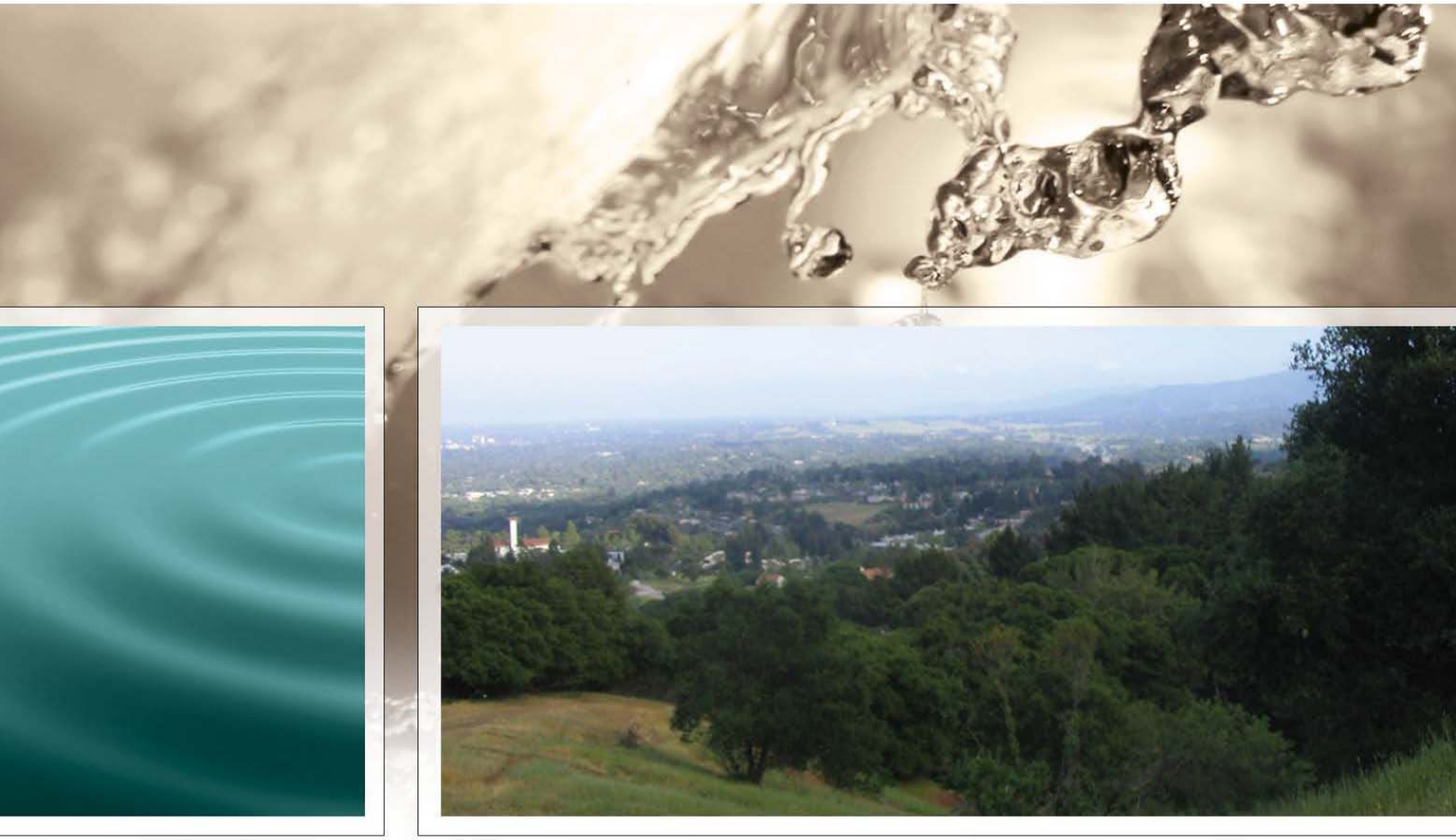

CITY OF SAN BRUNO

Water System Master Plan

WEST YOST ASSOCIATES

WATER SYSTEM MASTER PLAN

Prepared for

City of San Bruno

November 2012

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ES.1 WATER SYSTEM MASTER PLAN PURPOSE AND BENEFIT (CHAPTER 1)

This Water System Master Plan for the City of San Bruno (City) identifies strategies for maintaining and improving water system performance to meet existing and future water demands and guide 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 Fiscal Year (FY) 2034/35, consistent with the City's 2011 Urban Water Management Plan. Demand projections represent buildout of the City's General Plan and Transit Corridors Plan (*i.e.*, FY 2029/30) and also include additional water demands for future development through FY 2034/35;
- Evaluating and summarizing the City's available water supply sources including the proposed Regional Groundwater Storage and Recovery Project;
- Developing a calibrated distribution system hydraulic model using the City's geographical information system (GIS) and data collected during fire flow testing;
- Establishing Master Plan key assumptions, including developing performance and operational criteria for evaluating water system capacity, summarizing criteria from the City's previously completed seismic vulnerability assessment, and establishing criteria for identifying rehabilitation and replacement needs;
- Preparing a comprehensive system evaluation that addresses capacity, operational and seismic reliability, and rehabilitation and replacement needs for existing and FY 2034/35 conditions; and
- Developing a capital improvement program for recommended existing and future water system improvements.

The resulting Water System Master Plan CIP 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 ensures that projects are also efficiently coordinated to minimize overlaps; and
- **Balanced** – ensures that the City improves all facets of water service using available funding over time.

This Water System Master Plan is an update of the City's 2001 Water System Master Plan and will provide a comprehensive road map for the City's water system for the next 20 plus years. The following sections provide a brief summary of the key findings and recommendations from the evaluations completed in this Water System Master Plan.

ES.2 EXISTING WATER SYSTEM OVERVIEW (CHAPTER 2)

The City's water service area, which is about 5.5 square miles, is 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 and higher density residential, commercial, and institutional land uses in the east.

The City's service area includes 11 pressure zones and is served by approximately 120 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 26 pressure regulating stations. The City's key water system facilities were assessed during site visits conducted in the field on May 25, 2011. Significant findings and recommendations from these site visits are discussed in Chapter 2, and incorporated into rehabilitation and replacement project recommendations. Copies of the completed facility assessment forms have been provided to the City in a separate volume.

ES.3 MASTER PLAN TIMEFRAME AND PROJECTED DEMANDS (CHAPTER 3)

Existing (FY 2009/10) average daily water use for the City is 3.65 million gallons per day (mgd). However, water use to represent existing conditions for this Water System Master Plan was based on FY 2001/02 water production data (4.22 mgd) for consistency with water demand projections presented in the City's 2011 UWMP.

This Water System Master Plan evaluates system needs through FY 2034/35, consistent with the timeframe presented in the City's 2011 UWMP, which was adopted by the City Council in June 2011. The City's average daily water use is expected to increase to 5.13 mgd by FY 2034/35. Growth within the City is projected to occur due to development projects such as the mixed-use Transit Corridors Area Specific Plan development and other smaller new residential, commercial and office developments.

ES.4 AVAILABLE WATER SUPPLIES (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 (Regional System), 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.

Based on the available water supply sources listed above, the City is projected to have adequate supplies to meet water demands through the Water System Master Plan timeframe of FY 2034/35.

The City, City of Daly City and California Water Service Company (Cal Water) (purveyor for the City of South San Francisco) are considering participation in the SFPUC's Regional Groundwater Storage and Recovery Project (Regional Project). All three partner agencies operate groundwater wells located in the South Westside Basin, and also purchase surface water from SFPUC, delivered through its Regional System.

The proposed Regional Project is an in-lieu groundwater recharge program that would have two operating conditions, 'put' operations, in normal and wet years, and 'take' operations, in dry years. During put operations, SFPUC would provide additional surface water to the three partner agencies in order to reduce their groundwater pumping. During take operations, the City, City of Daly City, and Cal Water would utilize available groundwater supplies and reduce surface water deliveries, thereby freeing surface water supply to be delivered to other SFPUC customers. Under the proposed Regional Project, SFPUC would also construct new groundwater production well facilities, which would either be operated by the partner agencies or by SFPUC.

Results from the Conjunctive Use Pilot Project conducted during 2002 through 2005 showed that water can be successfully stored in the aquifer system through in-lieu recharge. The potential for success of an in-lieu project in the City continues to be studied, focusing on the impact of the extraction (Take Period) portion of the project. To date, Cal Water, the City of Daly City, and the City have not negotiated final agreements with SFPUC regarding a long-term conjunctive use program, though discussions are on-going. The Water System Master Plan bases future system analysis on 'put' operations, which would be the typical operating mode in most years.

ES.5 DEVELOPING A DISTRIBUTION SYSTEM HYDRAULIC MODEL (CHAPTER 5)

A comprehensive distribution system hydraulic model was developed from the City's geographic information system (GIS). West Yost verified the model system configuration (pipelines sizes, alignments, connections, and other facility sizes and locations), allocated existing 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 during the Master Plan. In developing 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, the hydraulic model provides a good tool for master planning purposes.

ES.6 ESTABLISHING THE MASTER PLANNING KEY ASSUMPTIONS (CHAPTER 6)

This Water System Master Plan presents a comprehensive assessment of the City's water distribution system, covering three different technical areas:

- Capacity Improvement Program, based on an evaluation to assess storage and pumping and regulating station facilities;
- Reliability Improvement Program, based on an evaluation of system operational reliability, assessed using the system hydraulic model, and seismic reliability, summarized from the City's 2003 Seismic Vulnerability Assessment; and
- Renewal and Replacement Program, based on a focused evaluation of pipelines, and key system facilities.

This chapter defines the key master planning assumptions for these three evaluations, including recommended performance and operational criteria for the City's water distribution system, seismic vulnerability criteria, as identified in the previous Seismic Vulnerability Assessment, and pipeline and facility replacement criteria used to develop a pipeline and facility rehabilitation and replacement program.

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 2001 Water System Master Plan. However, some of the previous water system design and operational criteria have been revised to reflect either more recent or more stringent standards for this Water System Master Plan.

ES.7 KEY TECHNICAL FINDINGS (CHAPTERS 7 AND 8)

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

- **System Capacity and Operational Reliability Evaluation:** While the City's existing distribution system has adequate capacity and reliability for normal operational needs, the City's most significant reliability 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 force. 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 reliability, particularly in older areas near the downtown area, where most pipelines are 2-inch and 4-inch diameter. Replacement of pipelines for fire flow reliability purposes also supports the need to replace aging pipelines.
- **Seismic Vulnerability Evaluation**. As identified in the City's 2003 Seismic Vulnerability Assessment, the City's distribution system storage tanks need reinforcement to minimize their vulnerability during seismic events. A number of other seismic improvements, such as reinforcing pipelines at fault crossings, restraining equipment at existing facilities and providing emergency generators, are also recommended.
- **Pipeline and Facility Renewal and Rehabilitation Program**. The City should prioritize main replacements in older areas of the system with smaller-diameter pipeline that has higher leak rates. The City should continue its ongoing well, pump station, tank and regulating station rehabilitation programs, and plan for longer-term replacement of some tanks.

These findings are discussed in greater detail below.

ES.7.1 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 Evaluation of the Existing Water*

System and *Chapter 8 Evaluation of Future Water System* evaluates system storage, peak pumping capacity and peak valve station capacity needs to meet system requirements.

The analysis also evaluates system reliability by hydraulically evaluating the system to assess hydraulic performance under peak hour and maximum day plus fire flow conditions.

Using the newly developed and calibrated hydraulic model, system evaluations were performed to identify system reliability improvements needed to meet the City's recommended performance and planning criteria. The system reliability analysis evaluated facilities and pipeline performance, assessing system flow and pressure for normal and emergency operations, and system redundancy and reliability. This analysis evaluated the City's water system under both existing and FY 2034/35 water demand conditions.

A majority of the improvements identified from the system capacity and reliability analysis were required to meet existing fire flow criteria. These projects also support the City's renewal and replacement of aging pipelines. Other system capacity improvements are also recommended to meet the required system supply capacity. A summary of the recommended capacity and reliability capital improvement projects, including the reason for each improvement group, is provided in Table ES-1.

Table ES-1. Summary of Recommended Capacity Improvement Projects

Improvement Group	Reason	Capital Cost, $M [a,b]
Pressure Regulating Station Capacity Improvements	Fire Flow– needed to provide additional supply capacity to zones to meet fire flows.	$5.8
Well, Storage and Pumping Capacity Improvements	Well, Storage and Pumping Capacity – need to provide adequate supply and storage capacity to more reliably supply customers	$12.2
Miscellaneous Capacity Improvements	Pressure Deficiencies and System Capacity – Needed to meet customer pressures and maintain system capacity to maintain and improve customer service during normal and emergency operations	$6.4
Future System Capacity Improvements	Growth and Supply Capacity for Regional Project – Needed to meet future growth. Improvements assume implementation of the Regional Groundwater Storage and Recovery Project and are needed to better supply Zone 1/4 and provide adequate storage during 'put' operations when surface water is provided in lieu of groundwater. Projects also address specific needs in the Transit Corridors Specific Plan Area.	$11.0
	Total	$35.3

(a) Costs shown are based on the December 2011 SF ENR CCI of 10205.

(b) Costs include base construction costs plus mark-ups equal to 62.5 percent for construction contingencies and project implementation.

ES.7.2 Operational and Seismic Reliability Improvement Program

The operational reliability analysis evaluates the performance of the City's water system to meet the City's recommended performance and planning criteria under existing and buildout water demand conditions. This analysis, documented in *Chapter 7 Evaluation of the Existing Water System* and *Chapter 8 Evaluation of Future Water System* evaluates operational reliability by assessing hydraulic performance of the distribution system under peak hour and maximum day plus fire flow conditions.

Using the newly developed and calibrated hydraulic model, system evaluations were performed to identify operational reliability improvements needed to meet the City's recommended performance and planning criteria. The reliability analysis evaluated facilities and pipeline performance, assessing system flow and pressure for normal and emergency operations, and system redundancy and reliability. This analysis evaluated the City's water system under both existing and FY 2034/35 water demand conditions.

A majority of the improvements identified from the operational reliability analysis are needed to meet existing fire flow criteria. These projects also support the City's ongoing renewal and replacement for aging infrastructure.

G&E Engineering Systems Inc. completed a Seismic Vulnerability Assessment for the City's existing water system facilities in 2003. Although the City has formulated and budgeted seismic improvement work, most projects identified from the Seismic Vulnerability Assessment have yet to be completed.

Since the current seismic vulnerability assessment was completed over eight years ago, West Yost recommends that a new seismic vulnerability assessment be conducted to more accurately identify the necessary seismic improvements required to meet current code requirements. Once the new seismic vulnerability assessment is completed, the CIP developed for this Water System Master Plan will need to be updated accordingly to include any seismic improvements that have been recommended. A summary of the recommended system and seismic reliability capital improvement projects is provided in Table ES-2.

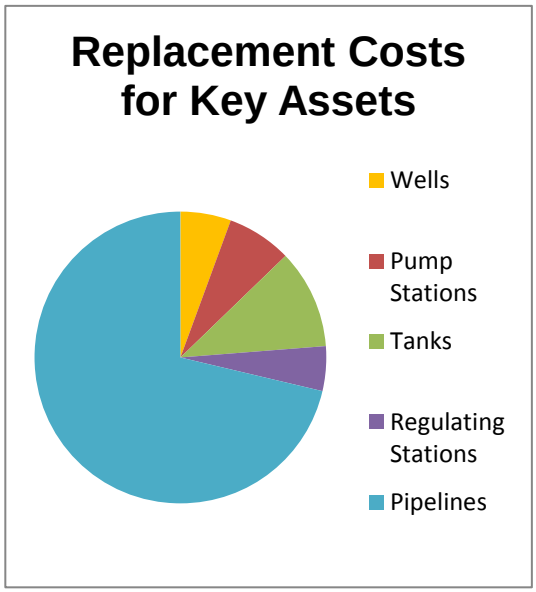
Table ES-2. Summary of Recommended Operational and Seismic Reliability Improvement Projects

Improvement Description	Improvement Reason	CIP Cost, $M[a,b]
Pipeline Reliability Improvements Priority 1	Fire Flow – highest priority to replace pipelines in areas where fire flows are 1/3 or less than current standards. Projects also address pipeline renewal and replacement needs.	$21.3
Pipeline Reliability Improvements Priority 2	Fire Flow – lower priority fire flow improvements where fire flows are less than current standards. Projects also address pipeline renewal and replacement needs.	$14.7
Tank Modification/ Seismic Retrofit	Reduce seismic vulnerability of tanks by providing seismic retrofits.	$3.0
Seismic Vulnerability Assessment Update	Re-evaluate key system facilities for latest seismic codes	$0.1
Pipeline Seismic Improvement Project	Reinforce pipelines at fault crossings.	$2.0
	Total	$41.1

(a) Costs shown are based on the December 2011 SF ENR CCI of 10205.
(b) Costs include base construction costs plus mark-ups equal to 62.5 percent for construction contingencies and project implementation.

ES.7.3 Rehabilitation and Replacement Program

The water system is a valuable asset, with a replacement value of approximately $223M in current dollars, for system pipelines and key facilities (wells, pump stations, tanks, pressure regulating stations).



A rehabilitation and replacement analysis was performed for pipelines using pipeline age and leak history data to assess pipeline replacement needs. Based on a review of the available pipeline leak history data, it was determined that there was a strong correlation of leaks with pipeline age and diameter. It was found that older pipelines, which were also typically smaller in diameter, had more leaks per length of pipe. Therefore, the recommended pipeline renewal and replacement projects target areas with older, small-diameter pipelines.

A rehabilitation and replacement analysis was performed for water system facilities using facility age and condition data 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. A summary of the recommended rehabilitation and replacement improvement projects to

address the water system renewal and replacement needs is provided in Table ES-3. This table does not include pipelines that were also identified as deficient in the reliability analysis. Most of the high priority pipeline reliability projects are also high priority for rehabilitation and replacement.

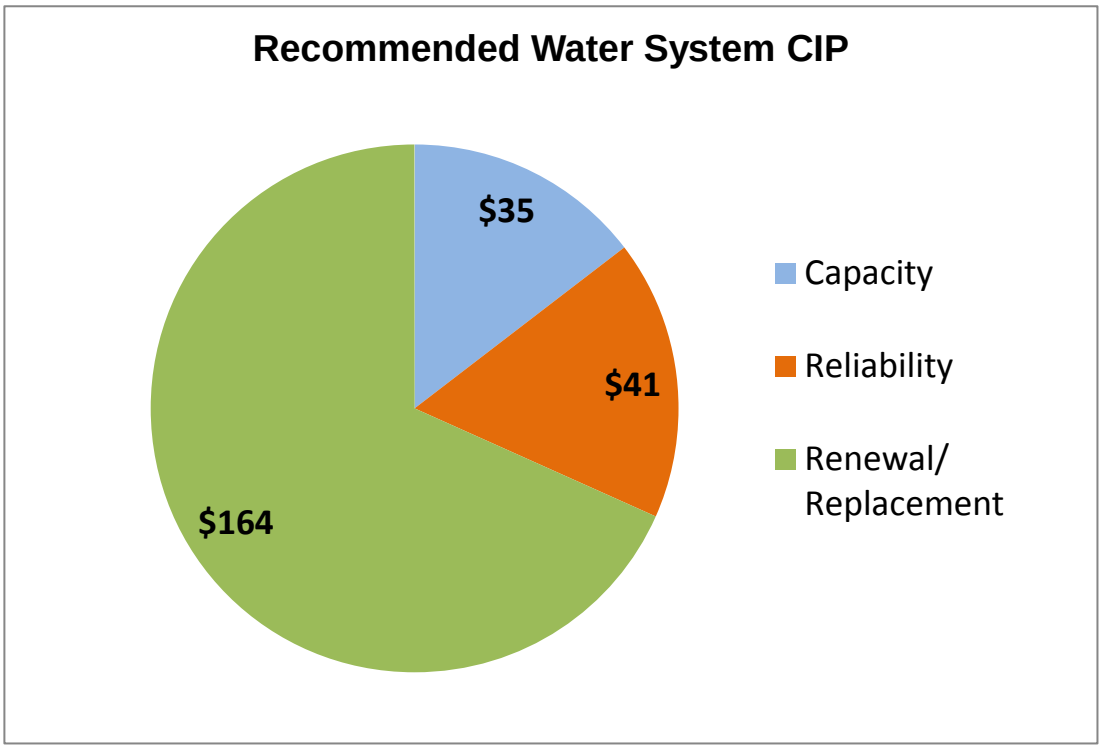
Table ES-3. Summary of Recommended Rehabilitation and Replacement Improvement Projects

Improvement	Reason for Improvement	CIP Cost, $M [a,b]
Rehabilitation and Replacement Pipeline Improvements Priority 1	Replacement of small-diameter pipelines (4-inch diameter and smaller) with highest leak history	$16.4
Rehabilitation and Replacement Pipeline Improvements Priority 2	Replacement of remaining small-diameter pipelines	$4.5
Rehabilitation and Replacement Pipeline Improvements Priority 3	Replacement of other pipelines. Budgeting placeholder with priorities to be established by the City	$100.2
Well, Storage, and Pumping Rehabilitation and Replacement Improvements	Rehabilitation and replacement of wells, storage tanks and pump stations to maintain facility reliability	$32.0
Miscellaneous Rehabilitation and Replacement Improvements	Maintain and replace ancillary water distribution system equipment to maintain system reliability	$10.6
	Total	$163.7

(a) Costs shown are based on the December 2011 SF ENR CCI of 10205.
(b) Costs include base construction costs plus mark-ups equal to 62.5 percent for construction contingencies and project implementation.

ES.8 CAPITAL IMPROVEMENT PROGRAM (CHAPTER 9)

The recommended water system CIP totals $240M in three program areas, as described in Section E.S.7, and as shown on the chart below. Figures ES-1, ES-2, ES-3 and ES-4 illustrate the locations of the recommended CIP improvement projects. Of the projects that were identified in the CIP, the projects required to mitigate existing system deficiencies would be funded from



rates. The projects required to meet water demands from future growth should be funded through development impact fees and would be funded as conditions of approval for new developments. However, depending on the timing of existing system improvements and new development, developers may need to incorporate improvements designated for the existing system to meet planned development needs.

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-4 provides a detailed list of projects, and 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-4. Recommended Implementation Schedule for Capital Improvement Program[a]

CIP ID	Improvement Type	Improvement Description	Capital Cost (includes mark-ups)[b,c,d]	2012-2016	2017-2021	Long-Term
Capacity Capital Improvement Projects						
Pressure Regulating Station Capacity Improvements						
EXCIP-RS-1	RS Upgrade	Upgrade existing RS 2 in Z12 with a 4-inch and an 8-inch valve.	439,000		439,000	
EXCIP-RS-2	RS Upgrade	Upgrade existing RS 15 with 2-inch and 6-inch valves for fire flow into Z8A.	439,000		439,000	
	Upsize Pipeline	Upsize 710' of pipeline to 8" by RS15.	208,000		208,000	
EXCIP-RS-3	RS Upgrade	Upgrade existing RS 13 with 2-inch and 6-inch valves for fire flow into Z7A.	439,000		439,000	
EXCIP-RS-4	RS Upgrade	Upgrade RS 17 with 2-inch and 6-inch valves.	439,000		439,000	
EXCIP-RS-5[h]	RS Upgrade	Upgrade RS 7 with 4-inch and 8-inch valves.	439,000		439,000	
	Upsize Pipeline	Upsize 480' of pipelines to 8" by RS 7.	141,000		141,000	
EXCIP-RS-6	New RS	Rebuild and reactivate RS 11 for fire flow service from Z7 to Z6.	439,000		439,000	
EXCIP-RS-7[h]	New RS	Install new RS at Claremont Drive and Plymouth Way to serve the Crestmoor area of Z6 with fire flow.	439,000		439,000	
EXCIP-RS-8	New RS	Install new RS at Susan Drive and Sharp Park Road to provide fire flow service from Z11 to Z10.	439,000		439,000	
	New Pipeline	Install 540' of new 8" pipeline from Z11 to Z10.	157,000		157,000	
EXCIP-RS-9	New RS	Install new RS at Westborough Boulevard and Fleetwood Drive to provide fire flow service from Z10 to Z9.	439,000		439,000	
	New Pipeline	Install 1,680' of new 8" pipeline between Z9 and Z10.	493,000		493,000	
EXCIP-RS-10	New RS	Install new RS at Oakmont Drive and Evergreen Drive to provide fire flow service from Z10 to Z8.	439,000		439,000	
EXCIP-RS-11	New RS	Install new RS at Piedmont Avenue and Madison Avenue to provide fire flow service from Z7 to Z6.	439,000		439,000	
EXCIP-CITY-12	RS Upgrade	Construct Cedar Mills Regulating Station; design has been completed and project is ready for construction; funds have already been encumbered	0		0	
		SUBTOTAL	5,828,000	0	5,828,000	0
Well, Storage, and Pumping Capacity Improvements						
EXCIP-W-1	New Well	New well in Z1/4; location to be determined	2,500,000	2,500,000		
EXCIP-T-1	New Storage Tank	Proposed new 1.4 MG storage tank in Z3/5.	4,942,000			4,942,000
	New Pump Station	New booster pump station in Z3/5 with firm capacity of 4.3 mgd.	2,776,000		2,776,000	
	New Pipeline	540' of proposed new 12" pipeline in Z3/5.	211,000			211,000
EXCIP-PS-1	New Pump	New booster pump at PS4 to increase flow capacity; to be implemented as part of Project EXCIP-CITY-4.	82,000		82,000	
	New Pipeline	Upsize 450' of pipeline to 12" by PS4.	173,550		173,550	
EXCIP-CITY-3	New Pump Station	Hydropneumatic pump station to supply NCCWD-supplied area directly from the City's system to eliminate surcharges to customers for NCCWD water	1,455,000		1,455,000	
		SUBTOTAL	12,140,000	2,500,000	4,487,000	5,153,000
Miscellaneous Capacity Improvements						
EXCIP-MISC-1	Re-zoning	Rezone a portion of Z1/4 to Z2	313,000			313,000
EXCIP-CITY-1	SCADA Radio	Radio transmission for the SCADA system to improve reliability	130,000			130,000
EXCIP-CITY-2	Groundwater Study	Groundwater Sustainability Study - Identify potential locations and production capacity for a new well for redundancy and groundwater reliability	110,000			110,000
EXCIP-CITY-5	Turnout Improvement	SFPUC Turnout Improvements Project - Install four vaults and associated pressure regulating facilities on four of five SFPUC turnouts, which are currently unregulated; vaults to include backflow	468,000	468,000		
EXCIP-CITY-13	Meter Infrastructure Upgrade	Advanced Water Meter Infrastructure Project that will enable City to remotely read the City's 12,200 water meters by installing two radio towers, a number of signal repeaters, and a regional network interface for data storage	2,970,000		2,970,000	
EXCIP-CITY-14	Standby Generation	Standby Generation Project - Provide backup power at well and booster pump stations that currently do not have standby generation or engine-driven pumping facilities to provide for backup during emergencies (Wells 16 and 18, Pump Stations 1, 2, 3 and 4), as well as one new portable diesel engine-driven pump	2,344,000		2,344,000	
EXCIP-CITY-21	Security Improvement	Security improvements at water system tanks, pump stations and wells; possible facilities improvements include security cameras, improved fencing, lighting improvements and more secure facility	100,000			100,000
		SUBTOTAL	6,435,000	468,000	5,314,000	653,000
Future System Capacity Improvements						
FUTCIP-T-1	New Tank	Proposed 1.0 MG new storage tank in Z1/4	4,388,000			4,388,000
	New Booster Pump Station	New booster pump station in Z1/4 with firm capacity of 4.3 mgd	2,776,000			2,776,000
	New Pipeline	Connect proposed Z1/4 Tank into the future water system with 2,090' of 12" pipeline	815,000			815,000
FUTCIP-P-1	Upsize Pipeline	Upsize 800' of existing 8" diameter pipeline near RS 25 to 12" diameter pipeline	312,000			312,000
FUTCIP-P-2	New Pipeline	Construct 7,000' of new 12-inch diameter pipeline to provide looping in the Transit Corridors Area, as identified in the Transit Corridors Plan.	2,700,000			2,700,000
		SUBTOTAL	10,991,000	0	0	10,991,000
		CAPACITY CAPITAL IMPROVEMENT PROJECTS TOTAL	**35,394,000**	**2,968,000**	**15,629,000**	**16,797,000**
Reliability Capital Improvement Program						
Pipeline Reliability Improvements Priority 1[e]						
EXCIP-P1-1	Upsize Pipeline	Upsize 6,480' of pipeline to 8" in Z1/4 at Cedar, Maple, Cherry, Chestnut, Beech, Oak, Hazel, and Acacia, all north of Jenvein; Chestnut between Kains and Park; Williams west of Cypress.	1,895,000	1,895,000		
EXCIP-P1-2	Upsize Pipeline	Upsize 5,730' of pipeline in Z2 to 8" on Donner at Niles, between Donner and Glen, Parkview, Glen, and Santa Lucia west of Parkview.	1,676,000	1,676,000		
	Upsize Pipeline	Upsize 3,040' of pipeline in Z2 to 10" near Pepper and Cedar, Hawthorne at Redwood, Redwood from Hawthorne to Niles.	1,037,000	1,037,000		
EXCIP-P1-3	Upsize Pipeline	Upsize 6,240' of pipelines to 8" in Z1/4 on Sylvan east of San Mateo, Huntington from Sylvan to north of San Felipe, Milton south of Sylvan, San Anselmo at Mastick, Florida at Milton, Texas, Terrace, Cupid, Georgia at Milton, San Anselmo and San Felipe, and East at Chapman. Approximately 300 feet within Transit Corridors Plan Area on Sylvan, east of San Mateo, short segment on San Anselmo.	1,824,000	1,824,000		
	New Pipeline	Install 250' of new 12" pipeline in Z1/4 between the south ends of 1st St and 2nd St, north of Well 20.	97,000	97,000		
EXCIP-P1-4	Upsize Pipeline	Upsize 7,850' of pipeline in Z1/4 to 8" on Linden from Kains to north of San Felipe, Angus, Acacia at Angus, El Camino Real and Alley, Poplar south of Crystal Springs, Elm at Crystal Springs, and Acacia at Crystal Springs. Approximately 3,900 feet within Transit Corridors Plan Area along Linden between Kains and Crystal Springs, short segment on Angus.	2,296,000		2,296,000	
EXCIP-P1-5	Upsize Pipeline	Upsize 9,030' of pipeline in Z1/4 to 8" at Cypress, Acacia, Elm, Poplar, and Linden, all south of San Felipe; Santa Lucia from Balboa to El Camino Real; Linden from Santa Lucia to Elamita; Lomita at Linden; Elamita.	2,641,000		2,641,000	
EXCIP-P1-6	Upsize Pipeline	Upsize 7,710' of pipeline in Z7 to 8" at Alpine, El Dorado, Crestmoor from El Dorado to Bryant; Kent, Ridgeway, Yorkshire, Rosewood, Bennington, Cambridge, Bryant, London, and Oxford, all at Crestmoor; Piedmont at Madison, and south end of Darby.	2,254,000		2,254,000	
	Upsize Pipeline	Upsize 800' of pipelines in Z7 to 10" at Piedmont from Crestmoor to RS 13 by Madison.	274,000		274,000	
	Upsize Pipeline	Upsize 2,660' of pipeline in Z7 to 12" on Glenview from RS 9 to Ridgeway, Skyline from Ridgeway to Bryant, Bryant from Skyline to Crestmoor.	1,037,000		1,037,000	
	Upsize Pipeline	Upsize 2,260' of pipeline in Z7 to 14" at Crestmoor from Bryant to Darby, and on Darby.	956,000		956,000	
EXCIP-P1-7	Upsize Pipeline	Upsize 8,980' of pipeline to 8" in Z1/4 on El Camino Real, Hensley, Green, and Masson, all north of Kains; El Camino Real, Hensley, Green, Masson, all north of Angus; Kains from El Camino Real to San Mateo; San Mateo from Kains to Angus; Angus from El Camino Real to San Mateo. Approximately 6,400 feet within Transit Corridors Plan Area on El Camino, Hensely, Kains, Sylvan, Huntington, Angus, San Mateo.	2,627,000		2,627,000	
	New Pipeline	60' of proposed new 8" pipeline in Z1/4 on El Camino Real at Kains.	16,000		16,000	
EXCIP-P1-8	Upsize Pipeline	Upsize 8,990' of pipeline to 8" in Z1/4 on Huntington, Tanforan west of Herman, Pacific, Atlantic, E Huntington north of Scott, Herman from Tanforan to Buena Vista, Buena Vista and Diamond, Montgomery from Scott to Walnut, Hermosa, Walnut at Montgomery, San Mateo, Hermosa, and San Mateo from Scott to north of Atlantic. Approximately 300 feet within Transit Corridors Plan Area on Walnut, west of San Mateo, Montgomery, between I-380, Huntington between Scott and Bayshore, Tanforan to Huntington continuing to Bayshore.	2,628,000		2,628,000	
		SUBTOTAL	21,258,000	6,529,000	14,729,000	
Pipeline Reliability Improvements Priority 2[f]						
EXCIP-P2-Z1/4	Upsize Pipeline	Upsize 7,310' of pipeline to 8" in Z1/4.	2,137,000		2,137,000	
	Upsize Pipeline	Upsize 1,480' of pipeline to 10" in Z1/4.	504,000		504,000	
EXCIP-P2-Z2	Upsize Pipeline	Upsize 4,150' of pipeline to 8" in Z2.	1,215,000		1,215,000	
	Upsize Pipeline	Upsize 420' of pipeline to 12" in Z2.	164,000		164,000	
EXCIP-P2-Z6	Upsize Pipeline	Upsize 8,740' of pipeline to 8" in Z6.	2,558,000		2,558,000	
	Upsize Pipeline	Upsize 1,300' of pipeline to 10" in Z6.	445,000		445,000	
EXCIP-P2-Z8	Upsize Pipeline	Upsize 3,900' of pipeline to 8" in Z8.	1,141,000		1,141,000	
EXCIP-P2-Z9	Upsize Pipeline	Upsize 660' of pipeline to 8" in Z9.	192,000		192,000	
EXCIP-P2-Z10	Upsize Pipeline	Upsize 7,140' of pipeline to 8" in Z10.	2,088,000		2,088,000	
	Upsize Pipeline	Upsize 1,820' of pipeline to 10" in Z10.	622,000		622,000	
EXCIP-P2-Z11	Upsize Pipeline	Upsize 1,800' of pipeline to 8" in Z11.	525,000		525,000	
	Upsize Pipeline	Upsize 2,790' of pipeline to 10" in Z11.	952,000		952,000	
	Upsize Pipeline	Upsize 2,990' of pipeline to 12" in Z11.	1,165,000		1,165,000	
EXCIP-P2-Z12	Upsize Pipeline	Upsize 3,500' of pipeline to 8" in Z12.	1,024,000		1,024,000	
EXCIP-JL[g]	Upsize Pipeline	Upsize 1,700' of pipeline to 12" in Z12.	0		0	
		SUBTOTAL	14,732,000	0	14,732,000	0

Table ES-4. Recommended Implementation Schedule for Capital Improvement Program[a]

CIP ID	Improvement Type	Improvement Description	Capital Cost (includes mark-ups)[b,c,d]	2012-2016	2017-2021	Long-Term
Seismic Reliability Improvements						
EXCIP-CITY-6	Tank Modifications/Seismic Retrofit Program	Evaluate and improve the ability of the City's existing storage tanks to withstand earthquakes and provide for ongoing maintenance and rehabilitation of tanks to maintain their condition; $965,000 has already been encumbered	3,046,000	3,046,000		
EXCIP-CITY-15	Seismic Assessment	Update the City's 2003 Seismic Vulnerability Assessment, based on current code requirements, which would include more comprehensive hazard review and updates to critical pipeline, tank and structural analyses based on the updated hazard assessment, as recommended in the 2003 Assessment	100,000			100,000
EXCIP-CITY-20	Seismic Pipeline Improvements	Seismic upgrades to water lines in vicinity of or crossing fault lines along San Bruno Avenue and Sneath Lane; 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; a budget placeholder is provided in this master plan. Costs to be developed in more detail in Seismic Vulnerability Assessment, EXCIP-CITY-15	2,000,000			2,000,000
		SUBTOTAL	5,146,000	3,046,000	0	2,100,000
		OPERATIONAL AND SEISMIC RELIABILITY CAPITAL IMPROVEMENT PROJECTS TOTAL	**41,136,000**	**9,575,000**	**29,461,000**	**2,100,000**
Rehabilitation and Replacement Capital Improvement Projects						
Pipeline Rehabilitation and Replacement Improvements Priority 1[i]						
RR-P1-1	Upsize Pipeline	Replace 5,030' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-3. Approximately 600 feet within Transit Corridors Plan Area.	1,470,000	1,470,000		
RR-P1-2	Upsize Pipeline	Replace 6,760' of small diameter pipeline with 8" pipeline. Approximately 2,900 feet within Transit Corridors Plan Area.	1,977,000	1,977,000		
RR-P1-3	Upsize Pipeline	Replace 14,380' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-4	4,206,000	2,206,000	2,000,000	
RR-P1-4	Upsize Pipeline	Replace 2,660' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-8. Approximately 500 feet within Transit Corridors Plan Area.	779,000		779,000	
RR-P1-5	New Pipeline	Replace 4,475' of small diameter pipeline with 8" pipeline	1,309,000	1,309,000		
RR-P1-6	Upsize Pipeline	Replace 3,290' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-1 and part of EXCIP-P1-4	961,000	961,000		
RR-P1-7	Upsize Pipeline	Replace 6,800' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-5 and part of EXCIP-P1-4	1,989,000		1,989,000	
RR-P1-8	Upsize Pipeline	Replace 4,800' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-7. Approximately 3,600 feet within Transit Corridors Plan Area.	1,408,000		1,408,000	
RR-P1-9	Upsize Pipeline	Replace 7,900' of small diameter pipeline with 8" pipeline	2,315,000			2,315,000
		SUBTOTAL	16,414,000	7,923,000	6,176,000	2,315,000
Pipeline Rehabilitation and Replacement Improvements Priority 2[j]						
RR-P2	Upsize Pipeline	Replace 15,460' of small diameter pipeline with 8" pipeline	4,522,000		2,000,000	2,522,000
		SUBTOTAL	4,522,000	0	2,000,000	2,522,000
Pipeline Rehabilitation and Replacement Pipeline Improvements Priority 3[k]						
RR-P3	Upsize Pipeline	Replace 240,860' of 6" and 8" pipeline with new 8" pipeline	70,450,000			
	Upsize Pipeline	Replace 32,810' of 10" pipeline with new 10" pipeline	11,198,000			
	Upsize Pipeline	Replace 35,150' of 12" pipeline with new 12" pipeline	13,709,000			
	Upsize Pipeline	Replace 11,150' of 14" pipeline with new 14" pipeline	4,711,000			
	Upsize Pipeline	Replace 110' of 16" pipeline with new 16" pipeline	48,000			100,116,000
		SUBTOTAL	100,116,000	0	0	100,116,000
Well, Tank and Pump Station Rehabilitation and Replacement Improvement Projects						
EXCIP-CITY-10	Replace Well	Abandon and replace existing Well 15, which is out of service; total cost is $3.2M, of which $0.2M has already been encumbered	3,000,000	3,000,000		
EXCIP-CITY-11	Rehabilitate Wells	Well Rehabilitation program that 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 five years, with replacement as needed	3,300,000	500,000	600,000	2,200,000
EXCIP-CITY-7	Replace Tank	Replace Tank 3, which is in poor structural condition to maintain system reliability and restore tank's full capacity; total cost is $2.5M, of which $1.3M has already been encumbered	1,200,000	1,200,000		
RR-T-2	Rehabilitate Tank	Tank Re-coating program to re-coat interior and exterior of above-grade steel tanks (T1, T4, T6, T6A, T7, T9, and T10); budgeting assumes two future re-coating projects within Master Plan	800,000	400,000		400,000
RR-T-3	Replace Tank	Tank replacement program to replace tanks that have reached the end of their useful lives; budgeting includes replacement of three tanks (T4, T6 and T7) within Master Plan timeframe	7,049,000			7,049,000
EXCIP-CITY-22	Rehabilitate Pump Stations	Improve and rehabilitate the City's pump stations to maintain pump station condition and performance	14,000,000	2,600,000		11,400,000
EXCIP-CITY-4	Upgrade Pump Station 4	PS4 College rehabilitation including replacement or upgrade of existing pumps, motors and controls that are reaching the end of their useful life to maintain reliability for Z11; this project to incorporate Project EXCIP-PS-1; total project is $3.7M, of which $2.0M has already been encumbered	1,700,000	1,700,000		
EXCIP-CITY-18	Rehabilitate Pressure Regulating Stations	Improve and rehabilitate the City's pressure reducing stations to maintain pressure reducing station performance	1,000,000			1,000,000
		SUBTOTAL	32,049,000	9,400,000	600,000	22,049,000
Miscellaneous Rehabilitation and Replacement Projects						
EXCIP-CITY-9	Update CMMS	Update the Computerized Maintenance Management System (CMMS) with geographical information from the City's GIS, and provide unique identification numbers for facilities in the CMMS	95,000			95,000
EXCIP-CITY-16	Upgrade Meter	Retrofit existing customer meters with cathodic protection in corrosive soils areas; $1 million is assumed for budgeting purposes, as more detailed analysis would be required for specific locations	1,000,000			1,000,000
EXCIP-CITY-17	Upgrade Meter	Replace existing water meters with Sensus Mag meter technology	7,287,000			7,287,000
EXCIP-CITY-8	Repair Pipeline	Spot repairs for the Spyglass neighborhood and on Merion Drive	500,000	500,000		
EXCIP-CITY-19	Replace Pipeline	Replace or slip-line the existing 14-inch pipeline from Station 2 to Tank 7 - the existing pipeline is in poor condition; cost reflects pipeline replacement cost for conservative estimate	1,743,000			1,743,000
		SUBTOTAL	10,625,000	500,000	0	10,125,000
		REHABILITATION AND REPLACEMENT CAPITAL IMPROVEMENT PROJECTS TOTAL	**163,726,000**	**17,823,000**	**8,776,000**	**137,127,000**
		CAPITAL IMPROVEMENT PROGRAM TOTAL	**240,256,000**	**30,366,000**	**53,866,000**	**156,024,000**

[a] Costs shown are based on the December 2011 SF ENR CCI of 10205.
[b] Costs include mark-ups equal to 62.5 percent (Design and Construction contingency: 30 percent of construction cost; Professional Services: 25 percent of construction cost plus construction contingencies).
[c] Total rounded to nearest $1,000.
[d] CIP Costs shown for City-Identified Projects are revised and do not include the funds already allocated toward the projects.
[e] Pipeline projects with P1 identifiers are Priority 1 (highest priority) projects. These projects are listed in order of priority, so that areas that are most deficient receive highest priority.
[f] Pipeline projects with P2 identifiers are Priority 2 (lower priority) projects. Each program lists the total pipeline length by pressure zone. Specific projects and sequencing to be determined by the City. Pipelines within these projects that overlapped with Rehabilitation and Replacement Pipeline Priority 1 projects have been excluded.
[g] Existing system fire flow improvement requires upsize to 8" diameter pipeline, if Jail Line Project does not proceed. If the Jail Line Project does proceed, future system peak hour capacity requires upsize to 12" diameter pipeline, which is estimated to be $770,000 after a 62.5 percent mark-up, and is to be funded by SFPUC.
[h] Project previously identified as part of Crestmoor evaluation and is currently under design.
[i] Pipeline projects with P1 identifiers are Priority 1 (highest priority) projects. These projects are listed in order of priority, so that areas with the poorest leak history and oldest pipelines receive highest priority. Only pipelines 4-inch and less in diameter are included, excluding parallel pipelines. Pipelines within these projects that overlapped with Capacity Pipeline Improvement Priority 1 projects have been excluded.
[j] Rehabilitation and Replacement Pipeline Improvements Priority 2 is one step lower in priority. This project is comprised of the rest of the pipelines 4-inch and less in diameter throughout the entire system, excluding parallel pipelines, that were not included in capacity pipeline improvement projects.
[k] Rehabilitation and Replacement Pipeline Improvements Priority 3 (lowest priority) is comprised of the rest of the pipelines throughout the entire system, excluding parallel pipelines, that were not included in Priority 1 or 2, or in any capacity pipeline improvement projects.

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 9-1_CapacityImpCIP.mxd 10/17/2012

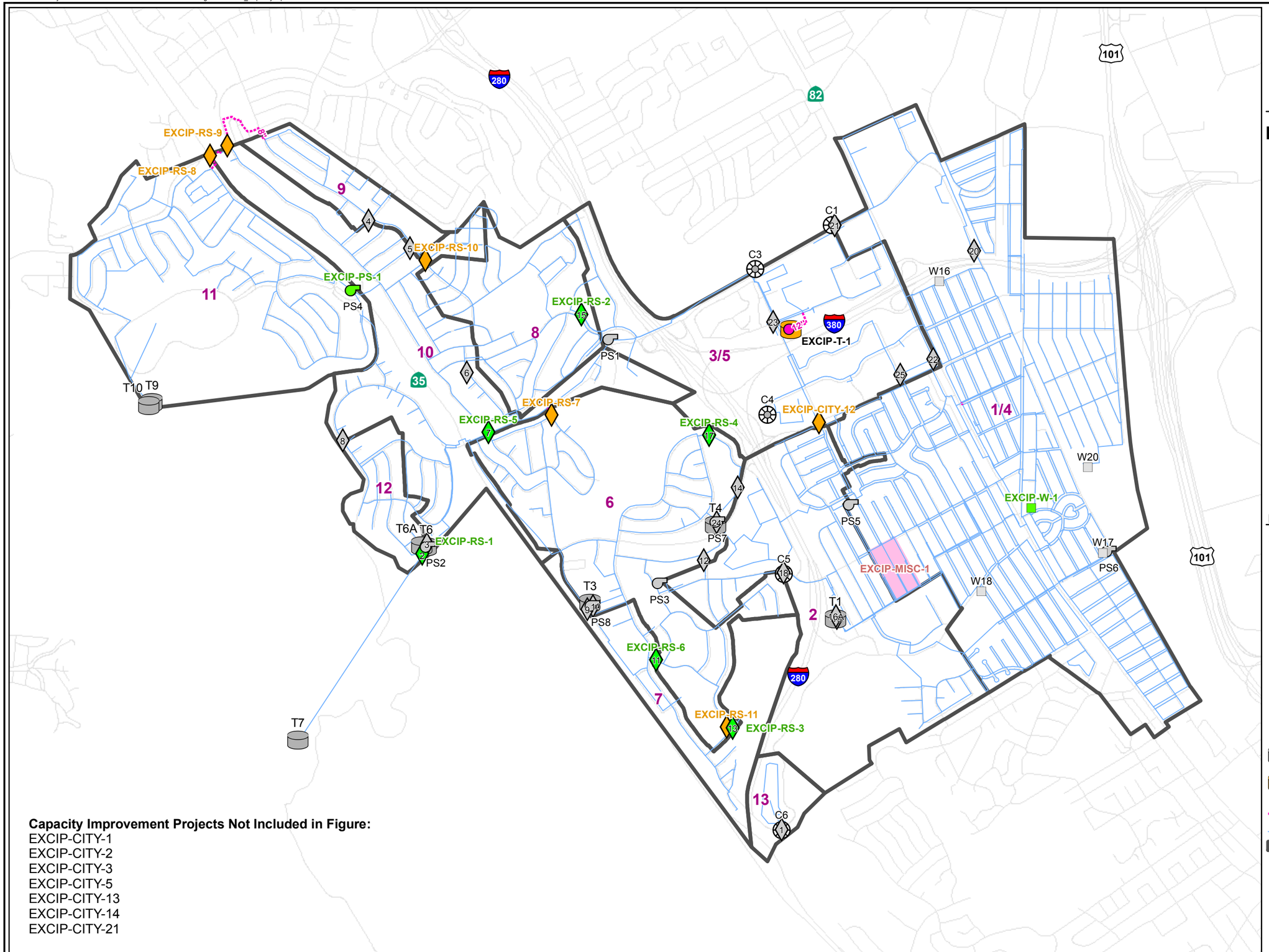


FIGURE ES-1

City of San Bruno
Water System Master Plan

RECOMMENDED EXISTING SYSTEM CAPACITY IMPROVEMENTS

N

0 880 1,760

Scale in Feet

Notes
1. Location of EXCIP-W-1 to be determined.

LEGEND

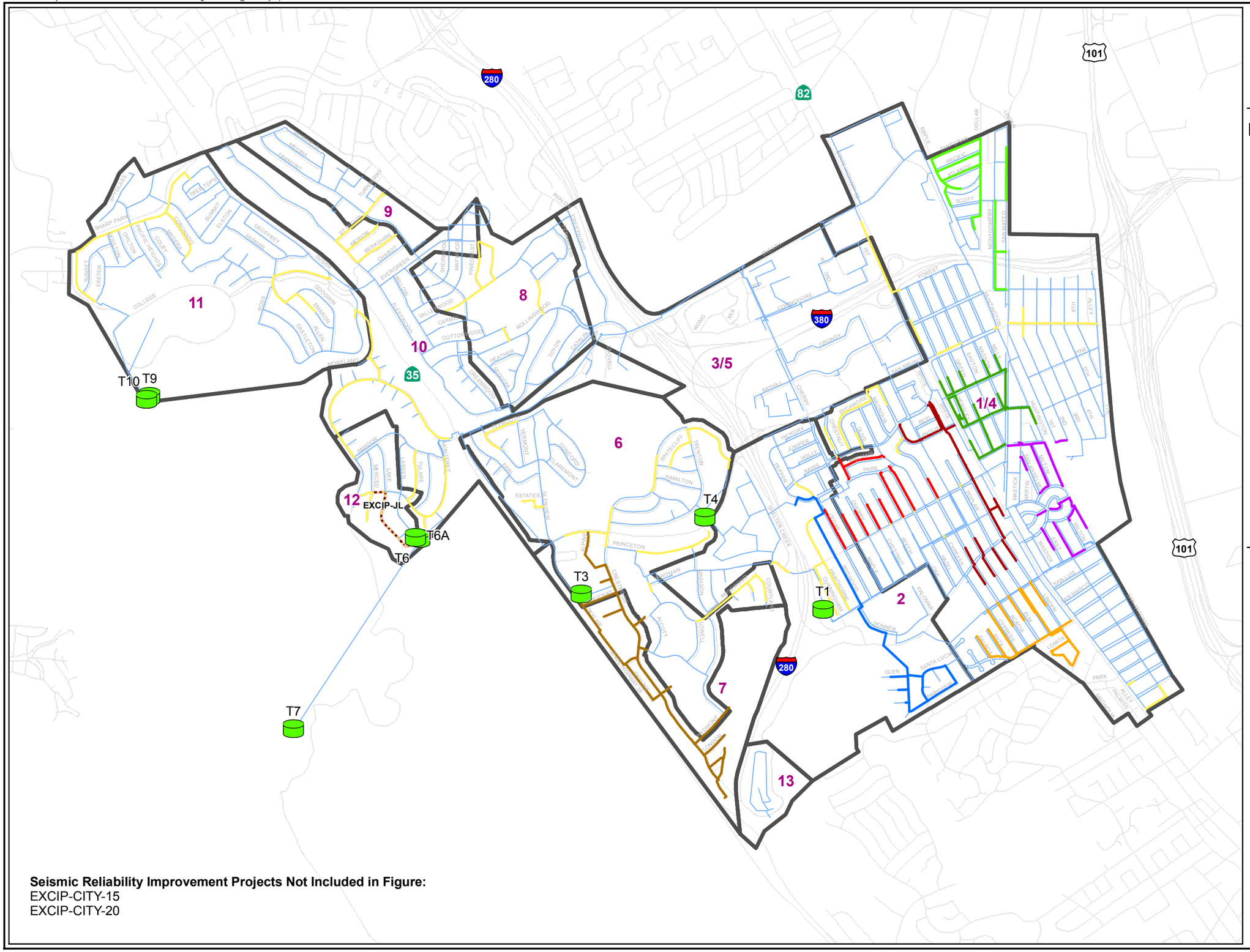
- Turnout
- Existing Well
- Proposed New Well
- Ex. Pressure Reg. Sta. (RS)
- Proposed Pressure RS Upsize
- Proposed New Pressure RS
- Ex. Booster Pump Sta. (PS)
- Proposed Booster PS Upsize
- Proposed New Booster PS
- Existing Storage Tank
- Proposed New Storage Tank
- Pipeline Improvement Associated With Tank, PS, or RS Improvement
- Water Main
- Pressure Zone Boundary

Capacity Improvement Projects Not Included in Figure:
EXCIP-CITY-1
EXCIP-CITY-2
EXCIP-CITY-3
EXCIP-CITY-5
EXCIP-CITY-13
EXCIP-CITY-14
EXCIP-CITY-21

CITY OF SAN BRUNO

WEST YOST ASSOCIATES

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 9-2_ReliabilityImpCIP.mxd 10/17/2012



Seismic Reliability Improvement Projects Not Included in Figure:
EXCIP-CITY-15
EXCIP-CITY-20

FIGURE ES-2

City of San Bruno
Water System Master Plan

RECOMMENDED EXISTING SYSTEM RELIABILITY IMPROVEMENTS

N

0 880 1,760
Scale in Feet

Notes
1. Pipeline improvements based upon Maximum Day Demands Plus Fire Flow evaluation.
2. Existing Maximum Day Demand is 6.33 mgd.
3. Assumes storage tank levels are half full, and available duty pumps are operating for pipeline improvements.
4. Results based on NO pipeline velocity constraint, but a minimum residual pressure of 20 psi was required.
5. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown on this figure.
6. EXCIP-P2 projects are grouped by pressure zone.

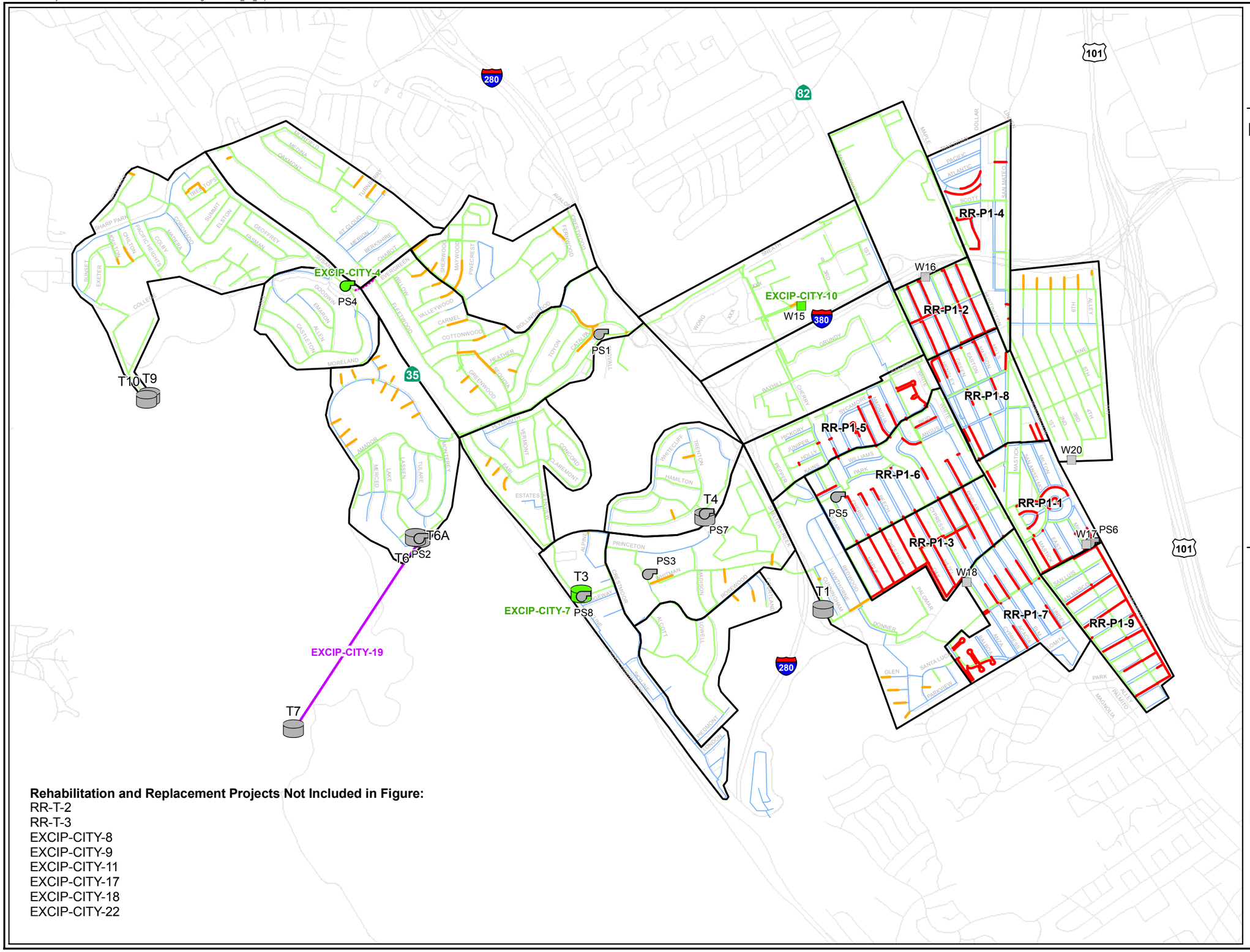
LEGEND

Seismic Reliability
- T-PROP-01

Pipeline Reliability
- EXCIP-P1-1
- EXCIP-P1-2
- EXCIP-P1-3
- EXCIP-P1-4
- EXCIP-P1-5
- EXCIP-P1-6
- EXCIP-P1-7
- EXCIP-P1-8
- EXCIP-P2
- EXCIP-JL
- Existing Pipeline
- Street
- Pressure Zone Boundary

WEST YOST ASSOCIATES

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 9-3_RR_ImpCIP.mxd 10/18/2012



Rehabilitation and Replacement Projects Not Included in Figure:

RR-T-2
RR-T-3
EXCIP-CITY-8
EXCIP-CITY-9
EXCIP-CITY-11
EXCIP-CITY-17
EXCIP-CITY-18
EXCIP-CITY-22

FIGURE ES-3

City of San Bruno Water System Master Plan

RECOMMENDED EXISTING SYSTEM REHABILITATION AND REPLACEMENT IMPROVEMENTS

N

0 880 1,760

Scale in Feet

Notes

1. Rehabilitation/Replacement (R/R) projects are grouped by subdivion boundaries.
2. Pipelines in both R/R Priority 1 program and the Reliability Priority 1 program are shown and budgeted in the Reliability Program. Likewise, projects in the R/R Priority 2 or 3 programs and in the Reliability Priority 2 program are budgeted and shown in the Reliability Program. See Figure 7-11 for all projects in the R/R program.

LEGEND

- Existing Well
- Well Replacement
- Ex. Booster Pump Sta. (PS)
- Booster PS Upgrade
- Existing Storage Tank
- Storage Tank Replacement
- RR-P1
- RR-P2
- RR-P3
- EXCIP-CITY-19
- Pipeline Improvement Associated With Tank, PS, or RS Improvement
- Water Main
- Subdivision
- Street

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 9-4_CIPFutSys.mxd 10/18/2012

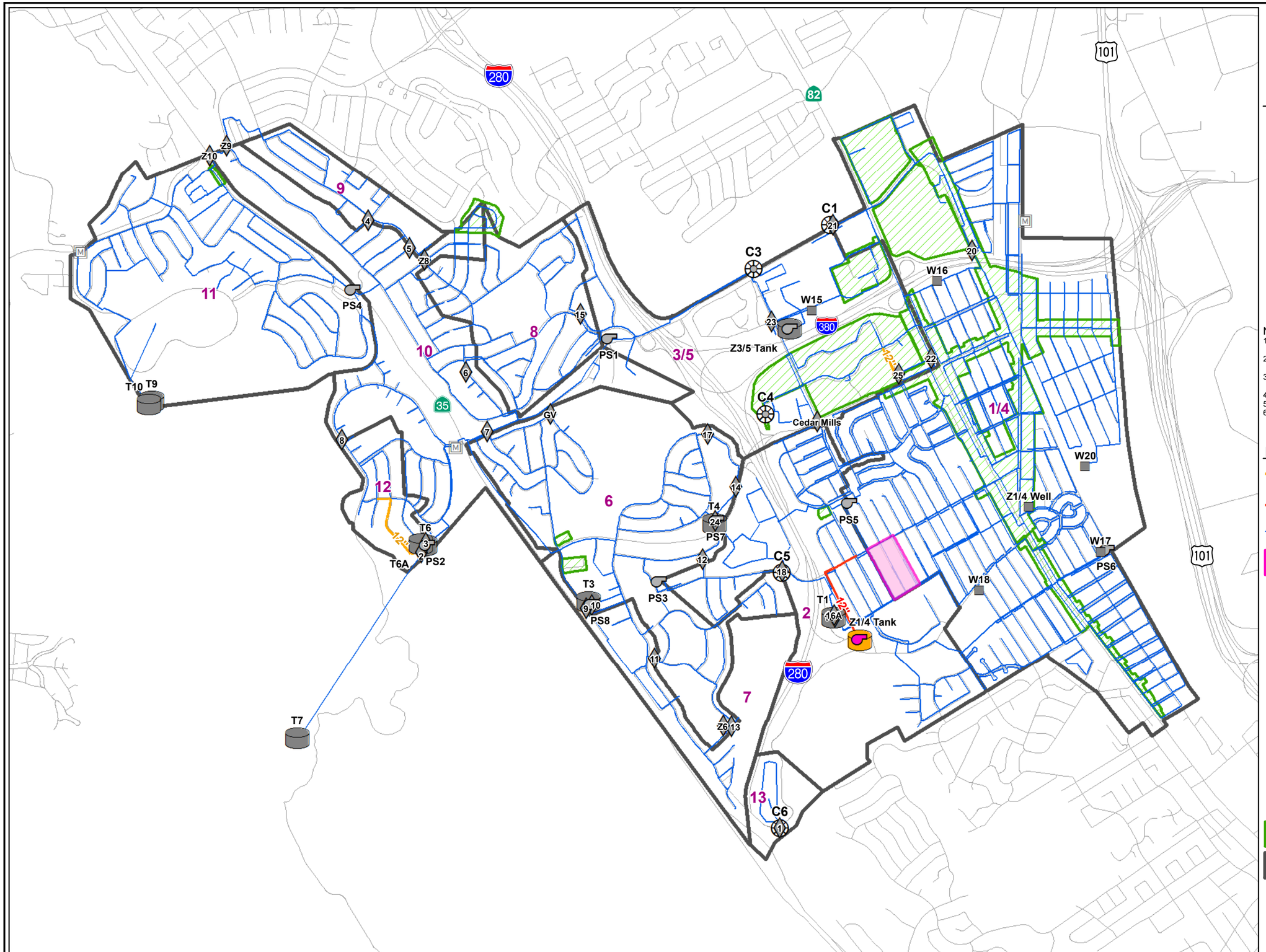


FIGURE ES-4

City of San Bruno
Water System Master Plan

RECOMMENDED WATER SYSTEM IMPROVEMENTS FUTURE SYSTEM

N

0 880 1,760

Scale in Feet

Notes
1. Future system improvements based on storage capacity evaluation and peak hour demand evaluation.
2. Peak hour demand evaluation assumes storage tanks are half full, and pump stations are operating at firm capacity.
3. Peak hour demand evaluation based on a future "put" operational scheme where groundwater use will be minimized.
4. Tank 3 was assumed to be replaced.
5. Pipelines selected for abandonment are not shown.
6. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

- Future System Pipeline Upsize
- Future System New Pipeline
- Pipeline
- Proposed Area for Rezoning
- Turnout
- Well
- Pressure Regulating Station
- Booster Pump Station (PS)
- Future System Booster PS
- Storage Tank
- Future System Storage Tank
- Emergency Connection
- Anticipated Development Area
- Pressure Zone Boundary

City of San Bruno

WEST YOST ASSOCIATES

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 Fiscal Year 2034/35 (consistent with the City's 2011 UWMP);
- Evaluating and summarizing the City's available water supply sources including the proposed Regional Groundwater Storage and Recovery Project;
- Developing a calibrated distribution system hydraulic model using the City's geographical information system (GIS) and data collected during fire flow testing;
- Establishing performance and operational criteria for evaluating the water system and identifying deficiencies as well as new facility needs, and developing a project prioritization methodology to provide a balanced capital improvement program (CIP);
- Preparing a capacity and operational reliability evaluation for existing and future FY 2034/35 water demand conditions to identify the City's water distribution system pipeline and facility needs;
- Reviewing and summarizing the existing seismic vulnerability assessment for water system wells, tanks, pump stations, and pipelines;
- 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 2001 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 Associates (West Yost) to prepare this Water System Master Plan on March 31, 2011.

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:	Water System Master Plan Key Assumptions
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:	Summary of Hydrant (C-factor) Test Results
Appendix B:	Cost Estimating Assumptions

1.3 ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations have been used throughout this Water System Master Plan to improve document clarity and readability.

ABAG	Association of Bay Area Governments
AC	Asbestos Cement
af/yr	Acre-Feet Per Year
BART	Bay Area Rapid Transit
BAWSCA	Bay Area Water Supply and Conservation Agency
Cal Water	California Water Service Company
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
CMMS	Computerized Maintenance Management System
DICL	Ductile Iron Cement Lined

DMM	Demand Management Measures
DOF	Department of Finance
DSS	Decision Support System
DWR	Department of Water Resources
ENR	Engineering News Record
ft	feet
ft/s	Feet Per Second
ft/kft	Feet Per Thousand Feet
FY	Fiscal Year
gpcd	Gallons Per Capita Per Day
gpm	Gallons Per Minute
GIS	Geographic Information System
GWMP	Groundwater Management Plan
HGL	Hydraulic Grade Line
ISG	Individual Supply Guarantee
MG	Million Gallons
mgd	Million Gallons Per Day
msl	Mean Sea Level
NAVD 88	National American Vertical Datum of 1988
NCCWD	North Coast County Water District
PGA	Peak Ground Acceleration
PS	Pump Station
psi	Pounds Per Square Inch
PVC	Polyvinyl Chloride
RS	Regulating Station
RTUs	Remote Terminal Units
SCADA	Supervisory Control and Data Acquisition
SFPUC	San Francisco Public Utilities Commission
SOI	Sphere of Influence
sq ft	Square Feet
SWRCB	State Water Resources Control Board
UAFW	Unaccounted for Water
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
UWMP	Urban Water Management Plan
Westside Basin	Westside Groundwater Basin
WSA	Water Supply Agreement
WSIP	Water System Improvement Program

1.4 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:

- Klara Fabry, Public Services Director
- Mark Reinhardt, Water System and Conservation Manager
- Martin Cardone, Water Services Manager
- Will Anderson, Associate Civil Engineer
- Frank Ingersoll, Maintenance Worker II
- Mark Sullivan, Housing and Redevelopment Manager
- Jim Shannon, Management Analyst
- Ray Razavi, Acting City Engineer

CHAPTER 2
Existing Water System Inventory

This chapter describes the City's existing water distribution system. Water system information was initially 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 May 25, 2011. Significant findings and recommendations from the site visits are included in the following sections below. Copies of the completed facility assessment forms have been provided to the City in a separate binder.

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 5.5 square miles and is concurrent with the city limits as shown on Figure 2-1. 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 and higher density residential, commercial, and institutional land uses in the east.

2.1.1 Pressure Zone Boundaries

There are eleven 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, and Zones 3 and 5 were also consolidated and are called Zone 3/5. 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.

Table 2-1. Summary of Existing Pressure Zones[a]

Pressure Zone	Range of Service Elevations, feet msl	HGL of Tank, Regulating Station or Turnout, feet msl	Static Service Pressures, psi	Water Supply Source(s)
Zone 1/4	5-164	247	36-105	SFPUC (Tanforan (C1) and Whitman (C5)) Turnouts[b] Pump Station 6 (Well 17) Wells 16,18, and 20
Zone 2	85-250	346	42-113	SFPUC (Whitman (C5)) Turnout Pump Station 5
Zone 3/5	45-335	455	52-177	SFPUC (Rollingwood (C3) and Bayhill (C4)) Turnouts
Zone 6	240-465	545	35-132	Pump Station 3 Pump Station 7
Zone 7	460-555	671	50-91	Zone 10 via Regulating Station 9
Zone 8	250-515	603	38-153	Zone 10 via Regulating Station 6
Zone 9	480-520	618	42-60	Zone 10 via Regulating Station 4
Zone 10	505-615	771	68-115	Pump Station 1 Pump Station 8
Zone 11	595-745	845	43-108	Pump Station 4
Zone 12	600-800	954	67-153	Pump Station 2 via Tank 7 and Regulating Station 2
Zone 13	400-425	539	49-60	NCCWD (Crystal Springs (C6)) Turnout via Regulating Station 1

[a] Source: Urban Water Management Plan, Public Review Draft, EKI (May 2011). Service elevations from Zones 8 and 13 were adjusted based on a review of static service pressures.
SFPUC = San Francisco Public Utilities Commission
NCCWD = North Coast County Water District
msl = mean sea level
psi = pounds per square inch
[b] Tanforan (C1) Turnout is an emergency turnout to provide fire supply to Tanforan Shopping Center. Whitman (C5) Turnout serves Zone 1/4 via Tank 1.

2.2 SERVICE CONNECTIONS AND POPULATION SERVED

This section summarizes the existing number of services and population served within the City. 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, is provided in *Chapter 3 Water Demands*.

2.2.1 Existing Service Connections

The City currently has six different customer sectors, which make up its 12,145 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 93 percent of the City's service connections are either Single Family or Multi-Family residential.

Table 2-2. Existing Number of Service Connections by Customer Sector[(a,b)]

Customer Sector	Number of Connections	Percent of Total Connections
Residential Single Family	10,367	85.4
Residential Multi-Family	889	7.3
Commercial	531	4.4
Industrial	3	0.02
Institutional	235	1.9
Other (Irrigation)	120	1.0
Total	12,145	100.0

(a) Source: Urban Water Management Plan, Public Review Draft, EKI (May 2011).
(b) Data from Fiscal Year 2009-2010.

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, the population has stabilized due to a lack of available land. The current population has been estimated to be 41,114 based on 2010 Census data, according to the Department of Finance[1] (DOF). 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 – wholesale surface water purchased from San Francisco Public Utilities Commission (SFPUC), retail surface water purchased from North Coast County Water District (NCCWD), and groundwater produced from the City's wells. Currently, approximately half of the City's total water supply comes from purchased surface water, and the remaining supply comes from the City's groundwater wells.

[1] *E-5 Population and Housing Estimates for Cities, Counties, and the State, 2010-2011, with 2010 Benchmark.* State of California, Department of Finance (May 2011).

2.3.1 Surface Water

The City currently purchases wholesale 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 1,658 acre-feet per year (af/yr) from the SFPUC.[2]

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 47 af/yr from NCCWD.[3]

2.3.2 Groundwater

Since the early 1900s, the City has used groundwater as a source of water supply. The City currently pumps 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's groundwater wells produced approximately 2,370 af/yr in 2010.[4]

A more detailed description of the City's existing water supply is provided in *Chapter 4 Water Supply*.

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 diagram 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 May 25, 2011. 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.

[2] Source: Data (2010 water data.xls) provided by City staff on May 2, 2011.

[3] Source: Data (2010 water data.xls) provided by City staff on May 2, 2011.

[4] Source: Data (2010 water data.xls) provided by City staff on May 2, 2011.

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 currently supply approximately 50 percent of the City's annual water production.

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 retail surface water from NCCWD directly to Zone 13. This connection is equipped with a pressure reducing valve (*i.e.*, Regulating Station 1).

Table 2-3 presents a summary of the existing surface water supply turnouts with their key characteristics.

Table 2-3. Surface Water Supply Turnouts[a]

Turnout ID	Location	SFPUC Pipeline	Service Zone	Elevation, feet	HGL, feet	Pressure, psi[b]
C1 - Tanforan	Sneath Lane and National Avenue	Sunset Supply	1/4[c]	84	308	55[d]
C3 - Rollingwood	Sneath Lane and Cherry Avenue	San Andreas	3/5	127	455	142
C4 - Bayhill	West end of Bayhill Drive	San Andreas	3/5	154	455	130
C5 - Whitman	2001 Whitman Way	San Andreas	1/4 and 2[c]	252	450	86
C6 - Crystal Springs	2901 Crystal Springs Road	Obtained via NCCWD Connection	13	411	--	55[e]

(a) Source: Urban Water Management Plan, Public Review Draft, EKI (May 2011).
(b) Based on data provided by City staff on June 10, 2011.
(c) Turnout C1 is an emergency turnout for Tanforan Shopping Center. Turnout C5 serves Zone 1/4 via Tank 1 and also serves a small area of Zone 2.
(d) Turnout is regulated down to 55 psi.
(e) Turnout is regulated down to 55 psi

During West Yost's site visit on May 25, 2011, it was identified that all the surface water supply turnouts are not currently monitored for flow or pressure, and only Turnout C1 can be controlled using the City's Supervisory Control and Data Acquisition (SCADA) system. To provide additional water system operational flexibility, it is recommended that flow meters, and SCADA system and monitoring be installed at each turnout.

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. According to City staff, the emergency connections on Highland Drive (NCCWD) and San Mateo Avenue (Cal Water) have been inactive for many years.

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 1,520 to 1,570 gallons per minute (gpm), or about 2.2 million gallons per day (mgd). 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 plans to replace this well and has completed a preliminary study to evaluate potential well sites.

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

Table 2-4. Active Groundwater Wells[a]

Well ID	Pressure Zone	Ground Surface Elevation, feet msl	Year Built	Depth to Bottom of Casing, feet	Screened Interval, feet msl	Average Extraction Rate, gpm[b]
Well 16 - Forest Lane	1/4	40	1991	580	-295 to -555	440
Well 17 - Corporate Yard	1/4	15	1993	420	-290 to -505	220
Well 18 - Cypress	1/4	50	1995	480	-205 to -440	250 to 300
Well 20 - Lions Field	1/4	12	2002	640	-300 to -504	610

(a) Source: Urban Water Management Plan, Public Review Draft, EKI (May 2011).
(b) The average extraction rate represents the actual average pumping rate of each well from January 2000 through December 2005.

Observations made during West Yost's site visit indicate that the City's groundwater well facilities are generally well maintained and are used regularly to meet water system demands. City staff prefers to operate the groundwater wells continuously to avoid mechanical issues during start-up. Table 2-5 summarizes the key findings and recommendations from the groundwater well facility assessments performed on May 25, 2011.

Table 2-5. Summary of Groundwater Well Facility Assessments

Well ID	Age, years	Treatment System	Pump Efficiency, %[a]	Backup Power	Recommendation(s)
Well 15 – Commodore[b]	27	N/A	N/A	Quick Connect	Site appears to be suitable for a new replacement well.
Well 16 - Forest Lane	20	Iron and manganese removal and disinfection	64	Quick Connect	--
Well 17 – Corporate Yard	18	Disinfection	55	Emergency Generator	Monitor pump efficiency; replace if efficiency continues to decrease.
Well 18 - Cypress	16	Disinfection	55	Quick Connect	Monitor pump efficiency; replace if efficiency continues to decrease.
Well 20 - Lions Field	9	Iron and manganese removal and disinfection	64	Auxiliary Engine	--

(a) Based on pump efficiency tests performed in March 2010.
(b) Well is inactive as of May 2010; pump and motor have been removed. West Yost visited the site to evaluate existing conditions and to provide recommendation(s).

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 75 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 spiral-wire-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[a]

Storage Tank ID	Pressure Zone	Ground Surface Elevation, feet msl	Diameter, feet	Height, feet[b]	Capacity, MG[c]		
					Total	Operational Minimum	Operational Maximum
T1 - Cunningham Drive	1/4	231	116	32	2.5	0.94	1.95
T3 - Glenview Drive	6	530	109	30	2.0	0.83	1.10
T4 - San Bruno Avenue	2	330	75	32	1.0	0.63	0.84
T6 - Lake Drive South	10	755	47	32	0.4	0.25	0.34
T6A - Lake Drive North	10	755	75	32	1.0	0.63	0.84
T7 - Sweeney Ridge	12	1,250	47	32	0.4	0.25	0.34
T9 - Skyline West	11	825	48	40	0.5	0.28	0.46
T10 - Skyline East	11	825	48	40	0.5	0.28	0.46
				Total Capacity	8.3	4.09	6.33

(a) Source: Urban Water Management Plan, Public Review Draft, EKI (May 2011).
(b) Height measured to tank overflow.
(c) Minimum and maximum tank capacities were calculated from operational water levels.

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. However, Tanks 7, 9 and 10 have issues with turnover due to low demand. As of late summer 2010, the City has installed PAX Water Mixers to each storage tank to improve water quality. The City will continue the use of the PAX Water Mixers and monitor water quality at Tanks 7, 9 and 10. Table 2-7 summarizes the key findings and recommendations from the storage tank facility assessments performed on May 25, 2011.

As shown in Table 2-7, Tank 3 is the City's oldest tank and is showing signs of deterioration. Tank 3 is scheduled to be replaced in 2012.

It should be noted that steel storage tanks are typically designed for a service life of 40 to 60 years with periodic maintenance including painting. As shown in Table 2-7, all of the City's steel tanks are at their typical steel tank design life. However, the latest inspections for the City's steel tanks indicate that all of the facilities are in good condition and that only routine maintenance activities (*i.e.*, interior and exterior painting) are recommended in the near future.

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	47	✓	✓		EBAA connection is scheduled for installation in 2011.
T3 - Glenview Drive	60	✓	✓	✓	Scheduled for replacement in 2012; site has space for additional storage.
T4 - San Bruno Avenue	49	✓	✓		--
T6 - Lake Drive South	49	✓			--
T6A - Lake Drive North	41	✓	✓		--
T7 - Sweeney Ridge	56	✓	✓		Monitor water quality due to low tank turnover.
T9 - Skyline West	41	✓	✓		Monitor water quality due to low tank turnover.
T10 - Skyline East	41	✓	✓		Monitor water quality due to low tank turnover.

(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 the City's groundwater supply wells and the SFPUC connections to the City's various pressure zones and storage tanks. With the exception of pump numbers 1 and 2 at Pump Station (PS) 5 and PS 6, all of the remaining booster pumps are vertical turbine, constant speed pumps, which range in size from 30 to 125 horsepower. Pump numbers 1 and 2 at PS 5 were upgraded to variable speed pumps in 2009, and pump numbers 1 and 2 at PS 6 are horizontal, split-case centrifugal pumps that operate at variable 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[a]

Pump Station ID	Source Pressure Zone	Service Pressure Zone	Ground Surface Elevation, feet msl	Number of Pumps	Nominal Pump Capacity, gpm[b]	Total Dynamic Head, feet	Horsepower
PS1 - Sneath Lane	3/5	10	295	3	570/750/750	345/500/500	60/125/125
PS2 - Lake Drive	10	12	745	2	600	580	100
PS3 - Whitman Way	2	6	330	2	300	100	30
PS4 - Pacific Heights/College	10	11	560	2	600	100	30
PS5 - Maple Avenue	1	2	95	3	500/600/600	165	60
PS6 - Corporate Yard	--	1/4	10	3	500/500/[c]	277/277/[c]	50/50/60
PS7 - San Bruno Avenue[d]	2	6	330	2	700	269	60
PS8 - Glenview Drive[e]	6	10	530	2	620	269	60

(a) Source: Urban Water Management Plan, Public Review Draft, EKI (May 2011).
(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) Nameplate was painted over; illegible. Pump is inactive and not connected to the clearwell.
(d) Equipped with a diesel 75 horsepower auxiliary pump.
(e) 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 May 25, 2011.

2.4.5 Pressure Regulating Stations

The City's water distribution system currently includes 26 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 2-9. Summary of Booster Pump Station Facility Assessments

Pump Station ID	Pump Efficiency, %[a]	Backup Power	Recommendation(s)			Comment(s)
			SCADA Flow Monitoring	Replace MCC	Flexible Connections for Suction/Discharge Pipe	
PS1 - Sneath Lane	59/49/71[b]	Quick Connect	✓	✓		Monitor pump efficiency; replace if efficiency continues to decrease.
PS2 - Lake Drive	64/57	Quick Connect (portable generator on-site)	✓	✓	✓	Monitor pump efficiency; replace if efficiency continues to decrease.
PS3 - Whitman Way	32/45	Quick Connect	✓	✓	✓	Pump efficiencies are low; replace if efficiency continues to decrease.
PS4 - Pacific Heights/College	46/37	Quick Connect	✓	✓	✓	Scheduled for replacement in 2012.
PS5 - Maple Avenue	63/42/56	Auxiliary Engine (portable generator on-site)				Pump efficiencies are low for new pumps; recommend re-testing.
PS6 - Corporation Yard	51/53	Emergency Generator		✓		Monitor pump efficiency; replace if efficiency continues to decrease.
PS7 - San Bruno Avenue	68/72	Emergency Pump				--
PS8 - Glenview Drive	71/70	Emergency Pump				--

[a] Based on pump efficiency tests performed in March 2010. Data presented that are separated by a slash indicate the individual characteristics of different pumps within the pump station.
[b] Pump 1B has been replaced since the last pump efficiency test performed in March 2010.

Table 2-10. Pressure Regulating Stations[a]

Station ID	Location	Function	Elevation, feet	Size	Pressure Setting, psi	Status
RS1	2901 Crystal Springs Road	Reduces pressure from NCCWD Turnout C6 to Zone 13	412	6”	55	Active
RS2	Lake Street Upper Vault (PS 2)	Reduces pressure from Tank 7 to Zone 12	792	4” / 2”	65 / 70	Active
RS3	Lake Street Lower Vault (PS 2)	Emergency bypass from Tanks 6 and 6A to Zone 12	736	4” / 2” 4” relief	90 / 96 113	Standby
RS4	2401 Oakmont	Reduces pressure from Zone 10 to Zone 9	502	6” / 2” 2” relief	45 / 50 113	Active
RS5	2600 Chabot Drive	Reduces pressure from Zone 9 to residences 2110 thru 2220 Oakmont Dr. and Monte Verde Park (Zone 9A)	479	6” / 2”	85 / 90	Active
RS6	1581 Greenwood Way	Reduces pressure from Zone 10 to Zone 8	548	6” / 4” 2” relief	19 / 24 20	Active
RS7	2850 Sneath Lane	Reduces pressure from Zone 10 to Zone 6	430	4” 2” relief	40 48	Standby
RS8	Sneath and Stanislaus	Reduces pressure from Zone 12 to Zone 12A	630	6” / 2” 2” relief	50 / 55 65	Active
RS9	760 Glenview Drive (PS 8)	Reduces pressure from Pump Station 8 to Zone 7	539	8” / 2”	52 / 57	Active
RS10	760 Glenview Drive (PS 8)	Reduces pressure from Zone 10 to Zone 6	530	8” / 2”	7 / 12	Standby
RS11	2581 Bennington	Reduces pressure from Zone 7 to Zone 6	436	4” 2.5” bypass	--	Inactive
RS12	591 Madison	Reduces pressure from Zone 6 to Zone 2	255	4” 2.5” bypass	83	Standby
RS13	190 Piedmont	Reduces pressure from Zone 7 to former Crestmoor High School (Zone 7A)	456	4” / 2”	65 / 72	Active
RS14	110 Livingston Terrace	Reduces pressure from Zone 6 and Zone 2	255	6” (two way)	43	Standby
RS15	Rollingwood Pump Station	Reduces pressure from Zone 8 to residences 2130 thru 2280 Rollingwood Dr. and 2200 to 2290 Fleetwood Dr (Zone 8A)	341	2” / 2”	45 / 50	Active
RS16	Tank 1 (Cunningham Way)	Tank 1 bypass to Zone 1/4	220	6”	10	Standby
RS16A	Tank 1 (Cunningham Way)	Supplemental supply from SFPUC to Tank 1, also used for emergency Tank 1 bypass	220	8” (altitude valve)	--	Active
RS17	2175 Crestmoor Drive	Reduces pressure from Zone 6 to houses on Crestmoor Drive and Livingston Terrace (Zone 6A)	339	4” / 2”	50 / 55	Active
RS18	SFPUC Connection 5 to Tank 4	Tank 4 bypass to Zone 2	252	2”	35	Standby
RS19	SFPUC Connection 5 to Tank 4	Tank 4 bypass to Zone 2	252	2”	35	Standby
RS20	Huntington Avenue and I-380	Reduces pressure from Zone 4 to Zone 1 or from Zone 1 to Zone 4 (two way)	19	6” / 6”	91	Active
RS21	Sneath and National	Reduces pressure from SFPUC Turnout C1 to Zone 1/4	54	10” / 4” 2” relief	62 / 67 72	Active
RS22	855 El Camino Real	Reduces pressure from Zone 3/5 to Zone 1/4 or from Zone 1/4 to Zone 3/5 (two way)	23	6” / 6” PSV/PRV	95 (PRV) 175 (PSV)	Active
RS23	Peninsula Place (1125 Cherry)	Supplies water when normal water meter is out of service	84	6”	95	Standby
RS24	Tank 4 (San Bruno Avenue)	Tank 4 bypass to Zone 2	320	6” / 2”	5 / 10	Standby
RS25[b]	Elm and San Bruno Avenue	Reduces pressure from Zone 3/5 to Zone 1/4 or from Zone 1/4 to Zone 3/5 (two way)	60	6” / 6”	92	Active

2.4.6 Distribution System Pipelines

There are approximately 118 miles of water main in the City's water service area that range in size from 2 to 16 inches in diameter. Most of the pipelines within the City's service area are made of cast iron (CI) or asbestos cement (AC). Most of the existing 2-inch diameter pipelines are made of galvanized steel; however, some of these pipelines have been replaced with polyvinyl chloride (PVC). The City has standardized on ductile iron cement lined (DICL) pipe for more recent pipeline improvement projects.

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	121,012	19.4
3	517	0.1
4	93,472	15.0
6	197,135	31.6
8	128,029	20.6
10	32,669	5.2
12	34,602	5.6
14	15,326	2.5
16	22	0.004
Total	622,784	100%

[(a)] Data includes all active pipelines present in the GIS data provided by Lynx Technologies on June 8, 2011.

Recently, some existing pipelines have failed as a result of pipeline corrosion. The City has performed a water main failure corrosion evaluation on Merion Drive, Spyglass Drive and Sea Cliff Way to help identify the cause of failure and evaluate future risk and methods for mitigation. This evaluation recommended installation of cathodic protection on ductile iron pipes located on Merion Drive, Spyglass Drive and Sea Cliff Way. Detailed results from the pipeline corrosion study are documented in a memorandum prepared by JDH Corrosion Consultants, Inc. dated December 28, 2010. A cathodic protection pilot study was recently completed in June 2011 to develop a methodology to retrofit cathodic protection onto the water distribution system pipelines.

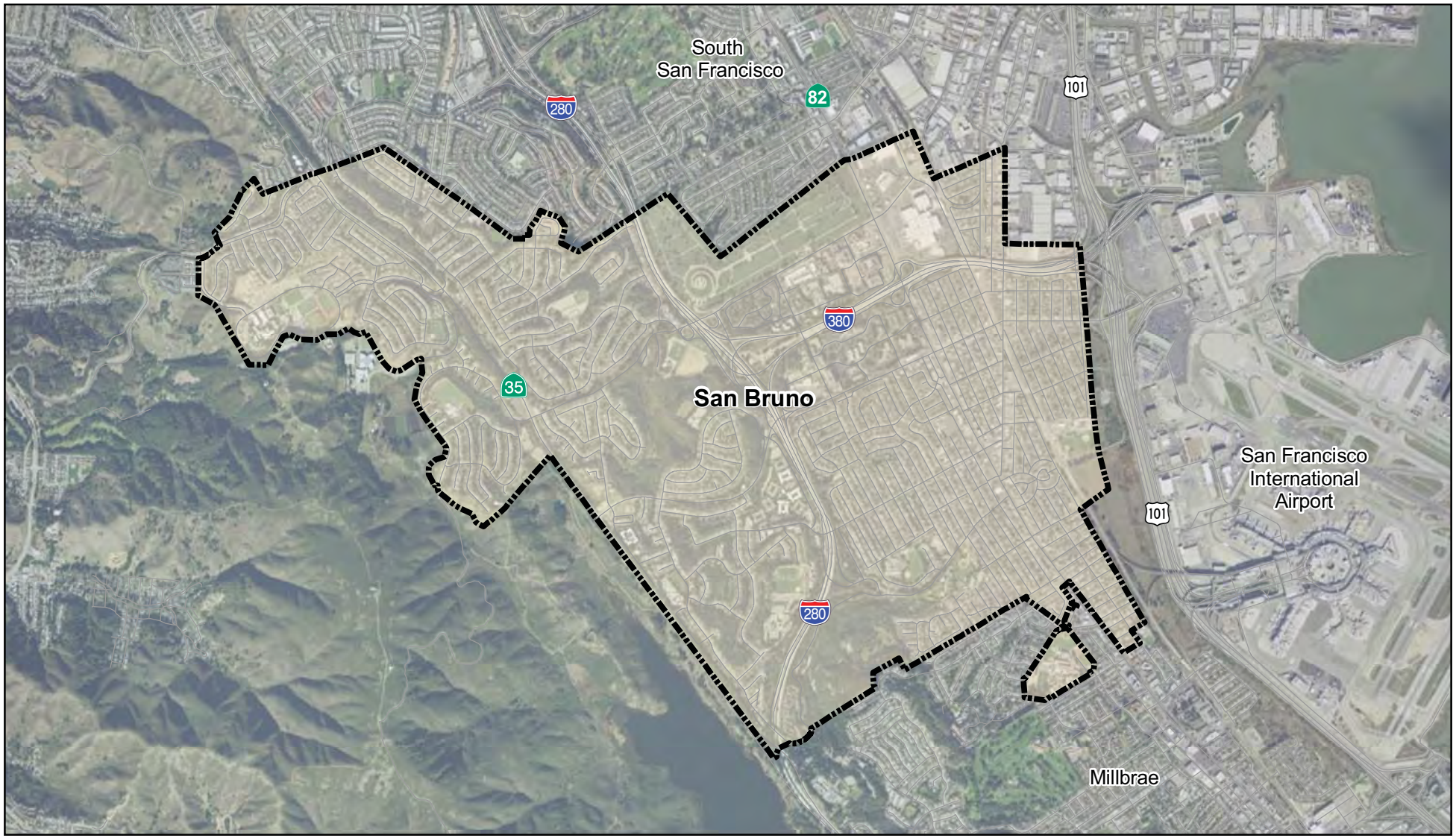
2.4.7 SCADA System

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. However, the City currently leases municipal communication cables for SCADA system communications, which do not provide reliable service during

emergencies. The City plans to install a radio transmitter and remote terminal units (RTUs) at each station to improve communications with each station.

No significant issues have been identified from the City's current SCADA system; however, it is recommended that the City implement a scheduled maintenance program for the SCADA system to track all equipment installation dates, regular maintenance, and calibrations. The following is a list of what should be considered for maintenance of the City's SCADA system:

- Continue to maintain FCC licensed radio frequencies for SCADA communications to ensure the integrity of the SCADA system.
- Maintain a spare computer, preloaded with SCADA software on hand, to quickly replace any failed computer.
- Maintain SCADA graphics programming to meet the needs of water system operations.
- Upgrade SCADA software regularly.
- Replace or upgrade RTUs on an on-going basis to maintain the reliability of the SCADA system.
- Obtain additional RTUs for emergency repair needs.



LEGEND

City Limits

Street

N

0 0.3 0.6

Scale in Miles

FIGURE 2-1

City of San Bruno
Water System Master Plan

CITY LIMITS BOUNDARY

WEST YOST ASSOCIATES

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 2-1_CityLimits.mxd 6/7/2011

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 2-2_PressZones.mxd 6/14/2011

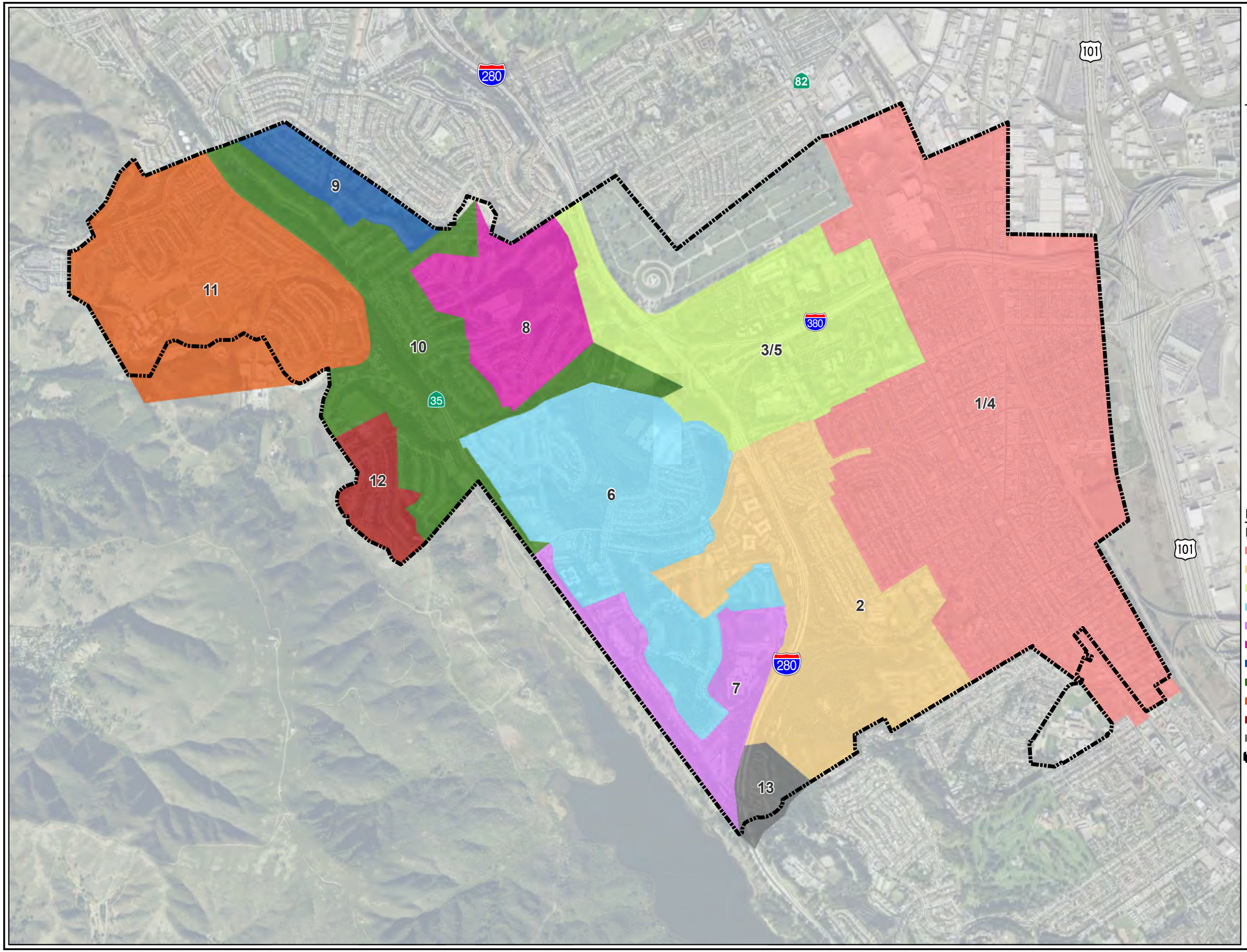


FIGURE 2-2

City of San Bruno Water System Master Plan

PRESSURE ZONES

N

0 880 1,760

Scale in Feet

LEGEND

Pressure Zone

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

WEST YOST ASSOCIATES

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 2-3_ExSys.mxd 1/13/2012

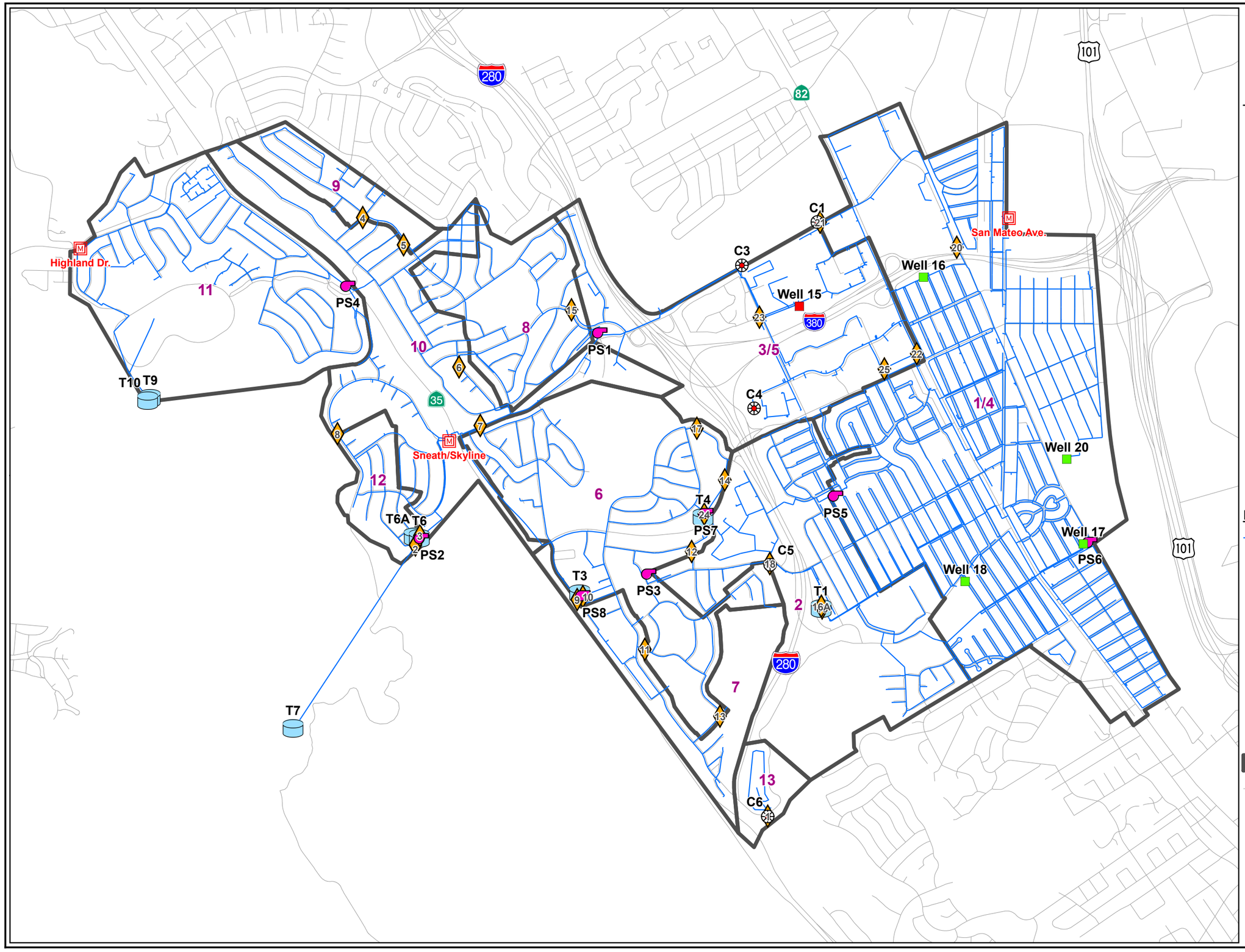


FIGURE 2-3

City of San Bruno
Water System Master Plan

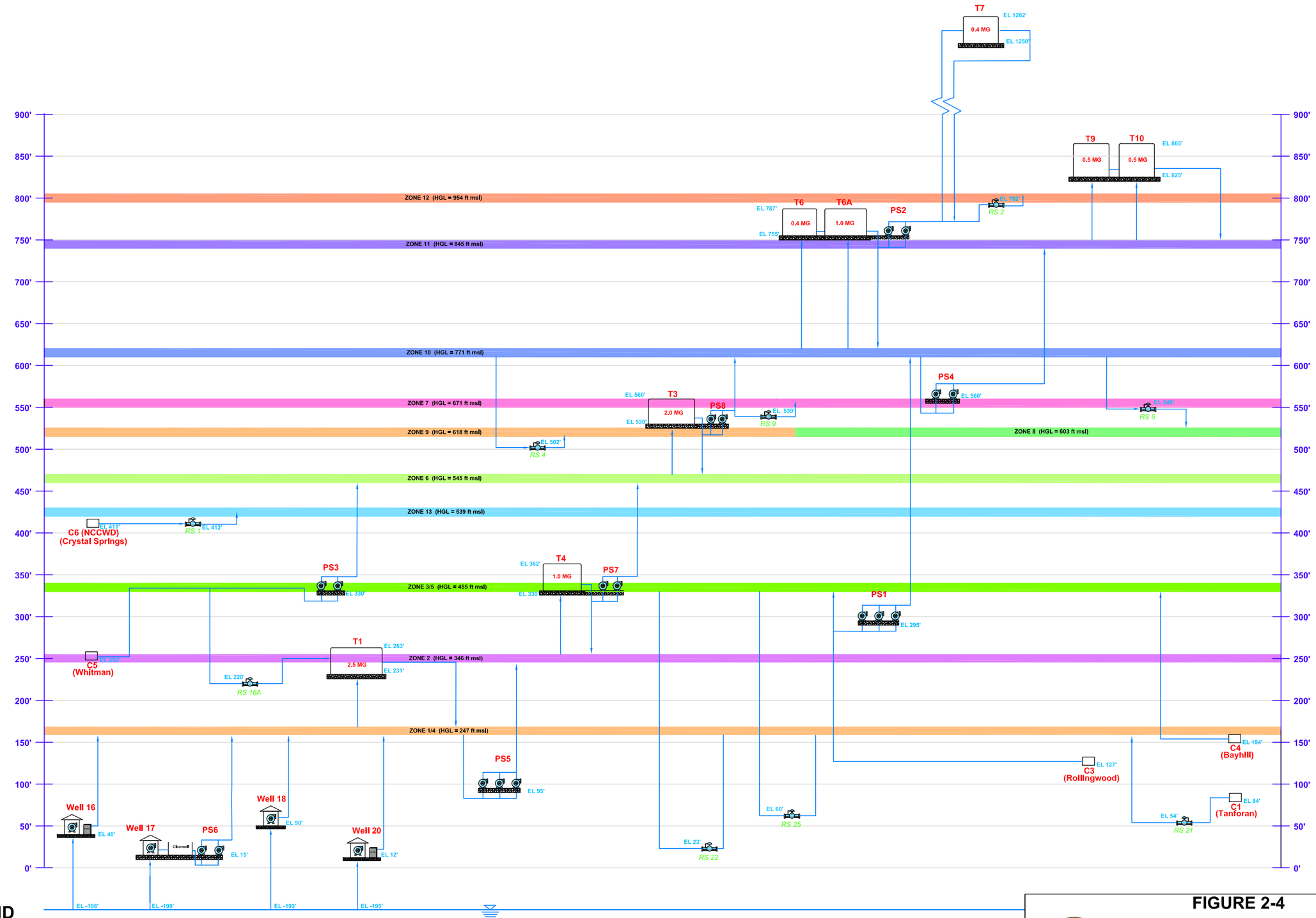
EXISTING WATER DISTRIBUTION SYTEM

LEGEND

- Pipeline
- Turnout
- Inactive Well
- Active Well
- Pressure Regulating Station
- Booster Pump Station
- Storage Tank
- Emergency Connection
- Pressure Zone Boundary
- Street

City of San Bruno

West Yost Associates



LEGEND

- WELL
- TANK
- FE/MN TREATMENT
- SURFACE WATER TURNOUT
- PUMP
- PRESSURE CONTROL

FIGURE 2-4

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

WEST YOST ASSOCIATES

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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 will subsequently be allocated to the hydraulic model to evaluate system performance for 2035 demand conditions.

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 5.5 square miles, is 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 and Future Population

The City provides water service to customers located within the service area, or the city limits. The historical and future City population estimates from 1980 to 2035 are shown in Table 3-1. As represented in Figure 3-1, the population has increased slightly since 1980 and is projected to increase at a slightly faster rate into 2035. It appears that the population in the City has stabilized in the recent years due to a lack of available land. Therefore, the projected increase in population at 2035 will mainly be from re-development and densification.

It should be noted that the 2010 population estimate of 41,114 was the April 1, 2010 estimate based on 2010 census data, provided by the DOF[1]; this slight dip in the population trend is most likely the result of DOF applying a consistent methodology between 2000 and 2005, and then adjusting their methodology based on actual 2010 census data.

[1] *E-5 Population and Housing Estimates for Cities, Counties, and the State, 2010-2011, with 2010 Benchmark.* State of California, Department of Finance (May 2011).

Table 3-1. Historical and Projected City Population

Year	City Population[a]
1980	35,417
1990	38,961
2000	40,165
2005	42,215
2010	41,114[b]
2015[c]	45,600
2020[c]	48,600
2025[c]	51,200
2030[c]	50,751
2035[c]	55,800

(a) Source: Urban Water Management Plan, (EKI, 2011).
(b) Source: *E-5 Population and Housing Estimates for Cities, Counties, and the State, 2010-2011, with 2010 Benchmark*. State of California, Department of Finance (May 2011). April 1, 2010 estimate.
(c) Based on projections from Association of Bay Area Governments (ABAG) developed in 2009, except for 2030, which is based on the General Plan plus Transit Corridors Plan.

3.1.3 Number of Service Connections

The City currently has six different customer sectors, which make up its 12,145 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 residential users, accounting for approximately 93 percent of all service connections.

Table 3-2. Number of Service Connections by Customer Sector in FY 2009/10[a]

Customer Sector	Number of Connections	Percent of Total Connections
Residential		
Single Family	10,367	85.4%
Multi-Family	889	7.3%
Subtotal Residential	11,256	93%
Non-Residential		
Commercial	531	4.4%
Industrial	3	0.02%
Institutional	235	1.9%
Other (Irrigation)	120	1.0%
Subtotal Non-Residential	889	7%
Total	12,145	100%

(a) Source: Urban Water Management Plan, Public Review Draft, EKI (May 2011).

3.2 HISTORICAL ANNUAL WATER USE

This section summarizes the City's historical water consumption, unaccounted for water and per capita water use.

3.2.1 Historical Annual Water Consumption

Table 3-3 summarizes historical annual water consumption by fiscal year (FY), from FY 2000/01 to FY 2009/10. Within this time period, the total consumption has decreased from a high of 4.00 mgd in FY 2000/01 to 3.24 mgd in FY 2009/10; this represents a 19 percent decrease in annual water consumption.

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 76 percent of total consumption, and non-residential water consumption averages 24 percent of total consumption.

Residential water consumption is comprised of single family and multi-family residential water use. The majority of residential water use is from single family residential water use, which makes up 53 percent of the City's total water use and 70 percent of all residential water use.

Non-residential water consumption includes commercial, industrial, institutional, and other water uses. The majority of non-residential water use is from commercial water use, which comprises 14 percent of the City's total water use and 58 percent of all non-residential water use. Industrial, Institutional, and Other water use accounts for the remaining 42 percent of non-residential water use, and is equal to approximately 10 percent of the City's total water use.

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

Customer Sector	Fiscal Year									
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Residential										
Residential Single Family	2.12	2.09	2.07	2.11	1.96	1.83	1.94	1.86	1.77	1.70
Residential Multi-Family	0.88	0.84	0.82	0.82	0.82	0.84	0.89	0.85	0.82	0.78
Subtotal Residential	3.00	2.94	2.89	2.92	2.78	2.67	2.84	2.71	2.59	2.48
Non-Residential										
Commercial	0.55	0.47	0.45	0.44	0.46	0.62	0.56	0.56	0.53	0.45
Industrial	0.01	0.01	0.01	0.00	0.00	0.003	0.003	0.003	0.003	0.002
Institutional	0.08	0.09	0.07	0.07	0.06	0.19	0.17	0.17	0.16	0.14
Other[c]	0.36	0.32	0.31	0.39	0.32	0.05	0.20	0.20	0.17	0.18
Subtotal Non-Residential	1.00	0.89	0.84	0.90	0.84	0.86	0.93	0.93	0.86	0.77
Total Water Use	4.00	3.83	3.73	3.83	3.61	3.54	3.77	3.64	3.46	3.24
Percent Residential	75%	77%	77%	76%	77%	75%	75%	74%	75%	77%
Percent Non-Residential	25%	23%	23%	23%	23%	24%	25%	26%	25%	24%

[a] Does not include unaccounted for water.

[b] FY 2000/01 to 2004/05 - Source: Urban Water Management Plan, Final, EKI (January 2007).
FY 2005/06 to 2009/10 - Source: Urban Water Management Plan, Public Review Draft, EKI (May 2011).

[c] Includes irrigation meters for commercial and institutional customers, temporary meters, and water used for main flushing.

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

Customer Sector	Annual Average Consumption, mgd[b]	Percent of Total	Percent of Use Type
Residential			
Residential Single Family	1.95	53%	70%
Residential Multi-Family	0.84	23%	30%
Subtotal Residential	2.78	76%	100%
Non-Residential			
Commercial	0.51	14%	58%
Industrial	0.004	0.1%	0.5%
Institutional	0.12	3%	14%
Other[c]	0.25	7%	28%
Subtotal Non-Residential	0.88	24%	100%
Total Consumption	3.67	100%	100%

(a) Does not include unaccounted for water.
(b) Average computed based on data from FY 2000/01 through 2009/10.
(c) Includes irrigation meters for commercial and institutional customers, temporary meters, and water used for main flushing.

3.2.2 Unaccounted for Water

Unaccounted for water (UAFW) is the difference between the quantity of water purchased/produced and the quantity of water consumed. UAFW 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 UAFW. In the last 10 years, the UAFW has ranged from 4.0 percent to 11.1 percent, with an average of 8 percent. This Water System Master Plan uses a UAFW factor of 8.5 percent, consistent with the City's 2011 Urban Water Management Plan (UWMP) (EKI, 2011a).

Table 3-5. Unaccounted For Water[a]

Fiscal Year	Water Production, mgd	Water Consumption, mgd	UAFW, mgd	Percent of Total
2000/01	4.22	4.00	0.22	5.2%
2001/02	4.15	3.83	0.32	7.7%
2002/03	4.07	3.73	0.34	8.4%
2003/04	4.14	3.83	0.31	7.5%
2004/05	3.76	3.61	0.15	4.0%
2005/06	3.83	3.54	0.29	7.6%
2006/07	3.69	3.77	-0.08	-2.1%
2007/08	3.91	3.64	0.27	7.0%
2008/09	3.85	3.46	0.39	10.1%
2009/10	3.65	3.24	0.41	11.1%
			Average Over Period	8%[b]
			Average in Past 5 Years	9%[b]

[a] FY 2000/01 to 2004/05 - Source: Urban Water Management Plan, Final, (EKI, 2007). FY 2005/06 to 2009/10 - Source: Urban Water Management Plan, (EKI, 2011a).
[b] Average does not include data from FY 2006/07, because data appears to be suspect.

3.2.3 Per Capita Water Use

Table 3-6 and Figure 3-2 show population and water production trends, and the computed per capita water use. Per capita water use decreased from 119 to 89 gallons per capita per day (gpcd) during the period from FY 1995/96 through FY 2009/10. The average per capita use for this period is 101 gpcd. The average per capita use over the past five years is 90 gpcd. Figure 3-2 shows an overall decreasing trend for both per capita water use and production, and an increasing trend for population.

Table 3-6. Per Capita Water Use, FY 1995/96 through FY 2009/10[a,b]

Fiscal Year	Water Production, mgd	Population	Per Capita Water Demand, gpcd
1995/96	4.71	39,535	119
1996/97	4.64	39,731	117
1997/98	4.43	39,956	111
1998/99	4.37	39,999	109
1999/00	4.40	40,078	110
2000/01	4.22	40,277	105
2001/02	4.15	40,139	103
2002/03	4.07	40,853	100
2003/04	4.14	40,858	101
2004/05	3.76	41,301	91
2005/06	3.83	41,451	92
2006/07	3.69	41,828	88
2007/08	3.91	43,286	90
2008/09	3.85	43,798	88
2009/10	3.65	41,128	89

(a) Sources:
- FY 1995/96 – FY 1999/00 population source: E-4 Historical Population Estimates for Cities, Counties and the State, 1991-2000, with 1990 and 2000 Census Counts, Department of Finance.
- FY 2000/01 – FY 2008/09 population source: E-5 Population and Housing Estimates for Cities, Counties and the State, 2001-2010, with 2000 Benchmark.
- FY 2009/10 population source: *E-5 Population and Housing Estimates for Cities, Counties, and the State, 2010-2011, with 2010 Benchmark*. State of California, Department of Finance (May 2011). January 1, 2010 estimate.

(b) All population estimates presented in this table are January 1 estimates of their corresponding fiscal year.

3.3 WATER CONSERVATION

This section summarizes the City's water conservation targets required to comply with Senate Bill x7-7, (*e.g.*, 20x2020 Legislation or SB 7), which requires urban water purveyors to reduce their per capita water use by 20 percent by 2020. As documented in the 2011 UWMP, the City is already meeting SB 7 requirements.

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. In FY 2009/10, the City had set aside $75,000 in its budget for water conservation. While the UWMP Act's 14 Demand Management Measure (DMM) coverage levels described in AB 1420 have not been met, the City has made considerable progress in DMM implementation. A water conservation plan will be prepared by 2012. Some of the City's actions with respect to the 14 DMMs include residential surveying, regular audits, metering, education, and participation in conservation-driven technology programs. Further details can be found in the City's 2011 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), State Water Resources Control Board (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.

Four methodologies are identified in SB 7 for establishing per capita water use targets:

Method 1: A 20 percent reduction from historical baseline per capita water use based on a 10-year running average per capita water use ending between December 31, 2004 and December 31, 2010.

Method 2: Per capita water use based on 55 gallons per capita per day water use for indoor residential water use, landscape irrigation use based on water efficiency equivalent to the standards of the Model Water Efficient Landscape Ordinance, and a 10 percent reduction from baseline commercial, industrial and institutional (CII) water use.

Method 3: 95 percent of the hydrologic region targets established for per capita water use based on the April 2009 Draft 20x2020 Water Conservation Plan.

Method 4: A provisional approach that considers the water conservation potential from (1) indoor residential savings, (2) metering savings, (3) commercial, industrial and institutional savings, and (4) landscape and water loss savings.

An agency can choose to use any of the four methods, and can select the method that results in the most favorable (*i.e.*, highest) urban water use target. Based on the 2011 UWMP, the City has adopted Method 3 with a calculated 2020 water use target of 124 gpcd. Since the City's baseline water use is currently at 95 gpcd, the City is already meeting its 2015 and 2020 water use targets. Also, the City's baseline use is less than 100 gpcd, so the City is not required to make any per capita water use reductions in order to comply with the requirements of the Water Conservation Act. The City is expected to continue to have a per capita use less than 100 gpcd through the Water System Master Plan time frame.

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 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.

The City receives approximately half of its water supply from the SFPUC Regional Water System through five turnouts. Most turnouts are equipped with totalizing flow meters that do not record instantaneous flowrate, but rather, the volume of water that passes through the meter. As a result, the only peak water use information available for the City's system is the monthly data collected and used by SFPUC for billing purposes. Therefore, maximum day and peak hour peaking factors had to be estimated for the City as discussed further below.

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). As the City does not maintain records with the data necessary to determine historical maximum day demands, peaking factors from similar water systems in the Peninsula were reviewed.

A maximum day peaking factor of 1.5 times the annual average day system demand was adopted previously in the City's 2001 Water System Master Plan. As discussed in the 2001 Water System Master Plan, this factor was based on data from the City of Daly City. More recent data from the South San Francisco District served by California Water Service Company indicates that a maximum day peaking factor of 1.5 was also adopted in their 2005-2006 Water Supply and Facilities Master Plan. Based on the limited data available, West Yost will continue to recommend a maximum day peaking factor of 1.5 times the annual average day system demand for planning purposes, until additional data can be collected to determine a more accurate maximum day peaking factor for the City.

3.4.2 Peak Hour Water Use

A peak hour peaking factor of 3.0 times the annual average day system demand was adopted previously in the City's 2001 Water System Master Plan. As discussed in the 2001 Water System Master Plan, 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. Based on the limited data available, West Yost will continue to recommend this peak hour peaking factor of 3.0 times the annual average day system demand for planning purposes until additional data can be collected to determine a more accurate peak hour peaking factor for the City.

3.4.3 Summary of Peaking Factors Used in Master Plan Analysis

Table 3-7 summarizes the maximum day and peak hour peaking factors that will be used for this Water System Master Plan.

Table 3-7. Adopted Peaking Factors

Demand Condition	Peaking Factor
Maximum Day Demand	1.5 times average daily demand
Peak Hour Demand	3.0 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 2035 Water System Master Plan time frame.

The demand projections used for this Water System Master Plan are the same as projections presented in the City's 2011 UWMP, and also reflect water use estimates developed for the Water Supply Assessment for the Transit Corridors Plan (Transit Corridors Plan WSA) (EKI, 2011b). Buildout of the General Plan plus Transit Corridors Plan area is estimated to occur by 2030. The 2011 UWMP presents demand projections through 2035.

Water use projections for these documents are based on a population and employment-based methodology using the Least Cost Planning Decision Support System (DSS) model, which uses population and employment statistics to project water use. For this Water System Master Plan, future demand projections must be correlated with land use information from the City's General Plan and the Transit Corridors Plan 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 Redevelopment Agency 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. Land use planning information used for the analysis was developed from the City of San Bruno General Plan (Dyett & Bhatia, 2008) and supporting documents, and the Transit Corridors Plan WSA. West Yost also worked with the City's Redevelopment Agency to identify locations of specific planned developments, consistent with the General Plan and Transit Corridors Plan. Information from these planning documents and from the City 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). Figure 3-3 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). In the spring of 2008, the City initiated 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. Although buildout of the General Plan was initially established at 2025, with inclusion of the Transit Corridors Plan, buildout is estimated at 2030. Figure 3-4 shows the City's General Plan Land Use map, including the Transit Corridors Plan area.

West Yost met with the City's Redevelopment Agency staff to review identified projects and potential development areas for new residential and commercial developments consistent with the General Plan and the Transit Corridors Plan. These projects and areas are summarized in Table 3-8 and are shown on Figure 3-5.

Table 3-8. Summary of Potential Residential and Commercial Developments per the General Plan and Transit Corridors Plan[(a)]

Land Use	Developments Included	Recent and Potential Dwelling Units (Residential) or Square Footage (Commercial)	Notes
Single Family Residential	Glenview Terrace, Cedar Grove, Skycrest, Merimont, South El Camino	66	• Glenview Terrace (16 units) and Cedar Grove (14 units) approved for development. • Skycrest (12 units) includes 24 units total, 12 units constructed in 2007 and 12 units not yet constructed. • Merimont (24 units) includes 70 units total, with building permits for last 24 units issued in 2009.
Multi-family Residential	The Crossings, Treetops, South El Camino	761	• The Crossings (350 units): permits obtained in 2008. Construction completed in 2010. • Treetops (308 units): vacant since 2006. Currently under re-construction. • South El Camino (103 units) per General Plan
Mixed Use, Multi-family Residential, Commercial	Transit Corridors Plan	1,610 (residential) 1,136,000	• Specific Plan under development. Planning data from Water Supply Assessment. Commercial development includes 190 hotel rooms
Commercial Regional Commercial, Regional Office	The Crossings, San Bruno Town Center, The Shops at Tanforan	443,600	• The Crossings (14,500 sq ft): one-half of commercial space leased as of June 2011. Hotel also planned. • San Bruno Town Center, The Shops at Tanforan: potential development per General Plan.
Regional Office	Bayhill Office Park	683,200	• Potential development per General Plan.

(a) Sources: General Plan Draft EIR, Table 3.1-2: Potential Buildout of Vacant and Underutilized Land (Surface Parking) under Proposed General Plan 2025; Transit Corridors Plan, Table 1 – Assumed Project Parameters for Land Use Based Demand Estimate; meeting and follow-up phone conversations with Mark Sullivan, Housing and Redevelopment Manager, City of San Bruno, Summer 2011.

3.5.2 Water Use Projections from Recent Planning Documents

Water demands for the Water System Master Plan were developed from water use estimates prepared for the Transit Corridors Plan WSA, and the 2011 UWMP. The Transit Corridors Plan WSA estimates water demands through FY 2029/30, the projected buildout of the General Plan and Transit Corridors Plan. However, the 2011 UWMP projects demands through FY 2034/35. Therefore, this Water System Master Plan uses a future demand for water system planning based on the 2011 UWMP FY 2034/35 projection.

Demand projections in the Transit Corridors Plan WSA and the 2011 UWMP 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 forecast. The 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. The DSS model uses the year 2001 as the 'base year' from which to project demands. This year was selected as representative of a normal year, where precipitation is approximately equal to the long-term average precipitation for the area. Water use for the City for the 2001 baseline year was 4.22 mgd as shown previously in Table 3-5.

Demand estimates for the Transit Corridors Plan use population and employment projections from the General Plan, as adjusted to account for this specific plan area. FY 2029/30 demand for the General Plan plus the Transit Corridors Plan area is 4.91 mgd, with 0.42 mgd in the Transit Corridors Plan area. Demand estimates for the 2011 UWMP were developed using 2009 ABAG population and employment projections. The projected total water use for FY 2034/35 is 5.13 mgd.

3.5.3 Unit Water Use Factors

As noted previously, for this Water System Master Plan, water use estimates developed from other planning documents must be correlated with land use information from the City's General Plan and the Transit Corridors Plan so that water use projections account not only for the quantity of new water use, but also where it will occur. This section summarizes the unit water use factors that were developed for the Water System Master Plan to estimate future residential and commercial water use. These unit water use factors are expressed in usage per dwelling unit, for residential use, and in usage per square foot of developed commercial space for commercial areas. These unit use factors are applied to the dwelling units and commercial square footage estimates show in Table 3-8 to estimate future residential and commercial water demand.

Residential use within the Transit Corridors Plan is anticipated to be multi-family residential. In order to estimate single family residential use, historical records for FY 2000/01 (the General Plan and DSS model baseline), and Department of Finance 2001 housing statistics were compared with Transit Corridors Plan estimates. Multi-family residential water use for the Transit Corridors Plan is about 70 percent of historical use. Future water use is expected to be lower than historical use, since calculations take into account conservation savings due to current plumbing codes, and anticipated use of water conservation savings devices. Therefore, historical single family residential use estimates were adjusted downward by the same percentage to estimate future single family use.

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 commercial square footage developed.

Table 3-9 summarizes unit water use factors developed for residential and non-residential uses from historical water use and from land-use based water use estimates provided in the Transit Corridors Plan WSA. Estimates shown in Table 3-9 incorporate UAFW, and therefore represent gross water use.

Table 3-9. Unit Water Use Factors for Projecting Demands[a]

Use Type	Unit Use
Single Family Residential[b]	160 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

(a) Factors represent gross water use and include 8.5 percent UAFW.
(b) Developed from FY 2000/01 historical records, DOF 2001 housing statistics, with adjustment of 30 percent to account for future conservation savings.
(c) Transit Corridors Plan WSA, Table B-1a. Factor shown in the WSA is 108 GPD/DU before inclusion of UAFW.
(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 UAFW.

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 is 0.38 mgd, compared with 0.42 using the DSS methodology.

3.5.4 Water Demand at Buildout of the General Plan and Transit Corridors Plan (FY 2029/30)

Table 3-10 summarizes FY 2029/30 water use, which reflects buildout of the General Plan and Transit Corridors Plan. The table shows existing demand, based on FY 2000/01 baseline water use, and water use due to development of the Transit Corridors Plan and other areas within the General Plan planning area.

Table 3-10. Water Demand at Buildout of General Plan and Transit Corridors Plan (FY 2029/30)[a]

Land Use	Area/Development	Recent and Potential Dwelling Units (Residential) or Square Footage (Commercial)	Unit Water Use, GPD/DU (Residential) or GPD/square foot (Commercial)	Total Water Use	
				mgd	gpm
Various	Existing System			4.22	2,931
Single Family Residential	Glenview Terrace, Cedar Grove, Skycrest, Merimont, South El Camino	66	160	0.011	7
Multi-Family Residential	The Crossings, Treetops	761	120	0.091	63
Mixed Use, Multi-Family Residential, Commercial	Transit Corridors Plan	[b]		0.42	292
Commercial, Regional Commercial	The Crossings, San Bruno Town Center, the Shops at Tanforan	443,600	0.19	0.084	59
Regional Office	Bayhill Office Park	683,200	0.13	0.089	62
			Total	4.91	3,414

[a] Sources: General Plan Draft EIR, Table 3.1-2: Potential Buildout of Vacant and Underutilized Land (Surface Parking) under Proposed General Plan 2025; Transit Corridors Plan: Table 1 – Assumed Project Parameters for Land Use Based Demand Estimate; meeting and follow-up phone conversations with Mark Sullivan, Housing and Redevelopment Manager, City of San Bruno.
[b] Water use estimated using DSS model as part of Transit Corridors Plan WSA analysis.

3.5.5 FY 2034/35 Water Use

Water use is projected to increase from 4.91 mgd in FY 2029/30 (based on buildout of General Plan plus Transit Corridors Plan) to 5.13 mgd in FY 2034/35 (based on 2011 UWMP), or by a difference of 0.22 mgd. Because this growth at FY 2034/35 is beyond the General Plan time frame, the specific developments or areas of growth have not been identified. Based on consultation with the City, additional growth could reasonably be expected to occur in the following areas:

- Transit Corridors Plan
- South El Camino
- The Crossings
- San Bruno Town Center
- The Shops at Tanforan
- Bayhill Office Park

Growth is assumed to be uniform throughout these areas, and the projected water demand for FY 2034/35 will be allocated to each of these growth areas proportionate to their demands at buildout of the General Plan and Transit Corridors Plan.

3.6 REFERENCES

Dyett & Bhatia, December 2008. *San Bruno General Plan.*

Dyett & Bhatia, December 2008, *San Bruno 2025: General Plan, Final Environmental Impact Report*

Erler & Kalinowski, Inc., June 2011 (EKI, 2011a). *City of San Bruno Urban Water Management Plan.*

Erler & Kalinowski, Inc., January 2007 (EKI, 2007). *City of San Bruno, Water Urban Water Management Plan.*

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State of California, Department of Finance, May 2010. *E-5 Population and Housing Estimates for Cities, Counties and the State, 2001-2010, with 2000 Benchmark.*

State of California, Department of Finance, May 2011. *E-5 Population and Housing Estimates for Cities, Counties, and the State, 2010-2011, with 2010 Benchmark.*

State of California, Department of Finance. *E-4 Historical Population Estimates for Cities, Counties and the State, 1991-2000, with 1990 and 2000 Census Counts.*

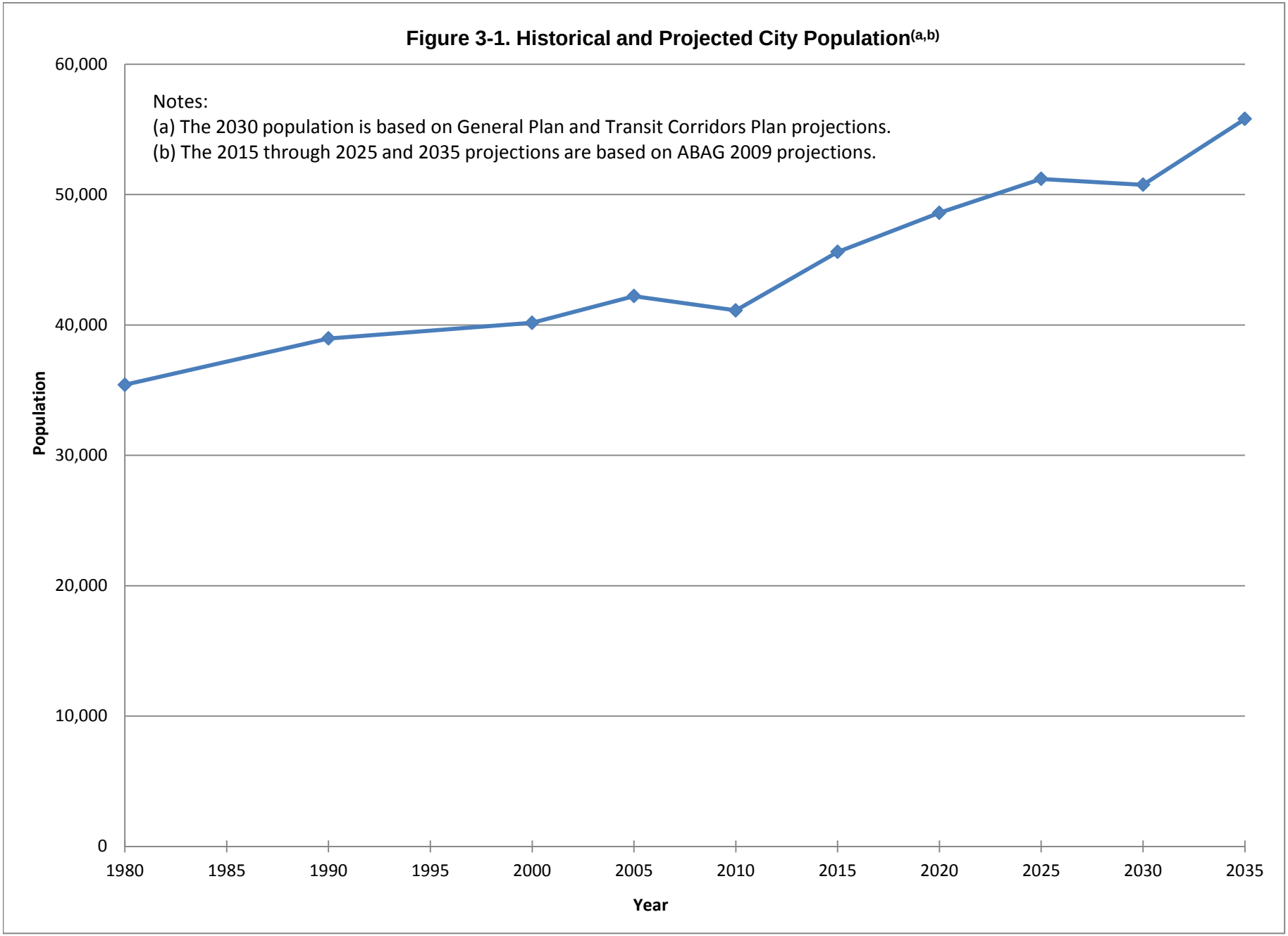
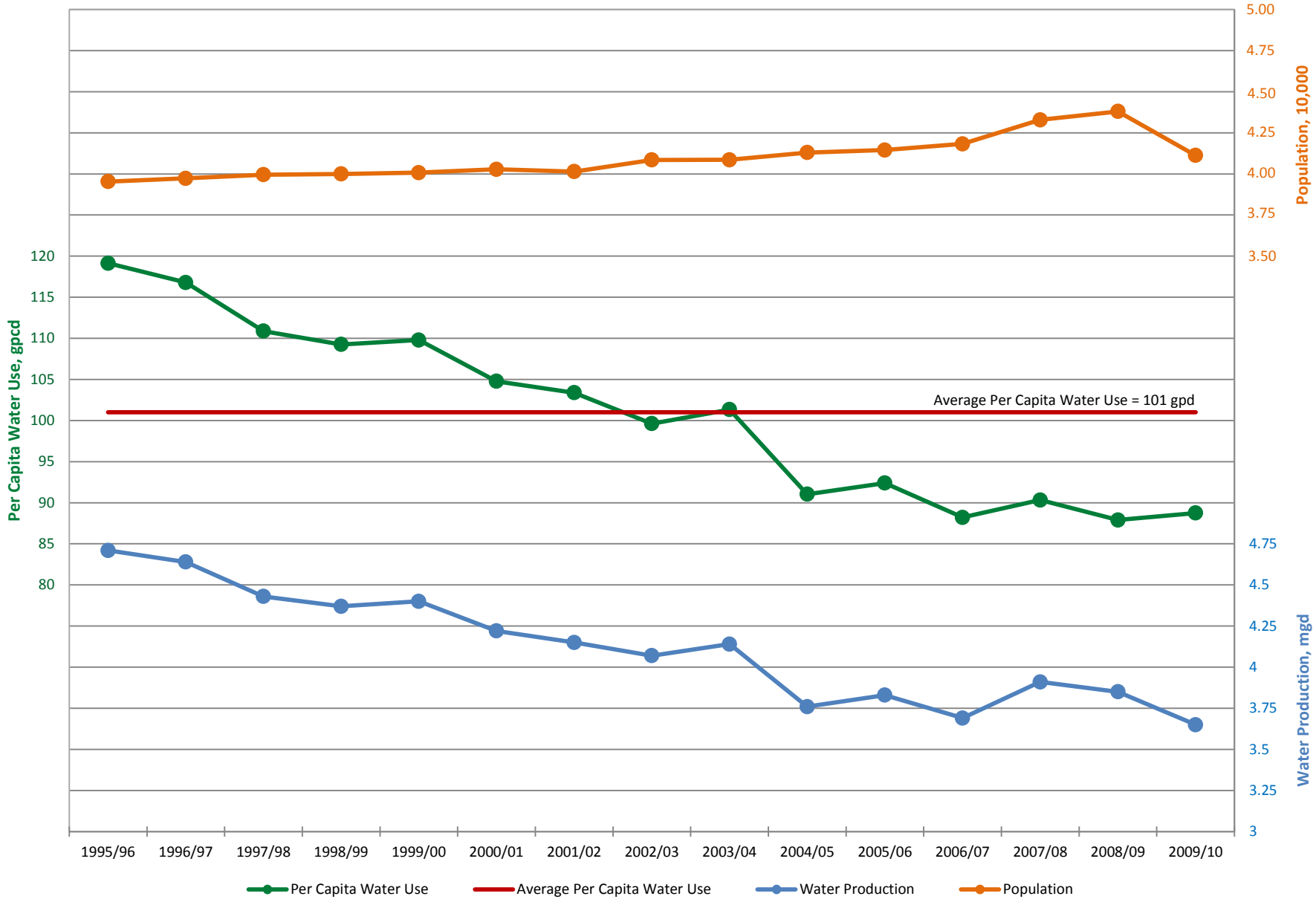


Figure 3-1. Historical and Projected City Population(a,b)
Notes:
(a) The 2030 population is based on General Plan and Transit Corridors Plan projections.
(b) The 2015 through 2025 and 2035 projections are based on ABAG 2009 projections.
Population
60,000
50,000
40,000
30,000
20,000
10,000
0
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
Year

Figure 3-2. Per Capita Water Use, Production, and Population



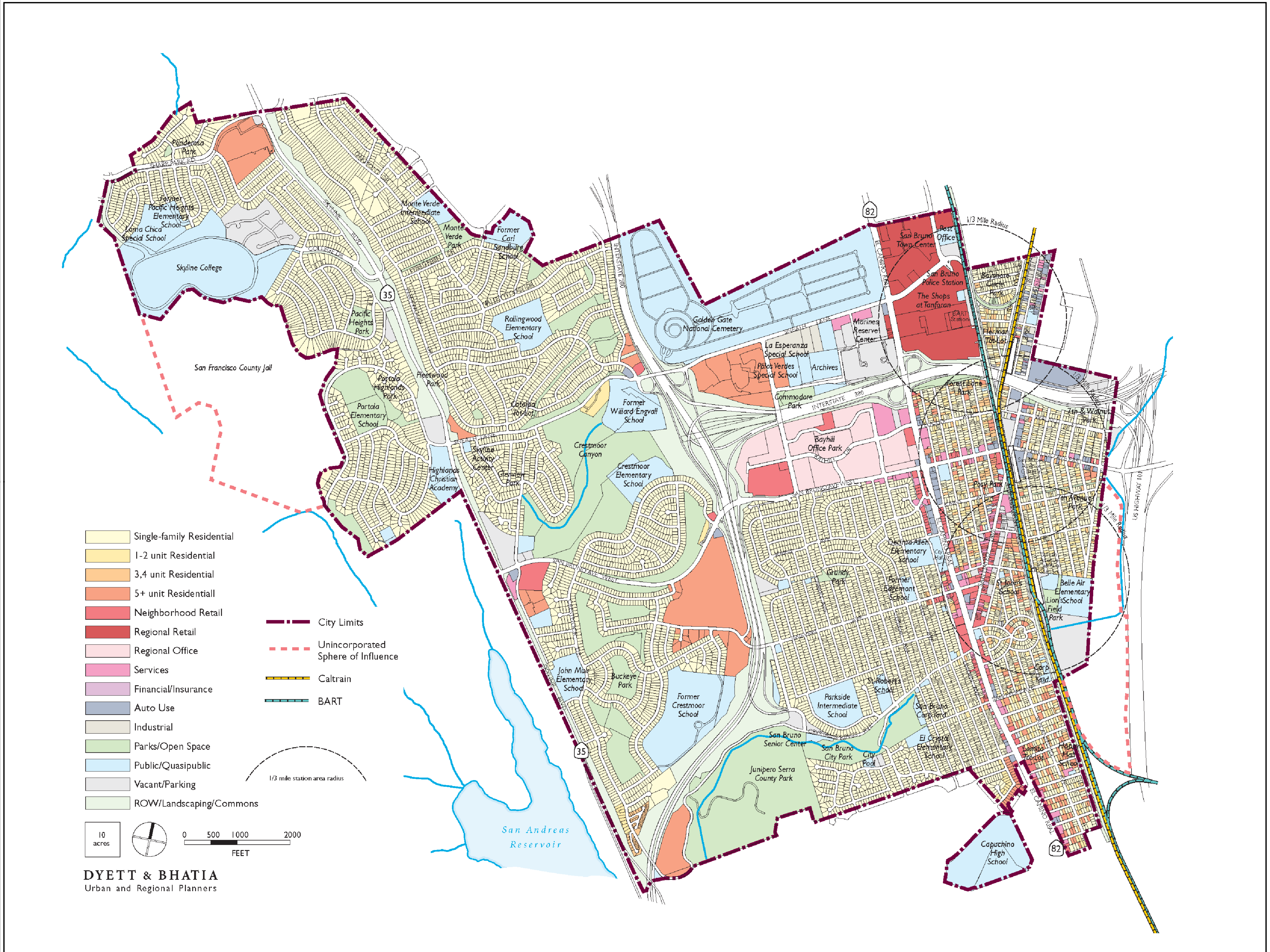


FIGURE 3-3

City of San Bruno
Water System Master Plan

EXISTING LAND USE

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

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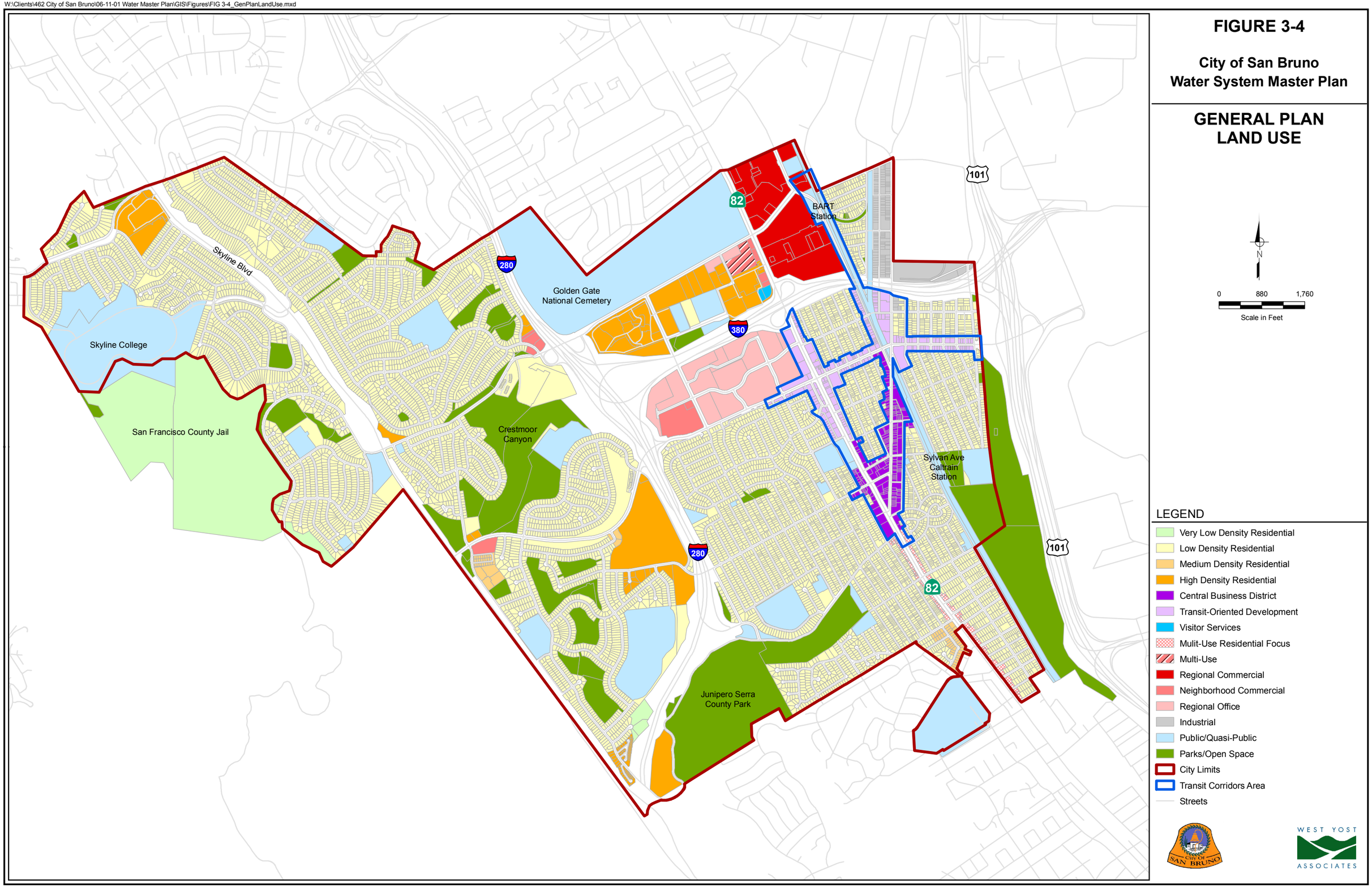

FIGURE 3-4

City of San Bruno Water System Master Plan

GENERAL PLAN LAND USE

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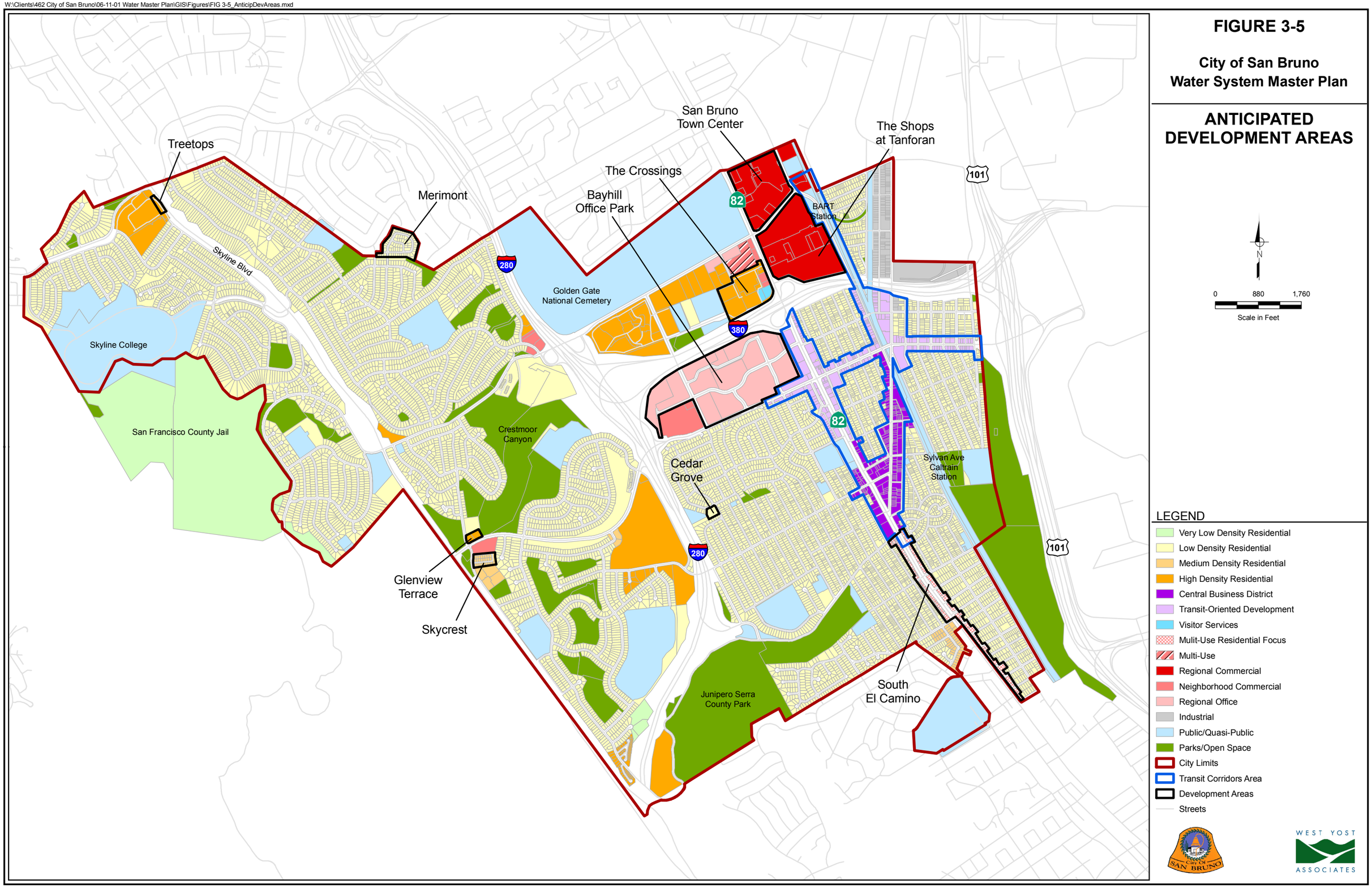

FIGURE 3-5

City of San Bruno Water System Master Plan

ANTICIPATED DEVELOPMENT AREAS

CHAPTER 4
Water Supply

This chapter summarizes the City's water supply sources and how these sources meet existing water demands and are projected to meet future water demands. Information presented in this chapter is summarized from the City's Urban Water Management Plan (UWMP; EKI, 2011). The following sections are included in this chapter:

- Historical Water Supply Sources
- Water Supply Projections
- Water Purchased from the SFPUC
- Water Purchased from the NCCWD
- Groundwater
- Regional Conjunctive Use

4.1 HISTORICAL WATER SUPPLY SOURCES

The City currently receives water from three supply sources:

- Wholesale surface water from the City and County of San Francisco's Regional Water System (Regional System), 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 FY 2005/06 through FY 2009/10.

Table 4-1. Historical Production by Source from FY 2005/06 through FY 2009/10, mgd

Supply Source	FY 2005/06	FY 2006/07	FY 2007/08	FY 2008/09	FY 2009/10
SFPUC					
Tanforan (#010024-01-6)	0.02	0.00	0.00	0.00	0.02
Rollingwood (#010026-01-1)	0.70	0.68	0.51	0.52	0.52
Bayhill (#010025-01-3)	0.69	0.70	0.70	0.68	0.54
Whitman (#010023-01-8)	0.65	0.44	0.78	0.69	0.39
Subtotal SFPUC	2.07	1.82	1.99	1.90	1.46
Groundwater					
Well # 15	0.00	0.04	0.24	0.21	0.12
Well # 16	0.62	0.64	0.30	0.69	0.63
Well # 17	0.30	0.28	0.27	0.21	0.37
Well # 18	0.00	0.07	0.33	0.31	0.25
Well # 20	0.79	0.81	0.73	0.49	0.78
Subtotal Groundwater	1.71	1.83	1.87	1.91	2.14
NCCWD					
Crystal Springs	0.05	0.04	0.05	0.05	0.04
Total Water Supply	3.83	3.69	3.91	3.85	3.65

4.2 WATER SUPPLY PROJECTIONS

Table 4-2 summarizes the City's future water demand projections and the supply sources that are projected to meet these water demands. As the table shows, the City is projected to have adequate supplies to meet water demands through the Water System Master Plan timeframe of 2035.

Table 4-2. Projected Future Water Demands and Supplies, mgd

Demands and Supplies	FY 2029/30	FY 2034/35
Water Demand	4.91	5.13
Supplies		
SFPUC	3.25	3.25
NCCWD	0.05	0.05
Groundwater[(a)]	2.10	2.10
Total Water Supplies	5.40	5.40
Supply Surplus	0.49	0.27

[(a)] Proposed groundwater supply may be substituted with surface water supply under the proposed Regional Groundwater Storage and Recovery Project (refer to Section 4.6 Regional Conjunctive Use for additional details).

4.3 WATER PURCHASED FROM THE SAN FRANCISCO PUBLIC UTILITIES COMMISSION

The City's wholesale water supply purchased from the SFPUC is delivered through the Regional System via four turnouts. Water from SFPUC is purchased in accordance with the 2009 Water Supply Agreement (WSA).[1]Additional details regarding water purchased from the SFPUC are provided below.

4.3.1 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.

4.3.2 SFPUC Water Supply 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 will deliver 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. Many of the water supply and reliability projects evaluated in the WSIP were originally put forth in the SFPUC's 2000 Water Supply Master Plan. An overview of the WSIP is shown on Figure 4-1.

A Program Environmental Impact Report (PEIR) was prepared in accordance with the California Environmental Quality Act for the WSIP. The PEIR, certified in 2008, analyzed the broad environmental effects of the projects in the WSIP at a program level and the water supply impacts of various alternative supplies at a project level. Individual WSIP projects are also undergoing individual project-specific environmental review as required.

In approving the WSIP, the SFPUC adopted a Phased WSIP Variant for water supply that was analyzed in the PEIR. This Phased WSIP Variant established a mid-term water supply planning milestone in 2018 when the SFPUC would re-evaluate water demands through 2030. At the same meeting, the SFPUC also imposed the Interim Supply Limitation, which limits the volume of

[1] "Water Supply Agreement between the City and County of San Francisco and Wholesale Customers in Alameda County, San Mateo County, and Santa Clara County", July 2009.

water that the member agencies and the City and County of San Francisco can collectively purchase from the Regional System to 265 mgd until at least 2018. Although the Phased WSIP Variant included a mid-term water supply planning milestone, it also included full implementation of all proposed WSIP facility improvement projects to insure that the public health, seismic safety, and delivery reliability goals were achieved as soon as possible.

As of June 30, 2012, the WSIP was overall 62 percent completed, with the planning work over 99 percent complete. Remaining projects identified in the WSIP are scheduled to be completed by December 2015.

4.3.3 2009 Water Supply Agreement

The business relationship between City and County of San Francisco (San Francisco) and its wholesale customers is largely defined by the 2009 WSA. The new WSA replaced the Settlement Agreement and Master Water Sales Contract that expired in June 2009. The WSA addresses the rate-making methodology used by San Francisco in setting wholesale water rates for its wholesale customers in addition to addressing water supply and water shortages for the Regional System. The WSA has a 25-year term.

In terms of water supply, the WSA provides for a 184 mgd (expressed on an annual average basis) "Supply Assurance" to the SFPUC's wholesale customers, subject to reduction, to the extent and for the period made necessary by reason of water shortage, due to drought, emergencies, or by malfunctioning or rehabilitation of the regional water system. The WSA does not guarantee that San Francisco will meet peak daily or hourly customer demands when their annual usage exceeds the Supply Assurance. The SFPUC's wholesale customers have agreed to the allocation of the 184 mgd Supply Assurance among themselves, with each entity's share of the Supply Assurance set forth on Attachment C to the WSA. The Supply Assurance survives termination or expiration of the WSA and each agency's Individual Water Sales Contract with San Francisco.

The Water Shortage Allocation Plan between the SFPUC and its wholesale customers, adopted as part of the WSA in July 2009, addresses shortages of up to 20 percent of system-wide use. The Tier 1 Shortage Plan allocates water from the Regional System between San Francisco Retail and the wholesale customers during system-wide shortages of 20 percent or less. The WSA also anticipated a Tier 2 Shortage Plan adopted by the wholesale customers, which would allocate the available water from the Regional System among the wholesale customers.

The City's WSA with San Francisco is supplemented by an individual Water Supply Contract. These contracts, which expire in 25 years, provide for a 184 mgd (expressed on an annual average basis) Supply Assurance to the SFPUC's 26 wholesale customers collectively. The City's Individual Supply Guarantee (ISG) is 3.25 mgd (or approximately 2,900 acre feet per year). Although the WSA and accompanying Water Supply Contract expire in 2034, the Supply Assurance (which quantifies San Francisco's obligation to supply water to its individual wholesale customers) survives their expiration and continues indefinitely.

4.3.4 Bay Area Water Conservation and Supply Agency

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

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 Regional System. BAWSCA provides the ability for the customers of the Regional System 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 regional water system; and build facilities jointly with other local public agencies or on its own to carry out the agency's purposes.

4.4 WATER PURCHASED FROM THE NORTH COAST COUNTY WATER DISTRICT

Water purchased from the NCCWD is also from the Regional System, 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 approximately 0.05 mgd of water from the NCCWD, as shown in Table 4-1. This water is served from the Crystal Springs turnout in Pressure Zone 13. The City does not anticipate any changes to its NCCWD water supply in the near future.

4.5 GROUNDWATER

Local groundwater supply for the City is from the southern 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 (Bartell, 1914). On average, from FY 2005-06 through FY 2009-10, groundwater use comprises about 50 percent of the City's total water supply.

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

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

4.5.1 Groundwater Management

In 1996, the City, Daly City, SFPUC, and other stakeholders (the Westside Partners) worked to develop a Groundwater Management Plan (GWMP) to aid in managing groundwater use within the Westside Basin.[3] A draft of the GWMP for the Westside Basin was completed in 1999 as a series of Technical Memoranda. Although not adopted by the Westside Partners due to data gaps and other concerns at the time, the cities and water purveyors that overly the Westside Basin have voluntarily implemented many of the recommendations and other aspects of the GWMP including (a) a basin-wide monitoring program, (b) saline water intrusion monitoring, (c) a recycled water program for non-potable uses, and (d) a source water and wellhead protection program.

In April 2005, SFPUC completed a GWMP for the North Westside Basin (SFPUC, 2005b). This GWMP covers the northern portion of the Westside Basin that is overlain by the City and County of San Francisco, where groundwater generally moves from east to west and most of the water added to the basin discharges to the Pacific Ocean.

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.

Although the South Westside Basin GWMP is largely being funded by the DWR grant, additional funding is being provided by Cal Water (purveyor for the City of South San Francisco), City of Daly City, City of San Bruno, and the SFPUC. It is being developed to provide a framework for regional groundwater management in the South Westside Basin that sustains the beneficial use of the groundwater resource. This includes 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. This Plan will also provide recommendations that are intended to manage groundwater levels and quality as well as land subsidence. The goal of the South Westside Basin GWMP is to ensure a sustainable, high-quality reliable groundwater supply at a fair price for beneficial uses achieved through local groundwater management.

[3] The intent of the AB3030 Grant Program (Section 10750 et seq. of the California Water Code) was to encourage local water service agencies to cooperatively manage groundwater resources within their jurisdictions. As such, AB3030 provides a systematic procedure for development of a GWMP, which is intended to include guidelines for groundwater basin extraction, recharge, conveyance, and quality.

Numerous public hearings addressing the South Westside Basin GWMP have occurred; and an advisory committee consisting of agencies and key stakeholders has been formed. Meetings with advisory committee members have been held from mid-2009 through early 2011 to coordinate stakeholder input and incrementally build the South Westside Basin GWMP. Entities represented on the advisory committee include BAWSCA, City of Brisbane, City of Burlingame, Cal Water, DWR, local cemeteries, Town of Colma, City of Daly City, Regional Water Quality Control Board, City of San Bruno, SFPUC, City of South San Francisco, and other interested citizens. The South Westside GWMP is scheduled to be completed in in spring 2012. A March 2011 draft of the South Westside GWMP has been circulated to the advisory committee members for review. Information presented in an updated draft dated June 2011 has been used herein to characterize and provide the most current understanding of the South Westside Basin (RMC, 2011).

As indicated above, the 1999 GWMP for the Westside Basin was prepared, but was not formally adopted by the Westside Partners. However, many of the recommendations contained in the 1999 GWMP were implemented voluntarily. Since the development of the 1999 GWMP, a significant amount of additional analysis has occurred including the development of new groundwater basin models (Hydrofocus, 2011) and the preparation of multiple drafts of the new GWMP. At the time of publication of the City's UWMP, the June 2011 draft GWMP had not yet been circulated to the public and had not been finalized.

4.5.2 Groundwater Basin Description

The City overlies the central portion of the 40 square mile Westside Basin[4]. The Westside Basin consists of unconsolidated colluvium that was deposited in a northwest trending trough in the underlying impervious bedrock. The approximate boundaries of the Westside Basin are shown on Figure 4-2. 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, 2003a; DWR, 2003). San Bruno Mountain and San Francisco Bay form the eastern boundary of the Westside Basin, while the Serra Fault[5] and the Pacific Ocean form the western boundary (Rogge, 2003; Yates, 2003a; DWR, 2003). Adjoining groundwater basins are the Lobos Basin to the north and the San Mateo Plain Aquifer to the south.

As discussed above, 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. Further discussion regarding aquifer conditions in the South Westside Basin are provided below.

[4] 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.

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

4.5.3 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 elevation of the bedrock surface is shown on Figure 4-3. As shown on this figure, 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).

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 Town of Colma, 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).

Groundwater within the South Westside Basin generally flows toward pumping centers within the City, Daly City, and South San Francisco. Groundwater elevation contours from the primary production aquifer within the Westside Basin are shown on Figure 4-4[6]. As shown on this figure, groundwater extraction has created significant depressions in the water table and water levels are more than 100 feet below sea level in many areas of the South Westside Basin. Concerns regarding the potential for salt water intrusion have been raised and are further discussed below. The City has instituted a program to monitor the potential effects of groundwater extraction on saltwater intrusion.

Water levels within the drinking water aquifers of the South Westside Basin are depressed well below sea level in many areas. 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 (RMC, 2011). 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 was awarded approximately $250,000 from the DWR's Local Groundwater Assistance Program (AB303) to institute a saltwater intrusion monitoring program for portions of the Westside Basin near the City. The City's program compliments efforts by the City of Daly City to monitor saltwater intrusion in the

[6] This figure is based upon water level measurements collected in the Fall of 2009.

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.

4.5.4 Basin Water Budget Analysis

A groundwater model was developed and used to simulate historical and existing groundwater conditions, including assessing groundwater budgets in the South Westside Basin (Hydrofocus, 2011). The results of this water budget analysis show that if groundwater users pump at 2008 projected production levels[7], the groundwater basin would remain in a reasonably balanced condition, with inflows within 2 percent of outflows. In 2010, rates of groundwater extraction were less than 2008 projected production levels utilized in the model[8] (RMC, 2011), indicating that the Westside Basin is not in overdraft.

The 2008 projected production level for the City utilized in the model was 2.1 mgd.

4.6 REGIONAL CONJUNCTIVE USE

The City, City of Daly City and Cal Water (purveyor for the City of South San Francisco) are considering participation in the SFPUC's Regional Groundwater Storage and Recovery Project (Regional Project). All three partner agencies operate groundwater wells located in the South Westside Basin, and also purchase surface water from SFPUC, delivered through its Regional System.

The proposed Regional Project is an in-lieu groundwater recharge program that would have two operating conditions, 'put' operations, in normal and wet years, and 'take' operations, in dry years. During put operations, SFPUC would provide additional surface water to the three partner agencies in order to reduce their groundwater pumping. During take operations, the City, City of Daly City, and Cal Water would utilize available groundwater supplies and reduce surface water deliveries, thereby freeing surface water supply to be delivered to other SFPUC customers. Under the proposed Regional Project, SFPUC would also construct new groundwater production well facilities, which would either be operated by the partner agencies or by SFPUC.

In 2002, SFPUC instituted a pilot project to evaluate the effects of in-lieu recharge on groundwater levels within the South Westside Basin.[9] As part of the Conjunctive Use Pilot Project, SFPUC provided the cities of Daly City, South San Francisco (served by Cal Water),

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[7] "2008 No Project Scenario" in Hydrofocus (2011). Under the 2008 No Project Scenario, total projected groundwater production from the South Westside Basin is 8,744 acre feet per year.

[8] Total estimated groundwater production levels from the South Westside Basin in 2010 were 7,904 acre feet (RMC, 2011).

[9] "In-lieu" recharge refers to the act of using surface water supplies to meet demands such that groundwater that would have been extracted is allowed to remain in the basin, thus increasing the quantity of groundwater in storage. This water is then available for subsequent use during drought years.

and San Bruno with additional surface water to supplement water that otherwise would have been pumped from their respective municipal water supply wells.

Between January 2003 and March 2005, the City received an average of 1.2 mgd of surface water from SFPUC as part of the Conjunctive Use Pilot Project. During this time, the City ceased production in water supply wells 15, 16, 17, and 18, with the exception of November 2003 through January 2004, when the Conjunctive Use Pilot Project was interrupted because surplus SFPUC system water was not available to offset groundwater use.

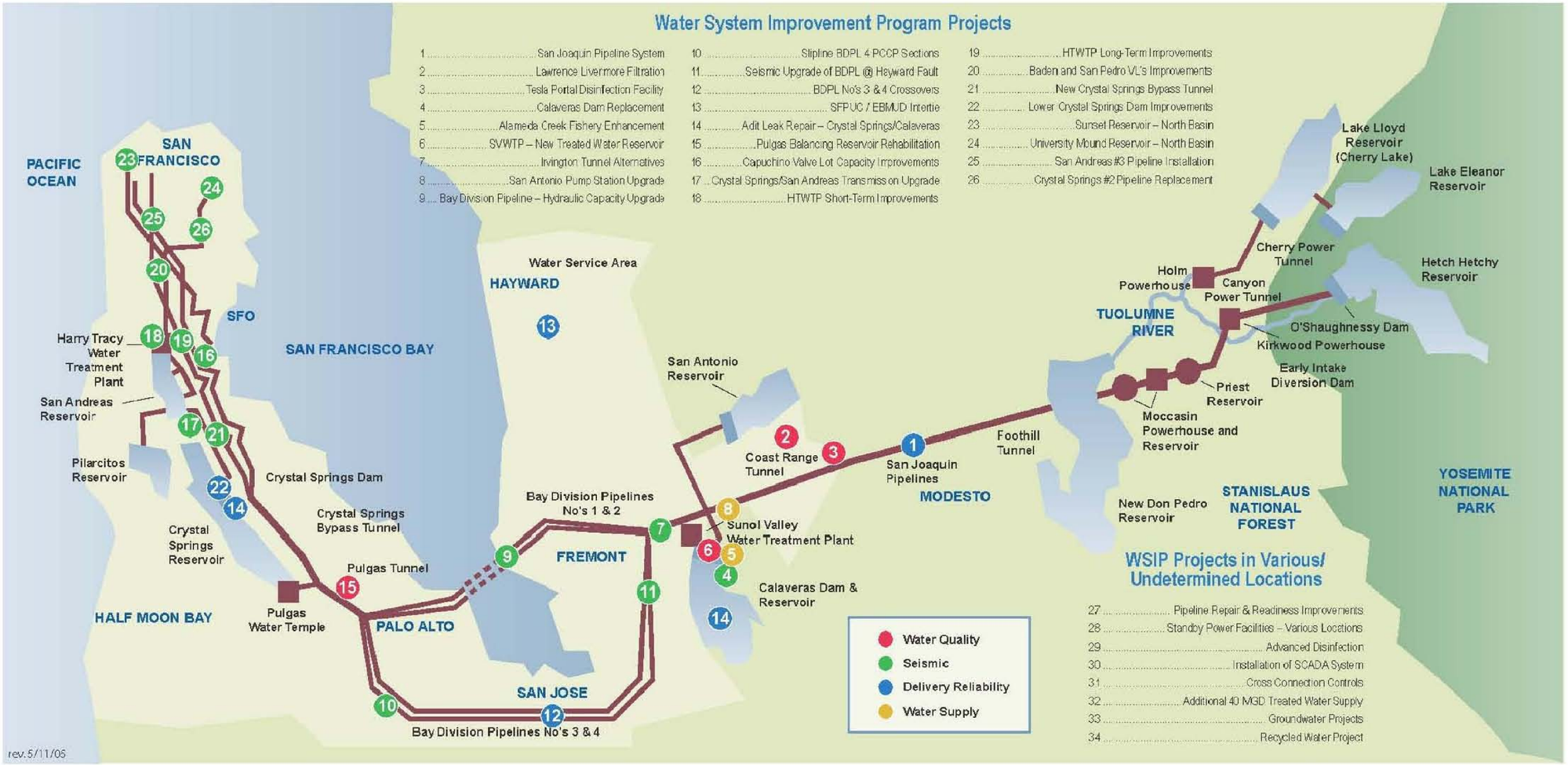
Results from the 2002 through 2005 Conjunctive Use Pilot Project showed that water can be successfully stored in the aquifer system through in-lieu recharge. The potential for success of an in-lieu project in the City continues to be studied, focusing on the impact of the extraction (Take Period) portion of the project. To date, Cal Water, the City of Daly City, and the City have not negotiated final agreements with SFPUC regarding a long-term conjunctive use program, though discussions are on-going.

An analysis of the potential impacts of the Regional Project on system operations is evaluated in *Chapter 8 Evaluation of Future System.*

FIGURE 4-1

City of San Bruno
Water System Master Plan

SFPUC WATER SYSTEM IMPROVEMENT PROGRAM PROJECTS



Source: San Francisco Public Utilities Commission, August 18, 2005

Notes
1. Source: City of San Bruno UWMP, EKI, June 2011.

Abbreviations:

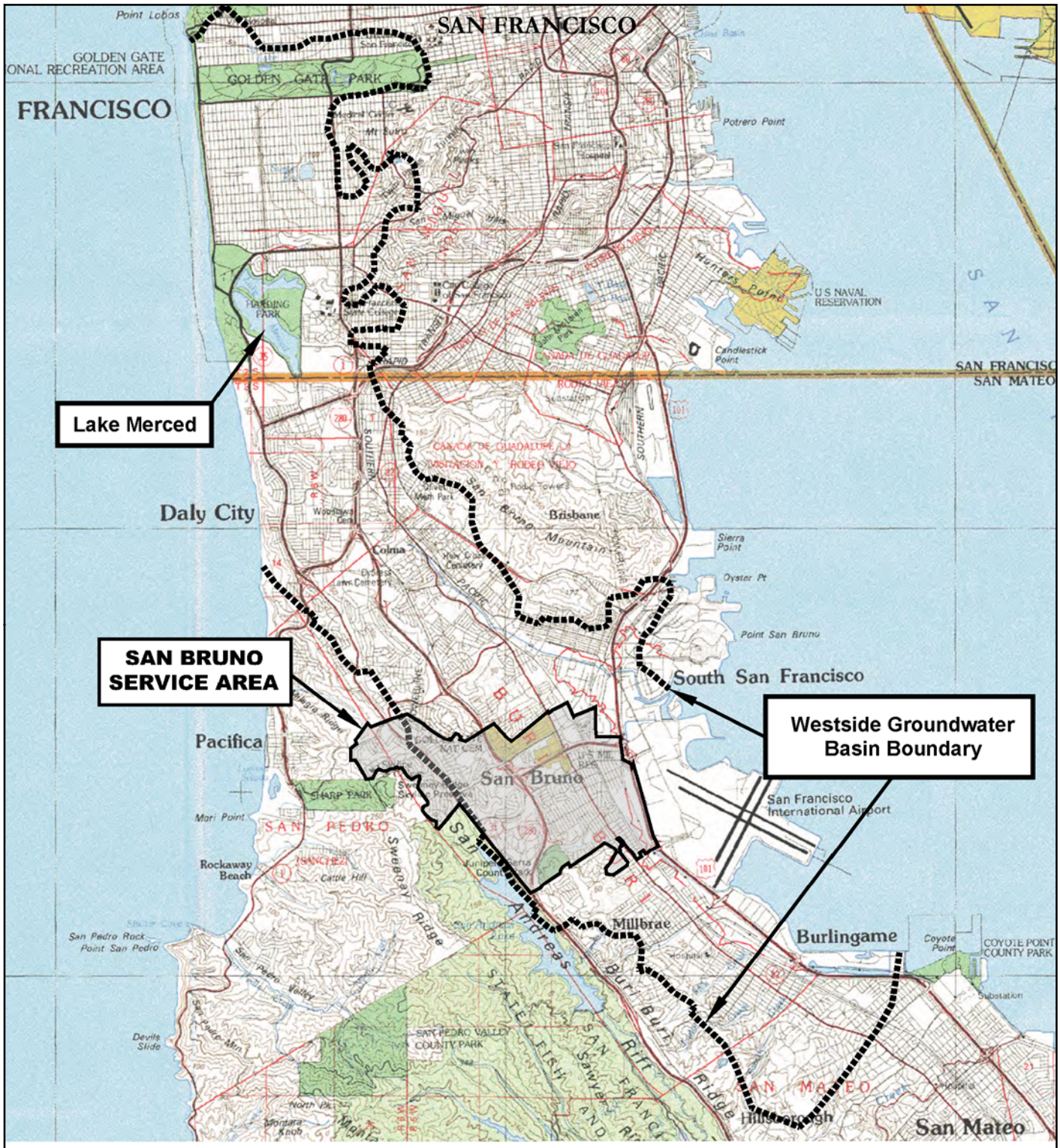
BDPL	= Bay Division Pipeline
EBMUD	= East Bay Municipal Utility District
HTWTP	= Henry Tracy Water Treatment Plant
MGD	= Millions of Gallons per Day
PCCP	= Prestressed Concrete Cylinder Pipe
SCADA	= Supervisory Control and Data
SFO	= San Francisco Airport
SFPUC	= San Francisco Public Utilities Commission
SVWTP	= Sunol Valley Water Treatment Plant
WSIP	= Water System Infrastructure Implementation Plan

Notes:

1. All locations are approximate.
2. Not to scale

City of San Bruno

WEST YOST ASSOCIATES



Notes
1. Source: City of San Bruno UWMP, EKI, June 2011.
2. All locations are approximate.
3. U.S.G.S. 1:100,000 Series Topographic Map, San Francisco Quandrangle, California 1978.

N

0 2 4

(Approximate Scale in Miles)

FIGURE 4-2

City of San Bruno
Water System Master Plan

WESTSIDE GROUNDWATER BASIN SITE VICINITY MAP

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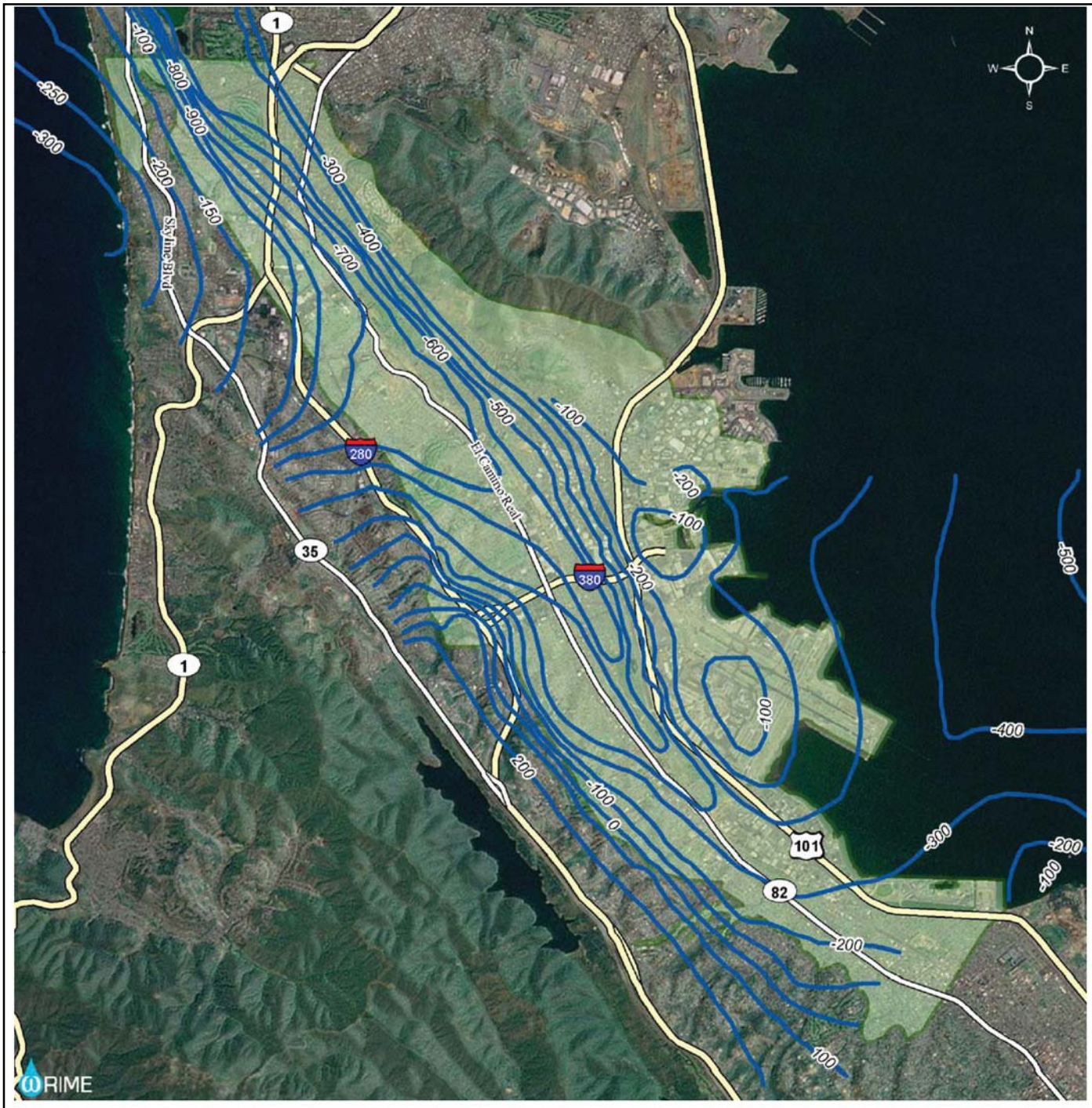

Notes:

1. Source: City of San Bruno UWMP, EKI, June 2011.
2. All locations are approximate.
3. Basemap source: Draft South Westside Basin Groundwater Management Plan, RMC, March 2011.

N

0 1.5 3

(Approximate Scale in Miles)

Legend:

- Plan Area
- Highways
- Bedrock Elevation (feet)

FIGURE 4-3

City of San Bruno
Water System Master Plan

BEDROCK ELEVATION

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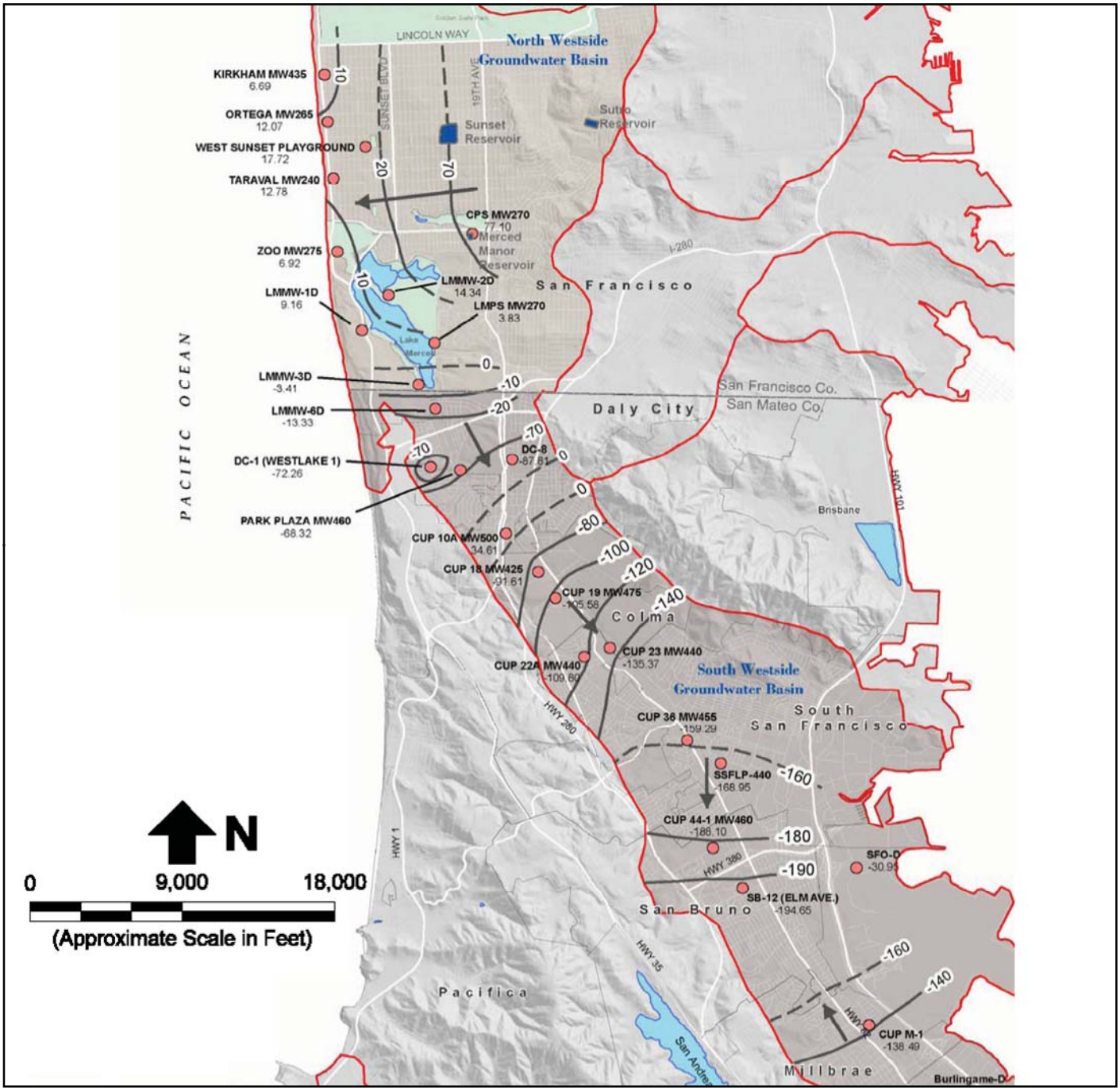


Legend:

- Lake
- Groundwater Basin Boundary (Source: CA Dept. of Water Resources, Bulletin 118 (2003), modified by Gus Yates, 2003)
- Approximate Groundwater Flow Direction
- Approximate Groundwater Elevation Contour (Dashed Where Inferred)
- Well Name
  Groundwater Elevation
  10/19/09 - 10/22/09
  (Feet, NAVD88)
  NA = Not Available

Notes:

1. Source: City of San Bruno UWMP, EKI, June 2011.
2. All locations are approximate.
3. Basemap source: *Final - 2009 Annual Groundwater Monitoring Report Westside Basin San Francisco and San Mateo Counties, California*, San Francisco Public Utilities Commission, May 2010.

FIGURE 4-4

City of San Bruno
Water System Master Plan

GROUNDWATER ELEVATION CONTOURS PRIMARY PRODUCTION AQUIFER, FALL 2009

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 5
Hydraulic Model Development

This chapter describes the development and calibration of the City's water system hydraulic model.

To develop the City's hydraulic network model, West Yost completed the following tasks:

- Used the City's existing water distribution system maps (exported from City's GIS) to create the hydraulic model;
- 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;
- Allocated existing water demands by using the City's spatially located metered account information to distribute demands within the hydraulic model; and
- Calibrated the City's water system hydraulic model to simulate pressures and flows observed in the field.

To accomplish these tasks, West Yost worked closely with the City's Water Division staff to obtain and review available:

- Information regarding existing transmission and distribution mains, storage tanks, groundwater wells, pump stations and other water supply facilities;
- As-built drawings and maps detailing sections of the system to confirm pipeline sizes, material type, age, locations and alignments; and
- Metered account data.

The water distribution system model was then calibrated using flow and pressure data observed in the field during July 2011. The hydraulic model development and calibration are described in the following sections.

5.1 DEVELOPMENT OF THE HYDRAULIC MODEL

West Yost developed a hydraulic model of the City's water system using a series of steps that included the following:

- Imported pipelines from the City's GIS, and added nodes and junctions
- Assigned approximate pipeline material, age, and roughness factor (C-factor)
- Allocated elevations to nodes and junctions
- Incorporated water system facilities
- Applied a naming scheme to each model element
- Spatially located meter accounts in GIS
- Allocated water demands in the hydraulic model

Each of these steps is discussed in more detail below.

5.1.1 Description of the Model and Model Elements

Innovyze's InfoWater program is the hydraulic modeling software used to represent the City's water system. This computer simulation model transforms information about the physical system into a mathematical model that solves for various flow conditions based on specified water demands. The computer model then generates information on pressure, flow, velocity and head loss that is used to analyze system performance and to identify system deficiencies. The model can also be used to verify the adequacy of recommended or proposed system improvements.

The hydraulic model is represented as a network of nodes (*e.g.*, location of a tank or location where pressure is monitored), and node-connecting elements (*e.g.*, pipes). However, because nodes are representative of various actual facilities (*e.g.*, tanks, pump stations, or wells) and their physical locations, a definition of each element was established during the development of the hydraulic model. A brief description of each type of node and node-connecting element is provided below.

Node: Nodes represent transitions in pipeline characteristics (*e.g.*, diameter) or points in the system where pressure is monitored. Nodes also represent locations in the system, such as pump station or tank connections, where metered water demands do not exist. Elevation and physical facility location are the data requirements for nodes.

Junction: Junctions represent locations in the system where water demands exist. In the model, water is subtracted from the system at junction locations. Junctions can also include transitions in pipeline characteristics (*e.g.*, diameter). Data requirements for junctions are the demand at each junction, elevation and location.

Pipe: Pipes (i.e., links) represent facilities that convey water from one point in the system to another, and are used in the model to represent pipelines or check valves. Diameter, from/to node or junction, length, and pipeline roughness factor are the input data required.

Reservoir: Reservoirs represent external sources of water for the model (*e.g.*, groundwater basin or supply turnout), and remain at a constant water level irrespective of the flow unless they are specified as variable-head reservoirs. Reservoirs are used to represent the source for each well and each surface water supply turnout in the City's model. Location and water surface elevation are the input data required.

Tank: Tanks are distinguished from reservoirs by having known volumes and water surface elevations that change with time as water flows into or out of the facility. This element is used to represent the City's storage tanks. Diameter, bottom elevation, overflow elevation, and location are the input data required.

Pump: Pumps represent locations in the model where the hydraulic grade line is raised to overcome elevation differences and friction losses, and are used to represent individual pumps at pump stations. Elevation, number of pumps, pump test results, pump curves, sequencing, pump efficiency, and location are the input data required.

Valve: Valves regulate either flow or pressure in the water distribution system model. Valve diameter, setting, elevation, and location are the input data required.

5.1.2 Pipelines, Nodes, and Junctions

City staff provided a GIS geodatabase file containing the geospatial location of existing pipelines for the City's water system. The geodatabase layer of the existing water pipelines was imported into the hydraulic model, but did not include "from" and "to" nodes (i.e., points designating the beginning and end of the pipeline). Consequently, InfoWater's Append Nodes feature was used to create and assign the beginning and end-points (from and to nodes) for the existing pipelines. In addition, West Yost also developed an attribute in the hydraulic model database to include the unique Pipe ID assigned by Lynx Technologies (the City's GIS consultant), allowing City staff to leverage or integrate model information with the City's GIS.

5.1.3 Pipeline Characteristics

The City's geodatabase layer for existing water pipelines did not include roughness factors. However, 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. Table 5-1 presents the preliminary C-factors assigned to each of the different pipeline material types within the City's water system. These C-factors were then validated during calibration of the hydraulic model, as described in Section 5.2.

5.1.4 System Elevations

Digital topology information for the City was extracted as a GIS shapefile using the software program TopoDepot®. TopoDepot® provides 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. TopoDepot® runs this grid of elevations through a Surface Contouring Program to generate the elevation contours; the resulting shapefile was used to assign service elevations to each node using the model's Elevation Interpolation feature. Certain service elevations (at the existing stations) were later confirmed during calibration. Model elevations are based on the National American Vertical Datum of 1988 (NAVD 88).

5.1.5 Water System Facilities

After the pipelines and nodes were incorporated into the hydraulic model, major system facilities (*e.g.*, turnouts, pressure reducing valves, groundwater wells, pump stations, and storage tanks) were digitized into the model. Each of these facilities was entered into the model based on drawings provided by City staff, when available, and some of the facilities data were verified during West Yost's site visits on May 25, 2011.

Table 5-1. Preliminary Pipeline C-Factors Assigned in the Model[a,b]

Year	Cast Iron (CI)		Asbestos Cement (AC)		Ductile Iron (DI)		Polyvinyl Chloride (PVC)	
	Diameter ≤ 8-inches	Diameter > 8-inches	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	NA	NA
1940-1949	90	110	120	120	NA	NA	NA	NA
1950-1959	100	110	120	120	NA	NA	NA	NA
1960-1969	120	120	120	120	NA	NA	NA	NA
1970-1979	120	120	NA	130	NA	NA	NA	NA
1980-1989	130	140	NA	130	NA	NA	NA	NA
1990-1999	NA	NA	NA	NA	NA	NA	NA	NA
2000s	130	140	NA	NA	135	140	NA	NA
Unknown	110	120	120	NA	NA	NA	130	NA

Year	Steel		Welded Steel (WS)		Galvanized Steel (GS)		Unknown	
	≤ 8-inches	> 8-inches	≤ 8-inches	> 8-inches	≤ 8-inches	> 8-inches	≤ 8-inches	> 8-inches
1900-1939	120	NA	NA	NA	75	NA	NA	NA
1940-1949	NA	NA	NA	NA	90	NA	NA	NA
1950-1959	NA	NA	NA	130	100	NA	NA	120
1960-1969	120	120	NA	130	120	NA	NA	NA
1970-1979	NA	NA	NA	NA	NA	NA	NA	125
1980-1989	NA	NA	NA	NA	NA	NA	NA	NA
1990-1999	NA	NA	NA	NA	NA	NA	NA	NA
2000s	NA	NA	NA	NA	NA	NA	NA	NA
Unknown	120	120	NA	NA	NA	NA	120	130

[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.
[b] NA - Not Applicable, material was not installed during these years.

5.1.6 Naming Scheme

After the major system facilities were digitized into the model, each model element was assigned a label which identifies the type of model element, the element's purpose, and the element's location. Assigning each model element a specific label allows the modeler to easily locate specific elements or more readily identify potential problems during the calibration process. The City's hydraulic model was populated using the naming scheme presented in Table 5-2.

5.1.7 Spatially Located Meter Accounts

This section describes the methodology used to spatially locate water consumption data collected by the City's water meters. City staff provided billing spreadsheets containing metered accounts and their corresponding metered consumption data by account, address and customer sector for each month of the year. Data from calendar year 2010 was used to develop the City's existing water demands for the hydraulic model; however, these demands were scaled up to represent FY 2000/01 production data because it was used as the baseline for projecting future water demands as discussed previously in Chapter 3.

Consumption data from metered accounts was spatially located by geocoding the account addresses to a GIS street file. West Yost was able to spatially locate 99.7 percent of the metered accounts (11,978 out of 12,018) present in the 2010 billing data provided by the City. This amounts to 98.2 percent of the total 2010 metered consumption within the City. The remaining consumption in the City was most likely from meters without proper addresses. Table 5-3 presents the percentage of total metered accounts and metered consumption spatially located for the City.

Figure 5-1 compares the spatially located water demand data with the existing pipelines imported into InfoWater. As shown in Figure 5-1, most areas with spatially located demands also had an existing pipeline. This correlation indicates that the GIS geodatabase layer used as the basis for the hydraulic model includes most of the existing pipelines required to serve current water demands.

Table 5-2. Naming Scheme for Network Elements

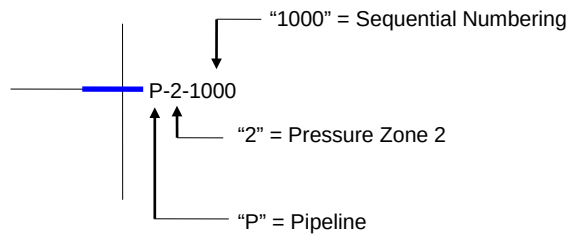
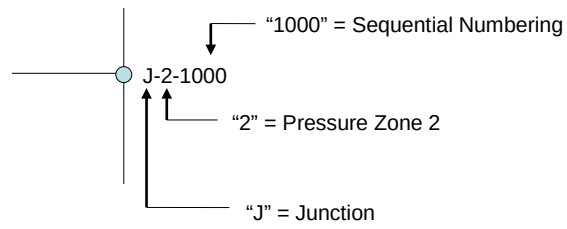
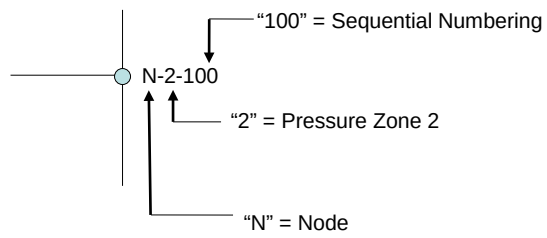
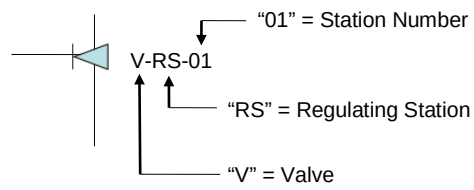
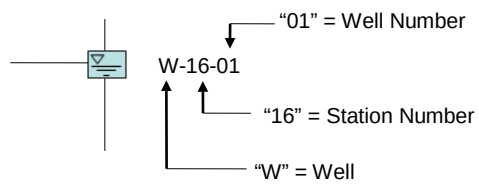
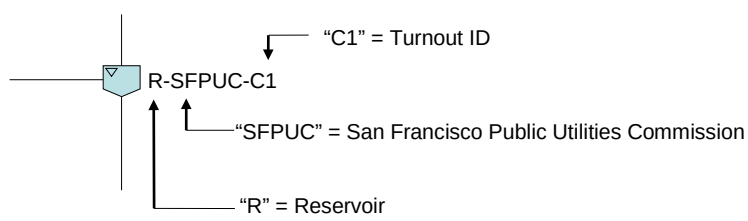
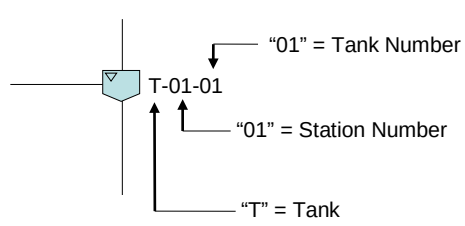
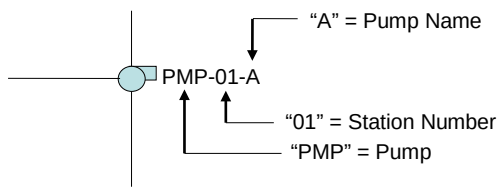
Model Component	Naming Scheme
Pipelines	
Junctions	
Nodes	
Regulating Stations	
Wells	
SFPUC Turnouts	
Tanks	
Pumps	

Table 5-3. Spatially Located Meter Results

Customer Sector	Number of Metered Accounts	Total "Metered" Demand, af/yr	Average Day Demand, gpm
Actual 2010[a]	12,018	3,620	2,244
Spatially Located (automated geocoding)	11,648	2,850	1,767
Spatially Located (manual geocoding)	330	704	436
Spatially Located Total[b]	11,978	3,554	2,203
Percent of Actual 2010	99.7%	98.2%	98.2%

(a) Data provided by City staff in May 2011.
(b) Based on West Yost's GIS.

5.1.8 Water Demand Allocation

For the City's water system, water demands were allocated in the hydraulic model using the spatially located meter demand data developed in the previous section and 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 staff reviewed the hydraulic model after running the Demand Allocator to confirm that the demands were allocated properly.

Water demand within the hydraulic model was allocated by customer sector to provide the City with additional flexibility in the model. Table 5-4 presents the demand column assigned to each customer sector within the hydraulic model.

Table 5-4. 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 in Junction database of the InfoWater model.
(b) May include all other water use types (*e.g.*, Industrial), excluding residential.
(c) Includes accounts that are metered, but not billed. These accounts are public sector water uses at City facilities.
(d) Meters from Pressure Zone 13 were not spatially located. Water demands were allocated based on 2010 production records.

5.2 HYDRAULIC MODEL CALIBRATION

The City's hydraulic model was calibrated to confirm that the computer simulation model can accurately represent the operation of the City's water distribution system under varying conditions. 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 developing the hydraulic model, locations were chosen for possible hydrant flow testing as shown on Figure 5-2. Because the City does not have specific information on individual pipeline age and material type for the entire water distribution system, hydrant tests were developed to collect general pipeline friction loss information in targeted areas, rather than attempt to estimate friction losses for individual pipelines. These hydrant tests were used to "spot-check" the preliminary 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 July 6, 2011. Table 5-5 provides the field status of each hydrant test. Of the original 13 scheduled hydrant tests, 12 hydrant tests were performed. One hydrant test was canceled due to constraints identified by City staff.

Table 5-5. Hydrant Test Locations and Status[a]

Test #	Approximate Diameter, inches[b]	Approximate Material Type	Approximate Year of Installation	Location	Field Status
1	6	CI	1928	Santa Maria Avenue, east of San Anselmo Avenue	Completed
2	8	CI	1940	Walnut Street, west of 7th Avenue	Completed
3	8	CI	1951	Camino Plaza, south of San Bruno Avenue	Completed
4	6	CI	1950	Redwood Avenue, north of Niles Avenue	Completed
5	4	CI	1937	Easton Avenue, south of Kains Avenue	Completed
6	8	CI	1975	Elm Avenue, south of Grundy Lane	Completed
7	6	CI[c]	1955	Claremont Drive, south of Fairmont Drive	Completed
8	6	AC	1956	Fernwood Drive	Completed
9[d]	6	CI	1960	St. Cloud Drive, northeast of Fleetwood Drive	Completed
10	8	CI	1958	Pacific Heights Boulevard, north of Sharp Park Road	Completed
A1	6	CI	1963	Lake Drive, south of Amador Avenue	Alternate, Completed
A2	8	AC	1956	Crestmoor Drive, north of Piedmont Avenue	Alternate, Completed
A3	6	CI	1920	Huntington Avenue, south of Euclid Avenue	Alternate, Not completed due to potential drainage issues

(a) 10 Test Locations (#1-10) and 3 Alternate Test Locations (#A1-A3).
(b) Tests did not involve closing valves to isolate specific pipeline diameters. Therefore, diameter shown is the general diameter of pipelines in the vicinity of the flowing hydrant.
(c) Initially assumed to be AC, but changed to CI based on City staff recommendation.
(d) Location was revised during the day of testing.

Each hydrant test involved flowing water through pipelines of a general size and approximate 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 routes 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.

Pipelines in the City's water system range in size from 2 to 16-inches in diameter. Pipeline materials consist mainly of CI and AC. Other pipeline materials as listed in Table 5-1 are also found in the City's water system. Prior to the model runs, each pipeline was assigned a preliminary C-factor based on the pipeline size and approximate material type and age as presented in Table 5-1.

Each hydrant flow test performed was then simulated using the hydraulic model of the City's water system. 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 for model calibration for water system master planning.

Results from the hydrant tests are discussed in more detail in the following section.

5.2.2 Hydrant (C-factor) Test Results

The results of the simulated hydrant flow tests generally validate the water system pipeline configuration and the assigned C-factors previously shown in Table 5-1. However, based on the comparison of the collected hydrant flow test data and model simulation results, seven of the hydrant flow tests (Tests 4, 6, 7, 8, 9, 10, and A1) required further review and evaluation because they did not meet the ±5 psi tolerance limit established for calibration. The results from the remaining hydrant tests indicate that the hydraulic model accurately simulates the City's water system, and is able to closely replicate field-observed pressures and flows. The detailed results of each individual hydrant test that was performed in the field are provided in Appendix A. Further discussions regarding Tests 4, 6, 7, 8, 9, 10, and A1 are provided below.

5.2.2.1 Test 4: 6-inch CI Pipelines Constructed Approximately in 1950

Initial model simulation results indicate that there may be system configuration issues (*e.g.*, partially closed valve(s), inaccurate representation of pipeline connectivity, *etc.*) within the area of Test 4. On August 23, 2011, City staff confirmed that there was a missing 4-inch diameter tie-in connection at Redwood Avenue and Niles Avenue. Simulation results from Test 4 met the ±5 psi tolerance limit once the connection at Redwood Avenue and Niles Avenue was accurately simulated within the hydraulic model.

5.2.2.2 Test 6: 8-inch CI Pipelines Constructed Approximately in 1975

Initial model simulation results indicate that there may be system configuration issues (*e.g.*, partially closed valve(s), inaccurate representation of pipeline connectivity, *etc.*) within the area of Test 6. On August 17, 2011, City staff confirmed that there was a missing 8-inch diameter tie-in connection at Elm Avenue and Bayhill Drive. Simulation results from Test 6 met the ±5 psi tolerance limit once the connection at Elm Avenue and Bayhill Drive was accurately simulated within the hydraulic model, except for the results from observed Hydrant 6A, where the difference between field-observed and model-simulated pressures was 18 psi. The model simulation results indicate that there may have been an error with the residual pressure reading at observed Hydrant 6A. Therefore, it is recommended that the data from Hydrant 6A not be used.

5.2.2.3 Test 7: 6-inch CI Pipelines Constructed Approximately in 1955

Initial model simulation results indicate that there may have been an error with the residual pressure reading at observed Hydrant 7B. The residual pressure reading dropped to zero during testing, which typically indicates that the residual pressure reading is invalid. The difference between field-observed and model-simulated pressures for Hydrant 7B was 11 psi. However, model simulation results from observed Hydrants 7A, 7C, and 7D were well within the ±5 psi tolerance limit. Therefore, it is recommended that the data from Hydrant 7B not be used.

5.2.2.4 Test 8: 6-inch AC Pipelines Constructed Approximately in 1956

Initial model simulation results indicate that there may be system configuration issues (*e.g.*, partially closed valve(s), inaccurate representation of pipeline connectivity, *etc.*) within the area of Test 8. On August 19, 2011, City staff re-performed Test 8 with updated settings at RS 6. Results from the hydraulic model for this updated Test continue to indicate that there may be a partially closed valve on the 6-inch diameter tie-in connection from Valleywood Drive. However, in late September 2011, City staff confirmed that all valves in the vicinity of Test 8 were open. It appears that model simulation results from Test 8 are currently inconclusive and may be due to configuration errors or other errors in field data collection that could not be identified at this time. Therefore, this test was not used to adjust modeled C-factors.

5.2.2.5 Test 9: 6-inch CI Pipelines Constructed Approximately in 1960

The locations of the flowing and observed hydrants for Test 9 were revised during the day of hydrant testing due to potential drainage issues with the original test locations. Therefore, Test 9 was revised and improvised in the field based on the City's field maps. Initial model simulation results indicate that there may have been an error with the residual pressure readings at observed Hydrants 9B and 9D. The difference between field-observed and model-simulated pressures for Hydrant 9B was 29 psi, and for Hydrant 9D, it was 21 psi. Hydraulic gradients computed from the field results were not consistent between Hydrants 9B and 9D and other field measurements. It is possible that the data provided for Hydrants 9B and 9D was not collected from the correct observation hydrants due to the nature of an improvised test (i.e., no clear maps were provided to field staff to locate the observed hydrants). Model simulation results from the remaining observed hydrants (Hydrants 9A and 9C) were well within the ±5 psi tolerance limit. Therefore, it is recommended that the data from Hydrants 9B and 9D not be used.

5.2.2.6 Test 10: 8-inch CI Pipelines Constructed Approximately in 1958

When simulation results from Test 10 were presented to City staff during a conference call held on August 10, 2011, City staff indicated that the area around Test 10 contains a mixture of pipeline material types (i.e., CI, AC, and PVC). Model simulation results from Test 10 appear inconclusive and may be due to the lack of the data on the actual pipeline materials installed in this area, configuration errors or other errors in field data collection. Therefore, this test was not used to adjust modeled C-factors.

5.2.2.7 Test A1: 6-inch CI Pipelines Constructed Approximately in 1963

Residual pressure readings from observed Hydrants A1C and A1D dropped to zero during testing. Typically this is an indication that the residual pressure readings are invalid. Without the pressure comparisons from Hydrants A1C and A1D, Test A1 simulates within the ±5 psi tolerance limit. Therefore, it is recommended that the data from Hydrants A1C and A1D not be used.

5.2.3 Hydraulic Model Calibration Findings and Conclusions

In summary, the results from the hydrant tests indicate that the hydraulic model is generally well calibrated within a 5 psi differential from the field hydrant test data. Twelve hydrant tests were conducted. Seven of the tests required additional review. Of these seven tests, two tests were used to identify model configuration issues (i.e., pipelines not identified in GIS) and results matched closely when these configuration errors were corrected. Three tests, where field results indicate that there were likely field data measurement errors, had at least 2 (out of 4) residual readings that could be used to validate the model. In only two of the twelve tests, model results could not be reconciled with field data.

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.

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 5-1_SpatiallyLocWatDem.mxd

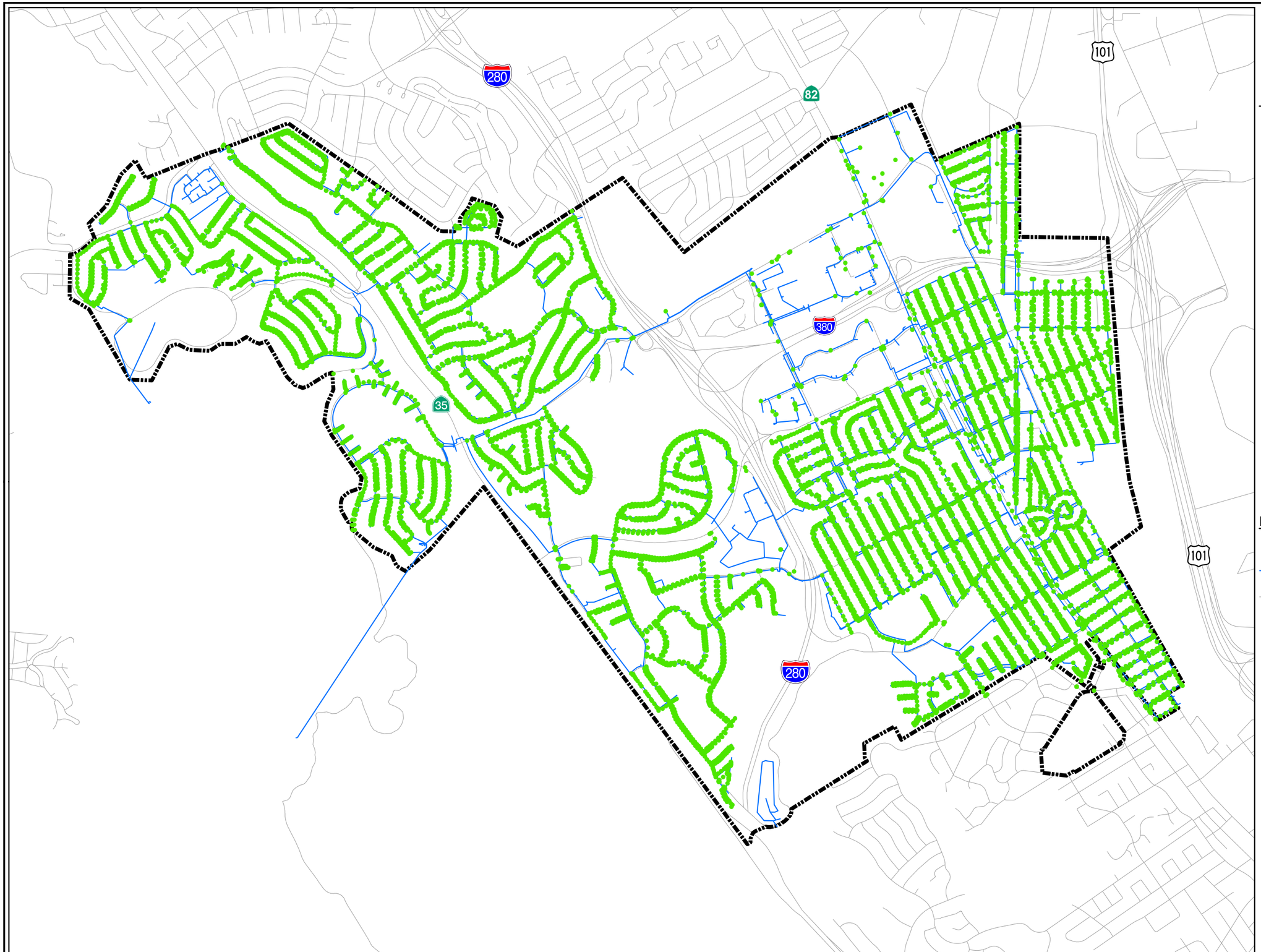


FIGURE 5-1

City of San Bruno
Water System Master Plan

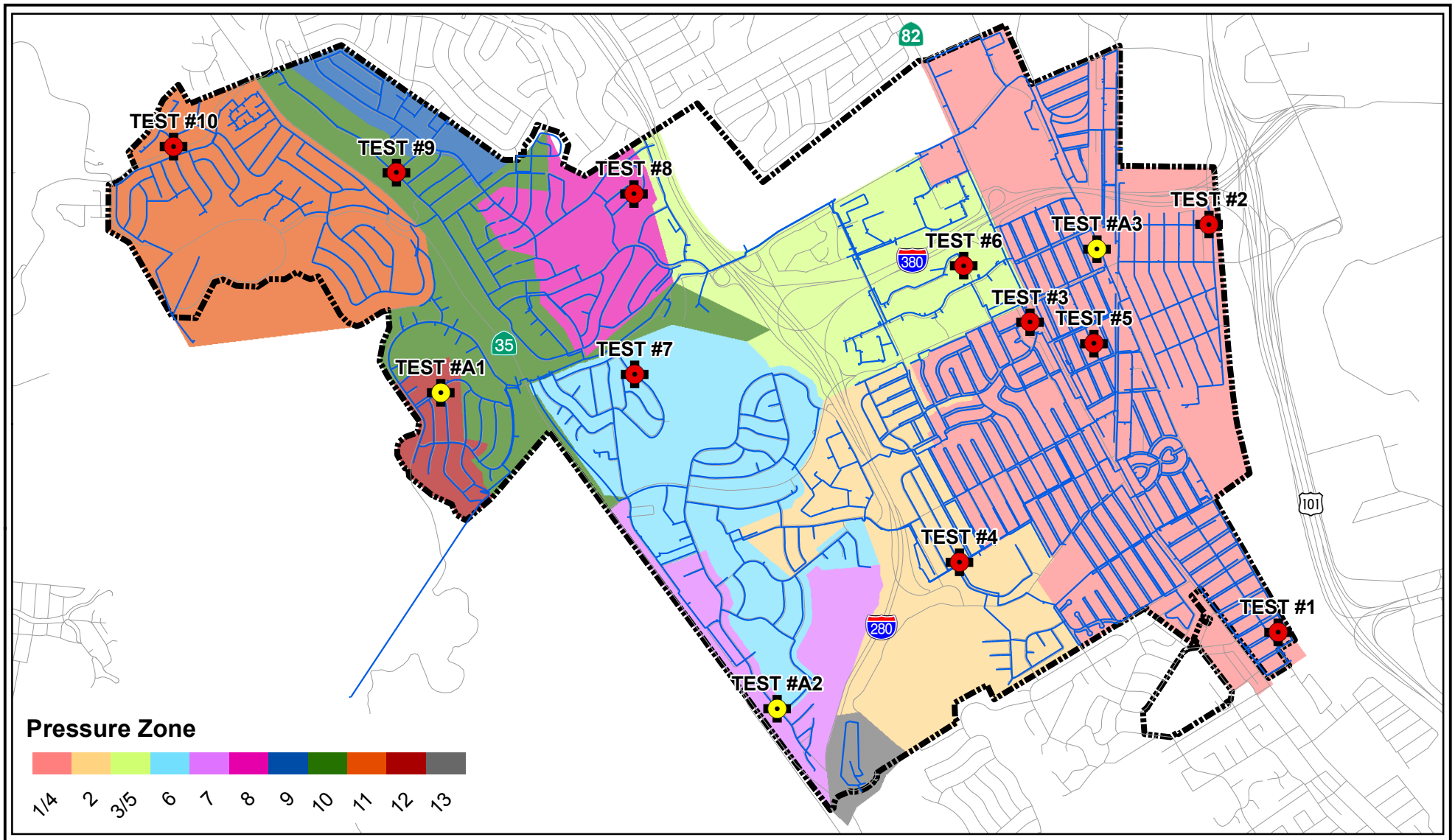
SPATIALLY LOCATED WATER DEMANDS

LEGEND

- Spatially Located Demand
- Existing Pipeline
- Street

City of San Bruno

West Yost Associates



LEGEND

- Test Location
- Alternate Test Location
- Existing Pipeline
- Street
- City Limits

N

0 1,250 2,500

Scale in Feet

FIGURE 5-2

City of San Bruno
Water System Master Plan

HYDRANT TEST LOCATIONS

WEST YOST ASSOCIATES

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CHAPTER 6
Water System Master Plan Key Assumptions

This Water System Master Plan presents a comprehensive assessment of the City's water distribution system, covering three different technical areas:

- Capacity Improvement Program, based on an evaluation to assess storage and pumping facilities and pipeline hydraulic capacity;
- Seismic Improvement Program, summarized from the City's 2003 Seismic Vulnerability Assessment; and
- Renewal and Replacement Program, based on a focused evaluation of pipelines, and key system facilities.

This chapter defines the key master planning assumptions for these three evaluations, including recommended performance and operational criteria for the City's water distribution system, seismic vulnerability criteria, as identified in the previous Seismic Vulnerability Assessment, and pipeline and facility replacement criteria used to develop a pipeline and facility renewal and replacement program.

The following sections of this chapter present the key assumptions and criteria for the City's water system in the following areas:

- Capacity Improvement Program
- Seismic Improvement Program
- Renewal and Replacement Program

6.1 CAPACITY AND RELIABILITY PROGRAM

The system capacity analysis evaluates the City's existing water system and its ability to meet the City's recommended performance and planning criteria under existing and buildout demand conditions. This analysis, documented in *Chapter 7 Evaluation of the Existing Water System* and *Chapter 8 Evaluation of Future Water System* evaluates system storage, peak pumping capacity and peak valve station capacity needs to meet system requirements, and hydraulically evaluates the system to assess hydraulic performance under peak hour and maximum day plus fire flow conditions.

The recommended performance and operational criteria 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 recommended water system performance and facilities sizing criteria will be used to assess the ability of the City's water system to provide adequate capacity, flow and pressure to customers within the water distribution system during normal operations and for emergencies, such as a fire or major pipeline outage. This evaluation uses the recommended performance and operational criteria to determine the City's water system deficiencies under current and future demands and to select the size of new facilities. Key water system design criteria and operational standards from the 2001 Water System Master Plan have been incorporated into this chapter. However,

some of the previous water system design and operational criteria have been revised to reflect either more recent or more stringent standards for this Water System Master Plan Update.

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

6.1.1 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 eleven 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.

6.1.1.1 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 (*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 and peak hour demand conditions will be conducted assuming 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 pump at firm capacity (*i.e.*, firm groundwater pumping capacity). Firm groundwater pumping capacity assumes that two of the City's existing groundwater wells will be out of service at any given time due to maintenance or operational issues.

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 sufficent 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 Requirements		
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.
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. Firm groundwater pumping capacity defined as the total capacity of all existing wells minus two wells.
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.
Groundwater Credit (GC)	Equal to the firm groundwater supply that can be reliably accessed (facilities equipped with auxiliary power).	Maximum credit equal to recommended emergency storage capacity.
Total Water Storage Capacity	0.75 x maximum day demand + Fire Flow Storage - GC	
Pressure Regulating Station Capacity		
Valve Capacity	Valve capacity equal to the larger of either peak hour demand or maximum day demand plus fire flow for pressure zones without storage where the pressure reducing station is sole 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	7 ft/s (preferred); 10 ft/s (maximum)	
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	130	For consistency in hydraulic modeling.
Pipeline Material	DICL	For consistency in hydraulic modeling.
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	7 ft/s (preferred); 10 ft/s (maximum)	
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling.
Pipeline Material	DICL	For consistency in hydraulic modeling.

[(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.

6.1.1.2 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 6.1.2 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. Assumptions regarding firm pumping capacity will also apply during a maximum day plus fire flow condition.

6.1.2 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.

6.1.3 Fire Flow Requirements

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), 2010 edition, which establishes minimum fire flows and durations for individual structures (see Appendix B of the 2010 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 requirements set forth in this Water System Master Plan are intended only for general planning

[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.

purposes, and may not be reflective of the actual fire flow requirements sought for specific development approvals, and will not identify specific existing non-conforming developments.

Table 6-2 presents the recommended fire flow requirements 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 requirements 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 requirements (see Appendix C of the 2010 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, to guide proper sizing for new pipelines.

6.1.4 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 and groundwater wells assumed to operate at firm pumping capacity; 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, whichever is larger, with booster pumps and groundwater wells assumed to operate at firm pumping capacity.

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.

6.1.5 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 demand 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 storage capacity evaluation also considers normal operating volumes of existing storage facilities, which may be slightly less than nominal operating volumes, to assess possible deficiencies.

[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.

Table 6-2. Recommended Fire Flow Requirements[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 requirements 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 were confirmed by the Fire Marshal during a meeting on June 9, 2011. 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 requirements and shall not exceed values listed in Table C105.1 of the 2010 CFC.

(e) The Fire Marshal normally allows up to a 50 percent reduction in fire flow if a building is provided with an approved automatic sprinkler system. However, the 2010 CFC also requires that no fire flow be less than 1,000 gpm for single family residential or 1,500 gpm for all other building types.

(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.

Based on the City's available groundwater wells, groundwater storage can account for a portion of the recommended emergency storage. The following must be true to use the groundwater supply to offset the need to provide surface storage:

- Groundwater supply is of potable water quality and can be reliably accessed (*i.e.*, wells are equipped with on-site emergency generators);
- Groundwater supply is not already being relied upon to meet the City's average day demand requirements; and
- Sufficient water distribution facilities are available to distribute this water to demand areas.

It will be assumed that only the firm groundwater supply will be available for a groundwater credit to offset the City's emergency storage requirement (*i.e.*, two existing groundwater wells assumed to be out of service). It should be noted that the groundwater credit cannot be greater than the recommended emergency storage volume.

6.1.6 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 station is the sole supply source, the total station capacity should be equal to a maximum day demand plus fire flow condition, or a peak hour demand condition, whichever is larger.

6.1.7 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 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.

6.1.7.1 Water Transmission System

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; and
- 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.

6.1.7.2 Water Distribution System

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; and
- 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.

6.2 SEISMIC RELIABILITY PROGRAM

A Seismic Vulnerability Assessment (G&E Engineering Systems, 2003) was completed for the City's water distribution system. The seismic vulnerability assessment used previous reports and data, along with field visual observations at key water system facilities to develop a seismic improvement program. The analysis considered earthquake-induced ground shaking, liquefaction and landslide hazards to develop study criteria, which are summarized below. For more information, see the 2003 Seismic Vulnerability Assessment report.

6.2.1 Ground Shaking Hazards

For facilities (tanks, pump stations, buildings and pipelines), ground shaking hazards are quantified in terms of Peak Ground Acceleration (PGA). The strongest ground shaking would occur for an earthquake on the San Andreas fault. Estimated PGA's for a magnitude 7.9 earthquake on the San Andreas fault range from 0.53 to 0.77, depending on location and predominant soil conditions.

Limited analysis was performed for key water system facilities. Recommendations are based on fragility models for tanks with similar style construction to those in the City's water system, supplemented by visual field observations.

6.2.2 Liquefaction

Liquefaction potential was assessed based on available mapping. Areas of highest risk are in the east part of the service area, in Pressure Zone 1, where there are localized areas with high to very high liquefaction susceptibility.

6.2.3 Landslide Hazards

An analysis for earthquake-induced landslide hazards using available mapping concluded that landslide movements would not pose a significant hazard to the City's water system. Therefore, no specific criteria were incorporated into the evaluation.

6.3 RENEWAL AND REPLACEMENT PROGRAM

As noted previously, the City has an ongoing renewal and replacement program to replace aging infrastructure. The Water System Master Plan includes a focused renewal and replacement program. This renewal and replacement program will identify and prioritize improvement projects to address the City's aging infrastructure.

For pipelines, the City's GIS has pipeline diameter information only. Therefore, pipeline material type and age have been generally estimated based on subdivision mapping provided by City staff. The City also has water main leak data for 2000 through 2007, 2009, and 2010, which has been spatially located and mapped in AutoCAD and GIS (AutoCAD for 2000-2007 and GIS for 2009-2010). Using this data, West Yost will analyze the existing water system pipelines and associated water main leak data to identify trends and develop prioritized groupings of pipelines for replacement. Pipelines that have been identified for replacement to meet recommended fire flow requirements will be categorized separately.

For facilities (*i.e.*, groundwater wells, pump stations, and storage tanks), the following sources will be used to establish renewal and replacement needs: (1) data collected from the inventory of the City's existing facilities (*see Chapter 2 Existing Water System Inventory*), (2) design useful life information for similar types of facilities, and (3) input from City staff.

Information from the facilities and pipeline evaluations will be used to develop replacement projects for inclusion in the City's CIP. Program descriptions and costs will also be included in the CIP.

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 planning criteria under existing water demand conditions. The system evaluation includes three general technical areas: a system capacity and reliability evaluation; a seismic vulnerability assessment; and a pipeline and facilities rehabilitation and replacement evaluation.

The system capacity and reliability evaluation includes an analysis of water storage capacity, pumping capacity, and regulating valve capacity. The analysis also includes a reliability 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 developed for this Water System Master Plan, which is described in *Chapter 5 Hydraulic Model Development*.

The seismic vulnerability assessment summarizes results from a previous City study that assessed the City's pump station, tank and pipeline facilities for seismic vulnerabilities. The study included a review of available reports and data, a field assessment of pump and tank facilities, and development of several recommended seismic projects.

The pipeline rehabilitation and replacement evaluation uses pipe age and leak history data to formulate replacement strategies for distribution system piping. Similarly, the facilities renewal and replacement evaluation uses facility design useful life, and input from City-identified programs 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 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; and
- Existing Capacity and Reliability Improvements.
- Seismic Vulnerability Assessment: summarizes results from the 2003 evaluation.
- Rehabilitation and Replacement Evaluation: evaluates pipeline and 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 2010 water meter data. Demands were then scaled to match groundwater and surface water delivery volumes for FY 2000/01. Average daily production in FY 2000/01 was used to represent the City's "base" water year for the hydraulic evaluations. This annual demand was used because it represents a higher water use than more recent years, and because it was used as the basis for water demand projections in other planning documents (*e.g.*, 2011 UWMP).

Maximum day and peak hour demands were estimated for the following existing system analysis. Due to limited data, the peaking factors are based on peaking factors from neighboring cities with similar water systems as well as the City's previously adopted factors (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	1,272	1.83	1,909	2.75	3,817	5.49
Zone 2	327	0.47	490	0.71	981	1.41
Zone 3/5	371	0.53	556	0.80	1,112	1.59
Zone 6	206	0.30	310	0.45	619	0.90
Zone 7	67	0.10	100	0.15	200	0.30
Zone 8	102	0.15	153	0.23	306	0.45
Zone 9	49	0.07	73	0.11	147	0.21
Zone 10	211	0.30	317	0.45	633	0.90
Zone 11	242	0.35	362	0.53	725	1.05
Zone 12	56	0.08	84	0.12	168	0.24
Zone 13	29	0.04	44	0.06	88	0.12
Total	2,932	4.22	4,398	6.33	8,796	12.66

(a) Demands from Zones 1/4, 6, 7, 8, 9, and 12 each include demands from their smaller subzones (*i.e.,* Zones 1/4A, 6A, 7A, 8A, 9A, and 12A).
(b) Average day demand is based on detailed billing records and adjusted to reflect FY 2000/01 production data. Billing records were spatially located and then aggregated by pressure zone.
(c) Maximum day demand calculated using a peaking factor of 1.5 times the average day demand.
(d) Peak hour demand calculated using a peaking factor of 3.0 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 results of the existing water system facility evaluation are discussed below.

7.2.1 Pumping Capacity Evaluation

The pumping capacity in the City's existing water system was evaluated to assess its 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. For groundwater wells, it was assumed that two existing wells could be out of service at any time.

When zones are supplied solely by pump station(s), the pumping capacity criterion for the City, described previously in *Chapter 6 Water System Master Plan Key Assumptions*, 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.

The City currently has 8 active booster pump stations, 4 active wells, and one inactive well. Three pump stations (PS2, PS7, and PS8) are located at grade-level storage tanks to access the available storage in these tanks, and one pump station, PS6, pumps from a clearwell which is supplied by Well 17.

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 column referring to zone supply capacity takes into account the supply from SFPUC turnouts. 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. Comparison of Existing and Required Pumping Supply Capacity

Service Zone and Supported Zones[a]	Average Day Demand, gpm	Maximum Day Demand, gpm	Supply Sources[f,g]	Other Zone Supply Capacity	Existing Pumping Capacity, gpm		Required Firm Pumping Capacity, gpm[i]	Firm Capacity Surplus (Deficit), gpm
				gpm	Total, gpm	Firm, gpm[h]		
Zone 1/4[b,c]	1,272	1,909	Wells 16, 17, 18, and 20 Whitman Turnout (C5)	3,100 [b]	1,520	910	2,964	1,046
Zone 2	327	490						
Zone 6	144	217						
Zone 7	21	32						
Zone 8	33	49						
Zone 9	16	24						
Zone 10	68	101						
Zone 11	77	116						
Zone 12	18	27						
Total	1,976	2,964						
Zone 2[d]	327	490	PS5 - Maple Avenue	0	1,700	1,100	1,056	44
Zone 6	144	217						
Zone 7	21	32						
Zone 8	33	49						
Zone 9	16	24						
Zone 10	68	101						
Zone 11	77	116						
Zone 12	18	27						
Total	704	1,056						
Zone 6[e]	206	310	PS3 - Whitman Way PS7 - San Bruno Avenue	0	2,000	1,000	658	342
Zone 7	21	32						
Zone 8	33	49						
Zone 9	16	24						
Zone 10	68	101						
Zone 11	77	116						
Zone 12	18	27						
Total	439	658						
Zone 10	211	317	PS1 - Sneath Lane PS8 - Glenview Drive	0	3,310	1,940	1,089	851
Zone 7	67	100						
Zone 8	102	153						
Zone 9	49	73						
Zone 11	242	362						
Zone 12	56	84						
Total	726	1,089						
Zone 11	242	362	PS4 - Pacific Heights/College	0	1,200	600	362	238
Zone 12	56	84	PS2 - Lake Drive	0	1,200	600	84	516

[a] Zone 1/4 represents Zone 1/4 and 1/4A. Likewise, Zones 6, 7, 8, 9, and 12 also represent their smaller subzones (Zones 6A, 7A, 8A, 9A, and 12A).

[b] Zone 1/4 also supplied by SFPUC Whitman Turnout (C5) through Tank 1. Supply capacity from turnout based on flow capacity of 8-inch altitude valve serving Tank 1.

[c] Zone 1/4 supporting zones:
- Zone 6 is partially supported by Zone 1/4 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 1/4 via PS8, and partially supported by SFPUC Rollingwood Turnout (C3) via PS1. In order to account for this, the demands for Zones 7-12 were multiplied by 0.32, which is the ratio of PS8 firm capacity to PS1+PS8 firm capacity.

[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 PS8, and partially supported by Turnout C3 via PS1. In order to account for this, the demands for Zones 7-12 were multiplied by 0.32, which is the ratio of PS8 firm capacity to PS1+PS8 firm capacity.

[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 0.32, which is the ratio of PS8 firm capacity to PS1+PS8 firm capacity.

[f] PS6, which pumps out of Clearwell, was not taken into account. Instead, Well 17 pumping capacity was taken into account as a more conservative pumping capacity estimate.

[g] Well 18 pumping capacity is 250 to 300 gpm; 250 gpm used as a conservative estimate.

[h] Firm booster pumping capacity is defined as the total booster pump station capacity with the largest pump out of service and firm groundwater pumping capacity is defined as the total groundwater capacity with two wells (Wells 15R and 20) out of service.

[i] 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.

Table 7-2 indicates that all service zones have surplus pumping capacity in excess of existing maximum day demand. The firm pumping capacity surplus ranges from 40 to 1,040 gpm. However, during discussions with City staff, a concern was expressed regarding the ability of PS4 to re-fill Tanks 9 and 10 (serving Zone 11) in a suitable time interval after a potential fire flow event. Based on a brief review of the required fire flow in Zone 11 (*i.e.*, 2,500 gpm for 2 hours) and the existing firm pumping capacity at PS4, West Yost recommends an additional pump be installed at PS4 to improve pumping reliability after a potential fire flow event.

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. Existing storage capacities reported in the table are based on nominal storage capacities calculated from tank geometry. The comparison between the City's available and required storage capacities indicates that there is an existing water storage capacity deficit of approximately 1.1 MG in Zone 3/5. It should be noted that Zone 1/4 currently has a minimal storage surplus and would require additional storage to meet future growth. Future storage needs are addressed in *Chapter 8 Evaluation of Future Water System*.

To eliminate the storage capacity deficit in Zone 3/5, a new 1.4 MG storage tank improvement is recommended in Zone 3/5; this larger volume (an additional 0.3 MG above the current storage capacity deficit) will be required to meet proposed future water demands in the zone. Based on discussions with City staff, this new storage tank will be preliminarily 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 3/5 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 3/5. It is recommended that SFPUC turnouts serving Zone 3/5 (*i.e.*, C3 and C4) be regulated[1] to lower Zone 3/5 system pressures <u>before</u> the design and construction of the recommended Zone 3/5 tank and booster pump station. Regulating Turnouts C3 and C4 will eliminate the need for larger booster pumps to overcome the high system pressures currently observed in Zone 3/5.

[1] Project is currently included in the City's 2011-2016 Work Plan.

Table 7-3. Comparison of Existing and Required Storage Capacity

Pressure Zone[a]	Water Supply Facility	Available Storage Capacity, MG			Required Storage Capacity, MG				Storage Surplus (Deficit), MG
		Reservoir Capacity	Groundwater Credit[b]	Total Available Storage[c]	Operational[d]	Emergency[e]	Fire Flow[f]	Total Required Storage	
Zone 1/4	Tank 1 - Cunningham Drive	2.50	--	2.66	0.69	1.37	0.54	2.60	0.06
	Well 16 - Forest Lane	--	--						
	Well 17 - Corporate Yard	--	0.16						
	Well 18 - Cypress	--	--						
	Well 20 - Lions Field	--	--						
Zone 2	Tank 4 - San Bruno Avenue	1.00	--	1.00	0.18	0.35	0.30	0.83	0.17
Zone 3/5	Well 15 Replacement	--	--	0.00	0.20	0.40	0.54	1.14	(1.14)
Zone 6[g]	Tank 3 - Glenview Drive	2.00	--	1.00	0.11	0.23	0.30	0.64	0.36
Zone 10[h]	Tank 6 - Lake Drive South	0.40	--	1.40	0.23	0.47	0.30	1.00	0.40
	Tank 6A - Lake Drive North	1.00	--						
Zone 11	Tank 9 - Skyline West	0.50	--	1.00	0.13	0.26	0.30	0.69	0.31
	Tank 10 - Skyline East	0.50	--						
Zone 12	Tank 7 - Sweeney Ridge	0.40	--	0.40	0.03	0.06	0.18	0.27	0.13

[a] Zone 1/4 represents Zone 1/4 and 1/4A. Likewise, Zones 6 and 12 also represent their smaller subzones (Zones 6A and 12A).

[b] Wells with backup power can provide supply that is equivalent to providing emergency storage in the zone, so a groundwater credit is applied for wells with on-site standby power. The groundwater credit is calculated based on the total capacity of wells with standby power (Well 17 and Well 20), minus the largest capacity well (Well 20). The emergency storage criterion is to provide emergency storage equal to 0.5 times the maximum day demand. Therefore, the groundwater credit is calculated as the volume equal to Well 17 pumping capacity over a 12-hour duration.

[c] Total available storage is the sum of the available reservoir capacity plus available groundwater credit.

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

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

[f] Based on demand for most severe fire recommended in the pressure zone multiplied by the corresponding recommended fire flow duration (see Table 6-2).

[g] Although Tank 3 has a nominal capacity of 2 MG, the tank is currently operated at reduced levels due to its poor structural condition. Tank replacement is recommended to continue to provide reliable storage for Zone 6.

[h] Required storage capacity includes demands for Zones 7, 8, and 9 since these zones are served by Zone 10.

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 Water System Master Plan Key Assumptions*, 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 with no storage, regulating stations must supply maximum day plus fire flow or peak hour demand, whichever is larger.

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

Table 7-4 compares existing available pressure regulating station capacity with the required pressure regulating station capacity for the ten pressure regulating stations that are associated with zones completely 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, 8A, and 12. Consequently, the pressure regulating stations serving these zones are recommended to be upsized to provide adequate capacity to meet fire flow needs. The following list summarizes the improvements recommended to meet the required valve capacity in the deficient zones:

- RS17 – Upsize 4-inch valve to 6-inch valve
- RS13 – Upsize 4-inch valve to 6-inch valve
- RS15 – Upsize 2-inch valve to 6-inch valve
- RS2 – Upsize 2-inch valve to 4-inch valve and upsize 4-inch valve to 8-inch valve

7.3 EXISTING WATER SYSTEM PERFORMANCE EVALUATION

This section discusses the hydraulic performance evaluation of the existing water distribution system. 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.

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

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

Zone	Maximum Day Demand, gpm	Fire Flow Requirement, gpm	Regulating Station	Valve Diameter, inches	Existing Valve Capacity, gpm[a]	Valve Capacity Requirement, gpm[b]	Valve Capacity Surplus (Deficit), gpm
Zone 6A	9	1,500	RS17	4	990	1,509	(259)
				2	260		
			Total		1,250		
Zone 7	98	2,500	RS9	8	3,900	2,598	1,562
				2	260		
			Total		4,160		
Zone 7A	2	1,500	RS13	4	990	1,502	(252)
				2	260		
			Total		1,250		
Zone 8	145	2,000	RS6	6	2,250	2,145	1,095
				4	990		
			Total		3,240		
Zone 8A	8	1,500	RS15	2	260	1,508	(988)
				2	260		
			Total		520		
Zone 9	72	2,000	RS4	6	2,250	2,072	438
				2	260		
			Total		2,510		
Zone 9A	2	1,500	RS5	6	2,250	1,502	1,008
				2	260		
			Total		2,510		
Zone 12[c,d]	84	1,500	RS2	4	990	1,584	(334)
				2	260		
			Total		1,250		
Zone 12A	10	1,500	RS8	6	2,250	1,510	1,000
				2	260		
			Total		2,510		
Zone 13	44	2,500	RS1	6	2,250	2,544	286
				3	580		
			Total		2,830		

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

[b] The criterion for sizing valves for these zones is maximum day demand plus fire flow or peak hour, whichever is greater.

[c] Zone 12 served by PS2 via RS2.

[d] Zone 12 also served by emergency bypass from Tanks 6 and 6A via RS3.

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 8,796 gpm (12.7 mgd). This analysis assumed that the storage tanks are 50 percent full and pump stations are operating at their firm capacity.

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 distribution main should not exceed 5 feet per thousand feet (ft/kft) and maximum velocities should not exceed 4 feet per second (ft/s) during normal demand conditions, to help minimize energy (pumping) costs due to undersized pipelines.

Results from the peak hour demand simulation indicate that the existing water system could 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 four low pressure 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, improvement projects were not recommended specifically for these junctions, which do meet the State's minimum standard of 20 psi. 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. To eliminate these low pressures during peak demand conditions, the City should consider re-zoning all Zone 1/4 junctions with elevations above 155 ft msl into Zone 2. However, this area is also evaluated in *Chapter 8 Evaluation of the Future Water System* to identify improvements that incorporate needs for future growth.

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. The analysis assumed that tanks are 50 percent full and pump stations are operating at their firm capacity.

As discussed in *Chapter 6 Water System Master Plan Key Assumptions*, 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 proposed 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 hydrant 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 hydrant 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 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, which is the oldest part of the City. Areas where available fire flows are between one-third of the criteria and the criteria are distributed throughout the distribution system and are not confined to a specific pressure zone or land use type. Section 7.4.1 details the distribution system improvements that are recommended in order to meet fire flow criteria throughout the existing water distribution system.

7.4 EXISTING SYSTEM CAPACITY AND RELIABILITY IMPROVEMENTS

This section describes the necessary pipeline, pressure regulating station, tanks, and pump station improvements based on both the system capacity and reliability evaluations of the existing water system. 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.

The following near-term distribution system projects were included in the capacity evaluations when identifying and sizing improvements:

- Tank 3 Replacement Project. Tank 3 is currently being operated at reduced levels from its 2 MG nominal capacity because of poor structural condition. Replacement of Tank 3 is currently included in the City's 2011-2016 Work Plan. Therefore, it is assumed that Tank 3 will be replaced.
- Crestmoor Improvements. As part of an earlier evaluation of the Crestmoor area in Zone 6, the following improvements were recommended to provide adequate fire flow to the Crestmoor area: upsize RS7, construct a new pressure regulating station, and install several pipeline improvements. These improvements were subsequently included in the hydraulic analysis for Zone 6.
- Cedar Mills Pressure Regulating Station. The pressure regulating station has been designed. When constructed, it will provide flow from Zone 3/5 to Zone 2 at Cherry Avenue and San Bruno Avenue. This improvement was subsequently included in the hydraulic analysis.

7.4.1 Pipeline Reliability Improvements

The hydraulic evaluation of the existing water distribution system was used to identify pipeline improvements that, when combined with the near-term improvements identified above and the pressure regulating station capacity improvements described in Section 7.4.2, meet the recommended fire flow criteria. The system was evaluated, and improvements were developed, on a zone-by-zone basis.

The hydraulic model was subsequently updated with the recommended improvements to determine if fire flow criteria could be met during a maximum day demand condition. Figure 7-6 shows available fire flows with the recommended facility and pipeline improvements. Consequently, with the recommended improvements, fire flow criteria were generally met across the entire system as shown on Figure 7-7. With the recommended improvements, almost all simulated hydrant locations in the distribution system meet the recommended fire flow criteria. The three hydrant locations that did not meet recommended fire flow criteria were reviewed, and it was determined that fire flow criteria would be met if supply from adjacent hydrants was utilized.

The pipeline improvements necessary to meet fire flow criteria have been categorized into two groups, Pipeline Reliability Improvements Priority 1 and Pipeline Reliability Improvements Priority 2.

- Pipeline Reliability Improvements Priority 1: These improvements include all of the deficient pipelines that meet less than one-third of the fire flow criteria. Improvements have been geographically grouped into eight different projects. Within each project group the number of hydrant junctions that met less than one-third of the fire flow criteria was summed and then divided by the length of pipelines within the group. The group with the highest result received a prioritization rank of 1, and is identified as EXCIP-P1-1 in the CIP. The group with the lowest result received a rank

of 8, and is identified as EXCIP-P1-8 in the CIP. Details on these eight projects are included in Section 7.7.

- Pipeline Reliability Improvements Priority 2: These improvements consist of the remainder of pipeline improvements necessary to meet fire flow criteria throughout the whole system. These improvements have been grouped by pressure zone, and are to be implemented and sequenced based on City needs and available funding. Details on these projects have also been included in Section 7.7.

7.4.2 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. The following pressure regulating station improvements are recommended:

- EXCIP-RS-1: Upgrade existing RS 2 in Z12 with a 4 inch and an 8 inch valve.
- EXCIP-RS 2: Upgrade existing RS 15 with 2 inch and 6 inch valves for fire flow into Z8A, and upsize 710 feet of pipeline to 8 inch diameter pipeline by RS 15.
- EXCIP-RS-3: Upgrade existing RS 13 with 2 inch and 6 inch valves for fire flow into Z7A.
- EXCIP-RS-4: Upgrade RS 17 with 2 inch and 6 inch valves.
- EXCI-RS-5: Upgrade RS 7 with 4 inch and 8 inch valves, and upsize 480 feet of pipelines to 8 inch diameter pipeline by RS 7.3
- EXCIP-RS-6: Rebuild and reactivate RS 11 for fire flow service from Z7 to Z6.4
- EXCIP-RS-7: Install new RS at Claremont Drive and Plymouth Way to serve the Crestmoor area of Z6 with fire flow.
- EXCIP-RS-8: Install new RS at Susan Drive and Sharp Park Road to provide fire flow service from Z11 to Z10, and install 540 feet of new 8 inch diameter pipeline from Z11 to Z10.
- EXCIP-RS-9: Install new RS at Westborough Boulevard and Fleetwood Drive to provide fire flow service from Z10 to Z9, and install 1,680 feet of new 8 inch diameter pipeline between Z9 and Z10.
- EXCIP-RS-10: Install new RS at Oakmont Drive and Evergreen Drive to provide fire flow service from Z10 to Z8.
- EXCIP-RS-11: Install new RS at Piedmont Avenue and Madison Avenue to provide fire flow service from Z7 to Z6.
- EXCIP-CITY-12: Construct Cedar Mills Regulating Station; design has been completed and project is ready for construction.

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[3] Project previously identified as part of Crestmoor evaluation and is currently under design.

[4] Project previously identified as part of Crestmoor evaluation and is currently under design.

7.4.3 Well, Storage, and Pumping Capacity Improvements

Four projects have been identified in the category Well, Storage, and Pumping Capacity Improvements. The following is a list of their CIP identifiers and their descriptions:

- EXCIP-W-1: This project is a new well, assumed to be located in Zone 1/4. This improvement is needed to provide additional supply capacity. The precise location of the new well will be determined by the City.
- EXCIP-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 3/5, provisionally placed in Commodore Park as shown on Figure 7-5.[5] A minimum active storage capacity of 1.4 MG is recommended to eliminate the storage deficiency identified in Zone 3/5. Due to the lack of suitable land at appropriate elevations for a gravity feed tank in Zone 3/5, 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 3/5 during peak demand conditions.
- EXCIP-PS-1: This project includes a new booster pump at PS4 to improve pumping reliability after a potential fire flow event. It is to be implemented as part of project EXCIP-CITY-4, which is the upgrade of the PS4. Suction piping in the vicinity of the PS is recommended to be upsized to 12-inch diameter pipeline.
- EXCIP-CITY-3: This improvement consists of a new hydropneumatic pump station and tank that supplies the NCCWD-supplied area directly from the City's system to eliminate surcharges to customers for purchase of NCCWD water.

7.4.4 Miscellaneous Capacity Improvements

West Yost and the City have identified a number of other improvements that will further enhance the capacity and reliability of the water system. These improvement projects are summarized below:

- EXCIP-MISC-1: Re-Zoning Project. This project re-zones a portion of Zone 1/4 to Zone 2 for additional fire flow reliability.
- EXCIP-CITY-1: SCADA Radio Transmitter Installation Project. This project will provide radio transmission for the SCADA system. The system is currently operated through the cable network with phone system backup, and both can be out of service at the same time. The cable network will become the backup system with implementation of this project. This project will significantly improve the reliability of the SCADA system during emergencies.

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

- EXCIP-CITY-2: Groundwater Sustainability Study. This project is a siting study to identify potential locations and production capacity for a new well, to enhance redundancy and groundwater reliability.
- EXCIP-CITY-5: SFPUC Turnout Improvements Project. This project includes the installation of four vaults and associated pressure regulating facilities on four of five SFPUC turnouts, which are currently unregulated. This project will alleviate high pressure issues in zones receiving water from unregulated turnouts, and will ensure that any malfunction within the SFPUC regional delivery system does not impact the City's water pressure.
- EXCIP-CITY-13: Advanced Water Meter Infrastructure Project. This project will enable City to remotely read the City's 12,000 water meters by installing two radio towers, a number of signal repeaters, and a regional network interface for data storage. This system will allow customers to monitor water consumption, and enable early detection of water leaks, resulting in water conservation, and freeing crews to be re-deployed towards preventative maintenance activities.
- EXCIP-CITY-14: Standby Generation Project. This project provides backup power at well and booster pump stations that currently do not have standby generation or engine-driven pumping facilities to provide for backup during emergencies (Wells 16 and 18, Pump Stations 1, 2, 3 and 4), as well as one new portable diesel engine-driven pump. This project will significantly improve the City's ability to maintain customer service during an emergency.
- EXCIP-CITY-21: Security Improvements Project. This project provides security improvements at water system tanks, pump stations and wells. Example facilities improvements include security cameras, improved fencing, lighting improvements and more secure facility locks.

7.5 SEISMIC VULNERABILITY ASSESSMENT

G&E Engineering Systems Inc. completed a Seismic Vulnerability Assessment for the City's existing water system facilities in 2003. Results from the assessment have been documented in a Seismic Vulnerability Assessment report prepared by G&E Engineering Systems Inc. and dated November 7, 2003. In summary, the 2003 Seismic Vulnerability Assessment identified the following seismic improvement projects for the City:

1. Comprehensive hazard review including more detailed analysis of water system seismic vulnerability;
2. Retrofit or replace fault crossing pipelines;
3. Restrain electrical panels;
4. Retrofit non-structural components;
5. Develop emergency operational plan;

6. Procure additional potable emergency generators;
7. Develop seismic design procedure manual for new water system installations;
8. Seismic retrofit of Tanks 1, 4, 6, 6A, 9, and 10 (higher priority);
9. Seismic retrofit of Tanks 3 and 7 (lower priority); and
10. Retrofit water treatment equipment.

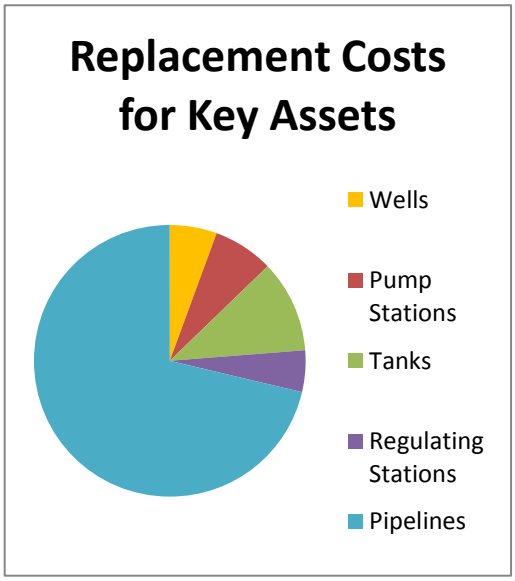
Based on discussions with City staff, projects have been defined and budgeted, but most projects have yet to be completed. The City plans to replace Tank 3 and implement a seismic retrofit of all other existing storage tanks in the near-term planning horizon. The following improvements are included in the Master Plan to address seismic needs.

- EXCIP-CITY-6: Tank Modifications/Seismic Retrofit Program. This project will evaluate and improve the ability of the City's seven water storage tanks to withstand seismic events and improve their operational reliability. Improvements include welding steel plates to tanks, installing piers to better anchor tanks, installing flexible pipe connections, building concrete rings around the base of tanks, improving access manholes, ladders and roof systems, and conducting tank spot repairs.
- EXCIP-CITY-7: Tank 3 Replacement Project (budgeted in Rehabilitation and Replacement Program). Tank 3 is in poor condition and must be operated at a reduced water level. This project would replace Tank 3 to maintain system reliability and restore the tank's full capacity.
- EXCIP-CITY-15: Seismic Vulnerability Assessment. This project will update the City's 2003 study based on current code requirements. It would also include more comprehensive hazard review, and tank and structural analysis based on the updated hazard assessment.
- EXCIP-CITY-20: Pipeline Seismic Improvement Project. This project will provide seismic upgrades to water lines in the vicinity of or crossing faults.

Once the new seismic vulnerability assessment is completed, project budgets identified in this Water System Master Plan will need to be updated to reflect the findings of the study.

7.6 REHABILITATION AND REPLACEMENT EVALUATION

The water system is a valuable asset, with a replacement value of approximately $223M in current dollars, for system pipelines and key facilities (wells, pump stations, tanks, pressure regulating stations).



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

7.6.1 Pipeline Rehabilitation and Replacement Evaluation

A focused pipeline rehabilitation and replacement program was developed using general pipeline age and material information and leak history data provided by the City. The City's GIS does not include information on pipeline materials or age. However, the City has general statistics on pipeline age and material type, based on historical subdivision maps that have been compiled by the City in a single map entitled Initial Infrastructure Construction Map. A comprehensive replacement program was developed, assuming eventual replacement of all pipelines within the system. The City should continue to collect and evaluate leak data to continue to refine and tailor the pipeline replacement program.

7.6.1.1 Leak History

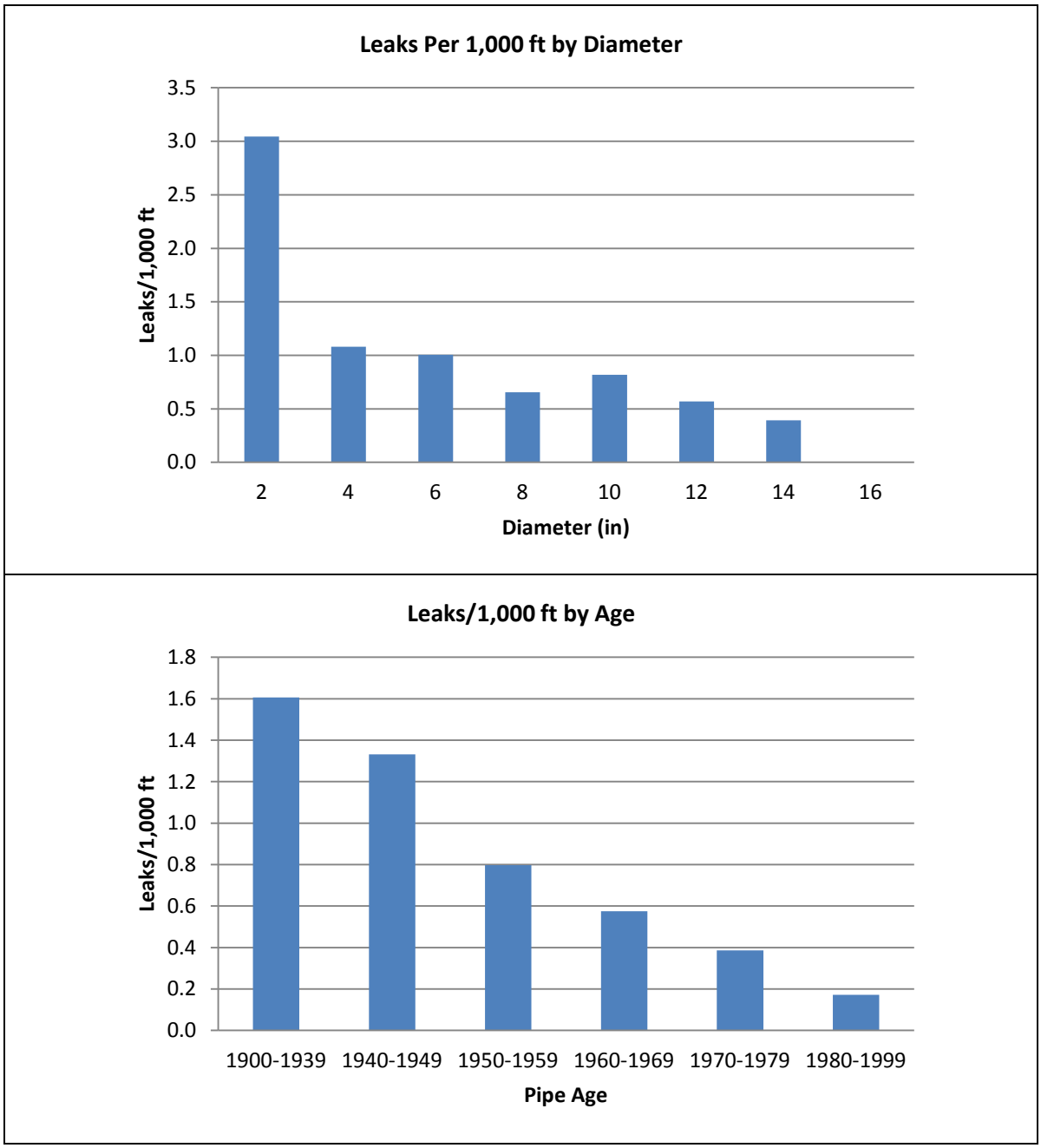
Since 2000, the City has been maintaining a record of leak occurrences throughout the City's water system. The records were initially graphically stored in an AutoCAD file (2000-2007), and in more recent years have been stored in GIS files (2009-2010). In order to develop leak statistics, the AutoCAD file was converted into GIS format and consolidated with the existing GIS leak files. Each leak was then assigned to the nearest water main. Table 7-5 and Figure 7-8 present the leak statistics by pipe diameter and by pipe age.

Table 7-5. Leak Statistics for City Pipelines (2000-07 and 2009-10)[a]

Pipe Diameter/ Pipe Age	Number of Leaks	Number of Leaks per 1,000 ft
Pipe Diameter		
2	118	3.0
4	90	1.1
6	190	1.0
8	84	0.7
10	27	0.8
12	20	0.6
14	6	0.4
16	0	0.0
Total	535	7.6
Pipe Age		
1900-1939	272	1.6
1940-1949	49	1.3
1950-1959	135	0.8
1960-1969	46	0.6
1970-1979	9	0.4
1980-1999	2	0.2
2000s[b]	22	0.7
Total	565	5.6

[a] This analysis excludes parallel pipes and their associated leaks.
[b] The leak statistics shown for the 2000s are higher than would be expected because a number of pipes with high leak counts were replaced sometime after 2000.

Figure 7-8. Leaks Statistics



Clear trends in leak occurrences can be observed from the leak statistics:

- The number of leaks generally increases as the pipe diameter decreases
- The number of leaks increases as pipe age increases

These trends are consistent with other cities and water agencies. All of the 2-inch water mains, which have the highest number of leaks per length of installed pipe, were installed from 1900 to 1939, falling into the oldest pipe group within the system.

7.6.1.2 Rehabilitation and Replacement Pipeline Improvements Prioritization

In order to group and prioritize rehabilitation and replacement pipeline projects, 25 subdivision polygons were delineated using the Initial Infrastructure Construction Map. Subdivisions were delineated in this manner so that each subdivision would contain pipelines with similar characteristics (*i.e.* material, age, and condition). The number of leaks within each subdivision was then summed and divided by the total length of pipeline, with Rank 1 being the subdivision with the most leaks per total length of pipeline. The polygons were divided into three groups based on the number of leaks identified. The programs prioritize small-diameter (4-inch and smaller), based on the much higher leak rates for small diameter pipelines. Projects are prioritized into the following groups:

- **Priority 1 Replacement Projects**: Replacement of 4-inch diameter and smaller pipelines in areas with two or more leaks per 1,000 feet of pipeline. Most of these areas are within Zone 1/4, which has the oldest and smallest diameter pipelines. Many of the streets in Zone 1/4 have two small-diameter water mains in parallel, typically a 2-inch and 4-inch. In developing improvement project lengths, it was assumed that both pipelines would be replaced with a single 8-inch diameter pipeline. Nine projects are identified in the Priority 1 category. Many of these projects overlap with areas where mains need to be upsized to meet current fire flow criteria.
- **Priority 2 Replacement Projects**: This group includes pipelines 4-inch and less in diameter throughout the rest of the system, excluding small diameter parallel pipelines. Priority 2 pipelines, while on average not as old and critical as the Priority 1 pipelines, are small and are reaching the end of their useful lives. Priority 2 pipelines have been grouped into one single project (RR-P2). Further analysis will be needed by the City to establish implementation priorities within this group.
- **Priority 3 Replacement Project**s. The lowest priority (Priority 3) pipeline project includes the remaining pipelines throughout the entire City water system, excluding small diameter parallel pipelines. This project has also been grouped into one project, identified as RR-P3.

7.6.2 Facilities Rehabilitation and Replacement Evaluation

The Facilities Rehabilitation and Replacement Evaluation assesses well, pump station, tank, 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 typical design useful life information, age, and condition information provided by the City to identify improvement needs. The rehabilitation programs for wells, pump stations, and tanks have been budgeted in the CIP.

7.6.2.1 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 oldest active pump, Well 16, is about 20 years old, and it is recommended that Well 17 and Well 18 pump efficiency be monitored and replaced if efficiencies continue to decrease. These items are incorporated in

the City's well rehabilitation program, identified in the CIP as EXCIP-CITY-11, which 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 five years, with replacement as needed.

The Well 15 abandonment and replacement project, identified in the CIP as EXCIP-CITY-10, is budgeted in the Capacity and Reliability Program.

7.6.2.2 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. The following projects from this program are included in the Water System Master Plan CIP:

- EXCIP-CITY-22 Pump Station Improvement and Replacement Project. This project includes replacement and rehabilitation for PS1, PS2, PS3, and PS6. This project should also incorporate findings from the condition assessment conducted as part of the Water System Master Plan which recommends installation of flow monitoring at PS1, PS2 and PS3, replacement of MCC's at all four pump stations, and installation of flexible couplings at PS 2 and 3.
- EXCIP-CITY-4 PS 4 Upgrade Project. This project will replace and upgrade existing pumps, motors and controls that have reached the end of their useful life. This project is currently under design, and is combined with Project EXCIP-PS1

7.6.2.3 Tanks

For tanks, typical guidelines indicate a design useful life of 50 to 80 years. The City has identified a need to replace Tank 3, which is in poor condition. Two additional programs have been identified to provide for ongoing maintenance and eventual replacement of other system tanks. These projects are summarized below:

- EXCIP-CITY-7. Tank 3 Replacement Project. Tank 3 is in poor condition and must be operated at a reduced water level. This project would replace Tank 3 to maintain system reliability and restore the tank's full capacity.
- EXCIP-RR-T-2. Tank Re-coating Program. This program provides for re-coating the interior and exterior of the above-grade steel tanks (T1, T4, T6, T6A, T7, T9 and T10). Budgeting assumes two replacements within the Master Plan timeframe.
- EXCIP-RR-T-3. Tank Replacement Program. Replacement of tanks as they reach the end of their design useful lives. Budgeting includes replacement of three tanks (T4, T6 and T7) within the Master Plan timeframe.

7.6.2.4 Pressure Regulating Stations

The City has in place a pressure regulating station rehabilitation program to maintain adequate performance. This project, EXCIP-CITY-18, Pressure Station Rehabilitation Project, improves and rehabilitates the City's pressure regulating stations to maintain their performance.

7.6.2.5 Other Rehabilitation and Replacement Projects

The City has identified a number of other improvements to further enhance the water system. These improvements do not fall under the categories of pipelines, wells, pump stations, tanks, or regulating stations. The following list presents the five improvements by their CIP ID:

- EXCIP-CITY-9: Computerized Maintenance Management System Update. The system will be updated with geographical information from the City's GIS. This will enable the City to more effectively track and analyze water system maintenance
- EXCIP-CITY-16: Meter Upgrade Project. This project would retrofit existing customer meters with cathodic protection in corrosive soils areas.
- EXCIP-CITY-17: Meter Replacement Project. This project would replace existing water meters with Sensus Mag meter technology, improving accuracy of customer usage and billings.
- EXCIP-CITY-8: Spot repairs for the Spyglass neighborhood and on Merion Drive. This project is needed to address pipeline corrosion issues in these areas.
- EXCIP-CITY-19: PS2 Discharge Pipeline Rehabilitation Project. Replace or slip-line the existing 14-inch pipeline from Station 2 to Tank 7 - the existing pipeline is in poor condition.

7.7 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 identified in the existing water system evaluation

Table 7-6 and Figure 7-9 summarize the Recommended Existing System Capacity Improvement Projects. Table 7-7 and Figure 7-10 present Recommended Reliability Improvement Projects, including pipeline improvements to meet current fire flow criteria and seismic reliability projects. Table 7-8 and Figure 7-11 summarize the Recommended Rehabilitation and Replacement Improvement Projects. Figure 7-11 includes all pipeline replacement projects. In the capital improvement projects and costs, presented in Chapter 9, projects are shown only for pipelines that are not also included in the Reliability program, to avoid duplication.

Table 7-6. Recommended Existing System Capacity Improvement Projects

CIP ID	Improvement Type	Reason for Improvement	Improvement Description	Zone
Pressure Regulating Station Capacity Improvements				
EXCIP-RS-1	RS Upgrade	Fire Flow	Upgrade existing RS 2 in Z12 with a 4-inch and an 8-inch valve	12
EXCIP-RS-2	RS Upgrade	Fire Flow	Upgrade existing RS 15 with 2-inch and 6-inch valves for fire flow into Z8A	8A
	Upsize Pipeline		Upsize 710' of pipeline to 8" by RS15	8A
EXCIP-RS-3	RS Upgrade	Fire Flow	Upgrade existing RS 13 with 2-inch and 6-inch valves for fire flow into Z7A	7A
EXCIP-RS-4	RS Upgrade	Fire Flow	Upgrade RS 17 with 2-inch and 6-inch valves	6
EXCIP-RS-5[(a)]	RS Upgrade	Fire Flow	Upgrade RS 7 with 4-inch and 8-inch valves	6
	Upsize Pipeline		Upsize 480' of pipelines to 8" by RS 7	6
EXCIP-RS-6	New RS	Fire Flow	Rebuild and reactivate RS 11 for fire flow service from Z7 to Z6	6
EXCIP-RS-7[(a)]	New RS	Fire Flow	Install new RS at Claremont Drive and Plymouth Way to serve the Crestmoor area of Z6 with fire flow	6
EXCIP-RS-8	New RS	Fire Flow	Install new RS at Susan Drive and Sharp Park Road to provide fire flow service from Z11 to Z10	10
	New Pipeline		Install 540' of new 8" pipeline from Z11 to Z10	10
EXCIP-RS-9	New RS	Fire Flow	Install new RS at Westborough Boulevard and Fleetwood Drive to provide fire flow service from Z10 to Z9	9
	New Pipeline		Install 1,680' of new 8" pipeline between Z9 and Z10	9
EXCIP-RS-10	New RS	Fire Flow	Install new RS at Oakmont Drive and Evergreen Drive to provide fire flow service from Z10 to Z8	8
EXCIP-RS-11	New RS	Fire Flow	Install new RS at Piedmont Avenue and Madison Avenue to provide fire flow service from Z7 to Z6	6
EXCIP-CITY-12	RS Upgrade	Capacity	Construct Cedar Mills Regulating Station; design has been completed and project is ready for construction; funds have already been encumbered	2
Well, Storage, and Pumping Capacity Improvements				
EXCIP-W-1	New Well	Supply Capacity	New well in Z1/4; location to be determined	1/4
EXCIP-T-1	New Storage Tank	Storage Capacity	Proposed new 1.4 MG storage tank in Z3/5	3/5
	New Pump Station		New booster pump station in Z3/5 with firm capacity of 4.3 mgd	3/5
	New Pipeline		540' of proposed new 12" pipeline in Z3/5	3/5
EXCIP-PS-1	New Pump	Pumping Capacity	New booster pump at PS4 to increase flow capacity; to be implemented as part of Project EXCIP-CITY-4	11
	New Pipeline		Upsize 450' of pipeline to 12" by PS4	10
EXCIP-CITY-3	New Pump Station	Capacity / Reliability	Hydropneumatic pump station to supply NCCWD-supplied area directly from the City's system to eliminate surcharges to customers for NCCWD water	13
Miscellaneous Capacity Improvements				
EXCIP-MISC-1	Re-zoning	Pressure Deficiency	Rezone a portion of Z1/4 to Z2	1/4
EXCIP-CITY-1	SCADA Radio	Reliability	Radio transmission for the SCADA system to improve reliability	Multiple
EXCIP-CITY-2	Groundwater Study	Capacity / Reliability	Groundwater Sustainability Study - Identify potential locations and production capacity for a new well for redundancy and groundwater reliability	Multiple
EXCIP-CITY-5	Turnout Improvement	Capacity / Reliability	SFPUC Turnout Improvements Project - Install four vaults and associated pressure regulating facilities on four of five SFPUC turnouts, which are currently unregulated; vaults to include backflow prevention	Multiple
EXCIP-CITY-13	Meter Infrastructure Upgrade	Reliability	meters by installing two radio towers, a number of signal repeaters, and a regional network interface for data storage	Multiple
EXCIP-CITY-14	Standby Generation	Reliability	Standby Generation Project - Provide backup power at well and booster pump stations that currently do not have standby generation or engine-driven pumping facilities to provide for backup during emergencies (Wells 16 and 18, Pump Stations 1, 2, 3 and 4), as well as one new portable diesel engine-driven pump	Multiple
EXCIP-CITY-21	Security Improvement	Reliability	Security improvements at water system tanks, pump stations and wells; possible facilities improvements include security cameras, improved fencing, lighting improvements and more secure facility locks	Multiple

[(a)] Project previously identified as part of Crestmoor evaluation and is currently under design.

Table 7-7. Recommended Existing System Reliability Improvement Projects

CIP ID	Improvement Type	Reason for Improvement[a]	Improvement Description	Zone
Pipeline Reliability Improvements Priority 1[b]				
EXCIP-P1-1	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 6,480' of pipeline to 8" in Z1/4 at Cedar, Maple, Cherry, Chestnut, Beech, Oak, Hazel, and Acacia, all north of Jenvein; Chestnut between Kains and Park; Williams west of Cypress	1/4
EXCIP-P1-2	Upsize Pipeline	Fire Flow	Upsize 5,730' of pipeline in Z2 to 8" on Donner at Niles, between Donner and Glen, Parkview, Glen, and Santa Lucia west of Parkview	2
			Upsize 3,040' of pipeline in Z2 to 10" near Pepper and Cedar, Hawthorne at Redwood, Redwood from Hawthorne to Niles	2
EXCIP-P1-3	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 6,240' of pipelines to 8" in Z1/4 on Sylvan east of San Mateo, Huntington from Sylvan to north of San Felipe, Milton south of Sylvan, San Anselmo at Mastick, Florida at Milton, Texas, Terrace, Cupid, Georgia at Milton, San Anselmo and San Felipe, and East at Chapman	1/4
	New Pipeline		Upsize 250' of new 12" pipeline in Z1/4 between the south ends of 1st St and 2nd St, north of Well 20	1/4
EXCIP-P1-4	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 7,850' of pipeline in Z1/4 to 8" on Linden from Kains to north of San Felipe, Angus, Acacia at Angus, El Camino Real and Alley, Poplar south of Crystal Springs, Elm at Crystal Springs, and Acacia at Crystal Springs	1/4
EXCIP-P1-5	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 9,030' of pipeline in Z1/4 to 8" at Cypress, Acacia, Elm, Poplar, and Linden, all south of San Felipe; Santa Lucia from Balboa to El Camino Real; Linden from Santa Lucia to Elamita; Lomita at Linden; Elamita	1/4
EXCIP-P1-6	Upsize Pipeline	Fire Flow	Upsize 7,710' of pipeline in Z7 to 8" at Alpine, El Dorado, Crestmoor from El Dorado to Bryant; Kent, Ridgeway, Yorkshire, Rosewood, Bennington, Cambridge, Bryant, London, and Oxford, all at Crestmoor; Piedmont at Madison, and south end of Darby	7
			Upsize 800' of pipelines in Z7 to 10" at Piedmont from Crestmoor to RS 13 by Madison	7
			Upsize 2,660' of pipeline in Z7 to 12" on Glenview from RS 9 to Ridgeway, Skyline from Ridgeway to Bryant, Bryant from Skyline to Crestmoor	7
			Upsize 2,260' of pipeline in Z7 to 14" at Crestmoor from Bryant to Darby, and on Darby	7
EXCIP-P1-7	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 8,980' of pipeline to 8" in Z1/4 on El Camino Real, Hensley, Green, and Masson, all north of Kains; El Camino Real, Hensley, Green, Masson, all north of Angus; Kains from El Camino Real to San Mateo; San Mateo from Kains to Angus; Angus from El Camino Real to San Mateo	1/4
	New Pipeline		60' of proposed new 8" pipeline in Z1/4 on El Camino Real at Kains	1/4
EXCIP-P1-8	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 8,990' of pipeline to 8" in Z1/4 on Huntington, Tanforan west of Herman, Pacific, Atlantic, E Huntington north of Scott, Herman from Tanforan to Buena Vista, Buena Vista and Diamond, Montgomery from Scott to Walnut, Hermosa, Walnut at Montgomery, San Mateo, Hermosa, and San Mateo from Scott to north of Atlantic	1/4
Pipeline Reliability Improvements Priority 2[c]				
EXCIP-P2-Z1/4	Upsize Pipeline	Fire Flow	Upsize 25,850' of pipeline to 8" in Z1/4	1/4
			Upsize 1,480' of pipeline to 10" in Z1/4	1/4
EXCIP-P2-Z2	Upsize Pipeline	Fire Flow	Upsize 4,310' of pipeline to 8" in Z2	2
			Upsize 420' of pipeline to 12" in Z2	2
EXCIP-P2-Z6	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 9,200' of pipeline to 8" in Z6	6
			Upsize 1,300' of pipeline to 10" in Z6	6
EXCIP-P2-Z8	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 3,900' of pipeline to 8" in Z8	8
EXCIP-P2-Z9	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 660' of pipeline to 8" in Z9	9
EXCIP-P2-Z10	Upsize Pipeline	Fire Flow	Upsize 7,170' of pipeline to 8" in Z10	10
			Upsize 1,820' of pipeline to 10" in Z10	10
EXCIP-P2-Z11	Upsize Pipeline	Fire Flow	Upsize 1,800' of pipeline to 8" in Z11	11
			Upsize 2,790' of pipeline to 10" in Z11	11
			Upsize 2,990' of pipeline to 12" in Z11	11
EXCIP-P2-Z12	Upsize Pipeline	Fire Flow	Upsize 3,500' of pipeline to 8" in Z12	12
EXCIP-JL[d]	Upsize Pipeline	Fire Flow	Upsize 1,700' of pipeline to 12" in Z12	12
EXCIP-CITY-6	Tank Modifications/ Seismic Retrofit Program	Seismic	Evaluate and improve the ability of the City's existing storage tanks to withstand earthquakes and provide for ongoing maintenance and rehabilitation of tanks to maintain their condition	Various
EXCIP-CITY-15	Seismic Vulnerability Assessment	Seismic	Update the City's 2003 Seismic Vulnerability Assessment, based on current code requirements, which would include more comprehensive hazard review and updates to critical pipeline, tank and structural analyses based on the updated hazard assessment, as recommended in the 2003 Assessment	--
EXCIP-CITY-20	Pipeline Seismic Improvement Project	Seismic	Seismic upgrades to water lines in vicinity of or crossing fault lines along San Bruno Avenue and Sneath Lane; 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	11, 12

[a] "Rehabilitation and Replacement" is included as a Reason for Improvement for Pipeline Reliability Improvements Priority 1 projects that overlap with Rehabilitation and Replacement Improvements Priority 1 projects, and for Pipeline Reliability Improvements Priority 2 projects that overlap with Rehabilitation and Replacement Improvements Priority 2 projects.

[b] Pipeline projects with P1 identifiers are Priority 1 (highest priority) projects. These projects are listed in order of priority, so that areas that are most deficient receive highest priority.

[c] Pipeline projects with P2 identifiers are Priority 2 (lower priority) projects. Each program lists the total pipeline length by pressure zone. Specific projects and sequencing to be determined by the City.

[d] Existing system fire flow improvement requires upsize to 8" diameter pipeline, if Jail Line Project does not proceed. If the Jail Line Project does proceed, future system peak hour capacity requires upsize to 12" diameter pipeline, and is to be funded by SFPUC.

Table 7-8. Recommended Rehabilitation and Replacement Improvement Projects

CIP ID	Improvement Type	Improvement Description	Zone
Pipeline Rehabilitation and Replacement Improvements Priority 1[a]			
RR-P1-1	Replace / Upsize Pipeline	Replace 11,260' of small diameter pipeline with 8" pipeline	1/4
RR-P1-2	Replace / Upsize Pipeline	Replace 6,760' of small diameter pipeline with 8" pipeline	1/4
RR-P1-3	Replace / Upsize Pipeline	Replace 16,850' of small diameter pipeline with 8" pipeline	1/4
RR-P1-4	Replace / Upsize Pipeline	Replace 10,890' of small diameter pipeline with 8" pipeline	1/4
RR-P1-5	Replace / Upsize Pipeline	Replace 4,480' of small diameter pipeline with 8" pipeline	1/4
RR-P1-6	Replace / Upsize Pipeline	Replace 13,280' of small diameter pipeline with 8" pipeline	1/4
RR-P1-7	Replace / Upsize Pipeline	Replace 14,540' of small diameter pipeline with 8" pipeline	1/4
RR-P1-8	Replace / Upsize Pipeline	Replace 13,800' of small diameter pipeline with 8" pipeline	1/4
RR-P1-9	Replace / Upsize Pipeline	Replace 7920' of small diameter pipeline with 8" pipeline	1/4
Pipeline Rehabilitation and Replacement Improvements Priority 2[b]			
RR-P2	Replace / Upsize Pipeline	Replace 20,520' of small diameter pipeline with 8" pipeline	Multiple
Pipeline Rehabilitation and Replacement Improvements Priority 3[c]			
RR-P3	Replace Pipeline	Replace 314,050' of 6" and 8" pipeline with new 8" pipeline	Multiple
	Replace Pipeline	Replace 32,810' of 10" pipeline with new 10" pipeline	Multiple
	Replace Pipeline	Replace 35,150' of 12" pipeline with new 12" pipeline	Multiple
	Replace Pipeline	Replace 11,200' of 14" pipeline with new 14" pipeline	Multiple
	Replace Pipeline	Replace 110' of 16" pipeline with new 16" pipeline	Multiple
Well, Storage, Pumping, and Pressure Regulating Station Rehabilitation and Reliability Improvements			
EXCIP-CITY-10	Replace Well	Abandon and replace existing Well 15, which is out of service	3/5
EXCIP-CITY-11	Rehabilitate Wells	Well Rehabilitation program that 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 five years, with replacement as needed	Multiple
EXCIP-CITY-7	Replace Tank	Replace Tank 3, which is in poor structural condition to maintain system reliability and restore tank's full capacity	6
RR-T-2	Rehabilitate Tanks	Tank Re-coating program to re-coat interior and exterior of above-grade steel tanks (T1, T4, T6, T6A, T7, T9, and T10); assume two future re-coating projects within Master Plan timeframe	Multiple
RR-T-3	Replace Tanks	Tank replacement program to replace tanks that have reached the end of their useful lives; budgeting includes replacement of three tanks (T4, T6 and T7) within Master Plan timeframe	Multiple
EXCIP-CITY-22	Rehabilitate Pump Stations	Improve and rehabilitate the City's pump stations to maintain pump station condition and performance	Multiple
EXCIP-CITY-4	Upgrade Pump Station 4	PS4 College rehabilitation including replacement or upgrade of existing pumps, motors and controls that are reaching the end of their useful life to maintain reliability for Z11; this project to incorporate Project EXCIP-PS-1	11
EXCIP-CITY-18	Rehabilitate Pressure Regulating Stations	Improve and rehabilitate the City's pressure reducing stations to maintain pressure reducing station performance	Multiple
Miscellaneous Rehabilitation and Replacement Projects			
EXCIP-CITY-9	Update CMMS	Update the Computerized Maintenance Management System (CMMS) with geographical information from the City's GIS, and provide unique identification numbers for facilities in the CMMS	Multiple
EXCIP-CITY-16	Upgrade Meter	Retrofit existing customer meters with cathodic protection in corrosive soils areas; $1 million is assumed for budgeting purposes, as more detailed analysis would be required for specific locations and costs	Multiple
EXCIP-CITY-17	Upgrade Meter	Replace existing water meters with Sensus Mag meter technology	Multiple
EXCIP-CITY-8	Repair Pipeline	Spot repairs for the Spyglass neighborhood and on Merion Drive	Multiple
EXCIP-CITY-19	Replace Pipeline	Replace or slip-line the existing 14-inch pipeline from Station 2 to Tank 7 - the existing pipeline is in poor condition	12

[a] Pipeline projects with P1 identifiers are Priority 1 (highest priority) projects. These projects are listed in order of priority, so that areas with the poorest leak history and oldest pipelines receive highest priority. Only pipelines 4-inch and less in diameter are included, excluding parallel pipelines.

[b] Pipeline Improvements Priority 2 is one step lower in priority. This project is comprised of the rest of the pipelines 4-inch and less in diameter throughout the entire system, excluding parallel pipelines.

[c] Pipeline Improvements Priority 3 (lowest priority) is comprised of the rest of the pipelines throughout the entire system, excluding parallel pipelines, that were not included in Priority 1 or 2.

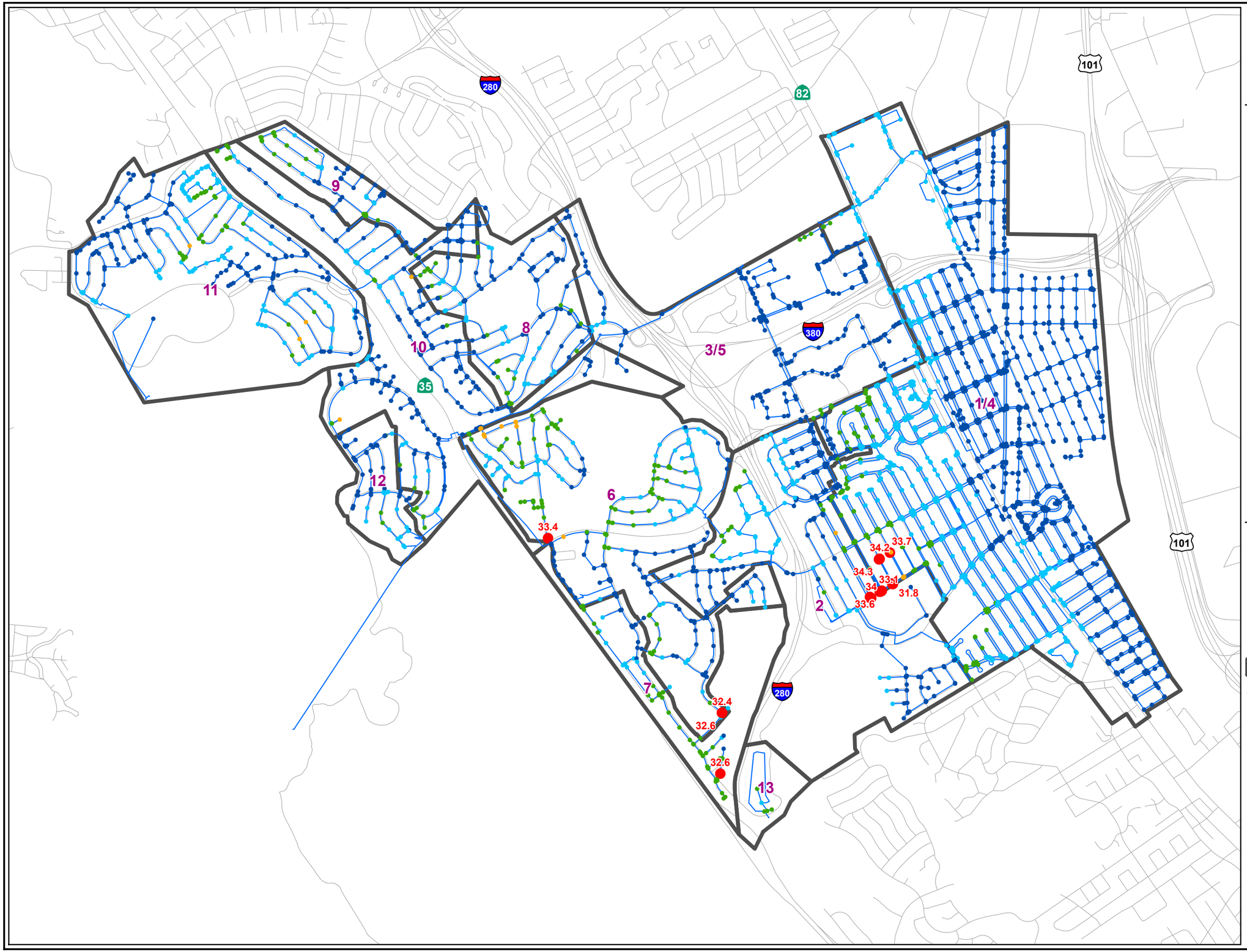


FIGURE 7-1

City of San Bruno
Water System Master Plan

PEAK HOUR PRESSURE EXISTING SYSTEM

N

0 880 1,760

Scale in Feet

Notes
1. Existing Peak Hour Demand is 12.66 mgd.
2. Assumes storage tank levels are half full, and pump stations are operating at firm capacity.
3. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

- Pressure < 35 psi
- 35 psi ≤ Pressure ≤ 40 psi
- 40 psi < Pressure ≤ 60 psi
- 60 psi < Pressure ≤ 80 psi
- Pressure > 80 psi
- Pressure Zone Boundary
- Pipeline
- Street

City of San Bruno

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 7-2_FF_Criteria.mxd 10/18/2012

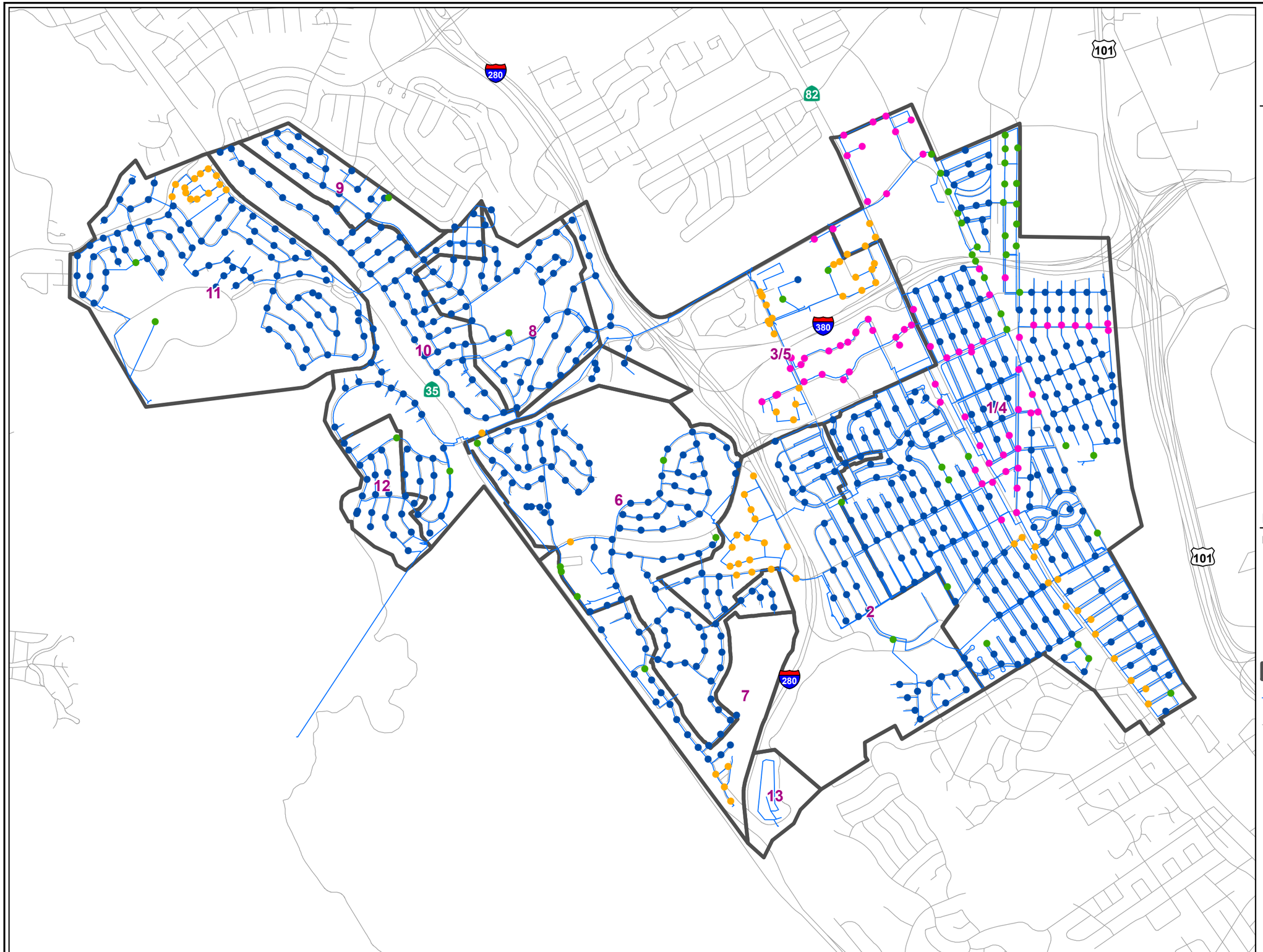

FIGURE 7-2

City of San Bruno
Water System Master Plan

RECOMMENDED EXISTING SYSTEM FIRE FLOW CRITERIA

N

0 880 1,760

Scale in Feet

Notes

1. The following land uses are associated with each fire flow demand:
   - 1,500 gpm - Low Density Residential
   - 2,000 gpm - Medium Density Residential, Industrial, Public/Quasi-Public, School
   - 2,500 gpm - High Density Residential, Visitor Services, Multi-Use Residential Focus, Neighborhood Commercial
   - 3,000 gpm - Central Business District, Regional Commercial, Regional Office, Transit-Oriented Development
2. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

Fire Flow Criteria

- 1,500 gpm
- 2,000 gpm
- 2,500 gpm
- 3,000 gpm
- Pressure Zone Boundary
- Pipeline
- Street

City of San Bruno

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 7-3_Avail_FF_Ex.mxd 1/19/2012

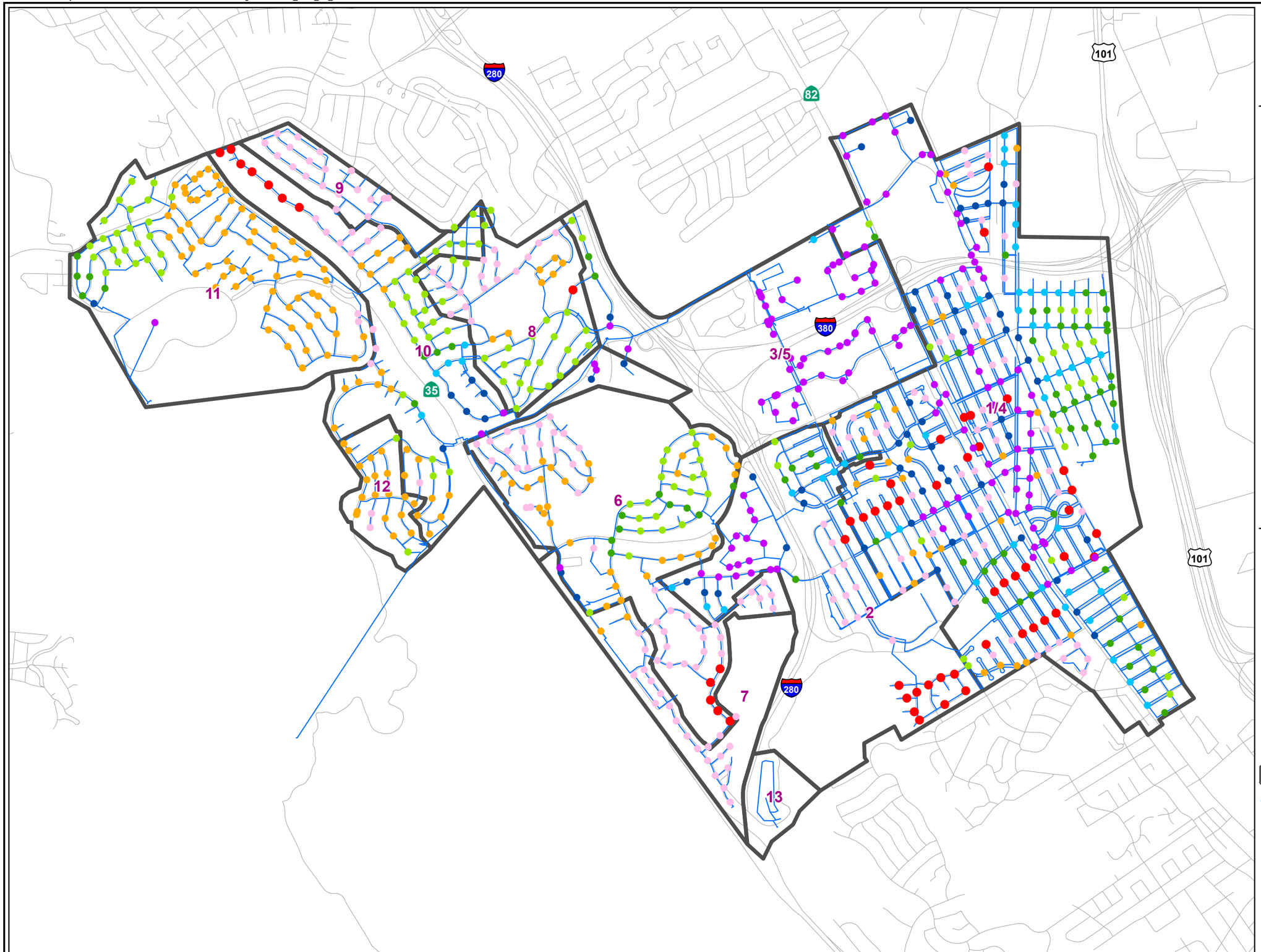

FIGURE 7-3

City of San Bruno
Water System Master Plan

AVAILABLE FIRE FLOW EXISTING MAXIMUM DAY DEMAND CONDITION

Notes
1. Existing Maximum Day Demand is 6.33 mgd.
2. Assumes storage tank levels are half full, and pump stations are operating at firm capacity.
3. Results based on NO pipeline velocity constraint, but a minimum residual pressure of 20 psi was required.
4. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

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
- Pressure Zone Boundary
- Pipeline
- Street

City of San Bruno

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 7-4_CompareAvailCriteria_Modified.mxd 10/18/2012

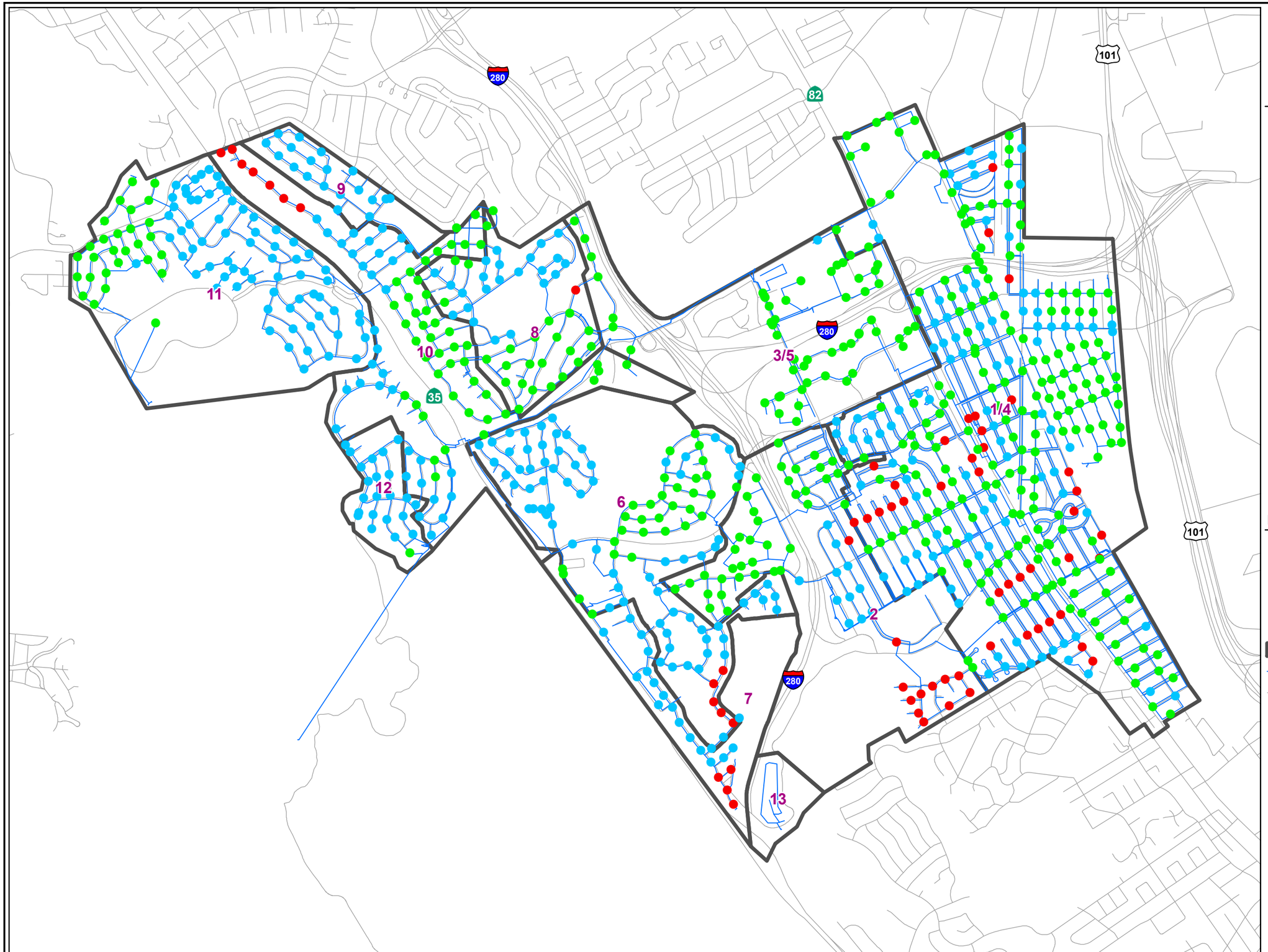

FIGURE 7-4

City of San Bruno
Water System Master Plan

COMPARISON OF AVAILABLE FIRE FLOW AND FIRE FLOW CRITERIA - EXISTING SYSTEM

Notes
1. Existing Maximum Day Demand is 6.33 mgd.
2. Assumes storage tank levels are half full, and available duty pumps are operating.
3. Results based on NO pipeline velocity constraint, but a minimum residual pressure of 20 psi was required.
4. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

- AvailableFlow < 1/3 of Fire Flow Criteria
- AvailableFlow > 1/3 of Fire Flow Criteria and < Fire Flow Criteria
- Available Flow > Fire Flow Criteria
- Pressure Zone Boundary
- Pipeline
- Street

City of San Bruno

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 7-5_Sys_w_Imprvmnts.mxd 1/19/2012

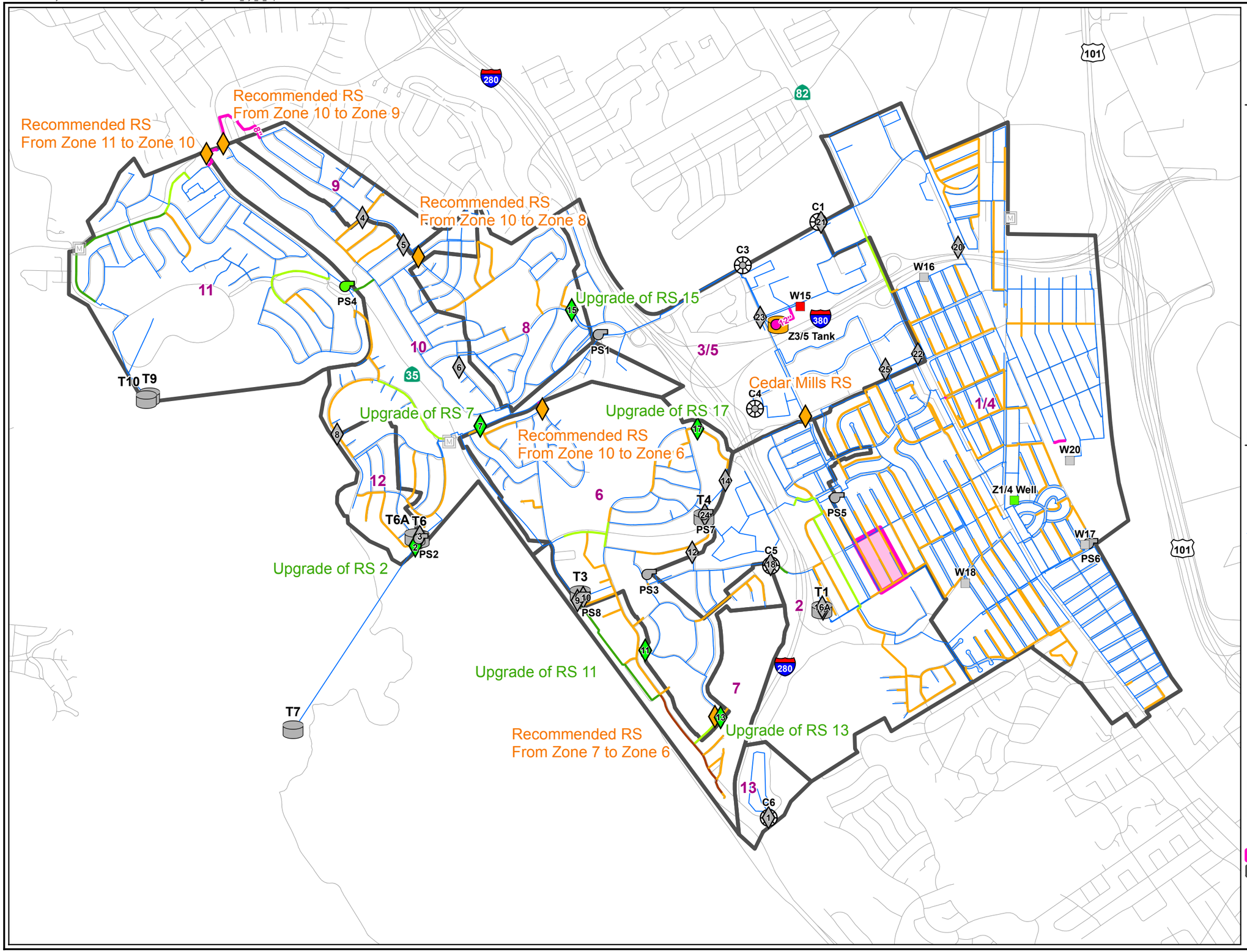

FIGURE 7-5

City of San Bruno
Water System Master Plan

RECOMMENDED WATER SYSTEM IMPROVEMENTS EXISTING SYSTEM

Notes
1. Improvements based upon Maximum Day Demands Plus Fire Flow evaluation.
2. Existing Maximum Day Demand is 6.33 mgd.
3. Assumes storage tank levels are half full, and available duty pumps are operating.
4. Results based on NO pipeline velocity constraint, but a minimum residual pressure of 20 psi was required.
5. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown on this figure.

LEGEND
- Proposed 8-inch Upsize
- Proposed 10-inch Upsize
- Proposed 12-inch Upsize
- Proposed 14-inch Upsize
- Proposed New Pipeline
- Existing Pipeline
- Turnout
- Existing Well
- Well 15 (to be replaced)
- Proposed New Well
- Ex. Pressure Reg. Sta. (RS)
- Proposed Pressure RS Upsize
- Proposed New Pressure RS
- Ex. Booster Pump Sta. (PS)
- Proposed Booster PS Upsize
- Proposed New Booster PS
- Existing Storage Tank
- Proposed New Storage Tank
- Emergency Connection
- Proposed Area for Rezoning
- Pressure Zone Boundary

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 7-6_Avail_FF_Imprvnts.mxd 1/19/2012

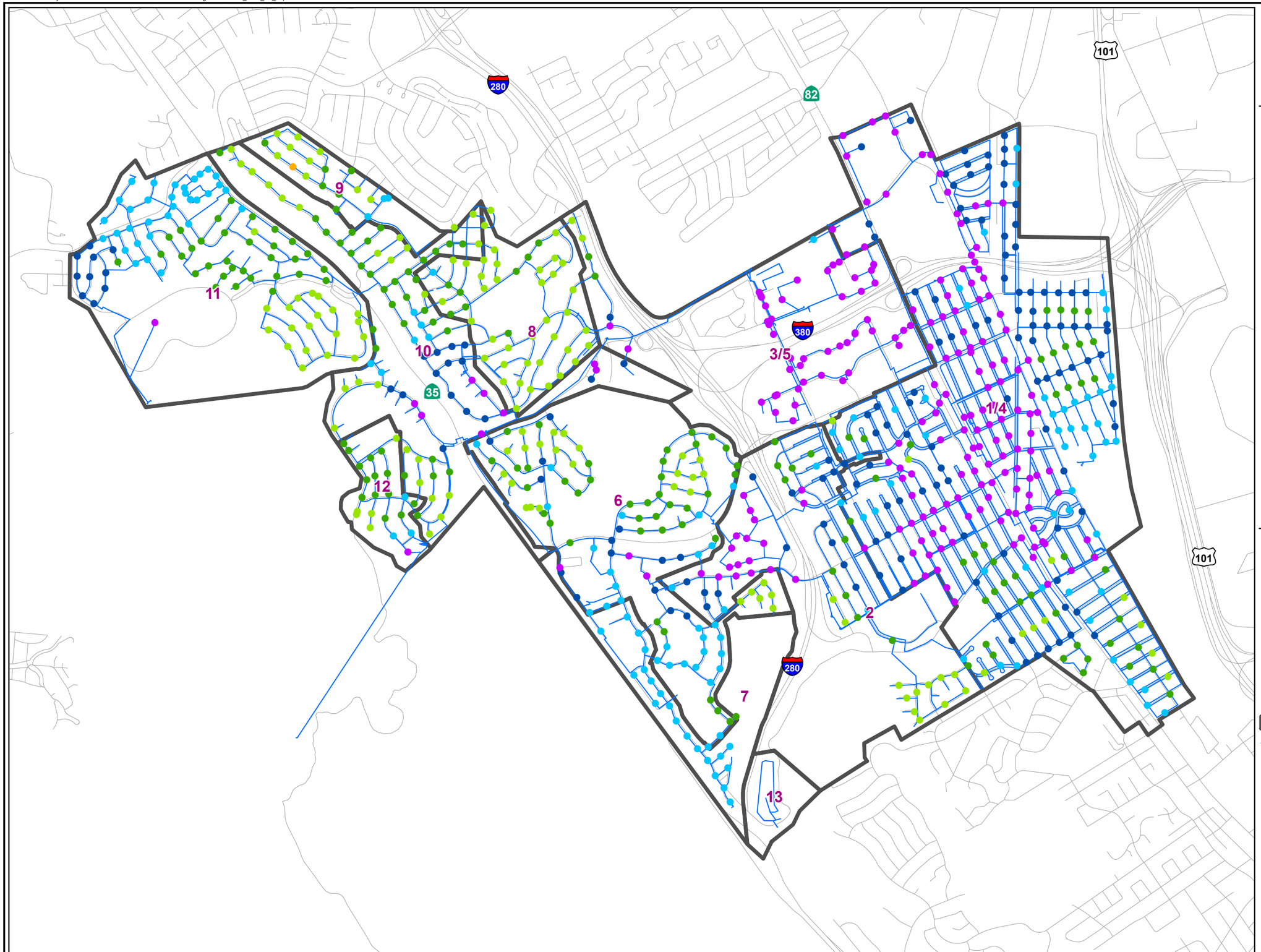

FIGURE 7-6

City of San Bruno
Water System Master Plan

AVAILABLE FIRE FLOW - EXISTING MAXIMUM DAY CONDITION WITH IMPROVEMENTS

N

0 880 1,760

Scale in Feet

Notes
1. Existing Maximum Day Demand is 6.33 mgd.
2. Assumes storage tank levels are half full, and pump stations are operating at firm capacity.
3. Results based on NO pipeline velocity constraint, but a minimum residual pressure of 20 psi was required.
4. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

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
- Pressure Zone Boundary
- Pipeline
- Street

City of San Bruno

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 7-7_ComprAvailCritWithImprvmnts.mxd 10/18/2012

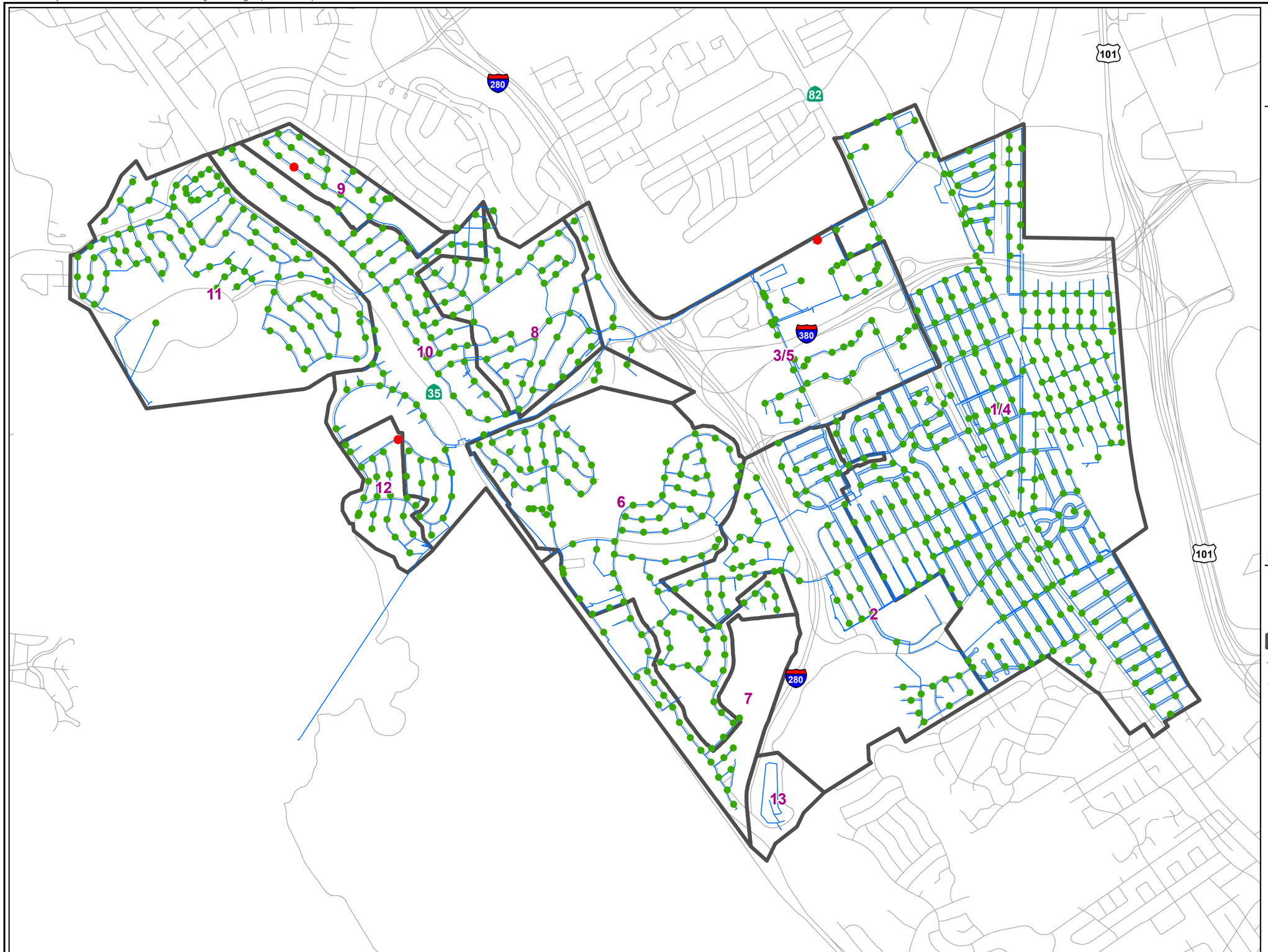

FIGURE 7-7

City of San Bruno
Water System Master Plan

COMPARISON OF AVAILABLE FIRE FLOW AND FIRE FLOW CRITERIA - EXISTING SYSTEM WITH IMPROVEMENTS

Notes
1. Existing Maximum Day Demand is 6.33 mgd.
2. Assumes storage tank levels are half full, and available duty pumps are operating.
3. Results based on NO pipeline velocity constraint, but a minimum residual pressure of 20 psi was required.
4. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

- Available Flow less than Fire Flow Criteria
- Availalbe Flow greater than Fire Flow Criteria
- Pressure Zone Boundary
- Pipeline
- Street

City of San Bruno

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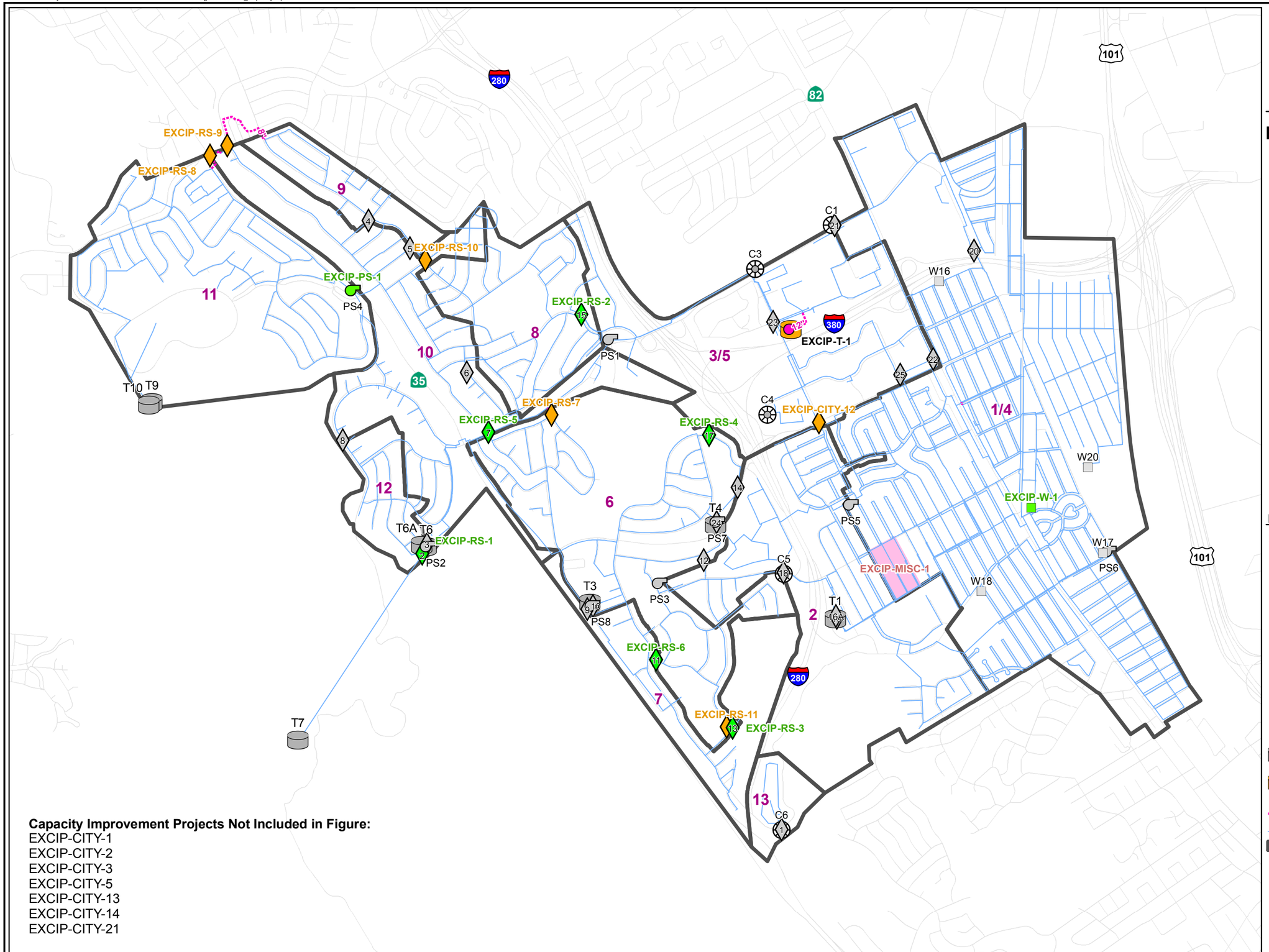
W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 7-9_CapacityImp.mxd 10/17/2012



Capacity Improvement Projects Not Included in Figure:
EXCIP-CITY-1
EXCIP-CITY-2
EXCIP-CITY-3
EXCIP-CITY-5
EXCIP-CITY-13
EXCIP-CITY-14
EXCIP-CITY-21

FIGURE 7-9

City of San Bruno
Water System Master Plan

RECOMMENDED EXISTING SYSTEM CAPACITY IMPROVEMENTS

Notes
1. Location of EXCIP-W-1 to be determined.

LEGEND
- Turnout
- Existing Well
- Proposed New Well
- Ex. Pressure Reg. Sta. (RS)
- Proposed Pressure RS Upsize
- Proposed New Pressure RS
- Ex. Booster Pump Sta. (PS)
- Proposed Booster PS Upsize
- Proposed New Booster PS
- Existing Storage Tank
- Proposed New Storage Tank
- Pipeline Improvement Associated With Tank, PS, or RS Improvement
- Water Main
- Pressure Zone Boundary

City of San Bruno

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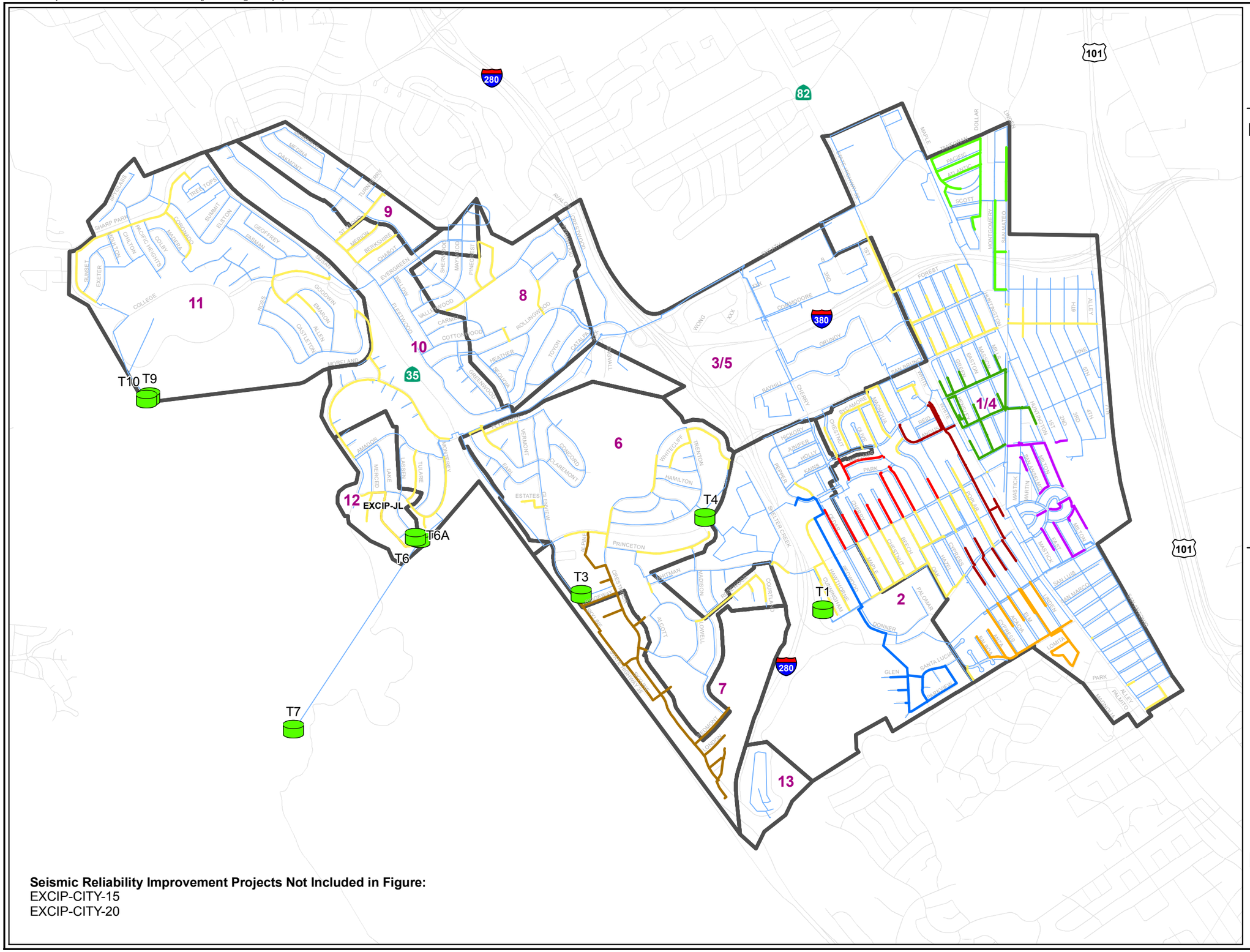
W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 7-10_ReliabilityImp.mxd 10/17/2012



Seismic Reliability Improvement Projects Not Included in Figure:
EXCIP-CITY-15
EXCIP-CITY-20

FIGURE 7-10

City of San Bruno
Water System Master Plan

RECOMMENDED EXISTING SYSTEM RELIABILITY IMPROVEMENTS

N

0 880 1,760
Scale in Feet

Notes
1. Pipeline improvements based upon Maximum Day Demands Plus Fire Flow evaluation.
2. Existing Maximum Day Demand is 6.33 mgd.
3. Assumes storage tank levels are half full, and available duty pumps are operating for pipeline improvements.
4. Results based on NO pipeline velocity constraint, but a minimum residual pressure of 20 psi was required.
5. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown on this figure.
6. EXCIP-P2 projects are grouped by pressure zone.

LEGEND

Seismic Reliability
- T-PROP-01

Pipeline Reliability
- EXCIP-P1-1
- EXCIP-P1-2
- EXCIP-P1-3
- EXCIP-P1-4
- EXCIP-P1-5
- EXCIP-P1-6
- EXCIP-P1-7
- EXCIP-P1-8
- EXCIP-P2
- EXCIP-JL
- Existing Pipeline
- Street
- Pressure Zone Boundary

CITY OF SAN BRUNO

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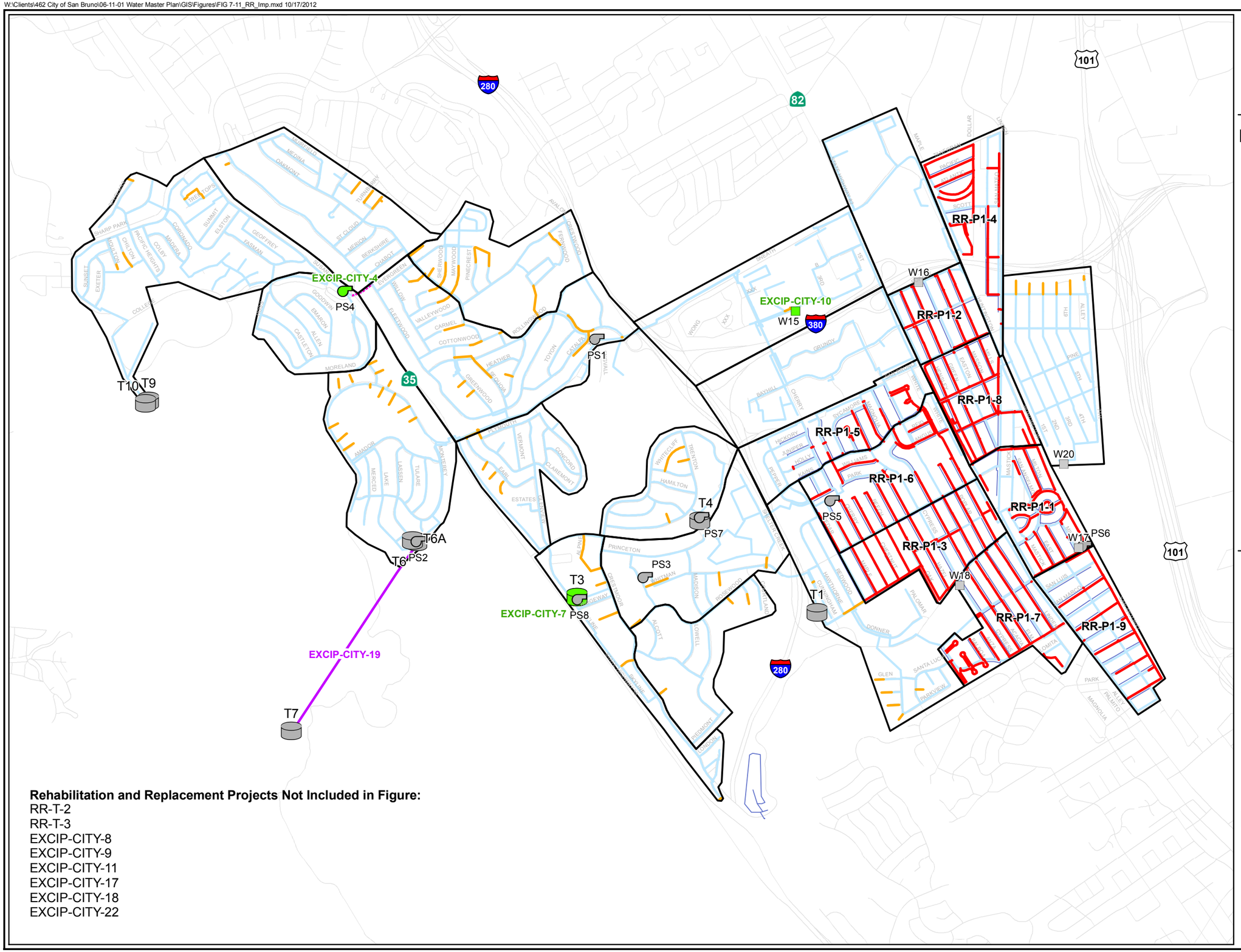
W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 7-11_RR_Imp.mxd 10/17/2012

FIGURE 7-11

City of San Bruno
Water System Master Plan

RECOMMENDED EXISTING SYSTEM REHABILITATION AND REPLACEMENT IMPROVEMENTS



Notes
1. RR-P1 projects are grouped according to subdivision boundaries.

LEGEND

- Existing Well
- Well Replacement
- Ex. Booster Pump Sta. (PS)
- Booster PS Upgrade
- Existing Storage Tank
- Storage Tank Replacement
- RR-P1
- RR-P2
- RR-P3
- EXCIP-CITY-19
- Pipeline Improvement Associated With Tank, PS, or RS Improvement
- Water Main
- Subdivision
- Street

Rehabilitation and Replacement Projects Not Included in Figure:
RR-T-2
RR-T-3
EXCIP-CITY-8
EXCIP-CITY-9
EXCIP-CITY-11
EXCIP-CITY-17
EXCIP-CITY-18
EXCIP-CITY-22

CITY OF SAN BRUNO

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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 planning criteria under future (FY 2034/35) water demand conditions. West Yost conducted this evaluation using an updated hydraulic model that incorporated 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. This chapter will identify 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 a reliability 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. Additional operational scenarios were also analyzed to assess operational efficiencies under the proposed Regional Groundwater Storage and Recovery Project (Regional Project) with SFPUC, City of Daly City, and California Water Service Company.

Evaluations, findings, and recommendations for supporting projected future water demands and addressing any deficiencies identified within the future 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:

- Projected Water Demands by Pressure Zone: summarizes demands by pressure zone used for the future water system evaluation;
- Future Water System Facility 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 during a normal supply year (*i.e.*, "put") operation;
- Evaluation of Regional Groundwater Storage and Recovery Project: assesses operational efficiencies under the proposed Regional Project (*i.e.*, "take" operation); and
- Summary of Recommended Improvements for the Future Water System.

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 future (*i.e.*, FY 2034/35) water demands for the City's water system were spatially located in the hydraulic model using information developed with the City's Redevelopment Agency staff. This information was presented previously in *Chapter 3 Water Demands* (see Table 3-10 and Figure 3-5).

Table 8-1. Water Demands for the Future (FY 2034/35) System Analysis

Pressure Zone[a]	Average Day Demand[c]		Maximum Day Demand[d]		Peak Hour Demand[e]	
	gpm	mgd	gpm	mgd	gpm	mgd
Zone 1/4	1,755	2.53	2,632	3.79	5,264	7.58
Zone 2	329	0.47	493	0.71	987	1.42
Zone 3/5	487	0.70	730	1.05	1,461	2.10
Zone 6	208	0.30	313	0.45	625	0.90
Zone 7	67	0.10	100	0.14	200	0.29
Zone 8	102	0.15	153	0.22	306	0.44
Zone 9	49	0.07	73	0.11	147	0.21
Zone 10	215	0.31	322	0.46	645	0.93
Zone 11	268	0.39	401	0.58	803	1.16
Zone 12	56	0.08	84	0.12	168	0.24
Zone 12 – Jail[b]	101	0.15	287	0.41	861	1.24
Zone 13	29	0.04	44	0.06	88	0.13
Total	3,666	5.29	5,632	8.10	11,555	16.64

(a) Demands from Zones 1/4, 6, 7, 8, 9, and 12 each include demands from their smaller subzones (*i.e.,* Zones 1/4A, 6A, 7A, 8A, 9A, and 12A).
(b) There is a proposal for the City to serve the existing San Francisco County Jail # 5. The jail currently receives water from the SFPUC Regional System. Demands for the jail are based on San Francisco County Jail #5 Water Supply Project DRAFT PreDesign TM, May 31, 2011, prepared by HDR.
(c) Existing demand is based on detailed billing records, and adjusted to reflect FY 2000/01 production data. Additional FY 2034/35 water use from new development was based on 2011 UWMP demand projections (see Table 3-10).
(3) Maximum day demand calculated using a peaking factor of 1.5 times the average day demand, except for demands from San Francisco County Jail #5.
(e) Peak hour demand calculated using a peaking factor of 3.0 times the average day demand, except for demands from San Francisco County Jail #5.

The City's future average day water demands are expected to increase by approximately 25 percent from the existing "base" water demands (*i.e.*, FY 2000/01). As discussed in *Chapter 7 Evaluation of Existing Water System*, water production data from FY 2000/01 was used to represent "base" water demands because it corresponds with water demand projections presented in the City's 2011 UWMP.

Most of the projected growth will occur in Zones 1/4, 3/5, 11, and 12. A summary of the projected development projects associated with the additional water demands for these pressure zones is provided below.

- Zone 1/4 – Transit Corridors Plan, San Bruno Town Center, The Shops at Tanforan, and South El Camino
- Zone 3/5 – Bayhill Office Park and The Crossings

- Zone 11 – Treetops
- Zone 12 – San Francisco County Jail #5[1]

8.2 FUTURE WATER SYSTEM FACILITY 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 evaluation is based on a normal supply year (*i.e.*, "put") operation and assumes that the City will be participating in the Regional Groundwater Storage and Recovery Project and maximizing their surface water use during normal supply years. A brief summary of the proposed Regional Project is provided below. Additional details and evaluation of the Regional Project are presented in Section 8.4. Results from the future water system facility evaluation are also discussed below.

8.2.1 Regional Project Overview

The proposed Regional Project is an in-lieu groundwater recharge program that would have two operating conditions, 'put' operations, in normal and wet years, and 'take' operations, in dry years. During put operations, SFPUC would provide additional surface water to the three partner agencies in order to reduce their groundwater pumping. During take operations, the City, City of Daly City, and California Water Service Company would utilize available groundwater supplies and reduce surface water deliveries, thereby freeing surface water supply to be delivered to other SFPUC customers. The following future water system facility evaluation assumes a normal supply year where groundwater use is minimized *(i.e.*, "put" operations) because this is the expected normal operating scenario once the Regional Project is implemented.

8.2.2 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. For groundwater wells, it was assumed that two existing wells could be out of service at any time.

[1] The following 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.

When zones are supplied by pump station(s), the pumping capacity criterion for the City, described previously in *Chapter 6 Water System Master Plan Key Assumptions*, 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 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. Note that Zone 1/4 was not evaluated because during a normal supply year operation for the future water system, the wells in Zone 1/4 will not be operated.

Table 8-2 indicates that all service zones that were evaluated have surplus pumping capacity in excess of the future maximum day demand, except for in Zone 2 (*i.e.*, PS5). The firm pumping capacity deficit in Zone 2 of the future water system is approximately 70 gpm; however, no improvements are recommended at this time since this deficiency is relatively small. It is recommended that City staff monitor the water system as water demands increase to determine if additional pumping capacity at PS5 is required.

8.2.3 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. Existing storage capacities reported in the table are based on nominal storage capacities calculated from tank geometry. The comparison between the City's available and required storage capacities indicates that there are no potable water storage capacity deficits in the future water system, except for Zone 1/4.

Zone 1/4 is projected to have a storage capacity deficit of approximately 1 MG by FY 2034/35. This deficit is caused by the additional growth projected in Zone 1/4 in conjunction with the normal supply year operation in the future water system. The proposed operational scheme during a normal supply year does not provide any groundwater credit to reduce the City's emergency storage requirement because the City's wells will not be active in order to maximize surface water use (*i.e.*, "put" operations).

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

Service Zone and Supported Zones[a]	Average Day Demand, gpm	Maximum Day Demand, gpm	Supply Sources[d]	Other Zone Supply Capacity	Existing and Proposed Pumping Capacity, gpm		Required Firm Pumping Capacity, gpm[f]	Firm Capacity Surplus (Deficit), gpm
				gpm	Total	Firm[e]		
Zone 2[b]	329	493	PS5 - Maple Avenue	0	1,700	1,100	1,166	(66)
Zone 6	146	219						
Zone 7	21	32						
Zone 8	33	49						
Zone 9	16	23						
Zone 10	69	103						
Zone 11	86	128						
Zone 12 + Jail	50	119						
Total	750	1,166						
Zone 6[c]	208	313	PS3 - Whitman Way PS7 - San Bruno Avenue	0	2,000	1,000	767	233
Zone 7	21	32						
Zone 8	33	49						
Zone 9	16	23						
Zone 10	69	103						
Zone 11	86	128						
Zone 12 + Jail	50	119						
Total	483	767						
Zone 10	215	322	PS1 - Sneath Lane PS8 - Glenview Drive	0	3,310	1,940	1,420	520
Zone 7	67	100						
Zone 8	102	153						
Zone 9	49	73						
Zone 11	268	401						
Zone 12 + Jail	157	371						
Total	858	1,420						
Zone 11	268	401	PS4 - Pacific Heights/College	0	1,800	1,200	401	799
Zone 12 + Jail	157	371	PS2 - Lake Drive	0	1,200	600	371	229

[a] Zones 6, 7, 8, 9, and 12 also include their smaller subzones (i.e., Zones 6A, 7A, 8A, 9A, and 12A).

[b] 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 PS8, and partially supported by Turnout C3 via PS1. In order to account for this, the demands for Zones 7-12 were multiplied by 0.32, which is the ratio of PS8 firm capacity to PS1+PS8 firm capacity.

[c] 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 0.32, which is the ratio of PS8 firm capacity to PS1+PS8 firm capacity.

[d] Proposed pumping capacity improvements from the existing system evaluation have been included (*i.e.* , new booster pump at PS4 with proposed capacity of 600 gpm).

[e] Firm booster pumping capacity is defined as the total booster pump station capacity with the largest pump out of service.

[f] Required firm capacity is defined as the firm pumping capacity equal to the maximum day demand in zones with storage and equal to the maximum day demand plus fire flow or peak hour demand, whichever is larger, in zones without storage.

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

Pressure Zone[a]	Water Supply Facility	Existing and Proposed Storage Capacity, MG			Required Storage Capacity, MG				Storage Surplus (Deficit), MG
		Reservoir Capacity	Groundwater Credit[b]	Total Available Storage[c]	Operational[d]	Emergency[e]	Fire Flow[f]	Total Required Storage	
Zone 1/4	Tank 1 - Cunningham Drive	2.5	--	2.50	0.95	1.90	0.54	3.39	(0.9)
	Well 16 - Forest Lane[g]	--	--						
	Well 17 - Corporate Yard	--	--						
	Well 18 - Cypress[g]	--	--						
	Well 20 - Lions Field	--	--						
	Future Well	--	--						
Zone 2	Tank 4 - San Bruno Avenue	1.0	--	1.00	0.18	0.36	0.30	0.84	0.2
Zone 3/5	Future Tank	1.4	--	1.40	0.26	0.53	0.54	1.33	0.1
	Well 15 Replacement	--	--						
Zone 6	Tank 3 - Glenview Drive[h]	2.0	--	2.00	0.11	0.23	0.30	0.64	1.4
Zone 10[i]	Tank 6 - Lake Drive South	0.4	--	1.40	0.23	0.47	0.30	1.00	0.4
	Tank 6A - Lake Drive North	1.0	--						
Zone 11	Tank 9 - Skyline West	0.5	--	1.00	0.15	0.29	0.30	0.74	0.3
	Tank 10 - Skyline East	0.5	--						
Zone 12[j]	Tank 7 - Sweeney Ridge	0.4	--	0.40	0.13	0.06	0.18	0.37	0.0

[a] Zone 1/4 represents Zone 1/4 and 1/4A. Likewise, Zones 6 and 12 also include their smaller subzones (i.e., Zones 6A and 12A).

[b] Wells with backup power can provide supply that is equivalent to providing emergency storage in a zone, so a groundwater credit is applied for wells with on-site standby power. The emergency storage criterion is to provide emergency storage equal to 50 percent of a maximum day demand. Therefore, the groundwater credit is calculated as the volume pumped over a 12-hour duration. However, during a "put" operation, groundwater wells are not operated to maximize surface water use. Therefore, no groundwater credit has been assigned to the City's available groundwater wells.

[c] Total available storage is the sum of the available reservoir capacity plus available groundwater credit.

[d] Based on 25 percent of maximum day demand (see Table 8-1).

[e] Based on 50 percent of maximum day demand (see Table 8-1).

[f] Based on demand for most severe fire flow recommended in the pressure zone multiplied by the corresponding recommended fire flow duration (see Table 6-2).

[g] Assumed to have on-site standby power installed based on recommendations from the existing water system evaluation.

[h] Although Tank 3 has a nominal capacity of 2 MG, the tank is currently operated at reduced levels due to its poor structural condition. For the future water system evaluation, Tank 3 was assumed to be replaced.

[i] Required storage capacity includes demands for Zones 7, 8, and 9 since these zones are served by Zone 10.

[j] 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 an on-site storage tank.

Therefore, to eliminate the proposed storage capacity deficit in the future water system, a new 1.0 MG storage tank improvement is recommended in Zone 1/4. Based on discussion with City staff, this new storage tank will be preliminarily located at the south end of Cunningham Way (close to Tank 1). Due to the lack of suitable land at appropriate elevations for a gravity feed tank, a new booster pump station will be required at the proposed storage tank site to supply water into Zone 1/4 during peak demand conditions. This booster pump station will be preliminarily sized at 4.3 mgd (firm capacity) to meet the most stringent fire flow recommended in Zone 1/4.

8.2.4 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 Water System Master Plan Key Assumptions*, 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 with no storage, pressure regulating stations must supply maximum day plus fire flow or peak hour demand, whichever is larger.

The City has ten pressure regulating stations that supply six different pressure zones, all of which are completely dependent on the pressure regulating stations for supply.[2] Therefore, the pressure regulating station capacity requirement is to provide maximum day plus fire flow or peak hour demand, whichever is greater. In all cases, the maximum day plus fire flow demand is the more critical supply condition.

Table 8-4 compares the existing and proposed pressure regulating station capacity with the required pressure regulating station capacity for the ten pressure regulating stations that are associated with zones that are completely 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.

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 evaluation presented in Section 8.2, the future water system performance evaluation is also is based on a normal supply year (*i.e.*, "put") operation and assumes that the City will be maximizing their surface water use during normal supply years under the proposed Regional Project. The following evaluations were performed to assess distribution system performance under the proposed FY 2034/35 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.

[2] 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

Zone	Maximum Day Demand, gpm	Fire Flow Requirement, gpm	Regulating Station	Valve Diameter, inches	Existing or Proposed Valve Capacity, gpm[a]	Valve Capacity Requirement, gpm[b]	Valve Capacity Surplus (Deficit), gpm
Zone 6A	9	1,500	RS17[c]	6	2,250	1,509	1,001
				2	260		
			Total		2,510		
Zone 7	98	2,500	RS9	8	3,900	2,598	1,562
				2	260		
			Total		4,160		
Zone 7A	2	1,500	RS13[c]	6	2,250	1,502	1,008
				2	260		
			Total		2,510		
Zone 8	145	2,000	RS6	6	2,250	2,145	1,095
				4	990		
			Total		3,240		
Zone 8A	8	1,500	RS15[c]	6	2,250	1,508	1,002
				2	260		
			Total		2,510		
Zone 9	72	2,000	RS4	6	2,250	2,072	438
				2	260		
			Total		2,510		
Zone 9A	2	1,500	RS5	6	2,250	1,502	1,008
				2	260		
			Total		2,510		
Zone 12 + Jail [d,e]	361	1,500	RS2[c]	8	3,900	1,861	3,029
				4	990		
			Total		4,890		
Zone 12A	10	1,500	RS8	6	2,250	1,510	1,000
				2	260		
			Total		2,510		
Zone 13	44	2,500	RS1	6	2,250	2,544	286
				3	580		
			Total		2,830		

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

[b] The criterion for sizing valves for these zones is maximum day demand plus fire flow or peak hour demand, whichever is greater.

[c] Pressure regulating station was proposed for capacity improvements based on the existing water system evaluation recommendations. Improved capacity shown.

[d] Zone 12 served by PS2 via RS2.

[e] Zone 12 also served by emergency bypass from Tanks 6 and 6A via RS3.

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 improvements recommended for the existing water system (see Figure 8-1) as well as the new Zone 1/4 tank and booster pump station recommended from the future water system facility evaluation. The purpose of the future water system performance evaluation is to identify any additional improvements that will be required in addition to the currently identified water system improvements 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. Recommended system improvements were identified to address and fix any pressure deficiencies found, and to fix any fire flow deficiencies identified in the future water distribution system. Typically, system improvements were not identified for 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 11,555 gpm (16.6 mgd). The peak hour demand is estimated at 3.0 times the average daily demand. This analysis assumed that the storage tanks are 50 percent full and pump stations are operating at their firm capacity.

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 distribution main should not exceed 5 ft/kft and maximum velocities should not exceed 4 ft/s during normal demand conditions, 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 Zones 6 and 7, there are three low pressure junctions located above the normal 'top of zone' elevations. Because these low pressure junctions are a result from high elevations rather than distribution system constrictions, improvement projects were not recommended specifically for these junctions, which do meet the State's minimum standard of 20 psi. Figure 8-2 also shows that there is a group of low pressure junctions located in Zone 1/4 near Tank 1. As discussed in *Chapter 7 Evaluation of Existing Water System*, these junctions are located very near the normal 'top of zone' elevation for Zone 1/4. This result indicates that with the addition of new water demands from future growth in this zone, water service connections in this area of low pressure should be re-zoned into Zone 2 to meet the City's minimum pressure criterion of 35 psi. It is recommended that all Zone 1/4 junctions with elevations above 155 ft msl be re-zoned into Zone 2. A potential tie-in location into Zone 2 would be at Niles Avenue and Cedar Avenue.

As illustrated on Figure 8-3, there are pipelines near RS25 that exceeded the preferred maximum pipeline velocity criterion of 7 ft/s during a peak hour demand condition. Because RS25[3] will be a main source of supply into Zone 1/4 during a "put" operational scheme (when surface water use is maximized), it is recommended that the existing 8-inch diameter pipelines be upsized to 12-inch diameter pipelines. It should be noted that based on the current settings for RS20 and RS22, no additional supply is provided from these pressure regulating stations into Zone 1/4. It is recommended that City staff review the pressure settings at RS20 and RS22 as the City moves forward with the Regional Project.

Figure 8-3 also identifies that the pipelines downstream of RS2 in Zone 12 have velocities between 5 and 7 ft/s during a peak hour demand condition. The existing 6-inch diameter pipelines have already been recommended for upsizing in the existing water system evaluation to 8-inch diameter pipelines. However, the additional distribution capacity required to potentially serve San Francisco County Jail #5 water demands suggests that these existing pipelines should be upsized to larger 12-inch diameter pipelines to meet the City's recommended maximum pipeline velocity criterion of 4 ft/s.

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. For the future water system evaluation, key junctions that represent hydrant locations that are located 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 pump stations are operating at their firm capacity.

As discussed in *Chapter 6 Water System Master Plan Key Assumptions*, 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 proposed 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 requirements, for all the tested locations in the future water system, are shown on Figure 8-4.

Figure 8-5 summarizes the available fire flow at each tested hydrant junction within the future water system while meeting the minimum residual pressure criterion of 20 psi. All tested locations met the minimum fire flow requirement of 1,500 gpm. The available fire flow result at each hydrant junction was subsequently compared to the fire flow criteria shown on Figure 8-4 to determine the location(s) of any fire flow deficiencies. Figure 8-6 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).

[3] RS25 was operated as a flow control valve set at 1,400 gpm to balance the supply from Zone 3/5 and Tank 1.

As shown on Figure 8-6, only one junction located in Zone 1/4 (near Turnout C1) did not meet the fire flow criterion. Based on the fire flow criterion of 3,000 gpm at this location, a comparison with the corresponding available fire flow result indicates that there is a deficiency of approximately 350 gpm. This fire flow deficiency was also identified in the existing water system evaluation. Further inspection of this area indicates that this hydrant is located near a dead-end and would require additional looping to meet the required fire flow demand. Because another hydrant located immediately upstream of this hydrant can provide the fire flow demand of 3,000 gpm, no improvement is currently recommended to fix this fire flow deficiency in the future water system.

8.4 EVALUATION OF REGIONAL GROUNDWATER STORAGE AND RECOVERY PROJECT

This section summarizes an evaluation of the City's participation in the proposed SFPUC Regional Groundwater Storage and Recovery Project for the South Westside Groundwater Basin. This evaluation assesses infrastructure needs and ways that the City could most efficiently operate their groundwater wells and booster pump stations. As discussed in *Chapter 4 Water Supply*, the City, City of Daly City and California Water Service Company (purveyor for the City of South San Francisco), are considering participation in the Regional Project. All three partner agencies operate groundwater wells located in the South Westside Groundwater Basin, and also purchase surface water from SFPUC, delivered through its Regional Water System.

A focused operational evaluation was performed to assess operational efficiencies for the City's project operations. For this operational evaluation, West Yost used monthly production records to assess worst-case conditions for each operating scenario, and then used the hydraulic model developed for the Water System Master Plan to assess whether new transmission facilities would be needed. Monthly production, pump efficiency and electrical cost data were then used to evaluate operational costs for alternative operations/configurations. The results of the evaluation are summarized in the following sections.

8.4.3 Additional Details on the Regional Project

Existing water supplies for the three partner agencies total 21.2 mgd.[4] Currently, these three partner agencies have an average annual groundwater production of about 6.7 mgd. The remaining 14.5 mgd of supply is from surface water supplied by the SFPUC through its Regional Water System turnouts. Under the proposed Regional Project, in 'put' years, partner agencies would increase their use of surface water to 19.9 mgd, and reduce groundwater production to 1.3 mgd. Alternatively, in 'take' years, partner agencies would provide 6.7 mgd from their groundwater supplies, the same as current operations, with the remaining supply provided by SFPUC. In addition, during take years, an additional 7.2 mgd could be supplied to the Regional Water System or directly to each partner agency from water that has been stored in the groundwater basin during normal and wet years and have been credited to an SFPUC storage account. The SFPUC is constructing groundwater wells that could be operated by partner

[4] Source: SFPUC Water System Improvement Program, Groundwater Conjunctive Use Project – FINAL Conceptual Engineering Report, November 2008, MWH.

agencies or by SFPUC to provide this additional 7.2 mgd in groundwater well capacity from the SFPUC's storage account.

Regional Project preliminary plans call for the City to not use its groundwater wells for supply during put years, and to provide 2.1 mgd of groundwater supply from City wells in take years. However, some groundwater may need to be utilized during put operations to provide operational flexibility. During the pilot program for the Regional Project, which was conducted in 2003 and 2004 to test put operations, the City reduced groundwater production and pumped an average of 0.5 mgd. The proposed 2.1 mgd groundwater supply in take years is based on the annual groundwater production in 2007.

Figure 8-7 shows the locations of the City's existing groundwater wells, potential replacement well sites for the City's Well 15, and potential sites for SFPUC regional wells that could be connected to the City of San Bruno's water system for take operations. The City currently has four active groundwater wells (Wells 16, 17, 18 and 20), all located in Zone 1/4. These wells have an average groundwater extraction capacity of 2.2 mgd based on long-term operations data. The City is evaluating replacement locations for Well 15, which was de-commissioned in 2010, and has a capital project for a new well to provide additional redundancy during take operations. Although the existing Well 15 site is located in Zone 3/5, the City is evaluating potential replacement locations in Zone 1/4 and Zone 3/5.

As part of the Regional Project, SFPUC is evaluating three locations for new groundwater wells that could be connected to the City of San Bruno's water system, or alternatively to the SFPUC's Regional Water System; two on the Golden Gate National Cemetery property, and one at Linear Park in South San Francisco. One well on the cemetery property, adjacent to Sneath Lane, has been completed and will be used to test take operations. It should be noted that the close proximity of the SFPUC's regional groundwater wells located in the Golden Gate National Cemetery to the City's water service area would suggest that these wells could potentially be connected to Zone 3/5. However, due to the high system pressures currently observed in Zone 3/5, it is recommended that SFPUC turnouts in Zone 3/5 be regulated before any new well(s) are connected.

To date, concept-level studies and a pilot program to evaluate put operations have been completed, and an environmental impact report is being prepared. California Water Service Company, City of Daly City and the City are currently in discussions with the SFPUC regarding specific operating agreements that would be needed to implement the Regional Project.

8.4.4 Put Operations – Maximize the Use of Surface Water

Proposed put operations call for the City to not use groundwater wells and meet customer water demands using only surface water. This is expected to be the normal operating scenario once the Regional Project is implemented. However, as discussed above, some groundwater may need to be utilized to provide operational flexibility.

The worst-case conditions for put operations would be meeting water demands during a maximum day demand condition, or during fire flow conditions. As described in Section 8.3, the hydraulic evaluation assessed both peak hour and maximum day plus fire flow demand

conditions with surface water as the sole supply source. This evaluation identified the need for improvements to piping on the Zone 3/5 side of RS25, to provide more surface water supply to Zone 1/4. The evaluation also found that pipeline improvements to meet fire flows for existing customers are sufficient for future fire flow needs, and that a small area in the southwest area of Zone 1/4, near Tank 1, should be re-zoned to maintain adequate system pressures. (Results from the existing system evaluation indicated that re-zoning would be required whether or not Zone 1/4 wells are operated.) A new tank and booster pump station in Zone 1/4 were also recommended to meet storage requirements during a put operation.

8.4.5 Take Operations – Maximize the Use of Groundwater

Proposed take operations call for the City to use 2.1 mgd of groundwater, on average, to meet customer water demands. As discussed earlier, additional groundwater supply may also be available to the City from additional wells being developed by SFPUC for the Regional Project; however, due to some uncertainty of future well locations and availability, this evaluation focuses on the City's existing wells.

Although the City may have some flexibility to provide additional peaking capacity from wells during summer months, and reduce production in winter months so that the annual average groundwater production equals 2.1 mgd, this evaluation assumed that the City would use wells year-round at an annual average groundwater production of 2.1 mgd, consistent with current operations. As noted previously, all of the City's active groundwater wells are located in Zone 1/4. For the following evaluation, it was assumed that groundwater would be first source of supply to meet water demands in Zone 1/4. Consequently, only groundwater production in excess of Zone 1/4 water demands can be used to meet water demands in other pressure zones.

Monthly production records from FY 2007/08 through FY 2009/10 were used to estimate the projected monthly water demands that will need to be met during a take operation. A review of the proposed water system operations during a take year indicate that the operational condition requiring the widest areal distribution of groundwater would be during the winter months when water demands are at their lowest, and groundwater will need to be supplied to upper pressure zones to meet the annual average groundwater production of 2.1 mgd. Based on this condition, Tables 8-5 and 8-6 present the estimated winter day water demands by pressure zone for existing and future water demand conditions, respectively.

Table 8-5. Representative Winter Day Water Demands for the Existing Water System

Pressure Zone[a]	Winter Day Demand[b]		Proposed Supply Source[c]	
	Gpm	mgd	Groundwater, mgd	Surface Water, mgd
Zone 1/4	1,031	1.48	1.48	
Zone 2	265	0.38	0.38	
Zone 3/5	301	0.43		0.43
Zone 6	167	0.24	0.24	
Zone 7	54	0.08		0.08
Zone 8	83	0.12		0.12
Zone 9	40	0.06		0.06
Zone 10	171	0.25		0.25
Zone 11	196	0.28		0.28
Zone 12	45	0.06		0.06
Zone 13	24	0.03		0.03
Total	2,377	3.41	2.10	1.31

(a) Demands from Zones 1/4, 6, 7, 8, 9, and 12 each include demands from their smaller subzones (*i.e.*, Zones 1/4A, 6A, 7A, 8A, 9A, and 12A).
(b) Existing average day demand was reduced to represent an average winter day demand. Average winter day based on historical monthly production data from FY 2007/08 through FY 2009/10.
(c) Proposed "take" operations call for the City to use 2.1 mgd of groundwater, on average, to meet customer demands. For this evaluation, it was assumed that remaining water demands will be met with purchased surface water.

Table 8-6. Representative Winter Day Water Demands for the Future (FY 2034/35) Water System

Pressure Zone[a]	Winter Day Demand[b]		Proposed Supply Source[c]	
	gpm	mgd	Groundwater, mgd	Surface Water, mgd
Zone 1/4	1,422	2.05	2.05	
Zone 2	267	0.38		0.38
Zone 3/5	395	0.57		0.57
Zone 6	169	0.24		0.24
Zone 7	54	0.08		0.08
Zone 8	83	0.12		0.12
Zone 9	40	0.06		0.06
Zone 10	174	0.25		0.25
Zone 11	217	0.31		0.31
Zone 12	45	0.06		0.06
Zone 12 – Jail[d]	82	0.12		0.12
Zone 13	24	0.03		0.03
Total	2,972	4.27	2.05	2.22

(a) Demands from Zones 1/4, 6, 7, 8, 9, and 12 each include demands from their smaller subzones (*i.e.*, Zones 1/4A, 6A, 7A, 8A, 9A, and 12A).
(b) Future average day demand was reduced to represent an average winter day demand. Average winter day based on historical monthly production data from FY 2007/08 through FY 2009/10.
(c) Proposed "take" operations call for the City to use 2.1 mgd of groundwater, on average, to meet customer demands. For this evaluation, it was assumed that remaining water demands will be met with purchased surface water.
(d) Proposed demands from the San Francisco County Jail #5 (Source: San Francisco County Jail #5 Water Supply Project DRAFT PreDesign TM, May 31, 2011, HDR).

Based on the estimated existing winter day water demands and the proposed annual average groundwater production of 2.1 mgd, Table 8-5 indicates that groundwater can be used to meet water demands in Zones 1/4, 2 and 6. The remaining estimated winter day demands (1.31 mgd) for all other zones will be supplied either by purchased surface water or additional groundwater supply that may be available from new wells; however, for this evaluation it was assumed that the remaining water demands will be met with surface water. It should be noted that as water demands increase due to seasonal changes or from additional development within the City's water service area, less groundwater will be available outside of Zone 1/4.

For example, as system water demands increase from the proposed additional development within the City's water service area, almost no groundwater will be available for upper zones as shown in Table 8-6. By FY 2034/35, it is projected that the majority of the proposed annual average groundwater production of 2.1 mgd can be used within Zone 1/4. Again, the remaining estimated winter day demands (2.22 mgd) for all other zones were assumed to be supplied by surface water.

Data presented in Table 8-5 assumes that during existing low demand conditions, Zones 2 and 6 will be served from groundwater produced in excess of what is needed in Zone 1/4 based on the City's existing operational scheme. However, the City can supply groundwater to other upper pressure zones (instead of Zones 2 and 6) via Zone 3/5 if a new booster pump station is constructed to deliver groundwater from Zone 1/4 into Zone 3/5.

Figure 8-8 illustrates the existing system schematic showing the two possible ways to supply water into Zones 7 through 12 either through PS1 from Zone 3/5 or PS8 from Zone 6, including the potential booster pump station between Zone 1/4 and Zone 3/5. Because the SFPUC turnouts (*i.e.*, C3 and C4) in Zone 3/5 are not currently regulated, the pressures in this pressure zone are very high; this will require the new booster pump station from Zone 1/4 to have a very high total dynamic head to overcome the existing system pressures in Zone 3/5 unless the City installs regulating devices at the SFPUC turnouts. In addition, the City should also consider the following when exploring the necessity of a new Zone 1/4 and Zone 3/5 booster pump station:

1. As water demands increase due to additional growth, especially in Zone 1/4, less groundwater will be available to upper pressure zones;
2. The potential for SFPUC regional groundwater wells (located by the Golden Gate National Cemetery) to be connected into Zone 3/5; and
3. The operating costs for serving the upper pressure zones (*i.e.*, Zones 7 through 12) via PS1 from Zone 3/5 versus PS8 from Zone 6, which is hydraulically connected to Zone 1/4 through PS3, PS7, and PS5 (see Figure 8-8).

The first two bullet points presented above suggest that as existing system conditions change over time due to additional water demands in conjunction with the implementation of the Regional Project in the near future, the need for a new booster pump station to supply groundwater into Zone 3/5 may not be necessary.

To evaluate the operating costs discussed in bullet point 3, the hydraulic model, historical monthly electrical costs and production records were used to assess operational efficiencies for the City's project operations. Results from the hydraulic model for the existing water system indicate that the City's upper pressure zones can be adequately served under both operational conditions (*i.e.*, either from PS1 or PS8) under a static representative winter day water demand condition. Subsequent review of historical monthly electrical costs[5], including monthly water production with the most recent pump efficiency test data[6] indicate that the operation of PS1 to serve Zones 7 through 12 could cost less (approximately 10 percent or roughly $100/MG/year less) than the operation of PS8, which requires water to be pumped from the lower pressure zones via PS3, PS7, and PS5.

[5] Monthly historical electrical cost and water production data from 2009 was reviewed for this evaluation.

[6] Based on pump tests performed in March 2010.

Although this evaluation indicates that it is less costly to serve the upper pressure zones through PS1, this does not automatically justify the construction of a new booster pump station from Zone 1/4 to Zone 3/5 to supply groundwater into the upper zones because there are additional capital and operational costs associated with this proposed pump station that need to be considered. Preliminary capital cost estimates for the new booster pump station indicate that it will be significantly higher than the cost savings from using PS1 to serve the upper pressure zones. Therefore, based on the current understanding and evaluation of a proposed take operation under the Regional Project, it is recommended that the City utilize existing water supply facilities to maximize groundwater use in Zones 1/4, 2, and 6 during a take year.

In order to further substantiate our recommendation, additional evaluation is required on the proposed Zone 1/4 to Zone 3/5 booster pump station once the Regional Project is better defined and finalized. For example, the new pump station may not be justified from a cost stand point, but it can provide the City with redundancy in water supply facilities. The City will need to review the potential for groundwater use in Zone 3/5 and Zones 7 through 12 with the potential use of new water supply facilities as additional information from the Regional Project is available and/or as water demands change. In conclusion, the City should consider the following recommendations as they adjust water system operations to implement the Regional Project:

- Evaluating the necessity for the proposed booster pump station from Zone 1/4 to Zone 3/5 based on a review of: (1) future water demands during various conditions (*e.g.*, winter and summer); and, (2) the proposed locations of all existing and future groundwater supply sources including the potential for SFPUC regional groundwater wells to be connected into Zone 3/5;
- Improving the pump efficiencies at PS3, PS5, PS7, and PS8 to reduce operational costs;
- Reviewing the firm pumping capacity at PS5 to determine potential limitations in supply to the upper pressure zones during other water demand conditions;
- Evaluating the annualized capital and operational costs for the proposed booster pump station from Zone 1/4 to Zone 3/5, which will vary depending if the City's plans to regulate flows from the SFPUC turnouts (this cost will need to be added to the current annual operational cost of PS1 and compared with the costs of the alternative operation through PS8); and
- Updating the current hydraulic model to perform an extended period simulation[7] *(e.g.*, over a 24-hour period) to better understand the City's water system operations over time and potentially identify other operational constraints during a take operation (*e.g.*, tank turnover) that may limit the City's choice of operations.

[7] The City's hydraulic model has been currently calibrated to perform static hydraulic evaluations (see *Chapter 5 Hydraulic Model Development*). Therefore, additional calibration will be required to develop an extended period simulation.

8.5 SUMMARY OF RECOMMENDED IMPROVEMENTS FOR THE FUTURE WATER SYSTEM

The recommended water system improvements required to adequately serve future water demands are summarized below by facility type, and major facility improvements are shown on Figure 8-9. It should be noted that these recommendations only identify facility improvements at a master plan level and do not constitute a design of such improvements. Subsequent detailed design is required to determine the exact sizes and final locations of these proposed facility improvements.

This section describes the improvements identified from the pumping, storage and pressure regulating station capacity evaluations, and the hydraulic evaluations of the future water system.

8.5.1 Water Service Connections

Based on the system pressure results from peak hour demand hydraulic evaluation, it is recommended that all Zone 1/4 junctions with elevations above 155 ft msl be re-zoned into Zone 2. A potential tie-in location into Zone 2 would be at Niles Avenue and Cedar Avenue. The approximate boundary of Zone 1/4 that should be re-zoned into Zone 2 is highlighted in pink on Figure 8-9.

8.5.2 Tank and Booster Pump Station

Based on results from the storage capacity evaluation, a new storage tank with a minimum active storage capacity of 1.0 MG is recommended to eliminate the storage deficiency identified in Zone 1/4 of the future water system. This new storage tank will be preliminarily located at the south end of Cunningham Way (close to Tank 1) as shown on Figure 8-9. Because the actual dimensions of the proposed storage facility have not been determined, the storage facility size of 1.0 MG does not include dead storage or freeboard storage requirements, which would be determined during design.

Due to the lack of suitable land at appropriate elevations for a gravity feed tank in Zone 1/4, a new booster pump station will also be required at the proposed storage tank site to supply water into Zone 1/4 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 for Zone 1/4.

8.5.3 Pump Stations

A slight pumping capacity deficiency was identified in Zone 2; however, no improvements are recommended at this time since this deficiency is relatively small. It is recommended that City staff monitor the water system as water demands increase to determine if additional pumping capacity at PS5 is required.

8.5.4 Pipelines

Based on the pipeline velocity results from peak hour demand hydraulic evaluation, the following pipeline improvements are recommended as shown on Figure 8-9:

- Install approximately 2,100 linear feet of new 12-inch diameter pipelines to connect the proposed Zone 1/4 Tank into the future water system.
- Upsize approximately 800 linear feet of existing 8-inch diameter pipelines near RS25 with 12-inch diameter pipelines.
- Upsize approximately 1,700 linear feet of existing 6-inch diameter pipelines near RS2 with 12-inch diameter pipelines (this supersedes the recommendation for 8-inch diameter pipeline upsize in *Chapter 7 Evaluation of Existing Water System*).

The future system Capital Improvement Program also includes 7,000 feet of new 12-inch diameter pipeline in the Transit Corridors Plan area, as identified in the Transit Corridors Plan, to complete looping in the downtown area for planned future development. Projects identified in the plan are summarized by area:

- **San Mateo North Corridor:** 1,000 feet of new water main along San Mateo Avenue North Corridor; 1,800 feet of new water main on San Bruno Avenue Corridor, and 600 feet of new main in El Camino Real to connect to existing 12-inch water main in El Camino Real.
- **San Mateo South Corridor:** 3,600 feet of new main from San Mateo Avenue and San Bruno Avenue, south along San Mateo Avenue, to connect to the existing 12-inch water main in El Camino Real South Corridor.

8.5.5 Pressure Regulating Stations

As the City moves forward with the Regional Groundwater Storage and Recovery Project, it is recommended that City staff review and adjust pressure settings at RS20 and RS22 to potentially supply water into Zone 1/4.

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 8-1_BaseFutSys.mxd 1/19/2012

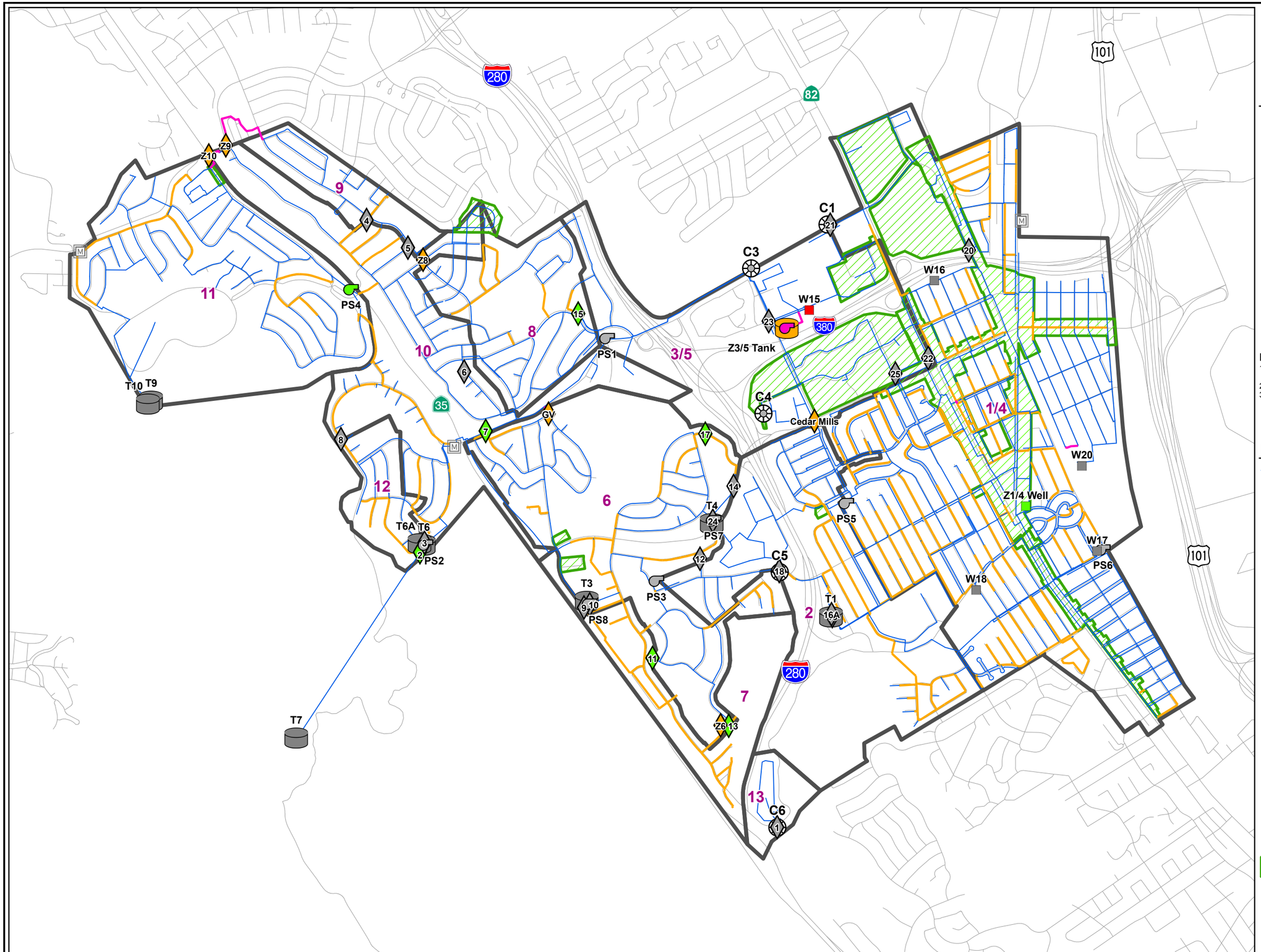

FIGURE 8-1

City of San Bruno
Water System Master Plan

BASE FUTURE SYSTEM FACILITIES

N

0 880 1,760

Scale in Feet

Notes
1. Based on improvements recommended in Chapter 7. Tank 3 was assumed to be replaced.
2. Pipelines selected for abandonment are not shown.
3. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

- Existing Pipeline
- Proposed Pipeline Upsize
- Proposed New Pipeline
- Turnout
- Existing Well
- Proposed New Well
- Well 15 (to be replaced)
- Ex. Pressure Reg. Sta. (RS)
- Proposed Pressure RS Upsize
- Proposed New Pressure RS
- Ex. Booster Pump Sta. (PS)
- Proposed Booster PS Upsize
- Proposed New Booster PS
- Existing Storage Tank
- Proposed New Storage Tank
- Emergency Connection
- Anticipated Development Area

CITY OF SAN BRUNO

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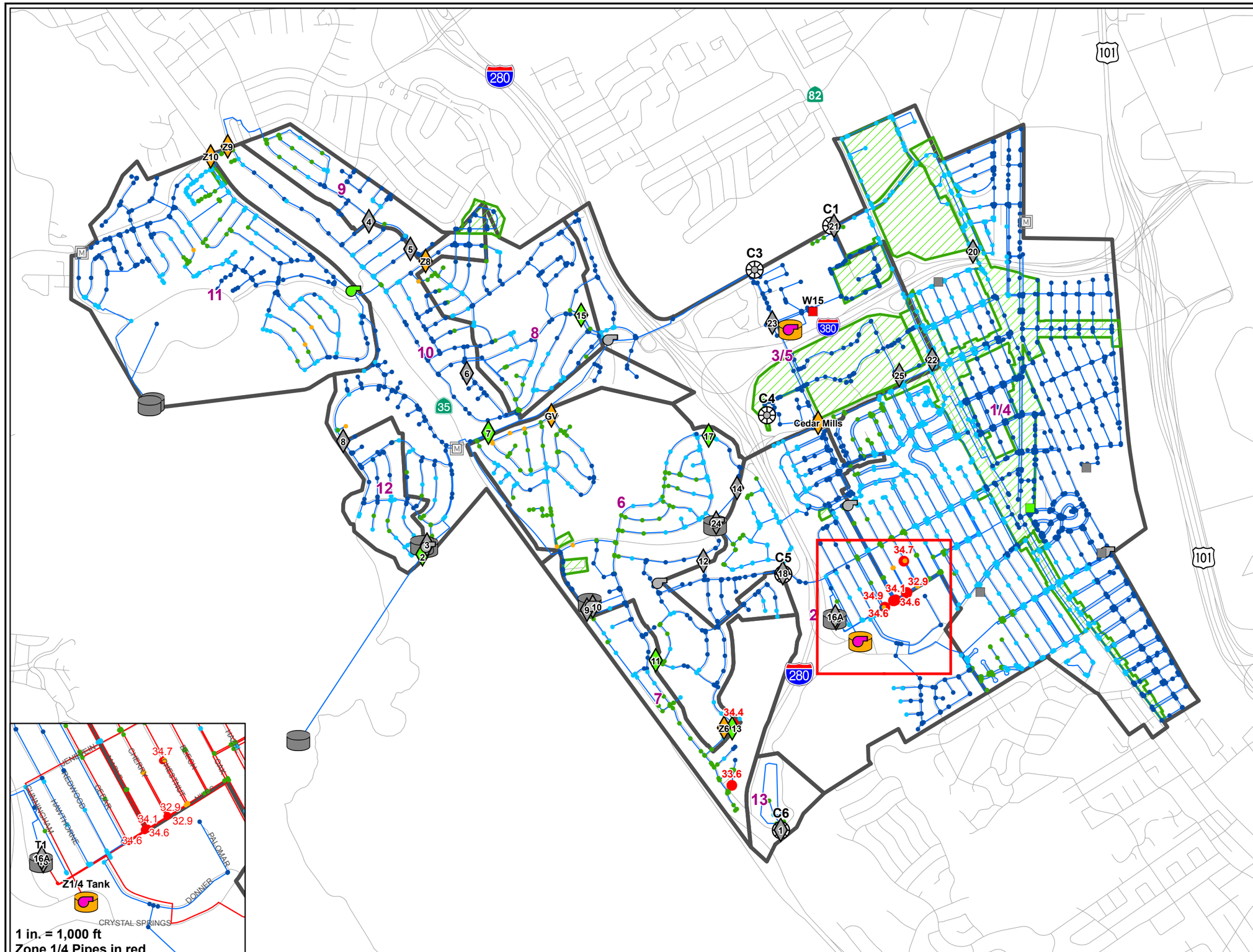

FIGURE 8-2

City of San Bruno
Water System Master Plan

PEAK HOUR PRESSURE FUTURE SYSTEM

0 880 1,760
Scale in Feet

Notes
1. Future peak hour demand = 16.64 mgd.
2. Assumes storage tanks are half full, and pump stations are operating at firm capacity.
3. Results based on a future "put" operational scheme where groundwater use will be minimized.
4. Results based on improvements recommended in Chapter 7. Tank 3 was assumed to be replaced. Also includes new 1.0 MG tank recommended in Zone 1/4.
5. Pipelines selected for abandonment are not shown.
6. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND
- Pressure < 35 psi
- 35 psi ≤ Pressure ≤ 40 psi
- 40 psi < Pressure ≤ 60 psi
- 60 psi < Pressure ≤ 80 psi
- Pressure > 80 psi
- Pipeline
- Existing Well
- Proposed New Well
- Well 15 (to be replaced)
- Ex. Pressure Reg. Sta. (RS)
- Proposed Pressure RS Upsize
- Proposed New Pressure RS
- Ex. Booster Pump Sta. (PS)
- Proposed Booster PS Upsize
- Proposed New Booster PS
- Existing Storage Tank
- Proposed New Storage Tank
- Anticipated Development Area

City of San Bruno

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 8-3_PHVelFutSys.mxd 1/19/2012

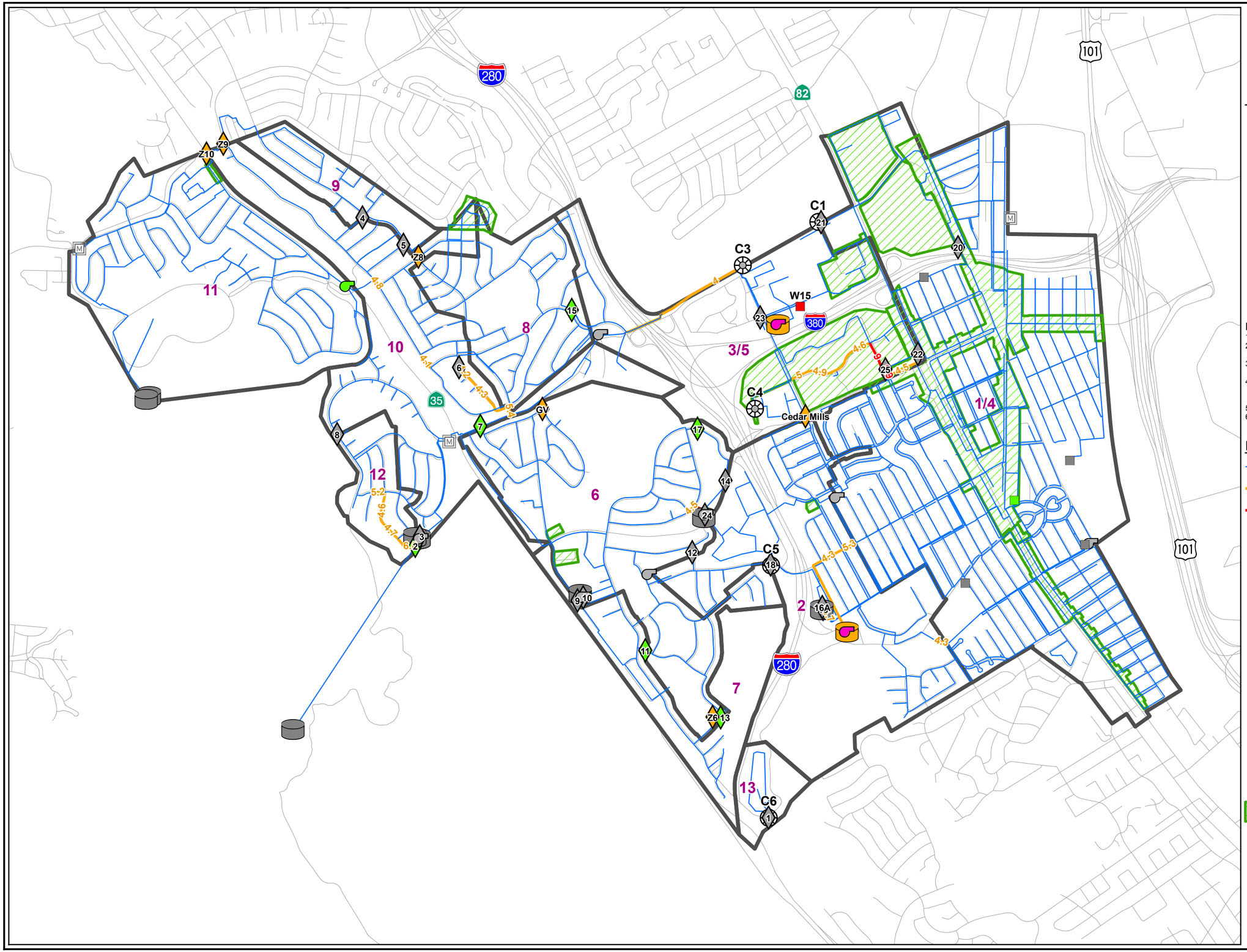

FIGURE 8-3

City of San Bruno
Water System Master Plan

PEAK HOUR PIPELINE VELOCITY - FUTURE SYSTEM

N

0 880 1,760

Scale in Feet

Notes

1. Future peak hour demand = 16.64 mgd.
2. Assumes storage tanks are half full, and pump stations are operating at firm capacity.
3. Results based on a future "put" operational scheme where groundwater use will be minimized.
4. Results based on improvements recommended in Chapter 7. Tank 3 was assumed to be replaced. Also includes new 1.0 MG tank recommended in Zone 1/4.
5. Pipelines selected for abandonment are not shown.
6. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

- Velocity ≤ 4 ft/s
- 4 ft/s < Velocity ≤ 7 ft/s
- Velocity > 7 ft/s
- Existing Well
- Proposed New Well
- Well 15 (to be replaced)
- Ex. Pressure Reg. Sta. (RS)
- Proposed Pressure RS Upsize
- Proposed New Pressure RS
- Ex. Booster Pump Sta. (PS)
- Proposed Booster PS Upsize
- Proposed New Booster PS
- Existing Storage Tank
- Proposed New Storage Tank
- Anticipated Development Area

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 8-4_FutFFReq.mxd 1/19/2012

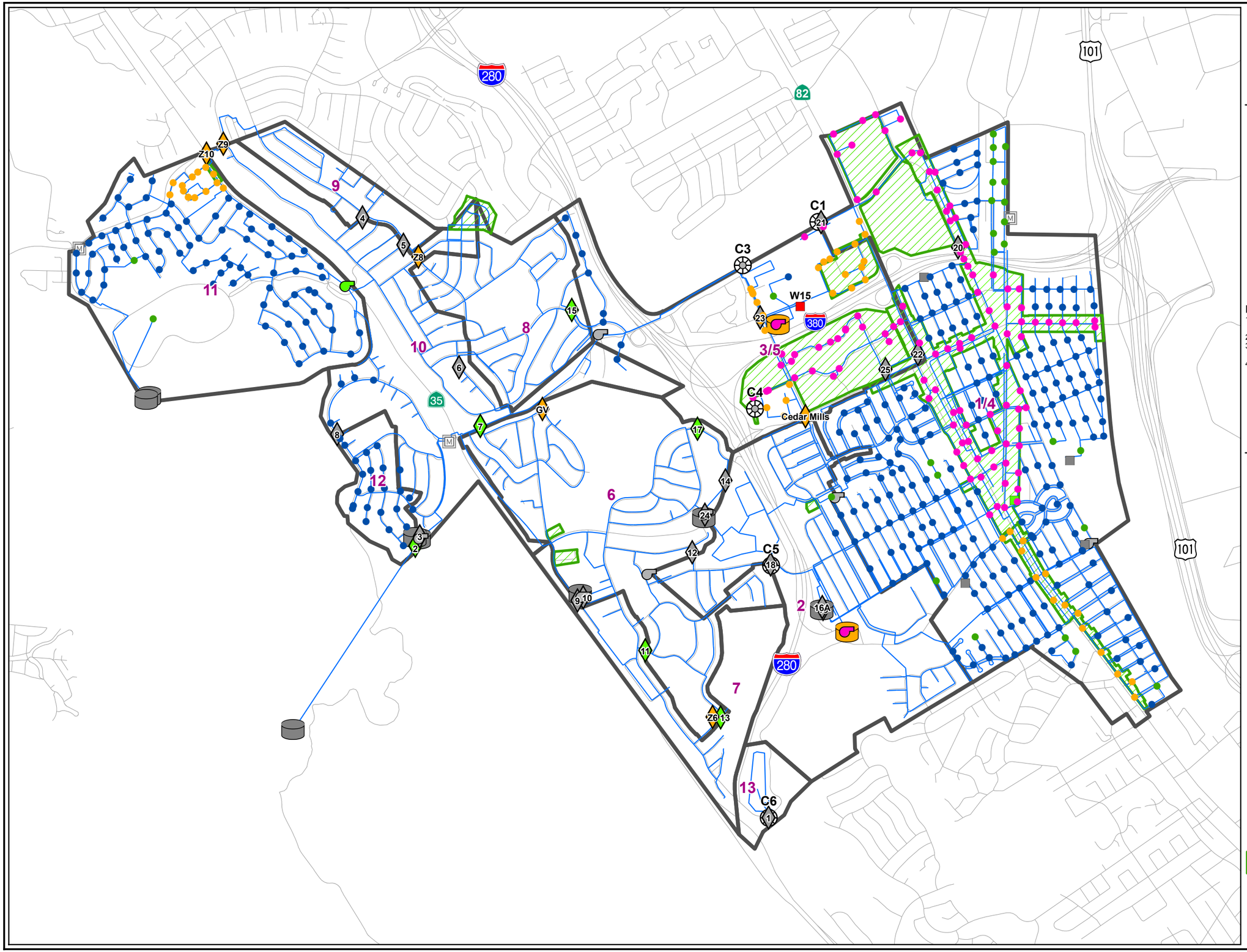

FIGURE 8-4

City of San Bruno
Water System Master Plan

RECOMMENDED FUTURE SYSTEM FIRE FLOW REQUIREMENTS

N

0 880 1,760

Scale in Feet

Notes

1. Fire flow requirements were only evaluated in pressure zones with significant changes in demands.
2. Pipelines selected for abandonment are not shown.
3. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.
4. Summary of land uses associated with each fire flow demand:
   - 1,500 gpm - Low Density Residential
   - 2,000 gpm - Medium Density Residential, Industrial, Public/Quasi-Public, School
   - 2,500 gpm - High Density Residential, Visitor Services, Multi-Use Residential Focus, Neighborhood Commercial, General Commercial
   - 3,000 gpm - Central Business District, Regional Commercial, Regional Office, Transit-Oriented Development

LEGEND

Fire Flow Requirement

- 1,500 gpm
- 2,000 gpm
- 2,500 gpm
- 3,000 gpm
- Pipeline
- Existing Well
- Proposed New Well
- Well 15 (to be replaced)
- Ex. Pressure Reg. Sta. (RS)
- Proposed Pressure RS Upsize
- Proposed New Pressure RS
- Ex. Booster Pump Sta. (PS)
- Proposed Booster PS Upsize
- Proposed New Booster PS
- Existing Storage Tank
- Proposed New Storage Tank
- Anticipated Development Area

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 8-5_FFAvailFutSys.mxd 1/19/2012

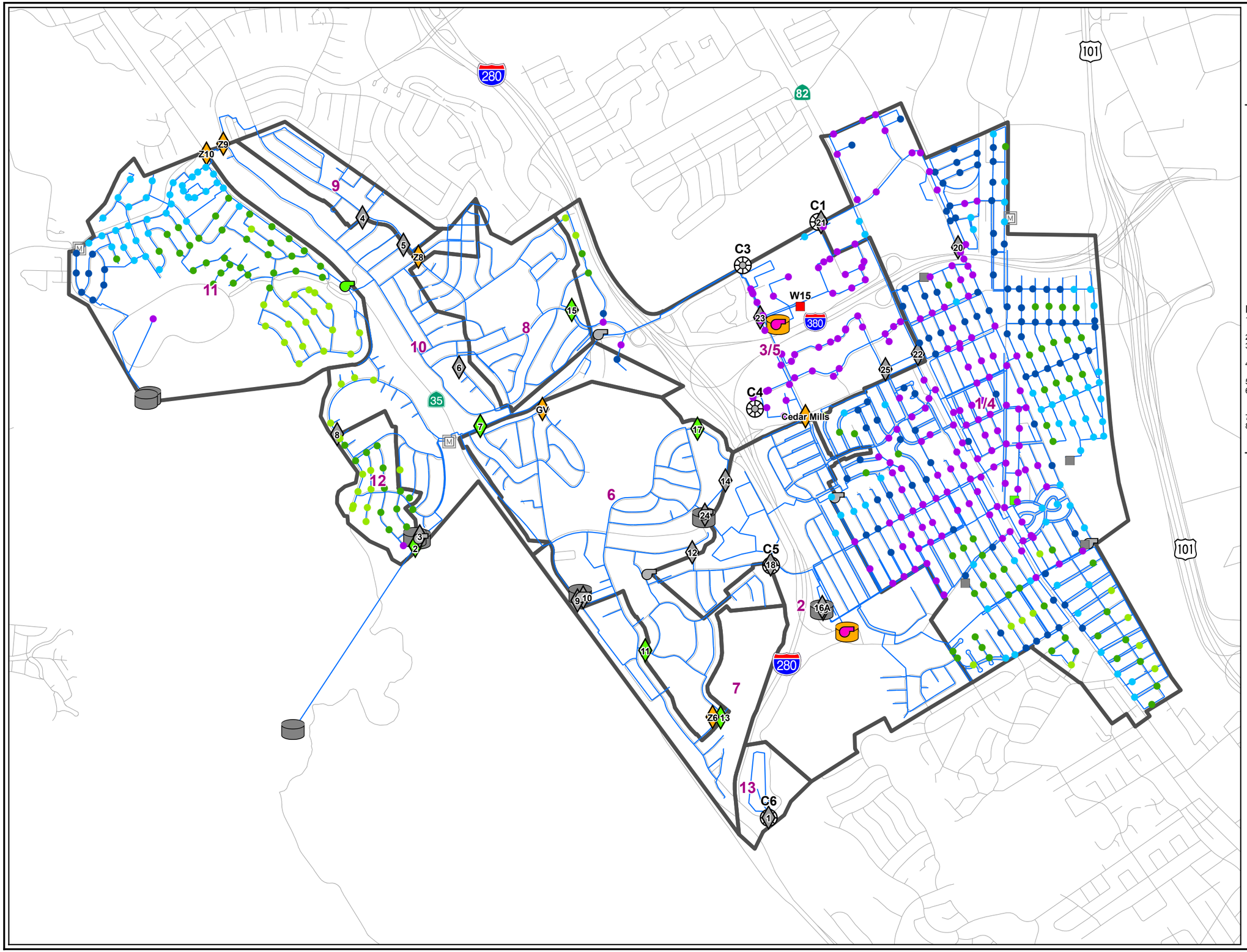

FIGURE 8-5

City of San Bruno
Water System Master Plan

AVAILABLE FIRE FLOW - FUTURE MAXIMUM DAY DEMAND CONDITION

N

0 880 1,760

Scale in Feet

Notes

1. Fire flow requirements were only evaluated in pressure zones with significant changes in demands.
2. Future maximum day demand = 8.10 mgd.
3. Assumes storage tanks are half full, and pump stations are operating at firm capacity.
4. Results based on NO pipeline velocity constraint, but a minimum residual pressure of 20 psi was required.
5. Results based on a future "put" operational scheme.
6. Results based on improvements recommended in Chapter 7. Tank 3 was assumed to be replaced. Also includes new 1.0 MG tank recommended in Zone 1/4.
7. Pipelines selected for abandonment are not shown.
8. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

Available Fire Flow

- 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
- Pipeline
- Existing Well
- Proposed New Well
- Well 15 (to be replaced)
- Ex. Pressure Reg. Sta. (RS)
- Proposed Pressure RS Upsize
- Proposed New Pressure RS
- Ex. Booster Pump Sta. (PS)
- Proposed Booster PS Upsize
- Proposed New Booster PS
- Existing Storage Tank
- Proposed New Storage Tank

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 8-6_FFCompFutSys.mxd 1/19/2012

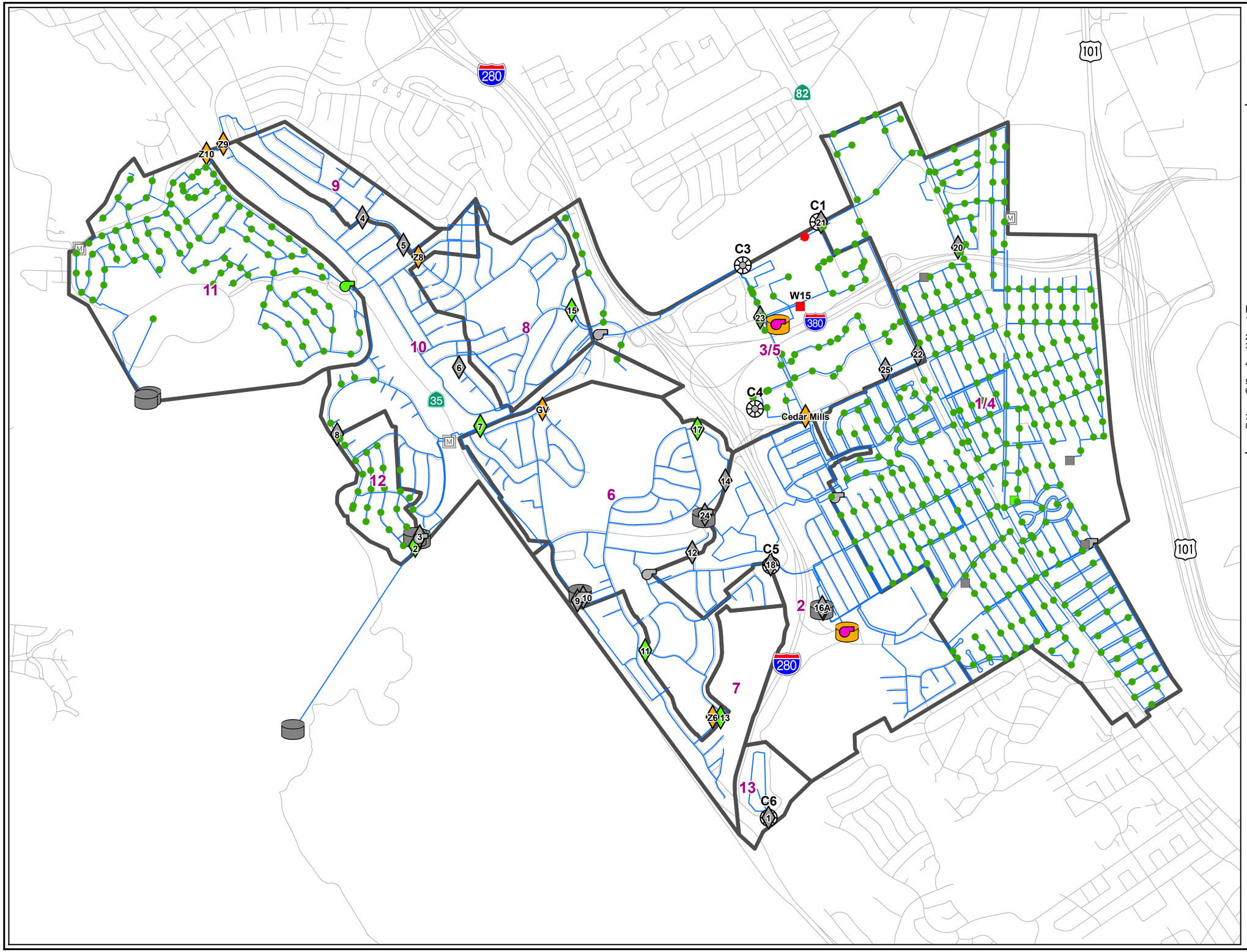

FIGURE 8-6

City of San Bruno
Water System Master Plan

COMPARISON OF AVAILABLE FIRE FLOW w/ REQUIRED FIRE FLOW

N

0 880 1,760

Scale in Feet

Notes

1. Fire flow requirements were only evaluated in pressure zones with significant changes in demands.
2. Future maximum day demand = 8.10 mgd.
3. Assumes storage tanks are half full, and pump stations are operating at firm capacity.
4. Results based on NO pipeline velocity constraint, but a minimum residual pressure of 20 psi was required.
5. Results based on a future "put" operational scheme.
6. Results based on improvements recommended in Chapter 7. Tank 3 was assumed to be replaced. Also includes new 1.0 MG tank recommended in Zone 1/4.
7. Pipelines selected for abandonment are not shown.
8. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

Fire Flow Status

- Failing
- Passing
- Pipeline
- Existing Well
- Proposed New Well
- Well 15 (to be replaced)
- Ex. Pressure Reg. Sta. (RS)
- Proposed Pressure RS Upsize
- Proposed New Pressure RS
- Ex. Booster Pump Sta. (PS)
- Proposed Booster PS Upsize
- Proposed New Booster PS
- Existing Storage Tank
- Proposed New Storage Tank

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W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 8-7_PotentialWellSites.mxd 11/4/2011

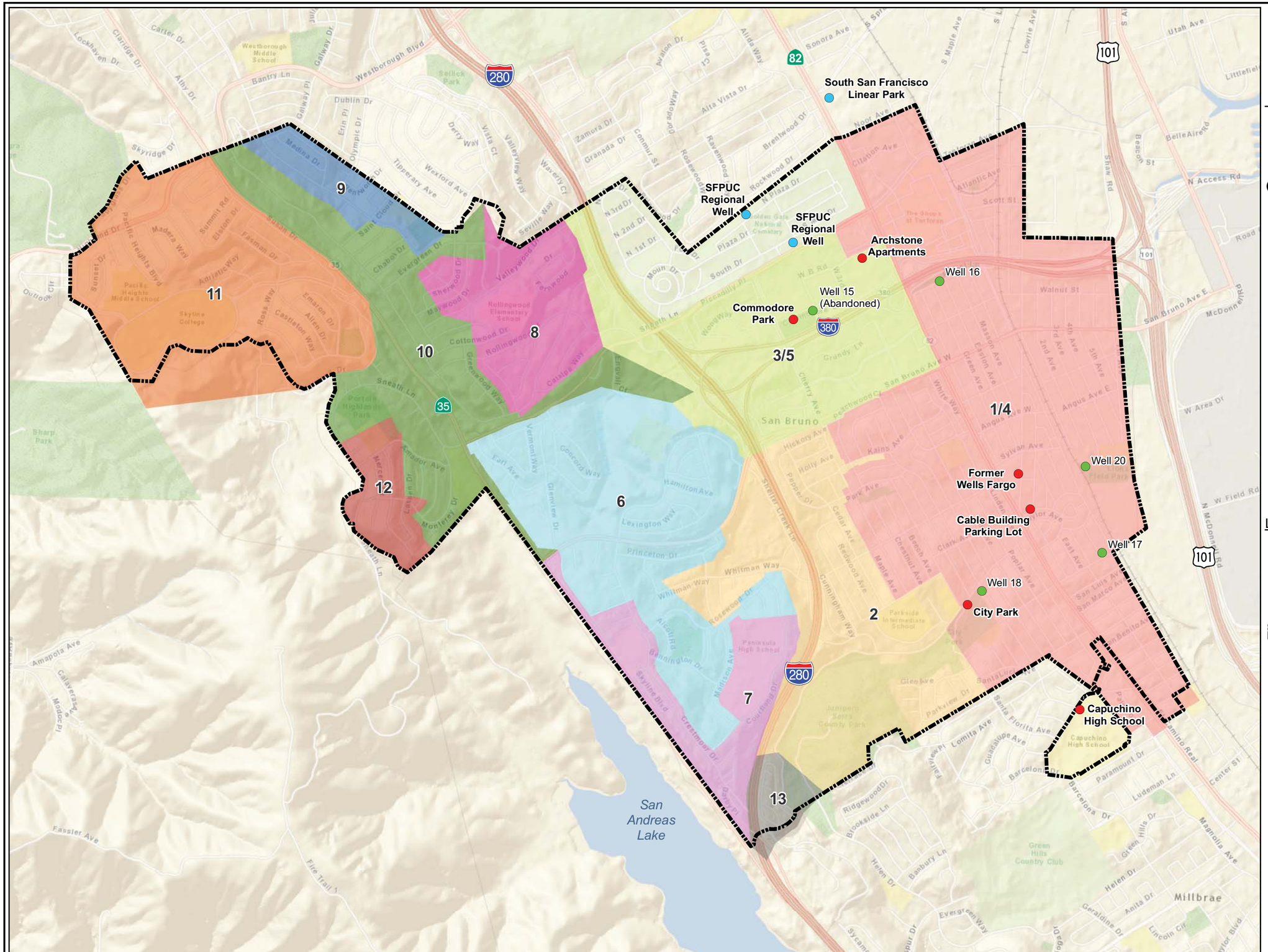

FIGURE 8-7

City of San Bruno Water System Master Plan

LOCATION OF EXISTING AND POTENTIAL WELL SITES FOR REGIONAL GROUNDWATER STORAGE AND RECOERY PROJECT

N

0 880 1,760

Scale in Feet

LEGEND

- Existing Production Wells
- Potential SFPUC Well Sites
- Potential Well 15 Replacement Sites
- City Limits

Pressure Zone

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

City of San Bruno

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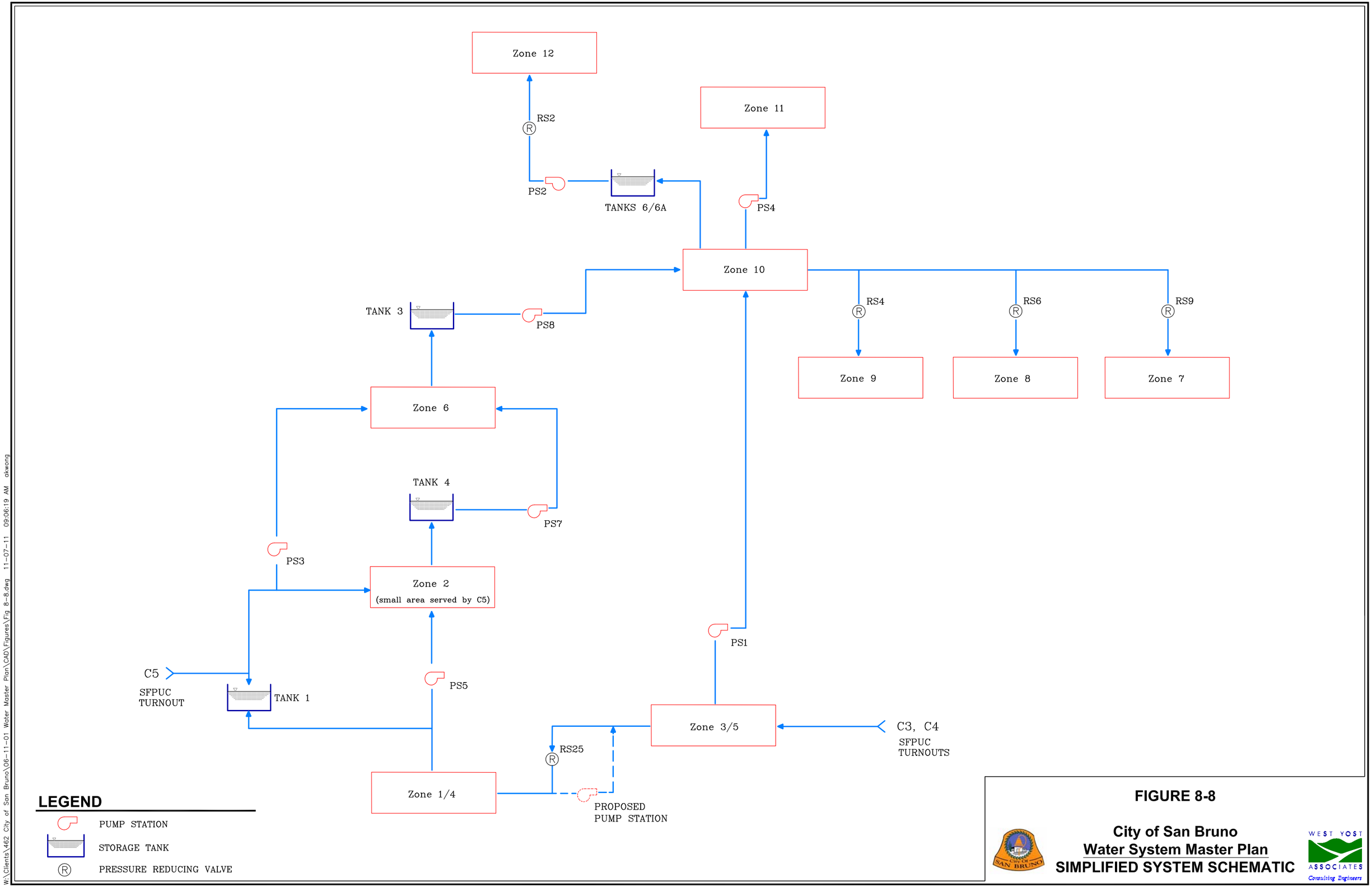

FIGURE 8-8

City of San Bruno
Water System Master Plan
SIMPLIFIED SYSTEM SCHEMATIC

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Consulting Engineers

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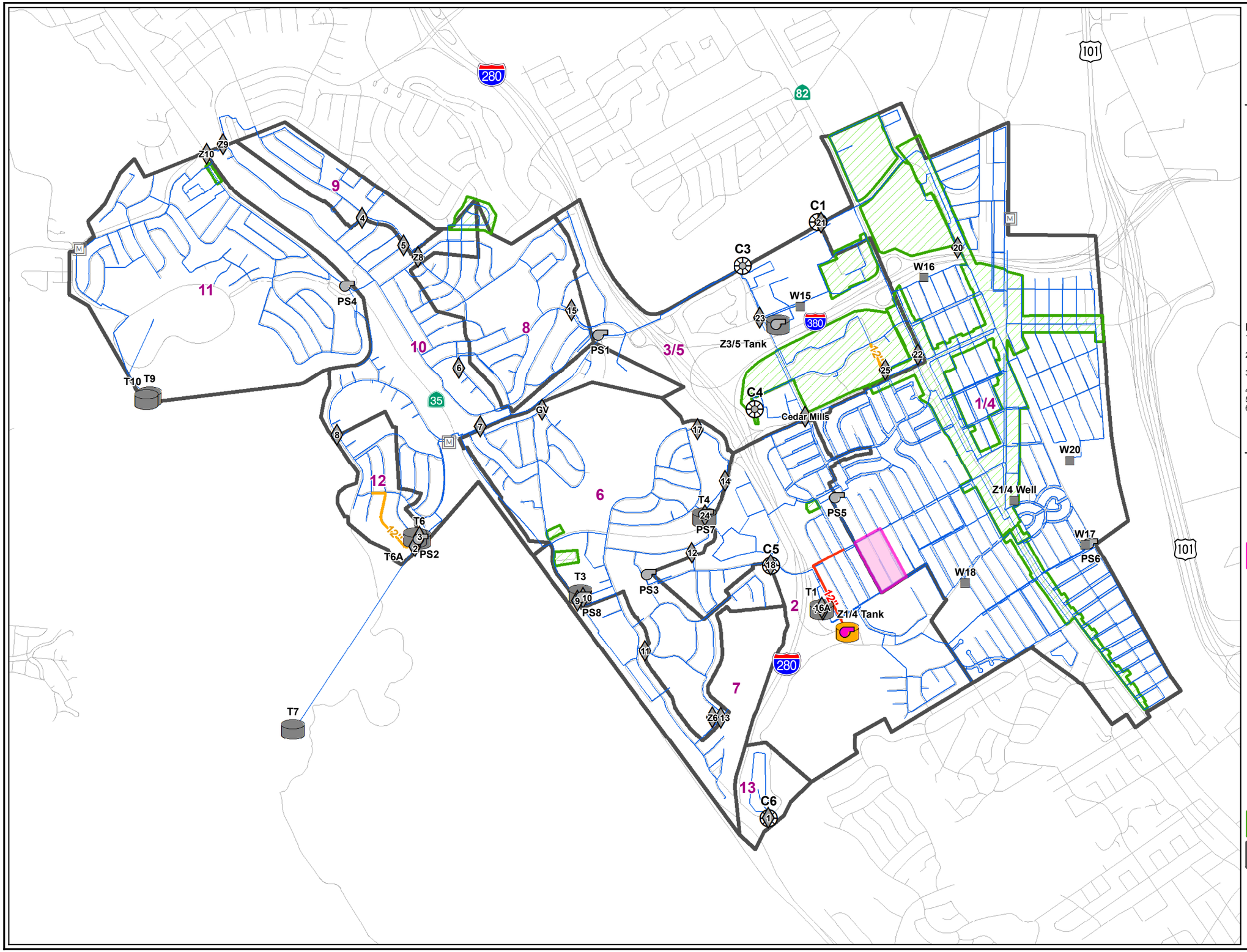

FIGURE 8-9

City of San Bruno
Water System Master Plan

RECOMMENDED WATER SYSTEM IMPROVEMENTS FUTURE SYSTEM

N

0 880 1,760

Scale in Feet

Notes

1. Future system improvements based on storage capacity evaluation and peak hour demand evaluation.
2. Peak hour demand evaluation assumes storage tanks are half full, and pump stations are operating at firm capacity.
3. Peak hour demand evaluation based on a future "put" operational scheme where groundwater use will be minimized.
4. Tank 3 was assumed to be replaced.
5. Pipelines selected for abandonment are not shown.
6. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown.

LEGEND

- Future System Pipeline Upsize
- Future System New Pipeline
- Pipeline
- Proposed Area for Rezoning
- Turnout
- Well
- Pressure Regulating Station
- Booster Pump Station (PS)
- Future System Booster PS
- Storage Tank
- Future System Storage Tank
- Emergency Connection
- Anticipated Development Area
- Pressure Zone Boundary

CITY OF SAN BRUNO

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9.1 OVERVIEW

This chapter presents the recommended capital improvement program (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 construction costs. The chapter also provides a prioritized implementation schedule for the capital improvement projects.

Probable construction 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 December 2011 dollars based on an Engineering News Record (ENR) Construction Cost Index (CCI) of 10205 (San Francisco Average). Construction costs were developed based on bids on 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 services during design and construction are 25 percent of the base construction costs plus the design and construction contingency, as listed below.

- Design and Construction Contingency: 30 percent
- Other Services: 25 percent of base construction costs plus Design and Construction Contingency:

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

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 do not include costs for annual operation and maintenance. A complete description of the assumptions used in the development of the estimated probable construction costs is provided in Appendix B.

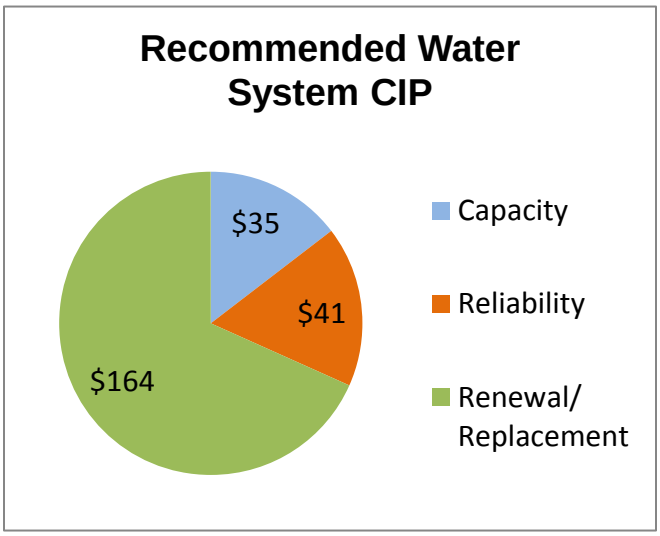
The following sections of this chapter describe the components of the potable water system capital improvement program developed for this Water System Master Plan:

- Recommended Water System Capital Improvement Program
  - Existing System Capital Improvement Program
  - Future System Capital Improvement Program
- Capital Improvement Program Implementation

9.2 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 for three program areas:

- Capacity Improvements
- Reliability Improvements
- Rehabilitation and Replacement Improvements



These programs total $240M, as shown on the chart to the right, and are summarized in Tables 9-1 through 9-3 and Figures 9-1 (Capacity Improvements), Figure 9-2 (Reliability Improvements) and Figure 9-3 (Rehabilitation and Replacement Improvements). The Existing System Capital Improvement Program does not take into account any new development, but only serves to improve the City's existing system. The Future System Capital Improvement Program, on the other hand, recommends improvements to meet the demands and requirements of the future system which includes planned development. These improvements are shown on Table 9-1 and Figure 9-1. In developing improvements to meet future system demands, improvements identified for the existing system were assumed to be in place. Depending on the timing of existing system improvements and new development, developers may need to incorporate improvements designated for the existing system to meet future system needs.

Preliminary capital cost estimates for the recommended existing and future water system improvements are presented in Tables 9-1 through 9-3. The total cost of water system improvements to support the City's existing and future water demands is estimated to be approximately $229.3 million (M) and $11.0M, respectively, amounting to a total of $240.3M. Of the total capital program, $35.4M addresses capacity needs, $41.1M addresses system and seismic reliability needs and $163.8M addresses rehabilitation and replacement needs.

In some instances, funds have already been encumbered by the City. Tables 9-1 through 9-3 show total estimated capital costs for project implementation, and then separately identify already encumbered funds. The $240.3M total for the CIP is a net cost, obtained by subtracting already encumbered funds from total capital costs.

9.3 CAPITAL IMPROVEMENT PROGRAM IMPLEMENTATION

Table 9-4 presents a recommended implementation schedule for capital improvements, showing capital expenditures in three groups: 2012 through 2016, 2017 through 2021, and long-term. Capital costs shown in the table include capital costs presented in Tables 9-1 through 9-3. For projects with partial funds already allocated, the net dollar amounts (total capital cost minus allocated funds) are shown in Table 9-4.

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 approximately to be implemented in the 2012 through 2016 time-frame include a mix of projects totaling $30.4M that address capacity needs ($3.0M), operational and seismic reliability needs ($9.6M) and rehabilitation and replacement needs ($17.8M). This combination of projects will address the City's most significant deficiencies and its highest priority needs.

Projects approximately to be implemented in the 2017 through 2021 timeframe include additional projects totaling $53.9M, and include capacity improvement projects ($15.6M), operational and seismic improvements ($29.5M) and rehabilitation and replacement projects ($8.8M).

Longer-term programs total approximately $153M and focus primarily on rehabilitation and replacement needs ($137M), with another $14M in capacity improvement projects, and 2M in operational and seismic reliability projects. 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.

The Capital Improvement Program also includes $11.0M in future system improvements, identified above in the long-term timeframe. Two projects in this category are a new 1.0 MG storage tank in Z1/4, including associated booster pumping station and piping, and a pipeline improvement in Z3/5 to reinforce the supply transmission from the SFPUC system to Z1/4. These projects will be needed to address future system growth and maintain adequate system pressure and fire flows in Z1/4 upon implementation of the Regional Groundwater Storage and Recovery Project for the South Westside Groundwater Basin, as described in Chapter 8. Specific timing and sequencing of these projects will need to be reviewed based on growth and as part of the City's participation in the Regional Groundwater Storage and Recovery Project.

The future system CIP also includes 7,000 feet of new 12-inch diameter pipeline in the Transit Corridors Plan area, as identified in the Transit Corridors Plan, to complete looping in the downtown area for planned future development. The Transit Corridors Plan also identified the need for replacement of existing mains in the plan area. A provisional estimate of 19,000 feet of

pipelines was estimated in the plan. The Water System Master Plan identifies approximately 21,000 feet of existing mains that need to be replaced in the Transit Corridors Area. These projects are included in the Pipeline Reliability Improvements Program and the Pipeline Rehabilitation and Replacement Program. Project descriptions for the projects in each program designate areas that fall within the Transit Corridors Plan area. Projects have a total capital cost of $6.1M, of which $3.8M is included in the Pipeline Reliability Improvements Program and $2.3M is included in the Pipeline Rehabilitation and Replacement Program.

Table 9-1. Recommended Capacity Capital Improvement Projects[a]

CIP ID	Improvement Type	Reason for Improvement	Improvement Description	Zone	Estimated Construction Cost	Capital Cost (includes mark-ups)[b,c]
Pressure Regulating Station Capacity Improvements						
EXCIP-RS-1	RS Upgrade	Fire Flow	Upgrade existing RS 2 in Z12 with a 4-inch and an 8-inch valve.	12	270,000	439,000
EXCIP-RS-2	RS Upgrade	Fire Flow	Upgrade existing RS 15 with 2-inch and 6-inch valves for fire flow into Z8A.	8A	270,000	439,000
	Upsize Pipeline		Upsize 710' of pipeline to 8" by RS15.	8A	128,160	208,000
EXCIP-RS-3	RS Upgrade	Fire Flow	Upgrade existing RS 13 with 2-inch and 6-inch valves for fire flow into Z7A.	7A	270,000	439,000
EXCIP-RS-4	RS Upgrade	Fire Flow	Upgrade RS 17 with 2-inch and 6-inch valves.	6	270,000	439,000
EXCIP-RS-5[d]	RS Upgrade	Fire Flow	Upgrade RS 7 with 4-inch and 8-inch valves.	6	270,000	439,000
	Upsize Pipeline		Upsize 480' of pipelines to 8" by RS 7.	6	86,760	141,000
EXCIP-RS-6	New RS	Fire Flow	Rebuild and reactivate RS 11 for fire flow service from Z7 to Z6.	6	270,000	439,000
EXCIP-RS-7[d]	New RS	Fire Flow	Install new RS at Claremont Drive and Plymouth Way to serve the Crestmoor area of Z6 with fire flow.	6	270,000	439,000
EXCIP-RS-8	New RS	Fire Flow	Install new RS at Susan Drive and Sharp Park Road to provide fire flow service from Z11 to Z10.	10	270,000	439,000
	New Pipeline		Install 540' of new 8" pipeline from Z11 to Z10.	10	96,840	157,000
EXCIP-RS-9	New RS	Fire Flow	Install new RS at Westborough Boulevard and Fleetwood Drive to provide fire flow service from Z10 to Z9.	9	270,000	439,000
	New Pipeline		Install 1,680' of new 8" pipeline between Z9 and Z10.	9	303,120	493,000
EXCIP-RS-10	New RS	Fire Flow	Install new RS at Oakmont Drive and Evergreen Drive to provide fire flow service from Z10 to Z8.	8	270,000	439,000
EXCIP-RS-11	New RS	Fire Flow	Install new RS at Piedmont Avenue and Madison Avenue to provide fire flow service from Z7 to Z6.	6	270,000	439,000
EXCIP-CITY-12	RS Upgrade	Capacity	Construct Cedar Mills Regulating Station; design has been completed and project is ready for construction; funds have already been encumbered	2	0	0
					SUBTOTAL	5,828,000
Well, Storage, and Pumping Capacity Improvements						
EXCIP-W-1	New Well	Supply Capacity	New well in Z1/4; location to be determined	1/4	1,540,000	2,500,000
EXCIP-T-1	New Storage Tank	Storage Capacity	Proposed new 1.4 MG storage tank in Z3/5.	3/5	3,041,000	4,942,000
	New Pump Station		New booster pump station in Z3/5 with firm capacity of 4.3 mgd.	3/5	1,708,000	2,776,000
	New Pipeline		540' of proposed new 12" pipeline in Z3/5.	3/5	130,080	211,000
EXCIP-PS-1	New Pump	Pumping Capacity	New booster pump at PS4 to increase flow capacity; to be implemented as part of Project EXCIP-CITY-4.	11	50,000	82,000
	New Pipeline		Upsize 450' of pipeline to 12" by PS4.	10	106,800	173,550
EXCIP-CITY-3	New Pump Station	Capacity / Reliability	Hydropneumatic pump station to supply NCCWD-supplied area directly from the City's system to eliminate surcharges to customers for NCCWD water	13	---	1,455,000
					SUBTOTAL	12,139,550
Miscellaneous Capacity Improvements						
EXCIP-MISC-1	Re-zoning	Pressure Deficiency	Rezone a portion of Z1/4 to Z2	1/4	192,600	313,000
EXCIP-CITY-1	SCADA Radio	Reliability	Radio transmission for the SCADA system to improve reliability	Multiple	---	130,000
EXCIP-CITY-2	Groundwater Study	Capacity / Reliability	Groundwater Sustainability Study - Identify potential locations and production capacity for a new well for redundancy and groundwater reliability	Multiple	---	110,000
EXCIP-CITY-5	Turnout Improvement	Capacity / Reliability	SFPUC Turnout Improvements Project - Install four vaults and associated pressure regulating facilities on four of five SFPUC turnouts, which are currently unregulated; vaults to include backflow prevention	Multiple	---	468,000
EXCIP-CITY-13	Meter Infrastructure Upgrade	Reliability	Advanced Water Meter Infrastructure Project that will enable City to remotely read the City's 12,200 water meters by installing two radio towers, a number of signal repeaters, and a regional network interface for data storage	Multiple	---	2,970,000
EXCIP-CITY-14	Standby Generation	Reliability	Standby Generation Project - Provide backup power at well and booster pump stations that currently do not have standby generation or engine-driven pumping facilities to provide for backup during emergencies (Wells 16 and 18, Pump Stations 1, 2, 3 and 4), as well as one new portable diesel engine-driven pump	Multiple	---	2,344,000
EXCIP-CITY-21	Security Improvement	Reliability	Security improvements at water system tanks, pump stations and wells; possible facilities improvements include security cameras, improved fencing, lighting improvements and more secure facility locks	Multiple	---	100,000
					SUBTOTAL	6,435,000
Future System Improvements						
FUTCIP-T-1	New Tank	Supply Capacity (Regional Project)	Proposed 1.0 MG new storage tank in Z1/4	1/4	2,700,000	4,388,000
	New Pump Station		New booster pump station in Z1/4 with firm capacity of 4.3 mgd	1/4	1,708,000	2,776,000
	New Pipeline		Connect proposed Z1/4 Tank into the future water system with 2,090' of 12" pipeline	1/4	501,360	815,000
FUTCIP-P-1	Upsize Pipeline	Peak Hour Capacity (Regional Project)	Upsize 800' of existing 8" diameter pipeline near RS 25 to 12" diameter pipeline	1/4	192,000	312,000
FUTCIP-P-2	New Pipeline	Future Development	Construct 7,000' of new 12-inch diameter pipeline to provide looping in the Transit Corridors Area, as identified in the Transit Corridors Plan.	1/4	1,660,000	2,700,000
					SUBTOTAL	10,991,000
					CAPACITY CAPITAL IMPROVEMENT PROJECTS TOTAL	**35,393,550**

[a] Costs shown are based on the December 2011 SF ENR CCI of 10205.

[b] Costs include mark-ups equal to 62.5 percent (Design and Construction Contingency: 30 percent of construction cost; Professional Services: 25 percent of construction cost plus design and construction contingencies).

[c] Total rounded to nearest $1,000.

[d] Project previously identified as part of Crestmoor evaluation and is currently under design.

Table 9-2. Recommended Reliability Capital Improvement Projects[a]

CIP ID	Improvement Item	eason for Improvement	Improvement Description	Zone	Construction Cost	Capital Cost (includes mark-ups)[c,d]	Funds Already Encumbered	Adjusted CIP Cost
Pipeline Reliability Improvements Priority 1[d]								
EXCIP-P1-1	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 6,480' of pipeline to 8" in Z1/4 at Cedar, Maple, Cherry, Chestnut, Beech, Oak, Hazel, and Acacia, all north of Jenvein; Chestnut between Kains and Park; Williams west of Cypress.	1/4	1,166,040	1,895,000		1,895,000
EXCIP-P1-2	Upsize Pipeline	Fire Flow	Upsize 5,730' of pipeline in Z2 to 8" on Donner at Niles, between Donner and Glen, Parkview, Glen, and Santa Lucia west of Parkview.	2	1,031,220	1,676,000		1,676,000
			Upsize 3,040' of pipeline in Z2 to 10" near Pepper and Cedar, Hawthorne at Redwood, Redwood from Hawthorne to Niles.	2	638,190	1,037,000		1,037,000
EXCIP-P1-3	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 6,240' of pipelines to 8" in Z1/4 on Sylvan east of San Mateo, Huntington from Sylvan to north of San Felipe, Milton south of Sylvan, San Anselmo at Mastick, Florida at Milton, Texas, Terrace, Cupid, Georgia at Milton, San Anselmo and San Felipe, and East at Chapman. Approximately 300 feet within Transit Corridors Plan Area on Sylvan, east of San Mateo, short segment on San Anselmo.	1/4	1,122,660	1,824,000		1,824,000
	New Pipeline		Install 250' of new 12" pipeline in Z1/4 between the south ends of 1st St and 2nd St, north of Well 20.	1/4	59,760	97,000		97,000
EXCIP-P1-4	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 7,850' of pipeline in Z1/4 to 8" on Linden from Kains to north of San Felipe, Angus, Acacia at Angus, El Camino Real and Alley, Poplar south of Crystal Springs, Elm at Crystal Springs, and Acacia at Crystal Springs. Approximately 3,900 feet within Transit Corridors Plan Area along Linden between Kains and Crystal Springs, short segment on Angus	1/4	1,413,000	2,296,000		2,296,000
EXCIP-P1-5	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 9,030' of pipeline in Z1/4 to 8" at Cypress, Acacia, Elm, Poplar, and Linden, all south of San Felipe; Santa Lucia from Balboa to El Camino Real; Linden from Santa Lucia to Elamita; Lomita at Linden; Elamita.	1/4	1,625,040	2,641,000		2,641,000
EXCIP-P1-6	Upsize Pipeline	Fire Flow	Upsize 7,710' of pipeline in Z7 to 8" at Alpine, El Dorado, Crestmoor from El Dorado to Bryant; Kent, Ridgeway, Yorkshire, Rosewood, Bennington, Cambridge, Bryant, London, and Oxford, all at Crestmoor; Piedmont at Madison, and south end of Darby.	7	1,386,900	2,254,000		2,254,000
			Upsize 800' of pipelines in Z7 to 10" at Piedmont from Crestmoor to RS 13 by Madison.	7	168,420	274,000		274,000
			Upsize 2,660' of pipeline in Z7 to 12" on Glenview from RS 9 to Ridgeway, Skyline from Ridgeway to Bryant, Bryant from Skyline to Crestmoor.	7	637,920	1,037,000		1,037,000
			Upsize 2,260' of pipeline in Z7 to 14" at Crestmoor from Bryant to Darby, and on Darby.	7	588,380	956,000		956,000
EXCIP-P1-7	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 8,980' of pipeline to 8" in Z1/4 on El Camino Real, Hensley, Green, and Masson, all north of Kains; El Camino Real, Hensley, Green, Masson, all north of Angus; Kains from El Camino Real to San Mateo; San Mateo from Kains to Angus; Angus from El Camino Real to San Mateo. Approximately 6,400 feet within Transit Corridors Plan Area on El Camino, Hensely, Kains, Sylvan, Huntington, Angus, San Mateo.	1/4	1,616,760	2,627,000		2,627,000
	New Pipeline		60' of proposed new 8" pipeline in Z1/4 on El Camino Real at Kains.	1/4	9,900	16,000		16,000
EXCIP-P1-8	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 8,990' of pipeline to 8" in Z1/4 on Huntington, Tanforan west of Herman, Pacific, Atlantic, E Huntington north of Scott, Herman from Tanforan to Buena Vista, Buena Vista and Diamond, Montgomery from Scott to Walnut, Hermosa, Walnut at Montgomery, San Mateo, Hermosa, and San Mateo from Scott to north of Atlantic. Approximately 300 feet within Transit Corridors Plan Area on Walnut, west of San Mateo, Montgomery, between I-380, Huntington between Scott and Bayshore, Tanforan to Huntington continuing to Bayshore.	1/4	1,617,300	2,628,000		2,628,000
				SUBTOTAL	13,081,490	21,258,000		21,258,000
Pipeline Reliability Improvements Priority 2[f]								
EXCIP-P2-Z1/4	Upsize Pipeline	Fire Flow	Upsize 7,310' of pipeline to 8" in Z1/4.	1/4	1,314,900	2,137,000		2,137,000
			Upsize 1,480' of pipeline to 10" in Z1/4.	1/4	310,380	504,000		504,000
EXCIP-P2-Z2	Upsize Pipeline	Fire Flow	Upsize 4,150' of pipeline to 8" in Z2.	2	747,540	1,215,000		1,215,000
			Upsize 420' of pipeline to 12" in Z2.	2	101,040	164,000		164,000
EXCIP-P2-Z6	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 8,740' of pipeline to 8" in Z6.	6	1,573,920	2,558,000		2,558,000
			Upsize 1,300' of pipeline to 10" in Z6.	6	273,630	445,000		445,000
EXCIP-P2-Z8	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 3,900' of pipeline to 8" in Z8.	8	702,180	1,141,000		1,141,000
EXCIP-P2-Z9	Upsize Pipeline	Fire Flow / Rehabilitation and Replacement	Upsize 660' of pipeline to 8" in Z9.	9	118,260	192,000		192,000
EXCIP-P2-Z10	Upsize Pipeline	Fire Flow	Upsize 7,140' of pipeline to 8" in Z10.	10	1,285,020	2,088,000		2,088,000
			Upsize 1,820' of pipeline to 10" in Z10.	10	382,830	622,000		622,000
EXCIP-P2-Z11	Upsize Pipeline	Fire Flow	Upsize 1,800' of pipeline to 8" in Z11.	11	323,100	525,000		525,000
			Upsize 2,790' of pipeline to 10" in Z11.	11	586,110	952,000		952,000
			Upsize 2,990' of pipeline to 12" in Z11.	11	716,640	1,165,000		1,165,000
EXCIP-P2-Z12	Upsize Pipeline	Fire Flow	Upsize 3,500' of pipeline to 8" in Z12.	12	630,000	1,024,000		1,024,000
EXCIP-JL[g]	Upsize Pipeline	Fire Flow	Upsize 1,700' of pipeline to 12" in Z12.	12	0	0		0
				SUBTOTAL	9,065,550	14,732,000		14,732,000
Seismic Reliability Improvements								
EXCIP-CITY-6	Tank Modifications/ Seismic Retrofit Program	Seismic Improvement	Evaluate and improve the ability of the City's existing storage tanks to withstand earthquakes and provide for ongoing maintenance and rehabilitation of tanks to maintain their condition; $965,000 has already been encumbered			4,011,000	965,000	3,046,000
EXCIP-CITY-15	Seismic Vulnerability Assessment	Seismic Improvement	Update the City's 2003 Seismic Vulnerability Assessment, based on current code requirements, which would include more comprehensive hazard review and updates to critical pipeline, tank and structural analyses based on the updated hazard assessment, as recommended in the 2003 Assessment			100,000	0	100,000
EXCIP-CITY-20	Pipeline Seismic Improvement Project	Seismic Improvement	Seismic upgrades to water lines in vicinity of or crossing fault lines along San Bruno Avenue and Sneath Lane; 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; a budget placeholder is provided in this master plan. Costs to be developed in more detail in Seismic Vulnerability Assessment, EXCIP-CITY-15			2,000,000	0	2,000,000
				SUBTOTAL		6,111,000	965,000	5,146,000
				Reliability Improvement Program Total		**42,101,000**	**965,000**	**41,136,000**

[a] Costs shown are based on the December 2011 SF ENR CCI of 10205.

[b] "Rehabilitation and Replacement" is included as a Reason for Improvement for Pipeline Capacity Improvements Priority 1 projects that overlap with Rehabilitation and Replacement Improvements Priority 1 projects, and for Pipeline Capacity Improvements Priority 2 projects that overlap with Rehabilitation and Replacement Improvements Priority 2 projects.

[c] Costs include mark-ups equal to 62.5 percent (Design and Construction Contingency: 30 percent of construction cost; Professional Services: 25 percent of construction cost plus design and construction contingency).

[d] Total rounded to nearest $1,000.

[e] Pipeline projects with P1 identifiers are Priority 1 (highest priority) projects. These projects are listed in order of priority, so that areas that are most deficient receive highest priority.

[f] Pipeline projects with P2 identifiers are Priority 2 (lower priority) projects. Each program lists the total pipeline length by pressure zone. Specific projects and sequencing to be determined by the City. Pipelines within these projects that overlapped with Rehabilitation and Replacement Pipeline Priority 1 projects have been excluded.

[g] Existing system fire flow improvement requires upsize to 8" diameter pipeline, if Jail Line Project does not proceed. If the Jail Line Project does proceed, future system peak hour capacity requires upsize to 12" diameter pipeline, which is estimated to be $770,000 after a 62.5 percent mark-up, and is to be funded by SFPUC.

Table 9-3. Recommended Rehabilitation and Replacement Capital Improvement Projects[a]

CIP ID	Improvement Type	Improvement Description	Zone	Estimated Construction Cost	Capital Cost (includes mark-ups)[b,c]	Funds Already Encumbered	Adjusted CIP Cost
Pipeline Rehabilitation and Replacement Improvements Priority 1[d]							
RR-P1-1	Replace / Upsize Pipeline	Replace 5,030' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-3. Approximately 600 feet within Transit Corridors Plan Area.	1/4	904,500	1,470,000	0	1,470,000
RR-P1-2	Replace / Upsize Pipeline	Replace 6,760' of small diameter pipeline with 8" pipeline. Approximately 2,900 feet within Transit Corridors Plan Area.	1/4	1,216,800	1,977,000	0	1,977,000
RR-P1-3	Replace / Upsize Pipeline	Replace 14,380' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-4	1/4	2,588,400	4,206,000	0	4,206,000
RR-P1-4	Replace / Upsize Pipeline	Replace 2,660' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-8. Approximately 500 feet within Transit Corridors Plan Area.	1/4	479,160	779,000	0	779,000
RR-P1-5	Replace / Upsize Pipeline	Replace 4,475' of small diameter pipeline with 8" pipeline	1/4	805,500	1,309,000	0	1,309,000
RR-P1-6	Replace / Upsize Pipeline	Replace 3,290' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-1 and part of EXCIP-P1-4	1/4	591,660	961,000	0	961,000
RR-P1-7	Replace / Upsize Pipeline	Replace 6,800' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-5 and part of EXCIP-P1-4	1/4	1,224,000	1,989,000	0	1,989,000
RR-P1-8	Replace / Upsize Pipeline	Replace 4,800' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-7. Approximately 3,600 feet within Transit Corridors Plan Area.	1/4	866,340	1,408,000	0	1,408,000
RR-P1-9	Replace / Upsize Pipeline	Replace 7,900' of small diameter pipeline with 8" pipeline	1/4	1,424,880	2,315,000	0	2,315,000
				SUBTOTAL	16,414,000	0	16,414,000
Pipeline Rehabilitation and Replacement Improvements Priority 2[e]							
RR-P2	Replace / Upsize Pipeline	Replace 15,460' of small diameter pipeline with 8" pipeline	Multiple	2,782,980	4,522,000	0	4,522,000
				SUBTOTAL	4,522,000	0	4,522,000
Pipeline Rehabilitation and Replacement Improvements Priority 3[f]							
RR-P3	Replace Pipeline	Replace 240,860' of 6" and 8" pipeline with new 8" pipeline	Multiple	43,354,080	70,450,000	0	70,450,000
	Replace Pipeline	Replace 32,810' of 10" pipeline with new 10" pipeline	Multiple	6,890,940	11,198,000	0	11,198,000
	Replace Pipeline	Replace 35,150' of 12" pipeline with new 12" pipeline	Multiple	8,436,480	13,709,000	0	13,709,000
	Replace Pipeline	Replace 11,150' of 14" pipeline with new 14" pipeline	Multiple	2,899,000	4,711,000	0	4,711,000
	Replace Pipeline	Replace 110' of 16" pipeline with new 16" pipeline	Multiple	29,700	48,000	0	48,000
				SUBTOTAL	100,116,000	0	100,116,000
Well, Storage, Pumping, and Pressure Regulating Station Rehabilitation and Replacement Improvements							
EXCIP-CITY-10	Replace Well	Abandon and replace existing Well 15, which is out of service; total cost is $3.2M, of which $0.2M has already been encumbered	3/5	---	3,200,000	200,000	3,000,000
EXCIP-CITY-11	Rehabilitate Wells	Well Rehabilitation program that 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 five years, with replacement as needed	Multiple	---	3,300,000	0	3,300,000
EXCIP-CITY-7	Replace Tank	Replace Tank 3, which is in poor structural condition to maintain system reliability and restore tank's full capacity; total cost is $2.5M, of which $1.3M has already been encumbered	6	---	2,500,000	1,300,000	1,200,000
RR-T-2	Rehabilitate Tanks	Tank Re-coating program to re-coat interior and exterior of above-grade steel tanks (T1, T4, T6, T6A, T7, T9, and T10); budgeting assumes two future re-coating projects within Master Plan timeframe	Multiple	---	800,000	0	800,000
RR-T-3	Replace Tanks	Tank replacement program to replace tanks that have reached the end of their useful lives; budgeting includes replacement of three tanks (T4, T6 and T7) within Master Plan timeframe	Multiple	---	7,049,000	0	7,049,000
EXCIP-CITY-22	Rehabilitate Pump Stations	Improve and rehabilitate the City's pump stations to maintain pump station condition and performance	Multiple	---	14,000,000	0	14,000,000
EXCIP-CITY-4	Upgrade Pump Station 4	PS4 College rehabilitation including replacement or upgrade of existing pumps, motors and controls that are reaching the end of their useful life to maintain reliability for Z11; this project to incorporate Project EXCIP-PS-1; total project is $3.7M, of which $2.0M has already been encumbered	11	---	3,700,000	2,000,000	1,700,000
EXCIP-CITY-18	Rehabilitate Pressure Regulating Stations	Improve and rehabilitate the City's pressure reducing stations to maintain pressure reducing station performance	Multiple	---	1,000,000	0	1,000,000
				SUBTOTAL	35,549,000	3,500,000	32,049,000
Miscellaneous Rehabilitation and Replacement Improvements							
EXCIP-CITY-9	Update CMMS	Update the Computerized Maintenance Management System (CMMS) with geographical information from the City's GIS, and provide unique identification numbers for facilities in the CMMS	Multiple	---	95,000	0	95,000
EXCIP-CITY-16	Upgrade Meter	Retrofit existing customer meters with cathodic protection in corrosive soils areas; $1 million is assumed for budgeting purposes, as more detailed analysis would be required for specific locations and costs	Multiple	---	1,000,000	0	1,000,000
EXCIP-CITY-17	Upgrade Meter	Replace existing water meters with Sensus Mag meter technology	Multiple	---	7,287,000	0	7,287,000
EXCIP-CITY-8	Repair Pipeline	Spot repairs for the Spyglass neighborhood and on Merion Drive	Multiple	---	500,000	0	500,000
EXCIP-CITY-19	Replace Pipeline	Replace or slip-line the existing 14-inch pipeline from Station 2 to Tank 7 - the existing pipeline is in poor condition; cost reflects pipeline replacement cost for conservative estimate	12	---	1,743,000	0	1,743,000
				SUBTOTAL	10,625,000	0	10,625,000
				REHABILITATION AND REPLACEMENT CAPITAL IMPROVEMENT PROJECTS TOTAL	**167,226,000**	**3,500,000**	**163,726,000**

[a] Costs shown are based on the December 2011 SF ENR CCI of 10205.

[b] Costs include mark-ups equal to 62.5 percent (Design and Construction Contingency: 30 percent of construction cost; Professional Services: 25 percent of construction cost plus design and construction contingencies).

[c] Total rounded to nearest $1,000.

[d] Pipeline projects with P1 identifiers are Priority 1 (highest priority) projects. These projects are listed in order of priority, so that areas with the poorest leak history and oldest pipelines receive highest priority. Only pipelines 4-inch and less in diameter are included, excluding parallel pipelines. Pipelines within these projects that overlapped with Capacity Pipeline Improvement Priority 1 projects have been excluded.

[e] Pipeline Improvements Priority 2 is one step lower in prioirty. This project is comprised of the rest of the pipelines 4-inch and less in diameter throughout the entire system, excluding parallel pipelines, that were not included in capacity pipeline improvement projects.

[f] Pipeline Improvements Priority 3 (lowest priority) is comprised of the rest of the pipelines throughout the entire system, excluding parallel pipelines, that were not included in Priority 1 or 2, or in any capacity pipeline improvement projects.

Table 9-4. Recommended Implementation Schedule for Capital Improvement Program[a]

CIP ID	Improvement Type	Improvement Description	Capital Cost (includes mark-ups)[b,c,d]	2012-2016	2017-2021	Long-Term
Capacity Capital Improvement Projects						
Pressure Regulating Station Capacity Improvements						
EXCIP-RS-1	RS Upgrade	Upgrade existing RS 2 in Z12 with a 4-inch and an 8-inch valve.	439,000		439,000	
EXCIP-RS-2	RS Upgrade	Upgrade existing RS 15 with 2-inch and 6-inch valves for fire flow into Z8A.	439,000		439,000	
	Upsize Pipeline	Upsize 710' of pipeline to 8" by RS15.	208,000		208,000	
EXCIP-RS-3	RS Upgrade	Upgrade existing RS 13 with 2-inch and 6-inch valves for fire flow into Z7A.	439,000		439,000	
EXCIP-RS-4	RS Upgrade	Upgrade RS 17 with 2-inch and 6-inch valves.	439,000		439,000	
EXCIP-RS-5[h]	RS Upgrade	Upgrade RS 7 with 4-inch and 8-inch valves.	439,000		439,000	
	Upsize Pipeline	Upsize 480' of pipelines to 8" by RS 7.	141,000		141,000	
EXCIP-RS-6	New RS	Rebuild and reactivate RS 11 for fire flow service from Z7 to Z6.	439,000		439,000	
EXCIP-RS-7[h]	New RS	Install new RS at Claremont Drive and Plymouth Way to serve the Crestmoor area of Z6 with fire flow.	439,000		439,000	
EXCIP-RS-8	New RS	Install new RS at Susan Drive and Sharp Park Road to provide fire flow service from Z11 to Z10.	439,000		439,000	
	New Pipeline	Install 540' of new 8" pipeline from Z11 to Z10.	157,000		157,000	
EXCIP-RS-9	New RS	Install new RS at Westborough Boulevard and Fleetwood Drive to provide fire flow service from Z10 to Z9.	439,000		439,000	
	New Pipeline	Install 1,680' of new 8" pipeline between Z9 and Z10.	493,000		493,000	
EXCIP-RS-10	New RS	Install new RS at Oakmont Drive and Evergreen Drive to provide fire flow service from Z10 to Z8.	439,000		439,000	
EXCIP-RS-11	New RS	Install new RS at Piedmont Avenue and Madison Avenue to provide fire flow service from Z7 to Z6.	439,000		439,000	
EXCIP-CITY-12	RS Upgrade	Construct Cedar Mills Regulating Station; design has been completed and project is ready for construction; funds have already been encumbered	0		0	
		SUBTOTAL	5,828,000	0	5,828,000	0
Well, Storage, and Pumping Capacity Improvements						
EXCIP-W-1	New Well	New well in Z1/4; location to be determined	2,500,000	2,500,000		
EXCIP-T-1	New Storage Tank	Proposed new 1.4 MG storage tank in Z3/5.	4,942,000			4,942,000
	New Pump Station	New booster pump station in Z3/5 with firm capacity of 4.3 mgd.	2,776,000		2,776,000	
	New Pipeline	540' of proposed new 12" pipeline in Z3/5.	211,000			211,000
EXCIP-PS-1	New Pump	New booster pump at PS4 to increase flow capacity; to be implemented as part of Project EXCIP-CITY-4.	82,000		82,000	
	New Pipeline	Upsize 450' of pipeline to 12" by PS4.	173,550		173,550	
EXCIP-CITY-3	New Pump Station	Hydropneumatic pump station to supply NCCWD-supplied area directly from the City's system to eliminate surcharges to customers for NCCWD water	1,455,000		1,455,000	
		SUBTOTAL	12,140,000	2,500,000	4,487,000	5,153,000
Miscellaneous Capacity Improvements						
EXCIP-MISC-1	Re-zoning	Rezone a portion of Z1/4 to Z2	313,000			313,000
EXCIP-CITY-1	SCADA Radio	Radio transmission for the SCADA system to improve reliability	130,000			130,000
EXCIP-CITY-2	Groundwater Study	Groundwater Sustainability Study - Identify potential locations and production capacity for a new well for redundancy and groundwater reliability	110,000			110,000
EXCIP-CITY-5	Turnout Improvement	SFPUC Turnout Improvements Project - Install four vaults and associated pressure regulating facilities on four of five SFPUC turnouts, which are currently unregulated; vaults to include backflow	468,000	468,000		
EXCIP-CITY-13	Meter Infrastructure Upgrade	Advanced Water Meter Infrastructure Project that will enable City to remotely read the City's 12,200 water meters by installing two radio towers, a number of signal repeaters, and a regional network interface for data storage	2,970,000		2,970,000	
EXCIP-CITY-14	Standby Generation	Standby Generation Project - Provide backup power at well and booster pump stations that currently do not have standby generation or engine-driven pumping facilities to provide for backup during emergencies (Wells 16 and 18, Pump Stations 1, 2, 3 and 4), as well as one new portable diesel engine-driven pump	2,344,000		2,344,000	
EXCIP-CITY-21	Security Improvement	Security improvements at water system tanks, pump stations and wells; possible facilities improvements include security cameras, improved fencing, lighting improvements and more secure facility	100,000			100,000
		SUBTOTAL	6,435,000	468,000	5,314,000	653,000
Future System Capacity Improvements						
FUTCIP-T-1	New Tank	Proposed 1.0 MG new storage tank in Z1/4	4,388,000			4,388,000
	New Booster Pump Station	New booster pump station in Z1/4 with firm capacity of 4.3 mgd	2,776,000			2,776,000
	New Pipeline	Connect proposed Z1/4 Tank into the future water system with 2,090' of 12" pipeline	815,000			815,000
FUTCIP-P-1	Upsize Pipeline	Upsize 800' of existing 8" diameter pipeline near RS 25 to 12" diameter pipeline	312,000			312,000
FUTCIP-P-2	New Pipeline	Construct 7,000' of new 12-inch diameter pipeline to provide looping in the Transit Corridors Area, as identified in the Transit Corridors Plan.	2,700,000			2,700,000
		SUBTOTAL	10,991,000	0	0	10,991,000
		CAPACITY CAPITAL IMPROVEMENT PROJECTS TOTAL	**35,394,000**	**2,968,000**	**15,629,000**	**16,797,000**
Reliability Capital Improvement Program						
Pipeline Reliability Improvements Priority 1[e]						
EXCIP-P1-1	Upsize Pipeline	Upsize 6,480' of pipeline to 8" in Z1/4 at Cedar, Maple, Cherry, Chestnut, Beech, Oak, Hazel, and Acacia, all north of Jenvein; Chestnut between Kains and Park; Williams west of Cypress.	1,895,000	1,895,000		
EXCIP-P1-2	Upsize Pipeline	Upsize 5,730' of pipeline in Z2 to 8" on Donner at Niles, between Donner and Glen, Parkview, Glen, and Santa Lucia west of Parkview.	1,676,000	1,676,000		
	Upsize Pipeline	Upsize 3,040' of pipeline in Z2 to 10" near Pepper and Cedar, Hawthorne at Redwood, Redwood from Hawthorne to Niles.	1,037,000	1,037,000		
EXCIP-P1-3	Upsize Pipeline	Upsize 6,240' of pipelines to 8" in Z1/4 on Sylvan east of San Mateo, Huntington from Sylvan to north of San Felipe, Milton south of Sylvan, San Anselmo at Mastick, Florida at Milton, Texas, Terrace, Cupid, Georgia at Milton, San Anselmo and San Felipe, and East at Chapman. Approximately 300 feet within Transit Corridors Plan Area on Sylvan, east of San Mateo, short segment on San Anselmo.	1,824,000	1,824,000		
	New Pipeline	Install 250' of new 12" pipeline in Z1/4 between the south ends of 1st St and 2nd St, north of Well 20.	97,000	97,000		
EXCIP-P1-4	Upsize Pipeline	Upsize 7,850' of pipeline in Z1/4 to 8" on Linden from Kains to north of San Felipe, Angus, Acacia at Angus, El Camino Real and Alley, Poplar south of Crystal Springs, Elm at Crystal Springs, and Acacia at Crystal Springs. Approximately 3,900 feet within Transit Corridors Plan Area along Linden between Kains and Crystal Springs, short segment on Angus.	2,296,000		2,296,000	
EXCIP-P1-5	Upsize Pipeline	Upsize 9,030' of pipeline in Z1/4 to 8" at Cypress, Acacia, Elm, Poplar, and Linden, all south of San Felipe; Santa Lucia from Balboa to El Camino Real; Linden from Santa Lucia to Elamita; Lomita at Linden; Elamita.	2,641,000		2,641,000	
EXCIP-P1-6	Upsize Pipeline	Upsize 7,710' of pipeline in Z7 to 8" at Alpine, El Dorado, Crestmoor from El Dorado to Bryant; Kent, Ridgeway, Yorkshire, Rosewood, Bennington, Cambridge, Bryant, London, and Oxford, all at Crestmoor; Piedmont at Madison, and south end of Darby.	2,254,000		2,254,000	
	Upsize Pipeline	Upsize 800' of pipelines in Z7 to 10" at Piedmont from Crestmoor to RS 13 by Madison.	274,000		274,000	
	Upsize Pipeline	Upsize 2,660' of pipeline in Z7 to 12" on Glenview from RS 9 to Ridgeway, Skyline from Ridgeway to Bryant, Bryant from Skyline to Crestmoor.	1,037,000		1,037,000	
	Upsize Pipeline	Upsize 2,260' of pipeline in Z7 to 14" at Crestmoor from Bryant to Darby, and on Darby.	956,000		956,000	
EXCIP-P1-7	Upsize Pipeline	Upsize 8,980' of pipeline to 8" in Z1/4 on El Camino Real, Hensley, Green, and Masson, all north of Kains; El Camino Real, Hensley, Green, Masson, all north of Angus; Kains from El Camino Real to San Mateo; San Mateo from Kains to Angus; Angus from El Camino Real to San Mateo. Approximately 6,400 feet within Transit Corridors Plan Area on El Camino, Hensely, Kains, Sylvan, Huntington, Angus, San Mateo.	2,627,000		2,627,000	
	New Pipeline	60' of proposed new 8" pipeline in Z1/4 on El Camino Real at Kains.	16,000		16,000	
EXCIP-P1-8	Upsize Pipeline	Upsize 8,990' of pipeline to 8" in Z1/4 on Huntington, Tanforan west of Herman, Pacific, Atlantic, E Huntington north of Scott, Herman from Tanforan to Buena Vista, Buena Vista and Diamond, Montgomery from Scott to Walnut, Hermosa, Walnut at Montgomery, San Mateo, Hermosa, and San Mateo from Scott to north of Atlantic. Approximately 300 feet within Transit Corridors Plan Area on Walnut, west of San Mateo, Montgomery, between I-380, Huntington between Scott and Bayshore, Tanforan to Huntington continuing to Bayshore.	2,628,000		2,628,000	
		SUBTOTAL	21,258,000	6,529,000	14,729,000	
Pipeline Reliability Improvements Priority 2[f]						
EXCIP-P2-Z1/4	Upsize Pipeline	Upsize 7,310' of pipeline to 8" in Z1/4.	2,137,000		2,137,000	
	Upsize Pipeline	Upsize 1,480' of pipeline to 10" in Z1/4.	504,000		504,000	
EXCIP-P2-Z2	Upsize Pipeline	Upsize 4,150' of pipeline to 8" in Z2.	1,215,000		1,215,000	
	Upsize Pipeline	Upsize 420' of pipeline to 12" in Z2.	164,000		164,000	
EXCIP-P2-Z6	Upsize Pipeline	Upsize 8,740' of pipeline to 8" in Z6.	2,558,000		2,558,000	
	Upsize Pipeline	Upsize 1,300' of pipeline to 10" in Z6.	445,000		445,000	
EXCIP-P2-Z8	Upsize Pipeline	Upsize 3,900' of pipeline to 8" in Z8.	1,141,000		1,141,000	
EXCIP-P2-Z9	Upsize Pipeline	Upsize 660' of pipeline to 8" in Z9.	192,000		192,000	
EXCIP-P2-Z10	Upsize Pipeline	Upsize 7,140' of pipeline to 8" in Z10.	2,088,000		2,088,000	
	Upsize Pipeline	Upsize 1,820' of pipeline to 10" in Z10.	622,000		622,000	
EXCIP-P2-Z11	Upsize Pipeline	Upsize 1,800' of pipeline to 8" in Z11.	525,000		525,000	
	Upsize Pipeline	Upsize 2,790' of pipeline to 10" in Z11.	952,000		952,000	
	Upsize Pipeline	Upsize 2,990' of pipeline to 12" in Z11.	1,165,000		1,165,000	
EXCIP-P2-Z12	Upsize Pipeline	Upsize 3,500' of pipeline to 8" in Z12.	1,024,000		1,024,000	
EXCIP-JL[g]	Upsize Pipeline	Upsize 1,700' of pipeline to 12" in Z12.	0		0	
		SUBTOTAL	14,732,000	0	14,732,000	0

Table 9-4. Recommended Implementation Schedule for Capital Improvement Program[a]

CIP ID	Improvement Type	Improvement Description	Capital Cost (includes mark-ups)[b,c,d]	2012-2016	2017-2021	Long-Term
Seismic Reliability Improvements						
EXCIP-CITY-6	Tank Modifications/Seismic Retrofit Program	Evaluate and improve the ability of the City's existing storage tanks to withstand earthquakes and provide for ongoing maintenance and rehabilitation of tanks to maintain their condition; $965,000 has already been encumbered	3,046,000	3,046,000		
EXCIP-CITY-15	Seismic Assessment	Update the City's 2003 Seismic Vulnerability Assessment, based on current code requirements, which would include more comprehensive hazard review and updates to critical pipeline, tank and structural analyses based on the updated hazard assessment, as recommended in the 2003 Assessment	100,000			100,000
EXCIP-CITY-20	Seismic Pipeline Improvements	Seismic upgrades to water lines in vicinity of or crossing fault lines along San Bruno Avenue and Sneath Lane; 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; a budget placeholder is provided in this master plan. Costs to be developed in more detail in Seismic Vulnerability Assessment, EXCIP-CITY-15	2,000,000			2,000,000
		SUBTOTAL	5,146,000	3,046,000	0	2,100,000
		OPERATIONAL AND SEISMIC RELIABILITY CAPITAL IMPROVEMENT PROJECTS TOTAL	**41,136,000**	**9,575,000**	**29,461,000**	**2,100,000**
Rehabilitation and Replacement Capital Improvement Projects						
Pipeline Rehabilitation and Replacement Improvements Priority 1[i]						
RR-P1-1	Upsize Pipeline	Replace 5,030' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-3. Approximately 600 feet within Transit Corridors Plan Area.	1,470,000	1,470,000		
RR-P1-2	Upsize Pipeline	Replace 6,760' of small diameter pipeline with 8" pipeline. Approximately 2,900 feet within Transit Corridors Plan Area.	1,977,000	1,977,000		
RR-P1-3	Upsize Pipeline	Replace 14,380' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-4	4,206,000	2,206,000	2,000,000	
RR-P1-4	Upsize Pipeline	Replace 2,660' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-8. Approximately 500 feet within Transit Corridors Plan Area.	779,000		779,000	
RR-P1-5	New Pipeline	Replace 4,475' of small diameter pipeline with 8" pipeline	1,309,000	1,309,000		
RR-P1-6	Upsize Pipeline	Replace 3,290' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-1 and part of EXCIP-P1-4	961,000	961,000		
RR-P1-7	Upsize Pipeline	Replace 6,800' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-5 and part of EXCIP-P1-4	1,989,000		1,989,000	
RR-P1-8	Upsize Pipeline	Replace 4,800' of small diameter pipeline with 8" pipeline; recommend simultaneously implementing with EXCIP-P1-7. Approximately 3,600 feet within Transit Corridors Plan Area.	1,408,000		1,408,000	
RR-P1-9	Upsize Pipeline	Replace 7,900' of small diameter pipeline with 8" pipeline	2,315,000			2,315,000
		SUBTOTAL	16,414,000	7,923,000	6,176,000	2,315,000
Pipeline Rehabilitation and Replacement Improvements Priority 2[j]						
RR-P2	Upsize Pipeline	Replace 15,460' of small diameter pipeline with 8" pipeline	4,522,000		2,000,000	2,522,000
		SUBTOTAL	4,522,000	0	2,000,000	2,522,000
Pipeline Rehabilitation and Replacement Pipeline Improvements Priority 3[k]						
RR-P3	Upsize Pipeline	Replace 240,860' of 6" and 8" pipeline with new 8" pipeline	70,450,000			
	Upsize Pipeline	Replace 32,810' of 10" pipeline with new 10" pipeline	11,198,000			
	Upsize Pipeline	Replace 35,150' of 12" pipeline with new 12" pipeline	13,709,000			
	Upsize Pipeline	Replace 11,150' of 14" pipeline with new 14" pipeline	4,711,000			
	Upsize Pipeline	Replace 110' of 16" pipeline with new 16" pipeline	48,000			100,116,000
		SUBTOTAL	100,116,000	0	0	100,116,000
Well, Tank and Pump Station Rehabilitation and Replacement Improvement Projects						
EXCIP-CITY-10	Replace Well	Abandon and replace existing Well 15, which is out of service; total cost is $3.2M, of which $0.2M has already been encumbered	3,000,000	3,000,000		
EXCIP-CITY-11	Rehabilitate Wells	Well Rehabilitation program that 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 five years, with replacement as needed	3,300,000	500,000	600,000	2,200,000
EXCIP-CITY-7	Replace Tank	Replace Tank 3, which is in poor structural condition to maintain system reliability and restore tank's full capacity; total cost is $2.5M, of which $1.3M has already been encumbered	1,200,000	1,200,000		
RR-T-2	Rehabilitate Tank	Tank Re-coating program to re-coat interior and exterior of above-grade steel tanks (T1, T4, T6, T6A, T7, T9, and T10); budgeting assumes two future re-coating projects within Master Plan	800,000	400,000		400,000
RR-T-3	Replace Tank	Tank replacement program to replace tanks that have reached the end of their useful lives; budgeting includes replacement of three tanks (T4, T6 and T7) within Master Plan timeframe	7,049,000			7,049,000
EXCIP-CITY-22	Rehabilitate Pump Stations	Improve and rehabilitate the City's pump stations to maintain pump station condition and performance	14,000,000	2,600,000		11,400,000
EXCIP-CITY-4	Upgrade Pump Station 4	PS4 College rehabilitation including replacement or upgrade of existing pumps, motors and controls that are reaching the end of their useful life to maintain reliability for Z11; this project to incorporate Project EXCIP-PS-1; total project is $3.7M, of which $2.0M has already been encumbered	1,700,000	1,700,000		
EXCIP-CITY-18	Rehabilitate Pressure Regulating Stations	Improve and rehabilitate the City's pressure reducing stations to maintain pressure reducing station performance	1,000,000			1,000,000
		SUBTOTAL	32,049,000	9,400,000	600,000	22,049,000
Miscellaneous Rehabilitation and Replacement Projects						
EXCIP-CITY-9	Update CMMS	Update the Computerized Maintenance Management System (CMMS) with geographical information from the City's GIS, and provide unique identification numbers for facilities in the CMMS	95,000			95,000
EXCIP-CITY-16	Upgrade Meter	Retrofit existing customer meters with cathodic protection in corrosive soils areas; $1 million is assumed for budgeting purposes, as more detailed analysis would be required for specific locations	1,000,000			1,000,000
EXCIP-CITY-17	Upgrade Meter	Replace existing water meters with Sensus Mag meter technology	7,287,000			7,287,000
EXCIP-CITY-8	Repair Pipeline	Spot repairs for the Spyglass neighborhood and on Merion Drive	500,000	500,000		
EXCIP-CITY-19	Replace Pipeline	Replace or slip-line the existing 14-inch pipeline from Station 2 to Tank 7 - the existing pipeline is in poor condition; cost reflects pipeline replacement cost for conservative estimate	1,743,000			1,743,000
		SUBTOTAL	10,625,000	500,000	0	10,125,000
		REHABILITATION AND REPLACEMENT CAPITAL IMPROVEMENT PROJECTS TOTAL	**163,726,000**	**17,823,000**	**8,776,000**	**137,127,000**
		CAPITAL IMPROVEMENT PROGRAM TOTAL	**240,256,000**	**30,366,000**	**53,866,000**	**156,024,000**

[a] Costs shown are based on the December 2011 SF ENR CCI of 10205.
[b] Costs include mark-ups equal to 62.5 percent (Design and Construction contingency: 30 percent of construction cost; Professional Services: 25 percent of construction cost plus construction contingencies).
[c] Total rounded to nearest $1,000.
[d] CIP Costs shown for City-Identified Projects are revised and do not include the funds already allocated toward the projects.
[e] Pipeline projects with P1 identifiers are Priority 1 (highest priority) projects. These projects are listed in order of priority, so that areas that are most deficient receive highest priority.
[f] Pipeline projects with P2 identifiers are Priority 2 (lower priority) projects. Each program lists the total pipeline length by pressure zone. Specific projects and sequencing to be determined by the City. Pipelines within these projects that overlapped with Rehabilitation and Replacement Pipeline Priority 1 projects have been excluded.
[g] Existing system fire flow improvement requires upsize to 8" diameter pipeline, if Jail Line Project does not proceed. If the Jail Line Project does proceed, future system peak hour capacity requires upsize to 12" diameter pipeline, which is estimated to be $770,000 after a 62.5 percent mark-up, and is to be funded by SFPUC.
[h] Project previously identified as part of Crestmoor evaluation and is currently under design.
[i] Pipeline projects with P1 identifiers are Priority 1 (highest priority) projects. These projects are listed in order of priority, so that areas with the poorest leak history and oldest pipelines receive highest priority. Only pipelines 4-inch and less in diameter are included, excluding parallel pipelines. Pipelines within these projects that overlapped with Capacity Pipeline Improvement Priority 1 projects have been excluded.
[j] Rehabilitation and Replacement Pipeline Improvements Priority 2 is one step lower in priority. This project is comprised of the rest of the pipelines 4-inch and less in diameter throughout the entire system, excluding parallel pipelines, that were not included in capacity pipeline improvement projects.
[k] Rehabilitation and Replacement Pipeline Improvements Priority 3 (lowest priority) is comprised of the rest of the pipelines throughout the entire system, excluding parallel pipelines, that were not included in Priority 1 or 2, or in any capacity pipeline improvement projects.

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 9-1_CapacityImpCIP.mxd 10/17/2012

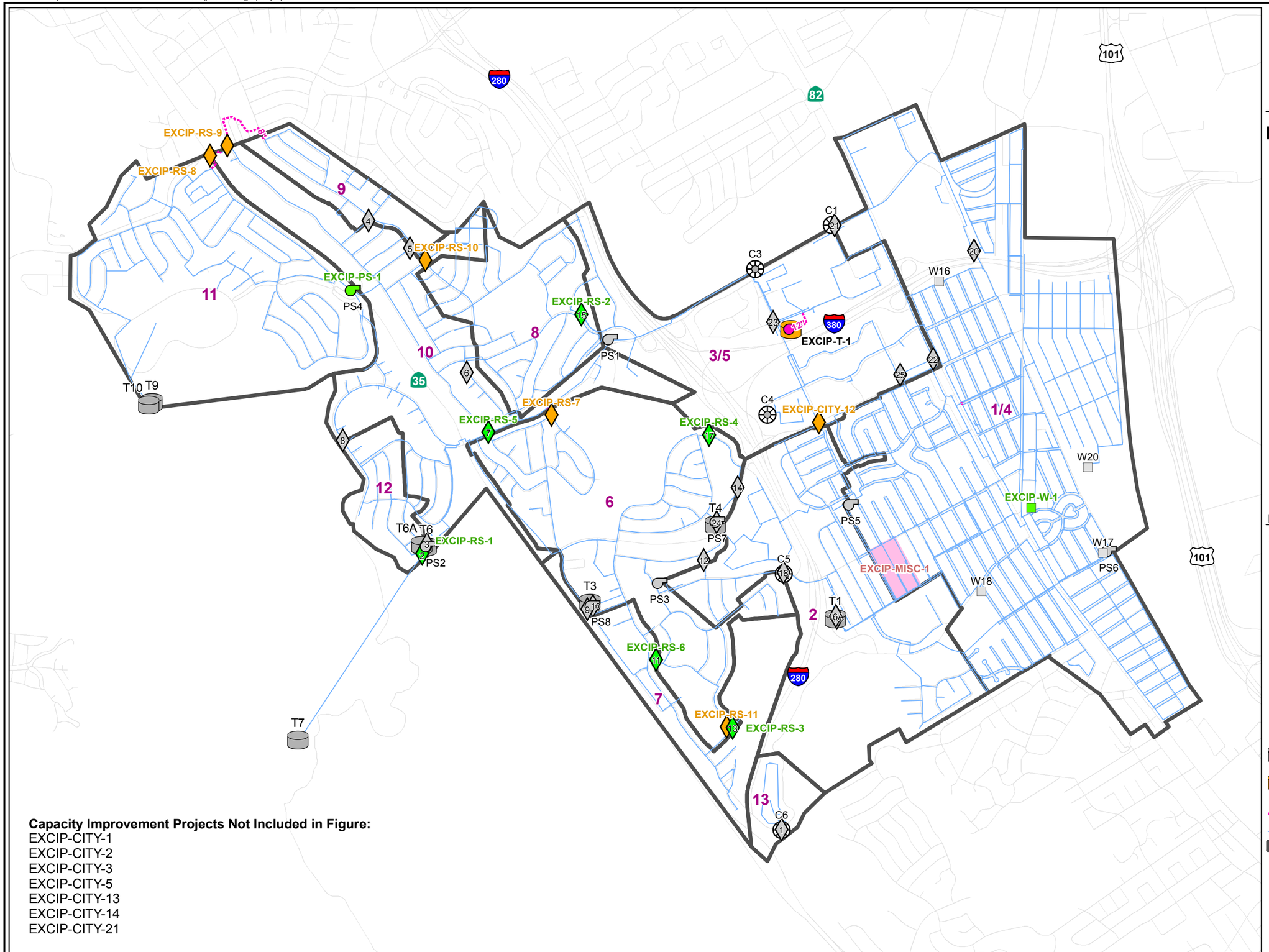


FIGURE 9-1

City of San Bruno
Water System Master Plan

RECOMMENDED EXISTING SYSTEM CAPACITY IMPROVEMENTS

N

0 880 1,760

Scale in Feet

Notes
1. Location of EXCIP-W-1 to be determined.

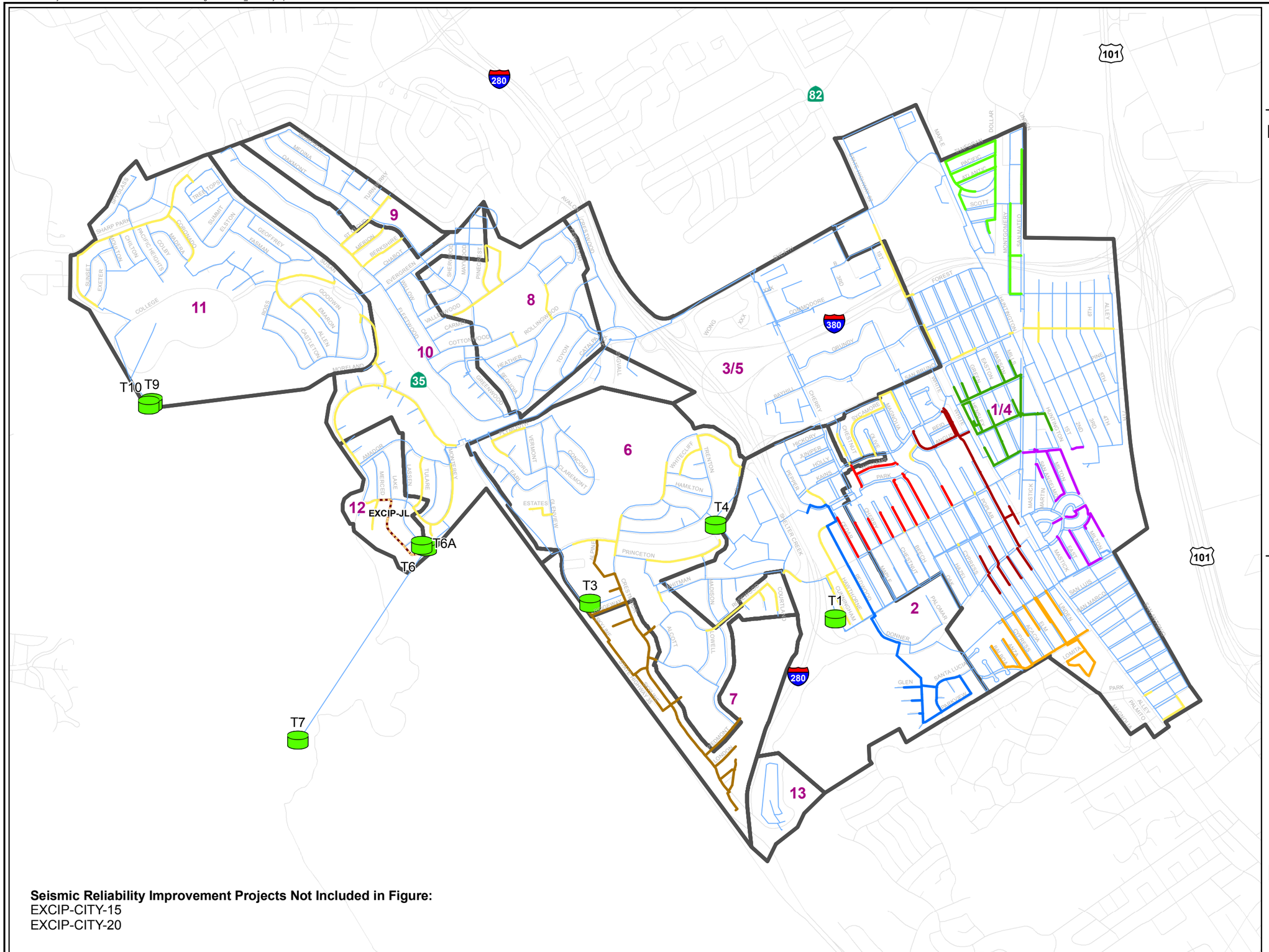
LEGEND

- Turnout
- Existing Well
- Proposed New Well
- Ex. Pressure Reg. Sta. (RS)
- Proposed Pressure RS Upsize
- Proposed New Pressure RS
- Ex. Booster Pump Sta. (PS)
- Proposed Booster PS Upsize
- Proposed New Booster PS
- Existing Storage Tank
- Proposed New Storage Tank
- Pipeline Improvement Associated With Tank, PS, or RS Improvement
- Water Main
- Pressure Zone Boundary

Capacity Improvement Projects Not Included in Figure:
EXCIP-CITY-1
EXCIP-CITY-2
EXCIP-CITY-3
EXCIP-CITY-5
EXCIP-CITY-13
EXCIP-CITY-14
EXCIP-CITY-21

WEST YOST ASSOCIATES

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 9-2_ReliabilityImpCIP.mxd 10/17/2012



Seismic Reliability Improvement Projects Not Included in Figure:
EXCIP-CITY-15
EXCIP-CITY-20

FIGURE 9-2

City of San Bruno
Water System Master Plan

RECOMMENDED EXISTING SYSTEM RELIABILITY IMPROVEMENTS

N

0 880 1,760
Scale in Feet

Notes
1. Pipeline improvements based upon Maximum Day Demands Plus Fire Flow evaluation.
2. Existing Maximum Day Demand is 6.33 mgd.
3. Assumes storage tank levels are half full, and available duty pumps are operating for pipeline improvements.
4. Results based on NO pipeline velocity constraint, but a minimum residual pressure of 20 psi was required.
5. Short, dead-end pipelines were not evaluated in the hydraulic model and are not shown on this figure.
6. EXCIP-P2 projects are grouped by pressure zone.

LEGEND

Seismic Reliability
- T-PROP-01

Pipeline Reliability
- EXCIP-P1-1
- EXCIP-P1-2
- EXCIP-P1-3
- EXCIP-P1-4
- EXCIP-P1-5
- EXCIP-P1-6
- EXCIP-P1-7
- EXCIP-P1-8
- EXCIP-P2
- EXCIP-JL
- Existing Pipeline
- Street
- Pressure Zone Boundary

CITY OF SAN BRUNO

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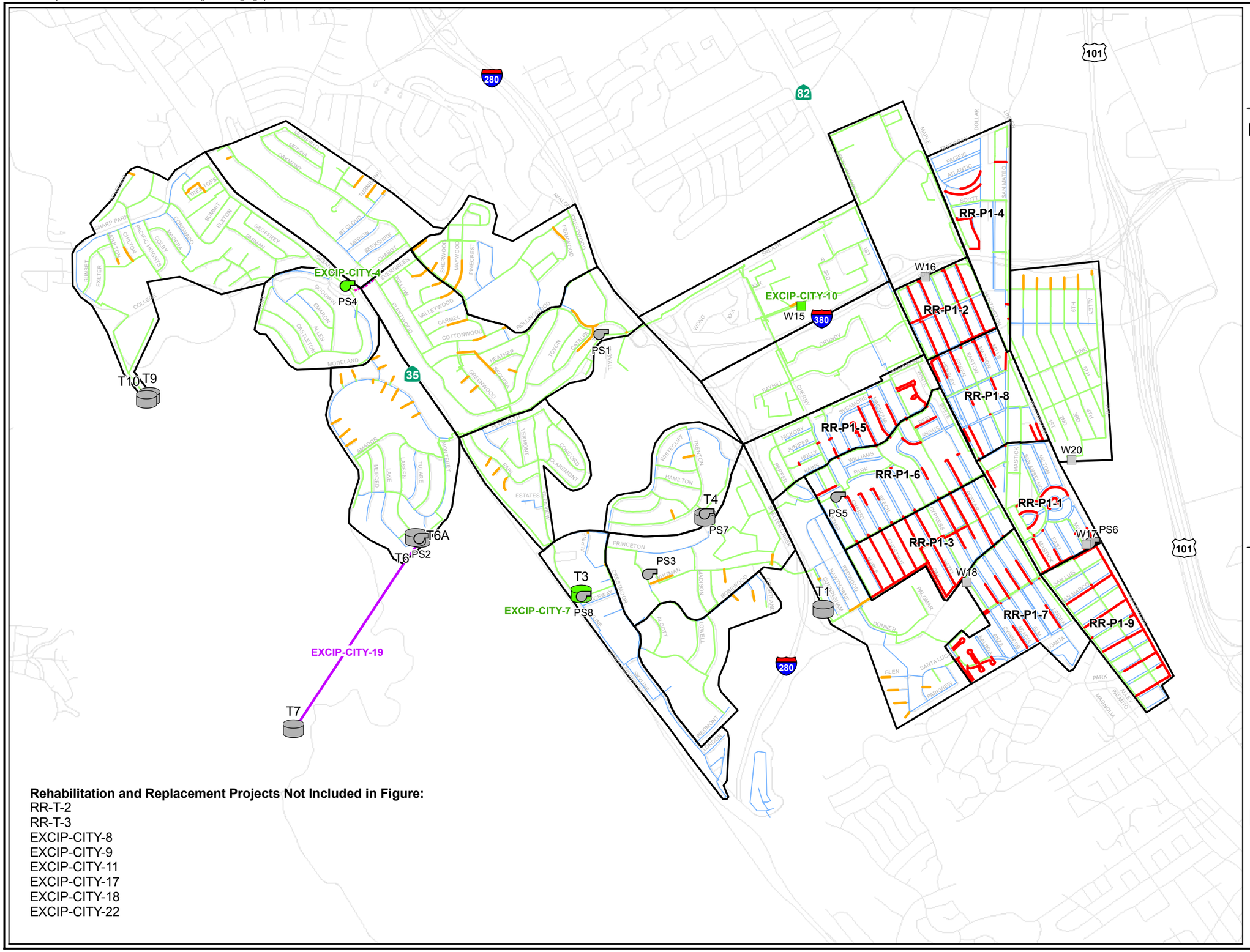
W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG 9-3_RR_ImpCIP.mxd 10/18/2012



Rehabilitation and Replacement Projects Not Included in Figure:

RR-T-2
RR-T-3
EXCIP-CITY-8
EXCIP-CITY-9
EXCIP-CITY-11
EXCIP-CITY-17
EXCIP-CITY-18
EXCIP-CITY-22

FIGURE 9-3

City of San Bruno Water System Master Plan

RECOMMENDED EXISTING SYSTEM REHABILITATION AND REPLACEMENT IMPROVEMENTS

N

0 880 1,760

Scale in Feet

Notes

1. Rehabilitation/Replacement (R/R) projects are grouped by subdivion boundaries.
2. Pipelines in both R/R Priority 1 program and the Reliability Priority 1 program are shown and budgeted in the Reliability Program. Likewise, projects in the R/R Priority 2 or 3 programs and in the Reliability Priority 2 program are budgeted and shown in the Reliability Program. See Figure 7-11 for all projects in the R/R program.

LEGEND

- Existing Well
- Well Replacement
- Ex. Booster Pump Sta. (PS)
- Booster PS Upgrade
- Existing Storage Tank
- Storage Tank Replacement
- RR-P1
- RR-P2
- RR-P3
- EXCIP-CITY-19
- Pipeline Improvement Associated With Tank, PS, or RS Improvement
- Water Main
- Subdivision
- Street

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APPENDIX A

Summary of Hydrant (C-factor) Test Results

APPENDIX A
Summary of Hydrant (C-factor) Test Results

Hydrant Test No. 1 (Zone 1/4)

Hydrant Test No. 1 was performed on Santa Maria Avenue, east of San Anselmo Avenue. This test was intended to confirm the C-factor (initially assumed to equal 75) assigned to 6-inch diameter, CI pipelines constructed approximately in 1928.

A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrates that the pressures predicted by the model are within ±5 psi of the measured field value. A comparison between the calibrated model results and the field data is shown in Table A-1 and indicates that the use of a C-factor equal to 75 for 6-inch diameter CI pipelines, constructed between 1900 and 1939, is valid.

Table A-1. Hydrant Test No. 1

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]	97	NA	NA	96	NA	NA	NA
1A[3]	94	83	11	94	81	13	-2
1B[4]	90	74	16	94	80	14	2
1C[5]	100	89	11	96	84	12	-1
1D[6]	97	88	9	95	85	11	-2

(1) Location of fire hydrants can be found on Figure A-1.
(2) The "Flowing Hydrant" is located on Santa Maria Avenue, east of San Anselmo Avenue.
(3) Hydrant 1A is located on Santa Maria Avenue, west of San Anselmo Avenue.
(4) Hydrant 1B is located at the intersection of San Diego Avenue and San Anselmo Avenue.
(5) Hydrant 1C is located on Santa Clara Avenue, east of San Anselmo Avenue.
(6) Hydrant 1D is located at the intersection of Santa Inez Avenue and San Anselmo Avenue.
NA = Not Applicable

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LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-1

City of San Bruno
Water System Master Plan

TEST #1
(6" CI 1928)

WEST YOST ASSOCIATES

Hydrant Test No. 2 (Zone 1/4)

Hydrant Test No. 2 was performed on Walnut Street, west of 7th Avenue. This test was intended to confirm the C-factor (initially assumed to equal 75) assigned to 8-inch diameter, CI pipelines constructed approximately in 1940.[1]

A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrates that the pressures predicted by the model are within ±5 psi of the measured field value. A comparison between the calibrated model results and the field data is shown in Table A-2 and indicates that the use of a C-factor equal to 75 for 8-inch diameter CI pipelines, constructed between 1900 and 1939, is valid.

Table A-2. Hydrant Test No. 2

Hydrant(1)	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing(2)	104	NA	NA	105	NA	NA	NA
2A(3)	105	68	37	105	65	40	-3
2B(4)	104	71	33	105	68	37	-4
2C(5)	105	73	32	105	70	35	-3

(1) Location of fire hydrants can be found on Figure A-2.
(2) The "Flowing Hydrant" is located on Walnut Street, west of 7th Avenue.
(3) Hydrant 2A is located on 7th Avenue, between Walnut Street and San Bruno Avenue E.
(4) Hydrant 2B is located on Walnut Street, west of 6th Avenue.
(5) Hydrant 2C is located on 6th Avenue, between Walnut Street and San Bruno Avenue E.
NA = Not Applicable

[1] The City's Initial Infrastructure Construction Map indicates that the Belle Air Park development began construction in the early 1900s. Therefore, pipeline C-factors in this area were assigned an approximate year range of 1900-1939.

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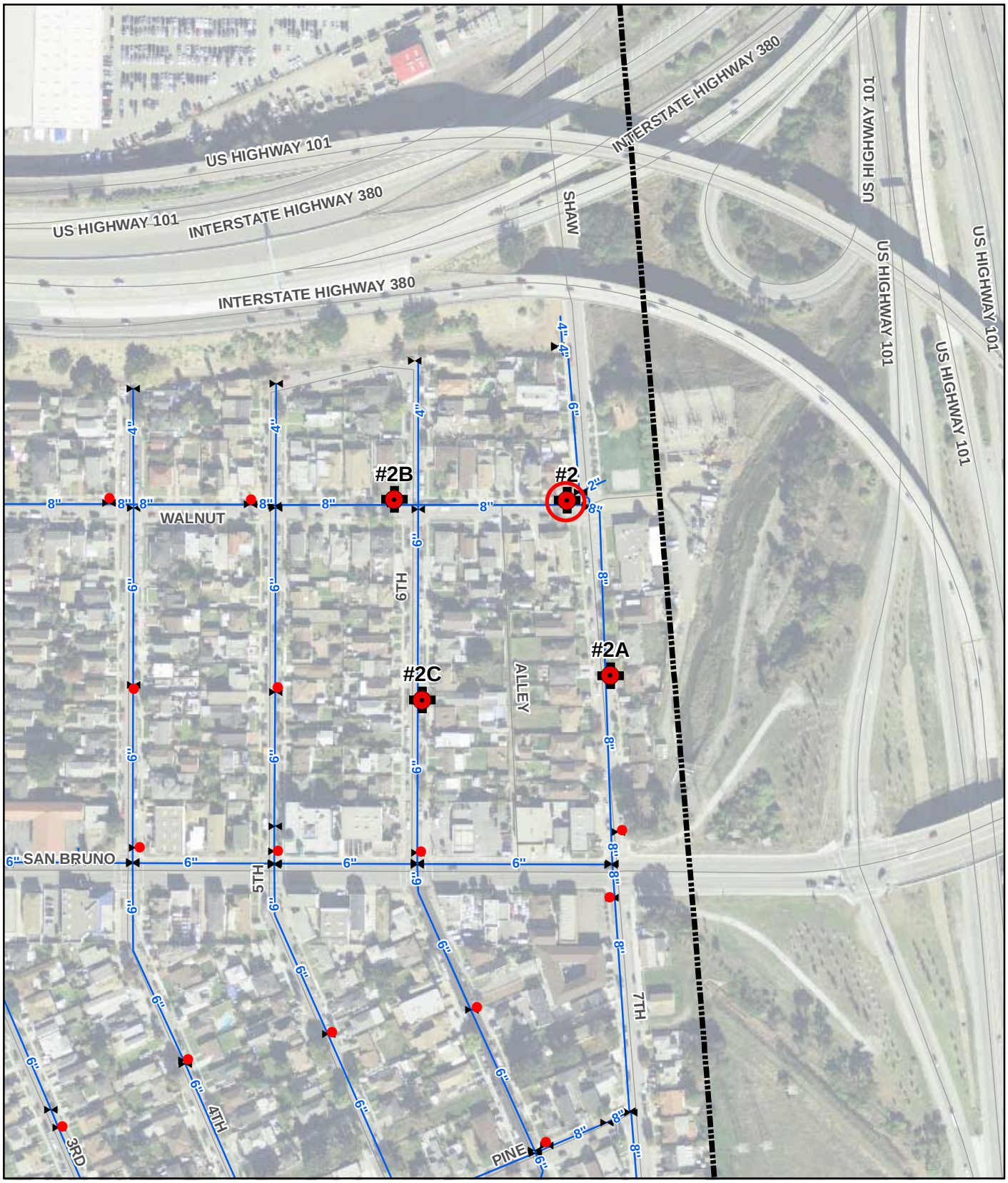


LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-2

City of San Bruno
Water System Master Plan

TEST #2
(8" CI 1940)

WEST YOST ASSOCIATES

Hydrant Test No. 3 (Zone 1/4)

Hydrant Test No. 3 was performed on Camino Plaza, south of San Bruno Avenue W. This test was intended to confirm the C-factor (initially assumed to equal 90) assigned to 8-inch diameter, CI pipelines constructed approximately in 1951.[2]

A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrates that the pressures predicted by the model are within ±5 psi of the measured field value. A comparison between the calibrated model results and the field data is shown in Table A-3 and indicates that the use of a C-factor equal to 90 for 8-inch diameter CI pipelines, constructed between 1940 and 1949, is valid.

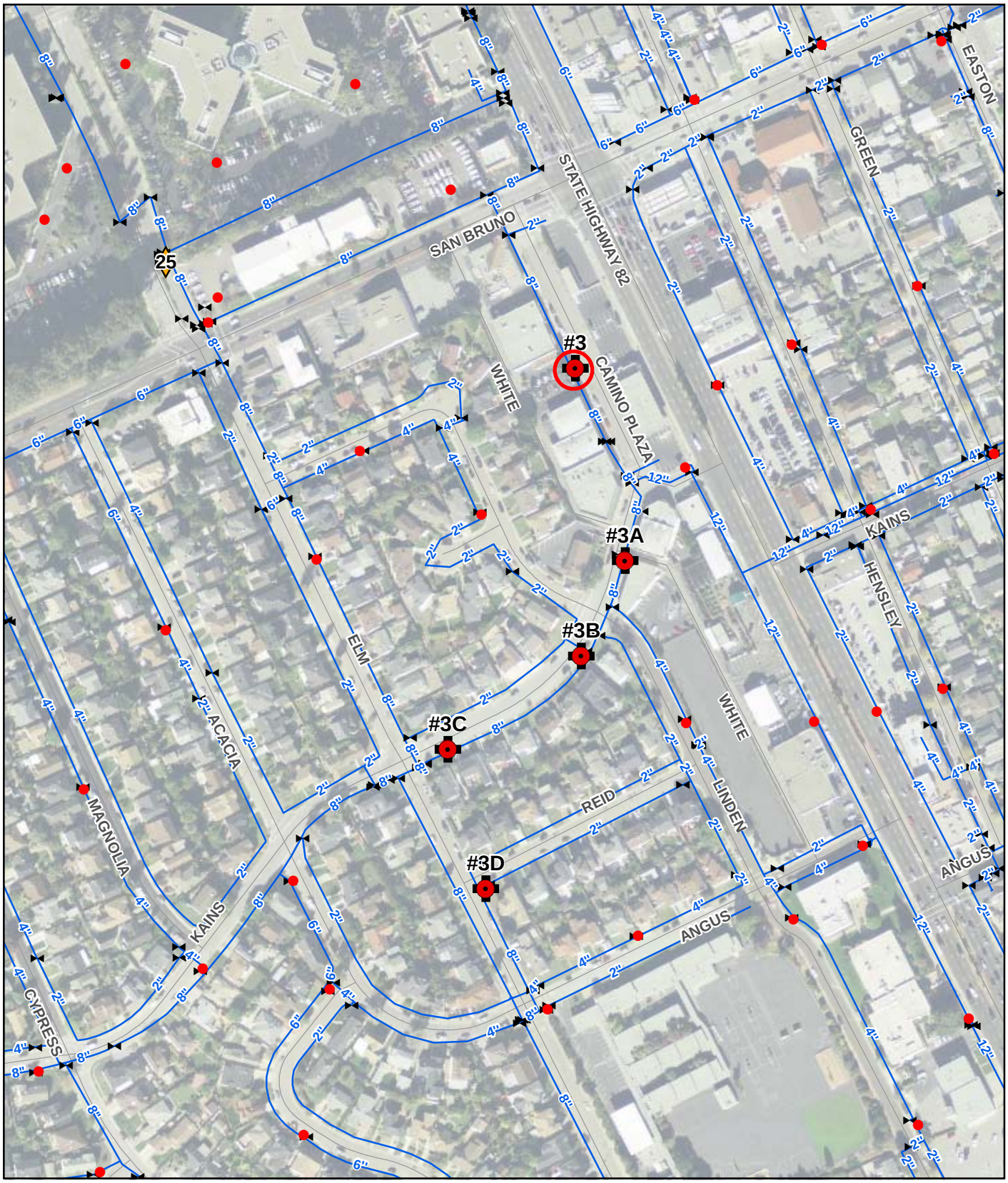
Table A-3. Hydrant Test No. 3

Hydrant(1)	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing(2)	87	NA	NA	87	NA	NA	NA
3A(3)	88	80	8	86	81	5	3
3B(4)	86	79	7	86	81	5	2
3C(5)	82	75	7	80	75	5	2
3D(6)	78	72	6	79	74	4	2

(1) Location of fire hydrants can be found on Figure A-3.
(2) The "Flowing Hydrant" is located on Camino Plaza, south of San Bruno Avenue W.
(3) Hydrant 3A is located on Kains Avenue, southwest of White Way.
(4) Hydrant 3B is located on Kains Avenue, southwest of Linden Avenue.
(5) Hydrant 3C is located on Kains Avenue, northeast of Elm Avenue.
(6) Hydrant 3D is located at the intersection of Reid Avenue and Elm Avenue.
NA = Not Applicable

[2] The City's Initial Infrastructure Construction Map indicates that the Mills Park 2 development began construction in the early 1940s. Therefore, pipeline C-factors in this area were assigned an approximate year range of 1940-1949.

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG A-3_HT3.mxd 6/20/2011



LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-3

City of San Bruno
Water System Master Plan

TEST #3
(8" CI 1951)

WEST YOST ASSOCIATES

Hydrant Test No. 4 (Zone 2)

Hydrant Test No. 4 was performed on Redwood Avenue, north of Niles Avenue. This test was intended to confirm the C-factor (initially assumed to equal 100) assigned to 6-inch diameter, CI pipelines constructed approximately in 1950.

Initial model simulation results shown in Table A-4A indicate that there may be system configuration issues (*e.g.*, partially closed valve(s), inaccurate representation of pipeline connectivity, etc.) within the area of Test 4. On August 23, 2011, City staff confirmed that in the field there was 4-inch diameter tie-in connection at Redwood Avenue and Niles Avenue that was not included in the GIS (and therefore not included in the model). Simulation results from Test 4 met the ±5 psi tolerance limit once the connection at Redwood Avenue and Niles Avenue was accurately simulated within the hydraulic model.

A revised comparison between the calibrated model results and the field data is shown in Table A-4B and indicates that the use of a C-factor equal to 100 for 6-inch diameter CI pipelines, constructed between 1950 and 1959, is appropriate.

Table A-4A. Hydrant Test No. 4

Hydrant[1]	Field Data			Modeled Data			Comparison
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	of Differential Pressures, psi (g = c-f)
Flowing[2]	80	NA	NA	79	NA	NA	NA
4A[3]	84	25	59	81	-35	116	-57
4B[4]	92	38	54	92	1	90	-36
4C[5]	90	42	48	84	20	64	-16
4D[6]	102	61	41	103	61	42	-1

(1) Location of fire hydrants can be found on Figure A-4.
(2) The "Flowing Hydrant" is located on Redwood Avenue, north of Niles Avenue.
(3) Hydrant 4A is located on Redwood Avenue, between flowing hydrant and Hydrant 4B.
(4) Hydrant 4B is located on Redwood Avenue, southeast of Jenevein Avenue.
(5) Hydrant 4C is located on Redwood Avenue, northwest of Hydrant 4B.
(6) Hydrant 4D is located at the intersection of Hawthorne Avenue and Redwood Avenue.
NA = Not Applicable

Table A-4B. Hydrant Test No. 4

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]	80	NA	NA	80	NA	NA	NA
4A[3]	84	25	59	82	20	61	-2
4B[4]	92	38	54	92	37	54	0
4C[5]	90	42	48	84	37	47	1
4D[6]	102	61	41	103	63	41	0

(1) Location of fire hydrants can be found on Figure A-4.
(2) The "Flowing Hydrant" is located on Redwood Avenue, north of Niles Avenue.
(3) Hydrant 4A is located on Redwood Avenue, between flowing hydrant and Hydrant 4B.
(4) Hydrant 4B is located on Redwood Avenue, southeast of Jenevein Avenue.
(5) Hydrant 4C is located on Redwood Avenue, northwest of Hydrant 4B.
(6) Hydrant 4D is located at the intersection of Hawthorne Avenue and Redwood Avenue.
NA = Not Applicable

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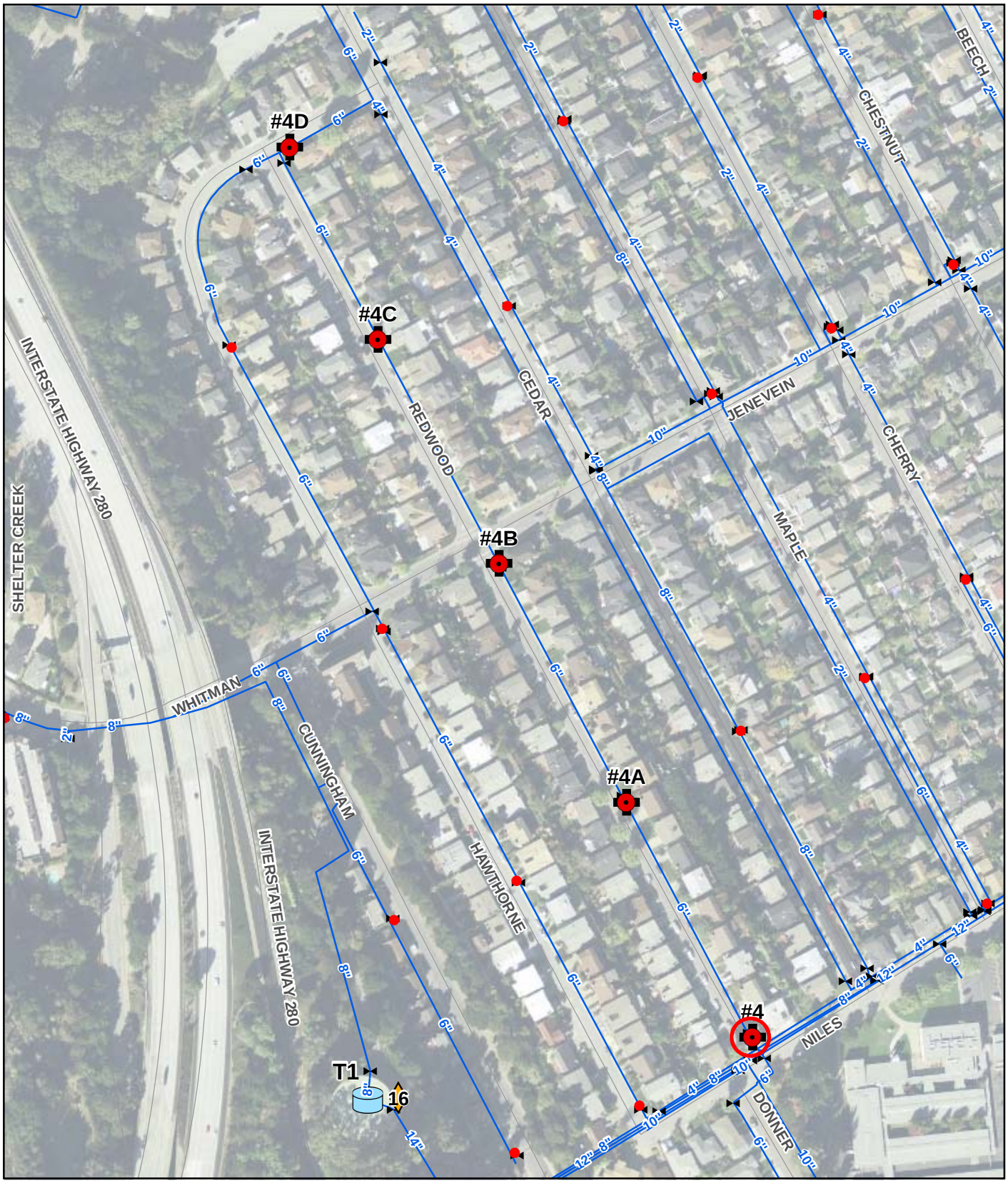

LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-4

City of San Bruno
Water System Master Plan

TEST #4
(6" CI 1950)

WEST YOST ASSOCIATES

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Hydrant Test No. 5 (Zone 1/4)

Hydrant Test No. 5 was performed on Easton Avenue, between Angus Avenue W and Kains Avenue. This test was intended to confirm the C-factor (initially assumed to equal 75) assigned to 4-inch diameter, CI pipelines constructed approximately in 1937.

A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrates that the pressures predicted by the model are within ±5 psi of the measured field value. A comparison between the calibrated model results and the field data is shown in Table A-5 and indicates that the use of a C-factor equal to 75 for 4-inch diameter CI pipelines, constructed between 1900 and 1939, is valid.

Table A-5. Hydrant Test No. 5

Hydrant[1]	Field Data			Modeled Data			Comparison
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	of Differential Pressures, psi (g = c-f)
Flowing[2]	98	NA	NA	97	NA	NA	NA
5A[3]	97	87	10	101	91	11	-1
5B[4]	98	87	11	99	88	11	0
5C[5]	98	79	19	97	81	16	3
5D[6]	96	80	16	94	79	16	0

(1) Location of fire hydrants can be found on Figure A-5.
(2) The "Flowing Hydrant" is located on Easton Avenue, between Angus Avenue W and Kains Avenue.
(3) Hydrant 5A is located on Masson Avenue, between Angus Avenue W and Kains Avenue.
(4) Hydrant 5B is located at the intersection of Angus Avenue W and Easton Avenue.
(5) Hydrant 5C is located at the intersection of Angus Avenue and Green Avenue.
(6) Hydrant 5D is located on Green Avenue, between Angus Avenue W and Kains Avenue.
NA = Not Applicable

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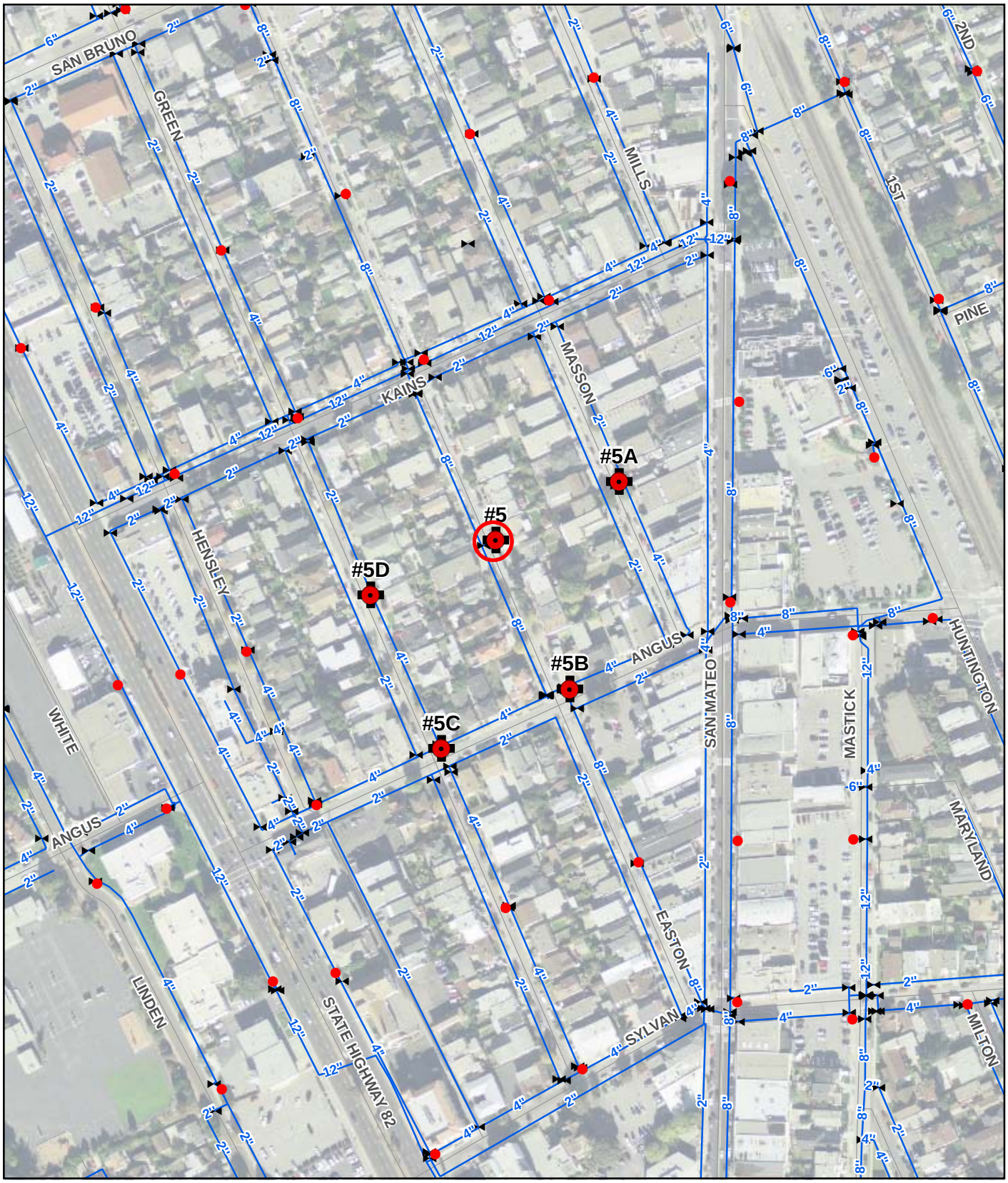

LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-5

City of San Bruno
Water System Master Plan

TEST #5
(4" CI 1937)

WEST YOST ASSOCIATES

Hydrant Test No. 6 (Zone 3/5)

Hydrant Test No. 6 was performed on Elm Avenue, southeast of Grundy Lane. This test was intended to confirm the C-factor (initially assumed to equal 120) assigned to 8-inch diameter, CI pipelines constructed approximately in 1975.

Initial model simulation results shown in Table A-6A indicate that there may be system configuration issues (*e.g.*, partially closed valve(s), inaccurate representation of pipeline connectivity, etc.) within the area of Test 6. On August 17, 2011, City staff confirmed that there was a missing 8-inch diameter tie-in connection at Elm Avenue and Bayhill Drive. Simulation results from Test 6 met the ±5 psi tolerance limit once the connection at Elm Avenue and Bayhill Drive was accurately simulated within the hydraulic model; however, the results from observed Hydrant 6A indicates a difference between field-observed and model-simulated pressures of 18 psi. The model simulation results indicate that there may have been an error with the residual pressure reading at observed Hydrant 6A. Therefore, it is recommended that the data from Hydrant 6A not be used.

A revised comparison between the calibrated model results and the field data is shown in Table A-6B and indicates that the use of a C-factor equal to 120 for 8-inch diameter CI pipelines, constructed between 1970 and 1979, is appropriate when results from Hydrant 6A are removed.

Table A-6A. Hydrant Test No. 6

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]	174	NA	NA	170	NA	NA	NA
6A[3]	176	120	56	168	18	150	-94
6B[4]	167	139	28	163	51	112	-84
6C[5]	158	133	26	155	69	87	-61
6D[6]	150	131	19	145	90	54	-35

(1) Location of fire hydrants can be found on Figure A-6.
(2) The "Flowing Hydrant" is located on Elm Avenue, southeast of Grundy Lane.
(3) Hydrant 6A is located at the intersection of Grundy Lane and Elm Avenue.
(4) Hydrant 6B is located on Grundy Lane, southwest of Hydrant 6A.
(5) Hydrant 6C is located on Grundy Lane, southwest of Hydrant 6B.
(6) Hydrant 6D is located on Grundy Lane, northeast of Cherry Avenue.
NA = Not Applicable

Table A-6B. Hydrant Test No. 6

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]	174	NA	NA	170	NA	NA	NA
6A[3]	176	120	56	168	131	38	18
6B[4]	167	139	28	163	134	29	-1
6C[5]	158	133	26	155	132	23	2
6D[6]	150	131	19	144	129	16	3

(1) Location of fire hydrants can be found on Figure A-6.
(2) The "Flowing Hydrant" is located on Elm Avenue, southeast of Grundy Lane.
(3) Hydrant 6A is located at the intersection of Grundy Lane and Elm Avenue.
(4) Hydrant 6B is located on Grundy Lane, southwest of Hydrant 6A.
(5) Hydrant 6C is located on Grundy Lane, southwest of Hydrant 6B.
(6) Hydrant 6D is located on Grundy Lane, northeast of Cherry Avenue.
NA = Not Applicable

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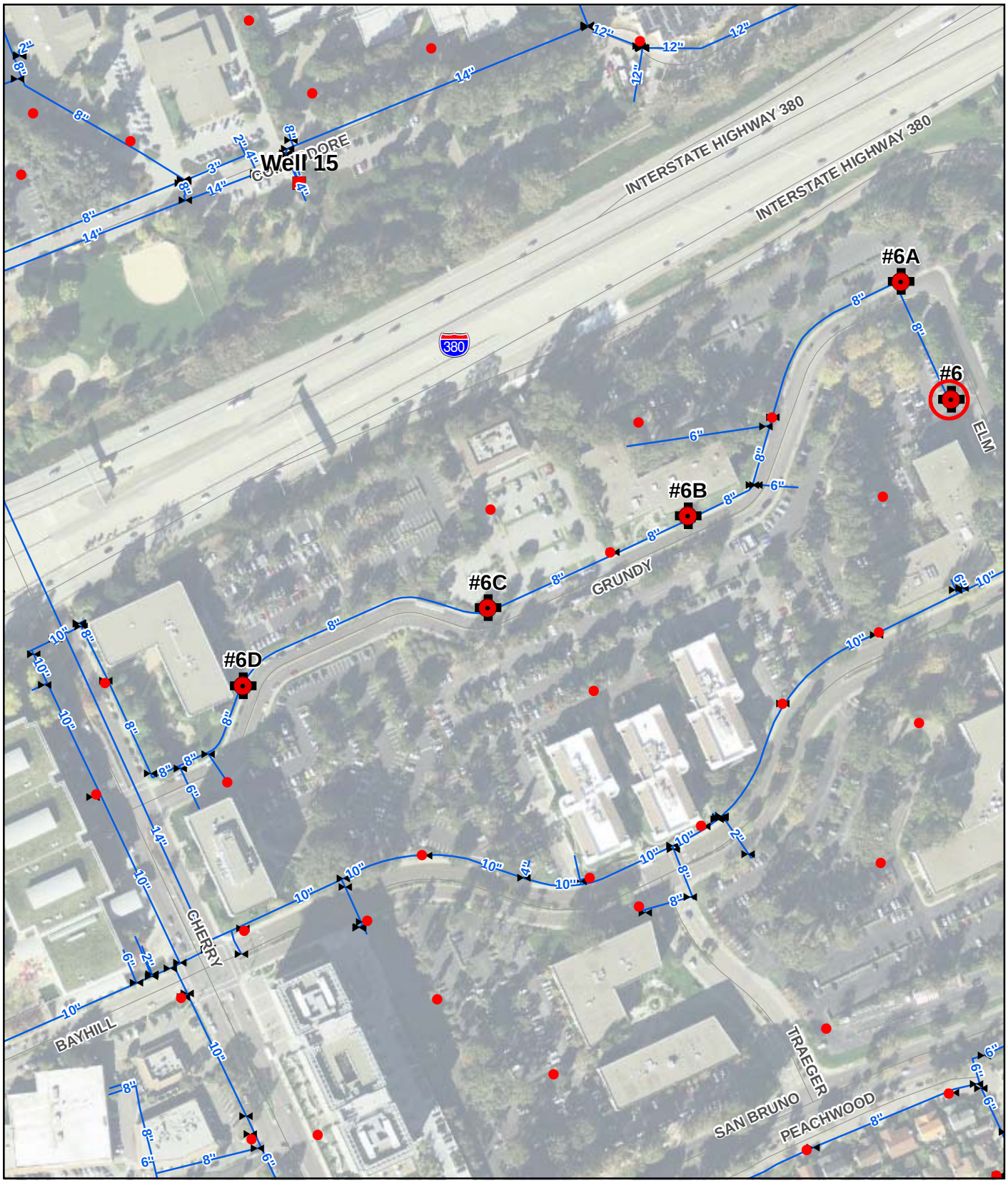

LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-6

City of San Bruno
Water System Master Plan

TEST #6
(8" CI 1975)

WEST YOST ASSOCIATES

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Hydrant Test No. 7 (Zone 6)

Hydrant Test No. 7 was performed on Claremont Drive, southeast of Fairmont Drive. This test was intended to confirm the C-factor (initially assumed to equal 100) assigned to 6-inch diameter, CI pipelines constructed approximately in 1955.[3]

A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrates that the pressures predicted by the model are within ±5 psi of the measured field value, except for the result at Hydrant 7B. Hydrant 7B shows a difference between measured and modeled pressures of 11 psi, which is not within the ±5 psi tolerance limit. In addition, the residual pressure reading dropped to zero during testing, which typically indicates that the residual pressure reading is invalid. Model-simulated results and the field-observed data are shown in Table A-7.

Since the model simulation results from observed Hydrants 7A, 7C, and 7D were within the ±5 psi tolerance limit, the results from the hydraulic model simulation indicate that for Test 7 there may have been an error with the residual pressure reading at Hydrant 7B. Therefore, it is recommended that the data from observed Hydrant 7B not be used.

Test 7 simulates within a 5 psi differential from the field hydrant test data after the pressure comparison at Hydrant 7B was removed. This result indicates that the current C-factor (*i.e.*, 100) assigned to 6-inch diameter CI pipelines, constructed between 1950 and 1959, is appropriate.

Table A-7. Hydrant Test No. 7

Hydrant(1)	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing(2)	45	NA	NA	54	NA	NA	NA
7A(3)	50	16	34	52	19	34	0
7B(4)	42	0	42	44	12	31	11
7C(5)	46	8	38	47	12	35	3
7D(6)	67	29	38	67	30	36	2

(1) Location of fire hydrants can be found on Figure A-7.
(2) The "Flowing Hydrant" is located on Claremont Drive, southeast of Fairmont Drive.
(3) Hydrant 7A is located on Claremont Drive, south of Plymouth Way.
(4) Hydrant 7B is located on Glenview Drive, south of Plymouth Way.
(5) Hydrant 7C is located on Fairmont Drive, southwest of Claremont Drive.
(6) Hydrant 7D is located on Claremont Drive, southeast of flowing hydrant.
NA = Not Applicable

[3] Pipelines were initially assumed to be AC until City staff requested West Yost to change the pipeline material type to CI to better reflect the pipelines that were actually installed in the Glenview area.

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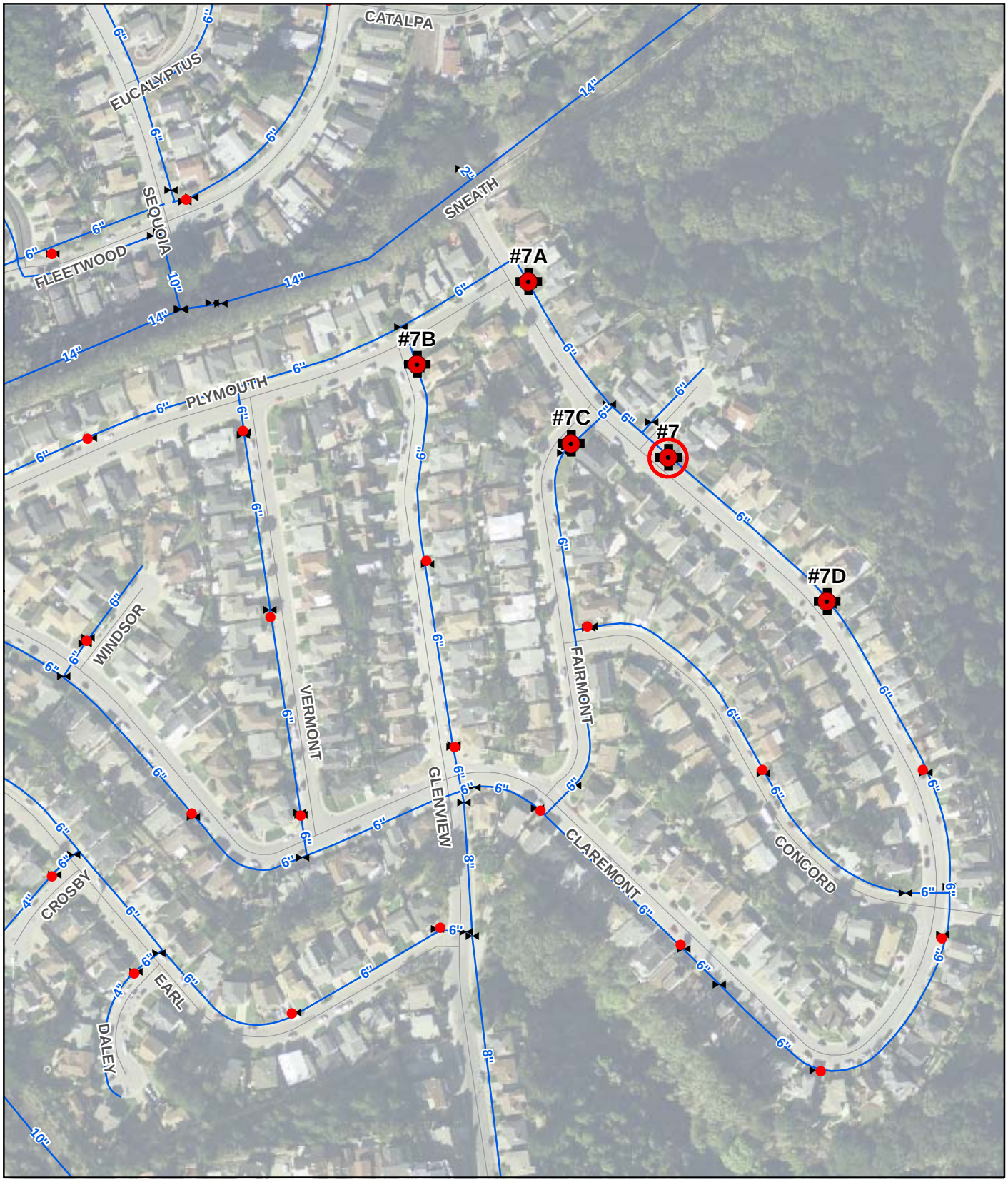

LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-7

City of San Bruno
Water System Master Plan

TEST #7
(6" AC 1955)

WEST YOST ASSOCIATES

Hydrant Test No. 8 (Zone 8)

Hydrant Test No. 8 was performed on Fernwood Drive, at the southeast corner of the loop. This test was intended to confirm the C-factor (initially assumed to equal 120) assigned to 6-inch diameter, AC pipelines constructed approximately in 1956.

Initial model simulation results shown in Table A-8A indicate that there may be system configuration issues (*e.g.*, partially closed valve(s), inaccurate representation of pipeline connectivity, etc.) within the area of Test 8. On August 19, 2011, City staff re-performed Test 8 with updated settings at RS 6. Results from the hydraulic model for this updated Test as shown in Table A-8B continue to indicate that there may be a partially closed valve on the 6-inch diameter tie-in connection from Valleywood Drive. However, in late September 2011, City staff confirmed that all valves in the vicinity of Test 8 were open. It appears that model simulation results from Test 8 are currently inconclusive and may be due to configuration errors or other errors in field data collection that could not be identified at this time. Therefore, this test was not used to adjust modeled C-factors.

Table A-8A. Hydrant Test No. 8

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]	90	NA	NA	93	NA	NA	NA
8A[3]	93	20	73	92	26	65	8
8B[4]	91	26	65	91	27	64	1
8C[5]	91	25	66	91	31	60	6
8D[6]	90	30	60	91	31	60	0

(1) Location of fire hydrants can be found on Figure A-8.
(2) The "Flowing Hydrant" is located on Fernwood Drive, southeast corner of the loop.
(3) Hydrant 8A is located on Fernwood Drive, southwest of the northeast corner of the loop.
(4) Hydrant 8B is located on Fernwood Drive, southwest of flowing hydrant.
(5) Hydrant 8C is located on Fernwood Drive, southwest of Hydrant 8A.
(6) Hydrant 8D is located on Fernwood Drive, southwest corner of the loop.
NA = Not Applicable

Table A-8B. Hydrant Test No. 8

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]	111	NA	NA	104	NA	NA	NA
8A[3]	110	58	52	103	80	23	29
8B[4]	109	62	47	102	80	22	25
8C[5]	110	59	51	102	81	21	30
8D[6]	110	60	50	102	81	21	29

(1) Location of fire hydrants can be found on Figure A-8.
(2) The "Flowing Hydrant" is located on Fernwood Drive, southeast corner of the loop.
(3) Hydrant 8A is located on Fernwood Drive, southwest of the northeast corner of the loop.
(4) Hydrant 8B is located on Fernwood Drive, southwest of flowing hydrant.
(5) Hydrant 8C is located on Fernwood Drive, southwest of Hydrant 8A.
(6) Hydrant 8D is located on Fernwood Drive, southwest corner of the loop.
NA = Not Applicable

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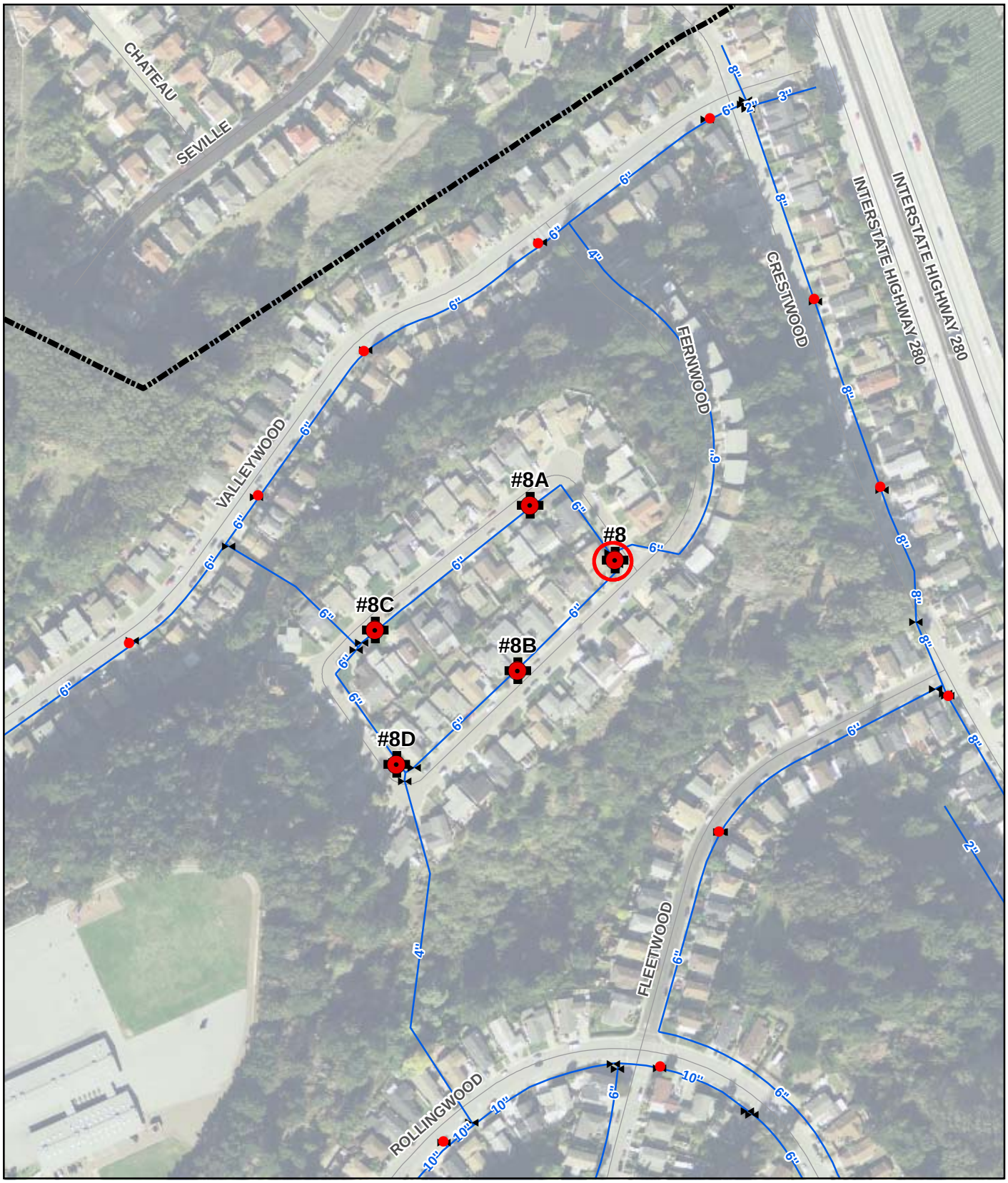

LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-8

City of San Bruno
Water System Master Plan

TEST #8
(6" AC 1956)

WEST YOST ASSOCIATES

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Hydrant Test No. 9 (Zone 10)

The locations of the flowing and observed hydrants for Test 9 were revised during the day of hydrant testing due to potential drainage issues with the original locations. Therefore, Test 9 was revised and improvised in the field based on the City's field maps. Hydrant Test No. 9 was performed on St. Cloud Drive, northeast of Fleetwood Drive. This test was intended to confirm the C-factor (initially assumed to equal 120) assigned to 6-inch diameter, CI pipelines constructed approximately in 1960.

Initial model simulation results indicate that there may have been an error with the residual pressure readings at observed Hydrants 9B and 9D. The difference between field-observed and model-simulated pressures for Hydrant 9B was 29 psi, and for Hydrant 9D, it was 21 psi. Hydraulic gradients computed from the field results were not consistent between Hydrants 9B and 9D and other field measurements. It is also possible that the data provided for Hydrants 9B and 9D was not collected from the correct observed hydrants due to the nature of an improvised test (*i.e.*, no clear maps were provided to field staff to locate the observed hydrants).

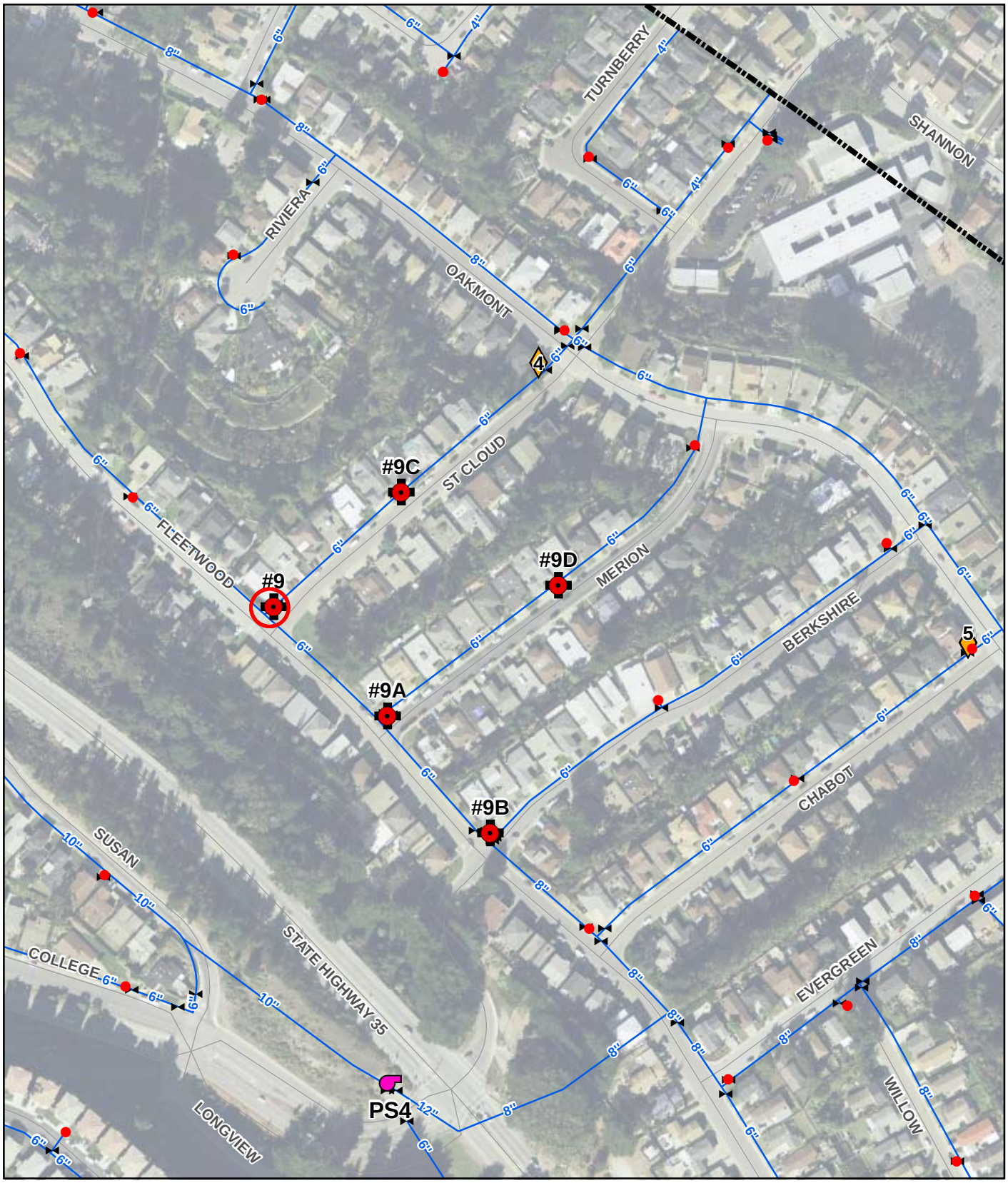
Model simulation results from the remaining observed hydrants (Hydrants 9A and 9C) were well within the ±5 psi tolerance limit. Therefore, it is recommended that the data from Hydrants 9B and 9D not be used. A comparison between the calibrated model results and the field data is shown in Table A-9 and indicates that the use of a C-factor equal to 120 for 6-inch diameter CI pipelines, constructed between 1960 and 1969, is appropriate when the results from Hydrants 9B and 9D are removed.

Table A-9. Hydrant Test No. 9

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]	107	NA	NA	112	NA	NA	NA
9A[3]	100	47	53	95	44	51	2
9B[4]	90	25	65	86	50	36	29
9C[5]	113	44	69	109	40	68	1
9D[6]	106	34	72	101	50	51	21

(1) Location of fire hydrants can be found on Figure A-9.
(2) The "Flowing Hydrant" is located on St. Cloud Drive, northeast of Fleetwood Drive.
(3) Hydrant 9A is located on Merion Drive, northeast of Fleetwood Drive.
(4) Hydrant 9B is located on Berkshire Drive, northeast of Fleetwood Drive.
(5) Hydrant 9C is located on St. Cloud Drive, northeast of flowing hydrant.
(6) Hydrant 9D is located on Merion Drive, northeast of Hydrant 9A.
NA = Not Applicable

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG A-9_HT9_rvsd.mxd 7/26/2011



LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

Note:
Test hydrant locations were revised as shown.

N

0 125 250

Scale in Feet

FIGURE A-9

City of San Bruno
Water System Master Plan

TEST #9
(6" CI 1960)

WEST YOST ASSOCIATES

Hydrant Test No. 10 (Zone 11)

Hydrant Test No. 10 was performed on Pacific Heights Boulevard, north of Sharp Park Road. This test was intended to confirm the C-factor (initially assumed to equal 100) assigned to 8-inch diameter, CI pipelines constructed approximately in 1958.

A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrates that the pressures predicted by the model are not within ±5 psi of the measured field value as shown in Table A-10.

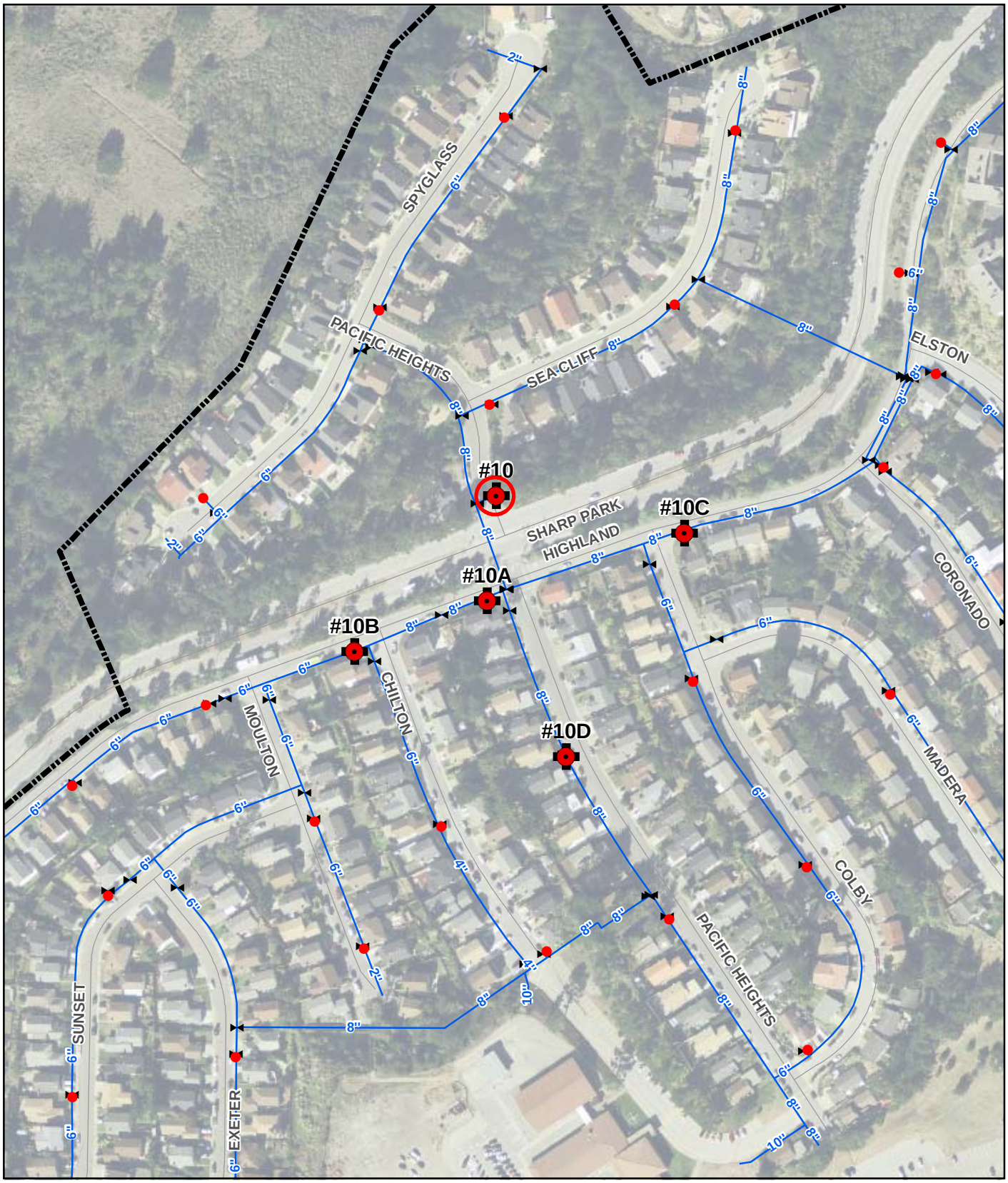
When these results were presented to City staff during a conference call held on August 10, 2011, City staff indicated that the area around Test 10 contains a mixture of pipeline material types (*e.g.*, CI, AC, and PVC). Therefore, model simulation results from Test 10 appear inconclusive and may be due to the lack of the data on the actual pipeline materials installed in this area, configuration errors or other errors in field data collection. However, the C-factor for a similar pipeline type (*i.e.*, 6-inch CI pipelines constructed between 1950 and 1959) was previously validated in Test 7. This confirms that the use of a C-factor equal to 100 for 8-inch diameter CI pipelines, constructed between 1950 and 1959, is appropriate.

Table A-10. Hydrant Test No. 10

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]	111	NA	NA	122	NA	NA	NA
10A[3]	111	75	36	117	85	31	5
10B[4]	120	103	17	122	92	29	-12
10C[5]	102	78	24	110	78	32	-8
10D[6]	98	86	12	107	76	31	-19

(1) Location of fire hydrants can be found on Figure A-10.
(2) The "Flowing Hydrant" is located on Pacific Heights Boulevard, north of Sharp Park Road.
(3) Hydrant 10A is located on Highland Drive, west of Pacific Heights Boulevard.
(4) Hydrant 10B is located on Highland Drive, west of Chilton Land.
(5) Hydrant 10C is located on Highland Drive, east of Colby Way.
(6) Hydrant 10D is located on Pacific Heights Boulevard, south of Highland Drive.
NA = Not Applicable

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG A-10_HT10.mxd 6/20/2011



LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-10

City of San Bruno
Water System Master Plan

TEST #10
(8" CI 1958)

WEST YOST ASSOCIATES

Hydrant Test No. A1 (Zone 12)

Hydrant Test No. A1 was performed on Lake Drive, south of Amador Avenue. This test was intended to confirm the C-factor (initially assumed to equal 120) assigned to 6-inch diameter, CI pipelines constructed approximately in 1963.

Residual pressure readings from observed Hydrants A1C and A1D dropped to zero during testing. Typically this is an indication that the residual pressure readings are invalid. Without the pressure comparisons from Hydrants A1C and A1D, Test A1 simulates within the ±5 psi tolerance limit. Therefore, it is recommended that the data from Hydrants A1C and A1D not be used.

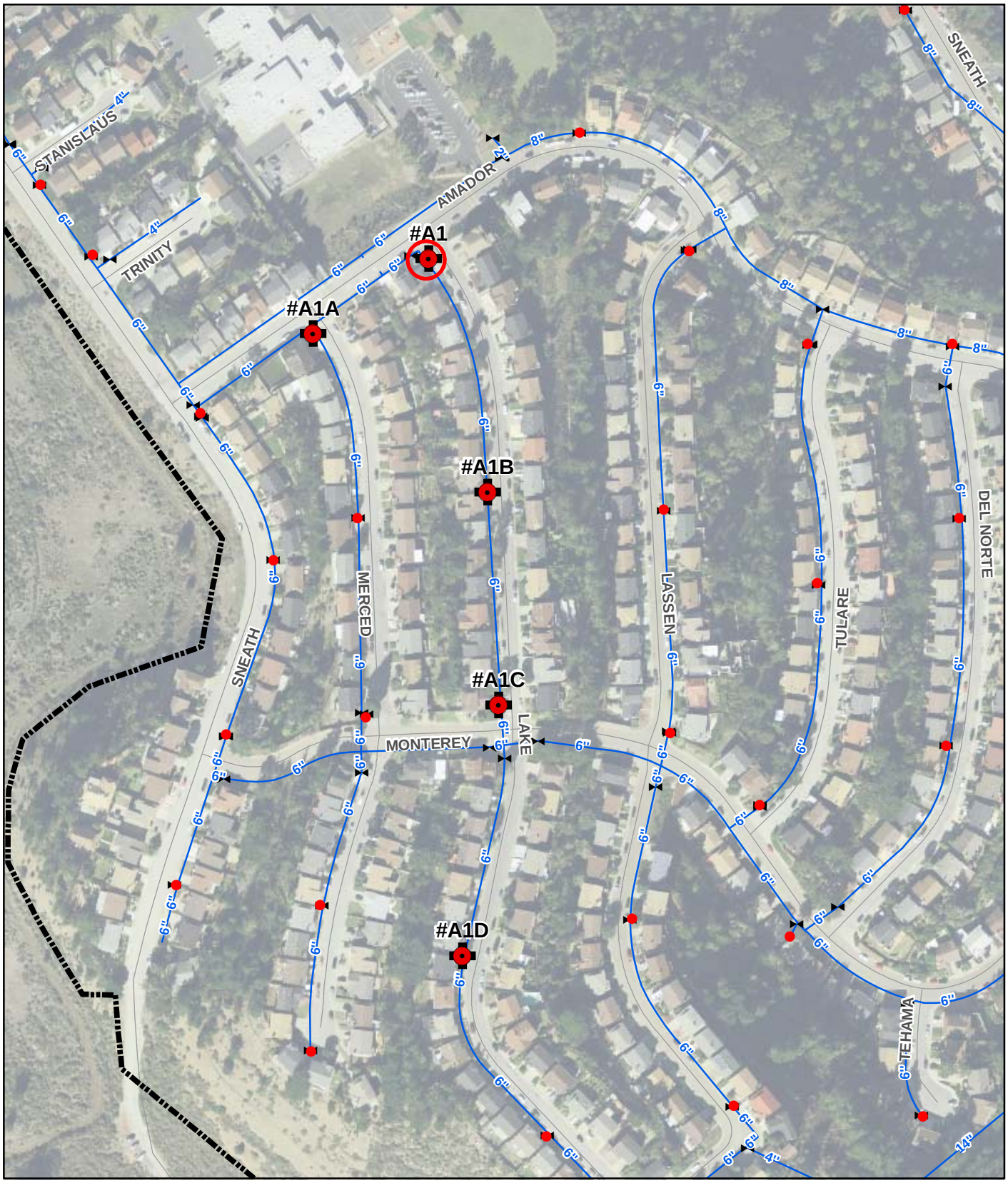
A comparison between the calibrated model results and the field data is shown in Table A-A1 and indicates that the use of a C-factor equal to 120 for 6-inch diameter CI pipelines, constructed between 1960 and 1969, is appropriate when the results from Hydrants A1C and A1D are removed.

Table A-A1. Hydrant Test No. A1

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]	110	NA	NA	108	NA	NA	NA
A1A[3]	112	22	90	111	23	88	2
A1B[4]	99	9	90	95	10	85	5
A1C[5]	85	0	85	82	7	75	10
A1D[6]	62	0	62	57	-5	62	--

(1) Location of fire hydrants can be found on Figure A-A1.
(2) The "Flowing Hydrant" is located on Lake Drive, south of Amador Avenue.
(3) Hydrant A1A is located on Merced Drive, south of Amador Avenue.
(4) Hydrant A1B is located on Lake Drive, south of flowing hydrant.
(5) Hydrant A1C is located on Lake Drive, north of Monterey Drive.
(6) Hydrant A1D is located on Lake Drive, south of Monterey Drive.
NA = Not Applicable

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG A-A1_HTA1.mxd 6/20/2011



LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-A1

City of San Bruno
Water System Master Plan

TEST #A1
(6" CI 1963)

WEST YOST ASSOCIATES

Hydrant Test No. A2 (Zone 7)

Hydrant Test No. A2 was performed on Crestmoor Drive, north of Piedmont Avenue. This test was intended to confirm the C-factor (initially assumed to equal 120) assigned to 8-inch diameter, AC pipelines constructed approximately in 1956.

A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrates that the pressures predicted by the model are within ±5 psi of the measured field value. A comparison between the calibrated model results and the field data is shown in Table A-A2 and indicates that the use of a C-factor equal to 120 for 8-inch diameter AC pipelines, constructed between 1950 and 1959, is valid.

Table A-A2. Hydrant Test No. A2

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]	34	NA	NA	44	NA	NA	NA
A2A[3]	40	14	26	44	15	29	-3
A2B[4]	41	16	25	49	22	26	-1
A2C[5]	45	23	22	42	18	24	-2

(1) Location of fire hydrants can be found on Figure A-A2.
(2) The "Flowing Hydrant" is located on Crestmoor Drive, north of Piedmont Avenue.
(3) Hydrant A2A is located on Crestmoor Drive, northwest of flowing hydrant.
(4) Hydrant A2B is located on Crestmoor Drive, northwest of Hydrant A2A.
(5) Hydrant A2C is located on Crestmoor Drive, southeast of Bryant Way.
NA = Not Applicable

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LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-A2

City of San Bruno
Water System Master Plan

TEST #A2
(8" AC 1956)

WEST YOST ASSOCIATES

Hydrant Test No. A3 (Zone 1/4)

Hydrant Test No. A3 was scheduled to be performed on Huntington Avenue, south of Euclid Avenue. This test was intended to confirm the C-factor (initially assumed to equal 75) assigned to 6-inch diameter, CI pipelines constructed approximately in 1920. This test was not performed in the field due to concerns about lack of water disposal locations identified by City staff. However, the C-factor for 6-inch diameter CI pipelines, constructed in the 1920s, was verified previously in Test 1.

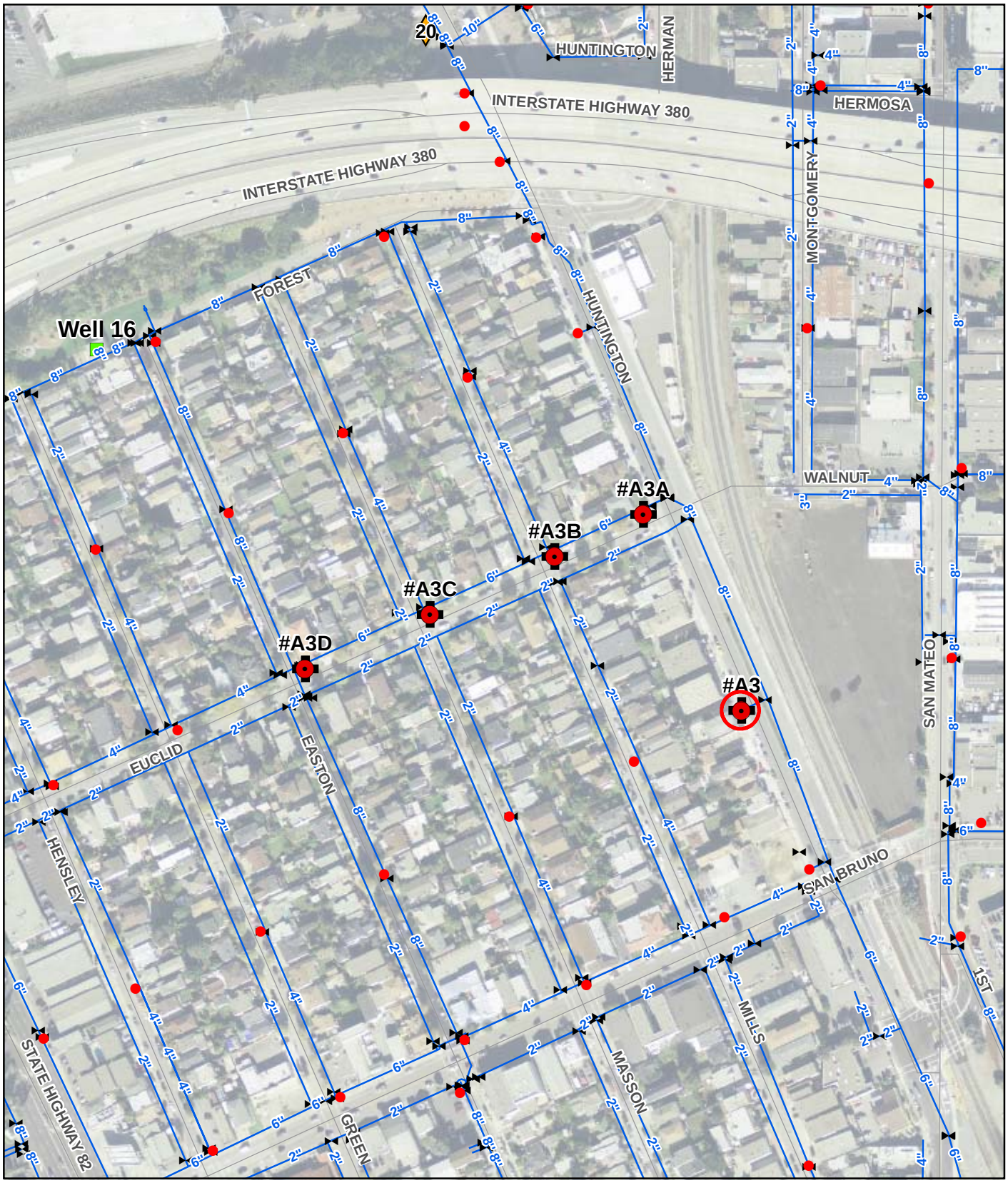
Table A-A3. Hydrant Test No. A3

Hydrant[1]	Field Data			Modeled Data			Comparison of Differential Pressures, psi (g = c-f)
	Static Pressure, psi (a)	Residual Pressure, psi (b)	Differential Pressure, psi (c = a-b)	Static Pressure, psi (d)	Residual Pressure, psi (e)	Differential Pressure, psi (f = d-e)	
Flowing[2]		NA	NA		NA	NA	NA
A3A[3]							
A3B[4]							
A3C[5]							
A3D[6]							

CANCELED

(1) Location of fire hydrants can be found on Figure A-A3.
(2) The "Flowing Hydrant" is located on Huntington Avenue, south of Euclid Avenue.
(3) Hydrant A3A is located on Euclid Avenue, west of Huntington Avenue.
(4) Hydrant A3B is located on Euclid Avenue, east of Mills Avenue.
(5) Hydrant A3C is located on Euclid Avenue, east of Masson Avenue.
(6) Hydrant A3D is located on Euclid Avenue, east of Easton Avenue.
NA = Not Applicable

W:\Clients\462 City of San Bruno\06-11-01 Water Master Plan\GIS\Figures\FIG A-A3_HTA3.mxd 6/20/2011



LEGEND

- Test Hydrant
- Hydrant
- Valve
- Existing Pipeline

N

0 125 250

Scale in Feet

FIGURE A-A3

City of San Bruno
Water System Master Plan

TEST #A3
(6" CI 1920)

WEST YOST ASSOCIATES

APPENDIX B

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.

All estimated construction costs have been adjusted to reflect December 2011 costs at an Engineering News Record (ENR) Construction Cost Index (CCI) of 10205 (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 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

1.1 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.

1.1.1 Storage Reservoirs

Table 1 summarizes the estimated construction costs for water storage reservoirs between the size range of 0.5 to 6.0 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 1. Construction Costs for Concrete Water Storage Reservoirs[a]	
Capacity, MG	Estimated Construction Cost, million dollars
0.5	2.3
1.0	2.7
2.0	3.6
3.0	4.4
4.0	5.3
5.0	6.2
6.0	7.0

[a] Based on December 2011 ENR CCI of 10205 (San Francisco Average).

1.1.2 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 zones. Estimated average construction costs for distribution pumping stations, as shown in Table 2, 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 2. Construction Costs for Booster Pump Stations[a]	
Firm Capacity[b], mgd	Estimated Construction Cost, million dollars
0.5	1.1
1	1.2
2	1.4
3	1.5
5	1.8
10	2.5

[a] Based on December 2011 ENR CCI of 10205 (San Francisco Average).
[b] Equal to the total pumping capacity with the largest pump assumed out of service or on standby (i.e., firm capacity).

1.1.3 Pipelines

Unit construction costs for potable water pipelines 8 through 14-inches in diameter are provided in Table 3. 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 3. Unit Construction Costs for Pipelines[a,b]

Pipeline Diameter, inches	Unit Construction Cost, $/linear foot
8	180
10	210
12	240
14	260

[a] Costs based on San Francisco peninsula pipeline cost estimates, scaled up to December 2011 ENR CCI of 10205 (San Francisco Average).
[b] Costs based on ductile iron cement-lined pipe.

1.1.4 Groundwater Production Wells

Well construction consists of pilot hole drilling, water quality/soil sampling, pilot hole reaming, well construction, well development and providing the necessary housing, pump, motor, automatic control equipment (SCADA), discharge piping, and disinfection equipment. Construction costs for new groundwater wells are estimated to be approximately $1,540,000 per well. This cost is representative of construction conducted under normal drilling conditions, and would be significantly higher for special or difficult locations.

1.1.5 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 $270,000. 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.

1.1.6 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 $230,000. This cost is representative of construction conducted under normal conditions, and would be significantly higher for special or difficult conditions.

1.2 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 were developed based on the City's 2001 Water System Master Plan Update including minor adjustments.

- Design and Construction Contingencies: 30 percent
  There may be changes during the design phase resulting from decisions by City staff or discovery of interfaces 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.
- Professional Services: 25 percent
  For professional services, 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 contingency cost 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 4. 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 4. 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
Professional Services		
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 Professional Services Total		$325,000
Estimated Total Project Cost		**$1,625,000**

[a] Assumed cost of an example project.