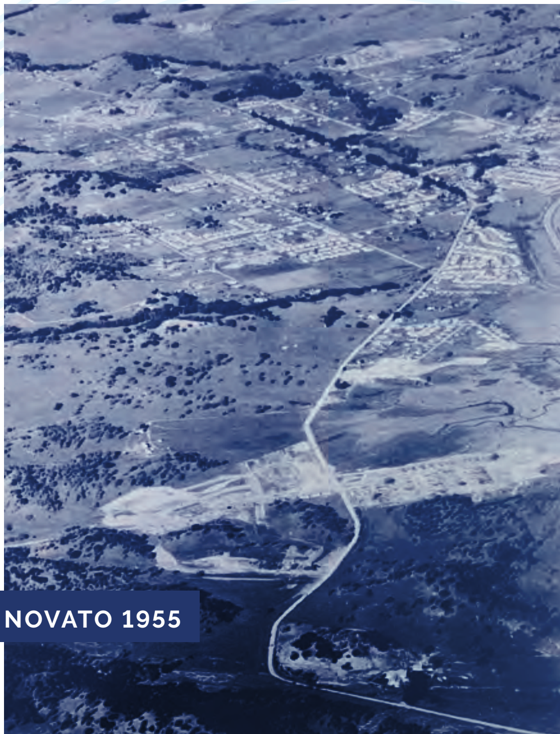

NOVATO 1955

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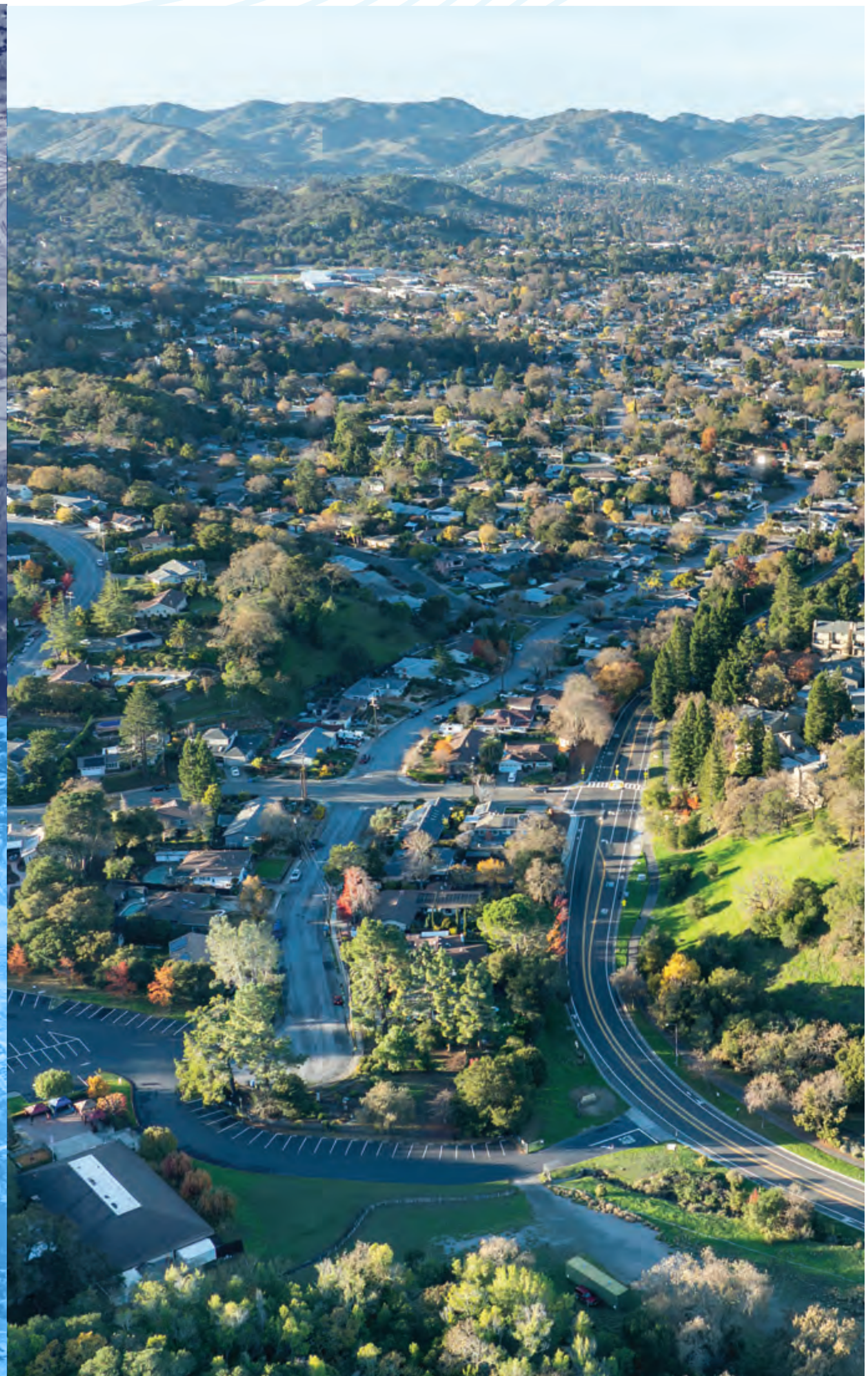

NOVATO 2025

2025

Novato Water System Master Plan Update

North Main Water District

NORTH MARIN WATER DISTRICT

DRAFT January 9, 2026

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Executive Summary

EXECUTIVE SUMMARY

ES.1 INTRODUCTION

North Marin Water District (District) has prepared this 2025 update of the Novato Water System Master Plan (Master Plan) to guide immediate and planned future system improvements. This Master Plan update identifies necessary system improvements for current operation, expands asset management methodologies, updates future water demand forecasts based on current State Housing Mandates, and integrates risk and resilience standards to improve the overall reliability of the Novato Water system. Separate and stand-alone Master Plans are developed for the District's West Marin Water System and Oceana Marin Wastewater System.

ES.2 EVALUATION CRITERIA AND SYSTEM PERFORMANCE

To evaluate the District's overall performance of its system, the key criteria were developed to evaluate both existing system configuration performance and to inform evaluation of future system performance as new development within the Novato Water system. By establishing uniform criteria, the Master Plan evaluation can identify potential performance deficiencies, informing the development of capital improvement projects to address and rectify these deficiencies.

ES.3 LOCAL WATER SUPPLY

The Local Water Supply section provides an overview of the District's water supply facilities and sources in its Novato water service area, along with the availability and reliability of the water supplies as presented in the District's 2020 Urban Water Management Plan (UWMP). Key sections include, Existing Supply Sources, Existing Stafford Lake Facilities, Water Supply Constraints, Water Supply Resiliency, and Recommended Water Supply Improvement Projects.

ES.4 EXISTING NOVATO WATER SYSTEM

The existing distribution system facilities of the Novato Water System are described to document key components including age of those components. The Master Plan also includes a general overview of system operation. West Marin Water System and Oceana Marin Wastewater System are not included within this section

ES.5 EXISTING NOVATO RECYCLED WATER SYSTEM

The recycled water system allows the District to reduce potable water use to meet large non-potable demands such as irrigation. The recycled water system has been in operation since 2007, but large-scale expansion is not anticipated at the time of preparation of this Master Plan. For future developments, the District will assess the potential of utilizing recycled water. The District requires that developers bear all costs associated with expansion and/or connection to the recycled water system.

ES.6 HISTORICAL WATER DEMANDS AND DEMAND FORECASTS

The historical, current, and forecast buildout water demands for the District's Novato Water System are presented to support evaluation of existing system performance and project the potential increase demands on the system based on potential develop. The forecasted buildout demands are separated into two categories near term and a full buildout scenarios. In addition, the Infrastructure Planning Demands are established to balance historical demands and future development that will be expected to comply with current regulations related to water use.

ES.7 STORAGE AND PUMPING CAPACITY EVALUATION

The Master Plan includes analysis to confirm whether the Novato Water System has sufficient pumping and storage capacity to meet the operational and emergency planning needs for the customers and for future expansion. The Infrastructure Planning Demands established as part of the Historical Water Demands and Demand Forecasts is used to evaluate the current system performance with future system performance evaluated by adding near term buildout projections.

ES.8 OPERATIONAL STRATEGY

An overview of key operational procedures is presented in this section to provide an overview of water system operations. The key procedures described inform the performance evaluation of the distribution system.

ES.9 HYDRAULIC EVALUATION

The hydraulic evaluation of the Novato Water System was conducted utilizing the hydraulic model that was created as part of the 2018 Master Plan update. The model was previously created utilizing GIS data and includes the entire system. An analysis of existing conditions and future conditions were evaluated to identify hydraulic adequacy under two demand conditions, including a Peak Hour Demand and a Maximum Day Demand plus fire flow evaluation. System improvement projects were identified to address distribution system hydraulic improvements.

ES.10 WATER QUALITY EVALUATION

Ensuring water quality is one of the primary goals of the District and was listed in the District's 2018 Strategic Plan as an ongoing need. Policy supports this goal with Board and management commitment to meeting or exceeding all US Environmental Protection Agency (EPA) and California Water Board Division of Drinking Water (DDW) regulatory requirements. Water quality is monitored by the Water Quality Division, whose responsibility is to provide oversight to all District activities as they relate to water quality. Section 10 presents information on the current water quality and provides recommendations for operational modifications and capital improvements related to water quality in the Novato Water System.

ES.11 ASSET MANAGEMENT

A key focus of the Master Plan was to enhance the District's Asset Management (AM) Program. The overall goal of the AM Program and this chapter is to establish a consistent, repeatable process for District staff to manage Novato water system assets in a way that delivers defined levels of service at the lowest lifecycle cost.

ES.12 NATURAL HAZARD RISK AND RESILIENCE ASSESSMENT

The District made the efforts to assess the natural hazard risks to and resilience of the Novato Water System (facilities and pipelines). Through this process, the District identified the most critical and vulnerable assets serving the Novato water service area, identified the District's current risk and resilience management practices and investments, and identified additional investment opportunities to improve resilience. The Master Plan identifies backbone facilities and pipelines and the relevant natural hazards that could impact the District's ability to meet its mission and maintain its critical functions. The Natural Hazard Risk and Resilience Assessment summarizes a risk-based system for prioritizing the most urgent risk-reduction projects, known as risk and resilience management strategies (RRMS). The overall assessment of District facilities in this Section is known as Natural Hazard Risk and Resilience Assessment (NHRRA).

ES.13 CAPITAL IMPROVEMENT PROGRAM

The final outcome of the Master Plan effort is the creation of the capital improvement program (CIP) developed to address the various deficiencies and new development demands identified in earlier sections. The CIP balances increase funding needs to address the deficiencies identified in the Master Plan by prioritizing improvement needs that could negatively affect the District's ability to deliver safe and clean drinking water reliably.

SECTION 1

Introduction

SECTION 1
Introduction

1.1 PURPOSE OF STUDY

North Marin Water District (District) has prepared this 2025 update of the Novato Water System Master Plan (Master Plan) to guide immediate and planned future system improvements. The previous Master Plan was updated in 2018. This Master Plan update identifies necessary system improvements for current operation, expands asset management methodologies, updates future water demand forecasts based on current State Housing Mandates, and integrates risk and resilience standards to improve the overall reliability of the Novato Water system. The 2025 Master Plan update is meant to expand the Master Plan from previous versions while recognizing that some new sections incorporated in this Master Plan update will be expanded in future updates. The 2025 Master Plan is intended to be a dynamic document in which the District can modify and update as new information, data, and practices are gathered and implemented. The Master Plan update includes a proposed Capital Improvement Program (CIP) that identifies the improvement projects and required funding throughout the planning period through Fiscal Year 2054/2055 (FY 54/55). Separate and stand-alone Master Plans are developed for the District's West Marin Water System and Oceana Marin Wastewater System.

Projects contained in the CIP are separated by budget category utilized in the District budgeting process. Projects are identified for the following categories.

Category 1	Pipelines
Category 2	Storage Tanks and Pump Stations
Category 3	Stafford Improvements
Category 4	Miscellaneous Improvements
Category 5	Recycled Water System
Category 6	Studies and Special Projects

Proposed projects related to water conservation and projects related to Stafford and other District facilities (Categories 3 & 4) and the Recycled Water System (Category 5) are beyond the scope of the master plan and new projects to supplement those projects presented in the five-year CIP and included in the FY 25/26 budget were not identified.

1.2 MAJOR MODIFICATIONS SINCE PREVIOUS PLANS

The 2002 Master Plan was prepared by the District to develop a long-range strategic plan for identifying and implementing necessary capital projects in the water transmission and distribution system. The 2002 Master Plan included consolidation of various recent planning efforts, development and calibration of hydraulic network models of the most critical pressure zones, development of a procedure and approach for quantifying current water consumption by zone, tracking new development within the District boundaries and projecting water demands through buildout. The result of the work was a CIP that identified a phased plan for implementing recommended capital projects.

The 2007 Master Plan update built on the original master plan, with updated historical water production records, updated development and water demand projections, and an updated hydraulic analysis utilizing the hydraulic models incorporating new system facilities that had been constructed since 2002. In addition, an asset management section was added to summarize the

District's efforts to collect data on existing infrastructure and create a reasonable plan to replace aging facilities.

The 2012 Master Plan update again built on the original (2002) master plan with updated water production records, updated development and buildout water demand projections, and incorporated a skeletonized hydraulic model using open-platform modeling software (EPANET) for analysis. A more comprehensive asset management section was included to reflect the District's shift in focus from new development to infrastructure replacement, and provided metrics related to historic maintenance and replacement costs.

The 2018 Master Plan update incorporated a fully developed hydraulic model of the entire Novato Service Area. The model includes the entire pipe and valve network, detailed information on the water storage tanks, pump stations, and pressure regulating devices. The hydraulic model leveraged Geographic Information System (GIS) data for the Novato Service Area. Previous master plan updates were based on less robust modeling information but the 2018 Master Plan update provided greater detail for making more informed decisions on how to spend limited capital funds to greatest benefit.

The 2025 Master Plan (the Master Plan) update builds on the 2018 Master Plan update with a further refined and updated hydraulic model, asset management enhancement, and integrated vulnerability analysis. This Master Plan update expands on previous asset management enhancements reflecting the District's investment in the NexGen Utility Management software to establish critical metrics for informing operational and infrastructure replacement strategies. Additionally, the 2025 Master Plan update incorporates new chapters to document previous District efforts and expanded focus including but not limited to resiliency, operational strategies, local water supplies, and recycled water systems to the discussion.

1.3 SCOPE OF PROJECT

The scope of work consisted of multiple discrete tasks focused on a particular topic. The following major tasks were performed for this project:

Task 1	Revise Existing Sections
Task 2	Prepare Water Supply Section
Task 3	Prepare Recycled Water Section
Task 4	Enhance Historical Water Demands and Demand Forecasts Section
Task 5	Prepare Operational Strategy Section
Task 6	Enhance Existing Hydraulic Evaluation Section
Task 7	Enhance Water Quality Section
Task 8	Enhance Asset Management Section
Task 9	Prepare Vulnerability Assessment and Resilience Plan Section
Task 10	Enhance Existing Capital Projects Evaluation Section
Task 11	Enhance Existing Capital Improvement Program Section

1.4 PROJECT TEAM

The project was performed as a collaborative effort between District staff, Freyer & Laureta Inc., Kennedy Jenks Consultants, and West Yost Associates Inc.

1.5 LIST OF ABBREVIATIONS

The following abbreviations were utilized in the report and are defined below.

Abbreviation	Definition
ACP	Asbestos Cement Pipe
ADPM	Average day peak month
AF	Acre feet
AFY	Acre feet per year
AFA	Annual acre feet
AM	Asset Management
AOC	Assimilable organic carbon
APT	Apartment
AVG	Average
AWIA	American Water Infrastructure Act
AWWA	American Water Works Association
BCP	Business Continuity Plan
CAP	Climate Adaptation Plan
CC	City/County Coordination
CCI	Construction Cost Index
CFS	Cubic feet per second
CI	Cast Iron
CIP	Capital Improvement Program
CL2	Chlorine
COP	Copper
CREAT	Climate Resilience Evaluation and Awareness Tool
CRMM	Climate Resilience Maturity Model
DBP	Disinfection By-products
DBPR	Disinfection By-Product Rule
DCMS	Distributed Control and Monitoring System
DPH	California Department of Health Services
DIP	Ductile Iron Pipe
DP	District Planning
DSOD	Division of Safety of Dams
DU	Dwelling unit
Ea	Each
EDU	Equivalent Dwelling Unit
ENR	Engineering News Record
EPA	Environmental Protection Agency
F&L	Freyer & Laureta Inc.
fps	Feet per second

Abbreviation	Definition
FRI	Financial Resilience Index
Ft	Foot, feet
FY	Fiscal Year
GAC	Granular Activated Carbon
GASB	Governmental Accounting Standards Board
gal	Gallons
GHG	Green House Gas
GIS	Geographic Information System
Gpd	Gallons per day
gpm	Gallons per minute
HA	Hydraulic Analysis
HAA	Haloacetic acids
HAFB	Hamilton Air Force Base
HDPE	High Density Polyethylene
HGL	Hydraulic Grade Line
HMP	Hazard Mitigation Plan
HP	Horsepower
ICS	Incident Command System
In	Inch
ISO	Insurance Services Organization
ISO 31000	International Organization for Standardization 31000
KJ	Kennedy Jenks Consultants
kW	Kilowatt
LGVSD	Las Gallinas Valley Sanitary District
LIMS	Laboratory Information Management System
LTESWTR	Long-term Enhanced Surface Water Treatment Rule
LWSES	Local Water Supply Enhancement Study
M/DBP	Microbial/Disinfection By-Product
MCL	Maximum contaminant level
mg	Million gallons
mg/l	Milligrams per liter
mgd	Million gallons per day
MH	Mobile Home
MMWD	Marin Municipal Water District
MOU	Memorandum of Understanding
ND	Non-detectable
NFPD	Novato Fire Protection District
NHRRA	Natural Hazard Risk and Resilience Assessment
NIMS	National Incident Management System
NMWD	North Marin Water District
NPV	Net Present Value
NSD	Novato Sanitary District
O&M	Operations and Maintenance

Abbreviation	Definition
ORI	Operational Resilience Index
PB	Polybutylene
PG&E	Pacific Gas and Electric
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
POU	Point-of-use
PR	Pressure Regulator
PS	Pump Station
psi	Pounds per square inch
PVC	Poly Vinyl Chloride
PVP	Potter Valley Project
RAA	Running annual average
RCP	Concrete Pressure Pipe
RRA	Risk and Resilience Assessment
RRMS	Risk and Resilience Management Strategy
SCADA	Supervisory Control and Data Acquisition
SCWA	Sonoma County Water Agency (aka Sonoma Water)
SDWA	Safe Drinking Water Act
SF	Single family
SP	Storage and Pumping Capacity Analysis
SS	Sanitary sewer
State Water Board	State Water Resource Control Board
STL	Steel
STP	Stafford Treatment Plant
SWTR	Surface Water Treatment Rule
TAP	Threat-Asset Pair
TDH	Total Dynamic Head
THC	Townhome /condominiums
THM	Trihalomethane
TOC	Total Organic Carbon
TTHM	Total trihalomethane
ug/l	Micrograms per liter
URI	Utility Resilience Index
UWMP	Urban Water Management Plan
VFD	Variable Frequency Drive
WQE	Water Quality Evaluation
WTP	Water Treatment Plant
WUI	Wildland Urban Interface
WY	West Yost Associates Inc.

SECTION 2

Evaluation Criteria and System Performance

SECTION 2
Evaluation Criteria and System Performance

This section provides an overview of the key criteria that will be used in subsequent sections to evaluate the overall performance of the Novato Water System. By establishing uniform criteria, the Master Plan evaluation can identify potential performance deficiencies to inform development of capital improvement projects to address the identified deficiencies.

2.1 INTRODUCTION

The evaluation criteria used to assess the performance of the Novato Water System are presented within this section. To perform the hydraulic evaluation of the existing and buildout water system, conduct storage and pumping capacity evaluations, and to develop Capital Projects related to system performance, evaluation performance criteria were selected to identify deficiencies and to rank the effectiveness of alternative improvements. Performance and evaluation criteria include:

- Water demand peaking factors for average day peak month (ADPM), maximum day (MDD) and peak hour (PHD) demands for use in developing current and buildout water demands
- Water system operating criteria, including minimum and maximum distribution system pressures and minimum and maximum pipeline velocities and head loss under various demand scenarios
- Storage capacity goals
- Pumping capacity goals
- System reliability goals
- Accepted operational reliability
- Level of service
- Water Service Extension

The performance and evaluation criteria are summarized in Table 2-1 and further described herein. Note that condition assessment criteria and analysis can be found in Section 9, Asset Management.

Table 2-1: Evaluation Criteria

Item	Criteria
Peaking Factors	• Average day peak month (ADPM) demand = annual average day x 1.6 • Maximum day demand (MDD) = annual average day x 1.6 • Peak hour demand (PHD) = annual average day x 2.8
Minimum pressure	• 40 psi under average day demand • 35 psi under maximum day demand • 20 psi at fire hydrant under fire event
Maximum pressure	• 80 psi (services with greater static pressure require a pressure regulator)
Maximum pipeline velocity	• 8 feet per second (fps) under average day demand (less than 16-inch diameter) • 5 fps under average day demand (16-inch or greater diameter) • 10 fps under maximum day or fire demand
Maximum pipeline head loss	• 3 feet per 1,000 feet under average day demand • 10 feet per 1,000 feet under maximum day demand
Fire flow/storage goals	• 3,500 gpm for three hours (parcels designated as commercial/industrial/institutional or multi-family within Zone 1 and 2) • 1,500 gpm for all other zones
Storage capacity goals	• Storage capacity goal per zone is sum of operational, fire and emergency storage volumes • Operational storage = 25% of maximum day demand • Fire storage = see above • Emergency storage = 100% of maximum day demand
Pumping capacity goals	• Firm Capacity = a pump station's capacity with the largest pump out of service. • District goal: size pumping facilities such that all pump stations have a firm capacity equal to (or greater than) the max day demand • Design consideration to conserve energy, maintain the efficiency of pumps, and the associated cost of peak period operations by pumping over a 16-hour duration.

2.2 WATER DEMAND PEAKING FACTORS

Peaking factors represent the increase above the average annual demand experienced during a specified time period. The various peaking conditions are statistical concepts or numerical values obtained from a review of historical data and, at times, tempered by engineering judgment. The following peaking conditions are of particular significance to hydraulic analysis of the water system as defined in chapter 4.

Average Day Peak Month (ADPM) demand describes a system's average daily usage during its single highest-demand month. This peaking factor recognizes that different customer groups may peak at different times, so it specifically isolates the average daily demand within the month where overall demand is highest.

Maximum Day Demand (MDD) is the highest amount of water used within a 24-hour period in a year, excluding fire flow, and is influenced by factors such as population, weather, and user classification. This peaking factor is useful to ensure that the system has sufficient supply and capacity even under peak conditions.

Peak Hour Demand (PHD) is the highest amount of water used in a single hour, usually occurring during the maximum day. This peaking factor is useful to ensure that the system can handle peak demands to prevent pressure loss and maintain water quality.

A further analysis of the water demand peaking factor breakdown can be found in Section 7.

2.3 HYDRAULIC NETWORK MODELING

Hydraulic models of Zone 1 and Zone 2 were previously prepared for the 2002 Master Plan and revised for the 2007, 2012, and 2018 Master Plan updates. These models are a representation of the Novato Water Distribution System, including pipeline facilities, water storage facilities, and pumping facilities. Each successive update incorporated new data obtained since the prior update. The hydraulic modeling for this Master Plan update relies on a fully built-out GIS for the entire Novato Service Area, resulting in a comprehensive model of the entire Novato system in which all pressure zones are analyzed simultaneously and in concert with each other. A more detailed description of the model preparation and proposed use of the model is included in Section 7.

2.4 WATER SYSTEM OPERATING CRITERIA

The following operating criteria was used to evaluate system operation and hydraulic analysis.

2.4.1 Distribution System Pressure

In accordance with District Regulation 11 and District Regulation 12, the respective minimum and maximum operating pressure under normal conditions for the Novato Water System is 40 psi and 80 psi, measured at the service meter or building pad. Service connections with less than 40 psi pressure are designated "low-pressure services" and will be furnished only in accordance with Regulation 11.

Service connections greater than 80 psi are designated "high-pressure services" and will be furnished only in accordance with Regulation 12. Services with normal static pressure greater than 80 psi are required to install a pressure regulating device. The maximum design pressure in distribution system pipelines is 150 psi unless special conditions mandate otherwise.

In evaluating the water system hydraulic operation, the minimum allowable pressure under MDD conditions is 35 psi and the minimum residual pressure at the fire hydrant under fire demand conditions is 20 psi.

2.4.2 Pipeline Flow and Velocity

Distribution system pipelines are sized to carry the greater of: 1) PHD; or 2) MDD plus fire flow. For most water systems including the Novato Service Area, MDD plus fire flow represents the most challenging condition to meet. Per the District's Regulation 21, the minimum pipeline diameter is 6 inches. Minimum distribution system pipe sizing in commercial and industrial areas is 12 inches. All pipe segments with a single fire hydrant shall be a minimum of 6 inches diameter; however, larger pipe diameters are preferred.

One other important factor related to the distribution system piping includes maximum velocity, which along with pipe diameter affects friction head losses. Pipeline velocity for distribution pipelines less than 16-inch diameter should be limited to approximately 8 fps under normal operation, while transmission pipelines 16 inches and greater in diameter should limited to 5 fps under normal operating conditions. Velocities could increase to approximately 10 fps without damage if not sustained for long periods.

In most situations, as long as the maximum velocity and pressure criteria are met, high head loss by itself is not an important factor. However, a pipe segment with high head loss may serve as a warning that the pipe is nearing the limit of its carrying capacity and may not have excess capacity to perform during peak demand conditions. It is good practice to limit head loss to no greater than 10 feet per 1,000 feet under MDD or fire flow conditions. Head loss should be limited to approximately 3 feet per 1,000 lineal feet of pipe under average day demand conditions.

2.5 WATER SUPPLY FACILITIES

Typically, water supply sources must be large enough to meet the various water demand conditions and be able to meet some demand during emergencies such as power outages and natural disasters. Ideally, water supply sources should meet the MDD. The diurnal fluctuations during the MDD are met by gravity storage capacity.

2.6 STORAGE FACILITIES

The detailed storage capacity evaluation is presented in Section 7 but the following criteria serves as a guideline for the analysis. Storage capacity goals for each zone consists of four components:

- Operational storage volume
- Fire storage volume
- Emergency storage volume
- Water quality

The sum of these four components is the total storage capacity for the specific pressure zone. The total storage capacity goal is compared to the existing storage capacity to determine if a surplus or deficit exists within the zone.

2.6.1 Operational Storage Volume

Operational storage volume is the amount of storage capacity required in a system to absorb fluctuations of demand versus supply. Ideally, water supply sources are sized to provide the MDD, with gravity storage capacity delivering the remainder during peak hourly demand periods. With adequate operational storage capacity, system pressures are stabilized and adequate storage can be provided for fire and emergency use. Operational storage capacity is assumed to be 25 percent of the MDD for each pressure zone.

2.6.2 Fire Storage Volume

Fire storage volume is provided for fire-fighting purposes to allow gravity flow in the event the source flow is interrupted. Fire storage volumes vary and are based on the specified fire flow rate for a specified duration as described above.

Fire flow rates are normally based on the requirements of the local Fire Marshal and Insurance Services Office (ISO) requirements. Fire flows are defined as a specified flow rate for a specified duration of time based on the structure size, type of building construction and land use.

The District and the Novato Fire Protection District (NFPD) have cooperatively outlined the following fire flow goals.

- 1,500 gpm (for two hours) for high hazard residential areas, including wildland urban interface (WUI) areas vulnerable to wildfires and areas with poor accessibility for fire-fighting capability,
- 1,500 gpm (for two hours) for all other residential areas.
- For commercial/industrial/institutional areas fire flow shall be 3,500 gpm (for three hours), with the total flow delivered from two to four hydrants.
- 3,500 gpm (for two hours) in the Buck Zone.

Based on the representative land use in each of the pressure zones, previous District experience, and in collaboration with NFPD, the District has adopted the following fire flow rates and fire storage volume goals for each pressure zone shown in Table 2-2.

Table 2-2: Fire Flow and Fire Storage Volume Goals

Service Area	Pressure Zone	Area Type(2)	Fire Flow Standard 2025	Fire Storage Goal(3) (gallons)
No. Novato Subzone	1	Comm	3500 gpm for 3 hrs	630,000
So. Novato Subzone	1	Comm	3500 gpm for 3 hrs	630,000
Zone 1 Total(1)	1	Comm	3500 gpm for 3 hrs	630,000
San Mateo/Trumbull Subzone	2	Comm	3500 gpm for 3 hrs	630,000
Sunset/Pacheco Subzone	2	Comm	3500 gpm for 3 hrs	630,000
Primary Zone 2 Total(1)	2	Comm	3500 gpm for 3 hrs	630,000
Crest	2	WUI	1500 gpm for 2 hrs	180,000
Black Point	2	WUI	1500 gpm for 2 hrs	180,000
Airbase	-	Comm	3500 gpm for 3 hrs	630,000
Cherry Hill	3	WUI	1500 gpm for 2 hrs	180,000
Half Moon	3	WUI	1500 gpm for 2 hrs	180,000

Table 2-2: Fire Flow and Fire Storage Volume Goals

Service Area	Pressure Zone	Area Type(2)	Fire Flow Standard	Fire Storage Goal(3) (gallons)
			2025	
Wild Horse Valley/Center Rd	3	WUI	1500 gpm for 2 hrs	180,000
Garner	3	WUI	1500 gpm for 2 hrs	180,000
Old Ranch Road	3	WUI	1500 gpm for 2 hrs	180,000
Dickson	3	WUI	1500 gpm for 2 hrs	180,000
Winged Foot	3	WUI	1500 gpm for 2 hrs	180,000
Ponti	3	WUI	1500 gpm for 2 hrs	180,000
San Andreas	3	WUI	1500 gpm for 2 hrs	180,000
Nunes	3	WUI	1500 gpm for 2 hrs	180,000
Buck	4	Comm	3500 gpm for 2 hrs	420,000
Upper Wild Horse(4)	4	n/a	n/a	0
Cabro Ct(4)	4	n/a	n/a	0
San Antonio (WCW)	misc.	Res	1500 gpm for 2 hrs	180,000
Windhaven(4)	misc.	n/a	n/a	0

1 Zone 1 total and Primary Zone 2 total represents hydraulically connected subzones.
2 Area types: Comm=Commercial, WUI=Wildland Urban Interface, Res=Residential
3 Indicates a fire flow goal for a specific duration to determine storage capacity volume.
4 No fire storage capacity is provided in tank. Tank is for domestic use only.

For the 2012 Master Plan Update, the Fire Flow Standard was revised from the 2007 Update to meet the 2010 California Fire Code for 10 of the 17 pressure zones. In Novato, all non-commercial pressure zones have been categorized as WUI/residential areas. While some pressure zones had been assigned this fire flow goal previously, others, such as Nunes and Dickson, were still showing the fire flow goal used during tank design, which is now outdated. All District potable water tanks are designed in cooperation with the NFPD, but for some tanks the fire storage component does not meet the current goal, as the fire code has been updated throughout the years.

Fire flow goals represent flows over a specific duration for the purpose of determining fire storage capacity. It is desirable to provide the fire flow goal everywhere in the distribution system; however, there are several locations within the system that cannot meet the fire flow goals due to small diameter pipelines or the piping configuration in that vicinity. It is not always possible to make improvements for all locations that cannot meet the updated fire flow goals.

2.6.3 Emergency Storage Volume

Emergency storage volume is the storage volume available to meet demand during emergency situations such as pipeline failures, major trunk main failures, pump failures, electrical power outages or other natural disasters. The volume of water allocated for emergency use is determined by historical record of emergencies experienced and by the amount of time which is expected to lapse before the emergency can be mitigated. The amount of emergency storage volume included within a particular water system is District-specified, based on an assessment of risk and the desired degree of system reliability. In California, emergency storage volumes range from 25 percent of average day demand to over 100 percent of MDD. The lower criterion would apply to systems with a single pressure zone, adequate and reliable water supply sources (usually with emergency power), and redundant sources. If some, or all, of these criteria do not apply, it is appropriate to use a higher figure.

The District has adopted a criterion of providing emergency storage capacity equivalent to one MDD for each pressure zone.

2.7 PUMPING FACILITIES

Providing adequate storage capacity is only one distribution system element that benefits system operation. Adequate pumping capacity must also be provided to enable the storage tank to recover depleted volume within a reasonable time frame. Undersized pumps may reduce the effectiveness of storage capacity. An analysis of pumping capacity is presented in Section 7.

To account for outages, routine maintenance procedures, and peak energy use periods, the District has adopted a criterion that all pump stations must have a firm capacity to pump the MDD over a 16-hour interval. Firm capacity is defined as the pump station capacity with one pump out of service. The District's goal is to have at least two pumps at each booster pump station.

2.8 RELIABILITY CRITERIA

Reliability criteria have been established for the major facilities and operation of the water system to provide a level of reliability for the system.

2.8.1 Water Sources

It is preferable to have more than one source of water supply for a water system to provide redundancy should one source be lost. The main supply source, Russian River water supplied via the Sonoma County Water Agency, is augmented by local Stafford Lake storage. Stafford Lake has supplied approximately 1,600 AF per year over the last 20 years, which is used primarily during warm weather months to offset peak Russian River demands. The minimum pool at Stafford Lake holds 1,400 AF, providing 90 days of STP production. Surface water treatment byproduct (sludge/supernatant) export from STP into the Novato Sanitary District's collection system is capped during wet weather months, which results in limited reliability of that water source during those months.

2.8.2 Pump Stations

District standard design practice includes review of pump efficiency, an adequate number of pumps, and emergency situations. Typically, the District configures pump stations to include a redundant pump, available for emergency and maintenance situations, while also ensuring the facility can provide 100% of the required capacity. In normal operations, the primary and redundant pumps alternate usage to ensure no single pump is used more than another. Additional reliability is provided by standby power. The District has made provisions for emergency standby power at the key Zone 2, 3 and 4 pump stations. Further analysis is presented in Section 13.

Standby power is in the form of portable generators deployed to a given site and connected to the pump station via generator transfer switches. Deployment of portable generators is limited by the number of generators on-hand, staffing capabilities, and access to the site. The District installed a battery backup at the San Marin Pump Station in 2024 and will continue to explore opportunities for enhancing standby power capabilities when appropriate.

2.8.3 Storage Tanks

Water storage capacity provides gravity supply of demands if a pump station is off-line or out of service. The District prefers to have at least two storage tanks for each pressure zone to allow one tank to remain in service while one is taken out of service for maintenance or repairs. All new tanks are designed to meet all seismic codes and safety requirements. Existing tanks not meeting current seismic codes and safety requirements have been evaluated and the seismic upgrade recommendations are further discussed in Section 13.

2.8.4 Distribution System Pipelines

The distribution system should be adequately looped to minimize dead ends and promote good water circulation. Ideally, there should be at least two paths for water delivery at all locations in the system. Looping is especially important for those areas that do not have storage facilities in the immediate vicinity.

Isolation valves should be located to allow shutdown of pipe segments enabling routine maintenance and emergency repairs which impact the fewest customers.

Cathodic protection is beyond the scope of this master plan. A future master plan should consider including an assessment of cathodic protection, or a standalone assessment should be performed.

SECTION 3

Local Water Supply

SECTION 3
Local Water Supply

This chapter provides an overview of the District's water supply facilities and sources in its Novato water service area, along with the availability and reliability of the water supplies as presented in the District's 2020 Urban Water Management Plan (UWMP). Key sections of this chapter include:

- Existing Supply Sources
- Existing Stafford Lake Facilities
- Water Supply Constraints
- Water Supply Resiliency
- Recommended Water Supply Improvement Projects

3.1 EXISTING SUPPLY SOURCES

Water supply for the District's Novato service area comes from two primary sources: (1) Russian River water supplied by SCWA; and (2) surface water stored in Stafford Lake. These water supply sources are described in detail in the District's 2020 UWMP and summarized below.

3.1.1 Russian River Supply

The primary water supply for the District's Novato water service area is treated water from SCWA's Russian River Project. Since 1961, the District has received this water supply under a contractual arrangement with SCWA. As shown on Figure 3-1, the District is one of eight retail water providers, including the Cities of Santa Rosa, Rohnert Park, Cotati, Petaluma, Sonoma, the Town of Windsor, and Valley of the Moon Water Districts, that receive Russian River water from SCWA. Although the Forestville County Water District and Marin Municipal Water District also receive water, they are not designated as water contractors as they have different agreements with SCWA. Russian River water is delivered to the District through the North Marin Aqueduct, a mortar-lined and tape wrapped steel transmission main extending from the Kastania Pump Station near Petaluma to the connection to the NMWD transmission/distribution system located north of San Marin Drive.

Russian River water originates in Mendocino County and is derived from both the Eel River (via Pacific Gas and Electric's Van Arsdale diversion at Cape Horn Dam feeding water through a 1.6 mile tunnel to the Potter Valley Powerhouse on the east fork of the Russian River) and the 1,485 square mile Russian River watershed, which includes most of Sonoma County and extends into Mendocino County to the northeast of the City of Ukiah. Just downstream of the Pacific Gas and Electric Company (PG&E) Potter Valley powerhouse, the Eel River diversions and winter runoff from the local watershed are impounded by Coyote Dam in Lake Mendocino, which is owned and operated by the U.S. Army Corps of Engineers. Releases are made during summer months into the Russian River.

At a point about 10 miles upstream of Guerneville on the Russian River, water is collected near the Wohler Pumping Plant by six thirteen-foot diameter collector wells (called Ranney Water Collectors). These deep wells collect river water that has been filtered through 60 to 90 feet of natural sand and gravel through perforated pipes that extend radially at the bottom of each well to a maximum horizontal distance of 175 feet. The thick layer of sand and gravel through which the water must pass before reaching the intake pipes provides a highly-efficient, natural filtration process which, with chlorination treatment, produces a clear, potable, bacteria-free water. This water is then fed directly into the SCWA aqueduct system. Water stored in Lake Mendocino and Lake Sonoma for water supply purposes totals 282,000 AF and is sufficient to meet the needs of the Sonoma and Marin County region.

The Potter Valley Project (PVP), owned and operated by PG&E, is a hydroelectric project that provides an interbasin water transfer from the main stem of the Eel River to the East Fork of the Russian River. Its operations are not coordinated with the operation of Coyote Valley Dam at Lake Mendocino. PG&E releases water from Lake Pillsbury to meet minimum instream flow requirements on the Eel River and to divert water through the Potter Valley Project to generate electricity and maintain minimum instream flow requirements in the East Fork Russian River. The water diverted through the Potter Valley Project flows into the East Fork of the Russian River. The Potter Valley Irrigation District diverts a portion of the released water for irrigation, with the remaining eventually flowing to Lake Mendocino. PG&E's license to operate the hydroelectric facility is issued by the Federal Energy Regulatory Commission, and expired in 2022. In July 2025, PG&E submitted a surrender application and decommissioning plan for the PVP to Federal Energy Regulatory Commission (FERC). The decommissioning plan for the PVP is discussed in further detail in Section 3.3.1.

The current water supply agreement between the District and SCWA, the Restructured Agreement, was executed in 2006, and replaced the Eleventh Amended Agreement from 2001. This agreement provides water delivery entitlements based on demand projections from each water contractor's service area general plans. The District's entitlement under this agreement includes a maximum delivery capacity of 19.9 million gallons per day (MGD), or 61.1 acre-feet per day. By contract, SCWA will provide the District a total delivery of up to 14,100 acre-feet (AF) per fiscal year.

SCWA, and thereby the District, faces curtailments when the Russian River water supply is limited, as discussed in Section 3.3.1.1.

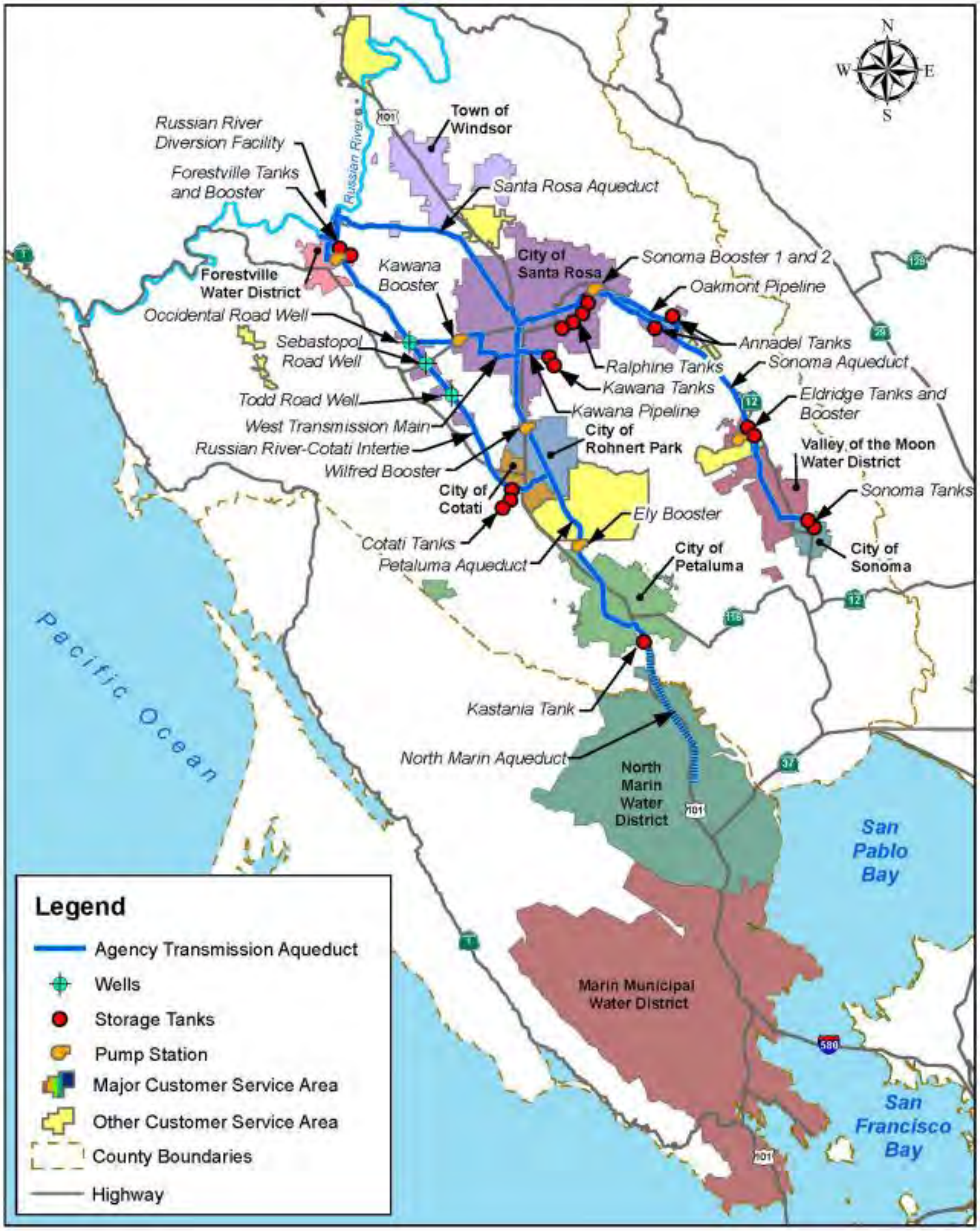


Figure 3-1. SCWA Service Area and Water Transmission System Facilities

3.1.2 Stafford Lake

The District augments water supply from SCWA with local water supply from Stafford Lake. Stafford Lake has a capacity of 4,450 AF. The lake captures runoff from an 8.3 square miles watershed, including land near the upper reaches of the Novato Creek, and provides approximately 20 percent of the Novato water service area's water supply. The lake and associated facilities are discussed in further detail in Section 3.2. The District's rights to local water supply are further discussed in Section 3.3.1.

Water supply from Stafford Lake is dependent on rainfall and runoff into the lake. When a dry year is anticipated following a below normal rainfall year, the District has the option to purchase winter water flows from the Russian River and backfeed the water into Stafford Lake. This supplemental water from SCWA is treated water that is fed back through the District's potable water transmission and distribution system into Stafford Lake and is then treated at the Stafford Treatment Plant (STP) and returned to the distribution system for use during the dry season. This process involves pumping SCWA through the San Marin pump station, bypassing the STP treatment process, and is dechlorinated, prior to discharging it into Stafford Lake. The maximum daily backfeeding rate is estimated to be 3 to 5 MGD. This supplemental water supply undergoes treatment at the STP prior to distribution to District customers.

In the past 30 years, the District purchased this supplemental water supply eight times, with volumes ranging from 39.35 AF to 1,100 AF. With increasing frequency of dry years due to climate change, the District anticipates more frequent purchase of winter water flows from SCWA. The District is considering potential system improvements that would allow it to convey additional flow from SCWA.

Water is drawn from Stafford Lake by an intake tower and fed into the STP, described in Section 3.2.3, either by gravity or pumping, depending on the lake level. Treated water from the STP is then pumped to the Zone 1 system using the High Service pump station with two 125 horsepower (hp) pumps and one 75 hp pump.

3.1.3 Recycled Water Supply

The District currently provides recycled water service to certain commercial, governmental and institutional customers for irrigation, dust control, construction activities, and commercial car washing within its Novato water service area. The recycled water distribution system includes approximately 17 miles of distribution pipelines and over 100 connections. Four storage tanks, with a total capacity of 1.5 MG, store recycled water to meet peak irrigation demands in the summer. The District receives recycled water from two local facilities through interagency agreements with Novato Sanitary District (NSD) and Las Gallinas Valley Sanitary District (LGVSD). The District is responsible for the storage and distribution of this water. The District's recycled water system is described in further detail in Chapter 5.

3.2 EXISTING STAFFORD LAKE FACILITIES

This section provides an overview of the District's existing facilities at Stafford Lake, including the Stafford Lake itself, the Stafford Lake (Novato Creek) Dam, and the Stafford Treatment Plant, collectively referred to as the Stafford Lake Facilities. The Stafford Lake Facilities provide local water supply for the Novato water service area and presents the District the opportunity to locally manage the resilience of some of its water supply.

3.2.1 Stafford Lake

Stafford Lake is located four miles west of downtown Novato. Stafford Lake has a surface area of 230 acres and holds 4,450 AF of water at a maximum elevation of 196 feet above sea level. The surrounding area provides for recreational activities, including fishing from the shoreline and hiking. The Marin County Regional Park and Indian Valley Golf Course are located within the basin. For protective measures, no swimming or boating is allowed at the lake. Areas away from the lake shoreline provide cattle grazing.

The District operates Stafford Lake seasonally to reduce peak demand in the SCWA Aqueduct system and to augment water supply from SCWA during the dry season. Water from this lake is treated at the STP. Water is drawn from the lake through an intake tower and is either gravity-fed or pumped to the STP, depending on the water surface elevation. The lake is generally in good condition but occasionally experiences water quality issues such as algae blooms and cyanobacteria, which are further detailed in Section 3.3.2.

3.2.2 Stafford Dam

Stafford Lake was created with the construction of the Stafford Dam on Novato Creek in 1951 to provide water supply to Novato. Stafford Dam's primary purpose is to store water supply for the Novato community. The dam is under the jurisdiction of the Department of Water Resources Division of Safety of Dams (DSOD). The Novato Creek Dam is listed under DSOD Dam No. 88-0; National Inventory of Dams National ID No. CA00321. An overview of the Stafford Dam facilities is shown on Figure 3-2.

Stafford Dam is an earthen embankment with a reinforced concrete spillway. The dam's spillway was raised in 1954 to an elevation of 196 feet (NGVD29) to increase the lake's capacity from 1,720 AF to 4,450 AF. In 1985 as part of a joint project with the Marin County Flood Control & Water Conservation District (MCFCWCD), the dam was enlarged and the crest was raised 8 feet to its current crest elevation of approximately 213 feet. The dam is currently 71 feet high and has a crest length of 650 feet. Concurrent with the dam raising, a new spillway was constructed downstream of the original one. The new spillway was constructed with a notched overflow to provide a flood control benefit by reducing and delaying the peak discharge flow rate through the spillway. The flood control crest elevation is 196 feet, with an emergency spillway at 199 feet. The City of Novato has experienced substantial development since 1985, resulting in a significantly higher percentage of impervious area downstream of Stafford Dam. For this reason, the flood control benefit of the newer spillway's notched overflow is now considered incidental except under unique hydrologic conditions as discussed below.

Since 1951, the District has made improvements to the dam to increase capacity, to pass probable maximum flood (PMF), and to improve floodwater release into Novato Creek. For safety and service reliability, the District has undertaken various projects to repair and maintain the dam and associated facilities. In 2025, the District, in cooperation with the MCFCWCD, completed a comprehensive hydrologic and hydraulic analysis. The analysis included determination of a new probable maximum precipitation (PMP) as well as the resulting PMF (previously evaluated in 1985). The analysis also updated the spillway rating curves and evaluated other hydrologic conditions including sequential rainfall events and future climate scenario conditions. The analysis also concluded that the dam could attenuate the initial peak flow and control the outflow prior to the start of larger subsequent peak events. While an initial storm peak can increase the peak flow and flooding impact of subsequent storm peaks, Stafford Lake's attenuation ability reduces the full impact of the subsequent peak to downstream flooding in the City of Novato.

Legend

Parcels

Stream - Perennial (NHD)

Stafford Treatment Plant Facilities

1 Dam

2 Grounds

11 Inlet Tower

12 VV1

13 RWPS

14 Main Building

15 Chem. Storage

16 GAC Building

17 Disinfection Building

18 Finished Clearwell

19 Booster PS

20 High Service PS

21 Sludge Thickener

22 Centrifuge

23 Solid Recirculation PS

24 Grinder PS

25 Reclaim Pond

Stafford Treatment Plant Aerial

Figure 3-2

Circa 2025

The District performs ongoing safety and risk assessments of the Dam to meet requirements established by California Division of Safety of Dams and other regulatory agencies. In addition, the District periodically undertakes projects using emerging technology where appropriate to improve its operational management of the Dam and improve its water supply resilience. Anticipated near term improvements are provided in Section 3.5.

3.2.3 Stafford Treatment Plant

Located at the base of Stafford Lake Dam as shown on Figure 3-2, the STP is designed to meet current and future water quality standards, improve system reliability, and enhance the aesthetic quality of the District's water supply for the Novato service area. The original treatment plant, built in 1954. In August 2006 the plant was upgraded with granular activated carbon filters to address taste and odor issues, and its clarifier was converted to a solids thickener.

The STP has a production capacity of 5.4 MGD and operates seasonally to reduce peak summer demands on the SCWA Russian River transmission system. Over the past twenty years, Stafford Lake has supplied an average of 1,606 AF (523 MG) of water per year, accounting for approximately nineteen percent (19%) of Novato's annual water demand for the District's Novato service area. The STP has a nominal production capacity of 6 MGD, with quantities treated each year depending on demand in the District's Novato service area and the amount of source water available in Stafford Lake.

Water from Stafford Lake is treated through various processes before being pumped to the District's potable water distribution system. The treatment process includes:

- Oxidation with chlorine dioxide, augmented with chlorine dosing
- Coagulation with polyaluminum chloride, ferric chloride, and a coagulant aid polymer
- Pretreatment clarification and filtration through three modular Actiflo™ clarifier and granular media filter units
- Filtration through granular activated carbon (GAC) contactor-filter units for enhanced removal of taste and odor compounds and disinfection byproduct precursors
- Disinfection with chlorine gas
- pH and corrosion control with sodium hydroxide addition

The STP also includes facilities for handling liquid waste streams from the treatment processes and sludge solids management for dewatering solids. Several waste/recycle streams are returned at various points upstream in the process. Liquid waste streams that cannot be recycled are discharged to NSD's sanitary sewer collection system, which are subject to restrictions in a discharge permit. Discharge constraints are further discussed in Section 3.3.1.4.

Since components of the STP are nearing the end of their life, and regulatory requirements continue to evolve, the District will consider a future effort to evaluate the useful life and purpose of these facilities, and consider replacement and rehabilitation needs in a future STP Facilities Master Plan Study. The District may consider upgrades in treatment technologies to meet regulatory requirements and improve operations and efficiency.

Anticipated major improvements to the STP include the following.

- **Chlorination Process Improvements:** The STP's chlorine gas use presents a high risk to the District staff and operations in Marin County. Chlorine gas poses a risk and safety issue. The District may lose its ability to use chlorine gas in the near future and may need to replace the process in the upcoming years.

- **Various Facilities Upgrade**: Many of the existing treatment facilities, like the existing GAC building, the Sludge Treatment System, and the High Service Pump Station Building, are approaching the end of their useful life. For example, the GAC building is over 50 years old and does not meet current design standards. The District will need to assess these facilities' useful life, efficiency, and conditions, and prioritize improvements, rehabilitation, and replacement.

The District's NEXGEN asset management program could provide valuable information to identify and prioritize repairs and replacements of components such as pump controllers, drivers, valves, blowers, and air compressors.

3.3 WATER SUPPLY CONSTRAINTS

The following sections present water supply constraints associated with the District's existing water supply sources, water quality, and climate change.

3.3.1 Supply Sources

3.3.1.1 Russian River Supply

The water available to SCWA's customers is limited by both physical and legal constraints. Physically, the capacity of SCWA's transmission system can restrict the District's water supply. The District receives water through the North Marin Aqueduct, a steel transmission main with diameters of 30, 36, and 42 inches, running from SCWA's Petaluma Aqueduct near Kastania Tank in south Petaluma to the northern end of the District's pipeline facilities in Novato, as shown on Figure 3-1.

Legally, SCWA operates under four water rights permits (Permits 12947A, 12949, 12950, and 16596) issued by the State Water Resources Control Board (State Water Board). These permits authorize SCWA to store up to 122,500 AF per year (AFY) of water in Lake Mendocino and up to 245,000 AFY in Lake Sonoma. Additionally, SCWA can divert or redivert up to 180 cubic feet per second (cfs) of water from the Russian River, with a limit of 75,000 AFY.

The permits also establish minimum instream flow requirements for fish and wildlife protection and recreation, which vary based on hydrologic conditions (normal, dry, and critical) as defined by SCWA's water rights permits and State Water Board Decision 1610, adopted in 1986. To meet these instream flow requirements, SCWA makes releases from Coyote Valley Dam and Warm Springs Dam. The Russian River Biological Opinion requires modifications to the minimum instream flow requirements on the Russian River and Dry Creek to maintain the Incidental Take Statement provided by the Biological Opinion.

Limited water supply on the Russian River could result in diversion curtailments. For example, during the 2021 statewide drought, the State Water Board issued an emergency regulation and curtailment order on June 15, 2021. This order restricted water diversion from the Upper Russian River, except for minimum public health and safety needs, and mandated a 20 percent reduction in diversions for SCWA in the lower Russian River.

3.3.1.2 Eel River-Russian River Transfers

In addition to contributions from its watershed on the east fork of the Russian River, Lake Mendocino has received inflows of interbasin transfers from the Eel River through the Potter

Valley Project (PVP) over the last 100 years. The PVP, owned and operated by Pacific Gas and Electric (PG&E), is a hydroelectric project that provides an interbasin water transfer to the East Fork of the Russian River. PG&E releases water from Lake Pillsbury to meet minimum instream flow requirements on the Eel River and to divert water through the PVP to generate electricity and maintain minimum instream flow requirements in the East Fork Russian River.

In November 2023 and again in January 2025, PG&E released draft applications for surrender of their FERC license for the PVP and an application of "Non-Project Use of Project Lands" (NPUPL). PG&E submitted a final application to FERC on July 25, 2025. The NPUPL would allow the Eel Russian Project Authority, a Joint Powers Authority created in 2023 to operate the New Eel-Russian Facility (NERF).

The NERF would consist of repurposing certain existing PVP water diversion infrastructure along with a new run-of-the-river pumping station to continue inter-basin transfers into the future. These water transfers would provide diversion volumes of approximately 30,000 AF per year maximum. Despite these future transfers being significantly less than the historical volumes, the recently approved Forecast Informed Reservoir Operations (FIRO) for Lake Mendocino could increase storage volumes in the reservoir to 110,000 AF.

However, the future transfers would be limited to certain natural flow conditions on the Eel River since PG&E's surrender application includes removal of Scott Dam and Cape Horn Dam. This condition will result in less total transfer volumes compared to historical transfer volumes. Further, transfer would be limited to specific periods of time (late fall, winter and possible early spring), which may conflict with available storage in Lake Mendocino. Impacts of the proposed NERF operations to the overall Russian River water supply availability is unknown at this time. However, if the NERF was not implemented, significant impacts to the Russian River water supply are anticipated, especially in the Upper River.

3.3.1.3 Stafford Lake Supply

Stafford Lake water supply comes from local runoff, including surface water conveyed by Novato Creek. The District holds two water rights on Novato Creek, a tributary to San Pablo Bay in Marin County. License 9831, issued by the State Water Board in 1970, authorizes 2.9 cfs of direct diversion from September 1 to June 30, with 4,000 AF diverted to storage (Stafford Lake) during the same period. The total amount authorized under License 9831 (direct diversion and storage) between the period of October 1 and September 30 of the subsequent year may not exceed 4,490 AF. Water Right Permit 18800, obtained in 1983, authorizes 9.75 cfs direct diversion during the period of October 1 through April 30, with 4,400 AF diverted to storage between November 1 and April 1. The combined storage allowed under Permit 18800 and License 9831 is limited to 4,400 AF. However, the permit authorizes 8,454 AF to be taken from the Novato Creek source during any water year (October 1 through September 30).

In addition to the local runoff water supply, the District has the option to purchase winter water flows from the Russian River and backfeed the water into Stafford Lake as discussed in Section 3.1.2. This water supply requires dechlorination prior to entering the lake and needs to be retreated through the STP prior to entering the potable water distribution system. This water supply presents the most expensive water supply source for the District due to conveyance operations and additional treatment costs.

Further, the District's transmission system limits how much water could be conveyed due to distribution system operations. If the District anticipates more frequent purchase of winter water flows from SCWA, the District will need to consider potential system improvements that would allow it to convey additional flow.

3.3.1.4 STP Production

The STP production of potable water is constrained by the District's wastewater discharge permit with NSD. The District service area discharge to NSD is subject to restrictions in the District's wastewater discharge permit, which includes the following limits:

- Daily flow limits of 40,000 gallons per day (gpd) from December through April
- Daily flow limits of 150,000 gpd from May through November
- Year-round instantaneous flow limit of 100 gallons per minute (gpm) or 144,000 gpd

Reject water from the STP is discharged into the NSD collection system. When a significant rainfall event is anticipated, the District must cease STP discharge into the NSD system. Therefore, the District's wastewater discharge permit with NSD constrains the STP from producing potable water year-round.

3.3.1.5 Recycled Water Supply

Low rainfall and increased water demand during higher temperatures lead to water conservation measures, reducing wastewater flows. Since recycled water is produced from highly treated wastewater, reduced wastewater flows directly affect the available recycled water supply. The District's recycled water supply is fully dependent on flows from NSD and LGVSD.

Currently, recycled water demands within the District's service areas are approximately 10 percent of the total wastewater volume treated at NSD, so the available recycled water supply is not expected to be significantly impacted in dry years. If recycled water supply production is adversely impacted during a drought, the District may supplement its recycled water supply with potable water as needed.

The District's recycled water distribution system installation is complete. The District has sufficient supply and may consider expansion if the customer or developer proposing expansion is funding the improvements.

3.3.2 Raw Water Quality

The District's Water Quality laboratory routinely analyzes both regulated and unregulated contaminants, providing testing services for quality control and customer concerns, and monitoring water from source to tap. The SCWA source is treated water and meets all primary and secondary standards. Stafford Lake treated water supply meets all primary drinking water standards for inorganic and organic chemicals, with no detections of organic chemicals in 20 years of monitoring and only low levels of naturally occurring trace elements. However, Stafford Lake can stratify, leading to algae blooms and occasional odor issues exceeding secondary standards.

The quality of raw water significantly impacts efficient operation of the STP, particularly turbidity and manganese levels. High turbidity often results from algal growth near the lake's surface, while high manganese concentrations are due to anaerobic biological activity in the lakebed sediment. Elevated manganese levels make it challenging for STP operations staff to add sufficient chlorine dioxide to meet the oxidant demand for both organics and inorganics, while staying within the regulatory limit for chlorite in treated water. Further study is needed to determine the specific manganese concentration threshold that causes these issues.

Raw water is drawn into the STP from Stafford Lake via an intake tower with two primary gates, 16 feet apart in elevation. Turbidity levels can vary widely depending on the intake elevation relative to the lake surface. Generally, water drawn closer to the surface contains more algae, while water from the lower gate has lower dissolved oxygen and higher manganese concentrations. The higher gate is used early in the production season but is closed when the lake's elevation leads to poor water quality, such as debris near the surface. The lower gate is used when conditions are unfavorable for the higher gate.

Several air diffusers near the intake tower prevent lake stratification by increasing dissolved oxygen levels through deeper strata. However, these diffusers can also introduce nutrients from the bottom sediment to the top layers, promoting algal growth and cyanobacteria. The District utilizes several methods to help with these issues, including increased aeration devices within the lake, Solar Bee mixers, and copper sulfate.

3.3.3 Climate Change

Climate change, characterized by warmer weather, reduced rainfall, and erratic weather patterns, can impact the District's water supply. SCWA's October 2021 Climate Adaptation Plan (CAP) assessed the impacts of climate change on water supply, flood management, and sanitation infrastructure, providing a roadmap for adaptation strategies. The CAP evaluated historical climate trends and future projections, identifying the region's susceptibility to floods, droughts, wildfires, and other extreme events. Since the District receives a significant portion of its water from SCWA, its water supply portfolio is also impacted by climate change as described in the CAP. The CAP projected the following climate change impacts for the Sonoma County region:

- Increased air temperature
- Increased variability of precipitation (more winter precipitation, less summer precipitation)
- Sea level rise
- More severe and frequent droughts
- Increased flooding
- Increased wildfires

The CAP outlined the following adaptation strategies for the water supply system:

- Improve water supply infrastructure resiliency
- Increase operational flexibility of water management facilities
- Enhance system integration and regional resilience
- Improve watershed and natural resources management
- Advance science and technology

SCWA's strategies help the District understand climate change impacts on its water supply portfolio and make informed decisions to enhance local water supplies. The District continues to support reducing greenhouse gases and improving air quality through its Green House Gas (GHG) Emission Reduction Program, which includes staff training on efficient vehicle operation and employee commute options. The District strives to improve Operational efficiencies at pump stations and purchases new fleet and materials with energy-efficient products.

The District is evaluating the regulatory issues affecting water quality due to climate change impacts. This is an ongoing study; therefore, results are not available but should be considered in any future recommendations or studies.

3.4 WATER SUPPLY RESILIENCY

The following sections present the District efforts to improve water supply resilience through existing interties and regional partnerships.

3.4.1 Emergency Interties

SCWA provides a significant portion of both the District and MMWD water supplies. The supply to the District is delivered to the distribution system from the North Marin Aqueduct at the north edge of its service area near the San Marin Control Station (see Figure 3-1), which is located roughly at the intersection of San Marin Drive and Redwood Boulevard. The North Marin Aqueduct continues south of the San Marin Control Station, where there are additional points of connection. The MMWD supply is conveyed to MMWD through the MMWD Novato Bypass pipeline. There are six interties between the District distribution system and the MMWD Novato Bypass pipeline that can transfer water between systems.

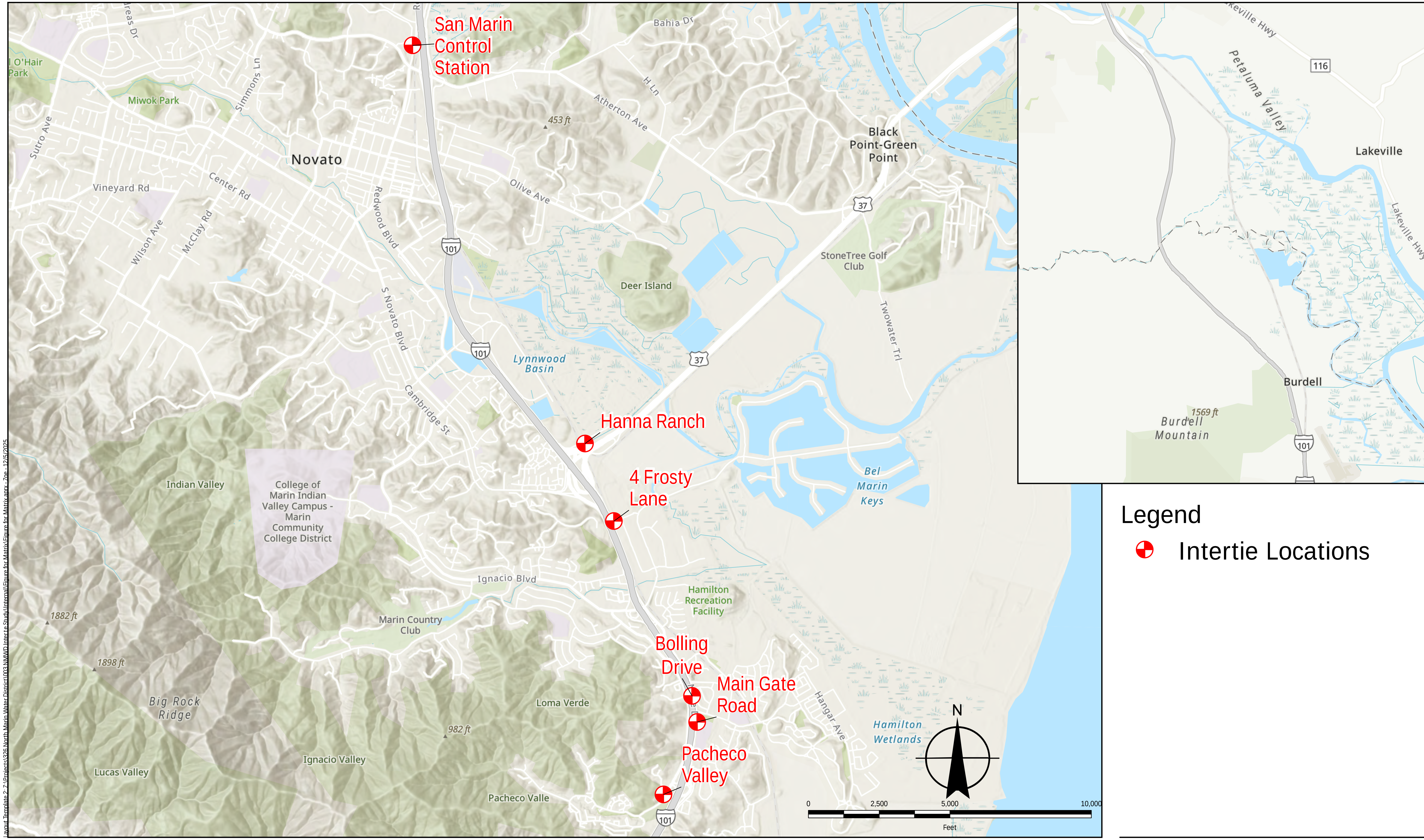
Under emergency conditions, an interagency transfer of water from MMWD could be provided through any of these six interties to supplement water supplied to the District distribution system by the STP. The intertie locations are shown on Figure 3-3.

Many of the interties are for emergencies only and are redundant within the system. With the exception of Intertie 6, the San Marin Control Station, the interties are inactive and out of service The Frosty Lane intertie was used in the past to provide additional flow and pressure to Zone 1 during emergencies. It is out of service due to a broken butterfly valve.

Table 3-1 NMWD and MMWD Interties

Intertie	Intertie Status
Intertie 1: Pacheco Valley	Inactive
Intertie 2: Bolling Drive	Inactive
Intertie 3: Main Gate Road	Inactive
Intertie 4: Frosty Lane	Inactive
Intertie 5: Hanna Ranch	Inactive
Intertie 6: San Marin Control Station	Active

The District and MMWD collaborated in 2023 to evaluate the status of all six interties and explore the feasibility of installing a seventh intertie at a new location. The District is currently evaluating the Pacheco Valley Intertie to determine if the connection can be reestablished for future use. Ultimately, MMWD and District determined that a new intertie is not feasible, but both agencies will continue to evaluate potentially reestablishing select interties. For example, MMWD's future pipeline replacement project, from Marinwood Tank to the Pacheco Valley Intertie could potentially include improvements to this intertie.



Legend

Intertie Locations

District and MMWD Interties

Figure 3-3

1/9/2026

3.4.2 Regional Partnerships

The District maintains partnerships with SCWA and MMWD to manage the region's water supply resilience.

3.4.2.1 Sonoma County Water Agency

The District actively collaborates and coordinates with SCWA for water supply planning. The District continues to coordinate with SCWA in the Sonoma-Marin Saving Partnership ((https://www.savingwaterpartnership.org/). This partnership advocates for water conservation and has had a meaningful impact on available water supply in the region.

In recent years, the District has provided input on SCWA's Water Supply Strategies Action Plan, Climate Adaptation Plan, and water use efficiency efforts. In April 2022, SCWA completed the Regional Water Supply Resiliency Study with input from the District as well as the other seven water contractors. The analysis provided several recommendations for short-term and long-term water supply resiliency.

The District's water supply is from SCWA's Russian River Project. As described in Section 3.1.1.1 and 3.3.1.2, the Russian River flows are augmented by the PVP, which is subject to a surrender and decommissioning application at the time of preparation of this plan. The decommissioning of the PVP could potentially reduce contributed flows to the Russian River. The District is working with SCWA to maintain its water rights and minimize PVP decommissioning impacts.

3.4.2.2 Marin Municipal Water District

The District collaborates and coordinates with MMWD to adapt to climate change, which is anticipated to lead to increased frequency of droughts and water supply shortage conditions. As discussed in Section 3.4.1, both the District and the MMWD water supplies are partially provided by SCWA and they jointly share six interties between the District distribution system and MMWD Novato Bypass pipeline to allow for interagency water transfer. Under emergency conditions, the District may transfer water from MMWD through any of these six interties to supplement water supplied to the District distribution system. Currently, the interties are substantially inactive and rarely used; some have fallen into disrepair. Following the landslide near Olompoli State Park in 2023, the District and MMWD began working on a plan to repair or rehabilitate some or all of these interties.

MMWD recently began planning work associated with a "Water Supply Conveyance Improvement Project" with the goal of enhancing the reliability, flexibility, and resiliency of MMWD's water system. A technical memorandum prepared by Carollo Engineers, Inc. in May 2024, for MMWD, evaluated project alternatives and one of the preferred alternatives (PETA-3) involves MMWD constructing a transmission pipeline from the North Marin Aqueduct, near Highway 101 and San Marin Drive, to the Nicasio and/or Soulajule Reservoirs. The alignment would generally follow San Marin Drive, Novato Boulevard, and Pt. Reyes Petaluma Boulevard. Its purpose would be to backfeed MMWD reservoirs during winter months with water from the Russian River (via SCWA) that would otherwise runoff into the Pacific Ocean. The District and MMWD have had preliminary discussions about opportunities to partner, and both agencies are committed to furthering those discussions as the project moves forward. In April 2025, MMWD approved an agreement with Carollo Engineers to begin design of the proposed pipeline described as PETA-3.

3.4.3 District Supply Enhancement Project Implementation

In 2022, the District explored alternatives to potentially enhance its local water supply and reduce dependence on SCWA supply. Feasible projects were identified and recommended in the 2022 Local Water Supply Enhancement Study (LWSES). The District has proceeded toward implementation of two projects:

- Improve Stafford Treatment Plant Process Water Recapture Efficiency
- Increase Stafford Lake Storage Capacity with Spillway Notch Slide Gate

These projects are discussed below, and updated cost estimates are provided.

3.4.3.1 Improvements at Stafford Treatment Plant

Seasonally, the District treats water stored in Stafford Lake through the STP to supplement the purchased water supply from SCWA as described in Section 3.2.3. After intake and pumping from the lake, the raw water undergoes various treatment processes before being pumped into the District's potable water distribution system.

The STP also handles liquid waste streams from the treatment processes and manages sludge solids through dewatering facilities. Some processed waste/recycle streams are returned upstream in the process, while non-recyclable liquid waste is discharged to the NSD sewer system. As described earlier in Section 3.3.1.4, the discharge is subject to permit restrictions, which includes daily flow limits of 40,000 gpd from December through April and 150,000 gpd from May through November, with a year-round instantaneous flow limit of 100 gpm or 144,000 gpd.

Current STP operations generate more wastewater than allowed under the NSD permit, particularly during peak summer demand. Consequently, the District must often stop potable water production after several hours to comply with the discharge limits.

The 2022 LWSES recommended three improvements to potentially increase the STP's water supply yield and to improve reliability:

- Pretreatment unit modifications
- Raw water intake modifications
- Replacement of the wastewater discharge pipeline

The pretreatment unit modifications, raw water intake modifications, and replacement of the wastewater discharge pipeline are ancillary improvements identified as part of the 2022 LWSES. The pretreatment unit modifications and raw water intake modifications improvements would not specifically increase the yield of the STP but would improve the reliability of the STP water supply yield. Updated cost estimates associated with these improvements are provided in Section 3.5.3.

3.4.3.2 Increase Stafford Lake Storage Capacity – Spillway Notch Slide Gate

Constructing a new adjustable spillway notch slide gate would increase Stafford Lake's storage volume by temporarily blocking the spillway notch. This slide gate could be adjusted from below the notch elevation to the top of the spillway crest elevation. The preferred option is a downward-opening slide gate, as shown in Figure 3.4, because it would not block the spillway notch when lowered, it could be bolted onto the upstream face of the existing spillway structure and would allow for maintenance from the ground above the spillway. The gate, measuring 10 feet wide and 3 feet tall, would be installed below the spillway notch and operated from the south bank of the spillway channel. The drive gear boxes would be located below the gate to avoid installing a crossbar at the top of the notch, minimizing debris accumulation that could block flow.

The slide gate could help the District capture more stormwater runoff. It is estimated to increase Stafford Lake's storage volume by approximately 726 AF, from 4,287 AF to 5,013 AF. During large storm events, the slide gate may need to be lowered to recover the flood control storage volume (from elevation 196 to 199 feet). After the storm passes, the gate could be raised again to capture runoff from subsequent storms.

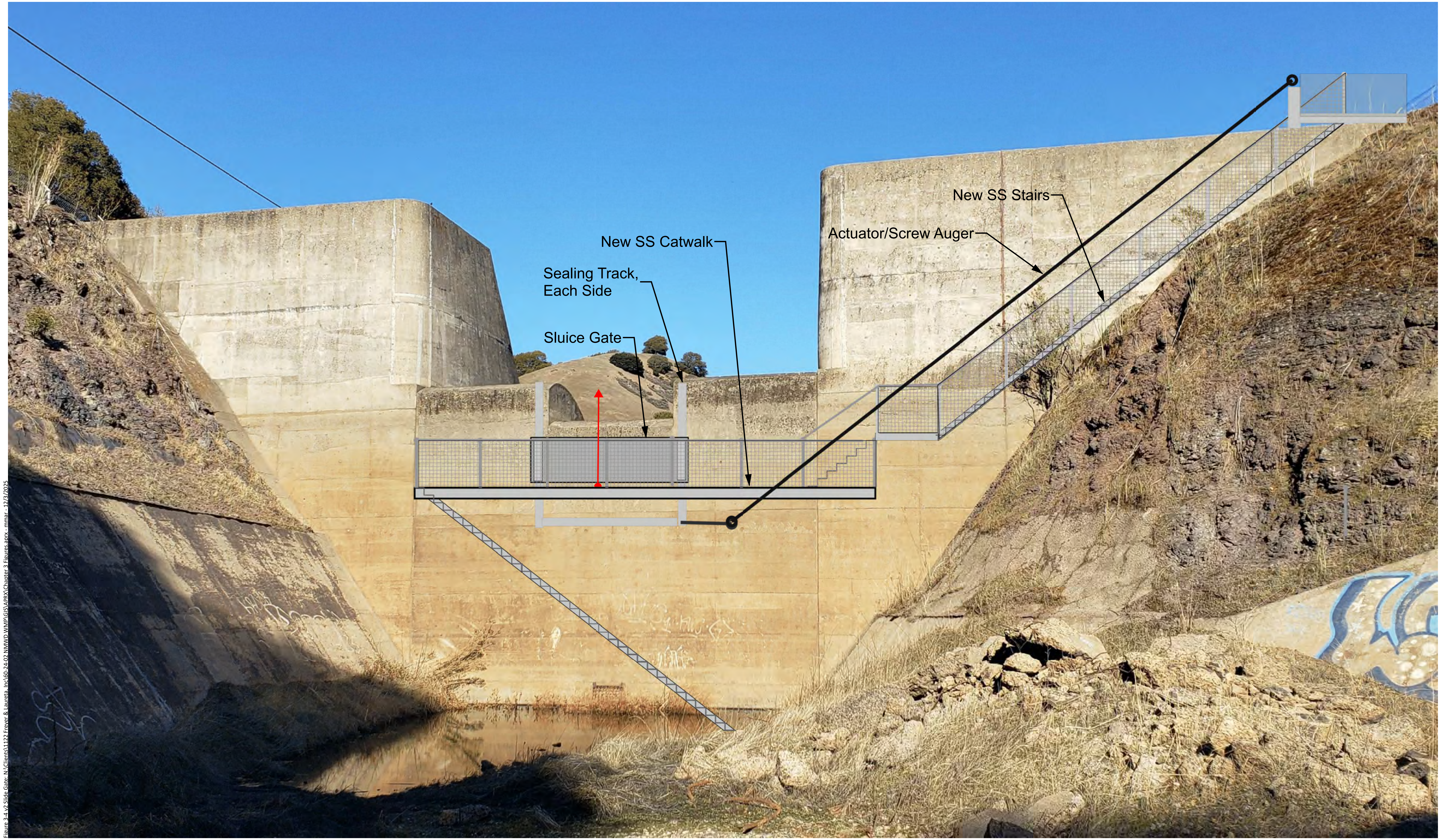
The District is in the early stages of advancing this project; however the District has received concurrence from DSOD on its proposed hydrologic analysis (PMP/PMF) and geotechnical analysis (seepage and stability) of the dam under the proposed project conditions. At this point, the District is exploring environmental and regulatory considerations associated with project implementation.

3.4.3.3 Updated Cost Estimates

The 2022 LWSES provided planning-level cost estimates for all recommended projects. The sections below describe the updated cost estimates for the Stafford Lake Capacity Improvements and the Stafford Lake Treatment Improvements. The 2022 LWSES utilized an Engineering News Record (ENR) San Francisco construction cost index (CCI) for November 2021 (14,421.03). The updated costs reflect the ENR San Francisco CCI for February 2025 (15,404.88).

3.4.3.4 Improvements at Stafford Treatment Plant

Planning-level cost estimates for the modification and operation of the improvements for the STP process water recapture efficiency and the ancillary improvements, along with assumptions, are provided in Table 3-2 and Table 3-3. The cost estimates shown have no additional modifications, only escalation to show 2025-dollar values. For this water supply alternative, a project allowance of 25 percent is used to account for planning, permitting, engineering, legal, and administrative costs. A separate cost is listed for performance testing. The 2022 LWSES provided two cost estimates, one for modifications to the pretreatment unit alone (on a per unit basis), and one for modifications per pretreatment unit along with ancillary modifications and improvement.



Stafford Lake Main Spillway Proposed Notch Slide Gate

Figure 3-4

1/9/2026

Figure 3-4 v2 Slide Gate: N:\Clients\1122 Freyer & Laureta, Inc\60-24-02 NMWD WMP\GIS\APRX\Chapter 3 Figures.aprx - mmar - 12/3/2025

The updated total capital cost for pretreatment modification is estimated to be $74,800, including the construction contingency of 40 percent and project allowance of 25 percent. The project allowance is specific to this option and includes planning, permitting, engineering, legal, and administrative costs. Replacement costs were identified to be $74,800, equivalent to the capital costs. An operating contingency of 30 percent was used to estimate operational costs over a 30-year period. No operation and maintenance (O&M) costs are assumed for this project. The net present value (NPV) cost is estimated to be $149,600 using a 3.5 percent discount rate. The unit cost for pretreatment modification is estimated to range from $75/AF to $250/AF over a 30-year period.

Table 3-2. Total Estimated Cost for the Pretreatment Modification

Cost Item	2022 LWSES Estimated Cost, dollars	2025 Estimated Cost, dollars
Total Capital Cost		
Pretreatment Modification[1]	10,000	10,700
Performance Testing[2]	60,000	64,100
Total Replacement Cost[3]	70,000	74,800
Total O&M Cost[4]	-	-
NPV Total Cost	**$140,000**	**$149,600**
Total Supply over 30 years[5], AF	600 to 2,100	600 to 2,100
Unit Cost over 30 years[6], dollar/AF	**$70 to $240**	**$75 to $250**

1 The construction contingency was estimated to be 40 percent and the project allowance for planning, permitting, engineering, legal, and administrative costs was estimated to be 25 percent.
2 Performance testing is estimated to be $60,000 (ENR CCI of November 2021) and assumes the performance testing would be led by an engineering consultant with assistance and supervision from the District staff. The engineering consultant would work with the District staff and the manufacturer to develop a work plan, collect data, among other efforts.
3 It is estimated that the valving equipment will need to be replaced every 5 years. An inflation rate of 3.0 percent and discount rate of 3.5 percent was applied to determine the net present value of the replacement costs over the 30-year operational cycle. The construction contingency was estimated to be 40 percent and the project allowance for planning, permitting, engineering, legal, and administrative costs was estimated to be 35 percent.
4 It is anticipated that overall O&M costs would remain the same or be slightly lower but cannot be determined without additional information that is not readily available.
5 Annual supply yield of 20 AF is assumed to be available during all years equating to 600 AF over 30 years. The modification could treat up to an additional 70 AFY, if available. This equates to 2,100 AFY over 30 years.
6 Unit Cost = NPV Total Cost divided by the total supply yield over 30 years.

The updated total capital cost for pretreatment modification and ancillary improvements is estimated to be $3.43 million, including the construction contingency of 40 percent and project allowance of 25 percent. The project allowance is specific to this option and includes planning, permitting, engineering, legal, and administrative costs. Replacement costs were identified to be $74,800. An operating contingency of 30 percent was used to estimate operational costs over a 30-year period. Operational cost includes materials and labor. The 30-year NPV O&M cost is estimated to be $192,300 using a 3.5 percent discount rate. The total NPV cost (total capital cost plus 30-year O&M costs) for the pretreatment modification and ancillary improvements is estimated to be $3.14 million. The unit cost for pretreatment modification and ancillary improvements is estimated to range from $1,580/AF to $5,530/AF over a 30-year period.

Table 3-3. Total Estimated Cost for the Pretreatment Modification and Ancillary Improvements

Cost Item	2022 LWSES Estimated Cost, dollars	2025 Estimated Cost, dollars
Total Capital Cost		
Pretreatment Modification[1]	10,000	10,700
Performance Testing[2]	60,000	64,100
Raw Water Intake Modification[(3]	2,700,000	2,884,300
Wastewater Discharge Pipeline Replacement[4]	442,000	472,200
Total Replacement Cost[5]	70,000	74,800
Total O&M Cost[6]	(180,000)	(192,300)
NPV Total Cost	**$3,102,000**	**$3,313,800**
Total Supply over 30 years[(g)], AF	600 to 2,100	600 to 2,100
Unit Cost over 30 years[(h)], dollar/AF	**$1,500 to $5,200**	**$1,580 to $5,530**

1 The construction contingency was estimated to be 40 percent and the project allowance for planning, permitting, engineering, legal, and administrative costs was estimated to be 25 percent.

2 Performance testing is estimated to be $60,000 (ENR CCI of November 2021) and assumes the performance testing would be led by an engineering consultant with assistance and supervision from the District staff. The engineering consultant would work with the District staff and the manufacturer to develop a work plan, collect data, among other efforts.

3 The capital cost for the raw water intake modification is a high-level cost based on discussions with the manufacturer, Ixom. The capital cost does not account for any contingencies.

4 The construction contingency was estimated to be 35 percent and the project allowance for planning, permitting, engineering, legal, and administrative costs was estimated to be 25 percent. The construction contingency was reduced from 40 percent to 35 percent due to the wastewater pipeline being a pipeline replacement (no CEQA, no easements, no property rights etc.).

5 For the pretreatment modification, it is estimated that the valving equipment will need to be replaced every 5 years. An inflation rate of 3.0 percent and discount rate of 3.5 percent was applied to determine the net present value of the replacement costs over the 30-year operational cycle. The construction contingency was estimated to be 40 percent and the project allowance for planning, permitting, engineering, legal, and administrative costs was estimated to be 35 percent. Replacement costs for the ancillary improvements were not included.

6 For the pretreatment modification, it is anticipated that overall O&M costs would remain the same or be slightly lower but cannot be determined without additional information that is not readily available. For the raw water intake modification, O&M costs are likely to be similar or slightly lower after implementation of the pretreatment unit modifications, but whether they would be significantly lower and by how much cannot be determined without additional information that is not readily available at this time. The District spends an estimated $9,000 (ENR CCI of November 2021) per year to perform maintenance on the existing wastewater discharge pipeline. If the existing pipeline were replaced, annual O&M costs are anticipated to be reduced by $9,000 (ENR CCI of November 2021) every year. Over a 30-year period, the District O&M costs are estimated be reduced by a total NPV of $180,000 (ENR CCI of November 2021)

(g) Annual supply yield of 20 AF is assumed to be available during all years equating to 600 AF over 30 years. The pretreatment modification could treat up to an additional 70 AFY, if available. This equates to 2,100 AFY over 30 years. The ancillary improvements would not increase the local water supply but would increase the reliability of the STP operations.

(h) Unit Cost = NPV Total Cost divided by the total supply yield over 30 years.

3.4.3.4.1 Stafford Lake Storage Capacity – Spillway Notch Slide Gate

Table 3-4 summarizes the cost estimate for the spillway modification by adding the spillway notch slide gate to increase the volume of Stafford Lake. The cost estimates shown have no additional modifications, only escalation to show 2025-dollar values. The updated total capital cost is estimated to be $1,008,500, including the construction contingency and project allowance of 45 percent. The project allowance is specific to this option and includes planning, permitting, engineering, legal, and administrative costs. No replacement costs were identified over the 30-year operational cycle used for cost estimating. An operating contingency of 30 percent was used to estimate operational costs over a 30-year period. Operational cost includes materials and labor. The 30-year NPV O&M cost is estimated to be $314,100 using a 3.5 percent discount rate. The total NPV cost (total capital cost plus 30-year O&M costs) for the spillway notch slide gate is estimated to be $1.32 million. The unit cost for the spillway notch slide gate is estimated to be $100/AF over a 30-year period.

Table 3-4. Total Estimated Cost for Spillway Notch Slide Gate

Cost Item	2022 LWSES Estimated Cost, dollars	2025 Estimated Cost, dollars
Total Capital Cost[1]	944,000	1,008,500
Total Replacement Cost[2]	-	-
Total 30-year O&M Cost[3]	294,000	314,100
NPV Total Cost	**1,238,000**	**1,322,600**
Total Storage Increase for 20 years[4], AF	14,520	14,520
Unit Cost over 30 years[5], dollar/AF	**90**	**95**

1 A sluice gate, stainless steel stairway and walkway, electrical power supply and boom truck rental/operator was included in the capital cost estimate. The construction contingency was estimated to be 40 percent and the project allowance for planning, permitting, engineering, legal, and administrative costs was estimated to be 45 percent.
2 The spillway notch slide gate alternative for increasing the storage volume of Stafford Lake does not assume any replacements are needed over the 30-year operational cycle.
3 The annual O&M cost was estimated to be $6,000 per year (ENR CCI of November 2021). An inflation rate of 3.0 percent was applied to materials and labor and a discount rate of 3.5 percent was applied to determine the net present value of the annual O&M costs over the 30-year operational cycle. An operating contingency of 30 percent was applied to the O&M cost.
4 The spillway notch slide gate is estimated to add an additional storage volume of 726 AFY to Stafford Lake. Assuming this storage volume would be utilized in 20 years of the 30-year operational cycle, the total storage volume would equate to 14,520 AF. Two-thirds of the 30-year operational cycle was assumed because Stafford Lake has spilled over the spillway two-thirds of the years over the last 23 years.
5 Unit Cost = NPV Total Cost divided by the total storage volume over 30 years. Unit cost is rounded up to the nearest 10.

3.5 RECOMMENDED WATER SUPPLY IMPROVEMENT PROJECTS

Table 3-5 presents the water supply improvements projects that could improve the District's water supply resilience. The improvement projects are categorized based on location relating to Stafford Dam, STP, Stafford Lake, and the General Distribution System. Because many of the future projects listed in Table 3-5 are conceptual, and because their scopes will need further consideration by the District, cost estimates are not provided at this time.

Table 3-5. Summary of Water Supply Improvement Projects

Recommended Improvement Project	Description	Project Status
Stafford Dam		
Automated Monitoring of Piezometer Wells	Implement automate monitoring system at the existing piezometer wells.	Planning
Stafford Dam Master Plan Study	Prepare a comprehensive study that evaluates the useful life, purpose, and replacement and rehabilitation of existing facilities.	Future Project
Intake Controls and Equipment Improvements	Replace or refurbish the intake controls and physical intake devices, including hoses.	Future Project
Spillway Refurbishment	Refurbish the spillway where spalling has been observed.	Future Project
Dam Lakeside Face Repairs	Assess and conduct repairs on the lakeside dam face, including the apron and gabion.	Future Project
Spillway Assessment	Evaluate the condition and purpose of both existing spillways. Conduct general maintenance to clean up the existing debris and buildup	Future Project
Stafford Treatment Plant		
STP Facilities Master Plan Study	Prepare a comprehensive study that evaluates the useful life, purpose, and replacement and rehabilitation of existing facilities.	Future Project
Chlorination Process Improvements	Replace or repair existing chlorination process.	Future Project
Various Facilities Upgrade	Conduct an assessment of STP facilities' useful life, efficiency, and conditions to prioritize improvements, rehabilitation, and replacement.	Future Project
Pretreatment Modification and Ancillary Improvements	Increase the STP water supply yield with improvement projects listed within the 2022 LWSES.	Future Project
Stafford Lake		
Spillway Notch Slide Gate	Increase Stafford Lake storage capacity by implementing a spillway notch slide gate as recommended in the 2022 LWSES.	In Progress
General Distribution System		
Pacheco Valley Intertie Rehabilitation	Reestablish and refurbish the existing Pacheco Valley intertie for future use.	Planning

3.6 REFERENCES

This section lists the voluntary consensus standards, regional and national best practice standards, and District-specific documents and assessments utilized in this chapter.

Sonoma County Water Agency. June 2021. 2020 Urban Water Management Plan, Figure 3-1.

North Marin Water District. June 2021. 2020 Urban Water Management Plan.

Drew McIntyre. November 12, 2021. Memorandum to Board of Directors on Stafford Lake Backfeeding – 2022 Water Year.

North Marin Water District. Draft Decision Process and Operational Guidelines for Backfeeding Stafford Lake. Received August 2025.

North Marin Water District. June 2021. 2020 Urban Water Management Plan.

North Marin Water District. July 2023. *Stafford Dam Fact Sheet*, (https://nmwd.com/your-water/stafford-dam/, accessed 2/24/2025)

North Marin Water District. July 2023. *Stafford Dam Fact Sheet*, (https://nmwd.com/your-water/stafford-dam/, accessed February 24, 2025)

ESA, *Stafford Lake and Novato Creek Hydrologic and Hydraulic Analysis*, June 2025

Sonoma County Water Agency. June 2021. *2020 Urban Water Management Plan*.

Pacific Gas and Electric, *PG&E Submits to FERC the Surrender Application and Decommissioning Plan for the Potter Valley Project*, https://www.pge.com/en/newsroom/currents/hometowns/pg-e-submits-to-ferc-the-surrender-application-and-decommissioni.html, August 7, 2025.

Eel-Russian Project Authority, *How future Eel River diversions might affect Russian River water supply*, https://www.sonomawater.org/media/PDF/Water%20Resources/Potter%20Valley%20-%20ERPA/Fact%20Sheets/ERPA%20Water%20Supply%20Fact%20Sheet.pdf, August 8, 2025.

Freyer & Laureta Inc, Emergency MMWD Supply Alternatives Review, Figure 1.

SECTION 4

Existing Novato Water System

SECTION 4:
Existing Novato Water System

Section 4 describes the existing distribution system facilities of the Novato Water System and presents a general overview of system operation.

4.1 NOVATO WATER SYSTEM OVERVIEW

The Novato Water System serves primarily the City of Novato and surrounding unincorporated areas in Marin County, encompassing approximately 76 square miles. The Novato Service Area boundary is shown on Figure 4-1.

As of September 2025, the Novato Service area had approximately 20,463 active service connections. The estimated service area population is 61,658.

4.2 WATER SUPPLY SOURCES

The District water supply for the Novato Service area is derived from two sources: 1) surface water stored in Stafford Lake; and 2) Russian River water supplied by Sonoma County Water Agency (SCWA). Further description for both water supply sources is presented Section 3.

4.3 DISTRIBUTION SYSTEM CHARACTERISTICS

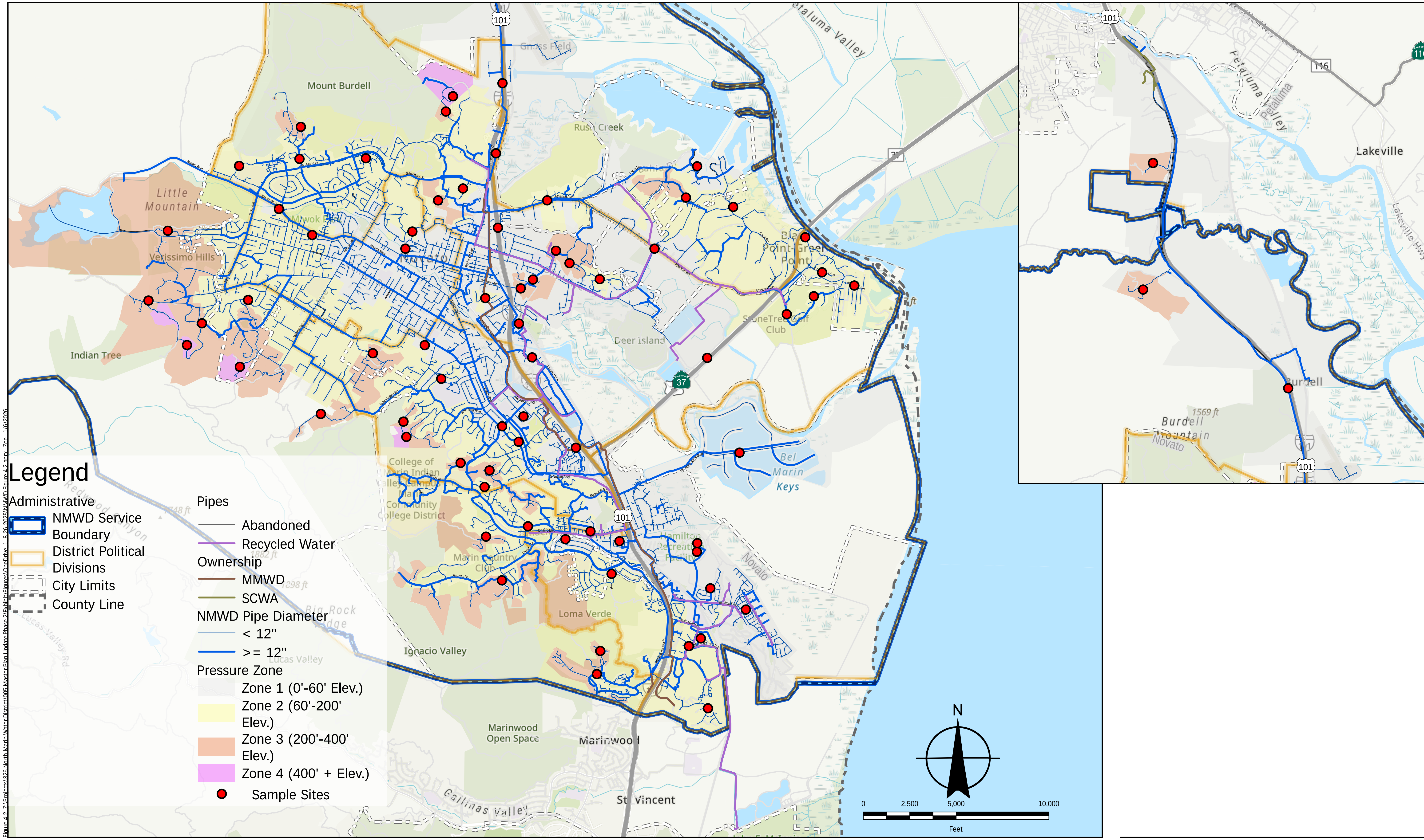
The distribution system facilities for the Novato Water System are described below. The distribution system piping and major facilities are shown on Figure 4-2. A schematic of the water system is shown on Figure 4-3.

4.3.1 Pressure Zones

The District has four separate pressure zones based on ground surface elevations. Each pressure zone has one or more water storage tanks that establish the maximum water surface elevation for that zone. The range of service elevations for each pressure zone is shown on Figure 4-4 with a brief overview below.

- The main pressure zone is Zone 1, which comprises the lower elevations (up to approximately Elevation 60 feet above sea level). This area covers most of the City of Novato and the area along Highway 101 on both sides of the freeway.
- Zone 2 serves Elevations between 60 and 200 feet above sea level. Primary Zone 2 is further divided into the sub-zone identified by the storage tanks that serve it – the San Mateo/Trumbull Zone 2 (north), and the Sunset/Pacheco Zone 2 (south). The dividing line between these two sub-zones is assumed to be along Indian Valley Road at Slowdown Court for purposes of this master plan. There are also pockets of Zone 2 within Zone 1 - in the Atherton area east of Highway 101 (Crest Zone and Black Point Zone) and in the Hamilton area of south-east Novato (Air Base Zone).
- Zone 3 serves between Elevations 200 and 400 feet above sea level. Zone 3 covers mostly the extreme western hills, pockets in the Atherton area, and smaller areas directly east of downtown and U.S. Highway 101. The Zone 3 systems are all separate, isolated systems fed by individual pump stations.
- Zone 4 serves elevations above 400 feet above sea level and includes two small, isolated areas. Several hydropneumatic pumping stations serve areas that cannot be easily served by the normal pressure zones.

Novato Service Area
Figure 4-1
1/9/2026



Distribution System
Figure 4-2
1/9/2026

NOVATO WATER SYSTEM
DISTRIBUTION PROFILE

REGULATING STATIONS NOT SHOWN ON DRAWING:

CAMBRIDGE & SUNSET PARKWAY
HAMILTON PALM DRIVE
SAN MARIN EAST
PLUM STREET

- REGULATED
- HYDROPNEUMATIC
- ZONE 4
- ZONE 3
- ZONE 2
- ZONE 1
- SUPPLY

●	PIPE CHANGE
□	GRAVITY STORAGE
○	HYDROPNEUMATIC STORAGE
N.O.T.	"NOT ON TELEMETRY"
	ONE WAY FLOW CHECK VALVE
UNO	UNLESS NOTED OTHERWISE
(AV)	ALTITUDE VALVE
(CB)	CHLORINE BOOST STATION
(FS)	FLOW SENSOR
(P)	PUMP
(CV)	CONTROL VALVE
(M)	METER
MG-###	MAXIMUM HYDRAULIC GRADIENT
OF-###	OVERFLOW
BM-###	BOTTOM

NOTES:

1. PUMP STATIONS SHOW FLOW WITH ONE PUMP RUNNING.
2. ALL PUMP STATIONS ARE EQUIPPED WITH FLOW METERS AND ARE ON TELEMETRY (UNO).
3. ELEVATIONS ON THIS SHEET ARE NGVD29 (UNO).

NO.	DATE	REVISION	BY	APP
10	06/05/25	ADDED CREST PS; SCHOOL RD PS OFFLINE; ADDED CENTER RD PRV	SD	AP
9	02/10/25	UPDATED OLD RANCH ROAD TANK INFORMATION (ELEV IN NAVD88, THIS TANK ONLY)	SD	TF
8	07/06/18	REMOVED NORMAN TANK, REVISED AND REFORMATTED INFORMATION IN FIGURE	SD	DJ
7	12/05/12	UPDATED TANK INFORMATION	AC	DJ
6	01/03/08	REMOVED HANCOCK TANK	LJ	MM
5	12/14/07	REVISED W.H.V., CENTER RD & CABRO PIPE CONFIGURATION	LJ	MM
4	01/19/07	ADDED BLACK POINT TANK, UPDATED INFO	LJ	MM
3	10/02/02	ADDED TANK DATA, AMMO HILL AND AIR BASE	MM	MM
2	10/19/98	ADDED WINDHAVEN AND BUCK PUMP STATIONS AND TANKS	PS	PS
1	05/07/98	ADDED TITLE BLOCK TO EXISTING DISTRIBUTION MAP	TM	PS

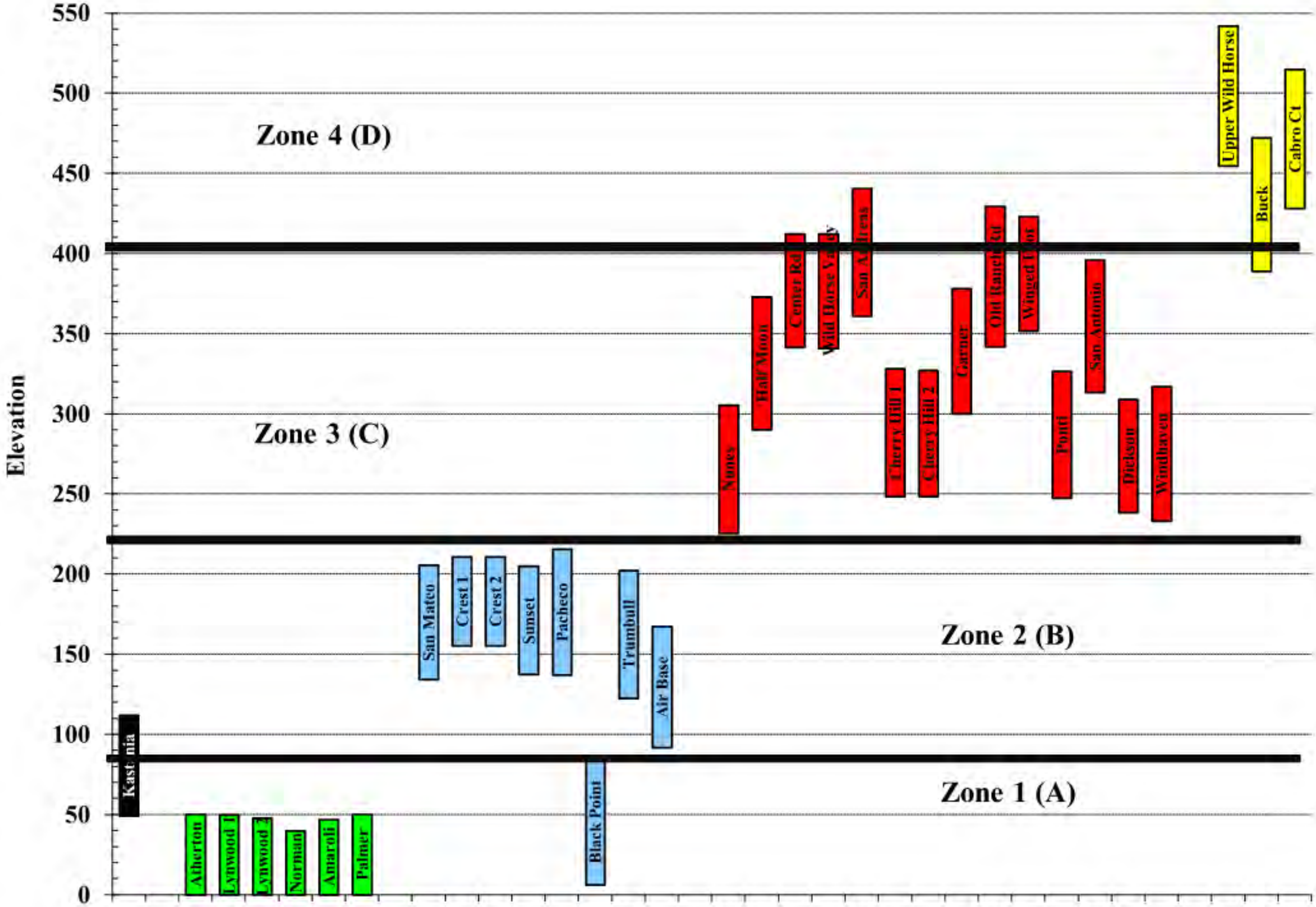
NORTH MARIN WATER DISTRICT

NOVATO WATER SYSTEM
DISTRIBUTION PROFILE

DES	DR	CH
TM, PS	TM	PS

APPROVED: CHIEF ENGINEER
R.E. C78430

SCALE : NONE
DATE : 05/28/97
SHEET NO. : 1 OF 1 SHEETS
SERVICE AREA 1 ACCT.NO. 52401 NO. OP13



Pressure Zone Service
Figure 4-4
1/9/2026

Approximately 46 percent of the total system demand is in Zone 1 and approximately 45.2 percent of the total system demand is in Zone 2. All the isolated Zone 3 (including Crest zone) and Zone 4 systems account for 8.8 percent of the total system demand. For further details see Section 6.

One or more pump stations deliver water for each higher pressure zone. Each of the pump stations is described below. In many locations, normally closed zone valves isolate a higher zone from a lower zone. Although not a normal operation, these valves can be opened manually to flow water into the lower zone. Both water sources enter the distribution system in Zone 1.

4.4 STORAGE TANKS

Each pressure zone has gravity storage capacity in one or more storage tanks. There are a total of 31 storage tanks throughout the Novato Water System, totaling almost 37.3 MG. Zone 1 has a storage capacity of 14.3 MG. Zone 2 has a total storage capacity of 18.9 MG. Zones 3 and 4 combined have a total storage capacity of 4.2 MG. Tank sizes range from 5,500 gallons to 5 MG. Pertinent information for all storage tanks is shown in Table 4-1.

4.5 HYDROPNEUMATIC SYSTEMS

The Novato Water System includes seven hydropneumatic systems serving smaller pressure zones that cannot be met from the primary pressure zones. There are seven hydropneumatic systems located throughout the Novato Water System – Hayden, Diablo Hills, Eagle Drive, Bahia, Rockrose, Indian Hills, and Garner. Pertinent information for all hydropneumatic systems is shown in Table 4-2. The last District approved hydropneumatic system was installed in 1986. Due to the high maintenance and operational complexities of these systems, the District position is that no additional hydropneumatic systems shall be permitted.

4.6 PUMP STATIONS

A total of 26 pump stations deliver water from a lower pressure zone to a higher pressure zone. Individual pumps range from 1 hp to 100 hp. Pumps are operated based on water surface levels in a storage tank serving the pressure zone. High and low level set points control the priority operation of the pumps within each station. Tank level set points vary by season. None of the pump stations have permanent standby power facilities. Portable generators are available to power the pump stations in emergency situations. Three of the large pumps at either the San Marin or Lynwood Pump Stations that serve Zone 2 can be run by emergency generators. Both stations have been retrofitted with manual transfer switches to disconnect from the power grid and to accommodate portable generator hookups.

Water is pumped from Zone 1 to Zone 2 by three main pump stations. The San Marin Pump Station feeds the Zone 2 San Mateo/Trumbull area. The Lynwood Pump Station feeds the Zone 2 Sunset/Pacheco area. The Crest Pump Station feeds the separate Crest Zone (including Blackpoint). Several other pump stations deliver water to separate Zone 3 areas served primarily from Zone 2. One pump station – Cherry Hill Pump Station – delivers water to the Cherry Hill Zone 3 directly from Zone 1. Two small pump stations pump from the North Marin Aqueduct – Windhaven and San Antonio. Pertinent information for all pump stations is shown in Table 4-3.

Table 4-1: Gravity Storage Tanks

Zone	Storage Tanks	Capacity (gal)	Overflow depth (ft)	Elevation		Inside Dia. (ft)	Gal Per Ft.	Type of Constr uction	Year Built
				Bottom	Overflow				
1	Lynwood 1	500,000	30.4	132.7	163.1	53.0	16,502	Welded Steel	1958
1	Lynwood 2	850,000	33.4	131.0	164.4	66.0	25,591	Welded Steel	1963
1	Norman	500,000	33.8	123.0	156.8	50.0	14,687	Welded Steel	1951
1	Atherton	5,000,00 0	31.5	133.0	164.5	164.0	158,78 0	Welded Steel	1973
1	Amaroli	4,500,00 0	30	130.0	160	108x2 16	170,67 1	Concre te	2002
1	Palmer Drive	3,000,00 0	30	130.0	160	130.0	99,270	Welded Steel	2008
Total Zone 1		14,350,000							
2	Sunset	5,000,00 0	35.5	288.0	323.5	155.2	141,50 6	Welded Steel	1963
2	Trumbull	1,500,00 0	23.5	285.0	308.5	104.5	64.154	Welded Steel	1963
2	San Mateo	5,000,00 0	31.5	288.7	320.2	164.5	159,16 7	Welded Steel	1966
2	Crest Tank 1	500,000	47.5	293.8	341.3	42.4	10,561	Welded Steel	1966
2	Crest Tank 2	500,000	47.5	293.8	341.3	42.5	10,611	Welded Steel	2011
2	Pacheco (a)	5,000,00 0	24.6	298.4	323.0	236x1 36	239,12 8	Concre te	1975
2	Black Point	324,000	24	168.0	192.0	48.0	13,535	Welded Steel	2000
2	Air Base	1,000,00 0	27.5	250.4	277.9	80.0	37,604	Welded Steel	1957
Total Zone 2		18,824,000							
Note: (a) Depth, 0.9ft. Capacity = 29,400 gal; 0.9 ft to 8.3 ft. refer to Depth/Capacity chart. 8.3 to 24.6 ft capacity = 239,128 gal./ft.									
3	Ponti	500,000	23.8	409.5	433.3	60.0	21,149	Welded Steel	1976
3	Cherry Hill 2	200,000	25.0	410	434.5	37.75	8,247	Welded Steel	1997
3	Cherry Hill 1	250,000	23.25	411.0	434.5	42.25	10,611	Welded Steel	1979
3	Garner	100,000	25.0	461.0	486.0	26.0	3,972	Welded Steel	1986
3	Half Moon	100,000	15.2	461.0	476.2	35.0	7,197	Welded Steel	1969
3	Center Road	500,000	32	495.3	527.3	52.0	15,885	Welded Steel	2007
3	Wild Horse Valley	500,000	31.5	495.3	526.9	50.0	15,885	Welded Steel	1966

Table 4-1: Gravity Storage Tanks (Cont.)

Zone	Storage Tanks	Capacity (gal)	Overflow depth (ft)	Elevation		Inside Dia. (ft)	Gal Per Ft.	Type of Construction	Year Built
				Bottom	Overflow				
3	Winged Foot	600,000	31.6	506.0	537.6	57.0	19,087	Welded Steel	1964
3	San Andreas	250,000	23.25	523.5	546.0	42.25	10,611	Welded Steel	1985
3	San Antonio	200,000	20.7	479.0	500.0	42.25	10,611	Welded Steel	1982
3	Dickson	250,000	32.5	392.0	424.5	36.5	7,828	Welded Steel	1988
3	Nunes	120,000	22.0	388.5	411.5	30.0	5,285	Welded Steel	1994
3	Old Ranch Road	50,000	15.4	512.5	527.9	23.5	3,244	Bolted Steel	2022
3	Windhaven	8,000	9	410.0	419.0	12.5	920	Concrete	1991
Total Zone 3		3,628,000							
4	Upper Wild Horse	44,000	15.5	625.0	640.5	21.5	2,389	Bolted Steel	1987
4	Buck	500,000	20.0	555.0	575.0	64.0	24,065	Welded Steel	1997
4	Cabro Court	5,500	6.0	608.0	614.0	12.5	918	Concrete	2001
Total Zone 4		549,500							
Novato System Total		37,351,500							

Table 4-2: Hydropneumatic Tank Systems

Hydropneumatic System	Tank Size Gal.	Pump Elev Ft.	Tank Elev Ft.	Pressure On	Pressure Off	Total Head Pump On	Total Head Pump Off	Year Built
Hayden	[1] 3,500	65	165	75 psi	90 psi	220 ft	275 ft	1963
Eagle Drive	[1] 4,000	160	315	38 psi	60 psi	405 ft	455 ft	1959
Bahia	3,000	238	290	60 psi	95 psi	377 ft	458 ft	1970
Rockrose Hydro	3,000	235	235	50 psi	68 psi	350 ft	392 ft	1980
Indian Hills	6,000	215	292	46 psi	62 psi	398 ft	435 ft	1982
Diablo	1,500	25	60	50 psi	70 psi	140 ft	187 ft	1985
Garner	4,200	462	462	56 psi	70 psi	591 ft	624 ft	1985
Total	17,700							

1 Two Tanks at These Sites

Table 4-3: Pump Stations

From Zone	To Zone	Location	# of Pumps	HP	Capacity Each Pump gpm	Suction Pressure	Discharge Pressure	Pumps To Tank
1	2	San Marin	3	100-100-100	1800	40 psi	120 psi	San Mateo
1	2	Lynwood	3	100-100-100	1800	66 psi	146 psi	Pacheco
1	2	School Road	2	30-30	400	50 psi	135 psi	Crest
1	[1]2	Hayden	2	5.0-5.0	75	33 psi	80 psi	[1]
1	3	Cherry Hill	2	15-15	140	42 psi	160 psi	Cherry Hill
1	*2	Diablo Hills	2	3.0-5.0	50	50 psi	65 psi	[1]
2	3	Davies	2	5.0-5.0	50	80 psi	180 psi	Old Ranch Rd.
2	3	Ridge Road	2	5.0-5.0	80	47 psi	120 psi	Half Moon
2	3	Truman	2	7.5-7.5	75	41 psi	110 psi	Garner
2	3	Winged Foot	2	15-15	150	50 psi	139 psi	Winged Foot
2	3	Ponti	2	15-15	250	50 psi	100 psi	Ponti
2	3	Trumbull	3	15-15-15	200	15 psi	135 psi	Wild Horse
2	3	San Andreas	2	10.0-10.0	110	40 psi	135 psi	San Andreas
2	*3	Eagle Drive	2	10.0-10.0	245	64 psi	120 psi	[1]
2	*3	Bahia	2	7.5-7.5	125	38 psi	70 psi	[1]
2	*3	Rockrose	2	5.0-5.0	80	40 psi	80 psi	[1]
2	*3	Indian Hills	2	7.5-7.5	125	50 psi	80 psi	[1]
2	3	Nunes	2	5.0-5.0	110	50 psi	90 psi	Nunes
2	3	Woodland Hts	2	7.5-7.5	110	55 psi	100 psi	Dickson
3	*4	Garner	2	5.0-5.0	50	10 psi	70 psi	[1]
3	4	Cabro Ct	2	1.5	25	30 psi	80 psi	Cabro Ct
3	4	Wild Horse Drive	2	3.0-3.0	50	70 psi	125 psi	U Wild Horse
3	4	Buck	2	5.0-5.0	100	25 psi	95 psi	Buck
Aqueduct	3	Windhaven	2	1.5-1.5	25	20 psi	165 psi	Windhaven
Aqueduct	3	San Antonio (WCW)	2	10.0-10.0	100	70 psi	185 psi	San Antonio
Aqueduct	Zone 1	Kastania	2	250-400	11,000-14,000	72 psi	105 psi	NMWD Zone 1

1 Hydropneumatic Systems

4.7 PRESSURE REGULATOR VALVES

Services located at elevations that do not match the primary zone elevations are served by intermediate pressure zones. Water is delivered to these intermediate pressure zones from a higher pressure zone through a pressure regulating station, which consists of two or three pressure reducing valves set at an appropriate downstream pressure to serve the zone. Downstream pressure setpoints are based on service elevations and varies for each valve. Pertinent information for all pressure regulator valves is shown in Table 4-4.

4.8 RELIEF VALVES

Pressure relief valves are located at the intermediate zones to open to relieve high pressure that may build up in the distribution system. Pertinent information for all relief valves is also shown in Table 4-4.

Table 4-4
Regulator Stations and Relief Valves

Regulator Stations					
Location	Elevation	Pressure Setting	From Zone	Upstream Pressure	Size
Western & Center Road	65 ft.	60 psi	San Marin 2	105 psi	6" 6"
Black Point At Highway 37	5 ft.	118 psi	Crest 2	145 psi	6" 6" 4" 4"
Black Point At Grandview (Beattie)	5 ft.	90 psi	Crest 2	118 psi	6" 6" 2"
Black Point at Lolanthus	65 ft.	65 psi	Crest 2	85 psi	6" 6" 2"
Calle De La Mesa	75 ft.	48 psi	Sunset 2	105 psi	6" 6" 2"
Cambridge & Sunset Parkway	25 ft.	80 psi	Sunset 2	132 psi	2" 3"
San Marin East On Santolina Dr.	35 ft.	70 psi	San Marin 2	118 psi	6" 6" 4"
Robinhood Dr at Pump Station	55 ft.	97 psi	Cherry Hill 3	165 psi	8" 8" 4"
Robinhood Dr Uphill	265 ft.	60 psi	Cherry Hill 3	80 psi	4" 4"
Atherton Avenue	58 ft.	76 psi	Cherry Hill 3	160 psi	6" 6" 4"
Hamilton Palm Dr. & Crescent Dr.	48 ft.	50 psi	Pacheco 2	115 psi	8" 8" 6"
Plum St. at Summers Ave	78 ft.	115 psi	Cherry Hill 3	154 psi	8" 6" 2"
Captain Nurse Circle	93 ft.	5 0psi	Air Base 2	80 psi	10" 10" 4"

Table 4-4
Regulator Stations and Relief Valves (Cont.)

Relief Valves					
Location	Elevation	Pressure Setting	From Zone	Upstream Pressure	Size
Western & Center Road	65 ft.	80 psi	n/a	n/a	2"
Black Point At Highway 37	5 ft.	128 psi	n/a	n/a	6"
Black Point At Grandview (Beattie)	5 ft.	100 psi	n/a	n/a	4"
Black Point At Lolanthus	65 ft.	74 psi	n/a	na/	4"
Calle De La Mesa	75 ft.	68 psi	n/a	n/a	3"
Cambridge & Sunset Parkway	25 ft.	100 psi	n/a	n/a	none
San Marin East On Santolina Dr.	35 ft.	90 psi	n/a	n/a	6"
Robinhood Dr. at Pump Station	55 ft.	117 psi	n/a	n/a	6" 6" 6"
Robinhood Dr. Uphill	265 ft.	80 psi	n/a	n/a	3"
Atherton Avenue	58 ft.	96 psi	n/a	n/a	6"
Hamilton Palm Dr. & Crescent Dr.	48 ft.	78 psi	n/a	n/a	8"
Plum St. at Summers Ave	78 ft.	125 psi	n/a	n/a	4"
Captain Nurse Circle	93 ft.	58 psi	n/a	n/a	6"

4.9 TRANSMISSION AND DISTRIBUTION PIPELINES

The transmission system consists of 16- through 30-inch diameter pipelines strategically located to convey water supply to the distribution system. The primary transmission mains include the 30-inch diameter (28.5-inch inside diameter) main connecting the North Marin Aqueduct to Zone 1 and the 18-inch pipeline delivering water from the Stafford Treatment Plant to Zone 1. The transmission mains run primarily north-south across the majority of Zone 1. Larger diameter transmission system piping is generally constructed of steel or reinforced concrete pressure pipe.

Most of the distribution system is comprised of 6-, 8-, 10- and 12-inch diameter pipelines to distribute water from the transmission mains. Distribution system pipelines are constructed primarily of PVC, asbestos cement, and cast iron. Pipelines in the older sections of the Novato System were constructed over 60 years ago and are constructed of cast iron pipe. Cast iron pipe installation ceased in the early 1950's when the District began to install asbestos cement pipe. Since 1992, distribution system piping was standardized with heavy walled PVC C900 pipe (design ratio 14, pressure class 305psi).

As of September 2025, the distribution system totals approximately 353 miles of pipeline, based on data obtained from the District's GIS. The distribution system pipeline characteristics, including the lengths of each pipe material, pipe diameter, and age of pipe, are shown in Table 4-5.

Table 4-5
Transmission and Distribution Pipeline Information

Pipeline Diameter	Pipe Length (ft)	% of Total
< 4-inch	69,936	4.3%
4-inch	105,398	6.5%
6-inch	313,285	19.3%
8-inch	573,538	35.3%
10-inch	27,603	1.7%
12-inch	294,999	18.2%
14-inch	24,665	1.5%
16-inch	97,189	6.0%
18-inch	25,310	1.6%
20- to 27-inch	24,990	1.5%
30-inch	67,760	4.2%
Total	**1,624,673**	**100.0%**

Pipe Material	Pipe Length (ft)	% of Total
Asbestos Cement (ACP)	963,738	59.3%
Cast Iron (CIP)	77,290	4.8%
Copper (COP)	4,167	0.3%
Plastic (PVC)	354,994	21.9%
Plastic (HDPE)	16,630	1.0%
Concrete Pressure Pipe (RCP)	14,190	0.9%
Steel (STL)	193,664	11.9%
Total	**1,624,673**	**100.0%**

Pipe Age	Pipe Length (ft)	% of Total
< 10 years	164,897	10.1%
10-19 years	158,838	9.8%
20-29 years	167,738	10.3%
30-39 years	339,440	20.9%
40-49 years	461,065	28.4%
50-62 years	274,910	16.9%
Unknown/Not listed - ACP	7,530	0.5%
Unknown/Not listed - CIP	34,345	2.1%
Unknown/Not listed - COP	3,080	0.2%
Unknown/Not listed - PVC	1,260	0.1%
Unknown/Not listed - HDPE	0	0.0%
Unknown/Not listed - RCP	0	0.0%
Unknown/Not listed - STL	11,570	0.7%
Total	**1,624,673**	**100.0%**

4.10 FUTURE DEVELOPMENT

There are several development projects that are planned throughout the service area. Future development projects are presented in Section 6 and are based on consultation with input from County of Marin and City of Novato planning staff.

SECTION 5

Existing Novato Recycled Water System

SECTION 5
Existing Novato Recycled Water System

This section provides an overview of the existing recycled water system. The recycled water system allows the District to reduce potable water use to meet large non-potable demands such as irrigation. The recycled water system has been in operation since 2007 but large scale expansion is not anticipated at the time of preparation of this Master Plan.

5.1 INTRODUCTION

Section 5 describes the existing recycled water system facilities within Novato service area and presents a general overview of system operation.

5.2 NOVATO RECYCLED WATER SYSTEM OVERVIEW

The Novato Recycled Water System is broken up into multiple areas referred to as the North, Central, and South service areas as depicted in Figure 5-1. As of September 2025, the Novato Recycled Service area had approximately 104 active service connections served by approximately 16.7 miles of pipelines.

5.3 RECYCLED WATER SUPPLY

Recycled water is produced at the Deer Island Recycled Water Facility (RWF) by the District, Davidson St. RWF by NSD, or LGVSD's RWF. A summary of the three different local RWF's is provided as follows:

- **Deer Island Recycled Water Facility (District)**: The Deer Island RWF receives treated secondary effluent from NSD and produces 0.5 MGD tertiary treated recycled water that meets the most stringent Title 22 standards. The District plans to cease operation of the Deer Island RWF beginning in 2026.
- **Davidson Street Recycled Water Facility (NSD):** The Davidson Street RWF, run by NSD, includes tertiary treatment, filtration units, and a disinfection facility. NSD can provide up to 2.5 MGD to serve the District's North and Central service areas.
- **Las Gallinas Valley Sanitary District Recycled Water Facility:** LGVSD's RWF capacity is over 5 MGD. Treatment is provided by membrane supply pumps and membrane filtration, high quality feed stock to the membrane ultrafiltration system, and chlorine disinfection. LGVWD supplies tertiary recycled water in conformance with Title 22 requirements to serve the District's South service area.

Recycled water is typically produced by NSD and LGVSD between May and November depending on weather and local water supply availability. When needed, recycled water can be produced outside of these months but both agencies prefer steady production rates to simplify operations. Once produced, the District is responsible for the storage and distribution of the recycled water. The District splits its recycled water program into two distinct areas based on the source of the recycled water: 1) North and Central Service Area with recycled water from NSD's Davidson Street RWF (with standby capacity from the District's Deer Island RWF) with storage in both Plum and Norman tanks, and 2) the South Service Area with recycled water from LGVSD with storage in the Reservoir Hill tank.

5.4 FUTURE DEVELOPMENT

The District has no plans to expand the recycled water system at this time. However, the District evaluates all developments for the potential of recycled water use based on proximity to the existing systems and proposed water use needs. The District requires that developers bear all costs associated with expansion and/or connection to the recycled water system.

SECTION 6

Historical Water Demands and Demand Forecasts

SECTION 6
Historical Water Demands and Demand Forecasts

The historical, current, and forecast buildout water demands for the District's Novato Water System are presented in this section.

6.1 HISTORICAL WATER PRODUCTION

Historical annual water production since FY 1955 for both water supply sources (i.e., Stafford Lake and SCWA) is shown in Table 6-1. Historically, approximately 10 to 25 percent of the annual water supply was obtained from the Stafford Lake water source through the Stafford Water Treatment Plant (STP). In 2005, STP was shut down for renovations. The upgraded plant was opened in 2006 and has produced between 8-33 percent of the annual water supply since. The production of STP dropped to 8% during a period of drought in FY 2021 and FY 2022. Since then, from FY 2023 and FY 2025, STP has provided between 13 to 33 percent of the total annual water supply. As a result of the availability of recycled water since 2007, many of the accounts that were used primarily for irrigation have been transferred to draw from the recycled water system. This transfer has resulted in a reduction of peak potable water system demands.

Table 6-1: Historical Water Supply Production

Potable Water Supply							Recycled Water (AF)
Fiscal Year	STP (AF)	SCWA (AF)	Annual Total (AF)	Annual Total (MG)	Annual Daily (MGD)	ADPM (MGD)	
1955	1,019		1,019	332	0.91	1.35	
1956	1,355		1,355	442	1.21	2.15	
1957	1,389		1,389	453	1.24	1.98	
1958	1,579		1,579	515	1.41	2.34	
1959	2,162		2,162	704	1.93	3.03	
1960	2,173		2,173	708	1.94	3.30	
1961	2,128	11	2,139	697	1.91	3.19	
1962	1,830	404	2,234	728	1.99	3.39	
1963	1,704	916	2,620	854	2.34	3.86	
1964	1,939	988	2,927	954	2.61	4.08	
1965	1,994	1,499	3,493	1,138	3.12	4.88	
1966	2,111	1,940	4,051	1,320	3.62	5.94	
1967	1,992	2,034	4,026	1,312	3.59	5.78	
1968	2,223	2,625	4,848	1,580	4.33	6.97	
1969	1,929	2,888	4,817	1,570	4.30	7.06	
1970	1,955	3,650	5,605	1,826	5.00	7.50	
1971	1,953	3,668	5,621	1,832	5.02	8.02	
1972	1,870	4,539	6,409	2,088	5.72	8.52	
1973	1,792	4,553	6,345	2,067	5.66	9.25	
1974	1,253	5,284	6,537	2,130	5.84	9.37	
1975	2,080	4,830	6,910	2,252	6.17	9.31	
1976	1,690	5,946	7,636	2,488	6.82	10.03	
1977	1,020	5,306	6,326	2,061	5.65	10.11	
1978	2,022	3,324	5,346	1,742	4.77	8.68	
1979	2,118	4,883	7,001	2,281	6.25	10.14	
1980	1,414	6,135	7,549	2,460	6.74	10.23	
1981	604	7,903	8,507	2,772	7.59	12.33	
1982	2,030	6,153	8,183	2,666	7.30	11.58	
1983	2,575	5,541	8,116	2,644	7.25	11.06	

Table 6-2: Historical Water Supply Production (Cont.)

Potable Water Supply							Recycled Water (AF)
Fiscal Year	STP (AF)	SCWA (AF)	Annual Total (AF)	Annual Total (MG)	Annual Daily (MGD)	ADPM (MGD)	
1984	2,532	6,721	9,253	3,015	8.26	12.05	
1985	684	8,623	9,307	3,033	8.31	12.75	
1986	1,028	8,324	9,352	3,047	8.35	12.70	
1987	1,902	7,901	9,803	3,194	8.75	12.81	
1988	974	8,918	9,892	3,223	8.83	12.57	
1989	1,188	8,361	9,549	3,111	8.52	12.44	
1990	1,157	8,386	9,543	3,109	8.52	13.09	
1991	1,217	8,852	10,069	3,281	8.99	12.92	
1992	1,438	8,008	9,446	3,078	8.43	11.50	
1993	1,952	7,169	9,121	2,972	8.14	12.25	
1994	1,917	7,914	9,831	3,203	8.78	13.18	
1995	1,065	8,714	9,779	3,186	8.73	13.59	
1996	2,039	8,289	10,328	3,365	9.22	13.49	
1997	2,136	8,503	10,639	3,467	9.50	13.92	
1998	2,323	6,888	9,211	3,001	8.22	14.08	
1999	2,502	7,687	10,189	3,320	9.10	13.67	
2000	2,029	8,757	10,786	3,514	9.63	14.05	
2001	2,241	9,065	11,306	3,684	10.09	15.05	
2002	1,762	9,255	11,017	3,590	9.83	15.06	
2003	2,762	7,867	10,629	3,463	9.49	15.72	
2004	2,006	9,499	11,505	3,749	10.27	15.60	
2005	734	9,326	10,060	3,278	8.98	14.78	
2006	0	10,797	10,797	3,518	9.64	15.58	
2007	1,071	10,103	11,174	3,641	9.97	15.60	3
2008	2,185	8,397	10,582	3,448	9.45	13.57	47
2009	1,912	8,382	10,294	3,354	9.19	13.60	75
2010	2,455	5,997	8,452	2,754	7.54	11.84	55
2011	2,713	6,179	8,892	2,897	7.94	12.20	54
2012	1,798	7,399	9,197	2,997	8.21	12.04	57
2013	2,317	7,436	9,753	3,178	8.71	12.76	81
2014	1,470	7,767	9,237	3,010	8.25	12.42	156
2015	1,758	5,917	7,675	2,501	6.85	10.28	148
2016	1,844	5,300	7,144	2,328	6.38	10.24	139
2017	2,320	5,159	7,479	2,437	6.68	10.01	144
2018	1,983	6,104	8,087	2,635	7.22	13.22	155
2019	1,740	6,272	8,013	2,611	7.15	13.71	191
2020	2,106	5,888	7,993	2,605	7.14	12.36	228
2021	649	7,305	7,954	2,592	7.10	14.38	257
2022	516	5,796	6,313	2,057	5.64	9.88	252
2023	1,953	4,067	6,021	1,962	5.37	11.31	201
2024	1,256	5,136	6,392	2,083	5.71	11.14	183
2025[1]	948	6,323	7,271	2,369	6.49		265

1 ADPM data not included for 2025 as monthly data was not available.

A breakdown of STP production and SCWA purchases from FY 2020 to FY 2025 is provided on Figure 6-1.

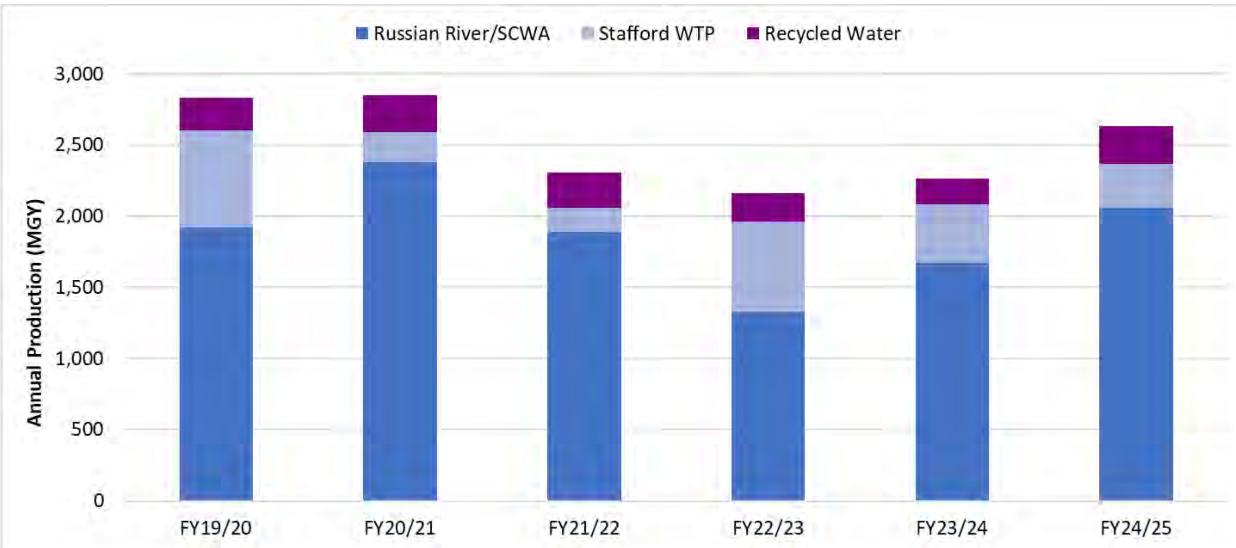


Figure 6-1: Production Breakdown by Source

6.2 EXISTING POTABLE WATER DEMANDS

Water demands from Calendar Year (CY) 2020 to CY2024 were utilized in this Master Plan for establishing near-term trends and developing future demand estimates. Monthly customer billing data from CY2020 to CY2024 was used to calculate the average annual and average daily demands (ADD). These demands were evaluated by customer type as well as pressure zones, which are discussed in Section 6.2.1 and Section 6.2.2.

6.2.1 Existing Potable Demands by Customer Type

The District maintains five principal residential customer classifications:

- single family detached unit (SF);
- single family attached unit, such as townhouse,
- condominium or duplex unit (THC);
- apartment unit (APT); and
- mobile home (MH).

The District maintains two other billing classifications that cover non-residential customers:

- commercial (CM) and
- government (GVT).

The classifications above were then grouped into the following customer types:

- single family residential,
- multi-family residential,
- commercial,
- irrigation and
- raw water.

The average water usage and number of active service connections from January 2020 to December 2024, per customer type is summarized in Table 6-2, along with a comparison to the same information presented in the 2018 Master Plan.

Table 6-3: Average Potable Demands by Customer Type

Customer Type	Consumption (MGY)		Number of Active Connections	
	2018	CY2020-CY2024 Average	2018	2024[1]
Single Family Residential	1,407	1,371	14,300	14,883
Multi-Family Residential	467	387	3,881	4,133
Commercial/Industrial/Institutional	586	322	1,464	1,001
Irrigation[2]		139		212
Raw Water[2]		61		2
Total	**2,469[3]**	**2,286[3]**	**19,645**	**20,231**

1 NMWD Billing Department values indicate all services active as of December 2024. Previous master plan documents may have incorporated alternative methods for calculating total number of services.

2 Data for irrigation and raw water was not provided in the 2018 WMP. 2020-2024 irrigation demand does not include recycled water.

3 2018 consumption is 7,578 acre-feet/year (AFY) and CY2020-CY2024 average potable consumption is 7,016 AFY.

The data showed a reduction in the overall water usage in the last five years compared to historical consumption, despite an increase in the number of active connections. The average potable water consumption per customer between 2020 to 2024 was 310 gallons per connection per day compared to 344 gallons per connection per day in 2018. This trend is attributed to several factors including local and statewide conservation efforts to address long-term droughts including mandatory water use reductions and implementation of surcharge rates during drought years, additional water savings due to more efficient indoor plumbing and fixtures, as well as relatively wet winters and mild summers from 2022 to 2024.

6.2.2 Existing Demands by Pressure Zone

As discussed in Section 4, the Novato water distribution system is divided into four pressure zones: Zone 1, Zone 2, Zone 3 and Zone 4. The accounts in the billing dataset were geolocated in GIS using the listed addresses and a meter shapefile was generated. Each geolocated meter was assigned to a pressure zone based on its location, and corresponding average demands were aggregated for each pressure zone. A breakdown of the CY2020-CY2024 average annual demands by pressure zone is provided in Table 6-3.

Table 6-4: Average Demands by Pressure Zone

Pressure Zone[1]	Average Annual Demand (CY2020-CY2024) (MGY)	% of Total System Demand
Zone 1	1,067	46.0%
Zone 2	1,004	45.2%
Zone 3	210	8.6%
Zone 4	5	0.2%
Total	**2,286**	**100%**

1 Only three zones are used for billing purposes.

6.2.3 Maximum Day Demand

Water demand peaking factors are utilized to evaluate hydraulic performance and identify potential deficiencies in a water distribution system. The MDD represents the highest daily demand in the system over an entire year. A water system is typically evaluated under MDD conditions or MDD plus fire flow conditions. These conditions allow the system to be stressed at a higher demand rate to determine if supply sources and pipeline capacities are adequate to meet the demand scenario. Hydraulic evaluation under MDD plus fire flow demand conditions represents a reasonable “worst case” scenario of system operation.

Since FY 2007, the MDD to ADD peaking factor has varied between 1.65 and 2.33. The 37-year average maximum day to average day peaking factor reported in the 2018 Water Master Plan was 1.82. MDD to ADD peaking factors generally range from 1.2 to 2.5 per American Water Works Association (AWWA) Manual M1. For this 2025 Master Plan, the daily peaking factor was calculated using daily production data from FY 2018 to FY 2025. Based on a maximum daily production of 10.9 MGD and average daily production of 6.8 MGD, the calculated daily peaking factor is 1.6. The reduction in peaking factor from the historical value is consistent with the reduction in water consumption that has been observed over the last few years.

6.2.4 Peak Hour Demand

The PHD represents the highest hourly demand on the entire system and simulates the highest flow rate expected on the hottest day of the year. PHD usually occurs during the morning or evening peak usage periods. Depending on the data, PHD is sometimes considered the “worst case” scenario instead of MDD plus fire flow. It is not appropriate to evaluate a system against a demand rate of PHD plus fire flow, as the likelihood of a fire event at the hottest hour demand of the year is extremely low.

Since recent hourly demand data was not available, the PHD to ADD peaking factor of 2.80 will be utilized for this 2025 Master Plan consistent with the value in the 2018 Master Plan. PHD to ADD peaking factors generally range from 1.6 to 5.0 per AWWA Manual M1.

6.2.5 Water Losses

The water delivered by the District that cannot be credited after accounting for water leaks, flushing flows, hydrant flow tests and other non-billed usage get reported as water loss. The amount of non-revenue water, which includes water losses as well as unbilled authorized consumption, exhibits a decreasing trend over the past 37 years. The District's 2023 AWWA Water Loss Audit reported that non-revenue water comprised 5.5% of the total water supplied by the District. This 2025 Master Plan update assumes that there will be no change in the percentage or share of non-revenue water in the future and is projected to continue at an average of approximately 5.5%.

6.3 FUTURE DEMAND FORECASTS

Previous water demand forecasts for the Novato Service Area were prepared in 1992 and based on the 1991 Countywide Plan. The 1996 City of Novato General Plan development forecast was consistent with the 1991 Countywide Plan, so no formal update of the water demand forecast was conducted at that time. Demands and development projections were updated in the 2007, 2012, and 2018 Master Plans.

For this 2025 Master Plan, the future water demand forecasts were developed using a GIS based analysis of the latest water meter data and land use assignments for the metered connections to develop unit demands (i.e., AF/acre) by land use. Since more recent water meter data was used, the unit demands reflect the statewide passive conservation measures that have been implemented since the 2018 Master Plan update. These unit demands were applied to undeveloped parcels to estimate future water demands by land use in two phases: near-term projections that reflect known developments and full buildout projections.

The following sections discuss the unit demand approach, near-term projections, and full buildout projections in greater detail.

6.3.1 Unit Demands

A unit demand analysis was performed based on land use categories for specific parcels within the Novato service area which were then linked in GIS with the average CY2020 to CY2024 water usage data for that parcel to inform potential unit demands by land use. This was done to ensure that the unit demands used to inform future demand projections reflect recent trends and incorporated water conservation measures that have resulted in demand reductions over the last five years. Demand on each parcel was aggregated by joining meters and parcels using Assessor's Parcel Number (APN) as the join field. Based on land use and zoning information obtained from the City and County databases, land use categories were assigned to the parcels and unit demand (i.e., usage per acre) for each land use type was calculated from the average 2020 to 2024 meter data to reflect the ADD.

A summary of these unit demands is provided in Table 6-4.

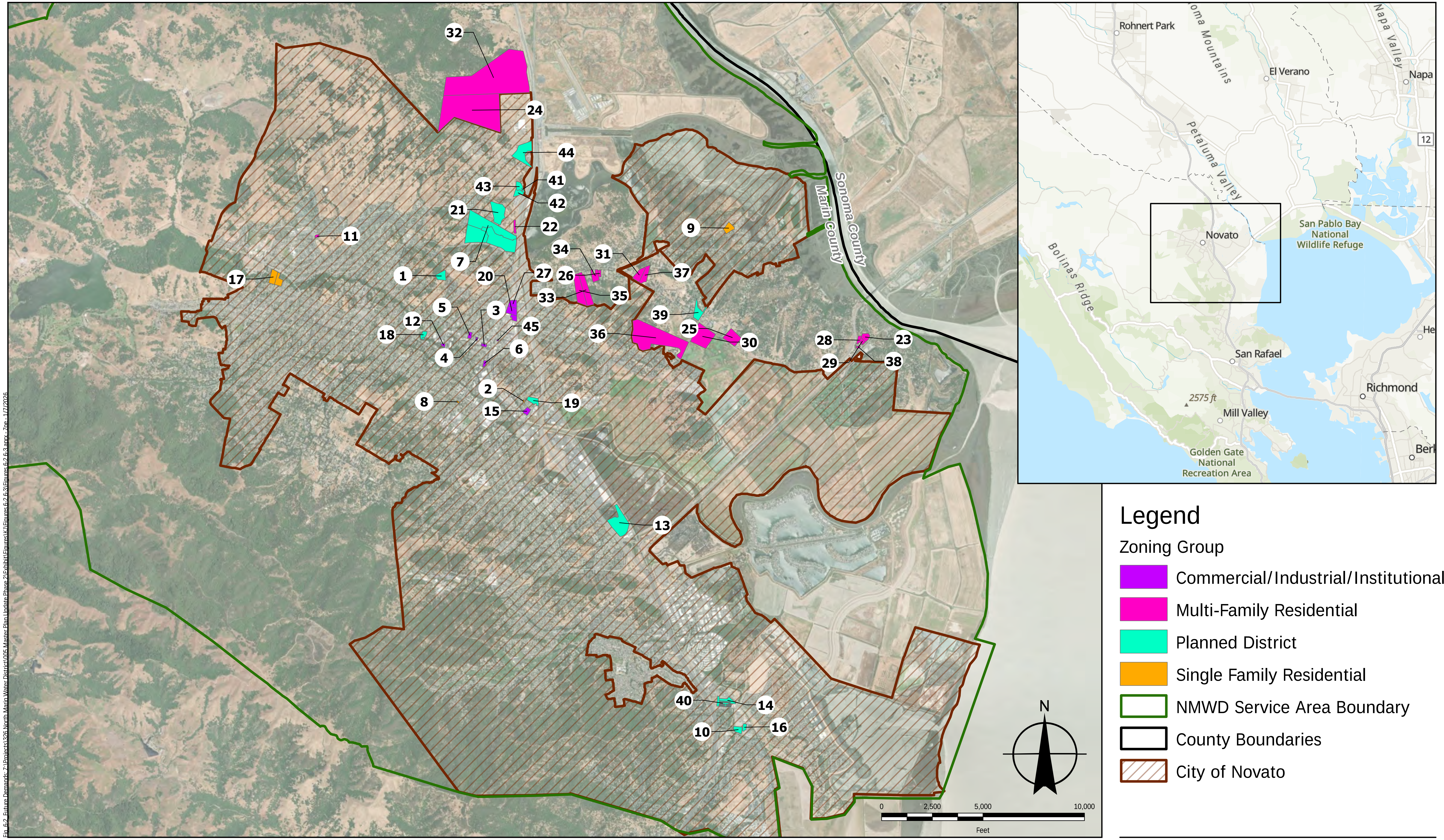
Table 6-5: Unit Demands by Land Use

Land Use Category	Metered Acres from GIS (ac)	Average CY2020-CY2024 Demand (AFY)	CY2020-CY2024 Unit Demand (AF/ac)
Agriculture	4,689	620	0.13
Commercial/Industrial/Institutional	996	426	0.43
Conservation	0	0	0.00
Mixed Use	13	22	1.62
Multi-Family Residential	446	260	0.58
Open Space	871	14	0.02
Parkland	128	15	0.11
Planned District[1]	3,102	2,958	0.95
Single Family Residential	2,861	2,613	0.91
Total	**13,106**	**6,927**	**-**

1 Planned District (PD) category may apply to any of the General Plan land use designations.

6.4 NEAR-TERM DEVELOPMENTS

Analysis of near-term projected water demands is based on new development slated to be constructed within the District service area boundaries. The near-term water demand forecast provided herein is updated with the July 2025 planned development list from the City of Novato Community Development and active new development applications in planning stages. In addition to the development within the City limits, two residential projects from the Marin County Housing Element – Buck Center Vacant Site and Atherton Corridor – were considered. A map showing the development projects is presented in Figure 6-2. The full list of near-term projects used for the analysis is provided in Appendix 2.



Future Demand Parcels
Figure 6-2
1/9/2026

The City and County projected developments add up to 533 acres of total parcel acreage. The land use category for each planned development project was identified using its APN. The projected annual water demand for each project was calculated by multiplying the corresponding unit demand by the parcel acreage. The additional near-term demand due to the planned projects is 388 AFY, which is about 5% of the existing CY2020 to CY2024 average demands. This brings the total near-term demand for existing as well as future users to 7,813 AFY (or 4,843 gpm).

A breakdown of the projected near-term demands by land use is provided in Table 6-5.

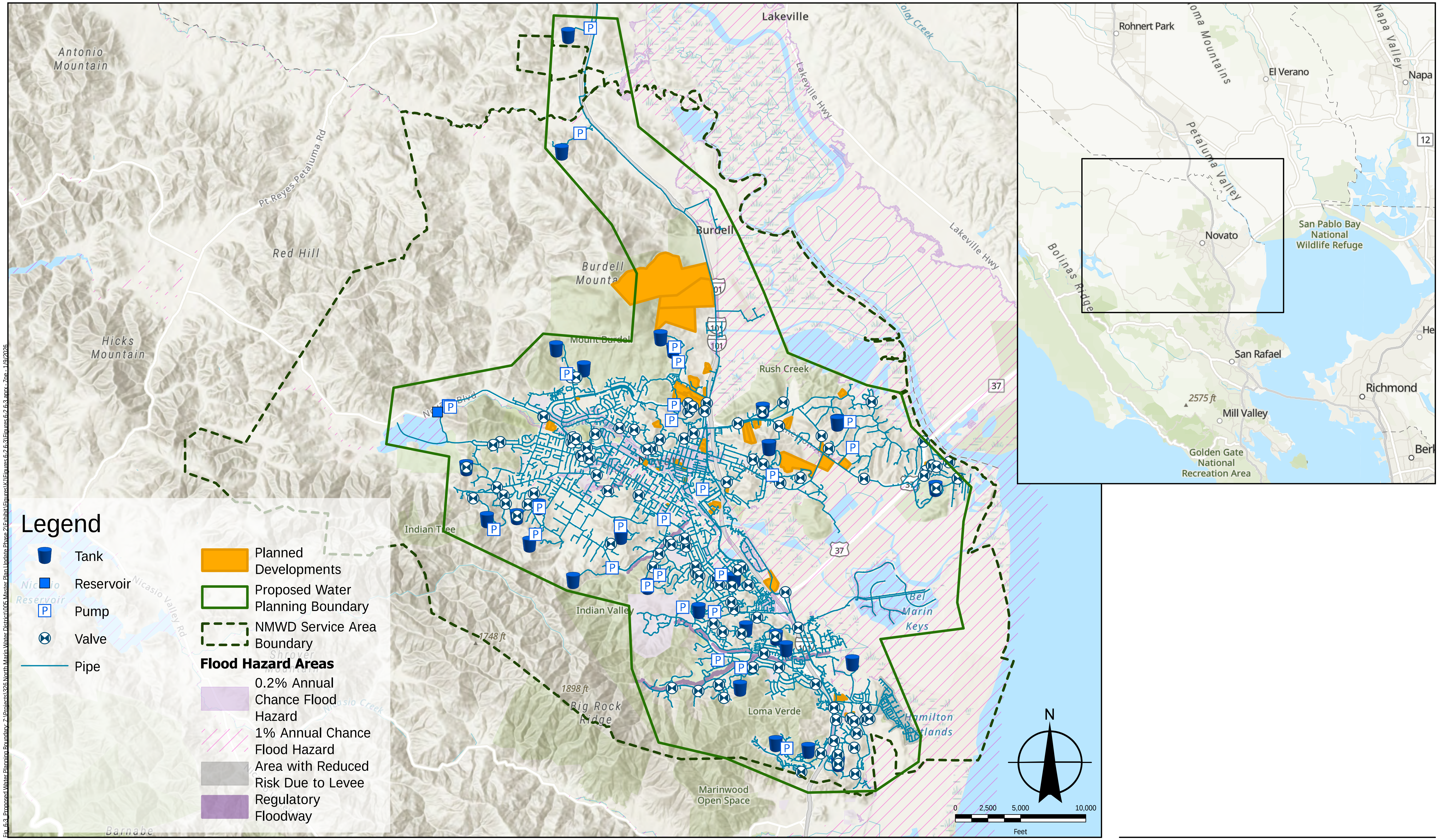
Table 6-6: Projected Near-Term Potable Water Demands

Land Use Category	Existing Demand (AFY)	Unit Demand (AFY/ac)	Area with Planned Developments (acres)	Additional Demands (AFY)	Projected Existing + Additional Demand (AFY)
Agriculture	620	0.132	0.0	0.0	620.2
Commercial/ Industrial/Institutional	426	0.428	15.1	6.4	432.4
Conservation	0	0.000	0.0	0.0	0.0
Mixed Use	22	1.618	0.0	0.0	21.7
Multi-Family Residential	260	0.583	363.8	212.1	472.0
Open Space	14	0.016	0.0	0.0	13.5
Parkland	15	0.115	0.0	0.0	14.7
Planned District	2,958	0.954	141.3	134.8	3,093.0
Single Family Residential	2,613	0.913	12.7	11.6	2,624.7
Total	**6,927**		**532.9**	**364.9**	**7,292.2**

6.4.1 "Full Buildout" Scenario Demand Projections

In addition to the near-term forecast, a "Full Buildout" Scenario growth analysis was developed at a high level to evaluate the District's potential maximum future water needs. This involved identifying a proposed water planning boundary within the District's overall service area which includes areas adjacent to, and that can be adequately served with, existing transmission mains. The planning boundary excludes open spaces, parks and agricultural lands with the assumption that these areas are not expected to be developed any further and will not require additional water.

A map of the proposed water planning boundary is provided below in Figure 6-3.



Proposed Water Planning Boundary

Figure 6-3

1/9/2026

The “Full Buildout” scenario was developed using an assumption that all parcels within the proposed water planning boundary (excluding open spaces, parks and agricultural areas) have the potential to be developed, creating a “full buildout” scenario. These include all parcels that fall under single family residential, multi-family residential, commercial/industrial/institutional, mixed use and planned district categories. The “Full Buildout” scenario demand was estimated by applying the unit demands to undeveloped parcels based on land use.

These undeveloped parcels were found to have a total area of 7,797 acres, contributing to 7,465 AFY of additional water demand. The total “Full Buildout” scenario demand including existing as well as near-term developments would be about 15,280 AFY. It should be noted that this demand represents the theoretical maximum of the District’s future demands. The level of development associated with the “Full Buildout” scenario is infeasible but used in this 2025 Master Plan to provide context to current, near-term, and theoretical long-term water demands.

A breakdown of the theoretical long-term demands by land use is provided in Table 6-6.

Table 6-7: Theoretical Long-Term Water Demands

Land Use Category	Additional Unmetered Area in NMWD Service Area (acres)	Additional Demands, AFY
Agriculture	15,679.1	0.0
Commercial/Industrial/Institutional (CII)	564.5	241.4
Conservation	272.4	0.0
Mixed Use	0.5	0.7
Multi-Family Residential	726.1	423.2
Open Space	5,242.9	0.0
Parkland	105.6	0.0
Planned District	4,422.8	4,218.1
Single Family Residential	2,083.3	1,902.9
Total (Residential + CII + Mixed Use + Planned District)	**7,797**	**6,786.4**
Total (Overall)	**29,097**	**-**

1 “Full Buildout” Scenario demand can be calculated with projected near-term demand (provided in Table 6-5 plus additional theoretical long-term demand described in Table 6-6 above.

A summary comparison of the existing, projected near-term and “Full Buildout” scenario demands is provided in Figure 6-4, along with the 2018, 2020, and 2025 Urban Water Management Plan (UWMP) projections. As shown in Figure 6-4, the “Full Buildout” scenario demands are significantly higher than what is projected in the last three UWMPs. Although the “Full Buildout” scenario is theoretically possible, the District does not anticipate that future demands would exceed the values shown as the Near-Term projected demands. The District intends to use the 2013 ADD of 8.7 MGD or 9,746 AFY (utilized in the 2018 WMP) for the purposes of infrastructure planning.

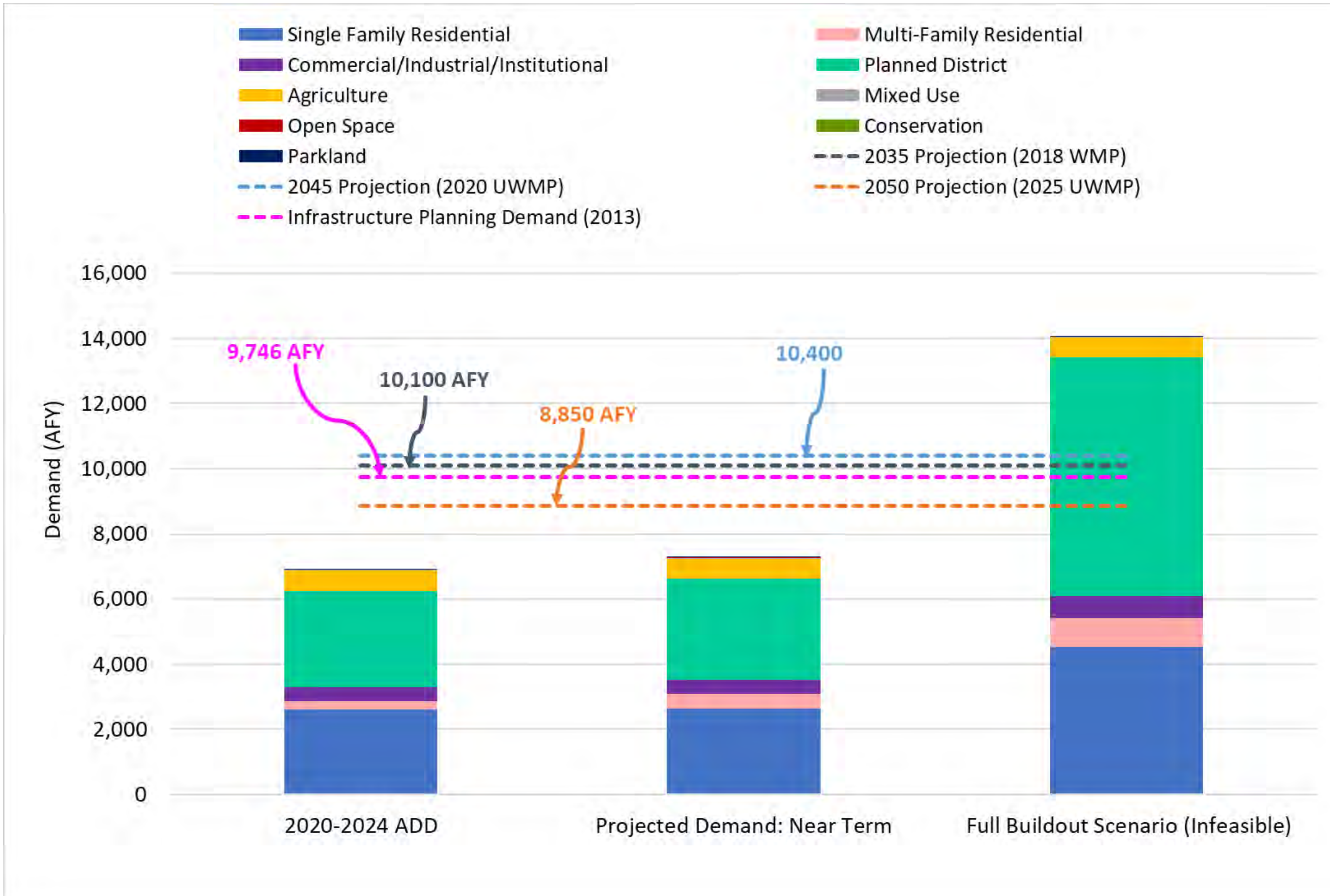


Figure 6-4: Existing vs Future Near-Term Demand vs "Full Buildout" Scenario Comparison

SECTION 7

Storage and Pumping Capacity Evaluation

SECTION 7
Storage and Pumping Capacity Evaluation

This section provides the analysis to confirming whether the Novato Water System has sufficient pumping and storage capacity to meet the operational and emergency planning needs for the customers.

7.1 INTRODUCTION

The storage and pumping capacity evaluation of the pressure zones and pump stations in the Novato Water System is presented in Section 7. The analysis is based on the "Infrastructure Planning Demands" from 2013 rather than the FY 2024 water demands, short-term projected demands, or the "Full Buildout" scenario water demands presented in Section 6. The decision was made to continue using 2013 demand numbers for planning and designing system infrastructure as they represent the highest (and therefore most conservative) demand values over the previous 15 years. Although the District is seeing a decline in demand values in recent years (due to two periods of drought, recycled water production offset, water conserving plumbing fixtures, and landscape water efficiency devices), there is not enough consistency in year-over-year demand values to justify lowering the values used for infrastructure planning at this time. In addition, RW demand would need to be offset by potable water should one of the RWF need to be taken offline during the peak season. The demand values used for infrastructure planning in future master plans will be reevaluated as necessary.

The existing storage capacity is compared to storage capacity requirements based on District storage criteria for each pressure zone, to determine storage capacity adequacy. Similarly, the existing firm pumping capacity is compared to pumping capacity requirements based on District pumping criteria for the major booster pump stations serving Zones 2, 3, and 4, to determine pumping capacity adequacy.

7.2 BACKGROUND/PREVIOUS STUDIES

The District has performed several storage and pumping capacity evaluations in recent years. In 1991, the District conducted an evaluation of storage capacity for Zones 1 and 2 (James M. Montgomery, Evaluation of Zone 1 Storage Requirements, 1991). That study concluded that Zone 2 had ample storage capacity to meet current and buildout demands, but that Zone 1 was deficient by approximately 3 million gallons. Specific storage capacity criteria were established during that study and adopted system wide.

In 1996, storage capacity was reviewed again for Zones 1 and 2 due to demand growth since 1991 and the long-term land use changes contained in the 1996 City of Novato General Plan (Soldati Engineering Services, Storage Evaluation and Siting Study, January 1997). This study concluded that Zone 1 was deficient by approximately 2.8 million gallons based on FY 1996 demands and would be deficient by approximately 8.8 million gallons by buildout (FY 2015). Zone 2 continued to have a surplus of storage capacity. The Crest Zone was deficient by approximately 430,000 gallons based on FY 1996 demands and would be deficient by approximately 750,000 gallons by buildout. The many separate isolated Zone 3 and 4 systems were not addressed in the 1996 study.

In 1998, a storage and pumping capacity study was prepared for the major Zone 3 and 4 service areas (Soldati Engineering Services, Zones 3 and 4 Storage Capacity Evaluation, April 20, 1999).

Service areas found to be deficient in storage and pumping capacity under both FY 1997 and buildout demand conditions were identified.

A storage and pumping capacity evaluation was performed in the 2002 Water System Master Plan utilizing FY 2001 demand and demand projections based on planned development at that time. The evaluation was updated in the 2007 Water System Master Plan utilizing FY 2006 demand and demand projections at that time. Both studies recommended additional storage capacity immediately for the Crest and Wild Horse Valley Zones, and additional storage capacity was recommended for Zone 1 to meet buildout demands. Additional pumping capacity was recommended immediately for the School Road and Trumbull Pump Stations, and additional pumping capacity was required for the Nunes and Buck Pump Stations to meet buildout demands.

A storage and capacity evaluation was performed again for the 2012 Water System Master Plan Update, utilizing FY 2011 demand and demand projections based on planned development at that time. The study recommended additional storage capacity for Zone 1 and the Half Moon and Old Ranch Road Zones to meet buildout and fire flow storage demands. The study also recommended the installation of a new tank in the Buck Zone to be constructed when buildout development occurs. No immediate additional pumping capacity was required, although the Lynwood and Cherry Hill pump stations were recommended for further study, while the Nunes and Buck pump station capacities were recommended to be increased after final approval of buildout development.

The 2018 Master Plan was updated to help guide immediate and planned future system improvements. The 2018 Master Plan identified necessary system improvements for both operation and, as water demands increase, incorporated replacement metrics related to asset age and material.

Using the Infrastructure Planning Demands, the storage and pumping capacity evaluations are similarly updated for all pressure zones within the Novato Water System. All pressure zones are included, except for the seven, small hydropneumatic pumping stations, the Cabro Court Zone, the San Antonio Zone and the Windhaven Zone due to the relatively small number of service connections.

7.3 EVALUATION METHODOLOGY

As described in Section 9, the previous 2018 model analysis relied on geolocated customer billing data to precisely allocate demands. This 2025 Master Plan update utilizes the same geolocated customer billing data with the Infrastructure Planning Demands. The pertinent storage capacity and pumping capacity evaluation criteria and pumping capacity evaluation criteria are presented in Section 2. Other major elements of the approach are summarized herein.

7.3.1 Storage Capacity Evaluation

The storage capacity evaluation is based on determining three storage volume components, as summarized below:

- **Operational Storage**: 25% of MDD for one day.
- **Fire Storage:** 1,500 gpm for two hours for residential areas and 3,500gpm for three hours in non-residential areas
- **Emergency Storage:** 100% of MDD for one day.

The sum of these three components is the total storage capacity goal for the specific pressure zone. This total storage capacity goal is compared to the existing storage capacity to determine if a surplus or deficit of storage capacity exists. A detailed discussion of this storage evaluation is presented later in this section.

The District also considers water quality and water age when determining the storage capacity in balance with critical storage components listed above. Generally, storage volumes have not been adjusted to address specific water quality and water age challenges but rather the District takes operational steps during periods of low demand. Further discussion on turnover and water quality, including operational strategies can be found in both the Section 8 and Section 10, respectively.

7.3.2 Pumping Capacity Evaluation

Providing adequate storage capacity is only one distribution system element that beneficially affects system operation. Adequate pumping capacity must be provided to enable the storage capacity to recover depleted volume in a reasonable time period. Undersized pumps may reduce the effectiveness of storage capacity. Therefore, it is necessary to evaluate the pumping capacity requirements at each booster pump station.

The pumping evaluation in this study consists of comparing the pumping requirement (calculated as MDD demand pumped over 16 hours for a given zone) to the firm capacity of the supplying pump station. Firm capacity is defined as the pump station capacity with the largest pump out of service. All the District's pump stations evaluated in this 2025 Master Plan have at least two pumps, except the San Marin, Lynwood, and Trumbull pump stations, which have three pumps. Many pump stations are required to pass water through to a higher zone than the one which the pump station is serving. The total flow that is required to be pumped through the station for both its zone and upper zones is included as appropriate when determining the total pumping capacity requirement.

7.3.3 Pressure Zone Water Demands

The storage and pumping evaluation in this 2025 Master Plan utilizes "Infrastructure Planning Demands" from 2013. Operational and emergency storage criteria, as well as the pumping capacity criteria, are based on MDD for each pressure zone. Pumping demands were obtained from FY 2013 billing data for the zones the pumps serve. In the case of Primary Zone 2, where multiple pump stations (Lynwood and San Marin) serve a single zone, the demands were split in the same ratio as was done in the 2018 Master Plan based on pump station flow totalizer data.

Water pumped into the pressure zone ideally should equal the consumption for each zone plus a percentage for lost (unaccounted) water. Discrepancies in the production versus consumption data can indicate: (1) lost (unaccounted) water; (2) a problem in the method of determining consumption data; (3) a problem in the obtaining and recording of production data; or (4) an issue in the actual performance of the pumps.

7.4 STORAGE CAPACITY EVALUATION

As with the pumping capacity analysis, the storage capacity requirements for each pressure zone for the Infrastructure Planning Demands and with buildout (FY 2040) water demands are described below. A comparison to prior evaluations and specific recommendations to address storage needs are presented later in this section.

7.4.1 FY2013 Water Demands

Storage capacity requirements by pressure zone for the "Infrastructure Planning Demands" from 2013 are shown in Table 7-1. Eleven of the seventeen pressure zones have surplus storage capacity based on the 2013 "Infrastructure Planning Demands", while the remaining six show a storage capacity deficit. All the major pressure zones were analyzed. Given the relatively small number of service connections, storage requirements for hydropneumatic systems, Cabro Ct, San Antonio & Windhaven pressure zones are not included.

7.4.1.1 Zone 1 Storage Capacity Summary

The Zone 1 North Novato Subzone has a storage surplus of 104 thousand gallons, while the Zone 1 South Novato Subzone has a larger storage surplus of approximately 2.9 million gallons. Since both subzones are connected hydraulically, storage capacity from each subzone is available to the other. Therefore, Zone 1 has sufficient storage capacity under the Infrastructure Planning Demands Scenario.

7.4.1.2 Zone 2 Storage Capacity Summary

The two main subzones within Zone 2, San Mateo/Trumbull and Sunset/Pacheco Subzones, each have a surplus of approximately 2.6 million gallons and 6.6 million gallons respectively. These subzones can also be connected hydraulically, so storage capacity from each subzone is available to the other, although the hydraulic grade line tends to be higher in the Sunset/Pacheco Subzone. This hydraulic connectivity is interrupted when demands are lower during the period between November through April when a zone valve located at Slowdown Court is closed to increase water turnover in the San Mateo tank to avoid water quality issues.

There are three other pressures zones within Zone 2. The Crest Zone has a surplus of approximately 469,000 gallons, while the Black Point and Air Base Zones have a surplus of 4,000 gallons and 138,000 gallons respectively.

7.4.1.3 Zone 3 Storage Capacity Summary

The Cherry Hill, Wild Horse Valley/Center Road, Dickson, Winged Foot, and Ponti Zones all have surplus storage capacity currently.

Fire storage requirements for the Cherry Hill zone is based on residential fire flow criteria, even though there is a small amount of commercial development in these areas.

Half Moon and Garner Zones each have storage capacity deficiencies, primarily due to the high fire storage component which is greater than the existing storage capacity for these zones. Each of these pressure zones have at least four days of MDD in storage capacity, so there is adequate capacity to withstand a limited loss of pumping. It was considered to combine the emergency storage component with the fire storage component for these small systems, as was done in the Dickson Zone. However, the Half Moon, Garner, and Old Ranch Road Zones have deficiencies despite the combination, so the components have been kept separate for future project planning.

The Nunes Zone has a deficiency equivalent to 84% of existing storage capacity 104,000 gallons. However, there are over 11.5 days of MDD in storage capacity, so there is adequate capacity to withstand a limited loss of pumping.

Table 7-1: Storage Capacity Evaluation (Infrastructure Planning Demands)

Pressure Zone (1)	Zone	Tanks	Total Zone Storage Capacity (gal)	Estimated Max Demand (2)(10) (gpd)	No. Days of Max Day Demand in Storage (3)	Operational Storage (4) (gal)	Fire Storage (4) (gal)	Emergency Storage (4) (gal)	Total Storage Required (gal)	Additional Storage Required (gal)
No. Novato Subzone(5)	1	Atherton (5 mg), Lynwood (two 0.675 mg tanks).	6,350,000	4,492,000	1.4	1,123,000	630,000	4,492,000	6,245,000	(105,000)
So. Novato Subzone(5)	1	Palmer (3 mg), Amaroli (4.5 mg)	7,500,000	3,186,000	2.4	796,500	630,000	3,186,000	4,613,000	(2,887,000)
Zone 1 Total	1		13,850,000	7,678,000	3.8	1,919,500	1,260,000	7,678,000	10,857,500	(2,992,500)
San Mateo/Trumbull Subzone(6)	2	San Mateo (5 mg), Trumbull (1.5 mg).	6,500,000	2,603,000	2.5	651,000	630,000	2,603,000	3,884,000	(2,616,000)
Sunset/Pacheco Subzone(6)	2	Sunset (5 mg), Pacheco (5 mg).	10,000,000	2,247,000	4.5	562,000	630,000	2,247,000	3,439,000	(6,561,000)
Primary Zone 2 Total	2		16,500,000	4,850,000	6.9	1,213,000	1,260,000	4,850,000	7,323,000	(9,177,000)
Crest	2	Crest (two 0.5 mg tanks)	1,000,000	257,000	3.9	64,300	210,000	257,000	532,000	(468,000)
Black Point	2	Black Point (0.324 mg)	324,000	88,000	3.7	22,000	210,000	88,000	320,000	(4,000)
Air Base	2	Air Base (1 mg)	1,000,000	185,000	5.4	46,300	630,000	185,000	862,000	(138,000)
Cherry Hill	3	Cherry Hill (0.45 mg)	450,000	155,000	2.9	38,800	210,000	155,000	404,000	(46,000)
Half Moon	3	Half Moon (0.1 mg)	100,000	24,000	4.1	6,000	210,000	24,000	240,000	**140,000**
Wild Horse Valley/Center Rd	3	Wild Horse Valley (0.5 mg), Center Rd (0.5 mg).	1,000,000	294,000	3.4	74,000	210,000	294,000	578,000	(422,000)
Garner	3	Garner (0.1 mg)	100,000	21,000	4.7	6,000	210,000	21,000	237,000	**137,000**
Old Ranch Road	3	Old Ranch Road (0.05 mg)	111,000	27,000	4.2	7,000	100,000	27,000	134,000	**23,000**
Dickson	3	Dickson (0.25 mg)	250,000	85,000	2.9	22,000	210,000	0(8)	232,000	(18,000)
Winged Foot	3	Winged Foot (0.6 mg)	600,000	78,000	7.7	20,000	210,000	78,000	308,000	(292,000)
Ponti	3	Ponti (0.5 mg)	500,000	96,000	5.2	24,000	210,000	96,000	330,000	(170,000)
San Andreas	3	San Andreas (0.25 mg)	250,000	32,000	7.7	8,000	210,000	32,000	250,000	0
Nunes	3	Nunes (0.12 mg)	120,000	10,000	11.5	3,000	210,000	10,000	223,000	**103,000**
Buck	4	Buck (0.5 mg)	500,000	80,000	6.3	20,000	630,000	80,000	730,000	**230,000**
Upper Wild Horse Valley	4	Upper Wild Horse Valley (0.044 mg)	44,000	10,000	4.3	3,000	0(7)	10,000	13,000	(31,000)

1 Only major pressure zones shown. Hydropneumatic systems and Cabro Ct, San Antonio and Windhaven pressure zones are not included.
2 Demands calculated using Section 6 results
3 This is the number of days of demand that could be met at the highest demand if all demand is served from the tank capacity only.
4 Storage criteria presented in Section 2.
5 North Novato and South Novato Subzone. are hydraulically connected.
6 San Mateo/Trumbull and Sunset/Pacheco Subzone are hydraulically connected.
7 Tank provides domestic service only; no fire storage volume provided in tank.
8 Emergency Storage has been combined with Fire Storage for this small system.
9 Surplus data is shown in parentheses.
10 Values rounded to the nearest thousand.

7.4.1.4 Zone 4 Storage Capacity Summary

Upper Wild Horse Valley Zone is considered to have a surplus as there is no fire storage volume provided by the tank. The Buck Zone has deficiency of 230,000 gallons

7.4.2 Buildout Water Demands

Storage capacity requirements by pressure zone for FY 2040 are shown in Table 7-2. Note that, as described in Section 6, the theoretical build-out is infeasible. Instead, the incremental Projected Near-Term Water Demands plus Infrastructure Planning Demands were utilized. Additional demand is expected in the North Novato Subzone, Half Moon Zone, Garner Zone, Old Ranch Road Zone, San Andreas Zone, Nunes Zone and the Buck Zone.

The North Novato Subzone has a near-term build-out deficiency of 105,000 gallons. The South Novato Subzone has a surplus of approximately 2.7 million gallons. These subzones can also be connected hydraulically, allowing storage capacity from each subzone to be available to the others, thereby negating the North Novato Subzone deficiency.

The Half Moon, Garner, Old Ranch Road, San Andreas, Nunes, and Buck all have significant storage deficits now and at the projected near-term build-out. These deficits are close to or exceed the total current tank capacity and are primarily due to fire storage requirements.

Table 7-2: Storage Capacity Evaluation (FY2040 Demands)

Pressure Zone [1]	Zone	Tanks	Total Zone Storage Capacity (gal)	Estimated Max Demand [2][10] (gpd)	No. Days of Max Day Demand in Storage [3]	Operational Storage [4] (gal)	Fire Storage [4] (gal)	Emergency Storage [4] (gal)	Total Storage Required (gal)	Additional Storage Required (gal)
No. Novato Subzone[5]	1	Atherton (5 mg), Lynwood (two 0.675 mg tanks).	6,350,000	4,660,000	1.4	1,165,000	630,000	4,660,000	6,455,000	**105,000**
So. Novato Subzone[5]	1	Palmer (3 mg), Amaroli (4.5 mg)	7,500,000	3,304,000	2.3	826,000	630,000	3,304,000	4,760,000	(2,740,000)
Zone 1 Total	1		13,850,000	7,964,000	3.6	1,991,000	1,260,000	7,964,000	11,215,000	(2,635,000)
San Mateo/Trumbull Subzone[6]	2	San Mateo (5 mg), Trumbull (1.5 mg).	6,500,000	2,700,000	2.4	675,000	630,000	2,700,000	4,005,000	(2,495,000)
Sunset/Pacheco Subzone[6]	2	Sunset (5 mg), Pacheco (5 mg).	10,000,000	2,330,000	4.3	582,500	630,000	2,330,000	3,543,000	(6,457,000)
Primary Zone 2 Total	2		16,500,000	5,030,000	6.7	1,258,000	1,260,000	5,030,000	7,548,000	(8,952,000)
Crest	2	Crest (two 0.5 mg tanks)	1,000,000	266,000	3.8	266,000	210,000	266,000	543,000	(457,000)
Black Point	2	Black Point (0.324 mg)	324,000	91,000	3.6	91,000	210,000	91,000	324,000	0
Air Base	2	Air Base (1 mg)	1,000,000	192,000	5.2	192,000	630,000	192,000	870,000	(130,000)
Cherry Hill	3	Cherry Hill (0.45 mg)	450,000	161,000	2.8	161,000	210,000	161,000	412,000	(38,000)
Half Moon	3	Half Moon (0.1 mg)	100,000	25,000	4.0	25,000	210,000	25,000	242,000	**142,000**
Wild Horse Valley/Center Rd	3	Wild Horse Valley (0.5 mg), Center Rd (0.5 mg).	1,000,000	305,000	3.3	305,000	210,000	305,000	592,000	(408,000)
Garner	3	Garner (0.1 mg)	100,000	22,000	4.5	22,000	210,000	22,000	238,000	**138,000**
Old Ranch Road	3	Old Ranch Road (0.05 mg)	111,000	28,000	4.0	7,000	100,000	28,000	135,000	**24,000**
Dickson	3	Dickson (0.25 mg)	250,000	88,000	2.8	88,000	210,000	0(8)	232,000	(18,000)
Winged Foot	3	Winged Foot (0.6 mg)	600,000	80,000	7.5	80,000	210,000	80,000	310,000	(290,000)
Ponti	3	Ponti (0.5 mg)	500,000	99,000	5.1	99,000	210,000	99,000	334,000	(166,000)
San Andreas	3	San Andreas (0.25 mg)	250,000	34,000	7.4	34,000	210,000	34,000	253,000	**3,000**
Nunes	3	Nunes (0.12 mg)	120,000	11,000	10.9	11,000	210,000	11,000	224,000	**104,000**
Buck	4	Buck (0.5 mg)	500,000	83,000	6.0	83,000	630,000	83,000	734,000	**234,000**
Upper Wild Horse Valley	4	Upper Wild Horse Valley (0.044 mg)	44,000	11,000	4.0	11,000	0[7]	11,000	14,000	(30,000)

1 Only major pressure zones shown. Hydropneumatic systems and Cabro Ct, San Antonio and Windhaven pressure zones are not included.
2 Demands calculated using Section 6 results
3 This is the number of days of demand that could be met at the highest demand if all demand is served from the tank capacity only.
4 Storage criteria presented in Section 2.
5 North Novato and South Novato Subzone. are hydraulically connected.
6 San Mateo/Trumbull and Sunset/Pacheco Subzone are hydraulically connected.
7 Tank provides domestic service only; no fire storage volume provided in tank.
8 Emergency Storage has been combined with Fire Storage for this small system.
9 Surplus data is shown in parentheses.
10 Values rounded to the nearest thousand.

7.4.3 Historical Comparison

A comparison of the storage capacity deficit from FY 2006, FY 2011, FY 2013, FY 2024 (Infrastructure Planning Demands) and the projected near-term build-out (FY 2040) is shown in Table 7-3. Five zones show a decrease in storage capacity surplus, while four tanks show an increase in deficit. Three show a change from a capacity deficit to a surplus, while three show an increase in surplus, and two go from a surplus to a deficit.

Table 7-3: Historical Comparison of Additional Storage Requirements

Tank/Pressure Zone	Zone	Total Zone Storage Capacity	Storage Deficit (Gallons)				
			FY 2006	FY 2011	FY 2013	FY 2024	FY 2040
Zone 1 Total	1	13,850,000	0	(4,742,000)	(4,644,000)	(3,622,602)	(2,634,000)
Primary Zone 2 Total	2	16,500,000	0	(9,057,000)	(7,961,000)	(9,177,000)	(8,952,000)
Crest	2	1,000,000	**299,000**	(404,000)	(495,000)	(495,000)	(457,000)
Black Point	2	324,000	n/a	**28,000**	**95,000**	**95,000**	0
Air Base	2	1,000,000	**406,000**	(70,000)	**216,000**	**216,000**	(129,000)
Cherry Hill	3	450,000	0	(2,000)	0	0	(39,000)
Half Moon	3	100,000	**197,000**	**150,000**	**125,000**	**125,000**	**142,000**
Wild Horse Valley/Center Rd	3	1,000,000	0	**313,000**	(293,000)	(293,000)	(408,000)
Garner (1)	3	100,000	**126,000**	**141,000**	**118,000**	**118,000**	**138,000**
Old Ranch Road	3	50,000	**64,000**	**188,000**	**71,000**	**22,500**	**23,500**
Dickson	3	250,000	**2,000**	(12,000)	(46,000)	(46,000)	(17,000)
Winged Foot	3	600,000	0	(264,000)	(285,000)	(285,000)	(289,000)
Ponti	3	500,000	0	(134,000)	(167,000)	(167,000)	(165,000)
San Andreas	3	250,000	0	**13,000**	(32,000)	(32,000)	**2,000**
Nunes	3	120,000	0	**107,000**	**84,000**	**84,000**	**104,000**
Buck	4	500,000	**160,000**	**159,000**	(43,000)	(43,000)	**234,000**
Upper Wild Horse Valley	4	44,000	0	(27,000)	(23,000)	(23,000)	(30,000)
Total		**36,638,000**	**1,254,000**	**1,099,000**	**709,000**	**660,500**	**643,500**

1 Additional storage capacity will not be constructed in this zone. See Section 5 for discussion.
2 Surplus data is shown in parentheses.

7.5 PUMPING CAPACITY EVALUATION

The pumping capacity requirements for each pressure zone for the Infrastructure Planning Demands and near term buildout (FY 2040) water demands are shown below. Specific recommendations to address pumping capacity needs are presented later in this section. Pumping capacity requirements by pump station are shown in Table 7-4 for the Infrastructure Planning Demands and FY 2040.

In 2018 Master Plan update, the Primary Zone 2 used a cumulative approach for firm capacity since Lynwood Pump Stations and San Marin Pump Stations were hydraulically connected. This approach analyzed both the Lynwood Pump Stations and San Marin Pump Stations as if the two pump stations were one station. The District has decided to move away from this approach and would rather the firm capacity of each individual station be assessed on its own.

The School Road Pump Station has been replaced with the new Crest Pump Station. The pumping capacities for all zones should be reviewed again when specific water use data from anticipated developments becomes available, to ensure a deficit does not occur.

Table 7-4: Project MDD Pump Station Demands
(Infrastructure Planning Demands [FY2024] & FY2040)

Pump Station	Pumps to Pressure Zones	Station Firm Capacity (gpm) [2]	FY 2024 Max Day Demand		FY 2040 Max Day Demand	
			(gdp)	(gpm) [3]	(gdp)	(gpm) [3]
San Marin	2	3,600	2,456,924	2,559	2,553,855	2,660
Lynwood	2	3,600	3,790,870	3,949	3,940,444	4,105
Primary Zone 2 Total		-	6,247,794	6,508	6,494,299	6,765
School Road	Crest, Bahia & Black Pt	400	441,868	460	459,302	478
Cheery Hill	Cherry Hill	140	187,163	195	194,548	203
Ridge Road	Half Moon	80	26,752	28	27,808	29
Trumbull	Wild Horse/Center, Upper Wild Horse, Cabro Ct.	680	345,947	360	359,596	375
Truman	Garner & Garner Hydro	75	30,211	31	31,403	33
Davies	Old Ranch Rd	50	21,768	23	22,627	24
Woodland Heights	Dickson	110	108,026	113	112,288	117
Winged Foot	Winged Foot	150	93,989	98	97,697	102
Ponti	Ponti	250	93,175	97	96,851	101
San Andreas	San Andreas	110	32,652	34	33,940	35
Nunes	Nunes & Buck	110	31,431	33	32,671	34
Buck	Buck	100	19,937	21	20,724	22
Wild Horse	Upper Wild Horse	50	11,494	12	11,948	12

1 Demand increase per pressure zone presented in Section 6
2 Pump station capacity with largest pump out of service
3 Calculated as maximum day demand pumped over 16 hours per day per District criterion.

7.5.1 Infrastructure Planning (FY 2024) Water Demands

Pumping capacity requirements for each pump station were assessed using geolocated billing data. The maximum day pumping requirement represents the gallons per minute pumping capacity needed by each pump station to pump the MDD over 16 hours, per District criterion.

7.5.2 Buildout Water Demands

Demand increases are expected in the projected near-term build-out scenario. School Road (now Crest), and Cherry Hill pump stations have limited capacity versus the calculated demand. Other future demand is expected in all other pressure zones except the Wild Horse Zone, but the total expected increases are minor in comparison.

Under current demand, pump stations Lynwood, School Road, Cherry Hill, and Woodland Heights have a deficiency. Recommendations to address these deficiencies are discussed later in this section.

7.5.3 Historical Comparison

A comparison of the pumping capacity deficit from FY 2006, FY 2011, 2013, 2024 (uses 2013 infrastructure planning demands), and projected near-term build-out (FY 2040) is shown in Table 7-5. If the projected near-term build-out were realized, the Lynwood, Crest, Cherry Hill, and Woodland Heights pump stations would have minor deficiencies.

Table 7-5: Historical Comparison of Additional Pumping Capacity Required

Pump Station	Pumps Directly to Pressure Zone	Station Firm Capacity (gpm) [1]	Pump Station Deficit [4]				
			FY 2006 (gdp)	FY 2011 (gpm) [3]	FY 2013 (gdp)	FY 2024 (gpm) [3]	FY 2040 (gpm)
San Marin	Primary Zone 2	3,600	221	(1802)	(890)	(1041)	(940)
Lynwood	Primary Zone 2	3,600				349	505
School Road	Crest	400	180	86	126	60	78
Cheery Hill	Cherry Hill	140	70	58	85	55	63
Ridge Road	Half Moon	80	0	(47)	(43)	(52)	(51)
Trumbull	Wild Horse/Center Rd.	680	177	(184)	(219)	(320)	(305)
Truman	Garner	75	0	(38)	(34)	(44)	(42)
Davies	Old Ranch Rd	50	0	(117)	(33)	(27)	(26)
Woodland Heights	Dickson	110	0	5	(13)	3	7
Winged Foot	Winged Foot	150	0	(45)	(38)	(52)	(48)
Ponti	Ponti	250	0	(121)	(123)	(153)	(149)
San Andreas	San Andreas	110	0	(66)	(79)	(76)	(75)
Nunes	Nunes & Buck	110	0	(72)	(60)	(77)	(76)
Buck	Buck	100	0	(76)	(69)	(79)	(78)
Wild Horse	Upper Wild Horse	50	0	(36)	(33)	(38)	(38)
Totals [3]		**11,305**	**648**	**149**	**211**	467	653

1 Pump station capacity with largest pump out of service
2 Firm capacity for hydraulically connected Zone 2 used to be calculated as a sum of the two connected pump stations. Deficiencies in the years 2006, 2011, and 2013 therefore the same for San Marin and Lynwood Pump Station.
3 These total storage deficit value for the system have not been offset by the individual zone surplus' listed. In other words, a surplus in one zone does not offset the deficit in another zone.
4 Surplus pumping capacity listed in parentheses.

7.6 PUMP STATION ENERGY USAGE EVALUATION

The 2018 Master Plan evaluated each pump station in terms of specific energy, and unit-cost of pumping, based on operational data during the period between 2014 and 2017. The term 'specific energy' in this context is defined as the energy required to pump one million gallons. Similarly, the unit cost of pumping is the combined costs of energy and demand charges divided by gallons pumped. These two metrics are useful for identifying and tracking changes in pump station performance over time. For example, simple changes in pump station control logic (i.e. off-peak pumping) can have a significant effect on specific energy and unit cost of pumping. Similarly, pump replacement or rebuilds can also influence these metrics.

Additionally, the District engages outside firms to perform tests of individual pump efficiency under the auspices of PG&E's energy efficiency incentive program. Under this program the District is eligible for free testing at some of their facilities. Test results provide measurements of overall pump efficiency (OPE) that considers the combined effects of motor and hydraulic efficiency.

This Master Plan update did not update the previous energy usage evaluation as operation for the District's pump stations has not changed significantly since the 2018 Master Plan. Refer to the 2018 Master Plan for the data and conclusions from the energy analysis.

7.7 CONCLUSIONS

The recommended improvements presented in the following sections are to address current and future storage and pumping capacity deficiencies. Specific project recommendations including estimates are presented in Sections 13.

7.7.1 Storage Capacity Improvements

Specific improvements to address pressure zones with inadequate storage capacity are presented below. Other pressure zones not specifically listed require no improvements.

7.7.1.1 Zone 1 Storage

Zone 1 currently has a substantial surplus of storage capacity. The combined total Zone 1 storage capacity does decrease but combined still yields a surplus through 2040. If demands increase as projected, the combined Zone 1 zones will be in surplus at the projected near-term build-out and no additional storage is needed in Zone 1.

7.7.1.2 Half Moon Zone

In the Half Moon Zone, the current storage capacity deficiency is primarily due to the fire flow goal of 1,500 gpm for 2 hours and the resulting storage requirement of 210,000 gallons. The District has confirmed fire flows in the system to be approximately 1,300 gpm. The NFPD is conducting its own fire fuels management program with homeowners in the area. The 1999 Zones 3 and 4 Storage Capacity Evaluation recommended construction of a new 300,000 gallon tank to replace the existing 100,000 gallon tank on the same site. These recommendations presented in the 1999 evaluation have proved challenging to implement due to a constrained site and no vacant land available for sale in the area. Therefore, the addition of storage capacity in this zone may not be feasible.

7.7.1.3 Garner Zone

In the Garner Zone, the storage capacity deficiency is primarily due to the fire flow goal of 1,500 gpm for 2 hours and the resulting storage requirement of 210,000 gallons. The District has confirmed flows between 775 gpm and 1,000 gpm within the zone in limited testing. Although fire storage capacity cannot be maintained in the existing tank, the zone does have over four days of MDD in storage capacity. This site has a relatively small tank with limited access and space for additional facilities. There are no other feasible sites, and the Garner Zone serves only small demands. Previous discussions with NFPD concluded that most homes within this zone are sprinkled and they have indicated that funds for storage construction would be better spent on older facilities requiring upgrades. Construction of additional storage capacity cannot be accomplished cost-effectively in this zone; therefore, no additional action is recommended.

7.7.1.4 Old Ranch Road

The Old Ranch Road Zone serves only thirteen homes in a remote forested area. Based on September 2018 discussion with the NFPD chief and fire marshal, it was agreed that the standard 1,500 gpm at 2-hour duration was not feasible given the limited existing development, and the fire storage requirement was set at 100,000 gallons. New future development may warrant additional storage requirement beyond the planned 100,000 gallons.

The District has confirmed fire flow of approximately 850 gpm in the area in limited testing. The fire hydrant at the highest elevation on the main line has a lower fire flow. As with the Half Moon Zone, NFPD conducts its own fire fuel management program with the homeowners in the immediate vicinity of this fire hydrant.

7.7.1.5 San Andreas

The San Andreas Zone fire flow has been updated to the standard WUI fire flow goal of 1,500 gpm for 2 hours with a resultant 210,000 gallons of required fire storage. In this small system with little operational demands, the fire storage is now 84% of the total storage requirement. The Zone has over 7 days on MDD. Additionally, the required additional capacity is only 1,000 gpm and does not warrant sufficient modifications to this tank.

7.7.1.6 Nunes Zone

The Nunes Zone fire flow has been updated to the standard WUI fire flow goal of 1,500 gpm for 2 hours with a resultant 210,000 gallons of required fire storage. In this small system with little operational demands, the fire storage is now 94% of the total storage requirement. It is recommended that instead of additional storage capacity construction, a fire flow backfeed valve, or control valve be installed at the tank site so higher-pressure Buck System water can be utilized for fire protection purposes. A solenoid operated control system like the ones installed at the Paradise Ranch Estates Pump Stations in the District's West Marin water system is advised.

7.7.1.7 Buck Zone

The Buck Zone fire flow has been updated to the standard WUI fire flow goal of 1,500 gpm for 2 hours with a resultant 210,000 gallons of required fire storage. In this system, the fire storage is now greater than the size of the existing tank. The zone has over 6 days of MDD storage. No additional modifications to this tank are planned currently.

7.7.2 Pumping Capacity Improvements

Specific improvements to address pump station capacity deficits are presented below. Other pump stations not specifically listed require no improvements.

7.7.2.1 Lynwood and San Marin Zone 2 Pump Stations

Through the modification of the District policy on firm capacity, Lynwood Pump Station is currently close to pumping capacity. However, the District is actively in the process of replacing the Lynwood Pump Station and the replacement pump station will meet the firm capacity requirements. Further analysis of Lynwood Pump Station can be found in the DRAFT Lynwood Pump Station Replacement Engineering Assessment prepared by Freyer & Laureta, Inc. dated February 16, 2023.

7.7.2.2 Crest Pump Station

The new Crest Pump Station has been constructed to replace the older School Road Pump Sation. At the time of this publication the station will have been operational for roughly 6 months. Data used in this report considers the older data of the School Pump Station. As additional demand and meter consumption become available, the District should monitor future demand and reevaluate the pumping capacity analysis.

7.7.2.3 Cherry Hill Pump Station

The Cherry Hill Pump Station has a pumping capacity deficit of approximately 63 gpm at projected near-term build-out. There is adequate storage capacity in this zone, and it may not be necessary to construct additional pumping capacity. The District should monitor future demand in the Cherry Hill zone and reevaluate the pumping capacity analysis at the time that design of a replacement pump station is initiated.

7.7.2.4 Woodland Heights Pump Station

Woodland Heights Pump Stations currently has a pumping capacity deficit, of roughly 3 gpm. In near-term build-out the deficit grows to 7gpm. Due to the historically small nature of the increase in demand at this pump station, and the adequate storage capacity in this zone, it may not be necessary to construct additional pumping capacity at this location. The District should monitor future demands and reevaluate the pumping capacity in future master plan updates.

SECTION 8

Operational Strategy

SECTION 8
Operational Strategy

An overview of key operational procedures is presented in this section to provide an overview of water system operations. The key procedures described below also inform performance evaluation of the distribution system.

8.1 INTRODUCTION

Operating the District's assets is an essential component of meeting the District's Mission of providing reliable, high-quality, environmentally responsible, and reasonably priced water service. Key operational components for the Novato Water System include Stafford Lake and water treatment plant, numerous storage tanks, and pump stations. This section has been added to the 2025 Master Plan to document the various operational strategies and challenges that District staff face that can directly impact how future infrastructure projects are planned and/or delivered.

8.2 SYSTEM CONTROL AND OPERATION

The District utilizes a Supervisory Control and Data Acquisition (SCADA) system which allows the system operator to remotely control and monitor pumps, tank levels, pressures and alarm settings for those facilities that are connected to the SCADA system. All the District's facilities are connected to the SCADA system except for minor facilities/appurtenances like regulating stations and intertie valve pits

8.3 WATER SUPPLY

8.3.1 Stafford Lake and Treatment Plant

As described in Section 4, Stafford Lake is one of the two potable water sources for the District. In operating the STP and Stafford Lake, the District's operational strategies were developed to manage challenges with water quality, pumping capacity, and other agency coordination.

Stafford Lake is subject to algae blooms and increased magnesium levels that have an adverse effect on the District's ability to achieve target purity levels. Solar powered mechanical mixers called solar bees and an aeration system have been implemented to minimize levels of algae blooms and magnesium throughout the year, however levels reach a point in the fall months that restricts the District from using Stafford Lake as a water source year-round.

Another operational constraint that limits District use of treated water from Stafford Lake is the lack operational flexibility that limits the distribution of treated water from STP to Zone 1 and the southern portion of Zone 2 via the Lynwood PS. San Marin PS which supplies the northern Portion of Zone 2 is not hydraulically connected to the STP because the supply pipeline to the PS is located north of the North Marin Aqueduct (NMA) Valve Pit. The District has identified potential piping improvements to modify the North Marin Aqueduct (NMA) Valve Pit near San Marin Drive to allow for treated water from STP to be fed to the San Marin Pump Station (other Primary Zone 2 pump station) which would increase redundancy for water pumped to Zone 2.

STP's operational goal is to be a zero-discharge facility, but operational constraints have resulted in the need to discharge directly into the Novato Sanitary District's (NSD) collection system. The District must comply with the NSD's discharge requirements which are based on their ability to treat backwash and sludge discharge (waste) flows from STP. NSD's current requirements only allow 40,000 gpd to be discharged to their collection system between December 1st to May 1st and 150,000 gpd after May 1st and until November 30th. These flow rates are based on available capacity in the NSD collection system and are intended to reduce the potential for a sanitary sewer overflow.

The District has studied options to reduce discharge (waste) quantities, however, most of the methods were cost prohibitive or required land acquisition thus these projects are not currently being pursued[1]. The District maintains good communication with the NSD, which allows both agencies' operations staff to coordinate exceptions to the discharge requirements in times of need.

8.3.2 SCWA

On average, the District purchases treated water from SCWA to provide approximately 75% of the Novato Water System demands, as discussed in Section 6. Water from SCWA is conveyed to the District via the (NMA). Generally, water is conveyed through the NMA by gravity except at times when Marin Municipal Water District (MMWD) is drawing water simultaneously as discussed in further detail below.

Flow control measurement of the SCWA water source is accomplished at the NMA Valve Pit located off Redwood Boulevard north of San Marin Drive. The NMA Valve Pit contains several appurtenances, including a flow meter, control valves and pressure taps upstream and downstream of the control valve. Flow passes through two valves: 1) a 24-inch motor-operated butterfly valve; and 2) a 12-inch flow control valve on the low flow bypass line. These valves have setpoints tied to the water level in Lynwood Tanks that control their operating position.

The minimum pressure needed from the NMA to sustain the District's system pressure is 60 psi as measured from the NMA Valve Pit. The minimum pressure needed from the NMA to fill the District's Zone 1 storage tanks is 75 psi as measured from the NMA Valve Pit.

To maintain adequate disinfection levels within the District's storage and distribution system, the average chlorine residual from SCWA is 1.3 to 1.0 milligrams per liter (mg/L). District operations staff can monitor chlorine residual levels in the SCWA system and will notify SCWA operations when chlorine residuals appear to be trending too low. If chlorine residual levels from SCWA drop below 0.7 mg/L, the District takes additional steps to monitor chlorine residual in several storage tanks that experience extended water age during periods of low demand.

8.3.3 Marin Municipal Water District Coordination

Marin Municipal Water District (MMWD) currently operates the Kastania Pump Station to increase flow within the North Marin Aqueduct, which allows MMWD to convey additional SCWA water supply into the northern portion of the MMWD system. MMWD has expressed a desire to maintain a constant flow rate through the NMA via the Kastania Pump Station. However, depending on what the District's current operation is, filling or draining tanks, the use of Kastania Pump Station can lead to over-pressurization in parts of the District's system. To address this issue, MMWD is considering installation of Variable Frequency Drives (VFD) to the Kastania Pump Station.

The District and MMWD had historically maintained six emergency interties to allow transfer of finished water directly between the two distribution systems. All six of the interties are currently offline (or in a state of disrepair). The District conducted a feasibility evaluation is 2023 to prioritize repairs. Due to other near-term projects having higher risk-based priority and there are no imminent plans to make improvements to the interties.

8.4 STORAGE TANK OPERATIONS

The two critical operational considerations for all storage tanks are the turnover time of the tanks and maintaining adequate storage volume to meet potential emergency demands. As described in Section 4 and Section 7, the District operates and maintains 31 storage tanks. The normal operational goal is to utilize 30% of the tank's capacity daily to help reduce water age and therefore maintain water quality.

Several tanks have altitude valves that close when the hydraulic grade line is above the valve set point to prevent overflow of the tank. Altitude valves exist at Atherton, Trumbull, Lynwood, Blackpoint, Airbase, Wild Horse (currently non-operational), Center Road, and Sunset Tanks. These tanks are in locations that must fill before another tank in their respective pressure zone, or at elevations well below the other tanks in their zone. All altitude valves are connected to and can be manipulated remotely from the District's SCADA system.

The altitude valve at the Trumbull Tank is set to close at a high-water level in Trumbull Tank and remains closed until the tank's low-water level setpoint is reached. During the time the altitude valve is closed, the Trumbull Tank is effectively off-line from Zone 2. When the altitude valve is closed, water from Trumbull Tank is used to feed directly into the Trumbull Pump Station, which fills both the Wild Horse Valley Tank and the Center Road Tank. The District is considering configuring SCADA to automatically open the altitude valve at the Trumbull Tank if pressure drops below a set suction pressure at the Ridge Road Pump Station.

Each tank has a high- and low-level alarm programmed in the SCADA system. For the majority of the District's tanks, the storage volume turnover is sufficient and water quality has been enhanced through the addition of mechanical mixers when needed. Chlorine residual levels are monitored weekly to maintain water quality.

Amaroli Tank within Zone 1 can experience low water use resulting in water age concerns. Amaroli Tank's water demands are limited due to its location in the southern portion of the system and that the tank does not serve as a primary supply to either of the Zone 2 pump stations, Lynwood Pump Station or San Marin Pump Station. The District is exploring the potential to relocate the Lynwood Pump Station to a more southerly location, which would increase turnover of Amaroli Tank and improve the relative water age. Further information on the potential Lynwood Pump Station relocation, including predicted benefit to turnover in select Zone 1 tanks including Amaroli Tank, is presented in the DRAFT Lynwood Pump Station Replacement Engineering Assessment prepared by Freyer & Laureta, Inc. dated February 16, 2023.

Storage capacity throughout the District's system is acceptable. However, Operations staff have noted that the combined storage of the Cherry Hill Tanks is undersized for the customer demands they serve. The Atherton Tank (Zone 1) currently acts as the emergency supply for the Cherry Hill Tanks (regulated Zone 2); however, due to the elevation of the Atherton Tank customers experience lower pressures than normal under these conditions. Two options to increase the functionality of the Cherry Hill system would be to (1) increase the storage capacity of the Cherry Hill Tanks or (2) increase the pumping capacity of the Cherry Hill Pump Station. Upgrade recommendations for the Cherry Hill Tanks and Pump Station are included in Section 14.

8.5 PUMP STATION OPERATIONS

District staff incorporate pump station strategies throughout the year to minimize energy costs by pumping during PG&E off-peak hours. As a cost-saving measure, District operations staff utilize partial day operation for pump stations during PG&E off-peak hours for electrical use. Currently, PG&E peak pricing occurs five hours each day from 4 pm to 9 pm. The District's operational goal is to pump water for a 16-hour period which avoids operating any pumps during the five-hour on-peak usage period plus 1.5 hours before and after the five-hour on-peak period.

During winter months, the off-peak savings are minimal due to the low water demands during this time. In practice, the District operates its pump stations for up to 16 hours a day but will override automation to pump up to 19 hours per day to ensure that customer demands are met during high water use periods (summer months).

All the upper pressure zone booster pump stations are controlled by water levels in key storage tanks. The San Marin Pump Station is controlled by San Mateo Tank and Trumbull Tank; and the Lynwood Pump Station is controlled by the Pacheco Valley Tank and Sunset Tank. Level set points vary for each storage tank and pump station based on staff experience and seasonal adjustments. District operations staff can select from more than one tank to determine the control point for when certain pumps shut off. For example, the San Marin Pump Station can be controlled by either San Mateo Tank levels or Trumbull Tank levels depending on the situation.

Each pump has a low suction and high discharge pressure alarm in the SCADA system. Pumps can be turned on or off manually from the SCADA system. Other system alarms included are power failure, pump failure, low battery, transducer failure, and communication failure alarms.

All pump stations that fill various storage tanks in the system have overflow and limit setpoints that override normal operating conditions to prevent the overflow or emptying of any tank. In addition to the pump station controls, a control valve with a remote terminal unit has been installed on the inlet/outlet pipeline to each tank and is operated via set points.

The MMWD Ignacio Pump Station operates based on the water level in Lynwood Tank with Atherton Tank as back-up. The pump station capacity is reduced in steps as the water level lowers in Lynwood Tank, until all flow is curtailed. Flow to MMWD can be curtailed at any time by the District in an emergency.

8.6 ADDITIONAL STRESSORS

Additional stress on the system can be caused by insufficient staffing, customer interaction, and/or external coordination challenges. District staff have recently implemented an enhanced on-call system that helps to better distribute staff workload for on-call and emergency work. Previously, the on-call system was reliant on too few staff members. The enhanced on-call system allows the rotation of a higher number of staff to be on-call.

Due to property rights and limited access through easements, certain tanks and pump stations can be challenging to maintain and operate. For example, Wild Horse Tank requires access through a customer's yard which is often restricted by a locked gate or other physical barriers. The District does have access rights; however, balancing the needs of both the customer and District can be challenging. The access road beyond the customer's property is unpaved and gets washed out following significant storms. The District maintains the access road when necessary. Installation of a remote operated control valve could reduce the number of trips needed through the customer's property and allow more flexibility in controlling the system.

As a result of the Tubbs and Nunes fires in October 2017, certain operational changes have been implemented that impact the District's storage and pumping strategies. For storage, when "red flag" warnings are issued by state and local fire protection agencies, the District will switch from the normal “time of use” mode of operations described above to operations that ignore the time of day and cost of energy to instead maximize tank storages. For pumping, to limit fire risk PG&E may choose to de-energize their systems during high fire potential events – potentially impacting the District’s ability to operate one or more pump stations. For this reason, each pump station has been modified with a physical transfer switch to allow them to be operated by a portable emergency generator. Automatic transfer switches and permanent generators are not currently being considered by the District at individual pump stations.

SECTION 9

Hydraulic Evaluation

SECTION 9
Hydraulic Evaluation

The hydraulic evaluation of the Novato Water System was conducted utilizing the hydraulic model that was created as part of the 2018 Master Plan update. The model was previously created utilizing GIS data and includes the entire system. This model was utilized and updated for the 2025 Master Plan updates. An analysis of existing conditions and future conditions were evaluated to identify hydraulic adequacy under two demand conditions, including a PHD and a MDD plus fire flow evaluation. System improvement projects were identified to address distribution system hydraulic improvements as defined in the sections below.

9.1 HYDRAULIC MODEL UPDATE

The prior hydraulic model created as part of the 2018 Master Plan and includes the entire Novato Water System. The only pipes that are not modeled are the service connection laterals. The model was created utilizing the software InfoWater Pro, an Autodesk software. The previous model was updated to reflect new infrastructure that has been constructed since the previous master plan update. GIS data was utilized to make any necessary updates to the model infrastructure to reflect 2025 conditions. Pipelines constructed after 2018 were added to the model using GIS data for length, diameter, and material type. In addition, tank elevations and pump station design flows that have been modified since 2018 were incorporated. These values were verified in the hydraulic model.

Water demands were updated in the model by importing the georeferenced locations of the District's water meters through GIS, and demands were able to be allocated to the system spatially. Demands throughout the system reflect Infrastructure Planning Demands described in Section 7.

The tanks and pressure regulating stations were modeled using the data from system tables presented in Section 2. The pump stations were all modeled by utilizing pump curves specific to each pump station.

9.2 WATER DEMANDS

As discussed in Section 7, the District determined that Infrastructure Planning Demands would be used for evaluating potential hydraulic deficiencies. For model runs under peak hour and maximum day conditions, a multiplier was applied to the 2025 Model baseline to determine those demands. Multipliers for maximum day and peak hour demands are presented in Section 6 and shown in Table 9-1.

The associated demand from each meter is allocated to the closest node in the model. This is a similar methodology utilized in the previous master plan update.

Table 9-1 summarizes the average demand (2025 Model baseline), maximum day and peak hour demand peaking factors utilized in the existing scenario in this master plan update:

Table 9-1
2018 and 2025 Demand Comparison

Scenario		Peaking Factor		ADD		MDD		PHD	
		MDD	PHD	GPM	MGD	GPM	MGD	GPM	MGD
Existing	2018 Master Plan	1.77	2.8	6,048	8.71	10,763	15.5	16,944	24.4
	2025 Master Plan	1.6	2.8	6,048	8.71	9,678	13.9	16,944	24.4
Future-Near-Term	2018 Master Plan	1.77	2.8	6,298	9.07	11,145	16.05	17,708	25.5
	2025 Master Plan	1.6	2.8	6,275[1]	9.04	10,040	14.46	17,569	25.3

1 The Future ADD is calculated by adding the additional near-term demand of 226 gpm, estimated in Section 6, to the existing ADD.

Fire flow demands in the model utilized the evaluation criteria presented in Table 2-1.

9.3 DISTRIBUTION SYSTEM ANALYSIS

The hydraulic network model was utilized to evaluate the performance of all zones' water distribution systems under the Infrastructure Planning Demand baseline and near-term future conditions described in Section 6 under PHD and MDD with fire flow water demands. The hydraulic model output results include flow, velocity and head loss for all pipe segments, hydraulic gradient for all tanks and reservoirs, pressure and hydraulic gradient for all network nodes in the system. This information is compared to evaluation criteria presented in Section 2 to determine hydraulic adequacy. Solutions to correct identified deficiencies are then applied to the model to determine their effectiveness.

Modelling was completed using steady-state analysis, which represents specific snapshots in time. The status of zone pumps, outflows from the zone, peaking factors, and pipelines and tanks that are in service or out of service are all input into the model as boundary conditions.

Extended-period simulations are typically reserved for modelling water quality, which was not a primary goal for the Master Plan effort, but the District may consider as part of a future Master Plan update.

9.3.1 Evaluation Criteria

To effectively evaluate the model runs, the model output results were compared against the evaluation criteria presented in Table 2-1. These criteria include minimum and maximum velocity, maximum head loss, residual pressure at fire nodes, and fire flow requirements. In addition, other system reliability criteria also govern the analysis.

9.3.2 Operation Parameters

Operations parameters for the modeling are summarized in Table 9-2.

Table 9-2
Model Operation Parameters

Equipment/Instruments	Status
Reservoirs	On
Tanks	On; with different initial depths under different scenarios
Non-hydropneumatic Pumps	Various[1]
Hydropneumatic Pumps	On
Zone Valves	Closed
PRV Stations	Active with pre-existing settings

9.4 MODEL SIMULATION APPROACH

All four zones of the distribution system were evaluated under three steady-state demand conditions:

1) Baseline under peak hour demand, with tanks two-thirds full; and
2) Baseline and under maximum day demand plus fire flow, with tank levels at 10 feet.
3) Future under maximum day demand plus fire flow, with tank levels at 10 feet.

The tank levels were set to represent a conservative input, especially to higher zones, as not all zone pumps are modeled as online.

The fire flow scenario is simulated for all nodes within the model in an iterative manner. Fire flow demands locations are consistent with the previous master plan update. The methodology of the previous analysis located fire flow demand at nodes where there are at least three connecting pipes that are 6 inches or larger. Analysis of fire-flow availability will be further detailed later in this section.

9.4.1 Assumptions

The following general simulation assumptions were used for the hydraulic analysis:

- For fire flow analysis, the storage tanks are operated at an initial water level of 10 feet that represents an estimated typical minimum level during maximum day demand in the summer, except for Cabro Court Tank and Windhaven Tank.
- For peak hour scenarios, the storage tanks are operated at a 2/3 of maximum water level.
- For other scenarios, the storage tanks are modelled as full.
- Kastania tank and Stafford WTP are online.

The fire flow analysis consisted of applying the fire demands at the nodes under the boundary conditions described in Table 9-2 and determining if the 20-psi residual pressure criterion is met. Fire flows exceeding 1,500 gpm are typically drafted from multiple hydrants near the actual fire. However, the model is limited to simulating all the flow from a single node. This simplification artificially inflates velocities for fire events, so the maximum velocity criterion was disregarded for fire flow availability evaluations. Note also that the 3,500 gpm fire flow requirement is for larger commercial and industrial land uses, and the fire flow requirement for predominantly residential areas is 1,500 gpm, including Wildland Urban Interface (WUI) areas.

[1] Pump station operation status and capacities are listed in the model parameter tables under each zone analysis.

In general, model results from PHD simulations did not reveal any significant hydraulic bottlenecks. In contrast, fire-flow scenarios revealed areas of the distribution system that could not satisfy the specified criterion. Therefore, all subsequent pipeline and operation improvement concepts were modeled for the purpose of meeting fire flow demands. Discussions of the model results and recommendations are summarized in the following sections.

9.5 HYDRAULIC ANALYSIS

The model input of tank levels, pump flows and SCWA aqueduct status under each evaluated scenario is found in Table 9-2. Only certain pump stations are turned on with their respective firm capacities. Although only certain pump stations are identified for pumping operation in this analysis, it is conservative to assume that water withdrawn/pumped from Zone 1 to Zone 2 is underestimated.

9.5.1 Existing Peak Hour Demand Scenario

The PHD scenario was run with existing demand data from

Table 9-1. The results of the analysis are outlined below:

9.5.1.1 Minimum Pressure Criteria

The simulation shows that nodes in the system meet the minimum pressure criterion under peak hour demand other than nodes in vicinity of water tanks and around dead ends at high elevations. It is also observed that lower pressures are shown in hydropneumatics pressure zones. Figure 9-1 shows the minimum pressure at each node under the existing PHD scenario.

9.5.1.2 Minimum Velocity Criteria

All pipes in the system meet the maximum velocity criterion (10 fps) except for the 4-inch pipeline south of the Stafford Lake Treatment Plant Pump station. This location is showing a high velocity due to the amount of demand served by this line and the diameter of the line. Figure 9-2 shows the maximum velocity at each node under the existing PHD scenario.

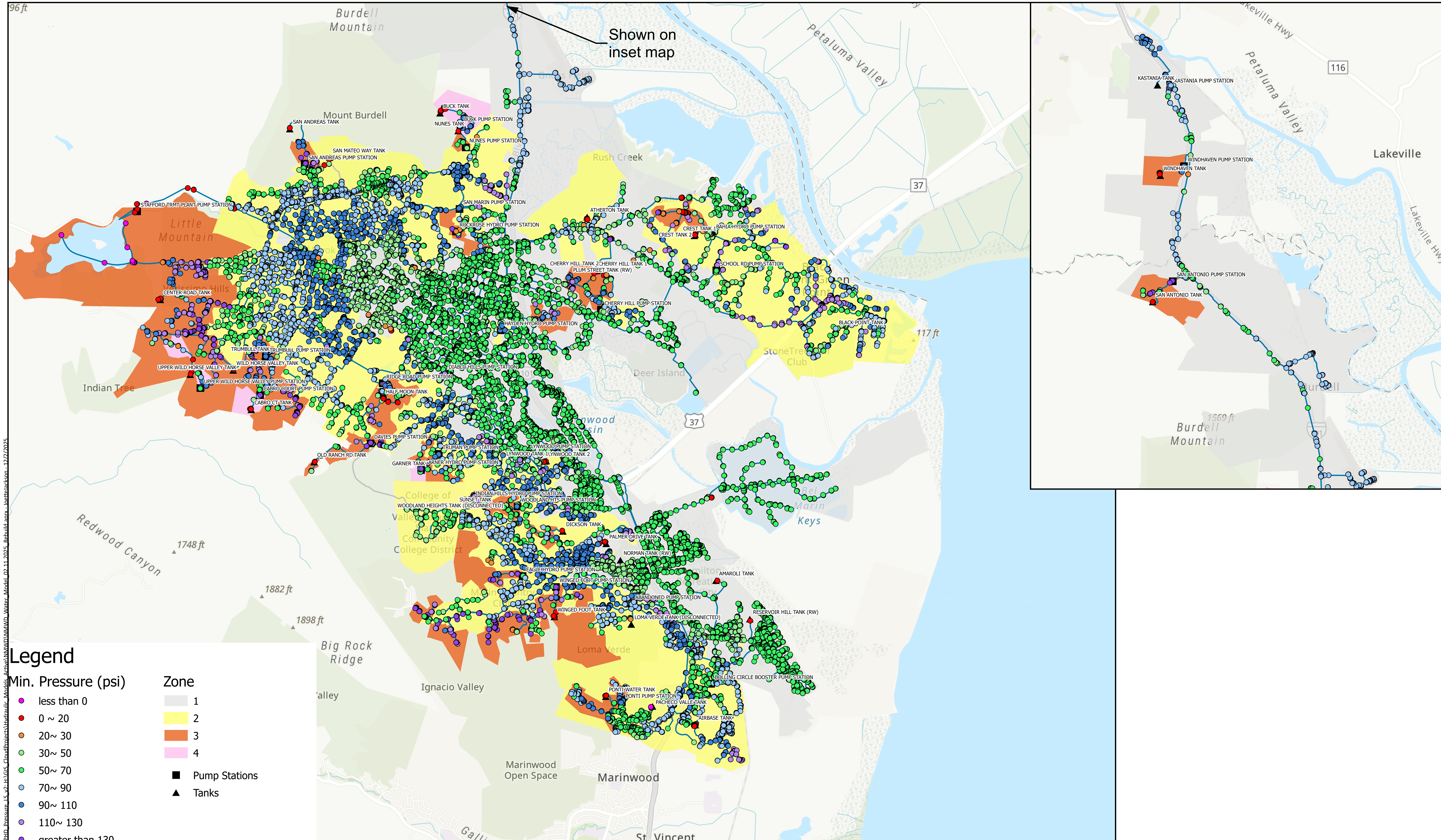
9.5.1.3 Minimum Headloss Criteria

Almost all pipes in the system meet the maximum head loss criterion (10ft/1000ft) except for the location listed below. These exceptions are not deemed significant enough to warrant a capital improvement project solely based on high head loss gradient, if adequate pressure is otherwise available at nearby service connections.

The 4-inch pipeline south of the STP Pump station does not meet the minimum headloss criteria. This location is showing a high headloss due to the amount of demand served by this line and the diameter of the line. Figure 9-3 shows the maximum head loss under the existing PHD scenario.

9.5.1.4 Key Conclusions

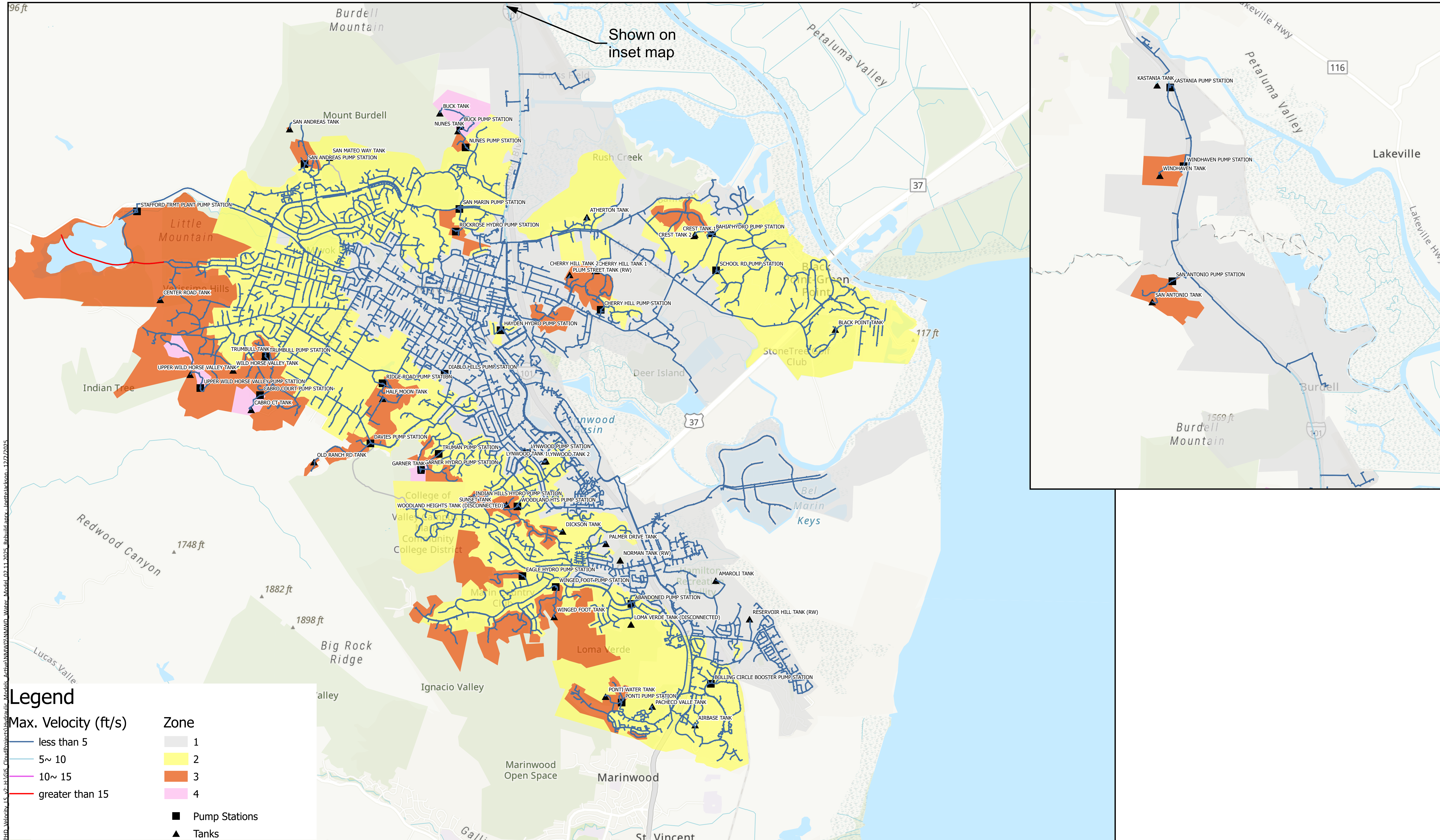
The Novato Water System shows no need for improvements to meet the existing PHD conditions. As stated previously stated, the minimum pressure criteria are met in all locations except for dead end mains and high elevations and areas around water tanks. The minimum velocity and headloss criteria are met in all locations except for the 4-inch line south of the Stafford Treatment Plant Pump Station due to the size of the line. Improvements to this line have already been identified by the District and included in the current Capital Improvements Plan as a project to be completed in the 2028 time frame.



Existing Peak Hour Demand - Minimum Pressure

Figure 9-1

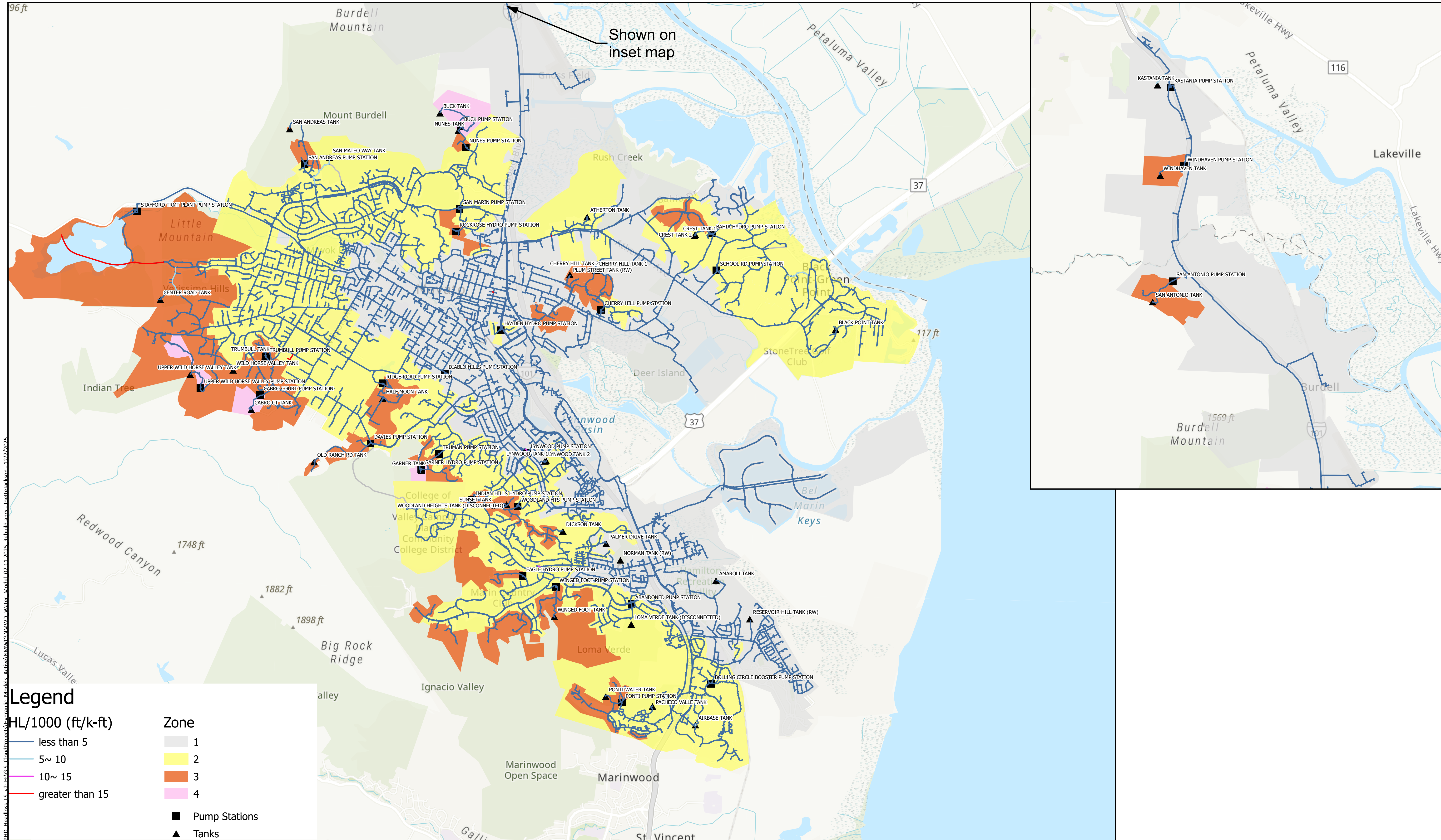
December 2025



Existing Peak Hour Demand - Maximum Velocity

Figure 9-2

December 2025



Existing Peak Hour Demand - Maximum Headloss

Figure 9-3

December 2025

9.5.2 Future Maximum Day Demand + Fire Flow Scenario

The model was run under MDD conditions that included the future near-term developments, plus a 3,500 gpm or 1,500 gpm fire flow located discreetly at junctions where at least three pipes connected, and pipe diameters are no smaller than 6 inches. Pipelines to serve future developments were not specifically added but the demand for those developments was assigned to the nearest node. Future pipelines should be sized when a request for service is made.

The deficit in residual pressure under this scenario is primarily caused by the incremental fire flow demands, as the magnitude of fire flow demand is much greater than that of the MDD. Therefore, only the future MDD plus fire flow scenario is analyzed and the results are assumed to be similar under the existing MDD plus fire flow scenario since the future ADD is only 200,000 gpd more than the existing ADD.

9.5.2.1 Results

Figure 9-4 and Figure 9-5 shows the amount of fire flow that can be delivered at junctions assigned a fire flow demand of 1,500 gpm and junctions assigned a 3,500 gpm demand, respectively. The fire flow is applied to those fire flow nodes where the calculated pressure under MDD conditions is less than 20 psi[2].

As in the 2018 Master Plan, there continue to be significant areas throughout the system that are unable to achieve the desired fire flow of 1,500 gpm for residential use developments and 3,500 gpm for commercial and industrial use. In general, areas where fire flow demand cannot be met share some common characteristics:

- isolated areas served by a single pipeline.
- areas on the extremities of the system far away from the main system.
- areas of predominantly smaller pipelines.
- higher elevations, where static pressures are lower.
- hydropneumatic pressure zones.

There continue to be areas where the desired fire flow of 1,500 gpm or 3,500 gpm, in addition to MDD, cannot be met.

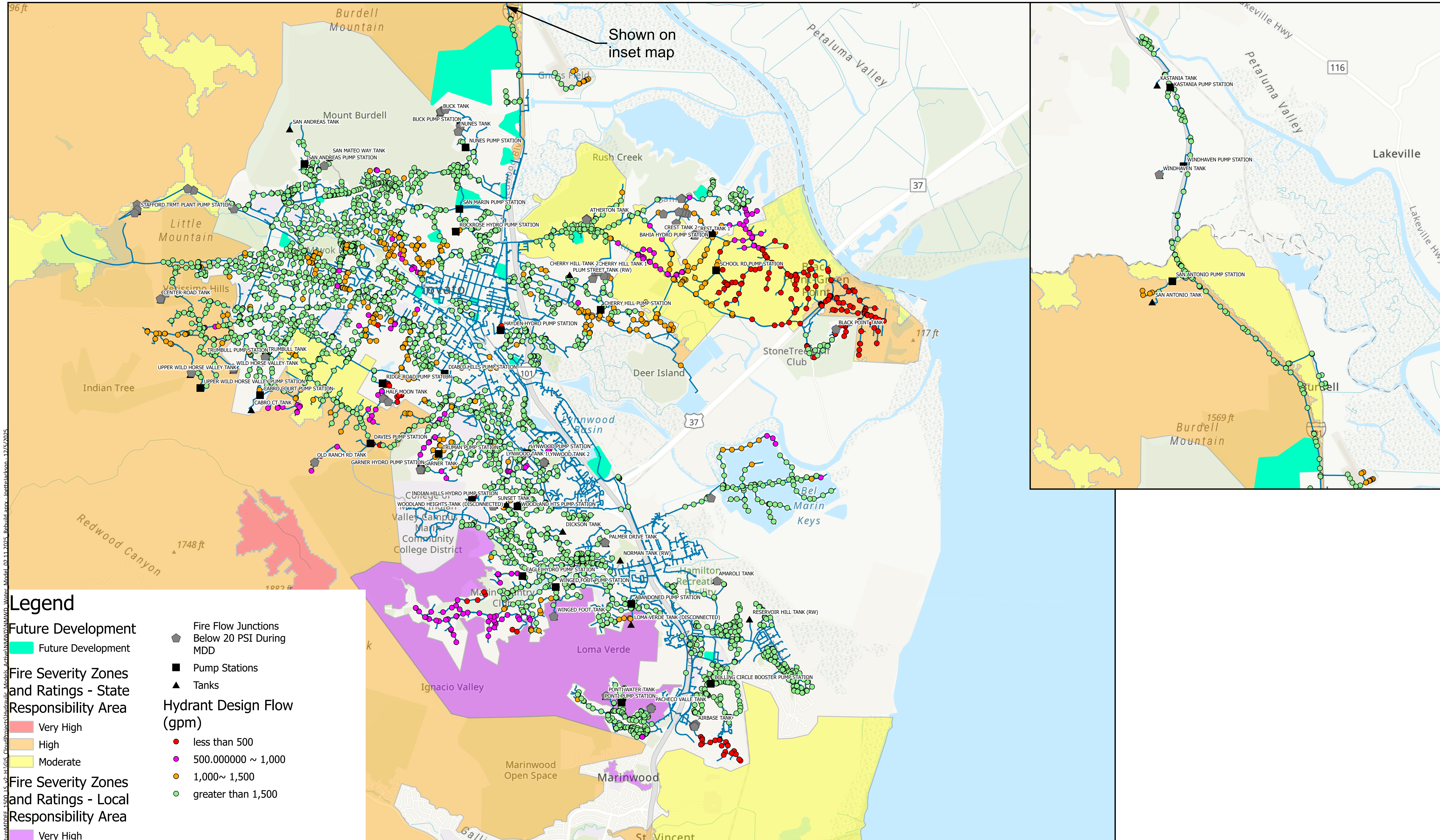
9.5.2.2 Proposed Improvements

Improvements were identified in the 2018 Master Plan to address fire flow deficiencies in key areas. This Master Plan update has identified that 2018 Master Plan improvements are still necessary in addressing fire flow deficiencies in these areas. Figure 9-6 and Figure 9-7 shows the estimated available fire flow that is able to be delivered at junctions assigned a fire flow demand of 1,500 gpm and junctions assigned a 3,500 gpm demand, respectively, including the improvements identified in the 2018 Master Plan. Although there is an increase in available fire

[2] The Innovyze model software has been coded to only apply fire flow to model nodes that are > 20 psi during MDD conditions to allow the model to converge under MDD plus fire flow conditions (i.e. applying fire flow to nodes that are < 20 psi could result in pressures lower than the specified criteria and would not allow the model to converge). The figures show nodes with < 20 psi under MDD as a grey pentagon; fire flow has been applied only to the remaining nodes in the model. In evaluating, areas for future improvements, both the grey nodes and those nodes that < 20 psi during the MDD plus fire flow should be considered.

flow with the proposed improvements in place, the improvements do not increase the amount of available fire flow to the recommended criteria of 1,500 gpm for residential areas and 3,500 gpm for nonresidential areas.

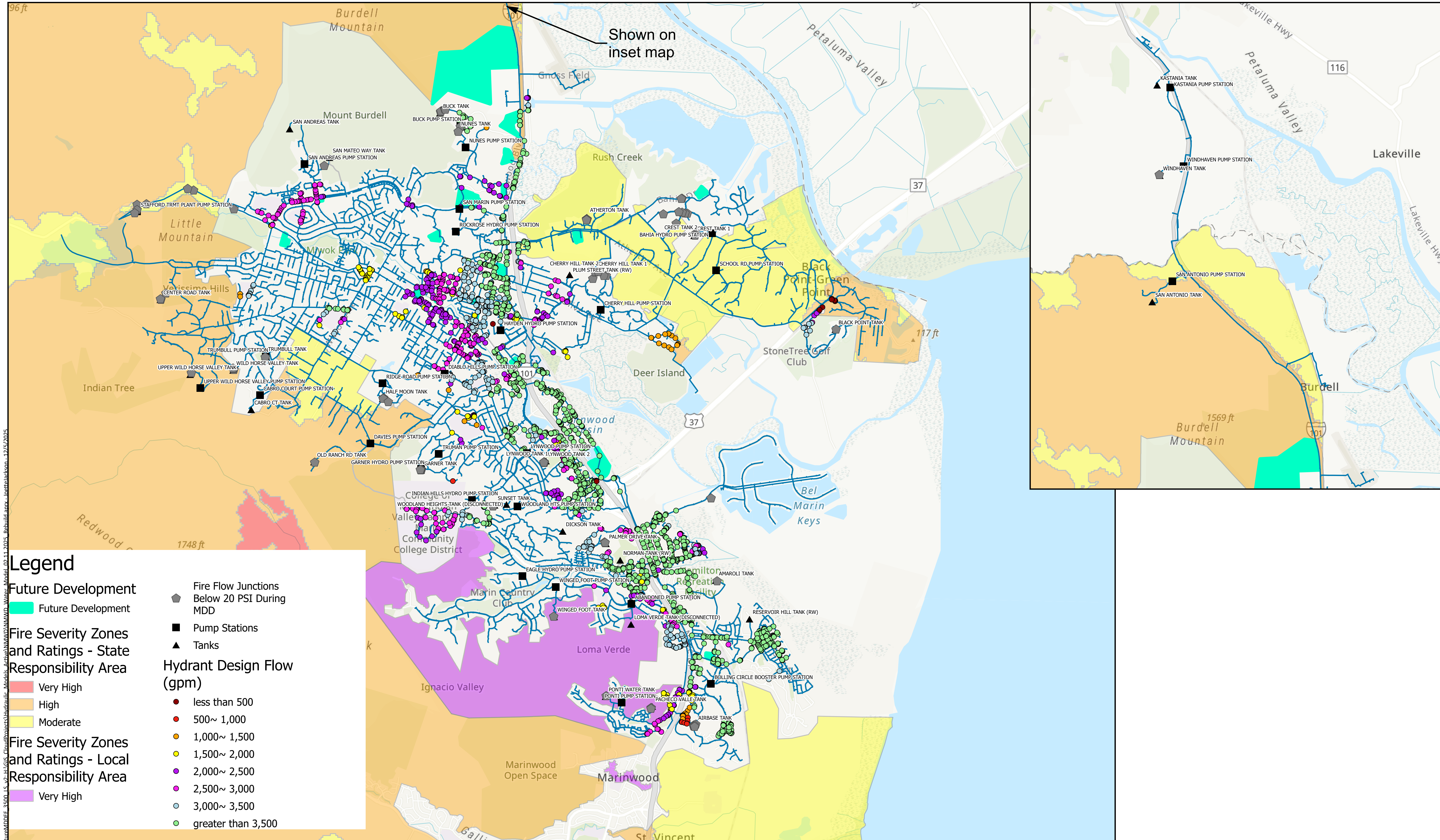
The 2018 Master Plan identified additional areas where the fire flow criteria could not be met, which the District, at the time, deemed to be not economically feasible to improve. Many of the same areas are present in current 2025 Model baseline, and the recommendation from the 2018 Master Plan to explore fire sprinklers in those areas remains. The presence of automatic fire sprinklers can significantly reduce the fire flow requirement at a given location, per International Code Council's (ICC) Fire-flow Requirements for Buildings. This concept is not included in the CIP projects as the District does not regulate nor has responsibilities for fire sprinkler installations.



Future MDD + Fire Flow - Maximum Fire Flow Demand (1,500gpm Junctions)

Figure 9-4

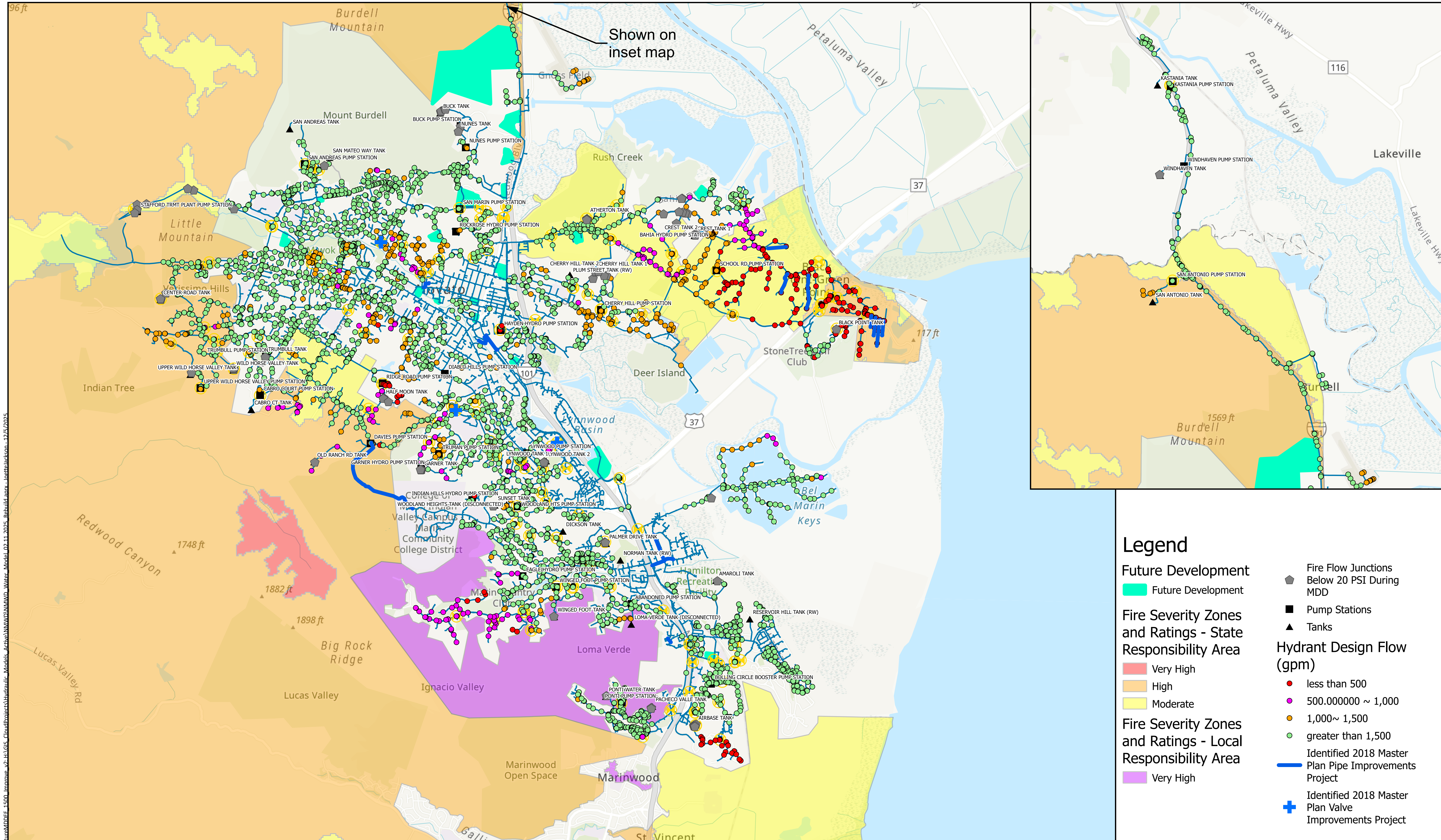
December 2025



Future MDD + Fire Flow - Maximum Fire Flow Demand (3,500gpm Junctions)

Figure 9-5

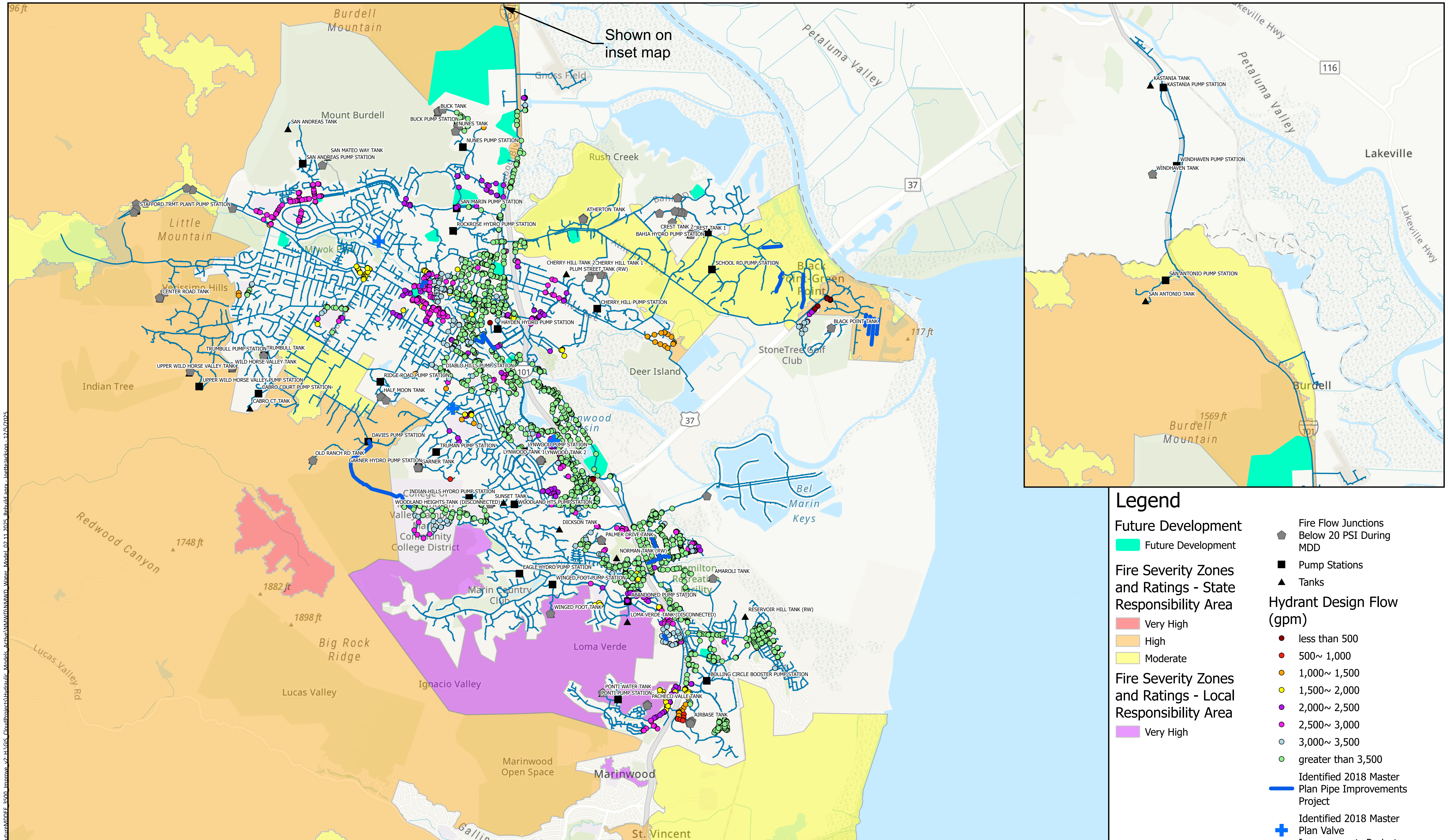
December 2025



Future MDD + Fire Flow - Maximum Fire Flow Demand (1,500gpm Junctions) With 2018 Master Plan Improvements

Figure 9-6

December 2025



Future MDD + Fire Flow - Maximum Fire Flow Demand (3,500gpm Junctions) With 2018 Master Plan Improvements

Figure 9-7

December 2025

SECTION 10

Water Quality Evaluation

SECTION 10
Water Quality Evaluation

10.1 INTRODUCTION

Ensuring water quality is one of the primary goals of the District and was listed in the District's 2018 Strategic Plan as an ongoing need. Policy supports this goal with Board and management commitment to meeting or exceeding all US Environmental Protection Agency (EPA) and California Water Board Division of Drinking Water (DDW) regulatory requirements. Water quality is monitored by the Water Quality Division whose responsibility is to provide oversight to all District activities as they relate to water quality. Section 10 presents information on the current water quality and provides recommendations for operational modifications and capital improvements related to water quality in the Novato Water System.

10.2 CURRENT WATER QUALITY

10.2.1 Source Water Quality

The two water supply sources for the Novato Water System have different physical quality characteristics. Stafford Lake water is a surface water supply with high levels of naturally-occurring organics that exhibit a high oxidant demand and that has potential to produce high levels of disinfection by-products (DBPs). Stafford Lake water is also subject to taste and odor problems due to algae growth in the lake. In 2015, DISTRICT contracted SRT Consultants to undertake a review of factors influencing algal growth and to formulate a comprehensive strategy for addressing taste and odor. SCWA water is a ground water supply that originates deep within the aquifer of the Russian River. Well supplies adjacent to and which augment the Russian River supply contain iron and manganese, hydrogen sulfide, and other aesthetically problematic constituents. The SCWA supply is naturally low in organics and requires minimal disinfection to maintain a disinfectant residual.

Comparison of the major constituents of the Stafford and SCWA treated water supplies is shown in Table 10-1.

Table 10-1: Source Water Quality Comparison

Constituent	SCWA Russian River Supply	Stafford Treatment Plant
Trihalomethanes	15-35	15-35
Haloacetic Acids	5-15	5-15
Total Organic Carbon (TOC)	<1-2	<1-2
Assimilable Organic Carbon (AOC)	Low	Low-Med
Chlorine Demand	Low	Low
T&O problems	Rare/slight	Infrequent
Turbidity	0.10 avg	0.09 avg
pH	8.2 – 8.4	8.0-8.9
Hardness	100 - 130	100 - 120
Conductivity	240-303	278-315
Corrosion Potential	Non-corrosive	Non-corrosive
[1] ND = non-detectable		

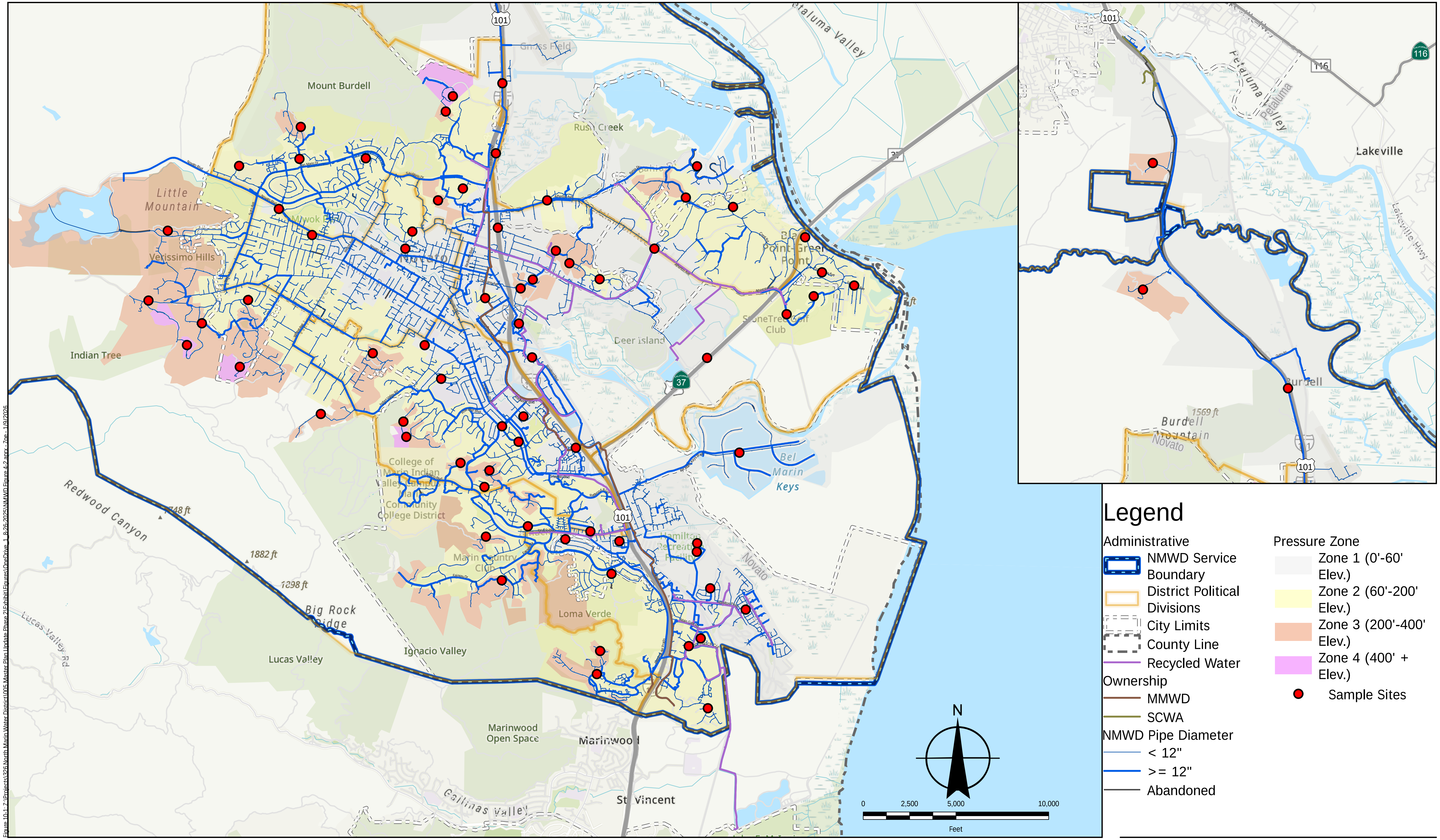
10.2.2 Existing Distribution System Water Quality

Under typical conditions, operation of the STP occurs from approximately May through October on daily 16 to 20 hour shifts. During this time, 3.5 MGD to 5.5 MGD of treated water is typically delivered to Zone 1. During peak production periods, STP water can provide up to 40 percent of water produced in the system. STP finished water has comparable chlorine demand and a slightly lower DBP formation potential than water from SCWA.

DISTRICT has a number of distribution system programs to maintain water quality. These programs include the installation of chlorine booster stations, augmenting storage tanks with chlorine on an as needed basis, and implementing a seasonal flushing program. Additionally the District has added passive and active mixing systems to storage tanks which has improved chlorine residual and water quality. Monitoring of chlorine and heterotrophic plate counts provides feedback to the successful operation of these programs. The District currently has 70 water quality monitoring locations as shown on Figure 10-1. The above-mentioned programs have contributed to significant improvements in maintaining adequate chlorine residual in the distribution system and resulting water quality.

The formation of DBPs is a critical issue that is a current focus of public health regulations. The Novato Water System has never had a violation of regulatory limits for DBPs and is in compliance with the 2009 Disinfection byproduct Rule, Stage 2 standard for THMs of 80 ug/L reported as running annual averages at each location sampled. STP water has a slightly lower DBP formation potential than SCWA water. DBPs are monitored at the entrance to the Novato distribution system and at eight distribution sample sites shown on Figure 10-1. The regulations have focused on DBPs in areas of the distribution system with higher water age because DBPs increase with contact time and chlorine concentration.

Water age can also aggravate problems associated with high chlorine demand. Storage reservoirs hold large quantities of water for emergency and fire suppression requirements for long periods. Dead-end mains with low-water usage can also increase the age of water held in the pipe. Efforts to lower water elevations in tanks on a frequent basis are limited by the storage requirements. Looping mains to minimize dead-end pipes is practiced where possible. In many cases, looping is not possible.



Distribution System
Figure 10-1
1/9/2026

10.3 DRINKING WATER REGULATIONS AND DISTRICT MONITORING PROGRAMS

The District operates the Novato Water System under an operating permit issued by DDW. DDW is responsible for enforcing both State and Federal (United States Environmental Protection Agency, EPA) drinking water regulations as a "primacy" State. DISTRICT's operating permit requires compliance with all State and Federal drinking water regulations and imposes several additional operating and monitoring conditions.

Discussion follows on the drinking water regulations and permit conditions that are most significant in regards to distribution system water quality. The purpose of the regulation, District's response and review of issues for the Novato community is addressed for each:

- Surface Water Treatment Rule (SWTR)
- Coliform Rule
- Disinfection By-Product Rules (DBP I and II)
- Long Term Enhanced SWTR and Filter Backwash Rule
- Lead and Copper Rule
- Cross Connection Control
- Other regulations and permit conditions
- Other DISTRICT programs and emerging issues

10.3.1 Surface Water Treatment Rule (SWTR)

- *Purpose of rule*:
  Assure surface water treatment (STP) disinfection and microbial removal process is effective.

- *Monitoring requirement*:
  Each routine sampling collected under the total coliform rule must include a test for disinfectant residual. If no residual is detected, a heterotrophic plate count (HPC) for bacterial growth may be substituted. If less than 500 colony forming units per milliliter are found, it is considered equivalent to a measurable residual.

- *District response*:
  Prior to 1991, District used the presence of chlorine in water as it entered the distribution system as the evidence of disinfection. After the promulgation of the SWTR, District initiated chlorine monitoring at each routine coliform sample site. Monitoring is conducted as described above including the substitution for HPC as appropriate.

- *Issues*:
  Currently, District uses detection of total combined chlorine as a trigger for regulatory HPC testing rather than free chlorine. This change was initiated after a discussion of SWTR requirements with the DDW District Engineer. HPC testing is still performed when free chlorine drops to non-detectable levels but the information is used as an operational control factor and is not reported as a regulatory requirement.

  District's goal is that all tanks in the system are monitored for chlorine residual weekly. Manual addition of chlorine to tanks occurs as needed, to maintain acceptable levels of residual throughout the system.

10.3.2 Coliform Rule

- *Purpose of rule:*
  Assure pathogenic microbial growth is not present in water supply.

- *Monitoring requirement:*
  Every separate hydraulic zone of water, as represented by a tank or pressure system, must be monitored monthly. DDW requires a minimum of 18 samples to be collected per week based on our population served.

- *District response:*
  Currently, 56 samples sites are identified in the District Coliform Sampling Plan. District has structured a sampling program that provides for sampling 18-19 sites on three separate routes, each sampled every three weeks.

- *Issues:*
  Historically the District relied on customer taps for sample sites. Finding suitable representative sample sites among residential and business taps was difficult. A standard sampling station design was developed and now 70 permanent, District-owned, sample stations are situated throughout the hydraulic zones and distributed in accordance with representing the zone's population density.

10.3.3 Disinfection By-Product Rules

- *Purpose of rules*:
  Minimize health effects related to chemicals formed during the disinfection process.

- *Monitoring requirement:*
  Distribution sampling is required on a quarterly basis at eight locations for total trihalomethanes and haloacetic acids. Compliance is based on locational running annual average. Locations were determined by conducting an Initial Distribution System Evaluation (IDSE) using a number of factors including results from increased system wide monitoring for one year, residence time, and population distribution.

  Daily monitoring is required at the entrance of the distribution system for chlorite and chlorate and monthly monitoring at an additional 3 locations in the distribution system. Any sample at the entrance of the distribution system with a chlorite concentration above 1.0 mg/L triggers sampling at the 3 locations in the distribution system within 24 hours.

- *District response*:
  District has monitored for THMs since 1978 and Haloacetic Acids (HAAs) since 1999. Both SCWA supply and STP (post rehab) have low DBP levels. Due to high total organic carbon (TOC)in Stafford Lake, prior to rehabilitation of the Stafford Treatment Plant, finished water had high levels of TTHMs which occasionally exceeded 100ug/l. Due to blending with SCWA water and seasonal operation of STP, the District never exceeded the Stage I EPA standard. In addition, the Stafford Treatment Plant was operated to minimize DBP formation by minimizing the chlorine pre-oxidant dose. New processes in place after the Stafford rehabilitation project have drastically reduced DBP formation. DBP concentrations are now similar to SCWA supply as a result.

The rule also requires a minimum reduction of TOC in treatment based on the TOC concentration in raw water and alkalinity. District routinely exceeds the removal requirement.

The MCL for chlorite is 1.0 mg/L; compliance is based on an average of the 3 distribution system samples. There is no MCL for chlorate but it has been included for several years as a candidate for regulation by the EPA.

- *Issues*:
  Use of chlorine dioxide as a replacement for chlorine as a pre-oxidant is a primary factor for the reduction of formation potential at STP, as well as improved coagulation and removal of DBP precursors prior to chlorine addition. The use of chlorine dioxide requires additional monitoring of chlorite and chlorate as DBPs.

  There is a conflict in simultaneous compliance with maintaining an adequate chlorine residual and keeping DBPs as low as possible. Other water utilities have converted to chloramines to lower DBPs while maintaining a disinfectant residual in the distribution system. Conversion to chloramines by District would require both water supply sources to be treated, and is not necessary under current standards.

  The process used in chlorine dioxide generation at STP requires chlorine gas. Chlorine gas is difficult to work with and caries additional permit requirements and procedures for safety. Alternative pre-oxidants exist (such as ozone) that would not require the use of chlorine gas and may have other positive characteristics; the district may consider studying modifications at STP to use these alternatives.

10.3.4 Long Term Enhanced Surface Water Treatment Rule Stage II (LT2) and Filter Backwash Rule

- *Purpose of rule*:
  LT2 enhances water quality by tightening treatment standards to provide removal of *Cryptosporidium*, a small parasite that resists standard disinfection methods. The Filter Backwash Rule identifies plant operational performance measures to assure *Cryptosporidium* cysts are removed in any recycle returned to the plant process.

- *Monitoring requirement:*
  Based on results of monitoring for cryptosporidium and E. Coli required by LT2 the district has been placed in "Bin 2" for compliance. Bin 2 water providers are required to achieve an additional 1 log removal of cryptosporidium in treatment.

- *District response:*
  The STP rehabilitation project specifically addressed compliance with these new rules by being able to meet filter performance standards which target the removal of *Cryptosporidium* oocysts and separates waste streams to exclude unpermitted recycling.

  Watershed source controls have been identified to augment the overall program by reducing the potential for *Cryptosporidium* to enter the lake. This is accomplished by working with local agricultural interests to reduce impacts of agricultural run-off on lake water quality.

- *Issues:*
  A component in the reduction of *Cryptosporidium* that should not be overlooked is watershed controls. This is one of the elements in the "tool box" proposed by the LT2 guidance. Implementing watershed controls and maintaining *Cryptosporidium* below certain levels is a protective measure that can take the place of increased levels of treatment. Monitoring of the Stafford Lake supply has resulted in finding few *Cryptosporidium* cysts over the past several years. Existing controls, including riparian fencing, erosion control and dairy waste management, may be credited for this performance. Future water quality could be impacted by modification of practices and land use by watershed landowners. The District maintains a hands-on approach and provides incentives for watershed landowners or lessees to implement best management practices.

  The watershed controls that have been identified for reducing microbial contaminants also reduce TOCs and nutrients that specifically trigger algal growth. Reduction in lake TOC will reduce both DBPs and chlorine demand in the finished water. If TOC is allowed to increase, more frequent replacement cycles for the GAC adsorption filters at Stafford Treatment Plant will continue to add to the cost of purification. TOC and nutrients can be used to measure effectiveness of watershed controls as a surrogate for *Cryptosporidium* monitoring.

10.3.5 Lead & Copper Rule

- *Purpose of rule:*
  Reduce corrosion of lead and copper in consumer plumbing.

- *Monitoring requirement:*
  Sixty residences have been identified to test for lead and copper. Currently, District is under a reduced monitoring program of 30 residences every three years. Biweekly pH monitoring is required for water entering the distribution system. Compliance is established by maintaining a pH greater than or equal to 8.0 in the Novato distribution system.

- *Issues:*
  Stafford water has always been pH-controlled. SCWA initiated pH control in 1995 after distribution monitoring by water contractors indicated copper concentrations above action levels. Sodium hydroxide is used to control pH at both Stafford and SCWA. Alternative corrosion control treatments have been evaluated by SCWA. No pH control is currently used by SCWA for their auxiliary well supplies.

  Customer calls related to green staining and metallic copper after-taste have essentially disappeared with SCWA's pH control practice.

  Changes in water pH and the presence of bromide can impact types of DBP formed. Studies are being conducted at the national level to compare risk factors of different DBP species that make up the THM and HAA standards. Future regulations may use a risk-based approach. The impact of pH on risk factors could cause a reevaluation of copper control by pH adjustment.

Some of the older valves in the distribution system, such as those associated with older fire service assemblies, have lead weights. These valves are being removed from the system as repairs are identified. The Novato distribution system has no lead service lines.

10.3.6 Cross-Connection Control

- *Relationship to Water Quality:*
  Contamination of a treated water supply within the distribution system due to cross-connection/backflow conditions is a primary concern. California regulations require that all water suppliers maintain a cross-connection control program with specific required elements including identifying those customers for which backflow control devices are indicated based on their on-site use, annual testing of devices and certification of personnel.

  The District has experienced cross-connection events in the distribution system. There have been several cases where soda-dispensing systems (soft drinks) have allowed carbonated water to backflow, causing copper leaching. The most serious cross-connection case was during a 1995 District test of a fire relay system involving use of a Novato Fire Protection District pumper truck to supply water to a higher pressure system zone. A surfactant in the fire pumper truck tank contaminated the zone.

  Other cross-connection events may not have been recognized and reported. Close compliance with the District program remains the strongest protection.

- *District Program:*
  The current District cross-connection program is the responsibility of the Maintenance Division. The responsibility includes identification of hazards within the system and assuring compliance with District regulation 6 and Title 17, California Code of Regulations. Recently, the State published Cross-Connection Control Policy Handbook and the District will evaluate the current program to determine if any updates to the District's policies is required.

  The District program differs from other local water agencies in that District staff test backflow prevention devices. This has the advantage of assuring that tests have been properly performed and costs are reduced for the rate payers because employees trained and supervised by the District's certified cross-connection control technician are used. Management provides the staff resources and oversight to assure that the program is carried out and minimal delays occur between a test failure and repairs.

- *Issues:*
  There have been several revisions to the California Code of Regulations, Title 17 governing selection and location of backflow preventers. A survey of the Novato cross-connection control program has revealed under-utilization of backflow devices throughout the system. The largest number of devices needed to bring the program current with state law are for commercial customers and multi-unit housing. The District has planned for the capital and maintenance costs for upgrading services and updated District regulations and fee schedules to cover these required costs.

10.3.7 Other Regulations and Permit Conditions

In addition to the regulations discussed above, DDW has regulations that focus on assuring that water systems are designed, constructed and operated in a manner compatible with public health goals. Cross connection control, State Waterworks Standards and Operator Certification stand out as regulations focused on maintaining water quality. In addition, the Novato Water System Permit issued by DDW cites specific operating conditions.

- Fluoridation Mandate
- State Waterworks Standards
- Operator Certification
- Novato Permit Provisions

10.3.7.1 Fluoridation Mandate

- *Purpose of California Legislative mandate:*
  Prevent dental health problems, thereby reducing State costs for dental services.

- *Requirement:*
  All water utilities with greater than 10,000 connections are required to submit and periodically update a cost estimate to fluoridate their supplies. State regulations rank DISTRICT in the top quartile of agencies (32/167) to receive funding for implementation of fluoridation. The funding source has not yet been identified. Funding for implementation must come from a source other than the ratepayers.

- *District response:*
  The Board of Directors has long held the position that fluoridation of District water supplies would only be initiated at the request of the voters. Little action has occurred at the State level regarding this legislative initiative to fluoridate water supplies.

- *Issues:*
  Fluoridation of supplies from both STP and the North Marin Aqueduct should occur simultaneously due to blending dynamics. Other SCWA contractors are ranked lower on the State ranking list which, if necessary, would cause District to request that the State re-evaluate their listing. The State would be asked to consider providing sufficient funds for the entire SCWA supply to be fluoridated as well as any supplemental sources of SCWA contractors.

  Should the State require District to fluoridate, planning should include provisions to provide space and controls to install fluoridation at STP and at a location off the North Marin Aqueduct or at Kastania PS. Since MMWD already fluoridates, site selection may be subject to negotiation if a combined system is desired.

  Hydrofluosilicic acid is considered an extremely hazardous chemical, and special provisions will have to be made for any installation of fluoridation facilities on the aqueduct and at Stafford Treatment Plant and to comply with local hazardous materials code

10.3.7.2 State Waterworks Standards

- *Relationship to Water Quality*:
  DDW sets regulations including design and construction standards to be used by water suppliers. These standards were recently revised. Specific design and construction criteria are identified to provide protection of public health.

- *Highlights of the Waterworks Standards as related to Novato:*
  - Requires an amendment to the water permit if volume of water delivered increases by more than 10 percent.
  - A source capacity report is required of all systems.
  - All coatings, linings, gaskets or sealing materials, joint compounds or tank materials must be certified to meet ANSI/NSF Standard 61.
  - Water Main separation from wastewater are restricted (10-ft. horizontal, 1 ft. above.)
  - Water Main separation from non-potable pipelines such as storm water and recycled water lines are restricted (4-ft. horizontal, 1 ft. above.)
  - Details on standards for flushing valves and blow-offs, air release valves and isolation valves are identified.
  - Reservoirs are required to have separate inlet and outlet and sampling taps.
  - A Distribution System Operation Plan is required with updates every five years.
  - Mapping Standards are identified.

- *Issues:*
  The most significant issue is the requirement for NSF Standard 61 certification for materials. Standard 61 addresses water quality contamination issues but does not address longevity or strength. Care must be taken in selecting appropriate materials.

  Both District and contract work will be required to be in compliance with these standards.

10.3.7.3 Operator Certification

- *Relationship to Water Quality*:
  All states are required to develop operator certification programs to comply with regulations. California water treatment operators have been certified for many years. As more focus has recently arisen related to distribution system operation, a California program has been underway since 2004 to certify distribution operators. Certification is also required for cross-connection control device testers.

- *District Program*:
  The District is required to have distribution operator certification for all employees with duties that involve decisions in operation, maintenance or repair of distribution system facilities. All District treatment operators are certified. The District's cross connection control technician is certified by AWWA as a tester and assumes the role of certifying other District personnel hired to test District devices.

- *Issues:*
  The most significant impact of the new California certification rules is the requirement for continuing education units and the successful testing of all employees to receive certification.

10.3.8 OTHER DISTRICT PROGRAMS AND EMERGING ISSUES

Distribution water quality is maintained if policies and procedures are in place to assure that good planning, construction and maintenance practices are followed. These programs developed by DISTRICT staff can be considered quasi-regulated because they are cited in the Novato Distribution Operations Plan that is reviewed and approved by DDW. Following is a review of:

- Tank inspections, operations and maintenance
- Valve Turning
- Flushing
- New construction approval process
- Water Quality Laboratory
- Source Controls and Treatment
- Emerging Issues

10.3.8.1 Tank Inspections, Operations and Maintenance

- *Relationship to Water Quality*:
  Storage tanks are a location of high vulnerability. Storage of water, while providing fire protection and emergency supply, can cause the water to age and lose chlorine residual. Screens on vents and overflows must be properly maintained to prevent intrusion by birds and animals.

- *District program:*
  The current District tank inspection program is carried out by the Operations division with occasional assistance from the Maintenance division. The Maintenance division conducts annual inspections, typically performed by the Electrical/Mechanical staff. The Operations division inspects tanks weekly for chlorine residuals and tank security issues. A water quality-focused inspection of all tanks typically occurs once a year during the winter. Samples are collected by the distribution system operator for lab analysis, including coliform growth and heterotrophic bacteria. Tank inspection observations are recorded in the database "Tank Cleaning Sch.xls" which is maintained by the Operations department. Tank Inspection forms are included in the individual tank binders located in the Engineering department. Tank inspections are conducted annually or anytime the tank undergoes cleaning.

  Reduced chlorine residuals have caused a tank chlorine augmentation program to be developed. Chlorine dispersion tubes have been installed in 22 tanks. A regular program is conducted by the Operations department to monitor all of the tanks and add chlorine tablets as necessary with exception of the largest tanks which are dosed by spraying CL2 solution over the surface of the water of the tank or adding calcium hypochlorite on a fill cycle. Records are maintained on this activity and correlation with lab sampling within the zone is reviewed by the Water Quality division. Significant improvement in maintaining adequate chlorine residual and a marked decrease in the number of coliform positive samples in the distribution system has been observed as a result of these actions

The pump operational set points at the storage tanks and system dynamics have a great influence on water age.

- *Issues:*
Tank inspections must be scheduled and maintenance prioritized so water quality problems are quickly remedied.

  Some overflows are protected by a weighted flapper valve, though their effectiveness has not been fully demonstrated. All flapper installations are inspected annually and improvements are made as needed.

  Overflow drains may not be located on facility drawings.

  Augmentation of tanks with chlorine tablets is time-consuming. If it is determined that ongoing chlorine augmentation is advantageous, alternatives to the program will be investigated.

  A system to chlorinate the larger tanks under emergency conditions is needed.

  Separate tank inlet and outlet pipelines have been designed for some DISTRICT tanks. Their performance has been positive in de-stratifying tank water and maintaining adequate chlorine residuals throughout the water column. Proposed Water Works Standards will require separate inlet and outlet pipelines.

10.3.8.2 Valve Turning Program

- *Relation to Water Quality:*
Turning all valves provides assurance that valves are functioning and can be used to valve off main breaks or contamination events in a timely manner. It also provides an opportunity for staff to gain knowledge of valve locations and assure they haven't been buried by new paving and are fully operational.

- *District program*:
District has a good program that provides for turning all distribution and transmission system valves in a cycle of a year and a half by the Construction Division.

- *Issues*:
A valve replacement program with identified goals should be considered.

10.3.8.3 Flushing

- *Relation to Water Quality:*
Flushing has long been identified as one of the most effective maintenance practices for improving water quality by removing sediments, corrosion by-product biofilms and introducing higher chlorine residual to stagnant dead ends.

- *District program:*
  The District initiated an annual, system-wide flushing program over 30 years ago. Budget constraints caused the program to be abbreviated in the '90s. Currently, flushing is carried out by Maintenance, Construction, and Operations department personnel, coordinated by the Distribution/Maintenance Foreman with flushing routes assigned to several flushing teams. Flushing is conducted annually.

- *Issues:*
  Flushing of dead ends and between pressure zones is complicated by the lack of flushing blow-offs at zone valves. The District continues to install zone valve blow-offs. Flushing zone-valve dead-ends without blow-offs requires that stagnant water from the higher zone be flushed to the lower zone which can jeopardize customer water quality, as well as the risks associated with introducing a higher pressure to an area.

  The STP rehabilitation has increased removal of iron and manganese from lake water. This has resulted in a smaller accumulation of fine sediment in the distribution system. Although the flushing program has been normally performed annually, cutting the program back due to water supply concerns has not resulted in an increase of colored water complaints.

  Stormwater protection rules require dechlorinating of all discharges of flushed water. The District has adopted a policy of dechlorinating at all flushing points; previously dechlorination took place only adjacent to locations that were perceived as being environmentally sensitive.

10.3.8.4 New Construction Approval Process

- *Relationship to Water Quality:*
  New facilities are approved for service by procedures that allow for their disinfection and subsequent testing to show no contamination. The final approval depends on more than the disinfection process but starts with good design and construction practices.

- *District Program*:
  Design review procedures include review for water quality concerns. District procedure EP-4-Disinfection documents construction, disinfection, and approval procedures. The Construction division has drafted procedures for liquid chlorine disinfection of mains. Protection of the sanitary condition of pipe in storage has been identified as a goal and is now practiced.

  Engineering currently includes a representative from the Water Quality division at pre-construction meetings on larger projects to review the approval process and discuss BMPs as relating to assuring water quality. Distribution of the appropriate standards related to disinfection and main approval to the project construction superintendent could be included on the job check list.

  Historically flushing velocities have been less than sufficient in many cases to clear lines. Tie-in to existing mains has been required in several cases prior to main approval in order to achieve flushing velocities. District has provided temporary connection with backflow protection to mains.

- *Issues:*
  The electrical/mechanical crew has developed a procedure for the disinfection of pressure reducing stations and their bypass valves. This procedure should be documented and periodically reviewed.

  Covered storage has been suggested to provide contamination protection for pipe and appurtenances in yard. In lieu of covered storage, end caps are used on stored pipe. End cap effectiveness requires prompt capping and contractor attention at job sites.

  District experience with pipeline disinfection using liquid hypochlorite is positive. Training District personnel on main disinfection procedures has been done to enhance the ability to respond to emergencies. However, the District utilizes outside contractors for pipeline disinfection on large, planned projects.

10.3.8.5 Water Quality Laboratory

- *Relationship to Water Quality*:
  The ability to consistently control and improve water quality is determined by the ability to quickly obtain data and detect trends. The ability to provide quantitative data that can be used to guide process control decisions allows for a higher quality product. It is the role of the laboratory to provide this data. An on-site laboratory equipped to perform tests on demand provides the timely detection that is crucial to good water quality control.

- *District Program:*
  District Water Quality laboratory is staffed and equipped to perform common regulatory tests and those tests that are routinely requested by staff or customers. The laboratory is certified under the California Environmental Laboratory Accreditation Program and staff are certified as Water Quality Analysts by the California-Nevada Section of the American Water Works Association. It has been the policy to equip the lab with the ability to perform those tests essential to monitoring constituents of concern, i.e., those that can be controlled by adjustment to either plant operations or distribution practices. Use of commercial laboratory services is limited to those tests of constituents that are required for regulatory purposes, primarily to show their absence, or to those tests which are not cost effective for the District to perform.

- *Issues:*
  The use of an Ion Chromatograph has been implemented to monitor chlorite and chlorate as DBPs of chlorine dioxide. This instrument has the added benefit of increasing the ability to monitor nutrients such as nitrate and phosphate which are of critical interest in evaluating watershed controls.

  There is no commercial laboratory in Marin County that is certified to perform bacteriological tests on water. The District laboratory has been asked by County Environmental Health if District would be capable of accepting private well bacteriological tests of Non-District County residents. The District laboratory routinely analyzes samples from NSD as part of the two district's mutual aid agreement. Then District lab also occasionally accepts samples from other regional public agencies. The lab should continue to market lab services to neighboring water and wastewater utilities to add revenue and reduce operational costs.

A Laboratory Information Management System (LIMS) was implemented in June 2007 and has been put into daily operation. This system allows for automated reporting from instruments and a streamlined, multistep process for validating results. All bench sheets and reports (including electronic reports to the state database) are generated from the LIMS.

Results of all testing are compiled and summarized in an Annual Water Quality Report. This report (identified as a Consumer Confidence Report as required by the US Safe Drinking Water Act) lists any detected contaminant or constituent with a primary standard as well as several constituents with secondary standards that may be of interest to consumers. The Annual Water Quality Report is sent to each customer in a special mailer and is posted on the District's website.

10.3.8.6 Source Controls and Treatment

- *Relationship to Water Quality*:
  Good source water quality is typically directly related to treated water quality. Improving source water quality can improve treated water quality.

- *District Program:*
  District has developed a Stafford Watershed Protection Plan. This plan is focused on implementing controls to improve lake water quality by reducing nutrients, erosion, pesticide/herbicide prohibitions and controls on leased property, and pathogens from entering Stafford Lake.

  Treatment controls implemented include mixing of the lake with solar powered circulating pumps (SolarBees), and adjustment of Lake Intake levels. The District's practice of treating the lake with copper sulfate to kill algal blooms has been discontinued since the addition of the SolarBees.

  Watershed Controls for Cryptosporidium have been proposed. See discussion under the Section titled "Microbial/Disinfection By-Product Rule, Long Term Enhanced SWTR and Filter Backwash Rule".

- *Issues*
  Lake aeration is an important control mechanism. When aeration was initiated in 1968, months of active algae production dropped from 7 to 6. After dairy controls were required in 1974, an additional month reduction was achieved due to lower nutrient levels. The effectiveness of the aeration system was reduced as the air release lines are located on the lake bottom became covered in bottom sediments, thus allowing nutrients to be disturbed. In 2006 solar powered mixers were installed in the lake to further reduce the occurrence of algae blooms, particularly blue green algae.

  As years pass sediments build in the lake. The sediment buildup at the intake tower has the potential to restrict the scour-gate. A barrier was constructed to minimize buildup and to provide a localized area for sediment removal. A formal lake sediment survey conducted in FY11 found that the accumulation of sediment in the lake is not very significant; therefore no formal sediment removal strategy has been developed.

10.3.8.7 Emerging Issues

- *Security of Facilities:*
  Terrorist attacks on the U.S. have raised concern about security measures and potential biological/chemical contamination. Security measures taken over the past three years include upgrades to access controls at the main office, corp yard, storage facilities and STP. On-line monitoring, increased surveillance, barriers etc., may be considered as new facilities are designed and older facilities are upgraded.

- *Point of Use Treatment:*
  Customers are increasingly turning to Point of Use (POU) treatment devices. The District may want to consider their role in providing customer service in this regard.

- *Contaminants of Emerging Concern (CECs):*
  Public concern with health effects from manmade chemicals found in pesticides and pharmaceuticals has increased over the past years. Scientific studies have revealed a number of environmental impacts from CECs that are released into waterways from wastewater treatment plants throughout the world. The EPA has included a number of these contaminants of drinking water testing as part of the Unregulated Contaminant Monitoring program (UCMR III). DISTRICT monitoring results in UCMR III did not show the presence of any of these. The results of UCMR III testing may result in future regulation for chemicals which are found to have wide occurrence at toxicologically relevant concentrations.

  Other monitoring for certain CECs has been conducted on Russian River water as well as treated water in MMWD's system with no detection. The District stays abreast of issues as they are identified.

10.4 WATER QUALITY GOALS

Based on the issues discussed and experienced the following goals are identified as appropriate to assure water quality in the Novato Water System:

1. A minimum 0.20 chlorine residual maintained at all points in the distribution system.
2. Heterotrophic plate counts not exceeding 500/ml bacteria at all points in the distribution system.
3. No taste and odor complaints or detection.
4. Total Trihalomethanes below 60 ug/L at all DBP sample sites; total haloacetic acids below 40 ug/L at all sample sites.
5. Annual inspection and testing of all reservoirs for bacterial quality and sediments that would warrant disinfection and/or cleaning.
6. All reservoirs cleaned (or bypassed for cleaning based on data) every five years.
7. Annually, flush all mains and turn all valves.
8. Expand the Cross Connection Control program and update supporting regulations to have consistent use of backflow preventers at any service for which the requirement is indicated consistent with California regulations
9. Test backflow prevention devices annually and repair within 45 days of failure identification date.
10. Maintain lead and copper below action level at all consumer taps.
11. Respond to customer complaints within the workday.
12. Reduce nutrients in Stafford source water to eliminate need for algae control with copper sulfate and to reduce TOC.

10.5 RECOMMENDATIONS

The following are recommended actions towards achieving water quality goals.

10.5.1 Source Quality

- Develop and implement nutrient control strategies on Stafford watershed to reduce TOC, chlorine demand and AOC.
- Install continuous turbidity monitoring of SCWA water supply.
- Encourage SCWA to treat well sources that have potential to exceed secondary standards and maintain > 0.5 mg/l CL2.
- Intake tower - Incorporate sediment removal components to Stafford intake structure to permit cleaning every 5 – 10 years.
- Water quality data can be analyzed to assess quality as a function of depth (strata), which can inform future decisions regarding intake tower modifications to provide additional operational flexibility related to intake elevations.

10.5.2 Treatment

Due to ongoing upgrading changes at the STP, no recommendations are included in this master plan other than reinforcement of treatment goals to reduce DBP formation, chlorine demand and TOC/AOC.

10.5.3 Distribution

1. Install continuous chlorine monitoring equipment at entry points to major zones.
2. Continue to identify low chlorine residual or excessive water age areas that can be mitigated by system looping or installation of chlorine boosters.
3. Develop emergency disinfection procedures that can provide disinfectant mixing in large storage reservoirs. Incorporate emergency disinfection taps in all pump stations and identify other strategic locations.
4. Improve flushing by including Engineering in annual update of flushing routes adding new mains.
5. Continue to install flushing blow-offs at dead-end valves.
6. A valve replacement program with identified goals should be considered.
7. Review security issues and address vulnerabilities as appropriate. Consider SCADA-based security alarms and general SCADA security.
8. Increase level of attention to cross connection control measures as recycled water is made available.
9. Consider electronic collection of cross connection control test results in the field that can be downloaded upon return to base.
10. Continue to replace the older DISTRICT-design fire service double check detector assembly and rely on fire systems with approved single detector checks and rely on the alarm check in the fire system to provide redundancy. The older checks should be removed to eliminate head loss, lead components and liability.
11. Consider use of a temporary intertie with backflow protection in new construction where flushing velocities are an issue.

10.5.4 Other Issues

1. Maintain laboratory service ability to meet customer priorities and provide feedback to operational issues. Utilize contract laboratory services to monitor regulated contaminants that are not a concern and testing and/or maintaining laboratory certification is not cost effective.
2. Integrate all District Information management systems including the development of a Laboratory Information Management System (LIMS). Information is critical to effective application of resources.
3. Provide laboratory services to County and other agencies.

10.6 REFERENCES

This section lists the voluntary consensus standards, regional and national best practice standards, and District-specific documents and assessments utilized in this chapter.

California Code of Regulations. Cross-Connection Control Policy Handbook, https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/cccph.html, December 8, 2025.

SECTION 11

Asset Management

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Asset Management

This chapter describes enhancements to the District's Asset Management (AM) Program undertaken as part of the 2025 Master Plan Update. The overall goal of the AM Program and this chapter is to establish a consistent, repeatable process for District staff to manage Novato water system assets in a way that delivers defined levels of service at the lowest lifecycle cost.

11.1 BACKGROUND

The District's AM Program has progressed over the past two decades, evolving from a foundational concept to a structured and integrated component of capital and operational planning. In 2007, the Board accepted the first Infrastructure Repair/Replacement Plan as part of the 2007 Master Plan Update. This initial effort defined asset management as a long-range planning tool to improve understanding of asset needs, replacement timing, and funding strategies.

The 2018 Master Plan further formalized asset management for the District. The 2018 Master Plan recognized that asset investment and renewal decisions directly influence long-term infrastructure performance and cost of service delivery. While many asset-related tasks had historically been performed across the organization, the 2018 Master Plan highlighted the need to consolidate and document these activities into a single framework to improve alignment between operational decisions and business planning outcomes. The 2018 Master Plan also:

- Introduced risk-based prioritization methods and began to link asset renewal strategies with performance goals and service level objectives, setting the stage for a more proactive and data-informed AM program;
- Focused on the top five buried infrastructure maintenance categories (polybutylene and copper services, meters, valves/air release vales, and mains); and
- Established a two-tiered planning horizon: a short-term (5-year) focus for capital planning and a broader 100-year outlook which encompasses the full life cycle of District assets.

As the Novato service area seemingly approaches full build-out, the District's focus has shifted from expansion to the repair and replacement (R&R) of aging infrastructure. Simultaneously, retirements among experienced staff resulted in loss of institutional knowledge, highlighting the need to move from an intuition-driven approach to one supported by data and systems. In response, the District initiated the selection and implementation of an Enterprise Asset Management (EAM) system—ultimately choosing NEXGEN Asset Management (NEXGEN) in 2018 following a needs assessment and comparative evaluation of AM software platforms.

11.1.1 2025 Status and Objectives

This 2025 Master Plan builds on prior asset management efforts and reflects meaningful advancements, notably the use of NEXGEN. Currently, NEXGEN is actively used by the Operations/Maintenance groups for work order management and asset tracking, capturing detailed data such as pump station events, installation dates, inspection records, and scan/test results. However, foundational data such as attribute information, labor hours, and distinctions between planned and unplanned maintenance remains incomplete. NEXGEN has not yet been configured adequately for use by the Construction/Maintenance or Engineering groups who still rely on paper-based or informal workflows, with many decisions historically driven by institutional knowledge rather than standardized data inputs. Both groups have expressed interest in adopting

NEXGEN to align tools District-wide, enhance data use, and ensure more equitable prioritization of assets across systems. The 2025 Master Plan update supports this goal by strengthening the use of NEXGEN and transitioning toward a data-driven, enterprise-wide asset management approach. As experienced staff retire and institutional knowledge is lost, implementing a consistent, structured framework for asset decision-making has become increasingly essential.

This 2025 Master Plan aims to enhance the existing AM Program by consolidating asset data across platforms, improving coordination between departments, and strengthening the linkage between condition, criticality, and capital planning. It also establishes a repeatable, data-based methodology to support consistent, long-term decision-making.

The following tasks were completed to support the 2025 Master Plan effort:

- **Reviewed and evaluated existing asset management data and tools**, including condition assessments, criticality ratings, business processes (inside and outside of NEXGEN), and supporting spreadsheets. This effort established a clear understanding of current practices and available data resources.
- **Updated condition and criticality rating methodologies** for tanks, pump stations, and pipelines. While the previous 2018 Master Plan focused on pipelines and appurtenances (services, valves, meters), the 2025 Master Plan emphasizes both pipeline and facility assets. The updated assessment methodology aligns with NEXGEN-based approaches and the existing pipeline vulnerability assessment.
- **Applied the updated methodologies to evaluate and rank District assets,** assigning condition and criticality values within NEXGEN. Results also supported development of both 5-year and 100-year R&R projections for tanks, pump stations, and pipelines.
- **Identified and prioritized capital improvement projects**, emphasizing high-priority, class-equitable improvements. This included preparation of a short-term (5-year) and long term (100-year plan).

Each task was complemented by a series of collaborative workshops that provided opportunities to review data, confirm assumptions, and confirm priorities. These efforts have strengthened the integration of asset management into the District's long-range planning and decision-making processes.

11.1.2 Available Information

The following information was used in the development of this work:

- Novato Water System Master Plan Update (2018)
- Pipeline Risk Assessment Framework Report and associated Excel file (2023)
- NEXGEN AM Asset Inventory Exports (March 2025)
- GIS Layers for Pump Stations, Tanks, and Pipelines (February 2025)
- Pumps and Tanks inventory Excel files (February 2025)
- Novato Service Area Zone Naming Plan list (February 2025)

The remaining sections of this chapter are organized as follows:

- **AM Program Mission and Goals** – Defines the mission, goals, and Levels of Service of the District's AM Program.
- **Asset Inventory** – Summarizes the assets included in the evaluation.
- **Risk Framework** – Describes the methodologies used to assess condition and criticality.
- **Risk Results** – Presents the findings of the risk assessment.
- **Asset Management Implementation Plan** – Presents the proposed implementation plans, including near-term priorities, long-term strategies, and potential future asset management enhancements.

11.2 AM PROGRAM MISSION AND GOALS

The District's mission and AM goals, originally established in the 2018 Master Plan, were reviewed and confirmed to remain applicable:

"Meet the expectations of our customers in providing potable and recycled water and sewer services that are reliable, high-quality, environmentally responsible, and reasonably priced."
The District's asset management goals are to:

1. Improve water system reliability by reducing system failure rates.
2. Minimize the time and money spent reacting to problems through proactive implementation of necessary AM maintenance and improvement projects.
3. Forecast exhausted asset replacement costs.
4. Develop a practical replacement plan.

The tasks completed as part of this 2025 Master Plan directly support and advance these mission-aligned goals, providing a more structured, data-informed approach to long-term asset planning and decision-making.

11.2.1 Levels of Service

Levels of Service (LOS) are the foundation of effective asset management, defining the performance standards that an organization commits to deliver to customers and stakeholders. LOS align utility management activities with community expectations, regulatory requirements, and organizational goals. LOS help agencies measure success in delivering reliable, high-quality services while balancing cost, risk, and performance.

Establishing sustainable LOS is critical to ensuring the District can meet stakeholder needs not just today, but over the long term as infrastructure ages, demands shift, and financial or environmental pressures evolve. Clear, measurable LOS goals also help prioritize capital investments and operational improvements in a way that is transparent and defensible.

Through a series of workshops, LOS goals were developed under each of the District's AM goals. Key performance indicators (KPIs) were identified to track LOS progress and monitor how effectively the District is meeting its mission and goals. Data for identified KPIs was confirmed to be already tracked informally or easily available to the District. The proposed LOS goals and associated KPIs are summarized in Table 11-1.

Table 11-1. AM Goals and Levels of Service

AM Goal	Proposed LOS Goals	Key Performance Indicators (How is it measured?)
1. Improve water system reliability by reducing system failure rates	• No asset failures resulting in boil water notices • No more than one 4-hour service interruption per year per customer	• Number of boil water notices • Number and duration of service interruptions per year (e.g. water main breaks)
2. Minimize the time and money spent reacting to problems through proactive implementation of necessary AM maintenance and improvement projects.	• 85:15 ratio of preventive maintenance vs. corrective (reactive/emergency) maintenance • Cycle all valves annually	• Labor and materials tracked on Work Orders • Valve Operation Program data
3. Forecast exhausted asset replacement costs	• Increased frequency of inspection and maintenance for assets past their recommended useful life	• Asset register with install dates and remaining useful life • Condition Assessment program to evaluate remaining life
4. Develop a practical replacement plan[1]	• Replace [or rehab] 1% of water pipelines per year, targeting highest risk pipes • No assets in "extreme" risk	• System renewal/replacement (% of funds) • Asset Risk as calculated using the methods below
1 Replacement asset availability and lead times should be taken into consideration when developing practical asset replacement plan.		

As the asset management program advances, the District may consider establishing processes to regularly review and update LOS goals. Over time, as the District tracks the performance of these goals, the results may lead to changes in operations, maintenance, and/or capital planning.

11.3 ASSET INVENTORY

The Novato water system includes the following major components:

- 31 potable water storage tanks
- 2 abandoned tanks and 3 recycled water tanks
- 26 pump stations, including Stafford Treatment Plant Pump Station
- 13 pressure regulating stations
- 7 hydro-pneumatic systems
- 353.1 miles of pipeline
- 2,725 fire hydrants
- 8,870 valves
- 20,708 service connections (includes active, inactive, and closed status for both potable and recycled)

The 2018 Master Plan focused on a selection of asset classes known to contribute most significantly to maintenance costs, including service connections (polybutylene and copper), meters, valves/air release valves, and pipelines. As part of this 2025 Master Plan, the scope of asset evaluations was selected to include pipelines, tanks, and pump stations (excluding the STP Pump Station). Above-ground facilities were prioritized in part because they were not comprehensively evaluated in previous efforts.

11.3.1 Pipelines

The District's GIS database was used to create an inventory of existing pipelines within the Novato water system. The GIS layer consists of 22,715 pipeline segments and associated asset data (e.g., installation year, diameter, material, length, etc.). Table 4-4 through Table 4-6 summarize the Novato system's pipelines by diameter, material, and decade of installation, respectively.

- The majority of the Novato water system pipelines, approximately 74 percent, have diameters between 6-inches and 12-inches.
- The majority of the Novato water system pipelines, approximately 52 percent, are asbestos cement. The next most common material is plastic.
- The majority of pipelines in the Novato water system, approximately 53 percent, were installed between the 1950s and 1980s. Minimal pipeline – 2 miles or 0.6 percent – has been installed in the 2020s, which reflects a slowdown of growth within the Novato water system.

11.3.2 Tanks and Pump Stations

District records and NEXGEN asset inventory exports were used to create an inventory of tanks and pump stations within the Novato water system. The Novato water system consists of 31 potable water storage tanks and 25 pump stations and associated asset data (e.g., installation year, capacity, material, etc.).

Table 4-1 presents a summary of the Novato system water storage tanks. Table 4-2 presents a summary of the Novato system pump stations.

11.4 RISK FRAMEWORK

Risk management is a core principle of asset management best practices, which recognizes that understanding and mitigating asset risk is essential to sustaining service delivery, managing costs, and prioritizing investments effectively over the long term.

The 2018 Master Plan recognized the need to better understand the "risk exposure" associated with asset failures in relation to expected service levels (2018 Master Plan, Page 8-1) and to prioritize asset renewal and replacement based on risk and cost of failure metrics (2018 Master Plan, Page 8-23).

This section describes the risk framework developed as part of this 2025 Master Plan and the methodology used to assess risk for Novato water system pipelines, tanks, and pump stations. The framework evaluates both the likelihood of failure and the consequence of failure (also referred to as criticality) to support data-driven prioritization. By applying a consistent approach across all asset types, the framework enables direct comparison of risk levels and ensures that capital investments are focused where the investments achieve the greatest systemwide risk reduction.

11.4.1 Methodology

The risk assessment developed for this 2025 Master Plan follows an approach aligned with industry best practices and the NEXGEN terminology and framework. Each asset or facility risk score was determined by evaluating two key components:

- **Asset Probability Index (API) – or the Likelihood of Failure:** Represents the likelihood that a failure will occur. This factor considers asset or facility condition, age, material, historical performance, and other attributes that influence the likelihood of failure.
- **Asset Impact Index (AII) – or the Consequence of Failure:** Represents the consequence or impact a failure would have on the District's ability to meet its established Levels of Service (LOS). Factors typically considered are covered by the 'triple bottom line' categories of social, environmental, or economic impacts.

Once API and AII scores are determined, a risk score is calculated for each pipeline and facility using the following formula:

Risk Score = 0.6 (API) + 0.4 (AII)

This risk formula is based on the 2018 Master Plan pipeline vulnerability assessment framework, giving greater weight to asset condition and likelihood of failure, compared to impact/consequence of failure. This approach is suitable when reliable condition and failure data are available, allowing for proactive management of aging infrastructure.

The general approach used in the risk assessment is illustrated in Figure 11-1. The risk assessment involves development of API, AII, and risk scores for each individual pipeline segment and each tank and pump station facility.

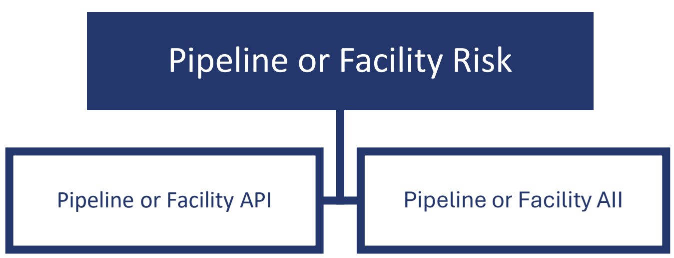


Figure 11-1. Risk Assessment Methodology

11.4.2 Asset Probability Index (API) Analysis

The API analysis evaluates the likelihood that an asset or facility will fail – defined as the inability to perform its intended function or meet established levels of service. A *failure mode* refers to the mechanism or condition by which the failure occurs, which may result from physical deterioration, operational issues, or exposure to external hazards. Several individual factors are used to estimate the API for each asset or facility. Factor selection is based on asset type, data availability, and District priorities.

11.4.2.1 Pipeline API

The factors considered in determining the API for pipelines are described in Table 11-2. Additional factors that may be incorporated into future risk analyses when data becomes available are noted in Section 11.8.

Table 11-2. Pipeline API Factors

Factor	Failure Mode	Description
Percent of Remaining Useful Life (RUL)	Physical Mortality	The percent of useful life remaining is used to reflect that older assets have a higher likelihood of failure due to material aging and wear from prolonged use. Remaining Useful Life (RUL) is calculated by subtracting the asset's age (calculated from its installation date) from its estimated useful life. The following estimated useful life values were used in the analysis[1]: • Asbestos Cement: 70 Years • Cast Iron: 60 Years • Cast Iron Mortar Lined: 100 Years • Copper: 100 Years • Fused PVC: 100 Years • Plastic: 50 Years • Steel: 100 Years • Steel Mortar AC: 100 Years
Failure History	Level of Service	Failure history considers that assets with historical failures are more likely to fail than assets that do not have historical failures.
Seismic Susceptibility, Liquefaction, and Landslide Potential	Natural Hazard Susceptibility	The potential for liquefaction or landslides considers that assets in areas of high liquefaction or historic landslides are more vulnerable. Assets in areas of high liquefaction may fail during an earthquake due to the increase of forces while assets in areas of historic landslides are more vulnerable due to the slope disruption to the surrounding soil.
1 Useful Life values established in the 2018 Pipeline Risk Assessment Framework Report		

Using the factors in Table 11-2, the following process is used to calculate the API for each pipeline:

1. The three pipeline API factors above are each translated into a numeric score from 1 to 10, with 10 indicating the highest API (highest likelihood of failure). The factors and definition for each score are presented in Table 11-3.
2. Each factor is weighted based on its relative importance in determining the overall API score, with additional consideration given to the quality and reliability of the underlying data. The factor weightings are also presented in Table 11-3. For pipelines, the *Percent of RUL* was assigned the highest weight, as asset age is the most consistent and representative indicator of condition. In contrast, the *Failure History* factor was weighted lower due to uncertainty regarding data completeness, and *Liquefaction/Landslide Potential* was acknowledged as a contributing risk but not a primary driver of failure in most areas.
3. The total weighted API score is calculated to obtain an API score, from 1 to 10, for each pipeline.

Table 11-3. Pipeline API Scoring Definitions

API Factor	Data Source	1	2	3	4	5	6	7	8	9	10	Factor Weight, Percent
		Rare		Unlikely		Possible		Probable		Certain		
Percent of RUL	Install Year (GIS Attribute)	>80	80-70	70-60	60-50	50-40	40-30	30-20; Unknown	20-10	10-0	<0	70%
Failure History	Leak Location Data (GIS Shapefile)		0		1			2			3+	10%
Liquefaction and Landslide Potential	US Liquefaction Susceptibility Map	Very Low		Low OR Surficial Deposits			Moderate OR Few Landslides		High OR Many Landslides		Very High OR Mostly Landslides	20%

11.4.2.2 Storage and Pumping Facility API

The API analysis for storage and pumping facilities was evaluated based on a scenario of one of the critical assets or components within that facility failing, not a failure of the entire facility. The factors considered in determining the API for tank and pump station facilities are described in Table 11-4.

Table 11-4. Facility API Factors

Factor	Failure Mode	Description
Percent of Useful Life Remaining (RUL)	Physical Mortality	The percent of useful life remaining is used to reflect that older assets have a higher likelihood of failure due to material aging and wear from prolonged use. RUL is calculated by subtracting the asset's age (calculated from its installation date) from its estimated useful life, which is based on industry standards. The following estimated useful life values were used in the analysis: • Concrete tank: 70 years • Welded steel tank: 50 years • Bolted steel tank: 40 years • Pump station: 40 years (Although pump stations include a range of individual assets with each asset lifespan varying significantly, a representative value of 40 years was selected to reflect the typical asset types and the need to assign a single value for consistent facility-level evaluation.)
Condition Rating (ACI)	Physical Mortality	A facility with visible degradation is more likely to fail. While condition and age are often dependent, newer components may be in poor condition due to environmental conditions or improper maintenance. A condition rating (ACI, or Asset Condition Index) was assigned to each discipline (mechanical, electrical, civil/structural, instrumentation/controls) at each facility based on assessments completed in March 2025. Discipline-level ratings were averaged to calculate the overall facility ACI. The ACI definitions and ratings for each facility are provided in Appendix A.
Liquefaction and Landslide Potential	Natural Hazard Vulnerability	The potential for liquefaction or landslides considers that assets in areas of high liquefaction or historic landslides are more vulnerable. Assets in areas of high liquefaction may fail during an earthquake due to the increase of forces while assets in areas of historic landslides are more vulnerable due to the slope disruption to the surrounding soil.

Using the factors in Table 11-4, the following process is used to calculate the API for each facility:

1. The three facility API factors above are translated into a numeric score from 1 to 10, with 10 indicating the highest API (highest likelihood of failure). The factors and definition for each score are presented in Table 11-5.
2. Each factor is weighted based on its relative importance in determining the overall API score, with additional consideration given to the quality and availability of the underlying data. The factor weightings are also presented in Table 11-5. The *Condition Rating (ACI)* received the highest weight due to its direct reflection of observed asset condition, while *Percent of RUL* and *Liquefaction/Landslide Potential* were weighted lower to reflect their supporting, but less condition-specific nature.
3. The total weighted API score is calculated to obtain an API score, from 1 to 10, for each facility.

Table 11-5. Facility API Scoring Definitions

API Factor	Data Source	1	2	3	4	5	6	7	8	9	10	Factor Weight, Percent
		Rare		Unlikely		Possible		Probable		Certain		
RUL	Install Year	>80	80-70	70-60	60-50	50-40	40-30	30-20; Unknown	20-10	10-0	<0	20%
Condition Rating (ACI)	District Staff Condition Assessment	Excellent		Good		Fair		Poor			Immediate Action	70%
Liquefaction/ Landslide Potential	US Liquefaction Susceptibility Map	Very Low		Low OR Surficial Deposits			Moderate OR Few Landslides		High OR Many Landslides		Very High OR Mostly Landslides	10%

11.4.3 Asset Impact Index (AII) Analysis

The AII analysis considers the impact or consequence that an asset failure may have on meeting the District's Levels of Service.

11.4.3.1 Pipeline AII

The factors considered in determining the AII for pipelines are described in Table 11-6. As discussed previously, asset failure impacts are categorized into environmental, economic, and social consequences. The selected AII factors often address more than one of these categories, reflecting the multifaceted nature of service disruptions.

Table 11-6. Pipeline Asset Impact Index Criteria

Category	Factor	Description
Environmental, Economic, Social	Capacity (Pipe Diameter)	The potential spill volume, water loss, and repair cost are assumed to increase with pipe diameter. Larger pipes pose greater risk for service disruption, repair cost, and broader system impact.
Social, Economic	Difficulty of Construction	Pipelines located in difficult-to-access areas such as creek crossings, bridges, or private property present challenges for repair and recovery, increasing coordination, repair time, and cost.
Social	Customer Service	A water pipe failure can disrupt service to all customers connected to that pipeline. The severity of the impact increases with the number of customer service connections affected.

Using the factors in Table 11-6, the following process is used to calculate the AII for each pipeline:

1. The three pipeline AII factors above are translated into a numeric score from 1 to 10, with 10 indicating the highest AII (highest impact if failure occurs). The factors and definition for each score are presented in Table 11-7.
2. Each factor is weighted based on its relative importance in determining the overall AII score, with additional consideration given to the quality and availability of the underlying data. *Capacity* received the highest weight because larger diameter pipelines are associated with higher spill volumes, greater water loss, and more extensive service disruptions. *Customer Service* impact was also heavily weighted, reflecting the direct effect on customers and the District's focus on customer service. *Difficulty of Constructio*n was weighted lower due to data limitations (see Table 11-7) and its secondary influence on immediate service.
3. The total weighted AII score is calculated to obtain an AII score, from 1 to 10, for each pipeline.

Table 11-7. Pipeline Asset Impact Index Scoring Definitions

All Factor	Data Source	1	2	3	4	5	6	7	8	9	10	Factor Weight, Percent
		Insignificant		Minor		Moderate		Major		Catastrophic		
Capacity	Pipe GIS Layer, Diameter attribute	4-inches or less		6 to 8-inches		10 - 14 inches		Unknown	16 to 20-inches	24 to 30 inches	≥ 36-inches	45%
Difficulty of Construction	Pipe Casing GIS Layer[1]	No Crossing (No Casing)									Railroad, Creek, Bridge, or Private Property Crossing (Casing)	15%
Customer Service	Lateral GIS Layer, Number of Customer Laterals on Pipe	0	1		2-3		4-5	6-7	8-9	10-12	≥ 13	40%

1 The GIS layer for pipeline casings was used as a proxy for crossings. The type of crossing was not available, so all crossings were rated the same (10).

11.1.1.1 Storage and Pumping Facility AII

Table 11-8 describes the criteria evaluated in considering the asset impact index rating for storage and pumping facilities.

Table 11-8. Facility Asset Impact Index Categories

Category/Factor	Description
Social	What is the impact on the District's levels of service and ability to provide water to customers in the Novato water system? What is the "time criticality" of each facility should it be inoperable?
Economic	What is the cost to repair/replace the failed component? What is the cost of denying service?
Environmental	What are the environmental consequences (impact to water bodies, permit violations, etc.) if this component failed?

Each facility was evaluated for the categories described in Table 11-8, and an overall asset impact score from 1 to 10 was estimated by averaging the three category scores. Staff utilized industry standard scoring definitions to develop facility impact scores, balancing professional judgement and relative comparison between facilities. As mentioned previously, failure was evaluated based on the assumption of a critical component within the facility failing, rather than assuming a complete facility failure. This approach provides a more realistic assessment of operational risks, provides a more accurate and actionable basis for risk prioritization, and aligns with best practices for consequence analysis.

11.5 RISK ASSESSMENT RESULTS

The risk assessment considers both the API and the AII to quantify the risks associated with each pipeline, tank, and pump station. Risk results were used to prioritize rehabilitation, replacement, or maintenance actions to meet established goals and Levels of Service. Once all API and AII scores were determined, a risk score was calculated for each pipeline and facility using the following formula:

$$\text{Risk Score} = 0.6\ (API) + 0.4\ (AII)$$

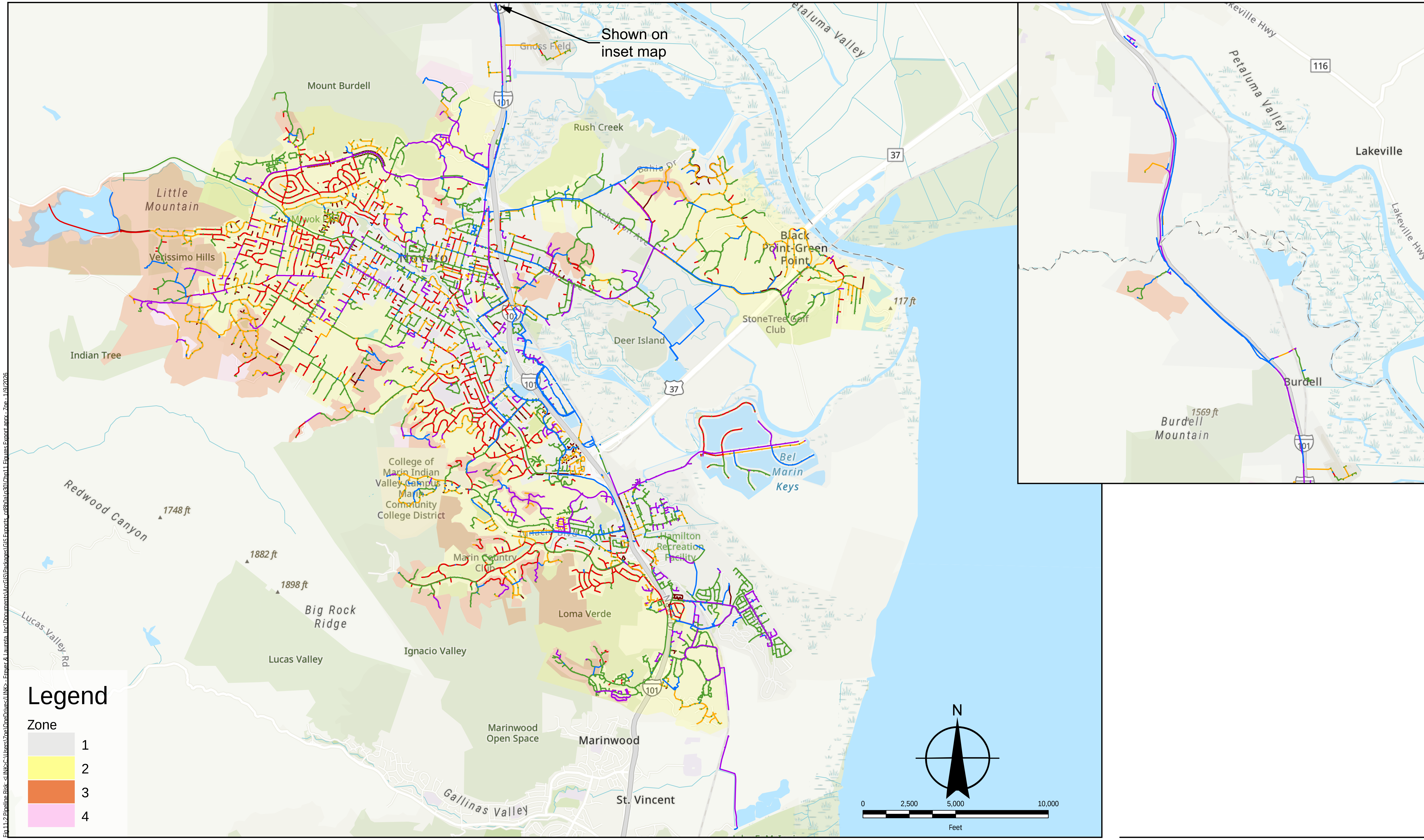
Based on the calculated risk score, a risk level was assigned to each pipeline asset and facility. Risk levels are prioritized into five risk levels: **Extreme, High, Medium, Low,** and **Negligible**, each of which is color-coded in Table 11-9.

Table 11-9. Risk Levels

Risk Level	Risk Scoring Range
Extreme	9+
High	7-9
Medium	5-7
Low	3-5
Negligible	1-3

11.5.1 Pipeline Risk Results

The pipeline risk assessment results are shown on Figure 11-2. Appendix 3 includes a table with the results. Less than 2 percent of pipelines fall within the Extreme or High risk level; approximately 39 percent of pipelines fall into the Medium risk level. The majority of pipelines (60 percent) fall into the Low or Negligible risk levels.



Pipeline Risk
Figure 11-2

1/9/2026

11.5.2 Storage and Pumping Facility Results

The facility risk assessment results are summarized in Table 11-10. Overall, the majority of facilities fall within the Medium risk level (66 percent), with a smaller number of facilities classified as High risk (7 percent) or Low risk (26 percent). No facilities were categorized as Extreme risk. Pump stations generally have higher risk scores compared to tanks. This outcome is expected, as tanks typically provide system redundancy and storage capacity, reducing the immediate consequence of a failure. In contrast, pump stations are critical for maintaining pressure and delivery, making failures more impactful to service reliability.

Table 11-10. Facility Risk Results

Risk Level	Risk Scoring Range	Count Pump Stations	Count Tanks	Percent of Facilities
Extreme	9+	0	0	0%
High	7-9	4	0	7%
Medium	5-7	9	17	66%
Low	3-5	2	12	26%
Negligible	1-3	0	1	2%

Appendix 3 includes the list of the tank facilities and pump station facilities ranked from highest risk to lowest risk score.

11.6 ASSET MANAGEMENT IMPLEMENTATION PLAN

The proposed implementation plans are based on the asset inventory, risk assessment, and LOS goals established in this chapter. The plans integrate the current Capital Improvement Program (CIP) and industry best practices, providing a prioritized, actionable plan for rehabilitation, replacement, and maintenance activities over both the short term (5–10 years) and long term (up to 100 years).

The implementation plans focus on advancing the District's AM goals by improving system reliability, supporting proactive decision-making, and aligning capital planning with condition, criticality, and risk-based priorities.

11.6.1 Short-Term Rehabilitation and Replacement Plan

The existing FY23-FY28 Capital Improvement Program (CIP) and recent condition assessment results were used to identify assets and facilities that are likely in poor condition and may require rehabilitation or replacement. Risk assessment results were then applied to prioritize these assets within a five-year planning horizon. This analysis was integrated with the existing CIP to develop short-term (5-year) project recommendations.

11.6.1.1 Pipeline R&R

This section presents the existing approach and the proposed short-term (5-year) pipeline rehabilitation and replacement plan.

11.6.1.1.1 Existing Pipeline R&R Plans

The current CIP (FY 2023-2028) allocates $1.5 million (M) to $2M per year for pipeline rehabilitation or replacement. These projects were originally identified in the 2018 Master Plan, prioritized based on Operations/Maintenance and Construction/Maintenance staff input, and continue to be implemented today. Remaining projects in groups 1a and 1b include location-specific projects and have been confirmed to remain necessary. Project group 1d from the FY 2026 budget captures general funding for pipes of certain material that the District identified as priority or age profiles, but which are not yet tied to specific locations or segments; the project funds from group 1d are further defined in Section 14.

11.6.1.1.2 Proposed Pipeline R&R Plan

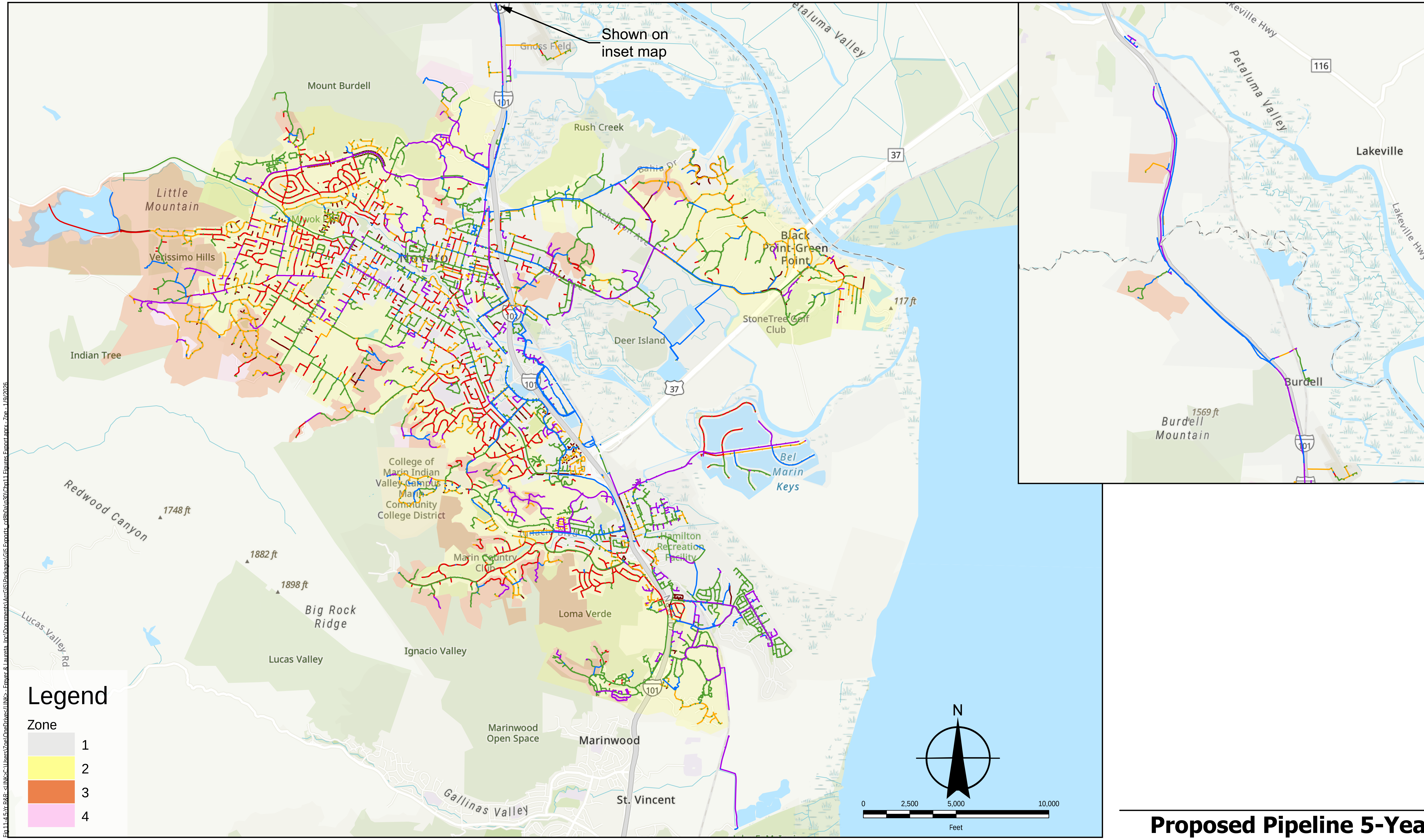
Appendix 3 includes a tabular summary of the priorities identified for the pipeline R&R plan. There is some overlap between the priorities; for example, by replacing a pipe with a high risk level, the same pipe could also be categorized as aging pipeline. The plan is intended to supplement the existing CIP projects in groups 1a, 1b, and 1c.

Replacement Targets & Implementation Plan

Industry standards, including guidelines from the American Public Works Association (APWA) and the American Society of Civil Engineers (ASCE) Infrastructure Report Card recommend replacing 1% of a water utility's pipeline network each year to maintain infrastructure over a 100-year lifecycle. For the Novato water system, this equates to replacing approximately 3.5 miles of pipeline annually. To supplement the existing CIP project list, the District will consider replacing an additional 1.25 miles of pipeline per year over the next five years as funding is available. Figure 11-3 present the proposed 5-year pipeline R&R plan. A tabular summary of the 5-year pipeline R&R is also included in Appendix 3. The recommended plan is incorporated into the CIP detailed in Section 14.

The method of renewal (e.g., open-cut, trenchless rehabilitation, etc.) will depend on the expected condition and location of each pipeline and should be determined during the design phase. During pipeline R&R planning and design, the following coordination and grouping strategies will be considered to optimize efficiency and minimize disruptions:

- Consider including pipelines adjacent to those identified in the 5-year plan even if their risk results are not identical. For example, a pipeline with a high number of service laterals may be prioritized in the 5-year plan due to its higher risk score, but the main pipeline serving it may not be included. Figure 8-4 illustrates this scenario in the Ferris Drive residential area – purple pipes are "High" risk and included in Year 1 through 4 of the 5-year CIP, while the Ferris Drive pipeline is not. Addressing both pipelines concurrently minimizes repeated construction in the same neighborhood, reducing disruptions and achieving economies of scale.
- Coordinate with the City and County to align with upcoming street paving, bridge upgrades, or other projects to minimize conflicts.
- Pipes are currently grouped by general geographic proximity. During planning and design, grouping could also be refined based on construction type or other criteria to support efficient bidding and project execution.



Proposed Pipeline 5-Year Rehab and Replacement
Figure 11-3

1/9/2026

Figure 11-4. Example of Considering Adjacent Pipelines for Inclusion in 5-Year Plan

11.6.1.2 Storage and Pumping Facility Improvements

This section presents the existing approach and the proposed short-term (5-year) storage and pumping facility improvement plan.

11.6.1.2.1 Existing Storage and Pumping Facility Improvement Plans

As of September 2025, the School Road (Crest) Pump Station (Project 2b-2 from the FY2026 budget) relocation was underway and the Old Ranch Road Tank Replacement project (Project 2a-1 from the FY2026 budget) was completed. All other facility-specific projects remain necessary. Project group 2d captures general funding for facilities but are not yet tied to specific sites. Chapter 14 includes further discussion of the project funds from group 2d to direct towards specific projects in the proposed plan.

11.6.1.2.2 Proposed Storage and Pumping Facility Improvement Plan

Since all existing CIP projects are still needed, the proposed 5-year facility improvement plan builds on the existing CIP, incorporating risk and condition assessment results. The proposed storage and pumping facility improvement plan is as follows:

1. *Prioritize existing CIP projects*: Use the risk results to prioritize the remaining CIP projects, ensuring that the highest-risk facilities are addressed first. The top ten highest risk facilities are the focus for the 5-year CIP.
2. *Identify and prioritize additional facilities*: Leverage risk and condition score results to determine the next facilities that will require upgrades, even if those facilities are not included in the current CIP.

Table 11-11 presents the proposed 5-year facility-specific improvement plan, which includes the following considerations:

- The top ten highest risk facilities were included, regardless of whether they have an existing CIP project.
- Some minor CIP projects (e.g., repairing the retaining wall at Cherry Hill Pump Station) have been expanded to include additional actions, such as full condition assessments.
- The seven hydro-pneumatic systems were evaluated in 2021 with the evaluation results presented to the District in a separate report[1] prepared by an engineering consultant. The assessment determined that all seven hydro systems had reached the end of design life and several were experiencing significant operations issues requiring regular maintenance work to maintain operability. Each hydro system assessed using four evaluation criterion including Physical Conditions, Operating Conditions, Energy Consumption, and Maintenance Needs. At each system, the pump station and hydro tanks were evaluated independently. Both the pump station and hydro tanks at each system were individually graded for each criteria on a sliding scale between 1 and 10 with 1 being inadequate/poor and 10 being excellent. All four criteria were weighed equally, and, therefore, a total of 80 points were possible when adding the score for each component. Bahia was evaluated to be the highest priority as the lowest scoring system. It should be noted that because each of the seven hydro systems serves a relatively small number of customers that the evaluation criteria did not necessarily consider the number of impacted customers. The 2025 Master Plan took impacted customers, among other consequence of failure factors, into consideration and, therefore, the hydro-pneumatic systems were not determined to be a high priority based on the relative risk score to other facilities.
- The "Other Tank & Pump Station Improvements" are now accounted for under facility-specific projects, eliminating the need for this category.

The recommended improvement plan was incorporated into the CIP detailed in Section 14.

[1] Technical Report, Final Engineering Assessment Memorandum for NMWD Hydro-Pneumatic Systems prepared by Freyer & Laureta, Inc. and AdvancedHydro Engineering, dated September 2, 2022.

Table 11-11. Proposed 5-Year Facility Improvement Plan

Project/Facility	Plan Details	Overall Facility Condition Score (1-5)	Risk Score & (Risk Level)
Cherry Hill Pump Station Improvements[1]	Perform detailed condition assessment to identify required upgrades. Repair existing retaining wall – see existing CIP.	5	8.40 (High)
Lynwood Pump Station Replacements[1]	Currently in design. See existing CIP.	5	8.39 (High)
Ridge Road Pump Station	Perform detailed condition assessment to identify required upgrades.	5	7.67 (High)
Woodland Heights Pump Station	Perform detailed condition assessment to identify required upgrades.	4.5	6.83 (Medium)
San Marin Pump Station	Perform detailed condition assessment to identify required upgrades.	4	6.81 (Medium)
Lynwood Tank 1[1]	Seismic upgrade and coating – see existing CIP.	4	6.71 (Medium)
Wild Horse Valley Tank	Perform detailed condition assessment to identify required upgrades.	4	6.49 (Medium)
Lynwood Tank 2[1]	Seismic upgrade and coating – see existing CIP.	4	6.47 (Medium)
Truman Pump Station	Perform detailed condition assessment to identify required upgrades.	4	6.35 (Medium)
Upper Wild Horse Valley Pump Station	Perform detailed condition assessment to identify required upgrades.	4	6.35 (Medium)
End of Top 10 highest risk facilities			
Half Moon Tank[1]	Perform detailed condition assessment to identify required upgrades. Property site acquisition – see existing CIP.	4	6.28 (Medium)
Davies Pump Station Upgrade[1]	See existing CIP.	4	6.04 (Medium)
Garner Tank[1]	Perform detailed condition assessment to identify required upgrades. Recoat – see existing CIP.	4	5.68 (Medium)
Nunes Tank[1]	Perform detailed condition assessment to identify required upgrades. Fire Flow Backfeed Valve – see existing CIP.	3	5.02 (Medium)

1 Denotes facility with an existing District CIP project.

11.6.2 Long-Term Replacement Projections

Long-term replacement projections (up to 100-years) were developed to start planning and budgeting for future replacement needs.

The long-term pipeline R&R projections are based on pipeline age and estimated RUL to forecast replacement needs over a 100-year horizon. A large portion of the Novato water system pipelines were installed between the 1950s and 1980s, making them 45–75 years old today. As these assets approach the end of their useful lives, the District is expected to face a "replacement wave," in which many pipelines will require replacement or upgrades within a similar timeframe. Table 11-12 and Figure 11-5 present the long-term pipeline replacement projections by decade. Pipelines in the Overdue category have already reached the end of their useful life (RUL ≤ 0 years).

Table 11-12. Long-Term Pipeline R&R Projections

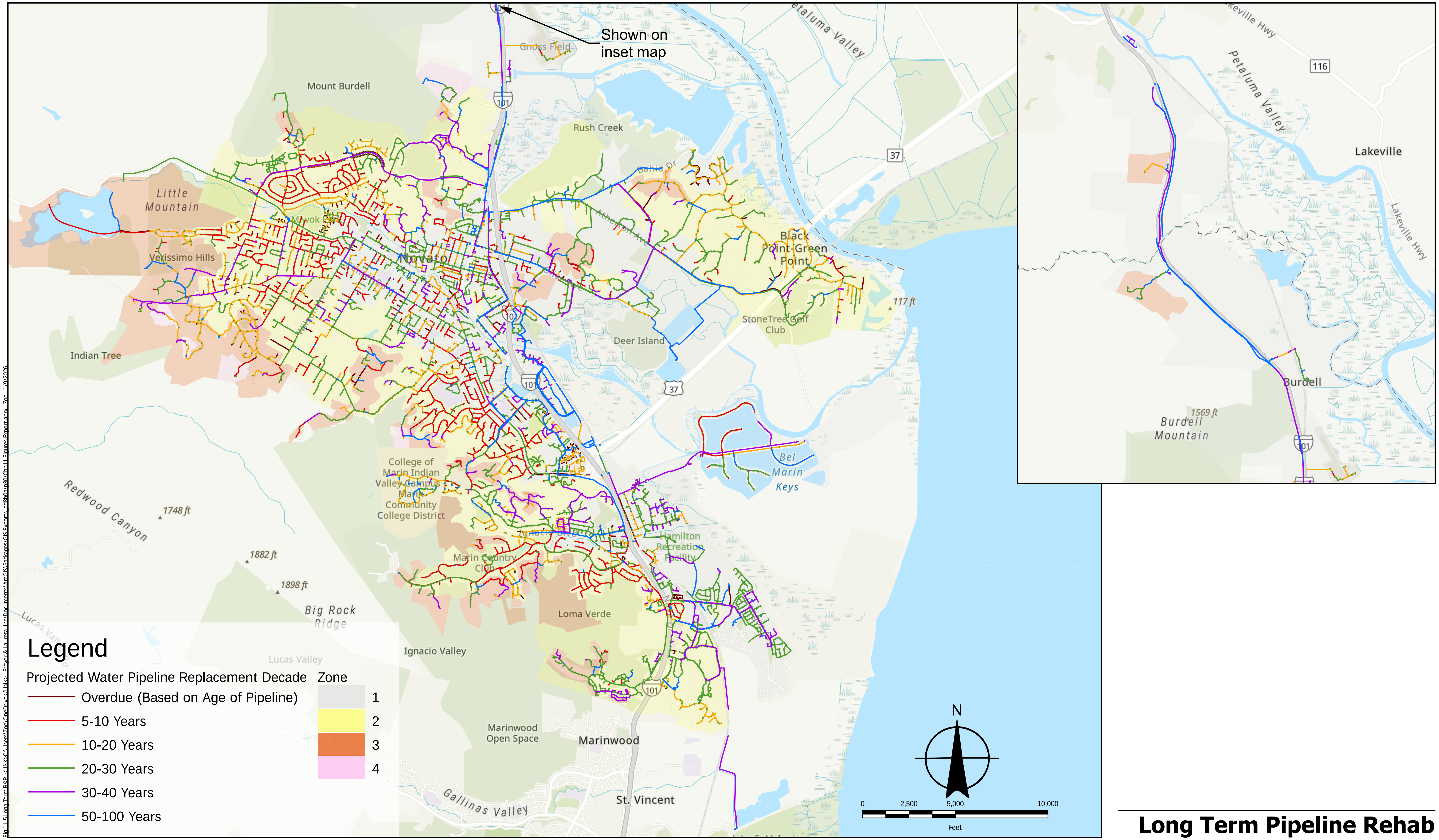
Year Range	Length of Pipelines, miles	Percent of System by Length
Overdue	12.5	4%
Year 0-10 (2025-2035)[1]	70.5	21%
Year 11-20 (2035-2045)	60.5	18%
Year 21-30 (2046-2055)	121.8	36%
Year 31-40 (2056-2065)	48.3	14%
Year 41-50 (2066-2075)	17.7	5%
Year 51-60 (2076-2085)	1.5	<1%
Year 61-70 (2086-2095)	3.4	1%
Year 71-80 (2096-2105)	3.2	1%
Year 81-90 (2106-2115)	9.8	3%
Year 91-100 (2116-2125)	3.5	1%

1 The pipes identified in the short-term (5-year) rehabilitation and replacement plan are included in this category to present a comprehensive view of future replacements.

As shown in Table 11-12, significant replacements are expected over the next 30 years. To proactively plan for the wave of replacements, the following actions will be considered:

1. Plan for Increased Replacements
   - Spread replacements over time by prioritizing segments based on condition, risk, location, or strategic importance, instead of waiting for mass end-of-life events.
   - Over the next three decades, the District may consider gradually increasing rehabilitation and replacement targets to 2% of the system) to stay ahead of aging infrastructure and align with industry standard recommendations to replace 1-4% of pipeline system per year. Continually evaluate resources to support target replacement and rehabilitation rates.

2. Strengthen Data-Driven Decision Making
   - Use available data to support and refine replacement planning. This includes:
     — Historical maintenance and repair records
     — Break history and leak frequency
     — Condition assessments
     — Customer service complaints and work order history
     — Hydraulic modeling outputs
   - Utilize NEXGEN to track and manage data.
3. Continue and Enhance the Collaborative Approach to CIP Selection
   - Continue this approach and support future decisions with data (maintenance records, condition assessments, work order history, etc.).
   - Continue to coordinate with the City and County to align with upcoming street paving, bridge upgrades, or other projects to minimize conflicts
4. Apply the Risk Framework
   - Use the risk assessment framework to prioritize pipelines each CIP period.



Long Term Pipeline Rehab and Replacement Projection

Figure 11-5

1/9/2026

11.6.3 Storage and Pumping Facilities

Table 11-13 displays the top 20 highest-risk storage and pumping facilities, summarized from Section 11.5.2, to supplement the top 10 presented in the 5-year plan. While this list provides a snapshot of the current highest risk facilities, it is not sufficient on its own to determine long-term improvement projects. Other chapters and strategic priorities outlined in this WMP such as system supply constraints, capacity needs, and resilience should also be considered when developing the long-term CIP.

Table 11-13. Top 20 Highest Risk Facilities

Risk Level	Risk Score	Facility
Extreme	--	--
High	8.40	Cherry Hill Pump Station
	8.39	Lynwood Pump Station
	7.67	Ridge Road Pump Station
Medium	6.83	Woodland Heights Pump Station
	6.81	San Marin Pump Station
	6.71	Lynwood Tank 1
	6.49	Wild Horse Valley Tank
	6.47	Lynwood Tank 2
	6.35	Upper Wild Horse Valley Pump Station
	6.28	Half Moon Tank
	6.25	Indian Hills Hydro Pump Station
	6.25	San Andreas Tank
	6.25	San Antonio Tank
	6.22	Winged Foot Pump Station
	6.04	Davies Pump Station
	5.97	Winged Foot Tank
	5.87	Ponti Pump Station
	5.87	Trumbull Tank
	5.83	Eagle Hydro Pump Station
	5.80	Sunset Tank
Low	--	--
Negligible	--	--

For pump stations, the District will consider the list presented in Table 11-13 for long-term planning of equipment replacements and upgrades and a prioritized condition assessment program. This aligns with the approach proposed in the 5-year facility improvement plan.

For tanks, a similar approach is recommended. The following rehabilitation intervals can be used as general guidance for planning major investments and long-term capital improvements:

- Every 10-15 years: Recoat/repaint tank and perform condition assessment along with a structural assessment (including a seismic evaluation).
- Every 20-30 years: Perform a condition assessment to assess the need for major rehabilitation including the rehabilitation/replacement of liners, coatings, and structural components.

- Every 40-50 years: Assess for replacement.

For all facilities, staff will consider tracking maintenance costs through work orders including labor, equipment, and materials. As a general guideline, if the maintenance cost for an individual asset over a 12-month period exceeds 50% of the asset's replacement cost, the District may consider replacement of the asset.

11.6.3.1 Forecasting Using NEXGEN

The District's NEXGEN system has a Prioritization module available that allows for forecasting asset replacement for up to a 25-year period. The Prioritization module is a tool where staff could create scenarios each CIP period based on proposed budget, risk threshold, and possible replacement deferral. Although the Prioritization module is available to the District, the tool requires the following information:

- Replacement costs for each asset
- Useful life by asset class (available from this WMP)
- Install date for each asset (available from this WMP)
- Asset Impact Index score for each asset (asset can adopt the Facility AII scores)

11.7 POTENTIAL FUTURE ASSET MANAGEMENT ENHANCEMENTS

The 2025 Master Plan continued to build upon the asset management program developed as part of the 2018 Master Plan. There will be more opportunities in the future to further strengthen the asset management capabilities. During this project, several additional needs and opportunities were identified beyond the original scope of work. These items were documented throughout the 2025 Master Plan process and associated workshops and are compiled here. To further strengthen the District's asset management capabilities, staff may consider the following for future implementation after the primary recommendations are completed or scheduled:

- NEXGEN Implementation and Utilization
  - Import Asset Probability Index, Asset Impact Index, and Risk scores for all facilities to prioritize maintenance and track high risk assets.
  - Incorporate condition assessments as scheduled routine preventive maintenance in NEXGEN to support future risk assessments, capital planning, and maintenance prioritization. The condition assessments completed for the 2025 Master Plan effort can be used as a baseline to track asset condition changes over time, evaluate performance trends, and refine long-term project needs.
  - Track maintenance costs on work orders (labor, equipment, materials) to support Levels of Service tracking and capital planning.
  - Import installation dates, replacement costs, and useful life data to utilize NEXGEN as central data repository and, when the District is ready, utilize the Prioritization module.
  - Incorporate valve maintenance activities – such as valve turning – into NEXGEN, and use maintenance records to identify and prioritize valves for future replacement.
  - Integrate GIS with NEXGEN for complete asset inventory and the ability to create work orders for pipelines.

- After implementation of the 5-year pipeline R&R plan, track the length of pipeline replaced or rehabilitated annually. Compare actuals with industry standards (e.g., how close is the District to meeting the 1-percent per year target – which equates to 3.5 miles annually for the District system). After the 5-year plan is complete, the District may consider gradually increasing target pipeline replacement towards 2% per year (7 miles annually). Continually evaluate resources to support target replacement and rehabilitation rates.
- Develop asset lifecycle business processes to capture roles, responsibilities, and systems of record for each step in the asset lifecycle. Establishing clearly defined business processes is essential for ensuring consistency, accountability, and efficiency in managing assets from planning and acquisition through operation, maintenance, and eventual replacement or disposal. Documenting roles and responsibilities helps eliminate ambiguity, supports staff training, and enables smooth handoffs between departments. Identifying systems of record ensures that critical data is stored, accessed, and updated in the appropriate platforms, reducing duplication, improving data integrity, and supporting informed decision-making across the organization. This foundation is critical for aligning asset management practices with industry standards and for achieving long-term reliability and cost-effectiveness.
- Implement a structured process for regular review – ideally conducted annually – of LOS and KPIs. This will help identify areas for improvement, adapt to changing stakeholder needs, and maintain alignment with the District's AM goals.
- Risk Framework Enhancements
  - For pipelines, the following may be considered:
    - Include backbone pipelines as an AII factor to consider critical conveyance pipelines.
    - Include critical customers, such as schools, hospitals, police, fire, etc., as an AII factor to account for pipelines that provide water to critical customers.
    - Include service outage impact from hydraulic model analysis as an AII factor. Currently, the number of service connections is used as a proxy to estimate service outage impacts. However, this approach prioritizes pipelines with many direct service connections while overlooking pipelines that feed those high-service areas. Incorporating hydraulic model results would provide a more accurate representation of outage risk by identifying critical pipelines whose failure would disrupt service to largest portions of the system.
    - Include soil type and water table as an API factor.
  - For tank and pump station facilities, the following may be considered:
    - Include critical customers and customers served by zone as an AII factor.
    - Perform asset-level risk assessment, instead of facility-level or discipline-level, to determine individual asset risk and prioritization. This would require asset-level condition and attribute (age) information.
  - For all asset-types:
    - Incorporate the Risk Framework into NEXGEN for the ability to run the risk assessment whenever the District needs to.
- Review and update GIS Pipe attribute data, particularly for Plastic Pipe. It was noted during the workshops that the GIS does not differentiate between thin-walled and other plastic pipe types.

SECTION 12

Natural Hazard Risk and Resilience Assessment

SECTION 12
Natural Hazard Risk and Resilience Assessment

This chapter describes the efforts made to assess the natural hazard risks to and resilience of the Novato Water System (facilities and pipelines). Through this process, the project team identified the most critical and vulnerable assets serving the Novato water service area, identified the District's current risk and resilience management practices and investments, and identified additional investment opportunities to improve resilience. Section 12 begins with identifying backbone facilities and pipelines and the relevant natural hazards that could impact the District's ability to meet its mission and maintain its critical functions. This chapter then summarizes a risk-based system for prioritizing the most urgent risk-reduction projects, known as risk and resilience management strategies (RRMS). The overall assessment of District facilities in this Section is known as Natural Hazard Risk and Resilience Assessment (NHRRA).

12.1 INTRODUCTION

For context in this section, risk is defined as the potential for threats or hazardous events to disrupt a water utility's ability to meet its mission and critical functions. Resilience is defined as the ability of an asset or system to adapt to or withstand the effects of a malevolent act or natural hazard with or without interruption to the asset or system's function or, if the function is interrupted, to rapidly return to a normal operating condition.

Risk and resilience were assessed to evaluate the potential impacts of natural hazards on the Novato water system and to identify ways to enhance the District's ability to withstand and recover from those impacts. Risk to a water system is a function of threat likelihood, vulnerability, and consequence. This chapter is organized into the following sections:

1. District's Existing Mitigation Measures
2. Risk and Resilience Assessment Methodology
3. Backbone Asset Characterization
4. Threat Characterization
5. Consequence Analysis
6. Vulnerability Analysis
7. Risk and Resilience Analysis Results
8. Risk and Resilience Management Strategies

This NHRRA should be considered supplemental to the District's all-hazards risk and resilience assessment compliant with the Safe Drinking Water Act (SDWA) §1433 as amended by section 2013 of America's Water Infrastructure Act of 2018 (AWIA), as discussed below.

12.1.1 Background

The District has proactively managed risk for many years through various methods such as building staff knowledge, managing assets, capital planning, and establishing partnerships with neighboring agencies. The District has extensive institutional knowledge in responding to emergency events over many years and a variety of events. Most recently, in 2023, the District responded to a landslide that impacted the primary water supply pipeline (NMA). The District was able to respond quickly and efficiently to determine the security of the pipeline and return to normal service. The limited impacts to the District's mission and critical functions from this event is reflective of the District's current level of organizational resilience.

In 2020, the District completed a Risk and Resilience Assessment (RRA) to meet the requirements of the SDWA §1433 as amended by AWIA. Updates to the District's RRA and Emergency Response Plan are required to be completed every five years. Once complete, the District self-certifies with the U.S. Environmental Protection Agency that these documents have been updated. This NHRRA builds on previous resilience studies, policies, and mitigation measures to 1) develop the framework for ongoing resilience planning that aligns with the SDWA §1433 requirements and 2) identify the next highest priority mitigation measures for inclusion in the CIP presented in Section 14.

Executing an NHRRA requires detailed information on the Novato Water System's facilities, operation, maintenance, and management strategies, and the history and local conditions of the area. Senior staff participated in a two-day workshop in March 2025 to discuss this information. The results of this workshop informed this Chapter.

The first step in conducting NHRRA was to identify and validate the District's mission. The District's mission is to:

"Meet the expectations of our customers in providing potable and recycled water and sewer services that are reliable, high-quality, environmentally responsible, and reasonably priced."

12.1.2 Available Information

The following background information was used for this analysis:

- Risk Assessment Summary Report for North Marin Water District (2020)
- North Marin Water District Emergency Operations Plan (2019)
- Marin County Operational Area Multi-Jurisdictional Hazard Mitigation Plan (2023)
- GIS Layers for Pump Stations, Tanks, and Pipes

12.2 EXISTING MITIGATION MEASURES

The term "mitigation measure" is defined as any organizational or operational capabilities to: reduce or minimize the damage caused by an event; support and complement response actions; or facilitate rapid recovery and reconstitution. Mitigation measures often include elements such as emergency operations planning, purchasing of spare parts, and employee training. Often, they result in reduction of short- and long-term consequences.

To support this NHRRA, the identification and evaluation of mitigation measures was accomplished through review of historical documents, plans, procedures, drawings, and the in-person workshop. A summary of existing District-wide mitigation measures in place to build resilience are listed below:

- Staff's knowledge of the system – staff understand how the distribution system operates, including where redundancies and weaknesses exist.
- Specific facilities have risk mitigation measures implemented through resilient design and construction standards and decision-making.
- Emergency response training is built into employee onboarding and emergency response exercises are conducted.

- The District and Board maintain good governance of emergency preparedness investments and practices. This is done during emergency events through timely communication and coordination with response partners and customers. This is also done during "blue sky" operations and planning activities through investment in mitigation measures to lessen the consequences of future events.
- Planning and response partnerships with nearby cities and districts.

Site-specific mitigation measures are included in Appendix 4A, Facility Mitigation Measures.

12.3 RISK AND RESILIENCE ASSESSMENT METHODOLOGY

Several standards, methods, and tools are used to conduct risk assessments and gauge a utility's resilience. The International Organization for Standardization 31000 Risk Management framework (ISO 31000) provides organizations with guidelines and principles for risk management. ISO 31000 does not seek to eliminate risks but rather is meant to help organizations identify their risks and establish a strategy for mitigating or reducing risks where appropriate. ISO 31000 guidelines recommend that risk analysis should include the following factors:

- The likelihood of events and consequences
- The severity of potential consequences
- Complexity and interconnectivity of sources of risk
- Effectiveness of existing risk controls
- Sensitivity and confidence levels

AWWA has also developed a suite of resources to help water and wastewater utilities assess risk and build resilience. The AWWA J100 – Risk and Resilience Management of Water and Wastewater Systems (J100 Standard) is an all-hazards methodology for assessing and managing risks to critical infrastructure. The J100 Standard allows for identification and communication of the risks to, and resilience of the organization under evaluation (i.e., the ability to withstand and/or return to service after an interruption).

Consistent with ISO 31000 guidelines, a qualitative risk assessment of the Novato Water system and assets was conducted by following the J100 Standard's seven interrelated steps, as depicted in Figure 12-1. It is important to note that this study is a high-level, qualitative risk evaluation. Typical AWIA all hazards RRAs include quantitative assumptions, such as estimated costs of consequences, and more detailed scoring of individual risk factors.

Figure 12-1. AWWA J100 Process

12.3.1 Climate Change Risk and Resilience Analysis Methodology

As part of the NHRRA, the effect of climate change on specific hazards and their impact to backbone facilities was evaluated. The EPA's Climate Resilience Evaluation and Awareness Tool (CREAT) was used to identify appropriate climate change risk evaluation scenarios. The EPA's CREAT includes a series of modules for inputting specific information for a utility and selecting applicable climate-driven hazards from a menu of likely scenarios. Several elements of CREAT were applied to support the analysis, as discussed in Section 12.8.

12.3.1.1 Climate Resilience Maturity Model

The Environmental Defense Fund's (EDF) Climate Resilience Maturity Model (CRMM) was used to assess the District' ability to meet climate challenges and measure their progress towards managing risks associated with climate change. The CRMM includes consideration of six categories, each rated on a scale of 0-3, where "no discernable process" is 0 and "efficient" is a 3. The six categories are described below:

1. **Governance – Executive Level Engagement and Leadership:** Organizations that identify and empower employees, including senior decision makers, to internally advocate for climate resilience policies, plans and actions will be better positioned to meet the challenges of extreme weather and other climate-related risks than those that don't.
2. **Climate-Aware Planning:** Organizations that plan and prepare for climate risks will be more resilient.
3. **Stakeholder and Community Collaboration:** Climate resilience measures must be pursued in collaboration with stakeholders in order to be built into organizational culture for durable and long-lasting success.
4. **Resilience and Adaptation Actions:** Organizations should take action based on insights from climate models and plans, using those insights to develop and implement projects to support critical functions.
5. **Customer Engagement and Coordination:** It is essential that customers and communities have a voice in the decision process, so that climate resilience investment decisions are made with them, not just about them.
6. **Attention to Equity:** Organizations are encouraged to give extra weighting to the interests of economically disadvantaged communities, to bring them closer to parity.

12.4 BACKBONE ASSET CHARACTERIZATION

Backbone (e.g. critical) asset characterization involves identifying assets whose absence or unavailability would significantly degrade the District's ability to carry out its mission or would have unacceptable financial, political, or physical consequences for the District, the community, and/or the environment. This step results in a list of backbone assets to be considered in subsequent assessment steps. Backbone asset characterization was accomplished via detailed discussion during the workshops in which the project team discussed the relative criticality of the assets and facilities in relation to the District's mission and levels of service.

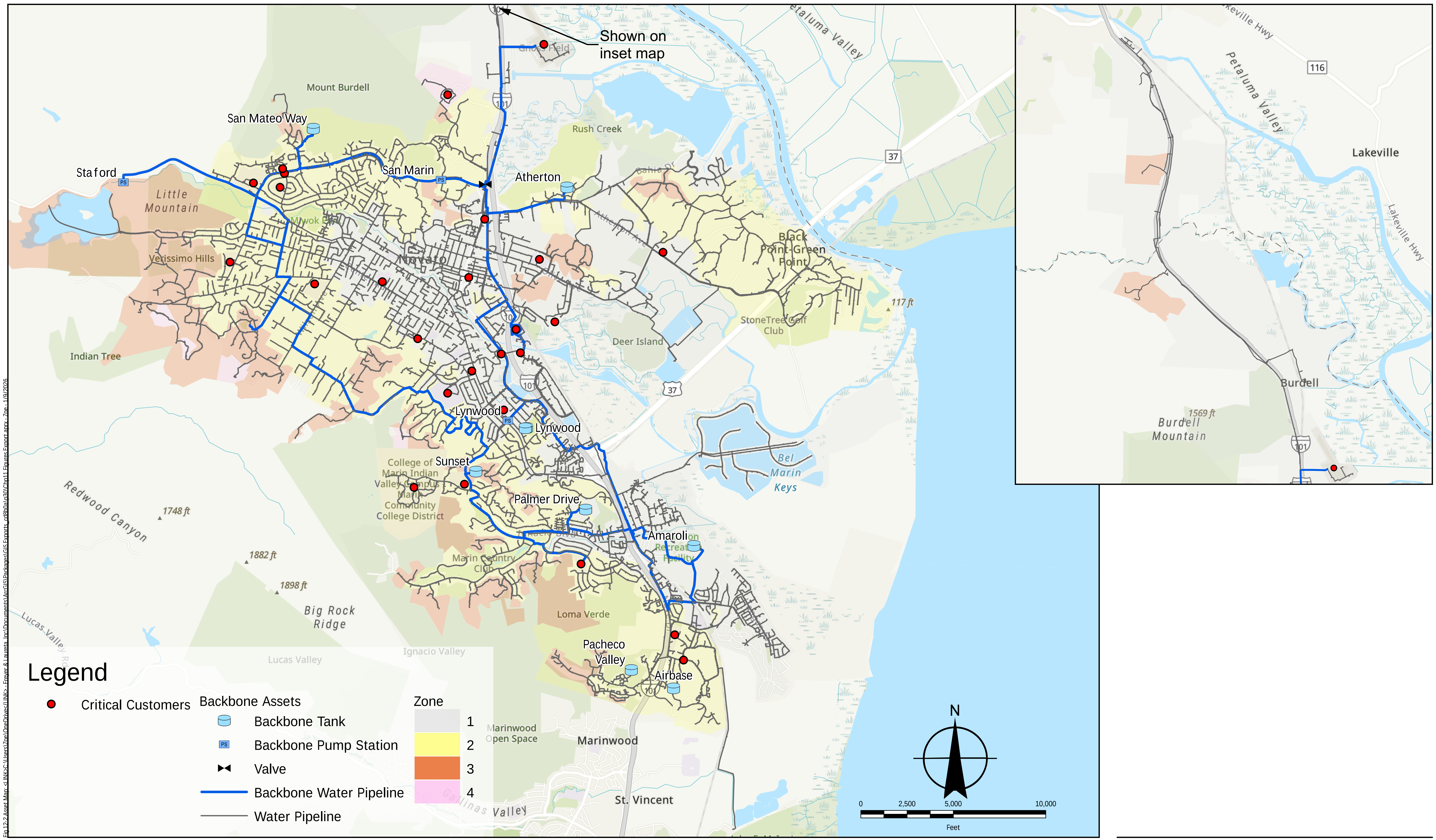
To determine if an asset should be prioritized and included further in asset characterization, these primary questions were considered:

- Which facilities are critical to maintaining established service levels?
- Which facilities support critical customers, such as governmental buildings, high volume consumers, or other critical sectors (e.g., healthcare facilities)?

The identification of backbone assets in each category is summarized in Table 12-1 and shown on Figure 12-2.

Table 12-1. Summary of Backbone Assets

Asset Category	Asset
Source Water	• Stafford Lake • Stafford Lake Dam • Russian River via SCWA
Storage Tanks	• Airbase Tank • Aramoli Tank • Atherton Tank • Lynwood Tank 1 • Lynwood Tank 2 • Pacheco Valle Tank • Palmer Tank • San Mateo Tank • Sunset Tank
Pump Stations	• Lynwood Pump Station • San Marin Pump Station
Transmission and Distribution Pipelines	• Distribution Pipelines as shown in Figure 12-2 • North Marin Aqueduct • San Marin Control Station (Aqueduct Valve)
Treatment	• Stafford Treatment Plant
Other	• SCADA System



NMWD Asset Map
Figure 12-2
1/9/2026

12.5 THREAT CHARACTERIZATION

The 2025 Master Plan focuses on assessing natural hazards, but future master plan efforts may include dependency hazards, proximity hazards, and malevolent acts to comply with the all-hazards RRA and SDWA 1433/AWIA requirements.

The Marin County Operational Area Multi-Jurisdictional Hazard Mitigation Plan (HMP) is a primary source for identification of and information on natural hazards relevant to the District. The HMP provides a list of historical natural hazard events that are applicable to a specific localized area and encompasses the District's assets.

Table 12-2 lists the various natural hazards applicable to the District, along with any observed impacts associated with the historical occurrence of such events within the service boundary. These hazards were reviewed with staff in the workshop to verify their importance in the NHRRA.

Table 12-2. Summary of Natural Hazards[1]

Hazard	Description and Local Applicability
Earthquake/Liquefaction	• The potential for earthquake damage exists throughout Marin County because of a combination of the number of active faults within and near the County and the presence of soils vulnerable to liquefaction. • The San Andreas Fault traverses Marin County running north and south in the western quarter of the County. • The eastern, more heavily populated part of Marin is less than ten miles from the northern section of the Hayward Fault. • The northern part of Marin is less than ten miles from the Rodgers Creek Fault.
Flood	• Most of City of Novato and some surrounding areas are within the Novato Creek watershed, which is within the 100-year floodplain.
High Wind Event	• Windstorms which bring damaging high-speed winds have been recorded in the area. • Several recent high wind occurrences have caused temporary loss of communications.
Wildfire	• Topography, fuel (vegetation), and weather contribute to wildfire potential. • The southern and western portions of the City of Novato is within the High Fire Severity Zone.
Landslides	• Most of the City of Novato has high susceptibility to landslides. Areas most at risk of landslides are areas where wildfires have destroyed vegetation, areas where landslides have occurred before, steep slopes, slopes that have been altered for construction of buildings and roads, channels along streams and rivers, and areas where surface runoff is detected. • In 2023, a landslide occurred threatening a pipeline, interrupting operations and activating the emergency operations protocols.

Table 12-2. Summary of Natural Hazards (Cont.)[1]

Hazard	Description and Local Applicability
Drought	• Recent drought conditions in California demonstrate the impacts to both individual utilities and the State as a whole. They also demonstrate both the utility's and State's ability to respond to a drought through both water resource management and water use reduction. • The most recent drought period resulted in State mandates for water conservation including a statewide 20 percent reduction in urban water use by the year 2020, which was achieved by the District.
Extreme Heat	• The frequency of heat waves has been increasing in recent years across the region. • Climate change will continue to cause more extreme heat events and, by the end of this century, the number of days with temperatures reaching or exceeding 100°F is projected to increase in the County. • Extreme heat is noted as a priority hazard in the HMP.
Dam Failure	• Failure of the Novato Creek Dam with Stafford Lake at full capacity would affect an area that extends approximately five miles down Novato Creek through parts of the unincorporated County and the City of Novato.
Harmful Algal Blooms (HABs)	• HABs occur when colonies of algae grow rapidly and cause toxins or deplete oxygen levels to the point where they become harmful or deadly to plants, animals, and humans. • During drought years, algal blooms in Stafford Lake have contributed to taste and odor issues.
Sea Level Rise	• It is projected that Marin County will experience a sea level rise of 1 to 5 feet by the end of this century. • Sea level rise could impact site access, low level pipelines, and transportation. Water quality issues may arise if assets become constantly submerged under water.

1 Natural Hazards identified for evaluation based on the Marin County Multi-Jurisdictional Hazard Mitigation Plan

12.5.1 Threat Likelihood Analysis

Threat likelihood analysis assigns an estimated likelihood to each hazard. Natural hazards were analyzed using historical data of recorded events from government sources, where available, and the HMP. Historical anecdotes of incident occurrences were also documented and considered. Each natural hazard threat was assigned a threat likelihood of high, medium, or low based on the annual probability of occurrence. Table 12-3 summarizes the threat likelihood for each hazard.

Table 12-3. Threat Likelihood

Hazard	Threat Likelihood (Annualized)
Earthquake/Liquefaction	Medium
Flood	Medium
High Wind Event	High
Wildfire	Medium
Landslides	Medium
Drought	Medium
Extreme Heat	High
Dam Failure	Low
Harmful Algal Blooms (HABs)	Low
Sea Level Rise	Low

12.5.2 Threat-Asset Pairs

A threat-asset pair (TAP) refers to the combination of a specific threat and a corresponding backbone asset within a system. Following the identification and characterization of hazards and backbone assets completed in the previous sections, TAPs were identified for further steps of the risk and resilience analysis, a full list of which can be found in Appendix 4B, Threat-Asset Pairs Identified for Analysis.

12.6 CONSEQUENCE ANALYSIS

Consequence analysis defines the immediate, short, and long-term losses and effects of each selected threat on each backbone asset. Under the J100 standard, worst reasonable consequences are defined as "the most severe but reasonable and credible consequences for a specific hazard."

The consequence analysis estimates the potential impacts (economic, human, operational, environmental) for each TAP. The following list outlines the criteria evaluated:

- **Number of fatalities** – includes both employees and non-employees who may be mortally injured or sickened due to the event.
- **Number of serious injuries** – includes both employees and non-employees who may be injured or sickened seriously enough to result in hospitalization.
- **Financial loss to utility** – includes any financial losses associated with the repair or replacement of assets or facilities, workaround costs, as well as any loss of revenue due to service denial.
- **Economic loss to the regional community** – includes any adverse impacts to regional economic activity resulting from the event (i.e., financial losses due to service denial).

Each TAP was analyzed by criteria category to establish a qualitative consequence of high, medium, or low for each category. The consequences were discussed during the in-person workshop and considered the mitigation measures summarized in Section 12.2. The consequence analysis results for each TAP can be found in Appendix 4C, Consequence Analysis Summary.

12.7 VULNERABILITY ANALYSIS

Vulnerability is defined as the probability that, given a specific threat, the estimated worst reasonable consequences will occur for an individual TAP. The ability of each backbone asset and its protective systems to withstand each specified threat or hazard is evaluated.

Any weakness in an asset's design, location, or protection systems, or the way the asset is operated that can contribute to failure is considered a vulnerability. Such weaknesses can lie in building characteristics, equipment properties, or operational and personnel practices.

For natural hazards, vulnerability is an estimation of the likelihood that the event results in the estimated consequence. For evaluation of risk in this assessment, a vulnerability of 1 was assigned for each TAP as each natural hazard was assumed to result in the worst reasonable estimated consequences.

12.8 RISK AND RESILIENCE ANALYSIS

The risk and resilience analysis combines the results from the previous sections to estimate the risk levels for each TAP, as described below. The potential impacts of climate change were also applied, as discussed in Section 12.8.1.1. In addition, the Utility Resilience Index (URI) is presented in Section 12.8.2.1 as an evaluation of the District's overall resilience.

12.8.1 Risk Analysis

Risk is the product of consequences, vulnerability, and threat likelihood, as shown below:

$$R = C \times V \times T$$

Where:

R = Risk

C = Consequences

V = Vulnerability

T = Threat Likelihood

The risk analysis was performed as a qualitative assessment, resulting in a risk level of high, medium-high, medium, medium-low, or low assigned to each TAP. Detailed risk results are presented in Appendix 4D, Risk Analysis Summary. Although none of the TAPs fell in the high-risk level, several fell into medium-high risk level. The largest risk levels are associated with impacts of earthquakes on several facilities and flooding at Lynwood Pump Station. Table 12-4 lists the top highest-ranking threat-asset pairs for the District in terms of risk level.

Table 12-4. Highest Risk Threat-Asset Pairs

Threat	Asset	Annualized Risk Level
Earthquake/Liquefaction	Source Water – Stafford Lake Dam	Medium High
Earthquake/Liquefaction	Lynwood Pump Station	Medium High
Earthquake/Liquefaction	San Marin Pump Station	Medium High
Earthquake/Liquefaction	Distribution Pipelines	Medium High
Earthquake/Liquefaction	North Marin Aqueduct	Medium High
Earthquake/Liquefaction	Stafford Treatment Plant	Medium High
Flood	Lynwood Pump Station	Medium High

Table 12-4. Highest Risk Threat-Asset Pairs (Cont.)

Threat	Asset	Annualized Risk Level
Earthquake/Liquefaction	Sunset Tank	Medium High
Earthquake/Liquefaction	Palmer Tank	Medium High
Earthquake/Liquefaction	Pacheco Valle Tank	Medium High
Earthquake/Liquefaction	Airbase Tank	Medium High
Earthquake/Liquefaction	Atherton Tank	Medium High
Earthquake/Liquefaction	Amaroli Tank	Medium High
Earthquake/Liquefaction	San Mateo Tank	Medium High
Earthquake/Liquefaction	Lynwood Tank 1	Medium High
Earthquake/Liquefaction	Lynwood Tank 2	Medium High

12.8.1.1 Climate Change Risk Analysis

The anticipated impacts of climate change were applied to the consequences, vulnerability, and threat likelihood to further refine the risk analysis for the future.

According to the EPA, CREAT incorporates the most current scientific information available and is regularly updated to reflect new findings and emerging climatological trends. CREAT was used to project potential future climate conditions for the District's Novato service area for three different future climate condition scenarios. These scenarios include:

1. Hot and Dry
2. Average
3. Warm and Wet

Climate change-related hazards relevant to the District were then identified and evaluated.

The following possible future conditions generated by CREAT for the Novato service area highlight the unique challenges associated with conducting a Climate-RRA. First, projecting the actual changes that the District will experience includes a great deal of uncertainty. In addition, each of the projection scenarios results in unique conditions and hazards. CREAT allows a user to assume either a near-term (2035) or longer-term (2060) timeframe for each assessment. For the District, the longer-term timeframe was selected. All analyses are completed for 2060. Figure 12-3 is the CREAT climate awareness output for the Novato service area for 2060.

What if the climate were significantly hotter?	**3.85°F** increase in average annual temperature and **6 days** over 100 °F per year by 2060
• Adjust treatment processes to warmer waters and altered water quality • Utility crews and equipment stressed during hot days	• Increased demand during hot days exceeding supply leads to outages and public health risks • Larger wildfires and damage to infrastructure and water resources under hotter conditions
What if the climate were significantly wetter?	**20.2%** change in annual precipitation and **27.44%** increase in 100-year storm by 2060
• Strained reservoirs, overwhelmed treatment and flooded facilities during sustained and intense storm events • Adjust treatment processes to lesser quality inflow due to soil erosion and contaminants from overland flows	• Flooded streets and basements throughout the community following heavy precipitation events • Health risk from Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs)
What if the climate were significantly drier?	**-3.82%** change in annual precipitation by 2060
• Revenue loss from reduced usage during voluntary or mandatory conservation actions in response to drought • Operational changes to increase efficiency, conserve and access alternate supplies during intense drought	• Disrupted historical storage cycles in aquifers, reservoirs and snowpack • Larger wildfires and damage to infrastructure and water resources under hotter conditions
How will rising sea level affect our community?	**9.92 to 31.18 inches** higher sea level by 2060
• Frequent flooding during storms due to higher sea level increasing storm surges • Coastal aquifers more vulnerable to saline intrusion with higher sea level	• Property damage and street flooding across coastal communities • Relocation of outfalls and facilities to accommodate moving shoreline

Figure 12-3. Novato Service Area CREAT Output (2060)

Based on the HMP, CREAT, and discussions within the workshops, six climate related hazards – floods, drought, ecosystem changes (includes water quality changes and vegetation changes), wildfire, extreme heat, and electrical service – were selected for evaluation. These hazards were applied to the relevant critical facilities and/or staff, as appropriate for further assessment. The risks associated with each climate TAP were evaluated qualitatively by assessing the potential change in impact of the hazard on the asset in 2060 compared to 2025. The change of each variable in the risk equation (consequence [C], vulnerability [V], and threat likelihood [T]) was assessed for the climate TAPs and summarized to increase, decrease, or remain similar (neutral) based on potential climate change impacts. Table 12-5 summarizes the expected 2060 Risk compared to 2025 Risk based on potential climate change impacts.

Table 12-5. Projected Risk Due to Climate Change Impacts

Threat-Asset Pairs	Consequences	Vulnerability	Threat Likelihood	2060 Risk Compared to 2025
2060 – Ecosystem Changes – Source Water	Neutral	Neutral	Increase	Neutral
2060 – Drought – Source Water	Increase	Increase	Increase	Increase
2060 – Flood – Facilities	Increase	Neutral	Increase	Increase
2060 – Wildfire – Facilities	Increase	Neutral	Increase	Increase
2060 – Extreme Heat – Facilities and Equipment	Increase	Decrease	Increase	Increase
2060 – Extreme Heat – Staff	Increase	Decrease	Increase	Increase
2060 – Electrical Service – Facilities	Neutral	Neutral	Increase	Neutral

12.8.2 Resilience Analysis

As stated earlier in the chapter, resilience is defined as the ability of a utility or an asset to adapt to or withstand the effects of a threat or hazard without interruption to the asset's or system's function, or, if the function is interrupted, to rapidly return to a normal operating condition.

12.8.2.1 Utility Risk Index

The URI is a system-level assessment of a utility's ability to absorb and/or cope with an incident and return to normal operations as quickly as possible. The URI allows users to quickly develop a snapshot of a utility's resilience. The URI is comprised of two subparts: Operational Resilience Index (ORI) and Financial Resilience Index (FRI). The URI establishes a weighted score, based on predetermined weighting established in AWWA's J100 standard, for a list of indicators, the sum of which reflects the performance level or utility/community condition. The sub-index numbers are summed separately to give ORI and FRI values and then summed together to yield a total URI score. The maximum URI value that a utility can achieve is 100, which would represent a completely resilient utility. Table 12-6 presents the ORI and FRI values and overall URI score.

12.8.2.1.1 Operational Resilience Index

The ORI reflects the tactical capacity of a utility to react quickly to and cope with various incidents that have the potential to disrupt operations. This index is based on a set of weighted indicators that reflect a utility's organizational preparedness and capabilities to respond and restore critical functions/services following an incident. ORI indicators include:

- Emergency Response Plan
- National Incident Management System (NIMS) Compliance
- Mutual Aid and Assistance
- Emergency Power for Critical operations
- Ability to Meet Minimum Daily Water Demand

- Critical Parts and Equipment
- Critical Staff Resilience

12.8.2.1.2 Financial Resilience Index

The FRI reflects the fiscal capacity of the utility and supporting community to react quickly and/or cope with various incidents that have the potential to disrupt operations. This index is based on a series of weighted indicators that reflect a utility's financial preparedness and capabilities to respond and restore critical functions and services following an incident. Indicators of FRI include:

- Business Continuity Plan (BCP)
- Utility Bond Rating
- Government Accounting Standards Board (GASB) Assessment
- Median Household Income
- Unemployment

12.8.2.1.3 Utility Resilience Index Summary

The utility profile rating (ratings range from 0, meaning least developed in that index – to 1.0, meaning very developed in that index) assigned to each indicator is multiplied by the respective weighting factor to result in a numeric score. The sub-index numbers (ORI and FRI) are summed separately and then summed together to yield a URI score. The District's URI score is 57.8 percent. Table 12-6 summarizes the components of the URI by indicator. Note that two of the financial indicators (household income, unemployment) are not within the District's control.
The URI score of 57.8 percent indicates that the District's resilience is moderate. In addition, the District plans to incorporate ICS (700/800) training for key staff as part of its ongoing employee development program. The District will continue documenting standard operating procedures and providing cross-training opportunities to increase critical staff resilience.

Table 12-6. Utility Resilience Index Summary

Utility Resilience Indicators	Utility Profile Rating (0 to 1)	Predetermined Weighting Factor	Weighted Score, percent
Operational Resilience Index			
O1: Emergency Response Plan Staff trained on ERP	0.5	0.1389	6.9
O2: NIMS Compliance ICS 100/200 provided to key staff	0.25	0.1561	3.9
O3: Mutual Aid and Assistance Mutual Aid/ Intrastate (e.g., Water/Agency Response Network [WARN])	0.75	0.1868	14.0
O4: Emergency Power for Critical Operations Greater than or equal to 73 hours	1.0	0.0595	6.0
O5: Ability to Meet Minimum Daily Water Demand ≥73 hrs	1.0	0.0966	9.7
O6: Critical Parts and Equipment 1-2 weeks	0.25	0.0878	2.2
O7: Critical Staff Resilience 26-50%	0.50	0.0605	3.0
ORI Subtotal	**-**		**45.7%**
Financial Resilience Index			
F1: Business Continuity Plan No BCP	0.0	0.0463	0.0
F2: Utility Bond Rating AA	0.75	0.0640	4.8
F3: GASB Assessment 41–60 % assessed	0.50	0.0176	0.9
F4: Unemployment <2–4 % National Average	0.75	0.0460	3.5
F5: Median Household Income >5–10 % State Median	0.75	0.0400	3.0
FRI Subtotal	**-**		**12.1%**
URI Total	**-**		**57.8%**

12.8.2.2 Climate Resilience Maturity Model Analysis

The CRMM was used to evaluate the District's capacity to manage climate change-related risks. Adaptive capacity is a critical pillar of the CRMM, reflecting a utility's ability to adjust operations, infrastructure, and planning in response to climate variability and long-term change. As a utility matures from basic awareness of climate risks to fully integrated resilience strategies, its adaptive capacity grows from isolated, short-term fixes to coordinated, forward-looking approaches.

During the workshops, staff were asked questions to ascertain their ranking in each of the six categories. Each category was rated on a scale of 0-3, where "no discernable process" is a 0 and "efficient" is a 3. Table 12-7 summarizes the District's CRMM results.

Table 12-7. Climate Resilience Maturity Model Results

Category	Rating	Reason
Governance – Executive Level Engagement and Leadership	2	The District has an ad-hoc drought risk committee and recognizes the need to have a climate resilience lead to oversee plans and actions to mitigate climate change-related risks.
Climate-Aware Planning	2	The District has been actively integrating climate resilience and adaptation measures into planning efforts and new designs, such as designing the new Lynwood Pump Station above the 500-year floodplain.
Stakeholder and Community Collaboration	2	The District regularly collaborates on climate-sensitive matters. For example, during the recent call for curtailments, NMWD collaborated with large water users regarding water conservation. The District has a robust website to communicate with the community.
Resilience Adaptation Actions	2	The District is actively working on a Regional Drought Contingency Plan and will be available to collaborate with regional Sea Level Rise coordination.
Customer Engagement and Coordination	2	The District has established mechanisms for regular community engagement by soliciting public input from local businesses and City of Novato departments such as the Fire Department. NMWD also integrates community perspective into planning and decision-making processes.
Attention to Equity	1	The District has identified vulnerable communities and recognizes the importance of equity in climate resilience, but has not yet developed or executed detailed plans to address the needs of marginalized or underserved populations

12.9 RISK AND RESILIENCE MANAGEMENT

Risk management is the deliberate, cyclical process of executing a risk analysis and then implementing actions to reduce risk. This is done, for example, by establishing or improving consequence mitigation tactics, building-in redundancy, entering into mutual aid pacts, creating emergency response plans, and training and exercising emergency response capabilities.

12.9.1 Risk and Resilience Management Strategies

The District has taken a proactive approach to risk mitigation and emergency management through previous capital projects, operational efforts, and training and exercises. The District's strategy in continuing to prepare for hazards is to consider resilience at all levels of decision making and planning for the water system. This approach will allow the District to better anticipate, absorb, and recover from a wide range of disruptions, including climate change impacts, natural disasters, and infrastructure failures. By embedding flexibility, redundancy, and adaptability into system design and operations, resilience-based planning supports more effective responses to uncertainty and change.

Based on current staff knowledge and facility information, the District's next resilience capital investments should focus on the highest-risk projects listed in Table 12-4. These include addressing seismic resilience at the Stafford Dam and Treatment Plant, Lynwood Pump Station (actively being replaced), San Marin Pump Station, and North Marin Aqueduct. These high-priority backbone facilities may need seismic upgrades to specific equipment, structures, and mechanical infrastructure that can be identified in more detailed seismic evaluations of each facility. Distribution pipelines that deliver water from the supply sources to critical customers should also be included in the District's resilience strategy; specific pipeline projects can be identified and prioritized by completing a pipeline seismic assessment.

Additionally, the District developed Risk and Resilience Management Strategies (RRMS) to further enhance its ability to mitigate risk and strengthen resilience against natural hazards. These RRMS projects are summarized in Appendix 4E. These RRMS projects will be prioritized and included for future operational planning considerations.

The District will consider the following:

- At the time for any tank or pump station upgrades or replacements, AWWA seismic guidelines will be required.
- Continued development of staff succession planning, including passthrough of institutional knowledge and critical system weak points, and National Incident Management System (NIMS) Incident Command System (ICS) training and certifications.
- Continued vegetation management at critical facilities.

12.10 REFERENCES

This section lists the voluntary consensus standards, regional and national best practice standards, and District-specific documents and assessments utilized in this chapter.

American Water Works Association, and American National Standards Institute. May 2021. ANSI/AWWA J100 21 Risk and Resilience Management of Water and Wastewater Systems.

Morley, Kevin. August 2019. What Makes a Utility Resilient? AWWA Opflow Publication, Vol.45, Issue 8, August 2019.

United States EPA. May 2016. Climate Resilience Evaluation and Awareness Tool (CREAT) Version 3.0 Methodology Guide.

Environmental Defense Fund. "Climate Resilience Maturity Model." *Environmental Defense Fund*, 2025, https://www.edf.org/climate-resilience-maturity-model.

Marin County. 2023. Marin County Operational Area Multi-Jurisdictional Hazard Mitigation Plan

SECTION 13

Capital Improvement Program

SECTION 13
Capital Improvement Program

This section presents the capital improvement program (CIP) developed to address the various deficiencies and new development demands identified in earlier sections. The section highlights prioritization to address overall risks that could negatively affect the District's ability to reliable deliver safe and clean drinking water.

13.1 INTRODUCTION

Section 13 presents the methodology used to create the CIP that allows the District to continue to provide safe and reliable service to the Novato customers while addressing the needs identified in earlier sections of this Master Plan. The approach to developing potential project costs is also presented in this section. To properly plan the potential improvements, the overall risk of failure of the existing infrastructure is identified including prioritization to balance annual budget while continuing to meet level of service goals established in the Section 11. The projects are first grouped into categories of similar improvement types and then the capital improvement program is developed based on previously identified vulnerabilities, deficiencies, and/or operational enhancements as shown in Figure 13-1 below.

Figure 13-1. Capital Improvement Program Development Approach

13.2 PROJECT DEVELOPMENT AND ESTIMATES

13.2.1 Project Categories

To coordinate with the District annual budgeting process, the projects are grouped in previously defined categories based on the improvement type. The budget category does not designate a particular priority for any individual project. The project categories are:

- *Category 1 Pipeline Improvements and Pipeline Replacements:* Pipeline replacement projects and additional pipelines needed.
- *Category 2 Storage Tanks & Pump Stations:* Projects that are related to the storage tanks and pump station facilities.
- *Category 3 Stafford Improvements:* Projects to improve the overall operations and implement critical maintenance improvements for STP, Stafford Reservoir, and Stafford Dam.
- *Category 4 Miscellaneous Improvements:* Projects or improvements to the system not otherwise captured in previous categories and can include but not necessarily limited to facilities, valves and other distribution system appurtenances, and cathodic protection.
- *Category 5 Recycled Water Improvements:* Projects and improvements to help maintain, extend, and operate the recycled water system.

The District budget does include other project categories that are related to Novato Water System components discussed throughout this Master Plan but were not specifically evaluated as part of this Master Plan. The other project categories include:

- Building and Yard
- Water Conservation
- Liability/Safety Modifications
- Studies and Special Projects

This Master Plan update focuses on the pipeline improvements, storage tanks and pump stations, and miscellaneous improvements based on the Novato Water System evaluations described in earlier sections. The FY 25/26 budget does include Stafford Improvements projects, Recycled Water Improvement projects and Studies and Special projects related to the Novato Water System and those projects are included in the CIP presented at the end of this section.

13.2.2 Project Cost Estimates

Project cost estimates were developed for each capital improvement project. Given the limited information available for each of the potential capital improvement projects, initial project cost estimates were developed using the following categories:

- Baseline construction cost – a conceptual-level estimate of probable construction cost;
- Contingency – added to the construction cost to cover unknowns;
- Design/Construction Management/Administration/Permitting – non-construction related costs necessary to successfully deliver each project;

Each category including cost estimating criteria is further discussed in the following paragraphs.

13.2.2.1 Baseline Construction Costs

Construction costs for new facilities are based on cost curves, engineering judgment, recent bid prices, historical trends, and recent District experience. All Opinions of Probable Project Cost (OPPC) were developed in accordance with American Association of Cost Engineers (AACE) guidance for Class 5 estimates and have a range of accuracy of +50%/-30%.

The line items and unit construction costs are based on normal construction conditions such working during normal business hours, within accessible areas, and other standard conditions that are routinely encountered by District or outside construction contractor work forces. Unusual construction conditions such as but not limited to night work, challenging excavation/subsurface conditions, and specialty construction trades must be addressed individually on a project-by-project basis. Contractor overhead and profit costs are included in the baseline construction costs.

13.2.2.2 Category 1 Pipeline Improvements and Pipeline Replacements

Unit prices for various pipe diameters constructed in pavement and in non-paved areas were developed using both historical District cost data and public bid results. The estimated pipeline unit cost includes pipe material, trenching (at minimum cover of approximately three feet below ground surface), installation of the pipe, fittings, appurtenances, service connections, backfill, pavement restoration (as applicable), traffic control and testing. Pipeline costs are for PVC C-900

(Class DR14) pipelines up to 16 inches in diameter and steel for pipelines 18-inch and greater. Table 13-1 lists unit construction costs utilized in this Master Plan update.

Table 13-1: Pipeline Unit Prices (shown in 2025 dollars)

Pipe Diameter	PVC Pipe Unit Cost ($/lf)		Steel Pipe Unit Cost ($/lf)	
	In Paved[1] Road	In Unpaved Road	Paved Road	Unpaved Road
6	250	225	-	-
8	350	325	-	-
12	500	475	-	-
16	675	650	-	-
18	-	-	750	725
24	-	-	1000	950
30	-	-	1250	1150

1 Unit cost for paved roads can increase by $15 to $20 per foot due to increased paving requirements by the City of Novato and Marin County. Application is on a case-by-case basis.

13.2.2.3 Category 2: Storage Tanks

Steel water storage tank construction is specialty work and it can be challenging to easily develop project estimates with cost curves and unit prices. It is possible to determine the tank structure cost with unit prices using professional experience and costs from similar projects. However, site limitations, excavation cost, access road cost, and other site-specific conditions vary between sites. Storage tank construction cost estimates have been developed utilizing recent bid prices and conceptual level site-specific estimates of non-structure costs there will be potential risks for cost modifications once a specific project initiates the conceptual design phase.

Unit pricing was developed for specific work activities such structural retrofit, coating replacement, and seismic improvements were developed and are shown in Table 13-2. Without a site specific condition assessment, potential work activities are limited to retrofit of the existing storage tank. Full replacement of any storage tank is not considered for this Master Plan.

Table 13-2: Storage Tank Unit Prices (shown in 2025 dollars)

Work Item	Unit	Unit Price	Description
Tank Rehabilitation	Gal	$0.70	Structural modifications include roof raising or reinforcing. Includes new liner and cathodic protection.
Seismic Upgrades	Ea	$500,000	Includes seismic tie down and mechanical pipe connections improvements.

13.2.2.4 Category 2: Pump Stations

Pump stations and pumping capacity modifications are unique in nature and conceptual-level cost estimates were developed based using professional experience and costs from similar projects.

Unit pricing developed for specific work activities such structural retrofit, coating replacement, and seismic improvements were developed and are shown in Table 13-3. Without a site specific condition assessment, potential work activities are limited to retrofit of the existing storage tank.

Table 13-3: Pump Station Unit Prices (shown in 2025 dollars)

Work Item	Unit	Unit Price	Description
Pumps less than 100 GPM	GPM	$20,500	Based on the flow from pumps at less than or at 100 GPM.
Pumps between 100 – 500 GPM	GPM	$11,500	Based on the flow from pumps at less than or at 500 GPM but greater than 100 GPM.
Pumps greater than 500 GPM	GPM	$2,250	Based on the flow from pumps at greater than 500 GPM.

13.2.2.5 Category 3: Stafford Improvements

Evaluation of STP, Stafford Reservoir, and Stafford Dam is outside of the scope of this Master Plan update. However, as the District continues to operate the Stafford facilities, any improvements identified to facilitate ongoing safe and reliable operation will require development of project estimates using similar methodologies as described in this section. Like Category 2 Storage Tanks & Pump station, the potential improvements will be unique in nature requiring costs to be developed on a project-by-project basis.

13.2.2.6 Category 4: Miscellaneous Improvements

Miscellaneous improvements include a range of potential improvements and conceptual-level cost estimates will be provided on a project-by-project basis.

13.2.2.7 Category 5: Recycled Water Improvements

Evaluation of potential recycled water improvements is outside of the scope of this Master Plan as expansion of the recycled water system is not anticipated. If a potential new recycled water user would request expansion of the recycled water system, the new user would be responsible for all project costs. However, the District will continue to operate the existing recycled water system and, like Category 1, pipeline replacement due to infrastructure age will be required in the future. Any potential recycled water improvements will primarily be pipeline related improvements. All estimates will use similar unit pricing as presented in Table 13-1 as pipeline project costs for potable water and recycled water are similar.

13.2.3 Construction Contingency

Since site-specific conditions are unknown for projects in the early planning stages, a 30 percent construction contingency will be added to each project baseline construction cost to account for unforeseen events and unknown conditions.

13.2.4 Non-construction Costs

To capture the total potential project costs, allowances for administration, permitting inclusive of California Environmental Quality Act compliance assuming all impacts can be mitigated, engineering, and construction management are incorporated into all project estimates. Based on experience with similar projects and in alignment with industry standards, a cost equal to 30% of the sum of the baseline construction cost including the construction contingency is applied to the cost estimates for both in-house and contracted design projects.

Costs for right-of-way easements and land acquisition are not included in the estimates. Generally, the District performs improvement projects within existing District owned lands, District easements, and public rights-of-way. However, during initial project planning and preliminary engineering, potential land acquisition requirements would be identified to inform updated project estimates.

13.3 DISTRIBUTION SYSTEM RISK MANAGEMENT

As noted earlier, the District's budgeting approach groups projects together by improvement type such as pipelines, pump stations, and storage tanks. Each infrastructure improvement type's risk exposure was evaluated as part of Section 11 to identify the potential deficiencies and impacts that may be experienced without a comprehensive infrastructure renewal program. One of the key outcomes from Section 11 was the need for the District to expand the existing pipeline renewal and replacement program. The pumping and storage components are also critical infrastructure assets evaluated in Section 11 but the pipeline components are the largest cumulative improvement type that will have the largest impact on the overall annual CIP budget.

13.3.1 Pipeline Material and Age

A significant portion of the Novato Water System was constructed in the 1950s and 1960s. The existing distribution system is a mix of asbestos cement pipe (ACP) (59%), cast iron pipe (CI) (5%), polyvinyl chloride (PVC) pipe (23%), and steel pipe (13%). Both the age and pipe material can impact the overall life of the pipeline segment but creating a renewal and replacement program simply based on pipe age and/or material does not adequately capture the overall performance of the District's distribution system.

As noted in Section 11.6.1.1.2, ASCE recommends that a water utility plan for replacing 1% of its water distribution pipelines annually to maintain a 100-year life cycle. As significant portions of the Novato Water System have been in service for over 70-years, the District can develop a risk based approach for its pipeline renewal and replacement program to meet the immediate needs to create a sustainable CIP while providing the necessary foundation for the next 100 years. The CIP does not only need to consider pipeline material mortality as identified by manufacturers and studies, but also the actual performance that the District has observed in its own distribution system. Creating a pipeline renewal and replacement program that begins with considering pipeline segment age and then overlaying performance data will allow the District to implement a CIP that meets a cost effective approach by assuring pipeline assets are not replaced prematurely.

13.3.2 Pipeline Performance

The District has tracked the number of annual leak repairs including, when possible, documenting the cause of the leak. Leaks provide a key indicator about the operational performance of the Novato Water System to better understand whether there may be a significant risk of failure of portions of the distribution system. First, the available leak information was plotted on Figure 13-2 to evaluate the number of leaks by the year a pipeline was installed. The leak data indicates that most of the leaks within the Novato Water System occurred for portions of the system installed prior to 1985 with the largest number of leaks occurring for portions of the system installed in the 1960s. The leak data based on pipeline age reinforces that the District should expect that the older portions of the system will likely begin experiencing operation and maintenance issues but that does not necessarily mean that the District's pipeline renewal and replacement program should simply begin with the older pipeline segments.

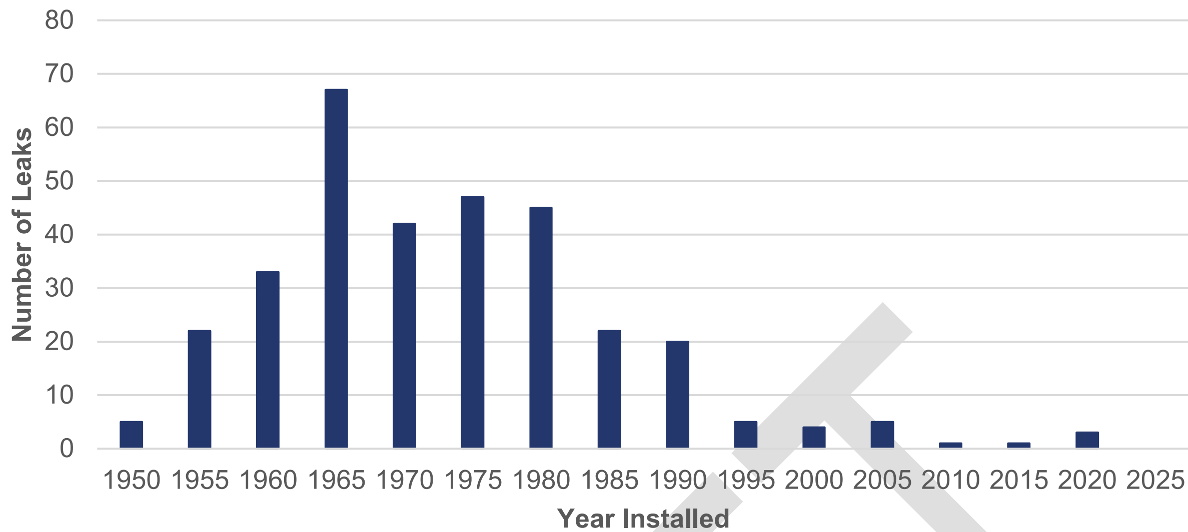


Figure 13-2: Number of Leaks By Year Installed

The District also tracks the total number of leaks per mile of pipe by pipe material and year installed. The following figures present the leak data for the four most common pipe materials for pipelines larger than 2-inches in diameter.

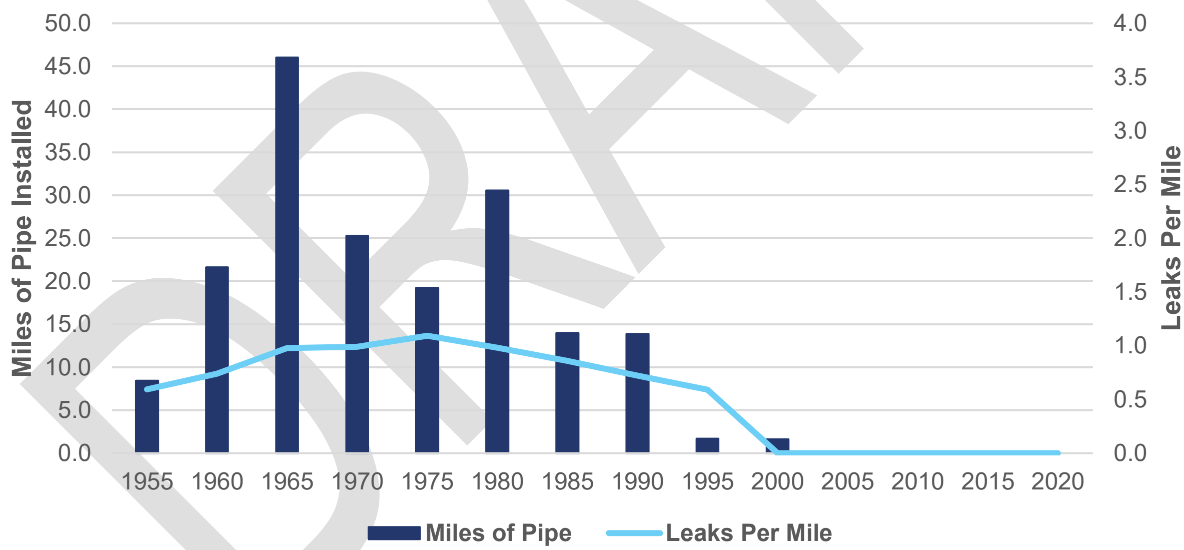


Figure 13-3: Leaks per Mile for ACP

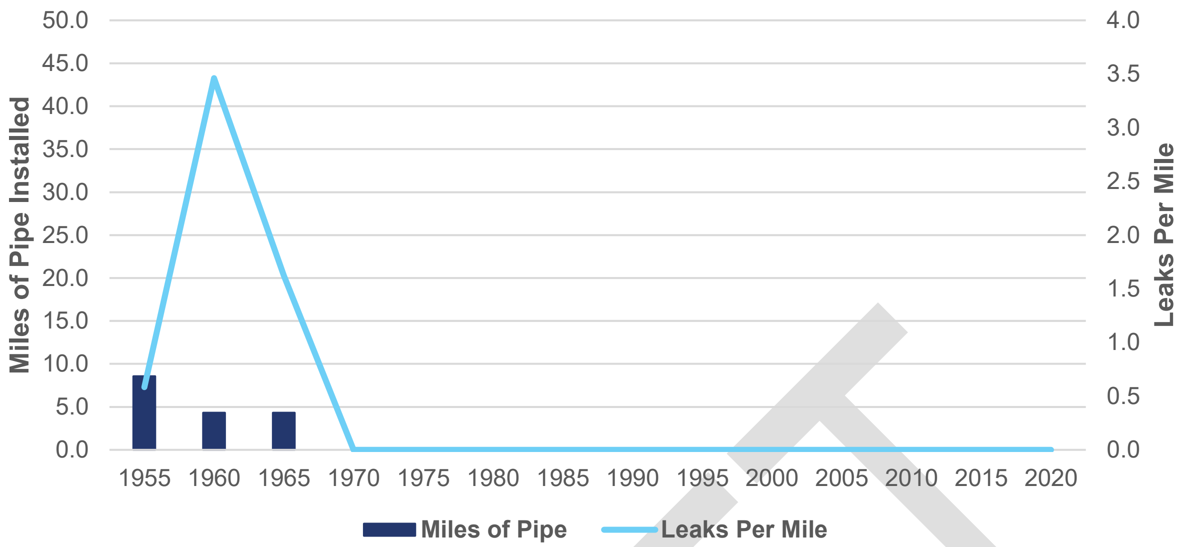


Figure 13-4: Leaks per Mile for CI

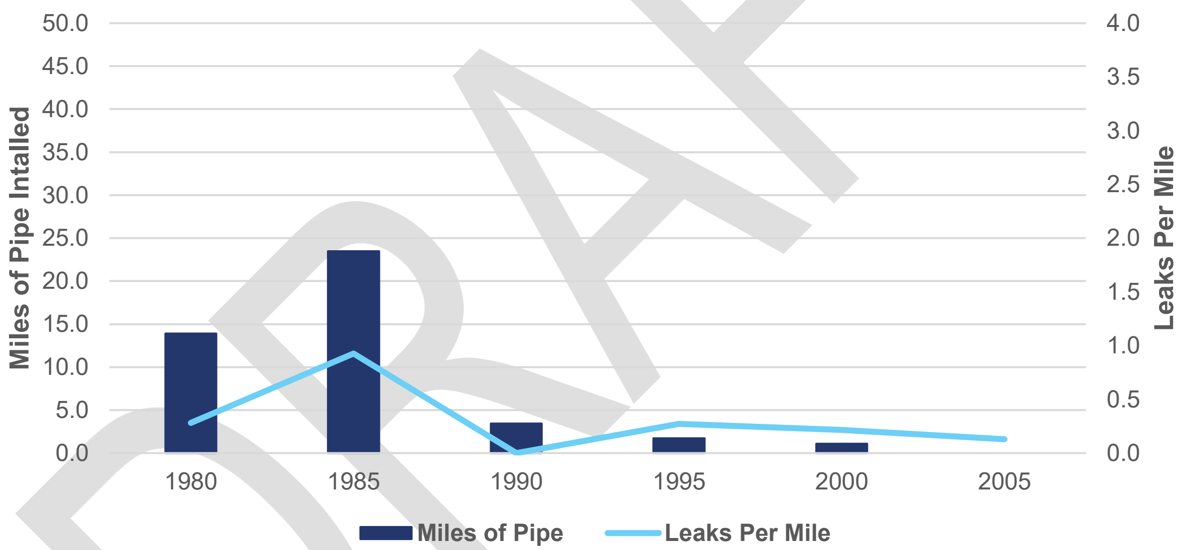


Figure 13-5: Leaks per Mile for PVC

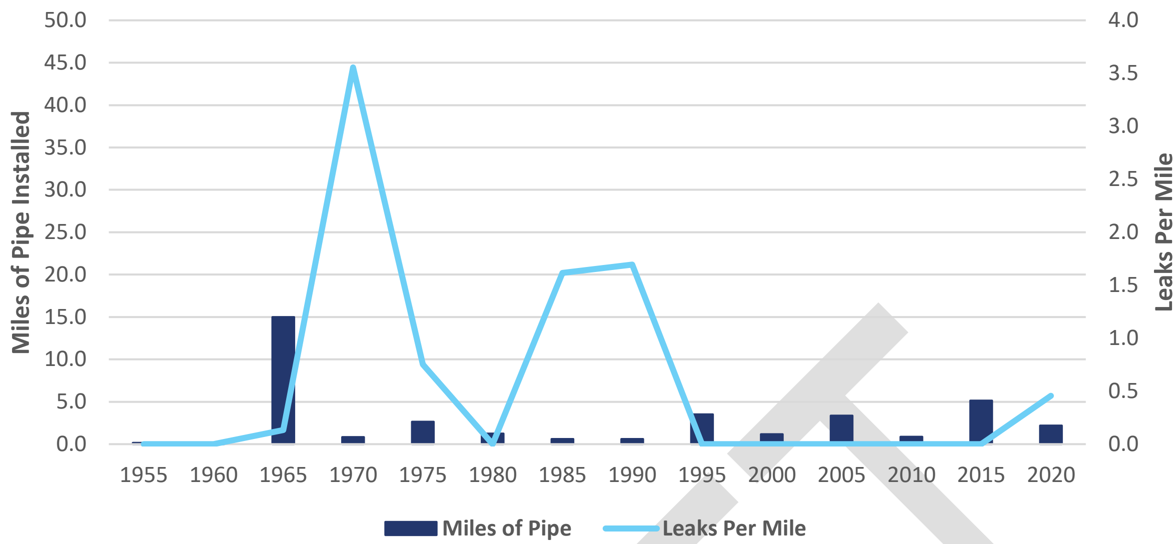


Figure 13-6: Leaks per Mile for Steel

The leak data shows that, although ACP is the most widely used pipe material in the Novato Water System, the number of leaks per mile is lower than both CIP and steel. PVC is the second most installed pipe material within the Novato Water System and the leak rate is similar to CI. What can be seen in Figure 13-4 for CI and Figure 13-6 for Steel is that there appears to be specific eras of pipe that are underperforming (e.g., the leak rate per mile is significantly higher). The District will continue to monitor those underperforming segments and consider focused projects as part of the CIP to address the worst performing portions of the distribution system with CI and/or Steel.

The leak data should also be evaluated considering the external factors that may contribute to areas within the distribution system or specific pipe materials that appear to have increased maintenance issues. The District also documents what caused the leak but that data is less conclusive. Sometimes the actual pipe manufacturing process of a certain era can contribute to increase leak rates or the construction methodology at the time of installation was poor. Determining the cause of the leak cannot always be easily determined because the field conditions may not allow District staff to accurately confirm whether the leak was due to material failure or another factor. The District has confirmed that of the documented 248 leaks that 37 of the leaks were caused by either an external hazard (e.g., contractor breaking pipe) or natural hazard (e.g., landslide). Another 18 leaks were likely the result of poor construction methods during original installation. The cause for the remaining 193 document leaks could not be determined.

13.3.3 Conclusion

Overall, the Novato Water System pipelines are performing as would be expected for a similar water utility with similar pipeline age and materials. The District's data does not indicate that ACP and PVC pipeline segments that represent most of the distribution system are at elevated risk of failure. The leak data for both CI and Steel indicate that there may be portions of the distribution system that are underperforming and the District will continue to monitor those areas to inform future CIPs. However, as recommended in Section 11, the District's pipeline renewal and replacement program does need to expanded over existing funding levels as a significant portions of the Novato Water System is now over 70 years old. The CIP should include increasing annual budget to allow the District to create balanced investment in its pipelines while recognizing the criticality of other system components and establishing a long-term pipeline renewal strategy.

13.4 PROJECT PRIORITIZATION

The proposed CIP should integrate a prioritization approach that balances addressing system deficiencies, asset risk and resiliency, and long-term renewal strategies to determine the planned implementation schedule for the projects identified in the following sections. The planned implementation schedule also recognizes budget and staff capacity constraints do affect the total number of projects that can be completed on an annual basis.

Table 13-4 presents the prioritization methodology used to develop the proposed CIP presented at the end of this section.

Table 13-4: Project Prioritization

Priority	Description	Comments
1	High Risk Pipelines (Appendix 3)	Begin replacing High Risk Pipeline segments as soon as budget is available and complete over five year timeline.
1	High Risk Pump Stations (Appendix 3)	Following completion of Lynwood Pump Station (Project 2b1), replace one High Risk Pump Station at a time until all High Risk Pump Stations replaced.
2	Medium Risk Pipelines (Table 11-10)	Following completion of High Pipeline Risk segment replacement or as budget is available, replace 1.25 miles of pipelines on an annual average basis over five years in accordance with Section 11 recommendations with total miles of pipe replaced increasing as additional funding may become available.
2	Medium Risk Pump Stations (Appendix 3)	Following completion of High Pump Station Risk replacements and alternating years with Medium Risk Storage Tanks, continue to replace one pump station at a time until all Medium Risk Pump Stations completed.
3	Medium Risk Storage Tanks (Appendix 3)	As budget is available and on alternating years with Medium Risk Pump Stations, complete one Medium Risk Storage Tank improvement project until all Medium Risk Storage Tanks completed.
4	Pipeline Redundancy and Looping	As budget is available based on Priority 1, complete one pipeline redundancy/looping improvement identified in Section 9 per year

13.5 CAPITAL IMPROVEMENT PROJECTS

The following sections present the identified capital improvement projects organized by project category. For each project category, individual project information summaries for projects identified to be implemented within the next five fiscal years of the completion of this Master Plan have been developed including a brief project need description, location map, and OPCC.

13.5.1 Category 1 Pipeline Improvements and Pipeline Replacements

Pipeline improvements have been identified through several evaluations performed as part of this Master Plan. The pipeline projects have been further grouped based on the following subcategories:

- Subcategory "a" projects are those pipeline improvements to improve operational resiliency within the distribution system such as providing new looped connections to improve water quality and enhance available flow or pressure to meet peak demands, replacing critical crossings, and implement an annual pipeline replacement program to replacing aging distribution pipelines.
- Subcategory "b" projects are those pipeline replacement projects primarily identified through asset management due to pipe age, pipe condition, and natural hazards risks.
- Subcategory "c" projects are for improvements specific to the Aqueduct pipeline that conveys water from SCWA to the District.
- Subcategory "d" projects are not specifically programmed projects but rather an annual budget to allow the District to coordinate with both City and County paving projects as well as replace aging polybutylene service lines on an as needed.

Summary level project information for each subcategory is presented in the following sections.

13.5.1.1 Category 1a Improvements

All projects presented in Appendix 5A that have a CIP Project NO. that begins with "1a" are projects to address pipeline deficiencies identified in earlier sections. Specifically, the projects identified in Section 11 as "High Risk" pipeline segments recommended to be completed over a five year period are included in this category. If a Category 1a project is anticipated to be completed after Fiscal Year 2030, a specific project description has not been created but the total budget to complete the implementation strategy based on the project prioritization presented in Table 13-4.

Included in the Category 1a projects are the Pipeline Redundancy and Loop projects. As those projects are currently considered to be the lowest priority, the projects identified in Section 9 are not anticipated to be completed until the end of the CIP planning period.

13.5.1.2 Category 1b Improvements

The Category 1b projects are to address pipeline asset management guidelines identified in earlier sections primarily related to pipeline age and condition. Specifically, the Category 1b projects are considered "Renewal and Replacement" projects to eventually replace 1.25 miles of pipelines based on an annual average basis calculated every five years. Based on the project prioritization, the Category 1b projects will begin to be implemented once most of the Category 1a projects are completed.

13.5.1.3 Category 1c Improvements

There are no specific Category 1c improvements identified in this Master Plan. However, the North Marin Aqueduct is a critical backbone infrastructure as noted in Section 11 and is at an elevated risk of damage due to Earthquake/Liquefaction threat as noted in Table 12-4. The District will continue to monitor operational performance of the aqueduct pipeline and may consider performing a future Pipeline Seismic Analysis as suggested in Section 12 (refer to Appendix 4E;

Planning and Studies Item 1) to determine if any future seismic improvements may be required for the North Marin Aqueduct.

13.5.1.4 Category 1d Improvements

All projects presented in Appendix 5A that have a CIP Project NO. that begins with “1d” are annual budget allowances to allow the District to implement projects on a yearly basis that are not otherwise driven by pipeline age, material, criticality, or other factors described above. The Fiscal Year 2026 budget includes Category 1d2 for Pipeline Resiliency Improvements to be identified in this Master Plan and those improvements are incorporated into future Category 1b described above. Future District budgets will likely remove Category 1d2.

13.5.2 Category 2 Storage Tanks & Pump Stations

Storage Tank and Pump Station improvement projects have been primarily identified through the asset management evaluation presented in Section 11. The project improvements have been grouped based on the following subcategories:

- Subcategory “a” projects are storage tank related projects including structural repairs, coatings, and expansion projects.
- Subcategory “b” projects are pump station projects primarily focused on replacement to address deficiencies such as redundancy, capacity deficiency, or age.

To balance CIP expenditures, the District will allocate portion of the available CIP budget to one pump station and one tank basis on an alternating basis. The alternating basis means that the District will first implement the highest priority pump station, Cherry Hills Pump Station (Project 2b5), as budget is available and once the pump station project is nearing completion than the District will select a storage tank related project. The alternating approach will allow the District to continue to improve critical components without pushing improvements to far out into the future thereby potentially elevating the risk to the District of failure of either a pump station or storage tank.

The Category 2b projects identified in this Master Plan are not inclusive of all District pump station and hydropneumatic system facilities. In future Master Plan updates as projects are completed, future pump station and hydropneumatics system facilities projects like those presented in Appendix 5C will continue to be integrated into long-term planning efforts.

A key conclusion from this Master Plan is that most hydropneumatic systems were determined to be Medium to Low Risk from an Asset Management perspective as shown in Appendix 4 primarily because each hydropneumatic system serves a small number of customers. Previous studies determined that all hydropneumatic systems are at the end of the useful life and the District anticipates that long-term operational costs for ongoing maintenance of those hydropneumatic systems to continue to increase until such time that the systems are replaced.

13.5.3 Category 3 Stafford Improvements

As noted above, evaluation of STP, Stafford Reservoir, and Stafford Dam is outside of the scope of this Master Plan update. The capital improvement program presented in Section 14 carries forward Category 3 improvements included in the Fiscal Year 2026 budget.

13.5.4 Category 4 Miscellaneous Improvements

The CIP carries forward Category 4 improvements included in the Fiscal Year 2026 budget.

13.5.5 Category 5 Recycled Water Improvements

The CIP carries forward Category 5 improvements included in the Fiscal Year 2026 budget.

13.6 CAPITAL IMPROVEMENT PROGRAM

To develop the Novato Water System CIP, the funding level should be established before beginning to create an implementation schedule based on the project priorities presented in Table 13-4. As discussed in Section 13.3, the distribution system is the largest asset group and does have an outsized influence on how available funds are prioritized. This section first evaluates potential funding strategies before presenting the proposed CIP.

13.6.1 Budget Strategy

Currently, the District includes on average $4 million in its annual budget for the CIP. The annual CIP budget has been increased over the last several years but this Master Plan has documented that the District is entering a new phase of infrastructure needs. Significant portions of the Novato Water System pipelines are over 70 years old and the District's pump stations are the next most critical infrastructure component. Beginning to increase annual budgets soon will be critical to allow the District to meet the level of service goals established in Table 11-1 and create the roadmap into the future to allow the District to continue to provide safe and reliable potable water.

Budget strategies considered as part of this Master Plan all include budget levels greater than the current average $4 million per year annual investment. The District should consider beginning to increase its annual CIP budget to address the deficiencies identified throughout this Master Plan and increase the overall resiliency of the Novato Water System. The selected budget level must also consider an appropriate level to mitigate risks while recognizing that the District may have staffing and resource limitations.

The potential budget strategies considered in this Master Plan include:

- Option A: $15 million per year, which would have the goal to replace all components based on material mortality rates presented in Table 11-2, allowing the District to maximize its annual CIP investment.
- Option B: $10 million per year, which would allow the District to focus replacement of key pumping and storage components while increasing the total miles of pipeline renewal and replacement program.
- Option C: $7 million per year, which would allow the District to increase its investment in asset renewal and replacement by selecting projects based on documented risks identified by District.

Each of the budget options described above would have varying annual needs. As shown in Figure 13-7, the annual budget for each option will vary, requiring the District to potentially vary the available funding. Increasing budget levels to achieve Option A would not be required in perpetuity but would result in fluctuations in budget level over time. While Option C would allow the District to establish a known annual investment, reducing the variability into the future.

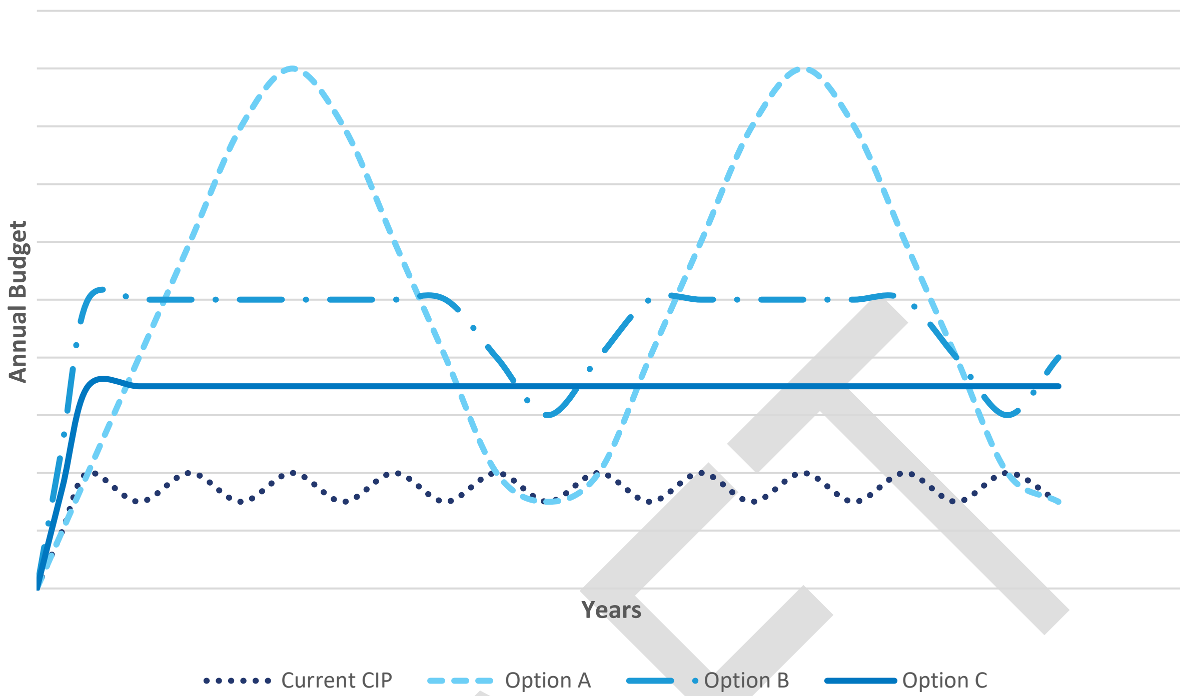


Figure 13-7: CIP Funding Options

Option A budget levels would allow the District to limit the number of assets that exceed recommended age but would require a significant increase in budget levels as well as investment in internal resources to allow the District to effectively utilize the increased annual budget. Two challenges with Option A are:

1) An increase in District resources would be required to successfully implement the CIP. With the variation in funding levels every 10 years to 15 years, the District would need to develop a parallel resource strategy to implement the CIP.

2) Once most of the facilities are replaced that were installed in the 1950's and 1960's, budget and resources would have to be scaled back to better parallel facilities installed in later years. This cycle would repeat in subsequent decades.

Option B budget level shows that a steadier investment reduces the peak potential budget need into the future but still represents a significant budget increase over current funding levels. Like Option A, the potential resource strategy must also be considered when evaluating the benefits of Option B. The $10 million per year budget does allow the District to address potential deficiencies identified in the Master Plan but, based on District experience, would likely require the District to increase its resources to successfully utilize the budget each year. Furthermore, the District anticipates that there would be periods where the full $10 million would not be required creating a similar cyclic budget needs to Option A but less severe.

Option C budget looks to balance the need to increase the annual infrastructure investments while recognizing that investment in District resources would also be required. The $7 million annual budget allows the District to address the high priority pipeline and pump station improvements identified in this Master Plan and establish a larger annual pipeline renewal and replacement program. The District can balance meeting level of service goals with replacing the infrastructure components at elevated risk of failure as identified by ongoing asset management analysis.

When overlaying the potential funding options in Figure 13-7, the District evaluated the potential risk mitigation that each funding level provides for infrastructure renewal and replacement. Option A would allow the District to significantly reduce the amount of aging infrastructure in the Novato Water System thereby reducing risk in the short term but the cyclical nature created by Option A would mean that the District future risk level would increase to similar levels continuously over the long term.

Option B funding levels allows the District to balance its actual needs based on actual risk that can be tracked as discussed in Section 13.3. However, Option B is still anticipated to potentially result in annual budget need variability over the long term. The future increase in potential risk is not as high as Option A but there is still opportunity for the District to better balance acceptable levels of risk with funding needs.

Option C allows the District to balance its actual risk with staff capacity to complete critical capital improvement projects. The District has an effective asset management program that will be enhanced by the steps taken as part of this Master Plan update. The District has also continued to evolve its construction installation requirements and material selection to extend the life of pipelines, pump stations, and storage tanks. Option C provides the best opportunity to increase the District's investment in renewal of the Novato Water System distribution system and methodically increase the reliability of both the pump stations and storage tanks.

13.6.2 Proposed Capital Improvement Program

The proposed CIP is presented in Table 13-5 based on the project prioritization presented in Table 13-4 using the Option C annual budget levels. The CIP is presented with annual project expenditures for the first five years beginning with the current Fiscal year 2025 based on the average annual funding level remain at $4 million per year. To allow the District to increase its investment into the Novato Water System critical assets renewal and replacement, the CIP assumes that beginning after Fiscal Year 2030 that the available CIP budget would increase annually over a 15 year timeline until the annual average budget is $7 million in Fiscal Year 2045.

The CIP presented in Table 13-5 estimates potential expenditures by the project categories described in Section 13.2.1 through Fiscal Year 2045. The actual scope of each potential project cannot be determined at this time but the proposed distribution of available annual CIP budget by the project categories based on the Project Prioritization presented in Table 13-4 while balancing investment across pipelines, pump stations, and storage tanks.

An overview of the CIP project locations for the next five fiscal years is shown on Figure 13-8. Individual project descriptions for each of the projects included in Fiscal Year 2026 through Fiscal Year 2030 are included in Appendix 5.

Table 13-5 Intentionally Not Included for Public Draft

Figure 13-8 Intentionally Not Included for Public Draft

Appendix 1

Table 4-2
Historical Potable Water Demands

Fiscal Year	Water Bank Total EDU (EDU)	Annual Production (AF)	Annual Demand [(1)] (AF)	Average Day Demand [(2)] (mgd)	Maximum Day Demand (mgd)	Peaking Factor[(3)] Max Day/Ave Day	Lost Water[(4)] (%)
1981	15,692	8,507	7,775	7.59	15.68	2.06	8.6%
1982	15,794	8,183	7,512	7.30	13.03	1.78	8.2%
1983	15,955	8,116	7,467	7.25	13.32	1.84	8.0%
1984	16,344	9,253	8,143	8.26	15.44	1.87	12.0%
1985	16,597	9,307	8,330	8.31	15.42	1.86	10.5%
1986	16,832	9,352	8,688	8.35	15.60	1.87	7.1%
1987	17,232	9,803	9,215	8.75	14.22	1.62	6.0%
1988	17,408	9,892	9,130	8.83	15.00	1.70	7.7%
1989	17,712	9,549	8,814	8.52	14.97	1.76	7.7%
1990	17,856	9,543	8,970	8.52	14.95	1.75	6.0%
1991	18,226	10,069	9,032	8.99	14.24	1.58	10.3%
1992	18,390	9,446	8,445	8.43	13.79	1.64	10.6%
1993	18,605	9,121	8,729	8.14	14.94	1.83	4.3%
1994	18,685	9,831	9,123	8.78	16.75	1.91	7.2%
1995	18,785	9,779	8,860	8.73	16.09	1.84	9.4%
1996	19,079	10,328	9,398	9.22	15.64	1.70	9.0%
1997	19,392	10,639	9,852	9.50	17.13	1.80	7.4%
1998	19,885	9,211	9,128	8.22	16.43	2.00	0.9%
1999	20,237	10,189	9,394	9.10	16.15	1.78	7.8%
2000	20,615	10,786	10,257	9.63	17.29	1.80	4.9%
2001	20,673	11,306	10,673	10.09	17.78	1.76	5.6%
2002	21,572	11,017	10,642	9.83	16.87	1.72	3.4%
2003	21,930	10,629	9,930	9.49	18.12	1.91	N/A
2004	22,628	11,505	11,033	10.27	17.21	1.68	4.1%
2005	22,768	10,060	9,399	8.98	17.17	1.91	N/A
2006	22,876	10,797	10,063	9.64	17.76	1.84	6.8%
2007	22,944	11,174	10,850	9.97	17.07	1.71	2.9%
2008	23,091	10,582	9,989	9.45	15.77	1.67	5.6%
2009	23,193	10,294	9,617	9.19	17.38	1.89	N/A
2010	23,299	8,452	7,896	7.54	13.41	1.78	N/A
2011	23,336	8,892	8,376	7.94	14.20	1.79	5.8%
2012	23,384	9,197	8,397	8.21	15.40	1.88	8.7%
2013	23,390	9,753	9,080	8.71	14.36	1.65	6.9%
2014	23,391	9,237	8,960	8.25	14.93	1.81	3.0%
2015	23,426	7,675	7,622	6.85	13.71	2.00	0.7%
2016	23,463	7,144	6,887	6.38	12.17	1.91	3.6%
2017	23,538	7,479	7,015	6.68	15.58	2.33	6.2%
				37-year average=	**15.54**	**1.82**	**6.6%**

Notes:

(1) Annual demand values listed are calculated from production values minus the lost water percentages reported in this table. For N/A values of lost water the 37-year average value of 6.6% was used.

(2) ADD values listed are based on billing data and do not include lost water.

(3) Peaking Factor (PF) is obtained by dividing the Max Day demand by the Average Day demand

(4) Lost water calculated separately and takes into account known water losses such as flushing flows, hydrant flows, etc.

Table 4-3
FY 2013 Water Demands

Pressure Zone	Annual Gross Demand[1] (gallons)	Average Day Demand[2] (gpd)	Average Day Demand (gpm)	Max Day/Ave Day Peaking Factor[3]	Maximum Day Demand (gpd)	Maximum Day Demand (gpm)
No. Novato Subzone	1,009,804,857	2,766,600	1,921	1.77	4,895,500	3,400
So. Novato Subzone	405,217,019	1,110,200	771	1.77	1,964,500	1,364
Zone 1 Total	**1,415,021,876**	**3,876,800**	**2,692**		**6,860,000**	**4,764**
Crest	53,562,456	146,700	102	1.77	259,700	180
Black Point	39,285,127	107,600	75	1.77	190,500	132
San Mateo/Trumbull Subzone	761,679,241	2,086,800	1,449	1.77	3,692,600	2,564
Sunset/Pacheco Subzone	543,401,535	1,488,800	1,034	1.77	2,634,400	1,829
Air Base	96,598,334	264,700	184	1.77	468,300	325
Zone 2 Total	**1,494,526,692**	**4,094,600**	**2,843**		**7,245,500**	**5,032**
Cherry Hill	44,462,282	121,800	85	1.77	215,600	150
Half Moon	7,305,106	20,000	14	1.77	35,400	25
Wild Horse Valley/Center Rd	86,840,719	237,900	165	1.77	421,000	292
Garner	6,162,487	16,900	12	1.77	29,900	21
Old Ranch Road	3,350,462	9,200	6	1.77	16,200	11
Dickson	19,222,299	52,700	37	1.77	93,200	65
Winged Foot	22,136,686	60,600	42	1.77	107,300	74
Ponti	25,110,990	68,800	48	1.77	121,700	85
San Andreas	6,175,802	16,900	12	1.77	29,900	21
Nunes	3,851,450	10,600	7	1.77	18,700	13
Zone 3 Total	**224,618,283**	**615,400**	**427**		**1,088,900**	**756**
Buck	6,044,314	16,600	12	1.77	29,300	20
Upper Wild Horse Valley	3,454,488	9,500	7	1.77	16,700	12
Cabro Ct	1,010,298	2,800	2	1.77	4,900	3
Zone 4 Total	**10,509,100**	**28,900**	**20**		**50,900**	**36**
Windhaven	1,244,148	3,400	2	1.77	6,000	4
San Antonio (WCW)	1,825,028	5,000	3	1.77	8,800	6
Misc Zone Total	**3,069,177**	**8,400**	**6**		**14,800**	**10**
Bahia Hydro	11,194,006	30,700	21	1.77	54,300	38
Hayden Hydro	4,184,333	11,500	8	1.77	20,300	14
Diablo Hills Hydro	1,295,745	3,500	2	1.77	6,300	4
Garner Hydro	2,003,953	5,500	4	1.77	9,700	7
Indian Hills Hydro	2,265,265	6,200	4	1.77	11,000	8
Rockrose Hydro	2,896,078	7,900	5	1.77	14,000	10
Eagle Dr Hydro	6,415,478	17,600	12	1.77	31,100	22
Hydro Zone Total	**30,254,857**	**82,900**	**58**		**146,700**	**102**

(1) Gross Annual Demands represent total production (billed consumption, unmetered consumption, fire hydrants, lost water, etc)

(2) Determined by dividing Gross Annual Demand by 365

(3) Peaking factor is multiplier to obtain maximum day demand from average day demand. Peaking factors obtained using average day demand data from 2004 and Max Day demand data from 2003.

Site No.	Map Grid	2020 - 2035 Development Projections	Development Year	APN	NMWD Zone	Residential (units)	Assisted Living (units)	Memory Care[1] (units)	Residential EDUs[3,4]	Residential Demand (AFY)	Commercial (SF)[2]	Industrial (SF)	Office (SF)	Office, Commercial & Industrial Demand (AFY)	Total Annual Demand (AFY)[6]	Average Daily Demand (gal/day)	ADD scaled to match 2015 UWMP (gal/day)[7]
		Development Projections															
		Approved															
1	K25	State Access Senior Apartments (801 State Access)	2020	157-970-04	S Zone 1	48			19	6.52					6.52	5,820	4,264
2	L26	516 Hospital Drive (Hamilton Hospital)	2020	157-690-52	Sunset/Pacheco		48		19	6.52	36,064			4.26	10.78	9,625	7,051
3	G9, G10, G11	Buck Institute	2030	125-180-61	Buck	130			130	44.13			106,000	12.53	56.66	50,577	37,052
4	L25	700 Hangar Avenue Infill (8 Hamilton Landing)	2020	157-690-09	S Zone 1								56,188	6.64	6.64	5,928	4,343
5	I20	Hanna Ranch	2020	153-340-06	N Zone 1	48			48	16.29	100,240			11.85	28.14	25,117	18,400
		Applications in Process															
6	K26	Hamilton Square Townhomes; 970 C Street	2020	157-980-05	S Zone 1	31			19	6.31					6.31	5,633	4,126
7	H17	Landing Court Townhomes (AHO site #2)	2020	153-162-70	N Zone 1	34			20	6.92					6.92	6,177	4,525
8, 9	I20, I21	5400 Hanna Ranch Rd. (McPhail's)	2020	153-220-16, 19	N Zone 1								59,600	7.04	7.04	6,288	4,606
10	K26	933 C Street (Northbay Children's Center)	2020	157-980-03	S Zone 1						6,769			0.80	0.80	714	523
11, 12	F15	1787 Grant Ave. Townhomes (AHO site #1)	2020	141-201-48, 12	N Zone 1	35			21	7.13					7.13	6,365	4,663
13, 14	G14	Atherton Place Townhomes 7533 and 7537 Redwood Blvd	2020	125-600-51, 52	N Zone 1	50			30	10.18	1,340			0.16	10.34	9,229	6,761
15	H11, H12	Laurel Ridge Senior Apts (AHO #3), 7711 Redwood Blvd	2025	125-580-16	SM/Trumbull	100			40	13.58					13.58	12,123	8,881
16, 17	K25, K26, L25, L26	Hamilton Cottages (Senior Housing Triangle)	2020	157-860-03, 04	S Zone 1	16			16	5.43					5.43	4,847	3,551
18	K13	Bahia Heights Subdivision	2025	143-272-07	N Zone 1	9			9	3.05					3.05	2,723	1,995
		Approved and In Process Subtotal				***501***	***48***		***371.40***	***126.06***	***144,413***		***221,788***	***43.28***	***169.34***	***151,165***	***110,740***
		North Redwood Blvd. Corridor															
		East of Redwood - South															
19, 20	H14, H15	7506 Redwood Blvd., AHO Site #4 (east of Trader Joe's)	2025	143-011-05, 08	N Zone 1						76,200			9.01	9.01	8,039	5,889
21	H14, H15	7530 Redwood Blvd. & 7546 Redwood - Dairymen's	2020	143-011-06	N Zone 1						88,500	-17,948		8.34	8.34	7,443	5,453
		East of Redwood - North (reallocates demand sites 22-27)									45,000			3.50	3.50	3,122	2,287
22, 23	H14, H15	7552 Redwood - Shamrock	2025	143-061-01, 02	N Zone 1							-6,227		-0.74	-0.74	-657	-481
24	H14, H15	7576 Redwood - Recycling Center	2030	143-061-06	N Zone 1							-3,760		-0.44	-0.44	-397	-291
25, 26	H14, H15	7586 Redwood - Solar/Fence	2025	143-061-10, 11	N Zone 1							-4,388		-0.52	-0.52	-463	-339
27	H14, H15	7596 Redwood - Landscape Materials	2030	143-061-08	N Zone 1						-1,032			-0.12	-0.12	-109	-80
28, 29	G14, G15	Olive/Redwood	2030	141-234-15, 16	N Zone 1	15			9	3.05	2,300			0.27	3.32	2,965	2,172
		North Redwood Blvd. Corridor Subtotal				***15***	***0***	***0***	***9.00***	***3.05***	***210,968***	***-32,323***	***0***	***19.29***	***22.34***	***19,944***	***14,611***
		North, North Redwood Blvd. Area															
30, 31, 32	G12, G13, H13	American Assets (Fireman's Fund Property)	2030	125-202-03, 04, 05	SM/Trumbull						30,000			3.55	3.55	3,165	2,319
33, 34	H12	Campus Properties - Wood Hollow (Hotel)	2025	125-202-13, 14	SM/Trumbull						46,865			5.54	5.54	4,944	3,622
35	G12	Oakview Office	2030	125-202-12	SM/Trumbull								24,000	2.84	2.84	2,532	1,855
36, 37	G11, H11	Campus Properties - Black John & Lands of Wright (Part of 7711 Redwood Blvd)	2030	125-580-17, 125-180-38	SM/Trumbull								180,000	21.27	21.27	18,990	13,911
38	H10	PG&E (Habitat for Humanity)	2025	125-180-49	SM/Trumbull								40,000	4.73	4.73	4,220	3,091
39	H9, H10	Birkenstock (Chg to business ofc/biotech)	2025	125-180-83	SM/Trumbull							-135,365	135,365	16.00	16.00	14,281	10,462
		North, North Redwood Blvd. Area Subtotal				***0***	***0***	***0***	***0.00***	***0.00***	***76,865***	***-135,365***	***379,365***	***53.92***	***53.92***	***48,132***	***35,260***
Site No.	**Map Grid**	**2020 - 2035 Development Projections**	**Development Year**	**APN**	**NMWD Zone**	**Residential (units)**	**Assisted Living (units)**	**Memory Care[1] (units)**	**Residential EDUs[3,4]**	**Residential Demand (AFY)**	**Commercial (SF)[2]**	**Industrial (SF)**	**Office (SF)**	**Office, Commercial & Industrial Demand (AFY)**	**Total Annual Demand (AFY)[6]**	**Average Daily Demand (gal/day)**	**ADD scaled to match 2015 UWMP (gal/day)[7]**
		Northwest Quad (bounded by Grant and Vallejo Streets and First and Seventh Streets)															
40	G15	1017 Fourth St.	2030	141-253-09	N Zone 1	1			1	0.34					0.34	304	222
41	G15	1053 Third St.	2030	141-261-30	N Zone 1	4			4	1.36					1.36	1,214	889
		2 redevelopment sites	2030	n/a	N Zone 1	3			3	1.02					1.02	911	667
		Northwest Quad Subtotal				***8***	***0***	***0***	***8.00***	***2.72***	***0***	***0***	***0***	***0.00***	***2.72***	***2,428***	***1,779***
		Downtown															
42	G15	Vallejo and First	2030	141-263-30	N Zone 1	6			4	1.22	1,000			0.12	1.34	1,195	875
43	G14	1110 Olive Ave.	2030	141-234-10	N Zone 1	2			2	0.68					0.68	607	445
44	G5	1320 Grant (and Fourth)	2030	141-261-29	N Zone 1	24			10	3.26	10,874			1.29	4.55	4,057	2,972
45	G15	7409 Redwood Blvd. (Enterprise Car Rental)	2030	141-264-22	N Zone 1	10			4	1.36	1,000			0.12	1.48	1,320	967
46	G15	7416 Redwood Blvd. (Chianti Restaurant)	2030	153-041-01	N Zone 1	13			5	1.77	2,250			0.27	2.04	1,817	1,331
47, 48	G15	1107 and 1119 Grant (Old Pini Hardware)	2025	141-282-07, 04	N Zone 1	32			13	4.34	13,000			1.54	5.88	5,246	3,843
49	G16	935 Front St. (Mission Lodge site)	2030	141-303-06	N Zone 1						16,204			1.92	1.92	1,710	1,252
50, 51, 52	G15	Olive and First	2030	141-244-03, 12 & 17	N Zone 1						4,000			0.47	0.47	422	309
		Downtown Subtotal				***87***	***0***	***0***	***37.20***	***12.63***	***48,328***	***0***	***0***	***5.71***	***18.34***	***16,373***	***11,995***
		Other Vacant/Underutilized															
53	H17	100 Landing Court	2035	153-170-56	N Zone 1								26,600	3.14	3.14	2,806	2,056
54	D12	200 San Marin Drive	2035	124-282-18	SM/Trumbull						6,700			0.79	0.79	707	518
55	G17	Hillside on Redwood/South of DeLong	2035	153-121-03	N Zone 1								8,600	1.02	1.02	907	665
56	I22	Victoria Commons 999 S. Novato Blvd.	2035	160-591-71	N Zone 1								10,000	1.18	1.18	1,055	773
57	K25	Hamilton Commissary Trangle -- HUD Parcel (826 State Access)	2025	157-970-07	S Zone 1						40,000			4.73	4.73	4,220	3,091
58	K25	Hamilton Commissary Triangle (802 State Access)	2025	157-970-03	S Zone 1						65,000			7.68	7.68	6,857	5,024
59	L26	Hamilton Town Center/Theater Parcel	2025	157-690-47	Sunset/Pacheco						6,000			0.71	0.71	633	464
60	M27	Hamilton Visiting Officer's Quarters	2030	157-690-53	Sunset/Pacheco	25			25	8.49	12,000			1.42	9.91	8,845	6,480
61, 62	K26	Hamilton School District Center (930 and 971 C St.)	2035	157-980-07, 08	S Zone 1						50,000			5.91	5.91	5,275	3,864
63	F21, F22, F23	Indian Valley College - Measure B projects	2025	150-480-12	Sunset/Pacheco						32,000			3.78	3.78	3,376	2,473
64, 65, 66	E15	Square Shopping Center	2030	132-183-14, 15, 16	N Zone 1	53			21	7.2	-24,805			-2.93	4.27	3,810	2,791
67	G18	Oakmont Senior Living 1461 S. Novato Blvd./Quest Church	2025	151-022-09	N Zone 1		50	28	20	6.79	20,288			2.40	9.19	8,202	6,008
68	F15	1905 Novato Blvd (AHO Site 5)	2025	140-011-66	N Zone 1	21			8	2.85					2.85	2,544	1,864
69	G15	Vallejo and Sixth	2025	141-221-74	N Zone 1	1			1	0.2					0.20	179	131
70	G14, G15	Vallejo and Sixth	2025	141-221-75	N Zone 1	1			1	0.2					0.20	179	131
		Other Vacant/Underutilized Subtotal				***101***	***50***	***28***	***75.80***	***25.73***	***207,183***	***0***	***45,200***	***29.83***	***55.56***	***49,595***	***36,332***
Site No.	**Map Grid**	**2020 - 2035 Development Projections**	**Development Year**	**APN**	**NMWD Zone**	**Residential (units)**	**Assisted Living (units)**	**Memory Care[1] (units)**	**Residential EDUs[3,4]**	**Residential Demand (AFY)**	**Commercial (SF)[2]**	**Industrial (SF)**	**Office (SF)**	**Office, Commercial & Industrial Demand (AFY)**	**Total Annual Demand (AFY)[6]**	**Average Daily Demand (gal/day)**	**ADD scaled to match 2015 UWMP (gal/day)[7]**
		Other Sites from HE Available Land Inventory															
71A	J22, J23	Bel Marin Keys Industrial Park (BioTech - 2020)	2020		S Zone 1							166,667		19.70	19.70	17,583	12,881
71B	J22, J23	Bel Marin Keys Industrial Park (BioTech - 2025)	2025		S Zone 1							166,667		19.70	19.70	17,583	12,881
71C	J22, J23	Bel Marin Keys Industrial Park (BioTech - 2030)	2030		S Zone 1							166,667		19.70	19.70	17,583	12,881
72	F15	1902 Novato Blvd.	2035	141-062-36	N Zone 1	5			5	1.7					1.70	1,518	1,112
73	F15	1811 Virginia Ave. (Our Lady of Loretto Church)	2035	141-142-16	N Zone 1	7			7	2.38					2.38	2,125	1,556
		Miscellaneous single family	2030	various	N Zone 1	30			30	10.18					10.18	9,087	6,657
		Miscellaneous second units	2030	various	S Zone 1	60			21	7.13					7.13	6,365	4,663
		Other sites from HE Available Land Inventory Subtotal				***102***	***0***	***0***	***63.00***	***21.39***	***0***	***500,001***	***0***	***59.09***	***80.48***	***71,844***	***52,631***
		County of Marin[5]															
74	J21, K21	Ronsheimer Parcels (formerly Leveroni)	2030	157-171-23, 24	S Zone 1	15			15	5.09					5.09	4,544	3,329
75	H8, H9, H10, H11, I9	Gnoss Field - Industrial Lands	2030	various	SM/Trumbull							50,000		5.91	5.91	5,275	3,864
76	J14, K14, L14, L15, M15	Gnoss Field/Atherton Ave/Greenpoint	2030	various	N Zone 1 and SM/Trumbull	232			232	78.75					78.75	70,299	51,499
77	M15, M16	Blackpoint - Neighborhood Commercial	2030	various	SM/Trumbull						4,288			0.51	0.51	452	331
78	M15, N15	Blackpoint - Residential Lands	2030	various	SM/Trumbull	105			105	35.64					35.64	31,815	23,307
79	D17, D18, E18,	Indian Valley	2030	various	Sunset/Pacheco	56			56	19.01					19.01	16,970	12,432
80	B16, B17, B18	Vineyard Road	2030	various	SM/Trumbull	1			1	0.34					0.34	304	222
		County of Marin Subtotal				***409***	***0***	***0***	***409.00***	***138.83***	***4,288***	***50,000***	***0***	***6.42***	***145.25***	***129,658***	***94,985***
		TOTAL DEVELOPMENT THROUGH 2035				***1,223***	***98***	***28***	***973***	***330.41***	***692,045***	***382,313***	***646,353***	***217.53***	***547.94***	***489,139***	***358,333***

[1] Memory care units are included in Commercial square footage.

[2] Existing Commercial includes all retail, flex and specialty space as defined and identified by CoStar Realty Information, Inc. as of October 2013

[3] Equivalent Dwelling Units per Reg 1: SFR/Duplex=1 EDU; Townhouse/Condo=0.6 EDU; Apartment=0.4 EDU; Mobile Home=0.35 EDU

[4] Non-SFR/Duplex development type assumptions based on lot size and input from City of Novato planning staff

[5] Marin County project development year from the buildout analysis done for the Marin Countywide Plan EIR

[6] Annual demand includes conservation savings and uses the following factors:

Residential =	0.339	AFY / EDU	=(1EDU)x(500gal/1ADPM)x(1adpm/1.65 ave day)x(365days/1yr)x(1AF/325,850 gal)
Comm/Govt =	0.118	AFY / 1,000 SF	per "Commercial EDU Factor Data-2017.xls" on 3/23/2018, averaging 31 commercial projects
Peaking Factor: ADPM/Avg. Day =	1.65		Calculated in spreadsheet "NMWD FY13 Use by Customer by Billing Period"

[7] All future demands have been scaled to match the total projected demands listed in the 2015 Urban Water Management Plan. A factor of 0.36 mgd/0.49 mgd was used.

Note: 1 EDU = 500 gallons/day

Table 4-4
Buildout Potable Water Demand Forecast

	Fiscal Year	A Annual AF (AF)	B Annual MG (MG)	C Ave Day (mgd)	D ADPM (mgd)	E Max Day (mgd)
Actual	1981	8,507	2,771.8	7.59	12.33	15.68
	1982	8,183	2,666.3	7.30	11.58	13.03
	1983	8,116	2,644.4	7.25	11.06	13.32
	1984	9,253	3,014.9	8.26	12.05	15.44
	1985	9,307	3,032.5	8.31	12.75	15.42
	1986	9,352	3,047.2	8.35	12.70	15.60
	1987	9,803	3,194.1	8.75	12.81	14.22
	1988	9,892	3,223.1	8.83	12.57	15.00
	1989	9,549	3,111.3	8.52	12.44	14.97
	1990	9,543	3,109.4	8.52	13.09	14.95
	1991	10,069	3,280.8	8.99	12.92	14.24
	1992	9,446	3,077.8	8.43	11.50	13.79
	1993	9,121	2,971.9	8.14	12.25	14.94
	1994	9,831	3,203.2	8.78	13.18	16.75
	1995	9,779	3,186.3	8.73	13.59	16.09
	1996	10,328	3,365.2	9.22	13.49	15.64
	1997	10,639	3,466.5	9.50	13.92	17.13
	1998	9,211	3,001.2	8.22	14.08	16.43
	1999	10,189	3,319.9	9.10	13.67	16.15
	2000	10,786	3,514.4	9.63	14.05	17.29
	2001	11,306	3,683.8	10.09	15.05	17.78
	2002	11,017	3,589.7	9.83	15.06	16.87
	2003	10,629	3,463.2	9.49	15.72	18.12
	2004	11,505	3,748.7	10.27	15.60	17.21
	2005	10,060	3,277.8	8.98	14.78	17.17
	2006	10,797	3,518.0	9.64	15.58	17.76
	2007	11,174	3,640.8	9.97	15.60	17.07
	2008	10,582	3,447.9	9.45	13.57	15.77
	2009	10,294	3,354.1	9.19	13.60	17.40
	2010	8,452	2,753.9	7.54	11.84	13.41
	2011	8,892	2,897.3	7.94	12.20	14.20
	2012	9,197	2,996.8	8.21	12.04	15.40
	2013	9,753	3,177.8	8.71	12.76	14.36
	2014	9,237	3,009.8	8.25	12.42	14.93
	2015	7,675	2,500.8	6.85	10.28	13.71
	2016	7,144	2,327.8	6.38	10.24	12.17
	2017	7,479	2,436.8	6.68	10.01	15.58
Forecast	2020	10,012	3,262.2	8.94	14.75	15.81
	2025	10,058	3,277.2	8.98	14.81	15.89
	2030	10,063	3,278.8	8.98	14.82	15.90
	2035	10,155	3,308.8	9.07	14.96	16.04

A: actual per NMWD Annual Reports = SCWA + STP supply
forecast demands per 2015 NWMD UWMP Table 4-2

B: = column A * 43560 * 7.48 / 1000000

C: = column B / 365

D: Historic annual ADPM peaking factor is 1.52, however, a more detailed analysis calculating individual peaking factors for all Novato service area customers resulted in an adjusted ADPM peaking factor of 1.65. See footnote 6 of Table 4-5 for additional details.

E: actual per NMWD Annual Reports
forecast = column C * 1.77
(MaxDay/AveDay peaking factor obtained using average day demand data from 2004 and Max Day demand data from 2003. See section 4.3.1 for detailed explanations)

Table 4-6
Incremental Average Day Demand (ADD) Projection (from specific plans)

Pressure Zone	FY 2020 ADD Increase (gpd)	FY 2025 Ave Day Demand Increase (gpd)	FY 2030 Ave Day Demand Increase (gpd)	FY 2035 Ave Day Demand Increase (gpd)	Total Ave Day Demand Increase (gpd)
North Novato Subzone	44,408	33,737	54,836	6,162	139,142
South Novato Subzone	36,739	21,460	27,352	3,864	89,415
Zone 1 Total	**81,147**	**55,197**	**82,187**	**10,026**	**228,557**
San Mateo/Trumbull Subzone	0	12,503	22,461	518	35,481
Sunset/Pacheco Subzone	0	2,473	1,276	0	3,749
Primary Zone 2 Total	**0**	**14,976**	**23,737**	**518**	**39,230**
Crest	0	0	31,406	0	31,406
Black Point	0	0	28,104	0	28,104
Wild Horse Valley / Center Rd	0	0	1,248	0	1,260
Cherry Hill	0	0	447	0	447
Buck	0	0	27,789	0	27,789
Half Moon	0	0	437	0	437
Old Ranch	0	0	656	0	656
Bahia	0	0	447	0	447
Upper Wild Horse Valley	0	0	12	0	0
Totals	**81,147**	**70,173**	**196,469**	**10,544**	**358,333**

(1) Demands from specific plan areas are tabulated in Table 4-5

Table 4-7

Projected Average Day Demand (ADD) (1)

Pressure Zone	FY 2013 Total ADD (gpd) (2)	FY 2020 Ave Day Demand (gpd)	FY 2025 Ave Day Demand (gpd)	FY 2030 Ave Day Demand (gpd)	FY 2035 Ave Day Demand (gpd)	Total Ave Day Demand Increase (gpd)
No. Novato Subzone	2,766,589	2,810,997	2,844,734	2,899,569	2,905,731	139,142
So. Novato Subzone	1,110,184	1,146,923	1,168,383	1,195,734	1,199,599	89,415
Zone 1 Total	**3,876,772**	**3,957,920**	**4,013,116**	**4,095,304**	**4,105,330**	**228,557**
Crest	146,746	146,746	146,746	178,152	178,152	31,406
Black Point	107,630	107,630	107,630	135,734	135,734	28,104
San Mateo/Trumbull Subzone	2,086,792	2,086,792	2,099,295	2,121,756	2,122,274	35,481
Sunset/Pacheco Subzone	1,488,771	1,488,771	1,491,244	1,492,520	1,492,520	3,749
Air Base	264,653	264,653	264,653	264,653	264,653	0
Zone 2 Total	**4,094,594**	**4,094,594**	**4,109,570**	**4,192,816**	**4,193,334**	**98,740**
Cherry Hill	121,814	121,814	121,814	122,261	122,261	447
Half Moon	20,014	20,014	20,014	20,451	20,451	437
Wild Horse Valley/Center Rd	237,920	237,920	237,920	239,168	239,168	1,248
Garner	16,884	16,884	16,884	16,884	16,884	0
Old Ranch Road	9,179	9,179	9,179	9,836	9,836	656
Dickson	52,664	52,664	52,664	52,664	52,664	0
Winged Foot	60,648	60,648	60,648	60,648	60,648	0
Ponti	68,797	68,797	68,797	68,797	68,797	0
San Andreas	16,920	16,920	16,920	16,920	16,920	0
Nunes	10,552	10,552	10,552	10,552	10,552	0
Zone 3 Total	**615,393**	**615,393**	**615,393**	**618,181**	**618,181**	**2,788**
Buck	16,560	16,560	16,560	44,348	44,348	27,789
Upper Wild Horse Valley	9,464	9,464	9,464	9,477	9,477	12
Cabro Ct	2,768	2,768	2,768	2,768	2,768	0
Zone 4 Total	**28,792**	**28,792**	**28,792**	**56,593**	**56,593**	**27,801**
Windhaven	3,409	3,409	3,409	3,409	3,409	0
San Antonio (WCW)	5,000	5,000	5,000	5,000	5,000	0
Misc Zone Total	**8,409**	**8,409**	**8,409**	**8,409**	**8,409**	**0**
Bahia Hydro	30,669	30,669	30,669	31,115	31,115	447
Hayden Hydro	11,464	11,464	11,464	11,464	11,464	0
Diablo Hills Hydro	3,550	3,550	3,550	3,550	3,550	0
Garner Hydro	5,490	5,490	5,490	5,490	5,490	0
Indian Hills Hydro	6,206	6,206	6,206	6,206	6,206	0
Rockrose Hydro	7,934	7,934	7,934	7,934	7,934	0
Eagle Dr Hydro	17,577	17,577	17,577	17,577	17,577	0
Hydro Zone Total	**82,890**	**82,890**	**82,890**	**83,337**	**83,337**	**447**
Totals	**8,706,849**	**8,787,997**	**8,858,169**	**9,054,638**	**9,065,182**	**358,333**

(1) See Table 4-6 for incremental demand increases by 5-year intervals.

(2) FY 2013 is actual day demand.

Table 4-8
Projected Maximum Day Water Demands[1]

Pressure Zone	FY 2013 Max Day Demand (gpd)	FY 2020 Max Day Demand (gpd)	FY 2025 Max Day Demand (gpd)	FY 2030 Max Day Demand (gpd)	FY 2035 Max Day Demand (gpd)	Total Max Day Demand Increase (gpd)
No. Novato Subzone	4,895,500	4,974,100	5,033,800	5,130,800	5,141,700	246,200
So. Novato Subzone	1,964,500	2,029,500	2,067,500	2,115,900	2,122,700	158,200
Zone 1 Total	**6,860,000**	**7,003,600**	**7,101,300**	**7,246,700**	**7,264,400**	**404,400**
Crest	259,700	259,700	259,700	315,200	315,200	55,500
Black Point	190,500	190,500	190,500	240,200	240,200	49,700
San Mateo/Trumbull Subzone	3,692,600	3,692,600	3,714,700	3,754,400	3,755,400	62,800
Sunset/Pacheco Subzone	2,634,400	2,634,400	2,638,800	2,641,000	2,641,000	6,600
Air Base	468,300	468,300	468,300	468,300	468,300	0
Zone 2 Total	**7,245,500**	**7,245,500**	**7,272,000**	**7,419,100**	**7,420,100**	**174,600**
Cherry Hill	215,600	215,600	215,600	216,300	216,300	700
Half Moon	35,400	35,400	35,400	36,200	36,200	800
Wild Horse Valley/Center Rd	421,000	421,000	421,000	423,200	423,200	2,200
Garner	29,900	29,900	29,900	29,900	29,900	0
Old Ranch Road	16,200	16,200	16,200	17,400	17,400	1,200
Dickson	93,200	93,200	93,200	93,200	93,200	0
Winged Foot	107,300	107,300	107,300	107,300	107,300	0
Ponti	121,700	121,700	121,700	121,700	121,700	0
San Andreas	29,900	29,900	29,900	29,900	29,900	0
Nunes	18,700	18,700	18,700	18,700	18,700	0
Zone 3 Total	**1,088,900**	**1,088,900**	**1,088,900**	**1,093,800**	**1,093,800**	**4,900**
Buck	29,300	29,300	29,300	78,500	78,500	49,200
Upper Wild Horse Valley	16,700	16,700	16,700	16,800	16,800	100
Cabro Ct	4,900	4,900	4,900	4,900	4,900	0
Zone 4 Total	**50,900**	**50,900**	**50,900**	**100,200**	**100,200**	**49,300**
Windhaven	6,000	6,000	6,000	6,000	6,000	0
San Antonio (WCW)	8,800	8,800	8,800	8,800	8,800	0
Misc Zone Total	**14,800**	**14,800**	**14,800**	**14,800**	**14,800**	**0**
Bahia Hydro	54,300	54,300	54,300	55,100	55,100	800
Hayden Hydro	20,300	20,300	20,300	20,300	20,300	0
Diablo Hills Hydro	6,300	6,300	6,300	6,300	6,300	0
Garner Hydro	9,700	9,700	9,700	9,700	9,700	0
Indian Hills Hydro	11,000	11,000	11,000	11,000	11,000	0
Rockrose Hydro	14,000	14,000	14,000	14,000	14,000	0
Eagle Dr Hydro	31,100	31,100	31,100	31,100	31,100	0
Hydro Zone Total	**146,700**	**146,700**	**146,700**	**147,500**	**147,500**	**800**
Totals	**15,406,800**	**15,550,400**	**15,674,600**	**16,022,100**	**16,040,800**	**634,000**

Appendix 2

CITY OF NOVATO
COMMUNITY DEVELOPMENT

CURRENT PLANNING PROJECTS
UNDER REVIEW & RECENTLY APPROVED

June 2025

Review Body Legend:	**Planner Contact Information:**		
ZA = Zoning Administrator	David Ayala, Planner I	(415) 899-8940	dayala@novato.org
CDD = Community Development Director	Vivek Damodaran, Senior Planner	(415) 899-8939	vdamodaran@novato.org
PWD = Public Works Director	Kaitlin Zitelli, Senior Planner	(415) 899-8941	kzitelli@novato.org
DRC = Design Review Commission	Brett Walker, Senior Planner	(415) 493-4711	bwalker@novato.org
PC = Planning Commission	Michael Smith, Principal Planner	(415) 899-8949	msmith@novato.org
CC = City Council	Steve Marshall, Deputy Director	(415) 899-8942	smarshall@novato.org

PRELIMINARY APPLICATIONS

PROJECT	DESCRIPTION	APPLICANT	PERMITS REQUIRED	REVIEW BODY	PLANNER(S)	STATUS/NOTES
970 C Street APN 157-980-05 P2025-015	Preliminary application for proposed development of 436 multi-family residential units.	Amanda Locke AMG Associates LLC 818-600-2518 alocke@amgland.com	TBD	TBD	Zitelli	Preliminary Application submitted March 17, 2025

RESIDENTIAL DEVELOPMENT PROJECTS – UNDER REVIEW

PROJECT	DESCRIPTION	APPLICANT	PERMITS REQUIRED	REVIEW BODY	PLANNER(S)	STATUS/NOTES
200 San Marin Drive Townhomes 200 San Marin Dr. APN 124-282-18 P2025-037	Proposal for 13 residential condominiums.	Jeff Dougherty Uplight Partners LLC., 415-634-7052 jdougherty@uplightpartners.com	Streamlined Residential Review (AB 2011) Density Bonus Design Review	CC	Zitelli	New Application – submitted June 10, 2025
Bahia River View II Vacant Parcels – Bahia Drive APNs 143-231-07 & -36 P2024-057	Proposed subdivision of two existing parcels into five separate parcels and development of each newly created parcel with a single-family home.	Jessica Smith jessica@polskyarchitects.com	Design Review Tentative Map	TBD	Damodaran	Applicant – Considering Design & Process Options Pending CEQA Analysis Objective Standards (Inconsistent) – November 16, 2024

RESIDENTIAL DEVELOPMENT PROJECTS – UNDER REVIEW						
PROJECT	**DESCRIPTION**	**APPLICANT**	**PERMITS REQUIRED**	**REVIEW BODY**	**PLANNER(S)**	**STATUS/NOTES**
7299 Redwood Apartments 946 Front St./7299 Redwood Blvd. APNs 141-303-06 & -07 P2024-054	Proposed development of an 82-unit apartment building on a vacant parcel.	Maracor Development bdickason@maracordev.com	Streamlined Residential Review (AB 2011) Density Bonus Design Review	CC	Damodaran	Under Review Resubmittal Received – June 27, 2025 Objective Standards (Inconsistent) – June 18, 2025 Resubmittal Received – May 22, 2025 Tolling Agreement – November 13, 2024 Objective Standards (Inconsistent) – November 7, 2024 Density Bonus Application (Complete) – October 9, 2024

MINOR RESIDENTIAL PROJECTS – UNDER REVIEW						
PROJECT	**DESCRIPTION**	**APPLICANT**	**PERMITS REQUIRED**	**REVIEW BODY**	**PLANNER(S)**	**STATUS/NOTES**
Sibrian Residence Addition 1101 Mirabella Ave. APN 141-285-14 P2025-030	Variance for residential addition built without permit.	Mary Sibrian	Variance	ZA	Zitelli	Incomplete – May 21, 2025 Application Submitted May 2, 2025
Lund Residence Deck Expansion 109 Indian Hills Dr. APN 150-592-03 P2025-034	Design review for a deck expansion, hillside parcel	Hans and Jennifer Lund	Minor Design Review	CDD	Zitelli	Application Deemed Complete – June 17, 2025 Pending CDD Action date.
Ghirardo Lot Line Adjustment 848 Sutro Ave. APNs 132-051-11, -24 P2025-031	Lot Line Adjustment	Peter Riechers	Lot Line Adjustment	CDD	Zitelli	Application Incomplete – June 4, 2025 Application Submitted May 7, 2025
Lucchesi Cert. of Compliance 850 Sutro Ave. APN 132-051-52 P2025-026	Certificate of Compliance	Peter Riechers	Certificate of Compliance	CDD	Zitelli	Application Incomplete – April 24, 2025 Application Submitted April 21, 2025
Ma Urban Lot Split 1690 Hill Rd. APN 140-261-73 P2025-021	SB 9 Urban Lot Split	Peter Riechers	Urban Lot Split	CDD	Zitelli	CDD Action Date Scheduled – June 27, 2025 Incomplete – April 30, 2025 Application Submitted April 2, 2025
Johnk Urban Lot Split 651 Canyon Rd. APN 146-110-96 P2025-024	SB 9 Urban Lot Split	Peter Riechers	Urban Lot Split	CDD	Zitelli	CDD Action Date Scheduled – July 7, 2025 Application Incomplete – May 5, 2025 Application Submitted April 8, 2025
Osbin Residence Design Review 1291 Seventh St. APN 141-120-03 P2025-014	Design review for 1 new single-family residence on a hillside lot	Osbin Diaz and Wuilson Diaz	Minor Design Review	CDD	Zitelli	Application Incomplete – April 7, 2025 Application Submitted – March 13, 2025

MINOR RESIDENTIAL PROJECTS – UNDER REVIEW						
PROJECT	DESCRIPTION	APPLICANT	PERMITS REQUIRED	REVIEW BODY	PLANNER(S)	STATUS/NOTES
Taylor Second Story Addition 2589 Topaz Drive APN 143-242-38 P2025-001	Second story addition above the detached garage.	Brian Kaplan	Design Review	CDD	Ayala	Application Withdrawn
Sheedy Tentative Map 2349 Novato Blvd. APNs 132-031-04, -08 P2024-003 & -004	Dividing 2 existing lots into 4 lots.	Mark Sheedy	Tentative Map	CDD	Damodaran	Approved – May 2, 2025
14 Creekview Court APN 160-940-21 P2024-073	New 11'9" tall pergola and BBQ area within a rear yard setback.	Stephen Maricich	Design Review	CDD	Ayala	Approved – May 14, 2025 Application Submitted – December 17, 2024
466 Fairway Drive APN 160-352-06 P2024-053	New 18-foot-tall golf netting accessory structure that extends 48-linear feet.	Rick Banghart & Zara Jellicoe	Design Review	CDD	Ayala	Pending Project Revisions Application Complete – August 23, 2024 Application Submitted – July 24, 2024
Egide Golf Netting 474 Fairway Drive APN 160-352-05 P2024-037	New 12-foot-tall golf netting accessory structure that extends 30-linear feet.	Mark & Stacey Egide	Design Review	CDD	Ayala	Pending Project Revisions Application Incomplete – July 20, 2024 Application Submitted – June 20, 2024
Landies Residential Addition 688 Wilson Avenue APN 140-301-23 P2024-033	New 637 square foot addition and interior remodel on a parcel subject to the Hillside Ordinance.	Andrew Landies	Design Review	CDD	Zitelli	Pending Action Date – July Application Incomplete – January 13, 2025 Application Submitted – April 30, 2024
829 Hayden Avenue APN 153-091-08 P2023-095	New 1,199 square foot deck on a hillside property.	Nicholas Serchia	Design Review	CDD	Ayala	Pending Project Revisions Application Incomplete – January 18, 2024 Application Submitted - December 20, 2023
61 Drakewood Lane APN 150-464-06 P2023-092	Wood landscape retaining wall and metal square mesh fencing which measures 3-6 feet tall in front yard.	Luis Arcos	Design Review	CDD	Ayala	CDD Approved – June 11, 2025
Adormeo Residential Expansion 767 Diablo Avenue APN 140-191-43 P2023-001	Expansion of an existing 604 square foot single-story residence to a 5,464 two-story residence	Mario Adormeo	Design Review	CDD or DRC	Zitelli	Pending Project Revisions DRC Workshop – March 15, 2023 Application Incomplete – January 31, 2023 Application Submitted – January 4, 2023
Oleander Vacation of ROW APN 153-182-58 E72022-001	Request to vacate public right-of-way at APN 153-182-58	Rick Ehrlinspiel	Vacation of ROW	PC	Damodaran	Application Incomplete – September 28, 2022 Application Submitted – August 31, 2022

MINOR RESIDENTIAL PROJECTS – UNDER REVIEW						
PROJECT	**DESCRIPTION**	**APPLICANT**	**PERMITS REQUIRED**	**REVIEW BODY**	**PLANNER(S)**	**STATUS/NOTES**
Locke Urban Lot Split 560 Trumbull Avenue APN 146-150-68 P2022-029	SB 9 Urban Lot Split	Peter Riechers	Parcel Map	CDD	Walker	Pending Settlement Agreement PC Appeal Hearing - May 23, 2022 Application Incomplete – April 25, 2022 Application Submitted – February 16, 2022
C-Ranch End of Shevelin Drive APN 150-030-01 P2021-094	Proposed development of a single-family home	Brian Chee	Design Review	DRC	Damodaran	DRC Hearing – Pending Application Complete - September 3, 2024 Application Submitted – September 29, 2021
1291 7th Street APN 141-120-03 P2021-005 & -006	Rezone from Planned District (PD) to Very Low Density Residential (RVL); 40,000 sq. ft. minimum lot size. Subdivision of parcel into two lots	Ted Pugh	Rezone Tentative Map	PC CC	Zitelli	Application Incomplete – February 11, 2021 Application Submitted – January 14, 2021

LIVE WORK PROJECTS - UNDER REVIEW						
PROJECT	**DESCRIPTION**	**APPLICANT**	**PERMITS REQUIRED**	**REVIEW BODY**	**PLANNER(S)**	**STATUS/NOTES**
Pavilions Eco Village 200 Landing Court APN 153-170-56 P2018-018	28 live/work units	Geoff Wood Novato Creek Partners (415) 921-5577 ggwood2@gmail.com	Master Plan Amendment Precise Development Plan Tentative Map Design Review	DRC PC CC	Walker	Pending Property Sale Pending CEQA Review DRC Hearing - Pending DRC Workshop - March 4, 2020 DRC Workshop - December 4, 2019

MIXED USE PROJECTS - UNDER REVIEW						
PROJECT	**DESCRIPTION**	**APPLICANT**	**PERMITS REQUIRED**	**REVIEW BODY**	**PLANNER(S)**	**STATUS/NOTES**
1st and Grant 1107 and 1119 Grant Ave. APNs 141-282-07, -04 P2023-057	AB 2011 project – 170 studio and 1-bedroom apartments, 100% affordable (less 3 market rate managers units). 6,794 sq. ft. of commercial space is proposed on the ground floor. 24 vehicle parking spaces are proposed.	AMG & CA Housing Defense Fund PO Box 260770, Encino, CA 91426 alocke@amgland.com; dylan@calhdf.org	Streamlined Residential Review (AB 2011) Density Bonus Tentative Map Design Review	CDD	Walker	Tolling Agreement - September 24, 2024 City Council Hearing – September 24, 2024 City Council Hearing – August 27, 2024 Objective Standards Compliance – July 3, 2024 Density Bonus Application –Complete – May 3, 2024 Tolling Agreement - December 18, 2023 Objective Standards Compliance - October 23, 2023 Applications Submitted – July 25, 2023

NON – RESIDENTIAL PROJECTS - UNDER REVIEW						
PROJECT	**DESCRIPTION**	**APPLICANT**	**PERMITS REQUIRED**	**REVIEW BODY**	**PLANNER(S)**	**STATUS/NOTES**
Made Local Marketplace 881 Grant Avenue APN 153-062-01 P2025-042	Alcohol sales for off-site consumption	Willow Peterson	Use Permit	CDD	Ayala	Under Review Application Submitted – June 25, 2025
Courtyard Hotel Fencing 1400 Hamilton Parkway APN 157-710-02 P2025-012	New perimeter fencing around Courtyard Marriot hotel	KR Commercial Interiors Inc	Minor Design Review	CDD	Zitelli	Application Incomplete – March 24, 2025 Application Submitted – March 5, 2025
Kia of Marin 105 Vintage Way APN 153-340-11 P2025-008	Exterior Remodel and minor addition	Shawn Montoya	Design Review	CDD	Ayala	Staff Report in progress Application Complete – March 20, 2025 Application Submitted – February 20, 2025
501 Davidson Self-Storage 501 Davidson Street APN 153-250-11 P2024-015 & -016	Self-Storage Facility	Vero-West Mario Ghilotti mario@vero-west.com	Use Permit Design Review	PC DRC	Walker	Resubmittal received May 8, 2025 - Currently under review. DRC Hearing: March 5, 2025 – DRC recommended conditional approval of the design aspects Application Submitted – February 20, 2024
Downtown Center LLA 1701 Grant Ave APNs 141-201-50, -52, -55, -56, & -57 P2023-052	LLA to change the boundaries between 2 existing lots	UG2 Novato CA LP 1000 4th Street, Suite 290 San Rafael, CA 94901 kevin@unitedgrowth.com	LLA	CDD	Walker	Awaiting Applicant Response – Building Code Compliance CDD Action Pending – November 26, 2024 Resubmittal Received – September 26, 2024 Application Incomplete - August 10, 2023 Application Submitted - July 18, 2023
Marsh Drive Mini-Storage 1 Marsh Road APN 153-220-22 P2023-033	Development of a new mini-storage facility	1 Marsh Drive, LLC Rocky Stich vstar1984@sbcglobal.net	Master Plan Precise Development Plan Design Review	DRC PC CC	Damodaran	Awaiting Design Revisions & Application Materials Application Incomplete – February 27, 2025 DRC Workshop – September 18, 2024 Application Incomplete – November 1, 2023 Project Revisions – October 26, 2023 Application Incomplete – May 31, 2023 Application Submitted – May 1, 2023
Costco Fuel Facility 300 Vintage Way APN 153-340-36 P2020-025	Gas Station – 28 fueling positions.	Costco, Inc. Sean Anderson (425) 313 -6973 sandersonj@costco.com	Use Permit Design Review	CC PC DRC	Walker	EIR in progress Application Submitted – April 13, 2020

NON – RESIDENTIAL PROJECTS - UNDER REVIEW

PROJECT	DESCRIPTION	APPLICANT	PERMITS REQUIRED	REVIEW BODY	PLANNER(S)	STATUS/NOTES
StoneTree Driving Range Two Water Trail APN 157-160-18 P2019-036	Golf driving range on 10-acre parcel owned by the Marin County Flood Control and Water Conservation District	Victor Woo Bay Club (415) 205-3753 Victor.woo@bayclubs.com	General Plan Amendment Rezone Use Permit	PC CC	Zitelli	Updated CEQA Technical Studies received June 2025 – Under Review. PC Hearing - June 8, 2020 Application Submitted – April 25, 2019
Hanna Ranch Mixed Use End of Rowland Boulevard APN 153-340-06 P2017-005	Costco Fuel Center 125 Room Hotel 12,500 SF – Retail 26,200 SF – Office 11,158 SF - Restaurants	Hanna Ranch Conservation, LLC c/o Brett Wood (310) 444-7770 x104	Master Plan Amendment Precise Development Plan Tentative Map Design Review	DRC PC CC	Marshall	Pending Litigation & Settlement Discussions Revised Plans – September 8, 2021 DRC Recommendation Hearing – October 4, 2017 DRC Workshop – August 16, 2017 Application Submitted – February 2, 2017

WIRELESS TELECOMMUNICATIONS FACILITIES

PROJECT	DESCRIPTION	APPLICANT	PERMITS REQUIRED	REVIEW BODY	PLANNER(S)	STATUS/NOTES
Verizon Wireless 75 Rowland Way APN 153-320-14 P2025-023	Eligible Facilities Request Modify Existing Facility	Verizon Wireless Attn: Eric Lentz 605 Coolidge Drive, Suite 100 Folsom, CA 95630	Eligible Facilities Permit	CDD	Ayala	Application Denied – May 31, 2025 Application Incomplete – May 1, 2025 Application Submitted – April 1, 2025

SELECT APPROVED PROJECTS STATUS

PROJECT	DESCRIPTION	APPLICANT	PERMITS APPROVED	REVIEW BODY	PLANNER(S)	STATUS/NOTES
Wine Down 7388 Redwood Boulevard APN 153-044-01 P2025-016	New restaurant and wine bar with alcohol sales for on- and off-site consumption. Use permit required for off-site alcohol sales.	Shareen Barrett	Use Permit	CDD	Ayala	ZA Approved – June 12, 2025
Greek Orthodox Church 1110 Highland Drive APN 160-150-03 P2022-114	New narthex addition and roof dome addition.	Nativity of Christ Greek Orthodox Church office@nativityofchrist.org	Master Plan Precise Development Plan Design Review	CDD	Damodaran	DRC Approved (Final Landscaping/Lighting) - June, 4, 2025 CC Conditionally Approved - February 25, 2025

SELECT APPROVED PROJECTS STATUS						
PROJECT	**DESCRIPTION**	**APPLICANT**	**PERMITS APPROVED**	**REVIEW BODY**	**PLANNER(S)**	**STATUS/NOTES**
Wood Hollow Residences 100 Wood Hollow APN 125-202-17 P2024-043	Proposed development of 66 single-family dwelling units on a 12.93 acre parcel, including associated site and circulation improvements.	100 Wood Hollow Drive Owner, LLC. Daniel.golub@hklaw.com	Tentative Map Design Review	CC	Marshall Damodaran	CC Approved – May 13, 2025
Martinez Tentative Map 10 Deer Island Ln APN 153-190-04 P2023-008	Dividing existing lot into 3 lots.	George Martinez	Design Review Tentative Map	CDD	Walker	Approved – January 28, 2025
15 Clausing Court SB 9 Dwellings 15 Clausing Court APN 153-162-32 P2023-098 & -099	New 800 square-foot SB 9 unit and two detached ADUs.	Martha Davis	SB 9 Dwelling Unit Permit and ADU Permit	CDD	Walker	Approved - December 5, 2024
The Lodge on Novato Creek 1787 Grant Ave RCFE 1787 Grant Ave APNs 141-201-48 and -12 P2023-080	Proposed RCFE and memory care facility with 55 assisted living units and 31 memory care beds in a 3 story, 73,000 square-foot building	Fulcrum Real Estate and Development Steve Ring steve@fulcrumredev.com	Design Review Density Bonus Use Permit	PC	Walker	Approved - November 18, 2024
Landing Court Multi-Family APN 153-162-70 P2023-055	Proposed 5-story multi-family apartment building with 301 units and no off-street parking spaces.	AMG; CA Housing Defense Fund PO Box 260770, Encino, CA 91426 alocke@amgland.com dylan@calhdf.org	Streamlined Residential Review (AB 2011) Density Bonus Design Review	CC	Walker	Approved - October 22, 2024
4th and Grant 1316 -1320 Grant Ave. & 1020 Fourth St. APN 141-261-29 P2023-058	AB 2011 project – 209 studio and one bedroom apartments, 100% affordable (less 3 market rate managers units). Approximately 5,335 square feet of retail space on the ground floor and 36 parking spaces total.	AMG & CA Housing Defense Fund PO Box 260770, Encino, CA 91426 alocke@amgland.com dylan@calhdf.org	Streamlined Residential Review (AB 2011) Density Bonus Tentative Map Design Review	CC	Damodaran	Approved – August 27, 2024

SELECT APPROVED PROJECTS STATUS						
PROJECT	**DESCRIPTION**	**APPLICANT**	**PERMITS APPROVED**	**REVIEW BODY**	**PLANNER(S)**	**STATUS/NOTES**
3rd and Grant 1212 and 1214 Grant Ave. APNs 141-262-12, -13 P2023-056	AB 2011 project – 56 one bedroom and studio apartments. 100% affordable (less 1 market rate manager's unit). Approximately 1,735 square feet of retail space on the ground floor. No parking is included in the project.	AMG & CA Housing Defense Fund PO Box 260770, Encino, CA 91426 alocke@amgland.com; dylan@calhdf.org	Streamlined Residential Review (AB 2011) Density Bonus Tentative Map Design Review	CDD	Damodaran	Approved – June 11, 2024
Downtown Center Restaurant Building and Drive-through 1727 Grant Ave (7th St frontage) APN 141-201-56 P2023-090	Proposed 3,370 square-foot pad building with a drive-through	United Growth Jake Shemano jake@unitedgrowth.com	Use Permit and Design Review	PC	Walker	Approved – May 13, 2024
777 San Marin Drive 773, 775, & 777 San Marin Drive APNs 125-202-03, -04, -05 P2021-077	Proposal to redevelop the former Fireman's Fund office campus as a master planned residential community featuring 1,081 residential units on 36-acres of the 65-acre property.	San Marin Owner, LLC c/o Pete Beritzhoff 408.680.4938 pete@baywestdevelopment.com	General Plan Amendment Master Plan Precise Development Plan Design Review	DRC PC CC	Marshall	Approved - January 23, 2024
Village at Novato 7530 Redwood Blvd APNs 143-011-05, -08 P2020-037	182 new residential units, 14,000 square feet of retail	ROIC CA, LLC Richard Schoebel rschoebel@roireit.net	General Plan Amendment Rezone Use Permit Design Review	DRC PC CC	Damodaran	Approved - January 23, 2024
Valley Oaks Redwood Blvd./Pinkston Road APNs 125-580-17, 125-180-28/38 P2021-047	General plan amendment and master plan proposal to allow development 81 residential dwellings plus 49 JADUs on approximately 38 acres.	Campus Properties, LLC c/o Michael Hooper (415) 298-7571 mhooper@campusproperties.com	General Plan Amendment Master Plan Precise Development Plan Vesting Tentative Map Design Review	DRC PC CC	Walker	Approved – January 9, 2024

SELECT APPROVED PROJECTS STATUS						
PROJECT	**DESCRIPTION**	**APPLICANT**	**PERMITS APPROVED**	**REVIEW BODY**	**PLANNER(S)**	**STATUS/NOTES**
Workforce & Veteran Housing Hamilton Commissary Triangle APN 157-970-07 P2019-055	26 Apartments (workforce) 24 Apartments (veterans) Commercial Kitchen/Events Building: 10,800 square feet 100% Affordable Housing	Homeward Bound of Marin Mary Kay Sweeney (415) 382-3363 mksweeney@hbofm.org	Precise Development Plan Design Review	DRC PC CC	Damodaran	Construction Complete – May 2025
Comstock Commons 200 San Marin Drive APN 124-282-18 P2019-002	6 live/work units	Comstock Commons, LLC. Roy Nee (415) 613-2242 roynee@gmail.com	Master Plan Precise Development Plan Tentative Map or Rezone Design Review	DRC PC CC	Damodaran	Approved – March 22, 2022
Habitat Redwood Boulevard 8161 Redwood Boulevard APN 125-180-49 P2019-054	Development of 80 affordable residential units and 2,200 square feet of commercial office.	Habitat for Humanity (415) 625-1002	General Plan Amendment Master Plan Precise Development Plan Tentative Subdivision Map Design Review	DRC PC CC	Walker	Time Extension Granted Approved – January 25, 2022
North Bay Children's Center 932 C Street APN 157-980-03 P2014-095	Pre-School (19,824 SF)	Susan Gilmore, Executive Director North Bay Children's Center (415) 883-6222 sgilmore@nbcc.net	Use Permit Design Review	PC DRC	Zitelli	Under Construction

Appendix 3

Table 1. Pipeline Risk Results				
Risk Level	Risk Scoring Range	Count of Pipe Segments	Length of Pipeline, miles	Percent in Water System by Length
Extreme	9+	0	0.0	0%
High	7-9	64	5.0	1.4%
Medium	5-7	4,894	136.6	38.7%
Low	3-5	15,555	180.7	51.2%
Negligible	1-3	2202	30.8	8.7%
Total	**-**	**22,715**	**353.1**	**100%**

Table 2. Summary of Tank Risk Results

Facility Name	Risk Score	Risk Level
Lynwood Tank 1	6.71	Medium
Wild Horse Valley Tank	6.49	Medium
Lynwood Tank 2	6.47	Medium
Half Moon Tank	6.28	Medium
San Andreas Tank	6.25	Medium
San Antonio Tank	6.25	Medium
Winged Foot Tank	5.97	Medium
Trumbull Tank	5.87	Medium
Sunset Tank	5.80	Medium
Garner Tank	5.68	Medium
Airbase Tank	5.60	Medium
Pacheco Valle Tank	5.51	Medium
San Mateo Tank	5.33	Medium
Dickson Tank	5.29	Medium
Amaroli Tank	5.18	Medium
Buck Tank	5.17	Medium
Nunes Tank	5.02	Medium
Ponti Water Tank	4.77	Low
Atherton Tank	4.76	Low
Upper Wild Horse Valley Tank	4.73	Low
Cherry Hill Tank 1	4.69	Low
Crest Tank 1	4.51	Low
Center Road Tank	4.45	Low

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Table 3. Summary of Pump Station Risk **Results**

Facility Name	Risk Score	Risk Level
Cherry Hill Pump Station	8.40	High
Lynwood Pump Station	8.39	High
School Road Pump Station	8.22	High
Ridge Road Pump Station	7.67	High
Woodland Heights Pump Station	6.83	Medium
San Marin Pump Station	6.81	Medium
Truman Pump Station	6.35	Medium
Upper Wild Horse Valley Pump Station	6.35	Medium
Indian Hills Hydro Pump Station	6.25	Medium
Winged Foot Pump Station	6.22	Medium
Davies Pump Station	6.04	Medium
Ponti Pump Station	5.87	Medium
Eagle Hydro Pump Station	5.83	Medium
Cabro Court Pump Station	5.71	Medium
Nunes Pump Station	5.69	Medium
Rockrose Hydro Pump Station	5.65	Medium
San Antonio Pump Station	5.65	Medium
San Andreas Pump Station	5.62	Medium
Hayden Hydro Pump Station	5.53	Medium
Diablo Hills Pump Station	5.53	Medium
Trumbull Pump Station	5.33	Medium
Buck Pump Station	5.31	Medium
Garner Hydro Pump Station	5.23	Medium

Table 2. Summary of Tank Risk Results		
Facility Name	Risk Score	Risk Level
Cherry Hill Tank 2	4.33	Low
Windhaven Tank	4.25	Low
Palmer Drive Tank	4.21	Low
Cabro Ct Tank	4.07	Low
Black Point Tank	3.79	Low
Crest Tank 2	3.73	Low
Old Ranch Road Tank	2.86	Negligible

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Table 3. Summary of Pump Station Risk Results		
Facility Name	Risk Score	Risk Level
Bahia Hydro Pump Station	4.81	Low
Windhaven Pump Station	4.55	Low

Table 4. Pipeline R&R Priorities	
Priority Categories	Length of Pipeline (miles)
"High" Risk Pipelines (64 segments)	5.0
Pipelines with Difficult Crossings (bridges, creeks, etc.)	3.7
Plastic Thin-Walled Pipe (<4 in)	14.1
Galvanized Steel Pipe	0.4
Aging Pipelines (60+ years)	104

Table 5. Proposed 5-Year Pipeline R&R Plan		
Year	Priority for Replacement	Length of Pipeline (miles)
Year 1	Existing FY25/26 CIP Projects 1a and 1b	varies
	"High" Risk Pipelines (1.25 miles of 5.0 miles total)	1.25
Year 2	Existing FY26/27 CIP Projects 1a and 1b	varies
	"High" Risk Pipelines (1.25 miles of remaining 3.75 miles)	1.25
Year 3	Existing FY27/28 CIP Projects 1a and 1b	varies
	"High" Risk Pipelines (1.25 miles of remaining 2.5 miles)	1.25
Year 4	Any remaining CIP Projects	TBD
	"High" Risk Pipelines (1.25 miles, which will complete all High Risk Pipelines)	1.25
Year 5	Any remaining CIP Projects	TBD
	Pipelines with Difficult Crossings (bridges, creeks, etc.) There are 3.7 miles of difficult crossings – the 1.25 miles replaced in Year 5 can be selected based on District preferences. The full 3.7 miles of difficult crossings are shown in Figure 8-4.	1.25

Appendix 4A

Appendix 12A. Novato Service Area Storage Facilities - Potable System

Zone	Storage Tanks	Capacity, gallons	Type of Construction	Year Built	Is Critical?	Anchors Needed?	Overflow Depth, ft	Column Support	Overflow Management	Seismic Valves	Notes
1	Lynwood 1	500,000	Welded Steel	1958	Yes	Yes	30.4	Yes	Flood House; High level alarm	No	These tanks are connected by a catwalk
1	Lynwood 2	850,000	Welded Steel	1963	Yes	No	33.4	Yes	Flood House; High level alarm	No	These tanks are connected by a catwalk
1	Atherton	5,000,000	Welded Steel	1973	Yes	No	31.5	Yes	Storm drain (but would flood house); High level alarm	No	
1	Amaroli Tank	4,500,000	Concrete	2002	Yes	No	30.0		High level alarm	No	
1	Palmer Drive	3,000,000	Welded Steel	2008	Yes	Anchored	30.0		High level alarm	No	
2	Sunset	5,000,000	Welded Steel	1963	Yes	No	35.5	Yes	Storm drain (but would overflow storm drain); High level alarm	No	
2	San Mateo	5,000,000	Welded Steel	1966	Yes	No	31.5	Yes	High level alarm	No	
2	Pacheco	5,000,000	Concrete	1975	Yes	No	24.6		Overflows into creek; High level alarm	No	
2	Air Base	1,000,000	Welded Steel	1957	Yes	No	27.5		Overflows into drainage system; High level alarm	No	

Appendix 12A. Novato Service Area Pumping Facilities - Pump Stations

Pump Station Name	Zone		Pump To Tank	Number of	Size, hp	Capacity, gpm	Pressure, psi		Is Critical Asset	Building Material?	Defensible Space	Seismic Resilience - Structure	Seismic Resilience - Equipment	Seismic Resilience - Piping
	From	To		Pumps	Each Pump	Each Pump	Suction	Discharge						
San Marin PS	1	2	San Mateo Tank	3	100	1,800	40	120	Yes	Brick and some wood elements, timber roof	Around a residence and not fully in control of the area around (try to keep clear but don't have much space on their lot)	Built in the 60s,low	anchored	Earthquake could cause damage but wouldn't be as risky as Lynwood
Lynwood PS	1	2	Various Zone 2 Tanks	3	100	1,800	66	146	Yes	Concrete & mostly underground	Completely defensible	"bunker"	anchored	failures in steel pipe around Lynwood

Appendix 4B

Appendix 12B. Summary of Threat Asset Pairs

No.	Threat	Asset
1	Drought	Source Water - Stafford Lake
2	Extreme Heat	Source Water - Stafford Lake
3	Harmful Algal Blooms	Source Water - Stafford Lake
4	Earthquake/Liquefaction	Source Water - Stafford Lake Dam
5	Drought	Source Water - Stafford Lake Dam
6	Drought	Source Water - SCWA
7	Extreme Heat	Source Water - SCWA
8	Harmful Algal Blooms	Source Water - SCWA
9	Earthquake/Liquefaction	AIRBASE TANK
10	Wildfire	AIRBASE TANK
11	Earthquake/Liquefaction	AMAROLI TANK
12	Earthquake/Liquefaction	ATHERTON TANK
13	Wildfire	ATHERTON TANK
14	Earthquake/Liquefaction	LYNWOOD TANK 1
15	Wildfire	LYNWOOD TANK 1
16	Earthquake/Liquefaction	LYNWOOD TANK 2
17	Wildfire	LYNWOOD TANK 2
18	Earthquake/Liquefaction	PACHECO VALLE TANK
19	Earthquake/Liquefaction	PALMER DRIVE TANK
20	Wildfire	PALMER DRIVE TANK
21	Earthquake/Liquefaction	SAN MATEO WAY TANK
22	Wildfire	SAN MATEO WAY TANK
23	Landslides	SAN MATEO WAY TANK
24	Earthquake/Liquefaction	SUNSET TANK
25	Wildfire	SUNSET TANK
26	Landslides	SUNSET TANK
27	Earthquake/Liquefaction	LYNWOOD PUMP STATION
28	High Wind Event	LYNWOOD PUMP STATION
29	Flood	LYNWOOD PUMP STATION
30	Extreme Heat	LYNWOOD PUMP STATION
31	Sea Level Rise	LYNWOOD PUMP STATION
32	Earthquake/Liquefaction	SAN MARIN PUMP STATION
33	High Wind Event	SAN MARIN PUMP STATION
34	Wildfire	SAN MARIN PUMP STATION
35	Landslides	SAN MARIN PUMP STATION
36	Extreme Heat	SAN MARIN PUMP STATION
37	Earthquake/Liquefaction	Distribution Pipelines
38	Landslides	Distribution Pipelines
39	Sea Level Rise	Distribution Pipelines
40	Earthquake/Liquefaction	Pipeline from SCWA Aqueduct
41	Landslides	Pipeline from SCWA Aqueduct
42	Earthquake/Liquefaction	San Marin Control Station (Aqueduct Valve)
43	Flood	San Marin Control Station (Aqueduct Valve)
44	Earthquake/Liquefaction	Stafford Lake WTP
45	High Wind Event	Stafford Lake WTP
46	Flood	Stafford Lake WTP
47	Wildfire	Stafford Lake WTP
48	Extreme Heat	Stafford Lake WTP
49	Dam Failure	Stafford Lake WTP
50	High Wind Event	SCADA System
51	Wildfire	SCADA System
52	Extreme Heat	SCADA System

Appendix 4C

Appendix 12C. Consequence Analysis Summary

No.	Threat	Asset	Loss to Utility: Repair/ Replacements ($)	Loss to Utility: Work Around Costs ($)	Loss to Utility: Loss of Service ($)	Regional Economic Impact ($)	Economic Loss due to Death ($)	Economic Loss due to Injury ($)	Total Consequence ($)
1	Drought	Source Water - Stafford Lake	L	L					L
2	Extreme Heat	Source Water - Stafford Lake	L	L					L
3	Harmful Algal Blooms	Source Water - Stafford Lake	L	L					L
4	Earthquake/Liquefaction	Source Water - Stafford Lake Dam	H	L				Y	H
5	Drought	Source Water - Stafford Lake Dam	L	L					L
6	Drought	Source Water - SCWA	L	L					L
7	Extreme Heat	Source Water - SCWA	L	L					L
8	Harmful Algal Blooms	Source Water - SCWA	L	L					L
9	Earthquake/Liquefaction	AIRBASE TANK	M	L				Y	H
10	Wildfire	AIRBASE TANK	H	L					H
11	Earthquake/Liquefaction	AMAROLI TANK	H	L					H
12	Earthquake/Liquefaction	ATHERTON TANK	H	L					H
13	Wildfire	ATHERTON TANK	H	L					H
14	Earthquake/Liquefaction	LYNWOOD TANK 1	L	L					M
15	Wildfire	LYNWOOD TANK 1	M	L					M
16	Earthquake/Liquefaction	LYNWOOD TANK 2	L	L					M
17	Wildfire	LYNWOOD TANK 2	M	L					M
18	Earthquake/Liquefaction	PACHECO VALLE TANK	H	L					H
19	Earthquake/Liquefaction	PALMER DRIVE TANK	M	L				Y	H
20	Wildfire	PALMER DRIVE TANK	H	L					H
21	Earthquake/Liquefaction	SAN MATEO WAY TANK	H	L				Y	H
22	Wildfire	SAN MATEO WAY TANK	H	L					H
23	Landslides	SAN MATEO WAY TANK	H	L				Y	H
24	Earthquake/Liquefaction	SUNSET TANK	H	L				Y	H
25	Wildfire	SUNSET TANK	M	L					M
26	Landslides	SUNSET TANK	H	L				Y	H
27	Earthquake/Liquefaction	LYNWOOD PUMP STATION	M						M
28	High Wind Event	LYNWOOD PUMP STATION	L	L					L
29	Flood	LYNWOOD PUMP STATION	H	M					H
30	Extreme Heat	LYNWOOD PUMP STATION	L	L					L
31	Sea Level Rise	LYNWOOD PUMP STATION	H	L					H
32	Earthquake/Liquefaction	SAN MARIN PUMP STATION	M						M
33	High Wind Event	SAN MARIN PUMP STATION	L	L					L
34	Wildfire	SAN MARIN PUMP STATION	H	L					H
35	Landslides	SAN MARIN PUMP STATION	H	L					H
36	Extreme Heat	SAN MARIN PUMP STATION	L	L					L
37	Earthquake/Liquefaction	Distribution Pipelines	M	L					M
38	Landslides	Distribution Pipelines	M	L					M
39	Sea Level Rise	Distribution Pipelines	M	M					M
40	Earthquake/Liquefaction	Pipeline from SCWA Aqueduct	M	L					M
41	Landslides	Pipeline from SCWA Aqueduct	M	L					M
42	Earthquake/Liquefaction	San Marin Control Station (Aqueduct Valve)	M	L					M
43	Flood	San Marin Control Station (Aqueduct Valve)	L	L					L
44	Earthquake/Liquefaction	Stafford Lake WTP	H	L					H
45	High Wind Event	Stafford Lake WTP	L	L					L
46	Flood	Stafford Lake WTP	H	L					H
47	Wildfire	Stafford Lake WTP	H	L					H
48	Extreme Heat	Stafford Lake WTP	L	L					L
49	Dam Failure	Stafford Lake WTP	H	L		Y	Y	Y	H
50	High Wind Event	SCADA System	L	M					M
51	Wildfire	SCADA System	M	M					M
52	Extreme Heat	SCADA System	L	L					L

Appendix 4D

Appendix 12D. Risk Analysis Summary

No.	Threat	Asset	Consequence ($)	Vulnerability (unitless)	Threat Likelihood (annualized probability)	Risk ($)
4	Earthquake/Liquefaction	Source Water - Stafford Lake Dam	H	1	M	MH
9	Earthquake/Liquefaction	AIRBASE TANK	H	1	M	MH
11	Earthquake/Liquefaction	AMAROLI TANK	H	1	M	MH
12	Earthquake/Liquefaction	ATHERTON TANK	H	1	M	MH
14	Earthquake/Liquefaction	LYNWOOD TANK 1	M	1	M	MH
16	Earthquake/Liquefaction	LYNWOOD TANK 2	M	1	M	MH
18	Earthquake/Liquefaction	PACHECO VALLE TANK	H	1	M	MH
19	Earthquake/Liquefaction	PALMER DRIVE TANK	H	1	M	MH
21	Earthquake/Liquefaction	SAN MATEO WAY TANK	H	1	M	MH
24	Earthquake/Liquefaction	SUNSET TANK	H	1	M	MH
27	Earthquake/Liquefaction	LYNWOOD PUMP STATION	M	1	M	MH
29	Flood	LYNWOOD PUMP STATION	H	1	H	MH
32	Earthquake/Liquefaction	SAN MARIN PUMP STATION	M	1	M	MH
37	Earthquake/Liquefaction	Distribution Pipelines	M	1	M	MH
40	Earthquake/Liquefaction	Pipeline from SCWA Aqueduct	M	1	M	MH
44	Earthquake/Liquefaction	Stafford Lake WTP	H	1	M	MH
10	Wildfire	AIRBASE TANK	H	1	M	M
13	Wildfire	ATHERTON TANK	H	1	M	M
15	Wildfire	LYNWOOD TANK 1	M	1	M	M
17	Wildfire	LYNWOOD TANK 2	M	1	M	M
20	Wildfire	PALMER DRIVE TANK	H	1	M	M
22	Wildfire	SAN MATEO WAY TANK	H	1	M	M
23	Landslides	SAN MATEO WAY TANK	H	1	M	M
25	Wildfire	SUNSET TANK	M	1	M	M
26	Landslides	SUNSET TANK	H	1	M	M
34	Wildfire	SAN MARIN PUMP STATION	H	1	M	M
35	Landslides	SAN MARIN PUMP STATION	H	1	M	M
38	Landslides	Distribution Pipelines	M	1	M	M
41	Landslides	Pipeline from SCWA Aqueduct	M	1	M	M
42	Earthquake/Liquefaction	San Marin Control Station (Aqueduct Valve)	M	1	M	M
43	Flood	San Marin Control Station (Aqueduct Valve)	L	1	H	M
47	Wildfire	Stafford Lake WTP	H	1	M	M
51	Wildfire	SCADA System	M	1	M	M
50	High Wind Event	SCADA System	M	1	H	ML
1	Drought	Source Water - Stafford Lake	L	1	H	L
2	Extreme Heat	Source Water - Stafford Lake	L	1	H	L
3	Harmful Algal Blooms	Source Water - Stafford Lake	L	1	M	L
5	Drought	Source Water - Stafford Lake Dam	L	1	H	L
6	Drought	Source Water - SCWA	L	1	H	L
7	Extreme Heat	Source Water - SCWA	L	1	H	L
8	Harmful Algal Blooms	Source Water - SCWA	L	1	L	L
28	High Wind Event	LYNWOOD PUMP STATION	L	1	H	L
30	Extreme Heat	LYNWOOD PUMP STATION	L	1	H	L
31	Sea Level Rise	LYNWOOD PUMP STATION	H	1	L	L
33	High Wind Event	SAN MARIN PUMP STATION	L	1	H	L
36	Extreme Heat	SAN MARIN PUMP STATION	L	1	H	L
39	Sea Level Rise	Distribution Pipelines	M	1	L	L
45	High Wind Event	Stafford Lake WTP	L	1	H	L
46	Flood	Stafford Lake WTP	H	1	L	L
48	Extreme Heat	Stafford Lake WTP	L	1	H	L
49	Dam Failure	Stafford Lake WTP	H	1	L	L
52	Extreme Heat	SCADA System	L	1	H	L

Appendix 4E

Appendix 12E. Draft Risk and Resilience Management Strategies (RRMS)

Project No. *Ref. #*	Project Name	Project Description Summary	Threat/ Hazard Category	Threats/ Hazards Addressed *by Asset/ Hazard*	Expected Benefit *Qualitative*	Cost *High/Med./Low*	Recommended Priority *High/Medium/Low/ Opportunistic*
PLANNING AND STUDIES							
1	Pipeline Seismic Analysis	Evaluate seismic performance of pipelines following American Lifelines Alliance Pipeline Fragility assessment methodology. (Removing pipes off of bridges included in Asset Management work).	Earthquake	Distribution Pipelines/Earthquake	To identify risk pipelines to further support pipeline replacement prioritization. Also identify pipes that require seismic mitigation when replacing pipes for other purposes.	Low	High
2	Tank Seismic Evaluation Update	Evaluate seismic performance of tanks considering anchoring, structural capacity, wave slosh height, overflow management. Could include backbone tanks only or include all tanks.	Earthquake	Tanks/Earthquake	To identify specific improvements needed to improve seismic resilience of tanks.	Medium (Depends on Number of Tanks)	High
3	Pump Station Evaluation	Evaluate seismic performance of pump stations considering structures, mechanical, electrical, and controls equipment.	Earthquake	Pump Station/Earthquake	To identify specific improvements needed to improve pump station resilience of tanks.	Medium (Depends on Number of Tanks)	High
4	Conduct an All-Hazards Risk and Resilience Assessment	Develop a Risk and Resilience Assessment that integrates the current natural hazard risk assessment with an assessment that evaluates malevolent threats, dependency hazards, and proximity hazards for the entire District water system. Use industry best practices to complete the assessment and identify improvements.	All-Hazards	All-Hazards	To identify additional risks to the District's Novato system.	Low	High
5	Stafford Treatment Plant Facility Risk Assessment	Develop a risk and resilience specific to the Stafford Treatment Plant, including evaluating vulnerabilities of buildings, processes, and equipment. Consider seismic, wildfire, high wind event, flood, and dam failure hazards. Include a condition assessment.	General	Stafford WTP	To identify additional risks to the Stafford WTP.	Low	Medium

Appendix 12E. Draft Risk and Resilience Management Strategies (RRMS)

Project No. *Ref. #*	Project Name	Project Description Summary	Threat/ Hazard Category	Threats/ Hazards Addressed *by Asset/ Hazard*	Expected Benefit *Qualitative*	Cost *High/Med./Low*	Recommended Priority *High/Medium/Low/ Opportunistic*
6	Evaluate the Potential for distributed energy resources	Evaluate the potential for DERs to support operations during PSPS events. A DER system generally includes a solar array and battery backups. A resilience-first implementation of a DER system allows for seamless transition between grid power, battery power, and backup generators.	Climate change	Facilities	Reduces the consequences from various threats and hazards.	Medium	Low
7	Business Continuity Planning	Develop a Business Continuity Plan to ensure continuity of business services and operations following an emergency. This project includes the development, implementation, and maintenance of the Business Continuity Plan. It is anticipated that additional projects may be identified through this project to improve business continuity and disaster recovery.	All	All	Reduced consequences due to a longer and less efficient response and recover time.	Low	Low
8	Document SCADA Network	Complete a review of the current SCADA network architecture. Develop a plan to upgrade the network to current industry best practices to achieve the reliability and cybersecurity desired by the District. This may also be completed as part of a SCADA Master Plan.	General	General	Reduces consequences and vulnerabilities if a cyberattack were to occur.	Low	Medium
9	SCADA Master Plan Development	Complete a SCADA Master Plan to take a holistic approach to upgrades, maintenance, and security of the SCADA system. This plan may inform both capital and operational planning.	General	General	Reduces consequences and vulnerabilities if a cyberattack were to occur.	Low	Medium

Appendix 12E. Draft Risk and Resilience Management Strategies (RRMS)							
Project No. *Ref. #*	**Project Name**	**Project Description Summary**	**Threat/ Hazard Category**	**Threats/ Hazards Addressed** *by Asset/ Hazard*	**Expected Benefit** *Qualitative*	**Cost** *High/Med./Low*	**Recommended Priority** *High/Medium/Low/ Opportunistic*
STAFF DEVELOPMENT							
10	Establish NIMS ICS Certification Goals	Confirm current certifications and establish guidance on desired levels of training and certifications for different Incident Management Team (IMT) roles. For example, a staff member who serves as the Incident Commander/Liaison should have the highest level of training (e.g. IS-300/400, general staff (e.g. the operations chief) should have a medium level of training (e.g. IS-700/800) and any staff who participates in emergency response should have a minimum amount of training (e.g. IS-100/200).	General	General	Reduces consequences and loss of service duration due to staff preparedness.	Low	High
11	Develop an Integrated Preparedness Plan	The District should develop an Integrated Preparedness Plan (IPP, formerly known as Multi-Year Training and Exercise Plans) to establish goals for staff emergency preparedness training and exercising for the District.	General	General	Reduces consequences and loss of service duration due to staff preparedness.	Medium	High
12	Staff Succession Planning	Develop succession planning for key staff, including passthrough of institutional knowledge, critical system weak points. Confirm SOPs are thorough and accurate.	General	General	Reduces consequence of knowledge gaps when staff leave	Low	High
ASSET MANAGEMENT PROJECTS							
13	Critical Spare Parts	Develop an inventory list of critical spare parts including minimum quantity needed, quantity on hand, assets associated with the part, and location of part. Long lead time items or items not having a known good spare shall be procured and kept in secure and readily accessible location.	Asset Failure	General	Reduced consequence of threats to the system	Medium	Medium
14	Consolidate all condition and risk studies into one central location (GASB, RRA, AM, etc.)	The District has numerous evaluations of District assets that include data such as asset condition, book value, replacement cost, and risks to the individual facilities and the utility as a whole. These should be integrated to more holistically inform risk and resilience management at the District.	General	General	Reduces likelihood of knowledge/document gaps occurring	Low	Medium

Appendix 12E. Draft Risk and Resilience Management Strategies (RRMS)

Project No. *Ref. #*	**Project Name**	**Project Description Summary**	**Threat/ Hazard Category**	**Threats/ Hazards Addressed** *by Asset/ Hazard*	**Expected Benefit** *Qualitative*	**Cost** *High/Med./Low*	**Recommended Priority** *High/Medium/Low/ Opportunistic*
SYSTEM IMPROVEMENTS							
15	Pipeline Seismic Retrofits	Implement critical projects identified in Pipeline Seismic Assessment. Until quantity of projects are known, include a capital outlay line item in CIP budget.	Earthquake	Distribution Pipelines/Earthquake	**Reduces consequences earthquake hazards for pipeline assets.**	**Medium**	**Medium**
16	Tank Seismic Retrofits	Implement critical projects identified in Tank Seismic Assessment. Until quantity of projects are known, include a capital outlay line item in CIP budget.	Earthquake	Tanks/Earthquake	**Reduces consequences earthquake hazards for tanks.**	**Medium**	**Medium**
17	Pump Station Seismic Retrofits	Implement critical projects identified in Pump Station Seismic Assessment. Until quantity of projects are known, include a capital outlay line item in CIP budget.	Earthquake	Pump Stations/Earthquakes	**Reduces consequences earthquake hazards for pump station facilities.**	**Medium**	**Medium**
18	Stafford Treatment Plant High Service Pump Station - Pump to Zone 2	Modify the pump station to include one or two pumps supplying Zone 2 to provide further redundancy to Zone 2.	**General**	**General**	**Reduces consequences and likelihood of loss of service to Zone 2 and 3.**	**Medium**	**Low**
GENERAL RESILIENCE AND EMERGENCY PREPAREDNESS PROJECTS							
19	Develop seismic design standards for backbone pipelines, and other facilities.	Establish standards that build resilience into system during development and other infrastructure replacement (e.g. restrained joint DIP across liquefiable soils).	Earthquake	General/Earthquakes	Reduces consequences earthquake hazards for new facilities/pipelines	Low	Medium
20	Collaboration with Critical Customers	Engage in discussion with the District's critical customers, such as medical facilities, to understand their water storage limitations in an emergency event to identify NMWD's level of service	General	General	Reduces regional social and economic impact	Low	High

Appendix 5A

Project Name:	Pipeline Replacement for SMART crossing east of 101.
CIP Project N0.:	1a3 **PriorityLevel:** Medium
Project Type:	Pipeline Replacement
Location:	SMART crossing east of 101

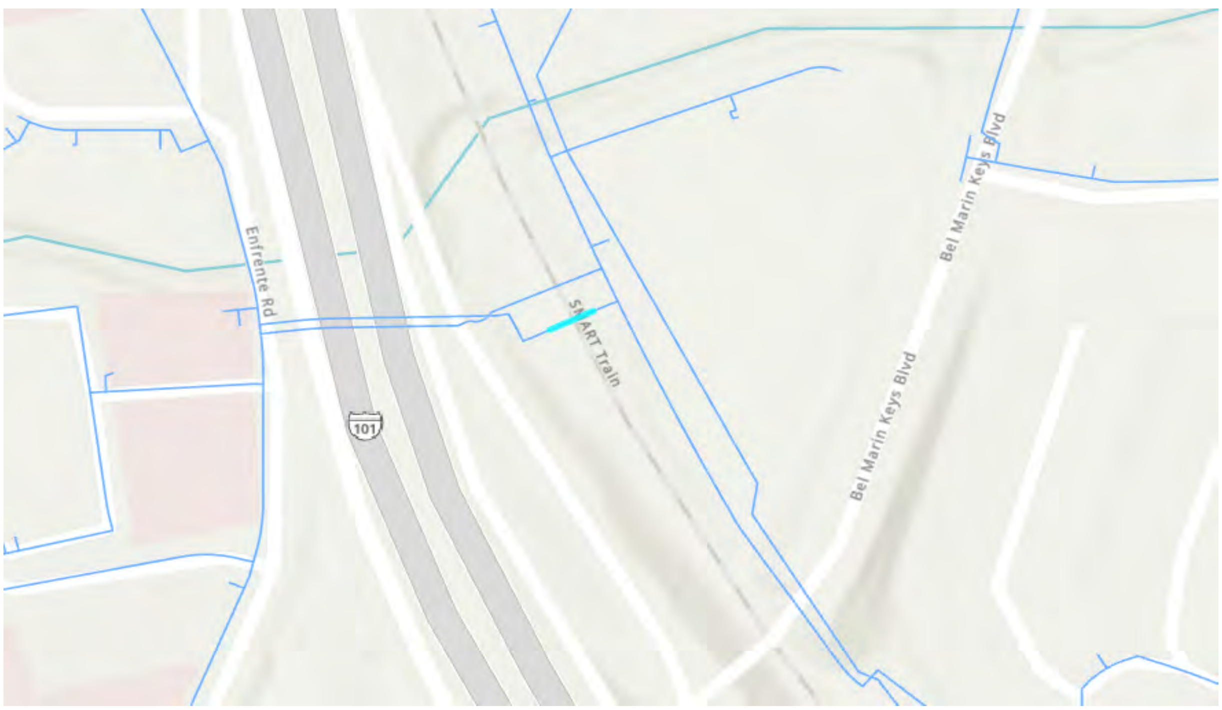
Project Description

Replacement of an existing 8" steel mortar lined asphalt main crossing the SMART train tracks east of 101, near the intersection of Nave Dr. and Bel Marin Keys Blvd.

Project Justification

Aging pipe network. Replacement needed to strengthen the resilience of the NMWD system.

Project Detail Map



Item	Quantity	Unit	Unit Cost	Total Cost
8" Water Main	60	LF	$350	$21,000
Tie ins	2	EA	$6,250	$12,500
			Contingency (30%)	$10,050
			Construction Total	$43,550
			Engineering, CM, Admin., and Permitting Cost (30%)	$14,000
			Total	$58,000

Project Name:	Pipeline Replacement for 101 Crossing		
CIP Project N0.:	1a3	**PriorityLevel:**	Medium
Project Type:	Pipeline Replacement		
Location:	Entrada Dr.		

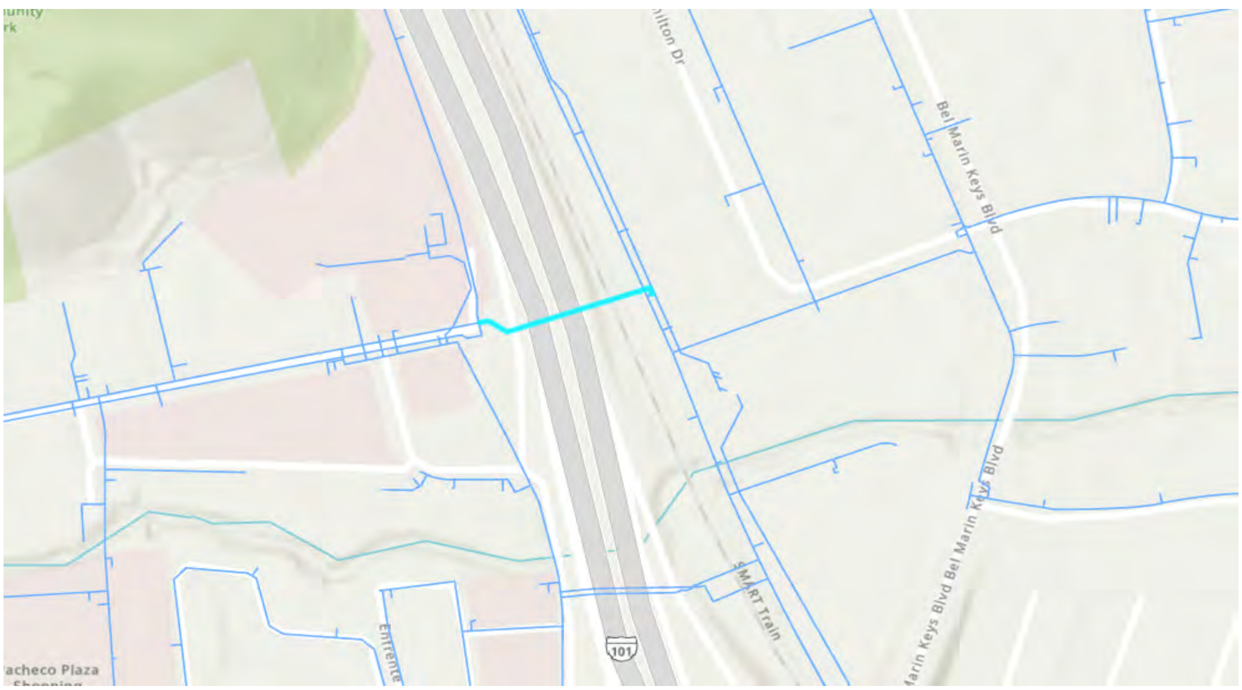
Project Description

Replacement of an existing 12" steel mortar lined asphalt main crossing 101 at Entrada Dr.to Hamilton Dr.

Project Justification

Aging pipe network. Replacement needed to strengthen the resilience of the NMWD system.

Project Detail Map



Item	Quantity	Unit	Unit Cost	Total Cost
12" Water Main	340	LF	$500	$170,000
Tie ins	2	EA	$6,250	$12,500
			Contingency (30%)	$54,750
			Construction Total	$237,250
			Engineering, CM, Admin., and Permitting Cost (30%)	$72,000
			Total	$310,000

Project Name:	Pipeline Replacement for Redwood Landfill		
CIP Project N0.:	1a3	**PriorityLevel:**	Medium
Project Type:	Pipeline Replacement		
Location:	Various location near Redwood Landfill		

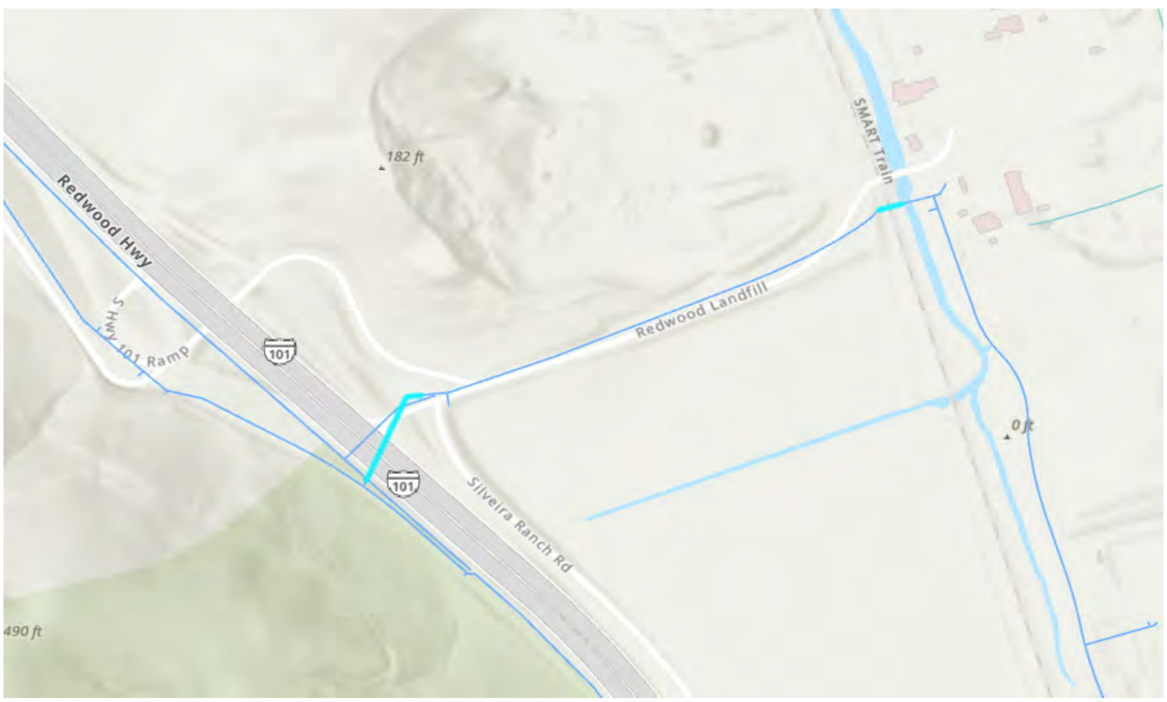
Project Description

Replacement of an existing 12" steel motar lined asphalt main located near Redwood Landfill.

Project Justification

Aging pipe network. Replacement needed to strengthen the resilience of the NMWD system.

Project Detail Map



Item	Quantity	Unit	Unit Cost	Total Cost
12" Water Main	445	LF	$500	$222,500
Tie ins	4	EA	$6,250	$25,000
			Contingency (30%)	$74,250
			Construction Total	$321,750
			Engineering, CM, Admin., and Permitting Cost (30%)	$97,000
			Total	$419,000

Project Name:	Pipeline Replacement for Roblar Dr.		
CIP Project N0.:	1a3	**PriorityLevel:**	Medium
Project Type:	Pipeline Replacement		
Location:	Roblar Dr.		

Project Description

Replacement of an existing 12" steel mortar lined asphalt main crossing the SMART train tracks.

Project Justification

Aging pipe network. Replacement needed to strengthen the resilience of the NMWD system.

Project Detail Map

Item	Quantity	Unit	Unit Cost	Total Cost
12" Water Main	75	LF	$500	$37,500
Tie ins	2	EA	$6,250	$12,500
			Contingency (30%)	$15,000
			Construction Total	$65,000
			Engineering, CM, Admin., and Permitting Cost (30%)	$20,000
			Total	$85,000

Project Name:	Pipeline Replacement for Kaehler St.		
CIP Project N0.:	1a3	**PriorityLevel:**	Medium
Project Type:	Pipeline Replacement		
Location:	Kaehler St.		

Project Description
Replacement of an existing 12" Steel-mortar lined asphalt main crossing the SMART train tracks roughly at Bolling Cir.

Project Justification
Aging pipe network. Replacement needed to strengthen the resilience of the NMWD system.

Project Detail Map

Item	Quantity	Unit	Unit Cost	Total Cost
12" Water Main	65	LF	$500	$32,500
Tie ins	2	EA	$6,250	$12,500
Hydrants	0	EA	$5,000	$0
Service Replacement	0	EA	$1,500	$0
			Contingency (30%)	$13,500
			Construction Total	$58,500
			Engineering, CM, Admin., and Permitting Cost (30%)	$18,000
			Total	$77,000

NORTH MARIN
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