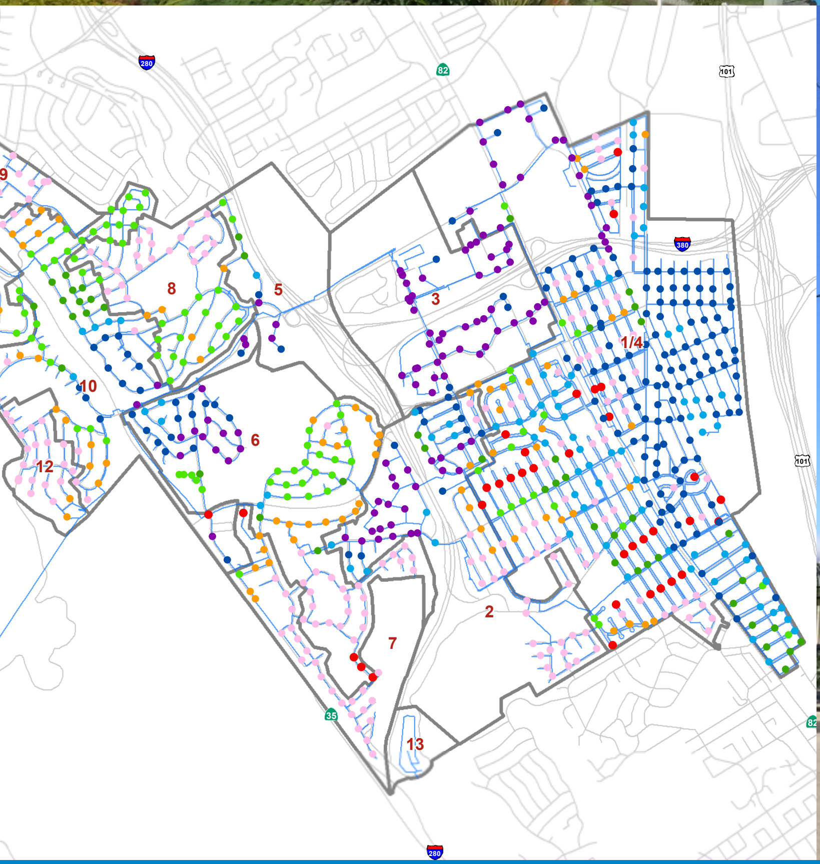

CITY OF SAN BRUNO

Water System Master Plan

DECEMBER 2022

WEST YOST
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FINAL REPORT | DECEMBER 2022

Water System Master Plan

PREPARED FOR

City of San Bruno

PREPARED BY

West Yost
Water. Engineered.

Water System Master Plan

Prepared for

City of San Bruno

Project No. 462-60-20-30

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LIST OF ACRONYMS AND ABBREVIATIONS

2012 WSMP	2012 Water System Master Plan
AB	Assembly Bill
AC	Asbestos Cement
ADU	Accessory Dwelling Units
BART	Bay Area Rapid Transit
BAWSCA	Bay Area Water Supply and Conservation Agency
BWA	Bartle Wells Associates
CCI	Construction Cost Index
CFC	California Fire Code
CI	Cast Iron
CII	Commercial, Industrial and Institutional
CIP	Capital Improvement Program
City	City of San Bruno
DI	Ductile Iron
DMMs	City Demand Management Measures

DWR	California Department of Water Resources
EKI	Erler & Kalinowski, Inc.
ENR	Engineering News Record
GIS	Geographical Information System
GPCD	Gallons Per Capita Per Day
GPM	Gallons per Minute
GS	Galvanized Steel
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GSR	Groundwater Storage and Recovery
GWMP	Groundwater Management Plan
HGL	Hydraulic Grade Line
ISG	Individual Supply Guarantee
MCCs	Motor Control Centers
MG	Million Gallons
MGD	Million Gallons per Day
MSL	Mean Sea Level
MWELO	Model Water Efficient Landscape Ordinance
NCCWD	North Coast County Water District
PSI	Pounds Per Square Inch
PVC	Polyvinyl Chloride
Regional GSR	Regional Groundwater Storage and Recovery Project
RS	Regulating Stations
RWS	Regional Water System
SB	Senate Bill
SCADA	Supervisory Control and Data Acquisition
SFCJ	San Francisco County Jail
SFPUC	San Francisco Public Utilities Commission
SGMA	Sustainable Groundwater Management Act
Strategy	Long-Term Reliable Water Supply Strategy
SWRCB	State Water Resources Control Board
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
WSA	Water Supply Agreement
WSAP	Water Shortage Allocation Plan
WSCP	Water Shortage Contingency Plan
WSIP	Water System Improvement Program
WSMP	Water System Master Plan

INTRODUCTION (CHAPTER 1)

This Water System Master Plan (WSMP) for the City of San Bruno (City) identifies strategies for maintaining adequate water system service levels for the City and guides capital expenditures for the City's water system. To accomplish these goals, the following key work tasks were performed in this Water System Master Plan:

- Evaluating and summarizing the existing water system facilities;
- Developing water demand projections through 2040;
- Evaluating and summarizing the City's available water supply sources;
- Updating and calibrating the distribution system hydraulic model using the City's geographical information system (GIS) and data collected during fire flow testing;
- Updating performance and operational criteria for evaluating the water system and identifying deficiencies as well as new facility needs;
- Preparing a capacity and operational reliability evaluation for existing and future 2040 water demand conditions to identify the City's water distribution system pipeline and facility needs;
- Evaluating the risk of failure for the City's existing water distribution system pipelines and developing a systematic replacement program which prioritizes the pipelines at highest risk;
- Developing a pipeline, pump station, tank, and groundwater well replacement strategy to address aging asset needs; and
- Developing a comprehensive capital improvement program (CIP) for recommended existing and future water system improvements.

The resulting WSMP CIP developed from these foundational tasks is:

- **Comprehensive** – considers the many facets of water service that are needed for a sustainable and reliable water system;
- **Prioritized** – gives precedence to improvements that are needed most to maintain the City's desired level of service, and efficiently coordinates projects to minimize overlaps; and
- **Balanced** – ensures that the City improves all facets of service using available funding over time.

This WSMP is an update to the City's 2012 WSMP and will provide a comprehensive road map for the City's water system for the next 20 or more years.

EXISTING WATER SYSTEM INVENTORY (CHAPTER 2)

The City's water service area, which is about 5.4 square miles, is generally contiguous with City Limits. The City is located in San Mateo County, south of the City of South San Francisco, north of the City of Millbrae, and just west of the San Francisco International Airport. The City is primarily an urban residential community with low density residential land uses in the west hillside and higher density residential, commercial, and institutional land uses in the east.

The City's service area includes twelve pressure zones and is served by approximately 116 miles of distribution pipelines, five (5) surface water supply turnouts, four (4) active groundwater wells, eight (8) storage tanks, eight (8) booster pump stations, and 31 pressure regulating stations. Key water system facilities were assessed during site visits conducted in the field on June 30, 2020. Significant findings and recommendations from these site visits are discussed in Chapter 2 and incorporated into rehabilitation and replacement project recommendations.

WATER DEMANDS (CHAPTER 3)

Existing (2019) average daily water production for the City is approximately 3 million gallons per day (mgd). Water use decreased significantly from 2014 to 2016 in response to the drought and state mandated conservation efforts. Although demands have increased in years since 2016, they remain well below pre-2014 levels. Residential use accounts for approximately 75 percent of the City's total water consumption.

This WSMP evaluates system needs through 2040. The City's average daily water use is expected to increase to 4.78 mgd by 2040. Growth within the City is projected to occur due to development projects such as the Bayhill Specific Plan, Transit Corridors Area Specific Plan, and other smaller new developments. Projected water demands from these developments were calculated using land use data and the City's unit water use factors, which were updated as part of this WSMP.

WATER SUPPLY (CHAPTER 4)

The City currently receives water from three supply sources:

- Wholesale surface water from the City and County of San Francisco's Regional Water System (RWS), operated by the San Francisco Public Utilities Commission (SFPUC), served through four connections to the City's system;
- Retail surface water purchased from North Coast County Water District (NCCWD), served through one connection to the City's system in Pressure Zone 13; and,
- Local groundwater from the South Westside Groundwater Basin.

Prior to 2016, groundwater use comprised about 50 percent of the City's total water supply. In 2016, the City reduced its use of groundwater in accordance with the Regional Groundwater Storage and Recovery Project (Regional GSR). The Regional GSR is an in-lieu groundwater recharge program that balances groundwater and RWS surface water supply to increase drought year water supplies. During wet and average years, water from the RWS is delivered to the City, which reduces the need to pump groundwater and allows the basin to naturally recharge and store additional water supply. In dry years, the City will maximize its use of groundwater and supplement with surface water.

Since 2016, the majority of the City's water supply is surface water from the SFPUC and NCCWD, both of which are supplied through the RWS. The RWS is predominantly supplied from runoff and snowmelt from the Sierra Nevada delivered through the Hetch Hetchy aqueducts, but also includes treated water produced by SFPUC from its local watersheds and facilities in Alameda and San Mateo counties. The City's remaining water supply is produced locally from its groundwater wells. The City currently operates four wells that extract groundwater from the central portion of the 40 square mile Westside Basin.

Chapter 4 presents an assessment of the City's projected supply and demand. The supply and demand assessment conservatively assumes that the Bay-Delta Plan Amendment, adopted by the State Water Resources Control Board (SWRCB) in 2018, will be implemented. Results indicate that the City's projected available supplies during a single dry year are not adequate to meet projected single dry year demands by as early as 2035. Similarly, during multiple dry years the City's projected available supplies are not adequate to meet projected demands by as early as 2030. This shortfall is primarily due to significant cutbacks in the City's supply from SFPUC which is significantly reduced in dry years due to the Bay-Delta Plan Amendment. In years with a supply shortfall, the City can implement its Water Shortage Contingency Plan (WSCP) to reduce demands to the level of available supply. Without the Bay-Delta Plan Amendment, supply shortfalls would be nearly eliminated.

HYDRAULIC MODEL UPDATE (CHAPTER 5)

The City's distribution system hydraulic model was updated using the City's GIS and Light Detection and Ranging (LiDAR) elevation data. West Yost allocated existing (2019) water demands by using spatially located customer billing information to distribute demands within the model, and calibrated the model using results from a hydrant testing program conducted in September 2020. In updating the model, West Yost worked closely with the City's Water Division staff to assure accuracy of the model. Based on the results of the model calibration, it can be concluded that the hydraulic model provides a reasonable representation of the City's water distribution system and can be used as a tool for master planning purposes.

SYSTEM PERFORMANCE AND OPERATIONAL CRITERIA (CHAPTER 6)

Chapter 6 defines the recommended performance and operational criteria for the City's water system, including allowable distribution system pressures, fire flow criteria, booster pump station capacity, water storage capacity, pressure regulating station capacity, and maximum pipeline velocity and head loss. Recommended performance and planning criteria frame the City's objectives for facility sizing and water distribution system performance and were developed based on key water system design criteria and operational standards presented in the 2012 WSMP. However, some of the previous water system design and operational criteria have been revised for this WSMP to reflect changes in water system operations.

EVALUATION OF EXISTING WATER SYSTEM (CHAPTER 7) AND FUTURE WATER SYSTEM (CHAPTER 8)

In summary, the technical evaluations identified the following key findings:

- **System Capacity and Operational Performance Evaluation:** While the City's existing distribution system has adequate capacity and reliability for normal operational needs, the City's most significant capacity needs are new pipelines and regulating stations to address fire flow needs. Most of the system was built when less stringent fire flow standards were in effect. While the system is generally well reinforced and many areas meet current standards, there is a need for new distribution system infrastructure to improve system capacity, particularly in older areas near the downtown area, where most pipelines are 2-inch and 4-inch diameter. Replacement of pipelines for fire flow purposes also supports the need to replace aging pipelines at high risk of failure. The system capacity analysis also found that additional storage capacity is needed.
- **Pipeline and Facility Renewal and Rehabilitation Program**. The City should prioritize replacing pipelines near the downtown areas. These pipelines are aging, contain many small diameter segments, and are at high risk of failure. The City should continue its ongoing well, pump station, tank, and regulating station rehabilitation programs, as well as plan for longer-term replacement of the remaining tanks.

These findings are discussed in greater detail below.

System Capacity Improvement Program

The system capacity analysis evaluates the City's water system facilities and their ability to meet the City's recommended performance and planning criteria under existing and buildout water demand conditions. This analysis, documented in Chapter 7 and Chapter 8, evaluates system storage, peak pumping capacity and peak valve station capacity needs to meet system requirements. The analysis found that additional storage capacity and pressure regulating station capacity are required to meet existing and future demands.

The analysis also evaluates system hydraulic performance under peak hour and maximum day plus fire flow conditions. Using the updated and calibrated hydraulic model, system flow and pressure were evaluated under normal and emergency operations and used to identify facility improvements required to meet the City's performance criteria. This analysis evaluated the City's water system under both existing and 2040 water demand conditions. The analysis found that while the City's water system generally meets the performance criteria under normal operations, a large portion of the City's system cannot provide sufficient fire flow to satisfy the City's fire flow criteria, since the system was designed to different standards in effect at the time of construction.

Therefore, a majority of the improvements identified from the system capacity and reliability analysis are required to meet existing fire flow criteria. These projects include replacement of existing pipelines or pressure reducing valves with new facilities of a larger diameter, or installation of new pressure reducing valves to increase supply to deficient pressure zones. These projects also support the City's renewal and replacement of aging pipelines.

Rehabilitation and Replacement Program

To develop a pipeline rehabilitation and replacement program, a risk assessment was performed to prioritize pipelines with the highest risk of failure for replacement. Pipeline properties used to perform the risk assessment include age, material, historical leak data, geologic conditions, criticality, diameter, and location. The risk assessment found that the majority of high-risk pipelines are in the City's Pressure Zone 1/4, consistent with the City's existing pipeline replacement workplan. High risk pipelines in the City's Pressure Zone 1/4 were then grouped into ten areas and prioritized for replacement.

A rehabilitation and replacement analysis was performed for water system facilities using facility age, condition data, and site visit results to assess replacement needs based on typical design useful life of each facility. In addition to the pipeline and facility rehabilitation and replacement projects, other miscellaneous rehabilitation and replacement projects were identified to further improve the operations and/or reliability of the City's water system.

Summary of Recommended Improvements

A summary of the recommended improvement projects to address the water system capacity and renewal and replacement needs is provided in Table ES-1. Many projects are recommended for both capacity and renewal and replacement reasons.

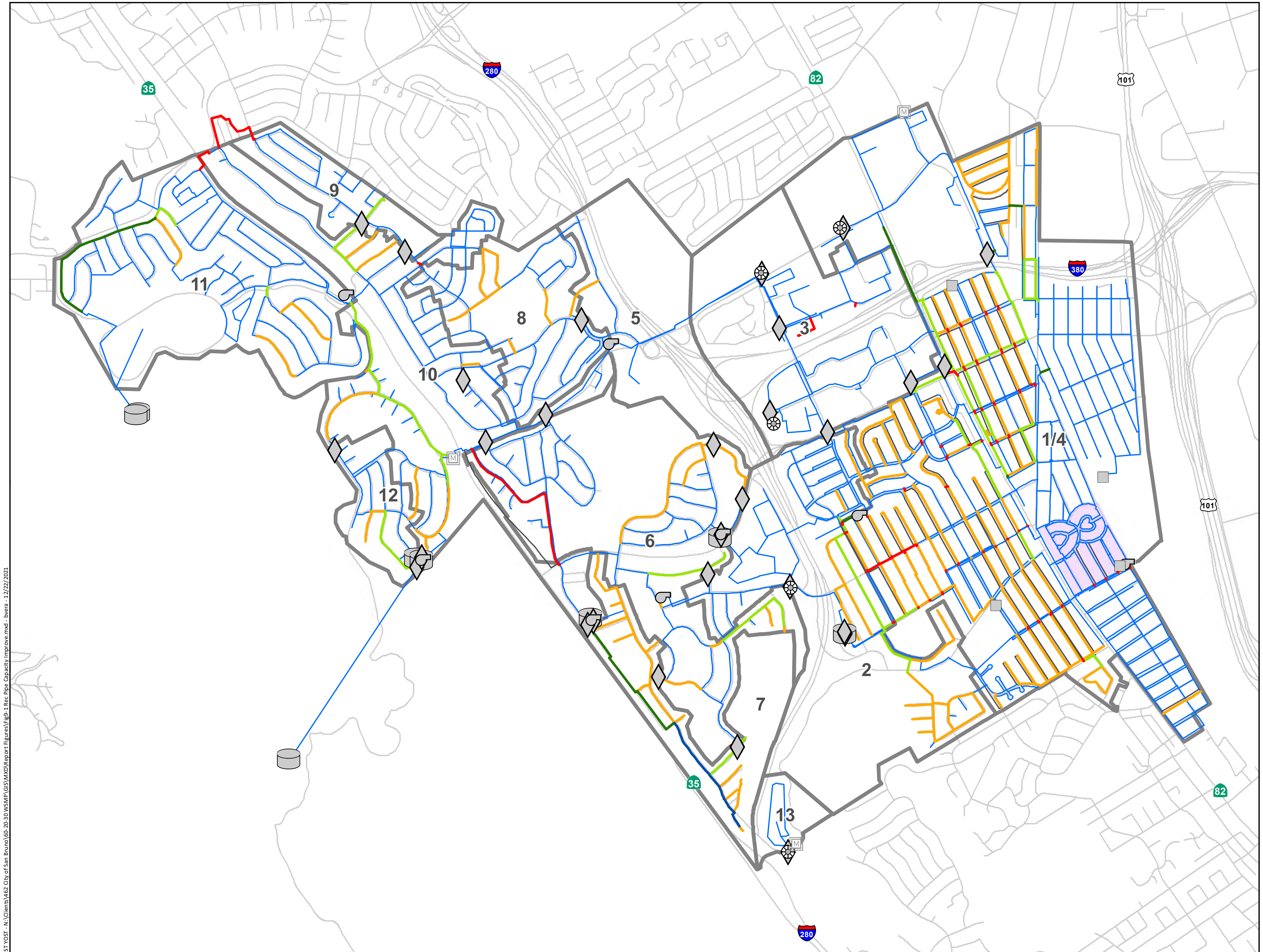
Improvement Group	Reasons	Capital Cost, $M [a]
Pipeline Improvements	**Fire Flow** – provide additional hydraulic capacity to meet fire flows. **Failure Risk** – replace aging pipelines at high risk of leaking or breaking.	$204.6
Well, Storage and Pumping Facility Improvements	**Capacity** – provide adequate supply and storage capacity to more reliably supply customers. **Failure Risk** – replace aging storage tanks vulnerable to seismic events. **Reliability** – install additional emergency generators to improve system reliability. **Asset Maintenance** – maintain existing facilities.	$86.9
Pressure Regulating Station Improvements	**Fire Flow** – provide additional supply capacity to meet fire flows. **Asset Maintenance** – maintain existing facilities.	$15.5
Miscellaneous Improvements	**Fire Flow** – maintain acceptable pressures at customer services during an emergency. **Data and Instrumentation** – improve City's ability to monitor customer water use. **Seismic Risk** – update City's seismic risk evaluation and perform recommended improvements. **Security Risks** – improve City's water system facility physical and cyber security. **Emergency Preparedness** – prepare plans and purchase equipment to better prepare City for emergency operations.	$10.7
	Total	**$318**

Table ES-1. Summary of Recommended Capital Improvement Projects

(a) Costs shown are based on the January 2021 San Francisco ENR CCI of 13,098. Costs include base construction costs plus mark-ups equal to 62.5 percent for construction contingencies and project implementation.

CAPITAL IMPROVEMENT PROGRAM (CHAPTER 9)

The recommended water system CIP totals $318M, as shown in Table ES-1, and on the chart below. Figures ES-1, ES-2, ES-3, ES-4 and ES-5 illustrate the locations of the recommended CIP improvement projects. With the implementation of improvements identified in the existing system evaluation, no additional improvements are required to meet future system demands. However, 1.0 MG of the storage capacity for the new 3.5 MG Tank 1 replacement project is allocated to provide storage for future development. Similarly, 0.8 MG of the storage capacity for the recommended 1.8 MG Zone 3 tank is to accommodate future demands.



Proposed 8-inch Upsize
Proposed 10-inch Upsize
Proposed 12-inch Upsize
Proposed 14-inch Upsize
Proposed New Pipeline
Proposed Abandoned Pipeline
Existing Pipeline
Turnout
Existing Active Well
Ex. Pressure Reg. Sta. (RS)
Ex. Booster Pump Station (PS)
Existing Storage Tank
Emergency Connection
Avenues 1-3
Pressure Zone Boundary

Notes:
1. Avenues 1-3 pipeline replacement project will be completed in 2021 and will resolve local fire flow deficiencies.
2. Capacity improvement projects are integrated into the pipeline capacity improvement projects shown on Figure 9-2.

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Figure ES-1

Recommended Pipeline Capacity Improvements

City of San Bruno
Water System Master Plan

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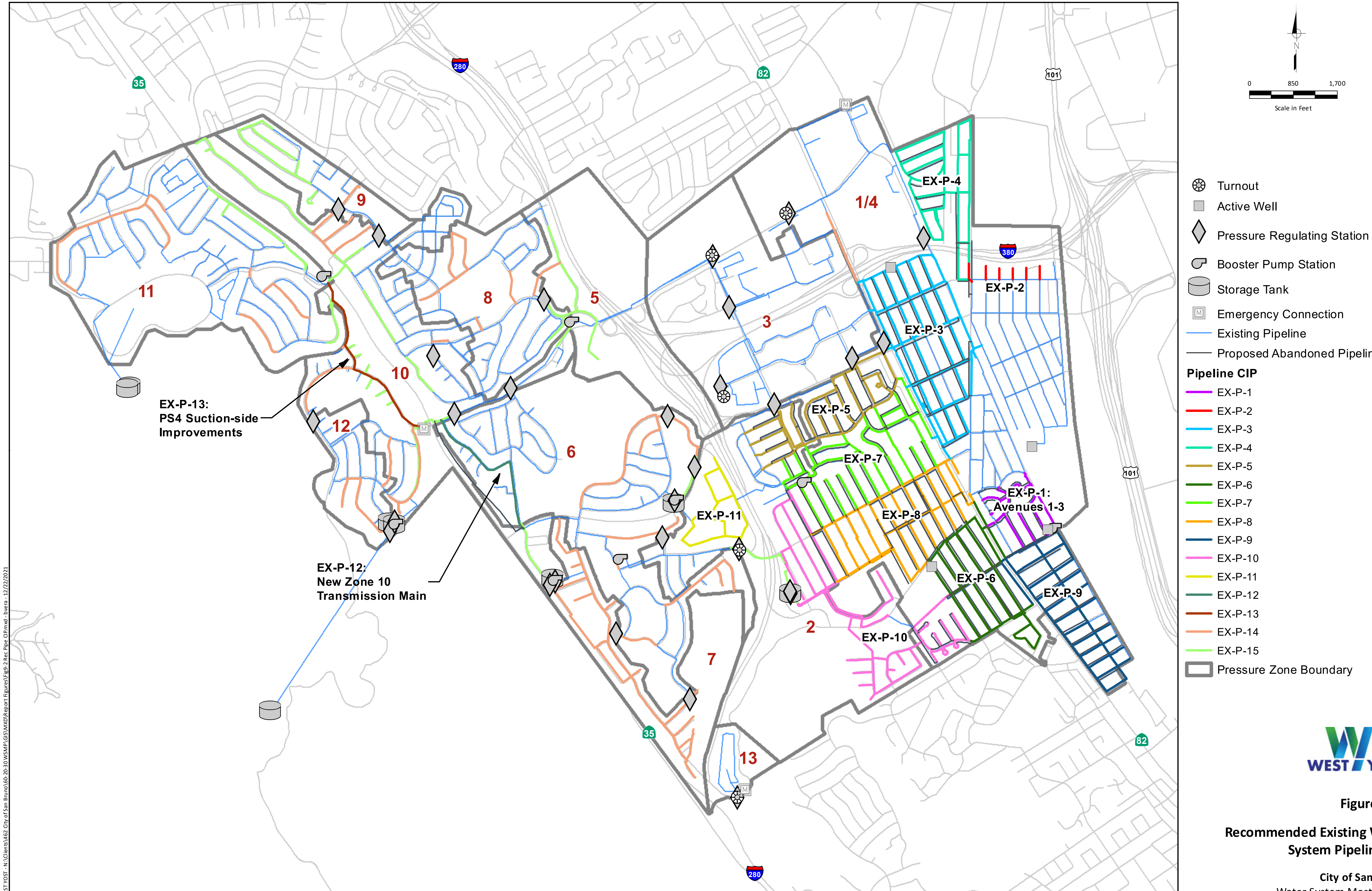

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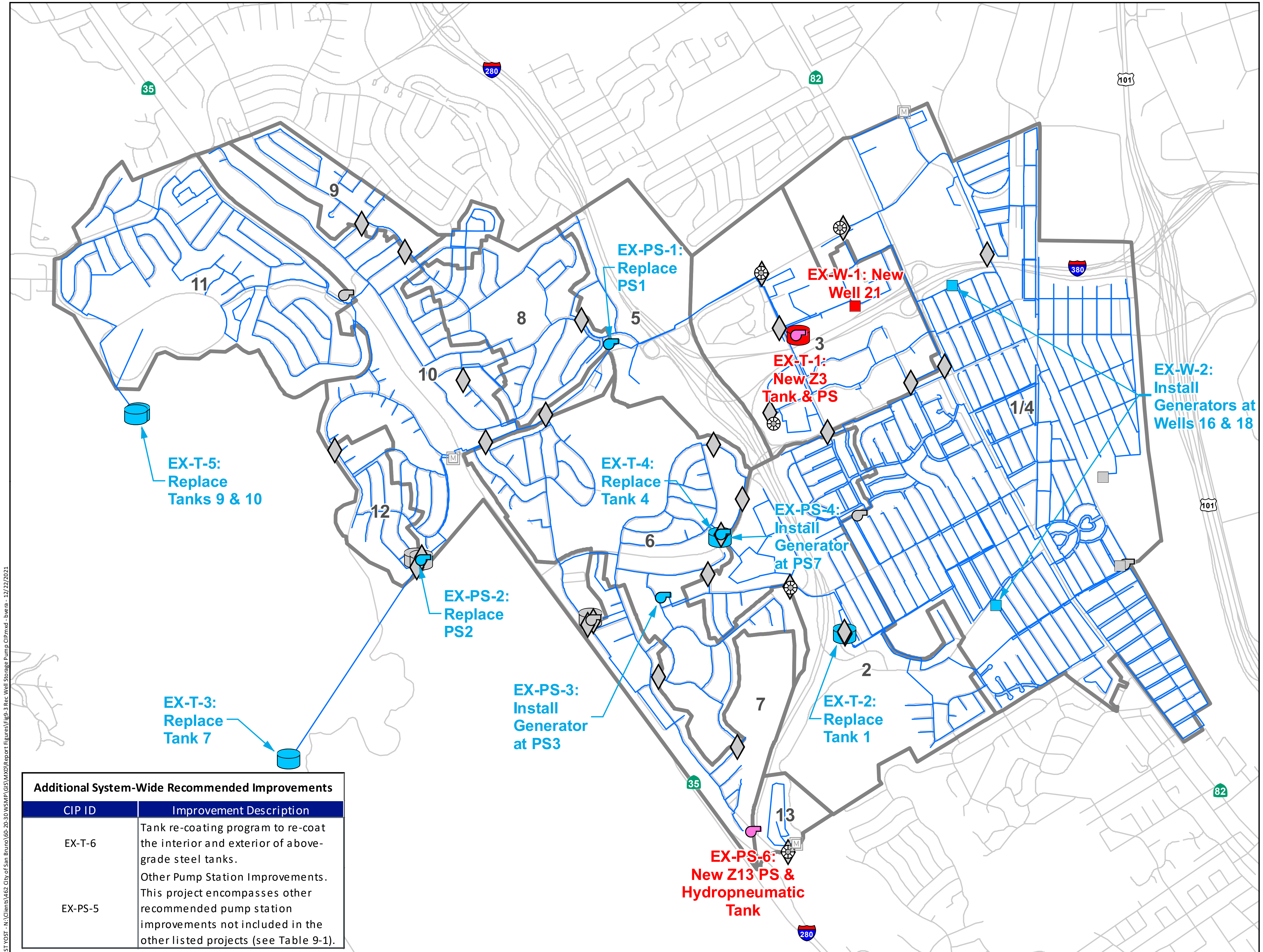
Figure ES-2

Recommended Existing Water System Pipeline CIP

City of San Bruno
Water System Master Plan



Additional System-Wide Recommended Improvements

CIP ID	Improvement Description
EX-T-6	Tank re-coating program to re-coat the interior and exterior of above-grade steel tanks.
EX-PS-5	Other Pump Station Improvements. This project encompasses other recommended pump station improvements not included in the other listed projects (see Table 9-1).

- Existing Pipeline
- Turnout
- Proposed New Well
- Proposed Well Upgrade
- Existing Active Well
- Proposed New Booster PS
- Proposed Booster PS Upgrade
- Ex. Booster Pump Station (PS)
- Proposed New Storage Tank
- Proposed Storage Tank Upgrade
- Existing Storage Tank
- Ex. Pressure Reg. Sta. (RS)
- Emergency Connection
- Pressure Zone Boundary

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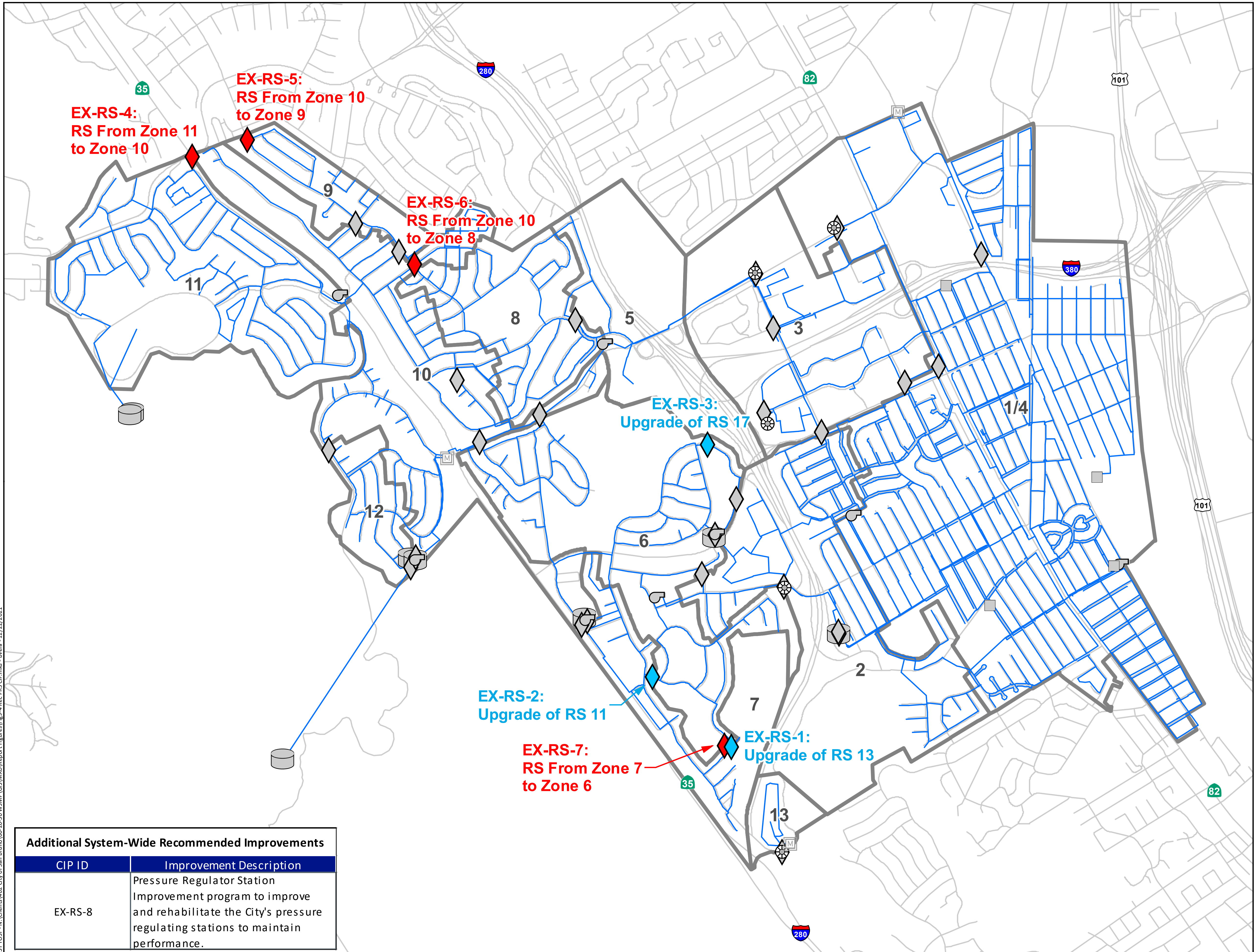
Figure ES-3

Recommended Well, Storage and Pumping Capital Improvement Projects

City of San Bruno

Water System Master Plan



Additional System-Wide Recommended Improvements

CIP ID	Improvement Description
EX-RS-8	Pressure Regulator Station Improvement program to improve and rehabilitate the City's pressure regulating stations to maintain performance.

0 850 1,700
Scale in Feet

- Existing Pipeline
- Turnout
- Existing Active Well
- Proposed New Pressure RS
- Proposed Pressure RS Upsize
- Ex. Pressure Reg. Sta. (RS)
- Ex. Booster Pump Station (PS)
- Existing Storage Tank
- Emergency Connection
- Pressure Zone Boundary

WEST YOST

Figure ES-4

Recommended Pressure Regulating Station Capital Improvement Projects

City of San Bruno
Water System Master Plan

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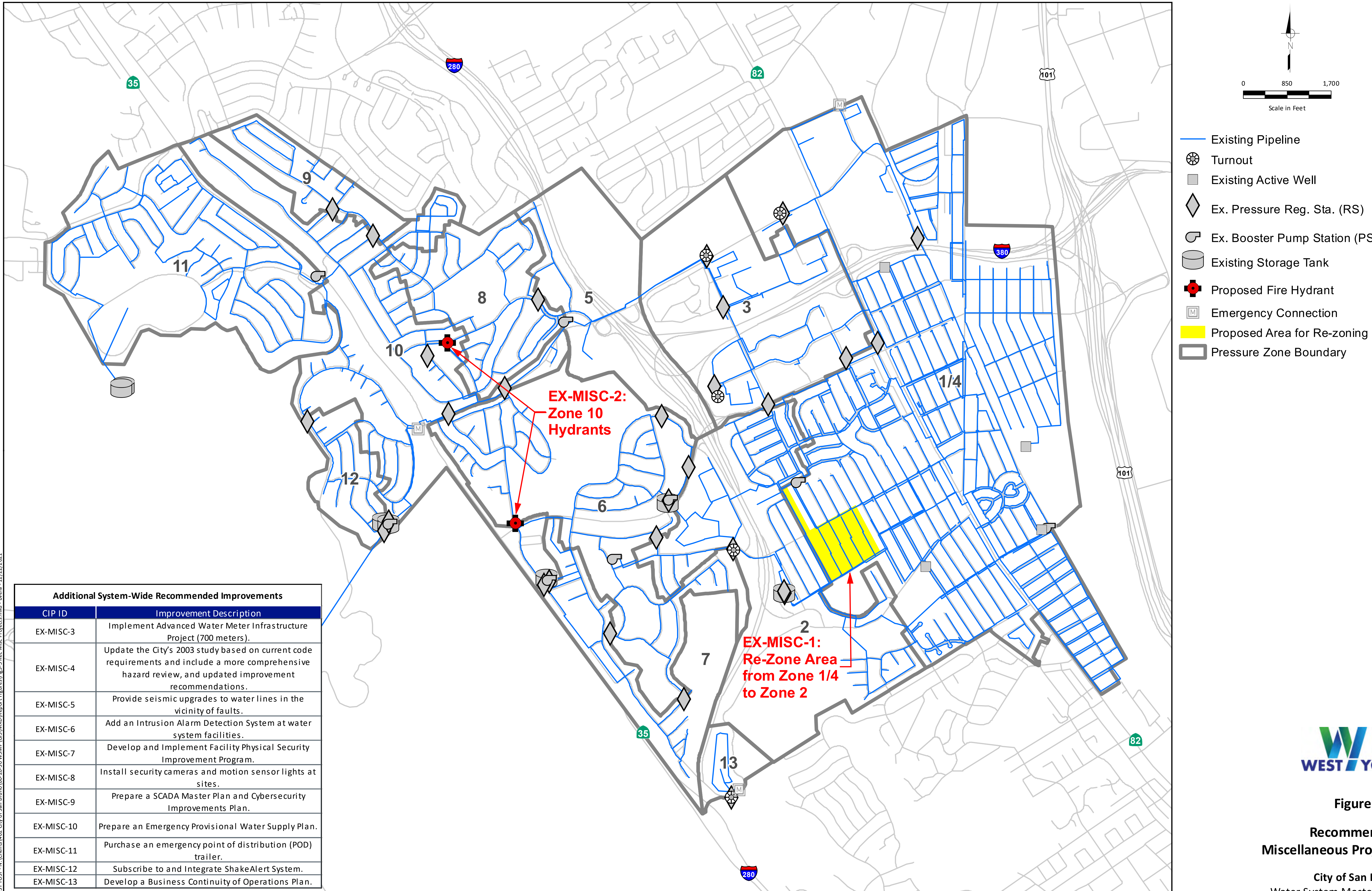

Additional System-Wide Recommended Improvements

CIP ID	Improvement Description
EX-MISC-3	Implement Advanced Water Meter Infrastructure Project (700 meters).
EX-MISC-4	Update the City's 2003 study based on current code requirements and include a more comprehensive hazard review, and updated improvement recommendations.
EX-MISC-5	Provide seismic upgrades to water lines in the vicinity of faults.
EX-MISC-6	Add an Intrusion Alarm Detection System at water system facilities.
EX-MISC-7	Develop and Implement Facility Physical Security Improvement Program.
EX-MISC-8	Install security cameras and motion sensor lights at sites.
EX-MISC-9	Prepare a SCADA Master Plan and Cybersecurity Improvements Plan.
EX-MISC-10	Prepare an Emergency Provisional Water Supply Plan.
EX-MISC-11	Purchase an emergency point of distribution (POD) trailer.
EX-MISC-12	Subscribe to and Integrate ShakeAlert System.
EX-MISC-13	Develop a Business Continuity of Operations Plan.

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Figure ES-5

Recommended Miscellaneous Projects

City of San Bruno

Water System Master Plan

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West Yost and the City reviewed the capital improvement program and developed a prioritized list of projects and implementation timeframe based on the results from the distribution system analysis, and the City's identified needs. Projects are placed on the schedule based on their priority, to address most critical needs first. Table ES-2 shows the recommended CIP implementation schedule in current dollars. Sequencing is generally based on the relative priorities of projects, with some adjustments to balance project implementation dollars with available funding. Sequencing also considers providing a mix of projects to provide a more balanced CIP.

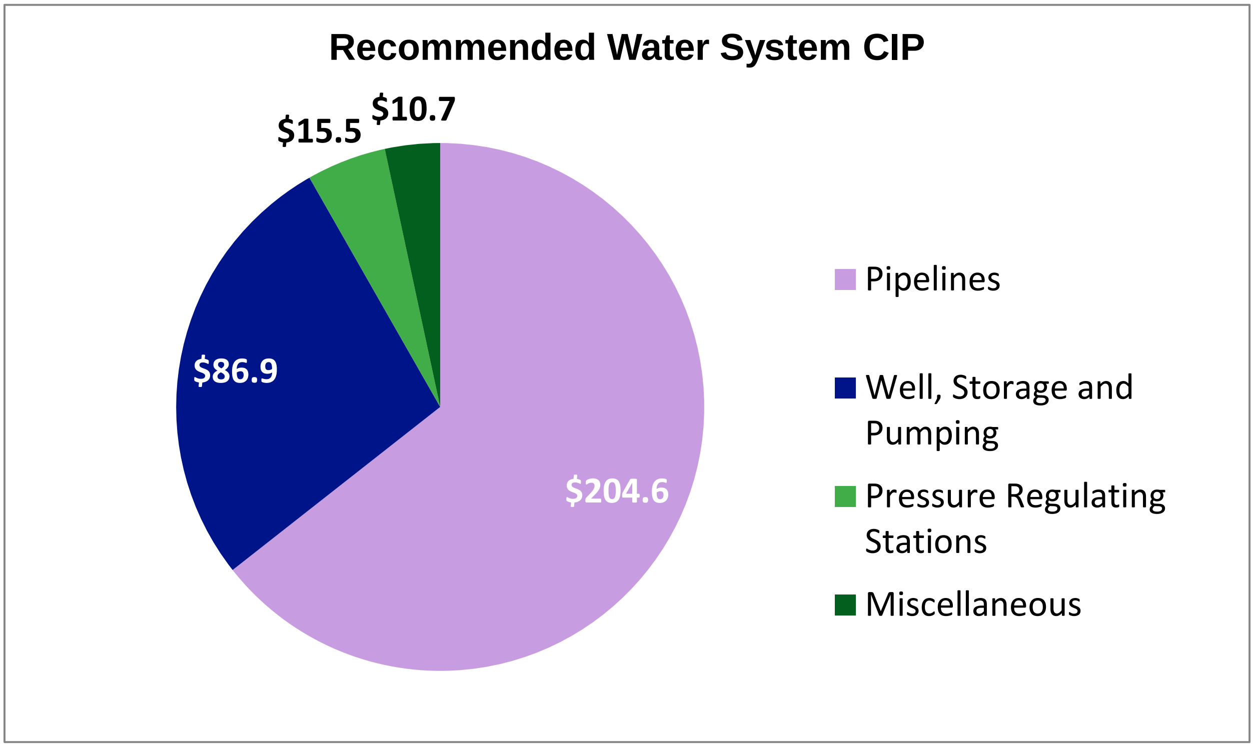


Table ES-2. Recommended Capital Improvement Program Schedule

Improvement Type	Capital Cost by Fiscal Years, Million Dollars [(a)]			
	FY 2022/23 through 2026/27	FY 2027/28 – FY 2031/32	Long-Term	Total
Pipeline Improvements	25.2	27.6	151.8	204.6
Well, Storage and Pumping Facility Improvements	39.8	8.9	38.2	86.9
Pressure Regulating Station Improvements	2.6	2.5	10.5	15.5
Miscellaneous Improvements	7.4	0.7	2.6	10.7
Total	74.9	39.7	203.1	318

[(a)] Costs shown are based on the January 2021 San Francisco ENR CCI of 13,098. Costs include base construction costs plus mark-ups equal to 62.5 percent for construction contingencies and project implementation. Totals may differ from quantities shown due to rounding.

As part of the WSMP, Bartle Wells Associates (BWA) prepared a high-level rate analysis to evaluate the impacts of implementing the capital program based on the recommendations in the WSMP, and alternative levels of funding. Ten-Year cash flow projections were developed for two alternatives:

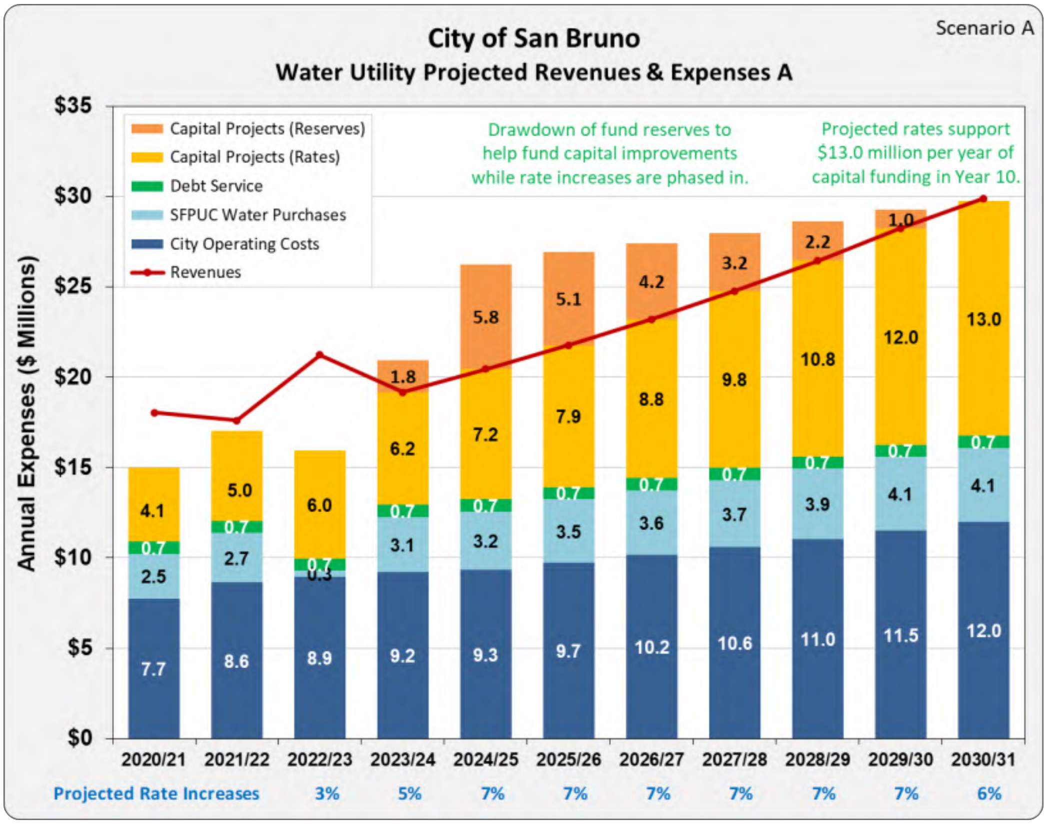
- **Alternative A** – Funding based on the recommended capital improvement program implementation schedule
- **Alternative B** – Funding based on 75 percent of the recommended capital improvement program level

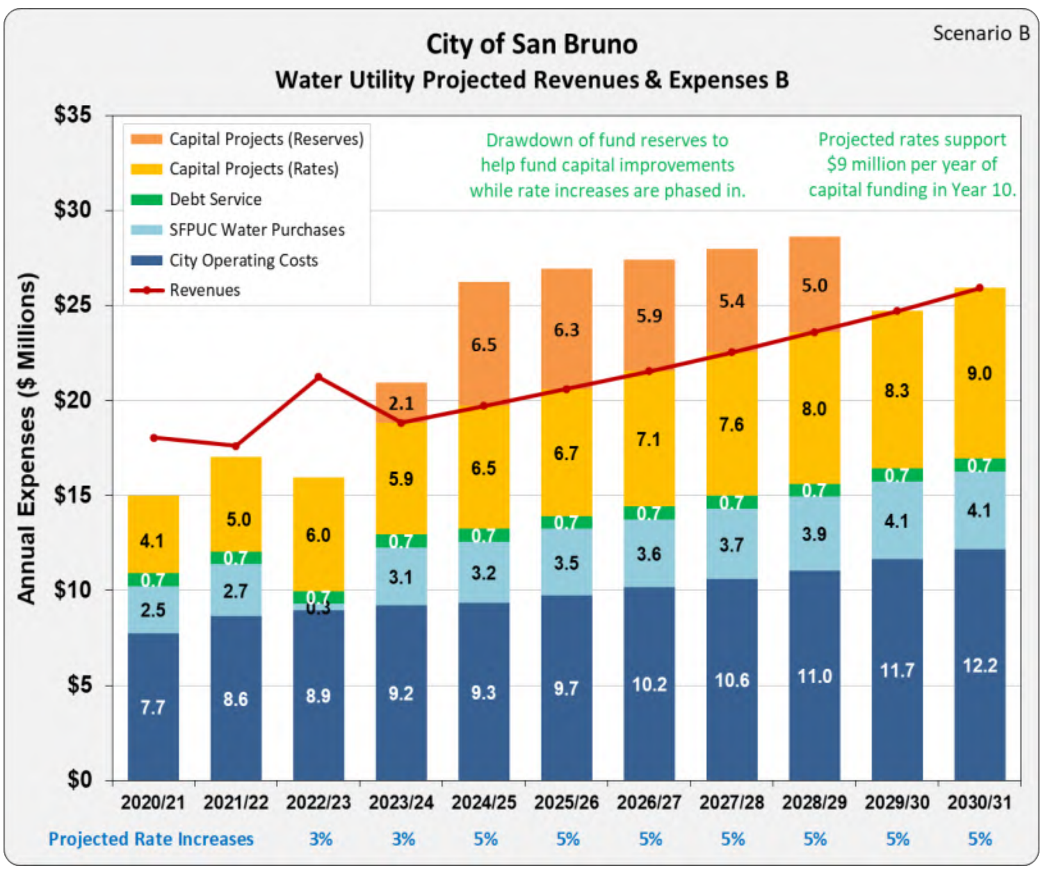
Figure ES-6 compares the result from the two alternatives. The top portion of the figure shows Alternative A and the bottom portion of the figure shows Alternative B. Each graphic shows the City operating costs, SFPUC water purchases, debt service, funding of capital projects from rates and funding of capital projects from reserves. Alternative A shows a projected rate increase of 3 percent in FY 2022/23, increasing to 7 percent by FY 2024/25 and continuing at 7 percent through FY 2029/30 and a 6 percent increase in FY 2030/31. This scenario uses approximately $23M in fund reserves, with the remaining projects funded through rates. Alternative B shows a projected rate increase of 3 percent in FY 2022/23, increasing to 5 percent by FY 2024/25 and continuing at 5 percent through the remainder of the 10-year period. This alternative uses approximately $32M in fund reserves, with the remaining projects funded through rates, and a final reserve balance of $14.6M, $1.1M above the reserve target.

Alternative A supports $13M/year of CIP funding after an initial phase in through FY2024/45, in line with the 10-year annual average funding requirements of the WSMP, escalated to account for 3 percent annual construction cost inflation. Alternative B supports the same level of CIP funding through FY 2028/29, but ultimately supports roughly $9M/year of future annual capital funding by the end of the decade due to reduced rate increases. The projections indicate that the City can address its future funding needs by drawing down a portion of its fund reserves while phasing in a series of gradual annual water rate increases over the next decade. Under Alternative A, the City would be able to support the full funding level recommended in the WSMP. Under Alternative B, the City would still be able to support a substantial level of capital funding over the next decade. However, the reduced rate increases would ultimately support a lower level of future annual CIP funding.

The rate projections presented in the WSMP are for planning purposes only. Going forward, the City should conduct a more-detailed water rate study to evaluate options for future rate increases.

Figure ES-6. Ten-Year Cash Flow Projections for Alternatives





CHAPTER 1
Introduction

This Water System Master Plan for the City of San Bruno (City) identifies strategies for maintaining adequate water system service levels for the City and guides capital expenditures for the City's water system. To accomplish these goals, the following key work tasks were performed in this Water System Master Plan:

- Evaluating and summarizing the existing water system facilities;
- Developing water demand projections through 2040;
- Evaluating and summarizing the City's available water supply sources;
- Updating and calibrating the distribution system hydraulic model using the City's geographical information system (GIS) and data collected during fire flow testing;
- Updating performance and operational criteria for evaluating the water system and identifying deficiencies as well as new facility needs;
- Preparing a capacity and operational reliability evaluation for existing and future 2040 water demand conditions to identify the City's water distribution system pipeline and facility needs;
- Evaluating the risk of failure for the City's existing water distribution system pipelines and developing a systematic replacement program which prioritizes the pipelines at highest risk;
- Developing a pipeline, pump station, tank, and groundwater well replacement strategy to address aging asset needs; and
- Developing a comprehensive CIP for recommended existing and future water system improvements.

The resulting Water System Master Plan CIP developed from these foundational tasks is:

- **Comprehensive** – considers the many facets of water service that are needed for a sustainable and reliable water system;
- **Prioritized** – gives precedence to improvements that are needed most to maintain the City's desired level of service, and efficiently coordinates projects to minimize overlaps; and
- **Balanced** – ensures that the City improves all facets of service using available funding over time.

This Water System Master Plan is an update to the City's 2012 Water System Master Plan and will provide a comprehensive road map for the City's water system for the next 20+ years.

1.1 AUTHORIZATION

The City authorized West Yost to prepare this Water System Master Plan on March 3, 2020.

1.2 REPORT ORGANIZATION

This Water System Master Plan is organized into the following chapters:

- Chapter 1: Introduction
- Chapter 2: Existing Water System Inventory
- Chapter 3: Water Demands
- Chapter 4: Water Supply
- Chapter 5: Hydraulic Model Development
- Chapter 6: System Performance and Operational Criteria
- Chapter 7: Evaluation of Existing Water System
- Chapter 8: Evaluation of Future Water System
- Chapter 9: Recommended Capital Improvement Program

The following appendices to this Water System Master Plan contain additional technical information, assumptions, and calculations:

- Appendix A: Site Visit Report – Steel Tank Structural Observation
- Appendix B: Hydrant Testing Plan for Hydraulic Model Calibration
- Appendix C: Cost Estimating Assumptions
- Appendix D: Financial and Rate Projections for the Water System Master Plan Capital Improvements Program

1.3 ACKNOWLEDGMENTS

The development of this Water System Master Plan would not have been possible without the key involvement and assistance from City staff. In particular, the following City staff provided comprehensive information, significant input, and important insights throughout the development of this Water System Master Plan:

- Jimmy Tan, Public former Works Director
- Hae Won Ritchie, City Engineer
- Mark Reinhardt, former Water System and Conservation Manager, City Project Manager
- Steve Salazar, Acting Water System and Conservation Manager, City Project Manager
- Martin Cardone, former Public Services Manager
- Robert Wood, Management Analyst
- Scott Zayac, Lead Maintenance Worker

The following team members contributed to the project:

- Elizabeth Drayer, Principal-in-Charge
- Polly Boissevain, Project Manager
- Nate Homan, Project Engineer
- Whitney Jones, Staff Engineer
- Amy Kwong, QC Review
- Jean Bolger, Report Production

CHAPTER 2
Existing Water System Inventory

This chapter describes the City's existing water distribution system. Water system information was obtained through the review of previous reports, maps, plans, operating records, and other available data provided to West Yost by City staff. The following sections of this chapter describe the components of the City's existing water distribution system:

- Water Service Area
- Service Connections and Population Served
- Water Supply Sources
- Water System Facilities

Site visits to key water system facilities were conducted in the field on June 30, 2020. Significant findings and recommendations from the site visits are included in the following sections below. Detailed findings from the steel tank structural condition assessment are documented in Appendix A.

2.1 WATER SERVICE AREA

The City is located in San Mateo County, south of the City of South San Francisco, north of the City of Millbrae, and just west of the San Francisco International Airport. The City is connected to major transportation corridors such as Highway 101, I-280, I-380, El Camino Real and Skyline Boulevard. The City is also served by two major public transit lines, Bay Area Rapid Transit (BART) and Caltrain. Figure 2-1 shows the boundary of the City Limits.

The City's water service area is about 5.4 square miles and the water service boundary is generally contiguous with the City Limits as shown on Figure 2-1[1]. Elevations within the City range from near sea level in the east to almost 900 feet on the northwestern edge of the City. The City is primarily an urban residential community with low density residential land uses in the west hillside areas and higher density residential, commercial, and institutional land uses in the east, towards San Francisco Bay.

2.1.1 Pressure Zones

There are twelve pressure zones within the City's water service area. Zones 1 and 4 were consolidated and are considered as one pressure zone called Zone 1/4. Zones 3 and 5 were previously consolidated and called Zone 3/5 in the 2012 WSMP. However, the installation of regulating stations 26 and 27 in 2015 separated Zone 3/5 into a regulated portion and an unregulated portion, which are called Zone 3 and Zone 5, respectively, in this WSMP. Zones 6, 7, 8, and 9 each have a small subzone served by a pressure regulating station, designated as Zones 6A, 7A, 8A, and 9A, respectively. Subzones are not referred to or shown separately from their respective parent zones in this WSMP unless explicitly stated otherwise. Figure 2-2 shows the boundary for each of the City's pressure zones, and Table 2-1 provides a summary of the existing pressure zone boundaries with their key characteristics.

[1] The City provides domestic service, but not irrigation service, to the Golden Gate Cemetery. The City does not serve the Capuchino High School.

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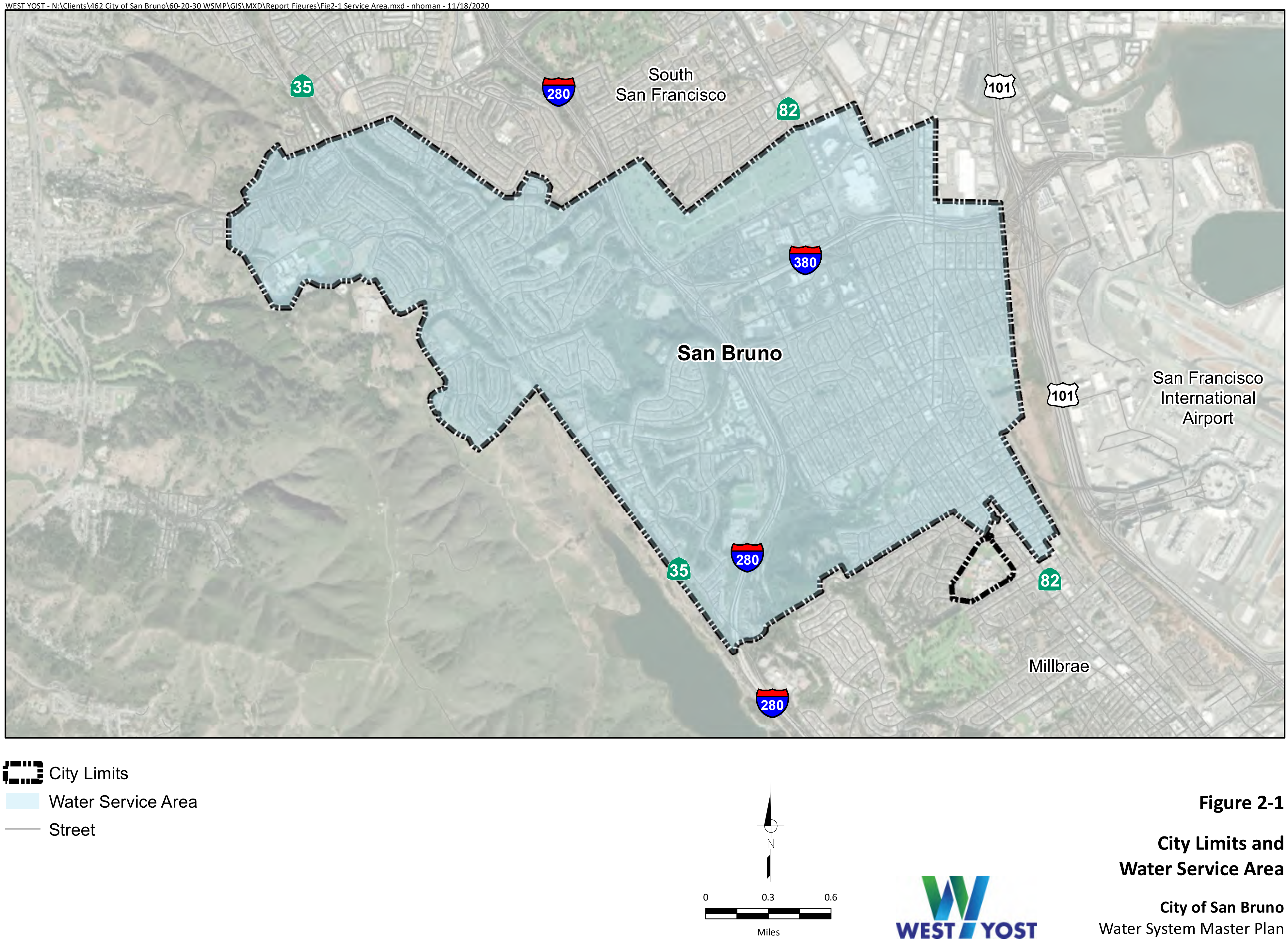


Figure 2-1

City Limits and Water Service Area

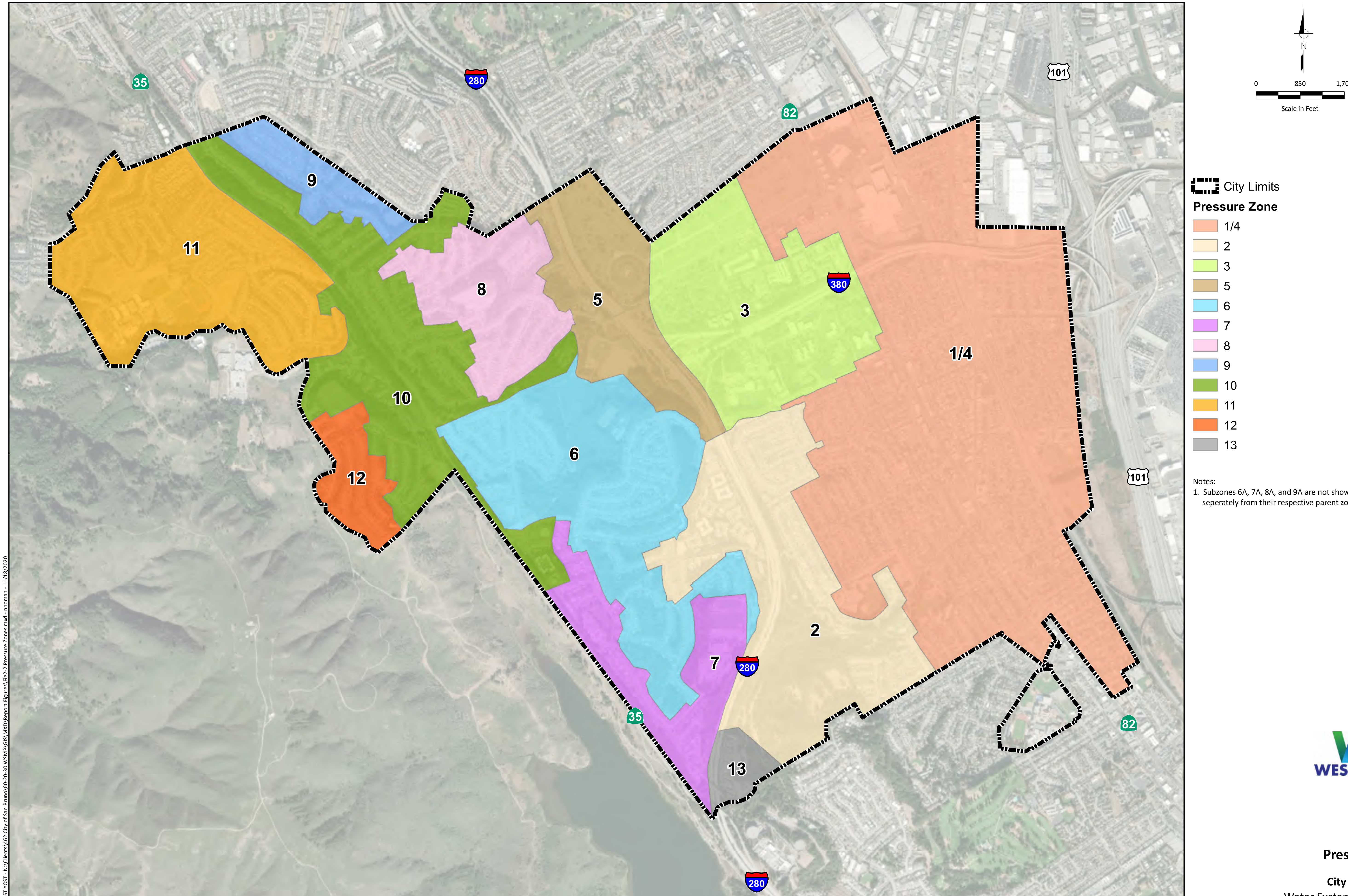
City of San Bruno
Water System Master Plan

Table 2-1. Summary of Existing Pressure Zones

Pressure Zone		Range of Service Elevations, feet msl[(a)]	HGL of Tank, Regulating Station, or Turnout, feet msl	Static Service Pressures, psi	Water Supply Source(s)
Zone 1/4		5-172	260	38-110	SFPUC (Tanforan (C1) and Whitman (C5)) Turnouts[(b)] Pump Station 6 (Well 17) Wells 16,18, and 20[(c)]
Zone 2	Main Zone[(d)]	83-229	362	57-120	Pump Station 5
	Whitman Way[(d)]	204-277	450	74-106	SFPUC (Whitman (C5)) Turnout
Zone 3[(e)]		50-170	355	80-131	SFPUC (Rollingwood (C3) and Bayhill (C4)) Turnouts via Regulating Stations 27 and 26
Zone 5[(e)]		124-272	455	79-142	SFPUC Rollingwood (C3) Turnout
Zone 6 (including Zone 6A)		226-447	560	49-144	Pump Station 3 Pump Station 7
Zone 7 (including Zone 7A)		437-561	659	42-95	Zone 10 via Regulating Station 9
Zone 8 (including Zone 8A)		250-513	601	38-151	Zone 10 via Regulating Station 6
Zone 9 (including Zone 9A)		374-499	592	40-94	Zone 10 via Regulating Station 4
Zone 10		428-673[(f)]	787	49-154[(f)]	Pump Station 1 Pump Station 8
Zone 11		480-753	855	44-161	Pump Station 4
Zone 12		634-835	952	50-137	Pump Station 2 via Tank 7 and Regulating Station 2
Zone 13		401-416	538	52-59	NCCWD (Crystal Springs (C6)) Turnout via Regulating Station 1

(a) Service elevations based on 2017 LiDAR data downloaded from San Mateo County and review of pressure zone boundaries.
(b) Tanforan (C1) Turnout is an emergency turnout to provide fire supply to the Tanforan Shopping Center. Whitman (C5) Turnout serves Zone 1/4 via Tank 1.
(c) Per the Regional Groundwater Storage and Recovery Project, City wells are only a significant source of supply during hydrologically dry years.
(d) The HGL for most of Zone 2 is set by Tank 4. A small portion of Zone 2 along Whitman Way is served directly from the Whitman (C5) Turnout at a higher HGL.
(e) Zones 3 and 5 were previously considered a combined zone (Zone 3/5). After the installation of RS27 and RS26 at the Rollingwood (C3) and Bayhill (C4) turnouts, respectively, Zone 3 is regulated to a lower hydraulic grade than Zone 5. Zone 5 receives unregulated supply from the Rollingwood (C3) turnout.
(f) Does not include services on Quail Point Circle, which are at a minimum elevation of approximately 336 ft. Calculated maximum static pressure at these services is 194 psi.

msl = mean sea level
HGL = hydraulic grade line
psi = pounds per square inch



City Limits

Pressure Zone

- 1/4
- 2
- 3
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13

Notes:
1. Subzones 6A, 7A, 8A, and 9A are not shown seperately from their respective parent zones.

WEST YOST

Figure 2-2

Pressure Zones

City of San Bruno
Water System Master Plan

2.2 SERVICE CONNECTIONS AND POPULATION SERVED

This section summarizes the existing number of services and population served within the City. *Chapter 3 Water Demands* provides a more complete description of the historical number of services and population, including how this data was used to estimate the number of services and population to be served in the future.

2.2.1 Existing Service Connections

The City currently has 11,902 metered service connections. All of the City's water service connections are metered, and a breakdown of the number of connections by customer sector is provided in Table 2-2. As shown in Table 2-2, approximately 94 percent of the City's service connections are either Single Family or Multi-Family residential.

Table 2-2. Number of Service Connections by Customer Sector in 2019[(a)]

Customer Sector	Number of Connections	Percent of Total Connections, percent
Single Family Residential	10,104	84.9
Multi-Family Residential	1085	9.1
Non-Residential	713	6.0
Total	**11,902**	**100%**

(a) From 2019 City metered water consumption data.

2.2.2 Existing Population

The City's population has grown steadily since its inception in 1914 as a railroad suburb and well into the 1960s when the population reached its peak growth rate with a population of over 35,000 people. Since then, population growth has slowed due to a lack of available land. The population in 2020 has been estimated to be 45,257 based on projections from the State of California Department of Finance. As mentioned previously, a more detailed discussion of the historical population is provided in *Chapter 3 Water Demands*.

2.3 WATER SUPPLY SOURCES

The City's water supply comes from three different sources – surface water purchased from SFPUC, surface water purchased from NCCWD, and groundwater produced from the City's wells. Historically, approximately half of the City's total water supply came from purchased surface water, and the remaining supply was produced from the City's groundwater wells. Starting in 2016, the City increased its use of surface water supplies during wet and normal years in accordance with the regional Groundwater Storage and Recovery (GSR) Project. The City now receives approximately 90 percent of its supplies from surface water in wet and normal years. Surface and groundwater supplies are summarized below. A more detailed description of the City's existing water supply is provided in *Chapter 4 Water Supply*.

2.3.1 Surface Water

The City currently purchases wholesale treated surface water from the City and County of San Francisco's Regional Water System, which is operated by the SFPUC. Approximately 85 percent of the SFPUC water supply originates from the Hetch Hetchy watershed, located in Yosemite National Park, and is stored in the Hetch Hetchy Reservoir. The remaining 15 percent of the SFPUC water supply is produced in the Alameda and Peninsula watersheds and stored in six different reservoirs located in the Alameda and San Mateo counties. Surface water from SFPUC is supplied to the City through four turnouts from the SFPUC transmission mains. The City currently purchases about 3,020 acre-feet per year (af/yr) from the SFPUC.[2]

Treated surface water supply from the NCCWD is also from the SFPUC's Regional Water System; however, the City purchases surface water directly from NCCWD. This purchased water supply is used exclusively to meet water demands in Zone 13, through the Crystal Springs turnout. The City currently purchases about 44 af/yr from NCCWD.[3]

2.3.2 Groundwater

The City has used groundwater as a source of water supply since the early 1990s. However, beginning in 2016 the City has reduced production from groundwater in normal and wet years to approximately 10 percent of its total annual supply. In dry years, the City can pump water from four active groundwater supply wells, extracting groundwater from the central portion of the 40 square mile Westside Groundwater Basin (Westside Basin). The City currently produces approximately 300 af/yr from its groundwater wells.[4]

2.4 WATER SYSTEM FACILITIES

The City's water system facilities (including surface water supply turnouts, groundwater wells, storage facilities, and booster pump stations) are located throughout the service area as shown on Figure 2-3. Figure 2-4 provides an overall schematic profile of the City's existing water distribution system showing the ground surface elevations of the existing water system facilities.

The components of the existing water system are discussed in more detail below, including significant findings and recommendations from the site visits conducted in the field on June 30, 2020. Except where otherwise noted, data on existing facilities is from the 2012 Water System Master Plan. The evaluation of facility capacities and their ability to meet existing and future potable water demands is described in *Chapter 7 Existing Water System Evaluation* and *Chapter 8 Future Water System Evaluation*, respectively.

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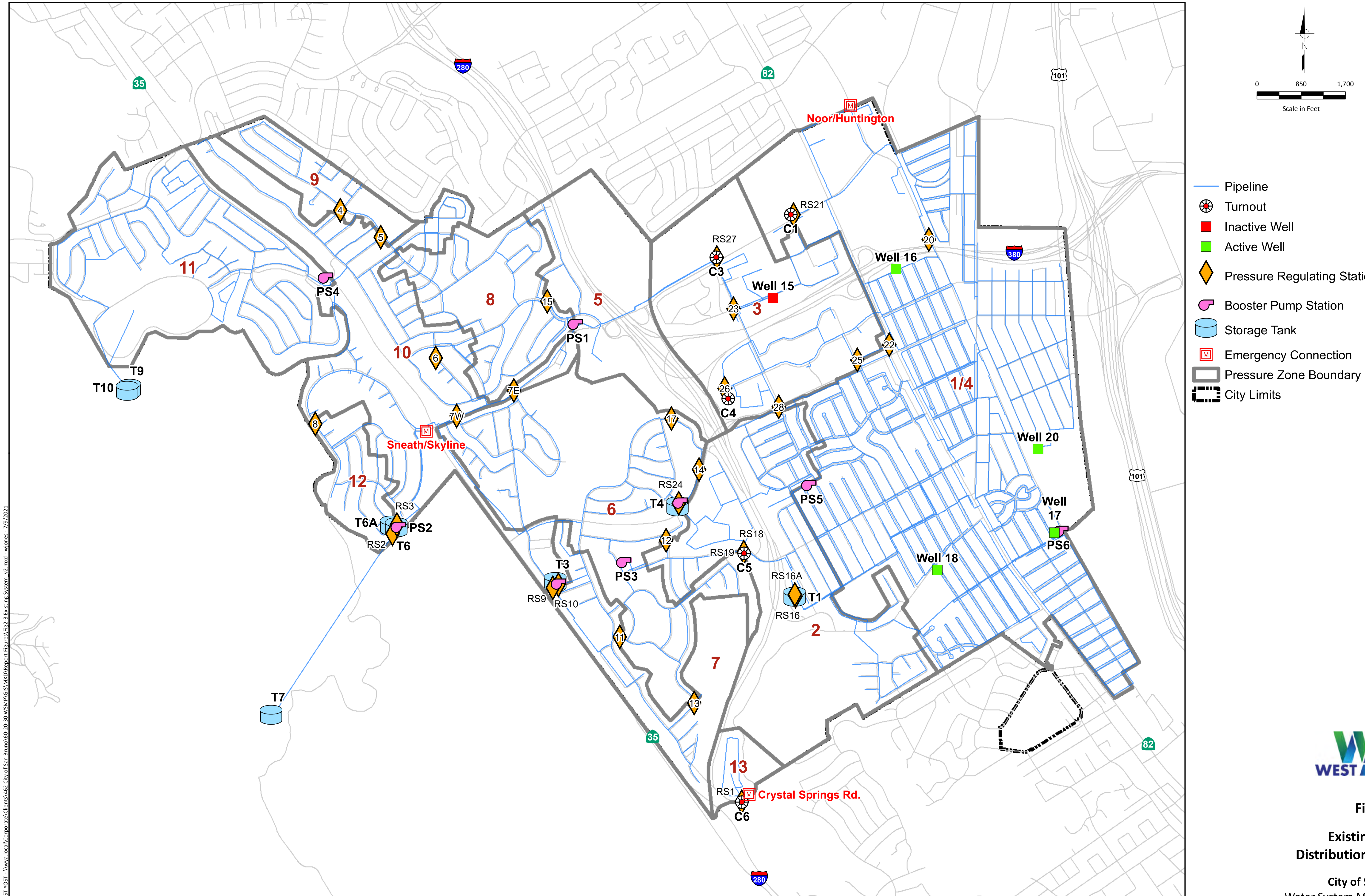
[2] Source: Average of SFPUC purchased supplies for 2017 through 2019. Data provided by City staff on April 13, 2020.

[3] Source: Average of NCCWD purchased supplies for 2017 through 2019. Data provided by City staff on April 13, 2020.

[4] Source: Average of groundwater produced for 2017 through 2019. Data provided by City staff on April 13, 2020.



WEST YOST

Figure 2-3

Existing Water Distribution System

City of San Bruno

Water System Master Plan

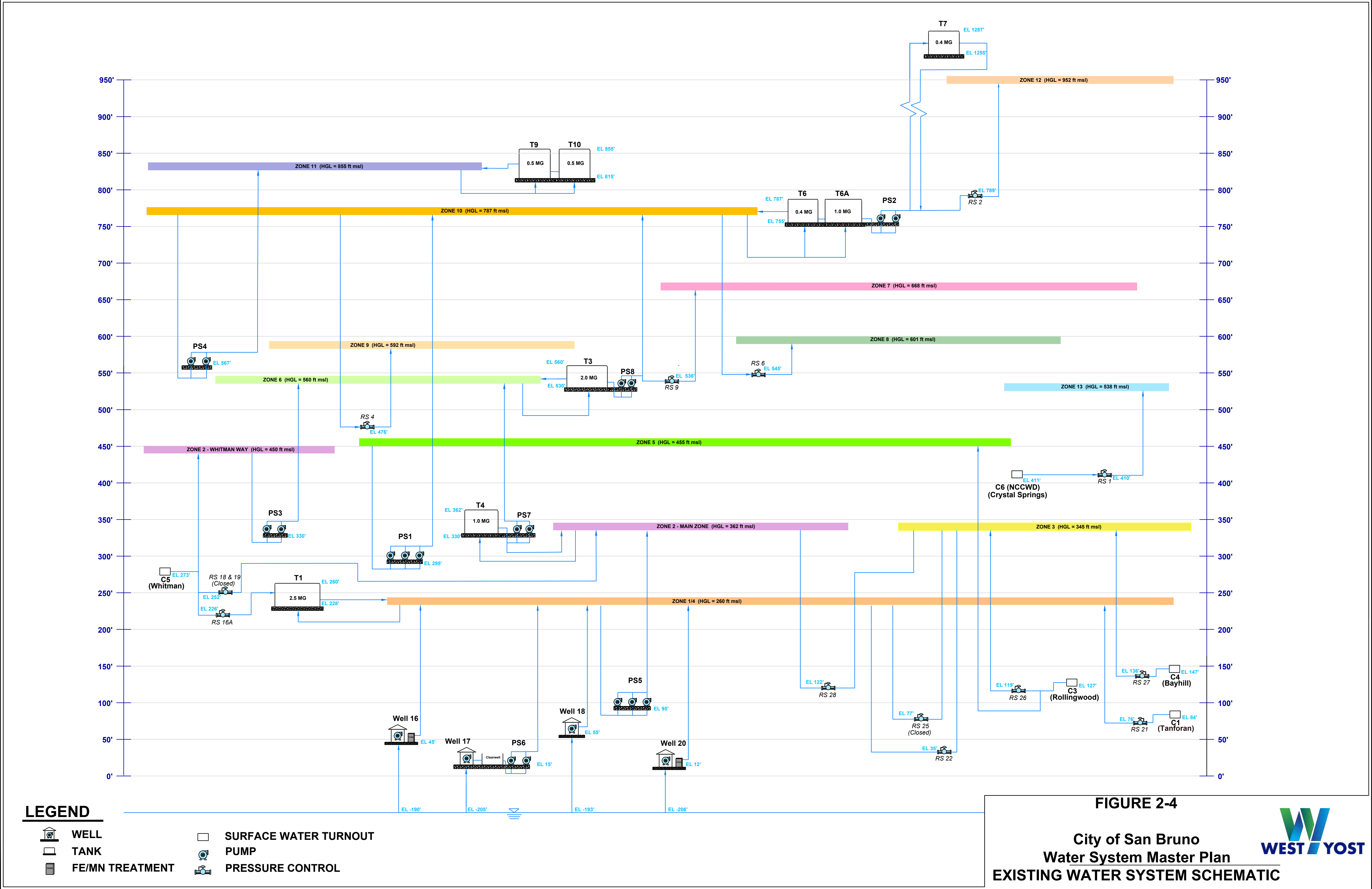


FIGURE 2-4

City of San Bruno
Water System Master Plan
EXISTING WATER SYSTEM SCHEMATIC

2.4.1 Surface Water Supply Turnouts

The City currently has a total of five surface water supply turnouts, as shown on Figure 2-3. Generally, these turnouts supply approximately 90 percent of the City's annual water production in normal and wet years.

Four of the turnouts supply wholesale surface water from SFPUC to the City. Each connection from SFPUC is equipped with an isolation valve and a recording meter. The remaining turnout supplies surface water from NCCWD directly to Zone 13. Turnouts C1, C4, and C6 are regulated with pressure reducing valves. Turnout C3 supplies Zone 3 through a regulated connection (RS27) and Zone 5 through an unregulated connection.

Table 2-3 summarizes the existing surface water supply turnouts and their key characteristics.

Table 2-3. Surface Water Supply Turnouts

Turnout ID	Location	SFPUC Pipeline	Service Zone	Elevation, feet[a]	SFPUC HGL, feet	Delivered Pressure, psi
C1 – Tanforan	Sneath Lane and National Avenue	Sunset Supply Pipeline	1/4[b]	84	308	Regulated (RS21): 67[c]
C3 – Rollingwood	Sneath Lane and Cherry Avenue	San Andreas Pipelines	3 and 5	127	455	Regulated (RS27): 95[c] Unregulated: 141
C4 – Bayhill	West end of Bayhill Drive	San Andreas Pipelines	3	147	455	Regulated (RS26): 95[c]
C5 – Whitman	2001 Whitman Way	San Andreas Pipelines	1/4 and 2[d]	273	450	Unregulated: 76 Regulated (RS18, RS19): 35[c]
C6 - Crystal Springs	2901 Crystal Springs Road	Obtained via NCCWD Connection	13	411	600	Regulated (RS1): 55[c]

(a) Turnout elevations updated based on 2017 LiDAR data downloaded from San Mateo County.
(b) Turnout C1 is an emergency turnout for Tanforan Shopping Center.
(c) Turnout is regulated by a pressure reducing valve. Valve settings based on data provided by City staff on April 29, 2020.
(d) Turnout C5 serves Zone 1/4 via Tank 1 and also serves a small area of Zone 2 via an unregulated connection. Turnout C5 can serve the rest of Zone 2 and fill Tank 4 via a regulated connection through RS18 and RS19, however these pressure regulating stations are typically inactive.

The City's surface water supply turnouts are all monitored for flow and pressure using the City's Supervisory Control and Data Acquisition (SCADA) system. However, the turnouts cannot be controlled through the SCADA system, and operational adjustments to the turnouts must be made manually by field staff.

The City currently has three emergency connections with neighboring water purveyors. As shown on Figure 2-3, there are two emergency connections with NCCWD and one emergency connection with California Water Service Company's (Cal Water) South San Francisco District.

2.4.2 Groundwater Wells

The City currently has four active groundwater wells as shown on Figure 2-3. The current pumping capacity of the City's active wells is approximately 1,590 gallons per minute (gpm), or about 2.3 million gallons per day (mgd), based on average extraction rates for the 2016 through 2019 summer months. Each well is equipped with sodium hypochlorite and ammonium hydroxide feed equipment to provide disinfection and residual disinfectant. In addition, two of the wells, Forest Lane and Lions Field (Wells 16 and 20), are also equipped with filtration systems, which help reduce iron and manganese concentrations and adjust pH levels prior to distribution.

Well 15 is currently inactive, as shown on Figure 2-3. The City is in the process of designing and constructing a new well, Well 21, to replace Well 15. It is anticipated that Well 21 will be completed in 2022.

Table 2-4 presents a summary of the existing active groundwater well facilities with their key characteristics.

Table 2-4. Groundwater Wells

Well ID	Pressure Zone	Ground Surface Elevation, feet msl[a]	Year Built	Depth to Bottom of Casing, feet	Screened Interval, feet msl	Average Extraction Rate, gpm[b]
Well 16 - Forest Lane	1/4	45	1991	580	-295 to -555	480
Well 17 - Corporation Yard	1/4	15	1993	420	-290 to -505	340
Well 18 - Cypress	1/4	55	1995	480	-205 to -440	230
Well 20 - Lions Field	1/4	12	2002	640	-300 to -504	540
Well 21 – Acapella[c]	3	74	NA	545	-321 to -441	550

(a) Groundwater well elevations updated based on 2017 LiDAR data downloaded from San Mateo County.
(b) The average extraction rate represents the average pumping rate during summer months (June through September) for 2016 through 2019, based on available City well logs.
(c) Well 21 is anticipated to be completed in 2022. Well parameters are from design documents produced by EKI in January 2015.

Observations made during West Yost's site visit indicate that the City's groundwater well facilities are generally well maintained and are exercised regularly. The City maintains a regular well rehabilitation program, and rehabilitation of Well 17 was completed in July 2021. In normal and wet years, groundwater wells are used to supplement SFPUC supply in the summer months. City staff prefers to avoid intermittent operation of the groundwater wells to reduce mechanical issues during start-up. The City will typically operate one or two wells for at least a week at a time to avoid these start-up issues. Table 2-5 summarizes the key findings and recommendations from the groundwater well facility assessments performed on June 30, 2020.

Table 2-5. Summary of Groundwater Well Facility Assessments					
Well ID	Age, years	Treatment System	Pump Efficiency, percent[(a)]	Backup Power	Recommendation(s)
Well 15 - Commodore[(b)]	35	N/A	N/A	Quick Connect	--
Well 16 - Forest Lane	28	Iron and manganese removal and disinfection	64	Quick Connect	Add security fence.
Well 17 - Corporation Yard[(c)]	26	Disinfection	54	Emergency Generator	Currently being rehabilitated.
Well 18 - Cypress	24	Disinfection	55	Quick Connect	Monitor pump efficiency; replace if efficiency continues to decrease. Enclose well head.
Well 20 - Lions Field	17	Iron and manganese removal and disinfection	69	Auxiliary Engine	--

(a) Based on pump efficiency tests performed in April 2018, except for Well 18 which is from testing performed in March 2010.
(b) Well is inactive as of May 2010; pump and motor have been removed. West Yost did not visit this site.
(c) Well 17 is currently being rehabilitated and was not visited during West Yost's site visits.

The Well 18 wellhead is outdoors, and City staff would like to enclose it for improved security. Well 16 has a consistent graffiti issue; therefore, an evaluation of additional security measures at this site should be conducted. It is recommended that the City install video surveillance cameras and motion sensor lights as a deterrent. Additional potential improvements could include adding a perimeter security fence.

2.4.3 Water Storage Facilities

The City currently operates eight water storage tanks as shown on Figure 2-3. The City has a total storage capacity of approximately 8.3 million gallons (MG); however, the tanks are generally operated between 50 to 80 percent of their total storage capacity based on daily and seasonal conditions. With the exception of Tank 3, all tanks are constructed of welded-steel and rest on oiled sand bases with concrete retaining rings. Tank 3 is a strand-wrapped, pre-stressed, concrete tank.

Table 2-6 presents a summary of the existing tank facilities with their key characteristics.

Table 2-6. Storage Tank Facilities

Storage Tank ID	Pressure Zone	Ground Surface Elevation, feet msl(a)	Diameter, feet	Height, feet(b)	Capacity, MG(c)		
					Total	Typical Operational Minimum	Typical Operational Maximum
T1 - Cunningham Drive	1/4	228	116	32	2.5	1.25	2.0
T3 - Glenview Drive(d)	6	530	107	30	2.0	1.0	1.6
T4 - San Bruno Avenue	2	330	75	32	1.0	0.5	0.8
T6 - Lake Drive South	10	755	47	32	0.4	0.2	0.32
T6A - Lake Drive North	10	755	75	32	1.0	0.5	0.8
T7 - Sweeney Ridge	12	1,255	47	32	0.4	0.2	0.32
T9 - Skyline West	11	815	48	40	0.5	0.25	0.4
T10 - Skyline East	11	815	48	40	0.5	0.25	0.4
				Total Capacity	**8.3**	**4.15**	**6.64**

(a) Tank elevations updated based on 2017 LiDAR data downloaded from San Mateo County.
(b) Height measured to tank overflow.
(c) Based on discussion with City staff, tanks are typically operated between 50% and 80% of total capacity.
(d) From Tank No. 3 Glenview Replacement Project design drawings, West Yost Associates (July 2014).

Observations made during West Yost's site visit indicate that the City's storage facilities are generally well maintained and are used regularly to meet water system demands. In the past, Tanks 7, 9 and 10 have experienced nitrification issues due to low demand. As of late summer 2020, the City has installed PSI Water Technologies Monoclor RCS systems in Tanks 3, 4, 7, 9 and 10 to improve water quality. The Monoclor RCS system is a chloramine management system that provides constant and reliable chloramine residual to improve water quality within the distribution system. To date, the RCS systems have resolved the nitrification issues in these tanks. All tanks have PAX mixers installed.

As mentioned previously, except for Tank 3, all of the City's storage tanks are welded steel tanks. Generally, welded steel tanks have an indefinite service life with regular interior and exterior recoating. Nevertheless, welded steel tanks that are older than 30 to 40 years typically do not meet current building and seismic codes. Consequently, there is a high likelihood of tank failure during a seismic event in high-risk seismic areas. A visual observation of Tanks 4, 9 and 10 was conducted during site visits on June 30, 2020. Note that "as-built" drawings were not available, and an extensive structural evaluation was not conducted. Therefore, recommendations are based on visional observations and general age of the tanks.

The Tank 4 (San Bruno Avenue) exterior coating appears to be in good condition. The interior coating was not observed. However, the tank does not have an anchorage system and has no visible concrete footing. Furthermore, because of the age of the tank it likely that the tank does not meet current seismic code requirements.

Tanks 9 and 10 (Skyline West and East) were constructed in the 1960's, and similar to Tank 4, neither tank includes an anchorage system nor has a concrete footing. Furthermore, because of the age of the tank it is likely that the tank does not meet current seismic code requirements.

Since none of the three tanks are designed with ring beam concrete footing or any anchorage system, they are susceptible to damage or loss of use during or after moderate to high seismic activity. Consequently, it is recommended that all three tanks (Tanks 4, 9, and 10) be replaced. Refer to Appendix A for detailed findings from the steel tank structural condition assessment.

Table 2-7 summarizes the key findings and recommendations from the storage tank facility assessments performed on June 30, 2020. As shown in Table 2-7, Tank 7 is the City's oldest tank and is showing signs of deterioration and is scheduled to be replaced in 2021/22. Tank 1 is also scheduled to be replaced in a similar time frame as Tank 7. The planned Tank 1 replacement will have an increased total storage capacity of 3.5 MG. Although Tanks 6 and 6A were not included in West Yost's site visits, it is also recommended that these tanks be replaced based on discussions with City staff. Of the five tanks recommended for future replacement after the completion of the new Tanks 1 and 7, Tank 4 should be replaced first, as it is one of the oldest tanks and is centrally located in the system. Tanks 9 and 10 should be replaced next, followed by Tanks 6 and 6A.

Table 2-7. Summary of Storage Tank Facility Assessments

Storage Tank ID[a]	Age, years	Recommendation(s)			Comment(s)
		Regular Schedule for Interior and Exterior Coating	Flexible Connections for Inlet/Outlet Pipe[b]	Replace Tank	
T1 - Cunningham Drive	55	n/a	✓	✓	Scheduled to be replaced in 2021 with a 3.5 MG prestressed concrete tank.
T3 - Glenview Drive	4	n/a	--	--	Replaced in 2016.
T4 - San Bruno Avenue	57	✓	✓	✓	Highest priority for replacement
T6 - Lake Drive South	57	✓	--	✓	Lowest priority for replacement
T6A - Lake Drive North	49	✓	✓	✓	Lowest priority for replacement
T7 - Sweeney Ridge	64	n/a	✓	✓	Scheduled to be replaced in 2021/22 with a prestressed concrete tank.
T9 - Skyline West	49	✓	✓	✓	Medium priority for replacement
T10 - Skyline East	49	✓	✓	✓	Medium priority for replacement

(a) All tanks are constructed of welded steel except for Tank 3. Tank 3 is a pre-stressed concrete tank.

(b) Flexible connections to inlet/outlet pipes were previously recommended in the 2003 Seismic Vulnerability Study completed by G&E Engineering Systems Inc.

2.4.4 Booster Pump Stations

The City currently operates eight booster pump stations as shown on Figure 2-3. The booster pump stations transfer water from lower pressure zones to higher pressure zones in the City's distribution system.[5] Most of the booster pumps are vertical turbine, constant speed pumps, except Pump Station (PS) 4 and PS 6, which have horizontal, split-case centrifugal pumps. Pump number 1 at PS 5, pump numbers 1 and 2 at PS 6, and the pumps at PS 4 are equipped with variable speed drives. All of the City's other pumps are constant speed. The City operates the booster pump stations either manually or based on the water levels in the storage tanks. Each booster pump station is equipped with a chlorine residual analyzer.

Table 2-8 presents a summary of the existing booster pump stations with their key characteristics.

Table 2-8. Booster Pump Stations

Pump Station ID	Source Pressure Zone	Service Pressure Zone	Ground Surface Elevation, feet msl[(a)]	Number of Pumps	Nominal Pump Capacity, gpm[(b)]	Total Dynamic Head, feet	Horsepower
PS1 - Sneath Lane	5	10	295	3	570/750/750	345/500/500	75[(c)]/125/125
PS2 - Lake Drive	10	12	753	2	600	580	100
PS3 - Whitman Way	2	6	330	2	300	100	30
PS4 - Pacific Heights/ College[(d)]	10	11	567	2	1,000	252	125
PS5 - Maple Avenue[(e)]	1	2	99	3	550	177	40
PS6 - Corporation Yard	--	1/4	10	3	500/500/[(f)]	277/277/[(f)]	50/50/60
PS7 - San Bruno Avenue[(g)]	2	6	340	2	700	269	60
PS8 - Glenview Drive[(h)]	6	10	530	2	700[(c)]	269	60

(a) Pump station elevations updated based on 2017 LiDAR data downloaded from San Mateo County.
(b) Data presented that are separated by a slash (e.g., 570/750) indicate the individual characteristics of different pumps within the pump station. Nominal pump capacity is as listed on pumps, actual capacity may be less due to wear.
(c) Updated based on notes taken during pump efficiency tests performed in April 2018.
(d) From pump curves and record drawings provided by the City in June 2017.
(e) From pump curves and record drawings provided by the City in November 2020 and April 2019, respectively.
(f) Nameplate was painted over; illegible. Pump is inactive and not connected to the clearwell.
(g) Equipped with a diesel 75 horsepower auxiliary pump.
(h) Equipped with two 5 horsepower pumps (inactive) and one diesel 75 horsepower auxiliary pump.

Observations made during West Yost's site visit indicate that the City's booster pump station facilities are generally well maintained and are used regularly to meet water system demands. Table 2-9 summarizes the key findings and recommendations from the booster pump station facility assessments performed on June 30, 2020.

[5] PS 6 pumps from the Well 17 treatment system to Zone 1/4.

Table 2-9. Summary of Booster Pump Station Facility Assessments

Pump Station ID	Pump Efficiency, %[a]	Backup Power[b]	Recommendation(s)			Comment(s)
			SCADA Flow Monitoring	Replace MCC[c]	Flexible Connections for Suction/Discharge Pipe[c]	
PS1 – Sneath Lane	60/68/77	Quick Connect	✓	✓		Potential electrical usage cost saving if Pump 1A rehabbed. Monitor pump efficiency; replace if efficiency continues to decrease. Station rehab project currently being designed.
PS2 – Lake Drive	61/78	Quick Connect with Portable Generator On-Site	✓	✓	✓	Monitor pump efficiency; replace if efficiency continues to decrease. Station rehab project currently being designed.
PS3 – Whitman Way	31/39	Quick Connect	✓	✓	✓	Pump efficiencies are low; replace pumps.
PS4 – Pacific Heights/College	62/57	Emergency Generator and Portable Generator On-Site				Pump efficiencies improved with pump replacement in 2014.
PS5 – Maple Avenue	63/59/59	Emergency Generator				Potential electrical usage cost saving if Pumps 2 and 3 rehabbed. Though efficiencies have improved still low. Recommend detailed pump evaluation.
PS6 – Corporation Yard	47/57	Emergency Generator	✓	✓		Potential electrical usage cost saving if Pump 1 rehabbed. Monitor pump efficiency; replace if efficiency continues to decrease.
PS7 – San Bruno Avenue	65/73	Emergency Pump	✓			Efficiency is acceptable.
PS8 – Glenview Drive	70/72	Emergency Pump	✓			Efficiency is acceptable.

(a) Based on pump efficiency tests performed in April 2018. Data presented that are separated by a slash indicate the individual characteristics of different pumps within the pump station.
(b) From list of diesel generators provided by City staff in April 2020.
(c) Recommendations from site assessments performed in May 2011 for the 2012 Water System Master Plan.

West Yost recommends that the PS 3 pumps be replaced, and that the pumps at PS 1, PS 2, and PS 6 be replaced if their efficiency continues to decrease. The pumps at PS 5 were replaced in 2009 but have unusually low efficiencies for relatively new pumps. It is recommended that a detailed study including spectral analysis be performed on the PS 5 pumps to identify the cause of the poor efficiencies. Other recommended pump station improvements include the addition of SCADA flow monitoring at all stations and the replacement of motor control centers (MCCs) at PS 1, PS 2, PS 3, and PS 6.

In addition to the specific pump projects discussed above, West Yost recommends that the City establish a program for regular replacement of booster pumps as they age and deteriorate.

2.4.5 Pressure Regulating Stations

The City's water distribution system currently includes 31 pressure regulating stations (RS) as shown on Figure 2-3. Typically, each pressure regulating station is equipped with pressure reducing valves that regulate the water from higher-pressure zones into lower-pressure zones, keeping the system pressure from exceeding practical limits.

Table 2-10 presents a summary of the existing pressure regulating stations with their key characteristics.

Table 2-10. Pressure Regulating Stations[a]

Station ID	Location	Function	Elevation, feet[b]	Size	Pressure Setting, psi	Status
RS1	2901 Crystal Springs Road	Reduces pressure from NCCWD Turnout C6 to Zone 13	410	6”	55	Active
RS2	Lake Street Upper Vault (PS 2)	Reduces pressure from Tank 7 to Zone 12	789	6” / 2” 2" relief	59[c] / 70 80	Active
RS3	Lake Street Lower Vault (PS 2)	Emergency bypass from Tanks 6 and 6A to Zone 12	751	4” / 2” 4” relief	90 / 96 113	Inactive
RS4	2401 Oakmont	Reduces pressure from Zone 10 to Zone 9	476	6” / 2” 2” relief	45 / 50 113	Active
RS5	2600 Chabot Drive	Reduces pressure from Zone 10 to residences 2110 thru 2220 Oakmont Dr. and Monte Verde Park (Zone 9A)	497	6” / 2”	85 / 90	Active
RS6	1581 Greenwood Way	Reduces pressure from Zone 10 to Zone 8	545	8”[c] / 4” 2” relief	19 / 24[c] 20	Active
RS7 West	2850 Sneath Lane	Reduces pressure from Zone 10 to Zone 6	440	8"[c] / 4"[c]	30[d] / 45[c]	Active
RS7 East	2500 Sneath Lane	Reduces pressure from Zone 10 to Zone 6	420	8"[c] / 4"[c]	37[d] / 52[c]	Active
RS8	Sneath and Stanislaus	Reduces pressure from Zone 12 to Zone 10	627	6” / 2” 2” relief	50 / 55 65	Inactive[c]
RS9	760 Glenview Drive (PS 8)	Reduces pressure from Pump Station 8 (Zone 10) to Zone 7	536	8” / 2”	48[d] / 53[d]	Active
RS10	760 Glenview Drive (PS 8)	Reduces pressure from Zone 10 to Zone 6	529	8” / 2”	7 / 12	Inactive
RS11	2581 Bennington	Reduces pressure from Zone 7 to Zone 6	443	4” 2.5” bypass	--	Inactive
RS12	591 Madison	Reduces pressure from Zone 6 to Zone 2	269	4” 2.5” bypass	83	Inactive
RS13	190 Piedmont	Reduces pressure from Zone 7 to former Crestmoor High School (Zone 7A)	467	4” / 2”	65 / 72	Active
RS14	110 Livingston Terrace	Reduces pressure from Zone 6 and Zone 2	258	6” (two way)	43	Inactive[c]
RS15A	Rollingwood Pump Station	Reduces pressure from Zone 8 to residences 2130 to 2280 Rollingwood Dr, 2200 to 2290 Fleetwood Dr, 2305 to 2371 Catalpa Way (Zone 8A)	343	2” / 2”	45 / 50	Active
RS15B	Rollingwood Pump Station	Reduces pressure from Zone 8 to Zone 5	343	4” / 2”	46/51	Inactive [c]
RS16	Tank 1 (Cunningham Way)	Tank 1 bypass to Zone 1/4	225	6”	10	Standby
RS16A	Tank 1 (Cunningham Way)	Supplemental supply from SFPUC to Tank 1, also used for emergency Tank 1 bypass	226	8” (altitude valve)	--	Active
RS17	2175 Crestmoor Drive	Reduces pressure from Zone 6 to houses on Crestmoor Drive and Livingston Terrace (Zone 6A)	355	4” / 2”	50 / 55	Active
RS 18	2081 Whitman Way	Supplemental supply from SFPUC Turnout C5 to Zone 2 and Tank 4	252	2”	35	Inactive[c]
RS 19	2081 Whitman Way	Supplemental supply from SFPUC Turnout C5 to Zone 2 and Tank 4	252	2”	35	Inactive[c]
RS20	Huntington Avenue and I-380	Reduces pressure from Zone 4 to Zone 1 or from Zone 1 to Zone 4 (two way)	33	6" (Z1 to Z4) 6" (Z4 to Z1)	91 96	Active Standby
RS21	Sneath and National	Reduces pressure from SFPUC Turnout C1 to Zone 1/4	76	10” / 4” 2” relief	62 / 67 72	Active
RS22	855 El Camino Real	Reduces pressure from Zone 3 to Zone 1/4 or from Zone 1/4 to Zone 3 (two way)[e]	35	4" / 4"[c] PSV/PRV	95 (PRV) 114 (PSV)	Active
RS23	Peninsula Place (1125 Cherry)	Supplies water when normal water meter is out of service	98	6”	92	Standby
RS24	Tank 4 (San Bruno Avenue)	Tank 4 bypass to Zone 2	337	6” / 2”	5 / 10	Inactive
RS25	Elm and San Bruno Avenue	Reduces pressure from Zone 3 to Zone 1/4 or from Zone 1/4 to Zone 3 (two way)	77	4" / 4"[c]	92	Inactive[c]
RS26	Bayhill	Reduces pressure from SFPUC Turnout C4 to Zone 3	136	8" / 4" 3" relief	86[d] / 95 100	Active
RS27	Cherry and Sneath Lane	Reduces pressure from SFPUC Turnout C3 to Zone 3	119	8" / 4" 3" relief	86[d] / 95 100	Active
RS28	Cedarwood Court	Reduces pressure from Zone 3 to Zone 2 or from Zone 2 to Zone 3 (two way)	122	8" (Z3 to Z2) 4" (Z2 to Z3) 3" relief	80[c] 40[c] unknown	Active

(a) Source: *RS table.xls* received from City on April 29, 2020.

(b) RS elevation based on drawings where available (RS7 East, RS7 West, RS26, RS27, and RS28). Where drawings were not available, RS elevation was estimated based on 2017 LiDAR data downloaded from an Mateo County and depth to valve measurements taken by City staff in the field (RS elevation = LiDAR elevation - depth to valve).

(c) Based on correspondence with City staff.

(d) Adjusted based on City's SCADA data for September 18, 2020.

(e) Currently both valves supply Zone 1/4 from Zone 3. To reverse direction of station, City staff can manually unbolt valves and turn them to face the opposite direction.

Active = setting allows water to flow through valve under typical water system operations

Standby = setting does not allow water to flow through valve under typical water system operations. Valve may open automatically under emergency operations.

Inactive = reducing station is manually shut off by closed valves.

2.4.6 Distribution System Pipelines

There are approximately 116 miles of water main in the City's water service area that range in size from 2 to 18-inches in diameter. Most of the pipelines within the City's service area are made of cast iron (CI) asbestos cement (AC), or Galvanized Steel (GS). Most of the existing 2-inch diameter pipelines are made of galvanized steel. New pipeline installed after 2000 is generally polyvinyl chloride (PVC) or ductile iron (DI). The City standards specify DI pipe for new water mains.

Table 2-11 provides a summary of total pipeline length by diameter within the City's water service area, and Figure 2-3 illustrates the layout of the City's water distribution pipeline system.

Table 2-11. Pipeline Lengths by Diameter[(a)]

Pipeline Diameter, in.	Length of Pipelines, feet	Percent in Water System
2	110,028	18.0
3	141	0.02
4	81,476	13.3
6	178,975	29.3
8	153,469	25.1
10	35,065	5.7
12	36,656	6.0
14	15,057	2.5
16	98	0.02
18	285	0.05
Total	**611,250**	**100%**

(a) Data based on updated GIS data provided by Lynx Technologies on June 17, 2020. Data was modified to exclude invalid pipeline diameters, inactive pipelines, and service laterals. Includes data for some pipelines included in the City's existing hydraulic model which are not included in the GIS data, but which have been confirmed by the City.

Historically, some City pipelines have failed as a result of pipeline corrosion. Cathodic protection will be incorporated into the water distribution system as new pipelines are installed by the City's rehabilitation and replacement program.

2.4.7 SCADA System

The City's SCADA system was installed in 2001 based on recommendations from the City's 2001 Water System Master Plan. Installation of the current SCADA system has significantly improved system operations and provides Operations staff the ability to remotely monitor and control the City's water system. The City has installed a radio transmitter and remote terminal units (RTUs) at each station to provide reliable communications with each station during an emergency.

As recommended in the City's Risk and Resilience Assessment Report, the City should develop a SCADA Master Plan and Cybersecurity Improvements Plan. These plans would include a baseline assessment of the City's existing SCADA and Business Enterprise system. Based on the outcome of this assessment, alternatives would be analyzed and recommendations for improvements would be developed. Implementation of these plans and subsequent improvements would ensure that the City's SCADA system is well maintained and would increase resiliency against cybersecurity threats to the water system.

CHAPTER 3
Water Demands

This chapter provides an overview of the City's water service area and describes the City's historical annual water use. Subsequent sections of this chapter examine water conservation, and historic peak water use. Finally, this chapter describes the data and methodology used to determine future water demand projections. The key sections of this chapter are:

- Service Area Description
- Historical Annual Water Use
- Water Conservation
- Peak Water Use
- Demand Projections

Future water demands developed in this chapter were allocated to the hydraulic model to evaluate system performance for 2040 demand conditions, discussed in Chapter 7 – Evaluation of Existing Water System.

3.1 SERVICE AREA DESCRIPTION

This section summarizes the City's service area, population and service connections.

3.1.1 Service Area Overview

The City's water service area, which is about 5.4 square miles, is generally concurrent with the city limits. The City is located in San Mateo County, south of the City of South San Francisco, north of the City of Millbrae, and just west of the San Francisco International Airport. The City is primarily an urban residential community with low density residential land uses in the west hillside area and higher density residential, commercial, and institutional land uses in the east.

3.1.2 Historical Population

The City provides water service to customers located within the service area. The historical City population estimates from 1990 to 2020 are shown in Table 3-1. As shown in Table 3-1, the population has increased since 1990, with a significant increase in population between 2005 and 2015. It appears that the population in the City has stabilized between 2015 and 2020 due to a lack of available land for development. Therefore, any future increase in population will primarily be from re-development and densification.

Table 3-1. Historical City Population[(a)]	
Year	City Population
1990	38,900
2000	40,165
2005	39,655
2010	41,114
2015	45,217
2020	45,257
(a) From Report E-4. Population and Housing Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Benchmark obtained from the State of California, Department of Finance on May 14, 2020.	

3.1.3 Number of Service Connections

The City currently has 11,902 metered service connections. A breakdown of the number of connections by customer sector is provided in Table 3-2. A majority of the water system customers are single family residential users, accounting for approximately 85 percent of all service connections.

Table 3-2. Number of Service Connections by Customer Sector in 2019[(a)]		
Customer Sector	Number of Connections	Percent of Total Connections
Single Family Residential	10,104	84.9
Multi-Family Residential	1,085	9.1
Non-Residential	713	6.0
Total	**11,902**	**100%**
(a) From 2019 City metered water consumption data.		

3.2 HISTORICAL ANNUAL WATER USE

This section summarizes the City's historical water consumption, non-revenue water and per capita water use.

3.2.1 Historical Annual Water Consumption

Table 3-3 summarizes historical annual water consumption by calendar year, from 2011 to 2020. Total consumption was relatively stable from 2011 to 2013, with an average annual consumption of 3.3 mgd. Water consumption decreased from 2014 to 2016, in response to the drought and state mandated conservation efforts. Demands have increased in all years since 2016. In 2020 residential demands were higher than typical and commercial demands were lower than typical due to the COVID-19 pandemic, which resulted in many people working from home and limited commercial and office activity.

Table 3-3. Historical Annual Water Consumption by Calendar Year, mgd[a,b]

Customer Sector	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Residential	2.43	2.49	2.48	2.23	2.14	1.99	2.06	2.11	2.10	2.20
Commercial	0.64	0.72	0.72	0.65	0.62	0.52	0.55	0.54	0.57	0.48
Government[c]	0.15	0.16	0.16	0.13	0.13	0.13	0.13	0.15	0.17	0.18
Total Water Use	**3.21**	**3.37**	**3.37**	**3.01**	**2.89**	**2.64**	**2.74**	**2.80**	**2.84**	**2.86**
Percent Residential	76	74	74	74	74	75	75	75	74	77
Percent Non-Residential	24	26	26	26	26	25	25	25	26	23

(a) Does not include non-revenue water.
(b) Source: Spreadsheets provided by the City Water Division.
(c) Includes water used for city parks and facilities. For years 2011 to 2013, "miscellaneous" use data is assumed to represent government use.

Table 3-4 shows the historical average annual water consumption by customer sector for the 10-year period and the percentage water use by customer sector. As shown in the table, residential water consumption averages 75 percent of total consumption, commercial water consumption averages 20 percent of total consumption, and City facility and irrigation consumption averages 5 percent of total consumption.

Table 3-4. Historical Average Annual Water Consumption by Customer Sector[a]

Customer Sector	Annual Average Consumption, mgd[b]	Percent of Total
Residential	2.22	74.8
Commercial	0.60	20.3
Government[c]	0.15	5.0
Total Water Use	**2.97**	**100%**

(a) Does not include non-revenue water.
(b) Average computed based on data from 2011 through 2020.
(c) Includes water used for city parks and facilities. For years 2011 to 2013, "miscellaneous" use data is assumed to represent government use.

3.2.2 Non-Revenue Water

Non-revenue water is the difference between the quantity of water purchased/produced and the quantity of water consumed. Non-revenue water typically includes water used for incidental purposes, such as hydrant testing, fire-fighting, water main flushing, and construction water, and also includes other unintended uses or sources of error, such as system leaks, water main breaks, and meter measurement error.

Table 3-5 summarizes the City's annual water production, water consumption, and non-revenue water. In the last 10 years, non-revenue water has ranged from 5.2 percent to 10.9 percent, with an average of 8.0 percent. Therefore, this Water System Master Plan uses a non-revenue water factor of 8.0 percent.

Table 3-5. Non-Revenue Water[(a)]

Year	Water Production, mgd	Water Consumption, mgd	Non-Revenue Water, mgd	Percent of Total
2011	3.58	3.21	0.37	10.3
2012	3.55	3.37	0.18	5.2
2013	3.67	3.37	0.31	8.3
2014	3.31	3.01	0.30	9.1
2015	3.06	2.89	0.17	5.7
2016	2.96	2.64	0.32	10.9
2017	3.04	2.74	0.29	9.7
2018	2.99	2.80	0.19	6.4
2019	3.03	2.84	0.19	6.1
2020	3.12	2.86	0.26	8.3
			Average Over Period	**8.0%**
			Average in Past Five-Years	**8.3%**

(a) Source: Spreadsheets provided by the City Water Division.

3.2.3 Per Capita Water Use

Table 3-6 and Figure 3-1 show population and water production trends, and the computed per capita water use. Per capita water use decreased from 95 to 69 gallons per capita per day (gpcd) during the period from 2005 through 2020. The average per capita use over the past five years is 67 gpcd. Between 2008 and 2015, Figure 3-1 shows an overall decreasing trend for both per capita water use and production, and an increasing trend for population. After 2015, per capita water use, production, and population appear to have stabilized.

Table 3-6. Per Capita Water Use, 2005 through 2020

Year	Water Production, mgd	Population[(a)]	Per Capita Water Demand, gpcd
2005	3.78	39,655	95
2006	3.68	39,474	93
2007	3.74	39,592	95
2008	3.95	40,773	97
2009	3.81	40,993	93
2010	3.64	41,144	88
2011	3.58	41,922	85
2012	3.55	42,931	83
2013	3.67	43,742	84
2014	3.31	44,023	75
2015	3.06	45,217	68
2016	2.96	45,494	65
2017	3.04	45,540	67
2018	2.99	45,558	66
2019	3.03	45,542	66
2020	3.12	45,257	69

(a) From Report E-4. Population and Housing Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Benchmark obtained from the State of California, Department of Finance on May 14, 2020.

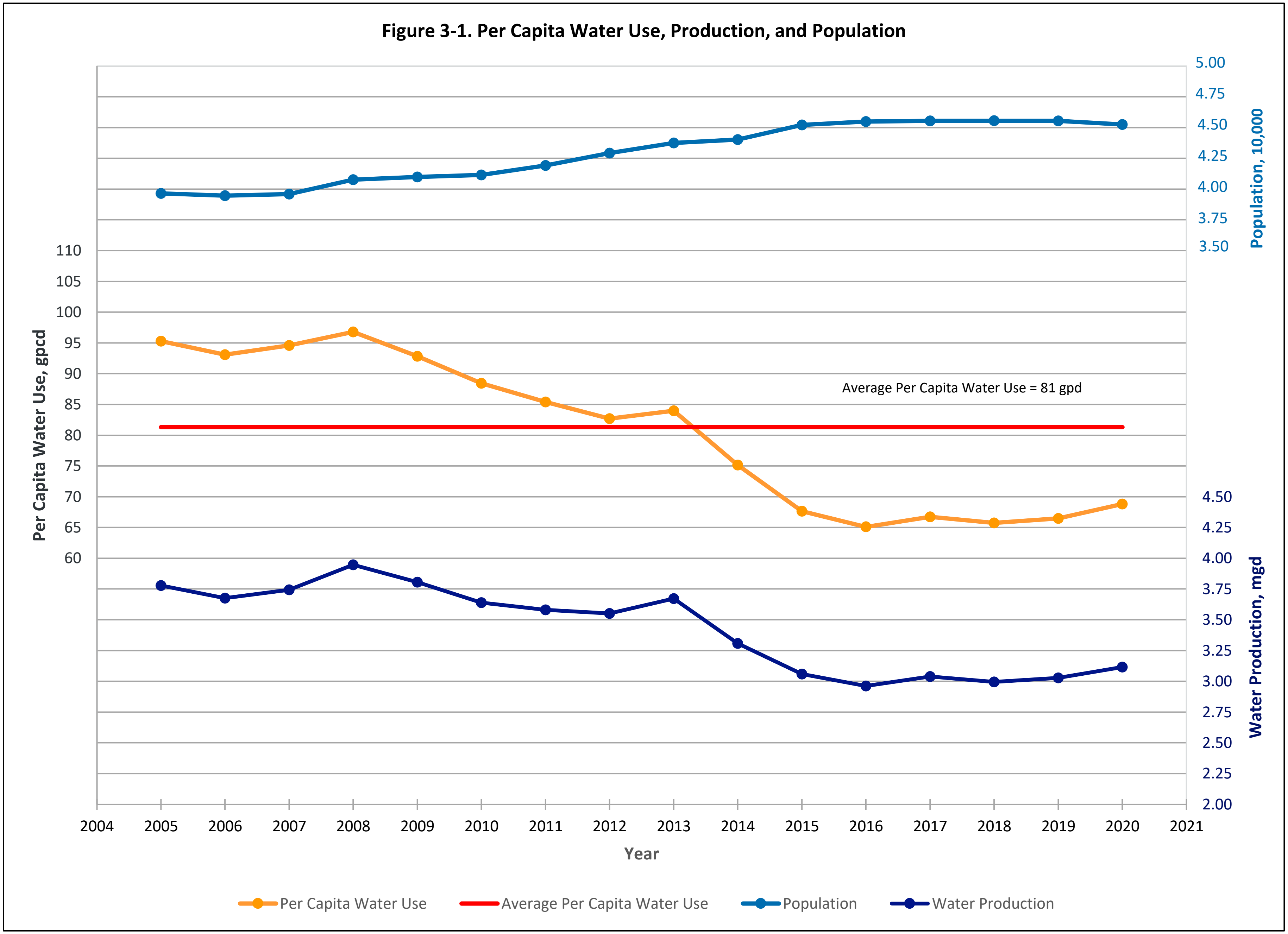


Figure 3-1. Per Capita Water Use, Production, and Population
Per Capita Water Use, gpcd
110
105
100
95
90
85
80
75
70
65
60
Population, 10,000
5.00
4.75
4.50
4.25
4.00
3.75
3.50
Water Production, mgd
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
Average Per Capita Water Use = 81 gpd
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year
Per Capita Water Use
Average Per Capita Water Use
Population
Water Production

3.3 WATER CONSERVATION

This section summarizes the existing water conservation programs and the City's water conservation targets required to comply with Senate Bill x7-7, (*e.g.*, 20x2020 Legislation or SB 7), SB 606, and AB 1668.

3.3.1 Existing Water Conservation

The City has been and continues to be a strong promoter of water conservation programs that improve water supply reliability and environmental benefits to the community. City residents have responded positively to these programs, resulting in savings exceeding water use reduction goals. City Demand Management Measures (DMMs) include water waste prevention ordinances, metering of all water customers, tiered conservation pricing for single family residences, public education and outreach, and distribution system loss management programs. Further details can be found in the City's 2020 UWMP.

3.3.2 Compliance with 20 x 2020 Legislation

In February 2008, Governor Arnold Schwarzenegger called for a statewide 20 percent reduction in per capita water use by 2020, and asked state and local agencies to develop a more aggressive plan of water conservation to achieve the goal. A team of state and federal agencies (the 20x2020 Agency Team) consisting of the California Department of Water Resources (DWR), SWRCB, California Energy Commission, Public Utilities Commission, Department of Public Health, Air Resources Board, CALFED Program, U.S. Bureau of Reclamation (USBR), and the California Urban Water Conservation Council was formed to develop a statewide implementation plan for achieving this goal.

On November 10, 2009, Governor Arnold Schwarzenegger signed SB 7, one of several bills passed as part of a comprehensive set of new Delta and water policy legislation. SB 7 requires a 20 percent reduction in urban water usage by 2020 and establishes various methodologies for urban water suppliers to establish their interim (2015) and final (2020) per capita water use targets.

Per the City's 2020 UWMP, the City's adopted per capita water use targets for 2015 (interim) and 2020 (final) are both 124 gpcd. As shown in Table 3-6, the City's per capita water use in 2015 was 68 gpcd, and the City's per capita water use in 2020 was 69 gpcd, which were well below the 2015 interim and 2020 final targets, respectively.

3.3.3 Making Water Conservation a California Way of Life

In May 2016, Governor Jerry Brown signed Executive Order B-37-16, instructing State agencies to help Californians adopt permanent changes to use water more wisely. The Executive Order laid out a framework for moving the State from temporary, emergency water conservation measures to a more lasting approach customized to the unique conditions of each local water agency.

In May 2018, the California State Legislature (Legislature) enacted two policy bills (Senate Bill (SB) 606 and Assembly Bill (AB) 1668) to establish a new foundation for long-term improvements in water conservation and drought planning to adapt to climate change and the resulting longer and more intense droughts in California. These two bills amended existing law to expand authorities and requirements to enable permanent changes and actions for those purposes to improve the State's water future for generations to come. SB 606 and AB 1668 are direct outcomes of Governor Brown's Executive Order B-37-16.

The recommendations in the April 2017 report entitled "Making Water Conservation a California Way of Life, Implementing Executive Order B-37-16" and subsequent extensive legislative outreach efforts informed the development of SB 606 and AB 1668. The new laws focus on establishing water use objectives and long-term water efficiency standards that apply to urban retail water suppliers, including:

- **Indoor Residential Water Use**: Although not all standards have been developed, the indoor residential water use efficiency standard has been set by the Legislature. Until January 1, 2025, the standard is set at 55 gpcd, then it drops to the greater of 52.5 gpcd or a standard developed by the DWR between January 2, 2025 and January 1, 2030; and then the greater of 50 gpcd or a standard developed by DWR after January 1, 2030.
- **Outdoor Residential Water Use and Commercial, Industrial and Institutional (CII) Irrigation with Dedicated Meters**: Per SB 606 and AB 1668, the SWRCB is required to adopt long-term standards for outdoor irrigation of landscape areas by June 30, 2022. The standards to be set shall incorporate the principles of the State's Model Water Efficient Landscape Ordinance (MWELO)[1], which considers evapotranspiration adjustment factors, landscape areas, maximum applied water allowance, reference evapotranspiration, and special landscape area.
- **Water Loss (due to leaks in water system pipes):** With regard to water loss standards, SB 555, passed in October 2015, requires the SWRCB to develop water loss performance standards for urban retail water suppliers. At the time of preparation of the WSMP, the SWRCB is in the process of adopting water loss standards. The SWRCB is required to evaluate the life-cycle cost of achieving these standards. The standards will incorporate local and operational conditions to determine economically achievable water loss reduction for each urban retail water supplier.

The water efficiency legislation only provides a "provisional standard" for indoor residential water use and does not currently provide specific information on what the water efficiency standards will be for outdoor residential water use and non-residential water uses. These standards will be developed in the coming years and should be further evaluated in subsequent planning studies. Also, there are no guarantees that urban retail water suppliers will meet the water efficiency standards to be set, so West Yost recommends that the City continue to consider more conservative water demand projections based on recent water use for their future water supply and system planning.

3.4 PEAK WATER USE

Water system facilities are generally sized for peak demand periods. The peaking conditions of most concern for water facility sizing are maximum day demand concurrent with fire flows and peak hour demand. Peak water use is typically expressed as a ratio, or peaking factor, dividing the peak water use by the average daily water use. These peaking factors are then used to project maximum day and peak hour water use for future conditions.

[1] California Code of Regulations Title 23 Chapter 2.7 Model Water Efficient Landscape Ordinance.

3.4.1 Maximum Day Water Use

The maximum day peaking factor relates the maximum day average daily demand to the annual average day system demand (*i.e.*, annual use divided by 365 days). Table 3-7 presents the City's maximum day peaking factors for 2016 through 2019. The maximum day peaking factor for this period ranges from 1.62 to 1.76, with an average factor of 1.68.

Table 3-7. Maximum Day Demand, 2016 through 2019

Year	Average Day Demand, mgd[(a)]	Maximum Day Demand, mgd[(b)]	Maximum Day Peaking Factor
2016	2.96	4.84	1.64
2017	3.04	5.14	1.69
2018	2.99	5.27	1.76
2019	3.03	4.90	1.62
Average Maximum Day Peaking Factor			**1.68**

(a) From Table 3-5, water production.
(b) Based on daily turnout production data from SFPUC EyeOnWater portal and the City's daily groundwater well logs.

A maximum day peaking factor of 1.5 times the annual average day system demand was used previously in the City's 2012 Water System Master Plan (2012 WSMP). As discussed in the 2012 WSMP, this factor was based on data from nearby agencies, as City-specific data was not available. West Yost recommends that the City's adopted maximum day peaking factor be increased to 1.75 based on the historical data presented in Table 3-7. Because this increased peaking factor is based on City-specific data, it should provide a more accurate estimate of the maximum day water use in the City than the previously adopted peaking factor.

3.4.2 Peak Hour Water Use

A peak hour peaking factor of 3.0 times the annual average day system demand, or 2.0 times the maximum day demand, was used previously in the City's 2012 WSMP. As discussed in the 2012 WSMP, this factor was not developed based on actual data, and was a conservative estimate of what the peak hour demand would be for the City. Until additional data can be collected to determine a more accurate peak hour peaking factor for the City, West Yost recommends that this peak hour peaking factor be increased to 3.5 times the annual average day system demand to reflect the recommended increase in the maximum day peaking factor. This increased peak hour peaking factor will be equivalent to 2.0 times the maximum day demand, which is consistent with the 2012 WSMP.

3.4.3 Summary of Peaking Factors Used in Master Plan Analysis

Table 3-8 summarizes the maximum day and peak hour peaking factors that will be used for this Water System Master Plan.

Table 3-8. Adopted Peaking Factors

Demand Condition	Peaking Factor
Maximum Day Demand	1.75 times average daily demand
Peak Hour Demand	3.5 times average daily demand

3.5 DEMAND PROJECTIONS

This section presents the demand projection methodology to estimate future potable water demands within the City's water service area and presents the demand projections through the 2040-time frame. Projected development by 2040 will be referred to as "buildout" in this Water System Master Plan.

The buildout demand projections used for this Water System Master Plan incorporate water use estimates developed for the Water Supply Assessment for the Transit Corridors Plan (Transit Corridors Plan WSA) (EKI, 2011). Demand projections in the Transit Corridors Plan WSA use a methodology that was adopted by the Bay Area Water Supply and Conservation Agency (BAWSCA) for all their member agencies for use in the Water Conservation Implementation Plan (Maddaus Water Management, 2009). This methodology is based on the Demand Side Management Least Cost Planning DSS model, developed by Maddaus Water Management, which uses population and employment data to develop a 30-year demand forecast. The DSS model is calibrated to a baseline year, and then future water demands are forecasted based on estimated growth in water service accounts, which are derived from the population and employment data.

However, for this Water System Master Plan, future demand projections must be correlated with land use information so that water use projections account not only for the quantity of new water use, but also where it will occur. Therefore, West Yost worked with the City's Planning Division to identify future growth areas within the City, and developed unit water use factors to estimate the water use in each of these growth areas.

3.5.1 Existing and Future Land Use

Land use planning information is used to develop estimates of where future development will occur and at what densities. This information is used along with unit water use factors to develop projections of future water demands for the City. West Yost worked with the City's Planning Division to identify locations of specific planned developments, consistent with the City's General Plan and Transit Corridors Plan. Land use planning information used for the analysis was developed from the Transit Corridors Plan WSA, previous hydraulic evaluations of development projects, and other documents provided by the Planning Division. Information from these planning documents is summarized in this section.

3.5.1.1 Existing Land Use

Existing land uses are largely segregated, with commercial uses concentrated in the downtown area, along El Camino Real, San Mateo Avenue and San Bruno Avenue, and in several regional and neighborhood shopping centers. Residential neighborhoods include smaller, mixed-density residences east of El Camino Real, and larger hillside homes in the hills on the west side of the City. The majority of the City's land area consists of residential use (52 percent); remaining uses include various commercial, industrial and institutional land uses (28 percent), Parks/Open Space (13 percent), and Other (7 percent).[2] Figure 3-2 shows the City's Existing Land Use map.

3.5.1.2 Future Land Use

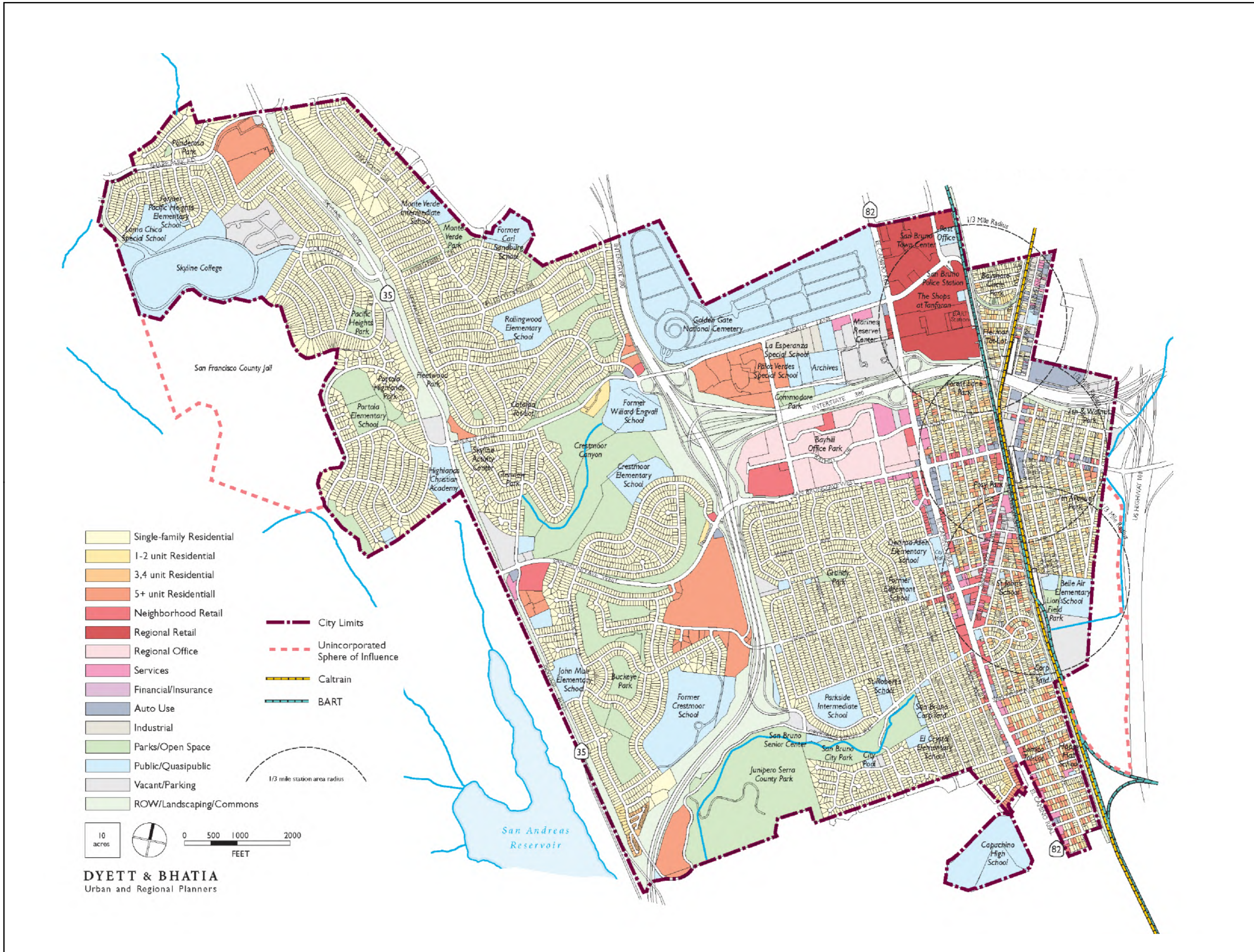
The City of San Bruno General Plan, adopted by the San Bruno City Council on March 24, 2009, contains the land use plan and policies within the City's incorporated limit and the City's Sphere of Influence (SOI). On February 12, 2013, the City Council adopted the Transit Corridors Area Specific Plan. The purpose of the plan, which complements the General Plan, is to provide more specific guidance on the development of the area along El Camino Real, San Bruno Avenue, San Mateo Avenue and Huntington Avenue in the core of the City where major transit connections already exist, and additional transit connections are planned. Buildout of the General Plan was initially established in 2025, and the Transit Corridors Plan extended the estimated buildout date to 2030. The City adopted the Bayhill Specific Plan on October 12, 2021. The Bayhill Specific Plan provides guidelines for the re-development of a cluster of large office buildings surrounding Bayhill Drive, including the YouTube campus. The anticipated changes in land use driven by the Bayhill Specific Plan are incorporated into future demand projections. Figure 3-3 shows the City's General Plan Land Use map, including the Transit Corridors Plan and Bayhill Specific Plan areas.

West Yost met with the City's Planning Division staff to review identified projects and potential development areas for new developments consistent with the General Plan, the Transit Corridors Plan and the Bayhill Specific Plan. These projects and areas are summarized in Table 3-9 and are shown on Figure 3-4.

The City's Planning Division also noted a significant increase in applications for Accessory Dwelling Units (ADUs), between 2010 to 2020. An ADU is defined as an attached or detached residential dwelling unit built on the same parcel as an existing primary single-family dwelling, which provides complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

Based on the observed trend in ADU applications, City staff estimate that there will be approximately 25 constructed in the City each year for the foreseeable future. Therefore, between 2020 and 2040, it is projected that 500 additional ADUs will be constructed. However, because ADUs are small and house few people, the additional water demands from these ADUs are not expected to have a significant impact on the City's buildout water demand. In addition, the locations of these additional ADUs are not currently identified.

[2] Existing land use breakdown is approximate and assumes that re-development since the 2012 WSMP has not significantly changed the City's land use composition.



Notes:

1. Source: San Bruno 2025: General Plan, Final Environmental Impact Report, December 2008.

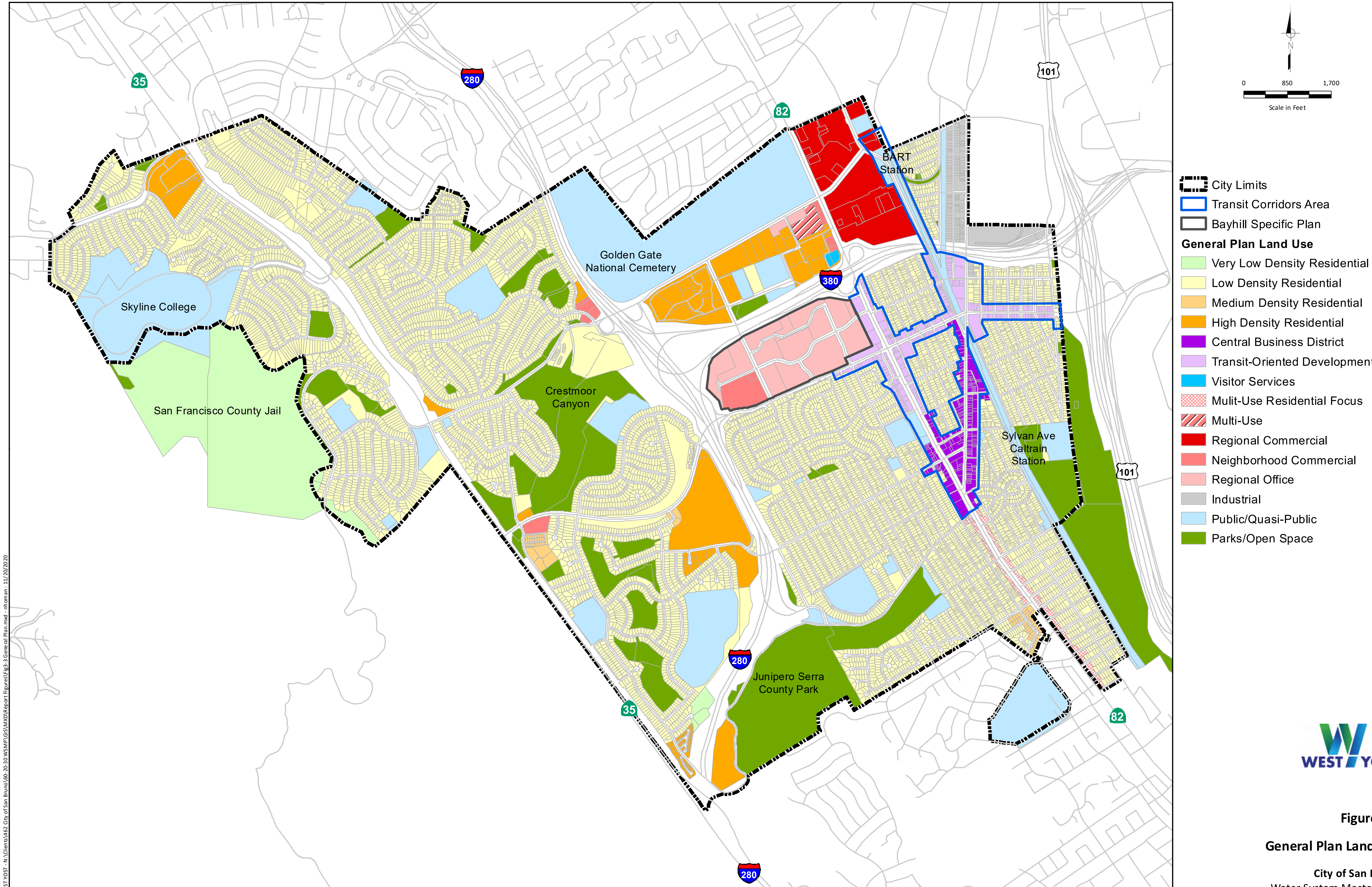
WEST YOST

Figure 3-2

Existing Land Use

City of San Bruno

Water System Master Plan



WEST YOST - N:\Clients\462 City of San Bruno\60-20-30 WSMP\GIS\MXD\Report Figures\Fig3-3 General Plan.mxd - nhoman - 11/20/2020

WEST YOST

Figure 3-3

General Plan Land Use

City of San Bruno
Water System Master Plan

Table 3-9. Summary of Identified Development Projects[a]

Project Name	Proposed Land Use	Quantity of: Dwelling Units (Residential), Students (School), or Square Footage (Commercial)	Units	Project Information
Transit Corridors Plan				
500 Sylvan Avenue	Multi-Family Residential	9	DU	Three-story residential building. Building permits are in review.
Mills Park (601-611, 643-799 El Camino Real, 701-751 Camino Plaza, 711-777 Kains Avenue)	Multi-Family Residential	427	DU	Two 1-5 story mixed-use story buildings. Revised project proposal accepted by City Council in June 2020
	Commercial Retail	8,000	0	
111 San Bruno Avenue	Multi-Family Residential	62	DU	Five-story mixed-use building. Building permits are in review.
	Commercial Retail	7,600	Square feet	
170 San Bruno Avenue	Commercial Office	16,718	Square feet	In pre-submittal stage.
	Commercial Retail	4,372	Square feet	
Other Transit Corridors Plan Developments	Varies			Provides development standards and design guidelines for redevelopment within the downtown core. Adopted by City Council in February 2013.
Bayhill Specific Plan				
Bayhill Specific Plan	Commercial Office	3,500,743	Square feet	Large cluster of offices, including YouTube headquarters. Draft Environmental Impact Report and Draft Specific Plan preparation underway.
	Commercial Retail	121,846	Square feet	
	Multi-Family Residential[b]	1,256	DU	
Other Developments				
San Bruno Golf Center	Single Family Residential	106	DU	Located at 2101 Sneath Lane. Still in the initial planning stage.
250 Courtland	Single Family Residential	267	DU	Former Crestmoor High School Site. Still in initial planning stage.
Glenview Terrace	Single Family Residential	29	DU	Located at 2880 San Bruno Avenue. Planning application under review.
Skyline College	Single Family Residential	40	DU	Located at 3300 College Drive. Under construction.
	Multi-Family Residential	30	DU	
271 El Camino Real	Multi-Family Residential	24	DU	Three-story building. Planning application under review.
The Crossing	Multi-Family Residential	178	DU	Spring Hill Suite. Still in initial planning stage.
160 El Camino Real	Multi-Family Residential	34	DU	Three-story hotel. Planning application under review.
Stratford School	School	348	Students	Located at 201 Balboa Way. Remodel of existing classrooms and expansion of existing structure at former El Crystal Elementary School. Approved by Planning Commission, anticipated to be complete by August 2021.
Allen School	School	500	Students	Located at 875 West Angust Avenue. Plans have been submitted.
Recreation and Aquatic Center in San Bruno City Park	Commercial Retail	47,000	Square feet	Located at 251 City Park Way. Demolition of existing Veterans Memorial building and pool to construct new two-story recreation and aquatic center. Building permits are under review. Construction anticipated to begin in 2021.

(a) Sources: City of San Bruno, August 2020, Major Development Projects in San Bruno; Erler & Kalinowski, Inc., June 2011, City of San Bruno, Water Supply Assessment for Transit Corridors Plan; West Yost, September 2019, Bayhill Specific Plan Water Supply Assessment; West Yost Associates, November 2020, DRAFT Water System Hydraulic Evaluation of the Allen Elementary School Replacement Project; conversation and correspondence with City Planning Division, May 2020.

(b) Bayhill multi-family residential units includes projected hotel rooms.

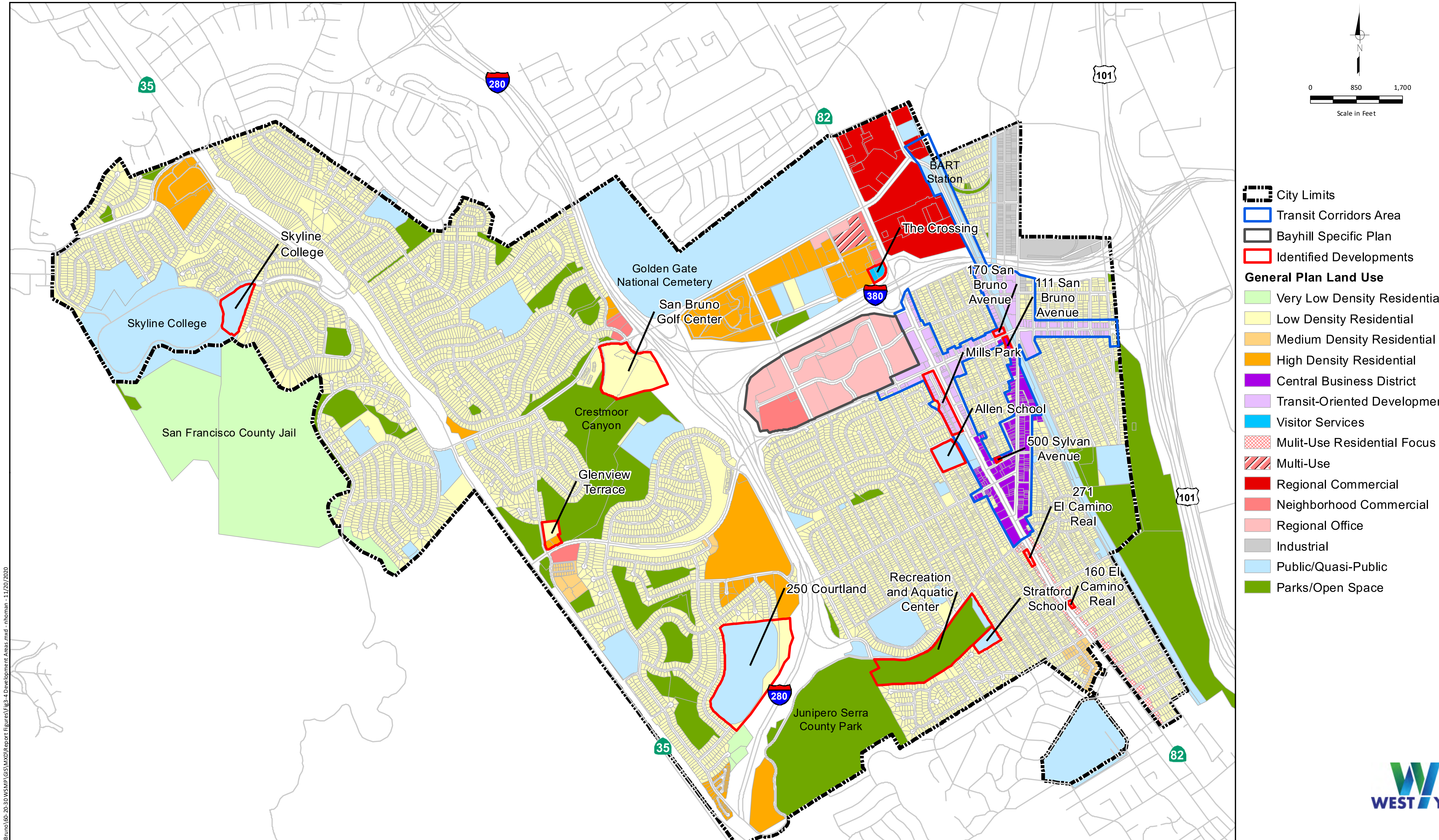


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Figure 3-4

Identified Development Areas

City of San Bruno
Water System Master Plan

3.5.2 Unit Water Use Factors

Water use factors are typically calculated by using historical water use and historical population or land use data to determine the historical ratio of water use to population, dwelling units, or acreage. Water use factors adopted in the 2012 WSMP were derived from 2001 historical records and housing statistics, or from the Transit Corridors Plan WSA. These unit water use factors are multiplied by projected dwelling units or land use area data to calculate a projected water demand estimate.

The 2012 WSMP water use factors for single family residential and multi-family residential land use were compared with historical City metered consumption data from 2017 through 2019. The comparison showed that single family residences have used an average of 147 gpd/du from 2017 through 2019, approximately 8.5 percent less than the 160 gpd/du factor adopted in the 2012 WSMP. Therefore, it is recommended that the City reduce its single-family residential use factor to 147 gpd/du to be consistent with recent water use patterns. Multi-family residences used an average of 121 gpd/du from 2017 through 2019, only 0.8 percent more than the 120 gpd/du factor adopted in the 2012 WSMP. Therefore, it is recommended that the City continue to use 120 gpd/du to project multi-family residential water use.

No adjustment was made to the commercial water use factors adopted in the 2012 WSMP. Commercial water use factors are from the Transit Corridors Plan WSA, which used a land-use based methodology developed by the Pacific Institute to estimate commercial demands from anticipated developed commercial square footage. These same factors were also used to project water demands in the Bayhill Specific Plan WSA.

As shown in Table 3-9, several school redevelopment projects are planned within the City. To estimate water demands from these projects, a water use factor for schools developed by the Pacific Institute was adjusted to account for modern water-efficient toilets. This factor is expressed in usage per student enrolled in the school.

Table 3-10 summarizes the unit water use factors recommended for residential and non-residential uses. Estimates shown in Table 3-10 incorporate non-revenue water, and therefore represent gross water use.

Table 3-10. Unit Water Use Factors for Projecting Demands[a]

Use Type	Unit Water Use Factor	Units
Single Family Residential[b]	147	GPD/DU
Multi-Family Residential[c]	120	GPD/DU
Commercial Office[d]	0.13	GPD/square foot
Commercial Retail[d]	0.19	GPD/square foot
School[e]	38.7	GPD/student

(a) Factors represent gross water use and include 8.0 percent non-revenue water.
(b) Based on historical City metered consumption data from 2017 - 2019.
(c) Erler & Kalinowski, Inc., June 2011, City of San Bruno, Water Supply Assessment for Transit Corridors Plan, Table B-1a. Factor shown in the WSA is 108 GPD/DU before inclusion of non-revenue water. Confirmed with historical City metered consumption data from 2017 - 2019.
(d) Transit Corridors Plan WSA, Table B-2a. Factors shown in the WSA are 0.12 GPD to 0.18 GPD/sf, before inclusion of non-revenue water.
(e) Based on Table E-26 from Pacific Institute, November 2003, Appendix E - Commercial Water Use and Potential Savings of Waste Not, Want Not: The Potential for Urban Water Conservation in California. Indoor water use factor adjusted to account for modern water-efficient toilets, and for inclusion of non-revenue water.

The Transit Corridors Plan WSA evaluated residential and commercial water use using land use information (dwelling units and commercial square footage) for the Transit Corridors Plan area as a check on the DSS methodology. Overall, the water use calculated using the two different methods was similar. Water use for the Transit Corridors Plan calculated using the land-use based methodology was 0.38 mgd, compared with 0.42 using the DSS methodology.

3.5.3 Projected Water Use

Table 3-11 presents the increase in water demands from identified development projects, calculated using the land use information and water use factors discussed above. Because many of these projects involve re-development of existing developed parcels, Table 3-11 shows the net increase in water demands after existing water demands are removed. Demands from identified developments, including full re-development of the Transit Corridors Plan area, is projected to increase demands by approximately 1.1 mgd. The majority of demands from identified developments are in the Transit Corridors Plan area (0.42 mgd) and the Bayhill Specific Plan area (0.52 mgd).

In addition to the water demands from identified development projects, the projected buildout demand also account for the potential extension of City water service to the San Francisco County Jail (SFCJ), which is adjacent to the northwest quadrant of the City. A previous study estimated the SFCJ's water demands to be approximately 0.15 mgd. The total future demands from existing customers, identified developments, and extension of service to the SFCJ is 4.23 mgd.

Also included in the projected buildout demand is an additional 0.55 mgd of water demand from unidentified future development to account for additional growth that could potentially occur by 2040 (e.g., ADUs). The estimate of 0.55 mgd was identified in consultation with City staff as a reasonable but conservative estimate of unidentified future growth. Although the precise locations of this future growth are unknown, it is anticipated that it will most likely occur in Zone 1/4. Therefore, an additional 0.55 mgd of future demands was allocated to Zone 1/4 to represent unidentified future development.

Table 3-12 shows that the total projected City water demand at buildout is 4.78 mgd. This total is consistent with the 2040 demand projection presented in the City's 2020 UWMP.

Table 3-11. Water Demand at Buildout from Identified Developments[(a)]									
Project Name	Proposed Land Use	Quantity of: Dwelling Units (Residential), Students (School), or Square Footage (Commercial)	Units	Potable Water Use Factor	Potable Water Use Factor Units	Projected Development Water Use, gpm	Existing Water Use, gpm[(b)]	Net Water Use, gpm	Net Water Use, mgd
Transit Corridors Plan Developments									
500 Sylvan Avenue	Multi-Family Residential	9	DU	120	GPD/DU	0.8	0.0	0.8	0.001
Mills Park (601-611, 643-799 El Camino Real, 701-751 Camino Plaza, 711-777 Kains Avenue)	Multi-Family Residential	427	DU	120	GPD/DU	35.6	4.0	32.7	0.047
	Commercial Retail	8,000	0	0.19	GPD/square foot	1.1			
111 San Bruno Avenue	Multi-Family Residential	62	DU	120	GPD/DU	5.2	1.1	5.1	0.007
	Commercial Retail	7,600	Square feet	0.19	GPD/square foot	1.0			
170 San Bruno Avenue	Commercial Office	16,718	Square feet	0.13	GPD/square foot	1.5	0.2	1.9	0.003
	Commercial Retail	4,372	Square feet	0.19	GPD/square foot	0.6			
Other Transit Corridors Plan Developments[(c)]	Varies					286.9	35.6	251.3	0.362
					Transit Corridor Plan Subtotal	**332.5**	**40.9**	**291.7**	**0.420**
Bayhill Specific Plan Developments									
Bayhill Specific Plan	Commercial Office	3,500,743	Square feet	0.13	GPD/square foot	316.0	74.3	362.5	0.522
	Commercial Retail	121,846	Square feet	0.19	GPD/square foot	16.1			
	Multi-Family Residential	1,256	DU	120	GPD/DU	104.7			
					Bayhill Specific Plan Subtotal	**436.8**	**74.3**	**362.5**	**0.522**
Other Identified Developments									
San Bruno Golf Center	Single Family Residential	106	DU	147	GPD/DU	10.8	5.6	5.2	0.008
250 Courtland	Single Family Residential	267	DU	147	GPD/DU	27.3	0.2	27.1	0.039
Glenview Terrace	Single Family Residential	29	DU	147	GPD/DU	3.0	0.0	2.9	0.004
Skyline College	Single Family Residential	40	DU	147	GPD/DU	4.1	0.0	6.6	0.009
	Multi-Family Residential	30	DU	120	GPD/DU	2.5			
271 El Camino Real	Multi-Family Residential	24	DU	120	GPD/DU	2.0	0.0	2.0	0.003
The Crossing	Multi-Family Residential	178	DU	120	GPD/DU	14.8	0.0	14.8	0.021
160 El Camino Real	Multi-Family Residential	34	DU	120	GPD/DU	2.8	0.0	2.8	0.004
Stratford School	School	348	Students	38.7	GPD/student	9.4	0.4	8.9	0.013
Allen School	School	500	Students	38.7	GPD/student	13.4	0.9	12.5	0.018
Recreation and Aquatic Center in San Bruno City Park	Commercial Retail	47,000	Square feet	0.19	GPD/square foot	6.2	0.0	6.2	0.009
					Other Identified Developments Subtotal	**96.3**	**7.1**	**89.2**	**0.128**
					Total All Identified Developments	**865.6**	**122.3**	**743.3**	**1.070**

(a) Sources: City of San Bruno, August 2020, Major Development Projects in San Bruno; Erler & Kalinowski, Inc., June 2011, City of San Bruno, Water Supply Assessment for Transit Corridors Plan; West Yost Associates, September 2019, Bayhill Specific Plan Water Supply Assessment; West Yost, November 2020, DRAFT Water System Hydraulic Evaluation of the Allen Elementary School Replacement Project; conversation and correspondence with City Planning Division, May 2020.

(b) Existing water use is equal to the 2019 metered consumption on parcels to be redeveloped, multiplied by a factor of 1.14 to scale to 2019 system production.

(c) Net water use estimated using DSS model as part of Transit Corridors Plan WSA analysis.

Demand Component	Total Water Use, gpm	Total Water Use, mgd
Existing Demands[a]	2,097	3.02
Identified Development Net Demands[b]	743	1.07
Extension of Service to San Francisco County Jail[c]	101	0.15
Subtotal	**2,941**	**4.23**
Unidentified Future Development[d]	380	0.55
Total Buildout Demand	**3,321**	**4.78**

Table 3-12. Projected Water Demand at Buildout (2040)

(a) Existing demand is equal to 2019 City water production.
(b) Refer to Table 3-11.
(c) Jail demands based on HDR Inc., May 2011, San Francisco County Jail #5 Water Supply Project DRAFT PreDesign TM.
(d) Additional demand from unidentified future development identified in consultation with City staff. Unidentified future development is anticipated to occur in Zone 1/4.

3.6 REFERENCES

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CHAPTER 4
Water Supply

This chapter summarizes the City's water supply sources and how these sources meet existing and future water demands. Information presented in this chapter is summarized from the City's 2020 Urban Water Management Plan (WYA, 2021) and the Bayhill Specific Plan Water Supply Assessment (WYA, 2019). The following sections are included in this chapter:

- Historical Water Supply
- Water Purchased from the SFPUC
- Water Purchased from the NCCWD
- Groundwater
- Regional Groundwater Storage and Recovery Project
- Reliability of the City's Water Supplies
- Basis of Water Supply Data
- Supply and Demand Assessment

4.1 HISTORICAL WATER SUPPLY

The City currently receives water from three supply sources:

- Wholesale surface water from the City and County of San Francisco's RWS, operated by the SFPUC, served through four connections to the City's system;
- Retail surface water purchased from NCCWD; and
- Local groundwater from the Westside Groundwater Basin.

Each of these supply sources is described further in this chapter. Table 4-1 summarizes historical production from these supply sources from 2011 through 2020.

Table 4-1. Historical Production by Source, mgd[a]

Supply Source	Calendar Year									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
San Francisco Public Utilities Commission (SFPUC) Turnouts										
Tanforan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.12	0.13
Rollingwood	0.59	0.69	0.72	0.72	0.67	0.49	0.46	0.42	0.43	0.51
Bayhill	0.48	0.49	0.54	0.49	0.35	0.35	0.45	0.66	0.65	0.77
Whitman	0.41	0.53	0.90	0.46	0.43	0.24	1.17	1.54	1.44	1.33
Subtotal SFPUC	**1.48**	**1.70**	**2.16**	**1.67**	**1.46**	**1.08**	**2.08**	**2.70**	**2.65**	**2.75**
Groundwater										
Well # 15	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well # 16	0.67	0.56	0.03	0.52	0.54	0.62	0.32	0.07	0.06	0.03
Well # 17	0.34	0.29	0.47	0.47	0.33	0.38	0.04	0.07	0.08	0.10
Well # 18	0.27	0.25	0.25	0.24	0.23	0.23	0.12	0.06	0.05	0.03
Well # 20	0.80	0.73	0.61	0.74	0.71	0.71	0.35	0.10	0.10	0.08
Subtotal Groundwater	**2.12**	**1.83**	**1.35**	**1.96**	**1.81**	**1.93**	**0.84**	**0.28**	**0.29**	**0.24**
North Coast County Water District (NCCWD) Turnout										
Crystal Springs	0.04	0.05	0.05	0.04	0.04	0.05	0.04	0.05	0.05	0.03
Total Water Production	**3.64**	**3.58**	**3.56**	**3.67**	**3.31**	**3.06**	**2.96**	**3.03**	**2.99**	**3.02**

(a) Data from spreadsheets provided by the City Water Division.

4.2 WATER PURCHASED FROM THE SAN FRANCISCO PUBLIC UTILITIES COMMISSION

The City's wholesale water supply purchased from the SFPUC is delivered through the Regional Water System via four turnouts. Water from SFPUC is purchased in accordance with the 2018 Amended and Restated Water Supply Agreement (WSA).[1] Additional details regarding water purchased from the SFPUC are provided below.

4.2.1 SFPUC Regional Water System Overview

The City and County of San Francisco's Regional Water System, operated by the SFPUC, is predominantly supplied from runoff and snowmelt from the Sierra Nevada, delivered through the Hetch Hetchy aqueducts, but also includes treated water produced by the SFPUC from its local watersheds and facilities in Alameda and San Mateo Counties.

The amount of imported water available to the SFPUC's retail and wholesale customers is constrained by hydrology, physical facilities, and the institutional parameters that allocate the water supply of the Tuolumne River. Due to these constraints, the SFPUC is very dependent on reservoir storage to firm-up its water supplies.

The SFPUC serves its retail and wholesale water demands with an integrated operation of local Bay Area water production and imported water from Hetch Hetchy. In practice, the local watershed facilities are operated to capture local runoff.

4.2.2 2018 Amended and Restated Water Supply Agreement

The business relationship between SFPUC and its wholesale customers is largely defined by the WSA between SFPUC and wholesale customers in Alameda County, San Mateo County and Santa Clara County. In July 2009, the WSA replaced the Settlement Agreement and Master Water Sales Contract that expired in June 2009, and in 2018, an Amended and Restated WSA was adopted. The WSA addresses the rate-making methodology used by SFPUC in setting wholesale water rates for its wholesale customers and includes a Water Shortage Allocation Plan (WSAP) that describes the method for allocating water from the RWS between Retail and Wholesale Customers during system-wide shortages of 20 percent or less. The WSAP, also known as the Tier One Plan, was amended in the 2018 Amended and Restated WSA. The Wholesale Customers' share is apportioned among the individual Wholesale Customers based on a separate methodology adopted by the Wholesale Customers, known as the Tier Two Plan. The Tier Two Plan, which initially expired in 2018, has been extended by the BAWSCA Board of Directors every year since for one additional calendar year. In November 2021, the BAWSCA Board voted to extend the Tier Two Plan through the end of 2022.

San Francisco has a perpetual commitment (Supply Assurance) to deliver 184 MGD to the 24 permanent Wholesale Customers collectively. San Jose and Santa Clara are not included in the Supply Assurance commitment and each has temporary and interruptible water supply contracts with San Francisco. The Supply Assurance is allocated among the 24 permanent Wholesale Customers through Individual Supply

[1] "Amended and Restated Water Supply Agreement between the City and County of San Francisco and Wholesale Customers in Alameda County, San Mateo County, and Santa Clara County", November 2018.

Guarantees (ISG), which represent each Wholesale Customer's allocation of the 184 MGD Supply Assurance. The City's ISG is 3.25 MGD.

4.2.3 Bay Area Water Supply and Conservation Agency

The City is a member of BAWSCA, an agency that was created on May 27, 2003 to represent the interests of the 26 cities, water districts, and private utilities in Alameda, Santa Clara and San Mateo counties that purchase water on a wholesale basis from the RWS.

BAWSCA is the only entity having the authority to directly represent the needs of the cities, water districts and private utilities (wholesale customers) that depend on the RWS. BAWSCA provides the ability for the customers of the RWS to work with San Francisco on an equal basis to ensure the water system gets fixed, and to collectively and efficiently meet local responsibilities.

BAWSCA has the authority to coordinate water conservation, supply and recycling activities for its agencies; acquire water and make it available to other agencies on a wholesale basis; finance projects, including improvements to the RWS; and build facilities jointly with other local public agencies or on its own to carry out the agency's purposes.

4.3 WATER PURCHASED FROM THE NORTH COAST COUNTY WATER DISTRICT

Water purchased from the NCCWD is also from the RWS, but is served directly from NCCWD, and is used exclusively to meet the demands of the Crystal Springs Terrace Apartments, located in Pressure Zone 13.

The City purchases water from NCCWD under the terms of Resolution No. 2001-52, Intertie and Water Service Agreement. The cost of water purchased from NCCWD is set according to NCCWD's Rate and Fee Schedule for governmental multi-unit residential property. There is no contractual limit to the quantity of water the City may purchase from NCCWD, except that purchases are "only such water service as [NCCWD] can normally render".

The City purchases approximately 0.05 mgd of water from the NCCWD, as shown in Table 4-1. The City does not anticipate any changes to its NCCWD water supply in the near future.

4.4 GROUNDWATER

Local groundwater supply for the City is from the Westside Basin, which is used by the cities of San Bruno, Daly City, and South San Francisco.[2] The City operates multiple production wells that extract groundwater from the central portion of the 40 square mile Westside Basin (*i.e.,* Basin 2-35, as defined by DWR). The City has used groundwater as a source of supply since the early 1900's. Prior to 2016, groundwater use comprised about 50 percent of the City's total water supply. In 2016 the City reduced its use of groundwater in accordance with the Regional Groundwater Storage and Recovery Project (Regional GSR). The Regional GSR Project is discussed further in Section 4.5.

The following sections provide a description of the hydrogeology and conditions within the Westside Basin and current management efforts within the Westside Basin.

[2] The northern portion of the Westside Basin is managed by SFPUC.

4.4.1 Groundwater Basin Description

The City overlies the central portion of the 40 square mile Westside Basin.[3] The Westside Basin consists of unconsolidated colluvium that was deposited in a northwest trending trough in the underlying impervious bedrock. The Westside Basin is bounded by bedrock highs in Golden Gate Park to the north and at Coyote Point to the south (Rogge, 2003; Yates, 2003; DWR, 2003). San Bruno Mountain and San Francisco Bay form the eastern boundary of the Westside Basin, while the Serra Fault[4] and the Pacific Ocean form the western boundary (Rogge, 2003; Yates, 2003; DWR, 2003). Adjoining groundwater basins are the Lobos Basin to the north and the San Mateo Plain Aquifer to the south.

The Westside Basin has been separated into two distinct areas for management purposes. These two areas have been defined as the North Westside Basin Area and the South Westside Basin Area. The City is located within the South Westside Basin Area. The approximate boundaries of the South Westside Basin are shown on Figure 4-1. Further discussion regarding aquifer conditions in the South Westside Basin are provided below.

4.4.1.1 Aquifer Conditions and Properties of the South Westside Basin

The Merced Formation and Colma Formation are the major unconsolidated units in the South Westside Basin and are the primary sources of groundwater. These formations were deposited on top of the Franciscan Formation, which forms the basement underlying these unconsolidated sediments. The deepest portions of the basin are in the northwest. Water bearing formations are thin in the areas of Millbrae and Burlingame. Water bearing formations are also thin near San Francisco Bay due to a bedrock ridge that extends in a north-south orientation near San Francisco International Airport. This ridge, along with surficial deposits of Bay muds in these areas, reduces the potential for sea water intrusion (RMC, 2011).

[3] A description the Westside Basin provided in California's Bulletin 118 was updated in 2006. In this update, DWR states that presently not enough data exists to provide either an estimate of the Westside Basin's groundwater budget or the groundwater extraction from the basin. Additional references, as identified herein, have been reviewed and used to evaluate the conditions within the basin.

[4] The Serra Fault is a series of thrust faults parallel to the San Andreas Fault in the Coast Ranges (Rogge, 2003).

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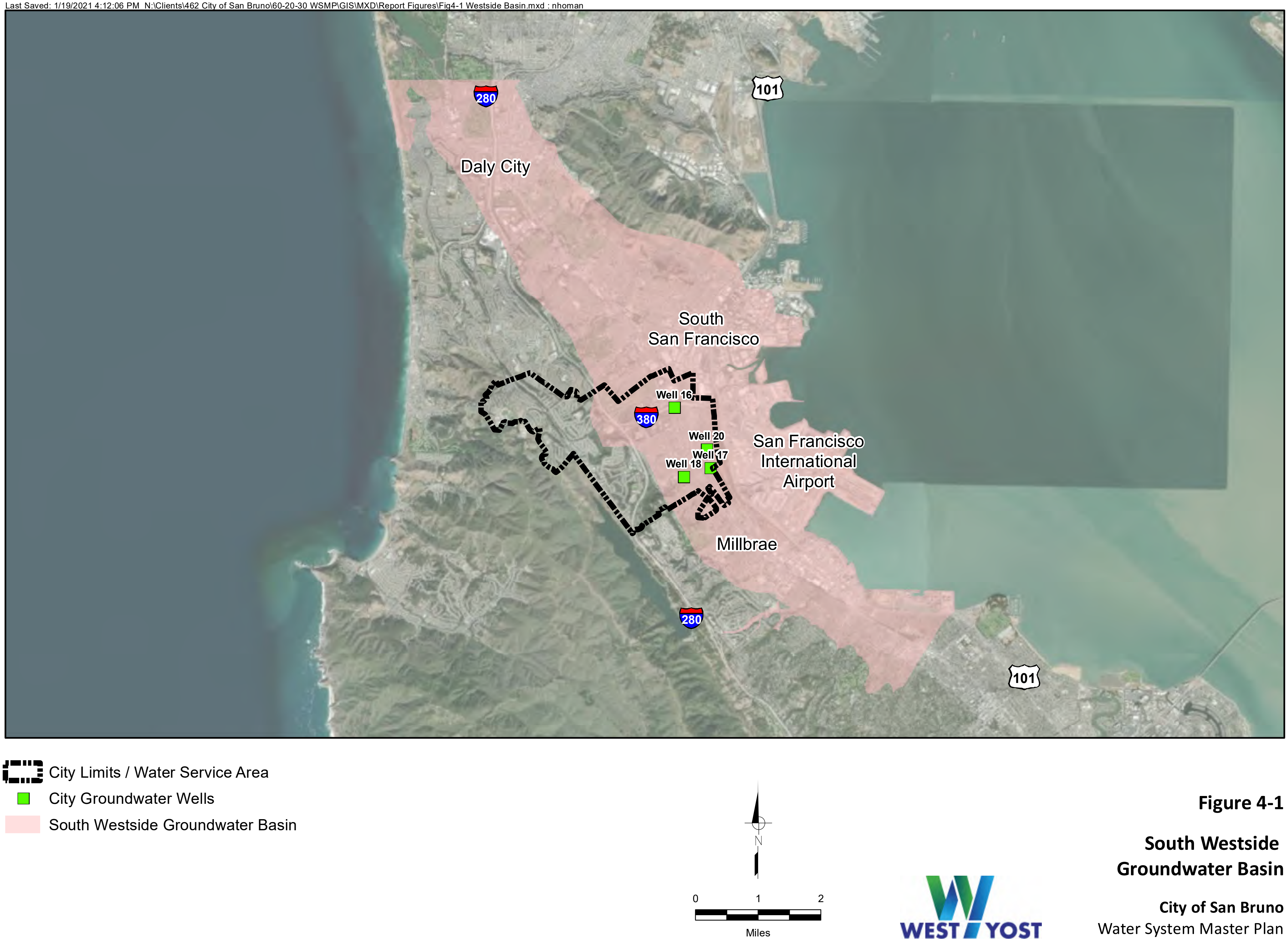

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Figure 4-1

South Westside Groundwater Basin

City of San Bruno
Water System Master Plan

Within the two major water bearing zones in the South Westside Basin, there are multiple smaller aquifer zones that are delineated vertically by different sand and clay layers within the Merced and Colma formations. As discussed above, the thickness and extent of these interbedded sand and clay layers vary spatially throughout the South Westside Basin.

All of the municipal groundwater extraction wells in the City, South San Francisco, and Daly City are screened in the deeper, confined Merced aquifer where the water quality is better. Shallow wells have been installed within the Colma Formation, typically to monitor groundwater in the vicinity of chemical release sites. Steep downward vertical gradients exist between the unconfined (upper) and confined (deeper) aquifers, but the hydraulic connection between the two aquifers is thought to be limited (Yates, 2003a; Luhdorff & Scalmanini, 2002).

Historically, groundwater within the South Westside Basin generally flowed toward pumping centers within the City, Daly City, and South San Francisco. Groundwater extraction has created significant depressions in the water table and historically water levels in the San Bruno area were about 200 feet below sea level. However, annual groundwater monitoring indicates that since 2016, levels have rebounded by 45 feet due to the Regional GSR Project (SFPUC, April 2021).

Water levels within the drinking water aquifers of the South Westside Basin are depressed well below sea level in many areas (SFPUC, April 2021). Relatively thick bay mud deposits and a buried bedrock ridge within 50 to 300 feet of the ground surface provide protection from seawater intrusion from San Francisco Bay. To date, City drinking water wells have not shown any impacts from seawater intrusion, although the basin is considered at risk for seawater intrusion according to the South Westside Basin Groundwater Management Plan (GWMP). While the extent and nature of potential connections between the drinking water within the Westside Basin and San Francisco Bay are not well understood, available data indicate that such connections could exist and seawater intrusion could occur given groundwater levels are below sea level. The City has a saltwater intrusion monitoring program for portions of the South Westside Basin near the City. The City's program complements efforts by the City of Daly City to monitor saltwater intrusion in the South Westside Basin. Both programs are aimed at protecting groundwater quality in the Westside Basin to assure the reliability of future supplies. Monitoring well clusters have been installed in areas near the Bay where the depth to the bedrock ridge is the deepest. These wells provide water level and water quality data.

4.4.1.2 Basin Water Budget Analysis

According to the GWMP (described below in Section 4.4.2), the South Westside Basin is in slight overdraft, resulting in a declining volume of storage. However, change of storage is within the margin of error associated with the data. Given the uncertainties and less than 2 percent change in storage, the GWMP concludes that the basin should be considered in balance.

4.4.2 Groundwater Management

In 2006, the City received a grant from DWR's Local Groundwater Assistance fund to develop a GWMP for the southern portion of the Westside Basin, which extends from Daly City to Burlingame (South Westside Basin). Municipalities that overlie the South Westside Basin include Daly City, Colma, South San Francisco, San Bruno, Millbrae and Burlingame. Groundwater within this portion of the basin generally flows toward pumping centers within Daly City, San Bruno and South San Francisco.

The South Westside Basin GWMP was completed in July 2012 by the City, in coordination with the City of Daly City, Cal Water, the SFPUC, and other stakeholders. This GWMP was developed to provide a framework for regional groundwater management in the South Westside Basin that sustains the beneficial use of the groundwater resource. This framework includes the following objectives: informing the public of the importance of groundwater to the South Westside Basin and the challenges and opportunities it presents; developing consensus among stakeholders on issues and solutions related to groundwater; building relationships among stakeholders within the basin and between state and federal agencies; and defining actions for developing programs to ensure the long-term sustainability of groundwater resources in the South Westside Basin.

The goal of the GWMP is to ensure a sustainable, high quality, reliable water supply at a fair price for beneficial uses achieved through local groundwater management. The GWMP provides steps for monitoring water quality and quantity in the basin. Each groundwater well in the basin has defined triggers for overdraft, seawater intrusion, and various water quality measures. The GWMP identifies two levels of trigger thresholds for each groundwater well based on historical water levels, and actions to address the trigger that is met.

The GWMP indicates that the South Westside Basin is not in overdraft, and that the City can sustain a groundwater production rate of 2.1 mgd on a long-term basis. While not anticipated, groundwater production could be limited if local monitoring wells detect overdraft is occurring in the vicinity of the City's wells.

4.4.2.1 Sustainable Groundwater Management Act

The Sustainable Groundwater Management Act of 2014 (SGMA), a three-bill legislative package composed of AB 1739 (Dickinson), SB 1168 (Pavley), and SB 1319 (Pavley), was passed in September 2014. The legislation provides a framework for sustainable management of groundwater supplies by local authorities, with a limited role for state intervention when necessary to protect the resource. The legislation lays out a process and a timeline for local authorities to achieve sustainable management of groundwater basins. It also provides tools, authorities and deadlines to take the necessary steps to achieve the goal. For local agencies involved in implementation, the requirements are significant and can be expected to take years to accomplish. The State Water Resources Control Board may intervene if local agencies do not form a Groundwater Sustainability Agency (GSA) and/or fail to adopt and implement a Groundwater Sustainability Plan (GSP).

SGMA applies to basins or subbasins designated by the DWR as high or medium priority basins, based on a statewide ranking that uses criteria including population and extent of irrigated agriculture dependent on groundwater. The SGMA 2019 Basin Prioritization findings indicate that 94 of California's 515 groundwater basins and subbasins are high and medium priority basins (DWR, 2020). These high and medium priority basins, in combination with existing adjudicated areas, account for 98 percent of California's annual groundwater pumping and supply 83 percent of the population which resides over the groundwater basins (DWR, 2020). The Westside Basin has been ranked as a Very Low priority basin. As a Very Low priority basin, the Westside Basin users are not mandated to form a GSA or develop a GSP at this time.

4.5 REGIONAL GROUNDWATER STORAGE AND RECOVERY PROJECT

In December 2014, the Regional GSR operating agreement was signed to ensure long-term management and sustainability of the South Westside Groundwater Basin through a strategic conjunctive use partnership. The partnership with the City, SFPUC, California Water Service (serving South San Francisco and Colma), and the City of Daly City allows the agencies to operate the basin jointly and provides a new 20-billion-gallon regional dry year groundwater supply. The project is included as part of the SFPUC Water Supply Improvement Program described in Section 4.6.1.1.

The Regional GSR Project is an in-lieu groundwater recharge program that balances groundwater and RWS surface water supply to increase drought year water supplies. As a participant, the City has two supply modes. During wet and average years, (termed 'put' years, when in-lieu groundwater banking occurs), water from the RWS is delivered to the City, which reduces the need to pump groundwater and allows the basin to naturally recharge and store additional water supply. The amount of additional surface water delivered in-lieu of groundwater will be "banked" by the SFPUC until it is needed during a drought or emergency. In dry years ('take' years), the City will maximize its use of groundwater and supplement with surface water and the SFPUC "banked" groundwater supply, as needed.

Each year, the SFPUC will notify the City if the SFPUC will be providing additional surface water supplies to offset the City's groundwater pumping. The City retains its full 2.1 mgd groundwater right, but a portion of that water right may be fulfilled by SFPUC in-lieu surface water. The City implemented conjunctive use operations starting in 2016.

The SFPUC imported water supply may also partially consist of groundwater during dry years. Under Phase 1 of the Regional GSR Project, 13 new groundwater production well facilities have been constructed in Northern San Mateo County. These new well facilities are connected to the SFPUC transmission system and may pump "banked" groundwater and deliver it as part of the SFPUC supply. Phase 2 of the project includes the construction of three test wells, completion of the South San Francisco Main well and pipeline, and the installation of chemical system monitoring, sampling, and storage at various sites. Phase 2 is projected to be complete in 2022 (SFPUC, May 2020).

4.6 RELIABILITY OF THE CITY'S WATER SUPPLIES

The amount of supply available from each of the City's water supply sources may vary under different hydrologic conditions. The sections below discuss the reliability of the City's supplies under Average Year, Single Dry Year, and Multiple Dry Year conditions.

4.6.1 SFPUC Reliability

The reliability of SFPUC's water supplies and the management strategies for addressing these reliabilities are discussed below based on information provided by SFPUC and BAWSCA.

4.6.1.1 SFPUC Water System Improvement Program

In order to enhance the ability of the SFPUC water supply system to meet identified service goals for water quality, seismic reliability, delivery reliability, and water supply, the SFPUC has undertaken the Water System Improvement Program (WSIP), approved on October 31, 2008. The WSIP has delivered capital improvements aimed at enhancing the SFPUC's ability to meet its water service mission of providing high quality water to customers in a reliable, affordable and environmentally sustainable manner. SFPUC's goal is to limit systemwide rationing to a maximum of 20 percent in any one year through implementation of the WSIP projects.

The WSIP includes 52 projects in the RWS. Forty-two of the WSIP regional projects have been completed, including: improvements at the Calaveras and Crystal Springs supply reservoirs; construction of the Tesla disinfection facility and improvements at the Sunol Valley and Harry Tracy water treatment plants; Bay Division Region pipeline replacements, interties and crossovers; construction of a new Crystal Springs Bypass Tunnel; rehabilitation of Pulgas Balancing Reservoir; and, Peninsula Region pipeline replacements and valve lot improvements. The only major regional WSIP projects still under construction are the Regional GSR and the Alameda Creek Recapture Projects. The Regional GSR Project is discussed above in Section 4.5 (SFPUC, May 2020).

It should be noted that the permitting obligations for the Calaveras Dam Replacement Project and the Lower Crystal Springs Dam Improvements include a combined commitment of 12.8 mgd for instream flows on average. When this is reduced by an assumed Alameda Creek Recapture Project recovery of 9.3 mgd, the net loss of water supply is 3.5 mgd.

4.6.1.2 SFPUC Alternative Water Supply Planning Program

The SFPUC has initiated, and is increasing and accelerating its efforts, to implement an Alternative Water Supply Planning Program to ensure that San Francisco can meet its Retail and Wholesale Customer water needs, address projected dry years shortages, and limit rationing to a maximum 20 percent system-wide in accordance with adopted SFPUC policies. This program is in its early planning stages and is intended to meet future water supply challenges and vulnerabilities such as environmental flow needs and other regulatory changes; earthquakes, disasters, and emergencies; increases in population and employment; and climate change. As the region faces future challenges – both known and unknown – SFPUC is considering this suite of diverse non-traditional supplies and leveraging regional partnerships to meet Retail and Wholesale Customer needs through 2045.

4.6.1.3 BAWSCA's Long-Term Reliable Water Supply Strategy

BAWSCA's Long-Term Reliable Water Supply Strategy (Strategy) was developed to quantify the water supply reliability needs of the BAWSCA member agencies through 2040, identify the water supply management projects and/or programs (projects) that could be developed to meet those needs, and prepare an implementation plan for the Strategy's recommendations. Successful implementation of the Strategy is critical to ensuring that there will be sufficient and reliable water supplies for the BAWSCA member agencies and their customers in the future.

When the 2015 Demand Study concluded it was determined that while there is no longer a regional normal year supply shortfall, there was a regional drought year supply shortfall of up to 43 MGD. In addition, key findings from the Strategy's project evaluation analysis included the following:

- Water transfers represent a high priority element of the Strategy
- Desalination potentially provides substantial yield, but its high effective costs and intensive permitting requirements make it a less attractive drought year supply alternative
- Other potential regional projects provide tangible, though limited, benefit in reducing dry-year shortfalls given the small average yields in drought years

Since 2015, BAWSCA has completed a comprehensive update of demand projections and engaged in significant efforts to improve regional reliability and reduce the dry-year water supply shortfall.

- **Water Transfers.** BAWSCA successfully facilitated two transfers of portions of ISG between BAWSCA agencies in 2017 and 2018. Such transfers benefit all BAWSCA agencies by maximizing use of existing supplies. BAWSCA is currently working on an amendment to the Water Supply Agreement between SFPUC and BAWSCA agencies to establish a mechanism by which member agencies that have an ISG may participate in expedited transfers of a portion of ISG and a portion of a Minimum Annual Purchase Requirement. In 2019, BAWSCA participated in a pilot water transfer that, while ultimately unsuccessful, surfaced important lessons learned and produced interagency agreements that will serve as a foundation for future transfers. BAWSCA is currently engaged in the BARR, described above, to identify opportunities to move water across the region as efficiently as possible, particularly during times of drought and emergencies.
- **Regional Projects.** Since 2015, BAWSCA has coordinated with local and State agencies on regional projects with potential dry-year water supply benefits for BAWSCA's agencies. These efforts include storage projects, indirect/direct water reuse projects, and studies to evaluate the capacity and potential for various conveyance systems to bring new supplies to the region.

In June 2020, BAWSCA updated the Regional Water Demand and Conservation Study (Demand Study). The goal of the Demand Study was to develop transparent, defensible, and uniform demand and conservation savings projections for each wholesale customer using a common methodology to support both regional and individual agency planning efforts. The Demand Study projections will be used to update BAWSCA's Strategy discussed above.

Through the Demand Study process, BAWSCA and the wholesale customers: (1) quantified the total average-year water demand for each BAWSCA member agency through 2045; (2) quantified passive and active conservation water savings potential for each individual wholesale customer through 2045; and (3) identified conservation programs for further consideration for regional implementation by BAWSCA. The Demand Study projected that by 2045 the collective active conservation efforts of the wholesale customers would yield an additional 37.3 mgd in savings beyond what has already been achieved for the BAWSCA service area (BAWSCA, 2020).

BAWSCA continues to implement the Strategy recommendations in coordination with BAWSCA member agencies. Strategy implementation will be adaptively managed to account for changing conditions and to ensure that the goals of the Strategy are met in an efficient and cost-effective manner. On an annual basis, BAWSCA will reevaluate Strategy recommendations and results in conjunction with development of the BAWSCA's FY 2021/22 Work Plan. In this way, actions can be modified to accommodate changing conditions and new developments.

4.6.1.4 SFPUC Water Shortage Allocation Plan

The WSA between the SFPUC and wholesale customers includes a WSAP that describes the method for allocating water from the RWS between Retail and Wholesale Customers during system-wide shortages of 20 percent or less. The WSAP, also known as the Tier One Plan, was amended in the 2018 Amended and Restated WSA. The Wholesale Customers' share is apportioned among the individual Wholesale Customers based on a separate methodology adopted by the Wholesale Customers, known as the Tier Two Plan. Discussion of the Tier One and Tier Two drought allocation plans are provided below.

4.6.1.4.1 Tier One Drought Allocations

SFPUC allocates water under the Tier One Plan when it determines that the projected available water supply is up to 20 percent less than projected system-wide water purchases. Table 4-2 shows the SFPUC (i.e., Retail Customers) share and the Wholesale Customers' share of the annual water supply available during shortages depending on the level of system-wide reduction in water use that is required. The Wholesale Customers' share will be apportioned among the individual Wholesale Customers based on a separate methodology adopted by the Wholesale Customers, known as the Tier Two Plan, discussed further below.

Table 4-2. Share of Available SFPUC Supplies Under Various Shortages

Level of System-Wide Reduction in Water Use Required, percent	Share of Available Water	
	Retail Customers, percent	Wholesale Customers, percent
5 or less	35.5	64.5
6 through 10	36.0	64.0
11 through 15	37.0	63.0
16 through 20	37.5	62.5

Source: SFPUC Common Language for BAWSCA Member Agencies' 2020 UWMPs, February 3, 2021.

The Tier One Plan allows for voluntary transfers of shortage allocations between SFPUC and any Wholesale Customer as well as between Wholesale Customers themselves. In addition, water "banked" by a Wholesale Customer, through reductions in usage greater than required, may also be transferred.

As amended in 2018, the Tier One Plan requires Retail Customers to conserve a minimum of 5 percent during droughts. If Retail Customer demands are lower than the Retail Customer allocation (resulting in a "positive allocation" to Retail) then the excess percentage would be re-allocated to the Wholesale Customers' share. The additional water conserved by Retail Customers up to the minimum 5 percent level is deemed to remain in storage for allocation in future successive dry years.

The Tier One Plan applies only when SFPUC determines that a system-wide water shortage exists and issues a declaration of a water shortage emergency under California Water Code Section 350. Separate from a declaration of a water shortage emergency, SFPUC may opt to request voluntary cutbacks from its Retail and Wholesale Customers to achieve necessary water use reductions during drought periods.

The Tier One Plan will expire at the end of the term of the WSA in 2034, unless mutually extended by San Francisco and the Wholesale Customers.

4.6.1.4.2 Tier Two Drought Allocations

The Wholesale Customers have negotiated and adopted the Tier Two Plan, referenced above, which allocates the collective Wholesale Customers share from the Tier One Plan among each of the 26 Wholesale Customers. These Tier Two allocations are based on a formula that takes into account multiple factors for each Wholesale Customer including:

- Individual Supply Guarantee

- Seasonal use of all available water supplies
- Residential per capita use

The water made available to the Wholesale Customers collectively will be allocated among them in proportion to each Wholesale Customer's Allocation Basis, which in turn is the weighted average of two components. The first component is the Wholesale Customer's Individual Supply Guarantee, as stated in the WSA, and is fixed. The second component, the Base/Seasonal Component, is variable and is calculated using the monthly water use for three consecutive years prior to the onset of the drought for each of the Wholesale Customers for all available water supplies. The second component is accorded twice the weight of the first, fixed component in calculating the Allocation Basis. Minor adjustments to the Allocation Basis are then made to ensure a minimum cutback level, a maximum cutback level, and a sufficient supply for certain Wholesale Customers.

The Allocation Basis is used in a fraction, as numerator, over the sum of all Wholesale Customers' Allocation Bases to determine each wholesale customer's Allocation Factor. The final shortage allocation for each Wholesale Customer is determined by multiplying the amount of water available to the Wholesale Customers' collectively under the Tier One Plan, by the Wholesale Customer's Allocation Factor.

The Tier Two Plan requires that the Allocation Factors be calculated by BAWSCA each year in preparation for a potential water shortage emergency. As the Wholesale Customers change their water use characteristics (e.g., increases or decreases in SFPUC purchases and use of other water sources, changes in monthly water use patterns, or changes in residential per capita water use), the Allocation Factor for each Wholesale Customer will also change. However, for long-term planning purposes, each Wholesale Customer shall use as its Allocation Factor, the value identified in the Tier Two Plan when adopted.

The Tier Two Plan, which initially expired in 2018, has been extended by the BAWSCA Board of Directors every year since for one additional calendar year. In November 2021, the BAWSCA Board voted to extend the Tier Two Plan through the end of 2022.

4.6.1.5 Adoption of the 2018 Bay-Delta Plan Amendment

4.6.1.5.1 Background

In December 2018, the SWRCB adopted amendments to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan Amendment) to establish water quality objectives to maintain the health of the Bay-Delta ecosystem. The SWRCB is required by law to regularly review this plan. The adopted Bay-Delta Plan Amendment was developed with the stated goal of increasing salmonid populations in three San Joaquin River tributaries (the Stanislaus, Merced, and Tuolumne Rivers) and the Bay-Delta. The Bay-Delta Plan Amendment requires the release of 30 to 50 percent of the "unimpaired flow"[5] on the three tributaries from February through June in every year type. In SFPUC modeling of the new flow standard, it is assumed that the required release is 40 percent of

[5] "Unimpaired flow represents the natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds." (Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (December 12, 2018) p.17, fn. 14.

unimpaired flow. The SWRCB has stated that it intends to implement the Bay-Delta Plan Amendment on the Tuolumne River by the year 2022, assuming all required approvals are obtained by that time.

There is much uncertainty surrounding implementation of the Bay-Delta Plan Amendment. Since adoption of the Bay-Delta Plan Amendment, over a dozen lawsuits have been filed in both State and Federal courts, challenging the SWRCB's adoption of the Bay-Delta Plan Amendment, including a legal challenge filed by the Federal government, at the request of the U.S. Department of Interior, Bureau of Reclamation. This litigation is in the early stages and there have been no dispositive court rulings as of this date.

The Bay-Delta Plan Amendment is not self-implementing and does not automatically allocate responsibility for meeting its new flow requirements to SFPUC or any other water rights holders. Rather, the Bay-Delta Plan Amendment merely provides a regulatory framework for flow allocation, which must be accomplished by other regulatory and/or adjudicatory proceedings, such as a comprehensive water rights adjudication or, in the case of the Tuolumne River, may be implemented through the water quality certification process set forth in Section 401 of the Clean Water Act as part of the Federal Energy Regulatory Commission's licensing proceedings for the Don Pedro and La Grange hydroelectric projects. It is currently unclear when the license amendment process is expected to be completed. This process and the other regulatory and/or adjudicatory proceedings would likely face legal challenges and have lengthy timelines, and quite possibly could result in a different assignment of flow responsibility (and therefore a different impact on SFPUC water supply).

In recognition of the obstacles to implementation of the Bay-Delta Plan Amendment, the SWRCB Resolution No. 2018-0059 adopting the Bay-Delta Plan Amendment directed staff to help complete a "Delta watershed-wide agreement, including potential flow measures for the Tuolumne River" by March 1, 2019, and to incorporate such agreements as an "alternative" for a future amendment to the Bay-Delta Plan to be presented to the SWRCB "as early as possible after December 1, 2019." In accordance with the SWRCB's instruction, on March 1, 2019, SFPUC, in partnership with other key stakeholders, submitted a proposed project description for the Tuolumne River that could be the basis for a voluntary substitute agreement with the SWRCB ("March 1st Proposed Voluntary Agreement"). On March 26, 2019, SFPUC adopted Resolution No. 19-0057 to support SFPUC's participation in the Voluntary Agreement negotiation process. To date, those negotiations are ongoing under the California Natural Resources Agency and the leadership of the Newsom administration.[6]

4.6.1.5.2 Impacts of the Bay-Delta Plan Amendment on SFPUC Regional Water System Supplies

The adoption of the Bay-Delta Plan Amendment may significantly impact the supply available from the RWS. SFPUC recognizes that the Bay-Delta Plan Amendment has been adopted and that, given that it is now State law, it must be assumed that it will be fully implemented. SFPUC also acknowledges that the plan is not self-implementing and therefore does not automatically go into effect. As noted above, the SFPUC is currently pursuing an alternative voluntary agreement as well as a lawsuit which would limit implementation of the Bay-Delta Plan Amendment. With both of these processes occurring on an unknown timeline, SFPUC does not know at this time when the Bay-Delta Plan Amendment is likely to go into effect. As a result, it makes sense to conduct future supply modeling for a scenario that does not include implementation of the Bay-Delta Plan Amendment, as that represents a potential supply reliability scenario.

[6] California Natural Resources Agency, "Voluntary Agreements to Improve Habitat and Flow in the Delta and its Watersheds,".

Because of the uncertainty surrounding implementation of the Bay-Delta Plan Amendment, SFPUC conducted a water service reliability assessment that included: (1) a scenario in which the Bay-Delta Plan Amendment is fully implemented in 2023, and (2) a scenario that considers the SFPUC system's current situation without the Bay-Delta Plan Amendment. The two scenarios provide a bookend for the possible future scenarios regarding RWS supplies. However, SFPUC presented the scenario with the Bay-Delta Plan Amendment as the primary scenario in its 2020 UWMP.

Although the SWRCB has stated it intends to implement the Bay-Delta Plan Amendment on the Tuolumne River by the year 2022, given the current level of uncertainty, it is assumed for the purposes of SFPUC's 2020 UWMP that the Bay-Delta Plan Amendment will be fully implemented starting in 2023.

4.6.1.6 Projected SFPUC Supplies

The City's water supply availability from the RWS under normal (average), single dry and multiple dry year conditions is described in Tables 4-3 and 4-4. Because the RWS water demands vary over the period evaluated, in addition to supply conditions (with and without the Bay-Delta Plan Amendment), the estimated availability of RWS supplies varies by year and by assumed conditions.

This variation in the City's SFPUC supply availability is shown in Table 4-3 with the Bay-Delta Plan Amendment and in Table 4-4 without the Bay-Delta Plan Amendment. As shown in Table 4-3, with the Bay-Delta Plan Amendment, SFPUC supply availability is reduced to as low as 46 percent of projected purchases in some dry years. As shown in Table 4-4, without the Bay-Delta Plan Amendment, supply availability is projected to be at least 81 percent of projected purchases.

Table 4-3. Projected SFPUC Supply Availability for the City of San Bruno in Years 2025 to 2045 with Bay-Delta Plan Amendment[(a,b)]

Year Type	2025, percent	2030, percent	2035, percent	2040, percent	2045, percent
Average Year	100	100	100	100	100
Single Dry Year	64	64	63	63	55
Consecutive 1st Dry Year	64	64	63	63	55
Consecutive 2nd Dry Year	55	55	54	54	55
Consecutive 3rd Dry Year	55	55	54	54	55
Consecutive 4th Dry Year	55	55	54	48	46
Consecutive 5th Dry Year	55	55	50	48	46

(a) Average year reliability derived from BAWSCA Table A: Wholesale RWS Actual Purchases in 2020 and Projected Purchases for 2025, 2030, 2035, 2040, and 2045; provided by BAWSCA on April 1, 2021.

(b) Dry year reliability derived from BAWSCA Tables G2, H2, I2, J2 and K2: Individual Agency Drought Allocations, Base Years 2025, 2030, 2035, 2040 and 2045; Single Dry Year is based on the 1st Year of five consecutive dry years; provided by BAWSCA on April 1, 2021.

Table 4-4. Projected SFPUC Supply Availability for the City of San Bruno in Years 2025 to 2045 without Bay-Delta Plan Amendment[a,b]					
Year Type	2025, percent	2030, percent	2035, percent	2040, percent	2045, percent
Average Year	100	100	100	100	100
Single Dry Year	100	100	100	100	100
Consecutive 1st Dry Year	100	100	100	100	100
Consecutive 2nd Dry Year	100	100	100	100	100
Consecutive 3rd Dry Year	100	100	100	100	100
Consecutive 4th Dry Year	100	100	100	100	81
Consecutive 5th Dry Year	100	100	100	100	81

(a) Average year reliability derived from BAWSCA Table A: Wholesale RWS Actual Purchases in 2020 and Projected Purchases for 2025, 2030, 2035, 2040, and 2045; provided by BAWSCA on April 1, 2021.

(b) Dry year reliability derived from BAWSCA Tables N, O1 and O2 showing Percent Cutback to the Wholesale Customers without the Bay-Delta Plan Amendment and Individual Agency Drought Allocations, Base Year 2045, without the Bay-Delta Plan Amendment; Single Dry Year is based on the 1st Year of five consecutive dry years; provided by BAWSCA on April 1, 2021. The City's Tier 2 Drought Cutback is 19.1%.

4.6.2 NCCWD Reliability

Because water purchased by the City from NCCWD originates from the RWS, the City's purchases of NCCWD supplies are subject to the same SFPUC reliability constraints as the City's supplies purchased directly from SFPUC. Therefore, it is assumed that supply reliability from the NCCWD will be the same as that presented in Tables 4-3 and 4-4.

4.6.3 Groundwater Reliability

The South Westside Basin has received sufficient recharge such that it has maintained relatively stable groundwater levels in recent years. Because the availability of groundwater is more dependent on long-term climate than year-to-year hydrology, and because the Regional GSR Project has been implemented to increase recharge of the South Westside Basin in wet and normal years, the City's groundwater supplies are not subject to reductions in dry years so long as the City does not exceed the estimated sustainable groundwater yield of 2.1 mgd.

The City is concerned about the effect of saltwater intrusion on the quality of its groundwater supplies. To date however, regional groundwater monitoring has detected no indication that saltwater intrusion has occurred in the City. Therefore, it is assumed that the City will be able to produce 2.1 mgd of groundwater from its wells during average, single dry, and multiple dry year droughts.

The estimated availability of the City's groundwater supplies is summarized in Table 4-5.

Table 4-5. Estimated Availability of the City's Groundwater Supplies[a]

Year Type	Available Groundwater Supply, percent
Average Year	0[b]
Single Dry Year	100
Consecutive 1st Dry Year	100
Consecutive 2nd Dry Year	100
Consecutive 3rd Dry Year	100
Consecutive 4th Dry Year	100
Consecutive 5th Dry Year	100

(a) The City's estimated sustainable groundwater yield is equal to 2.1 mgd.

(b) It is assumed that the City will not operate its groundwater wells during an average year, and this supply will be replaced with in-lieu surface water from SFPUC as part of the Regional GSR Project.

4.7 BASIS OF WATER SUPPLY DATA

As described above, the quantity of supply available from different water supply sources can vary from one year to the next depending on hydrologic conditions. Historical data, where available, were therefore used to develop a projected yield for each water supply source under three conditions: (1) average water year, (2) single dry year, and (3) multiple dry years.

The following basis of water supply data for each supply source are presented assuming with and without the Bay-Delta Plan Amendment to provide a comparison for worst and best-case supply conditions.

4.7.1 Basis of Water Supply Data for SFPUC Supplies

Based on SFPUC's estimated availability of wholesale RWS supplies, Table 4-6 shows the basis of water supply data for the City's surface water supplies from SFPUC with the Bay-Delta Plan Amendment. It is assumed that the Regional GSR Project will operate in 'put' mode in average years, and that the City will receive up to a maximum of 2.1 mgd of surface water from SFPUC in-lieu of utilizing groundwater supplies. Therefore, available SFPUC supplies in an average year are equal to available surface water for the City to purchase under its ISG, plus an additional 2.1 mgd of in-lieu water. In dry years, it is assumed that the Regional GSR Project will operate in 'take' mode, and that the City will not receive any in-lieu surface water from SFPUC.

As shown in Table 4-6, available SFPUC supply in dry years with the Bay-Delta Plan Amendment are significantly less than the City's full ISG of 3.25 mgd. Reductions in available SFPUC supplies are as high as 54 percent from projected purchases.

Table 4-6. Basis of Water Supply Data for the City's Supplies from SFPUC with the Bay-Delta Plan Amendment, mgd					
Year Type	2025	2030	2035	2040	2045
Average Year[a,b]	5.34	5.32	5.30	5.30	5.31
Single Dry Year[c]	2.07	2.05	2.03	2.03	1.75
Consecutive 1st Dry Year[c]	2.07	2.05	2.03	2.03	1.75
Consecutive 2nd Dry Year[c]	1.77	1.76	1.74	1.74	1.75
Consecutive 3rd Dry Year[c]	1.77	1.76	1.74	1.74	1.75
Consecutive 4th Dry Year[c]	1.77	1.76	1.74	1.54	1.49
Consecutive 5th Dry Year[c]	1.77	1.76	1.60	1.54	1.49

(a) Purchased surface water from BAWSCA Table A: Wholesale RWS Actual Purchases in 2020 and Projected Purchases for 2025, 2030, 2035, 2040, and 2045; provided by BAWSCA on April 1, 2021.

(b) In addition to purchased surface water, it is assumed that up to 2.1 mgd of in-lieu surface water will be available from SFPUC during average years as part of the Regional GSR Project.

(c) From BAWSCA Tables G2, H2, I2, J2 and K2: Individual Agency Drought Allocations, Base Years 2025, 2030, 2035, 2040 and 2045; Single Dry Year is based on the 1st Year of five consecutive dry years; provided by BAWSCA on April 1, 2021.

For comparison purposes, Table 4-7 shows the basis of water supply data for the City's supplies from SFPUC without the Bay-Delta Plan Amendment. As shown, without the Bay-Delta Plan Amendment, the only reduction in available SFPUC supplies occurs in the fourth and fifth dry years of the 2045 base year.

Table 4-7. Basis of Water Supply Data for the City's Supplies from SFPUC without the Bay-Delta Plan Amendment, mgd					
Year Type	2025	2030	2035	2040	2045
Average Year[a,b]	5.34	5.32	5.30	5.30	5.31
Single Dry Year[c]	3.24	3.22	3.20	3.20	3.21
Consecutive 1st Dry Year[c]	3.24	3.22	3.20	3.20	3.21
Consecutive 2nd Dry Year[c]	3.24	3.22	3.20	3.20	3.21
Consecutive 3rd Dry Year[c]	3.24	3.22	3.20	3.20	3.21
Consecutive 4th Dry Year[c]	3.24	3.22	3.20	3.20	2.60
Consecutive 5th Dry Year[c]	3.24	3.22	3.20	3.20	2.60

(a) Purchased surface water from BAWSCA Table A: Wholesale RWS Actual Purchases in 2020 and Projected Purchases for 2025, 2030, 2035, 2040, and 2045; provided by BAWSCA on April 1, 2021.

(b) In addition to purchased surface water, it is assumed that up to 2.1 mgd of in-lieu surface water will be available from SFPUC during average years as part of the Regional GSR Project.

(c) From BAWSCA Tables N, O1 and O2 showing Percent Cutback to the Wholesale Customers without the Bay-Delta Plan Amendment and Individual Agency Drought Allocations, Base Year 2045, without the Bay-Delta Plan Amendment; Single Dry Year is based on the 1st Year of five consecutive dry years; provided by BAWSCA on April 1, 2021.

4.7.2 Basis of Water Supply Data for NCCWD Supplies

Because water purchased by the City from NCCWD originates from the RWS, NCCWD supplies are subject to the same reliability constraints as SFPUC supply. Therefore, based on SFPUC's estimated availability of wholesale RWS supplies, Table 4-8 shows the basis of water supply data for the City's surface water supplies from NCCWD with the Bay-Delta Plan Amendment.

Table 4-8. Basis of Water Supply Data for the City's Supplies from NCCWD with the Bay-Delta Plan Amendment, mgd

Year Type	2025	2030	2035	2040	2045
Average Year(a)	0.05	0.05	0.05	0.05	0.05
Single Dry Year(b)	0.03	0.03	0.03	0.03	0.03
Consecutive 1st Dry Year(b)	0.03	0.03	0.03	0.03	0.03
Consecutive 2nd Dry Year(b)	0.03	0.03	0.03	0.03	0.03
Consecutive 3rd Dry Year(b)	0.03	0.03	0.03	0.03	0.03
Consecutive 4th Dry Year (b)	0.03	0.03	0.03	0.02	0.02
Consecutive 5th Dry Year(b)	0.03	0.03	0.03	0.02	0.02

(a) Purchased surface water from NCCWD in an average year is assumed to be equal to the historical maximum NCCWD supply received.
(b) Dry year NCCWD supply is assumed to be subject to the same level of reduction as the City's SFPUC supply.

Table 4-9 shows the basis of water supply data for the City's supplies from NCCWD without the Bay-Delta Plan Amendment.

Table 4-9. Basis of Water Supply Data for the City's Supplies from NCCWD without the Bay-Delta Plan Amendment, mgd

Year Type	2025	2030	2035	2040	2045
Average Year(a)	0.05	0.05	0.05	0.05	0.05
Single Dry Year(b)	0.05	0.05	0.05	0.05	0.05
Consecutive 1st Dry Yea (b)	0.05	0.05	0.05	0.05	0.05
Consecutive 2nd Dry Year(b)	0.05	0.05	0.05	0.05	0.05
Consecutive 3rd Dry Year(b)	0.05	0.05	0.05	0.05	0.05
Consecutive 4th Dry Year b)	0.05	0.05	0.05	0.05	0.04
Consecutive 5th Dry Year(b)	0.05	0.05	0.05	0.05	0.04

(a) Purchased surface water from NCCWD in an average year is assumed to be equal to the historical maximum NCCWD supply received.
(b) Dry year NCCWD supply is assumed to be subject to the same level of reduction as the City's SFPUC supply.

4.7.3 Basis of Water Supply Data for City's Groundwater Supplies

Table 4-10 presents the City's basis of water supply data for its groundwater supplies. It is assumed that the Regional GSR Project will operate in 'put' mode in average years, and that the City will receive up to a maximum of 2.1 mgd of surface water from SFPUC in-lieu of utilizing groundwater supplies. Therefore, groundwater supply is shown as 0 mgd in average years. In dry years, it is assumed that the Regional GSR Project will operate in 'take' mode, and that the City can utilize the full sustainable groundwater yield of 2.1 mgd.

Table 4-10. Basis of Water Supply Data for the City's Groundwater Supplies, mgd

Year Type	2025	2030	2035	2040	2045
Average Year[(a)]	0	0	0	0	0
Single Dry Year	2.10	2.10	2.10	2.10	2.10
Consecutive 1st Dry Year	2.10	2.10	2.10	2.10	2.10
Consecutive 2nd Dry Year	2.10	2.10	2.10	2.10	2.10
Consecutive 3rd Dry Year	2.10	2.10	2.10	2.10	2.10
Consecutive 4th Dry Year	2.10	2.10	2.10	2.10	2.10
Consecutive 5th Dry Year	2.10	2.10	2.10	2.10	2.10

(a) It is assumed that the City will not operate its groundwater wells during an average year. Instead, up to 2.1 mgd of in-lieu surface water will be available from SFPUC during average years as part of the Regional GSR Project.

4.7.4 Summary of Basis of Water Supply for the City

Table 4-11 and Table 4-12 present a summary of available City water supplies in normal, single dry, and multiple dry years with and without the Bay-Delta Plan Amendment, respectively.

Table 4-11. Summary of Basis of City Water Supplies with the Bay-Delta Plan Amendment, mgd

Year Type	2025	2030	2035	2040	2045
Average Year	5.39	5.37	5.35	5.35	5.36
Single Dry Year	4.20	4.18	4.16	4.16	3.88
Consecutive 1st Dry Year	4.20	4.18	4.16	4.16	3.88
Consecutive 2nd Dry Year	3.90	3.89	3.87	3.87	3.88
Consecutive 3rd Dry Year	3.90	3.89	3.87	3.87	3.88
Consecutive 4th Dry Year	3.90	3.89	3.87	3.66	3.61
Consecutive 5th Dry Year	3.90	3.89	3.73	3.66	3.61

Table 4-12. Summary of Basis of City Water Supplies without the Bay-Delta Plan Amendment, mgd					
Year Type	2025	2030	2035	2040	2045
Average Year	5.39	5.37	5.35	5.35	5.36
Single Dry Year	5.39	5.37	5.35	5.35	5.36
Consecutive 1st Dry Year	5.39	5.37	5.35	5.35	5.36
Consecutive 2nd Dry Year	5.39	5.37	5.35	5.35	5.36
Consecutive 3rd Dry Year	5.39	5.37	5.35	5.35	5.36
Consecutive 4th Dry Year	5.39	5.37	5.35	5.35	4.74
Consecutive 5th Dry Year	5.39	5.37	5.35	5.35	4.74

4.8 SUPPLY AND DEMAND ASSESSMENT

The City's projected supply and demand assessment for normal, single dry, and multiple dry years (five-year droughts) are quantified and discussed below. It is assumed for the purposes of this evaluation that the Bay-Delta Plan Amendment will be implemented to provide a more conservative supply and demand assessment. Demands for single dry and multiple dry years are assumed to be equal to demands in normal years. Where available supplies cannot meet normal year demands, the level of demand reduction and associated WSCP Stage needed to achieve that reduction are listed.

4.8.1 Normal Year

As shown in Table 4-13, the City's normal year supplies are adequate to meet projected normal year demands.

Table 4-13. Normal Year Supply and Demand Comparison, mgd					
Supply/Demand	2025	2030	2035	2040	2045
Supply Total	**5.39**	**5.37**	**5.35**	**5.35**	**5.36**
Demand Total	**3.53**	**3.95**	**4.37**	**4.78**	**4.78**
Surplus (Deficit)	1.86	1.42	0.98	0.57	0.58

4.8.2 Single Dry Year

As shown in Table 4-14, the City's single dry year supplies are not adequate to meet projected single dry year demands. Supply shortfalls ranging from 5 to 19 percent are projected after 2030. This shortfall is primarily due to significant cutbacks in the City's supply from SFPUC which is significantly reduced in dry years due to the Bay-Delta Plan Amendment.

In years with a supply shortfall, the City can implement its WSCP to reduce demands to the level of available supply. Implementation of WSCP Stage 1 in 2035 and of WSCP Stage 2 in 2040 and 2045 should achieve the necessary demand reductions required to meet available single dry year supplies.

It should be noted that without the Bay-Delta Plan Amendment, no supply shortfall would be anticipated as no cutbacks would be anticipated in the City's supply from SFPUC.

Table 4-14. Single Dry Year Supply and Demand Comparison, mgd

Supply/Demand	2025	2030	2035	2040	2045
Supply Total	4.20	4.18	4.16	4.16	3.88
Demand Total	3.53	3.95	4.37	4.78	4.78
Surplus (Deficit)	0.67	0.23	(0.21)	(0.62)	(0.90)
Supply Deficit, %	--	--	5%	13%	19%
WSCP Stage	--	--	1	2	2

4.8.3 Multiple Dry Years (Five-Year Droughts)

As shown in Table 4-15, the City's multiple dry year supplies are not adequate to meet projected multiple dry year demands. Significant supply shortfalls, ranging from 5 to 19 percent in the first year of the five-year dry period to 2 to 24 percent in the fifth year of the five-year dry period, are projected. This shortfall is primarily due to significant cutbacks in the City's supply from SFPUC which is significantly reduced in dry years due to the Bay-Delta Plan Amendment.

In years with a supply shortfall, the City can implement its WSCP to reduce demands to the level of available supply. The WSCP Stages required to achieve the necessary demand reductions range from Stage 1 to Stage 3 and are shown in Table 4-15.

It should be noted that without the Bay-Delta Plan Amendment, supply shortfalls would be nearly eliminated. A cutback of approximately 19 percent in the City's supply from the SFPUC would only occur in the fourth and fifth dry years of the 2045 base year. The only anticipated supply shortage would be less than 1 percent in the fourth and fifth dry years of the five-year dry period in 2045.

Table 4-15. Multiple Dry Year Supply and Demand Comparison, mgd					
Supply/Demand	2025	2030	2035	2040	2045
First Year					
Supply Total	4.20	4.18	4.16	4.16	3.88
Demand Total	3.53	3.95	4.37	4.78	4.78
Difference	0.67	0.23	(0.21)	(0.62)	(0.90)
Supply Deficit, %	--	--	5%	13%	19%
WSCP Stage	--	--	1	2	2
Second Year					
Supply Total	3.90	3.89	3.87	3.87	3.88
Demand Total	3.53	3.95	4.37	4.78	4.78
Difference	0.37	(0.06)	(0.50)	(0.91)	(0.90)
Supply Deficit, %	--	2%	11%	19%	19%
WSCP Stage	--	1	2	2	2
Third Year					
Supply Total	3.90	3.89	3.87	3.87	3.88
Demand Total	3.53	3.95	4.37	4.78	4.78
Difference	0.37	(0.06)	(0.50)	(0.91)	(0.90)
Supply Deficit, %	--	2%	11%	19%	19%
WSCP Stage	--	1	2	2	2
Fourth Year					
Supply Total	3.90	3.89	3.87	3.66	3.61
Demand Total	3.53	3.95	4.37	4.78	4.78
Difference	0.37	(0.06)	(0.50)	(1.12)	(1.17)
Supply Deficit, %	--	2%	11%	23%	24%
WSCP Stage	--	1	2	3	3
Fifth Year					
Supply Total	3.90	3.89	3.73	3.66	3.61
Demand Total	3.53	3.95	4.37	4.78	4.78
Difference	0.37	(0.06)	(0.64)	(1.12)	(1.17)
Supply Deficit, %	--	2%	15%	23%	24%
WSCP Stage	--	1	2	3	3

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CHAPTER 5
Hydraulic Model Update

This chapter describes the update and calibration of the City's water system hydraulic model. To update the City's hydraulic model, West Yost completed the following tasks:

- Used the City's updated water distribution system GIS data, which included infrastructure installed as of June 2020, to incorporate new or replaced pipelines, reducing valves, and other water system facilities into the hydraulic model;
- Updated model elevations using 2017 LiDAR data;
- Verified that the hydraulic model system configuration (pipeline sizes, alignments, connections, and other facility sizes and locations) is generally representative of the City's current water system; and
- Allocated recent existing water demands by using the City's spatially located metered account information from 2019 to distribute demands within the hydraulic model.

The updated water distribution system model was then calibrated using flow and pressure data observed in the field during September 2020. The hydraulic model update and calibration are described in the following sections.

5.1 UPDATE OF THE HYDRAULIC MODEL

The following sections describe the updates made to the City's hydraulic model.

5.1.1 Pipeline Updates

City staff provided an updated GIS geodatabase file containing the geospatial location of existing pipelines for the City's water system. West Yost reviewed the updated GIS file and compared it with the hydraulic model pipelines to identify areas in the model which needed to be updated with new or replaced pipelines.

The City's geodatabase layer for existing water pipelines does not include roughness factors. During development of the hydraulic model for the 2012 WSMP, the City provided West Yost with a pipeline subdivision map, which identified approximate pipeline material type and age by geographical location. Consequently, West Yost assigned a preliminary roughness factor (i.e., C-factor) based on experience and professional judgment to each pipeline by using its diameter, approximate material type, and approximate year of construction. These roughness factors were confirmed during model calibration performed in 2011. The C-factors previously adopted in the 2012 WSMP were validated or modified during more recent calibration of the hydraulic model performed in September 2020, as described in Section 5.2.

5.1.2 System Elevations

In the 2012 WSMP, model elevations were assigned based on interpolation of elevation contours generated from the U.S. Geological Survey (USGS) National Elevation Database Digital Elevation Model (NED DEM). NED DEM consists of a grid of elevation values posted approximately every 10 meters. A surface contouring program was used to generate the elevation contours; the resulting shapefile was used to assign service elevations to each node using the model's Elevation Interpolation feature.

However, more accurate elevation data is now available. As part of the model update for this WSMP, system elevations were updated using 2017 Light Detection and Ranging (LiDAR) data provided by San Mateo County. LiDAR is a remote sensing method which uses light reflection to map terrain, and typically produces vertical elevation data which is accurate to within less than one foot. This data appears to better match observed elevations in the steep and hilly sections of the City.

Model elevations are based on the National American Vertical Datum of 1988 (NAVD 88).

5.1.3 Water System Facilities

Properties of major system facilities (e.g., turnouts, pressure reducing valves, groundwater wells, pump stations, and storage tanks) were reviewed and updated in the hydraulic model to capture changes since the 2012 WSMP. Data from recent pump efficiency tests was used to adjust the pump curves in the hydraulic model to better match observed performance.

5.1.4 Water Demand Allocation

Updating the existing water demand allocation in the hydraulic model with recent water meter data improves the ability of the model to accurately simulate system performance by correctly representing where water use occurs in the City.

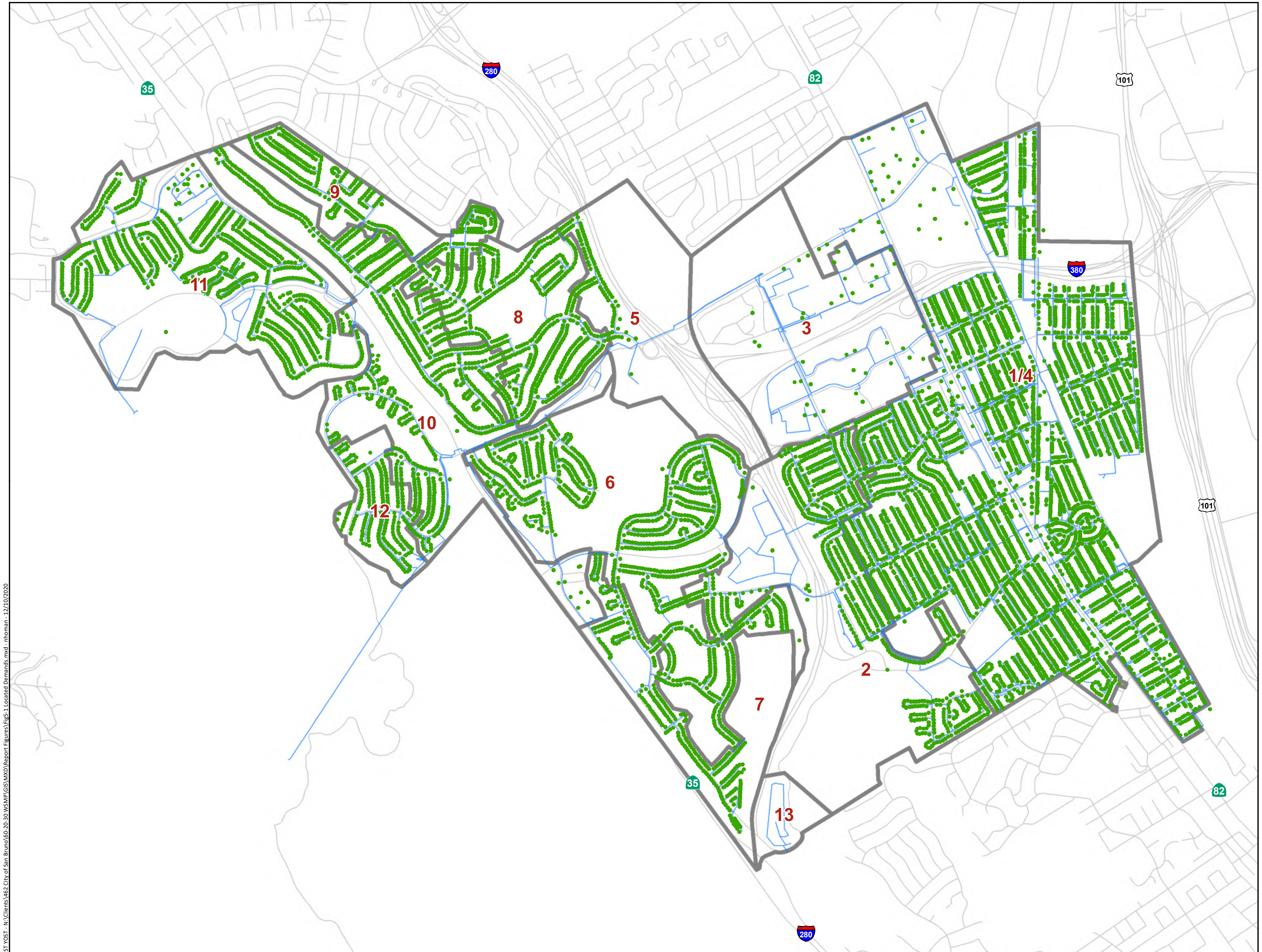
City staff provided GIS files containing spatially located water meters linked with metered consumption data for 2019 including charge codes indicating customer sector and street addresses. After manually locating some water meters without spatial coordinates using street addresses, West Yost was able to spatially locate over 97 percent of the metered demands in the provided files. However, the provided files did not include meter data from public facilities, and therefore, the located water demands are only equivalent to approximately 93 percent of the total water consumption recorded by the City for 2019. Table 5-1 presents the percentage of metered consumption spatially located.

Table 5-1. Spatially Located Demands Summary

Data Source	Total Metered Demand, mgd	Average Day Demand, gpm
Actual 2019[(a)]	2.84	1,974
Spatially Located (provided GIS files)	2.23	1,550
Spatially Located (manually located by West Yost)	0.41	282
Spatially Located Total[(b)]	**2.64**	**1,832**
Percent of Actual 2019	92.8%	92.8%

(a) Data provided by City staff in April 2020. Does not include non-revenue water.
(b) Based on West Yost's modified GIS.

Figure 5-1 compares the spatially located water demand data with the existing pipelines in the City's hydraulic model. As shown in Figure 5-1, most areas with spatially located demands also had an existing pipeline. This correlation indicates that the hydraulic model includes most of the existing pipelines required to serve current water demands.



N

0 850 1,700

Scale in Feet

Spatially Located Water Meter
Pipeline
Pressure Zone Boundary

Notes:
1. Water meters locations shown are based on 2019 billing records provided by the City on September 1, 2020.

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Figure 5-1

Spatially Located Water Demands

City of San Bruno
Water System Master Plan

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Located water demands were allocated in the hydraulic model using the Demand Allocator module of the modeling software. The Demand Allocator automatically assigns the spatially located demand point to the closest pipeline to its position in the system. West Yost determined the pressure zone serving each located water meter record, and then ran the Demand Allocator module separately for each pressure zone to ensure that demands were allocated to the correct pressure zone. West Yost staff reviewed the hydraulic model after running the Demand Allocator to confirm that the demands were allocated properly.

In the model, demands can be assigned in up to 10 different columns, which can be helpful to differentiate different demand types. Water demand in the hydraulic model was allocated by customer sector. Table 5-2 presents the demand column assigned to each customer sector within the hydraulic model.

Table 5-2. Customer Sector Assignment

Customer Sector	Demand Column in Model[a]
Single Family Residential	1
Multi-Family Residential	2
Commercial[b]	3
Not Billed[c]	4
Pressure Zone 13[d]	5

(a) Column number corresponds to Demand Column Number in Junction database of the InfoWater model.
(b) May include other non-residential water use types (e.g., Industrial).
(c) Reserved for accounts that are metered, but not billed. These accounts are for public sector water uses at City facilities. No data for these accounts was provided for this model update.
(d) Meter data for Pressure Zone 13 was not provided for this model update. Water demands were allocated based on 2019 production records.

After allocating metered demands from 2019 in the hydraulic model, these demands were scaled to match 2019 production data to account for the 7 percent of 2019 metered water consumption which could not be located and for non-revenue water. It is assumed that the unlocated demands are distributed evenly throughout the City, and that their exact location will not have a significant impact on hydraulic model results.

5.2 HYDRAULIC MODEL CALIBRATION

The City's hydraulic model was re-calibrated to confirm that the updated computer simulation model can accurately represent the operation of the City's water distribution system under varying conditions. The roughness of existing pipelines, expressed in the model as Hazen Williams C-factors (C-factors), changes as pipelines age and deteriorate. To ensure that the C-factors used in the 2012 WSMP are still representative of the City's 2020 water system, the City's hydraulic model was re-calibrated in September 2020. Calibration of the hydraulic model used data gathered through hydrant tests as described in the following sections.

5.2.1 Development of Hydrant (C-Factor) Tests

After updating the hydraulic model, locations were chosen for possible hydrant flow testing as shown on Figure 5-2. Unlike in the 2012 WSMP, the hydrant tests performed for this calibration were unidirectional style tests in which operators closed system valves near the flowing hydrant to provide a single flow path along which the pipeline head loss could be measured. Hydrant test locations were chosen based on several factors, including pipeline age, material, diameter, pressure zone, and availability of isolation valves. These hydrant tests were used to "spot-check" the pipeline friction factors (C-factors) assigned and to calibrate the model to ensure that the hydraulic model closely represents observed pressure conditions in the field.

Hydrant flow testing was scheduled and performed on September 18, 2020. Table 5-3 provides the field status of each hydrant test. Of the original ten scheduled hydrant tests (including two alternate tests), seven hydrant tests were performed. Three hydrant tests were canceled due to time constraints during the testing day. Out of the seven hydrant tests performed, one test (Test 3) was identified in the field as invalid due to suspected pipeline configuration issues, and although field data was gathered, evaluation of Test 3 was not performed.

Each hydrant test involved flowing water through pipelines of a specific diameter, material type, and age, and then measuring the pressure drops through the pipelines to determine friction losses. The hydrant test procedure consisted of monitoring discharge flow and pressure at the key flowing hydrant, and pressures at other hydrants along the supply route to that key hydrant. Static pressures were measured while the key hydrant was closed, and residual pressures were measured while the key hydrant was flowing.

Each valid hydrant flow test performed was then simulated using the hydraulic model of the City's water system. System controls and demands in the hydraulic model were adjusted based on SCADA data recorded during the testing day to mimic system operations observed in the field. Model results were compared to the field data to determine the accuracy of the model. The differences between observed static and residual pressures for the field hydrant test were calculated and compared to readings predicted by the model. The goal of the calibration effort was to achieve no greater than a 5 psi differential between the field hydrant test data and model-simulated results, based on standard engineering practice.

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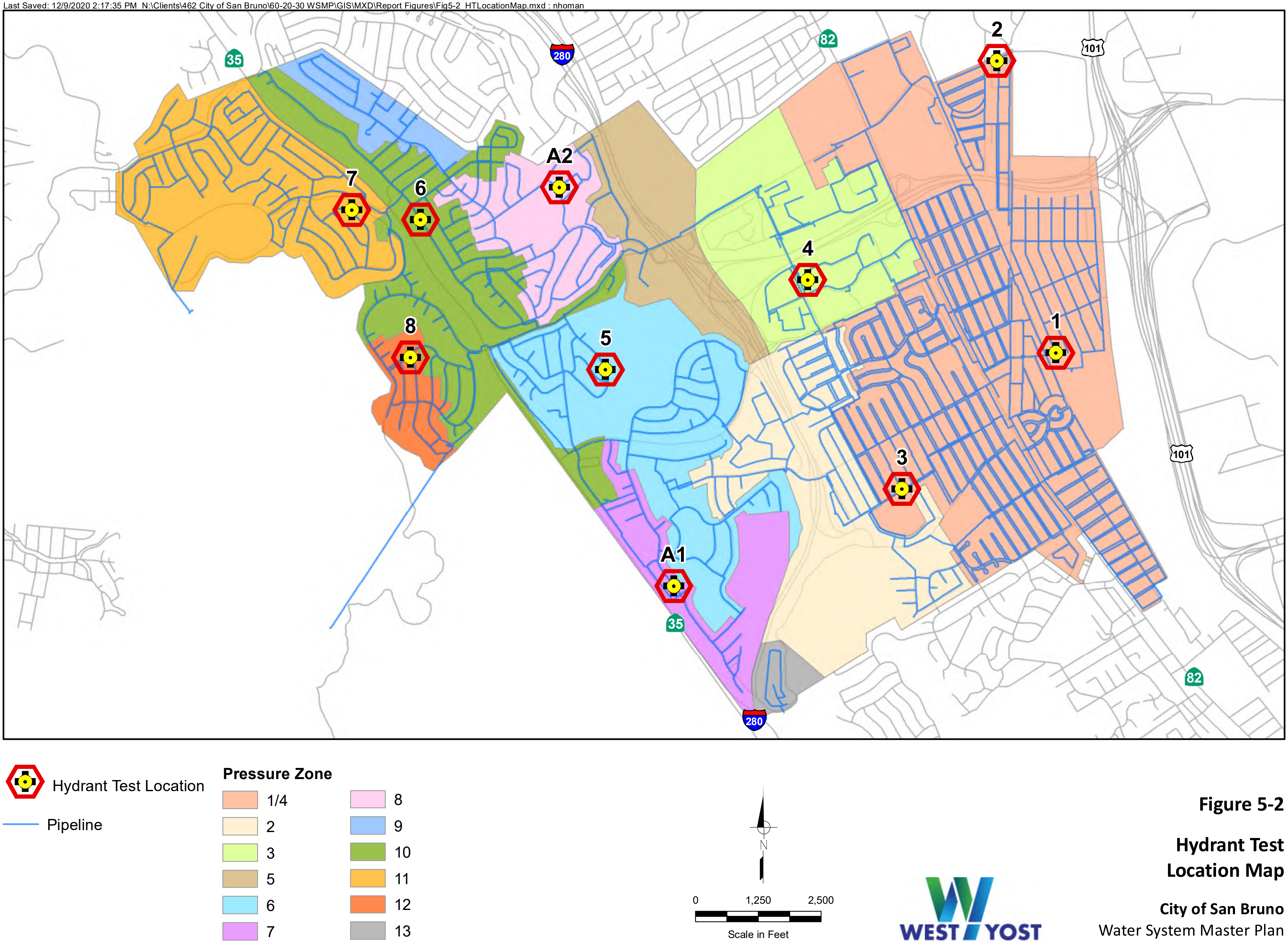

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Figure 5-2

Hydrant Test Location Map

City of San Bruno
Water System Master Plan

Table 5-3. Hydrant Test Locations and Status					
Test No.[(a)]	Pipeline Material	Approximate Installation Decade	Pipeline Diameter, inches	Location	Status
1	PVC[(b)]	2000s[(b)]	8	1st Avenue, between Pine Street and the dead-end south of Angus Avenue	Completed
2	CI	1930s	10	Tanforan Avenue and Montgomery Avenue	Not completed due to lack of time
3	CI	1930s	4	Cherry Avenue and Niles Avenue	Completed, test invalid
4	CI	1970s	8	Grundy Lane and Cherry Avenue	Completed
5	DI	2010s	8	Claremont Drive between Fairmont Drive and just past Concord Way	Completed
6	AC	1950s	6	Fleetwood Drive between Rollingwood Drive and Evergreen Drive	Completed
7	CI	1960s	6	Goodwin Drive between both intersections with Emaron Drive	Completed
8	CI	1960s	6	Lake Drive and Amador Avenue	Completed
A1	AC	1950s	6	Crestmoor Drive between Rosewood Drive and Bryant Way	Alternate, not completed due to lack of time
A2	AC	1950s	6	Fernwood Drive	Alternate, not completed due to lack of time

(a) Planned for eight test locations and two alternate test locations if time permitted.
(b) Initially assumed to be 1930s CI but found to be 2000s PVC based on discussion with City staff.

5.2.2 Hydrant (C-factor) Test Results

Table 5-4 presents the field data collected during hydrant testing and compares it with the results simulated by the hydraulic model. A detailed discussion regarding each of the completed hydrant tests is provided below.

5.2.2.1 Test 1: 8-inch PVC Pipelines Constructed in the 2000s

It should be noted that static pressures were not recorded in the field for hydrants 1A and 1B due to the maximum pressure limitation of the gauges used at these hydrants. The static pressures "recorded" at these hydrants were estimated based on the elevations and static pressures recorded at the other hydrants. Because of the lack of actual static pressure data at these locations, it is possible that the actual differential pressures are different than estimated.

Initial model simulation results were not in close agreement with the recorded field data. West Yost found that after increasing the C-factor (reducing the roughness) in PVC pipelines to 140, the model simulated results better matched observed data. However, even after this adjustment, the simulated results for Hydrant 1D are outside the ±5 psi tolerance limit. A closer examination of the data indicates that there may have been an error with the static pressure reading at observation Hydrant 1D. Therefore, it is recommended that the data from Hydrant 1D not be used. Because the remaining observation hydrants are within the ±5 psi tolerance limit, the C-factor for all PVC pipelines was updated from 130 to 140 system-wide in the hydraulic model.

5.2.2.2 Test 4: 8-inch CI Pipelines Constructed in the 1970s

Initial model simulation results indicated that there may be system configuration issues (partially closed valve(s), inaccurate representation of pipeline connectivity, etc.) in this area. On November 17th, 2020, City staff confirmed that the 8-inch diameter connection in Elm Avenue between Bayhill Drive and Grundy Drive that is in the model does not exist. This connection had been added to the model in the 2012 WSMP to resolve a configuration issue identified during calibration. However, a second connection between Bayhill Drive and Grundy Drive located in the parking lot east of 950 Elm Avenue was later added to the hydraulic model as part of work performed for the design of new regulating stations in Zone 3. Discussion with City staff confirmed that only the connection in the parking lot exists, and that the addition made in the 2012 WSMP was in the wrong alignment.

Initial model simulation results also indicated that RS26 and RS27, which regulate the pressure of the Zone 3 supply from the C4 and C3 turnouts, respectively, were not represented correctly in the model. Based on the SCADA data, the regulating settings for the 8-inch diameter valves at RS26 and RS27 were adjusted from 90 psi to 86 psi.

Table 5-4. Summary of Hydrant Test Calibration Results

Hydrant[a]	Field Data			Modeled Data			Comparison of Differential Pressures between Field and Modeled Data[b]
	Static Pressure, psi	Residual Pressure, psi	Differential Pressure, psi (Static - Residual)	Static Pressure, psi	Residual Pressure, psi	Differential Pressure, psi (Static - Residual)	
Hydrant Flow Test No. 1 [1st Avenue, Between Pine Street and the dead-end south of Angus Avenue]							
1	96	31	N/A	97	N/A	N/A	N/A
1A	96[c]	48	49	98	50	48	1
1B	97[c]	59	38	98	57	42	-4
1C	96	58	38	98	64	35	3
1D	100	65	36	97	69	28	8
Hydrant Flow Test No. 3 [Cherry Avenue and Niles Avenue][d]							
3	36	10	N/A	--	N/A	N/A	N/A
3A	33	32	1	--	--	--	--
3B	41	40	1	--	--	--	--
3C	56	56	0	--	--	--	--
Hydrant Flow Test No. 4 [Grundy Lane and Cherry Avenue]							
4	103	62	N/A	103	N/A	N/A	N/A
4A	103[c]	72	31	103	67	36	-6
4B	110[c]	80	30	111	81	30	1
4C	115	88	27	116	90	27	0
4D	120	96	25	119	94	25	0
Hydrant Flow Test No. 5 [Claremont Drive between Fairmont Drive and Concord Way]							
5	87	54	N/A	85	N/A	N/A	N/A
5A	93	67	26	94	68	26	0
5B	80	57	24	85	61	23	0
5C	72	51	21	76	55	20	1
5D	70	50	20	69	52	17	3
Hydrant Flow Test No. 6 [Fleetwood Drive between Rollingwood Drive and Evergreen Drive][e]							
6	76	25	N/A	--	N/A	N/A	N/A
6A	91	56	36	--	--	--	--
6B	90	63	27	--	--	--	--
6C	105	88	17	--	--	--	--
6D	125	125	0	--	--	--	--
Hydrant Flow Test No. 7 [Goodwin Drive between both intersections with Emaron Drive]							
7	80	5	N/A	80	N/A	N/A	N/A
7A	78	12	67	80	14	67	0
7B	77	19	59	81	22	59	0
7C	60	15	46	61	16	45	0
7D	77	49	29	81	51	30	-2
Hydrant Flow Test No. 8 [Lake Drive and Amador Avenue]							
8	105	15	N/A	108	N/A	N/A	N/A
8A	93	18	75	95	19	75	0
8B	75	15	61	81	19	62	-2
8C	45	12	34	56	10	47	-13
8D	53	20	33	54	21	33	0

(a) Location of hydrants can be found in the Hydrant Test Memorandum prepared by West Yost (Appendix B).
(b) The goal of the calibration effort is to achieve a differential pressure comparison within 5 psi for the observed hydrants.
(c) Static pressures not recorded due to maximum pressure limitation of the gauges used at these hydrants. The static pressures "recorded" at these hydrants were estimated based on the elevation and static pressures recorded at the other hydrants.
(d) Test 3 was invalid due to suspected pipeline configuration issues. Evaluation of the test in the hydraulic model was not performed.
(e) Test 6 could not be replicated in the hydraulic model due to valve operation issues.

After correcting this pipeline configuration issue and adjusting RS settings, model simulation results are within the ±5 psi tolerance limit, with the exception of the results from observation Hydrant 4A, where the difference between field-observed and model-simulated pressures was 6 psi. This may be because static pressures were not recorded in the field for hydrants 4A and 4B due to the maximum pressure limitation of the gauges used at these hydrants. The static pressures “recorded” at these hydrants were estimated based on the elevation and static pressures recorded at the other hydrants. Because of the lack of actual static pressure data at these locations, it is possible that the actual differential pressures are different than estimated. Therefore, it is recommended that the data from Hydrant 4A not be used. Because the remaining observation hydrants are within the ±5 psi tolerance limit, this test does not indicate a need to adjust the C-factor of 120 for CI pipelines constructed in the 1970s.

5.2.2.3 Test 5: 8-inch DI Pipelines Constructed in the 2010s

Initial model simulation results were not in close agreement with the recorded field data and indicated that RS7 West and RS7 East, which provide flow to Zone 6 from Zone 10 during a fire, were not represented correctly in the model. Based on the SCADA data, the regulating settings for the 8-inch diameter valves at RS7 West and RS7 East were adjusted from 40 psi to 30 psi and from 49 psi to 37 psi, respectively.

However, adjusting the settings of RS7 alone did not resolve the discrepancies between the field data and model simulation results. West Yost found that after increasing the C-factor (reducing the roughness) in ductile iron pipelines constructed in the 2010s to 144, as suggested by available literature, model simulated results were within the ±5 psi tolerance limit. Therefore, the C-factor for ductile iron pipelines installed in the 2010s was updated from 135 to 144 system-wide in the hydraulic model.

5.2.2.4 Test 6: 6-inch AC Pipelines Constructed in the 1950s

The planned valve operations for Test 6 were modified in the field. Initially, West Yost and City staff attempted to perform the test by operating the valves as shown in Appendix B. However, after closing the indicated valves, the flowing hydrant and the test pipeline were completely shut off from water supply. City staff then opened several valves, and water service was restored to the flowing hydrant. The test was then performed again with the valves open and residual pressure data was collected. An attempt was made to replicate the test conditions in the hydraulic model; however, because it is unknown where other potentially closed valves in the test vicinity might be located, the hydraulic model was unable to replicate the observed differential pressures at the observation hydrants and the suction pressures at Pump Station 4 recorded by the SCADA system. Therefore, this test was not used to adjust the C-factor of 120 for AC pipelines constructed in the 1950s.

5.2.2.5 Test 7: 6-inch CI Pipelines Constructed in the 1960s

Model simulation results were well within the ±5 psi tolerance limit. Therefore, this test does not indicate a need to adjust the C-factor for CI pipelines constructed in the 1960s.

5.2.2.6 Test 8: 6-inch CI Pipelines Constructed in the 1960s

Initial model simulation results were not in close agreement with the recorded field data and indicated that RS2 was not represented correctly in the model. Based on the SCADA data and correspondence with City staff, the regulating setting for the 6-inch diameter valve at RS2 was adjusted from 67 psi to 59 psi.

After adjusting RS2, model simulation results are within the ±5 psi tolerance limit, with the exception of the results from observation Hydrant 8C, where the difference between field-observed and model-simulated pressures was 13 psi. A closer examination of the data indicates that there may have been an error with the static pressure reading at observation Hydrant 8C. Therefore, it is recommended that the data from Hydrant 8C not be used. Because the remaining observation hydrants are within the ±5 psi tolerance limit, this test does not indicate a need to adjust the C-factor of 120 for CI pipelines constructed in the 1960s.

5.2.3 Hydraulic Model Calibration Findings and Conclusions

In summary, the results from the hydrant tests indicate that the hydraulic model is generally calibrated within a 5 psi differential from the field hydrant test data. Seven hydrant tests were conducted, one of which was discovered to be invalid in the field. Of the six tests simulated in the hydraulic model, three tests were used to identify updates to model RS settings, one test was used to identify a model configuration issue (i.e., pipelines not identified in GIS), and two tests were used to update the pipeline roughness factors used in the model. Table 5-5 summarizes the updated pipeline roughness factors assigned in the model. Three tests, where model simulated results indicate that there were likely field data measurement errors, had at least three (out of four) residual readings that could be used to validate the model. In only one of the six tests, model results could not be reconciled with field data due to valve operation issues.

These results indicate that the City's hydraulic model in general can accurately simulate a fire flow or other large demand conditions within the City. Based on the results of the hydraulic model calibration, it can be concluded that the hydraulic model provides a reasonable representation of the City's water distribution system and can be used for master planning purposes.

Table 5-5. Updated Pipeline C-Factors Assigned in the Model[a,b]

Year	Cast Iron (CI)		Asbestos Cement (AC)		Ductile Iron (DI)	
	Diameter ≤ 8-inches	Diameter > 8-inches	Diameter ≤ 8-inches	Diameter > 8-inches	Diameter ≤ 8-inches	Diameter > 8-inches
1900-1939	75	100	NA	120	NA	NA
1940-1949	90	110	120	120	NA	NA
1950-1959	100	110	120	120	NA	NA
1960-1969	120	120	120	120	NA	NA
1970-1979	120	120	NA	130	NA	NA
1980-1989	130	140	NA	NA	NA	NA
1990-1999	NA	NA	NA	NA	NA	NA
2000-2009	NA	NA	NA	NA	135	140
2010s	NA	NA	NA	NA	144[c]	144[c]

Year	Polyvinyl Chloride (PVC)		Welded Steel (WS)		Galvanized Steel (GS)	
	Diameter ≤ 8-inches	Diameter > 8-inches	Diameter ≤ 8-inches	Diameter > 8-inches	Diameter ≤ 8-inches	Diameter > 8-inches
1900-1939	NA	NA	NA	NA	75	NA
1940-1949	NA	NA	NA	NA	90	NA
1950-1959	NA	NA	NA	130	NA	NA
1960-1969	NA	NA	NA	130	NA	NA
1970-1979	NA	NA	NA	NA	NA	NA
1980-1989	NA	NA	NA	NA	NA	NA
1990-1999	NA	NA	NA	NA	NA	NA
2000-2009	140[c]	NA	NA	NA	NA	NA
2010s	140[c]	NA	NA	NA	NA	NA

(a) Pipeline installation year and material type information are approximate. Based on data presented in the Initial Infrastructure Construction Map and Material Type by Subdivision Table provided by the City for the 2012 WSMP. Updates to pipeline material and age information presented in the 2012 WSMP were made based on discussion with City staff. Pipes formerly designated as "Unknown" were assigned a pipe material based on nearby pipeline materials. Pipes formerly designated as "Steel" were updated to either Welded Steel or Galvanized Steel based on location and approximate age.

(b) NA - Not Applicable, material was not installed during these years.

(c) C-factor updated based on results of hydrant testing.

CHAPTER 6
System Performance and Operational Criteria

This chapter defines the recommended performance and operational criteria for the City's water distribution system, which frame the City's objectives for facility sizing and water distribution system performance. These criteria define the required fire flow and flow duration; maximum and minimum system pressures; and sizing for distribution system pump stations, pressure regulating stations, and system storage and distribution facilities. The criteria discussed below will be used to assess the ability of the City's water system to provide adequate capacity, flow and pressure to its customers during normal operations and for emergencies, such as a fire or major pipeline outage. The existing system and future system evaluations presented in Chapters 7 and 8, respectively, use the recommended performance and operational criteria to determine the City's water system deficiencies under current and future demands and to identify the size of new facilities.

Key water system performance and operational criteria are largely unchanged from the 2012 Water System Master Plan. The only significant changes to the criteria are:

- Due to the Regional Groundwater Storage and Recovery Project, the City's groundwater wells are assumed to be inactive for the purpose of evaluating pumping capacity;
- Due to the Regional Groundwater Storage and Recovery Project, the City's groundwater wells no longer provide emergency groundwater storage credit; and
- The City's maximum pipeline velocity criterion has been simplified to provide a clearer standard of performance.

Table 6-1 summarizes the recommended water system performance and operational criteria for the City that will be used in the water system capacity evaluations. These criteria are discussed in more detail below.

Table 6-1. Summary of Recommended Water System Performance and Operational Criteria

Component	Criteria	Remarks / Issues
Water System Performance		
Peak Supply Capacity		
Peak Water Demands - Normal Operating Conditions	*In Zones with balancing storage:* Provide firm supply capacity equal to maximum day demand; meet peak hour demand from a combination of supply capacity and balancing storage. *In Zones without balancing storage:* Provide firm supply capacity equal to peak hour demand.	Zones without storage are those which do not have direct access to storage facilities. Water supplies to these zones must be capable of meeting peak hour demand.
Peak Water Demands - Fire Flow Conditions	*In Zones with balancing storage:* Meet maximum day demand plus fire flow from a combination of supply capacity and balancing storage. *In Zones without balancing storage:* Provide maximum day demand plus fire flow from supply capacity.	Zones without storage are those which do not have direct access to storage facilities. Fire flow may be provided by an adjacent zone, but the supply sources directly serving the zone must have sufficient capacity to supply the recommended fire flow concurrent with a maximum day demand condition.
Distribution System Pressures		
Minimum Pressure - Normal Operating Conditions	35 psi at customer service connection	Services with pressure less than 35 psi require an individual booster pump.
Maximum Pressure	80 psi at customer service connection 120 psi at hydrant	Services with pressure greater than 80 psi require an individual pressure reducing valve.
Minimum Pressure - Fire Flow Conditions	20 psi	
Fire Flow Criteria		
Single Family Residential	New Development: 1,000 gpm @ 2 hrs; Existing Development: 1,500 gpm @ 2 hrs	See Table 6-2 for explanation of ranges in values. Requirements are general requirements for master planning purposes and may not be indicative of requirements for specific developments. It is assumed that new developments will be sprinklered.
Multi-Family Residential (2 stories or less)	New Development: 1,500 gpm @ 2 hrs; Existing Development: 2,000 gpm @ 2 hrs	
Multi-Family Residential (more than 2 stories)	New Development: 1,500 gpm @ 2 hrs; Existing Development: 2,500 gpm @ 2 hrs	
Residential Development adjacent to Wildland-Urban Interface Zones	New Development: 1,500 gpm @ 2 hrs; Existing Development: 1,500 gpm @ 2 hrs	
General Commercial	New Development: 2,500 gpm @ 2 hrs; Existing Development: 2,500 gpm @ 2 hrs	
Malls or High-Density Commercial Development	New Development: 2,500 gpm @ 2 hrs; Existing Development: 3,000 gpm @ 3 hrs	
Industrial (less than 10,000 sq. ft.)	New Development: 2,000 gpm @ 2 hrs; Existing Development: 2,000 gpm @ 2 hrs	
Schools	New Development: 2,000 gpm @ 2 hrs; Existing Development: 2,000 gpm @ 2 hrs	
Facilities Sizing		
Booster Pump Station Capacity		
Pumping Capacity	Firm pumping capacity equal to maximum day demand in zones with storage and equal to maximum day demand plus fire flow or peak hour demand, whichever is larger, in zones without storage.	Firm booster pumping capacity defined as the total capacity of all pumps minus the capacity of the largest pumping unit. Groundwater wells are assumed to be offline to simulate hydrologically normal and wet years.
Backup Power	Equal to the firm capacity of the pumping facility.	On-site generator for critical stations.[(a)] Plug-in portable generator for less critical stations.
Water Storage Capacity		
Operational Storage	0.25 x maximum day demand	
Emergency Storage	0.50 x maximum day demand	For emergencies such as power outages when pump stations may not be in service.
Fire Flow Storage	Fire flow demand for the most severe fire recommended in the pressure zone multiplied by the recommended duration	See Table 6-2.
Total Water Storage Capacity	0.75 x maximum day demand + Fire Flow Storage	
Pressure Regulating Station Capacity		
Valve Capacity	Valve capacity equal to maximum day demand plus fire flow or peak hour demand, whichever is larger, for pressure zones without storage where the pressure reducing station is primary supply source.	
Water Transmission Pipelines (10-inch diameter or larger)[(b)]		
Diameter	10-inch or larger	Locate new transmission pipelines within designated utility corridors wherever possible.
Maximum Velocity - Normal Conditions	4 ft/s	
Maximum Velocity - Fire Flow Conditions	10 ft/s	
Maximum Headloss - Normal Conditions	5 ft of loss per 1,000 ft of pipeline	
Maximum Headloss - Fire Flow Conditions	10 ft of loss per 1,000 ft of pipeline	
Hazen Williams "C" Factor	140	For consistency in hydraulic modeling. New water mains are typically PVC or ductile iron (DI). To be conservative, PVC pipeline is assumed.
Pipeline Material	PVC	

Table 6-1. Summary of Recommended Water System Performance and Operational Criteria

Component	Criteria	Remarks / Issues
Water Distribution Pipelines (8-inch diameter)[(b)]		
Minimum Pipeline Diameter	8-inch	Locate new distribution pipelines within designated utility corridors wherever possible.
Maximum Velocity - Normal Conditions	4 ft/s	
Maximum Velocity - Fire Flow Conditions	10 ft/s	
Hazen Williams "C" Factor	140	For consistency in hydraulic modeling. New water mains are typically PVC or DICL. To be conservative, PVC pipeline is assumed.
Pipeline Material	PVC	

(a) A booster pump station is defined as critical if it provides service to pressure zone(s) and/or service area(s) without sufficient fire or emergency storage or meets the following criteria:

- The largest facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas; or
- A facility that provides water from a supply turnout.

(b) Recommended pipeline velocity and headloss criteria are used for sizing new pipelines. Existing pipelines not meeting the recommended criteria would not be identified as deficient unless there are also pressure deficiencies.

6.1 PEAK SUPPLY CAPACITY

The City currently receives surface water supply from the SFPUC's Regional Water System and groundwater supply from the City's four active wells. Water is delivered throughout the City via twelve pressure zones.

Maximum day demand plus fire flow and peak hour demand conditions are used to assess the adequacy of the City's water supply facilities and transmission/distribution system during high demand periods. Adopted peaking factors for maximum day and peak hour demands were discussed in *Chapter 3 Water Demands*. The following sections discuss the assumptions and recommended performance criteria for different operating conditions during peak water demands.

6.1.1 Peak Water Demands – Normal Operating Conditions

In accordance with California Title 22 requirements, the City's water supply should be capable of meeting a maximum day demand condition. This means that the water system as a whole, including individual pressure zones with storage, should have supply capability to meet at least a maximum day demand condition without the use of balancing storage. However, a peak hour demand condition can be met from a combination of supply sources and storage (*i.e.*, water supplied from SFPUC's Regional Water System and groundwater wells, water delivered via pump stations and/or pressure regulating stations, and water stored in storage tanks). Pressure zones without storage should have sufficient supply capacity to meet at least a peak hour demand condition.

Evaluations of maximum day demand system supply capacity will be conducted assuming that the largest booster pump unit at each pump station is in standby mode (i.e., firm booster pumping capacity). In addition, the City's groundwater well system (well pumps) will be assumed to be off to simulate operations during a hydrologically normal or wet year.

Evaluations of peak hour demand system supply capacity will be conducted assuming that all booster pump stations are in standby mode. The City's booster pumps typically fill storage tanks during non-peak hours and are not typically run during peak hours.

6.1.2 Peak Water Demands – Fire Flow Conditions

In accordance with typical industry standards, individual pressure zones that have storage should have the capability to meet a demand condition equal to the occurrence of a maximum day demand concurrent with a single fire flow event while meeting the recommended system performance criteria (e.g., minimum and maximum system pressures) discussed under *Section 6.2 Distribution System Pressures*. The fire flow applicable for each pressure zone is based on the highest fire flow requirement designated in that pressure zone of the City's service area, which will be determined based on land uses as defined in the General Plan.

In pressure zones with storage, maximum day demand plus fire flow would be met by a combination of supply capacity and balancing storage. In pressure zones without storage, supply capacity must be sufficient to meet a maximum day demand plus fire flow condition. Evaluations of maximum day demand plus fire flow conditions will be conducted assuming that all booster pump stations are operating at firm capacity. In addition, the City's groundwater well system (well pumps) will be assumed to be off to simulate operations during a hydrologically normal or wet year.

6.2 DISTRIBUTION SYSTEM PRESSURES

Adequate system pressure is a basic indicator of acceptable distribution system performance. The recommended performance criteria for system pressures are:

- Allowable Pressures Under Normal Operating Conditions: 35 psi to 120 psi[1]
- Minimum Pressure Under Fire Flow Conditions: 20 psi

These performance criteria are applied to all areas that fall within the normal customer service elevation ranges for each pressure zone. Customers outside of the normal service elevation ranges may have an individual pressure regulator or booster pump installed.

6.3 FIRE FLOW CRITERIA

The City's Water Division operates and maintains the water distribution system within the City. The City's Fire Department (Fire Department) is concerned with the availability of adequate water supply for firefighting purposes and establishes minimum water flows and residual system pressures required during a firefighting event and provides these criteria to the Water Division for use in master planning.

It should be noted that the Fire Department uses the California Fire Code (CFC), 2019 edition, which establishes minimum fire flows and durations for individual structures (see Appendix B of the 2019 CFC). In contrast, this Water System Master Plan evaluates available fire flows to assess distribution system adequacy under current and future demand conditions, using general land use categories that represent different types of development. Therefore, the fire flow criteria set forth in this Water System Master Plan are intended only for general planning purposes, and may not be reflective of the actual fire flow criteria sought for specific development approvals, and will not identify specific existing non-conforming developments.

Table 6-2 presents the recommended fire flow criteria for the Water System Master Plan fire flow evaluation, based on general land use designations and guidelines from the City's Fire Marshal. These fire flow criteria will be used for the evaluation of the existing and future water system. Fire flows should be supplied at a minimum residual pressure of 20 psi, and the average spacing between fire hydrants shall be between 200 to 500 feet as determined by the recommended fire flow criteria (see Appendix C of the 2019 CFC).

The City has an ongoing renewal and replacement program to replace aging water mains. The fire flow criteria are used to determine sizing of pipelines to meet current requirements and to guide proper sizing for new pipelines.

[1] The Plumbing Code requires that individual services that exceed 80 psi have an individual pressure regulator on the service line; services that are less than 35 psi must have an individual booster pump on the service line.

Table 6-2. Recommended Fire Flow Criteria[a,b,c,d]

Land Use Designation	Non-Sprinklered			Sprinklered[e]		
	Fire Flow, gpm	Duration, hours	Recommended Storage, MG	Fire Flow, gpm	Duration, hours	Recommended Storage, MG
Single Family Residential[f]	1,500	2	0.18	1,000	2	0.12
Multi-Family Residential (≤ 2 stories)[g]	2,000	2	0.24	1,500	2	0.18
Multi-Family Residential (> 2 stories)[h]	2,500	2	0.30	1,500	2	0.18
Residential Development adjacent to Wildland-Urban Interface Zones	1,500	2	0.18	1,500	2	0.18
General Commercial[i]	2,500	2	0.30	2,500	2	0.30
Malls or High-Density Commercial Development[j]	3,000	3	0.54	2,500	2	0.30
Industrial (< 10,000 sq. ft.)	2,000	2	0.24	2,000	2	0.24
Schools[k]	2,000	2	0.24	2,000	2	0.24

(a) Construction type and fire flow calculation area are not generally known during the development of a master plan. Therefore, fire flow criteria are based on recommended fire flow standards provided by the City's Fire Marshal in a memorandum dated May 2, 2011. Additional fire flow standards for non-sprinklered developments were provided by the Fire Marshal in an email dated June 1, 2011. Fire flow recommendations adopted in the 2012 WSMP were confirmed by the Fire Marshal via email on August 3, 2020. Recommended fire flow standards do not include Type V-B construction.

(b) Unique projects or projects with alternate materials may require higher fire flows and should be reviewed by the Fire Marshal on a case-by-case basis (e.g., proposed commercial/industrial areas and schools).

(c) Fire flows to be supplied at a minimum residual pressure of 20 psi.

(d) Average spacing between fire hydrants shall be between 200 to 500 feet as determined by the recommended fire flow criteria and shall not exceed values listed in Table C102.1 of the 2019 CFC.

(e) The Fire Marshal normally allows a reduction in fire flow if a building is provided with an approved automatic sprinkler system.

(f) Includes Very Low Density Residential and Low Density Residential land uses from the City's General Plan.

(g) Includes Medium Density Residential land use from the City's General Plan.

(h) Includes High Density Residential and Multi Use – Residential Focus land uses from the City's General Plan.

(i) Includes Visitors Services and Neighborhood Commercial land uses from the City's General Plan.

(j) Includes Central Business District, Transit-oriented Development, Multi Use, Regional Commercial, and Regional Office land uses from the City's General Plan.

(k) Includes Public/Quasi-Public land use from the City's General Plan.

6.4 BOOSTER PUMP STATION CAPACITY

Sufficient water system pumping capacity should be provided to meet the following conditions within the water system:

1. **In pressure zones with balancing storage**: A maximum day demand with booster pumps assumed to operate at firm pumping capacity. Groundwater wells are assumed to be off to simulate operations during a hydrologically normal or wet year; and
2. **In pressure zones without balancing storage**: A maximum day demand concurrent with a fire flow event (with fire flow requirement based on the highest fire flow requirement for the different land use types within the pressure zone), or peak hour demand condition, whichever is larger, with booster pumps assumed to operate at firm pumping capacity. Groundwater wells are assumed to be off to simulate operations during a hydrologically normal or wet year.

Pumping facilities defined as critical[2] should be equipped with an on-site, backup power generator. Less critical pump stations should be equipped with a plug-in adapter to allow for interconnection to a portable generator, which should be brought to the site by City staff during a prolonged power outage.

6.5 WATER STORAGE CAPACITY

The City's recommended water storage capacity per pressure zone is to provide a storage volume equivalent to 75 percent of a maximum day demand plus fire flow (based on the highest fire flow requirement for the different land use types within the pressure zone) to meet operational, emergency, and fire flow storage requirements.

The 2012 WSMP allowed groundwater storage to account for a portion of the recommended emergency storage for the existing demand scenario, since groundwater wells were normally used at that time. However, because the groundwater wells are now assumed to be offline during hydrologically normal and wet years due to the Regional Groundwater Storage and Recovery Project, no emergency groundwater storage credit will be included in the City's storage capacity evaluation.

6.6 PRESSURE REGULATING STATION CAPACITY

The City has several smaller pressure zones that are served solely by pressure regulating stations. For pressure zones without storage and where the pressure regulating stations are the primary supply source, the total station capacity should be equal to a maximum day demand plus fire flow condition or peak hour demand condition, whichever is larger.

6.7 WATER TRANSMISSION AND DISTRIBUTION PIPELINE SIZING

The following criteria will be used as guidelines for sizing new transmission and distribution system pipelines. The City's existing system will be evaluated on a case-by-case basis. For example, if an existing

[2] A booster pump station is defined as critical if it provides service to pressure zone(s) and/or service area(s) without sufficient fire or emergency storage or meets the following criteria: (1) The largest facility that provides water to a particular pressure zone and/or service area; (2) A facility that provides the sole source of water to single or multiple pressure zones and/or service areas; or (3) A facility that provides water from a supply turnout.

pipeline experiences velocity or head loss in excess of the criteria described below, this condition, by itself, does not necessarily indicate a problem as long as the minimum system pressure criterion is satisfied.

Consequently, the City's existing system is evaluated using pressure as the primary criterion; and secondary criteria, such as pipeline velocity, head loss, age, and material type, are used as indicators to locate, and to help prioritize where water system improvements may be needed.

New transmission and distribution pipelines to serve the City's future planning areas should be located within designated utility corridors wherever possible. These designated utility corridors should be within public rights-of-way to minimize or eliminate the need for utility easements within private property.

6.7.1 Water Transmission System

The City's transmission pipelines are generally defined as being 10 inches in diameter or larger. For planning purposes, West Yost recommends the following criteria for water transmission pipelines:

- Maximum velocity of 4 ft/s and maximum head loss of 5 ft/kft during normal operating conditions
- Maximum velocity of 10 ft/s and maximum head loss of 10 ft/kft during fire flow conditions

For the existing water system pipelines, pipeline velocity and head loss criteria are not used to identify deficient facilities. However, these constraints are used for sizing new transmission system pipeline facilities.

6.7.2 Water Distribution System

The City's distribution pipelines are generally 8 inches in diameter or smaller. For planning purposes, West Yost recommends the following criteria for water distribution pipelines:

- Maximum velocity of 4 ft/s during normal operating conditions
- Maximum velocity of 10 ft/s during fire flow conditions

For the existing water system pipelines, pipeline velocity criteria are not used to identify deficient facilities. However, these velocity constraints are used for sizing new distribution system pipeline facilities.

CHAPTER 7
Evaluation of Existing Water System

This chapter presents the evaluation of the City's existing water distribution system and its ability to meet the City's recommended performance and operational criteria under existing water demand conditions. The system evaluation includes two general technical areas: a system capacity evaluation and a pipeline and facilities rehabilitation and replacement evaluation.

The system capacity evaluation includes an analysis of water storage capacity, pumping capacity, and regulating valve capacity. The analysis also includes an evaluation to assess the existing water system's ability to meet recommended operational and design criteria under maximum day demand plus fire flow and peak hour demand scenarios. West Yost conducted this evaluation using the hydraulic model updated for this Water System Master Plan, which is described in *Chapter 5 Hydraulic Model Update*.

The pipeline rehabilitation and replacement evaluation uses many factors, such as historical leak data, pipe age, pipe material, pipe diameter, and proximity to seismic faults, to evaluate the risk of pipeline failure for each pipeline segment in the system. Historical leak data and fire flow deficiencies identified in the hydraulic evaluation were then used to re-prioritize the replacement of the eight priority areas in the City's Ten-Year CIP Work Plan, all of which contain high risk pipes.

The facilities rehabilitation and replacement evaluation uses the results from the facility site evaluations discussed in Chapter 2, typical design useful life information, and age and condition information provided by the City to formulate rehabilitation and replacement strategies.

Evaluations, findings, and recommendations for addressing any deficiencies identified in the existing water distribution system are included in this chapter. Recommendations are used to develop a CIP, which includes an estimate of probable construction costs. The recommended CIP is described further in Chapter 9.

The following topics are presented in this chapter:

- Existing Water Demands by Pressure Zone: summarizes demands by pressure zone used for the existing water system evaluation
- Existing Water System Facility Capacity Evaluation: evaluates storage, peak pumping capacity and peak valve station capacity to meet existing system requirements
- Existing Water System Performance Evaluation: assesses the hydraulic performance of the water system under existing peak hour and maximum day plus fire flow conditions
- Existing System Capacity Improvements: details the recommended improvements to mitigate identified hydraulic deficiencies
- Rehabilitation and Replacement Evaluation: evaluates pipeline risk and recommends pipeline replacement priorities and evaluates facility rehabilitation and replacement needs
- Summary of Recommended Improvements for the Existing Water System

7.1 EXISTING WATER DEMANDS BY PRESSURE ZONE

Table 7-1 summarizes the City's water demands used for the existing water system analysis. The existing water demands for the City's water system were first spatially located in the hydraulic model using 2019 water meter data. Demands were then scaled to match groundwater and surface water delivery volumes for 2019. Average daily production in 2019 was used to represent the City's "base" water year for the hydraulic evaluations. This annual demand was used because it is the most recent data available and is considered to be the most representative of future water use by existing customers.

Maximum day and peak hour demands were estimated for the existing system analysis. The maximum day demand factor is based on the City's historical demand data for 2016 through 2019. Due to limited data, the peak hour factor is based on peaking factors from neighboring cities with similar water systems (see *Chapter 3 Water Demands* for more detail).

Table 7-1. Baseline Water Demands for the Existing System Analysis

Pressure Zone[a]	Average Day Demand[b]		Maximum Day Demand[c]		Peak Hour Demand[d]	
	gpm	mgd	gpm	mgd	gpm	mgd
Zone 1/4	858	1.24	1,502	2.16	3,004	4.33
Zone 2 - Main Zone	228	0.33	400	0.58	799	1.15
Zone 2 - Whitman Way	22	0.03	39	0.06	79	0.11
Zone 3	263	0.38	461	0.66	921	1.33
Zone 5	22	0.03	39	0.06	78	0.11
Zone 6	172	0.25	300	0.43	600	0.86
Zone 7	45	0.06	79	0.11	158	0.23
Zone 8	69	0.10	121	0.17	242	0.35
Zone 9	29	0.04	49	0.07	101	0.15
Zone 10	140	0.20	245	0.35	490	0.71
Zone 11	195	0.28	342	0.49	683	0.98
Zone 12	32	0.05	57	0.08	113	0.16
Zone 13	20	0.03	36	0.05	72	0.10
Total	**2,095**	**3.02**	**3,670**	**5.28**	**7,340**	**10.57**

(a) Demands from Zones 6, 7, 8, and 9 each include demands from their smaller subzones (i.e., Zones 6A, 7A, 8A, 9A).
(b) Average day demand is based on detailed 2019 billing records and adjusted to reflect 2019 production data. Billing records were spatially located and then aggregated by pressure zone.
(c) Maximum day demand calculated using a peaking factor of 1.75 times the average day demand.
(d) Peak hour demand calculated using a peaking factor of 3.5 times the average day demand.

7.2 EXISTING WATER SYSTEM FACILITY CAPACITY EVALUATION

To evaluate the existing water system facilities performance, the following analyses were conducted:

- Pumping Capacity Evaluation,
- Storage Capacity Evaluation, and
- Pressure Regulating Station Capacity Evaluation.

The existing water system facility capacity evaluation is based on a normal supply year (*i.e.*, "put") operation and assumes that the City is maximizing its surface water use during normal supply years as part of the Regional Groundwater Storage and Recovery Project. This is conservative, as it assumes that the City's groundwater wells do not contribute to pumping capacity or provide emergency storage credit. The results of the existing water system facility capacity evaluation are discussed below.

7.2.1 Pumping Capacity Evaluation

The pumping capacity in the City's existing water system was evaluated to assess the City's ability to deliver a reliable firm capacity to serve the existing water service area. Firm capacity assumes a reduction in total pumping capacity to account for pumps that are out of service at any given time due to mechanical breakdowns, maintenance, water quality, or other operational issues. At each booster pump station, firm booster pumping capacity was defined as the total booster pump station capacity with the largest pump out of service. To be conservative, it was assumed that the City's groundwater wells are inactive to simulate operations during a hydrologically normal or wet year. One booster pump station, PS6, pumps from a clearwell which is supplied by Well 17 and is therefore also assumed to be inactive.

When zones are supplied solely by pump station(s), the pumping capacity criterion for the City, described previously in *Chapter 6 System Performance and Operational Criteria*, requires the City's water system to have sufficient firm pumping capacity to meet peak demands. The firm pumping capacity must equal or exceed the maximum day demand in zones with storage, and maximum day plus fire flow or peak hour demand, whichever is larger, in zones without storage. In zones with storage, maximum day plus fire flow and peak hour demands are met from a combination of zone supply and storage.

Table 7-2 compares existing firm pumping capacity with required firm pumping capacity for existing water demand conditions. The left-hand side of the table shows the service zones and the corresponding supported zones, their associated demand, and the pump stations serving each service zone. As an example, PS5 directly serves Zone 2, but must also have sufficient pumping capacity to supply Zones 6 through 12 because they are supported by Zone 2. The right-hand side of the table shows the existing pumping capacity, the required firm pumping capacity based on the pumping capacity criterion, and the difference between the existing firm pumping capacity and the required firm pumping capacity.

Table 7-2 indicates that all service zones have surplus pumping capacity in excess of existing maximum day demand. The firm pumping capacity surplus for each pressure zone ranges from approximately 270 to 1,130 gpm.

Table 7-2. Comparison of Existing and Required Pumping Supply Capacity

Service Zone and Supported Zones[(a)]	Average Day Demand, gpm	Maximum Day Demand, gpm	Existing Pumping Capacity Pump Stations	Total, gpm	Firm, gpm[(b)]	Required Firm Pumping Capacity, gpm[(c)]	Firm Capacity Surplus (Deficit), gpm
Zone 2 - Main Zone[(d)]							
Zone 2 - Main Zone	228	400	PS5 - Maple Avenue	1,650	1,100	827	273
Zone 6	120	210					
Zone 7	11	19					
Zone 8	17	29					
Zone 9	7	12					
Zone 10	34	59					
Zone 11	47	83					
Zone 12	8	14					
Total	472	827					
Zone 6[(e)]							
Zone 6	172	300	PS3 - Whitman Way PS7 - San Bruno Avenue	2,000	1,000	610	390
Zone7	16	27					
Zone 8	24	42					
Zone 9	10	17					
Zone 10	49	85					
Zone 11	68	118					
Zone 12	11	20					
Total	348	610					
Zone 10							
Zone 10	140	245	PS1 - Sneath Lane PS8 - Glenview Drive	3,470	2,020	893	1,127
Zone 7	45	79					
Zone 8	69	121					
Zone 9	29	50					
Zone 11	195	342					
Zone 12	32	57					
Total	511	893					
Zone 11							
Zone 11	195	342	PS4 - Pacific Heights/College	2,000	1,000	342	658
Zone 12							
Zone 12	32	57	PS2 - Lake Drive	1,200	600	57	543

(a) Zone 6 includes Zones 6 and 6A. Likewise, Zones 7, 8, and 9 also include their smaller subzones (Zones 7A, 8A, and 9A).

(b) Firm booster pumping capacity is defined as the total booster pump station capacity with the largest pump at each station out of service.

(c) Required firm pumping capacity is equal to maximum day demand in zones with storage and equal to maximum day demand plus fire flow or peak hour demand, whichever is larger, in zones without storage. All of the City's zones supplied by pump stations have storage.

(d) Zone 2 supporting zones:
- Zone 6 is partially supported by Zone 2 via PS7, and partially supported by Turnout C5 via PS3. In order to account for this, the demands for Zone 6 were multiplied by 0.7, which is the ratio of PS7 firm capacity to PS3+PS7 firm capacity.
- Zones 7-12 are partially supported by Zone 2 via Zone 6 by way of PS8, and partially supported by Turnout C3 via PS1. In order to account for this, the demands for Zones 7-12 were multiplied by 0.25, which is the ratio of PS8 firm capacity to PS1+PS8 firm capacity (0.35) multiplied by the ratio of PS7 firm capacity to PS3+PS7 firm capacity (0.7).

(e) Zone 6 supporting zones:
- Zones 7-12 are partially supported by Zone 6 via PS8, and partially supported by Turnout C3 via PS1. In order to account for this, the demands for Zones 7-12 were multiplied by 0.35, which is the ratio of PS8 firm capacity to PS1+PS8 firm capacity.

During hydrologically dry years, the City will operate its groundwater wells at maximum capacity to retrieve groundwater banked by the GSR Project and reduce its use of SFPUC-supplied surface water. In these years, groundwater would be used to serve almost all of City demands during winter months when demands are low. Under these conditions, it is assumed that pumps at PS1 and PS3 would not run, because these pump stations supply water from SFPUC turnouts to upper pressure zones. However, even without these pump stations operating, the City has sufficient pumping capacity to move an adequate amount of groundwater supply from Zone 1/4 into the upper pressure zones to meet winter demands[1].

7.2.2 Storage Capacity Evaluation

The principal advantages that storage provides for the water system are: the ability to balance differences in demands and supplies; to provide emergency storage in case of supply failure; and to provide water to fight fires. The City's water storage capacity requirement is to provide a volume equal to 75 percent of a maximum day demand plus fire flow storage.

Table 7-3 compares the City's available water storage capacity with the required storage capacity by pressure zone. The comparison between the City's available and required storage capacities indicates that there is an existing storage capacity deficit of approximately 1.0 MG in Zone 3. To eliminate the storage capacity deficit in Zone 3, a new 1.8 MG storage tank improvement is recommended in Zone 3; this larger volume (an additional 0.8 MG above the current storage capacity deficit) will be required to meet proposed future water demands in the zone. Future storage needs are addressed in *Chapter 8 Evaluation of Future Water System*. Based on discussions with City staff, this new storage tank is planned to be located at Commodore Park (southeast corner of Commodore Drive and Cherry Avenue).

Due to the lack of suitable land at an appropriate elevation for a gravity feed tank, a new booster pump station will be required at the proposed storage tank site to supply water into Zone 3 during peak demand conditions. This booster pump station is preliminarily sized at 4.3 mgd (firm capacity) to meet the most stringent fire flow recommended in Zone 3.

7.2.3 Pressure Regulating Station Capacity Evaluation

The existing pressure regulating stations in the City's water system were evaluated to assess their ability to reliably supply the existing water service area. For zones served by pressure regulating stations, the criterion for the City, described previously in *Chapter 6 System Performance and Operational Criteria*, requires the City's pressure regulating stations to have sufficient capacity to meet peak demands. In zones with storage, regulating stations must supply the maximum day demand, and in zones without storage, regulating stations must supply maximum day plus fire flow or peak hour demand, whichever is larger.

[1] Based on historical City water use, existing winter demands are estimated to be 80 percent of average day demands, or 2.42 mgd. It was assumed that Zone 3 and Zone 5 winter demands (0.33 mgd) would continue to be met by supply from SFPUC turnouts during hydrologically dry years because these zones cannot currently be served by the City's groundwater wells. Existing City pumping capacity is sufficient to supply the remaining 2.09 mgd of winter demands to other pressure zones without PS1 and PS3 running.

Table 7-3. Comparison of Existing and Required Storage Capacity								
Pressure Zone[(a)]	Water Storage Facility	Available Storage Capacity, MG Reservoir Capacity[(b)]	Total Available Storage	Required Operational[(c)]	Emergency[(d)]	Fire Flow[(e)]	Total Required Storage	Storage Surplus (Deficit), MG
Zone 1/4	Tank 1 - Cunningham Drive	2.50	2.50	0.54	1.08	0.54	2.16	0.34
Zone 2 - Main Zone	Tank 4 - San Bruno Avenue	1.00	1.00	0.14	0.29	0.30	0.73	0.27
Zone 3	--	--	0.00	0.17	0.33	0.54	1.04	(1.04)
Zone 6[(f)]	Tank 3 - Glenview Drive	2.00	2.00	0.12	0.24	0.30	0.67	1.33
Zone 10[(g)]	Tank 6 - Lake Drive South	0.40	1.40	0.19	0.38	0.30	0.88	0.52
	Tank 6A - Lake Drive North	1.00						
Zone 11	Tank 9 - Skyline West	0.50	1.00	0.12	0.25	0.30	0.67	0.33
	Tank 10 - Skyline East	0.50						
Zone 12	Tank 7 - Sweeney Ridge	0.40	0.40	0.02	0.04	0.18	0.24	0.16
Zone 13	--	--	0.00	0.01	0.03	0.30	0.34	NA[(h)]

(a) Zone 6 also includes the small Zone 6A subzone.

(b) From Table 2-6.

(c) Based on 25 percent of maximum day demand (see Table 7-1).

(d) Based on 50 percent of maximum day demand (see Table 7-1).

(e) Based on flowrate for the land use with the highest requirement in the pressure zone multiplied by the corresponding recommended fire flow duration (see Table 6-2).

(f) Required storage capacity includes demands for the Whitman Way portion of Zone 2, which has no dedicated storage facilities. Zone 2 - Whitman Way can be provided with water from Zone 6 in an emergency via RS12.

(g) Required storage capacity includes demands for Zones 5, 7, 8, and 9. Zones 7, 8, and 9 are typically served by Zone 10 storage. Zone 5 can be provided with water from Zone 10 in an emergency via Zone 8 and RS15B.

(h) It is assumed that SFPUC facilities can provide sufficient storage capacity for Zone 13.

The City has seven different pressure zones and four subzones that are primarily dependent or completely dependent on the pressure regulating stations for supply.[2] Therefore, the pressure regulating station capacity requirement for the thirteen stations serving these zones is to provide maximum day plus fire flow or peak hour demand, whichever is greater. In most cases, the maximum day plus fire flow demand is the critical supply condition.

Table 7-4 compares existing available pressure regulating station capacity with the required pressure regulating station capacity for the thirteen pressure regulating stations that are primary supply sources for the zones dependent on pressure regulating stations for supply. The table shows that most zones have sufficient pressure regulating station capacity to meet the required flows, except for Zones 6A, 7A, and 13. Consequently, the large valves at RS13 and RS17 are recommended to be upsized to provide adequate capacity to meet fire flow needs. At RS1, there is an existing 3-inch valve which is currently only used when maintenance is being performed on the 6-inch valve. However, if the setting at this valve is adjusted so that it provides flow in response to a fire, the existing valves at RS1 have sufficient capacity. The following list summarizes the improvements recommended to meet the required valve capacity in the deficient zones:

- RS17 – Replace 4-inch valve with 6-inch valve
- RS13 – Replace 4-inch valve with 6-inch valve
- RS1 – Adjust 3-inch valve setting to provide flow during a fire

[2] Although Zone 12 is served by PS2 and Tank 7, the pump station and tank supply the zone via RS2.

Table 7-4. Comparison of Existing and Required Regulating Station Capacity

Zone	Maximum Day Demand, gpm	Fire Flow Requirement, gpm[(a)]	Peak Hour Demand, gpm	Regulating Station	Valve Diameter, inches	Existing Valve Capacity, gpm[(b)]	Valve Capacity Requirement, gpm[(c)]	Valve Capacity Surplus (Deficit), gpm
Zone 1/4	1,502[(d)]	NA[(d)]	NA[(d)]	RS16A	8	3,900	1,502	4,648
				RS20[(e)]	6	2,250		
					Total	6,150		
Zone 3	461	3,000	921	RS26	8	3,900	3,461	6,319
					4	990		
				RS27	8	3,900		
					4	990		
					Total	9,780		
Zone 6A	7	1,500	15	RS17	4	990	1,507	(257)
					2	260		
					Total	1,250		
Zone 7	79	2,500	158	RS9	8	3,900	2,579	1,581
					2	260		
					Total	4,160		
Zone 7A	1	2,000	2	RS13	4	990	2,001	(751)
					2	260		
					Total	1,250		
Zone 8	121	2,000	242	RS6	8	3,900	2,121	2,769
					4	990		
					Total	4,890		
Zone 8A	7	0	14	RS15	2	260	14	506
					2	260		
					Total	520		
Zone 9	49	2,000	99	RS4	6	2,250	2,049	461
					2	260		
					Total	2,510		
Zone 9A	1	0	2	RS5	6	2,250	2	2,508
					2	260		
					Total	2,510		
Zone 12[(f,g)]	57	1,500	113	RS2	6	2,250	1,557	953
					2	260		
					Total	2,510		
Zone 13	36	2,500	72	RS1	6	2,250	2,536	(286)

(a) Based on demand for most severe fire recommended in the pressure zone (Table 6-2). Subzones 8A and 9A do not serve any fire hydrants.

(b) Based on the intermittent maximum flow capacity for ClaVal model 90-01 PRV valves. However, actual flow capacity will vary depending on system conditions.

(c) The criterion for sizing valves for most zones is maximum day demand plus fire flow or peak hour demand, whichever is larger.

(d) Only maximum day demand is required to be supplied by Zone 1/4 regulation stations. Fireflow and peak hour demands for Zone 1/4 should be provided by available storage capacity in Tank 1.

(e) Supply from Turnout C1 has to pass through RS21 and RS20 to supply Zone 1. Because RS20 capacity is much less than RS21 capacity, and because Zone 1 demands are significantly greater than Zone 4 demands, RS20 capacity is conservatively used instead of RS21 capacity.

(f) Zone 12 served by PS2 and Tank 7 via RS2.

(g) Zone 12 can also be served by emergency bypass from Tanks 6 and 6A via RS3.

7.3 EXISTING WATER SYSTEM PERFORMANCE EVALUATION

This section discusses the hydraulic performance evaluation of the existing water distribution system. Consistent with the existing water system facility capacity evaluation presented in Section 7.2, the existing water system performance evaluation is also based on a normal supply year (*i.e.*, “put”) operation and assumes that the City is maximizing its surface water use during normal supply years under the GSR Project. This is conservative, as it assumes that the City’s groundwater wells will not be operated and will therefore not increase pressures or provide additional fire flow in Zone 1/4. The following evaluations were performed to assess distribution system performance under existing water demand conditions:

- Normal Operations - Peak Hour Demand Scenario: This scenario evaluates customer service pressures in the system during a peak hour demand condition.
- Emergency Operations - Maximum Day plus Fire Flow Scenario: This scenario evaluates available fire flows in the system under a maximum day demand condition.

These two scenarios use the hydraulic model developed for the Water System Master Plan to evaluate the existing water system performance. The purpose of the existing water system performance evaluation is to identify necessary improvements to support the City’s existing water demands while meeting the City’s recommended water system performance and operational criteria.

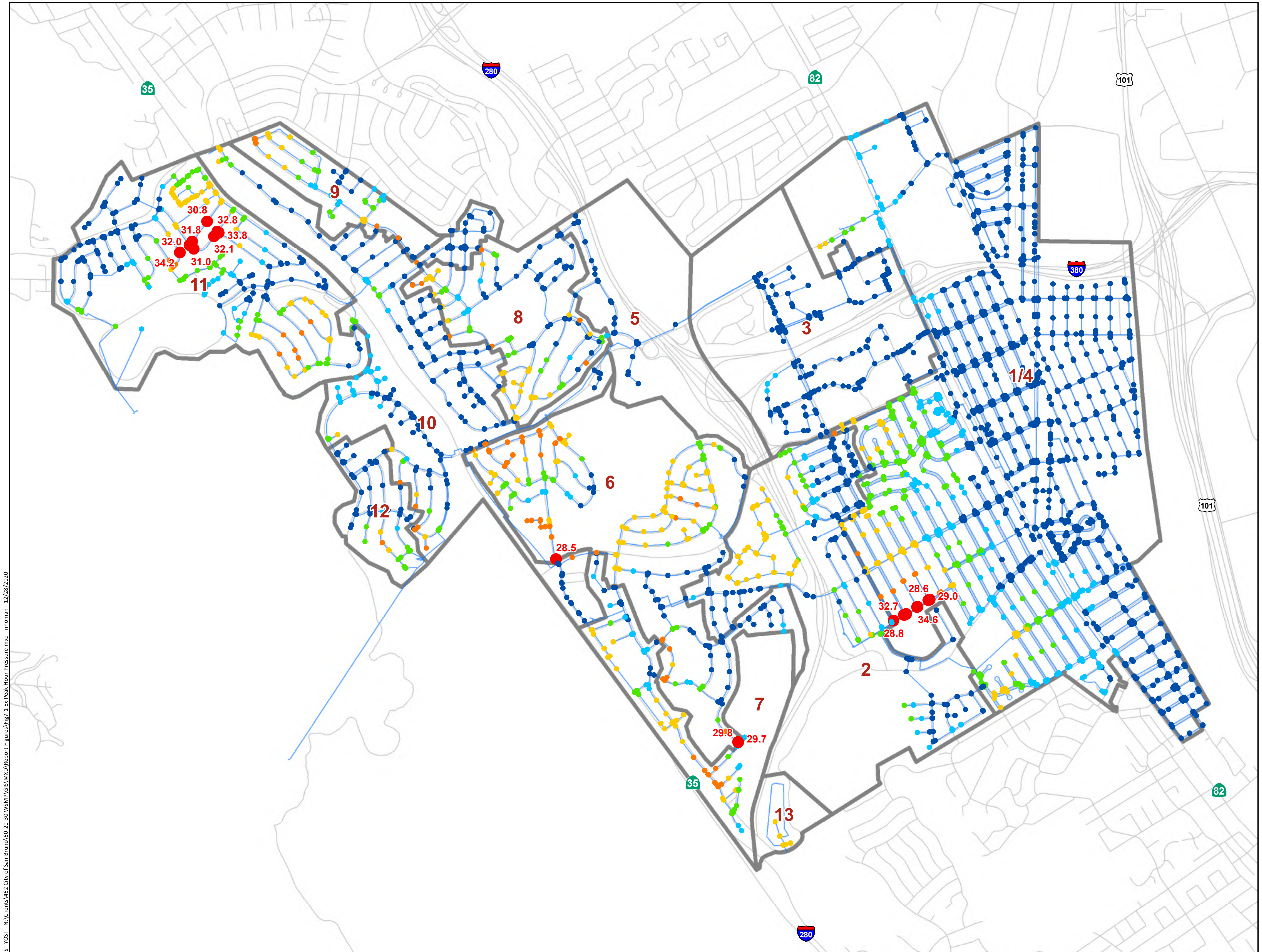
The existing water system is expected to deliver peak hour flows and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the performance criteria presented in Chapter 6. Recommended system improvements were identified to address and fix any pressure deficiencies found, and to fix any fire flow deficiencies in the existing water distribution system. System improvements were not identified for pipelines that did not meet velocity or head loss criteria where no pressure deficiencies were identified.

7.3.1 Normal Operations - Peak Hour Demand Scenario

Steady-state hydraulic analyses were conducted using the hydraulic model to evaluate system performance under existing peak hour demand conditions. As shown in Table 7-1, the peak hour demand for the existing water service area was calculated to be 7,340 gpm (10.6 mgd). This analysis assumed that the storage tanks are 50 percent full and that all pump stations are off.

During a peak hour demand scenario, a minimum pressure of 35 psi must be maintained at service connections throughout the entire water system. In addition, for planned pipelines, it is recommended that the maximum head loss per thousand feet of transmission main should not exceed 5 feet per thousand feet (ft/kft) and maximum velocities on transmission and distribution mains should not exceed 4 feet per second (ft/s) during normal operations, to help minimize energy (pumping) costs due to undersized pipelines.

Results from the peak hour demand simulation indicate that the existing water system can adequately meet the City’s minimum pressure criterion of 35 psi at all customer services, except for the few locations shown in red on Figure 7-1. In Zones 6 and 7, there are a few junctions located above or near the normal ‘top of zone’ elevations. Because these low-pressure junctions are a result of high elevations rather than distribution system constrictions, and because they do not represent many services, improvement projects were not recommended specifically for these locations, which do meet the State’s minimum standard of 20 psi.



Pipeline
Pressure Zone Boundary

Peak Hour Pressure

- Pressure < 35 psi
- 35 psi ≤ Pressure ≤ 50 psi
- 50 psi ≤ Pressure ≤ 60 psi
- 60 psi ≤ Pressure ≤ 70 psi
- 70 psi ≤ Pressure ≤ 80 psi
- Pressure > 80 psi

Notes:

1. Existing Peak Hour Demand is 10.57 mgd.
2. Assumes storage tank levels are half full, and all pump stations are off.
3. The City's existing hydraulic model is not an all-pipes model. Therefore, some short dead-end pipelines are not shown or evaluated.
4. Per the California Plumbing Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.

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Figure 7-1

Peak Hour Pressure Existing System

City of San Bruno

Water System Master Plan

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Figure 7-1 also shows that there is a group of low-pressure junctions located in Zone 1/4 near the west boundary of Zone 2. These junctions are located very near the normal 'top of zone' elevation for Zone 1/4. Because these junctions represent several blocks of services experiencing low pressures, the City should consider re-zoning all Zone 1/4 junctions with elevations above 150 ft mean sea level into Zone 2.

There is also a group of junctions in Zone 11 located at the top of a steep hill which do not meet the minimum pressure criterion. The recommended pipeline improvements discussed in Section 7.4.1 to address fire flow deficiencies in Zone 11 increase the minimum pressure in this area to approximately 34 psi. Because this is within one psi of the 35 psi criteria, and because further pipeline improvements or the creation of a hydropneumatic zone to service this area would be costly, no additional improvements are recommended.

7.3.2 Emergency Operations – Maximum Day Demand plus Fire Flow Scenario

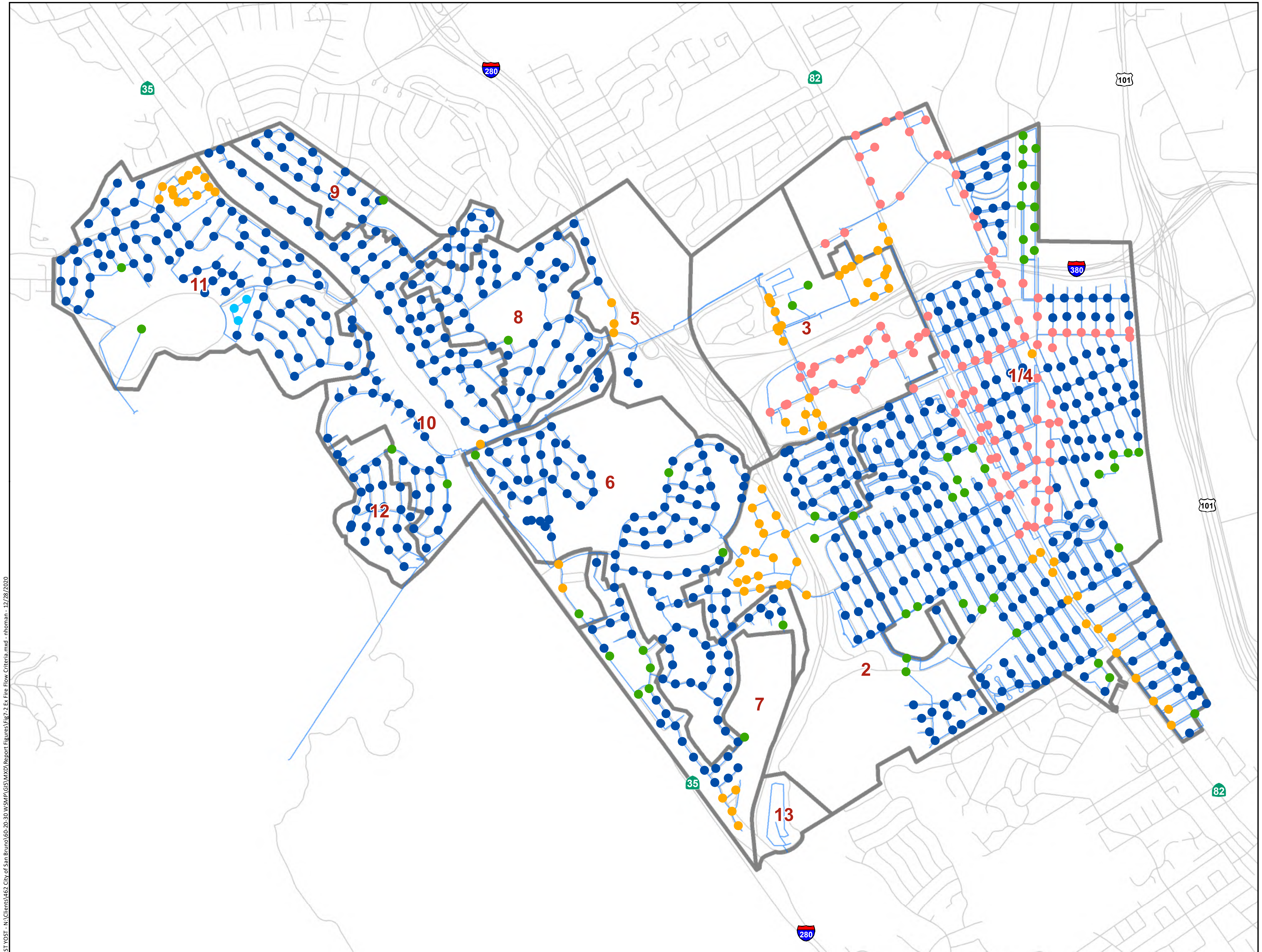
The City's existing water system was evaluated to identify areas where fire flows are less than current fire flow criteria. While the City does not have a specific policy requiring replacement of pipelines to meet current fire standards, the fire flow analysis identifies pipeline sizes needed to meet current criteria, so that pipelines can be properly sized as part of the City's ongoing renewal and replacement program.

To evaluate the existing water system under the maximum day demand plus fire flow scenario, InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow at a minimum residual pressure of 20 psi. For the existing system fire flow analysis, key junctions that represent hydrant locations were tested to determine the available flow that can be provided, in addition to meeting the maximum day demand. Available flow simulated by the hydraulic model represents the capacity of the water mains and does not account for losses through laterals or hydrant assembly. The analysis assumed that tanks are 50 percent full and that pump stations are operating at firm capacity.

As discussed in *Chapter 6 System Performance and Operational Criteria*, fire flow criteria were developed with input from the City's Fire Department based on the general character and type of existing construction, and allowable construction based on zoning requirements. The fire flow criteria for each tested location was assigned using the general land use categories representing different types of development to assess the adequacy of the existing water distribution system in meeting fire flow demands. The recommended fire flow criteria for all the tested locations are shown on Figure 7-2.

Figure 7-3 summarizes the available fire flow at each tested junction within the existing system while meeting the minimum residual pressure criterion of 20 psi. Zone 13 was not evaluated because it is served by a private fire system. The available fire flow result at each junction was subsequently compared to the fire flow criteria shown on Figure 7-2 to determine the locations(s) not meeting current criteria. Figure 7-4 presents the results of this comparison. Junctions colored in green indicate locations where the available fire flow is greater than the fire flow criteria (*i.e.*, pass), and junctions colored in red indicate locations where the available fire flow is less than the fire flow criteria (*i.e.*, fail). Junctions in red indicate that fire flow criteria are not satisfied at these junctions with the existing water system infrastructure.

As shown in Figure 7-4, all zones except Zone 3 have hydrant locations not meeting the recommended fire flow criteria. Areas where available flows are less than one-third of criteria are mostly in Zone 1/4. Areas where available fire flows are between one-third of the criteria and the full criteria are distributed throughout the distribution system and are not confined to a specific pressure zone or land use type. Section 7.4 details the distribution system improvements that are recommended in order to meet fire flow criteria throughout the existing water distribution system.



N

0 850 1,700

Scale in Feet

Pipeline

Pressure Zone Boundary

Fire Flow Criteria

- 1,000 gpm
- 1,500 gpm
- 2,000 gpm
- 2,500 gpm
- 3,000 gpm

Notes:

1. Fire flow criteria assigned based on existing land use. Refer to Table 6-2 for recommended fire flow criteria by land use type.

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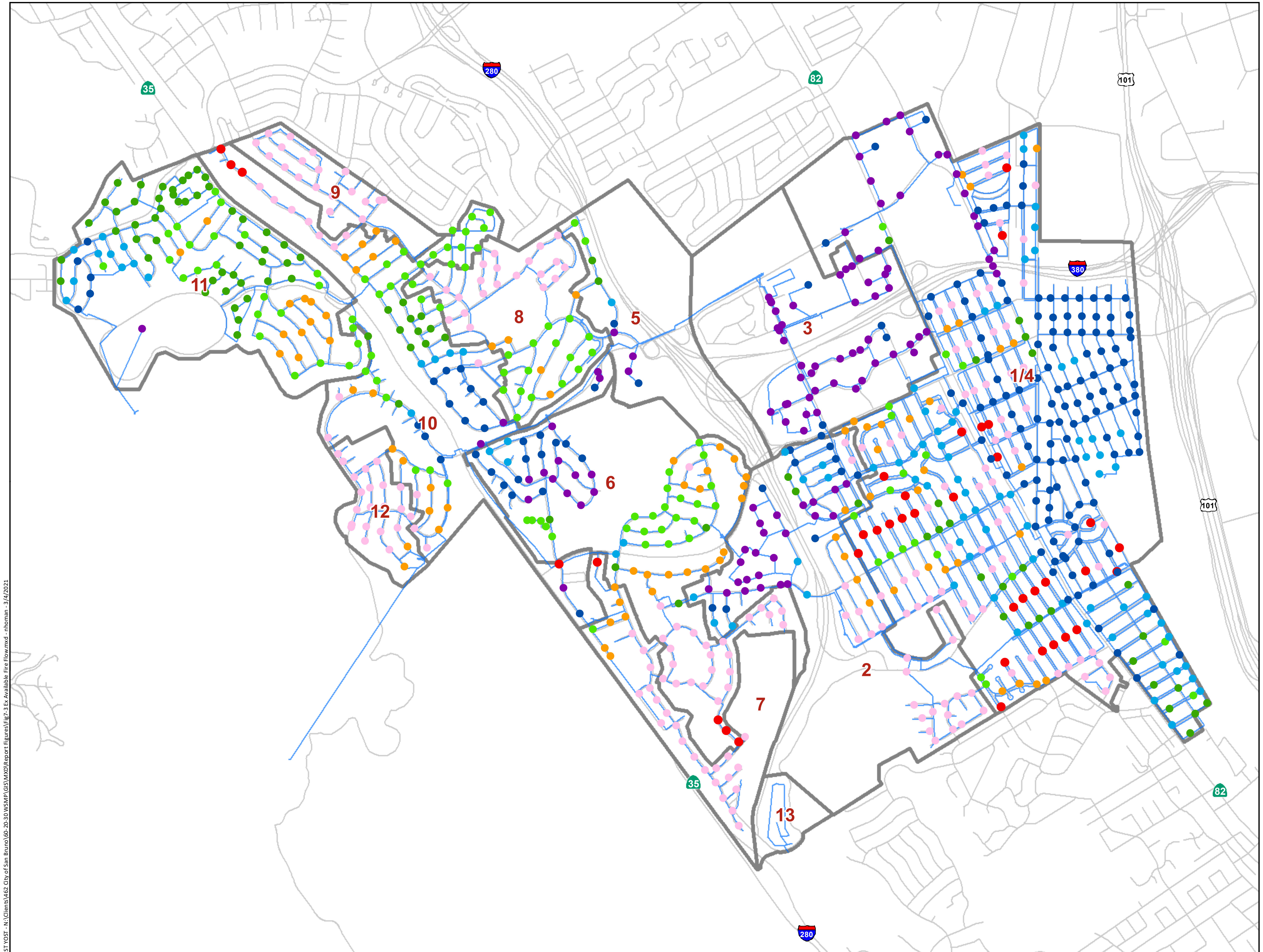
Figure 7-2

Recommended Existing System Fire Flow Criteria

City of San Bruno

Water System Master Plan



0 850 1,700
Scale in Feet

Pipeline
Pressure Zone Boundary

Available Fire Flow

- Less than 500 gpm
- 500 to 1,000 gpm
- 1,000 to 1,500 gpm
- 1,500 to 2,000 gpm
- 2,000 to 2,500 gpm
- 2,500 to 3,000 gpm
- 3,000 to 4,000 gpm
- Greater than 4,000 gpm

Notes:

1. Existing Maximum Day Demand is 5.28 mgd.
2. Assumes storage tanks are half full and that pump stations are operating at firm capacity.
3. The City's existing hydraulic model is not an all-pipes model. Therefore, some short dead-end pipelines are not shown or evaluated.
4. Available fire flow at 20 psi residual pressure. No pipeline velocity constraint was applied to existing pipelines.
5. Available fire flow represents the capacity of water mains and does not account for losses through laterals or hydrant assembly.

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Figure 7-3

Available Fire Flow
Existing Maximum Day Demand

City of San Bruno
Water System Master Plan

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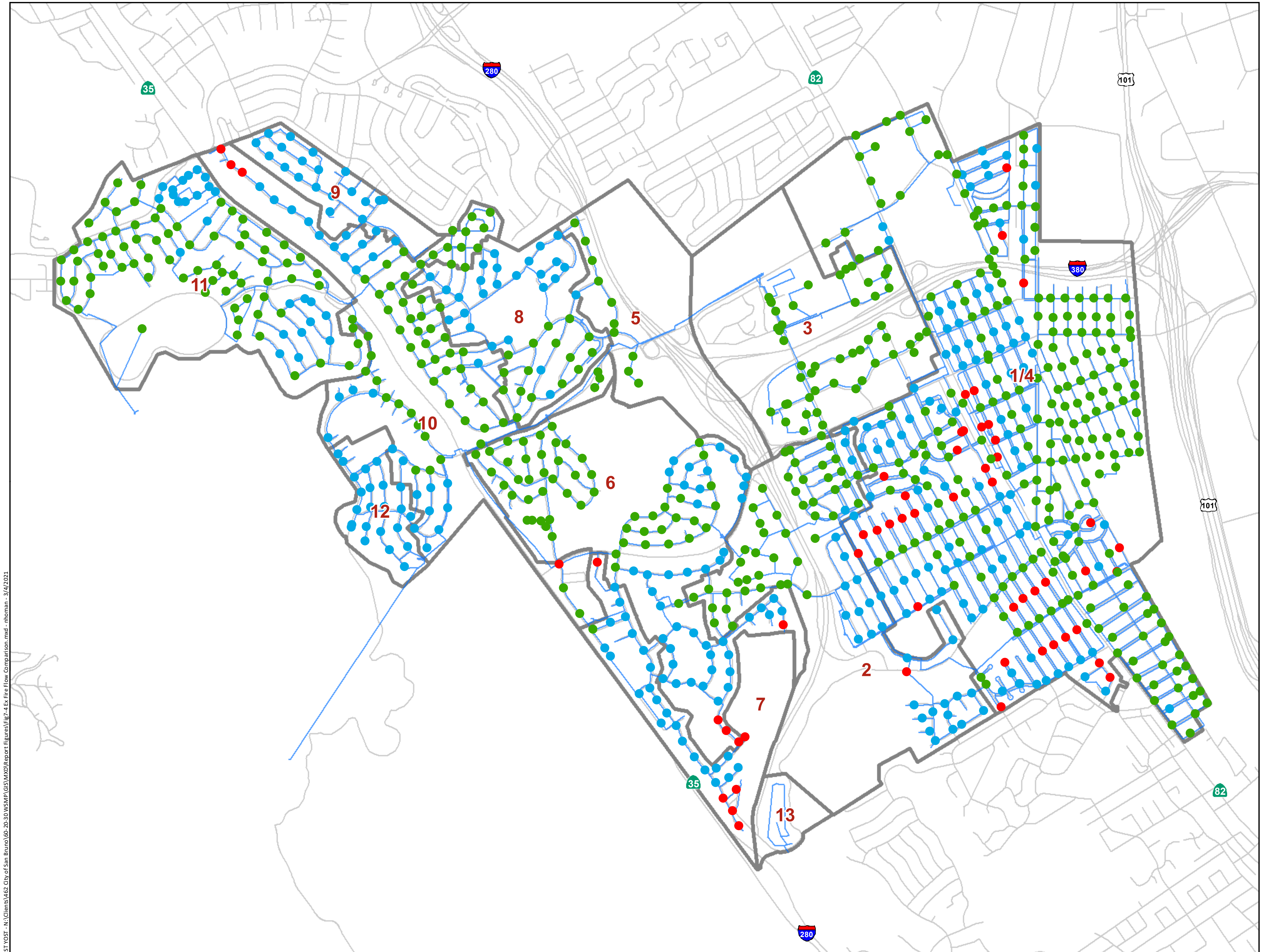


0 850 1,700

Scale in Feet

- Pipeline
- Pressure Zone Boundary

Comparison of Available Fire Flow and Fire Flow Criteria

- Does not meet Fire Flow Criteria, Available Flow < 1/3 Criteria
- Does not meet Fire Flow Criteria, Available Flow > 1/3 Criteria
- Meets Fire Flow Criteria

Notes:

1. Existing Maximum Day Demand is 5.28 mgd.
2. Assumes storage tanks are half full and that pump stations are operating at firm capacity.
3. The City's existing hydraulic model is not an all-pipes model. Therefore, some short dead-end pipelines are not shown or evaluated.
4. Available fire flow at 20 psi residual pressure. No pipeline velocity constraint was applied to existing pipelines.
5. Available fire flow represents the capacity of water mains and does not account for losses through laterals or hydrant assembly.

WEST YOST

Figure 7-4

Comparison of Available Fire Flow and Fire Flow Criteria Existing System

City of San Bruno

Water System Master Plan

7.4 EXISTING SYSTEM CAPACITY IMPROVEMENTS

This section describes the necessary pipeline, pressure regulating station, tank, and pump station improvements based on the system capacity and performance evaluations of the existing water system described above. All improvements identified in the hydraulic performance evaluation are required to meet fire flow criteria. Improvements are shown on Figure 7-5 and are summarized below.

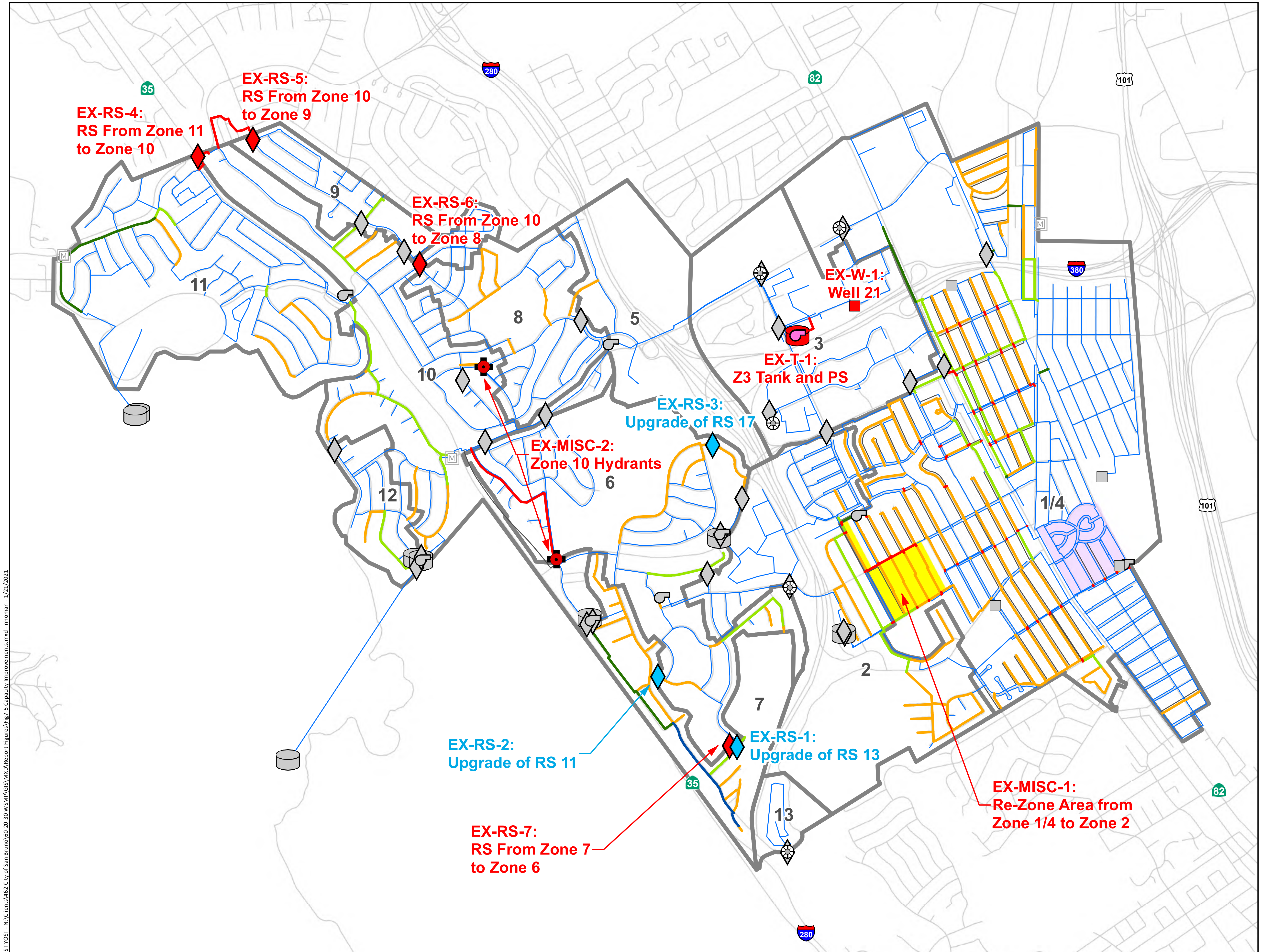
7.4.1 Pipeline Capacity Improvements

The hydraulic evaluation of the existing water distribution system was used to identify pipeline improvements that, when combined with the other improvements described below, meet the recommended fire flow criteria. The system was evaluated, and improvements were developed, on a zone-by-zone basis. As shown on Figure 7-5, recommended pipeline improvements consist primarily of upsizing existing pipelines to 8-inch diameter, although some areas require larger 10-inch diameter or 12-inch diameter pipelines to meet the fire flow criteria. The pressure zones requiring the most extensive pipeline upsizes are Zones 1/4, 2, and 7. All other zones, except for Zone 3, also require some pipeline improvements to satisfy the fire flow criteria.

In addition to upsizing pipelines, new pipeline connections are recommended to improve connectivity in Zone 1/4 and to facilitate the re-zoning of a small area from Zone 1/4 to Zone 2 (see Section 7.4.4 for additional information). It is also recommended that the City abandon the existing 10-inch diameter transmission main east of Highway 35 between San Bruno Avenue and Sneath Lane and connect the existing but inactive 12-inch diameter main in Earl Avenue and Glenview Drive to the existing Zone 10 pipelines. This will improve transmission capacity between PS8 and Tanks 6 and 6A, increase available fire flow in Zone 7, and eliminate an existing maintenance issue for the City.

In addition to the pipeline improvements recommended in Zone 10 to resolve fire flow deficiencies, it is recommended that the City upsize existing pipelines in Sneath Lane, Riverside Drive, Moreland Drive, and Longview Drive to 10-inch diameter mains to improve the suction-side pressure of PS4. Currently, operating one of the PS4 pumps at full speed causes low pressures and high pipeline velocities in Zone 10. Increasing the size of these pipelines will provide a high-capacity flow path from the existing 14-inch transmission main in Sneath Lane and Tanks 6 and 6A to PS4.

CIP identifiers and groupings for pipeline capacity improvements are discussed in Section 7.5.1.6 and are combined with the recommendations from the pipeline rehabilitation and replacement evaluation for easier implementation.



0 850 1,700
Scale in Feet

- Proposed 8-inch Upsize
- Proposed 10-inch Upsize
- Proposed 12-inch Upsize
- Proposed 14-inch Upsize
- Proposed New Pipeline
- Proposed Abandoned Pipeline
- Existing Pipeline
- Turnout
- Proposed New Well
- Existing Active Well
- Proposed New Pressure RS
- Proposed Pressure RS Upsize
- Ex. Pressure Reg. Sta. (RS)
- Proposed New Booster PS
- Ex. Booster Pump Station (PS)
- Proposed New Storage Tank
- Existing Storage Tank
- Proposed Fire Hydrant
- Emergency Connection
- Avenues 1-3
- Proposed Area for Re-zoning
- Pressure Zone Boundary

Notes:
1. Avenues 1-3 pipeline replacement project will be completed in 2021 and will resolve local fire flow deficiencies.

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Figure 7-5

Recommended Existing Water System Capacity Improvements

City of San Bruno
Water System Master Plan

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7.4.2 Well, Storage, and Pumping Capacity Improvements

Two projects have been identified in the category Well, Storage, and Pumping Capacity Improvements. Table 7-5 is a list of their CIP identifiers and their descriptions.

Table 7-5. Well, Storage, and Pumping Capacity Improvement Projects

CIP ID	Project Summary
EX-W-1	This project is the planned new Well 21, located in Zone 3. This improvement is needed to provide additional supply capacity and replace Well 15, which has been out of service for many years. The planned site for Well 21 is at the Acappella Site adjacent to The Crossing/San Bruno. This project includes the abandonment of the existing Well 15.
EX-T-1	This improvement consists of a new storage tank, a new booster pump station, and 540 feet of new 12-inch diameter pipeline in Zone 3, located at Commodore Park as shown on Figure 7-5. A minimum active storage capacity of 1.8 MG is recommended to eliminate the storage deficiency identified in Zone 3[a]. Due to the lack of suitable land at appropriate elevations for a gravity feed tank in Zone 3, a new booster pump station with a firm capacity of 4.3 mgd will also be required at the proposed storage tank site to supply water into Zone 3 during peak demand conditions.

(a) Because the actual dimensions of the proposed storage facility has not been determined, the recommended storage facility size does not currently include dead and freeboard storage requirements, which will be determined during design.

7.4.3 Pressure Regulating Station Capacity Improvements

Several existing pressure regulating stations require upgrades and several new pressure regulating stations are also recommended to improve fire flow availability. Table 7-6 lists the pressure regulating station capacity improvement projects.

Table 7-6. Pressure Regulating Station Capacity Improvement Projects

CIP ID	Project Summary
EX-RS-1	Upgrade existing RS13 with 6-inch and 2-inch valves for fire flow into Zone 7A.
EX-RS-2	Rebuild and reactivate RS11 with 6-inch and 2-inch valves for fire flow service from Zone 7 to Zone 6.
EX-RS-3	Upgrade existing RS17 with 6-inch and 2-inch valves for fire flow into Zone 6A.
EX-RS-4	Install new RS with 8-inch and 4-inch valves at Susan Drive and Sharp Park Road to provide fire flow service from Zone 11 to Zone 10 and install 540 feet of new 8-inch diameter pipeline from Zone 11 to Zone 10.
EX-RS-5	Install new RS with 8-inch and 4-inch valves at Oakmont Drive and Muirfield Circle to provide fire flow service from Zone 10 to Zone 9 and install 1,680 feet of new 8-inch diameter pipeline between Zone 9 and Zone 10.
EX-RS-6	Install new RS with 8-inch and 4-inch valves at Oakmont Drive and Evergreen Drive to provide fire flow service from Zone 10 to Zone 8.
EX-RS-7	Install new RS with 8-inch and 4-inch valves at Piedmont Avenue and Madison Avenue to provide fire flow service from Zone 7 to Zone 6.

7.4.4 Miscellaneous Capacity Improvements

West Yost and the City have identified some other miscellaneous capacity improvements that will further enhance the capacity and reliability of the existing water system. These improvement projects are summarized in Table 7-7 below.

Table 7-7. Miscellaneous Capacity Improvement Projects

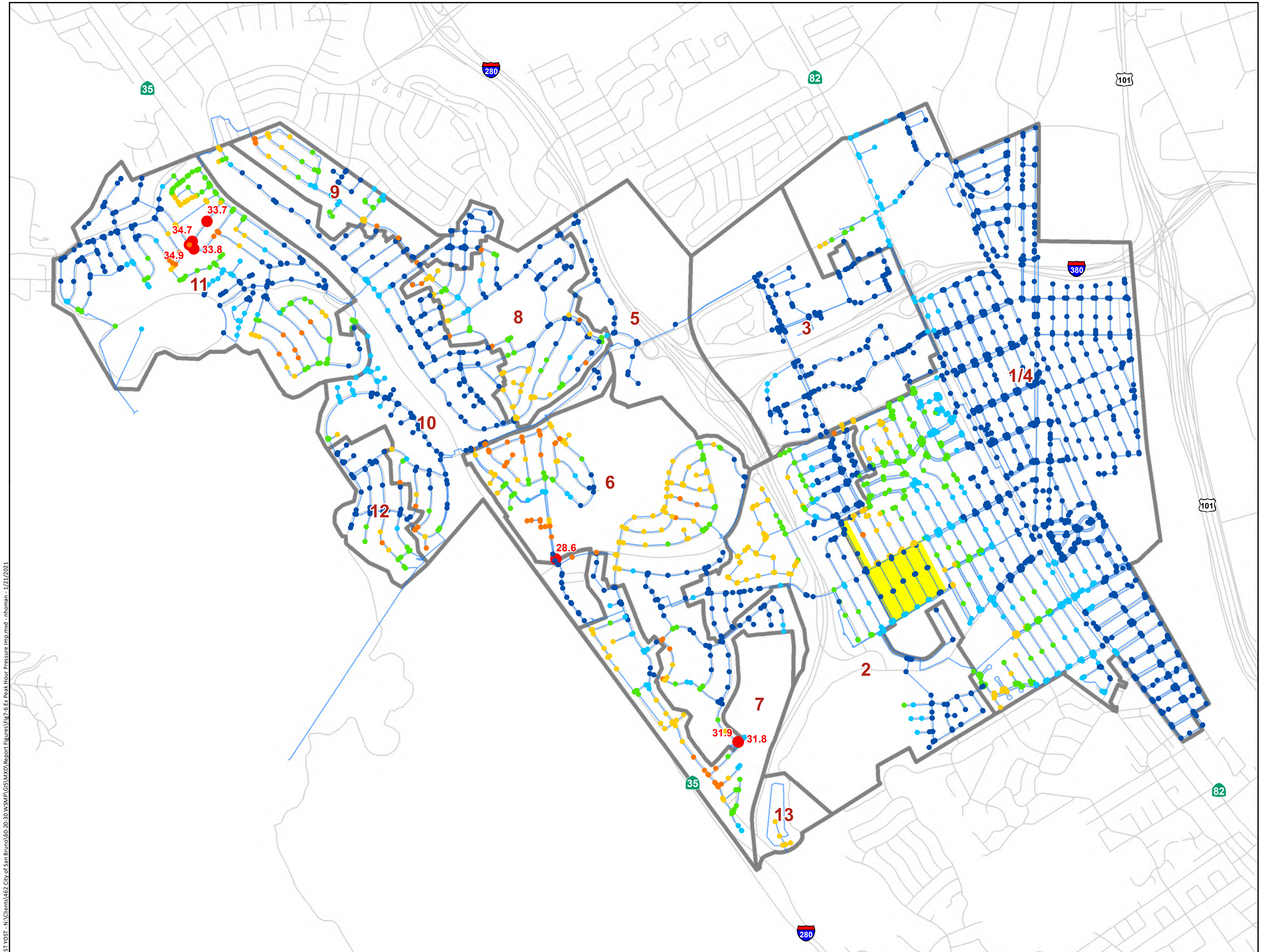
CIP ID	Project Summary
EX-MISC-1	Re-Zoning Project. This project re-zones a portion of Zone 1/4 to Zone 2 to improve peak hour pressures and for additional fire flow reliability. The area to be re-zoned encompasses the blocks of Maple Avenue, Cherry Avenue, Chestnut Avenue, and Beech Avenue between Niles Avenue and Jenevein Avenue, and the blocks of Cedar Avenue between Niles Avenue and Park Avenue. To implement the re-zoning, new pipeline connections would have to be constructed in Cedar Avenue and Niles Avenue, and a new Zone 2 main would have to be installed in Jenevein Avenue.
EX-MISC-2	Hydrant Replacements. This project would replace the existing Zone 6 hydrant at the intersection of Glenview Drive and Skyline Boulevard and the existing Zone 8 hydrant at the intersection of Sequoia Avenue and Rollingwood Drive with new hydrants which draw water from nearby Zone 10 pipelines to improve fire flow availability.

7.4.5 System Performance with Capacity Improvements

The hydraulic model was subsequently updated with the recommended improvements to confirm that they resolve or mitigate the identified deficiencies.

As shown on Figure 7-6, the recommended re-zoning of the area at the ‘top’ of Zone 1/4 to Zone 2 greatly increases the peak hour pressures in that portion of the system. A few junctions in Zones 6, 7, and 11 still exhibit pressures below 35 psi; however, as discussed above, these junctions are at or above the normal ‘top of zone’ elevation or are close to meeting the minimum pressure criterion.

Figure 7-7 shows available fire flows with the recommended facility and pipeline improvements. Consequently, with the recommended improvements, fire flow criteria are met across most of the entire system as shown on Figure 7-8. With the recommended improvements, all but one simulated fire flow location in the distribution system meet the recommended fire flow criteria. This location was reviewed, and it was determined that the fire flow criteria would be met if supply from adjacent hydrants was utilized.



Pipeline

Pressure Zone Boundary

Proposed Area for Re-zoning

Peak Hour Pressure

- Pressure < 35 psi
- 35 psi ≤ Pressure ≤ 50 psi
- 50 psi ≤ Pressure ≤ 60 psi
- 60 psi ≤ Pressure ≤ 70 psi
- 70 psi ≤ Pressure ≤ 80 psi
- Pressure > 80 psi

Notes:

1. Existing Peak Hour Demand is 10.57 mgd.
2. Assumes storage tank levels are half full, and all pump stations are off.
3. The City's existing hydraulic model is not an all-pipes model. Therefore, some short dead-end pipelines are not shown or evaluated.
4. Per the California Plumbing Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
5. Pipelines selected for abandonment are not shown.

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Figure 7-6

Peak Hour Pressure
Existing System with Improvements

City of San Bruno
Water System Master Plan

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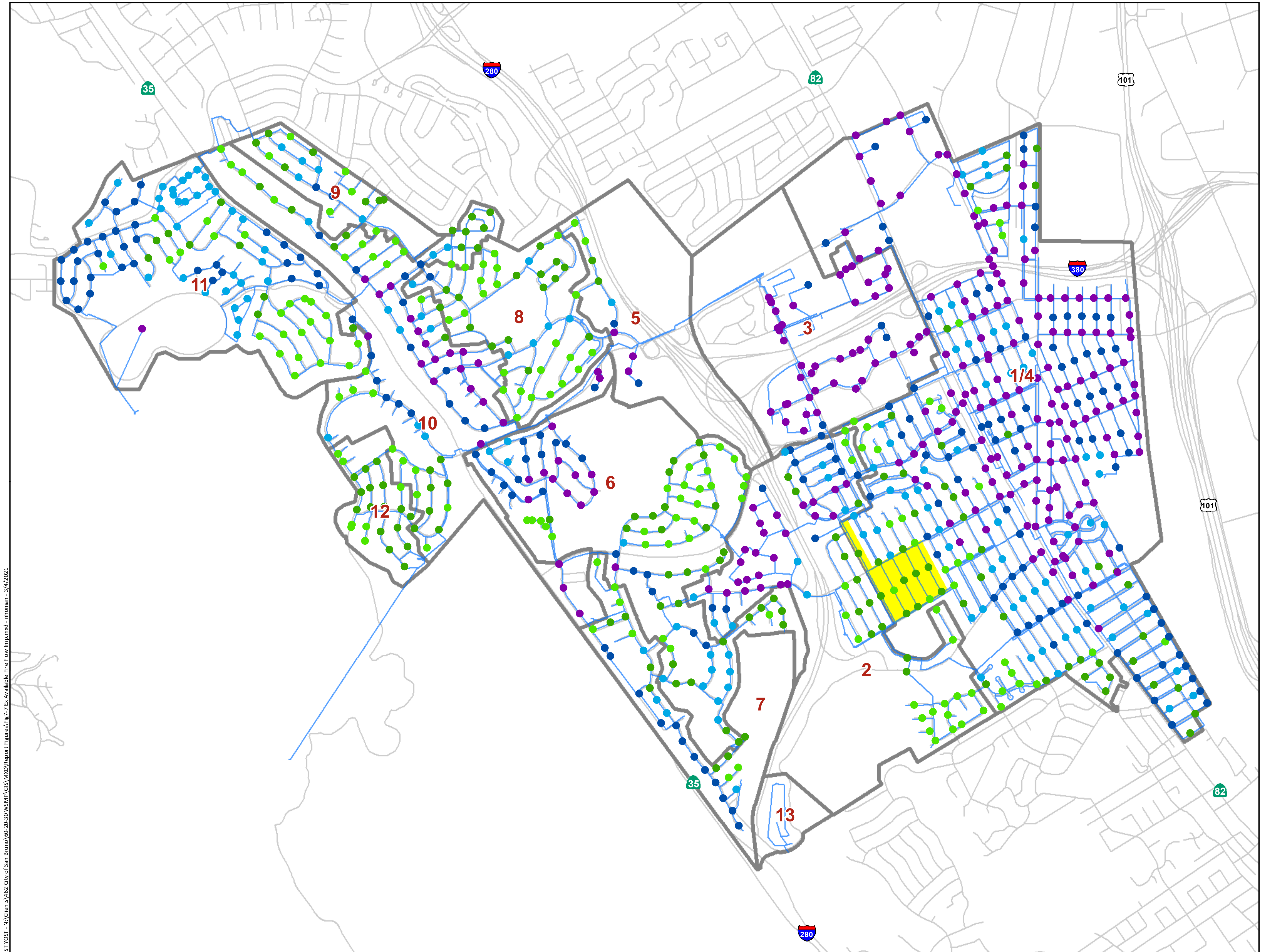

Pipeline

Pressure Zone Boundary

Proposed Area for Re-zoning

Available Fire Flow

- Less than 500 gpm
- 500 to 1,000 gpm
- 1,000 to 1,500 gpm
- 1,500 to 2,000 gpm
- 2,000 to 2,500 gpm
- 2,500 to 3,000 gpm
- 3,000 to 4,000 gpm
- Greater than 4,000 gpm

Notes:

1. Existing Maximum Day Demand is 5.28 mgd.
2. Assumes storage tanks are half full and that pump stations are operating at firm capacity.
3. The City's existing hydraulic model is not an all-pipes model. Therefore, some short dead-end pipelines are not shown or evaluated.
4. Available fire flow at 20 psi residual pressure. The pipeline velocity constraint was applied only to new or upsized pipelines.
5. Available fire flow represents the capacity of water mains and does not account for losses through laterals or hydrant assembly.
6. Pipelines selected for abandonment are not shown.

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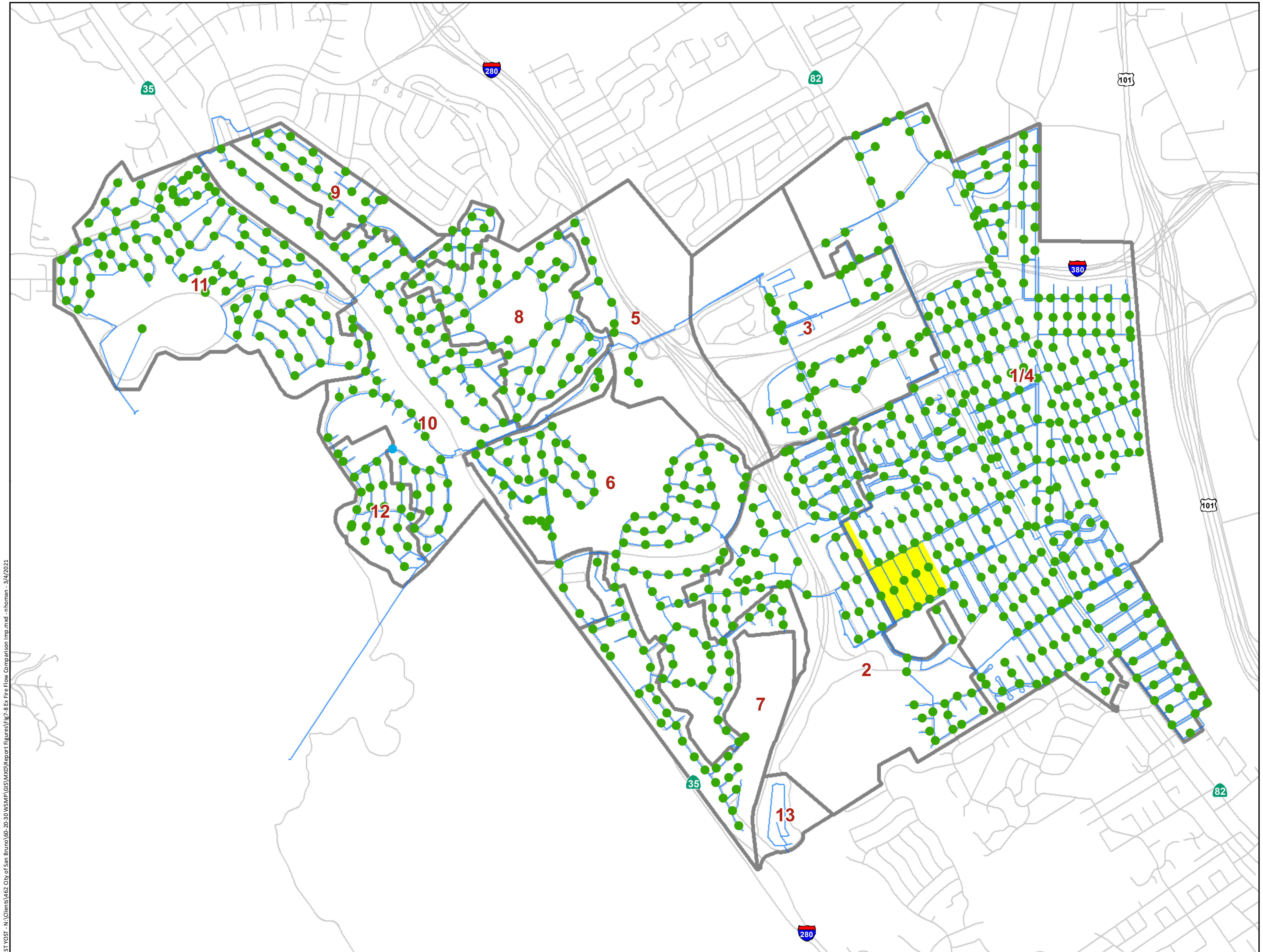
Figure 7-7

Available Fire Flow Existing Maximum Day Demand with Improvements

City of San Bruno

Water System Master Plan

WEST YOST - N:\Clients\462 City of San Bruno\60-20-30 WSMP\GIS\MXD\Report Figures\Fig7-7 Ex Available Fire Flow Imp.mxd - nhoman - 3/4/2021



N
0 850 1,700
Scale in Feet

- Pipeline
- Pressure Zone Boundary
- Proposed Area for Re-zoning

Comparison of Available Fire Flow and Fire Flow Criteria

- Does not meet Fire Flow Criteria, Available Flow < 1/3 Criteria
- Does not meet Fire Flow Criteria, Available Flow > 1/3 Criteria
- Meets Fire Flow Criteria

Notes:
1. Existing Maximum Day Demand is 5.28 mgd.
2. Assumes storage tanks are half full and that pump stations are operating at firm capacity.
3. The City's existing hydraulic model is not an all-pipes model. Therefore, some short dead-end pipelines are not shown or evaluated.
4. Available fire flow at 20 psi residual pressure. The pipeline velocity constraint was applied only to new or upsized pipelines.
5. Available fire flow represents the capacity of water mains and does not account for losses through laterals or hydrant assembly.
6. Pipelines selected for abandonment are not shown.

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Figure 7-8

Comparison of Available Fire Flow and Fire Flow Criteria Existing System with Improvements

City of San Bruno
Water System Master Plan

WEST YOST - N:\Clients\462 City of San Bruno\60-20-30 WSMP\GIS\MXD\Report Figures\Fig7-8 Ex Fire Flow Comparison Imp.mxd - nhoman - 3/4/2021

7.5 REHABILITATION AND REPLACEMENT EVALUATION

This section discusses the rehabilitation and replacement evaluations for pipelines, well, tank and pump station facilities, and other miscellaneous items. The primary purpose of these evaluations was to identify and prioritize the water system assets in need of repair or replacement.

7.5.1 Pipeline Rehabilitation and Replacement Evaluation

To develop a focused pipeline rehabilitation and replacement program, a risk assessment was performed to prioritize pipelines with the highest risk of failure for replacement. For this assessment, a pipeline failure is considered to be a structural failure that causes a water main to break or leak. Pipeline leaks and breaks must be isolated, dewatered, and disinfected as part of the repair process, and thus cause water service outages to customers. Leaks and breaks can also require costly emergency repairs which are disruptive to the community. This water pipeline risk assessment evaluated the likelihood and consequence of failure for water pipeline segments in the City's existing water system.[3] This section includes discussion of the following topics:

- Risk Assessment Methodology
- Likelihood of Failure Analysis
- Consequence of Failure Analysis
- Risk Assessment Results
- Prioritization of High-Risk Pipelines for Replacement

Hydraulic capacity failures of pipelines were evaluated previously in Section 7.3 and are not incorporated directly into the risk assessment. However, as discussed in Section 7.5.1.5, the hydraulic capacity deficiencies were used to further prioritize high risk areas in Zone 1/4 for replacement.

7.5.1.1 Risk Assessment Methodology

Likelihood of failure assesses the probability that a failure will occur, and consequence of failure considers the impact a failure may have on public health, the environment, and the community. The risk assessment considered several factors to evaluate likelihood of failure (pipeline age, pipeline material, and geologic conditions), as well as consequence of failure (critical pipelines, pipelines serving critical customers, pipeline diameter, and pipeline location). Each of these factors is discussed in detail below. These factors were used to assign overall ratings for likelihood of failure and consequence of failure to each pipe segment. The likelihood of failure ratings and the consequence of failure ratings were then combined to develop a comprehensive risk rating for each pipe segment.

[3] Based on pipelines represented in the City's existing system hydraulic model, which includes all hydraulically significant pipelines. Some short, dead-end pipelines were not evaluated. In addition, pipelines located on-site at major facilities (reservoirs, pump stations, etc.) were excluded from this evaluation.

7.5.1.2 Likelihood of Failure Analysis

The likelihood of failure analysis considers the probability that a failure will occur on a given pipeline segment. Its primary factor is the physical mortality of each pipeline, which considers the age and material of the pipeline. Ratings were assigned to different ages and material types based on the leak data provided by the City, as discussed in further detail below. The sum of the ratings for pipeline age and pipeline material is the total physical mortality rating, which can range from 2 to 10. The geologic conditions surrounding each pipeline were also examined and treated as a secondary factor. Geologic conditions include proximity to seismic faults and proximity to known areas of highly corrosive soil. As a secondary factor, geologic conditions was used to increase the likelihood of failure score for pipelines which received a total physical mortality rating less than 10, up to a maximum of 10. The geologic conditions factor had no affect on the likelihood of failure score for pipelines which received a total physical mortality rating of 10. The rating logic for the likelihood of failure analysis is presented in Table 7-8.

Table 7-8. Likelihood of Pipeline Failure Rating Factors

Factor	Rating (0 being the lowest, 5 being the highest)						Rating Logic
	0	1	2	3	4	5	
Physical Mortality							
Pipeline Age	--	Installed 1990 - 2020	Installed 1970 - 1989	Installed 1950 - 1969	--	Installed 1900 - 1949	Sum of Two Factors
Pipeline Material	--	All other materials not listed	--	Asbestos cement	Cast iron	Galvanized steel	
Geologic Conditions							
Proximity to Geologic Conditions	All other pipelines	--	Within 500 feet of seismic faults	Within 250 feet of seismic faults	Within 100 feet of seismic faults	Near high corrosivity soil (Shelter Creek area)	Single Factor
Total Likelihood of Failure Score:	Sum of Physical Mortality and Geologic Conditions (Up to a maximum score of 10)						

7.5.1.2.1 Physical Mortality

Physical mortality is the primary factor used to evaluate likelihood of failure because it denotes whether a pipeline has reached the end of its useful life. The pipeline age and pipeline material ratings were determined based on the historical leak data discussed below.

7.5.1.2.1.1 Historical Leak Data

Historical leak data was used to inform the ratings assigned to each pipe segment for physical mortality. Since 2000, the City has maintained a record of leak occurrences throughout the City's water system. Available spatially located leak data from 2000 through 2020 was provided by the City in GIS format. West Yost then assigned each leak record to the nearest water main. Figure 7-9 and Figure 7-10 present the leaks per 1,000 feet of pipelines by material type and installation year, respectively.

It should be noted that the City's GIS includes very little information on pipeline age or material. City staff provided general statistics on pipeline age and material type based on historical subdivision maps that have been compiled by the City into a single map titled "Initial Infrastructure Construction Map." Where data was not available, West Yost assigned the pipelines an age and material based on the properties of nearby pipelines and using best judgment.

As shown on Figure 7-9, pipelines installed in the 1940s or earlier have a very high leak rate and were therefore assigned a rating of 5. Pipelines installed in the 1950s and 1960s have the next highest leak rate, but since it is less than half that of pipelines installed prior to 1950, they were assigned a rating of 3. Pipelines installed in the 1970s and 1980s were assigned a rating of 2, and pipelines that were installed more recently than the 1980s were assigned a rating of 1.

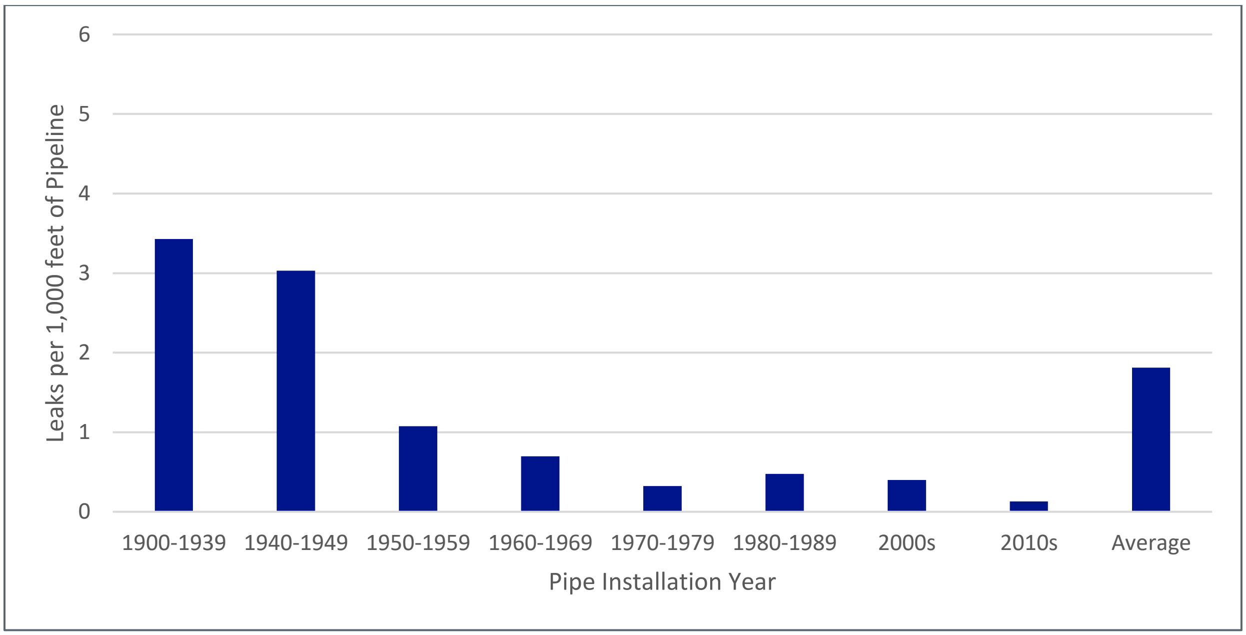


Figure 7-9. Leaks per 1,000 feet of Pipeline by Installation Date

As shown on Figure 7-10, galvanized steel pipelines experienced significantly more leaks per length than other pipeline materials and were therefore assigned a rating of 5. Cast iron and asbestos cement pipelines both experienced approximately 1.2 leaks per 1,000 feet; however, based on discussion with City staff, cast iron pipeline failures have been more significant than asbestos cement failures. Therefore, cast iron pipeline was assigned a rating of 4 and asbestos cement pipeline was assigned a rating of 3. All other material types (ductile iron, polyvinyl chloride, and welded steel) experience relatively low numbers of leaks per length and were assigned a rating of 1.

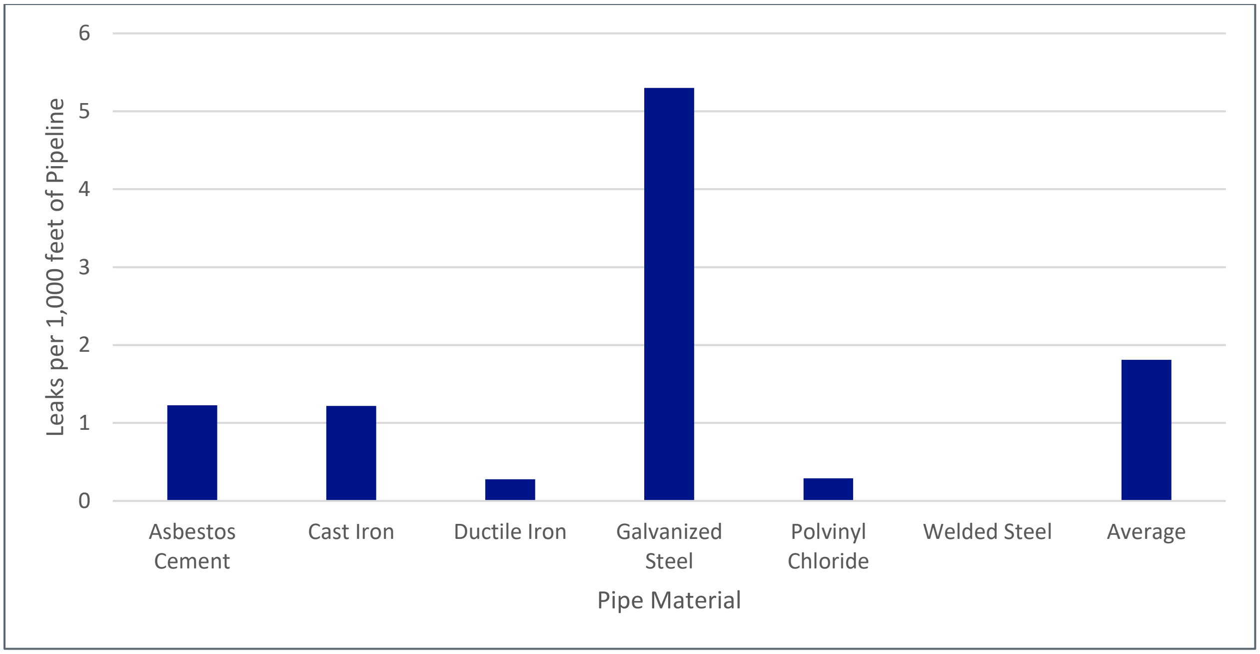


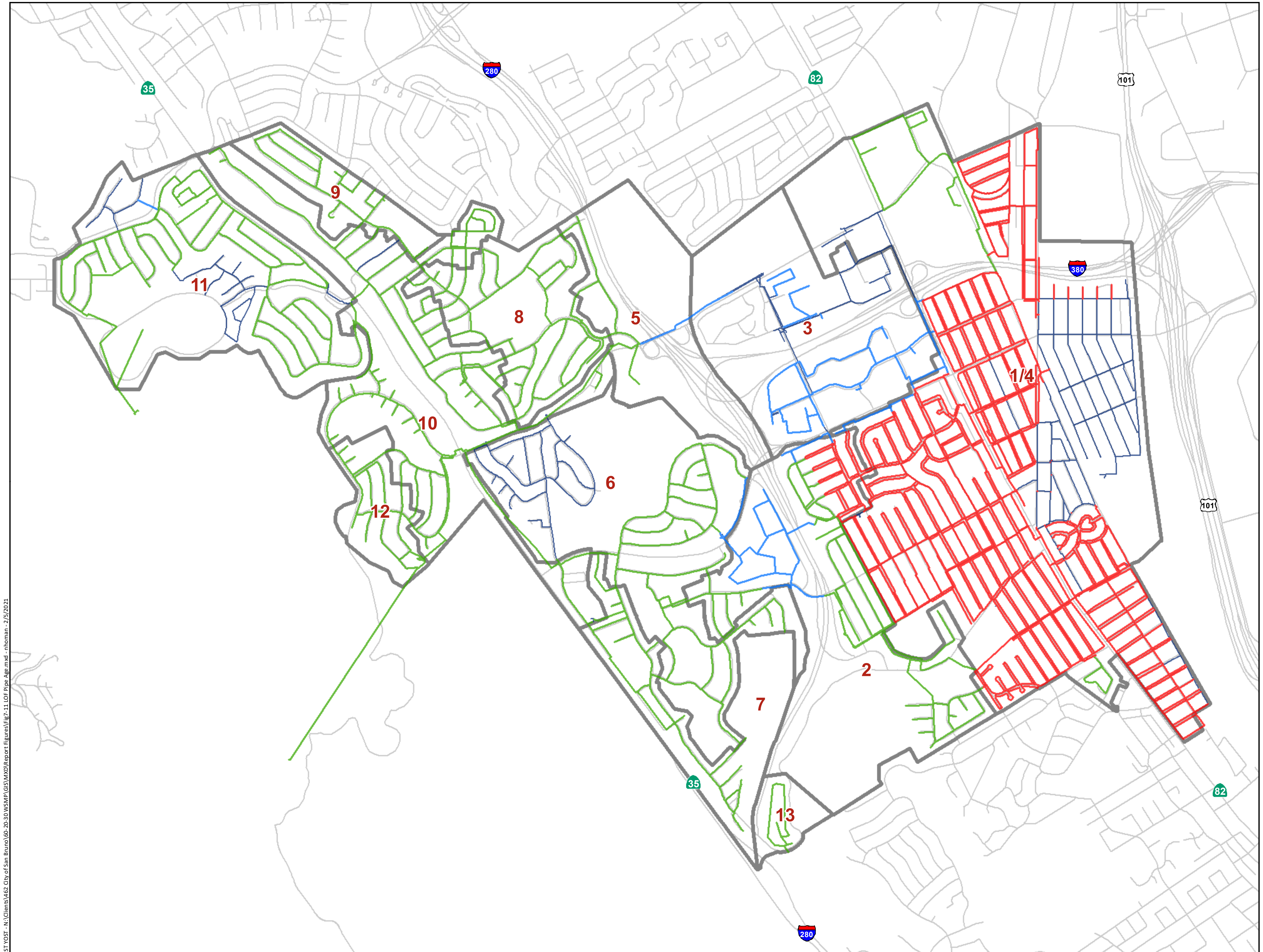
Figure 7-10. Leaks per 1,000 feet of Pipeline by Material Type

7.5.1.2.1.2 Physical Mortality Results

Ratings were assigned to each pipeline segment based on age and material type; these ratings were then added together to get a total physical mortality rating. The age ratings for evaluated system pipelines are shown on Figure 7-11 and the material type ratings are shown on Figure 7-12.

7.5.1.2.2 Geologic Condition

The geologic condition surrounding each pipeline was considered a secondary factor when evaluating likelihood of failure. Ratings were assigned based on proximity to seismic faults, as well as proximity to areas with highly corrosive soils. Pipelines within at least 500 feet of seismic faults were considered at elevated likelihood of failure for the purpose of this analysis. City staff indicated that pipelines in the Shelter Creek area have experienced numerous failures due to highly corrosive soil, and thus pipelines in this area were assigned a rating of 5. The geologic condition ratings for evaluated system pipelines are shown on Figure 7-13.



N

0 850 1,700

Scale in Feet

Pipeline Installation Year

- 1900 - 1949 (Rating = 5)
- 1950 - 1969 (Rating = 3)
- 1970 - 1989 (Rating = 2)
- 1990 - 2020 (Rating = 1)
- Pressure Zone Boundary

Notes:

1. A greater rating means a greater likelihood of failure.
2. Pipeline age data based primarily on the Initial Infrastructure Construction Map provided by City staff in 2011. Other data sources include the City GIS database, discussion with City staff, and infrastructure improvement plans.

WEST YOST

Figure 7-11

Likelihood of Failure Pipeline Age

City of San Bruno

Water System Master Plan

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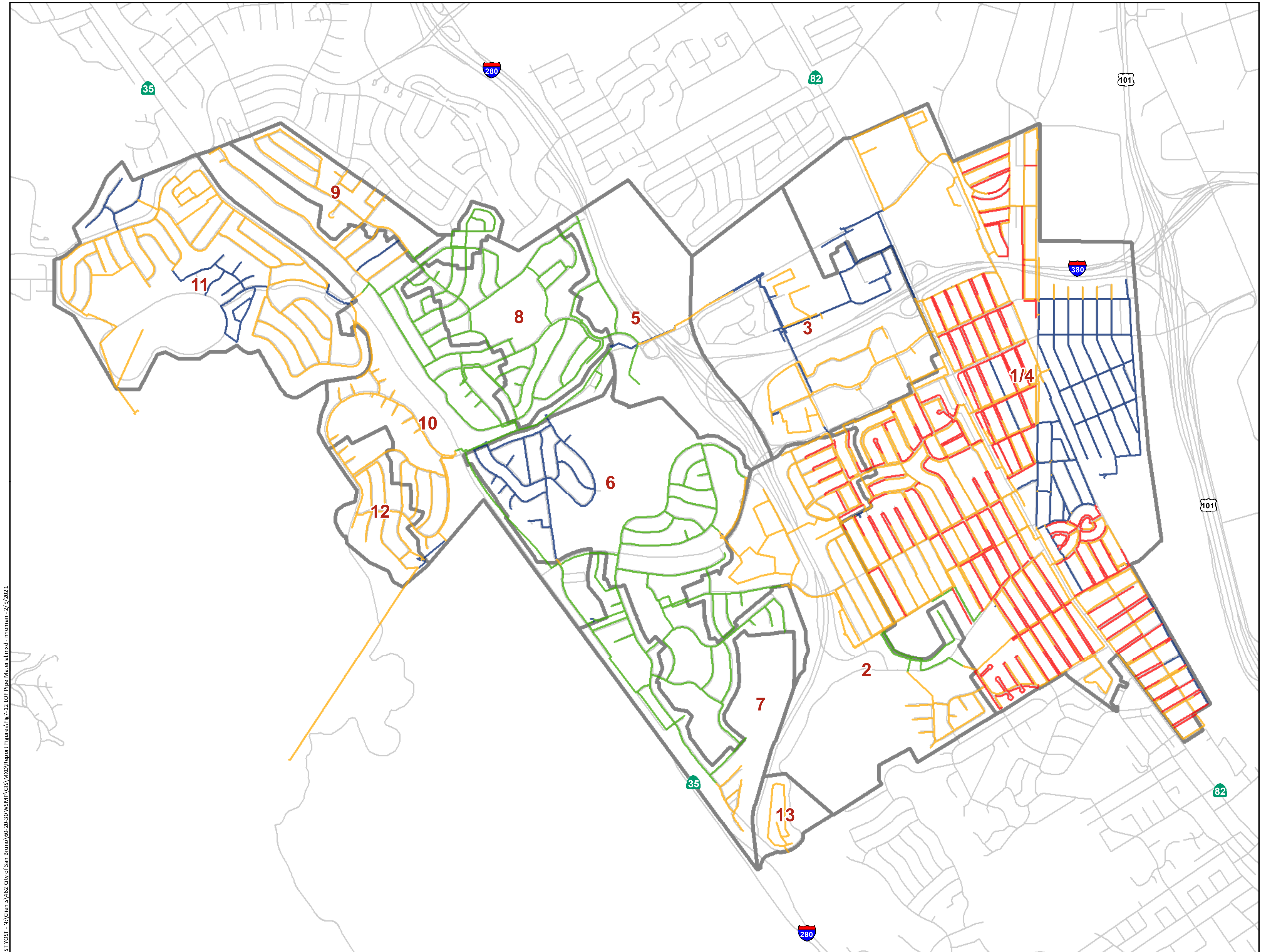

N

0 850 1,700

Scale in Feet

Pipeline Material

- Galvanized Steel (Rating = 5)
- Cast Iron (Rating = 4)
- Asbestos Cement (Rating = 3)
- All Other Pipe Materials (Rating = 1)
- Pressure Zone Boundary

Notes:

1. A greater rating means a greater likelihood of failure.
2. Pipeline material data based primarily on the table of pipeline age and material by subdivision provided by City staff in 2011. Other data sources include the City GIS database, discussion with City staff, and infrastructure improvement plans.

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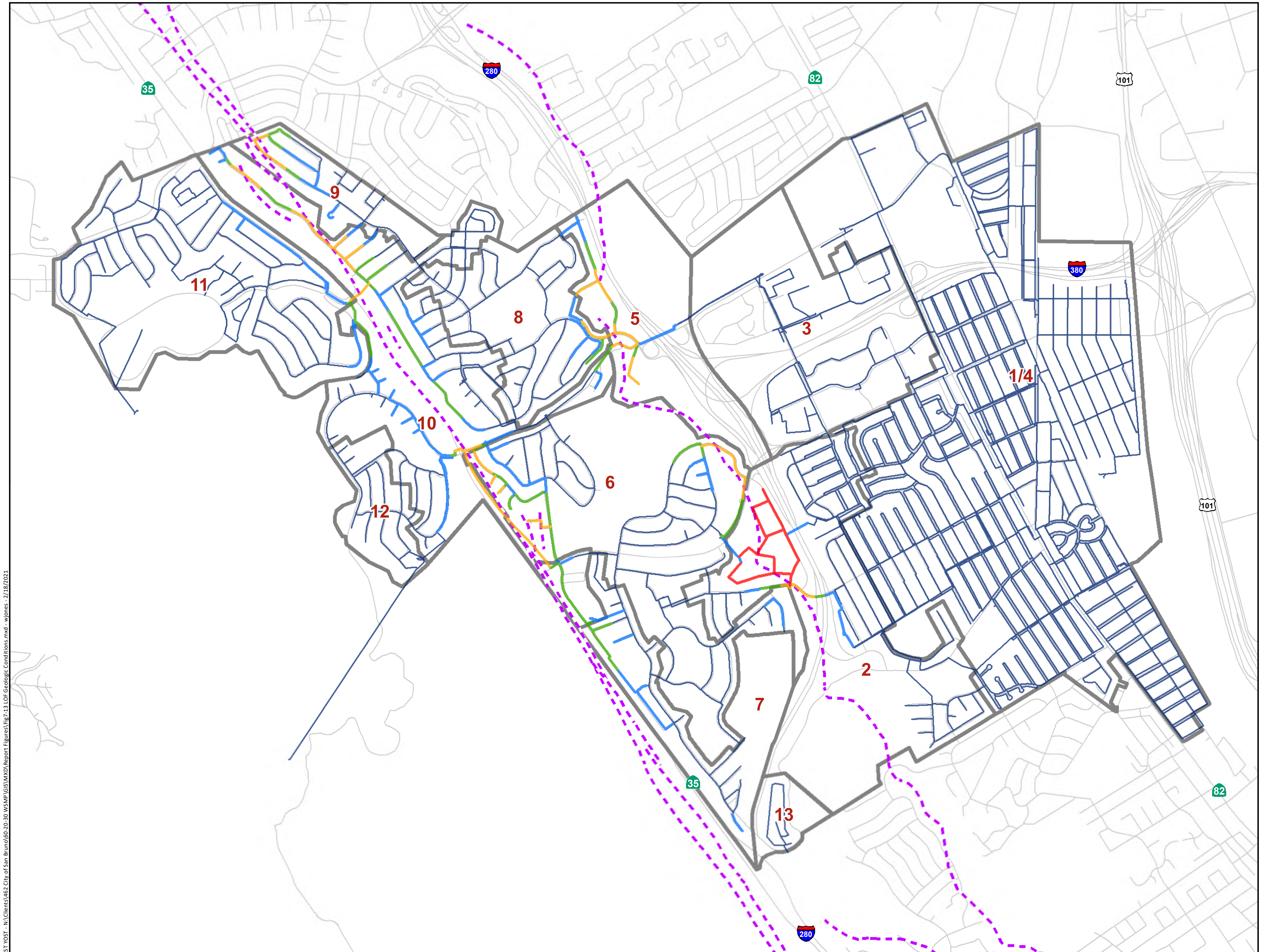
Figure 7-12

Likelihood of Failure Pipeline Material

City of San Bruno

Water System Master Plan



N

0 850 1,700

Scale in Feet

Pipelines Impacted by Geologic Conditions

- Shelter Creek High Corrosivity Soil (Rating = 5)
- Within 100 ft of Seismic Faults (Rating = 4)
- Within 250 ft of Seismic Faults (Rating = 3)
- Within 500 ft of Seismic Faults (Rating = 2)
- Other Existing Pipelines (Rating = 0)
- Seismic Fault
- Pressure Zone Boundary

Notes:

1. A greater rating means a greater likelihood of failure.
2. Seismic fault data was downloaded on 12/4/20 from the Interactive Fault Map located at www.usgs.gov.

WEST YOST

Figure 7-13

Likelihood of Failure Geologic Conditions

City of San Bruno

Water System Master Plan

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7.5.1.3 Consequence of Failure Analysis

The consequence of failure analysis considers the potential impacts from a main break. For this analysis, service impacts and emergency response impacts were considered. The service impact category considers the quantity of customers that will be without water if a given pipelines breaks, as well as whether any high priority customers will experience impacts if that pipeline breaks. The emergency response impact category takes into account the diameter of each pipeline and whether its location will make performing repairs more difficult. The rating logic for the consequence of failure analysis is presented in Table 7-9.

Table 7-9. Consequence of Pipeline Failure Rating Factors

Factor	Rating (0 being the lowest, 5 being the highest)						Rating Logic
	0	1	2	3	4	5	
Service Impacts							
Critical Pipelines	All other pipelines	--	--	--	--	Major non-looped pipelines	Maximum of Two Factors
Critical Customers	Pipelines serving all other customers	--	--	City Hall Basement, Police Department, Recreation Center, Senior Center	Public schools	Dialysis Centers	
Emergency Response Impacts							
Pipeline Diameter	--	4 inches or smaller	6 - 8 inches	10 inches	12 inches	14 inches or greater	Maximum of Two Factors
Locational Issues	All other pipelines	--	--	Within 50 feet of SFPUC pipelines or along major roads	Near gas lines	Crossing freeways or railroads	
Total Consequence of Failure Score:				Sum of Service Impacts and Emergency Response Impacts (Up to a maximum score of 10)			

7.5.1.3.1 Service Impact

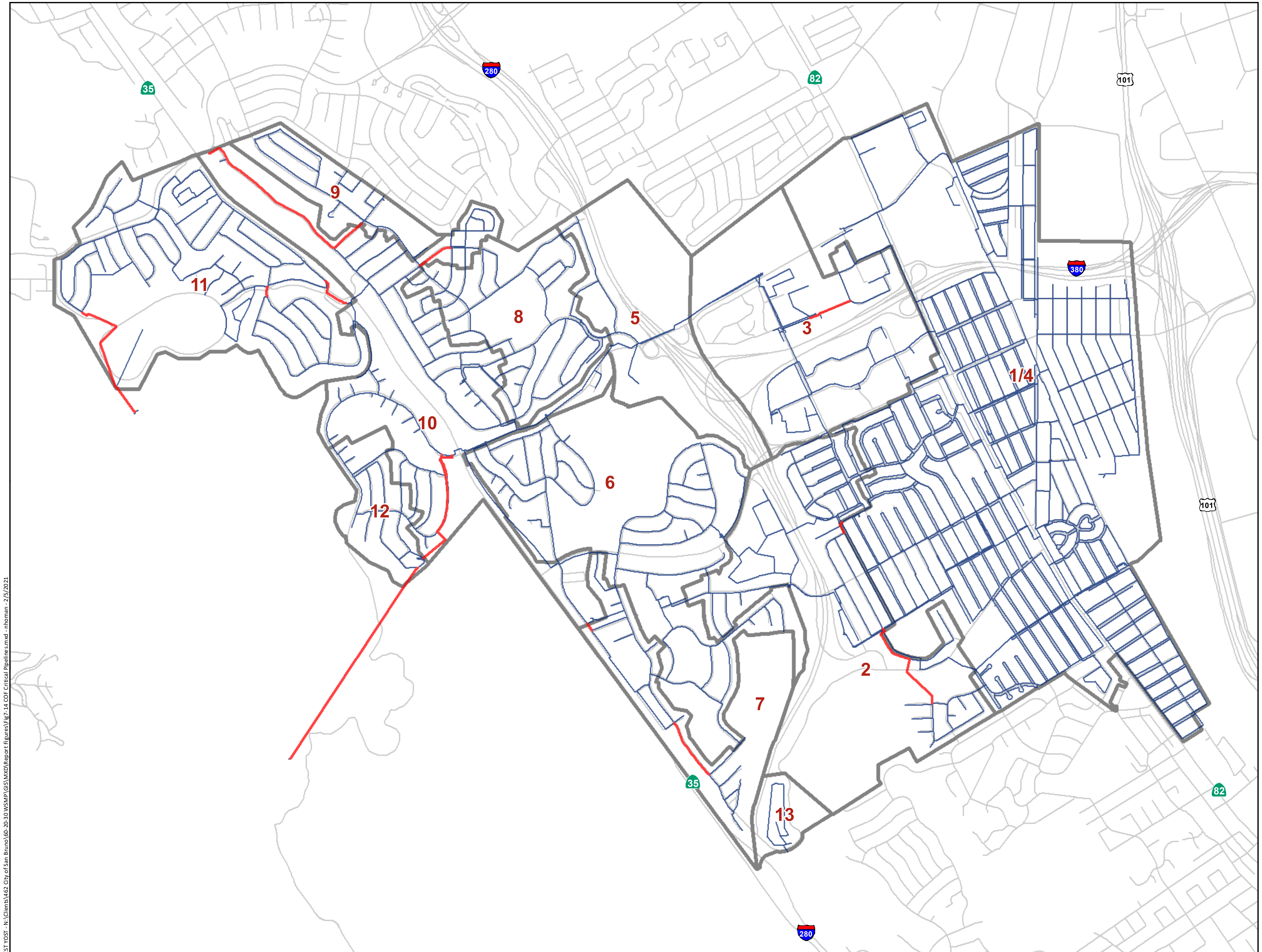
Service impact considers what quantity and type of customers will be impacted if a pipeline is out of service. Two factors were used to assess service impacts: critical pipelines and critical customers. Critical pipelines are either (1) a pipeline providing the sole source of supply for a significant number of services or (2) a long pipeline which is the sole connection between a critical storage tank or pump station and the rest of the distribution system. The location and rating of critical pipelines within the City's distribution system are shown on Figure 7-14.

Critical customers include all critical customers within City limits that are listed in the City's Emergency Response Plan (City Hall basement, the Police Department, the Senior Center, the Recreation Center, and all public elementary, middle, and high schools) and a dialysis center. The dialysis center was identified as the customer with greatest consequence of failure, as loss of service to this location may interrupt medical care. Public schools are the next most critical customers, followed by City Hall basement, the Police Department, the Senior Center, and the Recreation Center. The location of critical customers, as well as the location and rating of pipelines serving critical customers are shown on Figure 7-15.

7.5.1.3.2 Emergency Response Impact

Emergency response impact considers the difficulty involved with quickly accessing and repairing a given pipeline break. Two factors were used to assess emergency response impacts: diameter and locational issues. The greater the diameter of a pipeline, the more difficult it is to repair and the greater the quantity of water released to the surrounding environment. Thus, higher ratings were assigned to larger diameter pipelines. The diameter and rating of evaluated pipelines are shown on Figure 7-16.

Locational issues are defined as pipelines located in parts of the distributions system that are difficult to access, due to their proximity to freeways, railroads, major natural gas lines, SFPUC Regional Water System transmission pipelines, and major roads. Pipelines which cross freeways and railroads were considered the most difficult to access, followed by pipelines near major gas lines, and then by pipelines within 50 feet of SFPUC Regional Water System transmission pipelines or in major streets. Pipelines with locational issues and their ratings are shown on Figure 7-17.



N
0 850 1,700
Scale in Feet

Critical Pipelines

- Non-looped Pipes (Rating = 5)
- Other Existing Pipes (Rating = 0)
- Pressure Zone Boundary

Notes:

1. A greater rating means a greater consequence of failure.
2. Critical pipelines are either (1) a pipeline which provides the sole source of supply for a significant number of services, or (2) a long pipeline which is the sole connection between a critical storage tank or pump station and the rest of the distribution system.

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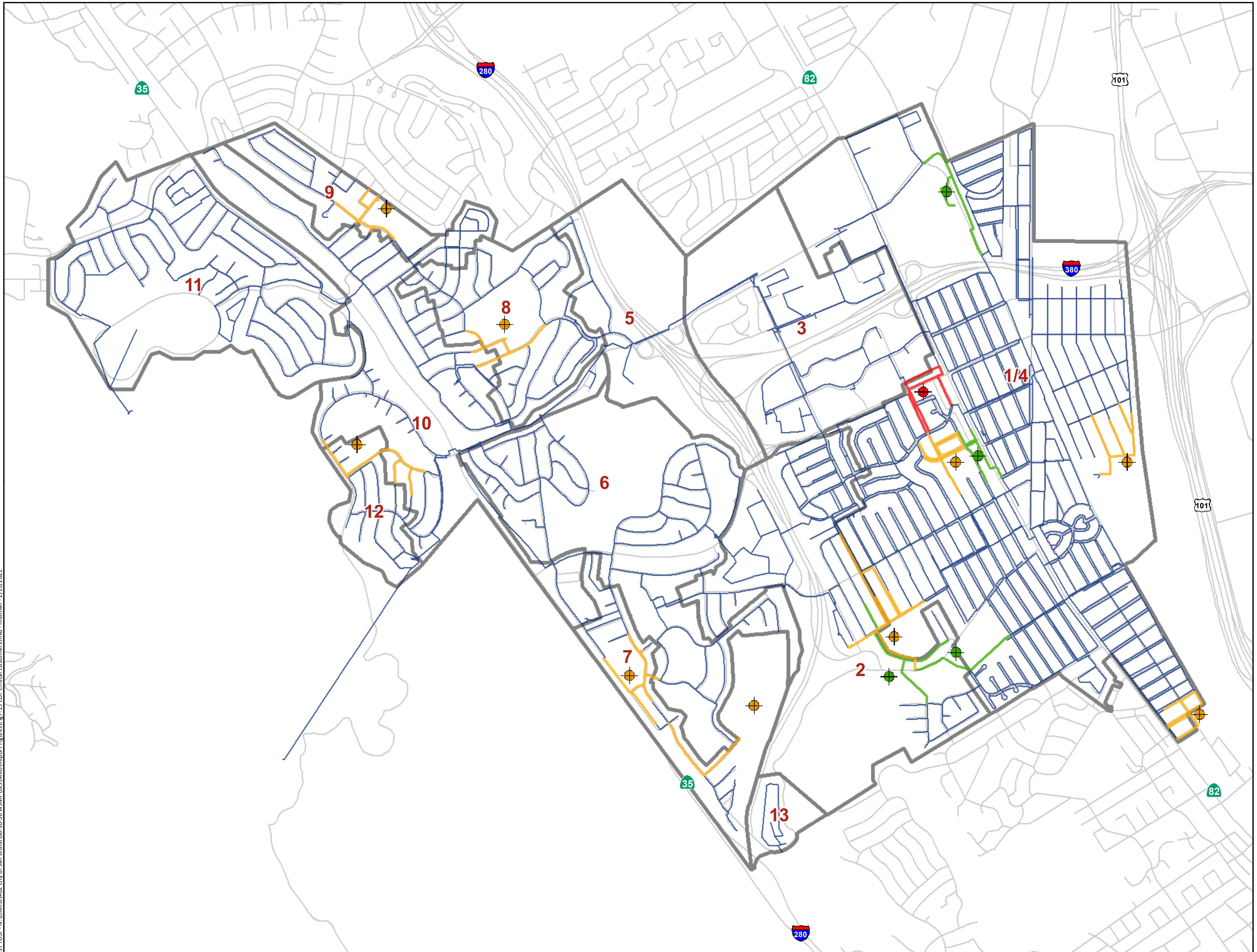
Figure 7-14

Consequence of Failure Critical Pipelines

City of San Bruno
Water System Master Plan



N

0 850 1,700

Scale in Feet

Critical Customer Pipelines

- Dialysis Center (Rating = 5)
- Public Schools (Rating = 4)
- City Hall basement, Police Department, Recreation Center, Senior Center (Rating = 3)
- Non-critical (Rating = 0)

Critical Customers

- Dialysis Center (Rating = 5)
- Public Schools (Rating = 4)
- City Hall Basement, Police Department, Recreation Center, Senior Center (Rating = 3)
- Pressure Zone Boundary

Notes:

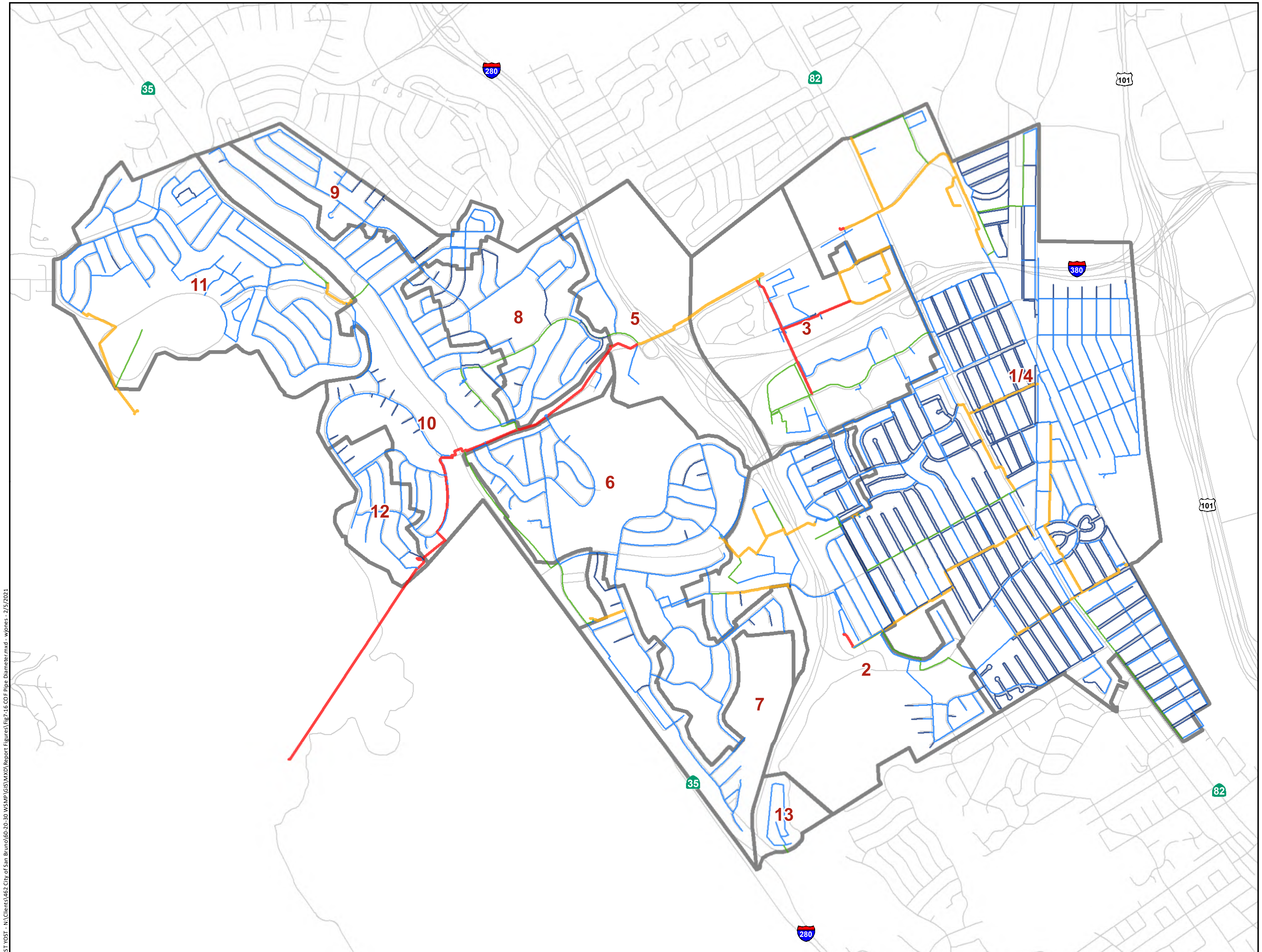
1. A greater rating means a greater consequence of failure.
2. Critical customers include those identified as such in the City's Emergency Response Plan. The dialysis center was also included as a critical customer for this evaluation.

WEST YOST

Figure 7-15

Consequence of Failure
Critical Customers

City of San Bruno
Water System Master Plan



N

0 850 1,700

Scale in Feet

Pipeline Diameter

- 14" or Larger (Rating = 5)
- 12" (Rating = 4)
- 10" (Rating = 3)
- 6" - 8" (Rating = 2)
- 4" or Smaller (Rating = 1)
- Pressure Zone Boundary

Notes:

1. A greater rating means a greater consequence of failure.

WEST YOST

Figure 7-16

Consequence of Failure Pipeline Diameter

City of San Bruno

Water System Master Plan

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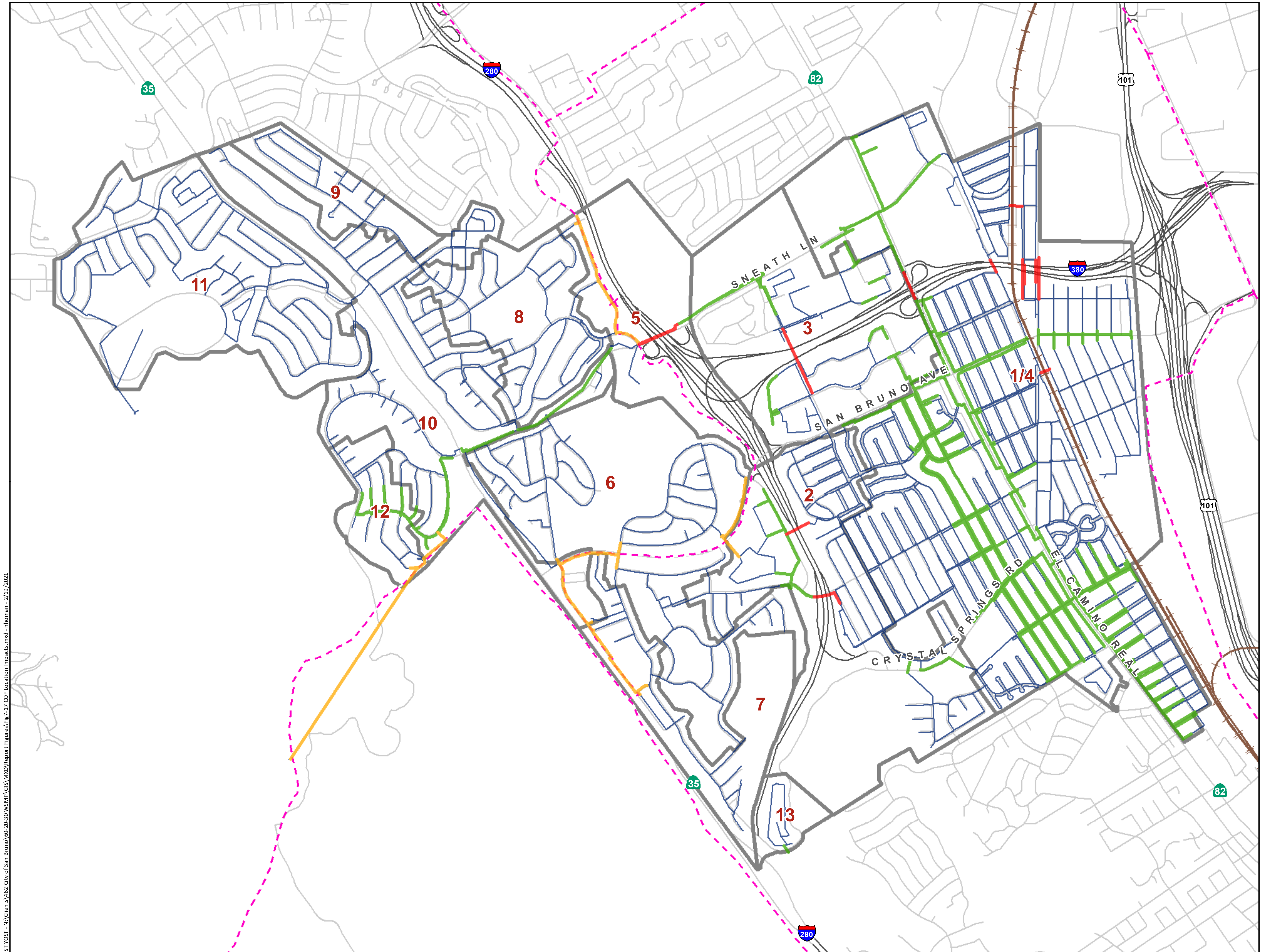

N

0 850 1,700

Scale in Feet

Pipelines Impacted by Location

- Crossing Freeways or Railroads (Rating = 5)
- Near Gas Lines (Rating = 4)
- Along Major Roads or within 50 feet of SFPUC Pipelines (Rating = 3)
- Other Existing Pipes (Rating = 0)
- Freeways
- Railroad
- Gas Line
- Pressure Zone Boundary

Notes:

1. A greater rating means a greater consequence of failure.
2. Gas line locations are approximate and were obtained from PG&E's online interactive map showing neighborhood gas lines.
3. Major roads include Sneath Lane, San Bruno Ave, Crystal Springs Road, and El Camino Real, as shown.
4. Pipelines within 50 feet of SFPUC transmission mains were identified by SFPUC staff.

WEST YOST

Figure 7-17

Consequence of Failure Locational Issues

City of San Bruno

Water System Master Plan

7.5.1.4 Risk Assessment Results

After tallying the likelihood and consequence of failures scores for each pipeline segment, the next step in the risk assessment was to assign an overall risk level to each pipeline. As shown in Table 7-10, the total scores for likelihood of failure and consequence of failure are each divided into five ranges (A through E), with E being the level with the greatest likelihood or consequence. By plotting the consequence of failure and likelihood of failure scores against each other, an overall risk level was assigned to each segment. Risk was grouped into five levels: High, Medium-High, Medium, Medium-Low, and Low.

Overall risk levels were assigned by examining the characteristics of pipelines within each cell of the risk matrix and adjusting the risk levels to provide a logical progression for replacement which aligns with City priorities. All pipelines with an 'E' rating in the Likelihood of Failure category were considered High Risk regardless of their consequence of failure rating. Because a large portion of the City's pipelines were installed in the 1940s or earlier and are composed of galvanized steel or cast iron, almost half of the City's pipelines are considered High Risk. Other overall risk levels were assigned based on a combination of likelihood of failure and consequence of failure.

Table 7-10 shows the total length of pipeline (in feet) out of a total of approximately 609,130 feet total that fall into each range. Pipelines located on-site at major facilities (reservoirs, pump stations, etc.) were excluded from this analysis. The resulting risk level for each individual pipe segment is shown on Figure 7-18 and described in further detail below.

Table 7-10. Risk Assessment Results

Linear Feet of Pipeline		Likelihood of Failure					
		A (2)	B (3-5)	C (6)	D (7-8)	E (9-10)	Total
Consequence of Failure	A (1-2)	53,411	5,879	70,704	80,303	178,385	388,682
	B (3-4)	16,094	80	16,752	16,125	93,436	142,487
	C (5)	3,313	991	2,267	6,983	8,189	21,743
	D (6)	4,059	0	4,642	6,355	2,355	17,411
	E (7-10)	805	1,104	7,381	13,592	15,924	38,806
	Total	77,682	8,054	101,746	123,358	298,289	609,129

Risk Levels:
- Dark Blue = Low Risk
- Light Blue = Medium-Low Risk
- Green = Medium Risk
- Orange = Medium-High Risk
- Red = High Risk

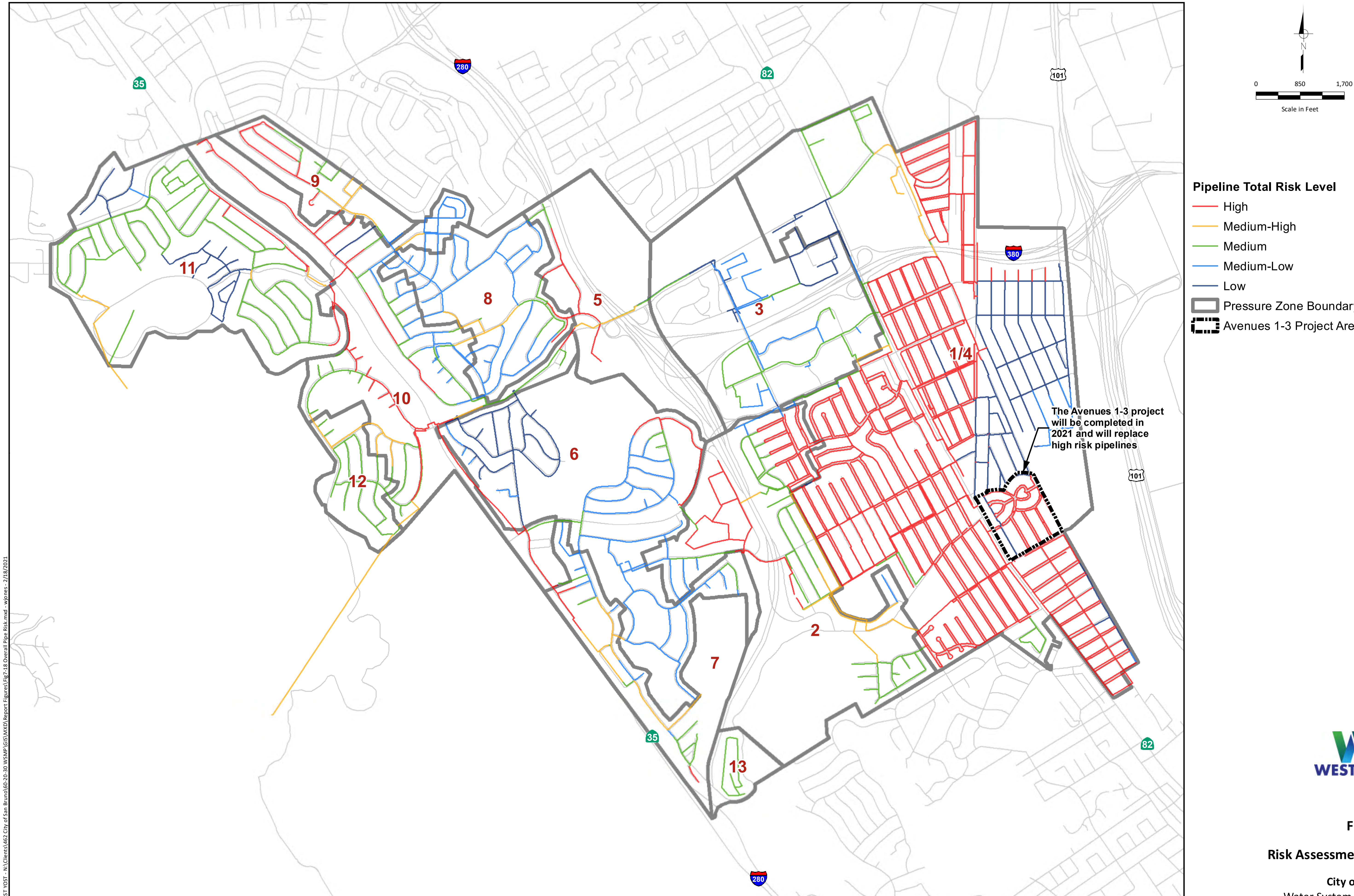

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Figure 7-18

Risk Assessment Results

City of San Bruno

Water System Master Plan

Low Risk. Approximately 12 percent of the system by length falls in the Low Risk category, as shown in dark blue on Figure 7-18. Water pipelines in this category typically contain the following characteristics:

- At the lower end of the scoring range, these pipelines are small diameter pipes (8 inches or less) constructed in the 2000s or later and consists of ductile iron or polyvinyl chloride material type with no other issues.
- At the higher end of the scoring range, these pipelines are small diameter pipes (8 inches or less) constructed in the 2000s or later using ductile iron material, that are within 250 feet of a seismic fault, are located along a major road, or near an SFPUC Regional Water System transmission pipeline, with no other issues. There are also some pipelines that are recently installed larger diameter pipes (10 – 12 inches) with no other issues.

Medium-Low Risk. Approximately 13 percent of the system by length falls in the Medium-Low Risk category, as shown in light blue on Figure 7-18. Water pipelines in this category typically contain the following characteristics:

- At the lower end of the scoring range, these are mostly larger diameter (14 inches) ductile iron pipelines installed in the 2000s, some of which are located along a major road, near an SFPUC Regional Water System transmission pipeline, or cross a freeway. There are also some small diameter (4 inches or less) asbestos cement pipelines installed in the 1950s with no other issues.
- At the higher end of the scoring range, these are mostly 6 to 8-inch diameter pipelines made of polyvinyl chloride and constructed in the 2000s or later, or they are pipelines made of asbestos cement and constructed in the 1950s. Of those, the pipelines that were more recently installed either serve critical customers or are located within 100 feet of a seismic fault. None are critical pipelines and they do not have locational or geologic issues.

Medium Risk. Approximately 19 percent of the system by length falls in the Medium Risk category, as shown in green on Figure 7-18. Water pipelines in this category typically contain the following characteristics:

- At the lower end of the scoring range, these are mostly small diameter pipelines (6 inches or less, some 8 inches) made of cast iron and installed in the 1950s and 1960s with no other issues.
- At the higher end of the scoring range, these are mostly larger diameter (12 and 14-inch with some 8-inch) pipelines installed in the 1950s or later and made of ductile iron, cast iron, or asbestos cement that are categorized as critical pipelines, are located near a gas line, or are located within 500 feet of a seismic fault, but do not serve critical customers. There are also some older (installed 1940s or earlier) larger diameter (12 inches or greater) pipelines with no other issues.

Medium-High Risk. Approximately 7 percent of the system by length falls in the Medium-High Risk category, as shown in orange on Figure 7-18. Water pipelines in this category typically contain the following characteristics:

- At the lower end of the scoring range, these are smaller diameter pipelines (mostly 6 inch) that were installed in the 1950s and made of asbestos cement and serve critical customers, but do not have geologic or locational issues and are not categorized as critical pipelines.

- At the higher end of the scoring range, these are pipelines that are mostly 10 inches in diameter or greater that were constructed in the 1950s or 1960s and are made of asbestos cement or cast iron. Most serve critical customers and some are also categorized as critical pipelines. There are also some smaller diameter pipelines (less than 6 inches) that are within 500 feet of a seismic fault or near a gas line and serve a critical customer.

High Risk. Approximately 49 percent of the system by length falls in the High Risk category, as shown in red on Figure 7-18. Water pipelines in this category typically contain the following characteristics:

- At the lower end of the scoring range, these pipelines are mostly small diameter (6 inches or smaller) and mostly installed in the 1940s or earlier, constructed of galvanized steel or cast iron and some within 500 feet of a seismic fault, with little other issues.
- At the higher end of the scoring range, these are pipelines of all diameters that are mostly made of galvanized steel, cast iron, and asbestos cement. Most were either installed in the 1940s or earlier and experience one additional issue, or they were installed in the 1950s to 1980s but experience a combination of two or more additional issues. The additional issues include being categorized as a critical pipeline, located within 500 feet of a seismic fault or near the Shelter Creek high corrosivity soils, serving critical customers, or located near a gas line, freeway, railroad, SFPUC Regional Water System transmission pipeline, or on a major road.

This risk assessment provides a generalized priority for pipeline replacement throughout the City's distribution system. The high risk category contains the pipelines that will need to be rehabilitated and replaced first and it also has the most pipelines of any of the categories. These high risk pipelines are further discussed and prioritized for replacement below.

7.5.1.5 Prioritization of High Risk Pipelines for Replacement

As shown on Figure 7-18, most of the pipelines categorized as high risk are located in Zone 1/4, indicating that portion of the distribution system should be one of the first areas targeted for rehabilitation and replacement. Most high risk pipelines in Zone 1/4 were previously divided into eight priority areas (1 being the highest priority and 8 being the lowest priority) in the City's Ten-Year CIP Work Plan, which grouped water system and sewer system improvements into discrete projects.

This section serves to re-prioritize the replacement of the water system within the eight priority areas using historical leak data (discussed in detail in Section 7.5.1.2.1.1) and fire flow availability (discussed in detail in Section 7.3.2). In addition to re-evaluating the eight previously established priority areas, two new priority areas which cover the remainder of the high risk areas in Zone 1/4 and Zone 2 were identified.

It should be noted that Priority Areas 1, 2, and 3 were not re-prioritized for a variety of reasons:

- Replacement of Priority Area 1 is nearly complete; the ongoing Avenues 1-3 project is anticipated to complete replacement of Priority Area 1 in 2021.
- Most of the planned infrastructure improvements in Priority Area 2 are for the sewer system, as the water pipelines are relatively new (installed in the 1990s or later). The water system is not the primary driver for prioritization of this area.
- Design of Priority Area 3 replacements has already begun.

Therefore, the re-prioritization of the water system improvements focused on Priority Areas 4 through 8, and the two newly identified areas. For this WSMP, the water system pipeline replacement priorities were updated based on the following:

- **Historical Leak Data:** As shown on Figure 7-19 and Table 7-11, there were pipeline leaks recorded between 2000 and 2020 in all priority areas. The large number of leaks in the southern portion of Priority Area 1 will be resolved by the Avenues 1-3 project. The two newly identified priority areas contained the most leaks per 1,000 feet of pipeline.
- **Fire Flow Results:** As shown on Figure 7-20 and Table 7-11, there are fire flow deficiencies in all priority areas, apart from Priority Area 2. The fire flow deficiencies in the southern portion of Priority Area 1 will be resolved by the Avenues 1-3 project. To compare fire flow deficiencies between areas, a fire flow deficiency score was calculated by assigning 1 point to each hydrant location where the available fire flow did not meet the criteria, but was at least greater than 1/3 of the criteria, and applying 2 points to each hydrant location where the available fire flow was less than 1/3 of the criteria. Priority Area 8 had the highest score per 1,000 feet of pipeline, followed by Priority Areas 5 and 7.

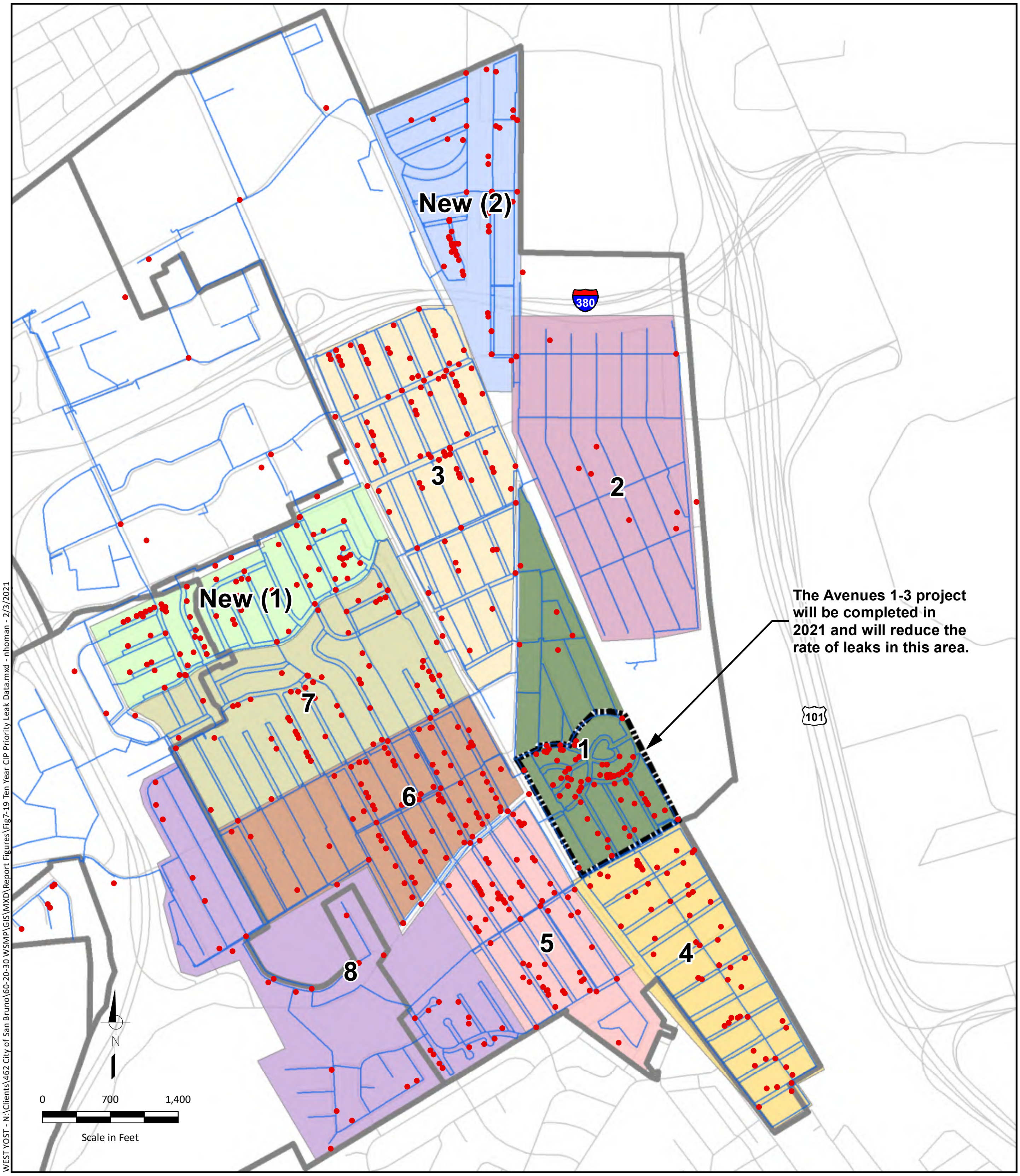
As shown on Table 7-11, the total leaks per 1,000 feet of pipeline were added to the fire flow deficiency score per 1,000 feet of pipeline to produce a combined metric with which to compare the priority areas to one another. The updated water system priority rankings for the priority areas are shown on Figure 7-21. Priority Areas 1, 2, and 3 were not re-prioritized, as discussed above. The water system improvements in the remaining seven areas were re-prioritized with revised priority rankings 4 through 10. The two newly identified areas were prioritized over the other previously established priority areas due to their high leak rate, and were identified as Revised Priority Areas 4 and 5. The three priority areas immediately west of El Camino Real were identified as Revised Priority Areas 6, 7, and 8. The former Priority Area 4 was re-prioritized as Revised Priority Area 9, and the former Priority Area 8 was re-prioritized as Revised Priority Area 10.

It should be noted that this re-prioritization does not account for the priorities of the sewer system within the work plan areas. It is recommended that the City consider the prioritized needs of both the sewer and water systems before adopting the revised work plan area prioritization presented in Table 7-11.

Table 7-11. Re-prioritization of Ten-Year CIP Work Plan Areas – Water System

Current Priority in Ten-Year CIP Work Plan	Linear Feet of Pipeline[(a)]	Number of Leaks[(b)]	Number of Leaks per 1,000 feet of Pipeline	Fire Flow Deficiency Score[(c)]	Fire Flow Deficiency Score per 1,000 feet of Pipeline	Combined Metric[(d)]	Recommended Updated Priority
1	24,403	115	4.71	9	0.37	5.08	1[(e)]
2	29,305	14	0.48	0	0.00	0.48	2[(f)]
3	49,258	134	2.72	38	0.77	3.49	3[(g)]
4	32,011	76	2.37	3	0.09	2.47	9
5	26,755	88	3.29	28	1.05	4.34	6
6	37,159	115	3.09	22	0.59	3.69	8
7	33,412	99	2.96	35	1.05	4.01	7
8	33,311	40	1.20	39	1.17	2.37	10
New (1)	27,517	106	3.85	14	0.51	4.36	5
New (2)	21,994	82	3.73	16	0.73	4.46	4

(a) Length of existing pipeline in priority area. Includes length of parallel pipelines in the same street.
(b) Leak data is from WaterLeakHistory.shp provided by the City on December 18, 2020. It contained data for years 2000 to 2014 and 2018 to 2020.
(c) Fire flow deficiency score was calculated by applying 1 point to each hydrant location where the available fire flow did not meet the criterion, but was at least greater than 1/3 of the criteria and applying 2 points to each hydrant location where the available fire flow was less than 1/3 of the criterion.
(d) Equal to fire flow deficiency score per 1,000 feet plus number of leaks per 1,000 feet of pipeline.
(e) Avenues 1-1 and 1-2 projects have been completed and replaced the majority of pipelines within Priority Area 1. The Avenues 1-3 project is currently replacing the remainder of pipelines in this area and is expected to be completed in 2021. Therefore, Priority Area 1 was not re-prioritized.
(f) Since prioritization of Priority Area 2 is primarily driven by sewer system replacements, it was not re-prioritized in this evaluation.
(g) Since design of Priority Area 3 pipeline replacements has begun, it was not re-prioritized in this evaluation.



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- Pipeline Leaks (2000 - 2014, 2018 - 2020)
- Existing Pipeline
- Avenues 1-3 Project Area
- Pressure Zone Boundary

Priority Areas

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- New (1)
- New (2)

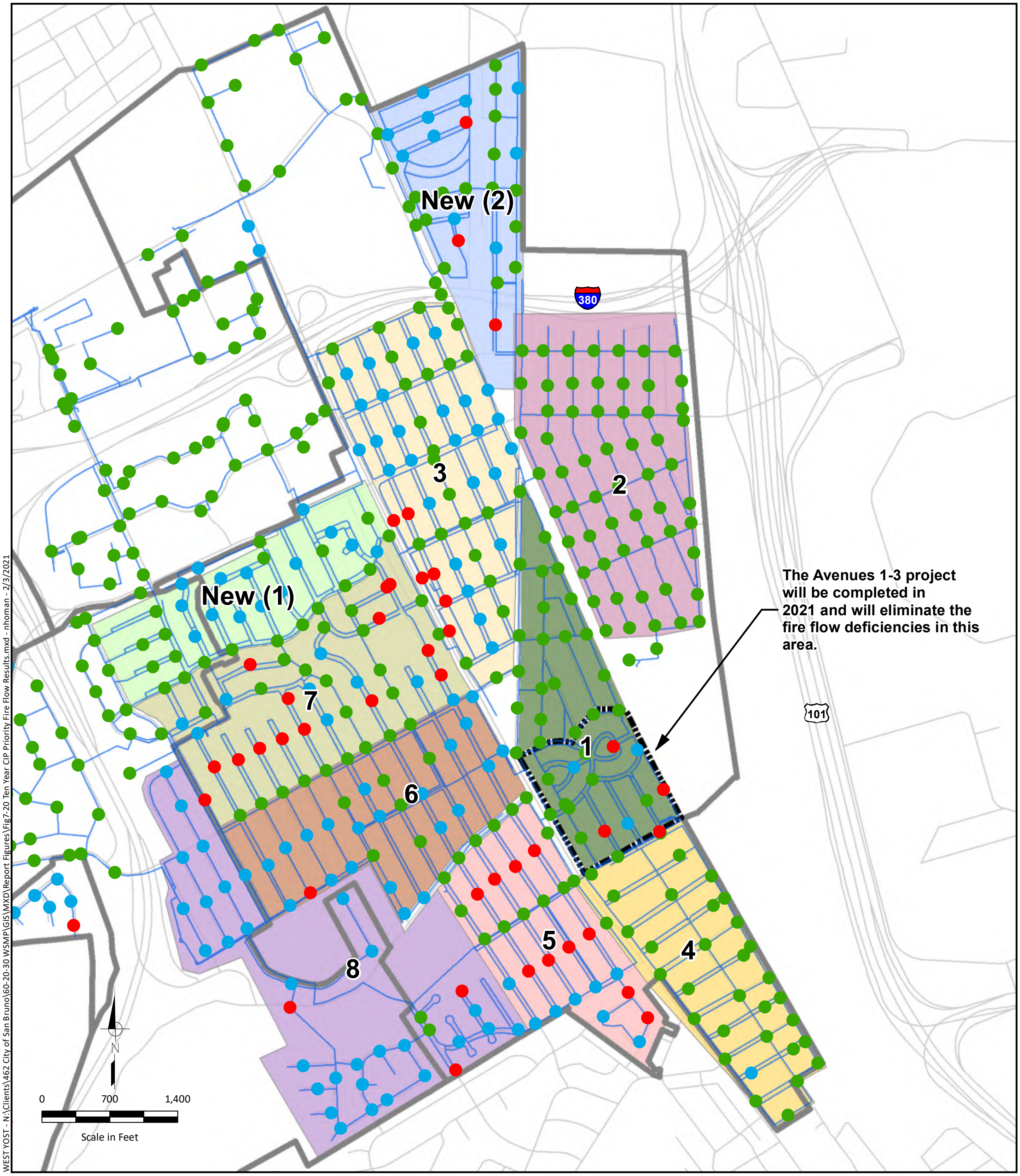
Notes:
1. Spatially located leak data was provided by City staff for years 2000 - 2014 and 2018 - 2020.
2. Leak records on pipelines which were subsequently replaced are not shown.

Figure 7-19

Ten-Year CIP Priority Areas Leak Data

City of San Bruno

Water System Master Plan



Existing Pipeline
Avenues 1-3 Project
Pressure Zone Boundary

Fire Flow Deficiency Score

- 2 Point Deficiency
- 1 Point Deficiency
- Meets Fire Flow Criteria

Priority Areas

1, 2, 3, 4, 5, 6, 7, 8, New (1), New (2)

Notes:

1. Fire flow deficiency score of 1 point indicates available flow was less than the fire flow criteria but greater than 1/3 of the criteria. Fire flow deficiency score of 2 points indicates available flow was less than 1/3 of the criteria.

Figure 7-20

Ten-Year CIP Priority Areas Fire Flow Deficiency Score

City of San Bruno
Water System Master Plan

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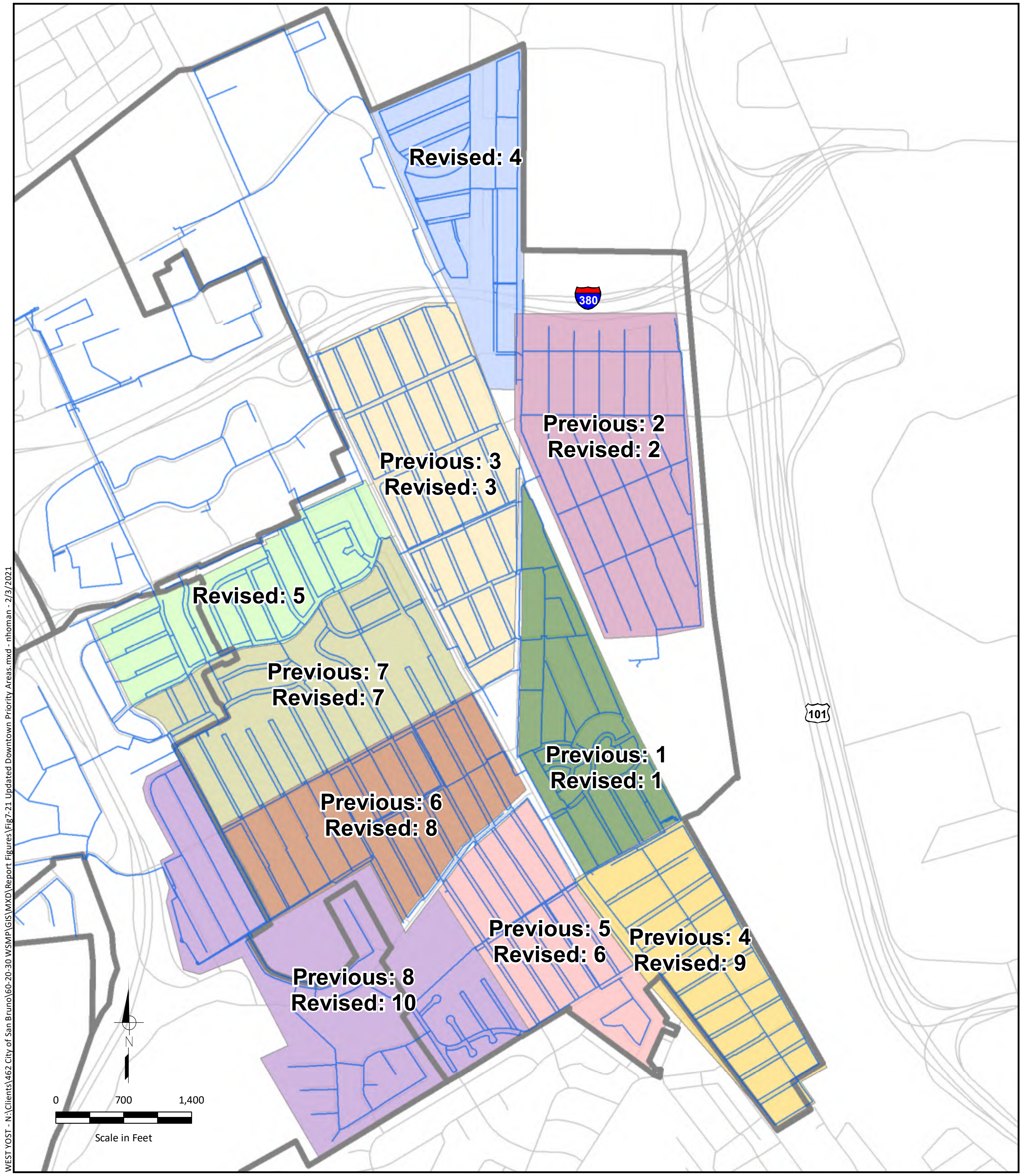

Existing Pipeline

Pressure Zone Boundary

Work Plan Areas: Previous Priority (Revised Priority)

- 1 (1)
- 2 (2)
- 3 (3)
- 4 (9)
- 5 (6)
- 6 (8)
- 7 (7)
- 8 (10)
- (5)
- (4)

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Figure 7-21

Re-Prioritized Priority Areas for Water System Improvements

City of San Bruno
Water System Master Plan

7.5.1.6 Summary of Pipeline Capital Improvement Projects

Pipeline improvements for the existing system are grouped into projects based on proximity or shared purpose. These projects include all pipeline capacity improvements discussed in Section 7.4.1 and the replacement of all high-risk pipelines identified in Section 7.5.1.4. Pipeline capacity improvements shown on Figure 7-5 have been included in the sizing of replacement pipelines within the Ten-Year CIP Work Plan areas and for other projects which include high-risk pipelines identified for capacity improvements. Pipeline projects with their CIP identifiers are summarized in Table 7-12 below and shown on Figure 7-22.

Table 7-12. Pipeline Capital Improvement Projects	
CIP ID	Project Summary
EX-P-1	Avenues 1-3 Project. This project will complete replacement of the pipelines in Priority Area 1 as outlined in the City's Ten-Year CIP Work Plan. Construction of this project is anticipated to be complete in 2021.
EX-P-2	Replacement and upsize of Priority Area 2 with 1,600 linear feet of new pipeline.
EX-P-3	Replacement and upsize of Priority Area 3 with 29,600 linear feet of new pipeline. Includes some recommended pipeline replacements in San Mateo Avenue not included in the Ten-Year CIP Work Plan.
EX-P-4	Replacement and upsize of Revised Priority Area 4 with 16,500 linear feet of new pipeline. This area was not previously included in the Ten-Year CIP Work Plan.
EX-P-5	Replacement and upsize of Revised Priority Area 5 with 16,900 linear feet of new pipeline. This area was not previously included in the Ten-Year CIP Work Plan.
EX-P-6	Replacement and upsize of Revised Priority Area 6 (formerly Priority Area 5) with 18,700 linear feet of new pipeline. Includes some recommended pipeline replacements in El Camino Real and Crystal Springs Road not included in the Ten-Year CIP Work Plan.
EX-P-7	Replacement and upsize of Revised Priority Area 7 (formerly Priority Area 7) with 20,000 linear feet of new pipeline. Includes installation of new pipeline connections required for re-zoning project EX-MISC-1.
EX-P-8	Replacement and upsize of Revised Priority Area 8 (formerly Priority Area 6) with 25,300 linear feet of new pipeline. Includes installation of new pipeline connections required for re-zoning project EX-MISC-1.
EX-P-9	Replacement and upsize of Revised Priority Area 9 (formerly Priority Area 4) with 18,800 linear feet of new pipeline.
EX-P-10	Replacement and upsize of Revised Priority Area 10 (formerly Priority Area 8) with 26,100 linear feet of new pipeline.
EX-P-11	This project will replace 6,300 linear feet of existing pipeline in the Shelter Creek area. These pipelines were identified as high risk due to the corrosive soil they are buried in. Pipeline replacements should be composed of corrosion resistant material and/or fitted with appropriate cathodic protection.
EX-P-12	This project will abandon the existing 10-inch diameter transmission main east of Highway 35 between San Bruno Avenue and Sneath Lane and connect the existing but inactive 12-inch diameter main in Earl Avenue and Glenview Drive to the existing Zone 10 pipelines. This will improve transmission capacity between PS8 and Tanks 6 and 6A, increase available fire flow in Zone 7, and eliminate an existing maintenance issue for the City.
EX-P-13	This project will replace and upsize 3,700 linear feet of existing pipelines in Sneath Lane, Riverside Drive, Moreland Drive, and Longview Drive to 10-inch diameter to improve the suction-side supply capacity to PS4. Currently, operating one of the PS4 pumps at full speed causes low pressures and high pipeline velocities in Zone 10. Increasing the size of these pipelines will provide a high-capacity flow path from the existing 14-inch transmission main in Sneath Lane and Tanks 6 and 6A to PS4.
EX-P-14	This project includes all pipeline replacements and upsizes required to address fire flow deficiencies not addressed in projects EX-P-1 through EX-P-13. Replacement and upsize of 47,600 linear feet of pipeline.
EX-P-15	This project includes the replacement of all high risk pipelines not included in projects EX-P-1 through EX-P-14. Replacement and upsize of 28,500 linear feet of pipeline.

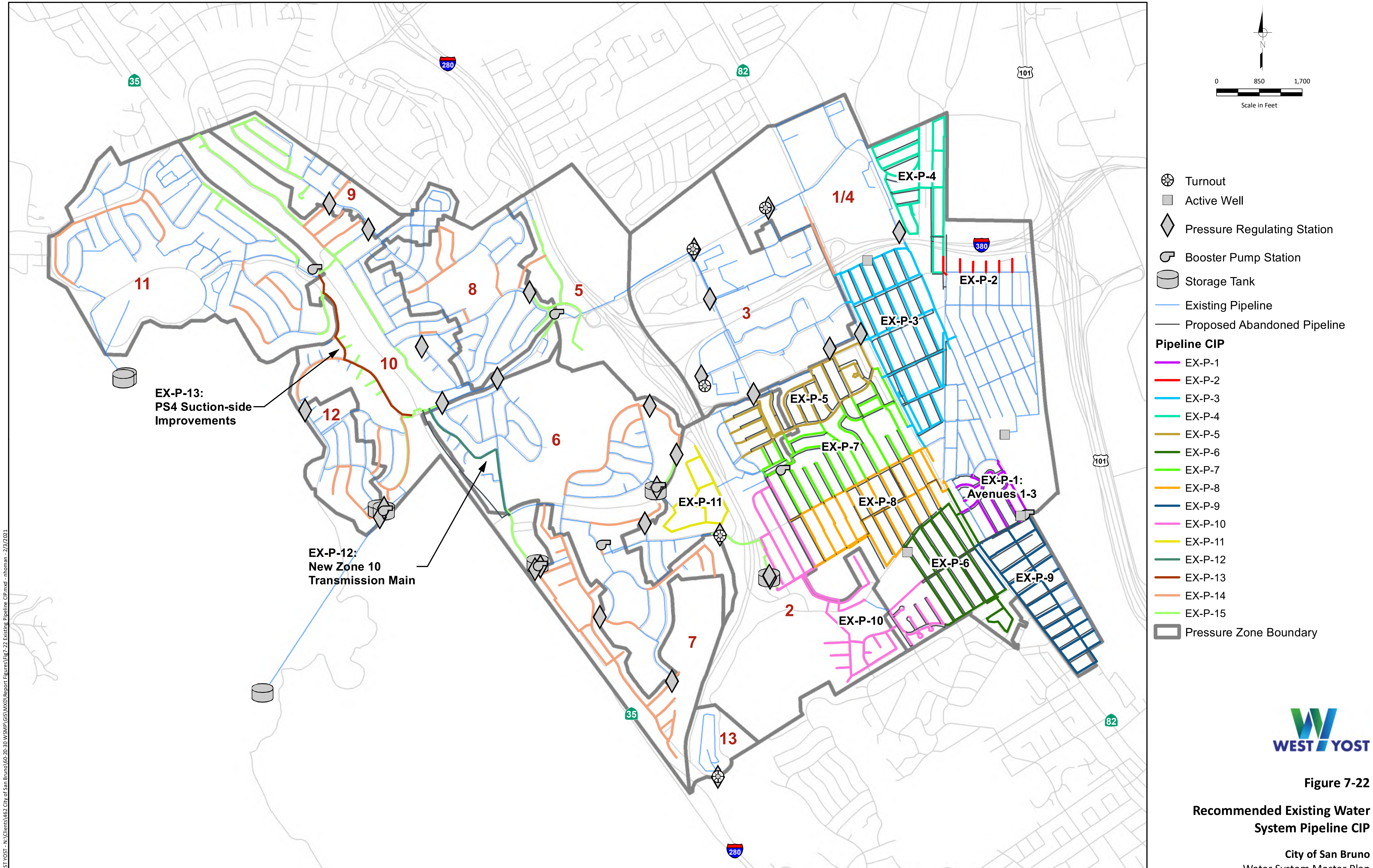

Figure 7-22

Recommended Existing Water System Pipeline CIP

City of San Bruno

Water System Master Plan

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7.5.2 Facilities Rehabilitation and Replacement Evaluation

The facilities rehabilitation and replacement evaluation assesses well, tank, pump station, and pressure regulating station conditions. The program includes recommendations for major rehabilitation/replacement projects that would be funded through the CIP. The facilities program considers results from the facility site evaluations discussed in Chapter 2, typical design useful life information, and age and condition information provided by the City to identify improvement needs.

7.5.2.1 Wells

Typical guidelines indicate that well equipment has a design useful life of 20 to 25 years, and wells have a design useful life of 50 years. As tabulated in Table 2-5, the pumps at Wells 16 and 18 are 28 and 24 years old, respectively, and have reached the end of their design life. Despite its age, the Well 16 pump continues to operate at acceptable efficiency, but will likely require replacement in the next 5 to 10 years. The Well 18 pump has low efficiency and it is recommended that the pump be replaced if its efficiency continues to decrease. Projects to provide for ongoing maintenance and replacement of groundwater wells are summarized in Table 7-13 below.

Table 7-13. Well Rehabilitation and Replacement Projects

CIP ID	Project Summary
EX-W-2	This project will install backup power at Wells 16 and 18, which do not currently have emergency power generation on-site. This project will significantly improve the City's ability to maintain customer service during an emergency.

7.5.2.2 Tanks

For tanks, typical guidelines indicate a design useful life of 50 to 80 years. As tabulated in Table 2-7, all of the City's tanks are 49 years old or older, except for the recently replaced Tank 3. In addition, several of the City's existing tanks do not meet current seismic code requirements, and are susceptible to damage or loss of use after moderate to high seismic activity. Therefore, it is recommended that many of the City's tanks be replaced within the Master Plan timeframe. Projects to provide for ongoing maintenance and replacement of water system tanks are summarized in Table 7-14 below.

Table 7-14. Tank Rehabilitation and Replacement Projects

CIP ID	Project Summary
EX-T-2	Replacement of Tank 1 with a new 3.5 MG concrete tank. The new tank is anticipated to be in service by the end of 2021.
EX-T-3	Replacement of Tank 7 with a new 0.4 MG concrete tank. The new tank is anticipated to be in service by the end of 2022. As part of this project, the existing 14-inch pipeline from PS2 to Tank 7 will also be replaced.
EX-T-4	Replacement of Tank 4 with a new concrete tank.
EX-T-5	Tank Replacement Program. Replacement of tanks as they reach the end of their design useful lives. Budgeting includes replacement of two tanks (T9 and T10) within the Master Plan timeframe.
EX-T-6	Tank Re-coating Program. This program provides for re-coating the interior and exterior of the above-grade steel tanks. It is assumed that two re-coating projects will take place within the Master Plan timeframe for budgeting.

7.5.2.3 Pump Stations

Similar to well facilities, typical guidelines indicate that pump station pumping equipment has a design useful life of 20 to 25 years, and pump station structures have a design useful life of 50 years. The City has an ongoing pump station rehabilitation program that takes into account the design useful life and specific facility conditions to provide pump station improvements. Table 7-15 shows the projects identified from this program, which have been included in the Water System Master Plan CIP.

Table 7-15. Pump Station Rehabilitation and Replacement Projects

CIP ID	Project Summary
EX-PS-1	Replacement of PS1 with a new re-designed pump station. It is recommended that the re-designed pump station include flow monitoring instrumentation and an on-site emergency generator.
EX-PS-2	Replacement of PS2 with a new re-designed pump station. It is recommended that the re-designed pump station include flow monitoring instrumentation, flexible connections for the suction and discharge piping, and an on-site emergency generator.
EX-PS-3	Installation of an emergency generator at PS3.
EX-PS-4	Installation of an emergency generator at PS7.
EX-PS-5	Other Pump Station Improvements. This project encompasses other recommended pump station improvements not included in the other listed projects. It includes rehabilitation or replacement of PS3 and PS6 booster pumps, installation of flow monitoring instrumentation at PS3, PS6, PS7, and PS8, replacement of MCC's at PS3 and PS6, installation of flexible couplings at PS3, and a detailed performance evaluation of the pumps at PS5.
EX-PS-6	This improvement consists of a new pump station and hydropneumatic tank to supply the NCCWD-supplied area (Zone 13) directly from the City's system to eliminate surcharges to customers for purchase of NCCWD water.

7.5.2.4 Pressure Regulating Stations

The City has in place a pressure regulating station rehabilitation program to maintain adequate performance. This project, EX-RS-8, Pressure Station Rehabilitation Project, improves and rehabilitates the City's pressure regulating stations to maintain their performance.

7.5.2.5 Other Rehabilitation and Replacement Projects

The City has identified a number of other miscellaneous improvements to further enhance the water system. These improvements do not fall under the categories of pipelines, wells, tanks, pump stations, or pressure regulating stations. Table 7-16 presents these improvements by their CIP identifiers.

Table 7-16. Other Rehabilitation and Replacement Projects

CIP ID	Project Summary
EX-MISC-3	Advanced Water Meter Infrastructure Project. The City has been replacing aging and unreliable water meters with upgraded meters which allow for instant remote monitoring and tracking of water usage online. City staff estimate that 700 advanced meters need to be installed on commercial services before project completion.
EX-MISC-4	Seismic Vulnerability Assessment. This project will update the City's 2003 study based on current code requirements. It would also include a more comprehensive hazard review, and update improvement recommendations based on the results.
EX-MISC-5	Pipeline Seismic Improvement Project. This project will provide seismic upgrades to water lines in the vicinity of faults. May include installation of isolation valves and bypass outlets for pipelines located adjacent to hazard zones; may also provide design for pipelines to withstand lateral and vertical offsets anticipated in fault zones.
EX-MISC-6	Intrusion Alarm Detection System. This project will add monitored intrusion alarms at water system facilities. The system will alert City staff if there is an unauthorized entry and that security has been breached.
EX-MISC-7	Develop and Implement Facility Physical Security Improvement Program. This program will identify sufficient physical security improvements that will detect, deter, or delay a potential malicious adversary. Implement projects identified in the improvement program.
EX-MISC-8	Security Camera Installation. This project would add security cameras to sites as well as motion sensor lights to deter intruders.
EX-MISC-9	SCADA Master Plan and Cybersecurity Improvements Plan. This project entails development of a SCADA Master Plan and a Cybersecurity Improvements Plan. These plans would include a baseline assessment of the City's existing SCADA and Business Enterprise system. Based on the outcome of this assessment, alternatives would be analyzed and recommendations for improvements would be developed. Implementation of these plans and subsequent improvements would ensure that the City's SCADA system is well maintained and increase resiliency against cybersecurity threats to the water system.
EX-MISC-10	Emergency Provisional Water Supply Plan. Prepare a plan that addresses the need to provide customers with provisional water in case of a complete water system outage. Perform annual exercising of emergency water distribution capabilities with staff and utility partners.
EX-MISC-11	Water Distribution Trailer/Provisional Water. Purchase an emergency point of distribution trailer for deployment as needed to provide a supplemental drinking water supply during emergency events.
EX-MISC-12	Subscribe and Integrate ShakeAlert System. Subscribe to ShakeAlert. Install automatic valves to prevent leakage of safe drinking water from assets. Integrate ShakeAlert with process controls to prevent earthquake damage to rotating equipment.
EX-MISC-13	Business Continuity Plan/Continuity of Operations Plan. Develop a plan to ensure financial and operational continuity during and following an emergency.

Projects EX-MISC-6 through EX-MISC-13 were recommended in the City's Risk and Resilience Assessment (RRA). Refer to the RRA for more details on these projects.

7.6 SUMMARY OF RECOMMENDED IMPROVEMENTS FOR THE EXISTING WATER SYSTEM

This section summarizes the improvements recommended to eliminate deficiencies, reduce structural vulnerability, and rehabilitate or replace pipelines and key water distribution system facilities in the existing water system.

Table 7-17 summarizes the recommended existing system capital improvement projects by project type. City projects which are included in the City's Fiscal Year 2021 – 2025 CIP and align with a recommended project are identified by City Project ID. Most recommended projects have not yet been assigned a City Project ID. Estimates for capital improvement project costs are presented in Chapter 9.

Table 7-17. Summary of Recommended Existing System Capital Improvement Projects

Identifier	City Project ID	Improvement Type	Reason for Improvement	Improvement Description	Zone
Pipeline Improvements					
EX-P-1	11007	Replace / Upsize Pipeline	Fire Flow / Failure Risk	Avenues 1-3 pipeline replacement project. Completion anticipated in 2021.	1/4
EX-P-2		Replace / Upsize Pipeline	Failure Risk	Replacement and upsize of Priority Area 2 with 1,600 linear feet of new pipeline. Install 1,200 lf of 8" pipeline and 400 lf of 10" pipeline.	1/4
EX-P-3	11009, 11010, 11011	Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Priority Area 3 with 29,600 lf of new pipeline. Install 18,300 lf of 8" pipeline, 9,100 lf of 10" pipeline, 2,200 lf of 12" pipeline.	1/4
EX-P-4		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 4 (not previously in Ten Year CIP Workplan) with 16,500 lf of new pipeline. Install 11,900 lf of 8" pipeline, 4,200 lf of 10" pipeline, and 400 lf of 12" pipeline.	1/4
EX-P-5		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 5 (not previously in Ten Year CIP Workplan) with 16,900 lf of new pipeline. Install 16,100 lf of 8" pipeline and 800 lf of 10" pipeline.	1/4, 2
EX-P-6		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 6 (formerly Priority Area 5) with 18,700 lf of new pipeline. Install 17,000 lf of 8" pipeline, 500 lf of 10" pipeline, 1,200 lf of 12" pipeline.	1/4
EX-P-7		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 7 (formerly Priority Area 7) with 20,000 lf of new pipeline. Install 16,400 lf of 8" pipeline, 2,000 lf of 10" pipeline, 1,600 lf of 12" pipeline. Includes installation of new pipeline connections required for re-zoning project EX-MISC-1.	1/4, 2
EX-P-8		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 8 (formerly Priority Area 6) with 25,300 lf of new pipeline. Install 18,000 lf of 8" pipeline, 3,900 lf of 10" pipeline, 3,400 lf of 12" pipeline. Includes installation of new pipeline connections required for re-zoning project EX-MISC-1.	1/4
EX-P-9		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 9 (formerly Priority Area 4) with 18,800 lf of new pipeline. Install 14,500 lf of 8" pipeline, 3,200 lf of 10" pipeline, 1,100 lf of 12" pipeline.	1/4
EX-P-10		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 10 (formerly Priority Area 8) with 26,100 lf of pipeline. Install 19,100 lf of 8" pipeline, 6,000 lf of 10" pipeline, 1,000 lf of 12" pipeline.	1/4, 2
EX-P-11		Replace / Upsize Pipeline	Failure Risk	Replace 6,300 lf of existing pipeline in the Shelter Creek area. Install 3,200 lf of 8" pipeline, 1,200 lf of 10" pipeline, 1,900 lf of 12" pipeline. Pipeline replacements should be composed of corrosion resistant material and/or fitted with appropriate cathodic protection.	2
EX-P-12		New Pipeline	Fire Flow / Failure Risk	Abandon existing 10" Zone 10 transmission main in Highway 35 and connect inactive 12" pipeline in Earl Avenue and Glenview Drive to Zone 10.	10
EX-P-13		Replace / Upsize Pipeline	Fire Flow / Low Pressures	PS 4 suction-side pipeline improvements. Replace and upsize 3,700 lf of pipeline in Sneath Lane, Riverside Drive, Moreland Drive, and Longview Drive to 10" diameter.	10
EX-P-14		Replace / Upsize Pipeline	Fire Flow	Replace and upsize 47,600 lf of pipeline to improve available fire flow. Includes all improvements required to meet fire flow requirements not included in projects EX-P-1 through EX-P-13. Install approximately 29,300 lf of 8" pipeline, 8,900 lf of 10" pipeline, 7,100 lf of 12" pipeline, 2,300 lf of 14" pipeline.	Multiple
EX-P-15		Replace / Upsize Pipeline	Failure Risk	Replace and upsize 28,500 lf of pipeline at high risk of failure. Includes all high risk pipelines not included in projects EX-P-1 through EX-P-14. Install approximately 21,500 lf of 8" pipeline, 3,700 lf of 10" pipeline, 200 lf of 12" pipeline, 2,900 lf of 14" pipeline, and 200 lf of 18" pipeline.	Multiple
Well, Storage, and Pumping Facility Improvements					
EX-W-1	84709	New Well	Capacity / Reliability	Acappella Well Project. Construction of new Well 21 in Zone 3 at the Acappella Site. Estimated well capacity is 550 gpm.	3
EX-W-2	84707, 11013, 11014, 11015	Rehabilitate Well	Asset Maintenance	The City's well rehabilitation program provides rehabilitation of underground well infrastructure every 10 years, replacement of filtration media every 10 years, and inspection and evaluation of pumps and motors every 5 years, with replacement as needed.	Multiple
EX-W-3		Install Generator	Reliability	Installation of emergency generators at Well 16 and Well 18.	1/4
EX-W-4		Abandon Well	Asset Maintenance	This project will abandon the existing Well 15, which will be replaced by Well 21	3
EX-T-1	11024	New Tank and Pump Station	Storage Capacity	New 1.8 MG storage tank and associated pump station with 4.3 mgd firm capacity in Zone 3	3
EX-T-2	85100	Replace Tank	Capacity / Failure Risk	Replacement of Tank 1 (Cunningham Tank) with new 3.5 MG concrete tank	1/4
EX-T-3	11022	Replace Tank and Pipeline	Failure Risk	Replacement of Tank 7 (Sweeney Ridge Tank) with new 0.4 MG concrete tank. Replacement of 14" inlet/outlet pipeline	12
EX-T-4	11023	Replace Tank	Failure Risk	Replacement of Tank 4 (San Bruno Avenue Tank, aka Princeton Tank)	2
EX-T-5		Replace Tank	Failure Risk	Replacement of other tanks as they reach end of useful life. Budgeting includes replacement of two tanks (T9, and T10) within Master Plan timeframe	Multiple
EX-T-6		Rehabilitate Tank	Asset Maintenance	Tank Re-coating program to re-coat the interior and exterior of above-grade steel tanks. Budgeting includes re-coating of two tanks within Master Plan timeframe.	Multiple
EX-PS-1	11004	Replace Pump Station	Asset Maintenance	Replacement of PS1 (Sneath Lane PS) with new re-designed pump station.	10
EX-PS-2	11003	Replace Pump Station	Asset Maintenance	Replacement of PS2 (Lake Drive PS) with new re-designed pump station.	12
EX-PS-3	11012	Install Generator	Reliability	Installation of emergency generator at PS3 (Whitman PS).	6
EX-PS-4	11021	Install Generator	Reliability	Installation of emergency generator at PS7 (San Bruno PS, aka Princeton PS).	6
EX-PS-5		Rehabilitate Pump Stations	Asset Maintenance	Other Pump Station Improvements. This project encompasses other recommended pump station improvements not included in the other listed projects. Includes rehabilitation or replacement of PS3 and PS6 booster pumps, installation of flow monitoring instrumentation at PS3, PS6, PS7, and PS8, replacement of MCC's at PS3 and PS6, installation of flexible couplings at PS3, and a detailed performance evaluation of the pumps at PS5.	Multiple
EX-PS-6		New Pump Station	Reliability	New pump station and hydropneumatic tank to supply the NCCWD-supplied area (Zone 13) directly from the City's system.	13
Pressure Regulating Station Improvements					
EX-RS-1	11020	RS Upgrade	Fire Flow	Upgrade existing RS13 with 6-inch and 2-inch valves for fire flow into Zone 7A.	7A
EX-RS-2		RS Upgrade	Fire Flow	Rebuild and reactivate RS11 with 6-inch and 2-inch valves for fire flow service from Zone 7 to Zone 6.	6
EX-RS-3		RS Upgrade	Fire Flow	Upgrade existing RS17 with 6-inch and 2-inch valves for fire flow into Zone 6A.	6A
EX-RS-4		New RS	Fire Flow	Install new RS with 8-inch and 4-inch valves at Susan Drive and Sharp Park Road to provide fire flow service from Zone 11 to Zone 10, and install 540 feet of new 8- inch diameter pipeline from Zone 11 to Zone 10.	10
EX-RS-5		New RS	Fire Flow	Install new RS with 8-inch and 4-inch valves at Oakmont Drive and Muirfield Circle to provide fire flow service from Zone 10 to Zone 9, and install 1,680 feet of new 8- inch diameter pipeline between Zone 9 and Zone 10.	9
EX-RS-6		New RS	Fire Flow	Install new RS with 8-inch and 4-inch valves at Oakmont Drive and Evergreen Drive to provide fire flow service from Zone 10 to Zone 8.	8
EX-RS-7		New RS	Fire Flow	Install new RS with 8-inch and 4-inch valves at Piedmont Avenue and Madison Avenue to provide fire flow service from Zone 7 to Zone 6.	6
EX-RS-8	11016, 11017, 11018, 11019	Rehabilitate RS	Asset Maintenance	Pressure Regulator Station Improvement program to improve and rehabilitate the City's pressure regulating stations to maintain performance	Multiple

Table 7-17. Summary of Recommended Existing System Capital Improvement Projects					
Identifier	City Project ID	Improvement Type	Reason for Improvement	Improvement Description	Zone
Miscellaneous Improvements					
EX-MISC-1		Re-Zoning	Fire Flow	Re-zone Maple Avenue, Cherry Avenue, Chestnut Avenue, and Beech Avenue between Niles Avenue and Jenevein Avenue and Cedar Avenue between Niles Avenue and Park Avenue from Zone 1/4 to Zone 2.	1/4, 2
EX-MISC-2		Hydrant Replacement	Fire Flow	Replace hydrants at Glenview Drive and Skyline Boulevard and at Sequoia Avenue and Rollingwood Drive with new hydrants connected to Zone 10 pipelines	10
EX-MISC-3	84132	Meter Upgrade	Data and Instrumentation	Advanced Water Meter Infrastructure Project. City staff estimate that 700 advanced meters need to be installed on commercial services before project completion.	Multiple
EX-MISC-4		Plan / Study	Seismic Risk	This project will update the City's 2003 study based on current code requirements. It would also include a more comprehensive hazard review, and update improvement recommendations based on the results.	Multiple
EX-MISC-5		Pipeline Improvements	Seismic Risk	This project will provide seismic upgrades to water lines in the vicinity of faults.	Multiple
EX-MISC-6		Physical Security Upgrades	Security Risks	Intrusion Alarm Detection System. Add monitored intrusion alarms at water system facilities. The system will alert City staff if there is an unauthorized entry and that security has been breached.	Multiple
EX-MISC-7		Physical Security Upgrades	Security Risks	Develop and Implement Facility Physical Security Improvement Program. This program will identify sufficient physical security improvements that will detect, deter, or delay a potential malicious adversary. Implement projects identified in the improvement program.	Multiple
EX-MISC-8		Physical Security Upgrades	Security Risks	Security Camera Installation. Add security cameras to sites as well as motion sensor lights to deter intruders.	Multiple
EX-MISC-9		Plan / Study	Security Risks	SCADA Master Plan and Cybersecurity Improvements Plan. These plans would include a baseline assessment of the City's existing SCADA and Business Enterprise system. Based on the outcome of this assessment, alternatives would be analyzed and recommendations for improvements would be developed. Implementation of these plans and subsequent improvements would ensure that the City's SCADA system is well maintained and increase resiliency against cybersecurity threats to the water system.	Multiple
EX-MISC-10		Plan / Study	Emergency Preparedness	Emergency Provisional Water Supply Plan. Prepare a plan that addresses the need to provide customers with provisional water in case of a complete water system outage. Perform annual exercising of emergency water distribution capabilities with staff and utility partners.	Multiple
EX-MISC-11		POD Trailer	Emergency Preparedness	Water Distribution Trailer/Provisional Water. Purchase an emergency point of distribution (POD) trailer for deployment as needed to provide a supplemental drinking water supply during emergency events.	Multiple
EX-MISC-12		SCADA and Valve Improvements	Seismic Risk	Subscribe and Integrate ShakeAlert System. Subscribe to ShakeAlert. Install automatic valves to prevent leakage of safe drinking water from assets. Integrate ShakeAlert with process controls to prevent earthquake damage to rotating equipment.	Multiple
EX-MISC-13		Plan / Study	Emergency Preparedness	Business Continuity Plan/Continuity of Operations Plan. Develop a plan to ensure financial and operational continuity during and following an emergency.	Multiple

CHAPTER 8
Evaluation of Future Water System

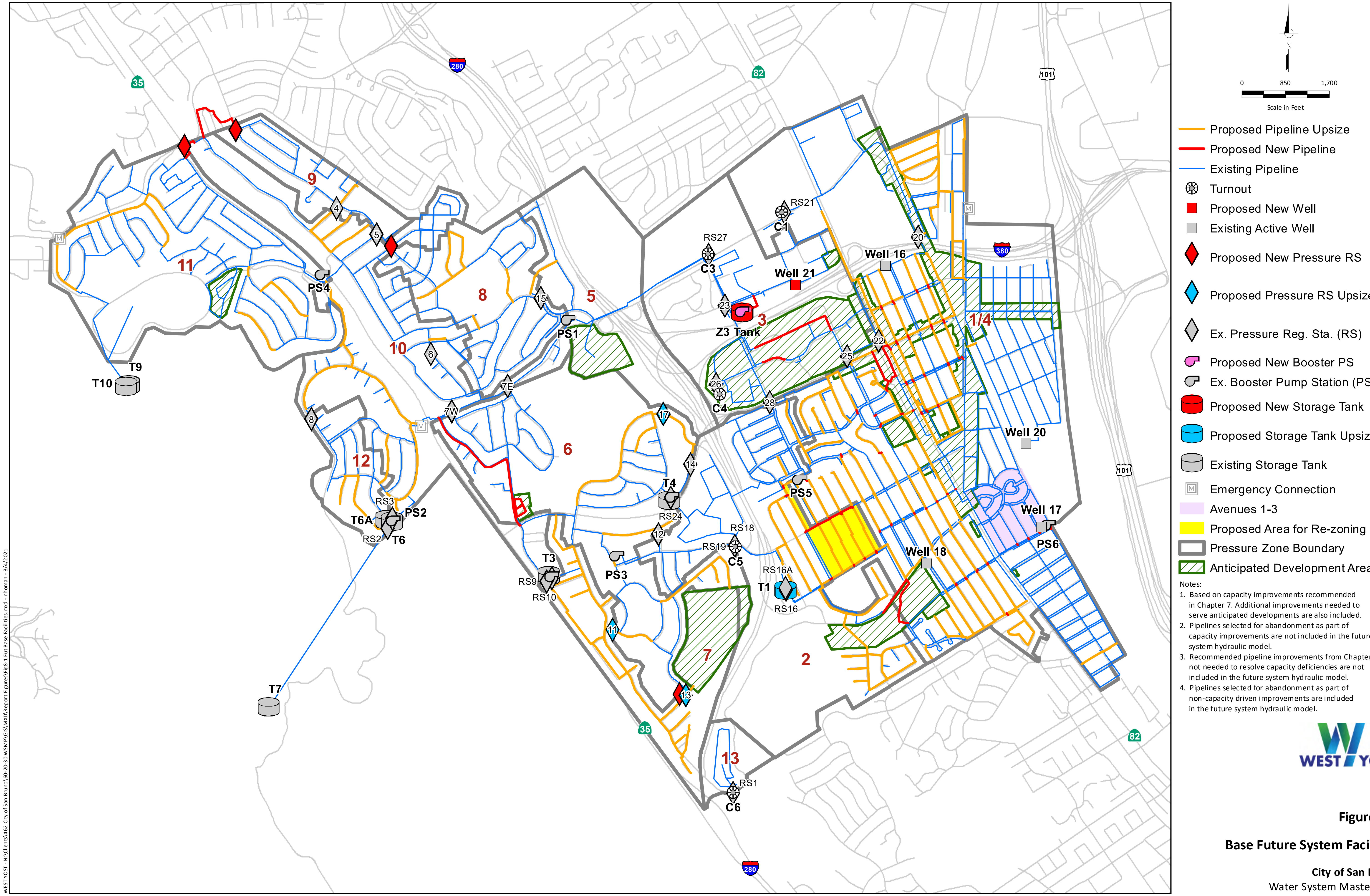
This chapter presents the evaluation of the City's future water distribution system and its ability to meet the City's recommended performance and operational criteria under future buildout (2040) water demand conditions. West Yost conducted this evaluation using an updated hydraulic model that incorporated capacity improvements needed to eliminate deficiencies identified previously in the existing water system evaluation (see *Chapter 7 Evaluation of Existing Water System*). The base future water system, which includes improvement recommendations from the existing water system evaluation, is illustrated on Figure 8-1. In general, only improvements recommended to resolve identified deficiencies that did not meet the City's system capacity and hydraulic performance criteria were incorporated into the base future water system. To be conservative, pipeline and facility upgrades which are recommended as part of the City's rehabilitation and replacement program but not required to resolve system capacity issues were not incorporated into the base future water system. Exceptions include the planned replacement and expansion of Tank 1 (CIP ID EX-T-2) and the installation or replacement of pipelines planned as part of specific identified development projects. This chapter identifies the additional improvements that will be required in addition to the identified existing water system improvements to support the City's projected water demands.

The future water system evaluation includes an analysis of water storage capacity, pumping capacity, and regulating valve capacity. The analysis also includes an evaluation to assess the future water system's ability to meet recommended operational and design criteria under maximum day demand plus fire flow and peak hour demand scenarios.

This chapter includes evaluations, findings, and recommendations for supporting projected future water demands and addressing any deficiencies identified within the future water distribution system. Recommendations are used to develop a CIP, which includes an estimate of probable construction costs. The recommended CIP is described further in Chapter 9.

The following topics are presented in this chapter:

- Projected Water Demands by Pressure Zone: summarizes demands by pressure zone used for the future water system evaluation
- Future Water System Facility Capacity Evaluation: evaluates storage, peak pumping capacity and peak valve station capacity to meet future system requirements
- Future Water System Performance Evaluation: assesses the hydraulic performance of the water system under future peak hour and maximum day plus fire flow conditions
- Summary of Recommended Improvements for the Future Water System



Notes:

1. Based on capacity improvements recommended in Chapter 7. Additional improvements needed to serve anticipated developments are also included.
2. Pipelines selected for abandonment as part of capacity improvements are not included in the future system hydraulic model.
3. Recommended pipeline improvements from Chapter 7 not needed to resolve capacity deficiencies are not included in the future system hydraulic model.
4. Pipelines selected for abandonment as part of non-capacity driven improvements are included in the future system hydraulic model.

WEST YOST

Figure 8-1

Base Future System Facilities

City of San Bruno

Water System Master Plan

8.1 PROJECTED WATER DEMANDS BY PRESSURE ZONE

Table 8-1 summarizes the City's water demands used for the future water system evaluation. The buildout (*i.e.*, 2040) water demands for the City's water system were spatially located in the hydraulic model using information provided by the City's Community Development staff. This information is presented in *Chapter 3 Water Demands* (see Table 3-12 and Figure 3-4).

Table 8-1. Water Demands for the 2040 System Analysis

Pressure Zone[a]	Average Day Demand[b]		Maximum Day Demand[c]		Peak Hour Demand[d]	
	gpm	mgd	gpm	mgd	gpm	mgd
Zone 1/4	1,562	2.25	2,734	3.94	5,468	7.87
Zone 2 - Main Zone	228	0.33	400	0.58	799	1.15
Zone 2 - Whitman Way	22	0.03	39	0.06	79	0.11
Zone 3	640	0.92	1,121	1.61	2,242	3.23
Zone 5	28	0.04	48	0.07	96	0.14
Zone 6	172	0.25	300	0.43	600	0.86
Zone 7	72	0.10	126	0.18	252	0.36
Zone 8	69	0.10	121	0.17	242	0.35
Zone 9	29	0.04	50	0.07	101	0.15
Zone 10	143	0.21	250	0.36	500	0.72
Zone 11	202	0.29	353	0.51	706	1.02
Zone 12	32	0.05	57	0.08	113	0.16
Zone 12 - Jail	101	0.15	287	0.41	861	1.24
Zone 13	20	0.03	36	0.05	72	0.10
Total	**3,320**	**4.78**	**5,922**	**8.52**	**12,131**	**17.46**

(a) Demands from Zones 6, 7, 8, and 9 each include demands from their smaller subzones (i.e., Zones 6A, 7A, 8A, 9A).
(b) Projected 2040 average day demand is from Table 3-12. Future demands were allocated to pressure zones based on the location of identified projects. 0.55 mgd of demand from unidentified future development was allocated to Zone 1/4.
(c) Maximum day demand is calculated using a peaking factor of 1.75 times the average day demand, except for demands from the San Francisco County Jail. Jail demands are from HDR Inc., May 2011, San Francisco County Jail #5 Water Supply Project DRAFT PreDesign TM.
(d) Peak hour demand is calculated using a peaking factor of 3.5 times the average day demand, except for demands from the San Francisco County Jail. Jail demands are from HDR Inc., May 2011, San Francisco County Jail #5 Water Supply Project DRAFT PreDesign TM.

The City's buildout average day water demands are expected to increase by approximately 58 percent from the existing "base" water demands. As discussed in *Chapter 7 Evaluation of Existing Water System*, water production data from 2019 was used to represent "base" water demands because it is the most representative of recent water use in the City.

Most of the projected growth will occur in Zones 1/4, 3, and 12. A summary of the major projected development projects associated with the additional water demands for these pressure zones is provided below.

- Zone 1/4 – Transit Corridors Plan, unidentified future development
- Zone 3 – Bayhill Specific Plan
- Zone 12 – San Francisco County Jail #5[1]

8.2 FUTURE WATER SYSTEM FACILITY CAPACITY EVALUATION

To evaluate the water system facilities performance for the projected future water demand condition, the following analyses were conducted:

- Pumping Capacity Evaluation,
- Storage Capacity Evaluation, and
- Pressure Regulating Station Capacity Evaluation.

The future water system facility capacity evaluation is based on a normal supply year (*i.e.*, "put") operation and assumes that the City will be maximizing its surface water use during normal supply years as part of the Regional Groundwater Storage and Recovery Project. This is conservative, as it assumes that the City's groundwater wells do not contribute to pumping capacity or provide emergency storage credit. Results from the future water system facility capacity evaluation are discussed below.

8.2.1 Pumping Capacity Evaluation

The pumping capacity in the City's future water system was evaluated to assess its ability to deliver a reliable firm capacity to serve the proposed future water service area. Firm pumping capacity assumes a reduction in total pumping capacity to account for pumps that are out of service at any given time due to mechanical breakdown, maintenance, water quality, or other operational issues. At each booster pump station, firm booster pumping capacity was defined as the total booster pump station capacity with the largest pump out of service. To be conservative, it was assumed that the City's groundwater wells are inactive to simulate operations during a hydrologically normal or wet year. One booster pump station, PS6, pumps from a clearwell which is supplied by Well 17 and is therefore also assumed to be inactive.

When zones are supplied by pump station(s), the pumping capacity criterion for the City, described previously in *Chapter 6 System Performance and Operational Criteria*, requires the City's water system to have sufficient firm pumping capacity to meet peak demands. The firm pumping capacity must equal or exceed the maximum day demand in zones with storage, and maximum day plus fire flow or peak hour demand, whichever is larger, in zones without storage. In zones with storage, maximum day plus fire flow and peak hour demands are met from a combination of zone supply and storage.

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[1] The future system evaluation assumes that the San Francisco County Jail #5 will be served by the City; however, the validity of this assumption depends on the result(s) from negotiations with SFPUC.

Table 8-2 compares existing and proposed firm pumping capacity with the required firm pumping capacity for future water demand conditions. The left-hand side of the table shows the service zones and the corresponding supported zones, their associated demand, and the pump stations serving each service zone. As an example, PS5 directly serves Zone 2, but must also have sufficient pumping capacity to supply Zones 6 through 12 because they are supported by Zone 2. The right-hand side of the table shows the existing and proposed pumping capacity, the required firm pumping capacity based on the pumping capacity criterion, and the difference between the existing and proposed firm pumping capacity and the required firm pumping capacity.

Table 8-2 indicates that all service zones that were evaluated have surplus pumping capacity in excess of the future maximum day demand. The firm pumping capacity surplus for each pressure zone ranges from approximately 190 to 780 gpm.

During hydrologically dry years, the City will operate its groundwater wells at maximum capacity to retrieve groundwater banked by the GSR Project and reduce its use of SFPUC-supplied surface water. In these years, groundwater would be used to serve a large portion of City demands during winter months when demands are low. Under these conditions, it is assumed that pumps at PS1 and PS3 would not run, because these pump stations supply water from SFPUC turnouts to upper pressure zones. However, even without these pump stations operating, the City has sufficient pumping capacity to move an adequate amount of groundwater supply from Zone 1/4 into the upper pressure zones to meet winter demands[2].

8.2.2 Storage Capacity Evaluation

The principal advantages that storage provides for the water system are: the ability to balance differences in demands and supplies; to provide emergency storage in case of supply failure; and to provide water to fight fires. The City's recommended water storage capacity requirement is to provide a volume equal to 75 percent of a maximum day demand plus fire flow storage.

Table 8-3 compares the City's available and proposed water storage capacity with the required storage capacity by pressure zone. The comparison between the City's available and required storage capacities indicates that there are no potable water storage capacity deficiencies in the future water system.

Two of the storage tank capital improvement projects described in Chapter 7 include additional capacity beyond what is needed to meet existing demands. The recommended Zone 3 tank discussed previously in Section 7.2.2 (CIP project EX-T-1) should have a minimum storage capacity of 1.8 MG. Approximately 1.0 MG of this storage capacity is required to meet existing demands, while 0.8 MG of capacity is needed to accommodate future Zone 3 demands.

Similarly, the replacement of Tank 1 with a new 3.5 MG tank (CIP project EX-T-2) will provide additional storage capacity needed to accommodate future Zone 1/4 demands. The existing 2.5 MG tank has sufficient capacity to meet existing demands, but only has 0.34 MG of surplus storage to accommodate future growth. Due to the GSR Project, the City's groundwater wells in Zone 1/4 cannot provide emergency storage credit to support the additional storage requirements from future growth. Therefore, an additional 1.0 MG of storage tank capacity is needed in Zone 1/4 to accommodate buildout storage requirements.

[2] Based on historical City water use, future winter demands are estimated to be 80 percent of average day demands, or 3.82 mgd. It was assumed that Zone 3 and Zone 5 winter demands (0.77 mgd) will be met by the planned Well 21 (CIP ID EX-W-1). Existing City pumping capacity is sufficient to supply the remaining 3.05 mgd of winter demands to other pressure zones without PS1 and PS3 running.

Table 8-2. Comparison of Existing, Proposed, and Required Pumping Supply Capacity in 2040

Service Zone and Supported Zones[a]	Average Day Demand, gpm	Maximum Day Demand, gpm	Existing Pumping Capacity: Pump Stations	Existing Pumping Capacity: Total, gpm	Existing Pumping Capacity: Firm, gpm[b]	Required Firm Pumping Capacity, gpm[c]	Firm Capacity Surplus (Deficit), gpm
Zone 2 - Main Zone[d]							
Zone 2 - Main Zone	228	400	PS5 - Maple Avenue	1,650	1,100	912	188
Zone 6	120	210					
Zone 7	17	31					
Zone 8	17	29					
Zone 9	7	12					
Zone 10	35	61					
Zone 11	49	86					
Zone 12	8	14					
Zone 12 - Jail	25	70					
Total	506	912					
Zone 6[e]							
Zone 6	172	300	PS3 - Whitman Way PS7 - San Bruno Avenue	2,000	1,000	731	269
Zone 7	25	44					
Zone 8	24	42					
Zone 9	10	17					
Zone 10	50	87					
Zone 11	70	122					
Zone 12	11	20					
Zone 12 - Jail	35	99					
Total	396	731					
Zone 10							
Zone 10	143	250	PS1 - Sneath Lane PS8 - Glenview Drive	3,470	2,020	1,245	775
Zone 7	72	126					
Zone 8	69	121					
Zone 9	29	50					
Zone 11	202	353					
Zone 12	32	57					
Zone 12 - Jail	101	287					
Total	648	1,245					
Zone 11							
Zone 11	202	353	PS4 - Pacific Heights/College	2,000	1,000	353	647
Zone 12							
Zone 12	32	57	PS2 - Lake Drive	1,200	600	344	256
Zone 12 - Jail	101	287					
Total	133	344					

(a) Zone 6 represents Zones 6 and 6A. Likewise, Zones 7, 8, and 9 also include their smaller subzones (Zones 7A, 8A, and 9A).

(b) Firm booster pumping capacity is defined as the total booster pump station capacity with the largest pump at each station out of service.

(c) Required firm pumping capacity is equal to maximum day demand in zones with storage and equal to maximum day demand plus fire flow or peak hour demand, whichever is larger, in zones without storage. All of the City's zones supplied by pump stations have storage.

(d) Zone 2 supporting zones:
- Zone 6 is partially supported by Zone 2 via PS7, and partially supported by Turnout C5 via PS3. In order to account for this, the demands for Zone 6 were multiplied by 0.7, which is the ratio of PS7 firm capacity to PS3+PS7 firm capacity.
- Zones 7-12 are partially supported by Zone 2 via Zone 6 by way of PS8, and partially supported by Turnout C3 via PS1. In order to account for this, the demands for Zones 7-12 were multiplied by 0.25, which is the ratio of PS8 firm capacity to PS1+PS8 firm capacity (0.35) multiplied by the ratio of PS7 firm capacity to PS3+PS7 firm capacity (0.7).

(e) Zone 6 supporting zones:
- Zones 7-12 are partially supported by Zone 6 via PS8, and partially supported by Turnout C3 via PS1. In order to account for this, the demands for Zones 7-12 were multiplied by 0.35, which is the ratio of PS8 firm capacity to PS1+PS8 firm capacity.

Table 8-3. Comparison of Existing, Proposed, and Required Storage Capacity in 2040

Pressure Zone[a]	Water Storage Facility	Available Storage Capacity, MG		Required Storage Capacity, MG				Storage Surplus (Deficit), MG
		Reservoir Capacity[b]	Total Available Storage	Operational[c]	Emergency[d]	Fire Flow[e]	Total Required Storage	
Zone 1/4	Tank 1 - Cunningham Drive	3.5[f]	3.50	0.98	1.97	0.54	3.49	0.01
Zone 2 - Main Zone	Tank 4 - San Bruno Avenue	1.00	1.00	0.14	0.29	0.30	0.73	0.27
Zone 3	Future Tank	1.80	1.80	0.40	0.81	0.54	1.75	0.05
Zone 6[g]	Tank 3 - Glenview Drive	2.00	2.00	0.12	0.24	0.30	0.67	1.33
Zone 10[h]	Tank 6 - Lake Drive South	0.40	1.40	0.21	0.43	0.30	0.94	0.46
	Tank 6A - Lake Drive North	1.00						
Zone 11	Tank 9 - Skyline West	0.50	1.00	0.13	0.25	0.30	0.68	0.32
	Tank 10 - Skyline East	0.50						
Zone 12 (including Jail)[i]	Tank 7 - Sweeney Ridge	0.40	0.40	0.12	0.04	0.18	0.34	0.06
Zone 13	--	--	0.00	0.01	0.03	0.30	0.34	NA[j]

(a) Zone 6 also includes the small Zone 6A subzone.

(b) From Table 2-6.

(c) Based on 25 percent of maximum day demand (see Table 7-1).

(d) Based on 50 percent of maximum day demand (see Table 7-1).

(e) Based on flowrate for the land use with the highest requirement in the pressure zone multiplied by the corresponding recommended fire flow duration (see Table 6-2).

(f) The planned Tank 1 replacement will increase the capacity of the existing Tank 1 by 1.0 MG.

(g) Required storage capacity includes demands for the Whitman Way portion of Zone 2, which has no dedicated storage facilities. Zone 2 - Whitman Way can be provided with water from Zone 6 in an emergency via RS12.

(h) Required storage capacity includes demands for Zones 5, 7, 8, and 9. Zones 7, 8, and 9 are typically served by Zone 10 storage. Zone 5 can be provided with water from Zone 10 in an emergency via Zone 8 and RS15B.

(i) Does not include emergency and fire flow storage for the San Francisco County Jail #5. Emergency and fire flow storage assumed to be provided by on-site storage tank.

(j) It is assumed that SFPUC facilities can provide sufficient storage capacity for Zone 13.

8.2.3 Pressure Regulating Station Capacity Evaluation

The existing and proposed pressure regulating stations in the City's water system were evaluated to assess their ability to reliably supply the future water service area. For zones served by pressure regulating stations, the criterion for the City, described previously in *Chapter 6 System Performance and Operational Criteria*, requires the City's pressure regulating stations to have sufficient capacity to meet peak demands. In zones with storage, pressure regulating stations must supply the maximum day demand, and in zones without storage, pressure regulating stations must supply maximum day plus fire flow or peak hour demand, whichever is larger.

The City has seven different pressure zones and four subzones that are primarily dependent or completely dependent on the pressure regulating stations for supply.[3] Therefore, the pressure regulating station capacity requirement for the fifteen stations serving these zones is to provide maximum day plus fire flow or peak hour demand, whichever is greater. In most cases, the maximum day plus fire flow demand is the critical supply condition.

Table 8-4 compares the existing and proposed pressure regulating station capacity with the required pressure regulating station capacity for the fifteen pressure regulating stations that are primary supply sources for the zones dependent on pressure regulating stations for supply. This table shows that all evaluated pressures zones will have sufficient valve capacity to meet the required flows in the future water system.

[3] Although Zone 12 is served by PS2 and Tank 7, the pump station and tank supply the zone via RS2.

Table 8-4. Comparison of Existing, Proposed, and Required Pressure Regulating Station Capacity in 2040

Zone	Maximum Day Demand, gpm	Fire Flow Requirement, gpm[a]	Peak Hour Demand, gpm	Regulating Station	Valve Diameter, inches	Existing Valve Capacity, gpm[b]	Valve Capacity Requirement, gpm[c]	Valve Capacity Surplus (Deficit), gpm
Zone 1/4	2,734	NA[d]	NA[d]	RS16A	8	3,900	2,734	3,416
				RS20[e]	6	2,250		
					Total	6,150		
Zone 3	1,121	3,000	2,242	RS26	8	3,900	4,121	5,659
					4	990		
				RS27	8	3,900		
					4	990		
					Total	9,780		
Zone 6A	7	1,500	15	RS17[f]	6	2,250	1,507	1,003
					2	260		
					Total	2,510		
Zone 7	126	2,500	252	RS9	8	3,900	2,626	1,534
					2	260		
					Total	4,160		
Zone 7A	49	2,000	97	RS13[f]	6	2,250	2,049	461
					2	260		
					Total	2,510		
Zone 8	121	2,000	242	RS6	8	3,900	2,121	7,659
					4	990		
				EXCIP-RS-6[g]	8	3,900		
					4	990		
					Total	9,780		
Zone 8A	7	0	14	RS15	2	260	14	506
					2	260		
					Total	520		
Zone 9	49	2,000	99	RS4	6	2,250	2,049	5,351
					2	260		
				EXCIP-RS-5[g]	8	3,900		
					4	990		
					Total	7,400		
Zone 9A	1	0	2	RS5	6	2,250	2	2,508
					2	260		
					Total	2,510		
Zone 12 (including Jail)[h,i]	344	1,500	974	RS2	6	2,250	1,844	666
					2	260		
					Total	2,510		
Zone 13	36	2,500	72	RS1[f]	6	2,250	2,536	294
					3	580		
					Total	2,830		

(a) Based on demand for most severe fire recommended in the pressure zone (Table 6-2). Subzones 8A and 9A do not serve any fire hydrants.

(b) Based on the intermittent maximum flow capacity for ClaVal model 90-01 PRV valves. However, actual flow capacity will vary depending on system conditions.

(c) The criterion for sizing valves for most zones is maximum day demand plus fire flow or peak hour demand, whichever is larger.

(d) Only maximum day demand is required to be supplied by Zone 1/4 regulation stations. Fireflow and peak hour demands for Zone 1/4 should be provided by available storage capacity in Tank 1.

(e) Supply from Turnout C1 has to pass through RS21 and RS20 to supply Zone 1. Because RS20 capacity is much less than RS21 capacity, and because Zone 1 demands are significantly greater than Zone 4 demands, RS20 capacity is conservatively used instead of RS21 capacity.

(f) Capacity improvements were proposed for pressure regulating station based on the existing water system evaluation. Improved capacity shown.

(g) New pressure regulating station recommended based on the existing water system evaluation.

(h) Zone 12 served by PS2 and Tank 7 via RS2.

(i) Zone 12 can also be served by emergency bypass from Tanks 6 and 6A via RS3.

8.3 FUTURE WATER SYSTEM PERFORMANCE EVALUATION

This section discusses the hydraulic performance evaluation of the future water distribution system. Consistent with the future water system facility capacity evaluation presented in Section 8.2, the future water system performance evaluation is also based on a normal supply year (*i.e.*, "put") operation and assumes that the City will be maximizing its surface water use during normal supply years under the GSR Project. This is conservative, as it assumes that the City's groundwater wells will not be operated and will therefore not increase pressures or provide additional fire flow in Zone 1/4. The following evaluations were performed to assess distribution system performance under the proposed buildout (2040) water demand condition:

- Normal Operations - Peak Hour Demand Scenario: This scenario evaluates customer service pressures in the system during a peak hour demand condition.
- Emergency Operations - Maximum Day plus Fire Flow Scenario: This scenario evaluates available fire flows in the system under a maximum day demand condition.

These two scenarios use the hydraulic model developed for the Water System Master Plan to evaluate the future water system performance. The hydraulic model used for the future system evaluation was first updated to include all capacity improvements recommended for the existing water system (see Figure 8-1). In general, rehabilitation and replacement improvements not required to resolve existing system capacity issues were not included in the hydraulic model. Exceptions include the planned replacement and expansion of Tank 1 (CIP ID EX-T-2) and the installation or replacement of pipelines planned as part of specific, identified development projects. The purpose of the future water system performance evaluation is to identify any additional capacity improvements that will be required to support the City's projected water demands.

The future water system is expected to deliver peak hour flows and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the performance criteria presented in Chapter 6. As discussed below, the improvements recommended in Chapter 7 to resolve the existing system capacity deficiencies also meet the needs of the future water system, and no additional improvements are recommended. System improvements were not identified for existing pipelines that did not meet velocity or head loss criteria where no pressure deficiencies were identified.

8.3.1 Normal Operations - Peak Hour Demand Scenario

Steady-state hydraulic analyses were conducted using the updated hydraulic model to evaluate system performance under future peak hour demand conditions. As shown in Table 8-1, the peak hour demand for the future water service area was calculated to be 12,132 gpm (17.5 mgd). The peak hour demand is estimated at 3.5 times the average daily demand. This analysis assumed that the storage tanks are 50 percent full and pump stations are off.

During a peak hour demand scenario, a minimum pressure of 35 psi must be maintained at service connections throughout the entire water system. In addition, for planned pipelines, it is recommended that the maximum head loss per thousand feet of transmission main should not exceed 5 ft/kft and maximum velocities on transmission and distribution mains should not exceed 4 ft/s during normal operations, to help minimize energy (pumping) costs due to undersized pipelines.

Results from the peak hour demand simulation indicate that the future water system could adequately meet the City's minimum pressure criterion of 35 psi at customer services, except for the few locations shown in red on Figure 8-2. In addition to the low-pressure junctions in Zones 6, 7, and 11, discussed previously in Chapter 7, there is one low pressure junction in Zone 1/4. Because this low-pressure junction is a result of high elevations rather than distribution system constrictions, and because it does not represent many services, no improvements are recommended specifically for this location, which does meet the State's minimum standard of 20 psi.

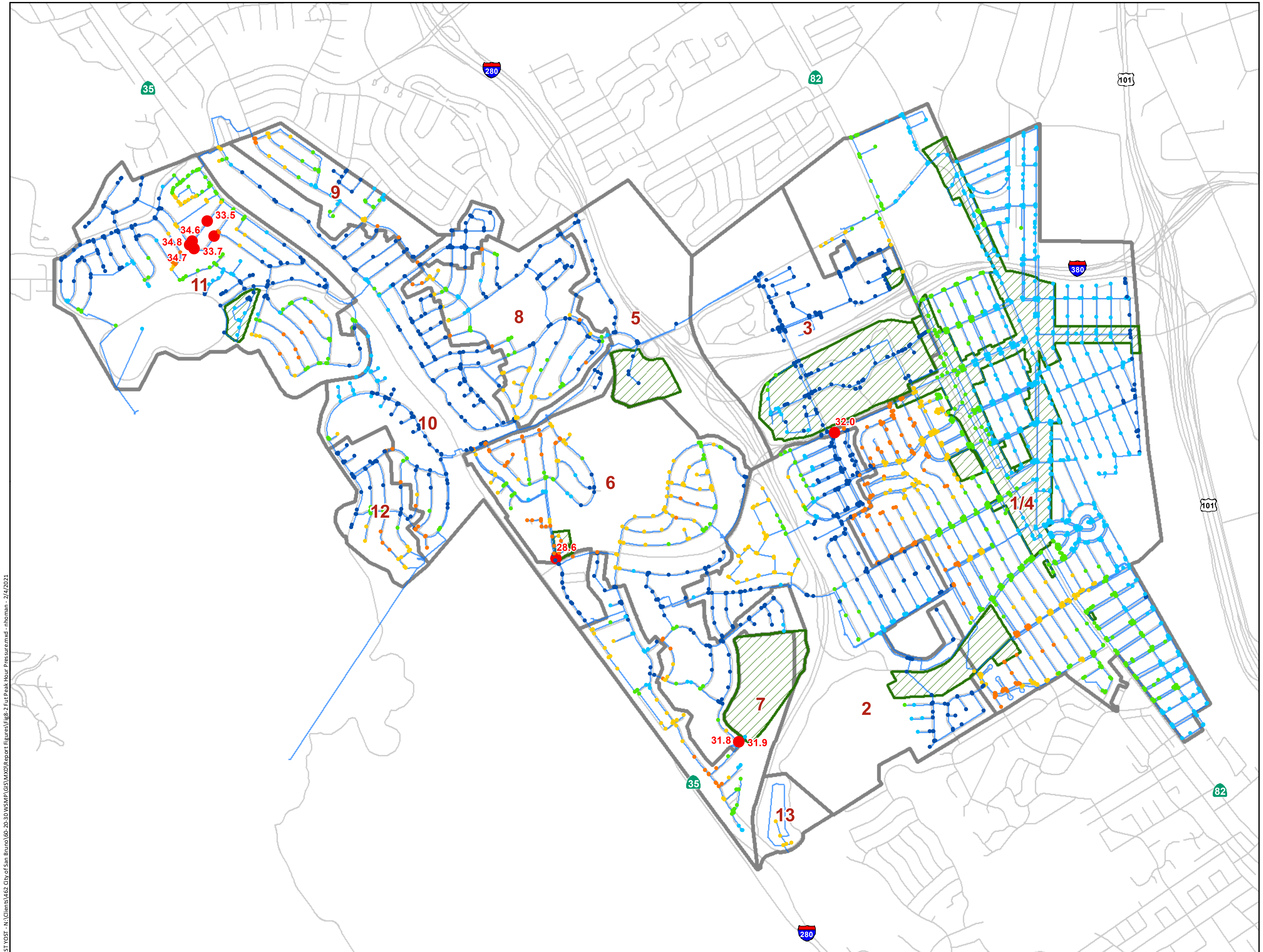
8.3.2 Emergency Operations – Maximum Day Demand plus Fire Flow Scenario

To evaluate the future water system under the maximum day demand plus fire flow scenario, InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow at a minimum residual pressure of 20 psi. Available flow simulated by the hydraulic model represents the capacity of the water mains and does not account for losses through laterals or hydrant assembly. For the future water system evaluation, key junctions that represent hydrant locations in pressure zones that have significant increases in water demand were tested to determine the available fire flow that can be provided, in addition to meeting the maximum day demand. This analysis assumed that the storage tanks are 50 percent full and that pump stations are operating at firm capacity.

As discussed in *Chapter 6 System Performance and Operational Criteria*, fire flow criteria were developed with input from the City's Fire Department based on the general character and type of existing construction, and allowable construction based on zoning requirements. The fire flow criteria for each tested location was assigned using the general land use categories representing different types of development to assess the adequacy of the future water distribution system in meeting fire flow demands. The recommended fire flow criteria for all the tested locations in the future water system are shown on Figure 8-3.

Figure 8-4 summarizes the available fire flow at each tested junction within the future water system while meeting the minimum residual pressure criterion of 20 psi. The available fire flow result at each junction was subsequently compared to the fire flow criteria shown on Figure 8-3 to determine the location(s) of any fire flow deficiencies. Figure 8-5 presents the results of this comparison. Junctions colored in green indicate locations where the available fire flow is greater than the fire flow criteria (*i.e.*, pass), and junctions colored in red indicate locations where the available fire flow is less than the fire flow criteria (*i.e.*, fail).

As shown on Figure 8-5, only three junctions located in Zone 1/4 did not meet the assigned fire flow criterion. Based on the fire flow criterion of 1,500 gpm at these locations, a comparison with the corresponding available fire flow result indicates that each location is deficient by less than 100 gpm. These locations were reviewed, and it was determined that fire flow criteria would be met if supply from adjacent hydrants was utilized, or if the additional pipeline replacements recommended for rehabilitation and replacement in Chapter 7 but not incorporated into the future system hydraulic model were implemented. Therefore, no additional improvements are recommended to resolve the fire flow deficiencies at these locations.



- Pipeline
- Pressure Zone Boundary
- Anticipated Development Area

Peak Hour Pressure

- Pressure < 35 psi
- 35 psi ≤ Pressure ≤ 50 psi
- 50 psi ≤ Pressure ≤ 60 psi
- 60 psi ≤ Pressure ≤ 70 psi
- 70 psi ≤ Pressure ≤ 80 psi
- Pressure > 80 psi

Notes:

1. Future Peak Hour Demand is 17.46 mgd.
2. Assumes storage tank levels are half full, and all pump stations are off.
3. The City's existing hydraulic model is not an all-pipes model. Therefore, some short dead-end pipelines are not shown or evaluated.
4. Per the California Plumbing Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.

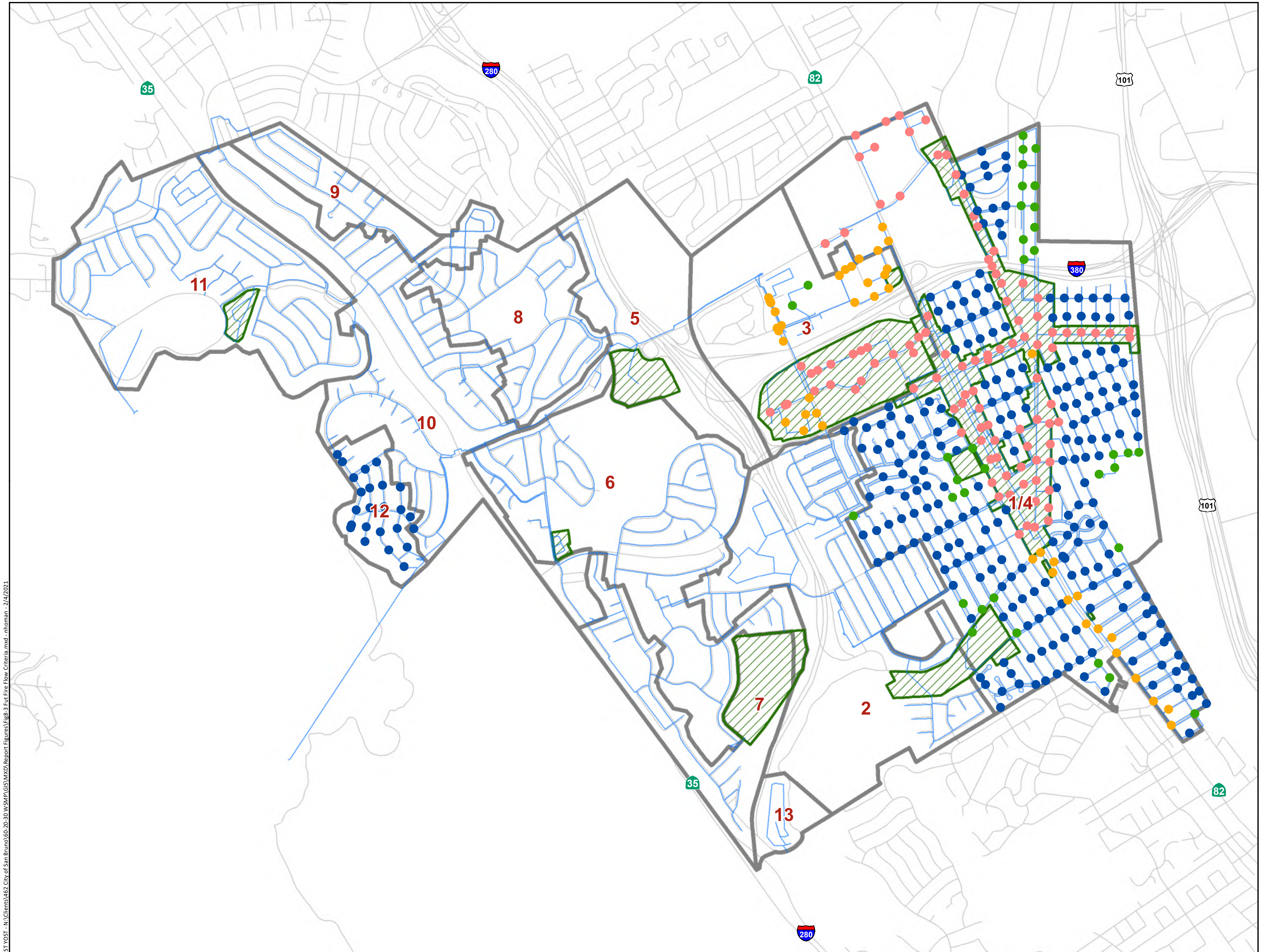
WEST YOST

Figure 8-2

Peak Hour Pressure Future System

City of San Bruno
Water System Master Plan

WEST YOST - N:\Clients\462 City of San Bruno\60-20-30 WSMP\GIS\MXD\Report Figures\Fig8-2 Fut Peak Hour Pressure.mxd - nhoman - 2/4/2021



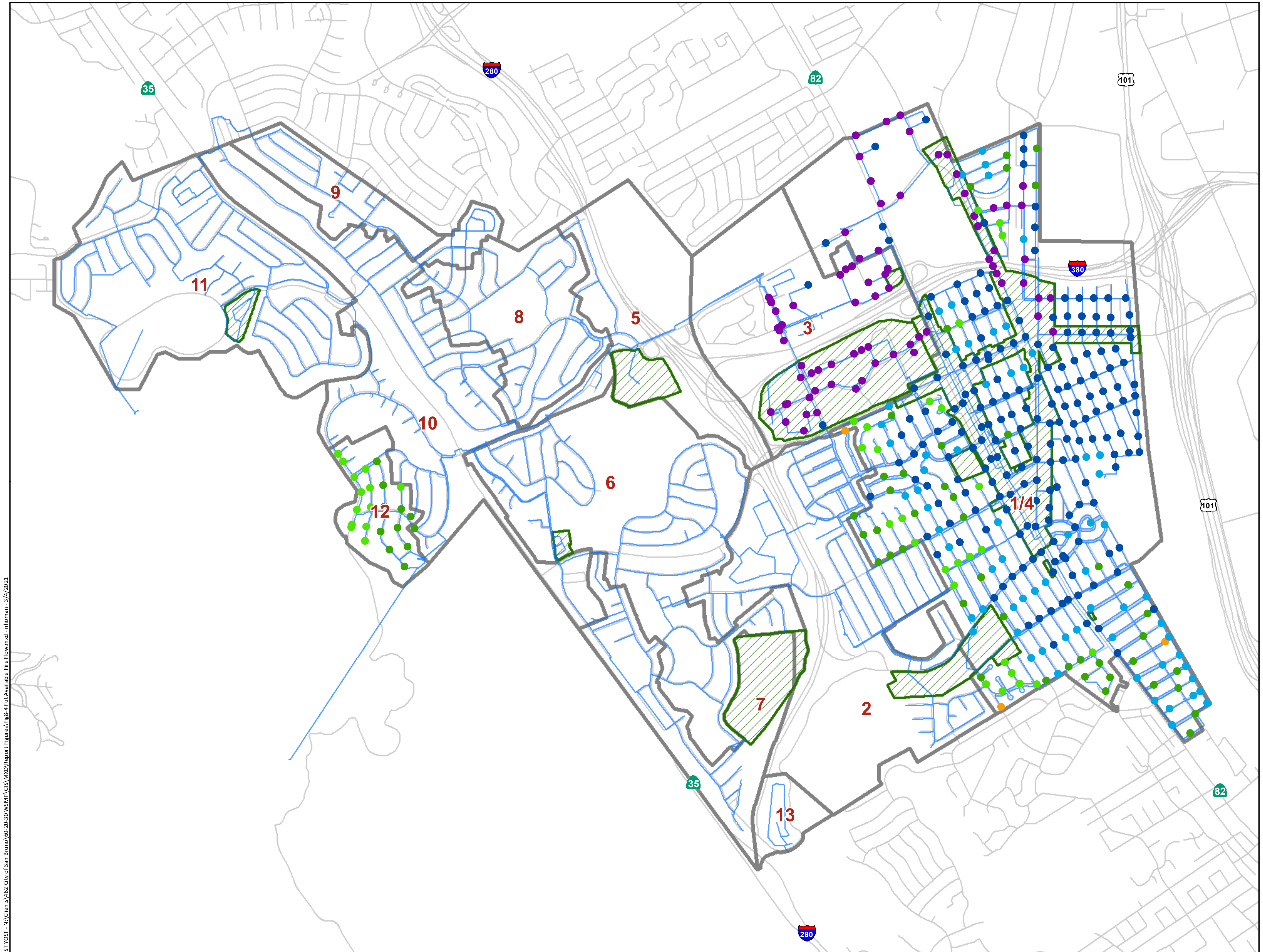
Notes:
1. Fire flow criteria assigned based on existing and anticipated land use. Refer to Table 6-2 for recommended fire flow criteria by land use type.
2. Future fire flow was only evaluated in pressure zones with significant increases in demand.

WEST YOST

Figure 8-3

Recommended Future System Fire Flow Criteria

City of San Bruno
Water System Master Plan



- Pipeline
- Anticipated Development Area
- Pressure Zone Boundary

Available Fire Flow

- Less than 500 gpm
- 500 to 1,000 gpm
- 1,000 to 1,500 gpm
- 1,500 to 2,000 gpm
- 2,000 to 2,500 gpm
- 2,500 to 3,000 gpm
- 3,000 to 4,000 gpm
- Greater than 4,000 gpm

Notes:
1. Future Maximum Day Demand is 8.52 mgd.
2. Assumes storage tanks are half full and that pump stations are operating at firm capacity.
3. The City's existing hydraulic model is not an all-pipes model. Therefore, some short dead-end pipelines are not shown or evaluated.
4. Available fire flow at 20 psi residual pressure. The pipeline velocity constraint was applied only to new or upsized pipelines.
5. Available fire flow represents the capacity of water mains and does not account for losses through laterals or hydrant assembly.
6. Future fire flow was only evaluated in pressure zones with significant increases in demand.

WEST YOST

Figure 8-4

Available Fire Flow
Future Maximum Day Demand

City of San Bruno
Water System Master Plan

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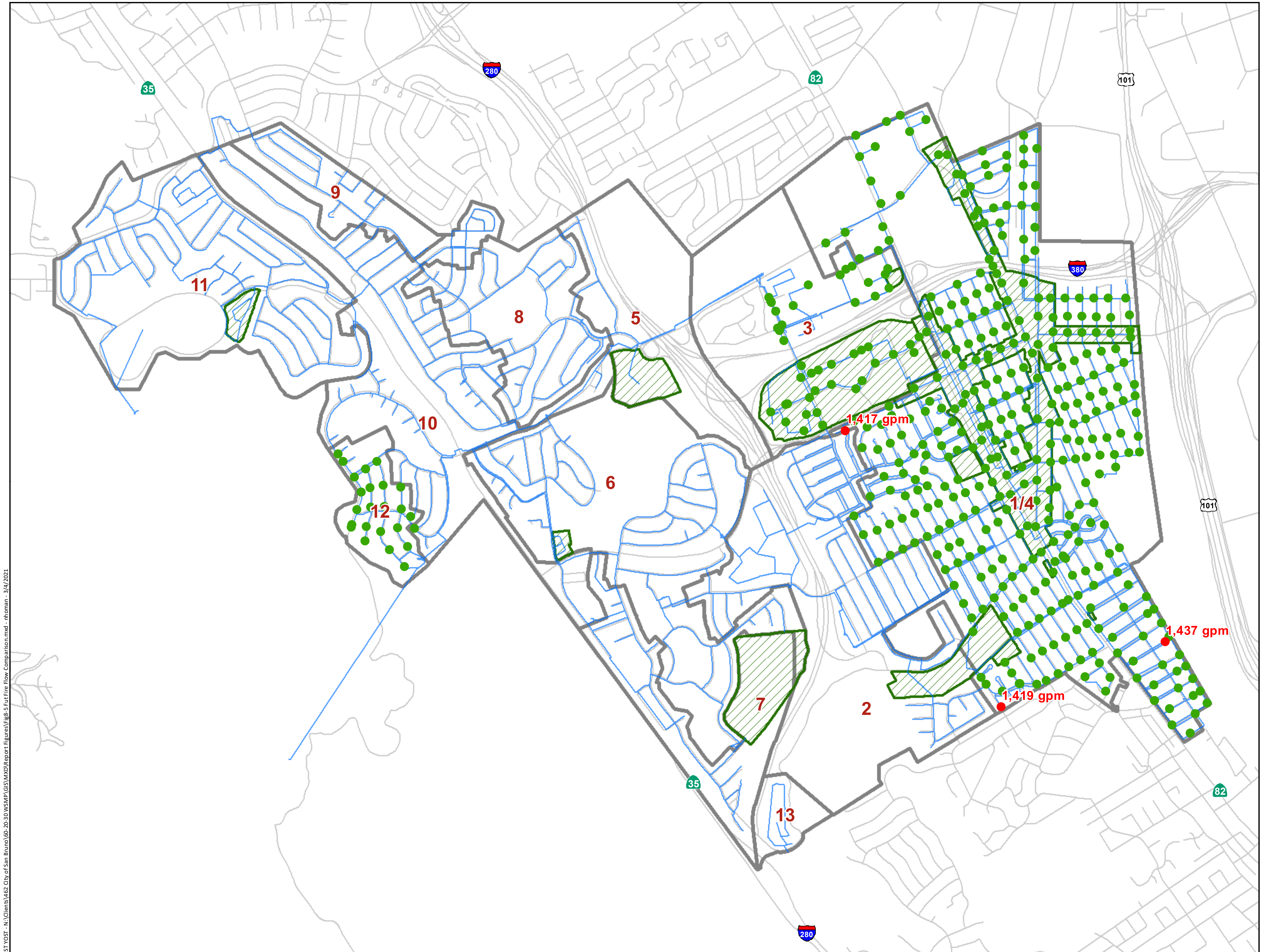


N

0 850 1,700

Scale in Feet

- Pipeline
- Anticipated Development Area
- Pressure Zone Boundary

Comparison of Available Fire Flow and Fire Flow Criteria

- Does not meet Fire Flow Criteria
- Meets Fire Flow Criteria

Notes:
1. Future Maximum Day Demand is 8.52 mgd.
2. Assumes storage tanks are half full and that pump stations are operating at firm capacity.
3. The City's existing hydraulic model is not an all-pipes model. Therefore, some short dead-end pipelines are not shown or evaluated.
4. Available fire flow at 20 psi residual pressure. The pipeline velocity constraint was applied only to new or upsized pipelines.
5. Available fire flow represents the capacity of water mains and does not account for losses through laterals or hydrant assembly.
6. Future fire flow was only evaluated in pressure zones with significant increases in demand.
7. Available flow is labeled in gpm for deficient locations.

WEST YOST

Figure 8-5

Comparison of Available Fire Flow and Fire Flow Criteria Future System

City of San Bruno
Water System Master Plan

WEST YOST - N:\Clients\462 City of San Bruno\60-20-30 WSMP\GIS\MXD\Report Figures\Fig8-5 Fut Fire Flow Comparison.mxd - nhoman - 3/4/2021

8.4 SUMMARY OF RECOMMENDED IMPROVEMENTS FOR THE FUTURE WATER SYSTEM

No additional improvements beyond those recommended in Chapter 7 are required to meet the City's water system performance criteria for the future water system.

However, it should be noted that 1.0 MG of the storage capacity for the new 3.5 MG Tank 1 replacement (CIP project EX-T-2) is allocated to provide storage for future development. Similarly, 0.8 MG of the storage capacity for the recommended 1.8 MG Zone 3 tank (CIP project EX-T-1) is to accommodate future demands.

CHAPTER 9
Recommended Capital Improvement Program

This chapter presents the recommended CIP for the City's existing and future water system. Recommendations for improvements to the existing and future water system were described previously in Chapters 7 and 8, respectively. It should be noted that the recommended CIP only identifies improvements at a master plan level and does not constitute a design of such improvements. Subsequent detailed design is required to determine the exact sizes and locations of these proposed improvements.

This chapter provides a summary of the recommended capital improvement projects, along with estimates of probable costs. The chapter also provides a prioritized implementation schedule for the capital improvement projects.

Probable project cost estimates are developed individually for each proposed improvement project. The chapter also establishes priorities for projects, based on City and consultant input, to develop a balanced capital improvement program that implements improvements in a coordinated manner and addresses most critical needs first.

Construction costs are presented in January 2021 dollars based on an Engineering News Record (ENR) Construction Cost Index (CCI) of 13098 (San Francisco Average). Construction costs were developed based on bids for City and other water facilities design projects and from standard cost estimating guides. The total CIP cost includes mark-ups equal to 62.5 percent of the estimated base construction costs. A design and construction contingency of 30 percent of the base construction costs is used. Markups for other project costs are 25 percent of the base construction costs plus the design and construction contingency, as listed below.

- **Design and Construction Contingency**: 30 percent
- **Other Project Costs**: 25 percent of base construction costs plus Design and Construction Contingency. Other Project Costs include allowances for design, soils investigation, surveying, construction management and inspection, office engineering during construction, CEQA compliance, City administration, public outreach and legal costs.

For this Water System Master Plan, it is assumed that new distribution system facilities will be developed in public rights-of-way or on public property; therefore, land acquisition costs have not been included. Proposed construction costs also do not include costs for annual operation and maintenance. A complete description of the assumptions used in the development of the estimated probable project costs is provided in Appendix C.

The following sections of this chapter describe the components of the potable water system capital improvement program developed for this Water System Master Plan:

- Recommended Potable Water System Capital Improvement Program
- Capital Improvement Program Implementation
- Rate Analysis and Funding

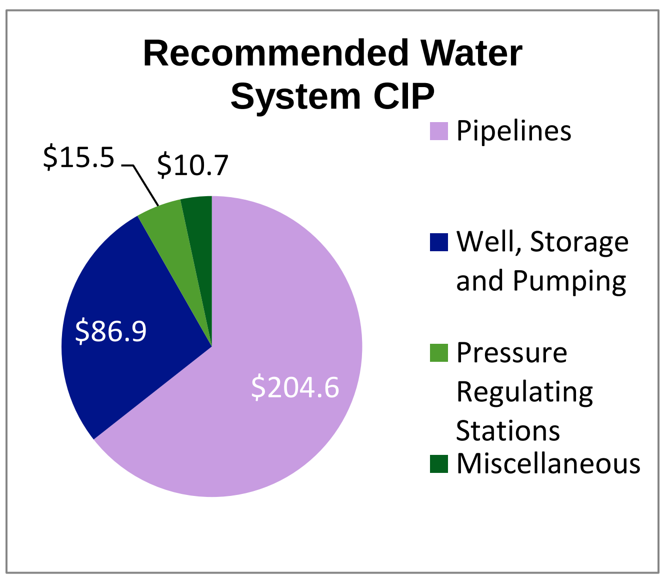
9.1 RECOMMENDED POTABLE WATER SYSTEM CAPITAL IMPROVEMENT PROGRAM

As described in Chapter 7 – *Evaluation of Existing Water System*, recommended water system capital improvement projects are formulated to address capacity and renewal/replacement needs. The projects are broken down into four groups based on improvement types:

- Pipelines
- Well, Storage and Pumping
- Pressure Regulating Stations
- Miscellaneous

As described in Chapter 8 – *Evaluation of Future Water System,* no additional improvements are required beyond those recommended in Chapter 7 to meet future system demands. However, 1.0 MG of the storage capacity for the new 3.5 MG Tank 1 replacement project is allocated to provide storage for future development. Similarly, approximately 0.8 MG of the storage capacity for the recommended 1.8 MG Zone 3 tank is to accommodate future demands.

These programs total approximately $318M, as shown on the chart to the right, and as summarized in Table 9-1. Table 9-1 summarizes each project with a CIP Identifier, improvement type, reason, description, location, cost estimating source, construction cost and capital cost. Many of the projects are included in the City's FY 2022-2026 capital program, and these projects also include the City Project ID.



Pipeline improvements include capacity improvements, to upsize pipelines to meet fire flow criteria, and pipeline replacements, prioritized based on the risk assessment summarized in Chapter 7. Figure 9-1 shows the pipeline capacity improvements. Figure 9-2 shows the pipeline replacement program, which integrates the capacity improvements shown on Figure 9-1.

Table 9-1. Capital Improvement Program Costs[a]

WSMP CIP Identifier	City Project ID	Improvement Type	Reason for Improvement	Improvement Description	Zone	Cost Estimate Source	Base Construction Cost, dollars	Construction Cost, dollars [b]	Total Capital Cost, dollars (includes mark-ups)[b]
Pipeline Improvements									
EX-P-1	11007	Replace / Upsize Pipeline	Fire Flow / Failure Risk	Avenues 1-3 pipeline replacement project. Completion anticipated in 2021.	1/4	City FY2022-2026 CIP	-	-	4,020,000
EX-P-2	11008	Replace / Upsize Pipeline	Failure Risk	Replacement and upsize of Priority Area 2 with 1,600 linear feet of new pipeline. Install 1,200 lf of 8" pipeline and 400 lf of 10" pipeline.	1/4	Appendix C	732,000	950,000	1,190,000
EX-P-3	11009, 11010, 11011	Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Priority Area 3 with 29,600 lf of new pipeline. Install 18,300 lf of 8" pipeline, 9,100 lf of 10" pipeline, 2,200 lf of 12" pipeline.	1/4	Appendix C	14,213,000	18,480,000	23,096,000
EX-P-4		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 4 (not previously in Ten Year CIP Workplan) with 16,500 lf of new pipeline. Install 11,900 lf of 8" pipeline, 4,200 lf of 10" pipeline, and 400 lf of 12" pipeline.	1/4	Appendix C	7,645,000	9,940,000	12,423,000
EX-P-5		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 5 (not previously in Ten Year CIP Workplan) with 16,900 lf of new pipeline. Install 16,100 lf of 8" pipeline and 800 lf of 10" pipeline.	1/4, 2	Appendix C	7,355,000	9,560,000	11,952,000
EX-P-6		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 6 (formerly Priority Area 5) with 18,700 lf of new pipeline. Install 17,000 lf of 8" pipeline, 500 lf of 10" pipeline, 1,200 lf of 12" pipeline.	1/4	Appendix C	8,360,000	10,870,000	13,585,000
EX-P-7		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 7 (formerly Priority Area 7) with 20,000 lf of new pipeline. Install 16,400 lf of 8" pipeline, 2,000 lf of 10" pipeline, 1,600 lf of 12" pipeline. Includes installation of new pipeline connections required for re-zoning project EX-MISC-1.	1/4, 2	Appendix C	9,172,000	11,920,000	14,905,000
EX-P-8		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 8 (formerly Priority Area 6) with 25,300 lf of new pipeline. Install 18,000 lf of 8" pipeline, 3,900 lf of 10" pipeline, 3,400 lf of 12" pipeline. Includes installation of new pipeline connections required for re-zoning project EX-MISC-1.	1/4	Appendix C	12,056,000	15,670,000	19,591,000
EX-P-9		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 9 (formerly Priority Area 4) with 18,800 lf of new pipeline. Install 14,500 lf of 8" pipeline, 3,200 lf of 10" pipeline, 1,100 lf of 12" pipeline.	1/4	Appendix C	8,678,000	11,280,000	14,102,000
EX-P-10		Replace / Upsize Pipeline	Fire Flow / Failure Risk	Replacement and upsize of Revised Priority Area 10 (formerly Priority Area 8) with 26,100 lf of pipeline. Install 19,100 lf of 8" pipeline, 6,000 lf of 10" pipeline, 1,000 lf of 12" pipeline.	1/4, 2	Appendix C	12,103,000	15,730,000	19,667,000
EX-P-11		Replace / Upsize Pipeline	Failure Risk	Replace 6,300 lf of existing pipeline in the Shelter Creek area. Install 3,200 lf of 8" pipeline, 1,200 lf of 10" pipeline, 1,900 lf of 12" pipeline. Pipeline replacements should be composed of corrosion resistant material and/or fitted with appropriate cathodic protection.	2	Appendix C	3,259,000	4,240,000	5,296,000
EX-P-12		New Pipeline	Fire Flow / Failure Risk	Abandon existing 10" Zone 10 transmission main in Highway 35 and connect inactive 12" pipeline in Earl Avenue and Glenview Drive to Zone 10.	10	City Staff	-	-	500,000
EX-P-13		Replace / Upsize Pipeline	Fire Flow / Low Pressures	PS 4 suction-side pipeline improvements. Replace and upsize 3,700 lf of pipeline in Sneath Lane, Riverside Drive, Moreland Drive, and Longview Drive to 10" diameter.	10	Appendix C	1,998,000	2,600,000	3,247,000
EX-P-14		Replace / Upsize Pipeline	Fire Flow	Replace and upsize 47,600 lf of pipeline to improve available fire flow. Includes all improvements required to meet fire flow requirements not included in projects EX-P-1 through EX-P-13. Install approximately 29,300 lf of 8" pipeline, 8,900 lf of 10" pipeline, 7,100 lf of 12" pipeline, 2,300 lf of 14" pipeline.	Multiple	Appendix C	23,768,000	30,900,000	38,623,000
EX-P-15		Replace / Upsize Pipeline	Failure Risk	Replace and upsize 28,500 lf of pipeline at high risk of failure. Includes all high risk pipelines not included in projects EX-P-1 through EX-P-14. Install approximately 21,500 lf of 8" pipeline, 3,700 lf of 10" pipeline, 200 lf of 12" pipeline, 2,900 lf of 14" pipeline, and 200 lf of 18" pipeline.	Multiple	Appendix C	13,771,000	17,900,000	22,378,000
						Total Pipeline CIP:	**-**	**-**	**204,575,000**
Well, Storage, and Pumping Facility Improvements									
EX-W-1	84709	New Well	Capacity / Reliability	Acappella Well Project. Construction of new Well 21 in Zone 3 at the Acappella Site. Estimated well capacity is 550 gpm. Includes the abandonment of the existing Well 15.	3	West Yost[c]	6,019,000	7,820,000	9,781,000
EX-W-2		Install Generator	Reliability	Installation of emergency generators at Well 16 and Well 18.	1/4	Appendix C	580,000	750,000	943,000

Table 9-1. Capital Improvement Program Costs[(a)]

WSMP CIP Identifier	City Project ID	Improvement Type	Reason for Improvement	Improvement Description	Zone	Cost Estimate Source	Base Construction Cost, dollars	Construction Cost, dollars [(b)]	Total Capital Cost, dollars (includes mark-ups)[(b)]
EX-T-1	11024	New Tank and Pump Station	Storage Capacity	New 1.8 MG storage tank and associated pump station with 4.3 mgd firm capacity in Zone 3. 1.0 MG storage capacity allocated to existing customers; 0.8 MG storage capacity allocated to future customers.	3	Bayhill Specific Plan Implementation Section	-	-	20,000,000
EX-T-2	85100	Replace Tank	Capacity / Failure Risk	Replacement of Tank 1 (Cunningham Tank) with new 3.5 MG concrete tank. 2.5 MG allocated to existing customers, 1.0 MG allocated to future customers.	1/4	City FY2022-2026 CIP[(d)]	-	-	10,122,000
EX-T-3	11022	Replace Tank and Pipeline	Failure Risk	Replacement of Tank 7 (Sweeney Ridge Tank) with new 0.4 MG concrete tank. Replacement of 14" inlet/outlet pipeline	12	City FY2022-2026 CIP	-	-	9,594,000
EX-T-4	11023	Replace Tank	Failure Risk	Replacement of Tank 4 (San Bruno Avenue Tank, aka Princeton Tank)	2	Appendix C	3,333,000	4,330,000	5,416,000
EX-T-5		Replace Tank	Failure Risk	Replacement of other tanks as they reach end of useful life. Budgeting includes replacement of two tanks (T9, and T10) within Master Plan timeframe	Multiple	Appendix C	6,665,000	8,660,000	10,831,000
EX-T-6		Rehabilitate Tank	Asset Maintenance	Tank Re-coating program to re-coat the interior and exterior of above-grade steel tanks. Budgeting includes re-coating of two tanks within Master Plan timeframe.	Multiple	2012 WSMP, scaled to Jan. 2021 dollars	-	-	1,027,000
EX-PS-1	11004	Replace Pump Station	Asset Maintenance	Replacement of PS1 (Sneath Lane PS) with new re-designed pump station.	10	City FY2022-2026 CIP	-	-	3,605,000
EX-PS-2	11003	Replace Pump Station	Asset Maintenance	Replacement of PS2 (Lake Drive PS) with new re-designed pump station.	12	City FY2022-2026 CIP	-	-	3,305,000
EX-PS-3	11012	Install Generator	Reliability	Installation of emergency generator at PS3 (Whitman PS).	6	City FY2022-2026 CIP	-	-	810,000
EX-PS-4	11021	Install Generator	Reliability	Installation of emergency generator at PS7 (San Bruno PS, aka Princeton PS).	6	City FY2022-2026 CIP	-	-	610,000
EX-PS-5		Rehabilitate Pump Stations	Asset Maintenance	Other Pump Station Improvements. This project encompasses other recommended pump station improvements not included in the other listed projects. Includes rehabilitation or replacement of PS3 and PS6 booster pumps, installation of flow monitoring instrumentation at PS3, PS6, PS7, and PS8, replacement of MCC's at PS3 and PS6, installation of flexible couplings at PS3, and a detailed performance evaluation of the pumps at PS5.	Multiple	West Yost[(e)]	-	-	7,500,000
EX-PS-6		New Pump Station	Reliability	New 3.7 mgd pump station and hydropneumatic tank to supply the NCCWD-supplied area (Zone 13) directly from the City's system.	13	Appendix C	2,078,000	2,700,000	3,377,000
						Total Well, Storage, and Pumping Facility CIP:	**-**		**86,921,000**
Pressure Regulating Station Improvements									
EX-RS-1	11020	RS Upgrade	Fire Flow	Upgrade existing RS13 with 6-inch and 2-inch valves for fire flow into Zone 7A.	7A	Appendix C	400,000	520,000	650,000
EX-RS-2		RS Upgrade	Fire Flow	Rebuild and reactivate RS11 with 6-inch and 2-inch valves for fire flow service from Zone 7 to Zone 6.	6	Appendix C	400,000	520,000	650,000
EX-RS-3		RS Upgrade	Fire Flow	Upgrade existing RS17 with 6-inch and 2-inch valves for fire flow into Zone 6A.	6A	Appendix C	400,000	520,000	650,000
EX-RS-4		New RS	Fire Flow	Install new RS with 8-inch and 4-inch valves at Susan Drive and Sharp Park Road to provide fire flow service from Zone 11 to Zone 10, and install 540 feet of new 8- inch diameter pipeline from Zone 11 to Zone 10.	10	Appendix C	632,000	820,000	1,027,000
EX-RS-5		New RS	Fire Flow	Install new RS with 8-inch and 4-inch valves at Oakmont Drive and Muirfield Circle to provide fire flow service from Zone 10 to Zone 9, and install 1,680 feet of new 8- inch diameter pipeline between Zone 9 and Zone 10.	9	Appendix C	1,122,000	1,460,000	1,823,000
EX-RS-6		New RS	Fire Flow	Install new RS with 8-inch and 4-inch valves at Oakmont Drive and Evergreen Drive to provide fire flow service from Zone 10 to Zone 8.	8	Appendix C	400,000	520,000	650,000
EX-RS-7		New RS	Fire Flow	Install new RS with 8-inch and 4-inch valves at Piedmont Avenue and Madison Avenue to provide fire flow service from Zone 7 to Zone 6.	6	Appendix C	400,000	520,000	650,000
EX-RS-8	11016, 11017, 11018, 11019	Rehabilitate RS	Asset Maintenance	Pressure Regulator Station Improvement program to improve and rehabilitate the City's pressure regulating stations to maintain performance	Multiple	City FY2022-2026 CIP	-	-	9,400,000
						Total Pressure Regulating Station CIP:	**-**		**15,500,000**
Miscellaneous Improvements									

Table 9-1. Capital Improvement Program Costs[a]

WSMP CIP Identifier	City Project ID	Improvement Type	Reason for Improvement	Improvement Description	Zone	Cost Estimate Source	Base Construction Cost, dollars	Construction Cost, dollars [b]	Total Capital Cost, dollars (includes mark-ups)[b]
EX-MISC-1		Re-Zoning	Fire Flow	Re-zone Maple Avenue, Cherry Avenue, Chestnut Avenue, and Beech Avenue between Niles Avenue and Jenevein Avenue and Cedar Avenue between Niles Avenue and Park Avenue from Zone 1/4 to Zone 2.	1/4, 2	2012 WSMP, scaled to Jan. 2021 dollars	247,000	320,000	401,000
EX-MISC-2		Hydrant Replacement	Fire Flow	Replace hydrants at Glenview Drive and Skyline Boulevard and at Sequoia Avenue and Rollingwood Drive with new hydrants connected to Zone 10 pipelines	10	Costs included in EX-P-14 and EX-P-15	-	-	0
EX-MISC-3	84132	Meter Upgrade	Data and Instrumentation	Advanced Water Meter Infrastructure Project. City staff estimate that 700 advanced meters need to be installed on commercial services before project completion.	Multiple	City FY2022-2026 CIP	-	-	6,017,000
EX-MISC-4		Plan / Study	Seismic Risk	This project will update the City's 2003 study based on current code requirements. It would also include a more comprehensive hazard review, and update improvement recommendations based on the results.	Multiple	City FY2022-2026 CIP	-	-	128,000
EX-MISC-5		Pipeline Improvements	Seismic Risk	This project will provide seismic upgrades to water lines in the vicinity of faults. A budget placeholder is provided in this master plan. Costs to be developed in more detail in Seismic Vulnerability Assessment, EX-MISC-4.	Multiple	2012 WSMP, scaled to Jan. 2021 dollars	-	-	2,567,000
EX-MISC-6		Physical Security Upgrades	Security Risks	Intrusion Alarm Detection System. Add monitored intrusion alarms at water system facilities. The system will alert City staff if there is an unauthorized entry and that security has been breached.	Multiple	City RRA	-	-	50,000
EX-MISC-7		Physical Security Upgrades	Security Risks	Develop and Implement Facility Physical Security Improvement Program. This program will identify sufficient physical security improvements that will detect, deter, or delay a potential malicious adversary. Implement projects identified in the improvement program.	Multiple	City RRA	-	-	260,000
EX-MISC-8		Physical Security Upgrades	Security Risks	Security Camera Installation. Add security cameras to sites as well as motion sensor lights to deter intruders.	Multiple	City RRA	-	-	290,000
EX-MISC-9		Plan / Study	Security Risks	SCADA Master Plan and Cybersecurity Improvements Plan. These plans would include a baseline assessment of the City's existing SCADA and Business Enterprise system. Based on the outcome of this assessment, alternatives would be analyzed and recommendations for improvements would be developed. Implementation of these plans and subsequent improvements would ensure that the City's SCADA system is well maintained and increase resiliency against cybersecurity threats to the water system.	Multiple	City RRA	-	-	800,000
EX-MISC-10		Plan / Study	Emergency Preparedness	Emergency Provisional Water Supply Plan. Prepare a plan that addresses the need to provide customers with provisional water in case of a complete water system outage. Perform annual exercising of emergency water distribution capabilities with staff and utility partners.	Multiple	City RRA	-	-	30,000
EX-MISC-11		POD Trailer	Emergency Preparedness	Water Distribution Trailer/Provisional Water. Purchase an emergency point of distribution (POD) trailer for deployment as needed to provide a supplemental drinking water supply during emergency events.	Multiple	City RRA	-	-	40,000
EX-MISC-12		SCADA and Valve Improvements	Seismic Risk	Subscribe and Integrate ShakeAlert System. Subscribe to ShakeAlert. Install automatic valves to prevent leakage of safe drinking water from assets. Integrate ShakeAlert with process controls to prevent earthquake damage to rotating equipment.	Multiple	City RRA	-	-	65,000
EX-MISC-13		Plan / Study	Emergency Preparedness	Business Continuity Plan/Continuity of Operations Plan. Develop a plan to ensure financial and operational continuity during and following an emergency.	Multiple	City RRA	-	-	50,000
						Total Miscellaneous CIP:	**-**		**10,698,000**
						Capital Improvement Program Total:	**-**		**317,694,000**

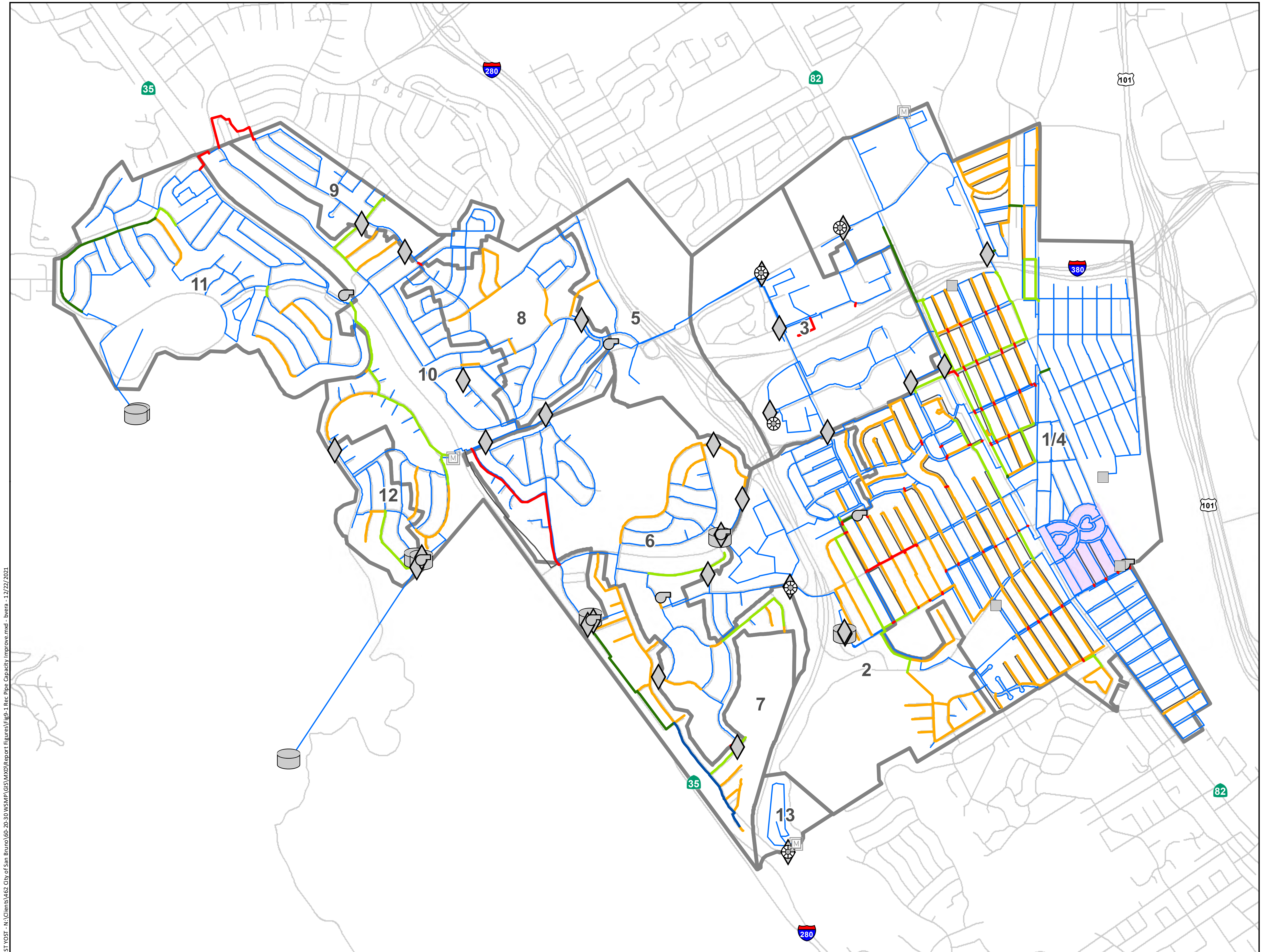
(a) Costs shown are based on the January 2021 San Francisco ENR CCI of 13,098. All costs rounded to nearest $1000.

(b) Construction costs include base construction cost and 30 percent construction contingency. Capital costs include markups of 25 percent of construction cost plus construction contingency.

(c) Cost estimated based on bids from similar well construction and abandonment projects in the San Francisco Bay Area.

(d) It is expected that SFPUC will pay for a portion of the Cunningham Tank replacement project. However, because SFPUC's share has yet to be determined, the entire project cost is included in the City's CIP to be conservative.

(e) Assumes annual budget of $500,000 for pump station improvements.



0 850 1,700
Scale in Feet

- Proposed 8-inch Upsize
- Proposed 10-inch Upsize
- Proposed 12-inch Upsize
- Proposed 14-inch Upsize
- Proposed New Pipeline
- Proposed Abandoned Pipeline
- Existing Pipeline
- Turnout
- Existing Active Well
- Ex. Pressure Reg. Sta. (RS)
- Ex. Booster Pump Station (PS)
- Existing Storage Tank
- Emergency Connection
- Avenues 1-3
- Pressure Zone Boundary

Notes:
1. Avenues 1-3 pipeline replacement project will be completed in 2021 and will resolve local fire flow deficiencies.
2. Capacity improvement projects are integrated into the pipeline capacity improvement projects shown on Figure 9-2.

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Figure 9-1

Recommended Pipeline Capacity Improvements

City of San Bruno
Water System Master Plan

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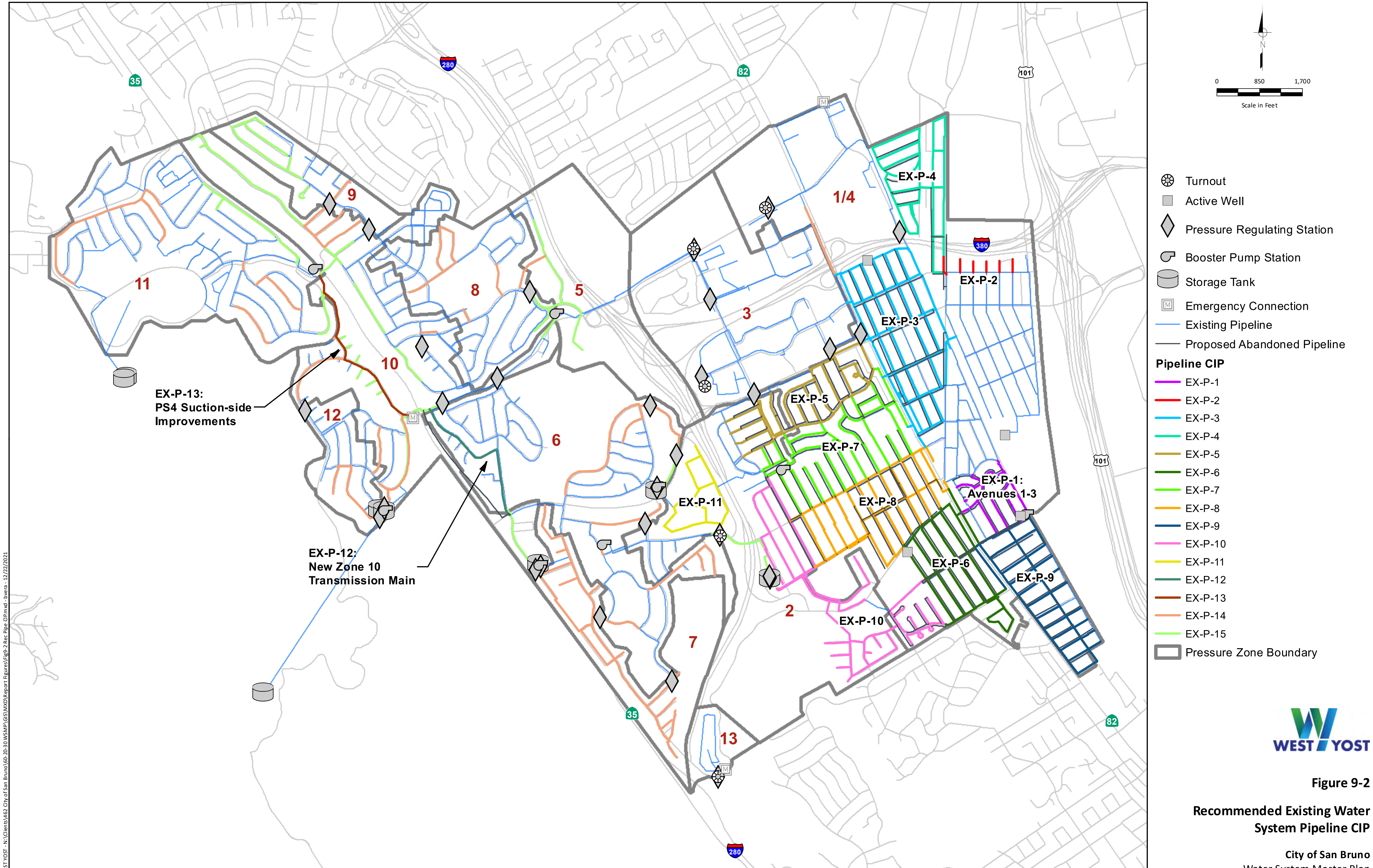


Figure 9-2

Recommended Existing Water System Pipeline CIP

City of San Bruno
Water System Master Plan

Figure 9-3 summarizes Well, Storage and Pumping improvements. These improvements include capacity projects to increase well capacity and storage capacity, projects to increase system reliability and replacement of aging facilities.

Figure 9-4 summarizes pressure regulating station improvements. These improvements include projects to upgrade existing pressure regulating stations to improve fire flow supply capacity to zones, and rehabilitation of existing stations to maintain performance.

Figure 9-5 summarizes miscellaneous improvements. These include projects to improve fire flow, meter upgrades, studies and projects to increase the system's seismic resiliency, and projects recommended in the City's Risk and Resilience Assessment, as required by the America's Water Infrastructure Act.

As noted previously, with the implementation of improvements identified in the existing system evaluation, no additional improvements are required to meet future system demands. However, 1.0 MG of the storage capacity for the new 3.5 MG Tank 1 replacement project is allocated to provide storage for future development. Similarly, approximately 0.8 MG of the storage capacity for the recommended 1.8 MG Zone 3 tank is to accommodate future demands.

9.2 CAPITAL IMPROVEMENT PROGRAM IMPLEMENTATION

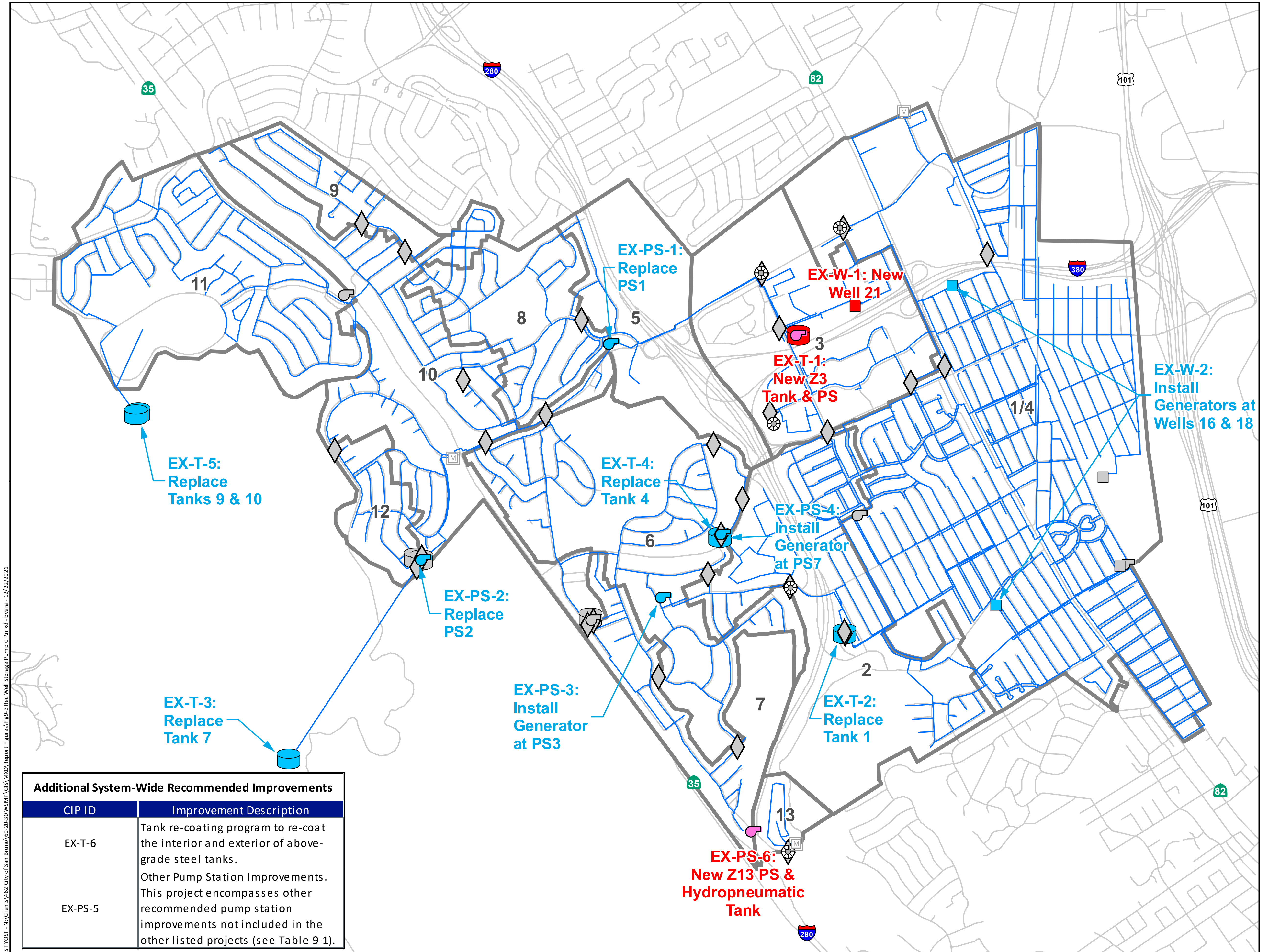
Table 9-2 presents a recommended implementation schedule for capital improvements, showing capital funds already appropriated as of FY 2022, and expenditures in three timeframes – FY 2023 through FY 2027, FY 2028 through FY 2032, and Long-Term.

West Yost and the City reviewed the capital improvement program and developed the prioritized list of projects and implementation timeframe based on the results from the distribution system analysis and the City's identified needs. Projects are placed on the schedule based on their priority, to address most critical needs first.

Projects to be implemented in the FY 2023 through FY 2027 timeframe include a mix of projects totaling $49M that address pipeline capacity and replacement needs ($15.5M), well, storage and pumping facility improvements ($31.1M), pressure regulating station improvements ($1.0M) and miscellaneous improvements ($1.4M). This combination of projects will address the City's most significant deficiencies and its highest priority needs.

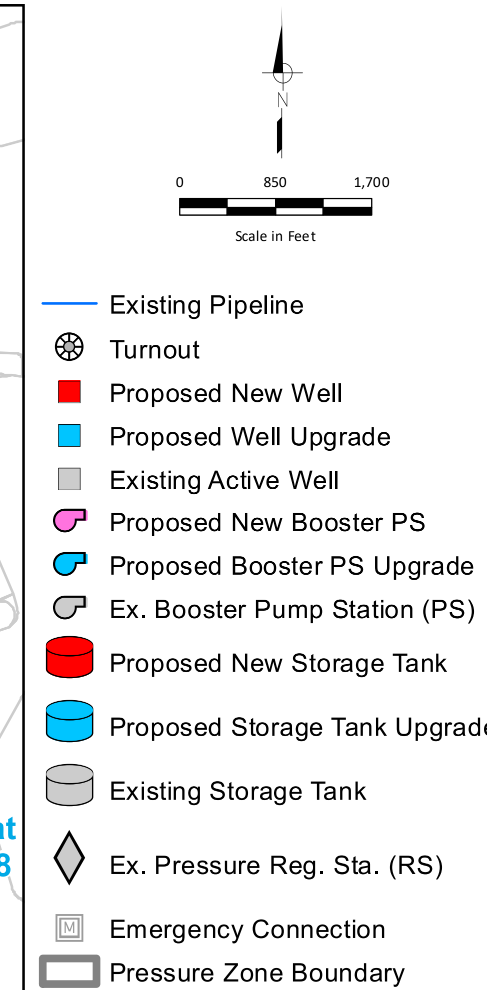
Projects to be implemented in the FY 2028 through FY 2032 timeframe include additional projects totaling $40M and include pipeline capacity and replacement needs ($27.6M), well, storage and pumping facility improvements ($8.9M), pressure regulating station improvements ($2.5M) and miscellaneous improvements ($0.7M).

Longer-term projects total approximately $203M and focus primarily on rehabilitation and replacement needs with $151.8M for pipelines and $38.2M for well, storage and pumping facilities and facility replacement needs. Pressure regulating station capacity needs ($10.5M) and miscellaneous improvements for seismic reliability ($2.6M) are also included in this timeframe. These are projects that are considered lower-priority and can be implemented as City funds are available. Timing for these projects will need to be re-assessed in future master plan updates.



Additional System-Wide Recommended Improvements

CIP ID	Improvement Description
EX-T-6	Tank re-coating program to re-coat the interior and exterior of above-grade steel tanks.
EX-PS-5	Other Pump Station Improvements. This project encompasses other recommended pump station improvements not included in the other listed projects (see Table 9-1).

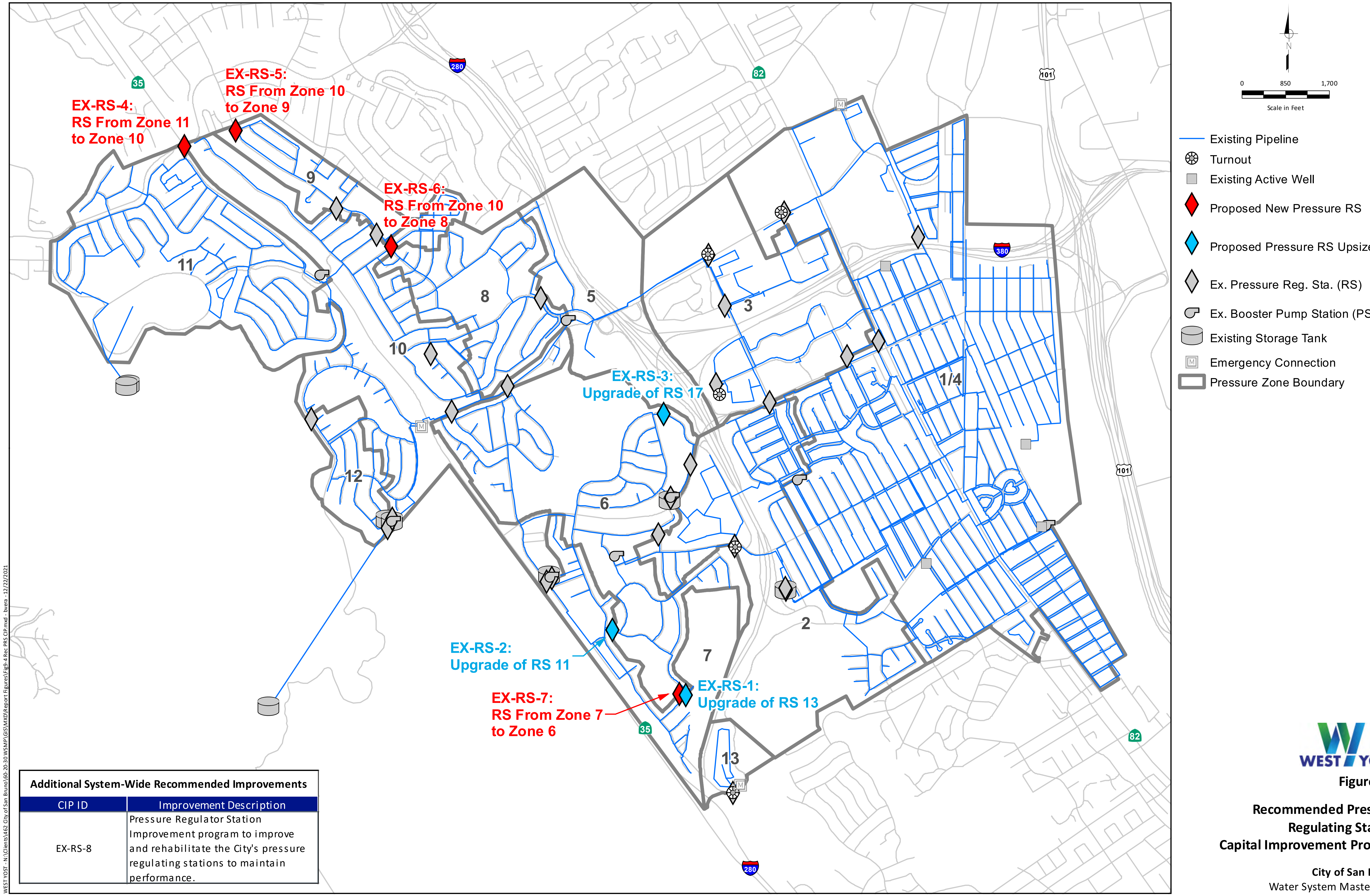


WEST YOST

Figure 9-3

Recommended Well, Storage and Pumping Capital Improvement Projects

City of San Bruno
Water System Master Plan



Additional System-Wide Recommended Improvements

CIP ID	Improvement Description
EX-RS-8	Pressure Regulator Station Improvement program to improve and rehabilitate the City's pressure regulating stations to maintain performance.

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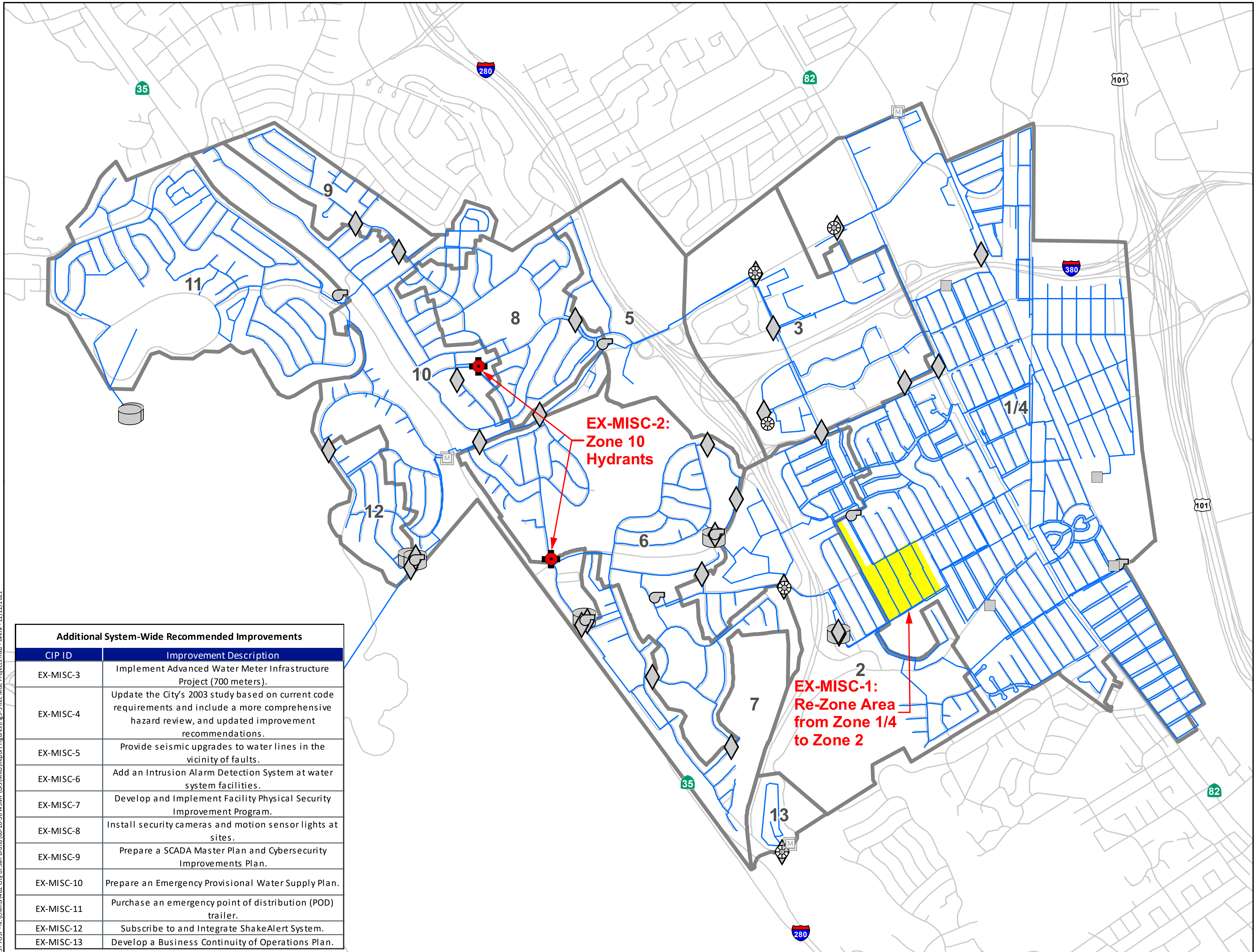
Figure 9-4

Recommended Pressure Regulating Station Capital Improvement Projects

City of San Bruno
Water System Master Plan



Additional System-Wide Recommended Improvements

CIP ID	Improvement Description
EX-MISC-3	Implement Advanced Water Meter Infrastructure Project (700 meters).
EX-MISC-4	Update the City's 2003 study based on current code requirements and include a more comprehensive hazard review, and updated improvement recommendations.
EX-MISC-5	Provide seismic upgrades to water lines in the vicinity of faults.
EX-MISC-6	Add an Intrusion Alarm Detection System at water system facilities.
EX-MISC-7	Develop and Implement Facility Physical Security Improvement Program.
EX-MISC-8	Install security cameras and motion sensor lights at sites.
EX-MISC-9	Prepare a SCADA Master Plan and Cybersecurity Improvements Plan.
EX-MISC-10	Prepare an Emergency Provisional Water Supply Plan.
EX-MISC-11	Purchase an emergency point of distribution (POD) trailer.
EX-MISC-12	Subscribe to and Integrate ShakeAlert System.
EX-MISC-13	Develop a Business Continuity of Operations Plan.

Existing Pipeline
Turnout
Existing Active Well
Ex. Pressure Reg. Sta. (RS)
Ex. Booster Pump Station (PS)
Existing Storage Tank
Proposed Fire Hydrant
Emergency Connection
Proposed Area for Re-zoning
Pressure Zone Boundary

WEST YOST

Figure 9-5

Recommended Miscellaneous Projects

City of San Bruno
Water System Master Plan

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Table 9-2. Recommended Capital Improvement Program Schedule[a,b]

WSMP CIP Identifier	City Project ID	Total Capital Cost, dollars	Funds Appropriated as of FY 2022	Remaining Capital Cost (= Total Capital Cost - Funds Appropriated)	Remaining Capital Cost, FY 2023 - FY 2027	Remaining Capital Cost, FY 2028 - FY 2032	Remaining Capital Cost, Long-Term
Pipeline Improvements							
EX-P-1	11007	$ 4,020,000	$ 4,020,000	$ -	$ -		
EX-P-2	11008	$ 1,190,000	$ 430,000	$ 760,000	$ 760,000		
EX-P-3	11009, 11010, 11011	$ 23,096,000	$ 5,200,000	$ 17,896,000	$ 8,948,000	$ 8,948,000	
EX-P-4		$ 12,423,000		$ 12,423,000		$ 12,423,000	
EX-P-5		$ 11,952,000		$ 11,952,000		$ 2,988,000	$ 8,964,000
EX-P-6		$ 13,585,000		$ 13,585,000			$ 13,585,000
EX-P-7		$ 14,905,000		$ 14,905,000			$ 14,905,000
EX-P-8		$ 19,591,000		$ 19,591,000			$ 19,591,000
EX-P-9		$ 14,102,000		$ 14,102,000			$ 14,102,000
EX-P-10		$ 19,667,000		$ 19,667,000			$ 19,667,000
EX-P-11		$ 5,296,000		$ 5,296,000	$ 5,296,000		
EX-P-12		$ 500,000		$ 500,000	$ 500,000		
EX-P-13		$ 3,247,000		$ 3,247,000		$ 3,247,000	
EX-P-14		$ 38,623,000		$ 38,623,000			$ 38,623,000
EX-P-15		$ 22,378,000		$ 22,378,000			$ 22,378,000
	Total Pipeline CIP:	**$ 204,575,000**	**$ 9,650,000**	**$ 194,925,000**	**$ 15,504,000**	**$ 27,606,000**	**$ 151,815,000**
Well, Storage, and Pumping Facility Improvements							
EX-W-1	84709	$ 9,781,000	$ 2,348,000	$ 7,433,000	$ 7,433,000		
EX-W-2		$ 943,000		$ 943,000		$ 943,000	
EX-T-1	11024	$ 20,000,000	$ 1,500,000	$ 18,500,000			$ 18,500,000
EX-T-2	85100	$ 10,122,000	$ 1,122,000	$ 9,000,000	$ 9,000,000		
EX-T-3	11022	$ 9,594,000	$ 1,094,000	$ 8,500,000	$ 8,500,000		
EX-T-4	11023	$ 5,416,000	$ 500,000	$ 4,916,000		$ 4,916,000	
EX-T-5		$ 10,831,000		$ 10,831,000			$ 10,831,000
EX-T-6		$ 1,027,000		$ 1,027,000		$ 514,000	$ 513,000
EX-PS-1	11004	$ 3,605,000	$ 355,000	$ 3,250,000	$ 3,250,000		
EX-PS-2	11003	$ 3,305,000	$ 355,000	$ 2,950,000	$ 2,950,000		
EX-PS-3	11012	$ 810,000	$ 810,000	$ -	$ -		
EX-PS-4	11021	$ 610,000	$ 610,000	$ -	$ -		
EX-PS-5		$ 7,500,000		$ 7,500,000		$ 2,500,000	$ 5,000,000
EX-PS-6		$ 3,377,000		$ 3,377,000			$ 3,377,000
	Subtotal:	**$ 86,921,000**	**$ 8,694,000**	**$ 78,227,000**	**$ 31,133,000**	**$ 8,873,000**	**$ 38,221,000**
Pressure Regulating Station Improvements							
EX-RS-1	11020	$ 650,000	$ 100,000	$ 550,000	$ 550,000		
EX-RS-2		$ 650,000		$ 650,000			$ 650,000
EX-RS-3		$ 650,000		$ 650,000			$ 650,000
EX-RS-4		$ 1,027,000		$ 1,027,000			$ 1,027,000
EX-RS-5		$ 1,823,000		$ 1,823,000			$ 1,823,000
EX-RS-6		$ 650,000		$ 650,000			$ 650,000
EX-RS-7		$ 650,000		$ 650,000			$ 650,000
EX-RS-8 [c]	11016, 11017, 11018, 11019	$ 9,400,000	$ 1,500,000	$ 7,900,000	$ 400,000	$ 2,500,000	$ 5,000,000
	Subtotal:	**$ 15,500,000**	**$ 1,600,000**	**$ 13,900,000**	**$ 950,000**	**$ 2,500,000**	**$ 10,450,000**
Miscellaneous Improvements							
EX-MISC-1		$ 401,000		$ 401,000		$ 401,000	
EX-MISC-2		$ -		$ -			$ -
EX-MISC-3	84132	$ 6,017,000	$ 6,017,000	$ -	$ -		
EX-MISC-4		$ 128,000		$ 128,000		$ 128,000	
EX-MISC-5		$ 2,567,000		$ 2,567,000			$ 2,567,000
EX-MISC-6		$ 50,000		$ 50,000	$ 50,000		
EX-MISC-7		$ 260,000		$ 260,000	$ 260,000		
EX-MISC-8		$ 290,000		$ 290,000	$ 290,000		
EX-MISC-9		$ 800,000		$ 800,000	$ 800,000		
EX-MISC-10		$ 30,000		$ 30,000		$ 30,000	
EX-MISC-11		$ 40,000		$ 40,000			$ 40,000
EX-MISC-12		$ 65,000		$ 65,000		$ 65,000	
EX-MISC-13		$ 50,000		$ 50,000		$ 50,000	
	Total Miscellaneous CIP:	**$ 10,698,000**	**$ 6,017,000**	**$ 4,681,000**	**$ 1,400,000**	**$ 674,000**	**$ 2,607,000**
Capital Improvement Program Total:		**$ 317,694,000**	**$ 25,961,000**	**$ 291,733,000**	**$ 48,987,000**	**$ 39,653,000**	**$ 203,093,000**

(a) Costs shown are based on the January 2021 San Francisco ENR CCI of 13,098.

(b) All costs rounded to nearest $1,000.

(c) Capital costs for FY 2022-2026 equal $1.9M based on the City budget in the FY 2022-2026 CIP. In subsequent years, a 30 percent allowance is added to account for any unforeseen additional costs.

9.3 RATE ANALYSIS AND FUNDING

As part of the WSMP, BWA prepared a high-level rate analysis to evaluate the impacts of implementing the capital improvement program based on the recommendations in the WSMP, and alternative levels of funding. Water enterprise financial data was provided by the City, including fund balances, historical financial results, and budget projections. This information was used to develop two rate scenarios, one based on the recommended WSMP, and an alternate funding program at 75 percent of the recommended CIP. The alternate funding scenario was selected to evaluate the impact on rates for a reduced funding scenario. This section summarizes the results of the rate analysis. Details of the evaluation are included in Appendix D.

For the rate analysis, annual cost escalation was incorporated into the capital improvement program presented in Table 9-2. Table 9-3 summarizes the recommended capital improvement program in current dollars and in escalated dollars.

Ten-Year cash flow projections were developed for two rate scenarios:

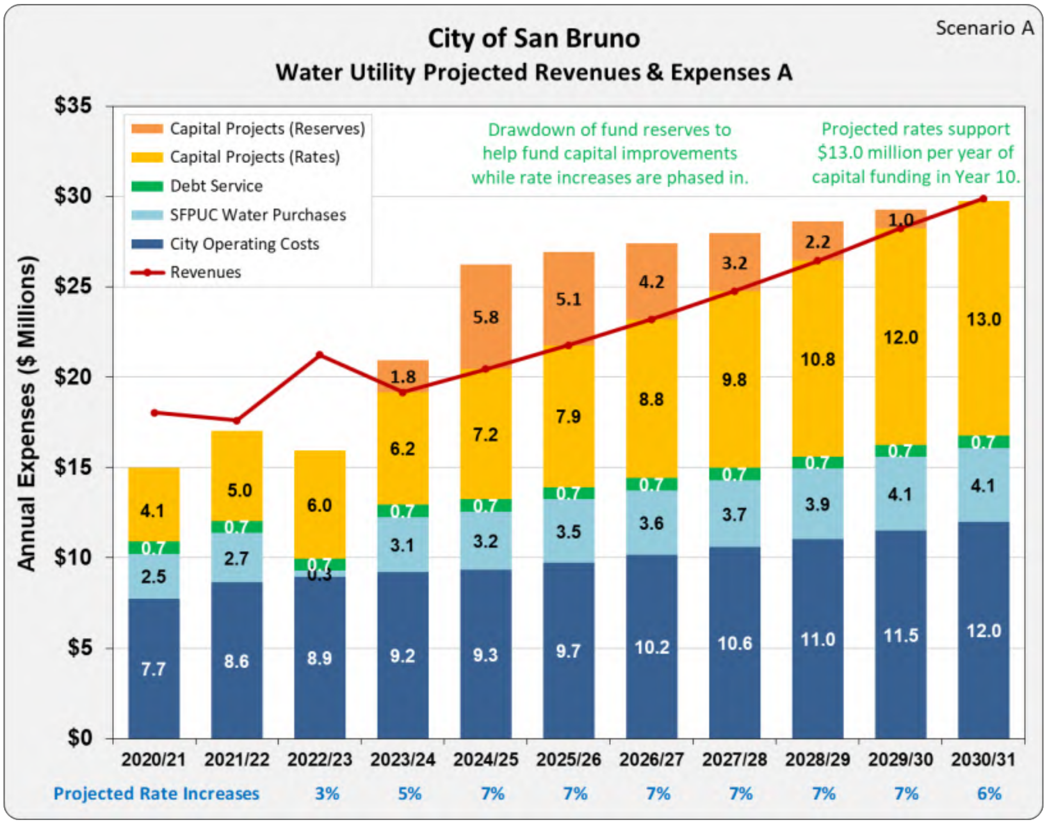
- **Alternative A** – Funding based on the recommended capital improvement program implementation schedule
- **Alternative B** – Funding based on 75 percent of the recommended capital improvement program level.

Figure 9-6 compares the results from the two alternatives. The top portion of the figure shows Alternative A and the bottom portion of the figure shows Alternative B. Each graphic shows the City's operating costs, SFPUC water purchases, debt service, funding of capital projects from rates and funding of capital projects from reserves. Alternative A shows a projected rate increase of 3 percent in FY 2022/23, increasing to 7 percent by FY 2024/25 and continuing at 7 percent through FY 2029/30 and a 6 percent increase in FY 2030/31. This alternative uses approximately $23M in fund reserves, with the remaining projects funded through rates. Alternative B shows a projected rate increase of 3 percent in FY 2022/23, increasing to 5 percent by FY 2024/25 and continuing at 5 percent through the remainder of the 10-year period. This alternative uses approximately $32M in fund reserves, with the remaining projects funded through rates, and a final reserve balance of $14.6M, $1.1M above the reserve target.

Alternative A supports $13M/year of CIP funding after an initial phase in through FY2024/45, in line with the 10-year annual average funding requirements of the Water System Master Plan, escalated to account for 3 percent annual construction cost inflation. Alternative B supports the same level of CIP funding through FY 2028/29, but ultimately supports roughly $9M/year of future annual capital funding by the end of the decade due to reduced rate increases. These projections indicate that the City can address its future funding needs by drawing down a portion of its fund reserves while phasing in a series of gradual annual water rate increases over the next decade. Under Alternative A, the City would be able to support the full funding level recommended in the Water System Master Plan. Under Alternative B, the City would still be able to support a substantial level of capital funding over the next decade. However, the reduced rate increases would ultimately support a lower level of future annual CIP funding.

Table 9-3. Recommended Capital Improvement Program, Current and Escalated Dollars

Capital Improvements	FY 2023 through FY 2027			FY 2028 - FY 2032	Long-term (FY 2033 - FY 2042)	Total
	Appropriated	Additional	Subtotal			
Water Capital Improvement Program (Current Dollars)						
Pipeline Improvements	$ 9,650,000	$ 15,504,000	$ 25,154,000	$ 27,606,000	$ 151,815,000	$ 204,575,000
Well, Storage & Pumping Facility Improvements	$ 8,694,000	$ 31,133,000	$ 39,827,000	$ 8,873,000	$ 38,221,000	$ 86,921,000
Pressure Regulating Station Improvements	$ 1,600,000	$ 950,000	$ 2,550,000	$ 2,500,000	$ 10,450,000	$ 15,500,000
Miscellaneous Improvements	$ 6,017,000	$ 1,400,000	$ 7,417,000	$ 674,000	$ 2,607,000	$ 10,698,000
Total	$ 25,961,000	$ 48,987,000	$ 74,948,000	$ 39,653,000	$ 203,093,000	$ 317,694,000
Water Capital Improvement Program (With 3% Escalation)						
Annual Cost Escalation			3%	3%	3%	
Years to Construction Mid-Point			2.5	2.5	2.5	
Cost Escalator			1.0767	1.2482	1.558	
Capital Program with Escalation			$ 80,697,000	$ 49,495,000	$ 316,419,000	$ 446,611,000
Average Annual Cost			$ 16,139,400	$ 9,899,000	$ 31,641,900	$ 22,330,550
Average First Ten Years				$ 13,019,200		



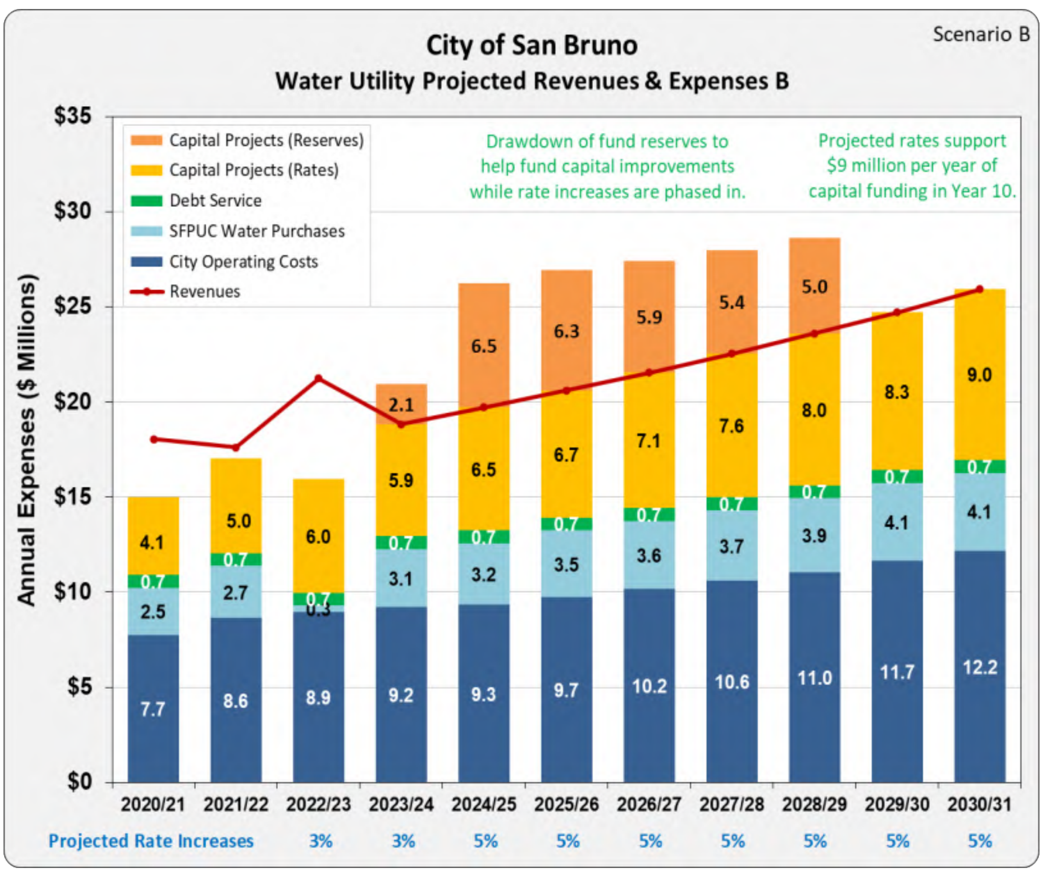


Figure 9-6. Ten-Year Cash Flow Projections for Alternatives

The rate projections presented in the Water System Master Plan are for planning purposes only. In general, BWA recommends agencies adopt smaller, gradual rate increases most years to support projected funding needs and keep rates in line with the cost of providing service. Going forward, the City can conduct a more-detailed water rate study when needed to evaluate options for future rate increases. Generally, a delay or deferral of near-term rate increases would result in the need for higher percentage rate increases in future years.

Appendix A

Site Visit Report – Steel Tank Structural Observation

Appendix 2A

Letter: Site Visit Report – Steel Tank Structural Observation San Bruno Water System Master Plan, July 24, 2020

July 24, 2020
Kleinfelder Project No. 2020.0677

Polly Boissevan
West Yost Associates
1777 Botelho Drive, Suite 240
Walnut Creek, CA 94596

Subject: **Site Visit Report**
Steel Tank Structural Condition Assessment Observation
San Bruno Water System Master Plan

Dear Ms. Boissevan:

This report summarizes Kleinfelder's structural field investigation of the three (3) steel water tanks in the City of San Bruno on June 30, 2020. The purpose of our investigation was to assess and observe the condition of the existing steel tanks. The following sections of the Report will provide detailed finding from our field investigation.

REVIEW OF EXISTING DOCUMENTS

At the time of our site visit, there was no as-built show drawings available for review for all three (3) tanks. However, we have reviewed the City's Water Master Plan dated November 2012, as prepared by West Yost Associates, for information regarding Tanks 4, 9 and 10.

FIELD INVESTIGATION AND FINDINGS

Kleinfelder conducted a site visit on June 30, 2020. We were accompanied by Mr. Jeff Wanlass from West Yost Associates along with the City of San Bruno Water Division staffs. The three tanks observed by Kleinfelder engineer were Tank 4, Tank 9 and Tank 10. The purpose of our site visit was to perform visual observation of the general structural condition, including exterior shell, foundation and anchorage system, of the tanks. No destructive or non-destructive testing was performed by Kleinfelder during the site visit. Photos and field notes of the tanks condition were taken. At the time of our visit, there was no as-built drawings for the tanks available for review. We were able to review the tank information as outline in the City's Water Master Plan (WMP) as prepared by West Yost Associates in 2012 for basic tank information.

All three tanks are currently in use. It is our understanding that, as part of the Water Master Plan, the City wishes to eventually replace these tanks with AWWA Type I prestressed concrete tanks that meets the current codes and seismic design standards.

General Information

Tank 4:

Tank 4 is a welded steel tank with a cone roof located on San Bruno Avenue. The tank was built in 1956 by Chicago Bridge and Iron Company according to the plaque on the tank (photo1). It has a 75 feet diameter with 32 feet shell height with capacity of 1.0 MG (million gallons). According to the WMP it has a maximum operational capacity of 0.84 MG. The tank foundation is uniformly backfilled and the footing is covered with a concrete walkway placed ½" to 1" from the tank wall (photo 2). However, we were unable to determine the exact thickness of the concrete walkway nor its elevation with respect to the top of the tank footing. The gap between the concrete walkway and the tank steel shell is filled with a layer of caulking material, which has deteriorated (photo 3). There is some evidence of minor rusting of the tank shell near the bottom due to water ponding in the gap between the tank and concrete walkway.

The tank shell appears to have been recoated over the years and appears to be in fair condition with no visible indication of rusting, except near the bottom as mentioned above (photo 4). The City has recently (exact year unknown) installed safety ladder system along with railing around the tank roof perimeter to allow for safe access to the tank from above. Kleinfelder engineer did not observe the tank roof.

There is no visible concrete ring footing supporting the tank. In addition, the tank does not appear to have an anchorage system.

Tank 9 & 10:

Tanks 9 & 10 also known as Skyline West and Skyline East are two steel tanks with cone dome roof located near Skyline Community College. The tanks are situated side-by-side about 20 feet apart (photo 5). Since there is no as-built drawing available, we were unable to determine the exact year the tanks were built. However, based on the observed construction of the tanks, we surmise that they might have been built sometime in the 1960s. The dimensions for both tanks are 48 feet diameters and 40 feet wall height. Each has a capacity of 0.5 MG. According to the WMP it has a maximum operational capacity of 0.46 MG. However, there may be slight discrepancy between the operational capacity of these two tanks as the overflow pipe on Tank 9 is placed at a lower elevation than that of Tank 10 (photo 6 & 7)

There is no concrete ring footing nor anchorage system visible. From our observation, it appears that both tanks were sitting directly on compacted soil (photo 8). The soil beneath the tanks were confined by a 10-inch wide concrete ring circumscribing the tank and placed approximately 10" from the tank wall (photo 9 & 10). We were unable to determine the depth of the buried concrete ring around the tanks. Visual observations indicate that the tank shell appear in fair condition with some indication of rusting around the perimeter near the top and bottom of both tanks (photo 11 & 12). Kleinfelder engineer did not observe the tank roof.

The City has recently (exact year unknown) installed safety ladder system along with railing around the tank roof perimeter to allow for safe access to the tank from above. See photo 13 for typical access ladder and railing for all tanks.

CONCLUSIONS

Based on our field observations it is our opinion that the existing tanks can remain in service in the near term with minimal risk of leakage. However, since all three tanks are not designed with ring beam footing nor any visible anchorage system, they are susceptible to damage or loss of use in area with moderate to high seismic activity. There is a high likelihood that all three tanks will fail due to overturning moments, sliding and/or shell buckling resulting from a seismic event. It is our recommendation that the City replace these tanks as soon as possible with new tanks that are designed based on current codes and seismic design standards. Furthermore, the City should address the potential ponding of water at the base of Tank 4.The gap between concrete walkway and tank shell should be cleaned of debris and rotted backer rod material. Any signs of corrosion at the bottom of the tank should be removed and recoated. The gap should be filled with backer rod material and cover with Sikaflex 2c sealant, or equal, to direct water from the base of the tank.

CLOSURE

This work was performed in a manner consistent with the level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions, and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

We trust this information meets your current needs. We appreciate the opportunity to be of professional service to you on this project. If you have any questions or require additional information, please do not hesitate to contact me at (619) 831-4597 or Eric Ng, Senior Principal Structural Engineer at (619) 831-4554.

Respectfully submitted by:
KLEINFELDER, INC.

Thuc Khuong, PE
Structural Professional

Eric Ng
Senior Principal Structural Engineer

Attachments: Appendix A – Site Visit Photos

APPENDIX A

Photo 1: Tank 4 - Year Built

Photo 2: Tank 4 - Concrete Walkway

Photo 3: Tank 4 - Deteriorated Caulking Around Tank Shell

Photo 4: Tank 4 - Minor Rusting At Base of Tank

Photo 5: Overview of Tank 9 & 10

Photo 6: Tank 10 Overflow Elevation

Photo 7: Tank 9 Overflow Elevation

Photo 8: Tanks 9 & 10 - Soil Beneath Bottom Shell of Tank

Photo 9: Tank 9 & 10 - Retaining Concrete Ring

Photo 10: Tanks 9 & 10 - Retaining Concrete Ring

Photo 11: Tank 9 - Rusting Around Perimeter of Tank

Photo 12: Tank 10 - Rusting Around Perimeter of Tank Bottom

Photo 13: Typical Access Ladder and Roof Railing

Appendix B

Hydrant Testing Plan for Hydraulic Model Calibration

WEST YOST ASSOCIATES

MEMORANDUM

DATE:	July 31, 2020	Project No.: 462-60-20-30 SENT VIA: EMAIL
TO:	Mark Reinhardt, City of San Bruno	
FROM:	Nathaniel Homan, PE, RCE C89903 Whitney Jones, EIT #169133	
REVIEWED BY:	Polly Boissevain, PE, RCE C36164	
SUBJECT:	City of San Bruno – Water System Master Plan Update Hydrant Testing Plan for Hydraulic Model Calibration	

This memorandum summarizes West Yost Associates' (West Yost) recommended program for hydrant testing, which is required to calibrate the City of San Bruno's (City) existing water system hydraulic model. The information provided in this memorandum presents the proposed hydrant test locations. The City should share this plan with the appropriate parties (e.g., Water Operations staff, Fire Department, etc.), so they are aware of the equipment being used or temporarily installed at the proposed testing locations. Hydrant testing is scheduled for the week of September 7th, 2020. The specific date the testing will be performed has yet to be determined.

HYDRANT TESTING PROGRAM

The purpose of the hydrant testing program is to confirm and "spot-check" the roughness factors (C-factors) that are assigned to pipelines in the City's hydraulic model. West Yost will use data collected though hydrant testing to verify if current pipeline C-factors assigned in the City's hydraulic model are appropriate and representative of actual field conditions. Hydrant test locations were selected based on the combination of pipeline diameter, available material/age estimates, and discussions with City Operations Staff. Results from this testing program will determine C-factor adjustments needed in the hydraulic model to better reflect field conditions.

Details related to the hydrant testing program are presented in the following sections:

- Personnel and System Data Requirements
- Hydrant Testing Schedule
- Testing Requirements and Procedure
- City's Responsibilities

Personnel and System Data Requirements

West Yost requests the following City personnel, system data, and supporting documents to accomplish the recommended hydrant testing program:

- Three (3) to five (5) City staff members (with vehicles) that will be available during regular working hours to assist with, but not limited to, the following:
  - Closing and re-opening valves, as needed before and after hydrant testing
  - Reading and recording hydrant pressure data
  - Flowing the test hydrant
  - Directing and controlling traffic, and hydrant flows, as necessary, to ensure safety during these hydrant flow tests, dechloramination, and directing the discharged water into the nearest drainage system during each test
  - Public outreach and interface, as necessary
- System information during the hydrant testing day that includes the following:
  - City SCADA data from all water distribution system facilities, in 1-minute increments during hydrant testing for the following facilities:
    - Reservoir levels (in feet) for all reservoirs, and altitude valve flowrate (gpm), if available
    - Pump Station information (pump operational status, speed settings, discharge pressures [psi], and flow rate [gpm]) for all booster pump stations
    - Groundwater well information (discharge pressure [psi], flow rate [gpm], and speed settings where/if applicable) for all wells
    - SFPUC and NCCWD turnouts (discharge pressure [psi], flow rate [gpm])
    - Distribution system pressure monitoring information at key City points, aside from the locations listed above, if available (pressure [psi])
- One copy of the City's Health and Safety Plan for testing hydrants

Hydrant Testing Schedule

West Yost requests that the hydrant testing be scheduled starting at approximately 7:30 AM on the testing day. West Yost will meet with the City staff a half hour before hydrant testing (7:00 AM) to conduct a brief field coordination meeting to review hydrant testing procedures and protocols (i.e., where to go and what to do) and to perform a safety briefing. West Yost will also use this coordination meeting to distribute pressure gauges (hydrant wrenches to be provided by City staff) necessary to complete the hydrant testing program. In addition, West Yost will also confirm with City staff what order they prefer to conduct tests (i.e., avoid school traffic or commuter traffic, etc.) and to review hydrant tests that may present minor challenges.

Testing Requirements and Procedure

West Yost plans to conduct up to eight (8) hydrant flow tests within the City's water system. Figure 1 shows the proposed hydrant test locations. In addition, two (2) alternative hydrant tests have been identified. If any of the eight (8) test locations are unable to be flowed, one of the alternative locations may be used. Table A-1, in Attachment A, lists the proposed test locations. Details regarding each of the proposed tests (e.g., flowing hydrant, observation hydrants, closed valves, etc.) are also provided in Attachment A (Figures A-1 through A-10).

Each hydrant test will involve maintaining flow from a single hydrant, while monitoring the residual pressure at three (3) to four (4) observation hydrants located near the flowing hydrant. The field observed static and residual pressure readings will then be used to confirm or adjust pipeline C-factors used to calibrate the hydraulic model to more closely reflect observed conditions. Hydrant test locations have been selected to isolate pipelines of a particular material type, diameter, and age. Tests will require City staff to close one (1) or more isolation valves prior to the test and then re-open these isolation valves following the test.

The general testing procedure at each of the hydrant test locations is outlined below and illustrated on Figure 2.

- **Step 1.** Before the test, flush the test (flowing) hydrant and each observation hydrant before attaching the pressure gauge. This allows sediments, which might damage the gauge or cause faulty readings, to be flushed out from the hydrant.
- **Step 2.** Attach the pressure gauge to the hydrant with the gauge's test cock valve **<u>open</u>**. Slowly open the hydrant and bleed off the gauge with the gauge's test cock until the hydrant is fully pressurized.
- **Step 3.** Close the gauge test cock valve, and then measure the static pressures at the designated test hydrant and each observation hydrant.
- **Step 4.** Flow the designated test hydrant and measure the discharge flow and pressure.
- **Step 5.** Measure the residual pressures at the designated test hydrant and at each observation hydrant while the test hydrant is flowing.
- **Step 6.** Continue monitoring pressure until the "all clear" is given by a West Yost employee. After the test hydrant is no longer flowing, record the static pressure, close the observation hydrants and then detach the pressure gauge. ***IMPORTANT:*** *Before closing the hydrant, be sure the gauge's test cock valve is open and bleeding while the hydrant is being closed.*

At least one (1) City staff member will be required at the flowing test hydrant and up to three (3) additional City personnel will be required in the field to measure static and residual pressures at the adjacent observation hydrants (refer to Attachment A). West Yost will provide at least three (3) staff members to direct, oversee, and assist in the field data collection work effort.

It is anticipated that each hydrant test will take no more than one (1) half hour and that each hydrant will be flowing for no more than 10 minutes during a test.

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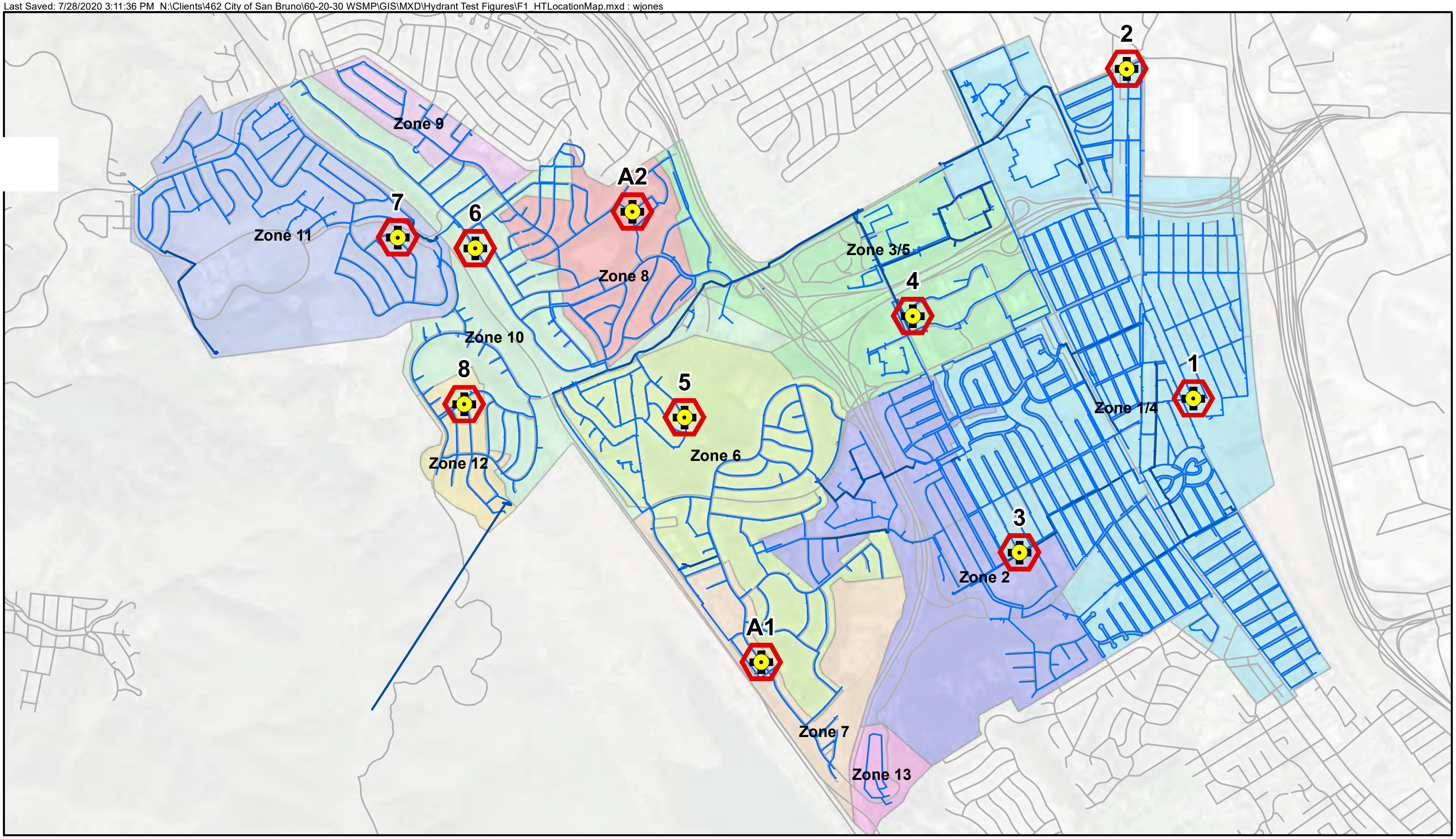

Hydrant Test Location

Pipeline (diameter less than 12 inches)

Pipeline (diameter 12 inches or greater)

N

0 1,250 2,500

Scale in Feet

City of San Bruno

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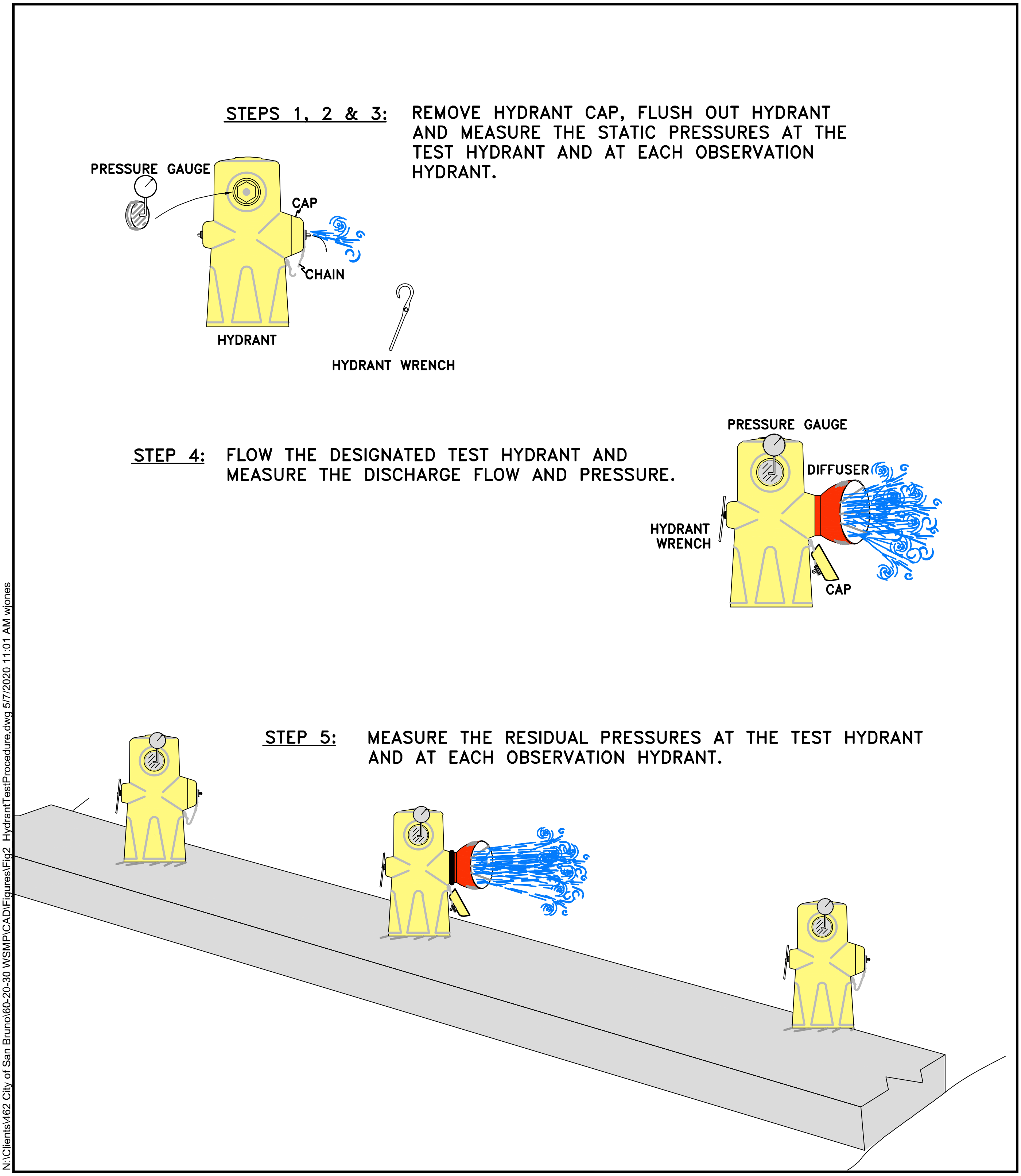
Figure 1

Hydrant Test Location Map

City of San Bruno
Water System Master Plan



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Note:
1. Figure is not to scale.

Figure 2

Hydrant Test Procedure

City of San Bruno
Water Master Plan Update

WEST YOST ASSOCIATES

Testing Equipment

West Yost will provide 2.5-inch and 4.5-inch diameter Swivel Piezo Diffusers and pressure gauges during the hydrant testing program. It is our recommendation that the 4.5-inch diameter Swivel Piezo Diffusers be used for all proposed hydrant tests. For any hydrant test where it is not possible to use this type of diffuser due to drainage or traffic control issues, an alternative method will need to be further evaluated and confirmed before the day of field testing. The following equipment is typically used by West Yost during hydrant testing:

- Hydrant wrenches
- Diffusers
- Pressure Gauges
- Plumber's Tape
- Hydrant Pressure Recorder(s) with Data Transfer Unit
- Hydrant Test Memo
- Mobile device (with a data plan) and Survey123 app installed to collect field data
- Vehicles/trucks
- Equipment needed to close valves and for traffic control
- Dechlorination equipment
- Two-way portable communication for each of the testing personnel

City's Responsibilities

The City will be responsible for providing the following hydrant testing equipment:

1. Hydrant wrenches
2. Vehicles/trucks to transport City staff
3. Equipment needed to close valves and for traffic control
4. Dechlorination equipment
5. Two-way portable communication for each of the testing personnel
6. Piece of plywood for redirecting flow

The City is also responsible for notifying other City staff and departments (i.e., Fire Department) about the scheduled hydrant testing, obtaining approvals that may be required, providing proper drainage of *the hydrant flow, following proper procedures for dechlorinating[1] test water, and providing additional personnel for traffic control, if required.*

West Yost requests that the City staff review and inspect each of the proposed hydrant test locations before the testing date to identify any potential problems or hazards with the selected locations. Of particular concern will be the potential for flooding landscaping, building basements, or creating hazardous traffic conditions. West Yost recommends that all drainage inlets/manholes be inspected near the testing site to confirm proper drainage. If possible, the City should also supply a piece of plywood in an effort to protect landscaping adjacent to the flowing hydrant. Additionally, location and status of valves that will be closed during the hydrant testing should be confirmed, with the valves tested to ensure operability. Detailed figures, which illustrate the flowing hydrant, observation hydrants, and valves to be closed are provided in Attachment A.

SUMMARY OF HYDRANT TESTING AND PRESSURE MONITORING PROGRAM

Hydrant testing will be performed as described above beginning at 7:30 AM on the testing day. The location descriptions and associated detailed location maps of the designated hydrants are presented in Attachment A. The City is responsible for notifying other City staff about the hydrant testing program and coordinating with the City's Fire Department, as needed.

After the completion of the hydrant testing, West Yost will coordinate with the City to obtain the following SCADA system data:

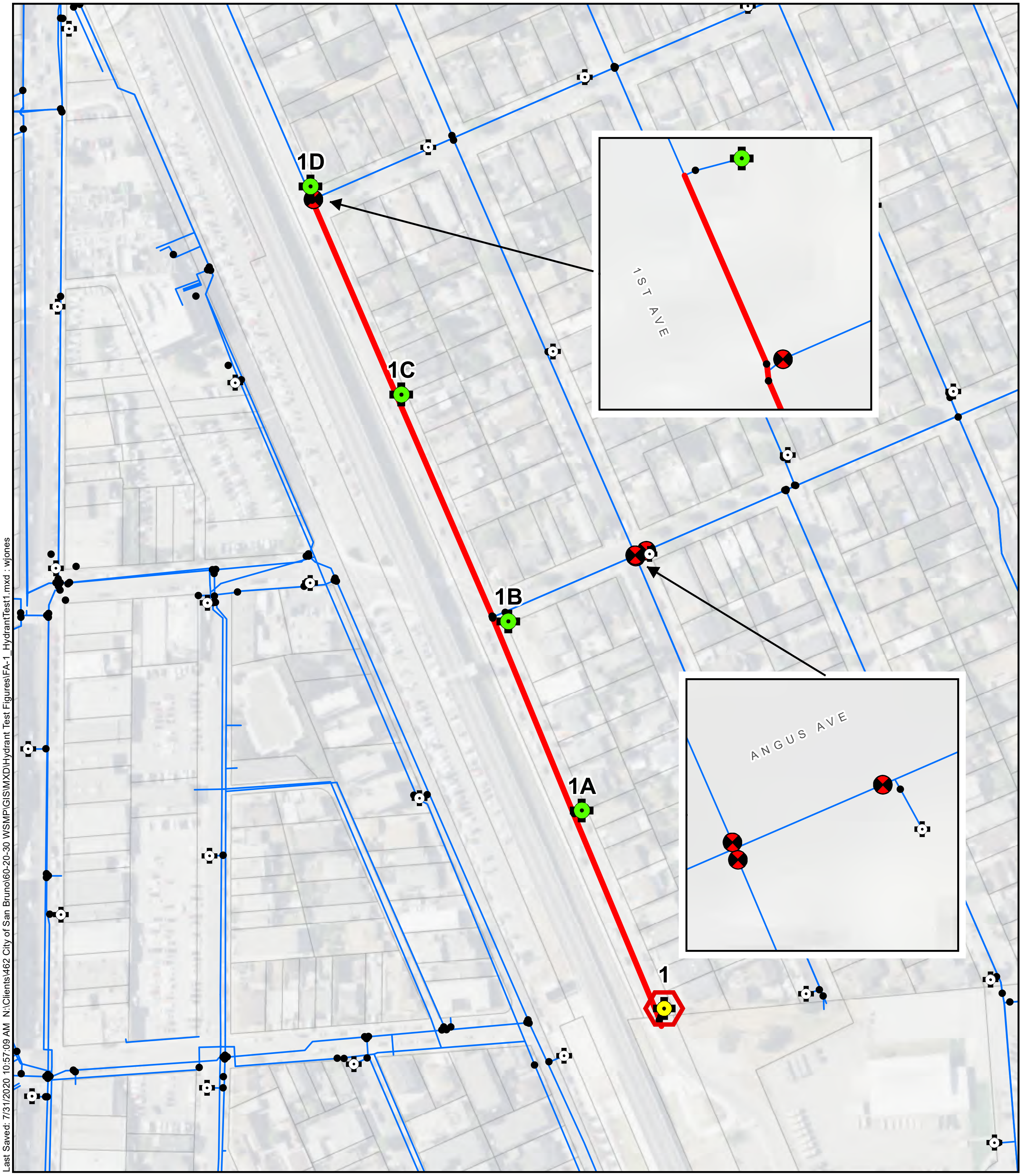
- 1-minute increments for all facilities listed in the Personnel and System Data Requirements section for the testing day.

West Yost requests a conference call with City staff approximately one week before the scheduled testing day to review and identify any potential issues that may occur during hydrant testing such as unavailable SCADA system data. An Outlook meeting request will be sent to City staff to schedule a suitable meeting date and time. In the meantime, please feel free to contact Nathaniel Homan at (818) 913-7940 if you have any questions or comments.

[1] Handling of water released from each hydrant test will need to comply with City Operations procedures and be consistent with the City's NPDES permit for planned releases from hydrant tests.

ATTACHMENT A

Hydrant Test Detail Figures



Hydrant Test Location

Test Pipeline

Pipeline

Observed Hydrant

Hydrant

Closed Valve (4 total)

Valve

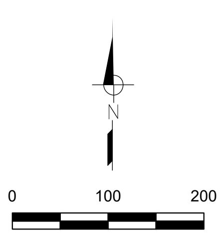


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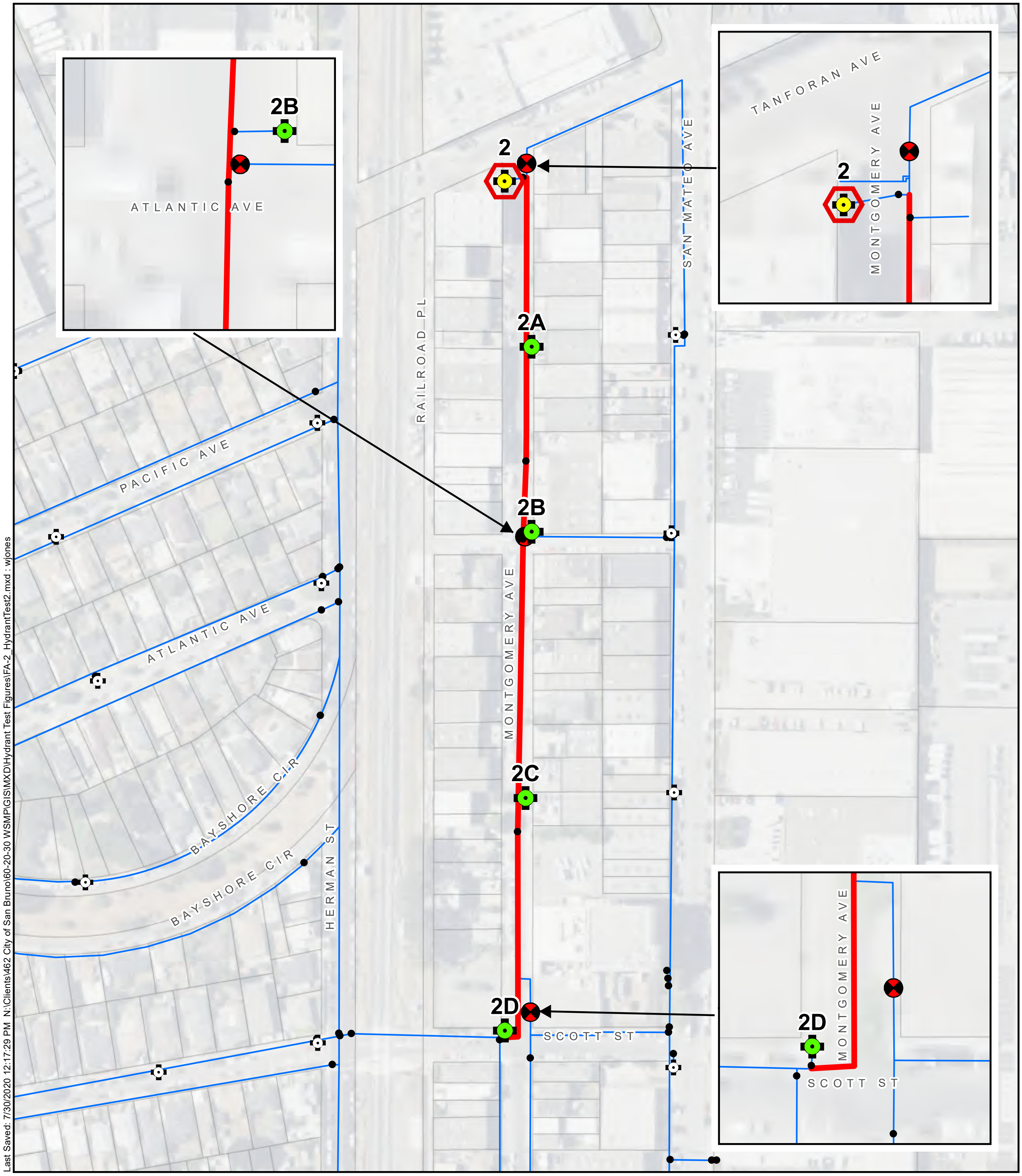
Figure A-1

Test 1
(8-inch CI - 1930s)

City of San Bruno
Water System Master Plan



Hydrant Test Location
Observed Hydrant
Hydrant
Closed Valve (3 total)
Valve
Test Pipeline
Pipeline

N

0 100 200
Scale in Feet

City of San Bruno

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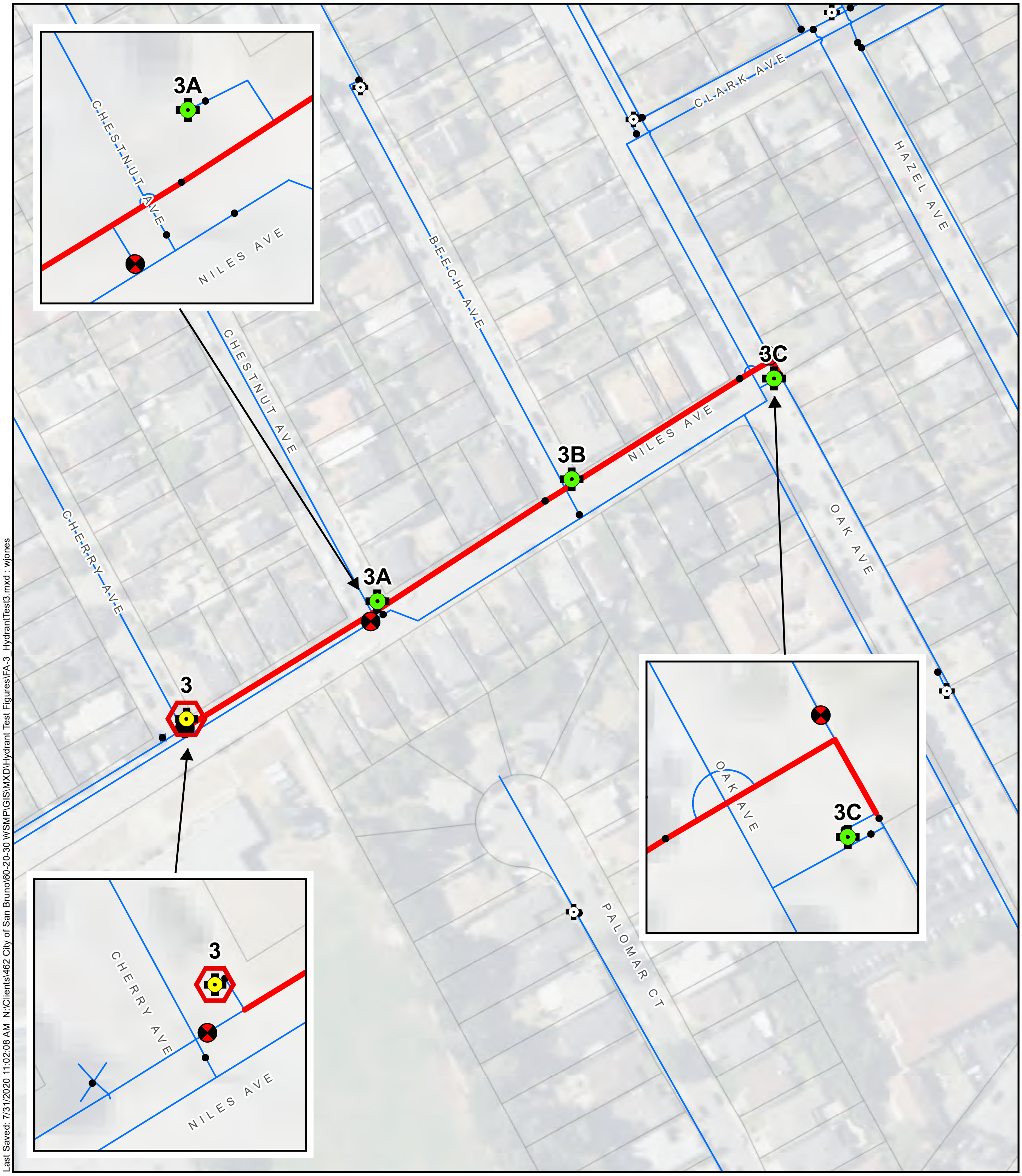
Figure A-2

Test 2
(10-inch CI - 1930s)

City of San Bruno
Water System Master Plan



Hydrant Test Location

Observed Hydrant

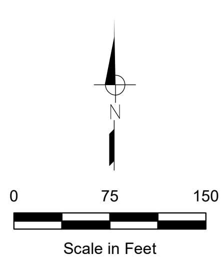
Hydrant

Closed Valve (3 total)

Valve

Test Pipeline

Pipeline



City Of SAN BRUNO

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Figure A-3

Test 3
(4-inch CI - 1930s)

City of San Bruno
Water System Master Plan

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Hydrant Test Location
Test Pipeline
Pipeline
Observed Hydrant
Hydrant
Closed Valve (1 total)
Valve

N

0 100 200
Scale in Feet

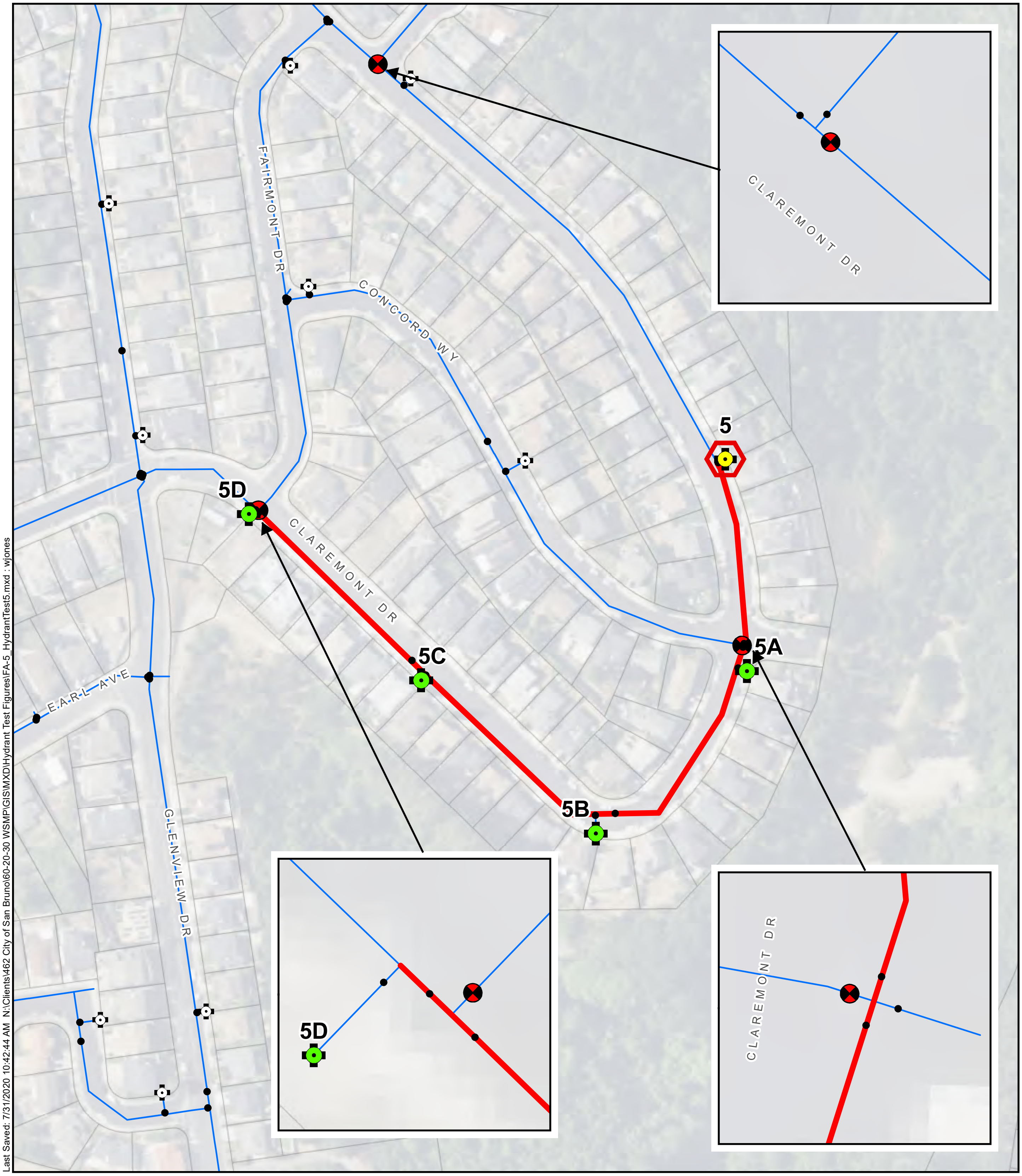
City of SAN BRUNO

WEST YOST ASSOCIATES

Figure A-4

Test 4
(8-inch CI - 1970s)

City of San Bruno
Water System Master Plan



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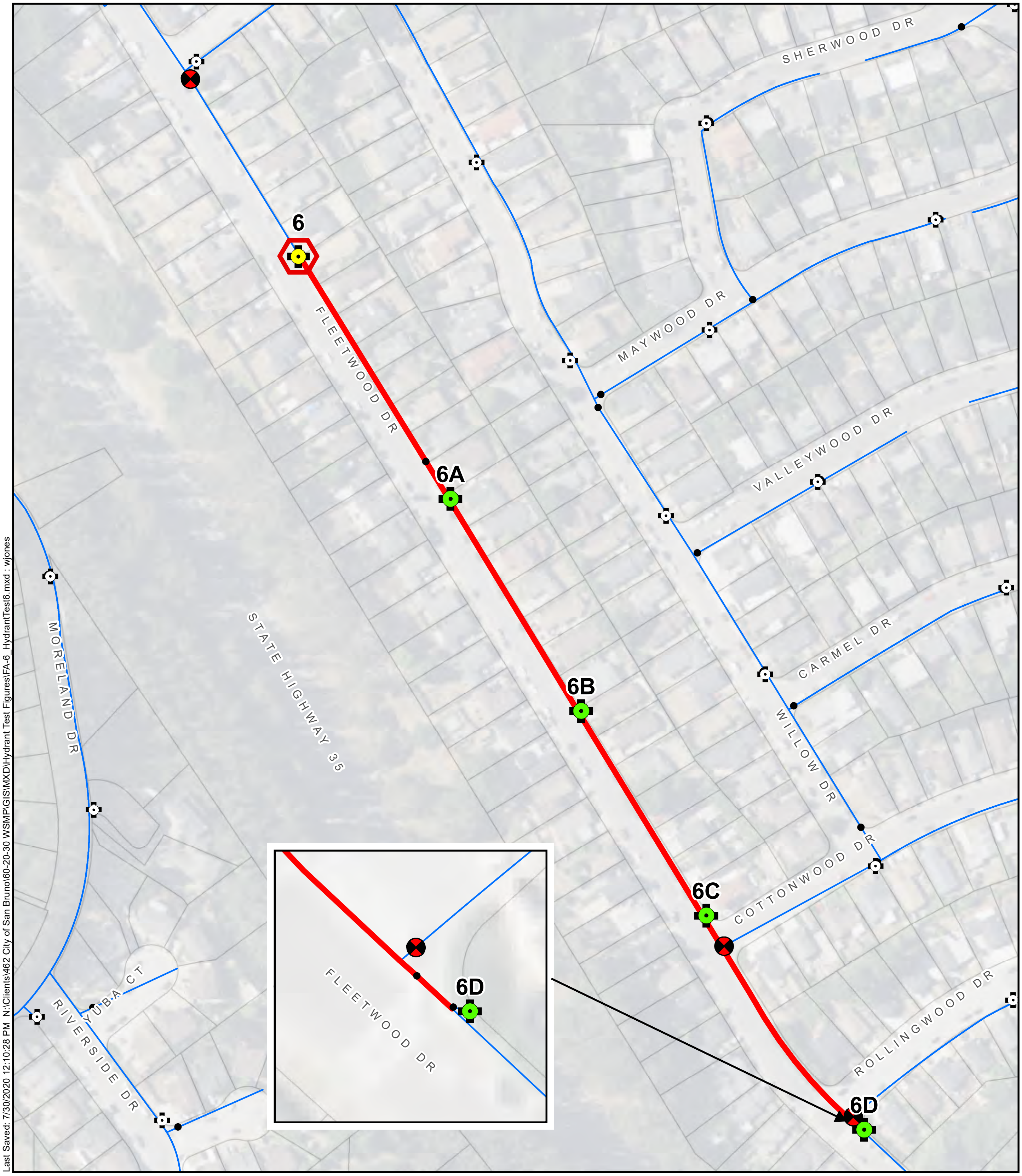
Hydrant Test Location
Test Pipeline
Pipeline
Observed Hydrant
Hydrant
Closed Valve (3 total)
Valve

0 100 200
Scale in Feet

Figure A-5

Test 5
(8-inch DI - 2010s)

City of San Bruno
Water System Master Plan



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Hydrant Test Location
Observed Hydrant
Hydrant
Closed Valve (3 total)
Valve
Test Pipeline
Pipeline

N

0 100 200
Scale in Feet

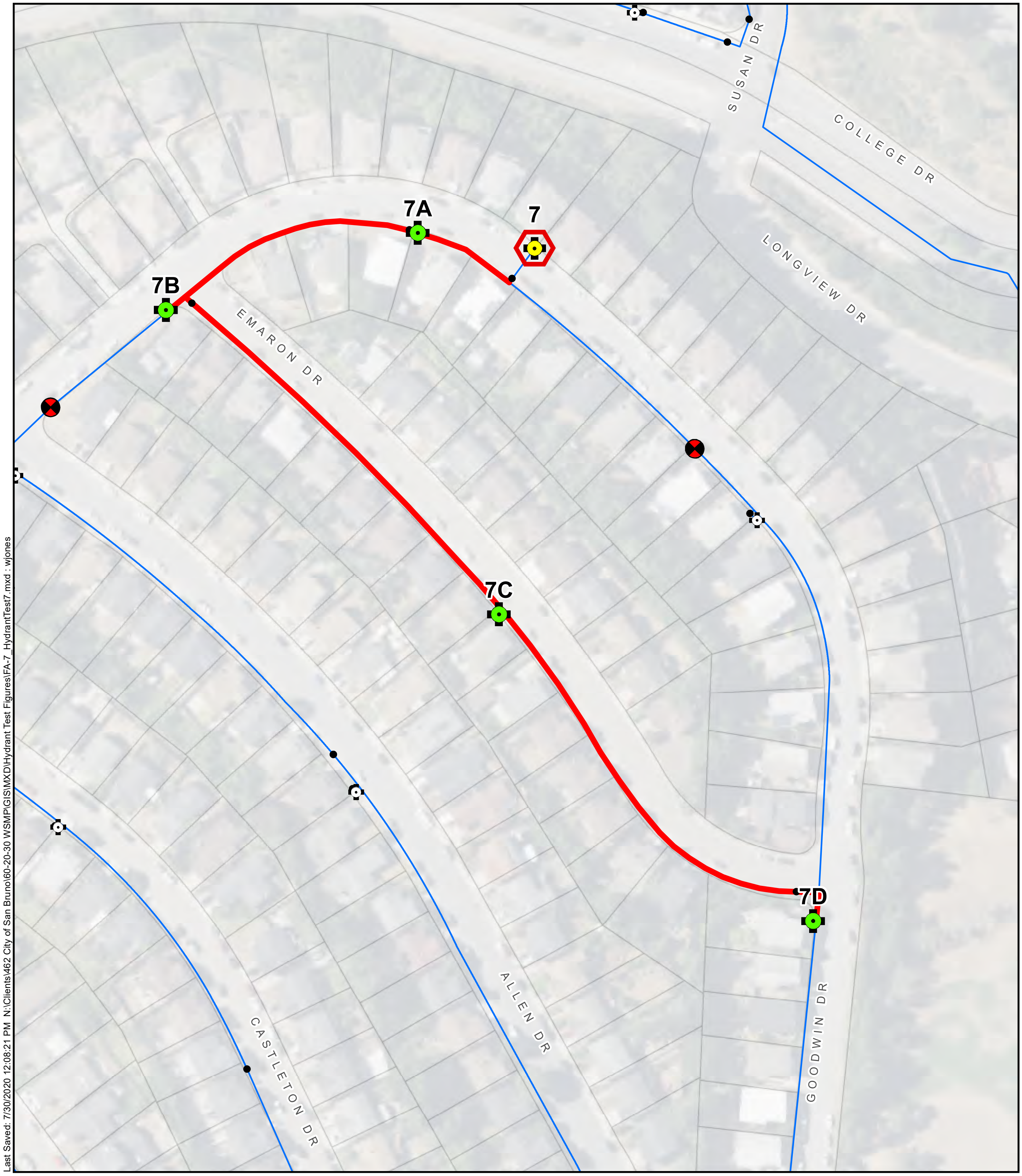
City Of SAN BRUNO

WEST YOST ASSOCIATES

Figure A-6

Test 6
(6-inch AC - 1950s)

City of San Bruno
Water System Master Plan



Hydrant Test Location
Observed Hydrant
Hydrant
Closed Valve (2 total)
Valve
Test Pipeline
Pipeline

0 75 150
Scale in Feet

City Of San Bruno

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Figure A-7

Test 7
(6-inch CI - 1960s)

City of San Bruno
Water System Master Plan

Hydrant Test Location

Observed Hydrant

Hydrant

Closed Valve (2 total)

Valve

Test Pipeline

Pipeline

N

0 125 250

Scale in Feet

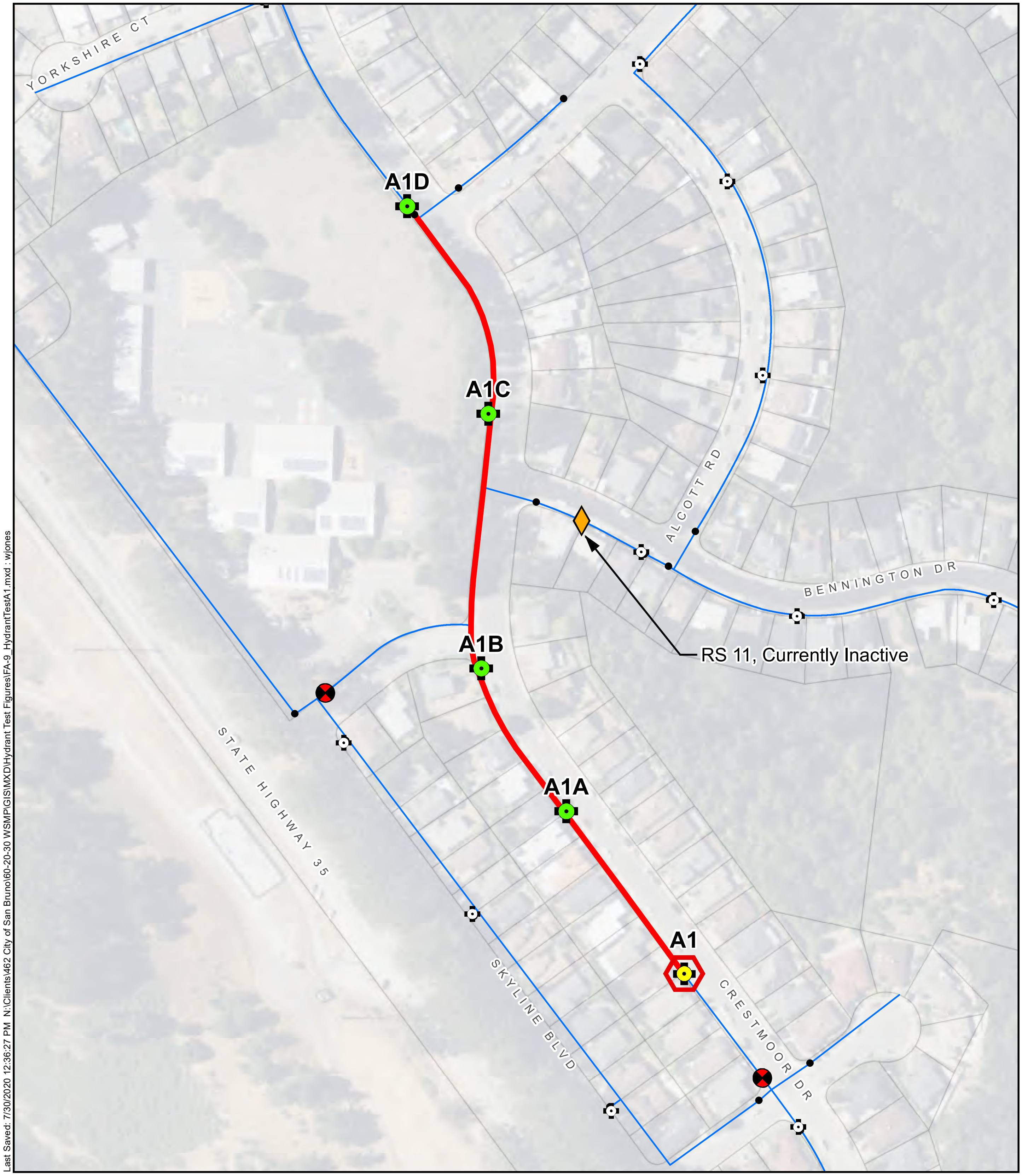
City Of San Bruno

WEST YOST ASSOCIATES

Figure A-8

Test 8
(6-inch CI - 1960s)

City of San Bruno
Water System Master Plan



Hydrant Test Location

Observed Hydrant

Hydrant

Closed Valve (2 total)

Valve

Pressure Reducing Valve

Test Pipeline

Pipeline

N

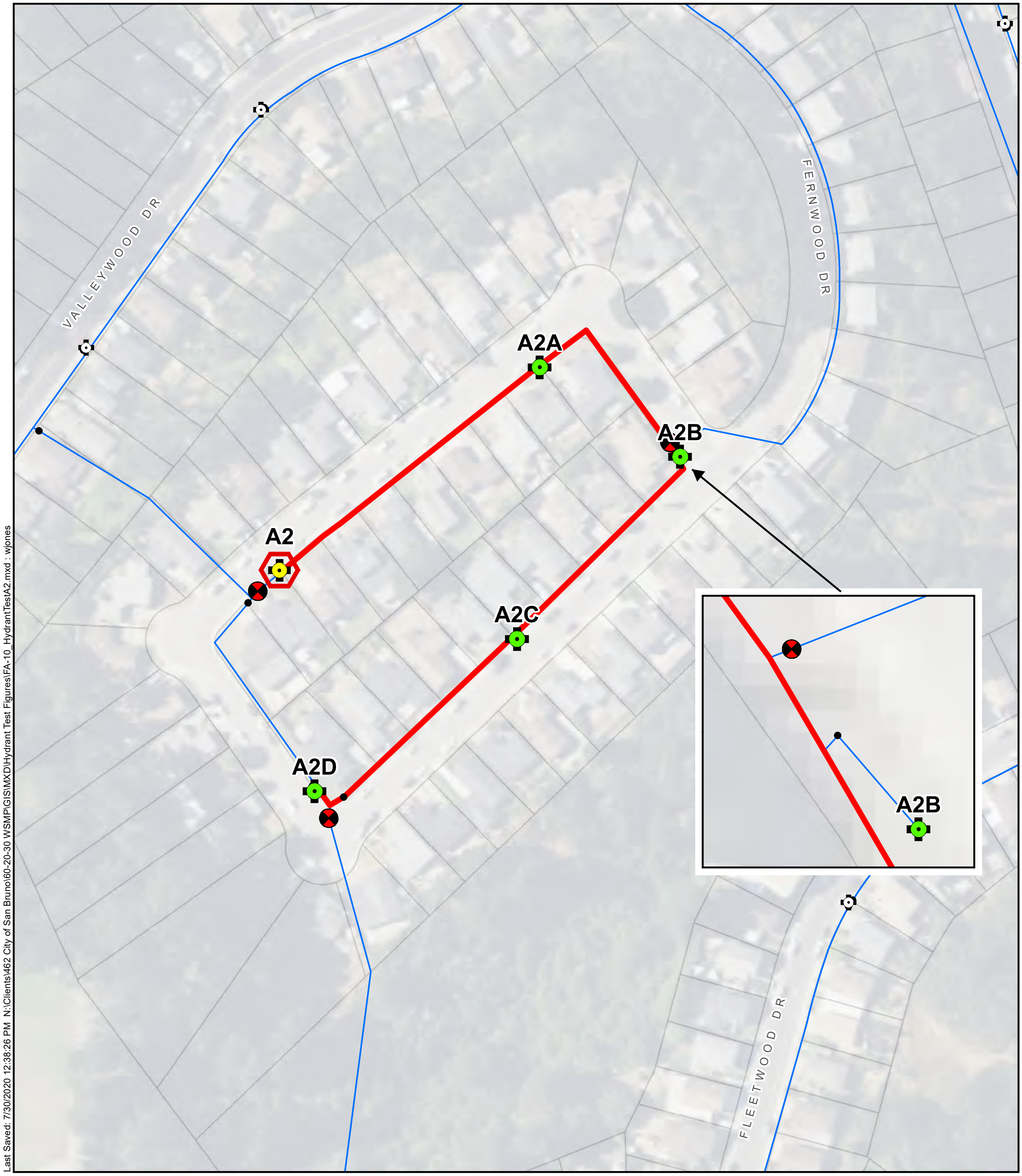
0 100 200

Scale in Feet

Figure A-9

Test A1
(6-inch AC - 1950s)

City of San Bruno
Water System Master Plan



Hydrant Test Location
Observed Hydrant
Hydrant
Closed Valve (3 total)
Valve
Test Pipeline
Pipeline

N
0 75 150
Scale in Feet

Figure A-10

Test A2
(6-inch AC - 1950s)

City of San Bruno
Water System Master Plan

Table A-1. Hydrant Test Locations[(a)]

Test No.	Pipeline Material	Approximate Installation Decade	Pipeline Diameter, Inches	Location	No. of Closed Valves	Zone
1	CI	1930s	8	1st Avenue, between Pine Street and the dead-end south of Angus Avenue	4	1/4
2	CI	1930s	10	Tanforan Avenue and Montgomery Avenue	3	1/4
3	CI	1930s	4	Cherry Avenue and Niles Avenue	3	1/4
4	CI	1970s	8	Grundy Land and Cherry Avenue	1	3/5
5	DI	2010s	8	Claremont Drive between Fairmont Drive and just past Concord Way	3	6
6	AC	1950s	6	Fleetwood Drive between Rollingwood Drive and Evergreen Drive	3	10
7	CI	1960s	6	Goodwin Drive between both intersections with Emaron Drive	2	11
8	CI	1960s	6	Lake Drive and Amador Avenue	2	12
A1	AC	1950s	6	Crestmoor Drive between Rosewood Drive and Bryant Way	2	7
A2	AC	1950s	6	Fernwood Drive	3	8

(a) 8 test locations and 2 alternate test locations if time permits.

Appendix C

Cost Estimating Assumptions

Appendix C
Cost Estimating Assumptions

This appendix provides the assumptions used by West Yost to estimate the probable construction costs for the planning and design of recommended water system facilities for the City's potable water system. Construction costs were developed based on a combination of data supplied by manufacturers, published industry standard cost data and curves, construction costs for similar facilities built by the City and/or other public agencies, and construction costs previously estimated by West Yost for similar facilities with similar construction cost indexes.

Additionally, the costs presented in this appendix are for construction only and do not include estimating uncertainties or unexpected construction costs (e.g., variations in final quantities) or cost estimates for land acquisition, engineering, legal costs, environmental review, soils investigation, surveying, construction management, and inspections and/or contract administration. Some of these additional cost items are referred to as contingency costs or mark-ups and are further described in the last section of this appendix.

The Association for the Advancement of Cost Engineering International (AACE International) has developed a cost estimating classification system based upon the amount of available project detail. The AACE International's classification system is presented in Table 1. The construction cost estimates presented in this appendix are consistent with AACE International's Class 5 cost estimating classification.

Table 1. AACE International Cost Estimate Classification System

AACE Class	Description	Accuracy Range	Typical Usage
Class 1	Project is 65 to 100 percent defined. Estimates use highly detailed quantity takeoffs for all processes and detailed unit costs.	-10% to +15%	Project bid check
Class 2	Project is 30 to 70 percent defined. Estimates use quantity takeoffs for all processes and detailed unit costs.	-15% to +20%	Project control
Class 3	Project is 10 to 40 percent defined. Estimates use quantity takeoffs for major items and detailed unit costs.	-20% to +30%	Budgeting, project authorization and funding
Class 4	Project is 1 to 15 percent defined. Estimating methods include process factors, scale-up factors, and modeling techniques.	-30% to +50%	Project screening and feasibility study, preliminary budgeting
Class 5	Project is 0 to 2 percent defined. Rough order-of-magnitude estimate based on limited information. Estimating methods include cost curves, scale-up factors, and modeling techniques.	-50% to +100%	Long-range capital planning, concept screening

All estimated construction costs have been adjusted to reflect January 2021 costs at an Engineering News Record (ENR) Construction Cost Index (CCI) of 13,098 (San Francisco Average). These construction costs are to be used for conceptual cost estimates only and should be updated regularly. Construction costs presented in this appendix are not intended to represent the lowest prices in the industry for each type of construction; rather they are representative of average or typical construction costs. These planning level construction cost estimates have been prepared for guidance in evaluating various facility improvement options, and are intended for budgetary purposes only, within the context of this master planning effort.

The following sections of this appendix describe the assumptions used to estimate the probable construction costs and contingencies for the planning and design of recommended water system facilities for the City's potable water system:

- Water System Construction Costs
- Contingency Costs and Mark-ups

Water System Construction Costs

The following sections present the construction cost estimates used to project probable construction costs for recommended water system facilities in the City's water system and are categorized by improvement project type.

Storage Reservoirs

Table 2 summarizes the estimated construction costs for water storage reservoirs between the size range of 0.5 to 2.0 MG. These costs generally include the installation of the storage tank, site piping, earthwork, paving, instrumentation, and all related sitework. Costs do not include land acquisition. It should be noted that these costs are representative of construction conducted under normal excavation and foundation conditions and would be significantly higher for special or difficult foundation requirements. Cost assumptions are for partially buried pre-stressed concrete tanks.

Table 2. Construction Costs for Concrete Water Storage Reservoirs[a,b]

Capacity, MG	Estimated Construction Cost, million dollars
0.5	2.8
1.0	3.3
1.5	3.9
2.0	4.5

(a) Based on January 2021 ENR CCI of 13,098 (San Francisco Average).
(b) Includes costs for storage tank, site piping, earthwork, paving, instrumentation.

Booster Pump Stations

Booster pump stations will be required at ground-level and below-grade reservoirs in order to lift water to the appropriate pressure zone. Estimated average construction costs for distribution pumping stations, as shown in Table 3, are based on enclosed stations with architectural and landscaping treatment suitable for residential areas. It should be noted that booster pump station costs can vary considerably, depending on factors such as architectural design, pumping head, and pumping capacity. Therefore, these costs presented below are representative of construction conducted under common or normal conditions and would be significantly higher for special or difficult conditions.

Booster pump station cost estimates include the installation of the booster pumps, site piping, earthwork, paving, on-site backup/standby power generator, SCADA, and all related sitework. Station designs will be based on the City's typical newer booster pump station configurations, which include 2 to 4 variable speed booster pumps installed in parallel to accommodate varying water demand conditions.

Table 3. Construction Costs for Booster Pump Stations[a,b]

Firm Capacity,[c] mgd	Estimated Construction Cost, million dollars
0.5	1.5
1	1.6
2	1.8
3	1.9
5	2.3
10	3.3

(a) Based on January 2021 ENR CCI of 13,098 (San Francisco Average).
(b) Includes costs for booster pumps, site piping, earthwork, paving, on-site backup/standby power generator, SCADA, and all related sitework.
(c) Equal to the total pumping capacity with the largest pump assumed out of service or on standby (i.e., firm capacity).

Pipelines

Unit construction costs for potable water pipelines 8 through 14-inches in diameter are provided in Table 4. These unit costs are for pipeline construction in developed areas and are representative of pipeline construction conducted under common or normal conditions, which would be significantly higher under special or difficult conditions.

The unit construction costs presented below generally include pipeline materials, trenching, placing and jointing pipe, valves, fittings, hydrants, service connections, placing imported pipe bedding, native backfill material, and asphalt pavement replacement, if required.

Table 4. Unit Construction Costs for Pipelines(a,b)

Pipeline Diameter, inches	Unit Construction Cost, $/linear foot
8	430
10	540
12	650
14	760

(a) Costs based on recent City pipeline replacement projects, scaled up to January 2021 ENR CCI of 13,098 (San Francisco Average).
(b) Includes costs for pipeline materials, trenching, placing and jointing, valves, fitting, hydrants, service connections, bedding, backfill, and asphalt replacement.

Pressure Regulating Stations

Interconnections (i.e., pressure regulating stations) are required to provide water supply between pressure zones during peak demands and/or emergency conditions. The construction cost for a new pressure regulating station or an existing pressure regulating station upgrade is estimated to be approximately $400,000. This cost is representative of construction conducted under normal conditions and would be significantly higher for special or difficult conditions.

Construction cost estimates for a pressure regulating station include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

Backup Power Generators

On-site backup power generators are recommended at key locations to provide power to pumps so that water can be pumped into the distribution system in the event of a power outage. These generators should be sized to meet the power demands of the pumps. The construction cost for a new on-site backup power generator is estimated to be approximately $290,000. This cost is representative of construction conducted under normal conditions and would be significantly higher for special or difficult conditions.

Contingency Costs and Mark-ups

Contingency costs and other mark-ups must be reviewed on a case-by-case basis because they will vary considerably with each construction project. However, to assist City staff with budgeting for recommended water system facility improvements, the following percentages are used to account for the total cost of a project:

- Design and Construction Contingencies: 30 percent
  There may be changes during the design phase resulting from decisions by City staff or unexpected discoveries that contribute to the design contingency. Changes during construction are typically a result of unforeseen site conditions or *force majeur* events which result in contractor change orders. *Force majeur* events include labor strikes, excessive rainy work days and other natural disasters.

- Other Project Costs: 25 percent
  For other project costs, a twenty-five percent mark-up to the construction cost plus design and construction contingencies includes the following:

Design:	7 percent
Soils Investigation:	1 percent
Surveying:	1 percent
Construction Management and Inspection:	6 percent
Office Engineering During Construction:	3 percent
CEQA Compliance, City Administration, Public Outreach, and Legal:	7 percent
Total:	25 percent

The total markup, including contingencies and other project costs, is compounded, and amounts to 62.5 percent of the estimated construction cost. However, it must be noted that for smaller or more complicated projects, the design cost may increase by 10 to 20 percent of the estimated construction cost.

An example application of these standard mark-ups to a project with an assumed base construction cost of $1.0 million is shown in Table 5. As shown, the total cost of all project construction contingencies will be 62.5 percent of the base construction cost for each construction project.

Table 5. Example Application of Mark-ups

Cost Component	Percent	Cost
Estimated Base Construction Cost[(a)]		$1,000,000
Contingencies and Mark-ups:		
Design and Construction Contingencies	30%	$300,000
Estimated Project Cost after Design and Construction Contingencies		$1,300,000
Other Project Costs		
Design	7%	$91,000
Soils Investigation	1%	$13,000
Surveying	1%	$13,000
Construction Management and Inspection	6%	$78,000
Office Engineering During Construction	3%	$39,000
CEQA Compliance, City Administration, Public Outreach, and Legal	7%	$91,000
Estimated Other Project Costs Total		$325,000
Estimated Total Project Cost		**$1,625,000**

(a) Assumed cost of an example project.

Appendix D

Financial and Rate Projections for the Water System Master Plan Capital Improvements Program

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Technical Memorandum

Date: December 20, 2021 **REVISED DRAFT**

To: Hae Won Ritchie, City Engineer, City of San Bruno
Polly Boissevain, Engineering Manager, West Yost

Cc: Matt Lee, Public Works Director, City of San Bruno

From: Alex Handlers, Principal, Bartle Wells Associates

Re: Water Financial & Rate Projections for the Water System Master Plan Capital Improvement Program

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Background & Objectives

Bartle Wells Associates (BWA) was retained as a subcontractor to West Yost Associates (West Yost) to develop financial and rate projections for the City of San Bruno's (City's) water enterprise designed to support the Capital Improvement Program (CIP) developed by West Yost in the Water System Master Plan update. This memo summarizes key findings of our analysis and presents two alternative rate scenarios designed to help support funding for the CIP projects identified in the Water System Master Plan. The rate projections presented are for planning purposes only; a more-detailed water rate study should be conducted to support the adoption of any future water rate increases. The analysis incorporates the latest financial information available from the City as well as substantial input from both West Yost and City staff.

Water Enterprise Financial Overview

The City of San Bruno provides water service to over 11,000 residential, commercial, institutional, and light industrial accounts. The City's water utility is accounted for as a self-supporting enterprise fund with revenues derived primarily from water service charges. As such, water rates need to be set at adequate levels to support funding for the water enterprise's operating and maintenance expenses, debt service requirements, and capital improvement needs.

The City has provided proactive financial stewardship by adopting gradual annual rate increases to support the water enterprise's funding needs in 18 of the past 20 years. Over the past decade, the City adopted a) a series of five annual 9.8% rate increases effective July 1 of 2012 through 2017, and b) most recently, a series of five annual 5% rate increases effective July 1 of 2017 through 2021. In response to the coronavirus pandemic and other factors, the City cancelled the rate increase that had been scheduled to go into effect July 1, 2021.

In recent years, the water enterprise has accrued a significant level of fund reserves due a number of factors including: a) gradual rate increases, b) lower-than-projected wholesale water rates levied by the SFPUC due to a prior overcollection of revenues from wholesale customers, c) a deferral of some major capital improvement projects that were budgeted but not funded in prior years, but are expected to be completed in upcoming years, and d) participation in a *Groundwater Storage and Recovery (GSR) Agreement* under which the City received a substantial volume of water from the SFPUC at no cost in return for a corresponding reduction in groundwater pumping over the past 5 fiscal years. Fund reserves are projected to be drawn down in future years to help fund the water system's capital improvement needs.

The City's water enterprise is currently in strong financial health but faces a number of financial challenges in future years including:

- Substantial capital improvement funding needs over the next decade and beyond as identified in the Water System Master Plan;
- Projected SFPUC wholesale water rate increases;
- Ongoing cost inflation;
- Potential impacts of a future drought.

Water Rates

Table 1 on the following page shows a recent history of water rates. Rates include both a) fixed Monthly Service Charges based on meter size, and b) Quantity Charges billed based on metered water consumption. Quantity Charges for single family residences are billed according to 3 inclining tiers while all other customers pay a uniform rate for all water use.

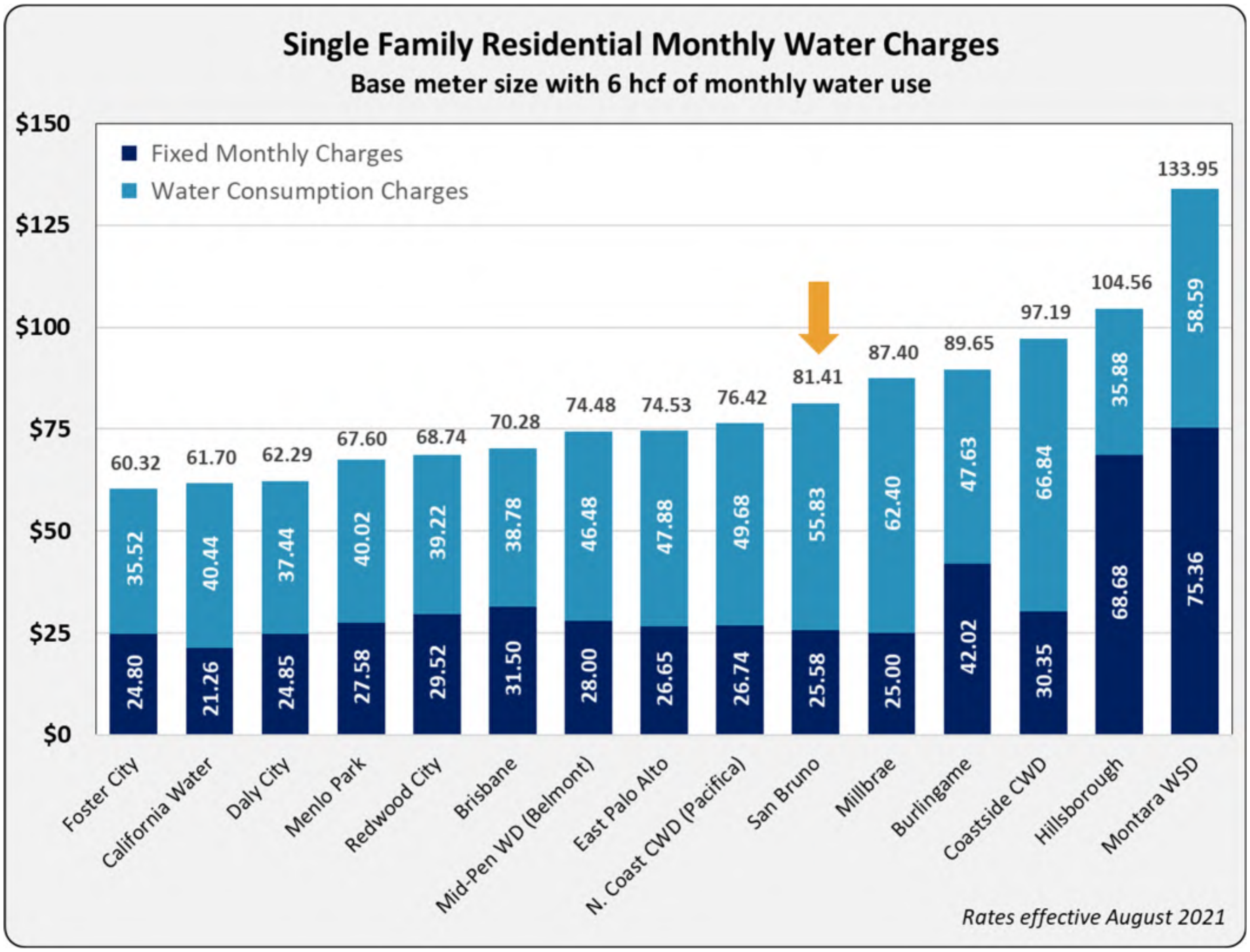
Table 1 – Water Rates

		July 1 2016	July 1 2017	July 1 2018	July 1 2019	July 1 2020	July 1 2021
Rate Increase %			5%	5%	5%	5%	~~5%~~
MONTHLY SERVICE CHARGES						Currently in effect	Cancelled
Fixed monthly charge based on meter size.							
Meter Size							
3/4-inch		$21.13	$22.10	$23.20	$24.36	$25.58	~~$26.86~~
1-inch		35.22	36.83	38.67	40.60	42.63	~~44.76~~
1-1/2 inch		70.43	73.67	77.33	81.20	85.27	~~89.53~~
2-inch		112.69	117.87	123.73	129.92	136.43	~~143.25~~
3-inch		211.30	221.00	232.00	243.60	255.80	~~268.59~~
4-inch		352.17	368.33	386.67	406.00	426.33	~~447.65~~
6-inch		704.33	736.67	773.33	812.00	852.67	~~895.30~~
8-inch		1,126.93	1,178.67	1,237.33	1,299.20	1,364.27	~~1,432.47~~
10-inch		1,619.97	1,694.33	1,778.67	1,867.60	1,961.13	~~2,059.18~~
QUANTITY CHARGES							
Billed based on metered water consumption ($ per hundred cubic feet or hcf)							
a) Single-Family Residential							
	Bi-Monthly Use						
Tier 1	0 - 10 hcf	$7.36	$7.78	$8.17	$8.58	$9.01	~~$9.46~~
Tier 2	11 - 20 hcf	8.83	9.31	9.78	10.27	10.78	~~11.32~~
Tier 3	> 20 hcf	11.78	12.38	13.00	13.65	14.33	~~15.05~~
b) All Other Accounts (All Water Use)		8.32	8.73	9.17	9.63	10.11	~~10.62~~
QUANTITY CHARGE (PER 100 GALLONS)							
a) Single-Family Residential			***For Informational Purposes Only***				
	Bi-Monthly Use						
Tier 1	0 - 10 hcf	$0.98	$1.04	$1.09	$1.15	$1.20	~~$1.26~~
Tier 2	11 - 20 hcf	1.18	1.24	1.31	1.37	1.44	~~1.51~~
Tier 3	> 20 hcf	1.57	1.66	1.74	1.82	1.92	~~2.01~~
b) All Other Accounts (All Water Use)		1.11	1.17	1.23	1.29	1.35	~~1.42~~

Accounts served by water procured from NCCWD are also charged a Differential Cost of Supply Charge reflecting the higher cost of water procured from this source.

Figure 1 shows a regional survey of monthly water charges for a typical single family home with 6 hundred cubic feet (hcf) of monthly water use. The City's water rates are currently a little higher than the regional median. For comparative purposes, the survey assumes the same level of water use for all agencies; however, agencies in northern San Mateo County (such as San Bruno) and on the Pacific Coast tend to have lower water use per home than agencies in central and southern San Mateo County. Rates can vary widely from agency to agency due to a wide range of factors.

Figure 1 – Single Family Monthly Water Rate Survey



Water Supply & Wholesale Water Rates

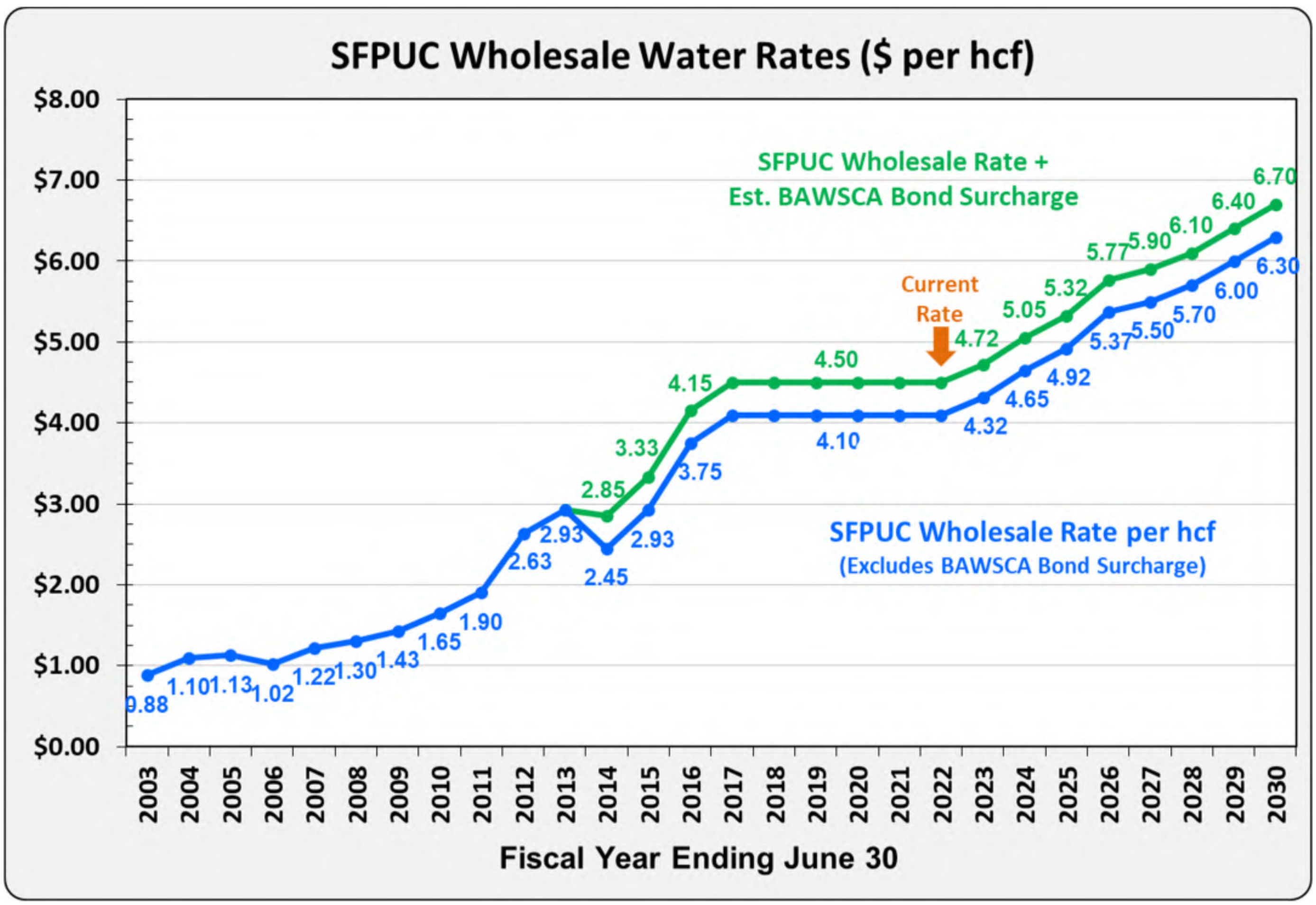
The City's water supply is provided by a combination of groundwater production from City wells and wholesale water supply imported from the San Francisco Public Utilities Commission (SFPUC) supplemented by a small amount of water purchased from the North Coast County Water District. City groundwater production is projected to generate a little over 60% of the City's water supply with the remaining 40% predominantly purchased from the SFPUC in future normal-year conditions.

The City's historical and ongoing investment in groundwater production facilities has provided a substantial financial benefit to the water enterprise as groundwater production costs – accounting for both operating expenses and the cost of capital facilities – are lower than costs for wholesale water supply purchased from the SFPUC. The City is a member of the Bay Area Water Supply and Conservation Agency (BAWSCA) that represents the collective interests of 24 regional agencies and 2 private water suppliers that contractually purchase water from SFPUC.

Figure 2 shows historical and projected SFPUC wholesale water rates along with estimated supplemental BAWSCA Bond Surcharges. The bond surcharges are billed by the SFPUC to recover costs for each agency's share of bonds issued by BAWSCA to prepay SFPUC for infrastructure benefiting wholesale customers in order to achieve an overall lower cost of water supply from the SFPUC.

The SFPUC has been able to defer wholesale rate increases for past five years due to the drawdown of funds previously over-collected from wholesale water customers. However, the excess funds have been drawn down and SFPUC anticipates resuming annual rate increases starting next fiscal year.

Figure 2 – SFPUC Wholesale Water Rates



The City is party to a *Groundwater Storage and Recovery (GSR) Agreement* with the SFPUC designed to increase groundwater storage to provide water supply reliability during periods of drought. Under the

GSR Agreement, over the past five fiscal years 2016/17 – 2020/21, the City received a substantial amount of water from the SFPUC at no cost in return for a corresponding reduction in groundwater pumping. This resulted in a temporary but substantial reduction in water supply costs over the past five years. Under the GSR Agreement, the City has also been granted a credit for 3,915 acre feet of future SFPUC water supply. However, this credit can only be applied under certain conditions.

Capital Improvement Program

Table 2 summarizes the Water System Master Plan Capital Improvement Program (CIP) developed by West Yost. The CIP identifies roughly $318 million of water system capital improvements (in 2021 dollars) including approximately $115 million over the first 10 years. For financial planning purposes, the table also projects future CIP costs with 3% annual cost escalation. With cost escalation, CIP costs over the first 10 years are estimated at approximately $130 million, averaging about $13 million per year. The capital improvements are needed to address existing water system deficiencies, replace aging infrastructure, and improve water supply reliability and fire flow.

Table 2 – Capital Improvement Program Summary

	Capital Cost 2021/22 - 2025/26			Capital Cost	Capital Cost	
	2021/22	Additional	Subtotal	2027 - 2031	Long Term	Total
WATER CIP (CURRENT $)*						
Pipeline Improvements	$9,650,000	$15,504,000	$25,154,000	$27,606,000	$151,815,000	$204,575,000
Well, Storage, & Pumping Facil Imprvmnts	8,694,000	31,133,000	39,827,000	8,873,000	38,221,000	86,921,000
Pressure Regulating Station Improvements	1,600,000	950,000	2,550,000	2,500,000	10,450,000	15,500,000
Miscellaneous Improvements	6,017,000	1,400,000	7,417,000	674,000	2,607,000	10,698,000
Total	25,961,000	48,987,000	74,948,000	39,653,000	203,093,000	317,694,000
WATER CIP (WITH 3% COST ESCALATION)						
Annual Cost Escalation			3.0%	3.0%	3.0%	
Years to Construction Mid-Point			2.50	7.50	15.00	
Cost Escalator			1.0767	1.2482	1.5580	
CIP with Cost Escalation			$80,696,000	$49,494,000	$316,412,000	$446,602,000
Average Annual Cost			*16,139,200*	*9,898,800*		
Average First 10 Years				*13,019,000*		

* Based on Water System Master Plan cost estimates dated 07/01/21 with costs based on the January 2021 ENR CCI for San Francisco Bay Area

Water Enterprise Financial Projections

Bartle Wells Associates developed 10-year water enterprise cash flow projections to evaluate future rate increases needed to support the capital funding needs identified in the Water System Master Plan. The projections incorporate the latest information available as well as a number of reasonable and slightly conservative assumptions, many of which are detailed on the tables. Projections were developed under two rate scenarios including:

- **Scenario A** – Phase in rate increases to support annual funding of $13 million per year of capital improvements, in line with the 10-year annual average funding requirements of the Water System Master Plan. Table 3 shows the detailed water cash flow projections for Scenario A, which are summarized graphically in Figure 3.
- **Scenario B** – Reduced rate scenario with future rate increases limited to 5%. Under this scenario the City can forge ahead with the same level of capital funding as Scenario A for a number of years assuming additional drawdown of fund reserves, but the reduced rate increases ultimately support a lower level of ongoing funding for capital improvements after 2028/29. Table 4 shows the detailed water cash flow projections for Scenario B, which are summarized graphically in Figure 4.

Both scenarios assume a) the City substantially draws down water enterprise fund reserves to fund the identified CIP projects while rate increases are gradually phased in, and b) the City takes a few years to phase up staffing capacity to manage the level of identified CIP funding. Key assumptions include:

Revenue Assumptions

- Water sales are based on projections for the current fiscal year based on year-to-date water sales, which are a little lower than the prior fiscal year. Water sales are subsequently projected to remain constant in future years assuming any increase due to growth are offset by additional conservation.
- Growth from new development and/or redevelopment is projected at the equivalent of 20 new single family homes per year. The City also anticipates receiving roughly $3 million in connection and capacity fees in 2022/23 from a major YouTube development project.

Expense Assumptions

- City operating and maintenance costs are based on the 2021/22 budget and escalate at the annual rate of 4% to account for future cost inflation.
- The projections assume 5% of annual CIP costs are accounted for as capital costs, not operating expenses, mainly for City engineering staff working on capital projects.
- Groundwater production is projected at 900,000 hcf per year with remaining water supply purchased from the SFPUC. The projections assume an increase in groundwater production costs starting in the current fiscal year as the City's recent curtailment of groundwater pumping under the GSR Agreement ended effective July 2021.

- The projections assume 2022/23 is a Recovery/Take Year under the GSR Agreement under which the City is not restricted from pumping groundwater and purchases supplemental SFPUC water supply provided by SFPUC's GSR Project Facilities. The water supply is provided at the same rate as the SFPUC's imported water supply. The City is able to apply its GSR water supply credit during GSR Recovery/Take Years as designated by the SFPUC. No GSR designations are assumed for future years.

- SFPUC wholesale water rates are based on the latest SFPUC projections. The projections assume the City is able to apply a portion of its credit under the GSR Agreement to offset SFPUC water supply costs in 2022/23, which has been designated a GSR Recovery/Take Year by the SFPUC.

- Scenario A supports $13 million per year of CIP funding (after an initial phase in through 2024/25), in line with the 10-year annual average funding requirements of the Water System Master Plan escalated to account for 3% annual construction cost inflation. Scenario B supports the same level of CIP funding through 2028/29, but ultimately supports roughly $9 million of future annual capital funding by the end of the decade due to reduced rate increases.

- The financial projections assume all capital projects are funded on a pay-as-you-go basis using available fund reserves and revenues generated from water rates, with no additional debt issuance.

- For financial planning purposes, the projections include a minimum fund reserve target equal to 50% of annual operating, maintenance and debt service costs, plus $5 million for emergency capital reserves. Maintaining a prudent minimal level of fund reserves provides a financial cushion for dealing with unanticipated expenses, revenue shortfalls, and emergency capital repairs. The projections assume the City will substantially draw down existing fund reserves, but still exceed the fund reserve target in future years.

Table 3 – Water Cash Flow Projections – Scenario A

San Bruno Water Cash Flow Projections A									Scenario A: Fund 10-Year Avg CIP ($13M/year)		
	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Overall Rate Adjustment	**5%**	**0%**	**3%**	**5%**	**7%**	**7%**	**7%**	**7%**	**7%**	**7%**	**6%**
Growth (3/4" Meter Equivalents)	-	20	20	20	20	20	20	20	20	20	20
Annual % Change in Water Sales	-	-3.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Water Sales (hcf)	1,395,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000
Plus 10% Unaccounted Water	1,535,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000
Groundwater Production (hcf)	165,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000
SFPUC Water Supply (hcf)	1,328,000	585,000	585,000	585,000	585,000	585,000	585,000	585,000	585,000	585,000	585,000
GSR Yearly Designation	Storage/Put	Hold Year	Recovery/Take	-	-	-	-	-	-	-	-
GSR Credit hcf (3,915 AF, 1,705,000 hcf)	-	-	(585,000)	-	-	-	-	-	-	-	-
SFPUC Rate per hcf	$4.10	$4.10	$4.32	$4.65	$4.92	$5.37	$5.50	$5.70	$6.00	$6.30	$6.30
Add'l Well O&M Costs per hcf	-	$1.00	$1.04	$1.08	$1.12	$1.16	$1.21	$1.26	$1.31	$1.36	$1.41
Interest Earnings Rate	0.5%	0.75%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
City Cost Escalation		4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Beginning Fund Balances	$41,628,000	$41,877,000	$42,428,000	$47,693,000	$45,902,000	$40,097,000	$34,954,000	$30,745,000	$27,527,000	$25,349,000	$24,324,000
REVENUES											
Water Rate Revenues	17,460,000	17,038,000	17,556,000	18,441,000	19,739,000	21,128,000	22,615,000	24,207,000	25,911,000	27,734,000	29,409,000
Investment Income	254,000	314,000	424,000	477,000	459,000	401,000	350,000	307,000	275,000	253,000	243,000
Connection & Capacity Fees	176,000	200,000	3,200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Other/Miscellaneous	143,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Total Revenues	18,033,000	17,602,000	21,230,000	19,168,000	20,448,000	21,779,000	23,215,000	24,764,000	26,436,000	28,237,000	29,902,000
EXPENSES											
Operating & Maintenance											
Salaries & Benefits	2,814,000	2,992,000	3,112,000	3,236,000	3,365,000	3,500,000	3,640,000	3,786,000	3,937,000	4,094,000	4,258,000
Less Capital Project Staffing (5% of C	(115,000)	(250,000)	(300,000)	(400,000)	(650,000)	(650,000)	(650,000)	(650,000)	(650,000)	(650,000)	(650,000)
Supplies & Materials	1,699,000	1,867,000	1,942,000	2,020,000	2,101,000	2,185,000	2,272,000	2,363,000	2,458,000	2,556,000	2,658,000
Utilities	506,000	420,000	437,000	454,000	472,000	491,000	511,000	531,000	552,000	574,000	597,000
Add'l Well Production & Maint Cost	0	735,000	764,000	794,000	823,000	853,000	889,000	926,000	963,000	1,000,000	1,036,000
SFPUC/NCCWD Wholesale Water	2,135,000	2,399,000	2,527,000	2,720,000	2,878,000	3,141,000	3,218,000	3,335,000	3,510,000	3,686,000	3,686,000
SFPUC GSR Credits (3,915 AF)	0	0	(2,527,000)	0	0	0	0	0	0	0	0
SFPUC Meter Charges	153,000	153,000	159,000	165,000	172,000	179,000	186,000	193,000	201,000	209,000	217,000
BAWSCA Bond Surcharge	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
Internal/Intergovt Charges	2,843,000	2,872,000	2,987,000	3,106,000	3,230,000	3,359,000	3,493,000	3,633,000	3,778,000	3,929,000	4,086,000
Subtotal	10,215,000	11,368,000	9,281,000	12,275,000	12,571,000	13,238,000	13,739,000	14,297,000	14,929,000	15,578,000	16,068,000
Debt Service											
2017 Water Revenue Bonds	682,000	683,000	684,000	684,000	682,000	684,000	685,000	685,000	685,000	684,000	684,000
Subtotal	682,000	683,000	684,000	684,000	682,000	684,000	685,000	685,000	685,000	684,000	684,000
Capital Improvements	4,088,000	5,000,000	6,000,000	8,000,000	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000
Total Expenses	14,985,000	17,051,000	15,965,000	20,959,000	26,253,000	26,922,000	27,424,000	27,982,000	28,614,000	29,262,000	29,752,000
Revenues Less Expenses	3,048,000	551,000	5,265,000	(1,791,000)	(5,805,000)	(5,143,000)	(4,209,000)	(3,218,000)	(2,178,000)	(1,025,000)	150,000
Ending Fund Balances	44,676,000	42,428,000	47,693,000	45,902,000	40,097,000	34,954,000	30,745,000	27,527,000	25,349,000	24,324,000	24,474,000
Reserve Target: 50% O&M&D + $5M CIP	10,450,000	11,030,000	9,980,000	11,480,000	11,630,000	11,960,000	12,210,000	12,490,000	12,810,000	13,130,000	13,380,000
Debt Service Coverage	11.46	9.13	17.47	10.08	11.55	12.49	13.83	15.28	16.80	18.51	20.23

Note: The projections assume 2022/23 is a Recovery/Take Year under the Groundwater Storage & Recovery (GSR) Agreement, but do not assume any GSR designations for future years.

Figure 3 – Projected Revenues & Expenses – Scenario A

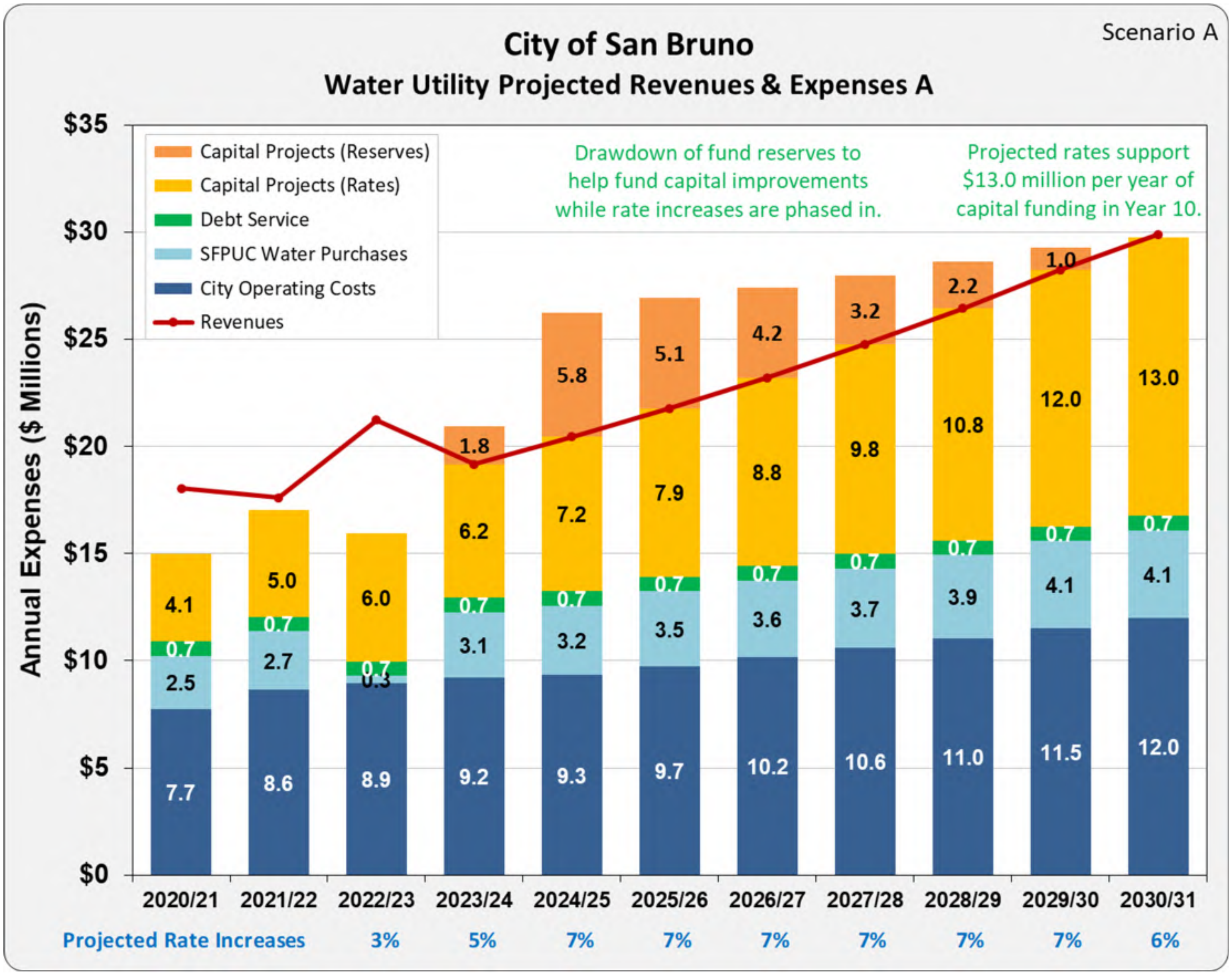


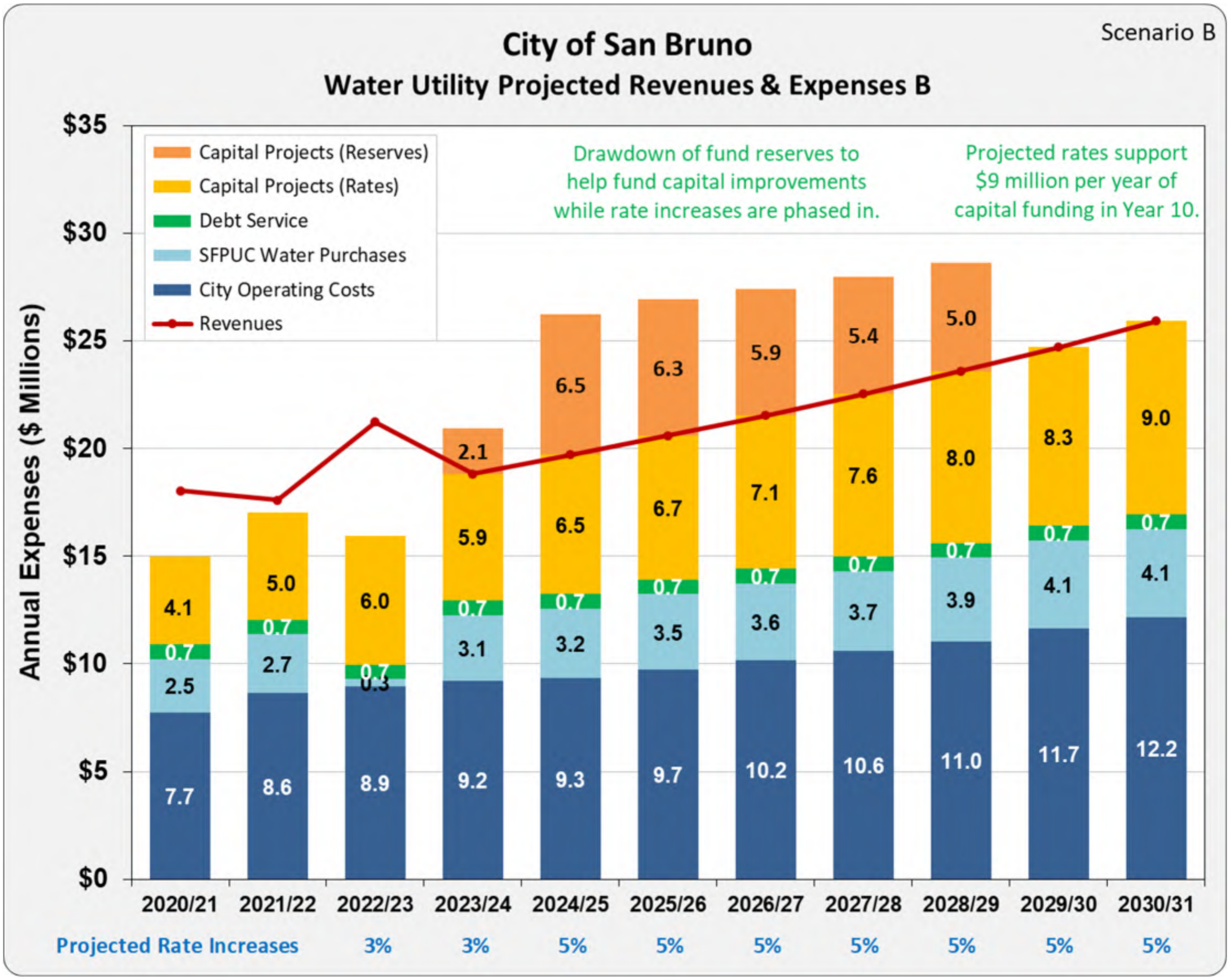
Table 4 – Water Cash Flow Projections – Scenario B

San Bruno Water Cash Flow Projections B — Scenario B: Reduced Rate Increases

	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Overall Rate Adjustment	**5%**	**0%**	**3%**	**3%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**
Growth (3/4" Meter Equivalents)	-	20	20	20	20	20	20	20	20	20	20
Annual % Change in Water Sales	-	-3.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Water Sales (hcf)	1,395,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000
Plus 10% Unaccounted Water	1,535,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000	1,485,000
Groundwater Production (hcf)	165,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000
SFPUC Water Supply (hcf)	1,328,000	585,000	585,000	585,000	585,000	585,000	585,000	585,000	585,000	585,000	585,000
GSR Yearly Designation	Storage/Put	Hold Year	Recovery/Take	-	-	-	-	-	-	-	-
GSR Credit hcf (3,915 AF, 1,705,000 hcf)	-	-	(585,000)	-	-	-	-	-	-	-	-
SFPUC Rate per hcf	$4.10	$4.10	$4.32	$4.65	$4.92	$5.37	$5.50	$5.70	$6.00	$6.30	$6.30
Add'l Well O&M Costs per hcf	-	$1.00	$1.04	$1.08	$1.12	$1.16	$1.21	$1.26	$1.31	$1.36	$1.41
Interest Earnings Rate	0.5%	0.75%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
City Cost Escalation		4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Beginning Fund Balances	$41,628,000	$41,877,000	$42,428,000	$47,693,000	$45,551,000	$39,006,000	$32,684,000	$26,803,000	$21,361,000	$16,342,000	$14,640,000
REVENUES											
Water Rate Revenues	17,460,000	17,038,000	17,556,000	18,090,000	19,002,000	19,960,000	20,966,000	22,022,000	23,131,000	24,297,000	25,521,000
Investment Income	254,000	314,000	424,000	477,000	456,000	390,000	327,000	268,000	214,000	163,000	146,000
Connection & Capacity Fees	176,000	200,000	3,200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Other/Miscellaneous	143,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Total Revenues	18,033,000	17,602,000	21,230,000	18,817,000	19,708,000	20,600,000	21,543,000	22,540,000	23,595,000	24,710,000	25,917,000
EXPENSES											
Operating & Maintenance											
Salaries & Benefits	2,814,000	2,992,000	3,112,000	3,236,000	3,365,000	3,500,000	3,640,000	3,786,000	3,937,000	4,094,000	4,258,000
Less Capital Project Staffing (5% of C	(115,000)	(250,000)	(300,000)	(400,000)	(650,000)	(650,000)	(650,000)	(650,000)	(650,000)	(500,000)	(450,000)
Supplies & Materials	1,699,000	1,867,000	1,942,000	2,020,000	2,101,000	2,185,000	2,272,000	2,363,000	2,458,000	2,556,000	2,658,000
Utilities	506,000	420,000	437,000	454,000	472,000	491,000	511,000	531,000	552,000	574,000	597,000
Add'l Well Production & Maint Cost	0	735,000	764,000	794,000	823,000	853,000	889,000	926,000	963,000	1,000,000	1,036,000
SFPUC/NCCWD Wholesale Water	2,135,000	2,399,000	2,527,000	2,720,000	2,878,000	3,141,000	3,218,000	3,335,000	3,510,000	3,686,000	3,686,000
SFPUC GSR Credits	0	0	(2,527,000)	0	0	0	0	0	0	0	0
SFPUC Meter Charges	153,000	153,000	159,000	165,000	172,000	179,000	186,000	193,000	201,000	209,000	217,000
BAWSCA Surcharge	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
Internal/Intergovt Charges	2,843,000	2,872,000	2,987,000	3,106,000	3,230,000	3,359,000	3,493,000	3,633,000	3,778,000	3,929,000	4,086,000
Subtotal	10,215,000	11,368,000	9,281,000	12,275,000	12,571,000	13,238,000	13,739,000	14,297,000	14,929,000	15,728,000	16,268,000
Debt Service											
2017 Water Revenue Bonds	682,000	683,000	684,000	684,000	682,000	684,000	685,000	685,000	685,000	684,000	684,000
Subtotal	682,000	683,000	684,000	684,000	682,000	684,000	685,000	685,000	685,000	684,000	684,000
Capital Improvements	4,088,000	5,000,000	6,000,000	8,000,000	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000	10,000,000	9,000,000
Total Expenses	14,985,000	17,051,000	15,965,000	20,959,000	26,253,000	26,922,000	27,424,000	27,982,000	28,614,000	26,412,000	25,952,000
Revenues Less Expenses	3,048,000	551,000	5,265,000	(2,142,000)	(6,545,000)	(6,322,000)	(5,881,000)	(5,442,000)	(5,019,000)	(1,702,000)	(35,000)
Ending Fund Balances	44,676,000	42,428,000	47,693,000	45,551,000	39,006,000	32,684,000	26,803,000	21,361,000	16,342,000	14,640,000	14,605,000
Reserve Target: 50% O&M&D + $5M CIF	10,450,000	11,030,000	9,980,000	11,480,000	11,630,000	11,960,000	12,210,000	12,490,000	12,810,000	13,210,000	13,480,000
Debt Service Coverage	11.46	9.13	17.47	9.56	10.46	10.76	11.39	12.03	12.65	13.13	14.11

Note: The projections assume 2022/23 is a Recovery/Take Year under the Groundwater Storage & Recovery (GSR) Agreement, but do not assume any GSR designations for future years.

Figure 4 – Projected Revenues & Expenses – Scenario B



Water Rate Projections

Table 5 summarizes the water rate projections identified under each cash flow scenario and also shows future annual CIP funding levels and projected drawdowns of fund reserves. Each scenario assumes rate increases are phased in gradually over the period shown to support the CIP funding levels included in each scenario.

Table 5 –Water Rate Projections

	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Scenario A										
Water Rate Increases	**0%**	**3%**	**5%**	**7%**	**7%**	**7%**	**7%**	**7%**	**7%**	**6%**
CIP Funding ($ Millions)	$5.0	$6.0	$8.0	$13.0	$13.0	$13.0	$13.0	$13.0	$13.0	$13.0
Drawdown of Fund Rsrvs ($ Millions)	-	-$1.8	-$5.8	-$5.1	-$4.2	-$3.2	-$2.2	-$1.0	-	
Scenario B										
Water Rate Increases	**0%**	**3%**	**3%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**
CIP Funding ($ Millions)	$5.0	$6.0	$8.0	$13.0	$13.0	$13.0	$13.0	$13.0	$10.0	$9.0
Drawdown of Fund Rsrvs ($ Millions)	-	-$2.1	-$6.5	-$6.3	-$5.9	-$5.4	-$5.0	-$1.7	-	

In general, a delay or deferral of near-term rate increases would result in the need for higher percentage rate increases in future years. For example, if rate increases were deferred for two additional fiscal years until 2024/25 – with no rate increases for 3 years from 2021/22 through 2023/24 – future annual rate increases years would need to be a little higher (e.g. 8% per year in Scenario A) to generate the same level of annual CIP funding by 2030/31.

Water Use & Water Supply

As part of our analysis, Bartle Wells Associates reviewed the City's historical monthly water use and water supply data which is summarized on the tables on the following pages. The City's water use has remained relatively constant despite the coronavirus pandemic. Water use in fiscal year 2020/21 was only slightly higher than in 2018/19, the last full fiscal year prior to impact from the coronavirus pandemic, with a roughly 4% increase in residential usage more than offsetting a roughly 13% decrease in commercial use.

Water supply in recent historical years reflects the City's participation in the GSR Program and does not reflect future water supply assumptions. As noted, over the past five fiscal years, the City received a substantial amount of water from the SFPUC at no cost in return for a corresponding reduction in groundwater pumping.

Table 6 – Water Use by Month

	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total (hcf)	Total (AF)
2017/18 Water Use (hcf)														
Residential	98,929	84,385	105,093	82,391	98,284	74,142	88,842	71,291	85,285	68,624	85,930	76,210	1,019,406	2,340
Commercial	27,776	30,657	30,668	26,609	24,779	17,467	16,300	17,972	17,100	16,051	20,681	25,619	271,679	624
City	9,395	9,857	10,193	8,627	5,787	1,989	1,462	1,958	1,861	2,278	5,082	9,033	67,522	155
Total	136,100	124,899	145,954	117,627	128,850	93,598	106,604	91,221	104,246	86,953	111,693	110,862	1,358,607	3,119
2018/19 Water Use (hcf)														
Residential	99,235	83,302	108,893	81,401	107,093	74,114	96,641	69,252	82,283	65,068	90,124	75,180	1,032,586	2,370
Commercial	26,792	27,975	29,575	26,397	22,340	19,005	15,114	16,228	16,541	18,965	23,859	27,192	269,983	620
City	10,455	12,030	9,621	8,496	6,467	2,753	1,300	2,206	4,901	1,830	5,690	6,433	72,182	166
Total	136,482	123,307	148,089	116,294	135,900	95,872	113,055	87,686	103,725	85,863	119,673	108,805	1,374,751	3,156
2019/20 Water Use (hcf)														
Residential	104,044	82,122	105,703	82,444	99,083	74,819	86,683	69,158	86,527	72,266	99,115	79,921	1,041,885	2,392
Commercial	25,820	29,117	31,174	27,895	27,219	20,221	16,385	18,247	8,851	26,180	16,201	19,345	266,655	612
City	9,721	11,705	11,645	10,375	9,644	5,438	3,168	3,703	4,331	5,831	5,300	9,451	90,312	207
Total	139,585	122,944	148,522	120,714	135,946	100,478	106,236	91,108	99,709	104,277	120,616	108,717	1,398,852	3,211
2020/21 Water Use (hcf)														
Residential	108,328	88,279	113,474	85,834	106,905	76,531	93,931	70,930	88,345	69,007	97,563	77,828	1,076,955	2,472
Commercial	23,179	25,626	22,382	21,042	21,441	16,602	13,273	12,950	14,605	19,118	21,564	23,818	235,600	541
City	12,279	13,084	9,574	7,521	7,544	3,835	3,021	3,193	2,539	5,093	7,324	7,907	82,914	190
Total	143,786	126,989	145,430	114,397	135,890	96,968	110,225	87,073	105,489	93,218	126,451	109,553	1,395,469	3,204
2021/22 Water Use (hcf)														
Residential	99,080	77,895	97,460										274,435	630
Commercial	26,237	27,172	26,813										80,222	184
City	9,587	8,452	9,797										27,836	64
Total	134,904	113,519	134,070	-	-	-	-	-	-	-	-	-	382,493	878

Source: Based on monthly water use data provided by West Yost and the City of San Bruno.

Table 7 – Water Supply by Month

	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total (hcf)	Total (AF)
2017/18 Water Supply (hcf)														
Wells	12,930	13,080	13,036	13,253	11,747	13,486	8,840	14,262	13,061	14,323	13,494	13,829	155,341	357
SFPUC	113,342	135,352	130,261	109,369	97,616	105,668	91,871	87,626	93,886	92,934	122,593	129,285	1,309,803	3,007
NCCWD	2,043	2,044	2,029	2,028	1,977	1,976	1,860	1,859	1,836	1,836	1,961	1,962	23,411	54
Total	128,315	150,476	145,326	124,650	111,340	121,130	102,571	103,747	108,783	109,093	138,048	145,076	1,488,555	3,417
2018/19 Water Supply (hcf)														
Wells	12,768	4,124	14,166	6,508	13,484	14,709	6,853	13,580	14,364	15,582	13,649	9,825	139,612	321
SFPUC	119,235	136,866	119,224	97,586	104,661	99,365	94,911	86,332	94,926	102,297	113,596	129,565	1,298,564	2,981
NCCWD	2,057	2,056	3,888	1,638	1,638	1,071	1,071	975	975	946	946	1,234	18,495	42
Total	134,060	143,046	137,278	105,732	119,783	115,145	102,835	100,887	110,265	118,825	128,191	140,624	1,456,671	3,344
2019/20 Water Supply (hcf)														
Wells	1,227	14,456	11,484	7,453	10,864	-	13,174	13,809	14,703	1,282	12,824	9,030	110,306	253
SFPUC	131,267	137,064	122,585	115,869	108,311	120,738	83,960	105,336	107,464	106,008	125,419	136,511	1,400,532	3,215
NCCWD	1,234	1,502	1,503	873	874	885	885	946	947	1,163	1,164	1,172	13,148	30
Total	133,728	153,022	135,572	124,195	120,049	121,623	98,019	120,091	123,114	108,453	139,407	146,713	1,523,986	3,499
2020/21 Water Supply (hcf)														
Wells	14,349	12,423	14,479	14,520	14,105	13,412	14,091	17,765	15,635	5,342	10,500	18,783	165,404	380
SFPUC	128,986	135,657	110,866	109,817	109,187	99,794	82,640	94,325	105,412	118,954	122,494	110,268	1,328,400	3,050
NCCWD	1,172	1,172	1,172	1,176	1,175	841	841	1,043	1,044	1,043	1,044	1,050	12,773	29
Total	144,507	149,252	126,517	125,513	124,467	114,047	97,572	113,133	122,091	125,339	134,038	130,101	1,506,577	3,459
2021/22 Water Supply (hcf)														
Wells	69,697	78,147	73,858										221,702	509
SFPUC	68,454	60,969											129,423	297
NCCWD	1,051												1,051	2
Total	139,202	139,116	73,858	-	-	-	-	-	-	-	-	-	352,176	808

Source: Based on monthly water use data provided by West Yost and the City of San Bruno.

Conclusions

The of City of San Bruno has historically provided proactive financial stewardship by adopting gradual annual water rate increases to support the funding needs of its water enterprise. In recent years, the water enterprise has accrued a significant level fund reserves due a number of factors including a temporary deferral of capital improvement project funding and participation in the GSR Agreement with SFPUC which has resulted in reduced SFPUC water supply costs over the past 5 fiscal years. The City's water enterprise is currently in strong financial health but faces substantial capital improvement funding needs over the next decade and beyond as identified in the Water System Master Plan.

BWA developed financial and rate projections to support the water enterprise's future costs of service including the Water System Master Plan CIP. The projections indicate the City can address its future funding needs by drawing down a portion of its fund reserves while phasing in a series of gradual annual water rate increases over the next decade. This memo presents financial and rate projections under two scenarios including a scenario designed to support full funding of the Water System Master Plan CIP and a reduced rate scenario with future rate increases limited to 5%. Under the reduced rate scenario, the City would still be able to support a substantial level of capital funding over the next decade; however the lower level of rate increases would ultimately support a lower level of future annual CIP funding.

The rate projections presented in this technical memorandum are for planning purposes only. In general, BWA recommends agencies adopt smaller, gradual rate increases most years to support projected funding needs and keep rates in line with the cost of providing service. Going forward, the City can conduct a more-detailed water rate study when needed to evaluate options for future rate increases. In general, a delay or deferral of near-term rate increases would result in the need for higher percentage rate increases in future years.

WE SUPPORT OUR COMMUNITIES

WE ARE WATER FOCUSED

WE TAKE PRIDE IN WHAT WE DO

WE STRIVE TO BECOME OUR BEST

WE DO WHAT'S RIGHT

WE BELIEVE IN QUALITY

WE LISTEN

WE SOLVE CHALLENGING PROBLEMS

WE SEE THE BIGGER PICTURE

WE TAKE OWNERSHIP

WE COLLABORATE

WE HAVE FUN

WE ARE WEST YOST

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