City of Mountain View


# Water Master Plan

Prepared by HydroScience Engineers
for the City of Mountain View | August 2022

HydroScience

City of Mountain View

# Water Master Plan

Prepared by HydroScience Engineers, Inc.



August 2022

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AC | asphalt concrete |
| ACP | asbestos cement pipe |
| ADD | average day demand |
| AFY | acre-feet per year |
| ARV | air relief valve |
| ATS | automatic transfer switch |
| AWWA | American Water Works Association |
| BAWSCA | Bay Area Water Supply and Conservation Agency |
| BDPL | Bay Division Pipeline |
| C-factor | coefficient of friction factor |
| Cal OES | California Governor’s Office of Emergency Services |
| Cal Water | California Water Service Company |
| ccf | hundred cubic feet |
| CCP | Concrete Cylinder Pipe |
| CEQA | California Environmental Quality Act |
| CIP | cast iron pipe, capital improvement program/plan |
| City | City of Mountain View |
| CMU | Concrete Masonry Unit |
| CVP | Central Valley Project |
| DDW | Division of Drinking Water |
| DIP | ductile iron pipe |
| DSS Model | Demand Side Management Decision Support System Model |
| DU | dwelling unit |
| DWR | Department of Water Resources |
| EPS | extended period simulation |
| ESDC | engineering services during construction |
| FCV | flow control valve |
| FF | fire flow |
| fps | feet per second |
| ft | feet, foot |
| FY | fiscal year |
| General Plan | 2030 Mountain View General Plan |
| GFCI | ground-fault circuit interrupter |
| GP | general purpose |
| GIS | Geographic Information System |

# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| gpd | gallon(s) per day |
| gpd/acre | gallon(s) per day per acre |
| gpd/DU | gallon(s) per day per dwelling unit |
| gpm | gallon(s) per minute |
| GSA | Groundwater Sustainability Agency |
| GSAP | Grade Separation and Access Project |
| HDPE | high density polyethylene pipe |
| HGL | hydraulic grade line |
| hp | horsepower |
| HydroScience | HydroScience Engineers, Inc. |
| HVAC | heating, ventilation, and air conditioning |
| ISG | Individual Supply Guarantee |
| ISRF | Infrastructure State Revolving Fund Program |
| IT | Information Technology |
| MCC | Motor Control Center |
| MDD | maximum day demand |
| MFR | multi-family residential |
| MG | million gallons |
| MGD | million gallons per day |
| PF | peaking factor |
| PHD | peak hour demand |
| PRV | pressure-reducing valve |
| psi | pounds per square inch |
| PSV | pressure-sustaining valve |
| PV | photovoltaic |
| PVC | polyvinyl chloride pipe |
| ROW | right-of-way |
| RTU | remote telemetry unit |
| RWFS | Recycled Water Feasibility Study |
| RWQCP | Regional Water Quality Control Plant |
| RWS | City and County of San Francisco’s Regional Water System |
| SCADA | supervisory control and data acquisition |
| SFPUC | San Francisco Public Utilities Commission |
| SFR | single-family residential |
| SR | state route |

# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| SWP | State Water Project |
| TM | technical memoranda, technical memorandum |
| UPS | uninterruptible power supply |
| USBR | United States Bureau of Reclamation |
| UWMP | Urban Water Management Plan |
| Valley Water | Santa Clara Valley Water District |
| VFD | variable frequency drive |
| VSP | variable speed pump |
| WTP | water treatment plant |

# SECTION 1 – INTRODUCTION AND PURPOSE

HydroScience Engineers, Inc. (HydroScience) was retained by the City of Mountain View (City), to prepare an update to the City's Water Master Plan (Master Plan), which includes development of a Capital Improvement Plan (CIP) based on the current (2021) and future (2030) planning horizons. This section outlines the background and Master Plan objectives.

## 1.1 Background

The City is located in Santa Clara County at the south end of the San Francisco Bay (see **Figure 1-1**), roughly 35 miles south of San Francisco. It is an urban, industrial, and residential community serving a population of approximately 80,000.

In 2010, the City prepared its previous Water Master Plan. Since that time, the City has periodically maintained and updated its potable water hydraulic model to reflect distribution system infrastructure improvements.

In an effort to assure the safety and reliability of the water supply and distribution system, the City initiated the development of this Master Plan. Considerations for drought and population growth have prompted retailers to more thoroughly evaluate available water supplies and conditions that may require the use of emergency storage, supply, and operation. To that end, the City conducted a comprehensive update of the hydraulic model to evaluate both emergency water shortage conditions as well as normal hydraulic operations as part of this iteration of the Master Plan.

### 1.1.1 Service Area

The City, along with California Water Service Company (Cal Water), provide water service to the community and the service area coincides with the City's municipal boundary (see **Figure 1-2**). The City's water supply sources consist of purchased treated water from the San Francisco Public Utilities Commission (SFPUC) and Santa Clara Valley Water District (Valley Water), groundwater, and recycled water produced at the City of Palo Alto's Regional Water Quality Control Plant (RWQCP).

The City provides drinking water to the community via a network of over 175 miles of pipelines and three storage and pumping facilities to maintain system pressure and provide active and emergency storage. Neighboring water retailers and wholesalers include the City of Palo Alto, Cal Water's Los Altos District, and the City of Sunnyvale. Nearby recycled water producers include the City of Sunnyvale.

## 1.2 Objectives

The objectives of this Master Plan project are to:

- Conduct a comprehensive review and update the City's hydraulic model.
- Evaluate the City's water distribution system under both normal and peak operating conditions.
- Evaluate the City's water distribution system under water shortage conditions.

- Evaluate the City's water storage and supply.
- Develop a CIP and time schedule to address system deficiencies and to support system reliability based on a prioritized list of criteria.

These objectives were developed in collaboration with City staff.

### 1.2.1 Previous Studies/Existing Documents

The following is a brief description of previous studies and documents reviewed and used in the preparation of this Master Plan.

- **Water System Master Plan (August 2010):** The 2010 Water System Master Plan served as a comprehensive update to the 1990 Water Master Plan. The 2010 update addressed updates to the hydraulic model, revised growth assumptions, design criteria and recommendations for hydraulic improvements. Additionally, the 2010 update provided infrastructure condition replacement recommendations.
- **City of Mountain View 2020 Urban Water Management Plan (June 8, 2021):** The Urban Water Management Plan (UWMP) provides an analysis of the City's available water supply, during normal and dry-year scenarios, compared to current and projected water demand. The UWMP is a link between land use planning and water supply planning, developed to evaluate if sufficient water is available to meet the needs of Mountain View's existing and future water customers. Projected demands look 20 years into the future to assure that the City has planned for, and is prepared to address, the water needs within their service area. The 2020 UWMP also includes an update to the Water Shortage Contingency Plan.

The following technical memoranda (TMs) were completed in conjunction with the Master Plan Study and are incorporated as references to the Master Plan. Where appropriate, details and summaries of findings have been included in the body of the Master Plan Report.

- **TM #1 Calibration Plan:** The purpose of this TM is to establish an updated calibration plan complete with test locations and field testing procedures. Field testing as detailed in the plan was implemented by the City with support from HydroScience in October 2020. Results from the hydrant testing and system monitoring served as the basis for calibration of the updated hydraulic model.
- **TM #2 Water and Sewer System Modeling Software Evaluation:** This TM presents an evaluation of available software programs from the two leading software vendors, Innovyze and Bentley, for both water and sewer hydraulic modeling. The software evaluation included multiple criteria including: purchase and subscription pricing; available features and applications; software stability; software accuracy; platform compatibility needs/interface (i.e. ArcGIS, AutoCAD, SCADA); ease of use; technical support; and vendor reputation. It was recommended that the City continue to use InfoWater for water modeling.
- **TM #3 Water and Sewer Basic Assumptions and Criteria:** The purpose of this TM was to present the basic assumptions and performance criteria that were subsequently used for hydraulic model evaluation for both water and sewer systems. The water distribution system performance criteria recommended in the TM included pressure, velocity, water age, fire flow requirements, and supply and storage requirements under various system conditions (i.e. maximum day demand, peak hour demand, etc.).

- **TM #4 Water and Sewer Hydraulic Model Data:** The purpose of this TM is to present the data and process used to update and build the water distribution system and sewer collection system hydraulic models. For the water distribution system hydraulic model, the TM summarizes the condition and elements in the City's hydraulic model prior to updates made for the 2021 Master Plan and documents the data sources referenced to update the model and the data review and process implemented to update the model.

In addition to the TMs completed, a comprehensive corrosivity evaluation was completed, as described below:

- **2022 City of Mountain View Citywide Soil Corrosivity Survey & Corrosion Control Evaluation Report:** This report was prepared by JDH Corrosion Consultants in support of this master planning effort. The purpose for this comprehensive soil corrosivity evaluation is to develop a database related to the corrosion potential of the soils throughout the City to asbestos cement, ductile iron, cast iron, dielectric coated steel and mortar-coated steel water main pipes. Furthermore, based on these findings, the objective is to provide long term corrosion control strategies for both new and existing water mains and to incorporate these strategies into the Master Plan. The report is included as **Appendix A**.

## 1.3 Report Organization

This Master Plan consists of ten sections followed by appendices that provide supporting documentation for the analyses present in the body of the Master Plan. The sections are as follows:

- **SECTION 1 – Introduction and Purpose:** This section presents the background leading to the development of this Master Plan, a description of previous studies, and objectives and organization of the Master Plan.
- **SECTION 2 – Water Supply:** This section provides a general overview of the available water supplies to the service area including, wholesalers, groundwater wells, emergency interties, and recycled water.
- **SECTION 3 – System Description:** This section describes the City's water supply, storage, and distribution system infrastructure; pressure zones; and general system operation.
- **SECTION 4 – Water Demand Analysis:** This section outlines the land use categories identified for existing and future conditions and details the methodology and results of the water demand analysis, which in turn was used to populate and calibrate the hydraulic model.
- **SECTION 5 – Hydraulic Model Update and Calibration:** This section documents the process and updates made to the hydraulic model as well as the method, assumptions, and results of the model calibration.
- **SECTION 6 – Storage and Supply Analysis:** This section details the basis for the storage and supply criteria and presents the results of the analyses under three emergency scenarios considering wholesale water supply outages.
- **SECTION 7 – Results of Hydraulic Modeling Analyses:** This section details the scenarios developed as part of the hydraulic model development and reviews the results and notable deficiencies identified under each scenario.

- **SECTION 8 – Condition Assessment:** This section summarizes the results of the onsite condition assessment performed in July 2020 as well as the results of the desktop assessment of the distribution pipeline, which form the basis of the CIP recommendations.
- **SECTION 9 – Capital Improvement Program:** This section presents the recommended capital improvement projects, costs, and timeline for implementation.
- **SECTION 10 – References:** This section provides a list of the references used in the development of the Master Plan.

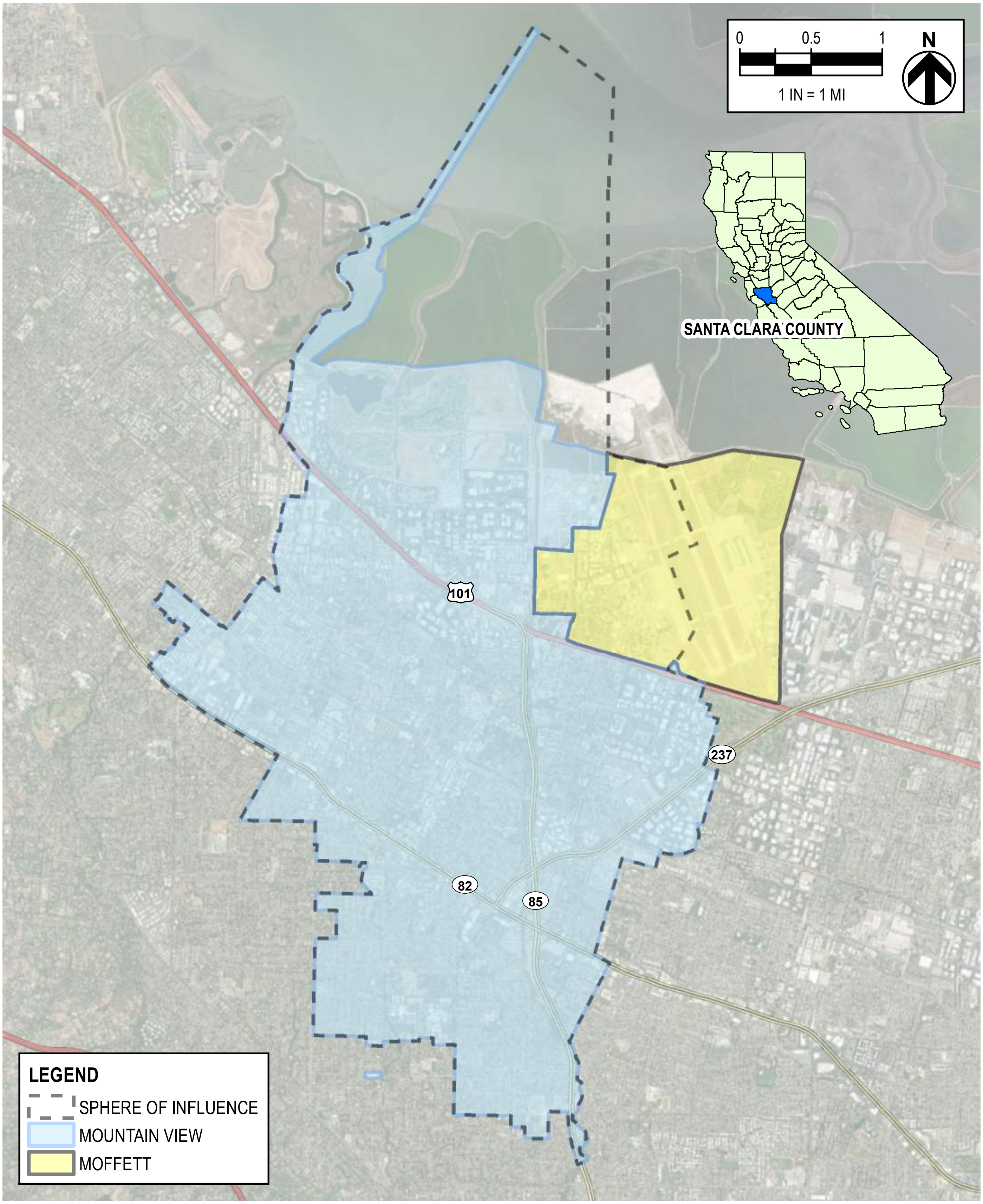


**FIGURE 1-1**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
PROJECT LOCATION MAP

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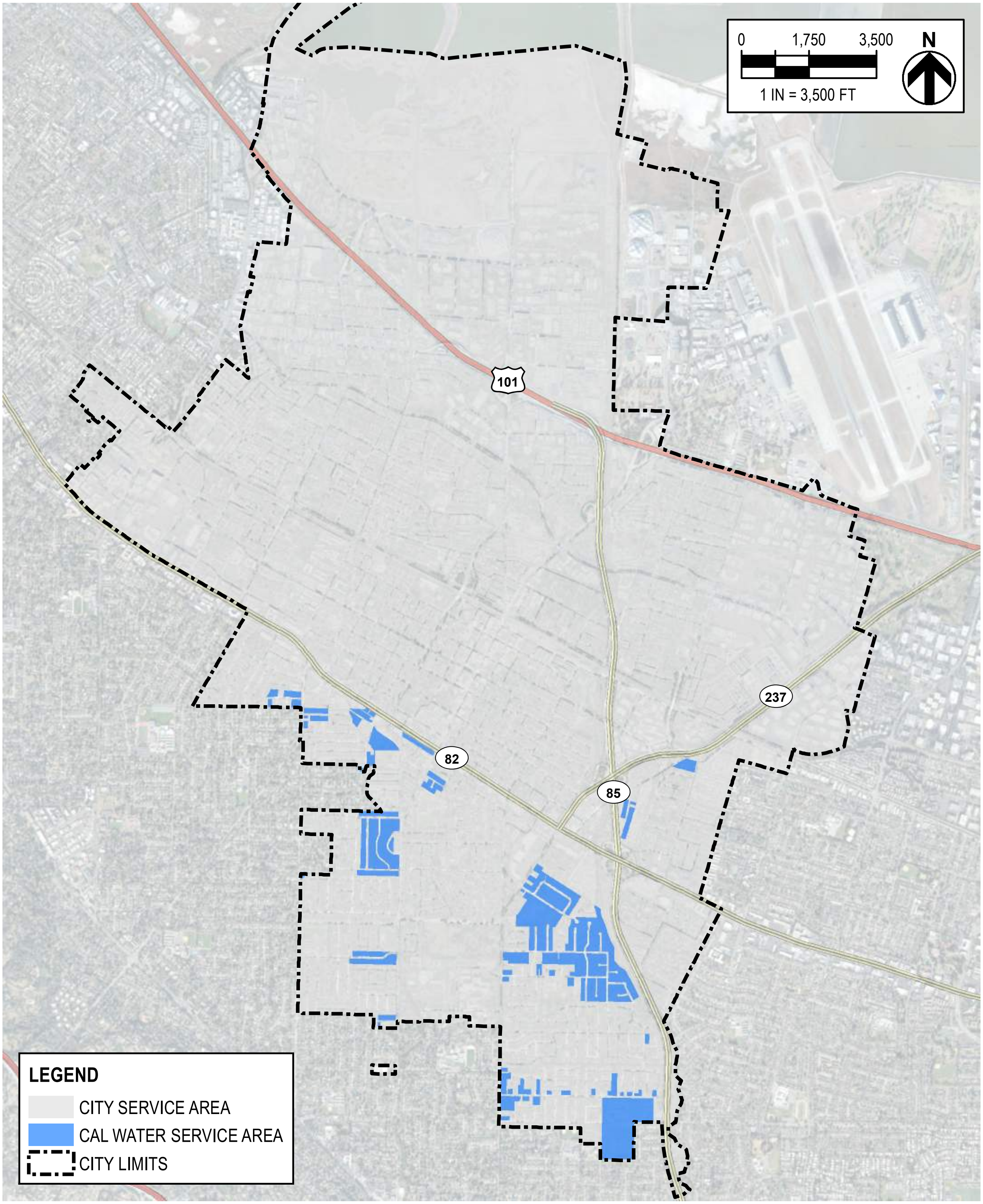


**FIGURE 1-2**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
WATER SERVICE AREA

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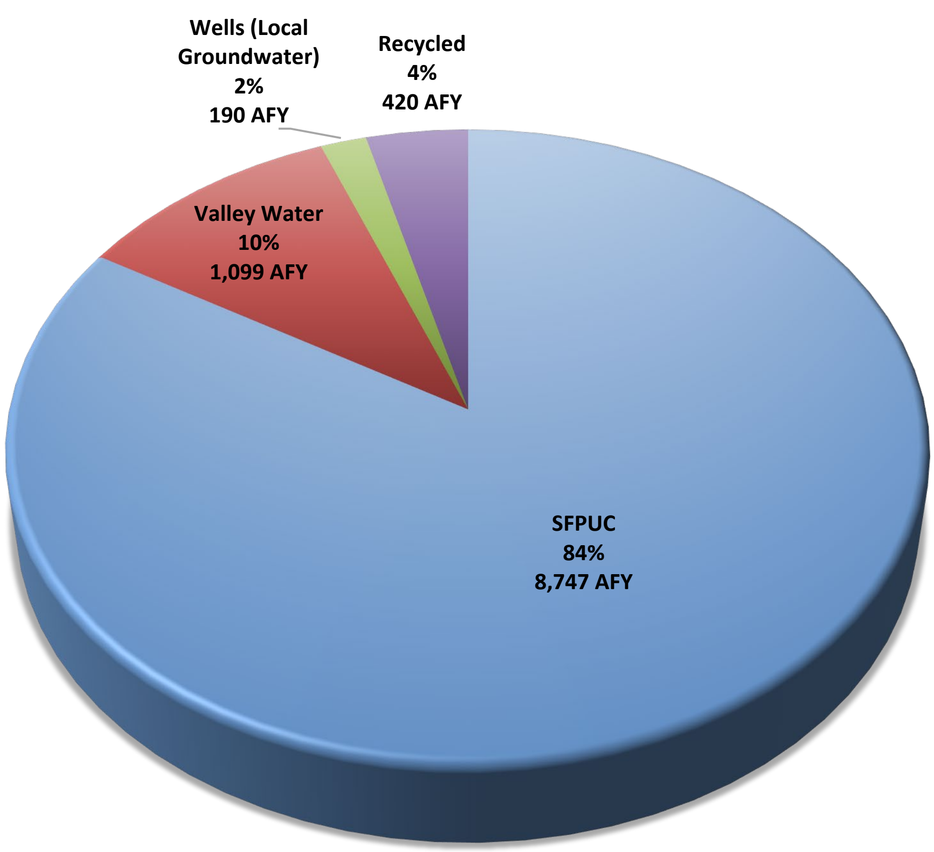
# SECTION 2 – WATER SUPPLY

The City retails potable drinking water and recycled water within the City limits. Cal Water, an investor-owned water utility, also retails potable drinking water from Valley Water and groundwater wells in pocket areas of the City.

The City has three sources of potable water supply: purchased surface water from SFPUC, purchased treated surface water from Valley Water, and groundwater from four, City-owned and operated wells. The City also has potable distribution system inter-ties to the cities of Sunnyvale and Palo Alto that are reserved for use in case of an emergency. An additional source of non-potable water comes from the RWQCP in the form of recycled water.

**Figure 2-1** represents the percentage of water supply from each source for the year 2020 as described in the City's 2020 UWMP. **Figure 3-1** shown in the following section illustrates the potential sources of supply (wells, SFPUC, Valley Water, and emergency interties) for the City within each pressure zone.

**Figure 2-1: Water Supply Sources (2020)**



## 2.1 Purchased Water – SFPUC and Valley Water

The City receives water from the City and County of San Francisco's Regional Water System (RWS), which is operated by the SFPUC. This supply is predominantly from the Sierra Nevada, delivered through the Hetch Hetchy aqueducts, but also includes treated water produced by the SFPUC from its local watersheds and facilities in Alameda and San Mateo Counties. The SFPUC supply is primarily unfiltered Hetch Hetchy water with a blend of filtered water from the Sunol Valley water treatment plant (WTP). The City has an Individual Supply Guarantee (ISG) of 12.46 MGD (or approximately 13,957 AFY), which is the guaranteed amount allocated to the City in the agreement with SFPUC. The minimum purchase amount is 8.93 MGD (10,003 AFY). Due to the minimum purchase requirement, the City's typical strategy is to maximize the use of the SFPUC water supply. The City receives water from the SFPUC from three turnouts (Escuela – Turnout 5, Escuela – Turnout 7, and Whisman – Turnout 14) from SFPUC's Bay Division Pipelines No. 3 and No. 4.

The City also purchases treated surface water from Valley Water through an entitlement of imported Central Valley Project (CVP) water and the State Water Project (SWP) water, as well as surface water from local reservoirs. Valley Water's imported water is conveyed through the Sacramento-San Joaquin Delta then pumped and delivered to Santa Clara County through three main pipelines: the South Bay Aqueduct, which carries water from the SWP, and the Santa Clara and Pacheco Conduits, which bring water from the federal CVP. Treated water delivered to the City is typically treated at Valley Water's Rinconada Water Treatment Plant. The current contractual agreement between the City and Valley Water sunsets in 2054; it was effective in 1984 with a 70-year term. There is a single turnout connection from Valley Water's West Pipeline to the City's distribution system located in the southern end of the distribution system.

## 2.2 Local Groundwater

The City owns and operates four active groundwater wells (Wells 19, 21, 22, and 23). The wells are used by the City as a supplemental source to the imported SFPUC and Valley Water supplies. Valley Water is responsible for groundwater management in Santa Clara County and manages two groundwater subbasins: the Santa Clara Subbasin (DWR Subbasin 2-9.02) and the Llagas Subbasin (DWR Subbasin 3.301). In its water supply planning, Valley Water frequently splits the Santa Clara Subbasin into two subareas, the Santa Clara Plain and the Coyote Valley.

The City's groundwater comes from the Santa Clara Plain subarea of the Santa Clara Subbasin. While the basin is not adjudicated, Valley Water does not limit the volume of water extracted from the basin. Valley Water uses water rates as a groundwater management tool, modifying the treated water surcharge to encourage or discourage groundwater pumping. All the active wells are operated on a weekly basis. Water supplied by these wells is fluoridated but is not chlorinated.

## 2.3 Emergency Interties

The City has inter-connections for emergency transfers with the cities of Sunnyvale and Palo Alto. There are six un-metered interties which are intended only for short-term disruptions in supply within the immediate area of the intertie. **Table 2-1** lists the emergency interties. Although the interties are directly connected to Zone 2, the City has the ability to move water between all pressure zones using pressure-reducing valves (PRVs) discussed in **Section 3.1.3**.

**Table 2-1: Emergency Interties**

| Location | Inter-Agency Connection | Pressure Zone |
|---|---|---|
| Maude/237 | Sunnyvale | 2 |
| Bernardo/Evelyn | Sunnyvale | 2 |
| El Camino/Crestview | Sunnyvale | 2 |
| Knickerbocker/Dale | Sunnyvale | 2 |
| Monroe/Silva | Palo Alto | 2 |
| Del Medio/Silva | Palo Alto | 2 |

## 2.4 Recycled Water

The City's existing recycled water irrigation program distributes recycled water from the RWQCP to some of the City's largest water customers in the North Bayshore area. The system consists of pumping from the RWQCP, a network of distribution pipeline, and the Shoreline Irrigation Pump Station. There are approximately 52 recycled water customers in the City that have a combined peak day recycled water demand of 1.2 MGD. The use and expansion of recycled water throughout the City will continue to offset the demands on the potable water system. When developing the water demand analysis, only potable water was considered in the development of water use factors. The City published an update to their 2014 Recycled Water Feasibility Study (RWFS) in March 2022 to incorporate changes in existing and future planning strategies. As part of this effort, the City has identified areas of potential recycled water expansion. **Figure 2-2** presents the existing recycled water facilities and the recycled water use area as well as the potential expansion areas.

## 2.5 California Water Service Company – Los Altos Suburban District

Cal Water's Los Altos Suburban District (District) serves the City of Los Altos, fringe sections of the cities of Cupertino, Los Altos Hills, Mountain View, Sunnyvale and adjacent unincorporated areas of Santa Clara County. Relative to the District, the City is located along the northwestern boundary with small pocket areas within the City that are served by the District. District water is comprised of purchased water from Valley Water and local groundwater. Cal Water serves roughly 2% of the water demand within the City boundaries. The service area map in the previous section (**Figure 1-2**) identifies the areas served by the District.

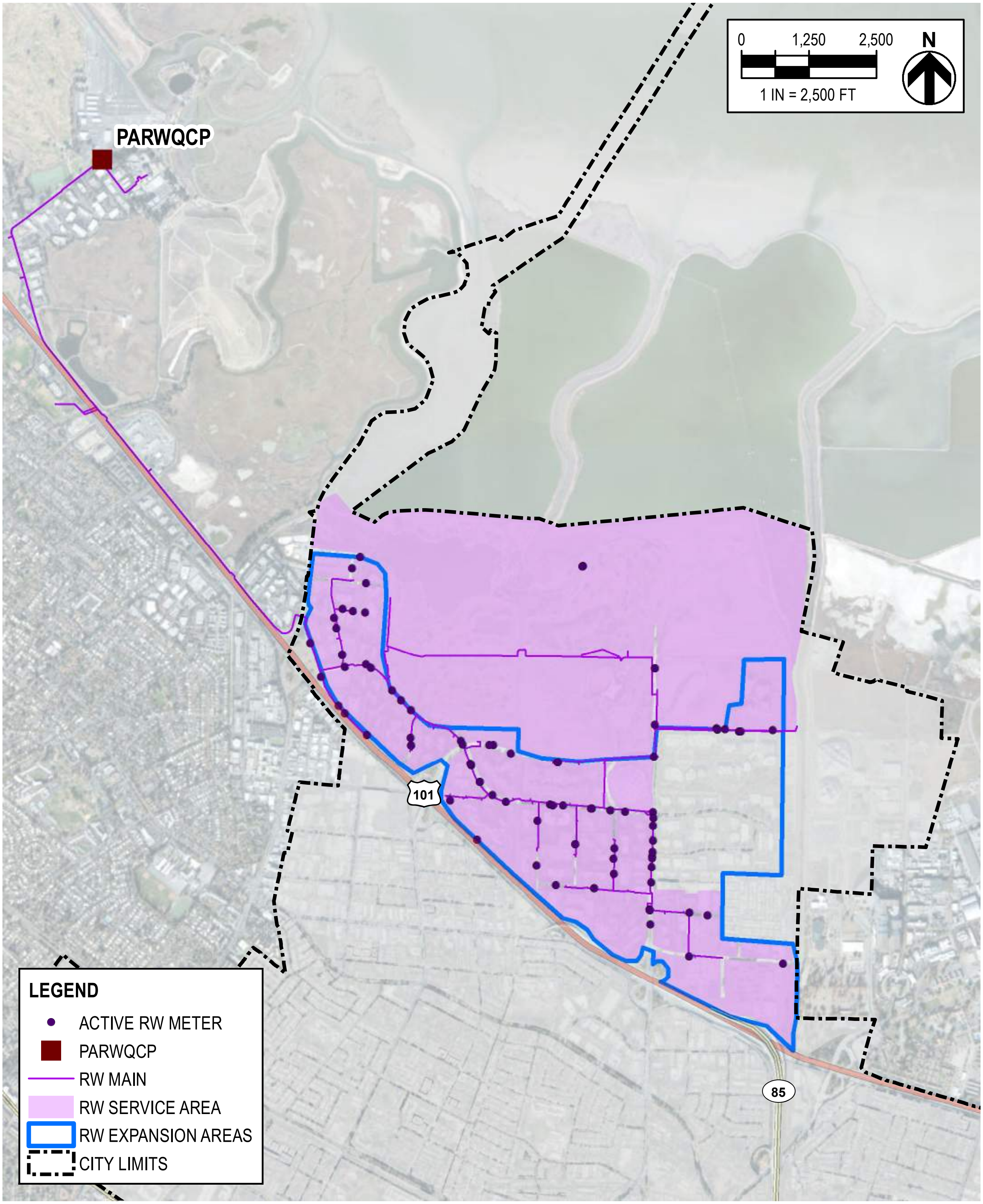



**FIGURE 2-2**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
RECYCLED WATER SYSTEM AND SERVICE AREA

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# SECTION 3 – SYSTEM DESCRIPTION

Provided in this section is a more detailed description of the service area and a summary of the water system facilities.

## 3.1 Pressure Zones

The City's distribution system is separated into three different pressure zones. These zones are delineated such that each zone covers a range of elevation change.

- **Zone 1** is located in the northern most section of the City and is served with water from the SFPUC Turnout 5 and Well 21. Well 22 can also serve Zone 1, if needed. Well 23 supplies water to Graham Reservoir, which has the ability to pump to Zone 1. Elevations for Zone 1 range from sea level (0 feet) up to 80 feet. The hydraulic grade is 184 feet and pressures in Zone 1 range from approximately 44 psi at the Zone 2 boundary to 78 psi at sea level and varies based on demand throughout the day.
- **Zone 2** is located south of Zone 1 and ranges in elevation from 33 feet to 165 feet. Zone 2 is served a blend of SFPUC and groundwater from Wells 19, 22, and 23, though the majority of the water supply is from SFPUC Turnouts 7 and 14. The hydraulic grade is 270 feet and pressures range from 44 to 102 psi in Zone 2 and varies based on demand throughout the day.
- **Zone 3** is the smallest pressure zone in the City and is located in the southern edge where elevations range from 137 feet to 190 feet. The Valley Water Turnout is located in this zone. The hydraulic grade is 308 ft. Pressures range from 51 to 75 psi in Zone 3 and varies based on demand throughout the day.

Storage and pumping facilities are used to maintain water supply and pressure in each respective zone. The following sections describe the various water supply and pressure regulating facilities including turnouts, groundwater wells, PRVs, storage facilities, and pump stations. See **Figure 3-1** for a map of the pressure zones, PRVs, supply, and storage and pumping facilities.

### 3.1.1 Turnout Connections

Turnout connections are the physical connections from the wholesale water supply to the retailer (i.e. the City). The City operates three turnouts from SFPUC and one from Valley Water. Turnouts are fed by SFPUC's Bay Division Pipelines No. 3 and No. 4 and Valley Water's West Pipeline. Each connection is metered and pressure from the connections are reduced via a PRV.

**Table 3-1** lists the City's four turnout connections, pressure zone served, and estimated capacity based on the size of the turnout.

**Table 3-1: Purchased Water Turnout Connections**

| Turnout Location and No. | Wholesaler | Pressure Zone | Capacity (gpm) |
|---|---|---|---|
| Escuela Ave – Turnout 5 | SFPUC | 1 | 7,000 |
| Escuela Ave – Turnout 7 | SFPUC | 2 | 7,000 |
| Whisman Rd – Turnout 14 | SFPUC | 2 (can serve 1 via PRV) | 14,000 |
| Miramonte Ave Turnout | Valley Water | 3 | 3,500 |

### 3.1.2 Groundwater Wells

There are four active groundwater wells used to supplement the City's water supply. These are not the primary source of water during normal operating conditions; however, they are operated regularly to assure that they are properly exercised and available. In recent years, their production has ranged from 400 to 900 gpm and could produce up to 1,880 MG annually, if needed. Well 23 operates differently than the other wells since it is used to fill Graham Reservoir. Well 23 typically runs at approximately 700-800 gpm and operates based on Graham Reservoir levels. **Table 3-2** identifies each groundwater well, its capacity, and the pressure zone(s) it serves.

**Table 3-2: City of Mountain View Groundwater Wells**

| Groundwater Well | Pressure Zone | Pumping Capacity (gpm) |
|---|---|---|
| Well 19 | 2 | 1,200 |
| Well 21 | 1 | 777 |
| Well 22 | 1 or 2 | 800 |
| Well 23 | 1 or 2 | 800 |

### 3.1.3 Pressure-Reducing Valves (PRVs)

There are 12 PRVs strategically located in the distribution system to control and maintain pressure in each zone. PRVs are used to regulate the pressure coming from high pressure turnouts and between pressure zones. The settings of these valves vary based on their location and elevation within the system. Per the City's current annual CIPs, a new PRV will be installed in the vicinity of the N Whisman Rd and Evandale Ave intersection to connect Zone 1 to Zone 2 water mains. **Table 3-3** provides details about each turnout and pressure zone PRV.

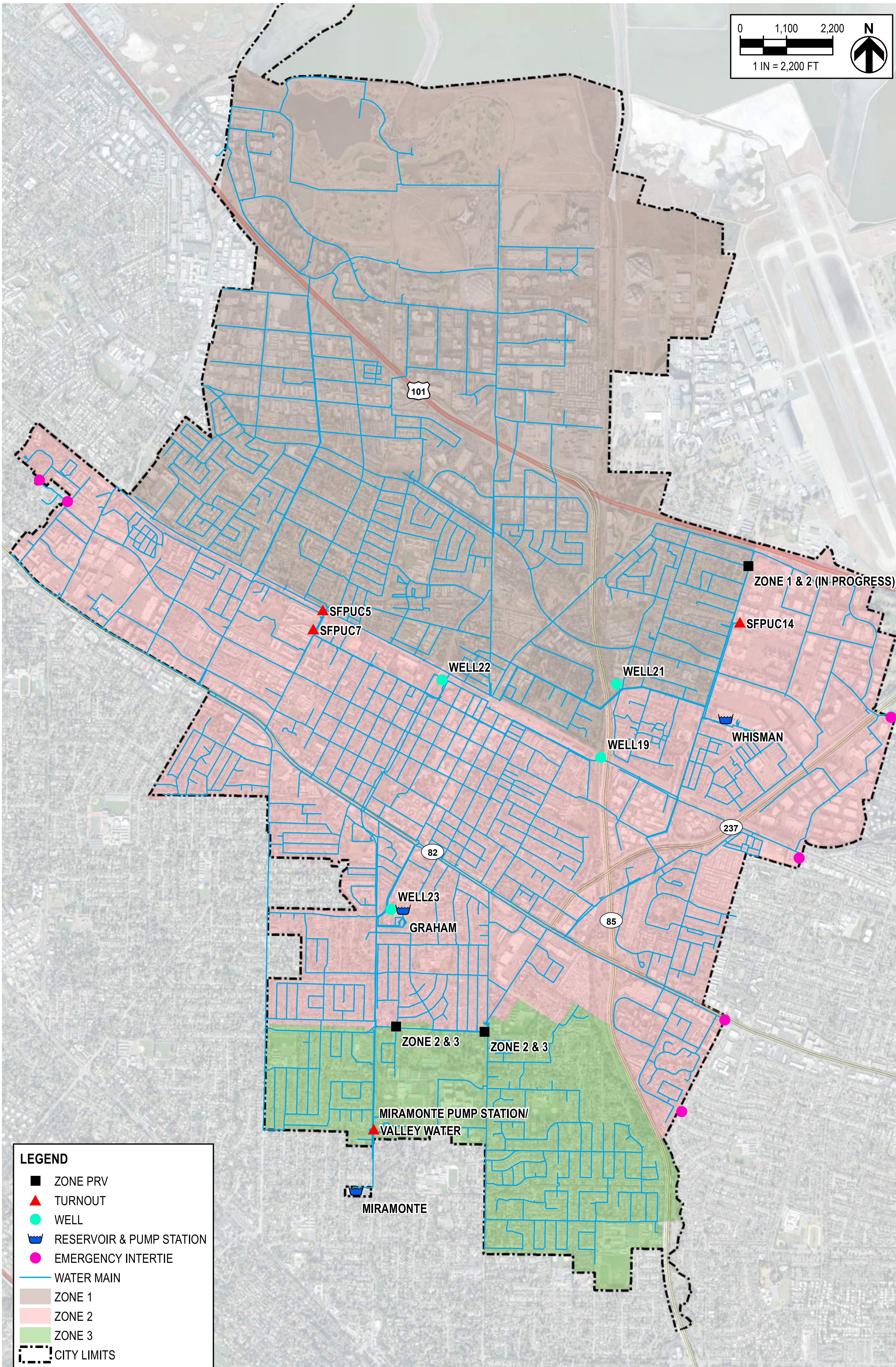


**FIGURE 3-1**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
WATER SUPPLY, STORAGE, AND DISTRIBUTION FACILITIES

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**Table 3-3: Pressure-Reducing Valves (PRVs)**

| Facility Name/Served | Purpose/Location | Setting (psi) |
|---|---|---|
| Turnout 14 PRVs (3) | Maintains Turnout 14 discharge pressure | 95 psi |
| Turnout 5 PRVs (3) | Maintains Turnout 5 discharge pressure | 42-56 psi |
| Turnout 7 PRVs (3) | Maintains Turnout 7 discharge pressure | 92 psi |
| Valley Water PRV | Maintains Valley Water turnout discharge pressure | 65 psi |
| Zone PRV 1 | Zone 2 & 3 Boundary Pressure Sustaining/Reducing/Relief Valve at Cuesta & Begen | 62 psi |
| Zone PRV 2 | Zone 2 & 3 Boundary Pressure Sustaining/Reducing/Relief Valve at Cuesta & Grant | 62 psi |
| Zone PRV 3 (In Progress) | Zone 1 & 2 PRV near the intersection of N Whisman Rd and Evandale Ave. Will connect Zone 1 to Zone 2 water mains to meet future demand. | TBD |

### 3.1.4 Storage Facilities

Currently, the City has four active storage facilities with a total capacity of 17.3 million gallons (MG). **Table 3-4** lists the City's potable water storage facilities. These facilities provide maximum day demand (MDD) and emergency storage.

**Table 3-4: Water Storage Facilities**

| Facility Name | Pressure Zone Served | Construction Type | Capacity (MG) |
|---|---|---|---|
| Graham | 1 or 2 | open cut, concrete-lined | 8 |
| Miramonte 1 | 1 or 3 | open cut, concrete-lined | 1.2 |
| Miramonte 2 | 1 or 3 | open cut, concrete-lined | 2.1 |
| Whisman | 1 or 2 | open cut, concrete-lined | 6 |
| **Total** | | | **17.3** |

### 3.1.5 Pump Stations

The City's water distribution system is equipped with three active pump stations. The pump stations are designed to pump water from the storage facilities and maintain pressure in the distribution system. Provided is a brief description of each pump station, as follows:

- **Whisman Pump Station:** The Whisman Pump Station serves both pressure Zones 1 and 2 with two pumps each dedicated to each pressure zone, four pumps in total. Each zone has one active-duty pump and one backup pump, which alternate in operation. This pump station is currently operated manually to encourage reservoir turnover.
- **Graham Pump Station:** The Graham Pump Station is configured with five pumps, two of which serve Zone 1 and three that serve Zone 2. The pumps that serve Zone 1 include one active-duty pump and one backup pump, which alternate in operation. The pumps that service Zone 2 include two active-duty and one backup that alternate in operation. The Graham Pump

Station is operated to avoid pumping at the same time as Whisman. The pump station has the capability to fill Miramonte Reservoirs through Zone 1 if needed.

- **Miramonte Pump Station:** This pump station has four pumps; one pump that functions as a smaller jockey pump at lower flows and three larger equivalent capacity pumps that operate as two active-duty and one backup, in alternating operation. This pump station is fed by Miramonte Reservoirs and serves Zone 3. The pumps are activated when Zone 3 pressure drops below 56 psi.

Operational information for each booster plant pump is provided in **Table 3-5**.

**Table 3-5: Pump Stations**

| Pump Number | Flow Rate (gpm) | Horsepower (Hp) | Pump Type[1] |
|---|---|---|---|
| Graham Zone 2 – 1 | 2,700 | 200 | vertical turbine |
| Graham Zone 2 – 2 | 2,700 | 200 | vertical turbine |
| Graham Zone 2 – 3 | 2,700 | 200 | vertical turbine |
| Graham Zone 1 – 4 | 2,800 | 100 | vertical turbine |
| Graham Zone 1 – 5 | 2,800 | 100 | vertical turbine |
| Whisman Zone 2 – 1 | 2,500 | 200 | horizontal split-case centrifugal |
| Whisman Zone 2 – 2 | 2,500 | 250 | horizontal split-case centrifugal |
| Whisman Zone 1 – 3 | 3,000 | 125 | horizontal split-case centrifugal |
| Whisman Zone 1 – 4 | 3,000 | 125 | horizontal split-case centrifugal |
| Miramonte 1 | 869 | 40 | horizontal split-case centrifugal |
| Miramonte 2 | 1,450 | 150 | horizontal split-case centrifugal |
| Miramonte 3 | 1,450 | 150 | horizontal split-case centrifugal |
| Miramonte 4 | 1,450 | 150 | horizontal split-case centrifugal |

Notes:
1. All pumps operate with variable frequency drives (VFDs).

## 3.2 Water Distribution System

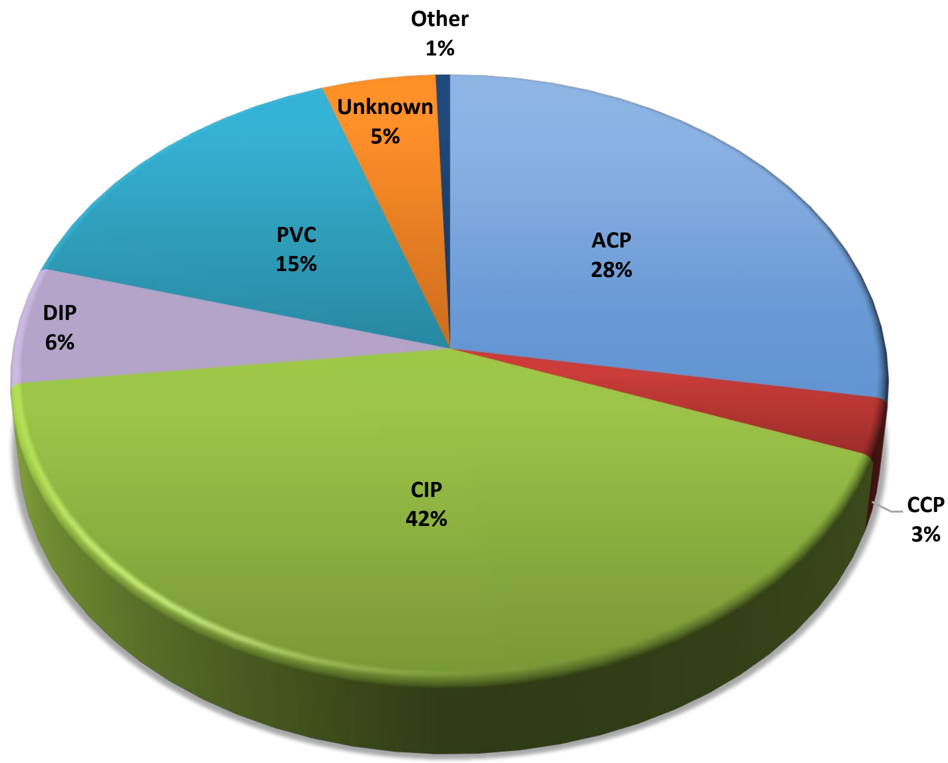
The system consists of over 175 miles of distribution system pipeline. The pipeline and appurtenance sizes vary from 4-inches to 27-inches in diameter and consist of a variety of pipe materials. **Table 3-6** presents the pipe size and materials by length and **Figure 3-3** and **Figure 3-4** show pipeline diameters and materials, respectively. **Figure 3-2** presents the breakdown of pipeline materials by percentages. Cast iron pipe (CIP) is the predominate material in the distribution system at 43% followed by asbestos cement pipe (ACP) which represents 28% of the system. Pipelines with unknown material are shown on **Figure 3-5**. All figures exclude Cal Water infrastructure.

**Table 3-6: Water Distribution System Pipelines**

| Material | Length of Pipe (ft) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ACP | CCP | CIP | DIP | HDPE | PVC | Steel | Unknown | Total |
| 4-in | 1,547 | | 16,725 | 3,128 | | 347 | 1,260 | 544 | 23,551 |
| 6-in | 5,468 | | 54,690 | 1,552 | | 2,015 | 247 | 7,865 | 71,837 |
| 8-in | 140,858 | | 232,055 | 27,690 | 169 | 118,812 | 1,064 | 19,656 | 540,304 |
| 10-in | 49 | | 21,264 | 92 | | 433 | | 291 | 22,129 |
| 12-in | 95,930 | 97 | 71,100 | 7,949 | | 20,364 | | 5,725 | 201,165 |
| 14-in | 4,736 | 1,671 | | 541 | | | | 1,216 | 8,164 |
| 16-in | 8,424 | 10,744 | 90 | 780 | | 1,060 | 260 | 5,964 | 27,322 |
| 18-in | | 4,096 | 12 | 2,782 | | | | 597 | 7,487 |
| 20-in | | 1,498 | | | | | | 35 | 1,533 |
| 21-in | | 9,782 | | | | | | 69 | 9,851 |
| 24-in | | | 19 | 13,873 | | 70 | | 996 | 14,958 |
| 27-in | | | 67 | | | | 2,428 | | 2,495 |
| **Total** | **257,012** | **27,888** | **396,022** | **58,387** | **169** | **143,101** | **5,259** | **42,958** | **930,796** |

Notes:
1. ACP = Asbestos Cement Pipes
2. CCP = Concrete Cylinder Pipe
3. CIP = Cast Iron Pipe
4. DIP = Ductile Iron Pipe
5. HDPE = High Density Polyethylene Pipe
6. PVC = Polyvinyl Chloride Pipe

**Figure 3-2: Distribution System Pipeline Material by Percentage**




## 3.3 Soil Conditions

As part of this Master Plan effort, a desktop review and analysis were conducted to further define soil corrosivity within the service area and evaluate the City's current corrosion control practices.

JDH conducted in-situ soil resistance measurements at 23 locations (i.e. project sites) within the City between the years 2010 and 2021. This data was supplemented with the data from the 98 locations identified in the ConCeCo Engineering report from 1989, which together provides a representative soil resistivity sample across the City's service area. **Figure 3-6** shows the average in-situ soil corrosivity based on the measured resistivity at the identified locations. **Figure 3-7** provides the percentage of the soils by average corrosivity classification from 2.5 ft to 10 ft.

In general, based on the average soil resistivity at 2.5 ft to 10 ft depth, the soils in the City classify as "corrosive" to buried DIP, CIP, dielectric coated steel, and mortar coated steel. The resistivities from 2.5 ft to 10 ft are the most appropriate depths from which to analyze soil conditions affecting metallic pipelines because this is the depth at which most of the pipes are buried. Based on this resistivity data it is likely that most; if not all future metallic pipeline installations will require some type of corrosion control to meet long term useful life expectations in Mountain View. The detailed report is included as **Appendix A**.

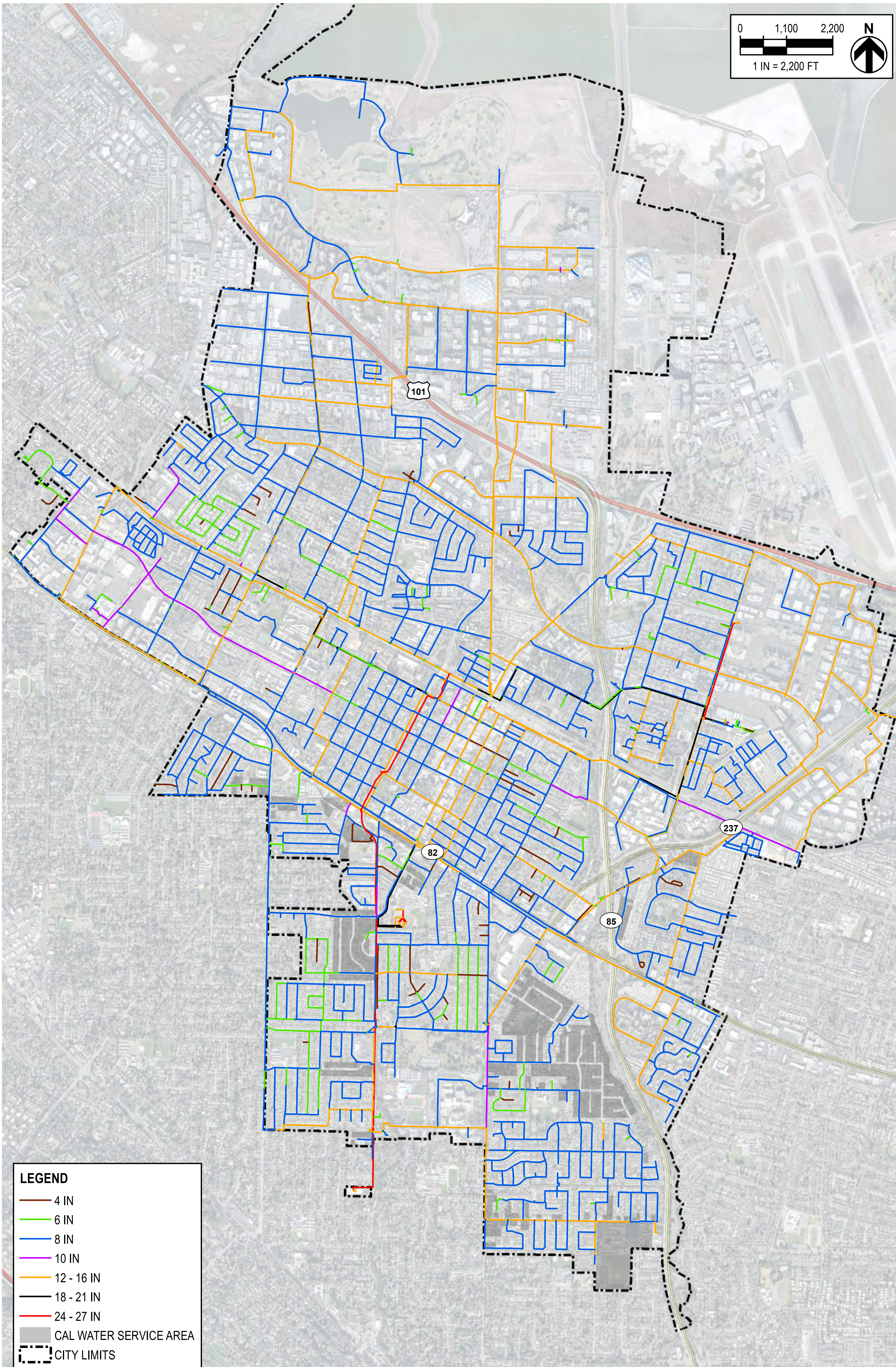



**FIGURE 3-3**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
DISTRIBUTION PIPELINE DIAMETERS

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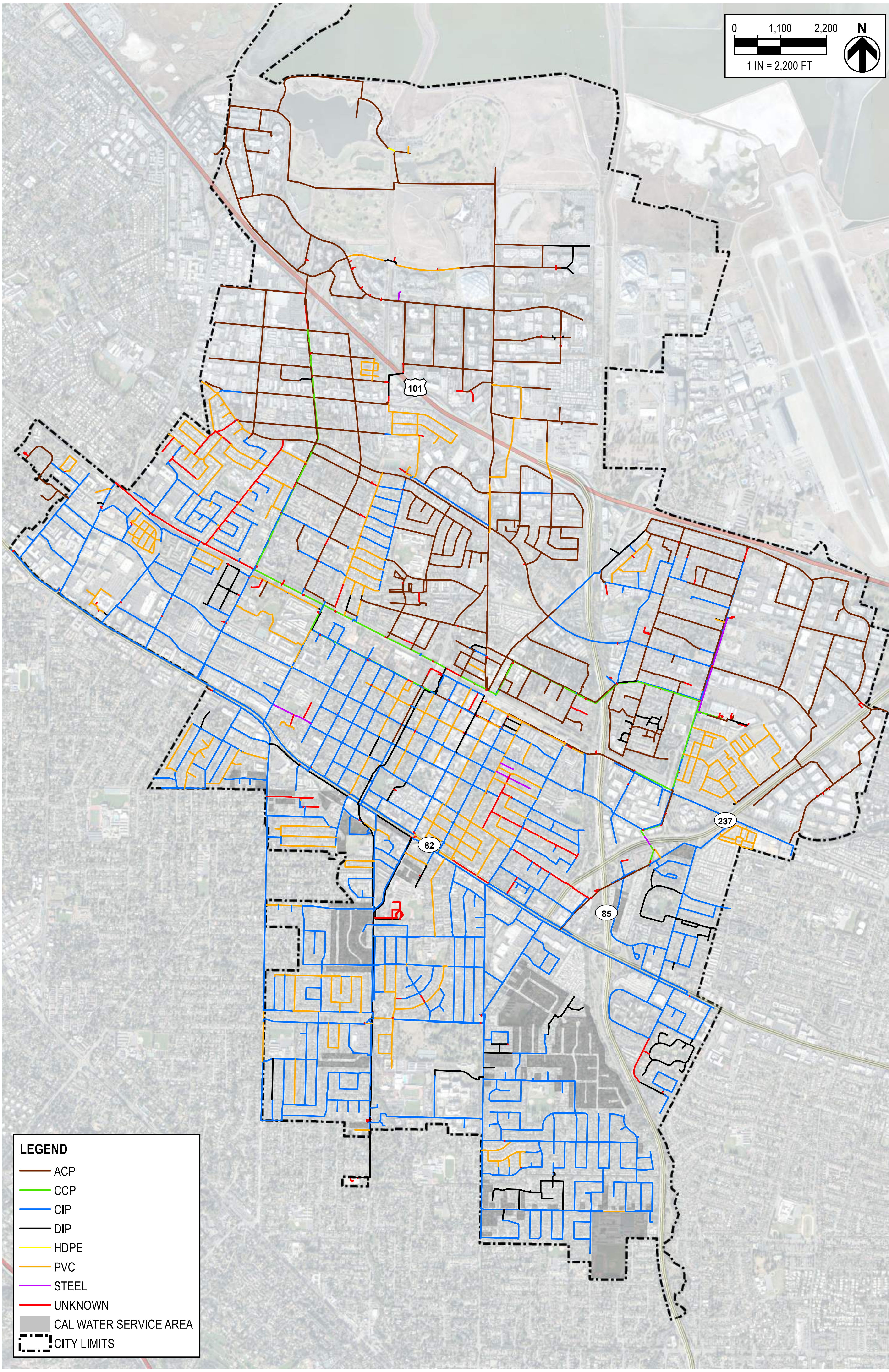


**FIGURE 3-4**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
DISTRIBUTION PIPELINE MATERIALS

HydroScience

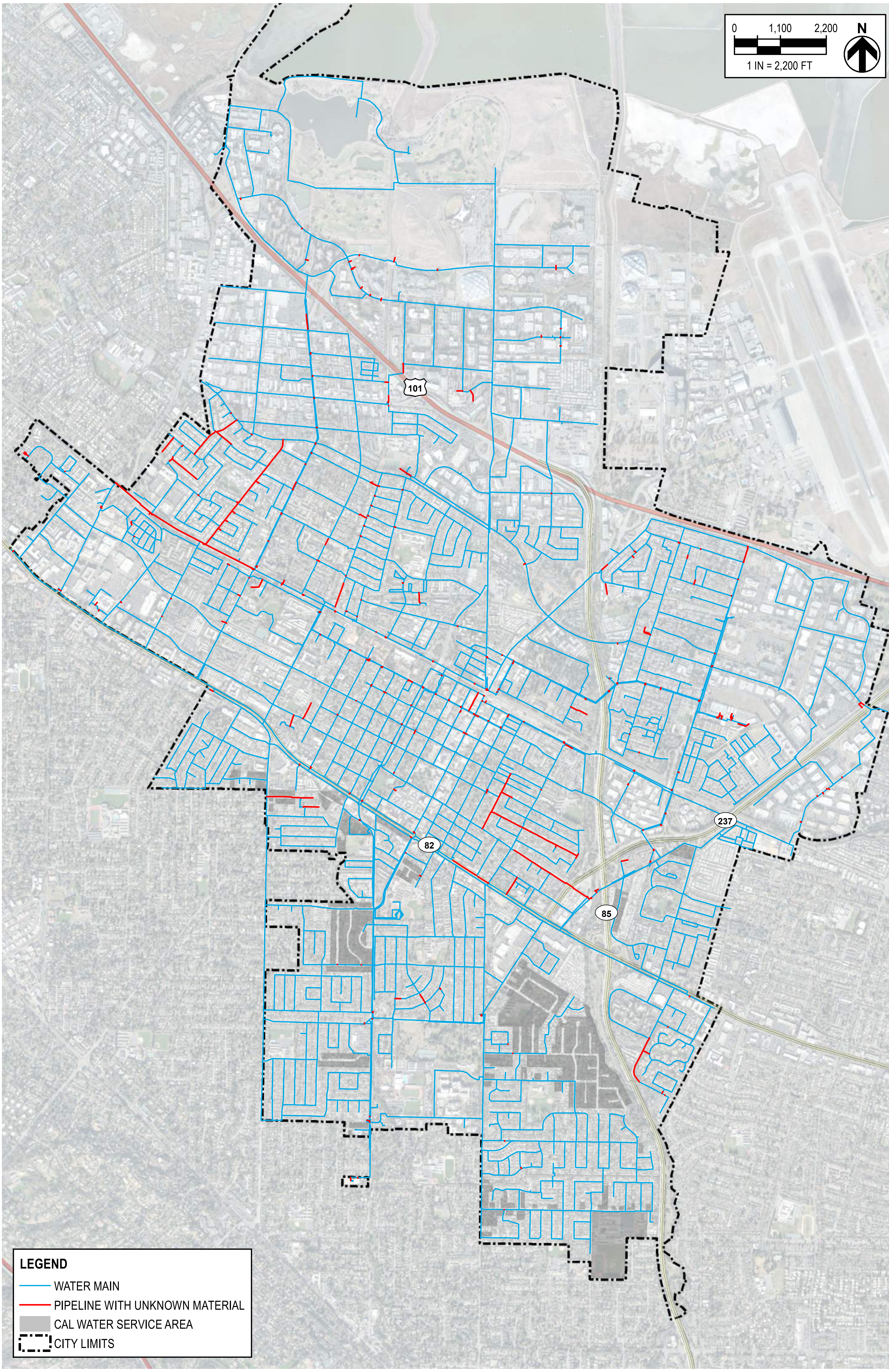


**FIGURE 3-5**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
DISTRIBUTION PIPELINES WITH UNKNOWN MATERIALS

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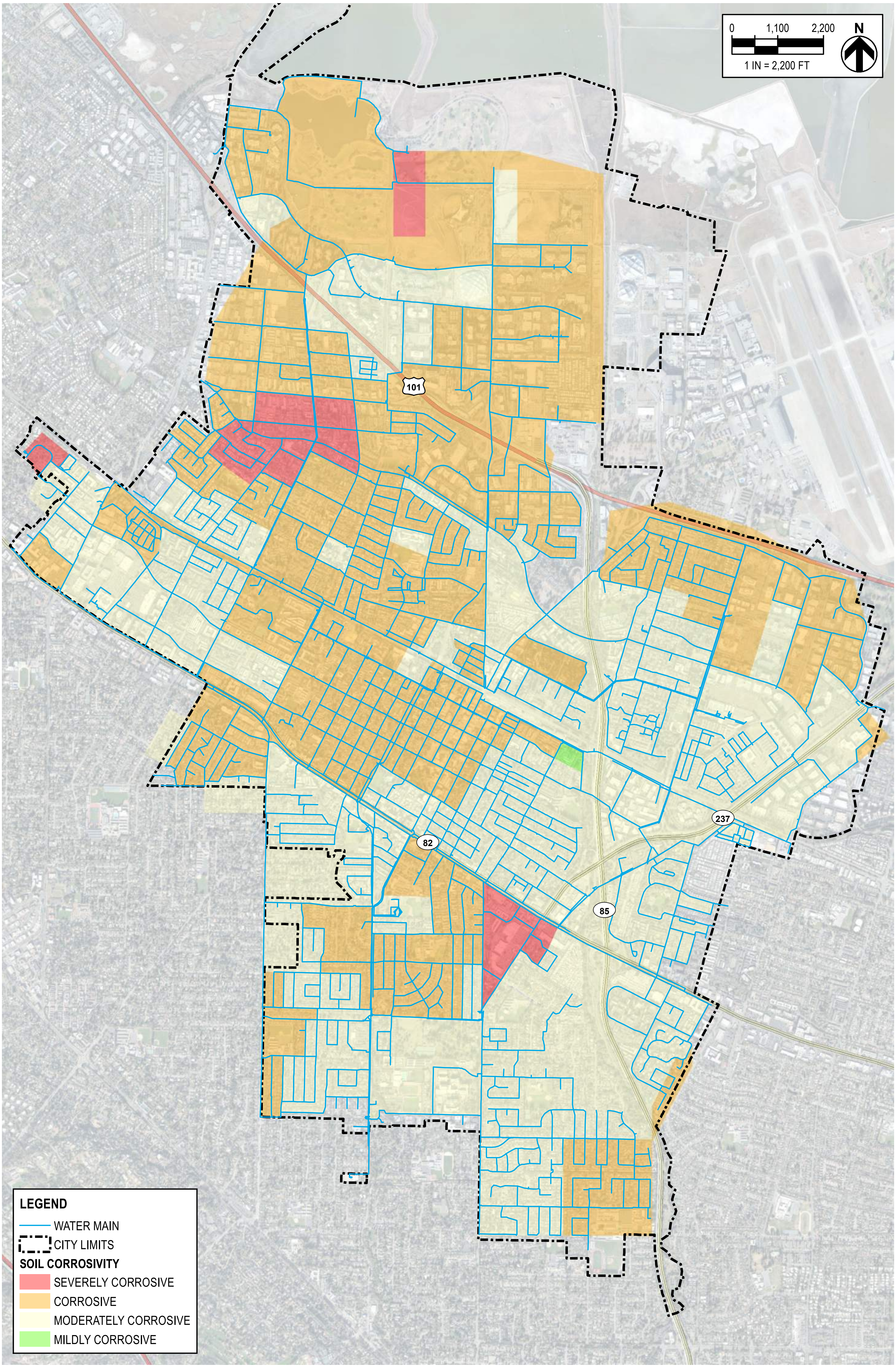


**FIGURE 3-6**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
SOIL CORROSIVITY CLASSIFICATION MAP

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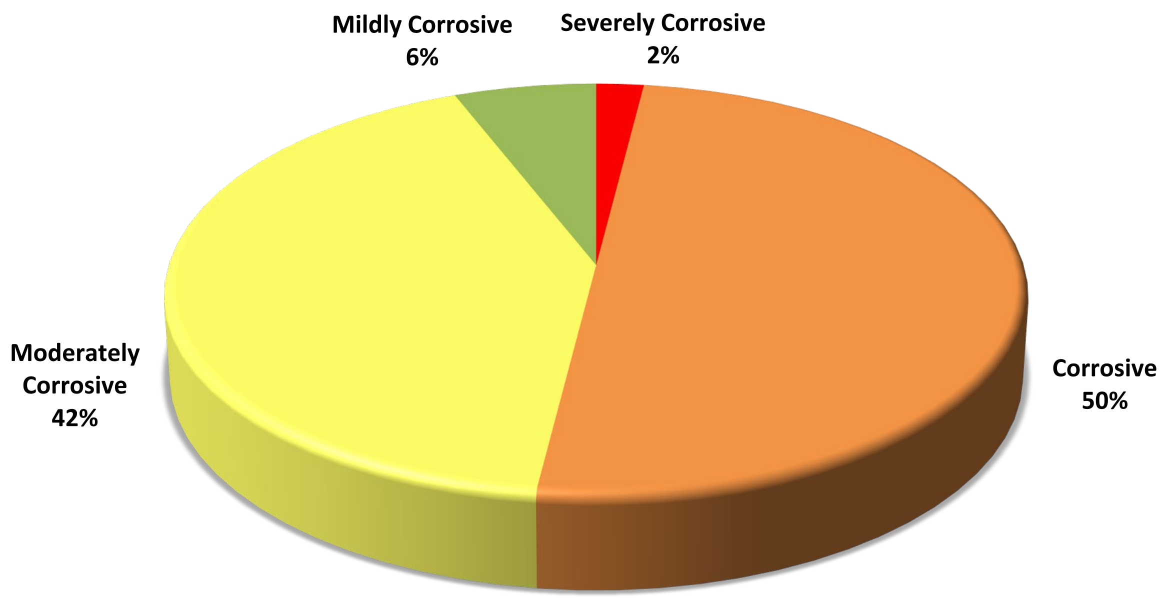
**Figure 3-7: In Situ Soil Classification by Percentage**



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# SECTION 4 – WATER DEMAND ANALYSIS

This section describes the water demand analysis and development of land use based unit water demands. The intent of the analysis is to first develop a baseline average annual water demand year. Once the baseline is established, other scenarios can be developed for analysis. Demands were based on water meter billing data for fiscal year (FY) 2015/16 through 2019/20. Metered use was related to land use using GIS to develop land use based unit factors. These factors were then used to populate the hydraulic model.

## 4.1 Metered Water Use

Water meter billing records for FY 2015/16 to 2019/20 were used to develop total Average Day Demand (ADD) for the entire service area as well as unit demand factors for each land use type.

The records include meter readings and billing data over varying periods of time for a total of 21,595 distinct water meters. Each record contains an associated address, meter number, account number, and customer user type. Fire and recycled water meter reads were excluded from total ADD; demands for fire protection are handled separately in the model as part of the MDD plus fire flow scenario. Recycled water customers were individually assigned a reduced potable demand based on their average potable water use from historical billing data.

### 4.1.1 Average Day Demand (ADD)

Water billing records were used to estimate the City's total ADD. ADD is defined as the average demand on the entire system over a specific period of interest. The average water use for each individual customer was calculated for each fiscal year; the sum of all City customers average water use throughout the fiscal year is the system ADD. **Table 4-1** summarizes the calculated ADD for FY 2015/16 through 2019/20.

**Table 4-1: Average Day Demand (ADD)**

| FY | 2015/16 | 2016/17 | 2017/18 | 2018/19 | 2019/20 | Average (2017-2020) |
|---|---|---|---|---|---|---|
| ADD (MGD) | 7.39 | 7.49 | 8.21 | 8.25 | 8.74 | 8.40 |

The increase in water use from FY 2016/17 to 2017/18 can be attributed to a rebound effect from drought-related conservation measures following the state-wide drought between 2012-2016. To ensure a conservative estimate for the City's ADD, the ADDs of FY 2017/18 to 2019/20 were averaged to obtain an ADD of 8.40 MGD.

### 4.1.2 Maximum Day Demand (MDD) Development

Maximum Day Demand (MDD) represents a typical peak summer day demand condition. To analyze summer demands, water use records were analyzed on a monthly basis. Water demands from billing records were categorized and summed by month for FY 2015/16 through FY 2019/20 using each meter's start and end read date. The top three months in terms of demand were averaged to provide a representation of MDD. This average was then divided by the correlating FY ADD in **Table 4-1** to obtain a peaking factor (PF), which is the ratio of MDD over ADD.

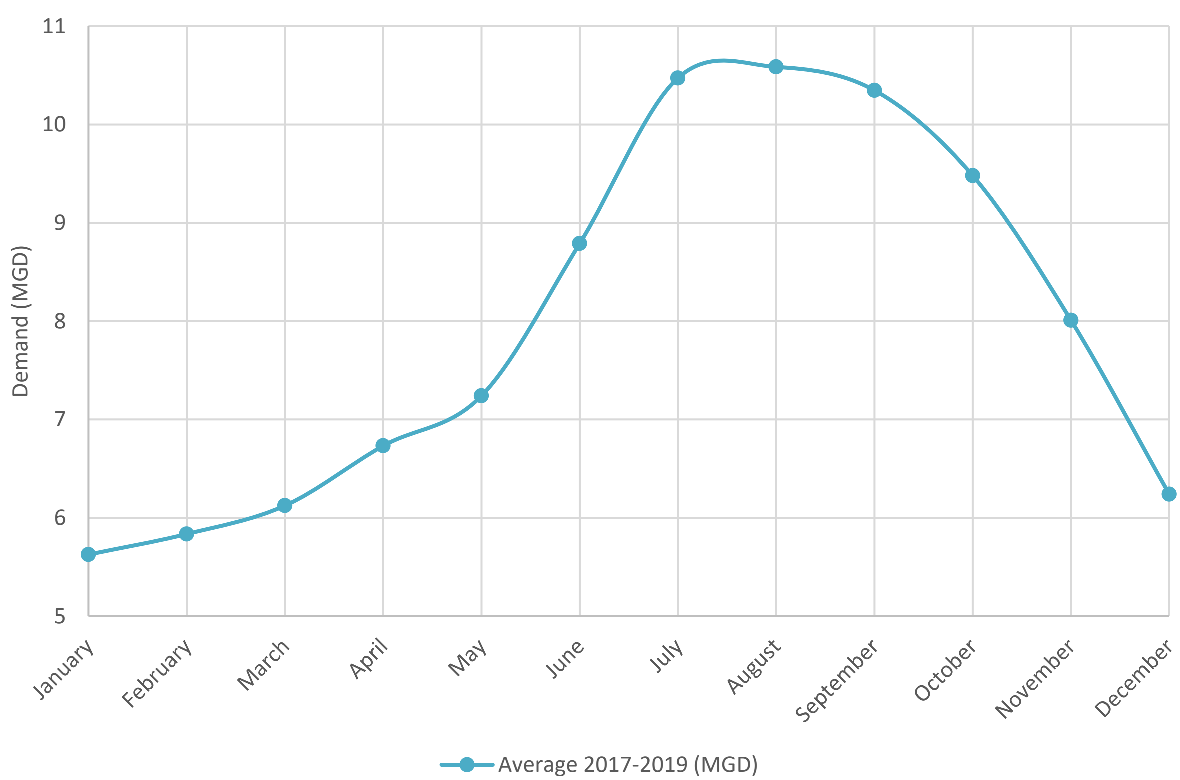
**Figure 4-1** represents the average monthly demands from FY 2017/18 to FY 2019/20. As shown, July, August, and September typically have the highest demands.

**Table 4-2** provides the MDD calculated for each fiscal year and the corresponding peaking factors. The average MDD and PF represents the three most recent fiscal years, FY 2017/18 to FY 2019/20

**Table 4-2: Maximum Day Demand (MDD)**

| | 2015/16 | 2016/17 | 2017/18 | 2018/19 | 2019/20 | Average (2017-2020) |
|---|---|---|---|---|---|---|
| MDD (MGD) | 8.42 | 9.46 | 10.26 | 10.39 | 10.75 | 10.47 |
| Peaking Factor | 1.14 | 1.26 | 1.25 | 1.26 | 1.23 | 1.25 |

**Figure 4-1: Average Monthly Demand (2017-2019)**



## 4.2 Land Use and Parcel Zoning

For planning purposes, customer demands are developed based on land use as it is assumed that users with the same, or similar, land use types will have similar water demand patterns. This enables the City to plan for future redevelopment and adjust for changes in the way particular customer types use water. Using the customer meter billing data, potable water use factors for each land use type are developed and calibrated to the total ADD.

Each parcel was first identified by its 2021 land use. This accounted for land uses that were not yet fully developed per the projected General Plan (2030). The City's GIS geodatabase included both a parcel feature class and a land use feature class. These two files were merged in GIS using the spatial join function, resulting in a land use assigned to each City parcel within the service area. **Figure 4-2** presents the 2021 land use types for all parcels in the City.

For modeling purposes, land use types are grouped according to their anticipated water use pattern; land uses expected to generate similar water demands were consolidated into land use categories to facilitate the water demand analysis. This serves two primary purposes: 1) to limit the level of complexity in the water demand analysis and 2) to fit within the category limits dictated by the InfoWater software. There are 26 different land use types which were consolidated into 12 land use categories based on their land use descriptions in the General Plan and an analysis of annual average demand from the water meter billing data. These consolidations are presented in **Table 4-3**.

Within City limits, not every parcel is connected to the City's potable water distribution system. There are some parcels that receive water from Cal Water and are thus excluded from this analysis. Those parcels are designated with "No Demand."

**Figure 4-3** displays the consolidated land use categories listed in **Table 4-3**.

**Table 4-3: Consolidated Land Use Categories**

| 2021 Land Use Codes | | Consolidated Land Use Categories | |
|---|---|---|---|
| **Code** | **Land Use** | **Code** | **Land Use** |
| VAC | Vacant | - | - |
| RET | Retail, including Banks and Personal Services | COM | Commercial |
| MIN | Mini-Mart | | |
| GAS | Gas Station | | |
| MFRent | Multi-Family 3+ Rental | HDR | High Density Residential |
| R&D | Research and Development | IND | Industrial |
| IND | Industrial | | |
| SFD | Single Family Detached | LDR | Low Density Residential |
| SFA | Single Family Attached | LMDR | Low Medium Density Residential |
| SF+ADU | Single Family + ADU | | |
| MFMob | Multi-Family Mobile Homes | MBL | Mobile Homes |
| MFCon | Multi-Family 3+ Condo | MDR | Medium Density Residential |
| MFDupRent | Multi-Family Duplex Rental | | |
| MFDupCon | Multi-Family Duplex Condo | | |
| MOT | Motel | MOT | Motel/Hotel |
| REST | Restaurant | MU | Mixed Use |
| Mixed Use | Mixed Use | | |
| FF | Fast Food | | |
| OFF | Office | OFF | Office |
| REC | Recreation | OS | Open Space |
| SER | Services - Vehicle, Construction, Business and similar | PF | Public Facility |
| MED | Medical | | |
| INST | Institution | | |
| HSC | High School | | |
| GSC | Grade School | | |
| CHU | Church | | |

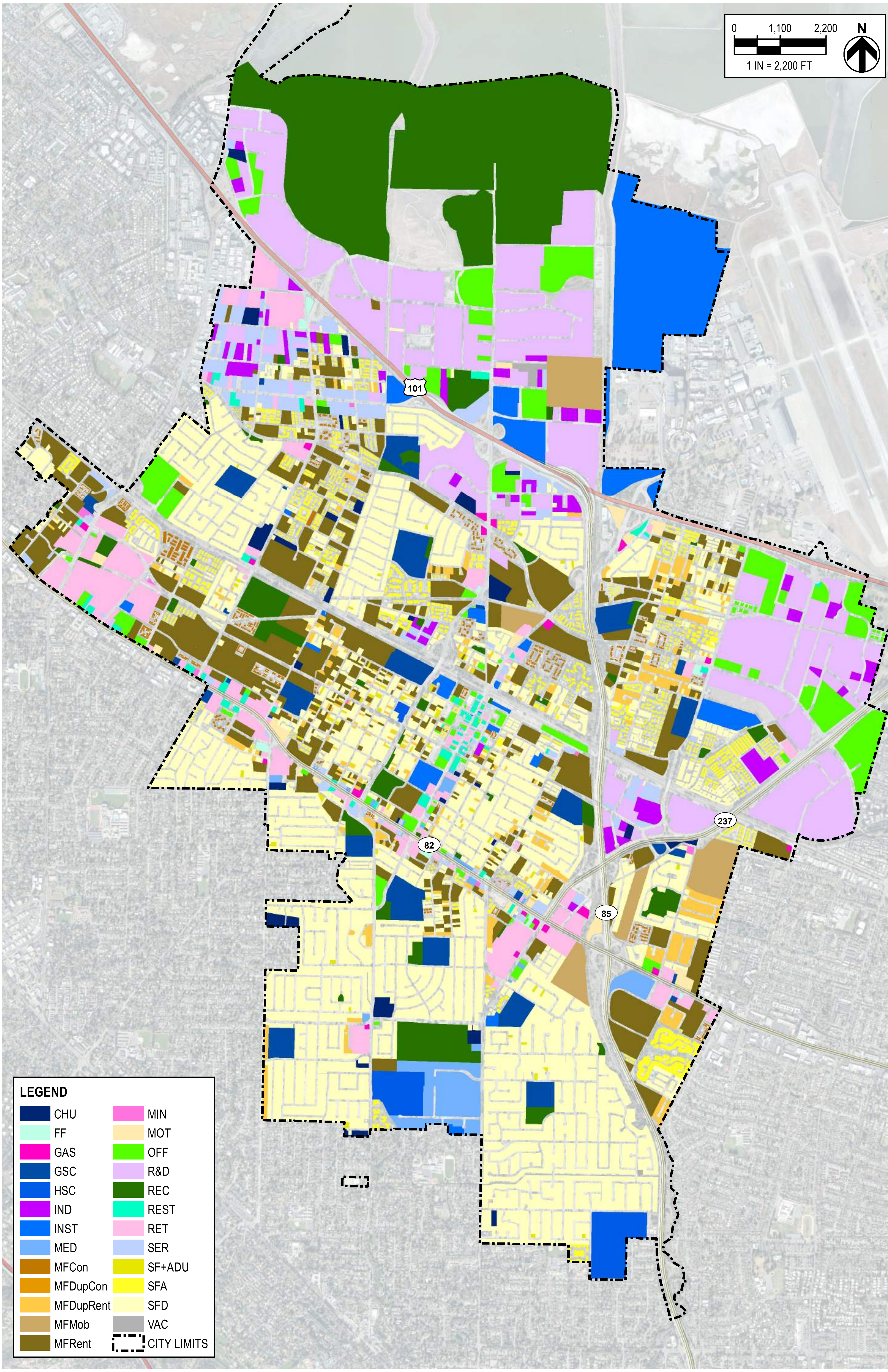



**FIGURE 4-2**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
2021 LAND USE

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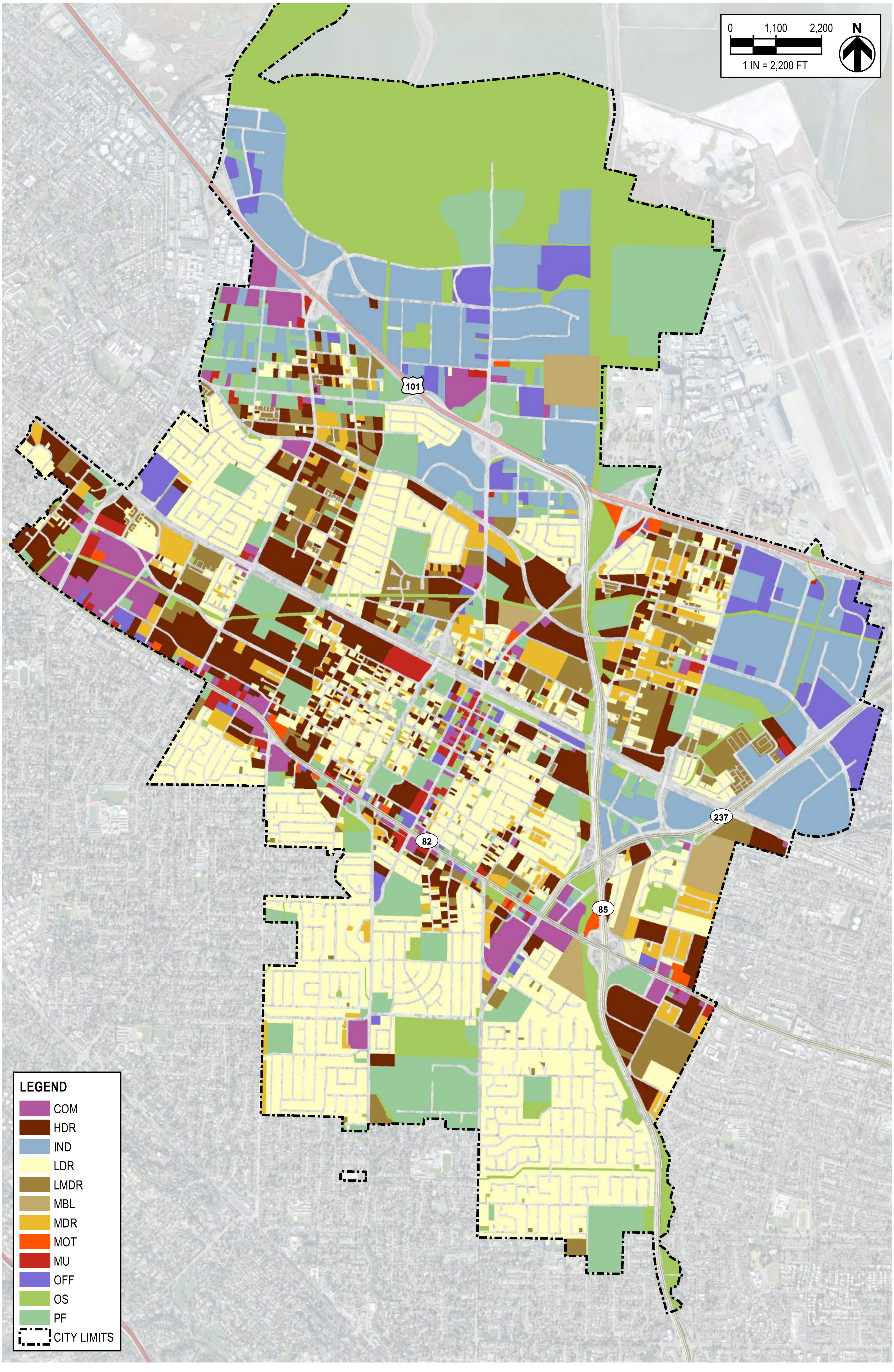


**FIGURE 4-3**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
CONSOLIDATED LAND USE CATEGORIES

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## 4.3 Potable Water Unit Factor Development

Water use unit factors were developed using customer meter billing data matched to the corresponding parcels and land uses. Individual water demand use factors were developed for each of the 12 consolidated land use categories (**Table 4-3**). Detailed further in **Section 4.3.1**, demand from large users was removed from the water billing dataset prior to this analysis. It is noted that water use trends for 2020 were greatly affected by the COVID-19 pandemic which began in early 2020 and led to several Regional Shelter-In-Place/Stay-at-Home Orders and local emergency restrictions. It is expected that water use patterns will largely return, thus pre-pandemic water use conditions are used as the basis for estimating water use factors.

For the low-density residential land use, the unit demand factor was developed based on the number of billing accounts and the average water use per account, resulting in a factor in units of gpd per dwelling unit (gpd/DU). The high-density residential unit factor is shown in both gpd/acre and gpd/DU for future planning purposes. Parcels determined to be vacant lots based on aerial imagery were assigned a demand of 0 gpd.

For all other land use types, unit demand factors are expressed in units of gpd per acre (gpd/acre). These area-based water use factors were developed by linking the meter billing data to the City parcels using street addresses and account numbers. Most discrepancies were manually reconciled, though a small number of meters and their recorded demand were ultimately not spatially assigned. These parcels were assigned demand based on land use designation. The demand (gpd) of each meter was normalized by the respective parcel area (acres) based on GIS and averaged over the five-year period to develop preliminary area-based water use factors.

Each unit factor was compared with unit factors developed for cities in the surrounding region to ensure they were in-line with expectations and iteratively adjusted to calibrate against expected overall ADD. The resulting unit factors are detailed in **Table 4-4**.

**Table 4-4: Water Use Unit Factors by Land Use Category**

| Land Use Code | Unit Factor | Unit |
|---|---|---|
| MU | 5,400 | gpd/acre |
| COM | 2,000 | gpd/acre |
| HDR[1] | 2,600 | gpd/acre |
| IND | 800 | gpd/acre |
| LDR | 210 | gpd/DU[2] |
| LMDR | 290 | gpd/DU[2] |
| MDR | 1,700 | gpd/acre |
| MBL | 1,100 | gpd/acre |
| OFF | 1,600 | gpd/acre |
| PF | 1,000 | gpd/acre |
| MOT | 3,800 | gpd/acre |
| OS | 800 | gpd/acre |

Notes:
1. Alternatively, 147 gpd/DU.
2. Assume one dwelling unit per parcel.

Water demand unit factors were then applied back to the GIS parcel shapefile by multiplying the appropriate unit factor by the parcel area contained within the parcel feature class.

### 4.3.1 Large Users

For planning and modeling purposes, large water users are defined as customers that consume an unusually high quantity of water for their user type and area. Large users are typically identified and removed from the unit demand analysis to avoiding skewing water use factors. Demands for large users are then manually added to the model to ensure they and their impact to the water infrastructure are accurately represented.

For this analysis, the top 50 water user meter accounts from the FY 2018/19 through 2019/20 billing data – in terms of average gpd – were identified from the water billing data set. These users were removed for the unit factor development described above and then manually included in the water demand totals and at their respective locations in the hydraulic model. The top water users are shown on **Figure 4-4**.

### 4.3.2 Modeled ADD

Unit factors were applied to all parcels except the ones designated as large users. Large user demands were manually added to their corresponding parcels. Using InfoWater, the parcels are linked to the nearest node (i.e. junction) in the model and the unit factors applied to the respective parcel to generate the effective water demand. ADD results for the applied water use factors in the model compared to historical ADD is presented in **Table 4-5**.

**Table 4-5: Modeled ADD using Unit Factors vs. Historical ADD**

| Parameter | ADD (MGD) |
|---|---|
| Modeled ADD | 8.41 |
| Historical ADD | 8.40 |
| % Difference | 0.13% |

The modeled ADD is slightly larger than the historical ADD, and was identified to be representative of historical average day demands in the City.

## 4.4 Future Demand Forecast

The future demand forecast is based on anticipated near term development and projected population increase. For the purposes of the Master Plan, demand projections from the 2020 UWMP were used as the basis for the future demand forecast through 2030. In partnership with the Bay Area Water Supply and Conservation Agency (BAWSCA), the City developed a forecasting model to facilitate future water supply planning. The model, referred to as the DSS Model (Demand Side Management Decision Support System Model) was used in the development of the City's UWMP projections. The model considers three scenarios:

- **Scenario A:** the base-case which is the high-end estimate without consideration for plumbing code efficiencies or active conservation measures.
- **Scenario B:** the plumbing code scenario, which considers water savings driven by code and fixture and appliance replacement.
- **Scenario C:** the plumbing code and active conservation scenario, which considers further implementation of water conservation measures beyond the effects of the plumbing code. These measures are generally voluntary and encouraged by the City but can be difficult to predict the level of implementation.

The City has planned for Scenario B as the representative scenario for water demand projections. Water loss is estimated at 6.6%. Future potable demands through 2030 as projected by the forecasting model is presented in **Table 4-6**.

**Table 4-6: Projected Water Demands**

| Parameter | unit | 2020[1] | 2025 | 2030 |
|---|---|---|---|---|
| Population | persons | 79,772 | 91,810 | 98,080 |
| 2020 UWMP | MGD | 8.8 | 10.4 | 10.8 |
| Water Master Plan | MGD | 8.4 | 10.4 | 10.8 |

Notes
1. The 2020 demand for the UWMP is based on actual 2020 calendar year usage. Due to the onset of the COVID-19 pandemic and for the potential for mandated Stay-at-Home orders to skew 2020 demand, the Water Master Plan uses an estimate based on average historical water use by fiscal year (see **Section 4.1.1**).

Projections for the Master Plan expanded on the unit factors established for the base existing scenario and consider near-term planned redevelopment as well as full development of any underutilized parcels, in collaboration with City planning staff. "Redevelopment" for the purpose of the Master Plan represents a change in land use, typically from a non-residential use (e.g., industrial, commercial, etc.) to a residential or mixed-use type. "Development" of a parcel is transitioning to full utilization as its projected land use. Parcels slated for redevelopment were assigned updated land uses to account for the change in future water use. **Figure 4-5** highlights the areas where land use type or utilization is expected to change by 2030, as well as areas of planned redevelopment. Unit factors were adjusted to address increases in population and projected water demand. Unit factors were redistributed to the distribution system according to land use and large users were assumed to continue water usage at a similar rate.

Future unit demand factors were developed for each of the 12 consolidated land use categories (**Table 4-3**). Residential based land use factors are expected to be more affected due to increase in population and housing density in the future.

As with the existing use factors, single family residential factors are expressed in units of gpd/DU and all other land use types are expressed in units of gpd/acre. Some unit factors are larger in the future scenario to account for an increase in projected City population. The 2020 UWMP indicates a 15% increase in population and a 27% increase in total water use from 2020 to 2030. Since the City is mostly built out, the increased population could result in higher density housing and higher average water use per residential parcel. The resulting unit factors are detailed in **Table 4-7**.

**Table 4-7: Future Water Use Unit Factors by Land Use Category**

| Land Use Code | Unit Factor | Unit |
|---|---|---|
| MU | 5,400 | gpd/acre |
| COM | 2,000 | gpd/acre |
| HDR | 2,800 | gpd/acre |
| IND | 800 | gpd/acre |
| LDR | 225 | gpd/DU[1] |
| LMDR | 300 | gpd/DU[1] |
| MDR | 1,800 | gpd/acre |
| MBL | 1,100 | gpd/acre |
| OFF | 1,600 | gpd/acre |
| PF | 1,000 | gpd/acre |
| MOT | 3,800 | gpd/acre |
| OS | 800 | gpd/acre |

Notes:
1. Assume one dwelling unit per parcel.

Water demand unit factors were then applied back to the GIS parcel shapefile by multiplying the appropriate unit factor by the parcel area contained within the parcel feature class. Existing large users were assumed to continue to be large users in the future unless they were located on a parcel that will be redeveloped by 2030. Future large users were manually assigned demands. Using InfoWater, the parcels are linked to the nearest node (i.e. junction) in the model and the unit factors/manual demands were applied to the respective parcel to generate the effective water demand.

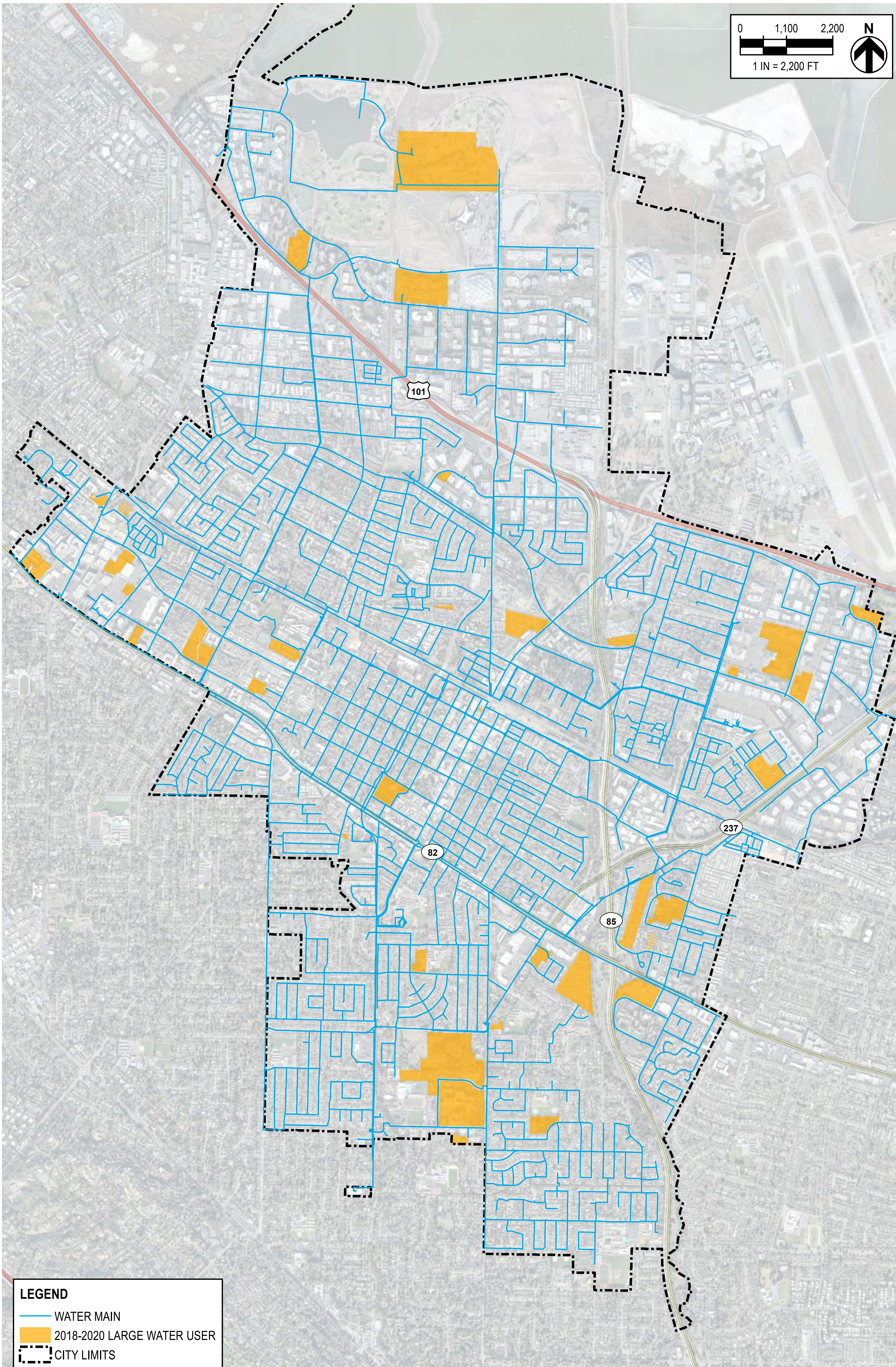


**FIGURE 4-4**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
LARGE WATER USERS

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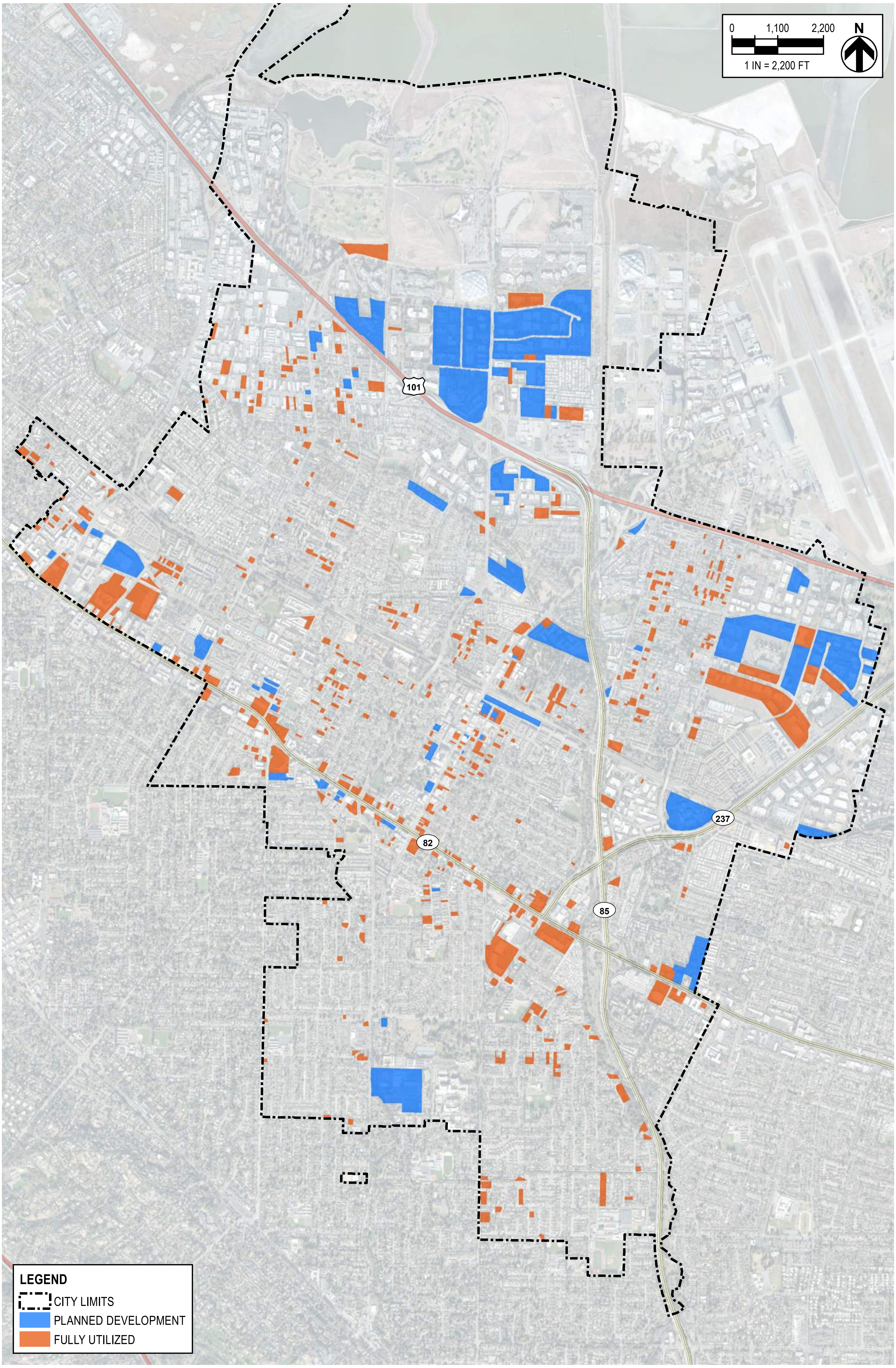


**FIGURE 4-5**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
MODIFIED FUTURE (2030) LAND USE

HydroScience

# SECTION 5 – HYDRAULIC MODEL UPDATE AND CALIBRATION

This section describes the process of updating and calibrating the City's existing hydraulic model and provides a summary of the updates. To identify areas of concern, the existing model infrastructure was reviewed against as-built drawings, City GIS files, and capital improvement project (CIP) documents. The model was updated to reflect the most current reference source.

## 5.1 Hydraulic Model Desktop Review and Update

The City's existing potable water hydraulic model was developed using InfoWater software by Innovyze® in 2010 as part of the 2010 Water System Master Plan. The City continues to use InfoWater for this update of the existing model and analysis of the system. For this update, InfoWater Version 12.5 is utilized.

The model is limited to City-maintained and owned facilities and excludes service lines. **Table 5-1** summarizes the model infrastructure from 2010 compared with this update, and this section summarizes the model elements and updates.

**Table 5-1: Summary of Model Infrastructure**

| Infrastructure | 2010 Units | 2021 Update Units | Notes |
|---|---|---|---|
| Pipelines (ft) | 956,982 | 982,169 | Includes active and inactive pipes |
| Junctions | 4,247 | 7,517 | Excludes inactive junctions[1] |
| Valves | 3,253 | 64 | Includes active and inactive valves[1] |
| Pumps | 16 | 16 | Whisman Pump Station (4), Miramonte Pump Station (4), Graham Pump Station (5), Groundwater Well Pumps 19, 21, and 22[2] |
| Storage Reservoirs | 3 | 4 | Miramonte Reservoirs, Whisman Reservoir, and Graham Reservoir[3] |
| Turnouts | 4 | 4 | Valley Water turnout and the three SFPUC turnouts are modeled as reservoirs[4] |
| Wells | 4 | 4 | Wells 19, 21, 22, and 23 are modeled as reservoirs[2,4] |

Notes:
1. The existing hydraulic model includes 3,205 general purpose valves that represent open butterfly and gate valves/inactive valves in the system. To improve model efficiency, these valves were replaced with junctions.
2. The existing hydraulic model includes Wells 10, 17, and 20 and their corresponding pumps. These pumps will be destroyed and were labeled as inactive in the model. Well 9 and pump were destroyed and were also labeled as inactive in the model.
3. City reservoirs are modeled as tanks. Miramonte Reservoir No. 1 and Miramonte Reservoir No. 2 were previously modeled as a single storage tank.
4. The model identified "reservoir" represent unlimited supply at a constant elevation head equivalent to available pressure/water level at the facility.

### 5.1.1 Groundwater Wells and Booster Pumps

The hydraulic model contains eight wells. Wells 10, 17, and 20 and their corresponding pumps will be destroyed and were labeled as inactive in the model as part of this infrastructure update. Well 9 and pump were destroyed and were also labeled as inactive in the model.

The water distribution system contains 16 booster pumps. In the model, all pumps are modeled with a design point curve, multiple point curve, or exponential 3-point curve. Pumps with a design point curve and exponential 3-point curve have a single modeled design head and design flow point. For the accuracy desired in a model calibration, it is preferred to model pumps with actual manufacturer pump curves or recent pump tests. Through coordination with City Staff and pump manufacturers, pump curves were obtained for the Miramonte, Graham, and Whisman pump stations and incorporated into the hydraulic model. Manufacturer pump curves for the groundwater wells were unavailable. A summary of active model pumps is presented in **Table 5-2**.

**Table 5-2: Active Model Pump Information**

| Model ID | Description | Curve Type | El. (ft) | Design Head (ft) | Design Flow (gpm) |
|---|---|---|---|---|---|
| WHISMAN_P3_Z1 | Whisman Pump #3 - Zone 1 | Multiple Point Curve[1] | 74 | 128 | 3000 |
| WHISMAN_P4_Z1 | Whisman Pump #4 - Zone 1 | Multiple Point Curve[1] | 74 | 128 | 3000 |
| WHISMAN_P2_Z2 | Whisman Pump #2 - Zone 2 | Exponential 3-Point Curve | 73 | 228 | 2,500 |
| WHISMAN_P1_Z2 | Whisman Pump #1 - Zone 2 | Exponential 3-Point Curve | 73 | 228 | 2,500 |
| MIRAMONTE_P1 | Miramonte Pump #1 | Design Point Curve | 170 | 120 | 869 |
| MIRAMONTE_P2 | Miramonte Pump #2 | Multiple Point Curve[1] | 169 | 165 | 2670 |
| MIRAMONTE_P3 | Miramonte Pump #3 | Multiple Point Curve[1] | 170 | 165 | 2670 |
| MIRAMONTE_P4 | Miramonte Pump #4 | Multiple Point Curve[1] | 170 | 165 | 2670 |
| GRAHAM_P1_Z1 | Graham Pump #1 - Zone 1 | Multiple Point Curve[1] | 119 | 75 | 2800 |
| GRAHAM_P2_Z1 | Graham Pump #2 - Zone 1 | Multiple Point Curve[1] | 119 | 75 | 2700 |
| GRAHAM_P1_Z2 | Graham Pump #1 - Zone 2 | Multiple Point Curve[1] | 119 | 234 | 2800 |
| GRAHAM_P2_Z2 | Graham Pump #2 - Zone 2 | Multiple Point Curve[1] | 119 | 234 | 2700 |
| GRAHAM_P3_Z2 | Graham Pump #3 - Zone 2 | Multiple Point Curve[1] | 119 | 234 | 2700 |
| WELL_19_PUMP | Well 19 Pump | Design Point Curve | 88 | 279 | 1,200 |
| WELL_21_PUMP | Well 21 Pump | Design Point Curve | 70 | 204 | 777 |
| WELL_22_PUMP | Well 22 Pump | Design Point Curve | 68 | 182 | 800 |

Notes:
1. Operating points are provided for pumps modeled with a multiple point curve.

### 5.1.2 Storage Reservoirs

The City operates four reservoirs: Whisman, Graham, and two reservoirs at Miramonte. All reservoirs are modeled as tanks. The Miramonte Reservoirs are rectangular, belowground reservoirs. In the 2010 hydraulic model, Miramonte was modeled as a single tank. HydroScience added a model tank adjacent to T5000 (Miramonte) to better represent the physical configuration of the Miramonte Reservoirs. Miramonte Reservoirs are modeled as two cylindrical tanks with identical features and a combined equivalent capacity matching the reservoirs. The objective is to ensure the two reservoirs have the same hydraulic grade. The Whisman and Graham model tanks were quality checked against available record drawings and confirmed by City Staff; no changes were made to the dimensions of these two tanks. Model IDs were updated to reflect the name of the reservoir. Updated modeling attributes for the model tanks are presented in **Table 5-3**.

**Table 5-3: Model Storage Tanks and Settings**

| Model ID | Description | Elevation (ft) | Maximum Level (ft) | Diameter (ft) | Volume (MG) |
|---|---|---|---|---|---|
| WHISMAN_R | Whisman Reservoir | 55 | 20 | 226 | 6 |
| MIRAMONTE_R1 and MIRAMONTE_R2[1] | Miramonte Reservoirs No. 1 and 2 | 169 | 12 | 150 | 3.2 |
| GRAHAM_R | Graham Reservoir | 79 | 34 | 200 | 8 |

Notes:
2. Miramonte model tanks represent the combined equivalent volume of Miramonte Reservoirs.

### 5.1.3 Valves

The existing hydraulic model contained a total of 3,242 active valves and 11 inactive valves. The active valves include 3,234 general purpose (GP) valves, two flow control valves (FCV), one pressure-sustaining valve (PSV), and five pressure reducing valves (PRV). Of the active GP valves, 3,202 valves are set to fully open and 32 valves are set to closed. Fully open valves typically represent open butterfly and gate valves in the distribution system. These are designed for system isolation for operations and maintenance purposes and have no effect on system hydraulics. However, eight fully open GP valves are located downstream of water supply sources such as turnouts, reservoirs, or wells to control discharge head or flow.

To increase model efficiency, 3,205 GP valves were replaced with junctions. This includes the 3,194 open GP valves that were not located near a supply source and the existing 11 inactive valves.

The 32 active GP valves that are set to closed in the model were kept in the updated hydraulic model. Of the 32 valves, one valve is a redundant valve in place for maintenance purposes, and 31 valves represent pressure zone boundary valves that are closed during normal operations.

Five GP supply source valves were added to the updated model to facilitate reservoir fill/drain conditions. One open GP valve was added on Oak St at the Zone 1 and Zone 2 boundary based on record drawings.

**Figure 5-1** displays the locations of all active valves of interest, excluding the open GP valves that did not influence system hydraulics.

**Table 5-4** summarizes the model FCVs, PSV, and PRVs. The following updates were made to the non-GP model valves:

- Valves along abandoned pipelines were inactivated.
- Two newly installed PRVs between Zone 2 and 3 boundaries were added to the model. These valves allow flow between the two zones during emergencies.
- Two valves were added to each SFPUC turnout to mimic the physical infrastructure.

**Table 5-4: Model Valves (FCV, PSV, PRV)**

| Model ID | Valve Type | Purpose | Location | Elevation (ft) | Diameter (in) | Setting |
|---|---|---|---|---|---|---|
| PRV1_ SFPUC5 | PRV | Maintains Turnout 5 discharge pressure | Off Escuela Ave | 61 | 14 | 58 psi |
| PRV2- SFPUC5 | PRV | Maintains Turnout 5 discharge pressure | Off Escuela Ave | 61 | 14 | 58 psi |
| PRV3_ SFPUC5 | PRV | Maintains Turnout 5 discharge pressure | Off Escuela Ave | 61 | 8 | 49 psi |
| PRV1_ SFPUC7 | PRV | Maintains Turnout 7 discharge pressure | Off Escuela Ave | 61 | 8 | 92 psi |
| PRV2_ SFPUC7 | PRV | Maintains Turnout 7 discharge pressure | Off Escuela Ave | 61 | 12 | 92 psi |
| PRV3_ SFPUC7 | PRV | Maintains Turnout 7 discharge pressure | Off Escuela Ave | 61 | 12 | 92 psi |
| PRV1- SFPUC14 | PRV | Maintains Turnout 14 discharge pressure | Off N Whisman Rd | 55 | 14 | 95 psi |
| PRV2- SFPUC14 | PRV | Maintains Turnout 14 discharge pressure | Off N Whisman Rd | 55 | 14 | 95 psi |
| PRV3- SFPUC14 | PRV | Maintains Turnout 14 discharge pressure | Off N Whisman Rd | 55 | 14 | 95 psi |
| V8006 | FCV | Leads to Whisman Reservoir | Off N Whisman Rd | 74 | 12 | 2,000 gpm |
| V8036 | PRV | Maintains Valley Water turnout discharge pressure | Off Miramonte Ave | 169 | 12 | 60 psi |
| V8018 | PSV | Leads to Graham Reservoir | Off Miramonte Ave | 119 | 12 | 50 psi |
| V8004 | FCV | Leads to Whisman Reservoir | Off N Whisman Rd | 74 | 12 | 2,000 gpm |
| V8026 | FCV | Leads to Graham Reservoir | Off Miramonte Ave | 118 | 12 | 700 gpm |
| V-3907 | PRV | Pressure sustaining/ reducing/relief valve between Zones 2 and 3 | Cuesta Dr and Begen Ave | 138 | 8 | 62 psi |
| V-3869 | PRV | Pressure sustaining/ reducing/relief valve between Zones 2 and 3 | Cuesta Dr and Grant Rd | 143 | 5 | 62 psi |

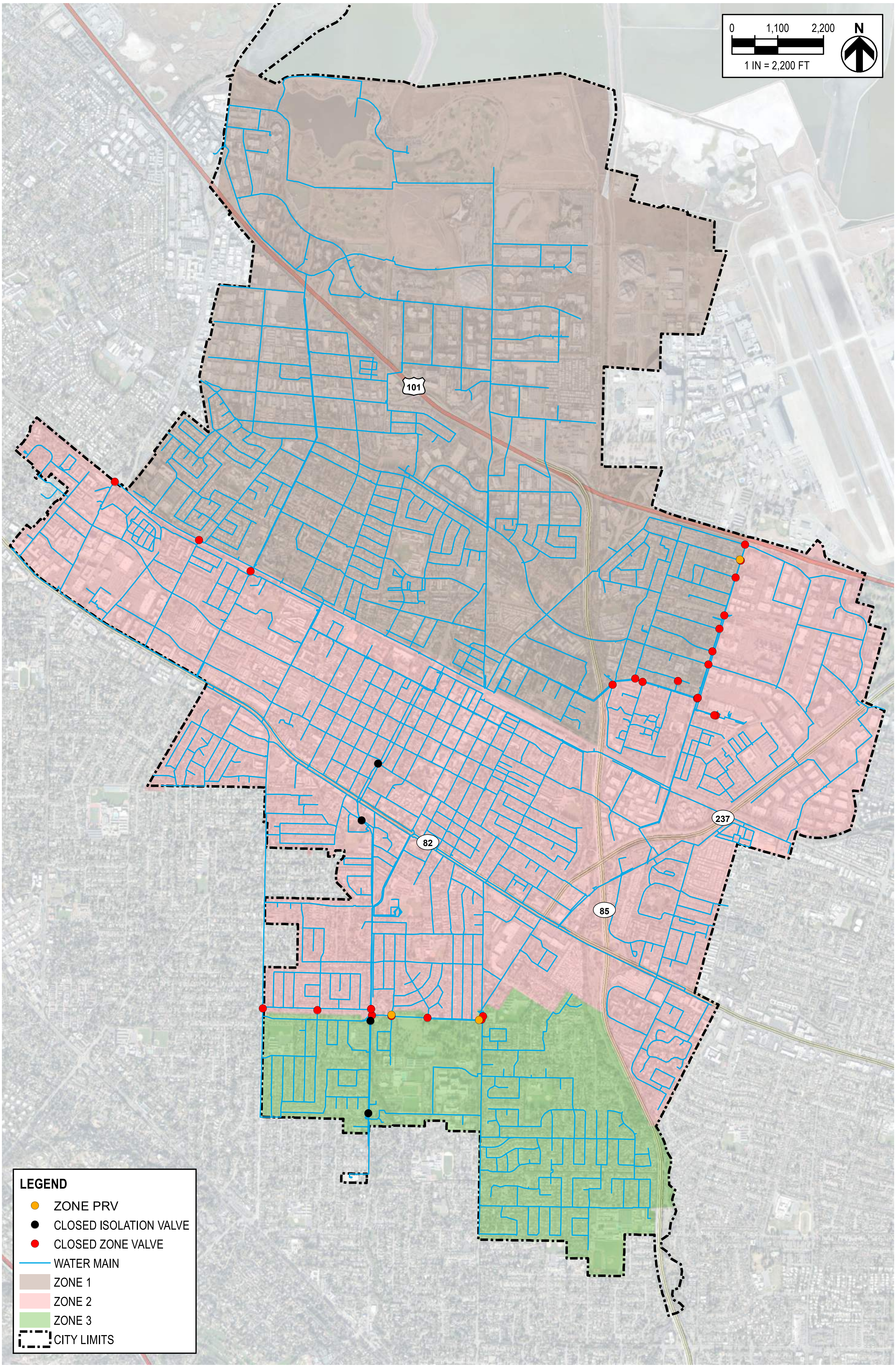


**FIGURE 5-1**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
HYDRAULIC MODEL VALVES

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### 5.1.4 Junctions

Junctions in the hydraulic model represent pipe intersections, water customers, fire hydrants, or a change in pipe characteristic(s). Model junctions were updated per record drawings and in conjunction with the updated model pipelines to maintain pipe connectivity (excluding the valves replaced with junctions). **Figure 5-2** presents the locations of all updated pipelines. Junctions along updated pipelines were updated, added, and/or removed as appropriate.

### 5.1.5 Distribution Pipelines

HydroScience conducted a review of system pipelines, identifying discrepancies and reconciling them against record drawings provided by the City. Approximately 20 miles of pipe were updated/added per City comments and record drawings. This includes any pipelines that were made inactive and removed from the model. Inactive pipelines represent abandoned pipes or private lines. **Figure 5-2** presents the locations of all updated pipelines.

## 5.2 Field Data

As part of the calibration process, the City collected 110 hours of field data. The data was captured from October 26 – 31, 2020. The following is a brief description of the data collected and used in the calibration:

- **Data logger pressure monitoring:** Monarch Instrument Track-It™ Pressure/Temperature Data Loggers were installed at 12 locations throughout to City to capture pressure readings at six-second intervals from October 26 – 31, 2020; this is referred to as the "monitoring period." This data is used for calibration of the 24-hour extended period simulation (EPS).
- **Hydrant testing data:** The City conducted hydrant flow testing on October 28, 2020. Staff manually recorded hydrant flows and static and residual pressures at the hydrants; this is referred to as the "testing period." Hydrant testing data was used for steady state model calibration.
- **SCADA data outputs:** SCADA data was compiled for all water supply sources and reservoirs that were operational during the monitoring and testing period. This data was used to understand typical week operations and establish operating conditions in the model for calibration. This data was also used to develop diurnal patterns.

**Figure 5-3** provides the monitoring and testing site locations. In general, each site consists of three hydrants in sequence that were monitored and/or flowed.

### 5.2.1 System-Wide Pressure Monitoring

System-wide pressure monitoring provides a baseline for understanding system hydraulics and performance during normal conditions. Pressure data loggers were installed at 12 sites for the duration of the monitoring period and were programmed to record pressures at six-second intervals.

### 5.2.2 Hydrant Flow Testing

The City conducted hydrant flow testing on October 28, 2020, at 12 test sites. Flow testing was conducted at hydrants adjacent to datalogger sites. This allowed the data loggers to capture the system response during hydrant flow. Residual pressure was also captured using a pressure gage on the next adjacent hydrant where three hydrants were available in sequence. The accuracy of the pressure gage was ± 2.0 psi; the datalogger accuracy is within ± 0.25%.

Flow was measured using a handheld pitot tube. The accuracy of the pitot tube is 40 gpm for the 4-inch and 20 gpm for the 2-1/2-inch hydrant nozzle. Thus, there is an inherent level of error in flow and pressure readings for hydrant testing that is considered for the calibration.

As part of the hydrant flow testing, the City also conducted coefficient of friction factor (C-factor) testing for 6-inch/8-inch CIP and 8-inch ACP. These pipe types are the most commonly found within the City's distribution system (see **Table 3-6**). Results of the C-factor tests were incorporated into the hydraulic model. Manually and electronically recorded flow and pressure readings are provided in **Table 5-5**.

**Table 5-5: Hydrant Flow Testing Data**

| Pressure Zone | Site No. | Pipe Size (inch) | Estimated Flow (gpm) | Static Pressure (psi)[1] | Residual Pressure (psi)[1] |
|---|---|---|---|---|---|
| 1 | 1 | 8 | 1,100 | 73.3 | 69.0 |
| | 2 | 8 | 950 | 71.1 | 65.4 |
| | 3 | 8 | 1,060 | 67.3 | 62.3 |
| | 4 | 6 | 840 | 59.4 | 52.3 |
| | 5 | 8 | 920 | 50.5 | 48.4 |
| 2 | 6 | 8 | 1,250 | 85.5 | 83.2 |
| | 7 | 6 | 1,160 | 72.3 | 69.2 |
| | 8 | 8 | 1,000 | 68.0 | 60.6 |
| | 9 | 6 | 800 | 57.6 | 53.5 |
| | 10 | 8 | 840 | 52.6 | 49.5 |
| 3 | 11 | 6 | 1,060 | 64.4 | 58.9 |
| | 12 | 6 | 920 | 63.3 | 56.3 |

Notes:
1. Field static and residual pressures are the average of data logger pressure readings over one minute prior to or during the flow test.

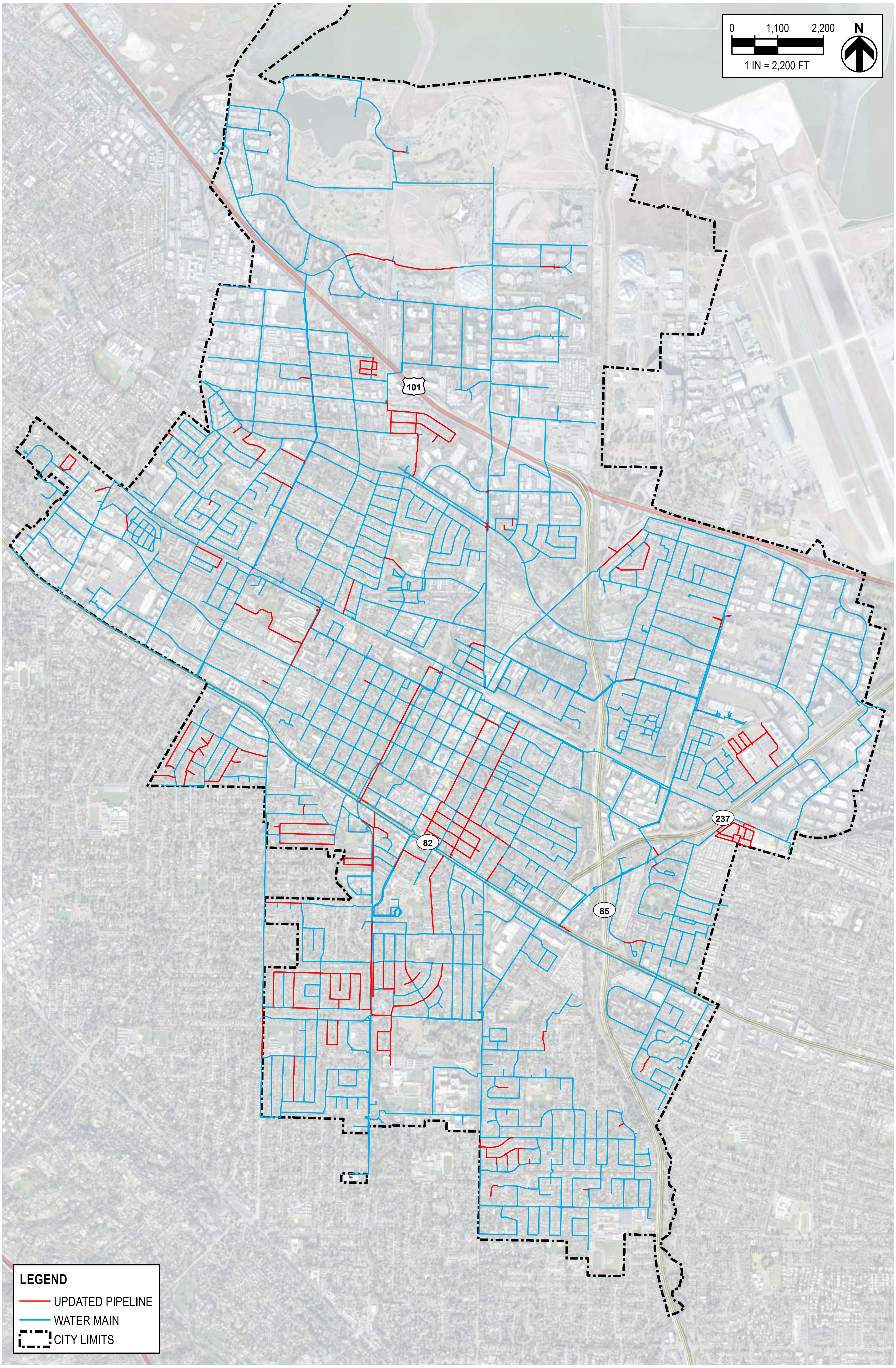


**FIGURE 5-2**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
HYDRAULIC MODEL PIPELINE UPDATES

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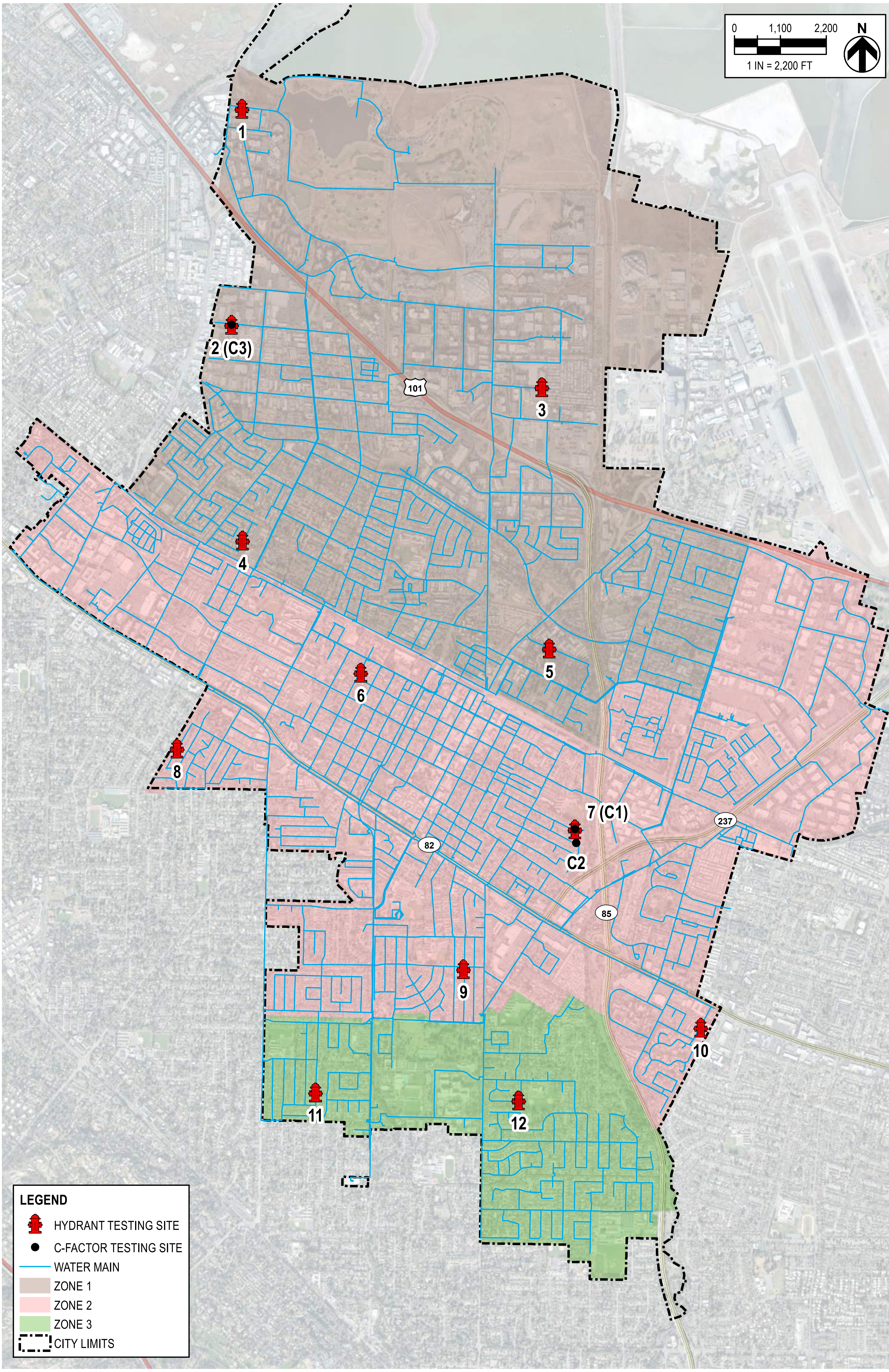


**FIGURE 5-3**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
MONITORING AND TESTING SITES

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## 5.3 Model Calibration

The model was calibrated against the hydrant flow and pressure shown in **Table 5-5** for steady state and the 24-hour pressure readings for EPS. For calibration, the following facility conditions were simulated:

- **Groundwater Wells:** During the calibration period, all groundwater wells were closed. The model was updated to reflect this.
- **Valley Water Turnout:** The pressure setting of the PRV downstream of Valley Water turnout was set to 62 psi.
- **Turnout 5:** The pressure setting of the PRV downstream of Turnout 5 was updated to 49 psi when Miramonte is full and 58 psi when Miramonte is filling.
- **Turnout 7:** The pressure setting of the PRV downstream of Turnout 7 was updated to 92 psi.
- **Turnout 14:** The pressure setting of the PRV downstream of Turnout 14 was updated to 95 psi.
- **Pressure Zone Valves:** During the calibration period, all zones were isolated from each other, thus all zone valves in the model were closed.
- **Reservoirs:** Reservoir levels were updated for all calibration scenarios to reflect SCADA levels at the time of each hydrant flow test.

These conditions formed the basis for the calibration scenarios.

### 5.3.1 SCADA Data

SCADA data was processed to determine system demand, develop the diurnal curve, and understand supply operations during the calibration period. The system demands and supply operations were used to create the calibration scenarios, described below. Hourly water balances were created to determine system demands. A water balance is a simple mass balance:

System Demand = Water Supplied – Water Stored

The SCADA data was also used to identify which water supply sources were active during each test over the testing period so that the appropriate sources were activated for the steady-state hydrant flow simulations.

The only active water supply sources during the data collection period were Valley Water and SFPUC turnouts. The SCADA data included turnout flow rates, which were processed to determine hourly volumetric flow rates for the week of data collection. **Table 5-6** lists the turnouts that supplied the system and the corresponding flow ranges.

**Table 5-6: Turnouts Flowing During the Calibration Period**

| Turnout Name | Flow Range (gpm) | Monday 10/26 | Tuesday 10/27 | Wednesday 10/28 | Thursday 10/29 | Friday 10/30 | Saturday 10/31 | Sunday 11/1 |
|---|---|---|---|---|---|---|---|---|
| Turnout 5 | 1 – 6,841 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Turnout 7 | 790 – 6,981 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Turnout 14 | 27 – 8,334 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Valley Water | 365 – 1,506 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

The SCADA data for system reservoirs contained water levels, inflow rates for Graham Reservoir, and outflow pumping rates for both Whisman and Graham pump stations. During the calibration period, all four storage reservoirs were in operation and are listed in **Table 5-7**.

**Table 5-7: Storage Reservoir Operating During Calibration Period**

| Reservoir Name | Weekday Water Level Range (ft) |
|---|---|
| Miramonte No. 1 and No. 2[1] | 5.2 – 10.1 |
| Whisman | 10.3 – 18.6 |
| Graham | 14.5 – 29.9 |

Notes:
1. The SCADA output tables for the Miramonte Reservoirs represents levels for Miramonte Reservoir No. 1. The reservoirs are plumbed together and it is assumed that the two reservoirs have the same hydraulic grade.

The reservoir level changes correspond to water supplied, water demand, and water stored. Generally, if reservoir levels increase, then excess water is being stored beyond water demand; and if water levels decrease, demand is being met by water supplied and supplemented by stored water. The exception is where reservoirs are pumped down on a timer to encourage reservoir turnover for water quality purposes. Water demand for each weekday was determined from the resulting water balance based on hourly supply and storage flow rates. The daily demands are provided in **Table 5-8**.

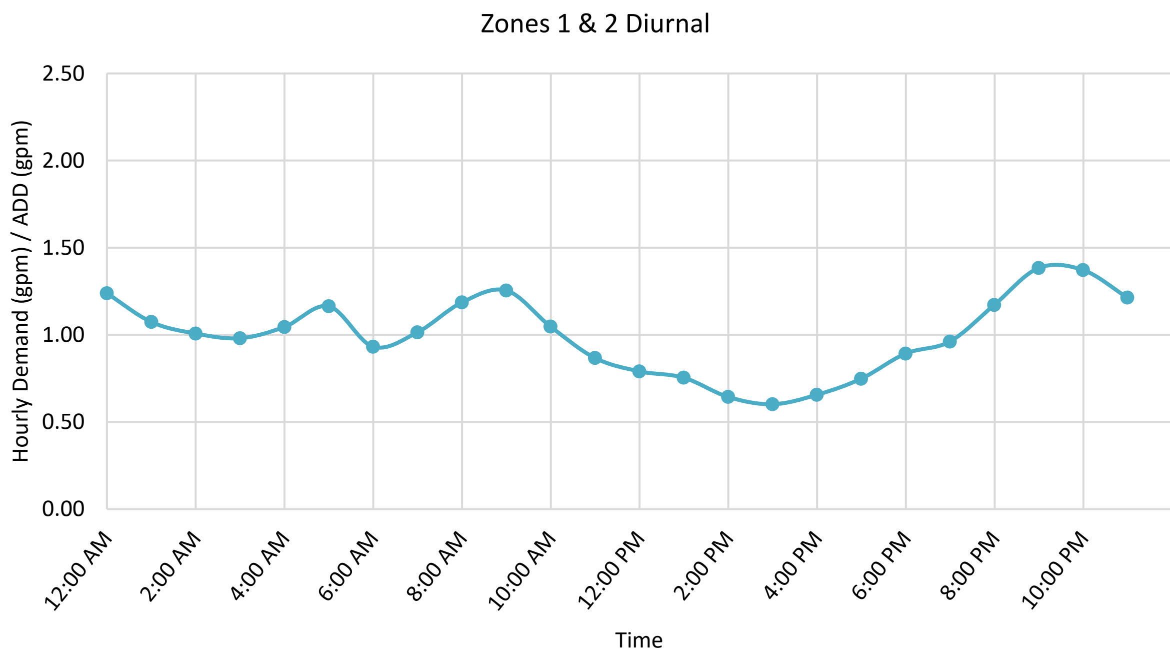
**Table 5-8: Average Daily Demands**

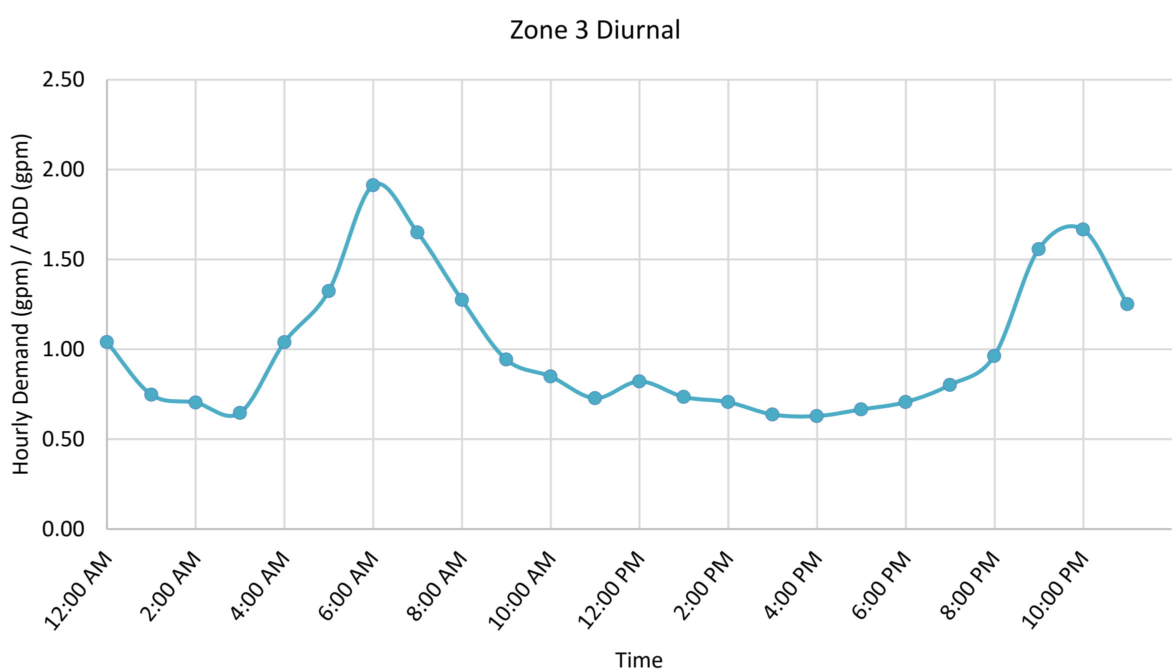
| Weekday | Average Daily Demand (gpm) |
|---|---|
| Monday 10/26 | 6,960 |
| Tuesday 10/27 | 6,450 |
| Wednesday 10/28 | 9,610[1] |
| Thursday 10/29 | 7,610 |
| Friday 10/30 | 7,390 |
| Saturday 10/31 | 6,900 |
| Sunday 11/1 | 5,550 |

Notes:
1. Whisman Reservoir was filling on Wednesday, 10/28, and is likely not reflective of actual demand on that day.

Representative diurnal curves were developed for Zones 1 and 2, which is a combined diurnal curve, and a separate curve for Zone 3. Typical diurnal curves are characterized by two peaks, resulting from early morning and early evening water usage. The diurnal curves are shown in **Figure 5-4**. The highest ratio of hourly demand/ADD defined the peak hour demand (PHD) PF for each respective zone. PHD represents the peak hour of a maximum day. Zone 3 consists of mostly residential use, which could explain the higher peaks shown in the Zone 3 diurnal curve.

**Figure 5-4: Diurnal Curves**



## 5.4 Steady-State Calibration

Hydrant flow testing was modeled under steady state conditions. The intent is to recreate field demands and operations such that the modeled results are like those observed during testing. In total, 24 scenarios were created to represent each of the tests conducted in the field.

For each site, two pressure conditions were documented: static system pressures prior to hydrant flow testing and residual pressures during hydrant flow testing. Thus, each hydrant test had a corresponding static and residual scenario. The system demands were obtained from processing the SCADA data for active water supply sources. The scenarios were modified to match the water supply sources that were operating during the testing and then adjusted iteratively as part of the calibration process.

All static pressure scenarios were developed and run first. These represent pre-hydrant flow conditions. The results were compared to field results. After the static pressures were within +/- 5-10% of field results, the hydrant flow scenarios were tested. The pump efficiencies were adjusted as needed to approximate supply ratios documented by SCADA.

Steady state calibration results are presented in **Table 5-9**.

**Table 5-9: Steady-State Calibration Results**

| Press. Zone | Site No. | Facility ID | Model Junction ID | Static Pressure (psi) | | Diff. % | Residual Pressure (psi) | | Diff. % |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Field | Model | | Field | Model | |
| 1 | 1 | A2-011 | J-1668 | 73.3 | 70.3 | 4% | 69.0 | 66.9 | 3% |
| | 2 | D2-003 | J-1517 | 71.1 | 70.0 | 2% | 65.4 | 63.6 | 3% |
| | 3 | D4-050 | J-4212 | 67.3 | 66.5 | 1% | 62.3 | 60.4 | 3% |
| | 4 | F2-043 | J-1154 | 59.4 | 58.2 | 2% | 52.3 | 52.9 | -1% |
| | 5 | G5-005 | J-3998 | 50.5 | 49.3 | 2% | 48.4 | 47.2 | 3% |
| 2 | 6 | H3-031 | J-893 | 85.5 | 86.5 | -1% | 83.2 | 85.0 | -2% |
| | 7 | I5-049 | J-3597 | 72.3 | 74.6 | -3% | 69.2 | 70.9 | -3% |
| | 8 | H2-022 | J-17 | 68.0 | 70.2 | -3% | 60.6 | 64.4 | -6% |
| | 9 | K4-020 | J-1886 | 57.6 | 60.7 | -5% | 53.5 | 57.6 | -8% |
| | 10 | K6-012 | J-3289 | 52.6 | 54.5 | -4% | 49.5 | 52.3 | -6% |
| 3 | 11 | L3-025 | J-476 | 64.4 | 64.5 | 0% | 58.9 | 59.8 | -2% |
| | 12 | L4-014 | J-1759 | 63.3 | 64.2 | -1% | 56.3 | 57.3 | -2% |

## 5.5 Extended Period Simulation (EPS) Calibration

Normal operating conditions were modeled using a 24-hour EPS. The EPS feature is a tool for analyzing system operation under an extended timeframe. For the purposes of these analyses, EPS scenarios are designed to model response to hourly diurnal demand variation over a normal day of operation. System-wide pressure data captured by the data loggers as well as flows and pressures captured via SCADA at turnouts, reservoirs, and groundwater wells were used to calibrate the EPS scenarios.

The data loggers collected extensive pressure data (every six-seconds). Each data set was processed and summarized into average hourly pressures from October 26, 2020 to November 1, 2020 (Monday to Sunday). The objective is to represent system pressures on a typical weekday; thus the pressure data was processed as follows:

- Monday and Tuesday were omitted from the data set because the diurnal curves did not match the expected patterns for service areas based on land use;
- Wednesday was omitted from the data set since it was the heaviest day of flow testing; and
- Saturday and Sunday were omitted from the data set because they do not represent a typical weekday.

Thursday and Friday were the remaining viable options for pressure readings. Thursday was chosen as the representative day during the calibration period because the diurnal curve was most indicative of what would be expected from a system of this size and land use.

A single EPS scenario was created to represent the typical 24-hour condition observed during the calibration period. The average demand for Thursday, October 29 (7,614 gpm) was applied to the scenario using the Zone 1 & 2 and Zone 3 diurnal curves to allocate demands over 24 hours. Supply source flowrates varied from day to day during the calibration period due to the fill cycles of reservoirs. The operational settings modified were supply source status, valve settings, and reservoir starting levels. HydroScience created controls and logical rule sets for all pumps in the system. Controls and logical rules within InfoWater allow the pumps to turn on or off depending on a specific condition such as system pressure, time of day, or reservoir level. Only the logical rules for those pumps active on October 29, 2020 were active in the EPS scenario.

Initial model results were outside of the desired accuracy compared to the data logger pressure readings. Through an iterative approach, adjustments were made to the model to bridge this gap.

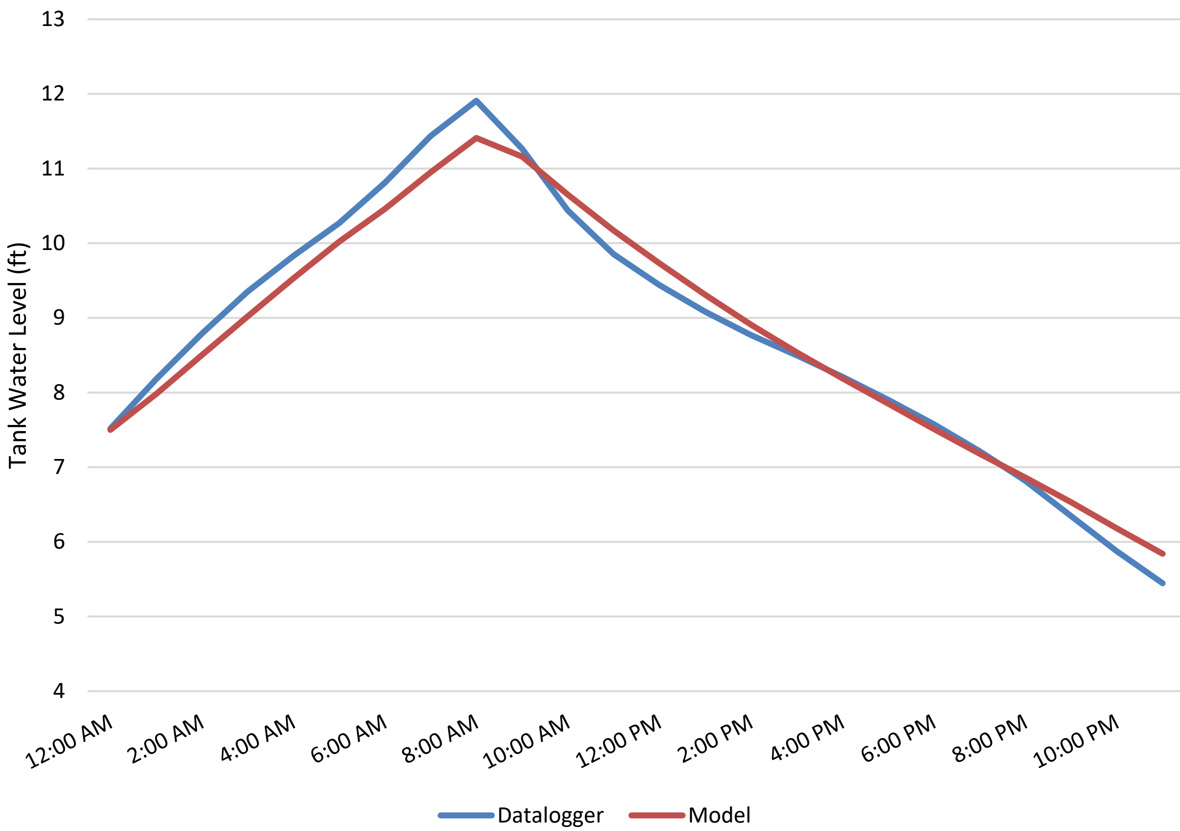
The strategy during the calibration was to establish known variables and iteratively adjust the unknown variables within the range of estimated operating parameters. This strategy is standard industry practice. Pressure readings are largely a function of system demands and supply. The system demands were fixed, but the supplies varied. HydroScience analyzed the model results to determine if the supplies were behaving like field data. The following adjustments were made during the EPS calibration:

- Adjusted hydraulic grade lines (HGLs) at all system turnouts. This was done to obtain flow rates and pressures which mirrored those in the SCADA output tables;
- Assigned a pressure versus flow rate curve to the Valley Water PRV to more accurately represent conditions illustrated in SCADA;
- Created controls at Turnout 5 PRVs and Miramonte Reservoirs fill and drain valves to mirror fill and flow cycles observed in SCADA data; and
- Created Variable Speed Pump (VSP) controls for Miramonte, Graham, and Whisman Reservoir pump stations. VSP controls are an InfoWater feature used to model Variable Frequency Drive (VFD) pumps. The VSP controls were created based on SCADA screenshots provided by the City.

HydroScience checked pump station flow rates with SCADA output tables and confirmed system operations with City operations personnel throughout this iterative process. Once the calibration was complete, all supply sources, including the Miramonte Reservoirs, were flowing at rates similar to what was witnessed in the field. **Figure 5-5** presents the reservoir levels at Miramonte Reservoirs during the calibration period along with the modeled EPS reservoir levels.

The overall objective was to represent pressure in the system to within 10%. All hourly EPS model results were within 5% of field results. The full results are included in **Appendix B**. Figures show modeled and measured pressures at each site and include a 5% margin for reference.

**Figure 5-5: Actual and Modeled Miramonte Reservoir Levels**



# SECTION 6 – STORAGE AND SUPPLY ANALYSIS

A storage and supply tool was developed for the City to evaluate multiple supply conditions and varying permutations. For this Master Plan, four scenarios were evaluated under existing and 2030 conditions. Summaries of the scenarios analyzed are as follows:

- **Baseline Scenario:** For this scenario, it is assumed that all supplies are available and there are no wholesaler outages. This serves as the baseline scenario.
- **Scenario 1 (No Valley Water):** For this scenario it is assumed that the Valley Water turnout is offline and unavailable. In this scenario, the entire City distribution system is supplied by SFPUC and groundwater.
- **Scenario 2 (No SFPUC):** For this scenario it is assumed that all SFPUC turnouts are offline and unavailable. In this scenario, the entire City distribution system is supplied by Valley Water and groundwater.
- **Scenario 3 (No Wholesale Supply):** For this scenario it is assumed that both SFPUC and Valley Water turnouts are offline and unavailable. In this scenario, the system is supplied by groundwater only.

The storage criteria are described in this section followed by the results of the analysis.

## 6.1 Storage Capacity Criteria

The City's municipal water system services three pressure zones and consists of four wholesale water turnouts, four reservoirs, three pump stations, and four active groundwater supply wells. These reservoirs should provide enough storage, in each pressure zone, to meet the following four main storage requirements:

- Operational/Equalization Storage;
- Fire Flow Storage;
- Short-Term Emergency Storage; and
- Reserve/Long-Term Emergency Storage.

Waterworks Standards dictate that:

> *At all times, a public water system's water source(s) shall have the capacity to meet the system's MDD. …the system shall be able to meet four hours of PHD with source capacity, storage capacity, and/or emergency source connections.*
>
> *Both the MDD and PHD requirements shall be met in the system as a whole and in each individual pressure zone.*

City storage is evaluated to ensure that the zone storage and total storage held fulfills the Waterworks Standards. It is noted that these storage requirements are not in addition to the City's operational, fire flow, and short- and long-term emergency storage, rather, the sum of those storage requirements must meet the Waterworks Standards, at minimum.

### 6.1.1 Operational/Equalization Storage

Operational storage is designed to moderate fluctuations during normal operations between supply and demand in the distribution system. The recommended volume is the amount of storage required to balance the differences between average hourly demand and diurnal MDD variations, while also accounting for system losses. This is represented in **Figure 6-1** and **Figure 6-2**. The equalization volume is the volume above average day demand and under the max day diurnal. This volume is equivalent to 0.80 MG for the system.

**Figure 6-1: Zone 1 and 2 System Water Demands**

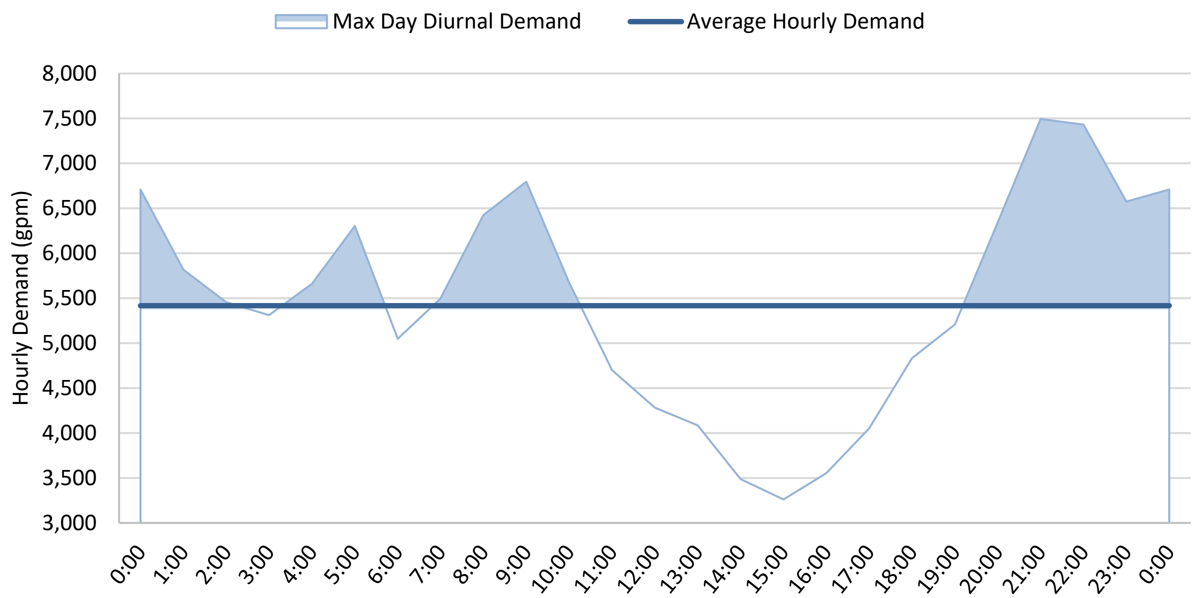
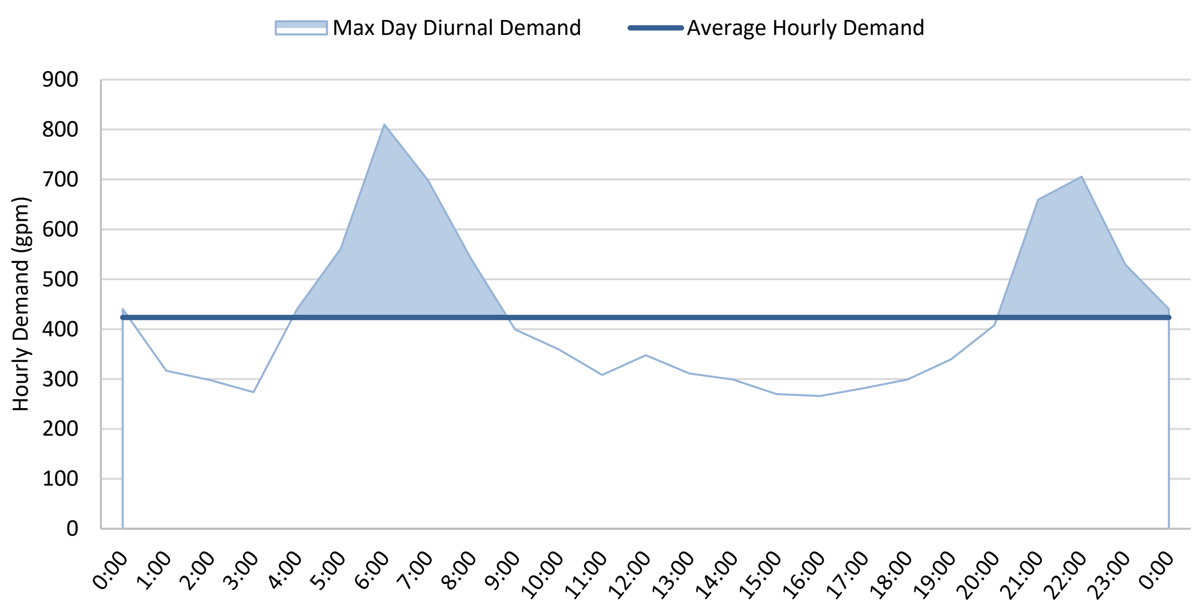



**Figure 6-2: Zone 3 System Water Demands**



Currently, the City can "float" off the turnout connections to the wholesalers' systems, SFPUC and Valley Water. This means that the City is able to take peak demands from each turnout up to the turnout capacity at variable flow quantities throughout the day. The alternative to "floating" would require that the City utilize constant flows from each turnout along with storage to manage daily fluctuations.

### 6.1.2 Fire Flow Storage

Fire flow standards are based on AWWA M31 – Distribution System Requirements for Fire Protection (AWWA M31) and the local fire authority. Per AWWA M31, required fire flow refers to the rate of flow, at a residual pressure of 20 psi, and for a specific duration, that is necessary to control a major fire. The volume reserved for fire protection is typically equivalent to the maximum fire flow and duration based on land use that would occur within a pressure zone or service area.

Fire flow requirements from the 2010 Master Plan were reviewed for consideration in this Master Plan. Slight modifications were made to the flows and duration, though the criteria remained largely the same. The fire flows were provided to the Fire Marshal for review and they were confirmed to be acceptable. The land use-based fire flow values, duration, and storage volumes are provided in **Table 6-1**.

**Table 6-1: Fire Flow Storage Criteria**

| Land Use | Required Fire Flow[1,2] (gpm) | Duration (hours) | Required Fire Storage (MG) |
|---|---|---|---|
| Single-Family Residential | 1,500 | 2 | 0.18 |
| Multi-Family Residential | 2,500 | 2 | 0.30 |
| Public/Schools | 2,500 | 2 | 0.30 |
| Business and Commercial | 3,500 | 3 | 0.63 |
| Industrial[3] | 3,500 – 5,000 | 4 | 1.20 |

Notes:

2. The 2019 California Fire Code allows for a reduction in fire flow for buildings with fire sprinklers.
3. The absolute minimum required fire flow is 1,500 gpm.
4. Actual required fire flow and duration for industrial centers depends on the size of parcel and type of facility.

### 6.1.3 Short-Term Emergency Storage

This is the storage volume needed to supply the system during short-term emergencies within the City if local water supply is temporarily reduced or turned off. This may be due to a power outage or mechanical failure of a local supply source. The equivalent of total flow for a maximum day's demand is recommended to manage temporary local emergencies. The intent is to provide enough capacity to allow City staff sufficient time to repair facilities and return them to service or mitigate the emergency with backup power or by activating emergency supplies.

### 6.1.4 Reserve/Long-Term Emergency Storage

This volume is needed in the event of regional emergencies when either wholesaler water supply is disrupted. The City's storage and supply will be evaluated to determine the available MDD equivalents.

## 6.2 Storage and Supply Analysis

The storage and supply analysis considers the system's ability to meet a conservative fire flow event during a peak summer day (MDD) and identifies the number of additional consecutive peak summer days that could be met with available turnouts, groundwater wells, and storage reservoirs. The intent is to better understand system reliability under various supply scenarios that may result from emergencies or planned maintenance.

For this analysis, four supply scenarios were evaluated and are presented in **Table 6-2**. The first scenario is the baseline with all sources of supply operational. The remaining three scenarios consider permutations of wholesaler outages at the turnouts. All scenarios consider groundwater supply to be available and storage reservoirs to be full and operational.

**Table 6-2: Storage and Supply Scenarios Analyzed**

| Scenario | SFPUC Turnouts | Valley Water Turnout | Groundwater Wells |
|---|---|---|---|
| Baseline | ✓ | ✓ | ✓ |
| Scenario 1 | ✓ | | ✓ |
| Scenario 2 | | ✓ | ✓ |
| Scenario 3 | | | ✓ |

The analysis was conducted with the following assumptions:

- Fire flow is based on the most conservative fire flow for the service area, which is 5,000 gpm for four hours based on the industrial land use type (**Table 6-1**).
- Design flow is determined by either the PHD or MDD+FF, whichever is greater. For this analysis, required flow is based on MDD+FF as this was the more conservative flow for all scenarios.
- Demands represent 100% of anticipated MDD assuming no drought- or emergency-related conservation. It is noted, however, that conservation measures and water use restrictions would likely be implemented in the event of a water emergency.
- Future demands by zone were calculated using projected unit factors and planned development and scaled using the DSS model (see **Section 4.4**).
- All reservoirs were assumed to start full with a combined total of 17.3 MG of stored water available at the start of each analysis.
- Per AWWA M31, a system is considered reliable when delivery is also possible with the most critical limiting component out of service for a specified length of time. For each pump station it was assumed the largest pump to each zone was offline.

- Supply and storage were evaluated based on 24-hr MDD plus 4-hr fire flow with the fire flow occurring at time step zero. Additional days are based on MDD.
- Demand is first met by available turnout and groundwater supply then supplemented from storage facilities if demand is greater than available supply.
- Supply totals assumed maximum available flow from each active wholesaler.

**Table 6-3** provides a summary of demand and storage assumptions for each year evaluated.

**Table 6-3: Summary of Demand and Storage Assumptions**

| Year | MDD (gpm) | FF (gpm) | MDD+FF (gpm) | Available Flow from Storage (gpm) | Available Storage (MG) |
|---|---|---|---|---|---|
| 2020 | 7,293 | 5,000 | 12,293 | 17,469 | 17.3 |
| 2025 | 8,998 | 5,000 | 13,998 | 17,469 | 17.3 |
| 2030 | 9,366 | 5,000 | 14,366 | 17,469 | 17.3 |

The results of each scenario are described in more detail in the following sections. **Appendix C** provides the detailed inputs and outputs for the supply and storage analysis tool. **Figure 6-3**, **Figure 6-4**, **Figure 6-5**, and **Figure 6-6** shows the relationship between demand, supply, and storage as well as the total available storage and the volume consumed for each scenario, respectively.

### 6.2.1 Baseline Scenario (All Wholesale and Groundwater Supplies Available)

This scenario serves as a baseline condition. Under this scenario, there are no shortages or facilities offline. **Table 6-4** summarizes the existing and future MDD including 5,000 gpm of fire flow; the resulting shortages during a 24-hr MDD+FF, if any; and the storage volume needed to augment any shortages.

**Table 6-4: Baseline Scenario – Supply and Storage Consumption for 24hr MDD + FF**

| Year | MDD+FF (gpm) | Available Supply (gpm) | MDD+FF Excess/ (Shortage) (gpm) | Storage Consumed (MG) | Remaining Storage (MG) | Total Days (days) |
|---|---|---|---|---|---|---|
| 2020 | 12,293 | 12,958 | 666 | 0.0 | 17.3 | continuous |
| 2025 | 13,998 | 12,783 | (1,215) | 0.3 | 17.0 | continuous |
| 2030 | 14,366 | 12,616 | (1,750) | 0.4 | 16.9 | continuous |

In year 2020, MDD+FF can be met by turnout and groundwater supply alone. In both future years (2025 and 2030) available supply is less than MDD+FF and some water is required from available storage to supplement supply and meet MDD+FF. All demand conditions are met from now through 2030 with existing supply and storage. Beyond meeting a 24hr MDD+FF, the system can continuously meet MDDs with no limitation since available supply is greater than MDD.

### 6.2.2 Scenario 1 (No Valley Water – SFPUC and Groundwater Supplies Available)

In this scenario, Valley Water is offline, and the system would rely on SFPUC and existing groundwater supplies. This scenario represents a wholesaler outage or maintenance activity. **Table 6-5** summarizes the existing and future MDD including 5,000 gpm of fire flow; the resulting shortages during a 24-hr MDD+FF, if any; and the storage volume needed to augment any shortages.

**Table 6-5: Scenario 1 – Supply and Storage Consumption for 24hr MDD + FF**

| Year | MDD+FF (gpm) | Available Supply (gpm) | MDD+FF Excess/ (Shortage) (gpm) | Storage Consumed (MG) | Remaining Storage (MG) | Total Days (days) |
|---|---|---|---|---|---|---|
| 2020 | 12,293 | 12,229 | (64) | 0.0 | 17.3 | continuous |
| 2025 | 13,998 | 12,054 | (1,944) | 0.5 | 16.8 | continuous |
| 2030 | 14,366 | 11,887 | (2,479) | 0.6 | 16.7 | continuous |

In all years, available supply is less than MDD+FF and some water is required from the storage reservoirs to supplement supply and meet MDD+FF. All demand conditions are met from now through 2030 with existing supply and storage. Beyond meeting a 24hr MDD+FF, the system can continuously meet MDDs with no limitation since available supply is greater than MDD.

### 6.2.3 Scenario 2 (No SFPUC – Valley Water and Groundwater Supplies Available)

In this scenario, SFPUC is offline, and the system would rely on Valley Water and existing groundwater supplies. This scenario represents a wholesaler outage or maintenance activity. **Table 6-6** summarizes the existing and future MDD including 5,000 gpm of fire flow; the resulting shortages during a 24-hr MDD+FF, if any; and the storage volume needed to augment any shortages.

**Table 6-6: Scenario 2 – Supply and Storage Consumption for 24hr MDD + FF**

| Year | MDD+FF (gpm) | Available Supply (gpm) | MDD+FF Excess/ (Shortage) (gpm) | Storage Consumed (MG) | Remaining Storage (MG) | Total Days (days) |
|---|---|---|---|---|---|---|
| 2020 | 12,293 | 4,306 | (7,987) | 5.5 | 11.8 | 3.7 |
| 2025 | 13,998 | 4,131 | (9,867) | 8.2 | 9.1 | 2.3 |
| 2030 | 14,366 | 3,964 | (10,402) | 9.0 | 8.3 | 2.1 |

In all years, available supply is less than MDD+FF and some water is required from the storage reservoirs to supplement supply and meet MDD+FF. All demand conditions are met from now through 2030 with existing supply and storage. Given that available supply is less than MDD in all years evaluated, there is a limitation on the number of days the system can operate using available supply and storage. Under these conditions, the system can meet nearly four days of MDD under 2020 conditions, over two days in 2025, and up to two days in 2030.

### 6.2.4 Scenario 3 (No Wholesale Supply – Only Groundwater Supplies Available)

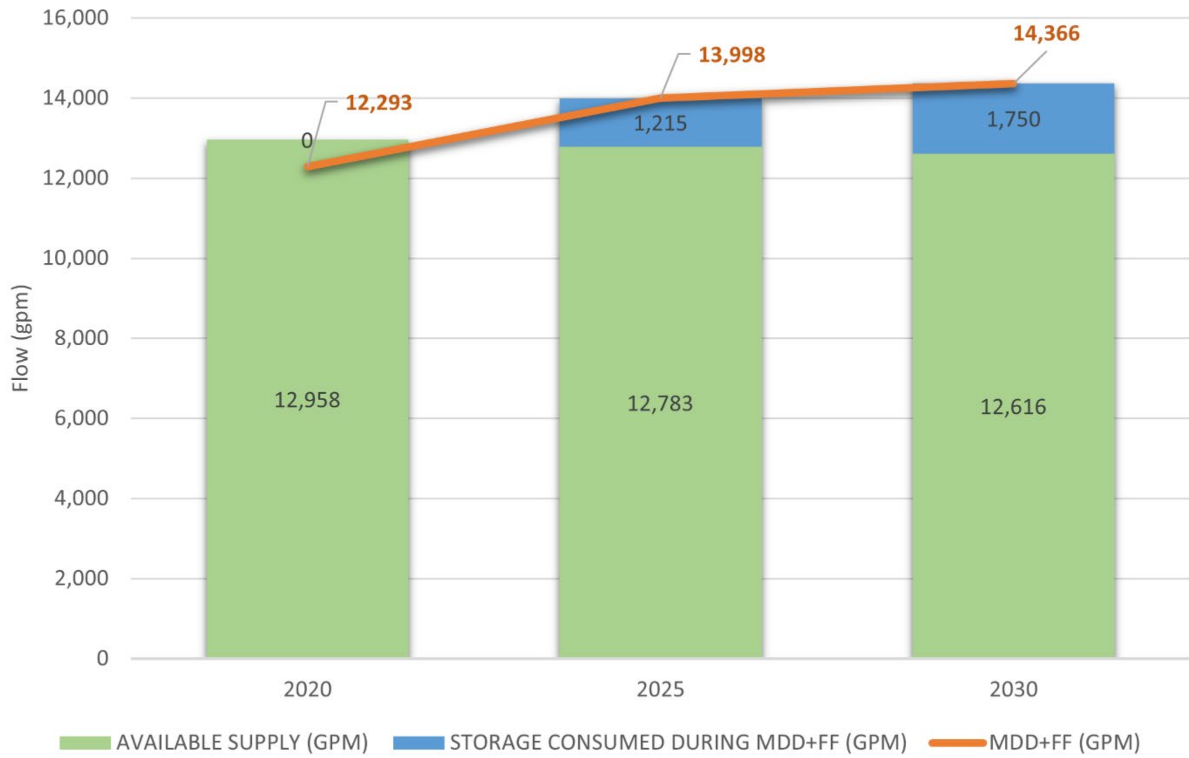
In this scenario, only groundwater supplies are available and all wholesale water supply is offline. This scenario represents a catastrophic event. **Table 6-7** summarizes the existing and future MDD including 5,000 gpm of fire flow; the resulting shortages during a 24-hr MDD+FF, if any; and the storage volume needed to augment any shortages.

**Table 6-7: Scenario 3 – Supply and Storage Consumption for 24hr MDD + FF**

| Year | MDD+FF (gpm) | Available Supply (gpm) | MDD+FF Excess/ (Shortage) (gpm) | Storage Consumed (MG) | Remaining Storage (MG) | Total Days (days) |
|---|---|---|---|---|---|---|
| 2020 | 12,293 | 3,577 | (8,716) | 6.6 | 10.7 | 3.0 |
| 2025 | 13,998 | 3,402 | (10,596) | 9.3 | 8.0 | 2.0 |
| 2030 | 14,366 | 3,235 | (11,131) | 10.0 | 7.3 | 1.8 |

In all years, available supply is less than MDD+FF and some water is required from the storage reservoirs to supplement supply and meet MDD+FF. All demand conditions are met from now through 2030 with existing supply and storage. Given that available supply is less than MDD in all years evaluated, there is a limitation on the number of days the system can operate using available supply and storage. Under these conditions, the system can meet three days of MDD under 2020 conditions, two days in 2025, and nearly two days in 2030.

**Figure 6-3: Scenario Supply and Storage Evaluation Baseline – All Supplies Available**



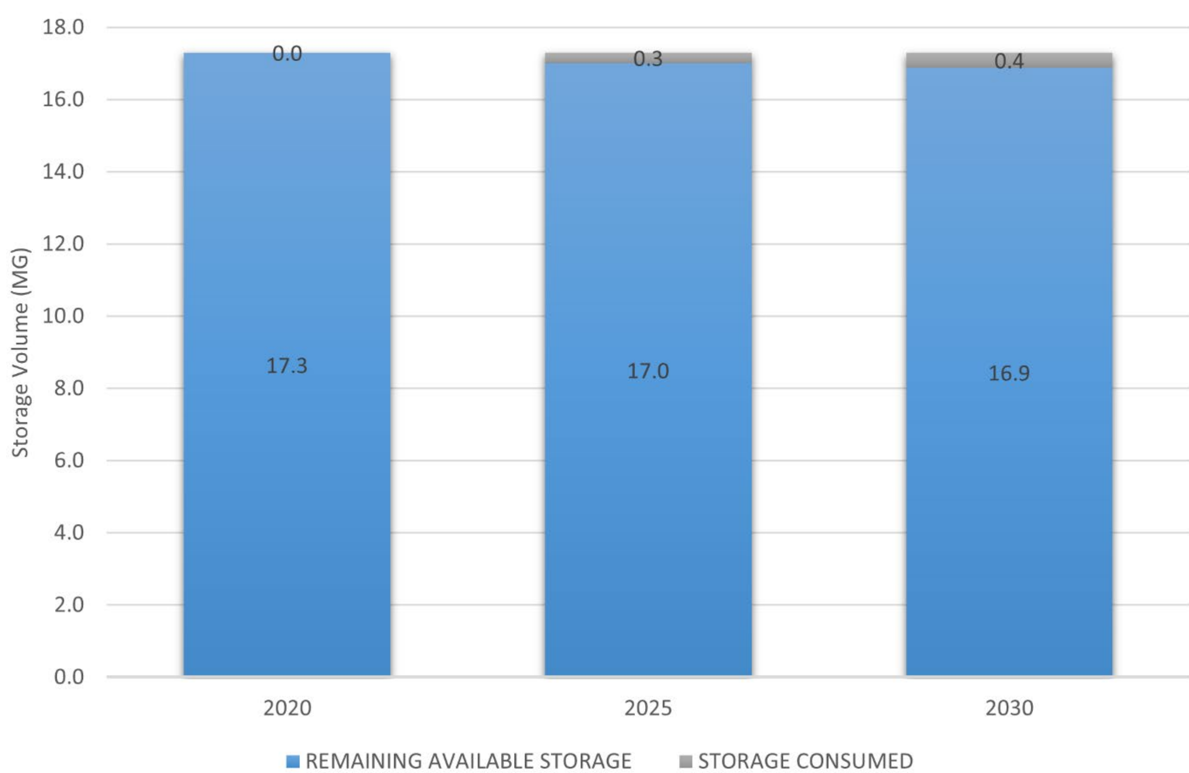



**Figure 6-4: Supply and Storage Evaluation Scenario 1 – No Valley Water**

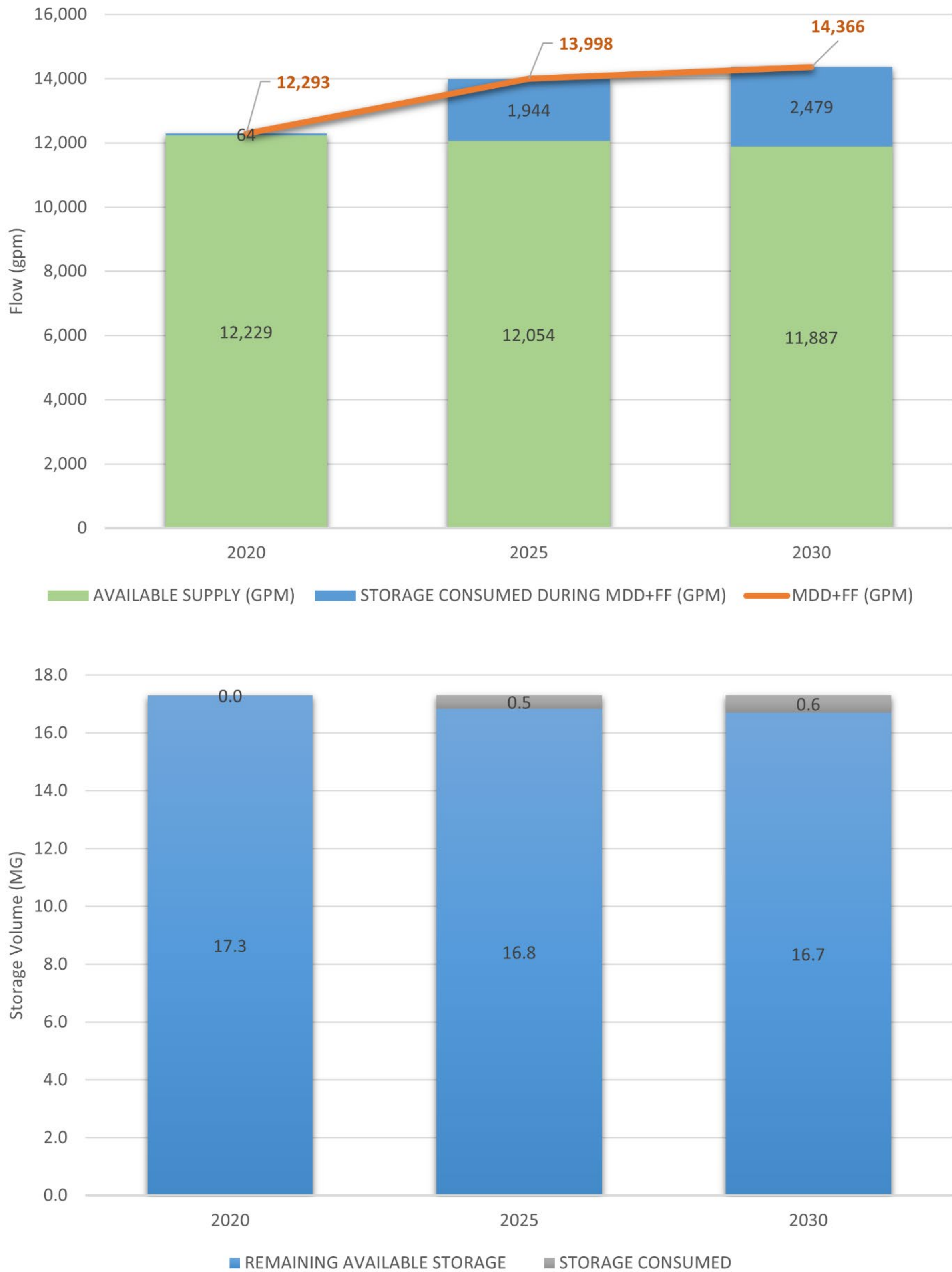
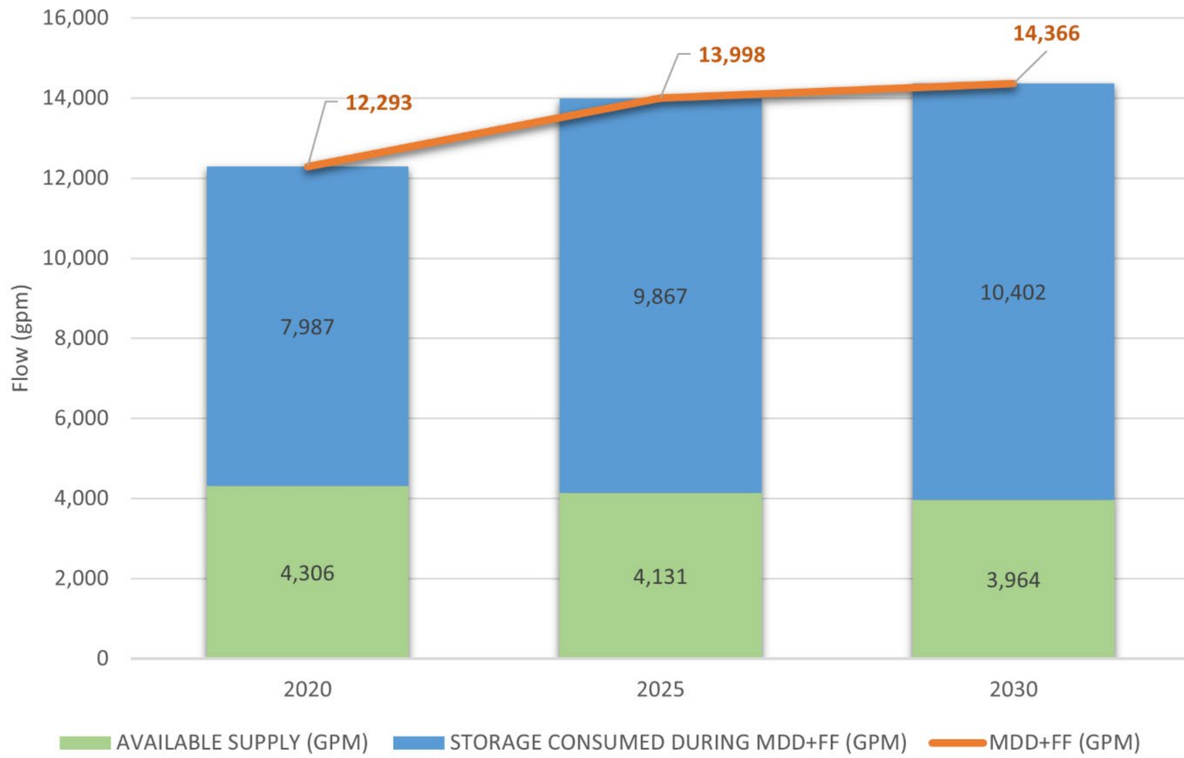


**Figure 6-5: Supply and Storage Evaluation Scenario 2 – No SFPUC**



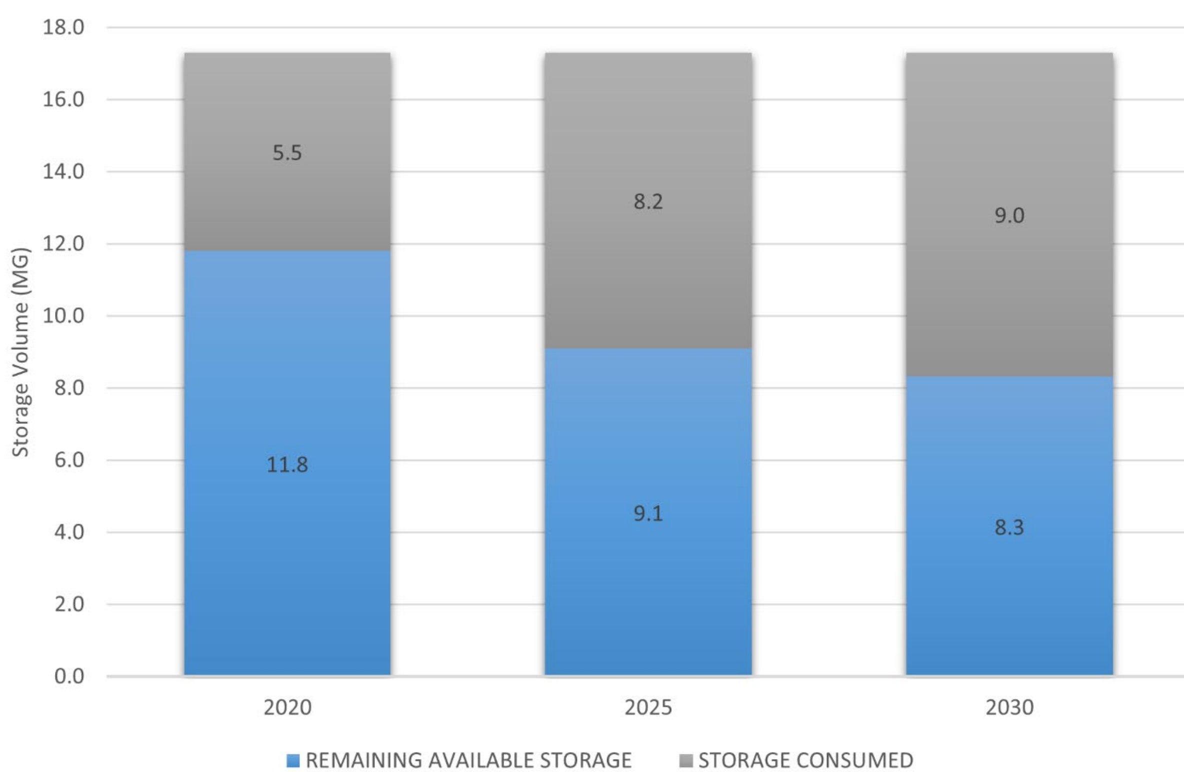
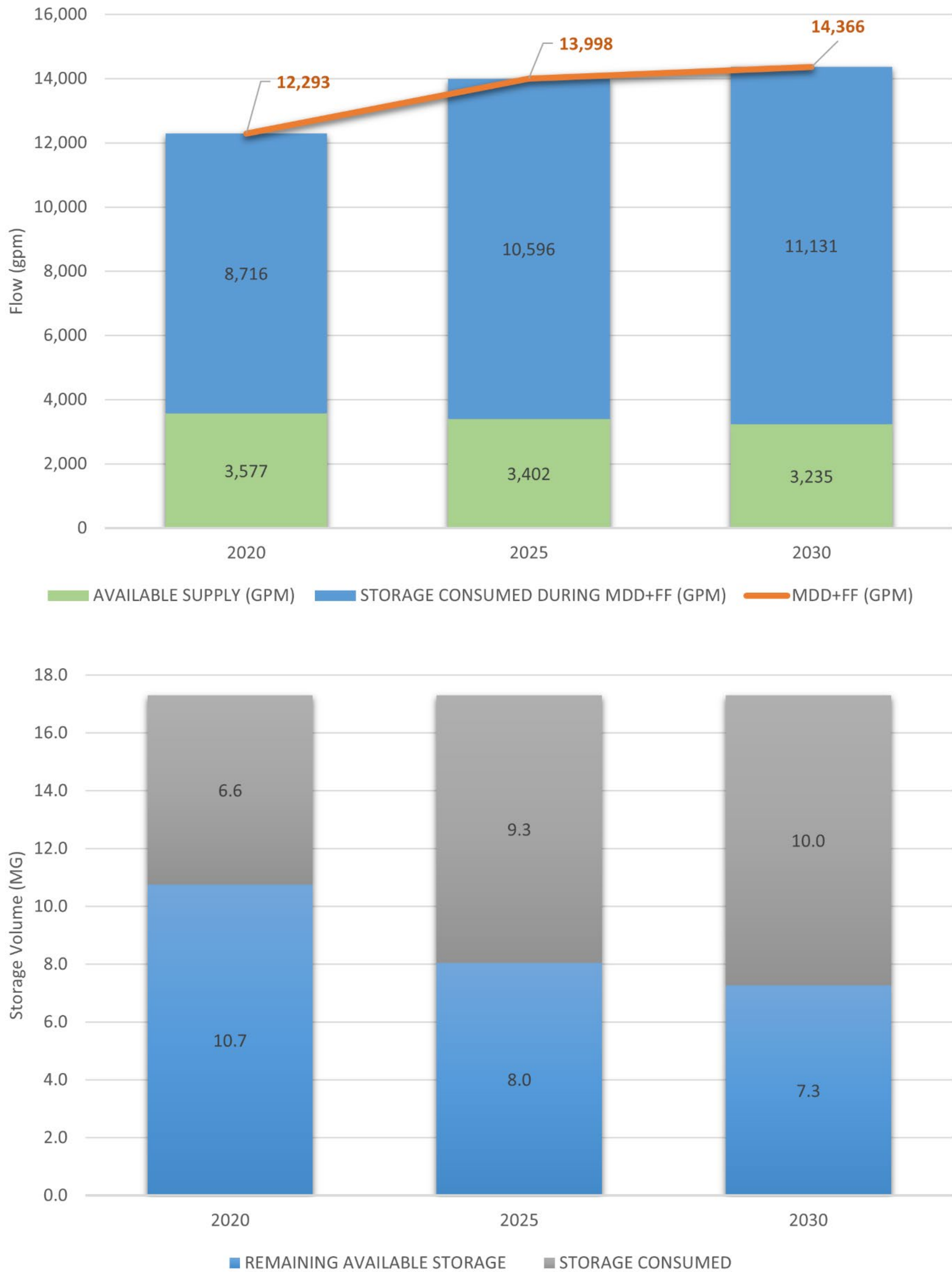



**Figure 6-6: Supply and Storage Evaluation Scenario 3– No SFPUC or Valley Water**



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# SECTION 7 – RESULTS OF HYDRAULIC MODELING ANALYSES

This section summarizes the modeling criteria and provides the results of the hydraulic analyses and identified deficiencies.

## 7.1 Modeling and Performance Criteria

Once calibrated, the system is evaluated under various scenarios to confirm adequate hydraulic capacity to meet PHD, MDD, and MDD+FF conditions.

The following criteria were established and used for evaluation of the water system and are intended to ensure that the system can accommodate peak demands while maintaining residual system pressure and without excessive wear or energy usage.

- **Minimum and Maximum Pressure** – Minimum pressure performance criteria were developed in accordance with California Waterworks Standard Section 64602, and maximum pressure performance criteria were developed to meet general industry standard practices. Maintaining minimum system pressure assures that water quality is maintained to prevent the entrance of pathogens or constituents into the distribution system and to assure that customers have adequate pressure at the tap, which prevents the opportunity for backflow. However, operating at higher pressures increases the potential of water loss in the system due to leaks and main breaks and generally increases wear and tear on the infrastructure.
- **Maximum Velocity** – Maximum velocities are based on those observed in neighboring cities as well as the recommendations by the American Water Works Association (AWWA). Recommended velocities can vary based on pipe material, age, and system configuration. The recommended range is 3 to 10 feet per second (fps) for average and peak flows. Seven fps is the recommended maximum velocity at all times, excluding fire flow. Headloss gradient and velocity are evaluated simultaneously to provide a stronger analysis than considering them separately; this ensures adequate flow rates while limiting excessive wear on the system or energy usage. Operating at high velocities scour mains and can potentially damage the cement mortar lining of ductile iron pipe, though it is acceptable for short periods of time in the event of an emergency (i.e., fire).

  Maximum velocities for fire flow differ for utilities based on system condition and typically range from 10 to 15 fps. For a well-maintained system, it is acceptable to allow a higher maximum velocity during fire events. It is expected that these flows would be for emergencies only and would be for a short period of time. Sizing a pipeline based on lower allowable pipe velocities can lead to oversizing of facilities, contributing to long-term water quality issues. Thus, 15 fps is recommended for City pipelines adjacent to a fire flow event.

**Table 7-1** presents a summary of the distribution system criteria that will be used to evaluate the performance of the City's water distribution system.

**Table 7-1: Distribution System Performance Criteria**

| Criteria | Value |
|---|---|
| Minimum allowable pressure at peak hour demand [1] | 40 psi |
| Minimum allowable pressure at maximum day with fire demand (residual) [1,2] | 20 psi |
| Maximum allowable pressure[3] | 105 psi |
| Maximum allowable velocity at all times excluding fire flow[4] | 7 ft/s |
| Maximum allowable velocity with fire flow demand[4] | 15 ft/s |
| Maximum allowable headloss gradient[4] | 0.015 ft/ft |

Notes:
1. California Waterworks Standards Article 8 Section 64602
2. AWWA M31 Distribution System Requirements for Fire Protection
3. AWWA M32: Computer Modeling of Water Distribution Systems
4. Industry standards

Fire flow requirements from the 2010 Master Plan were reviewed for consideration in this Master Plan. Slight modifications were made to the flows and duration, though the criteria remained largely the same. The fire flows were provided to the Fire Marshal for review and they were confirmed to be acceptable. The land use-based fire flow values, duration, and storage volumes are provided in **Table 7-2**.

**Table 7-2: Fire Flow Criteria**

| Land Use | Required Fire Flow (gpm) |
|---|---|
| Single-Family Residential | 1,500 |
| Multi-Family Residential | 2,500 |
| Public/Schools | 2,500 |
| Business and Commercial | 3,500 |
| Industrial[1] | 3,500 – 5,000 |

Notes:
1. Actual required fire flow and duration for industrial depends on the size of parcel and type of facility.
2. The 2019 California Fire Code allows for a reduction in fire flow for buildings with fire sprinklers.

## 7.2 Hydraulic Modeling Results

The entire service area was modeled and evaluated based on the velocity, pressure, and headloss performance criteria presented in **Table 7-1**. Minimum velocity for normal operation is 7 fps and 15 fps is for MDD + FF. The minimum normal operating pressure is 40 psi and the criterion for minimum residual pressure is 20 psi. No pipelines exceeded velocity or headloss gradient criteria during existing and future MDD or PHD scenarios.

The service area was analyzed for existing and 2030 conditions under the following scenarios:

- **Average Day Demand (ADD):** This analysis establishes the base demands for the system during normal operating conditions. Water demands in the system are escalated from the ADD condition to evaluating peak conditions in the system. Generally, this scenario is not evaluated for deficiencies and functions as the baseline scenario for scaling MDD and PHD scenarios.
- **Maximum Day Demand (MDD):** MDD diurnal patterns are applied to all customers in the hydraulic model and service area and the scenario is run as both steady state and EPS scenarios. The steady state scenario identifies deficiencies in the system representative of average demand over the course of a maximum day. The EPS scenario represents the maximum day showing hourly conditions and operations according to the diurnal patterns.
- **Peak Hour Demand (PHD):** The PHD represents the peak in the diurnal curve. Peaking factors were applied at all nodes within the service area according to the respective diurnal curve. This scenario identifies deficiencies in the system during the peak hour on the MDD.
- **Maximum Day Demand + Fire flow (MDD+FF):** This analysis identifies deficiencies within the system associated with a related fire flow event. Fire flows occur at existing hydrants in the system and fire flow rates are determined by the most conservative land use type at the respective hydrant. When evaluating for fire flow deficiencies, considerations are taken for meeting a fire event using multiple hydrants and for facilities, particularly new developments, that would qualify for flow exceptions based on the installation of fire sprinklers.

The results for the various scenarios for both existing and 2030 conditions are discussed below.

### 7.2.1 Existing Modeled Conditions – Maximum Day and Peak Hour Demands

Existing modeled conditions capture the system as it is at the time of the Master Plan development. This includes capital improvement projects that have been constructed to date in the distribution system. The system demands are also representative of, and consistent with, documented usage in the 2020 UWMP as well as analyzed metered water use data. Modeling results are presented below:

- **MDD:** Under steady state MDD conditions, the distribution system is able to meet all performance criteria. It is noted that low pressures shown in **Figure 7-1** represent the transmission main from Miramonte Reservoirs to Zone 1. As these reservoirs are floating on Zone 1 and open to the atmosphere, pressures in the transmission main will range from 4 psi at the reservoir outlet to 48 psi at the entry point to Zone 1. The lowest pressures in Zones 1, 2, and 3 are 47 psi, 45 psi, and 52 psi, respectively. Zone 2 experiences the highest pressures in the system, greater than 80 psi. A small region at the northeastern boundary of Zone 2 along Fairchild Dr near Ellis St, experiences pressures of up to 101 psi. Higher pressure pipelines can experience more wear and tear and be subject to greater water losses. The highest velocity in the system is 3 fps and is typically experienced near Turnouts 5 and 7. System pressures for MDD are shown in **Figure 7-1**.
- **PHD:** During PHD conditions, the system is able to meet all performance criteria with the exception of Miramonte transmission main, as described above. Pressures are also consistently high in the northeastern region of Zone 2. During PHD conditions, the system meets the minimum criteria of 40 psi. Pressure range is approximately 45 psi to 101 psi. System pressures for PHD are shown in **Figure 7-2**.

### 7.2.2 2030 Modeled Conditions– Maximum Day and Peak Hour Demands

Future 2030 modeled conditions capture the system after implementation of planned capital improvement projects and take into account development/redevelopment of parcels (defined in **Section 4.4**). The system demands are also reflective of anticipated demands as described in **Section 4.4**, consistent with UWMP planning models. Modeling results are presented below:

- **MDD:** Under steady state MDD conditions, the distribution system is able to meet all performance criteria for 2030. Similar to existing conditions, low pressures shown in **Figure 7-3** represent the transmission main from Miramonte Reservoirs to Zone 1. The lowest pressures in Zones 1, 2, and 3 are 43 psi, 45 psi, and 51 psi, respectively. Pressure distribution is similar, with Zone 2 experiencing the highest pressures, up to 101 psi. The highest velocity in the system is 5 fps and is similarly experienced in lines by Turnouts 5 and 7. System pressures during MDD are shown in **Figure 7-3**.
- **PHD:** During PHD conditions, the system continues to meet all performance criteria with the same exception (Miramonte transmission main). During PHD conditions, the system meets the minimum criteria of 40 psi. Pressure range is approximately 43 psi to 100 psi with Zone 2 experiencing the highest pressures. System pressures for PHD are shown in **Figure 7-4**.

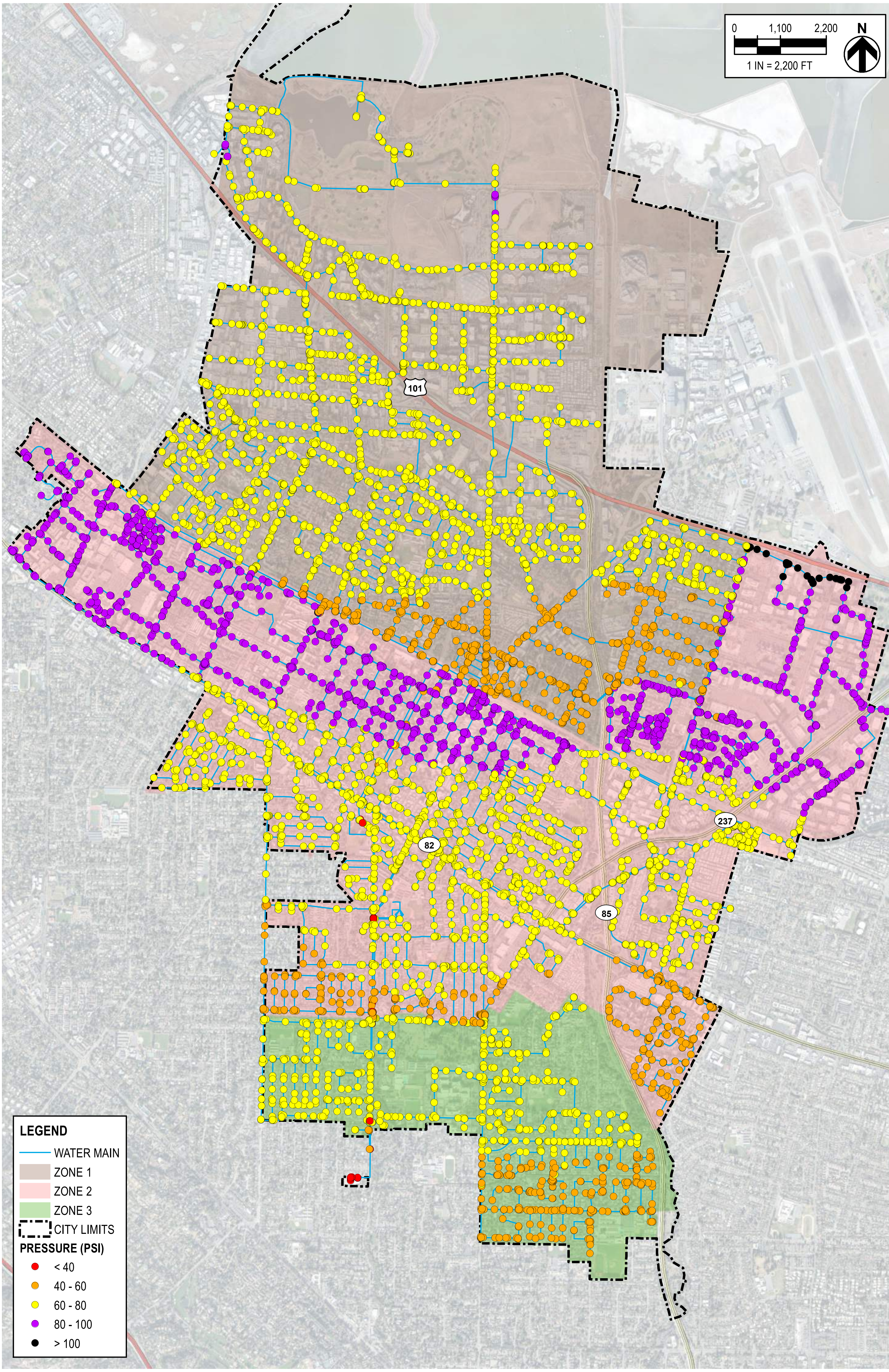



**FIGURE 7-1**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
MAXIMUM DAY DEMAND RESULTS - EXISTING CONDITION

HydroScience

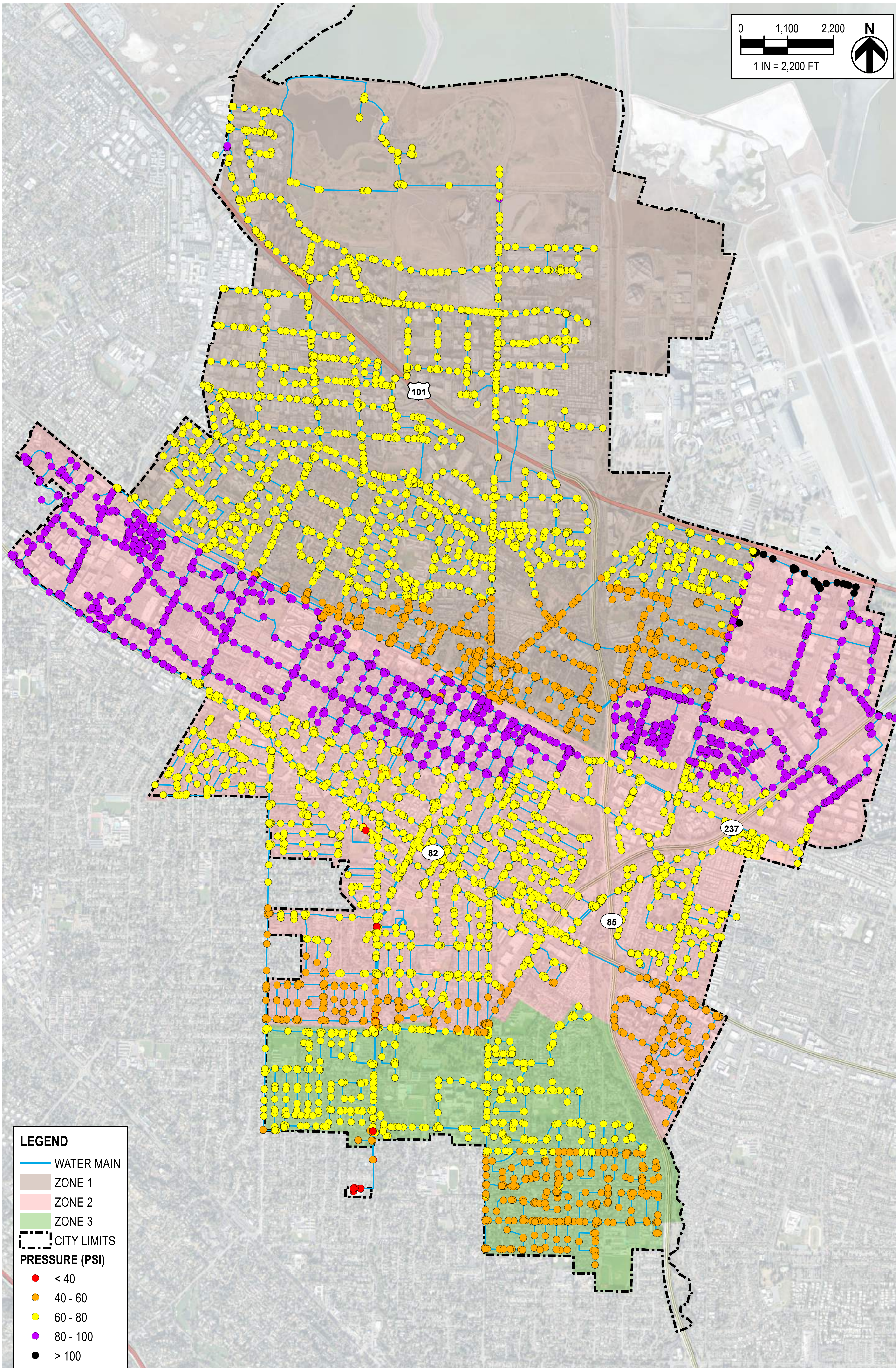



**FIGURE 7-2**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
PEAK HOUR DEMAND RESULTS - EXISTING CONDITION

HydroScience

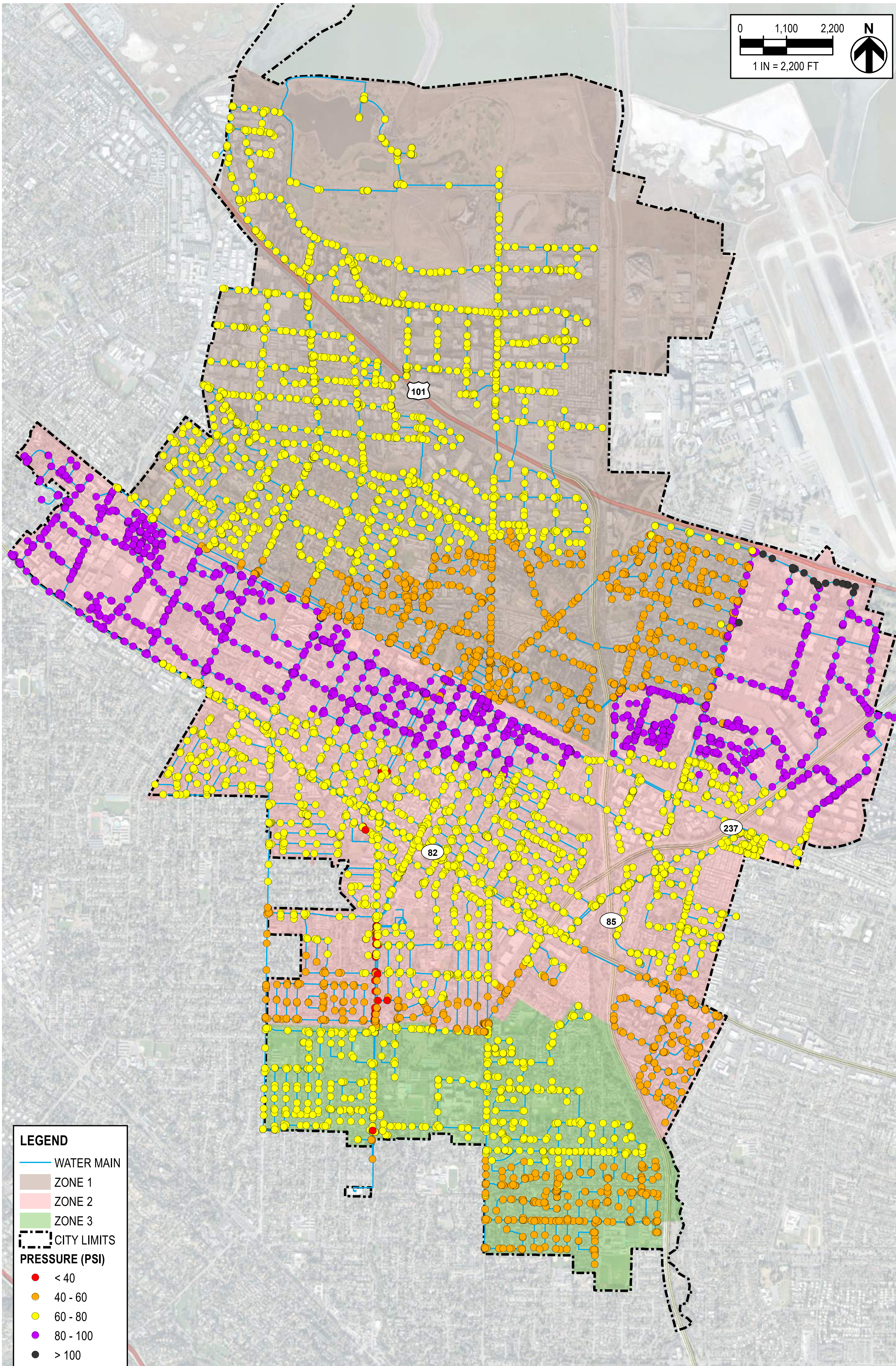



**FIGURE 7-3**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
MAXIMUM DAY DEMAND RESULTS - FUTURE (2030) CONDITION

HydroScience

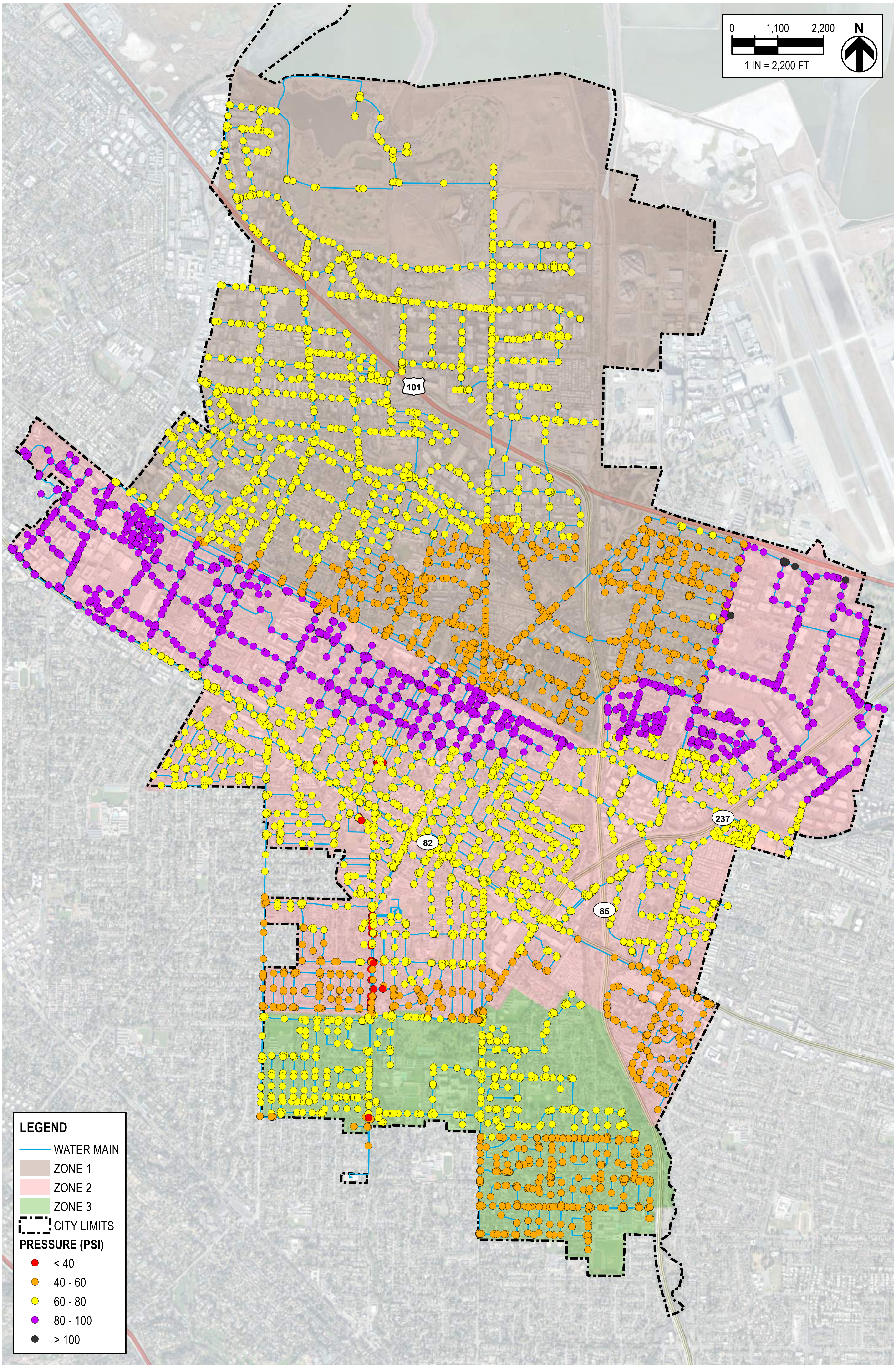



**FIGURE 7-4**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
PEAK HOUR DEMAND RESULTS - FUTURE (2030) CONDITION

HydroScience

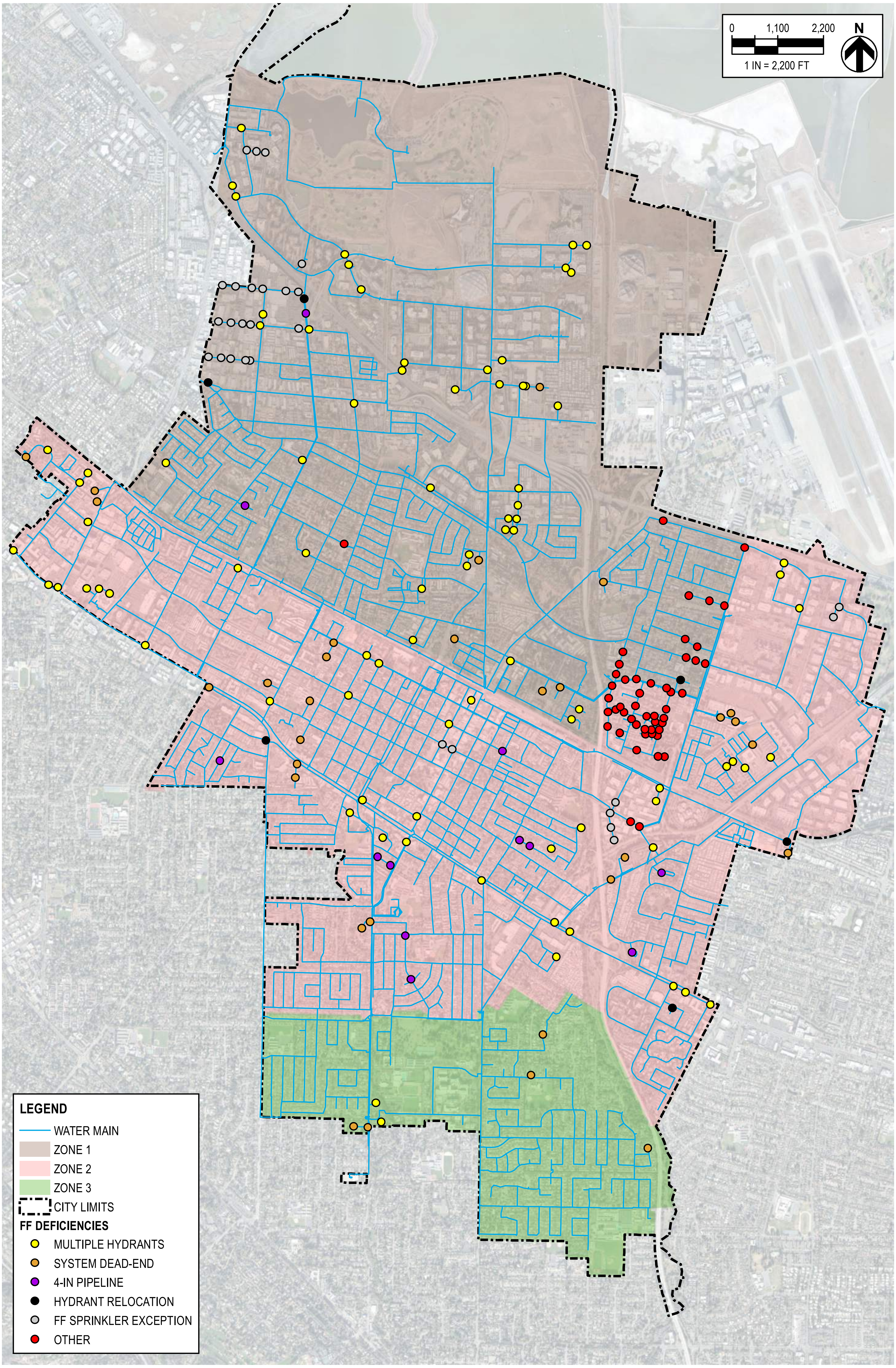



**FIGURE 7-5**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
MAXIMUM DAY DEMAND + FIRE FLOW RESULTS

HydroScience

### 7.2.3 Maximum Day Demand plus Fire Flow

MDD+FF deficiencies occur when a hydrant node is unable to meet MDD+FF while maintaining system pressure above minimum criteria and pipeline velocity below maximum criteria. When evaluating deficiencies, the approach is to review both the existing and future conditions in parallel to identify improvements needed to meet long-term needs while also considering the timing and urgency of those improvements if the deficiency is triggered by a change in the way water is used. It was assumed that areas with future residential or large building redevelopment would have fire sprinklers and would qualify for fire flow reductions. It was also assumed that hydrants that were within 5% of required flow were within the acceptable margin of error and not considered deficient. Additionally, when reviewing deficiencies, sites that have two hydrants available to meet the fire flow or other hydrants adjacent to the site that can meet fire flow, were not considered deficient. These hydrants are presented on **Figure 7-5** (yellow nodes). Provided are descriptions of the most common types of deficiencies identified:

- **Cul-de-sacs/System dead-ends:** During MDD+FF conditions, the system exhibited some deficiencies in cul-de-sacs where system dead-ends occur. These are often limited by velocity constraints in the pipelines leading to the dead-end. It is noted the maximum flow rate through a 6-inch pipeline at 15 fps is 1,320 gpm, thus any flow greater than this through a 6-inch pipeline will cause velocities to exceed the maximum criteria, which is common in the residential cul-de-sacs where fire flow demand is 1,500 gpm or 2,500 gpm. The maximum flowrate through an 8-inch pipeline at 15 fps is 2,350 gpm, which is 6% less than the required fire flow for multi-family homes (2,500 gpm). See **Figure 7-5** for all hydrants on dead-end lines that were unable to meet velocity and/or pressure criteria (orange nodes). These deficiencies were generally caused by velocity constraints and/or large head loss through 6-inch/8-inch pipelines typical for residential cul-de-sacs. This is not to say that fire flow is not available, but instead that velocities would be outside of the preferred criteria, which may lead to excessive wear and tear. It is also noted that actual flows at hydrants can vary based on pipe roughness and hydrant nozzles/features. While upsizing the pipelines will resolve the fire flow deficiency, it can promote water quality issues.

  These areas may be considered for upsizing as part of the City's annual water main replacement program. When slated for replacement, the City should confirm and evaluate the fire flow requirements, water age, and water quality if considering upsizing.

- **4-inch pipelines:** The City currently has 4-inch diameter mains within the distribution system. Most hydrants located on or near these mains were unable to meet MDD+FF conditions due to velocity constraints through the 4-inch pipelines (purple nodes on **Figure 7-5**). These pipelines are generally located in areas that are looped and where land uses dictate lower fire flows (up to 2,500 gpm). Upsizing these pipelines to 8-inches would resolve these fire flow deficiencies.

- **Hydrant relocation/installation:** Several hydrants that experienced deficiencies during MDD+FF are located on small diameter pipes (6-inch and 8-inch) that are near/adjacent to larger diameter pipelines with a greater capacity for fire flow. If the hydrant services were reconnected to the larger diameter pipes, these deficiencies would be resolved. These hydrants are presented as black nodes on **Figure 7-5**.

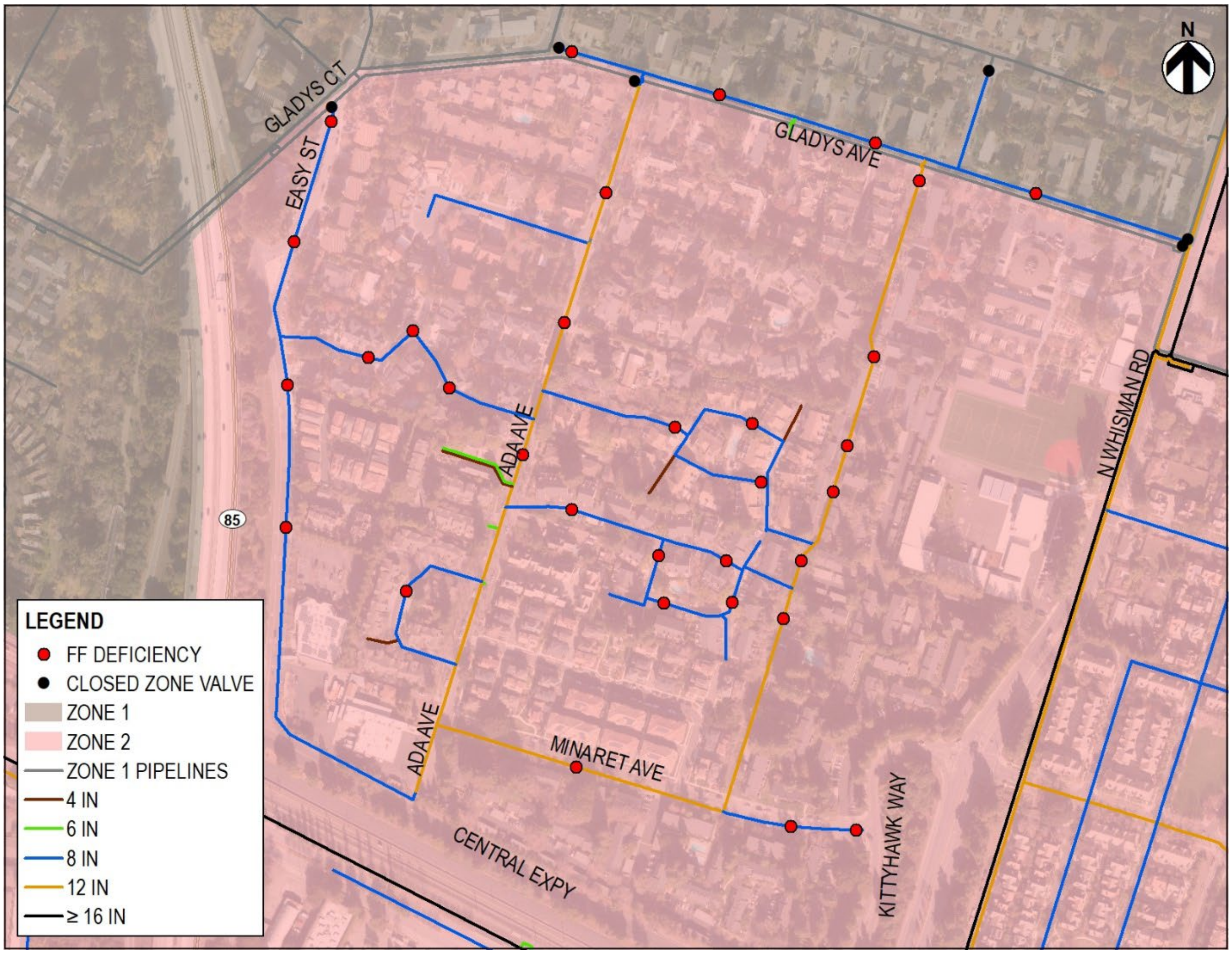
- **Fire flow sprinkler exceptions:** The fire flow criteria in **Table 7-2** dictates a range of required flow from 3,500 gpm to 5,000 gpm for commercial and industrial land uses. Some mixed commercial and industrial areas had fire flow deficiencies primarily due to larger fire flow demands coupled with dead-end pipelines or smaller diameter loops (gray nodes on **Figure 7-5**). It was noted that the buildings in these areas may be sprinklered and given exception to the required fire flow.

  One such area is a mixed commercial and industrial area west of Rengstorff Ave from Charleston Rd to Wyandotte St at the edge of the City's distribution system. The area has deficiencies of over 50% of required flow due to both dead-end pipelines and flow requirements of 4,000 gpm. This area is located at the boundary of the City system bordered by the City of Palo Alto. There is City of Palo Alto infrastructure on San Antonio Rd, and it is assumed that in the event of an emergency, flow could be supplemented by hydrants on the Palo Alto water main. For further redundancy, the City may consider installing a manual intertie with the City of Palo Alto at this location.

Four sites failed to meet velocity and/or pressure criteria and were defined to be outside of the fire flow conditions listed above. These sites include Whisman Station Dr, the northeast area of Zone 1, E Dana St, and Montecito Ave. All deficiencies related to these sites are shown as red nodes on **Figure 7-5**. Each deficiency is described in further detail below.

- **Whisman Station Dr:** Thirty hydrants were identified as deficient due to exceeding velocity criteria in an area at the edge of Zone 2, bounded by Central Expressway, SR 85, Gladys Ave, and N Whisman Rd. The area is primarily multi-family residential, which requires a fire flow of 2,500 gpm. All hydrants were able to receive at least 87% of required flow before reaching the maximum allowable velocity. All deficiencies were due to high velocities in the 8-inch CIP feed on Gladys Ave and N Whisman Rd, as this is the only line feeding the area (see **Figure 7-6**). There are no other points of connection for this area to receive Zone 2 supply. Besides the criteria exceedances, there is currently no redundancy to this area and should the 8-inch pipeline on Gladys Ave fail, the entire area would be without water service. It is recommended that the pipeline in Minaret Ave be upsized and extended across N Whisman Rd for a second point of connection to provide redundancy and address the fire flow deficiencies.

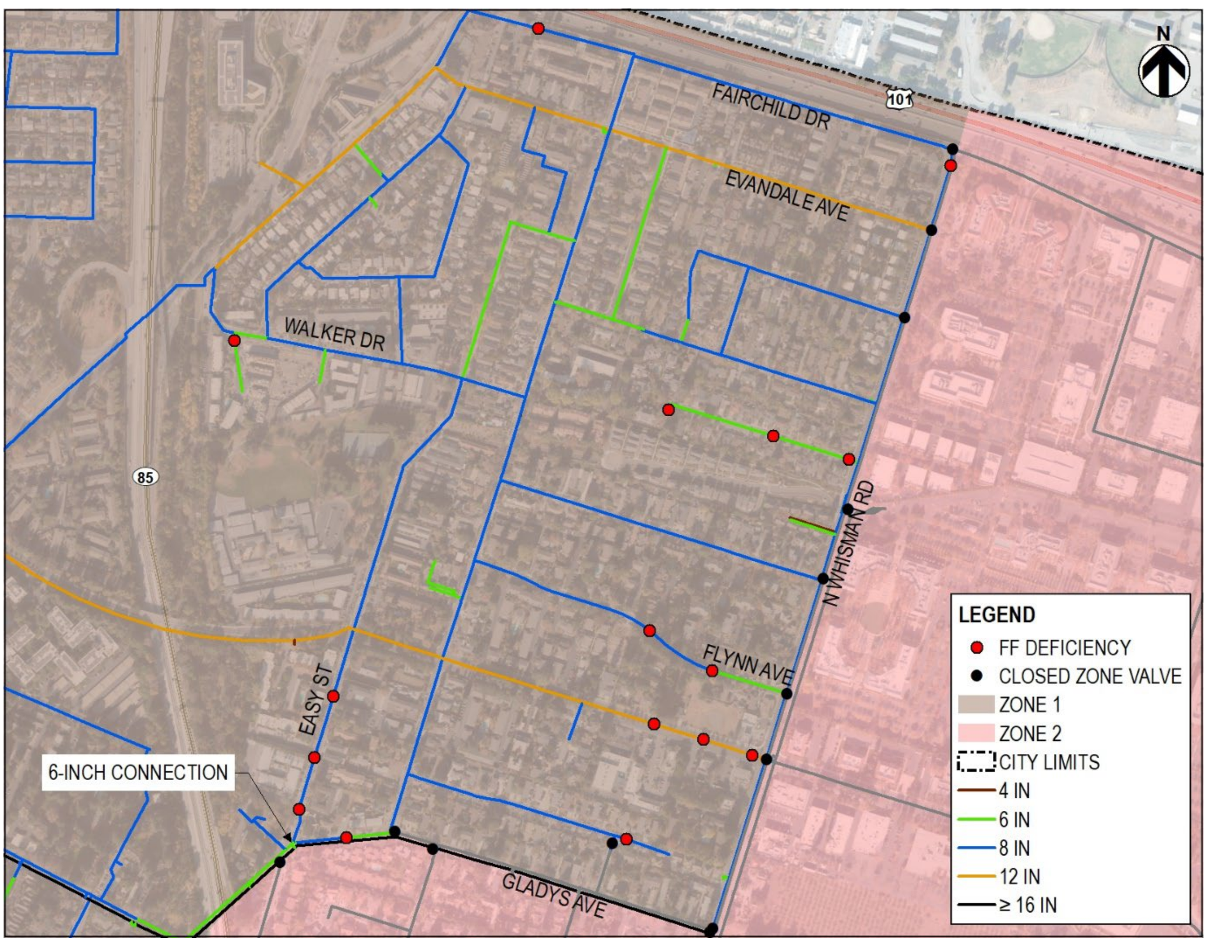
**Figure 7-6: Whisman Station Dr**



- **Northeast Zone 1:** Several hydrants in the northeast area of Zone 1 experience fire flow deficiencies during MDD+FF. The area is at the Zone 1/ 2 boundary and is contained between North Whisman Rd and Easy St. Most of the land use in the area is multi-family residential, although there are some businesses and single-family homes. Seven hydrants experience velocity criteria exceedances due to a 6-inch connection at the intersection of Gladys Ave and Easy St. Approximately 45 feet of 6-inch ACP connects 8-inch lines on Easy St and Gladys Ave to a 21-inch concrete transmission line on Gladys Ave (see **Figure 7-7**). Six hydrants have available fire flow that is 87% of required demand; however, one hydrant directly east of the connection receives only 70% of required demand.

  The remaining deficiencies in this area are due to generally lower pressures at the Zone 1/2 boundary on the intersection of Fairchild Dr and N Whisman Rd. Elevations in the area are typically higher than the rest of Zone 1 and are normally operating at lower pressures. The maximum percent difference between hydrant available flow and demand is 13%. The City currently has plans to install a PRV to connect Zone 1 to Zone 2 as part of the Annual Water and Sewer Main Replacements, Project 19-21. This PRV would be located near the intersection of N Whisman Rd and Evandale Ave, which is just south of Fairchild Dr. During low pressure conditions, this valve would allow for water to move from Zone 2 to Zone 1, which would alleviate low pressures in the northeast Zone 1 area.

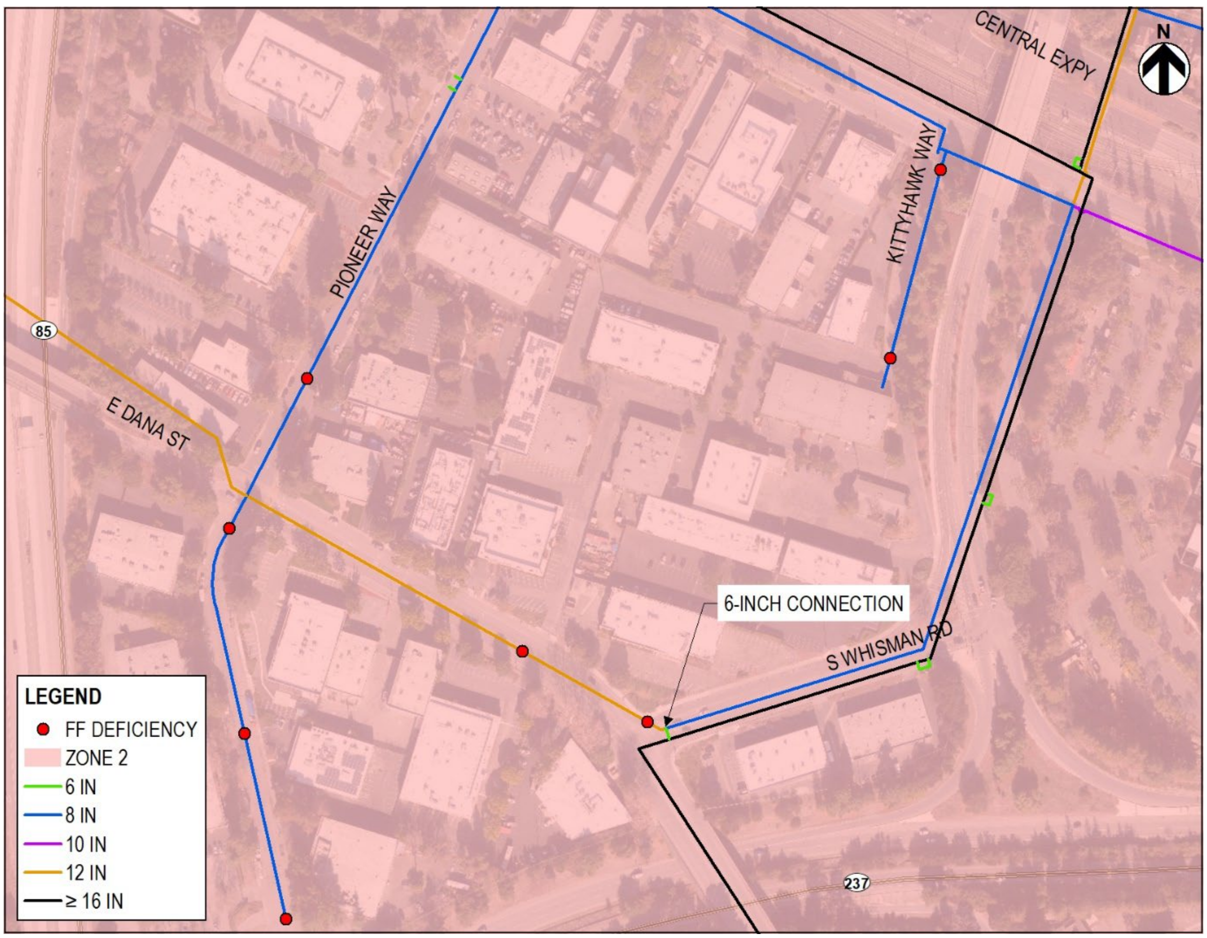
**Figure 7-7: Northeast Zone 1**



While the installation of the PRV will address some hydrant deficiencies that are closer in proximity to the PRV, there are still velocity related deficiencies near the 6-inch connection on Easy St and Gladys Ave. Some pipes surrounding the connection are slated for replacement based on the pipeline condition assessment (see **Section 9.4**). It is recommended that this small pipe segment be upsized at the time this area is considered for improvement with the annual water main replacement program.

- **E Dana St:** A mixed commercial and industrial area bordered by SR 85, SR 237, and Central Expressway has fire flow deficiencies due to velocity constraints in a 6-inch connection to a 16-inch concrete transmission line at the intersection of S Whisman Rd and E Dana St. All hydrants in the area receive at least 86% of required flow. **Figure 7-8** presents the location of the 6-inch connection as well as all deficiencies in the area. It is recommended that this small pipe segment be investigated and upsized, if necessary, at the time this area is considered for improvement with the annual replacement program. The 12-inch pipeline on E Dana St and S Whisman Rd is identified for prioritized replacement (see **Section 8.6.2**).

**Figure 7-8: E Dana St**



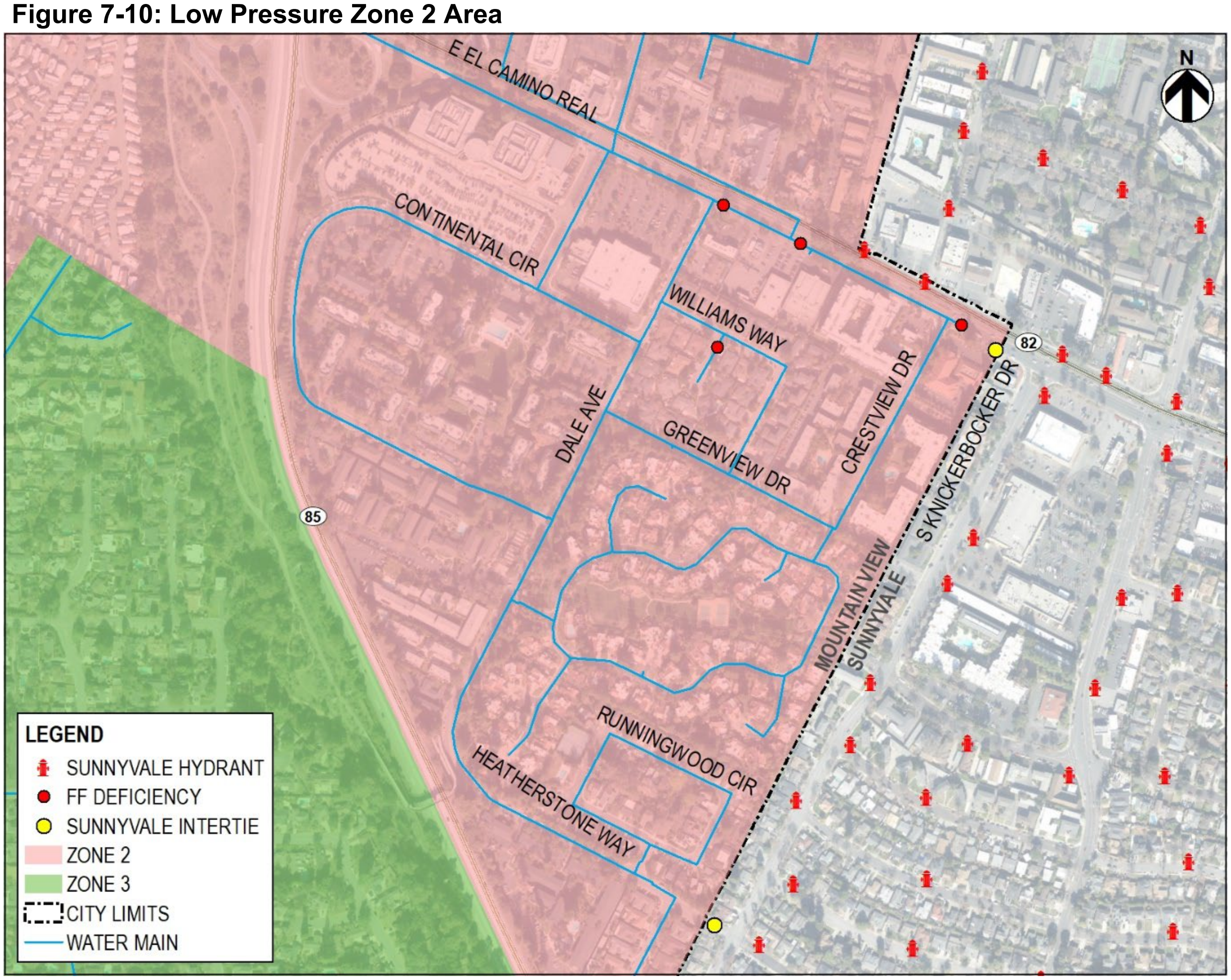
- **Montecito Ave:** Several multi-family residential homes are serviced on either side of Montecito Ave, between Sierra Vista Ave and Farley St. This area is looped, with approximately 41 feet of 6-inch CIP between two segments of 8-inch ACP on Montecito Ave. Although other hydrants on this street can receive required multi-family fire flow (2,500 gpm) during MDD, the hydrant directly west of the 6-inch bottleneck receives 90% of required flow due to velocity constraints in the smaller 6-inch connection (**Figure 7-9**). It is recommended that this small pipe segment be investigated and upsized if necessary. All pipes on Montecito Ave northwest of the deficient node are identified for prioritized replacement through the pipeline condition assessment (see **Section 8.6.2**). It is recommended that this small pipe segment be upsized at the time this area is considered for improvement with the annual replacement program.

**Figure 7-9: Montecito Ave**

**Edge of service area/bottleneck:** An area located in Zone 2 at the boundary between Zones 2 and 3, bordered by State Route (SR) 85, El Camino Real, and the City of Sunnyvale experienced generally low pressures during MDD+FF, ranging from 32 to 38 psi. The land use in this area consists of primarily single family homes, which have a lower fire flow demand of 1,500 gpm. Although pressures are typically low in this area, all nodes can meet fire flow demands without violating MDD+FF pressure constraints. The few fire flow deficiencies shown in **Figure 7-10** are due to velocity constraints and can be met by flowing multiple hydrants, moving the hydrant to an adjacent larger diameter main, or upsizing the main.

During emergency scenarios (see **Section 7.3**), pressures in this area approach 40 psi. It is difficult to loop pipes in this area since it is at the edge of the system and the nature of the physical barrier created by SR 85. However, it is noted that there are City of Sunnyvale fire hydrants along S Knickerbocker Dr and El Camino Real (shown on **Figure 7-10**) that could be accessed at the City boundaries. Additionally, there are two Sunnyvale interties in this area, one at the intersection of S Knickerbocker Dr and Heatherstone Way and another at the intersection of El Camino Real and Crestview Dr. These interties could potentially be activated in the event of an emergency to provide additional flow and supplement low pressures in this area.

**Figure 7-10: Low Pressure Zone 2 Area**



## 7.3 Emergency Scenarios

The calibrated model was used to evaluate three emergency scenarios. These emergency scenarios represent situations in which one or more wholesale water supply sources are offline for extended periods of time. HydroScience analyzed both existing and future (2030) conditions. All scenarios were run under MDD conditions to analyze the most conservative circumstances. The emergency scenarios were modeled using 24-hour EPS simulations. The six emergency scenarios are:

- **Scenarios 1A and 1B (No Valley Water – SFPUC and Groundwater Supplies Available):** For these scenarios it is assumed that the Valley Water turnout is offline and unavailable. The system is supplied by SFPUC and groundwater and evaluated under existing and 2030 demand conditions.
- **Scenarios 2A and 2B (No SFPUC – Valley Water and Groundwater Supplies Available):** For these scenarios it is assumed that all SFPUC turnouts are offline and unavailable. The system is supplied by Valley Water and groundwater and evaluated under existing and 2030 demand conditions.
- **Scenarios 3A and 3B (No Wholesale Supply – Only Groundwater Supplies Available):** For these scenarios it is assumed that both SFPUC and Valley Water turnouts are offline and unavailable. The system is supplied by groundwater only and evaluated under existing and 2030 demand conditions.

**Table 7-3** below summarizes the scenarios, the active components for each scenario, and the demand conditions.

**Table 7-3: Emergency Scenarios**

| Scenario | SFPUC Turnouts | Valley Water Turnout | Groundwater Wells | Demand Condition |
|---|---|---|---|---|
| Scenario 1A | ✓ | | ✓ | 2020 MDD |
| Scenario 1B | ✓ | | ✓ | 2030 MDD |
| Scenario 2A | | ✓ | ✓ | 2020 MDD |
| Scenario 2B | | ✓ | ✓ | 2030 MDD |
| Scenario 3A | | | ✓ | 2020 MDD |
| Scenario 3B | | | ✓ | 2030 MDD |

### 7.3.1 Scenarios 1A and 1B – Existing and 2030 No Valley Water

In these scenarios, Valley Water is offline and the system relies on SFPUC and existing groundwater supplies. The Valley Water turnout is the main source of supply for Zone 3. For these scenarios, Zone 3 was supplied by Miramonte Reservoir through the Miramonte booster pump station. During periods of low demand throughout the day, Miramonte Reservoir is filled by SFPUC turnouts or the Graham Zone 1 booster pump station. The fill schedules for Graham and Whisman were unchanged. The loss of supply from Valley Water can be further supplemented by activating one of the groundwater wells. For both existing and 2030 scenarios, apart from continuous flow from the Miramonte booster pump station, most water supply operations are unchanged, and the system can provide a sustainable supply of water.

The results of the analyses show that under these conditions, the system can meet MDD while staying within established performance criteria. Available supply, even without Valley Water turnout, is greater than 2020 and 2030 MDD so the system can sustainably operate under these circumstances. **Figure 7-11** and **Figure 7-12** illustrate minimum pressures for emergency scenarios 1A and 1B.

### 7.3.2 Scenarios 2A and 2B – Existing and 2030 No SFPUC

These scenarios represent system operations with all SFPUC turnouts (Turnouts 5, 7, and 14) closed. The majority of demands for Zones 1 and 2 are met by SFPUC supply. As a result of closing all SFPUC turnout connections, system demands must be supplemented by the groundwater wells, the Valley Water turnout, and the storage reservoirs.

The operations for existing and 2030 scenarios were analyzed separately, but ultimately yielded the same strategy. All groundwater wells, storage reservoirs, and Valley Water turnout were active for these analyses. It was determined that for these scenarios to sustainably operate, pressure Zones 2 and 3 must be operated as a single pressure zone. Zone 3 demands throughout the day are consistently less than the Valley Water turnout capacity. As a result of combining Zones 2 and 3, this surplus flow from the Valley Water turnout can be used to supplement Zone 2 supplies. In the hydraulic model, two PRV zone valves at the boundary of Zones 2 and 3 were opened and set to 62 psi. This allowed the excess flow from Valley Water turnout to supply Zone 2 and offset the rate at which both Graham and Whisman Reservoirs drained.

Under this new configuration, the pressure settings at the Valley Water PRV may need to be adjusted for Graham or Whisman Zone 2 pumps to flow. In addition, without SFPUC flow, Whisman Reservoir would be filled by Graham booster pump station and Well 19 during times of low demand. It was assumed in this scenario that Well 23 would continuously fill Graham Reservoir regardless of whether the reservoir is filling or draining. Also under this scenario, the supply from Miramonte Reservoir was minimal. This is largely due to the higher head from the Whisman and Graham Zone 1 pumps. Miramonte booster pump station was not operated or required for these analyses.

The results of the analyses show that the system can meet 2020 and 2030 MDD while staying within established performance criteria for up to 24 hours given the supply deficit. **Figure 7-13** and **Figure 7-14** illustrate minimum pressures for emergency scenarios 2A and 2B.

### 7.3.3 Scenarios 3A and 3B – Existing and 2030 No Wholesale Supply

In these scenarios, only groundwater supplies are available and all wholesale water supply is offline. Under these conditions, the system will rely heavily on the storage reservoirs.

For both the existing and 2030 scenarios, all SFPUC (Turnouts 5, 7, and 14) and Valley Water turnouts were closed and all groundwater wells and storage reservoirs were active. Like Scenarios 2A and 2B, pressure Zones 2 and 3 must be operated as a single pressure zone. This is done to assure Zone 3 customers have redundant water supplies. Also, Whisman Reservoir is filled by Graham booster pump station and Well 19 during times of low demand. The strategy for both the existing and 2030 scenarios was to assure Whisman and Graham booster pump stations did not pump into the same pressure zone. This was so the pumps would not compete against one another. Also, all groundwater wells, including Well 23, were set to flow for the entirety of the scenarios. Miramonte Reservoir continues to float on pressure Zone 1.

For the existing scenario, pressure Zone 1 was supplied by Well 21, Whisman pump station, and Miramonte Reservoir. Whisman Reservoir is filled by head from Zone 2 during times of low demand. While Whisman Reservoir is filling, Miramonte Reservoir will supplement pressure Zone 1 demands. It should be noted that without the SFPUC turnouts, Miramonte Reservoir is unable to fill with current system settings. The City will have to manually fill Miramonte Reservoir at times of low system demand not coinciding with Whisman Reservoir fill. Pressure Zones 2 and 3, now operating as a single pressure zone, were supplied by Wells 19 and 22, and Graham and Miramonte booster pump stations. In this configuration, Miramonte and Graham booster pump stations supply the same pressure zone. As a result, the City will have to adjust the SCADA settings to allow for both pump stations to operate. With the current pump settings, the hydraulic grade line at the Miramonte booster pump station is approximately 27 feet higher than the Graham booster pump station. This difference in head makes it difficult for Graham booster pump to supply flow.

Due to the increase in system demands, the 2030 scenario required a different supply configuration than described above. Pressure Zone 1 was supplied by Well 21, Graham booster pump station, and Miramonte Reservoir. Similar to the existing scenario, Miramonte Reservoir fill will have to be manually operated by the City. Pressure Zones 2 and 3 were supplied by Wells 19 and 22, Whisman, Miramonte and Graham booster pump stations. As described above, Whisman Reservoir will be filled during times of low demand. However, due to the increase in demands in the year 2030, Graham Zone 1 booster pump station will have to supplement Zone 1 demands while Whisman Reservoir fills. Throughout the day, Miramonte booster pump station will be pumping into the same zone as either Graham or Whisman booster pump stations. The SCADA pressure settings will have to be adjusted to allow for an even distribution of flow between the separate booster pump stations.

The results of these analyses demonstrate that the system can meet 2020 MDD while adhering to established performance criteria for up to 24 hours given the supply deficit. However, under 2030 MDD conditions, there are some customers that reach minimum pressures as low as 37 psi in Zones 1 and 3. The results are presented in **Figure 7-15** and **Figure 7-16**.

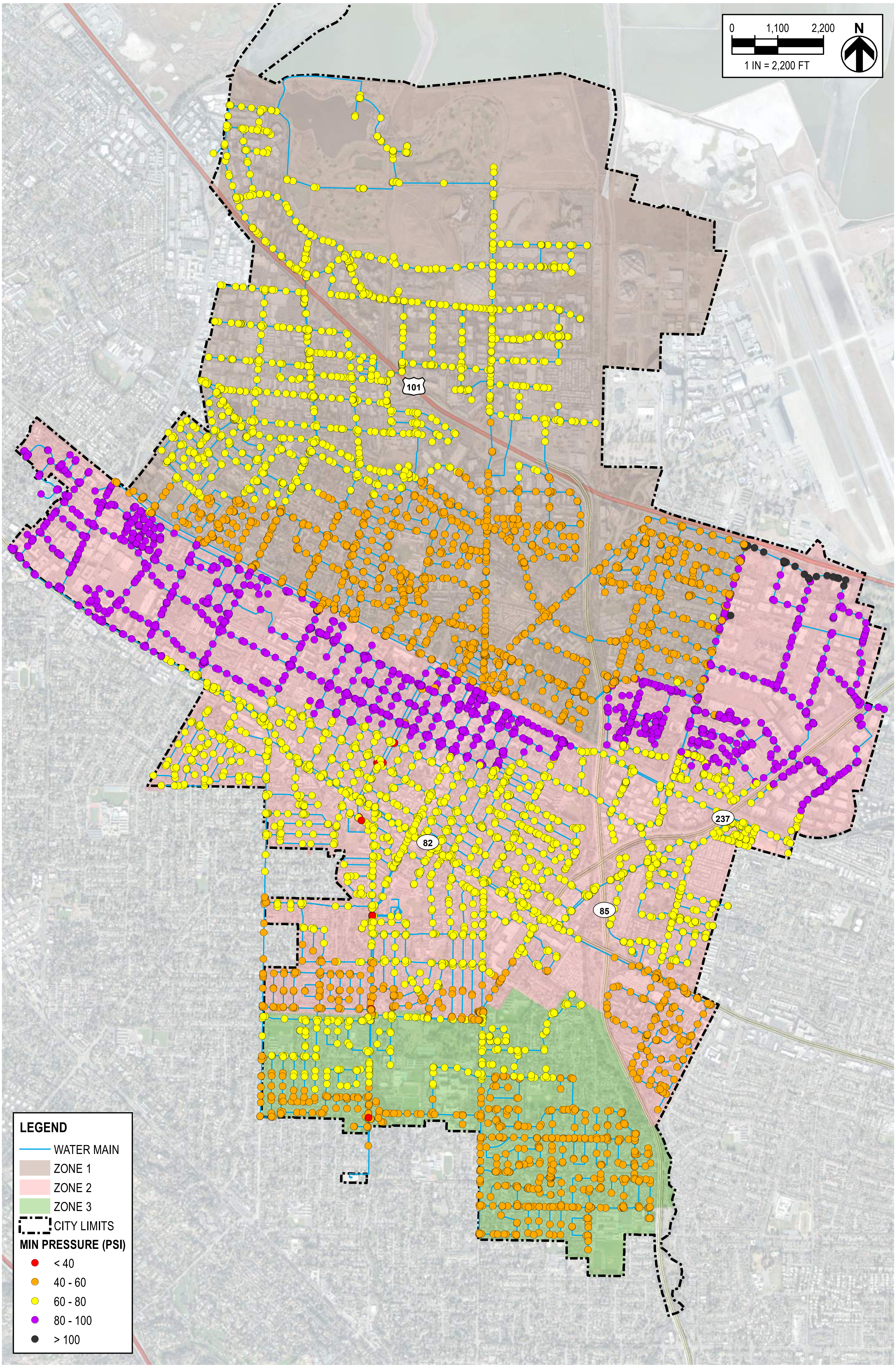



**FIGURE 7-11**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
SCENARIO 1A - EXISTING NO VALLEY WATER

HydroScience

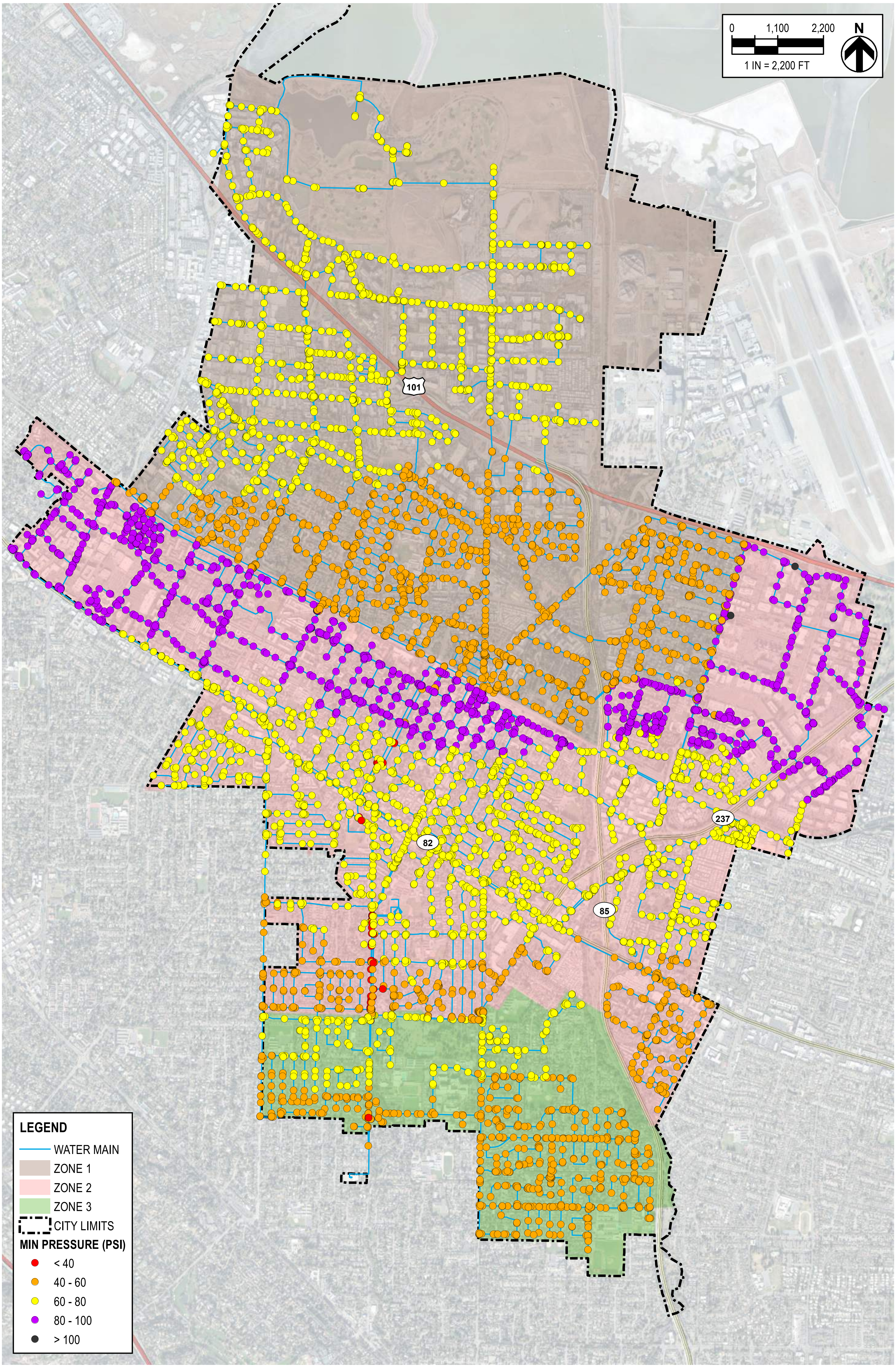



**FIGURE 7-12**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
SCENARIO 1B - 2030 NO VALLEY WATER

HydroScience

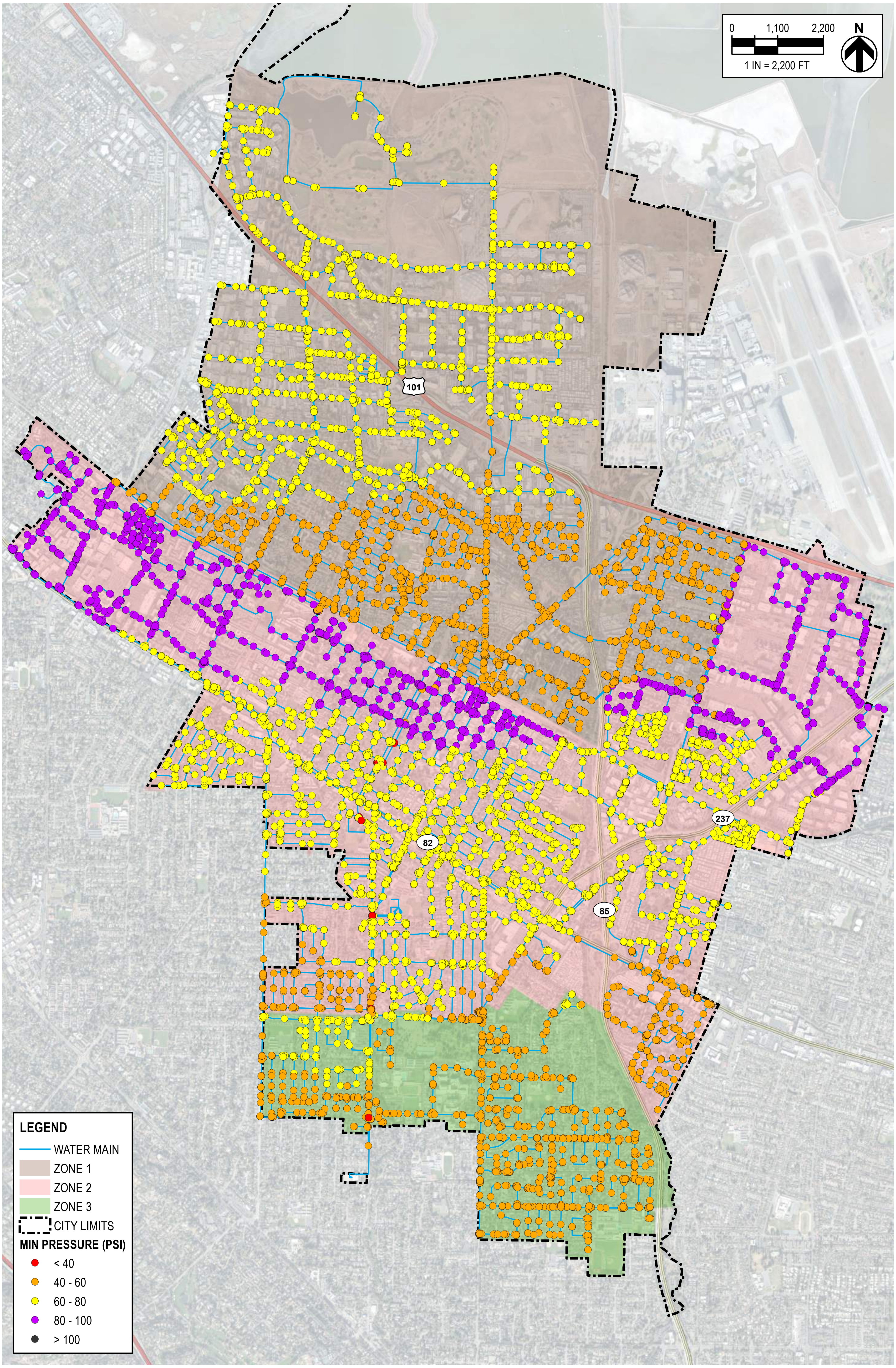



**FIGURE 7-13**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
SCENARIO 2A - EXISTING NO SFPUC

HydroScience

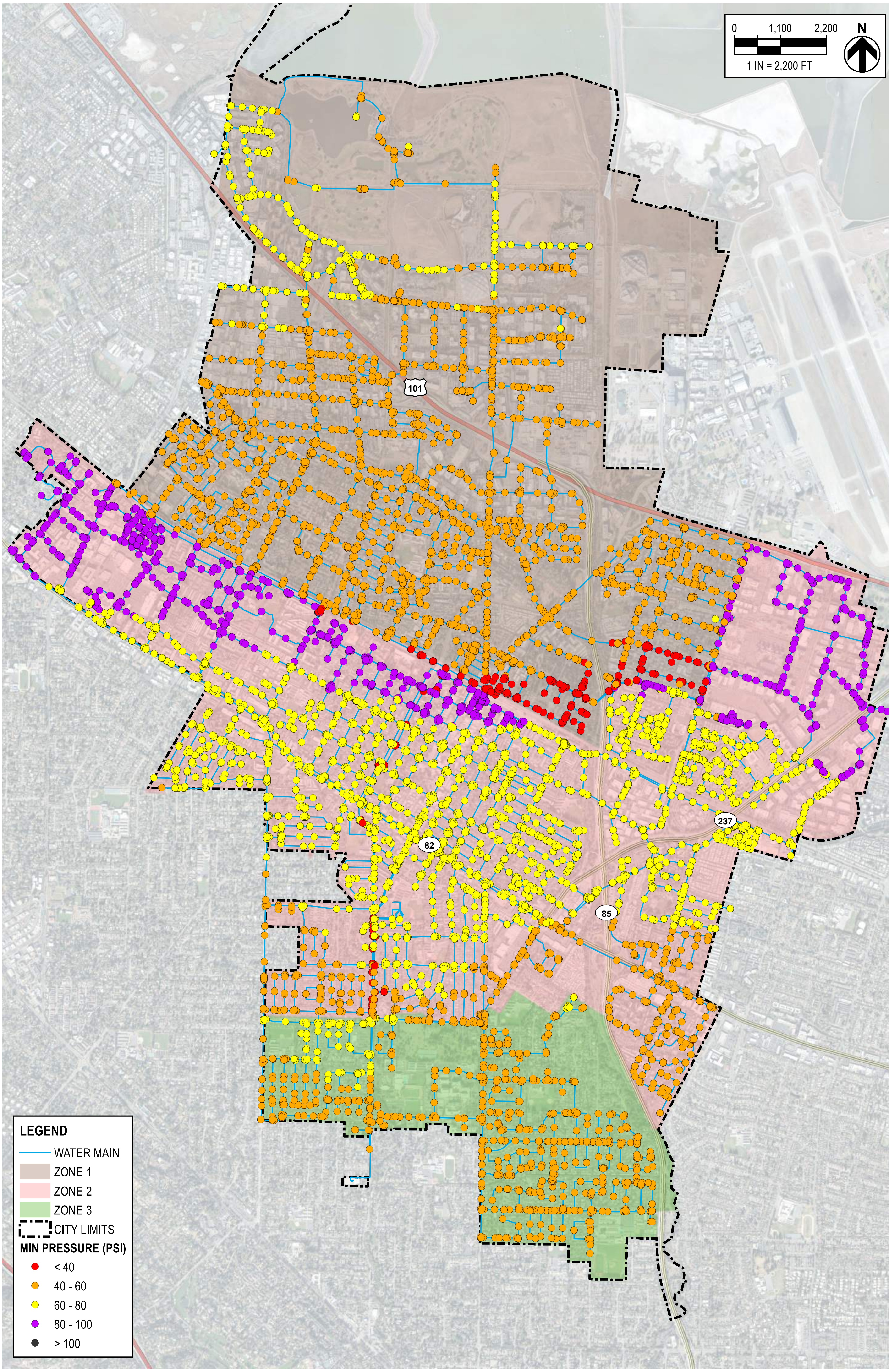



**FIGURE 7-14**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
SCENARIO 2B - 2030 NO SFPUC

HydroScience

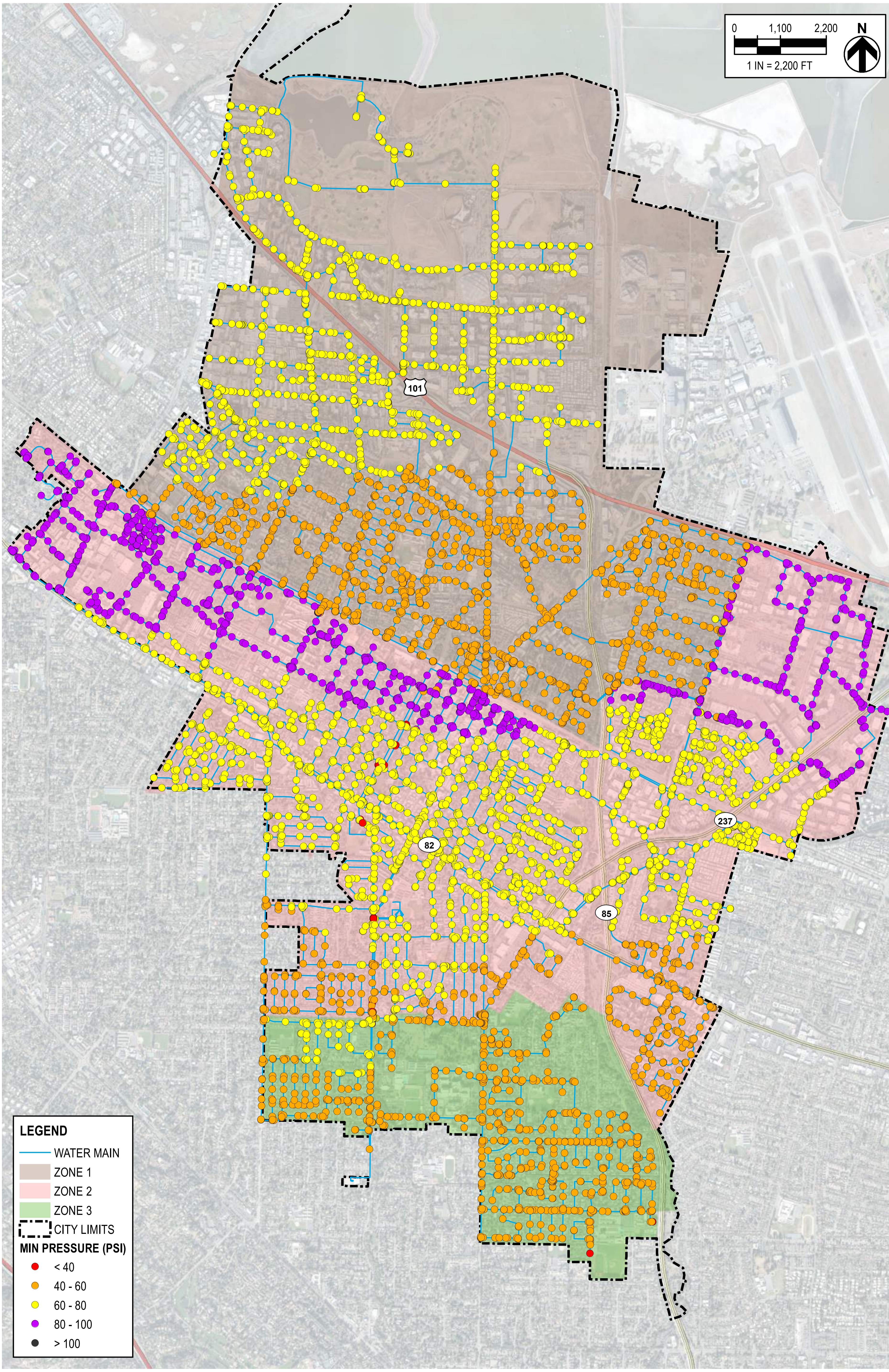



**FIGURE 7-15**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
SCENARIO 3A - EXISTING NO WHOLESALE SUPPLY

HydroScience

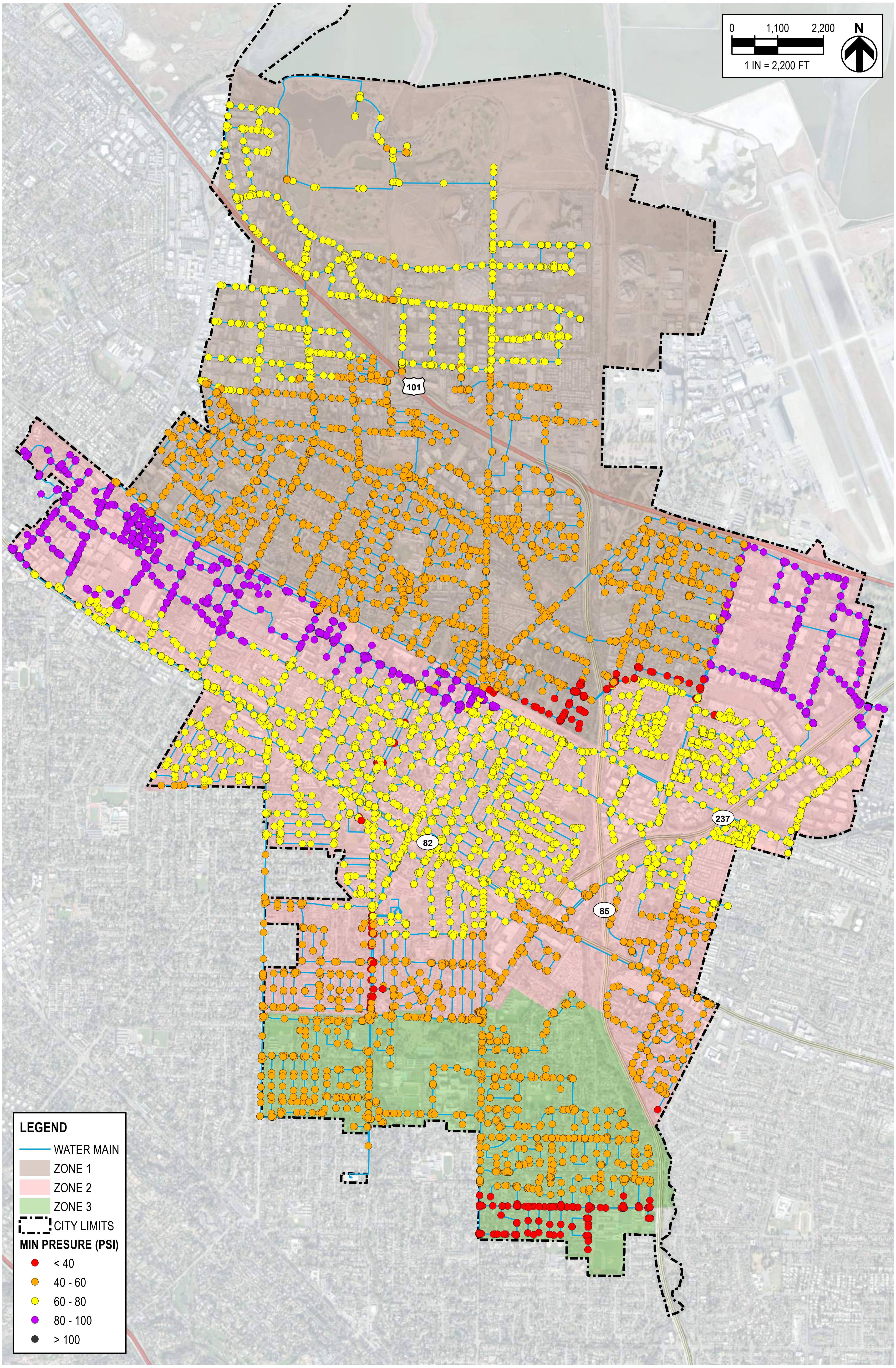



**FIGURE 7-16**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
SCENARIO 3B - 2030 NO WHOLESALE SUPPLY

HydroScience

# SECTION 8 – CONDITION ASSESSMENT

HydroScience staff conducted a condition assessment of each of the water supply facilities as part of the Water Master Plan. Site visits were attended by both HydroScience and Water Operations staff. Staff visited facilities on July 19 & 20, 2021 to visually document facility conditions. As part of the assessment, HydroScience also conducted Operations staff interviews to capture any notable operational issues and challenges experienced by Operations staff when operating and maintaining the facilities.

Provided is a discussion of each of the facilities and the notable deficiencies identified by HydroScience and Operations staff. Facility inspection forms are included as **Appendix D** for reference along with summaries of the noted deficiencies and recommended improvements for each facility.

## 8.1 Graham Reservoir and Pump Station

The Graham Reservoir and Pump Station is a relatively new facility, constructed in 2004. It consists of a buried 8 MG reservoir and a pump station designed to serve both Zones 1 and 2. Two pumps are dedicated to Zone 1 and three pumps to Zone 2. The pump station was noted to be in very good condition. The facility is equipped with two surge tanks (one for each zone) to dampen pressure variances and prevent water hammer. The vertical turbine pumps were offline at the time of inspection, and it was noted by Operations staff that two existing vertical turbine pumps had recently experienced operational problems. Zone 2, Pump 3 (200 hp) catastrophically failed in 2019 for reasons under investigation. Zone 1, Pump 2 (100 hp) was found to have vibrational issues in 2020, as well as failed bushings and damaged spider supports. The City has conducted a vibration study but has not yet pinpointed the root cause of the pump failures. It is noted that it is unusual for a facility to experience two separate pump failures and implies that the problem may not be isolated to a defective pump. There were no notable leaks, corrosion, or safety hazards identified. Slight wear and tear were identified on mechanical piping coating and mild corrosion of the hydropneumatic air relief valve (ARV) and mechanical piping. It was noted that proper arc flash labeling was not installed on the Motor Control Center (MCC). The architectural building was noted to be in excellent condition.

The Graham Reservoir is a relatively new 8 MG open cut reservoir, constructed beneath the recently developed Graham Middle School sports field. A comprehensive inspection of the underground facility and its ancillary systems was unavailable; however, the reservoir is said to be in excellent condition according to Operations staff.

**Recommendations:** In the near term, it is recommended that the City execute a study on the existing vertical turbine pump shaft and vibration issues to determine the root cause of recent failures. The City is executing an Arc Flash Study and should install a warning label for operator safety where required.

Replacement of mechanical, electrical, and communications components are recommended at the end of their useful life including valves, pump VFDs, and communications radio. Mechanical coatings should also be reapplied every 10 to 20 years, depending upon condition, to prevent corrosion of piping and mechanical components and maintain the longevity of the facility. Specifically, near term recommendations include:

- Replace existing communication radio; and,
- Replace/rehabilitate hydropneumatic ARV and mechanical piping that are showing signs of accelerated corrosion.

## 8.2 Whisman Reservoir and Pump Station

The Whisman Reservoir is a 6 MG open cut, concrete lined reservoir with a structural concrete raised roofing system with intermittent supporting columns and corrugated metal roofing panels. The roof is equipped with an operational photovoltaic (PV) solar array that is permanently mounted over the corrugated metal roofing. The existing concrete liner and foundation are reported to be in good condition. The reservoir was originally constructed in 1962 and the roofing system was rehabilitated in 2011. However, PV panel penetrations have created leaks in the roofing panels and the corrugated panel foam seal inserts are being pulled out by animals creating access for nesting. The roof hatch is also outdated and difficult to operate while also being deficient in access safety features and fall protection.

The reservoir's original drainage flapper valve does not completely shut, which can allow storm water surge to enter reservoir drainage. Operations staff have installed a manually operated plug to prevent reservoir contamination, but it is difficult to access and operate. Since the reservoir was completely full, a comprehensive inspection of the entire facility and its ancillary systems was infeasible due to restricted access.

The pump station serves mainly Zone 2 and has the capability to serve Zone 1. The pump station is noted to be in fair condition. Mechanical components have reached the end of their useful life. Suction piping is showing signs of outer corrosion. Pump 1 and 2 concrete pedestals are spalling likely due to water intrusion and reinforcement corrosion/expansion. Metal pump frames have also split due to concrete failure and expansion. The pump room has historically had drainage issues, prompting the City to move the VFDs and install them on a pedestal. The building is also showing signs of degradation and the asphalt concrete (AC) paving around the site is failing.

**Recommendations:** As the Whisman facility is one of the oldest, there are several improvements recommended, the highest priorities are as follows:

- Rehabilitate the Whisman Pump Station as designated in the Whisman Pump Station Assessment Study;
- Replace reservoir drainage system piping and manholes from reservoir drain tie-in to offsite discharge. Includes replacement of existing reservoir drain flapper valve that does not close completely;
- Seal roof leakage from PV panel solar array penetrations;
- Slurry seal existing AC maintenance road surrounding reservoir;
- Construct new site lighting for maintenance safety and security;
- Demolish existing and abandoned Electrical Panel; and,
- Install reservoir Main Hatch Intrusion switch and integrate into SCADA.

Lower priority elements that should be considered within the next five years include:

- Rehabilitate slide gates at reservoir inlet/outlets;
- Perform comprehensive condition assessment on underground concrete cylinder pipeline interconnections between the existing reservoir, pump station, and valve pit systems;
- Remove and replace existing reservoir access hatch to include fall protection and entry handrailing;
- Replace existing vehicular and man gates and chain link fencing where required throughout yard. Include entry alarm signals to City SCADA;
- Rehabilitate interior/exterior architectural finish of existing pump building and replace the roof.

Replacement of the mechanical components is recommended as original equipment servicing both facilities has reached the end of its useful life. The City is planning to rehabilitate Whisman Pump Station in 2022 to modernize the facility's mechanical and electrical infrastructure. Any mechanical components that are not included in the 2022 Whisman Pump Station Rehabilitation project should be replaced as part of a future project, including pumps, valves, piping and architectural facilities.

## 8.3 Miramonte Reservoirs and Pump Station

The Miramonte reservoirs and the pump station are located on two separate sites, roughly 0.25 miles apart along Miramonte Ave. Miramonte reservoirs provide storage and pressure head to Zone 1. The reservoirs are 2.1 MG and 1.2 MG. The smaller reservoir was constructed in 1945 and improved in 1991 and the larger reservoir was constructed in 2004. Since both reservoirs were completely full, a comprehensive inspection of the entire facility and its ancillary systems was infeasible due to restricted access.

The roof for the 1.2 MG reservoir's is finished with corrugated sheet metal and supported by a structural steel framing system. The reservoir is an open cut style basin and lined with concrete. The interior is fully vented with mesh to promote proper chemical volatilization while also preventing animal contamination. There was corrosion noted on the structural metal roof framing coating system, but no defects noted to the concrete basin or reservoir structure were identified. The overflow basin hatch and the fill pipeline were noted to have insufficient fall protection. The reservoir's underground fill pipeline is located within an 18 ft deep confined space vault with outdated electrical and safety facilities. According to Operations staff, the underground fill pipeline Rotork butterfly valve operator often fails, requiring a confined space entry to repair the electrical operator.

The larger reservoir is an open cut style basin with a concrete liner and a structural concrete roofing system. The structural concrete roofing system appears to be in good condition with no major cracking identified. Inspection revealed that the concrete joint and expansion joint sealant has completely failed, requiring reapplication to prevent water intrusion, reinforcement corrosion and reservoir contamination. Cracks were identified in the perimeter concrete drainage channel. As this facility is newer, the hatches are equipped with a netted catchment system for fall protection.

HydroScience noted during the condition assessment that that the existing surfacing of the reservoir parcel and maintenance road is a mixture of exposed soil/dirt and a crushed rock vehicular access corridor. The crushed rock corridor surfacing appears to be wearing thin in various locations of the yard, exposing large patches of underlying dirt/base which could prevent maintenance vehicle access during wet periods of the year. Rehabilitation of the existing crushed rock maintenance vehicle corridor is recommended to reinforce the crushed rock vehicular section to prevent continued degradation of the existing surface and upgrade site drainage. Operations staff reports that site drainage is good however, signs of minor ponding and rutting were identified. It was also noted that the fencing is not connected to an alarm system or City SCADA.

The Miramonte Pump Station currently functions without any operational issues reported by Operations staff. The existing pumping system meets distribution pressures without reported vibrational problems or signs of defect. The existing VFDs are antiquated, and recent failures have emphasized the lack of available replacement parts. The facility's existing communication and controls system is also outdated, requiring modernization to prevent catastrophic failures. The mechanical components are generally in good condition. The onsite distribution system also includes two hydropneumatic surge tanks for protection against water hammer. The surge tanks are in an underground vault presenting a confined space with noticeable corrosion located on the tank shell and mechanical connections. The fluoride dosing system has also exceeded its useful lifespan, showing signs of degradation and corrosion. The architectural building was also noted to be in good condition however, noise complaints have been submitted from residents in the surrounding community due to the generator and pumps.

**Recommendations:** As the Miramonte facilities includes both new and old components, there are several improvements recommended for the reservoirs, the highest priorities include:

- Remove and reconstruct expansion joint sealant surrounding the perimeter roof, penetrations, and construction/expansion joints for the 2.1 MG reservoir to prevent water intrusion/contamination;
- Replace pump VFD;
- Add safety grate fall protection to hydropneumatic hatches;
- Replace existing remote telemetry unit (RTU) and upgrade controls;
- Replace existing MCC and associated raceways/conductors;
- Install main circuit breaker and necessary raceways and conductors; and,
- As part of the planned Arc Flash Study, install warning labeling on MCC for operator safety.

Lower priority elements at the reservoir site to be considered within the next five to ten years include:

- Replace valve and Rotork motorized operator located in 18 ft deep reservoir fill pipeline vault. Update electrical to valve operator and lighting;
- Install safety mechanism on 18 ft deep fill pipeline access manhole;
- Evaluate site irrigation and replace damaged sections. Install drip irrigation where necessary for existing vegetation;
- Upgrade site security and fencing/gates and include entry alarm signal to SCADA;
- Retrofit/rehabilitate reservoir metal roofing system to address seismic susceptibility/sloshing;

- Rehabilitate reservoir metal roof framing coating system to address areas of corrosion and coating failure;
- Replace overflow basin hatch fall protection netting system with safety grate system;
- Perform condition assessment of underground piping surrounding both reservoirs; and,
- Reconstruct and regrade site crushed rock vehicular corridor for improved maintenance access and drainage.

Improvements recommended for the pump station facility for consideration it the next five to ten years include:

- Replace the jockey pump;
- Replace the fluoride dosing pump and piping;
- Recoat the Hydropneumatic surge tank that is showing signs of corrosion;
- Replace building HVAC;
- Rehabilitate site pavement; and,
- Install generator sound enclosure.

Replacement of mechanical, electrical, and communications components at both facilities are recommended at the end of their useful life including valves, pump VFDs, and communications radio. Mechanical coatings should also be reapplied every 10 to 20 years, depending upon condition, to prevent corrosion of piping and mechanical components and maintain the longevity of the facility.

## 8.4 Turnouts

The City operates four turnouts from regional water wholesalers SFPUC and Valley Water. Three turnouts are from SFPUC and one from Valley Water. The City operates a fluoride dosing station at the Valley Water turnout. Each turnout facility and its condition are described below.

### 8.4.1 Turnouts 5 and 7 (SFPUC)

Turnouts 5 and 7 are at a shared facility. The turnouts, flow meters, and related isolation valves are maintained by SFPUC. The City owns and operates the equipment downstream of the SFPUC meters which includes the PRVs, isolation valves, flow meters, ARVs, and appurtenant equipment. The PRVs reduce pressure from 120 psi in the SFPUC transmission piping down to approximately 58 psi at Turnout 5 and 92 psi at Turnout 7. The six existing PRVs are installed in a below grade, covered utility vault, and are generally well maintained and in good operational condition. The PRVs require regular maintenance and have no reported defects. The PRV vault concrete is in good condition; however, the aluminum access hatch is approaching the end of its useful life with corrosion identified at the hatch hinges and frame. The City-maintained isolation gate valves are also partially exposed and showing signs of normal wear and faded protective exterior coatings. The pressure relief/combination valves are also exposed and unprotected.

There is a fluoride chemical building onsite that is no longer used for that purpose as SFPUC provides fluoridated water. Site conditions are generally good; however, the site pavement should be seal coated.

**Recommendations:** The highest priority improvements at the turnouts include:

- Install entry alarm to existing access gate and site security cameras and integrate entry alarm signal into SCADA;
- Replace existing control panel uninterruptible power supply (UPS);
- Demolish abandoned electrical utility meter; and,
- Replace existing RTU panel and upgrade controls.

Improvements recommended for the turnout facility for consideration within the next five to ten years include:

- Rehabilitate fluoridation building exterior condition. Replace existing steel doors;
- Slurry seal existing AC driveway; and,
- Replace all existing buried isolation gate valves surrounding PRV vault (12 total City valves). Buried SFPUC valves surrounding meters are not included.

### 8.4.2 Turnout 14 (SFPUC)

Turnout 14 provides fill supply to Miramonte Reservoirs. Like Turnouts 5 and 7, the Turnout 14 flow meter and related isolation valves are maintained by SFPUC. The City owns and operates the equipment downstream of the SFPUC meters which includes the PRVs, isolation valves, flow meters, ARVs, and appurtenant equipment. The PRVs reduce pressure from 120 psi in the SFPUC transmission piping down to approximately 95 psi. The three existing PRVs are installed in a below grade, covered utility vault, and are generally well maintained and in good operational condition. The PRVs require regular maintenance and have no reported defects. The PRV vault concrete is in good condition however, the aluminum access hatch is approaching the end of its useful life with corrosion identified at the hatch hinges and frame. The City maintained isolation gate valves are also reported to be in good working condition however, the partially exposed areas of the valves are showing signs of normal wear and faded protective exterior coatings.

There is a fluoride chemical building onsite that is no longer used for that purpose as SFPUC provides fluoridated water. Site conditions are generally fair. The site pavement should be seal coated.

**Recommendations:** The highest priority improvements at the turnout site includes:

- Reconstruct magnetic flow meter enclosure with precast vault or enclosure;
- Add entry alarm to existing access gate and integrate into SCADA;
- Replace water sampling station Bay Division Pipeline (BDPL) #4 MV;
- Replace control panel UPS;
- Replace existing RTU panel and upgrade controls; and,

- Install protective control panel bollards.

Improvements recommended for the turnout facility for consideration within the next five to ten years include:

- Replace all existing isolation gate valves surrounding PRV vault (six total City valves). Buried SFPUC valves surrounding meters are not included;
- Replace existing Val-matic ARV/vacuum relief valve on discharge piping;
- Rehabilitate fluoridation building exterior condition and replace existing steel doors;
- Rehabilitate existing control cabinet enclosures to address surface corrosion; and,
- Slurry seal existing AC driveway.

### 8.4.3 Valley Water Turnout

The Valley Water Turnout is located at the Miramonte Pump Station site. The turnout includes site piping, isolation valves, underground flow meter, electrical operators and control, utility vaults and respective piping and appurtenances. The 10-inch PRV reduces supply pressure in the Valley Water transmission pipeline from 105 psi to 62 psi prior to distribution into Zone 3. The City owns and operates the equipment downstream of the Valley Water meter which includes a combination of below and above grade piping. The above grade piping has no reported defects; however, the existing condition indicates signs of degradation and wear. SCADA records indicate that this PRV is experiencing headloss in correlation to the flow rate and is unable to hold pressure steady. Other related site conditions for Miramonte Pump Station are described/addressed in **Section 8.3**.

**Recommendations:** There are no recommended improvements within the upcoming ten-year CIP window. However, it is recommended that the PRV be serviced to determine if the cause of the head losses can be identified and repaired.

## 8.5 Groundwater Wells

According to the Division of Drinking Water (DDW), the City owns four active groundwater wells and three inactive groundwater wells that have not yet been destroyed in accordance with the California Department of Water Resources (DWR) standards. Each of the active wells is equipped with a fluoride dosing station. HydroScience staff visited each active well (Wells 19, 21, 22, and 23) along with one inactive well (Well 17) to document each facility's existing condition. HydroScience did not visit two additional inactive/abandoned wells (Well 10 and 20). Wells 10, 17, and 20 will be destroyed in accordance with DWR Well Standards by the end of spring 2022. Each groundwater well facility and its condition are described below.

### 8.5.1 Well 17

Well 17 has been permanently decommissioned by Operations staff but not officially destroyed in accordance with state requirements. The underground well facilities, pumps, chemical building, and onsite electrical equipment are still in their original condition. All critical equipment has been locked out to prevent tampering. The well discharge mechanical has been demolished and removed by Operations staff. The well discharge and vertical distribution riser have been blind flanged and abandoned.

**Recommendation:** The City has no reported plans to reinstate this well. It is recommended that it be destroyed per DWR requirements. In general, the well must be inspected, filled, and properly sealed to protect the groundwater supply.

### 8.5.2 Well 19

Well 19 is a high-capacity water well system and one of four active existing water wells in the City that supplements water supply to Zone 2. The facility is located on West Evelyn Ave, underneath SR 85 and was originally constructed in 1999. The remote facility is equipped with a 1,200 GPM vertical turbine pump constructed on an above grade concrete pedestal. The turbine well pump is noted to be in good physical and working condition. All related valves and piping are also in good condition. Inspection revealed that the magnetic flow meter installed on the discharge piping is showing signs of external wear. The well is currently operated once per week to exercise the mechanical equipment.

A dedicated fluoridation facility is enclosed in a standard modular prefabricated building which includes dosing pumps, fluoride storage, water, electrical, and ancillary equipment. The chemical dosing equipment is experiencing corrosion and there is evidence of chemical leak captured in the containment reservoir. The fluoridation dosing system also has no dedicated backup in the event of failure, which would disrupt the supply of chemical during discharge operations.

The facility's electrical system is original and has reached the end of its useful lifespan. Site security is currently good; however, due to local unhoused population encampments behind the facility, security improvements are recommended.

**Recommendations:** The mechanical components are generally in good condition. Other equipment needs rehabilitation or replacement. Highest priorities include:

- Reconstruct level transducer to eliminate manual sounding;
- Replace control panel UPS;
- Seal unused control panel sections;
- Replace existing MCC and necessary raceways and conductors;
- Replace existing RTU panel and upgrade controls;
- Add entry alarm to existing access gate and integrate into SCADA;
- Install site security cameras; and,
- As part of the planned Arc Flash Study, install warning labeling on MCC for operator safety.

Improvements recommended for the well site for consideration within five to ten years include:

- Replace magnetic flow meter;
- Recoat above grade mechanical assembly;

- Replace chemical dosing pump and integrate a redundant spare pump and mechanical dosing system;
- Modernize generator controls and automatic transfer switch (ATS);
- Slurry seal and crack seal AC pavement;
- Refinish/regrade site crushed rock surfacing;
- Rehabilitate the fluoride building exterior finish;
- Replace site security redwood fencing and reconstruct new fencing system to isolate and protect facility from transient encampments commonly located behind facility;
- Conduct condition assessment on underground piping between well discharge to meter; and,
- Evaluate need for well pump VFD.

### 8.5.3 Well 21

Well 21 is a high-capacity water well system and one of four active existing water wells in the City that supplements water supply to Zone 1. The facility is located within Creekside Park, at the intersection of Easy St and Gladys Ave. The well was originally constructed in 1997 and recently rehabilitated in 2017. Well 21 is equipped with a standard style submersible pumping system installed in a 600 ft underground perforated casing pipe. The pump and its relative supply are noted to be in good physical and working condition. All related mechanical equipment is in good condition and the downstream valves and piping are new. The well is currently operated once per week to exercise the mechanical equipment.

A dedicated fluoridation facility is enclosed in a building which includes dosing pumps, fluoride storage, water, electrical, and ancillary equipment. The chemical dosing equipment is in good condition.

The site security is good; however due to the potential for public tampering within Creekside Park, security cameras, and intrusion alarms are recommended. The facility was also found to have no site lighting for worker safety during nighttime operations. Surrounding trees generate significant debris onsite and site drainage is fair and could be improved.

Various electrical facilities were upgraded as part of the 2019 improvement project; however, the existing MCC and RTU are original and have exceeded the end of their useful lifespan.

**Recommendations:** The mechanical components are generally in good condition. Highest priority improvements include:

- Install force balanced flex tend expansion joint fitting for seismic protection on 30' pipeline;
- Add entry alarm to existing access gate and integrate into SCADA;
- Improve site lighting;
- Replace existing RTU panel and upgrade controls;
- Replace existing MCC and necessary raceways and conductors;
- As part of the planned Arc Flash Study, install warning labeling on MCC for operator safety; and,

- Refinish/regrade site crushed rock surfacing to eliminate standing water.

Improvements recommended for the well site for consideration within five to ten years include:

- Slurry seal AC driveway;
- Rehabilitate the fluoride building exterior finish; and,
- Conduct condition assessment on underground piping between well discharge to zone water main.

### 8.5.4 Well 22

Well 22 is a high-capacity water well system and one of four active existing water wells in the City that supplements water supply to Zone 1 with the ability to also service Zone 2 via downstream valve intertie. The facility is located along West Evelyn Ave in the northwest corner of the City of Mountain View Police Department parking lot. The well was originally constructed in 2005. Well 22 is equipped with a standard style submersible pumping system installed in a 565 foot underground perforated casing pipe. The pump and its relative supply are noted to be in good physical and working condition. All related mechanical equipment is in good condition although coatings are peeling. The well is currently operated once per week to exercise the mechanical equipment.

The well is located within a concrete masonry unit (CMU) building, which has standard security features and noted to be in excellent condition. The building also houses the fluoridation equipment which has no reported deficiencies. The site is completely enclosed in heavy duty steel fencing and secure from public interference. The vehicular entry gate is manually operated and poses no injury risks due to the gates ease of operation. The site civil features and asphalt pavement is nearing the end of its operational life and requires near term improvement.

The existing electrical and instrumentation features of the well facility are original and have exceeded their useful lifespan.

**Recommendations:** The mechanical components are generally in good condition. Highest priority improvements include:

- Add entry alarm to site security fencing and CMU building doors and integrate signals to SCADA;
- Replace existing RTU and upgrade controls. Evaluate condition of MCC and determine if RTU upgrade warrants MCC improvements;
- As part of the planned Arc Flash Study, install warning labeling on MCC for operator safety;
- Relocate existing pressure transmitter instrumentation;
- Relocate and replace existing receptacles with ground-fault circuit interrupters (GFCI) and weatherproof covers;
- Install site lighting at the well for operator access and safety;
- Install security cameras; and,

- Maintain trees growing over existing generator and reconstruct entry staircase with full length platform for operator access.

Improvements recommended for the well site for consideration within five to ten years include:

- Reapply protective coating on all above grade mechanical piping, valves, and pump;
- Slurry seal AC site pavement and driveway; and,
- Replace existing emergency eyewash and shower.

### 8.5.5 Well 23

Well 23 is located at Graham Reservoir and Pump Station and is designed to fill the Graham Reservoir, which provides blending with SFPUC water. There were no reported defects by either HydroScience or Operations staff. The piping, well pedestal, pump/electrical components were noted to be operationally sound and in working order. Replacement of mechanical components are recommended as they reach the end of their useful life.

### 8.5.6 Wells 10 and 20

These wells were not visited as part of the site investigation. These wells will be destroyed in accordance with DWR Well Standards by summer of 2022.

**Recommendation:** The City has no reported plans to reinstate these wells. It is recommended that it be destroyed per DWR requirements. In general, the well must be inspected, filled, and properly sealed to protect the groundwater supply.

## 8.6 Pipelines

A desktop condition assessment was conducted to evaluate and identify pipeline with the highest probability of failure to drive the recommendations for the City's annual rehabilitation and replacement program. This analysis considers age, material, and soil conditions to assess likelihood of failure for each pipeline. The results of this assessment are incorporated into the CIP recommendations presented in **Section 9.4**. Below is a discussion of the criteria and analysis used to prioritize the pipelines for replacement.

### 8.6.1 Criteria

A pipeline's likelihood of failure is determined by a combination of factors. For this analysis, the following criteria, each briefly described below, were considered:

- **Pipe age** – In general, as a pipe ages, the likelihood of failure increases.
- **Soil corrosivity** – Metallic pipe are more susceptible to failure in corrosive soil conditions.
- **Soil type** – The expansion and contraction of certain soil types can, over time, affect pipes of brittle material.

A rating system was applied to each criterion from 0 to 4 representing low to high likelihood of failure.

**Pipe Age:** A pipeline's expected useful life is a difficult attribute to quantify as it is based on many factors such as pipe material, soil conditions, water quality, proper maintenance, etc. In ideal conditions with thorough maintenance, pipes can reliably serve a water system for up to 100 years or more.

For this criterion, pipelines were assigned a rating based on the decade in which they were installed according to **Table 8-1**. While other factors affect useful life, the criterion assumes no significant adverse condition. Other factors that contribute to the expected useful life are considered in the other criteria for this analysis. The City's GIS geodatabase contained install dates for approximately 75% of the system's pipelines. Where there was no install data available, pipelines were assigned the average install date for that material. Where both install date and material were unavailable, pipes were labeled as unknown. **Figure 8-1** presents a map of the pipeline ratings according to pipe age.

**Table 8-1: Pipeline Ratings Based on Pipe Age**

| Decade Installed | Pipe Age Rating |
|---|---|
| 1940s | 4 |
| 1950s | 3 |
| 1960s[1] | 2 |
| 1970s | 1 |
| 1980s or later | 0 |

Notes:
1. Pipelines with unknown install date and material were assigned an average rating of 2.

**Soil Corrosivity:** As summarized in **Section 3.3**, JDH conducted a study of the corrosion potential of the City's soils, included as **Appendix A**. JDH classified the City's soils as corrosive to buried DIP, CIP, dielectric coated steel, and mortar coated steel at depths of 2.5 ft to 10 ft.

For this desktop condition assessment, pipelines were assigned a criterion rating according to **Table 8-2** based on material and the location relative to identified levels of corrosivity as presented in **Figure 3-6**. Where a single pipeline intersects two corrosivity levels, the higher rating was assigned. Where soil corrosivity values were not available, particularly on the outer edges of the City, pipes were assigned the rating of the nearest corrosivity level. **Figure 8-2** presents a map of the pipeline ratings according to material and soil corrosivity.

**Table 8-2: Pipeline Ratings Based on Soil Corrosivity**

| Resistivity at depth 2.5-10 ft (ohm-cm) | Corrosivity Category | Metallic Pipe Rating[1] | Non-Metallic Pipe Rating |
|---|---|---|---|
| 0-500 | Severely corrosive | 4 | 0 |
| 501-2,000 | Corrosive | 3 | 0 |
| 2,001-8,000 | Moderately corrosive | 2 | 0 |
| 8,001-32,000 | Mildly corrosive | 1 | 0 |

Notes:
1. Pipelines with unknown or conflicting materials were assumed to be metallic.

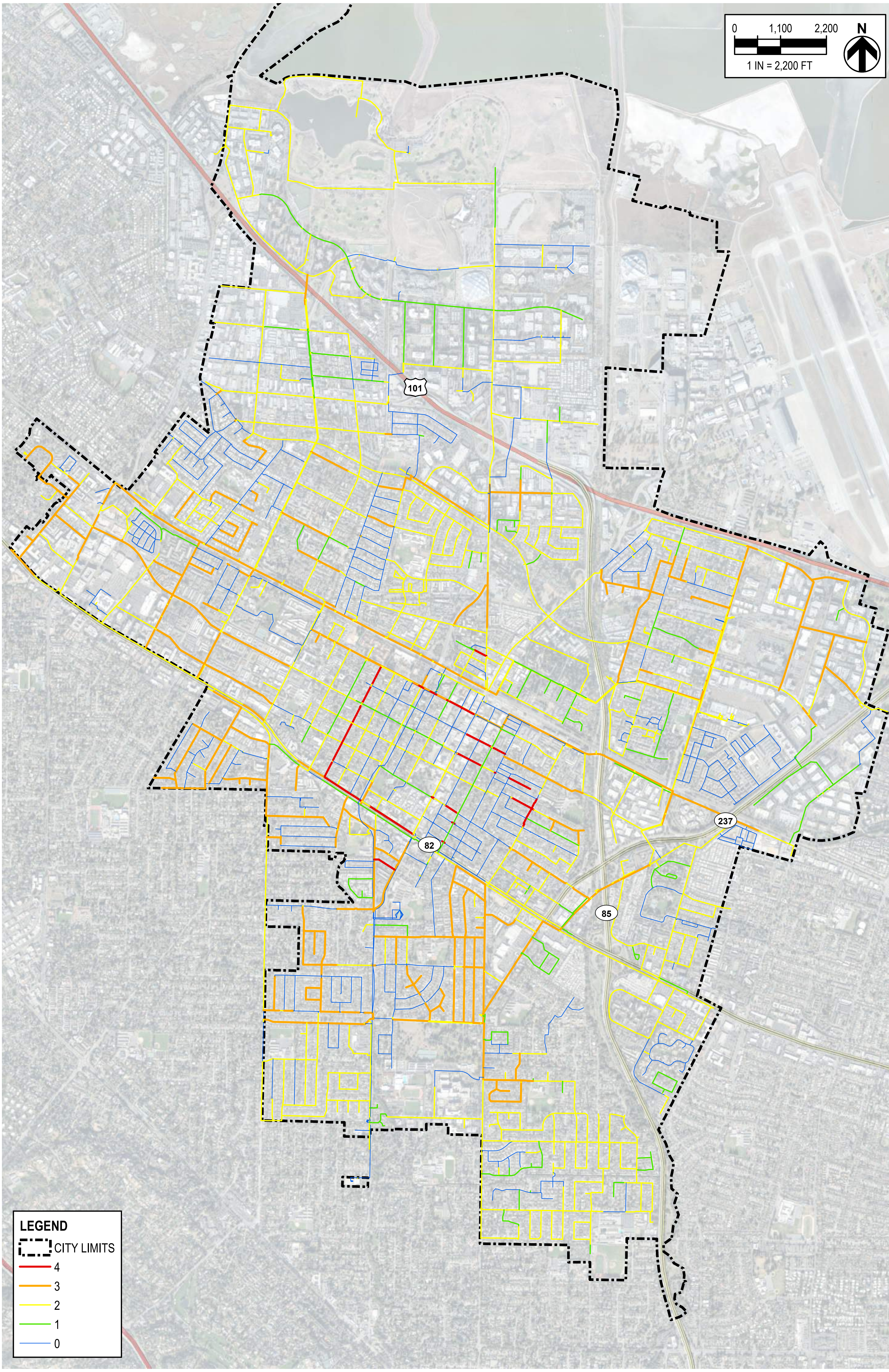
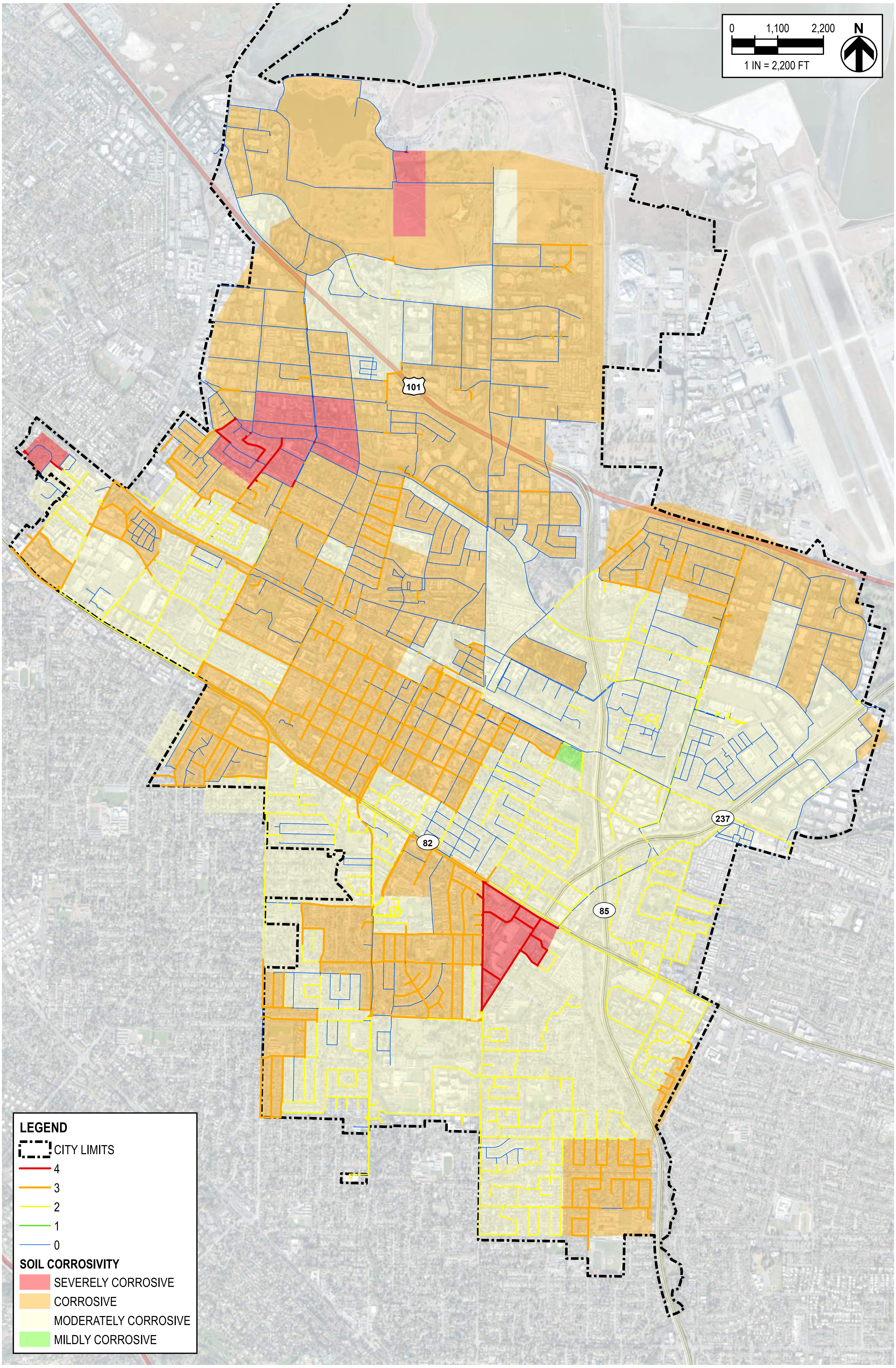



**FIGURE 8-1**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
PIPELINE RATINGS - PIPE AGE

HydroScience




HydroScience

**FIGURE 8-2**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
PIPELINE RATINGS - SOIL CORROSIVITY

**Soil Type:** In addition to the corrosivity of City soils, the soil composition can also affect the useful life of certain pipe materials in the distribution system. As described in the corrosion study by JDH (**Appendix A**), both CIP and ACP are susceptible to breakage and/or failure in areas that contain alluvial/clay soils due to the expansive properties of the soil. CIP and ACP are brittle pipe materials that are sensitive to the cycles of soil expansion and contraction in the wet and dry seasons, respectively. More specifically, smaller diameter pipes are the most vulnerable.

There are two primary soil types that underly the City according to the California Geologic Survey, both containing alluvial/clay materials. The majority of the material is alluvium (Q) and a small area at the southwest boundary of the City is older alluvium (Qoa). In general, along the peninsula and entering the South San Francisco Bay region, soils tend to be clayey type along the bay and transition to sand and gravel, then rock in the hillsides. For this assessment, each pipeline was assigned a soil type rating based on the soil type, pipe material, and pipe diameter according to **Table 8-3**. Both soil types are clayey soils. **Figure 8-3** presents a map of the pipeline ratings based on soil type.

**Table 8-3: Pipeline Ratings Based on Soil Type**

| Soil Type | Material[1] | Diameter | Soil Type Rating |
|---|---|---|---|
| Q – Alluvium | ACP, CIP | < 6-in | 4 |
| | | 6-in | 3 |
| | | 8-in | 2 |
| | | > 8-in | 1 |
| | All other materials | All diameters | 0 |
| Qoa – Older Alluvium | ACP, CIP | < 6-in | 3 |
| | | 6-in | 2 |
| | | 8-in | 1 |
| | | > 8-in | 0 |
| | All other materials | All diameters | 0 |

Notes:
1. Pipelines with unknown or conflicting materials were assumed to be in the ACP, CIP category.

### 8.6.2 Pipeline Replacement Prioritization

With each pipeline assigned a rating for each of the three criteria described above, the sum of the ratings provided each pipeline's overall score ranging from 0 to 11 presented in **Figure 8-4**. The range represents lowest to highest likelihood of failure and directly correlates to lowest to highest priority for replacement. All pipelines with scores of 10 to 11 and a majority of those with a score of 9 are CIP in "corrosive" or "severely corrosive" soils. They are predominantly 6-inches but range from 4- to 8-inches in diameter.

**Table 8-4** provides additional detail regarding the scoring and typical conditions driving each score.

**Table 8-4: Prioritization Scores**

| Score | Priority | Notes |
|---|---|---|
| 10-11 | Very High | Small diameter CIP in corrosive to severely corrosive soil installed in the 1940s and 1950s |
| 9 | High | Small diameter CIP in moderately to severely corrosive soil installed in the 1940s, 1950s, and 1960s |
| 7-8 | Moderately High | Small to medium diameter CIP in moderately corrosive to corrosive soil installed in the 1950s, 1960s, and 1970s |
| 5-6 | Moderate | Small diameter ACP and medium diameter CIP in mildly corrosive to corrosive soil installed in the 1950s through the 2000s |
| 3-4 | Low | Medium to large diameter ACP, CCP, CIP, and DIP in mildly corrosive to corrosive soil |
| 0-2 | Very Low | Medium to large diameter PVC and other non-metallic materials |

There are four clusters of pipelines that have been identified as the highest priority for replacement due to the highest likelihood of failure. Potential consequence related to accessibility, impact to business, and potential discharge to waterways were also considered when prioritizing pipelines. They are identified by their respective neighborhoods in order of descending priority:

1. Cuesta Park and Old Mountain View – This area contains the highest density of pipelines with scores of 8 through 11 and is deemed the highest priority for replacement.
2. Shoreline West – This area contains pipelines with scores of 7 through 11 and is located in central Mountain View. A water main failure in this area would cause a major disruption to businesses.
3. Monta Loma – This area consists of pipelines with scores of 6 through 10 in a residential area of the City.
4. North Whisman – This area contains pipelines with scores of 8 and 9 also in a residential area of the City.
5. 4-inch Mains – This group includes 4-inch mains located throughout the City prioritized based on capacity.

These areas are prioritized for replacement and discussed further in **Section 9.4** as part of the annual water main replacement program.

### 8.6.3 Copper Service Lines

In addition to the factors considered above, corrosion can occur in areas where two different metals are electronically coupled. The City's distribution system sees this where copper services are connected to metallic (CIP and DIP) water mains. According to the available GIS services shapefile, **Figure 8-5** displays the locations where known copper services are connected to metallic water mains.

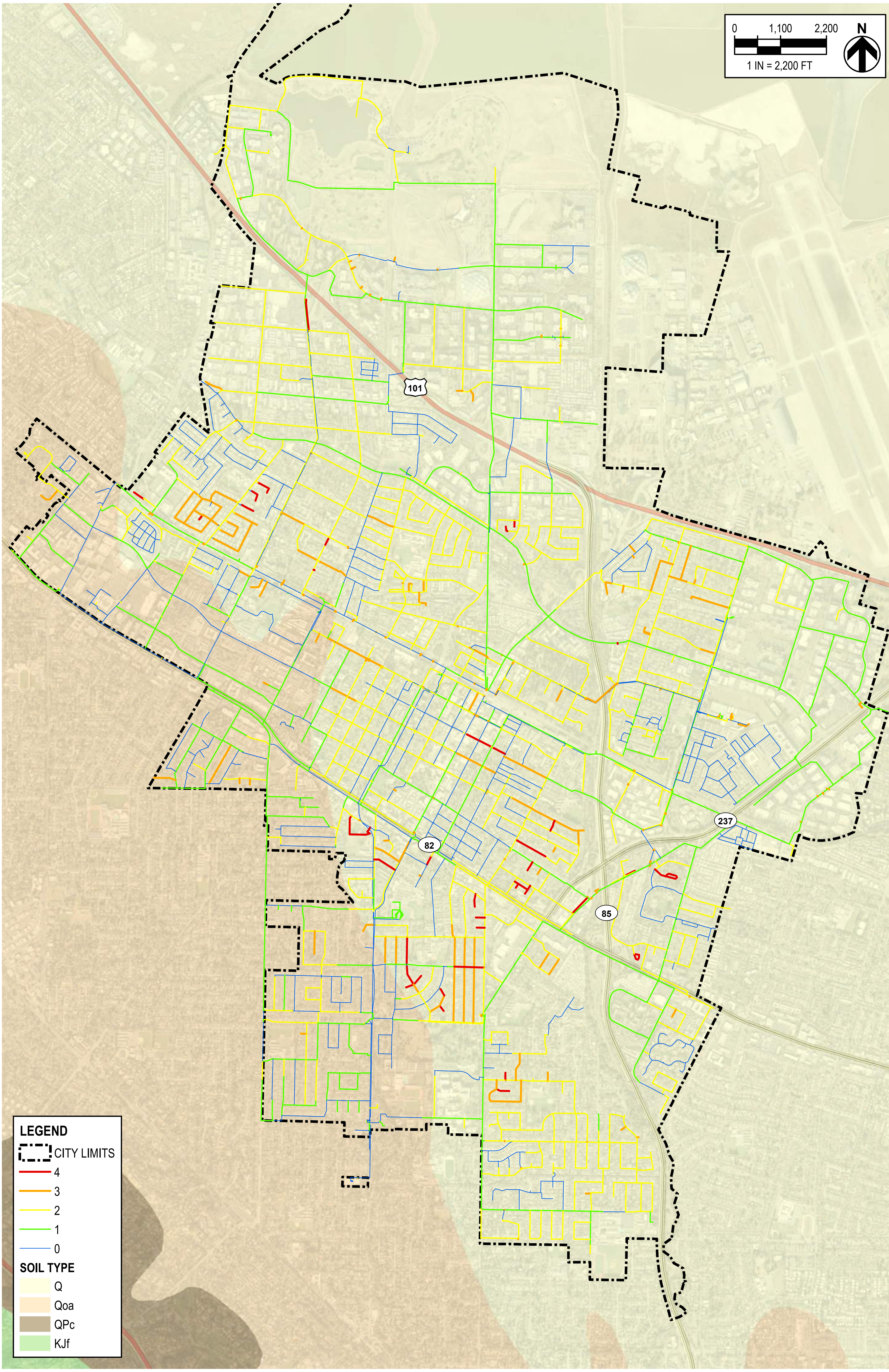



**FIGURE 8-3**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
PIPELINE RATINGS - SOIL TYPE

HydroScience

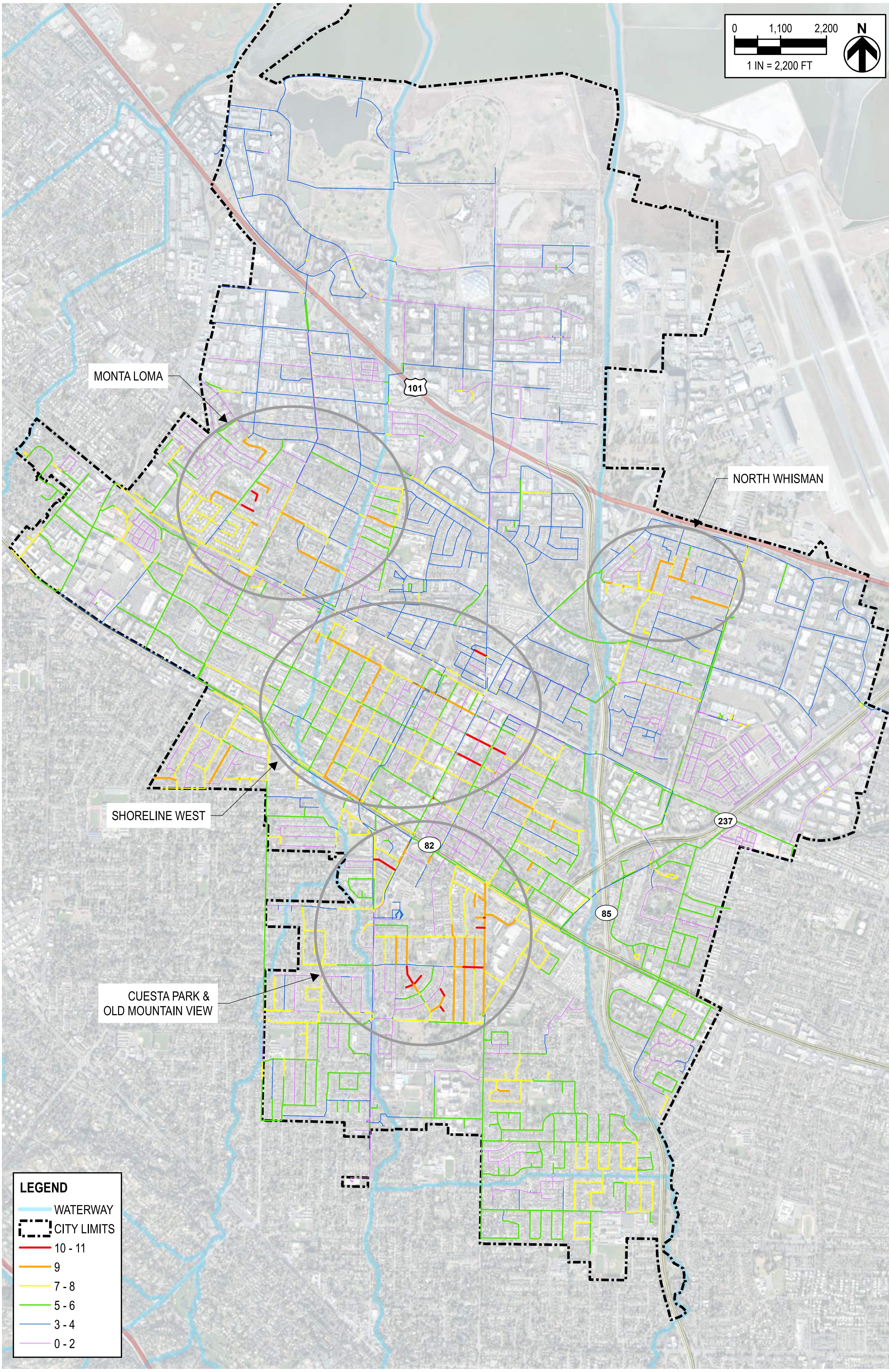



**FIGURE 8-4**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
OVERALL PRIORITIZATION SCORES

HydroScience

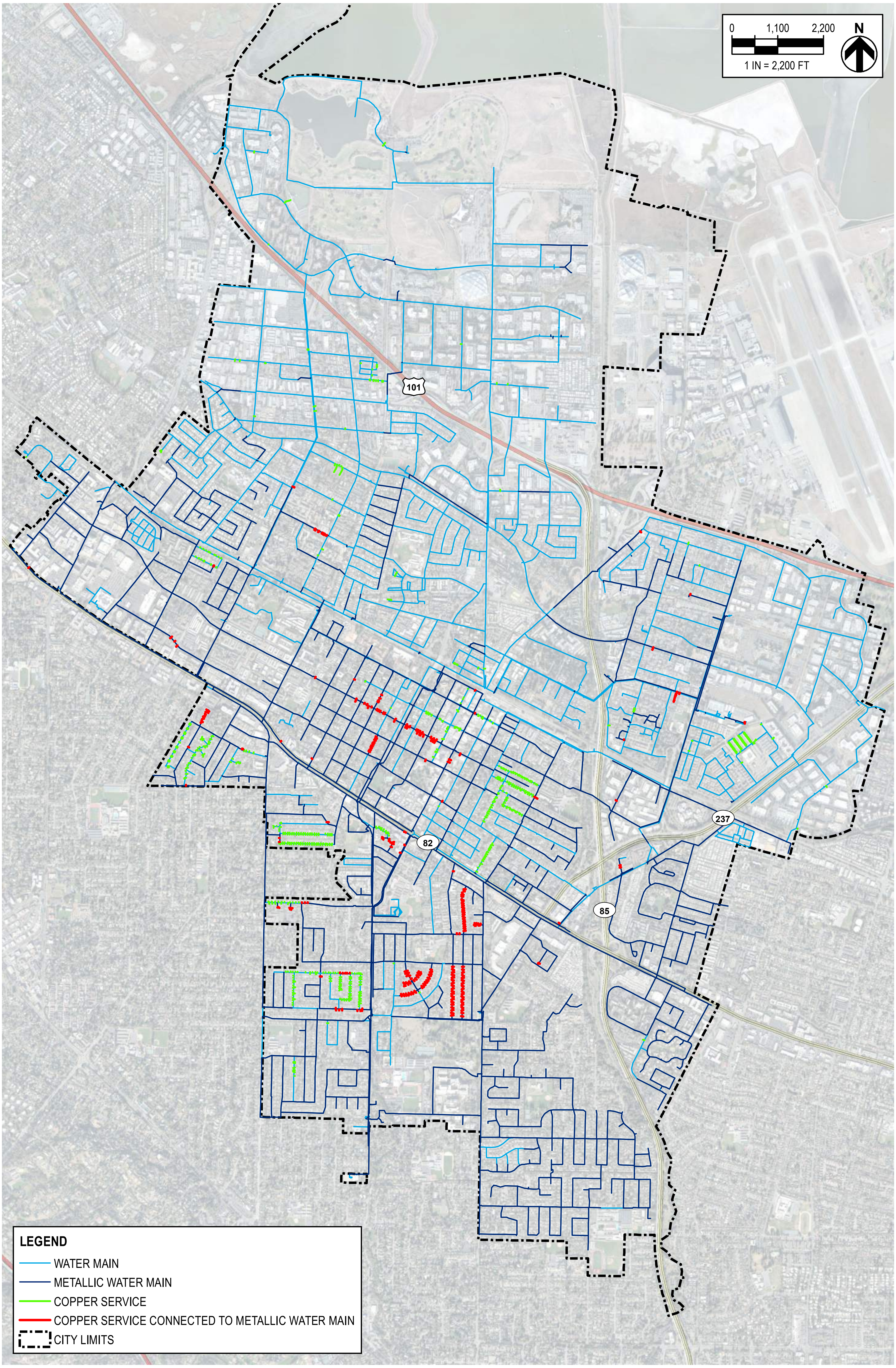



**FIGURE 8-5**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
COPPER SERVICES CONNECTED TO METALLIC WATER MAIN

HydroScience

# SECTION 9 – CAPITAL IMPROVEMENT PROGRAM

This section presents the projects proposed to continue to ensure the reliable and safe delivery of water to the City's customers and the estimated costs and schedule for implementation of the capital improvement program (CIP). Projects are designed to improve water quality, provide redundancy where there is none, and/or meet the performance criteria. In general, the purpose of a water system CIP is to:

- Maintain and enhance water infrastructure to continue to maintain a high level of service to the community;
- Prioritize and address preventive maintenance, infrastructure replacement at the end of useful life or at risk of failure, regulatory requirements, and safety; and,
- Develop and implement projects to ensure continued and reliable delivery of safe and high-quality drinking water to all customers.

Provided is a brief description of existing approved CIP projects followed by the recommended CIP projects.

## 9.1 Existing Capital Improvement Plan Projects

The five-year CIP is adopted biennially, with a full plan developed in odd-numbered years and a focus only on the upcoming fiscal year in even-numbered years. The City's program is intended to provide safe, reliable water supply to its customers. Provided below is a brief summary of the active improvements as well as those currently planned in the service area that will be funded through the Water Enterprise Fund.

**Non-Discretionary Projects (FY 22/23-26/27):** Non-discretionary projects are primarily annual and periodic infrastructure maintenance projects to preserve the City's significant investment in its infrastructure and facilities. They also include projects required for regulatory compliance. They include small inflationary adjustments over time. Provided is the project name and number along with a brief description and dedicated annual funding. Annual funding is summarized in **Table 9-1**.

- **Water System Improvements and Recycled Water System Improvements (Project 23-06):** Scheduled replacement of water and recycled water system components and minor unscheduled improvements to the City's water system.
- **Annual Water Main/Service Line Replacement (Project 23-08):** Replace corroded and/or undersized water main pipes on various streets. The replacements include water services, fire hydrants, and saddle replacements.
- **Developer Reimbursements (Project 23-22):** Construction of street and utility improvements concurrent with private development. Adjacent properties benefiting from street and utility improvements will be required to reimburse the City for the improvements.

- **Information Technology (IT) Projects:** These are five separate IT projects designed to support City facilities and staff. These projects are funded by a variety of sources; only funding sourced from the Water Fund is summarized herein.
  - Land Management System and Paperless Permitting System (Project 11-18)
  - WiFi Systems at City Facilities (Project 13-18)
  - Permanent Audio/Video Equipment in Conference Rooms (Project 17-18)
  - Citywide Website Software Update/Content Migration (Project 21-32), and
  - IT Infrastructure and Telecommuting Support(Project 21-33).

**Table 9-1: Summary of Non-Discretionary Projects Sourced from Water Fund**

| Project No. | FY 22/23 | FY 23/24 | FY 24/25 | FY 25/26 | FY 26/27[1] | Total |
|---|---|---|---|---|---|---|
| 23-06 | $680,000 | $694,000 | $708,000 | $722,000 | $736,000 | **$3,540,000** |
| 23-08 | $2,797,000 | $2,853,000 | $2,910,000 | $2,968,000 | $3,027,000 | **$14,555,000** |
| 23-22 | $33,000 | $34,000 | $34,000 | $35,000 | $36,000 | **$172,000** |
| IT Projects | $30,000 | $30,000 | $30,000 | $30,000 | $30,000 | **$150,000** |
| **Total** | **$3,540,000** | **$3,611,000** | **$3,682,000** | **$3,755,000** | **$3,829,000** | **$18,417,000** |

Notes
1. Assuming 2% increase in budget annually except for IT projects which are typically amended annually.

**Discretionary Projects (FY 22/23-23/24):** Discretionary projects are those that do not fit the non-discretionary description and require approval of the City Council. The sources of potential Discretionary projects include City plans and studies (e.g., Precise Plans, Transportation Plans, Sea-Level Rise Study, Utility Master Plans, Parks and Open Space Plan, etc.), City Council goals and priorities, project submittals from all City departments, and the unscheduled projects in the current CIP. The following projects are currently slated for funding in fiscal years shown in **Table 9-2**.

- **Well 17, 10, and 20 Abandonment:** This project is to abandon Wells 17, 10, and 20 in compliance with DWR requirements. Funding for this project was allocated from the Water Fund in a prior FY. This project is expected to be complete in 2022.
- **MOC—Confined Space/Trench, Design (Project 22-33):** Design project would include building an “in-ground” confined space and trench rescue training prop. Cal-OSHA requires fire departments to perform annual confined space and trench rescue training. This prop will provide a suitable location for those mandatory drills. The prop will also be used by Public Works personnel for the same purpose. Total funding for design planned in FY 21/22 is $250,000 of which $62,000 is sourced from the Water Fund. Total funding for this project construction in FY 23/24 is $710,000, of which $177,000 is sourced from the Water Fund.
- **Electrical Arc Flash Assessment (Project 22-39):** This project is to conduct arc flash evaluations at pumps and wells to meet State Safety Regulations (OSHA standard §2940.11. Protection from Flames and Electric Arcs). Total funding for this project is $120,000 of which half ($60,000) was sourced from the Water Fund in FY 21/22.
- **Downtown Utility Improvements — Design and Construction (Project 22-41):** The project is to design and construct the relocation/abandonment of the 16-inch water transmission main outside the Moffett/Castro/Central Expressway intersection and replacement with an 18-inch

bypass outside the Transit Center Grade Separation and Access Project (GSAP). This project will also upsize the 900-feet of existing sanitary sewer main downstream of the Transit Center GSAP and relocate the water main and sanitary sewer main impacted by the Evelyn ramp portion of the Transit Center GSAP. Total funding for this project is $8,210,000 of which $2,000,000 is sourced from the Water Fund in FY 22/23 and $300,000 was sourced from the Water Fund in FY 21/22

- **Recycled Water System Expansion, Phase I (Project 23-40):** The project is to begin the recommended implementation of the expansion of the City's recycled water system listed in the Recycled Water Feasibility Study Update. Total funding for this project is $4,190,000 and is sourced from the Water Fund in FY 22/23.
- **Miramonte Reservoir Pump Station Improvements (Project 23-43):** This project includes the design of the electrical system and variable frequency drive (VFD) at the Miramonte Pump Station. The proposed improvements include the replacement of automatic transfer switch (ATS), electrical metering panel, VFDs, and programmable logic controller/remote terminal unit (PLC/RTU), and radio hardware. Total funding for this project is $390,000 and is sourced from the Water Fund in FY 22/23.
- **Smart Metering Program (Project 23-45):** Implement a system to remotely read water meters and notify customers of potential water leaks. This CIP provides funding for the first phase of conversion, which includes installation of a network and conversion of existing radio water meters to advanced metering. The City will be implementing the project in partnership with Valley Water through a cost share agreement. Valley Water will reimburse the City as meters are converted and for a portion of new software costs. Initial funding for this project is $2,000,000 of which $1,000,000 is sourced from the Water Fund in FY 22/23.
- **Utility Rate Study (Project 23-46):** The City plans to conduct a comprehensive cost of service analysis for the City's water, recycled water and sewer utilities to evaluate the City's rate structures and provide options for funding future expenditures. The last water and sewer rate study was completed in 2013. Total funding for this project is $200,000 of which $100,000 is sourced from the Water Fund in FY 22/23.

**Table 9-2: Summary of Discretionary Projects Sourced from Water Fund**

| Funding Source | FY 22/23 | FY 23/24 |
|---|---|---|
| 22-33 | - | $177,000 |
| 22-41 | $2,000,000 | - |
| 23-40 | $4,190,000 | - |
| 23-43 | $390,000 | - |
| 23-45 | $1,000,000 | - |
| 23-46 | $100,000 | - |
| **Total** | **$7,680,000** | **$177,000** |

**Summary:** There are also projects funded in prior fiscal years that have been amended to receive additional funds in FY 22/23. A summary of non-discretionary, discretionary, and amendments to existing capital improvement projects sourced from the Water Fund through FY 26/27 is provided in **Table 9-3**.

**Table 9-3: Summary of All Current Projects Sourced from Water Fund**

| Project Type | FY 22/23 | FY 23/24 | FY 24/25 | FY 25/26 | FY 26/27 | Total |
|---|---|---|---|---|---|---|
| Non-Discretionary | $3,540,000 | $3,611,000 | $3,682,000 | $3,755,000 | $3,829,000 | **$18,417,000** |
| Discretionary | $7,680,000 | $177,000 | - | - | - | **$7,857,000** |
| Amendments[1] | $3,676,000 | - | - | - | - | **$3,676,000** |
| **Total** | **$14,896,000** | **$3,788,000** | **$3,682,000** | **$3,755,000** | **$3,829,000** | **$29,950,000** |

Notes:

1. Total amendments impacting the Water Fund in FY 22/23 (Source: City of Mountain View California Operating Budget Fiscal Year 2022-23, June 14, 2022).

## 9.2 Cost Basis and Project Estimates

The purpose of approximating the cost of construction is to appropriate a conservative level of funding for each identified project included within the proposed scope of the City's upcoming CIP. **Appendix E** contains details of the preliminary cost estimates for all projects analyzed as part of this Master Plan. This section describes the basis for development of the unit costs and associated costs for project specific details including pipelines, mobilization, traffic control, and pavement resurfacing.

### 9.2.1 Construction Unit Costs

Unit costs for pipelines, mechanical equipment, and appurtenances were estimated based on recent project bid tabulation for similar Capital Improvement Projects in the Bay Area as well as our experience estimating the cost of similar local projects. Pipeline installation projects are estimated using a loaded construction cost estimate per foot of pipeline installed provided by the City. For conceptual planning and cost comparisons of pipeline projects, the following parameters and associated unit costs were globally applied to projects.

**Table 9-4: Cost Estimating Parameters**

| Cost Parameter | Cost | Applied to: |
|---|---|---|
| Project Mobilization/Demobilization | 5% | Construction Subtotal |
| 8-inch pipeline | $410 per foot | Pipeline length |
| 12-inch pipeline | $440 per foot | Pipeline length |
| 8-inch gate valve | $4,000 | Each |
| 12-inch gate valve | $8,000 | Each |
| Street overlay/repair | $15 per sf | Per square foot assuming 3.0 ft trench width and 9-inch depth |
| Pipeline Appurtenances | 10% | Pipeline costs |

Other costs include traffic control and special construction, which were developed for each project individually based on the complexity of the project.

### 9.2.2 Soft Costs

Soft costs are additional project costs that are not considered to be contractor construction costs. These costs include engineering design, permitting, construction administration, and construction management. Typical soft costs include:

- Engineering design and permitting is expected to also address California Environmental Quality Act (CEQA) requirements to identify significant environmental impacts, if any;
- Administrative and construction management costs are those costs associated with the administration of the contract and management of the project; and,
- The construction contingency provides an allotment of funds designated for unexpected issues that can change the scope of the project.

**Table 9-5** provides a summary of the parameters used for estimating the soft costs. Soft costs were applied to all projects.

**Table 9-5: Soft Cost Estimating Parameters**

| Cost Parameter | Cost | Applied to: |
|---|---|---|
| Engineering Design, Consulting, and Permitting Services | 17.5% | Construction Subtotal |
| Engineering Services during Construction (ESDC), Construction Management, & Inspection Services | 20% | Construction Subtotal |
| Construction Cost and Market Contingency | 30% | Construction Subtotal |

## 9.3 Proposed CIP Projects

This section presents the water distribution system CIP projects proposed to address the City's infrastructure improvement needs within the next 20-year period. The proposed CIP takes into consideration the identified deficiencies in the system and presents projects to address those deficiencies along with projects to improve system reliability. Detailed cost estimates are provided in **Appendix E**.

### 9.3.1 Highest Priority Improvements (FY 22/23-26/27)

The following projects are the highest priority projects for implementation in the next five years. A summary of the costs for FY 22/23-26/27 improvements is provided in **Table 9-6**.

**<u>Graham PS – Vertical Turbine Failures Root Cause Analysis:</u>** It is recommended that the City procure a study to evaluate the vertical turbine pump shaft vibration issues to determine root cause of recent failures, discussed in **Section 8.1**. This study should be independent of the City's on-call contract for pump repair services and build upon previous vibration testing by conducting a forensic analysis of the pumping system and its operational parameters. The intent is to avoid ongoing or future catastrophic failure at this facility. The estimated cost to conduct the evaluation including a 30% contingency is $98,000.

**<u>Miramonte Pump Station Rehabilitation:</u>** This project is a comprehensive rehabilitation of the Miramonte pump station including mechanical, electrical, communication, and civil improvements.

This would involve the replacement of the VFDs, jockey pump, fluoride dosing system and related mechanical piping, valves, and appurtenances. The hydropneumatic surge tanks would be rehabilitated, to address mechanical corrosion, by recoating the tanks with a protective coating. The surge tank hatches would be equipped with fall protection. The MCC would be replaced along with associated electrical components. The existing RTU would be replaced, and controls upgraded (per the SCADA Master Plan). A main circuit breaker would be installed along with associated electrical raceways/conduit for a local disconnect. The generator sound enclosure would be replaced to improve sound dampening and address neighboring noise complaints. The pump room heating, ventilation, and air conditioning (HVAC) would be replaced, and the site AC pavement rehabilitated.

The estimated cost for this project, including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $2,327,000. It is noted that the City has budgeted for the design of the electrical and VFDs (Project 23-43).

**SCADA Master Plan:** The intent of a SCADA Master Plan is to develop a programmatic approach to improving and maintaining the SCADA system. A SCADA Master Plan will identify issues including:

- Any system hardware or software that is obsolete and difficult to update or replace leaving the City vulnerable to failures,
- Vulnerabilities in system protection from network attacks,
- Limitations for workers to access the control system remotely,
- Elements that are vulnerable to catastrophe,
- Patchwork components that can make the system difficult to operate and maintain,
- General inefficiencies, and
- Lack of documentation.

The SCADA Master Plan will document the existing state of the system, identify the requirements and gaps in the system, evaluate alternatives, and develop a CIP for implementation over a defined period of time, ideally in coordination with other facility improvements. It is recommended that the City develop this plan in the near term so that SCADA improvements can be coordinated with other recommended facility improvements. The estimated cost to develop the SCADA Master Plan, including a 30% contingency, is $325,000. Funding for the project would be shared between Water and Wastewater Funds. It is estimated that the contribution from the Water Fund would be $162,500.

**Whisman Station Dr:** It is proposed that the 8-inch pipeline in Minaret Ave be upsized to 12-inch and continue across along Whisman Station Dr to provide the area with a second point of connection to improve fire flow availability and redundancy. The preferred alignment would be evaluated as part of the design. The alignment as shown in **Figure 9-1** would upsize 340 ft of 8-inch pipe to 12-inch and construct 500 ft of new 12-inch pipe. An encroachment permit may be required due to the proximity to Central Expressway.

The estimated cost for this project is $868,000, including engineering design, ESDC, construction management and inspection, and contingency.

**Figure 9-1: Whisman Station Dr**

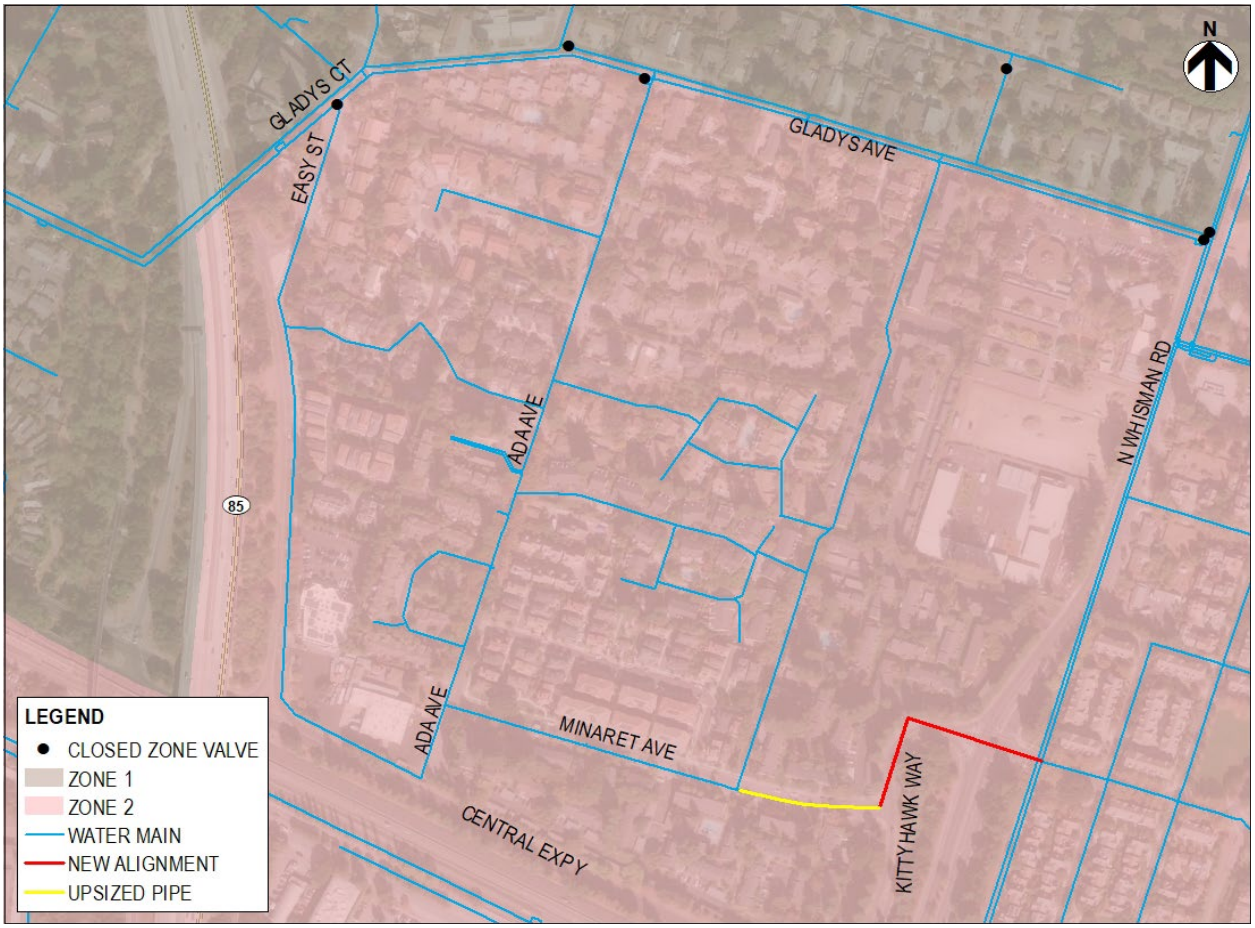



**Table 9-6: Highest Priority Improvements Cost Estimate (Years 1-5 [FY 22/23-26/27])**

| Description | Cost ($) |
|---|---|
| Graham Pump Station – Vertical Turbine Pump Vibration Root Cause Analysis | $75,000 |
| Miramonte Pump Station Rehabilitation Project | $1,389,000 |
| Remote Facility SCADA Master Plan | $125,000 |
| Whisman Station Dr | $518,000 |
| **Subtotal** | **$2,107,000** |
| Engineering Design and Consulting Services (17.5%) | $334,000 |
| ESDC, Construction Management, & Inspection Services (20%) | $381,000 |
| Construction Cost and Market Contingency (30%) | $632,000 |
| **Project Total** | **$3,454,000** |

### 9.3.2 High Priority Improvements (FY 27/28-31/32)

These improvements are considered high priority and would be implemented in the 6- to 10-year timeframe. Remote facility control improvements are recommended in coordination with the SCADA improvements identified in the SCADA Master Plan. A summary of the costs for FY 27/28-31/32 improvements is provided in **Table 9-7**.

**Whisman Pump Station Rehabilitation Project:** The Whisman Pump Station rehabilitation is in design as of the writing of this Master Plan. The highest priority improvement is to modernize the pump station's electrical and control system for autonomous operation. The retrofit is expected to include the replacement of existing MCC-A, control cabinet, and VFD harmonic filters with a new set of electrical equipment compatible with programmable controllers and autonomous operation. In addition to the electrical improvements and pump drive replacements, a complete replacement of Pumps 1 and 2 and their structural concrete pedestals was determined to be a high priority improvement as part of the Whisman Pump Station Assessment Study. Replacement of the Zone 2 pumps would remove a potential threat to the City's redundant means of potable water supply should the SFPUC turnout ever be compromised or disabled. The rehabilitation project will also include seismic upgrades for the existing pump station building, various electrical improvements, safety improvements, facility drainage, and replacement of Pumps 1 and 2 and respective piping and appurtenances.

The cost to implement the Whisman Pump Station rehabilitation is estimated to be $1,620,000. The costs represent construction related costs to implement the design. The design is currently under contract. The cost including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $2,714,000.

**Whisman Pump Station Rehabilitation Project (Optional Improvements):** Low priority rehabilitation items were identified as optional improvements in the Whisman Pump Station Assessment Study. These rehabilitation items are expected to include, but not be limited to, replacement of Pumps 3 and 4 and respective piping and appurtenances, architectural building upgrades, valve vault modernization, replacement of the existing Zone 1 and 2 pressure relief/sustaining valves, and electrical improvements. The project is also scheduled to include the rehabilitation of the interior and exterior architectural finish of the existing pump building and the condition assessment of the underground suction and discharge piping system. The optional improvements will be executed as part of the Whisman Pump Station Rehabilitation Project based on available funding and at the City's discretion.

The estimated cost of the optional improvements, including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $1,652,000.

**Remote Facility Controls and SCADA Improvement Project:** This project is intended to facilitate the implementation of the SCADA Master Plan recommendations and take advantage of economies of scale. This project includes the improvement of controls and communication equipment at all facilities identified with deficiencies including Graham Pump Station; Turnouts 5, 7, and 14; and all active groundwater wells. While there are site specific improvements considered for each facility, common improvements include MCC replacement; control panel and RTU replacement; conduits, handholes, and equipment wiring; instrumentation; control system integration; and testing and commissioning.

The estimated cost of this project, including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $4,146,000.

**Table 9-7: High Priority Improvements Cost Estimate (Years 6-10 [FY 27/28-31/32])**

| Description | Cost ($) |
|---|---|
| Whisman Pump Station Rehabilitation | $1,620,000 |
| Whisman Pump Station Rehabilitation Project - Optional | $986,000 |
| Remote Facility Controls and SCADA Improvement Project | $2,475,000 |
| **Construction Subtotal** | **$5,081,000** |
| Engineering Design and Consulting Services (17.5%) | $889,000 |
| ESDC, Construction Management, & Inspection Services (20%) | $1,016,000 |
| Construction Cost and Market Contingency (30%) | $1,524,000 |
| **Project Total** | **$8,510,000** |

### 9.3.3 Medium Priority Improvements (FY 32/33-36/37)

These improvements are considered medium priority and would be implemented in the 11- to 15-year timeframe. A summary of the costs for FY 32/33-36/37 improvements is provided in **Table 9-8**.

**Graham PS – Hydropneumatic Tank Improvement Project:** This is the rehabilitation project for the hydropneumatic tank piping and appurtenances only. The estimated cost for this project, including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $84,000.

**Whisman Reservoir Site Improvement Project:** This project includes various improvements related to the reservoir and the site, including the following:

- Replacement of reservoir drainage system piping and manholes from reservoir drain tie-in to offsite discharge. Includes replacement of existing reservoir drain flapper valve that does not close completely;
- Rehabilitation of the reservoir slide gates at reservoir inlet/outlets;
- Condition assessment of underground reservoir piping system;
- Sealing of PV panel solar array penetrations to repair roof leakage;
- Removal and replacement of the existing reservoir access hatch to include fall protection and entry handrailing;
- Slurry sealing existing AC maintenance road surrounding reservoir;
- Replacement of existing vehicular and man gates and chain link fencing where required throughout yard and include entry alarm signals to City SCADA;
- Construct new site lighting for maintenance safety and security;
- Demolish existing abandoned electrical panel; and,
- Install reservoir main hatch intrusion switch and integrate into SCADA.

The estimated cost of this project, including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $1,670,000.

**Rehabilitation of SFPUC Turnouts 5, 7, and 14:** This project includes the rehabilitation of the two sites hosting the three SFPUC turnouts. Similar improvements are needed at both facilities including:

- Replacement of all of the existing isolation gate valves surrounding PRV Vault (12 valves at both sites);
- Rehabilitation of the respective fluoride building exteriors and replacement of the existing steel doors;
- Slurry sealing of the AC driveways; and,
- Installation of an entry alarm on existing entry gates and site security cameras. Integration of the alarm signals into SCADA.

Beyond these improvements, Turnout 14 requires additional work, including:

- Replacement of existing Valmatic ARV/vacuum relief valve on discharge piping;
- Reconstruction of the magnetic flow meter enclosure with precast vault or enclosure; and,
- Replacement of water sampling station at BDPL #4 MV.

It is assumed that the remote facility controls and SCADA improvements to these sites will have been completed as part of the FY 27/28-31/32 improvements described in **Section 0**. The estimated cost of these projects, including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $985,000 for Turnouts 5/7 and $879,000 for Turnout 14.

**Well 19 Improvements:** This project includes general rehabilitation of the site and improvements to mechanical, instrumentation, and electrical components. The remote facility controls and SCADA improvements to these sites will have been completed as part of the FY 27/28-31/32 improvements described in **Section 0**. The project includes the follow improvements:

- Replacement of the magnetic flow meter;
- Recoating of above grade mechanical assembly;
- Replacement of the fluoride dosing pump and integration of a redundant spare pump and mechanical dosing system;
- Reconstruction of the level transducer to eliminate manual sounding;
- Updating of the generator controls and ATS;
- Slurry sealing and crack sealing the AC pavement;
- Refinishing/regrading site crushed rock surfacing;
- Rehabilitation of the fluoride building exterior finish;
- Replacement of site security redwood fencing and reconstruction of new fencing system to isolate and protect facility from homeless transient camps commonly located behind facility;
- Condition assessment of underground piping between well discharge to meter;
- Installation of entry alarm to existing access gate and integration into SCADA; and,

- Installation of site security cameras.

The estimated cost of these projects, including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $769,000.

**Well 21 Improvements:** This project includes general rehabilitation of the site and improvements to mechanical, instrumentation, and electrical components. The remote facility controls and SCADA improvements to these sites will have been completed as part of the FY 27/28-31/32 improvements described in **Section 0**. The project includes the follow improvements:

- Slurry sealing the AC driveway;
- Refinishing/regrading site crushed rock surfacing to eliminate standing water;
- Rehabilitation of the fluoride building exterior finish;
- Installation of force balanced flex tend expansion joint fitting for seismic protection on 30 ft pipeline;
- Condition assessment of underground piping between well discharge to Zone 1 water main;
- Installation of entry alarm to existing access gate and integration into SCADA; and,
- Installation of site lighting and respective electrical.

The estimated cost of this project, including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $643,000.

**Table 9-8: Medium Priority Improvements Cost Estimate (FY 32/33-36/37)**

| Description | Cost ($) |
|---|---|
| Graham PS – Hydropneumatic Tank Improvement Project | $50,000 |
| Whisman Reservoir Improvement Project | $997,000 |
| Turnouts 5 & 7 Rehabilitation Project | $588,000 |
| Turnout 14 Rehabilitation Project | $525,000 |
| Well 19 Improvement Project | $459,000 |
| Well 21 Improvement Project | $384,000 |
| **Construction Subtotal** | **$3,003,000** |
| Engineering Design and Consulting Services (17.5%) | $526,000 |
| ESDC, Construction Management, & Inspection Services (20%) | $601,000 |
| Construction Cost and Market Contingency (30%) | $901,000 |
| **Project Total** | **$5,031,000** |

### 9.3.4 Low Priority Improvements (FY 37/38-41/42)

These improvements are considered lower priority and would be implemented in the 15- to 20-year timeframe. A summary of the costs for the FY 37/38-41/42 improvements is provided in **Table 9-9**.

**Miramonte Reservoir Rehabilitation Project:** This project will address the seismic deficiencies at the site and include the rehabilitation of various mechanical, electrical, civil, and safety related elements at the site including:

- Retrofit and rehabilitation of the reservoir metal roofing system to address seismic susceptibility/sloshing;
- Rehabilitation of the reservoir metal roof framing coating system to address areas of corrosion and coating failure;
- Replacement of the overflow basin hatch fall protection netting system with a safety grate system;
- Replacement of the valve and Rotork motorized operator on 18 ft deep reservoir fill pipeline at the 1.2 MG reservoir, including electrical and integration;
- Installation of safety fall protection mechanism on 18 ft deep fill pipeline access manhole at the 1.2 MG reservoir;
- Removal and reconstruction of the 2.1 MG reservoir expansion joint sealant surrounding perimeter roof, penetrations, and construction/expansion joints to prevent water intrusion and contamination;
- Condition assessment of underground piping surrounding both reservoirs;
- Regrading of site crushed rock driveway/maintenance road for improved maintenance access and drainage;
- Evaluation of site irrigation and replacement of damaged sections. Installation of drip irrigation where necessary for existing vegetation;
- Upgrade of site security. It is noted that the site fencing is being replaced as a separate existing CIP (Project 23-42) which will be funded by the Construction/Conveyance Tax; and,
- Installation of entry alarm and integration into SCADA.

The estimated cost of this project, including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $1,724,000.

**Well 22 Improvement Project:** This project includes general rehabilitation of the site and improvements to mechanical, instrumentation, and electrical components. The remote facility controls and SCADA improvements to these sites will have been completed as part of the FY 27/28-31/32 improvements described in **Section 0**. The project includes the follow improvements:

- Reapplication of protective coating on all above grade mechanical piping, valves, and pump;
- Slurry sealing the AC pavement and driveway;
- Replacement of the existing emergency eyewash and shower;

- Installation of entry alarm to existing access gate and integration into SCADA;
- Installation of site security cameras;
- Installation of site lighting and respective electrical at the well for operator safety; and,
- Maintenance of trees growing over existing generator and reconstruction of the entry staircase with full length platform for operator access.

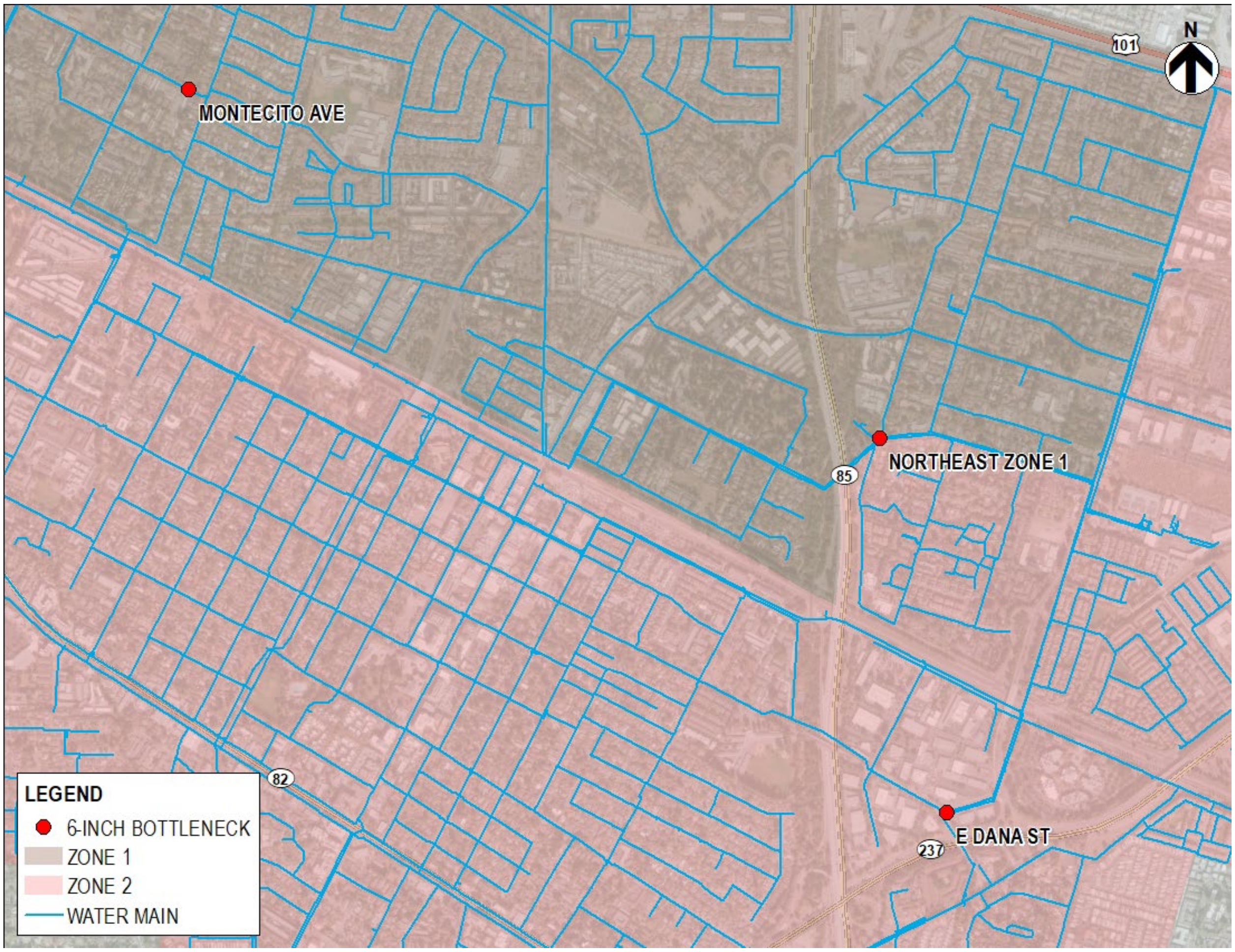
The estimated cost for construction of this project including engineering design, ESDC, construction management and inspection, and contingency is estimated to be $456,000.

**Improve 6-inch connection bottlenecks:** There are three 6-inch connections that are potential bottlenecks to providing adequate fire flow. The three sites include:

- **Northeast Zone 1:** It is recommended that approximately 50 feet of 6-inch ACP is upsized to 8-inch, as shown in **Figure 9-2**, to provide sufficient flow to the area.
- **E Dana St:** To reduce headloss and provide additional flow for the high fire flow demand, it is recommended that approximately 25 feet of 6-inch pipe is upsized to 12-inch, matching the diameters of the connecting pipes on E Dana St (see **Figure 9-2**).
- **Montecito Ave:** To reduce velocity and headloss through this segment, it is recommended that approximately 50 feet of 6-inch CIP is upsized to 8-inch, eliminating the 6-inch bottleneck (see **Figure 9-2**).

These projects can also be integrated into the annual water main replacement program. The approximate cost of these improvements is $154,000 including engineering design, ESDC, construction management and inspection, and contingency.

**Figure 9-2: All 6-inch Bottlenecks**




**4-inch Mains:** It is recommended that the City upsize 4-inch pipeline to reduce headloss and mitigate fire flow deficiencies throughout the system. Approximately 6,600 feet of pipeline is recommended to be upsized to 8-inch due to fire flow deficiencies related to flow through 4-inch pipelines described in **Section 7.2.3** and presented in **Figure 7-5**. Small segments of 6- and 8-inch pipeline that were identified as high priority to replace in **Section 8.6.2** were grouped with these 4-inch pipelines due to their proximity.

The approximate cost of these improvements is $7,138,000 including engineering design, ESDC, construction management and inspection, and contingency.

**Hydrant Relocation:** Some fire flow deficiencies noted in **Section 7.2.3** could be improved by relocating hydrants to larger pipelines. It is recommended that six hydrants currently installed on small diameter pipelines be relocated to nearby larger diameter pipes (see **Figure 7-5**). These improvements can be integrated with the water main replacement program as those areas are improved.

The approximate cost of these improvements is $90,000 including engineering design, ESDC, construction management and inspection, and contingency.

**Table 9-9: Low Priority Improvements Cost Estimate (FY 37/38-41/42)**

| Description | Cost ($) |
|---|---|
| Miramonte Reservoir Rehabilitation Project | $1,029,000 |
| Well 22 Improvement Project | $272,000 |
| Northeast Zone 1, E Dana St, and Montecito Ave Bottlenecks | $92,000 |
| 4-inch Mains | $4,262,000 |
| Hydrant Relocation | $54,000 |
| **Construction Subtotal** | **$5,709,000** |
| Engineering Design and Consulting Services (17.5%) | $999,000 |
| ESDC, Construction Management, & Inspection Services (20%) | $1,142,000 |
| Construction Cost and Market Contingency (30%) | $1,713,000 |
| **Project Total** | **$9,563,000** |

### 9.3.5 Proposed CIP Projects Summary

The proposed CIP projects are presented on **Figure 9-3** and summarized in **Table 9-10.**

**Table 9-10: Proposed CIP Projects**

| Project ID[1] | Priority | Location | Length (ft) | Existing Diameter (in) | New Diameter (in) | New (N) Replace (R) | Total Cost[2] |
|---|---|---|---|---|---|---|---|
| - | Highest | SCADA Master Plan (not shown on **Figure 9-3**) | - | - | - | - | $162,500 |
| - | High | Remote Facility Controls and SCADA Improvement Project (not shown on **Figure 9-3**) | - | - | - | - | $4,146,000 |
| 1 | Highest | Graham PS – Vertical Turbine Failures Root Cause Analysis | - | - | - | - | $98,000 |
| 1 | Medium | Graham PS – Hydropneumatic Tank Improvement | - | - | - | - | $84,000 |
| 2 | High | Whisman Pump Station Rehabilitation (including optional improvements) | - | - | - | - | $4,366,000 |
| 2 | Medium | Whisman Reservoir Site Improvement | - | - | - | - | $1,670,000 |
| 3 | Highest | Miramonte Pump Station Rehabilitation | - | - | - | - | $2,327,000 |
| 3 | Low | Miramonte Reservoir Rehabilitation | - | - | - | - | $1,724,000 |
| 4 | Medium | Rehabilitation of SFPUC Turnouts 5, 7, and 14 | - | - | - | - | $1,864,000 |
| 5 | Medium | Well 19 Improvements | - | - | - | - | $769,000 |

| Project ID[1] | Priority | Location | Length (ft) | Existing Diameter (in) | New Diameter (in) | New (N) Replace (R) | Total Cost[2] |
|---|---|---|---|---|---|---|---|
| 6 | Medium | Well 21 Improvements | - | - | - | - | $643,000 |
| 7 | Low | Well 22 Improvements | - | - | - | - | $456,000 |
| 8 | Low | Hydrant relocation on Golf Ct and Williams Wy | - | - | - | - | $15,000 |
| 9 | Low | Hydrant relocation on E Evelyn Ave | - | - | - | - | $15,000 |
| 10 | Low | Hydrant relocation on Kittoe Dr and James Dr | - | - | - | - | $15,000 |
| 11 | Low | Hydrant relocation on Ednamary Way | - | - | - | - | $15,000 |
| 12 | Low | Hydrant relocation on Middlefield Rd | - | - | - | - | $15,000 |
| 13 | Low | Hydrant relocation on N Rengstorff Ave | - | - | - | - | $15,000 |
| 14 | Low | Montalto Dr and Cornelia Ct | 1,590 | 4 | 8 | R | $1,412,000 |
| 14 | Low | Montalto Dr and Lola Ln | 20 | 8 | 8 | R | $35,000 |
| 14 | Low | Montalto Dr and Lola Ln | 190 | 6 | 8 | R | $183,000 |
| 15 | Low | Bourbon Ct | 410 | 4 | 8 | R | $410,000 |
| 16 | Low | Harpster Dr | 560 | 4 | 8 | R | $541,000 |
| 17 | Low | Hedgerow Ct | 930 | 4 | 8 | R | $864,000 |
| 18 | Low | Dalma Dr | 780 | 4 | 8 | R | $734,000 |
| 19 | Low | W Dana St between Castro St and Bush St | 960 | 4 | 8 | R | $864,000 |
| 19 | Low | W Dana St and View St | 70 | 8 | 8 | R | $87,000 |
| 20 | Low | Judson Dr | 1,060 | 4 | 8 | R | $978,000 |
| 21 | Low | Laura Ln | 320 | 4 | 8 | R | $332,000 |
| 22 | Low | N Rengstorff Ave | 740 | 4 | 8 | R | $698,000 |
| 23 | Low | Connection bottlenecks - Easy St and Gladys Ave (Northeast Zone 1) | 50 | 6 | 8 | R | $55,000 |
| 24 | Low | Connection bottlenecks - E Dana St | 25 | 6 | 12 | R | $44,000 |
| 25 | Low | Connection bottlenecks - Montecito Ave | 50 | 6 | 8 | R | $55,000 |
| 26 | Highest | Whisman Station Dr and Minaret Ave | 340 | 8 | 12 | R | - |
| 26 | Highest | Whisman Station Dr and Minaret Ave | 500 | - | 12 | N | $868,000 |

Notes:
1. Numbering does not represent priority.
2. Total cost includes engineering design, ESDC, construction management and inspection, and contingency.

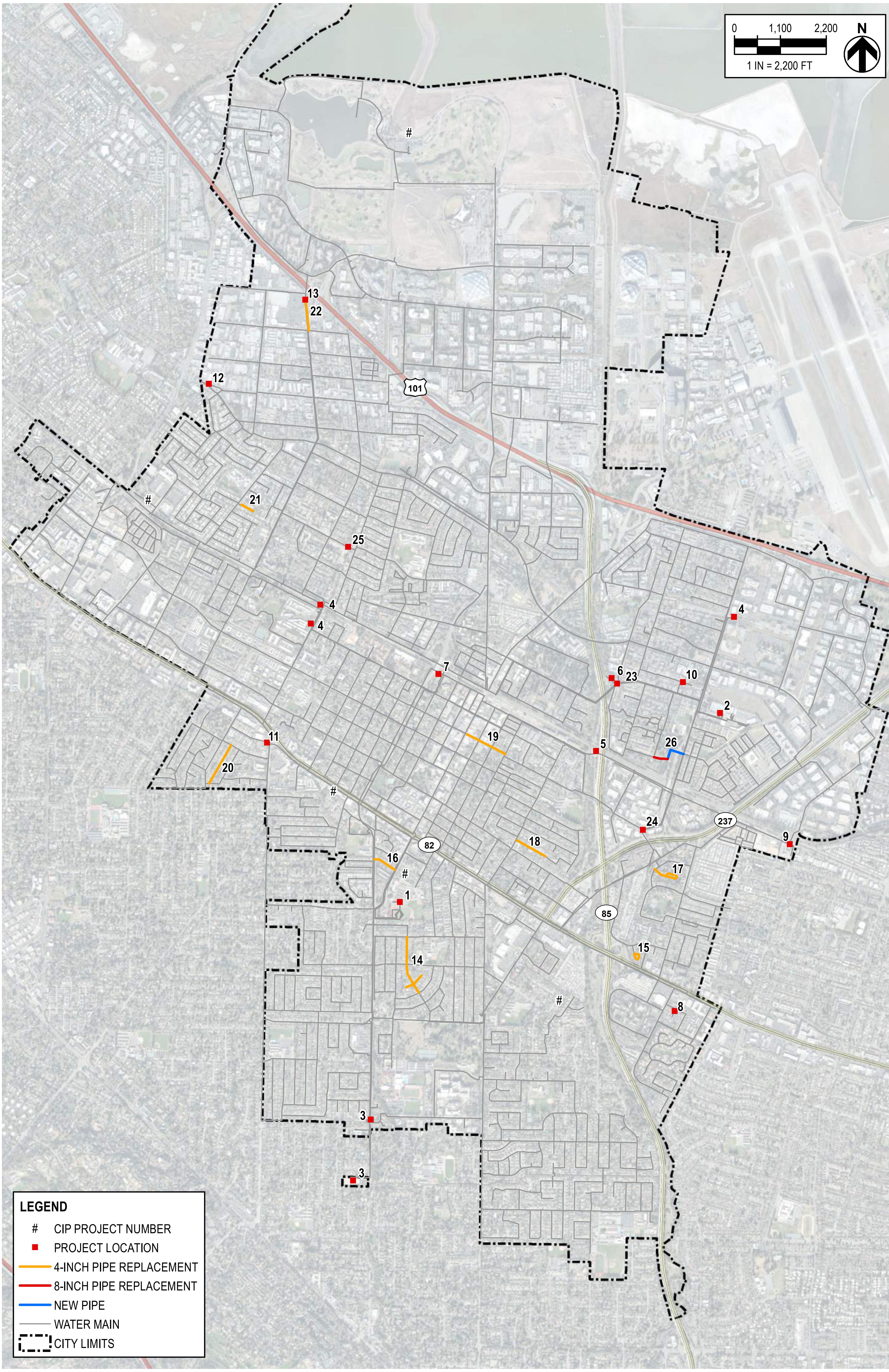



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**FIGURE 9-3**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
PROPOSED CIP PROJECTS

## 9.4 Annual Water Main Replacement

Based on the results of the desktop condition assessment of the distribution pipeline as described in **Section 8.6.2**, five groups have been identified as high priority for pipeline replacement. The highest scoring pipelines within each region have been identified for inclusion up to the nearest intersection or up to tie-ins with low scoring/low priority pipelines. The areas are shown in **Figure 9-4**, listed in **Table 9-11**, and identified in descending order of priority, as follows:

- **Group 1 – Cuesta Park and Old Mountain View:** This area is roughly bounded by Miramonte Ave, El Camino Real, Grant Rd, and Cuesta Dr and is within a severely corrosive area. Pipelines recommended for replacement include 2,800 ft of 4-inch, 6,800 ft of 6-inch, and 4,200 ft of 8-inch. In total, 13,800 ft of CIP of varying sizes to replace. It is assumed, for cost estimating purposes, that all 4- and 6-inch pipeline will be upsized to 8-inches. Sizing would be confirmed during design. The total cost to improve this area is estimated to be $12.9 M in 2022 dollars.
- **Group 2 – Shoreline West:** This area is roughly bounded by Escuela Ave, Central Expressway, SR 85, and El Camino Real and is within a corrosive area. Pipelines recommended for replacement include 700 ft of 4-inch, 4,000 ft of 6-inch CIP, and 5,700 ft of 8-inch CIP. In total, 10,400 ft of CIP of varying sizes to replace. It is assumed, for cost estimating purposes, that all 4- and 6-inch pipeline will be upsized to 8-inches. Sizing would be confirmed during design. The total cost to improve this area is estimated to be $26.0 M in 2022 dollars.
- **Group 3 – Monta Loma:** This area is roughly bounded by Burgoyne St, W Middlefield Rd, San Antonio Rd, and California St and is within a corrosive area. Pipelines recommended for replacement include of 400 ft of 4-inch, 8,200 ft of 6-inch, and 500 ft of 8-inch. In total, 9,200 ft of CIP of varying sizes to replace. It is assumed, for cost estimating purposes, that all of the pipelines will be replaced with new 8-inch pipelines. Sizing would be confirmed during design. The total cost to improve this area is estimated to be $7.3 M in 2022 dollars.
- **Group 4 – North Whisman:** This area is at the eastern end of the City, in an area roughly bounded by Bayshore Freeway, N Whisman Rd, E Middlefield Rd, and SR 85. The pipelines recommended for replacement consist of 700 ft of 4-inch CIP, 1,000 ft of 4-inch DIP, 6 ft of 4-inch PVC, 3,800 ft of 6-inch CIP, and 1,100 ft of 8-inch CIP and is within a corrosive area. In total, 6,600 ft of varying sizes and material to replace. It is assumed, for cost estimating purposes, that all 4- and 6-inch pipeline will be upsized to 8-inches and larger pipelines will be replaced in kind. Sizing would be confirmed during design. The total cost to improve this area is estimated to be $13.8 M in 2022 dollars.
- **Group 5 – 4-inch Mains:** This group considers 4-inch mains located throughout the City that are not included in the 4-inch Main improvement project identified in **Section 9.3.4** and **Figure 9-3**. All 4-inch mains that were constructed along easements and do not appear to have any connected services were also excluded from this selection. Approximately 8,800 feet of 4-inch pipeline of various material is identified in Group 5.

**Table 9-11: Annual Replacement Projects**

| Group | Project ID | Location | Length (ft) | Existing Diameter(s) (in) | New Diameter (in) | Total Cost |
|---|---|---|---|---|---|---|
| 1 | AR PROJECT 1-1 | Nilda Ave, Barbara Ave, Gretel Ln | 3,470 | 4, 6 | 8 | $3,219,000 |
| | AR PROJECT 1-2 | Phyllis Ave, Tyler Park Way | 3,100 | 8 | 8 | $2,870,000 |
| | AR PROJECT 1-3 | Drucilla Dr, Bonita Ave | 3,200 | 4, 6 | 8 | $2,964,000 |
| | AR PROJECT 1-4 | Petie Way, Katie Ct, Phyllis Ct, Pamela Dr, Villa Nueva Ct | 2,180 | 4, 6, 8 | 8 | $2,025,000 |
| | AR PROJECT 1-5 | Begen Ave, Lane Ave, Castro St, Creeden Way | 1,940 | 4, 6 | 8 | $1,798,000 |
| 2 | AR PROJECT 2-1 | W El Camino Real, Pettis Ave | 4,090 | 6, 8 | 8 | $3,792,000 |
| | AR PROJECT 2-2 | California St, Mercy St, Olive Ct | 2,690 | 4, 6 | 8 | $2,491,000 |
| | AR PROJECT 2-3 | Villa St, Lauella Ct | 3,660 | 4, 6, 8 | 8 | $3,393,000 |
| 3 | AR PROJECT 3-1 | Lida Dr, Laura Ln, Montecito Ave, Craig Ct | 1,950 | 4, 6, 8 | 8 | $1,809,000 |
| | AR PROJECT 3-2 | Thaddeus Dr, Emmons Dr, Thompson Ct | 1,410 | 4, 6, 8 | 8 | $1,312,000 |
| | AR PROJECT 3-3 | San Luis Ave, Hackett Ave | 3,300 | 4, 6, 8 | 8 | $3,058,000 |
| 4 | AR PROJECT 4-1 | Walker Dr, Easy St, Keller Dr | 2,670 | 6, 8 | 8 | $2,474,000 |
| | AR PROJECT 4-2 | Walker Dr and N Whisman Rd, Murlagan Ave, Piazza Dr, Tyrella Ave | 2,570 | 6, 8 | 8 | $2,381,000 |
| 5 | AR PROJECT 5 | Multiple locations | 8,050 | 4 | 8 | $7,456,000 |

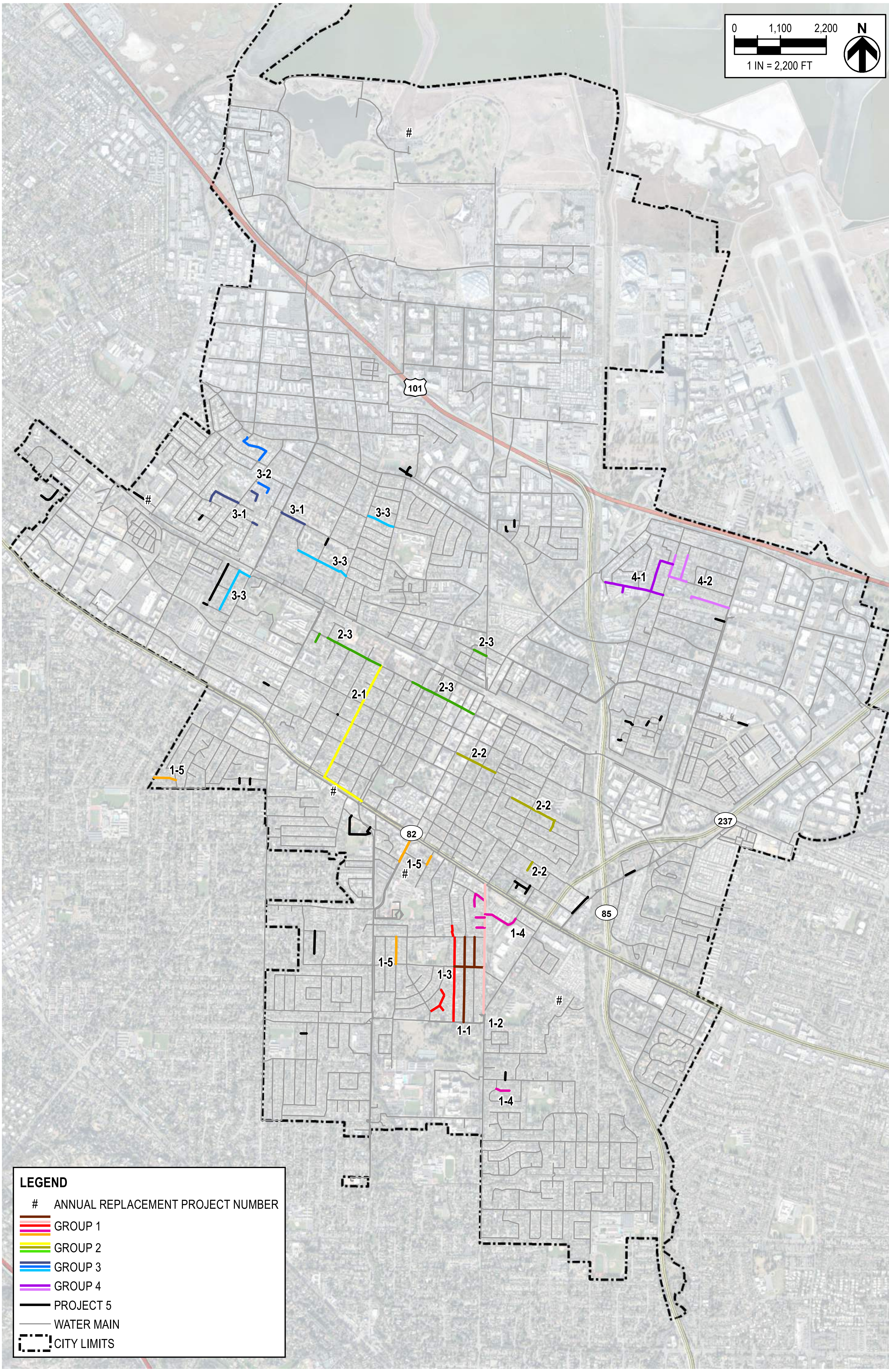


**FIGURE 9-4**
CITY OF MOUNTAIN VIEW
WATER MASTER PLAN
ANNUAL REPLACEMENT PROJECTS

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## 9.5 Proposed Capital Improvement Plan

The Water CIP is primarily funded by the water enterprise fund which includes the user rate structure and connection fees. Provided below is a proposed budget and schedule for the CIP and recommended projects over 20 years. The most critical projects are scheduled for earlier implementation. It is noted that the timing of projects can be adjusted based on operating conditions and available funding. **Table 9-12** presents the proposed improvement projects in 5-year increments.

**Table 9-12: Summary of All Current Projects Sourced from Water Fund**

| Project Type | Years 1-5 FY 21/22-25/26 | Years 6-10 FY 26/27-30/31 | Years 11-15 FY 31/32-35/36 | Years 16-20 FY 36/37-40/41 |
|---|---|---|---|---|
| Discretionary | $7,857,000 | - | - | - |
| Amendments | $3,676,000 | - | - | - |
| Non-Discretionary[1] | $3,862,000 | $4,268,000 | $4,726,000 | $5,226,000 |
| Annual Replacement[2] | $14,555,000 | $16,071,000 | $17,746,000 | $19,592,000 |
| **Proposed Improvements** | | | | |
| Highest Priority | $3,454,000 | | | |
| High Priority | | $8,510,000 | | |
| Medium Priority | | | $5,031,000 | |
| Low Priority | | | | $9,563,000 |
| **Total Proposed Projects** | **$33,404,000** | **$28,849,000** | **$27,503,000** | **$34,381,000** |

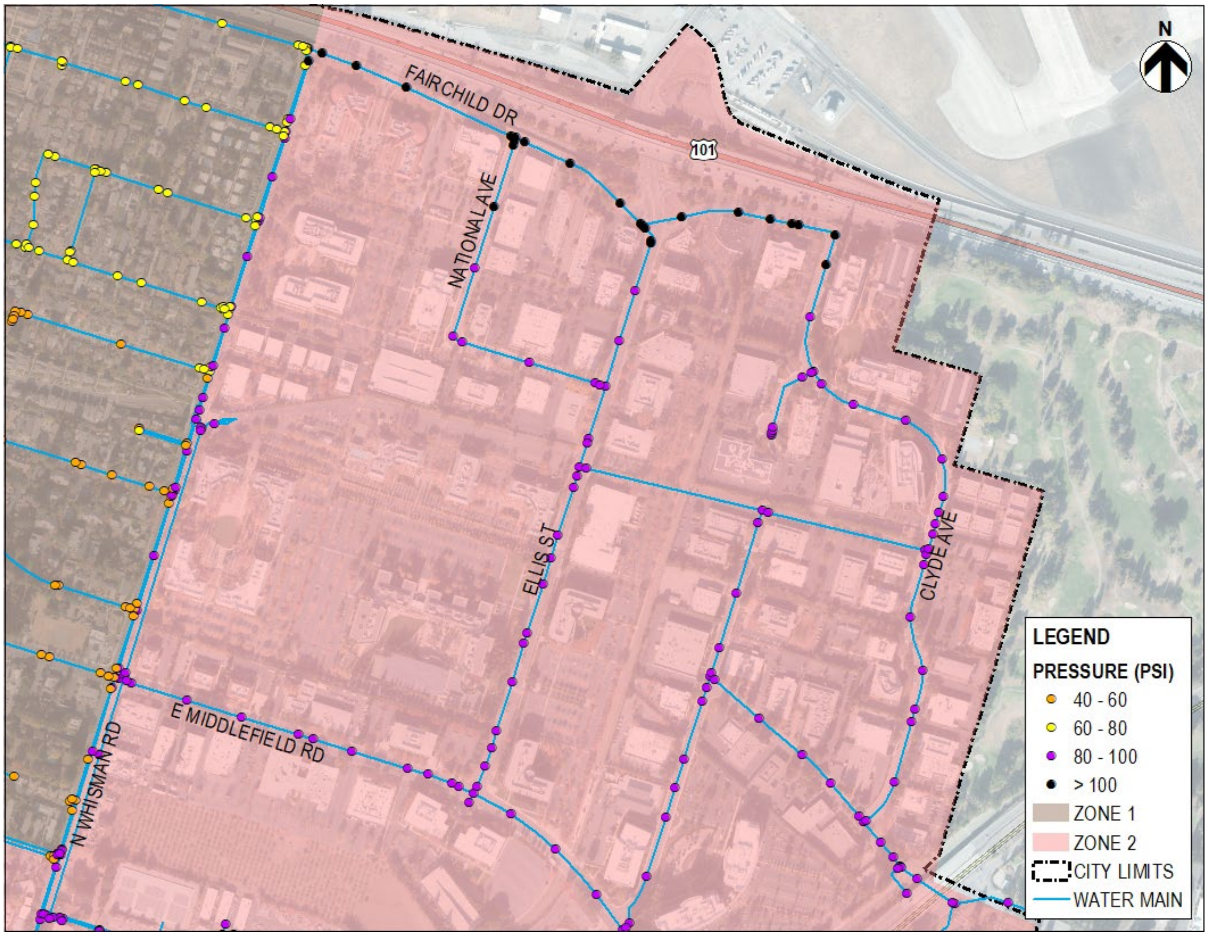
Notes:
1. Non-discretionary project budget is based on existing City non-discretionary projects thru FY25/26. Budget from FY 26/27 thru FY 41/42 is estimated assuming 2% increases annually consistent with adopted budget allocation.
2. Annual replacement budget is based on existing City Project 23-08 thru FY25/26. Budget from FY 26/27 thru FY 41/42 is estimated assuming 2% increases annually consistent with adopted budget allocation.

## 9.6 Other Recommendations

**Residential Dead-Ends:** During MDD+FF conditions, the system exhibited some deficiencies in cul-de-sacs where system dead-ends occur (see **Figure 7-5)**. These deficiencies are typically the result velocity constraints in the pipelines leading to the dead-end. While upsizing the pipelines will resolve the fire flow deficiency, it can result in water quality issues. These areas should be reviewed and considered as part of the City's annual water main replacement program.

**Zone 2 High Pressures:** A small region at the northeastern boundary of Zone 2 along Fairchild Dr near Ellis St, has pressures up to 101 psi (see **Figure 9-5**). Higher pressure pipelines can experience more wear and tear and be subject to greater water losses. Pressure in that area could be managed by installing zone valves along Clyde Ave and Ellis St at the trail right-of-way and incorporating that region into Zone 1.

**Figure 9-5: Zone 2 High Pressures**




**Galvanic Corrosion from Copper Services:** Ductile iron pipe failure due to galvanic corrosion can result from direct coupling to copper services without the use of insulating coupling. As a life extension strategy, anodes are recommended for installation in the water meter boxes for all copper water services that are directly attached to cast iron and ductile iron pipes as a way to mitigate the corrosive effects of a galvanic corrosion cell. It is recommended that these couplings be identified for anode installation. Anodes should be installed with new installations where copper services will be tapped into known metallic water mains. It is also recommended that the City incorporate anode installation for existing couplings as the opportunity arises, for example while servicing or replacing water meters. See **Figure 8-5** for locations of copper services connected to metallic water mains.

**Pipelines with Unknown Material:** There is approximately 42,958 feet of pipeline with unknown material (see **Figure 3-5**), which the City can reconcile using data mining through as-builts or tracking during existing projects that coincide with the identified pipes.

## 9.7 Funding for CIP Projects

The City uses enterprise funds to account for City operations that are financed and operated like private business enterprises. The City's enterprise utility funds are fully funded by the rates charged to customers; there is no General Fund support to the utility funds. Use of this type of fund permits user charges, including water rates, recycled water rates, meter fees, and connection fees, to finance or recover the cost of providing the City's services to customers on a continuing basis. The Water fund accounts for activities associated with providing water services including construction and maintenance of the water distribution systems. A separate reserve is used to account for the capacity and development impact fees collected to fund capital projects. A general reserve is used for emergencies, contingencies and rate stabilization. Provided is a description of various funds that are conditionally available for project funding:

- **Water Revenue Fund –** Restricted to operation and maintenance of all facilities required to supply, distribute, and meter potable and recycled water. This is a dedicated fund supported by water service charges.
- **CIP Reserve –** General Fund surpluses as approved by the City Council and a portion of lease revenues. There are no restrictions on the type or location of projects to be funded.
- **Construction and Conveyance Tax –** Revenues derived from construction and real property conveyance fees. Expenses are restricted to implementation of the CIP, including servicing bonds issued in connection with capital improvements; however, there are no restrictions on the type or location of projects.
- **Shoreline Regional Park Community Fund –** The State Legislature created the Shoreline Regional Park Community (Shoreline Community or SRPC). Tax increment derived on the difference between the frozen base year value and the current fiscal year
- assessed value and other revenues generated from the activities of the Shoreline Community are to be utilized to develop and support the Shoreline Community and surrounding North Bayshore Area. In addition to annual operations and maintenance expenses, the SRPC is used for various types of capital projects, including utility (water, sewer, storm drain) improvements, to support the North Bayshore Area:
- **Development Fees and Charges**
  - Impact Fees: For water infrastructure, uses are restricted to projects/improvements identified in the Shoreline Community Development Impact Fee—Water nexus study.
  - Utility Capacity Charges: Used for new or upsized water and sewer utility mains to meet growing service demands Citywide.
  - Community and Public Benefit Funds: A developer may be required by Council under certain conditions to provide community or public benefits, such as area improvements or affordable housing, as a result of their development project. A developer may pay a fee in lieu of providing these community or public benefits which will then be used by the City to provide capital improvements in the general area of the development as approved by the City Council.
- **Equipment Maintenance and Replacement Fund:** The purpose of this fund is to account for centralized fleet maintenance costs and to charge a proportionate share to all funds utilizing maintenance services. In addition, this fund accounts for certain equipment replacement requirements of the City.

Other funding sources may include grant and loan programs for both water system reliability and improvements, as well as recycled water projects. Funding may be in the form of grants or loans. Notable programs that the City may qualify for include:

- **California Department of Water Resources (DWR)**
  - *Sustainable Groundwater Management Implementation Grant Program:* Competitive grants to support implementation of local and regional groundwater projects required to support sustainable groundwater management. Eligible applicants will be Groundwater Sustainability Agencies (GSAs); member agencies of GSAs; an entity that represents a GSA(s) which can include public agencies, or mutual water companies; and agencies with an approved alternative plan. Eligible projects may include activities or tasks that include the development of groundwater recharge projects with surface water, stormwater, recycled water, and other conjunctive use projects, or projects that prevent or clean up contamination of groundwater that serves as a source of drinking water. Other eligible project types are projects and programs that support water supply reliability, water conservation, and water use efficiency and water banking, exchange, and reclamation. Round 2 funding is available to medium- or high-priority basins. Round 2 solicitation is expected to be advertised in October 2022 and awarded summer 2023.
  - *Water Use Efficiency CalConserve Revolving Fund Loan Program:* This program provides loans to local agencies to provide low-interest loans to customers for water use efficiency upgrades and for onsite improvements to repair or replace leaking pipes. Loan recipient agencies would then offer customer low-interest or no-interest loans. Loan financing would remove first-cost barriers to efficiency upgrades.
- **California Infrastructure and Economic Development Bank**
  - *Public Agency Revenue Bonds:* Bond financings for various state and local government agencies for various public or economic development projects.
  - *Infrastructure State Revolving Fund Program (ISRF):* The ISRF Program provides direct loan financing to public agencies and nonprofit corporations sponsored by public agencies, for a wide variety of infrastructure and economic development projects. ISRF financing is available in amounts ranging from $50,000 to $25 million with loan terms for the useful life of the project up to a maximum of 30 years. Eligible ISRF applicants include any subdivision of a local government, including cities, counties, special districts, assessment districts, joint powers authorities, and eligible nonprofit corporations.
  - *California Lending for Energy and Environmental Needs (CLEEN) Center:* The CLEEN Center provides direct loan financing to public agencies to help meet the State's goals for greenhouse gas reduction, water conservation, and environmental preservation. Financing can be in amounts from $500 thousand to $30 million.
- **California Governor's Office of Emergency Services (Cal OES)**
  - *Building Resilient Infrastructure and Communities (BRICs):* BRIC implements a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding in future disasters. Eligible subapplicants with projects that mitigate risk to public infrastructure, include innovative partnerships, mitigate risk to one or more lifelines, incorporate nature-based solutions, or incentivize adoption and enforcement of modern building codes are especially encouraged to apply.

- **State Water Resources Control Board**
  - *Drinking Water State Revolving Fund:* This program provides low-interest loans and grants for planning and construction projects that support public water systems in meeting compliance with drinking water standards. Eligible projects include planning/design and construction of drinking water infrastructure projects including: consolidation; water meters; water storage; treatment systems; replacement of aged water transmission or distribution mains, groundwater wells, or other infrastructure; private services; interconnections; pipeline extensions.
  - *Water Recycling Funding Program:* This program promotes use of treated municipal wastewater to augment or offset State/local fresh water supplies. Eligible projects include recycled water treatment; recycled water storage, distribution, and pumping; groundwater recharge; indirect potable reuse; and surface water augmentation.
- **United States Bureau of Reclamation (USBR)**
  - *Sustain and Manage America's Resources for Tomorrow (WaterSMART):* The USBR sponsors a number of funding opportunities through the WaterSMART program including projects that address water and energy efficiency, drought response, water recycling (Title XVI), water marketing, water conservation, desalination, and water resources. Projects are selected through a competitive process and the focus is on projects that can be completed within two or three years. Funding opportunities and cycles can be found on the USBR WaterSMART website at https://www.usbr.gov/watersmart/.

The scope of the project will dictate funding qualification. As projects are defined, an inquiry can be submitted to the California Financing Coordinating Committee to determine program qualification. **Appendix F** includes a copy of the Common Inquiry Form. Additionally, the California State Library has created the *California Grants Portal*, a website (www.grants.ca.gov/) that provides a centralized location to find State grant opportunities. Grant seekers are now able to see all current grant and loan opportunities that are offered on a competitive or first-come basis and can search and filter their results.

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## SECTION 10 – REFERENCES

Provided are a list of sources used in the development of the Master Plan. These documents are incorporated herein by reference.

*American Water Works Association, Manual of Water Supply Practices M32: Computer Modeling of Water Distribution Systems*

*American Water Works Association, Manual of Water Supply Practices M31: Distribution System Requirements for Fire Protection*

*California Code of Regulations Titles 22 and 24*

*California Water Service Company, 2020 Urban Water Management Plan – Los Altos Suburban District, June 2021*

*City of Mountain View, 2010 Water System Master Plan, August 2010*

*City of Mountain View, 2020 Urban Water Management Plan, June 8, 2021*

*City of Mountain View, California Operating Budget Fiscal Year 2022-23, June 14, 2022*

*City of Mountain View, Capital Improvement Program Adopted FY 2021-22, Planned FY 2022-23 through 2025-26, Adopted June 22, 2021*

*City of Mountain View, Mountain View 2030 General Plan, Adopted July 10, 2012*

*City of Mountain View, Recycled Water Feasibility Study, March 2014*

*City of Mountain View, Recycled Water Feasibility Study, March 2022*

*City of Mountain View, Seismic Vulnerability Assessment, July 23, 2007*

*City of Mountain View, Water Loss Audit Reports, 2016-2020*

*HydroScience Engineers, TM #1 Distribution System Model Calibration Plan, October 20, 2020*

*HydroScience Engineers, TM #2 Water and Sewer System Modeling Software Evaluation, October 23, 2020*

*HydroScience Engineers, TM #3 Water and Sewer Basic Assumptions and Criteria, January 7, 2021*

*HydroScience Engineers, TM #4 Water and Sewer Hydraulic Model Data, September 24, 2021*

*Maddaus Water Management, Inc., Demand Side Management Least Cost Planning Decision Support System Model (DSS Model), 2017 Update*

*Water Supply Agreement between the City and County of San Francisco and Wholesale Customers in Alameda County, San Mateo County and Santa Clara County, July, 2009*

*Individual Supply Agreement between the City and County of San Francisco and Wholesale Customers in Alameda County, San Mateo County and Santa Clara County, July, 2009*

*Water Supply Contract between the City of Mountain View and Valley Water, 1984*

**APPENDIX A**

City of Mountain View

Water Master Plan

2022 City of Mountain View Citywide Soil Corrosivity Survey & Corrosion Control Evaluation Draft Report

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**APPENDIX B**

City of Mountain View

Water Master Plan

Hydraulic Model EPS Results

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**APPENDIX C**

City of Mountain View

Water Master Plan

Storage and Supply Tool Inputs and Outputs

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**APPENDIX D**

City of Mountain View
Water Master Plan
Facility Inspection Forms

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## APPENDIX E

City of Mountain View
Water Master Plan
Cost Estimates

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**APPENDIX F**
City of Mountain View
Water Master Plan
Common Inquiry Form

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