City of Lakewood

FINAL - 2017 Water System Master Plan

August 2017

Control Automation Design, Inc.

STETSON ENGINEERS INC.

861 Village Oaks Drive, Suite 100 • Covina, California 91724
Phone: (626) 967-6202 • FAX: (626) 331-7065 • www.stetsonengineers.com

Northern California • Southern California • Arizona • Colorado

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EXECUTIVE SUMMARY

The City of Lakewood's Department of Water Resources (City) 2017 Water System Master Plan Update (2017 Update) is an update of the City's 2002 Water System Master Plan. This 2017 Update provides details on the City's historical and future demands, its water supply sources and water quality requirements, the City's water production and distribution facilities, and the City's finished water pumping, storage, and distribution facilities. The 2017 Update also provides conclusions and recommendations, including cost estimates for improvements and an implementation plan.

Water Supplies and Demands

A summary of the City's historical and projected water demands is provided in Table ES-1 and Table ES-2. The following summarizes the water demand information provided.

- The majority of the City's potable water supplies comes from groundwater production. The City uses recycled water supplies from the Los Angeles County Sanitation Districts (LACSD) through the City of Cerritos. The City also has access to imported water from Metropolitan Water District of Southern California (MWD) through Central Basin Municipal Water District.
- The City's historical water demands averaged 9,175 AFY, with a range between 6,869 and 10,369 AFY.
- Projected water demands from 2020 to 2040 are estimated to be lower than the current water demand of approximately 7,100 AFY due to the City's built-out condition and the City's implementation of required water conservation measures.

Table ES-1 Historical Water Demands

Fiscal Year	Potable Water Demand (AF)	Recycled Water Demand (AF)	Total Water Demand (AF)
1996-97	9,473	541	10,015
1997-98	8,538	388	8,926
1998-99	8,878	446	9,324
1999-00	9,127	478	9,605
2000-01	8,718	405	9,123
2001-02	9,194	423	9,617
2002-03	9,070	346	9,416
2003-04	9,433	426	9,859
2004-05	8,841	303	9,144
2005-06	9,205	380	9,585
2006-07	9,929	440	10,369
2007-08	9,432	413	9,846
2008-09	8,641	383	9,024
2009-10	9,070	442	9,512
2010-11	7,713	429	8,143
2011-12	8,022	452	8,474
2012-13	9,275	487	9,762
2013-14	8,690	549	9,239
2014-15	7,177	468	7,645
2015-16	6,387	482	6,869
Average	**8,741**	**434**	**9,175**

Table ES-2 Projected Water Demands

Year	Potable Water Demand (AF)	Recycled Water Demand (AF)	Total Water Demand (AF)
2020	6,667	502	7,169
2025	6,801	502	7,303
2030	6,937	502	7,439
2035	7,076	502	7,578
2040	7,098	502	7,600

Water Production and Distribution Facilities

Summary listings of the City's water production and distribution facilities are provided in Tables ES-3 through ES-7. The City's water facilities include the following.

- 10 potable wells and 1 irrigation well
- Plant 4 includes 3 storage tanks, 7 booster pumps, 2 wells, and an arsenic treatment system.
- Plant 13 includes 5 storage tanks and 4 booster pumps.
- Plant 22 includes a reservoir, one well, and 4 booster pumps.
- Two imported water connections with MWD.
- Three emergency connections with the City of Cerritos, the City of Long Beach, and Golden State Water Company.

Table ES-3 Groundwater Production Wells

Name	Year of Installation	Well Depth (ft bgs)	Motor Size (hp)	Capacity (gpm)	Services
Potable					
Well #2A	1970	656	50	500	System
Well #4	1937	656	75	700	System
Well #8	1945	385	75	1,000	Plant 4 Tanks
Well #10	1950	876	60	975	Plant 4 Tanks
Well #13A	2003	1,120	100	1,200	Plant 13 Tanks
Well #15A	2001	1,050	100	1,750	Plant 4 Tanks
Well #17	1951	1,134	100	1,100	System
Well #18	1951	1,108	100	1,000	System
Well #22	1996	1,080	200	1,200	Plant 22 Reservoir
Well #27	2010	970	200	2,250	Plant 4 Tanks
Total				11,675	
Irrigation					
Well #6	1969	602	40	500	Irrigation

Table ES-4 Booster Pump Facilities

Name	Year of Installation	Power (hp)	Capacity (gpm)
Plant 4, Booster #2	1965	50	1,000
Plant 4, Booster #3	1965	50	1,000
Plant 4, Booster #4	1965	100	1,700
Plant 4, Booster #5	1965	100	2,000
Plant 4, Booster #6	1965	50	1,000
Plant 4, Booster #7	1965	60	1,120
Plant 4, Booster #8	2017	125	2,600
Plant 13, Booster #1	2017	40	800
Plant 13, Booster #2	2017	50	1,000
Plant 13, Booster #3	2017	75	1,500
Plant 13, Booster #4	2017	75	1,500
Plant 22, Booster #1	1990	40	750
Plant 22, Booster #2	1990	40	925
Plant 22, Booster #3	1990	40	950
Plant 22, Booster #4	1990	60	1,350
Total			19,195

Table ES-5 Water Storage Facilities

Name	Year of Installation	Material	Capacity (MG)	Source
Plant 4, Tank 1	1965	Steel	1.5	Wells #8, #10, #15A, #27
Plant 4, Tank 2	1965	Steel	1.5	Wells #8, #10, #15A, #27
Plant 4, Tank 3	1996	Pre-Stressed Concrete	5.4	Wells #8, #10, #15A, #27
Plant 13, Tank 1	1950	Steel	0.454	Well #13A
Plant 13, Tank 2	1950	Steel	0.454	Well #13A
Plant 13, Tank 3	1950	Steel	0.454	Well #13A
Plant 13, Tank 4	1997	Steel	0.454	Well #13A
Plant 13, Tank 5	1965	Steel	0.22	Well #13A
Reservoir 22	1954	Cast-in Place Concrete	2.5	Well #22
Total			12.9	

Table ES-6 Imported Water Connections (MWD / CBMWD)

Name	Location	Capacity (cfs)	Capacity (gpm)
CENB-43	Southeast corner of Allington Street and Woodruff Avenue (Inactive in 2017)	15	6,700
CENB-49	East Union Pacific Railroad right of way and south of Carson Street	15	6,700

Table ES-7 Emergency Interconnections

Name	Location	Direction	Size (Inches)	Capacity (gpm)
City of Cerritos	Palo Verde Avenue at Andy Street	2-way	12	5,000
City of Long Beach	Palo Verde Avenue south of Carson Street	2-way	12	5,000
Golden State Water Company (GSWC)	North side of Carson Street at the San Gabriel River	2-way	12	5,000

Conclusions and Recommendations

The 2017 Update recommends an initial 10-year CIP project schedule from fiscal year 2017-18 through fiscal year 2026-27. Additional improvements will be needed after the initial 10-year CIP project schedule to replace aging facilities and address other water system needs. As a result, the 2017 Update provides an additional CIP summary schedule from fiscal year 2027-28 through fiscal year 2036-37. The following is a listing of conclusions and recommendations from the 2017 Update for inclusion in the CIP project schedule.

Water Quality

1) Continue monitoring and reporting in accordance with Title 22 requirements. Continue monitoring for upcoming regulations (including establishment of a 1,2,3-Trichlorpropane Maximum Contaminant Level). It is recommended the City update its existing Vulnerability Assessment and Emergency Response Plan reports as needed.

Groundwater Wells (Casings)

2) Based on current life expectancy projections, two wells (Wells #4 and #8) have a theoretical estimated remaining service life of less than five years. Replacement of these wells should be considered in the near future.
    a. **The 2017 Update recommends construction of a new well in the near future.** Construction of a new well will provide sufficient replacement production capacity in the event Wells #4 and #8 are removed from service. The City is currently in the process of constructing a new production well which will be able to replace the combined capacities of Wells #4 and #8.

3) Three wells (Wells #10, #17, and #18) have an estimated remaining service life of less than ten years. Redevelopment of these well casings on a regular basis is recommended. Replacement of these wells should be considered in 10 to 25 years. **The 2017 Update recommends construction of a new well in the future to provide sufficient replacement production capacity.**

4) Two wells (Wells #2A and #6) have an estimated remaining service life of 11 years. All other wells (Wells #13A, #15A, #22, and #27) appear to have at least 20 years of projected remaining life expectancy. Although life expectancy projections for these wells should continue to be reviewed periodically, there are no immediate recommendations for these wells at this time.

Groundwater Wells (Pumps)

5) The Well #10 pump was originally installed in 1950 and the pump was last replaced in 2003. Although SCE pump tests indicate the well pump is currently efficient, the well pump should be scheduled for replacement if pump efficiency declines. Remaining well pump components should be replaced pursuant to the City's Asset Management Plan (see Item 23 below).

6) The Well #8 pump was originally installed in 1945 and the pump and motor were last replaced in 1997. The Well #8 pump should be scheduled for replacement (if the well is not replaced as recommended above). SCE pump tests for Well #8 are not available. Remaining well pump components should be replaced pursuant to the City's Asset Management Plan (see Item 23 below).

7) Based on recent SCE pump test results, there are currently five well pumps which are operating inefficiently (Wells #2A, #4, #15A, #18, and #6). However, the motors and/or pumps for Wells #2A, #4, #15A, and #18 have been replaced within the past seven years. Although there may be annual energy cost savings associated with improving or replacing these well pumps, there does not appear to be an overall economic benefit at this time.
    a. **The City's Asset Management Plan (See Item 23 below) recommends replacement of the pumps for Wells #2A, #15A, and #18 within the next several years.** The immediate replacement of these well pumps have not been included in the 10-year CIP schedule.

Booster Pumps

8) Based on recent SCE pump test results, there are currently four booster pumps which are operating inefficiently (Plant 4, Boosters #2, #3, #4, and #6). Although there may be annual energy cost savings associated with improving or replacing these booster pumps, there does not appear to be an overall economic benefit at this time.

9) Plant 4 booster pumps (Boosters #2, #4, #6, and #7) have a remaining service life of two years and should be scheduled for replacement or refurbishment. **The 2017 Update recommends replacement of these booster pumps in the near future.**

10) Plant 22, Boosters #1, #2, #3, and #4 have a remaining service life of seven years. Replacement or refurbishment of should be considered periodically to increase the remaining service life. However, replacement of these booster pumps is not necessary if Reservoir 22 is removed from service (see recommendation below).

Storage Reservoirs

11) The City's existing reservoirs have sufficient storage capacity to meet equalization, emergency, and fire flow requirements under current and future conditions. In addition, the City's existing reservoirs have sufficient storage capacity under current and future conditions with Reservoir 22 removed from service.

12) The City's three oldest water storage facilities (Plant 13, Tank 1, Tank 2 and Tank 3) have an estimated remaining service life of 12 years. Although life expectancy projections for these reservoirs should continue to be reviewed periodically, there are no immediate recommendations for these reservoirs at this time.
    a. The Asset Management Plan (see Item 23 below) recommends replacement of these three tanks in 2020. Replacement of these the three tanks have not been included in the 10-year CIP schedule.

13) In general, steel reservoirs should be recoated every 20 years (without cathodic protection) and 25 years (with cathodic protection) to ensure proper protection against corrosion.
    b. Plant 13, Tanks 1, 2, 3, 4 and 5 were last coated over 20 years ago. **Although these reservoirs include cathodic protection, the 2017 Update recommends the City recoat these reservoirs in the next 5 to 10 years**.

14) Recent reservoir inspections reports prepared for each of the City's storage facilities recommend the following:

    c. Perform regular cleaning, inspection and repair cycles every two years for each reservoir.
    d. For Plant 13, Tanks 4 and 5, recoat roof exterior and do not use cathodic system rectifier until it is repaired for Tank 5. The City has indicated it has recently recoated the roof exterior for Plant 13, Tanks 4 and 5.
    e. For Reservoir 22, repair the cracking in the interior roof and walls and floors or replace the concrete. Due to the high cost of required repairs, the inspection report recommends replacement of Reservoir 22.

15) The City may consider preparing comprehensive analysis reports for each of its reservoirs. The reports would include corrosion and structural/seismic evaluations based on applicable standards and guidelines (including from the American Water Works Association and the Occupation Safety and Health Administration).

16) **The 2017 Update recommends the City remove Reservoir 22 from service.** The inspection report for Reservoir 22 recommends replacement of the reservoir. The City's existing reservoirs have sufficient storage capacity under current and future conditions with Reservoir 22 removed from service. In addition, the hydraulic model only identified an additional 3 model node locations with fire flow deficiencies with as a result of Reservoir 22 being removed from service (see discussion below).

Imported Water Connections

17) Perform routine testing and maintenance on the CENB-49 connection located in the southwestern part of the system. The hydraulic model indicates retaining CENB-49 will provide a hydraulic benefit to the system. The City has placed the CENB-43 connection in an inactive status as of 2017.

Recycled Water System

18) The City's existing recycled water distribution system includes approximately six miles of pipeline and serves approximately 482 AFY to over 41 metered connections. A proposed recycled water expansion would increase the system by an additional 11 miles and serve an additional 159 AFY of recycled water. The estimated cost to construct the proposed recycled water system expansion is approximately $7,700 per AF and is significantly higher than the City's existing cost of using potable water. It is not recommended the City pursue this expansion of its recycled water system at this time.

19) The City may be able to provide approximately 434 AFY of recycled water service to the Lakewood Golf Course if the City of Long Beach is unable to continue providing service (as a result of reduced recycled water supplies) and the City installs additional infrastructure. The proposed recycled water service would include construction of approximately 3 miles of pipeline. The estimated cost to construct the proposed recycled water system expansion is approximately $500 per AF, which excludes the cost to purchase recycled water. The City should continue seeking potential grants to fund an expansion of City's existing recycled water system.

Supervisory Control and Data Acquisition (SCADA) System

20) Control Automation Design (CAD) performed a review of the City's existing SCADA system. CAD recommended radio network, SCADA software, and hardware (i.e. Programmable Logic Controller)

upgrades at various sites. **The 2017 Update recommends the City implement these SCADA improvements into its CIP schedule.**

AMI / Billing System

21) The City's current billing system is not designed for use with water systems. In addition, the City manually obtains meter readings and can only access data on a bimonthly basis. **The 2017 Update recommends the City incorporate advanced meter infrastructure (AMI) improvements into its CIP schedule** to improve data collection from meters and simplify the billing process for customers. The new system will include an AMI system, including software and managed services implementation and AMI network management, and replacement of all the City's meters and registers.

Asset Management Plan

22) GHD prepared an "Asset Management Plan" to serve as a long-range planning document for managing the water production facility assets owned and operated by the City (including all groundwater production wells and all facilities associated with Plants 4, 13, and 22), over the next 10 to 20 years. The Asset Management Plan provides a schedule of annual investment costs (including rehabilitation and replacement of facilities) required to maintain service. **The 2017 Update recommends the City incorporate the recommended Asset Management Plan replacement schedule into the City's CIP schedule.**

Hydraulic Modeling

23) The hydraulic model was updated with the 2014/2015 pipe replacement records and 2015 pump test data, and re-calibrated based on 2016 fire flow test data. Hydraulic modeling runs were performed for existing and future maximum day demands plus fire flow conditions. Distribution pipe deficiencies were identified based on certain pressure, velocity, head loss, and fire flow criteria.

24) The hydraulic model identified 125 model node locations with fire flow deficiencies under the maximum day demand plus fire flow conditions requirements based on an existing average annual demand of 7,100 AFY. The model also identified an additional 3 model node locations with fire flow deficiencies as a result of removing Reservoir 22 from service. The model was used to identify 133 pipeline improvements to resolve all the fire flow deficiencies. **The 2017 Update recommends**

replacement of these 133 pipelines (first priority) with larger diameter pipelines (See Section 6.3.4 and Appendix G).

25) **The 2017 Update recommend replacement of an additional 36 pipelines (first priority) due to historical maintenance problems and leaks (See Section 6.4.2 and Appendix G.**

26) Using the age, material, and pipeline size data in the hydraulic model, an additional 68 pipeline locations for upgrades (second priority) have been identified for the annual replacement program. These secondary priority pipelines include transmission mains 10-inches or larger and greater than 60 years old. These aging pipelines are critical in delivering water through the City's distribution system and should be replaced before they begin to fail. In addition, second priority pipelines include the replacement of 4-inch cast iron pipe and greater than 60 years old. Approximately 89 percent of the City's distribution system leaks have been associated with this type of pipe (i.e. 4-inch cast iron pipe greater than 60 years old). **The 2017 Update recommends replacement of these 68 pipeline replacements (second priority) (See Section 6.4.2 and Appendix J).**

Table ES-8 provides the summary of the City's annual CIP budget based on the recommendations provided in the 2017 Update.

Table ES-8 Capital Improvement Plan (CIP) Budget Summary

Fiscal Year	Annual Total
2017-18	$2,450,400
2018-19	$2,500,300
2019-20	$2,497,900
2020-21	$2,509,000
2021-22	$2,474,200
2022-23	$2,488,800
2023-24	$2,464,600
2024-25	$2,449,800
2025-26	$2,532,800
2026-27	$2,457,900
2027-28	$2,488,650
2028-29	$2,496,950
2029-30	$2,493,000
2030-31	$2,506,200
2031-32	$2,522,600
2032-33	$2,522,800
2033-34	$2,406,700
2034-35	$2,494,700
2035-36	$2,412,800
2036-37	$2,548,000

CHAPTER 1

INTRODUCTION AND OVERVIEW

The City of Lakewood's Department of Water Resources (City) 2017 Water System Master Plan Update (2017 Update) is an update of the City's "Water Master Plan" originally prepared in 2002. This 2017 Update reviews and updates the City's historical and current water demands and supplies and water quality requirements; evaluates and provides recommendations on the City's groundwater, pumping, storage, and treatment facilities; and presents a capital improvement plan schedule and cost estimates of potential system improvements.

1.1 System Description

1.1.1 City of Lakewood Formation and Location

The City of Lakewood was incorporated on March 9, 1954. The City of Lakewood is located about 20 miles southeast of the City of Los Angeles and was estimated by the U.S. Census Bureau to have a population of approximately 81,600 in July of 2015. The City of Lakewood has an area of about 9.5 square miles and is surrounded by Long Beach on its southwest and west sides, Cypress and Hawaiian Gardens on its east side, Cerritos on its northeast side, and Bellflower on its north side. Water service to the City of Lakewood is provided by the City's Department of Water Resources and Golden State Water Company (GSWC). The City provides water service west of the San Gabriel River (74 percent of the total population within the City of Lakewood's municipal boundaries) and GSWC provides water service east of the San Gabriel River (26 percent of the total population within the City of Lakewood's municipal boundaries). The location of the City's service area is provided in Figure 1-1.

1.1.2 City Management

The City Council of Lakewood has five members, who each serve a four-year term. Once every year the city council elects one council member to serve as mayor and another to be the vice mayor. In 1959, the City gained the rights to use and sustain the water system. The City's Department of Water Resources is responsible for managing the City's water system.

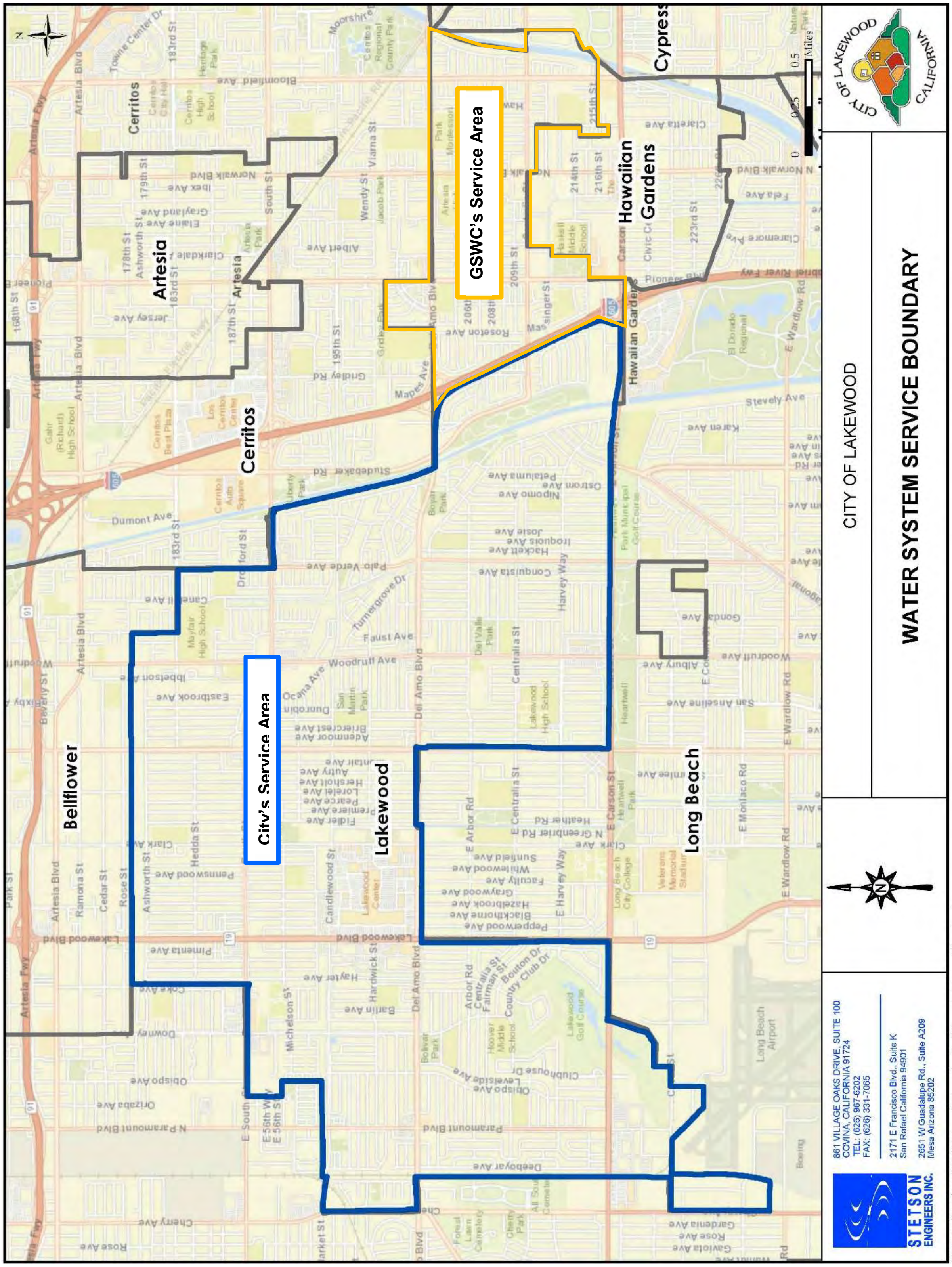

Figure 1-1 Water System Service Boundary

1.2 Organization of the Water System Master Plan Update Report

This 2017 Update provides a comprehensive assessment of the water distribution system issues and water quality requirements confronting the City as it plans for the next 20 years. This Update is prepared to assist the City in making strategic and facility planning decisions. The report is organized as follows:

- Chapter 1 provides an introduction to the 2017 Master Plan Update.
- Chapter 2 projects water demands within the City's service area to the year 2040. Forecasts in this 2017 Update represent long-term average annual water use as well as seasonal and shorter term peak demands.
- Chapter 3 discusses the City's sources of water supply and includes opportunities which may increase the City's water supply reliability and utilize new water supply sources.
- Chapter 4 reviews the various water quality requirements the City must comply with in order to provide domestic potable drinking water service and summarizes the current quality of the water served by the City.
- Chapter 5 provides information on the City's groundwater production facilities (including wells, booster pumps, reservoirs, and treatment facilities). Information regarding the condition and performance of the City's existing finished water pumping, storage and distribution facilities is provided. It also presents recommendations for capital improvements to improve system operations and performance, and maintain system reliability and redundancy.
- Chapter 6 evaluates the current condition of water storage and water pumping facilities, and hydraulics in the distribution system. It also provides information

on proposed facilities, water main replacement needs, and reservoir improvements to enhance the performance of water pumping, storage, and distribution facilities.

- Chapter 7 provides a plan for implementing the facility improvements identified in this 2017 Update. Certain projects, studies, or monitoring activities for the substantive components of the water system are important for continued proper operation of the City's water system. This 2017 Update summarizes these actions, prioritizes the facility improvements, summarizes cost estimates, and provides implementation schedules.

Preparation of the City's 2017 Update was based on currently available information on the facilities and conditions of the City's water system. In addition, some evaluations, conclusions, and recommendations in the 2017 Update were based on the water system hydraulic model. This 2017 Update should be considered a guideline and the City may need to change the priorities presented in this report in response to considerations that cannot be foreseen at this time.

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CHAPTER 2

WATER DEMANDS

2.1 Introduction

This section presents current and projected water demands within the City's service area to the year 2040. Projected water demands in this 2017 Update represent long-term average annual water demand as well as seasonal and shorter term peak demands. The City's 2015 Urban Water Management Plan (2015 UWMP), dated June 2015, was reviewed in preparing this section.

2.2 Water Service Connections and Population

As discussed in Chapter 1, the City's Department of Water Resources serves approximately 74 percent of the total population within the City of Lakewood's municipal boundaries. The City of Lakewood's municipal boundaries had approximately 20,280 service connections in 2002 and approximately 20,340 service connections in 2015. A majority of the City's land use is for residential purposes. Pursuant to the City's 2015 UWMP, the City's population was estimated to be 81,601 by the U.S. Census Bureau on July 1, 2015. Table 2-1 shows the current and projected populations for the City of Lakewood and the City's Department of Water Resources' service area.

Table 2-1 Current and Projected Population

Year	City of Lakewood	City's Department of Water Resources Service Area
2010	80,048	59,704
2015	81,601	59,331
2020	81,500	60,019
2025	82,315	60,117
2030	83,138	60,335
2035	83,300	60,492
2040	84,152	60,705

Source:
Population data was obtained from Table 3-2 of the City's 2015 UWMP. Population projections for 2040 were interpolated based on 2010 to 2035 population data.

2.3 Water System Demands

2.3.1 Historical, Current, and Projected Water Production and Demands

The City's potable water supplies are from groundwater production, imported water from Metropolitan Water District of Southern California (MWD), and purchased water from other systems. The City also has access to recycled water supplies for irrigation purposes. Since fiscal year 2012-13, the City has delivered water to other water systems, adding to its production. Table 2-2 shows the historical and current total water demands for the City.

Table 2-2 Historical Water Demands

Fiscal Year	Potable Water Demand (AF) (1)	Recycled Water Demand (AF)	Total Water Demand (AF)
1996-97	9,473	541	10,015
1997-98	8,538	388	8,926
1998-99	8,878	446	9,324
1999-00	9,127	478	9,605
2000-01	8,718	405	9,123
2001-02	9,194	423	9,617
2002-03	9,070	346	9,416
2003-04	9,433	426	9,859
2004-05	8,841	303	9,144
2005-06	9,205	380	9,585
2006-07	9,929	440	10,369
2007-08	9,432	413	9,846
2008-09	8,641	383	9,024
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2010-11	7,713	429	8,143
2011-12	8,022	452	8,474
2012-13	9,275	487	9,762
2013-14	8,690	549	9,239
2014-15	7,177	468	7,645
2015-16	6,387	482	6,869
Average	**8,741**	**434**	**9,175**

Source:
Historical water demand data is based on groundwater production, imported water, purchased water, recycled water, and water delivery data provided by the City (see Section 3.1)
(1) Potable demand = (total groundwater production) - (Well #6 production) + (purchased water) - (water delivered to Long Beach)

Table 2-3 shows the projected total water demands for the City from 2020 to 2040. The City's projected water demand is calculated based on the urban per capita water use target developed pursuant to the Water Conservation Act of 2009, or Senate Bill 7 (SBX7-7), which is described in the City's 2015 UWMP. The projected water demands are consistent with projected water demands from the City's 2015 UWMP. The City's projected water demands over the next 20 years are generally lower than the current demand of 7,100 AFY. This is because the City is currently almost in build-out condition and the City will continue existing conservation programs to meet the requirements under the Water Conservation Act of 2009.

Table 2-3 Projected Water Demands

Year	Potable Water Demand (AF)	Recycled Water Demand (AF)	Total Water Demand (AF)
2020	6,667	502	7,169
2025	6,801	502	7,303
2030	6,937	502	7,439
2035	7,076	502	7,578
2040	7,098	502	7,600

Source:
Projected potable and recycled water demands through 2035 were obtained from Table 4-2B of the City's 2015 UWMP. Water demands for 2040 were estimated based on the City's projected water use target of approximately 104.4 GPCD in 2035, from Table 4-2 of the City's 2015 UWMP, and the City's projected 2040 population (see Table 2-1).

Methodologies for calculating baseline and compliance urban per capita water use for the consistent implementation of the Water Conservation Act of 2009 have been published by the California Department of Water Resources (DWR) in its February 2016 guidance document.[1] DWR's guidance document was used by the City to determine the required water use parameters which are discussed in the City's 2015 UWMP. The City developed the baselines and targets individually and not regionally. Based on the guidance document, the City's 2015 UWMP determined a "2015 Interim Urban Water Use Target" of 103 gallons per capita day (GPCD) and a "2020 Urban Water Use Target" of 99 GPCD. The City currently meets both the 2015 and 2020 water use targets. In addition, the City is projected to continue meeting the 2020 water use target. These urban per capita water use targets are further described in the City's 2015 UWMP.

[1] Methodologies for Calculating Baseline and Compliance Urban per Capita Water Use, California Department of Water Resources, February 2016.

2.3.2 Historical Water Losses (Unaccounted for Water)

Unaccounted-for water is the difference between the amount of water produced and the amount of water billed to customers. Within the water system, the following are expected sources of unaccounted-for water: inaccurate metering due to faulty meters and water use not metered such as firefighting, flushing of the water system, and washing filters at the treatment plants.

According to the City's 2015 UWMP, the volume of water loss in 2015 was approximately 327 AF, which is approximately 6 percent of the total water production in 2015.

2.3.3 Maximum Day Potable Water Demands

The City's average daily demand (ADD) for any year is calculated by dividing the total annual water usage for that year by 365 days. The Maximum Day Demand (MDD) is calculated by multiplying the average daily demand by a peaking factor of 1.5, which is based on recent production data provided by City Staff. Table 2-4 summarizes the projected maximum day water demands.

Table 2-4 Maximum Day Potable Water Demands

Year	Average Day Demands (AFY)	Average Day Demands (ADD) (MGD)	Maximum Day Demands (MDD) (1) (MGD)
2020	6,667	5.9	8.9
2025	6,801	6.1	9.1
2030	6,937	6.2	9.3
2035	7,076	6.3	9.5
2040	7,098	6.3	9.5

Note:

(1) MGD=Million Gallons per day

(2) MDD=ADDx1.5 (based on maximum day water production provided by City staff)

2.4 Recycled Water Demands

The City purchases recycled water produced by the Los Angeles County Sanitation Districts (LACSD) from the City of Cerritos, to fulfill some of its landscape irrigation demands for schools, medians, and parks. The City's historical and projected recycled water demands are summarized in Table 2-2 and Table 2-3, respectively. A further discussion regarding the City's recycled water supplies is provided in Section 3.1.3.

CHAPTER 3

WATER SUPPLIES AND REGIONAL OPPORTUNITIES

3.1 Water Supplies

The City's main source of water is groundwater from the Central Basin, but it also uses recycled water and has the ability to obtain treated imported water from MWD and purchased water from other systems. A summary of the City's water supply sources and water quantities from each is summarized in Table 3-1.

3.1.1 Central Basin Groundwater

The Central Basin is located in Los Angeles County approximately 20 miles southeasterly of downtown Los Angeles. Central Basin covers approximately 270 square miles and is bounded on the north by the Hollywood Basin and the Elysian, Repetto, Merced, and Puente Hills, to the east by the Los Angeles County/Orange County line, and to the south and west by the Newport-Inglewood Uplift.

Table 3-1 Historical Annual Water Production (AF)

Fiscal Year	Groundwater Production (1)	Imported Water (MWD) (2)	Recycled Water (LACSD) (3)	Purchased Water (4)	Total Water Production	Water Deliveries to Others (5)
1996-97	9,392	0	541	120	10,054	0
1997-98	8,536	0	388	36	8,960	0
1998-99	8,915	0	446	0	9,361	0
1999-00	9,167	0	478	0	9,645	0
2000-01	8,758	0	405	0	9,163	0
2001-02	9,229	0	423	0	9,652	0
2002-03	9,102	0	346	0	9,448	0
2003-04	9,464	0	426	0	9,890	0
2004-05	8,869	0	303	0	9,172	0
2005-06	9,234	0	380	0	9,614	0
2006-07	9,965	0	440	0	10,405	0
2007-08	9,472	0	413	0	9,885	0
2008-09	8,679	0	383	0	9,062	0
2009-10	9,108	0	442	0	9,549	0
2010-11	7,752	0	429	0	8,181	0
2011-12	8,061	0	452	0	8,513	0
2012-13	9,825	0	487	0	10,312	(522)
2013-14	10,152	0	549	0	10,701	(1,418)
2014-15	8,670	0	469	0	9,138	(1,462)
2015-16	7,087	0	482	0	7,569	(665)
Average:	8,972	0	434	8	9,414	(203)

Notes:

(1) Groundwater production data was obtained from Water Replenishment District of Southern California reporting.

(2) The City has not purchased imported water supplies from MWD since 1991.

(3) Recycled water data was obtained from Central Basin Watermaster Annual Reports (1995-2015) and the City (2015-16).

(4) Data for purchased water from other water systems (i.e. City of Cerritos) was provided by the City.

(5) Data for water deliveries to other water systems (i.e. Long Beach Conjunctive Use Program) was provided by the City and from State Water Resources Control Board - Division of Drinking Water (SWRCB-DDW) reporting. Delivery data from 2012 SWRCB-DDW reporting was included within fiscal year 2012-13 totals.

Groundwater production in Central Basin is restricted to adjudicated rights fixed by the Central Basin Judgment and managed by a court-appointed Watermaster. The Central Basin was originally adjudicated in 1966 and the “Third Amended” Central Basin Judgment was filed by the Los Angeles Superior Court on December 23, 2013. The

Central Basin Judgment limits the annual amount of groundwater each party to the Judgment may extract from the Central Basin. The limit is referred to as an “Allowed Pumping Allocation” (APA). Pursuant to the Judgment, the total extraction right for each party includes a party’s APA, any contractual right acquired through lease or other agreements, and any right to extract stored water or carryover water. The Judgement contains the following provisions to provide flexibility in the control of groundwater extractions:

- A party may over extract groundwater from the Central Basin annually by up to 20 percent of its APA or 20 AF, whichever is greater.
- The Judgment allows parties to convert carryover water to storage in the Central Basin. A party may store up to 200 percent of its APA, provided storage is available, for later recovery.
- Beginning in fiscal year 2016-17, a party to the Judgment can carryover 60 percent of its unused APA (less water in its storage account) into the following fiscal year.
- During a declared water emergency, a party may carryover additional water (exceeding the normal carryover amount) up to an additional 35 percent of its APA (less water in its storage account)
- A party may not extract in excess of 140 percent of the sum of its APA and leased water amounts without Watermaster approval

Allowed Pumping Allocation

The City’s current APA in the Central Basin is 9,432 AF (as of fiscal year 2016-17).

Carryover

The City in FY 2016-17 has the right to carryover up to approximately 5,159 AF (or up to 60 percent of its APA of 9,432 AF, less the amount of water in storage which is currently 1,815 AF). The City also has drought carryover amounts of 1,500 AF from 1991.

Table 3-2 Carryover Water (AF)

Fiscal Year	Carryover for Following Fiscal Year (AF)			
	DCO-77 [(1)]	DCO-99 [(1)]	Normal [(2)]	Total
2010-11	0.59	1,929.38	1,886	3,816
2011-12	0.59	1,929.38	1,858	3,788
2012-13	0.59	1,929.38	1,744	3,674
2013-14	0.59	1,929.38	724	2,654
2014-15	0.59	1,929.38	886	2,816
2015-16	0.00	1,500.00	346	1,846
Average:	0.49	1,857.82	1,241	3,099

Notes:

(1) Drought carryover (DCO) quantities obtained from Central Basin Watermaster Annual Reports

(2) Normal carryover quantities obtained from Central Basin Watermaster Annual Reports

As shown in Table 3-2, over the past six years, the City's normal carryover has averaged approximately 1,241 AF and the City's total carryover (including drought carryover) has averaged approximately 3,099 AF.

Leases

As shown in Table 3-4, the City has historically leased water to and from other water agencies. The City has averaged a net lease of approximately 350 AFY of water to others.

Table 3-3 Historical Leases (AFY)

Fiscal Year	Leases by the City to Others [1]	Leases from Others to the City [1] [2]	Net Leases to the City
1995-96	(450)	400	(50)
1996-97	(50)	0	(50)
1997-98	0	0	0
1998-99	(500)	0	(500)
1999-00	(300)	0	(300)
2000-01	(500)	0	(500)
2001-02	(500)	300	(200)
2002-03	0	0	0
2003-04	(170)	0	(170)
2004-05	(750)	0	(750)
2005-06	(1,400)	900	(500)
2006-07	(300)	900	600
2007-08	(600)	500	(100)
2008-09	(435)	600	165
2009-10	(560)	185	(375)
2010-11	0	300	300
2011-12	(1,400)	0	(1,400)
2012-13	(420)	700	280
2013-14	(300)	0	(300)
2014-15	(1,500)	0	(1,500)
2015-16	(3,000)	1,000	(2,000)
Average	(625)	275	(350)

Notes:

[1] Data was obtained from Central Basin Watermaster Annual Reports (1995-2015) and the City (2015-16)
[2] Lease amounts include 900 AF during fiscal year 2005-06 and 900 AF during fiscal year 2006-07 assigned by the City of Long Beach Water Department pursuant to a 2005 water storage agreement.

Historical data indicate the Central Basin has been well managed for over its adjudication period, resulting in a stable and reliable water supply. There are no contemplated basin management changes, other than the planned use of recycled water for groundwater replenishment. Based on these historical and on-going management practices, the groundwater supply in the Central Basin has been reliable and the City will be able to rely on the Central Basin for adequate supply over the next 20 years under single year and multiple year droughts. Table 3-1 describes the total water produced by the City from Central Basin over the last twenty years.

Storage

The City currently has the right to store up to approximately 18,864 AF in the Central Basin (or up to 200 percent of its APA of 9,432 AF) if storage is available, for later recovery. As shown in Table 3-2, the City currently has 1,815 AF of water stored within the Central Basin (or approximately 10 percent of its storage right). In order to maximize its existing and future water supply opportunities, the City should continue to store water in addition to water it is able to carryover and lease.

Table 3-4 Historical Storage Transactions (AF)

Fiscal Year	Water Placed into Storage [1]	Water Extracted from Storage	Individual Storage Account Balance
2013-14	500	0	500
2014-15	0	0	500
2015-16	1,315	0	1,815

Notes:
[1] A Central Basin water storage program was implemented in fiscal year 2013-14, which allows the City to store up to 200 percent of their Allowed Pumping Allocation, provided if space is available. Storage data was obtained from Central Basin Watermaster Annual Reports and the City.

3.1.2 Treated Imported Water

Although the City has two connections with MWD through CBMWD to purchase imported treated water (see Section 5.1.4), the City has not purchased imported water from its MWD connections since 1991. The City anticipates it will purchase imported water in the future only during emergency situations.

3.1.3 Emergency Interconnections

The City has emergency interconnections with the City of Cerritos, the City of Long Beach, and Golden State Water Company. Water has not been purchased from the City of Cerritos, the City of Long Beach, or Golden State Water Company since fiscal year 1997-98.

3.1.4 Recycled Water

The City started using recycled water in 1989. The City currently receives recycled water supplies from LACSD's Los Coyotes Reclamation Plant through the City of Cerritos. The City currently has over 41 metered connections in its recycled water system. Figure 3-1 shows the system's current recycled water system. The City's average recycled water use has been approximately 434 AF per year (AFY) over the last 20 years. The recycled water is used for landscape irrigation at schools, medians, and parks. Figure 3-1 also shows the City's recycled water customers. Recycled water use during fiscal year 2015-16 is provided in Table 3-5. A further discussion of potential recycled water use within the City is provided in Section 3.2.

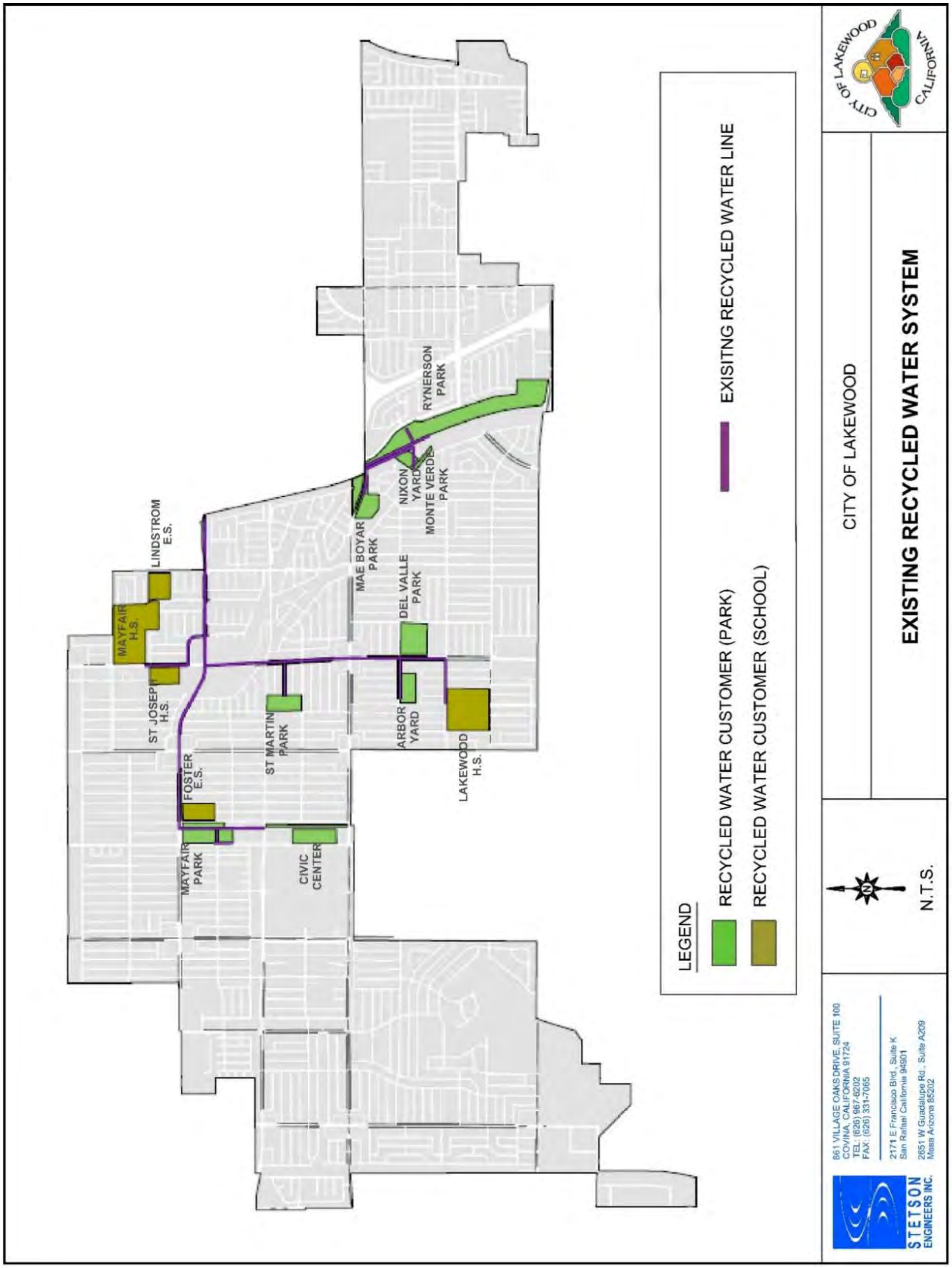

Figure 3-1 Existing Recycled Water System

Table 3-5 Recycled Water Connections and Usage (Fiscal Year 2015-16)

Location	Meter Size (inches)	Total Usage (AF)
Mae Boyer Park North (West San Gabriel 3)	4	15
Candlewood Street (Recycled Fire Hydrant)	4	31
River Park - South Side	4	56
River Park - East Side	2	7
Mae Boyer Park - North Side	4	24
Monte Verde Park	4	38
Mae Boyer Park - South Side	4	16
6344-Serves S/S North Side	2	1
6311 North Side	2	1
5557-Canehill South Side	2	0
6115 North Side	2	1
6103-Serves S/S North Side	2	0
5730 East Side	2	0
5836 East Side	2	24
Mayfair School	4	46
St. Joseph School	4	12
My Hoa Farm-Han Luong	3	10
South/Dunrobin South Side	2	1
5743 Hersholt South Side	2	1
South/Pearce South Side	2	1
Mayfair Park/South St.	2	10
Steven Foster School	2	19
Mayfair Park-Fidler	2	7
S/E Candlewood	2	11
S/W Candlewood	2	23
Mayfair Park-Clark	4	22
5800 Pearce North Side	2	1
5801 Hersholt North Side	2	1
5300 East Side	2	1
5148 East Side	2	0
5002 East Side	2	2
Dashwood West Side	2	11
Jose San Martin Park	4	20
Eberle West Side	2	1
4755 West Side	2	4
City Water Yard	4	26
Lakewood High School	4	27
Across from Del Valle in Parkway	2	13

Jose Del Valle Park	4	19
Loomis East Side	2	1
Del Amo Median with Studebaker	2	2
Total:	41	503
Supply Master Meters	3	482

Source:
Recycled water demands provided by City Staff.

Note:
503 AF represents the total metered amount from the 41 recycled water users
482 AF represents the total metered amount from the 3 recycled water supply master meters

3.2 Additional Recycled Water Use and Supply

As discussed in Section 3.1.4, the City's existing recycled water distribution system includes approximately six miles of pipeline and serves approximately 482 AFY to over 41 metered connections. A proposed recycled water system expansion was reviewed in the City's "Feasibility Study for the Proposed Expansion of the Lakewood Recycled Water System" in July 2010 (2010 Feasibility Study). A current evaluation of the proposed recycled water system expansion is provided below.

<u>Proposed Recycled Water Expansion</u>

The City's 2010 Feasibility Study evaluated potential irrigation customers currently served by potable water that could be converted to recycled water through expansion of the City's existing recycled water distribution system. The 2010 Feasibility Study identified and evaluated five phases of a recycled water system expansion for supplying recycled water to an additional 60 potential users / sites with an estimated usage of approximately 159 AFY. The total cost estimated by the 2010 Feasibility Study for the recycled water system expansion was approximately $7.3 million.

A map showing the potential recycled water system expansion phases is included in Figure 3-2. A summary breakdown of the estimated recycled water usage and costs for each phase is provided in Table 3-6. The unit prices and engineering costs provided in the 2010 Feasibility Study appear reasonable, based on a comparison with other similar recycled water projects located in Los Angeles County.

As noted in the City's 2015 UWMP, however, the 2010 Feasibility Study excluded approximately 3.9 miles of distribution pipeline needed to complete the recycled water system expansion. In addition, it was noted the 2010 Feasibility Study did not account for on-site retrofit costs required by each potential recycled water customer in order to receive recycled water service. The estimated costs for these missing pipelines and retrofits provided in the 2015 UWMP were reviewed and appear reasonable based on a comparison with other similar recycled water projects located in Los Angeles County. The 2015 UWMP estimated the total recycled water system expansion costs at approximately $17.7 million (based on year 2015 dollars).

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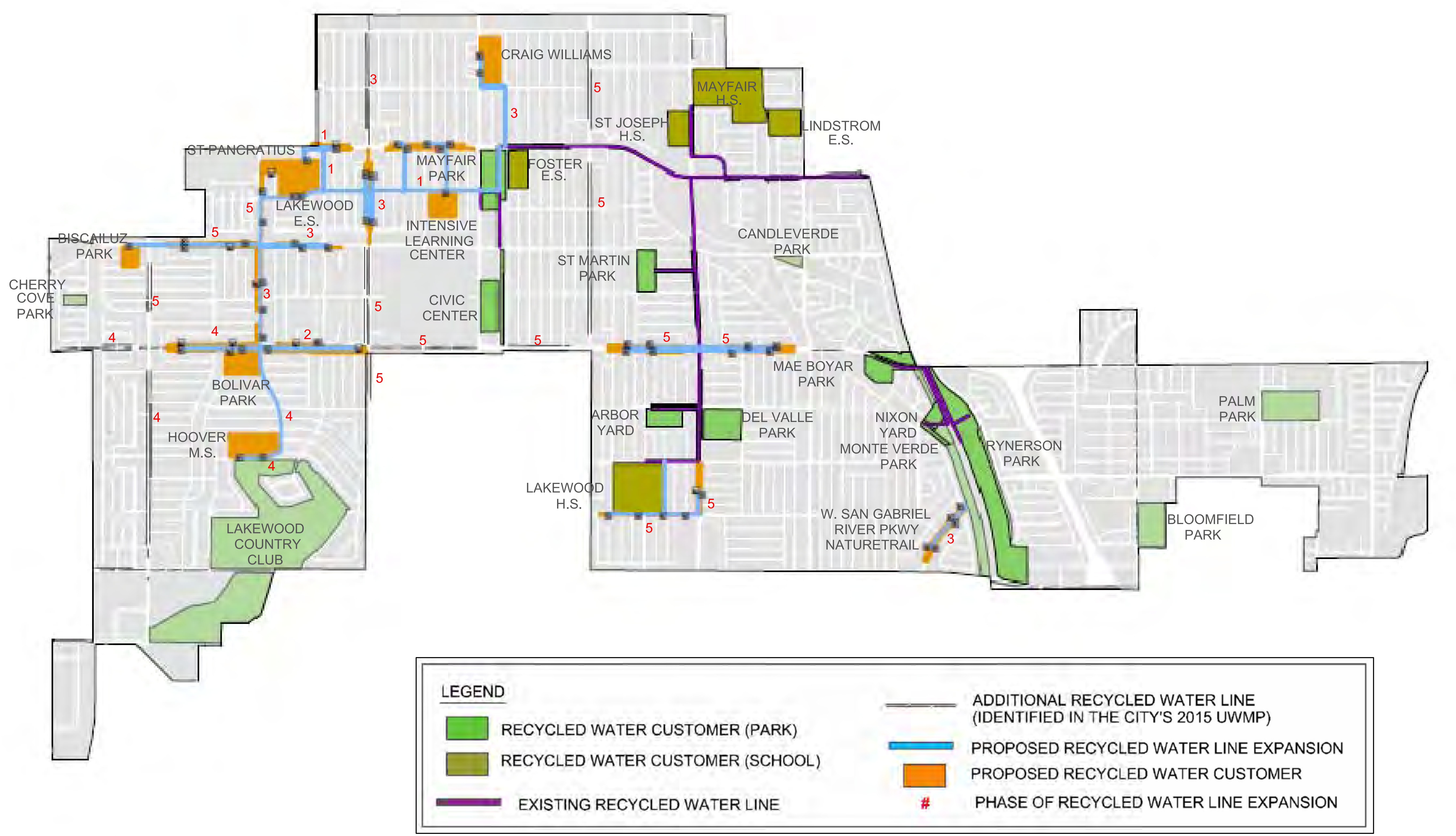

STETSON ENGINEERS INC.
861 VILLAGE OAKS DRIVE, SUITE 100
COVINA, CALIFORNIA 91724
TEL: (626) 967-6202
FAX: (626) 331-7065
2171 E Francisco Blvd., Suite K
San Rafael California 94901
2651 W Guadalupe Rd., Suite A209
Mesa Arizona 85202

CITY OF LAKEWOOD

PROPOSED RECYCLED WATER SYSTEM EXPANSION

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Based on building cost indexes from RS Means Construction Guides, the total recycled water system expansion costs in 2017 dollars is approximately $18.7 million. The annual amortized cost based on a 5 percent interest rate over 30 years is approximately $1.23 million. The resulting cost per AF for the City to construct recycled water infrastructure to provide service to additional customers is approximately $7,700 per AF (or $1.23 million / 159 AF), which excludes the cost to purchase recycled water. The current cost for the City to produce its groundwater supplies is approximately $400 per AF, which includes production and operations costs and Water Replenishment District of Southern California assessments. The estimated cost on a per AF basis for the City to expand and serve additional recycled water users is significantly higher than the City's cost of using groundwater supplies. The cost to construct a new groundwater production well is approximately $2 million (or approximately $0.13 million per year based on a 5 percent rate over 30 years). The resulting cost rate based on a production capacity of 2,000 AFY is approximately $70 per AF. The total cost for a new well (including construction, production and operations, and assessment costs) is approximately $470 per AF and is cheaper than the proposed recycled water system expansion. As a result, it would not appear to be economically feasible for the City to proceed with the proposed recycled water system expansion as described in the 2010 Feasibility Study unless significant grant funding is available.

Table 3-6 Recycled Water Expansion

Phase	Estimated Length (Feet)	Estimated Cost (1)	Updated 2017 Estimated Cost (2)	Recycled Water Yield (AFY) (1)	Amortized Cost per AF
1	5,600	$1.57 M	$2.93 M	45	$4,200
2	8,000	$1.45 M	$3.08 M	31	$6,500
3	6,900	$0.75 M	$2.01 M	18	$7,300
4	10,700	$0.65 M	$2.32 M	25	$6,000
5	27,000	$2.86 M	$8.33 M	40	$13,500
Total	58,200	$7.28 M	$18.67 M	159	$7,700

Notes:

(1) Total estimated cost and recycled water usage obtained from City's 2010 Feasibility Study for the Proposed Expansion of the Lakewood Recycled Water System.

(2) Updated estimated cost include additional 3.9 miles of recycled water pipeline and site retrofits conversion costs. 2017 costs indexed from the City's estimates in 2015 Urban Water Management Plan.

Potential Recycled Water Service to the Lakewood Golf Course

The Lakewood Golf Course is located within the City's service area but is currently served recycled water by the City of Long Beach. According to LACSD's annual reports, the Lakewood Golf Course's recycled water demand during fiscal year 2014-15 was approximately 434 AFY. The City may be able to provide recycled water service to the Lakewood Golf Course which would allow the City of Long Beach to serve its recycled water supplies to other customers within Long Beach.

According to the 2010 Feasibility Study, the proposed recycled water system expansion appears to include pipelines entering the Lakewood Golf Course. As a result, no significant additional infrastructure would be required. Assuming the same proposed costs, but with an additional 434 AFY to serve the Lakewood Golf Course, the proposed recycled water system expansion cost is approximately $2,100 per AF (or $1.23 million / 593 AF), which excludes the cost to purchase recycled water.

Alternatively, the City may be able to provide recycled water to the Lakewood Golf Course through use of CBMWD's recycled water supplies. As discussed previously, the City currently purchases recycled water supplies produced by LACSD from the City of Cerritos. In order to serve recycled water from CBMWD to the Lakewood Golf Course, the City would need to construct a pipeline and a connection to CBMWD's recycled water distribution system, located approximately three (3) miles to the north. Based on a capital cost of approximately $3 million to install this infrastructure, the annual amortized cost based on a 5 percent interest rate over 30 years is approximately $0.2 million. The cost to serve 434 AFY of recycled water from CBMWD to the Lakewood Golf Course is approximately $500 per AF (or $0.2 million / 434 AF), which excludes the cost to purchase recycled water.

The City should continue working with the Cities of Long Beach and Cerritos for potential expansion of City's existing recycled water system, including review of pipe alignments, supply, and hydraulics to provide service to the Lakewood Golf Course. In addition, the City should continue working with CBMWD for potential grants to fund an expansion of the City's existing recycled water system.

MWD and LACSD Carson Plant Project

MWD is currently partnering with LACSD to investigate the viability of providing Full Advanced Treatment (FAT) for up to 150 MGD (about 168,000 AFY) of treated wastewater from LACSD's Joint Water Pollution Control Plant in Carson, California (Carson Plant). The FAT recycled water from the Carson Plant would be delivered in up to 60 miles of transmission pipelines for Indirect Potable Reuse (IPR) by replenishing and/or injecting the recycled water into various groundwater basins within MWD's service area. The IPR water would subsequently offset an equal amount of untreated imported water from the State Water Project and/or the Colorado River, which otherwise historically may have been used for groundwater replenishment; and in the future, could be used for other potable purposes. Based on preliminary information provided by MWD, the proposed pipeline alignment appears to be located near the vicinity of the City's service area. The City should continue monitoring the progress of the Carson Plant project for potential use of IPR water by the City.

Availability of Recycled Water Supply from LACSD

Another factor in the feasibility of the City's recycled water system expansion is the availability of recycled water supply from LACSD. According to a January 2017 discussion, LACSD staff confirmed sufficient recycled water is available through the City of Cerritos' contract with LACSD and sufficient recycled water is being produced at LACSD's Los Coyotes Water Reclamation Plant to supply the City's proposed recycled water system expansion. However, several unknown factors could potentially change the availability of the recycled water supply. Those factors are discussed below:

- LACSD has been experiencing a long-term decline in the amount of wastewater being discharged into the system as a result of the recent drought and subsequent conservation measures in its tributary sewer area. As a result, LACSD has been producing less recycled water from all treatment facilities, with a steady decline in production since 2006. LACSD is uncertain whether or not there will be sufficient recycled water supplies available for the City in the future to meet the additional recycled water demands as part of the proposed expansion.
- The California Water Code Section 1211 requires that LACSD file an application with the State Water Resources Control Board for a change of place of use for any recycled water that is diverted from its current discharge to the San Gabriel River. LACSD is currently working on an application to cover all current discharge to the entire San Gabriel River and planned reuse outside of the river, with an anticipated completion date within the next year. The timing and availability of recycled water to supply additional recycled water users within the City is dependent on the

outcome of the processing of this application, which cannot be predicted at this time.

3.3 Stormwater Capture Programs

The City is currently implementing projects to capture stormwater for infiltration and reuse purposes. The City is located within the Los Cerritos Channel, the Lower San Gabriel River, and the Lower Los Angeles River Watersheds which are subject to National Pollutant Discharge Elimination System (NPDES) requirements[1]. In addition, the City is a permittee or a participating agency in the following watershed groups:

- Permittee under the Los Cerritos Channel Watershed Group (LCC)
- Participating agency of the Lower San Gabriel River Watershed Group (LSGR)
- Participating agency of the Lower Los Angeles River Watershed Group (LLAR).

These watershed groups have developed individual Watershed Management Programs[2] (WMPs) to establish programs and projects for compliance with the NPDES permit requirements, including meeting total maximum daily load (TMDL) limit requirements in urban runoff. As a permittee or participating agency, the City is currently implementing stormwater capture and infiltration/reuse projects. In addition to meeting NPDES requirements, these projects may result in groundwater recharge into the Central Basin and reduce the amount of potable water used for irrigation within the City. These stormwater projects are described below.

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[1] NPDES Permit No. CAS004001 and NPDES Permit No. CAS004003

[2] Los Cerritos Channel Watershed Management Program, Los Cerritos Channel Management Group, June 8, 2015; Lower San Gabriel River Watershed Management Program, Lower San Gabriel Watershed Group, June 12, 2015; and Lower Los Angeles River Watershed Management Program, Lower Los Angeles River Watershed Group, June 27, 2014.

3.3.1 Bolivar Park Stormwater Capture

The City is currently implementing a "Stormwater and Runoff Capture Project" at Simon Bolivar Park (Bolivar Park) located in the western part of the City. The proposed Bolivar Park project is intended to reduce metals and other pollutants in the Del Amo Channel (located several hundred feet to the east) by capturing dry-weather runoff as well as the first-flush of wet weather runoff. In addition, it is estimated the project will provide approximately 623 AFY of stormwater for groundwater recharge and approximately 10 AFY of treated stormwater to offset potable water use for irrigation at Bolivar Park. The Bolivar Park project system consists of the following components:

- A channel diversion system, which would divert runoff from the Del Amo Channel to Bolivar Park;
- A pretreatment facility and pump station;
- An underground storage and infiltration facility (approximately 38,895 square feet); and
- A water treatment system (filtering unit and ultraviolet treatment) to filter and sanitize stored water. The quantity of treated water is estimated to meet approximately 99 percent of the irrigation requirements at Bolivar Park.

The stormwater capture project at Bolivar Park is estimated to cost $11 million, which has been funded by the California Department of Transportation (Caltrans) for design and construction. The City will be responsible for operating and maintaining the proposed facilities.

The design for the Bolivar Park project was completed in January 2016 and an Initial Study/Mitigated Negative Declaration for the project was completed in June 2016. Construction of the Bolivar Park project began in November 2016 and is expected to be completed by Spring of 2018.

3.3.2 Mayfair Park Stormwater Capture

Similar to the project at Bolivar Park, the City is implementing a stormwater capture project at Mayfair Park located in the northern part of the City. Mayfair Park was identified by the LCC Watershed Group in their WMP as a first order water capture site, a site in which stormwater can be captured and reused for irrigation. However, the WMP noted that infiltration/recharge may not be feasible due to the depth to groundwater and the widespread presence of clay lenses in the subsurface.

The development and design of the stormwater capture project at Mayfair Park would be similar to the Bolivar Park project. The City is also expected to receive $15 million from Caltrans to fully fund the project at Mayfair Park. According to the Los Cerritos WMP, implementation of the project at Mayfair Park is expected in 2019.

3.3.3 Other Potential Stormwater Capture Sites

The LCC Watershed WMP identified additional potential stormwater capture projects at Heartwell Park and the Skylinks Golf Course, located in the City of Long Beach near the City's southern border. Development of Concept Plans for these sites is planned for June 2018. The LSGR Watershed WMP identified additional potential stormwater capture projects located within the City at Palms Park, Bloomfield Park, an elementary school, and one high school for the Coyote Creek Sub-Watershed. The LSGR Watershed WMP also identified Rynerson Park, Boyar Park, and an open space trail (5104 Stevely Avenue) located within the City as potential capture sites for the San Gabriel River Sub-Watershed. The LLAR Watershed WMP identified Cherry Cove Park located within the City as a potential stormwater capture site. It is recommended the City continue to monitor these potential stormwater capture projects and pursue additional funding.

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CHAPTER 4

WATER QUALITY REGULATORY REQUIREMENTS AND ISSUES

The City must comply with various water quality requirements in order to provide domestic potable drinking water service. The City currently obtains its water supply from groundwater within the Central Basin. The City has the option to use treated imported surface water purchased from MWD through CBMWD. The City maintains three emergency interconnections with Golden State Water Company, City of Cerritos, and City of Long Beach. Because the City may use MWD water and purchased water for emergency purposes only, water quality requirements associated with surface water and purchased water use are not discussed in this section. The City's water quality requirements are discussed in the following sections and a summary of recommendations is provided in Table 4-2. The City can use the provided recommendations as strategy and backup for any current and future decision-making. It is important that the City continue to monitor and comply with all applicable regulations that could have material impact on the water system operations and its customers.

4.1 Water System Vulnerability

The City's water system vulnerability assessment follows the guidelines in the Drinking Water Source Assessment and Protection Program and the Bioterrorism Act.

4.1.1 Drinking Water Source Assessment and Protection (DWSAP) Program

Every state is required to develop and implement a Source Water Assessment Program in accordance with the 1996 Federal Safe Drinking Water Act (SDWA) amendments. Section 11672.60 of the California Health and Safety Code requires the development and implementation of a program to protect sources of drinking water. In response to both of these legal mandates, the DWSAP Program was developed. The State Water Resources Control Board Division of Drinking Water (SWRCB-DDW) is the lead agency for developing and implementing the DWSAP Program**.** The assessment includes:

- Delineation of the area around a drinking water source through which contaminants might move and reach that drinking water supply;
- Inventory of possible contaminating activities (PCAs) that might lead to the release of microbiological or chemical contaminants within the delineated area; and
- Determination of the PCAs to which the drinking water source is most vulnerable.

The DWSAP Program addresses both groundwater and surface water sources. The groundwater portion of the DWSAP Program serves as the SWRCB-DDW's wellhead protection program. In developing the surface water components of the DWSAP Program, SWRCB-DDW integrated the existing requirements for watershed sanitary surveys.

The City completed the DWSAP requirements for its groundwater sources in 2003 and 2006. A general statement of the City's source water vulnerability based on the DWSAP assessment must be included in annual Consumer Confidence Reports. The City will continue to submit a source water assessment to SWRCB-DDW when a new well is placed into active service.

An underground storage tank (UST) is defined by law as "any one or combination of tanks, including pipes connected thereto, that is used for the storage of hazardous substances and that is substantially or totally beneath the surface of the ground." An Open leaking underground storage tank (LUST) site has an ongoing investigation and/or remediation of potential contamination. LUST sites are identified as a PCA within a DWSAP assessment. According to the SWRCB-DDW, there are approximately 15 Open LUST sites within the service area of the City.

4.1.2 Bioterrorism Act

On June 12, 2002, the United States Congress passed Public Law 107-188, entitled the "Public Health Security and Bioterrorism Preparedness and Response Act of 2002" (Bioterrorism Act). The Bioterrorism Act requires public water systems serving populations greater than 3,300 to perform a Vulnerability Assessment and to complete or update an Emergency Response Plan. Water systems serving a population of 100,000 or greater were required to complete a Vulnerability Assessment by March 31, 2003 with an updated Emergency Response Plan certification due within six months of submittal of the Vulnerability Assessment. The City's Emergency Response Plan and discussion of Vulnerability Assessment are included in a document entitled Emergency Operations Procedures (2013).

Vulnerability Assessment

The Vulnerability Assessment was required to detail the water system's vulnerability to terrorist attacks or other intentional acts that are intended to disrupt the ability of the system to provide a reliable and safe supply of drinking water. The Vulnerability Assessment included a review of:

- Pipes and constructed conveyances;
- Physical barriers;
- Water collection, pre-treatment, treatment, storage, and distribution facilities;
- Electronic, computer or other automated systems;

- The use, storage, or handling of various chemicals;
- Operation and maintenance of the water system.

The City completed and submitted a Vulnerability Assessment in 2003, and prepared an update in 2006. Although there are no Federal or State requirements beyond completion and submittal of the report, the Vulnerability Assessment shall be maintained as a confidential, working document. The City shall implement all Vulnerability Assessment recommendations that are technically and financially feasible on an appropriate timescale. The City shall keep the document up-to-date as water system security upgrades are implemented. Water utility managers shall review the Vulnerability Assessment periodically as a way to ensure that the water system is operating within the acceptable level of security risk.

Emergency Response Plan

The Emergency Response Plan is required to identify responses to activities, or the results of activities, associated with the undesired events discussed in the Vulnerability Assessment. The Emergency Response Plan includes plans, procedures, and identification of staff and equipment to respond to, or significantly mitigate the consequences of such events. Federal guidelines state that the Emergency Response Plan must contain action plans for at least the following four events:

- Water System Contamination;
- Structural Damage/Physical Attack;
- Cyber Attack on SCADA or Operational Computer System;
- Hazardous Chemical Release from Water System Facilities.

SWRCB-DDW has required that California public water systems have and maintain an emergency preparedness plan. These plans mainly encompassed responses to natural disasters such as earthquakes, fires, and floods. California water utilities subject to the requirements of the Bioterrorism Act were required to update this existing plan.

The City previously completed an Emergency Response Plan in 2004 and provided certification. SWRCB-DDW requires that water utilities submit the Emergency Response Plans to the district engineers each time the plan is updated. The City shall continue to revise and update its Emergency Response Plan to reflect any operational or system changes. In addition, all water system employees shall be trained on the Emergency Response Plan. At a minimum, all employees shall review the Emergency Response Plan annually. Appropriate training exercises shall also be conducted periodically. The City is currently preparing an update to its Emergency Response Plan.

4.2 Drinking Water Quality Monitoring and Reporting

4.2.1 Title 22 Drinking Water Quality and Monitoring Regulations

Chapter 15 of Title 22 California Code of Regulations (Title 22) “Domestic Water Quality and Monitoring Regulations” sets enforceable standards for chemical and bacteriological contaminants in drinking water. A drinking water standard under Title 22 includes a maximum permissible concentration allowed in drinking water, associated monitoring frequencies for potable water sources, best available technologies (BATs) for removing the contaminant from drinking water and public notification in the event of a violation of a standard. The categories of chemical contaminants regulated under Title 22 include radiological chemicals, organic chemicals, and inorganic chemicals. Distribution systems must also be monitored for bacteriological constituents (total coliform and E. Coli) and aesthetic properties of the water (color, odor and turbidity) under Title 22. Other chapters of the California Code of Regulations regulate disinfection residuals (total and free chlorine) and disinfection byproducts (total trihalomethanes and haloacetic acids) in distribution systems and lead and copper at the tap.

There are two categories of drinking water standards in Title 22 (primary and secondary standards):

A primary drinking water regulation (or primary standard) is a legally enforceable standard that applies to public water systems. Primary standards place an emphasis on the protection of public health and establish a contaminant's maximum contaminant level (MCL) as close as is technically and economically feasible to its public health goal (PHG). Primary MCLs have been established for constituents for which there are known health effects and for which SWRCB-DDW has evaluated the technical and economic impacts of setting the MCL. A list of regulated constituents and current MCLs can be found at:

http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/MCLsandPHGs.shtml

A secondary drinking water regulation (or secondary standard) is an enforceable standard that applies to cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. Secondary MCLs have been established for certain constituents at levels for which there are no known health effects.

Primary Maximum Contaminant Levels – City Wells

The City is required to monitor for these constituents at its raw water sources at frequencies set forth by SWRCB-DDW. These frequencies are published every three years by SWRCB-DDW and are provided to the City in a tabular form called Vulnerability Assessment tables. The current vulnerability tables published by SWRCB-DDW are effective from January 1, 2017 through December 31, 2019. Some Title 22 Synthetic Organic Chemicals (depending on the source), asbestos, beta/photon emitters, strontium-90, and tritium are waived from the City source water monitoring requirements for this monitoring period.

The City monitors for the required Title 22 constituents. Water quality data indicate the past detection of arsenic above the MCL of 10 micrograms per liter (ug/l), as follows:

- Water from Well #27 has exceeded the MCL for arsenic in the past. Water from Well #27 is treated for arsenic by oxidation, coagulation, and filtration. Arsenic in Well #27 has not exceeded the MCL in recent years. An additional discussion of the City's arsenic treatment is provided in Section 5.1.6.

In order to remove the regulated constituent exceeding the MCL (arsenic), the City has implemented SWRCB-DDW-approved treatment technologies at the impacted source (see Section 5.1.6). The treatment technologies (oxidation, coagulation, and filtration) used by the City are included in the Title 22 list of BATs that are available for achieving compliance with the MCLs.

The City's currently meets all other water quality regulations, including for Perchlorate (MCL = 6 ug/L). As of August 1, 2017, the SWRCB-DDW removed the MCL of 10 ug/L for hexavalent chromium, which the City was in compliance, due to the economic feasibility statewide of complying with the MCL. The SWRCB-DDW is beginning work on establishing a new MCL for hexavalent chromium.

Secondary MCLs – City Wells

On May 2, 2006, SWRCB-DDW published a revision to the Secondary Drinking Water Standards in Title 22. A list of current secondary MCLs can be found at:

http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chemicalcontaminants.shtml

These revisions include the removal of the acceptable limit for corrosivity and clarification of the Secondary MCL compliance determination procedure. Currently, constituents with Secondary MCLs must be sampled at least once every three years at all groundwater sources.

Water from Well #22 historically has experienced noticeable odor. The odor in the water from Well #22 never exceeded the secondary MCL. Well #22 is monitored for sulfides (total and dissolved), which may be contributing to the presence of odor. The revised Secondary MCL regulations have no expected impacts on the City's remaining groundwater wells.

4.2.2 Notification Levels

Notification Levels (NLs) are health-based advisory levels established by SWRCB-DDW for chemicals in drinking water that lack MCLs. A list of current NLs can be found at:

http://www.swrcb.ca.gov/drinking_water/certlic/drinkingwater/NotificationLevels.shtml

If chemicals are found at concentrations greater than their NLs, certain requirements and recommendations apply. The level at which SWRCB-DDW recommends removal of a drinking water source from service is called the "response level." If a drinking water NL is exceeded, the State law requires timely notification by the public water purveyor to the local governing bodies (e.g., city council, county board of supervisors, or both).

Water from Wells #2A, #8, and #17 currently exceeds the NL for 1,4-dioxane of 1 ug/l. Water from these wells is currently monitored quarterly.

The City should continue following SWRCB-DDW regulatory updates for 1,4-Dioxane closely and pursue appropriate actions, as necessary.

4.2.3 Federal Unregulated Contaminant Monitoring Rule

The 1996 SDWA amendments require the USEPA to issue a new list of no more than 30 unregulated contaminants to be monitored by public water systems (PWSs) once every five years.

UCMR 3

The third Unregulated Contaminant Monitoring Rule (UCMR 3) was finalized in 2012 and requires monitoring for 30 contaminants using USEPA and/or "consensus organization analytical methods" during calendar years 2013 to 2015. UCMR 3 includes a total of 30 new contaminants, grouped under three separate lists, which requires monitoring, as follows:

- **List 1 - Assessment Monitoring.** List 1 monitoring implements common analytical method technologies used by drinking water laboratories. For UCMR 3, all PWSs serving more than 10,000 people (plus 800 representative PWSs serving 10,000 or fewer people) are required to monitor for 21 "List 1" contaminants during a 12-month period between January 2013 and December 2015.

- **List 2 - Screening Survey.** List 2 monitoring implements specialized analytical method technologies not commonly used by drinking water laboratories. All PWSs serving more than 100,000 people, 320 representative PWSs serving 10,001 to 100,000 people, and 480 representative PWSs serving 10,000 or fewer people are required to monitor for seven "List 2" contaminants during a 12-month period between January 2013 and December 2015.

- **List 3 - Pre-Screen Testing.** List 3 monitoring implements newer method technologies not commonly used by drinking water laboratories. For UCMR 3, USEPA is required to select 800 representative PWSs serving 1,000 or fewer people that do not disinfect. These PWSs with wells that are located in areas of karst or fractured bedrock, are required to participate in monitoring for two "List 3" viruses during a 12-month period between January 2013 and December 2015.

UCMR 3 monitoring is as follows:

- Time frame – One consecutive 12-month period between January 2013 and December 2015 (monitoring can span more than one calendar year, as long as conducted during a consecutive 12-month period).

- Monitoring Frequency:
    - Groundwater – Monitoring is required twice in one consecutive 12-month period. Sample events must occur 5 to 7 months apart.
    - Surface Water or Groundwater under Direct Influence of Surface Water (GWUDI) – Monitoring is required in four consecutive quarters, with sampling events occurring 3 months apart.

- Monitoring Location – "Entry Point to the Distribution System" (EPTDS) for all contaminants (Lists 1, 2 and 3), as well as at the distribution system maximum residence time (DSMRT) sampling locations for chromium, chromium-6, cobalt, molybdenum, strontium, vanadium and chlorate, which are included in List 1.

- Laboratories – Samples must be analyzed by USEPA-approved laboratories for UCMR 3.

The City conducted two UCMR 3 sampling events, five to seven months apart, during a 12-month period between February 2015 and October 2015 for Assessment Monitoring (List 1). Each sampling event consisted of collecting samples from ten EPTDS and one DSMRT location in the distribution system. The ten EPTDS locations are located after the chlorination point for the City's groundwater wells. The DSMRT location consists of a selected residential home located in the distribution system. Table 4-1 provides a summary of the UCMR 3 sampling results.

Table 4-1 Summary of UCMR 3 Sampling Results

Contaminant	Results (µg/L)	
	Entry Points to the Distribution System (EPTDS)	Distribution System Maximum Residence Time (DSMRT)
1,1-Dichloroethane	ND - 0.037	ND
1,4-Dioxane	ND - 3.5	ND
Chlorate	ND - 540	150 - 300
Chromium, Total	ND - 1.4	0.25 - 0.41
Chromium, Hexavalent	ND - 1.4	0.082 - 0.32
Molybdenum	2.3 - 5	3.1 - 4.8
Strontium	180 - 670	260 - 470
Vanadium	ND - 4.1	0.76 - 2.4

Note:
ND = not detected
Only detected contaminants listed.

The City was required to monitor for 21 "List 1" contaminants. Sampling results for 8 contaminants are provided in the table above. Concentrations of the remaining 13 sampled contaminants (including 1,2,3-Trichloropropane; 1,3-Butadiene; Chloromethane (methyl chloride); Bromomethane (methyl bromide); Chlorodifluoromethane (HCFC-22); Bromochloromethane (halon 1011); Cobalt; Perfluorooctanesulfonic sulfonate (PFOS); Perfluorooctanoic acid (PFOA); Perfluorononanoic acid (PFNA); Perfluorohexanesulfonic acid (PFHxS); Perfluoroheptanoic acid (PFHpA); Perfluorobutanesulfonic acid (PFBS) were ND.

UCMR 4

EPA published the fourth Unregulated Contaminant Monitoring Rule (UCMR 4) in the Federal Register on December 20, 2016. UCMR 4 became effective on January 19, 2017. UCMR 4 requires monitoring of 30 chemical contaminants (List 1 contaminants) using analytical methods developed by EPA and "consensus organizations" during calendar years 2018 through 2020, including the following:

10 Cyanotoxins

- One cyanotoxin group
    - Total microcystins
- Nine cyanotoxins
    - Microcystin-LA
    - Microcystin-LF
    - Microcystin-LR
    - Microcystin-LY
    - Microcystin-RR
    - Microcystin-YR
    - Nodularin
    - Anatoxin-a
    - Cylindrospermopsin

20 Additional Contaminants

- Two metals
    - Germanium
    - Manganese
- Nine pesticides/pesticide manufacturing by-product
    - Alpha-hexachlorocyclohexane
    - Chlorpyrifos
    - Dimethipin

  - Ethoprop
  - Oxyfluorfen
  - Profenofos
  - Tebuconazole
  - Total permethrin (cis- and trans-)
  - tribufos
- Three brominated haloacetic acid (HAA) groups
  (notes: [1] brominated HAA monitoring also includes sampling for two indicators: total organic carbon [TOC] and bromide; [2] UCMR 4 HAA samples are not required for water systems that are not subject to HAA5 monitoring requirements under the Disinfectants/Disinfection Byproduct Rule [D/DBPR])
  - HAA5
  - HAA6Br
  - HAA9
- Three alcohols
  - 1-Butanol
  - 2-Methoxyethanol
  - 2-Propen-1-ol
- Three semi-volatile organic chemicals
  - Butylated hydroxyanisole
  - o-Toluidine
  - Quinoline.

PWSs, including the City, are required to monitor for all 10 List 1 cyanotoxins during a 4-consecutive month period from March 2018 through November 2020, and 20 List 1 additional contaminants during a 12-month period from January 2018 through December 2020, based on the following frequencies:

- 10 List 1 Cyanotoxins

- Surface Water (SW) and Groundwater Under the Direct Influence of Surface Water (GWUDI) Systems (not applicable to the City)
  - Twice per month for four consecutive months during monitoring timeframe of March 2018 through November 2020 (total of eight sampling events)
- Groundwater (GW) Systems (applicable to the City)
  - Not required

- 20 Additional List 1 Contaminants
  - SW and GWUDI Systems (not applicable to the City)
    - Four consecutive quarters over the course of 12 months during the monitoring timeframe of January 2018 through December 2020 (total of four sampling events, three months apart)
  - GW Systems (applicable to the City)
    - Twice over the course of 12 months during the monitoring timeframe of January 2018 through December 2020 (total of two sampling events, five to seven months apart).

Sampling locations are as follows:

- 10 List 1 Cyanotoxins – entry points to the distribution system (EPTDS)
- 20 Other List 1 Contaminants
  - Two Metals – EPTDS
  - Eight Pesticides and One Pesticide Manufacturing Byproduct – EPTDS
  - Three Brominated HAA Groups – D/DBPR HAA location(s) in the distribution system
    - TOC and Bromide (indicators) – source water intake location, prior to any treatment (concurrent with HAA sample collection in the distribution system)
  - Three Alcohols – EPTDS
  - Three Semivolatile Organic Chemicals – EPTDS.

All samples must be analyzed by EPA-approved laboratories for UCMR 4.

4.2.4 Disinfectant and Disinfection Byproduct Rule (D/DBPR)

Stage 1 D/DBPR

Disinfection of drinking water is one of the major public health advances in the 20th century; however, the disinfectants themselves can react with naturally-occurring materials in the water to form disinfection byproducts (DBPs) which may pose health risks. Amendments to the SDWA in 1996 require USEPA to develop rules to reduce DBPs in drinking water.

USEPA promulgated the Stage 1 Disinfectant and Disinfection Byproduct Rule (D/DBPR) on December 16, 1998. SWRCB-DDW adopted the Stage 1 D/DBPR on June 17, 2006. The Stage 1 D/DBPR updates and supersedes the 1979 regulations for total trihalomethanes (TTHM). The Stage 1 D/DBPR applies to all public water systems that add a chemical disinfectant to the drinking water supply. The Stage 1 D/DBPR reduces exposure to three disinfectants and many disinfection byproducts. The rule establishes maximum residual disinfectant level goals (MRDLGs) and maximum residual disinfectant levels (MRDLs) for three chemical disinfectants - chlorine, chloramines and chlorine dioxide. The MRDLs are 4 milligrams per liter (mg/l) (as Cl_2) for chlorine and chloramines, and 0.8 mg/l (as ClO_2) for chlorine dioxide. It also establishes MCL goals and MCLs for the following DBPs: four total trihalomethanes (TTHM), five haloacetic acids (HAA5), chlorite and bromate. Chlorite is monitored only in systems using chlorine dioxide as a disinfectant whereas bromate is required to be monitored only in systems using ozone. TTHM and HAA5 monitoring is required by any water system using chlorine as a disinfectant.

Under the Stage 1 D/DBPR, the MCL for TTHM is 0.080 mg/l and the MCL for HAA5 is 0.060 mg/l. The new MCL for TTHM lowers the previous standard of TTHM from 0.10 mg/l to 0.080 mg/l. Compliance is based on the running annual average of the quarterly results. A quarterly result is the average of the results from all of the sampling locations taken that quarter.

Stage 2 D/DBPR

USEPA published the final Stage 2 D/DBPR on January 4, 2006 and the final rule was effective on March 6, 2006. The Stage 2 D/DBPR applies to all public water systems that add a chemical disinfectant to the drinking water supply. The Stage 2 D/DBPR strengthens public health protection for customers of systems that deliver disinfected water by requiring such systems to meet MCLs as an average at each compliance monitoring location (instead of as a system-wide average as in previous rules) for two groups of DBPs, TTHM and HAA5. The rule targets systems with the greatest risk and builds incrementally on existing rules. This regulation will reduce DBP exposure and related health risks, and provide more equitable public health protection.

The major difference between the Stage 1 D/DBP Rule and Stage 2 D/DBP Rule is the compliance calculation of TTHM and HAA5. Stage 1 D/DBPR compliance is based on a system-wide running annual average (RAA), while Stage 2 D/DBPR compliance is based on the running annual average at each location, which is referred to as the locational running annual average (LRAA). Under the Stage 2 D/DBPR, the MCLs for TTHM and HAA5 remain the same as the Stage 1 D/DBPR

SWRCB-DDW has adopted the federal Stage 2 D/DBP Rule and the new regulation became effective on June 21, 2012. The State Stage 2 D/DBP Rule contains the provisions of the federal Stage 2 D/DBP Rule and additional State-only requirements.

Routine and Reduced Stage 2 D/DBPR Monitoring Requirements

The Stage 2 D/DBPR compliance monitoring for the City began in October 2012 in accordance with the SWRCB-DDW-approved site-specific Stage 2D/DBPR monitoring. The City monitors for TTHM and HAA5 at four locations throughout the distribution system once every quarter, under the Stage 2 D/DBPR.

4.2.5 Radionuclide Rule

USEPA promulgated the final drinking water standard for radionuclides on December 7, 2000. The final rule includes the MCLs and monitoring requirements for gross alpha, radium-226, radium-228, uranium, and beta/photon emitters. The final rule was effective on December 8, 2003. The State was required to adopt or issue a radionuclide rule that is no less stringent than the final Federal rule. SWRCB-DDW published the final Radionuclide Drinking Water Standards dated January 27, 2006. The State radionuclide rule was effective on June 11, 2006.

Under the radionuclide rule, radium-226 and radium-228 were to be analyzed and reported separately, in addition to gross alpha and uranium analysis. An initial round of four consecutive quarterly samples was to be completed by December 31, 2007. The MCL for gross alpha remains at 15 picocuries per liter (pCi/l) and the MCL for radium-226 and radium-228 remains as 5 pCi/l, as the sum of the two constituents. The MCL for uranium is 20 pCi/l.

Radionuclide monitoring varies depending on the initial results for gross alpha, radium-226, radium-228 and uranium monitoring frequency is based on the initial round of analysis results:

a) If the results are below the detection limit for purposes of reporting (DLR), the monitoring requirement is one sample every nine years;

b) If the results are below or equal to ½ the MCL but above or equal to the DLR, the monitoring requirement is one sample every six years;

c) If the results are above ½ the MCL but below or equal to the MCL, the monitoring requirement is one sample every three years; and d) If the results are over the MCL, the sources have to be monitored quarterly continuously until the running annual average is below the MCL, or the owner must provide treatment at the State's discretion.

The City completed the initial round of four consecutive quarterly samples at all of its wells and radionuclide concentrations were low. The City's wells fit into category a or b, above, requiring future testing at either six or nine year intervals.

4.2.6 Revised Total Coliform Rule

In 1989, USEPA published the Total Coliform Rule (TCR) which became effective in 1990. The purpose of the TCR is to protect public health by requiring monitoring for the presence of microbial contamination in the drinking water distribution system. On February 13, 2013, USEPA published the Revised Total Coliform Rule (RTCR) which is intended to improve public health protection. The RTCR became effective on April 1, 2016.

According to SWRCB-DDW, the revisions include the new Coliform Treatment Technique requirement replacing the Total Coliform MCL, and a new E.coli MCL regulatory limit. The RTCR establishes a "find-and-fix" approach for investigating and correcting causes of coliform problems within the water distribution system.

A water system that exceeds the current Total Coliform MCL must conduct a Level 1 Assessment. The completed assessment must be submitted to SWRCB-DDW within 30 days of the exceedance. Public notification (Tier 2) is required within 30 days of the exceedance. The Level 1 Assessment requires the water system to identify a possible cause for the total coliform positive samples and corrective actions taken/needed. Failure to complete the corrective actions is a violation of the Coliform Treatment Technique in the RTCR.

A water system that exceeds the E.coli MCL under the existing Acute Total Coliform MCL conditions in Title 22 must conduct a Level 2 Assessment. The water system must notify SWRCB-DDW by the end of the business day to schedule a Level 2 assessment. Public notification (Tier 1) is required within 24 hours of the exceedance. The Level 2 Assessment is performed by SWRCB-DDW. Similar to the Level 1 assessment, the Level 2 Assessment requires the water system to identify a possible cause for the total coliform positive samples and corrective actions taken/needed. Failure to return the assessment or complete the corrective actions is a violation of the Coliform Treatment Technique in the Federal RTCR.

4.2.7 Groundwater Rule

On November 8, 2006, the USEPA promulgated the federal Groundwater Rule to provide for increased protection against microbial pathogens in public water systems that use groundwater sources. The major components of the rule include:

1) Sanitary survey prepared by SWRCB-DDW every three years, unless the water system provides 4-log inactivation/removal of viruses;

2) Triggered source water monitoring when a routine distribution system sample is positive for total coliform, unless the water system provides 4-log inactivation/removal of viruses;

3) Notification of groundwater wholesaler by a consecutive system within 24 hours of the consecutive system being notified of a positive total coliform distribution system sample;

4) Triggered source water monitoring by a groundwater wholesaler within 24 hours of being notified by a consecutive system of a positive total coliform distribution system sample;

5) Corrective action is required if there is a significant deficiency or groundwater source of fecal contamination ("significant deficiencies" include, but are not limited to, defects in design, operation, or maintenance, or a failure or malfunction of the sources, treatment, storage, or distribution system that SWRCB-DDW determines to be causing, or have potential for causing, the introduction of contamination into the water delivered to consumers.); and

6) Monitoring to ensure disinfection treatment achieves 4-log inactivation/removal of viruses, if treatment is required or applied in lieu of performing triggered monitoring.

Under the Groundwater Rule, beginning December 1, 2009, if any sample collected during routine distribution system sampling has a total coliform-positive result, one sample must be collected at each well **not receiving 4-log virus inactivation/removal** and analyzed for *E. coli* within 24 hours of receiving the total coliform-positive result. If *E. coli* is detected, five more repeat samples must be collected from each well that was initially *E. coli*-positive and tested for *E. coli* within 24 hours.

SWRCB-DDW has adopted the federal Groundwater Rule which became effective in August 2011. The City will continue to perform compliance monitoring and reporting in accordance with SWRCB-DDW requirements. The City complies with the triggered source monitoring requirements.

4.2.8 Lead and Copper Rule

On January 12, 2000, USEPA promulgated revisions to the Lead and Copper Rule, previously adopted on December 11, 1995. On October 11, 2003, SWRCB-DDW published final lead and copper Requirements for Drinking Water. The revised rules clarify the lead and copper requirements, but do not substantially modify the requirements from what was previously required.

PWSs must monitor for lead and copper at a number of residential taps based on the population served. The required number of lead and copper samples may be reduced depending on the historical results. Compliance is based on the 90^{th} percentile concentration for all samples collected. The Action Level (AL) for lead is 0.015 mg/l and for copper is 1.3 mg/l. The Action Level is the concentration which cannot be exceeded in more than 10 percent of the samples.

The City is currently on a reduced monitoring schedule for lead and copper and is required to collect lead and copper samples at a minimum of 30 taps in its distribution system once every three years. The most recent set of lead and copper samples was collected in 2015 and the 90^{th} percentile concentrations for lead and copper were 0.0023 mg/l and 0.3 mg/l, respectively. The City is in compliance with the lead and copper ALs and will continue to monitor lead and copper levels in its distribution system once every three years.

4.2.9 1,2,3-Trichloropropane

In 1999, SWRCB-DDW established a NL of 0.005 ug/l for 1,2,3-trichloropropane (1,2,3-TCP) in drinking water. The NL is at the same concentration as the SWRCB-DDW DLR. Certain requirements and recommendations apply if 1,2,3-TCP is detected above its NL.

In 2009, the State Office of Environmental Health Hazard Assessment (OEHHA) established the PHG for 1,2,3-TCP at 0.0007 ug/l. The PHG was established by OEHHA for use by SWRCB-DDW to establish an MCL. Health and Safety Code Section 116365(a) requires SWRCB-DDW to establish an MCL at a level as close as is technically and economically feasible to the contaminant's PHG. PHGs are contaminant concentrations in drinking water that do not pose a significant risk to health. SWRCB-DDW will have to consider the economic and technical feasibility of treating 1,2,3-TCP-contaminated water to arrive at an MCL that is still protective of public health.

In July 2016, SWRCB-DDW held a public workshop to discuss the 1,2,3-TCP MCL development process. During the workshop, SWRCB-DDW announced a preliminary staff recommendation for the 1,2,3-TCP MCL at 0.005 ug/l, which is also the current NL and DLR. SWRCB-DDW provided a draft 1,2,3-TCP MCL schedule as follows (SWRCB-DDW indicated these dates may change):

- Spring 2017 – SWRCB-DDW adoption
- Summer 2017 – regulations become effective
- January 2018 – initial monitoring begins.

In July 2017, SWRCB-DDW adopted an MCL of 0.005 ug/l for 1,2,3-TCP. The City will be required to conduct initial monitoring consisting of four quarterly sampling of 1,2,3-TCP for all its wells beginning January 2018. Regulatory compliance for the City will be based on the average of four quarters of sampling. If 1,2,3-TCP is not detected during the initial four quarters of sampling, subsequent routine monitoring will consist of two quarterly samples in one year during each subsequent 3-year compliance period (with the next period being from 2020 to 2022).

4.2.10 Drinking Water Regulations Process

As part of the MCL process, SWRCB-DDW evaluates the technical and economic feasibility of regulating a chemical contaminant. Technical feasibility includes an evaluation of commercial laboratories' ability to analyze for and detect the chemical in drinking water, the costs of monitoring, and the costs of treatment required to remove it. Costs are required by law to be considered whenever MCLs are adopted.

To determine the technical and economic feasibility, SWRCB-DDW generally goes through the following steps:

1) Receives the PHG from OEHHA
2) Selects possible alternative draft MCL concentrations for evaluation
3) Evaluates the occurrence data
4) Evaluates available analytical methods and estimates monitoring costs at alternative draft MCL concentrations
5) Estimates population exposures at the alternative draft MCL concentrations
6) Identifies best available technologies for treatment
7) Estimates treatment costs at the alternative draft MCL concentrations
8) Reviews the costs and associated health benefits (health risk reductions) that result from treatment at the alternative draft MCL concentrations
9) Proposes the draft MCL

Then the proposed MCL moves through the formal regulatory process (http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/MCLprocess.shtml).

4.3 Poly/Orthophosphate Treatment

The City has been injecting phosphates into water extracted from its groundwater wells since 1967. There are two types of phosphates; orthophosphates and polyphosphates. Orthophosphates consist of single phosphates which combine with the calcium hardness present in the water to provide a calcium orthophosphate film to reduce corrosion. Polyphosphates consist of phosphates that are linked together to form a long chain of sodium or potassium ions. Polyphosphates are used to sequester naturally-occurring minerals present in the water, such as iron, manganese, and calcium hardness. Polyphosphates sequester the minerals, allowing the minerals to remain in solution instead of reacting with chlorine, oxidizing and causing red water. The City has been injecting a blend of 50 percent orthophosphates and 50 percent polyphosphates.

The primary function of continuously injecting poly/orthophosphates in the City's water is to reduce corrosion in the City's distribution system, with the secondary function of sequestering iron present in the water. Water quality from the City's wells show concentrations of iron and manganese below secondary MCLs. In addition, the Aggressive Index of water from the City's wells appears to indicate water from the City's wells is non-corrosive. However, approximately 40 percent of the pipelines within the City's distribution system consist of ductile or cast iron material installed prior to 1960. The age and material of pipes are potential factors in corrosion and the presence of iron within the City's distribution system. The supplier of the poly/orthophosphates has indicated continuous application of poly/orthophosphates in the City's water is necessary to maintain the protective film that reduces corrosion in the City's distribution system. City staff reports that older pipelines that have been visually inspected appear to be in good condition. The City is currently reviewing methods to optimize the use of poly/orthophosphates within the City's distribution system.

4.4 Public Notification of Drinking Water Quality

The City's water customers are notified of their drinking water quality through an annual Consumer Confidence Report (CCR) and a triennial PHG report. These reports are further discussed below.

4.4.1 Consumer Confidence Reports (CCR)

In 1996, Congress amended the SDWA, adding a requirement that water systems deliver to their customers a brief annual water quality report. Based on the SDWA, effective May 26, 2001, the California Health and Safety Code (Title 22, Chapter 15, Article 20, Section 116470) requires every community water system to prepare an annual CCR and deliver the CCR to its customers by July 1. The City's water quality report for the year 2016 has been posted on the City's website.

The CCR must contain the following:

1) Water system information, which includes name and telephone number of contact person, information on public participation opportunities, information in Spanish that the report content is important, and information for other non-English speaking populations;

2) Source of water and the results of the source water vulnerability assessment;

3) Summary of data on detected regulated and unregulated contaminants, possible source(s) of each contaminant, and if the water system received any violations; and

4) Educational information on nitrate, arsenic, lead, radon and cryptosporidium, if applicable.

4.4.2 Public Health Goal Reports

Senate Bill 1307 was enacted on January 1, 1997 and requires water systems serving more than 10,000 service connections that detect one or more contaminants in drinking water exceeding the applicable PHG or the MCLG to prepare a written report to inform the public about the safety of the drinking water. The initial PHG report required by Senate Bill 1307 was due on July 1, 1998, and subsequent reports are due every three years thereafter. The latest PHG report for the City was completed on July 1, 2016. A new PHG report is scheduled to be completed by July 1, 2019. In accordance with Section 116470 (c) of the California Health and Safety Code, a public hearing must be held after the PHG reports are completed to receive comments on each water system's PHG report.

4.5 Summary of Water Quality Regulatory Requirements

The anticipated impacts to the City from water quality regulations discussed in this section are summarized in Table 4-2. The anticipated Title 22 water quality monitoring requirements for the City's wells are summarized in Table 4-3.

Table 4-2 Summary of Water Quality Regulatory Requirements

Water Quality Regulations	Expected Actions or Impacts to the City
Drinking Water Source Assessment Program	Reports completed in 2003 and 2006. New wells subject to DWSAP Program requirements.
Bioterrorism Act	Review and update vulnerability assessment and emergency response plan as needed.
Title 22 Regulated Constituents	Continue source water monitoring in accordance with Title 22 and the latest vulnerability tables by SWRCB-DDW. Continue treated water monitoring in accordance with water supply permit.
Secondary MCL Regulations	No expected impacts.
Federal UCMR3	The City completed Assessment Monitoring completed in 2015.
Federal UCMR4	Review/update water system information on EPA's electronic reporting system; monitor for unregulated contaminated pursuant to scheduled established by EPA
Stage 2 D/DBP Rule MCL Compliance	Continue monitoring in accordance with Stage 2 rule.
Radionuclide Rule	Perform follow-up monitoring based on latest results.
Revised Total Coliform Rule	Continue monitoring in accordance with the RTCR.
Groundwater Rule	Continue to perform compliance monitoring and reporting in accordance with SWRCB-DDW requirements. Continue complying with the triggered source monitoring requirements.
Lead and Copper Rule	Continue monitoring once every three years; no impacts expected.
1,2,3-TCP	Begin initial four quarters of sampling in 2018.
Consumer Confidence Reports	Complete report annually and distribute to customers by July 1 each year.
Public Health Goal Reports	A new PHG report is scheduled to be completed by July 1, 2019.

Table 4-3 Summary of Title 22 Water Quality Monitoring Requirements

Title 22 Monitoring	Well									
	2A	4	8	10	13A	15A	17	18	22	27
VOCs - Table 64444-A Part (a) (from Title 22 of the California Code of Regulations)										
Annually	√	√	√	√	√	√	√	√	√	√
Quarterly if > DLR but < MCL								PCE		
Monthly if > MCL										
SOCs - Table 64444-A Part (b)										
Two quarterly samples in one year during 3-year period 2017-2019										
Alachlor	√						√	√	√	√
Atrazine	√						√	√	√	√
Bentazon	√						√	√	√	√
Benzo(a)pyrene	Waived									
Carbofuran	√						√	√	√	√
Chlordane	√						√	√	√	√
2,4-D	√						√	√	√	√
Dalapon	Waived									
Dibromochloropropane									√	√
Di(2-ethylhexyl)adipate	Waived									
Di(2-ethylhexyl)phthalate	√	√	√	√	√	√	√	√	√	√
Dinoseb	√						√	√	√	√
Diquat	√						√	√	√	√
Endothall	√						√	√	√	√
Endrin	√						√	√	√	√
Ethylene Dibromide									√	√
Glyphosate	√						√	√	√	√
Heptachlor	Waived									
Heptachlor Epoxide	Waived									
Hexachlorobenzene	Waived									
Hexachlorocyclopentadiene	Waived									
Lindane	√						√	√	√	√
Methoxychlor	√						√	√	√	√
Molinate	Waived									
Oxamyl	√						√	√	√	√
Pentachlorophenol	√						√	√	√	√
Picloram	Waived									
Polychlorinated Biphenyls	Waived									
Simazine	√						√	√	√	√
Thiobencarb	Waived									
Toxaphene	√						√	√	√	√
2,3,7,8-TCDD (Dioxin)	Waived									
1,2,3-TCP (initial monitoring: four quarterly samples during 2018) (4Q)	4Q	4Q	4Q	4Q	4Q	4Q	4Q	4Q	4Q	4Q
2,4,5-TP (Silvex)	Waived									

Title 22 Monitoring	Well									
	2A	4	8	10	13A	15A	17	18	22	27
INORGANIC CHEMICALS - Table 64431-A										
Asbestos	Waived									
Chromium, Hexavalent										
Every three years	√	√	√	√	√	√	√	√	√	√
Nitrate										
Annually if < 1/2 MCL	√	√	√	√	√	√	√	√	√	√
Quarterly if ≥ 1/2 MCL but ≤ MCL										
Nitrite										
Every three years if < 1/2 MCL	√	√	√	√	√	√	√	√	√	√
Quarterly if ≥ 1/2 MCL but ≤ MCL										
Perchlorate										
Every three years	√	√	√	√	√	√	√	√	√	√
Quarterly if ≥ DLR but ≤ MCL										
Other inorganic chemicals										
Every three years	√	√	√	√	√	√	√	√	√	√
GENERAL MINERAL - Section 64449(b)(2)										
Every three years	√	√	√	√	√	√	√	√	√	√
SECONDARY STANDARDS - Table 64449-A										
Every three years	√	√	√	√	√	√	√	√	√	√
SECONDARY STANDARDS - Table 64449-B										
Every three years	√	√	√	√	√	√	√	√	√	√
RADIONUCLIDES - Sections 64442 and 64443										
One sample in 9 years, if < DLR (9Y)										
One sample in 6 years, if ≥ DLR but ≤ 1/2 MCL (6Y)										
One sample in 3 years, if > 1/2 MCL but ≤ MCL (3Y)										
Gross Alpha Particle Activity	9Y	9Y	9Y	6Y	9Y	9Y	9Y	6Y	9Y	9Y
Radium-226 and Radium-228	9Y	9Y	9Y	9Y	9Y	9Y	9Y	9Y	9Y	9Y
Uranium	6Y	9Y	9Y	6Y	9Y	9Y	9Y	6Y	9Y	9Y
Others										
Tritium	Waived									
Strontium	Waived									
Beta/Photon Emitters	Waived									
OTHERS - with Notification Level										
1,4-Dioxane										
Quarterly (per recommendation based on past detections above the Notification Level)	√						√	√		

VOCs = Volatile Organic Chemicals

DLR = Detection Limit for Purposes of Reporting

MCL = Maximum Contaminant Level

PCE = Tetrachloroethylene

SOCs = Synthetic Organic Chemicals

2,4-D = 2,4-Dichlorophenoxyacetic acid

2,3,7,8-TCDD = 2,3,7,8-Tetrachlorodibenzo-p-Dioxin

1,2,3-TCP = 1,2,3-Trichloropropane

2,4,5-TP = 2(2,4,5-Trichlorophenoxy) propionic acid

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CHAPTER 5

EVALUATION OF FACILITY AGES, EFFICIENCIES, AND CONDITIONS

5.1 Summary of Groundwater, Pumping, Storage, and Treatment Facilities

The City's primary source of potable water supply is groundwater, which is currently produced from ten active wells located within the Central Basin. The City has an additional well for irrigation purposes. To supplement the City's groundwater supply, the City has two connections with CBMWD (one active and one inactive) to obtain treated imported water from MWD. In addition, the City has three (3) emergency connections with the City of Cerritos, City of Long Beach, and Golden State Water Company.

The City's water system facilities, including its wells, treatment plants, booster stations, and reservoirs, are summarized in Table 5-1 and are discussed in the following sections. The locations of the City's wells, reservoirs, and booster stations are provided in Figure 5-1 through Figure 5-11. Photographs of the City's water system facilities are provided in Appendix A.

Table 5-1 Summary of Water Supply Facilities

Facility Name	Reference
Plant 4	
Tanks 1, 2, and 3	(Table 5-3)
Boosters #2, #3, #4, #5, #6, #7, and #8	(Table 5-4)
Well #4	(Table 5-2)
Well #27	(Table 5-2)
Arsenic Treatment	
Plant 13	
Tanks 1, 2, 3, 4, and 5	(Table 5-3)
Boosters #1, #2, #3, and #4	(Table 5-4)
Plant 22	
Reservoir 22	(Table 5-3)
Well #22	(Table 5-2)
Boosters #1, #2, #3, and #4	(Table 5-4)
Other Facilities	
Well #2A	(Table 5-2)
Well #8	(Table 5-2)
Well #10	(Table 5-2)
Well #13A	(Table 5-2)
Well #15A	(Table 5-2)
Well #17	(Table 5-2)
Well #18	(Table 5-2)
Well #6 (Irrigation)	(Table 5-2)
CENB-43	(Table 5-5)
CENB-49	(Table 5-5)
Interconnection (Long Beach)	(Table 5-6)
Interconnection (Cerritos)	(Table 5-6)
Interconnection (Golden State Water Company)	(Table 5-6)

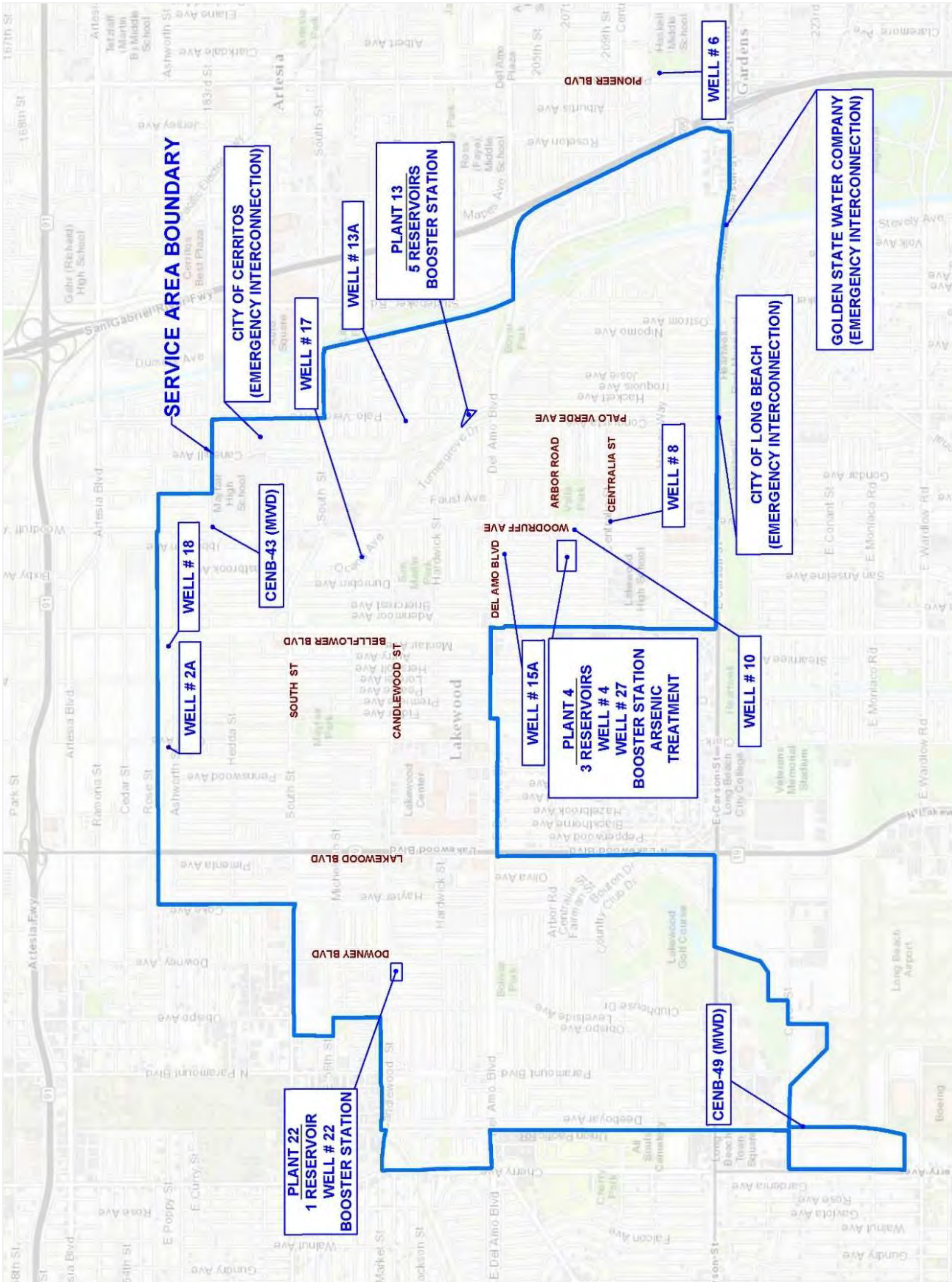

Figure 5-1 Summary of the City's Water System Facilities

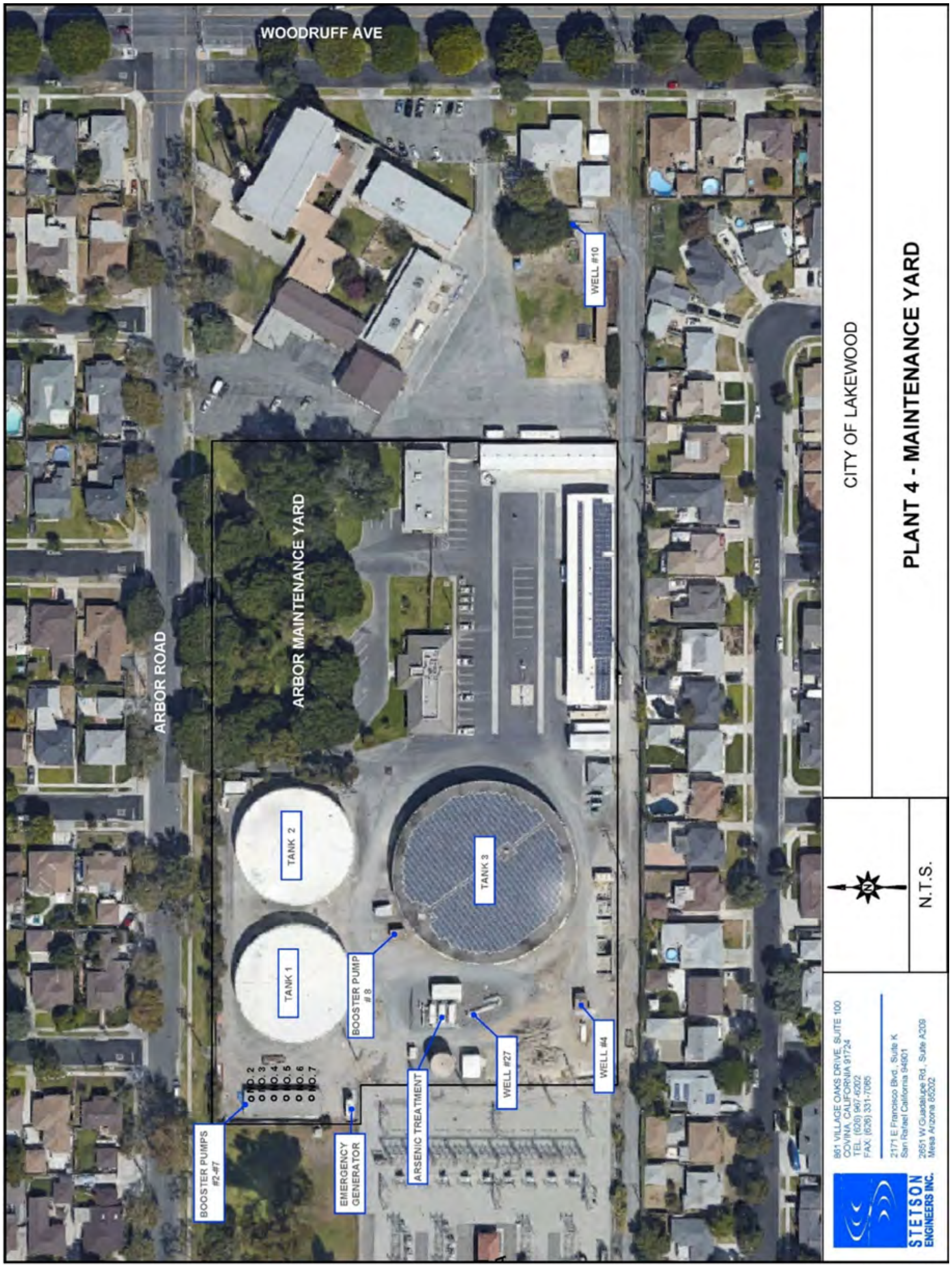

Figure 5-2 Plant 4 (Wells #4, #10, and #27)

Figure 5-3 Plant 13

Figure 5-4 Plant 22 (Well #22)

Figure 5-5 Well #2A

Figure 5-6 Well #6

Figure 5-7 Well #8

Figure 5-8 Well #13A

Figure 5-9 Well #15A

Figure 5-10 Well #17

Figure 5-11 Well #18

5.1.1 Groundwater Wells

The City currently produces potable groundwater from ten wells (Wells #2A, #4, #8, #10, #13A, #15A, #17, #18, #22, and #27) located in Central Basin. The City also produces groundwater from Well #6 for irrigation at Bloomfield Park. Wells #4 and #27 are located at Plant 4 and Well #22 is located at Plant 22. The combined capacity of the ten potable wells is about 11,675 gallons per minute (gpm). Information on these wells is summarized in Table 5-2.

Hydropneumatic Tanks

The City currently owns hydropneumatic tanks at several well sites, including at Wells #2A, #4, #6, #17, #18, and #22 (the tanks at Wells #2A, #17, and #22 are located below ground). Hydropneumatic tanks contain both water and air under pressure and can exert or absorb pressure. The City previously used its hydropneumatic tanks to deliver water under pressure to the distribution system. However, the City has since installed additional water storage reservoirs and booster pumps and does not currently require use of its hydropneumatic tanks. Although the City does not use its hydropneumatic tanks to deliver water, the City can use its hydropneumatic tanks to reduce pressure surges at its well sites which are not equipped with an air release valve. Air valves are used to regulate air discharge from the well pump column during pump start up to prevent shock and air entering the system resulting from the accelerating water column. Currently, the hydropneumatic tanks are not operational and would need to be refurbished prior to returning to use. The use of hydropneumatic tanks to deliver water to the distribution system might provide some minimal reduction in run time for a few of the booster pumps in the system. Refurbishment of the hydropneumatics tanks could require the following: cleaning and recoating tanks, repairing/replacing pressure relief valves, pressure gauges, gaskets, and repairing rust, corrosion and/or cracks, etc. Many of the hydropneumatics tanks are buried, which would increase the cost of the returning the tanks to service. The minimal benefit that would be provided by the hydropneumatic tanks does not appear to justify the cost to refurbish them. However, the City should further evaluate the condition of its hydropneumatic tanks and whether it is feasible to operate these tanks.

Table 5-2 Groundwater Production Wells

Name	Year of Installation	Well Depth (ft bgs)	Motor Size (hp)	Capacity (gpm)	Services
Potable					
Well #2A	1970	656	50	500	System
Well #4	1937	656	75	700	System
Well #8	1945	385	75	1,000	Plant 4 Tanks
Well #10	1950	876	60	975	Plant 4 Tanks
Well #13A	2003	1,120	100	1,200	Plant 13 Tanks
Well #15A	2001	1,050	100	1,750	Plant 4 Tanks
Well #17	1951	1,134	100	1,100	System
Well #18	1951	1,108	100	1,000	System
Well #22	1996	1,080	200	1,200	Plant 22 Reservoir
Well #27	2010	970	200	2,250	Plant 4 Tanks
Total				11,675	
Irrigation					
Well #6	1969	602	40	500	Irrigation

Source:
Well data provided by the City

Notes:
ft = feet
bgs = below ground surface
hp = horsepower
gpm = gallons per minute

5.1.2 Booster Station Pumps

Information on the City's booster station pumps is summarized in Table 5-3. Currently there are a total of 15 booster pumps, with a total capacity of approximately 19,195 gpm.

Table 5-3 Booster Pump Facilities

Name	Year of Installation	Power (hp)	Capacity (gpm)	Notes
Plant 4, Booster #2	1965	50	1,000	
Plant 4, Booster #3	1965	50	1,000	Newer motor installed (2013)
Plant 4, Booster #4	1965	100	1,700	
Plant 4, Booster #5	1965	100	2,000	Newer motor installed (2015)
Plant 4, Booster #6	1965	50	1,000	
Plant 4, Booster #7	1965	60	1,120	
Plant 4, Booster #8	2017	125	2,600	Includes VFD
Plant 13, Booster #1	2017	40	800	Completed Early 2017
Plant 13, Booster #2	2017	50	1,000	Completed Early 2017
Plant 13, Booster #3	2017	75	1,500	Completed Early 2017
Plant 13, Booster #4	2017	75	1,500	Completed Early 2017
Plant 22, Booster #1	1990	40	750	
Plant 22, Booster #2	1990	40	925	
Plant 22, Booster #3	1990	40	950	
Plant 22, Booster #4	1990	60	1,350	
Total			19,195	

Source:

Booster pump data provided by the City. The years of installation for Plant 4, Boosters #2 through #7 are estimated based on discussion with City staff. The year of installation for Plant 4, Booster #8 is estimated based on the year of installation of Plant 4, Tank 3.

Notes:

hp = horsepower

gpm = gallons per minute

VFD = Variable Frequency Drive

5.1.3 Reservoirs

The City currently utilizes 7 steel reservoirs and 2 concrete reservoirs with a total physical water storage capacity of approximately 12.9 million gallons (MG). Information on the City's reservoirs is summarized in Table 5-4.

Table 5-4 Water Storage Facilities

Name	Year of Installation	Material	Capacity (MG)	Source
Plant 4, Tank 1	1965	Steel	1.5	Wells #8, #10, #15A, #27
Plant 4, Tank 2	1965	Steel	1.5	Wells #8, #10, #15A, #27
Plant 4, Tank 3	1996	Pre-Stressed Concrete	5.4	Wells #8, #10, #15A, #27
Plant 13, Tank 1	1950	Steel	0.454	Well #13A
Plant 13, Tank 2	1950	Steel	0.454	Well #13A
Plant 13, Tank 3	1950	Steel	0.454	Well #13A
Plant 13, Tank 4	1997	Steel	0.454	Well #13A
Plant 13, Tank 5	1965	Steel	0.22	Well #13A
Reservoir 22	1954	Cast-in Place Concrete	2.5	Well #22
Total			12.9	

Source:
Reservoir data provided by the City

Notes:
MG = million gallons

5.1.4 Imported Water Connections

The City has two connections with CBMWD to purchase imported treated water from MWD. Information on the City's imported water connections is summarized in Table 5-5. The City has placed the CENB-43 connection in an inactive status as of 2017.

Table 5-5 Imported Water Connections (MWD / CBMWD)

Name	Location	Capacity (cfs)	Capacity (gpm)	Number of Meters	Meter Size	Number of Discharge Lines	Discharge Line Size
CENB-43	Southeast corner of Allington Street and Woodruff Avenue	15	6,700	1	14"	1 2 2	6" 8" 12"
CENB-49	East Union Pacific Railroad right of way and south of Carson Street	15	6,700	1	14"	1 1	6" 10"

Source:

City's 2002 Water Master Plan

Notes:

cfs = cubic feet per second

gpm = gallons per minute

5.1.5 Emergency Interconnections

The City has one emergency connection each with the City of Cerritos, the City of Long Beach, and Golden State Water Company. The total capacity of the three connections is 15,000 gpm. Information on the City's emergency interconnections is shown in Table 5-6.

Table 5-6 Emergency Interconnections

Name	Location	Direction	Size (Inches)	Capacity (gpm)	Notes
City of Cerritos	Palo Verde Avenue at Andy Street	2-way	12	5,000	Metered / Automatically operated if pressure drops below ~35 psi for either system
City of Long Beach	Palo Verde Avenue south of Carson Street	2-way	12	5,000	Metered / Manually operated
Golden State Water Company (GSWC)	North side of Carson Street at the San Gabriel River	2-way	12	5,000	Metered / Automatically operated if pressure drops below ~35 psi for the City or below ~35 psi for GSWC

Source:
City's 2002 Water Master Plan
Notes:
gpm = gallons per minute
psi = pounds per square inch

5.1.6 Treatment Facilities

The City operates an arsenic treatment facility located at Plant 4 to remove arsenic contamination from Well #27. In 2008, concentrations of arsenic at Well #27 were detected above water quality standards. As a result, the City constructed an arsenic treatment facility which includes three filtration vessels in parallel formation, chemical storage tanks, and a backwash tank. The locations of the arsenic treatment facility components are provided in Figure 5-12. Chemicals used in the treatment facility operations include the following:

- Sodium hypochlorite is used as a disinfectant and oxidizer
- Ferric chloride is used to add iron to enhance arsenic removal.

- Sulfuric acid was used to lower the pH in influent water to improve treatment; however, the City has not used sulfuric acid since January 2011 due to acceptable pH levels in the influent water.
- Sodium hydroxide was used to increase pH and provide corrosion control, but has not been used since January 2011.

Arsenic is removed through an oxidation, coagulation, and adsorption / filtration process. Raw groundwater from Well #27 is mixed with sodium hypochlorite and then ferric chloride through an in-line static mixer. After mixing, the water is then sent to three filtration vessels (two are active and one is on standby) containing media with manganese dioxide, which attracts oxidized forms of arsenic (as well as iron and manganese). Each filter vessel has the capacity to treat approximately 1,125 gpm of water. The finished water is then pumped in Plant 4, Tank 3 reservoir.

The City performs a backwash of the arsenic treatment filter vessels approximately every 12 hours to remove precipitated arsenic and iron compounds from the filter media and to reduce the pressure in the filter vessels. The water produced from each backwashing event is approximately 9,000 gallons which is stored in a backwash tank (with a capacity of 65,000 gallons). The precipitated solids settlep inside the backwash tank and the remaining top layer of backwash water is pumped to the beginning of the arsenic treatment process. The settled sludge is periodically hauled away for proper disposal.

Due to decreasing concentrations of arsenic in Well #27, the City has recently submitted a letter to the SWRCB-DDW requesting a permit amendment to allow the City to allow water produced from Well #27 to bypass the arsenic treatment system. Arsenic concentrations over the past 5 years have averaged approximately 7.6 ug/L, which is below 80 percent of the MCL.

<u>LACSD Disposal of Backwash Water</u>

As an alternative to periodic hauling of sludge away from the backwash tank, the City may consider disposing the backwash water produced by the arsenic treatment into LACSD's wastewater system. Assuming the disposal of 9,000 gallons of backwash water over a 30-minute period (or about 300 gpm) in order to avoid sludge settling inside the backwash tank, a 6-inch diameter pipeline and connection would need to be constructed to deliver the backwash water to LACSD's wastewater system. However, the City will need to submit an application to LACSD to determine the requirements for disposal of backwash water. LACSD may require the City to construct a pipeline directly connecting with LACSD's industrial waste discharge line. In addition, LACSD may have certain arsenic discharge limits and may require the City to remove the suspended solids within the backwash water prior to discharge. Assuming the City meets LACSD's application requirements, it is estimated the City would construct a new 6-inch pipeline to the LACSD's 27-inch diameter Joint Outfall C – Unit D sewer main located at the intersection of Arbor Road and Clark Avenue approximately one mile westerly of the arsenic treatment plant. The estimated industrial waste connection fee is about $200,000 based on a discharge rate of 18,000 gallons per day. In addition to the connection fee, an annual treatment surcharge of approximately $2,000 would be required based on the volume of industrial waste and the location of the discharge. The estimated cost to construct the 6-inch diameter backwash discharge line is approximately $1 million. The amortized cost of the pipeline construction and connection fee at 5 percent interest over 30 years is approximately $80,000 per year. However, City staff has indicated the cost to haul away the backwash tank sludge is approximately $32,000 per year. In addition, in the event that LACSD requires the City to connect to an industrial waste line further from Plant 4 than Joint Outfall C – Unit D sewer main, it would result in higher construction cost. Due to the high capital investment needed to construct the new backwash discharge line along with the industrial waste connection fee, it appears to be more economically feasible to continue hauling the backwash sludge offsite for disposal.

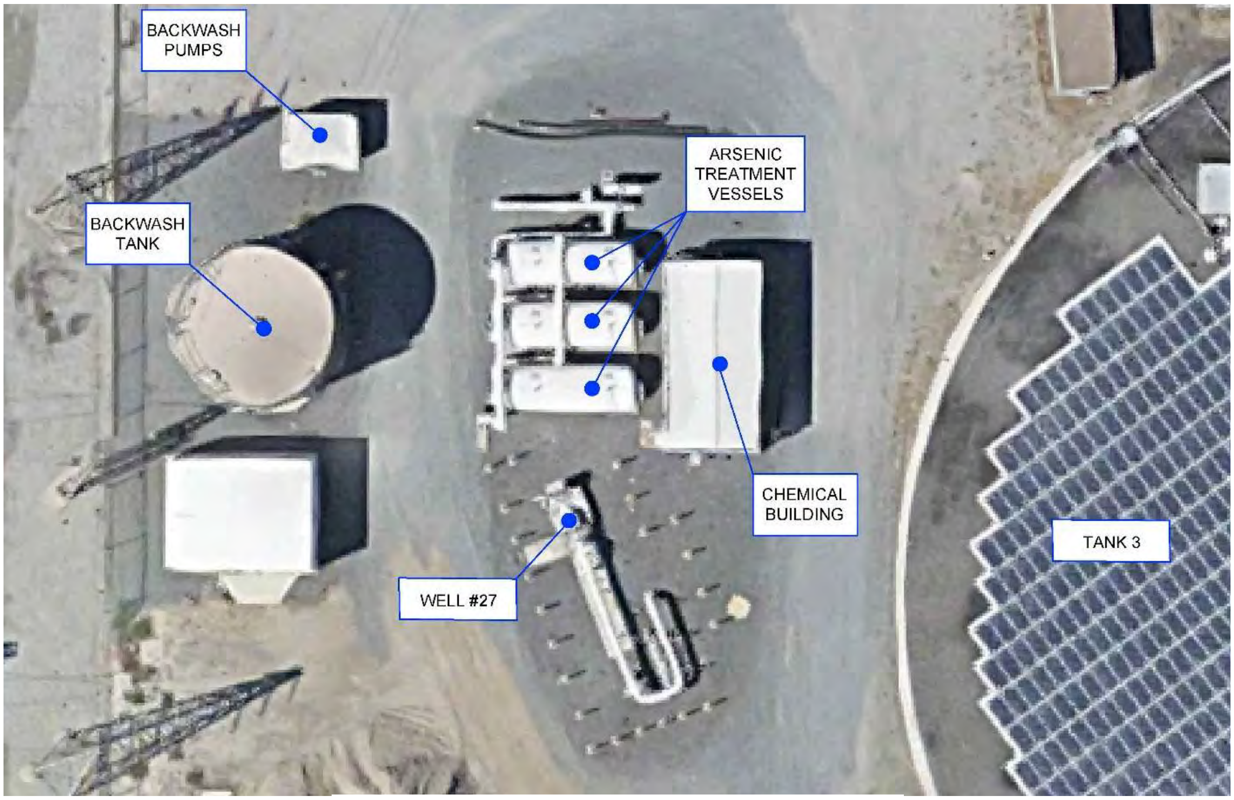

Figure 5-12 Arsenic Treatment Facility

5.1.7 Distribution Pipelines

The City has approximately 950,000 feet of distribution pipelines. The pipes range from 4 inches to 27 inches in diameter and are made up of a variety of materials, including cast iron, asbestos cement, polyvinyl chloride (PVC) pipe, ductile iron, concrete cylinder pipe, and steel. A breakdown of the City's pipelines by size, type, and age is provided in Appendix B. A further discussion regarding the City's distribution pipelines is provided in Section 6.4.1. A summary of the City's distribution pipelines is provided in Table 5-7.

Table 5-7 Summary of City's Distribution Pipelines by Length (Feet)

Pipe Size (inches)	CI	AC	ST	DI	CCP	C900	Total	Percentage
4	140,567	12,559	0	64	0	0	153,190	16.2%
6	50,644	122,666	488	31,022	0	25	204,846	21.6%
8	78,852	78,172	1,371	51,845	0	192,728	402,968	42.5%
10	36,505	948	818	1,432	0	407	40,110	4.2%
12	34,845	23,557	1,163	12,523	344	7,218	79,650	8.4%
14	3,551	46	0	0	0	0	3,597	0.4%
16	5,898	287	1,932	1,493	14,847	0	24,457	2.6%
18	2,896	86	338	35	0	0	3,354	0.4%
20	0	0	15	0	18,087	0	18,102	1.9%
24	0	0	0	1,490	360	0	1,850	0.2%
27	0	0	0	21	15,935	0	15,956	1.7%
Total	**353,758**	**238,322**	**6,124**	**99,924**	**49,574**	**200,379**	**948,080**	**100.0%**

Notes:

CI = Cast Iron

AC = Asbestos Cement

ST = Steel

DI = Ductile Iron

CCP = Concrete Cylinder

C900 = Polyvinyl Chloride

5.1.8 Supervisory Control and Data Acquisition (SCADA)

The City incorporates a SCADA system to control different parts of its water system facilities from one central location. The City's SCADA system is composed of SCADA software, Programmable Logic Controllers (PLCs), and communications connections. The PLCs are located at 14 sites (all of the wells and all of the plants). Plant 4 serves as the central location and is connected to all the other sites via radio network or modems. Plant 4 controls facilities including the wells, reservoirs, booster stations, and the treatment plant. The SCADA computers communicate to six (6) of the remote sites with hardwired modems; and to the remaining eight (8) remote sites with a radio network. Each remote site is equipped with a PLC to monitor and control the site's reservoirs, boosters, wells, or treatment plant.

Three (3) SCADA improvement projects have been identified (radio network upgrades, SCADA software upgrades, and PLC upgrades) are summarized below. Additional information on the City's current SCADA system and potential improvements is provided in the City of Lakewood's SCADA Master Plan 2017 (Appendix C). It is recommended the City implement these SCADA improvements into its CIP schedule.

- SCADA computers at Plant 4 are operating on older computers running on a Windows XP Pro operating system which is no longer supported by Microsoft. SCADA software also will only run on Windows XP Pro. It is recommended the City replace its SCADA computers with updated operating systems and software.
- The MDS 9810 radios used at various sites (including Plant 13, Well 2A, Well 4, Well 6, Well 13A, Well 17, Well 18, Well 22, and Well 27) to communicate with Plant 4 are obsolete and should be replaced. In addition, the MDS 9810 radios do not offer encryption. The remaining sites are currently hardwired to communicate through telephone lines and modems (including Plant 4, Well 8, Well 10, and Well 15). The modems are obsolete and should be replaced with new radios for ease of use and maintenance (the location of the conduits for the existing copper lines cannot be easily traced or identified). A Radio Survey can be done prior to installation of the new radio system to ensure that the radio signals are adequate.
- The PLCs located at Well 6 and Well 27 are obsolete and should be replaced.

5.1.9 Advanced Meter Infrastructure (AMI)

The City plans to invest in a new billing system, provided by Fathom, which offers technology and software specifically designed for water systems. The new system includes advanced meter infrastructure (AMI) which will enhance the efficiency of the water system through: maximizing reading success rate and billing accuracy; reduce meter reading and equipment costs; improve data collections from the system (i.e. meters), and improve the billing process for customers. The new system will also upgrade the City's current billing system (Munis), which is not designed to be used for water systems. The City has difficulty obtaining information regarding meter readings from the existing system. In addition, the information is only provided bimonthly.

The new AMI system will include software, managed services, and AMI network management, and replacement of all the City's meters and registers. It is recommended the City incorporate the AMI, and billing system improvements into its CIP schedule.

5.2 Remaining Service Life Evaluation

The projected service life of the City's facilities varies depending on the equipment type. The California Public Utilities Commission's (CPUC) "Standard Practice for Determination of Straight-Line Remaining Life Depreciation Accruals", provides average ranges of equipment service life for different types of utilities, including water systems. These service life ranges are based upon factors such as the future effect of wear and tear, decay, action of the elements, inadequacy, and public requirements. Based upon these CPUC ranges, Stetson Engineers Inc. has previously developed specific service life estimates for use in valuation projects in Los Angeles County. Table 5-8 provides initial service life estimates, developed by Stetson Engineers Inc., for the purpose of determining the need to replace the different types of facilities operated by the City:

Table 5-8 Initial Estimated Service Life for the Water Utility Facilities

Facility Type	Initial Estimated Service Life (Years)	Iowa / Survivor Curve (To Determine Remaining Life)
Well Casing	40	S_1 (40)
Well Pumps	25	S_1 (25)
Booster Pumps	25	S_1 (25)
Steel Reservoirs	50	S_1 (50)
Concrete Reservoirs	50	L1 (50)

Source:

California Public Utilities Commission's "Standard Practice for Determination of Straight-Line Remaining Life Depreciation Accruals, Standard Practice U-4" (January 1961)

The initial service life estimates provided in Table 5-8 are only applied to new equipment. Service life estimates can change slightly once the equipment is actually in operation. The CPUC relies on various "Iowa Curves" (or Survivor Curves) to determine the remaining service life of equipment that has been in operation. Based on the current age of facilities, the corresponding Iowa Curves can be used to determine and/or interpolate the remaining service life. In some cases, Iowa Curves can also be used to determine the remaining service life of operating equipment that has already exceeded its original estimated service life. The Iowa Curves have been applied to the City's facilities to estimate the remaining service life of certain facilities for the purposes of making replacement recommendations.

5.2.1 Remaining Service Life – Well Casing

An important factor in determining the service life of a well casing is the ability of the casing to resist corrosion, which can cause holes to develop in the well casing and cause screen/perforation slot sizes to increase, allowing sand, fines and gravel pack to enter the well. Typically, the area of a well casing most vulnerable to corrosion lies between the static water level and pumping level, due to the alternating wet and dry conditions. Greater than average corrosion occurs in this area for steel casing, which a majority of the City's wells are constructed of. Doubling the wall thickness may extend the life of a well casing four or more times. The use of copper bearing material in a well casing can increase corrosion resistance by approximately two times.

Although a standard method has not been developed to determine the life of a well based on constituents of the water, it is generally accepted that the presence of bicarbonate retards corrosion and chloride accelerates corrosion. Groundwater containing calcium carbonate (alkaline waters), which is present in the City wells, tends to encrust, rather than corrode, which promotes well casing longevity. Because encrustation tends to reduce production capacity, it must be removed periodically to restore the production capacity of the well.

Well casings should be inspected with video equipment whenever the pump is pulled to visually inspect the need for remedial work. Several maintenance and rehabilitation techniques can maintain or restore the well casing effectiveness including redevelopment (sand pumping, swabbing, air lift pumping, and surging and backwashing), chemical redevelopment (acid treatment and dispersing agents), mechanical redevelopment (wire brushing and high-pressure water jetting), screen cleaning (vibratory explosives), structural repairs (liners, complete relining, and screen replacement), and well deepening. The appropriate technique can be determined from the video survey.

As discussed previously, the service life for a well casing is estimated to be 40 years. The remaining service life projections for well casings were estimated using the S_1 (40) Iowa Curve. According to Table 5-9, there are seven wells that have exceeded the original service life of 40 years. However, based on the current life expectancy projections, five wells (Wells #4, #8, #10, #17, and #18) have an estimated remaining service life of less than ten years. The City is currently in the process of constructing a new production well, which will be able to replace the combined capacities of Wells #4 and #8. Redevelopment of the remaining well casings could maintain their production capacity. Replacement of the remaining casings should be considered in the near future if redevelopment is not practical. Two additional wells have an estimated remaining service life of 11 years (Wells #2A and #6). All other well casings appear to have at least 20 years of projected remaining life expectancy.

Table 5-9 Remaining Service Life - Well Casings (Years)

Name	Year of Installation	Current Age (1)	Original Service Life (Years)	Estimated Remaining Service Life (2)
Potable				
Well #2A	1970	47	40	**11**
Well #4	1937	80	40	**4**
Well #8	1945	72	40	**5**
Well #10	1950	67	40	**6**
Well #13A	2003	14	40	**27**
Well #15A	2001	16	40	**26**
Well #17	1951	66	40	**6**
Well #18	1951	66	40	**6**
Well #22	1996	21	40	**23**
Well #27	2010	7	40	**33**
Irrigation				
Well #6	1969	48	40	**11**

Notes:

(1) Age is based on a current year of 2017

(2) Estimated remaining service life for well casings are based on an S_1(40) Iowa Curve using the CPUC's "Standard Practice for Determination of Straight-Line Remaining Life Depreciation Accruals, Standard Practice U-4" (January 1961)

5.2.2 Remaining Service Life – Well Pumps and Booster Pumps

A major cause of deterioration in pump performance is damage resulting from cavitation, pumping of air or sand, encrustation, corrosion, rust, normal wear or any combination of these conditions. Cavitation occurs when gas bubbles in the water collapse under high pressure, which can cause severe vibration of pump components.

Air intrusion reduces pump capacity and efficiency due to the volume the air occupies. Sand pumping wears down the impeller, bearings, and pump bowl, making them less efficient. Encrustation can plug the impellers, bowls, and even the pump head. Corrosion of the impellers, bowls, or column pipe may increase the wear and failure of pump components. Rust on pump components can increase friction losses and decrease operating efficiency.

For the purposes of this 2017 Update, refurbishment and replacement are considered maintenance options to increase the service life and efficiency of well or booster pumps. Replacement consists of replacing the existing pump and/or motor. Refurbishment activities include motor repairs, rebuilding of the motor, head shaft installation, trimming the pump impellers, and re-setting of bowl depth (to prevent pumping of air or sand).

As discussed previously, the service life for well and booster pumps is estimated to be 25 years. The remaining service life projections for well and booster pumps were estimated using the S_1 (25) Iowa Curve. According to Table 5-10, the wells pump for Well #6 has an estimated remaining service life of three years based on the original equipment. Well # 6 has undergone partial replacement since the year 2010 to increase the remaining service life. All other well pumps have an estimated remaining service life of more than 10 years.

Table 5-10 Remaining Service Life – Well Pumps (Years)

Name	Year of Original Installation	Date of Last Motor Replacement	Date of Last Pump Replacement	Current Age [(1)]	Original Service Life	Estimated Remaining Service Life of Pump/Motor [(2)]
Potable						
Well #2A	1970	Jan 2010	Sep 2002	15	25	**13**
Well #4	1937	May 2015	May 2015	2	25	**23**
Well #8	1945	Jun 1997	Jun 1997	20	25	**10**
Well #10	1950	Jun 2010	Feb 2003	14	25	**14**
Well #13A	2003	Mar 2016	Mar 2016	1	25	**24**
Well #15A	2001	May 2011	May 2011	6	25	**19**
pWell #17	1951	May 2015	May 2015	2	25	**23**
Well #18	1951	Mar 2012	Mar 2012	5	25	**20**
Well #22	1996	Jul 2015	Jul 2015	2	25	**23**
Well #27	2010	Jul 2016	Jul 2016	1	25	**24**
Irrigation						
Well #6 [(7)]	1969	Nov 2010	(Original Motor)	48	25	**3**

Notes:

[(1)] Age is based on a current year of 2017

[(2)] Estimated remaining service life for well casings are based on an S_1(40) Iowa Curve using the CPUC's "Standard Practice for Determination of Straight-Line Remaining Life Depreciation Accruals, Standard Practice U-4" (January 1961)

According to Table 5-11, there are six booster pumps at Plant 4 that have a remaining service life of two years based on the original equipment (Boosters #2, #3, #4, #5, #6, and #7). Two of these booster pumps (Boosters #3 and #5) have had motor replacements within the past five years, likely increasing the remaining service life. The remaining Plant 4 booster pumps should be scheduled for replacement or refurbishment. Five booster pumps have an estimated remaining service life of five to ten years (Plant 4, Booster #8 and Plant 22, Boosters #1, #2, #3, and #4). Replacement or refurbishment of these booster pumps should be considered in the near future to increase the remaining service life. The City's remaining booster pumps were installed in 2017 (at Plant 13) and have an estimated remaining service life of 25 years.

The following is a summary of potential improvements for the City's booster pumps:

- Plant 4 booster pumps (Boosters #2, #4, #6, and #7) should be scheduled for replacement or refurbishment.
- Replacement or refurbishment of Plant 22, Boosters #1, #2, #3, and #4 should be considered in the near future to increase the remaining service life. However, replacement of these booster pumps is not necessary if Reservoir 22 is removed from service (see Section 5.4.1).
- Additional replacement and/or refurbishment of booster pumps should be scheduled based on declining pump efficiencies from pump tests (see Section 5.3) and from the City's Asset Management Plan (see Section 5.5).

It is recommended the City continues its program to periodically replace and refurbish well and booster pumps to maintain adequate service life and efficiency.

Table 5-11 Remaining Service Life – Booster Pump Facilities (Years)

Name	Year of Installation	Date of Last Motor Replacement (3)	Current Age (1)	Original Service Life (Years)	Estimated Remaining Service Life (Based on Original Equipment) (2)
Plant 4, Booster #2	1965	-	52	25	**2**
Plant 4, Booster #3	1965	2013	52	25	**2**
Plant 4, Booster #4	1965	-	52	25	**2**
Plant 4, Booster #5	1965	2015	52	25	**2**
Plant 4, Booster #6	1965	-	52	25	**2**
Plant 4, Booster #7	1965	-	52	25	**2**
Plant 4, Booster #8	2017	2017	0	25	**25**
Plant 13, Booster #1	2017	-	0	25	**25**
Plant 13, Booster #2	2017	-	0	25	**25**
Plant 13, Booster #3	2017	-	0	25	**25**
Plant 13, Booster #4	2017	-	0	25	**25**
Plant 22, Booster #1	1990	-	27	25	**7**
Plant 22, Booster #2	1990	-	27	25	**7**
Plant 22, Booster #3	1990	-	27	25	**7**
Plant 22, Booster #4	1990	-	27	25	**7**

Notes:

(1) Date of last motor replacement based on City records. The motor for Plant 4, Booster #6 appears to have previously been replaced, however, the replacement date is unknown.

(2) Age is based on a current year of 2017.

(3) Estimated remaining service life for booster pumps are based on an S_1(25) Iowa Curve using the CPUC's "Standard Practice for Determination of Straight-Line Remaining Life Depreciation Accruals, Standard Practice U-4" (January 1961)

5.2.3 Remaining Service Life – Water Storage Facilities

The City has nine water storage facilities. Two of these water storage facilities are constructed from concrete (Plant 4, Tank 3 and Reservoir 22), while the remaining facilities are constructed from steel. As discussed previously, the service life for either steel or concrete water storage facilities is estimated to be 50 years. While concrete water storage facilities are relatively maintenance free, steel water storage facilities require periodic maintenance. A significant maintenance activity for steel tanks involves periodic repainting to avoid rust and corrosion. The remaining service life projections for the reservoirs were estimated using the S_1 (50) Iowa Curve. The remaining service life projections for concrete reservoirs were estimated using the L_1 (50) Iowa Curve. As shown in Table 5-11, the City's concrete reservoirs have a remaining service life projection of at least 18 years and its steel reservoirs have a remaining service life projection of at least 12 years. The three oldest water storage facilities (Plant 13, Tank 1, Tank 2 and Tank 3) have an estimated remaining service life of 12 years; however, these facilities were relined or recoated in 1966 and cleaned in 2015 which could extend the service life, but it is not quantifiable. Additional recommendations regarding reservoir improvements are provided in Section 5-4.

Table 5-12 Remaining Service Life - Water Storage Facilities (Years)

Name	Year of Installation	Current Age (2)	Original Service Life (Years)	Estimated Remaining Service Life (3)	Date of Last Cleaning	Date of Re-lined or Coated
Plant 4, Tank 1	1965	52	50	**16**	2006	2006
Plant 4, Tank 2	1965	52	50	**16**	2015	2006
Plant 4, Tank 3 (1)	1996	21	50	**34**	2008	-
Plant 13, Tank 1	1950	67	50	**12**	2015	1996
Plant 13, Tank 2	1950	67	50	**12**	2015	1996
Plant 13, Tank 3	1950	67	50	**12**	2015	1996
Plant 13, Tank 4	1997	20	50	**32**	2015	1997
Plant 13, Tank 5	1965	52	50	**16**	2015	1996
Reservoir 22 (1)	1954	63	50	**18**	2016	-

Notes:

(1) Concrete reservoirs

(2) Age is based on a current year of 2017.

(3) Estimated remaining service life for steel and concrete tanks are based on S_1(50) Iowa Curves and L_1(50) Iowa Curves, respectively, using the CPUC's "Standard Practice for Determination of Straight-Line Remaining Life Depreciation Accruals, Standard Practice U-4" (January 1961)

5.3 SCE Pump Efficiency Tests

Southern California Edison (SCE) periodically performs pump tests on a majority of the City's wells and booster pumps. These SCE pump tests help the City identify inefficient pumps. Based on recommendations provided by SCE, inefficient pumps may need to be replaced or refurbished depending on their age, plant efficiency, and power requirements. In general, increasing the efficiency of a low efficiency pump that is operating at full capacity will result in significant electrical cost savings. Furthermore, as plant efficiencies typically decrease over time, there is an increased potential for electrical cost savings through upgrading or replacing pumps. However, if an inefficient pump is operating at a reduced capacity, the electrical cost savings may not be significant. Changes in the City's operation of pumping plants may result in revisions to the conclusions presented in this Master Plan based on the SCE pump tests.

5.3.1 SCE Pump Efficiency Tests – Well Pumps

The results of recent SCE pump tests for the City's well pumps are summarized in Table 5-13. According to the results, well pump operation efficiencies range between 54.7 percent to 67.2 percent. In addition, SCE has identified the well pumps which are "efficient" or "inefficient". It should be noted the City has installed a new pump and motor at Well 13A since the time of the SCE pump tests. Based on the SCE pump test results, there are currently four well pumps which are operating inefficiently (Wells #2A, #4, #15A, #18, and #6). A cost analysis review of the replacement of these well pumps is provided in Section 5.3.5.

Table 5-13 Well Pump Efficiencies

Well Pump	Test Date	Pumping Capacity (gpm) (1)	Plant Efficiency (1)	SCE Classification (1)	Date of Last Motor Replacement	Date of Last Pump Replacement
Potable						
Well #2A	Feb 2017	411	57.7%	**Inefficient (2)**	Jan 2010	Sep 2002
Well #4	Feb 2017	653	58.7%	**Inefficient (2)**	May 2015	May 2015
Well #8	-	-	-	-	Jun 1997	Jun 1997
Well #10	Feb 2017	774	60.4%	Efficient	Jun 2010	Feb 2003
Well #13A	Aug 2017	1,139	62.7%	Efficient	Mar 2016	Mar 2016
Well #15A	Feb 2017	1,457	61.1%	**Inefficient (2)**	May 2011	May 2011
Well #17	Feb 2017	904	64.5%	Efficient	May 2015	May 2015
Well #18	Feb 2017	601	61.1%	**Inefficient (2)**	Mar 2012	Mar 2012
Well #22	Feb 2017	846	67.2%	Efficient	Jul 2015	Jul 2015
Well #27	Feb 2017	2,349	66.0%	Efficient	Jul 2016	Jul 2016
Irrigation						
Well #6	Feb 2015	317	54.7%	**Inefficient (4)**	Nov 2010	-

Notes:

(1) Based on Southern California Edison (SCE) pump test results

(2) SCE indicates there is potential to improve pump efficiency.

(3) The motor and pump for Well #13A have been replaced since the date of the most recent SCE pump test.

(4) Not available. Well #6 SCE pump test result from March 2011 incorporated.

5.3.2 Potential Annual Cost Savings – Well Pumps

SCE indicates there is a potential for annual energy savings by improving well pump efficiency to at least 65 to 70 percent. Although there is an increased potential for energy savings through upgrading or replacing older pumps, the economics of replacing inefficient pumps that were recently replaced or installed may also need to be considered. Table 5-14 summarizes the potential annual energy cost savings for the City's well pumps that have the potential for significant costs savings.

Table 5-14 Potential Well Pump Energy Cost Savings

Well Pump	Test Date	Existing Annual Energy Use (kWh) (1)	Average Cost per kWh (1)	Existing Annual Energy Cost (1)	Pump Efficiency (Existing) (1)	Pump Efficiency (Proposed) (1)	Proposed Annual Energy Savings (1)
Potable							
Well #2A	Feb 2017	180,984	$0.10	$18,250.89	57.7%	65.0%	**$2,048**
Well #4	Feb 2017	326,376	$0.10	$31,095.14	58.7%	65.0%	**$3,036**
Well #8	-	-	-	-	-	-	-
Well #10	Feb 2017	178,404	$0.09	$16,819	60.3%	-	-
Well #13A	Aug 2017	134,868	$0.12	$16,543.46	62.7%	-	-
Well #15A	Feb 2017	443,868	$0.09	$40,597.94	61.2%	65.0%	**$2,400**
Well #17	Feb 2015	598,704	$0.13	$75,089	69.4%	-	-
Well #18	Feb 2017	407,160	$0.09	$36,346	61.1%	69.0%	**$4,173**
Well #22	Feb 2017	608,700	$0.18	$112,020	67.2%	-	**-**
Well #27	Feb 2017	222,876	$0.17	$38,248	66.0%	-	**-**
Irrigation							
Well #6	Feb 2015	16,908	$0.28	$4,709	54.7%	65.0%	**$747**

Notes:

(1) Based on Southern California Edison (SCE) pump test results

(3) The motor and pump for Well #13A have been replaced since the date of the most recent SCE pump test.

5.3.3 SCE Pump Efficiency Tests – Booster Pumps

The results of recent SCE pump tests for the City's booster pumps are summarized in Table 5-15. According to the results, booster pump operation efficiencies range between 59.9 percent to 71.5 percent. In addition, SCE has identified the well pumps which are "efficient" or "inefficient". Based on the SCE pump test results, there are currently four booster pumps which is operating inefficiently (Plant 4, Booster #2, #3, #4, and #6). A cost analysis review of the replacement of these booster pumps is provided in Section 5.3.5.

Table 5-15 Booster Pump Efficiencies

Booster Pump	Test Date	Pumping Capacity (gpm) (1)	Plant Efficiency (1)	SCE Classification (1)	Date of Last Motor Replacement
Plant 4, Booster #2	Jan 2017	746	61.0%	**Inefficient** (2)	-
Plant 4, Booster #3	Jan 2017	656	61.2%	**Inefficient** (2)	2013
Plant 4, Booster #4	Jan 2017	1,397	59.9%	**Inefficient** (2)	-
Plant 4, Booster #5	Jan 2017	1,590	71.5%	Efficient	2015
Plant 4, Booster #6	Jan 2017	769	61.8%	**Inefficient** (2)	-
Plant 4, Booster #7	Jan 2017	1,113	71.0%	Efficient	-
Plant 4, Booster #8	Apr 2017	1,970	68.4%	Efficient	-
Plant 13, Booster #1	Aug 2017	900	62.7%	Efficient	-
Plant 13, Booster #2	Aug 2017	1,011	63.7%	Efficient	-
Plant 13, Booster #3	Aug 2017	1,663	60.2%	Efficient	-
Plant 13, Booster #4	Aug 2017	1,722	62.8%	Efficient	-
Plant 22, Booster #1	Feb 2017	930	69.2%	Efficient	-
Plant 22, Booster #2	Feb 2017	842	67.8%	Efficient	-
Plant 22, Booster #3	Feb 2015	790	66.1%	Efficient	-
Plant 22, Booster #4	Feb 2017	1,111	65.1%	Efficient	-

Notes:

(1) Based on Southern California Edison (SCE) pump test results

(2) SCE indicates there is potential to improve pump efficiency.

5.3.4 Energy Saving Analysis – Booster Pumps

Similar to well pumps, there is potential for annual energy savings by improving booster pump efficiency to at least 65 to 70 percent. Although there is an increased potential for energy savings through upgrading or replacing older pumps, the economics of replacing inefficient pumps that were recently replaced or installed may also need to be considered. Table 5-16 summarizes the potential annual energy cost savings for the City's booster pumps that have the potential for significant costs savings.

Table 5-16 Potential Booster Pump Efficiency Pump Energy Cost Savings

Well Pump	Test Date	Existing Annual Energy Use (kWh) (1)	Average Cost per kWh (1)	Existing Annual Energy Cost (1)	Pump Efficiency (Existing) (1)	Pump Efficiency (Proposed) (1)	Proposed Annual Energy Savings (1)
Plant 4, Booster #2	Jan 2017	55,368	$0.11	$5,931	61.0%	66.0%	$446
Plant 4, Booster #3	Jan 2017	120,372	$0.11	$12,893	61.3%	66.0%	$926
Plant 4, Booster #4	Jan 2017	22,872	$0.11	$2,449	59.9%	68.0%	$293
Plant 4, Booster #5	Jan 2015	55,104	$0.08	$4,465	69.9%	-	-
Plant 4, Booster #6	Jan 2017	12,288	$0.11	$1,316	61.9%	66.0%	$82
Plant 4, Booster #7	Jan 2015	120	$0.08	$10	69.4%	-	-
Plant 4, Booster #8	Apr 2017	120,600	$0.11	$12,916	68.4%	-	-
Plant 13, Booster #1	Aug 2017	182,172	$0.15	$26,916	62.7%	-	-
Plant 13, Booster #2	Aug 2017	211,236	$0.15	$31,209	63.7%	-	-
Plant 13, Booster #3	Aug 2017	4,572	$0.15	$677	60.2%	-	-
Plant 13, Booster #4	Aug 2017	4,248	$0.15	$627	62.9%	-	-
Plant 22, Booster #1	Feb 2017	456	$0.18	$84	69.2%	-	-
Plant 22, Booster #2	Feb 2015	218,064	$0.11	$24,356	66.4%	-	-
Plant 22, Booster #3	Feb 2017	15,936	$0.18	$2,932	67.7%	-	-
Plant 22, Booster #4	Feb 2017	156	$0.18	$31	65.0%	-	-

Notes:

(1) Based on Southern California Edison (SCE) pump test results

5.3.5 Cost Saving Analysis – Energy Cost Versus Pump Refurbishment or Replacement Cost

In addition to the SCE cost savings analysis of increasing pump efficiencies provided above, applicable SCE pump tests have been evaluated to determine if refurbishment or replacement of the well or booster pumps is the most economical way to increase efficiency. For the purposes of evaluation, refurbishment is assumed to provide an additional 12.5 years of service life to a pump at a cost of approximately $20,000 for booster pumps and $45,000 for well pumps. Refurbishment should generally be applied only to newer pumps. Replacement of a pump is assumed to provide 25 years of service life at a cost of approximately $40,000 for booster pumps and $150,000 for well pumps. The present worth of the potential annual power cost savings, using a 5 percent rate of return over the estimated life of the pump, is compared to the cost for refurbishment and replacement. If the present worth of the potential annual power cost savings is greater than the cost for refurbishment or replacement, it has been assumed that refurbishment or replacement of a well or booster pump is economical.

The City's well and/or booster pumps considered for refurbishment or replacement are summarized in Table 5-17 and Table 5-18, respectively. The refurbishment and/or replacement of well and booster pumps do not appear economical. In general, a relatively newer pump should be refurbished, with the possibility of future replacement when plant efficiency declines again. Alternatively, a relatively older pump should be replaced, with the possibility of future refurbishment.

Table 5-17 Cost Analysis for Replacement or Refurbishment of Well Pumps

Pump Name	Proposed Annual Energy Savings (1)	Present Worth of Potential Annual Power Savings (2)		Present Worth of Savings over 12.5 Years Less Refurbishment Costs ($45,000) (3)	Present Worth of Savings over 25 Years Less Replacement Costs ($150,000) (4)
		Refurbishment (12.5 yrs @ 5%)	Replacement (25 yrs @ 5%)		
Well #2A	$2,048	$18,701	$28,863	($26,299.30)	($121,137)
Well #4	$3,036	$27,721	$42,785	($17,279.06)	($107,215)
Well #15A	$2,400	$21,918	$33,829	($23,081.77)	($116,171)
Well #18	$4,173	$38,109	$58,818	($6,891.36)	($91,182)
Well #6	$747	$6,819	$10,524	($38,181.40)	($139,476)

Notes:

(1) Based on Southern California Edison (SCE) pump test results

(2) Refurbishment is assumed to provide 12.5 years of service life. Replacement is assumed to provide 25 years of service life. The present worth assumes a refurbishment or replaced pump remain at an equal efficiency level compared to the original pump over the projected service life.

(3) Present worth of refurbishment (5.0% for 12.5 years) minus $45,000, the assumed cost for well pump refurbishment.

(4) Present worth of replacement (5.0% for 25 years) minus $150,000, the assumed cost for well pump replacement.

Table 5-18 Cost Analysis for Replacement or Refurbishment of Booster Pumps

Pump Name	Proposed Annual Energy Savings (1)	Present Worth of Potential Annual Power Savings (2)		Present Worth of Savings over 12.5 Years Less Refurbishment Costs ($20,000) (3)	Present Worth of Savings over 25 Years Less Replacement Costs ($40,000) (4)
		Refurbishment (12.5 yrs @ 5%)	Replacement (25 yrs @ 5%)		
Plant 4, Booster #2	$446	$4,073	$6,287	**($15,926.56)**	**($33,713)**
Plant 4, Booster #3	$926	$8,456	$13,051	**($11,543.91)**	**($26,949)**
Plant 4, Booster #4	$293	$2,676	$4,130	**($17,324.43)**	**($35,870)**
Plant 4, Booster #6	$82	$752	$1,161	**($19,248.01)**	**($38,839)**

Notes:

(1) Based on Southern California Edison (SCE) pump test results

(2) Refurbishment is assumed to provide 12.5 years of service life. Replacement is assumed to provide 25 years of service life. The present worth assumes a refurbishment or replaced pump remain at an equal efficiency level compared to the original pump over the projected service life.

(3) Present worth of refurbishment (5.0% for 12.5 years) minus $20,000, the assumed cost for booster pump refurbishment.

(4) Present worth of replacement (5.0% for 25 years) minus $40,000, the assumed cost for booster pump replacement.

5.4 Condition Assessment of Reservoirs

The City's facilities include two concrete reservoirs and seven steel reservoirs. Concrete reservoirs are either partially or predominantly buried underground. All of the steel reservoirs are constructed above ground.

The City's concrete reservoirs should periodically be inspected for damage and cracking. Exterior inspections are typically limited to external areas above ground. Generally, the exterior face of a reservoir, in addition to weathering, is under tension and is more likely to crack. Conversely, the interior face of a reservoir is under compression and is less likely to crack. Reservoir areas covered in dirt may exhibit different cracking tendencies, although cracks cannot be determined unless earthwork is performed or if there is a presence of water leakage. Reservoir cracks can be repaired or resealed to prevent further spreading of cracks and possible water leakage.

An important maintenance concern regarding steel reservoirs is periodic repainting to avoid rust and corrosion. The presence of rust is likely caused by damaged paint, in which case the reservoir should be sandblasted and repainted. All the City's steel reservoirs are equipped with a cathodic protection system to protect against internal corrosion.

Dive / Corr Inc. has been periodically preforming inspection and prepares inspection reports for the City's reservoirs. Table 5-19 summarizes the dates of the most recent City reservoir inspections:

Table 5-19 Reservoir Inspection Date

Reservoir Name	Dive / Corr Inspection Date
Reservoir 22	February 16, 2016
Plant 4, Tank 1	February 27, 2014
Plant 4, Tank 2	June 12, 2015
Plant 4, Tank 3	May 1, 2017
Plant 13, Tank 1	June 12, 2015
Plant 13, Tank 2	June 12, 2015
Plant 13, Tank 3	June 12, 2015
Plant 13, Tank 4	June 12, 2015
Plant 13, Tank 5	June 12, 2015

The inspection reports provide recommendations for each reservoir (a summary is provided in Appendix D), including the following:

- Regular cleaning, inspection and repair cycles every two years for each reservoir.
- For Reservoir 22, repair the cracking in the interior roof and walls and floors or replace the reservoir.
- For Plant 13, Tanks 4 and 5, recoat roof exterior and do not use cathodic system rectifier until it is repaired for Tank 5. The City indicated it has recently recoated the roof exterior for Plant 13, Tanks 4 and 5. In addition, the City removed the rectifiers for Tanks 4 and 5 in May 2017, and passive sacrificial anodes were installed in each tank.

A summary of recommendations is provided in Table 5-20 below.

Table 5-20 Reservoir Inspection Summary

Name	Recommendations
Reservoir 22	**Replacement or repair (considerable leakage at wall to floor joint line, notable roof cracking. Overflow openings are clogged)**
Plant 4, Tank 1	Reattach vent straps, Annual roof cleaning
Plant 4, Tank 2	Recoat rust zones on roof exterior
Plant 4, Tank 3	Monitor cracking in roof underside, Monitor and remove interior deposits (possibly filter media)
Plant 13, Tank 1	Monitor previous leak at the corner on the rectangular manway quarterly
Plant 13, Tank 2	Reinspect reservoir in 2 years
Plant 13, Tank 3	Reinspect reservoir in 2 years
Plant 13, Tank 4	**Recoat roof exterior**
Plant 13, Tank 5	**Recoat roof exterior**

5.4.1 Removal of Reservoir 22

It is recommended the City remove Reservoir 22 from service. The inspection report for Reservoir 22 recommends replacement of the reservoir. The City's existing reservoirs have sufficient storage capacity under current and future conditions with Reservoir 22 removed from service (see Section 6.2). In addition, the hydraulic model identified only an additional three (3) model nodes with fire flow deficiencies at MDD plus fire flow as a result of Reservoir 22 being removed from service (see Section 6.3).

5.4.2 Reservoir Maintenance

In general, regular cleaning, inspection, and repair cycles are recommended every two (2) years for each reservoir.

An important maintenance item for steel reservoirs is periodic repainting to avoid rust and corrosion. Reservoir damage should be repaired or resealed when found to prevent further rusting and possible water leakage. The City periodically inspects the external and internal conditions of its reservoirs. In order to maintain reservoirs in good condition, a routine maintenance schedule is required to recoat these reservoirs. In general, steel reservoirs should be recoated every 20 years (without cathodic protection) and 25 years (with cathodic protection) to ensure proper protection against corrosion. Although the frequency of recoating will vary based on the use of the reservoir and the water quality, the City should plan to recoat each reservoir at least every 20 years because not all of its reservoirs are equipped with cathodic protection.

When maintenance is deferred, coating systems will not achieve the designed life they are intended for, potentially resulting in premature failure and structural damage to the underlying substrate. Structural damage includes the deterioration of the interior rafters and lateral braces, requiring partial or full replacement. In addition, deep pitting or perforations in the tank bottom, deterioration of the center vent structure or the ladder, and severe pitting of the shell may also occur and require reservoir replacement.

Concrete reservoirs should periodically be inspected for damage and cracking. Exterior inspections of the concrete reservoir are limited to external areas above ground. Generally, the exterior face of a reservoir, in addition to weathering, is under tension and is more likely to crack. Conversely, the interior face of a reservoir is under compression and is less likely to crack. Reservoir areas covered in dirt may exhibit different cracking tendencies, although cracks cannot be determined unless earthwork is performed or if there is a presence of water leakage. Reservoir cracks can be repaired or resealed to prevent further spreading of cracks and possible water leakage.

5.4.3 Comprehensive Analysis Report

The City may consider preparing comprehensive analysis reports for each of its reservoirs. The reports include structural and seismic evaluations based on applicable standards and guidelines (including from AWWA and the Occupation Safety and Health Administration (OSHA)). The reports can include various safety and structural retrofit recommendations to comply with AWWA guidelines. These retrofits can include the following installation and/or replacements:

- In accordance with Section 3.6.1.4 of AWWA guidelines D100-11 roof rafters (structural beams used to support the roof of a reservoir) shall be designed using the allowable stress design provisions of the American Institute of Steel Construction (AISC) for A36 material when the roof design live load is 50 lb/ft^2 or less. For roof design live loads greater than 50 pounds per square foot, roof rafter design may utilize higher allowable stresses when using material with minimum specified yield strength greater than A36 material. Other design components, including lateral support of rafters, placement of rafters, coating, and maximum rafter spacing are also detailed in Section 3.6.1 of AWWA guidelines D100-11.

- A seismic evaluation may need to be performed on the City's reservoirs to determine if reservoirs are at risk from seismic action, including roof damage, shell hoop tension failure, shell elephant foot buckling due to seismic overturning moments, piping damage and foundation failure.

- Reservoir roof damage can occur due to sloshing wave forces. AWWA D100-11 includes freeboard calculation guidelines to protect the reservoir roof, lowering the overflow pipe location and reducing storage capacity. AWWA D110-04 guidelines provide similar guidelines for concrete reservoirs.

- According to AWWA D110-04 guidelines, which were unavailable when the City's reservoirs were constructed, unanchored reservoirs have a minimum bottom pipe penetration limit to prevent leak and/or tears if the bottom shell were to uplift during a seismic event. Increasing the height of these penetrations is not desirable because it impacts the useable capacity of the reservoir. If the reservoir is anchored, the pipe penetration limit does not apply, and it minimizes the impact to the useable capacity. Existing reservoirs may be equipped with flex couplings to mitigate piping damage in all of the unanchored reservoirs. Unanchored reservoirs are also at a higher risk of buckling and overturning forces that result in uplift on the bottom of the reservoirs.

- In accordance with Section 7.4.1 of AWWA guidelines D-100-11 for carbon steel tanks, general access to the reservoir, including ladders, stairs, platforms, rails, access openings, and safety devices, shall comply with OSHA standards.

- In accordance with Section 7.4.4 of AWWA guidelines D-100-11, two shell manholes shall be provided in the first ring of a tank shell.

5.5 Asset Management Plan

GHD prepared a working draft of the City's "Asset Management Plan" in January 2017. The Asset Management Plan was prepared as a long-range planning document for managing the water production facility assets owned and operated by the City, over the next 10 to 20 years. The Asset Management Plan provides a framework to manage costs, risks, and levels of service of the City's assets, while additionally identifying future funding requirements. The City's water production facility assets covered by the Asset Management Plan include the Plant 4, Plant 13, and Plant 22 facilities as well as other water distribution system assets including other wells, SCADA, etc.

The Asset Management Plan provides information regarding the following water supply facility categories:

- Booster Pump Station (including pumps, motors, valves, enclosures, and starters)
- Well (including pumps, motors, valves, meters, and control building)
- Reservoir (including storage tanks, ladders, pumps, and valves)
- Treatment Plant (including pumps, electrical buildings, valves, tanks, and control panels)
- General (including electrical conduits, pipes, and fittings)

Assets are categorized by location and type. Table 5-21 provides a summary of the number of City assets reviewed and their replacement value.

Table 5-21 Asset Inventory and Replacement Value

Plant	Category	Number of Assets	Value ($M)
Plant 13	Booster Pump Station	43	0.3
	General	2	1.1
	Reservoir	10	3.5
	Treatment Plant	24	0.6
	Well	12	2.4
Plant 22	General	2	0.3
	Reservoir	13	7.7
	Well	66	3.2
Plant 4	Booster Pump Station	79	0.9
	General	2	5.1
	Reservoir	29	22.4
	Treatment Plant	77	1.5
	Well	124	12.3
System	Well	66	6.5
City Wide	General	1	0.2
Total		**550**	**68.0**

Source:
City Draft Asset Management Plan, January 2017

An asset management strategy will enable assets to provide the desired levels of service, while managing risk at the lowest life cycle cost. High-risk assets were identified in the Asset Management Plan and prioritized over lower risk assets for replacement and maintenance. A life cycle analysis was prepared and recommended the budget required to provide service in a sustainable way. Analysis of the asset registry gives the long-term costs of replacing and/or maintaining (rehabilitating) assets. Table 5-22 provides the projected annual investment costs required to maintain service.

Table 5-22 Projected Asset Replacement and Rehabilitation Costs

Year	Replacement Costs	Rehabilitation Costs	Total Costs
2017	$2,411,963	$308,496	$2,720,459
2018	$126,325	$69,569	$195,894
2019	$307,710	$94,464	$402,174
2020	$2,591,951	$39,054	$2,631,005
2021	$28,800	$112,752	$141,552
2022	$401,700	$61,763	$463,463
2023	$25,225	$159,956	$185,181
2024	$604,100	$51,774	$655,874
2025	$349,800	$180,405	$530,205
2026	$31,550	$47,970	$79,520
2027	$2,655,737	$112,627	$2,768,364
2028	$28,625	$45,192	$73,817
2029	$521,210	$87,084	$608,294
2030	$1,453,425	$44,969	$1,498,394
2031	$2,468,600	$64,836	$2,533,436
2032	$440,508	$107,519	$548,027
2033	$37,600	$88,516	$126,116
2034	$5,435,590	$94,492	$5,530,082
2035	$507,600	$63,412	$571,012
2036	$260,150	$98,721	$358,871
	20 Year Total		**$22,621,740**
	Average Annual Renewal		**$1,131,087**

Source:

City Draft Asset Management Plan, January 2017

It is recommended the City incorporate the schedule of asset replacements recommended in the Asset Management Plan into the City's CIP schedule with the following modifications:

- The immediate replacement of the pumps for Wells #2A, #10, #15A, and #18 are not included in the CIP schedule. These well pumps have been refurbished or replaced since at least 2002 and do not require immediate replacement. It should be noted the Asset Management Plan schedules periodic replacement of these well pumps in the long-term which are included in the CIP schedule.

- The replacement of Plant 13, Tank 1, Tank 2 and Tank 3 (by 2020) are not included in the CIP schedule. These storage facilities currently have an estimated remaining service life of 12 years. Although life expectancy projections for these reservoirs should continue to be reviewed periodically, there are no replacement recommendations for these reservoirs at this time.

- The replacement of wells in 2030 and 2031 is not included in the CIP schedule.

- The replacement of one of two reservoirs in 2034 is not included in the CIP schedule.

A summary of the recommended replacements based on the draft Asset Management Plan is provided in Appendix E.

The City should continue updating the Asset Management Plan annually in order to reflect the continuous improvement of asset management practices and data refinement.

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CHAPTER 6

EVALUATION OF FACILITY CAPACITIES TO MEET DEMANDS

6.1 Introduction

This section evaluates the condition and performance of the City's existing finished water pumping, storage and distribution facilities and presents recommendations for capital improvements to improve system operations and performance, to accommodate future growth and development, and to maintain system reliability and redundancy. This section also presents the criteria against which the existing system facilities were evaluated.

6.1.1 Evaluation Criteria

The adequacy of existing system facilities to meet current and projected water demands and to deliver adequate fire flows was evaluated using a hydraulic model of the distribution system. Meeting system requirements depends upon the proper design and performance of distribution and transmission piping, storage reservoirs, booster pumps, and regulating valves. The following criteria for distribution piping (Section 6.1.1.1) and storage (Section 6.1.1.2) were used to evaluate the City's existing distribution system and to plan for future improvements, upgrades, and expansions of distribution and storage facilities.

6.1.1.1 Evaluation Criteria for Transmission and Distribution Piping

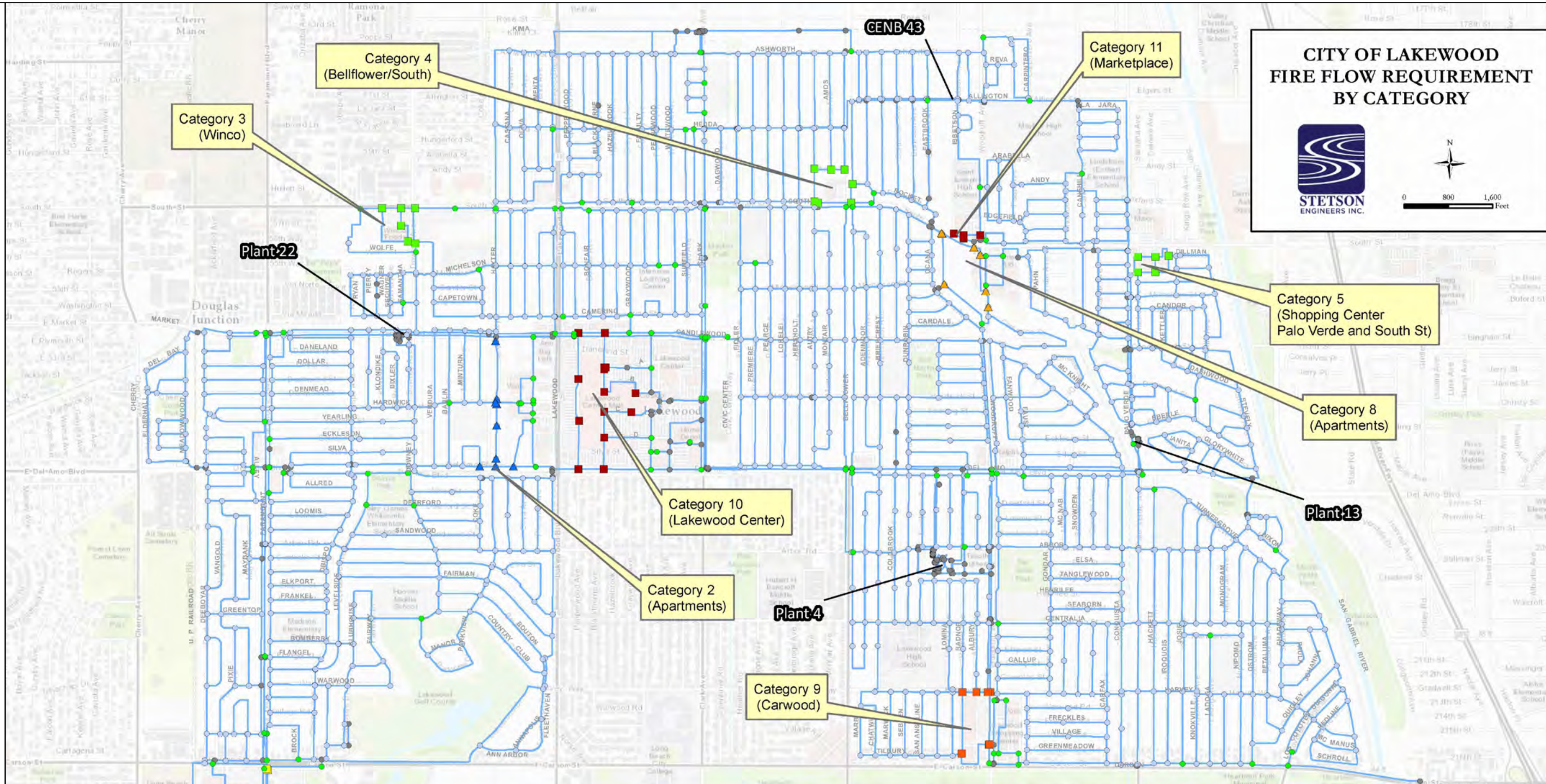
Design guidelines for transmission and distribution vary from state to state and from utility to utility. The American Water Works Association (AWWA) provides some guidelines and many states regulate certain performance criteria. Also, the CPUC, counties, cities, fire agencies, and the Insurance Service Office (ISO) set standards for fire flow requirements for individual structures within a service area. However, design criteria are often left to the discretion of the water utility.

In general, the City's network of water distribution piping must accommodate multiple objectives:

- **Capacity**: Achieve adequate delivery capacity and acceptable pipeline head losses.
- **Fire Flow**: Supply fire flows at recommended levels.
- **Growth**: Accommodate future service area development through system expansion.
- **Redundancy**: Provide multiple delivery points to areas.
- **Reliability**: Maintain physical condition of system through pro-active rehabilitation and replacement to minimize unscheduled loss of service.

To evaluate the performance of the existing transmission and distribution piping system and to plan conservatively for future growth while maintaining system reliability, the criteria presented in Table 6-1 were used for hydraulic evaluation (including hydraulic modeling) of transmission and distribution pipeline mains for this Master Plan Update. The fire flow criteria shown in Table 6-1 are also presented in Figure 6-1.

FIGURE 6-1



Map Symbol	Category ID	Building Description	Fire Flow Requirement (gpm)
● (light blue)	1	Single Family Homes - Predominantly <3,600 sf	1,750
▲ (blue)	2	Apartments (Lakewood Manor) - 2 story - 15,000 sf per bldg, 16 bldgs	3,250
■ (green)	3	Winco Foods - 3400 E South St	3,750
■ (green)	4	Shopping Center - Bellflower and South St	3,750
■ (green)	5	Shopping Center - Palo Verde and South St	3,750
● (green)	6	Commerical / Institute	3,750
■ (yellow)	7	Walmart Supercenter - 2770 E Carson St	4,000
▲ (orange)	8	Apartments (Olivewood) - 2 story, 149 units (apartments.com), Avg 840 sf/unit, Approx 10 bldgs at 25,000 sf/bldg	4,250
■ (orange)	9	Carwood West Shopping Center	4,750
■ (red)	10	Lakewood Center (Mall) - 2 Story, built in 1950	6,000
■ (dark red)	11	Lakewood Marketplace	6,000
● (grey)	-	Non-Demand Node	-

STETSON ENGINEERS INC.
861 VILLAGE OAKS DRIVE, SUITE 100
COVINA, CALIFORNIA 91724
TEL: (626) 967-6202
FAX: (626) 331-7065
2171 E Francisco Blvd., Suite K
San Rafael California 94901
2651 W Guadalupe Rd., Suite A209
Mesa Arizona 85202

CITY OF LAKEWOOD

FIRE FLOW REQUIREMENTS BY CATEGORY

CITY OF LAKEWOOD CALIFORNIA

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Table 6-1 Design Guidelines for Transmission and Distribution Pipeline Mains

Parameter	Criteria
Minimum Pressure at MDD	35 psi
Maximum Pressure at MDD	120 psi
Pipe Velocity (1) at MDD	< 7 feet per second
Maximum Head Loss (1) at MDD	10 feet per 1,000 feet (Single pipe maximum loss of 1 foot)
Fire Flow (Commercial and Industrial) (2) at MDD	
Southwest Lakewood (Walmart)	4,000 gpm for 4 hrs
Northwest Lakewood (Winco Foods)	3,750 gpm for 3 hrs
Central Lakewood (Lakewood Center)	6,000 gpm for 4 hrs
North Lakewood (Shopping center at Bellflower and South)	3,750 gpm for 3 hrs
East Lakewood (Lakewood Marketplace)	6,000 gpm for 4 hrs
East Lakewood (Shopping center at Palo Verde and South)	3,750 gpm for 3 hrs
Southeast Lakewood (Carwood West)	4,750 gpm for 4 hrs
Fire Flow (Residential) (2) at MDD	
Northwest Lakewood (Multi family)	3,250 gpm for 3 hrs
East Lakewood (Multi family)	4,250 gpm for 4 hrs
Single Family Homes (Average of 1,900 square feet)	1,750 gpm for 2 hrs

Notes:
MDD = Maximum Day Demand
gpm = gallons per minute
psi = pounds per square inch
(1) AWWA Standard
(2) Based on the 2016 California Fire Code and the Los Angeles County Fire Department standards

6.1.1.2 Evaluation Criteria for Distribution System Storage Facilities

Water is stored to provide water pressure, equalize pumping rates, equalize supply and demand over periods of high consumption, provide surge relief, and furnish water during fires and other emergencies. Storage may also serve as part of the treatment process, either by providing increased detention time or by blending water supplies to obtain a desired concentration.

Storage facilities must be sized to sufficiently provide for the following:

- **Equalization Storage**: Provide equalization to the daily fluctuation of water demand.
- **Fire Suppression Storage**: Meet the demands of fire fighting for a specified period of time within the service area.
- **Emergency Storage**: Provide water reserves for contingencies such as system failures, power outages and other emergencies.

<u>Equalization Storage</u>

The operational component of storage is determined by the fluctuation in hourly demand during the maximum day of operation. The amount of equalization storage required is a function of the finished water pumping capacity, distribution piping capacity, and system demand characteristics. Equalization storage is generally less expensive than increased capacities of finished water pumps and distribution piping beyond that required to meet the maximum day demand (MDD) or peak day demand. Consequently, it is desirable to size the pumping and piping systems to carry MDD, with equalization storage sized to carry demands in excess of the MDD up to the peak hour demand (PHD). According to *Distribution Network Analysis for Water Utilities* (AWWA), equalization storage should be approximately 50 percent of the total storage required and between 20 to 25 percent of the Average Day Demand (ADD). The U.S. Army Corps of Engineers (USACE) recommends that the combined equalization and emergency storage be 50 percent of average total daily domestic demand plus all industrial demands (Source: USACE, 1984: Engineering and Design Manual - Water Supply, Water Storage – Mobilization Construction). An equalization storage requirement of 25 percent of the

MDD, which is approximately 42.5 percent of the ADD was used to evaluate storage in this Master Plan Update.

The current and projected (2040) potable MDDs in the City's service area are approximately 8.0 MGD and 9.0 MGD, respectively. Based on an equalization storage requirement of 25 percent of the MDD, the estimated equalization storage for the City's service area is summarized in Table 6-2.

Table 6-2 Reservoir Storage Requirements

Year	Potable Demands			Storage Requirements			
	Potable Water Demands (1)	ADD (2)	MDD (3)	Equalization Storage (4)	Fire Storage (5)	Emergency Storage (6)	Total Required Storage
	(AFY)	(MGD)	(MGD)	(MG)	(MG)	(MG)	(MG)
2015	6,174	5.5	8.0	2.0	1.4	1.4	**4.8**
2020	6,668	6.0	9.0	2.3	1.4	1.5	**5.2**
2025	6,801	6.1	9.0	2.3	1.4	1.5	**5.2**
2030	6,937	6.2	9.0	2.3	1.4	1.6	**5.2**
2035	7,076	6.3	9.0	2.3	1.4	1.6	**5.3**
2040	7,098	6.3	9.0	2.3	1.4	1.6	**5.3**

Notes:

ADD = Average Day Demand

MDD = Maximum Day Demand

(1) Potable water demands from Table 2-3

(2) 1 MGD = 1,120 AFY

(3) MDD = 1.5 x ADD

(4) Equalization storage is based on 25 percent of the MDD

(5) Fire storage is based on 6,000 gpm for 4 hours.

(6) Emergency storage is based on 25 percent of the ADD

Fire Suppression Storage

The fire suppression reserve requirement is often determined by local governments or fire marshals. The fire flow requirements for different land uses within the City were based on the 2016 California Fire Code and the Los Angeles County Fire Department standards. The maximum fire flow requirement within the City's service area is 6,000 gpm for 4 hours based on the size of the Lakewood Center mall the Lakewood Marketplace. The estimated fire flow requirements within the City's service area are summarized in Table 6-1. The required fire suppression storage within the City's service area is based on the highest required fire flow rate multiplied by the required fire flow duration. The estimated fire suppression storage within the City's service area is summarized in Table 6-2. The total required fire storage in the City's service area is estimated to be approximately 1.4 MG.

Emergency Storage

Emergency storage is the volume of water required to supply a system during planned or unplanned outages. The amount of emergency storage included within a particular water distribution system is an owner option based upon an assessment of risk and a capability to pay for the standby provisions. Emergency storage may be included at only one or a limited number of storage sites.

AWWA recommends that an emergency storage equal to 20 to 25 percent of the ADD be provided. This emergency storage should meet customer demands for a period of six hours to allow for repair of main breaks, restoration of power, or repair of equipment failures. For the purposes of developing this Master Plan Update, an emergency storage requirement of 25 percent of the ADD was used to calculate required emergency storage.

The current and projected (2040) potable ADDs in the City's service area are approximately 5.5 MGD and 6.3 MGD, respectively. Based on an emergency storage requirement of 25 percent of the ADD, the total estimated emergency storage requirements for the City's service area is summarized in Table 6-2.

6.1.1.3 Evaluation Criteria for Water Pumping Facilities

Pumping facilities are usually sized to meet the range of demands from average day demands to maximum day demand while maintaining desirable pressures. This section provides criteria for evaluating the pumping facilities in the City's distribution system.

Groundwater Pumping Facilities

The water supply facilities in the system should be capable of providing sufficient water to meet the MDD with the largest capacity well out of service. For example, loss of power, pipeline failure, or the presence of contamination could result in one groundwater production being out of service.

Booster Pumping Facilities

If adequate storage facilities are available, booster pump facilities should be capable of delivering the MDD to a system, with the largest capacity booster pump out of service, while providing desired pressures of 35 psi to 120 psi. For larger systems including the City, the adequacy of water facilities, including booster pumps, are normally evaluated through reliable hydraulic modeling.

6.2 Existing Distribution System Overview and Evaluation

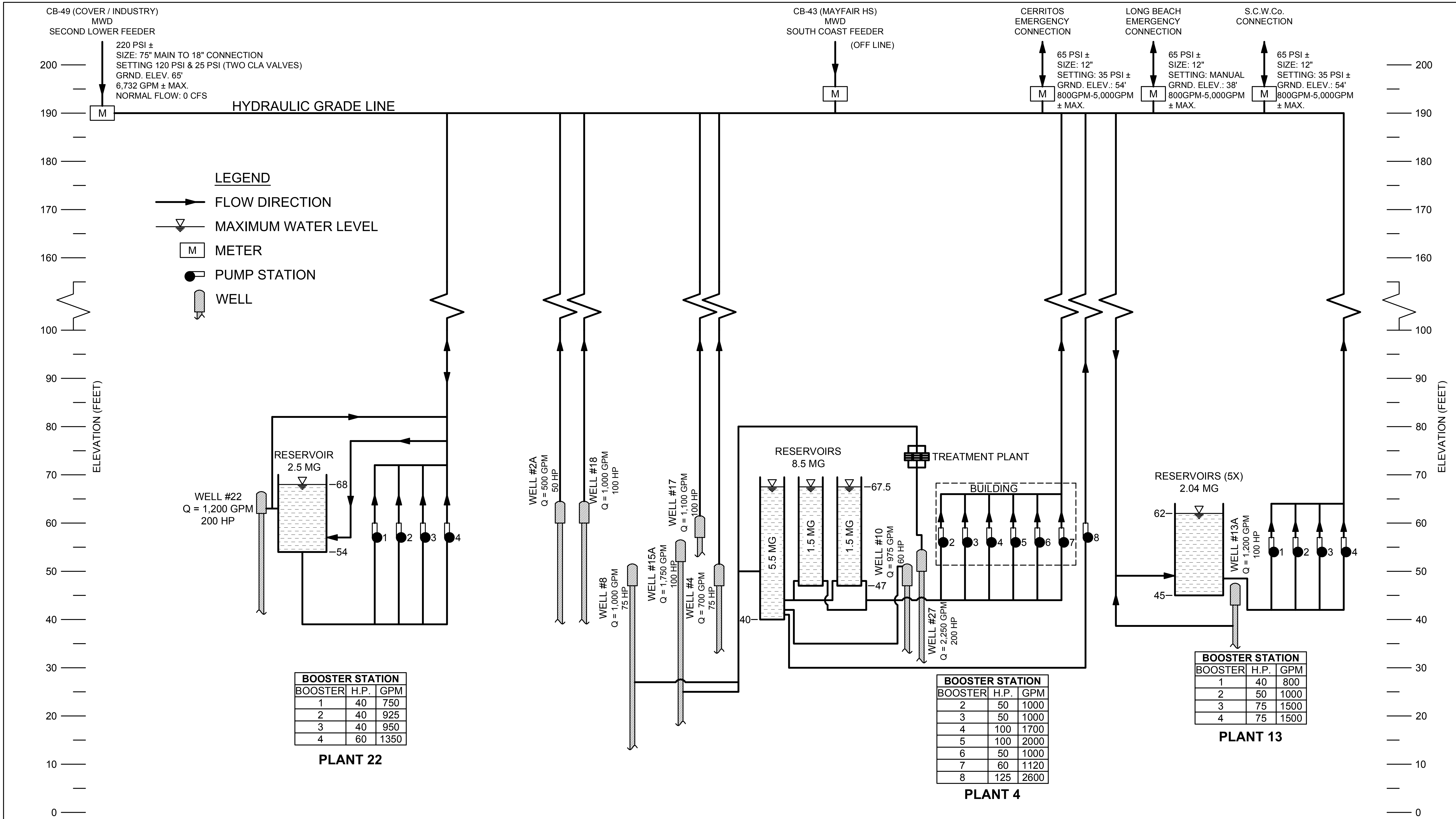
The City's water distribution system contains approximately 180 miles of pipes in diameters ranging from 4 to 27 inches (Table 5-7). Pipe sizes of 6 and 8 inches make up approximately 64 percent of the distribution system. Most of the pipe materials in the

City's distribution system are cast iron pipe, with substantial amounts of asbestos cement, polyvinyl chloride, and ductile iron pipe as well.

Ground elevations within the City's service area range from about 35 feet to 70 feet above Mean Sea Level (MSL). The City's water system consists of one pressure zone. In general, pressure zone boundaries are established to maintain acceptable distribution system pressures shown in Table 6-1.

The City's distribution schematic is shown on Figure 6-2.

FIGURE 6-2



PLANT 22

BOOSTER STATION		
BOOSTER	H.P.	GPM
1	40	750
2	40	925
3	40	950
4	60	1350

PLANT 4

BOOSTER STATION		
BOOSTER	H.P.	GPM
2	50	1000
3	50	1000
4	100	1700
5	100	2000
6	50	1000
7	60	1120
8	125	2600

PLANT 13

BOOSTER STATION		
BOOSTER	H.P.	GPM
1	40	800
2	50	1000
3	75	1500
4	75	1500

STETSON ENGINEERS INC.
861 VILLAGE OAKS DRIVE, SUITE 100
COVINA, CALIFORNIA 91724
TEL: (626) 967-6202
FAX: (626) 331-7065
2171 E Francisco Blvd., Suite K
San Rafael California 94901
2651 W Guadalupe Rd., Suite A209
Mesa Arizona 85202

CITY OF LAKEWOOD

WATER SYSTEM SCHEMATIC

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6.2.1 Evaluation of Finished Water Storage

The City's distribution system includes nine finished water storage reservoir facilities. The total physical capacity or rated storage capacity of the existing water system is approximately 12.9 MG. However, for the purposes of this Master Plan Update, a useable or operating capacity has been used and is based on freeboard requirements. Reservoir freeboard is defined as the distance from the maximum operating level of water within the reservoir to the lowest level of the roof framing. Although methods to determine the freeboard height criteria above the maximum operating level are provided in AWWA Standard D100-11 (Standard for Welded Carbon Steel Tanks for Water Storage) for carbon steel tanks and AWWA Standard D110-04 (Wire & Strand Wound, Circular, Prestressed Concrete Water Tanks) for concrete tanks, it is estimated the useable capacity of the City's reservoirs is approximately 85 percent of the physical capacities. As a result, the total useable capacity of the City's water system is approximately 11.0 MG.

As discussed above, the existing and future finished storage requirements are evaluated based on three requirements consisting of the operational equalization, fire suppression reserve, and emergency supply. Table 6-4 summarizes the City's current and projected storage requirements through 2040. Table 6-5 indicates there are no current or projected storage shortages within the City's distribution system.

As discussed in Section 5.4.1, it is recommended the City remove Reservoir 22 from service. According to Table 6-4, there are no current or projected storage shortages within the City's distribution system with Reservoir 22 removed from service.

Table 6-3 Summary of Storage Evaluation

Year	Total Required Storage (1)	Existing Storage			Proposed Storage (Excludes Reservoir 22) (3)		
		Total Rated Capacity	Total Operating Capacity (2)	Storage Surplus / (Shortage)	Total Rated Capacity	Total Operating Capacity (2)	Storage Surplus / (Shortage)
	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)
2015	**4.8**	12.9	11.0	**6.2**	10.4	8.8	**4.0**
2020	**5.2**	12.9	11.0	**5.8**	10.4	8.8	**3.6**
2025	**5.2**	12.9	11.0	**5.8**	10.4	8.8	**3.6**
2030	**5.2**	12.9	11.0	**5.8**	10.4	8.8	**3.6**
2035	**5.3**	12.9	11.0	**5.7**	10.4	8.8	**3.5**
2040	**5.3**	12.9	11.0	**5.7**	10.4	8.8	**3.5**

Notes:

ADD = Average Day Demand

MDD = Maximum Day Demand

(1) Total required storage from Table 7-2 based on equalization, fire flow, and emergency storage requirements

(2) Based on a reservoir operating capacity estimate of 85 percent of the rated capacity

(3) Proposed storage is based on removal of Reservoir 22 from service (2.5 MG of rated capacity)

6.2.2 Evaluation of Finished Water Pumping

The City's groundwater supplies are produced from the Central Basin. There are ten (10) active potable wells in the service area with a pumping capacity of approximately 11,675 gpm (or 16.8 MGD). As discussed in Section 6.1.1.3, the water supply facilities in the system should be capable of providing sufficient water to meet the MDD with the largest capacity well out of service. Excluding Well #27 (the City's largest capacity well), the total capacity of the City's remaining groundwater wells is approximately 9,425 gpm (or 13.6 MGD). The remaining total well capacity is sufficient in meeting the City's projected MDD of 9.5 MGD in future years (See Section 2.3.3).

The City's booster pumps are summarized in Section 5.1.2. Currently there are fifteen (15) booster pumps with a total capacity of approximately 19,195 gpm (or 28.5 MGD). As discussed in Section 6.1.1.3, the booster pump facilities should be capable of providing sufficient water to meet the MDD with the largest booster pump out of service. In addition, as discussed in Section 5.4.1, it is recommended the City remove Reservoir 22 from service. Excluding the largest capacity booster pump (Plant 4, Booster #8) and the Plant 22 boosters (tied into Reservoir 22), the remaining booster pump facilities have a total capacity of approximately 12,620 gpm (or 18.1 MGD) and are sufficient in meeting the City's projected MDD of 9.5 MGD in future years.

6.3 Water Distribution System Hydraulic Evaluation Using the Hydraulic Modeling

Computer hydraulic modeling analysis is a method of predicting the hydraulic gradient pattern, pressures, and flows across a water distribution network under a given set of conditions. The hydraulic gradient pattern depends upon the magnitude and location of system demands, the characteristics of the pipes in the distribution system, and the flows and gradients at network boundaries such as reservoirs and pumping stations. The head loss through each pipe is a function of flow rate, pipe diameter, length, and internal roughness. The available pressure or head, at any point in the network is the difference between the hydraulic gradient and the pipeline centerline elevation.

As part of this investigation, a hydraulic network model developed using H2OMAP software was used to assess hydraulic capacity, water supply reliability, and fire flow capabilities throughout the City of Lakewood's water transmission and distribution system. The original hydraulic model (model) provided by the City (previously developed and calibrated by IDModeling in 2013) was updated by Stetson to represent all water mains (pipe sizes of 4 inches and greater), groundwater pumps and booster pumps, regulating valves, storage reservoirs, groundwater wells and water demands that were provided by the City in 2016. The updated model was recalibrated to the observed system pressures during the 2016 fire flow tests (refer to Appendix F for detailed information about the model update and recalibration). The recalibrated model was then used to determine nodal pressures and hydraulic gradient, pipe flows, velocities and head loss, and available fire flow at hydrant for different conditions. The updated and recalibrated model of the distribution system initially contained 1,949 pipe segments (total pipe length of 180 miles) and 1,315 model nodes. The model nodes are typically pipe intersections, changes in direction, changes in pipe size, or demand locations. During the fire flow analysis, in order to more accurately simulate fire flow capabilities of the system, an additional 61 nodes (representing hydrants) were inserted at all fire hydrant locations along 4-inch diameter pipes. The resulting model used for hydraulic analysis in Section 6.3 included a total of 1,376 model nodes.

The criteria listed in Section 6.1.1.1 were used to evaluate system performance. Limitations or deficiencies within the system under different conditions were identified. Alternative improvements were investigated to identify those most effective in fixing the identified deficiencies.

The following hydraulic analyses were conducted using the updated and recalibrated hydraulic model:

1) Hydraulic analysis of pressure distributions, pipe velocities, and head loss within the existing system under the current ADD and MDD conditions (7,100 AFY)
2) Hydraulic analysis of fire flow capabilities of the existing system under the current MDD condition (7,100 AFY)
3) Hydraulic analysis of fire flow capabilities of the existing system with Reservoir 22 taken out of service under the current MDD condition (7,100 AFY)
4) Hydraulic analysis of proposed solutions for the existing system under the current demand condition (7,100 AFY)
5) Hydraulic analysis of proposed solutions for the existing system with Reservoir 22 taken out of service under the current demand condition (7,100 AFY)
6) Sensitivity analysis evaluating the relative hydraulic benefits to the existing system with MWD connections (CENB-43 and CENB-49), a proposed 12-inch emergency interconnection with Long Beach, or modified booster pump operation at Plant 4 under the current MDD condition (7,100 AFY)

The first analysis was performed to evaluate the system pressures, pipe velocities, and head loss of the existing system under ADD and MDD conditions (7,100 AFY in fiscal year 2015-16; see Section 2.3.1) and to identify system deficiencies. The second analysis was conducted to evaluate the fire flow capability of the existing system under the current MDD condition. The third analysis was performed to evaluate the fire flow capabilities of the existing system with Reservoir 22 taken out of service under MDD conditions. As discussed in Section 5.4.1, it is recommended the City remove Reservoir 22 from service. The fourth and the fifth analyses were conducted to identify effective solutions in fixing the identified deficiencies. The sixth sensitivity analysis was intended to evaluate the relative hydraulic benefit of additional water supply sources including operation of the MWD connections, a proposed emergency interconnection, and modified booster pump operations at Plant 4.

Operational settings of pumps, valves, and reservoirs for the hydraulic analyses were determined based on the operating conditions during the 2016 fire flow tests, which was considered as the “normal operations condition”. Specifically, the normal operations condition assumes the following wells/boosters turned on:

- Wells: #2A, #4, #17, #18;
- Plant 4 Boosters: #2, #3, #5, #7;
- Plant 13 Booster: #1; and
- Plant 22 Boosters: #1, #3.

The remaining wells connected to storage tanks were left on for estimating well outflows, except Well #14 which has been abandoned in 2013, and Well #27 which has water quality issues. The imported water supply from MWD at CENB-43 and CENB-49 is assumed to be unavailable under the normal operations condition. All simulation runs were conducted using the steady state model.

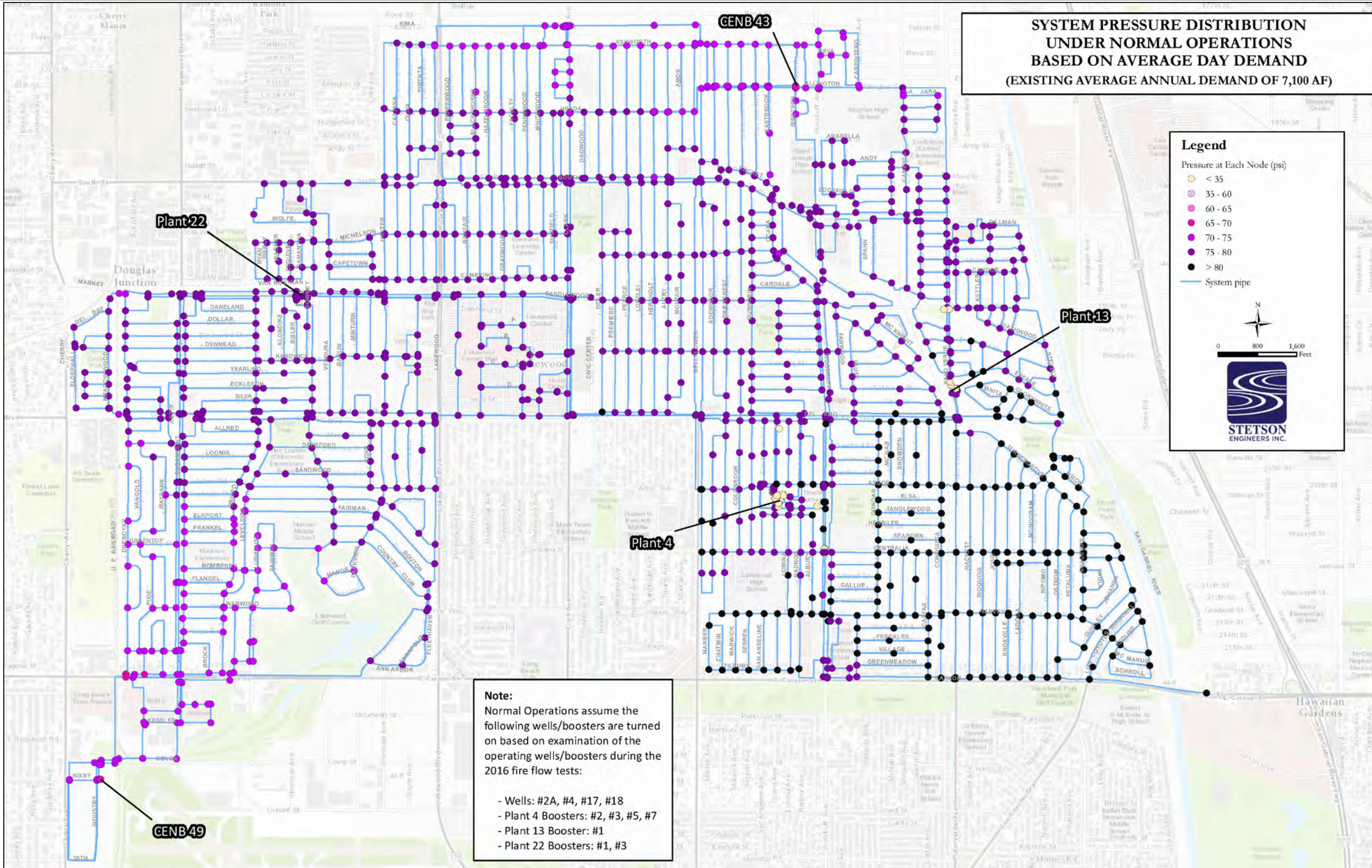
6.3.1 Modeling Analysis No. 1 - Pressures, Pipe Velocities, and Head Loss of the Existing System (ADD and MDD)

This analysis was intended to evaluate the system pressures, pipe velocities, and head loss of the existing system under ADD and MDD conditions (7,100 AFY) and to identify system deficiencies. The ADD condition represents the average day condition of the existing system and the MDD condition represents the maximum demand day condition, such as a summer hot day condition.

Figure 6-3 shows the simulated pressure distributions of the system under the ADD condition. The simulated results under ADD conditions show that 33 model nodes have pressures less than 35 psi and no model nodes have pressures greater than 120 psi throughout the City's water distribution system. Figure 6-4 shows the simulated pressure distributions of the system under MDD conditions. The simulated results under MDD conditions show that 33 model nodes have pressures less than 35 psi and no model nodes have pressures greater than 120 psi throughout the City's water distribution system. All low pressure nodes are located near the reservoirs at the upstream side of the booster pump stations. These nodes are not considered as system deficiencies because they are not associated with a water service connection and their low pressures are expected due to their locations.

Examination of the modeling results for pipe velocities and head loss found that no pipe has a velocity greater than 7 feet per second under MDD conditions. Six (6) pipes have head loss greater than 10 feet per 1,000 feet under MDD conditions, but the head loss of each single pipe is less than 1 foot because of the short length of the pipes. These pipes were not considered system deficiencies.

In summary, the existing system is adequate to meet the criteria shown in Table 6-1 for pressure, pipe velocity, and head loss.



861 VILLAGE OAKS DRIVE, SUITE 100
COVINA, CALIFORNIA 91724
TEL: (626) 967-6202
FAX: (626) 331-7065

2171 E Francisco Blvd., Suite K
San Rafael California 94901

2651 W Guadalupe Rd., Suite A209
Mesa Arizona 85202

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SYSTEM PRESSURE DISTRIBUTION (ADD)

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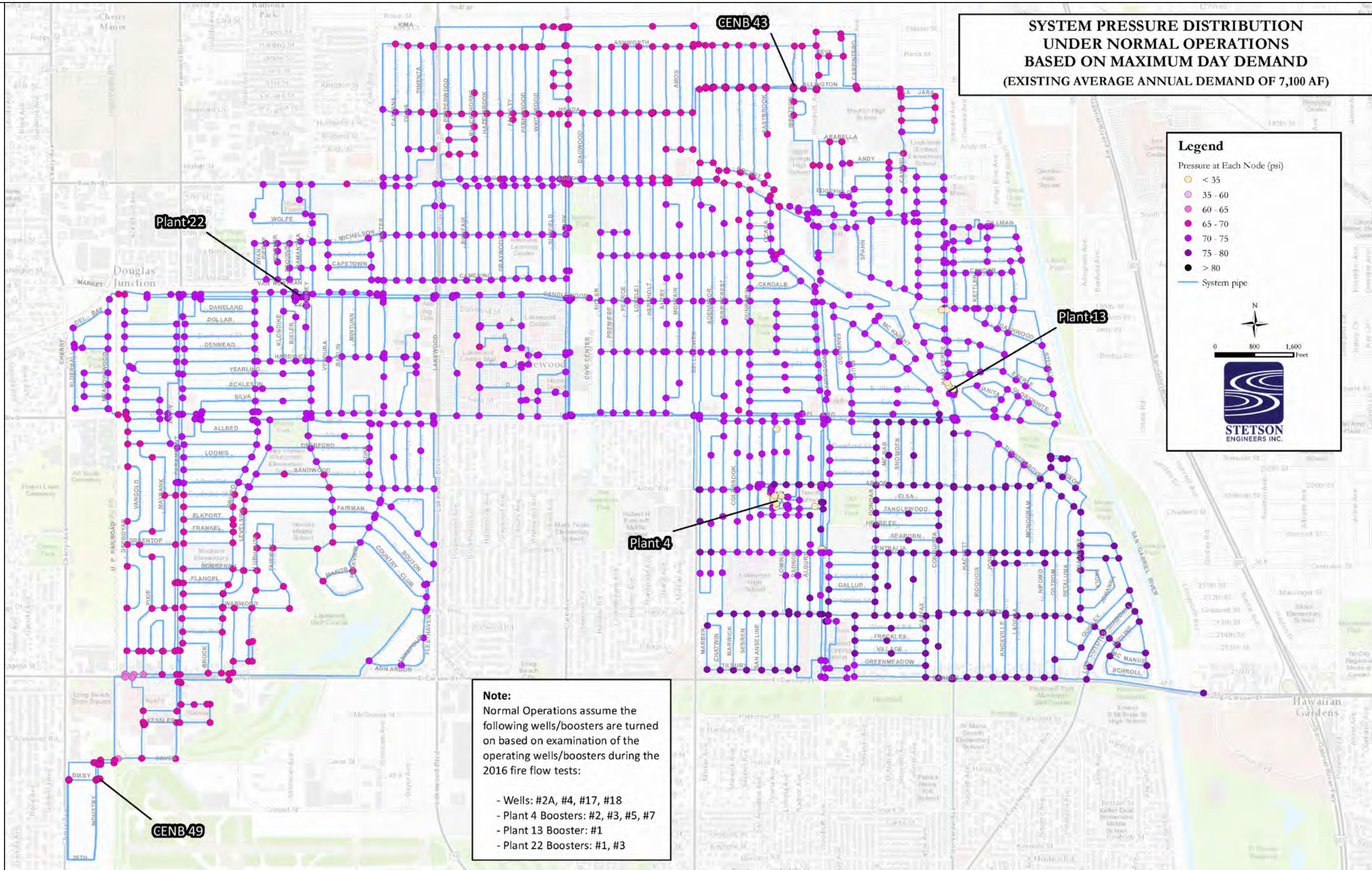
SYSTEM PRESSURE DISTRIBUTION UNDER NORMAL OPERATIONS BASED ON MAXIMUM DAY DEMAND
(EXISTING AVERAGE ANNUAL DEMAND OF 7,100 AF)



Note:
Normal Operations assume the following wells/boosters are turned on based on examination of the operating wells/boosters during the 2016 fire flow tests:

- Wells: #2A, #4, #17, #18
- Plant 4 Boosters: #2, #3, #5, #7
- Plant 13 Booster: #1
- Plant 22 Boosters: #1, #3

STETSON ENGINEERS INC.
861 VILLAGE OAKS DRIVE, SUITE 100
COVINA, CALIFORNIA 91724
TEL: (626) 967-6202
FAX: (626) 331-7065

2171 E Francisco Blvd., Suite K
San Rafael California 94901

2651 W Guadalupe Rd., Suite A209
Mesa Arizona 85202

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SYSTEM PRESSURE DISTRIBUTION (MDD)

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6.3.2 Modeling Analysis No. 2 - Fire Flow Deficiencies of the Existing System (MDD+FF)

In addition to supplying water for domestic, commercial, and industrial uses, a municipal distribution system should be capable of supplying an adequate and dependable flow for fire fighting. The purpose of this analysis is to calculate the available fire flow at 20 psi residual pressure during the maximum day demand condition and to determine the existing system capability to provide the required fire flows for different types of building structures. The selected fire flow requirements are shown in Table 6-1 and Figure 6-1.

For modeling purposes, all model nodes were considered as fire hydrants. Fire hydrants are typically located somewhere between model nodes. The computer model was configured to calculate available fire flows at a residual pressure of 20 psi for all nodes in the distribution system.

Figure 6-5 shows the identified nodes with fire flow deficiencies. The simulated results show that 125 model nodes fail to meet the fire flow requirements under current MDD conditions.

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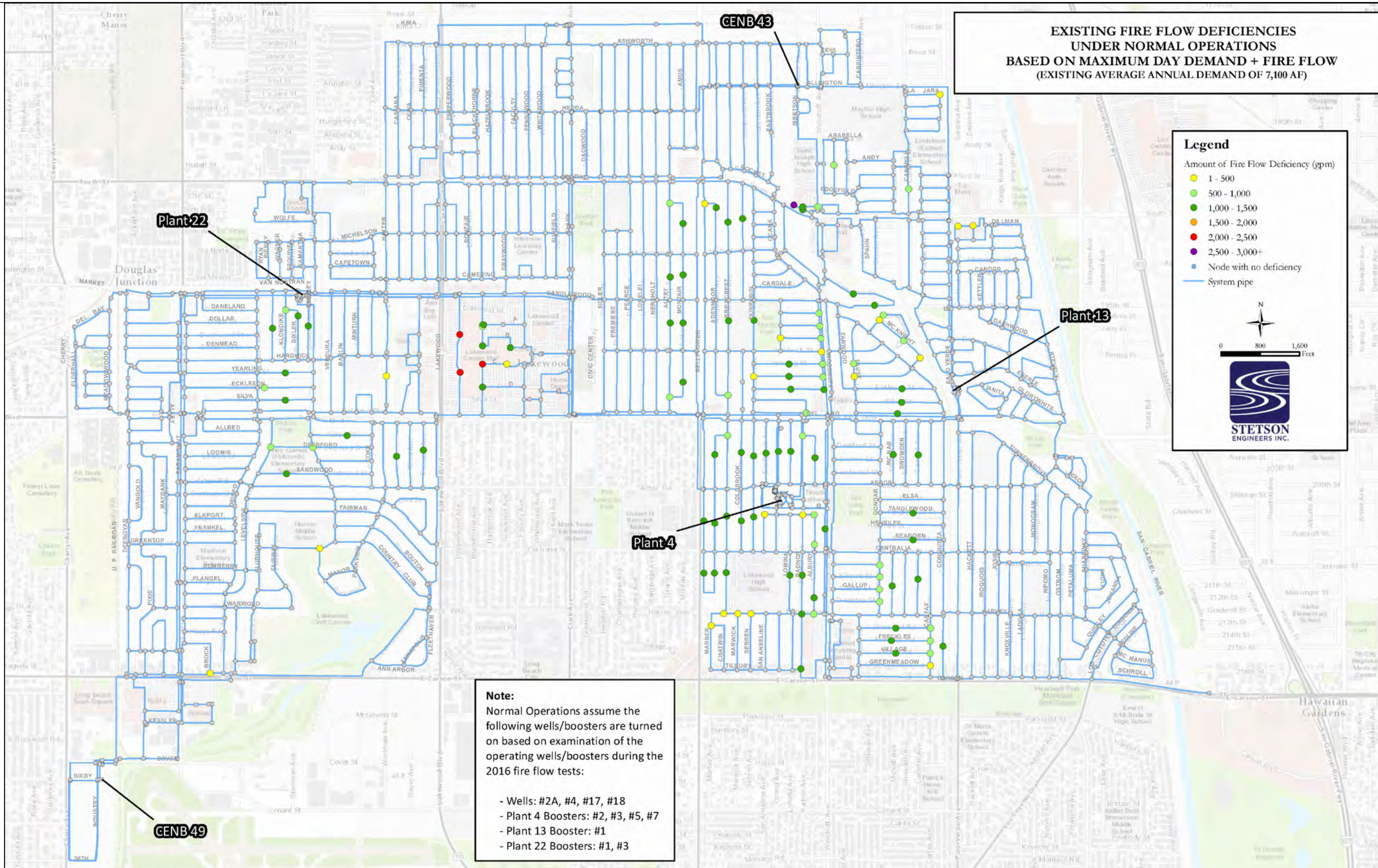
EXISTING FIRE FLOW DEFICIENCIES UNDER NORMAL OPERATIONS BASED ON MAXIMUM DAY DEMAND + FIRE FLOW
(EXISTING AVERAGE ANNUAL DEMAND OF 7,100 AF)



Note:
Normal Operations assume the following wells/boosters are turned on based on examination of the operating wells/boosters during the 2016 fire flow tests:

- Wells: #2A, #4, #17, #18
- Plant 4 Boosters: #2, #3, #5, #7
- Plant 13 Booster: #1
- Plant 22 Boosters: #1, #3

STETSON ENGINEERS INC.
861 VILLAGE OAKS DRIVE, SUITE 100
COVINA, CALIFORNIA 91724
TEL: (626) 967-6202
FAX: (626) 331-7065
2171 E Francisco Blvd., Suite K
San Rafael California 94901
2651 W Guadalupe Rd., Suite A209
Mesa Arizona 85202

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FIRE FLOW DEFICIENCIES (MDD+FF)

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6.3.3 Modeling Analysis No. 3 - Fire Flow Deficiencies of the Existing System without Reservoir 22 (MDD+FF)

As discussed in Section 5.4.1, it is recommended the City remove Reservoir 22 from service. Reservoir 22 is a concrete storage facility which was installed in 1954. This reservoir has significant cracking in the interior roof and walls and floors and requires repair of the cracking or replacement of the reservoir. This analysis is intended to evaluate the fire flow capabilities of the existing system with Reservoir 22 taken out of service under the MDD conditions.

Removal of Reservoir 22 also includes the removal of the Plant 22 boosters (#1, #2, #3, and #4) that currently lift water from the reservoir into the system. The water from Well #22 that currently discharges to the reservoir will be directly pumped into the water distribution system. For this analysis, the model was modified accordingly to reflect these changes.

Figure 6-6 shows the identified nodes with fire flow deficiencies. The simulated results show that 128 model nodes have fire flow deficiencies under MDD conditions. Compared to that existing system that has 125 nodes identified with fire flow deficiencies under MDD condition (see Section 6.3.2), an additional 3 nodes fail to meet the fire flow requirements under MDD conditions, if Reservoir 22 is taken out of service.

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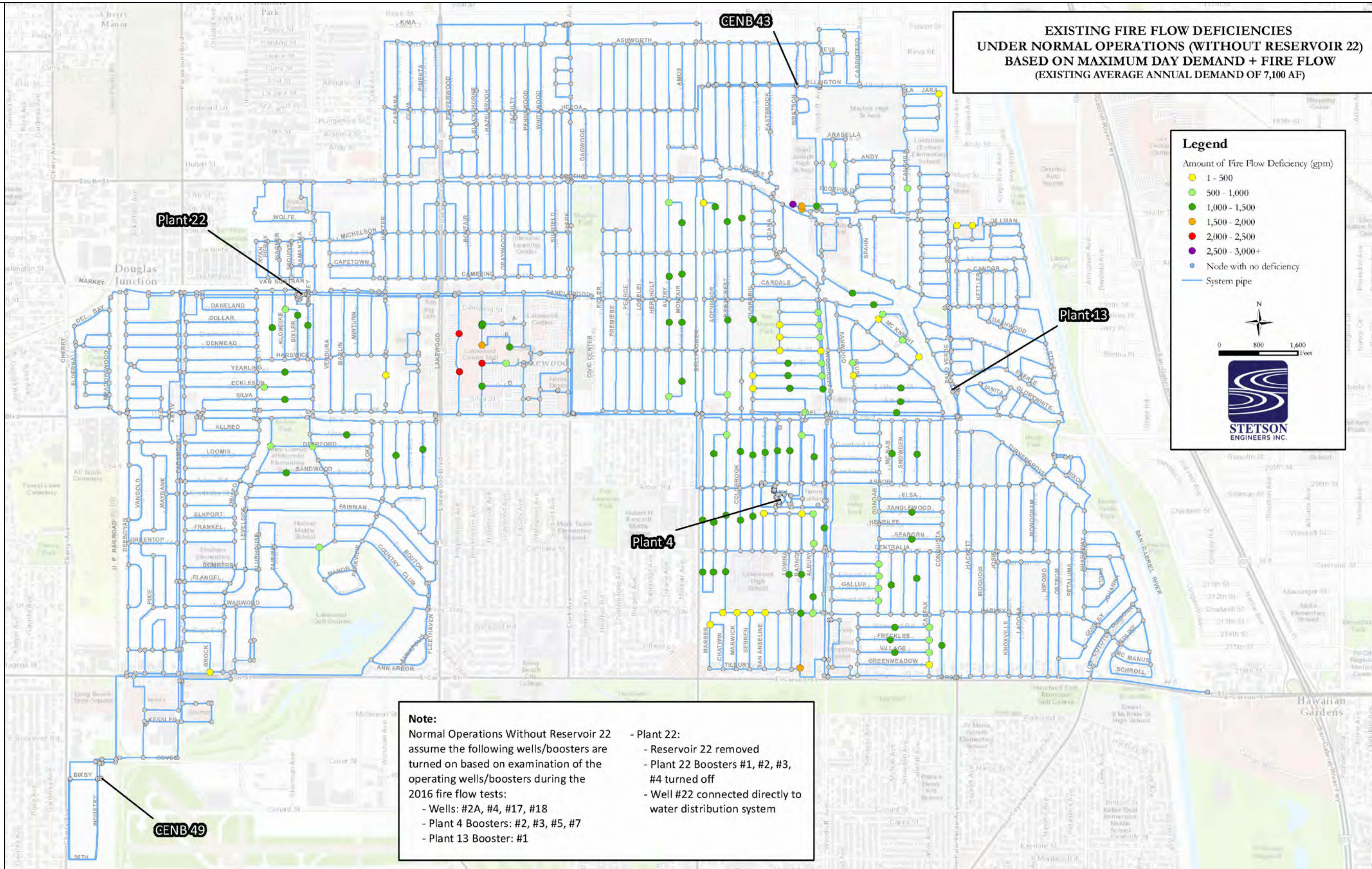
EXISTING FIRE FLOW DEFICIENCIES UNDER NORMAL OPERATIONS (WITHOUT RESERVOIR 22) BASED ON MAXIMUM DAY DEMAND + FIRE FLOW
(EXISTING AVERAGE ANNUAL DEMAND OF 7,100 AF)



Note:
Normal Operations Without Reservoir 22 assume the following wells/boosters are turned on based on examination of the operating wells/boosters during the 2016 fire flow tests:
- Wells: #2A, #4, #17, #18
- Plant 4 Boosters: #2, #3, #5, #7
- Plant 13 Booster: #1

- Plant 22:
  - Reservoir 22 removed
  - Plant 22 Boosters #1, #2, #3, #4 turned off
  - Well #22 connected directly to water distribution system

STETSON ENGINEERS INC.
861 VILLAGE OAKS DRIVE, SUITE 100
COVINA, CALIFORNIA 91724
TEL: (626) 967-6202
FAX: (626) 331-7065
2171 E Francisco Blvd., Suite K
San Rafael California 94901
2651 W Guadalupe Rd., Suite A209
Mesa Arizona 85202

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FIRE FLOW DEFICIENCIES WITHOUT RESERVOIR 22 (MDD+FF)

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6.3.4 Modeling Analysis No. 4 – Proposed Solutions to Address Fire Flow Deficiencies of the Existing System

The simulated results in Section 6.3.2 show that various areas in the existing water system have inadequate fire flows, as previously shown in Figure 6-5. The purpose of this section is to develop complete and cost-effective solutions to resolve these deficiencies. To do this, the pipe hydraulic modeling data and information (roughness and material) were modified to the proposed new pipe upgrades and the model was run iteratively, until the fire flow deficiencies were eliminated for all fire flow-deficient nodes. The upgrades to the water distribution system developed in this section will be incorporated into the CIP schedule (See Chapter 7).

Appendix G provides a summary of the identified “first priority” pipes to be upgraded to provide adequate fire flows, with their locations shown on Figure 6-7. A total of 133 existing pipes, approximately 20.7 miles, are recommended as first priority” pipes and should be upgraded to PVC (C900) pipes in diameter of 8 to 12 inches. The locations of these pipelines are provided in Figure 6-7a.

Examination of the simulated results for the proposed solutions found that all identified fire flow deficiencies would be addressed. The proposed solutions can greatly enhance fire flow capabilities at the deficient locations, and are able to provide required fire flows for their designated building structures at a residual pressure of 20 psi.

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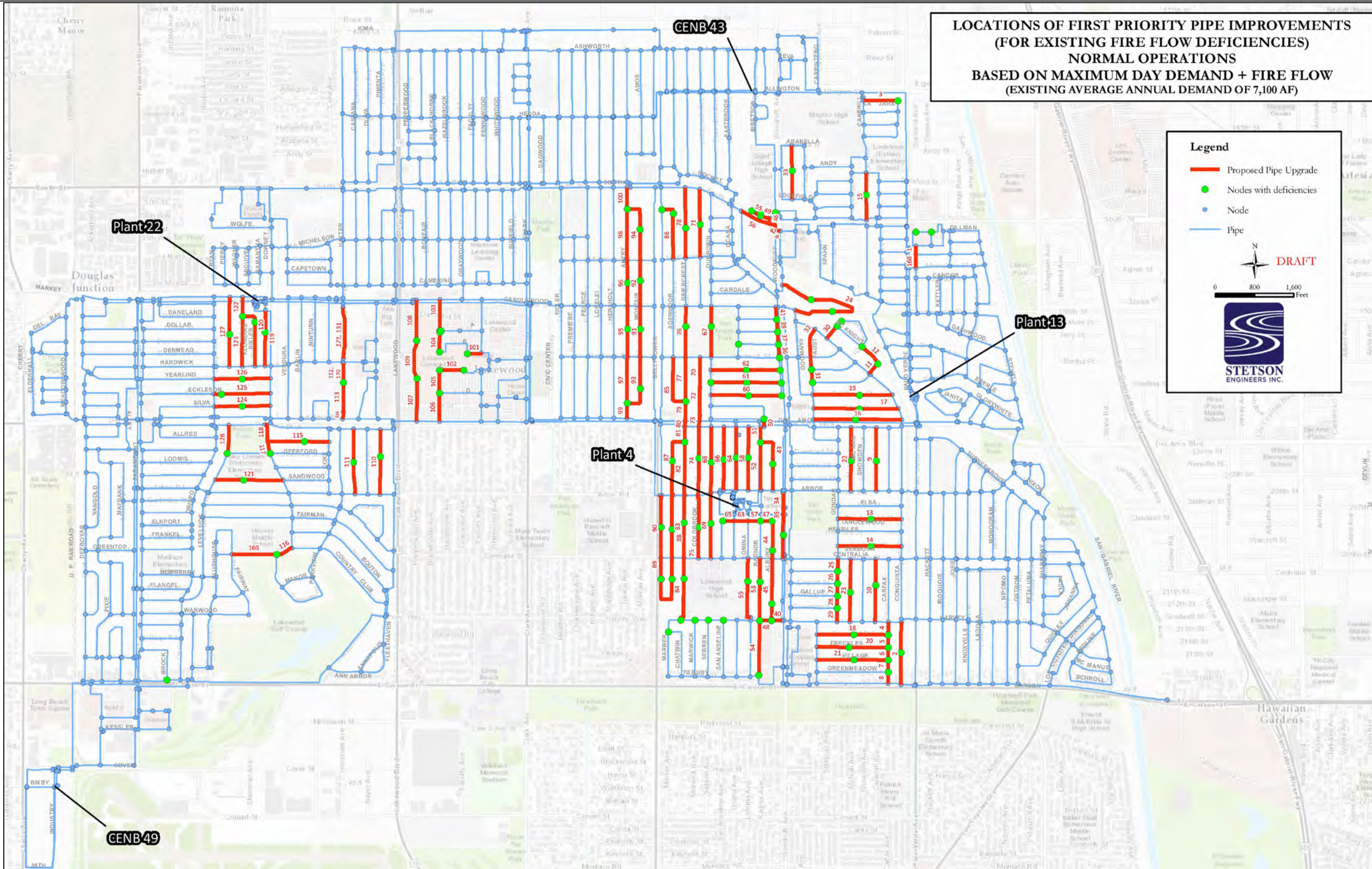

STETSON ENGINEERS INC.
861 VILLAGE OAKS DRIVE, SUITE 100
COVINA, CALIFORNIA 91724
TEL: (626) 967-6202
FAX: (626) 331-7065
2171 E Francisco Blvd., Suite K
San Rafael California 94901
2651 W Guadalupe Rd., Suite A209
Mesa Arizona 85202

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PROPOSED PIPELINE IMPROVEMENTS ("FIRST PRIORITY") - FIRE FLOW DEFICIENCIES

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6.3.5 Modeling Analysis No. 5 – Proposed Solutions to Address Fire Flow Deficiencies of the Existing System without Reservoir 22

The simulated results in Section 6.3.3 show that there would be 3 more nodes having fire flow deficiencies with Reservoir 22 out of service, as previously shown in Figure 6-6.

Similar to the analysis of proposed solutions for the existing system in Section 6.3.4, an analysis of proposed solutions was conducted for the existing system without Reservoir 22. Compared to the proposed solutions for the deficiencies in the existing system with Reservoir 22 in service, no additional pipes need to be upgraded for meeting the fire flow requirements with Reservoir 22 out of service.

6.3.6 Modeling Analysis No. 6 – Fire Flow Sensitivity Analysis of Additional Water Supplies

A useful functionality of the hydraulic model is the ability to simulate system performance associated with various alternative facility operations. The hydraulic model was used to perform a “sensitivity analysis” to review and compare the relative benefits of various water supply operations, or scenarios, based on their impact on flow deficiencies.

As discussed in Section 6.3.2, the hydraulic model identified 125 model nodes with fire flow deficiencies under MDD conditions (or “baseline” conditions), with a maximum deficiency of approximately 2,650 gpm. For this sensitivity analysis, the hydraulic model was run to evaluate fire flow deficiencies for baseline conditions along with following additional operating scenarios:

1) CENB-43 connection operating
2) CENB-49 connection operating
3) A proposed 12-inch emergency interconnection operating
4) All Plant 4 boosters operating

Scenario 1 is based on the City operating its CENB-43 connection to receive imported water supplies from MWD. CENB-43 is located in the northeastern portion of the system and has a capacity of 6,700 gpm. Although pressure in the MWD system near CENB-43 is approximately 220 psi, it is assumed the City will receive MWD water at a pressure of 100 psi through a pressure reducing valve. In addition, although the City has not operated CENB-43 in over 20 years, it is assumed the connection is in working condition. However, it is noted the City is considering the removal of the CENB-43 connection. The hydraulic model identified 92 model nodes with fire flow deficiencies under Scenario 1, with a maximum deficiency of approximately 1,230 gpm.

Scenario 2 is based on the City operating its CENB-49 connection to receive imported water supplies from MWD. CEN-49 is located in the southwestern portion of the system and has a capacity of 6,700 gpm. Although pressure in the MWD system near CENB-49 is approximately 220 psi, it is assumed the City will receive MWD water at a pressure of 100 psi through a pressure reducing valve. In addition, although the City has not operated CENB-49 in over 20 years, it is assumed the connection is in working condition. The hydraulic model identified 103 model nodes with fire flow deficiencies under Scenario 2, with a maximum deficiency of approximately 2,030 gpm.

Scenario 3 is based on the City operating a proposed 12-inch emergency interconnection to receive water from the City of Long Beach. The proposed interconnection is located in the northwestern portion of the system near the intersection of South Street and Obispo Avenue. The capacity of the proposed interconnection is 5,000 gpm. The design pressure of the proposed interconnection is approximately 60 psi. Although the proposed interconnection can be used for emergency water supply purposes, the modeling results indicate operating the proposed interconnection at 60 psi will not provide a fire flow benefit to the City. For the purposes of this sensitivity analysis, the hydraulic model was run assuming the City will receive water at a pressure 100 psi through the proposed emergency interconnection to provide some fire flow benefit. Based on receiving water at a pressure of 100 psi, the hydraulic model identified 109 model nodes with fire flow deficiencies under Scenario 3, with a maximum deficiency of approximately 2,190 gpm.

Scenario 4 is based on all seven (7) of the Plant 4 boosters operating simultaneously. Under the normal baseline conditions, only four (4) of the Plant 4 boosters are operating simultaneously. The hydraulic model identified 113 model nodes with fire flow deficiencies under Scenario 4, with a maximum deficiency of approximately 2,300 gpm.

Figures showing the modeling results and fire flow deficiencies for each of the four operating scenarios, including a “baseline only” scenario, are provided in Appendix H. Each figure includes selected nodes with the amount of deficiency labeled (in gpm).

Based on the results of this sensitivity analysis, all four operating scenarios appear to provide hydraulic benefit within the City’s distribution system. Scenario 1 (CENB-43) appears to provide the most relative hydraulic benefit to the system (especially in the Lakewood Mall area with the largest fire flow requirement), then followed by Scenario 2, Scenario 3, and Scenario 4. The quantity of deficient nodes, as well as the magnitudes of the deficiencies for similar nodes, decrease for the more beneficial scenarios. Based on discussion with City staff, the City is considering removing CENB-43 from service. It appears that retaining and operating CENB-49 (Scenario 2) will provide a hydraulic benefit to the system. The proposed Long Beach emergency interconnection will not provide a significant hydraulic benefit to the system compared to normal operations, however, it would provide an emergency source of water supply.

The four operating scenarios were evaluated only for comparison purposes regarding their ability to reduce deficiencies as a representation of their hydraulic benefit relative to one another. These scenarios were not evaluated for the purposes of identifying potential solutions to address fire flow deficiencies. As discussed in Section 6.3.4, replacement of existing pipelines with larger pipelines has been recommended for inclusion in the City's CIP schedule to address all fire flow deficiencies within the City under baseline conditions.

6.4 Water Main Replacement Program

Historical records show that all pipe materials are vulnerable to some kind of chemical or physical deterioration, and all water mains will eventually require rehabilitation and/or replacement. Aging pipe infrastructure and chronic water main breaks are a common problem for most water utilities.

Water main rehabilitation and replacement programs typically target "at-risk" segments of the distribution system, and the factors typically considered to affect prioritization of rehabilitation and replacement projects include pipe material, age, pressure, soil type, and previous maintenance history. There is a need for the City of Lakewood to begin the development of a Water Main Rehabilitation and Replacement Program. The purpose is to proactively, rather than reactively, identify and improve water main segments with characteristics indicating the greatest potential for future maintenance and failure problems. The highest priority for the Rehabilitation and Replacement Program will be to maintain the structural integrity of the water distribution system.

6.4.1 Water Main Condition Assessment

The foundation of any proactive rehabilitation and replacement program is accurate and sufficient information and data pertaining to the condition of the existing distribution system. The water distribution system contains approximately 180 miles of pipe in diameters ranging from 4 to 27 inches. Over one third of pipes in the entire piping system are cast iron (CI) pipes (see Appendix I). Approximately 89 percent of the City distribution system leaks over the past 17 years have been associated with 4-inch diameter cast iron pipelines (refer to Appendix I for detailed analysis of historical pipeline leak records). The pipeline leak records also include large size transmission mains. These leaking transmission mains are all greater than 60 years old.

6.4.2 Recommendations on Water Main Maintenance and Reliability Improvements

As discussed in Section 6.3.4, a total of 133 existing pipes, approximately 20.7 miles, are recommended as "first priority" pipes to provide adequate. The locations of these pipelines are provided in Figure 6-7a. Based on review of historical maintenance records and discussions with City operators, an additional 36 pipeline replacements are recommended as first priority pipes. These pipelines are primarily 4-inch lines which the City has identified as historically having numerous maintenance problems and leaks. The locations of these pipelines are provided in Figure 6-8 (and a listing is provided in Appendix G).

In addition to the first priority pipe upgrades identified based on hydraulic modeling for improvement of fire flow capabilities of the system, a "secondary priority" pipe list (see Appendix J) was also developed based on analysis of historical leak records. The criteria used includes the following:

- Replacement of 4-inch diameter CI pipes installed prior to 1950 due to age and leak records. As discussed in Section 6.4.1, approximately 89 percent of system leaks over the past 17 years have been associated with 4-inch diameter CI pipelines. It is recommended these pipes be upgraded to new 8-inch PVC (C900) pipe
- Replacement of large size transmission mains (10" to 27") installed prior to 1950 due to age. It is recommended these pipes be replace with similar size PVC (C900) pipes in diameters of 10 to 12 inches, and to cement mortar lined and coated steel (CMLCS) pipes in diameter of 14 to 27 inches.

As shown in Appendix J, a total of 68 pipes, approximately 6.1 miles, are recommended to be upgraded to C900 pipes in diameters of 8 to 12 inches, and to CMLCS pipes in diameter of 14 to 27 inches. Appendix J provides a summary of the identified secondary priority CIP pipes to be upgraded to provide adequate fire flows, with their locations shown on Figure 6-9.

A CIP schedule for the first priority and second priority pipelines is provided in Chapter 7. A projected budget for these pipelines is also included. The CIP schedule also includes a "third priority" listing of recommended pipelines, which is based on the following criteria

- Replacement of remaining pipelines installed before 1950, due to age;
- Replacement of concrete cylinder pipe installed between 1970 and 1979 due to the higher rates of failure[1];
- Replacement of transmission pipelines installed between 1950 and 1959, due to age; and
- Replacement of pipelines installed between 1950 and 1959, including 4-inch and greater cast iron pipe, due to age.

[1] Pursuant to the American Water Works Association's "Failure of Prestressed Concrete Cylinder Pipe", 2008

Although a projected budget for third priority pipelines has been included in the CIP schedule, specific locations for these pipelines have not been identified. Because these third priority pipelines are scheduled beyond the initial 10-year CIP schedule, it is recommended these pipeline recommendations be reevaluated over time based on an on-going methodical City data collection program. The potential elements of a data collection program are discussed below.

The City could perform expanded visual inspections (e.g. closed circuit television inspection of the interior of the pipelines) and non-destructive testing (e.g. acoustic leak detection, stray current studies, sonic/ultrasonic thickness testing, infrared testing, and electromagnetic testing) as appropriate for various pipelines. These testing methods can be used to determine various pipe characteristics (including internal corrosion, cracks, air holes, thickness, and porosity information.) The City could also perform soil surveys to determine if soils are corrosive and use “corrosion coupons” to measure and monitor exterior corrosion levels for its metal pipelines. (Corrosion coupons are machined thin bars of various metals which are installed externally to the piping system on a coupon rack.) Potential additional testing could also be recommended by a corrosion engineer. The City may also consider the use of leak detection and pipeline testing methods in assessing conditions for pipeline replacement projects (in addition to the prioritized pipeline replacement projects discussed above).

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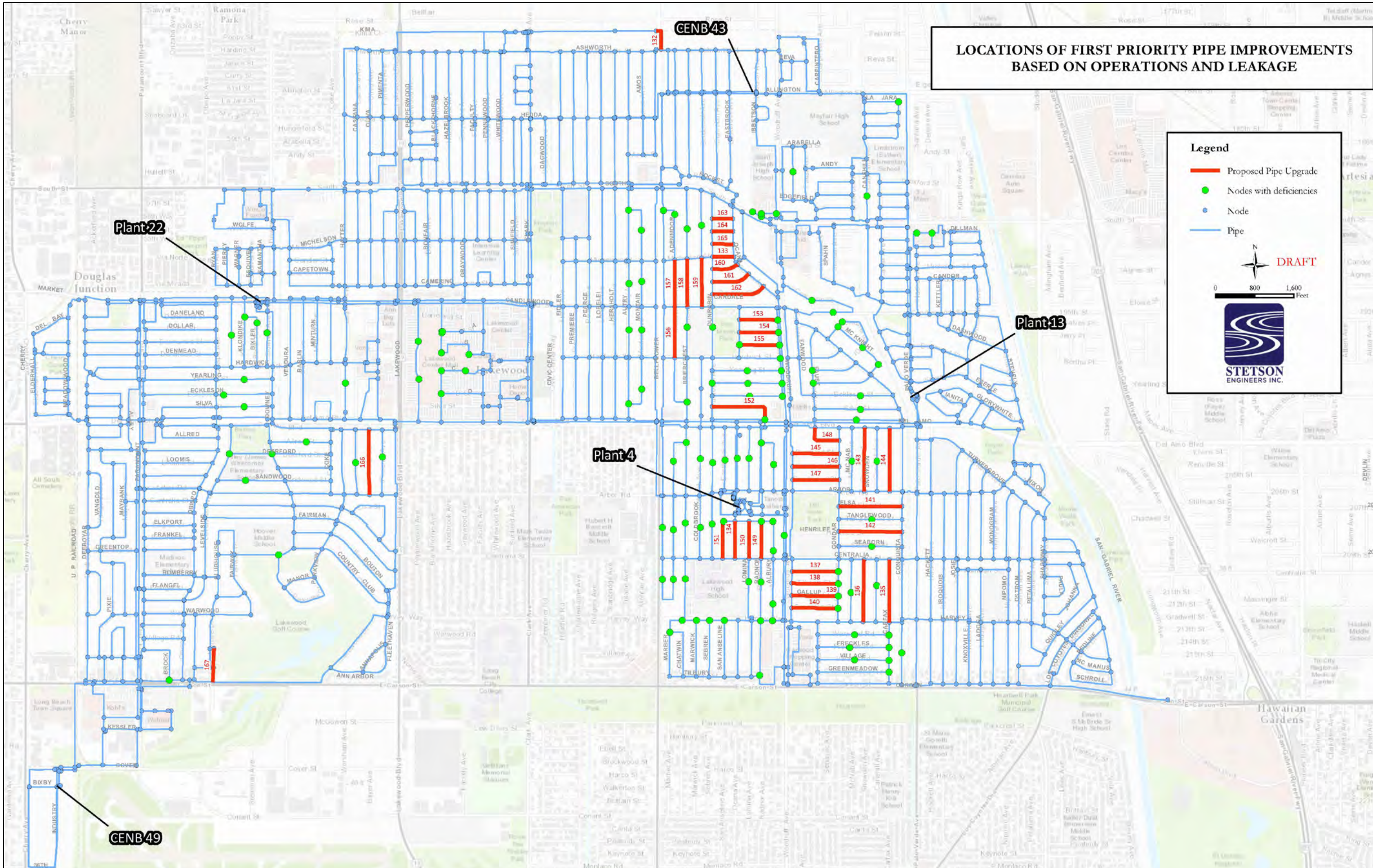

STETSON ENGINEERS INC.
861 VILLAGE OAKS DRIVE, SUITE 100
COVINA, CALIFORNIA 91724
TEL: (626) 967-6202
FAX: (626) 331-7065

2171 E Francisco Blvd., Suite K
San Rafael California 94901

2651 W Guadalupe Rd., Suite A209
Mesa Arizona 85202

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PROPOSED PIPELINE IMPROVEMENTS ("FIRST PRIORITY") - OTHER

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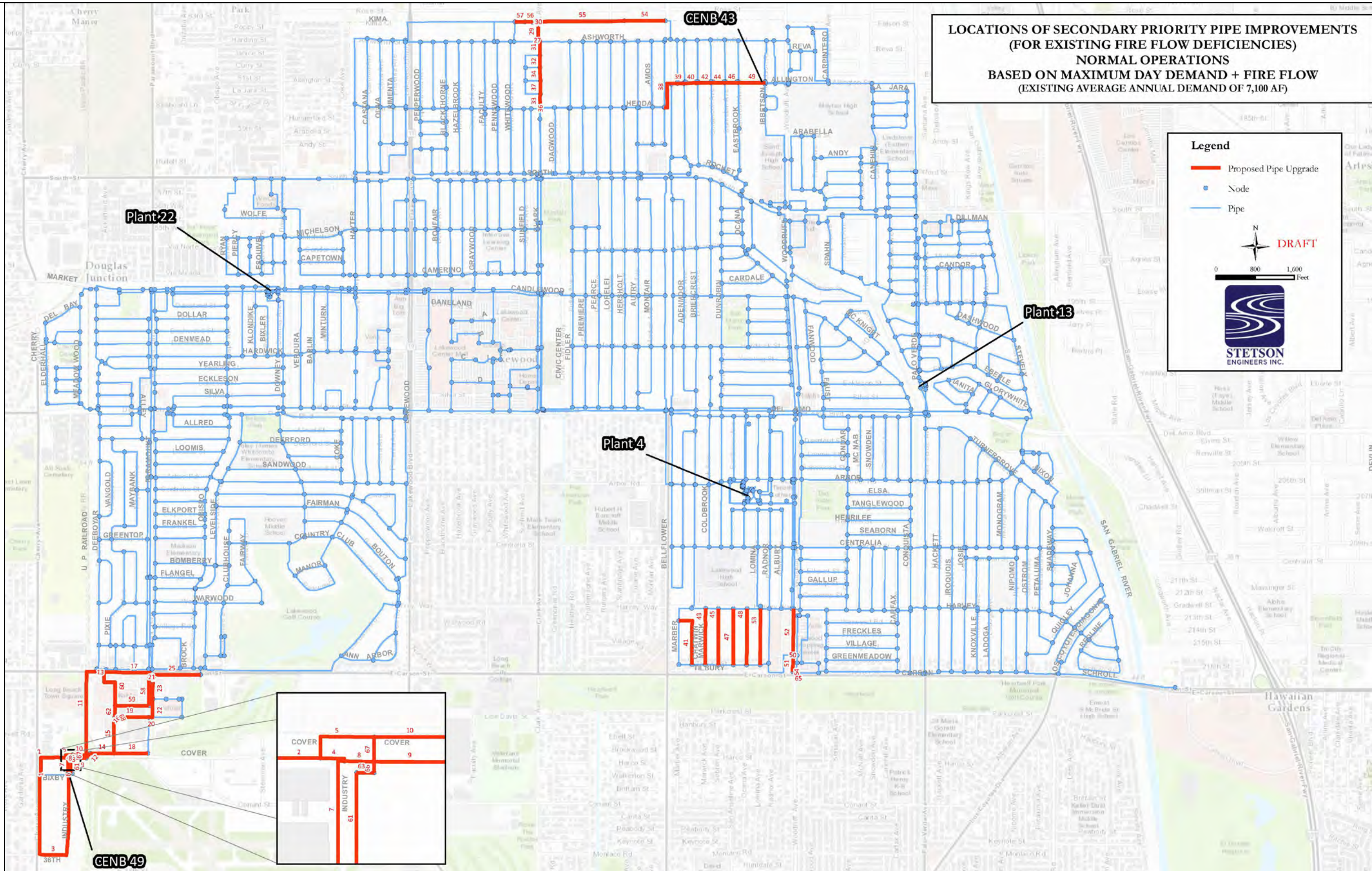

STETSON ENGINEERS INC.
861 VILLAGE OAKS DRIVE, SUITE 100
COVINA, CALIFORNIA 91724
TEL: (626) 967-6202
FAX: (626) 331-7065
2171 E Francisco Blvd., Suite K
San Rafael California 94901
2651 W Guadalupe Rd., Suite A209
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PROPOSED PIPELINE IMPROVEMENTS ("SECOND PRIORITY")

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CHAPTER 7

IMPLEMENTATION PLAN AND COST ESTIMATES

7.1 Introduction

This chapter sets forth a plan for implementing needed improvements identified in this 2017 Update. Certain projects, studies, or monitoring activities for the substantive components of the water system (i.e. water demand and supply, water production facilities, and water distribution) are important to maintain reliable water service. The implementation plan summarizes these actions, prioritizes the facility improvements, summarizes cost estimates, and provides implementation schedules.

The 2017 Update provides a "road map" for the City's continued success in ensuring water services to its customers. It is based on the best-available knowledge of the future from the perspective of the present. Because regulatory requirements, regional development, and customer demand will change over the next 20 years, the City will review and adjust elements of the 2017 Update periodically. The implementation plan includes monitoring of developing trends, customer demand, the performance of the water system, and regulatory requirements.

The cost estimates contained in this report are order-of-magnitude estimates. Final project costs and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. As a result, final project costs will vary from the estimates presented here.

7.2 CIP Project Scheduling and Summary

Table 7-1 summarizes the 20-year CIP project budget from FY 2017-18 through FY 2036-37. Additional improvements will be needed after FY 2036-37 to replace aging facilities and address other water system needs. The annual CIP budget is based on approximately $2.5 million per year.

Table 7-2 summarizes the 20-year CIP project schedule from FY 2017-18 through FY 2036-37. The City's projected CIP schedule for the next 20 years includes projects recommended by the 2017 Update from review of the City's facilities and from the hydraulic modeling. The schedule also includes replacement and rehabilitation projects from the draft Asset Management Plan. The cost estimates for the new water system facilities are based on vendor cost information, unit cost data published by R.S. Means, and Stetson experience on similar projects. Where appropriate, costs were escalated to the current 2017 dollars based on Engineering New Record (ENR) construction cost indexes. All capital costs were initially estimated in terms of 2017 dollars and adjusted to future dollars based on the 20-year project schedule using an annual inflationary rate of 3 percent. In addition to the costs for each component of the proposed water system improvements, cost for contingencies, planning, engineering and design as well as project management and administration were factored into the total project cost. Costs for land acquisition, energy, operation and maintenance were not included in the cost estimates.

A water system generally includes three substantive components: water demand and supply, water treatment, and water distribution system. The City's water system mainly relies on groundwater wells as its source of water supply. In addition to the identified immediate projects listed in Table 7-1 and the recommended CIP projects listed in Table 7-2, the following actions and monitoring activities are also important to the City's continued success in ensuring water services to its customers and are recommended for the water demand/supply, groundwater treatment, and water distribution components:

Water Demand and Supply:

- Monitor water production from each source.
- Monitor actual water uses in the water system, and compare to the Master Plan projections.
- Revise Master Plan projections of water demand based on water use monitoring.
- Revise Capital Improvement Program based on revised water demand projection.
- Pursue water conservation program to reduce water demands and seasonal water use to achieve the water conservation goal as set forth in SBX7_7.
- Develop and employ methods for tracking water conservation savings.

Groundwater Treatment:

- Monitor source water quality.
- Monitor performance of groundwater treatment facilities.
- Monitor development of groundwater treatment regulatory requirements.
- Monitor best treatment alternatives for meeting proposed regulatory requirements for groundwater treatment.

Water Distribution System:

- Monitor development of regulatory requirements.
- Monitor distribution system water quality to ensure compliance with regulatory standards, and to ensure customer satisfaction with aesthetic quality.
- Collect pipe attribute data on new installations and replacement.

Table 7-1 Capital Improvement Plan (CIP) Budget Summary

Fiscal Year	Annual Total
2017-18	$2,450,400
2018-19	$2,500,300
2019-20	$2,497,900
2020-21	$2,509,000
2021-22	$2,474,200
2022-23	$2,488,800
2023-24	$2,464,600
2024-25	$2,449,800
2025-26	$2,532,800
2026-27	$2,457,900
2027-28	$2,488,650
2028-29	$2,496,950
2029-30	$2,493,000
2030-31	$2,506,200
2031-32	$2,522,600
2032-33	$2,522,800
2033-34	$2,406,700
2034-35	$2,494,700
2035-36	$2,412,800
2036-37	$2,548,000

Table 7-2 Capital Improvement Plan (CIP) Schedule

Description	Recommended Year of Implementation (Fiscal Year)	Implementation Year Costs
-		
Water Supply Facility Improvements		
Plant 4 Replacements (See App. E) (Includes installation of a new Well #28, first year of funding)	**2017-18**	**$ 1,105,600**
Plant 13 Replacements (See App. E)	**2017-18**	**$ 36,500**
Plant 22 Replacements (See App. E)	**2017-18**	**$ 74,300**
System and Other Replacements and Rehabilitation (See App. E)	**2017-18**	**$ 32,000**
AMR / AMI / Billing system (Fathom)	**2017-18**	**$ 980,500**
SCADA Improvements (Radio, Software, Hardware)	**2017-18**	**$ 221,500**
Pipeline Upgrades (First Priority)	**2017-18**	**$ -**
0 feet of pipe (See App. G)		
Water Supply Facility Improvements		
Plant 4 Replacements (See App. E) (Includes installation of a new Well #28, second year of funding)	**2018-19**	**$ 1,069,800**
Plant 13 Replacements (See App. E)	**2018-19**	**$ -**
Plant 22 Replacements (See App. E)	**2018-19**	**$ -**
System and Other Replacements and Rehabilitation (See App. E)	**2018-19**	**$ -**
AMR / AMI / Billing system (Fathom)	**2018-19**	**$ 980,500**
Remove Reservoir 22 (Demolition)	**2018-19**	**$ 450,000**
Pipeline Upgrades (First Priority)	**2018-19**	**$ -**
0 feet of pipe (See App. G)		
Water Supply Facility Improvements		
Plant 4 Replacements (See App. E)	**2019-20**	**$ 521,400**
Plant 13 Replacements (See App. E)	**2019-20**	**$ -**
Plant 22 Replacements (See App. E)	**2019-20**	**$ -**
System and Other Replacements and Rehabilitation (See App. E)	**2019-20**	**$ 355,400**
AMR / AMI / Billing system (Fathom)	**2019-20**	**$ 980,500**

Pipeline Upgrades (First Priority) 4,693 feet of pipe (See App. G)	**2019-20**	**$**	**640,600**
Water Supply Facility Improvements			
Plant 4 Replacements (See App. E)	**2020-21**	**$**	**150,600**
Plant 13 Replacements (See App. E)	**2020-21**	**$**	**-**
Plant 22 Replacements (See App. E)	**2020-21**	**$**	**-**
System and Other Replacements and Rehabilitation (See App. E)	**2020-21**	**$**	**218,600**
AMR / AMI / Billing system (Fathom)	**2020-21**	**$**	**980,500**
Pipeline Upgrades (First Priority) 8,336 feet of pipe (See App. G)	**2020-21**	**$**	**1,159,300**
Water Supply Facility Improvements			
Plant 4 Replacements (See App. E)	**2021-22**	**$**	**-**
Plant 13 Replacements (See App. E)	**2021-22**	**$**	**19,200**
Plant 22 Replacements (See App. E)	**2021-22**	**$**	**84,100**
System and Other Replacements and Rehabilitation (See App. E)	**2021-22**	**$**	**-**
AMR / AMI / Billing system (Fathom)	**2021-22**	**$**	**980,500**
Recoat Plant 13, Tanks #1 and #2	**2021-22**	**$**	**400,000**
Pipeline Upgrades (First Priority) 6,979 feet of pipe (See App. G)	**2021-22**	**$**	**990,400**
Water Supply Facility Improvements			
Plant 4 Replacements (See App. E)	**2022-23**	**$**	**351,900**
Plant 13 Replacements (See App. E)	**2022-23**	**$**	**73,100**
Plant 22 Replacements (See App. E)	**2022-23**	**$**	**74,200**
System and Other Replacements and Rehabilitation (See App. E)	**2022-23**	**$**	**-**
AMR / AMI / Billing system (Fathom)	**2022-23**	**$**	**980,500**
Pipeline Upgrades (First Priority) 6,969 feet of pipe (See App. G)	**2022-23**	**$**	**1,009,100**
Water Supply Facility Improvements			
Plant 4 Replacements (See App. E)	**2023-24**	**$**	**1,400**
Plant 13 Replacements (See App. E)	**2023-24**	**$**	**28,300**

Plant 22 Replacements (See App. E)	**2023-24**	**$**	**-**
System and Other Replacements and Rehabilitation (See App. E)	**2023-24**	**$**	**600**
AMR / AMI / Billing system (Fathom)	**2023-24**	**$**	**980,500**
Recoat Plant 13, Tanks #3 and #5	**2023-24**	**$**	**400,000**
Pipeline Upgrades (First Priority)	**2023-24**	**$**	**1,053,800**
7,085 feet of pipe (See App. G)			
Water Supply Facility Improvements			
Plant 4 Replacements (See App. E)	**2024-25**	**$**	**522,400**
Plant 13 Replacements (See App. E)	**2024-25**	**$**	**-**
Plant 22 Replacements (See App. E)	**2024-25**	**$**	**61,500**
System and Other Replacements and Rehabilitation (See App. E)	**2024-25**	**$**	**159,100**
AMR / AMI / Billing system (Fathom)	**2024-25**	**$**	**980,500**
Pipeline Upgrades (First Priority)	**2024-25**	**$**	**726,300**
4,708 feet of pipe (See App. G)			
Water Supply Facility Improvements			
Plant 4 Replacements (See App. E)	**2025-26**	**$**	**172,800**
Plant 13 Replacements (See App. E)	**2025-26**	**$**	**19,300**
Plant 22 Replacements (See App. E)	**2025-26**	**$**	**210,600**
System and Other Replacements and Rehabilitation (See App. E)	**2025-26**	**$**	**40,600**
AMR / AMI / Billing system (Fathom)	**2025-26**	**$**	**980,500**
Recoat Plant 13, Tank #4	**2025-26**	**$**	**200,000**
Pipeline Upgrades (First Priority)	**2025-26**	**$**	**909,000**
5,758 feet of pipe (See App. G)			
Water Supply Facility Improvements			
Plant 4 Replacements (See App. E)	**2026-27**	**$**	**16,200**
Plant 13 Replacements (See App. E)	**2026-27**	**$**	**2,200**
Plant 22 Replacements (See App. E)	**2026-27**	**$**	**-**
System and Other Replacements and Rehabilitation (See App. E)	**2026-27**	**$**	**22,900**
AMR / AMI / Billing system (Fathom)	**2026-27**	**$**	**980,500**
Pipeline Upgrades (First Priority)	**2026-27**	**$**	**1,436,100**

9,168 feet of pipe (See App. G)			
Routine Water Supply Facility Improvements (Replacements) (Includes installation of a new well, first year of funding)	**2027-28**	**$**	**1,784,650**
Pipeline Upgrades (First Priority) 4,405 feet of pipe (See App. J)	**2027-28**	**$**	**704,000**
Routine Water Supply Facility Improvements (Replacements) (Includes installation of a new well, second year of funding)	**2028-29**	**$**	**1,824,450**
Pipeline Upgrades (First Priority) 4,125 feet of pipe (See App. J)	**2028-29**	**$**	**672,500**
Routine Water Supply Facility Improvements (Replacements)	**2029-30**	**$**	**743,300**
Pipeline Upgrades (First Priority) 10,525 feet of pipe (See App. J)	**2029-30**	**$**	**1,749,700**
Routine Water Supply Facility Improvements (Replacements)	**2030-31**	**$**	**666,100**
Pipeline Upgrades (First Priority) 10,853 feet of pipe (See App. J)	**2030-31**	**$**	**1,840,100**
Routine Water Supply Facility Improvements (Replacements)	**2031-32**	**$**	**709,100**
Pipeline Upgrades (First Priority) 9,497 feet of pipe (See App. J)	**2031-32**	**$**	**1,813,500**
Routine Water Supply Facility Improvements (Replacements)	**2032-33**	**$**	**686,400**
Pipeline Upgrades (First Priority) 10,269 feet of pipe (See App. J)	**2032-33**	**$**	**1,836,400**
Routine Water Supply Facility Improvements (Replacements / Rehabilitation)	**2033-34**	**$**	**60,400**
Pipeline Upgrades (First Priority) 12,803 feet of pipe (See App. J)	**2033-34**	**$**	**2,346,300**

Routine Water Supply Facility Improvements (Replacements) (Includes installation of a new reservoir, first year of funding)	**2034-35**	**$**	**1,548,500**
Pipeline Upgrades (First Priority) 5,156 feet of pipe (See App. J)	**2034-35**	**$**	**946,200**
Routine Water Supply Facility Improvements (Replacements) (Includes installation of a new reservoir, second year of funding)	**2035-36**	**$**	**2,412,800**
Pipeline Upgrades (First Priority) 0 feet of pipe (See App. J)	**2035-36**	**$**	**-**
Routine Water Supply Facility Improvements (Replacements) (Includes installation of a new reservoir, third year of funding)	**2036-37**	**$**	**2,004,800**
Pipeline Upgrades (First Priority) 2,844 feet of pipe (See App. J)	**2036-37**	**$**	**543,200**

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