2015 Water System Master Plan Update
Final | November 2017
# CITY OF WEST SACRAMENTO
## 2015 WATER SYSTEM MASTER PLAN UPDATE

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2015 Water Master Plan Update
EXECUTIVE SUMMARY

INTRODUCTION
This Water Master Plan (Plan) has been prepared to update the City of West Sacramento's (City) 2005 Water System Plan. The purpose of this new Plan is to

- Review and document the current water distribution system,
- Develop and update the hydraulic model that incorporates the growth projections in the 2035 General Plan Update,
- Document the current approach of to the water meter installation program,
- Review and summarize the findings of the condition assessment of the City's George Kristoff Water Treatment Plant (GKWTP),
- Provide recommendations leading to short and long range capital improvement projects that will improve the system's reliability and allow flexibility for growth,
- Coordinate and provide supporting information for the 2035 General Plan Update, and
- Review, analyze, and provide a comprehensive financial analysis and rate plan.

The Plan evaluates the existing system and its ability to meet the anticipated requirements for water source, quality, transmission, storage, and distribution over a twenty-year planning period. Water system improvement projects have been developed to meet the changing demands of regulatory impacts, population growth, and infrastructure repair and replacement. The Plan also identifies planning level costs of the improvement projects and provides a financial plan for funding the projects.

The data used for this Plan was current as of December 31, 2014 and the Plan was developed in 2015 and 2016. This Plan will be used as a guide in maintaining and improving the water system in the short-term over the next five years and also provide a planning framework over the long-term 20-year planning horizon.

EXISTING SYSTEM
The City provides potable water service to its residential, commercial, industrial, and institutional customers within the City limits. The City’s municipal water supply system consists of treated surface water at the George Kristoff Water Treatment Plant (GKWTP), which is located on the northern edge of the City. Water is transmitted from the GKWTP to the City’s customers via a transmission and distribution system, consisting of approximately 189 miles of pipelines up to 54 inches in diameter. Figure ES.1 shows the City's current supply and distribution system facilities, including the nine storage tanks and ten booster pump stations.
Historically, the sole source of water supplied to the City was groundwater. Since the GKWTP went online, it has been the main water supply facility for the City. The GKWTP expansion in 2003-2004 increased the plant capacity to a maximum of 58 million gallons per day (mgd) (permitted capacity is 40 mgd November – March; 58 mgd April – October). The GKWTP uses a treatment process consisting of chemical coagulation, Actiflo® high rate clarification, dual media granular activated carbon filtration, and chlorine disinfection. The City no longer uses groundwater as a primary source of potable water supply.

With the GKWTP as the main water supply facility for the City, the water system meets peak demands and provides customers a reliable water supply, and therefore the City’s groundwater wells provide only emergency backup supply to GKWTP if needed. Further, at this time the City does not have any reported drinking water violations.

**SYSTEM DESIGN AND PERFORMANCE CRITERIA**

This Plan defines the goals and criteria that establish system operation and performance in the City’s water distribution system. The criteria were found to meet the federal, state, and local water regulations. The City’s fire flow standards changed for this Plan to accommodate the new development in accordance with the new General Plan.

**HISTORICAL AND FUTURE POPULATION**

The City’s General Plan data as of August 2014 predicts household, retail employment, and non-retail employment growth between 2012 and 2035 for specific "pseudo parcels", or groups of parcels, within the City. The City’s historical population data and population projections are summarized in Table ES.1.

| Table ES.1 City Population Projections 2015 Water Master Plan Update City of West Sacramento |
|---------------------------------|---------------------------------|
| **Year** | **Population** |
| 2015(1) | 49,504 |
| 2020(2) | 56,602 |
| 2025(2) | 64,717 |
| 2030(2) | 73,996 |
| 2035(2) | 84,605 |

**Notes:**
(1) California Department of Finance Report E-5 population estimate.
(2) From West Sacramento 2015 Urban Water Management Plan Update.
CURRENT AND PROJECTED WATER DEMANDS

The Plan also presents historical water production and consumption trends for the City and provides water demand projections through the year 2035. Projecting realistic future water demands is necessary to plan for infrastructure projects and securing adequate water supply to serve future growth within the City.

The City provided historical production data for the years 2008 through 2013, as well as metered consumption/account data for the years 2010 through 2013. The historical demand data were evaluated to characterize the unique water use patterns of the City's customers. Table ES.2 shows the City's total annual production.

| Table ES.2 | Historical Water Production |
| 2015 Water Master Plan Update |
| City of West Sacramento |

<table>
<thead>
<tr>
<th>Year</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Production (MG)</td>
<td>5,203</td>
<td>4,711</td>
<td>4,490</td>
<td>4,674</td>
<td>5,006</td>
<td>5,260</td>
</tr>
<tr>
<td>Average Day Demand (mgd)</td>
<td>14.2</td>
<td>12.9</td>
<td>12.3</td>
<td>12.8</td>
<td>13.7</td>
<td>14.4</td>
</tr>
<tr>
<td>Maximum Day Demand (mgd)</td>
<td>25.6</td>
<td>24.5</td>
<td>26.8</td>
<td>21.8</td>
<td>26.5</td>
<td>24.4</td>
</tr>
<tr>
<td>Date of MDD</td>
<td>June</td>
<td>July</td>
<td>July</td>
<td>9/9</td>
<td>8/11</td>
<td>7/3</td>
</tr>
<tr>
<td>MDD/ADD Peaking Factor</td>
<td>1.80</td>
<td>1.89</td>
<td>2.18</td>
<td>1.70</td>
<td>1.94</td>
<td>1.69</td>
</tr>
<tr>
<td>Average MDD/ADD Peaking Factor</td>
<td>1.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Existing average day residential, commercial, and irrigation demands of each neighborhood were increased by the updated annual growth rates to predict future demands. Future residential demand was then adjusted downward to account for the City's assumption that future residential customers will consume less water than current customers due to conservation efforts, projected development classifications, and other factors. The demand of the City's ten large consumers was kept constant at 1.5 mgd throughout the planning period.

The water system's average daily demand (ADD) is predicted to nearly double in 20 years from approximately 14.2 mgd to 23.9 mgd. The maximum daily demand (MDD) is projected to reach nearly 45 mgd. Figure ES.2 provides a summary of the existing and future water demand projections.
AVERAGE AND MAXIMUM DAY DEMAND PROJECTIONS

FIGURE ES.2
CITY OF WEST SACRAMENTO
2015 WATER MASTER PLAN UPDATE
WATER SUPPLY EVALUATION

The City has numerous water supplies to meet it short-term and long-term planning needs. Specifically, the City’s three main water assets – SWRCB Appropriate Water Right Permit 18150, Bureau of Reclamation Central Valley Project (CVP) Contract 0-07-20-W0187, and the North Delta Water Agency Contract – provide the foundation of the City’s water supply portfolio. All of these assets, as well as future assets that the City may develop, create sufficient water supplies to meet the City’s existing and future demands.

SWRCB Water Right Permit 18150

The City’s Water Right Permit 18150 allows the City to divert water from the Sacramento River watershed from January through June and again from September through December each year. The Permit is subject to Term 91 that may alter the City’s ability to divert water in certain hydrological and regulatory conditions. As such, in normal years because of Term 91, the City suspends water diversions under its Permit beyond May and restarts diversions in late October. The total available supply under the Permit is 18,350 acre-feet per year with a maximum diversion rate of 62 cubic feet per second. The supply is available for use anywhere in the City’s service area. The City is diligently working to convert this Permit into a Water Right License by applying the water to reasonable and beneficial uses.

In dry years, this supply is only available in the months when the supply may be legally diverted – before Term 91 or water right curtailment orders are issued. As such, the supply in a single dry year has been reduced to 6,960 acre-feet from the 18,350 acre-foot maximum. Moreover in extreme or extended dry conditions, the supply may be further reduced as Term 91 or water right curtailment orders are implemented. In these conditions, this supply is reduced to a maximum of 3,480. The details of this supply reduction are more fully described in the water supply section of this document.

Bureau of Reclamation Contract 0-07-20-W0187

The City’s CVP Contract 0-07-20-W0187 captures two parts of the City’s water assets – Permit 18150 and a CVP Project Water supply. Under the contract, the United States Bureau of Reclamation (Reclamation) delivers both a base supply – the City’s Permit water – and a Project Supply – water derived from storage in Shasta Reservoir. The contract total is 23,600 acre-feet. The Permit supply is subject to the same conditions as described above.

The Project Supply is a contract entitlement between the City and Reclamation. The City is required to purchase a minimum of approximately 9,400 acre-feet per year (increasing about 50 acre-feet per year until 2019) even though it uses approximately 5,200 acre-feet of this water in recent years. Moreover, the City is required to purchase 20, 88, 100, and 100 percent of CVP Project supply as a percentage of the total water diverted during June through September, respectively, for use in the City’s service area.
In dry conditions, this water supply may be reduced based upon the Bureau of Reclamation’s Municipal and Industrial Shortage Policy. This policy mandates reduction in CVP Project Supply deliveries that are derived from a baseline condition. The baseline condition is the generally derived from the last three years of actual use during normal water supply conditions. Although certain additional qualifying criteria may be incorporated into the project supply deliveries, this baseline is the starting point to calculate the volume of CVP water available to the City under dry conditions. Reclamation then reduces this baseline amount by a given percentage. North of the Delta Municipal and Industrial users have the lowest supply cutbacks – normally in the 25% range. But in 2015 – the driest year in California’s history – CVP Project Supplies to North of the Delta CVP Municipal and Industrial contractors were cut by 75% from the baseline use. This drastic supply shortage reduction was accompanied by mandatory water rationing criteria established by the SWRCB. Thus, although this reduction may occur again in the future, the corresponding demand reductions offset the supply reliability concerns.

The City will also look to augment its CVP Project Supply in the future. In 2019, when the City’s CVP contract expires, the City will seek to augment its CVP Project Supply water assets in order to meet the City’s future water supply needs. Specifically, the City is seeking to secure as much as 18,000 acre-feet of CVP Project Supply water under this contract by 2045.

North Delta Water Agency Contract

The North Delta Water Agency (NDWA) Contract is a contract between NDWA and the California Department of Water Resources (DWR) for deliveries of water to the NDWA service area under all conditions. The NDWA Contract provides water supply deliveries in exchange for a payment of $170,000 per year to DWR.

The City may use the NDWA Contract supply in areas within the City that lie within the NDWA boundaries. A portion of the City located generally north of the Union Pacific Railroad tracks is outside of the NDWA service area and is therefore unable to use NDWA water supplies. Accordingly, in dry conditions the only supplies available in this location are the supplies derived from the City’s Permit and CVP contract.

The City uses the NDWA contract supplies as a back-up supply to meet its customers’ needs under certain hydrological and regulatory conditions. Specifically, the City has historically used the supply only when other supplies are not available to meet the City’s needs. During the 2014-15 drought, the City relied heavily on the NDWA Contract supply to meet its residents’ needs as the Permit supply had been curtailed and CVP Project supplies were significantly reduced. As such, the NDWA Contract supply was the most reliable dry year supply in the City’s water supply portfolio. The City anticipates continuing to use this supply as a redundant supply to its supplement its other water assets.
**Additional Water Supplies**

The City has additional water supplies – or potential access to those supplies – that it may develop to augment its supply portfolio in the future. Both groundwater and recycled water may be expanded to meet the City’s demands.

Groundwater was the City’s first water supply. Because of naturally occurring water quality conditions, the City transitioned its principle potable supplies to surface water sources derived from its three surface water assets. The City has recently recognized that groundwater assets may be used again by the City to either meet non-potable demands – like irrigation of parks and median strips – or treated and blended with surface water supplies to augment the potable water system. The City plans to develop and use groundwater assets in order to best manage its entire water portfolio in the future.

The City also has access to recycled water supplies derived from the Sacramento Regional County Sanitation District’s (SRCSD) recycled water system. The Title 22 tertiary treatment and disinfection are required by SRCSD’s new discharge permit. These treatment efforts render the water potentially suitable for alternative non-potable water uses. These uses potentially include, irrigating parks and median strips as well as meeting demands for other landscapes or industrial facilities located within the City’s service area. Although these discussions are in their infancy, the potential to utilize an additional valuable source of water in the City could augment the reliability of the City’s other potable supply assets and expand the City’s water supply portfolio.

**Water Supply Summary**

In short, the City’s long-term water supply outlook is positive. The City will continue to use its Permit supply, extend, and augment its CVP Project supply, and use the NDWA Contract supply as a backup source for dry year reliability. The City’s options to develop and use groundwater and recycled water may also add flexibility to the City’s water management efforts. Altogether, these water assets provide the City with a reliable existing and future water supply portfolio.

**HYDRAULIC MODEL UPDATE AND CALIBRATION**

The Plan describes the development and calibration of the City’s water distribution system hydraulic model. This hydraulic model was used to identify existing and future system deficiencies and to recommend the improvements.

The City’s previous water distribution system hydraulic model was developed using the H₂ONET Water software package, developed by Innovyze (formerly MWH Soft). The last major update to the hydraulic model was performed in 2005 by Carollo as part of the City’s previous Water Master Plan Update. The H₂ONET model is considered a "skeletonized" model, meaning that it only included major water mains within the City, and excluded many smaller diameter pipelines (typically 6-inch and smaller water mains). The model was
converted to include more features for more detailed water system evaluations, GIS Data conversion, and a full pipe model of the City's system.

Carollo coordinated closely with City staff regarding the supervisory control and data acquisition (SCADA) and field data needs that were required to calibrate the updated hydraulic model. A macro calibration process was also conducted that involved several steps such as transmission main connectivity, system pressures, and facility characteristics. In summary, the calibration results indicate the model generally predicts conditions similar to those observed in the field. For both steady state and extended period conditions, the model provides an accurate representation of the City’s distribution system and system operations to a level suitable to support the City’s future hydraulic modeling endeavors.

WATER SYSTEM CAPACITY AND OPERATIONAL ANALYSIS

Once the hydraulic model was updated, a capacity evaluation and hydraulic modeling analysis for the existing system under current and future (year 2035) demand conditions was performed. A condition assessment of the City's George Kristoff Water Treatment Plant (GKWTP), tanks, and booster pump stations was also performed. Analysis includes recommended improvements required to mitigate existing capacity deficiencies, to serve future growth, and to address the findings of the condition assessment.

The City will need to construct an additional 11.8 MG of storage to meet the projected 2035 demand requirements. A total of six new tanks are recommended. Each tank will be a new ground level tank, with a booster pump station and an altitude valve, similar to the City's current storage tanks.

Approximate 35,700 linear feet (6.8 miles) of fire flow improvements were also recommended due to deficient residual pressures (less than 20 psi) found in the system during the hydraulic modeling.

New transmission main and backbone system improvements are recommended in order to develop transmission looping in new growth areas and avoid dead ends, to facilitate the efficient movement of water through the existing water distribution system to new growth areas and major facilities, and to provide additional transmission capacity from the North Area to the Southport Area.

The water treatment plant evaluation was designed to identify, at a high level, improvements needed to maintain plant production capacity and reliability as the plant continues to age. The plant can reliably produce up to 45 mgd with existing facilities. Some improvements are needed to the intake and other unit processes to produce the maximum permitted 58 mgd production.

The evaluation was based on methodologies of Asset Management (AM), the International Infrastructure Management Manual (IIMM), and input from City staff relating to operational
and maintenance issues for the various plant systems and components. The GKWTP evaluation included the visual inspection of 188 GKWTP assets in 15 areas of the plant.

Each asset in the inventory was assessed during the inspection and given a condition score based on a 1 to 5 scale, where a score of 1 would indicate a 100 percent of useful life remaining, and a 5 would represent 10 percent of useful life remaining. The relationship between condition score and percentage of remaining life reflects the logic that once an asset deteriorates to a below-average condition, its probability of failure increases, and its remaining years in service decline more rapidly than for assets that are maintained in above-average condition. Overall, 12 assets, in eight process areas, received a condition score of 5. These 12 assets represent over six percent of the number of assets in the inventory. The majority of assets received a condition score of 2 or 3. The 12 assets are shown in Table ES.3 along with their installation year and remaining useful life.

<table>
<thead>
<tr>
<th>Process Area Asset Description</th>
<th>Assessment Comments</th>
<th>Install Year</th>
<th>Useful Life</th>
<th>Remaining Useful Life(1)</th>
<th>Cost(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intake Facilities and Pump Station</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake Knife Gate Valve 1</td>
<td>Non-operational valve operator</td>
<td>2004</td>
<td>20</td>
<td>2</td>
<td>$20,000</td>
</tr>
<tr>
<td>Intake Knife Gate Valve 2</td>
<td>Non-operational valve operator</td>
<td>2004</td>
<td>20</td>
<td>2</td>
<td>$20,000</td>
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<tr>
<td>Intake Knife Gate Valve 3</td>
<td>Non-operational valve operator</td>
<td>2004</td>
<td>20</td>
<td>2</td>
<td>$20,000</td>
</tr>
<tr>
<td><strong>Raw Water Manifold and Reclaimed Water Pumping</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonic Conditioner SWGR-A</td>
<td>Not working</td>
<td>2004</td>
<td>30</td>
<td>3</td>
<td>$32,000</td>
</tr>
<tr>
<td><strong>Actiflo® Clarification No. 1 and No. 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonic Conditioner MCC-ACT-1</td>
<td>Not working</td>
<td>2004</td>
<td>15</td>
<td>1.5</td>
<td>$32,000</td>
</tr>
<tr>
<td><strong>Recycled Water Basins no. 1 and No. 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sludge Disposal Pump 3</td>
<td>Out of service</td>
<td>2014</td>
<td>15</td>
<td>1.5</td>
<td>$40,000</td>
</tr>
<tr>
<td><strong>Filtration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonic Conditioner MCC-FI</td>
<td>Not working</td>
<td>2003</td>
<td>30</td>
<td>3</td>
<td>$32,000</td>
</tr>
</tbody>
</table>
An assessment of current operational strategies and equipment efficiencies relative to alternative operation and/or more energy efficient equipment was also performed. A baseline and energy evaluation was conducted of the City’s current water system energy consumption and greenhouse gas (GHG) emissions.

The City appears to be compliant with the California Division of Drinking Water (DDW) Regulations. Several regulations at the Federal level are either under development or recently went into effect. Of particular note is the scope of the water protected under the Clean Water Act. This rule may impact City activities given the city’s proximity to the Sacramento River. Additionally, the Clean Power Plant Rule, effective December 2015, may impact energy costs to the City both in the short- and long-term. DDW is also developing a number of regulations, the City should closely monitor the development of the Surface Water Augmentation Using Recycled Water regulation.
CAPITAL IMPROVEMENTS PLAN

The purpose of the Capital Improvements Plan (CIP) is to provide the City with a guideline for planning and budgeting of its water distribution system (WDS) and the George Kristoff Water Treatment Plant (WTP). The CIP consists of schedule and cost estimates for the recommended improvements and is shown in detail in the appendix of this plan. The projects are described in the following phases:

- Phase 1 (2016 - 2020)
- Phase 2 (2021 - 2025)
- Phase 3 (2026 - 2030)
- Phase 4 (2031 - 2035)

Figure ES.3 shows a summary of the capital improvement costs by phase for the water distribution system and the water treatment plant. Further detail of the projects is broken out by year during Phase 1, and is shown in the appendix.

This CIP is used to determine the financial needs of the City to meet the identified Plan goals. All identified CIP projects may not be funded at the level or in the time period shown based on results of the financial analysis and impacts on rates and connection fees.

FINANCIAL ANALYSIS

The water master plan update also involved a financial analysis, which includes development of a 5-year financial plan, water rate recommendations for a 5-year period, and an update to the City’s water system impact fees.

Water Rates

The City’s current water rates were designed to generate the annual revenue necessary to fund operating and capital costs of the City’s water system, as well as to distribute the revenue requirements equitably among the classes of users in accordance with their differing demands placed on the system. The financial analysis was performed to update the rates in order to cover the first five years of the Water Master Plan (i.e., Phase I). The Financial analysis includes estimated operating and maintenance costs, current and future debt service obligations, and capital improvement projects selected to be implemented during this period. Annual expenses in the financial analysis include current debt service payments from a 2012 revenue bond, as well as an anticipated $15.0 bond issuance in 2018 to fund the selected Phase 1 capital improvements summarized in Figure ES.3.
Reflects average annual CIP spending during Phase 2 of the Master Plan Projects, which covers FY 2021-22 through FY 2026-27

Figure ES.3 Funded Phase I CIP Summary

Although the City has installed water meters for approximately 80 percent of customers, not all customers with water meters are being charged metered rates. Currently, there are approximately 11,300 residential flat-rate customers and 6 general service flat-rate customers (e.g., commercial, industrial, and multi-family accounts with 4 or more dwelling units), all of who will be transitioned to metered customers over the next few years.

The current model assumes that the City will fully implement the water meters by December 2018 and bill all customers based on the metered rate by the beginning of calendar year 2020 by transitioning more than 3,000 flat rate customers, from flat to metered billing, each year.
Maintaining water rates at their current levels for the five-year planning period will not adequately fund the ongoing operations and maintenance costs and the necessary capital improvements, as illustrated in Figure ES.4.

![Annual Revenue Requirements](image)

In order to meet the operating and maintenance expenses, PayGo capital expenses, debt payments, and reserve level obligations of the water utility, it is recommended that the City increase water rates as shown in Figure ES.5.
The recommended rate increases will attain a water fund reserve balance above the target by FY 2021-2022, as shown in Figure ES.6.
Water System Connection Fees

New development connecting to the City’s water system is charged a one-time connection fee at the time of connection. The purpose of the connection fee is to ensure that development pays its fair share of the costs associated with providing system capacity.

The connection fee is based on the reasonable cost of capacity per service connection. The reasonable cost is derived based on the value of facilities that provide capacity for growth. The unit cost of capacity is calculated by dividing the cost of existing and future facilities by the capacity provided by the facilities. The available capacity is based on the current level of water demand and wastewater discharge per customer. By using the current level of connections, the connection fee represents the average cost of capacity paid for by current customers. In effect, the approach follows the buy-in, or average cost, methodology.

For metered water systems, the industry practice is to derive connection fees based on the size of the service connection, which is a direct measure of the capacity that is provided. The City’s current water connection fee is based on the sizes of the service connection for single family, commercial, and industrial customers. However, multifamily and mobile home customers are based on a charge per dwelling unit. In order to simplify and standardize the calculation of fees, we recommend charging all customers based on an Equivalent Meter
Unit (EMU) basis instead of the current dwelling unit basis for multifamily and mobile home customers. An EMU represents the capacity of the smallest meter size available, a 3/4” meter. Larger meters equal more EMUs depending on how their rated capacities compare with one EMU. An EMU-based structure aligns the connection fee with the capacity provided by the size of the meter installed. Such a structure is also consistent with the City’s water rate structure.

Table ES.4 summarizes the current and proposed water connection fees. It can be seen that the current connection fees have not kept pace with full cost recovery. These water connection fees are approximately 16 percent greater than the City’s current connection fees. With the proposed connection fees, the City recovers its initial construction costs and subsequent maintenance costs that rate payers would otherwise incur to provide capacity for future connections. The proposed water connection fees are charged based on the size of water meter installed and is the same for all customer classes.

<table>
<thead>
<tr>
<th>Table ES.4 Current and Proposed Water Connection Fees</th>
<th>2015 Water Master Plan Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of West Sacramento</td>
<td></td>
</tr>
<tr>
<td><strong>Customer Type</strong></td>
<td><strong>Capacity Multiplier</strong></td>
</tr>
<tr>
<td>Single Family, Commercial, and Industrial</td>
<td></td>
</tr>
<tr>
<td>Meter Size</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td></td>
<td>1&quot;</td>
</tr>
<tr>
<td></td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td></td>
<td>2&quot;</td>
</tr>
<tr>
<td></td>
<td>3&quot;</td>
</tr>
<tr>
<td></td>
<td>4&quot;</td>
</tr>
<tr>
<td></td>
<td>6&quot;</td>
</tr>
<tr>
<td></td>
<td>8&quot;</td>
</tr>
<tr>
<td></td>
<td>10&quot;</td>
</tr>
<tr>
<td></td>
<td>12&quot;</td>
</tr>
</tbody>
</table>

$ per Dwelling Unit

| Multi Family *                                      | $4,103                      |
| Mobile Home Park                                   | $4,103                      |

* Includes duplexes, triplexes, condos, townhomes, or any type of dwelling intended for residential use other than single family residential.
This chapter presents a brief summary of the City of West Sacramento (City) water distribution service area, the goals of this 2015 Water 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 BACKGROUND

The City is located in eastern Yolo County in California's Central Valley. The City is bounded on its northern, eastern, and western sides by water bodies, including the Sacramento River (north and east) and the Sacramento River Deep Water Ship Channel and Yolo Bypass (west). The closest neighboring cities are Sacramento to the north and east, Davis to the west, and Woodland to the northeast. The City is part of a four-county metropolitan area that includes Yolo County, Sacramento County, and portions of Placer County and El Dorado County.

The City’s previous Master Plan was completed in 2005 by Carollo. Because the City’s previous Master Plan is ten years old, coupled with new growth assumptions provided in the City’s 2035 General Plan Update, the City decided to update the 2005 Master Plan to identify the infrastructure necessary to provide adequate service for existing customers and to service the projected growth identified in the City’s 2035 General Plan Update.

An environmental review of this Water Master Plan was performed by Ascent Environmental (Memo dated 5/23/17) and is attached as an appendix to this document.

1.2 WATER SERVICE AREA

The planning boundary for this Master Plan is comprised of the City limits, which extend from the Sacramento River and Tule Lake Road on the north, the Sacramento River on the east, Shangri-La Slough on the south, and the Yolo Bypass on the west. The City limits are shown in Figure 1.1. Currently, there are areas within the City limits that are undeveloped and/or not connected to the water distribution system. Figure 1.1 also identifies the areas within the City limits that are currently connected to the water distribution system.

Lands north of the Sacramento Deep Water Channel bound by the Sacramento River and Interstate 80 are considered the North Area, including Washington/Broderick and Bryte, which are older, well-established neighborhoods. Lands south and east of the Sacramento Deep Water Ship Channel are considered the Southport area. The historic industrial and farming community of West Sacramento occupied the central part of the present-day city north of the deep water ship channel, stretching from the Sacramento River in the east to the Yolo Bypass in the west. Figure 1.2 shows the City’s neighborhood areas.
Legend
- City Limits
- Water Features
- Parcels
- West Sacramento Neighborhoods

WEST SACRAMENTO NEIGHBORHOODS
FIGURE 1.2
CITY OF WEST SACRAMENTO
2015 WATER MASTER PLAN UPDATE
The north Area includes a mix of residential, commercial, and industrial development. There is a large industrial development located in the southwestern portion of the north area that has high fire protection demands.

1.3 PLANNING PERIOD

The Master Plan study area is intended to include the existing City limits and development within that could occur through the year 2035 as identified in the City's 2035 General Plan Update.

1.4 STUDY GOALS

The goals of this Master Plan are to:

- Review and update the current water distribution system;
- Develop and updated hydraulic model that incorporates the growth projections in the 2035 General Plan Update;
- Review and provide guidance to the existing water meter program;
- Review and Summarizes the findings of the condition assessment of the City's George Kristoff Water Treatment Plant (GKWTP);
- Provide recommendations leading to short and long range capital improvement projects that will improve the system’s reliability and allow flexibility for growth;
- Coordinate and provide supporting information for the 2035 General Plan Update; and
- Review, analyze, and provide a comprehensive financial analysis and rate plan.

1.5 SCOPE AND AUTHORIZATION

The purpose of this Master Plan is to identify capacity deficiencies in the distribution system, develop feasible alternatives to correct these deficiencies, and plan the infrastructure that will serve future development. On June 18, 2014, the City approved a professional service agreement with Carollo Engineers, Inc. (Carollo) to prepare this Master Plan for the water distribution system, which included the following main tasks:

- Task 100: Water System Data Collection, Facility Inspections, and Analysis
- Task 200: Develop Water System Design and Level of Service Criteria
- Task 300: Develop Current and Projected Water Demands
- Task 400: Evaluate Water Supply Diversity, Vulnerability, and Utilization Characteristics
- Task 500: Hydraulic Model Evaluation, Update, and Calibration
1.6 REPORT ORGANIZATION

The Master Plan has been organized into nine chapters, an executive summary, and multiple appendices that provide supporting documentation for the information presented in the report. The subjects discussed in each chapter are briefly described below:

Chapter 1 – Introduction. This chapter presents a brief summary of the City water distribution service area, the goals of this Master Plan, and the objectives of the study.

Chapter 2 – Existing Water System. This chapter presents an overview of the City’s existing water distribution system, water supply, storage, and pumping facilities. First, the City’s water supply sources are described, followed by a description of the City’s water distribution system and its facilities.

Chapter 3 – System Design and Performance Criteria. This chapter defines the goals and criteria that establish system operation and performance in the City water distribution system. Level of Service (LOS) Goals provide a high-level vision for the system to ensure that it meets the City’s mission, vision, and values. System planning criteria provide the standards for the detailed analysis of all major system components for identifying deficiencies and required improvements.

Chapter 4 – Current and Projected Water Demands. This chapter presents historical water production and consumption trends for the City and provides water demand projections through the year 2035. Projecting realistic future water demands is necessary to plan for infrastructure projects and securing adequate water supply to serve future growth within the City.

Chapter 5 – Water Supply Evaluation. This chapter summarizes the City's current and future water resources, and identifies the water supply scenarios that support the City's long-term planning objectives. Key legal and regulatory issues that implicate the long-term reliability of the City's water assets are described, and recommended strategies to mitigate the identified risks are described.

Chapter 6 – Water Model Update and Calibration. The chapter describes the development and calibration of the City's water distribution system hydraulic model. This
hydraulic model was used to identify existing and future system deficiencies and to recommend the improvements described in Chapter 7.

**Chapter 7 – Water System Capacity and Operational Analysis.** This chapter presents the findings and results of the capacity evaluation and hydraulic modeling analysis for the existing system under current and future demand conditions, summarizes the findings of the condition assessment of the City's George Kristoff Water Treatment Plant (GKWTP), tanks, and booster pump stations. This also includes the recommended improvements required to mitigate existing capacity deficiencies, to serve future growth, and to address the findings of the condition assessment.

**Chapter 8 – Capital Improvement Program.** This chapter presents the recommended capital improvement projects, a summary of the capital costs, and assessment of the costs that the City will need to recover from existing rate payers and future development.

**Chapter 9 – Financial Analysis.** This chapter defines a near- and long-term funding strategy for the City that addresses potential impacts on customer usage due to modifications of the rate structures, completion of the water metering program, and usage restrictions due to drought conditions. The chapter defines the level of rate increases that will be necessary in order to fund ongoing expenditures and identified capital needs, meet debt service obligations, achieve policy objectives and reserve targets, and adhere to Proposition 218 requirements. This chapter also identifies updated water connection fees to equitably recover costs to serve new developments.

1.7 **ACKNOWLEDGEMENTS**

We would like to thank the following City staff for their assistance and oversight of this project:

- Dereck Goodwin, P.E./QSD; Project Manager/Senior Civil Engineer
- Dan Mount; Operations Manager
- Nitish Sharma; City Budget Manager
- Phil Wright; Assistant City Manager - Administrative Services
- Mark Collier, P.E.; Principal Engineer
- David Tilley; Principal Planner
- Justin Hardy; Senior Planner
- Wendy Williams; Senior Civil Engineer
- Brian Coward; Engineering Technician III
- Chris Kania, GKWTP Superintendent
The following Carollo staff members were principally involved in this project:

- Chris Cleveland, P.E.; Project Manager
- Lara Kammereck, P.E.; Water System Planning Manager
- Ryan Orgill, P.E.; Hydraulic Modeling/Capacity Analysis/CIP
- Alena Bennett, P.E.; Water Demand Projections
- Ricky Gutierrez, P.E.; Condition Assessment
- Felicia James, P.E.; CIP
- Kevin Christensen, GIS/Graphics
- Kara Scheitlin, Technical Editor

In addition, the following other team members were involved in this project:

- Greg Young, P.E. - Tully and Young; Water Rights
- Gwyn-Mohr Tully, - Tully and Young; Water Rights
- John Farnkopf, - HF&H; Financial and Rates
- Rick Simonson, HF&F; Financial and Rates
This chapter presents an overview of the City of West Sacramento’s (City’s) existing water distribution system, water supply, storage, and pumping facilities. First, the City’s water supply sources are described, followed by a description of the City’s water distribution system and its facilities.

2.1 WATER SYSTEM DESCRIPTION

The City provides potable water service to its residential, commercial, industrial, and institutional customers within the City limits. The City’s municipal water supply system consists of treated surface water at the George Kristoff Water Treatment Plant (GKWTP), which is located on the northwest edge of the City. Water is transmitted from the GKWTP to the City’s customers via a transmission and distribution system, with pipe sizes up to 54 inches in diameter. Figure 2.1 shows the City's current supply and distribution system facilities, including the nine storage tanks and ten booster pump stations.

2.1.1 Water System History

In January 1987, the City was incorporated and assumed ownership and responsibility for operation of the water system from the East Yolo Community Services District, which had purchased the system in 1983 from the Washington Water and Light Company, a subsidiary of Citizens Utilities Company of California.

Since its incorporation and initiation of operation of the water system, the City has made major improvements, the most significant being the construction of the GKWTP in 1987-1988, and expansion in 2003-2004. At this location, treated water is pumped to customers and reservoirs via the distribution system. The GKWTP allowed the City to convert from groundwater to surface water from the Sacramento River.

2.1.2 Supply Sources

Historically, the sole source of water supplied to the City was groundwater. Since the GKWTP went online, it has been the main water supply facility for the City. The GKWTP expansion in 2003-2004 increased the plant capacity to a maximum of 58 million gallons per day (mgd) (permitted capacity is 40 mgd November – March; 58 mgd April – October). The GKWTP uses a treatment process consisting of chemical coagulation, Actiflo® high rate clarification, dual media granular activated carbon filtration, and chlorine disinfection.

With the GKWTP as the main water supply facility for the City, the water system meets peak demands and provides customers a reliable water supply, and therefore the City’s groundwater wells provide only emergency backup supply to GKWTP if needed. Table 2.1 contains information on the backup Southport wells. These two wells are located near
Snapdragon Circle and Coffeeberry Road, and are treated through the Southport Groundwater Treatment Plant. The Southport Treatment Plant has a capacity to treat 2.9 mgd from the two wells. In addition, there is an inactive storage tank and booster pump station located at this site.

### Table 2.1 Southport Backup Groundwater Well System

<table>
<thead>
<tr>
<th>City of West Sacramento</th>
<th>2015 Water Master Plan Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southport Treated Well Water Capacity, mgd</td>
<td>2.9</td>
</tr>
<tr>
<td>Well #20, mgd</td>
<td>2.3</td>
</tr>
</tbody>
</table>

**Notes:**
1. Treatment consists of chlorination, sequestering, oxidation-filtration, and sand removal.

#### 2.1.2.1 Water Rights

The City is entitled to 23,600 acre-feet per year (AFY) of surface water through combined appropriative rights and Federal water. Sacramento River water is available through the authority of a permit granted by the State Water Resources Control Board (SWRCB) during the months of September through June. River water is purchased through a contract with the U.S. Bureau of Reclamation (BuRec) during the months of June through September. In addition, most of the City lies within the North Delta Water Agency (NDWA). This contract assures that the State will provide entities within the NDWA service area with a dependable water supply of adequate quantity and quality for municipal, industrial, and agricultural purposes. Each of the rights are described in detail below. Table 2.2 shows a summary of the contracts and Table 2.3 contains a summary of the City’s entitlements.

### Table 2.2 City Water Rights Contracts

<table>
<thead>
<tr>
<th>City of West Sacramento</th>
<th>2015 Water Master Plan Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract</td>
<td>Description</td>
</tr>
<tr>
<td>Appropriative Water Right (Permit 18150)</td>
<td>Issued by SWRCB; Can divert a maximum of 18,350 AFY from Sacramento River. Subject to Term 91 conditions.</td>
</tr>
<tr>
<td>Bureau of Reclamation Contract 0-07-20-W0187</td>
<td>Referred to as the CVP Project Supply, provides the City an additional 5,250 AFY from Sacramento River. Specific purchase requirements from June-Sept.</td>
</tr>
<tr>
<td>North Delta Water Agency Contract</td>
<td>Back-up supply to meet customer demands and when Term 91 conditions are in place.</td>
</tr>
</tbody>
</table>

**Notes:**
1. cfs = cubic feet per second, AFY = acre-feet per year
Table 2.3 City Surface Water Entitlements
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Period of Use</th>
<th>Authority</th>
<th>Maximum Diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>January to May</td>
<td>Appropriative Right</td>
<td>62 cfs</td>
</tr>
<tr>
<td>June</td>
<td>Appropriative Right</td>
<td>62 cfs</td>
</tr>
<tr>
<td></td>
<td>BuRec Contract</td>
<td>No Limit</td>
</tr>
<tr>
<td>July</td>
<td>BuRec Contract</td>
<td>No Limit</td>
</tr>
<tr>
<td>August</td>
<td>BuRec Contract</td>
<td>No Limit</td>
</tr>
<tr>
<td>September</td>
<td>Appropriative Right</td>
<td>62 cfs</td>
</tr>
<tr>
<td></td>
<td>BuRec Contract</td>
<td>No Limit</td>
</tr>
<tr>
<td>October to December</td>
<td>Appropriative Right</td>
<td>62 cfs</td>
</tr>
<tr>
<td>Year-round</td>
<td>NDWA Contract</td>
<td>No Limit</td>
</tr>
<tr>
<td><strong>Annual</strong></td>
<td><strong>Appropriative Right</strong></td>
<td><strong>18,350 AFY</strong></td>
</tr>
<tr>
<td></td>
<td><strong>BuRec Contract and Appropriative Right</strong></td>
<td><strong>23,600 AFY</strong></td>
</tr>
</tbody>
</table>

(maximum combined diversions)

Notes:
(1) cfs = cubic feet per second, AFY = acre-feet per year

- **Appropriative Water Right.** The City has an appropriative right for diversion of surface water from the Sacramento River (Permit Number 18150), issued by the SWRCB. Under this right, the City is allowed to divert up to 18,350 AFY of water from the Sacramento River at the GKWTP intake structure. The permit was issued in 1981 and limits the diversion of water to the periods of January 1 through June 30, and September 1 through December 31 of each year, with a maximum rate of diversion for municipal use limited to 62 cubic feet per second (cfs), about 40 mgd.

Under the Permit, the City does not have the right to divert water during the high demand months of July and August. This diversion is authorized under the State's appropriative water rights law. As such, it is subject to reduction by the SWRCB, if necessary, due to drought conditions and/or to meet downstream water quality objectives. In the Permit, the SWRCB reserves the right to modify, reduce, or completely eliminate the authorized diversions because of variations in demand and hydrologic conditions within the Sacramento River Basin and/or the need to meet downstream water quality objectives in the Delta.

The Permit is also subject to a special water right condition called “Term 91” that allows the state to limit or eliminate the City’s ability to use this water under certain conditions Under Term 91, diversions were reduced by 100 percent during the drought years of 1991 and 1992 between the months of June and October. In more
recent years, Term 91 restrictions of varying severity and duration have become more typical. As explained in further detail in Chapter 5, Term 91 conditions were triggered during the 2014-2015 drought years due to reduced runoff. The City relied primarily on its NDWA contract to meet its water demands in 2014 and 2015 – helping the City avoid any serious water supply crisis.

- **Drought Reduction Requirements.** During natural changes in hydrology, drought conditions, and regulatory induced shortages, the City may receive reduced allocations from BuRec. During droughts or water shortages the City implements conservation measures to reduce water use. Refer to the 2015 Urban Water Management Plan for further information.

- **Bureau of Reclamation Contract.** To obtain a firm surface water supply during the summer months, the City entered into a forty-year agreement with BuRec (Contract No. 0- 07-20-W0187) that authorizes the City to divert from the Sacramento River a specified quantity of the water supply created by the Central Valley Project (CVP). The contract was entered into in 1980, and allows the City to divert up to 23,600 AFY from the Sacramento River of combined appropriative right and BuRec water. The total diversion amount of 23,600 AFY is equivalent to an annual average day diversion of 21.1 mgd. The BuRec contract does not limit the maximum rate or months of diversion from the river by the City. The contract does obligate the City to pay for specified percentages of the diverted quantities during the months of June through September, and requires the City to purchase a certain minimum annual quantity. The City is required to purchase 20, 88, 100, and 100 percent of the water diverted during the months of June, July, August, and September, respectively. As a result, 20 percent and 100 percent of the water purchased in June and September, respectively, usually comes from BuRec or the NDWA water supply entitlement, even though diversions from the City’s appropriative right during these periods may be legal in normal water years. In some years, additional Term 91 limits have been imposed on the City’s appropriative right, causing an increased percentage of diverted water to come from the BuRec supply and the NDWA supply. The contract has an increasing schedule of minimum purchase starting at 105 acre-feet (AF) in 1981 and increasing to 9,680 AF after 40 years. The minimum purchase requirement in 2009 and 2010 was 8,860 AF. The City is maximizing beneficial use under its contract relative to provisions of the Central Valley Project Improvement Act (CVPIA) and regional cooperation.

Provisions in the contract allow for its renewal for successive periods and to increase or decrease the quantity of water available to the City. The City is required under the contract to prepare and implement a water conservation program for all water diverted from the river. This program must be submitted to BuRec for approval every five years. The 2010 Urban Water Management Plan (UWMP) was submitted to BuRec for review and approval to satisfy this requirement. The City will submit a revised 2015 UWMP following the completion of this Water Master Plan.
The contract states that BuRec will use all reasonable means to prevent shortages in the quantity of water available to the City. However, the contract also states that no liability shall accrue against the United States if shortages occur due to drought or other causes, which are beyond the control of the United States. During drought conditions, CVP diversions can be cut back significantly, as was the case in 1992 when they were reduced by 75 percent. The cutbacks experienced in 1992 are consistent with the CVP water shortage policy for the Sacramento River. The City used alternative water supplies, including the NDWA water, during these deficits.

- **North Delta Water Agency.** The City has an additional water supply through the NDWA. The NDWA was formed in 1974 to protect the water resources in specific portions of Yolo, Solano, Sacramento, and San Joaquin counties. The majority of the City lies within the NDWA boundary. In 1981, the NDWA negotiated the "Contract Between the California Department of Water Resources for the Assurance of a Dependable Water Supply of Suitable Quality." This contract assures that the State, through both the State Water Project (SWP) and CVP, will maintain within the NDWA a dependable water supply of adequate quantity and quality for municipal, industrial, and agricultural purposes. In exchange for this assurance, the NDWA agreed to pay the State $170,000 per year starting in 1982. The annual payments are subject to adjustments every five years. Payments to the NDWA are made by all landowners within the NDWA boundaries through annual tax assessments on their property, including the City.

In 1998, DWR and NDWA developed a Memorandum of Understanding (MOU) during the Bay-Delta Water Rights hearings conducted by the SWRCB). This MOU states that the 1981 contract between DWR and NDWA remains in full force and effect. DWR agreed that if diversions were modified to achieve flow objectives from the Bay-Delta Water Quality Control Plan, water within the NDWA would be subject to the existing obligation of DWR to provide water to the area subject to reasonable and beneficial use. A copy of the agreement between DWR and NDWA is included in Appendix A.

During the 1987-1992 drought years, contractors of the CVP and SWP received reduced deliveries from the projects. During these drought years, however, diversions from the Sacramento River by water purveyors within the NDWA, including the City, were not reduced because the City executed its rights under its NDWA contract. The City's surface water supply is assured under the NDWA contract, even if its appropriative right and BuRec contract deliveries are reduced. Use of this supply is limited to the portion of the City that is within NDWA boundaries. NDWA's northern boundary is along the Union Pacific Railroad (UPRR) tracks. The area within the City north of the UPRR tracks is served water obtained under appropriative/contractual entitlements. The volume of water available for use under this contract is not limited.
2.1.2.2 Groundwater Wells

As described above, the GKWTP supplies the City with treated surface water from the Sacramento River. Though groundwater had been used as a water supply source for the City in the past, groundwater production for regular delivery was discontinued in 1995. As such, many of the groundwater wells in the City have been deactivated or are only considered for use during emergencies. In the past, groundwater in the City has required treatment for iron, manganese, and other constituents prior to domestic or industrial consumption.

2.1.2.3 Water Quality

The Sacramento River is a plentiful raw water source for municipal use. However, upstream water management and use can affect the quality of water in the Sacramento River. Regulation of stream flow, which reduces high water flows and increases summer and fall flows, substantially lessens water quality variations and enhances its suitability for municipal use. Flow is regulated by Federal and State flood control and storage facilities.

Extensively-irrigated agriculture upstream from the City tends to degrade Sacramento River water quality. During the spring and fall, irrigation return flows are discharged to drainage canals that flow directly into the river; during the winter, local runoff also flows over agricultural lands, increasing the turbidity in the water and introduces herbicides and pesticides into the river. Intensive agriculture in the Sacramento Valley, especially pesticide-dependent rice farming, increases the concentration of compounds such as Molinate and Thiobencarb.

The California Department of Food and Agriculture, in cooperation with the State Water Resources Control Board (SWRCB), has implemented a tailwater management program for Sacramento Valley rice growers to reduce discharges of Molinate and Thiobencarb into the Sacramento River. The City, in partnership with the City of Sacramento, the County of Sacramento, and the East Bay Municipal Utility District (EBMUD) participates in the Rice Pesticide Workgroup, which monitors and reports rice pesticide discharge to the Regional Water Quality Control Board (RWQCB). The City also participates in many other programs to keep the river clean, including the Keep the Waters Clean Campaign in partnership with the City of Sacramento, the County of Sacramento, and EBMUD; the Sanitary Survey of the Sacramento River Watershed in partnership with the City of Sacramento, City of Roseville, and EBMUD; the Drinking Water Source Assessment Program (DWSAP) which works to identify sources of contamination and respond to possible contamination; and the Regional Water Authority Water Efficiency Program which works to help agencies better meet regulations in water conservation programs.

The City monitors water quality in the Sacramento River on a daily basis. Samples taken at the City water intake indicate that river water in the vicinity of the East Yolo water intake has very low concentrations of total dissolved solids and has dissolved concentrations of heavy metals below laboratory analytical detection limits. The Sacramento River has historically
been highly turbid and naturally carries high sediment loads. During peak regional storm
events, the river’s total sediment load often increases by several times its average levels.
Turbidity and increased settlement load can result in longer particulate settling times at the
water treatment plant when purifying drinking water. In addition, the increased turbidity
could result in reduced oxygen levels in the river, potentially causing adverse effects on
aquatic species.

Numerous entities hold National Pollutant Discharge Elimination System (NPDES) permits
for discharges into the Sacramento River above the City. Some of these are wastewater
treatment plants and cooling water discharges. Most of the permits are held by industrial
dischargers such as food processing plants. Permitted discharge could contain a variety of
contaminants including household pesticides, sediments, natural organic matter, heavy
metals, oil, and grease.

Non-point source dischargers to the Sacramento River above the City include agricultural
drains and urban runoff outlets. Other non-point sources generally do not require NPDES
permits. Contaminants that could affect water quality include agricultural runoff, household
pesticides, sediments, natural organic matter, heavy metals, oil, and grease.

In general, water quality in the Sacramento River has a limited effect on the City’s ability to
provide its service area with a reliable source of high quality drinking water. The GKWTP is
a robust facility with high rate clarification processes (Actiflo®) as well as granular activated
carbon filters. As a result, the City is capable of effectively treating very large volumes of
water for a wide range of water quality parameters, and remains in compliance with all
current regulatory standards. A copy of the City’s 2014 consumer confidence report is
included in Appendix B.

2.1.3 Pressure Zones

The topography of the City is generally flat. The ground elevations within the City range
from approximately 7 feet to 47 feet above mean sea level, with the higher elevations just to
the northeast of where State Route 84, or Jefferson Boulevard, crosses the Deepwater Ship
Channel. Due to the minor variations in ground elevation throughout the service area, the
City’s water distribution system historically consisted of a single pressure zone.

With the construction of the Inline Booster Pump Station in 2009, however, the City now
has the ability to operate the system as two distinct pressure zones. The pressure zones
are separated generally by the Deepwater Ship Channel. The area north of the Deepwater
Ship Channel is commonly referred to as the “North Area.” Pressure to the North Area is
maintained by the GKWTP high service pumps, as well as the booster pump stations within
the area.

The area south of the Deepwater Ship Channel is known as the “Southport Area.” For the
majority of the day in the summertime and all of the wintertime, the Inline Booster Pump
Station is not operated, and therefore the pressure in the Southport Area is maintained by
the GKWTP and the booster pump stations throughout the City. The Inline Booster Pump Station includes a check valve that does not allow water from the Southport Area to flow back into the North Area.

In the summertime, the City has experienced pressure issues in the past when filling the Carlin and Bridgeway Lakes Tanks simultaneously. For this reason, the City operates the Inline Booster Pump Station in the summer time during the hours that these two tanks are both being filled, which increases system pressures in the Southport Area.

2.1.4 Storage Reservoirs

Water distribution systems rely on stored water to help equalize daily fluctuations between supply and demand, to supply sufficient water for firefighting, and to meet demands during an emergency or an unplanned outage of a major source of supply.

The City’s water system has nine reservoirs at eight different sites with a combined capacity of 25.1 million gallons (MG). The locations of the City’s existing reservoirs are shown on Figure 2.1, while detailed information for each of the reservoirs is summarized in Table 2.4.

Each of the City’s storage reservoirs are cylindrical ground-level reservoirs, ranging in volume from 1.5 to 4.0 MG each. The two, 4.0 MG GKWTP clear wells are filled from the GKWTP directly. The remaining reservoirs are filled from water pumped by the GKWTP high service pump station, through altitude valves installed at each tank site. The reservoirs are filled on a “time of day” basis, which varies depending on the time of year and the tank site. Table 2.4 summarizes the hours when each tank is typically filled, and the typical operating band (level) that is maintained.
<table>
<thead>
<tr>
<th>Reservoir Name</th>
<th>Volume (MG)</th>
<th>Floor Elevation (ft.)</th>
<th>High Water Elevation (ft.)</th>
<th>Height (ft.)</th>
<th>Diameter (ft.)</th>
<th>Year Constructed</th>
<th>Typical Operating Band(1) (ft.)</th>
<th>Time of Day for Tank Filling(1),(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GKWTP Clear Wells</td>
<td>4.0</td>
<td>10.0</td>
<td>34.0</td>
<td>24.0</td>
<td>170</td>
<td>2006</td>
<td>14.0'-24.0'</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>10.0</td>
<td>34.0</td>
<td>24.0</td>
<td>170</td>
<td>2006</td>
<td>14.0'-24.0'</td>
<td>--</td>
</tr>
<tr>
<td>Oak St.</td>
<td>2.0</td>
<td>17.0</td>
<td>45.5</td>
<td>28.5</td>
<td>110</td>
<td>1985</td>
<td>15.0'-26.5'</td>
<td>S: 20:30-11:30 W: 23:00-08:00</td>
</tr>
<tr>
<td>Northeast</td>
<td>2.0</td>
<td>25.5</td>
<td>54.0</td>
<td>28.5</td>
<td>110</td>
<td>1987</td>
<td>10.0'-25.0'</td>
<td>S: 20:00-06:00 W: 06:30-14:00</td>
</tr>
<tr>
<td>Central</td>
<td>2.0</td>
<td>20.5</td>
<td>49.0</td>
<td>28.5</td>
<td>110</td>
<td>1987</td>
<td>15.0'-25.0'</td>
<td>S: 23:30-06:30 W: 13:00-22:00</td>
</tr>
<tr>
<td>West Sacramento Industrial Park (PSIP)</td>
<td>1.5</td>
<td>16.8</td>
<td>40.8</td>
<td>24.0</td>
<td>106</td>
<td>1977</td>
<td>10.0'-20.0'</td>
<td>S: 20:15-06:15 W: 14:00-22:00</td>
</tr>
<tr>
<td>Bridge District</td>
<td>3.0</td>
<td>23.0</td>
<td>61.5</td>
<td>38.5</td>
<td>120</td>
<td>2011</td>
<td>15.0'-35.0'</td>
<td>S: 23:00-11:00 W: 21:30-08:00</td>
</tr>
<tr>
<td>Carlin</td>
<td>3.0</td>
<td>13.1</td>
<td>44.6</td>
<td>31.5</td>
<td>130</td>
<td>2001</td>
<td>15.0'-25.0'</td>
<td>S: 06:15-14:00 W: 12:00-21:00</td>
</tr>
<tr>
<td>Bridgeway Lakes</td>
<td>3.6</td>
<td>8.6</td>
<td>35.6</td>
<td>27.0</td>
<td>150</td>
<td>2005</td>
<td>13.0'-20.0'</td>
<td>S: 20:00-11:30 W: 06:00-12:30</td>
</tr>
</tbody>
</table>

Notes:
(1) Source: City operations staff
(2) S = Summer, W = Winter
2.1.5 Booster Pump Stations

Booster pumping stations deliver water from areas of lower pressure into areas of higher-pressure, typically from one pressure zone to another, a supply source, or from a storage tank. Multiple pumps at each station help to increase water system reliability by ensuring that water can still be boosted if one pump is out of service.

The City has ten active booster pumping stations within its distribution system. The locations of the City’s existing pump stations are shown on Figure 2.1, while detailed information for each of the reservoirs is summarized in Table 2.5. Each of the booster pump stations, with the exception of the Inline Booster Pump Station, pump water from one of the ground level storage reservoirs described in Section 2.1.4 into the distribution system.

The largest pump station in the City is the High Service Pump Station, which conveys treated water from the GKWTP Clearwells into the distribution system. This facility includes 11 high service pumps, each with a capacity of 5.0 mgd. Four of the high service pumps are controlled with variable frequency drives (VFDs) to provide a set pressure of 60 pounds per square inch (psi). However, the City will operate the pump station as low as 55 psi and as high as 63 psi. There is typically at least one VFD pump on at all times and as many as six other high service pumps on. This pump station also includes a hydropneumatic tank.

The Inline Booster Pump Station was constructed in 2009 to address low pressure conditions in the Southport Area, and is operated in the summertime to increase system pressures when the Carlin and Bridgeway Lakes Reservoirs are being filled simultaneously. In the winter time, and in the summer when the Carlin and Bridgeway Lakes Reservoirs are not filled simultaneously, the Inline Booster Pump Station is not operated, and the Southport Area is fed from the North Area directly. However, there is a check valve on the bypass line of the Inline Booster Pump Station, which does not allow water from the Southport Area to flow into the North Area.

The remaining booster pump stations are used to pump water from the ground level storage reservoirs into the distribution system during peak demand periods. The booster pumps are operated in a Time of Day mode, but also have pressure set points to turn the pumps on or off based on system pressures. Table 2.5 summarizes the operational control schemes for each booster pump station, and indicates which pump stations are equipped with VFDs.

2.1.6 Distribution System

The City’s current water distribution system consists of approximately 189 miles of pipelines up to 54-inches. Figure 2.1 shows a map of the existing distribution system, pipe diameters, and alignments. The information presented on Figure 2.1 was developed based on a review and analysis of the City’s most recent water system geographic information system (GIS) database, the previous hydraulic model, the City’s “schematic” water system GIS database, and the City’s water system plat map (which was provided in pdf format).
<table>
<thead>
<tr>
<th>Pump Station Name</th>
<th>Pump No.</th>
<th>VFD</th>
<th>Hp</th>
<th>Capacity (gpm)</th>
<th>TDH (ft.)</th>
<th>Time of Day Pumping</th>
<th>Pressure Controls (psi)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>GKWTP High Service Pumps</td>
<td>TWP 1</td>
<td>Yes</td>
<td>200</td>
<td>3,500</td>
<td>140</td>
<td>--</td>
<td>--</td>
<td>One VFD is on at all times. Pressure is typically 60 psi. Pumps are started or shutoff if system pressure is above or below pressure setpoint by about +/-3 psi.</td>
</tr>
<tr>
<td></td>
<td>TWP 2</td>
<td>Yes</td>
<td>200</td>
<td>3,500</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TWP 3</td>
<td>Yes</td>
<td>200</td>
<td>3,500</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TWP 5</td>
<td>No</td>
<td>200</td>
<td>3,500</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TWP 6</td>
<td>No</td>
<td>200</td>
<td>3,500</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TWP 7</td>
<td>No</td>
<td>200</td>
<td>3,500</td>
<td>170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TWP 8</td>
<td>No</td>
<td>200</td>
<td>3,500</td>
<td>170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TWP 9</td>
<td>Yes</td>
<td>200</td>
<td>3,500</td>
<td>170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TWP 10</td>
<td>No</td>
<td>200</td>
<td>3,500</td>
<td>170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TWP 11</td>
<td>No</td>
<td>200</td>
<td>3,500</td>
<td>170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TWP 12</td>
<td>No</td>
<td>200</td>
<td>3,500</td>
<td>170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oak St.</td>
<td>M1</td>
<td>No</td>
<td>75</td>
<td>1,750</td>
<td>127</td>
<td>S: 11:30-20:30</td>
<td>40</td>
<td>One Pump is typically run daily. The smaller pump is used in winter, and the larger pump in summer.</td>
</tr>
<tr>
<td></td>
<td>M2</td>
<td>No</td>
<td>75</td>
<td>1,750</td>
<td>127</td>
<td>W: 08:00-23:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M3</td>
<td>No</td>
<td>30</td>
<td>700</td>
<td>127</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>601</td>
<td>No</td>
<td>30</td>
<td>550</td>
<td>135</td>
<td>S: 11:45-20:00</td>
<td>40</td>
<td>One Pump is typically run daily. The smaller pump is used in winter, and the larger pump in summer.</td>
</tr>
<tr>
<td></td>
<td>602</td>
<td>No</td>
<td>30</td>
<td>550</td>
<td>135</td>
<td>W: 21:30-06:30</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>603</td>
<td>No</td>
<td>75</td>
<td>1,800</td>
<td>135</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>604</td>
<td>No</td>
<td>75</td>
<td>1,800</td>
<td>135</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central</td>
<td>701</td>
<td>No</td>
<td>30</td>
<td>550</td>
<td>135</td>
<td>S: 18:00-23:30</td>
<td>40</td>
<td>One Pump is typically run daily. The smaller pump is used in winter, and the larger pump in summer.</td>
</tr>
<tr>
<td></td>
<td>702</td>
<td>No</td>
<td>30</td>
<td>550</td>
<td>135</td>
<td>W: 07:00-13:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>703</td>
<td>No</td>
<td>75</td>
<td>1,800</td>
<td>136</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>704</td>
<td>No</td>
<td>75</td>
<td>1,800</td>
<td>136</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Station Name</td>
<td>Pump No.</td>
<td>VFD</td>
<td>Hp</td>
<td>Capacity (gpm)</td>
<td>TDH (ft.)</td>
<td>Time of Day Pumping$^{(1),(2)}$</td>
<td>Pressure Controls$^{(1)}$ (psi)</td>
<td>Notes$^{(1)}$</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------</td>
<td>-----</td>
<td>-----</td>
<td>----------------</td>
<td>-----------</td>
<td>---------------------------------</td>
<td>-------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>West Sacramento Industrial Park (PSIP)</td>
<td>1509</td>
<td>No</td>
<td>100</td>
<td>1,400</td>
<td>140</td>
<td>S: 11:15-20:15</td>
<td>40</td>
<td>70 One Pump is typically run daily.</td>
</tr>
<tr>
<td></td>
<td>1510</td>
<td>No</td>
<td>100</td>
<td>2,800</td>
<td>140</td>
<td>W: 04:00-14:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1511</td>
<td>No</td>
<td>100</td>
<td>2,800</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge District</td>
<td>P110</td>
<td>Yes</td>
<td>100</td>
<td>3,000</td>
<td>100</td>
<td>S: 11:00-23:00</td>
<td>40</td>
<td>70 VFD Set Point = 60 psi. One Pump is typically run daily.</td>
</tr>
<tr>
<td></td>
<td>P120</td>
<td>Yes</td>
<td>100</td>
<td>3,000</td>
<td>100</td>
<td>W: 08:00-21:30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carlin</td>
<td>P21</td>
<td>Yes</td>
<td>125</td>
<td>2,800</td>
<td>140</td>
<td>S: 22:00-06:30</td>
<td>40</td>
<td>70 VFD Set Point = 60 psi. One Pump is typically run daily. The smaller pump is used in winter, and the larger pump in summer.</td>
</tr>
<tr>
<td></td>
<td>P22</td>
<td>Yes</td>
<td>125</td>
<td>2,800</td>
<td>140</td>
<td>W: 22:00-12:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P23</td>
<td>No</td>
<td>125</td>
<td>2,800</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P24</td>
<td>Yes</td>
<td>75</td>
<td>1,400</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridgeway Lakes</td>
<td>P25</td>
<td>Yes</td>
<td>150</td>
<td>2,400</td>
<td>170</td>
<td>S: 11:30-21:45</td>
<td>40</td>
<td>70 VFD Set Point = 60 psi. One Pump is typically run daily.</td>
</tr>
<tr>
<td></td>
<td>P26</td>
<td>Yes</td>
<td>150</td>
<td>2,400</td>
<td>170</td>
<td>W: 12:30-22:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P27</td>
<td>Yes</td>
<td>150</td>
<td>2,400</td>
<td>170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inline Booster Pump Station</td>
<td>P28</td>
<td>Yes</td>
<td>200</td>
<td>7,500</td>
<td>65</td>
<td>S: 06:15-11:30</td>
<td>--</td>
<td>-- Not operated in the winter. In the summer, one pump is typically run daily. VFD set point when running = 70 psi.</td>
</tr>
<tr>
<td></td>
<td>P29</td>
<td>Yes</td>
<td>200</td>
<td>7,500</td>
<td>65</td>
<td>W: n/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P30</td>
<td>Yes</td>
<td>200</td>
<td>7,500</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
(1) Source: City operations staff
(2) S = Summer, W = Winter
The City is currently in the process of creating a comprehensive GIS database of its water distribution system. Therefore, the City’s most recent GIS database is only partially complete. Furthermore, the City’s previous GIS database (the “Schematic” database) is largely complete, but lacks important attribute data, such as pipe diameter, material, etc., and therefore could not be used by itself to update the system map. In order to create a complete system map and to update the City’s hydraulic model, it was necessary to fill in the incomplete portions of the City’s current, partially complete, GIS database. This was accomplished by first adding missing pipelines from the City’s previous water system hydraulic model into the system map. The previous model is “skeletonized” though, and does not include small diameter pipelines (typically 6 inches in diameter and smaller). Smaller diameter pipelines in the missing areas were digitized from the linework in the City’s “Schematic” GIS database, and pipeline diameters were added manually from the City’s water system plat map pdf.

Table 2.6 provides a breakdown by diameter of the water distribution system, excluding laterals. Figure 2.2 presents the information provided in Table 2.6 graphically. As shown on Table 2.6, roughly 55 percent of the City’s distribution system is 8 inches in diameter or smaller, with 8 inches representing the most prevalent pipeline diameter. About 31 percent of the system is 10 inches or 12 inches in diameter, and 14 percent of the system is larger than 12 inches in diameter.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Database Source</th>
<th>Current GIS Database (ft.)</th>
<th>2005 Hydraulic Model (ft.)</th>
<th>“Schematic” GIS Database (ft.)</th>
<th>Total Length (miles) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot; and Smaller</td>
<td>Current GIS Database</td>
<td>14,060</td>
<td>7,670</td>
<td>11,840</td>
<td>33,570</td>
</tr>
<tr>
<td>6&quot;</td>
<td>Current GIS Database</td>
<td>41,450</td>
<td>51,330</td>
<td>25,950</td>
<td>118,730</td>
</tr>
<tr>
<td>8&quot;</td>
<td>Current GIS Database</td>
<td>275,380</td>
<td>73,030</td>
<td>47,910</td>
<td>396,320</td>
</tr>
<tr>
<td>10&quot;</td>
<td>Current GIS Database</td>
<td>57,500</td>
<td>11,620</td>
<td>3,550</td>
<td>72,670</td>
</tr>
<tr>
<td>12&quot;</td>
<td>Current GIS Database</td>
<td>164,130</td>
<td>67,980</td>
<td>4,050</td>
<td>236,160</td>
</tr>
<tr>
<td>14&quot;</td>
<td>Current GIS Database</td>
<td>9,050</td>
<td>970</td>
<td>0</td>
<td>10,020</td>
</tr>
<tr>
<td>16&quot;</td>
<td>Current GIS Database</td>
<td>40,670</td>
<td>14,430</td>
<td>0</td>
<td>55,100</td>
</tr>
<tr>
<td>18&quot;</td>
<td>Current GIS Database</td>
<td>2,090</td>
<td>4,180</td>
<td>0</td>
<td>6,270</td>
</tr>
<tr>
<td>20&quot;</td>
<td>Current GIS Database</td>
<td>17,320</td>
<td>2,130</td>
<td>0</td>
<td>19,450</td>
</tr>
<tr>
<td>24&quot;</td>
<td>Current GIS Database</td>
<td>14,390</td>
<td>2,200</td>
<td>0</td>
<td>16,590</td>
</tr>
</tbody>
</table>
Table 2.6  Water Distribution System Pipeline Summary
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Current GIS Database (ft.)</th>
<th>2005 Hydraulic Model (ft.)</th>
<th>“Schematic” GIS Database (ft.)</th>
<th>Total Length (ft.)</th>
<th>Total Length (miles)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30&quot;</td>
<td>3,320</td>
<td>3,390</td>
<td>0</td>
<td>6,710</td>
<td>1.3</td>
<td>0.7%</td>
</tr>
<tr>
<td>36&quot;</td>
<td>20,770</td>
<td>2,560</td>
<td>0</td>
<td>23,330</td>
<td>4.4</td>
<td>2.3%</td>
</tr>
<tr>
<td>42&quot;</td>
<td>180</td>
<td>0</td>
<td>0</td>
<td>180</td>
<td>0.0</td>
<td>0.0%</td>
</tr>
<tr>
<td>54&quot;</td>
<td>2,780</td>
<td>0</td>
<td>0</td>
<td>2,780</td>
<td>0.5</td>
<td>0.3%</td>
</tr>
<tr>
<td>Total</td>
<td>663,090</td>
<td>241,490</td>
<td>93,300</td>
<td>997,880</td>
<td>189.0</td>
<td>100%</td>
</tr>
</tbody>
</table>

(%) 66.4% 24.2% 9.3% 100%

Figure 2.2  Pipeline Distribution by Diameter

2.1.7  Water Meter Program

The City is currently in the process of implementing a water meter program Citywide. This program consists of several elements, including installation of new water meters in older neighborhoods and retrofitting existing meters. In addition, the City requires new development and major remodel projects to place meters on residential and business properties.

The City’s metering program has been successful, and to date, the City is approximately 60 percent metered. The goal of the program is for the City to become 100 percent metered.
by 2018. In order to accomplish this, the City will continue water meter installations through stand-alone water meter projects that encompass entire neighborhoods, as well as in conjunction with water main replacement projects. Appendix C provides a map of areas that are currently metered, and areas where meters will be installed in the year 2015.

Currently, all commercial and industrial customers are metered in the City, and are billed on a metered rate. There are approximately 8,500 metered residential customers within the City. The City currently gives residential customers with water meters the option to continue with a flat rate billing structure, or to choose a tiered rate based on the volume of water consumed. According to City staff records, roughly 840 customers had chosen the metered billing rate as of the year 2013. The remaining metered and unmetered customers are billed based on a flat rate.
This chapter defines the goals and criteria that establish system operation and performance in the City of West Sacramento (City) water distribution system. Level of Service (LOS) Goals provide a high-level vision for the system to ensure that it meets the City’s mission, vision, and values. System planning criteria provide the standards for the detailed analysis of all major system components for identifying deficiencies and required improvements.

### 3.1 LEVEL OF SERVICE CRITERIA

For the purposes of this Master Plan, LOS Goals are intended to bridge communications and expectations between the long-term and broader view of the City Council, and the day-to-day operations and problem solving required of City staff. It is important to distinguish LOS Goals from planning criteria, as the latter are focused on system design and operational requirements.

LOS goals were developed in conjunction with City staff, and were based on the mission statement of the public works department.

> It is the mission of the Public Works Department to deliver sustainable infrastructure and quality services that benefit the public and add value to our community.

> We accomplish our mission with collaboration, integrity and a sense of pride; through an empowered workforce that is accountable, safe, and responsive; and through stewardship of our community’s resources.

The following elements were selected to provide the basis for the LOS Goals, and they were grouped into three categories, as summarized in Table 3.1.

<table>
<thead>
<tr>
<th>Public Works Mission</th>
<th>LOS Goal Category</th>
<th>Relevance to the Water Master Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Services</td>
<td>Quality Water and Service</td>
<td>Regulatory compliance goals, and capacity to meet existing and future demands</td>
</tr>
<tr>
<td>Integrity</td>
<td>Reliability</td>
<td>Maintaining service following a significant event</td>
</tr>
<tr>
<td>Sustainable Infrastructure and Stewardship of Resources</td>
<td>Sustainability and Environmental Stewardship</td>
<td>Efficient use of resources (water and power)</td>
</tr>
</tbody>
</table>
For each of the three Public Works Mission categories, LOS Goals were identified and discussed with City staff at a project workshop. Based on input and feedback from City staff, the LOS Goals were revised to more closely reflect the City's intended goals of the Master Plan. The LOS Goals for each category are presented below.

- **Quality Water and Service**
  - Meet all current and anticipated regulatory requirements.
  - Provide sufficient supply and pressure to meet customer demands in all areas of the City.
  - Provide capacity to support future growth within the City, including future industrial growth associated with the food processing industry.

- **Integrity**
  - Provide sufficient supply and pressure to meet customer demands in all areas.
  - Meet most customer demands, including fire suppression requirements, while maintaining a minimum system pressure of 20 pounds per square inch (psi).
  - Provide adequate flood protection for all major water distribution system facilities.

- **Sustainability and Environmental Stewardship**
  - Optimize the useful life of water system assets.
  - Continued implementation of the City's water meter installation program.
  - Plan system facilities to reduce carbon footprint to the extent possible, including the incorporation of solar power where possible.

### 3.2 PLANNING CRITERIA

The City's water supply, storage, and distribution facilities were evaluated based on the planning criteria defined in this section. The developed criteria address the water supply capacity, storage capacity, acceptable service pressures, and distribution main performance.

#### 3.2.1 Water Supply Capacity

In accordance with industry standard practices, as well as the California Department of Public Health's (CDPH) 2008 Water Works Standards criteria for "New and Existing Source Capacity," the water system's water source shall have the capacity to meet the system's maximum day demand (MDD). Demands in excess of MDD required for peak hour demand (PHD) or for fire flows are planned to come from storage.

The City's main source of supply is treated surface water from the George Kristoff Water Treatment Plant (GKWTP). The reliable supply capacity at buildout of the GKWTP is 58 million gallons per day (mgd). Therefore, in the case of the City, the GKWTP must be capable of treating and pumping the MDD. Demands in excess of the MDD are pumped...
from the City’s storage tanks into the distribution system through the individual booster pump stations at each tank site.

3.2.2 Storage Requirements

The principal function of storage is to provide a reserve supply of water for: 1) operational equalization; 2) fire reserve; and 3) emergency needs. Operational equalization storage is directly related to the amount of water necessary to meet peak demands. The intent of operational equalization storage is to provide the difference in quantity between the customer's peak demands and the system's reliable available supply. The volume of water allocated for emergency uses is decided based on the historical record of emergencies experienced, and on the amount of time which is expected to lapse before a hypothetical emergency can be corrected.

3.2.2.1 Operational Equalization Storage

This storage is the amount of desirable stored water in a system to regulate fluctuations in demand so that extreme variations will not be imposed on the source of supply. Operational equalization storage typically serves the peak demands exerted within the MDD. With operational equalization storage, system pressures are improved and stabilized to better serve customers throughout the service area. Operational equalization storage is commonly estimated between 10 percent and 50 percent of the MDD. The City was compared to other similarly sized communities in California and was found to be a small to medium-sized water system. An operational equalization storage equal to 25 percent of the City's MDD was therefore recommended by City Staff for this planning effort.

The American Water Works Association (AWWA) M-32 states that operational storage is typically between 10 to 15 percent of the MDD for large systems, but could exceed 30 percent for small systems or arid climates.

The CDPH 2008 Water Works Standards stipulate that a water system shall be able to meet four hours of PHD with source capacity, storage capacity, and/or emergency source connections. Four hours of PHD is approximately equal to 25 percent of the City’s MDD, which is equal to the recommended operational equalization storage.

3.2.2.2 Fire Storage

Fire storage is the amount required to meet the necessary fire flow demands. In general, the recommended fire storage volume is determined by multiplying the highest required fire flow by its corresponding duration. For municipalities with multiple pressure zones, the recommended fire storage is determined by pressure zone. In the case of the City, there is one pressure zone for most of the day, however, there are times when the City's Inline BPS pumps and water distribution system is operated as two distinct pressure zones. For this reason, it is recommended that the required fire flow storage be provided in both the North Area and the Southport Area.
The recommended fire flows and durations used in this Master Plan are summarized in Section 3.2.5 and were developed based on input from City staff, including the City's Fire Marshall, Carollo experience on similar projects, and a review of fire flow requirements for similar agencies in the Sacramento area and throughout the state. As discussed in Section 3.2.5, the maximum recommended fire flow and duration are 4,000 gallons per minute (gpm) for a duration of four hours. This provision equates to a storage requirement of 0.96 million gallons (MG) and will allow the water system to respond to fires in residential, commercial, or industrial areas.

### 3.2.2.3 Emergency Storage

This storage is the volume recommended to meet demands during emergency situations such as pipeline failures, major distribution main failures, pump failures, electrical power outages, or natural disasters. The amount of emergency storage included within a particular water distribution system is an owner option, based on an assessment of risk, the desired degree of system dependability, economic considerations, and water quality concerns. In California, emergency storage is usually estimated at 50 to 100 percent of the MDD. The City recommends an emergency storage equal to 50 percent of the MDD for this planning effort.

### 3.2.2.4 Total Storage

The recommended minimum operational storage capacity for the City is equal to 25 percent of the MDD. Additionally, the recommended fire storage capacity is equivalent to 0.96 MG for each zone (North Area and Southport Area). The recommended emergency storage is equal to 50 percent of the MDD. These criteria are summarized with the following equation. Vs is the total required storage volume, in gallons, per zone.

\[
Vs = 25\ \text{percent} \ MDD + \text{Fire Flow} + 50\ \text{percent} \ MDD, \text{ or}
\]

\[
Vs = 0.75 \ MDD + 0.96 \ MG
\]

\[
MDD \text{ is the maximum day demand, in gallons}
\]

\[
\text{Fire Flow is equivalent to 0.96 MG}
\]

### 3.2.3 Service Pressures

Pressures maintained within the distribution system vary depending on distribution system operations and pressure zone topography. It is essential that the water pressure in a consumer's residence or place of business be neither too high nor too low. Low pressures, below 30 pounds per square inch (psi), cause annoying flow reductions when more than one water-using appliance is used. High pressures may cause faucets to leak and valve seats to wear out quickly. Additionally, high service pressures usually result in wasted water and high water utility bills. The Uniform Plumbing Code (UPC) requires that water pressures
not exceed 80 psi at service connections, unless the service is provided with a pressure-reducing device.

The AWWA Manual on Distribution Network Analysis of Water Utilities (AWWA M-32), indicates that pressures between 30 psi and 90 psi are generally expected during the range of system water demands. For the purposes of this Master Plan, minimum service pressure criteria were developed for various demand conditions, as summarized below.

- **Average Day Demand (ADD):** In order to provide adequate service pressures for fire sprinkler systems, the City would like to maintain a minimum desirable service pressure of 50 pounds psi during a typical ADD condition.

- **Peak Hour Demand (PHD):** The City's Water System Design Standards specify a minimum service pressure of 35 psi during the PHD condition. This criterion is typical of distribution systems in California that are similar to the City's.

- **Maximum Day Demand (MDD) + Fire Flow:** This pressure criterion is related to fire flows and was devised to ensure adequate positive pressure head for the booster pumps in the fire trucks. The industry standard fire pressure criterion requires a minimum acceptable residual pressure of 20 psi at the connecting hydrant.

### 3.2.4 Distribution Mains

Transmission mains are generally sized to carry the greater of: 1) the PHD; or 2) the MDD plus fire flow. Other criteria related to the distribution piping include the maximum and minimum velocities and the maximum allowable friction losses.

High velocities may cause damage to the pipes and to their appurtenances. Normally, velocities of 10 feet per second (fps) (AWWA M-32), or higher, do not cause ill effects if they occur for a limited duration. It is normally good practice to limit pipe velocities to no more than 7 fps on a continuous basis.

New distribution/transmission system pipelines 12 inches in diameter or less should be sized for a maximum pipeline velocity of 5 fps, while new distribution system pipelines 16 inches in diameter or more should be sized for a maximum pipeline velocity of 4 fps.

Provided that the maximum velocity criteria and the pressure criteria are not exceeded, high pipeline head loss by itself is not a controlling factor. However, it may be an indication that the pipe is nearing the limit of its carrying capacity, and may not have sufficient capacity to perform under stringent conditions. Good practice dictates monitoring pipes that have a head loss in excess of 10 feet per 1,000 feet (AWWA M-32).

### 3.2.5 Fire Flows

Fire flows stress a water system in the area of the fire and often identify existing deficiencies. The deficiencies are generally associated with pipe sizes (diameter) or age (roughness) that result in high headloss and lower pressures. The fire flow criteria
measures a system’s ability to deliver a high rate of water while maintaining a minimum pressure.

To evaluate the effect of fire flows throughout the distribution system, large point demands are applied at fire hydrants. The fire flow demands are run concurrent with the maximum day demand. Simulating maximum day demand plus fire flows also demonstrates the performance of supply sources, booster pumps, and storage tanks operating under the upper limit high demand conditions.

Below are the City’s Staffs recommended fire flow criteria for the different land uses within the City.

- Single-Family Residential fire flows: 2,000 gpm for a duration of two hours
- Multi-Family Residential fire flows: 3,000 gpm for a duration of three hours
- Commercial fire flows: 4,000 gpm for a duration of four hours
- Institutional fire flows: 4,000 gpm for a duration of four hours
- Industrial/Business Park fire flows: 4,000 gpm for a duration of four hours
- School fire flows: 4,000 gpm for a duration of four hours

It should be noted that the City’s previous Master Plan included more conservative fire flow criteria assumptions than the criteria listed above. The recommended fire flow criteria used in this Master Plan Update were developed based on input from City staff, including the City’s Fire Marshal, Carollo experience on similar projects, and a review of fire flow requirements for similar agencies in the Sacramento area and throughout the state. Certain facilities, such as large manufacturing facilities, may require fire flows in excess of those listed, as stipulated by the California Fire Code. This Master Plan assumes that all required fire flows in excess of 4,000 gpm would be met through private onsite water supplies or supplemental storage. This approach is consistent with industry standard practice.
This chapter presents historical water production and consumption trends for the City of West Sacramento (City) and provides water demand projections through the year 2035. Projecting realistic future water demands is necessary to plan for infrastructure projects and securing adequate water supply to serve future growth within the City.

4.1 PLANNING DATA

The City has recently completed the process of updating their General Plan. Land use maps as well as the 2035 household and employment growth assumptions were updated by the City in August of 2015 and provided the basis for demand projections.

The City previously prepared the 2015 Urban Water Management Plan (UWMP), which was submitted to and accepted by the Department of Water Resources (DWR). This document also contains demand projections using methods based on information and planning documents available at that time. The 2015 UWMP did not include the planning assumptions from the City’s new General Plan, as the data was not available at the time of the UWMP development.

Therefore, the UWMP does not take into account development zoning, growth projections by neighborhood and land use type, or other more recent planning principals that were developed as part of, and contained in, the City’s recently adopted General Plan. However, the method of projecting future water demands contained in this Water Master Plan document is based on more recent and more detailed planning concepts that are anticipated to more closely reflect future growth patterns and water demands through the planning period.

For reference, a summary of the previous method used in the 2015 UWMP has been described below. The remainder of this chapter describes the more detailed method used for this Water Master Plan.

4.1.1 2015 UWMP Demand Projection Method

Demand projections were estimated in the 2015 UWMP based on the following data and methods:

- Population projections used the 2015 calculated population (persons per connection method) and an annual growth rate of 2.72 percent (provided by the City planning department based on the 2013 Housing Element). The 2015 population was used as the anchor for the annual population projections.
• Water usage data was collected from 2001 to 2015.
• UWMP Baseline water usage used to determine the target per capita daily usage was based on a 2001-2010 average of 291 gallons per capita per day (gpcd).

Using 2015 usage by sector (as reported in the DW report sent to the State by the City) the portion of the total usage by sector was used to project usage in the future by each respective sector. This assumes the percent use distribution between sectors remains the same. The analysis resulted in an estimated 2035 water demand of 19.8 million gallons per day (mgd).

4.1.2 Existing Land Use

The many land use categories of the City's existing land use map were consolidated into four categories that correspond to their four customer classes.

• Single-family residential (SFR)
• Multi-family residential (MFR)
• Commercial
• Park

This simplified existing land use map is shown as Figure 4.1. The existing service area consists of approximately 6,600 acres that are distributed into each of the four land use types as shown in Table 4.1. The largest land use category is commercial, which includes retail businesses, non-retail businesses, industrial areas, and government facilities such as schools. Most of the rest of the City is single-family, with some multi-family developments and park space. Approximately 8 percent of the existing service area is vacant.

4.1.3 Growth Projections

The City's General Plan data as of August 2014 predicts household, retail employment, and non-retail employment growth between 2012 and 2035 for specific "pseudo parcels", or groups of parcels, within the City. These growth projections are shown and summarized by neighborhood on Figure 4.2

The City's historical population data and population projections are summarized in Table 4.2.
### Table 4.1 Land Use Summary
**2015 Water Master Plan Update**  
City of West Sacramento

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-family</td>
<td>2,205</td>
</tr>
<tr>
<td>Multi-family</td>
<td>254</td>
</tr>
<tr>
<td>Commercial</td>
<td>3,429</td>
</tr>
<tr>
<td>Parks</td>
<td>188</td>
</tr>
<tr>
<td>Vacant Single-family Zoning</td>
<td>70</td>
</tr>
<tr>
<td>Vacant Multi-family Zoning</td>
<td>73</td>
</tr>
<tr>
<td>Vacant Commercial Zoning</td>
<td>394</td>
</tr>
<tr>
<td>Vacant Park Zoning</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total**<sup>(1)</sup> 6,616

**Notes:**
1. Does not include right of way acreage.

### Table 4.2 City Population Projections
**2015 Water Master Plan Update**  
City of West Sacramento

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>49,504</td>
</tr>
<tr>
<td>2020&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>56,602</td>
</tr>
<tr>
<td>2025&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>64,717</td>
</tr>
<tr>
<td>2030&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>73,996</td>
</tr>
<tr>
<td>2035&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>84,605</td>
</tr>
</tbody>
</table>

**Notes:**
GENERAL PLAN GROWTH PROJECTIONS

2035 Growth

Legend

- Negative Emp Growth
- Neighborhood Boundary
- Negative HH Growth
- TAZ Boundary
- Negative DU Growth

HOUSEHOLDS

Retail Employment

Non-Retail Employment

Total Employment

HH Growth

RET Growth

NRET Growth
4.1.3.1 Growth Rates

The General Plan growth projections, shown in Figure 4.2, were used to calculate annual residential and nonresidential growth rates by neighborhood. These growth rates were used to grow existing Average Day Demand (ADD) in order to predict future ADD. Table 4.3 shows the 2035 residential and non-residential annual growth rate assumptions by neighborhood. The General Plan offers an overall recommendation and general guidance for the type of land use and development that is expected to occur, but cannot make specific recommendations for parcels since that is the responsibility of the owner. Therefore, the General Plan growth numbers may not align with new developments in the future or the proposed developments, as more fully described below.

Recent water studies for the Washington and North East Village of Southport neighborhoods provided detailed demand projection information that was incorporated into the growth rates for those two neighborhoods. The growth rates for Washington were adjusted so that 2035 demands would match the "expected development" ADD of 651 gallons per minute (gpm), which is equivalent to 0.937 mgd, that was established in a November 2014 evaluation performed by West Yost Associates.

A new development called Liberty, within the North East Village of Southport, is expected to be constructed within the planning period. It will consist of 1,166 single-family homes and 335 multi-family units, as well as a school, parks, and commercial areas. The General Plan growth numbers do not account for all of the development planned for this area. In January 2015 Morton Pitalo prepared a water study for the Liberty development. The General Plan residential growth numbers were increased to include the 2015 Liberty development data, as provided by the City. Liberty households and the non-residential growth rates were adjusted so that 2035 demands would include the 0.085 mgd demand of the school, commercial customers, and parks of the Liberty development as estimated in the Morton Pitalo water study.
### Table 4.3 General Plan 2035 Growth Assumptions
#### 2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Neighborhood</th>
<th>Residential Annual Growth Rate</th>
<th>Nonresidential Annual Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North Area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broderick/Bryte</td>
<td>0.4%</td>
<td>3.7%</td>
</tr>
<tr>
<td>Central Business City</td>
<td>5.6%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Iron Triangle</td>
<td>35.9%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Lighthouse</td>
<td>6.5%</td>
<td>29.4%</td>
</tr>
<tr>
<td>Michigan Glide</td>
<td>0.3%</td>
<td>0.7%</td>
</tr>
<tr>
<td>North of Port Industrial</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Old West Sacramento</td>
<td>0.2%</td>
<td>3.1%</td>
</tr>
<tr>
<td>Pioneer Bluff</td>
<td>43.4%</td>
<td>8.9%</td>
</tr>
<tr>
<td>Port North Terminal</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Port of Sacramento Industrial Park</td>
<td>0.2%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Riverpoint</td>
<td>0.0%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Riverside/CHP</td>
<td>0.0%</td>
<td>1.7%</td>
</tr>
<tr>
<td>South of West Capitol</td>
<td>0.7%</td>
<td>-0.1%</td>
</tr>
<tr>
<td>Triangle</td>
<td>15.5%</td>
<td>15.7%</td>
</tr>
<tr>
<td>Washington</td>
<td>6.4%</td>
<td>1.4%</td>
</tr>
<tr>
<td>West Capitol</td>
<td>3.4%</td>
<td>-0.6%</td>
</tr>
<tr>
<td>West End</td>
<td>0.0%</td>
<td>0.4%</td>
</tr>
<tr>
<td>West Harbor</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Southport</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North East Village of Southport</td>
<td>3.0%</td>
<td>5.2%</td>
</tr>
<tr>
<td>North West Village of Southport</td>
<td>0.3%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Rural Core</td>
<td>0.2%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Seaway</td>
<td>0.0%</td>
<td>6.7%</td>
</tr>
<tr>
<td>SIP</td>
<td>4.8%</td>
<td>7.7%</td>
</tr>
<tr>
<td>South East Village of Southport</td>
<td>36.6%</td>
<td>18.9%</td>
</tr>
<tr>
<td>South West Village of Southport</td>
<td>3.8%</td>
<td>10.2%</td>
</tr>
<tr>
<td>Stone Lock</td>
<td>37.3%</td>
<td>41.3%</td>
</tr>
</tbody>
</table>
4.2 HISTORICAL WATER PRODUCTION AND CONSUMPTION

The City provided historical production data for the years 2008 through 2013, as well as metered consumption/account data for the years 2010 through 2013. The historical demand data were evaluated to characterize the unique water use patterns of the City's customers.

Several key demand parameters were generated. These parameters are peaking factors, typical single family residential water use, typical water use by customer class, per capita water demands, and unaccounted for water (UFW). These parameters were used as the basis for the existing demand estimates, and the future demand projections.

4.2.1 Historical Water Production

Water production varies annually in response customer water usage, which is correlated to weather, development, economic conditions, and conservation activities. The City's total annual production, as shown in Table 4.4, has been somewhat variable since 2008, and has ranged from 4,490 million gallons (MG) in 2010 to 5,260 MG in 2013.

<p>| Table 4.4 Historical Water Production 2015 Water Master Plan Update City of West Sacramento |</p>
<table>
<thead>
<tr>
<th>Year</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Production (MG)</td>
<td>5,203</td>
<td>4,711</td>
<td>4,490</td>
<td>4,674</td>
<td>5,006</td>
<td>5,260</td>
</tr>
<tr>
<td>Average Day Demand (mgd)</td>
<td>14.2</td>
<td>12.9</td>
<td>12.3</td>
<td>12.8</td>
<td>13.7</td>
<td>14.4</td>
</tr>
<tr>
<td>Maximum Day Demand (mgd)</td>
<td>25.6</td>
<td>24.5</td>
<td>26.8</td>
<td>21.8</td>
<td>26.5</td>
<td>24.4</td>
</tr>
<tr>
<td>Date of MDD</td>
<td>June</td>
<td>July</td>
<td>July</td>
<td>9/9</td>
<td>8/11</td>
<td>7/3</td>
</tr>
<tr>
<td>MDD/ADD Peaking Factor</td>
<td>1.80</td>
<td>1.89</td>
<td>2.18</td>
<td>1.70</td>
<td>1.94</td>
<td>1.69</td>
</tr>
<tr>
<td>Average MDD/ADD Peaking Factor</td>
<td><strong>1.87</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.2.1.1 Average Day Demand (ADD)

The ADD represents the daily average demand for the entire year. It is calculated by dividing the total water produced in any given year by the number of days per year. These values for the years 2008 through 2013 are presented in Table 4.4. As shown in this table, the minimum ADD during this period was 12.3 mgd in 2011, and the highest ADD was 14.4 mgd in 2013.
4.2.1.2 **Maximum Day Demand**

The Maximum Day Demand (MDD) is a critical demand condition, and is used to evaluate system supply, reservoir capacity, and pump station capacity. The MDD is defined as the highest production in one day in a given year, and usually occurs in the summer. Table 4.4 presents the historical MDD from 2008 through 2013, and includes the date of occurrence for each year (if available). The MDD has ranged from 21.8 mgd in 2011 to 26.8 mgd in 2010.

In order to develop future MDD projections, the historical MDD to ADD peaking factor was calculated, as shown in Table 4.4. The MDD to ADD peaking factor fluctuated between 1.69 in 2013 and 2.18 in 2010. On average, the MDD to ADD peaking factor was 1.87 from 2008 to 2013. This value was used to calculate the future MDD.

4.2.1.3 **Diurnal Demand Variations**

Diurnal demand curves describe the variation in system demand throughout the day. The diurnal curve is used in conjunction with extended period simulation (EPS) runs of the hydraulic model to evaluate the distribution system. An EPS model run simulates the water system operation over a 24-hour or longer period of time. City supervisory control and data acquisition (SCADA) data was used to develop separate summer and winter diurnal curves for the two main parts of the City's water system. The north area consists of the part of the city north of the Sacramento River Deep Water Ship Channel, while Southport is all of the city south of the channel. The diurnal curves are shown in Figure 4.3 and Figure 4.4. The resulting summertime peak hour demand (PHD) to MDD peaking factor for the North area is 1.33, while the peaking factor for Southport is 1.77.

4.2.2 **Per Capita Water Demand**

Historical City residential per capita water use is calculated by dividing the City’s total production by the total population. Table 4.5 shows the historical per capita demands from 2010 to 2013. The per capita demand ranged between 252 gpcd (2010) to 287 gpcd (2013), averaging 269 gpcd for the four-year period of 2010 through 2013.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>ADD (mgd)</th>
<th>Per Capita Demand (gpcd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>48,744</td>
<td>12.30</td>
<td>252</td>
</tr>
<tr>
<td>2011</td>
<td>49,051</td>
<td>12.81</td>
<td>261</td>
</tr>
<tr>
<td>2012</td>
<td>49,606</td>
<td>13.68</td>
<td>276</td>
</tr>
<tr>
<td>2013</td>
<td>50,157</td>
<td>14.41</td>
<td>287</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>269</strong></td>
<td></td>
</tr>
</tbody>
</table>
NORTH AREA DIURNAL PATTERNS

FIGURE 4.3

CITY OF WEST SACRAMENTO
2015 WATER MASTER PLAN UPDATE

Typical Summer Diurnal (Sept. 2014)
Typical Winter Diurnal (Dec. 2014)
4.2.3 Historical Water Customer Accounts

The City divides its customers into four categories as follows:

- Single-family residential
- Multi-family residential
- Commercial
- Irrigation

The number of accounts for each customer category for the years 2010 through 2013 is summarized in Table 4.6. The data associated with MFR customers in Table 4.6 corresponds to individual multi-family units, rather than the number of water connections. This provides a better understanding of water use by household (as opposed to the water use for an apartment complex as a whole). The irrigation accounts were assumed to be parks and irrigation users for commercial and non-residential properties.

<table>
<thead>
<tr>
<th>Table 4.6 Historical Number of Water Accounts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 Water Master Plan Update</td>
</tr>
<tr>
<td>City of West Sacramento</td>
</tr>
<tr>
<td>Customer Class</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Residential</td>
</tr>
<tr>
<td>Single-Family – Metered</td>
</tr>
<tr>
<td>Flat Rate Billing Structure</td>
</tr>
<tr>
<td>Metered Billing Structure</td>
</tr>
<tr>
<td>Single-Family – Unmetered</td>
</tr>
<tr>
<td>Multi-Family – Metered(1)</td>
</tr>
<tr>
<td>Multi-Family – Unmetered(1)</td>
</tr>
<tr>
<td>Non-Residential</td>
</tr>
<tr>
<td>Commercial – Metered</td>
</tr>
<tr>
<td>Commercial – Unmetered</td>
</tr>
<tr>
<td>Irrigation – Metered</td>
</tr>
<tr>
<td>Large Consumers</td>
</tr>
<tr>
<td><strong>Total Accounts</strong></td>
</tr>
</tbody>
</table>

Notes:
(1) For 2010 through 2012 City records do not distinguish between metered and unmetered accounts.

The City is in the process of implementing its water meter program. At this time not all customers are metered. Most commercial and irrigation customers have meters, but nearly 40 percent of residential customers were not metered in 2013. City records for 2010
through 2012 do not distinguish between metered and unmetered multi-family customers. In addition, to-date the City has allowed residential customers to choose either a flat rate billing structure or a metered billing rate structure. The majority of the City's SFR customers have selected the flat rate billing structure. In 2013, approximately 11 percent of the SFR customers with meters were billed by the metered rate. In the future, however, the City plans to bill all of its customers by the metered rate. Note that in other cities where meters have been installed a reduction in water use has been documented. The City should continue to monitor its consumption in newly metered areas to future establish the residential water use.

Accounts correlating to the City's top ten largest consumers in 2013 are tallied separately in the row "Large Consumers," due to the unique nature of these customers' demands. The accounts of the Large Consumers were subtracted from the total number of accounts in the appropriate category in Table 4.6.

The total number of accounts has grown only slightly by 4.3 percent during the period from 2010 through 2013.

### 4.2.4 Historical Metered Water Consumption

At this time, the total water consumption of the City's customers is not known because the City is not yet fully metered. Historical metered water consumption data by customer class for the years 2010 through 2013 were obtained from the City's billing records and are presented in Table 4.7. Consumption of the City's ten largest consumers was considered independently from the other customer categories and appears in a separate row in Table 4.7.

<table>
<thead>
<tr>
<th>Table 4.7 Historical Metered Water Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 Water Master Plan Update</td>
</tr>
<tr>
<td>City of West Sacramento</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Customer Class</th>
<th>Annual Metered Consumption by Year (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
</tr>
<tr>
<td>Residential</td>
<td></td>
</tr>
<tr>
<td>Single-Family</td>
<td>4.85</td>
</tr>
<tr>
<td>Multi-Family Only Estimate(^{(1)})</td>
<td>0.69</td>
</tr>
<tr>
<td>Non-Residential</td>
<td></td>
</tr>
<tr>
<td>Commercial + Multi-Family</td>
<td>3.32</td>
</tr>
<tr>
<td>Commercial Only Estimate(^{(2)})</td>
<td>2.62</td>
</tr>
<tr>
<td>Irrigation</td>
<td></td>
</tr>
<tr>
<td>Large Consumers</td>
<td>1.14</td>
</tr>
</tbody>
</table>

**Notes:**

\(^{(1)}\) Estimated based on November 2014 multi-family consumption rate.

\(^{(2)}\) Estimated by subtracting estimated multi-family consumption from the commercial + multi-family consumption.
The City’s billing records do not distinguish between multi-family and commercial metered consumption. The City measured multi-family metered consumption for the month of November 2014, and this value multiplied by 12 was used to estimate 2013 MFR consumption as listed in Table 4.7. 2010, 2011, and 2012 multi-family consumption rates were estimated assuming a constant rate of consumption per MFR household at the November 2014 level. The commercial only estimates for years 2010 through 2013 as shown in Table 4.7 were calculated by subtracting the multi-family consumption estimate from the total commercial and multi-family consumption records.

It is recommended that the City begin distinguishing between multi-family and commercial metered consumption. These two customer classes typically have different water demand patterns; by analyzing them separately the City would avoid using estimates and better understand how these customers impact the water system.

4.2.4.1 Large Consumers

The demand trends for the City’s large consumer are evaluated separately so that their demand can be allocated to their precise location in the water system model.

The City’s ten largest consumers consist of four commercial accounts, three multi-family complexes, and three government accounts. Their locations are shown in Figure 4.5. Historical consumption for these accounts is shown in Table 4.8 for years 2010 through 2013. The demand of these ten largest consumers has fluctuated up and down slightly through the years. The maximum historical consumption for each large consumer during this time period is shown in the right column of Table 4.8.

In the future, the demand of these individual large customers is not likely to grow significantly, based on discussions with the City Staff. Thus, it is predicted that the large consumers will demand the maximum use of 1.50 mgd in the planning period years.

4.2.5 Equivalent Dwelling Units

The concept of an equivalent dwelling unit (EDU) is used to express water use by non-residential customers as an equivalent number of SFR customers. An EDU is the amount of water consumed by a typical full-time SFR.

Water use per EDU is calculated by dividing the total metered volume of water utilized in the SFR customer class by the total number of metered SFR accounts. This number defines the average SFR water use per account. The volume of water used by other customer classes is divided by the average SFR water use to determine the number of EDUs utilized by other customer classes.
FIGURE 4.5
CITY OF WEST SACRAMENTO
2015 WATER MASTER PLAN UPDATE

Legend

Large Water Users
City Limits
Water Features
Neighborhoods

LARGE CONSUMERS

E:\West_Sacramento_FND\Project Folders\For Water Comp Plan\Fig_4.03.mxd
### Table 4.8 Historical Large Consumers Demand

#### 2015 Water Master Plan Update

**City of West Sacramento**

<table>
<thead>
<tr>
<th>Customer</th>
<th>Average Day Demand by Year (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
</tr>
<tr>
<td>Washington Unified School District</td>
<td>0.27</td>
</tr>
<tr>
<td>NorCal Beverage Company</td>
<td>0.27</td>
</tr>
<tr>
<td>California Highway Patrol</td>
<td>0.19</td>
</tr>
<tr>
<td>Agrium(^{(2)})</td>
<td>0.18</td>
</tr>
<tr>
<td>Harsch Investments Properties</td>
<td>0.12</td>
</tr>
<tr>
<td>United States Postal Service</td>
<td>0.06</td>
</tr>
<tr>
<td>River City Stadium Management</td>
<td>0.05</td>
</tr>
<tr>
<td>Touchstone Owners Association</td>
<td>0.05</td>
</tr>
<tr>
<td>Evergreen Circle Management</td>
<td>0.05</td>
</tr>
<tr>
<td>Westwind Estates</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.28</strong></td>
</tr>
</tbody>
</table>

**Notes:**

(1) Maximum annual water use between 2010 and 2013.
(2) Per the City, Agrium will be leaving the system. Demand was included in the projections, as it was assumed that a future food processor user with a similar demand will be taking its place.

The average daily consumption per account for each customer class for years 2010 through 2013 is shown in Table 4.9. The average metered SFR daily consumption volume was 526 gallons. Therefore, the City's EDU value is 526 gallons per day (gpd). 2010 data was not used in the average EDU value calculation because the consumption rate of 891 gpd per account (gpd/acct) appears to be an outlier.
Table 4.9  
**Historical Water Consumption per Account (gpd/acct)**

2015 Water Master Plan Update  
City of West Sacramento

<table>
<thead>
<tr>
<th>Customer Class</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Average</th>
<th>EDUs/acct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single-Family(1)</td>
<td>891</td>
<td>496</td>
<td>520</td>
<td>562</td>
<td>526</td>
<td>1.0</td>
</tr>
<tr>
<td>Flat Rate Billing</td>
<td>944</td>
<td>520</td>
<td>549</td>
<td>597</td>
<td>555</td>
<td></td>
</tr>
<tr>
<td>Metered Billing</td>
<td>307</td>
<td>262</td>
<td>263</td>
<td>285</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>Multi-Family</td>
<td>181</td>
<td>181</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Residential</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>3,052</td>
<td>2,803</td>
<td>3,433</td>
<td>2,265</td>
<td>2,888</td>
<td>5.5</td>
</tr>
<tr>
<td>Irrigation</td>
<td>3,197</td>
<td>3,197</td>
<td>6.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large Consumers</td>
<td>163,398</td>
<td>170,863</td>
<td>167,849</td>
<td>188,466</td>
<td>172,644</td>
<td>328.5</td>
</tr>
</tbody>
</table>

Notes:
(1) Averages years 2011 through 2013 because 2010 data appears to be an outlier.

While on average all metered single-family customers consume 526 gpd, there is a big difference between the average daily water consumption of single-family customers with flat rate billing and customers with metered billing. Flat rate customers use 555 gpd on average while metered billing customers consume only 270 gpd. Flat rate customers on average consume more than twice the typical metered billing customer. As the City transitions to metered billing for all customers, it is likely that single-family consumption will decline.

The last column in Table 4.9 shows the average number of EDUs per account for each customer category served by the City. The typical MFR unit consumes 0.3 EDUs, or less than one third the use of a single-family house, while commercial accounts are equivalent to 5.5 EDUs on average. Irrigation accounts use 6.1 EDUs per account on average.

### 4.2.6 Unaccounted for Water

UFW is equal to total production minus total demand. Total production equals metered source water production. Total demand is the volume of water authorized for use by the water system. Because the City is not fully metered at this time, total demand is not known. However, total average day demand for years 2008 through 2013 for each customer class was estimated by multiplying the total number of accounts of each customer class, as presented in Table 4.8, by the EDU per account (EDU/acct) values presented in Table 4.9. The estimated average day demand for the City for years 2008 through 2013 is shown in Table 4.10.
Table 4.10  Estimation of Unaccounted for Water (mgd)
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Estimated Demand by Customer Type (mgd)</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single-Family Residential</td>
<td>6.1</td>
<td>6.2</td>
<td>6.3</td>
<td>6.3</td>
<td>6.4</td>
<td>6.4</td>
</tr>
<tr>
<td>Multi-Family Residential</td>
<td>1.0</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Commercial</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Irrigation</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.8</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Large Consumers</td>
<td>0.0</td>
<td>0.7</td>
<td>1.1</td>
<td>1.2</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Total Estimated Demand (mgd)</td>
<td>10.5</td>
<td>11.1</td>
<td>11.7</td>
<td>11.9</td>
<td>12.0</td>
<td>12.3</td>
</tr>
<tr>
<td>Total Production(^1) (mgd)</td>
<td>14.2</td>
<td>12.9</td>
<td>12.3</td>
<td>12.8</td>
<td>13.7</td>
<td>14.4</td>
</tr>
<tr>
<td>Unaccounted for Water(^2) (mgd)</td>
<td>3.9</td>
<td>1.8</td>
<td>0.6</td>
<td>0.9</td>
<td>1.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Unaccounted for Water</td>
<td>28%</td>
<td>14%</td>
<td>5%</td>
<td>7%</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td>Average Unaccounted for Water</td>
<td>13%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
(1) From Table 4.1.
(2) Equal to total production minus estimated total demand.

Comparing total production to estimated demand gives an estimate of UFW. Between 2008 and 2013, the estimated UFW averaged roughly 13 percent of production. The City’s 2015 UWMP performed a similar evaluation based only on year 2015 and estimated 18 percent of production UFW. Future calculations of UWF must follow the AWWA Audit for water loss based on detailed records.

### 4.3 ESTIMATE OF EXISTING DEMANDS BY NEIGHBORHOOD

In order to evaluate the capacity of the water system using the hydraulic model, the total system demands are allocated into the location of use. The demand of each neighborhood within the City was estimated by developing water demand factors based on the City’s existing land use geographic information system (GIS) data.

City-specific land use water demand factors (WDFs) were developed from the historical demand data. In the development of the WDFs, it was estimated that underutilized acres consume 50 percent of the water of fully utilized acres. Subsequently, demands were assigned to each neighborhood by multiplying the number of acres of each land use type by its respective WDF. These estimated land use based WDFs are provided in Table 4.11 for reference.
Table 4.11  Water Demand Factors  
2015 Water Master Plan Update  
City of West Sacramento

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>Water Demand Factor (gallons per day per acre [gpad])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Family Residential</td>
<td>3,559</td>
</tr>
<tr>
<td>Multi-Family Residential</td>
<td>7,054</td>
</tr>
<tr>
<td>Commercial</td>
<td>1,778</td>
</tr>
<tr>
<td>Parks</td>
<td>418</td>
</tr>
</tbody>
</table>

The estimated 2013 average day, max day, and peak hour demands for each neighborhood are presented in Table 4.12. Subtotals for North Area and Southport are provided. As shown in Table 4.12, roughly 64 percent of the estimated existing demand (9.1 mgd, on an ADD basis) is located in the North Area, and the remaining 36 percent of the City's demand (5.1 mgd) is located in the Southport Area.

A West Yost evaluation of the Washington District estimated existing demands this neighborhood as 370,080 gpd. The Washington District neighborhood existing demands listed in Table 4.12 are consistent with the West Yost estimates.

4.4  2035 DEMAND PROJECTIONS

This section summarizes the future 2035 demand projections that were developed for the City's water system based on historical water demand trends and General Plan future growth assumptions. The demand projections are used for the capacity analysis described in Chapter 7. It should be noted that the current General Plan is considerably different that the previous General Plan. Projections for growth rates and characteristics have changed dramatically from the previous General Plan, with lower anticipated growth rates, and more growth projected to occur in the northern part of the City than previously anticipated. These changes are reflected in this Water Supply Master Plan through the Capital Improvement Plan to support the updated General Plan.
Table 4.12 Existing Water Demands by Neighborhood
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Neighborhood</th>
<th>2013 ADD (mgd)</th>
<th>2013 MDD (mgd)</th>
<th>2013 PHD (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North Area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broderick/Bryte</td>
<td>2.0</td>
<td>3.7</td>
<td>4.9</td>
</tr>
<tr>
<td>Central Business City</td>
<td>0.1</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>Iron Triangle</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Lighthouse</td>
<td>0.3</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Michigan Glide</td>
<td>0.8</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>North of Port Industrial</td>
<td>0.7</td>
<td>1.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Old West Sacramento</td>
<td>0.9</td>
<td>1.7</td>
<td>2.3</td>
</tr>
<tr>
<td>Pioneer Bluff</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>Port North Terminal</td>
<td>0.2</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Port of Sacramento Industrial Park</td>
<td>1.5</td>
<td>2.8</td>
<td>3.7</td>
</tr>
<tr>
<td>Riverpoint</td>
<td>0.2</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Riverside/CHP</td>
<td>0.7</td>
<td>1.3</td>
<td>1.7</td>
</tr>
<tr>
<td>South of West Capitol</td>
<td>0.5</td>
<td>0.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Triangle</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>Washington</td>
<td>0.4</td>
<td>0.7</td>
<td>0.9</td>
</tr>
<tr>
<td>West Capitol</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>West End</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>West Harbor</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>9.1</td>
<td>17.0</td>
<td>22.6</td>
</tr>
<tr>
<td><strong>Southport Area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North East Village of Southport</td>
<td>1.6</td>
<td>3.0</td>
<td>5.3</td>
</tr>
<tr>
<td>North West Village of Southport</td>
<td>2.3</td>
<td>4.3</td>
<td>7.5</td>
</tr>
<tr>
<td>Rural Core</td>
<td>0.2</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Seaway</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>SIP</td>
<td>0.3</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>South East Village of Southport</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>South West Village of Southport</td>
<td>0.7</td>
<td>1.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Stone Lock</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>5.1</td>
<td>9.4</td>
<td>16.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14.2</td>
<td>26.4</td>
<td>39.3</td>
</tr>
</tbody>
</table>
4.4.1 Demand Projection Parameters

Numerous factors and assumptions contribute to the estimation of future water demands. The parameters used to project future demands, which are listed in Table 4.13, include EDU value, EDU per account for each customer class, peaking factors, UFW percentage, and large consumer demand.

<table>
<thead>
<tr>
<th>Table 4.13 Demand Projection Parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2015 Water Master Plan Update</strong></td>
<td></td>
</tr>
<tr>
<td><strong>City of West Sacramento</strong></td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Value</td>
</tr>
<tr>
<td>EDU Value (gpd/EDU)</td>
<td>526</td>
</tr>
<tr>
<td>Future Residential Customer EDU Value (gpd/EDU)</td>
<td>350</td>
</tr>
<tr>
<td>MDD/ADD Peaking Factor</td>
<td>1.87</td>
</tr>
<tr>
<td>North Area PHD/MDD Peaking Factor</td>
<td>1.33</td>
</tr>
<tr>
<td>Southport PHD/ADD Peaking Factor</td>
<td>1.77</td>
</tr>
<tr>
<td>Percent Unaccounted for Water</td>
<td>13%</td>
</tr>
<tr>
<td>Large Consumers Demand (mgd)</td>
<td>1.50</td>
</tr>
</tbody>
</table>

4.4.1.1 EDU Values

It is anticipated that residential customers connecting to the water system in the future will use less water than the historical average of 526 gpd. The City's historical consumption data shows that customers billed by their metered consumption on average use half as much water as customers billed a flat monthly rate. As the City completes its metering program, all single-family accounts will be transitioned to metered billing, giving customers a strong incentive to reduce consumption. In addition, according to City planners, future development in the City will consist of higher density homes and more water efficient construction, also likely to contribute to a lower single-family consumption rate.

For conservative planning purposes, the future demand projections are based on the current EDU value of 526 gpd per EDU (gpd/EDU) for existing customers. However, for future customers, an EDU value of 350 gpd/EDU was assumed. This assumption was developed based on input from City staff and Carollo's experience with similar agencies, and is one third less than the current EDU value. In addition, the demand projections assume that future commercial and irrigation customers will consume the same amount of water per account as historical customers. This assumption is likely conservative, but is appropriate for planning purposes.

In addition to more water efficient construction, all new and rehabilitated landscape projects must comply with the City’s Water efficient Landscape Ordinance (Title 13, Section 13.04, Article XII of the City’s Municipal Code). This ordinance applies to new development.
projects with an aggregate landscape area equal to or greater than 500 square feet and rehabilitated landscape projects with an aggregate landscape area equal to or greater than 2,500 square feet. The ordinance includes restrictions on the usage of turf and high water use plants. The use of more drought tolerant landscaping and regionally appropriate plants and trees are encouraged.

4.4.1.2 MDD to ADD Peaking Factor

The existing MDD to ADD peaking factor of 1.87 was used as the basis for future demand projections. The PHD peaking factors were derived from the diurnal curves shown in Figure 4.3 and Figure 4.4.

4.4.2 Demand Projections

Existing average day residential, commercial, and irrigation demands of each neighborhood were increased by the annual growth rates in Table 4.3 to predict future demands. Future residential demand was then adjusted downward to account for the City's assumption that future residential customers will consume less water than current customers. The demand of the City's ten large consumers was kept constant at 1.5 mgd throughout the planning period.

The peaking factors listed in Table 4.13 were applied to convert future ADD to MDD and PHD.

The water system's ADD is predicted to nearly double in 20 years from approximately 14.2 mgd to 23.9 mgd. MDD is projected to reach nearly 45 mgd. The 2035 water demand projections are presented by neighborhood in Table 4.14. Table 4.15 and Figure 4.6 provide a summary of the existing and future water demand projections.

The City's future industrial water use is projected using the nonresidential growth rates derived from the General Plan employment projections and the historical water consumption of the City's largest consumers. The City may gain new industrial water customers, such as food processors, beyond the employment projections in the General Plan, which may increase future demands. The City asked Carollo to perform an analysis of the impact to the distribution system related to four potential industrial food processing "zones" within the City. The potential demands associated with each industrial food processing zone, and the infrastructure required to supply the increase in demand associated with each zone is provided in a technical memorandum, which is included in Appendix D for reference.

4.5 SUMMARY

West Sacramento water demands are projected to increase from an existing ADD of approximately 14.2 mgd to a 2035 ADD of 23.9 mgd. 2035 MDD and PHD are forecast as 44.7 mgd and 66.6 mgd, respectively.
### Table 4.14 2035 Water Demand Projections by Neighborhood
#### 2015 Water Master Plan Update
**City of West Sacramento**

<table>
<thead>
<tr>
<th>Neighborhood</th>
<th>ADD (mgd)</th>
<th>MDD (mgd)</th>
<th>PHD (mgd)</th>
</tr>
</thead>
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<td>1.3</td>
<td>1.7</td>
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<tr>
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<td>2.0</td>
<td>2.6</td>
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<tr>
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<td>3.4</td>
<td>4.5</td>
</tr>
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<td><strong>28.9</strong></td>
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<td><strong>44.7</strong></td>
<td><strong>66.6</strong></td>
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### Table 4.15: Existing and Future Demands Summary

**2015 Water Master Plan Update**  
City of West Sacramento

<table>
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<tr>
<th>Area</th>
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<th>2035 Demands</th>
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<td>MDD (mgd)</td>
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<td>9.4</td>
</tr>
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<td><strong>Total</strong></td>
<td><strong>14.2</strong></td>
<td><strong>26.4</strong></td>
</tr>
</tbody>
</table>
AVERAGE AND MAXIMUM DAY DEMAND PROJECTIONS

FIGURE 4.6
CITY OF WEST SACRAMENTO
2015 WATER MASTER PLAN UPDATE
The purpose of this chapter is to (1) describe the City of West Sacramento’s (City’s) water assets; (2) assess each water asset’s reliability under differing supply conditions; and (3) explain future water supply conditions that implicate the City’s General Plan Update build out conditions. The information in this document may be used for the Water Master Plan supply section, Urban Water Management Plan supply and integration sections, and General Plan water supply analysis.

As described in the text below, the City’s existing water assets provide reliable water supplies in normal and dry year conditions. The City’s planned water right perfection and existing asset supply augmentation prudently aligns with the City’s planned growth. The City has redundant water supply sources and opportunities to create further redundancy by developing alternative water supply sources if it so chooses. In short, the City’s thoughtful water supply planning has created a sound roadmap for water supply reliability both now and in the future.

5.1 SURFACE WATER ASSETS

The City has three surface water assets for use in its service area. These assets are: a water right with the State Water Resources Control Board (SWRCB), a contract with the United States Bureau of Reclamation (Reclamation), and a water entitlement through North Delta Water Agency (NDWA). These assets were developed and secured over the course of the last half-century in an effort to encourage responsible growth by the City, create water supply redundancy, and to protect the City against drought conditions.

Throughout the 2013-2015 drought, the City was able to provide water supplies to meets its needs. The City’s water supplies were not curtailed to such an extent as to prevent the City from making adequate deliveries to its customers. During 2015, the City was actively reducing its water consumption in order to meet the SWRCB’s mandated water use restrictions. Although the City showed extensive water use reductions, absent the SWRCB’s mandate, the City’s conservation would not likely have been as great given the characteristics of the City’s water supply assets and its historical use patterns. As such, the City’s supplies have proven adequate to meet historical demands.

The foregoing analysis will show how the City will develop and use its supplies in order to meet future demand conditions. Moreover, this document will demonstrate how the City will secure sufficient additional water assets in the future to meet its long-term water supply needs anticipated as part of the City’s General Plan Update.
5.1.1 SWRCB Water Right Permit 18150

The City holds an appropriative water right issued by the State Water Resources Control Board – Permit 18150 with a priority date of 1977 (Permit). This Permit allows the City to divert water from the Sacramento River for use in its service area. Specifically, the Permit allows the City to divert water from January 1 to June 30 of each year and then again from September 1 to December 31 of each year with a maximum rate of diversion limited to 62 cubic feet per second (cfs).\(^1\) The City diverts this water from the Sacramento River and delivers it to the Bryte Bend Water Treatment Plant. Accordingly, based upon the full diversion right, the City may divert a maximum of 18,350 acre-feet of water per year (AFY) under this Permit.

The Permit is subject to a special water right condition called “Term 91" that allows the state to limit or eliminate the City’s ability to use this water under certain conditions. Term 91 is declared by the SWRCB when it is determined that the State Water Project (SWP) and U.S. Bureau of Reclamation’s Central Valley Project (CVP) are required to release stored water in excess of low natural flow to meet Sacramento Valley in-basin uses plus export demands. Natural flow is the flow that would have occurred in the natural river systems if the dams in the Sacramento River watershed did not exist. In short, when direct diversions are not allowed because of Term 91, the City of West Sacramento is denied water under the Permit. In dry conditions, Term 91 is most likely to be triggered and the City must curtail use of this water right. In extremely dry conditions, appropriative water rights are curtailed in order of priority that may force the City to forego water use under the right even earlier in the water year than may be triggered by the Term 91 condition. The City’s Permit has often been subject to Term 91, with the Permit term in effect as early as March in some years. Whenever the Term 91 condition is triggered, the City is prohibited from diverting water under the Permit until the SWRCB lifts the Term 91 conditions.

The City’s water right Permit is not a legally perfected water right. Under the SWRCB’s water rights process, an applicant must complete three regulatory stages in order to secure the water right: application, permit, and license. In order to receive a water right license, the permit-holder must demonstrate that it has put the full water supply allowed under the water right to reasonable and beneficial use. Once this prerequisite is demonstrated, the City may petition the SWRCB to receive a water right license – legally perfecting the water right. Until the license is issued, the City’s supply anticipated for future delivery is not fully secured.

The City’s Permit is incorporated into the Bureau of Reclamation (Reclamation) Contract described in the next section. The incorporation into that contract creates another layer of security in receiving deliveries of the permitted supply as provided by Reclamation’s operation of Shasta Reservoir.

\(^1\) This is equivalent to about 120 acre-feet per day, if the maximum rate occurs for 24 hours.
5.1.2 Reclamation Contract 0-07-20-W0187

The City has a Federal Central Valley Project water supply contract with the United States Bureau of Reclamation. This contract resulted from an assignment of the rights and obligations under the contract from the East Yolo Community Services District. The contract incorporates supplies derived from the City’s Permit (described above) and provides additional water derived from Reclamation’s water rights managed under the CVP. For the City, these supplies primarily originate from the CVP’s Shasta dam and reservoir. This additional water is referred to as the CVP Project Supply. The contract provides the City a total of 23,600 acre-feet per year, incorporating the City’s Permit with its maximum annual diversion of 18,350 acre-feet. The contract does not limit the maximum rate or months of diversion from the river by the City.

The City uses the CVP Project Supply throughout the water year. In June, July, August, and September, the City is required to purchase CVP Project Supply water to meet demands on a schedule described in the contract. Specifically, the City is required to purchase 20, 88, 100, and 100 percent of the water diverted during those respective months, but it is not required to divert the purchased water. The contract requires a minimum purchase of CVP Project Supply annually, with the annual quantity increasing by about 90 acre-feet each year of the contract term. In 2015, this minimum purchase was 9,350 acre-feet. The contract expires in 2019 and the minimum purchase in that year is 9,680. Under normal allocation conditions, the City has historically used only about 5,200 acre-feet of CVP Project Supply.

The CVP Project Supply may be used anywhere in the City’s service area. But in one area of the City, north of the Union Pacific Railroad tracks, the CVP Project Supply is the primary source of water that the City uses in this location in the summer months. Accordingly, in dry years, the CVP water is first earmarked for this area and then remaining supplies are used in other areas within the City.

In times of water shortage, the base supply – derived from the City’s Permit – is subject to the water right cutbacks imposed by the SWRCB. The CVP Project Supply is subject to a set of restrictions derived from Reclamation’s Municipal and Industrial Shortage Policy. The shortage policy essentially requires reductions in CVP Project Supply deliveries that are measured from a water use baseline. The water use baseline is derived from the average of the last three years of normal (i.e. 100 percent allocation) CVP Project Supply use by the City. This baseline may then be modified based upon new growth and planned growth in the water year, as well as other adjustments based upon alternative water supplies used. The three-year average is then reduced by a percentage as determined by Reclamation as part of their annual operations planning. Before the recent drought, the most the CVP Project Supply had ever been reduced was 75 percent of the three-year average use. But in 2015, due to Reclamation’s operations planning, the North of Delta CVP Project Supply for
Municipal and Industrial contracts was reduced to only 25 percent of the three-year average use. This exceptional reduction in 2015 is considered an anomaly for purposes of dry year water supply planning. And even with this excessive reduction, the City is able to use alternative supplies to meet its customers’ needs.

The City has successfully transferred surplus CVP Project Supply in both normal and wet years. Since the City’s total use is about 5,200 AFY and the minimum quantity that the City must pay for exceeds 9,000 AFY, the City has about 4,000 acre-feet of CVP Project Supply available in years where Reclamation provides 100 percent allocation. This surplus has been sold to other CVP contractors in the Sacramento Valley, as allowed under Reclamation’s contracting provisions. Revenues from these water sales have been used to offset the payments to Reclamation associated with the City’s CVP Project Supply allocation.

Provisions in the contract allow for the renewal of the contract for successive periods and to increase or decrease the quantity of water available to the City. The current contract expires in 2019. Renewal of this contract is discussed in Section 1.4 below. The contract also requires the City to prepare and implement a water conservation program for all water diverted from the river. Detailed information regarding the City’s conservation efforts must be submitted to Reclamation for approval every five years.

5.1.3 North Delta Water Agency Contract

The City’s third water asset is surface water available for diversion under provisions of the North Delta Water Agency (NDWA) contract. The NDWA was formed in 1974 to protect the water resources in specific portions of Yolo, Solano, Sacramento, and San Joaquin counties. In 1981, the NDWA executed the "Contract between the California Department of Water Resources for the Assurance of a Dependable Water Supply of Suitable Quality" (NDWA Contract) as a settlement of claims related to the then-proposed “Peripheral Canal.” The NDWA Contract assures that the State, through both the State Water Project (SWP) and DWR’s water right permits, will maintain within the NDWA service area a dependable water supply of adequate quantity and quality for municipal, industrial, and agricultural purposes. In exchange for this assurance, the NDWA agreed to pay the California Department of Water Resources (DWR) $170,000 per year starting in 1982. Furthermore, in 1998, DWR and NDWA developed a Memorandum of Understanding (MOU) during the Bay-Delta Water Rights hearings conducted by the SWRCB. This MOU states that the 1981 contract between DWR and NDWA remains in full force and effect.

The annual payments to DWR are subject to adjustments every five years. Payments to the NDWA – that are used to pay NDWA expenses, including DWR fees – are made by all landowners within the NDWA boundaries through annual tax assessments on their properties, including the property owners within NDWA inside the City and its Sphere of Influence (SOI). NDWA uses its authority to adjust the property taxes for NDWA
landowners under the auspices of Proposition 218. The City only delivers a portion of the NDWA water to land that it owns. The City diverts and delivers the additional NDWA waters on behalf of all of the landowners within the City’s boundary that lie within the NDWA. A small portion of the City, north of the Union Pacific railroad track, lies outside of the NDWA boundary.

The City uses the NDWA Contract as a back-up supply to meet its customers’ demands. Although the City may at some point choose to rely on the supply to meet normal year demands, it currently limits its use of this source to (1) the month of July when the Permit supply is unavailable; (2) in times during the year when its Permit supply is constrained by Term 91; and (3) during shortage conditions relative to its other water assets.

During the 2014-2015 drought years, CVP M&I contractors received significantly reduced deliveries from Reclamation. Moreover, due to reduced runoff, Term 91 conditions were triggered in March. And, in early June 2015, many pre-1914 water rights were completely curtailed, requiring many purveyors to find alternative supplies. The City relied primarily on its NDWA contract to meet its water demands in 2014 and 2015 – helping the City avoid any serious water supply crisis.

The majority of the City lies within the NDWA boundary. The NDWA Contract water may be used in the geographical area roughly south of the Union Pacific Railroad (UPRR) tracks, which incorporates between 80 and 90 percent of the City’s water service area. As such, the small portion of the City’s service area north of the UPRR tracks may not have access to the NDWA contract for reliability protection. As described above, this small area relies almost exclusively on the City’s Permit and CVP Contract Supply.

The NDWA Contract provides an extremely valuable water supply to the City. The water under this contract is 100 percent reliable in all year types.

5.1.4 Summary of Surface Water Supplies

Table 5.1 below summarizes the current and projected surface water supply sources for the City of West Sacramento.
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<tr>
<th>Month of Use</th>
<th>Authority</th>
<th>Normal Year Reliability</th>
<th>Dry Year Reliability</th>
<th>Maximum Diversion</th>
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<tr>
<td></td>
<td>NDWA</td>
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<tr>
<td></td>
<td>Project Supply</td>
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<td>50%</td>
<td>No Limit</td>
</tr>
<tr>
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</tr>
<tr>
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<td>July</td>
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<td>September</td>
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The combination of all of the City’s surface water supplies – its only current supply source for its potable water deliveries – indicates that the needed volumes are reliable in all year types. The distribution of those supplies, however, varies greatly depending on the year and the water supply conditions. Below in Figure 5.1 and Figure 5.2, the City’s water supply allocation for a normal year and an extreme dry year (2015) are depicted. The utility of the NDWA supply as a reserve supply to handle drought conditions is apparent.

Figure 5.1  Normal Year Utility of City’s Water Assets

Figure 5.2  Dry Year Utility of City's Water Assets
5.1.5 Water Supply Resiliency

The City currently withdraws all of its Sacramento River surface water at the George Kristoff Water Treatment Plant, at the far northern part of the City and water distribution system. Transmission mains convey water throughout the City, including limited transmission alignments across the deep water channel to Southport. As a means of increasing surface water supply resiliency the City continues to evaluate locations for a second surface water intake and treatment plant in the southern part of the City. One possible location that has been evaluated and has merit is at the western shore of Chicory Bend on the Sacramento River. This location is approximately across the River from the Pocket area of Sacramento. Having a second intake, treatment plant, and source of supply in the southern part of the City provides numerous advantages. Land planning in this area should consider potential siting of an intake, raw water pipeline, treatment plant site, and potable water conveyance into the distribution system. Should the City decide to build redundancy with a 10-20 MGD treatment plant, approximately 6 acres should be reserved for future planning for the plant, plus an intake location, and easements for the raw water and treated water transmission pipelines. Specific capacity and land needs will require further evaluation.

5.2 GROUNDWATER

The City overlies the Yolo Subbasin of the Sacramento Valley Groundwater Basin. The Yolo Subbasin covers approximately 256,000 acres or 400 square miles. The Yolo Subbasin is bounded on the east by the Sacramento River, on the west by the Coast Range, on the north by Cache Creek, and on the south by Putah Creek. The total storage capacity of the Yolo Subbasin exceeds 6 million acre-feet.

Historically, the sole source of water supplied to the City was groundwater. The City moved away from groundwater sources because of the heavy mineralization issues associated with groundwater that affected the quality of water delivered to its customers. The City does, however, retain some wells and anticipates developing additional groundwater wells that may be used to meet raw water demands in the City as well as emergency end user supplies that will be blended with less-mineralized surface water sources out of the Sacramento River watershed.

The City has three wells in its Southport Area: the Southport Treated Water Well with 2.9 mgd capacity; Well #19 with 1,000 gpm capacity; and Well #20 with 1,600 gpm capacity. These wells are depicted in Table 5.2 below. These wells are not currently used within the City for potable uses and are not considered as part of this sustainability analysis.
The Sustainable Groundwater Management Act (SGMA) of 2014, will alter how water supplies derived from groundwater are used throughout the Yolo Subbasin. The Water Resources Association of Yolo County (WRA) as well as the Yolo County Farm Bureau has begun to develop a governance structure to meet the requirements of SGMA. The City of West Sacramento is a member of WRA. The SGMA requires a Groundwater Sustainability Agency (GSA) to be formed by July 1, 2017 and a Groundwater Sustainability Plan (GSP) to be completed by 2022. The new governance and management of the basin will be an ongoing effort through the next water management planning cycle.

5.3 WATER TREATMENT AND DELIVERY

In 1988, the City’s Bryte Bend Water Treatment Plant (BBWTP) went online and has been the main water treatment and delivery facility for the City. The BBWTP treats surface water from the Sacramento River derived from Permit 18150, CVP Project Supplies, and NDWA Contract. The BBWTP was expanded in 2003-2004 to a maximum capacity of 58 million gallons per day (mgd) (permitted capacity = 40 mgd November – March; 58 mgd April – October). The BBWTP uses a treatment process consisting of chemical coagulation, Actiflo® high rate clarification, dual media granular activated carbon filtration, and chlorine disinfection. With the BBWTP as the main water supply facility for the City, the water system is able to meet peak demands and supply reliable to customers.

5.4 FUTURE WATER SUPPLY DELIVERIES

As described in Section 5.1 above, the City’s water supplies are subject to future uncertainty. Specifically, the reliability of Permit 18150 in certain year types because of Term 91 and its Permit status as well as the uncertainty in the City of West Sacramento’s CVP Contract renewal processes may render those two sources vulnerable. In contrast, the North Delta Water Agency contract appears relatively stable as a long-term back-up supply.

5.4.1 Future Supply under Permit 18150

Permit 18150’s Term 91 condition is subject to the regulatory uncertainties that are triggered by Delta water supply issues. In other words, if regulatory decision makers determine that additional water supplies are necessary for balanced conditions in the Delta, then Term 91 may trigger earlier in the season in a normal water year. Similarly, if climatic

<table>
<thead>
<tr>
<th>Table 5.2</th>
<th>City of West Sacramento Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2015 Water System Master Plan Update</td>
</tr>
<tr>
<td></td>
<td>City of West Sacramento</td>
</tr>
<tr>
<td>Well</td>
<td>Capacity</td>
</tr>
<tr>
<td>Southport Treated Well Water Capacity, mgd</td>
<td>2.9</td>
</tr>
<tr>
<td>Well #1, gallons per minute (gpm)</td>
<td>1,000</td>
</tr>
<tr>
<td>Well #20, gpm</td>
<td>1,600</td>
</tr>
</tbody>
</table>
conditions change – due to predicted outcomes of climate change – then potentially snowmelt and runoff patterns may change again affecting Term 91 triggers.

The City may also have some additional issues in perfecting water usage under Permit 18150 and in transitioning the Permit into a license through the SWRCB process. The Permit requires applying all water supplies described under the Permit to beneficial uses in the time allotted in the Permit. It may be difficult for the City to apply all water supplies under the Permit to the full extent feasible based upon the City’s diversion capacity, its treatment capacity, and its delivery capacity in the months when the Permit water may be diverted. Although the total volume under the right at 18,350 acre-feet per year (62 cfs) could be used by the City, the limited window to divert and use that water may prove problematic. As such, we consider the existing normal year diversion amounts as a conservative estimate in the context of future use of this water asset. This maximum amount is 13,920 acre-feet per year.

5.4.2 Future Supply CVP Contract 0-07-20-W0187

The City’s CVP contract also expires in 2019. The expiration of this contract poses two issues to the City: (1) how will the contract renewal process inre the City’s permit supply under this contract (if at all); and (2) will the City be able to increase its CVP Project Supply allocation under the contract in order to meet its full build-out need while preserving its NDWA supply as a backup supply. The City has initiated its assessment of CVP Project Supply needs and has determined that this supply should be the City’s primary supply over the course of the hottest and driest months of a calendar year – June, July, August and September. This characterization matches the characterization of the CVP Project Supply water asset in the City’s current water planning efforts and diversion patterns.

The City intends to initiate negotiations with Reclamation within the next year. These negotiations will focus on increasing the volume of CVP Project Supply available under the CVP contract. Reclamation has conceded that it considers the NDWA supply a back-up supply to the City’s primary supply sources. This characterization, coupled with the increased scrutiny on groundwater assets coming through the SGMA process, should help the City in its contract renewal process. In the event that the City is stymied in these efforts, the City will pursue other actions to increase its water supplies as described briefly in the water transfer discussion below. For purposes of long-term planning, the City will assume that its contract renewal process allows supplies to meet its planned build-out demand conditions. As such, this planning document uses a conservative estimate showing a minimum of 9,680 acre-feet per year of CVP Project Supply allocation will be available in 2020. Moreover, the plan anticipates that this CVP Project Supply will continue to increase in reasonable incremental volumes through the planning horizon, nearly doubling at 18,000 acre-feet, by 2045.
5.4.3 Future Supply of Groundwater

The third piece of the City’s future water supply planning includes development of groundwater wells to potentially blend with surface water assets and provide an additional layer of emergency back-up supply. Although the City currently does not have significant well capacity to deliver water to meet its customer needs, it anticipates developing such capacity in the future. As such, future water supply characterizations indicate a conservative figure of 500 acre-feet of groundwater available starting in 2030 and double that amount, to 1,000 acre-feet, by 2045.

5.4.4 Future Supply from North Delta Water Agency Contract

The final component of the City’s future supply is the North Delta Water Agency contract. Existing City policy indicates that this supply should primarily be considered a back-up supply in planning for normal years, single dry, and multiple dry years.

For purposes of future planning for normal years, the NDWA supply is limited to approximately 10 percent of the City’s overall supply. For purposes of dry year planning, the NDWA supply makes up the entire deficit of supply that the City’s primary water supplies do not fill.

5.4.5 Integrated Future Supply Tables

Below in Table 5.3, Table 5.4, and Table 5.5, the City’s normal year, single dry year, and multiple dry years supply reliability tables are respectively shown. These forecasted supply tables follow the conservative assumptions included in this planning document. The normal year plan shows 2020 total supplies available to the City at 25,960 acre-feet per year and 2045 available supplies to the City at 36,112 acre-feet per year. The increased supply also indicates some additional groundwater being used within the City to either move through its potable water system or offset some potable demand (both having the same effect on the potential integration of supply and demand).

<table>
<thead>
<tr>
<th>Table 5.3 City of West Sacramento Normal Year Supply Reliability 2015 Water System Master Plan Update City of West Sacramento</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Source (values in acre-feet/yr)</td>
</tr>
<tr>
<td>Permit 18150</td>
</tr>
<tr>
<td>CVP Project Supplies</td>
</tr>
<tr>
<td>North Delta Water Agency</td>
</tr>
<tr>
<td>Groundwater</td>
</tr>
<tr>
<td>Total Supply</td>
</tr>
</tbody>
</table>
### Table 5.4 City of West Sacramento Single Dry Year Supply Reliability
2015 Water System Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Supply Source (values in acre-feet/yr)</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tr>
<td>Permit 18150</td>
<td>6,960</td>
<td>6,960</td>
<td>6,960</td>
<td>6,960</td>
<td>6,960</td>
<td>6,960</td>
</tr>
<tr>
<td>CVP Project Supplies</td>
<td>7,260</td>
<td>7,500</td>
<td>9,000</td>
<td>10,500</td>
<td>12,000</td>
<td>13,500</td>
</tr>
<tr>
<td>North Delta Water Agency</td>
<td>11,740</td>
<td>11,852</td>
<td>12,552</td>
<td>13,252</td>
<td>13,952</td>
<td>14,652</td>
</tr>
<tr>
<td>Groundwater</td>
<td>0</td>
<td>0</td>
<td>500</td>
<td>500</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Total Supply</td>
<td>25,960</td>
<td>26,312</td>
<td>29,012</td>
<td>31,212</td>
<td>33,912</td>
<td>36,112</td>
</tr>
</tbody>
</table>

### Table 5.5 City of West Sacramento Multi-Dry Year Supply Reliability
2015 Water System Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Supply Source (values in acre-feet/yr)</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multi-Dry Year 1 (same as &quot;Single Dry&quot;)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permit 18150</td>
<td>6,960</td>
<td>6,960</td>
<td>6,960</td>
<td>6,960</td>
<td>6,960</td>
<td>6,960</td>
</tr>
<tr>
<td>CVP Project Supplies</td>
<td>7,260</td>
<td>7,500</td>
<td>9,000</td>
<td>10,500</td>
<td>12,000</td>
<td>13,500</td>
</tr>
<tr>
<td>North Delta Water Agency</td>
<td>11,740</td>
<td>11,852</td>
<td>12,552</td>
<td>13,252</td>
<td>13,952</td>
<td>14,652</td>
</tr>
<tr>
<td>Groundwater</td>
<td>0</td>
<td>0</td>
<td>500</td>
<td>500</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Total Supply</td>
<td>25,960</td>
<td>26,312</td>
<td>29,012</td>
<td>31,212</td>
<td>33,912</td>
<td>36,112</td>
</tr>
<tr>
<td><strong>Multi-Dry Year 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permit 18150</td>
<td>3,480</td>
<td>3,480</td>
<td>3,480</td>
<td>3,480</td>
<td>3,480</td>
<td>3,480</td>
</tr>
<tr>
<td>CVP Project Supplies</td>
<td>4,840</td>
<td>5,000</td>
<td>6,000</td>
<td>7,000</td>
<td>8,000</td>
<td>9,000</td>
</tr>
<tr>
<td>North Delta Water Agency</td>
<td>17,640</td>
<td>17,832</td>
<td>19,032</td>
<td>20,232</td>
<td>21,432</td>
<td>22,632</td>
</tr>
<tr>
<td>Groundwater</td>
<td>0</td>
<td>0</td>
<td>500</td>
<td>500</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Total Supply</td>
<td>25,960</td>
<td>26,312</td>
<td>29,012</td>
<td>31,212</td>
<td>33,912</td>
<td>36,112</td>
</tr>
<tr>
<td><strong>Multi-Dry Year 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permit 18150</td>
<td>3,480</td>
<td>3,480</td>
<td>3,480</td>
<td>3,480</td>
<td>3,480</td>
<td>3,480</td>
</tr>
<tr>
<td>CVP Project Supplies</td>
<td>4,840</td>
<td>5,000</td>
<td>6,000</td>
<td>7,000</td>
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<td>North Delta Water Agency</td>
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<td>0</td>
<td>500</td>
<td>500</td>
<td>1,000</td>
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<td>Total Supply</td>
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<td>26,312</td>
<td>29,012</td>
<td>31,212</td>
<td>33,912</td>
<td>36,112</td>
</tr>
</tbody>
</table>
The Single Dry Year water supply depicted in Table 5.4 shows a 50 percent reduction in available supplies under Permit 18150 resulting from an earlier Term 91 trigger as well as a 25 percent reduction under the City’s CVP Project Supply in accordance with Reclamation’s Municipal and Industrial Shortage Policy described in Section 1.1.2. Table 5.4 also shows that the NDWA supply increases in order to meet deficits caused by reduction in the other available supplies. Last, Table 5.4 shows additional future groundwater supplies available.

The Multi-Dry Year water supply depicted in Table 5.5 shows a first and second year dry year reduction that matches the supply reductions in a Single Dry Year. However, in year 3 of a multi-year supply deficit, the plan adds additional supply reductions in accordance with future planning predictions. Permit 18150 is reduced by 75 percent indicating that Term 91 is in effect preventing diversions under this right in 8 out of 12 months in a calendar year. CVP Project Supplies are reduced to 50 percent of their totals in accordance with Reclamation’s Municipal and Industrial Shortage Policy as described in Section 1.2.2 above. NDWA allocations paradoxically increase to make up the supply deficits coupled with additional groundwater allocations. The plan anticipates that demands will decrease in the second and third year of a multi-year dry scenario as a City’s (or the SWRCB’s) demand reduction measures are activated to reduce overall water demand on the City’s available supplies.

5.5 TRANSFER OPPORTUNITIES

The City of West Sacramento has water transfer opportunities available both to provide and procure water. The City of West Sacramento’s varied water assets allow it to make water available to other users in many areas to California through readily accepted water transfer protocols. For instance, delivering water in accordance with transfer provisions in the City’s CVP contract. In addition, the City’s location on the Sacramento River allow it to not only access a large variety of water supplies derived from the Sacramento River watershed (potentially for its own use or exchange), but also access to a primary delivery system – the Sacramento River – that would allow water to reach other areas in the State via the federal and state pumping facilities in the Delta. As such, the City is in a prime position to engage in water transfers in California.

The City has already executed water transfers in years past. For instance, the City entered a short-term water transfer agreement with the Dunnigan Water District (District) for the transfer of untreated surface water to the District. Under the agreement, the City sold a minimum of 1,000 acre-feet per year of CVP Project Supply water to the District in exchange for payment. The special rules under the Central Valley Project Improvement Act (CVPIA) applicable to in-watershed CVP Project Supply water transfers among CVP Project Supply water contractors were utilized in developing and executing this transfer project. The City anticipates further CVP Project Supply transfers under the in-basin water transfer provisions of the CVPIA.
Other transfer opportunities may also be available to the City. The City’s ability to develop groundwater may allow it to engage in groundwater substitution transfers where the City delivers its surface water and replaces the amount delivered with groundwater. The City may engage in conservation-based transfers where the City derives benefits from its long-term water conservation efforts that reduce overall per capita demand freeing up unused, yet conserved supplies, for transfer. Last, the City may engage in exchange arrangements with neighboring water purveyors where the City delivers a portion of its surface water asset to a water purveyor so that the water purveyor can deliver its water supplies to a third party. It is likely that these more complex types of water transfers would occur in drier years when water pricing renders a complex transfer more enticing.

The City may also participate in the buyer’s market for water in the future. Purchases of additional water supplies could come in the form of option agreements to provide water under certain hydrological or regulatory conditions. For instance, the City may wish to protect against extreme drought conditions and enter an option contract to purchase water for the months of April, May, September and October in case Term 91 is triggered earlier or longer than expected under certain hydrological conditions. These acquired supplies may serve areas beyond the reach of the City’s NDWA contract.

The City has numerous water transfer opportunities in order to provide supplies to other water users in the state as well as acquire water supplies during certain conditions. These opportunities will be developed in the context of the next planning cycle for the City as growth manifests under the auspices of its General Plan Amendment.

5.6 DESALINATED WATER OPPORTUNITIES

At the present time, the City does not foresee any opportunities for the use of desalinated water, including ocean water, brackish ocean water, and brackish groundwater, as a long-term supply since the City is not located near the coast or a brackish groundwater source.

5.7 RECYCLED WATER OPPORTUNITIES

The City has not developed a recycled water plan at this time. It is anticipated, however, that water recycling planning discussions will take place in the future between the City and the Sacramento Regional County Sanitation District (SRCSD). The SRCSD conveys and treats the City’s wastewater beyond the boundaries of the City’s service area.

5.7.1 Wastewater Collection, Treatment Systems, and Disposal

In 2007, the City’s South River Road wastewater treatment plant (WWTP) was taken offline and all wastewater flows were diverted outside of the City’s service area through the newly constructed Lower Northwest Interceptor (LNWI), a major pipeline with pumping facilities constructed by SRCSD. The City collection system connects to the LNWI pipeline at a transfer facility next to the Parlin Ranch subdivision in Southport, south of Linden Road and
adjacent to the Clarksburg Line Trail. Sewer flows are then conveyed by a gravity line to a pump station just south of the City limits where they are then pumped under the Sacramento River in a force main to the main treatment plant of SRCSD just north of Elk Grove. The City continues to operate and maintain its existing wastewater collection system.

5.7.2 Current and Projected Recycled Water Use

At the present time, no discussions have taken place between the City and SRCSD regarding the future availability and use of recycled water. Therefore, no plans currently exist to equip the City with recycled water infrastructure. As a result, current projected use of recycled water within the City’s service area through 2045 is zero, as a recycled water source does not exist within the City service area at this time. There may be opportunity to use recycled water within the City’s service area depending upon coordination with its regional partners and stakeholders. Although no formal recycled water timeline has been discussed between the City and SRCSD, the City does anticipate this discussion with SRCSD in the future. With the introduction of recycled SRCSD water to the nearby Elk Grove/Laguna area, as well as increased demands for water within the City, recycled water will be an alternative supply that will be considered in the City’s future planning.

5.7.3 Potential Uses of Recycled Water

No infrastructure exists at this time to support recycled water use within the City. If future recycled water planning discussions with SRCSD prove fruitful, however, potential uses of recycled water within the City could include:

- Urban (park and streetscape) landscape irrigation,
- Residential irrigation,
- School landscape irrigation, and,
- Dual-plumbed business/commercial developments.

At the present time, the City has not made any commitment to pursue any of the above recycled water uses. Currently, recycled water use is not economically feasible in this area since new infrastructure would be required and this burden would make recycled water costs prohibitive when compared to other water supplies available.

5.7.4 Encouraging Recycled Water Use

As recycled water planning discussions begin with SRCSD, recycled water projects may be identified and pursued by the City, provided that those projects are feasible and cost-effective, and that they will provide water supply benefits both to the City and to the greater SRCSD service area. If these conditions can be met, methods to encourage recycled water use can be developed to maximize project benefits.
5.7.5 Recycled Water Use Optimization

At the present time, no recycled water use optimization plan has been developed due to the lack of recycled water infrastructure within the City’s service area and that all wastewater is treated outside of the service area by SRCSD.

5.8 SUMMARY

The City of West Sacramento has sufficient water assets to meet its short-term water supply needs. Water Right Permit 18150 and Reclamation Contract 0-07020-W0187 provide sufficient normal year supplies to meet the City’s demands. The City, however, continues to grow and there are indications that climatic conditions may alter the volume of supply and runoff patterns associated with water assets derived from the City’s water rights. In some normal years in the near future, regulatory and hydrological conditions may trigger Permit 18150’s “Term 91” that may require other City water sources be used to meet potential supply deficits. The City’s current supplies are adequate to meet these conditions.

In dry years, the Permit 18150 and CVP Project Supply are subject to reductions. The North Delta Water Agency contract provides a reliable back-up supply when dry conditions occur. Although this supply does not cover all areas within the City and its sphere of influence, the NDWA supply provides a valuable replacement supply in the NDWA service area so that the Permit supply and CVP Project supply can be directed to the northern parts of the City. Accordingly, the City’s water supply in dry years is reliable.

The City’s future water supplies require supplemental actions in order to make them fully protected. As described above, Permit 18150 needs to be legally perfected and transitioned into a “water right license” before this water asset is finally secure. Moreover, the City’s CVP contract must be renegotiated and extended – a normal occurrence for these types of contracts – in order to continue water deliveries beyond 2019 and augment future CVP Project supplies. The City’s NDWA contract supplies remain a reliable back-up supply for dry years into the foreseeable future. Last, the City may develop additional water assets through drilling wells for backup and non-potable water supplies as well as acquiring recycled water supplies derived from the Sacramento Regional County Sanitation District.

In short, the City’s long-term water supply outlook is positive. The City will continue to use its Permit supply, extend and augment its CVP Project supply, and use the NDWA Contract supply as a backup source for dry year reliability. The City’s options to develop and use groundwater and recycled water may also add flexibility to the City’s water management efforts. Altogether, these water assets provide the City with a reliable existing and future water supply portfolio.
Chapter 6

WATER MODEL UPDATE AND CALIBRATION

The chapter describes the development and calibration of the City of West Sacramento’s (City’s) water distribution system hydraulic model. This hydraulic model was used to identify existing and future system deficiencies and to recommend the improvements described in Chapter 7.

6.1 HYDRAULIC MODEL UPDATE

This section summarizes the process used to update the City’s hydraulic computer model of the water distribution system, including a summary of the previous model, modeling software selection, the hydraulic model elements, the model update process, water demand allocation, and the development of a revised diurnal curve.

6.1.1 Previous Hydraulic Model

The City’s previous water distribution system hydraulic model was developed using the H2ONET Water software package, developed by Innovyze (formerly MWH Soft). The last major update to the hydraulic model was performed in 2005 by Carollo as part of the City’s previous Water Master Plan Update. The H2ONET model is considered a "skeletonized" model, meaning that it only included major water mains within the City, and excluded many smaller diameter pipelines (typically 6-inch and smaller water mains).

6.1.2 Selected Hydraulic Modeling Software

In the decade since the previous hydraulic model was originally developed, significant improvements have been made to the hydraulic modeling software available on the market. Most notably, improvements include enhanced graphical user interfaces (GUIs), the availability of add-on tools, and geographic information system (GIS) compatibility. This Master Plan Update provided the City an opportunity to reexamine the software available on the market today and make a decision about continuing the use of H2ONET or converting the model to one of the newer software packages.

Carollo conducted an evaluation of the major water hydraulic modeling software applications on the market today. The results of the evaluation are presented in a technical memorandum, which is provided in Appendix E for reference. This technical memorandum (TM) summarizes the major software vendors, briefly explains software features, compares the advantages and disadvantages of each software program, and provides a software program recommendation for the City.

Based on the results of the evaluation, it was agreed that the City’s hydraulic model would be updated and calibrated using InfoWater, developed by Innovyze. InfoWater is a comprehensive hydraulic and dynamic water quality modeling software application that utilizes the same computational engine as H2ONET (the City’s previous hydraulic model).
InfoWater uses the Environmental Protection Agency’s (EPA) EPANET model simulation engine, which is widely used throughout the world for planning, analysis, and design related to water distribution systems. The advantage of the InfoWater package over the City’s previous hydraulic modeling software (H2ONET) is that it is run directly within the ArcGIS environment, and therefore offers an enhanced GUI and a variety of additional features and functionality not available in the AutoCAD based H2ONET.

### 6.1.3 Previous Hydraulic Model Review

A thorough review of the City's previous H2ONET hydraulic model was performed, as well as a review of the City's most current GIS database of the water distribution system. The purpose of this review was to determine the best approach to develop an updated water system hydraulic model for the City. Two approaches were considered. The first was to import the City's previous hydraulic model into InfoWater directly from H2ONET, and to add additional pipelines from the City's current GIS database to construct an "all-pipe" model for the City. The second approach was to build a new model directly from the City's most current GIS database, and to fill in any data gaps from the H2ONET model.

Based on the review of the City's H2ONET hydraulic model, and the City's current GIS database, it was decided to use the second approach. There were several reasons for the selection of this approach, including:

1. The City's H2ONET hydraulic model was built from older AutoCAD based maps of the water distribution system, which did not "line up" well with the City's current GIS database.

2. By using the City's current GIS database, the City's new hydraulic model will contain the latest available pipeline alignment information.

3. Any pipeline replacement projects that have been implemented in the last decade would be included in the City's current GIS database, and would eliminate the need for manually comparing the old model pipeline data (e.g., diameter, etc.) with the new pipeline data.

Following the model review process, Carollo provided the City with updated system maps, and tables summarizing the major facility data associated with the City's tanks and pump stations. The information obtained from City staff as part of this process was used to confirm that each modeled facility and the modeled system pipelines were represented as accurately as possible in the updated hydraulic model.

### 6.1.4 Modeled Water Distribution System

The City's modeled water distribution system consists of over 189 miles of pipelines up to 54 inches in diameter. As described in Section 2.1.6, a multi-step process was used to develop a comprehensive up-to-date database of the City's existing water distribution system. The City's current GIS database was the main building block for this work, and was
supplemented by additional information where required to fill in data gaps. The hydraulic model was constructed using this up-to-date database, and includes all known water main facilities at the time the updated model was developed. Figure 6.1 shows the modeled water distribution system.

6.1.5 Elements of the Hydraulic Model

The following provides a brief overview of the various elements of the hydraulic model and the required input parameters associated with each:

- **Junctions.** Locations where pipe sizes change, where pipelines intersect, or where water demands are applied are represented by junctions in the hydraulic model. Required inputs for junctions include service elevation and water demands.

- **Pipes.** Water mains are represented as pipes in the hydraulic model. Input parameters for pipes include length, roughness (Hazen Williams C factor), diameter, and whether or not the pipe is a check valve (i.e., does not allow reverse flow).

- **Tanks.**
  - **Cylindrical and Variable Area Tanks:** Water tanks are included in the hydraulic model as either cylindrical tanks or variable area tanks, depending on the complexity of the tank geometry. Required input parameters for cylindrical tanks include bottom elevation, maximum level, initial level, and diameter. Required input parameters for variable area tanks include bottom elevation, maximum level, initial level, and a curve that varies the cross sectional area of the tank depending on the tank level (developed as appropriate based on As-built drawings).
  - **Fixed Head Reservoirs:** For water distribution system modeling, fixed head reservoirs are used to represent a water source with a constant hydraulic grade line (HGL). Typically, fixed head reservoirs are used to represent water sources, such as groundwater or other sources of water (such as the George Kristoff WTP). In the case of the George Kristoff WTP, it was modeled as a fixed head reservoir with a flow control valve and a pressure setting.

- **Pumps.** Pumps are included in the hydraulic model as links. Input parameters for pumps include pump curves and operational controls.

- **Valves.** Certain types of valves, such as altitude valves and pressure reducing valves, are represented explicitly as valves in the hydraulic model. Required input parameters for valves include diameter, operational controls, and other settings or headloss curves depending on the type of valve.

- **Demands.** Water demands are applied at specific junctions in the hydraulic model. Up to ten different demands can be assigned at a particular junction.
6.1.6 Model Update and Expansion

The City's hydraulic model combines information on the physical and operational characteristics of the distribution system, and performs calculations to solve a series of mathematical equations to simulate flows in pipes.

The model update process consisted of nine steps, as described below:

- **Step 1**: The first step involved in the model conversion process was to extract relevant data from the City's existing H2ONET model. This was accomplished by exporting the relevant data from the model as shapefiles using the "Export Manager" that is built into the H2ONET software. In addition, other relevant control/facility data were tabulated from the H2ONET model.

- **Step 2**: The City's updated GIS database files, along with the previous model shapefiles, were combined to create one single, updated database.

- **Step 3**: The distribution system layer shapefiles were then imported into InfoWater using the "GIS Exchange" functionality of InfoWater.

- **Step 4**: The City's storage tanks and pump stations were then imported into the model using the "GIS Exchange" feature, and operational information, such as pump controls and altitude valve settings were input into the model manually based on information provided by the City.

- **Step 5**: Junctions, or areas where two pipelines meet in the model, are required at every pipe intersection and dead end, as well as other areas in the model where demands are applied. Junctions were added into the model using InfoWater's "Append Nodes" feature.

- **Step 6**: Elevations were applied to each modeled junction using the City's ground elevation contour file and the "Elevation Extractor" tool in InfoWater.

- **Step 7**: InfoWater includes several connectivity tools that are used to verify that each pipeline in the model is connected properly. The model flagged questionable pipelines and facilities, which were reviewed and corrected, if necessary.

- **Step 8**: The City's GIS database breaks pipelines at each gate valve location within the system. Because gate valves are not required in the hydraulic model, the modeled pipelines do not need to include individual short reaches of pipe associated with the gate valves. The hydraulic model skeletonizer tool was used to combine these types of multiple connected reaches of pipelines by using common features (i.e., diameter, age, and material). This process reduces model complexity, the number of modeled pipes in the system (thereby reducing model license fees), and minimizes model run times.
• **Step 9**: The hydraulic model contains certain run parameters that need to be set by the user at the beginning of the project. These include run duration, time steps, reporting parameters, output units, and other technical parameters. Once the run parameters were established, the model was debugged to ensure that it ran without errors or warnings.

6.1.7 **Diurnal Pattern Development**

As a part of the calibration process, the City provided 5-minute flow data for the George Kristoff WTP (GKWTP), the Inline Booster Pump Station (BPS), and tank level data. Additionally, the City provided flow and discharge pressure data for the City's remaining booster pump stations, and tank fill rate data, where available. This data was used to establish a daily diurnal demand pattern by balancing the total inflow into the water distribution system and the change in storage. Separate diurnal patterns were developed for the North Area and the Southport Area. These diurnal patterns, which are provided in Section 4.2.1.3, were applied into the hydraulic model for use in 24-hour model simulations.

6.1.8 **Water Demand Allocation**

Allocation of water demands to appropriate nodes in the hydraulic model was accomplished in several steps that included an analysis of Citywide land use distribution and review of historical water production records, water consumption records, and connection information by customer type. For existing demands, water demands were allocated for specific parcels in the system to match the existing water demands summarized in Chapter 4. The resulting water demands matched the 2014 average day demand (ADD) condition. Variations to the ADD, such as maximum day demand (MDD) were also developed by creating separate demand sets to simulate high demand conditions. The diurnal curves presented previously were also input in the hydraulic model to conduct 24-hour extended period simulations. Allocation of future water demands followed a similar procedure as the allocation of existing water demands.

6.2 **HYDRAULIC MODEL CALIBRATION**

This section summarizes overall methodology employed to calibrate the City’s water system hydraulic model, and provides a detailed description of each of the major components of the model calibration process.

6.2.1 **Model Calibration Data Collection**

Carollo coordinated closely with City staff regarding the supervisory control and data acquisition (SCADA) and field data needs that were required to calibrate the updated hydraulic model. The required calibration data included site maps for specific fire flow test locations, pressure logger locations, and included a list of the SCADA data needs, durations, time intervals, and units. This section summarizes the data collection process that was conducted.
6.2.1.1 SCADA Data Gathering

Field testing and data gathering for model calibration took place for three separate time periods:

- **Extended Period Simulation (EPS) Data Gathering Period**: September 10 - 24, 2014
- **Fire Flow Test Data Gathering Period**: December 1 - 7, 2014
- **Second EPS Data Gathering Period**: April 17 - 28, 2015

For each of these time periods, Carollo coordinated with City staff to obtain 5-minute data for all of the major SCADA points within the water distribution system, including reservoir levels, tank fill rate (if available), booster pump station flows, booster pump station discharge pressure, and flow/discharge pressure at the GKWTP. The location of major facilities in the system where SCADA data were available is shown on Figure 6.2. This data was primarily used to generate the diurnal patterns for the North and Southport Areas and for the EPS model calibration, but it was also used to identify boundary conditions for the fire flow calibration. Table 6.1 identifies the SCADA data sources that were provided by the City.

6.2.1.2 Temporary Pressure Logger Installation

In addition to the data obtained from the City’s SCADA system from the major system facilities, Carollo also provided temporary pressure loggers to City staff that were attached to hydrants within the City’s distribution system. The data obtained from the temporary pressure loggers consisted of 5-minute pressure data for the duration of the EPS data gathering periods. Figure 6.2 shows the hydrant locations where the temporary pressure loggers were installed. Pressure loggers used in the September 2014 data gathering period are shown in green, and the additional pressure loggers installed in April 2015 are shown in yellow.

The pressure logger distribution in September 2014 was selected to get a good representation of system pressures throughout the City. For April 2015, the additional pressure loggers were distributed in order to isolate system pressure along the main transmission pipelines that deliver water the west side of the Southport area. The April 2015 data was used to better understand a discrepancy in the Southport area that was encountered during the EPS calibration process. Table 6.2 provides a list of each City hydrant number and the time period each hydrant had a pressure logger installed. Note that in some cases, the same pressure logger was used in April 2015, but was moved to a different hydrant location.
<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Measurement</th>
<th>Unit</th>
<th>Interval</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tanks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge District</td>
<td>level</td>
<td>ft.</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td></td>
<td>altitude valve flow (fill rate)</td>
<td>gpm</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Bridgeway</td>
<td>level</td>
<td>ft.</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td></td>
<td>altitude valve flow (fill rate)</td>
<td>gpm</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Carlin</td>
<td>level</td>
<td>ft.</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Central</td>
<td>level</td>
<td>ft.</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Northeast</td>
<td>level</td>
<td>ft.</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Oak</td>
<td>level</td>
<td>ft.</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>PSIP</td>
<td>level</td>
<td>ft.</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td><strong>Pump Stations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge District</td>
<td>flow</td>
<td>gpm</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td></td>
<td>discharge pressure</td>
<td>psi</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Bridgeway</td>
<td>flow</td>
<td>gpm</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td></td>
<td>discharge pressure</td>
<td>psi</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Carlin</td>
<td>flow</td>
<td>gpm</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td></td>
<td>discharge pressure</td>
<td>psi</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Central</td>
<td>discharge pressure</td>
<td>psi</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Inline</td>
<td>discharge pressure</td>
<td>psi</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Northeast</td>
<td>discharge pressure</td>
<td>psi</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>Oak</td>
<td>discharge pressure</td>
<td>psi</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td>PSIP</td>
<td>discharge pressure</td>
<td>psi</td>
<td>5 min</td>
<td>SCADA</td>
</tr>
<tr>
<td><strong>George Kristoff Water Treatment Plant</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>GKWTP</td>
<td>flow</td>
<td>gpm</td>
<td>5 min</td>
<td>SCADA</td>
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<tr>
<td></td>
<td>discharge pressure</td>
<td>psi</td>
<td>5 min</td>
<td>SCADA</td>
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</table>
### Table 6.2 Temporary Pressure Logger Locations

2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Pressure Logger No.</th>
<th>Hydrant ID</th>
<th>Measurement</th>
<th>Unit</th>
<th>Interval</th>
<th>Time Period of Data</th>
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<tr>
<td>C7</td>
<td>C21-10</td>
<td>pressure</td>
<td>psi</td>
<td>5 min</td>
<td>Sep. 14</td>
</tr>
<tr>
<td>C9</td>
<td>C16-10</td>
<td>pressure</td>
<td>psi</td>
<td>5 min</td>
<td>Apr. 15</td>
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<tr>
<td>C10</td>
<td>B10-06</td>
<td>pressure</td>
<td>psi</td>
<td>5 min</td>
<td>X</td>
</tr>
<tr>
<td>C13</td>
<td>F15-09</td>
<td>pressure</td>
<td>psi</td>
<td>5 min</td>
<td>X</td>
</tr>
<tr>
<td>C17</td>
<td>F22-14</td>
<td>pressure</td>
<td>psi</td>
<td>5 min</td>
<td>X</td>
</tr>
<tr>
<td>C4</td>
<td>D19-08</td>
<td>pressure</td>
<td>psi</td>
<td>5 min</td>
<td>X</td>
</tr>
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<td>C5</td>
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<td>pressure</td>
<td>psi</td>
<td>5 min</td>
<td>X</td>
</tr>
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<td>C18</td>
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<td>psi</td>
<td>5 min</td>
<td>X</td>
</tr>
<tr>
<td>C20</td>
<td>G25-02</td>
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<td>psi</td>
<td>5 min</td>
<td>X</td>
</tr>
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<td>C21</td>
<td>F20-11</td>
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<td>psi</td>
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<td>X</td>
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<td>C22</td>
<td>D21-21</td>
<td>pressure</td>
<td>psi</td>
<td>5 min</td>
<td>X</td>
</tr>
<tr>
<td>C23</td>
<td>E23-17</td>
<td>pressure</td>
<td>psi</td>
<td>5 min</td>
<td>X</td>
</tr>
<tr>
<td>C24</td>
<td>F24-02</td>
<td>pressure</td>
<td>psi</td>
<td>5 min</td>
<td>X</td>
</tr>
</tbody>
</table>

#### 6.2.1.3 Fire Flow Field Testing

Carollo selected 20 fire flow testing sites, which are also shown on Figure 6.2. Fire flow tests were conducted on December 4, 2014 and December 5, 2014 at each of the 20 selected sites. Each of these tests consisted of a fire flow test using one flowing hydrant and two pressure hydrants, and were performed by City staff and observed by Carollo. The testing sites are distributed across the City and were selected based on location, accessibility, and representation of the various portions of the City’s distribution system. Each of the testing sites are shown in detail on an individual detail map (Appendix F).

The test sites were selected such that they create a good geographical coverage of the City’s entire distribution system. The tests were located as far away from transmission lines as possible to increase the chance that a substantial pressure drop (generally greater than 10 pounds per square inch [psi]) is observed during the tests. Additionally, the test sites were selected as to provide as little traffic impact as possible.

Due to ongoing severe drought conditions, it was decided to conduct the fire flow field testing in the month of December when demands were low. Typically, it is desirable to perform these types of tests in the summertime when demands are higher, because the residual pressure drop in the system will be higher than in low demand periods. The data obtained from wintertime tests are still suitable for model calibration, but are not ideal.
6.2.1.4 Follow Up Field Testing

During the EPS model calibration process using the September 2014 data, it was discovered that the hydraulic model was not accurately simulating the tank fill rates in the Bridgeway and Carlin Tanks, when each tank was being filled simultaneously and the Inline BPS was operating. Based on these discrepancies, it was decided to collect additional pressure logger data in April 2015. After a review of the April 2015 pressure logger and SCADA data, Carollo and the City were able to isolate the potential location of a system obstruction or closed valve in the vicinity of Jefferson Boulevard and Linden Road. In order to isolate a more precise location of the discrepancy, City staff and Carollo staff conducted some additional field testing near this intersection. Several hydrant pressure readings were taken north and south of this intersection immediately before and immediately after the Inline BPS turned on. Based on this test, it was confirmed that there was a potential closed valve or some other obstruction at this intersection. Therefore, for the purposes of model calibration, the model assumed a closed valve at this intersection. Subsequent system analyses, however, assumed that the closed valve would be reopened.

The City performed additional reconnaissance of this area in order to attempt to locate the valve issue. City crews were able to locate a dry pipeline near Pheasant Hollow Drive/Linden that was believed to be the cause of the issue. There is a valve in this intersection that was not shown on any City maps. Figure 6.3 provides a detail map of this intersection.

6.2.2 Model Calibration Methodology and Results

The purpose of a water system hydraulic model is to estimate, or predict, how the water distribution system will respond under a given set of conditions. One way to test the accuracy of the hydraulic model is to create a set of known conditions in the water system and then compare the results observed in the field against the results of the hydraulic model simulation using the same conditions. Flow tests conducted in the field on the water system can yield a profound tool in verifying data used in the hydraulic model and a greater understanding of how the water system operates.

Field testing can indicate errors in the data used to develop the hydraulic model, or show that a condition might exist in the field not otherwise known. Valves, which are reported as being open, might actually be closed (or vice versa), an obstruction could exist in a pipeline, or pressure settings for a pressure reducing valve (PRV) may be slightly different than noted. Field testing can also correct erroneous model data such as incorrect pipe diameters or connections.

As discussed in Section 6.2.1.4, the only major discrepancy identified was located in the Southport Area of the system. Subsequent field testing was able to isolate the cause of the discrepancy, and the hydraulic model was run assuming a closed valve near Jefferson Boulevard and Linden Road. A few other very minor differences were noted, and are described in the following sections.
Assumed Location of Closed Valve

Legend

- Modeled Pipelines

DETAIL MAP OF DRY PIPE AT PHEASANT HOLLOW AND LINDEN

FIGURE 6.3

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Data obtained from the field tests can be used to determine appropriate roughness coefficients for each pipeline, as roughness coefficient can vary with age and pipe material. Other parameters can also be adjusted to generate a calibrated model.

The calibration process for the City’s water distribution system hydraulic model consisted of three parts, a macro calibration, a fire flow test calibration, and an EPS calibration.

6.2.2.1 Macro Calibration

Initially, the model was run under existing demand conditions and necessary adjustments were made to produce reasonable system pressures. Such adjustments include modifications of pipeline connectivity, operational controls, ground elevations, and facility characteristics.

The macro calibration process involves several steps to ensure that the model produces reasonable results:

- **Transmission Main Connectivity.** Using the connectivity features of the modeling software, the connectivity of the transmission mains within the distribution system was verified. Problems found using the connectivity locators were reviewed to determine whether adjustments were needed to the connectivity of the model. Output reports of pipe flow characteristics, such as headloss (feet per thousand feet [ft/kft]) and velocity (feet per second [fps]) were also used to locate problem areas where additional adjustments may be necessary.

- **System Pressures.** The macro calibration compared the model output to the typical pressures observed within the distribution system in psi. This process was used to locate major errors in model creation, elevations, or connectivity, as well as changes that reflect how operational controls of the system should be implemented in the model.

- **Facility Characteristics.** Hydraulic model results were compared to data provided by the City to verify that facility attributes entered into the model, such as the physical characteristics of the tanks and pumps, produced results comparable to what the City experiences.

6.2.2.2 Extended Period Simulation Calibration

The extended period calibration is intended to calibrate the EPS capabilities of the hydraulic model by closely matching the model pressures and flows to field conditions over a 24-hour period. The primary varied parameters for this calibration were operational controls and pipeline roughness coefficients, although other parameters were also adjusted as calibration results were generated.

Two separate EPS calibrations were performed, one based on data collected during September 2014, and the other based on data collected during April 2015. The second
EPS calibration was performed to isolate a model discrepancy in the Southport Area, as previously described in Section 6.2.1.4.

For the September 2014 calibration period, Wednesday September 17, 2014 was selected for use as the 24-hour EPS calibration day. September 17, 2014 was chosen because it represented a typical demand day and because there were no unusual flow spikes or dips in the system-wide diurnal for this day.

For the April 2015 calibration period, Wednesday April 22, 2015 was selected for use as the 24-hour EPS calibration day. Similar to the September calibration period, April 22, 2015 was chosen because it represented a typical demand day and because there were no unusual flow spikes or dips in the system-wide diurnal for this day.

The calculated daily demand for the calibration days were estimated to be 3,670 gallons per minute (gpm) and 2,430 gpm for September 17, 2014 and April 22, 2015, respectively. For each EPS calibration model runs, the demands allocated in the hydraulic model were scaled to match these demand estimates.

The EPS calibration compared model simulated pump station flows and discharge pressures, tank levels, and tank fill rates (where available) to the field measured data. In addition, model simulated pressures at the pressure logger locations were compared to the actual field pressures recorded during the calibration day.

A comparison of model results to observed field conditions for the Northeast Tank Level and the Inline Pump Station Discharge Pressure for the September 2014 calibration period is shown on Figure 6.4 and Figure 6.5, respectively. Similar model results for the remaining facilities are presented in Appendix G.

Overall, the trends seen in the field data are well predicted by the model, with the inclusion of the closed valve near Pheasant Hollow and Linden. Some notable items from the EPS model calibration effort include:

- **Pheasant Hollow/Linden Valve**: The model results shown in Appendix G show the model predicted pressures at certain pressure logger locations in Southport without the closed valve (shown with a purple line). As shown, the calibration results track very well with the closed valve.

- **West Sacramento Industrial Park (PSIP) Discharge Pressure (September 2014 EPS Calibration)**: It was noted that the model simulated pressures did not match well with the SCADA data provided for this facility during the September 2014 model calibration. City staff confirmed that the pressure gauge at this location was not reading correctly, and it was replaced prior to April 2015. The model predicted pressures at this location matched well for the April 2015 EPS calibration period.
FIGURE 6.4

EPS CALIBRATION RESULTS - NORTHEAST TANK LEVEL

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FIGURE 6.5

EPS CALIBRATION RESULTS - INLINE
BPS DISCHARGE PRESSURE

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2015 WATER MASTER PLAN UPDATE
6.2.2.3 Fire Flow Test Calibration

The calibration of fire flow tests is intended to closely match model simulated pressures to field pressures under similar high demand and system boundary conditions. The primary varied parameter for this calibration is pipeline roughness coefficient, although other parameters can also be adjusted as calibration results are generated.

Hazen-Williams roughness coefficients, or C-factors, have industry accepted value ranges based on pipeline material, diameter, and age. Characteristics specific to the City water distribution system such as water quality, temperature, construction methodologies, material suppliers, and other factors may result in roughness coefficients that differ from the average of the industry accepted ranges. Fire flow calibration refines the initial estimation of the value of roughness coefficients that best indicate the conditions of the City’s distribution system.

During average day flows, roughness coefficients have a relatively small effect on the operation of the distribution system. However, as the flows increase in the system on higher demand days, velocity within pipelines increase and roughness coefficients contribute more to overall system headloss. Fire flow tests artificially create high demand events to generate more headloss, allowing a better estimation of the pipeline roughness coefficients.

Fire flow tests stress the distribution system by creating a differential between the HGL at the point of hydrant flow and the system HGL at neighboring hydrants. This HGL differential increases the effect of the roughness coefficients on system losses and allows adjustments to the model to match model pressures to field pressures within an acceptable tolerance. As the model is adjusted to match system pressures, roughness coefficients should be adjusted only within a tolerance of industry accepted roughness coefficient ranges. If a model is unable to match the calibration results without leaving the acceptable range of roughness coefficient values for a given pipeline material and age, there may be cause for further investigation of a previously unknown field condition. Examples of such conditions, which typically arise during hydraulic model calibration, include closed valves, partially closed or malfunctioning valves, extreme corrosion within pipelines, connectivity, and diameter errors in GIS layers or record drawings, and diurnal patterns of large water users.

A separate hydraulic model scenario was created for each flow test for both the static and the dynamic, or flowing, condition. The flow observed at each fire flow hydrant was assigned as a demand to the model node at the location of the hydrant. Because the fire flow calibration is a steady state simulation, model demands were adjusted in each fire test scenario to match the time that the tests were conducted. Residual pressures were then read at each hydrant location while the hydrant was flowing. Model results were considered acceptable if they fall within a 10 percent tolerance or a 10-psi value. Table 6.3 shows a summary of the fire test model calibration results.
Table 6.3  Fire Flow Calibration Results  
2015 Water Master Plan Update  
City of West Sacramento

<table>
<thead>
<tr>
<th>Test Site</th>
<th>Test Location</th>
<th>Date/Time</th>
<th>Hydrant Type</th>
<th>Hydrant ID</th>
<th>Hydrant Flow (gpm)</th>
<th>Hydrant Pressure (psi)</th>
<th>Hydrant Pressure (psi)</th>
<th>Field Measured Data</th>
<th>Model Simulated Data</th>
<th>Percent Difference</th>
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<td></td>
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<td></td>
<td></td>
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<td>Flowing</td>
<td>B11-22</td>
<td>914</td>
<td>--</td>
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<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pressure</td>
<td>B11-06</td>
<td>--</td>
<td>61</td>
<td>58</td>
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<td>56.7</td>
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<td>-2.2%</td>
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<td></td>
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<td>B12-02</td>
<td>--</td>
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<td>55</td>
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<td>862</td>
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<td>--</td>
<td>--</td>
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<td>3</td>
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<td>-4.8%</td>
<td>-2.6%</td>
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<td>4</td>
<td>E Street and 7th Street</td>
<td>12/4/2014 8:33 AM</td>
<td>Flowing</td>
<td>B13-18</td>
<td>934</td>
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Notes:
1. Values shown in **Blue Italics** were adjusted down by 4 psi to adjust for apparent gauge error. Value shown in **Red Italics** shows a significant discrepancy between pressure hydrant 1 and pressure hydrant 2. This reading was thrown out for model calibration purposes.
As shown in Table 6.3, the comparison of model results to observed field data are good. There are a few notable items from the fire flow calibration results:

- **Secondary Pressure Hydrant:** On December 4, 2014, the secondary pressure hydrant consistently read about 4 pounds per square inch (psi) higher than the primary pressure hydrant, for both static and residual demand conditions. The elevation difference between hydrants for the West Sacramento tests was minimal. It appears that the secondary pressure hydrant pressure gauge was reading consistently high. Therefore, the field recorded pressures for the secondary hydrants were adjusted down by four psi.

- **Test 7:** For Test 7, the secondary pressure hydrant read a pressure of about 14 psi higher than the primary pressure hydrant. Again, as this area was flat, it is highly unlikely that these recorded pressures are accurate. It is assumed that the gauge readings were recorded incorrectly at this location.

### 6.2.2.4 Calibration Result Summary

In summary, the calibration results indicate the model generally predicts conditions similar to those observed in the field. Within a few isolated areas of the model, there are a few minor discrepancies, but the overall distribution system is very well represented by the model.

Based on the results of the calibration, it can be concluded that the model is calibrated to steady state and extended period conditions. The model provides an accurate representation of the City’s distribution system and system operations to a level suitable to support the City’s future hydraulic modeling endeavors.
Chapter 7

WATER SYSTEM CAPACITY AND OPERATIONAL ANALYSIS

This chapter presents the findings and results of the capacity evaluation and hydraulic modeling analysis for the City of West Sacramento's (City's) existing distribution system under current and future (year 2035) demand conditions, and summarizes the findings of the condition assessment of the City's George Kristoff Water Treatment Plant (GKWTP). Recommendations for improvements that are required to mitigate existing capacity deficiencies, to serve future growth, and to address the findings of the condition assessment are provided herein.

7.1 WATER DISTRIBUTION SYSTEM CAPACITY EVALUATION

This section presents the results of the capacity evaluation of the City's water supply, distribution, and storage facilities. A detailed analysis of the system's technical requirements, cost effectiveness, and reliability, was also conducted. Resulting recommendations for improvements to mitigate existing system deficiencies and serve future users are also provided.

7.1.1 Supply Evaluation

As described in Chapter 2, the City's water distribution system consists of two major areas that can operate as distinct pressure zones (North Area and Southport Area). The GKWTP, which is the City's only source of treated water, pumps to the North Area. The plant has a permitted capacity of 40 million gallons per day (mgd) from November through March and 58 mgd from April through October. The City also operates the Inline Booster Pump Station (BPS) that can boost water from the North Area to the Southport Area as needed (the City typically operates the Inline BPS when filling two tanks simultaneously in Southport to increase system pressures; otherwise, Southport is fed from the North Area directly without a pump station). The Inline BPS has a firm capacity of 15,000 gallons per minute (gpm), or 21.6 mgd.

The supply evaluation compares the existing and future maximum day demand (MDD) to the supply capacity of the GKWTP and the Inline BPS. Demands in excess of the MDD (e.g., peak hour demand and fire flow demands) will be met through storage.

The supply analysis was performed for the two major areas of the City's distribution system (North and Southport) for existing and future demand conditions. Figure 7.1, a simplified schematic representation of the distribution system, shows how water is supplied to the City's customers.
Figure 7.1 West Sacramento Distribution System Schematic

Table 7.1 summarizes the supply evaluation for both existing and future demand conditions. The North Area's existing MDD is 26.4 mgd, and the Southport Area has an existing MDD of 9.4 mgd. Anticipated future conditions show that by 2035, the North Area's MDD will increase to 44.7 mgd and the Southport Area will increase to 16.3 mgd. The GKWTP and the Inline BPS therefore have sufficient capacity to meet existing and future MDD conditions.

<table>
<thead>
<tr>
<th>Area</th>
<th>Supply Capacity (mgd)</th>
<th>MDD (mgd)</th>
<th>Surplus Capacity (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Existing</td>
<td>Future (2035)</td>
</tr>
<tr>
<td>North Area(1)</td>
<td>58.0</td>
<td>26.4</td>
<td>44.7</td>
</tr>
<tr>
<td>Southport Area(2)</td>
<td>21.6</td>
<td>9.4</td>
<td>16.3</td>
</tr>
</tbody>
</table>

Notes:
(1) The supply capacity of the North Area must be sufficient to meet the entire citywide demand because the Southport Area is supplied by the North Area.
(2) The Southport Area is supplied by the North Area primarily through the Inline Booster Pump Station.
7.1.2 Storage Evaluation

The City currently has nine active storage reservoirs with a total volume of 25.1 million gallons (MG), including 8.0 MG of storage in the GKWTP clear wells. According to City staff, the City needs to maintain a minimum volume of approximately 1.5 MG for chlorine contact time. This equates to a total useable storage volume of 23.6 MG, with 17 MG of the storage capacity located in the North Area and the remaining 6.6 MG located in the Southport Area. The purpose of the tanks is to provide the City with operational storage to meet peak hour demands (PHDs), operational equalization storage, fire flow storage, and emergency storage.

Storage capacity criteria are defined and discussed in Chapter 3. Operational equalization storage is defined as 25 percent of the MDD. Emergency storage is defined as 50 percent of the MDD. As the City’s average day demand (ADD) and MDD increases annually, so does the required storage. The required fire flow storage is equal to the largest fire flow demand multiplied by the duration. In the case of West Sacramento, the largest fire flow is equal to 4,000 gpm for a duration of four hours, which is equivalent to 0.96 MG. It was agreed that for reliability purposes, both the North Area and the Southport Area should each have a fire flow storage volume of 0.96 MG.

Required storage volumes through year 2035 based on these assumptions are presented in Table 7.2 and Table 7.3. As shown, there is a current storage surplus of 1.9 MG citywide, although the Southport Area shows a deficiency of 1.4 MG under existing conditions. For 2035 demand conditions, a total of 11.8 MG of storage will be required for the system.

<table>
<thead>
<tr>
<th>Area</th>
<th>Existing MDD (mgd)</th>
<th>Available Storage (MG)</th>
<th>Required Storage (MG)</th>
<th>Surplus (Deficit)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Operational(1) Fire(2) Emergency(3) Total</td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>16.99</td>
<td>17.0</td>
<td>4.25</td>
<td>0.96</td>
</tr>
<tr>
<td>Southport Area</td>
<td>9.44</td>
<td>6.6</td>
<td>2.36</td>
<td>0.96</td>
</tr>
<tr>
<td>Citywide</td>
<td>26.43</td>
<td>23.6</td>
<td>6.61</td>
<td>1.92</td>
</tr>
</tbody>
</table>

Notes:
(1) Operational = 25 percent of MDD.
(2) Fire = 4,000 gpm for 4 hours.
(3) Emergency = 50 percent of MDD.
Table 7.3  
2015 Water Master Plan Update 
City of West Sacramento 

<table>
<thead>
<tr>
<th>Area</th>
<th>2035 MDD (mgd)</th>
<th>Available Storage (MG)</th>
<th>Required Storage (MG)</th>
<th>Surplus (Deficit)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2035</td>
<td>Operational (1)</td>
<td>Fire (2)</td>
</tr>
<tr>
<td>North Area</td>
<td>28.31</td>
<td>17.0</td>
<td>7.08</td>
<td>0.96</td>
</tr>
<tr>
<td>Southport Area</td>
<td>16.34</td>
<td>6.6</td>
<td>4.09</td>
<td>0.96</td>
</tr>
<tr>
<td>Citywide</td>
<td>44.66</td>
<td>23.6</td>
<td>11.17</td>
<td>1.92</td>
</tr>
</tbody>
</table>

Notes: 
(1) Operational = 25 percent of MDD. 
(2) Fire = 4,000 gpm for 4 hours. 
(3) Emergency = 50 percent of MDD.

7.1.3 System Pressure Analysis

In accordance with the criteria summarized in Chapter 3, system pressure analyses were performed using the hydraulic model for ADD, MDD, and PHD conditions. This section summarizes the results of the analysis for existing and future demand conditions.

For the ADD and PHD demand conditions, the hydraulic model was used to identify service nodes within the distribution system with pressures that violate the established pressure criteria (per Section 3.2.3). For the ADD condition, the City would like to maintain a pressure of 50 pounds per square inch (psi) in the system. Under PHD conditions, the City's minimum pressure criterion is 35 psi.

7.1.3.1 Existing System

Under existing ADD conditions, there are a few areas of the system that are located at higher elevations, resulting in pressures that are slightly below the desired minimum pressure criterion of 50 psi. These types of conditions are typical of water distribution systems and are shown in yellow and orange on Figure 7.2. The lowest pressure in these areas is only slightly less than 50 psi, and this condition occurs during tank fill cycles. Under normal supply conditions (i.e., pumps operating), system pressures in most areas exceed 50 psi, and generally are maintained in the upper 50 to low 60 psi range. The far eastern edge of the Bridge District and Washington District have some areas of lower pressures that are due to the higher elevations in these areas. Modifications to the tank fill rates (i.e., adjusting altitude valves to maintain a slightly higher pressure during fill cycles) and/or adjustments to the GKWTP discharge pressure, however, could help to improve system pressures in most of the areas shown in orange on Figure 7.2.
An option to increase system pressures for the highest areas in the eastern portion of the North Area during an ADD condition is to add a small boosted zone near the river. However, this would increase system complexity and would likely require the construction of additional transmission mains as well as a booster pump station for the area.

Under PHD conditions, the model did not identify any locations where system pressures were below 35 psi. Pressure in the lowest pressure areas generally ranged from 40 to 45 psi, as shown on Figure 7.3, and in most areas, the lowest system pressure during PHD conditions do not fall below 45 psi.

**7.1.3.2 Future (2035) System**

The model was run to identify the locations of nodes with system pressures that would fall below 50 psi (the City's targeted minimum pressure) under future ADD conditions. Based on input from City staff, the future system analysis was performed assuming that the GKWTP discharge pressure could be increased in an effort to minimize the number of nodes below 50 psi. It was assumed that the GKWTP would discharge at a pressure of 65 psi for the future system evaluation. Figure 7.4 shows the minimum pressures in the system during the future ADD condition. As shown on Figure 7.4, the number of nodes with system pressures below 50 psi are reduced with the increased discharge pressure out of the GKWTP, however, there are still a few areas that do fall below the target pressure.

Under future PHD conditions, the model did not identify any locations where system pressures would fall below the City's target minimum pressure of 35 psi. In most areas, the lowest system pressure during PHD conditions does not fall below 45 psi. Figure 7.5 shows the projected future PHD minimum pressures.

**7.1.4 Fire Flow Analysis**

The hydraulic model performs a steady state simulation at each node and reports the residual pressure at the node to evaluate impacts of fire flow demands on the system. Nodes with less than 20 psi of residual pressure were considered deficient.

Fire flow demands were simulated at all nodes within the existing system. Specific nodes were excluded where appropriate if a fire hydrant was not located near the model node (such as dead end pipes without fire hydrants). Fire flow demands were not simulated at tank sites.

**7.1.4.1 Existing System**

The existing system fire flow simulations were performed using the hydraulic model fire flow simulator. This simplifies the model by eliminating the requirement for assigning individual fire flow demands to all nodes. Initially, 109 of the 2,687 fire flow nodes were identified as deficient due to residual pressures of less than 20 psi.
For deficient nodes where fire flow demands exceeded 2,000 gpm, or where there were multiple fire hydrants in close proximity serving a single site, the fire flow demands were distributed between the two hydrants. This approach is realistic because hydrants typically are not capable of supplying more than 2,000 gpm, and firefighting of large fires typically takes place using multiple hydrants.

The fire flow analysis was repeated using multiple hydrants to verify if the identified deficiencies described above remained or were resolved. Distributing the fire flow over two adjacent nodes typically results in a higher residual pressure compared with the use of one node, which would assume that the entire fire flow demand for a site would be supplied through one hydrant. Using this approach, 7 of the 109 fire flow deficiencies were resolved.

After this more detailed analysis, 102 fire flow nodes remained deficient. These deficient nodes are depicted in red on Figure 7.6. In general, the fire flow deficiencies are located in the older portions of the City. The water mains in these areas are small diameter pipelines that weren't originally designed to meet the current fire flow criteria used for this Master Plan. Individual improvements to address these deficiencies are presented in later sections of this chapter. Fourteen of the remaining fire flow deficiencies are near the planned Liberty Development, and are located on backyard mains that the City plans to remove/abandon. Once the new mains are constructed, these fire flow deficiencies will be resolved.

7.1.4.2 Future (2035) System

For future conditions, a fire flow simulation was performed in a similar manner as the existing system model simulations. After the proposed existing fire flow improvements have been made, no additional fire flow deficiencies that could not be addressed by distributing large fire flow demands amongst two nodes were observed in the future system model runs.

7.1.5 Pipeline Analysis

A pipeline velocity analysis was performed to identify pipelines within the distribution system with velocities or headlosses that do not conform to the criteria provided in Chapter 3. This section summarizes the results of that analysis.

7.1.5.1 Existing System

No pipelines that exceeded the pipeline velocity and headloss criteria under existing conditions were identified.

7.1.5.2 Future (2035) System

The model predicted that, under future conditions, there are a few locations within the City where additional transmission mains will be required due to hydraulic limitations (i.e., high velocities/headlosses) resulting from increased capacity requirements. Proposed transmission improvements are described in Section 7.1.6.
Carlin Tank and Pump Station

Central Tank and Pump Station

PSIP Tank and Pump Station

Bridgeway Tank and Pump Station

Oak Street Tank and Pump Station

High Service Pump Station

Bridge District Tank and Pump Station

Northeast Tank and Pump Station

George Kristoff Water Treatment Plant

City to replace backyard mains in this area

Legend
- Existing Fire Flow Deficiency
- Fire Flows Split between two nodes - no deficiency
- Water Features
- Parcels
- Southport Area
- North Area

FIGURE 7.6
EXISTING FIRE FLOW DEFICIENCIES
CITY OF WEST SACRAMENTO
2015 WATER MASTER PLAN UPDATE
7.1.6 Proposed Distribution System Capacity Improvements

Figure 7.7 provides an illustration of the recommended improvements that will mitigate capacity deficiencies in the existing water system, as well as planned improvements to serve future development. Each project will need further site-specific or project-level engineering analysis and proposed solutions to be consistent with the overall infrastructure approach in this Master Plan.

7.1.6.1 Storage Improvements

As discussed in Section 7.1.2, the City will need to add an additional 11.8 MG of storage to meet projected 2035 demand requirements. A total of five new tanks and replacement of one existing tank are recommended based on analysis conducted for this Master Plan. Similar to the City’s current storage tanks, each tank will be located at ground level, and will include a booster pump station to pump out of the tank and an altitude valve to fill the tank. The locations of the proposed tanks were identified based on input from City staff. A more detailed tank siting analysis should be performed during preliminary design of each tank and booster pump station.

Below is a summary of the location and purpose of each of the proposed tanks for additional capacity within the system. The life expectancy of a tank varies, so the City should continue to monitor and inspect the condition of existing tanks on a regular basis to evaluate if a tank needs to be replaced or rehabilitated.

- **The Rivers Tank/PS (Project T-01):** It is recommended that a new, 1.9 MG tank be constructed near the intersection of Lighthouse and Fountain Drive in the northeast portion of the City to accommodate future growth. The City is requiring that this tank be constructed as part of the second phase of the proposed Rivers development in the Lighthouse neighborhood.

- **Bridgeway Lakes 2 Tank/PS (Project T-02):** The City currently has space and plumbing at the existing Bridgeway Lakes Tank site for a second tank. The City has stated that a 3.0 MG tank, which would mitigate the existing storage deficit and serve future growth within the Southport Area, could be constructed at this site.

- **New Port of Sacramento Industrial Park (PSIP) Tank/PS (Project T-03):** The City has reported that the existing 1.5 MG PSIP tank is in poor condition and is in need of complete replacement. The two most feasible locations for this new tank are the existing tank site or a vacant site near the Granada Inn. For the purposes of this Master Plan, it was assumed that the Granada Inn location will be selected, because the existing tank site is located on a site that is desirable for industrial development. A more detailed site analysis should be conducted during preliminary design of this tank. It is recommended that the replacement tank volume be increased to 2.3 MG to replace the existing tank volume and meet future infill demands in the North Area.
• **Liberty Tank/PS (Project T-04):** It is recommended that a new 2.1 MG tank be constructed near the proposed Liberty development area. This project is required to accommodate future growth in the eastern portion of the Southport Area.

• **Pioneer Bluff Tank/PS (Project T-05):** It is recommended that a new 2.5 MG tank be constructed near Drever Street and Soule Street. This project is required to accommodate future growth in the Pioneer Bluff neighborhood in the North Area.

• **Southeast Tank/PS (Project T-06):** It is recommended that a new 1.5 MG tank be constructed near Davis Street adjacent to the River in the Southport Area. This project is required to accommodate future growth southeast portion of the Southport Area.

7.1.6.2 **Fire Flow Improvements**

As discussed previously, under existing conditions, the model identified 102 fire flow nodes with deficient (less than 20 psi) residual pressures. To mitigate these deficiencies, recommendations for pipeline improvements were developed. These improvements generally consist of replacement of smaller diameter (≤ 6 inches) pipelines with a larger (8 to 12 inch) diameter pipelines. It is recommended that these replacement projects be incorporated into the City’s annual pipeline replacement program, and be assigned a higher priority than pipelines that are not capacity deficient. In total, approximately 35,700 linear feet (6.8 miles) of fire flow improvements are recommended. Figure 7.7 shows the locations of the proposed fire flow improvements, and Table 7.4 provides additional detail related to each improvement.

7.1.6.3 **Transmission/Backbone Main Improvements**

It is recommended that new transmission main and backbone system improvements be implemented in order to develop transmission looping in new growth areas and avoid dead ends. The transmission looping will also facilitate the efficient movement of water to new growth areas and major facilities through the existing water distribution system, and will provide additional transmission capacity from the North Area to the Southport Area. The recommended transmission main improvements are described below:

• **Project TM-1A/1B (Parallel PSIP Pipeline):** The City is considering the construction of a new transmission main that crosses the Deepwater Ship Channel in the Southport Industrial Park (SIP) from the PSIP (see Project TM-2 below). In order to efficiently move water to this new transmission main, and to improve the ability to move water to the PSIP tank sites in the future, it is recommended that a new parallel 12-inch diameter pipeline be constructed on West Capitol Avenue and Enterprise Boulevard from Interstate 80 to Channel Drive. The total length of this pipeline is approximately 10,400 linear feet. TM-1A will be constructed first, from Northport Drive to the pump station on Enterprise (approximately 6,000 linear feet). TM-1B will be constructed later, from the pump station on Enterprise to Channel Drive (approximately 4,400 linear feet).
<table>
<thead>
<tr>
<th>Improv. ID</th>
<th>Location</th>
<th>Extent</th>
<th>Diam. (inches)</th>
<th>Length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FF-1</td>
<td>Lisbon Ave.</td>
<td>Water St. to N. Hobson Ave.</td>
<td>12</td>
<td>600</td>
</tr>
<tr>
<td>FF-2</td>
<td>May St./Myrtle Ave.</td>
<td>Bryte Ave. to Todhunter Ave.</td>
<td>8</td>
<td>1,700</td>
</tr>
<tr>
<td>FF-3</td>
<td>Anna St.</td>
<td>Bryte Ave. to Todhunter Ave.</td>
<td>10</td>
<td>1,300</td>
</tr>
<tr>
<td>FF-4</td>
<td>Todhunter Ave.</td>
<td>Anna St. to Hobson Ave.</td>
<td>12</td>
<td>1,200</td>
</tr>
<tr>
<td>FF-5</td>
<td>Dobros Dr.</td>
<td>Bryte Ave. to End of Dobros</td>
<td>8</td>
<td>500</td>
</tr>
<tr>
<td>FF-6</td>
<td>Simonter St.</td>
<td>Sacramento Ave.</td>
<td>10</td>
<td>700</td>
</tr>
<tr>
<td>FF-7</td>
<td>Freemont Blvd.</td>
<td>Hobson Ave. to Kegle Dr.</td>
<td>10</td>
<td>1,100</td>
</tr>
<tr>
<td>FF-8</td>
<td>Woodhaven Pl.</td>
<td>Fountain Dr. to Wedgewood Ct.</td>
<td>10</td>
<td>800</td>
</tr>
<tr>
<td>FF-9</td>
<td>Cummins Way/6th St.</td>
<td>8th St. to Welland Way</td>
<td>8</td>
<td>1,200</td>
</tr>
<tr>
<td>FF-10</td>
<td>B St.</td>
<td>4th St. to 2nd St.</td>
<td>8</td>
<td>900</td>
</tr>
<tr>
<td>FF-11</td>
<td>Harriet Ln.</td>
<td>D St. to North of D St.</td>
<td>10</td>
<td>400</td>
</tr>
<tr>
<td>FF-12</td>
<td>E St.</td>
<td>West St. to 7th St.</td>
<td>10</td>
<td>1,900</td>
</tr>
<tr>
<td>FF-13</td>
<td>Oak St/Sacramento Ave.</td>
<td>Sacramento to North of RR</td>
<td>8</td>
<td>1,900</td>
</tr>
<tr>
<td>FF-14</td>
<td>Sutter St.</td>
<td>West Capitol to First St.</td>
<td>8</td>
<td>1,500</td>
</tr>
<tr>
<td>FF-15</td>
<td>Duluth St./Galveston St.</td>
<td>Harbor Blvd. to Canal St.</td>
<td>10</td>
<td>2,100</td>
</tr>
<tr>
<td>FF-16</td>
<td>Houston St.</td>
<td>West Capitol to Canal St.</td>
<td>12</td>
<td>1,400</td>
</tr>
<tr>
<td>FF-17</td>
<td>Glide Ave.</td>
<td>West Capitol to Rice Ave.</td>
<td>10</td>
<td>2,500</td>
</tr>
<tr>
<td>FF-18</td>
<td>Pecan St.</td>
<td>Holly St. to Michigan Blvd.</td>
<td>8</td>
<td>1,300</td>
</tr>
<tr>
<td>FF-19</td>
<td>Manzanita Way</td>
<td>North of Portsmouth Ave.</td>
<td>10</td>
<td>800</td>
</tr>
<tr>
<td>FF-20</td>
<td>Halyard Dr.</td>
<td>Beacon Blvd. to Harbor Blvd.</td>
<td>10</td>
<td>800</td>
</tr>
<tr>
<td>FF-21</td>
<td>Port St.</td>
<td>Shore St. to Terminal St.</td>
<td>10</td>
<td>1,300</td>
</tr>
<tr>
<td>FF-22</td>
<td>Harbor Blvd./Del Monte St.</td>
<td>Shore St. to Industrial Blvd.</td>
<td>10</td>
<td>1,300</td>
</tr>
<tr>
<td>FF-23</td>
<td>Deerwood St.</td>
<td>Grande Vista Ave. to 19th St.</td>
<td>8</td>
<td>1,700</td>
</tr>
<tr>
<td>FF-24</td>
<td>Bonita Ct.</td>
<td>Fernwood St. to End of Bonita</td>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>FF-25</td>
<td>Maryland Ave.</td>
<td>17th St. to 15th St.</td>
<td>8</td>
<td>1,500</td>
</tr>
<tr>
<td>FF-26</td>
<td>Delaware Ave.</td>
<td>11th St. to 15th St.</td>
<td>8</td>
<td>1,300</td>
</tr>
<tr>
<td>FF-27</td>
<td>Sharon Ct.</td>
<td>Betty Way to End of Sharon</td>
<td>8</td>
<td>600</td>
</tr>
<tr>
<td>FF-28</td>
<td>Angel Ct.</td>
<td>Betty Way to End of Angel</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>FF-29</td>
<td>Teal Dr./Mandarin C t.</td>
<td>Summerfield Dr.</td>
<td>8</td>
<td>500</td>
</tr>
<tr>
<td>FF-30</td>
<td>Crystal Ct.</td>
<td>Lagoon Ln. to End of Crystal</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>FF-31</td>
<td>Sageflower Pl./Bridge Pl.</td>
<td>In Apartment Complex</td>
<td>10</td>
<td>2,600</td>
</tr>
<tr>
<td>FF-32</td>
<td>Bridge Pl.</td>
<td>In Apartment Complex</td>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>FF-33</td>
<td>Redond Rd.</td>
<td>East of Stonegate Dr.</td>
<td>8</td>
<td>100</td>
</tr>
<tr>
<td>FF-34</td>
<td>Drever St.</td>
<td>At Jefferson Blvd.</td>
<td>8</td>
<td>100</td>
</tr>
</tbody>
</table>
• **Project TM-2 (Deepwater Ship Channel Crossing at PSIP/SIP):** In order to improve reliability to the Southport Area of the system, the City is planning to install two new pipelines that cross the Deepwater Ship Channel. One would be located at the new South River Road Bridge (see Project TM-7 below) and the other will be located at a future bridge site that will connect PSIP to SIP. It is recommended that a 3,500-linear foot, 16-inch diameter pipeline be constructed. In order to prevent backflow from the Southport Area to the North Area when the Inline BPS operates, it was assumed that a new check valve would be installed at the crossing site. Alternatively, a pressure reducing valve (PRV) or a modulating gate valve configured to close when the Inline BPS is operating could be used.

• **Project TM-3 (West Capitol Transmission Main):** The future system analysis showed high velocities (in excess of 10 feet per second) during PHD conditions in an existing main along West Capitol Boulevard. In order to mitigate this condition, a new 3,200-linear foot, 16-inch diameter transmission main is recommended along West Capitol from Jefferson Boulevard to Delta Lane.

• **Projects TM-4 through TM-6 (Pioneer Bluff Transmission Mains):** These transmission mains are recommended to provide water to the Pioneer Bluff redevelopment area, to the proposed Pioneer Bluff tank site, and to the second new Deepwater Ship Channel crossing at the new South River Road Bridge. A total of 7,500 linear feet of pipeline is recommended, with pipeline diameters ranging from 12 to 20 inches.

• **Project TM-7 (Deepwater Ship Channel Crossing at the South River Road Bridge):** The City is currently in the process of constructing the new South River Road Bridge, and has installed a 15-inch diameter pipeline attached to the bridge. This proposed transmission main would connect the North Area to the Southport Area and tie into the pipeline that has been installed on the bridge. A new 16-inch diameter transmission main (4,600 linear feet) is recommended, as well as a new check valve to prevent reverse flow from the Southport Area to the North Area.

• **Project TM-8 (Village Parkway Extension):** This short (1,100-linear foot) reach of 16-inch diameter transmission main is currently under construction. This project will complete a loop from the existing 16-inch diameter main on Village Parkway to the planned 16-inch diameter main that will be installed as part of the planned Liberty Development.

• **Project TM-9 (Jefferson Boulevard Transmission to Bridgeway Tanks):** Upon construction of the second tank at the Bridgeway Lakes tank site, additional transmission capacity will be needed to transfer water from the North Area to the tank site. For this reason, it is recommended that the existing 24-inch diameter transmission main on Jefferson Boulevard be extended to the tank site. This would require approximately 10,200 linear feet of pipeline. Construction of this pipeline should be timed to coincide with the construction of the second Bridgeway Tank, unless further evaluation can justify delaying this project.
• Projects TM-10 through TM-12 (Southeast Transmission Mains): These transmission mains are recommended to provide a backbone network for future growth in the Southeast area of Southport, and to transfer water from the Jefferson Boulevard transmission main to the proposed Southeast Tank. A total of 14,800 linear feet of 16-inch and 20-inch diameter transmission main would be required for these projects.

7.1.6.4 Developer Planned Improvements

The City provided detailed utility plan information for two planned developments in the City - the Rivers development in the North Area, and the Liberty development in the Southport Area. These pipelines were included in the hydraulic model and sized to meet future conditions in conformance with guidelines described in Chapter 3. However, since the developers will be responsible for installing these facilities, they will not be included in the water distribution system capital improvement program (CIP). The developer planned improvement projects are shown on Figure 7.7.

7.2 WATER TREATMENT PLANT EVALUATION

The GKWTP evaluation was designed to identify, at a high level, improvements needed to maintain plant production capacity and reliability as the plant ages. The existing GKWTP facilities can reliably produce up to 45 mgd. Some improvements to the intake and other unit processes are required to meet the maximum permitted 58 mgd production capacity. The improvements identified to maintain reliable production are included in Chapter 8 (Capital Improvement Program).

Visual condition assessments were performed for the above-ground assets to establish remaining useful life values for each asset. The evaluation focused on major plant components in need of repair or replacement to maintain plant capacity and reliability. The evaluation did not include a detailed analysis or testing of plant components or structures, or performance evaluations of the plant's treatment processes.

This section summarizes the assessment process and the results of this evaluation. Additional details can be found in the Water Treatment Plant Visual Condition Assessment Technical Memorandum, which is included in Appendix H.

7.2.1 Background

The GKWTP was constructed in 1987 to treat flow diverted from the Sacramento River to drinking water standards, and pump the treated water into the existing water distribution system. The plant's treatment processes consist of chemical coagulation, Actiflo® high rate clarification, dual media filtration with granular activated carbon (GAC) and sand, and chlorine disinfection.
7.2.2 Assessment Approach

The evaluation approach was based on the methodologies of Asset Management (AM), the International Infrastructure Management Manual (IIMM), and input from City staff relating to operational and maintenance issues for the various plant systems and components.

Prior to the visual condition assessment, an asset inventory of the aboveground assets was prepared from as-built drawings and an export from the City’s maintenance management system. The list of assets was organized by plant process and, where possible, attributes were populated for sizing criteria, age, capacity, and other important information.

The visual condition assessment was conducted on January 29, 2015 by a multi-disciplinary engineering team that included senior discipline engineers with electrical/instrumentation and process expertise. During the assessment, the condition of each asset was evaluated on a one-through-five ranking scale, based on the IIMM. The IIMM expresses condition in terms of the amount of repair needed to bring an asset to “like new” condition. The assessments were based on visual observations, inquiries into maintenance and performance history, design criteria, installation date, and typical condition parameters that were specific to each asset. Table 7.5 defined the condition scores assigned during the assessment.

<table>
<thead>
<tr>
<th>Score</th>
<th>Description(1)</th>
<th>Required Repair Percentage(1)(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excellent</td>
<td>0%</td>
</tr>
<tr>
<td>2</td>
<td>Good</td>
<td>1-10%</td>
</tr>
<tr>
<td>3</td>
<td>Fair</td>
<td>11-20%</td>
</tr>
<tr>
<td>4</td>
<td>Poor</td>
<td>21-50%</td>
</tr>
<tr>
<td>5</td>
<td>Very Poor</td>
<td>&gt;50%</td>
</tr>
</tbody>
</table>

Notes:
(1) Adapted from the International Infrastructure Management Manual.
(2) Percentage of asset requiring repair: The percentage of the asset value needed to return the asset to a condition ranking of one.

Following the visual condition assessment, each asset's remaining useful life was calculated based the condition scores and information collected in the field. The remaining useful life for each asset is based on the current condition and is an estimate of the remaining number of years until the end of the physical life of the asset. Rather than relying only on the age of the asset, an estimate of remaining useful life is based on the observed condition.

Useful life estimates for each asset category were estimated based on meetings with City staff, industry standard guidelines (e.g., American Water Work Association (AWWA), American Society of Civil Engineers (ASCE), and the IIMM), and Carollo’s discipline-
specific experience. Table 7.6 identifies the useful life of each asset category assessed during the evaluation.

Table 7.6 Useful Life Based on Asset Category
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Asset Category</th>
<th>Original Useful Life(^{(1)})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil/Sitework</td>
<td>50</td>
</tr>
<tr>
<td>Structural</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>50</td>
</tr>
<tr>
<td>Concrete</td>
<td>50</td>
</tr>
<tr>
<td>Fiberglass</td>
<td>25</td>
</tr>
<tr>
<td>Steel</td>
<td>25</td>
</tr>
<tr>
<td>Plastic</td>
<td>10</td>
</tr>
<tr>
<td>Mechanical</td>
<td></td>
</tr>
<tr>
<td>General/Other</td>
<td>20</td>
</tr>
<tr>
<td>Valves</td>
<td>35</td>
</tr>
<tr>
<td>Pumps – Water</td>
<td>20</td>
</tr>
<tr>
<td>Pumps – Wastewater</td>
<td>15</td>
</tr>
<tr>
<td>Chemical Equipment</td>
<td>15</td>
</tr>
<tr>
<td>Coolers/ACs/Fans</td>
<td>15</td>
</tr>
<tr>
<td>Electrical</td>
<td></td>
</tr>
<tr>
<td>Instrumentation</td>
<td>30</td>
</tr>
</tbody>
</table>

Notes:
\(^{(1)}\) These values are based on the International Infrastructure Management Manual, Edition 2006, USEPA guides, other industry references, and Carollo project experience.

Using the condition score, the remaining useful life is calculated using a percentage of the asset's initial useful life estimate. This percentage is shown in Table 7.7.

Table 7.7 Remaining Useful Life Calculation
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Condition Score(^{(1)})</th>
<th>% of Useful Life Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>90%</td>
</tr>
<tr>
<td>3</td>
<td>80%</td>
</tr>
<tr>
<td>4</td>
<td>60%</td>
</tr>
<tr>
<td>5</td>
<td>10%</td>
</tr>
</tbody>
</table>

Notes:
\(^{(1)}\) As defined in Table 7.5.
The relationship between condition score and percentage of remaining life reflects the logic that once an asset deteriorates to a below-average condition, its probability of failure increases and its remaining years in service decline more rapidly than for assets that are maintained in above-average condition. Based on the condition assessment and original useful life of the assets, the remaining useful life for each asset in the inventory was estimated using this methodology.

### 7.2.3 Assessment Results

The GKWTP evaluation included the visual inspection of 188 GKWTP assets in 15 areas of the plant. Table 7.8 identifies the inspected areas of the plant and the number of assets in each area.

<table>
<thead>
<tr>
<th>Process Area</th>
<th>Structural</th>
<th>Mechanical</th>
<th>Electrical and Instrumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake Facilities and Pump Station</td>
<td>5</td>
<td>23</td>
<td>-</td>
</tr>
<tr>
<td>Raw Water Manifold and Reclaimed Water Pumping</td>
<td>-</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Actiflo® Clarification No. 1 and 2</td>
<td>7</td>
<td>26</td>
<td>20</td>
</tr>
<tr>
<td>Recycled Water Basins No. 1 and No. 2</td>
<td>-</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Filtration</td>
<td>4</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Process Drain Pump Station</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Residuals Handling</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Operations Building</td>
<td>1</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Chemical Feed and Storage</td>
<td>6</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Low Lift Pump Station</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Lab Mechanical Building</td>
<td>1</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Clearwell Storage</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>High Service Pumps</td>
<td>1</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>Backwash Pump Station</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Drain Water and Instrument Pump Station</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>32</strong></td>
<td><strong>96</strong></td>
<td><strong>60</strong></td>
</tr>
</tbody>
</table>

**Notes:**
(1) Only components meeting the definition of an asset are included in the inventory.
Each plant area was assessed for adequate reliability, redundancy, and adequate capacity. The assessment found all areas of the plant to be adequate in these areas except:

- Intake Pumping Station, Intake Valve Vault, and Raw Water Electrical Building have inadequate capacity at build out (current capacity is adequate).
- Actiflo® Mixing Vaults Nos. 1 and 2, and Actiflo® Basins Nos. 1 and 2 have inadequate reliability/redundancy.
- Recycled Water Basins No. 1 and 2 have inadequate reliability/redundancy.

Each asset in the inventory was assessed during the inspection and given a condition score based on a 1 to 5 scale. The results are shown in Table 7.9. The table also shows the number of assets that received each condition score in each process area.

<table>
<thead>
<tr>
<th>Process Area</th>
<th>Number of Assets by Condition Score(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Intake Facilities and Pump Station</td>
<td>3</td>
</tr>
<tr>
<td>Raw Water Manifold and Reclaimed Water Pumping</td>
<td>-</td>
</tr>
<tr>
<td>Actiflo® Clarification No. 1 and 2</td>
<td>4</td>
</tr>
<tr>
<td>Recycled Water Basins No. 1 and No. 2</td>
<td>-</td>
</tr>
<tr>
<td>Filtration</td>
<td>1</td>
</tr>
<tr>
<td>Process Drain Pump Station</td>
<td>-</td>
</tr>
<tr>
<td>Residuals Handling</td>
<td>-</td>
</tr>
<tr>
<td>Operations Building</td>
<td>2</td>
</tr>
<tr>
<td>Chemical Feed and Storage</td>
<td>1</td>
</tr>
<tr>
<td>Low Lift Pump Station</td>
<td>1</td>
</tr>
<tr>
<td>Lab Mechanical Building</td>
<td>-</td>
</tr>
<tr>
<td>Clearwell Storage</td>
<td>2</td>
</tr>
<tr>
<td>High Service Pumps</td>
<td>2</td>
</tr>
<tr>
<td>Backwash Pump Station</td>
<td>-</td>
</tr>
<tr>
<td>Drain Water and Instrument Pump Station</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17</td>
</tr>
</tbody>
</table>

Notes:
(1) Condition scores are based on 1 to 5 scale per Table 7.2.
Overall, 12 assets from eight process areas received a condition score of 5. These 12 assets represent over 6 percent of the number of assets in the inventory. The majority of assets received a condition score of 2 or 3. Table 7.10 identifies the installation year and remaining useful life of these 12 assets.

<table>
<thead>
<tr>
<th>Process Area Asset Description</th>
<th>Assessment Comments</th>
<th>Install Year</th>
<th>Useful Life</th>
<th>Remaining Useful Life(1)</th>
<th>Cost(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake Facilities and Pump Station</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake Knife Gate Valve 1</td>
<td>Non-operational valve operator</td>
<td>2004</td>
<td>20</td>
<td>2</td>
<td>$20,000</td>
</tr>
<tr>
<td>Intake Knife Gate Valve 2</td>
<td>Non-operational valve operator</td>
<td>2004</td>
<td>20</td>
<td>2</td>
<td>$20,000</td>
</tr>
<tr>
<td>Intake Knife Gate Valve 3</td>
<td>Non-operational valve operator</td>
<td>2004</td>
<td>20</td>
<td>2</td>
<td>$20,000</td>
</tr>
<tr>
<td>Raw Water Manifold and Reclaimed Water Pumping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonic Conditioner SWGR-A</td>
<td>Not working</td>
<td>2004</td>
<td>30</td>
<td>3</td>
<td>$32,000</td>
</tr>
<tr>
<td>Actiflo® Clarification No. 1 and 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonic Conditioner MCC-ACT-1</td>
<td>Not working</td>
<td>2004</td>
<td>15</td>
<td>1.5</td>
<td>$32,000</td>
</tr>
<tr>
<td>Recycled Water Basins No.1 and No. 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sludge Disposal Pump 3</td>
<td>Out of service</td>
<td>2014</td>
<td>15</td>
<td>1.5</td>
<td>$40,000</td>
</tr>
<tr>
<td>Filtration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonic Conditioner MCC-FI</td>
<td>Not working</td>
<td>2003</td>
<td>30</td>
<td>3</td>
<td>$32,000</td>
</tr>
<tr>
<td>Operations Building</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Security System</td>
<td>-</td>
<td>2000</td>
<td>15</td>
<td>1.5</td>
<td>$15,000</td>
</tr>
<tr>
<td>Radio System</td>
<td>Upgrades needed</td>
<td>2004</td>
<td>15</td>
<td>1.5</td>
<td>$10,000</td>
</tr>
<tr>
<td>Clearwell Storage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underdrain Pump 1</td>
<td>Corrosion from caustic leak</td>
<td>1987</td>
<td>15</td>
<td>1.5</td>
<td>$20,000</td>
</tr>
<tr>
<td>Underdrain Pump 2</td>
<td>Corrosion from caustic leak</td>
<td>1987</td>
<td>15</td>
<td>1.5</td>
<td>$20,000</td>
</tr>
<tr>
<td>High Service Pumps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTU-5</td>
<td>-</td>
<td>2004</td>
<td>15</td>
<td>1.5</td>
<td>$37,000</td>
</tr>
</tbody>
</table>

Notes:
(1) Calculated using Table 7.9 based on condition score of 5, value shown in years.
(2) Direct Replacement Cost, does not include markup for engineering or administrative costs. See Chapter 8 for capital costs.
7.2.4 Recommended Projects

The GKWTP is performing well overall, and the City's good maintenance practices are reflected in the prolonged service life of many of the GKWTP assets. Nevertheless, there are many assets will be in need of renewal within the Master Plan’s planning period. More information is provided in the Water Treatment Plant Condition Assessment technical memorandum (Appendix H). The following summarizes the recommended improvements at the GKWTP. Project costs and phasing associated with these improvements are provided in Chapter 8.

- **Actiflow® Clarification No. 1 & 2**: Twelve improvements (Projects AF-01 to AF-51) are proposed for assets associated with the Actiflo® Clarification process. The most significant (albeit not the most critical) of these improvement projects will be a structural rehabilitation of the two Actiflo® tanks. The required projects include the following:
  - Butterfly valves
  - Flow meters
  - Generator testing
  - Harmonic conditioner replacement
  - Hydrocyclone replacements
  - Instrumentation replacements
  - Mixers
  - Sand pump improvements
  - SCADA system replacements
  - Structural rehabilitation
  - Tube settler replacements
  - Variable Frequency Drive (VFD) replacements

- **Backwash Pump Recoating (Projects BWP-1 and BWP-2)**: Projects BWP-1 and 2 will include recoating of the vertical turbine pumps

- **Chemical Feed Projects**: The following projects are recommended for rehabilitation of the City's chemical feed assets.
  - **Project CF-1 (Polymer Feed Pumps)**: The polymer feed pumps in the Chemical Feed and Storage process area will be replaced during Phase 4 of the CIP.
  - **Projects CF-2 and CF-3 (Dry Polymer Batching and Mixing Equipment)**: During Phase 4 of the CIP, it is anticipated that the motor operator/electrical actuators for the dry polymer batching and mixing equipment will need to be replaced. The caustic metering pump will also be replaced as part of these projects.
• **Clearwell Underdrain Projects**: The following four replacement projects are recommended for the Clearwell Storage process area. Project phasing and costs are provided in Chapter 8.
  - Clearwell Underdrain Pumps (Projects CW-1 and CW-2)
  - Clearwell Drain Pump Station Programmable Logic Controller (PLC) (Project CW-3)
  - 60-inch air actuated inlet valve (Project CW-4)

• **Filtration Projects (Projects FR-01 to FR-17)**: The following improvements are proposed for assets in the Filtration process area. Each improvement has been assigned a phase designation based on the condition and criticality of the asset (see Chapter 8). The majority of the projects are projected to be completed in 2016, including a filter media replacement project. The harmonic conditioner replacement project is considered a critical project.
  - Backwash equipment
  - Filter media replacement
  - Filter SCADA system replacements
  - Harmonic conditioner replacement
  - VFD replacements

• **High Service Pumps (Projects HSP-01 to HSP-21)**: The following improvements for the High Service Pump process area have been identified:
  - Pump replacements over time
  - Condition assessment for the Motor Control Center
  - Filter SCADA system replacements
  - Standby generators
  - High Service Pump VFDs
  - Air relief replacement

• **Intake Facilities and Pump Station (Projects ISP-01 to ISP-29)**: CIP projects ISP-01 to ISP-29 are the improvements for the Intake Facilities and Pump Station, and include the following:
  - Valve replacements
  - Fuel reconditioning
  - Oil testing and load bank testing
  - Raw water pump replacements
  - Air compressor replacement
  - Air tank condition assessment
  - Air tank replacement
  - Fish screen assessment
  - Fish screen replacement
- **Lab Mechanical Building**: The following projects are recommended for the City's Laboratory Mechanical Building. Project phasing and costs are provided in Chapter 8.
  - SCADA System Replacements (Project LMB-1)
  - Mechanical/Electrical Assessment (Project LMB-2)
- **Low Lift Pump Station**: The following projects are recommended for the City's low-lift pump station.
  - Projects LPS-1 to LPS-8 are pump replacement and recoat/reseal pump projects for the four vertical turbine pumps located at the Low Lift Pump Station.
  - SCADA Replacement (Project LPS-9)
- **Operations Building (Projects OPS-1 to OPS-4)**: The Operations building will undergo SCADA replacements for the Radio System, the Security System, SCADA Rack, and the RTU-6.
- **Process Drain Pump Station**: The following projects are recommended for the City's Process Drain Pump Station. Project phasing and costs are provided in Chapter 8.
  - Process Drain Pump Recoating (Project PD-2 and PD-6): The submersible pumps at the process drain pump station will undergo recoating projects.
  - TM Analyzer (Project PD-3): The operations room in the process drain pump station will have a TM analyzer installed.
  - Security System (Project PD-4): The security cameras at the pump station are scheduled to be replaced.
- **Raw Water Manifold and Reclaimed Water Pumping (Projects RW-01 to RW-16)**: The following projects are recommended for the raw water manifold and reclaimed water pumping. Project phasing and costs are provided in Chapter 8. The harmonic conditioner replacement is considered a critical project.
  - Flow meters
  - Reclaimed water pump coating and replacements
  - Safety improvements
  - SCADA system replacements
  - VFD assessments and replacements
- **Recycled Water Basins (Projects RWB-01 to RWB-12)**: The following improvements are recommended for the recycled water basins. Project phasing and costs are provided in Chapter 8.
  - Actuator replacement
  - Cross collectors inspection and replacement
  - Decanter replacement
  - Recycled pump replacement
  - Sludge collector replacements
• **Facility-Wide Measuring Equipment and Transmitters**: The following projects are recommended for the City's Facility-Wide Measuring Equipment and Transmitters.

  - **Measurement Instrumentation Replacements (Project FAC-1)**: Approximately $100,000 per year for five years should be allocated to replacing measurement instrumentation devices throughout the facilities.
  - **PLC Racks, Components, Integrator Controls (Project FAC-2)**: Approximately $500,000 should be budgeted for year 3 of the CIP for replacing facility-wide equipment.

### 7.3 WATER DISTRIBUTION SYSTEM CONDITION EVALUATION

#### 7.3.1 Remaining Useful Life: Pipelines

Asset management of buried infrastructure consists of two primary focus areas: (1) operation and maintenance activities, and (2) rehabilitation and replacement activities. Inspections, repairs, and preventative maintenance efforts aim to optimize the useful life of pipelines and appurtenances. This plan addresses capital projects that provide for the rehabilitation or replacement of assets once they have reached the end of their useful life.

An inventory of the buried infrastructure for the City's water distribution system was established from geographic information system (GIS) data provided by the City. Table 7.11 lists the useful life estimates by pipe material used to develop the replacement projections.

<table>
<thead>
<tr>
<th>System</th>
<th>Pipe Material (Abbreviation)</th>
<th>Useful Life (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Asbestos Cement Pipe (ACP)</td>
<td>75</td>
</tr>
<tr>
<td>Water</td>
<td>Cast Iron Pipe (CIP)</td>
<td>65</td>
</tr>
<tr>
<td>Water</td>
<td>Ductile Iron Pipe (DIP)</td>
<td>82</td>
</tr>
<tr>
<td>Water</td>
<td>Cement Mortar Lined &amp; Coated Steel Pipe (CMLC, CMLW)</td>
<td>80</td>
</tr>
<tr>
<td>Water</td>
<td>Steel Cylinder Pipe (STL)</td>
<td>80</td>
</tr>
<tr>
<td>Water</td>
<td>Polyvinyl Chloride Pipe (PVC)</td>
<td>85</td>
</tr>
<tr>
<td>Water</td>
<td>Copper (COP)</td>
<td>50</td>
</tr>
<tr>
<td>Water</td>
<td>Galvanized (GAL)</td>
<td>50</td>
</tr>
<tr>
<td>Water</td>
<td>Diameters less than 6&quot; regardless of material</td>
<td>50</td>
</tr>
<tr>
<td>Water</td>
<td>Unknown material (UNK)</td>
<td>65</td>
</tr>
</tbody>
</table>
Figure 7.8 shows a map of the City's proposed water main replacement timeline for the water distribution system. Table 7.12 shows a summary of the water main replacement costs by fiscal year. The majority of the existing ACP water mains are anticipated to reach the end of their useful life by the FY2046 - FY2050 CIP range. These water mains were installed between 1972 and 1975 and have an assumed useful life of 75 years. Chapter 8 summarizes the length of pipe and associated costs to be replaced by CIP phase (which are broken down in to five year increments).

<table>
<thead>
<tr>
<th>Fiscal Year (FY) CIP Range</th>
<th>Water Main Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown Installation Date</td>
<td>$367,000</td>
</tr>
<tr>
<td>FY16-FY20</td>
<td>$291,000</td>
</tr>
<tr>
<td>FY21-FY25</td>
<td>$541,000</td>
</tr>
<tr>
<td>FY26-FY30</td>
<td>$2,493,000</td>
</tr>
<tr>
<td>FY31-FY35</td>
<td>$2,020,000</td>
</tr>
<tr>
<td>FY36-FY40</td>
<td>$1,364,000</td>
</tr>
<tr>
<td>FY41-FY45</td>
<td>$4,365,000</td>
</tr>
<tr>
<td>FY46-FY50</td>
<td>$17,911,000</td>
</tr>
<tr>
<td>FY51-FY55</td>
<td>$15,440,000</td>
</tr>
<tr>
<td>FY56-FY60</td>
<td>$12,614,000</td>
</tr>
<tr>
<td>FY61-FY65</td>
<td>$13,919,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$71,322,000</strong></td>
</tr>
</tbody>
</table>

*Notes: (1) Does not include contingency markup.*

### 7.3.2 Tank and Pump Stations Condition Assessment

Site visits and visual inspections were conducted of all nine of the City's water system storage reservoirs and pump stations on September 10, 2014.

All of the City's reservoirs throughout the distribution system are AWWA D100 steel tanks. Only two of the existing tanks are anchored: the PSIP Reservoir and the new Bridge District Reservoir. The new Bridge District Reservoir is also pile supported, while the other reservoirs have concrete ring-wall style foundations.
The City has a regular inspection program to inspect the inside of the reservoirs every three to four years. Recent inspection reports and the inspection schedule were provided to the condition assessment team. With the exception of the Central Storage Tank, which has coating that is 26 years old, all tanks have been coated within the last 20 years.

Assessment of the reservoirs and pump stations identified several seismic vulnerabilities. A seismic analysis of these facilities for anchorage, settlement, available freeboard within the tank, and need for piping flexibility for both the storage tanks and pump stations is recommended.

The area encompassed by the City, including the existing and the proposed reservoir and supply systems discussed herein, is considered prone to flooding based on Federal Energy Management Agency (FEMA) flood risk analyses. An existing system of levees that provide flood protection for the City are undergoing improvements to bring the network into compliance with Army Corp of Engineers standards.

While these existing and improved levees will provide sound protection for the City, a breach of any of these protections would pose significant issues for both the City’s infrastructure and population, independent of their water supply. As such, increasing the elevation of the reservoirs and pump stations would have minimal benefit for the City under flood conditions, especially considering the economic feasibility of such a design. Further discussion of the City’s flood vulnerability is available in the Tank and Pump Station Condition, Seismic, and Flood Vulnerability Assessment technical memorandum (included in Appendix I).

7.3.2.1 Recommendations

The following list describes the recommended projects based on the pump station and reservoir visual condition assessment. Projects that are common to several of the pump station and reservoir facilities are listed first, followed by site-specific projects:

- **Tank Recoating/Lining Project (Oak Street Reservoir, Central Reservoir, and Carlin Reservoir):** Carollo recommends implementing a tank recoating and relining project. These specific tank sites are showing signs of corrosion or degradation on the structure of the reservoir.

- **Flexible Piping Retrofits:** In California, areas with high probability of seismic activity may require flexible pipe connections and expansion joints to account for seismic stresses. Flexible pipe connections are designed to protect water or wastewater pipeline systems from the stresses produced by ground motion either from seismic activity, in addition to gradual soil subsidence.

  Piping at the Northeast, Oak Street, Port of Sacramento Industrial Parkway, and Central Reservoir sites were found to have flexible piping concerns. Poor flexibility for pump station piping is likely to fail in a seismic event. All tank piping connections are below grade so were not visible for inspection.
• **Security Improvements**: Security cameras for closed-circuit television (CCTV) video surveillance are needed at both the Oak Street Reservoir and Northeast reservoirs. Additionally, retrofitting of the Northeast reservoir perimeter fencing is recommended to restrict climbing the fence.

• **Northeast Reservoir and Pump Station**: This reservoir and pump station appeared to be at seismic risk and should be further evaluated. Staff considers this a critical facility since it delivers water to the Washington District. The tank has experienced differential settlement to the extent that it is visibly tilting. Drainage improvements are also recommended for this facility.

• **Oak Street Reservoir**: Concrete rehabilitation is recommended for the Oak Street Reservoir where the concrete foundation requires attention.

• **Port of Sacramento Industrial Park Reservoir**: This pump station and reservoir need substantial improvements, and is recommended for decommissioning. A new replacement pump station and reservoir is proposed for the vacant site near the Granada Inn.

• **Southport Reservoir and Pump Station**: The facility is no longer operated with the exception of one emergency well that is used for irrigation only. The second well is out of service. This facility is recommended for demolition.

### 7.4 OPERATIONAL ANALYSIS

This section provides results of an assessment of the City's current operational strategies and equipment, and provides recommendations for alternative operational strategies and/or more energy efficient equipment that could be installed.

#### 7.4.1 Baseline Evaluation

A baseline evaluation of the City's current water system energy consumption and greenhouse gas (GHG) emissions was performed. Potential improvements were identified during the evaluation that could support City and State sustainability and Climate Action Plan goals. The improvements were developed to meet the following objectives:

• Improve efficiency.

• Improve reliability.

• Reduce operating costs.

• Reduce maintenance costs.

• Reduce GHG emissions.

• Minimize number of start/stops.

• Reduce required power infrastructure.
The historical approach to pump station design has been to select the design point and focus the efforts around this one point on the system head curve. However this approach focuses on conditions that are only met infrequently. Typically, the system is operating at different conditions, resulting in poor efficiencies under most operating conditions.

Design of pump stations has trended toward designing with an emphasis on energy efficiency. This requires designing around the entire range of operating conditions, with an emphasis on the average or normal operating conditions. Understanding the range of flows and heads in combination with each other that will need to be accommodated by the pump station is critical to an energy efficient design.

The design of a pump station is dependent upon our ability to understand the operating conditions and to tailor the design to match the demands of the system. For example, a system where the total dynamic head (TDH) changes significantly from summer to winter may require pumps with a wider range of higher efficiencies and the use of VFDs. If the system head curve (change in discharge pressure with flow) is flat and not dependent upon the flowrate leaving the pump station or the static elevation (on the suction) and the discharge does not change over time, then pumps with a higher single best efficiency point (without a wide range of higher efficiency) and constant speed motors will be the best fit from an energy efficiency perspective.

VFDs allow the speed of a pump to slow down, resulting in reduced flowrates and corresponding lower TDHs. VFDs have been used (and misused) as a tool to provide increased operational flexibility and energy savings. However, oftentimes little consideration is given to the fact that VFDs have efficiency losses associated with their use. Hydraulic gains in efficiency due to a wider range of high efficiencies must counterbalance the electrical efficiency losses using a VFD (unless operational consideration dictates the use of a VFD – i.e., very tight flow control requirements).

Depending on the loading of a VFD, the efficiency loss can range from 4 to 10 percent. At 100 percent of the rated load (horsepower), the electrical efficiency losses are approximately 4 percent. At 50 percent of the rated load (horsepower), the electrical efficiency losses are approximately 10 percent. Another issue with VFDs is the fact that pump curves flatten out at low speeds and can result in operational challenges when attempting to pump at lower flows.

The City has already begun implementing the following energy efficiency measures as noted for each pump and pump stations listed in Table 7.13:

- Taking into account the variation in water demand from winter to summer months - having pumps of two different capacities for use depending on the season (average conditions).
### Table 7.13  Booster Pump Station Summary
#### 2015 Water Master Plan Update
##### City of West Sacramento

<table>
<thead>
<tr>
<th>Pump Station Name</th>
<th>Pump No.</th>
<th>VFD</th>
<th>Hp</th>
<th>Capacity (gpm)</th>
<th>TDH (ft)</th>
<th>Time of Day Pumping&lt;sup&gt;(1),(2)&lt;/sup&gt;</th>
<th>Pressure Controls&lt;sup&gt;(1)&lt;/sup&gt; (psi)</th>
<th>Notes&lt;sup&gt;(1)&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>GKWTP High Service Pumps</td>
<td>TWP 1</td>
<td>Yes</td>
<td>200</td>
<td>3,500</td>
<td>140</td>
<td>--</td>
<td>--</td>
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<td></td>
<td>TWP 2</td>
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<td>140</td>
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<td>--</td>
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<tr>
<td></td>
<td>TWP 3</td>
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<td>3,500</td>
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<td>TWP 5</td>
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<td>TWP 6</td>
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<td>--</td>
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<td></td>
<td>TWP 7</td>
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<td></td>
<td>TWP 8</td>
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<td>3,500</td>
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<td></td>
<td>TWP 9</td>
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<td>3,500</td>
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<tr>
<td></td>
<td>TWP 10</td>
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<td></td>
<td>TWP 11</td>
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</tr>
<tr>
<td></td>
<td>TWP 12</td>
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<td>3,500</td>
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<td>Oak Street</td>
<td>M1</td>
<td>No</td>
<td>75</td>
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<td>127</td>
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<td>70</td>
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<td></td>
<td>M2</td>
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<td>75</td>
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<td>550</td>
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<td>70</td>
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<td></td>
<td>602</td>
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<td>30</td>
<td>550</td>
<td>135</td>
<td>W: 21:30-06:30</td>
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<td>70</td>
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<tr>
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<td>603</td>
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<td>75</td>
<td>1,800</td>
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<td>604</td>
<td>No</td>
<td>75</td>
<td>1,800</td>
<td>135</td>
<td></td>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>Pump Station Name</td>
<td>Pump No.</td>
<td>VFD</td>
<td>Hp</td>
<td>Capacity (gpm)</td>
<td>TDH (ft)</td>
<td>Time of Day Pumping(^{(1),(2)})</td>
<td>Pressure Controls(^{(1)}) (psi)</td>
<td>Notes(^{(1)})</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
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<td>-----------------------------</td>
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<td>Central</td>
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<td>30</td>
<td>550</td>
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<td>702</td>
<td>No</td>
<td>30</td>
<td>550</td>
<td>135</td>
<td>W: 07:00-13:00</td>
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<td></td>
<td>703</td>
<td>No</td>
<td>75</td>
<td>1,800</td>
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</tr>
<tr>
<td></td>
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<td>1,800</td>
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<td>100</td>
<td>1,400</td>
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<td></td>
<td>1510</td>
<td>No</td>
<td>100</td>
<td>2,800</td>
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<td>100</td>
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<td>Bridge District</td>
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<td>70</td>
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<tr>
<td></td>
<td>P120</td>
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<td>100</td>
<td>3,000</td>
<td>100</td>
<td>W: 08:00-21:30</td>
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<td></td>
</tr>
<tr>
<td>Carlin</td>
<td>P21</td>
<td>Yes</td>
<td>125</td>
<td>2,800</td>
<td>140</td>
<td>S: 22:00-06:30</td>
<td>40</td>
<td>70</td>
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<tr>
<td></td>
<td>P22</td>
<td>Yes</td>
<td>125</td>
<td>2,800</td>
<td>140</td>
<td>W: 22:00-12:00</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>P23</td>
<td>No</td>
<td>125</td>
<td>2,800</td>
<td>140</td>
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<td>P24</td>
<td>Yes</td>
<td>75</td>
<td>1,400</td>
<td>140</td>
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<tr>
<td>Bridgeway Lakes</td>
<td>P25</td>
<td>Yes</td>
<td>150</td>
<td>2,400</td>
<td>170</td>
<td>S: 11:30-21:45</td>
<td>40</td>
<td>70</td>
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<tr>
<td></td>
<td>P26</td>
<td>Yes</td>
<td>150</td>
<td>2,400</td>
<td>170</td>
<td>W: 12:30-22:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P27</td>
<td>Yes</td>
<td>150</td>
<td>2,400</td>
<td>170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inline Booster</td>
<td>P28</td>
<td>Yes</td>
<td>200</td>
<td>7,500</td>
<td>65</td>
<td>S: 06:15-11:30</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P29</td>
<td>Yes</td>
<td>200</td>
<td>7,500</td>
<td>65</td>
<td>W: n/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P30</td>
<td>Yes</td>
<td>200</td>
<td>7,500</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
(1) Source: City Operations Staff.
(2) S = summer, W = winter.
• Replacing constant speed motors with VFD (premium efficiency) motors.
• Operating the GKWTP during fewer hours per day during times of the year where this mode is possible to still meet demands.

### 7.4.2 Energy Evaluation Results

The current (or baseline) energy consumption and GHG emissions were estimated based on current operation conditions, available pump information (Table 7.13), and the following assumptions:

- The evaluation will include only the finished water pump station and the distribution system within the City service area, and will not include the withdrawal, source water delivery, and treatment of water sources at the GKWTP.
- The pumps are powered by electricity purchased from Sacramento Municipal Utility District (SMUD).
- GHG emissions are estimated based on:
  - Global warming potentials pursuant to the California Air Resources Board (CARB) Mandatory Reporting Regulation.
  - 2014 emission factors developed for SMUD electricity.

The results of the preliminary energy evaluation are presented in Table 7.14.

<table>
<thead>
<tr>
<th>Pump Station Name</th>
<th>Electricity Consumption (kWh/year)$^{(1)}$</th>
<th>Carbon Dioxide Equivalent Emissions (MT/year)$^{(2)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>GKWTP High Service Pumps</td>
<td>14,959,108</td>
<td>3,798</td>
</tr>
<tr>
<td>Oak Street</td>
<td>161,159</td>
<td>41</td>
</tr>
<tr>
<td>Northeast</td>
<td>127,316</td>
<td>32</td>
</tr>
<tr>
<td>Central</td>
<td>84,877</td>
<td>22</td>
</tr>
<tr>
<td>PSIP</td>
<td>272,180</td>
<td>69</td>
</tr>
<tr>
<td>Bridge District</td>
<td>354,112</td>
<td>90</td>
</tr>
<tr>
<td>Carlin</td>
<td>293,358</td>
<td>74</td>
</tr>
<tr>
<td>Bridgeway Lakes</td>
<td>411,395</td>
<td>104</td>
</tr>
<tr>
<td>Inline Booster</td>
<td>145,811</td>
<td>37</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16,809,318</strong></td>
<td><strong>4,268</strong></td>
</tr>
</tbody>
</table>

Notes:

$^{(1)}$ kWh/year = kilowatt-hours per year.
$^{(2)}$ MT/year = metric tons per year.
It would be beneficial for the City to develop pump curves with power use data to provide a more accurate picture of the energy efficiency of the pumps under current conditions. Once the pump curves are analyzed, the following approaches should be considered (when relevant) to maximize overall energy efficiency and minimize GHG emissions:

- Compare the actual pump curve to the original pump curve to understand how much the pump curve has changed over time. The current operating range versus the best efficiency point/range of the pump should reasonably match the original design intent. Depending on how far apart these two ranges are, the pump could be rebuilt back to its original condition, or pump replacement could be warranted (and may have a short payback).

- If the pump is currently undersized from a flow and motor horsepower perspective, consider installation of a larger impeller in the existing pump (horizontal split-case pumps only). This change would increase the capacity of the pump and provide a larger operating range if the pump has a VFD.

- Re-examine the dynamics of the distribution system to see if pumps can be operated during off-peak power times (depending on the power rate schedule) and if the pump stations can be shut down during peak usage times. The GKWTP already operates the pump station (12 hours on/12 hours off) for energy optimization.

- Make sure that all pump motors are premium efficiency motors, and test any premium efficiency motors that have been rebuilt. Many times a motor rebuild will not be performed in such a manner as to return the motor to premium efficiency.

- Examine the setpoints of the altitude valves to determine if the low setting of the valve can be increased to minimize loss of system pressure across the valve during the filling cycle.

- Examine the tanks and filling cycles to determine if any installations could utilize energy recovery (reverse pump). Sites with the highest differential pressures, long fill times, and the most consistent fill rates would be the best candidates for this potential energy recovery.

- If demand charges from the power utility are significant, consider running the pumps longer at lower flowrates to minimize the maximum demand charges.

Using the approach outlined above, some utilities have observed as much as 10 percent energy savings. It should be noted that some of the measures identified above could potentially be in conflict with each other, so all options should be considered holistically to identify the preferred solution.

### 7.4.3 Summary of Regulations

Water treatment and supply facilities must meet all state and federal water quality regulations. The Environmental Protection Agency (EPA) is responsible for enforcement of federal regulations, and the state guidelines are regulated by the California Division of
Drinking Water (DDW). While the City drinking water is typically derived from the Sacramento River then treated and distributed from the GKWTP (DDW water system facility number CA5710003-002), two standby groundwater wells (Well 19 and Well 20) at the Southport WTP (DDW water system facility number CA5710003-029) require that regulations for both surface water and groundwater apply. In addition to these existing requirements, the City must be prepared to address future regulations promulgated in the increasingly stringent regulatory environment.

At this time the City does not have any reported drinking water violations.

7.4.3.1 Recent DDW Regulatory Developments

Some of the regulations promulgated by DDW over the past 5 years are listed in Table 7.15. The Long Term 2 Enhances Surface Water Treatment Rule (LT2) was promulgated by the EPA in 2006, and the State of California version of the LT2, by the California Department of Public Health (DPH, now DDW) went into effect July 2013.

<table>
<thead>
<tr>
<th>Effective Date</th>
<th>Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/1/2014</td>
<td>Hexavalent Chromium Maximum Contaminant Level (MCL) (DPH-11-005)</td>
</tr>
<tr>
<td>6/18/2014</td>
<td>Groundwater Replenishment Using Recycled Water (DPH-14-003E)</td>
</tr>
<tr>
<td>7/1/2013</td>
<td>Long Term 1 and 2 Enhanced Surface Water Treatment Rules (LT2ESWTR: DPH-09-014)</td>
</tr>
<tr>
<td>6/21/2012</td>
<td>Disinfectant Residual, Disinfection Byproducts, and Disinfection Byproduct Precursors (D/DBP: DPH-09-004)</td>
</tr>
<tr>
<td>9/22/2011</td>
<td>Point of Entry Treatment (DPH-10-011E)</td>
</tr>
<tr>
<td>8/18/2011</td>
<td>Ground Water Rule (GWR: DPH-09-007)</td>
</tr>
</tbody>
</table>

Based on available historical records the City is compliant with the regulations discussed below:

- **Hexavalent chromium**: The City has monitored both the Sacramento River and the GKWTP treated water for hexavalent chromium. While trace levels have been previously reported, all tests performed on treated water in the past 5 years have been below detection limits.

- **LT2ESWTR**: DDW currently regulates the City as a system serving 46,500 people. As such the second round of source water monitoring for the Long-Term 2 Enhanced Surface Water Treatment Rule was initiated in April 2015. Prior to beginning the second round of source water monitoring, the City executed a Memorandum of Understanding with six other municipal water purveyors (Roseville, Sacramento, EBMUD, PCWA,
SCWA, and WDCWA) for a sanitary survey update of the Sacramento River Watershed area, provided by Starr Consulting. While the Starr Consulting will continue the project through June 2016, the report will be delivered to DDW in December 2015.

- **D/DBP**: Ongoing monitoring of raw and finished water total organic carbon (TOC), and total trihalomethanes/haloacetic acids (TTHM/HAA5) locational running annual averages (PSIP Reservoir, Central Reservoir, Marshall and Golden Gate, Bridgeway Lake Reservoir, 3081 Mareca Way, 2100 Manchester Rd, 1494 Redding Rd, Northwest Reservoir) demonstrate compliance with the D/DBP Rules.

- **GWR**: Only applicable to the use of Well 18 and Well 19, currently on standby, this rule requires 4-log virus treatment or additional monitoring and reporting.

Other recent updates to The Blue Book¹ have addressed fees payable to the State, updates to water conservation program and associated violations, new emergency conservation and associated water rights requirements, and updates to providing public well inspection reports.

### 7.4.3.2 On-going Regulatory Development

In addition to the recently promulgated regulations, other ongoing regulatory developments include:

- **Cyanotoxins Health Advisories**: In response to the Drinking Water Protection Act (H.R. 212), the EPA submitted a strategic plan² to the United States Congress outlining approaches and projects to control and manage algal toxins in source waters and treat algal toxins in drinking water. As a part of this plan, the EPA issued the non-regulatory guidance for the cyanotoxins microcystins and cylindrospermopsin outlined in Table 7.16.³

<table>
<thead>
<tr>
<th>Table 7.16 Cyanotoxin Health Advisory Concentrations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 Water Master Plan Update</td>
</tr>
<tr>
<td>City of West Sacramento</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Chemical</th>
<th>10-day Health Advisory Value</th>
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<tbody>
<tr>
<td></td>
<td>Bottle-fed infants and</td>
</tr>
<tr>
<td></td>
<td>pre-school children</td>
</tr>
<tr>
<td></td>
<td>School-age children and adults</td>
</tr>
<tr>
<td>Microcystins</td>
<td>0.3 µg/L</td>
</tr>
<tr>
<td>Cylindrospermopsin</td>
<td>0.7 µg/L</td>
</tr>
</tbody>
</table>


• **Draft Fourth Contaminant Candidate List:** The EPA proposed the fourth Unregulated Contaminant Monitoring Rule (UCMR 4) to require monitoring for 30 chemical contaminants/groups between 2018 and 2020 using analytical methods developed by EPA, consensus organizations or both. This monitoring provides a basis for future regulatory determinations and, as warranted, actions to protect public health. The list includes:
  
  - **Cyanotoxins:** total microcystin, microcystin-LA, microcystin-LF, microcystin-LR, microcystin-LY, microcystin-RR, microcystin-YR, Nodularin, anatoxin-a, cylindrospermopsin.
  
  - **Metals:** Germanium, Manganese.
  
  - **Pesticides and Pesticide Manufacturing Byproduct:** alpha-hexachlorocyclohexane, Chlorpyrifos, Dimethipin, Ethoprop, Oxyfluorfen, Profenofos, tebuconazole, total permethrin (cis- & trans-), Tribufos.
  
  - **Brominated Haloacetic Acid Groups:** HAA5, HAA6Br, HAA9.
  
  - **Alcohols:** 1-butanol, 2-methoxyethanol, 2-propen-1-ol.
  
  - **Semivolatile Chemicals:** butylated hydroxyanisole, o-toluidine, Quinoline.

• **Strontium:** The EPA identified strontium as a constituent being considered for regulation in the Drinking Water Contaminant Candidate List 3 (CCL3)\(^4\). If the EPA determines that strontium should be regulated, the determination will be issued in the Final Third Regulatory Determinations expected in 2019 or 2020.

• **Department of Health and Human Services Recommended Fluoride Level:** The U.S. Department of Health and Human Services released the final Public Health Service (PHS) recommendation for the optimal fluoride level in drinking water to prevent tooth decay. The new recommendation is that fluoride in drinking water be maintained at 0.7 milligrams of fluoride per liter. The previous range recommended by the PHS was 0.7 to 1.2 milligrams per liter (mg/L), issued in 1962.

  Evaluation of monthly samples submitted to DDW over the last year indicate that water fluoride concentrations ranged from 0.5 and 0.9 mg/L, with an average of 0.8 mg/L. It should be noted that the PHS optimal level should viewed as a target concentration, not as a maximum. As such, the current treatment appears adequate given the variation of the ambient fluoride concentration in the Sacramento River.

• **Water Sector Cybersecurity:** On February 19, 2013, Presidential Executive Order 13636 – Improving Critical Infrastructure\(^5\), directed the National Institute of Standards and Technology (NIST) to lead the development of a framework to reduce cyber risks to critical infrastructure. In response, the CIPAC Water Sector Cybersecurity Strategy Workgroup (Workgroup) was convened by the Water Sector Coordinating Council (SCC)

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\(^4\) Also as a part of CCL3, EPA rejected the regulation of dimethoate, 1,3-dinitrobenzene, terbufos and terbufos sulfone.

and the Government Coordinating Council (GCC) to improve the resiliency of the Water and Wastewater Systems Sector (Water Sector) by developing a strategy to promote and facilitate use of the NIST Framework for Improving Critical Infrastructure Cybersecurity (Cybersecurity Framework). Their final report and recommendations were issued (April 2015) to help provide a method that critical infrastructure owners and operators can use to create, assess, or improve comprehensive cybersecurity programs. The AWWA Water Industry Technical Action Fund Project #503 also provides recommended practices and a cybersecurity guidance tool to help prioritize related improvements.

- **Waters of the United States:** on May 27, 2015, the EPA and US Army Corps of Engineers jointly announced a final rule defining the scope of water protected under the Clean Water Act (CWA), revising regulations that have been in place for more than 25 years. Due to the proximity of the Sacramento River to a variety of the City’s properties, this rule may impact City activities. Jurisdictional waters are conceptually illustrated below in Figure 7.9.

![Figure 7.9 West Sacramento Distribution System Schematic](source)


**Notes:** “Jurisdictional by Rule” waters are jurisdictional per se without case-specific analysis. Other waters in this figure may be jurisdictional if there is a significant nexus to a jurisdictional downstream water. See text for discussion.

Figure 7.9 West Sacramento Distribution System Schematic

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• **Clean Power Plan Rule:** On August 3, 2015, EPA announced the Clean Power Plan carrying out EPA’s obligations under section 111(d) of the Clean Air Act, the Clean Power Plan sets carbon dioxide (CO2) emissions performance rates for affected power plants that reflect the “best system of emission reduction” (BSER), and leaves it up to the states to develop their own plans that will achieve those rates, with guidelines for the development, submittal and implementation of those plans. This Rule\(^9\), effective December 22, 2015, requires individual states to deploy energy efficiency measures to meet their own goals to reduce carbon pollution from power plants. While the full impact of this regulation is not known, it is likely to increase energy costs to the City both in the short- and long-term.

• **Other EPA Regulations:** A number of other regulations are currently under development by the EPA.
  
  - **Lead and Copper Rule Long-Term Revisions** – Substantial revisions to the existing rule have been recommended by the EPA National Drinking Water Advisory Council Working Group related to this Rule, and issued in April 2015 in their final report.\(^{10}\) Currently, the schedule to address the recommendations for regulatory implementation is uncertain. The next set of compliance samples are to be collected in 2016. The last round (2013) reported a 90th percentile for lead and copper to be 2.2 micrograms per liter (µg/L) and 0.31 mg/L. Both were below their respective action levels of 15 µg/L and 1.3 mg/L, respectively.
  
  - **Prohibition on Use of Lead Pipes, Solder, and Flux** - Implementing Revisions to Section 1417 of the Safe Drinking Water Act (SDWA).
  
  - **Perchlorate** – Perchlorate has been regulated in California (maximum contaminant level [MCL] of 6 µg/L) since October 2007. On February 11, 2011, the EPA announced that it would regulate perchlorate. There are still no clear indications of when an MCL from the EPA is anticipated.
  
  - **Six-Year Review** - EPA is required to review each primary drinking water regulation in the SDWA every six years. It was indicated that chlorate and nitrosamines will be in this third Six-Year Review scheduled to be released in 2016.

• **Other California Regulations:** A number of other regulations are currently under development by DDW.
  
  - **Revised Total Coliform Rule** – EPA revised the 1989 Total Coliform Rule (TCR) on February 13, 2013. The revisions require systems that have an indication of coliform contamination in the distribution system to assess the problem and take corrective action that may reduce cases of illnesses and deaths due to potential fecal contamination and waterborne pathogen exposure. Water systems must comply with the Revised TCR by April 1, 2016.

\(^{10}\) [http://www.awwa.org/Portals/0/files/legreg/documents/FinalLCR.pdf](http://www.awwa.org/Portals/0/files/legreg/documents/FinalLCR.pdf)
- Surface Water Augmentation Using Recycled Water – This regulation is required to be adopted by December 31, 2016. The indirect potable reuse regulations should be closely monitored to help proactively assuage concerns that the City’s consumers may have and assess potential impacts to the GKWTP Sacramento River source.
- Cross Connection Control – The existing draft regulations are being revised. A schedule is unclear at this time.
- Others – In addition to the above, discussions related to the revised regulation of nitrosamines, manganese, 1, 4 dioxane, and chlorite have been publicized by DDW. Details related to the MCL have not yet been released. It is anticipated that these potential regulations are still several years out.

7.4.3.3 Current Regulations

In addition to the regulations currently under development, a suite of existing regulations are currently being addressed by GKWTP and other City staff. A summary of key regulations are listed in Table 7.17.

Based on operational information and observations at GKWTP, additional discussion related to selected constituents is provided below.

- **Molinate** – DDW MCL = 20 µg/L: Low- to sub-µg/L concentrations of this rice pesticide have been periodically detected in the Sacramento River over the decades of monitoring. This chemical is currently phased out of use, and has not been detected in the GKWTP treated water within the past 5 years.

- **Thiobencarb** – DDW MCL = 70 µg/L: Low- to sub-µg/L concentrations of this rice pesticide have been periodically detected in the Sacramento River over the decades of monitoring. It has not been detected in the GKWTP treated water within the past 5 years. The GAC media in the filters was recently replaced, so the original treatment goals for Thiobencarb adsorption with GAC if it is present in the raw water is now restored.

- **Odors** – DDW Secondary Maximum Contaminant Level (SMCL) = 3 TON: The Sacramento River has low-level concentrations of compounds that can cause earthy-musty tastes and odors year round (e.g., 2-methylisoborneol, geosmin), but most often in the summer time. The existing GAC in the filters has limited capacity to remove trace organics. To provide a reliable adsorptive barrier, a change out of the media is recommended. The removal of these compounds may also be achieved through biological filtration. While operating the GAC filters biologically is possible, additional investigation would be necessary to characterize the water treatment performance of the filters performance with respect to odor-causing compounds, pesticides, and other potential compounds of concern.

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   [https://sdwis.waterboards.ca.gov/PDWW/JSP/SampleResults.jsp?tinwsys_is_number=6208&tinwsys_st_code=CA&counter=0](https://sdwis.waterboards.ca.gov/PDWW/JSP/SampleResults.jsp?tinwsys_is_number=6208&tinwsys_st_code=CA&counter=0)
Table 7.17  Overview of Key Drinking Water Regulations
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Requirements and Maximum Contaminant Level (MCL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe Drinking Water Act (SDWA) and National Primary Drinking Water Regulations (NPDWR)</td>
<td>Maximum contaminant levels (MCLs), maximum contaminant level goals (MCLGs) and/or treatment techniques set for 83 contaminants, including turbidity, seven microorganisms (two of which are indictors), four radionuclides, 16 inorganic contaminants, and 57 organic contaminants.</td>
</tr>
<tr>
<td>Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 D/DBPR)</td>
<td>Trihalomethanes (TTHM) limit of 0.080 mg/L; haloacetic acids (HAA5) of 0.060 mg/L MCL for bromate of 0.010 mg/L; MCL for chlorite of 1.0 mg/L Compliance for TTHMs &amp; HAA5 based on a running annual average (RAA).</td>
</tr>
<tr>
<td>Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 D/DBPR)</td>
<td>Perform Initial Distribution System Evaluation (IDSE) to identify new DBP compliance locations. Change compliance calculations from RAA to Locational Running Annual Averages (LRAA).</td>
</tr>
<tr>
<td>Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)</td>
<td>Source water monitoring and treatment technique requirements to address Cryptosporidium.</td>
</tr>
<tr>
<td>Arsenic Rule</td>
<td>Arsenic MCL: 0.010 mg/L.</td>
</tr>
<tr>
<td>Secondary Drinking Water Regulations</td>
<td>Non-enforceable standards for aesthetic parameters.</td>
</tr>
<tr>
<td>Partnership for Safe Water</td>
<td>Voluntary standards and practices to minimize risk of microbial contamination of treated water.</td>
</tr>
<tr>
<td>Inorganic Chemicals</td>
<td>Existing MCLs for a number of different metals and other inorganic chemicals.</td>
</tr>
<tr>
<td>Synthetic and volatile organic chemicals</td>
<td>Existing MCLs for a number of different herbicides, pesticides, solvents and other organic chemicals. Monitoring and reporting requirements.</td>
</tr>
<tr>
<td>Lead and Copper Rule (LCR) and 2007 Revisions</td>
<td>Requires water suppliers to optimize their treatment system to control corrosion in customer’s plumbing; If lead action levels are exceeded, requires the suppliers to educate their customers about lead and suggest actions they can take to reduce their exposure to lead through public notices and public education programs.</td>
</tr>
<tr>
<td>Hexavalent chromium, Cr(VI)</td>
<td>DDW = 10 µg/L MCL. EPA will be deciding whether and when to set an MCL.</td>
</tr>
<tr>
<td>Nitrosamines</td>
<td>DDW 10 ng/L notification levels for NDEA, NDMA, NDPA Establishment of MCL level or schedule currently unclear.</td>
</tr>
</tbody>
</table>
• **Treated Water Turbidity:** The treated water turbidity routinely remains below regulatory limits. While not currently impacting regulatory compliance, attrition of GAC filter media over time has reduced filter performance, resulting in shortening of run times. If allowed to continue, a degradation in filtered water quality or an inability to continuously provide design flow rates would be anticipated.

• **Manganese:** While treated water concentrations of manganese (and iron) remain below SMCL limits, its presence in the raw water and apparent staining on the basins should be taken into consideration when changing operational conditions (i.e. point of oxidant addition) or if filters are going to remain out of service and become anoxic. Under these conditions, the manganese that has accumulated in the GKWTP would be dissolved (i.e., mobilized) resulting in it being released into the distribution system in bulk.

• **Distribution System Metals:** While compliance for most metals (except for lead and copper) are determined at the point of entry into the distribution system, it is recommended that the distribution system pipe be periodically inspected to determine both integrity and accumulation of metals. While the treated water may not have detectable concentrations of various metals, the prolonged distribution of metals at concentrations below method detection limits may still lead to significant accumulation over time. Changes in the operation of the distribution system, reversal of flow direction, areas with extended residence time/loss of chlorine residual, or other contributing factors may result in the mobilization of accumulated metals. System monitoring, as well as development of any necessary corrective actions can help to alleviate challenges associated with release of accumulated metals into the distribution system.

7.4.3.4 **Regulatory Review Results**

The City appears to be compliant with the California DDW Regulations. Several regulations at the Federal level applicable to the City's system are either under development or recently went into effect. Of particular note is expansion of the scope of the water protected under the Clean Water Act. The change to this rule may impact City activities given its proximity to the Sacramento River. Additionally, the Clean Power Plant Rule, effective December 2015, may impact energy costs to the City both in the short- and long-term. DDW is also developing a number of regulations the City should closely monitor, including the development of the Surface Water Augmentation Using Recycled Water regulation and proactively address customer's concerns regarding indirect potable reuse.

The City’s recent GAC replacement capital project is important for maintaining compliance with regulatory requirements. Additionally, regulatory-influenced operation and maintenance considerations include reviewing the impacts of out-of-service times for the filters on manganese concentrations and managing the distribution system to minimize the accumulation and subsequent mobilization of metal deposits.
7.4.4 Other Citywide Projects

This section summarizes additional improvement project recommendations that are needed on a Citywide basis.

- **Corporation Yard (Corp Yard)**
  - The City is going through the process of relocating certain facilities off of the riverfront in order to add high-end retail stores and utilize the river for city attractions and business retention. The existing "Corp Yard", located in the Pioneer Bluff, previously held the City's sewer sanitation facility, and currently the parks and maintenance facility, and public works facility for both water and sewer programs. The relocation of the Corp Yard project is estimated to be $20 million. For the purpose of this plan and CIP, the water system's portion of the project is approximately $3 million and is estimated to be used during Phase 1 of the CIP.

- **Facility Radio Telemetry Unit SCADA Replacement**
  - The City expressed concerns about the conditions of the radio system associated with equipment Radio Telemetry Units (RTUs). Many locations frequently fail or have significant issues that are associated with process failures or manual onsite equipment control. These are identified in the CIP as SCADA replacement projects. It is recommended that the entire radio system throughout the plant as well as with related components that are out of date or nonfunctional be replaced as part of these projects.
  - The most notable malfunctioning radios are the laboratory room radio associated with RTU 7 (CIP project LMB-01), the high service pump station radio associated with RTU-5 (CIP project HSP-01), and the Actiflo™ radios (CIP projects AF-10 and AF-11). The Actiflo™ RTUs have not been serviced in years and are experiencing frequent processing failures.

- **Generator Testing and Improvements**
  - A specific program for regular generator testing is recommended as a system-wide project. Though not a replacement or rehabilitation project, generator testing is recommended in order to prolong the life of the existing generators and monitor emissions for air quality. For example, National Fire Protection Association (NFPA) Level 1 and Level 2 generators are required to be tested on a monthly basis according to NFPA 110 (Sec. 8.4.2).
  - During the condition assessment effort, it was noted that a full load bank test has not been performed. The City's large electrical generators are manufactured by Cummins, which recommends that "at minimum, a load bank test should be performed on an annual basis to improve the life of the engine and alternator. The test gives you peace of mind that your generator will remain reliable throughout power interruptions and keeps your business running." The load bank testing and air quality monitoring should also include oil testing, which is also a recommended preventative maintenance activity.
- Procurement of a remote generator is a need identified by plant operators. The remote generator would serve as a back-up for the existing generator and surrounding pump stations.

- **Variable Frequency Drives (VFD) Replacement/VFD Cooling Unit**
  - An age-based replacement along with electrical/instrumentation and controls (I&C) assessment of VFDs and VFD cooling fans is recommended as multiple VFDs have broken down or failed throughout the plant.
  - Pumps with VFD issues include the high service pump station pumps, raw water intake pumps, and Actiflo® pumps.

- **Harmonic Conditioner Replacement**
  - Problems with the harmonic conditioners directly affect the performance of associated assets such as VFDs. Many of the VFD units mentioned above have overheated or failed due to malfunctions in the harmonic conditioners. This project directly affects other units at the plant, and is therefore considered to be a critical facility project. The most notable assets observed to have issues were the high service pump station, the filter gallery, and raw water manifold.

- **Facility Recoating and Mechanical Seals Project**
  - Several assets from the GKWTP were included for mechanical recoating. The locations in need of mechanical recoating are the low lift pump station, the backwash pumps, and the process drain pumps.
  - The vertical turbine pumps at the low lift pump stations have blown seals that need replacement. Significant leaking with corrosion will occur if blown seals are not replaced, and can lead to structural and process concerns as time progresses.

- **Water Meter Installation Program and Meter Replacement Program:**
  - The City has an active residential water meter installation program to achieve fully metered status by 2020. All industrial and commercial users are currently metered. At the writing of this master plan, approximately 5,880 existing meters with older technology have been replaced. Approximately 5,420 meters have been installed with the updated technology in past five years. The City will be installing an additional 4,000 meters by 2020, bringing the total number of installed meters to approximately 15,300.
  - Once a residential customer's meter has been installed, there will be a standard implementation schedule for the conversion from a flat rate to a consumptive (volumetric) rate bill over a 60 day period. A sample draft schedule of this conversion through 2020 and the areas of the City to be converted are shown in Figure 7.10. For 3/4- to 1-inch meters used for residential services, the City has standardized on a Sensus SRII-EB AMR series with electronic SR-2 TR/TL programmable register and MXU transceiver to achieve uniformity throughout the
BEGIN VOLUMETRIC RATES

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<th>BILLING CYCLE</th>
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<td>12/20/2016</td>
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<td>13**</td>
<td>6/20/2019</td>
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<td>14**</td>
<td>8/20/2019</td>
<td>25th</td>
<td>10/25/2019</td>
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</tbody>
</table>

* ±1,000 CONVERSIONS IN EACH PHASE
** PHASE COULD BE ADJUSTED, DATE DEPENDENT ON METER INSTALLATION DATE.

CONVERSION FROM FLAT TO CONSUMPTION WATER RATE. PHASE NUMBER & BOUNDARY
BILLING ZONE & BILL DATE - 5TH
BILLING ZONE & BILL DATE - 15TH
BILLING ZONE & BILL DATE - 25TH
system. The City currently plans to continue specifying this proprietary product through the meter implementation period.

- An ongoing replacement program for installed meters is planned based on anticipated life expectancy of the three major components of the water meter: the meter body, the register, and the MXU. Costs have been included in the CIP for the anticipated replacement cycle of each component based on area and date of installation. Table 7.18 lists the estimated replacement cost and anticipated replacement cycle for each meter component.

- The City currently utilizes the Sensus FlexNet AMI System, which received and stores meter readings. This system, and its underlying operating platform are outdated and the City is currently investigating replacement options including a cloud-based hosted data-center approach to meter reading data, which will increase significantly as the City is fully metered. This Software as a Service (SaaS) would migrate preexisting software to a hosted solution with all current features and functionality. No hardware changes would be required with this transition. This system would consist of the following 5 primary components:
  
  o Meter with the 520M SmartPoint (already being installed or being installed)
  o Tower Gateway Base (TGB)
    - AMI Tower for meter data reception. The City currently has one Sensus Metro TGB in service at the Port
  o Regional Network Interface (RNI)
    - AMI Network management System available as a hosted services or licensed installation. The City currently has onsite servers.
  o Sensus Analytics Core Essentials Meter Data Management System (MDM)
    - AMI Platform for meter data management.
    - Provides alarm monitoring, leak detection, integration to billing, and is expandable to include GIS, SCADA, and other operational functions. Expandable to Customer User Portals.
  o FlexNet Licensed Wireless Operations
    - Annual "Support and Maintenance" for continued operation of RNI, TGB, and End Point components.

- A transition process would be required to upgrade the current system to one similar to the one described above. The process would include:
  
  o Migration of existing Meter Data Management (MDM) meter reading data to a hosted data-center environment.
  o Turn-key upgrade migration service for existing RNI setups and servers to current RNI.
  o Installation, configuration, and validation of Sensus Analytics (SA) MDM Software.
City Staff training.

### Table 7.18 Meter Component Replacement Costs and Frequency
#### 2015 Water Master Plan Update
#### City of West Sacramento

<table>
<thead>
<tr>
<th>Meter Component</th>
<th>Historical Replacement Cost ($)</th>
<th>Anticipated Replacement Cycle (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot; Meter Body</td>
<td>$300</td>
<td>20</td>
</tr>
<tr>
<td>Meter Register</td>
<td>$200</td>
<td>20</td>
</tr>
<tr>
<td>520M MXU</td>
<td>$275</td>
<td>20</td>
</tr>
</tbody>
</table>

**Notes:**
1. Replacement cycle discussed with the City.

### Smart Technology Initiative Integration
- Consistent with the City's Smart Technology Initiative, the Water Master Plan includes a number of forward-looking, cutting edge goals and projects to use technology to provide the most efficient and effective tools and approaches to maintain the City's water system. The following are components of this approach.
  - As mentioned previously, meters are being installed in accordance with the City's Smart Technology initiative. New meters utilize fixed location transmitters (at each meter) and receivers to allow water usage information to be updated frequently without the need for manual meter reading. It also can allow customers to receive more detailed water use information to assist with improving water conservation.
  - In addition to installing new meters, there is a program to replace previously installed older technology water meter transponders (Sensus 505) with the current standard transponder (Sensus 520M). This smart technology gives the City the ability to collect instantaneous volumetric readings in short increments. As explained in more detail later in this section, leak detection will be more readily performed due to this smart technology, as the readings will provide the volumetric changes in residential areas more frequently and the City will be able to cross reference these changes with their production to distinguish between meter error and actual usage. It is projected that this replacement program will be completed by 2020.
  - Once the meter reading hardware is in place, a future recommended software upgrade of the meter reading system is to migrate to a cloud-based data platform. This will allow the City to manage the large amount of data generated from up to hourly readings of each meter within the City, serve up the usage data to customers to allow them to better manage their water use, and efficiently connect this data to City platforms such as GIS and account...
billing. It will also allow analysis of water usage trends across the City and over time in response to policy changes such as conservation efforts and code changes such as landscape ordinances.

- Once the City is fully metered, leak detection within the City's distribution system can be more readily performed. Typically a water loss control program starts with a water audit, which provides a top-down accounting of estimated revenue and nonrevenue water as well as defines real losses as a subcategory of nonrevenue water. The City's Smart Meter platform can be used to generate detailed usage data to target potential areas of water loss. Value can be assigned to the nonrevenue water and used to determine funding interventions to reduce real losses (leak detection and repair) and apparent losses (meter errors). A program to quantify, study, and address water loss is recommended once all City water customers are metered.
This chapter combines the City of West Sacramento's (City's) supply, storage, pipeline, and other general projects that were recommended in the previous chapters and presents a comprehensive capital improvements program (CIP) for the water system. The purpose of this CIP is to provide the City with guidelines for planning and budgeting capital projects for the water distribution system and the George Kristoff Water Treatment Plant (GKWTP).

### 8.1 PROJECT PRIORITIZATION

As discussed in Chapter 7, the capital projects identified will allow the water distribution system and the GKWTP to reliably serve the City's current and future (2035) peak demand conditions. The improvement projects were prioritized based on the following factors:

- Projects that have typically reached the end of their useful life.
- Upgrading existing facilities to mitigate current capacity deficiencies, and increasing the reliability of existing facilities.
- Upgrading existing facilities to accommodate future growth.
- Implementing condition assessment projects for the City’s water distribution system and the GKWTP.

Based on these factors, each project was placed in one of four phases. Projects that are considered high priority (projects to mitigate high priority existing capacity deficiencies, and for facilities that have typically reached the end of their useful life) are targeted for implementation in Phase 1 (2016-2020). Projects considered medium-risk are targeted for implementation in Phase 2 (2021-2025). Projects that are considered lower risk are targeted for implementation in Phase 3 (2026-2030) and projects that will allow the City to mitigate expected long-term deficiencies are targeted for implementation in Phase 4 (2031-2035).

The projects recommended for the City's CIP have been assigned a project name associated with the type of project. Table 8.1 shows the abbreviations used to designate the projects for both the water distribution system and the George Kristoff Water Treatment Plant (GKWTP). Chapter 7 includes detailed project descriptions for each capital improvement. This chapter includes a summary of the estimated capital costs and phasing of the projects.
Table 8.1 Abbreviations for Capital Improvement Projects
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Water Distribution System</th>
<th>Water Treatment Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity Projects</td>
<td>Repair and Replacement Projects</td>
</tr>
<tr>
<td>&quot;FF&quot; Fire Flow Improvements</td>
<td>&quot;AF&quot; Actiflo™ Clarification No. 1 &amp; 2</td>
</tr>
<tr>
<td>&quot;TM&quot; Capacity Improvements</td>
<td>&quot;BWP&quot; Backwash Pump</td>
</tr>
<tr>
<td>&quot;T&quot; New Tank and Pump Stations</td>
<td>&quot;CF&quot; Chemical Feed</td>
</tr>
<tr>
<td>Rehabilitation Projects</td>
<td></td>
</tr>
<tr>
<td>&quot;RR&quot; Water Main Replacements</td>
<td>&quot;FR&quot; Filtration</td>
</tr>
<tr>
<td>&quot;PS&quot; Tank and Pump Station</td>
<td>&quot;HSP&quot; High Service Pumps</td>
</tr>
<tr>
<td>Tank Recoating</td>
<td>&quot;IPS&quot; Intake Pump Station</td>
</tr>
<tr>
<td>Security Improvements</td>
<td>&quot;LMB&quot; Lab/Mechanical Building</td>
</tr>
<tr>
<td>Seismic Analysis</td>
<td>&quot;LPS&quot; Low Lift Pump Station</td>
</tr>
<tr>
<td>&quot;MR&quot; Meter Projects</td>
<td>&quot;OPS&quot; Operations Building</td>
</tr>
<tr>
<td>Miscellaneous Projects</td>
<td></td>
</tr>
<tr>
<td>&quot;CY&quot; Corporation Yard Relocation</td>
<td>&quot;PD&quot; Process Drain Pump Station</td>
</tr>
<tr>
<td></td>
<td>&quot;RW&quot; Raw and Recycled Water Pumping</td>
</tr>
<tr>
<td></td>
<td>&quot;RWB&quot; Recycled Water Basins</td>
</tr>
<tr>
<td></td>
<td>&quot;FAC&quot; Facility Wide Measuring</td>
</tr>
<tr>
<td></td>
<td>Equipment and Transmitters</td>
</tr>
</tbody>
</table>

Recommendations for the City's CIP were developed based upon a capacity analysis and an asset management methodology that uses a risk assessment for prioritizing replacement needs. The risk assessment examined the vulnerability, or likelihood of failure, and criticality, or consequence of failure, for each of the assets. The risk assessment also incorporates the results of a visual condition assessment and seismic screening for the treatment plant facilities, the reservoirs, and the pump stations as described in Chapter 7.

8.2 CAPITAL IMPROVEMENT PROJECT COSTS

The capacity upgrades and other water system capital improvements set the foundation for the City's water distribution system and GKWTP CIP. The costs are presented as present value based on an Engineering News Record Construction Cost Index (ENR CCI) number of 10037 (20 Cities Index, July 2015). Costs are not escalated to future years.

8.3 COST ESTIMATING ACCURACY

The cost estimates presented in the 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.

For strategic business planning efforts like this master plan, the Association for the Advancement of Cost Engineering (AACE) recommends the "Class 5" estimating approach. AACE delineates five estimate classes, with Class 5 estimates generally being prepared using limited information. Class 5 estimates generally use stochastic estimating methods such as cost-to-capacity curves and various scaling factors resulting in a lump sum cost. Consequently, estimated costs have a wide range of accuracy (up to -50 percent to +100 percent.) Class 5 estimates are typically prepared for a number of strategic business planning purposes including, but not limited to, project screening, evaluation of resource needs and budgeting, and long-range capital planning, such as this Master Plan.

8.4 CONSTRUCTION UNIT COSTS

The construction costs are representative of water system facilities under normal construction conditions and schedules. Costs have been estimated for public works construction.

8.4.1 Pipeline Unit Costs

Assumptions for pipeline unit costs are shown in Table 8.2. Consistent with typical master-planning methodology, pipeline materials have not been specified for this cost estimate. All costs are in 2015 dollars, and, therefore, inflation correction for the future CIP budgets would be needed to fund the renewal projects.
Table 8.2  Unit Construction Costs - Water Buried Assets
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Unit Construction Cost(^{(1)}) ($/linear foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>$100</td>
</tr>
<tr>
<td>4</td>
<td>$100</td>
</tr>
<tr>
<td>6</td>
<td>$150</td>
</tr>
<tr>
<td>8</td>
<td>$155</td>
</tr>
<tr>
<td>10</td>
<td>$195</td>
</tr>
<tr>
<td>12</td>
<td>$205</td>
</tr>
<tr>
<td>16</td>
<td>$275</td>
</tr>
<tr>
<td>18</td>
<td>$310</td>
</tr>
<tr>
<td>20</td>
<td>$340</td>
</tr>
<tr>
<td>24</td>
<td>$390</td>
</tr>
<tr>
<td>30</td>
<td>$410</td>
</tr>
<tr>
<td>36</td>
<td>$485</td>
</tr>
<tr>
<td>42</td>
<td>$585</td>
</tr>
<tr>
<td>48</td>
<td>$640</td>
</tr>
<tr>
<td>Unknown Diameter (assume 8 inches)</td>
<td>$155</td>
</tr>
</tbody>
</table>

Notes:
(1) ENR 20-City Index = 10037 (ENR 20-City Index, July 2015). Does not include contingency markup.

8.4.2 Tank and Booster Station Unit Costs

This Master Plan includes tank and pump station improvement projects in order to meet projected 2035 demand requirements as discussed in Chapter 7. The unit cost for these projects was calculated to be approximately $1.9/gallon, based on the construction cost for recent tank projects in the City. Costs were generated by inputting the appropriate capacity and calculating the corresponding construction costs.

8.4.3 Direct Costs

Direct costs for each capital improvement were estimated based on various reference sources. Where possible, the cost from a 100-percent design estimate or a schedule of values was used and converted to current dollars. Other cost sources included Carollo reference projects, the R.S. Means price catalog, Carollo’s Unit Price Catalog, and vendor quotes. In cases where a Carollo reference project was used, the costs provided in the reference project were adjusted for location via R.S. Means location factors, and for inflation using the appropriate ENR CCI.
8.5 PROJECT COSTS AND CONTINGENCIES

Project cost estimates are calculated based on elements, such as the project location, size, length, land acquisition needs, and other factors. Allowances for project contingencies consistent with a Class 5 estimate are also included in the project costs prepared as part of this study, as outlined in this section.

8.5.1 Baseline Construction Cost

This is the total estimated construction cost, in dollars, of the proposed improvement projects. Baseline construction costs were calculated by multiplying the estimated number of units by the unit cost, such as length of pipeline times the average cost per lineal foot of pipeline.

8.5.2 Estimated Construction Cost

Contingency costs must be reviewed on a case-by-case basis because they will vary considerably with each project. Consequently, it is appropriate to allow for uncertainties associated with the preliminary layout of a project. Such factors as unexpected construction conditions, the need for unforeseen mechanical items, and variations in final quantities are a few of the items that can increase project costs for which it is wise to make allowances in preliminary estimates.

Since knowledge about site-specific conditions of each proposed project is limited at the master-planning stage, a 30-percent contingency was applied to the Baseline Construction Cost to account for unforeseen events and unknown conditions. This contingency accounts for unknown site conditions such as poor soil, unforeseen conditions, environmental mitigations, and other unknowns and is typical for master planning projects. The Estimated Construction Cost for the proposed water system improvements consists of the Baseline Construction Cost plus the 30-percent construction contingency.

8.5.3 Capital Improvement Cost

Other project construction contingency costs include costs associated with engineering, construction-phase professional services, and project administration. Engineering services associated with new facilities include preliminary investigations and reports, right-of-way (ROW) acquisition, foundation explorations, preparation of drawings and specifications during construction, surveying and staking, sampling of testing material, and start-up services. Construction-phase professional services cover such items as construction management, engineering services, materials testing, and inspection during construction. Finally, there are project administration costs, which cover such items as legal fees, environmental/California Environmental Quality Act (CEQA) compliance requirements, financing expenses, administrative costs, and interest during construction.
The cost of these items can vary, but, for the purpose of this study, it is assumed that the other project contingency costs will equal approximately 25 percent of the Estimated Construction Cost.

As shown in the following sample calculation of the capital improvement cost, the total cost of all project construction contingencies (construction, engineering services, construction management, and project administration) is 62.5 percent of the baseline construction cost. Calculation of the 62.5 percent is the overall markup on the baseline construction cost to arrive at the capital improvement cost. It is not an additional contingency.

Example:

- **Baseline Construction Cost**: $1,000,000
- **Construction Contingency (30%)**: $300,000
- **Estimated Construction Cost**: $1,300,000
- **Engineering Cost + Construction Management + Project Administration (25%)**: $325,000
- **Capital Improvement Cost**: $1,625,000

### 8.6 CAPITAL PROJECTS

This section summarizes the capital costs and phasing for the GKWTP, storage, distribution and transmission systems, and pump stations. Conditions that were observed at multiple locations throughout the plant or the distribution system were consolidated into facility-wide or system-wide projects. These projects may require simultaneous replacement of associated assets or a sequenced replacement schedule. These considerations are factored into the analysis conducted to establish the CIP. A full list of recommended projects, which are also discussed in Chapter 7, is provided in the Table 8.3 and Table 8.4.
<table>
<thead>
<tr>
<th>ID</th>
<th>Project</th>
<th>Type of Improv.</th>
<th>Description/Street</th>
<th>Description Limits</th>
<th>CIP #</th>
<th>Proposed Start Year</th>
<th>Proposed End Year</th>
<th>Phase 1 2016-2020 ($</th>
<th>Phase 2 2017-2022 ($</th>
<th>Phase 3 2023-2026 ($</th>
<th>Future Improvements ($</th>
<th>Estimated Improvement Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>FF-01 Fire Flow Improvements</td>
<td>Pipe: Liberty Ave</td>
<td>Water Dis. to South Ave</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>$280,000</td>
<td>-</td>
<td>-</td>
<td>$280,000</td>
<td>-</td>
<td>Capacity Related Projects</td>
</tr>
<tr>
<td>FF-02 Fire Flow Improvements</td>
<td>Pipe: I-505 to South Ave</td>
<td>Water Dis. to South Ave</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>FF-03 Fire Flow Improvements</td>
<td>Pipe: Alvar St</td>
<td>Water Dis. to Trulia Ave</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>Capacity Related Projects</td>
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</tr>
<tr>
<td>FF-04 Fire Flow Improvements</td>
<td>Pipe: Southlake Ave</td>
<td>Water Dis. to Alvar Ave</td>
<td>Extending</td>
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<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>Capacity Related Projects</td>
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<tr>
<td>FF-05 Fire Flow Improvements</td>
<td>Pipe: Diablo St</td>
<td>Water Dis. to End of Diablo</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>FF-06 Fire Flow Improvements</td>
<td>Pipe: River Dr</td>
<td>Sacramento Ave. to End of Alvar</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>FF-07 Fire Flow Improvements</td>
<td>Pipe: Ferris Ave</td>
<td>Holland Ave. to Walnut St</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>FF-08 Fire Flow Improvements</td>
<td>Pipe: Woodrow St.</td>
<td>Federation St. to Whittington Cl</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>Capacity Related Projects</td>
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</tr>
<tr>
<td>FF-09 Fire Flow Improvements</td>
<td>Pipe: Cooperage Way</td>
<td>8th St. to 16th Way</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>FF-10 Fire Flow Improvements</td>
<td>Pipe: 8th St. to 3rd St (Culvert New Loop)</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>Capacity Related Projects</td>
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<tr>
<td>FF-11 Fire Flow Improvements</td>
<td>Pipe: Halyard Dr</td>
<td>Beacon Blvd. to Harbor Blvd</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>Capacity Related Projects</td>
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<tr>
<td>FF-12 Fire Flow Improvements</td>
<td>Pipe: 8th St to 7th St</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
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<td>-</td>
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<td>Capacity Related Projects</td>
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<td></td>
</tr>
<tr>
<td>FF-13 Fire Flow Improvements</td>
<td>Pipe: Oak Bluffs Avenue Ave</td>
<td>Sacramento Ave. to North of Railroad</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>-</td>
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<td>Capacity Related Projects</td>
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</tr>
<tr>
<td>FF-14 Fire Flow Improvements</td>
<td>Pipe: 12th St</td>
<td>Water Dis. to 11th St (100 Line Fresh St)</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
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<td>-</td>
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<td>Capacity Related Projects</td>
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</tr>
<tr>
<td>FF-15 Fire Flow Improvements</td>
<td>Pipe: 14th St at Whittington Cl</td>
<td>Water Dis. to 14th St</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
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<td>Capacity Related Projects</td>
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<tr>
<td>FF-16 Fire Flow Improvements</td>
<td>Pipe: 10th St at Whittington Cl</td>
<td>Water Dis. to 10th St</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>FF-17 Fire Flow Improvements</td>
<td>Pipe: Oak Ave</td>
<td>Water Dis. to 10th Ave</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>Capacity Related Projects</td>
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</tr>
<tr>
<td>FF-18 Fire Flow Improvements</td>
<td>Pipe: 17th St to 16th St</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
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</tr>
<tr>
<td>FF-19 Fire Flow Improvements</td>
<td>Pipe: 19th St at 18th St</td>
<td>Water Dis. to 18th St</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>FF-20 Fire Flow Improvements</td>
<td>Pipe: 21st St</td>
<td>Water Dis. to 20th St</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
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<td>Capacity Related Projects</td>
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</tr>
<tr>
<td>FF-21 Fire Flow Improvements</td>
<td>Pipe: 23rd St</td>
<td>Water Dis. to 22nd St</td>
<td>Extending</td>
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<tr>
<td>FF-22 Fire Flow Improvements</td>
<td>Pipe: 25th St</td>
<td>Water Dis. to 24th St</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
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</tr>
<tr>
<td>FF-23 Fire Flow Improvements</td>
<td>Pipe: 27th St</td>
<td>Water Dis. to 26th St</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>FF-24 Fire Flow Improvements</td>
<td>Pipe: 29th St</td>
<td>Water Dis. to 28th St</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>TM-02 Capacity Improvements</td>
<td>Pipe: Future Bridge Site at PSIP Deepwater Ship Channel Crossing at PSIP/SIP Future</td>
<td>Future Bridge Site at PSIP Deepwater Ship Channel Crossing at PSIP/SIP Future</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>TM-03 Capacity Improvements</td>
<td>Pipe: West Capitol Boulevard Jefferson Boulevard to Delta Lane Future</td>
<td>Future Bridge Site at PSIP Deepwater Ship Channel Crossing at PSIP/SIP Future</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>TM-06 Capacity Improvements</td>
<td>Pipe: Jackson, Dreyer, and Soulle St Jefferson Boulevard to End of Soulle Street Future</td>
<td>Future Bridge Site at PSIP Deepwater Ship Channel Crossing at PSIP/SIP Future</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>TM-07 Capacity Improvements</td>
<td>Pipe: South River Road Bridge Deepwater Ship Channel Crossing @ South River Rd Bridge Future</td>
<td>Future Bridge Site at PSIP Deepwater Ship Channel Crossing at PSIP/SIP Future</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>TM-08 Capacity Improvements</td>
<td>Pipe: Village Parkway Ex. Main on Village Parkway to Liberty Development Main Future</td>
<td>Future Bridge Site at PSIP Deepwater Ship Channel Crossing at PSIP/SIP Future</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>TM-10 Capacity Improvements</td>
<td>Pipe: Bevan Road Antioch Avenue to Jefferson Boulevard Future</td>
<td>Future Bridge Site at PSIP Deepwater Ship Channel Crossing at PSIP/SIP Future</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>T-01 New Tank &amp; Pump Stations</td>
<td>Tank/PS</td>
<td>The Rivers Tank/PS</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>T-02 New Tank &amp; Pump Stations</td>
<td>Tank/PS</td>
<td>Bridgeway Lakes 2 Tank/PS</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>T-04 New Tank &amp; Pump Stations</td>
<td>Tank/PS</td>
<td>Southeast Tank/PS</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>T-05 New Tank &amp; Pump Stations</td>
<td>Tank/PS</td>
<td>Liberty Tank/PS</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>T-06 New Tank &amp; Pump Stations</td>
<td>Tank/PS</td>
<td>Village Parkway/Linden Road</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
<tr>
<td>T-07 New Tank &amp; Pump Stations</td>
<td>Tank/PS</td>
<td>Village Parkway Extension east of Davis Road</td>
<td>Extending</td>
<td>40</td>
<td>280,000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Capacity Related Projects</td>
<td></td>
</tr>
</tbody>
</table>

**Capacity Related Projects Subtotal**: 7,354,000$ | 11,226,000$ | 3,105,000$ | 1,509,000$ | 1,119,000$ | 63,214,000$
Table 8.3
Table 8.2
Table 8.2

Water Distribution System CIP
2015 Water Master Plan Update
City of West Sacramento
Project Length/Size and Cost

ID

Project

Type of
Improv.

Description/Street

Description/ Limits

CIP
Reason

Proposed
Ex. Size/
Size/
Diam.
Diam.
(in)
(in)

Replace/
New

Length
(ft)

Phasing
Capital
Improvement
Cost(1),(2),(3)
($)

Reimbursement Category
Phase 2
2021-2025
($)

Phase 1
2016-2020
($)

Phase

Phase 3
2026-2030
($)

Future
Users
Benefit

Phase 4
2031-2035
($)

Existing
Improvements
($)

Future
Improvements
($)

Rehab Related Projects
RR-01

Water Main Replacements

Pipe

Phase 1 WDS Replacements

various locations (excludes FF projects listed above)

Existing

varies

varies

R/R

1,821

$

474,000

1

$

474,000

$

-

$

-

$

-

0%

$

474,000

$

-

RR-02

Water Main Replacements

Pipe

Phase 2 WDS Replacements

various locations (excludes FF projects listed above)

Existing

varies

varies

R/R

3,402

$

835,000

2

$

-

$

835,000

$

-

$

-

0%

$

835,000

$

-

RR-03

Water Main Replacements

Pipe

Phase 3 WDS Replacements

various locations (excludes FF projects listed above)

Existing

varies

varies

R/R

17,032

$

3,897,000

3

$

-

$

-

$

3,897,000

$

-

0%

$

3,897,000

$

-

RR-04

Water Main Replacements

Pipe

Phase 4 WDS Replacements

various locations (excludes FF projects listed above)

Existing

varies

varies

R/R

11,924

$

2,724,000

4

$

-

$

-

$

-

$

2,724,000

0%

$

2,724,000

$

-

$

1,000,000

MR-01

Water Meter Installation Program

Meter

Various Locations

Meter installation for coversion from flat to volumetric rate

Existing

varies

varies

Replace

N/A

$

1,600,000

1

0%

$

1,600,000

$

-

MR-02

Meter Body Replacement

Meter

Meter Body Replacement

25% of total meter bodies to be replaced every five years starting in Phase

Existing

varies

varies

Replace

N/A

$

7,458,750

2,3,4

$

1,864,688

$

1,864,688

$

1,864,688

0%

$

5,594,063

$

-

MR-03

Meter Register Replacement

Meter

Meter Register Replacement

25% of total meter registers to be replaced every five years starting in Phas Existing

varies

varies

Replace

N/A

$

4,972,500

2,3,4

$

1,243,125

$

1,243,125

$

1,243,125

0%

$

3,729,375

$

-

MR-04

Meter MXU replacement

Meter

Meter MXU replacement

50% of total MXUs to be replaced in Phase 4

Existing

varies

varies

Replace

N/A

$

6,837,188

4

$

-

$

-

$

3,418,594

0%

$

3,418,594

$

-

$

$

300,000

$

300,000

PS-01

Tank Recoating/Lining

Tank/PS

Tank recoating/lining

Oak St Reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

75,000

1

$

-

$

-

$

-

0%

$

75,000

$

-

PS-02

Tank Recoating/Lining

Tank/PS

Tank recoating/lining

Carlin Reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

75,000

1

75,000
$

75,000

$

-

$

-

$

-

0%

$

75,000

$

-

PS-03

Tank Recoating/Lining

Tank/PS

Tank recoating/lining

Central Reservoir Pump Station

Existing

varies

varies

Rehab

N/A

$

75,000

1

$

75,000

$

-

$

-

$

-

0%

$

75,000

$

-

PS-04

Security improvements

Tank/PS

Security improvements

North East Reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

12,000

1

$

12,000

$

-

$

-

$

-

0%

$

12,000

$

-

PS-05

Security improvements

Tank/PS

Security improvements

Oak St Reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

17,000

1

$

17,000

$

-

$

-

$

-

0%

$

17,000

$

-

PS-06

Pump & VFD Replacements

Tank/PS

Pump 1-P110

Bridge District Reservoir and Pump Station

Existing

100 hp

Replace

N/A

$

82,000

4

$

-

$

-

$

-

$

82,000

0%

$

82,000

$

-

PS-07

Pump & VFD Replacements

Tank/PS

Pump 2-P120

Bridge District Reservoir and Pump Station

Existing

100 hp

Replace

N/A

$

82,000

4

$

-

$

-

$

-

$

82,000

0%

$

82,000

$

-

PS-08

Pump & VFD Replacements

Tank/PS

Pump 1

Carlin Reservoir and Pump Station

Existing

125 hp

Replace

N/A

$

90,000

4

$

-

$

-

$

-

$

90,000

0%

$

90,000

$

-

PS-09

Pump & VFD Replacements

Tank/PS

Pump 2

Carlin Reservoir and Pump Station

Existing

125 hp

Replace

N/A

$

90,000

4

$

-

$

-

$

-

$

90,000

0%

$

90,000

$

-

PS-10

Pump & VFD Replacements

Tank/PS

Pump 3

Carlin Reservoir and Pump Station

Existing

125 hp

Replace

N/A

$

90,000

4

$

-

$

-

$

-

$

90,000

0%

$

90,000

$

-

PS-11

Pump & VFD Replacements

Tank/PS

Pump 4

Carlin Reservoir and Pump Station

Existing

125 hp

Replace

N/A

$

90,000

4

$

-

$

-

$

-

$

90,000

0%

$

90,000

$

-

PS-12

Pump & VFD Replacements

Tank/PS

Pump 1- P28

In-Line Booster Pump Station

Existing

Replace

N/A

$

106,000

4

$

-

$

-

$

-

$

106,000

0%

$

106,000

$

-

PS-13

Pump & VFD Replacements

Tank/PS

Pump 2- P29

In-Line Booster Pump Station

Existing

Replace

N/A

$

106,000

4

$

-

$

-

$

-

$

106,000

0%

$

106,000

$

-

PS-14

Pump & VFD Replacements

Tank/PS

Pump 3- P30

In-Line Booster Pump Station

Existing

Replace

N/A

$

106,000

4

$

-

$

-

$

-

$

106,000

0%

$

106,000

$

-

PS-15

Pump & VFD Replacements

Tank/PS

Pump 1 - 601

North East Reservoir and Pump Station

Existing

30 hp

Replace

N/A

$

41,000

4

$

-

$

-

$

-

$

41,000

0%

$

41,000

$

-

PS-16

Pump & VFD Replacements

Tank/PS

Pump 2- 602

North East Reservoir and Pump Station

Existing

30 hp

Replace

N/A

$

41,000

4

$

-

$

-

$

-

$

41,000

0%

$

41,000

$

-

PS-17

Pump & VFD Replacements

Tank/PS

Pump 3- 603

North East Reservoir and Pump Station

Existing

75 hp

Replace

N/A

$

74,000

4

$

-

$

-

$

-

$

74,000

0%

$

74,000

$

-

PS-18

Pump & VFD Replacements

Tank/PS

Pump 4- 604

North East Reservoir and Pump Station

Existing

75 hp

Replace

N/A

$

74,000

4

$

-

$

-

$

-

$

74,000

0%

$

74,000

$

-

PS-19

Pump & VFD Replacements

Tank/PS

Pump 1- M1

Oak St Reservoir and Pump Station

Existing

75 hp

Replace

N/A

$

74,000

4

$

-

$

-

$

-

$

74,000

0%

$

74,000

$

-

PS-20

Pump & VFD Replacements

Tank/PS

Pump 2- M2

Oak St Reservoir and Pump Station

Existing

75 hp

Replace

N/A

$

74,000

4

$

-

$

-

$

-

$

74,000

0%

$

74,000

$

-

PS-21

Pump & VFD Replacements

Tank/PS

Pump 3- M3

Oak St Reservoir and Pump Station

Existing

30 hp

Replace

N/A

$

41,000

4

$

-

$

-

$

-

$

41,000

0%

$

41,000

$

-

PS-22

Pump & VFD Replacements

Tank/PS

Pump 1

Bridge District Reservoir and Pump Station

Existing

150 hp

Replace

N/A

$

65,000

4

$

-

$

-

$

-

$

65,000

0%

$

65,000

$

-

PS-23

Pump & VFD Replacements

Tank/PS

Pump 2

Bridge District Reservoir and Pump Station

Existing

150 hp

Replace

N/A

$

65,000

4

$

-

$

-

$

-

$

65,000

0%

$

65,000

$

-

PS-24

Pump & VFD Replacements

Tank/PS

Pump 3

Bridge District Reservoir and Pump Station

Existing

150 hp

Replace

N/A

$

65,000

4

$

-

$

-

$

-

$

65,000

0%

$

65,000

$

-

PS-25

Pump & VFD Replacements

Tank/PS

VFD 1

Bridge District Reservoir and Pump Station

Existing

Replace

N/A

$

82,000

4

$

-

$

-

$

-

$

82,000

0%

$

82,000

$

-

PS-26

Pump & VFD Replacements

Tank/PS

VFD 2

Bridge District Reservoir and Pump Station

Existing

Replace

N/A

$

82,000

4

$

-

$

-

$

-

$

82,000

0%

$

82,000

$

-

PS-27

Pump & VFD Replacements

Tank/PS

VFD 1

Bridgeway Lake reservoir and Pump Station

Existing

Replace

N/A

$

106,000

4

$

-

$

-

$

-

$

106,000

0%

$

106,000

$

-

PS-28

Pump & VFD Replacements

Tank/PS

VFD 2

Bridgeway Lake reservoir and Pump Station

Existing

Replace

N/A

$

106,000

4

$

-

$

-

$

-

$

106,000

0%

$

106,000

$

-

PS-29

Pump & VFD Replacements

Tank/PS

VFD 3

Bridgeway Lake reservoir and Pump Station

Existing

Replace

N/A

$

106,000

4

$

-

$

-

$

-

$

106,000

0%

$

106,000

$

-

PS-31

Seismic Analyses

Tank/PS

Seismic Analysis

North East Reservoir and Pump Station

Existing

Rehab

N/A

$

17,000

1

$

-

$

-

$

-

0%

$

17,000

$

-

varies

varies

$

17,000

PS-32

Seismic Retrofits

Tank/PS

Seismic Retrofit or Replacement

North East Reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

501,000

1

$

501,000

$

-

$

-

$

-

0%

$

501,000

$

-

PS-33

Seismic Analyses

Tank/PS

Seismic Analysis

Bridgeway Lake reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

17,000

1

$

17,000

$

-

$

-

$

-

0%

$

17,000

$

-

PS-34

Seismic Analyses

Tank/PS

Seismic Analysis

Central Reservoir Pump Station

Existing

varies

varies

Rehab

N/A

$

17,000

1

$

17,000

$

-

$

-

$

-

0%

$

17,000

$

-

PS-35

Seismic Analyses

Tank/PS

Seismic Analysis

Carlin Reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

17,000

1

$

17,000

$

-

$

-

$

-

0%

$

17,000

$

-

PS-36

Seismic Analyses

Tank/PS

Seismic Analysis

Oak St Reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

17,000

1

$

17,000

$

-

$

-

$

-

0%

$

17,000

$

-

PS-37

Seismic Analyses

Tank/PS

Seismic Analysis

Bridge District Reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

17,000

1

$

17,000

$

-

$

-

$

-

0%

$

17,000

$

-

PS-38

Misc. Tank & PS Improvements

Tank/PS

PS piping flexibility improvements

Central Reservoir Pump Station

Existing

varies

varies

Rehab

N/A

$

250,000

1

PS-39

Misc. Tank & PS Improvements

Tank/PS

Drainage improvements

North East Reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

5,000

1

PS-40

Misc. Tank & PS Improvements

Tank/PS

Rehabilitation of concrete foundation

Oak St Reservoir and Pump Station

Existing

varies

varies

Rehab

N/A

$

7,000

1

$
$

250,000

5,000

Rehab Related Projects Subtotal

$

1,583,000

$

450,000

Water Distribution System CIP Total

$

8,889,000

$

11,676,000

$

903,000
$3,193,000
$
4,008,000
$27,458,000

$

7,000

$

250,000

$

7,000

$

1,759,000

$

1,126,000

$

-

$

-

$

-

0%

$

250,000

$

-

$

-

$

-

$

-

0%

$

5,000

$

-

$

-

$

-

$

-

0%

$

7,000

$

-

$

3,942,813

$

7,004,813

$

11,188,406

$

25,329,031

$

-

$

27,025,813

$

23,971,813

$

29,621,406

$

44,863,031

$

63,214,000

Notes:
1. Estimated Construction Cost to account for unforeseen events and unknown conditions (30%).
2. Additional markups include engineering, management, environmental, and legal (25%)
3. Total Contingency Markup = 62.5% (125%x130%-100%). ENR CCI = 10,037 (20 Cities, July 2015)

Page 2 of 2


| ID | Project | Type of Improvement | Description/Assets | Process Area | Process | Phase 1 2016-2020 (\$) | Phase 2 2021-2025 (\$) | Phase 3 2026-2030 (\$) | Phase 4 2031-2035 (\$) | Picket | Existing Improvements (\$) | Picket Improvements (\$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AF-03 | 2016 | Harmonic Conditioner Replacement | Harmonic Conditioner Replacement | Actiflo Clarification No. 1 and 2 | 52,000 | 52,000 | 52,000 | 52,000 | 0% | 104,000 | 52,000 |
| AF-04 | 2017 | Instrumentation Replacement | Instrumentation Replacement | Actiflo Clarification No. 1 and 2 | 17,000 | 17,000 | 17,000 | 17,000 | 0% | 34,000 | 17,000 |
| AF-05 | 2018 | Instrumentation Replacement | Instrumentation Replacement | Actiflo Clarification No. 1 and 2 | 17,000 | 17,000 | 17,000 | 17,000 | 0% | 34,000 | 17,000 |
| AF-06 | 2019 | Instrumentation Replacement | Instrumentation Replacement | Actiflo Clarification No. 1 and 2 | 17,000 | 17,000 | 17,000 | 17,000 | 0% | 34,000 | 17,000 |
| AF-07 | 2020 | Instrumentation Replacement | Instrumentation Replacement | Actiflo Clarification No. 1 and 2 | 17,000 | 17,000 | 17,000 | 17,000 | 0% | 34,000 | 17,000 |
| AF-08 | 2021 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |
| AF-09 | 2022 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |
| AF-10 | 2023 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |
| AF-11 | 2024 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |
| AF-12 | 2025 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |
| AF-13 | 2026 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |
| AF-14 | 2027 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |
| AF-15 | 2028 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |
| AF-16 | 2029 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |
| AF-17 | 2030 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |
| AF-18 | 2031 | Membrane Replacement | Membrane Replacement | No. 1 and 2 | 83,000 | 83,000 | 83,000 | 83,000 | 0% | 166,000 | 83,000 |

**Table 8.4** George Kessell Water Treatment Plant CIP

2015 Master Plan Update:
City of West Sacramento
<table>
<thead>
<tr>
<th>ID</th>
<th>ID Reference</th>
<th>Project Type</th>
<th>Description/Assets</th>
<th>Process Area</th>
<th>Phase</th>
<th>Capital Improvement Cost ($)(1),(2),(3)</th>
<th>Fractional Capital Improvements Benefits</th>
<th>Existing Improvements Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>P-04</td>
<td>HSP</td>
<td>High Service Pump Replacements</td>
<td>High Service Pump Replacement</td>
<td>High Service Pumps</td>
<td>1-4</td>
<td>244,000 $</td>
<td>0%</td>
</tr>
<tr>
<td>181</td>
<td>P-11</td>
<td>HSP</td>
<td>High Service Pump Replacements</td>
<td>High Service Pump Replacement</td>
<td>High Service Pumps</td>
<td>2-3</td>
<td>244,000 $</td>
<td>0%</td>
</tr>
<tr>
<td>182</td>
<td>P-13</td>
<td>HSP</td>
<td>High Service Pump Replacements</td>
<td>High Service Pump Replacement</td>
<td>High Service Pumps</td>
<td>2-5</td>
<td>244,000 $</td>
<td>0%</td>
</tr>
<tr>
<td>183</td>
<td>P-14</td>
<td>HSP</td>
<td>High Service Pump Replacements</td>
<td>High Service Pump Replacement</td>
<td>High Service Pumps</td>
<td>2-6</td>
<td>244,000 $</td>
<td>0%</td>
</tr>
<tr>
<td>184</td>
<td>P-15</td>
<td>HC</td>
<td>Motor Control Center (condition assessment)</td>
<td>Motor Control Center (condition assessment)</td>
<td>MCC-HS</td>
<td>1</td>
<td>9,000 $</td>
<td>0%</td>
</tr>
<tr>
<td>185</td>
<td>P-17</td>
<td>HSP</td>
<td>High Service Pump VFDs</td>
<td>VFD Replacement</td>
<td>VFD</td>
<td>1 PMP-HP-010</td>
<td>87,000 $</td>
<td>0%</td>
</tr>
<tr>
<td>186</td>
<td>P-18</td>
<td>IPS</td>
<td>Intake Facilities and Pump Station Improvements</td>
<td>Valve Replacement</td>
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<td>33,000 $</td>
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<td>187</td>
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<tr>
<td>193</td>
<td>B-01</td>
<td>LMB</td>
<td>SCADA System Replacements</td>
<td>SCADA Replacement</td>
<td>RTU-7</td>
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<td>194</td>
<td>B-02</td>
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<td>LP</td>
<td>OP</td>
<td>Monitoring &amp; Control</td>
<td>Monitoring &amp; Control System Replacement</td>
<td>RTU-7</td>
<td>Operations Building</td>
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<td>196</td>
<td>S-03</td>
<td>OPS</td>
<td>Operations Building Improvements</td>
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<td>Operations Building</td>
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<td>197</td>
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<td>PD</td>
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<td>Process Drain Pump Recoating</td>
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<td>198</td>
<td>PD</td>
<td>PD</td>
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<td>Install TM Analyzer Operations Room</td>
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<td>199</td>
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## Table 8.3     City of West Sacramento

### Future

#### 2016-2020

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<tr>
<th>Description/Assets</th>
<th>Process Area</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Contingency Markup (1)</th>
<th>Existing Improvements (2)</th>
<th>Future Improvements (3)</th>
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<td>RW-02</td>
<td>RW Flow Meters Replacement</td>
<td>Magnetic Flow Meters</td>
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<td>Reclaimed Water Pump</td>
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<td>RW-07</td>
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<td>Reclaimed Water Pump</td>
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<td>-</td>
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<td>RW-11</td>
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<td>RW Safety Improvements</td>
<td>Safety Crash Barrier of RWB-04</td>
<td>Crash Barriers</td>
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<td>0</td>
<td>-</td>
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<tr>
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<td>VFD Crash Barriers</td>
<td>120V Alternating Current (AC)</td>
<td>RW</td>
<td>$1,000</td>
<td>0</td>
<td>-</td>
<td>$1,000</td>
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<td>RW-14</td>
<td>RW VFD Assessments and Replacements</td>
<td>VFD Crash Barriers</td>
<td>120V Alternating Current (AC)</td>
<td>RW</td>
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<td>0</td>
<td>-</td>
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<td>RW-15</td>
<td>RW VFD Assessments and Replacements</td>
<td>VFD Crash Barriers</td>
<td>120V Alternating Current (AC)</td>
<td>RW</td>
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<td>0</td>
<td>-</td>
<td>$41,000</td>
</tr>
<tr>
<td>RW-16</td>
<td>RW Raw Water Manifold Structural Rehabilitation</td>
<td>Raw Water Manifold Structural Rehabilitation</td>
<td>Raw Water Manifold</td>
<td>RW</td>
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<td>0</td>
<td>-</td>
<td>$142,000</td>
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<td>RWB-01</td>
<td>RWB Recycle Pump Replacements</td>
<td>Recycle Pump Replacement</td>
<td>Sludge Disposal Pump 3</td>
<td>Recycled Water Basins No. 1 and No. 2</td>
<td>$65,000</td>
<td>0</td>
<td>-</td>
<td>$65,000</td>
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<td>RWB-02</td>
<td>RWB Recycle Pump Replacements</td>
<td>Recycle Pump Replacement</td>
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<td>Recycled Water Basins No. 1 and No. 2</td>
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<td>0</td>
<td>-</td>
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<td>RWB-03</td>
<td>RWB Recycle Pump Replacements</td>
<td>Recycle Pump Replacement</td>
<td>Sludge Disposal Pump 2</td>
<td>Recycled Water Basins No. 1 and No. 2</td>
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<td>RWB-04</td>
<td>RWB Cross Collector Inspection and Replacement</td>
<td>Cross Collector Replacement</td>
<td>Cross Collector Type</td>
<td>Recycled Water Basins No. 1 and No. 2</td>
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<td>-</td>
<td>$98,000</td>
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<td>RWB Cross Collector Inspection and Replacement</td>
<td>Cross Collector Replacement</td>
<td>Cross Collector Type</td>
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<td>0</td>
<td>-</td>
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<td>RWB-06</td>
<td>RWB Decanter Replacements</td>
<td>Decanter Replacement</td>
<td>Decanters</td>
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<td>0</td>
<td>-</td>
<td>$41,000</td>
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<tr>
<td>RWB-07</td>
<td>RWB Actuator Replacements</td>
<td>Actuator Replacement</td>
<td>Gates - Limitorque Actuators</td>
<td>Recycled Water Basins No. 1 and No. 2</td>
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<td>$17,000</td>
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<tr>
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<td>FAC Measurement Instrumentation Replacements</td>
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<td>Facility-wide measuring equipment and transmitters</td>
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<td>1</td>
<td>-</td>
<td>$100,000</td>
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<tr>
<td>FAC-02</td>
<td>FAC PLC racks, components, and integrator controls</td>
<td>PLC racks, components, and integrator controls Replacement</td>
<td>Facility-wide measuring equipment and transmitters</td>
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<td>1</td>
<td>-</td>
<td>$50,000</td>
</tr>
</tbody>
</table>

### Notes

1. Estimated Construction Cost to account for unforeseen events and unknown conditions (30%).
2. Additional analysis includes engineering, management, environmental, and legal (3%).
3. Total Construction Management fee paid for engineering and management services for a total of 3%.

### Total

<table>
<thead>
<tr>
<th>RW-02</th>
<th>RW-05</th>
<th>RW-06</th>
<th>RW-07</th>
<th>RW-08</th>
<th>RW-11</th>
<th>RW-12</th>
<th>RW-16</th>
<th>RWB-01</th>
<th>RWB-02</th>
<th>RWB-03</th>
<th>RWB-04</th>
<th>RWB-05</th>
<th>RWB-06</th>
<th>RWB-07</th>
<th>FAC-01</th>
<th>FAC-02</th>
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<tbody>
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<td>$122,000</td>
<td>$122,000</td>
<td>$122,000</td>
<td>$122,000</td>
<td>$114,000</td>
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<td>$65,000</td>
<td>$65,000</td>
<td>$98,000</td>
<td>$98,000</td>
<td>$41,000</td>
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</tbody>
</table>
8.6.1 Water Distribution System - Capacity Projects

8.6.1.1 Fire Flow Improvements ("FF" Projects)

As discussed in Chapter 7, a model of the existing system identified 102 fire flow nodes with deficient (less than 20 pounds per square inch [psi]) residual pressures. To mitigate these deficiencies, recommendations for pipeline improvements were developed and identified in Table 7.4. An additional, separate evaluation in the Washington District was performed at the request of the City. Results are contained in a TM included as Appendix L, improvement recommendations are consistent with those included herein.

Table 8.5 shows the estimated costs of the recommended fire flow improvement projects, broken out by phase. Projects FF-1 to FF-18 are proposed to be finished during Phase 1 and have specific years labeled in the table.

<table>
<thead>
<tr>
<th>Improv. ID</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>FF-1 to FF-4 (2016)</td>
<td>$1,440,000</td>
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<tr>
<td>FF-5 to FF-8 (2017)</td>
<td>$951,000</td>
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<tr>
<td>FF-9 to FF-12 (2018)</td>
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<tr>
<td>FF-13 (2017)</td>
<td>$479,000</td>
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<tr>
<td>FF-14 to FF-16 (2019)</td>
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<tr>
<td>FF-17 to FF-18 (2020)</td>
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<td>FF-19 to FF-22</td>
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<td>FF-23 to FF-24</td>
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<td>FF-25 to FF-26</td>
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<td>FF-34</td>
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<td>Total</td>
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<td>$2,936,000</td>
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8.6.1.2 Corporation Yard ("CY" Projects)

Chapter 7 discussed the City's long-term project of relocating the Corporation Yard ("Corp Yard") from its existing location, which includes the City's Public Works facility. The water system's estimated portion for this project is approximately $3,000,000 and will be assumed to be used in Phase 1 of the Capital Improvement Plan (2017).
8.6.1.3 Capacity Improvements ("TM" Projects)

As explained in Chapter 7, it is recommended that new transmission main and backbone system improvements be implemented in order to develop transmission looping in new growth areas and avoid dead ends. Table 8.6 below shows the estimated costs of the proposed capacity improvement projects, broken down by phase.

<table>
<thead>
<tr>
<th>Improv. ID</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
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<tbody>
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<td>TM-03</td>
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<td>TM-04</td>
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<td>$554,000</td>
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<td>TM-09 (2017)</td>
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8.6.1.4 New Tank and Pump Stations ("T" Projects)

As discussed in Section 7.1.2, the City will need to add an additional 11.8 million gallons (MG) of storage to meet projected 2035 demand requirements. A total of five new tanks and replacement of one existing tank is recommended based on analysis conducted for this Master Plan. Table 8.7 shows the breakdown of the estimated costs by phase for the proposed projects.
Table 8.7 Proposed New Tank & Pump Station ("T" Projects) CIP Breakdown
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>Improv. ID</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
</tr>
</thead>
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<td>$7,719,000</td>
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<td>$41,064,000</td>
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8.6.2 Water Distribution System - Rehabilitation Projects

8.6.2.1 Water Main Replacements ("RR" Projects)

As previously described, water main replacement projects for the City's distribution system have been broken down by phase in the CIP. The length of water main anticipated to need replacement in each phase listed below was determined based on the estimated life remaining for each water main.

- **Project RR-01 (Phase 1 WDS Replacements):** Approximately 1,821 linear feet (lf) of water mains in various locations throughout the City would be replaced during Phase 1 of the Capital Improvement Plan, specifically in 2016. The estimated cost is $474,000.

- **Project RR-02 (Phase 2 WDS Replacements):** Approximately 3,402 lf of water mains in various locations throughout the City would be replaced during Phase 2 of the Capital Improvement Plan (2021-2025), with an estimated cost of $835,000.

- **Project RR-03 (Phase 3 WDS Replacements):** Approximately 17,032 lf of water mains in various locations throughout the City would be replaced during Phase 3 of the Capital Improvement Plan (2026-2030), with an estimated cost of $3,897,000.

- **Project RR-04 (Phase 4 WDS Replacements):** Approximately 11,924 lf of water mains in various locations throughout the City would be replaced during Phase 4 of the Capital Improvement Plan (2031-2015), with an estimated cost of $2,724,000.

8.6.2.2 Water Meter Replacement Program ("MR" Projects)

As explained in Chapter 7, the City has an active residential water meter installation program to achieve fully metered status by 2020. All industrial and commercial users are currently metered. The meters consist of three major components, each with an anticipated replacement cycle of approximately 20 years. Below are the recommended projects to be implemented into the CIP to replace the three components of the meters.
• **Project MR-01 (Water Meter Installation Program):** Approximately $1,600,000 has been estimated to cover the additional costs for converting meters from flat to volumetric rate utilizing Smart Meter Technology. It is anticipated that $1,000,000 will be needed for 2016, and $300,000 will be used in 2017 and 2018.

• **Project MR-02 (Meter Body Replacements):** Approximately 25 percent of the total meter body components will be replaced during each phase of the Capital Improvement Plan, beginning in Phase 2 (2021-2025) with an estimated cost of $1,864,700 per phase.

• **Project MR-03 (Meter Register Replacements):** Approximately 25 percent of the total meter register components will be replaced during each phase of the Capital Improvement Plan, beginning in Phase 2 (2021-2025), with an estimated cost of $1,243,100 per phase.

• **Project MR-04 (520M MXU Replacements):** Approximately 50 percent of the total meter body components will be replaced during Phase 4 of the Capital Improvement Plan (2031-2035), with an estimated cost of $3,418,600.

### 8.6.2.3 Tank and Pump Station Rehabilitation ("PS" Projects)

As discussed in Chapter 7, a visual condition assessment of the pump stations and reservoirs were conducted and recommendations were outlined for proposed rehabilitation projects. Table 8.8 is a summary of the "PS" projects that are detailed in the CIP, broken out by phase. The miscellaneous tank and pump station improvement projects recommended in Phase 1 vary throughout the five-year period and are not specifically called out by year.

| Table 8.8 Proposed Tank and Pump Station ("PS" Projects) CIP Breakdown 2015 Water Master Plan Update City of West Sacramento |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Projects        | Phase 1         | Phase 2         | Phase 3         | Phase 4         | Total           |
| Tank Recoating/Lining (2016-17) | $225,000 |                |                | $225,000        |
| Security Improvements (2017)  | $29,000 |                |                | $29,000         |
| Pump & VFD Replacements       | $1,938,000 | $1,938,000    |                |                |
| Seismic Analyses (2018)        | $603,000 |                |                | $603,000        |
| Misc. Tank & PS Improvements   | $262,000 |                |                | $262,000        |
| **Total**                  | **$1,119,000** | **$0**          | **$0**          | **$1,938,000** | **$3,057,000** |
8.6.3 Water Treatment Plant - Rehabilitation and Replacement Projects

Based on the January 2015 facility tour, the projects described in the following sections are recommended for the various GKWTP processes/facilities. More information is provided in Chapter 7 and in the Water Treatment Plant Condition Assessment technical memorandum (Appendix H).

8.6.3.1 Actiflo™ Clarification No. 1 & 2 ("AF" Projects)

The twelve improvements (AF-01 to AF-51 in the CIP) shown in Table 8.9 are proposed for assets associated with the Actiflo Clarification process. Each improvement has been assigned a phase designation based on the condition and criticality of the asset. The most significant (albeit not the most critical) of these improvement projects will be a structural rehabilitation of the two Actiflo™ tanks during Phase 4 (2031-2035), with an estimated cost of approximately $3.25 million. As previously noted, it is essential that the condition of each asset with a Phase 2, 3, or 4 designation, be monitored so that any changes in criticality of improvements for that asset can be identified early, and the project can be accelerated or delayed accordingly.

Table 8.9 Actiflo™ Clarification No. 1 & 2 ("AF" Projects) CIP Breakdown
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>CIP Project</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butterfly Valves</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$100,000</td>
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<td>$0</td>
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<td>$0</td>
<td>$83,000</td>
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<tr>
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<td>$33,000</td>
<td>$33,000</td>
<td>$33,000</td>
<td>$132,000</td>
</tr>
<tr>
<td>Harmonic Condition Replacer</td>
<td>$52,000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$52,000</td>
</tr>
<tr>
<td>Hydrocyclone Replacements</td>
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<td>$0</td>
<td>$85,000</td>
<td>$0</td>
<td>$0</td>
<td>$85,000</td>
</tr>
<tr>
<td>Mixers</td>
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<td>$164,000</td>
<td>$0</td>
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<td>$882,000</td>
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<tr>
<td>Sand Pump Improvements</td>
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<td>$0</td>
<td>$0</td>
<td>$36,000</td>
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</tr>
<tr>
<td>SCADA System Replacements</td>
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<td>$0</td>
<td>$326,000</td>
<td>$0</td>
<td>$326,000</td>
</tr>
<tr>
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<td>$0</td>
<td>$0</td>
<td>$3,250,000</td>
<td>$3,250,000</td>
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<tr>
<td>Tube Settler Replacements</td>
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<td>$0</td>
<td>$52,000</td>
<td>$0</td>
<td>$104,000</td>
</tr>
<tr>
<td>VFD Replacements</td>
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<td>$0</td>
<td>$0</td>
<td>$70,000</td>
<td>$70,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$518,000</strong></td>
<td><strong>$282,000</strong></td>
<td><strong>$494,000</strong></td>
<td><strong>$4,094,000</strong></td>
<td><strong>$5,388,000</strong></td>
</tr>
</tbody>
</table>
8.6.3.2 Backwash Pump Recoating ("BWP" Projects)

Projects BWP-1 and 2 will include recoating of the vertical turbine pumps located at the Backwash Pump Station during year 4 of Phase 1 and then again during Phase 4. The estimated cost is $9,000 per project.

8.6.3.3 Chemical Feed ("CF" Projects)

The following projects are recommended for rehabilitation of the City's chemical feed assets.

- **Project CF-1 (Polymer Feed Pumps):** The polymer feed pumps in the Chemical Feed and Storage process area will be replaced during Phase 4 of the CIP at an estimated cost of $33,000.

- **Projects CF-2 and CF-3 (Dry Polymer Batching and Mixing Equipment):** During Phase 4 of the CIP, it is anticipated that the motor operator/electrical actuators for the dry polymer batching and mixing equipment will need to be replaced. The caustic metering pump will also be replaced as part of these projects. The estimated cost for each of these projects is $90,000.

8.6.3.4 Clearwell Underdrain ("CW" Projects)

The following four replacement projects are recommended for the Clearwell Storage process area.

- **Projects CW-1 and CW-2 (Clearwell Underdrain Pumps):** The two clearwell underdrain pumps are scheduled to be replaced in Phase 1, year 5 of the CIP at an estimated cost of $33,000 each.

- **Project CW-3 (Pump Station PLC):** The Clearwell Drain pump station programmable logic controller (PLC) will be replaced in Phase 3 of the CIP at an estimated cost of $33,000.

- **Project CW-4 (Valve Replacement):** The 60-inch air actuated inlet valves are scheduled to be replaced by Phase 3 of the CIP at an estimated cost of $33,000.

8.6.3.5 Filtration ("FR" Projects)

The five improvements (identified in the CIP as FR-01 to FR-17) shown in Table 8.10 proposed for assets in the Filtration process area. Each improvement has been assigned a phase designation based on the condition and criticality of the asset. The majority of the projects are projected to be completed in 2016, including a filter media replacement project estimated to cost $667,000. The harmonic conditioner replacement project is considered a critical project.
Table 8.10 Filtration ("FR" Projects) CIP Breakdown
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>CIP Project</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backwash Equipment</td>
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<td>$667,000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$667,000</td>
</tr>
<tr>
<td>Filter SCADA System Replacements</td>
<td>$20,000</td>
<td>$228,000</td>
<td>$0</td>
<td>$0</td>
<td>$248,000</td>
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<tr>
<td>Harmonic Conditioner Replacement</td>
<td>$52,000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$52,000</td>
</tr>
<tr>
<td>VFD Replacements</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$854,000</strong></td>
<td><strong>$228,000</strong></td>
<td><strong>$0</strong></td>
<td><strong>$435,000</strong></td>
<td><strong>$1,517,000</strong></td>
</tr>
</tbody>
</table>

8.6.3.6 High Service Pumps ("HSP" Projects)

Six types of improvements (identified as HSP-01 to HSP-21) for the High Service Pump process area have been identified in the CIP. Table 8.11 shows the breakdown of the projects by phase. It is proposed that the standby generators be replaced during Phase 3 of the CIP, which will cost approximately $813,000 per generator.

Table 8.11 High Service Pumps ("HSP" Projects) CIP Breakdown
2015 Water Master Plan Update
City of West Sacramento

<table>
<thead>
<tr>
<th>CIP Project</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Service Pump Replacements</td>
<td>$0</td>
<td>$732,000</td>
<td>$488,000</td>
<td>$1,464,000</td>
<td>$2,684,000</td>
</tr>
<tr>
<td>Motor Control Center (condition assessment)</td>
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<td>$0</td>
<td>$0</td>
<td>$17,000</td>
</tr>
<tr>
<td>Filter SCADA System Replacements</td>
<td>$114,000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$114,000</td>
</tr>
<tr>
<td>Standby Generators</td>
<td>$0</td>
<td>$0</td>
<td>$1,626,000</td>
<td>$0</td>
<td>$1,626,000</td>
</tr>
<tr>
<td>High Service Pump VFDs</td>
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<td>$0</td>
<td>$348,000</td>
<td>$357,000</td>
</tr>
<tr>
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<td>$0</td>
<td>$0</td>
<td>$7,000</td>
<td>$7,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$140,000</strong></td>
<td><strong>$732,000</strong></td>
<td><strong>$2,114,000</strong></td>
<td><strong>$1,819,000</strong></td>
<td><strong>$4,805,000</strong></td>
</tr>
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</table>

8.6.3.7 Intake Facilities and Pump Station ("ISP" Projects)

CIP projects ISP-01 to ISP-29 are the improvements for the Intake Facilities and Pump Station. They have been consolidated in Table 8.12 by the type of improvement and broken out by phase.
### Table 8.12 Intake Facilities and Pump Station ("ISP" Projects) CIP Breakdown

**2015 Water Master Plan Update**

City of West Sacramento

<table>
<thead>
<tr>
<th>CIP Project</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve Replacements</td>
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<td>$0</td>
<td>$165,000</td>
<td>$264,000</td>
</tr>
<tr>
<td>Fuel Reconditioning</td>
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<td>$57,000</td>
<td>$57,000</td>
<td>$57,000</td>
<td>$228,000</td>
</tr>
<tr>
<td>Oil Testing and Load Bank Testing</td>
<td>$17,000</td>
<td>$17,000</td>
<td>$17,000</td>
<td>$17,000</td>
<td>$68,000</td>
</tr>
<tr>
<td>Raw Water Pump Replacements</td>
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<td>$0</td>
<td>$244,000</td>
<td>$976,000</td>
<td>$1,220,000</td>
</tr>
<tr>
<td>Air Compressor Replacement</td>
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<td>$80,000</td>
</tr>
<tr>
<td>Air Tank Condition Assessment</td>
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<td>$0</td>
<td>$0</td>
<td>$9,000</td>
</tr>
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<tr>
<td>Fish Screen Assessment</td>
<td>$17,000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$17,000</td>
</tr>
<tr>
<td>Fish Screen Replacement</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$270,000</td>
<td>$270,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$199,000</strong></td>
<td><strong>$108,000</strong></td>
<td><strong>$318,000</strong></td>
<td><strong>$1,582,000</strong></td>
<td><strong>$2,207,000</strong></td>
</tr>
</tbody>
</table>

#### 8.6.3.8 Lab Mechanical Building ("LMB" Projects)

The following projects are recommended for the City's Laboratory Mechanical Building.

- **Project LMB-1 (SCADA System Replacements):** The SCADA system is scheduled to be replaced during Phase 3 of the CIP at an estimated cost of $49,000.
- **Project LMB-2 (Mechanical/Electrical Assessment):** The SWBD/MCC-M will undergo an assessment during Phase 1 of the CIP (2016) for approximately $9,000 and is scheduled to be replaced during Phase 4 of the CIP at an estimated cost of $132,000.

#### 8.6.3.9 Low Lift Pump Station ("LPS" Projects)

The following projects are recommended for the City's low-lift pump station.

- **Projects LPS-1 to LPS-8** are pump replacement and recoat/reseal pump projects for the four vertical turbine pumps located at the Low Lift Pump Station. These projects will be performed during Phases 1 (2016) and 4 of the CIP. The recoat/reseal projects are estimated to cost $9,000 each and the pump replacement projects are estimated to cost $122,000 each.
- **Project LPS-9 (SCADA Replacement):** The SWGR/MCC-C SCADA system is scheduled to be replaced during Phase 4 of the CIP at an estimated cost of $429,000.
8.6.3.10 Operations Building ("OPS" Projects)

The following projects are recommended for the City's Operations Building.

- **Projects OPS-1 to OPS-4 (SCADA Replacement):** The Operations building will undergo SCADA replacements for the following assets:
  - Radio System (2016) at an estimated cost of $17,000.
  - Security System (2016) at an estimated cost of $25,000.
  - SCADA Rack (Phase 2) at an estimated cost of $25,000.
  - RTU-6 (Phase 3) at an estimated cost of $212,000.

8.6.3.11 Process Drain Pump Station ("PD" Projects)

The following projects are recommended for the City's Process Drain Pump Station.

- **Project PD-2 and PD-6 (Process Drain Pump Recoating):** The submersible pumps at the process drain pump station will undergo recoating projects during Phase 1 (2016) and Phase 4 of the CIP at an estimated cost of $9,000 each.

- **Project PD-3 (TM Analyzer):** The operations room in the process drain pump station will have a TM analyzer installed during Phase 1 (2016) of the CIP at an estimated cost of $7,000.

- **Project PD-4 (Security System):** The security cameras at the pump station are scheduled to be replaced during Phase 1 (2016) of the CIP at an estimated cost of $22,000.

8.6.3.12 Raw Water Manifold and Reclaimed Water Pumping ("RW" Projects)

Projects RW-01 to RW-16 found in the CIP are the improvements for the Raw Water Manifold and Reclaimed Water Pumping process area. They have been summarized in Table 8.13 by the type of improvement and broken out by phase. As explained later in this chapter, the harmonic conditioner replacement is considered a critical project.
Table 8.13  Raw Water Manifold and Reclaimed Water Pumping ("RW" Projects)  
CIP Breakdown  
2015 Water Master Plan Update  
City of West Sacramento

<table>
<thead>
<tr>
<th>CIP Project</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Meters</td>
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<td>$0</td>
<td>$33,000</td>
<td>$0</td>
<td>$33,000</td>
</tr>
<tr>
<td>Harmonic Conditioner Replacement</td>
<td>$52,000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$52,000</td>
</tr>
<tr>
<td>Raw Water Manifold Structural Rehabilitation</td>
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<td>Reclaimed Electrical Improvements</td>
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<td>$0</td>
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</tr>
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<td>Reclaimed Water Pump Coating &amp; Replacements</td>
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<td>$0</td>
<td>$33,000</td>
<td>$33,000</td>
</tr>
<tr>
<td>SCADA System Replacements</td>
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<td>$0</td>
<td>$114,000</td>
<td>$483,000</td>
<td>$597,000</td>
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<td>$0</td>
<td>$0</td>
<td>$119,000</td>
<td>$128,000</td>
</tr>
<tr>
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<td>$0</td>
<td>$147,000</td>
<td>$1,328,000</td>
<td>$1,578,000</td>
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8.6.3.13  Recycled Water Basins ("RWB" Projects)

Projects RWB-01 to RWB-12 found in the CIP are the improvements for the Recycled Water Basins. They have been summarized in Table 8.14 by the type of improvement and broken out by phase.
8.6.3.14 Facility-Wide Measuring Equipment and Transmitters ("FAC" Projects)

The following projects are recommended for the City's Facility-Wide Measuring Equipment and Transmitters.

- **Project FAC-1 (Measurement Instrumentation Replacements):** Approximately $100,000 per year during Phase 1 of the CIP will be allocated to replacing measurement instrumentation devices throughout the facilities.

- **Project FAC-2 (PLC Racks, Components, Integrator Controls):** Approximately $500,000 is budgeted for year 3 of Phase 1, replacing facility-wide equipment.

8.7 CAPITAL IMPROVEMENT PROJECT IMPLEMENTATION

As outlined in Chapter 7, the proposed capital improvements are prioritized based on their urgency to mitigate existing deficiencies and condition issues and for servicing future growth. The capital improvements were phased according to the improvement categories described in Section 8.1 into one of the following phases:

- **Phase 1 (2016 - 2020):** These projects are considered high-priority. They have high criticality based on the results of the condition assessment (typically having reached the end of their useful life) or are capacity deficient.

- **Phase 2 (2021 - 2025):** This phase includes projects that are considered medium-risk based on the City's understanding of the facilities and capital improvement program.
• **Phase 3 (2026 - 2030):** Phase 3 projects are classified as falling within the lower range of medium-risk projects. It is recommended that the City monitor these projects to determine if they should be shifted to either Phase 2 or Phase 4.

• **Phase 4 (2031 - 2035):** These projects are improvements that will allow the City to mitigate expected long-term deficiencies. Similar to Phase 3 projects, these need to be monitored and reviewed on a regular basis to determine if they should be accelerated to a Phase 2 or 3 project.

### 8.8 SUMMARY OF FINDINGS

Capital improvement costs have been developed for improvements to the GKWTP, the reservoirs and pump stations, and the distribution system. The timing for these capital expenditures over the next twenty years is divided into the following five-year phases: Phase 1 (FY2016 - FY2020), Phase 2 (FY2021 - FY2025), Phase 3 (FY2026 - FY2030), and Phase 4 (FY2031 - FY2035). Capital needs were attributed to specific years for Phase 1 and the total costs for each of the remaining phases were evenly distributed across the five-year time periods, as shown in the CIP (Table 8.3 and Table 8.4). The key findings of this chapter are summarized below:

• **Water Treatment Plant**
  – The GKWTP is performing well overall, and the City's good maintenance practices are reflected in the prolonged service life of many of the GKWTP assets. Nevertheless, there are many assets that will be in need of renewal within the Master Plan's planning period.
  – High-risk assets were identified, and recommendations for replacement rehabilitation in the short-term (five-year) planning horizon were provided. The costs assigned to each project have been allocated to specific years for the first five-year planning phase, based on input from City staff.
  – Phase 4 of the planning period (FY2031 - FY2035) represents a dramatic increase in replacement expenditures, primarily due to structural improvements and pump replacements anticipated at that time.
  – VFDs at the high service pump station, the filter gallery, and raw water manifold, have experienced overheating or failure due to problems with the harmonic conditioners, directly impacting the performance of other process units at the plant. As a result, harmonic conditioner replacement is considered a critical facility project.

• **Reservoirs and Pump Stations**
  – The condition assessments found that the pumps associated with system pump stations are generally in good condition. However, with a typical useful life of 20 years for water service pumps, most of these pumps are scheduled for replacement during Phase 4 of the planning period. It is likely that the actual timing for replacement of individual pumps will vary.
• **Water Distribution System**
  - Capital planning for the water distribution system includes:
    - pipeline replacements or new interconnections (i.e. looping) for fire flow improvements,
    - new transmission mains for capacity improvements, and
    - end-of-life water main replacements.
    - meter component replacement

The costs assigned to each improvement has been prioritized and allocated to specific years across the four planning phases (FY2016 - FY2035), based on input from City staff. Table 8.15 below shows the types of projects broken out by phase.

<table>
<thead>
<tr>
<th>CIP Project</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDS New Tank and Pump Stations</td>
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<td>$16,364,000</td>
<td>$0-</td>
<td>$12,350,000</td>
<td>$41,064,000</td>
</tr>
<tr>
<td>Fire Flow Improvements</td>
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<td>$932,000</td>
<td>$0</td>
<td>$10,598,000</td>
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<tr>
<td>Water Main Replacements</td>
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<td>$2,724,000</td>
<td>$7,930,000</td>
</tr>
<tr>
<td>Corporation Yard</td>
<td>$3,000,000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$3,000,000</td>
</tr>
<tr>
<td>Capacity Improvements</td>
<td>$8,795,000</td>
<td>$3,783,000</td>
<td>$9,551,000</td>
<td>$6,083,000</td>
<td>$28,212,000</td>
</tr>
<tr>
<td>Water Meter Replacements</td>
<td>$1,600,000</td>
<td>$3,107,813</td>
<td>$3,107,813</td>
<td>$6,526,406</td>
<td>$14,342,031</td>
</tr>
<tr>
<td>Tank &amp; Pump Stations</td>
<td>$1,119,000</td>
<td>$0</td>
<td>$0</td>
<td>$1,938,000</td>
<td>$3,057,000</td>
</tr>
<tr>
<td>WTP Related Projects</td>
<td>$3,849,000</td>
<td>$1,440,000</td>
<td>$3,784,000</td>
<td>$10,592,000</td>
<td>$19,665,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$37,917,000</strong></td>
<td><strong>$28,465,813</strong></td>
<td><strong>$21,271,813</strong></td>
<td><strong>$40,213,406</strong></td>
<td><strong>$127,868,031</strong></td>
</tr>
</tbody>
</table>

Table 8.15 shows the distribution of capital costs by project type. As shown on Figure 8.1, WDS new tank and pump station projects and capacity improvement projects account for the largest portions of the capital improvement project costs at 29 percent and 20 percent, respectively. Water treatment plant-related projects, the Corporation Yard relocation project, water meter replacement projects, and fire flow improvement projects account for roughly 14, 13, 10, and 7 percent of the total CIP costs, respectively. The remaining 8 percent of the CIP costs are associated with water main replacement and tank and pump station rehabilitation projects.
8.9 EXISTING VERSUS FUTURE USERS COST SHARE

The improvements proposed in this study either benefit existing users, or is required to service new development and future users. Some of the projects provide benefits to both existing and future users. An opinion of benefit to future users by project is included in the CIP. A summary of the existing and future user cost share for the proposed projects by phase is summarized in Table 8.16. As shown, the total estimated cost for system improvements through 2035 is roughly $127.9 million. The improvement projects between existing and future users are allocated relatively evenly, with new tanks and pump stations, corporation yard, and capacity improvement projects focused mainly on future users.
### Table 8.16  CIP Cost by Reimbursement Category  
2015 Water Master Plan Update  
City of West Sacramento

<table>
<thead>
<tr>
<th>Project Category</th>
<th>Existing Users</th>
<th>Future Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDS New Tank and Pump Stations</td>
<td>$9,062,000</td>
<td>$32,002,000</td>
</tr>
<tr>
<td>Fire Flow Improvements</td>
<td>$10,598,000</td>
<td>$0</td>
</tr>
<tr>
<td>Corporation Yard</td>
<td>$3,000,000</td>
<td></td>
</tr>
<tr>
<td>Water Main Replacements</td>
<td>$7,930,000</td>
<td>$0</td>
</tr>
<tr>
<td>Capacity Improvements</td>
<td>$3,262,000</td>
<td>$24,950,000</td>
</tr>
<tr>
<td>Water Meter Replacements</td>
<td>$14,342,031</td>
<td>$0</td>
</tr>
<tr>
<td>Tank &amp; Pump Stations</td>
<td>$3,057,000</td>
<td>$0</td>
</tr>
<tr>
<td>WTP Related Projects</td>
<td>$19,665,000</td>
<td>$0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$70,916,031</strong></td>
<td><strong>$56,952,000</strong></td>
</tr>
</tbody>
</table>
9.1 INTRODUCTION

This chapter describes the process of and recommendations for updated water rates and water and sewer connection fees to support the 2015 Water Master Plan (WMP) Capital Improvements Plan projects that have been selected for implementation during the initial Phase 1 planning period. The contents of this chapter were originally contained in two memoranda prepared separately, and were adopted by the City of West Sacramento City Council on Wednesday, October 18, 2017. The memoranda contents have been included herein as they appeared in the original documents, except for reformatting to be consistent with the overall WMP document.

Section 9.2 consists of the Water Rate Update and Section 9.3 consists of the Water and Sewer Connection Fee Update.

9.2 WATER RATE UPDATE

This memorandum describes the development of water rate recommendations for the City of West Sacramento’s (City’s) water utility for Fiscal Years (FYs) 2016-17 through 2021-22. It includes a description of the current water rates, as well as the calculation of proposed water rates for the next five years.

9.2.1 Introduction

The City’s water enterprise serves all commercial, residential, and industrial customers within its City limits, approximately 19,000 connections, consuming an estimated 11.9 Million Gallons per Day (mgd). The City owns and operates the George Kristoff Water Treatment Plant (WTP), formally known as the Bryte Bend Water Treatment Plant, obtaining raw water from the Sacramento River. The City’s water system currently includes 23.6 million gallons of storage capacity (via tanks and reservoirs) and roughly 180 miles of pipelines to deliver the treated water to its customers.

The goals of this rate study include the following:

- Develop a financial plan that provides appropriate funding from existing and future water customers;
- Develop utility rates based on generally the rate-setting principles;
- Develop utility rates that minimize or eliminate the annual operating deficit in the water enterprise fund; and
- Conduct comprehensive regional utility rate comparisons.
What follows is a summary of the Finance Plan analysis and recommended rates for the City’s water enterprise fund.

9.2.2 Customer Classes and Current Monthly Rates

The City’s current water rates were designed to generate the annual revenue necessary to fund operating and capital costs of the City’s water system, as well as to distribute the revenue requirements equitably among the classes of users in accordance with their differing demands placed on the system. The Financial Plan was developed to update the rates in order to cover the first five years of the Water Facilities Master Plan (i.e., Phase I). The Financial Plan includes estimated operating and maintenance costs, current and future debt service obligations, and capital improvement needs (based on the Water Facilities Master Plan).

Although the City has installed approximately 80 percent of the water meters for all customers, but not all customers with water meters are being charged the metered rates. Currently, there are approximately 11,300 residential flat-rate customers and 6 general service flat-rate customers (e.g., commercial, industrial, and multi-family accounts with 4 or more dwelling units), all of who will be transitioned to metered customers over the next few years. The current model assumes that the City will fully implement the water meters by December 2018 and bill all customers based on the metered rate by the beginning of calendar year 2020 by transitioning more than 3,000 flat rate customers, from flat to metered billing, each year.

Figure 9.1 and Figure 9.2 summarize the current user classes and rates. Currently, nearly 90 percent of residential accounts are flat rate customers that pay the fixed monthly rates shown in Figure 9.1 based on the size of their service connections. Approximately 10 percent of residential customers and 99 percent of non-residential customers are charged a fixed monthly service charge plus a commodity charge based on the water used during the billing period, at rates shown in Figure 9.2.

<table>
<thead>
<tr>
<th>Flat Rate Customers</th>
<th>$/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential (1, 2, or 3 units)</td>
<td></td>
</tr>
<tr>
<td>Up to 3/4&quot; service</td>
<td>$39.30</td>
</tr>
<tr>
<td>1&quot; service</td>
<td>$40.50</td>
</tr>
<tr>
<td>Additional Units</td>
<td>$22.30</td>
</tr>
<tr>
<td>General Service</td>
<td>$/month</td>
</tr>
<tr>
<td>5/8&quot; X 3/4&quot; service</td>
<td>$44.40</td>
</tr>
<tr>
<td>3/4&quot; service</td>
<td>$49.15</td>
</tr>
<tr>
<td>1&quot; service</td>
<td>$93.80</td>
</tr>
<tr>
<td>1-1/2&quot; service</td>
<td>$179.05</td>
</tr>
</tbody>
</table>

Figure 9.1 Current Flat Water Rates
A spreadsheet model was developed to derive revenue requirements for FY 2017-18 through FY 2021-22. The revenue requirements represent the costs that must be covered by revenue from rates and other sources. The City’s operating and capital budget for FY 2016-17 served as the starting point for projecting the City’s expenses and revenues over the five-year planning period. The escalation factors summarized in Figure 9.3 were incorporated in the model for projecting expense and revenues. The assumptions include a projected 3 percent annual reduction in residential water demand as customers are transitioned to metered billing; water use tends to decrease as customers are billed based on actual water use instead of a flat fee.
The application of these assumptions to the O&M and capital expenses are summarized graphically in Figure 9.4 and are described in more detail below.

Figure 9.4 Total Annual Projected Revenue Requirements

9.2.2.2 O&M Expenses

The City’s O&M expenses are projected in Figure 9.5 to increase by an average of 3.2 percent per year from approximately $6.3 million to $7.3 million over the five-year planning period. Annual increases are generally driven by the salary and benefit cost escalators because three quarters of the water budget is for personnel costs (including administrative overhead expenses). Chemical and utility expenses are projected to increase as the result of projected inflationary increases of 4 percent per year. Water purchases are projected to increase a net 2 percent per year, based on growth and inflationary cost increases, partially offset by a decrease in water use due to residential accounts transitioning from flat rate charges to metered charges based on actual water.

The City has water rights with North Delta Water Agency that are under negotiation. It is expected that these rights will be renegotiated and a new water supply contract finalized by July 2019. The outcome of these negotiations is unknown at this time. The current model does not include any future costs related to the water contract negotiations other than what is in the current budget, escalated as described above.
9.2.2.3 **Capital Expenses**

The City’s capital expenses are summarized in Figure 9.6. Annual costs range from a low of $1.6 million in FY 2021-22 to a high of $13.4 million in FY 2017-18. The City plans to fund a portion of these capital improvements through a $15.0 million revenue bond and the remaining on a pay-as-you-go (PAYGo) basis. The City’s rates do not directly fund each year’s capital improvements. Instead, the funding for the City’s capital expenses takes the form of smooth annual contributions of $1.5M in rate revenue to the Capital Reserve. These capital projects will be funded in varying amounts each year from the Capital Reserve and proceeds from the $15.0 million revenue bond. In this way, rates can be modulated smoothly by using the Capital Reserve as a buffer. These contributions are in effect the capital expenses.
### Reflects average annual CIP spending during Phase 2 of the Master Plan Projects, which covers FY 2021-22 through FY 2026-27

#### Figure 9.6 Funded Phase 1 CIP Summary

#### 9.2.2.4 Water Fund Reserves

In addition to covering annual expenses, water service charges need to generate revenue to maintain adequate operations and capital reserves. To determine what constitutes adequate reserve amounts, the City’s water enterprise fund balance at the end of FY 2015-16 was subdivided into Operating and Capital Reserves. In this way, it is possible to set recommended target balances for each purpose.
9.2.2.5 Operating Reserve Target

Operating reserves serve multiple purposes ranging from monthly to annual cash flow management. On a monthly basis, the Operating Reserve provides working capital to cover the lag between when the City incurs operating expenses and when it receives revenue from customers. Providing adequate funding for Operating Reserves is the highest priority. The City’s current policy is to maintain an Operating Reserve equal to 50 percent of its annual operating expenses. Therefore, during this five-year planning period, the Operating Reserve target ranges from $3.2M in FY 2017-18 to $3.7M in FY 2021-22.

Setting the target balance for the Operating Reserve at the working capital requirement is a minimal level of reserves. Rates should always be set to maintain at least this much in Operating Reserves. This level of Operating Reserves should provide sufficient liquidity for meeting monthly cash flow as well as for a certain amount of annual cash flow needs, which can be affected by other conditions that are outside the City’s control:

- Variances between projected and actual expenditures.
- Variances between projected and actual revenue, which are impacted by conservation.

The Operating Reserve may also have the ability to buffer these annual conditions without the need for rate increases. In this way, the Operating Reserve can be used to smooth rate increases from year to year.

9.2.2.6 Capital Reserve Target

The Capital Reserve provides liquidity to fund construction for projects that are funded on a PAYGo basis (as opposed to those that are funded from debt). With adequate capital reserves, the City is able to pay contractors without encroaching on the Operating Reserves. A target reserve balance of $1.5M was used.

Maintaining the target balance for the Capital Reserve is recommended after meeting the minimum balance for the Operating Reserve.

9.2.3 Water Enterprise Fund Balance

As illustrated in Figure 9.2, current revenue at current rates is not sufficient to cover the City’s O&M, capital, and reserve requirements over the five-year planning period. Figure 9.7 shows the projected year-end fund balances without rate increases (dashed green line). The year-end fund balance for FY 2015-16 is near the fund balance target, which is the combination of the Operating and the Capital Reserve targets (blue line). However, based on the projected operating and capital expenses discussed above, without a rate increase over the next five years, the City’s Water Enterprise Fund Balance will drop below the minimum target (red line, which is equal to the Operating Reserve target) and go negative sometime in FY 2018-19. Section V of this report provides our proposed rate increases to avoid dropping below the minimum target and reach the target balance by FY 2021-22.
9.2.3.1 Water Rate Recommendations

In order to meet the O&M expense, capital expense, debt payment, and reserve level obligations of the water utility (as described in Section III of this Chapter), it is recommended that the City increase water revenues by the amounts shown in Figure 9.8.

Figure 9.8 shows the projected year-end water fund balance with the rate revenue increases recommended in Figure 9.8 (solid green line) and without the rate increases (dashed green line).

Although the projections show straight lines between years, the fund balance will be drawn down substantially during each year. In other words, the reserves are actively drawn on at all times during the year but only periodically added to when payments are received from the County. The reserves are not simply accumulated without being used.
The recommended revenue increases will attain a fund balance above the target by FY 2021-2022.

![Figure 9.9](image-url)  
*Figure 9.9 Projected Year-End Water Enterprise Fund Balance*

### 9.2.3.2 Water Rate Design and Proposed Rates

Figure 9.10 presents the proposed water rates for FY 2017-18 through FY 2021-22 that will generate the annual increases in revenue (as summarized in Figure 9.8). The proposed rate schedule includes flat water rates even though the transition to 100 percent metered water rate customers is anticipated to be completed by June 30, 2020 in case unforeseen circumstances prevent the full transition as planned.

#### 9.2.3.2.1 Flat Rates and Fixed Service Charges

Balancing the revenue from fixed and variable charges with fixed and variable costs is a consideration in rate design. The differences between fixed and variable costs and charges can affect cash flow, which is also a consideration in determining reserve fund target balances. Greater cash flow differences call for higher target balances to buffer the fluctuations. Approximately 49 percent of the City’s current water rate revenue is from fixed charge sources: flat rates and fixed service charges (for those customers with metered billing). This level of revenue from fixed sources provides the benefit of revenue stability. Typically, fixed costs (i.e., costs that do not fluctuate with the amount of water used each month, such as: salaries and benefits, capital costs, etc.) account for 70 percent to 80 percent of a water system’s annual costs.
It is not the practice in the water industry to set the revenue from fixed charges equal to the fixed costs. The California Urban Water Conservation Council’s best management practice for setting rates recommends limiting the revenue from fixed charges to 30 percent of total rate revenue because it is recognized that not all fixed revenue comes from fixed charges. A significant amount of revenue comes from commodity charges associated with non-seasonal water demand (i.e., primarily indoor water use and minimal outdoor water use and irrigation), which is predictably fixed.

The recommended rates in Figure 9.10 are designed to maintain the 49 percent of revenue coming from the flat rates and fixed service charges during the Financial Planning period. This will help maintain revenue stability during the transition to fully metered rates as customer water use tends to decrease when transitioning to metered billing.

### 9.2.3.2.2 Commodity Charges

The City’s residential customers, who have elected to be billed the metered water rates instead of the flat rates, are currently charged a three-tier increasing block rate structure. The City’s non-residential customers are charged a uniform commodity rate, which is higher than the top residential tier.

The *San Juan Capistrano* Appellate Court decision required a more rigorous cost-basis for the increasing block rate structure at the City of San Juan Capistrano. When increasing block rates are implemented, the number of tiers and size of those tiers must be determined. Historical water use patterns specific to the water supplier’s customers is required to determine appropriate breakpoints for an increasing block rate structure and because the City is still in the process of installing meters, the necessary water use details are not available; therefore, we recommend a uniform commodity rate for all customers. As customers transition from flat rate charges to metered rate charges, water use tends to decrease as customers are more aware of how much water they use and how their bills can be reduced if they use less water. Once all customers have been transitioned to metered billing for a year or two, it would be appropriate for the City to re-examine increasing block rates for its residential customers.

The proposed commodity rates in Figure 9.10 include a transition period to gradually increase the residential commodity rate to equal the non-residential commodity rate during the fourth year of the Financial Plan (July 1, 2020), instead of increasing the residential commodity rate significantly in the first year. This gradual transition will help reduce rate shock for residential customers.
### Flat Water Rates

**Residential Flat Rates (1, 2, or 3 units) - $/month**

<table>
<thead>
<tr>
<th>Size</th>
<th>Current</th>
<th>7/1/2018</th>
<th>7/1/2019</th>
<th>7/1/2020</th>
<th>7/1/2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 3/4&quot; meter</td>
<td>$39.30</td>
<td>$42.05</td>
<td>$44.15</td>
<td>$47.48</td>
<td>$53.84</td>
</tr>
<tr>
<td>1&quot; meter</td>
<td>$40.50</td>
<td>$43.34</td>
<td>$45.50</td>
<td>$48.93</td>
<td>$55.49</td>
</tr>
<tr>
<td>Additional units</td>
<td>$22.30</td>
<td>$23.86</td>
<td>$25.05</td>
<td>$26.94</td>
<td>$30.55</td>
</tr>
</tbody>
</table>

**General Service Flat Rates - $/month**

<table>
<thead>
<tr>
<th>Size</th>
<th>Current</th>
<th>7/1/2018</th>
<th>7/1/2019</th>
<th>7/1/2020</th>
<th>7/1/2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8&quot; x 3/4&quot; meter</td>
<td>$44.40</td>
<td>$47.51</td>
<td>$49.89</td>
<td>$53.64</td>
<td>$60.83</td>
</tr>
<tr>
<td>3/4&quot; meter</td>
<td>$49.15</td>
<td>$52.59</td>
<td>$55.22</td>
<td>$59.38</td>
<td>$67.34</td>
</tr>
<tr>
<td>1&quot; meter</td>
<td>$93.80</td>
<td>$100.37</td>
<td>$105.38</td>
<td>$113.33</td>
<td>$128.52</td>
</tr>
<tr>
<td>1 1/2&quot; meter</td>
<td>$179.05</td>
<td>$191.58</td>
<td>$201.16</td>
<td>$216.33</td>
<td>$245.32</td>
</tr>
</tbody>
</table>

### Metered Water Rates

**Fixed Service Charges - All Customers - $/month**

<table>
<thead>
<tr>
<th>Size</th>
<th>Current</th>
<th>7/1/2018</th>
<th>7/1/2019</th>
<th>7/1/2020</th>
<th>7/1/2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 3/4&quot; meter</td>
<td>$13.15</td>
<td>$18.02</td>
<td>$23.42</td>
<td>$23.89</td>
<td>$24.37</td>
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<td>1&quot; meter</td>
<td>$21.90</td>
<td>$30.00</td>
<td>$39.00</td>
<td>$39.78</td>
<td>$40.58</td>
</tr>
<tr>
<td>1 1/2&quot; meter</td>
<td>$43.70</td>
<td>$59.87</td>
<td>$77.83</td>
<td>$79.39</td>
<td>$80.97</td>
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<td>2&quot; meter</td>
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<td>3&quot; meter</td>
<td>$140.07</td>
<td>$191.90</td>
<td>$249.46</td>
<td>$254.45</td>
<td>$259.54</td>
</tr>
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<td>4&quot; meter</td>
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<td>$299.85</td>
<td>$389.81</td>
<td>$397.61</td>
<td>$405.56</td>
</tr>
<tr>
<td>6&quot; meter</td>
<td>$437.59</td>
<td>$599.50</td>
<td>$779.35</td>
<td>$794.94</td>
<td>$810.84</td>
</tr>
<tr>
<td>8&quot; meter</td>
<td>$700.22</td>
<td>$959.30</td>
<td>$1,247.09</td>
<td>$1,272.03</td>
<td>$1,297.47</td>
</tr>
<tr>
<td>10&quot; meter</td>
<td>$1,066.50</td>
<td>$1,376.91</td>
<td>$1,792.58</td>
<td>$1,828.43</td>
<td>$1,865.00</td>
</tr>
<tr>
<td>12&quot; meter</td>
<td>$1,477.16</td>
<td>$2,023.63</td>
<td>$2,636.72</td>
<td>$2,683.33</td>
<td>$2,737.00</td>
</tr>
</tbody>
</table>

**Commodity Rates - $/CCF**

<table>
<thead>
<tr>
<th>Size</th>
<th>Current</th>
<th>7/1/2018</th>
<th>7/1/2019</th>
<th>7/1/2020</th>
<th>7/1/2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Tier - 0-10 CCF/mo.</td>
<td>$1.24</td>
<td>$1.57</td>
<td>$1.19</td>
<td>$2.15</td>
<td>$2.39</td>
</tr>
<tr>
<td>2nd Tier - 11-50 CCF/mo.</td>
<td>$1.36</td>
<td>$1.57</td>
<td>$1.19</td>
<td>$2.15</td>
<td>$2.39</td>
</tr>
<tr>
<td>3rd Tier - 51+ CCF/mo.</td>
<td>$1.70</td>
<td>$1.57</td>
<td>$1.19</td>
<td>$2.15</td>
<td>$2.39</td>
</tr>
<tr>
<td>Non-Residential Rate (all use)</td>
<td>$1.99</td>
<td>$2.13</td>
<td>$2.30</td>
<td>$2.35</td>
<td>$2.39</td>
</tr>
</tbody>
</table>

1 CCF = 100 cubic feet = 748 gallons

**Figure 9.10** Current and Proposed Water Rates

### 9.2.3.3 Bill Impacts and Comparisons to Neighboring Agencies

Figure 9.11 provide sample bill impacts for residential and non-residential customers over the 5-year Financial Planning period. The sample bill impacts include three typical residential customers: 1) a flat rate customer with a ¾" meter; 2) a metered rate customer with a ¾" meter using 11 hundred cubic feet (CCF) per month, which is the estimated average residential water use; and, 3) a metered rate customer with a ¾" meter using two times the average water use, 22 CCF per month. Figure 9.11 also includes sample bills for non-residential customers with average non-residential water use (107 CCF per month) and low water use (20 CCF per month).
A regional utility rate survey was conducted to compare the City’s proposed water rates for FY 2017-18 to other regional cities that provide similar service. Figure 9.12 compares the City’s current and proposed FY 2017-18 water bill for the average residential customer using 11 CCF per month to neighboring jurisdictions and Figure 9.13 compares the City’s current and proposed FY 2017-18 water bill for the average non-residential customer using 107 CCF per month based on average non-residential water use derived from the City’s billing data from June 2015 through May 2016.

The residential rate comparison is based on only the metered customer charges these agencies are fully metered.
Figure 9.12  Residential Bill Comparison (3/4” meter; 11 CCF per month)

Figure 9.13  Non-Residential Bill Comparison (1” meter; 107 CCF per month)
9.3 WATER AND SEWER CONNECTION FEE UPDATE

This technical memorandum reports the results of our analysis of the City of West Sacramento's water and sewer service connection fees (alternatively known as capacity fees). This memo describes the study background, approach and analysis, and summarizes our findings; tables from the model are included as an attachment.

9.3.1.1 Background

New development connecting to the City’s water and sewer systems is charged a one-time connection fee at the time of connection. The purpose of the connection fee is to ensure that development pays its fair share of the costs associated with providing system capacity. Connection fees are a type of development impact fee that public agencies may impose as a condition of development under the authority of California Government Code Section 66000 et seq., the Mitigation Fee Act. The Act requires that “those fees or charges shall not exceed the estimated reasonable cost of providing the service”\(^1\). Because the Act does not prescribe a formula or procedure for determining “the estimated reasonable cost,” it is the responsibility of the analyst to employ a method that yields a reasonable result.

The courts generally regard fees as being reasonable if they are not capricious, arbitrary, or discriminatory. Fees are capricious if there is no factual basis for the underlying data used to make the calculations. Fees are arbitrary if there is no logical rationale for choosing among alternatives. Fees are discriminatory if they disproportionately allocate costs to one class of service at the expense of another class.

The connection fee is based on the reasonable cost of capacity per service connection. The reasonable cost is derived based on the value of facilities that provide capacity for growth. This report updates the City’s water and sewer connection fees, which were last updated in May 2005 (water) and June 2007 (sewer). Since then, the fees have been periodically increased but the fee structures have remained unchanged. When the sewer connection fee was updated in 2007, the City decommissioned its treatment plan and connected to the Sacramento County Regional Sanitation District's (SRCSD) treatment and disposal facilities. The City’s sewer connection fee no longer included the treatment component (with the exception of demolition costs related to the decommissioned plant.) Figures 9.14 and 9.15 summarize the City’s current water and sewer connection fees, respectively.

---

\(^1\) Mitigation Fee Act Section 66013(a).
### Single Family, Commercial, and Industrial Customers

<table>
<thead>
<tr>
<th>Meter Size</th>
<th>$ Per Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>$7,893</td>
</tr>
<tr>
<td>1&quot;</td>
<td>$13,180</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>$26,282</td>
</tr>
<tr>
<td>2&quot;</td>
<td>$42,066</td>
</tr>
<tr>
<td>3&quot;</td>
<td>$84,211</td>
</tr>
<tr>
<td>4&quot;</td>
<td>$131,565</td>
</tr>
<tr>
<td>6&quot;</td>
<td>$263,054</td>
</tr>
<tr>
<td>8&quot;</td>
<td>$420,900</td>
</tr>
<tr>
<td>10&quot;</td>
<td>$605,109</td>
</tr>
<tr>
<td>12&quot;</td>
<td>$1,131,241</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Customer Type</th>
<th>Current Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>$3,405</td>
</tr>
<tr>
<td>Multi Family</td>
<td></td>
</tr>
<tr>
<td>1 bedroom</td>
<td>$2,724</td>
</tr>
<tr>
<td>2 bedrooms</td>
<td>$3,065</td>
</tr>
<tr>
<td>&gt;2 bedrooms</td>
<td>$3,405</td>
</tr>
<tr>
<td>Commercial</td>
<td>$/1000 sq. ft.</td>
</tr>
<tr>
<td>Water related</td>
<td>$417</td>
</tr>
<tr>
<td>General</td>
<td>$837</td>
</tr>
<tr>
<td>Neighborhood</td>
<td>$837</td>
</tr>
<tr>
<td>Community</td>
<td>$837</td>
</tr>
<tr>
<td>Highway</td>
<td>$837</td>
</tr>
<tr>
<td>Office</td>
<td>$837</td>
</tr>
<tr>
<td>Industrial</td>
<td>$/1000 sq. ft.</td>
</tr>
<tr>
<td>Water related</td>
<td>$248</td>
</tr>
<tr>
<td>Light</td>
<td>$248</td>
</tr>
<tr>
<td>Mixed Comm/Ind</td>
<td>$542</td>
</tr>
<tr>
<td>Business Park</td>
<td>$1,012</td>
</tr>
<tr>
<td>Heavy</td>
<td>TBD*</td>
</tr>
</tbody>
</table>

* Includes duplexes, triplexes, condos, townhomes, or any type of dwelling intended for residential use other than single family residential

---

**Figure 9.14** Current Water Connection Fees

**Figure 9.15** Current Sewer Connection Fees
9.3.1.2 Approach and Analysis

Our approach derives the connection fees in terms of the unit cost of facilities required to provide capacity for growth. Existing facilities are included in the connection fee calculation because they provide capacity for growth. The existing facilities constitute a network with capacity for both existing rate payers as well as capacity for growth. Growth does not use only the increment of future capacity in the future facilities. These future facilities will be integral with the existing facilities.

The existing facilities are included in the connection fee calculation so that growth reimburses existing ratepayers for the investment made by rate payers on growth’s behalf. The investment is valued at today’s replacement cost to give effect to the cumulative value since the original cost was incurred. The value includes the original construction cost plus subsequent ongoing maintenance. The value of maintenance is reflected in the replacement cost because, since their construction, all facilities have been maintained and provide service indistinguishable from recently constructed facilities. Without the cost of maintenance incurred by rate payers, the facilities would fall into disrepair and would be unable to serve growth.

The unit cost of capacity was calculated by dividing the cost of existing and future facilities by the capacity provided by the facilities. The available capacity was based on the current level of water demand and wastewater discharge per customer. By using the current level of connections, the connection fee represents the average cost of capacity paid for by current customers. In effect, the approach follows the buy-in, or average cost, methodology. By using the buy-in methodology, it was not necessary to determine the portion of facilities attributable to growth, as is done in some connection fee studies.

9.3.1.3 Analytical Approach

Three steps are required to determine the connection fees: (1) identify the facilities that benefit growth, (2) determine the cost of those facilities, and (3) determine the capacity provided by those facilities. The approach used in this report to address each of these steps is described below.

9.3.1.4 Facilities That Benefit Growth

Connection fees are used to recover growth’s fair share of the costs of existing facilities that were funded by rate payers and that provide capacity for growth. Growth can occur anywhere within the service area. Hence, the facilities required to serve the City’s current customers are the same facilities that provide service for growth. In effect, the City’s current water distribution and sewer collection systems are each integral networks that provide capacity for growth.

The connection fee also includes projected capital improvements that benefit growth over the next five years. Those future facilities are included with the existing facilities because
five years is the typical period for which connection fees are set before another update should be conducted.

Figure 9.16 summarizes the current and planned facilities that are included in the connection fee calculation.

<table>
<thead>
<tr>
<th>Water Facilities</th>
<th>Wastewater Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment plant</td>
<td>Collection pipelines</td>
</tr>
<tr>
<td>Transmission pipelines</td>
<td>Lift stations</td>
</tr>
<tr>
<td>Distribution pipelines &amp; hydrants</td>
<td>Interceptor pipelines</td>
</tr>
<tr>
<td>Booster pump stations</td>
<td>Treatment Plant (SRCSD)</td>
</tr>
<tr>
<td>Storage reservoirs</td>
<td>Vehicles &amp; equipment</td>
</tr>
<tr>
<td>Vehicles &amp; equipment</td>
<td>Corporation yard</td>
</tr>
<tr>
<td>Corporation yard</td>
<td>Land</td>
</tr>
<tr>
<td>Land</td>
<td></td>
</tr>
</tbody>
</table>

Figure 9.16  Facility Costs Recovered by Connection Fees

9.3.1.4.1 Value of Facilities

The determination of reasonable costs begins by determining the value of the facilities. The value should reflect the original cost of constructing the facilities plus any subsequent costs incurred by rate payers to maintain the facilities so that they are capable of providing capacity for growth, when and if it occurs. A reasonable approach to determining this value is referred to as “replacement cost new” (RCN) by utility valuation specialists. RCN value represents the original cost escalated from the construction date based on construction cost inflation. In effect, the RCN value represents the cost to construct capacity today.

RCN value recovers the original cost of construction. RCN value also compensates rate payers for incurring the subsequent costs of maintaining facilities. By maintaining facilities, the capacity for both existing users and growth retains its ability to provide service. Rate payers are entitled to recover the cost of maintenance because they have no choice but to maintain not only the capacity they are using but also the unused capacity available for growth, when and if it occurs. Rate payers are entitled to receive reimbursement from growth for having maintained growth’s share of capacity.

The incremental difference between the original cost and the RCN is presumed to recover the cost of maintenance, although no exacting calculation has been made of the amount of maintenance that has ensued since the original construction. Such a calculation would be very difficult particularly if no data are available. However, for purposes of cost recovery the incremental difference is deemed to be a reasonable proxy for depreciation.

We note that rate payers are not only entitled to recover their original construction investment and the subsequent maintenance that they have advanced on behalf of growth, but are also entitled to earn a reasonable return on their outlay. A separate determination of this reasonable return has not been made but is assumed to be included in the incremental difference along with the recovery of maintenance costs.
It may be appropriate to consider making certain of the adjustments to the RCN value summarized in Figure 9.17.

<table>
<thead>
<tr>
<th>Cost</th>
<th>Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt funded facilities</td>
<td>Include cumulative retired debt service, not full construction cost. Exclude outstanding debt service.</td>
</tr>
<tr>
<td>Post-construction costs (maintenance, repairs, carrying cost of capital)</td>
<td>Include depreciation (optional).</td>
</tr>
<tr>
<td>Contributed capital</td>
<td>Exclude. Capacity only benefits tract. Exclude. Capacity only benefits individual connections.</td>
</tr>
<tr>
<td>- In-tract facilities</td>
<td></td>
</tr>
<tr>
<td>- Customer meters, services, laterals</td>
<td></td>
</tr>
<tr>
<td>Construction work in progress</td>
<td>Exclude. Facilities are not in service.</td>
</tr>
<tr>
<td>Capital reserves</td>
<td>Exclude. Facilities are not in service.</td>
</tr>
</tbody>
</table>

**Figure 9.17  Recommended Cost Recovery Adjustments**

Capital facilities are typically funded either directly from rate revenue on a pay-as-you-go (PAYGo) basis or from borrowed funds such as bonds or loans. When borrowed funds are used, it is reasonable for rate payers to be reimbursed for the debt service they have retired but not for the outstanding indebtedness. Hence, in the case of debt-funded infrastructure, it is appropriate to include the cumulative principal and interest cost that rate payers have incurred instead of the full acquisition cost. In this way, growth is not reimbursing rate payers for borrowed funds.

As previously discussed, the cost of infrastructure for which rate payers are due reimbursement does not end with the original construction of the assets. There are certain post-construction costs that should be considered. Maintenance and repair costs at least partially offset depreciation. These costs can be reimbursed by not deducting depreciation. In addition, rate payers incur the cost of carry capital costs until they receive reimbursement from growth. It is assumed that rate payers are indirectly reimbursed for this opportunity cost by not deducting depreciation.

We note that, while it is common for depreciation to be deducted from the RCN value in deriving connection fees, we believe this deduction fails to provide full cost recovery to rate payers. Deducting depreciation from replacement costs results in a value that is referred to by valuation experts as “Replacement Cost New Less Depreciation” or RCNLD. RCNLD value is generally regarded by the courts as a reasonable estimate of fair market value for purposes of transferring ownership of utility assets. RCNLD value represents the value of the utility that a willing buyer might pay a willing seller to purchase the utility. We believe it is inappropriate to base connection fees on RCNLD value because connection fees are not paid by growth to purchase a share of the utility. Paying a connection fee does not confer ownership when it is paid; rather, it reimburses rate payers for the costs they bore to provide capacity for growth when and if it occurs.
Deducting depreciation means that rate payers do not achieve full cost recovery. This is particularly apparent with facilities that are fully depreciated and still in service providing capacity for growth. In this case, rate payers receive no reimbursement for facilities that they paid for to provide capacity for growth that is still available and for which rate payers continue to incur carrying costs, waiting for growth to eventually occur at its convenience. By deducting depreciation, rate payers receive no incentive to risk their capital on behalf of growth.

Contributed capital can be excluded for facilities that do not provide system-wide capacity such as in-tract facilities, which includes customer meters, services, and laterals. In-tract facilities are facilities constructed by developers specifically for the benefit of subdivisions without any additional capacity for other connections. Data are often not available to estimate exactly how much capital was contributed by developers. However, reasonable estimates can be made to minimize how much contributed capital is included in the connection fee calculation so that double counting is avoided.

Equity can be tied up in providing capacity in the forms of construction work in progress and capital reserves. This equity does not result in plant in service that is functioning to provide capacity and should be excluded.

### 9.3.1.4.2 Capacity in Facilities

The connection fee represents the unit cost of capacity. The unit cost is determined by dividing the value of the facilities by the current number of connections served. In this way, the connection fee is the average cost paid by today’s connections. In order to join the system, new connections need to pay the average cost so that they are at the same level of capital participation as existing connections and thereby have fully reimbursed existing connections so that all connections have borne an equivalent cost.

The current number of water connections is converted to a standard connection referred to as an equivalent meter unit (EMU). An EMU represents the capacity of the smallest meter size available, a 3/4” meter. Larger meters equal more EMUs depending on how their rated capacities compare with one EMU.

The current number of sewer connections is converted to a standard connection referred to as an equivalent dwelling unit (EDU). An EDU relates multi family, commercial, and industrial connections to an equivalent single family residential connection based on the ratio of the customer’s estimated daily sewered water use compared to that of a single family residence. Because the City’s sewer connection fee only recovers collection system costs, there is no need to account for differences in the strength of wastewater, which would be needed for wastewater treatment facilities.
9.3.1.4.3 Unit Cost of Capacity

The connection fee for an EMU or EDU represents the unit cost of capacity. Dividing the value of the water system facilities by the number of EMUs served determines the unit cost of the City’s water system. Dividing the value of the sewer system facilities by the number of EDUs served determines the unit cost of the City’s sewer system.

In effect, the connection fees represents the unit cost associated with the capacity that ratepayers have funded. By paying this unit cost, each EMU or EDU attains the same level of capital participation in the facilities as an existing rate payer. The connection fee should not be viewed as the cost of a share in the facilities. Paying a connection fee does not convey an ownership share in the facilities. Paying a connection fee only provides reimbursement to those who bore the cost of providing capacity for future connections.

9.3.2 Calculation Methodology – Water

9.3.2.1 Water Facilities Included in Calculation

The City owns and operates the George Kristoff Water Treatment Plant (WTP), formally known as the Bryte Bend Water Treatment Plant, obtaining raw surface water from the Sacramento River. The City’s water system currently includes 23.6 million gallons of storage capacity (via tanks and reservoirs) and roughly 180 miles of pipelines to deliver the treated water to its customers. The City’s water enterprise serves all commercial, residential, and industrial developments within its City limits, approximately 19,000 connections, consuming an estimated 11.9 Million Gallons per Day (mgd).

The Water Master Plan identifies a recommended capital improvement program to address existing water system deficiencies and provide for future growth through buildout of the City’s General Plan. Recommended water distribution system capital improvements include: fire flow improvements, new distribution system pipelines, new distribution system storage tanks and associated booster pump stations, and funding of ongoing programs such as the small main replacement program and maintenance and repair of water system appurtenances. Treatment plant capital improvements include: filter media replacement, measurement instrumentation replacement, and general routine repairs and maintenance.

9.3.2.2 Value of Water Facilities

The value of the City’s existing and future water system is summarized in Figure 9.18.
The City’s pipelines were valued based on current construction costs. Unit costs of construction were applied to an inventory of the pipelines to determine their RCN value. The unit costs include all costs, such as construction costs and overheads for design and construction management. Figure 9.19 summarizes the value of these facilities.

Other water system infrastructure was valued by escalating the original construction costs to current year costs using the Engineering News Record Construction Cost Index as of December 2016. The inventory of the City’s existing water pump stations, storage tanks, valves, fire hydrants, and other non-pipeline infrastructure was compiled by the City as of December 31, 2016. The inventory includes the acquisition date, original cost, and estimated service lives for each asset, based on the City’s records. Land was valued at its original book value. A copy of the inventory of existing water facilities and the RCN calculations is shown in Appendix K.
In 2002 and 2003, the City issued revenue bonds to fund the expansion of the Bryte Bend Water Treatment Plant and these bonds were refinanced in 2012 and 2013. The asset valuation includes the cumulative retired debt service on the bonds, rather than the full construction cost of the Water Treatment Plant. In this way, double counting of the principal is avoided, which would have occurred if the principal were included in the connection fee (in the form of construction cost) and again in the rates after the connection is made (in the form of debt service). All of the principal and interest paid to date should be included in deriving the connection fees because it represents a cost borne by rate payers for facilities that benefit growth.

The value of future facilities in the capital improvement program for the next five years is presented in current dollars based on the City’s capital improvement projects.

Developer-contributed in-tract facilities were excluded from the valuation. Based on discussions with staff, we have estimated 10 percent of the smaller pipelines do not provide capacity for growth, but rather are located within subdivisions and provide capacity on within the tract.

### 9.3.2.3 Capacity in Water Facilities

We determined the capacity of the water system based on the number of Equivalent Meter Units (EMUs) projected to be connected in 2020. 350 gallons per day is the average daily flow assumed in the Master Plan per ¾” meter. Dividing this flow into the projected 16.6 mgd demand yields 47,429 EMUs as summarized in Figure 9.20.

#### Equivalent Meter Unit (EMU) Calculation

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected System Demand - 2020 (gpd)</td>
<td>16,600,000</td>
</tr>
<tr>
<td>Average Flow per 3/4” Meter (gpd)</td>
<td>350</td>
</tr>
<tr>
<td>Total Demand (EMUs)</td>
<td>47,429</td>
</tr>
</tbody>
</table>

Figure 9.20 Equivalent Meter Units

### 9.3.2.4 Connection Fee Structure – Water

Figure 9.21 summarizes the current fee structure and proposed modifications. The most significant change is moving from charging multi-family dwellings on a per dwelling unit basis to charging based on the size of the service connection, which is a direct measure of the capacity that is provided.
9.3.2.5 Connection Fee Calculation - Water

The RCN values of the water facilities in Figure 9.18 serve as the basis for the connection fee. The connection fee is determined by dividing the value by the system’s total capacity shown in Figure 9.20. The resulting $9,145 connection fee per EMU is shown in Figure 9.22.

<table>
<thead>
<tr>
<th>Water System Assets</th>
<th>NET Replacement Cost New (RCN)</th>
<th>NET RCN per EMU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipelines</td>
<td>47,429 EMUs$^2$</td>
<td></td>
</tr>
<tr>
<td>8 inch and smaller</td>
<td>$114,144,105</td>
<td>$2,407</td>
</tr>
<tr>
<td>10 inch</td>
<td>$20,635,418</td>
<td>$435</td>
</tr>
<tr>
<td>12 to 18 inch</td>
<td>$110,801,828</td>
<td>$2,336</td>
</tr>
<tr>
<td>≥ 19 inch</td>
<td>$48,574,496</td>
<td>$1,024</td>
</tr>
<tr>
<td>Subtotal, Pipelines</td>
<td>$294,155,846</td>
<td>$6,202</td>
</tr>
<tr>
<td>Other Infrastructure</td>
<td>$61,598,945</td>
<td>$1,299</td>
</tr>
<tr>
<td>Land</td>
<td>$1,193,450</td>
<td>$25</td>
</tr>
<tr>
<td>Retired Debt Service</td>
<td>$43,701,531</td>
<td>$921</td>
</tr>
<tr>
<td>Capital Improvement Projects (2016-2020)</td>
<td>$33,107,534</td>
<td>$698</td>
</tr>
<tr>
<td>Grand Total</td>
<td>$433,757,307</td>
<td>$9,145</td>
</tr>
</tbody>
</table>

$^1$ From Figure 9.18  
$^2$ From Figure 9.20

The connection fee for each meter size, regardless of customer class (e.g., single family, multi family, commercial), is derived by multiplying the $9,145 unit cost per EMU times the capacity multipliers for each meter. An EMU represents the number of ¾-inch meters to which a larger meter is equivalent. For example, a 1-inch meter provides 1.67 times as much capacity as a ¾-inch meter. The capacity multipliers are based on the meter’s nominal capacity. The resulting connection fees, by meter size, are shown in Figure 9.23.
Note that with this set of water connection fees that are based on the capacity of each connection, there is no need to have separate connection fees for multi-family and mobile home parks. The City’s current water connection fees for multi-family and mobile home parks is charged per unit. We recommend charging both of these classes on the basis of the size of the connection serving the apartment or the mobile home park instead of charging per dwelling unit.

Comparison with Other Agencies’ Connection Fees – Water

Figure 9.24 compares the City’s existing and proposed residential water connection fees for a ¾” service, with other neighboring agencies.
9.3.3 IV. CALCULATION METHODOLOGY – SEWER

9.3.3.1 Sewer Facilities Included in Calculation

The City’s sewer enterprise serves all commercial, residential, and industrial developments within its City limits, approximately 19,000 connections. The City operates and maintains the collection system, consisting of 12 sewer pump stations and approximately 160 miles of pipelines. The wastewater is collected and delivered to the SRCSD’s wastewater treatment plant via the Lower Northwest Interceptor (LNWI), a 19-mile pipeline.

9.3.4 Value of Sewer Facilities

The value of the City’s existing and future sewer system is summarized in Figure 9.25.

<table>
<thead>
<tr>
<th>Sewer System Assets</th>
<th>Replacement Cost New</th>
<th>Developer Contributions</th>
<th>NET Replacement Cost New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipelines†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 inch and smaller</td>
<td>$147,230,380</td>
<td>-$14,723,038</td>
<td>$132,507,342</td>
</tr>
<tr>
<td>10 inch</td>
<td>$18,109,270</td>
<td>-$1,810,927</td>
<td>$16,298,343</td>
</tr>
<tr>
<td>12 to 18 inch</td>
<td>$49,171,140</td>
<td>$0</td>
<td>$49,171,140</td>
</tr>
<tr>
<td>≥ 19 inch</td>
<td>$17,778,280</td>
<td>$0</td>
<td>$17,778,280</td>
</tr>
<tr>
<td>Subtotal, Pipelines</td>
<td>$232,289,070</td>
<td>-$16,533,965</td>
<td>$215,755,105</td>
</tr>
<tr>
<td>Other Infrastructure</td>
<td>$36,821,182</td>
<td>$0</td>
<td>$36,821,182</td>
</tr>
<tr>
<td>Land</td>
<td>$1,609,463</td>
<td>$0</td>
<td>$1,609,463</td>
</tr>
<tr>
<td>Retired Debt Service</td>
<td>$5,703,923</td>
<td>$0</td>
<td>$5,703,923</td>
</tr>
<tr>
<td>Capital Improvement Projects (2016-2020)</td>
<td>$9,737,006</td>
<td>$0</td>
<td>$9,737,006</td>
</tr>
<tr>
<td>WWTP Decommission/Demolition</td>
<td>$13,800,000</td>
<td>$0</td>
<td>$13,800,000</td>
</tr>
<tr>
<td>Grand Total</td>
<td>$299,960,645</td>
<td>-$16,533,965</td>
<td>$283,426,680</td>
</tr>
</tbody>
</table>

Figure 9.25 Sewer Collection System Replacement Cost

The City’s collection system pipelines comprise the majority of the sewer system replacement cost and were valued based on current construction costs. Unit costs of construction were applied to an inventory of the pipelines to determine their RCN value.
The unit costs include all costs, such as construction costs and overheads for design and construction management. Figure 9.26 summarizes the value of these facilities.

<table>
<thead>
<tr>
<th>Diameter (inches)</th>
<th>Pipe Length (linear feet)</th>
<th>$ per Linear Foot</th>
<th>RCN</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4,560</td>
<td>$130.00</td>
<td>$592,800</td>
</tr>
<tr>
<td>6</td>
<td>226,307</td>
<td>$190.00</td>
<td>$42,998,330</td>
</tr>
<tr>
<td>8</td>
<td>414,557</td>
<td>$250.00</td>
<td>$103,639,250</td>
</tr>
<tr>
<td>10</td>
<td>58,417</td>
<td>$310.00</td>
<td>$18,109,270</td>
</tr>
<tr>
<td>12</td>
<td>65,764</td>
<td>$370.00</td>
<td>$24,332,680</td>
</tr>
<tr>
<td>15</td>
<td>32,873</td>
<td>$460.00</td>
<td>$15,121,580</td>
</tr>
<tr>
<td>16</td>
<td>513</td>
<td>$460.00</td>
<td>$235,980</td>
</tr>
<tr>
<td>18</td>
<td>17,238</td>
<td>$550.00</td>
<td>$9,480,900</td>
</tr>
<tr>
<td>21</td>
<td>15,294</td>
<td>$640.00</td>
<td>$9,788,160</td>
</tr>
<tr>
<td>24</td>
<td>8,881</td>
<td>$740.00</td>
<td>$6,571,940</td>
</tr>
<tr>
<td>27</td>
<td>1,058</td>
<td>$830.00</td>
<td>$878,140</td>
</tr>
<tr>
<td>30</td>
<td>587</td>
<td>$920.00</td>
<td>$540,040</td>
</tr>
<tr>
<td>Total</td>
<td>846,136</td>
<td></td>
<td>$232,289,070</td>
</tr>
</tbody>
</table>

Figure 9.26 Value of Sewer Collection System Pipelines

Other water system infrastructure was valued by escalating the original construction costs to current year costs using the Engineering News Record Construction Cost Index as of December 2016. The inventory of the City’s existing pump stations, lift stations, and other non-pipeline infrastructure was compiled by the City as of December 31, 2016. The inventory includes the acquisition date, original cost, and estimated service lives for each asset, based on the City’s records. Land was valued at its original book value. A copy of the inventory of existing facilities and the RCN calculations is shown in Appendix K.

The asset valuation includes the cumulative retired debt service on the City’s 1978 sewer revenue bond to fund the construction and acquisition of the City’s wastewater treatment plant and a loan from the State Water Resources Control Board from 2004 for sewer improvements. All of the principal and interest paid to date was included in deriving the connection fees because it represents a reimbursable cost borne by rate payers for facilities that benefit growth.

The value of future facilities in the capital improvement program for the next five years is presented in current dollars based on the City’s capital improvement projects identified in the Wastewater System Master Plan.

Developer-contributed in-tract facilities were excluded from the valuation. Based on discussions with staff, we have estimated 10 percent of the smaller pipelines do not provide capacity for growth, but rather are located within subdivisions and provide capacity on within the tract.

In 2004, the City entered into a wastewater services agreement with SRCSD to treat the City’s wastewater upon the City decommissioning its wastewater treatment plant in 2007. The City’s treatment plant is no longer in use and will require an estimated $13,800,000 to
fully decommission and demolition the plant. We have included these costs in the valuation of the wastewater system.

9.3.5 Capacity in Sewer Facilities

We determined the current capacity of the sewer system in terms of the number of Equivalent Dwelling Units (EDUs) by dividing the projected dry weather flow by the average residential dry weather sewer flow (135 gallons per day), identified in the Wastewater Master Plan, as summarized in Figure 9.27.

<table>
<thead>
<tr>
<th>Equivalent Dwelling Unit (EDU) Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Dry Weather Flow - 2020 (gpd)</td>
</tr>
<tr>
<td>Average Residential Sewer Flow (gpd)</td>
</tr>
<tr>
<td>Total EDUs</td>
</tr>
</tbody>
</table>

Figure 9.27  Equivalent Dwelling Units

9.3.6 Connection Fee Structure – Sewer

Figure 9.28 summarizes the current fee structure and proposed modifications.

<table>
<thead>
<tr>
<th>Charge</th>
<th>Current Practice</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Single family</td>
<td>Charged per dwelling unit (assumes 235 gallon per day)</td>
<td>No charge. Confirm 235 gpd daily capacity per dwelling unit.</td>
</tr>
<tr>
<td>2. Multiple dwelling units</td>
<td>Charged per bedroom</td>
<td>Follow SRCSD practice.</td>
</tr>
<tr>
<td></td>
<td>- 3 bedrooms = 1 single family</td>
<td>- All multiple dwelling units = 75% of single family charge.</td>
</tr>
<tr>
<td></td>
<td>- 2 bedrooms = 90% single family</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 bedroom = 80% single family</td>
<td></td>
</tr>
<tr>
<td>3. Commercial/Industrial</td>
<td>Charged per 1,000 sq ft based on land use class.</td>
<td>Charge in proportion to single family based on estimated wastewater discharge.</td>
</tr>
<tr>
<td>4. Accessory dwelling units</td>
<td>Under review by City.</td>
<td>Conform with SB 1069 - pro rate based on floor size or fixture units.</td>
</tr>
<tr>
<td>5. Fixture units</td>
<td>35 fixture units per single family unit.</td>
<td>Confirm 35 fixture unit equivalency.</td>
</tr>
</tbody>
</table>

Figure 9.28  Proposed Structural Modifications - Sewer

Two changes are recommended. First, it is recommended that the multi dwelling unit charge should be set equal to 75 percent of the single-family rate (per dwelling unit), instead of the current practice of 80 percent, 90 percent, or 100 percent of the single-family rate based on the number of bedrooms. This change aligns the City with the same practice as SRCSD. Second, it is recommended that the commercial/industrial charges should be updated with the same wastewater production assumptions used in the Wastewater System Master Plan. When this is done, it can be seen that the current assumptions of wastewater production per 1,000 square feet are much lower than updated estimates.

9.3.7 Connection Fee Calculation - Sewer

The RCN values of the wastewater facilities in Figure 9.25 serve as the basis for the connection fee. The connection fee is determined by dividing the value by the system’s total
capacity shown in Figure 9.27. The resulting $5,979 connection fee per EDU is shown in Figure 9.29.

<table>
<thead>
<tr>
<th>Sewer System Assets</th>
<th>NET Replacement Cost New (RCN)</th>
<th>NET RCN per EDU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipelines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 inch and smaller</td>
<td>$132,507,342</td>
<td>$2,795</td>
</tr>
<tr>
<td>10 inch</td>
<td>$16,298,343</td>
<td>$344</td>
</tr>
<tr>
<td>12 to 18 inch</td>
<td>$49,171,140</td>
<td>$1,037</td>
</tr>
<tr>
<td>≥ 19 inch</td>
<td>$17,778,280</td>
<td>$375</td>
</tr>
<tr>
<td>Subtotal, Pipelines</td>
<td>$215,755,105</td>
<td>$4,551</td>
</tr>
<tr>
<td>Other Infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$36,821,182</td>
<td></td>
<td>$777</td>
</tr>
<tr>
<td>Land</td>
<td>$1,609,463</td>
<td>$34</td>
</tr>
<tr>
<td>Retired Debt Service</td>
<td>$5,703,923</td>
<td>$120</td>
</tr>
<tr>
<td>Capital Improvement Projects (2016-2020)</td>
<td>$9,737,006</td>
<td>$205</td>
</tr>
<tr>
<td>WWTP Decommission/Demolition</td>
<td>$13,800,000</td>
<td>$291</td>
</tr>
<tr>
<td>Grand Total</td>
<td>$283,426,680</td>
<td>$5,979</td>
</tr>
</tbody>
</table>

1 From Figure 9.25
2 From Figure 9.27

Figure 9.29  Sewer Connection Fee Calculation Per EDU

The single family connection fee is $5,946 per EDU. The City’s current multi family connection fee is based on the number of bedrooms per dwelling unit, which is a practice that existed before the City’s wastewater was treated by SRCSD. SRCSD’s practice for charging multi family connection fees is to charge 75 percent of the single family connection fee. We recommend that the City implement the same practice to maintain consistency with the multi-family charges by SRCSD. A reduced fee for multi family dwelling units is fairly common in the industry as multi family dwelling units discharge less wastewater than single family dwellings. On average, multi family dwelling units are smaller and have fewer persons per household than single family dwellings, thus resulting in less wastewater to be collected and transported through the City’s sewer system.

9.3.7.1 Commercial/Industrial Connection Fee

The City currently charges commercial and industrial customers a connection fee per 1,000 square feet of the commercial/industrial building for various land use types. The connection fee per EDU calculated in Figure 9.29 was converted to a connection fee per 1,000 square feet charge based on the estimated flow per 1,000 square feet used in the Wastewater System Master Plan as shown in Figure 9.30.
Figure 9.30 Sewer Connection Fees Calculation Per 1,000 Square Feet

For example, the Commercial Water Related connection fee of $1,771 is derived by multiplying the $5,979 per EDU times the ratio of 100 GPD divided by 135 GPD (0.741). The residential, commercial, and industrial connection fees are summarized in Figure 9.31.

<table>
<thead>
<tr>
<th>Customer Type</th>
<th>Current Rate</th>
<th>Proposed Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>$/DU</td>
<td>$/DU</td>
</tr>
<tr>
<td>Single Family</td>
<td>$3,405</td>
<td>$5,979</td>
</tr>
<tr>
<td>Multi Family</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 bedroom</td>
<td>$2,724</td>
<td>$4,484</td>
</tr>
<tr>
<td>2 bedrooms</td>
<td>$3,065</td>
<td>$4,484</td>
</tr>
<tr>
<td>&gt;2 bedrooms</td>
<td>$3,405</td>
<td>$4,484</td>
</tr>
<tr>
<td>Commercial</td>
<td>$/1000 sq. ft.</td>
<td>$/1000 sq. ft.</td>
</tr>
<tr>
<td>Water related</td>
<td>$417</td>
<td>$1,771</td>
</tr>
<tr>
<td>General</td>
<td>$837</td>
<td>$1,771</td>
</tr>
<tr>
<td>Neighborhood</td>
<td>$837</td>
<td>$1,417</td>
</tr>
<tr>
<td>Community</td>
<td>$837</td>
<td>$1,417</td>
</tr>
<tr>
<td>Highway</td>
<td>$837</td>
<td>$1,417</td>
</tr>
<tr>
<td>Office</td>
<td>$837</td>
<td>$1,771</td>
</tr>
<tr>
<td>Industrial</td>
<td>$/1000 sq. ft.</td>
<td>$/1000 sq. ft.</td>
</tr>
<tr>
<td>Water related</td>
<td>$248</td>
<td>$709</td>
</tr>
<tr>
<td>Light</td>
<td>$248</td>
<td>$709</td>
</tr>
<tr>
<td>Mixed Comm/Ind</td>
<td>$542</td>
<td>$1,063</td>
</tr>
<tr>
<td>Business Park</td>
<td>$1,012</td>
<td>$1,417</td>
</tr>
<tr>
<td>Heavy</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Figure 9.31 Current and Proposed Sewer Connection Fees
9.3.8 Comparison with Other Agencies' Connection Fees – Sewer

Figure 9.32 compares the City’s existing and proposed residential sewer connection fees with other neighboring agencies.

Figure 9.32 Single-family Sewer Connection Fee Comparison

<table>
<thead>
<tr>
<th>City</th>
<th>Basis For Charge</th>
<th>SFR Per Unit</th>
<th>MFR % of SFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacramento*</td>
<td>Lateral size</td>
<td>$5,685</td>
<td>100%</td>
</tr>
<tr>
<td>Davis</td>
<td>Per dwelling unit</td>
<td>$6,150</td>
<td>54%</td>
</tr>
<tr>
<td>Woodland</td>
<td>Per dwelling unit</td>
<td>$6,401</td>
<td>83%</td>
</tr>
<tr>
<td>Lincoln</td>
<td>Per dwelling unit</td>
<td>$6,444</td>
<td>100%</td>
</tr>
<tr>
<td>Folsom*</td>
<td>Per dwelling unit</td>
<td>$6,514</td>
<td>78%</td>
</tr>
<tr>
<td>West Sac - North (Current)*</td>
<td>SFR by unit, MFR per unit by # of bedrooms</td>
<td>$6,763</td>
<td>80%-100%</td>
</tr>
<tr>
<td>West Sac - North (Proposed)*</td>
<td>SFR and MFR per unit</td>
<td>$9,337</td>
<td>75%</td>
</tr>
<tr>
<td>Roseville</td>
<td>Per dwelling unit</td>
<td>$7,802</td>
<td>100%</td>
</tr>
<tr>
<td>West Sac - Southport (Current)*</td>
<td>SFR by unit, MFR per unit by # of bedrooms</td>
<td>$8,928</td>
<td>80%-100%</td>
</tr>
<tr>
<td>West Sac - Southport (Proposed)*</td>
<td>SFR and MFR per unit</td>
<td>$11,502</td>
<td>75%</td>
</tr>
<tr>
<td>Elk Grove*</td>
<td>Per dwelling unit</td>
<td>$9,015</td>
<td>100%</td>
</tr>
</tbody>
</table>

* Includes additional SRCSD connection fees for wastewater treatment of $5,523 per connection, with the exception of West Sacramento’s North area, which SRCSD charges a lower connection fee of $3,358 for areas it has determined to be infill.
JANUARY 14 1981

East Yolo Community Services District
General Manager
P. O. Box 802
West Sacramento, CA 95691

APPLICATION 25615 PERMIT 18150

Your water right permit is enclosed. The Board requires that you submit annual reports showing the progress you have made in the construction of your project or, if constructed, the use made under your permit which would qualify for licensing purposes. We will mail the forms to you when the reports are due.

Please note that, with respect to other rights attaching to this source, the priority of this right commences with the date of the application. Therefore, in time of water shortage, those with rights senior to yours can take their water first. Additional limitations on the diversion of water are specified by the terms of this permit. You should read the terms and conditions carefully so that you are familiar with your responsibilities as an appropriator of water under this entitlement.

After the project has been completed, an inspection will be made to determine the amount of water which has been placed to beneficial use within the terms of the permit. A license will then be issued confirming a right to that amount of water.

Please inform us of any change in address or ownership.

D. W. Sadiston
Program Manager
Hearing Section

Enclosure
PERMIT FOR DIVERSION AND USE OF WATER

PERMIT 13140

Application 25516 of EAST YOLO COMMUNITY SERVICES DISTRICT
19515 SOUTHERN RIVER ROAD, WEST SACRAMENTO, CALIFORNIA 95691

Filed on DECEMBER 22, 1977, has been approved by the State Water Resources Control Board SUBJECT TO VESTED RIGHTS and is the limitations and conditions of this Permit.

Permittee is hereby authorized to divert and use water as follows:

1. Source:

<table>
<thead>
<tr>
<th>SACRAMENTO RIVER</th>
<th>SUESUN RAN</th>
<th>TRIBUTARY TO</th>
</tr>
</thead>
</table>

2. Location of point of diversion:

| ON THE WEST BANK OF THE SACRAMENTO RIVER ABOUT 750 FEET NORTH OF THE CENTER LINE OF THE PIONEER MEMORIAL BRIDGE | W1/4 OF N1/4 | 3 | 8h4p | NO |

| COUNTY OF YOLO |

3. Purpose of use:

| MUNICIPAL | CAST YOLO COMMUNITY SERVICES DISTRICT WITHIN PROJECTED SECTION 26 TO 35, TEN, N4E, AND SECTIONS 7 TO 10, 15 TO 10, 10 TO 27, 27 TO 29 AND 29 TO 30, TEN, N4E, N06E. |

4. Place of use:

<table>
<thead>
<tr>
<th>Section</th>
<th>Township</th>
<th>Range</th>
<th>Easement</th>
</tr>
</thead>
</table>

The place of use is shown filed with the State Water Resources Control Board.
5. THE WATER APPROPRIATED SHALL BE LIMITED TO THE QUANTITY WHICH CAN BE EQUITABLY USED AND SHALL NOT EXCEED 62 CUBIC FEET PER SECOND TO BE DIVERTED FROM JANUARY 1 TO JUNE 30 AND FROM SEPTEMBER 1 TO DECEMBER 31 OF EACH YEAR. THE MAXIMUM AMOUNT DIVERTED UNDER THIS PERMIT SHALL NOT EXCEED 18,350 ACRE-FOOT PER YEAR.

6. THE AMOUNT AUTHORIZED FOR APPROPRIATION MAY BE REDUCED IN THE LICENSE IF INVESTIGATION WARRANTS.

7. CONSTRUCTION WORK SHALL BE COMPLETED WITHIN TWO YEARS FROM DATE OF PERMIT AND SHALL BE COMPLETED BY DECEMBER 1, 1955.

8. COMPLETE APPLICATION OF THE WATER TO THE AUTHORIZED USE SHALL BE MADE BY DECEMBER 1, 2000.

9. PROGRESS REPORTS SHALL BE SUBMITTED PROMPTLY BY PERMITTEE WHEN REQUESTED BY THE STATE WATER RESOURCES CONTROL BOARD UNTIL LICENSE IS ISSUED.

10. PERMITTEE SHALL ALLOW REPRESENTATIVES OF THE STATE WATER RESOURCES CONTROL BOARD AND OTHER PARTIES AS MAY BE AUTHORIZED FROM TIME TO TIME BY SAID BOARD, REASONABLE ACCESS TO PROJECT WORKS TO DETERMINE COMPLIANCE WITH THE TERMS OF THIS PERMIT.

11. PURSUANT TO CALIFORNIA WATER CODE, SECTIONS 100 AND 275, ALL RIGHTS AND PRIVILEGES UNDER THIS PERMIT AND ANY LICENSE ISSUED PURSUANT THERETO, INCLUDING METHOD OF DIVERSION, METHOD OF MEASUREMENT, AND QUANTITY OF WATER DIVERTED, ARE SUBJECT TO THE CONTINUING AUTHORITY OF THE STATE WATER RESOURCES CONTROL BOARD IN ACCORDANCE WITH LAW AND THE INTEREST OF THE PUBLIC WELFARE TO PREVENT WASTE, UNREASONABLE USE; UNREASONABLE METHOD OF USE, OR UNREASONABLE METHOD OF DIVERSION OF SAID WATER.

THE CONTINUING AUTHORITY OF THE BOARD MAY BE EXERCISED BY IMPOSING SPECIFIC REQUIREMENTS OVER AND ABOVE THOSE CONTAINED IN THIS PERMIT WITH A VIEW TO MINIMIZING WASTE OF WATER AND TO ACHIEVING THE REASONABLE WATER REQUIREMENTS OF PERMITTEE WITHOUT UNREASONABLE DRAFT ON THE SOURCE. PERMITTEE MAY BE REQUIRED TO IMPLEMENT SUCH PROGRAMS AS (1) ACQUIRING OR RECLAIMING THE WATER ALLOCATED; (2) USING WATER RECLAIMED BY ANOTHER ENTITY INSTEAD OF ALL OR PART OF THE WATER ALLOCATED; (3) RESTRICTING DIVERSIONS SO AS TO ELIMINATE AGRICULTURAL TAILWATER OR TO INCREASE RETURN FLOW; (4) SUPPRESSING EVAPORATION LOSSES FROM WATER SURFACES; (5) CONTROLLING PHYTOPLANKTON GROWTH; AND (6) INSTALLING, MAINTAINING, AND OPERATING EFFICIENT WATER MEASURING DEVICES TO ASSURE COMPLIANCE WITH THE QUANTITY LIMITATIONS OF THIS PERMIT AND TO DETERMINE ACCURATELY WATER USE AGAINST REASONABLE REQUIREMENTS FOR THE AUTHORIZED PROJECT. NO ACTION WILL BE TAKEN PURSUANT TO THIS PARAGRAPH UNLESS THE BOARD DETERMINES, AFTER NOTICE TO AFFECTED PARTIES AND OPPORTUNITY FOR HEARING, THAT SUCH SPECIFIC REQUIREMENTS ARE PHYSICALLY AND FINANCIALLY FEASIBLE AND ARE APPROPRIATE TO THE PARTICULAR SITUATION.

12. THE QUANTITY OF WATER DIVERTED UNDER THIS PERMIT AND ANY LICENSE ISSUED PURSUANT THERETO IS SUBJECT TO MODIFICATION BY THE STATE WATER RESOURCES CONTROL BOARD IF, AFTER NOTICE TO THE PERMITTEE AND AN OPPORTUNITY FOR HEARING, THE BOARD FINDS THAT SUCH MODIFICATION IS NECESSARY TO MEET WATER QUALITY OBJECTIVES IN WATER QUALITY CONTROL PLANS WHICH HAVE BEEN OR MAY BE ESTABLISHED OR MODIFIED PURSUANT TO DIVISION 7 OF THE WATER CODE. NO ACTION WILL BE TAKEN PURSUANT TO THIS PARAGRAPH UNLESS THE BOARD FINDS THAT (1) ACCURATE WASTE DISCHARGE REQUIREMENTS HAVE BEEN PRESCRIBED AND ARE IN EFFECT WITH RESPECT TO ALL WASTE DISCHARGES WHICH HAVE ANY SUBSTANTIAL EFFECT UPON WATER QUALITY IN THE AREA INVOLVED, AND (2) THE WATER QUALITY OBJECTIVES CANNOT BE ACHIEVED SOLELY THROUGH THE CONTROL OF WASTE DISCHARGES.

13. IN ACCORDANCE WITH SECTION 1603 AND/OR SECTION 8100 OF THE FISH AND GAME CODE, NO DIVERSION FACILITY SHALL BE CONSTRUCTED OR WATER DIVERTED UNDER THIS PERMIT UNTIL APPLICANT HAS CONSUMED A STREAM OR LAKE ALTERATION AGREEMENT WITH THE DEPARTMENT OF FISH AND GAME AND/OR THE DEPARTMENT HAS DETERMINED THAT MEASURES NECESSARY TO PROTECT FISH AND GAME HAVE BEEN INCORPORATED INTO THE PLANS AND CONSTRUCTION OF SUCH DIVERSION FACILITY. THE CONSTRUCTION, OPERATION, OR MAINTENANCE COSTS OF ANY FACILITY REQUIRED PURSUANT TO THIS PROVISION SHALL BE BORNE BY THE PERMITTEE.

14. THE STATE WATER RESOURCES CONTROL BOARD RESERVES JURISDICTION OVER THIS PERMIT TO CHARGE THE SEASON OF DIVERSION TO CONFORM TO THE RESULTS OF A COMPREHENSIVE ANALYSIS OF THE AVAILABILITY OF UNAPPROPRIATED WATER IN THE SACRAMENTO RIVER BASIN. ACTION TO CHANGE THE SEASON OF DIVERSION WILL BE TAKEN ONLY AFTER NOTICE TO INTERESTED PARTIES AND OPPORTUNITY FOR HEARING.

15. THIS PERMIT IS SUBJECT TO PRIOR RIGHTS. PERMITTEE IS PUT ON NOTICE THAT DURING SOME YEARS WATER WILL NOT BE AVAILABLE FOR DIVERSION DURING PORTIONS OR ALL OF THE SEASON AUTHORIZED HEREBIN. THE ANNUAL VARIATIONS IN OCCURRENCE AND HYDROLOGIC CONDITIONS IN THE SACRAMENTO RIVER BASIN ARE SUCH THAT IN ANY YEAR OF WATER SCARCITY THE SEASON OF DIVERSION AUTHORIZED HEREBIN MAY BE REDUCED OR COMPLETELY ELIMINATED IN ORDER OF THIS BOARD MADE AFTER NOTICE TO INTERESTED PARTIES AND OPPORTUNITY FOR HEARING.
Sixth, no diversion is authorized by this permit which satisfaction of Indus Basin entitlements requires release of supplemental project water. The board shall advise permittee of the probability of imminent curtailment of diversions as far in advance as practicable based on anticipated requirements for supplemental project water provided by the Central Valley Project or the State water project operators. The board shall notify the permittee of curtailment of diversions when it finds that no water is available for diversion under this permit.

For the purpose of initially determining supplemental project water required for Indus Basin entitlements, the following definitions shall apply:

A. Indus Basin entitlements are defined as all rights to divert water from streams tributary to the Sacramento-San Joaquin Delta or the Delta-Fork area within the respective basins of origin or the legal delta, unavoidable natural requirements for riparian habitat and conveyance losses, and flows required by the board for maintenance of water quality and fish and wildlife. Export diversions and project carriage water are specifically excluded from the definition of Indus Basin entitlements.

B. Supplemental project water is defined as water imported to the basin by the projects, and water released from project storage, which is in excess of water required for project export and project Indus deliveries.

Notice of curtailment of diversion under this term shall not be issued by the board until:

1. Project operators jointly develop and demonstrate to the board a reasonably accurate method of calculating supplemental project water.

2. The board has approved the method of calculating supplemental project water and has confirmed the definitions of Indus Basin entitlements and supplemental project water after public hearing.

3. The project operators have notified the board that the release of supplemental project water is imminent or has occurred. Such notice should include the times and amounts of releases or potential releases.

4. The board finds that supplemental project water has been released or will be released.

17. In order to prevent degradation of the quality of water during and after construction of the project, prior to commencement of construction permittee shall file a report pursuant to Water Code section 13260 and shall comply with any water discharge requirements imposed by the California Regional Water Quality Control Board, Central Valley Region, or by the State Water Resources Control Board.

18. The State Water Resources Control Board retains continuing authority over this permit and any license issued pursuant thereto to require permittee to implement a water conservation program to assure that water is not being used in an unreasonable manner.

19. The total quantity of water diverted under this permit, together with that diverted under contract with the United States shall not exceed 23,600 acre-feet per annum.

This permit is issued and permittee takes it subject to the following provisions of the Water Code:

Section 13260. If the permit is revoked for any reason or the water supplied thereunder is diverted in any manner not authorized by the permit, the permit is null and void subject to provisions of this section.

Section 13274. No permit is issued hereunder unless the permittee agrees to refrain from any action which will interfere with or hinder the development of the project or the carrying out of this provision, and the permittee agrees to refrain from any action which will interfere with or hinder the development of the project or the carrying out of this provision, and the permittee agrees to refrain from any action which will interfere with or hinder the development of the project or the carrying out of this provision, and the permittee agrees to refrain from any action which will interfere with or hinder the development of the project or the carrying out of this provision.

January 14, 1951

State Water Resources Control Board

/L. C. Spencer/

Chief, Division of Water Rights
ASSUMPTION OF CONTRACT AND CONSENT THERETO

CONTRACT BETWEEN THE UNITED STATES OF AMERICA AND EAST YOLO COMMUNITY SERVICES DISTRICT, to divert water from Sacramento River sources, providing for Project water service and agreement on diversion of water.

CONTRACT NO. 0-07-20-W0187

ASSUMPTION OF CONTRACT

CITY OF WEST SACRAMENTO hereby assumes Contract No. 0-07-20-W0187 and agrees to be bound by and perform all the terms and conditions of said contract, dated July 1, 1980, a copy of which is attached hereto as Exhibit "A" and incorporated herein by this reference.

CITY OF WEST SACRAMENTO

Dated: May 17, 1989

CONSENT TO ASSUMPTION OF CONTRACT

THE UNITED STATES OF AMERICA hereby consents to the assumption by the CITY OF WEST SACRAMENTO of Contract No. 0-07-20-W0187 between the UNITED STATES and EAST YOLO COMMUNITY SERVICES DISTRICT.

THE UNITED STATES OF AMERICA

Dated: ________________________

By ________________________

DTWSAC5
**UNIVERSAL STATES**
DEPARTMENT OF THE INTERIOR
WATER AND POWER RESOURCES SERVICE
Central Valley Project, California

**CONTRACT BETWEEN THE UNITED STATES OF AMERICA AND**
EAST YOLO COMMUNITY SERVICES DISTRICT, DIVERTER OF WATER FROM
SACRAMENTO RIVER SOURCES, PROVIDING FOR PROJECT WATER
SERVICE AND AGREEMENT ON DIVERSION OF WATER

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<td>25</td>
<td>Confirmation of Contract</td>
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<td>26</td>
<td>Changes in Contractor’s Service Area</td>
<td>24</td>
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<td>27</td>
<td>Signature Page</td>
<td>24</td>
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Exhibit A
Map of Contractor's Service Area
UNITED STATES
DEPARTMENT OF THE INTERIOR
WATER AND POWER RESOURCES SERVICE
Central Valley Project, California

CONTRACT BETWEEN THE UNITED STATES OF AMERICA AND
EAST YOLO COMMUNITY SERVICES DISTRICT, DIVERTER OF WATER FROM
SACRAMENTO RIVER SOURCES, PROVIDING FOR PROJECT WATER
SERVICE AND AGREEMENT ON DIVERSION OF WATER

THIS CONTRACT, made this 1st day of July, 1890, in
pursuance generally of the Act of June 17, 1902 (32 Stat. 388), and
acts amendatory or supplementary thereto, between THE UNITED STATES OF
AMERICA, hereinafter referred to as the United States, acting through
the Secretary of the Interior, and the EAST YOLO COMMUNITY SERVICES
DISTRICT, hereinafter referred to as the District or Contractor, a
public agency of the State of California, duly organized, existing,
and acting pursuant to the laws thereof, with its principal place of
business in West Sacramento, California.

WITNESSETH, That:

EXPLANATORY RECITALS

WHEREAS, pursuant to authorizing acts, the United States has
under construction and is operating the Central Valley Project, California
for the development, conservation, and utilization of water resources
in California in the Sacramento, the American, the San Joaquin, and
the Trinity River Basins; and
WHEREAS, the Contractor asserts that it will obtain rights to divert, and will divert, for reasonable beneficial use, water from the natural flow of the Sacramento River; and

WHEREAS, the construction and operation of the integrated and coordinated Central Valley Project have changed and will further change the regimen of the Sacramento, American, San Joaquin, and Trinity Rivers and the Sacramento-San Joaquin Delta from unregulated flow to regulated flow; and

WHEREAS, the United States asserts that it has rights to divert, is diverting, and will continue to divert waters from said Rivers and said Delta in connection with the operation of the said Central Valley Project; and

WHEREAS, to assure the Contractor of the enjoyment and use of the regulated flow of said Rivers and Delta, and to provide for the economical operation of the Central Valley Project by, and the reimbursement to, the United States for expenditures made for said Project;

NOW, THEREFORE, in consideration of the performance of the herein contained provisions, conditions, and covenants, it is agreed as follows:

—Explanatory Recitals
DEFINITIONS

1. When used herein, unless otherwise expressed or incompatible with the intent hereof, the term:

   (a) "Secretary" or "Contracting Officer" shall mean the Secretary of the United States Department of the Interior or his duly authorized representative;

   (b) "Project" shall mean the Central Valley Project, California, of the Water and Power Resources Service;

   (c) "year" shall mean a calendar year;

   (d) "base supply" shall mean the quantity of water established in Article 7 which the United States agrees may be diverted by the Contractor from Sacramento River each year without payment to the United States for such quantities diverted;

   (e) "Project water" shall mean the quantity of water established in Article 7 to be diverted each year by the Contractor from Sacramento River for which payment shall be made by the Contractor;

   (f) "total supply" shall mean the sum of the base supply and Project water; and

   (g) "municipal, industrial, and domestic water" (hereinafter referred to as M&I) shall mean water furnished to municipalities, to industrial establishments, for commercial recreation, and for other non-agricultural uses.
TERM OF CONTRACT

2. This contract shall be effective on the date first hereinafter written for a period of 40 years; Provided, That under terms and conditions agreeable to the parties renewals may be made by the Contractor for successive periods not to exceed 40 years each. The terms and conditions of each renewal shall be agreed upon not later than 1 year prior to the expiration of the then existing contract; Provided further, That if the Contractor has not acquired title to the facilities of the Washington Water and Light Company and become the sole purveyor of water within its service area by January 1, 1981, this contract shall terminate; And provided further, That the Contracting Officer may extend said termination date at his discretion if in his opinion the Contractor is actively pursuing acquisition of said facilities and attempting to become said sole purveyor of water.

WATER TO BE FURNISHED TO THE CONTRACTOR

3. (a) Subject to the conditions, limitations, and provisions hereinafter expressed, the Contractor is hereby entitled and authorized to divert from the Sacramento River for beneficial use within its service area delineated on Exhibit A, attached hereto and made a part hereof, a maximum of 23,600 acre-feet of water annually.
(b) If at any time on the basis of studies conducted by the Contracting Officer and the Contractor jointly it is determined that the water needs of the Contractor for the remainder of the term of this contract are for quantities greater or lesser than the maximum quantity established in this article, the parties may amend this contract so as to decrease, or to the extent that additional water is available, as determined by the Contracting Officer, increase the quantities of water to be furnished by the United States. It also shall be the right of the Contractor to contract with other parties or develop its own additional water supplies provided that the development of such water supplies shall not involve the use of any facilities or water rights of the United States without its permission.

(c) Water diverted by the Contractor under this contract shall be used or furnished by the Contractor only for M&I purposes.

(d) No sale or other disposal of any water or the right to the use thereof for use on land other than that shown on Exhibit A shall be made by the Contractor without first obtaining the written consent of the United States thereto.

(e) The Contractor shall develop and implement an effective water conservation program for all water diverted under this contract. That water conservation program shall contain definite goals, appropriate water conservation measures, and time schedules for meeting the
water conservation objectives. While the contents and standards of
a given water conservation program are primarily matters of State
and local determination, there is a strong Federal interest in
developing an effective water conservation program because of this
contract.

(f) A water conservation program, acceptable to the Contract-
ing Officer, shall be in existence prior to diversion of water pursuant
to this contract. At 5-year intervals, thereafter, the Contractor shall
resubmit, and the Contracting Officer shall review the water conserva-
tion program. After consultation with the Contractor, the Contracting
Officer may require modifications to the water conservation program.

(g) The United States assumes no responsibility for and
neither it nor its officers, agents, or employees shall have any
liability for or on account of:

(1) The control, carriage, handling, use, disposal,
or distribution of said water outside the facilities constructed
and then being operated and maintained by the United States;

(2) Claims of damage of any nature whatsoever, in-
cluding, but not limited to, property loss or damage, personal
injury or death arising out of or connected with the control,
carriage, handling, use, disposal, or distribution of said water
outside of the hereinabove referred to facilities; and
(3) Any damage whether direct or indirect arising out
of or in any manner caused by a shortage of water whether such
shortage be on account of errors in operation, drought, or un-
avoidable causes.

QUALITY OF WATER

4. The United States assumes no responsibility with respect to
the quality of water to be furnished pursuant to this contract, it
being understood and agreed that the Contractor shall be solely
responsible for such treatment as may be required to render such
water suitable for the purposes for which it is to be used.

RETURN FLOW

5. The United States reserves the right to the use of all waste,
seepage, and return-flow water derived from Project water diverted
from the Sacramento River by the Contractor and which escapes or is
discharged beyond the boundaries of the area shown on Exhibit A and
nothing herein shall be construed as an abandonment or a relinquish-
ment by the United States of the right to use any such water.
WATER SHORTAGE AND APPORTIONMENT

6. (a) In its operation of the Project, the United States will use all reasonable means to guard against a condition of shortage in the quantity of water available to the Contractor pursuant to this contract. Nevertheless, if a shortage does occur during any year because of drought, or other causes which, in the opinion of the Contracting Officer, are beyond the control of the United States, no liability shall accrue against the United States or any of its officers, agents, or employees for any damage, direct or indirect, arising therefrom.

(b) In any year that the Contracting Officer determines there is a shortage in the quantity of water available to customers of the United States from the Project, the Contracting Officer will apportion available water among the water users by reducing deliveries to all users by the same percentage, unless he is prohibited by existing contract, Project authorizations, or he determines that some other method of apportionment is required to prevent undue hardship.

8 Article 6
7. (a) The Contractor shall make payments to the United States each year at the rate of $9.00 for each acre-foot of Project water required to be paid for in accordance with subdivision (d) of this article.

(b) The water rate shall be adjusted effective January 1, 1981, and every 5th year thereafter to account for changes in costs (including operation, maintenance and replacement) for Project water supply, as appropriate, in accordance with the then current M&I rate setting policies of the Project.

(c) The Contracting Officer will make available to the Contractor the computations, appropriate rate policy, and cost allocation upon which any proposed rate adjustment is based and will afford the Contractor not less than 3 months to study, to comment, and the opportunity to consult on the proposed adjustment of rates, the rate policies, or the cost allocation procedures before announcing an adjustment of the rate. Final determination of an adjustment will be announced by the Contracting Officer after consideration of the Contractor's comments but not less than 6 months prior to the effective date thereof.
(d) The Contractor shall pay for the quantity of water determined in accordance with the following:

1. Twenty percent of all water diverted from the Sacramento River during the month of June of each year;
2. Eighty-eight percent of all water diverted from the Sacramento River during the month of July each year; and
3. One Hundred percent of the water diverted from the Sacramento River during the months of August and September of each year.

(e) Notwithstanding the provisions of subdivision (d) of this article the Contractor shall have paid for, by October 31 of each year, the quantity of water shown on the following table (years shown in the table refer to the year of execution of this contract and the following years): Provided, That if the Contractor is unable in any year to accept quantity sufficient to satisfy the total minimum for that year, the amount of payments for water not used may be applied to meet the payment for water taken in excess of the minimum requirement in any of the subsequent 5 years but not thereafter. Provided further, That payments for water received in excess of the annual minimum may be used to satisfy minimum payments due during any of the subsequent 5 years but not thereafter.
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<td>9,590</td>
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<td>40</td>
<td>9,680</td>
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(f) In the event the United States is unable to deliver the scheduled quantity of water due to water shortage or other disruption of service and part or all of the undelivered water was required to meet the contract minimum then the minimum amount which the Contractor shall be required to pay for in such year will be reduced to the amount determined pursuant to subdivision (d) of this article.

METHOD OF PAYMENT FOR WATER

8. The method of payments to be made by the Contractor for water furnished pursuant to this contract shall be as follows:

(a) Prior to June 1 of each year the Contractor shall pay for the Project water scheduled to be diverted during June and July. Before the end of June and July, the Contractor shall pay for the Project water to be diverted pursuant to the latest approved schedule during the second month immediately following: Provided, That if the Contractor does not begin diversion of water before January 1, 1981, before the first day of each month of that year and the first day of each month of each year thereafter until the Contractor begins diversion of water, the Contractor shall pay for 1/12th of the quantity of water that will fulfill the total minimum quantity requirement for that year specified in Article 7.
(b) Adjustment for any difference between the payment for the scheduled quantities of water and payment for the quantities of water actually diverted in any month shall be made in the month immediately following: Provided, That the quantity of water paid for in any year shall not be less than the quantity necessary to fulfill the minimum quantity requirement or the actual quantity delivered in that year, as specified and provided in subdivision (c) of Article 7. By November 1 the Contractor shall make any additional payment necessary to pay for the total quantity of water the Contractor is obligated to pay for that year pursuant to Article 7.

(c) In the event the Contractor is unable, fails, or refuses to divert the quantities of water available for diversion by it and which it is required to pay for pursuant to this contract, said inability, failure, or refusal shall not relieve the Contractor of the obligation to pay for such water, and the Contractor agrees to make payment in the same manner as if such water had been diverted by the Contractor.

AGREEMENT ON WATER QUANTITIES

9. (a) During the term of this contract and any renewal thereof:

Articles 8 - 9—
(1) It shall constitute full agreement as between the United States and the Contractor as to the quantity of water and the allocation thereof between base supply and Project water which may be diverted by the Contractor from the Sacramento River for beneficial use within the area shown on Exhibit A which said diversion, use, and allocation shall not be disturbed so long as the Contractor shall fulfill all of its obligations hereunder; and

(2) The Contractor shall not claim any right against the United States in conflict with the provisions hereof.

(b) Nothing herein contained is intended to or does limit rights of the Contractor against others than the United States or of the United States against any person other than the Contractor:

Provided, however, That in the event the Contractor, the United States, or any other person shall become a party to a general adjudication of rights to the use of water of the Sacramento River system, this contract shall not jeopardize the rights or position of either party hereto or of any other person and the rights of all such persons in respect to the use of such water shall be determined in such proceedings the same as if this contract had not been entered into, and if final judgment in any such general adjudication shall determine that the rights of the parties hereto are different from
the rights as assumed herein, the United States shall submit to the
Contractor an amendment to give effect to such judgment and the
contract shall be deemed to have been amended accordingly unless
within 60 days after submission of such amendment to the Contractor
the Contractor elects to terminate the contract or within the same
period of time the parties agree upon mutually satisfactory amend-
ments to give effect to such judgment.

(c) In the event this contract terminates, the rights of
the parties to thereafter divert and use water shall exist as if
this contract had not been entered into. However, the fact that
this contract places a limit on the total supply to be diverted
annually by the Contractor during the contract term and segregates
it into base supply and Project water, shall not jeopardize the
rights or position of either party with respect to its water rights
or the yield thereof at all times after the contract terminates. It
is further agreed that the Contractor at all times will first use water
to the use of which it is entitled by virtue of its own water rights,
and neither the provisions of this contract, action taken thereunder, nor
payments made thereunder to the United States by the Contractor shall be
construed as an admission that any part of the water used by the Con-
tractor during the term of this contract was in fact water to which it
would not have been entitled under water rights owned by it nor shall

15
—Article 9—
receipt of payments thereunder by the United States from the Con-
tractor be construed as an admission that any part of the water used
by the Contractor during the term of this contract was in fact water
to which it would have been entitled under water rights owned by it.

POINT OF DIVERSION AND MEASUREMENT OF WATER

10. (a) All water diverted by the Contractor from Sacramento
River will be diverted at such point or points as may be mutually
agreed upon in writing by the Contracting Officer and the Contractor.

(b) All water diverted by the Contractor at the point or
points established pursuant to subdivision (a) of this article through
metering facilities installed and operated and maintained by the
Contractor at the Contractor's expense. Upon request of the Contracting
Officer the accuracy of such measurements may be investigated by either
of the parties and any errors appearing therein adjusted.

(c) A computation of the total quantity of water diverted
each month by the Contractor from the Sacramento River shall be
furnished by the Contractor to the Contracting Officer on or before
the 7th day of the following month or at other times upon the request
of the Contracting Officer.
11. (a) Before November 1 of each year, the Contractor shall submit a schedule in writing to the Contracting Officer in a form and from an operational standpoint satisfactory to the Contracting Officer indicating the desired times and quantities for the delivery of water pursuant to this contract during the following year. Within the provisions hereof, the United States shall attempt to make said water available in accordance with said schedule or any revision thereof satisfactory to the Contracting Officer submitted by the Contractor within a reasonable time before the desired change of times or quantities, or both, for delivery.

(b) If in any year after the Contracting Officer has approved a schedule or any revision thereof submitted by the Contractor pursuant to subdivision (a) of this article, the United States is unable to furnish any portion of the water in the quantities, and at the times requested in the schedule and the Contractor does not elect to divert and does not divert such water at other times during such year, the Contractor shall be entitled to an adjustment as provided in Article 8 hereof.

(c) If the Contractor during any month diverts a quantity of water in addition to that which it has requested for such month in its schedule, the Contractor shall be deemed to have revised its
1 schedule and ordered such additional water and the United States shall be deemed to have accepted such revision as satisfactory.

2 As soon thereafter as possible the Contractor shall submit a revised schedule to the United States for the remaining quantity to be diverted during that year.

6 COMPLIANCE WITH RULES AND REGULATIONS

12. The Secretary may from time to time promulgate rules and regulations to implement the reclamation laws. The Contractor agrees to abide by such final rules and regulations lawfully adopted. This contract is subject to all such lawful rules and regulations now or hereafter in force when not inconsistent with any express and specific provisions herein. Such rules and regulations are made a part of this contract.

PENALTY FOR DELINQUENT PAYMENTS

13. The Contractor shall pay a penalty on installments or charges which become delinquent computed at the rate of 1% per month of the amount of such delinquent installments or charges for each day from such delinquency until paid. Provided, That no penalty shall be charged to the Contractor unless such delinquency continues for more than 30 days in which event the penalty shall accrue from the initial date of delinquency.
ASSIGNMENT LIMITED—SUCCESSORS AND ASSIGNS OBBLIGATED

14. 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 part or interest therein shall be valid until approved by the Contracting Officer.

OFFICIALS NOT TO BENEFIT

15. (a) No member of or delegate to Congress or resident commissioner shall be admitted to any share or part of this contract or to any benefit that may arise therefrom, but this restriction shall not be construed to extend to this contract if made with a corporation for its general benefit.

(b) No official of the Contractor shall receive any benefit that may arise by reason of this contract other than as a water user within the Project and in the same manner as other water users within the Project.

CONTINGENT ON APPROPRIATION OR ALLLOTMENT OF FUNDS

16. The expenditure or advance of any money or the performance of any work by the United States hereunder which may require appropriation of money by the Congress or the allotment of funds shall be contingent upon such appropriation or allotment being made. The failure of the Congress to appropriate funds or the absence of any allotment of funds shall not relieve the Contractor from any obligations then accrued under this contract and no liability shall accrue to the United States in case such funds are not appropriated or allotted.

BOOKS, RECORDS, AND REPORTS

17. The Contractor shall establish and maintain accounts and other books and records pertaining to its financial transactions, land use and crop census, water supply, water use, and to other matters as the Contracting Officer may require for purposes of this contract. Reports thereon shall be furnished to the Contracting Officer in such form and on such date or dates as he may require. Subject to applicable Federal laws and regulations, each party shall have the right during office hours to examine and make copies of each other’s books and records relating to matters covered by this contract.

Articles 14 - 17
EQUAL OPPORTUNITY

18. During the performance of this contract, the Contractor agrees as follows:

(1) 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 pay 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.

(2) 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.

(3) 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.

(4) 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.
(5) 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.

(6) 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.

(7) The Contractor will include the provisions of paragraphs (1) through (7) 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 a 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.
1. The Contractor agrees that it will comply with Title VI of the Civil Rights Act of July 7, 1964 (78 Stat. 141) and all requirements imposed by or pursuant to the Department of the Interior Regulation (43 CFR 17) issued pursuant to that title, to the end that, in accordance with Title VI of that Act and the Regulation, no person in the United States shall, on the grounds of race, color, sex, or national origin be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Contractor receives financial assistance from the United States and hereby gives assurance that it will immediately take any measures to effectuate this agreement.

(b) If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the Contractor by the United States, this assurance obligates the Contractor, or, in the case of any transfer of such property, any transferee for the period during which the real property or structure is used for a purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance obliges the Contractor for the period during which it retains ownership or possession of the property. In all other cases, this assurance obligates the Contractor for the period during which the Federal financial assistance is extended to it by the United States.

(c) This assurance is given 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 United States, 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 financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall reserve the right to seek judicial enforcement of this assurance. This assurance is binding on the Contractor, its successors, transferees, and assignees.
20. 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.

GENERAL OBLIGATION—BENEFITS CONDITIONED UPON PAYMENT

21. (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. No water will be made available to the Contractor through Project facilities during any period in which the Contractor may be in arrears in the advance payment of any charges due the United States. The Contractor shall not furnish water made available pursuant to this contract for lands or parties which are in arrears more than 12 months in the advance payment of charges as levied or established.

NOTICES

22. 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 Regional Director, Mid-Pacific Region, Water and Power Resources Service, 2800 Cottage Way, Sacramento, California 95825, and on behalf of the United States, when mailed, postage prepaid, or delivered to the Board of Directors, of the East Yolo Community Services District, Post Office Box 802, West Sacramento, California 95691. 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

23. The execution of this contract shall be authorized or ratified by the qualified electors of the Contractor at an election held for that purpose. The Contractor, after the election and upon the execution of this contract, shall promptly secure a final decree of the proper court.
of the State of California approving and confirming the contract and
decreeing and adjudging it and the apportionment of the benefits made
thereunder to be lawful, valid, and binding on the Contractor. The
Contractor shall furnish to the United States a certified copy of such
decree and of all pertinent supporting records.

24. While this contract is in effect, no change shall be made
in the Contractor's service area by inclusion or exclusion of lands,
by dissolution, consolidation, merger, or otherwise except upon the
Contracting Officer's written consent in advance.

IN WITNESS WHEREOF, the parties hereto have executed this
contract the day and year first hereinafore written.

THE UNITED STATES OF AMERICA

By [Signature]
Acting Regional Director, Mid-Pacific Region
Water and Power Resources Service

EAST YOLO COMMUNITY SERVICES DISTRICT

By [Signature]
President

[Seal]

Attest:

By [Signature]
Secretary

---Articles 23--24
Signatures
RESOLUTION NO. 79-40

OF THE BOARD OF DIRECTORS OF THE EAST
YOLO COMMUNITY SERVICES DISTRICT APPROVING
CONTRACT BETWEEN THE UNITED STATES OF AMERICA
AND THE EAST YOLO COMMUNITY SERVICES DISTRICT
FOR DIVERSION OF WATER AND AUTHORIZING EXECU-
TION

WHEREAS, the East Yolo Community Services District has
negotiated a contract with the United States of America, Department
of Interior, Water and Power Resources Service, for a surface water
supply for the District and its inhabitants; and

WHEREAS, the United States Department of Interior has
forwarded the contract to the District for execution pursuant to a
cover letter dated December 7, 1979; and

WHEREAS, said contract has been approved by the voters of
this District, and by the Board of Directors, and appears to be in
appropriate form;

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors
of the East Yolo Community Services District that the Contract
Between The United States of America and The East Yolo Community
Services District, Diverter of Water From Sacramento River Sources
Providing for Project Water Service and Agreement on Diversion of
Water REV.W.O. 7/18/79 is hereby approved by the Board of Director
of this District and the President and the Secretary of the Dis-
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AYES: Kristoff, Misfeldt, Landerman, Collins, Cameron
NOES: NONE
ABSENT: NONE

[Signature]
President, Board of Directors

ATTEST:

[Signature]
David A. Breninger
Secretary, Board of Directors
CERTIFICATION

I, David A. Breninger, Secretary of the Board of Directors of the East Yolo Community Services District, certify that the foregoing Resolution No. 79-40 is a true copy of the same resolution adopted by a meeting of the East Yolo Community Services District held on December 20, 1979 and the foregoing is in full force and effect on this date.

Dated: __December 24__, 1979

[Signature]

David A. Breninger
Secretary, Board of Directors
East Yolo Community Services District
IN REPLY
REFER TO:

MP-440
832

Mr. Larry S. Gossett
Department of Public Works
City of West Sacramento
PO Box 449
West Sacramento CA 95691

Subject: Contract Assumption, Commencement of Diversions, and Critical Year Reductions, City of West Sacramento, Central Valley Project (Your Letters Dated August 30, 1988; December 30, 1988; and January 23, 1989) (Water Service)

Dear Mr. Gossett:

Thank you for enclosing a copy of Resolution No. 85-13 (Resolution), dated October 23, 1985, of the Yolo County Local Agency Formation Commission in your December 30, 1988, letter to the Bureau of Reclamation (Reclamation). This letter is also intended to facilitate the completion of the contract assumption, and to formally advise the City of West Sacramento (City) of the restoration of Central Valley Project (CVP) long-term water entitlements.

The Resolution provides, among other matters, for the dissolution of the East Yolo Community Services District (East Yolo) and assumption by the City of the functions of East Yolo. We are enclosing for signature by the proper official of the City a consent of assumption form. Execution of the consent form by the City, and thereafter by the Regional Director of Reclamation's Mid-Pacific Region, will formalize and complete the assumption of Contract No. 0-07-20-W0187 (Contract W0187) by the City.

Your August 30, 1988, letter states the City intends to initiate delivery of CVP water in 1989 pursuant to Contract W0187. Reclamation is pleased to be able to provide water service to the City. As a result of the initiation of diversions and pursuant to subdivision (d) of Article 7 of Contract W0187, the City must pay the United States for the following quantities of water:

1. Twenty percent of all water diverted during the month of June of each year;

2. Eighty eight percent of all water diverted during the month of July of each year; and,

3. One hundred percent of all water diverted during the months of August and September of each year.
Commencement of diversions by the City will institute a change in the method of payments relative to those made in prior years. In accordance with the requirements of subdivision (a) of Article 8 of Contract W0187, the City is required to pay prior to June 1 of each year for all CVP water to be diverted during June and July. Before the end of June and July the City is required to pay for all CVP Project water scheduled to be diverted during the month thereafter. All such payments will include credit for water not used but previously paid for, if the City takes in excess of its minimum requirements in any of the subsequent 5 years as provided by subdivision (a) of Article 7.

On March 31, 1989, Reclamation announced full restoration of long-term CVP water entitlements. Due to heavy precipitation and snowfall in March 1989, the United States has withdrawn the scheduled imposition of water deficiencies upon CVP contractors.

We request the City to submit its future water schedules and other contract matter to Reclamation's Willows Office, PO Box 988, Willows, CA 95988-0988. Mr. Jankitsch is available at the Willows Office to answer questions regarding your contract or other related matters. He may be contacted at (916) 934-7066.

Sincerely,

[Signature]

NEIL W. SCHILD
ASSISTANT REGIONAL DIRECTOR

Enclosure
CONSIDERATION OF RESOLUTION NO. 89-67
APPROVING ASSUMPTION OF CONTRACT NO. 0-07-20-W0187
BETWEEN THE UNITED STATES OF AMERICA AND THE CITY OF WEST SACRAMENTO.

INITIATED OR
REQUESTED BY: [X] Staff [ ] Council

REPORT COORDINATED
OR PREPARED BY:

Larry S. Coletti, Director of Public Works

ATTACHMENT [X] [ ] No [X] INFORMATION [ ] DIRECTION [X] ACTION

RECOMMENDED ACTION
IT IS RECOMMENDED that your Council adopt Resolution No. 89-67, approving the
Assumption of Contract No. 0-07-20-W0187 between the United States of America and the City
of West Sacramento.

REASON FOR RECOMMENDED ACTION
To formalize the assumption of the contract for Sacramento River Water diversion originally
entered into between the US Bureau of Reclamation and East Yolo Community Services District.

BACKGROUND AND DISCUSSION
On July 1, 1980, East Yolo Community Services District Board of Directors entered into a
contract with the U.S. Department of Interior, Bureau of Reclamation to divert Central Valley
Project water from the Sacramento River for treatment in the Bryte Bend Water Treatment
Plant. The contract provides for diversion of a maximum of 23,600 acre feet of water annually
for 40 years at an initial rate of $9.00 for each acre foot. This rate is to be adjusted every 5th
year to account for changes in costs for project water.

The City of West Sacramento uses water provided by the State of California Department of
Water Resources, at no cost, from 1 October thru 31 May each year. However, only Bureau of
Reclamation Central Valley Project Water is available June thru September each year.

ATTACHMENTS
1. Resolution No. 89-67
2. Bureau Letter with Contract
RESOLUTION NO. 89-67
APPROVING ASSUMPTION OF CONTRACT NO. 0-07-20-W0187
BETWEEN THE UNITED STATES OF AMERICA AND THE CITY OF WEST SACRAMENTO
FOR DIVERSION OF WATER AND AUTHORIZING EXECUTION

WHEREAS, on July 1, 1980 the Board of Directors of the East Yolo Community Services
District entered into Contract No. 0-07-20-W01987 with the United States of America,
Department of the Interior which authorized the diversion of Central Valley Project water from
Sacramento River sources for a surface water supply for the residents of West Sacramento and
surrounding areas; and

WHEREAS, on January 1, 1987, the East Yolo Community Services District was dissolved
by the incorporation of the City of West Sacramento ("City"); and

WHEREAS, the City is the successor to all rights, duties, and obligations of the dissolved
District; and

WHEREAS, the United States Department of the Interior requires that City assume said
contract by executing the Consent of Assumption attached hereto as Exhibit A and incorporated
herein.

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of West
Sacramento hereby approved the assumption of Contract No. 0-07-20-W0187 and agrees to be
bound by and perform all the terms and conditions of said contract dated July 1, 1980 and that
the Mayor is hereby authorized to execute said contract on behalf of the City.

PASSED AND ADOPTED by the City Council of the City of West Sacramento at a regular
meeting held on this 17th day of May, 1989 by the following vote on roll call:

AYES:
NOES:
ABSENT:

ATTEST:

Helen M. Kanowsky, Deputy City Clerk

Fidel A. Martinez, Mayor
CONTRACT
BETWEEN
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
AND
NORTH DELTA WATER AGENCY
FOR THE ASSURANCE
OF A DEPENDABLE WATER SUPPLY OF SUITABLE QUALITY
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CONTRACT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND THE NORTH DELTA WATER AGENCY
FOR THE ASSURANCE OF A DEPENDABLE WATER SUPPLY OF SUITABLE QUALITY

THIS CONTRACT, made this 23rd day of January, 1971, between the STATE OF CALIFORNIA, acting by and through its DEPARTMENT OF WATER RESOURCES (State), and the NORTH DELTA WATER AGENCY (Agency), a political subdivision of the State of California, duly organized and existing pursuant to the laws thereof, with its principal place of business in Sacramento, California.

RECATS

(a) The purpose of this contract is to assure that the State will maintain within the Agency a dependable water supply of adequate quantity and quality for agricultural uses and, consistent with the water quality standards of Attachment A, for municipal and industrial uses, that the State will recognize the right to the use of water for agricultural, municipal, and industrial uses within the Agency, and that the Agency will pay compensation for any reimbursable benefits allocated to water users within the Agency resulting from the Federal Central Valley Project, and the State Water Project, and offset by any detriments caused thereby.

(b) The United States, acting through its Department of the Interior, has under construction and is operating the Federal Central Valley Project (FCVP).

(c) The State has under construction and is operating the State Water Project (SWP).

(d) The construction and operation of the FCVP and SWP at times have changed and will further change the regimen of rivers tributary to the Sacramento-San Joaquin Delta (Delta) and the regimen of the Delta channels from unregulated flow to regulated flow. This regulation at times improves the quality of water in the Delta and at other times diminishes the quality from that which would exist in the absence of the FCVP and SWP. The regulation at times also alters the elevation of water in some Delta channels.

(e) Water problems within the Delta are unique within the State of California. As a result of the geographical location of the lands of the Delta and tidal influences, there is no physical shortage of water. Intrusion of saline ocean water and municipal, industrial, and agricultural discharges and return flows, tend, however, to deteriorate the quality.

(f) The general welfare, as well as the rights and requirements of water users in the Delta, require that there be maintained in the Delta an adequate supply of good quality water for agricultural, municipal and industrial uses.

(g) The law of the State of California requires protection of the reas within which water originates and the waterbodies in which water is developed. The Delta is such an area and within such a waterbodied. Part 45 of Division 6 of the California Water Code affords a priority to provision of salinity control and maintenance of an adequate water supply in the Delta for reasonable and beneficial uses of water and relegates to lesser priority all exports of water from the Delta to other areas for any purpose.

(h) The Agency asserts that water users within the Agency have the right to divert, are diverting, and will continue to divert, for reasonable beneficial use, water from the Delta that would have been available therein if the FCVP and SWP were not in existence, together with the right to enjoy or acquire such benefits to which water users may be entitled as a result of the FCVP and SWP.

(i) Section 4.4 of the North Delta Water Agency Act, Chapter 83, Statutes of 1973, as amended, provides that the Agency has no authority or power to affect, bind, prejudice, impair, restrict, or modify water rights within the Agency.

(j) The State asserts that it has the right to divert, is diverting, and will continue to divert water from the Delta in connection with its operation of the SWP.

(k) Operation of SWP to provide the water quality and quantity described in this contract constitutes a reasonable and beneficial use of water.

(l) The Delta has an existing gradient or relationship in quality between the westerly portion most seriously affected by ocean salinity intrusion and the interior portions of the Delta where the effect of ocean salinity intrusion is diminished. The water quality criteria set forth in this contract establishes minimum water qualities at various monitoring locations. Although the water quality criteria at upstream locations is shown as equal in some periods of some years to the water quality at the downstream locations, a better quality will in fact exist at the upstream locations at almost all times. Similarly, a better water quality than that shown for any given monitoring location will also exist at interior points upstream from that location at almost all times.

(m) It is not the intention of the State to acquire by purchase or by proceeding in eminent domain or by any other manner the water rights of water users within the Agency, including rights acquired under this contract.

(n) The parties desire that the United States become an additional party to this contract.

AGREEMENTS

1. Definitions. When used herein, the term:

(a) “Agency” shall mean the North Delta Water Agency and shall include all of the lands within the boundaries at the time the contract is executed as described in Section 9.1 of the North Delta Water Agency Act, Chapter 283, Statutes of 1973, as amended.

(b) “Calendar year” shall mean the period January 1 through December 31.

(c) “Delta” shall mean the Sacramento-San Joaquin Delta as defined in Section 12220 of the California Water Code as of the date of the execution of the contract.

(d) “EC” shall mean Electrical Conductivity (EC) shall mean the electrical conductivity of a water sample measured in millimhos per centimeter per square centimeter corrected to a standard temperature of 25 degrees Celsius determined in accordance with procedures set forth in the publication entitled “Standard Methods of Examination of Water and Waste Water”, published jointly by the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation, 13th Edition, 1971, including such revisions thereof as may be made subsequent to the date of this contract which are approved in writing by the State and the Agency.

(e) “Federal Central Valley Project” (FCVP) shall mean the Central Valley Project of the United States.

(f) “Four-River Basin Index” shall mean the most current forecast of Sacramento Valley unimpaired runoff as presently published in the California Department of Water Resources Bulletin 120 for the sum of the flows of the following Sacramento River above Bend Bridge near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River at Smartsville; American River, total inflow to Folsom Reservoir. The May 1 forecast shall continue in effect until the February 1 forecast of the next succeeding year.

(g) “State Water Project” (SWP) shall mean the State Water Resources Development System as defined in Section 12931 of the Water Code of the State of California.

(h) “SWRCB” shall mean the State Water Resources Control Board.

(i) “Water users” shall mean all water users and/or water districts.
through September 30 of the following year.

2. Water Quality.
   (a) (i) The State will operate the SWP to provide water quality at least equal to the better of (1) the standards adopted by the SWRCB as they may be established from time to time; or (2) the criteria established in this contract as identified on the graphs included as Attachment A.
   (ii) The 14-day running average of the mean daily EC at the identified location shall not exceed the values determined from the Attachment A graphs using the Four-River Basin Index except for the period February through March of each year at the location on the Sacramento River at Emanon for which the lower value of the 80 percent probability range shall be used.
   (iii) The quality criteria specified herein shall be met at all times except for a transition period beginning one week before and extending one week after the date of change in periods as shown on the graphs of Attachment A. During this transition period, the WP will be operated to provide as uniform a gradient as possible over the two-week period from one set of criteria to the next so as to arrive at the new criteria one week after the date of change in period as shown on the graphs of Attachment A.
   (b) While not committed affirmatively to achieving a better water quality at interior points upstream from Emanon than those set forth on Attachment A, the State agrees not to alter the Delta hydraulic in such a manner as to cause a measurable adverse change in the ocean salinity gradient or relationship among the various monitoring locations shown on Attachment B and interior points upstream from these locations, with any particular flow at Emanon.
   (c) Whenever the recorded 14-day running average of mean daily EC of water in the Sacramento River at Sacramento exceeds 25 mmhos, the quality criteria indicated on the graphs of Attachment A may be adjusted by adding to the value taken therefrom a product of 1.5 times the amount that the recorded EC of the Sacramento River at Sacramento exceeds 0.25 mmhos.

3. Monitoring. The quality of water shall be measured by the State as needed to monitor performance pursuant to Article 2 proof with equipment installed, operated, and maintained by the State, at locations indicated on “Attachment B”. Records of such measurements shall be regular intervals furnished to the Agency.
   ill monitoring costs at North Fork Mokelumne River near Walnut Grove, Sacramento River at Walnut Grove, and Steamboat Slough at Sutter Slough incurred by the State solely for this contract shall be shared equally by the Agency and the State. All monitoring costs to be borne by the Agency for monitoring at the above locations are included in the payment under Article 10.

   (a) If a structural emergency occurs such as a levee failure or failure of an SWP facility, which results in the State’s failure to meet the water quality criteria, the State shall not be in breach of its contract if it makes all reasonable efforts to operate SWP facilities so that the water quality criteria will be met as soon as possible. For any period in which SWP failure results in failure of the State to meet the water quality criteria, the State shall waive payment under Article 10, prorated for that period, and the amount shall be deducted from the next payment due.
   (b) (i) A drought emergency shall occur when all of the following occur:
      (1) The Four-River Basin Index is less than an average of 9,000,000 acre feet in two consecutive years (which occurred in 1934 and 1976-7); and
      (2) An SWRCB emergency regulation is in effect providing for the operation of the SWP to maintain water quality different from that provided in this contract and any SWP agricultural contractors in the Sacramento Valley is being reduced by at least 50 percent of these agricultural entitlements (it being the objective of the SWP to avoid agricultural deficiencies in excess of 25 percent) or the total of water supplied to meet annual entitlements of all SWP contractors is being reduced by at least 15 percent of all entitlements, whichever results in the greater reduction in acre feet delivered.
   (ii) A drought emergency shall terminate if any of the conditions in (b)(i) of this Article ceases to exist or if the flow past Sacramento after October 1 exceeds 20,000 cubic feet per second each day for a period of 30 days.
   (iii) Notwithstanding the provisions of Article 2(a), when a drought emergency exists, the emergency water quality criteria of the SWRCB shall supersede the water quality requirements of this contract to the extent of any inconsistency provided, however, that the State shall use all reasonable efforts to preserve Delta water quality, taking into consideration both the limited water supply available for that purpose and recognizing the priority established for Delta protection referred to in Recital (g).
   (iv) When a drought emergency exists, and an overland supply is not available to an individual water user comparable in quality and quantity to the water which would have been available to the user under Attachment A, the State shall compensate the user for loss of net income for each acre either (A) planted to a more salt-tolerant crop in the current year, (B) not planted to any crop in the current year provided such determination not to plant was reasonable based on the drought emergency, or (C) which had a reduced yield due to the drought emergency, calculated on the basis of the user’s average net income for any three of the prior five years for each such acre. A special contract claims procedure shall be established by the State to expedite and facilitate the payment of such compensation.

5. Overland Water Supply Facilities.
   (a) Within the general objectives of protecting the western Delta areas against the destruction of agricultural productivity as a result of the increased salinity of waters in the Delta channels resulting in part from SWP operation, the State may provide diversion and overland facilities to supply and distribute water to Sherman Island as described in the report entitled “Overland Agricultural Water Facilities Sherman Island” dated January 1980. Final design and operating specifications shall be subject to approval of the Agency and Reclamation District No. 341. The Agency or its transferees will assume full ownership, operation, and maintenance responsibility for such facilities after successful operation as specified. After the facilities are constructed and operating, the water quality criteria for the Sacramento River at Emanon shall apply at the intake of the facilities in Three Mile Slough.
   (b) The State and the Agency may agree to the construction and operation of additional overland water supply facilities within the Agency, so long as each landowner served by the overland facilities receives a quality of water not less than that specified in Attachment A for the upstream location nearest to his original point of diversion. The design and operation of such facilities and the cost sharing thereof are subject to approval of any reclamation district which includes within its boundaries the areas to be served. The ownership, operation, and maintenance of diversion works and overland facilities shall be the subject of a separate agreement between the Agency or its transferees and the State.

6. Flow Impact. The State shall not convey SWP water so as to cause a decrease or increase in the natural flow, or reversal of the natural flow direction, or to cause the water surface elevation in Delta channels to be altered, to the detriment of Delta channels or water users within the Agency. If lands, levees, embankments, or revetments adjacent to Delta channels within the Agency inur
vided as a result of altered water surface elevations as a result of the conveyance of water from the SWP to lands outside the Agency after the date of this contract, the State shall repair or alleviate the damage, shall improve the channels as necessary, and shall be responsible for all diversion facility modifications required.

7. Place of Use of Water.
   (a) Any subcontract entered into pursuant to Article 18 shall provide that water diverted under this contract for use within the Agency shall not be used or otherwise disposed of outside the boundaries of the Agency by the subcontractor.
   (b) Any subcontract shall provide that all return flow water from water diverted within the Agency under this contract shall be returned to the Delta channels. Subject to the provisions of this contract concerning the quality and quantity of water to be made available to water users within the Agency, and to any reuse or recapture by water users within the Agency, the subcontractor relinquishes any right to such return flow, and as to any portion thereof which may be attributable to the SWP, the subcontractor recognizes that the State has not abandoned such water.
   (c) If water is attempted to be used or otherwise disposed of outside the boundaries of the Agency so that the State's rights to return flow are interfered with, the State may seek appropriate administrative or judicial action against such use or disposal.
   (d) This article shall not relieve any water user of the responsibility to meet discharge regulations legally imposed.

8. Scope of Contract.
   (a) During the term of this contract
      (i) This contract shall constitute the full and sole agreement between the State and the Agency as to (1) the quality of water which shall be in the Delta channels, and (2) the payment for the assurance given that water of such quality shall be in the Delta channels for reasonable and beneficial uses on lands within the Agency, and said diversions and uses shall not be disturbed or challenged by the State so long as this contract is in full force and effect.
      (ii) The State recognizes the right of the water users of the Agency to divert from the Delta channels for reasonable and beneficial uses for agricultural, municipal and industrial purposes on lands within the Agency, and said diversions and uses shall not be disturbed or challenged by the State so long as this contract is in full force and effect, and the State shall furnish such water as may be required within the Agency to the extent not otherwise available under the water rights of water users.
      (iii) The State shall not claim any right against the State in conflict with the provisions hereof so long as this contract remains in full force and effect.

   (a) This contract shall continue in full force and effect until such time as it may be terminated by the written consent and agreement of the parties hereto, provided that 40 years after execution of this contract and every 40 years thereafter, there shall be a six-month period of adjustment during which any party to this contract can negotiate with the other parties to revise the contract as to the provisions set out in Article 10. If, during this period, agreement as to a requested revision cannot be achieved, the parties shall petition a court of competent jurisdiction to resolve the issue as to the appropriate payment to be made under Article 10. In revising Article 10, the court shall review water quality and supply conditions within the Agency under operation of the FCVP and SWP, and identify any reimbursable benefits allocated to water users within the Agency resulting from operation of the FCVP and SWP, offset by any detriments caused thereby. Until such time as any revision is final, including appeal from any ruling of the court, the contract shall remain in effect as without such revision.
   (b) In the event this contract terminates, the parties' water rights to quality and quantity shall exist as if this contract had not been entered into.

10. Amount and Method of Payment for Water.
    (a) The Agency shall pay each year as consideration for the assurance that an adequate water supply and the specific water quality set forth in this contract will be maintained and monitored, the sum of one hundred seventy thousand dollars ($170,000.00). The annual payments shall be made to the State one-half on or before January 1 and one-half on or before July 1 of each year commencing with January 1, 1982.
    (b) The payment established in (a) above shall be subject to adjustment as of January 1, 1987, and every fifth year thereafter.
    (c) The payments provided for in this article shall be deposited by the State in trust in the California Water Resources Development System Revenue Account in the California Water Resources Development Bond Fund. The trust shall continue for five years (or such longer period as the State may determine) but shall be terminated when the United States executes a contract as provided in Article 11 with the State and the Agency at which time the proportion of the trust fund that reflects the degree to which the operation of the FCVP has contributed to meeting the water quality standard under this contract as determined solely by the State shall be paid to the United States (with a pro rata share of interest). In the event that the United States has not entered into such a contract before the termination of the trust, the trust fund shall become the sole property of the State.

11. Participation of the United States. The Agency will exercise its best efforts to secure United States joinder and concurrence with the terms of this contract and the State will diligently attempt to obtain the joinder and concurrence of the United States with the terms of this contract and its participation as a party hereto. Such concurrence and participation by the United States in this contract shall include a recognition ratified by the Congress that the excess land provisions of Federal reclamation law shall not apply to this contract.

12. Remedies.
of the provisions of this contract by a decree of the Superior Court in Sacramento County requiring the State to meet the standards set forth in this contract. If the water quality in Delta channels falls below that provided in this contract, then, at the request of the Agency, the State shall cease all diversions to storage in SWP reservoirs or release stored water from SWP reservoirs or cease all export by the SWP from Delta channels, or any combination of these, to the extent that such action will further State compliance with the water quality standards set forth in this contract, except that the State may continue to export from Delta channels to the extent required to meet water quality requirements in contracts with the Delta agencies specified in Section 11456 of the California Water Code.

(b) To the extent permitted by law, the State agrees to forego the use of eminent domain proceedings to acquire water rights of water users within the Agency or any rights acquired under this contract for water or water quality maintenance for the purpose of exporting such water from the Delta. This provision shall not be construed to prohibit the utilization of eminent domain proceedings for the purpose of acquiring land or any other rights necessary for the construction of water facilities.

(c) Except as provided in the water quality assurances in Article 2 and the provisions of Article 6 and Article 8, neither the State nor its officers, agents, or employees shall be liable for or on account of:

(i) The control, carriage, handling, use, disposal, or distribution of any water outside the facilities constructed, operated and maintained by the State.

(ii) Claims of damage of any nature whatsoever, including but not limited to property loss or damage, personal injury or death arising out of or connected with the control, carriage, handling, use, disposal or distribution of any water outside of the facilities constructed, operated and maintained by the State.

(d) The use by the Agency or the State of any remedy specified herein for the enforcement of this contract is not exclusive and shall not deprive either from using any other remedy provided by law.

13. Comparable Treatment. In the event that the State gives on the whole substantially more favorable treatment to any other Delta entity under similar circumstances than that accorded under this contract to the Agency, the State agrees to renegotiate this contract to provide comparable treatment to the Agency under this contract.

GENERAL PROVISIONS

14. Amendments. This contract may be amended or terminated at any time by mutual agreement of the State and the Agency.

15. Reservation With Respect to State Laws. Nothing herein contained shall be construed as attempting or otherwise preventing the Agency, or any person, firm, association, corporation, or public body claiming by, through, or under the Agency, from contesting by litigation or other lawful means, the validity, constitutionality, construction or application of any law of the State of California.

16. Opinions and Determinations. Where the terms of this contract provide for action to be based upon the opinion, judgment, approval, review, or determination of either party hereto, such terms are not intended to be and shall never be construed as permitting such opinion, judgment, approval, review, or determination to be arbitrary, capricious or unreasonable.

17. Successors and Assigns Obligated. This contract and all of its provisions shall apply to and bind the successors and assigns of the parties hereto.

18. Assignment and Subcontract. The Agency may enter into subcontracts with water users within the Agency boundaries in which the assurances and obligations provided in this contract as to such water user or users are assigned to the area covered by the subcontract. The Agency shall remain primarily liable and shall make all payments required under this contract. No assignment or transfer of this contract, or any part hereof, rights hereunder, or interest herein by the Agency, other than a subcontract containing the same terms and conditions, shall be valid unless and until it is approved by the State and made subject to such reasonable terms and conditions as the State may impose. No assignment or transfer of this contract or any part hereof, rights hereunder, or interest herein by the State shall be valid except as such assignment or transfer is made pursuant to and in conformity with applicable law.

19. Books, Records, Reports, and Inspections Thereof. Subject to applicable State laws and regulations, the Agency shall have full and free access at all reasonable times to the SWP account books and official records of the State as insofar as the same pertain to the matters and things provided for in this contract, with the right at any time during office hours to make copies thereof, and the proper representatives of the State shall have similar rights with respect to the account books and records of the Agency.

20. Waiver of Rights. Any waiver at any time by either party hereto of its rights with respect to a default, or any other matter arising in connection with this contract, shall not be deemed to be a waiver with respect to any other default or matter.

21. Assurance Relating to Validity of Contract. This contract shall be effective after its execution by the Agency and the State. Promptly after the execution and delivery of this contract, the Agency shall file and prosecute to a final decree, including any appeal therefrom to the highest court of the State of California, in a court of competent jurisdiction a special proceeding for the judicial examination, approval, and confirmation of the proceedings of the Agency's Board of Directors and of the Agency leading up to and including the making of this contract and the validity of the provisions thereof as a binding and enforceable obligation upon the State and the Agency. If, in this proceeding or other proceeding before a court of competent jurisdiction, any portion of this contract should be determined to be constitutionally invalid, then the remaining portions of this contract shall remain in full force and effect unless modified by mutual consent of the parties.

22. Notices. All notices that are required either expressly or by implication to be given by one party to the other shall be deemed to have been given if delivered personally or if enclosed in a properly addressed, postage prepaid, envelope and deposited in a United States Post Office. Unless or until formally notified otherwise, the Agency shall address all notices to the State as follows:

Director, Department of Water Resources
P.O. Box 388
Sacramento, California 95802

and the State shall address all notices to the Agency as follows:

North Delta Water Agency
921 11th St., Room 703
Sacramento, California 95814

IN WITNESS WHEREOF, the parties hereto have executed this contract on the date first above written.

Approved as to legal form and sufficiency:

By /s/ P. A. TOWNER
Chief Counsel
Dept. of Water Resources

By /s/ RONALD B. ROBIE
Chief Counsel
North Delta Water Agency

By /s/ GEORGE BASTE
General Counsel
North Delta Water Agency

By /s/ W. R. DARSIE
Chairman
Board of Directors

STATE OF CALIFORNIA

By /s/ RONALD B. ROBIE
Dept. of Water Resources

NORTH DELTA WATER AGENCY

By /s/ W. R. DARSIE
Chairman
Board of Directors
1) If the deliveries are less than full entitlement for three months in the forthcoming year, the criteria for December become equal to the period between August 13 through November 30, and for January it becomes 3.3.

2) The horizontal axis is in terms of millions of acre-feet of predicted flow, using the Rio Grande basin index from the most recent issue of Bulletin 120; except for February and March the lower value of the 80% probability as shown in the most recent issue of Bulletin 120 shall be used.

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**SACRAMENTO AT EMPATY**

ACRE-FEET IN MILLIONS  

**NORTH FOR E PORELISIC AT HAINHAT GROVE**

ACRE-FEET IN MILLIONS

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**SACRAMENTO AT MALHAT GROVE**

**SACRAMENTO AT MALHAT GROVE**

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**SACRAMENTO AT MALHAT GROVE**

**SACRAMENTO AT MALHAT GROVE**

ACRE-FEET IN MILLIONS

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AGREEMENT

WHEREAS, The State of California, through its Department of Water Resources (DWR), and the North Delta Water Agency entered into a Contract for the Assurance of a Dependable Water Supply of Suitable Quality on January 28, 1981 under which, inter alia, the State agreed to operate the State Water Project to provide water qualities at least equal to the better of (1) standards adopted by the State Water Resources Control Board, or (2) criteria identified on the graphs included as Attachment A;

WHEREAS, Article 5 of the 1981 Contract permits a shift of Attachment A water quality criteria for the Sacramento River at Emmaton to a location on Three Mile Slough upon completion of an overland facility to supply and distribute water to Sherman Island;

WHEREAS, with the concurrence of landowners on Sherman Island and NDWA, DWR commenced a program of land acquisition on Sherman Island in lieu of building the overland facility described in Article 5;

WHEREAS, DWR presented plans to Reclamation District 341 for an overland facility to service lands remaining in private ownership and R.D. 341 approved the plans;

WHEREAS, DWR presented the same plans to NDWA; but prior to NDWA reaching a decision to approve or disapprove the plans, DWR
reached agreement in principle with the remaining landowners to purchase their lands on Sherman Island, making an overland facility unnecessary.

WHEREAS, DWR and NDWA wish to amend the 1981 Contract to change the monitoring station at Emmaton to Three Mile Slough for the reason that DWR is pursuing its land acquisition program in lieu of the overland facility;

WHEREAS, the parties disagree on whether DWR should pay assessments on land it owns within NDWA's jurisdiction, and wish to resolve the issue herein;

IT IS HEREBY AGREED:


1. Subject to the terms and conditions set forth in this agreement, NDWA approves the State's plans for acquisition of agricultural lands on Sherman Island and agrees that such acquisition is in lieu of the overland facility described in Article 5 of the 1981 Contract.
2. NDWA agrees that the water quality criteria for the Sacramento River at Emmaton shall apply at the monitoring station at Three Mile Slough, as shown on Exhibit A, attached hereto and incorporated herein by reference.

3. State agrees that NDWA's approval in paragraph 1 is contingent, and paragraph 2 shall only be effective, upon State's acquiring fee title to, or a water quality easement or similar waiver on, those agricultural lands on Sherman Island which are specified in the draft report entitled "Overland Agricultural Facilities Sherman Island" dated January 1980. The parties agree that the 1981 Contract imposes no obligation relating to the quality of water for domestic uses on Sherman Island.

4. State agrees to hold harmless from all costs, defend and indemnify NDWA for any claim or action brought by any person or entity based on this agreement, including any claim or action based on the change in water quality criteria for the Sacramento River under the 1981 Contract.

5. State agrees to reimburse NDWA for engineering costs paid for review of the plans for the overland facility, based on invoices received for work performed between May 12, 1995 and July 3, 1995, inclusive.

6. State agrees that NDWA may permanently reduce its annual payments due under Article 10 of the 1981 Contract by a percentage, equal to the percentage of acreage of land owned or
hereafter acquired by the Department of Water Resources within NDWA's jurisdiction compared to all lands within NDWA's jurisdiction. NDWA agrees not to assess or assert any right to assess DWR-owned lands. In all other respects, payment obligations imposed by the 1981 Contract shall remain the same.

7. The term of this agreement is concurrent with that of the 1981 Contract.

8. This agreement shall be effective immediately after it is both signed by DWR and approved by the NDWA Board of Directors. NDWA agrees to deliver to DWR a copy of the resolution authorizing NDWA to enter into this agreement.

9. NDWA shall promptly notice a hearing on this amendment pursuant to California Water Code Appendix section 115-7.6 and hold a hearing pursuant to Water Code Appendix section 155-7.6. If a substantial written protest is received, NDWA shall promptly hold an election on this amendment pursuant to Water Code appendix section 115-7.6. If an election is held and the majority of the votes cast do not approve this amendment, the term of the agreement (as defined in paragraph 8), shall be changed to a one-year term as an interim agreement pursuant to Water Code Appendix section 115-7.1, and all other terms of this agreement shall remain valid for the one-year interim period.

10. Promptly after the execution and delivery of this contract, NDWA shall file and prosecute to a final decree.
including any appeal therefrom to the highest court of the State of California, in a court of competent jurisdiction a special proceeding for the judicial examination, approval, and confirmation of the proceedings of the NDWA Board of Directors and of NDWA leading up to and including the making of this contract and the validity of the provisions thereof as a binding and enforceable obligation upon the State and the NDWA. If, in this proceeding or other proceeding before a court of competent jurisdiction, any portion of this contract should be determined to be invalid, then the remaining portions of this contract shall remain in full force and effect unless modified by mutual consent of the parties.

NORTH DELTA WATER AGENCY

[Signature]
W.R. Darsie, Chairman
Board of Directors

Dated: 12-21-96

STATE OF CALIFORNIA,
DEPARTMENT OF WATER RESOURCES

[Signature]
David N. Kennedy
Director

Dated: 1-21-97

Approved as to legal form and sufficiency:

[Signature]
Steve Saxton
Attorney for North Delta Water Agency

Dated: 12/17/96

Approved as to legal form and sufficiency:

[Signature]
Susan N. Weber
Chief Counsel

Dated: 1/17/97

agndw a 12-18-96
MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding is entered into this 26th day of May, 1998, by and between North Delta Water Agency (hereinafter “Agency”) and Department of Water Resources, State of California (hereinafter “DWR”).

RECITALS

A. In 1981, DWR entered into a contract (hereinafter “1981 Contract”) with Agency under which Agency agreed to make certain payments to DWR in exchange for DWR making water of a specified quality and adequate quantity available for the use of diverters within the boundaries of Agency. The 1981 Contract remains in full force and effect.

B. The State Water Resources Control Board (“State Board”) has initiated a water right proceeding in order to allocate the obligation to implement water quality objectives contained in the Bay-Delta Water Quality Control Plan adopted by the State Board on May 22, 1995 (hereinafter “1995 Plan”).

C. The purpose of this Memorandum of Understanding is to set forth the joint position of Agency and DWR as to the legal effect of the 1981 Contract with respect to the obligation of water users within Agency, if any, to implement water quality objectives contained in the 1995 Plan.

UNDERSTANDINGS

1. DWR agrees that any obligation to curtail or modify diversions in order to assist in achieving any flow or salinity objective of the 1995 Plan imposed upon the use of water within Agency is entirely in the scope of the existing obligation of DWR under the 1981 Contract to provide water from the State Water Project supply, subject to the
limitations of reasonable and beneficial use. During the term of this Memorandum of Understanding, no party shall assert, before the State Board or in any court, that any other party must reduce or eliminate any of its direct diversions, diversions to storage or re-diversion of stored water, or release any previously stored water so long as the other party's method of use and method of diversion are reasonable under Article X, Section 2 of the California Constitution.

2. The parties agree that the payments made by Agency to DWR pursuant to the 1981 Contract constitute full and adequate consideration for the obligation of DWR described in paragraph 1 of this Memorandum of Understanding.

3. The parties agree that the assurances contained in the 1981 Contract, including the obligation of DWR to provide water to Agency users from State Water Project supplies, and in paragraph 1 of this Memorandum of Understanding, do not apply to any transfer of water outside Agency. The parties agree that the 1981 Contract does not affect any underlying rights the water users within the Agency may have to transfer water to the extent that such a transfer would be permissible under California law in the absence of the 1981 Contract.

4. Nothing in this Memorandum of Understanding constitutes an admission by Agency, express or implied, that the State Board has authority to limit or otherwise modify any right to divert water for use within Agency.

5. Nothing in this Memorandum of Understanding constitutes an amendment of the 1981 Contract as it presently exists.
6. This Memorandum of Understanding shall be effective only for the purposes of the currently pending SWRCB water right hearings to allocate the obligation to implement the 1995 Plan's water quality objectives, and for no other purpose.

THE NORTH DELTA WATER AGENCY

By: Dennis Loisy

Date: 4/20/98
Title: Chairman

COUNSEL:

[Signature]

THE DEPARTMENT OF WATER RESOURCES

By: [Signature]
Title: Director
Date: 5/26/98

APPROVED FOR LEGAL FORM & SUFFICIENCY:

[Signature]
Chief Counsel

C:\OFFICE\WPWIN\DAVID\BDHRG.19
AGREEMENT BETWEEN
CITY OF WEST SACRAMENTO
and
DUNNIGAN WATER DISTRICT
for the
PURCHASE, SALE and TRANSFER of WATER

This Agreement sets forth the terms for an annual transfer of water by and between the City of West Sacramento (hereinafter “City”), a municipal corporation of the state of California and Dunnigan Water District (hereinafter “Dunnigan”), a public agency of the state of California. The City and District are hereafter collectively referred to as “Parties.”

RECITALS

A. The City has an entitlement to water from the federal Central Valley Project (“CVP”) under Contract No. 0-07-20-W0187 (“the CVP Project Supply”);

B. Dunnigan has an entitlement to water from the CVP under Contract No. 14-06-200-399 LTR 1;

C. The City and Dunnigan are both located within the area of origin of CVP water as that term is defined under California law and used in section 3405(a)(1)(M) of the Central Valley Project Improvement Act (CVPIA), Title 34 of Public Law 102-575;

D. The United States Bureau of Reclamation (“Reclamation”) makes allocations of CVP Project Supply to its contractors each year, including to the City (“City’s Allocation”);

E. The City desires to sell and Dunnigan desires to purchase at least 1,000 acre feet of the City’s Allocation for delivery each year beginning in 2011 and continuing for four (4) years;

F. This MOU sets forth the terms and conditions for the delivery of a portion of the City’s Allocation; and

G. The delivery of the portion of the City’s Allocation to be transferred under this Agreement is consistent with the authorized place of use and purpose of use of the CVP Project Supply as established by the California State Water Resources Control Board in the water right permits held by the United States for the CVP.

NOW, THEREFORE, the Parties hereby agree to the terms and conditions of the sale, purchase and transfer of a portion of the City’s Allocation as follows:

1. Recitals Incorporated.
The foregoing recitals shall be incorporated as material provisions this Agreement ("Agreement") and made a part thereof for all purposes

2. Term.

This Agreement shall be effective as of the last date of execution by either Party, and shall be in effect for a term ending February 28, 2015. Neither party shall have any right of renewal or right to enter into any extension of the Agreement beyond April 15, 2015. The Parties agree to work in good faith to renew the Agreement in the context of environmental regulatory conditions. Water purchased under this Agreement shall not be delivered to Dunnigan after the date of termination.

3. Time is of the Essence.

Time is of the essence in the performance of each and every term of the Agreement.

a. Quantity of Water.

Subject to the execution of the Agreement, consent of Reclamation, and subject to paragraph 4 hereof, in each year that the Agreement is in effect, the City shall sell and Dunnigan shall purchase at least 1,000 acre-feet of the City’s Allocation of CVP Project Supply (“Transfer Water”).

b. City shall make available to Dunnigan additional amounts of City’s Allocation as follows:

i. By February 1 of each year, the City shall notify Dunnigan of the amount of additional quantities of Transfer Water (“Additional Transfer Water”) available for purchase from the City for that year.

ii. By April 1 of each year, Dunnigan will notify City of the amount of Additional Transfer Water it elects to purchase from the City for that year. Such notification will create a binding obligation on Dunnigan to pay for the Additional Transfer Water it elects to purchase.


City guarantees the availability of Transfer Water unless the City’s Allocation is less than 2,500 acre-feet in any given year that this Agreement is in effect, in which situation the City guarantees delivery to Dunnigan of all City Allocation in excess of 1,500 acre-feet.

5. Point of Delivery.

The point of delivery of Transfer Water under the Agreement shall be Shasta Reservoir.


City shall have no responsibility for conveyance or delivery of Transfer Water under the
Agreement. Dunnigan shall be wholly responsible to make any and all arrangements with Reclamation necessary for the conveyance and timing of delivery of the Transfer Water from Shasta Reservoir to the District’s diversion at the Tehama-Colusa Canal.


City makes no representation or assurance of the quality of Transfer Water for any purpose, and Dunnigan agrees to accept delivery of and use the Transfer Water at its own risk.

8. Payment for Water.

Dunnigan will pay City for the Transfer Water and Additional Transfer Water as follows:

a. On April 1 of each year in which the Agreement is in effect, Dunnigan shall reimburse the City an amount equal to the CVP water costs imposed by Reclamation on the City for each acre-foot of CVP Project Supply made available to the City, multiplied by the amount of Transfer Water and Additional Transfer Water being made available to Dunnigan by the City in that year.

b. On May 1 of each year, Dunnigan will make a payment to the City equal to the sum of amounts determined under subparagraphs (i) and (ii) below:

i. If the Transfer Water and the Additional Transfer Water that the City will make available totals 3,000 acre-feet or more, Dunnigan will pay Twelve thousand five hundred dollars ($12,500), whether or not Dunnigan elects to take the entire total water supply. If the Transfer Water and Additional Transfer Water totals less than 3,000 acre-feet, the $12,500 sum will be reduced pro-rata, in accordance with the amount of the total water supply that Dunnigan elects to take; and

ii. A premium for all Transfer Water and Additional Transfer Water based on Dunnigan’s mid-April CVP Project Supply Allocation (“Dunnigan’s Allocation”) announced by Reclamation, calculated as follows:

   1. If Dunnigan’s Allocation is greater than 80%, the premium will be $50 per acre-foot of water purchased under the Agreement;

   2. If Dunnigan’s Allocation is less than or equal to 80%, but greater than 50%, the premium will be $62 per acre-foot of water purchased under the Agreement; and

   3. If Dunnigan’s Allocation is less than 50%, the premium will be $75 per acre-foot of water purchased under the Agreement.

c. In addition to the payments set forth in paragraph 8(a) and 8(b) above, Dunnigan shall pay City the amount of all charges for the Transfer Water and Additional Transfer Water that may be imposed on City by Reclamation, to the extent such
charges are in addition to the CVP contract water rate imposed by Reclamation on City, multiplied by the amount of water made available to Dunnigan under this Agreement. Such payment shall be due within thirty days of the date on which payment of such charges become due from City to Reclamation or thirty days from the date on which City notifies Dunnigan of the imposition of such charges, whichever occurs last.

d. Payments under this paragraph 8 shall be due for the Transfer Water, and for any portion of the Additional Transfer Water that Dunnigan elects to purchase in its April 1 notice to the City, whether or not Dunnigan takes actual delivery of any portion of the Transfer Water or Additional Transfer Water.

9. **Use of Transfer Water.**

a. Dunnigan shall not allow the use of Transfer Water or Additional Transfer Water in a manner that is unreasonable or inconsistent with Reclamation Law.

b. Dunnigan shall not resell Transfer Water or Additional Transfer Water, and shall not sell or exchange any other water available to it, except to landowners within its jurisdictional boundaries.

10. **Consent of Reclamation.**

Upon execution of the Agreement by the last of the Parties to execute, Dunnigan shall submit a request to Reclamation for its written consent, together with a proposed schedule for delivery of the Transfer Water. This Agreement shall not be effective unless and until Reclamation provides written consent to the transfer of City's Allocation to Dunnigan as provided in this Agreement.

11. **Water Rights Not Affected**

No transfer of water pursuant to the Agreement shall confer on any third person or entity any appropriative, public trust or other right to water. Nothing in the Agreement shall operate as a forfeiture, diminution or impairment of any rights of the City to its full deliveries of CVP Water Supply after the expiration of the term of the Agreement, and shall in no way prejudice the City's rights thereto. Consistent with the provisions of California Water Code sections 109, 475, 1011, 1244 and 11961, the Parties agree that no transfer under the Agreement, nor the Agreement itself, is to be considered evidence of the City's lack of need for or beneficial use of water in the amount of the Transfer Water or Additional Transfer Water.

12. **Indemnity.**

Each Party shall agree to protect, defend, indemnify, and hold harmless the other Party, its directors, officers, agents, employees and consultants from and against any and all third-party losses, claims, liens, demands and causes of action of very kind and character
connected with or arising directly or indirectly out of the performance or non-
performance by the indemnifying party hereunder of the Agreement.


a. Authority. Each signatory of the Agreement shall represent that s/he is authorized
to execute the Agreement on behalf of the Party for which s/he signs. Each Party
shall represent that it has legal authority to enter into this Agreement and to
perform all obligations under the Agreement.

b. Amendment. The Agreement may be amended or modified only by written
instrument executed by each of the Parties to the Agreement.

c. Jurisdiction and Venue. The Agreement shall be governed by and construed in
accordance with the laws of the State of California, except for its conflict of law
rules. A suit, action or proceeding brought under the scope of the Agreement
shall be brought and maintained to the extent allowed by law in the County of
Yolo.

d. Headings. The paragraph headings used in the Agreement are intended for
convenience only and shall not be used in interpreting the Agreement or in
determining any of the rights or obligations of the Parties to the Agreement.

e. Construction and Interpretation. The Agreement is the result of negotiations and
each Party has had a full and fair opportunity to revise the terms. As a result, the
normal rule of construction that any ambiguities are to be resolved against the
drafting Party shall not apply in the construction or interpretation of the
Agreement.

f. Entire Agreement. This Agreement will constitute the entire Agreement of the
Parties with respect to the subject matter of the Agreement and supersedes any
prior oral or written agreement, understanding, or representation relating to the
subject matter of the Agreement.

g. Partial Invalidity. If after the date of execution of the Agreement, any provision
of the Agreement is held to be illegal, invalid, or unenforceable under present or
future laws effective during the term of the Agreement, such provision shall be
fully severable. However in lieu thereof, there shall be added a provision as
similar in terms to such illegal, invalid, or unenforceable provision as may be
possible and be legal, valid and enforceable.

h. Successors and Assigns. The Agreement shall be binding on and inure to the
benefit of the successors and assigns of the respective Parties to the Agreement.
No Party may assign its interests in or obligations under the Agreement without
the written consent of the other Party, which consent shall not be unreasonably
withheld or delayed.
i. **Waivers.** Waiver of any breach or default shall not constitute a continuing waiver or a waiver or any subsequent breach either of the same or of another provision of the Agreement and forbearance to enforce one or more of the remedies provided in the Agreement shall not be deemed to be a waiver of that remedy.

j. **Attorney’s fees and Costs.** The prevailing Party in any litigation or other action to enforce or interpret the Agreement shall be entitled to reasonable attorneys’ fees, expert witnesses’ fees, costs of suit, and other and necessary disbursements in addition to any other relief deemed appropriate by a court of competent jurisdiction.

k. **Necessary Actions.** Each Party agrees to execute and deliver additional documents and instruments and to take any additional actions as may be reasonably required to carry out the purposes of the Agreement.

l. **Compliance with Law.** In performing their respective obligations under the Agreement, the Parties shall comply with and conform to all applicable laws, rules, regulations and ordinances.

m. **Third Party Beneficiaries.** The Agreement shall not create any right or interest in any non-Party or in any member of the public as a third party beneficiary.

n. **Counterparts.** The Agreement may be executed in one or more counterparts, each of which shall be deemed to be an original, but all of which together shall constitute but one and the same instrument.

o. **Notice.** Any notice, request, tender, demand, deliver, approval or other communication provided for, required or arising under this Agreement shall be in writing and shall be deemed delivered upon personal service or three business days after deposit in the United States mail, certified or with return receipt requested, addressed to the Party as follows, or such other address as a Party may by notice under this Paragraph 15(o) designate:

<table>
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<tr>
<th>To: City:</th>
<th>To: Dunnigan</th>
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Water Transfer Agreement September 13, 2010
The Parties, by the signature of their authorized representatives, hereby agree to the principles set forth in this Agreement.

Date: ____________________________  Date: ____________________________

**City of West Sacramento**

By: ____________________________  By: ____________________________

Name: ____________________________  Name: ____________________________

Title: ____________________________  Title: ____________________________

**Attest:**

City Clerk  Secretary to the Board

Approved as to Form:

City Attorney  District Counsel
AGREEMENT BETWEEN
CITY OF WEST SACRAMENTO
and
DUNNIGAN WATER DISTRICT
for the
PURCHASE, SALE and TRANSFER of WATER

This Agreement sets forth the terms for an annual transfer of water by and between the City of West Sacramento (hereinafter “City”), a municipal corporation of the state of California and Dunnigan Water District (hereinafter “Dunnigan”), a public agency of the state of California. The City and District are hereafter collectively referred to as “Parties.”

RECITALS

A. The City has an entitlement to water from the federal Central Valley Project ("CVP") under Contract No. 0-07-20-W0187 ("the CVP Project Supply");

B. Dunnigan has an entitlement to water from the CVP under Contract No. 14-06-200-399 LTR 1;

C. The City and Dunnigan are both located within the area of origin of CVP water as that term is defined under California law and used in section 3405(a)(1)(M) of the Central Valley Project Improvement Act (CVPIA), Title 34 of Public Law 102-575;

D. The United States Bureau of Reclamation ("Reclamation") makes allocations of CVP Project Supply to its contractors each year, including to the City ("City’s Allocation");

E. The City desires to sell and Dunnigan desires to purchase at least 1,000 acre feet of the City’s Allocation for delivery each year beginning in 2011 and continuing for four (4) years;

F. This MOU sets forth the terms and conditions for the delivery of a portion of the City’s Allocation; and

G. The delivery of the portion of the City’s Allocation to be transferred under this Agreement is consistent with the authorized place of use and purpose of use of the CVP Project Supply as established by the California State Water Resources Control Board in the water right permits held by the United States for the CVP.
NOW, THEREFORE, the Parties hereby agree to the terms and conditions of the sale, purchase and transfer of a portion of the City’s Allocation as follows:

1. Recitals Incorporated.

The foregoing recitals shall be incorporated as material provisions this Agreement ("Agreement") and made a part thereof for all purposes.

2. Term.

This Agreement shall be effective as of the last date of execution by either Party, and shall be in effect for a term ending February 28, 2015. Neither party shall have any right of renewal or right to enter into any extension of the Agreement beyond April 15, 2015. The Parties agree to work in good faith to renew the Agreement in the context of environmental regulatory conditions. Water purchased under this Agreement shall not be delivered to Dunnigan after the date of termination.

3. Time is of the Essence.

Time is of the essence in the performance of each and every term of the Agreement.

a. Quantity of Water.

Subject to the execution of the Agreement, consent of Reclamation, and subject to paragraph 4 hereof, in each year that the Agreement is in effect, the City shall sell and Dunnigan shall purchase at least 1,000 acre-feet of the City’s Allocation of CVP Project Supply ("Transfer Water").

b. City shall make available to Dunnigan additional amounts of City’s Allocation as follows:

i. By February 1 of each year, the City shall notify Dunnigan of the amount of additional quantities of Transfer Water ("Additional Transfer Water") available for purchase from the City for that year.

ii. By April 1 of each year, Dunnigan will notify City of the amount of Additional Transfer Water it elects to purchase from the City for that year. Such notification will create a binding obligation on Dunnigan to pay for the Additional Transfer Water it elects to purchase.


City guarantees the availability of Transfer Water unless the City’s Allocation is less than 2,500 acre-feet in any given year that this Agreement is in effect, in which situation the City guarantees delivery to Dunnigan of all City Allocation in excess of 1,500 acre-feet.
5. **Point of Delivery.**

The point of delivery of Transfer Water under the Agreement shall be Shasta Reservoir.

6. **Delivery of Water.**

City shall have no responsibility for conveyance or delivery of Transfer Water under the Agreement. Dunnigan shall be wholly responsible to make any and all arrangements with Reclamation necessary for the conveyance and timing of delivery of the Transfer Water from Shasta Reservoir to the District’s diversion at the Tehama-Colusa Canal.

7. **Water Quality.**

City makes no representation or assurance of the quality of Transfer Water for any purpose, and Dunnigan agrees to accept delivery of and use the Transfer Water at its own risk.

8. **Payment for Water.**

Dunnigan will pay City for the Transfer Water and Additional Transfer Water as follows:

   a. On April 1 of each year in which the Agreement is in effect, Dunnigan shall reimburse the City an amount equal to the CVP water costs imposed by Reclamation on the City for each acre-foot of CVP Project Supply made available to the City, multiplied by the amount of Transfer Water and Additional Transfer Water being made available to Dunnigan by the City in that year.

   b. On May 1 of each year, Dunnigan will make a payment to the City equal to the sum of amounts determined under subparagraphs (i) and (ii) below:

      i. If the Transfer Water and the Additional Transfer Water that the City will make available totals 3,000 acre-feet or more, Dunnigan will pay Twelve thousand five hundred dollars ($12,500), whether or not Dunnigan elects to take the entire total water supply. If the Transfer Water and Additional Transfer Water totals less than 3,000 acre-feet, the $12,500 sum will be reduced pro-rata, in accordance with the amount of the total water supply that Dunnigan elects to take; and

      ii. A premium for all Transfer Water and Additional Transfer Water based on Dunnigan’s mid-April CVP Project Supply Allocation (“Dunnigan’s Allocation”) announced by Reclamation, calculated as follows:

         1. If Dunnigan’s Allocation is greater than 80%, the premium will be $50 per acre-foot of all water purchased under the Agreement;

         2. If Dunnigan’s Allocation is less than or equal to 80%, but greater than 50%, the premium will be $62 per acre-foot of water purchased under the Agreement; and
3. If Dunnigan’s Allocation is less than 50%, the premium will be $75 per acre-foot of water purchased under the Agreement.

c. In addition to the payments set forth in paragraph 8(a) and 8(b) above, Dunnigan shall pay City the amount of all charges for the Transfer Water and Additional Transfer Water that may be imposed on City by Reclamation, to the extent such charges are in addition to the CVP contract water rate imposed by Reclamation on City, multiplied by the amount of water made available to Dunnigan under this Agreement. Such payment shall be due within thirty days of the date on which payment of such charges become due from City to Reclamation or thirty days from the date on which City notifies Dunnigan of the imposition of such charges, whichever occurs last.

d. Payments under this paragraph 8 shall be due for the Transfer Water, and for any portion of the Additional Transfer Water that Dunnigan elects to purchase in its April 1 notice to the City, whether or not Dunnigan takes actual delivery of any portion of the Transfer Water or Additional Transfer Water.

9. Use of Transfer Water.

a. Dunnigan shall not allow the use of Transfer Water or Additional Transfer Water in a manner that is unreasonable or inconsistent with Reclamation Law.

b. Dunnigan shall not resell Transfer Water or Additional Transfer Water, and shall not sell or exchange any other water available to it, except to landowners within its jurisdictional boundaries.

10. Consent of Reclamation.

Upon execution of the Agreement by the last of the Parties to execute, Dunnigan shall submit a request to Reclamation for its written consent, together with a proposed schedule for delivery of the Transfer Water. This Agreement shall not be effective unless and until Reclamation provides written consent to the transfer of City’s Allocation to Dunnigan as provided in this Agreement.

11. Water Rights Not Affected

No transfer of water pursuant to the Agreement shall confer on any third person or entity any appropriative, public trust or other right to water. Nothing in the Agreement shall operate as a forfeiture, diminution or impairment of any rights of the City to its full deliveries of CVP Water Supply after the expiration of the term of the Agreement, and shall in no way prejudice the City’s rights thereto. Consistent with the provisions of California Water Code sections 109, 475, 1011, 1244 and 11961, the Parties agree that no transfer under the Agreement, nor the Agreement itself, is to be considered evidence of the City’s lack of need for or beneficial use of water in the amount of the Transfer Water or Additional Transfer Water.
12. Indemnity.

Each Party shall agree to protect, defend, indemnify, and hold harmless the other Party, its directors, officers, agents, employees and consultants from and against any and all third-party losses, claims, liens, demands and causes of action of any kind and character connected with or arising directly or indirectly out of the performance or non-performance by the indemnifying party hereunder of the Agreement.


a. Authority. Each signatory of the Agreement shall represent that s/he is authorized to execute the Agreement on behalf of the Party for which s/he signs. Each Party shall represent that it has legal authority to enter into this Agreement and to perform all obligations under the Agreement.

b. Amendment. The Agreement may be amended or modified only by written instrument executed by each of the Parties to the Agreement.

c. Jurisdiction and Venue. The Agreement shall be governed by and construed in accordance with the laws of the State of California, except for its conflict of law rules. A suit, action or proceeding brought under the scope of the Agreement shall be brought and maintained to the extent allowed by law in the County of Yolo.

d. Headings. The paragraph headings used in the Agreement are intended for convenience only and shall not be used in interpreting the Agreement or in determining any of the rights or obligations of the Parties to the Agreement.

e. Construction and Interpretation. The Agreement is the result of negotiations and each Party has had a full and fair opportunity to revise the terms. As a result, the normal rule of construction that any ambiguities are to be resolved against the drafting Party shall not apply in the construction or interpretation of the Agreement.

f. Entire Agreement. This Agreement will constitute the entire Agreement of the Parties with respect to the subject matter of the Agreement and supersede any prior oral or written agreement, understanding, or representation relating to the subject matter of the Agreement.

g. Partial Invalidity. If after the date of execution of the Agreement, any provision of the Agreement is held to be illegal, invalid, or unenforceable under present or future laws effective during the term of the Agreement, such provision shall be fully severable. However in lieu thereof, there shall be added a provision as similar in terms to such illegal, invalid, or unenforceable provision as may be possible and be legal, valid and enforceable.

h. Successors and Assigns. The Agreement shall be binding on and inure to the benefit of the successors and assigns of the respective Parties to the Agreement.
No Party may assign its interests in or obligations under the Agreement without the written consent of the other Party, which consent shall not be unreasonably withheld or delayed.

i. *Waivers.* Waiver of any breach or default shall not constitute a continuing waiver or a waiver or any subsequent breach either of the same or of another provision of the Agreement and forbearance to enforce one or more of the remedies provided in the Agreement shall not be deemed to be a waiver of that remedy.

j. *Attorney’s fees and Costs.* The prevailing Party in any litigation or other action to enforce or interpret the Agreement shall be entitled to reasonable attorneys’ fees, expert witnesses’ fees, costs of suit, and other and necessary disbursements in addition to any other relief deemed appropriate by a court of competent jurisdiction.

k. *Necessary Actions.* Each Party agrees to execute and deliver additional documents and instruments and to take any additional actions as may be reasonably required to carry out the purposes of the Agreement.

l. *Compliance with Law.* In performing their respective obligations under the Agreement, the Parties shall comply with and conform to all applicable laws, rules, regulations and ordinances.

m. *Third Party Beneficiaries.* The Agreement shall not create any right or interest in any non-Party or in any member of the public as a third party beneficiary.

n. *Counterparts.* The Agreement may be executed in one or more counterparts, each of which shall be deemed to be an original, but all of which together shall constitute but one and the same instrument.

o. *Notice.* Any notice, request, tender, demand, deliver, approval or other communication provided for, required or arising under this Agreement shall be in writing and shall be deemed delivered upon personal service or three business days after deposit in the United States mail, certified or with return receipt requested, addressed to the Party as follows, or such other address as a Party may by notice under this Paragraph 15(o) designate:

<table>
<thead>
<tr>
<th>To: City:</th>
<th>To: Dunnigan Water District</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
The Parties, by the signature of their authorized representatives, hereby agree to the principles set forth in this Agreement.

Date: __________________________

City of West Sacramento
By: __________________________
Name: __________________________
Title: __________________________

Attest: __________________________

City Clerk

Approved as to Form: __________________________

City Attorney

Date: __________________________

Dunnigan Water District
By: __________________________
Name: __________________________
Title: __________________________

Attest: __________________________

Secretary to the Board

Approved as to Form: __________________________

District Counsel
The City of West Sacramento is dedicated to supplying its customers with a safe and reliable supply of high quality drinking water. We are pleased to present this annual report, which conforms to a federal regulation that requires community water systems to provide customers with detailed information about their drinking water. It includes information about water supply sources, water treatment, water quality, drinking water regulations, and water conservation programs. We hope that the information in this report increases your understanding of the water treatment process and your confidence in the quality of the water you drink.

Landlords who receive this report should forward it to tenants residing within the city, for their information. Additional copies are available upon request. Please contact the City of West Sacramento Public Works Department, (916) 617-4850. This report is also available at the City of West Sacramento web site www.cityofwestsacramento.org/dpy/depta/water/water_operations/.

The Rice Pesticide Workgroup, being of our residents, the City actively participates in several West Sacramento's continuing growth and to the health and well-being of our community. Given the importance of the Sacramento River to our water systems, we are expanding to include new rice pesticides. In addition, our program of frequent surveys for residents, commercial, industrial, and institutional customers of the service we provide and promise to continue to operate equipment at maximum efficiency.

The City of West Sacramento promotes water conservation at all times. Wise water use is foremost in our commitment to the community. Considering the many uses of our drinking water in our day-to-day lives, water efficiency is now a way of life. For more information on this topic visit: www.cityofwestsacramento.org/water.

WATER CONSERVATION
Over 4.1 billion gallons of high quality drinking water was treated in 2014. This water was not used for drinking, but for landscape watering. An easy and effective way to conserve water is to follow the City’s water conservation ordinance by using an odd-even watering schedule for outdoor landscaping. For more information, please visit www.cityofwestsacramento.org/water.

WATER EFFICIENCY
The City of West Sacramento continues to install water meters as we work towards compliance with California State Law, Assembly Bill No. 514 (AB 514). Water meters enable the City to quantify customer water use and help increase water conservation by making people aware of their water use. When people are charged for their actual measured use, they tend not to waste it, thereby reducing their overall water consumption.

The City has been installing water meters in phases. The next round of water meter installations will begin this summer, with installation of approximately 900 water meters throughout the City. The second project will start late summer/early fall and will install over 200 meters. Water meter installation program is expected to be complete in 2018. Customers will be transitioned from paying a flat rate for water to paying a metered rate for the actual amount used. Prior to the switch, customers will receive several months of water use data in order to prepare for the change. For additional information about the water meter program contact the Project Manager Dereck Goodwin, Associate Civil Engineer at (916) 617-4700.

FOR QUESTIONS ABOUT THIS REPORT:
Dan Mount
Public Works Operations Manager
(916) 617-4860

FOR ADDITIONAL COPIES OF THIS REPORT:
Public Works Department
(916) 617-4850

TO REPORT PROBLEMS AFTER HOURS:
Public Works Department
(916) 372-3375

TO REPORT WATER WASTE:
(916) 617-4545

FOR BILLING QUESTIONS:
Finance Department
(916) 617-4589

FOR WATER METER RETROFIT PROGRAM:
Dereck Goodwin
(916) 617-4700

FOR WATER QUALITY COMPLAINTS:
George Kristoff Water Treatment Plant
(916) 617-4850

EPA Safe Drinking Water Hotline
(800) 426-4791

CITY OF WEST SACRAMENTO WEB SITE:
www.cityofwestsacramento.org

CITY COUNCIL MEETINGS:
Twice monthly: Wednesdays at 7 P.M. in the City Council Chambers, 1110 West Capitol Ave.

For specific dates check the “City Calendar” on www.cityofwestsacramento.org or phone (916) 617-4500.

TO REPORT WATER WASTE:
(916) 617-4545

WATER CONSERVATION
Over 4.1 billion gallons of high quality drinking water was treated at the GWTP in 2014. Most of this water was not used for drinking, but for landscape watering. An easy and effective way to conserve water is to follow the City’s water conservation ordinance by using an odd-even watering schedule for outdoor landscaping. For more information, please visit www.cityofwestsacramento.org/water.

WATER QUALITY

2014 CONSUMER CONFIDENCE REPORT

WATER EFFICIENCY
There are a variety of bacteria, parasites, and viruses which can potentially cause health problems if humans ingest them in drinking water. Testing for each of these potential pathogens (disease-causing agents) would be difficult and expensive. Instead, water quality and public health workers measure coliform levels. The presence of any coliforms in drinking water suggests that there may be a pathway through which waterborne disease-causing agents could enter the drinking water distribution system (pipes, storage facilities, etc.).

For drinking water, total coliforms are used to determine the adequacy of treatment and the quality of drinking water in the distribution system. The absence of total coliforms in the distribution system minimizes the likelihood that fecal pathogens are present in the distribution system. Total coliforms are used to determine the vulnerability of a system to fecal contamination.

The MCL for total coliforms is no more than 5 of the samples collected per month containing total coliforms. In 2014 the city collected and analyzed 645 samples for total coliforms and E. coli. All samples collected in this time frame tested negative for total coliforms.

LEAD AND COPPER

Under modern regulations, the City of West Sacramento tests your water for lead and copper every three years to determine if any leaching has occurred from household plumbing. Our last round of lead and copper testing took place in the summer of 2016. Results for lead testing ranged from non-detectable to 2.4 ppm. The 90th percentile value for lead was 0.2 ppb. These results are below the 15 ppb federal Action Level for lead. Results for copper testing ranged from non-detectable to 7.0 ppm. The 90th percentile value for copper was 0.33 ppm. These results are below the 1.3 ppm federal Action Level for copper. Our next round of lead and copper testing will take place in the summer of 2019.

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. The City is responsible for providing you with water that is safe to drink. You, on the other hand, must provide the protection associated with the service lines connected to your water meter. The City provides lead service lines and piping and is responsible for the first 30 feet of piping beyond the water meter. The homeowner provides all piping beyond the water meter, including the service line and the service lateral. If you have lead service lines, you must take steps to prevent lead from being introduced in your water system. You can do this by flushing your tap for 2-3 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may want to request a water test. Instructions for lead in drinking water, testing methods, and steps you can take to minimize exposure can be found on the Safe Drinking Water Hotline at (800) 426-4791.

NITRATE

Nitrate in drinking water at levels above 45 mg/L is a health risk for infants of less than 6 months of age. Such nitrate levels in drinking water can interfere with the capacity of the infant’s blood to carry oxygen, resulting in a serious illness; symptoms include shortness of breath and blueness of skin. Nitrate levels of 45 mg/L or higher can be harmful to the ability of the blood to carry oxygen in other individuals, such as pregnant women and those with certain specific enzyme deficiencies. If you are caring for an infant, or you are pregnant, you should ask advice from your health care provider. The City does not test for nitrate levels.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer and undergoing chemotherapy, persons who have HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care provider.

Nitrate is not detected in drinking water from March to September. Spring flow may bring some surface water contaminants to the plant and some surface water treatment processes may not be in operation. The City has used modern equipment and procedures, in our own state-certified laboratory, to test the effects of drinking water on health. The City's water is tested to the highest level for nitrate that is required in Federal and State regulations. These tests are done in addition to nitrate levels that are detected in drinking water. The City has modified their treatment processes in order to operate within these limits.

TURBIDITY

Turbidity is a measure of the cloudiness of the water. We monitor it because it is a good indicator of the effectiveness of our filtration system. The EPA’s Interim Enhanced Surface Water Treatment Rule requires that the Combined Filter Efficiency (CFE) turbidity be less than 0.3 NTU at least 95% of the measurements taken each month, and that the maximum CFE turbidity not exceed 1 NTU. The City has achieved the highest level of the CFE turbidity was 0.11 NTU.

WATER QUALITY ANALYSIS RESULTS

DISENFRONT BYPRODUCTS

There are a variety of bacteria, parasites, and viruses which can potentially cause health problems if humans ingest them in drinking water. Testing for each of these potential pathogens (disease-causing agents) would be difficult and expensive. Instead, water quality and public health workers measure coliform levels. The presence of any coliforms in drinking water suggests that there may be a pathway through which waterborne disease-causing agents could enter the drinking water distribution system (pipes, storage facilities, etc.).

In order to ensure that tap water is safe to drink, the U.S. Environmental Protection Agency (USEPA) and the State Water Resources Control Board (SWRCB) have set Maximum Contaminant Levels (MCL) for contaminants in water provided by public water systems. SWRCB regulations also establish limits for contaminants in bottled water that provide the same protection for public health.

The sources of drinking water (both tap water and bottled water) include lakes, rivers, streams, wells, springs, and ground water. A significant portion of our drinking water travels over the surface of the land or through the ground it dissolves natural mineral deposits, while all imported water comes from reservoirs and lakes. Tap water is treated to remove substances resulting from the presence of animals or plants. Tap water is treated to remove substances naturally-occurring organic matericals.

Inorganic

Water Quality All public water supplies must meet stringent federal and state regulations. Treatment delivered to you and your family not only improves the quality of your drinking water but also ensures your safety. We know this because we continually test our water using modern equipment and procedures, in our own state-certified laboratory, to test the effects of drinking water on health. The City uses a variety of water analysis, including sampling at over fifty representative locations throughout the city, assures safe water for you and your family.
2015

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<th>PROJECT NAME</th>
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= NEIGHBORHOODS OR AREAS THAT HAVE A WATER METER & RADIO READ TRANSCEIVER. RESIDENTS SHOULD BE RECEIVING WATER USE INFORMATION IN THEIR UTILITY INVOICE.

= 2015 INSTALLATIONS 4800 METERS
WATER METER PROGRAM

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<th>APPROX. # OF METERS</th>
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- 2015 INSTALLATIONS

2700 METERS
WATER METER RATE CONVERSION PROGRAM BOUNDARIES

SENSUS 505 TRANSPONDERS THAT NEED TO BE UPGRADED TO 520M

BEGIN VOLUMETRIC RATES

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Notes:
1. This exhibit does not include water meter route 15.
2. A total of 1384 Sensus 505 transponders exist citywide (excluding water meter route 15.)

Legend:
- Total of Sensus 505 transponders in phase
- Address with Sensus type 505 transponder

Date: 8/31/2015
Title: CITY OF WEST SACRAMENTO WATER METER PROGRAM
Project: Boundaries of rate conversion areas
W.O. #: 21001
Sheet 1 of 1

City of West Sacramento
Engineering Services
21001 Water Meter Program
Sensus 505 Locations for Retrofit
SENSUS 505 LOCATIONS MAP_1.DWG
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RAMIREZ, MANUEL
CITY OF WEST SACRAMENTO

TECHNICAL MEMORANDUM
FOOD INDUSTRY CAPACITY ENHANCEMENTS

FINAL
August 2016
CITY OF WEST SACRAMENTO

TECHNICAL MEMORANDUM

FOOD INDUSTRY CAPACITY ENHANCEMENTS

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1.0 SUMMARY

As an extension of the development of the Water System Master Plan Update, Carollo was tasked by the City of West Sacramento (City) to conduct an evaluation of the impacts and required capital projects for the City to allow development of high water use food industries.

The evaluation included the development of four redevelopment scenarios that used the projected 2035 City-wide water demands as the baseline for the required water infrastructure. Each scenario evaluated the impacts and determined the required capital projects within one of the four industrial zones. The scenarios included:

- Scenario 1: Future System (2035) with Riverside Food Industry.
- Scenario 2: Future System (2035) with PSIP Food Industry.
- Scenario 3: Future System (2035) with Port Food Industry.
- Scenario 4: Future System (2035) with Southport Food Industry.

Water demand projections for each scenario included the assumption that 25 percent of the industrial area within each of the industrial zones would be allowed to develop food service industry that had used a water demand rate of 6,000 gallons per day per acre (gpd/ac). The remaining area with the industrial zones was assumed to 2,950 gpd/ac. These demand rates were based on similar use rates from other agencies across the state. Areas zoned as residential within each of the industrial zones are not expected to redevelop, and were therefore not included in the total industrial food processing zone acreage.

The demands for each scenario increased the overall water usage City-wide between 1.1 and 8.8 percent with the development of the Southport resulting in the largest increase in water demand (2.11 million gallons per day [mgd] or 8.8 percent based on Average Day Demands) due to the largest potential area of proposed Food Industry development.

Based on the supply, distribution system, and storage analysis the recommended projects summarized in Table 1 were developed along with associated costs. The assumed developed area, assumed water use, and cost per gallon of assumed available capacity are shown in Table 2. The cost per gallon for all four scenarios ranges between $0.86/gallon per day for Riverside and $2.71/gallon per day for Southport. Differences in other factors, such as developable area and water supply rights should also factor into the ultimate decision of where to locate the Food Industry Zone.
<table>
<thead>
<tr>
<th>Project Number</th>
<th>Description</th>
<th>Est. Capital Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 Master Plan (Baseline CIP)</td>
<td></td>
<td>91,141,500</td>
</tr>
<tr>
<td>Riverside Food Industry Zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-1-1</td>
<td>0.4 MG Storage Tank</td>
<td>1,235,000</td>
</tr>
<tr>
<td>P-1-1</td>
<td>24-inch Diameter Pipeline</td>
<td>19,000</td>
</tr>
<tr>
<td>Total Riverside Food Industry</td>
<td></td>
<td>1,254,000</td>
</tr>
<tr>
<td>PSIP Food Industry Zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-2-1</td>
<td>2.3 MG Storage Tank/Pipelines</td>
<td>7,009,000</td>
</tr>
<tr>
<td>P-2-1</td>
<td>16-inch Diameter Pipeline</td>
<td>268,000</td>
</tr>
<tr>
<td>P-2-2(2)</td>
<td>20-inch Diameter Pipeline</td>
<td>768,000</td>
</tr>
<tr>
<td>P-2-3</td>
<td>24-inch Diameter Pipeline</td>
<td>19,000</td>
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<tr>
<td>Total PSIP Food Industry</td>
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<td>8,064,000</td>
</tr>
<tr>
<td>Port Food Industry Zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-3-1</td>
<td>1.0 MG Storage Tank</td>
<td>3,088,000</td>
</tr>
<tr>
<td>P-3-1</td>
<td>24-inch Diameter Pipeline</td>
<td>19,000</td>
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<tr>
<td>Total Port Food Industry</td>
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<td>3,107,000</td>
</tr>
<tr>
<td>Southport Food Industry Zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-4-1</td>
<td>3.0 MG Storage Tank</td>
<td>9,263,000</td>
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<tr>
<td>P-4-1</td>
<td>24-inch Diameter Pipeline</td>
<td>19,000</td>
</tr>
<tr>
<td>Total Southport Food Industry</td>
<td></td>
<td>9,282,000</td>
</tr>
</tbody>
</table>

**Notes:**

1. Costs are provided as present value based on an ENR CCI number of 10,037, which corresponds with the 20-City Average Index in July 2015. Costs are not escalated to future years.
2. Costs associated with project P-2-1 reflect the difference between the 2015 Master Plan cost projection for a 12-inch diameter pipeline (TM-1) and the 20-inch diameter pipeline recommended in this TM.
Table 2  Proposed Food Industry Zone Water Supply Costs
Food Industry Capacity Enhancement
City of West Sacramento

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverside</td>
<td>390</td>
<td>90</td>
<td>1.45</td>
<td>2.71</td>
<td>$0.86</td>
</tr>
<tr>
<td>PSIP</td>
<td>823</td>
<td>206</td>
<td>3.05</td>
<td>5.70</td>
<td>$2.64</td>
</tr>
<tr>
<td>Port</td>
<td>473</td>
<td>118</td>
<td>1.76</td>
<td>3.28</td>
<td>$1.76</td>
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<tr>
<td>Southport</td>
<td>924</td>
<td>213</td>
<td>3.43</td>
<td>6.41</td>
<td>$2.71</td>
</tr>
</tbody>
</table>

Notes:
(1) 25 percent of the total industrial acreage was assumed to be Food Zone Area.
(2) The ADD was multiplied by 1.87.
(3) Average Day capacity.

2.0 BACKGROUND

The City is interested in evaluating the costs of accommodating additional food industry users within four industrial zones in the City. The City contracted with Carollo Engineers (Carollo) to conduct this evaluation in conjunction with the ongoing Water System Master Plan Update. The four industrial zones that are being considered for additional food related industrial use are:

- Riverside Zone
- Port Zone
- PSIP Zone
- Southport Zone

The City contracted with Carollo to perform an evaluation of the distribution system with the addition of four industrial food zones under future (year 2035) conditions. Carollo utilized the City’s water system hydraulic model, developed as part of the Water Master Plan Update, to evaluate the impact to the City’s distribution system with the addition of each food zone. Additionally, capacity improvements were recommended to address capacity deficiencies associated with the development of each food zone.
3.0 PROJECT SCOPE

The objective of this technical memorandum (TM) is to document the development and evaluation of system improvements required to accommodate additional food industry users within each specific neighborhood zone. The specific objectives include:

- Develop water demand estimates for each of the four industrial zones.
- Evaluate the future distribution system with the new industrial demands and develop storage and capacity improvements to mitigate future system deficiencies.
- Develop planning level cost estimates for the proposed improvement projects.

4.0 PROPOSED FOOD INDUSTRIES

The City has proposed four zones as areas designated for food industries. These four zones would incorporate eight neighborhoods, which are listed in Table 3. As previously mentioned, food industry water demands were applied to the total non-residential acreage of each proposed zone. According to Table 3, the Southport zone has the largest amount of acreage. Figure 1 shows the proposed zones and the existing water distribution system.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Assumed Industrial Acreage</th>
<th>Food Industry Zone Capacity Enhancement</th>
<th>City of West Sacramento</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food Industry Zone</strong></td>
<td><strong>Neighborhood</strong></td>
<td><strong>Industrial Acreage</strong></td>
<td></td>
</tr>
<tr>
<td>Riverside</td>
<td>Riverside/CHP</td>
<td>390</td>
<td></td>
</tr>
<tr>
<td><strong>Riverside Total</strong></td>
<td></td>
<td><strong>390</strong></td>
<td></td>
</tr>
<tr>
<td>PSIP</td>
<td>Port of Sacramento</td>
<td>823</td>
<td></td>
</tr>
<tr>
<td><strong>PSIP Total</strong></td>
<td></td>
<td><strong>823</strong></td>
<td></td>
</tr>
<tr>
<td>Port</td>
<td>North of Port Industrial</td>
<td>208</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Port North Terminal</td>
<td>182</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Port of Sacramento</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Old West Sacramento</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td><strong>Port Total</strong></td>
<td></td>
<td><strong>473</strong></td>
<td></td>
</tr>
<tr>
<td>Southport</td>
<td>SIP</td>
<td>632</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seaway</td>
<td>292</td>
<td></td>
</tr>
<tr>
<td><strong>Southport Total</strong></td>
<td></td>
<td><strong>924</strong></td>
<td></td>
</tr>
</tbody>
</table>
5.0 WATER DEMAND SUMMARY

For this study, the water distribution system was evaluated under future (year 2035) demand conditions. The Water Master Plan Update (Master Plan) developed water demands for each City neighborhood and projected that the 2035 average day demand (ADD) will be approximately 16,597 gallons per minute (gpm), or 23.9 mgd. The City’s 2035 maximum day demand (MDD) is estimated to be 31,042 gpm (44.7 mgd), which equates to a MDD/ADD peaking factor of 1.87.

Future water demands for the proposed food industry zones were developed based on a review of similar agencies throughout the west coast with large industrial water users. Based on this review, it was decided that a water duty factor (WDF) of 6,000 gallons per day per acre (gpd/acre) would be applied to 25 percent of the total industrial acreage in each zone (representing heavy industrial use), while a more typical WDF of 2,950 gpd/acre would be applied to the remaining 75 percent of each industrial food processing zone.

Table 4 summarizes the water demand for each of the four zones. With the redevelopment of the four proposed zones, the 2035 City-wide demand projections are expected to increase above the projections identified in the Water Master Plan Update. The demands for each scenario are expected to increase the overall water usage City-wide between 1.1 and 8.8 percent above the demand projections included in the City’s Water Master Plan Update.

In addition to the City-wide demand projections, the Master Plan developed future water demands for each neighborhood within the City. As part of this hydraulic analysis, the future industrial demands in each of the proposed zones were replaced with the new food industry demands shown in Table 4.

<table>
<thead>
<tr>
<th>Area</th>
<th>Total Acreage</th>
<th>25% Coefficient (gpd/Acre)</th>
<th>75% Coefficient (gpd/Acre)</th>
<th>ADD(1) gpm</th>
<th>MDD(2) mgd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverside</td>
<td>390</td>
<td>6,000</td>
<td>2,950</td>
<td>1,010</td>
<td>1.45</td>
</tr>
<tr>
<td>PSIP</td>
<td>823</td>
<td>6,000</td>
<td>2,950</td>
<td>2,120</td>
<td>3.05</td>
</tr>
<tr>
<td>Port</td>
<td>473</td>
<td>6,000</td>
<td>2,950</td>
<td>1,220</td>
<td>1.76</td>
</tr>
<tr>
<td>Southport</td>
<td>924</td>
<td>6,000</td>
<td>2,950</td>
<td>2,380</td>
<td>3.43</td>
</tr>
</tbody>
</table>

Notes:
(1) 25 percent of the total acreage was multiplied by 6,000 gpd/acre and the remaining 75 percent was multiplied by 2,950 gpd/acre.
(2) The ADD was multiplied by 1.87.
Table 5 summarizes the City wide demands with and without the additional demands associated with the changes to the proposed industrial zones. As shown in the table, the inclusion of the industrial food zones would increase the overall City-wide demands. The Southport area would result in the largest increase in demands as compared to the Master Plan. With development of Southport, the City-wide demands would increase from 23.91 mgd to 26.02 mgd, an increase of approximately 8.8 percent. For Riverside, PSIP and Port industrial food zones, the demands in the northern pressure zone will increase, while the Southport industrial food zone will increase demands in the southern pressure zone.

<table>
<thead>
<tr>
<th>Area</th>
<th>ADD (2035)</th>
<th>MDD (2035)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gpm</td>
<td>mgd</td>
</tr>
<tr>
<td>2015 Water Master Plan Update (Baseline Demand Projections)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>10,530</td>
<td>15.16</td>
</tr>
<tr>
<td>Southport Area</td>
<td>6,080</td>
<td>8.75</td>
</tr>
<tr>
<td>Total</td>
<td>16,610</td>
<td>23.91</td>
</tr>
<tr>
<td>City Wide Demands With Riverside</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>10,710</td>
<td>15.42</td>
</tr>
<tr>
<td>Southport Area</td>
<td>6,080</td>
<td>8.75</td>
</tr>
<tr>
<td>Total</td>
<td>16,790</td>
<td>24.17</td>
</tr>
<tr>
<td>City Wide Demands With PSIP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>11,660</td>
<td>16.78</td>
</tr>
<tr>
<td>Southport Area</td>
<td>6,080</td>
<td>8.75</td>
</tr>
<tr>
<td>Total</td>
<td>17,730</td>
<td>25.53</td>
</tr>
<tr>
<td>City Wide Demands With Port</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>11,020</td>
<td>15.87</td>
</tr>
<tr>
<td>Southport Area</td>
<td>6,080</td>
<td>8.75</td>
</tr>
<tr>
<td>Total</td>
<td>17,100</td>
<td>24.62</td>
</tr>
<tr>
<td>City Wide Demands With Southport</td>
<td></td>
<td></td>
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<tr>
<td>North Area</td>
<td>10,530</td>
<td>15.16</td>
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<tr>
<td>Southport Area</td>
<td>7,540</td>
<td>10.86</td>
</tr>
<tr>
<td>Total</td>
<td>18,070</td>
<td>26.02</td>
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</tbody>
</table>

6.0 SYSTEM EVALUATION

This section presents the results of the capacity evaluation of the water supply, distribution, and storage facilities. The system evaluation considered each of the four zones individually.
and was analyzed under 2035 conditions with the Master Plan improvements incorporated. Figure 2 illustrates the recommended Master Plan capacity improvements. In total, four scenarios were evaluated in accordance with criteria established in the Master Plan. The model scenarios evaluated as part of this study include the following:

- Scenario 1: Future System (2035) with Riverside Food Industry.
- Scenario 2: Future System (2035) with PSIP Food Industry.
- Scenario 3: Future System (2035) with Port Food Industry.
- Scenario 4: Future System (2035) with Southport Food Industry.

### 6.1 Supply System Evaluation

As documented in the City’s Master Plan, the supply capacity for the northern pressure zone is 58 mgd, while the south has a supply capacity of 21.6 mgd. Table 6 summarizes the supply evaluation with the addition of the four proposed zones. As shown, the City will have sufficient capacity at build-out. It should be noted that the Southport Industrial Zone increases system demands significantly in the Southport Area, and based on the pumping capacity evaluation, would leave only a 1.3 mgd surplus in the capacity of the Inline BPS.

<table>
<thead>
<tr>
<th>Area</th>
<th>Supply Capacity (mgd)</th>
<th>MDD (2035)</th>
<th>Surplus Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>gpm</td>
<td>mgd</td>
</tr>
<tr>
<td>2015 Water Master Plan Update</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>58</td>
<td>19,670</td>
<td>44.7</td>
</tr>
<tr>
<td>Southport Area</td>
<td>21.6</td>
<td>11,319</td>
<td>16.3</td>
</tr>
<tr>
<td>Riverside</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>58</td>
<td>22,000</td>
<td>45.1</td>
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<tr>
<td>Southport Area</td>
<td>21.6</td>
<td>11,350</td>
<td>16.3</td>
</tr>
<tr>
<td>PSIP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>58</td>
<td>21,760</td>
<td>47.7</td>
</tr>
<tr>
<td>Southport Area</td>
<td>21.6</td>
<td>11,350</td>
<td>16.3</td>
</tr>
<tr>
<td>Port</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>North Area</td>
<td>58</td>
<td>20,580</td>
<td>46.0</td>
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<td>Southport Area</td>
<td>21.6</td>
<td>11,350</td>
<td>16.3</td>
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<tr>
<td>Southport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>58</td>
<td>19,660</td>
<td>48.6</td>
</tr>
<tr>
<td>Southport Area</td>
<td>21.6</td>
<td>14,324</td>
<td>20.3</td>
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</tbody>
</table>
6.2 Storage Evaluation

The City currently has nine storage tanks with a combined volume of 25.1 million gallons (MG), including 8.0 MG of storage at the George Kristoff Water Treatment Plant (GKWTP) clearwells. However, the clearwells require a minimum volume of 1.5 MG for chlorine contact time, therefore, the total usable storage is 23.6 MG. The purpose of the tanks are to also provide the City with operational storage to meet peak hour demands (PHD), fire flow storage (4,000 gpm for four hours), and emergency storage.

The criterion for operational storage is defined as 25 percent of the MDD, while emergency storage is defined as 50 percent of MDD. As the City’s MDD increase with the addition of new industries, the storage requirements will also increase.

The Master Plan recommended the addition of 6 new storage tanks with a total volume of 11.8 MG to meet demands at 2035. As shown in Table 7, the recommended tanks are required to offset the storage deficiencies in the Northern area (5.20 MG) and the Southport Area (6.62 MG).

Table 7 also shows the required storage with the addition of each industrial food zone. As shown, additional storage beyond recommendations within the 2015 Master Plan will be required to meet the system’s criteria. The column titled “Required Storage in Excess of Master Plan Recommendations” represents the increase in storage due to the addition of each industrial food zone.

6.3 Distribution System Evaluation

Under future demand conditions the hydraulic model was utilized to evaluate pressure and velocities within the system’s pipelines. Criteria from the Master Plan were used to evaluate the system under each scenario. As stated, velocities within the system’s pipeline should not exceed 7 feet per second (fps) and pressure should not drop below 50 pounds per square inch (psi) for ADD, 35 psi for PHD, and 20 psi for MDD plus fire flow.

The increase in demands due to the addition of the food industries has attributed to additional deficiencies beyond those identified in the Master Plan. The distribution system evaluation identified pipelines requiring replacement due to high velocities and the need of parallel pipelines to efficiently move water to and from storage facilities. The recommended improvements are detailed in the following section.
Table 7  Future Storage Evaluation Summary  
Food Industry Zone Capacity Enhancement  
City of West Sacramento

<table>
<thead>
<tr>
<th>Area</th>
<th>2035 MDD (mgd)</th>
<th>Available Storage (MG)</th>
<th>Required Storage (MG)</th>
<th>Reqd. Storage in Excess of Master Plan Recommendations</th>
<th>City-wide Surplus (Deficient)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Operational</td>
<td>Fire</td>
<td>Emergency</td>
<td>Total</td>
</tr>
<tr>
<td>2015 Water Master Plan Update</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>28.31</td>
<td>17</td>
<td>7.08</td>
<td>0.96</td>
<td>14.16</td>
</tr>
<tr>
<td>Southport Area</td>
<td>16.34</td>
<td>6.6</td>
<td>4.09</td>
<td>0.96</td>
<td>8.17</td>
</tr>
<tr>
<td>Citywide</td>
<td>44.66</td>
<td>23.6</td>
<td>11.17</td>
<td>1.92</td>
<td>22.33</td>
</tr>
<tr>
<td>City Wide With Riverside</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>28.80</td>
<td>17.00</td>
<td>7.20</td>
<td>0.96</td>
<td>14.40</td>
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<td>16.34</td>
<td>6.60</td>
<td>4.09</td>
<td>0.96</td>
<td>8.17</td>
</tr>
<tr>
<td>Citywide</td>
<td>45.14</td>
<td>23.60</td>
<td>11.29</td>
<td>1.92</td>
<td>22.57</td>
</tr>
<tr>
<td>City Wide With PSIP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>31.34</td>
<td>17.00</td>
<td>7.84</td>
<td>0.96</td>
<td>15.67</td>
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<tr>
<td>Southport Area</td>
<td>16.34</td>
<td>6.60</td>
<td>4.09</td>
<td>0.96</td>
<td>8.17</td>
</tr>
<tr>
<td>Citywide</td>
<td>47.68</td>
<td>23.60</td>
<td>11.92</td>
<td>1.92</td>
<td>23.84</td>
</tr>
<tr>
<td>City Wide With Port</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>29.64</td>
<td>17.00</td>
<td>7.41</td>
<td>0.96</td>
<td>14.82</td>
</tr>
<tr>
<td>Southport Area</td>
<td>16.34</td>
<td>6.60</td>
<td>4.09</td>
<td>0.96</td>
<td>8.17</td>
</tr>
<tr>
<td>Citywide</td>
<td>45.98</td>
<td>23.60</td>
<td>11.50</td>
<td>1.92</td>
<td>22.99</td>
</tr>
<tr>
<td>City Wide With Southport</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Area</td>
<td>28.31</td>
<td>17.00</td>
<td>7.08</td>
<td>0.96</td>
<td>14.16</td>
</tr>
<tr>
<td>Southport Area</td>
<td>20.28</td>
<td>6.60</td>
<td>5.07</td>
<td>0.96</td>
<td>10.14</td>
</tr>
<tr>
<td>Citywide</td>
<td>48.59</td>
<td>23.60</td>
<td>12.15</td>
<td>1.92</td>
<td>24.30</td>
</tr>
<tr>
<td>Notes:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) Operational = 25 percent of MDD.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Fire = 4,000 gpm for 4 hours.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) Emergency = 50 percent of MDD.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7.0 RECOMMENDED IMPROVEMENTS

Based on the analysis of each scenario, capacity improvements are required to mitigate deficiencies related to the build-out of each food zone. Figures 3 through 6 illustrate the recommended improvements to mitigate capacity deficiencies for each scenario (beyond what has already been planned for as part of the Water Master Plan Update for year 2035 conditions). Table 8 summarizes the recommended improvements for each scenario.

- **Scenario 1: Riverside**
  - **Improvement T-1-1**: This project involves the construction of a 0.4 MG storage tank and associated booster pumps. The project is recommended to serve the proposed Riverside food zone and is located at the intersection of Riverside Parkway and Reed Avenue. The tank will connect to the existing system at an existing 16-inch.
  
  - **Improvement P-1-1**: Approximately 30 feet of 20-inch diameter pipeline will require replacement with a 24-inch diameter pipeline at the intersection of Reed Avenue and Harbor Boulevard. This small stretch of pipeline serves as the direct connection between the 16-inch diameter pipeline serving the Riverside food zone and the arterial 54-inch diameter pipeline. This project is recommended to mitigate velocities above the criteria of 7.0 fps.

- **Scenario 2: PSIP**
  - **Improvement T-2-1**: This scenario includes the addition of a 2.3 MG storage tank and associated booster pumps. The project is recommended to serve the proposed PSIP food zone and is located west of Industrial Boulevard and Parkway Boulevard. The tank will connect to the existing system at a 12-inch diameter pipeline and a proposed 20-inch diameter parallel pipeline.
  
  - **Improvement P-2-1**: Approximately 600 feet of 12-inch diameter pipeline will require replacement with a 16-inch diameter pipeline in W. Capitol Avenue. This project is recommended to mitigate low pressure.
  
  - **Improvement P-2-2**: This project will require the upsizing of a 2015 Master Plan pipeline project (TM-1). Project TM-1 recommends a 12-inch diameter parallel pipeline in West Capitol Avenue. With the addition of the PSIP food industries, the proposed pipeline would need to be upsized to accommodate two 2.3 MG storage tanks. This project requires approximately 3,500 feet of 20-inch diameter pipeline in West Capitol Avenue. The project is recommended to mitigate low pressure as the proposed storage tanks cycle.
  
  - **Improvement P-2-3**: Approximately 30 feet of 20-inch diameter pipeline will require replacement with a 24-inch diameter pipeline at the intersection of Reed Avenue and Harbor Boulevard. This project is recommended to mitigate velocities above the criteria of 7.0 fps.
Table 8  Recommended Improvement Projects  
Food Industry Zone Capacity Enhancement  
City of West Sacramento

<table>
<thead>
<tr>
<th>Figure No.</th>
<th>Description/ Street</th>
<th>Purpose</th>
<th>Ex. Size/ Diam (in)</th>
<th>New Size/ Diam</th>
<th>Replace/ New</th>
<th>Length (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pipelines</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P-1-1</td>
<td>Reed Avenue</td>
<td>Required to mitigate high velocities.</td>
<td>20</td>
<td>24</td>
<td>Replace</td>
<td>30</td>
</tr>
<tr>
<td>P-2-1</td>
<td>W. Capitol Avenue</td>
<td>Required to address low pressure near proposed storage tank.</td>
<td>12</td>
<td>16</td>
<td>New</td>
<td>600</td>
</tr>
<tr>
<td>P-2-2</td>
<td>W. Capitol Avenue</td>
<td>Required to address low pressure near proposed storage tank.</td>
<td>-</td>
<td>24</td>
<td>Replace</td>
<td>3,500</td>
</tr>
<tr>
<td>P-2-3</td>
<td>Reed Avenue</td>
<td>Required to mitigate high velocities.</td>
<td>20</td>
<td>24</td>
<td>Replace</td>
<td>30</td>
</tr>
<tr>
<td>P-3-1</td>
<td>Reed Avenue</td>
<td>Required to mitigate high velocities.</td>
<td>20</td>
<td>24</td>
<td>Replace</td>
<td>30</td>
</tr>
<tr>
<td>P-4-1</td>
<td>Reed Avenue</td>
<td>Required to mitigate high velocities.</td>
<td>20</td>
<td>24</td>
<td>Replace</td>
<td>30</td>
</tr>
<tr>
<td><strong>Storage Tanks and Booster Pumps</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-1-1</td>
<td>Riverside Parkway and Reed Avenue</td>
<td>New tank and booster pump station to address storage deficiency with the build-out of Riverside food industry.</td>
<td>-</td>
<td>0.4 MG</td>
<td>New</td>
<td>-</td>
</tr>
<tr>
<td>T-2-1</td>
<td>Industrial Boulevard and Parkway Boulevard</td>
<td>New tank and booster pump station to address storage deficiency with the build-out of PSIP food industry.</td>
<td>-</td>
<td>2.3 MG</td>
<td>New</td>
<td>-</td>
</tr>
<tr>
<td>T-3-1</td>
<td>Industrial Parkway and Beacon Boulevard</td>
<td>New tank and booster pump station to address storage deficiency with the build-out of Port food industry.</td>
<td>-</td>
<td>1.0 MG</td>
<td>New</td>
<td>-</td>
</tr>
<tr>
<td>T-4-1</td>
<td>Southport Parkway</td>
<td>New tank and booster pump station to address storage deficiency with the build-out of Southport food industry.</td>
<td>-</td>
<td>3.0 MG</td>
<td>New</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes:**
(1) Final location of storage may vary.
• Scenario 3: Port
  – Improvement T-3-1: This project entails the addition of a 1.0 MG storage tank and associated booster pumps. This project is recommended to serve the proposed Port food zone and is located near the intersection of Industrial Parkway and Beacon Boulevard. The tank will connect to the existing system at a 12-inch diameter pipeline.
  – Improvement P-3-1: Approximately 30 feet of 20-inch diameter pipeline will require replacement with a 24-inch diameter pipeline at the intersection of Reed Avenue and Harbor Boulevard. This project is recommended to mitigate velocities above the criteria of 7.0 fps.

• Scenario 4: Southport
  – Improvement T-4-1: This scenario includes the addition of a 3.0 MG storage tank and associated booster pumps. This project is recommended to serve the proposed Southport food zone and is located on Southport Parkway. The tank will connect to the existing system at a 20-inch diameter pipeline.
  – Improvement P-4-1: Approximately 30 feet of 20-inch diameter pipeline will require replacement with a 24-inch diameter pipeline at the intersection of Reed Avenue and Harbor Boulevard. This project is recommended to mitigate velocities above the criteria of 7.0 fps.

8.0 PROBABLE COST ESTIMATES

The cost estimates were prepared for general planning purposes and guidance in project evaluation and implementation. Final project costs will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors such as detailed utility and topography surveys. The cost estimates presented herein are based on unit costs from the Master Plan.

Cost estimates within this report are considered “Order-of-Magnitude” (Class 5) level estimates, as defined by the Association for the Advancement of Cost Engineering (AACE). Typical accuracy ranges for Class 5 estimates are -20 to -50 percent on the low side, and +30 to +100 percent on the high side.

Construction costs were estimated by increasing the total base cost by 25 percent (Contingency Cost) to account for unexpected construction conditions. The total project cost was estimated as the construction cost plus 30 percent for engineering, legal, and administration costs. The estimated capital cost for each alternative is 162.5 percent of the baseline construction cost.
Table 9 provides the overall estimated capital cost associated with each scenario and includes pipeline replacement, additional storage tanks, and booster pump stations. In addition, the Master Plan cost estimates are included in the table for comparison. Costs associated with project P-2-1 reflect the difference between the Master Plan cost projection for a 12-inch diameter pipeline (TM-1) and the 20-inch diameter pipeline recommended in this TM. The capital cost for project TM-1 considered 3,500 feet of 12-inch diameter pipeline.

As shown in the Table, Southport food industry will have the largest capital cost relative to the other alternatives.

<table>
<thead>
<tr>
<th>Table 9</th>
<th>Probable Cost Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Industry Zone Capacity Enhancement</td>
<td>City of West Sacramento</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Description</th>
<th>Est. Capital Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 Master Plan (Baseline CIP)</td>
<td>Riverside Food Industry Zone</td>
<td></td>
</tr>
<tr>
<td>T-1-1</td>
<td>0.4 MG Storage Tank</td>
<td>1,235,000</td>
</tr>
<tr>
<td>P-1-1</td>
<td>24-inch Diameter Pipeline</td>
<td>19,000</td>
</tr>
<tr>
<td><strong>Total Riverside Food Industry</strong></td>
<td></td>
<td><strong>1,254,000</strong></td>
</tr>
<tr>
<td>PSIP Food Industry Zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-2-1</td>
<td>2.3 MG Storage Tank/Pipelines</td>
<td>7,009,000</td>
</tr>
<tr>
<td>P-2-1</td>
<td>16-inch Diameter Pipeline</td>
<td>268,000</td>
</tr>
<tr>
<td>P-2-2(2)</td>
<td>20-inch Diameter Pipeline</td>
<td>768,000</td>
</tr>
<tr>
<td>P-2-3</td>
<td>24-inch Diameter Pipeline</td>
<td>19,000</td>
</tr>
<tr>
<td><strong>Total PSIP Food Industry</strong></td>
<td></td>
<td><strong>8,064,000</strong></td>
</tr>
<tr>
<td>Port Food Industry Zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-3-1</td>
<td>1.0 MG Storage Tank</td>
<td>3,088,000</td>
</tr>
<tr>
<td>P-3-1</td>
<td>24-inch Diameter Pipeline</td>
<td>19,000</td>
</tr>
<tr>
<td><strong>Total Port Food Industry</strong></td>
<td></td>
<td><strong>3,107,000</strong></td>
</tr>
<tr>
<td>Southport Food Industry Zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-4-1</td>
<td>3.0 MG Storage Tank</td>
<td>9,263,000</td>
</tr>
<tr>
<td>P-4-1</td>
<td>24-inch Diameter Pipeline</td>
<td>19,000</td>
</tr>
<tr>
<td><strong>Total Southport Food Industry</strong></td>
<td></td>
<td><strong>9,282,000</strong></td>
</tr>
</tbody>
</table>

Notes:

1) Costs are provided as present value based on an ENR CCI number of 10,037, which corresponds with the 20-City Average Index in July 2015. Costs are not escalated to future years.

2) Costs associated with project P-2-1 reflect the difference between the 2015 Master Plan cost projection for a 12-inch diameter pipeline (TM-1) and the 20-inch diameter pipeline recommended in this TM.
CITY OF WEST SACRAMENTO

2015 WATER MASTER PLAN UPDATE

TECHNICAL MEMORANDUM NO. 1
MODEL SOFTWARE SELECTION

FINAL
January 2015
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1.0 INTRODUCTION

The City of West Sacramento (City) has contracted with Carollo Engineers, Inc. (Carollo) to update its Water Master Plan (2015 Master Plan). As part of the City’s previous Water Master Plan (2005 Water Master Plan), a hydraulic computer model of the City’s water distribution system was developed using the H2ONet hydraulic modeling software application, developed by Innovyze, Inc. (formerly MWH Soft).

In the past decade, improvements have been made to the hydraulic modeling software available on the market. Most notably, the industry has moved away from traditional AutoCAD based or stand-alone software platforms toward more geographic information system (GIS) integrated platforms. In addition, enhancements to model graphical user interfaces (GUIs), as well as the emergence of several new “add-on tools” has occurred since the model was last updated. This technical memorandum presents a summary of the major software vendors, briefly explains software features, compares the advantages and disadvantages of each software program, and provides a recommendation for the software program to be used for preparation of the City’s 2015 Master Plan.

The information and recommendations summarized in this technical memorandum is based on Carollo’s extensive experience with each of the software packages evaluated. The recommended software was selected based on a qualitative analysis of each software package as it relates to the City’s hydraulic modeling needs.

2.0 SOFTWARE VENDORS

There are many software packages that can potentially address the needs of the City, and all vary in their methods of analysis and user friendliness. Water system hydraulic modeling software packages from three (3) top software vendors (as well as an open source alternative developed by the United States Environmental Protection Agency [USEPA]) were evaluated and are listed below in alphabetical order:

- **Bentley Systems, Inc.:** Bentley Systems, Inc. (Bentley) is an engineering and architecture software company with corporate headquarters in Exton, Pennsylvania. Bentley added a suite of water, wastewater, and storm water analysis software through its acquisition of Connecticut based Haestad Methods, Inc. in 2004. The company offers two water distribution system software packages: WaterCAD and WaterGEMS.

- **Danish Hydraulic Institute:** The Danish Hydraulic Institute (DHI) is an international hydraulic consulting and research institution headquartered in Denmark. There are
three offices in the United States: Portland, Oregon, St. Petersburg, Florida, and Solana Beach, California. The company’s MIKE URBAN software application includes a water distribution system-modeling platform.

- **Innovyze**: Innovyze is headquartered in Broomfield, Colorado, and is a leading provider of software products geared towards hydraulics and hydrology. In 2009, Colorado based MWH Soft and British based Wallingford Software merged into a single company (MWH Soft), which in 2011 was renamed Innovyze. Innovyze offers four water distribution system modeling software packages. These are H2ONet, H2OMap Water, InfoWater, and InfoWorks WS.

- **USEPA**: Most of the water distribution system software applications presented in this evaluation utilize the hydraulic engine associated with the USEPA’s EPANET 2.0 hydraulic model, which is an open source software application offered free of charge from the USEPA.

A comparison of the technical features of the software vendors and the modeling software that each vendor offers is presented in Table 1. This table allows a side-by-side comparison of features in each software package. The features that have the greatest impact on the selection of an appropriate software package are discussed in detail as part of this memo.

### 3.0 EVALUATION CRITERIA

As a way to evaluate the pros and cons of each software package, several criteria are used, including:

- Hydraulic calculations
- Graphical User Interface and Usability
- GIS Interface
- Scenario Management
- Enhanced Features and Tools
- Customer Service, Support, and User Base
- Cost

Carollo recommends the City select a model that is easy to operate, compatible with GIS software and data sources, has the ability to analyze several scenarios with multiple facility options, can be run by many consultants in the water field (the City has indicated the current plan is not to have City staff operate the water model), and is cost effective. Model users may also find it necessary to use the software vendor’s customer service and support to troubleshoot operating issues associated with model use. Each of the criteria listed above is briefly discussed in this TM.
<table>
<thead>
<tr>
<th>Technical Characteristics</th>
<th>Bentley</th>
<th>DHI</th>
<th>Innovyze</th>
<th>USEPA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WaterCAD</td>
<td>WaterGEMS</td>
<td>MIKE URBAN</td>
<td>H₂ONET</td>
</tr>
<tr>
<td>Platform</td>
<td>AutoCAD</td>
<td>ArcGIS</td>
<td>Stand-Alone</td>
<td>AutoCAD</td>
</tr>
<tr>
<td>Computation Method</td>
<td>EPANET</td>
<td>EPANET</td>
<td>EPANET</td>
<td>EPANET</td>
</tr>
<tr>
<td>Useability</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
</tr>
<tr>
<td>GIS Compatibility</td>
<td>Average</td>
<td>Excellent</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Scenario Management</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Calculates demands based on GIS land use</td>
<td>via GIS</td>
<td>via GIS</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Automated Fire Flow Analysis</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Water Quality Simulations</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Tools to size new mains</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Unidirectional Flushing</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Customizable tabular reports</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Graphically compares the results of multiple simulations</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Internet Based Model Network/Output Viewer Available</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Sister Sewer/Storm Modeling Software</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Single Licenses Cost (2,000 pipe version)</td>
<td>$8,278</td>
<td>$13,455</td>
<td>$8,400</td>
<td>$5,000</td>
</tr>
<tr>
<td>Maintenance and Service (Annual Fee)</td>
<td>$1,993</td>
<td>$3,231</td>
<td>$1,960</td>
<td>$1,000</td>
</tr>
</tbody>
</table>

Notes:
(1) Costs presented are for the standard fixed seat license. Pricing differs for the floating seat licenses and the suite packages.
(2) InfoWorks is based on a 2,500 node license (2,000 link license not available)
3.1 Computational Engine

Most water distribution system hydraulic modeling software programs utilize the EPANET computational engine. Therefore, the model output should be consistent from one software platform to another. Of the eight water distribution system software programs evaluated as part of this project, all but one utilizes the EPANET computational engine. The one exception to this is that InfoWorks WS utilizes its own proprietary computational engine called WS SIM.

3.2 Graphical User Interface and Usability

In order for a model to be an effective tool for City Staff in planning and development, it must be user friendly and easy to operate. The operating system must be graphically based and intuitive in its operation. Adding facilities to the existing system and creating scenarios for new improvements should be straightforward and intuitive.

3.3 GIS Interface

Municipal and utility operators use GIS software and databases to control, organize, and catalog system data into easy to access and useable formats. Therefore, GIS compatibility is an essential element of any infrastructure modeling software. The ability to synchronize system databases with modeling software can result in significant time saving for City Staff and your consultants. Software should be able to display GIS data, such as land use, aerial photos, zoning data, parcels, and growth boundaries on the screen in order to allocate flows, and evaluate new facilities based on planning assumptions.

Often, GIS data has topology flaws that need to be corrected before the modeling software can run. Software packages with data diagnostic tools to identify and correct these topology flaws can save time in the model building and updating process.

3.4 Scenario Management

Typically, a planning level hydraulic model serves several purposes. First, the model is used to analyze the existing system and determine where capacity deficiencies and operational problems exist. The second purpose is to evaluate the system under future demand conditions. To be used effectively, the model will need to be able to create and modify multiple scenarios in order to evaluate the effects of infrastructure changes (e.g. new pipelines, tanks, pump stations) and increased demands on the distribution system. The ability of a model to create and manage what-if scenarios is a necessary component of hydraulic model construction and analysis.
3.5 Enhanced Features and Tools

Many times, the availability of certain data analysis tools and “add-on” toolbars can provide added benefits to the end user. These tools can provide tangible savings to the end user in terms of increased efficiency in performing a given task. In addition, the availability of advanced modules and other add-on features can be beneficial to the City. For example, some of the evaluated software packages provide a unidirectional flushing tool (as an add-on package), which are used to develop flushing programs, and identify valves to close/open, pipeline velocities, and required flush time/volume. The availability of these tools and add-on features should play a role in the selection of the preferred software platform for the City. The advantage to the City of the availability of add-on features is that many consulting firms have already purchased these add-on licenses, and therefore, the City’s model could be used to develop programs (such as a unidirectional flushing program) without the City actually purchasing the add-on tools.

3.6 Customer Service, Support, and User Base

Operation of a computer model requires a direct relationship with the software vendor in order to troubleshoot any problems that may arise during model operation. Technical service representatives, on-line help, help files, and operating manuals all factor into the customer service and support evaluation. Customer support should be fast, responsive, and technically qualified to handle the most advanced modeling questions. New and infrequent users usually have many questions regarding the operation of modeling software, and a helpful and responsive customer support department can be an invaluable tool.

An evaluation of customer service and support provided by the software vendors is subjective at best, since the evaluation is influenced by the specific personalities and experiences of both parties. Anecdotal information obtained from other software users is subject to biases as well. However, establishing and maintaining a good working relationship with the vendor can be very helpful to maximize the benefits obtained from the software. Maintaining a good personal relationship with the software vendor is probably the most effective way to obtain extra support and software enhancements when needed.

Additionally, it is important to consider the user base of each software program when selecting the preferred model for the City. Software platforms with a larger user base are more likely to receive more frequent software updates than platforms with a smaller user base.

3.7 Widespread Industry Usage

Because the City does not intend to operate the hydraulic model using internal staff, it is important that the software package selected have widespread use within the water industry and with many consultants. This allows the City to have many options from which to select a modeler to update, maintain, and run model scenarios.
In many cases, developers will be asked to conduct hydraulic modeling analysis through their own engineering consultant that may or may not have a license of the hydraulic modeling software. Therefore, compatibility with other modeling software is also an important consideration.

3.8 Cost

The cost of a software package involves several items. With any software package, the associated costs include license fees, support and maintenance fees, and additional add-on modules. The cost for the packages evaluated in this report range from $5,000 to $13,455 (the open source EPANET model is available for no cost). Software package costs are given in the information matrices (Table 1).

Although the City does not intend to purchase the modeling software in the near term, it may choose to do so at some point in the future. For this reason, the costs of each software package are an important consideration in the model selection process.

4.0 SCREENING LEVEL EVALUATION

Carollo conducted a preliminary evaluation based on the hydraulic calculations, number of users, cost, and ease of use criteria. Table 1 displays a comparison between the water system modeling software’s cost and technical characteristics. Considering the criteria described above InfoWorks and EPANET are not recommended for the reasons described below.

- **EPANET**: While available at no cost, EPANET is not recommended for a number of reasons. This software platform is very difficult to use and is not compatible with GIS. In addition, this program does not support scenario management and lacks the features and capabilities that are available from the other software vendors. EPA does not provide user support.

- **InfoWorks WS**: InfoWorks WS is most commonly used in Europe. While there is a fairly large user base for the collection system (sewer) version of InfoWorks, there are very few users (less than a handful) of the water distribution system version of InfoWorks in the United States. In addition, InfoWorks is notoriously difficult to use, and is more expensive than most of the other software available. For these reasons, InfoWorks is not recommended.

5.0 COMPREHENSIVE EVALUATION

After the preliminary evaluation was completed, the remaining software packages, WaterCAD, WaterGEMS (Bentley), H₂ONET, H₂OMAP Water, InfoWater (Innovyze), and MIKE URBAN (DHI) were further evaluated.
5.1 Computational Engine

Each of the screened software packages utilize the EPANET computational engine. Therefore, each of the screened should produce similar model results (output).

5.2 Graphical User Interface and Usability

The ease of use of each package is a very important factor in the software selection process. The user interface for the Innovyze programs has many features that help the user to quickly see and identify associated facility data and controls. The attribute browser allows the user to click on a facility and view or edit information in the database. This feature is useful for analysis when focusing on specific sections of the system, such as new facilities or system upgrades. The user interface has a control center that displays GIS layer information as well as operational data, annotation, and map display operations that create an easy means to manipulate operational data and view output results for the entire system.

In general, the usability of both H2OMap and InfoWater are excellent. H2OMap Water and InfoWater are identical programs, with the key difference being that H2OMap Water is a stand-alone program, whereas InfoWater runs directly within the ArcGIS environment. H2ONET has the same functionality and most of the same toolbars and commands as both H2OMap Water and InfoWater, but is somewhat difficult to view model elements and navigate the model workspace.

WaterCAD and WaterGEMS are reasonable easy to use, and the model layout is intuitive, for the most part. However, these two programs do have some features that have the disadvantage of unneeded complexity for the new or infrequent user. As an example, model controls (pump on/off set points) are more difficult to identify and manipulate in WaterCAD or WaterGEMS as compared to the Innovyze products.

Another drawback of the WaterCAD and WaterGEMS software is that it uses a proprietary database. In doing so, external databases, such as Microsoft Excel, cannot be used to view or edit model data or output results. In general, the usability of the Bentley products is average.

MIKE URBAN is fairly easy to use, and the model layout is intuitive. It includes some nice data auditing and flagging features, as well as fairly straightforward presentation of model results and attribute data. In general, the usability of MIKE URBAN is good.

5.3 GIS Interface

Typically, most of the data in a modern water distribution system model comes from GIS databases. These information systems are increasingly becoming the primary repository for spatial infrastructure data. In recent years, the City has been working to expand upon its water, wastewater, and storm drainage system GIS databases.
H₂ONET runs with the AutoCAD environment, but it does have the ability to import and export data to and from GIS shapefiles. However, it lacks the ability to display GIS background layers.

H₂OMap Water and MIKE URBAN operate in a stand-alone mode that allows these programs to run very efficiently. These programs can easily read, write, and manipulate GIS data. However, by not running directly within the ArcGIS environment, the GIS functionality of these programs can be limited to a certain extent. For example, in H₂OMap Water, GIS shapefiles can be added as background layers in these models, but the ability to modify how the background layers are shown is somewhat limited. MIKE URBAN uses ArcObjects, which provides most of the functionality of ArcGIS with a slightly different layout.

InfoWater runs directly within ESRI’s ArcGIS software program, so every user of these modeling programs must also have a copy of the GIS software. These modeling programs are able to use additional GIS functionality, as well as built in data diagnostic tools available in the standard package. This software tends to be selected by users who have experience and like working from within the GIS software.

WaterCAD can work in an AutoCAD, MicroStation, or a stand-alone environment, whereas WaterGEMS can work in AutoCAD, MicroStation, stand-alone, or in ArcGIS. WaterCAD can read and write GIS data. WaterGEMS can read, write, and manipulate GIS data.

5.4 Scenario Management

Each of the screened software packages offer sophisticated parent child tree scenario creation and management schemes. This feature allows the user to set up multiple what if scenarios based on a variety of model parameters.

The Innovyze software packages also have a facility manager, which enables the model to display only the facilities that are modeled in that simulation. The Innovyze data set manager is very useful in organizing and controlling what facilities and controls are associated with each scenario. WaterCAD, WaterGEMS, and MIKE URBAN also have facility management tools, but they are generally less user friendly.

5.5 Enhanced Features and Tools

All of the screened hydraulic models have a number of helpful tools and add-on features that streamline the hydraulic model development process. These include features such as automated fire flow tools, engineering validation/connectivity tools, demand allocation tools, automated calibration tools, and other advanced modules and extensions (e.g., unidirectional flushing, pressure zone manager, etc.) In general, InfoWater has the most features and tools available. WaterCAD, WaterGEMS, MIKE URBAN, and H₂OMap Water have slightly fewer features and tools compared to InfoWater, but still offer a very good selection of features and tools. H₂ONET offers the least number of enhanced features of the screened alternatives.
5.6 Customer Service, Support, and User Base

Innovyze customer support has been good with timely and supportive response to issues, such as software bugs and technical problems. Innovyze has shown that they are responsive to clients needs and are able to quickly provide enhancements when needed. Instructional manuals are adequate. E-mail and telephone support is the best means of quickly obtaining solutions. Innovyze also has an online user forum and "Insider Blog" that can also be helpful.

WaterCAD and WaterGEMS offers several support and maintenance options. Users have the option to pay an annual fee or pay a price for each service contract. Anecdotal information obtained from other users was less complimentary on timely responses and personal service.

The MIKE URBAN support is responsive and can successfully handle support problems. They have a nice list of "Frequently Asked Questions" and an online user forum, which can be helpful.

The Innovyze and Bentley products have a large user base throughout the United States; MIKE URBAN is less commonly used for water distribution system modeling in the United States.

5.7 Widespread Industry Use

As described in the previous section, the Innovyze and Bentley products have the largest user base of the software evaluated. Typically, most engineering consultants that provide hydraulic modeling services have licenses for products from each of these vendors, and can work in the hydraulic model directly.

Some smaller (typically local engineering firms that do mostly development related work) may not have a copy of either the Bentley or Innovyze products. For water system models, this is not a concern because nearly every software platform (with the exception of InfoWorks WS) utilizes the EPANET hydraulic engine and include the functionality to export models to EPANET and import models from EPANET. Therefore, conversion of a hydraulic model from one software program to the other is a simple process. Typically, a smaller firm without a license for the commercially available products will run the hydraulic model in EPANET, which is a free download available from the USEPA.

5.8 Cost

Software costs are a major factor in the selection of a modeling package. Even though the City's current plan is not to have in-house modeling capabilities and a software license, this may change in the future, so costs have been described below. Costs discussed here are for a 2,000-pipe version unless otherwise noted, and are useful to identify the relative
difference in costs between the different software programs. For larger models, the cost for each program will increase. The cost for all software packages are summarized in Table 1.

The cost for the H2ONET is $5,000 for a new unlimited pipe license. The annual maintenance fee for H2ONET is $1,000.

Both InfoWater and H2OMAP Water have a single license fee of $6,000. Support and maintenance fees cost $1,000 annually. Network licenses are available, as well as Pro, Suite and Executive Suite versions of the software for an additional cost.

WaterCAD is priced at $8,728 with a support and maintenance fee of $1,993. SewerGEMS is priced at $13,455 with an annual support and maintenance fee $3,231.

MIKE URBAN is priced at $8,400 with an annual support and maintenance fee of $1,960.

6.0 RECOMMENDATION

The City could successfully update their water distribution system model in any of the six screened water distribution system hydraulic modeling software platforms (H2ONET, H2OMap Water, InfoWater, WaterCAD, WaterGEMS, and MIKE URBAN). Based on the above evaluations and our previous experience, we recommend Innovyze’s InfoWater software for the following reasons:

- Runs directly in ArcGIS
- Superior or comparable ease of use
- Excellent scenario manager
- Best value in terms of features/capabilities to cost
- Excellent features and add-on tools
- Widespread usage in the United States water industry

Based on our current understanding, the City is not ready to purchase the InfoWater software. Instead, they intend to utilize consulting firms to run the model as needed. However, should the City wish to purchase the hydraulic model in the future, a license can be obtained by contacting the City’s local Innovyze representative:

Peter Martin
Client Service Manager, Innovyze, Inc.
Roseville, CA
Telephone: 916-740-3210
Email: peter.martin@innovyze.com
For the City’s needs, it is recommended that the “base” package be purchased, and that the annual maintenance fees be kept up to date.

The InfoWater Suite and Executive Suite packages offer some additional features and functionality, which typically will not be used by City staff. The add-on Unidirectional Flushing tool is a nice feature that the City would like to utilize at some point in the future. However, unidirectional flushing analysis is a fairly complex modeling exercise that is best performed by an engineering consultant. For this reason, the City likely does not need to purchase this feature.
FIRE FLOW TEST 2

DETAIL 2

CITY OF WEST SACRAMENTO
WATER MASTER PLAN UPDATE
FIRE FLOW TEST 7
DETAIL 7
CITY OF WEST SACRAMENTO
WATER MASTER PLAN UPDATE
FIRE FLOW TEST 8

DETAIL 8

CITY OF WEST SACRAMENTO
WATER MASTER PLAN UPDATE
FIRE FLOW TEST 14
DETAIL 14
CITY OF WEST SACRAMENTO
WATER MASTER PLAN UPDATE
FIRE FLOW TEST 16

DETAIL 16

CITY OF WEST SACRAMENTO
WATER MASTER PLAN UPDATE
FIRE FLOW TEST 19
DETAIL 19
CITY OF WEST SACRAMENTO
WATER MASTER PLAN UPDATE
Legend

- Primary Flow Hydrant (F-1)
- Primary Pressure Hydrant (P-1)
- Secondary Pressure Hydrant (P-2)
- Other Hydrants

Water Pipelines
- Water Main
- Service Laterals

FIRE FLOW TEST 20
DETAIL 20

CITY OF WEST SACRAMENTO
WATER MASTER PLAN UPDATE
2015 WATER SYSTEM MASTER PLAN UPDATE

EXTENDED PERIOD SIMULATION (EPS) CALIBRATION
Based on September 2014 Field Data (Assuming Closed Valve at Jefferson and Linden)

City of West Sacramento

June 2015

Job No: 9620A.00
EPS Calibration - Oak St Res/PS Discharge (psi)

2015 Water Master Plan Update
City of West Sacramento

Pressure (psi) vs. Time

SCADA - 9/17/14
Model Simulated
EPS Calibration - Bridgeway Lakes Res/PS Discharge (psi)
2015 Water Master Plan Update
City of West Sacramento

Pressure (psi)

Time

SCADA - 9/17/14
Model Simulated
EPS Calibration - Pressure Logger C9 (psi)

2015 Water Master Plan Update
City of West Sacramento

Pressure (psi)

Time

SCADA - 9/17/14
Model Simulated
2015 WATER SYSTEM MASTER PLAN UPDATE

EXTENDED PERIOD SIMULATION (EPS) CALIBRATION
Based on April 2015 Field Data (Assuming Closed Valve at Jefferson and Linden)

City of West Sacramento

June 2015

Job No: 9620A.00
EPS Calibration - Northeast Res/PS Tank Level (feet)

2015 Water Master Plan Update
City of West Sacramento

Level (feet)

Time

SCADA - 4/22/15
Model Simulated
EPS Calibration - Inline PS Discharge (psi)

2015 Water Master Plan Update
City of West Sacramento

Pressure (psi) vs Time

- SCADA - 4/22/15
- Model Simulated
EPS Calibration - Bridgeway Lakes Res/PS Tank Level (feet)
2015 Water Master Plan Update
City of West Sacramento

Level (feet)

Time

SCADA - 4/22/15
Model Simulated
EPS Calibration - Pressure Logger C18 (psi)
2015 Water Master Plan Update
City of West Sacramento

Model Simulated (Without Closed Valve)
Model Simulated (With Closed Valve)

Pressure (psi) vs. Time

- SCADA - 4/22/15
- Model Simulated (Without Closed Valve)
- Model Simulated (With Closed Valve)
EPS Calibration - Pressure Logger C20 (psi)
2015 Water Master Plan Update
City of West Sacramento
EPS Calibration - Pressure Logger C21 (psi)
2015 Water Master Plan Update
City of West Sacramento

Pressure (psi)

Time

SCADA - 4/22/15
Model Simulated (Without Closed Valve)
Model Simulated (With Closed Valve)
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<th>Date/Time</th>
<th>Hydrant Type</th>
<th>Hydrant ID</th>
<th>Field Measured Data (^\text{1)})</th>
<th>Model Simulated Data</th>
<th>Percent Difference</th>
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Notes:
1. Values shown in **Blue Italic** were adjusted down by 4 psi to adjust for apparent guage error. Value shown in **Red Italic** shows a significant discrepancy between pressure hydrant 1 and pressure hydrant 2. This reading was thrown out for model calibration purposes.
CITY OF WEST SACRAMENTO

WATER SYSTEM MASTER PLAN

TECHNICAL MEMORANDUM
WATER TREATMENT PLANT CONDITION ASSESSMENT

FINAL
August 2016
CITY OF WEST SACRAMENTO
WATER SYSTEM MASTER PLAN
TECHNICAL MEMORANDUM
WATER TREATMENT PLANT CONDITION ASSESSMENT

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August 2016
1.0 INTRODUCTION

This purpose of this Technical Memorandum (TM) is to present and summarize the findings of the George Kristoff Water Treatment Plant (GKWTP) Visual Condition Assessment Task of the City of West Sacramento (City) Water System Master Plan. This task involved defining the existing GKWTP assets and assessing their rehabilitation or replacement needs using asset management methodology. This methodology included a visual condition assessment as well as input from City staff relating to operational and maintenance issues for the various plant systems and components. To identify and prioritize renewal needs, a risk assessment was conducted that examined the vulnerability, or likelihood of failure, and criticality, or consequence of failure for each of the GKWTP assets. When other planning considerations have been identified in the Master Plan, such as the timing of regulatory-driven improvements, the findings from this TM will be incorporated into a detailed and comprehensive Capital Improvements Program (CIP) for the City.

2.0 SUMMARY OF FINDINGS

The key findings of this TM are summarized below:

- Overall, the GKWTP is performing very well and good maintenance practices are reflected in the extended service life of many of the GKWTP assets. Much of the facility is relatively new, built during the 2002-2004 expansion. However, there are facilities still in use from the original construction dating back to 1987 which are nearing the end of their useful life. Therefore, many assets will be in need of rehabilitation or replacement during the Master Plan's planning period.

- High-risk assets were identified and it is recommended that these be replaced or rehabilitated in the short-term (5 year) planning horizon.

The Master Plan will evaluate these baseline renewal needs both within the treatment plant and in the distribution system in conjunction with other needs at the City, namely those driven by regulatory changes, capacity needs, or efficiency initiatives.

3.0 BACKGROUND AND OBJECTIVES

The City currently operates and maintains a water distribution system and treatment plant with a service area of approximately 23 square miles.

The GKWTP diverts water from the Sacramento River to the plant, which has a permitted capacity of 40 million gallons per day (mgd) November through March and 58 mgd April
through October\(^1\). The GKWTP uses a treatment process consisting of chemical coagulation, Actiflo® high rate clarification, dual media filtration with granular activated carbon (GAC) and sand, and chlorine disinfection. Treated water is pumped to customers and remote reservoirs via the distribution system. The GKWTP allowed the City to convert from reliance on groundwater to surface water from the Sacramento River. The City has made major investments in water supply and treatment, the most significant being the construction of the GKWTP in 1987-1988 (previously known as the Bryte Bend Water Treatment Plant), and its subsequent expansion in 2002-2004.

4.0 APPROACH

The approach used to assess the City’s above-ground assets at the GKWTP is described in the following sections.

4.1 Asset Management Methodology

The methodologies used to evaluate the GKWTP are based on current practices that are commonly applied within municipal water asset management programs. The goal was to identify major plant components that should be repaired or replaced over the planning period. The visual condition assessment consisted of building an asset inventory, observing the assets, evaluating condition, and estimating remaining useful life of each asset. This information will be used in conjunction with asset management techniques to assist the City in prioritizing projects across the asset groups.

The following terms explain the asset management calculations that will be used to prioritize projects within the City’s Master CIP. **Criticality** is the consequence of failure, estimated using a scoring matrix that rates consequences in the categories of health and safety, financial impact, environmental impact, and ability to restore the asset to service. To assist the City in prioritizing projects across varied asset groups, the methodologies used within this analysis are consistent with those used to evaluate assets within the City’s distribution system. **Vulnerability** is the likelihood of failure, estimated as the inverse of the number of years of service life remaining. The number of years of service life remaining is estimated based on the asset’s original useful life, or designed service life, adjusted for current condition and/or age. The condition assessment portion of this report describes the considerations that were used to estimate asset vulnerability. **Risk** is the basic metric used for prioritization, and this is defined as the product of vulnerability and criticality.

4.2 Asset Inventory

An asset inventory was developed primarily from GKWTP as-built drawings, as well as an export from the City’s maintenance management system. Major individual assets were evaluated alone, while minor assets were grouped together to comprise the asset inventory.

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\(^1\) 2010 Urban Water Management Plan, page 4-1
and class hierarchy. An “asset” was generally defined as a complete physical component of a facility that enables service to be provided, is critical to plant operation, and/or has a value greater than $10,000. The term “above-ground asset” refers to any structure, equipment, or site work owned and operated by the City, while “below-ground asset” refers to pipes and appurtenances. Below-ground assets within the plant site were more specifically referred to as “process piping,” indicating pipes that carry flow from one unit process to the next.

The GKWTP assets are organized into a database by unit process. The database is configured to provide a complete summary of the above-ground asset inventory, including condition, useful life and risk data, as well as replacement cost estimates. The asset management database was then used to develop prioritized rehabilitation and replacement (R&R) projects and to evaluate the short- and long-term renewal forecast for the City’s GKWTP assets.

4.3 Condition Scoring System

The condition of each asset was evaluated on a one-through-five ranking scale, based on the International Infrastructure Management Manual (IIMM). In the IIMM, condition is expressed in terms of the amount of repair needed to bring an asset to “like new” condition. The definitions for the one-through-five condition ranking system from the IIMM are presented in Table 1. The assessments were visual assessments only and did not include diagnostic testing or entry into confined spaces. The assessment included inquiries into maintenance and performance history as well as design criteria, installation date, and typical condition parameters that could be used to standardize the procedure for future assessments.

<table>
<thead>
<tr>
<th>Score(1)</th>
<th>Description(1)</th>
<th>Required Repair Percentage(1)(2)</th>
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<tbody>
<tr>
<td>1</td>
<td>Excellent</td>
<td>0%</td>
</tr>
<tr>
<td>2</td>
<td>Good</td>
<td>1-10%</td>
</tr>
<tr>
<td>3</td>
<td>Fair</td>
<td>11-20%</td>
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<tr>
<td>5</td>
<td>Very Poor</td>
<td>&gt;50%</td>
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Notes:
(1) Adapted from the International Infrastructure Management Manual.
(2) Percentage of asset requiring repair: The percentage of the asset value needed to return the asset to a condition ranking of one.
5.0 VISUAL CONDITION ASSESSMENT

On January 29, 2015 a site visit was conducted at the City of West Sacramento, George Kristoff Water Treatment Plant to perform a visual condition assessment on the plant equipment. City staff attending included Dereck Goodwin, Brian Frank, and Bob Kahrs of the City of West Sacramento. Carollo Engineers (Carollo) staff attending included Alexander Bugbee (Assessment Coordinator), Mike Dadik (Structural), Daniel Robinson (Electrical/Instrumentation and Controls), and Richard Gutierrez (Mechanical/Process). The condition of each asset was evaluated on a one-through-five scale based on the IIMM.

The key observations made during the condition assessment performed by Carollo are summarized in the following sections. Additional details, including installation year and condition rankings for each asset, are provided in Appendix A.

5.1 Intake Pumping Station, Intake Valve Vault, Raw Water Electrical Building, and Standby Generator

Overall Mechanical Condition Rating = 3
Overall Structural Condition Rating = 2
Overall Electrical Condition Rating = 2

Adequate Redundancy – Yes
Adequate Capacity – Current, Yes; Build out, No

This facility was constructed with the original plant and put into service in 1987. The major equipment at this facility consist of five vertical turbine pumps in a wet well, fish screens, intake knife gates, wet-well isolation knife gates, electrical building, standby generator, and air scour system for the fish screens which consists of compressors, air tanks, and associated piping. Four of the pumps were replaced in the 2004 Expansion. Only pump PMP-RW-020 is original. PMP-RW-020 and 050 have variable frequency drives (VFDs) and are used most frequently. The two constant speed pumps are used less often, during higher demand conditions. The facility is in good condition overall with some minor operational issues from ancillary equipment. Pump repairs have consisted of motor rewinding. No work on the impellers has been performed. It was not possible to inspect the interior of the wet well or the fish screen as they were submerged. The exterior concrete appeared in good condition with only minor deterioration.

Coatings were in fair shape with some peeling. Recoating of all mechanical equipment including pumps, piping, valves, and gate operators will be necessary within 5 years. Air piping has more corrosion and appears to have gone more time without recoating, likely due to accessibility issues.
Plant staff noted a lack of security as an issue at this pump station. There are security cameras but no intrusion alarms. The fencing is easy to bypass. Break-ins have occurred at this facility.

### 5.1.1 Mechanical

Specific asset information and condition are listed below.

- **Five Raw Water Intake Pumps, Vertical Turbine, Condition = 2**
  - PMP-RW-020 – 125 horsepower (hp), 890 revolutions per minute (rpm), rated for 6,940 gallons per minute (gpm) at 50 feet total dynamic head (TDH), on VFD (1987).

- **30-inch Isolation valves between intake cells and piping, Condition = 4**
  - Five 30-inch diameter intake knife gate valves, replaced in 2004, tag numbers VLV-RW-011, 021, 031, 051, 061.
  - Two 30-inch diameter knife gate valves for isolating intake wet wells, original 1987, tag numbers VLV-RW-001, 002.
  - Three of the seven valve operators are not operational. One is broken in the closed position which creates operational issues for the pumping station since it makes some pumps inoperable under low river conditions.
  - Valve operators that are operational are difficult to operate due to configuration with 2-inch operating nuts located below grating.

- **Raw Water Intake Manifold/Valve Vault, Condition = 2**
  - Includes 24-inch diameter swing check, butterfly isolation valves, and air/vacuum valves. All valves were replaced in 2004 and are in good condition.

- **Five Fish Screens, Condition = 2,**
  - These were replaced in 2004, no visual assessment could be made, submerged, but City staff did not note any issues with the screens.

- **Fish Screen Air System, Condition = 4**
  - Three air tanks – Appear to be from original 1987 construction. They are in good condition. Some leaks in the air piping were noted.
  - Two Air Compressors (located in Filter Gallery), CMP-AC-010, 020 (installed in late 1990s), 25 hp, 125 pounds per square inch (psi). There are issues with compressors. They require frequent maintenance: over $1,000 per year spent in maintenance per compressor, and parts are difficult to find.
– Leaking and corroded air piping was observed.
– Fish screen air piping around pump station has failed and is in need of replacement. Lines freeze in the winter when they are most frequently used making the system inoperable.
– Air actuated valves are not accessible and therefore very difficult to service.

• Standby Generator Fuel Storage Tank, Condition = 4
  – Tank is large and rarely used. Fuel in tank is likely very old as there is no fuel maintenance system. If generator was needed for a longer duration, old fuel could cause issues. Recommend replacement in the near future. Hire fuel cleaning company to test and renew fuel.

• Raw Water Electrical Building Standby Generator, Condition = 3
  – Generator is Tier 0, and was installed as part of original plant (1987). Generator is rarely used but is the only way to run the Intake Pumping Station during a power outage. Yolo County Air Quality Inspector recommended taking this generator out of service due to its age, however, the generator has not had any operational issues other than it smokes heavily. Almost failed opacity testing due to amount of smoke. Replacement may be required if future opacity test does not meet requirements.
  – Emergency generator coating had approximately 17-percent failure at welds, wedges, as well as failed at vibration isolators.

5.1.2 Structural

• Intake Pumping Station Structure condition = 2
  – Concrete condition = 2
  – Galvanized steel grating condition = 2
  – Coating condition = 3

• During the site visit there was evidence of corrosion initiating on the guard rail, grating at loading, kick plates, and misc. connectors. There was approximately 20-percent isolated coating failure.

• Concrete bars, beams, and grating are all made of galvanized pipe. The pipe, conduit, and pumps were coated and in good condition.

• Intake Valve Vault exterior is in good condition as it was replaced in 2004. Interior was not assessed.

• Raw Water Electrical Building: Roofing was replaced 8 years ago after railroad track accident damaged mounted A/C. There was evidence of paint peeling and minor coating failure at air piping.
5.1.3 **Electrical**

Overall, the Raw Water Electrical Building facility is in good condition with the following exceptions:

- Harmonic conditioner MCC-ACT-1, Condition = 5, requires replacement and was not functional during the site visit.

- Both Actiflo® Radio Telemetry Units (RTUs), Condition = 4, have not been serviced in years and are experiencing occasional processing failures. The panel is a remote input/output (I/O) panel that communicates via radio, a full radio replacement is recommended.

- Pump VFDs, Condition = 4, The City has experienced a high failure rate with the VFDs and the associated cooling fans. An age-based replacement is recommended with an electrical assessment.

5.1.4 **Recommendations**

Near term:

- Restore 30-inch valves to operational. Evaluate cost of repair vs. replacement.
- Extend 30-inch isolation valve stems so that they may be operated below the grate.
- Replace fish screen air system. Provide adequate piping insulation to avoid line freezing.
- Replace harmonic conditioner MCC-ACT-1.
- Replace Actiflo® radio system.
- Reccoat mechanical equipment within 5 years.

Within planning horizon:

- Business case to evaluate alternatives to correct the issues with the compressor.
- Schedule regular maintenance of Actiflo® RTUs.
- Schedule electrical assessments and replacement of Intake Pump VFDs.
- Business case to evaluate alternatives to address standby generator and fuel storage tank issues.
5.2 Raw Water Manifold and Reclaimed Water Pump Station

Overall Mechanical Condition Rating = 2
Overall Structural Condition Rating = N/A
Overall Electrical Condition Rating = N/A

Adequate Redundancy – Yes
Adequate Capacity – Current, Yes; Build out, No

Portions of this facility were constructed with the original plant and put into service in 1987. The Recycled Water Pump Station and modifications to the manifold were made as part of the 2004 Expansion Project.

Coatings were in good shape with some chalking and peeling. Recoating of mechanical equipment will be necessary within 5 years.

5.2.1 Mechanical

• Four Reclaimed Water Pumps, Vertical Turbine, manufacturer is SIMFLO.
  – PMP-RC-010, 020, 030, 040 – 15 hp, 880 rpm, 1,400 gpm, 26 feet TDH.
  – Each pump discharge has a 10-inch silent check valve and a 10-inch butterfly valve.
  – Each pump has a 12-inch butterfly valves on the buried inlet pipe.

• Recycled Water Pump Station Discharge Flowmeter, FSE-RC-101 – 18-inch Magnetic Flowmeter – Krogne

• Raw Water Manifold condition = 2
  – The manifold pipe has various motorized valves with electric motor operators (Auma) and a few manual valves.
  – Pipe coating is faded but in decent condition.
  – Seal of new raw water pipe at retaining wall beginning to crack.

5.2.2 Structural

No structural assets assessed at this location.

5.2.3 Electrical

No electrical assets assessed at this location.
5.2.4 **R&R Recommendations**

Near term:

- Recoat mechanical equipment within 5 years.

Within planning horizon:

- Preventative maintenance as prescribed by the manufacturer and operation and maintenance (O&M) manuals for the pumps and valves.

5.3 **Actiflo® Mixing Vaults Nos. 1 and 2, and Actiflo® Basins Nos. 1 and 2**

Overall Mechanical Condition Rating = 2-3  
Overall Structural Condition Rating = 1  
Overall Electrical Condition Rating = 2  

Adequate Reliability/Redundancy – No  
Adequate Capacity – Current, Yes; Build out, No

All elements associated with the Actiflo® process were installed as part of the 2004 Expansion Project.

5.3.1 **Mechanical**

- **Mixing Vault Nos. 1 and 2, Condition = 2**
  - Two 30-inch diameter Krohne Magnetic Flowmeters, FSE-AC-101, 201.
  - Two 30-inch diameter motor actuated butterfly valves (Pratt Valves, Auma Actuators), VLV-AC-102, 202. Auma actuators have been good but are used frequently and need to be reliable. Should start replacing over the next 10 years.

- **Actiflo® Tanks, Condition = 2**
  - Two Coagulation Tank Mixers (Philadelphia), 15 hp, 1,775 rpm, MXR-AC-120, 220. Gear boxes on the mixers require more frequent oil sampling. The City has started an annual oil sampling program. The spider inside the mixer couplers requires replacing every couple of years. The City has shelf spares for the smaller 15 and 25 hp mixer motors.
  - Two Injection Tank Mixers (Philadelphia), 15 hp, 1,775 rpm, MXR-AC-130, 230.
  - Two Maturation Tank Mixers with VFDs (Philadelphia), 25 hp, 1,775 rpm, MXR-AC-140, 240.
– Two Settling Tank Sludge Collector Mechanism with VFDs, 3 hp, 0.17-0.07 rpm, SSC-AC-110, 210. No spare motors on-hand. Some concern about reliability and time to get replacement parts if equipment fails. The gears on collector SSC-AC-110 are making noise, maintenance required.
– Tube settlers are made of polyethylene. Appear to be in good condition, however, City is concerned with material becoming brittle from exposure to sunlight. According to the manufacturer, the expected life is 15 years. The existing tube settlers were installed in 2004 and therefore will likely need to be replaced within 5 years.

• Sand/Sludge Collection, Condition = 3
  – Four Sand Pumps, 20 hp, 400 gpm, 70 feet TDH Flowserve centrifugal pump, PMP-AC-110, 120, 210, 220.
  – Four Hydrocyclones, HDC-AC-110, 120, 210, 220. Hydrocyclones require replacement tips at least twice a year, sometimes more frequent. Has become part of routine maintenance.
  – Sand Pumps – Pumps require frequent maintenance, one of the most maintenance intensive pieces of equipment at the plant. Maintenance staff estimates approximately $3,500 a year per pump spent on maintenance. Pump seals are no longer manufactured, expensive to replace (~$6,000 per seal). Glass lined discharge piping also requires frequent replacement due to wear from sand, approximately every 5 to 6 years.
  – Flowmeters, 8-inch diameter.

• Analyzers, Condition = 2
  – Turbidity, ASE-AC-001 (recently replaced).
  – pH/Temperature Probe, ASE-AC-002.
  – Fluoride Analyzer, Wallace and Tiernan is in good condition, Hach needs replacing.
  – Effluent Cl2 analyzer, scheduled for replacement with Hach model in July.

• Elevator from Sand Storage Room (installed in 2004), Condition =1, City has as service contract for this equipment and it has been maintained in good condition.

5.3.2 Structural

• Actiflo® Filter Overflow Channel, Condition = 1
• Actiflo® electrical building, Condition = 1
  – CMU building with standard metal roof.
• Clarification Sedimentation Basins, Condition = 2
  – Galvanized steel guard rail and pipe supports some rust welds and bolts, Condition = 2
  – Aluminum stairs, Condition = 1
  – Concrete tank walls, Condition = 2
    o Losing cement paste below water surface although only partially visible. Tank requires annual pressure wash to remove algae which could be contributing the erosion of concrete wall.
    o Exterior east and west sides of tanks have efflorescence and leaching at cracks (minor).
    o Minor leaks and efflorescence at north wall and ceiling in pipe gallery.
  – Coating of mixers, Condition = 4, beginning to fail.
  – Stainless steel (SST) troughs, Condition = 2, have minor corrosion near weirs possibly due to chemical addition.
  – Pipe coating, Condition = 4, considerable chalking of coatings apparent.
  – Instrumentation room, Condition = 2, efflorescence located at minor cracks in ceiling and south process wall.
  – Sand storage room, Condition = 3, drainage at ceiling door is an issue, sand bagged to stop runoff at door.

• Sand Pump Room (mechanical room)
  – Efflorescence from leaks in North wall.
  – Ceiling to south wall joint leaks significantly between filters 3 and 4.

• Large Storage Building condition = 1 (2007)

• Chemical trench vault condition = 2 (2002)
  – Joints between precast sections at bottom of the chemical trench require sealing.

5.3.3 Electrical

• Primary Industrial Electric Manufacturing (IEM) switchgear has portions installed in 1988. An assessment and maintenance plan is recommended for this switchgear as well as a crash barrier for protection.

• Emergency Standby Generator (installed in 2004), runs process and control room, Condition = 1.
5.3.4 **R&R Recommendations**

**Near term:**

- Schedule replacement of the spider inside the mixer couplers for the Coagulation Tank Mixers.
- Maintenance is required for the gears on collector SSC-AC-110.
- Evaluate replacement options for sand pumps.
- Evaluate replacement options for sludge collector mechanisms or purchase shelf spare for reliability.
- Schedule replacement of glass lined discharge piping for sand pumps.
- Develop an assessment and maintenance plan for the Primary IEM switchgear.
- Install a crash barrier for protection of the switchgear.
- Replace tube settlers in Actiflo® basin.

**Within planning horizon:**

- Schedule replacements of Auma actuators.
- Piping and coating rehabilitation for the Clarification Sedimentation Basins.

5.4 **Process Drain Pump Station**

**Overall Mechanical Condition Rating = 2**
**Overall Structural Condition Rating = 2**
**Overall Electrical Condition Rating = N/A**

Adequate Reliability/Redundancy – Yes
Adequate Capacity – Yes

5.4.1 **Mechanical**

- Two Submersible Pumps, PMP-PD-010, 020 (installed in 2004). These pumps were in good condition with regular wear, Condition = 2.
- Associated pump discharge check and isolation valves in the adjacent vault are in good condition, Condition = 2.
5.4.2 **Structural**

The wet well and valve vault are precast concrete buried structures and appear to be in good condition.

5.4.3 **Electrical**

No electrical assets were assessed at this location.

5.4.4 **R&R Recommendations**

No recommendations at this time.

5.5 **Operations Room**

Overall Mechanical Condition Ranking = N/A
Overall Structural Condition Rating = 2
Overall Electrical Condition Rating = N/A

5.5.1 **Mechanical**

No mechanical assets were assessed at this location.

5.5.2 **Structural**

Structural was found to be in good to fair condition at this location. Galvanized steel supports may require attention in the future due to age.

5.5.3 **Electrical**

No electrical assets were assessed at this location.

5.5.4 **R&R Recommendations**

Near term: none at this time.

Within planning horizon: Monitor condition of galvanized steel supports.

5.6 **Recycled Water Basin Nos. 1 and 2**

Overall Mechanical Condition Rating = 5
Overall Structural Condition Rating = 3
Overall Electrical Condition Rating = N/A

Adequate Reliability/Redundancy – No, Basin 2 is out of service, leaving no redundancy. Also, probability of failure of sludge collectors is high. Only backup is to manually remove sludge.

Adequate Capacity – Yes
5.6.1 **Mechanical**

- Gates with Limitorque Actuators, Condition = 3. Recycle Basin Gates have had some issues with seals, gates are seizing and actuators over-torquing. Seal replacement required soon.

- Four Sludge Collectors, chain and flight type (installed ~1990), Condition = 5, Sludge collector mechanism chains and flights are brittle and significantly deteriorated. Rail system is rusting and could fail structurally. Drives and sprockets are in slightly better condition. Guides are in poor condition. System runs every other night for 3 hours. If system fails, will have to remove sludge manually.

- Cross Collectors, screw type, 2 hp (installed ~1990), Condition = 3. Condition of cross collectors and motors is good considering the age of the equipment.

- Sludge Disposal Pumps, (2 installed in 2014, 1 out of service), PMP-SD-010, 020, 030, Condition = 3. Three pumps total, but one is currently out of service and needs to be replaced. Currently only need to have one operational. Get about 6 years of life out of pump volute, currently on a 3-year replacement cycle per pump. Pumps wear out quickly due to sand. Two pumps were replaced last year.

- Decanters (installed in 2004, hoses replaced ~2013), Condition = 2. No operational issues. Hoses were replaced within last 2 years. May need to be replaced in about 10 years.

5.6.2 **Structural**


- Basin No. 2 is out of service due to poor condition, leaving no redundancy.

- Redwood baffles are in poor condition due to age, Condition = 5.

- Corrosion on galvanized steel davit crane between basins 1 and 2.

- Iron contamination on SST collector drive covers.

- Galvanized steel guardrail contains isolated corrosion at joints and welds.

- During test for concrete softness, more than a half inch could be removed with chipping tool.

5.6.3 **Electrical**

No electrical assets were assessed at this location.
5.6.4 R&R Recommendations

Near term:

- Replace seals for the Recycle Basin Gates.
- Replace the Sludge collector mechanism and guides.
- Replace rail system.
- Replace out of service sludge disposal pump.
- Conduct comprehensive structural evaluation of basins and evaluate repair or replacement options.

Within planning horizon:

- Replacement of decanter hoses.
- Structural rehabilitation or replacement of basins.

5.7 Filters and Filter Gallery

Overall Mechanical Condition Rating = 2
Overall Structural Condition Rating = 2
Overall Electrical Condition Rating = N/A

Adequate Reliability/Redundancy – Yes

Adequate Capacity – Current, Yes; Build out, No

5.7.1 Mechanical

- Filter Influent Valves, Condition = 3 – 48 total large valves (>36 inches) with motor actuators. There was evidence of some sun damage on actuators and flexible conduit to motors. Have had some issues with oil separating and leaking from actuator motors.
- Backwash pump flowmeter, 30-inch diameter, FSE-BW-001, Condition = 2.
- Air Scour Blower, 125 hp, 2,450 standard cubic feet per minute (scfm), Hibon Multistage Blower installed outdoors, BLW-FI-001, Condition = 2.
  - Blower seems to be oversized for the application. There is no pressure regulator or pressure gauge on the discharge so it is difficult for operators to control the pressure from the blower. Operators noted that it may make sense to repurpose this blower to another location and install a new appropriately sized blower for air scour.
• Two Backwash Waste Pumps, Vertical Turbine, 75 hp, 12,250 gpm, 14.3 feet TDH, (Manufacturer: SIMFLO), PMP-WB-010, 020, Condition = 2.

• The GAC media has experienced significant degradation and is being replaced two filters at a time.

5.7.2 Structural

• Filter Bed Structure, Condition = 2 (constructed in 1987)
  – Concrete softening below the normal water surface, due to annual power washing of walls.
  – Galvanized steel guardrail and grating in good condition.
  – Leaks from cracks at form ties.

• Filters Control Building = 1 (constructed in 2003)

• Filter Pipe Gallery = 2 (constructed in 2003)
  – Leaks in North wall, dry side.
  – Electrical room at filter gallery, leaks behind circuit breaker.

5.7.3 Electrical

• Harmonic Oscillators - The harmonic oscillators were not functional at this location, and replacement is recommended.

• RTU-3 and 4 have not been serviced in a few years and age-based replacement is recommended. All other equipment in good condition.

5.7.4 R&R Recommendations

Near term:

• Start a replacement schedule for all valve motor actuators.

• Address structural leaks.

• Service the RTUs.

• Continue GAC replacement program.

Within planning horizon:

• Replace RTUs.

• Replace air scour blower due to operational reliability issues.
5.8 Chemical Storage and Dosing Facilities

Overall Mechanical Condition Rating = 2
Overall Structural Condition Rating = 2
Overall Electrical Condition Rating = N/A

Adequate Reliability/Redundancy – Yes
Adequate Capacity – Yes

5.8.1 Mechanical

• Chemical Metering Pumps, Watson Marlow. Caustic pump is missing and needs replacement. Plant has shelf spares for Milton Roy metering pumps. Metering pumps are easy to get and replace when they break down. No major issues in this area except for run indication not showing up in supervisory control and data acquisition (SCADA) for Watson Marlow pumps.

• Alum Storage Tank, fiber reinforced plastic (FRP), 8,000 gallons (installed ~1987). Issues with minor leaking of FRP tanks, Condition = 3.

• Polyaluminum chloride (PACL) Storage Tank, FRP, 8,000 gallons (installed ~2004), Condition = 2.

• PACL Storage Tank, FRP, 3,000 gallons (installed ~1987), Condition = 3.

• Two Fluoride Bulk Tanks, (installed ~2009). These tanks are essentially new, Condition 1.

• Containment Area Sump Pump, 5 hp, Condition = 3.

• Dry Polymer Batching and Mixing Equipment, Condition = 2.

• Polymer Feed Pumps, Condition = 2.

5.8.2 Structural

• Insulation cracking.

• Sump is not coated and contains rusted galvanized steel.

• Vinyl ester coating is good.

5.8.3 Electrical

No electrical assets were assessed at this location.
5.8.4 R&R Recommendations

Near term:

- Replace caustic pump.
- Address leaking alum storage tank.

Within planning horizon: no additional recommendations at this time.

5.9 Low Lift Pump Station

Overall Mechanical Condition Rating = 3
Overall Structural Condition Rating = 2
Overall Electrical Condition Rating = N/A

Adequate Reliability/Redundancy – Yes
Adequate Capacity – Current, Yes; Build out, No

5.9.1 Mechanical

- Four Vertical Turbine Pumps, Simflo, 100 hp, 10,625 gpm, 23.2 feet TDH, 1,200 rpm, PMP-LL-010, 020, 030, 040, Condition = 3. Pump seals are blown and leak heavily. Pump columns require recoating. There is space for one future pump.

5.9.2 Structural

- Low lift pump station building condition = 2
  - Exteriors good, no leaks on the walls. Interior was observed from the west hatch.
  - The stainless steel ladder is corroded.

5.9.3 Electrical

No electrical assets were assessed at this location.

5.9.4 R&R Recommendations

Near term: Replace vertical turbine pump seals and recoat pump columns.

Within planning horizon: Replace corroded stainless steel ladder.

5.10 Laboratory/Mechanical Building and Chlorine Room

Overall Mechanical Condition Rating = 2
Overall Structural Condition Rating = 2
Overall Electrical Condition Rating = 3
Adequate Reliability/Redundancy – Yes

Adequate Capacity – Yes

5.10.1 Mechanical

No large mechanical equipment at this location, only laboratory equipment.

5.10.1 Structural

Lab Mechanical Building Condition = 2 (1987)

- Asphalt shingle roof needs replacement: The City’s previous CIP planned the roof replacement at $50,000. Has not yet been implemented.

5.10.2 Electrical

- SWBD/MCC-M has been abandoned, but is still in fair condition.
- Radio replacement was requested in relation to the RTU-7 at this location.

5.10.3 R&R Recommendations

Near term:

- Replace RTU-7.
- Replace roof of Lab Mechanical Building.

Within planning horizon: no additional recommendations at this time.

5.11 High Service Pump Station and Hydropneumatic Surge Tank

Overall Mechanical Condition Rating = 2
Overall Structural Condition Rating = 2
Overall Electrical Condition Rating = 3

Adequate Reliability/Redundancy – Yes

Adequate Capacity – Current, Yes; Build out, No

5.11.1 Mechanical

- Eleven Pumps total at this location. Pumps on VFDs get more runtime, but are on a rotation cycle.
– PMP-HP-050 recently had the motor rewound.
– PMP-HP-080 motor was fixed within the last 10 years.
– PMP-HP-040 (not included among the five pumps) was removed because of a cracked can.
– One check valve is leaking slightly.
– Six High Service Pumps (2004), SIMFLO Vertical Turbine Pumps, 200 hp, 3,500 gpm, 170 feet TDH, PMP-HP-010, 020, 090, 100, 110, 120 (Pumps 010, 020, 090 on VFDs)

• Maintenance would like to start a pump refurbishment program on the High Service Pumps to improve reliability. Reduced voltage starters need to be upgraded to soft starters. VFDs may require replacement. Air relief valves need to be on a replacement/maintenance program.

• The hydropneumatic tank, Condition = 2. Tank will need to be recoated in near future.

• The plant finished water flow meter does not function. True plant production cannot be measured and is currently estimated from pump curves for pumps that are operational.

5.11.2 Structural

• High service electrical building was observed to be in excellent condition. The building is uncoated cement mortar construction. The architectural paint on the doors and wood trim requires a coating trim up.

5.11.3 Electrical

• Radios associated with RTU need replacement due to obsolescence, Condition = 4.

• Switchboard - B/ATS and MCC-HS were observed to be in fair condition, Condition = 3. Minor rusting and paint scratches were present and door hinges are stiff. The City would like to have a condition assessment done on the switchboard and motor control center (MCC).

• High Service Pump Station Standby Generator, installed in 2004, feeds half of High Service Pump Station and Laboratory, Condition = 2.
  – Backwash Pump Station Standby Generator, installed in 2008, feeds other half of High Service Pump Station and Backwash Pump Station, Condition = 2.
  – All other electrical equipment at this location was found to be in good condition.
5.11.4 **R&R Recommendations**

Near term:

- Replace pump PMP-HP-040.
- Develop a pump refurbishment program for the High Service Pumps.
- Evaluate replacement/upgrade options for the reduced voltage starters and VFDs.
- Develop both maintenance and replacement programs for the air relief valves.
- Replace RTU radios.
- Schedule condition assessment of the switchboard and MCC.
- Recoat hydropneumatic tank and electrical building trim.
- Install finished water flowmeter that functions.

Within planning horizon:

- Implement maintenance and asset renewal programs described above.

5.12 **Backwash Pump Station**

Overall Mechanical Condition Rating = 2  
Overall Structural Condition Rating = N/A  
Overall Electrical Condition Rating = N/A  

Adequate Reliability/Redundancy – Yes  
Adequate Capacity – Yes

No electrical or structural was assessed at this location.

5.12.1 **Mechanical**

- Two Simflo Vertical Turbine Pumps, 100 hp, PMP-BW-010, 020.
- Two 24-inch diameter silent check valves and two 24-inch diameter discharge butterfly valves.

5.12.2 **Structural**

No structural assets were assessed at this location. Pump Station is slab-on-grade construction.

5.12.3 **Electrical**

No electrical assets were assessed at this location.
5.12.4 R&R Recommendations
No recommendations at this time.

5.13 Clearwells and Underdrain Pump Station

Clearwells:
Overall Mechanical Condition Rating = 2
Overall Structural Condition Rating = 2
Overall Electrical Condition Rating = 2

Underdrain Pump Station:
Overall Mechanical Condition Rating = 4
Overall Structural Condition Rating = 2
Overall Electrical Condition Rating = 2

Adequate Reliability/Redundancy – Yes
Adequate Capacity – Yes

5.13.1 Mechanical
  - Underdrain Pump Station pumps need replacement due to corrosion from caustic leak. Currently, staff cannot lift pumps out of wet well due to corrosion of pump lifting chains.
- Air actuated inlet valves, 60-inch diameter, Condition = 2.
- Clearwell 2 has a torn Hypalon baffle that requires repair, Condition = 4.

5.13.2 Structural
- Caustic Storage Area Building was found to be in good condition. There was evidence of top coat failing. Minor corrosion was present at the base of the tank ladder.
- Clearwell 1 and 2 were found to be in good condition. Condensation from the cover has also stained the wall exterior. The clearwells are inspected by divers every three years.
- The drain water valve vault was found to be in good condition.

5.13.3 Electrical
- Trihalomethane (THM) Analyzer desired for process optimization.
- Remote I/O Panel at this location in good condition. No issues present.
- Level sensor in wet well does not transmit signal to SCADA.
5.13.4 R&R Recommendations

Near term:

- Replace underdrain pump station pumps.
- Replace corroded pump lifting chains.
- Repair or replace torn Hypalon baffle at the clearwell.
- Restore or replace, as appropriate, level sensor in wet well so that it transmits signal to SCADA.

Within planning horizon: no additional recommendations at this time.

6.0 SUMMARY

Each asset in the inventory was assessed during the inspection and given a condition score based on a 1 to 5 scale. The results are shown in Table 2. The table shows the number of assets that received each condition score in each process area.

<table>
<thead>
<tr>
<th>Process Area</th>
<th>Condition Score(1)</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Intake Facilities and Pump Station</td>
<td>3</td>
</tr>
<tr>
<td>Raw Water Manifold and Reclaimed Water Pumping</td>
<td>-</td>
</tr>
<tr>
<td>Actiflo® Clarification No. 1 and 2</td>
<td>4</td>
</tr>
<tr>
<td>Recycled Water Basins No. 1 and No. 2</td>
<td>-</td>
</tr>
<tr>
<td>Filtration</td>
<td>1</td>
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<tr>
<td>Process Drain Pump Station</td>
<td>-</td>
</tr>
<tr>
<td>Residuals Handling</td>
<td>-</td>
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<tr>
<td>Operations Building</td>
<td>2</td>
</tr>
<tr>
<td>Chemical Feed and Storage</td>
<td>1</td>
</tr>
<tr>
<td>Low Lift Pump Station</td>
<td>1</td>
</tr>
<tr>
<td>Lab Mechanical Building</td>
<td>-</td>
</tr>
<tr>
<td>Clearwell Storage</td>
<td>2</td>
</tr>
<tr>
<td>High Service Pumps</td>
<td>2</td>
</tr>
<tr>
<td>Backwash Pump Station</td>
<td>-</td>
</tr>
<tr>
<td>Drain Water and Instrument Pump Station</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

Notes:
(1) Condition scores are based on 1 to 5 scale.
Overall, 12 assets, in 8 process areas, received a condition score of 5. These 12 assets represent nearly 6 percent of the number of assets in the inventory. The majority of assets received a condition score of 2 or 3. The near term and planning horizon recommendations for managing the water treatment plant assets include both capital expenditure needs (primarily replacements) and operation and maintenance expenditure needs (primarily repairs or scheduled maintenance). These recommendations are summarized in the Table 3 and Table 4 below.

Table 3  Near Term Recommendations (within 5 years)
GKWTP Condition Assessment
City of West Sacramento

<table>
<thead>
<tr>
<th>Operations &amp; Maintenance Needs</th>
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<tr>
<td>• Repair operators for 30-inch diameter valves at intake facility</td>
</tr>
<tr>
<td>• Recoat mechanical equipment</td>
</tr>
<tr>
<td>• Repair gears on settling tank sludge collector mechanism</td>
</tr>
<tr>
<td>• Implement maintenance plan for primary IEM switchgear</td>
</tr>
<tr>
<td>• Replace seals for the recycle basin gates</td>
</tr>
<tr>
<td>• Maintenance of filter facility RTUs</td>
</tr>
<tr>
<td>• Repair leaks at filter bed and filter pipe gallery</td>
</tr>
<tr>
<td>• Repair alum storage tank leaks</td>
</tr>
<tr>
<td>• Replace vertical turbine pump seals and recoat pump columns at the low lift pump station</td>
</tr>
<tr>
<td>• Implement maintenance program for the high service pump station air relief valves</td>
</tr>
<tr>
<td>• Condition assessment of high service pump station switchboard and MCC</td>
</tr>
<tr>
<td>• Recoat hydropneumatic tank and electrical building trim at the high service pump station</td>
</tr>
<tr>
<td>• Replace pump lifting chains at the underdrain pump station</td>
</tr>
<tr>
<td>• Repair torn Hypalon baffle at the clearwell</td>
</tr>
<tr>
<td>• Repair level sensor at the wet well for the clearwells</td>
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</table>

<table>
<thead>
<tr>
<th>Capital Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Replace fish screen air system</td>
</tr>
<tr>
<td>• Replace harmonic conditioner</td>
</tr>
<tr>
<td>• Replace Actiflo® radio system</td>
</tr>
<tr>
<td>• Replace RTU at the mechanical building</td>
</tr>
<tr>
<td>• Replace RTU radios at the high service pump station</td>
</tr>
<tr>
<td>• Replace coagulation tank mixer spider</td>
</tr>
<tr>
<td>• Replace glass lined discharge piping for sand pumps</td>
</tr>
<tr>
<td>• Install crash barrier to protect switchgear</td>
</tr>
<tr>
<td>• Replace tube settlers in Actiflo® basin</td>
</tr>
<tr>
<td>• Replace recycled water basin sludge collector mechanism</td>
</tr>
<tr>
<td>• Replace rail system at recycled water basin</td>
</tr>
<tr>
<td>• Replace sludge disposal pump at recycled water basin</td>
</tr>
<tr>
<td>• Replace valve motor actuators serving the filter facility</td>
</tr>
<tr>
<td>• Replace caustic pump</td>
</tr>
<tr>
<td>• Replace the mechanical building roof</td>
</tr>
<tr>
<td>• Replace high service pump: PMP-HP-040</td>
</tr>
</tbody>
</table>
Table 3  Near Term Recommendations (within 5 years)
GKWTP Condition Assessment
City of West Sacramento

- Implement a refurbishment program for the high service pumps
- Replace finished water flowmeter
- Replace air relief valves serving the high service pump station
- Replace underdrain pump station pumps
- Business cases for:
  - replacement of sand pumps
  - sludge collector mechanisms
  - structural evaluation of recycled water basin
  - evaluation of the reduced voltage starters and VFDs for the high service pumps

Table 4  Planning Horizon Recommendations (5+ years)
GKWTP Condition Assessment
City of West Sacramento

Operations & Maintenance Needs

- Maintenance of Actiflo® RTUs
- Electrical assessment of Intake Pump VFDs
- Preventative maintenance for all valves and pumps
- Monitor and maintain condition of galvanized steel supports
- Replace decanter hoses at recycled water basins
- Business cases for:
  - compressor at raw water intake facility
  - standby generator at raw water electrical building

Capital Needs

- Replace Auma actuators
- Plung and coating rehabilitation for clarification sedimentation basins
- Structural rehabilitation or replacement of recycled water basins
- Replace RTUs for the filter facility
- Replace filter facility air scour blower
- Replace corroded stainless steel ladder at the low lift pump station
APPENDIX I – TANK AND PUMP STATION CONDITION, SEISMIC, AND FLOOD VULNERABILITY ASSESSMENT
CITY OF WEST SACRAMENTO
WATER SYSTEM MASTER PLAN UPDATE
TECHNICAL MEMORANDUM
TANK AND PUMP STATION CONDITION, SEISMIC,
AND FLOOD VULNERABILITY ASSESSMENT
FINAL
August 2016
# CITY OF WEST SACRAMENTO
## WATER SYSTEM MASTER PLAN UPDATE
### TECHNICAL MEMORANDUM
#### TANK AND PUMP STATION CONDITION, SEISMIC, AND FLOOD VULNERABILITY ASSESSMENT

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APPENDIX B VISUAL INSPECTION SITE VISIT NOTES
Technical Memorandum

TANK AND PUMP STATION CONDITION, SEISMIC, AND FLOOD VULNERABILITY ASSESSMENT

1.0 INTRODUCTION

On September 10, 2014, site visits were conducted of all nine of the City of West Sacramento (City) water system storage reservoirs and pump stations. Attending the site visits were Dereck Goodwin and Brian Frank of the City of West Sacramento, Ricky Gutierrez, and Preet Chaggar of Carollo Engineers. The purpose of the site visits was to conduct a visual condition assessment of the facilities. The information gathered through this effort was used to evaluate the seismic vulnerability of each of the City’s pump stations and reservoirs. No non-destructive or destructive structural testing was performed as part of the assessments. Visual assessments were limited to the exterior of tanks, and in some cases interior inspections from roof access hatches.

2.0 GENERAL FINDINGS FOR RESERVOIRS

All of the City’s reservoirs outside of the treatment plant site are American Water Works Association (AWWA) D100 steel tanks. Only two of the existing tanks are anchored, Port Sacramento Industrial Park (PSIP) Reservoir and the new Bridge District Reservoir. Only the new Bridge District Reservoir is pile supported, all other reservoirs have concrete ring-wall style foundations. The City has a regular inspection program to inspect the inside of the reservoirs every 3 to 4 years. Recent inspection reports as well as the inspection schedule were provided and are included in Appendix A for reference. With the exception of the Central Storage Tank, all tanks have been coated within the last 20 years. The coating on the Central Tank is 26 years old. Site visit notes from the visual inspections are included in Appendix B.

3.0 FLOOD VULNERABILITY ASSESSMENT

West Sacramento is almost completely surrounded by water, so flood vulnerability is a constant concern. The City is protected by a series of levees that are in the process of being upgraded, with the goal of protection from a 200-year frequency weather event. Therefore all tank and pump station facilities within the City are vulnerable to flooding if weather events occur above the current levee system capacity or a levee breaks.

The most reasonable approach to addressing flood vulnerability of tank and pump station facilities is to strengthen and improve the levees protecting the City, which is already underway. Therefore there are no capital improvement program (CIP) projects recommended at these facilities to address specific flood protection concerns. Some
facilities are more susceptible to flooding or high groundwater due to their location in close proximity to a levee. These facilities have been identified in the individual sections below.

4.0 NORTHEAST RESERVOIR AND PUMP STATION

The Northeast Reservoir and Pump Station was constructed in 1988. The tank was retrofitted in 2008, including relining, coating, and weld repairs. The steel tank has a ringwall foundation and capacity of 2.097 million gallon (MG) with a 110-foot diameter and a 28.5-foot height. The typical level when full is 25.0 feet and it is drained to 10.0 feet on a daily basis.

The pumping station is outdoors on a concrete slab-on-grade and has four pumps, none of which are variable frequency drive (VFD) controlled. Two pumps are 75 horsepower (Hp) (603 & 604) and the other two pumps are 30 Hp (601 & 602).

4.1 Overall Condition and Operational Issues

Overall Condition Rating = 3 (Fair)

Asset Criticality – High, this facility is critical for delivering water to the Washington District.

The following issues were observed and/or discussed with City Staff:

- The tank is visibly tilting. This was also noticed by operations staff during draining of the tank, since the floor is no longer level and water pools on one side of the tank.
- There is no drain inlet for the overflow from this tank. If the tank overflows it will flood nearby residences. This presents a liability risk to the City.
- There are no security cameras at this site.
- Grouting under tank is spalling.
Flexibility in the overflow piping from the tank does not meet current code requirements.

Flexibility in the pump station discharging piping does not meet current code requirements.

4.2 Seismic Adequacy

The tank has experienced some differential settlement as evidenced by the tilting. The soils in this vicinity are known to be liquefiable and have relatively low bearing capacities based on recent geotechnical investigations at the nearby Bridge District tank. Most facilities of this type constructed in this area are now constructed using deep foundations. Although the tank is not in eminent danger of collapse, it could experience more severe damage if a seismic event were to occur. The tank is also unanchored, which increases the seismic vulnerability.
vulnerability of this asset due to uplift forces experienced during a seismic event. Additional analysis is warranted to determine the reliability of this tank and the associated risk.

Piping flexibility for both the tank and pump station are lacking and could fail in a seismic event. In addition, the design tank freeboard is less than potential sloshing wave height, and therefore is susceptible to more severe damage during a seismic event.

4.3 Flood Vulnerability

Facility is adjacent to Sacramento River levee.

4.4 Potential CIP Items

- FY2015 – FY2020
  - Tank Seismic Analysis
  - Drainage improvements
- FY2020 – FY2025
  - Tank Seismic retrofit or replacement
  - Security improvements

5.0 OAK ST. RESERVOIR AND PUMP STATION

The Oak Street Reservoir and Pump Station facility was constructed in 1985 and is the third oldest reservoir in the system. The storage tank has a 2.0 MG capacity with a 110-foot diameter and a 28.5-foot height. The typical level when full is 26.5 feet and is drained to 15.0 feet daily. The pump station was last coated in March 2005 and is on the current CIP for recoating.

The pumping station is outdoors on a concrete slab-on-grade and has three pumps, none of which are VFD controlled. Two pumps are 75 Hp (M1 & M2) and the third is 30 Hp (M3).

5.1 Overall Condition and Operational Issues

Overall Condition Rating = 3 Fair

Asset Criticality – Low, this tank is located closer to the water treatment plant (WTP) which has two storage clearwells. During the winter the tank functions as a surge tank and is not really used for storage.
The following issues were observed and/or discussed with City Staff:

- Tank coating is original, in poor condition, and has visible rust stains throughout.

- The ringwall foundation has several cracks and some spalling of concrete.

- There is a security camera at this site, but no closed-circuit television (CCTV). The perimeter fencing is chainlink and easy to climb. Improved security is desired by operators for this facility.
- Lack of flexibility in tank and pump station piping.
- Lack of thrust restraints and supports on pump station discharge piping.

5.2 Seismic Adequacy

The ringwall foundation has considerable cracking and spalling of concrete which could be further damaged or compromised in a seismic event. The tank is also unanchored, which increases the seismic vulnerability of this asset due to uplift forces experienced during a seismic event. The piping at both the tank and the pump station have poor flexibility and could also likely experience damage in a seismic event. The actual freeboard of the tank is less than the sloshing wave height, and therefore the tank roof is susceptible to damage in a seismic event.

5.3 Potential CIP Items

- FY2015 – FY2020
  - Tank coating/lining
  - Rehabilitation of concrete foundation
  - Security improvements

6.0 PORT SACRAMENTO INDUSTRIAL PARK RESERVOIR AND PUMP STATION

The PSIP Reservoir and Pump Station facility was constructed in 1976 and is the oldest reservoir currently in use in the system. A new roof was installed for the tank in December 2005 and the tank was relined and coated. The tank floor was also repaired at this time due to severe corrosion. The storage tank has a capacity of 1.5 MG, with a
106-foot diameter and a 24.0-foot height. The typical level when full is 20.0 feet and the tank is drained to 10.0 feet daily. This is one of the few tanks in the system that is anchored.

The pump station is enclosed in a prefabricated steel building and has three pumps, none are VFD controlled. All three pumps are 100 Hp (1509, 1510, & 1511). There is a portable generator housed at this location.

This site also includes a communications antenna that the City uses for communicating with all remote facilities. A well treatment system and diesel fire pump are also located at this site, but have been abandoned in-place and are no longer in use.

6.1 Overall Condition and Operational Issues

Overall Condition Rating = 4 (Poor) for Pump Station, 3 (Fair) for Reservoir

Asset Criticality – Medium. Higher criticality than Oak Street. However, the reservoir is located in the corner of the City and is backed-up by both Central and Oak Street Reservoirs. Per operations staff, the facility is required to be online when Inline Pump Station is operating.

The following issues were observed and/or discussed with City Staff:

- Pump station has some corrosion on exterior metal paneling.
- Pump discharge pipe supports are inadequate and would likely fail in a seismic event.
- The pump manifold has severe corrosion.
- Pump station electrical equipment including the motor control center (MCC), generator, and radio equipment generator are in need of replacement. MCC is unanchored and could collapse in a seismic event.

- Cracks visible in tank foundation concrete.

- Pump station and tank piping lack flexibility.
• The site has limited security, consisting only of intrusion switches.

6.2 Seismic Adequacy

The tank is anchored and in decent condition since it was retrofitted 10 years ago. The pump station has several issues including lack of pipe supports, limited piping flexibility, and severe corrosion of piping and appurtenances. The actual freeboard of the tank is less than the sloshing wave height, and therefore the tank roof is susceptible to damage in a seismic event. Electrical gear is also unanchored. Replacement of the pump station equipment and piping is recommended in the near future.

6.3 Flood Vulnerability

This facility is located adjacent to a levee with the Yolo causeway on the opposite side. The tank is elevated approximately 6 feet above surrounding grade at the site. The pump station is at a lower grade.

6.4 Potential CIP Items

• FY2015 – FY2020
  – Retrofit/replacement of facility recommended.
  – Replacement or additional pipe capacity needed to increase transmission capacity between this facility and the distribution system.
7.0 CENTRAL RESERVOIR AND PUMP STATION

The Central Reservoir and Pump Station facility was constructed in 1988. The tank has not be relined or coated since it was constructed, however it is in decent shape. The storage tank capacity is 2.097 MG, with a 110-foot diameter and 28.5-foot height. The typical level when full is 25.0 feet and is drained to 15.0 feet daily.

The pump station is outdoor slab-on-grade and consists of four pumps, none of which are VFD controlled. Two pumps are 75 Hp (703 & 704) and the other two pumps are 30 Hp (701 & 702).

7.1 Overall Condition and Operational Issues

Overall Condition Rating = 3 (Fair)

Asset Criticality – High, frequently used. Backup to PSIP tank.

The following issues were observed and/or discussed with City Staff:

- Some corrosion was noticeable at the base of tank and walls. Recoating recommended in near future.
Limited flexibility for pump station piping, likely to fail in seismic event. Discharge piping has leaked in the past and was repaired. All tank piping connections are below grade so were not visible for inspection.

7.2 Seismic Adequacy

The concrete ringwall foundation is in good condition. The tank being unanchored increases the seismic vulnerability of this asset due to uplift forces experienced during a seismic event. The actual freeboard of the tank is less than the sloshing wave height, and therefore the tank roof is susceptible to damage in a seismic event. Pump station piping flexibility is lacking and would likely rupture in a seismic event.

7.3 Flood Vulnerability

The tank is located near the Deep Water Channel in a low-lying area. This area is susceptible to flooding from tidal influences. The levee is also lower in this area so this facility is at higher risk of flooding.

7.4 Potential CIP Items

- FY2015 – FY2020
  - Tank recoating/lining

- FY2020-FY2025
  - Pump station piping flexibility improvements
8.0 IN-LINE BOOSTER PUMP STATION

The In-line Booster Pump Station was constructed in 2001. It consists of a masonry building housing three pumps that are all VFD controlled. All three pumps are 200 Hp (P28, P29, & P30). The pump station is run primarily for filling both the Carlin Pump Station and Bridgeway Lakes Pump Station during the summer months. There is no reservoir at this facility.

8.1 Overall Condition and Operational Issues

Overall Condition Rating = 1 (Like New)

Asset Criticality – High, required to be operational during summer months.

The following issues were observed and/or discussed with City Staff:

- No issues noted by operations staff
- Some minor shrinkage cracking visible in concrete slab.
- Some minor shear cracking visible in walls.
- Some diagonal shear cracking at wall openings.
8.2 Seismic Adequacy

The facility appears to be adequate for a seismic event.

8.3 Potential CIP Items

- None noted.

9.0 SOUTHPORT RESERVOIR AND PUMP STATION

The Southport Reservoir and Pump Station facility was constructed in 1973. The tank has a capacity of 1.046 MG and a 90-foot diameter by 22-foot height. The facility is no longer operated with the exception of one emergency well that is used for irrigation only. The second well is out of service. The operational well is rated for 1,200 gallons per minute (gpm) at 180-foot total dynamic head (TDH).

9.1 Overall Condition and Operational Issues

Overall Condition Rating = 5 (About to Fail)

Asset Criticality – Low
The following issues were observed and/or discussed with City Staff:

- Significant corrosion visible throughout facility.
- Cracking visible in concrete foundations.
- Masonry grout deterioration in pump station building.
- Significant wood deterioration at the wood diaphragm in the pump station building.

9.2 Seismic Adequacy

The facility is highly vulnerable.

9.3 Potential CIP Items

- FY2015 – FY2020
  - Recoat well pump to maintain operability, if desired.
- FY2020 - FY2025
  - Demolish and replace facility if needed for capacity.

10.0 CARLIN RESERVOIR AND PUMP STATION

The Carlin Reservoir and Pump Station facility was constructed in 2002. The storage tank has a capacity of 3.0 MG with a 130-foot diameter and a 31.5-foot height. The typical level when full is 25.0 feet and it is drained to 15.0 feet daily.

The pump station is housed in a concrete masonry (CMU) building with a flexible wood diaphragm. It consists of four pumps that are VFD controlled. Three pumps are 125 Hp (P21, P22 & P23) and the fourth pump is 75 Hp (P24). The site also includes a standby generator. Repair of cracks in the CMU walls was performed last year and the pump station walls were recoated.

10.1 Overall Condition and Operational Issues

Overall Condition Rating = 2 (Good)

Asset Criticality – High, this facility is one of the most critical in the system since it is one of only two tanks serving the south area of the City.

The following issues were observed and/or discussed with City Staff:

- Some corrosion is visible on the interior and exterior of the tank.
• Tank piping not visible since it is below grade.

• Some cracking visible in concrete at base of pumps.

• Cracking on the inside face of walls, underneath the openings at approximately the same location as the previously repaired cracks located on the outside face of the walls.

10.2 Seismic Adequacy

Tank is unanchored but in good condition overall. The lack of anchorage increases the seismic vulnerability of this asset due to uplift forces experienced during a seismic event. Pump Station piping flexibility is adequate. Damage due to sloshing wave height is not a concern.

10.3 Flood Vulnerability

This facility is more susceptible to flooding since the levee is lower in this area. The Main Drain Pump Station is the only way to get flood water out of the south area of the City.

10.4 Potential CIP Items

• FY2015 – FY2020
  – Tank recoating/lining.

11.0 BRIDGEWAY LAKES RESERVOIR AND PUMP STATION

The Bridgeway Lakes Reservoir and Pump Station is one of the newest facilities in the system, having been constructed in 2006. The storage tank has a capacity of 3.0 MG with a 150-feet diameter and a 27.0-feet height. The typical operating water level when full is 20.0 feet and it is drained to 13.0 feet daily.
The pump station is housed in a CMU building and includes three pumps that are all on VFDs. All three pumps are 150 Hp (P25, P26 & P27).

11.1 Overall Condition and Operational Issues

Overall Condition Rating = 2 (Good)

Asset Criticality – High, this facility is one of the most critical in the system since it is one of only two tanks serving the south area of the City.

The following issues were observed and/or discussed with City Staff:

- Some corrosion in chlorination room due to chlorine exposure
- Some minor cracking in CMU walls and concrete floors
11.2 Seismic Adequacy

Tank is unanchored but in good condition overall. The lack of anchorage increases the seismic vulnerability of this asset due to uplift forces experienced during a seismic event. Pump Station piping flexibility is adequate. Damage due to sloshing wave height is not a concern.

11.3 Flood Vulnerability

This facility is more susceptible to flooding since the levee is lower in this area. The Main Drain Pump Station is the only way to get flood water out of the South area of the City.

11.4 Potential CIP Items

- None noted.

12.0 BRIDGE DISTRICT RESERVOIR AND PUMP STATION

The Bridge District Reservoir and Pump Station facility was constructed in 2012 and is the newest reservoir in the system. The tank has a capacity of 3.1 MG with a 120-foot diameter and a 38.5-foot height. The typical level when full is 35.0 feet and is drained to 15.0 feet daily. The tank is anchored and has a pile supported foundation.

The pump station is housed in a CMU building and has two pumps that are VFD controlled. Both pumps are 100 Hp (P110 & P120). The pump station also has a pile supported foundation.

12.1 Overall Condition and Operational Issues

Overall Condition Rating = 1 (Like New)

Asset Criticality – Medium, currently not critical but necessary for future development in Bridge District.

The following issues were observed and/or discussed with City Staff:

- None Noted.

12.2 Seismic Adequacy

The facility is adequate for a seismic event.

12.3 Potential CIP Items

- None noted.
APPENDIX A – COPY OF WATER STORAGE TANK INSPECTION REPORTS
<table>
<thead>
<tr>
<th>Site Name, #, and Type:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess. Team:</td>
<td>Time:</td>
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<tr>
<td>Recorder:</td>
<td>Pg. of</td>
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<th>Asset Area (Process or assessment map area)</th>
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<th>3/16 west</th>
<th>3/16 tank</th>
<th>3/16 PS</th>
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<td>Tank</td>
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<td>3.5</td>
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<td>3/16 steel</td>
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<td>Outdoor/Indoor (Oil)</td>
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<td>Vendor/Manufacturer</td>
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<td>Dimensions (LXWXH) or diam.</td>
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<td>Roof condition</td>
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<td>original coating</td>
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<tr>
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<td>coating condition ~ 2 yrs</td>
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<td>Wall Thickness</td>
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<tr>
<td>Warrants higher level analysis</td>
<td>Yes, tank is leaked</td>
<td>Flexibility of pipe</td>
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<td>Size or Capacity</td>
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<tr>
<td>Construction Material</td>
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<td>Warrants higher level analysis</td>
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<tr>
<td>Issues: (eg. spalling, corrosion, paint, setting, cracks, adequate for service)</td>
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<tr>
<td>Recommendations/Notes:</td>
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<td>(Rehab/etc.)</td>
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</table>

- Cracks in foundation
- New roof & pipe replacement in 2005
- 3/16 concrete
- Severe concrete
- Security is an issue
- Concrete is a significant issue
- Removed corrosion
- Need new paint and sealant
- Need to replace

Notes critical
- Long than usual

All foundations are
- Notch wall
<table>
<thead>
<tr>
<th><strong>Facility Assessment Form - Structural</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Site Name, #, and Type:</strong></td>
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<td><strong>Assess. Team:</strong></td>
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<td><strong>Recorder:</strong></td>
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<tr>
<th><strong>Asset Area (Process or assessment map area):</strong></th>
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<td><strong>Asset Type (Tank, reservoir, building etc):</strong></td>
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<td><strong>TANK</strong></td>
<td><strong>FIRE 5X5 TANK</strong></td>
<td><strong>FIRE 5X5 TANK</strong></td>
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<td><strong>Material</strong></td>
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<td><strong>Warrants higher level analysis</strong></td>
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<td><strong>Construction Material</strong></td>
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**Issues:** (eg. spalling, corrosion, paint, setting, cracks, adequate for service)

- Concrete is cracked, not in good condition.
- Paint is not in good condition.
- Corrosion issues present.
- Cracks in concrete.
- Steel beams corroding.
- Concrete needs repair.

**Recommendations/Notes:** (Rehab/etc.)

- Concrete is cracked.
- Paint is not in good condition.
- Corrosion issues present.
- Steel beams corroding.
- Concrete needs repair.
- Paint is not in good condition.
- Corrosion issues present.

---

**Notes:**

- Concrete is cracked.
- Paint is not in good condition.
- Corrosion issues present.
- Steel beams corroding.
- Concrete needs repair.

---

**Citizens Comments:**

- Concrete is cracked.
- Paint is not in good condition.
- Corrosion issues present.
- Steel beams corroding.
- Concrete needs repair.

---

**Retrofitting Projects:**

- Concrete is cracked.
- Paint is not in good condition.
- Corrosion issues present.
- Steel beams corroding.
- Concrete needs repair.
# Facility Assessment Form - Structural

<table>
<thead>
<tr>
<th>Site Name, #, and Type:</th>
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<tbody>
<tr>
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<th>IN-LINE BOOSTER</th>
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<tr>
<td>Asset Type (Tank, reservoir, building etc)</td>
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<td>PS</td>
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<tr>
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<td>Roofing System</td>
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<td>Warrants higher level analysis</td>
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<tr>
<td>Significant corrosion</td>
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<td>Paint embossment is coated</td>
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<tr>
<td>Corrosion is diep</td>
<td>Significant cracks in pump housing</td>
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<tr>
<td>Major flaw, roofing lap, water determinants</td>
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<td>Recommendations/Notes: (Reliability)</td>
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<td>(Notes: consider adding an erosion barrier)</td>
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* Get by W if water is down then it's okay but not more
* Filling line going to PS if 1/2" x 1/2" more sure 1/2" x 1/2" is in the model.
Facility Assessment Form - Structural

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<tr>
<th>Condition (1-5, 1=new, 5 about to fail)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Original Installation Year</th>
<th>1988 has been retrofitted</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Camera Photo #</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Outdoor/Indoor (On/Off)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Vendor/ Manufacturer</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Dimensions (LxWxH) or diam.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Material</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Roofing System</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Roof condition</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Indoor Paint/ Coating Condition</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Outdoor Paint/ Coating Condition</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Wall Thickness</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Warrants higher level analysis</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Size or Capacity</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Construction Material</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Warrants higher level analysis</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Issues: (eg. spalling, corrosion, paint, settling, cracks, adequate for service)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Recommendations/Notes: (Rehabilitation etc.)</th>
</tr>
</thead>
</table>

- Piping - two flex couplings on overflow.
- Pump station discharge coupling looks inadequate in AC piping.
<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Name, #, and Type:</td>
<td>OAK St. Tank</td>
</tr>
<tr>
<td>Assess. Team:</td>
<td>Ricky Gutierrez &amp; Robert Clarkan</td>
</tr>
<tr>
<td>Recorder</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>9/10/14</td>
</tr>
<tr>
<td>Time</td>
<td>8:31</td>
</tr>
<tr>
<td>Asset Area (Process or assessment map area)</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td></td>
</tr>
<tr>
<td>Asset Type (Tank, reservoir, building etc)</td>
<td></td>
</tr>
<tr>
<td>Condition (1-5, 1=new, 5=about to fail)</td>
<td>1985</td>
</tr>
<tr>
<td>Original Installation Year</td>
<td></td>
</tr>
<tr>
<td>Camera Photo #</td>
<td>Grass at 1986 photo</td>
</tr>
<tr>
<td>Outdoor/Indoor (Oil)</td>
<td>Outdoor Pump Station</td>
</tr>
<tr>
<td>Vendor/Manufacturer</td>
<td></td>
</tr>
<tr>
<td>Dimensions (LXWXH) or diam.</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td></td>
</tr>
<tr>
<td>Roofing System</td>
<td></td>
</tr>
<tr>
<td>Roof condition</td>
<td></td>
</tr>
<tr>
<td>Indoor Paint/Coating Condition</td>
<td></td>
</tr>
<tr>
<td>Outdoor Paint/Coating Condition</td>
<td></td>
</tr>
<tr>
<td>Wall Thickness</td>
<td></td>
</tr>
<tr>
<td>Warrants higer level analysis</td>
<td></td>
</tr>
<tr>
<td>Size or Capacity</td>
<td>2 - 75 Hp + 130 Hp</td>
</tr>
<tr>
<td>Construction Material</td>
<td></td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
</tr>
<tr>
<td>Issues: (eg. spalling, corrosion, paint, settling, cracks, adequate for service)</td>
<td>Above grade tank inlet &amp; outlet w/ FCA on each. Not much sheet restraint for discharge pumps. Mat under tank falling apart. Unanchored tank.</td>
</tr>
<tr>
<td>Recommendations/Notes: (Rehab/etc.)</td>
<td>Poor security - Corrosion, rust, coating starting to fail, Not as critical, close to tank during winter. Foundation has some cracks &amp; spalling.</td>
</tr>
</tbody>
</table>
### Facility Assessment Form - Structural

**Site Name, #, and Type:** Port Sac. Industrial Plant (PSIP)  
**Date:**  
**Assess. Team:**  
**Time:**  
**Recorder:**  

<table>
<thead>
<tr>
<th>Asset Area (Process or assessment map area)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
</tr>
<tr>
<td>Asset Type (Tank, reservoir, building etc)</td>
</tr>
<tr>
<td>Condition (1-5, 1=new, 5 about to fail)</td>
</tr>
</tbody>
</table>
| Original Installation Year                 | 1970  
| Camera Photo #                             |  
| Outdoor/Indoor (Oil)                       | Indoor P.S.  
| Vendor/ Manufacturer                       |  
| Dimensions (LxWxH) or diam.               |  
| Material                                   | Metal Bldg. Some corrosion on exterior of P.S. Paneling  
| Roofing System                             |  
| Roof condition                             |  
| Indoor Paint/ Coating Condition            |  
| Outdoor Paint/ Coating Condition           |  
| Wall Thickness                              |  
| Warrants higher level analysis             |  
| Size or Capacity                           | 1350 gpm - 100 HP - 3 pumps  
| Construction Material                      |  
| Warrants higher level analysis             |  
| Issues: (eg. spalling, corrosion, paint, settling, cracks, adequate for service) | Site includes automatic transmits for all facilities  
Tank is leaking - 5 - 10 years required it to be re-routed. New roof installed. Coating still in decent shape  
Some rust spots  
Some cracks in foundation concrete  
Anchor bolts not snug?  
| Recommendations/Notes: (Rehab/etc.)         | Use to be well treated. Facility now abandoned  
Use to have fire pump (diesel) no longer exists  
Portable generator on site  
Device behind it for conveyer, elevated 6 - 7' above surrounding grade  

2nd lowest priority - the Oak is the least priority of repair. If not in use, bolt it down. No security, just intrusion switch.
<table>
<thead>
<tr>
<th>Site Name, #, and Type:</th>
<th>Central Tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>9/10/14</td>
</tr>
<tr>
<td>Recorder:</td>
<td></td>
</tr>
<tr>
<td>Time:</td>
<td>9:53</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Asset Area (Process or assessment map area)</th>
<th>Near Point of W. Sac river channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td></td>
</tr>
<tr>
<td>Asset Type (Tank, reservoir, building etc)</td>
<td></td>
</tr>
<tr>
<td>Condition (1-5, 1=new, 5 about to fail)</td>
<td>1988</td>
</tr>
<tr>
<td>Original Installation Year</td>
<td>Start 1713</td>
</tr>
<tr>
<td>Camera Photo #</td>
<td></td>
</tr>
<tr>
<td>Outdoor/Indoor (Oil)</td>
<td>Outdoor 9.5</td>
</tr>
<tr>
<td></td>
<td>Same config as North East</td>
</tr>
<tr>
<td>Vendor/Manufacturer</td>
<td></td>
</tr>
<tr>
<td>Dimensions (LXWXH) or diam.</td>
<td>110' dia x 28'6'' H - 2,097 MG</td>
</tr>
<tr>
<td>Material</td>
<td>Steel tank</td>
</tr>
<tr>
<td>Roofing System</td>
<td>Knuckle, Steel</td>
</tr>
<tr>
<td>Roof condition</td>
<td></td>
</tr>
<tr>
<td>Indoor Paint/Coating Condition</td>
<td></td>
</tr>
<tr>
<td>Outdoor Paint/Coating Condition</td>
<td></td>
</tr>
<tr>
<td>Wall Thickness</td>
<td></td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
</tr>
<tr>
<td>Size or Capacity</td>
<td>2 x 2 gpm, 2.30 Hp, 20 75 Hp</td>
</tr>
<tr>
<td>Construction Material</td>
<td>Non anchored Tank</td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
</tr>
<tr>
<td>Issues: (eg. spalling, corrosion, paint, settling, cracks, adequate for service)</td>
<td>Had leak at FCA only on some rust at tank base walls.</td>
</tr>
<tr>
<td></td>
<td>discharge coupling at P5 was repaired. Pump discharge above grade at some coating failure on tank base walls.</td>
</tr>
</tbody>
</table>

Recommendations/Notes: (Rehab/Event) | Curved in foundation appears to be in good condition tank except level/sample |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Name, #, and Type:</td>
<td>9/10/14</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Assess. Team:</td>
<td>R. Garrett &amp; P. Chagger</td>
</tr>
<tr>
<td>Recorder:</td>
<td>Pg. _ of _</td>
</tr>
<tr>
<td>Asset Area (Process or assessment map area)</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>Reservoir P. S.</td>
</tr>
<tr>
<td>Asset Type (Tank, reservoir, building etc)</td>
<td></td>
</tr>
<tr>
<td>Condition (1=5, 1=new, 5 about to fail)</td>
<td>2002</td>
</tr>
<tr>
<td>Original Installation Year</td>
<td></td>
</tr>
<tr>
<td>Camera Photo #</td>
<td>Indoor P. S. - Cmap. - Cracks were repaired last year in well</td>
</tr>
<tr>
<td>Outdoor/Indoor (Oil)</td>
<td>CIST</td>
</tr>
<tr>
<td>Vendor/Manufacturer</td>
<td>3.147 Mga</td>
</tr>
<tr>
<td>Dimensions (LxWxH) or diam.</td>
<td>Steel, 1/1 Concrete foundation - non-anchored.</td>
</tr>
<tr>
<td>Material</td>
<td>Steel, Knuckle roof. Corrosion near vault.</td>
</tr>
<tr>
<td>Roofing System</td>
<td></td>
</tr>
<tr>
<td>Roof condition</td>
<td></td>
</tr>
<tr>
<td>Indoor Paint/ Coating Condition</td>
<td>New coating on Pump Station Good Condition. Some rust on frame.</td>
</tr>
<tr>
<td>Outdoor Paint/ Coating Condition</td>
<td></td>
</tr>
<tr>
<td>Wall Thickness</td>
<td></td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
</tr>
<tr>
<td>Size or Capacity</td>
<td>125 HP Split Case Pumps 4 pumps 2,800 gpm</td>
</tr>
<tr>
<td>Construction Material</td>
<td></td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
</tr>
<tr>
<td>Issues: (eg. spalling, corrosion, paint, settling, cracks, adequate for service)</td>
<td></td>
</tr>
<tr>
<td>Recommendations/Notes: (Rehab/etc.)</td>
<td>Most critical facility Bridgewater tank only backup. But need both for this side of town. Both this one and this one on WFD5. Closer to development.</td>
</tr>
<tr>
<td><strong>Facility Assessment Form - Structural</strong></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Site Name, #, and Type:</strong> Bridgeway Lake, Tank 4 PS.</td>
<td><strong>Date:</strong> 9/20/14</td>
</tr>
<tr>
<td><strong>Assess. Team:</strong></td>
<td><strong>Time:</strong> 11:22</td>
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<tr>
<td><strong>Recorder:</strong></td>
<td></td>
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<tr>
<td><strong>Asset Area (Process or assessment map area):</strong></td>
<td></td>
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<tr>
<td><strong>Process:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Asset Type (Tank, reservoir, building etc):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Condition (1-5, 1=new, 5 about to fail):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Original Installation Year:</strong> 2004</td>
<td></td>
</tr>
<tr>
<td><strong>Camera Photo #:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Outdoor/Indoor (Oil):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Vendor/Manufacturer:</strong></td>
<td>CBS Tank</td>
</tr>
<tr>
<td><strong>Dimensions (LWXH) or diam.:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Material:</strong> Cold Bldg, Steel tank, concrete foundation</td>
<td></td>
</tr>
<tr>
<td><strong>Roofing System:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Roof condition:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Indoor Paint/Coating Condition:</strong> Coating for PS good. Tank coating OK some corrosion at base.</td>
<td></td>
</tr>
<tr>
<td><strong>Outdoor Paint/Coating Condition:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Wall Thickness:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Warrants higher level analysis:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Size or Capacity:</strong> 3Mg Tank, 2400 gpm pumps on VFD’s, 3 pumps 150Hp, Sulzer</td>
<td></td>
</tr>
<tr>
<td><strong>Construction Material:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Warrants higher level analysis:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Issues: (eg. spalling, corrosion, paint, setting, cracks, adequate for service)</strong>: Some cracks in Ann wall at PS floor at pipe penetrations. Pump coatings good. No straps on pipe supports. No seismic bracing on lighting. Tank unanchored.</td>
<td></td>
</tr>
<tr>
<td><strong>Recommendations/Notes:</strong> (Rehab/eqtc.)</td>
<td></td>
</tr>
</tbody>
</table>
### Facility Assessment Form - Structural

<table>
<thead>
<tr>
<th>Site Name, #, and Type:</th>
<th>Southport</th>
<th>Date: 9/10/14</th>
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</thead>
<tbody>
<tr>
<td>Assess. Team:</td>
<td></td>
<td>Time: 11:59</td>
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<tr>
<td>Recorder:</td>
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</table>

<table>
<thead>
<tr>
<th>Asset Area (Process or assessment map area)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>2 Emergency Wells, 1 out of Service, 1 tank out of service</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Asset Type (Tank, reservoir, building etc)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition (1-5, 1=new, 5 about to fail)</td>
<td></td>
</tr>
<tr>
<td>Original Installation Year</td>
<td>1973 Tank - out of Service 1 mg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Camera Photo #</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor/Indoor (Oil)</td>
<td></td>
</tr>
<tr>
<td>Vendor/Manufacturer</td>
<td></td>
</tr>
<tr>
<td>Dimensions (LxWxH) or diam.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Roofing System</td>
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</tr>
<tr>
<td>Roof condition</td>
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</tr>
<tr>
<td>Indoor Paint/Coating Condition</td>
<td></td>
</tr>
<tr>
<td>Outdoor Paint/Coating Condition</td>
<td></td>
</tr>
<tr>
<td>Wall Thickness</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Warrants higher level analysis</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Size or Capacity</td>
<td>1200 gpm, 180' TDH</td>
</tr>
<tr>
<td>Construction Material</td>
<td></td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Issues: (eg. spelling, corrosion, paint, settling, cracks, adequate for service)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendations/Notes: (Rehab/etc.)</td>
<td>Only 2-3&quot; lines to get water from WTP to South side. That is why backup. Palmadessa new pipe &amp; Jefferson one pipe crossings some sectional main.</td>
</tr>
<tr>
<td>Asset Area (Process or assessment map area)</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>Process</td>
<td></td>
</tr>
<tr>
<td>Asset Type (Tank, reservoir, building etc)</td>
<td></td>
</tr>
<tr>
<td>Condition (1-5, 1=new, 5 about to fail)</td>
<td></td>
</tr>
<tr>
<td>Original Installation Year</td>
<td></td>
</tr>
<tr>
<td>Camera Photo #</td>
<td></td>
</tr>
<tr>
<td>Outdoor/Indoor (Off)</td>
<td></td>
</tr>
<tr>
<td>Vendor/Manufacturer</td>
<td></td>
</tr>
<tr>
<td>Dimensions (LXWXH) or diam.</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td></td>
</tr>
<tr>
<td>Roofing System</td>
<td></td>
</tr>
<tr>
<td>Roof condition</td>
<td></td>
</tr>
<tr>
<td>Indoor Paint/Coating Condition</td>
<td></td>
</tr>
<tr>
<td>Outdoor Paint/Coating Condition</td>
<td></td>
</tr>
<tr>
<td>Wall Thickness</td>
<td></td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
</tr>
<tr>
<td>Size or Capacity</td>
<td>7500 gpm 71' 3 pumps</td>
</tr>
<tr>
<td>Construction Material</td>
<td></td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
</tr>
<tr>
<td>Issues: (eg. spalling, corrosion, paint, settling, cracks, adequate for service)</td>
<td></td>
</tr>
<tr>
<td>Recommendations/Notes: (Rehab/etc.)</td>
<td></td>
</tr>
</tbody>
</table>

**Good condition - Good flexibility in piping - Good overall - Minor shrinkage - cracks -**
<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Code</th>
<th>Type</th>
<th>Status</th>
<th>Date</th>
<th>Code</th>
<th>Status</th>
<th>Date</th>
<th>Code</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>Southport</td>
<td>0.05</td>
<td>1.0</td>
<td>1.046</td>
<td></td>
<td>1.558</td>
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<td>120.0</td>
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<td>0.060</td>
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<tr>
<td>2015</td>
<td>PTSD Storage Tank</td>
<td>3.147</td>
<td>210</td>
<td>23.0</td>
<td></td>
<td>32.7</td>
<td></td>
<td>24.8</td>
<td></td>
<td>17.0</td>
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<tr>
<td>2015</td>
<td>Carlin Storage Tank</td>
<td>4.208</td>
<td>210</td>
<td>24.0</td>
<td></td>
<td>42.0</td>
<td></td>
<td>24.8</td>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td>2015</td>
<td>BBWTP West</td>
<td>4.208</td>
<td>210</td>
<td>24.0</td>
<td></td>
<td>42.0</td>
<td></td>
<td>24.8</td>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td>2015</td>
<td>East Clewell</td>
<td>20.5</td>
<td>210</td>
<td>28.5</td>
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<td>2.0</td>
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<td>0.0</td>
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<td>2.0</td>
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<tr>
<td>2015</td>
<td>Clewell</td>
<td>3.039</td>
<td>210</td>
<td>23.0</td>
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<td>32.0</td>
<td></td>
<td>22.5</td>
<td></td>
<td>3.0</td>
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<tr>
<td>2017</td>
<td>Bridge Sequoia</td>
<td>3.255</td>
<td>210</td>
<td>32.5</td>
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<td>3.255</td>
<td></td>
<td>22.5</td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>2014</td>
<td>Bridge District</td>
<td>3.0</td>
<td>210</td>
<td>30.0</td>
<td></td>
<td>3.0</td>
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<td>0.0</td>
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<td>3.0</td>
</tr>
<tr>
<td>2014</td>
<td>Northeast Storage Tank</td>
<td>2.025</td>
<td>210</td>
<td>28.5</td>
<td></td>
<td>2.025</td>
<td></td>
<td>28.5</td>
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<td>2.0</td>
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<tr>
<td>2014</td>
<td>Oak Storage Tank</td>
<td>2.025</td>
<td>210</td>
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<td>2.025</td>
<td></td>
<td>28.5</td>
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<td>2.0</td>
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</tbody>
</table>

City of West Sacramento Water Storage Tank Inspection Program
City of West Sacramento
Bryte Bend WTP
400 North Harbor
West Sacramento, CA 95605

ATTN: Brian Frank:

On November 18, 2013 Aqua Video Engineering conducted a visual warranty inspection of the welded steel drinking water reservoir interior. The bottom was not cleaned prior to inspection.

<table>
<thead>
<tr>
<th>Name:</th>
<th>PSIP Reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity:</td>
<td>1.5 Million Gallons</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>Diameter: 106', Height: 24'</td>
</tr>
<tr>
<td>Construction:</td>
<td>Welded Steel</td>
</tr>
<tr>
<td>Date Constructed:</td>
<td>1976</td>
</tr>
<tr>
<td>Last Inspection:</td>
<td>2009</td>
</tr>
<tr>
<td>Last Cleaning:</td>
<td>2009</td>
</tr>
</tbody>
</table>

PART 1. CONDITION OF COATING AND RESERVOIR STRUCTURE

1.1 SIDEWALL: The side wall consists of three stacked concentric rings.

The side wall is coated with an epoxy coating which is in good condition in the top two rings. Isolated rust spots around tank in bottom ring with no pattern.

1.2 BOTTOM: This reservoir had 1/8" of sediment in patches. The debris did allow for a complete inspection of the bottom. The coating appears to be in very good condition with no flaws observed.

1.3 ROOF STRUCTURE: The roof structure appeared to be structurally sound. The epoxy coating is in good condition with no flaws observed.

1.4 SUPPORT POLE: There are four center support poles which are structurally sound and in good condition. The coating is in very good condition.

7435 Fairway Two Avenue, # 10 ~ Fair Oaks, CA  95628 ~ (916) 961-0350
FAX (916) 961-0353
EMAIL: AveDive@comcast.net
PART 2: ACCESS

2.1 ACCESS HATCH: The 36" X 36" coated steel access hatch, and cover is structurally sound and in very good condition.

2.2 EXTERIOR LADDER: The coated steel exterior ladder is structurally sound and in good condition. It is equipped with a safety cage, climb device and guard rail. The coating is in very good condition with no flaws observed. [Photograph #29]

2.3 INTERIOR LADDER: The coated steel Interior Ladder is structurally sound and in good condition.

2.4 MANWAYS: This reservoir is equipped with two manways: Both are in good condition. The two 24" diameter Manways are structurally sound and sealed.

PART 3: APPURTENANCES

3.1 INLET/OUTLET: The inlet/outlet enters the reservoir through the floor and is unobstructed and in good condition.

3.2 OVERFLOW: The diameter overflow is structurally sound and in good condition. The coating is in very good condition with no imperfections observed.

PART 4. ADDITIONAL OBSERVATIONS

4.1 WATER LEVEL INDICATOR: This reservoir is equipped with a transducer.

4.2 ROOF VENT: The center roof vent is structurally sound with screens in tact.

4.3 LEAKS: No leaks were found from the water level to the bottom of the reservoir.

4.4 CAPPED PENETRATION: The 2" capped penetration is unobstructed and in good condition.

PART 5. CONCLUSIONS AND RECOMMENDATIONS:

5.1 A regular inspection and repair program will allow the City of West Sacramento to extend the life of this reservoir.

Submitted,
Dave Jones
Dave Jones
Aqua Video Engineering
City of West Sacramento
Bryte Bend WTP
400 North Harbor
West Sacramento, CA 95605

ATTN: Dan Mount:

On November 16, 2011 Aqua Video Engineering conducted a visual inspection of the welded steel drinking water reservoir interior. The bottom was not cleaned prior to inspection.

<table>
<thead>
<tr>
<th>Name:</th>
<th>Oak Streett Reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity:</td>
<td>2 Million Gallons</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>Diameter: 110', Height: 28'</td>
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<tr>
<td>Construction:</td>
<td>Welded Steel</td>
</tr>
<tr>
<td>Date Constructed:</td>
<td>1985</td>
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<tr>
<td>Last Inspection:</td>
<td>Unknown</td>
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<tr>
<td>Last Cleaning:</td>
<td>Unknown</td>
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</tbody>
</table>

PART 1. CONDITION OF COATING AND RESERVOIR STRUCTURE

1.1 **SIDEWALL:** The side wall consists of three stacked concentric rings.

The side wall is coated with an epoxy coating which is in good condition. There are rust spots mostly near weld seams at floor. No other flaws observed.  [Photographs #1 through 9]

1.2 **BOTTOM:** This reservoir had 1/8" of sediment in patches. The debris did allow for a complete inspection of the bottom. The coating appears to be in very good condition with isolated rust spots with no pattern. [Photographs 7 through 16]

1.3 **ROOF STRUCTURE:** The roof structure appeared to be structurally sound. The epoxy coating is in good condition with surface rust in crevices at the weld seams and above the beams.  [Photographs #17 through 22]

1.4 **SUPPORT POLE:** The Center support pole and the nine surrounding support poles are all structurally sound and in good condition. The coating is in good condition.  [Photographs #22 through 27]

7435 Fairway Two Avenue, # 10 ~ Fair Oaks, CA 95628 ~ (916) 961-0350
FAX (916) 961-0353
EMAIL: AveDive@comcast.net
PART 2: ACCESS

2.1 ACCESS HATCH: The 40" X 40" coated steel access hatch, and cover is structurally sound and in very good condition. Rust spots and rust staining on opening edge. Rust staining on hatch cover where it hits opening. [Photograph #28]

2.2 EXTERIOR LADDER: The coated steel exterior ladder is structurally sound and in good condition. It is equipped with a safety cage, climb device and guard rail. The coating is in fair good condition with worn or peeled spots on rungs, runners, and cage exposing undercoating and rust. [Photograph #29]

2.3 INTERIOR LADDER: The coated steel Interior Ladder is structurally sound and in good condition. Rust observed where rungs meets runner and in crevices and on stand-off. [Photographs #30 through 31]

2.4 MANWAYS: The two 24" diameter Manways are structurally sound and sealed. Rust spots on both manway edge. Rust also in crevices of both swing-arms. [Photographs #32 through 35]

PART 3: APPURTENANCES

3.1 INLET: The 24" inlet is unobstructed and in good condition with no flaws observed. [Photographs #36 through 37]

3.2 OUTLET: The 24" diameter outlet is unobstructed and in good condition with no flaws observed. [Photographs #38 through 39]

3.3 DRAIN: The 10" drain is unobstructed and in good condition with no flaws observed. [Photograph #40]

3.4 OVERFLOW: The 10" diameter overflow is structurally sound and in good condition. The coating is in very good condition with no flaws observed. [Photographs #41 through 44]

PART 4. ADDITIONAL OBSERVATIONS

4.1 WATER LEVEL INDICATOR: This reservoir is equipped with a 2" telemetry penetration. The mechanical indicator has been abandoned. [Photographs #45 through 49]

4.2 ROOF VENT: The 54" center roof vent and 36" perimeter roof vents are structurally sound with screens in tact. [Photographs #50 through 51]

4.3 LEAKS: No leaks were found from the water level to the bottom of the reservoir.

4.4 CATHODIC PROTECTION: The reservoir is equipped with a cathodic protection that appears to be working properly. [Photograph #53]
City of West Sacramento

Water Storage Tank Inspection / Cleaning

_Northeast Storage Tank – May 2012_

The city conducted the cleaning of the storage tank. Project took 1 week to complete and place back online. There was minimal sediment on the floor of the tank.
City of West Sacramento

Inspection of one 2,000,000 Steel Welded Water Storage Tank
(Northeast Tank)

Date of Services:
October 26, 2001

Inspection Completed By:
AQUA-TECH COMPANY
P.O. BOX 1961
CARMICHAEL CA, 95609-1961
(916) 482-3703
Aqua-Tech Company
P.O. Box 1961
Carmichael, Ca 95609-1961
(916) 482-3703

December 19, 2002

Attention: Dan Mount
Water Treatment Plant Manager
City of West Sacramento
400 North Harbor Blvd.
West Sacramento, Ca 95605

REFERENCE: Inspection of one (1) 2,000,000 steel welded water storage tank. Facility is referenced as “Northeast Tank”.

This Report is furnished as a description of the inspection and should be included with any past documenting reports on this facility.

Pursuant to our dive team operations please review the following

The above mentioned facility was inspected by our firm on October 26, 2001. This facility was observed in good condition with a few deficiencies observed. Please review the following written inspection report for detailed descriptions

**Interior Ladder**

The tank interior ladder was observed intact and in very good condition. The ladder safety-climb fall protection apparatus was observed intact with moderate to severe corrosion. This must be replaced if dry entries are to be made into this facility.

**Common Inlet/Outlet Pipe**

N/A

**Inlet Pipe**

The tank inlet pipe was observed in the lower tank shell. This pipe was observed intact with areas of moderate to severe corrosion.

**Outlet Pipe**

The tank outlet pipe was observed intact and in good condition. No visible deterioration was observed.
Tank Floor
The tank floor was sparsely covered with sediment that was measured from less than 1/8” to 1/4”. Through the existing sediment layer the divers were able to view a good majority of the tank floor. The floor coating was observed intact with several areas of small corrosion nodules and very small blisters. All of the corrosion areas are small and do not seem to present any threat to leakage at his time.

Tank Shell Walls
The tank shell was observed intact and in good condition. All tank shell walls were observed with a few areas of minor coating blistering and very minor corrosion.

Tank Shell Access Manway
Both of the tank shell access manways were observed intact and in good condition. The manways were observed with minor corrosion on the swing hinge and minor corrosion and coating blistering on the cover plate.

Tank Overflow Structure
The tank overflow pipe was observed intact and in good condition. Very minor corrosion was observed.

Interior Roof Structure
The underside of the tank roof structure was observed intact and in good condition. A few small areas of typical corrosion were observed on the rafters, at the entry points of the Cathodic Protection System and the underside of the roof plates.

Tank Floor Drain
The tank floor drain was observed intact with no visible deterioration.

Tank Support Column
The tank center support column and the six (6) outer satellite columns were observed intact with nearly all the same conditions. The columns pole sections were observed intact with areas of minor to moderate corrosion and minor coating blistering. The column floor base plates were observed intact with minor corrosion and minor coating blistering.

Liquid Level Indicator
The tank level indicator was observed intact and in working operation. No visible deterioration was observed.

It is our opinion that this tank be left in service and completely operational at this time. All tank floor sediment should be removed as soon as possible to help with water quality and to allow the tank floor to be thoroughly inspected. The floor sediment can be removed with the tank in-service and completely operational. All corrosion areas below the water line can be repaired while the tank is in service utilizing an underwater epoxy that is safe for drinking water. These repairs can be completed in approximately two (2) days with no tank down time. Regular maintenance for these types of facilities is to
include inspection once a year, exterior cleaning as needed and interior cleaning every three years or as sediment levels dictate.

Thank you for retaining our services, if we can be of further assistance please feel free to contact a company representative at one of the telephone numbers listed below.

Sincerely,

Michael E. Johnson
Company Telephone Numbers;
Office: (916) 482-3703          Cellular: (916) 715-0732

AQUA-TECH COMPANY       P.O. Box 1961 Carmichael, CA 95609-1961       (916)482-3703
City of West Sacramento

Water Storage Tank Inspection / Cleaning

*Central Storage Tank – September 2012*

The Inspection was conducted

By Aqua Video Engineering

Video is the only documentation. Aqua Video was in as an emergency inspection. The tank overflowed on 09/17/2012. Mount wanted tank roof inspected for possible damage. The floor and side were also inspected. No damage and very little sediment were found.

No further action taken.
City of West Sacramento
Bryte Bend Water Treatment Plant
400 North Harbor Blvd.
West Sacramento, CA 95605

ATTN.: Dan Mount

On November 21, 2003, Aqua Video Engineering conducted a visual inspection of the steel drinking water reservoir. The inspection was conducted in a clockwise manner with the access hatch at the 12:00 o'clock position.

Name: Central Reservoir
Capacity: 2 MG
Dimensions: 110' Diameter, 28.6' Height
Construction: Steel
Date Constructed: Unknown
Last Inspection/Cleaning: 2001

PART 1. CONDITION OF COATING AND RESERVOIR STRUCTURE

1.1 SIDEWALL: The sidewall is in good condition with no cracking observed. In the top ring there is surface rust in the area where the water level fluctuates. Also, 8 isolated rust spots appear throughout the tank, each 1/2" to 2" in size. There is also an isolated spot of 10 blisters, 1/4" to 1/2" in size, near the ladder. Heavy sediment staining appears in the bottom ring.

1.2 BOTTOM: The bottom was covered with 1/8" of sand. The debris allowed for only a limited inspection of approximately 15% of the bottom. The coating on the bottom of the reservoir is in good condition with no cracking or blisters observed. There are patches of surface rust about 1" in diameter under the C.P. anodes. Isolated rust spots are found along the seams.

1.3 ROOF STRUCTURE: The roof structure is in fair condition. No blisters or cracking was observed. Rust is streaming down the sidewall with crevice corrosion and rust build up on the support braces. Sediment staining is present where the wall meets the roof.
PART 2. CONCLUSIONS AND RECOMMENDATIONS:

2.1 We recommend that this reservoir be cleaned. Additionally, the water level indicator wire to the float broke loose and needs to be repaired. A regular inspection program (every 3-5 years) will allow the City of West Sacramento to forecast future maintenance requirements and make small repairs, if necessary, thus prolonging the life of this facility.

TOTAL COST TO CLEAN RESERVOIR & REPAIR WATER LEVEL INDICATOR : $950.00

Submitted,

[Signature]

Dave Jones
City of West Sacramento
Bryte Bend Water Treatment Plant
400 North Harbor Blvd.
West Sacramento, CA 95605

ATTN.: Dan Mount

On November 21, 2003, Aqua Video Engineering conducted a visual inspection of the steel drinking water reservoir. The inspection was conducted in a clockwise manner with the access hatch at the 12:00 o'clock position.

Name: Northeast Booster Reservoir
Capacity: 2 MG
Dimensions: 110' Diameter, 28.6' Height
Construction: Steel
Date Constructed: Unknown
Last Inspection/Cleaning: 2001

PART 1. CONDITION OF COATING AND RESERVOIR STRUCTURE

1.1 SIDEWALL: The sidewall is in fair condition with no cracking or peeling observed. Approximately 5000+ isolated and grouped blisters, each 1/16" to 1/4" in size, appear in all rings, with 90% of the blisters being in the top ring. Isolated rust spots, 3000+, each 1/16" to 1/4" in size, are found bleeding through the blisters in the top ring where the water level fluctuates, with the worst areas between the 3:00 and 8:00 positions. There are isolated rust spots around the tank that are not associated with blisters.

1.2 BOTTOM: The bottom was covered with 1/8" of sand and silt. The coating on the bottom of the reservoir is in good condition with no cracking, peeling or blisters observed. Rust spots, 400+, each 1/16" to 1/2" in size, were observed. One dozen groupings of rust spots are due to slug from roof work. The slag has damaged the coating. Also, isolated rust spots appear around the tank which are not due to debris around the tank. The old C.P. plates around the tank are fused to the floor with rust.
1.3 **ROOF STRUCTURE:** The roof structure is in good condition. No blisters, cracking or peeling was observed. Crevice corrosion appeared at the seam and overlap. Rust was found to be streaming across the ceiling and down the sidewalls.

**PART 2. CONCLUSIONS AND RECOMMENDATIONS:**

2.1 We recommend that this reservoir be cleaned. A regular inspection program (every 3-5 years) will allow the City of West Sacramento to forecast future maintenance requirements and make small repairs, if necessary, thus prolonging the life of this facility.

**COST TO CLEAN RESERVOIR:** $900.00

Submitted,

[Signature]

Dave Jones
ATTN: Brian Frank:

On November 18, 2013 Aqua Video Engineering conducted a visual warranty inspection of the welded steel drinking water reservoir interior. The bottom was not cleaned prior to inspection.

Name: Carlin Reservoir
Capacity: 3,147 Million Gallons
Dimensions: Diameter: 130', Height: 32'
Construction: Welded Steel
Date Constructed: 2002
Last Inspection: Unknown
Last Cleaning: Unknown

PART 1. CONDITION OF COATING AND RESERVOIR STRUCTURE

1.1 SIDEWALL: The side wall consists of four stacked concentric rings.

The side wall is coated with an epoxy coating which is in good condition. Isolated rust spots and blisters behind interior ladder.

1.2 BOTTOM: This reservoir had 1/8" of sediment in patches. The debris did allow for a complete inspection of the bottom. The coating appears to be in very good condition with no flaws observed.

1.3 ROOF STRUCTURE: The roof structure appeared to be structurally sound. The epoxy coating is in good condition with no flaws observed.

1.4 SUPPORT POLE: There are seven support poles around one center support pole all in good condition. The coating is in good condition.
PART 2: ACCESS

2.1 ACCESS HATCH: The 36" X 36" coated steel access hatch, and cover is structurally sound and in very good condition.

2.2 EXTERIOR LADDER: The coated steel exterior ladder is structurally sound and in good condition. It is equipped with a climb device, platform and guard rail. The coating is in very good condition with no flaws observed. [Photograph #29]

2.3 INTERIOR LADDER: The coated steel Interior Ladder is structurally sound and in good condition.

2.4 MANWAYS: This reservoir is equipped with two 36" manways: Both are in good condition. The two 36 "Manways are structurally sound and sealed.

PART 3: APPURTENANCES

3.1 INLET: The inlet enters the reservoir through the floor and across the reservoir. It is unobstructed and in good condition.

3.2 OUTLET: The outlet enters through the floor and is unobstructed and in good condition.

3.3 DRAIN: The drain enters through the floor and is unobstructed in good condition.

3.4 OVERFLOW: The overflow is structurally sound and in good condition. The coating is in very good condition with no imperfections observed.

PART 4. ADDITIONAL OBSERVATIONS

4.1 WATER LEVEL INDICATOR: This reservoir is equipped with a Altitude valve in good condition.

4.2 ROOF VENT: The center roof vent is structurally sound with screens in tact.

4.3 LEAKS: No leaks were found from the water level to the bottom of the reservoir.

4.4 SAMPLE TAP: The sample tap penetration is unobstructed and in good condition.

PART 5. CONCLUSIONS AND RECOMMENDATIONS:

5.1 A regular inspection and repair program will allow the City of West Sacramento to extend the life of this reservoir.

Submitted,

Dave Jones
Dave Jones
Aqua Video Engineering
City of West Sacramento  
Bryte Bend WTP  
400 North Harbor  
West Sacramento, CA 95605

ATTN: Dan Mount:

On November 16, 2011 Aqua Video Engineering conducted a visual inspection of the welded steel drinking water reservoir interior. The bottom was not cleaned prior to inspection.

<table>
<thead>
<tr>
<th>Name</th>
<th>Bridgeway Lakes Reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>3 Million Gallons</td>
</tr>
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<td>Dimensions</td>
<td>Diameter: 150', Height: 27'</td>
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<tr>
<td>Construction</td>
<td>Welded Steel</td>
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<tr>
<td>Date Constructed</td>
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<td>Last Inspection</td>
<td>Unknown</td>
</tr>
<tr>
<td>Last Cleaning</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

**PART 1. CONDITION OF COATING AND RESERVOIR STRUCTURE**

1.1 **SIDEWALL:** The side wall consists of three stacked concentric rings.

The side wall is coated with an epoxy coating which is in good condition. There are rust spots throughout tank due to holidays in coating. Surface rust around weld seam between rings #2 and 3 at the 7:00 to 8:00 o'clock position (access hatch is 12:00) May have something to do with inlet opening pointed that way. [Photographs #1 through 9]

1.2 **BOTTOM:** This reservoir had 1/8" of sediment in patches. The debris did allow for a complete inspection of the bottom. The coating appears to be in good condition with isolated rust spots with no pattern. [Photographs 7 through 16]

1.3 **ROOF STRUCTURE:** The roof structure appeared to be structurally sound. The epoxy coating is in good condition with surface rust in crevices at the weld seams and above the beams. [Photographs #17 through 22]

1.4 **SUPPORT POLE:** The Center support pole and the seven surrounding support poles are all structurally sound and in good condition. The coating is in good condition with isolated rust spots on some poles. [Photographs #22 through 27]

7435 Fairway Two Avenue, # 10 ~ Fair Oaks, CA ~ 95628 ~ (916) 961-0350  
FAX (916) 961-0353  
EMAIL: AveDive@comcast.net
PART 2: ACCESS

2.1 ACCESS HATCH: The 40" X 40" coated steel access hatch, and cover is structurally sound and in very good condition. No flaws observed. [Photograph #28]

2.2 EXTERIOR LADDER: The coated steel exterior ladder is structurally sound and in good condition. It is equipped with a safety cage, climb device and guard rail. The coating is in fair good condition with peeled spots on rungs, runners, and cage exposing galvanized steel. [Photograph #29]

2.3 INTERIOR LADDER: The coated steel Interior Ladder is structurally sound and in good condition. Rust spots observed on rungs and runners. [Photographs #30 through 31]

2.4 MANWAYS: The two 30" diameter Manways are structurally sound and sealed. Rust spots on both manway edge. [Photographs #32 through 35]

PART 3: APPURTENANCES

3.1 INLET: The 14" inlet is unobstructed and in good condition with rust observed in crevices at anchor straps and couplings. [Photographs #36 through 37]

3.2 OUTLET: The 20" diameter outlet is unobstructed and in good condition with rust spots on edges of baffle. [Photographs #38 through 39]

3.3 DRAIN: The 8" drain is unobstructed and in good condition with no flaws observed. [Photograph #40]

3.4 OVERFLOW: The 18" diameter overflow is structurally sound and in good condition. The coating is in very good condition with no flaws observed. [Photographs #41 through 43]

PART 4. ADDITIONAL OBSERVATIONS

4.1 WATER LEVEL INDICATOR: This reservoir is equipped with a 2" telemetry penetration and a Hi-Lo water level floats. [Photographs #44 through 47]

4.2 ROOF VENT: The 36" center roof vent and 24" perimeter roof vent are structurally sound with screens in tact. [Photographs #48 through 49]

4.3 LEAKS: No leaks were found from the water level to the bottom of the reservoir.

4.4 1" SAMPLE TAP: The reservoir is equipped with a 1" sample tap that is in good condition. [Photograph #50 through 51]

4.5 FLOOR PENETRATIONS: There are two 14" floor penetrations that are unobstructed and in good condition. [Photographs #52 through 53]
Brian/Dan,

The tank and pump station were put into uninterrupted service on or about 3/20/13. The coating work was completed sometime before that – on 3/12/13 I was told the bacteriological and taste tests were satisfactory. Specifications 09974-1.05A. and B. indicate the OWNER is to establish the date for the warranty inspection in the eleventh month following completion of the coating. The specifications also indicate the warranty inspection is waived and the Contractor's work is considered complete if the inspection isn't scheduled with 12 months. A copy of the specification is attached for your perusal.

**Any objections to scheduling the warranty inspection for 9:00am on Wednesday, 2/12/14?**

A mid-week inspection will give you time to finish draining the tank – you'll have to bolt on the drain line extension to get the last 5' of water out. It will also give the Contractor time to mobilize the scaffolding, lighting, ventilation, etc. Hopefully with an inspection in mid-February, the tank will be back in service before hot weather arrives.

Note that the warranty on the exterior coating has been extended to 3 years. You may or may not want to perform an inspection of the exterior in 2014.

Fred Tadewaldt, PE
PSOMAS | Balancing the Natural and Built Environment
Resident Engineer
Program/Construction Management
1110 West Capitol Avenue, 2nd Floor
West Sacramento, CA 95691
Cell: 916.826.3365
City of West Sacramento

Water Storage Tank Inspection / Cleaning

*Southport Storage Tank – January 2007*

The Inspection and Cleaning was conducted by Aqua Tech.

Southport PS was taken offline (O/S) in June 2009
<table>
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<th>Site Name, #, and Type:</th>
<th>Northeast Reservoir</th>
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</thead>
<tbody>
<tr>
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<td>9/10/14</td>
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<td>Time:</td>
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<table>
<thead>
<tr>
<th>Asset Area (Process or assessment map area)</th>
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</thead>
<tbody>
<tr>
<td>Process</td>
</tr>
<tr>
<td>Asset Type (Tank, reservoir, building etc)</td>
</tr>
<tr>
<td>Condition (1-5, 1=new, 5 about to fail)</td>
</tr>
<tr>
<td>Original Installation Year</td>
</tr>
<tr>
<td>1988 has been retrofitted</td>
</tr>
<tr>
<td>Recently replaced in wind</td>
</tr>
<tr>
<td>Camera Photo #</td>
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<td>Outdoor/Indoor (On/Off)</td>
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<tr>
<td>Vendor/Manufacturer</td>
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<tr>
<td>Dimensions (LxWxH) or diam.</td>
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<tr>
<td>Material</td>
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<td>Roof condition</td>
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<td>Indoor Paint/Coating Condition</td>
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<tr>
<td>Outdoor Paint/Coating Condition</td>
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<td>Wall Thickness</td>
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<tr>
<td>Warrants higher level analysis</td>
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<tr>
<td>Size or Capacity</td>
</tr>
<tr>
<td>Construction Material</td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
</tr>
</tbody>
</table>

**Issues:** (e.g. spalling, corrosion, paint, settling, cracks, adequate for service)

- Noanchorage
- Looks like ringwall steel flow.
- Opened
- Noticed some settlement when draining lines are addition
- Grant made tank spacing

**Recommendations/Notes:** (Rehab/et al.)

- Piping - two flex couplings on overflow
- Pump station discharge coupling looks inadequate in AC pacing
<table>
<thead>
<tr>
<th>Site Name, #, and Type:</th>
<th>OAK St. Tank</th>
<th>Date: 9/10/14</th>
</tr>
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<tbody>
<tr>
<td>Assess. Team:</td>
<td>Ricky Gutierrez &amp; Richard Chang</td>
<td>Time: 8:51</td>
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<tr>
<td>Recorder:</td>
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<td>Pg. 1 of 1</td>
</tr>
<tr>
<td>Asset Area (Process or assessment map area)</td>
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<td>Process</td>
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<td></td>
</tr>
<tr>
<td>Asset Type (Tank, reservoir, building etc)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition (1-5, 1=new, 5=about to fail)</td>
<td>1985</td>
<td></td>
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<tr>
<td>Original Installation Year</td>
<td></td>
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</tr>
<tr>
<td>Camera Photo #</td>
<td>Start or 1984 Photo</td>
<td></td>
</tr>
<tr>
<td>Outdoor/Indoor (Oil)</td>
<td>Outdoor Pump Station</td>
<td></td>
</tr>
<tr>
<td>Vendor/ Manufacturer</td>
<td></td>
<td></td>
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<tr>
<td>Dimensions (LXWXH) or diam.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td></td>
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<tr>
<td>Roofing System</td>
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<tr>
<td>Roof condition</td>
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<td></td>
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<tr>
<td>Indoor Paint/ Coating Condition</td>
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<tr>
<td>Outdoor Paint/ Coating Condition</td>
<td></td>
<td></td>
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<tr>
<td>Wall Thickness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size or Capacity</td>
<td>2.75 HP + 130 HP.</td>
<td></td>
</tr>
<tr>
<td>Construction Material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Issues: (e.g. spalling, corrosion, paint, settling, cracks, adequate for service)</td>
<td>Above grade tank inlet &amp; outlet w/ FCA on each.</td>
<td>Not much slack restraint for discharge pumps.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mat under tank falling apart</td>
</tr>
<tr>
<td>Recommendations/Notes: (Rehab/elec.)</td>
<td>Poor security - Camera pits no CTV</td>
<td>rust.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not as critical, close to tank during winter:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foundation has some cracks &amp; spalling.</td>
</tr>
<tr>
<td>Site Name, #, and Type:</td>
<td>Port Sac, Industrial Plant (PSIP)</td>
<td>Date:</td>
</tr>
<tr>
<td>-----------------------</td>
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</tr>
<tr>
<td>Assess. Team:</td>
<td></td>
<td>Time:</td>
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<tr>
<td>Recorder:</td>
<td></td>
<td>Pg.</td>
</tr>
</tbody>
</table>

**Facility Assessment Form - Structural**

<table>
<thead>
<tr>
<th>Asset Area (Process or assessment map area)</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Process</th>
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</thead>
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<table>
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<tr>
<th>Outdoor/Indoor (Oil)</th>
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<tr>
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<tr>
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<tr>
<th>Wall Thickness</th>
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<tr>
<th>Warrants higher level analysis</th>
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</thead>
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<tr>
<th>Size or Capacity</th>
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<thead>
<tr>
<th>Construction Material</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Warrants higher level analysis</th>
</tr>
</thead>
</table>

**Issues:** (esp. spalling, corrosion, paint, settling, cracks, adequate for service)

<table>
<thead>
<tr>
<th>Site includes automatic transits for all facilities</th>
</tr>
</thead>
</table>

| Tank is anchored - 5-10 years required it to be new roof installed, coating still in decent shape |

| Some rust spots |

| Some cracks in foundation concrete |

| Anchor bolts not snug? |

<table>
<thead>
<tr>
<th>Recommendations/Notes: (Rehab/etc.)</th>
</tr>
</thead>
</table>

| Use to be well treated facility now abandoned |

| Use to have fire pump (diesel) no longer exists |

| Portable generator onsite |

| Deuce behind it for conveyer, elevated 6-7' above surrounding grade |

2nd lowest priority: The Oil in terms of priority in corner of town back-up by central at Oil. If running In line then need it. No security, just intrusion switch.
<table>
<thead>
<tr>
<th><strong>Facility Assessment Form - Structural</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Site Name, #, and Type:</strong> Central Tank</td>
</tr>
<tr>
<td><strong>Assess. Team:</strong></td>
</tr>
<tr>
<td><strong>Recorder:</strong></td>
</tr>
</tbody>
</table>

| **Asset Area (Process or assessment map area):** | Near Point of W. Sac. river or sewer channel |
| **Process**                                      |                                               |
| **Asset Type (Tank, reservoir, building etc)***  |                                               |
| **Condition (1-5, 1= new, 5= about to fail)**   | 1988                                           |
| **Original Installation Year**                  | Start 1713                                     |
| **Camera Photo #**                              |                                               |
| **Outdoor/Indoor (Oil)***                       | Outdoor 9.5. Same config. as North East       |
| **Vendor/Manufacturer**                         |                                               |
| **Dimensions (LxWXH) or diam.**                 | 110'dia x 28'h H - 2,097 MG                   |
| **Material**                                    | Steel tank                                                 |
| **Roofing System**                              | Knuckle Steel                                            |
| **Roof condition**                              |                                               |
| **Indoor Paint/Coating Condition**              |                                               |
| **Outdoor Paint/Coating Condition**             |                                               |
| **Wall Thickness**                              |                                               |
| **Warrants higher level analysis**              |                                               |

| **Size or Capacity**                            | 2x2 gmp, 230 hp, 20 75 hp               |
| **Construction Material**                       | Non anchored tank                         |

<p>| <strong>Warrants higher level analysis</strong>              |                                               |
| <strong>Issues: (eg. spalling, corrosion, paint, settling, cracks, adequate for service)</strong> | Had leak at FCA only on some rust at walls. Discharge coupling of P5 was repaired. Pump discharge above grade at some couplings. Failure on some coating. |
| <strong>Recommendations/Notes: (Rehab/et al.)</strong>       | Curvate in foundation appears below grade connections to be in good condition tank except level sample |</p>
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<td><strong>Process</strong></td>
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<td><strong>Asset Type (Tank, reservoir, building etc)</strong></td>
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<tr>
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<tr>
<td><strong>Original Installation Year</strong></td>
</tr>
<tr>
<td><strong>Camera Photo #</strong></td>
</tr>
<tr>
<td><strong>Outdoor/Indoor (Oil)</strong></td>
</tr>
<tr>
<td><strong>Vendor/Manufacturer</strong></td>
</tr>
<tr>
<td><strong>Dimensions (LXWXH) or diam.</strong></td>
</tr>
<tr>
<td><strong>Material</strong></td>
</tr>
<tr>
<td><strong>Steel, wi/ concrete foundation - non-anchored.</strong></td>
</tr>
<tr>
<td><strong>Roofing System</strong></td>
</tr>
<tr>
<td><strong>Steel, Knudle roof. Corrosion near wind.</strong></td>
</tr>
<tr>
<td><strong>Roof condition</strong></td>
</tr>
<tr>
<td><strong>Indoor Paint/Coating Condition</strong></td>
</tr>
<tr>
<td><strong>Outdoor Paint/Coating Condition</strong></td>
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<td><strong>Wall Thickness</strong></td>
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<tr>
<td><strong>Warrants higher level analysis</strong></td>
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<tr>
<td><strong>Size or Capacity</strong></td>
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<tr>
<td><strong>Construction Material</strong></td>
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<tr>
<td><strong>Warrants higher level analysis</strong></td>
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<tr>
<td><strong>Issues: (eg. spalling, corrosion, paint, settling, cracks, adequate for service)</strong></td>
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**Recommendations/Notes: (Rehab/ etc.)**

**Most critical facility Bridgewater tank only backup but need both for this side of town. Both this one and this one on UFD's. Closer to development.**
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<tr>
<td><strong>Time:</strong></td>
</tr>
<tr>
<td><strong>Recorder:</strong></td>
</tr>
</tbody>
</table>

| **Asset Area (Process or assessment map area)** | |
| **Process** | |
| **Asset Type (Tank, reservoir, building etc)** | |
| **Condition (1-5, 1=new, 5 about to fail)** | 2006 |
| **Original Installation Year** | |
| **Camera Photo #** | |
| **Outdoor/Indoor (Oil)** | |
| **Vendor/Manufacturer** | AIC Tank |
| **Dimensions (LXWXH) or diam.** | |
| **Material** | Corrugated steel tank, concrete foundation |
| **Roofing System** | |
| **Roof condition** | |
| **Indoor Paint/Coating Condition** | Corrosion at base |
| **Outdoor Paint/Coating Condition** | Coating for 5 years. Tank coating OK, some corrosion at base. |
| **Wall Thickness** | |
| **Warrants higher level analysis** | |
| **Size or Capacity** | 3m³ Tank, 2400gpm pumps on VFD's, 3 pumps - 150HP - Sullair. |
| **Construction Material** | |
| **Warrants higher level analysis** | |

| **Issues:** (eg. spalling, corrosion, paint, setting, cracks, adequate for service) |
| Some cracks in concrete wall, 5 PS floor at pipe penetrations. |
| Pump coatings good. No straps on pipe supports. |
| No seismic bracing on lighting. Tank unanchored. |

| **Recommendations/Notes:** (Rehab/letc.) | |
| Asset Area (Process or assessment map area) |  |
| Process | 2 Emergency Wells  out of service 1 tank out of service |
| Asset Type (Tank, reservoir, building etc) |  |
| Condition (1-5, 1=new, 5=about to fail) |  |
| Original Installation Year | 1973 tank - out of service 1 mg |
| Camera Photo # |  |
| Outdoor/Indoor (Oil) |  |
| Vendor/Manufacturer |  |
| Dimensions (LXWXH) or diam. |  |
| Material |  |
| Roofing System |  |
| Roof condition |  |
| Indoor Paint/ Coating Condition |  |
| Outdoor Paint/ Coating Condition |  |
| Wall Thickness |  |
| Warrants higher level analysis |  |
| Size or Capacity | 2000gm 180' TDH |
| Construction Material |  |
| Warrants higher level analysis |  |
| Issues: (eg. spelling, corrosion, paint, settling, cracks, adequate for service) |  |

**Recommendations/Notes; (Rehab/etc.)**

Only 2-3 in. lines to get water from WTP to South side. That is why backup.

Palmadessa new or pipe

Jefferson are pipe crossings

Same sectional man.
<table>
<thead>
<tr>
<th>Site Name, #, and Type:</th>
<th>7/1/06 Pump Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>9/10/14</td>
</tr>
<tr>
<td>Time:</td>
<td>1:05</td>
</tr>
</tbody>
</table>

| Recorder:             | Pg. ___ of ___      |

<table>
<thead>
<tr>
<th>Asset Area (Process or assessment map area)</th>
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<tbody>
<tr>
<td>Process</td>
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<tr>
<td>Asset Type (Tank, reservoir, building etc)</td>
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<tr>
<td>Condition (1-5, 1=new, 5 about to fail)</td>
</tr>
<tr>
<td>Original Installation Year</td>
</tr>
<tr>
<td>Camera Photo #</td>
</tr>
<tr>
<td>Outdoor/Indoor (Off)</td>
</tr>
<tr>
<td>Vendor/ Manufacturer</td>
</tr>
<tr>
<td>Dimensions (LXWXH) or diam.</td>
</tr>
<tr>
<td>Material</td>
</tr>
<tr>
<td>Roofing System</td>
</tr>
<tr>
<td>Roof condition</td>
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<td>Indoor Paint/ Coating Condition</td>
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<tr>
<td>Outdoor Paint/ Coating Condition</td>
</tr>
<tr>
<td>Wall Thickness</td>
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<tr>
<td>Warrants higher level analysis</td>
</tr>
<tr>
<td>Size or Capacity</td>
</tr>
<tr>
<td>Construction Material</td>
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<tr>
<td>Warrants higher level analysis</td>
</tr>
<tr>
<td>Issues: (eg. spalling, corrosion, paint, settling, cracks, adequate for service)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendations/Notes: (Rehab/etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good condition - Good flexibility in piping Good overall, minor scratches, cracks</td>
</tr>
</tbody>
</table>
## Facility Assessment Form - Structural

<table>
<thead>
<tr>
<th>Site Name, #, and Type:</th>
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<tbody>
<tr>
<td>Assess. Team:</td>
<td>Time:</td>
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<tr>
<td>Recorder:</td>
<td></td>
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<tr>
<td>eVEM- EAST</td>
<td></td>
</tr>
<tr>
<td>OAK ST.</td>
<td></td>
</tr>
<tr>
<td>Pipe Tank (PB)</td>
<td></td>
</tr>
<tr>
<td>Pipe PS</td>
<td></td>
</tr>
</tbody>
</table>

### Asset Area (Process or assessment map area)
- Water, east
- Oak ST.
- Pipe Tank
- Pipe PS

### Process
- Tank
- Tank
- Pipe/Steel Structure

### Condition (1-5, 1=new, 5 about to fail)
- 2
- 3.5
- 3.5

### Original Installation Year
- 1982
- 1985
- 1978

### Camera Photo #

### Outdoor/Indoor (Oi)

### Vendor/Manufacturer

### Dimensions (LWxWxH) or diam.
- 110" x 35" x 20"

### Material
- 304C
- Steel
- 304C
- Steel

### Roofing System

### Roof condition

### Indoor Paint/Coating Condition
- Re-coated ~ 5 years ago
- Original Coating

### Outdoor Paint/Coating Condition
- Re-coated ~ 5 years ago
- Coating Condition 2.5
- Coating Condition 2.5

### Wall Thickness

### Warrants higher level analysis
- Yes, tank is leaking
- Flexibility of pipe

### Size or Capacity

### Construction Material
- Carbon Steel
- Stainless Steel
- Carbon Steel

### Warrants higher level analysis
- Cracks in foundation
- Soft soil replaced in 2007
- 3.5" Plate
- Repaired once due to corrosion
- Look at whether repeat approach and repair is an issue
- Crack is a significant issue
- Percentage of pipe is an issue

### Recommendations/Notes:
- Need re-fitwall pipe
- Need replacement 2" pipe
- Need pipe replacement 2" pipe
- Need tie-in wall
- Need to replace 3"
- Need to replace 1/4"
- Need to replace 1/4"
- Need new roof screws
- Need new roof screws
- Need new roof screws
- Need new roof screws
- Need new roof screws
- Need new roof screws

### Other Notes
- All foundations are
- Water wall
<table>
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<tbody>
<tr>
<td>CENTRAL</td>
<td></td>
</tr>
<tr>
<td>CALVIN TANK</td>
<td></td>
</tr>
<tr>
<td>CALVIN PS</td>
<td></td>
</tr>
<tr>
<td>PFEIFER</td>
<td></td>
</tr>
</tbody>
</table>

| Process | |
|---------| |
| Asset Type (Tank, reservoir, building etc) | |
| TANK | |
| TANK | |
| BLOG-MAKINDY | |
| WED EKER | DISAPPEAR | |

| Condition (1-5, 1=new, 5 about to fail) | |
|----------------------------------------| |
| 4 | |
| 2 | |

| Original Installation Year | |
|---------------------------| |
| 1980 | |
| 2000 | |
| 2006 | |

| Camera Photo # | |
|---------------| |

| Outdoor/Indoor (Oil) | |
|---------------------| |

| Vendor/Manufacturer | |
|---------------------| |

| Dimensions (LxWXH) or diam. | |
|-----------------------------| |
| STEEL | |

| Roofing System | |
|----------------| |

| Roof condition | |
|----------------| |

| Indoor Paint/ Coating Condition | |
|---------------------------------| |
| STEEL | |

| Outdoor Paint/ Coating Condition | |
|----------------------------------| |

| Wall Thickness | |
|----------------| |

| Warrants higher level analysis | |
|--------------------------------| |

| Size or Capacity | |
|------------------| |

| Construction Material | |
|------------------------| |

| Warrants higher level analysis | |
|--------------------------------| |

| Issues: (eg. spalling, corrosion, paint, setting, cracks, adequate for service) | |
|----------------------------------------------------------------------------------| |

| Recommendations/Notes: (Rehab/etc.) | |
|-------------------------------------| |

---

- COATING IS IN ORDER
- CORROSION IS NOT PRESENT
- NO CRACKS OR CRACKS ARE SMALL AND NOT CRITICAL
- MATERIALS ARE IN GOOD CONDITION

- COATING FAILS TO PROTECT AGAINST CORROSION
- CRACKS ARE LARGE AND CRITICAL
- MATERIALS ARE IN POOR CONDITION

- STEEL BEAMS CORRODED
- COATING NOT PROTECTIVE
- CONCRETE IS CHOCKED
- LINER SEALANTS ARE SEVERELY FAILURE
- CONSTRUCTION детали are insufficient

- WEAKENING IN CONCRETE
- STEEL INTEGRITY LOST
- CONSTRUCTION детали are insufficient

- NOT CRITICAL
- REPAIR IS NOT REQUIRED
- NOT CRITICAL

---

- WEAKENING IN CONCRETE
- STEEL INTEGRITY LOST
- CONSTRUCTION детали are insufficient

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<td>Pg. of</td>
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<th>Asset Area (Process or assessment map area)</th>
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<tbody>
<tr>
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<td>RS</td>
<td>RS</td>
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<td>Condition (1-5, 1=New, 5 = about to fail)</td>
<td>5</td>
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<tr>
<td>Original Installation Year</td>
<td>1973</td>
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<tr>
<td>Size or Capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction Material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warrants higher level analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Issues: (eg. spalling, corrosion, paint, setting, cracks, adequate for service) | | | |
|-------------------------------------------------------------------|---|---|
| Significant cracks, no fixability | | | |
| Paint flaking | | | |
| Concrete deteriorating, significant cracks in pump foundation | | | |
| Masonry of wall roofing | | | |
| Needs stucco or stucco repair | | | |
| | | | |

| Recommendations/Notes: (Relate/Note:) | | | |
|----------------------------------------|---|---|
| | | | |

- Masonry of course dia. / gable beams
- Stucco cracks are for cracks, masonry more inclusive.
- Electrical room
- Minor shingle cracks or no cracks
- To determine pump or tank cracks/foundation
- Stucco cracks & walling

---

*Get by 11 if we can do that than it's many months more
* Filling line going to [Pump 11'-12'] more sure 16' x 12' is in the model
Management insight as clear as the water you deliver.

Now that’s refreshing.

Sensus Essential Water Analytics provides the core business functionality you need to streamline customer service and operations.

Part of our suite of intelligent infrastructure software, this bundle of applications equips you with user-friendly dashboards, so you can make informed decisions quickly and confidently. Our powerful data management tools aggregate information from your AMI, AMR and other sources. And these intuitive apps are delivered by a secure connection to the cloud right to your desktop, tablet or smart phone - just a click, tap or touch away - wherever and whenever you want.

Role-based access allows service providers to share information across the organization - from customer service and operations to accounting and rates - for improved productivity, visibility and decision-making.

Sensus Essential Water Analytics:

- **Data Store** - a secure, cloud-based information warehouse that stores system and network data for the applications. Three years of storage is included.

- **Report Access** - a management tool that offers a menu of reports that instantly summarize the information you need to know right away.

- **Device Access** - a customer service tool that presents detailed usage history and trends, identifies anomalies and enables custom alert programming to track specific issues.

- **Billing Access** - a billing interface tool that previews and audits billing extracts for issues, enabling the utility to take corrective action, then generates final billing files for production.

- **Meter Insight** - a validation tool that provides a summary of incoming network meter data from and identifies issues to be addressed.
Big data doesn’t have to be a big deal.

We believe in making data easy to work with. That’s why Sensus Analytics offers you the flexibility to purchase single applications or pre-bundled packages of our most popular apps to harness the power of big data for energy and water utilities.

Our cloud-based platform aggregates data from different information systems across your company into intuitive applications that are easy to use and quick to implement. That means less reliance on IT resources and lengthy training and more customer satisfaction, service reliability, quality and operational efficiency.

Here’s how we do it:

**App-based**
Each purpose-built application accesses data from multiple systems and presents it in user-friendly dashboards

**Flexible**
Select a package of tools for billing and system management or single applications that help achieve key initiatives

**Accessible**
Our secure, cloud-based delivery platform puts your information within reach no matter where you are

**Affordable**
There’s no need to purchase, install, update or maintain special software, licenses or hardware - or set aside valuable office space to house it

**Fresh**
Applications are continuously updated as information enters the system, so you can make decisions based on the latest data

**Integratable**
Sensus Analytics draws information from many systems through the cloud, so there’s little time and cost required for standard systems integration

**Scalable**
Our Data Store and three years of included cloud-based storage enables you to add applications, or increase storage, quickly – often in hours

**Visible**
Role-based access allows information sharing across the organization - from customer service and operations to accounting and rates - for improved efficiency and cross-functional understanding

**Ready to learn more?**

Visit sensus.com/analytics, click the “request a demo” button to schedule a personal demonstration with one of our analytics specialists.
Corporate Information

Corporate Headquarters
8601 Six Forks Road
Suite 700
Raleigh, North Carolina 27615

About Sensus

Sensus helps a wide range of public service providers—from utilities to cities to industrial complexes and campuses—do more with their infrastructure to improve quality of life in their communities. We enable our customers to reach farther through the application of technology and data-driven insights that deliver efficiency and responsiveness. We partner with them to anticipate and respond to evolving business needs with innovation in sensing and communications technologies, data analytics and services. Learn more at sensus.com and follow us on Facebook, LinkedIn and Twitter through @sensusglobal.
Core Feature: Account Dashboard
Core Feature: Zoom & Scroll Events
Core Feature: Account Data

<table>
<thead>
<tr>
<th>Device Number</th>
<th>72982928</th>
</tr>
</thead>
<tbody>
<tr>
<td>Account Number</td>
<td>206913</td>
</tr>
<tr>
<td>Device Type</td>
<td>Water</td>
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<tr>
<td>Meter Type</td>
<td></td>
</tr>
<tr>
<td>Radio ID</td>
<td>13432464</td>
</tr>
<tr>
<td>Status</td>
<td>Active</td>
</tr>
<tr>
<td>Customer Name</td>
<td>DENNIS KENNEDY</td>
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<tr>
<td>Parent</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>1236 Reese Street, Redwood City Ca, 94061</td>
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</tbody>
</table>

Data Source: Interval

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<th>Time</th>
<th>Read</th>
<th>Quality</th>
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<td>9/09/15 12:00 AM</td>
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<td>Missing Data</td>
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<td>Raw</td>
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Core Feature: Account Alarms

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<th>Data</th>
<th>Alarms</th>
<th>Usage Profile</th>
<th>Watch Me</th>
<th>Map</th>
<th>Details</th>
<th>Commands</th>
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<tbody>
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<td>Device Number</td>
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<td>1236 Reese Street</td>
<td></td>
<td>Redwood City Ca, 94061</td>
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</tr>
</tbody>
</table>

No data available in table
Core Feature: Account Usage Profile

Device Number: 72982928
Device Type: Meter
Meter Type: Water
Radio ID: 13432464
Status: Active
Account Number: 206913
Customer Name: DENNIS KENNEDY
Parent: 
Location: 1236 Reese Street
Redwood City CA, 94061

Full Timeframe Profile

Winter Profile
no data available

Combined Shoulder Profile
no data available
Core Feature: Account Tracking
Core Feature: Acct Track Parameters
Core Feature: Notify Anybody

- If this device sends a Leak Detected alarm,
  notify Ryan Carnathan - via Sms

Add Notification

Submit
Core Feature: Map View
### Core Feature: Account Details

<table>
<thead>
<tr>
<th>Device Number</th>
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<tbody>
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<tr>
<td></td>
<td>Redwood City CA, 94061</td>
</tr>
</tbody>
</table>

**Customer**

- **Phone Number**
- **Cell Phone Number**
- **Email** ds kennedy01@gmail.com

**Service Delivery Point**

- **SDP ID** 206913
- **Status** Connected
- **Latitude** 37.47101
- **Longitude** -122.2307

**Account**

- **Service Type** SF RESIDENTIAL
- **Service Cycle** 17380
- **Billing Cycle** E06
- **Route** 6999

**Account**

- **Usage UOM**
- **Number of Dials** 4
- **CIS Meter Multiplier**
- **Load Profile** False
- **Read Method** AMI
- **Meter Size** 0.625
- **Zone**
Core Feature: On-Demand Meter Read

Device Number: 72982928
Device Type: Meter
Meter Type: Water
Radio ID: 13432464
Status: Active

Account Number: 206913
Customer Name: DENNIS KENNEDY
Parent: 1236 Reese Street, Redwood City, CA 94061
Location: 

Address: 1236 REESE STREET, REDWOOD CITY

Data | Alarms | Usage Profile | Watch Me | Map | Details | Commands
--- | --- | --- | --- | --- | --- | ---

Read Meter Request
Optional Feature: High Water by Zone
Optional Feature: Leak Trending
Optional Feature: Meter Sizing
Section 6: Customer Portal Tour
Customizable Login

Single Login Integrated to Bill Pay
Multilingual
Mobile Ready, Shortcut not ‘App’
Send Notifications

- 4 Notifications
- Billing Cycle Threshold: 31% of billing cycle threshold consumed
- Outdoor Watering: 5:00 pm - 11:00 pm
- Nights: Monday, Wednesday, and Friday
- 5,266 Gallons used this billing cycle
- 3 Alerts

© 2015 Sensus All Rights Reserved | Terms and Conditions | SENSUS
Supports Multiple Accounts
Supports Multiple Meters on Account
Relates Use to Time, Date, and Weather
Integrated to Billing
Set Vacation Monitors and Recipients

Daily Usage alert
Alert me when a meter is using more than a given amount in a day.

Meter #87376001
234 Midtown Ave Anytown ST 55555

Average Use
28.3 Gallons

Alert me when usage exceeds
Gallons

Vacation Alerts
Temporarily override your normal data.

Meter #87376001
234 Midtown Ave Anytown ST 55555

Alert me when usage exceeds
Gallons

Enabled

Save
Customer Settings: Set Alert Limits

Billing Cycle Usage Alert
Alert me when a meter is using more than a given amount in a billing cycle.

Meter #87376001
Average Use
16,240 Gallons
Alert me when usage exceeds
17000 Gallons

Daily Usage Alert
Alert me when a meter is using more than a given amount in a day.

Meter #87376001
Average Use
258.3 Gallons
Alert me when usage exceeds
250 Gallons

Vacation Alerts
Temporarily override your normal daily alert usage.

Meter #87376001
Alert me when usage
Save
Customer Settings: Alert Recipients

Alert Recipients

Configure which alerts you want to receive and add additional alert recipients.

Mary Johnson [Account Owner] Email mary.johnson@hometown.com
Text 000-0000
No alerts found. Use the Edit button to configure alert recipients.

Green Thumb Landscapers Email green.thumb.landscapers@hometown.com
Text 406-555-1212
Send email, text when meters detect Leak Detected, Daily Usage Warning

Add alert recipient
Edit Contact Info

User Settings

Manage your contact information and other account details.

Mary Johnson

User Name
mary.johnson@hometown.com

Email address for alerts and notifications
mary.johnson@hometown.com

Cell Phone for Text Messages (optional)
000-0000

Change Password

Update
| CT | Type | Asset ID | Asset Description | S | In-Svc Date | Fun Life | Original Value | Accr. Depr. | Current Value | ENR CCI Index | ENR CCI Dec. 2016 | ENR CCI Ratio | Replacement Cost New | RCNL 3 |
|----|------|----------|-------------------|---|-------------|---------|----------------|-------------|--------------|---------------|----------------|----------------|----------------|---------------------|------|
| EF | 1 | FA001057 | Land | AC 03-Jun-88 1988 | WT 0 | 0, 1,193,450 | 0 | 0 | 1,193,450 | 1.00 | 1,193,450 | 1,193,450 | |
| EF | 3 | FA000770 | Chlorine Generation (Carlin & Bridgeway) | AC 03-Jun-03 2003 | WT 40 | 1,032,807 | 25,820 | 335,660 | 697,147 | 6694 | 10338 | 1.54 | 1,595,034 | 1,076,651 |
| EF | 3 | FA000774 | Water Tank - Bridgeway Lakes | AC 03-Jun-09 2009 | WT 40 | 2,009,239 | 50,231 | 351,617 | 1,657,622 | 8570 | 10338 | 1.21 | 2,433,747 | 1,999,591 |
| EF | 3 | FA000775 | Maturation Mixers - 400 N Harbor | AC 03-Jun-06 2006 | WT 25 | 39,881 | 1,595 | 11,165 | 28,716 | 7751 | 10338 | 1.33 | 53,192 | 38,300 |
| EF | 3 | FA000941 | 231 Second Street | AC 03-Jun-83 1983 | WT 20 | 46,307 | 0 | 46,307 | 0 | 4066 | 10338 | 2.54 | 117,738 |
| EF | 3 | FA000942 | Southport Treat Plant | AC 03-Jun-83 1983 | WT 20 | 307,448 | 0 | 307,448 | 0 | 4066 | 10338 | 2.54 | 781,701 |
| EF | 3 | FA000943 | SW of Industrial & Enterprise | AC 03-Jun-83 1983 | WT 20 | 6,561 | 0 | 6,561 | 0 | 4066 | 10338 | 2.54 | 16,682 |
| EF | 3 | FA000944 | Water Treatment Plant - 400 N Harbor | AC 03-Jun-89 1989 | WT 37 | 113,322,277 | 306,278 | 8,764,275 | 2,568,002 | 4615 | 10338 | 2.24 | 25,385,283 | 5,752,548 |
| EF | 3 | FA000945 | Water Treatment Plant - 401 N Harbor | AC 03-Jun-83 1983 | WT 20 | 236,407 | 0 | 236,407 | 0 | 4066 | 10338 | 2.54 | 601,076 |
| EF | 3 | FA000946 | Recycle Sludge System | AC 03-Jun-83 1983 | WT 20 | 144,629 | 0 | 144,629 | 0 | 4066 | 10338 | 2.54 | 367,725 |
| EF | 3 | FA000947 | Recycle Sludge System | AC 03-Jun-92 1992 | WT 20 | 117,355 | 0 | 117,355 | 0 | 4985 | 10338 | 2.07 | 243,373 |
| EF | 3 | FA000948 | Water Treatment Plant - 400 N Harbor | AC 03-Jun-95 1995 | WT 20 | 60,691 | 0 | 60,691 | 0 | 5471 | 10338 | 1.89 | 114,682 |
| EF | 3 | FA000949 | PSIP Filter Med | AC 03-Jun-98 1998 | WT 5 | 7,303 | 0 | 7,303 | 0 | 5920 | 10338 | 1.75 | 12,754 |
| EF | 3 | FA000950 | Storage Tanks | AC 03-Jun-98 1998 | WT 5 | 5,845 | 0 | 5,845 | 0 | 5920 | 10338 | 1.75 | 10,207 |
| EF | 3 | FA000951 | Water Treatment Plant - Chlorine Room | AC 03-Jun-98 1998 | WT 5 | 4,771 | 0 | 4,771 | 0 | 5920 | 10338 | 1.75 | 8,331 |
| EF | 3 | FA000952 | Summit - Air Compressor | AC 30-Jun-99 1999 | WT 5 | 20,897 | 0 | 20,897 | 0 | 6059 | 10338 | 1.71 | 35,655 |
| EF | 3 | FA000953 | Water Treatment Plant - 400 N Harbor | AC 03-Jun-00 2000 | WT 10 | 145,788 | 0 | 145,788 | 0 | 6221 | 10338 | 1.66 | 242,269 |
| EF | 3 | FA000954 | Oratech, Sigma Res | AC 03-Jun-00 2000 | WT 5 | 7,877 | 0 | 7,877 | 0 | 6221 | 10338 | 1.66 | 13,090 |
| EF | 3 | FA000955 | Water Treatment Plant Valves 1-8 - 400 N Harbor | AC 03-Jun-01 2001 | WT 5 | 30,367 | 0 | 30,367 | 0 | 6343 | 10338 | 1.63 | 49,493 |
| EF | 3 | FA001096 | Water Treatment Plant - Port of Sac | AC 03-Jun-04 2004 | WT 25 | 351,717 | 14,069 | 168,828 | 182,889 | 7115 | 10338 | 1.45 | 511,040 | 265,736 |
| EF | 3 | FA001162 | Oak Street Pump Station MCC Replacement | AC 03-Jun-04 2004 | WT 25 | 140,199 | 5,608 | 39,256 | 100,943 | 7115 | 10338 | 1.45 | 203,707 | 146,669 |
| EF | 3 | FA001163 | Storage Building @ BBWTP | AC 03-Jun-06 2006 | WT 25 | 96,942 | 3,878 | 27,146 | 69,796 | 7751 | 10338 | 1.33 | 129,297 | 93,091 |
| EF | 3 | FA001165 | Reclalm Basins - 400 N Harbor | AC 03-Jun-09 2009 | WT 25 | 49,259 | 1,970 | 13,790 | 35,468 | 8570 | 10338 | 1.21 | 59,421 | 42,785 |
| EF | 3 | FA001207 | In-Line Booster Pump | AC 03-Jun-11 2011 | WT 20 | 1,583,480 | 79,174 | 395,870 | 1,187,610 | 9070 | 10338 | 1.14 | 1,804,854 | 1,353,640 |
| EF | 3 | FA001208 | In-Line Booster Pump | AC 03-Jun-11 2011 | WT 20 | 4,778,901 | 238,945 | 994,074 | 1,994,725 | 5,546 | 10338 | 1.14 | 5,446,999 | 4,085,250 |
| EF | 3 | FA001473 | Carlin Water Tank | AC 03-Jun-15 2015 | WT 40 | 2,913,879 | 72,045 | 72,045 | 2,841,034 | 10035 | 10338 | 1.03 | 3,001,852 | 2,926,815 |
| EF | 3 | FA001488 | Bridge District Water Tank | AC 30-Jun-15 2015 | WT 40 | 809,918 | 20,248 | 20,248 | 789,670 | 10035 | 10338 | 1.03 | 834,372 | 813,513 |

**Summary:**

- **Total:** 843,258,585
- **Current Value:** 4,085,250

**Cost New:** 4,085,250
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Asset ID

Asset Description

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In‐Svc Date

Fun Life Orig. Value Curr. De r.

Accum. Depr. Current Value

ENR CCI ENR CCI ENR CCI Replacement
Index Dec. 2016 Ratio
Cost New
5210
10338
1.98
26,089
4406
10338
2.35
35,554
7115
10338
1.45
20,241
7115
10338
1.45
19,577
7115
10338
1.45
20,241
7966
10338
1.30
14,403
7751
10338
1.33
42,901
7751
10338
1.33
119,919
7966
10338
1.30
13,634
7966
10338
1.30
33,738
8310
10338
1.24
8,737
8570
10338
1.21
7,097
8799
10338
1.17
798,615
9070
10338
1.14
5,972
9070
10338
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FA001197
FA001198
FA001638
FA001639
FA001640
FA001642
FA001643
FA001644
FA001645
FA001646
FA001647
FA001648

3/4 Ton Truck
Backhoe
Generator
Body To Carry W
Generator
Vin# 8308
Dump #1284
Vactk#5914
Vin 3638 Message Board
S#1352 Backhoe Loader 310 SG
HVAC Unit
Fall Protection
Engine/Generator
Air Compressor
Ditch Witch Excavator
Ford F450
JD 410L Backhoe
Trail King TKT24LP Trailer
AB Service ETO Drive ‐ Water P
GAC Filter #1
GAC Filter #2
GAC Filter #3
GAC Filter #4
GAC Filter #5
GAC Filter #6

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Water Tank ‐ Southport Basin 3
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Storage Tank/ Pump ‐ Oak St
Pumps @ Southport
Water Meter And Strainers
Fire Hydrant Replacement Prog
Replace Water Main (Del, Maine, Penn)
Pumps ‐ Central
Pumps ‐ Northeast
Water Tank ‐ Northeast
Water Tank ‐ Central
Hydrants
Meter
Harbor Water Lines Adjustment
BBWTP Landscaping Project
Water Plant Security ‐ 400 N Harbor

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Newport South Water Meter Retrofit
Water Meter Retrofit Area ‐ Memorial Park North
Water Meter Retrofit Area ‐ Memorial Park South
Liquid Chlorine System
Linden West Water Main Replacement Project
Water Meter Retrofit Program
Water System Repairs
Water Master Plan ‐ 2014

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5 16,753,766 416,480 4,607,470 12,146,296

Subtotal - Excl. Pipelines (valued separately) 24,700,858 569,384 9,205,637 15,495,221 36,890,112 20,528,634
CITY OF WEST SACRAMENTO

TECHNICAL MEMORANDUM

WASHINGTON DISTRICT IMPROVEMENT ANALYSIS

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1.0 INTRODUCTION

The City of West Sacramento (City) contracted with Carollo Engineers, Inc. (Carollo) to update its Water Master Plan (2015 Master Plan). As part of this project, the City’s hydraulic model was rebuilt based on the City’s most recent GIS data. The hydraulic model includes all water distribution infrastructure within the City’s service area. A set of recommended improvements was developed based on evaluating the existing and future scenarios of the updated hydraulic model.

Prior to the completion of the 2015 Master Plan, a separate analysis of the Washington District was conducted by West Yost Associates (West Yost). The hydraulic model used by West Yost included only a small portion of City’s water infrastructure and included assumptions based on boundary conditions. The evaluation by West Yost resulted in a separate set of recommended improvements within the Washington District.

The City is moving forward with some of the recommended improvements identified by West Yost. The hydraulic model was updated to include the proposed improvements and an analysis was performed to evaluate the impact these improvements have on the overall system, as well as the recommended improvements identified in the 2015 Master Plan.

2.0 BACKGROUND

The Washington District is located in the northeast corner of the City within the North Area. The District is bound by A Street and Yolo County Park to the north, West Capitol Avenue to the south, and the Sacramento River to the east. On the west side, it is bound by 6th street from A Street to the railroad and on 8th street following the railroad south. The Washington District consists of approximately 194 acres. West Yost conducted an analysis of this area and provided recommended improvements.

The City is implementing the following improvements recommended by West Yost:

- **Improvement 1**: Replacing an existing 6-inch diameter water main with an 8-inch diameter main along B Street and to also complete this loop at Metro Lane.
- **Improvement 2**: Constructing a new 12-inch water main on 6th Street to connect with the 8-inch water main on West Capitol Avenue.
- **Improvement 3**: Replacing the 8-inch diameter main on 5th Street with a 12-inch diameter main.
- **Improvement 4**: Constructing a new 8-inch diameter main along West Capitol Avenue.
Figure 1 shows a detailed map of the improvements in the Washington District.

### 3.0 PLANNING CRITERIA

The City’s water supply, storage, and distribution facilities were evaluated based on the planning criteria defined in this section. The developed criteria address acceptable service pressures, and distribution main performance.

#### 3.1 Service Pressures

Pressures maintained within the distribution system vary depending on distribution operations and pressure zone topography. It is essential that water pressure in a consumer’s residence or place of business is neither too high nor too low. The AWWA Manual on Distribution Network Analysis of Water Utilities (AWWA M-32), indicates that pressures between 30 pounds per square inch (psi) and 80 psi are generally expected during the range of system water demands. Minimum service pressure criteria were developed for various demand conditions as part of the 2015 Master Plan. The pressure criteria are summarized below:

- **Peak Hour Demand (PHD):** The City’s Water System Design Standards specify a minimum service pressure of 35 psi during the PHD condition. This criterion is typical of distribution systems in California that are similar to the City’s.

- **Maximum Day Demand (MDD) + Fire Flow:** This pressure criterion is related to fire flows and was devised to ensure adequate positive pressure head for booster pumps in fire trucks. The industry standard fire pressure criterion requires a minimum acceptable residual pressure of 20 psi at the connecting hydrant.

#### 3.2 Distribution Mains

Transmission mains are generally sized to carry the greater of the PHD or the MDD plus fire flow. Other criteria related to distribution piping include the maximum and minimum velocities and maximum allowable head loss.

High velocities may cause damage to the pipes and to their appurtenances. It is normally good practice to limit pipe velocities to no more than 7 feet per second (fps). Provided that the maximum velocity and pressure criteria are not exceeded, high pipeline head loss by itself is not a controlling factor. It may be an indication that the pipe is nearing the limit of its carrying capacity, and may not have sufficient capacity to perform under stringent conditions. Good practice dictates monitoring pipes that have a head loss in excess of 10 feet per 1,000 feet (AWWA M-32).
Legend

- Washington Improvements
- Washington District Limits
- Water Pipelines
- Water Features
- Parcels
- Pump Station

WASHINGTON DISTRICT IMPROVEMENTS
FIGURE 1
CITY OF WEST SACRAMENTO
WASHINGTON DISTRICT IMPROVEMENT ANALYSIS
4.0 MASTER PLAN EVALUATION

This section summarizes the findings of the hydraulic analysis performed on the City’s existing distribution system under current and future demand conditions as part of the 2015 Master Plan. The 2015 Master Plan accounted for the future increases in demand associated with the Washington District, as outlined in the City’s General Plan Update. A system pressure analysis, fire flow analysis, and pipeline analysis were performed on the existing and future system.

The system pressure analysis was performed to ensure system pressures met the criteria outlined in Section 3.1. Under current and future PHD conditions, the model did not identify any system pressures that fell below 35 psi. In most areas during PHD conditions, pressures do not fall below 45 psi.

For the fire flow analysis, the model performs a steady state simulation at each node and reports residual pressure at the node to evaluate impacts of fire flow demands on the system. Nodes with residual pressures less than 20 psi are considered deficient. Fire flow simulations were performed using the fire flow simulator. This simplifies the model by eliminating the requirement for assigning individual fire flow demands to all nodes. For the existing system, 109 out of 2,687 fire flow nodes were identified as deficient Citywide. Some of these deficiencies were alleviated by distributing large fire flows amongst two nodes. Figure 2 shows the deficient nodes for the existing system within the Washington District depicted in red. For the future system, after the proposed existing fire flow improvements from the 2015 Master Plan are been implemented, no additional fire flow deficiencies that could not be addressed by distributing large fire flows amongst two nodes were observed in the model runs.

The pipeline analysis was performed to identify pipelines within the system that do not conform to the criteria outlined in Section 3.1. Under existing conditions, no pipelines exceeding the pipeline velocity and head loss criteria were identified. Under future conditions, the model predicted that there were a few locations where additional transmission mains will be required due to hydraulic limitations. These updates are outlined in the 2015 Master Plan.

The results for these analyses were then compared to the results of the analyses performed to include the Washington District improvements the City is implementing from the West Yost recommendations to evaluate the impact of these improvements on the overall system and the recommended improvements identified in the 2015 Master Plan.
5.0  WASHINGTON DISTRICT IMPROVEMENT ANALYSIS

The hydraulic model was updated to include the Washington District improvements that the City intends to implement. This section presents the findings as a result of the hydraulic model analysis for the City’s existing distribution system under current and future conditions with the Washington District improvements.

5.1  System Pressure Analysis

The system pressure analysis was performed using the hydraulic model under PHD conditions. The City would like to maintain a minimum pressure of 35 psi under PHD conditions.

5.1.1  Existing System with Washington Improvements

Under existing PHD conditions, the updated model did not identify any locations where system pressures were below 35 psi. In most areas, the pressures did not fall below 45 psi. Pressures in the Washington District remained relatively the same after the improvements were added. Most of the Washington District had pressures near 50 psi.

5.1.2  Future System with Washington Improvements

Under PHD conditions, the updated model did not identify any location where system pressures fell below 35 psi. In most areas, the pressure did not fall below 45 psi.

5.2  Fire Flow Analysis

The fire flow analysis was performed similarly to how it was done previously. Fire flow nodes with residual pressures below 20 psi were flagged as deficient.

5.2.1  Existing System with Washington Improvements

Fire flow simulations were performed using the fire flow simulator. With the implementation of the proposed Washington District improvements, 100 out of 2,691 fire flow nodes were identified as deficient throughout the City’s system. As noted in Section 4.0, 109 nodes were identified as deficient Citywide without the Washington District improvements. 9 of the 109 fire flow deficiencies were alleviated due to the Washington District improvements. The deficiencies that were alleviated can be attributed to the improvements on B Street near Washington Place. Figure 3 shows the nodes that are deficient within the Washington District after the improvements were made.
FIRE FLOW DEFICIENCIES WITH WASHINGTON IMPROVEMENTS

LEGEND

- Fire Flow Deficiencies
- Washington Improvements
- Water Pipelines
- Water Features
- Parcels
- Pump Station

WASHINGTON DISTRICT IMPROVEMENT ANALYSIS

FIGURE 3
5.2.2 **Future System with Washington Improvements**

For future conditions, a fire flow simulation was performed in a similar manner as the existing system model simulations. After the proposed existing fire flow improvements have been implemented, no additional fire flow deficiencies that could not be addressed by distributing large fire flows amongst two nodes were observed in the model runs. The Washington District improvements had a negligible impact on the fire flow deficiencies for future conditions, aside from the 9 fire flow deficiencies that were resolved under the existing system analysis.

5.3 **Pipeline Analysis**

A pipeline velocity analysis was performed to identify pipelines within the system that do not conform to the criteria outlined in Section 3.1.

5.3.1 **Existing System with Washington Improvements**

No pipelines that exceeded the pipeline velocity and head loss criteria under existing conditions were identified. The velocities and head losses in the Washington District remained relatively the same after the improvements were added.

5.3.2 **Future System with Washington Improvements**

The model predicted that, under future conditions, there are a few locations within the City where additional transmission mains will be required due to hydraulic limitations. The improvements to the Washington District did not add or remove any of the proposed transmission improvements described in the 2015 Master Plan Update.

6.0 **CONCLUSIONS AND RECOMMENDATIONS**

Based on the results of the hydraulic modeling, the Washington District improvements alleviate some of the fire flow deficiencies, but otherwise have a negligible impact on system pressures, velocities, and head losses in the Washington District and throughout the City in the existing scenario. Overall, the Washington District improvements had a negligible impact on the results of the future system analysis.

The following summarizes the findings of this analysis:

- Future demand increases in the Washington District were accounted for as part of the 2015 Master Plan Update, in accordance with the growth projections identified in the City's General Plan Update.

- Improvement 1 was included in the 2015 Master Plan as a recommended improvement project. Implementation of this project is recommended, and would mitigate 9 deficient fire flow nodes.
• Improvements 2, 3, and 4 were shown to have a negligible impact to the existing and future system when implemented. Implementation of these projects can be pursued at the City's discretion.

• It is recommended that the City still plan to construct the additional fire flow improvements identified in the 2015 Master Plan as funding allows.