contained in the discharge. Also included are prohibitions on discharges not specifically allowed under the permit, and provisions that describe required actions by the discharger, including industrial pretreatment, pollution prevention, and self-monitoring. All counties that have storm drain systems that service a population of 100,000 or more, as well as construction sites one (1) acre or larger, must file for and obtain an NPDES permit. Additionally, the EPA's Storm Water Phase I Final Rule requires an operator or a regulated municipal separate storm sewer system to develop, implement, and enforce a program to reduce pollutants in post-construction runoff to the City's storm drain system from new developments and redevelopment projects that result in land disturbance of (one) 1 or more acres, such as Best Management Practices (BMPs), ordinances, or other regulatory mechanisms.

National Flood Insurance Program

The Federal Emergency Management Agency (FEMA) is mandated to evaluate flood hazards as a result of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. FEMA provides Flood Insurance Rate Maps (FIRMs) for local and regional planners to promote efficient land and floodplain development and to identify potential flood areas based on current conditions. The National Flood Insurance Program provides flood insurance to homeowners, renters, and businesses, and works with communities to adopt and enforce floodplain management regulations that help mitigate flooding effects. FEMA completes Flood Insurance Studies to delineate a FIRMs.

## 2.3 State Regulations

California Porter-Cologne Water Quality Control Act[4]

The Porter-Cologne Water Quality Control Act is the principal law governing water quality in California, for both above- and below-ground supplies. This act designated the SWRCB as the statewide water quality planning agency, and gave authority to nine (9) Regional Water Quality Control Boards (RWQCB) to oversee water quality on a day-to-day basis at both the local and regional levels. RWQCBs develop Regional Water Quality Plans (Basin Plans), regulate all pollutant or nuisance discharges that may affect either surface or groundwater, and implementing said water quality plans. The Central Valley RWQCB oversees the Fresno area.

[3] Environmental Protection Agency (EPA), National Pollutant Discharge Elimination System (NPDES), 1972.
[4] California Porter-Cologne Water Quality Act, California Water Code Div. 7 §13000 et seq. (1969)

The Central Valley RWQCB issues and enforces NPDES permits in Fresno, which allows the RWQCB to regulate where and how waste is disposed, including the discharge volume and effluent limits of the waste and the monitoring and reporting responsibilities of the discharger. The RWQCB also conducts inspections of permitted discharges and monitors permit compliance.

Statewide General Construction Permit[5]

The SWRCB issued the General Construction Permit (GCP), Order No. 2012-0006-DWQ, which requires construction projects of one (1) acre or larger to file specific Permit Registration Documents with the SWRCB prior to beginning construction. The documents include a Notice of Intent, risk assessment, site map, Storm Water Pollution Prevention Plan (SWPPP), annual fee, and a signed certification statement. The SWPPP must include applicable Best Management Practices (BMP) to be enacted during construction to prevent soil erosion and discharge of other construction-related pollutants that could contaminate nearby water resources. The SWPPP must also include a visual monitoring plan, a chemical monitoring program for nonvisible pollutants, and a sediment monitoring plan. The GCP also includes post-construction runoff reduction requirements.

## 2.4 Local Regulations

Storm water management is mainly regulated by the Central Valley RWQCB and the FMFCD. There are other local regulations and planning documents that assist the City in overseeing storm water management and infrastructure.

Fresno General Plan[6]

The City's General Plan contains the following goals, policies, and objectives relevant to the provision of wastewater service and facilities (Table 2.1):

**Table 2.1 City of Fresno General Plan Objectives and Policies Relevant to Recycled Water Supply**

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| Policy NS-2-b | **Soil Analysis Requirement.** Identify areas with potential geologic and/or soils hazards, and require development in these areas to conduct a soil analysis and mitigation plan by a registered civil engineer (or engineering geologist specializing in soil geology) prior to allowing on-site drainage or disposal for wastewater, stormwater runoff, or swimming pool/spa water. |
| Objective NS-3 | Minimize the risks to property, life, and the environment due to flooding and stormwater runoff hazards. |
| Policy NS-3-a | **Stormwater Drainage and Flood Control Master Plan.** Support the full implementation of the FMFCD Storm Drainage and Flood Control Master Plan, the completion of planned flood control and drainage system facilities, and the continued maintenance of stormwater and flood water retention and conveyance facilities and capacities. Work with the FMFCD to make sure that |

[5] California State Water Resources Control Board(SWRCB), Order No. 2012-0006-DWQ, "National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities," 2012.

[6] City of Fresno, "Fresno General Plan," December 18, 2014.

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| | its Storm Drainage and Flood Control Master Plan is consistent with the General Plan. |
| Policy NS-3-b | **Curb and Gutter Installation.** Coordinate with Fresno Metropolitan Flood Control District (FMFCD) to install curbing, gutters, and other drainage facilities with priority to existing neighborhoods with the greatest deficiencies and consistent with the Storm Drainage and Flood Control Master Plan. |
| Policy NS-3-c | **Dual Use Facilities.** Support multiple uses of flood control and drainage facilities as follows:<br>• Use, wherever practical, FMFCD facilities for groundwater management and recharge; and<br>• Promote recreational development of ponding basin facilities located within or near residential areas, compatible with the stormwater and groundwater recharge functions. |
| Policy NS-3-e | **Pollutants.** Work with FMFCD to prevent and reduce the existence of urban stormwater pollutants pursuant to the requirements of the National Pollution Discharge Elimination Systems Act. |
| Policy NS-3-f | **Flooding Emergency Response Plans.** Work with responsible agencies to update emergency dam failure inundation plans, evacuation plans and other emergency response plans for designated flood-prone areas, including the San Joaquin riverbottom. |
| Policy NS-3-g | **Essential Facilities Siting Outside of Floodplains.** Avoid siting emergency response and essential public facilities, such as fire and police stations, within a 100-year floodplain, unless it can be demonstrated that the facility can be safely operated and accessed during flood events. |
| Policy NS-3-h | **Runoff Controls.** Implement grading regulations and related development policies that protect area residents from flooding caused by urban runoff produced from events that exceed capacity of the Storm Drainage and Flood Control Master Plan system of facilities. Place all structures and/or flood-proofing in a manner that does not cause floodwaters to be diverted onto adjacent property, increase flood hazards to other property, or otherwise adversely affect other property. |
| Policy NS-3-i | **New Development Must Mitigate Impact.** Require new development to not significantly impact the existing storm drainage and flood control system by imposing conditions of approval as project mitigation, as authorized by law. As part of this process, closely coordinate and consult with the FMFCD to identify appropriate conditions that will result in mitigation acceptable and preferred by FMFCD for each project. |
| Policy NS-3-k | **100-Year Floodplain Policy.** Require developers of residential subdivisions to preserve those portions of development sites as open space that may be subject to 100-year flood events, unless the flood hazard can be substantially mitigated by development project design. |
| Policy NS-3-l | **200-Year Floodplain Protection.** Promote flood control measures that maintain natural conditions within the 200-year floodplain of rivers and streams and, to the extent possible, combine flood control, recreation, water quality, and open space functions. Discourage construction of permanent improvements that would be adversely affected by periodic floods within the 200-year floodplain, particularly in the San Joaquin riverbottom. |

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| Policy NS-3-m | **Flood Risk Public Awareness.** Continue public awareness programs to inform the general public and potentially affected property owners of flood hazards and potential dam failure inundation. Remind households and businesses located in flood-prone areas of opportunities to purchase flood insurance. |
| Policy RC-6-f | **Regulate Sewage Disposal Facilities.** Oppose development of new sewage disposal facilities either within the Planning Area or upgradient (north and east) of the Planning Area, unless the treatment facilities produce effluent that:<br>• Will not degrade the aquifer in the long term;<br>• Will not introduce contaminants into surface water that would negatively affect its potential economic use for drinking water.<br>• Will not deleteriously affect downstream agricultural and urban uses; and<br>• Will not degrade sensitive riparian habitat. |

City of Fresno Municipal Code[7]

Article 7, "Urban Storm Water Quality Management and Discharge Control," of Chapter 6, "Municipal Services and Utilities," of the City of Fresno Municipal Code includes provisions regarding storm water discharge for the City. The purpose of the Storm Water Quality Management and Discharge Control Ordinance is to ensure the health, safety, and general welfare of citizens, and protect the water quality of water courses and water bodies in accordance with the Clean Water Act (CWA) by reducing pollutants in urban storm water discharges to the maximum practicable extent and by prohibiting non-stormwater discharges to the storm drain system.

FMFCD Post-Development Standards Technical Manual[8]

The FMFCD published a Post-Development Standards Technical Manual in 2014 to provide development and redevelopment standards to address stormwater quality requirements for projects in areas that do not drain to the Regional Stormwater Management Basin System. Per the manual, five (5) drainage areas in the FMFCD service area do not drain into a stormwater management basin, and two (2) areas outside the service area do not drain into a regional stormwater management basin. These post-development requirements were developed to comply with the MS4 Permit maintained for stormwater and non-stormwater discharges from MS4 to waters of the United States. The manual provides guidance and recommendations for implementing stormwater quality BMPs with the intention of improving water quality and mitigating potential water quality impacts from stormwater and non-stormwater discharges.

FMFCD Standard Plans and Specifications

The FMFCD maintains a set of standard Specifications and Plans intended to serve as requirements for FMFCD improvements and projects. The specifications and plans are maintained and published by FMFCD for use by designers and Contractors.

[7] City of Fresno Municipal Code, Chapter 6, "Municipal Services and Utilities, Article 7, "Urban Storm Water Quality Management and Discharge Control."
[8] Fresno Metropolitan Flood Control District, "Post-Development Standards Technical Manual," prepared by Larry Walker Associates, June 2014.

**CHAPTER 3**
**EXISTING CONDITIONS**

## 3.1 Storm Drainage Infrastructure

### 3.1.1 General

The Plan Area is located in the Upper Dry Subbasin of the Tulare-Buena Vista Lakes Watershed. The Tulare-Buena Vista Lakes Watershed generally consists of the drainage area of the San Joaquin Valley south of the San Joaquin River; this includes major population centers as Fresno, Bakersfield, Porterville, Hanford, Tulare, and Visalia. Encompassing approximately 10.5 million acres, water primarily flows through the watershed from the northeast to the southwest, from the Sierra Nevada to the San Joaquin Valley. Rivers in the basin typically end at the Tulare Lake and Buena Vista Lake in the western San Joaquin Valley, but some surface water can drain north to the San Joaquin River during years of extreme rainfall. The main rivers that produce surface waters within the basin include the Kings, Kaweah, Tule, and Kern Rivers. Additional suppliers of surface water in the basin area include the San Luis Canal/California Aqueduct System, Friant-Kern Canal, and the Delta-Mendota Canal, which contribute imported surface waters to the basin.9

The Upper Dry Subbasin is approximately 2,126 square miles in area, and encompasses much of western Fresno County and small portions of Kings and San Benito Counties. There are several streams that run throughout both the basin and subbasin, of which the major ones include Dry Creek, Dog Creek, and Fancher Creek. Drainage in much of the subbasin area has been utilized as agricultural irrigation supply through the engineering and construction of numerous canal and conveyance systems.

There are a number of flood control reservoirs that work to control flows and provide irrigation supplies; these include the Friant Dam, Mendota Dam, Pine Flat Dam, Redbank Dam, Big Dry Creek Dam, Fancher Creek Dam, Redbank Creek , Pup Creek, and the Alluvial Drain Detention Basins. These facilities, along with the numerous canals, convey discharges throughout the City of Fresno.

### 3.1.2 Fresno Metropolitan Flood Control District (FMFCD)

Stormwater collection in the City of Fresno is typically completed via FMFCD facilities. It begins with street gutters that collect and convey stormwater runoff to storm drain inlets. The runoff is collected in these inlets and delivered to FMFCD's pipe networks, pump stations, and infiltration basins for groundwater recharge. Most runoff is discharged into recharge basins, but during heavy rainfall events, excess runoff overflows into a system of relief channels and canals that discharge to the San Joaquin River, its tributary streams, local agricultural canals, and FID facilities.

FMFCD's Storm Drain Master Plan divides the District into many local drainage areas of one to two square miles throughout Fresno. All inlets, pipes, and pump stations within each drainage area are maintained by the District. The gutters, along with public streets and sidewalks, are maintained by the City of Fresno Street Maintenance Division. It is assumed that this maintenance agreement will remain in place for the foreseeable future. The District's Storm Drainage and Flood Control Master Plan includes 164 adopted or proposed drainage areas, with all but five (5) areas

[9] California Regional Water Quality Control Board Central Valley Region, "Water Quality Control Plan for the Tulare Lake Basin," Third Edition, May 2018.

served by a retention or detention facility.[10] FMFCD basins have been sized for capacities of two-year storms and for at least 60% of average rainfall [9]; FMFCD allows a 20% change in volume before basins need to be resized or relocated.[11]

Some portions of the Plan Area have been annexed by the FMFCD and are part of existing FMFCD drainage areas serving the Plan Area. These include:

- North SEDA (area bound between McKinley Avenue and the Gould Canal)
    - Drainage Area BS
        - Basin BS
        - Redbank Basin
    - Drainage Area DS
        - Drainage DS
- Central SEDA (area bound between Jensen and McKinley Avenues)
    - Drainage Area DV
        - Basin DV
    - Drainage Area BM
        - Basin BM
    - Drainage Area BL
        - Basin BL
- Southern SEDA (area bound between North and McKinley Avenues)
    - Drainage Area BG
        - Basin BG
    - Drainage Area CS
        - Basin CS

Drainage Areas DS and DV have existing basins that have been constructed, but the area has not been built out to master-planned conditions; these areas have been considered as proposed for analysis purposes.

The rest of the Plan Area is outside the District's service area and currently relies on other means of storm water drainage to control flooding. The District is developing drainage areas for the Plan Area, and these area will be discussed further in Chapter 4. See Figure 3.1 for the existing FMFCD drainage areas/facilities in the Plan Area.

### 3.1.3 Fresno Irrigation District (FID)

The FMFCD maintains groundwater recharge contracts with the Cities of Fresno and Clovis, as well as the FID to provide for dry season delivery of imported surface water into the District's local basins for detention/retention of water for groundwater recharge purposes. The District, along with several other entities, also maintains a Master Discharge Agreement with the FID to discharge stormwater into designated FID canals to prevent flooding. FMFCD may do so as long as they do not overtax canal capacities, cause damage, endanger personal property, deposit poor quality water, or interfere with the primary use of the FID system to transport and distribute irrigation water.

There are a number of existing FID facilities that cross the Plan Area, including canals and pipelines; these include, from northeast to southwest: Redbank Creek, the Gould Canal, the Gray Colony Canal, Dog Creek, the Mill Canal, the Temperance Canal, the Fancher Creek Canal, the Briggs Canal, the East Branch West Branch Canal, the Hansen Canal, and the Armstrong Canal.

[10] Fresno Metropolitan Flood Control District, "2016 District Services Plan," 2016.
[11] City of Fresno, Section 4.9, "Hydrology and Water Quality," "Southwest Fresno Specific Plan Draft EIR," August 2017.

These facilities currently serve portions of the Plan Area with irrigation water and stormwater runoff collection. There are a number of FID and private pipelines that help convey the irrigation water to users in the area. See Figure 3.2 for the existing FID facilities in the Plan Area.

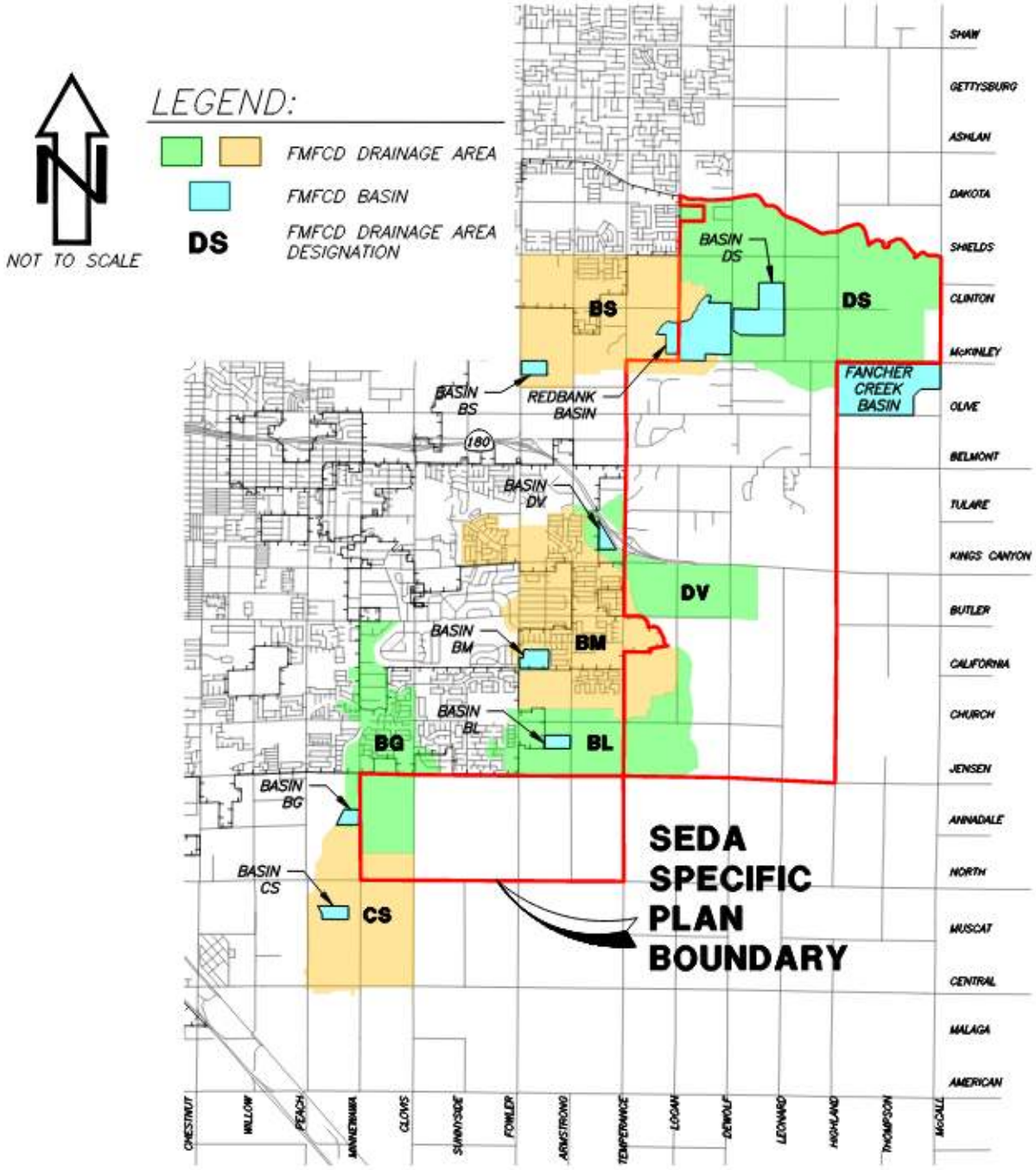



**Figure 3.1 Existing FMFCD Drainage Areas and Basins within SEDA**

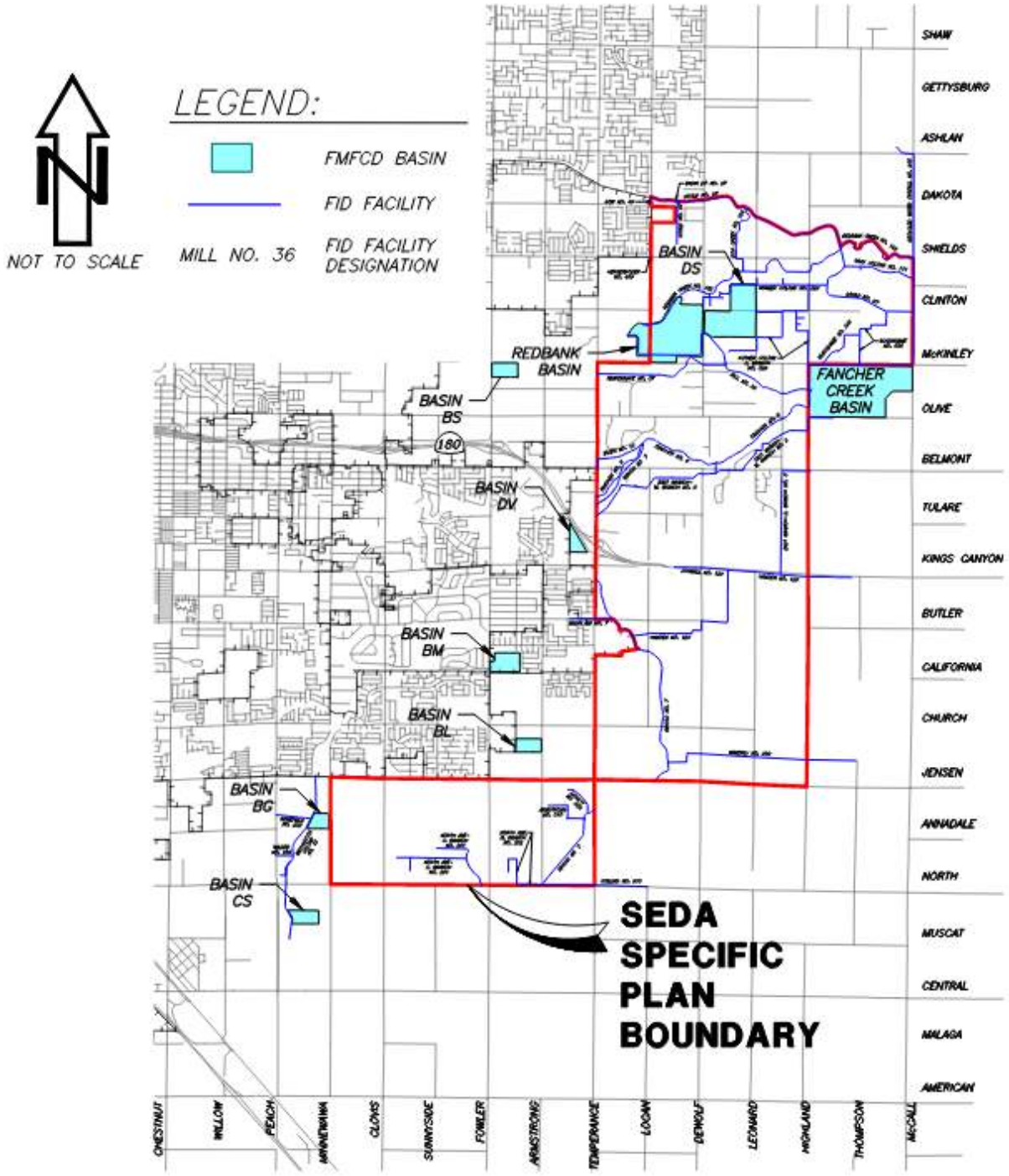



**Figure 3.2: Existing FID Facilities within SEDA**

# CHAPTER 4
# FUTURE STORM DRAIN INFRASTRUCTURE

## 4.1 General

The FMFCD's Storm Drainage and Flood Control Master Plan designates proposed improvements to the Plan Area to provide storm drain and flood control facilities for stormwater runoff. The FMFCD is currently developing proposed drainage areas and basins, along with facilities including inlets and pipelines, for the Plan Area, and all proposed improvements discussed in this chapter are preliminary and have not been officially approved and/or finalized.[12]

## 4.2 General Plan Policies

The General Plan discusses aspects of the storm drain and flood control systems as they pertain to development in Fresno. New storm drainage facilities are funded and constructed by owners/developers of properties pursuant to the City's drainage fee requirements in fresno Municipal Code §12-1901 et. Seq., or constructed by FMFCD themselves under publicly awarded contracts. The City requires all drainage to be directed toward public streets to allow stormwater to travel along paved surfaces and into FMFCD inlets. The FMFCD pipeline network is designed with a peak flow capacity to accommodate a two-year storm; the basin capacities are determined from a percentage of this two-year storm runoff, but with a volume of 6 inches of rainfall. All basins are also designed with relief systems so that dewatering can occur between rain events and additional capacity can be created.

Any infill project that increases the amount of impervious surfaces, changes existing drainage patterns, and/or generates storm flows faster/greater than the existing condition could result in overburdening of the existing stormwater collection system. New developments are required to mitigate any increase in runoff by either increasing the capacity of the system (e.g., build more infrastructure), or maintain all runoff onsite to ensure offsite runoff does not increase.

The City also utilizes drainage basins for groundwater recharge, as well as for passive and active recreational uses in residential areas. Several basins throughout Fresno have received improvements that encourage recreational use, such as baseball and playground areas. Basins also provide critical areas for open space and urban wildlife habitats.

Per Section 9.4, "Storm Drainage and Flood Control," of the General Plan, a portion of the SEDA Plan Area has not yet been annexed by the FMFCD, and therefore storm drain improvements were not designed at the time the General Plan was adopted. Storm Water Master Plans for the Plan Area were to be developed and adopted based on the General Plan requirements once all of SEDA was annexed by the District.

The General Plan includes two (2) locations of proposed storm drain basins within the Plan Area, of which both have been annexed and constructed. These include the Redbank Basin and Basin DS, both of which are located in the northern portion of the Plan Area (north of McKinley Avenue). See Figure 4.1 for the General Plan Land Use Map with the proposed basins shown.

[12] Wade, Denise, FMFCD Master Plan Special Projects Manager, Email to Blair, Church & Flynn, February 22, 2022.

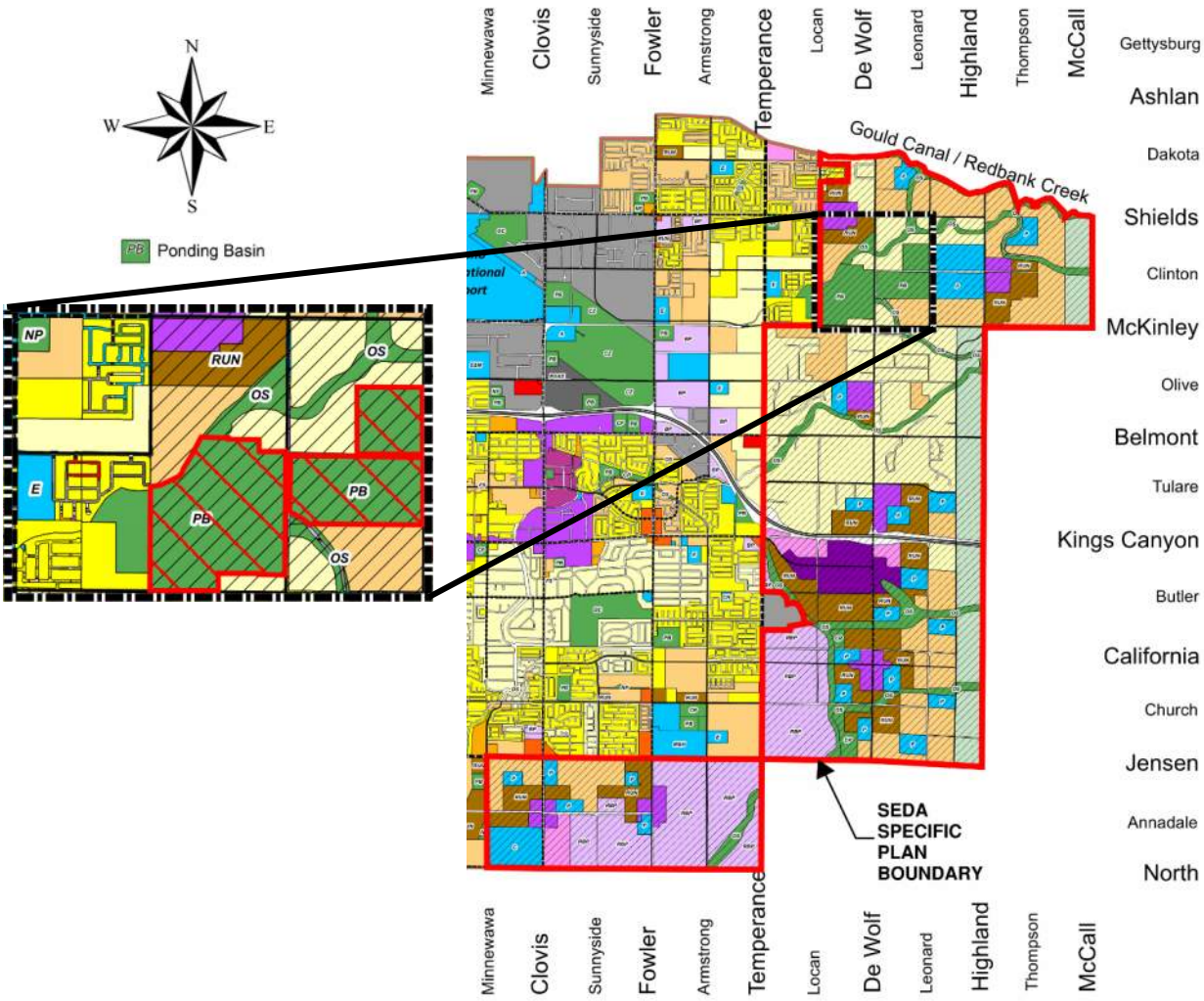



**Figure 4.1 General Plan Land Use within SEDA**

Source: City of Fresno, "Fresno General Plan," December 18, 2014.

## 4.3 Master Plan Improvements

In accordance with the Storm Drain and Flood Control Master Plan and other planning documents provided, the FMFCD is developing improvements for the Plan Area for storm drain facilities. As mentioned, the Plan Area encompasses all or part of the following existing drainage areas: BG, BL, BM, BS, CS, DS and, DV. Proposed drainage areas for SEDA include DT, DU, DW, DX, DY, and DZ. Most of the existing drainage areas include existing storm drain collection facilities, while the proposed drainage areas generally have no existing storm drain facilities. Areas DS and DV are the exceptions in that they are existing drainage areas with basins but have not yet been built out to master plan conditions. See Figure 4.2 for a map of existing and proposed drainage areas and basins.

FMFCD improvements include storm drain inlets and piping, which are being analyzed and developed in conjunction with the proposed land uses within the Plan Area. Those portions of the Plan Area encompassed in existing drainage areas include master planned utilities designed by FMFCD.

There are seven (7) existing basins contributing to storm water collection for the Plan Area, and six (6) proposed basins within the Plan Area. There are also two (2) existing basins outside of the Plan Area that are not part of existing drainage areas, including the Redbank Basin and the Fancher Creek Basin, that may contribute to additional drainage capacity; however, these two basins were not considered in this study. Drainage area acreages and basin capacities are listed in Table 4.1. FMFCD basins are designed for a capacity of a two-year storm and for at least 60 percent of average rainfall. Per the FMFCD, the proposed drainage areas for SEDA have not been adopted yet, and the basin locations have not been finalized; those presented here have been placed by FMFCD staff. The Specific Plan must be analyzed and evaluated for impacts on the aggregate area and each planned basin area; this analysis will be discussed in Chapter 5.

**Table 4.1 Drainage Areas and Basin Capacities**

| Drainage Area Designation | Drainage Area Size [A] (Acres) | Basin Volume [B] (Acre-Ft) |
|---|---|---|
| Existing Drainage Areas/Basins | | |
| BG | 755 | 232.1 |
| BL | 782 | 301.1 |
| BM | 1,519 | 390.4 |
| BS | 1,341 | 396.7 |
| CS | 854 | 346.5 |
| DS [C] | 1,960 | 1,383.3 |
| DV [C] | 505 | 230.0 |
| Proposed Drainage Areas/Basins | | |
| DT | 983 | 232.4 |
| DU | 1,307 | 323.8 |
| DW | 756 | 233.9 |
| DX | 879 | 304.5 |
| DY | 749 | 295.2 |
| DZ | 698 | 263.6 |

[A] Drainage areas obtained from GIS Shape files provided by FMFCD
[B] Basin volumes obtained from H&H calculation sheets provided by FMFCD
[C] Existing Drainage Area and basin but not yet built out

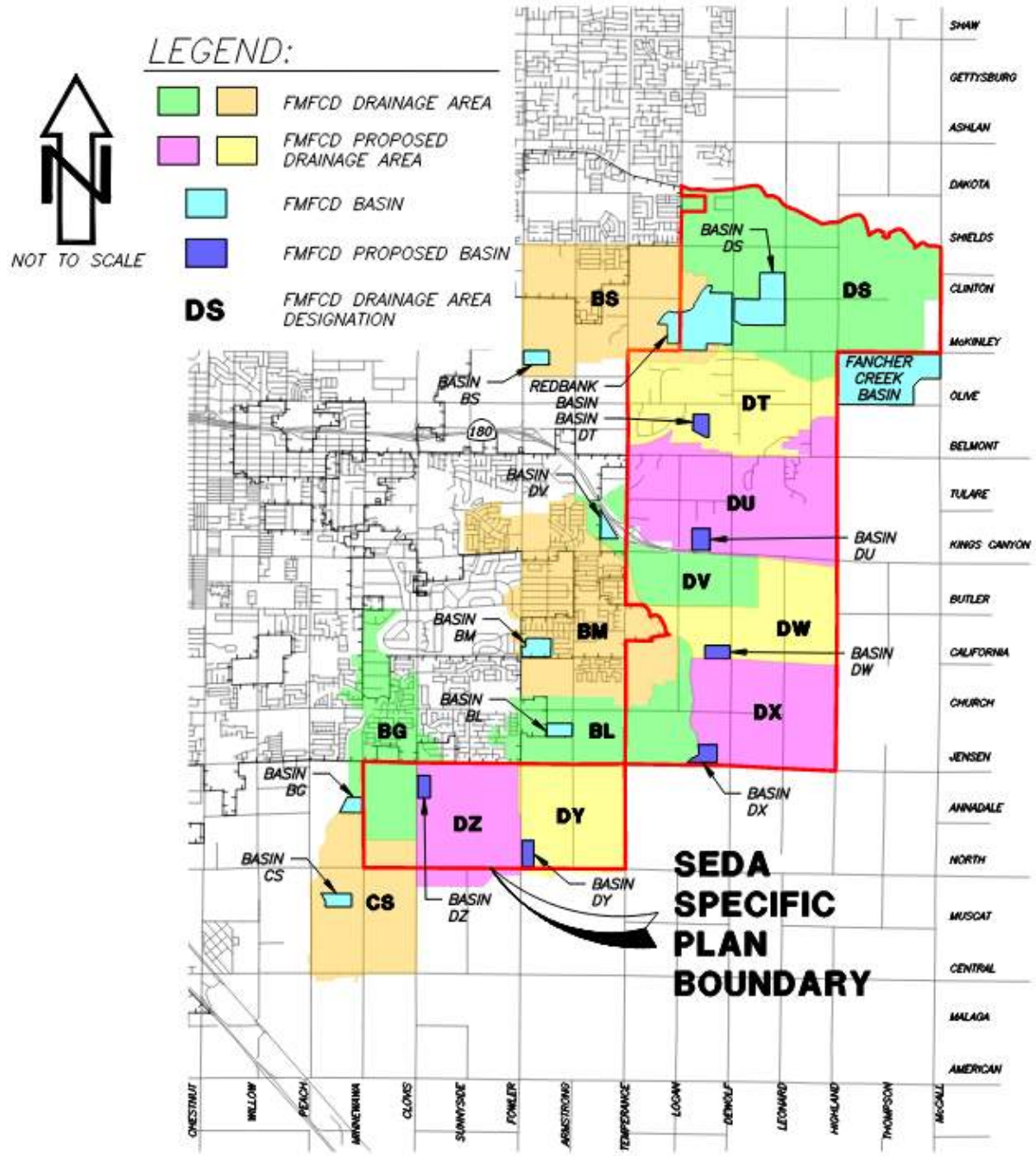



**Figure 4.2 Proposed FMFCD Drainage Areas and Basins in SEDA**

# CHAPTER 5
# SPECIFIC PLAN STORM DRAIN RUNOFF ANALYSIS

## 5.1 General

The SEDA Specific Plan revised the General Plan buildout land use classifications in the Plan Area to new SEDA-specific land use classifications – see Figure 5.1 for the General Plan Land Use Map of the Plan Area, and Figure 5.2 for the SEDA Specific Plan Land Use Map for the chosen alternative for the Plan Area. With changes in land use classifications, the Plan Area will need to be evaluated for impacts to the existing and proposed stormwater collection system due to changes in stormwater runoff.

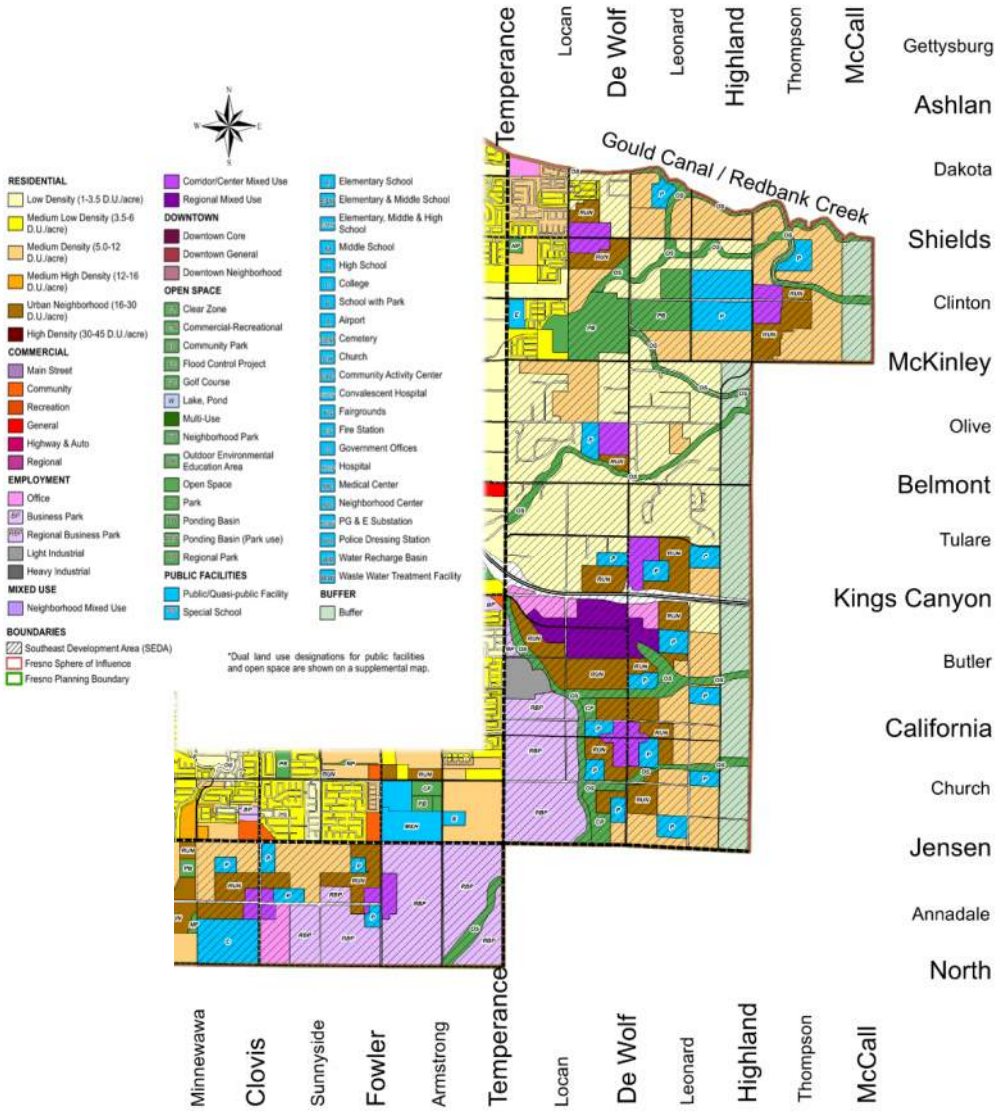
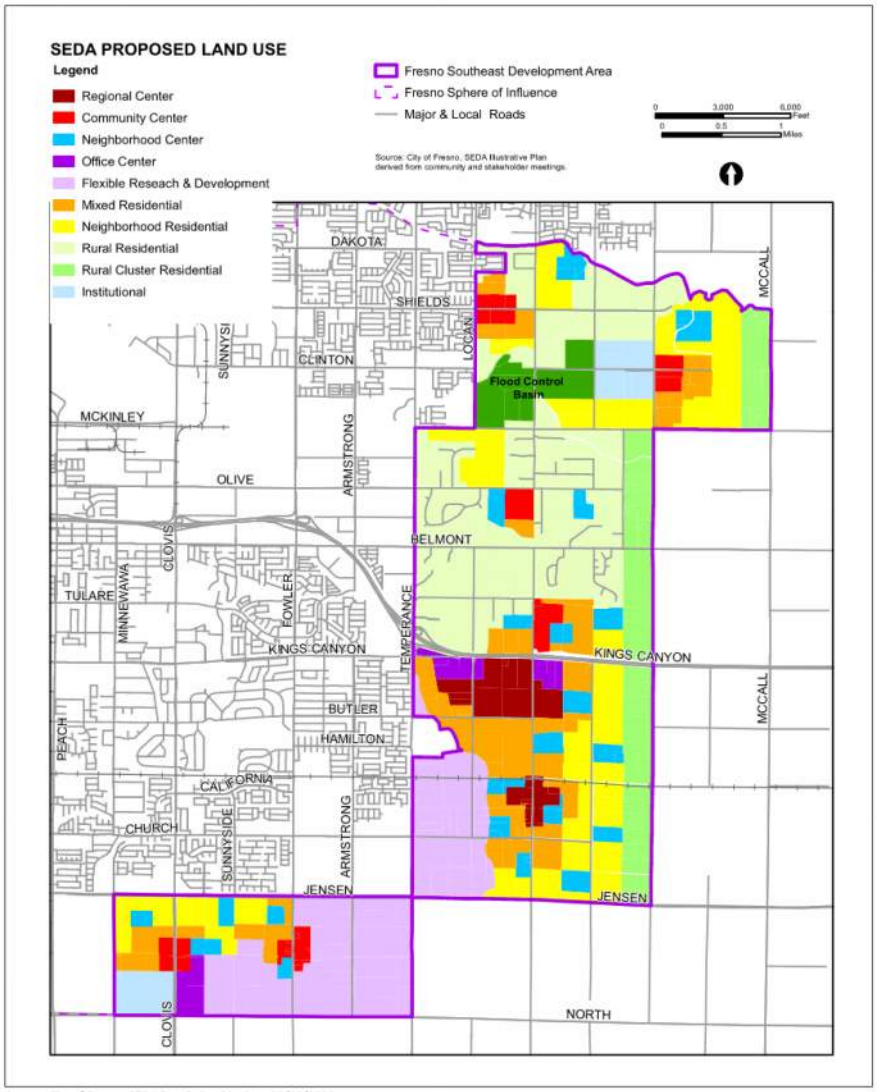



**Figure 5.1 General Plan Land Use Map for SEDA Plan Area**
Source: City of Fresno General Plan, Figure LU-1, December 2014, Figure Updated 3/2/2021



Source: City of Fresno, SEDA Regulating Districts, 02/10/2022.

**Figure 5.2 SEDA Proposed Land Use**
Source: Southeast Development Area Specific Plan Notice of Preparation,
First Carbon Solutions, 02/2022

Increases in CA values result in increased peak runoff rates, which can increase friction losses in pipes and lead to a decline in a collection system's ability to convey stormwater runoff from inlets to basins. This can cause flooding at the inlets and manholes of the collection system. Basins will also receive increased volumes of stormwater runoff that may surpass their design volumes, resulting in a deficit between what the basin can store and the amount of runoff produced. This may cause flooding of surrounding streets at the basins. Basins are designed with relief systems to help drain stored runoff in between storm events to maximize capacity during storm events.

The FMFCD grading design criteria requires that, to the greatest extent, water due to flooding at basins and inlets cannot exceed the finished floor of adjacent buildings before it can flow out of the catchment area for the basin or inlet. This is to ensure buildings are not flooded due to drainage collection or disposal system failures. This will be an important factor in future developments within the Plan Area.

## 5.2 Analysis Methodology

This analysis compares the Equivalent Areas (CA value) of each existing and proposed drainage area within SEDA between the General Plan Land Uses and the SEDA Specific Plan Land Uses. Generally speaking, the CA value is a measure of the imperviousness of an area, and is a product of the area (A) of a specific land use and its runoff factor (C). The drainage area, CA, is calculated as the sum of all individual land use areas multiplied by their runoff factors. The equivalent General Plan land uses for the SEDA land uses are shown in Table 5.1.

The technical analysis of the impacts of land use changes in the Plan Area was focused on comparing the changes in equivalent area for each drainage area of the General Plan to the Specific Plan to determine potential impacts to future storm drain collection systems and to assist in the development of mitigation measures if necessary. The methodology used to calculate the CA values for each case utilized land use data obtained from the City and design data from FMFCD. General Plan land use classifications and Specific Plan land use classifications were provided by the City of Fresno Planning and Development Department in the form of GIS (Geographic Information System) and Shape files. GIS and Shape files were also obtained from FMFCD for the existing drainage areas encompassed by the Plan Area.

For the General Plan land use analysis, the FMFCD's "Recommended Design C-Factors for the City of Fresno" was used. Not all land uses described in the General Plan are listed in this table, so some C-factors were estimated based on their description, while others were taken from FMFCD's hydraulic and hydrology spreadsheets when possible. Table 5.2 shows the C-factors used for the General Plan analysis.

The FMFCD is currently developing updated C Factors for the SEDA Specific Plan land use classifications; a set of preliminary values have been developed, and these were used in completing the SEDA Specific Plan analysis; see Table 5.3 for these C-factors.

[13].

**Table 5.1 General Plan–SEDA Equivalent Land Use Classifications**

| SEDA Specific Plan Land Use Classifications [A] | Equivalent General Plan Land Use Classification [B] |
|---|---|
| Residential – Mixed Residential | Residential – Urban Neighborhood |
| Residential – Neighborhood Residential | Residential – Medium Density |
| Residential – Rural Residential | Residential – Low Density |
| Residential – Rural Cluster Residential | Residential – Low Density |
| Employment – Office Center | Employment – Office |
| Employment – Flexible Research & Development | Employment – Business Park/ Regional Business Park |
| Employment – Institutional | Public Facilities – College/School with Park |
| Mixed Use – Regional Center | Mixed Use – Regional Mixed Use |
| Mixed Use – Community Center | Mixed Use – Corridor/Center Mixed Use |
| Mixed Use – Neighborhood Center | Public Facilities – Neighborhood Center |
| Open Space – Flood Control Basin | Open Space – Ponding Basin |
| Other | Streets/Railroad/Canals/Etc. |

[A] City of Fresno, "Notice of Preparation of a Program Environmental Impact Report for the Southeast Development Area Specific Plan, Fresno, California," February 22, 2022.
[B] City of Fresno, "Fresno General Plan," December 18, 2014.

[13] Blair, Church & Flynn, "Storm Drainage Technical Report for the City of Fresno General Plan Update MEIR," June 17, 2013.

**Table 5.2 FMFCD Recommended Design C-Factors**

| General Plan Land Use Classification | Equivalent FMFCD Land Use Classification | "C" Factor for 2 Year Return Period |
|---|---|---|
| Residential – Low Density | Low Density Residential (0-2 DU/ac) | 0.29 |
| Residential – Medium Low Density | Medium Low (2-5 DU/ac) | 0.29 |
| Residential – Medium Density | Medium Density (5-10 DU/ac) | 0.32 |
| Residential – Medium High Density | Medium-High Density (10-23 DU/ac) | 0.42 |
| Residential – Urban Neighborhood | High Density Residential (23-44 DU/ac) | 0.55 |
| Employment – Office | Office Commercial | 0.65 |
| Employment – Light Industrial | Light Industrial | 0.65 |
| Employment – Business Park | Heavy Industrial | 0.75 |
| Employment – Regional Business Park | | |
| Corridor-Center Mixed Use | Regional Shopping Center | 0.70 |
| Regional Mixed Use | Community Commercial | 0.70 |
| Public Facility | MDR-50 | 0.50 |
| Public Facility - Church | | |
| Public Facility - College | | |
| Public Facility – Elementary School | | |
| Public Facility – Middle & High School | | |
| Commercial – Community | Community Commercial | 0.70 |
| Open Space | Open Space | 0.20 |
| Open Space – Community Park | | |
| Open Space – Golf Course | | |
| Open Space – Neighborhood Park | | |
| Open Space – Park | | |
| Open Space – Ponding Basin | | |
| Open Space (Trail) | | |
| Canal | Open Space | 0.20 |
| Planned Road | Roads | 0.90 |
| Planned Trail | Open Space | 0.20 |
| Railroad | Railroad | 0.50 |
| SEGA Buffer | Rural Density Residential (0-0.7 DU/ac) | 0.29 |
| SEGA School with Park | MDR-50 | 0.50 |
| Roads | Roads | 0.90 |

**Table 5.3 SEDA "C" Factors**

| SEDA Specific Plan Land Use Classifications | FMFCD Land Use Classification | Runoff C-Factor |
|---|---|---|
| Residential – Mixed Residential | Mixed Residential | 0.46 |
| Residential – Neighborhood Residential | Neighborhood Residential | 0.52 |
| Residential – Rural Residential | Low Density (0-2 DU/ac) | 0.29 |
| Residential – Rural Cluster Residential | Rural Cluster Residential | 0.31 |
| Employment – Office Center | Office Center | 0.65 |
| Employment – Flexible Research & Development | Flexible Research & Development | 0.74 |
| Employment – Institutional | Institutional | 0.60 |
| Mixed Use – Regional Center | Community Commercial | 0.70 |
| Mixed Use – Community Center | Community Center | 0.67 |
| Mixed Use – Neighborhood Center | Neighborhood Center | 0.61 |
| Open Space – Flood Control Basin | Open Space | 0.20 |
| Other | Roads | 0.90 |

Since the drainage areas within the Plan Area are still under development, FMFCD provided design and analysis documents that included the basic drainage area information needed to complete the analysis, including drainage area size in acres and proposed basin volumes. GIS and Shape files were georeferenced to the California State Plane Coordinate System, Zone 4, Foot, NAD83 Datum for analysis. This allowed mapping of the land uses to pull information necessary to complete the analysis, including the area of each land use. The product of each land use area and its C factor was calculated and summed to determine the total Equivalent Area for the drainage area. This procedure was completed for the General Plan land uses and the Specific Plan land uses.

For both SEDA and General Plan areas, roads and some waterways were not included in the shape files provided, meaning the land use areas do not completely fill the basin boundary areas. Through visual inspection of aerial photography, we determined which areas were water. It was assumed that the remaining difference in areas were roads. Thus, road areas were calculated by finding the total land use areas (including water) and subtracting it from the basin boundary area.

The Equivalent Area data was used to evaluate the required storage capacity for each drainage area, and how this compared to the existing/proposed drainage basins in the plan Area. The analysis was separated into two categories – existing and proposed. This is because, as has been established in this study, some of the Plan Area is encompassed within existing drainage areas already established by FMFCD, and thus only a portion of that drainage area's total runoff is affected by the change in land use from General to Specific Plan. Additionally, the FMFCD has already completed runoff and volume calculations for these basins, which are already constructed and in use.

Analysis for the existing drainage areas consisted of calculating the increase in runoff volume for the portion of the existing drainage area locating within the Plan Area from the General Plan to the Specific Plan, and adding this increase to the FMFCD's calculated runoff volume for the whole existing drainage area. This combined runoff volume was then deducted from the design volume of the existing basin in said drainage area to determine the remaining basin volume available.

Analysis for the proposed drainage areas differed slightly from the existing analysis. Because the drainage areas and basins proposed for the Plan Area are preliminary, FMFCD calculations for

the drainage area runoffs were not used; instead, the GIS and shape files of the City's land uses and FMFCD's drainage areas and basins were used to develop independent calculations for the runoff volumes of each proposed drainage area based on the General Plan land uses. Thus, the area and volume values may differ slightly from those obtained from FMFCD. The proposed analysis consisted of calculating the runoff volume for each proposed drainage area based on the General Plan land uses and the Specific Plan land uses, then finding the difference between them to determine an increase in runoff volume due to the Specific Plan. This increase was used in conjunction with proposed basin volumes provided by FMFCD to determine how much the runoff collected by the basin changed, and what the remaining available capacity was for each basin.

Runoff volume for each drainage area was determined using similar methods as the FMFCD:

- Q = C x A x d x F
    - Q = Runoff Volume, ac-ft
    - A = Total area impacted by SEDA within a basin's boundary, ac
    - D = Rainfall depth (0.5 feet for all basins)
    - F = Safety Factor (FMFCD uses 1.2 for a 20% buffer)

## 5.3 Results

The total runoff volume was determined for each drainage area under the General Plan and Specific Plan. In general, all drainage areas experienced some amount of increase in runoff volume. See Table 5.4and Table 5.5 for the results of the analysis completed for the existing and proposed drainage areas, and Appendix A for a more detailed version of the analysis.

As shown, none of the existing basins exceed a 20% change in runoff volume, and all existing basins have sufficient capacity available to accommodate the increase in runoff volume as a result of the Specific Plan development.

With regards to the proposed basins, there are two (2) basins of concern – Basin DW and Basin DX. Basin DW experiences a 16.2% increase in runoff volume, and while this does not exceed the 20% threshold, it does exceed the available volume of the proposed basin by 12.8 acre-feet, meaning that FMFCD will need to reevaluate Basin DW's capacity. Basin DX has the opposite problem – while there is still 34 acre-feet of capacity available in the basin, the total runoff volume increased by 25.4%, which exceeds the 20% threshold. FMFCD will need to reevaluate either the basin's size or location to accommodate this increase in runoff.

There may be a number of reasons as to why some of the basins experienced higher increases in runoff volumes from the General Plan to the Specific Plan.

One reason could be that the SEDA boundary has increased from that shown in the General Plan, indicated by the increased area of total land uses. The total area of the General Plan land uses is 8,253.76 acres, while the total area of the Specific Plan land uses was found to be 8,325.57 acres – an increase of approximately 72 acres. This increase will lend itself to an increase in developed area which may have increase C values, as well as increases in land use areas that will contribute to an increase in runoff volume.

Another contributor to increased runoff volume is changes in land use classifications. For the most part, the land use classifications remained fairly similar in nature and category when transitioning from the General Plan to the Specific Plan. However, a few areas of land uses in drainage areas DW and DX changed to different land uses that have larger runoff factors; these include "Public Facilities – School with Park," and "Buffer." Per the SEDA Specific Plan land use map, all but one area defined as "School with Park" in the General Plan land use map changed to the SEDA

"Neighborhood Center" land use. Similarly, the areas denoted as "Buffer" land use in the General Plan changed to "Rural Custer Residential" in the SEDA Specific Plan.

Finally, many SEDA land uses increased in area from their General Plan counterparts seemingly due to the elimination of the "Open Space" land uses included in the General Plan for the Plan Area, which totaled approximately 617 acres. As shown in Figure 5.2, approximately 249 acres of "Open Space," and "Community Park" areas were removed from the Plan Area within Drainage Areas DW and DX, and those areas were absorbed by adjacent land uses, including various residential and mixed use land uses. Open Space land uses have a significantly smaller runoff factor than other land uses; consequently, this means that these Open Space areas were added to other land uses with larger runoff factors, thereby increasing the total runoff volume of Drainage Areas DW and DX within the SEDA Plan Area when compared to the General Plan buildout condition.

**Table 5.4 General Plan (GP) and Specific Plan (SP) Anticipated Runoff Volume for Existing Basins Encompassed within SEDA**

| Drainage Area | GP FMFCD Design Runoff Volume (ac-ft) | SP Runoff Volume Increase (ac-ft) | SP Runoff Volume Increase (%) | GP FMFCD Basin Design Volume (ac-ft) | Remaining Basin Volume (ac-ft) |
|---|---|---|---|---|---|
| BG | 213.2 | 8.50 | 4.0% | 232.1 | 10.4 |
| BL | 274.0 | 4.00 | 1.5% | 301.1 | 23.1 |
| BM | 379.3 | 0.46 | 0.1% | 390.4 | 10.7 |
| BS | 332.2 | 5.34 | 1.6% | 396.7 | 59.2 |
| CS | 310.4 | 4.75 | 1.5% | 346.5 | 31.3 |

**Table 5.5 General Plan (GP) and Specific Plan (SP) Anticipated Runoff Volume for**

| Drainage Area | GP Runoff Volume (ac-ft) | SP Runoff Volume Increase (ac-ft) | SP Runoff Volume Increase (%) | GP FMFCD Basin Design Volume (ac-ft) | Remaining Basin Volume (ac-ft) |
|---|---|---|---|---|---|
| DS | 433.8 | 85.2 | 19.6% | 1,383.3 | 864.3 |
| DT | 207.3 | 18.7 | 9.0% | 232.4 | 6.4 |
| DU | 305.0 | 3.8 | 1.3% | 323.8 | 15.0 |
| DV | 171.7 | 6.6 | 3.8% | 230.0 | 51.7 |
| DW | 212.3 | 34.4 | 16.2% | 233.9 | -12.8 |
| DX | 215.7 | 54.8 | 25.4% | 304.5 | 34.0 |
| DY | 279.9 | 10.4 | 3.7% | 295.2 | 4.9 |
| DZ | 237.4 | 11.1 | 4.7% | 263.6 | 15.1 |

**CHAPTER 6**
**IMPACTS AND MITIGATION**

## 6.1 SEDA Planning

Improvements within the Plan Area will require modifications to master planned storm drain facilities and infrastructure. These facilities are being designed and developed by FMFCD in close coordination with the City.

A draft policy document has been completed for the SEDA Specific Plan (March 2022), which includes updated policies for the Plan Area, and proposed improvements to meet the chosen alternative for development of the area. Included among these are policies directly related to storm drainage in the Plan Area.[14] These include:

**Table 6.1 SEDA Specific Plan Draft Policies Related to Recycled Water**

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| Policy UF-7.3 | Parking Design – Support vibrant, walkable, and accessible communities by successfully integrating and managing parking facilities within the urban fabric.<br>Minimize Heat Island Effect & Stormwater Runoff: Use planting, shading and paving techniques to minimize environmental impacts of parking facilities…<br>• Soil and planting materials on surface lots shall serve to:<br>o Arrest sediment movement<br>o Trap sediment-attached substances<br>o Encourage infiltration<br>o Encourage nutrient-fixing and absorption of flushed surface contaminants during detention and infiltration<br>o Enhance water-cooling effect by shading runoff during detention and infiltration<br>• Paving in high-density and commercial areas should consist of pervious pavement systems or equivalent technology, achieving a reduction of not less than 50% net impervious cover, for at least 50% of total pavement area as compared to a typical concrete or asphalt concrete system. |
| Policy OS-1.1 | Joint Use of Open Spaces – Establish agreements to share facilities between the City of Fresno and Fresno Metropolitan Flood Control District, Fresno Irrigation District, and other local and regional agencies and organizations. At a minimum, and as early as possible with respect to development plans, the City of Fresno shall:<br>• Establish joint-use agreements with the Fresno Metropolitan Flood Control District to provide access to storm drainage/recharge basins for recreational use, where appropriate.<br>• Establish joint-use agreements with the Fresno Irrigation District to provide public access to areas adjacent to canals and creeks. These agreements should address issues associated with the provision of canal side trails, where appropriate. |

[14] City of Fresno, "Southeast Development Area Specific Plan Policy Draft," March 2022.

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| Policy OS-2.3 | Stormwater Management Features – Maximize the use of green stormwater management infrastructure – such as ponds, basins, swales, and other low-impact systems – within the open space system.<br>*Coordinate with Fresno Metropolitan Flood Control District (FMFCD) to incorporate green infrastructure within city parks and trails.* |
| Policy PF-8.1 | Provision of Water, Stormwater, & Wastewater Infrastructure – Provide water, stormwater, and wastewater infrastructure in accordance with the policies of the Water Resources Element. Refer to the Water Resources Element for detailed information. |
| Policy RC-4.3 | Maximizing Groundwater Recharge – Establish integrated systems within the SEDA open space network to maximize recharge using stormwater, treated wastewater, and excess surface water supplies. Facilitate increased porosity and en-route stormwater recharge through the use of porous conveyance methods such as bioswales, naturalized channels, and layered basins. Recharge and related systems shall be addressed in the SEDA Infrastructure Assessment. |
| Policy RC-4.4 | Utilization of Recreation & Open Spaces as Groundwater Recharge Areas – Support recreation opportunities with a range of parks and multi-use trails by establishing joint-use agreements with Fresno Metropolitan Flood Control District to allow access to storm drainage/recharge basins for recreational use, when appropriate (see Open Space and Recreation Policy OS-1.2). |
| Policy RC-5.1 | Stormwater Runoff – Implement stormwater management practices that minimize stormwater runoff impacts on the Tulare Lake Watershed.<br>• *Compact Development*: Limit impervious cover by clustering new, higher density development within the SEDA, directing growth away from undeveloped portions of the watershed.<br>  o *Compact Development* – Reduce the building footprint and overall impervious surface to minimize lot coverage on a per unit basis.<br>  o *Parking demand management* – Reduce the demand for parking stalls to lower the amount of impervious surface (and environmental impacts).<br>• *Low Impact Development Practices*: Implement practices such as natural conveyance, bioswales, and raingardens that minimize, slow and filter street runoff and remove pollutants, lowering peak volume and reducing the size and cost of stormwater infrastructure.<br>  o Natural conveyance<br>  o Bioswales<br>  o Raingardens |
| Policy RC-5.2 | Hazardous Materials – Prevent contamination of the groundwater table and surface water resources.<br>• *Signage*: Install appropriate signage to deter the discharge of hazardous materials into storm drains.<br>• *Pollution Prevention*: Provide information to SEDA residents on appropriate ways to dispose of hazardous materials and chemicals.<br>• *Pesticide Reduction*: Discourage all pesticide use for agricultural and landscaping uses within the SEDA. |

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| | • *Remediation:* Encourage rapid clean-up of contaminated groundwater consistent with applicable laws and regulations. |
| Policy RC-5.3 | Construction Erosion – Prevent erosion on construction sites during storm events.<br>• *Erosion & Sedimentation Control Plan*: Require all construction projects to create and implement a plan using state and local best management practices for erosion and sedimentation control.<br>• *Runoff Control*: Prevent loss of soil by stormwater runoff and sedimentation of storm sewers or receiving streams. |
| Policy RC-6.3 | Flood Control & Stormwater Management – Evaluate and provide infrastructure to minimize community flood risk, enhance water quality, and provide locations for active recreation. Schematic designs will be included in the pending EIR-related water infrastructure planning tasks, as well as the SEDA Infrastructure Assessment.<br>Sub-Area or Development Proposal Delivery: Proposed stormwater systems shall be identified at the time of development project approval to the satisfaction of the City of Fresno. Systems must work within the requirements established in the pending EIR-related water infrastructure planning tasks, and the SEDA Infrastructure Assessment.<br>• Stormwater Runoff Reductions – The City of Fresno and the developer will identify specific reduction measures required for the development proposal to move forward.<br>• Detailed Engineering: Infrastructure planning and engineering will be conducted with the proposed demand reduction factors included. |
| Policy RC-6.4 | Shared Resources & Infrastructure – Develop methods and systems to share resources, infrastructure, and to capture the highest possible value for all public agencies. Resource-sharing strategies and plans shall be included in the SEDA Infrastructure Assessment.<br>• Water infrastructure Systems, Stormwater Systems, & Assessment: The Water Section of the Resource Conservation Element will include a full Infrastructure Assessment (Water Supply Assessment, or WAS), as well as trunk infrastructure diagrams for water, wastewater, and stormwater systems. This work is being completed by the Fresno Metropolitan Flood Control District, and the City's consultants as part of the preparation of the Environmental Impact Report (EIR) for the SEDA Plan. All this work and analysis will eventually be integrated into this, and other sections as required.<br>• Infrastructure Assessment: The WSA, currently underway as part of the SEDA EIR process, will include:<br>o Surface water analysis and allocation for the SEDA<br>o Groundwater analysis and allocation for the SEDA<br>o Recycled water systems analysis and planning for the SEDA<br>• Water Infrastructure Planning: Informed by the results of the WSA, infrastructure plans will describe the following components of the water, wastewater, and stormwater systems for the SEDA:<br>o Stormwater |

| Objective/Policy Number | Objective/Policy Text |
|---|---|
| | ▪ Stormwater plan map (including basins and conveyances)<br>▪ Size and design standards for infrastructure basins and features. |

## 6.2 5.2 Impacts of Significance

The proposed Specific Plan would result in a significant impact if it would:

1. Violate any water quality standards or waste discharge requirements (e.g. NPDES or RWQCB requirements) or otherwise substantially degrade surface or groundwater quality.

   The Plan Area will undergo development as the Specific Plan is enacted, which will result in various construction activities for new projects that could impact water quality through soil erosion and increased silt and debris discharged into runoff, or present risks to surface water quality through the use of construction materials such as fuel or solvents. These risks may result in contamination of stormwater. New projects 1 acre or larger in size will be required to comply with the General Construction Permit, Order No. 2012-0006-DWQ, issued by the SWRCB, and will need to develop and implement a Storm Water Pollution Prevention Plan (SWPPP) to estimate sediment risk from construction activities to receiving waters, and specify Best Management Practices (BMPs) that would be used by the project to minimize pollution of stormwater.

   The Plan Area will eventually be under the jurisdiction of the FMFCD for storm water and flood control management (portions of the Plan Area are currently within FMFCD boundaries, with the rest actively being developed and annexed). Operation of projects developed under the Specific Plan could produce the same contaminants that construction does. Water quality treatment for post-construction discharges to stormwater in the FMFCD urban flood control system area is provided by retention basins. Development in the FMFCD Master Plan area is exempt from further water quality requirements as long as the FMFCD's Storm Water Quality Management Plan is implemented. Storm drainage improvements are funded by local drainage fees paid by developments and constructed by either FMFCD, developers, or both. Basins are effective at reducing average concentrations of a broad range of contaminants via filtration through soil, and are bult to design criteria exceeding Statewide Standard Urban Stormwater Mitigation Plan standards. Construction and operational impacts would be less than significant.

2. Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin.

   The FMFCD is developing designs for proposed drainage areas and basins for the Plan Area, and some portions of the area are already served by existing drainage areas and basins. As developed by FMFCD, the Plan Area's storm drain system will include facilities to capture the runoff from proposed land uses and convey it to retention basins where it will infiltrate into the soil. As designed, basins have the capacity for a two-year storm and for at least 60 percent of average annual rainfall. The existing and proposed basins will encourage groundwater recharge through stormwater collection; the impact would be less than significant.

3. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through addition of impervious surfaces, in a manner which would:
    a. Result in a substantial erosion or siltation on- or off-site;

        The drainage pattern in the Plan Area would remain similar to the conditions established for drainage systems in the City's General Plan and FMFCD planning documents; runoff from developed properties would be conveyed to public streets and via curbs and gutters to storm drain inlets, and then through piping systems to FMFCD basins where the runoff would be stored and infiltrated into the soil. Retention basin capacities for the Plan Area are shown in Table 4.1. Proposed basins are being designed and sized for SEDA Specific Plan buildout, and per the analysis in this study may require additional storage in the form of new or expanded basins. Additionally, the FMFCD master plan includes many proposed storm drain facilities to be installed within the Plan Area and proposed drainage areas. Impacts would be less than significant.

        The main natural sources of erosion in the area are wind and flowing water. Erosion can be exacerbated by construction activities if effective erosion control measures are not in place. Siltation, the settling of sediment to the bed of a stream or lake, can result from soil erosion, and can negatively impact natural watercourses. Portions of the Plan Area are currently used for agriculture and the General Plan includes areas for open space. At buildout of the proposed Specific Plan, many of the areas will be developed with land uses consisting of buildings, paved areas, and landscaping. Bare soil on farmland is more susceptible to erosion than developed land. Though areas of the Specific Plan will maintain mixed use facilities for agriculture and open land uses, implementation of the Specific Plan is expected to not result in a significant increase of onsite erosion, and impacts would be less than significant as long as proper erosion control and SWPPP measures are carried out during and post-construction/development.

    b. Substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;

        Development as part of the Specific Plan will increase the amount of impervious surfaces onsite and thus increase runoff from the Plan Area. As discussed in Chapter 5, the buildout of the Specific Plan when compared to the General Plan would result in a net change of 248 ac-ft in expected runoff; FMFCD allows a 20 percent change in required basin volumes before the basin must be modified; as shown, the buildout of the Specific Plan results in a change in required volume of more than 20 percent in one basin (Basin DX), and the exceedance of one basin's proposed capacity (Basin DW). The basins in questions will need to be revised or resized in conjunction with those other basins proposed for the SEDA Plan Area and the master plan storm drain facilities.

        Minimum finish floor elevations in all developments under the Specific Plan would be required to be above flood pool elevations at affected sites, and such project would be designed and graded to not impede the flow of flood waters around or through the sites (per Fresno General Plan Policy NS-3-h). Proposed basins will be constructed to complete the proposed storm drain system. Development of the Specific Plan would not alter drainage patterns to cause flooding on or offsite, and the impacts would be less than significant.

c. Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial or additional sources of polluted runoff;

As stated above under 3.b, the buildout of the Specific Plan when compared to the General Plan would result in a net change of 248 ac-ft in expected runoff; FMFCD allows a 20 percent change in required basin volumes before the basin must be modified; as shown, the buildout of the Specific Plan results in a change in required volume of more than 20 percent in one basin (Basin DX), and the exceedance of one basin's proposed capacity (Basin DW). These two basins will need to be revised by resizing or relocating; impacts would be less than significant if these basins are revised.

As stated above under 1, construction and operational impacts would be less than significant with regards to runoff pollution as long as proper erosion control and SWPPP measures are carried out during and post-construction/development.

d. Impede or redirect flood waters.

As stated above in 3.a, the drainage pattern in the Plan Area would remain similar to the conditions established for drainage systems in the City's General Plan and FMFCD planning documents. Impacts would be less than significant

4. Risk release of pollutants due to project inundation in flood hazard, tsunami, or seiche zones.

Development within floodplains puts structures in danger of repeat flooding from sources of flooding; in Fresno, these sources include the San Joaquin River and a number of foothill creeks, including Big Dry Creek, Dry Creek Canal, Redbank Creek, Fancher Creek, and several other smaller tributaries. Additionally, there are regulatory facilities that help control said bodies of water, including the Big Dry Creek Dam and Reservoir, the Fancher creek Dam and Fancher Creek Detention Basin, and the Redbank Dam and Redbank Creek Detention Basin.

FEMA (Federal Emergency Management Agency) classifies areas into various zones according to the risks associated with flooding of said areas. The Plan Area includes the following zones:

- Zone X (Unshaded) – areas outside of the 500-year (0.2% annual chance) floodplain with minimal risk of flooding.
- Zone X (Shaded) – areas between the 100-year and 500-year floodplain with moderate risk of flooding; areas within the 500-year (0.2% annual chance) floodplain, areas within the 100-year (1% annual chance) floodplain with average depths of less than 1 foot or with drainage areas less than 1 square mile, and areas protected by levees from the 100-year (1% annual chance) flood.
- Zone A – A Special Flood Hazard Area (SFHA) within the 100-year (1% annual chance) floodplain with high risk of flooding; Base Flood Elevations (BFE) have not been determined.
- Zone AE – A Special Flood Hazard Area (SFHA) within the 100-year (1% annual chance) floodplain with high risk of flooding; Base Flood Elevations (BFE) have been determined.
- Zone A/AE, Regulatory Floodway – A Special Flood Hazard Area (SFHA) within the 100-year (1% annual chance) floodplain with high risk of flooding; the channel of a river or other watercourse and the adjacent land areas that must be reserved

in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

FEMA prepares Flood Insurance Rate Maps (FIRMS) to map flood zones in order to assist communities with floodplain management regulations and flood insurance requirements. FEMA has prepared multiple FIRMS for the City that show floodplain zones throughout Fresno and surrounding areas. According to the FIRMs that include SEDA, a majority of the Plan Area is outside the 100-year flood zones; most areas are located within Zone X (Unshaded). However, several areas in the northern portion of SEDA (north of California State Route 180) are within zones of higher flood chances, including Zones X (Shaded), A, AE, and A/AE Regulatory Floodplains; these areas are mainly adjacent to existing rivers, creeks, canals, or detention basins.

As shown on FIRM Number 06019C1595H, areas surrounding and along the Fancher Creek are within Zone X (Shaded), the area containing the Redbank Detention Basin is within Zone A, areas surrounding and along the Mill Ditch and Redbank Creek are within Zone AE, and a portion of the Redbank Creek along the northern SEDA border is defined as a Regulatory Floodplain.

FEMA developed the Flood Insurance Program (FIP), of which the City is a participant of, to communities to adopt FIRMS, appoint a trained Floodplain Administrator, adopt a floodplain ordinance modeled after the FIP model ordinance, and enforce the ordinance and the requirements of Title 40 of the Code of Federal Regulations (40 CFR – Protection of Environment), Subchapter D (Water Programs, parts 100 – 149). The City enforces these requirements through Chapter 11, Article 6 of the Fresno Municipal Code (Fresno Flood Plain Ordinance), which outlines specific requirements for floodproofing of structures. The Specific Plan include developments that will be located within these SFHAs; development within these areas will require significant floodproofing, and any required review and approval of the developments by the City, FMFCD, FEMA, and any other governing body. If developments follow the floodplain ordinance, and General Plan objectives and policies are implemented, impacts associated with flooding of developments within the 100-year floodplain would be less than significant.

The plan area is located approximately 6 miles south of Big Dry Creek Dam. An expanded drain was installed at the base of the downstream side of the dam in 2014 to prevent potential damage to the dam from seepage under the dam. The dam is also inspected annually by the California Department of Water Resources Division of Safety of Dams. Considering recent improvements and regular maintenance of the dam, the potential for dam failure is considered slight, and buildout of the Specific Plan would not exacerbate flood hazards due to dam inundation, and impacts would be less than significant. No areas in the Plan Area are mapped as protected from 100-year floods by levees, and thus buildout of the Specific Plan would not place people or structures in the Plan Area at risk of flooding due to levee failure; impacts would be less than significant.

A tsunami is an ocean wave caused by a sudden displacement of the ocean floor, most often due to an earthquake. The Plan Area is approximately 115 miles inland from the Pacific Ocean and is at elevation ranging from about 308 feet amsl (above mean sea level) at the southwest corner to 372 feet amsl at the northeast corner of the area. The Plan Area is not at risk of flooding due to a tsunami, and impacts would be less than significant.

A seiche is a surface wave created when an inland water body is shaken, usually by an earthquake. The nearest body of water capable of generating a seiche is Big Dry Creek Reservoir about 6 miles north of the Plan Area. The Plan Area is not at risk of flooding due to a seiche, and impacts would be less than significant.

5. Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan.

   As stated above under 1, construction and operational impacts would be less than significant with regards to runoff pollution as long as proper erosion control and SWPPP measures are carried out during and post-construction/development.

   As stated above under 2, no additional or expanded basins will be required beyond those proposed, and the existing and proposed basins will encourage groundwater recharge through stormwater collection; the impact would be less than significant.

6. Require or result in the relocation or construction of new or expanded storm water drainage facilities , the construction of which could cause significant environmental effects.

   As development of the Plan Area occurs under the Specific Plan, new and expanded storm drain facilities will be necessary to adequately accommodate the increase in stormwater flows due to an increase in impervious surfaces. Implementation of the Specific Plan would result in significant impact on existing drainage facilities. The transition from General Plan to Specific Plan, though, proposes a modest transfer of density and land uses throughout the Plan Area, which will modify the distribution of stormwater generation. Under both the General Plan and Specific Plan, stormwater generation will continue to increase as growth continues.

   The Plan Area does have master planned FMFCD utilities, including inlets, pipelines, basins, and drainage areas, which have been designed to accommodate the General Plan developments, and are being modified for the SEDA Specific Plan developments. As established in Chapter 5, the majority of the planned facilities will be sufficient to provide drainage for the Specific Plan improvements without significant environmental impacts, except for Basin DW and DX which will require reassessment and possibly resizing or relocation. FMFCD plans for drainage facilities but does not construct facilities until such time as development. Therefore, impacts related to the construction of new storm drain treatment facilities or expansion of baseline facilities would be less than significant.

   Mitigation measures related to storm drain systems are established and required in the FMFCD Master Plan and the City General Plan MEIR. Stormwater collection and handling must adhere to these mitigation measures.

## 6.3 Conclusions

City planning documents, including but not limited to the General Plan, and FMFCD Master Plan documents, will need to be updated to account for the development of the SEDA, and account for the policies and revisions present in the Specific Plan.

Mitigations for SEDA from the 2025 General Plan to the SEDA Specific Plan include:

a) Develop an update to the FMFCD Storm Drainage and Flood Control Master Plan.
b) Reassess and update SEDA drainage areas and associated basins.
c) Install master-planned storm drain facilities (inlets, pipes, manholes, etc.)
d) Construct proposed storm drain basins in Plan Area.

# Appendix A

Supporting Calculations

# Basin BG

Catchment Area Impacted by
SEDA (Acres): 248.52

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 17.63 | Regional Shopping Center | 12.34 | 7.40 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 90.43 | Medium Density (5-10 DU/acre) | 28.94 | 17.36 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 76.79 | High Density (23-44 DU/acre) | 42.23 | 25.34 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 0.00 | Office Commercial (OC) | 0.00 | 0.00 |
| Public Facility - College | 37.08 | *MDR-50 | 18.54 | 11.13 |
| Open Space | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 0.00 | Railroad | 0.00 | 0.00 |
| SEGA Buffer | 0.00 | Rural Density (0-0.7 DU/acre) | 0.00 | 0.00 |
| SEGA School with Park | 14.23 | *MDR-50 | 7.12 | 4.27 |
| | | | | |
| | | | | |
| Roads = 248.52 - Sum(Row5-22) | 12.36 | | 11.12 | 6.67 |

| | | | |
|---|---|---|---|
| Totals (Row5-25): | 236.16 | | |
| Totals check(Row 35-41): | 236.16 | | |
| Grand Total: | 248.52 | 120.29 | 72.17 |

**City of Fresno GIS Data**

| Planned Land Use Designation | AREA Square Feet | AREA Acres |
|---|---|---|
| Corridor - Center Mixed Use | 318351.032 | 7.3 |
| Corridor - Center Mixed Use | 449554.1694 | 10.3 |
| Public Facility - College | 1615363.932 | 37.1 |
| Residential - Medium Density | 3939151.455 | 90.4 |
| Residential - Urban Neighborhood | 1976162.571 | 45.4 |
| Residential - Urban Neighborhood | 1368654.263 | 31.4 |
| SEGA School with Park | 620014.4444 | 14.2 |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 21.92 | Community Center | 14.69 | 8.81 |
| Regional Center | 0.00 | Community Commercial | 0.00 | 0.00 |
| Rural Residential | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Neighborhood Residential | 90.39 | Neighborhood Residential | 47.00 | 28.20 |
| Mixed Residential | 78.56 | Mixed Residential | 36.14 | 21.68 |
| Flexible Reseach & Dev | 0.00 | Flexible Reseach & Dev | 0.00 | 0.00 |
| Office Center | 0.00 | Office Center | 0.00 | 0.00 |
| Institutional | 37.08 | Institutional | 22.25 | 13.35 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 0.00 | Rural Cluster Residential | 0.00 | 0.00 |
| Neighborhood Center | 14.23 | Neighborhood Center | 8.68 | 5.21 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Roads = 248.52 - Sum(Row5-15) | 6.33 | | 5.70 | 3.42 |

| | | | |
|---|---|---|---|
| Totals (Row5-25): | 242.19 | | |
| Totals check(Row 35-51): | 242.19 | | |
| Grand Total: | 248.52 | 134.46 | 80.68 |

**South East Development Area GIS Data**

| SEDA Land Use Designation | AREA Square Feet | AREA Acres |
|---|---|---|
| Neighborhood Center | 620014.1528 | 14.2 |
| Community Center | 441325.9625 | 10.1 |
| Community Center | 449554.7152 | 10.3 |
| Community Center | 64146.81362 | 1.5 |
| Institutional | 205954.8112 | 4.7 |
| Institutional | 1409410.031 | 32.4 |
| Mixed Residential | 226488.3359 | 5.2 |
| Mixed Residential | 33004.7502 | 0.8 |
| Mixed Residential | 167139.3305 | 3.8 |
| Mixed Residential | 1853185.982 | 42.5 |
| Mixed Residential | 1142160.354 | 26.2 |
| Neighborhood Residential | 474014.9778 | 10.9 |
| Neighborhood Residential | 534268.1394 | 12.3 |
| Neighborhood Residential | 307533.5408 | 7.1 |
| Neighborhood Residential | 1824150.244 | 41.9 |
| Neighborhood Residential | 600741.8441 | 13.8 |
| Neighborhood Residential | 196656.4626 | 4.5 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| **14.17** | **8.50** | **12%** |

# Basin BL

Catchment Area Impacted by
SEDA (Acres): 322.00

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 0.00 | Regional Shopping Center | 0.00 | 0.00 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 0.00 | Medium Density (5-10 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 0.00 | High Density (23-44 DU/acre) | 0.00 | 0.00 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 289.78 | *Heavy Industrial (M-3) | 217.33 | 130.40 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 0.00 | Office Commercial (OC) | 0.00 | 0.00 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 17.45 | Open Space (OS) | 3.49 | 2.09 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 0.78 | Railroad | 0.39 | 0.23 |
| SEGA Buffer | 0.00 | Rural Density (0-0.7 DU/acre) | 0.00 | 0.00 |
| SEGA School with Park | 0.00 | *MDR-50 | 0.00 | 0.00 |
| | | | | |
| Water | 0.00 | | | |
| Roads<br>= 322.00 - Sum(Row5-22) | 14.00 | | 12.60 | 7.56 |
| Totals (Row 5-25): | 308.00 | | | |
| Totals check (Row 36-42): | 308.00 | | | |
| Grand Total: | 322.00 | | 233.81 | 140.29 |

| City of Fresno GIS Data | | |
|---|---|---|
| Planned Land Use Designation | AREA | AREA |
| | Square Feet | Acres |
| Railroad | 34096.29946 | 0.78274333 |
| Employment - Regional Business Park | 377036.1641 | 8.655559322 |
| Employment - Regional Business Park | 1320690.482 | 30.31888159 |
| Open Space | 527343.3901 | 12.10613843 |
| Employment - Regional Business Park | 2271777.545 | 52.15283621 |
| Employment - Regional Business Park | 8653125.424 | 198.6484257 |
| Open Space | 232616.3489 | 5.340136568 |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 0.00 | Community Center | 0.00 | 0.00 |
| Regional Center | 0.00 | Community Commercial | 0.00 | 0.00 |
| Rural Residential | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Neighborhood Residential | 0.12 | Neighborhood Residential | 0.06 | 0.04 |
| Mixed Residential | 0.53 | Mixed Residential | 0.24 | 0.15 |
| Flexible Reseach & Dev | 306.33 | Flexible Reseach & Dev | 226.69 | 136.01 |
| Office Center | 0.00 | Office Center | 0.00 | 0.00 |
| Institutional | 0.00 | Institutional | 0.00 | 0.00 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 0.00 | Rural Cluster Residential | 0.00 | 0.00 |
| Neighborhood Center | 0.09 | Neighborhood Center | 0.06 | 0.03 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Water | 0.00 | | | |
| Roads<br>=322.00 - Sum(Row5-15) | 14.93 | | 13.44 | 8.06 |
| Totals (Row 5-25): | 307.07 | | | |
| Totals check (Row 36-82): | 308.02 | | | |
| Grand Total: | 322.00 | | 240.48 | 144.29 |

| South East Development Area GIS Data | | |
|---|---|---|
| SEDA Land Use Designation | AREA | AREA |
| | Square Feet | Acres |
| Mixed Residential | 215.1461909 | 0.004939077 |
| Mixed Residential | 1130.235735 | 0.025946642 |
| Mixed Residential | 1384.500257 | 0.031783752 |
| Mixed Residential | 322.7493189 | 0.007409305 |
| Flexible Reseach & Dev | 362973.4273 | 8.332723307 |
| Mixed Residential | 487.0722759 | 0.011181641 |
| Mixed Residential | 1048.401183 | 0.024067979 |
| Mixed Residential | 512.7368059 | 0.011770817 |
| Flexible Reseach & Dev | 8522.850824 | 0.195657732 |
| Mixed Residential | 595.7038072 | 0.013675478 |
| Mixed Residential | 72.72043017 | 0.001669431 |
| Flexible Reseach & Dev | 134915.512 | 3.097233977 |
| Flexible Reseach & Dev | 216186.7314 | 4.962964448 |
| Flexible Reseach & Dev | 213546.8294 | 4.902360639 |
| Flexible Reseach & Dev | 243332.2297 | 5.58613934 |
| Flexible Reseach & Dev | 300.0198701 | 0.006887508 |
| Flexible Reseach & Dev | 255197.8796 | 5.858537182 |
| Flexible Reseach & Dev | 100367.4186 | 2.304118885 |
| Flexible Reseach & Dev | 106258.8376 | 2.439367254 |
| Flexible Reseach & Dev | 106837.0671 | 2.452641578 |
| Flexible Reseach & Dev | 55.66158321 | 0.001277814 |
| Flexible Reseach & Dev | 173685.2173 | 3.987263941 |
| Flexible Reseach & Dev | 270601.3684 | 6.212152627 |
| Flexible Reseach & Dev | 36734.86293 | 0.843316412 |
| Flexible Reseach & Dev | 416567.1922 | 9.563066856 |
| Flexible Reseach & Dev | 133778.6584 | 3.071135408 |
| Neighborhood Residential | 37.62668571 | 0.00086379 |
| Flexible Reseach & Dev | 364169.7004 | 8.36018596 |
| Neighborhood Residential | 5088.487416 | 0.116815597 |
| Flexible Reseach & Dev | 118154.2107 | 2.712447444 |
| Flexible Reseach & Dev | 1291508.412 | 29.64895345 |
| Flexible Reseach & Dev | 2048776.226 | 47.03343035 |
| Flexible Reseach & Dev | 409301.2818 | 9.396264505 |
| Flexible Reseach & Dev | 611252.9732 | 14.0324374 |
| Flexible Reseach & Dev | 92619.18669 | 2.126243955 |
| Flexible Reseach & Dev | 418565.3447 | 9.608938124 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| **6.67** | **4.00** | **3%** |

| | | |
|---|---|---|
| No Value | 41377.29077 | 0.949891891 |
| Flexible Reseach & Dev | 215985.0342 | 4.958334118 |
| Neighborhood Center | 3970.954896 | 0.091160581 |
| Flexible Reseach & Dev | 175317.5284 | 4.024736649 |
| Flexible Reseach & Dev | 810210.1828 | 18.59986645 |
| Flexible Reseach & Dev | 834440.3303 | 19.1561141 |
| Neighborhood Residential | 25.35820066 | 0.000582144 |
| Flexible Reseach & Dev | 823193.062 | 18.89791235 |
| Mixed Residential | 17426.80011 | 0.400064282 |
| Flexible Reseach & Dev | 1040972.349 | 23.89743684 |
| Flexible Reseach & Dev | 1309457.897 | 30.06101691 |

# Basin BM

Catchment Area Impacted by SEDA (Acres): 188.32

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 0.00 | Regional Shopping Center | 0.00 | 0.00 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 0.00 | Medium Density (5-10 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 0.00 | High Density (23-44 DU/acre) | 0.00 | 0.00 |
| Employment - Business Park | 12.78 | *Heavy Industrial (M-3) | 9.58 | 5.75 |
| Employment - Regional Business Park | 160.45 | *Heavy Industrial (M-3) | 120.34 | 72.20 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 0.00 | Office Commercial (OC) | 0.00 | 0.00 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 5.07 | Open Space (OS) | 1.01 | 0.61 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 3.59 | Railroad | 1.79 | 1.08 |
| SEGA Buffer | 0.00 | Rural Density (0-0.7 DU/acre) | 0.00 | 0.00 |
| SEGA School with Park | 0.00 | *MDR-50 | 0.00 | 0.00 |
| | | | | |
| Water | 0.00 | | | |
| Roads =188.32 - Sum(Row5-15) | 6.43 | | 5.79 | 3.47 |

Totals (Row 5-25): 181.88
Totals check (Row36-45): 246.57

Grand Total: 188.32 138.52 83.11

**City of Fresno GIS Data**

| Planned Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Open Space | 31288.28941 | 0.7 |
| Open Space | 373.5063682 | 0.0 |
| Employment - Regional Business Park | 4443134.181 | 102.0 |
| Railroad | 156211.2625 | 3.6 |
| Employment - Regional Business Park | 2546139.217 | 58.5 |
| Open Space | 31731.317 | 0.7 |
| Employment - Business Park | 556545.878 | 12.8 |
| Open Space | 157340.1257 | 3.6 |
| ~~Employment - Light Industrial~~ | ~~2817871.803~~ | |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 0.00 | Community Center | 0.00 | 0.00 |
| Regional Center | 0.00 | Community Commercial | 0.00 | 0.00 |
| Rural Residential | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Neighborhood Residential | 0.00 | Neighborhood Residential | 0.00 | 0.00 |
| Mixed Residential | 0.83 | Mixed Residential | 0.38 | 0.23 |
| Flexible Reseach & Dev | 177.39 | Flexible Reseach & Dev | 131.27 | 78.76 |
| Office Center | 0.00 | Office Center | 0.00 | 0.00 |
| Institutional | 0.00 | Institutional | 0.00 | 0.00 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 0.00 | Rural Cluster Residential | 0.00 | 0.00 |
| Neighborhood Center | 0.00 | Neighborhood Center | 0.00 | 0.00 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| No Value | 3.64 | Railraod | 1.82 | 1.09 |
| | | | | |
| | | | | |
| | | | | |
| Water | 0.00 | | | |
| Roads =188.32 - Sum(Row5-15) | 6.45 | | 5.81 | 3.48 |

Totals (Row 5-25): 181.86
Totals check (Row36-65): 181.86

Grand Total: 188.32 139.28 83.57

**South East Development Area GIS Data**

| SEDA Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Mixed Residential | 434.4155206 | 0.01 |
| Mixed Residential | 31288.50015 | 0.72 |
| Mixed Residential | 14.88610306 | 0.00 |
| Mixed Residential | 477.3342314 | 0.01 |
| Flexible Reseach & Dev | 112364.6504 | 2.58 |
| Flexible Reseach & Dev | 201364.5703 | 4.62 |
| Flexible Reseach & Dev | 199014.0181 | 4.57 |
| Mixed Residential | 667.9870436 | 0.02 |
| Flexible Reseach & Dev | 102899.9885 | 2.36 |
| Mixed Residential | 3089.59024 | 0.07 |
| Mixed Residential | 372.5425372 | 0.01 |
| Mixed Residential | 1.015040097 | 0.00 |
| Flexible Reseach & Dev | 359571.6911 | 8.25 |
| Flexible Reseach & Dev | 36628.23522 | 0.84 |
| Flexible Reseach & Dev | 314539.8141 | 7.22 |
| Flexible Reseach & Dev | 77406.36687 | 1.78 |
| Flexible Reseach & Dev | 8958.590626 | 0.21 |
| Flexible Reseach & Dev | 18.2845006 | 0.00 |
| Flexible Reseach & Dev | 813475.0382 | 18.67 |
| Flexible Reseach & Dev | 1472813.914 | 33.81 |
| Flexible Reseach & Dev | 263.0631197 | 0.01 |
| Flexible Reseach & Dev | 871313.7327 | 20.00 |
| Flexible Reseach & Dev | 76341.87283 | 1.75 |
| Flexible Reseach & Dev | 771375.0745 | 17.71 |
| No Value | 158394.644 | 3.64 |
| Flexible Reseach & Dev | 1295225.728 | 29.73 |
| Flexible Reseach & Dev | 654987.1312 | 15.04 |
| Flexible Reseach & Dev | 1457307.325 | 33.46 |
| | | |
| Flexible Reseach & Dev | -1098694.819 | -25.22 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| **0.76** | **0.46** | **1%** |

# Basin BS

Catchment Area Impacted by SEDA (Acres): 260.29

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 0.00 | Regional Shopping Center | 0.00 | 0.00 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 17.26 | Low Density (0-2 DU/acre) | 5.01 | 3.00 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 84.95 | Medium Density (5-10 DU/acre) | 27.18 | 16.31 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 0.00 | High Density (23-44 DU/acre) | 0.00 | 0.00 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 0.00 | Office Commercial (OC) | 0.00 | 0.00 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 3.22 | Open Space (OS) | 0.64 | 0.39 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 149.33 | Open Space (OS) | 29.87 | 17.92 |
| Railroad | 0.00 | Railroad | 0.00 | 0.00 |
| SEGA Buffer | 0.00 | Rural Density (0-0.7 DU/acre) | 0.00 | 0.00 |
| SEGA School with Park | 0.00 | *MDR-50 | 0.00 | 0.00 |
| | | | | |
| Water | 0.00 | | | |
| Roads =260.29 - Sum(Row5-15) | 5.53 | | 4.98 | 2.99 |
| Totals (Row 5-25): | 254.76 | | | |
| Totals check (Row36-46): | 254.76 | | | |
| Grand Total: | 260.29 | | 67.68 | 40.61 |

**City of Fresno GIS Data**

| Planned Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Residential - Low Density | 1183.927465 | 0.03 |
| Residential - Low Density | 300838.8573 | 6.91 |
| Residential - Medium Density | 1945544.61 | 44.66 |
| Residential - Low Density | 142414.5145 | 3.27 |
| Residential - Low Density | 116789.2063 | 2.68 |
| Open Space | 140144.7304 | 3.22 |
| Residential - Low Density | 190682.013 | 4.38 |
| Open Space - Ponding Basin | 7735420.549 | 177.58 |
| Residential - Medium Density | 1754977.236 | 40.29 |
| Open Space - Ponding Basin | -1230667.512 | -28.25 |
| ~~Residential - Medium Low Density~~ | ~~1068372.058~~ | |
| ~~Residential - Medium Low Density~~ | ~~79386.35718~~ | |
| ~~Residential - Medium Low Density~~ | ~~271154.0297~~ | |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 0.00 | Community Center | 0.00 | 0.00 |
| Regional Center | 0.00 | Community Commercial | 0.00 | 0.00 |
| Rural Residential | 52.53 | Low Density (0-2 DU/acre) | 15.23 | 9.14 |
| Neighborhood Residential | 49.37 | Neighborhood Residential | 25.67 | 15.40 |
| Mixed Residential | 0.00 | Mixed Residential | 0.00 | 0.00 |
| Flexible Reseach & Dev | 0.00 | Flexible Reseach & Dev | 0.00 | 0.00 |
| Office Center | 0.00 | Office Center | 0.00 | 0.00 |
| Institutional | 0.00 | Institutional | 0.00 | 0.00 |
| Park_OS_FloodControl | 152.68 | Open Space (OS) | 30.54 | 18.32 |
| Rural Cluster Residential | 0.00 | Rural Cluster Residential | 0.00 | 0.00 |
| Neighborhood Center | 0.00 | Neighborhood Center | 0.00 | 0.00 |
| | | | | |
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| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Water | 0.00 | | | |
| Roads =260.29 - Sum(Row5-15) | 5.71 | | 5.14 | 3.08 |
| Totals (Row 5-25): | 254.58 | | | |
| Totals check (Row36-72): | 254.58 | | | |
| Grand Total: | 260.29 | | 76.58 | 45.95 |

**South East Development Area GIS Data**

| SEDA Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Rural Residential | 275.556951 | 0.01 |
| Rural Residential | 887.4387904 | 0.02 |
| Neighborhood Residential | 1.413990371 | 0.00 |
| Neighborhood Residential | 404.28945 | 0.01 |
| Park_OS_FloodControl | 831290.5503 | 19.08 |
| Park_OS_FloodControl | 177603.7938 | 4.08 |
| Mixed Residential | 4.215678275 | 0.00 |
| Neighborhood Residential | 109662.7723 | 2.52 |
| Rural Residential | 212663.1192 | 4.88 |
| Rural Residential | 356.0999362 | 0.01 |
| Rural Residential | 1333.900221 | 0.03 |
| Neighborhood Residential | 744334.0298 | 17.09 |
| Rural Residential | 125329.4753 | 2.88 |
| Rural Residential | 15119.46326 | 0.35 |
| Rural Residential | 83051.1117 | 1.91 |
| Rural Residential | 25748.74874 | 0.59 |
| Rural Residential | 296.491578 | 0.01 |
| Rural Residential | 82477.01139 | 1.89 |
| Rural Residential | 90850.18603 | 2.09 |
| Rural Residential | 176418.3332 | 4.05 |
| Rural Residential | 63.59468293 | 0.00 |
| Park_OS_FloodControl | 10146.621 | 0.23 |
| Park_OS_FloodControl | 4053.492783 | 0.09 |
| Rural Residential | 1003973.26 | 23.05 |
| Park_OS_FloodControl | 123436.5213 | 2.83 |
| Park_OS_FloodControl | 904145.7385 | 20.76 |
| Rural Residential | 116789.0385 | 2.68 |
| Park_OS_FloodControl | 1116512.635 | 25.63 |
| Neighborhood Residential | 217590.4349 | 5.00 |
| Rural Residential | 211277.1655 | 4.85 |
| Rural Residential | 39693.42244 | 0.91 |
| Rural Residential | 17977.76703 | 0.41 |
| Rural Residential | 83785.21764 | 1.92 |
| Neighborhood Residential | 216000.0892 | 4.96 |
| Neighborhood Residential | 862466.8282 | 19.80 |
| Park_OS_FloodControl | 865655.9748 | 19.87 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| **8.90** | **5.34** | **13%** |

| | | |
|---|---|---|
| Park_OS_FloodControl | 2618015.943 | 60.10 |

# Basin CS

Catchment Area Impacted by
SEDA (Acres): 80.08

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 0.00 | Regional Shopping Center | 0.00 | 0.00 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 0.00 | Medium Density (5-10 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 0.00 | High Density (23-44 DU/acre) | 0.00 | 0.00 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 0.00 | Office Commercial (OC) | 0.00 | 0.00 |
| Public Facility - College | 79.17 | *MDR-50 | 39.59 | 23.75 |
| Open Space | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 0.00 | Railroad | 0.00 | 0.00 |
| SEGA Buffer | 0.00 | Rural Density (0-0.7 DU/acre) | 0.00 | 0.00 |
| SEGA School with Park | 0.00 | *MDR-50 | 0.00 | 0.00 |
| | | | | |
| Water | 0.00 | | | |
| Roads<br>= 80.08 - Sum(Row5-22) | 0.91 | | 0.82 | 0.49 |

| | | | |
|---|---|---|---|
| Totals (Row5-25): | 79.17 | | |
| Totals check(Row 36): | 79.17 | | |
| Grand Total: | 80.08 | 40.40 | 24.24 |

**City of Fresno GIS Data**

| Planned Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Public Facility - College | 3448709.476 | 79.17 |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 0.00 | Community Center | 0.00 | 0.00 |
| Regional Center | 0.00 | Community Commercial | 0.00 | 0.00 |
| Rural Residential | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Neighborhood Residential | 0.00 | Neighborhood Residential | 0.00 | 0.00 |
| Mixed Residential | 0.00 | Mixed Residential | 0.00 | 0.00 |
| Flexible Reseach & Dev | 0.00 | Flexible Reseach & Dev | 0.00 | 0.00 |
| Office Center | 0.00 | Office Center | 0.00 | 0.00 |
| Institutional | 79.17 | Institutional | 47.50 | 28.50 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 0.00 | Rural Cluster Residential | 0.00 | 0.00 |
| Neighborhood Center | 0.00 | Neighborhood Center | 0.00 | 0.00 |
| | | | | |
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| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Water | 0.00 | | | |
| Roads<br>= 80.08 - Sum(Row5-22) | 0.91 | | 0.82 | 0.49 |

| | | | |
|---|---|---|---|
| Totals (Row5-25): | 79.17 | | |
| Totals check(Row 36-38): | 79.17 | | |
| Grand Total: | 80.08 | 48.32 | 28.99 |

**South East Development Area GIS Data**

| SEDA Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Mixed Residential | 5.267727096 | 0.00012 |
| Institutional | 3018487.701 | 69.3 |
| Institutional | 430220.7426 | 9.9 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| | | |
| **7.92** | **4.75** | **20%** |

# Basin DS

Catchment Area Impacted by SEDA (Acres): 1934.94

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 95.15 | Regional Shopping Center | 66.61 | 39.96 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 313.03 | Low Density (0-2 DU/acre) | 90.78 | 54.47 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 628.03 | Medium Density (5-10 DU/acre) | 200.97 | 120.58 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 169.22 | High Density (23-44 DU/acre) | 93.07 | 55.84 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 0.00 | Office Commercial (OC) | 0.00 | 0.00 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 185.45 | Open Space (OS) | 37.09 | 22.25 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 113.68 | Open Space (OS) | 22.74 | 13.64 |
| Railroad | 0.00 | Railroad | 0.00 | 0.00 |
| SEGA Buffer | 134.30 | Rural Density (0-0.7 DU/acre) | 38.95 | 23.37 |
| SEGA School with Park | 203.06 | *MDR-50 | 101.53 | 60.92 |
| | | | | |
| Water | 15.71 | | | |
| Roads = 1934.94 - Sum(Row5-22) | 77.30 | | 69.57 | 41.74 |
| Totals (Row5-25): | 1841.93 | | | |
| Totals check(Row 36-91): | 1841.93 | | | |
| Grand Total: | 1934.94 | | 721.30 | 432.78 |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 96.94 | Community Center | 64.95 | 38.97 |
| Regional Center | 0.00 | Community Commercial | 0.00 | 0.00 |
| Rural Residential | 550.58 | Low Density (0-2 DU/acre) | 159.67 | 95.80 |
| Neighborhood Residential | 526.15 | Neighborhood Residential | 273.60 | 164.16 |
| Mixed Residential | 175.61 | Mixed Residential | 80.78 | 48.47 |
| Flexible Reseach & Dev | 0.00 | Flexible Reseach & Dev | 0.00 | 0.00 |
| Office Center | 0.00 | Office Center | 0.00 | 0.00 |
| Institutional | 149.77 | Institutional | 89.86 | 53.92 |
| Park_OS_FloodControl | 113.10 | Open Space (OS) | 22.62 | 13.57 |
| Rural Cluster Residential | 147.19 | Rural Cluster Residential | 45.63 | 27.38 |
| Neighborhood Center | 84.38 | Neighborhood Center | 51.47 | 30.88 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Water | 15.71 | | | |
| Roads = 1934.94 - Sum(Row5-22) | 75.51 | | 67.96 | 40.78 |
| Totals (Row5-25): | 1843.72 | | | |
| Totals check(Row 36-91): | 1843.72 | | | |
| Grand Total: | 1934.94 | | 856.54 | 513.92 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| **135.24** | **81.14** | **19%** |

**City of Fresno GIS Data**

| Planned Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Corridor - Center Mixed Use | 1181852.752 | 27.13 |
| Corridor - Center Mixed Use | 1127933.365 | 25.89 |
| Corridor - Center Mixed Use | 1041644.956 | 23.91 |
| Corridor - Center Mixed Use | 793312.549 | 18.21 |
| Open Space | 7403.589931 | 0.17 |
| Open Space | 126.923315 | 0.00 |
| Open Space | 1257730.606 | 28.87 |
| Open Space | 152297.0733 | 3.50 |
| Open Space | 342176.423 | 7.86 |
| Open Space | 717859.1756 | 16.48 |
| Open Space | 381259.7611 | 8.75 |
| Open Space | 37825.119 | 0.87 |
| Open Space | 3161566.994 | 72.58 |
| Open Space | 1085513.121 | 24.92 |
| Open Space | 862790.0302 | 19.81 |
| Open Space | 63146.05935 | 1.45 |
| Open Space | 8479.981247 | 0.19 |
| Open Space - Ponding Basin | 1634323.699 | 37.52 |
| Open Space - Ponding Basin | 3317690.782 | 76.16 |
| Residential - Low Density | 13020.86476 | 0.30 |
| Residential - Low Density | 192037.2247 | 4.41 |
| Residential - Low Density | 1741135.322 | 39.97 |
| Residential - Low Density | 210285.9861 | 4.83 |
| Residential - Low Density | 130607.8794 | 3.00 |
| Residential - Low Density | 3013618.816 | 69.18 |
| Residential - Low Density | 524298.8045 | 12.04 |
| Residential - Low Density | 1520362.482 | 34.90 |
| Residential - Low Density | 1781577.261 | 40.90 |
| Residential - Low Density | 564304.8462 | 12.95 |
| Residential - Low Density | 762139.9148 | 17.50 |
| Residential - Low Density | 2103763.63 | 48.30 |
| Residential - Low Density | 331062.8293 | 7.60 |
| Residential - Low Density | 747374.1104 | 17.16 |
| Residential - Medium Density | 5641736.349 | 129.52 |
| Residential - Medium Density | 158.2397194 | 0.00 |
| Residential - Medium Density | 1488384.615 | 34.17 |

**South East Development Area GIS Data**

| SEDA Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Rural Cluster Residential | 7403.817498 | 0.17 |
| Rural Residential | 15100.32896 | 0.35 |
| Rural Residential | 24996.96041 | 0.57 |
| Rural Residential | 126.9982087 | 0.00 |
| Rural Residential | 31.38611577 | 0.00 |
| Rural Residential | 87118.99812 | 2.00 |
| Rural Residential | 87910.10412 | 2.02 |
| Rural Residential | 87604.94337 | 2.01 |
| Rural Residential | 87114.35491 | 2.00 |
| Rural Residential | 88282.52105 | 2.03 |
| Rural Residential | 98822.02028 | 2.27 |
| Park_OS_FloodControl | 893.962097 | 0.02 |
| Neighborhood Residential | 430729.9572 | 9.89 |
| Institutional | 199968.8988 | 4.59 |
| Institutional | 223718.7107 | 5.14 |
| Institutional | 209975.3343 | 4.82 |
| Institutional | 209928.8091 | 4.82 |
| Institutional | 219680.0516 | 5.04 |
| Institutional | 186948.0828 | 4.29 |
| Institutional | 193767.0305 | 4.45 |
| Institutional | 191954.7505 | 4.41 |
| Rural Residential | 1621.922576 | 0.04 |
| Rural Residential | 1882.299222 | 0.04 |
| Rural Residential | 1914.108734 | 0.04 |
| Rural Residential | 3443.87913 | 0.08 |
| Rural Residential | 405.4100871 | 0.01 |
| Rural Residential | 72492.16677 | 1.66 |
| Rural Residential | 87298.53588 | 2.00 |
| Rural Residential | 195028.0376 | 4.48 |
| Rural Residential | 195703.0843 | 4.49 |
| Rural Residential | 211989.8439 | 4.87 |
| Institutional | 842911.721 | 19.35 |
| Rural Residential | 435679.3061 | 10.00 |
| Rural Residential | 181039.9038 | 4.16 |
| Rural Residential | 202791.0066 | 4.66 |
| Rural Residential | 805214.2904 | 18.49 |

| | | |
|---|---|---|
| Residential - Medium Density | 1401621.21 | 32.18 |
| Residential - Medium Density | 1930932.991 | 44.33 |
| Residential - Medium Density | 295612.9858 | 6.79 |
| Residential - Medium Density | 1689150.657 | 38.78 |
| Residential - Medium Density | 4417719.759 | 101.42 |
| Residential - Medium Density | 3382627.854 | 77.65 |
| Residential - Medium Density | 1613478.965 | 37.04 |
| Residential - Medium Density | 2158065.288 | 49.54 |
| Residential - Medium Density | 3337698.565 | 76.62 |
| Residential - Urban Neighborhood | 3522025.825 | 80.85 |
| Residential - Urban Neighborhood | 2107173.817 | 48.37 |
| Residential - Urban Neighborhood | 1086057.498 | 24.93 |
| Residential - Urban Neighborhood | 656012.337 | 15.06 |
| SEGA Buffer | 1133180.945 | 26.01 |
| SEGA Buffer | 3051118.745 | 70.04 |
| SEGA Buffer | 1665648.612 | 38.24 |
| SEGA School with Park | 948718.1857 | 21.78 |
| SEGA School with Park | 1372765.575 | 31.51 |
| SEGA School with Park | 3235148.802 | 74.27 |
| SEGA School with Park | 3288738.252 | 75.50 |

| | | |
|---|---|---|
| ~~Residential - Medium Low Density~~ | ~~90735.3134~~ | |
| ~~Residential - Medium Low Density~~ | ~~82528.89732~~ | |
| ~~Residential - Medium Low Density~~ | ~~73553.82899~~ | |
| ~~Residential - Medium Low Density~~ | ~~166080.9516~~ | |

| | | |
|---|---|---|
| Rural Residential | 205769.1946 | 4.72 |
| Rural Residential | 297377.7359 | 6.83 |
| Rural Residential | 849971.4997 | 19.51 |
| Rural Residential | 209756.7897 | 4.82 |
| Rural Residential | 423735.1208 | 9.73 |
| Rural Residential | 199206.4031 | 4.57 |
| Neighborhood Center | 127318.1079 | 2.92 |
| Neighborhood Residential | 119733.3817 | 2.75 |
| Neighborhood Residential | 1076188.976 | 24.71 |
| Rural Residential | 1599807.604 | 36.73 |
| Neighborhood Residential | 2056978.268 | 47.22 |
| Rural Residential | 90887.15379 | 2.09 |
| Rural Residential | 103507.7617 | 2.38 |
| Neighborhood Residential | 501949.9517 | 11.52 |
| Rural Residential | 366070.9157 | 8.40 |
| Neighborhood Residential | 67.51966792 | 0.00 |
| Community Center | 117762.7094 | 2.70 |
| Community Center | 99965.04375 | 2.29 |
| Neighborhood Residential | 109773.1354 | 2.52 |
| Rural Residential | 70.03535309 | 0.00 |
| Mixed Residential | 432189.0374 | 9.92 |
| Community Center | 405024.1139 | 9.30 |
| Community Center | 418892.2336 | 9.62 |
| Mixed Residential | 415955.4874 | 9.55 |
| Rural Residential | 94004.57093 | 2.16 |
| Rural Residential | 100092.1616 | 2.30 |
| Mixed Residential | 670102.0858 | 15.38 |
| Community Center | 405596.775 | 9.31 |
| Rural Residential | 213359.6098 | 4.90 |
| Community Center | 103874.7127 | 2.38 |
| Neighborhood Residential | 146983.0897 | 3.37 |
| Rural Residential | 105791.3856 | 2.43 |
| Rural Residential | 36765.9258 | 0.84 |
| Rural Residential | 41354.13301 | 0.95 |
| Rural Residential | 36294.90393 | 0.83 |
| Rural Residential | 109899.1932 | 2.52 |
| Rural Residential | 58755.08511 | 1.35 |
| Rural Residential | 110868.5774 | 2.55 |
| Rural Residential | 54407.87502 | 1.25 |
| Rural Residential | 68188.86569 | 1.57 |
| Rural Residential | 100298.7349 | 2.30 |
| Rural Residential | 76869.60876 | 1.76 |
| Rural Residential | 6574.9956 | 0.15 |
| Rural Residential | 6264.331446 | 0.14 |
| Rural Residential | 108387.1646 | 2.49 |
| Rural Residential | 43471.66823 | 1.00 |
| Rural Residential | 42413.40881 | 0.97 |
| Rural Residential | 45177.83659 | 1.04 |
| Rural Residential | 326219.2639 | 7.49 |
| Rural Residential | 189473.6268 | 4.35 |
| Rural Residential | 215169.0924 | 4.94 |
| Neighborhood Residential | 1281965.527 | 29.43 |
| Rural Residential | 42568.22445 | 0.98 |
| Rural Residential | 43424.55723 | 1.00 |
| Rural Residential | 45089.65001 | 1.04 |
| Rural Residential | 101739.4956 | 2.34 |
| Rural Residential | 39447.65011 | 0.91 |
| Rural Residential | 142466.0227 | 3.27 |
| Rural Residential | 28221.07518 | 0.65 |
| Rural Residential | 104342.4037 | 2.40 |
| Rural Residential | 673445.7872 | 15.46 |
| Rural Residential | 745168.5973 | 17.11 |
| Rural Residential | 773047.4362 | 17.75 |
| Neighborhood Residential | 595449.1561 | 13.67 |
| Neighborhood Residential | 639384.5793 | 14.68 |
| Neighborhood Residential | 799184.008 | 18.35 |
| Rural Cluster Residential | 890.4987555 | 0.02 |
| Neighborhood Residential | 40753.12557 | 0.94 |
| Neighborhood Residential | 911553.3109 | 20.93 |
| Rural Cluster Residential | 1975.863716 | 0.05 |
| Neighborhood Residential | 1280885.484 | 29.41 |
| Rural Cluster Residential | 441128.9076 | 10.13 |
| Community Center | 388442.2444 | 8.92 |
| Mixed Residential | 217311.8625 | 4.99 |
| Mixed Residential | 208218.7486 | 4.78 |
| Neighborhood Residential | 965080.038 | 22.16 |
| Neighborhood Residential | 523827.0048 | 12.03 |
| Mixed Residential | 415104.6885 | 9.53 |
| Neighborhood Residential | 470532.0263 | 10.80 |

| | | |
|---|---|---|
| Mixed Residential | 763160.7524 | 17.52 |
| Neighborhood Residential | 42645.36831 | 0.98 |
| Mixed Residential | 1088562.543 | 24.99 |
| Mixed Residential | 445196.3942 | 10.22 |
| Mixed Residential | 384470.8387 | 8.83 |
| Community Center | 793410.4813 | 18.21 |
| Neighborhood Residential | 62814.30372 | 1.44 |
| Neighborhood Center | 341.254905 | 0.01 |
| Neighborhood Residential | 2319190.236 | 53.24 |
| Rural Cluster Residential | 690010.5181 | 15.84 |
| Rural Cluster Residential | 214747.8888 | 4.93 |
| Neighborhood Residential | 111231.701 | 2.55 |
| Mixed Residential | 203367.1777 | 4.67 |
| Mixed Residential | 212919.3155 | 4.89 |
| Rural Cluster Residential | 2134225.336 | 49.00 |
| Neighborhood Residential | 755647.5199 | 17.35 |
| Neighborhood Residential | 57374.69939 | 1.32 |
| Neighborhood Center | 144617.2744 | 3.32 |
| Neighborhood Center | 888342.1938 | 20.39 |
| Rural Residential | 87119.57837 | 2.00 |
| Rural Residential | 87910.62741 | 2.02 |
| Rural Residential | 87119.38494 | 2.00 |
| Rural Residential | 87119.9298 | 2.00 |
| Rural Residential | 87602.60603 | 2.01 |
| Rural Residential | 87122.9595 | 2.00 |
| Rural Residential | 88314.57463 | 2.03 |
| Rural Residential | 88357.94566 | 2.03 |
| Rural Residential | 87042.33953 | 2.00 |
| Rural Residential | 87045.03506 | 2.00 |
| Rural Residential | 99848.19717 | 2.29 |
| Rural Residential | 97777.48837 | 2.24 |
| Rural Residential | 96628.3104 | 2.22 |
| Rural Residential | 388700.6085 | 8.92 |
| Neighborhood Residential | 103799.8271 | 2.38 |
| Neighborhood Residential | 103605.9274 | 2.38 |
| Neighborhood Residential | 103408.4225 | 2.37 |
| Neighborhood Residential | 106948.5129 | 2.46 |
| Neighborhood Residential | 404043.1101 | 9.28 |
| Neighborhood Residential | 849226.7069 | 19.50 |
| Neighborhood Residential | 807963.7571 | 18.55 |
| Neighborhood Residential | 427971.7136 | 9.82 |
| Rural Residential | 43283.54766 | 0.99 |
| Rural Residential | 497010.4744 | 11.41 |
| Rural Residential | 3447.320902 | 0.08 |
| Rural Residential | 375813.6632 | 8.63 |
| Rural Residential | 879237.7949 | 20.18 |
| Rural Residential | 256365.6651 | 5.89 |
| Rural Residential | 194491.1208 | 4.46 |
| Rural Residential | 211491.5008 | 4.86 |
| Rural Residential | 184177.0579 | 4.23 |
| Institutional | 2392238.125 | 54.92 |
| Rural Residential | 203991.6061 | 4.68 |
| Rural Residential | 117608.0541 | 2.70 |
| Rural Residential | 787324.9985 | 18.07 |
| Rural Residential | 2629004.49 | 60.35 |
| Rural Residential | 311520.2883 | 7.15 |
| Neighborhood Residential | 444709.7878 | 10.21 |
| Neighborhood Center | 421589.8808 | 9.68 |
| Community Center | 69269.0362 | 1.59 |
| Neighborhood Residential | 275.903669 | 0.01 |
| Rural Residential | 1504.547585 | 0.03 |
| Neighborhood Residential | 2740.202912 | 0.06 |
| Mixed Residential | 432174.8914 | 9.92 |
| Mixed Residential | 1379239.218 | 31.66 |
| Rural Residential | 98032.3808 | 2.25 |
| Rural Residential | 99940.96752 | 2.29 |
| Community Center | 205326.7454 | 4.71 |
| Community Center | 205394.2411 | 4.72 |
| Rural Residential | 213429.9047 | 4.90 |
| Rural Residential | 213424.2808 | 4.90 |
| Rural Residential | 213431.0528 | 4.90 |
| Rural Residential | 103368.0109 | 2.37 |
| Rural Residential | 99745.47922 | 2.29 |
| Rural Residential | 100049.9499 | 2.30 |
| Community Center | 103869.2219 | 2.38 |
| Community Center | 103872.0042 | 2.38 |
| Neighborhood Residential | 107245.5323 | 2.46 |
| Neighborhood Residential | 706949.9095 | 16.23 |
| Rural Residential | 53161.20225 | 1.22 |

| | | |
|---|---|---|
| Rural Residential | 68387.43999 | 1.57 |
| Rural Residential | 283556.5233 | 6.51 |
| Rural Residential | 346999.0862 | 7.97 |
| Rural Residential | 178242.2919 | 4.09 |
| Rural Residential | 184181.4423 | 4.23 |
| Rural Residential | 182681.9174 | 4.19 |
| Rural Residential | 57253.3998 | 1.31 |
| Rural Residential | 280600.3847 | 6.44 |
| Rural Residential | 219333.8402 | 5.04 |
| Rural Residential | 173453.439 | 3.98 |
| Rural Residential | 87017.99484 | 2.00 |
| Rural Residential | 9171.457086 | 0.21 |
| Rural Cluster Residential | 32500.12708 | 0.75 |
| Rural Cluster Residential | 1601541.317 | 36.77 |
| Park_OS_FloodControl | 4925665.018 | 113.08 |
| Institutional | 1652830.595 | 37.94 |
| Rural Residential | 115507.4776 | 2.65 |
| Rural Residential | 42487.47424 | 0.98 |
| Rural Residential | 46901.50421 | 1.08 |
| Rural Cluster Residential | 40271.97733 | 0.92 |
| Rural Residential | 9950.314598 | 0.23 |
| Neighborhood Residential | 237326.3994 | 5.45 |
| Neighborhood Residential | 63762.17134 | 1.46 |
| Neighborhood Residential | 112607.7 | 2.59 |
| Rural Cluster Residential | 434125.5857 | 9.97 |
| Neighborhood Residential | 70013.53255 | 1.61 |
| Neighborhood Residential | 42006.03532 | 0.96 |
| Rural Cluster Residential | 204166.4469 | 4.69 |
| Rural Cluster Residential | 96673.97195 | 2.22 |
| Neighborhood Residential | 478394.67 | 10.98 |
| Neighborhood Center | 476277.6708 | 10.93 |
| Neighborhood Residential | 1148264.607 | 26.36 |
| Neighborhood Center | 68219.55934 | 1.57 |
| Rural Cluster Residential | 117660.3987 | 2.70 |
| Neighborhood Center | 1548986.648 | 35.56 |
| Rural Cluster Residential | 215856.0053 | 4.96 |
| Rural Cluster Residential | 178514.299 | 4.10 |
| Community Center | 802114.1643 | 18.41 |
| Mixed Residential | 174138.4466 | 4.00 |
| Neighborhood Residential | 216695.0697 | 4.97 |
| Neighborhood Residential | 216062.4371 | 4.96 |
| Neighborhood Residential | 212569.9967 | 4.88 |
| Neighborhood Residential | 89023.69678 | 2.04 |
| Neighborhood Residential | 20987.87269 | 0.48 |
| Mixed Residential | 207384.7894 | 4.76 |
| Neighborhood Residential | 542461.0775 | 12.45 |

# Basin DT

Catchment Area Impacted by SEDA (Acres): 982.29

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 41.29 | Regional Shopping Center | 28.90 | 17.34 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 624.26 | Low Density (0-2 DU/acre) | 181.04 | 108.62 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 99.74 | Medium Density (5-10 DU/acre) | 31.92 | 19.15 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 15.20 | High Density (23-44 DU/acre) | 8.36 | 5.02 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 0.00 | Office Commercial (OC) | 0.00 | 0.00 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 70.97 | Open Space (OS) | 14.19 | 8.52 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 0.00 | Railroad | 0.00 | 0.00 |
| SEGA Buffer | 43.15 | Rural Density (0-0.7 DU/acre) | 12.51 | 7.51 |
| SEGA School with Park | 25.64 | *MDR-50 | 12.82 | 7.69 |
| | | | | |
| Water | 0.00 | | | |
| Roads = 982.29 - Sum(Row5-22) | 62.03 | | 55.83 | 33.50 |
| Totals (Row5-25): | 920.26 | | | |
| Totals check(Row 36-62): | 920.26 | | | |
| Grand Total: | 982.29 | | 345.57 | 207.34 |

**City of Fresno GIS Data**

| Planned Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Residential - Low Density | 107701.0163 | 2.47 |
| Residential - Low Density | 22304.58071 | 0.51 |
| Residential - Low Density | 777778.0567 | 17.86 |
| Residential - Medium Density | 123.6608068 | 0.00 |
| Residential - Low Density | 3561526.635 | 81.76 |
| Residential - Medium Density | 3451815.687 | 79.24 |
| Residential - Low Density | 441427.934 | 10.13 |
| Residential - Low Density | 2683484.289 | 61.60 |
| Residential - Low Density | 2116565.696 | 48.59 |
| Open Space | 484913.9463 | 11.13 |
| Open Space | 1872710.693 | 42.99 |
| SEGA School with Park | 1117008.759 | 25.64 |
| Corridor - Center Mixed Use | 1798548.559 | 41.29 |
| Residential - Low Density | 3095669.45 | 71.07 |
| Residential - Urban Neighborhood | 662088.7259 | 15.20 |
| Residential - Medium Density | 892947.6185 | 20.50 |
| Residential - Low Density | 727891.5302 | 16.71 |
| Residential - Low Density | 326065.6394 | 7.49 |
| Residential - Low Density | 5190175.693 | 119.15 |
| Residential - Low Density | 1562390.87 | 35.87 |
| Residential - Low Density | 3125840.905 | 71.76 |
| Residential - Low Density | 852421.7297 | 19.57 |
| Residential - Low Density | 2145688.677 | 49.26 |
| Residential - Low Density | 455896.831 | 10.47 |
| SEGA Buffer | 1229159.41 | 28.22 |
| Open Space | 733928.0443 | 16.85 |
| SEGA Buffer | 650360.8087 | 14.93 |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 41.29 | Community Center | 27.66 | 16.60 |
| Regional Center | 0.00 | Community Commercial | 0.00 | 0.00 |
| Rural Residential | 672.21 | Low Density (0-2 DU/acre) | 194.94 | 116.96 |
| Neighborhood Residential | 79.25 | Neighborhood Residential | 41.21 | 24.72 |
| Mixed Residential | 18.30 | Mixed Residential | 8.42 | 5.05 |
| Flexible Reseach & Dev | 0.00 | Flexible Reseach & Dev | 0.00 | 0.00 |
| Office Center | 0.00 | Office Center | 0.00 | 0.00 |
| Institutional | 0.00 | Institutional | 0.00 | 0.00 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 60.00 | Rural Cluster Residential | 18.60 | 11.16 |
| Neighborhood Center | 49.23 | Neighborhood Center | 30.03 | 18.02 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Water | 0.00 | | | |
| Roads = 982.29 - Sum(Row5-22) | 62.02 | | 55.82 | 33.49 |
| Totals (Row5-25): | 920.26 | | | |
| Totals check(Row 36-352): | 920.26 | | | |
| Grand Total: | 982.29 | | 376.68 | 226.01 |

**South East Development Area GIS Data**

| SEDA Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Rural Residential | 3196.210271 | 0.07 |
| Rural Residential | 3890.579187 | 0.09 |
| Rural Cluster Residential | 6251.833456 | 0.14 |
| Rural Residential | 87.77426423 | 0.00 |
| Rural Residential | 1586.092555 | 0.04 |
| Rural Cluster Residential | 1602.017268 | 0.04 |
| Mixed Residential | 797092.1256 | 18.30 |
| Rural Residential | 7264.592711 | 0.17 |
| Rural Residential | 4103.871787 | 0.09 |
| Rural Residential | 50375.57406 | 1.16 |
| Rural Residential | 2077.408377 | 0.05 |
| Rural Residential | 95664.13947 | 2.20 |
| Rural Residential | 67462.83732 | 1.55 |
| Rural Residential | 40200.14101 | 0.92 |
| Rural Residential | 50290.93046 | 1.15 |
| Rural Residential | 10746.87615 | 0.25 |
| Rural Residential | 45.60951075 | 0.00 |
| Rural Residential | 167.291003 | 0.00 |
| Rural Residential | 527171.2415 | 12.10 |
| Rural Residential | 183604.6911 | 4.21 |
| Rural Cluster Residential | 9939.523733 | 0.23 |
| Rural Cluster Residential | 154776.5004 | 3.55 |
| Rural Residential | 101785.1554 | 2.34 |
| Rural Residential | 114059.9057 | 2.62 |
| Rural Residential | 100164.4237 | 2.30 |
| Rural Residential | 49435.00106 | 1.13 |
| Rural Residential | 101121.2432 | 2.32 |
| Rural Residential | 81530.72791 | 1.87 |
| Rural Residential | 470871.1363 | 10.81 |
| Rural Residential | 60241.90403 | 1.38 |
| Rural Residential | 154941.9148 | 3.56 |
| Rural Residential | 149610.6359 | 3.43 |
| Rural Residential | 106025.542 | 2.43 |
| Rural Residential | 86276.91151 | 1.98 |
| Rural Residential | 86139.95947 | 1.98 |
| Rural Residential | 86436.91924 | 1.98 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| **31.11** | **18.66** | **9%** |

| | | |
|---|---|---|
| Rural Residential | 87745.54293 | 2.01 |
| Rural Residential | 95051.00501 | 2.18 |
| Rural Residential | 83335.01504 | 1.91 |
| Rural Residential | 125415.4384 | 2.88 |
| Rural Residential | 250953.5451 | 5.76 |
| Rural Residential | 49709.23536 | 1.14 |
| Rural Residential | 49850.87338 | 1.14 |
| Rural Residential | 10053.24166 | 0.23 |
| Rural Residential | 589715.7473 | 13.54 |
| Rural Residential | 59368.89619 | 1.36 |
| Rural Residential | 83642.1042 | 1.92 |
| Rural Residential | 26769.16052 | 0.61 |
| Rural Residential | 28931.68326 | 0.66 |
| Community Center | 1784169.941 | 40.96 |
| Community Center | 14378.73072 | 0.33 |
| Rural Residential | 83330.08024 | 1.91 |
| Rural Residential | 81456.97705 | 1.87 |
| Rural Residential | 482286.2619 | 11.07 |
| Rural Residential | 79089.77405 | 1.82 |
| Rural Residential | 91023.67211 | 2.09 |
| Rural Residential | 71461.64408 | 1.64 |
| Rural Residential | 68324.31257 | 1.57 |
| Rural Residential | 69914.31223 | 1.61 |
| Rural Residential | 67853.48833 | 1.56 |
| Rural Residential | 73852.89621 | 1.70 |
| Rural Residential | 76189.21078 | 1.75 |
| Rural Residential | 88027.66298 | 2.02 |
| Rural Residential | 79198.32443 | 1.82 |
| Rural Residential | 92604.03379 | 2.13 |
| Rural Residential | 89983.19089 | 2.07 |
| Rural Residential | 89262.00522 | 2.05 |
| Rural Residential | 90508.60545 | 2.08 |
| Rural Residential | 88612.34667 | 2.03 |
| Rural Residential | 90295.71623 | 2.07 |
| Rural Residential | 90187.87976 | 2.07 |
| Rural Residential | 90079.40732 | 2.07 |
| Rural Residential | 92700.81298 | 2.13 |
| Rural Residential | 88470.36932 | 2.03 |
| Rural Residential | 90184.74794 | 2.07 |
| Rural Residential | 96331.68906 | 2.21 |
| Rural Residential | 90002.92676 | 2.07 |
| Rural Residential | 86199.69417 | 1.98 |
| Rural Residential | 88005.78695 | 2.02 |
| Rural Residential | 92292.23593 | 2.12 |
| Rural Residential | 90235.29912 | 2.07 |
| Rural Residential | 105392.0957 | 2.42 |
| Rural Residential | 76087.60482 | 1.75 |
| Rural Residential | 88506.80853 | 2.03 |
| Rural Residential | 92851.1347 | 2.13 |
| Rural Residential | 94885.23121 | 2.18 |
| Rural Residential | 87843.10157 | 2.02 |
| Rural Residential | 89931.83593 | 2.06 |
| Rural Residential | 87207.37488 | 2.00 |
| Rural Residential | 110305.187 | 2.53 |
| Rural Residential | 100758.1282 | 2.31 |
| Rural Residential | 80442.80084 | 1.85 |
| Rural Residential | 93599.02843 | 2.15 |
| Rural Residential | 61546.0956 | 1.41 |
| Rural Residential | 43939.2124 | 1.01 |
| Rural Residential | 18780.26636 | 0.43 |
| Rural Residential | 74139.77288 | 1.70 |
| Rural Residential | 96371.87209 | 2.21 |
| Rural Residential | 98571.17004 | 2.26 |
| Rural Residential | 20288.47496 | 0.47 |
| Rural Residential | 94964.42599 | 2.18 |
| Rural Residential | 20444.07703 | 0.47 |
| Rural Residential | 24346.24696 | 0.56 |
| Rural Residential | 21252.09299 | 0.49 |
| Rural Residential | 39175.98998 | 0.90 |
| Rural Residential | 24808.62293 | 0.57 |
| Rural Residential | 17919.95999 | 0.41 |
| Rural Residential | 38551.96409 | 0.89 |
| Rural Residential | 129055.7076 | 2.96 |
| Rural Residential | 33150.66909 | 0.76 |
| Rural Residential | 32990.76111 | 0.76 |
| Rural Residential | 107122.5066 | 2.46 |
| Rural Residential | 95761.88211 | 2.20 |
| Rural Residential | 21479.6454 | 0.49 |
| Rural Residential | 97543.56134 | 2.24 |

| | | |
|---|---|---|
| Rural Residential | 37929.96232 | 0.87 |
| Rural Residential | 38486.97617 | 0.88 |
| Rural Residential | 38434.95849 | 0.88 |
| Rural Residential | 152470.9543 | 3.50 |
| Rural Residential | 332533.5968 | 7.63 |
| Rural Residential | 15142.37818 | 0.35 |
| Rural Residential | 132089.9673 | 3.03 |
| Rural Residential | 88999.22301 | 2.04 |
| Rural Residential | 408981.4106 | 9.39 |
| Rural Residential | 98620.59979 | 2.26 |
| Rural Residential | 88401.52266 | 2.03 |
| Rural Residential | 117578.2948 | 2.70 |
| Rural Residential | 108851.6467 | 2.50 |
| Rural Residential | 94972.9356 | 2.18 |
| Rural Residential | 51935.09624 | 1.19 |
| Rural Residential | 84290.39888 | 1.94 |
| Rural Residential | 84924.28033 | 1.95 |
| Rural Residential | 192434.8484 | 4.42 |
| Rural Cluster Residential | 38223.94752 | 0.88 |
| Rural Cluster Residential | 83235.76243 | 1.91 |
| Rural Cluster Residential | 101645.2036 | 2.33 |
| Rural Residential | 86063.32713 | 1.98 |
| Rural Residential | 85102.99585 | 1.95 |
| Rural Cluster Residential | 310929.07 | 7.14 |
| Rural Residential | 108366.9851 | 2.49 |
| Rural Residential | 108054.7353 | 2.48 |
| Rural Residential | 111938.3429 | 2.57 |
| Rural Residential | 87095.93754 | 2.00 |
| Rural Residential | 87171.98813 | 2.00 |
| Rural Residential | 87112.3155 | 2.00 |
| Rural Residential | 87209.45224 | 2.00 |
| Rural Residential | 109243.9107 | 2.51 |
| Rural Residential | 87176.71748 | 2.00 |
| Rural Residential | 217835.9645 | 5.00 |
| Rural Residential | 87122.62285 | 2.00 |
| Rural Residential | 99074.09772 | 2.27 |
| Rural Residential | 241789.4296 | 5.55 |
| Rural Residential | 88817.79194 | 2.04 |
| Neighborhood Residential | 51150.02583 | 1.17 |
| Neighborhood Residential | 51149.97489 | 1.17 |
| Neighborhood Residential | 97650.04077 | 2.24 |
| Neighborhood Residential | 2459094.835 | 56.45 |
| Rural Residential | 80578.4541 | 1.85 |
| Rural Residential | 77561.62865 | 1.78 |
| Rural Residential | 87567.2114 | 2.01 |
| Rural Residential | 87362.54752 | 2.01 |
| Rural Residential | 87120.78311 | 2.00 |
| Rural Residential | 87133.03733 | 2.00 |
| Rural Residential | 87145.09601 | 2.00 |
| Rural Residential | 86962.02458 | 2.00 |
| Neighborhood Residential | 787887.3295 | 18.09 |
| Rural Residential | 87115.29553 | 2.00 |
| Rural Residential | 87120.51896 | 2.00 |
| Rural Residential | 157957.7967 | 3.63 |
| Rural Residential | 87409.65462 | 2.01 |
| Rural Residential | 86593.93313 | 1.99 |
| Rural Residential | 82363.7779 | 1.89 |
| Rural Residential | 104320.2546 | 2.39 |
| Rural Residential | 104276.9491 | 2.39 |
| Rural Residential | 104233.7622 | 2.39 |
| Rural Residential | 104190.2807 | 2.39 |
| Rural Residential | 115018.2296 | 2.64 |
| Rural Residential | 218460.147 | 5.02 |
| Rural Residential | 319571.695 | 7.34 |
| Rural Residential | 117676.6104 | 2.70 |
| Rural Residential | 94293.61016 | 2.16 |
| Rural Residential | 197035.5989 | 4.52 |
| Rural Residential | 87563.05841 | 2.01 |
| Rural Residential | 87830.24033 | 2.02 |
| Rural Residential | 88943.29802 | 2.04 |
| Rural Residential | 87307.32232 | 2.00 |
| Rural Residential | 87999.31473 | 2.02 |
| Rural Residential | 87154.50427 | 2.00 |
| Neighborhood Residential | 4883.075021 | 0.11 |
| Rural Residential | 87367.02493 | 2.01 |
| Neighborhood Residential | 123.6106461 | 0.00 |
| Rural Residential | 1265.91467 | 0.03 |
| Rural Residential | 46084.81642 | 1.06 |
| Rural Residential | 61616.05623 | 1.41 |

| | | |
|---|---|---|
| Rural Residential | 60549.1156 | 1.39 |
| Neighborhood Center | 1180393.161 | 27.10 |
| Rural Residential | 7739.490803 | 0.18 |
| Rural Residential | 48345.92256 | 1.11 |
| Rural Residential | 10569.25757 | 0.24 |
| Rural Residential | 91531.70705 | 2.10 |
| Rural Residential | 83358.27153 | 1.91 |
| Rural Residential | 90207.1247 | 2.07 |
| Rural Residential | 94087.31789 | 2.16 |
| Rural Residential | 215276.6734 | 4.94 |
| Rural Cluster Residential | 43414.22401 | 1.00 |
| Rural Cluster Residential | 41536.62342 | 0.95 |
| Rural Cluster Residential | 40231.54251 | 0.92 |
| Rural Cluster Residential | 555642.3347 | 12.76 |
| Rural Cluster Residential | 27582.8598 | 0.63 |
| Rural Cluster Residential | 902.6539311 | 0.02 |
| Rural Residential | 76180.3725 | 1.75 |
| Rural Residential | 49812.09934 | 1.14 |
| Rural Residential | 46043.81733 | 1.06 |
| Rural Residential | 118176.063 | 2.71 |
| Rural Residential | 106133.3121 | 2.44 |
| Neighborhood Center | 963874.396 | 22.13 |
| Rural Residential | 78515.49702 | 1.80 |
| Rural Residential | 8212.712292 | 0.19 |
| Rural Residential | 81214.14792 | 1.86 |
| Rural Residential | 29253.45781 | 0.67 |
| Rural Residential | 24717.29157 | 0.57 |
| Rural Residential | 18073.9497 | 0.41 |
| Rural Residential | 144322.4464 | 3.31 |
| Rural Residential | 74655.76475 | 1.71 |
| Rural Residential | 100372.7405 | 2.30 |
| Rural Residential | 107231.5539 | 2.46 |
| Rural Residential | 94267.34921 | 2.16 |
| Rural Residential | 66352.89966 | 1.52 |
| Rural Residential | 39881.01275 | 0.92 |
| Rural Residential | 21792.64497 | 0.50 |
| Rural Residential | 16459.86659 | 0.38 |
| Rural Residential | 35263.79729 | 0.81 |
| Rural Residential | 36424.37467 | 0.84 |
| Rural Residential | 86953.02643 | 2.00 |
| Rural Residential | 105259.4557 | 2.42 |
| Rural Residential | 1547243.932 | 35.52 |
| Rural Residential | 85823.45008 | 1.97 |
| Rural Residential | 86280.95973 | 1.98 |
| Rural Residential | 98345.79514 | 2.26 |
| Rural Residential | 87143.86882 | 2.00 |
| Rural Residential | 87396.58246 | 2.01 |
| Rural Residential | 88860.85778 | 2.04 |
| Rural Residential | 87910.22911 | 2.02 |
| Rural Residential | 86977.77751 | 2.00 |
| Rural Residential | 90282.65107 | 2.07 |
| Rural Residential | 85559.00749 | 1.96 |
| Rural Residential | 76190.23934 | 1.75 |
| Rural Residential | 114344.2869 | 2.62 |
| Rural Residential | 95445.49688 | 2.19 |
| Rural Residential | 89822.4184 | 2.06 |
| Rural Residential | 161667.6322 | 3.71 |
| Rural Residential | 86517.20495 | 1.99 |
| Rural Residential | 91198.72968 | 2.09 |
| Rural Residential | 121326.1725 | 2.79 |
| Rural Residential | 86275.76545 | 1.98 |
| Rural Residential | 88119.63333 | 2.02 |
| Rural Residential | 85813.68371 | 1.97 |
| Rural Residential | 91040.91958 | 2.09 |
| Rural Residential | 83162.84178 | 1.91 |
| Rural Residential | 98747.99037 | 2.27 |
| Rural Residential | 91232.94402 | 2.09 |
| Rural Residential | 80505.91904 | 1.85 |
| Rural Residential | 85752.65782 | 1.97 |
| Rural Residential | 83789.99532 | 1.92 |
| Rural Residential | 84491.04558 | 1.94 |
| Rural Residential | 87763.1044 | 2.01 |
| Rural Residential | 87201.38835 | 2.00 |
| Rural Residential | 87035.78763 | 2.00 |
| Rural Residential | 24583.74797 | 0.56 |
| Rural Residential | 55113.36636 | 1.27 |
| Rural Residential | 107708.6463 | 2.47 |
| Rural Residential | 48028.52167 | 1.10 |
| Rural Residential | 153490.8679 | 3.52 |

| | | |
|---|---|---|
| Rural Residential | 40581.08295 | 0.93 |
| Rural Residential | 841184.9698 | 19.31 |
| Rural Residential | 86278.26567 | 1.98 |
| Rural Residential | 86966.86308 | 2.00 |
| Rural Residential | 91255.37789 | 2.09 |
| Rural Residential | 88417.37201 | 2.03 |
| Rural Residential | 2315.71598 | 0.05 |
| Rural Residential | 108248.1829 | 2.49 |
| Rural Residential | 39053.33287 | 0.90 |
| Rural Residential | 44780.57852 | 1.03 |
| Rural Residential | 187655.7343 | 4.31 |
| Rural Residential | 256581.1662 | 5.89 |
| Rural Cluster Residential | 68704.58252 | 1.58 |
| Rural Cluster Residential | 223349.0415 | 5.13 |
| Rural Residential | 157320.756 | 3.61 |
| Rural Residential | 236601.3176 | 5.43 |
| Rural Residential | 206759.2542 | 4.75 |
| Rural Residential | 177545.8919 | 4.08 |
| Rural Cluster Residential | 905480.8574 | 20.79 |
| Rural Residential | 108388.7339 | 2.49 |
| Rural Residential | 112855.275 | 2.59 |
| Rural Residential | 109888.4183 | 2.52 |
| Rural Residential | 108367.6087 | 2.49 |
| Rural Residential | 108387.3157 | 2.49 |
| Rural Residential | 87238.20984 | 2.00 |
| Rural Residential | 87100.99929 | 2.00 |
| Rural Residential | 86901.07296 | 1.99 |
| Rural Residential | 217833.5694 | 5.00 |
| Rural Residential | 87117.608 | 2.00 |
| Rural Residential | 87125.12825 | 2.00 |
| Rural Residential | 86925.06989 | 2.00 |
| Rural Residential | 87122.62332 | 2.00 |
| Rural Residential | 87131.24296 | 2.00 |
| Rural Residential | 23689.30591 | 0.54 |
| Rural Residential | 118933.4217 | 2.73 |
| Rural Residential | 118585.6811 | 2.72 |
| Rural Residential | 87240.74977 | 2.00 |
| Rural Residential | 87392.58765 | 2.01 |
| Rural Residential | 87815.17539 | 2.02 |
| Rural Residential | 92040.57848 | 2.11 |
| Rural Residential | 87145.92492 | 2.00 |
| Rural Residential | 87145.8953 | 2.00 |
| Rural Residential | 108181.0092 | 2.48 |
| Rural Residential | 100324.0821 | 2.30 |

# Basin DU

Catchment Area Impacted by SEDA (Acres): 1306.62

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 50.36 | Regional Shopping Center | 35.25 | 21.15 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 694.85 | Low Density (0-2 DU/acre) | 201.51 | 120.90 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 36.01 | Medium Density (5-10 DU/acre) | 11.52 | 6.91 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 121.59 | High Density (23-44 DU/acre) | 66.87 | 40.12 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 0.00 | Office Commercial (OC) | 0.00 | 0.00 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 28.44 | Open Space (OS) | 5.69 | 3.41 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 0.00 | Railroad | 0.00 | 0.00 |
| SEGA Buffer | 199.94 | Rural Density (0-0.7 DU/acre) | 57.98 | 34.79 |
| SEGA School with Park | 71.16 | *MDR-50 | 35.58 | 21.35 |
| | | | | |
| Water | 0.00 | | | |
| Roads = 1306.62 - Sum(Row5-22) | 104.28 | | 93.85 | 56.31 |

Totals (Row5-25): 1202.34
Totals check(Row 36-57): 1202.34

Grand Total: 1306.62 508.26 304.95

### City of Fresno GIS Data

| Planned Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| SEGA Buffer | 2456373.11 | 56.39 |
| Residential - Low Density | 297.7900811 | 0.01 |
| Residential - Low Density | 4581820.698 | 105.18 |
| Residential - Low Density | 1153839.107 | 26.49 |
| Residential - Low Density | 902111.9657 | 20.71 |
| Residential - Low Density | 1400531.707 | 32.15 |
| Residential - Urban Neighborhood | 2207552.586 | 50.68 |
| Open Space | 435768.9154 | 10.00 |
| Open Space | 803060.8594 | 18.44 |
| Residential - Low Density | 3858512.903 | 88.58 |
| SEGA School with Park | 970773.2815 | 22.29 |
| SEGA School with Park | 1331323.72 | 30.56 |
| Residential - Low Density | 8438841.837 | 193.73 |
| Residential - Urban Neighborhood | 3088862.724 | 70.91 |
| Residential - Medium Density | 1568470.94 | 36.01 |
| Residential - Low Density | 252693.8715 | 5.80 |
| Residential - Low Density | 3146275.091 | 72.23 |
| Residential - Low Density | 817131.35 | 18.76 |
| Residential - Low Density | 5715690.197 | 131.21 |
| SEGA School with Park | 797498.2972 | 18.31 |
| Corridor - Center Mixed Use | 2193551.052 | 50.36 |
| SEGA Buffer | 6252926.135 | 143.55 |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 48.38 | Community Center | 32.41 | 19.45 |
| Regional Center | 0.00 | Community Commercial | 0.00 | 0.00 |
| Rural Residential | 723.79 | Low Density (0-2 DU/acre) | 209.90 | 125.94 |
| Neighborhood Residential | 36.01 | Neighborhood Residential | 18.72 | 11.23 |
| Mixed Residential | 129.37 | Mixed Residential | 59.51 | 35.71 |
| Flexible Reseach & Dev | 0.00 | Flexible Reseach & Dev | 0.00 | 0.00 |
| Office Center | 0.00 | Office Center | 0.00 | 0.00 |
| Institutional | 0.00 | Institutional | 0.00 | 0.00 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 199.94 | Rural Cluster Residential | 61.98 | 37.19 |
| Neighborhood Center | 69.35 | Neighborhood Center | 42.30 | 25.38 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Water | 0.00 | | | |
| Roads = 1306.62 - Sum(Row5-22) | 99.78 | | 89.80 | 53.88 |

Totals (Row5-25): 1206.84
Totals check(Row 36-386): 1206.84

Grand Total: 1306.62 514.64 308.78

### South East Development Area GIS Data

| SEDA Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Rural Residential | 31723.85146 | 0.73 |
| Rural Residential | 886.156783 | 0.02 |
| Rural Residential | 297.7989703 | 0.01 |
| Rural Cluster Residential | 26309.24815 | 0.60 |
| Neighborhood Center | 507301.2872 | 11.65 |
| Rural Residential | 45380.89897 | 1.04 |
| Rural Residential | 42896.27628 | 0.98 |
| Rural Residential | 181602.5114 | 4.17 |
| Rural Residential | 88498.81292 | 2.03 |
| Rural Residential | 87254.3451 | 2.00 |
| Rural Residential | 85635.42767 | 1.97 |
| Rural Residential | 473707.6376 | 10.87 |
| Rural Residential | 2002.111579 | 0.05 |
| Rural Residential | 2578.130602 | 0.06 |
| Rural Residential | 17884.41502 | 0.41 |
| Rural Residential | 15191.2793 | 0.35 |
| Rural Residential | 15286.79779 | 0.35 |
| Rural Residential | 15477.80605 | 0.36 |
| Rural Residential | 9767.479144 | 0.22 |
| Rural Residential | 37500.95583 | 0.86 |
| Rural Residential | 13022.1597 | 0.30 |
| Rural Residential | 16818.85514 | 0.39 |
| Rural Residential | 12596.13465 | 0.29 |
| Rural Residential | 12675.67503 | 0.29 |
| Rural Residential | 12644.6617 | 0.29 |
| Rural Residential | 12798.15174 | 0.29 |
| Rural Residential | 17661.89295 | 0.41 |
| Rural Residential | 20609.06122 | 0.47 |
| Rural Residential | 12810.1256 | 0.29 |
| Rural Residential | 12802.65779 | 0.29 |
| Rural Residential | 13703.18371 | 0.31 |
| Rural Residential | 13779.71447 | 0.32 |
| Rural Residential | 3626.668074 | 0.08 |
| Rural Residential | 14311.26544 | 0.33 |
| Rural Residential | 16370.34874 | 0.38 |
| Rural Residential | 12946.19921 | 0.30 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| 6.38 | 3.83 | 1% |

| | | |
|---|---|---|
| Rural Residential | 18439.95676 | 0.42 |
| Rural Residential | 12664.12504 | 0.29 |
| Rural Residential | 16286.84103 | 0.37 |
| Rural Residential | 13992.71832 | 0.32 |
| Rural Residential | 16650.85122 | 0.38 |
| Rural Residential | 13415.2016 | 0.31 |
| Rural Residential | 11990.11855 | 0.28 |
| Rural Residential | 15705.2182 | 0.36 |
| Rural Residential | 26492.83237 | 0.61 |
| Rural Residential | 69365.07889 | 1.59 |
| Rural Residential | 41112.04007 | 0.94 |
| Rural Residential | 41830.0985 | 0.96 |
| Rural Residential | 16828.37003 | 0.39 |
| Rural Residential | 16179.30406 | 0.37 |
| Rural Residential | 15949.79825 | 0.37 |
| Rural Residential | 16144.32224 | 0.37 |
| Rural Residential | 14238.25392 | 0.33 |
| Rural Residential | 14417.75041 | 0.33 |
| Rural Residential | 14332.22401 | 0.33 |
| Rural Residential | 13842.20973 | 0.32 |
| Mixed Residential | 31244.25252 | 0.72 |
| Rural Residential | 34425.37511 | 0.79 |
| Mixed Residential | 56110.35516 | 1.29 |
| Mixed Residential | 727135.321 | 16.69 |
| Rural Residential | 71523.26945 | 1.64 |
| Rural Residential | 102562.1226 | 2.35 |
| Mixed Residential | 680834.3741 | 15.63 |
| Rural Residential | 98769.39908 | 2.27 |
| Rural Residential | 97162.58576 | 2.23 |
| Rural Residential | 98209.4733 | 2.25 |
| Rural Residential | 86751.56715 | 1.99 |
| Rural Residential | 88545.59893 | 2.03 |
| Rural Residential | 105102.2634 | 2.41 |
| Mixed Residential | 219105.3765 | 5.03 |
| Rural Residential | 89500.97642 | 2.05 |
| Rural Residential | 113665.8643 | 2.61 |
| Rural Residential | 96855.85624 | 2.22 |
| Rural Residential | 100608.2879 | 2.31 |
| Rural Residential | 206335.0939 | 4.74 |
| Rural Residential | 94080.38785 | 2.16 |
| Rural Residential | 93829.81963 | 2.15 |
| Rural Residential | 89108.51947 | 2.05 |
| Rural Residential | 96601.04394 | 2.22 |
| Rural Residential | 12530.42764 | 0.29 |
| Rural Residential | 12039.2663 | 0.28 |
| Rural Residential | 1067.485486 | 0.02 |
| Rural Residential | 52118.15795 | 1.20 |
| Rural Residential | 12279.26839 | 0.28 |
| Rural Residential | 3807.770217 | 0.09 |
| Rural Residential | 13590.29907 | 0.31 |
| Rural Residential | 2166.072956 | 0.05 |
| Rural Residential | 92223.15512 | 2.12 |
| Rural Residential | 88190.57565 | 2.02 |
| Rural Residential | 87217.99612 | 2.00 |
| Rural Residential | 11204.59997 | 0.26 |
| Rural Residential | 10619.38839 | 0.24 |
| Rural Residential | 10894.85761 | 0.25 |
| Rural Residential | 215622.4019 | 4.95 |
| Rural Residential | 216927.8482 | 4.98 |
| Rural Residential | 52858.25718 | 1.21 |
| Rural Residential | 198949.7167 | 4.57 |
| Rural Residential | 43714.27613 | 1.00 |
| Rural Residential | 53863.76359 | 1.24 |
| Rural Residential | 42282.18228 | 0.97 |
| Rural Residential | 99691.12033 | 2.29 |
| Rural Residential | 828154.2346 | 19.01 |
| Rural Residential | 129639.7698 | 2.98 |
| Rural Residential | 143422.5774 | 3.29 |
| Rural Residential | 87140.50837 | 2.00 |
| Rural Residential | 95207.16965 | 2.19 |
| Rural Residential | 96934.51011 | 2.23 |
| Rural Residential | 87131.86345 | 2.00 |
| Rural Residential | 97501.49348 | 2.24 |
| Rural Residential | 97697.87239 | 2.24 |
| Rural Residential | 87134.04398 | 2.00 |
| Rural Residential | 104000.4154 | 2.39 |
| Rural Residential | 88617.25632 | 2.03 |
| Rural Residential | 93751.84848 | 2.15 |
| Rural Residential | 90878.181 | 2.09 |

| | | |
|---|---|---|
| Rural Residential | 109296.476 | 2.51 |
| Rural Residential | 98694.07166 | 2.27 |
| Rural Residential | 114816.9434 | 2.64 |
| Rural Residential | 114365.8787 | 2.63 |
| Rural Residential | 254207.0299 | 5.84 |
| Rural Residential | 91187.15877 | 2.09 |
| Rural Residential | 93780.30802 | 2.15 |
| Rural Residential | 91191.75111 | 2.09 |
| Rural Residential | 86925.97782 | 2.00 |
| Rural Residential | 55516.85409 | 1.27 |
| Rural Residential | 54919.44359 | 1.26 |
| Rural Residential | 26548.83657 | 0.61 |
| Rural Residential | 86256.35153 | 1.98 |
| Rural Residential | 97569.90613 | 2.24 |
| Rural Residential | 95374.35882 | 2.19 |
| Rural Residential | 102070.9581 | 2.34 |
| Rural Residential | 109004.3322 | 2.50 |
| Rural Residential | 97339.35592 | 2.23 |
| Rural Residential | 118972.6959 | 2.73 |
| Rural Residential | 62153.3122 | 1.43 |
| Rural Residential | 126494.3059 | 2.90 |
| Rural Residential | 111224.3407 | 2.55 |
| Rural Residential | 208952.6328 | 4.80 |
| Rural Residential | 277772.1545 | 6.38 |
| Rural Residential | 124378.8793 | 2.86 |
| Rural Residential | 449262.7564 | 10.31 |
| Rural Residential | 219180.2445 | 5.03 |
| Rural Residential | 175935.8595 | 4.04 |
| Rural Residential | 95203.53707 | 2.19 |
| Rural Residential | 97359.96085 | 2.24 |
| Rural Residential | 41492.10587 | 0.95 |
| Rural Residential | 101107.2836 | 2.32 |
| Rural Residential | 285709.7235 | 6.56 |
| Rural Residential | 84124.12106 | 1.93 |
| Rural Residential | 26451.37092 | 0.61 |
| Rural Residential | 106710.6186 | 2.45 |
| Rural Residential | 13422.77143 | 0.31 |
| Rural Residential | 46022.1845 | 1.06 |
| Mixed Residential | 2487640.274 | 57.11 |
| Neighborhood Center | 384844.8292 | 8.83 |
| Rural Residential | 84478.41794 | 1.94 |
| Rural Residential | 415320.4235 | 9.53 |
| Community Center | 53867.73158 | 1.24 |
| Community Center | 51173.64819 | 1.17 |
| Rural Cluster Residential | 813512.1733 | 18.68 |
| Neighborhood Residential | 690933.4736 | 15.86 |
| Neighborhood Residential | 877537.3279 | 20.15 |
| Neighborhood Center | 1331324.032 | 30.56 |
| Rural Residential | 43935.71828 | 1.01 |
| Rural Cluster Residential | 39560.29061 | 0.91 |
| Rural Cluster Residential | 582368.8566 | 13.37 |
| Rural Cluster Residential | 40818.60513 | 0.94 |
| Rural Cluster Residential | 123705.0384 | 2.84 |
| Rural Cluster Residential | 36265.85255 | 0.83 |
| Rural Residential | 15809.45798 | 0.36 |
| Rural Residential | 101030.1173 | 2.32 |
| Rural Residential | 54983.52663 | 1.26 |
| Rural Residential | 89083.19831 | 2.05 |
| Rural Residential | 83265.7934 | 1.91 |
| Rural Residential | 87516.72036 | 2.01 |
| Rural Residential | 87238.01036 | 2.00 |
| Rural Residential | 188146.5842 | 4.32 |
| Rural Cluster Residential | 6363.765093 | 0.15 |
| Rural Cluster Residential | 150523.807 | 3.46 |
| Rural Cluster Residential | 107879.6496 | 2.48 |
| Rural Cluster Residential | 101381.1951 | 2.33 |
| Rural Residential | 4237.777975 | 0.10 |
| Rural Residential | 150333.0742 | 3.45 |
| Rural Residential | 132476.6772 | 3.04 |
| Rural Residential | 140474.2081 | 3.22 |
| Rural Residential | 83918.33021 | 1.93 |
| Rural Residential | 131742.2798 | 3.02 |
| Rural Residential | 239553.3399 | 5.50 |
| Rural Residential | 146746.1775 | 3.37 |
| Rural Residential | 185329.0437 | 4.25 |
| Rural Residential | 424023.7758 | 9.73 |
| Rural Residential | 42654.88896 | 0.98 |
| Rural Residential | 25663.19183 | 0.59 |
| Rural Residential | 38866.16156 | 0.89 |

| | | |
|---|---|---|
| Rural Residential | 12775.58085 | 0.29 |
| Rural Residential | 12747.27359 | 0.29 |
| Rural Residential | 2326.43564 | 0.05 |
| Rural Residential | 5286.115064 | 0.12 |
| Rural Residential | 5971.575957 | 0.14 |
| Rural Residential | 3911.195845 | 0.09 |
| Rural Residential | 3395.314275 | 0.08 |
| Rural Residential | 7565.936976 | 0.17 |
| Mixed Residential | 204530.0981 | 4.70 |
| Community Center | 2002275.587 | 45.97 |
| Mixed Residential | 197807.104 | 4.54 |
| Rural Residential | 45124.18933 | 1.04 |
| Rural Residential | 114836.9038 | 2.64 |
| Rural Residential | 93997.12275 | 2.16 |
| Rural Residential | 87584.59027 | 2.01 |
| Rural Residential | 91296.83957 | 2.10 |
| Rural Residential | 209495.4135 | 4.81 |
| Rural Residential | 86976.32256 | 2.00 |
| Rural Residential | 89607.15825 | 2.06 |
| Rural Residential | 7044.369302 | 0.16 |
| Rural Residential | 14787.77764 | 0.34 |
| Rural Residential | 12881.66551 | 0.30 |
| Rural Residential | 14974.25983 | 0.34 |
| Rural Residential | 12726.65612 | 0.29 |
| Rural Residential | 12169.1367 | 0.28 |
| Rural Residential | 12922.65657 | 0.30 |
| Rural Residential | 12536.64697 | 0.29 |
| Rural Residential | 12493.15 | 0.29 |
| Rural Residential | 3481.67013 | 0.08 |
| Rural Residential | 12710.11961 | 0.29 |
| Rural Residential | 16037.84449 | 0.37 |
| Rural Residential | 16157.3345 | 0.37 |
| Rural Residential | 21043.60285 | 0.48 |
| Rural Residential | 12941.6738 | 0.30 |
| Rural Residential | 12932.6576 | 0.30 |
| Rural Residential | 13468.67612 | 0.31 |
| Rural Residential | 18524.42362 | 0.43 |
| Rural Residential | 17357.36152 | 0.40 |
| Rural Residential | 17736.40561 | 0.41 |
| Rural Residential | 14406.74849 | 0.33 |
| Rural Residential | 16685.36847 | 0.38 |
| Rural Residential | 16188.82584 | 0.37 |
| Rural Residential | 17292.41345 | 0.40 |
| Rural Residential | 16590.87623 | 0.38 |
| Rural Residential | 17132.39884 | 0.39 |
| Rural Residential | 17348.91815 | 0.40 |
| Rural Residential | 18328.43162 | 0.42 |
| Rural Residential | 17779.92643 | 0.41 |
| Rural Residential | 16940.37484 | 0.39 |
| Rural Residential | 16793.87214 | 0.39 |
| Rural Residential | 22029.10678 | 0.51 |
| Rural Residential | 11520.60895 | 0.26 |
| Rural Residential | 14775.7918 | 0.34 |
| Rural Residential | 13541.17731 | 0.31 |
| Rural Residential | 15928.80933 | 0.37 |
| Rural Residential | 15242.31831 | 0.35 |
| Rural Residential | 13087.20734 | 0.30 |
| Rural Residential | 14789.75696 | 0.34 |
| Rural Residential | 14348.73395 | 0.33 |
| Rural Residential | 17867.39377 | 0.41 |
| Mixed Residential | 567095.3732 | 13.02 |
| Mixed Residential | 15056.94005 | 0.35 |
| Mixed Residential | 85249.69529 | 1.96 |
| Rural Residential | 92209.75454 | 2.12 |
| Rural Residential | 96578.97154 | 2.22 |
| Rural Residential | 85407.81693 | 1.96 |
| Neighborhood Center | 688267.0983 | 15.80 |
| Rural Residential | 93508.23436 | 2.15 |
| Rural Residential | 87334.07102 | 2.00 |
| Rural Residential | 95285.063 | 2.19 |
| Rural Residential | 92273.04502 | 2.12 |
| Rural Residential | 94911.86809 | 2.18 |
| Rural Residential | 95087.81702 | 2.18 |
| Neighborhood Center | 109231.6507 | 2.51 |
| Rural Residential | 88954.00874 | 2.04 |
| Rural Residential | 91673.17928 | 2.10 |
| Rural Residential | 90481.65775 | 2.08 |
| Rural Residential | 93034.7136 | 2.14 |
| Rural Residential | 93410.82334 | 2.14 |

| | | |
|---|---|---|
| Rural Residential | 92506.74241 | 2.12 |
| Rural Residential | 88143.46526 | 2.02 |
| Rural Residential | 372297.243 | 8.55 |
| Rural Residential | 102078.2042 | 2.34 |
| Rural Residential | 5890.524751 | 0.14 |
| Rural Residential | 5710.100981 | 0.13 |
| Rural Residential | 87724.73103 | 2.01 |
| Rural Residential | 204700.5652 | 4.70 |
| Rural Residential | 203649.8485 | 4.68 |
| Rural Residential | 41342.64218 | 0.95 |
| Rural Residential | 25894.66602 | 0.59 |
| Rural Residential | 94929.60949 | 2.18 |
| Rural Residential | 93650.44329 | 2.15 |
| Rural Residential | 107289.1189 | 2.46 |
| Rural Residential | 93110.44151 | 2.14 |
| Rural Residential | 82081.77164 | 1.88 |
| Rural Residential | 69055.56848 | 1.59 |
| Rural Residential | 168857.807 | 3.88 |
| Rural Residential | 63432.23992 | 1.46 |
| Rural Residential | 26585.31887 | 0.61 |
| Rural Residential | 103012.1954 | 2.36 |
| Rural Residential | 103836.3999 | 2.38 |
| Rural Residential | 2035770.402 | 46.73 |
| Rural Residential | 426160.7248 | 9.78 |
| Rural Residential | 2811.66051 | 0.06 |
| Rural Residential | 97475.91544 | 2.24 |
| Rural Residential | 102254.749 | 2.35 |
| Rural Residential | 112756.2236 | 2.59 |
| Rural Residential | 114380.8347 | 2.63 |
| Rural Residential | 124659.5398 | 2.86 |
| Rural Residential | 222944.0344 | 5.12 |
| Rural Residential | 133477.3655 | 3.06 |
| Rural Residential | 113736.3859 | 2.61 |
| Rural Residential | 35920.8004 | 0.82 |
| Rural Residential | 83950.85956 | 1.93 |
| Rural Residential | 115835.479 | 2.66 |
| Rural Residential | 86197.06826 | 1.98 |
| Rural Residential | 88666.27511 | 2.04 |
| Rural Residential | 86711.61272 | 1.99 |
| Rural Residential | 85032.69363 | 1.95 |
| Rural Residential | 81755.20946 | 1.88 |
| Rural Residential | 92407.66178 | 2.12 |
| Rural Residential | 91735.1243 | 2.11 |
| Rural Residential | 89252.76825 | 2.05 |
| Rural Residential | 177733.0379 | 4.08 |
| Rural Residential | 107666.7766 | 2.47 |
| Rural Residential | 82449.0975 | 1.89 |
| Rural Residential | 129559.6432 | 2.97 |
| Rural Residential | 67307.47032 | 1.55 |
| Rural Residential | 73716.76752 | 1.69 |
| Rural Residential | 74268.80091 | 1.70 |
| Rural Residential | 250918.3241 | 5.76 |
| Rural Residential | 98513.12997 | 2.26 |
| Rural Residential | 224370.6335 | 5.15 |
| Rural Residential | 101185.1964 | 2.32 |
| Rural Residential | 22290.59194 | 0.51 |
| Rural Cluster Residential | 3164269.752 | 72.64 |
| Rural Cluster Residential | 59780.69645 | 1.37 |
| Rural Cluster Residential | 59780.7509 | 1.37 |
| Rural Cluster Residential | 458413.0977 | 10.52 |
| Mixed Residential | 363746.8997 | 8.35 |
| Rural Residential | 4763010.21 | 109.34 |
| Rural Cluster Residential | 1697169.152 | 38.96 |
| Rural Cluster Residential | 810360.2739 | 18.60 |
| Rural Residential | 45210.46925 | 1.04 |
| Rural Residential | 57483.10311 | 1.32 |
| Rural Residential | 44409.35465 | 1.02 |
| Rural Residential | 54780.33036 | 1.26 |
| Rural Residential | 18413.91571 | 0.42 |
| Rural Residential | 86992.97427 | 2.00 |
| Rural Residential | 90178.00128 | 2.07 |
| Rural Residential | 17573.87771 | 0.40 |
| Rural Cluster Residential | 210943.4452 | 4.84 |
| Rural Cluster Residential | 219893.1073 | 5.05 |
| Rural Residential | 91347.17556 | 2.10 |
| Rural Residential | 77773.96207 | 1.79 |
| Rural Residential | 95252.86995 | 2.19 |
| Rural Residential | 674433.636 | 15.48 |

# Basin DV

Catchment Area Impacted by SEDA (Acres): 398.87

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 0.00 | Regional Shopping Center | 0.00 | 0.00 |
| Regional Mixed-Use | 208.64 | Community Commercial | 146.05 | 87.63 |
| Residential - Low Density | 0.16 | Low Density (0-2 DU/acre) | 0.05 | 0.03 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 0.00 | Medium Density (5-10 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 48.55 | High Density (23-44 DU/acre) | 26.70 | 16.02 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 79.80 | Office Commercial (OC) | 51.87 | 31.12 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 43.18 | Open Space (OS) | 8.64 | 5.18 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 0.00 | Railroad | 0.00 | 0.00 |
| SEGA Buffer | 0.00 | Rural Density (0-0.7 DU/acre) | 0.00 | 0.00 |
| SEGA School with Park | 0.00 | *MDR-50 | 0.00 | 0.00 |
| | | | | |
| Water | 0.00 | | | |
| Roads =398.87 - Sum(Row5-22) | 18.55 | | 16.70 | 10.02 |
| Totals (Row5-25): | 380.31 | | | |
| Totals check(Row 36-49): | 380.31 | | | |
| Grand Total: | 398.87 | | 249.99 | 150.00 |

### City of Fresno GIS Data

| Planned Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Residential - Urban Neighborhood | 50144.92094 | 1.15 |
| Open Space | 420564.4053 | 9.65 |
| Residential - Urban Neighborhood | 2064571.502 | 47.40 |
| Open Space | 800524.6718 | 18.38 |
| Employment - Office | 1677784.893 | 38.52 |
| Employment - Office | 1125002.039 | 25.83 |
| Regional Mixed-Use | 1441467.614 | 33.09 |
| Regional Mixed-Use | 1520050.345 | 34.90 |
| Residential - Low Density | 6760.298127 | 0.16 |
| Employment - Office | 297926.9151 | 6.84 |
| Employment - Office | 375299.326 | 8.62 |
| Regional Mixed-Use | 6126786.971 | 140.65 |
| Open Space | 659637.2426 | 15.14 |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 0.00 | Community Center | 0.00 | 0.00 |
| Regional Center | 223.45 | Community Commercial | 156.42 | 93.85 |
| Rural Residential | 1.81 | Low Density (0-2 DU/acre) | 0.53 | 0.32 |
| Neighborhood Residential | 0.00 | Neighborhood Residential | 0.00 | 0.00 |
| Mixed Residential | 68.54 | Mixed Residential | 31.53 | 18.92 |
| Flexible Reseach & Dev | 0.19 | Flexible Reseach & Dev | 0.14 | 0.08 |
| Office Center | 88.04 | Office Center | 57.23 | 34.34 |
| Institutional | 0.00 | Institutional | 0.00 | 0.00 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 0.00 | Rural Cluster Residential | 0.00 | 0.00 |
| Neighborhood Center | 0.00 | Neighborhood Center | 0.00 | 0.00 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Water | 0.00 | | | |
| Roads =398.87 - Sum(Row5-22) | 16.84 | | 15.15 | 9.09 |
| Totals (Row5-25): | 382.03 | | | |
| Totals check(Row 36-84): | 382.03 | | | |
| Grand Total: | 398.87 | | 260.99 | 156.59 |

### South East Development Area GIS Data

| SEDA Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Flexible Reseach & Dev | 4468.025071 | 0.10 |
| Flexible Reseach & Dev | 582.1269892 | 0.01 |
| Flexible Reseach & Dev | 29.52919758 | 0.00 |
| Flexible Reseach & Dev | 26.22616893 | 0.00 |
| Flexible Reseach & Dev | 354.9173678 | 0.01 |
| Flexible Reseach & Dev | 2655.877158 | 0.06 |
| Mixed Residential | 76239.01801 | 1.75 |
| Mixed Residential | 424881.7975 | 9.75 |
| Mixed Residential | 343624.1975 | 7.89 |
| Mixed Residential | 84336.46845 | 1.94 |
| Mixed Residential | 555503.8437 | 12.75 |
| Mixed Residential | 50957.54829 | 1.17 |
| Mixed Residential | 98529.51653 | 2.26 |
| Mixed Residential | 254635.4158 | 5.85 |
| Mixed Residential | 1096794.671 | 25.18 |
| Office Center | 233664.4656 | 5.36 |
| Office Center | 401661.5638 | 9.22 |
| Office Center | 448894.3853 | 10.31 |
| Office Center | 669640.243 | 15.37 |
| Office Center | 407884.8643 | 9.36 |
| Office Center | 516645.9484 | 11.86 |
| Office Center | 858954.3248 | 19.72 |
| Office Center | 297842.7068 | 6.84 |
| Regional Center | 41023.12399 | 0.94 |
| Regional Center | 1720173.544 | 39.49 |
| Regional Center | 42649.15588 | 0.98 |
| Regional Center | 141820.0295 | 3.26 |
| Regional Center | 1635243.978 | 37.54 |
| Regional Center | 611641.023 | 14.04 |
| Regional Center | 327518.9852 | 7.52 |
| Regional Center | 53666.22779 | 1.23 |
| Regional Center | 756493.0073 | 17.37 |
| Regional Center | 855548.4575 | 19.64 |
| Regional Center | 1283173.427 | 29.46 |
| Regional Center | 258066.8526 | 5.92 |
| Regional Center | 1712609.074 | 39.32 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| **10.99** | **6.60** | **4%** |

| | | |
|---|---|---|
| Regional Center | 293867.3579 | 6.75 |
| Rural Residential | 124.8070353 | 0.00 |
| Rural Residential | 1.612217946 | 0.00 |
| Rural Residential | 11460.73198 | 0.26 |
| Rural Residential | 1172.505174 | 0.03 |
| Rural Residential | 928.0891124 | 0.02 |
| Rural Residential | 604.3594203 | 0.01 |
| Rural Residential | 85.22064049 | 0.00 |
| Rural Residential | 5832.142702 | 0.13 |
| Rural Residential | 58791.40203 | 1.35 |
| | | |
| Mixed Residential | 1098694.819 | |
| Flexible Reseach & Dev | -200541.1116 | |
| | | |
| ~~Office Center~~ | ~~10927.54979~~ | |
| ~~Office Center~~ | ~~6103.422205~~ | |
| ~~Rural Residential~~ | ~~11460.61612~~ | |
| ~~Rural Residential~~ | ~~45938.72168~~ | |
| ~~Rural Residential~~ | ~~1737.37273~~ | |
| ~~Rural Residential~~ | ~~11512.90902~~ | |
| ~~Rural Residential~~ | ~~11564.9562~~ | |

# Basin DW

Catchment Area Impacted by SEDA (Acres): 756.17

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 0.00 | Regional Shopping Center | 0.00 | 0.00 |
| Regional Mixed-Use | 1.13 | Community Commercial | 0.79 | 0.47 |
| Residential - Low Density | 39.51 | Low Density (0-2 DU/acre) | 11.46 | 6.87 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 135.21 | Medium Density (5-10 DU/acre) | 43.27 | 25.96 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 220.86 | High Density (23-44 DU/acre) | 121.48 | 72.89 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Light Industrial | 0.32 | Light Industrial | 0.21 | 0.12 |
| Employment - Office | 0.67 | Office Commercial (OC) | 0.44 | 0.26 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 103.57 | Open Space (OS) | 20.71 | 12.43 |
| Open Space - Community Park | 12.59 | Open Space (OS) | 2.52 | 1.51 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 6.39 | Railroad | 3.20 | 1.92 |
| SEGA Buffer | 147.94 | Rural Density (0-0.7 DU/acre) | 42.90 | 25.74 |
| SEGA School with Park | 70.60 | *MDR-50 | 35.30 | 21.18 |
| | | | | |
| Water | 0.00 | | | |
| Roads =756.17 - Sum(Row5-22) | 17.38 | | 15.64 | 9.38 |
| Totals (Row5-25): | 738.79 | | | |
| Totals check(Row 36-69): | 738.79 | | | |
| Grand Total: | 756.17 | | 297.91 | 178.74 |

### City of Fresno GIS Data

| Planned Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Employment - Light Industrial | 13470.95401 | 0.31 |
| Regional Mixed-Use | 12997.26643 | 0.30 |
| Residential - Urban Neighborhood | 48796.62584 | 1.12 |
| Residential - Medium Density | 37805.57846 | 0.87 |
| Railroad | 130827.7137 | 3.00 |
| SEGA School with Park | 835794.4945 | 19.19 |
| Residential - Urban Neighborhood | 657990.0404 | 15.11 |
| Residential - Urban Neighborhood | 3468853.436 | 79.63 |
| Open Space - Community Park | 548383.7364 | 12.59 |
| Employment - Light Industrial | 439.462936 | 0.01 |
| Open Space | 483901.9106 | 11.11 |
| Employment - Office | 29214.75318 | 0.67 |
| Regional Mixed-Use | 36261.15522 | 0.83 |
| SEGA Buffer | 203.8136373 | 0.00 |
| Residential - Medium Density | 2538511.672 | 58.28 |
| Residential - Low Density | 1721002.458 | 39.51 |
| Residential - Medium Density | 1128543.22 | 25.91 |
| SEGA School with Park | 977778.9372 | 22.45 |
| Residential - Medium Density | 118884.5171 | 2.73 |
| Open Space | 1088436.447 | 24.99 |
| Residential - Urban Neighborhood | 1592846.921 | 36.57 |
| Residential - Urban Neighborhood | 399851.8703 | 9.18 |
| Residential - Urban Neighborhood | 969349.3728 | 22.25 |
| Residential - Urban Neighborhood | 1232316.722 | 28.29 |
| Residential - Medium Density | 378594.988 | 8.69 |
| Residential - Medium Density | 1641948.162 | 37.69 |
| Residential - Urban Neighborhood | 1250842.507 | 28.72 |
| Residential - Medium Density | 45489.77458 | 1.04 |
| SEGA School with Park | 1261746.545 | 28.97 |
| Railroad | 80418.05344 | 1.85 |
| Railroad | 67235.19096 | 1.54 |
| Open Space | 2065319.769 | 47.41 |
| SEGA Buffer | 6443922.51 | 147.93 |
| Open Space | 873876.4433 | 20.06 |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 0.00 | Community Center | 0.00 | 0.00 |
| Regional Center | 3.06 | Community Commercial | 2.14 | 1.28 |
| Rural Residential | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Neighborhood Residential | 207.76 | Neighborhood Residential | 108.04 | 64.82 |
| Mixed Residential | 284.10 | Mixed Residential | 130.69 | 78.41 |
| Flexible Reseach & Dev | 0.10 | Flexible Reseach & Dev | 0.07 | 0.04 |
| Office Center | 0.71 | Office Center | 0.46 | 0.28 |
| Institutional | 0.00 | Institutional | 0.00 | 0.00 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 154.97 | Rural Cluster Residential | 48.04 | 28.82 |
| Neighborhood Center | 81.44 | Neighborhood Center | 49.68 | 29.81 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| no value | 7.85 | Open Space (OS) | 1.57 | 0.94 |
| | | | | |
| Water | 0.00 | | | |
| Roads =756.17 - Sum(Row5-22) | 16.18 | | 14.56 | 8.74 |
| Totals (Row5-25): | 739.99 | | | |
| Totals check(Row 36-99): | 739.99 | | | |
| Grand Total: | 756.17 | | 355.25 | 213.15 |

### South East Development Area GIS Data

| SEDA Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Flexible Reseach & Dev | 43.66764205 | 0.001 |
| Flexible Reseach & Dev | 34.97282372 | 0.001 |
| Flexible Reseach & Dev | 560.8587542 | 0.01 |
| Mixed Residential | 176268.2389 | 4.05 |
| Flexible Reseach & Dev | 3621.561532 | 0.08 |
| Regional Center | 14837.46829 | 0.34 |
| Neighborhood Residential | 17745.89172 | 0.41 |
| Regional Center | 113.5855245 | 0.003 |
| Regional Center | 12883.59951 | 0.30 |
| Neighborhood Residential | 86123.87452 | 1.98 |
| Neighborhood Center | 192753.0142 | 4.43 |
| Rural Cluster Residential | 1609389.997 | 36.95 |
| Neighborhood Residential | 40586.62054 | 0.93 |
| Neighborhood Center | 874931.142 | 20.09 |
| Mixed Residential | 756200.2041 | 17.36 |
| Neighborhood Residential | 116670.1153 | 2.68 |
| Neighborhood Residential | 318923.7345 | 7.32 |
| Mixed Residential | 867945.2717 | 19.93 |
| Office Center | 31093.03517 | 0.71 |
| Neighborhood Residential | 85831.86508 | 1.97 |
| Neighborhood Residential | 1635171.116 | 37.54 |
| Neighborhood Residential | 1293258.127 | 29.69 |
| Neighborhood Residential | 1686282.295 | 38.71 |
| Mixed Residential | 443457.937 | 10.18 |
| Mixed Residential | 608343.6087 | 13.97 |
| Mixed Residential | 1747201.217 | 40.11 |
| Mixed Residential | 1690808.119 | 38.82 |
| Mixed Residential | 86801.40441 | 1.99 |
| Mixed Residential | 857688.751 | 19.69 |
| Mixed Residential | 443108.7488 | 10.17 |
| Mixed Residential | 420854.8216 | 9.66 |
| Mixed Residential | 54019.09131 | 1.24 |
| Rural Cluster Residential | 13269.28351 | 0.30 |
| Regional Center | 29811.47362 | 0.68 |
| Regional Center | 28792.8341 | 0.66 |
| No Value | 22075.7274 | 0.51 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| **57.35** | **34.41** | **19%** |

| | | |
|---|---|---|
| No Value | 23031.50148 | 0.53 |
| Mixed Residential | 369859.6302 | 8.49 |
| Neighborhood Center | 305970.3165 | 7.02 |
| Mixed Residential | 373160.7187 | 8.57 |
| Neighborhood Residential | 623737.6225 | 14.32 |
| Neighborhood Center | 912325.8181 | 20.94 |
| Mixed Residential | 547530.3496 | 12.57 |
| Neighborhood Residential | 169536.6401 | 3.89 |
| Rural Cluster Residential | 2153783.697 | 49.44 |
| Rural Cluster Residential | 40263.10123 | 0.92 |
| Neighborhood Residential | 5316.240574 | 0.12 |
| Neighborhood Residential | 587889.8035 | 13.50 |
| Neighborhood Residential | 1668418.805 | 38.30 |
| Neighborhood Residential | 669512.84 | 15.37 |
| Mixed Residential | 1599962.913 | 36.73 |
| Rural Cluster Residential | 1541740.852 | 35.39 |
| Rural Cluster Residential | 102871.0691 | 2.36 |
| Mixed Residential | 55763.45615 | 1.28 |
| Rural Cluster Residential | 1254293.317 | 28.79 |
| Neighborhood Center | 1261745.74 | 28.97 |
| Regional Center | 46833.74402 | 1.08 |
| Mixed Residential | 1276422.9 | 29.30 |
| No Value | 154330.9315 | 3.54 |
| No Value | 55743.32787 | 1.28 |
| Rural Cluster Residential | 13355.16286 | 0.31 |
| Neighborhood Residential | 45222.49069 | 1.04 |
| Rural Cluster Residential | 21336.2245 | 0.49 |
| No Value | 86631.46088 | 1.99 |

# Basin DX

Catchment Area Impacted by SEDA (Acres): 879.02

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 55.06 | Regional Shopping Center | 38.54 | 23.13 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 274.43 | Medium Density (5-10 DU/acre) | 87.82 | 52.69 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 142.94 | High Density (23-44 DU/acre) | 78.62 | 47.17 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 0.00 | Office Commercial (OC) | 0.00 | 0.00 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 76.10 | Open Space (OS) | 15.22 | 9.13 |
| Open Space - Community Park | 34.85 | Open Space (OS) | 6.97 | 4.18 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 0.44 | Railroad | 0.22 | 0.13 |
| SEGA Buffer | 140.59 | Rural Density (0-0.7 DU/acre) | 40.77 | 24.46 |
| SEGA School with Park | 119.39 | *MDR-50 | 59.69 | 35.82 |
| | | | | |
| Water | 0.00 | | | |
| Roads =879.02 - Sum(Row5-22) | 35.21 | | 31.69 | 19.01 |
| Totals (Row5-25): | 843.81 | | | |
| Totals check(Row 36-67): | 843.81 | | | |
| Grand Total: | 879.02 | | 359.54 | 215.73 |

### City of Fresno GIS Data

| Planned Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Open Space | 590.1602888 | 0.01 |
| SEGA School with Park | 980538.4318 | 22.51 |
| Railroad | 19288.85529 | 0.44 |
| Residential - Medium Density | 2089180.98 | 47.96 |
| Residential - Urban Neighborhood | 227741.7547 | 5.23 |
| Open Space | 651684.4879 | 14.96 |
| Residential - Urban Neighborhood | 215760.4101 | 4.95 |
| Open Space | 32281.78959 | 0.74 |
| Open Space - Community Park | 1518214.301 | 34.85 |
| Corridor - Center Mixed Use | 1355442.527 | 31.12 |
| Corridor - Center Mixed Use | 1043030.342 | 23.94 |
| Residential - Medium Density | 1722605.678 | 39.55 |
| SEGA Buffer | 4474989.751 | 102.73 |
| Residential - Urban Neighborhood | 1648104.45 | 37.84 |
| Residential - Urban Neighborhood | 794549.8544 | 18.24 |
| Open Space | 1091530.686 | 25.06 |
| Residential - Medium Density | 1702083.493 | 39.07 |
| Residential - Medium Density | 2196271.242 | 50.42 |
| Residential - Medium Density | 577955.4385 | 13.27 |
| Residential - Medium Density | 1158507.961 | 26.60 |
| Residential - Urban Neighborhood | 1602844.155 | 36.80 |
| Residential - Medium Density | 814978.2031 | 18.71 |
| SEGA School with Park | 726989.5376 | 16.69 |
| Residential - Urban Neighborhood | 1737564.93 | 39.89 |
| SEGA School with Park | 819665.2071 | 18.82 |
| SEGA School with Park | 676883.645 | 15.54 |
| SEGA School with Park | 1226236.35 | 28.15 |
| Open Space | 561147.5549 | 12.88 |
| SEGA School with Park | 770312.5193 | 17.68 |
| Open Space | 977883.9109 | 22.45 |
| SEGA Buffer | 1648958.168 | 37.85 |
| Residential - Medium Density | 1692628.049 | 38.86 |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 0.00 | Community Center | 0.00 | 0.00 |
| Regional Center | 65.20 | Community Commercial | 45.64 | 27.38 |
| Rural Residential | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Neighborhood Residential | 321.36 | Neighborhood Residential | 167.11 | 100.26 |
| Mixed Residential | 181.08 | Mixed Residential | 83.29 | 49.98 |
| Flexible Reseach & Dev | 1.88 | Flexible Reseach & Dev | 1.39 | 0.83 |
| Office Center | 0.00 | Office Center | 0.00 | 0.00 |
| Institutional | 0.00 | Institutional | 0.00 | 0.00 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 152.45 | Rural Cluster Residential | 47.26 | 28.36 |
| Neighborhood Center | 121.36 | Neighborhood Center | 74.03 | 44.42 |
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| | | | | |
| | | | | |
| | | | | |
| Water | 0.00 | | | |
| Roads =879.02 - Sum(Row5-22) | 35.70 | | 32.13 | 19.28 |
| Totals (Row5-25): | 843.32 | | | |
| Totals check(Row 36-135): | 843.83 | | | |
| Grand Total: | 879.02 | | 450.85 | 270.51 |

### South East Development Area GIS Data

| SEDA Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Flexible Reseach & Dev | 1025.976569 | 0.02 |
| Flexible Reseach & Dev | 1.59667206 | 0.00004 |
| Flexible Reseach & Dev | 15.10405347 | 0.0003 |
| Mixed Residential | 3415.270802 | 0.08 |
| Flexible Reseach & Dev | 144.8605603 | 0.003 |
| Neighborhood Residential | 22239.07842 | 0.51 |
| Mixed Residential | 168991.7814 | 3.88 |
| Mixed Residential | 427032.6694 | 9.80 |
| Regional Center | 51457.96587 | 1.18 |
| Rural Cluster Residential | 3253.183429 | 0.07 |
| Neighborhood Residential | 224717.5025 | 5.16 |
| Flexible Reseach & Dev | 9153.120377 | 0.21 |
| Flexible Reseach & Dev | 2513.365357 | 0.06 |
| Flexible Reseach & Dev | 1.932517865 | 0.00004 |
| Flexible Reseach & Dev | 2668.881749 | 0.06 |
| Mixed Residential | 4279.59023 | 0.10 |
| Mixed Residential | 193658.8139 | 4.45 |
| Mixed Residential | 247766.4579 | 5.69 |
| Neighborhood Center | 260688.6104 | 5.98 |
| Neighborhood Center | 439560.5698 | 10.09 |
| Regional Center | 60454.61495 | 1.39 |
| Mixed Residential | 21599.02041 | 0.50 |
| Regional Center | 811074.1901 | 18.62 |
| Mixed Residential | 63.84747571 | 0.00 |
| Flexible Reseach & Dev | 8984.815181 | 0.21 |
| Neighborhood Center | 464146.4978 | 10.66 |
| Flexible Reseach & Dev | 7399.548333 | 0.17 |
| Flexible Reseach & Dev | 6013.694174 | 0.14 |
| Regional Center | 83272.81112 | 1.91 |
| Regional Center | 7145.068762 | 0.16 |
| Mixed Residential | 782485.829 | 17.96 |
| Mixed Residential | 805914.8807 | 18.50 |
| Mixed Residential | 100463.5518 | 2.31 |
| Mixed Residential | 33086.7133 | 0.76 |
| Mixed Residential | 32671.58817 | 0.75 |
| Neighborhood Residential | 16570.8002 | 0.38 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| **91.30** | **54.78** | **25%** |

| | | |
|---|---|---|
| Neighborhood Residential | 835702.9911 | 19.19 |
| Neighborhood Center | 883376.7006 | 20.28 |
| Rural Cluster Residential | 733841.1092 | 16.85 |
| Neighborhood Residential | 876546.134 | 20.12 |
| Rural Cluster Residential | 37461.84148 | 0.86 |
| Rural Cluster Residential | 842987.6356 | 19.35 |
| Neighborhood Residential | 3415233.127 | 78.40 |
| Mixed Residential | 1680386.659 | 38.58 |
| Neighborhood Residential | 37658.88056 | 0.86 |
| Neighborhood Residential | 841243.7609 | 19.31 |
| Flexible Reseach & Dev | 505.9704946 | 0.01 |
| Neighborhood Residential | 1382039.24 | 31.73 |
| No Value | 22007.6433 | 0.51 |
| Regional Center | 840.4635111 | 0.02 |
| Neighborhood Center | 347871.156 | 7.99 |
| Neighborhood Center | 44990.1962 | 1.03 |
| Neighborhood Center | 197991.3859 | 4.55 |
| Regional Center | 152732.5473 | 3.51 |
| Regional Center | 294569.9377 | 6.76 |
| Neighborhood Center | 571278.3175 | 13.11 |
| Regional Center | 111.6336036 | 0.00 |
| Neighborhood Residential | 776314.0179 | 17.82 |
| Mixed Residential | 1108955.099 | 25.46 |
| Mixed Residential | 261643.995 | 6.01 |
| Neighborhood Residential | 219824.7616 | 5.05 |
| Neighborhood Residential | 258963.6946 | 5.94 |
| Flexible Reseach & Dev | 22806.23968 | 0.52 |
| Mixed Residential | 803987.4268 | 18.46 |
| Regional Center | 153294.8974 | 3.52 |
| Regional Center | 52124.13877 | 1.20 |
| Neighborhood Center | 173568.2225 | 3.98 |
| Regional Center | 45559.78846 | 1.05 |
| Mixed Residential | 45686.83696 | 1.05 |
| Mixed Residential | 47952.83086 | 1.10 |
| Mixed Residential | 45284.70258 | 1.04 |
| Regional Center | 73166.7915 | 1.68 |
| Regional Center | 83557.26887 | 1.92 |
| Flexible Reseach & Dev | 6662.134612 | 0.15 |
| Flexible Reseach & Dev | 13919.763 | 0.32 |
| Regional Center | 898814.0338 | 20.63 |
| Mixed Residential | 69068.67645 | 1.59 |
| Rural Cluster Residential | 769442.6469 | 17.66 |
| Rural Cluster Residential | 81699.06879 | 1.88 |
| Rural Cluster Residential | 857695.1982 | 19.69 |
| Rural Cluster Residential | 838416.1562 | 19.25 |
| Neighborhood Center | 589163.4775 | 13.53 |
| Neighborhood Center | 39995.03917 | 0.92 |
| Neighborhood Center | 391770.5263 | 8.99 |
| Neighborhood Residential | 577954.2497 | 13.27 |
| Neighborhood Center | 245118.1408 | 5.63 |
| Mixed Residential | 240892.0415 | 5.53 |
| Neighborhood Residential | 785012.7076 | 18.02 |
| Neighborhood Residential | 15226.7662 | 0.35 |
| Mixed Residential | 762348.5144 | 17.50 |
| Regional Center | 71840.14449 | 1.65 |
| Neighborhood Residential | 1219285.818 | 27.99 |
| Neighborhood Residential | 652860.9832 | 14.99 |
| Neighborhood Residential | 105472.1133 | 2.42 |
| Rural Cluster Residential | 864405.8608 | 19.84 |
| Rural Cluster Residential | 786645.5536 | 18.06 |
| Rural Cluster Residential | 824850.6239 | 18.94 |
| Neighborhood Residential | 22949.62016 | 0.53 |
| Neighborhood Residential | 1712588.919 | 39.32 |
| Neighborhood Center | 637065.9974 | 14.63 |

# Basin DY

Catchment Area Impacted by SEDA (Acres): 648.83

## General Plan Area Calculations

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 27.20 | Regional Shopping Center | 19.04 | 11.42 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 0.00 | Medium Density (5-10 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 0.00 | High Density (23-44 DU/acre) | 0.00 | 0.00 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 540.98 | *Heavy Industrial (M-3) | 405.74 | 243.44 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 0.00 | Office Commercial (OC) | 0.00 | 0.00 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 44.02 | Open Space (OS) | 8.80 | 5.28 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 0.00 | Railroad | 0.00 | 0.00 |
| SEGA Buffer | 0.00 | Rural Density (0-0.7 DU/acre) | 0.00 | 0.00 |
| SEGA School with Park | 0.00 | *MDR-50 | 0.00 | 0.00 |
| | | | | |
| Water | 0.00 | | | |
| Roads =648.83 - Sum(Row5-22) | 36.63 | | 32.97 | 19.78 |
| Totals (Row5-25): | 612.20 | | | |
| Totals check(Row 36-40): | 612.20 | | | |
| Grand Total: | 648.83 | | 466.55 | 279.93 |

**City of Fresno GIS Data**

| Planned Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Employment - Regional Business Park | 8097137.463 | 185.88 |
| Employment - Regional Business Park | 12175534.32 | 279.51 |
| Employment - Regional Business Park | 3292601.401 | 75.59 |
| Open Space | 1917367.619 | 44.02 |
| Corridor - Center Mixed Use | 1184879.009 | 27.20 |

## SEDA Area Calculations

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 30.80 | Community Center | 20.64 | 12.38 |
| Regional Center | 0.00 | Community Commercial | 0.00 | 0.00 |
| Rural Residential | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Neighborhood Residential | 0.00 | Neighborhood Residential | 0.00 | 0.00 |
| Mixed Residential | 0.00 | Mixed Residential | 0.00 | 0.00 |
| Flexible Reseach & Dev | 581.39 | Flexible Reseach & Dev | 430.23 | 258.14 |
| Office Center | 0.00 | Office Center | 0.00 | 0.00 |
| Institutional | 0.00 | Institutional | 0.00 | 0.00 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 0.00 | Rural Cluster Residential | 0.00 | 0.00 |
| Neighborhood Center | 0.00 | Neighborhood Center | 0.00 | 0.00 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Water | 0.00 | | | |
| Roads =648.83 - Sum(Row5-22) | 36.64 | | 32.97 | 19.78 |
| Totals (Row5-25): | 612.19 | | | |
| Totals check(Row 36-78): | 612.19 | | | |
| Grand Total: | 648.83 | | 483.84 | 290.30 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| 17.29 | 10.38 | 4% |

**South East Development Area GIS Data**

| SEDA Land Use Designation | AREA | AREA |
|---|---|---|
| | Square Feet | Acres |
| Community Center | 89487.27483 | 2.05 |
| Community Center | 134740.2111 | 3.09 |
| Community Center | 48557.39241 | 1.11 |
| Community Center | 39620.00034 | 0.91 |
| Community Center | 225108.2932 | 5.17 |
| Community Center | 64611.83442 | 1.48 |
| Community Center | 662048.8822 | 15.20 |
| Community Center | 36848.29636 | 0.85 |
| Community Center | 40691.96701 | 0.93 |
| Flexible Reseach & Dev | 1383535.3 | 31.76 |
| Flexible Reseach & Dev | 49648.13803 | 1.14 |
| Flexible Reseach & Dev | 4006.923742 | 0.09 |
| Flexible Reseach & Dev | 753118.2987 | 17.29 |
| Flexible Reseach & Dev | 1745905.768 | 40.08 |
| Flexible Reseach & Dev | 672548.1334 | 15.44 |
| Flexible Reseach & Dev | 930265.6496 | 21.36 |
| Flexible Reseach & Dev | 102040.0754 | 2.34 |
| Flexible Reseach & Dev | 818551.6973 | 18.79 |
| Flexible Reseach & Dev | 811614.553 | 18.63 |
| Flexible Reseach & Dev | 163058.2982 | 3.74 |
| Flexible Reseach & Dev | 842072.7333 | 19.33 |
| Flexible Reseach & Dev | 803760.2082 | 18.45 |
| Flexible Reseach & Dev | 1693046.614 | 38.87 |
| Flexible Reseach & Dev | 824968.6918 | 18.94 |
| Flexible Reseach & Dev | 816890.082 | 18.75 |
| Flexible Reseach & Dev | 38984.94497 | 0.89 |
| Flexible Reseach & Dev | 923032.3969 | 21.19 |
| Flexible Reseach & Dev | 868908.6238 | 19.95 |
| Flexible Reseach & Dev | 275894.7473 | 6.33 |
| Flexible Reseach & Dev | 69171.01337 | 1.59 |
| Flexible Reseach & Dev | 730735.5681 | 16.78 |
| Flexible Reseach & Dev | 624759.9064 | 14.34 |
| Flexible Reseach & Dev | 888498.0522 | 20.40 |
| Flexible Reseach & Dev | 727426.7223 | 16.70 |
| Flexible Reseach & Dev | 723571.3533 | 16.61 |
| Flexible Reseach & Dev | 788268.4933 | 18.10 |

| | | |
|---|---|---|
| Flexible Reseach & Dev | 822036.505 | 18.87 |
| Flexible Reseach & Dev | 818504.2693 | 18.79 |
| Flexible Reseach & Dev | 812659.0822 | 18.66 |
| Flexible Reseach & Dev | 813173.7603 | 18.67 |
| Flexible Reseach & Dev | 1479702.356 | 33.97 |
| Flexible Reseach & Dev | 801838.3261 | 18.41 |
| Flexible Reseach & Dev | 703181.933 | 16.14 |

# Basin DZ

Catchment Area Impacted by SEDA
(Acres): 645.56

| Land Use Classification | General Plan Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | General Plan Required Basin CA | General Plan Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Corridor - Center Mixed Use | 28.72 | Regional Shopping Center | 20.10 | 12.06 |
| Regional Mixed-Use | 0.00 | Community Commercial | 0.00 | 0.00 |
| Residential - Low Density | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Residential - Medium High Density | 0.00 | Medium High Density (10-23 DU/acre) | 0.00 | 0.00 |
| Residential - Medium Density | 124.51 | Medium Density (5-10 DU/acre) | 39.84 | 23.91 |
| Residential - Medium Low Density | 0.00 | Medium Low (2-5 DU/Acre) | 0.00 | 0.00 |
| Residential - Urban Neighborhood | 95.71 | High Density (23-44 DU/acre) | 52.64 | 31.58 |
| Employment - Business Park | 0.00 | *Heavy Industrial (M-3) | 0.00 | 0.00 |
| Employment - Regional Business Park | 228.50 | *Heavy Industrial (M-3) | 171.38 | 102.83 |
| Employment - Light Industrial | 0.00 | Light Industrial | 0.00 | 0.00 |
| Employment - Office | 63.89 | Office Commercial (OC) | 41.53 | 24.92 |
| Public Facility - College | 0.00 | *MDR-50 | 0.00 | 0.00 |
| Open Space | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Community Park | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Open Space - Ponding Basin | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Railroad | 0.00 | Railroad | 0.00 | 0.00 |
| SEGA Buffer | 0.00 | Rural Density (0-0.7 DU/acre) | 0.00 | 0.00 |
| SEGA School with Park | 59.13 | *MDR-50 | 29.56 | 17.74 |
| | | | | |
| Water | 0.00 | | | |
| Roads =645.56 - Sum(Row5-22) | 45.11 | | 40.60 | 24.36 |
| Totals (Row5-25): | 600.45 | | | |
| Totals check(Row 36-51): | 600.45 | | | |
| Grand Total: | 645.56 | | 395.65 | 237.39 |

| SEDA Equivalent Land Use | SEDA Catchment Areas [from GIS table below] (Acres) | FMFCD Land Use | SEDA Required Basin CA | SEDA Required Basin Volume [CA*0.5*1.2] (acre-ft) |
|---|---|---|---|---|
| Community Center | 34.54 | Community Center | 23.14 | 13.89 |
| Regional Center | 0.00 | Community Commercial | 0.00 | 0.00 |
| Rural Residential | 0.00 | Low Density (0-2 DU/acre) | 0.00 | 0.00 |
| Neighborhood Residential | 120.83 | Neighborhood Residential | 62.83 | 37.70 |
| Mixed Residential | 86.71 | Mixed Residential | 39.89 | 23.93 |
| Flexible Reseach & Dev | 236.72 | Flexible Reseach & Dev | 175.17 | 105.10 |
| Office Center | 65.30 | Office Center | 42.45 | 25.47 |
| Institutional | 0.00 | Institutional | 0.00 | 0.00 |
| Park_OS_FloodControl | 0.00 | Open Space (OS) | 0.00 | 0.00 |
| Rural Cluster Residential | 0.00 | Rural Cluster Residential | 0.00 | 0.00 |
| Neighborhood Center | 71.10 | Neighborhood Center | 43.37 | 26.02 |
| | | | | |
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| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Water | 0.00 | | | |
| Roads =645.56 - Sum(Row5-22) | 30.36 | | 27.32 | 16.39 |
| Totals (Row5-25): | 615.20 | | | |
| Totals check(Row 36-81): | 615.20 | | | |
| Grand Total: | 645.56 | | 414.17 | 248.50 |

| CA Difference | Volume Difference | Percent Difference |
|---|---|---|
| 18.52 | 11.11 | 5% |

| City of Fresno GIS Data | | |
|---|---|---|
| Planned Land Use Designation | AREA | AREA |
| | Square Feet | Acres |
| SEGA School with Park | 438518.3973 | 10.07 |
| Residential - Medium Density | 5423515.354 | 124.51 |
| SEGA School with Park | 756003.5535 | 17.36 |
| SEGA School with Park | 796875.4912 | 18.29 |
| SEGA School with Park | 584116.5818 | 13.41 |
| Corridor - Center Mixed Use | 394101.7458 | 9.05 |
| Corridor - Center Mixed Use | 75052.67239 | 1.72 |
| Employment - Regional Business Park | 919277.3683 | 21.10 |
| Residential - Urban Neighborhood | 3104281.755 | 71.26 |
| Corridor - Center Mixed Use | 465122.3869 | 10.68 |
| Residential - Urban Neighborhood | 226426.6211 | 5.20 |
| Employment - Regional Business Park | 5733176.48 | 131.62 |
| Employment - Office | 2782964.559 | 63.89 |
| Employment - Regional Business Park | 3301043.316 | 75.78 |
| Corridor - Center Mixed Use | 316711.9269 | 7.27 |
| Residential - Urban Neighborhood | 838367.3556 | 19.25 |

| South East Development Area GIS Data | | |
|---|---|---|
| SEDA Land Use Designation | AREA | AREA |
| | Square Feet | Acres |
| Neighborhood Center | 629357.3993 | 14.45 |
| Mixed Residential | 678598.8045 | 15.58 |
| Community Center | 24943.06139 | 0.57 |
| Flexible Reseach & Dev | 1679064.88 | 38.55 |
| Community Center | 58842.33589 | 1.35 |
| Mixed Residential | 27232.56708 | 0.63 |
| Flexible Reseach & Dev | 96693.78536 | 2.22 |
| Office Center | 1605604.134 | 36.86 |
| Flexible Reseach & Dev | 64895.31535 | 1.49 |
| Community Center | 400643.0462 | 9.20 |
| Neighborhood Center | 540915.44 | 12.42 |
| Flexible Reseach & Dev | 87444.17656 | 2.01 |
| Flexible Reseach & Dev | 818535.8245 | 18.79 |
| Neighborhood Residential | 1211516.801 | 27.81 |
| Flexible Reseach & Dev | 71027.31018 | 1.63 |
| Mixed Residential | 679916.9716 | 15.61 |
| Neighborhood Residential | 1662299.669 | 38.16 |
| Neighborhood Residential | 766048.478 | 17.59 |
| Neighborhood Residential | 756003.2291 | 17.36 |
| Office Center | 1170819.527 | 26.88 |
| Mixed Residential | 30259.51772 | 0.69 |
| Flexible Reseach & Dev | 60197.2641 | 1.38 |
| Mixed Residential | 890518.1146 | 20.44 |
| Mixed Residential | 24017.25283 | 0.55 |
| Mixed Residential | 412818.1988 | 9.48 |
| Community Center | 31778.86213 | 0.73 |
| Community Center | 31889.91095 | 0.73 |
| Community Center | 323308.7792 | 7.42 |
| Flexible Reseach & Dev | 869110.7513 | 19.95 |
| Flexible Reseach & Dev | 3258767.387 | 74.81 |
| Mixed Residential | 168870.2854 | 3.88 |
| Neighborhood Center | 584116.8439 | 13.41 |
| Flexible Reseach & Dev | 3305636.062 | 75.89 |
| Community Center | 40900.0405 | 0.94 |
| Community Center | 43264.14604 | 0.99 |
| Community Center | 30090.49367 | 0.69 |

| | | |
|---|---|---|
| Mixed Residential | 864982.929 | 19.86 |
| Neighborhood Center | 452826.0388 | 10.40 |
| Community Center | 451077.3855 | 10.36 |
| Neighborhood Center | 889845.0087 | 20.43 |
| Neighborhood Residential | 28089.31741 | 0.64 |
| Neighborhood Residential | 47238.77204 | 1.08 |
| Neighborhood Residential | 791562.5801 | 18.17 |
| Neighborhood Residential | 560.0292567 | 0.01 |
| Office Center | 68215.14987 | 1.57 |
| Community Center | 67836.1618 | 1.56 |

# Appendix B

FMFCD Storm Drain and Flood Control Master Plan

# Exhibit A

- F.M.F.C.D. BOUNDARY
- DRAINAGE AREA BOUNDARY
- BQ DRAINAGE AREA DESIGNATION
- EXISTING PIPELINES
- DESIGN PIPELINES
- PROPOSED PIPELINES
- ACQUIRED BASIN FACILITY
- PROPOSED BASIN FACILITY
- NON-PLANNED AREAS
- AG USE FEE EXEMPTION
- CHANNELS AND CANALS
- RURAL STREAMS
- CITY SPHERE

FRESNO

CLOVIS

BIG DRY CREEK RESERVOIR

ALLUVIAL DRAIN BASIN

PUP CREEK ENTERPRISE DETENTION BASIN

PUP CREEK BASIN

FANCHER CREEK RESERVOIR

REDBANK RESERVOIR

REDBANK BASIN

FANCHER GOULD BASIN

FANCHER CREEK BASIN

DRY CREEK EXTENSION BASIN

CALIFORNIA STATE UNIVERSITY FRESNO

FRESNO - YOSEMITE INTERNATIONAL

Sierra Sky Park Airport

Fresno Chandler Airport

Landfill

WOODWARD PARK

ROEDING PARK

LEAKY ACRES

Woodward Lake

Sunnyside Country Club

SAN JOAQUIN RIVER

KINGS RIVER

# Fresno Metropolitan Flood Control District

## STORM DRAINAGE AND FLOOD CONTROL MASTER PLAN

FRESNO COUNTY, CALIFORNIA

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## Appendix C

FMFCD Recommended Design "C" Factors for the City of Fresno

**FRESNO METROPOLITAN FLOOD CONTROL DISTRICT**

**RECOMMENDED DESIGN "C" FACTORS**
**FOR**
**THE CITY OF FRESNO**

NOTE: 1) The recommended "C" Factors & R/G times are for typical developments and should be verified by the Engineer for applicability.

| FMFCD Land Use Designation | FMFCD Land Use Color Code | City of Fresno Allowable Density and Land Use Zoning | "C" Factor - Return Period (Years) | | | | | | | | Recommended Roof to Gutter Time (min.) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | | | *5 | *10 | *25 | *50 | *100 | | |
| | | | 1.10 | 1.00 | 1.20 | Supplement "C" Factor is 1.00 | | | | | | |
| Rural Density Residential (RD-R) | Na | 0 to 0.7 units/ac<br>AE-20<br>AE-5<br>R-A | 0.319 | 0.29 | 0.348 | 0.33 | 0.38 | 0.46 | 0.52 | 0.58 | 25 | |
| Low Density Residential (LD-R) | | 0 to 2.0 units/ac<br>R-A<br>R-1-E<br>R-1-A<br>R-1-B | 0.319 | 0.29 | 0.348 | 0.33 | 0.38 | 0.46 | 0.52 | 0.58 | 25 | |
| Medium-Low Density Residential (MLD-R) | | 2.0 to 5.0 units/ac<br>R-1-A<br>R-1-B<br>R-1-C | 0.319 | 0.29 | 0.348 | 0.33 | 0.38 | 0.46 | 0.52 | 0.58 | 25* | *Use 20 min. if drainage is piped to front yard. |
| Medium Density Residential (MD-R)<br><br>@ 45% C-Factor<br>@ 50% C-Factor | | 5.0 to 10.0 units/ac<br>R-1-C<br>R-1<br>R-2-A<br>R-1 45<br>R-1 50 | 0.352<br><br>Na<br>Na | 0.32<br><br>0.45<br>0.50 | 0.384<br><br>Na<br>Na | 0.36 | 0.42 | 0.51 | 0.57 | 0.64 | 20*<br><br>20<br>20 | *Use 20 min. for new development after 6/19/2008 - for prior development use 25 min. |
| Medium-High Density Residential (MHD-R) | | 10.0 to 23.0 units/ac<br>R-2-A<br>R-2<br>R-3-A | 0.462 | 0.42 | 0.504 | 0.47 | 0.52 | 0.60 | 0.65 | 0.71 | 20 | May have private on-site system. If present adjust R/G time as necessary. |
| High Density Residential (HD-R) | | 23.0 to 44.0 units/ac<br>R-3-A<br>R-3<br>R-4 | 0.605 | 0.55 | 0.66 | 0.62 | 0.68 | 0.79 | 0.85 | 0.90 | 20 | May have private on-site system. If present adjust R/G time as necessary. |
| Neighborhood Commercial (NC) | | C-1<br>C-L | 0.77 | 0.70 | 0.84 | 0.74 | 0.77 | 0.82 | 0.84 | 0.90 | 10 | May have private on-site system. If present adjust R/G time as necessary. |
| Community Commercial (CC) | | C-2<br>C-L | 0.77 | 0.70 | 0.84 | 0.74 | 0.77 | 0.82 | 0.84 | 0.90 | 10 | May have private on-site system. If present adjust R/G time as necessary. |
| Regional Shopping Center (RC) | | C-3<br>C-4 | 0.77 | 0.70 | 0.84 | 0.74 | 0.77 | 0.82 | 0.84 | 0.90 | 10 | May have private on-site system. If present adjust R/G time as necessary. |
| General Heavy Strip (GC or GHS) | | C-5<br>C-6<br>C-P | 0.77 | 0.70 | 0.84 | 0.74 | 0.77 | 0.82 | 0.84 | 0.90 | 10 | May have private on-site system. If present adjust R/G time as necessary. |
| Office Commercial (OC) | | R-P<br>C-P<br>RP-L | 0.715 | 0.65 | 0.78 | 0.69 | 0.72 | 0.76 | 0.78 | 0.85 | 10 | May have private on-site system. If present adjust R/G time as necessary. |
| Light Industrial (LI) | | M-1-P<br>M-1<br>C-M | 0.715 | 0.65 | Na | 0.69 | 0.72 | 0.76 | 0.78 | 0.85 | 15 | May have private on-site system. If present adjust R/G time as necessary. |
| Heavy Industrial (HI) | | M-1-P<br>M-1<br>M-2<br>M-3 | 0.825 | 0.75 | Na | 0.80 | 0.83 | 0.88 | 0.90 | 0.90 | 15 | May have private on-site system. If present adjust R/G time as necessary. |
| Road (Road) | Na | Na | Na | 0.90 | Na | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 5 | For arterial & collector roads verify that landscape setback is typical. If not adjust "C" as necessary. |
| Open Space (OS) | Na | Na | 0.22 | 0.20 | 0.24 | 0.23 | 0.26 | 0.32 | 0.36 | 0.40 | Na | Use for open space areas that are mostly grass. Use surface flow time curve or other means to establish Tc. |

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