Appendix F

Utilities and Service Systems Information

Milpitas Metro Specific Plan Water Supply Assessment

FINAL REPORT | NOVEMBER 2021

Milpitas Metro Specific Plan
Water Supply Assessment

PREPARED FOR

City of Milpitas

PREPARED BY

WEST YOST
Water. Engineered.

Milpitas Metro Specific Plan
Water Supply Assessment

Prepared for

City of Milpitas

Project No. 977-60-21-01



Project Manager: Elizabeth Drayer, PE	November 2, 2021 Date
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FINAL REPORT | NOVEMBER 2021

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LIST OF ACRONYMS AND ABBREVIATIONS

2021 WMP	2021 Water Master Plan
AF	Acre-feet
AFY	Acre-feet Per Year
BART	Bay Area Rapid Transit
BAWSCA	Bay Area Water Supply and Conservation Agency
City	City of Milpitas
CVP	Central Valley Project
CWC	California Water Code

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Delta	Sacramento-San Joaquin Delta
DSS Model	Decision Support System Demand Model
DWR	California Department of Water Resources
EIR	Environmental Impact Report
ETo	Evapotranspiration
FERC	Federal Energy Regulatory Commission
GMP	Groundwater Management Plan
gpcd	Gallons Per Capita Per Day
gpd	Gallons Per Day
gsf	Gross Square Feet
HTWTP	Harry Tracy Water Treatment Plant
ISG	Individual Supply Guarantee
MG	Million Gallons
MGSP	Milpitas Gateway-Main Street Specific Plan
MGY	Million Gallons per Year
MID	Modesto Irrigation District
Proposed Project	Milpitas Metro Specific Plan
R&D	Research and Development
RWS	SFPUC Regional Water System
SB	Senate Bill
SBWR	South Bay Water Recycling
sf	Square Feet
SFPUC	San Francisco Public Utilities Commission
SGMA	Sustainable Groundwater Management Act
SVAWPC	Silicon Valley Advanced Water Purification Center
SVWTP	Sunol Valley Water Treatment Plant
SWP	State Water Project
SWRCB	State Water Resources Control Board
TID	Turlock Irrigation District
USEPA	United States Environmental Protection Agency
UWMP	Urban Water Management Plan
VTA	Santa Clara Valley Transit Authority
WQC	Water Quality Certification
WSA	Water Supply Assessment
WSAP	Water Shortage Allocation Plan
WSCP	Water Shortage Contingency Plan
WSIP	Water System Improvement Plan
WTP	Water Treatment Plant
WUF	Water Use Factor

EXECUTIVE SUMMARY

Overview

West Yost has prepared this Water Supply Assessment (WSA) for the City of Milpitas (City) in accordance with California Water Code (CWC) sections 10910 through 10915 and in connection with the proposed Milpitas Metro Specific Plan (Proposed Project). This WSA has been prepared using information on the City's available water supplies and projected water demands as documented in the City's 2020 Urban Water Management Plan (UWMP) and the City's 2021 Water Master Plan (2021 WMP). Information on the Proposed Project has been provided by Urban Field Studio and M-Group, the planning consultants responsible for the development of the Milpitas Metro Specific Plan.

The Proposed Project is located in the southern portion of the City, directly adjacent to City limits. Currently an industrial district, the Proposed Project area encompasses an approximately 3/4-mile radius centered around the City's Transit Center, which is located at the intersection of Montague Expressway and Capitol Avenue. The Proposed Project area was previously included in the City's 2008 Transit Area Specific Plan (TASP) which planned for 7,577 residential units, 2,240,000 square feet of retail space, and 1,050,000 square feet of office space to be built by 2020. Over the last 12 years, much of the TASP vision has become a reality, including the newly opened BART station and VTA Transit Center, new housing, parks, a grocery store, and other shops under development. By 2019, 92 percent of the planned residential units were under development.

As the area neared residential capacity as planned for in the TASP, the City began the process to update the Specific Plan governing development in the area. The plan area boundaries were adjusted to include a research and development subdistrict adjacent to Highway 680 (referred to as the Innovation District) and opportunities for additional housing development along Main Street. The area was renamed "Milpitas Metro" to reflect its vibrancy, urban nature, and excellent transit connections.

The Proposed Project, to be developed over the next 20 years, includes 7,000 units of new, multi-family residential development (approximately 14,000 new residents) located near transit that maximizes transit ridership and creates a vibrant residential community. New non-residential development in the Proposed Project area is expected to include office, retail, research and development (R&D), light manufacturing, and hotel uses. These uses are concentrated in the Great Mall subdistrict and the Innovation District, with the greatest amount of retail and commercial development occurring along Great Mall Parkway and Montague Expressway and office development being concentrated along Montague Expressway and South Milpitas Boulevard. R&D and light manufacturing will be concentrated in the Innovation District on the east side of the Proposed Project area. The Proposed Project is expected to create approximately 12,284 new jobs, stemming from approximately 3,000,000 square feet (sf) of office space, 300,000 sf of retail space, and 700 hotel rooms.

Projected Water Demands

Consistent with policies established in the 2008 TASP, the Proposed Project will be served with potable water for domestic uses and recycled water for landscape irrigation uses.

Potable water demand for the Proposed Project was estimated using proposed development information from M-Group and water use factors (WUF) developed for similar projects and locations. A WUF is defined as the estimated water use per unit of a given land use type. WUFs in this WSA are presented in gallons per day (gpd) per dwelling unit (du, for residential land uses), sf (for office and retail land uses), or room (for hotels).

The estimated potable water demand for the Proposed Project is approximately 500 million gallons per year (MGY). Actual potable demands for the Proposed Project may be lower, because WUFs were developed from existing water users that may have less efficient plumbing fixtures than what will be provided for the Proposed Project. Newer developments like the Proposed Project are required to have ultra-low flow plumbing fixtures and encouraged to incorporate water collection and retention devices (e.g., rain barrels) into building design to allow for water reuse.

Recycled water will be provided for landscape irrigation purposes within the Proposed Project area. The estimated recycled water demand for the Proposed Project is approximately 53 MGY. The City purchases recycled water from South Bay Water Recycling (SBWR) and operates and maintains the recycled water distribution facilities within City boundaries. For parcels that do not have current access to a recycled water main, a recycled water main will be required to be installed up to and across the frontage of the parcel. The cost of extending the main, not including the length across the frontage, will be funded using the development impact fees to be collected. It is anticipated that adequate recycled water supplies will be available to meet the landscape irrigation demands within the Proposed Project area.

While projected water demands for the Proposed Project were not specifically identified in the City's 2020 UWMP, the City's 2020 UWMP references the Proposed Project in the City's future land use projections, and future projected water connections associated with the Proposed Project were incorporated into the Decision Support System Model (DSS Model) used to project the City's future water demands. Therefore, the City's 2020 UWMP does include the Proposed Project in its water demand projections.

Water Supply Availability and Reliability

As discussed in this WSA, the City purchases all its potable water supplies from the San Francisco Public Utilities Commission (SFPUC) and Valley Water. In emergencies, the City can also pump groundwater, but groundwater is not part of the City's active water supply portfolio. Therefore, the availability and reliability of the City's water supply is largely dependent on its water supply contracts with the SFPUC and Valley Water and their respective water supply reliability, which is detailed in each agency's 2020 UWMP.

SFPUC Regional Water System Reliability

The Bay Area Water Supply and Conservation Agency (BAWSCA) represents the SFPUC's 26 Wholesale Customers (including the City). In February 2015, BAWSCA published the Long-Term Reliable Water Supply Strategy Phase II Final Report (Phase II Final Report), which quantifies the water supply reliability needs of its member agencies through 2040 and identifies water management actions that could be developed to meet those needs. BAWSCA is currently implementing the strategy recommendations from the Phase II Final Report in coordination with its member agencies.

The SFPUC is improving the reliability of its Regional Water System (RWS) by implementing the Water System Improvement Plan (WSIP) and Alternative Water Supply Program. The WSIP is forecast to be completed in December 2021 and aims to meet customer water needs in non-drought and drought conditions through defined projects that improve seismic, delivery, water quality, and water supply reliability for the RWS. In contrast, the Alternative Water Supply Program is in its early planning stages and is intended to meet future water supply challenges and vulnerabilities such as environmental flow needs and other regulatory changes; earthquakes, disasters, and emergencies; increases in population and employment; and climate change.

One major factor in RWS supply reliability is an amendment to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan Amendment), which was adopted by the State Water Resources Control Board (SWRCB) in December 2018. The adopted Bay-Delta Plan Amendment was developed with the stated goal of increasing salmonid populations in three San Joaquin River tributaries (the Stanislaus, Merced, and Tuolumne Rivers) and the Bay-Delta. Actual implementation details of the Bay-Delta Plan Amendment (as adopted by the SWRCB) remain uncertain, but its requirements would mean that the SFPUC could only meet the projected water demands presented in its 2020 UWMP in normal hydrologic years and not in single dry years or multiple dry years.

Procedures to allocate RWS supplies during SFPUC system shortages are specified in agreements between the SFPUC and the Wholesale Customers. In 2019, the Wholesale Customers and the SFPUC adopted the November 2018 Amended and Restated Water Supply Agreement, which included a Water Shortage Allocation Plan (WSAP) to allocate RWS water to retail and wholesale customers during system-wide shortages of 20 percent or less. For water shortages greater than 20 percent, the SFPUC will meet with the Wholesale Customers to determine if an allocation methodology can be agreed upon by the SFPUC and the Wholesale Customers.

Valley Water Reliability

Valley Water maintains diverse water supply sources to meet demands in Santa Clara County, including groundwater recharge, local surface water, imported water from State and federal projects, and recycled/purified water. While the City's supplies from Valley Water consist exclusively of imported water from the State Water Project and Central Valley Project, the reliability of Valley Water's overall supply portfolio remains relevant. For example, if Valley Water's groundwater supply reliability decreased significantly, it would strain Valley Water's remaining supplies, including imported water.

Valley Water's supplies are constrained by hydrologic variability, with other constraints specific to each source. Imported water is conveyed through the Sacramento-San Joaquin Delta (Delta), which is threatened by levee failures, sea level rise, climate change, and declining populations of protected fish species. Natural recharge is insufficient to meet Valley Water's groundwater demands, so Valley Water's managed recharge program is critical to maintaining groundwater supply. Groundwater quality, specifically nitrate, is also a concern. Lastly, Valley Water's local surface water supplies are vulnerable to regulatory requirements, including reservoir operating rules and supporting instream flow needs.

City of Milpitas Water Supply Reliability

The City's 2020 UWMP assumes the Bay-Delta Plan Amendment is implemented, which significantly reduces SFPUC supplies during dry years. Furthermore, supplies from Valley Water may have drought shortages of up to 20 percent in the future if some of Valley Water's Water Supply Master Plan 2040 (WSMP) projects are not implemented, or provide less benefits than expected, and imported supplies are reduced by 25 percent or severe allocation cuts occur during droughts as have been experienced during

this drought and the previous drought. As a result, the City's 2020 UWMP assumes three groundwater wells (each pumping at 1.2 million gallons per day) will be online by 2030, with a fourth online by 2035. These new groundwater wells are triggered by future development projected in the City's service area and shall be funded through associated development impact fees. It should also be noted that the City's 2021 WMP identifies infrastructure improvements needed to serve proposed new development within the City's service area. These include supply (e.g., a new Valley Water turnout) and storage capacity improvements that are also triggered by future development projected in the City's service area and shall be funded through associated development impact fees.

During normal hydrologic years the City's water supplies can meet projected demands (including demands for the Proposed Project) through 2045. During a single dry year in 2025 or a five-year drought starting in 2025, City supplies are insufficient to meet projected demands. As described in Sections 7 and 8 of this WSA and Chapter 7 of the City's 2020 UWMP, supply shortfalls in prolonged droughts will either require significant measures to be implemented to reduce water use, as outlined in the City's 2020 Water Shortage Contingency Plan (WSCP) (included in Chapter 8 of the City's 2020 UWMP), or the City may supplement some or most of the supply shortfall through groundwater pumping. Once the City's groundwater wells come online (assumed in 2030), and assuming that the wells produce sufficient flow while meeting water quality standards, the City's dry year supplies can better meet projected demands in single dry and multiple dry years. There are small supply shortfalls starting in the third year of a five-year drought starting in 2030 and the fourth year of a five-year drought starting in 2045. To address these supply shortfalls, the City expects to implement its WSCP and reduce water demands as needed.

Pursuant to CWC section 10910(c)(4) and based on the technical analyses described in this WSA, the City finds that the total projected water supplies determined to be available for the Proposed Project during a 20-year projection will meet the projected water demand associated with the Proposed Project, in addition to existing and planned future uses.

1.0 INTRODUCTION

The City of Milpitas Metro Specific Plan (Proposed Project) seeks to transform approximately 400 acres of an industrial district into a transit-oriented community. Located in the southern portion of the City of Milpitas (City) surrounding the Milpitas Bay Area Rapid Transit (BART) and Santa Clara Valley Transit Authority (VTA) light rail stations, the Proposed Project consists of approximately 7,000 dwelling units, 3,000,000 gross square feet (gsf) of office space, 300,000 gsf or retail space, and 700 hotel rooms.

This Water Supply Assessment (WSA) supports the Environmental Impact Report (EIR) for the Proposed Project. The following sections describe the legal requirement for the WSA and the Proposed Project background.

1.1 Legal Requirement for a Water Supply Assessment

California Senate Bill 610 (SB 610) and Senate Bill 221 (SB 221) amended state law, effective January 1, 2002, to improve the link between information on water supply availability and certain land use decisions made by cities and counties. SB 610 and SB 221 were companion measures which sought to promote more collaborative planning between local water suppliers and cities and counties. Both statutes require detailed information regarding water availability to be provided to city and county decision-makers prior to approval of specified large development projects. The purpose of this coordination is to ensure that prudent water supply planning has been conducted, and that planned water supplies are adequate to meet existing demands, anticipated demands from approved projects and tentative maps, and the demands of proposed projects.

SB 610 amended California Water Code (CWC) sections 10910 through 10915 (inclusive) to require land use lead agencies to:

- Identify any public water purveyor that may supply water for a proposed development project
- Request a WSA from the identified water purveyor

The purpose of the WSA is to demonstrate the sufficiency of the purveyor's water supplies to satisfy the water demands of the proposed project, while still meeting the water purveyor's existing and planned future uses. CWC sections 10910 through 10915 delineate the specific information that must be included in the WSA.

SB 221 amended State law (California Government Code Section 66473.7) to require that approval by a city or county of certain residential subdivisions[1] requires an affirmative written verification of sufficient water supply. SB 221 was intended as a fail-safe mechanism to ensure that collaboration on finding the needed water supplies to serve a new large residential subdivision occurs before construction begins.

[1] Per California Government Code Section 66473.7(a)(1), subdivision means a proposed residential development of more than 500 dwelling units.

1.2 Need for and Purpose of Water Supply Assessment

The purpose of this WSA is to perform the evaluation required by SB 610 (CWC sections 10910 through 10915) in connection with the Proposed Project. This WSA does not reserve water, or to function as a "will serve" letter or any other form of commitment to supply water (see CWC section 10914), nor is it intended to meet the requirements of SB 221. The provision of water service will continue to be undertaken in a manner consistent with applicable City policies and procedures, consistent with existing law.

This WSA for the Proposed Project has been prepared by West Yost, as requested by the City, the responsible water purveyor for the Proposed Project.

1.3 Water Supply Assessment Preparation, Format, and Organization

The format of this WSA is intended to follow CWC sections 10910 through 10915 to clearly delineate compliance with the specific requirements for a WSA. This WSA includes the following sections:

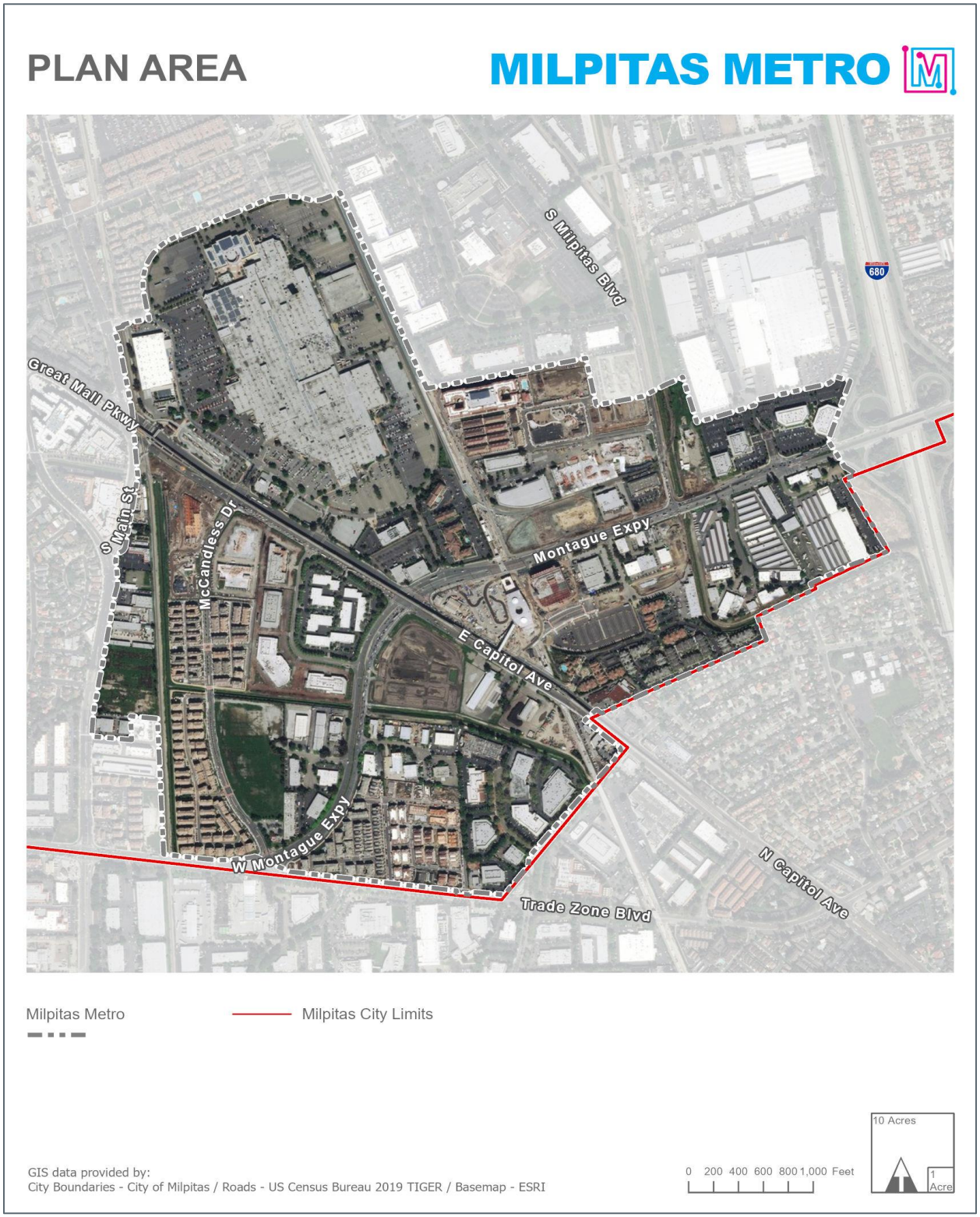
Section 1: Introduction
Section 2: Description of the Proposed Project
Section 3: Required Determinations
Section 4: City of Milpitas Municipal Water System
Section 5: City of Milpitas Municipal Water Demands
Section 6: City of Milpitas Municipal Water Supplies
Section 7: Water Supply Reliability
Section 8: Determination of Water Supply Sufficiency Based on the Requirements of SB 610
Section 9: Water Supply Assessment Approval Process
Section 10: References

Relevant citations of CWC sections 10910 through 10915 are included throughout this WSA to demonstrate compliance with the specific requirements of SB 610.

1.4 Proposed Project Location and Overview

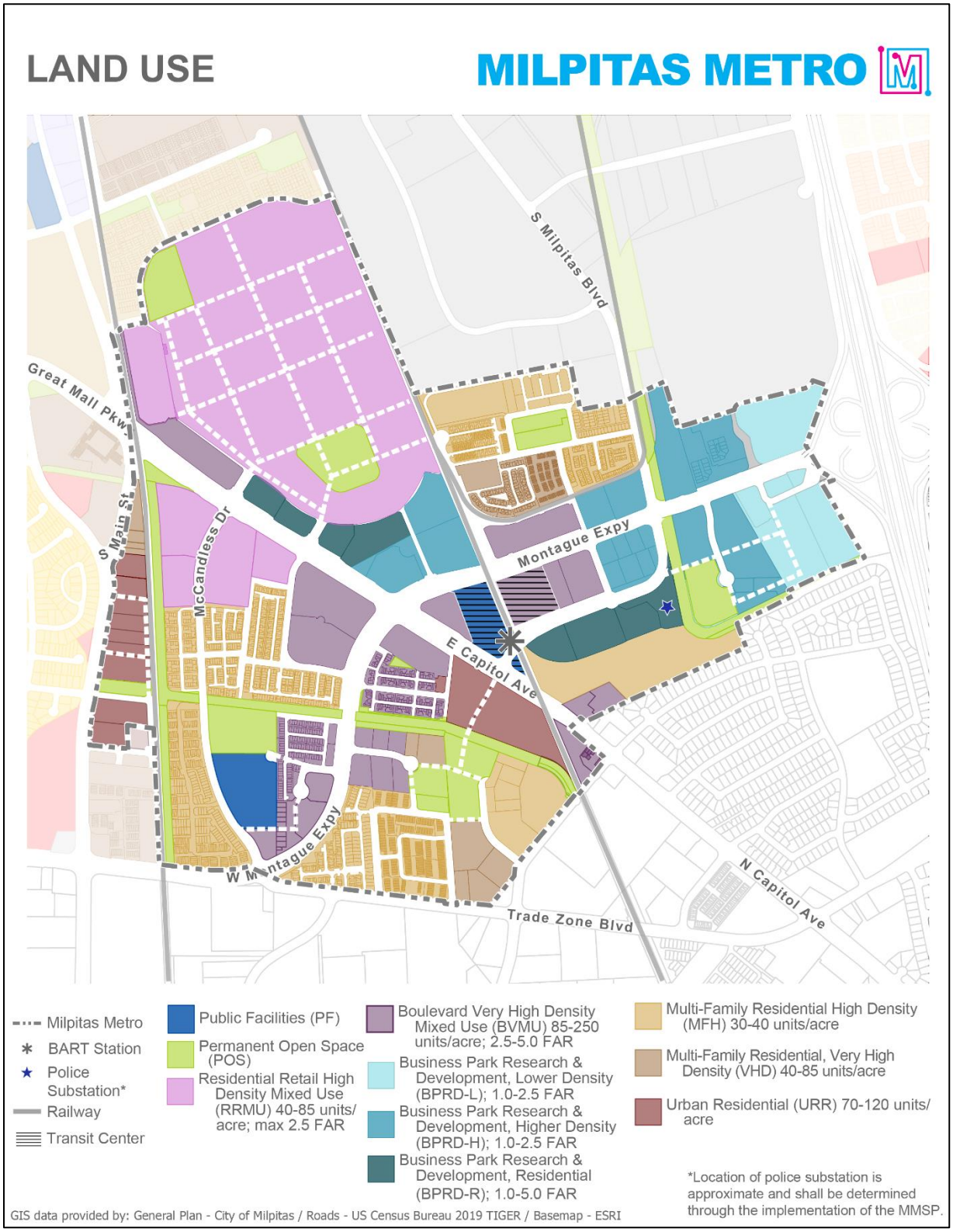
The Proposed Project is located in the southern portion of the City, directly adjacent to City limits. Currently an industrial district, the Proposed Project area encompasses an approximately 3/4-mile radius centered around the City's Transit Center, which is located at the intersection of Montague Expressway and Capitol Avenue. Figure 1-1 shows the Proposed Project site.

The Proposed Project seeks to create a vibrant mix lifestyle retail, high-density housing, and/or offices along the major streets of Great Mall Parkway, Montague Expressway, and East Capitol Avenue. Near the Transit Center, the Proposed Project will have high- to very high-density housing and/or high-intensity office and employment uses. Figure 1-2 presents the land uses for the Proposed Project, and Figure 1-3 presents the five subdistricts, each with its own character based on the allocated mix of land uses and development densities, parks placement, street grid, pedestrian connections, and proximity to the BART station.



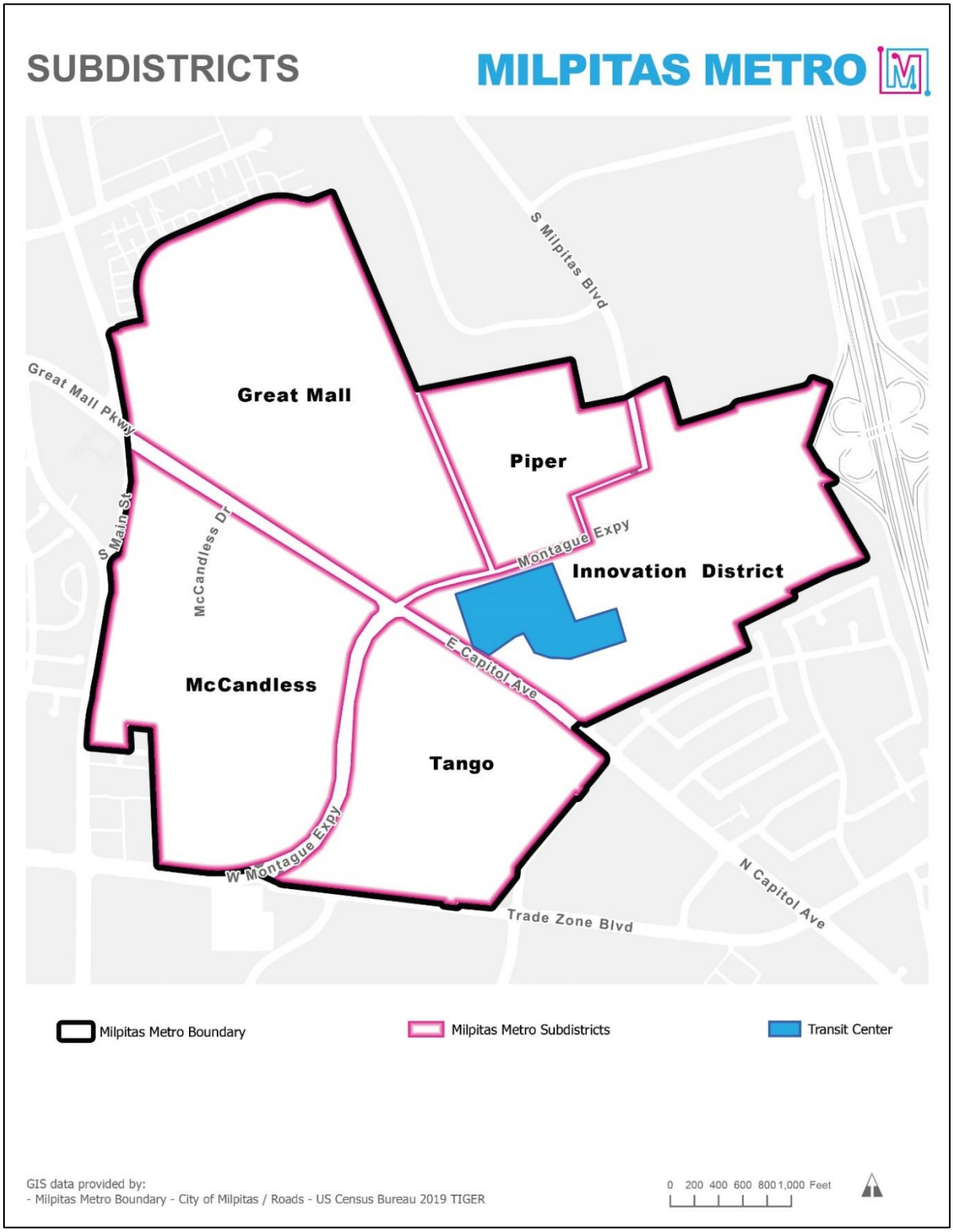
Source: Figure 2.1-2, Milpitas Metro Specific Project Description, prepared by Urban Field Studio, dated April 2021.

Figure 1-1. Proposed Project Location



Source: M-Group (October 2021)

Figure 1-2. Proposed Project Land Use



Source: M-Group (October 2021)

Figure 1-3. Proposed Project Subdistricts

2.0 DESCRIPTION OF THE PROPOSED PROJECT

The following sections describe the Proposed Project, including its location, proposed land uses, and projected water demand.

2.1 Project Description and Proposed Land Uses

In the late 2000's, the Milpitas Metro area was largely an industrial area characterized by wide, fast-moving arterial streets, rail crossings, culverted streams, and the presence of the Great Mall, a regional shopping center located in a former Ford manufacturing plant. An opportunity for change was envisioned, catalyzed by major transit connections through the VTA light rail and planned BART station, along with the on-going growth of Silicon Valley and the broader Bay Area. The Transit Area Specific Plan (TASP) was developed in 2008 and planned for 7,577 residential units, 2,240,000 square feet of retail space, and 1,050,000 square feet of office space to be built by 2020.

Over the last 12 years, much of the TASP vision has become a reality, including the newly opened BART station and VTA Transit Center, new housing, parks, a grocery store, and other shops under development. By 2019, 92 percent of the planned residential units were under development.

As the area neared residential capacity as planned for in the TASP, the City began the process to update the Specific Plan governing development in the area. The plan area boundaries were adjusted to include a research and development subdistrict adjacent to Highway 680 (referred to as the Innovation District) and opportunities for additional housing development along Main Street. The area was renamed "Milpitas Metro" to reflect its vibrancy, urban nature, and excellent transit connections.

The Proposed Project, to be developed over the next 20 years, assumes 7,000 units of new residential development, all of which will be in multi-family structures, with approximately 14,000 new residents, with a high level of residential density near transit that maximizes transit ridership and creates a vibrant residential community. New non-residential development in the Proposed Project area is expected to include office, retail, research and development (R&D), light manufacturing, and hotel uses. These uses are concentrated in the Great Mall subdistrict and the Innovation District, with the greatest amount of retail and commercial development occurring along Great Mall Parkway and Montague Expressway and office development being concentrated along Montague Expressway and South Milpitas Boulevard. Hotels are expected to add approximately 700 rooms. R&D and light manufacturing will be concentrated in the Innovation District on the east side of the Proposed Project area.

The Proposed Project is expected to create approximately 12,284 new jobs, stemming from approximately 3,000,000 square feet (sf) of office space, 300,000 sf of retail space, and 700 hotel rooms. Of the 3,000,000 sf of anticipated office space, 2,500,000 sf is projected to be accommodated in the Innovation District. Within the Innovation District, 20 percent of this space is expected to be developed for industrial uses, and 80 percent will be developed for office uses.

It should be noted that the estimate of new jobs does not reflect the number of jobs lost by the demolition of existing buildings for new development. The Proposed Project area currently consists of predominantly residential, mixed-use, and commercial uses. There are 63.5 acres of industrial, light industrial, and research and development (R&D) uses. The Proposed Project would redevelop approximately 23.6 acres of industrial and R&D land uses into residential uses and an additional 24 acres of industrial into office space and is expected to displace approximately 952 existing industrial jobs. However, the redevelopment

of the Innovation District is expected to generate 1,111 industrial jobs, resulting in a net gain of 159 industrial jobs.

2.2 Projected Water Demand for the Proposed Project

Consistent with policies established in the 2008 TASP, the Proposed Project will be served with potable water for domestic uses and recycled water for landscape irrigation uses.

Potable water demand for the Proposed Project was estimated using projected development data from M-Group and water use factors (WUF) developed for similar projects and locations. A WUF is defined as the estimated water use per unit of a given land use type. The WUFs used in the WSA were different than the WUFs used in the City's 2021 Water Master Plan (2021 WMP) as the development data for the Proposed Project was more refined for this WSA. The WUFs used in the 2021 WMP were based on gallons per day per acre of development, while the WUFs used in this WSA were based on gallons per day (gpd) per dwelling unit (du, for residential land uses), sf (for office and retail land uses), or room (for hotels).

Table 2-1 presents the estimated potable water demand for the Proposed Project, which is approximately 500 million gallons per year (MGY). The estimated total potable water demand for the Proposed Project presented in Table 2-1 is likely conservative. Actual potable demands for the Proposed Project may be lower, because WUFs were developed from existing water users that may have less efficient plumbing fixtures than what will be provided for the Proposed Project. Newer developments like the Proposed Project are required to have ultra-low flow plumbing fixtures and encouraged to incorporate water collection and retention devices (e.g., rain barrels) into building design to allow for water reuse.

Recycled water will be provided for landscape irrigation purposes within the Proposed Project area. As shown in Table 2-1, the estimated recycled water demand for the Proposed Project is 53 MGY. This demand estimate is based on the Proposed Project's approximate landscaped area (43.7 acres or 1.90 million sf, per M-Group) and the Maximum Applied Water Allowance equation in the Model Water Efficient Landscape Ordinance (MWELO).

The City purchases recycled water from South Bay Water Recycling (SBWR) and operates and maintains the recycled water distribution facilities within City boundaries. For parcels which do not have current access to a recycled water main, a recycled water main will be required to be installed up to and across the frontage of the parcel. The cost of extending the main, not including the length across the frontage, will be funded using the development impact fees to be collected. It is anticipated that adequate recycled water supplies will be available to meet the landscape irrigation demands within the Proposed Project area.

Table 2-1. Estimated Water Demand for the Proposed Project

Land Use Designation[a]	Projected Development[a]	Water Use Factor[b]	Potable Water Demand, MGY
Residential	7,000 du	135 gpd/du	344.9
Retail	300,000 sf	0.14 gpd/sf	15.3
Office	3,000,000 sf	0.1 gpd/sf	109.5
Hotel	700 rooms	115 gpd/room	29.4
		Total Potable Water Demand	**499.1**
		Total Recycled Water Demand for Irrigation[c]	**53.0**

(a) Source: M-Group Milpitas Metro Specific Project Description (Table 2.2-1)

(b) WUFs developed for similar municipalities based on actual consumption.

(c) Consistent with policies established in the 2008 TASP, irrigation demands within the Proposed Project area will be met with recycled water. Irrigation demand for the Proposed Project is estimated based on landscaped area (provided by M-Group in October 2021) and the Maximum Applied Water Allowance per MWELO. Actual irrigation demand may be less based on proposed landscaping and planting plans which have not yet been developed.

With an estimated 14,000 new residents, the Proposed Project's potable water use is approximately 98 gallons per capita per day (gpcd). This is slightly lower than the City's actual per capita water use in 2020 (108 gpcd), as presented in its 2020 UWMP and would therefore be expected to help lower the City's overall per capita water demand.

3.0 REQUIRED DETERMINATIONS

The following sections describe the required determinations for a WSA.

3.1 Does SB 610 Apply to the Proposed Project?

10910 (a) Any city or county that determines that a project, as defined in Section 10912, is subject to the California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code) under Section 21080 of the Public Resources Code shall comply with this part.

10912 (a) "Project" means any of the following:

(1) A proposed residential development of more than 500 dwelling units.

(2) A proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space.

(3) A proposed commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space.

(4) A proposed hotel or motel, or both, having more than 500 rooms.

(5) A proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area.

(6) A mixed-use project that includes one or more of the projects specified in this subdivision.

(7) A project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500-dwelling unit project.

As shown in Table 3-1, the Proposed Project meets the definition of a "Project" as specified in CWC Section 10912(a). The Proposed Project has not been the subject of a previously adopted WSA and has not been included in an adopted WSA for a larger project. Therefore, according to CWC section 10910(a), a WSA is required for the Proposed Project.

Table 3-1. Does the Proposed Project Meet the SB 610 Definition of a "Project"?

SB 610 Project Definition Components	Proposed Project Quantity	Meets the SB 610 Definition of a "Project"?
Residential > 500 dwelling units	7,000	YES
Retail > 1,000 employees or > 500,000 sf	857 employees 300,000 sf	NO
Commercial Office Building > 1,000 employees or > 250,000 sf	9,615 employees 3,000,000 sf	YES
Hotel/Motel > 500 rooms	700	YES
Industrial Plant/Park > 1,000 employees or > 40 acres or > 650,000 sf	N/A	NO
Mixed Use Project that includes one or more of the above	Yes	YES
A Project that would demand the amount of water required by a 500-dwelling unit project	Yes	YES
SB 610 Required?	--	**YES**

3.2 Does SB 221 Apply to the Proposed Project?

In 2001, SB 221 amended State law to require that approval by a city or county of certain residential subdivisions requires an affirmative written verification of sufficient water supply. Per California Government Code section 66473.7(a)(1), a subdivision means a proposed residential development of more than 500 dwelling units. The Proposed Project includes 7,000 residential dwelling units and is therefore subject to the requirements of SB 221. A verification of sufficient water supply (SB 221) report will be required prior to final approvals.

3.3 Who is the Identified Public Water System?

> *10910(b) The city or county, at the time that it determines whether an environmental impact report, a negative declaration, or a mitigated negative declaration is required for any project subject to the California Environmental Quality Act pursuant to Section 21080.1 of the Public Resources Code, shall identify any water system that is, or may become as a result of supplying water to the project identified pursuant to this subdivision, a public water system, as defined by Section 10912, that may supply water for the project*
>
> *10912 (c) "Public water system" means a system for the provision of piped water to the public for human consumption that has 3,000 or more service connections…*

Since the Proposed Project is located within City limits, the City is the identified public water system for the Proposed Project.

3.4 Does the Identified Water Supplier have an adopted UWMP and does the UWMP include the projected water demand for the Proposed Project?

> *10910(c)(1) The city or county, at the time it makes the determination required under Section 21080.1 of the Public Resources Code, shall request each public water system identified pursuant to subdivision (b) to determine whether the projected water demand associated with a proposed project was included as part of the most recently adopted urban water management plan adopted pursuant to Part 2.6 (commencing with Section 10610).*

The City's 2020 UWMP was adopted in June 2021. While projected water demands for the Proposed Project were not specifically identified in the City's 2020 UWMP, the City's 2020 UWMP references the Proposed Project in the City's future land use projections, and future projected water connections associated with the Proposed Project were incorporated into the Decision Support System Model (DSS Model) used to project the City's future water demands. Therefore, the City's 2020 UWMP does include the Proposed Project in its water demand projections.

4.0 CITY OF MILPITAS MUNICIPAL WATER SYSTEM

The following sections describe the City's existing water service area, including population and climate information.

4.1 Water Service Area

Located in Santa Clara County at the southern tip of the San Francisco Bay, the City is bordered by the City of Fremont to the north and the City of San Jose to the south. The City's water service area is approximately 12 square miles and is generally coincident with City limits, except for some areas in the Calaveras Hills along the City's eastern edge. The City can be divided into two distinct topographical areas: the relatively flat "valley floor" on the western side and the steeper "hillside" area within the Calaveras Hills.

As of December 2020, the City had 16,360 active service connections, including recycled water and fire accounts. Of the City's existing developed land, the primary land uses are residential, commercial, and industrial.

4.2 Population

The City expects significant population growth due to redevelopment associated with two major development areas, the Proposed Project and the Milpitas Gateway-Main Street Specific Plan (MGSP). Table 4-1 shows the City's projected population as presented in the City's 2020 UWMP. The population projections include the projected population for the Proposed Project, approximately 14,000 new residents, as well as other proposed development projects in the City's service area. As shown in Table 4-1, the City's population is projected to increase from approximately 78,000 in 2020 to over 120,000 by 2045.

Table 4-1. City of Milpitas Existing and Projected Population

	2020	2025	2030	2035	2040	2045
Population Served	77,961	90,400	98,100	106,000	113,200	120,400

Source: City of Milpitas 2020 UWMP (Table 3-1).

4.3 Climate

The City is in a region with a Mediterranean climate, characterized by mild, wet winters and warm, dry summers. The rainy season typically begins in October and ends in May, and the area experiences an average annual precipitation of approximately 14.6 inches. Average temperatures in the area range from a minimum of 40.9°F in January to a maximum of 81.8°F in July.

The average annual reference evapotranspiration (ETo) for the City's service area is approximately 45 inches per year. ETo is a standardized measurement of water lost as evaporation from soil and transpiration from a reference crop. The water demand of different landscaping and crops can be approximated as the difference between precipitation and ETo. As shown in Table 4-2, monthly ETo is greater than the monthly precipitation from March through November. Annual ETo is over three times greater than annual precipitation, resulting in high irrigation demands during the dry season.

Climate data for the City's service area is shown in Table 4-2.

Table 4-2. City of Milpitas Service Area Monthly Climate Data[a]

Month	Average ETo, inches	Average Total Precipitation, inches	Average Temperature, °F	
			Min	Max
January	1.37	2.88	40.9	58.1
February	2.00	2.69	43.5	61.9
March	3.30	2.31	45.2	65.4
April	4.43	1.20	46.9	69.5
May	5.43	0.44	50.5	74.2
June	6.08	0.10	53.8	79.0
July	6.26	0.02	56.1	81.8
August	5.57	0.07	56.2	81.3
September	4.36	0.19	55.2	80.4
October	3.10	0.76	51.3	74.3
November	1.69	1.50	45.3	65.2
December	1.31	2.41	41.5	58.5
Total/Average	**44.9**	**14.6**	**48.9**	**70.8**

(a) Source: Reference evapotranspiration data for Union City station #171 are from the Department of Water Resources, California Irrigation Management Information System. Temperature and precipitation data are from the Western Regional Climate Center for Station #047821 San Jose from 1 January 1893 to 9 June 2016.

5.0 CITY OF MILPITAS MUNICIPAL WATER DEMANDS

10910(c)(2) If the projected water demand associated with the proposed project was accounted for in the most recently adopted urban water management plan, the public water system may incorporate the requested information from the urban water management plan in preparing the elements of the assessment required to comply with subdivisions (d), (e), (f) and (g).

The descriptions provided below for the City's water demands are based on the City's 2020 UWMP (adopted in June 2021) and its 2021 Water Master Plan (2021 WMP). This section covers historical and existing (2020) water demand, future water demand, and dry year water demand.

5.1 Historical and Existing Water Demand

Table 5-1 shows the City's water demand (based on water production) from 2016 through 2020. Over that period, the City's water demand grew steadily from approximately 2,800 MGY to nearly 3,100 MGY, an increase of approximately 9 percent.

Table 5-1. City of Milpitas Historical Water Demand

	Demand, MGY				
	2016	2017	2018	2019	2020
Potable Water Demand[(a)]	2,816	2,900	2,962	3,040	3,073
Recycled Water Demand[(b)]	257	277	410	342	357
Total Water Demand	**3,073**	**3,177**	**3,372**	**3,382**	**3,430**

(a) Source: City of Milpitas 2021 WMP (Table 5-1) and 2020 UWMP (Table 4-3).
(b) Source: City data provided for the 2021 WMP for 2016-2019 and 2020 UWMP (Table 4-3) for 2020.

5.2 Future Water Demand

Table 5-2 shows the City's projected normal water year demands through 2045, as presented in the City's 2020 UWMP. Potable water projections are based on the Decision Support System demand model (DSS Model), which breaks down historical water use by water service account type (e.g., single-family residential, multi-family residential, commercial) and specific end uses (e.g., toilets, faucets, showers, irrigation). To project future demands, the DSS Model incorporates the projected growth and end-use water consumption for each water service account type, as well as water savings from potential water conservation measures and plumbing and appliance codes. Based on these projections, potable water demands are projected to increase more in the next 5 years (approximately 850 MGY from 2020 to 2025) than in the following 20 years (2025-2045). As shown in Table 5-2, the City's water demand is projected to increase by approximately 600 MGY between 2025 and 2045.

Table 5-2. City of Milpitas Projected Future Water Demand – Normal Hydrologic Years					
	Projected Water Demand, MGY				
	2025	2030	2035	2040	2045
Potable Water Demand[(a)]	3,925	4,075	4,226	4,376	4,517
Recycled Water Demand[(a)]	400	400	400	400	400
Total Water Demand	**4,325**	**4,475**	**4,626**	**4,776**	**4,917**
(a) Source: City of Milpitas 2020 UWMP (Table 4-3).					

5.3 Dry Year Water Demand

As part of its 2020 UWMP, the City updated its Water Shortage Contingency Plan (WSCP), which the City uses to respond to water shortages caused by drought or other emergencies. Water shortages occur when available supplies are insufficient to meet normally expected, or unconstrained, water demands. As presented in Table 5-3, the City's WSCP identifies six standard water shortage levels (besides Level 0), each corresponding to an estimated shortage range compared to the normal condition. A "Level 0 Shortage" corresponds to the normal supply condition; under a "Level 0 Shortage" the City does not anticipate any supply reductions but still enforces permanent water waste prohibitions and proceeds with planned water efficiency best practices.

Table 5-3. City of Milpitas Water Shortage Levels	
Water Shortage Level	Percent Supply Reduction
0	0
1	Up to 10 percent
2	11 – 20 percent
3	21 – 30 percent
4	31 – 40 percent
5	41 – 50 percent
6	More than 50 percent
Source: City of Milpitas 2020 WSCP (Table 3-1)	

During dry water years, the City's water supplies may be reduced. The City anticipates implementing the demand reduction measures outlined in its WSCP as needed to reduce water demands to a level that can be met with available water supplies. However, both the City's 2020 UWMP and this WSA conservatively assume that additional water conservation that may occur in single or multiple dry years will not happen. In other words, demands in future single or multiple dry years are unconstrained. Table 5-4 presents the projected future single and multiple dry year water demands, per the City's 2020 UWMP.

Table 5-4. City of Milpitas Projected Future Water Demand – Dry Years

Hydrologic Condition	Demand Reduction[a]	Projected Demand, MGY				
		2025	2030	2035	2040	2045
Single Dry Year[b]	0%	4,325	4,475	4,626	4,776	4,917
Multiple Dry Years[c]	0%	4,325	4,475	4,626	4,776	4,917

(a) This WSA conservatively assumes no demand reduction in dry years. Demands may be reduced in dry years if the City implements its Water Shortage Contingency Plan; however, such a demand reduction is not assumed or relied upon for the purposes of the Single Dry Year and Multiple Dry Year evaluations for this WSA.

(b) Source: City of Milpitas 2020 UWMP (Table 7-3).

(c) Represents demands for each year of the five-year multiple dry year period. Source: City of Milpitas 2020 UWMP (Table 7-4).

6.0 CITY OF MILPITAS MUNICIPAL WATER SUPPLIES

10910(c)(2) If the projected water demand associated with the proposed project was accounted for in the most recently adopted urban water management plan, the public water system may incorporate the requested information from the urban water management plan in preparing the elements of the assessment required to comply with subdivisions (d), (e), (f) and (g).

10910(d)(1) The assessment required by this section shall include an identification of any existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project, and a description of the quantities of water received in prior years by the public water system…under the existing water supply entitlements, water rights, or water service contracts.

10910(e) If no water has been received in prior years by the public water system…under the existing water supply entitlements, water rights, or water service contracts, the public water system…shall also include in its water supply assessment…an identification of the other public water systems or water service contract holders that receive a water supply or have existing water supply entitlements, water rights, or water service contracts, to the same source of water as the public water system.

10910(f) If a water supply for a proposed project includes groundwater, the following additional information shall be included in the water supply assessment.

(1) A review of any information contained in the urban water management plan relevant to the identified water supply for the proposed project.

(2) A description of any groundwater basin or basins from which the proposed project will be supplied. For those basins for which a court or the board has adjudicated the rights to pump groundwater, a copy of the order or decree adopted by the court or the board and a description of the amount of groundwater the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), has the legal right to pump under the order or decree. For basins that have not been adjudicated, information as to whether the department has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most recent bulletin of the department that characterizes the condition of the groundwater basin, and a detailed description by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), of the efforts being undertaken in the basin or basins to eliminate the long-term overdraft condition.

(3) A detailed description and analysis of the amount and location of groundwater pumped by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), for the past five years from any groundwater basin from which the proposed project will be supplied. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historical use records.

(4) A detailed description and analysis of the amount and location of groundwater that is projected to be pumped by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), from any basin from which the proposed project will be supplied. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historical use records.

(5) An analysis of the sufficiency of the groundwater from the basin or basins from which the proposed project will be supplied to meet the projected water demand associated with the proposed project. A water assessment shall not be required to include the information required by this paragraph if the public water system determines, as part of the review required by paragraph (1), that the sufficiency of groundwater necessary to meet the initial and projected water demand associated with the project was addressed in the description and analysis required by paragraph (4) of subdivision (b) of Section 10631.

The descriptions provided below for the City's water supplies are based on the City's 2020 UWMP (adopted in June 2021), the San Francisco Public Utilities Commission's (SFPUC) 2020 UWMP (June 2021), and Valley Water's 2020 UWMP (June 2021). This section covers the City's potable water supplies from the SFPUC and Valley Water, groundwater from the Santa Clara Valley Subbasin, and recycled water from South Bay Water Recycling (SBWR).

6.1 Water Supply Overview

Under normal conditions, imported water currently comprises the City's entire potable water supply. The City purchases treated water from the SFPUC and Valley Water, and these supplies are normally separated within the City's distribution system. According to the City's 2020 UWMP, beginning in 2030 the City plans to augment imported water supplies with groundwater pumped from the local Santa Clara Valley Subbasin.

Recycled water is produced at the San José-Santa Clara Regional Wastewater Facility and delivered to the City by SBWR, a division within the City of San Jose's Environmental Services Department.

6.2 Water Supply from SFPUC

The SFPUC is a department of the City and County of San Francisco, which owns and operates the San Francisco Regional Water System (RWS). The RWS spans from Hetch Hetchy Valley in Yosemite National Park to the City of San Francisco and consists of over 280 miles of pipeline, 11 reservoirs, five pump stations, and two water treatment plants. RWS elements include:

- Hetch Hetchy Watershed and System
- Bay Area System (consisting of the Alameda Watershed and System and the Peninsula Watershed and System)
- Water Treatment
- Water Storage

Each of these elements is described further below.

6.2.1 Hetch Hetchy Watershed and System

Approximately 85 percent of the water supply to the RWS originates in the Hetch Hetchy watershed, located in Yosemite National Park, and flows down the Tuolumne River into the Hetch Hetchy Reservoir. Water from the Hetch Hetchy watershed is managed through the Hetch Hetchy Water and Power Project (Hetch Hetchy Project). The Hetch Hetchy Project is generally composed of the reservoirs, hydroelectric generation and transmission facilities, and water transmission facilities from the Hetch Hetchy Valley west to the Alameda East Portal of the Coast Range Tunnel in Sunol Valley. Water system components of the Hetch Hetchy Project are also referred to as the Hetch Hetchy System.

In the Hetch Hetchy System, water is diverted from Hetch Hetchy Reservoir into a series of tunnels and aqueducts from the Sierra Nevada to the San Joaquin Pipelines that cross the San Joaquin Valley to the Coast Range Tunnel, which connects to the Alameda System at the Alameda East Portal. Hetch Hetchy System water is disinfected at the Tesla Treatment Facility.

6.2.2 Bay Area System

Approximately 15 percent of the water supply to the SFPUC RWS originates locally in the Alameda and Peninsula watersheds. The local Bay Area water system is comprised of two parts—the Alameda System and the Peninsula System—generally consisting of the facilities west of Alameda East Portal, including the 63,000-acre Alameda and Peninsula watersheds, storage reservoirs, two water treatment plants, and the distribution system that delivers water to retail and wholesale customers.

6.2.2.1 Alameda Watershed and System

The Alameda System includes two reservoirs, San Antonio Reservoir and Calaveras Reservoir, which collect water from the San Antonio Creek, Upper Alameda Creek, and Arroyo Hondo watersheds in Alameda County. San Antonio Reservoir also receives water from the Hetch Hetchy System. Conveyance facilities in the Alameda System connect the Hetch Hetchy System and Alameda water sources to the Peninsula System. The Bay Division Pipelines (BDPLs) cross the South Bay to the Peninsula System, delivering water to customers along the pipeline route. The Sunol Valley Water Treatment Plant (SVWTP) filters and disinfects water supplied from San Antonio Reservoir and Calaveras Reservoir.

6.2.2.2 Peninsula Watershed and System

The Peninsula System includes conveyance facilities connecting the BDPLs to the City of San Francisco distribution system and other customers on the Peninsula. Two reservoirs, Crystal Springs Reservoir and San Andreas Reservoir, collect runoff from the San Mateo Creek watershed. Crystal Springs Reservoir also receives water from the Hetch Hetchy System. A third reservoir, Pilarcitos Reservoir, collects runoff from the Pilarcitos Creek watershed and directly serves one of the Wholesale Customers, the Coastside County Water District (which serves the City of Half Moon Bay), along with delivering water to the Crystal Springs and San Andreas Reservoirs. The Harry Tracy Water Treatment Plant (HTWTP) filters and disinfects water supplied from Crystal Springs Reservoir and San Andreas Reservoir before it is delivered to customers on the Peninsula and the City of San Francisco distribution system.

6.2.3 Water Treatment

The Hetch Hetchy Reservoir is the largest unfiltered water supply on the West Coast and one of only a few large unfiltered municipal water supplies in the nation. The water originates from spring snow melt flowing down the Tuolumne River to Hetch Hetchy Reservoir, where it is stored. This high-quality water source comes from well-protected wilderness areas in Yosemite National Park and meets or exceeds all federal and State criteria for watershed protection. Water from Hetch Hetchy Reservoir is protected in pipes and tunnels as it is conveyed to the Bay Area and only requires pH adjustment to control pipeline corrosion and disinfection for bacteria control. Based on the SFPUC's disinfection treatment practice, extensive bacteriological quality monitoring, and high operational standards, the U.S. Environmental Protection Agency (USEPA) and the State Water Resources Control Board (SWRCB) Division of Drinking Water determined that the Hetch Hetchy water source meets federal and State drinking water quality requirements without the need for filtration.

A new USEPA regulation took effect in 2012 requiring secondary disinfection for all unfiltered drinking water systems to control the waterborne parasite cryptosporidium. To comply with this regulation, the SFPUC completed construction of a new ultraviolet treatment facility in 2011. The Tesla Treatment Facility is a key component of the Water System Improvement Program (WSIP) and further enhances the Hetch Hetchy System's high-quality water. The facility has a capacity of 315 million gallons per day (mgd), making it the third largest ultraviolet drinking water disinfection facility in the United States.

All water derived from sources other than Hetch Hetchy Reservoir is treated at one of two treatment plants: the SVWTP or the HTWTP. The SVWTP primarily treats water from the Alameda System reservoirs and has both a peak capacity and sustainable capacity of 160 mgd. Treatment processes include coagulation, flocculation, sedimentation, filtration, and disinfection. Fluoridation, chloramination, and corrosion control treatment are provided for the combined Hetch Hetchy System and SVWTP water at the Sunol chloramination and fluoridation facilities. The HTWTP treats water from the Peninsula System reservoirs and has a peak capacity of 180 mgd and a sustainable capacity of 140 mgd. Treatment processes include ozonation, coagulation, flocculation, filtration, disinfection, fluoridation, corrosion control treatment, and chloramination. Major upgrades to the SVWTP were completed in 2013 and to the HTWTP in 2015.

6.2.4 Water Storage

Most of the water delivered by the SFPUC is supplied by runoff from the upper Tuolumne River watershed on the western slope of the central Sierra Nevada. Three major reservoirs collect runoff: Hetch Hetchy Reservoir, Lake Lloyd, and Lake Eleanor. A "water bank" in Don Pedro Reservoir is integrated into system operations.2 Don Pedro Reservoir is jointly owned and operated by Modesto Irrigation District (MID) and Turlock Irrigation District (TID) and is located on the Tuolumne River downstream of the Hetch Hetchy System.

Table 6-1 displays the storage capacity of the RWS as presented in SFPUC's 2020 UWMP.

As a by-product of water delivery and water supply management, hydroelectric power is also generated by the Hetch Hetchy Project. Water stored in Hetch Hetchy Reservoir is used for hydroelectric generation and also satisfies instream flow requirements when released downstream. Normally, only Hetch Hetchy Reservoir water supplies are exported to the Bay Area, while releases from Lake Eleanor and Lake Lloyd are used to satisfy instream flow requirements, satisfy Raker Act entitlements to MID and TID downstream, and produce hydroelectric power. The Hetch Hetchy Water and Power System is comprised of three major hydroelectric powerhouses along the Tuolumne River (Holm, Kirkwood, and Moccasin) that have a collective generating capacity of nearly 400 megawatts.

Downstream of the Hetchy System, the SFPUC utilizes local watersheds in the Bay Area. The Crystal Springs, San Andreas, and Pilarcitos Reservoirs, located in San Mateo County, capture local runoff in the Peninsula watershed. In Alameda County, the Calaveras and San Antonio Reservoirs capture local runoff in the Alameda watershed. In addition to using these facilities to capture local runoff, San Andreas, San Antonio, and Crystal Springs Reservoirs also provide storage for the Hetch Hetchy System and, along with Calaveras Reservoir, are important water supply sources in the event of an interruption to Hetch Hetchy System deliveries.

[2] MID and TID have senior water rights to the SFPUC for the Tuolumne River water and are entitled to the first increment of flow in the basin. Water bank provides a credit and debit system which allows the SFPUC to divert water upstream while meeting its obligations to TID and MID. Through this mechanism the SFPUC may pre-deliver the TID and MID entitlements and credit the water bank so that at other times the SFPUC may retain water upstream while TID and MID debit the water bank.

The SFPUC recently completed the Calaveras Dam Replacement Project, which replaced the seismically vulnerable 93-year-old old dam with a New Calaveras Dam. Prior to the dam replacement, the Calaveras Reservoir was operating at one-third of its capacity due to restrictions imposed by the Department of Water Resources (DWR) Division of Safety of Dams. The SFPUC began impounding water behind the new dam in the winter of 2018/2019 and continued the initial fill of the reservoir during the 2019/2020 winter season.

Table 6-1. Regional Water System Storage Capacity

Reservoir	Storage Capacity	
	Acre-Feet, AF	Billions of Gallons, BG
Up-Country[a]		
Hetch Hetchy	360,360	117.4
Lake Lloyd[b]	273,300	89.1
Lake Eleanor	27,100	8.8
Subtotal	**660,760**	**215.3**
Local		
Calaveras (East Bay)[c]	96,800	31.5
San Antonio (East Bay)	50,500	16.5
Crystal Springs (Peninsula)[d]	69,300	22.6
San Andreas (Peninsula)	19,000	6.2
Pilarcitos (Peninsula)	3,100	1.0
Subtotal	**238,700**	**77.8**
Total Regional Water System[e]	**899,460**	**293.1**

Source: SFPUC 2020 UWMP (Table 3-1).

(a) Three other regulating reservoirs are also part of the RWS: Early Intake, Priest, and Moccasin Reservoirs.

(b) Storage capacity shown includes flashboards, which are structures placed in a spillway to increase the capacity of a reservoir.

(c) Calaveras Reservoir was constructed with a storage capacity of 96,800 AF. Since December 2001, in response to safety concerns about the seismic stability of the dam and a directive from the Division of Safety of Dams (DSOD), the SFPUC has held the maximum water level at approximately 37,800 AF (roughly 40 percent of its maximum capacity). The construction of a new replacement dam downstream was completed in 2019 to restore the dam's full storage capacity, and the dam was continuing to be filled over the 2019/2020 winter season.

(d) Crystal Springs Reservoir has a maximum storage capacity of 22.1 BG (at 291.8 feet). Based on permit conditions, the reservoir is currently operated at 287.8 feet (4 feet below capacity).

(e) This includes 63,700 AF in dead storage (i.e., the volume in a reservoir below the lowest controllable level). In addition, the SFPUC may draw against a credit of up to 570,000 AF in storage in a water bank account in Don Pedro Reservoir, for total storage for planning purposes of 1,469,460 AF.

6.3 Water Supply from Valley Water

Formerly known as the Santa Clara Valley Water District, Valley Water is a special district that manages water resources for all of Santa Clara County, including 142 miles of raw and treated water pipelines, 101 groundwater recharge ponds, more than 275 miles of jurisdictional streams, 10 dams and surface water reservoirs, three water treatment plants, an advanced recycled water purification center, and a state-of-the-art water quality laboratory. Local surface water and groundwater comprise approximately half of Valley Water's supply, with the remainder imported from the State Water Project (SWP), the Central Valley Project (CVP), and the SFPUC.

Per the City's contract with VW, potable water deliveries consist of SWP and CVP water only. SWP and CVP water is treated at either the Penitencia or Santa Teresa Water Treatment Plant (WTP) before delivery to the City. Valley Water also operates the Rinconada WTP, but it primarily serves the west side of Santa Clara County. The Penitencia and Santa Teresa WTPs began operations in 1974 and 1989, respectively. In 2006, disinfection facilities at each WTP were upgraded to use ozone instead of chlorine. Not only is ozone a strong disinfectant, but it can also improve taste and odor while also reducing the formation of disinfection byproducts. At both WTPs, raw water is treated via coagulation/flocculation (to remove silt and particles), ozone disinfection, and granular activated carbon filtration (to remove dissolved chemicals). Filtered water is then treated with chloramine to maintain a disinfection residual through the distribution system.

6.4 Groundwater Supply

Currently, the City does not use groundwater to meet customer demands under normal conditions but may use it if water supplies from the SFPUC or Valley Water are interrupted. The City has one existing well, Pinewood Well, which is fully developed and currently permitted as a standby source (i.e., to be used only for short-term emergencies). The SWRCB Division of Drinking Water allows standby sources like Pinewood Well to be used no more than five consecutive days and no more than 15 calendar days per year.

Two other wells are either planned or in construction. Curtis Well was completed in 2003 but remains unequipped. Construction of the McCandless Well was completed in 2020. Equipping of the Curtis Well as a production well and the McCandless Well as a standby (emergency) well are anticipated to be completed by 2024.

6.4.1 Groundwater Basin Description

The City overlies the Santa Clara Valley Subbasin (DWR Basin Number 2-009.02), which is managed by Valley Water. The Santa Clara Valley Subbasin (subbasin) is not adjudicated, nor has DWR identified it to be in overdraft. However, as part of the implementation of the Sustainable Groundwater Management Act (SGMA), the subbasin was identified as high priority based on overlying population, projected growth, number of wells, irrigation acreage, groundwater reliance, and groundwater impacts. As such, the subbasin is subject to the requirements of SGMA.

To comply with SGMA, Valley Water developed a Groundwater Management Plan (GMP), which DWR approved as an alternative to a Groundwater Sustainability Plan. Valley Water's GMP identifies two overall goals for managing the subbasin: (1) optimizing groundwater supply reliability and minimizing land subsidence; and (2) protecting groundwater from existing and potential contamination, including saltwater intrusion. To achieve these goals, Valley Water's strategies include conjunctive management of surface water and groundwater, maintaining and developing adequate groundwater models and monitoring systems, and working with regulatory and land use agencies to protect recharge areas, promote natural recharge, and prevent groundwater contamination.

6.4.2 Future Well Operation

Groundwater can supplement reduced supplies from the SFPUC or Valley Water during prolonged droughts. As presented in its 2020 UWMP, the City expects to rely on groundwater to augment supplies and meet demands during future dry years. The Pinewood, Curtis, and McCandless wells, in addition to other future wells described in the City's 2020 UWMP that are triggered by future development in the City's service area, are critical components of the City's future water supply portfolio. As described in the

City's 2021 WMP, the City may also use groundwater storage credits to offset some of the aboveground emergency storage requirements triggered by future development.

6.5 Recycled Water Supply from SBWR

SBWR is the regional permit holder for recycled water in the City (as well as other locations), ensuring compliance with State regulations for recycled water quality and use. The City purchases recycled water from SBWR and sells it to end users within its service area. In 2020, the City delivered recycled water to over 220 customers, mainly for landscape irrigation.

Tertiary treated recycled water is produced at the San José-Santa Clara Regional Wastewater Facility, one of the largest such treatment facilities in California. SBWR's recycled water system consists of over 150 miles of pipeline, five pump stations, and 10 million gallons (MG) of storage in reservoirs. SBWR delivers more than four billion gallons of recycled water per year to more than 900 commercial customers, an average of 11 mgd.

6.6 Summary of Existing and Additional Planned Future Water Supplies

Table 6-2 summarizes the City's current and projected future (normal hydrologic year) supplies by source, as presented in the City's 2020 UWMP.

Table 6-2. City of Milpitas Current and Projected Future Water Supplies

Water Source	Supply, MGY					
	2020, Actual[a]	2025[a]	2030[b]	2035[b]	2040[b]	2045[b]
Purchased from SFPUC	2,159	2,410	2,470	2,570	2,660	2,750
Purchased from Valley Water	914	1,445	1,505	1,536	1,586	1,637
Recycled Water from SBWR	357	400	400	400	400	400
Active Conservation[c]	0	70	100	120	130	130
Total	**3,430**	**4,325**	**4,475**	**4,626**	**4,776**	**4,917**

(a) Source: City of Milpitas 2020 UWMP (Table 6-8).
(b) Source: City of Milpitas 2020 UWMP (Table 6-9).
(c) The City participates in Valley Water's conservation program and assumes the associated water savings are part of the future water supply portfolio.

7.0 WATER SUPPLY RELIABILITY

10910(c)(4) If the city or county is required to comply with this part pursuant to subdivision (b), the water supply assessment for the project shall include a discussion with regard to whether the total projected water supplies, determined to be available by the city or county for the project during normal, single dry, and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses.

10911(a) If, as a result of its assessment, the public water system concludes that its water supplies are, or will be, insufficient, the public water system shall provide to the city or county its plans for acquiring additional water supplies, setting forth the measures that are being undertaken to acquire and develop those water supplies. If the city or county, if either is required to comply with this part pursuant to subdivision (b), concludes as a result of its assessment, that water supplies are, or will be, insufficient, the city or county shall include in its water supply assessment its plans for acquiring additional water supplies, setting forth the measures that are being undertaken to acquire and develop those water supplies. Those plans may include, but are not limited to, information concerning all of the following:

(1) The estimated total costs, and the proposed method of financing the costs, associated with acquiring the additional water supplies.

(2) All federal, state, and local permits, approvals, or entitlements that are anticipated to be required in order to acquire and develop the additional water supplies.

(3) Based on the consideration set forth in paragraphs (1) and (2), the estimated timeframes within which the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), expects to able to acquire additional water supplies.

The reliability of the City's water supply is largely dependent on its water supply contracts with the SFPUC and Valley Water and their respective water supply reliability. This section is based largely on 2020 UWMPs developed by the City, SFPUC, and Valley Water, all three of which were adopted by the respective agencies in June 2021.

7.1 BAWSCA's Long-Term Reliable Water Supply Strategy

The City is a member of the Bay Area Water Supply and Conservation Agency (BAWSCA), which represents the SFPUC's 26 Wholesale Customers and coordinates each of their water conservation programs. In February 2015, BAWSCA published the Long-Term Reliable Water Supply Strategy Phase II Final Report (Phase II Final Report), which quantifies the water supply reliability needs of its member agencies through 2040 and identifies water management actions that could be developed to meet those needs. Key findings of the Phase II Final Report include the following:

- There is no longer a regional normal hydrologic year supply shortfall.
- There is a regional drought year supply shortfall of up to 43 mgd.
- Water transfers score consistently high across the various performance measures and within various portfolio constructs and thus represent a high-priority element of the strategy.
- Desalination also potentially provides substantial yield, but its high costs and intensive permitting requirements make it a less attractive drought-year supply alternative. However, given the limited options for generating significant yield for the region, desalination warrants further investment in information as a hedge against the loss of local or other imported supplies.

- The other potential regional projects provide tangible, though limited, benefit in reducing dry-year shortfalls given the small average yields in drought years.

BAWSCA is implementing the strategy recommendations in coordination with its member agencies. Strategy implementation will be adaptively managed to account for changing conditions and to ensure that the goals of the strategy are met efficiently and cost-effectively.

Due to the size of the supply and reliability need and the uncertainty regarding the yield of some strategy projects, BAWSCA will need to pursue multiple actions and projects to increase water supply reliability for its member agencies. On an annual basis, BAWSCA will reevaluate strategy recommendations and results in conjunction with development of the work plan for the following year. In this way, actions can be modified to accommodate changing conditions and new developments.

7.2 SFPUC RWS Reliability

This section details the reliability of the SFPUC RWS, including its WSIP, dry-year water supply projects, Alternative Water Supply Program, and projected reliability.

7.2.1 Water System Improvement Program

Approved on October 31, 2008, the SFPUC's WSIP is a $4.8 billion, multi-year capital program that seeks to improve the delivery reliability of the RWS. The WSIP consists of 87 projects spread over seven counties and is forecast to be completed in December 2021. The objectives of the WSIP related to water supply include:

- Meet average annual water demand of 265 mgd from the SFPUC watersheds for retail and wholesale customers during non-drought years for system demands
- Meeting dry-year delivery needs with no greater than 20 percent system-wide rationing in any one year
- Reducing vulnerability of the water system to damage from earthquakes
- Providing the redundancy needed to accommodate outages
- Diversifying water supply options during non-drought and drought periods
- Improving use of new water sources and drought management, including groundwater, recycled water, conservation, and transfers

The WSIP benefits the City by improving the reliability of wholesale water purchased from the SFPUC, especially during periods of drought. While WSIP projects help meet customer water needs in non-drought and drought conditions, it also includes projects that specifically augment water supplies during droughts. These dry-year supply projects are discussed below.

7.2.2 Dry-Year Water Supply Projects

The following projects are part of the WSIP and will help meet water demand during dry years, as well as help to improve the seismic, delivery, water quality, and water supply reliability for the RWS:

- Calaveras Dam Replacement Project
- Alameda Creek Recapture Project
- Lower Crystal Springs Dam Improvements
- Regional Groundwater Storage and Recovery Project
- Dry-Year Water Transfer

To achieve its target of meeting at least 80 percent of its customer demand during droughts at 265 mgd, the SFPUC must successfully implement the dry-year water supply projects included in the WSIP and described in detail in the following sections. Furthermore, the permitting obligations for the Calaveras Dam Replacement Project and the Lower Crystal Springs Dam Improvements include a combined commitment of 12.8 mgd for instream flows on average. When this commitment is reduced for an assumed Alameda Creek Recapture Project recovery of 9.3 mgd, the net loss of water supply is 3.5 mgd. The SFPUC's participation in regional water supply reliability efforts, such as the Bay Area Regional Desalination Project (BARDP), additional water transfers, and other projects may help to make up for this shortfall.

7.2.2.1 Calaveras Dam Replacement Project

Calaveras Dam is located near a seismically active fault zone and was determined to be seismically vulnerable. To address this vulnerability, the SFPUC constructed a new dam of equal height downstream of the existing dam. The EIR was certified by the San Francisco City Planning Commission in 2011. Construction of the new dam was completed in September 2018, and the overall project was completed in July 2019.

7.2.2.2 Alameda Creek Recapture Project

The Alameda Creek Recapture Project will recapture the water system yield lost due to instream flow releases at Calaveras Reservoir or bypassed around the Alameda Creek Diversion Dam and return this yield to the RWS through facilities in the Sunol Valley. Water that naturally infiltrates from Alameda Creek will be recaptured into an existing quarry pond known as Surface Mining Permit-24 Pond F2. The project will be designed to allow the recaptured water to be pumped to the SVWTP or to San Antonio Reservoir.

The San Francisco Planning Department published the Draft EIR for the project in November 2016, and the San Francisco Planning Commission certified the Final EIR in June 2017. However, in response to an appeal on the certification action, additional analysis was required and sections of the Draft EIR were recirculated for public review and comment in late 2019. The revised Final EIR was certified in April 2020. Construction of the project will occur from spring 2021 to spring 2023.

7.2.2.3 Lower Crystal Springs Dam Improvements

The Lower Crystal Springs Dam Improvements were substantially completed in May 2012. While the project has been completed, significant environmental permitting issues remain. After lowering the reservoir elevation due to Division of Safety of Dams restrictions, habitat for the Fountain Thistle, an endangered plant, was discovered. Before the reservoir elevation can be raised, new plant populations

must be restored incrementally. The result is that it may be several years before the original reservoir storage volume can be realized.

7.2.2.4 Regional Groundwater Storage and Recovery Project

The Regional Groundwater Storage and Recovery Project is a strategic partnership between the SFPUC and three San Mateo County agencies: the California Water Service Company (serving South San Francisco and Colma), the City of Daly City, and the City of San Bruno. The project seeks to balance the management of groundwater and surface water resources to safeguard supplies during droughts. During years of normal or heavy rainfall, the project would provide additional surface water to the partner agencies in San Mateo County, allowing them to reduce the amount of groundwater that they pump from the South Westside Groundwater Basin. Over time, the reduced pumping would allow the aquifer to recharge and result in increased groundwater storage of up to 20 billion gallons. In dry years, when less surface water is available, the saved water will be pumped from up to 16 new groundwater well recovery facilities.

The project's Final EIR was certified in August 2014. Phase 1 of this project consists of construction of 13 well sites and is over 99 percent complete (as of February 2021). Phase 2 of this project consists of completing construction of the well station at the South San Francisco Main site and some carryover work that has not been completed from Phase 1. Design work for Phase 2 began in early 2020, and the 100 percent design package is currently being drafted.

A new but related project called the Regional Groundwater Treatment Improvements was approved in the SFPUC's 10-Year Water Enterprise Capital Improvement Program for fiscal years 2021-2030 and includes treatment facilities to address groundwater qualities at several of the wells constructed as part of the Regional Groundwater Storage and Recovery Project. This treatment project will be initiated in 2021.

7.2.2.5 Dry-Year Water Transfers

In 2012, a dry-year transfer was proposed between the MID and the SFPUC. Negotiations were terminated because an agreement could not be reached. Subsequently, the SFPUC had discussions with the Oakdale Irrigation District for a one-year transfer agreement for 2 mgd. No progress towards agreement on a transfer was made in 2019, but the irrigation districts recognize the SFPUC's continued interest, and the SFPUC will continue to pursue transfers as part of its Alternative Water Supply Program.

7.2.3 Alternative Water Supply Program

The SFPUC continues to investigate acquiring additional water supplies and increasing its overall water supply reliability through the Alternative Water Supply Program, which is driven by:

- Amendments to the Water Quality Control Plan for the San Francisco Bay/ Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan Amendment, described further in Section 7.2.4.1), which may reduce RWS supply during dry years
- A net supply shortfall following implementation of the WSIP
- The SFPUC's perpetual obligation to supply 184 mgd to the Wholesale Customers
- The adopted goal to limit rationing to no more than 20 percent system-wide during droughts
- The potential need to identify water supplies required to offer permanent status to interruptible customers

This program is in its early planning stages and is intended to meet future water supply challenges and vulnerabilities such as environmental flow needs and other regulatory changes; earthquakes, disasters, and emergencies; increases in population and employment; and climate change. As the region faces future challenges (both known and unknown) the SFPUC is considering this suite of diverse, non-traditional supplies and leveraging regional partnerships to meet Retail and Wholesale Customer needs through 2045.

The capital projects under consideration in the Alternative Water Supply Program are still in the early feasibility or conceptual planning stages. These water supply projects would take 10 to 30 years to implement, and each option has its own challenges and uncertainties that may hinder implementation. Even if all the projects identified through the current planning process could be implemented, there would still be a supply shortfall to meet projected needs.

The SFPUC will prepare an Alternative Water Supply Plan by July 2023, which will include a planning framework that will consider water supply needs and related tradeoffs, guide the decisions to proceed with environmental review, and continue the development of projects that can best meet anticipated water supply needs. In the meantime, the SFPUC has been preparing quarterly reports to update the status of planning efforts regarding the regional and local water supply, storage, and related infrastructure projects.

7.2.4 Projected RWS Supply Reliability

This section discusses the considerations for projecting future RWS supply reliability, including factors affecting future RWS supplies and procedures for allocating RWS supplies during shortages.

7.2.4.1 Factors Affecting Future RWS Supplies

7.2.4.1.1 Adoption of the 2018 Bay-Delta Plan Amendment

In December 2018, the SWRCB adopted the Bay-Delta Plan Amendment to establish water quality objectives to maintain the health of the Bay-Delta ecosystem. The SWRCB is required by law to regularly review this plan. The adopted Bay-Delta Plan Amendment was developed with the stated goal of increasing salmonid populations in three San Joaquin River tributaries (the Stanislaus, Merced, and Tuolumne Rivers) and the Bay-Delta. The Bay Delta-Plan Amendment requires the release of 30 to 50 percent of the “unimpaired flow” on the three tributaries from February through June in every year type (i.e., wet, normal, dry, and critically dry). In SFPUC modeling of the new flow standard, it is assumed that the required release is 40 percent of unimpaired flow.

If the Bay-Delta Plan Amendment is implemented, the SFPUC will be able to meet the projected water demands presented in its 2020 UWMP in normal hydrologic years but not in single dry years or multiple dry years. For single dry years, wholesale supply shortfalls (relative to wholesale demand) range from approximately 36 percent in 2025 to almost 46 percent in 2045. For multiple dry years, wholesale supply shortfalls reach almost 54 percent in the fourth and fifth years of a five-year drought starting in 2045.

By comparison, without the Bay-Delta Plan Amendment the SFPUC can meet wholesale demands during all single dry years between 2025 and 2045 and all multiple dry years except for the fourth and fifth years of a five-year drought starting in 2045.

The SWRCB has stated that it intends to implement the Bay-Delta Plan Amendment on the Tuolumne River by the year 2022, assuming all required approvals are obtained by that time. But implementation of the Bay-Delta Plan Amendment is uncertain for several reasons:

- Since adoption of the Bay-Delta Plan Amendment, over a dozen lawsuits have been filed in both state and federal courts, challenging the SWRCB's adoption of the Bay-Delta Plan Amendment, including a legal challenge filed by the federal government, at the request of the U.S. Department of Interior, Bureau of Reclamation. This litigation is in the early stages, and there have been no dispositive court rulings to date.
- The Bay-Delta Plan Amendment is not self-implementing and does not automatically allocate responsibility for meeting its new flow requirements to the SFPUC or any other water rights holders. Rather, the Bay-Delta Plan Amendment merely provides a regulatory framework for flow allocation, which must be accomplished by other regulatory and/or adjudicatory proceedings, such as a comprehensive water rights adjudication or, in the case of the Tuolumne River, may be implemented through the water quality certification process set forth in Section 401 of the Clean Water Act as part of the Federal Energy Regulatory Commission's (FERC) licensing proceedings for the Don Pedro and La Grange hydroelectric projects.
- On January 15, 2021, the SWRCB released the Clean Water Act Section 401 Water Quality Certification for the TID and MID Don Pedro Hydroelectric Project and La Grange Hydroelectric Project, FERC Project Nos. 2299 and 14581 (WQC). The WQC includes the 40 percent unimpaired flow objective from the Bay-Delta Plan Amendment, as well as additional conditions that, if incorporated into FERC licenses for the Don Pedro and La Grange Projects, would severely impact SFPUC's water supply; the WQC's requirements differ significantly from the recommended flows and conditions that FERC has analyzed in the Staff Alternative of its Final Environmental Impact Statement for the licenses. To date, FERC has not taken action to incorporate the WQC into the licenses or to finalize the licenses for issuance. At this time, it is highly uncertain whether the WQC will be implemented by either the State or federal government.

In June 2021, in response to various comments from wholesale customers regarding the reliability of the RWS as described in the SFPUC's 2020 UWMP, the SFPUC provided a memorandum[3] (June 2021 Memo) describing its efforts to remedy the potential effects of the Bay-Delta Plan Amendment. As described in the June 2021 Memo (included in Appendix A of this WSA), the SFPUC's efforts include:

- Pursuing a Tuolumne River Voluntary Agreement
- Evaluating the drought planning scenario in light of climate change
- Pursuing alternative water supplies
- In litigation with the State over the Bay-Delta Plan Amendment
- In litigation with the State over the proposed Don Pedro FERC Water Quality Certification

[3] San Francisco Public Utilities Commission, June 2021. *Regional Water System Reliability and UWMP 2020*.

7.2.4.1.2 Potential State and Federal Regulations

The SFPUC's operation of the RWS is subject to numerous State and federal agency permits designed to protect drinking water quality and the environment. These existing permits, as well as permitting for future projects, may increase the releases from or bypasses of SFPUC facilities. Changes to instream flow requirements or flow schedules may impact the water supply reliability of the RWS. For example, the re-licensing of the Don Pedro Reservoir by FERC may require additional water released from the reservoir to preserve aquatic species in the lower Tuolumne River.

7.2.4.1.3 Additional Water Supply Decisions

The SFPUC is evaluating two decisions that would impact water supplies:

- Whether to make the cities of San Jose and Santa Clara, which are currently supplied on a temporary and interruptible basis, permanent customers
- Whether to increase the Wholesale Customer Supply Assurance above 184 mgd to meet future demands

The SFPUC initially committed to make these decisions by the end of 2018, but this deadline was deferred to 2028 to allow the SFPUC to conduct additional supply reliability studies and environmental reviews.

7.2.4.2 Water Shortage Allocation Procedures

Procedures to allocate RWS supplies during SFPUC system shortages are specified in agreements between the SFPUC and the Wholesale Customers. Water shortage allocation procedures are described below.

In 2019, the Wholesale Customers and the SFPUC adopted the November 2018 Amended and Restated Water Supply Agreement, which included a Water Shortage Allocation Plan (WSAP) to allocate RWS water to retail and wholesale customers during system-wide shortages of 20 percent or less. The WSAP has two tiers, which are described below.

- The Tier One Plan allocates water between the SFPUC and the Wholesale Customers collectively based on the level of the shortage (up to 20 percent). This plan applies only when the SFPUC determines that a system-wide water shortage exists and issues a declaration of a water shortage emergency under CWC Section 350. The SFPUC may also opt to request voluntary cutbacks from San Francisco and the Wholesale Customers to achieve necessary water use reductions during drought periods. The allocations outlined in the Tier One Plan are provided in Table 7-1.

Table 7-1. Tier One Plan Water Shortage Allocations

System-Wide Reduction Required	Share of Available Water	
	SFPUC	Wholesale Customers
≤ 5%	35.5%	64.5%
6% to 10%	36.0%	64.0%
11% to 15%	37.0%	63.0%
16% to 20%	37.5%	62.5%

- The Tier Two Plan allocates the collective Wholesale Customer share among the Wholesale Customers based on a formula that accounts for each Wholesale Customer's Individual Supply Guarantee (ISG), seasonal use of all available water supplies, and residential per capita use. The water made available to the Wholesale Customers collectively will be allocated among them in proportion to each Wholesale Customer's Allocation Basis, which is the weighted average of the Wholesale Customer's ISG and the Base/Seasonal Component. The Allocation Basis is used as the numerator over the sum of all Wholesale Customers' Allocation Bases to calculate each Wholesale Customer's Allocation Factor. The final shortage allocation for each Wholesale Customer is determined by multiplying the amount of water available to the Wholesale Customers collectively over the Tier One Plan by the individual Wholesale Customer's Allocation Factor. BAWSCA calculates each wholesale customer's Allocation Factors annually in preparation for a potential water shortage emergency.

For water shortages greater than 20 percent, the SFPUC will meet with the Wholesale Customers to determine if modifications to the Tier One Plan can be agreed upon by the SFPUC and the Wholesale Customers. If an agreement cannot be reached, the SFPUC may allocate water at its discretion, subject to challenge by the Wholesale Customers, unless all the Wholesale Customers direct that a particular Tier Two allocation methodology be used. The City is susceptible to these modifications to its purchased water supply since it is a Wholesale Customer of the SFPUC.

7.3 Valley Water Reliability

While the City's supplies from Valley Water consist exclusively of imported water from the SWP and CVP, the reliability of Valley Water's overall supply portfolio remains relevant. For example, if Valley Water's groundwater supply reliability decreased significantly, it would strain Valley Water's remaining supplies, including imported water.

In a 2021 memo to its retailers (included in Appendix B of this WSA), Valley Water noted that DWR is very prescriptive about the UWMP and has specific requirements per its guidebook on what to report and how to report it. As a result, Valley Water's 2020 UWMP shows that there would be no water supply shortage, even during droughts. The water supply analysis in Valley Water's 2020 UWMP represents long-term projections that were based on modeling analysis, and therefore depend on the input data and modeling assumptions, including the following:

- **Higher imported water delivery** – DWR provided the Delivery Capability Report (DCR) 2019 for contractors to use in their UWMPs. The DCR 2019 dataset does not include future regulations that may result in up to a 25 percent reduction of imported water deliveries.
- **Lower demand projection** - The Valley Water demands are based on the 2020 Monitoring and Assessment Plan projection, which are significantly lower than what was used in previous UWMPs and Valley Water's Water Supply Master Plan (note: Valley Water's demands are within 1 to 5 percent difference with retailer demands from 2025 to 2040, and 10 percent for 2045).
- **Planned water supply projects** – Valley Water's 2020 UWMP includes the Water Supply Master Plan recommended projects per Board direction.

Given these assumptions, Valley Water's water supply analysis should be interpreted as providing a more optimistic picture than will likely occur with future water deliveries which are likely to be impacted by future regulations and climate change. If some Water Supply Master Plan 2040 projects are not implemented, or provide less benefit than expected, and imported supplies are reduced by 25 percent or severe allocation cuts occur during droughts as have been experienced during this drought and the previous drought, then Valley Water does expect to have drought shortages of up to 20 percent in the future.

Valley Water maintains diverse water supply sources to meet demands in Santa Clara County, including groundwater recharge, local surface water, imported water from State and federal projects, and recycled/purified water. The following presents the constraints on each supply source, as presented in Valley Water's 2020 UWMP.

7.3.1 Imported Water

Imported water supplies are subject to hydrologic variability, regulatory requirements to protect fisheries and water quality, and conveyance limitations. Local and out-of-county storage can help mitigate the impacts of hydrologic variability, but drought conditions also exacerbate water quality concerns in the Sacramento-San Joaquin Delta (Delta), which supplies the SWP and CVP. Valley Water addresses water quality variations by blending sources and/or switching sources to its WTPs.

Delta-conveyed supplies are also at risk from Delta levee failures (due to seismic threats and flooding), sea level rise, climate change, and declining populations of protected fish species. Valley Water continues to evaluate the costs and benefits of participating in the Delta Conveyance Project relative to other water supply options, including developing additional local supplies, securing and optimizing Valley Water's existing water system, and expanding water conservation.

7.3.2 Groundwater

Valley Water's groundwater supply is constrained by hydrologic variability, the operational storage capacity within the Santa Clara and Llagas subbasins, and managed and natural recharge. Natural recharge is insufficient to meet Valley Water's groundwater demands, so Valley Water's managed recharge program is critical to maintaining groundwater supply. The estimated operational storage capacity within the Santa Clara and Llagas subbasins is approximately 548,000 acre-feet (AF, about 179,000 MG), while Valley Water has about 144,000 acre-feet per year (AFY, about 47,000 MGY) of managed recharge capacity.

Groundwater quality is also a concern. While the Santa Clara and Llagas subbasins generally have high quality groundwater, elevated nitrate levels are found in some wells in the Coyote Valley and Llagas areas. Nitrate concentrations are generally stable or declining, and Valley Water has several programs to reduce nitrate in groundwater and protect groundwater quality overall.

7.3.3 Local Surface Water

Valley Water's local surface water supplies are vulnerable to hydrologic variability and regulatory requirements, including reservoir operating rules and supporting instream flow needs. Both wetter and drier years present challenges to Valley Water. In wetter years, Valley Water cannot capture all available supply due to reservoir capacity constraints and flood protection needs. In drier years, Valley Water is challenged to maintain its groundwater recharge program due to reduced storage in local reservoirs, reduced imported water allocations, and regulations and permit conditions that require Valley Water to maintain environmental stream flows.

7.3.4 Recycled and Purified Water

Recycled and purified water are growing supply sources for Santa Clara County. Both recycled and purified water are developed from wastewater, but purified water is further treated through proven multistage and multibarrier processes (e.g., microfiltration, reverse osmosis, and ultraviolet disinfection) to produce water of sufficient quality to supplement existing potable water supplies (i.e., potable reuse). Valley Water produces up to 8 mgd of purified water at its Silicon Valley Advanced Water Purification Center (SVAWPC). SVAWPC-produced purified water is currently blended with tertiary treated recycled water to improve the quality and allow for non-potable use by a wider variety of customers.

Recycled water constraints mainly consist of treatment and distribution capacities. Also, as Valley Water develops potable reuse capacity, there may be less wastewater available to produce recycled water for traditional non-potable uses like irrigation. Potential constraints for potable reuse of purified water include reverse osmosis concentrate disposal, source water availability, public acceptance, permitting, hydrogeologic conditions, and cost.

7.4 Dry Year Water Supply

The City's 2020 UWMP assumes the Bay-Delta Plan Amendment is implemented, which significantly reduces SFPUC supplies. Furthermore, as described above, supplies from Valley Water may have drought shortages of up to 20 percent in the future if some of Valley Water's Water Supply Master Plan 2040 (WSMP) projects are not implemented, or provide less benefits than expected, and imported supplies are reduced by 25 percent or severe allocation cuts occur during droughts as have been experienced during this drought and the previous drought. As a result, the City's 2020 UWMP assumes three groundwater wells (each pumping at 1.2 mgd) will be online by 2030, with a fourth online by 2035. These new groundwater wells are triggered by future development projected in the City's service area and shall be funded through associated development impact fees.

Table 7-2 presents the City's projected supplies during single and multiple dry years from 2025 through 2045.

Table 7-2. City of Milpitas Projected Water Supplies – Dry Years

Hydrologic Condition	Supply, MGY				
	2025	2030	2035	2040	2045
Single Dry Year[a]	3,460	4,475	4,626	4,776	4,917
Multiple Dry Years – Year 1[b]	3,450	4,475	4,626	4,776	4,917
Multiple Dry Years – Year 2[b]	3,230	4,475	4,626	4,776	4,917
Multiple Dry Years – Year 3[b]	2,940	4,370	4,626	4,776	4,917
Multiple Dry Years – Year 4[b]	2,940	4,370	4,626	4,776	4,870
Multiple Dry Years – Year 5[b]	2,940	4,370	4,626	4,776	4,870

(a) Source: City of Milpitas 2020 UWMP (Table 7-3).
(b) Source: City of Milpitas 2020 UWMP (Table 7-4).

8.0 DETERMINATION OF WATER SUPPLY SUFFICIENCY BASED ON THE REQUIREMENTS OF SB 610

> *10910(c)(4) If the city or county is required to comply with this part pursuant to subdivision (b), the water supply assessment for the project shall include a discussion with regard to whether the total projected water supplies, determined to be available by the city or county for the project during normal, single dry, and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses.*
>
> *10911 (a) If, as a result of its assessment, the public water system concludes that its water supplies are, or will be, insufficient, the public water system shall provide to the city or county its plans for acquiring additional water supplies, setting forth the measures that are being undertaken to acquire and develop those water supplies.*

Pursuant to CWC section 10910(c)(4) and based on the technical analyses described in this WSA, the City finds that the total projected water supplies determined to be available for the Proposed Project during a 20-year projection will meet the projected water demand associated with the Proposed Project, in addition to existing and planned future uses.

As discussed in this WSA, the City is a member of agency of BAWSCA and purchases water from the SFPUC RWS. BAWSCA is investigating projects and implementing strategies to continuously improve the reliability of the water supplies to its member agencies. Additionally, as indicated in the SFPUC's June 2021 Memo to its wholesale customers (included in Appendix A of this WSA), the SFPUC is actively pursuing all options to resolve the potential effects of the Bay-Delta Plan Amendment and remains committed to creating benefits for the Tuolumne River while meeting water supply level of service goals and objectives for its retail and wholesale customers.

Table 8-1 summarizes the projected availability of the City's existing and planned future water supplies and demands in normal, single dry, and multiple dry years through 2045. For the purposes of this WSA, no demand reductions are assumed during dry years. As shown in Table 8-1, during normal hydrologic years the City's water supplies can meet projected demands through 2045. During a single dry year in 2025 or a five-year drought starting in 2025, City supplies are insufficient to meet projected demands. There is a 20 percent supply shortfall for a single dry year in 2025 and a supply shortfall between 20 and 32 percent for five dry years starting in 2025. Supply shortfalls in prolonged droughts will either require significant measures to be implemented to reduce water use, as outlined in the City's 2020 WSCP (included in Chapter 8 of the City's 2020 UWMP), or the City may supplement some or most of the supply shortfall through groundwater pumping.

Once the City's groundwater wells come online (assumed in 2030), assuming that the wells produce sufficient flow while meeting water quality standards, the City's dry year supplies can better meet projected demands in single dry and multiple dry years. As shown in Table 8-1, there are small supply shortfalls starting in the third year of a five-year drought starting in 2030 (approximately 2 percent) and the fourth year of a five-year drought starting in 2045 (1 percent). To address these supply shortfalls, the City expects to implement its WSCP and reduce water demands as needed.

It should be noted that the City's 2021 WMP identifies infrastructure improvements needed to serve proposed new development within the City's service area. These include supply (e.g., a new Valley Water

turnout) and storage capacity improvements that are triggered by future development projected in the City's service area and shall be funded through associated development impact fees.

Table 8-1. Summary of City of Milpitas Water Supply Sufficiency

Hydrologic Condition		Volume, MGY				
		2025	2030	2035	2040	2045
Normal Hydrologic Year						
Available Water Supply[(a)]		4,325	4,475	4,626	4,776	4,917
Total Water Demand[(b)]		4,325	4,475	4,626	4,776	4,917
	Potential Surplus (Deficit)	-	-	-	-	-
	Supply Shortfall, percent	-	-	-	-	-
Single Dry Year						
Available Water Supply[(c)]		3,460	4,475	4,626	4,776	4,917
Total Water Demand[(d)]		4,325	4,475	4,626	4,776	4,917
	Potential Surplus (Deficit)	(865)	-	-	-	-
	Supply Shortfall, percent	20%	-	-	-	-
Multiple Dry Years						
Multiple-Dry Year 1	Available Water Supply[(c)]	3,450	4,475	4,626	4,776	4,917
	Total Water Demand[(d)]	4,325	4,475	4,626	4,776	4,917
	Potential Surplus (Deficit)	(875)	-	-	-	-
	Supply Shortfall, percent	20%	-	-	-	-
Multiple-Dry Year 2	Available Water Supply[(c)]	3,230	4,475	4,626	4,776	4,917
	Total Water Demand[(d)]	4,325	4,475	4,626	4,776	4,917
	Potential Surplus (Deficit)	(1,095)	-	-	-	-
	Supply Shortfall, percent	25%	-	-	-	-
Multiple-Dry Year 3	Available Water Supply[(c)]	2,940	4,370	4,626	4,776	4,917
	Total Water Demand[(d)]	4,325	4,475	4,626	4,776	4,917
	Potential Surplus (Deficit)	(1,385)	(105)	-	-	-
	Supply Shortfall, percent	32%	2%	-	-	-
Multiple-Dry Year 4	Available Water Supply[(c)]	2,940	4,370	4,626	4,776	4,870
	Total Water Demand[(d)]	4,325	4,475	4,626	4,776	4,917
	Potential Surplus (Deficit)	(1,385)	(105)	-	-	(47)
	Supply Shortfall, percent	32%	2%	-	-	1%
Multiple-Dry Year 5	Available Water Supply[(c)]	2,940	4,370	4,626	4,776	4,870
	Total Water Demand[(d)]	4,325	4,475	4,626	4,776	4,917
	Potential Surplus (Deficit)	(1,385)	(105)	-	-	(47)
	Supply Shortfall, percent	32%	2%	-	-	1%

(a) From Table 6-2 of this WSA.
(b) From Table 5-2 of this WSA.
(c) From Table 7-2 of this WSA.
(d) From Table 5-4 of this WSA.

9.0 WATER SUPPLY ASSESSMENT APPROVAL PROCESS

> *10910 (g)(1) Subject to paragraph (2), the governing body of each public water system shall submit the assessment to the city or county not later than 90 days from the date on which the request was received. The governing body of each public water system, or the city or county if either is required to comply with this act pursuant to subdivision (b), shall approve the assessment prepared pursuant to this section at a regular or special meeting.*

The City of Milpitas City Council must approve this WSA at a regular or special meeting. Furthermore, this WSA must be included in the Draft EIR being prepared for the Proposed Project.

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Appendix A

SFPUC Memo: Regional Water System Supply Reliability and UWMP 2020

San Francisco
Water Power Sewer
Services of the San Francisco Public Utilities Commission

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TO: SFPUC Wholesale Customers

FROM: Steven R. Ritchie, Assistant General Manager, Water

DATE: June 2, 2021

RE: Regional Water System Supply Reliability and UWMP 2020

This memo is in response to various comments from Wholesale Customers we have received regarding the reliability of the Regional Water System supply and San Francisco's 2020 Urban Water Management Plan (UWMP).

As you are all aware, the UWMP makes clear the potential effect of the amendments to the Bay-Delta Water Quality Control Plan adopted by the State Water Resources Control Board on December 12, 2018 should it be implemented. Regional Water System-wide water supply shortages of 40-50% could occur until alternative water supplies are developed to replace those shortfalls. Those shortages could increase dramatically if the State Water Board's proposed Water Quality Certification of the Don Pedro Federal Energy Regulatory Commission (FERC) relicensing were implemented.

We are pursuing several courses of action to remedy this situation as detailed below.

Pursuing a Tuolumne River Voluntary Agreement

The State Water Board included in its action of December 12, 2018 a provision allowing for the development of Voluntary Agreements as an alternative to the adopted Plan. Together with the Modesto and Turlock Irrigation Districts, we have been actively pursuing a Tuolumne River Voluntary Agreement (TRVA) since January 2017. We believe the TRVA is a superior approach to producing benefits for fish with a much more modest effect on our water supply. Unfortunately, it has been a challenge to work with the State on this, but we continue to persist, and of course we are still interested in early implementation of the TRVA.

Evaluating our Drought Planning Scenario in light of climate change

Ever since the drought of 1987-92, we have been using a Drought Planning Scenario with a duration of 8.5 years as a stress test of our Regional Water System supplies. Some stakeholders have criticized this methodology as being too conservative. This fall we anticipate our Commission convening a workshop

London N. Breed
Mayor

Sophie Maxwell
President

Anson Moran
Vice President

Tim Paulson
Commissioner

Ed Harrington
Commissioner

Newsha Ajami
Commissioner

Michael Carlin
Acting
General Manager

regarding our use of the 8.5-year Drought Planning Scenario, particularly in light of climate change resilience assessment work that we have funded through the Water Research Foundation. We look forward to a valuable discussion with our various stakeholders and the Commission.

Pursuing Alternative Water Supplies

The SFPUC continues to aggressively pursue Alternative Water Supplies to address whatever shortfall may ultimately occur pending the outcome of negotiation and/or litigation. The most extreme degree of Regional Water System supply shortfall is modeled to be 93 million gallons per day under implementation of the Bay-Delta Plan amendments. We are actively pursuing more than a dozen projects, including recycled water for irrigation, purified water for potable use, increased reservoir storage and conveyance, brackish water desalination, and partnerships with other agencies, particularly the Turlock and Modesto Irrigation Districts. Our goal is to have a suite of alternative water supply projects ready for CEQA review by July 1, 2023.

In litigation with the State over the Bay-Delta Plan Amendments

On January 10, 2019, we joined in litigation against the State over the adoption of the Bay-Delta Water Quality Control Plan Amendments on substantive and procedural grounds. The lawsuit was necessary because there is a statute of limitations on CEQA cases of 30 days, and we needed to preserve our legal options in the event that we are unsuccessful in reaching a voluntary agreement for the Tuolumne River. Even then, potential settlement of this litigation is a possibility in the future.

In litigation with the State over the proposed Don Pedro FERC Water Quality Certification

The State Water Board staff raised the stakes on these matters by issuing a Water Quality Certification for the Don Pedro FERC relicensing on January 15, 2021 that goes well beyond the Bay-Delta Plan amendments. The potential impact of the conditions included in the Certification appear to virtually double the water supply impact on our Regional Water System of the Bay-Delta Plan amendments. We requested that the State Water Board reconsider the Certification, including conducting hearings on it, but the State Water Board took no action. As a result, we were left with no choice but to once again file suit against the State. Again, the Certification includes a clause that it could be replaced by a Voluntary Agreement, but that is far from a certainty.

I hope this makes it clear that we are actively pursuing all options to resolve this difficult situation. We remain committed to creating benefits for the Tuolumne River while meeting our Water Supply Level of Service Goals and Objectives for our retail and wholesale customers.

cc.: SFPUC Commissioners
Nicole Sandkulla, CEO/General Manager, BAWSCA

Appendix B

Valley Water Memo: Urban Water Management Plan Retailer Talking Points

Valley Water's Urban Water Management Plan
Retailer Talking Points

The Urban Water Management Plan (UWMP) is a long-range planning document that is developed to meet state requirements. At request of our retailers, Valley Water provides below talking points for our 2020 UWMP. We hope these talking points provide consistent messaging and can help address some of the questions that the retailers may have at their own UWMP hearing.

Water Supply Reliability

Department of Water Resources (DWR) is very prescriptive about the plan and has specific requirements per its guidebook on what to report and how to report it. As a result, Valley Water's UWMP shows that there would be no water supply shortage, even during droughts. The water supply analysis in this plan represents long-term projections that were based on modeling analysis, and therefore depend on the input data and modeling assumptions:

1. **Higher imported water delivery -** DWR provided the Delivery Capability Report (DCR) 2019 for contractors to use in their UWMPs. The DCR 2019 dataset does not include future regulations that may result in up to a 25% reduction of imported water deliveries.
2. **Lower demand projection -** The demands are based on the 2020 Monitoring and Assessment Plan (MAP) projection, which are significantly lower than what was used in previous UWMPs and the Water Supply Master Plan (WSMP).
    - **Note:** Valley Water's demands are within 1- 5% difference with retailer demands from 2025 to 2040, and 10% for 2045.
3. **Planned water supply projects** - This year's UWMP includes the WSMP recommended projects per Board direction.

Given these assumptions, the water supply analysis should be interpreted as providing a more optimistic picture than will likely occur with future water deliveries likely impacted by regulations and climate change. If some WSMP projects are not implemented or provide less benefits than expected and imported supplies are reduced by 25% or severe allocation cuts occur during droughts as we have experienced during this drought and the previous, then Valley Water **does** expect to have drought shortages of up to 20% in the future.

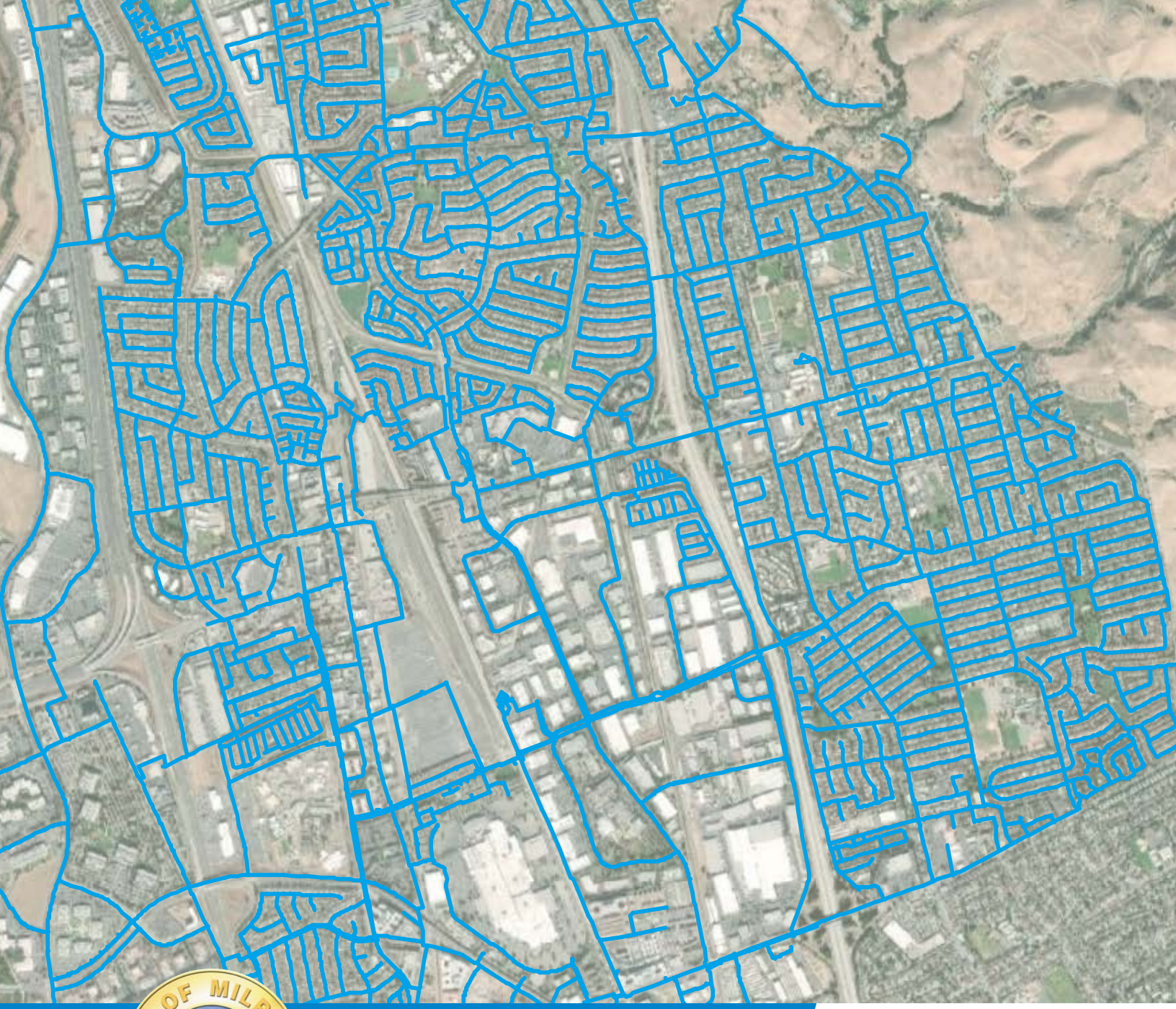
Drought Risk Analysis

Valley Water used the 1988-1992 drought for water supply analysis and Drought Risk Analysis, because the model DWR used to develop their delivery projections for use in the UWMP does not go beyond 2003. For the 1988-1992 drought, the lowest total annual imported water delivery in the DCR 2019 dataset is 83,200AF, with 48% of CVP allocation. Yet Valley Water's current CVP allocation is 25%, showcasing the disconnect between data provided by DWR and current conditions. The UWMP effort is a modeling analysis evaluation and the results are reflective of the input data and modeling assumptions.

Valley Water's Next Steps

The UWMP provides an opportunity for Valley Water to work with its retailers and other agencies to understand their water supply planning for the next 25 years. However, the current DWR dataset isn't reflective of the climate of uncertainty within our water supplies and therefore, Valley Water will continue to use its WSMP and annual MAP framework to guide its long-term water supply planning efforts and inform the Board on investment decisions. This process includes monitoring projects costs and benefits, demands, climate change science, policy or regulatory actions, and making adjustments to the water supply investment strategy as needed to ensure reliability. The next annual MAP Board update is scheduled for Fall 2021.

City of Milpitas Water Master Plan



CITY OF MILPITAS

Water Master Plan

MARCH 2021

FINAL DRAFT REPORT

WEST YOST
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FINAL DRAFT REPORT | MARCH 2021

Water Master Plan

PREPARED FOR

City of Milpitas

PREPARED BY

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Water Master Plan

Prepared for

City of Milpitas

Project No. 270-60-19-16



Project Manager: Elizabeth Drayer, PE	03-02-21 Date
QA/QC Review: Polly Boissevain, PE	03-02-21 Date

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LIST OF ACRONYMS AND ABBREVIATIONS

2009 Update/2009 WMPU	2009 Water Master Plan Update
2020 WMP	2020 Water Master Plan
AB 1668	Assembly Bill 1668
AC	Asbestos Cement
ACWD	Alameda County Water District
ADD	Average Day Demand
af	Acre-Feet
af/yr	Acre-Feet Per Year
AMI	Advanced Metering Infrastructure
APN	Assessor's Parcel Number
AWIA	America's Water Infrastructure Act
AWWA	American Water Works Association
BART	Bay Area Rapid Transit
BAWSCA	Bay Area Water Supply And Conservation Agency
CIP	Capital Improvement Program
CIP ID	Capital Improvement Program ID
City	City of Milpitas
COF	Consequence Of Failure
County	Santa Clara County
CVP	Central Valley Project
CY	Calendar Year
DDW	Division of Drinking Water
Delta	Sacramento-San Joaquin Delta
DIP	Ductile Iron Pipe
DWR	Department of Water Resources
EIR	Environmental Impact Report
EPRV	Emergency Pressure Reducing Valve
ERP	Emergency Response Plan
Ft/kft	Feet Per 1,000 Feet
Ft/s	Feet Per Second
GIS	Geographical Information System
gpcd	Gallons Per Capita Per Day
gpd	Gallons Per Day
HGL	Hydraulic Grade Line
HPR	Hydrant Pressure Recorder
HydroScience	HydroScience Engineers, Inc.
I-680	Interstate 680
I-880	Interstate 880
ISG	Individual Supply Guarantee
Legislature	California State Legislature

LOF	Likelihood of Failure
LUA Report	Land Use Alternatives Report
LWU	Large Water Users
Maddaus	Maddaus Water Management, Inc.
MDD	Maximum Day Demand
MG	Million Gallons
mgd	Million Gallons Per Day
msl	Mean Sea Level
MSP	Midtown Specific Plan
MWELO	Model Water Efficient Landscape Ordinance
NRW	Non-Revenue Water
PG&E	Pacific Gas and Electric
PHD	Peak Hour Demand
PM	Preventative Maintenance
PRVs	Pressure Reducing Valves
PS	Pump Station
Psi	Pounds Per Square Inch
PVC	Polyvinyl Chloride
R&R	Rehabilitation and Replacement
RMC	Raines, Melton & Carella
RRA	Risk and Resilience Assessment
RWS	Regional Water System
SB X7-7	Water Conservation Act of 2009
SBWR	South Bay Water Recycling
SCADA	Supervisory Control and Data Acquisition
SCVWD	Santa Clara Valley Water District
SFPUC	San Francisco Public Utilities Commission
SJW	San Jose Water
SOI	Sphere of Influence
SWRCB	State Water Resources Control Board
TASP	Transit Area Specific Plan
TDH	Total Dynamic Head
UPC	Uniform Plumbing Code
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
VTA	Valley Transit Authority
VW	Valley Water
WTP	Water Treatment Plant
WUF	Water Use Factors

WATER MASTER PLAN PURPOSE

The purpose of this Water Master Plan for the City of Milpitas (City) is to evaluate the existing system infrastructure and incorporate impacts of short-term and long-term planned growth to develop a comprehensive road map for the City's Water System Capital Improvement Program (CIP). The City's last Water Master Plan was completed in 2002 and was then updated in 2009 to incorporate an analysis of the impacts of the City's Milpitas Metro Specific Plan (then known as the Transit Area Specific Plan). The City is continuing to experience significant growth and is currently in the process of updating its General Plan and two key specific plans, Milpitas Gateway-Main Street Specific Plan (formerly known as the Midtown Specific Plan) and Milpitas Metro Specific Plan.

Since the completion of the 2009 Water Master Plan Update (2009 WMPU), the State endured five years of drought starting in 2012, including the driest four consecutive years in California history (2012-2015). These unprecedented conditions led to statewide mandated water conservation, significant surface water supply reductions and curtailments, and legislation establishing new statewide water efficiency standards and contributing to new water use patterns and trends.

These factors make it critical to both reassess the City's water needs, priorities, and strategies and reevaluate water system infrastructure improvements, with a goal of ensuring a safe and reliable water supply for the City's residents and businesses.

WATER MASTER PLAN OBJECTIVES

The primary objectives of this Water Master Plan are to:

- Evaluate historical and existing water demands to understand current water use patterns, trends, and unit water use factors and develop future water demand projections based on current updates being made to the General Plan
- Review and refine performance and planning criteria used to evaluate the water system and formulate recommendations for future facilities
- Perform a condition assessment of the City's water assets, including evaluating criticality and likelihood of failure, consequence of failure, and business risk exposure for horizontal assets (e.g., pipes, valves) and vertical assets (e.g., reservoirs, pump stations)
- Prepare a water utility asset renewal and replacement study to provide priorities for asset renewal and replacement
- Develop and calibrate the City's water system hydraulic model using InfoWater modeling software to provide an accurate tool for evaluating various water system scenarios
- Evaluate the need for new backbone water facilities (including pipelines, storage facilities and pumping facilities) to serve buildout of the City's General Plan (estimated by the year 2040)
- Evaluate existing and projected source capacity (per Section 64558, Title 22, of the California Code of Regulations) to ensure that adequate storage is provided throughout the City's water system to meet existing and future needs and requirements
- Develop a capital improvement program for recommended potable water system facilities

EXISTING AND PROJECTED FUTURE LAND USE

Most of the City's existing land use is single family residential, which is located primarily in the north and the east. Industrial and commercial land uses comprise much of the City's southern and western regions. The City anticipates future growth in the form of smaller development projects identified in several Opportunity Areas located throughout the City and significant new development in two large planning areas (Gateway-Main Street and Metro Plan areas). Opportunity Areas were previously defined by the City's Planning and Economic Development departments and represent locations throughout the City that can accommodate future growth and support economic development while protecting natural resources and open space.

Figure ES-1 shows the locations of each Opportunity Area and briefly describes the land use plan for that area. Growth strategies and goals are outlined in the City's General Plan and detailed for Gateway-Main Street and the Metro Plan Area in their respective specific plans.

Since updates to the General Plan, Milpitas Gateway-Main Street Specific Plan, and Milpitas Metro Specific Plan are currently in progress, West Yost coordinated with the City's Planning Department and HydroScience Engineers, Inc. (HydroScience), who is developing the City's Sewer Master Plan, to develop land use planning assumptions for use in the Water and Sewer Master Plans. These future land use assumptions are preliminary but represent conservative estimates of future development.

Table ES-1 summarizes buildout land use assumptions used in this report to model potential future growth. This Water Master Plan conservatively assumes the high end of the dwelling unit range will be constructed, and that areas shown in Table ES-1 are additional new development (not redevelopment). While this "new development" assumption may double-count some existing demands in growth areas where redevelopment occurs, it was necessary based on limited data. Parcel-specific development data was not available, so West Yost could not identify whether a future development was replacing an existing development (and replacing existing water use) or in addition to existing development (with additional water use).

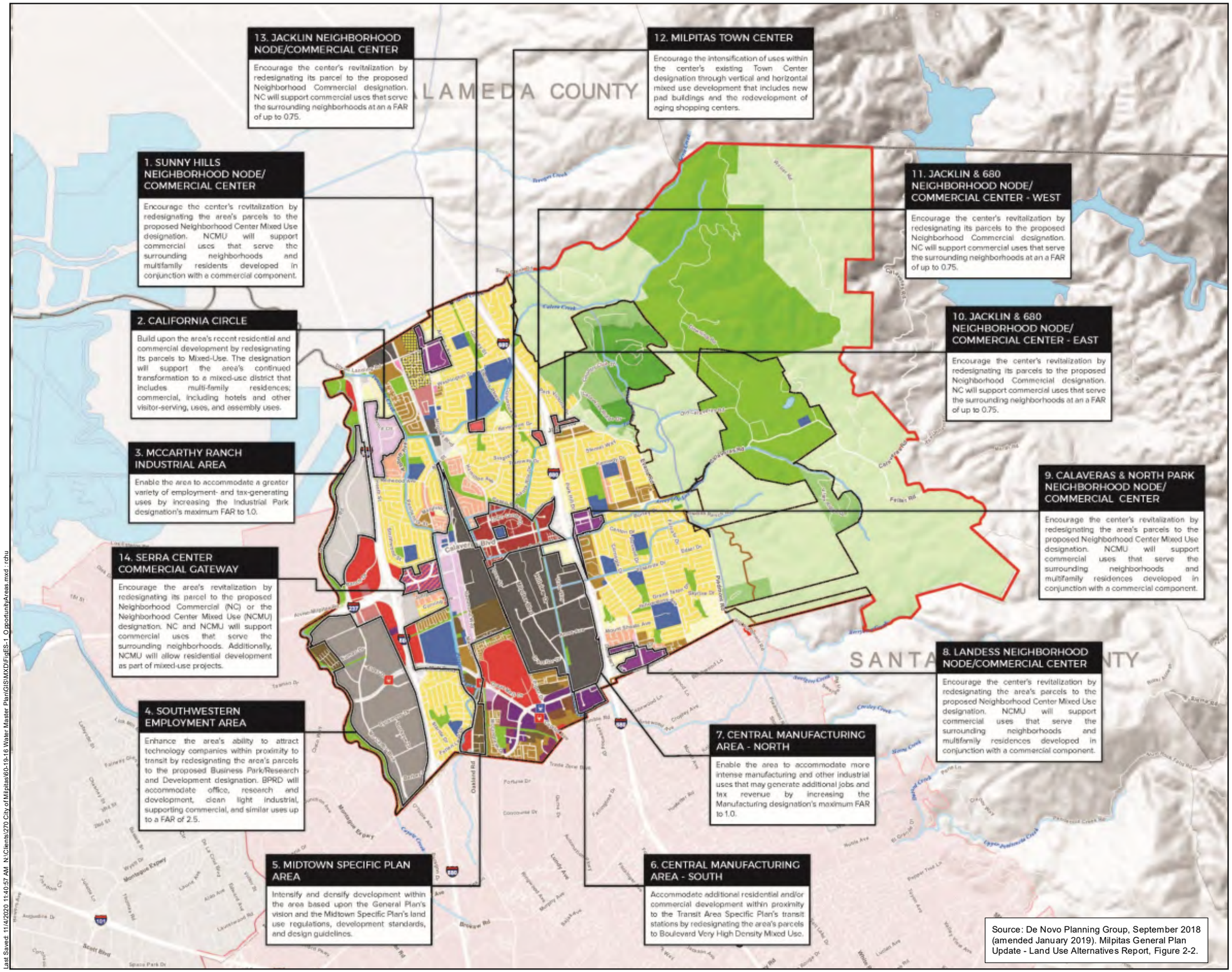

Figure ES-1

Opportunity Areas

City of Milpitas
2020 Water Master Plan

Table ES-1. Potential New Growth at Buildout[a]

Development	Land Use Designation[b]	Total Acres	Range of Potential New Dwelling Units		New Non-Residential Building Square Footage
			Low	High	
Opportunity Areas - Residential					
Sunny Hills Neighborhood Node/Commercial Center	NCMU	19.92	275	350	569,573
California Circle	NCMU	54.10	248	360	551,816
California Circle	HDR	18.26	252	365	551,816
Landess Neighborhood Node/Commercial Center	NCMU	38.03	450	625	521,274
Calaveras & North Park Neighborhood Node/Commercial Center	NCMU	28.28	325	425	416,836
Milpitas Town Center	HDR[c]	38.07	400	525	434,872
	Subtotal	196.66	1,950	2,650	3,046,187
Opportunity Areas - Non-Residential					
McCarthy Ranch Industrial Area	INP	192.29	-	-	3,049,301
Southwestern Employment Area	BPRD	488.26	-	-	5,126,097
Central Manufacturing Area - North	MFG	492.14	-	-	2,602,882
Jacklin & 680 Neighborhood Node/Commercial Center - East	NC	7.95	-	-	152,321
Jacklin & 680 Neighborhood Node/Commercial Center - West	NC	6.42	-	-	75,502
Jacklin Neighborhood Node/Commercial Center	NC	9.79	-	-	99,629
	Subtotal	1,196.85	-	-	11,105,732
Milpitas Gateway-Main Street Specific Plan					
HDR Subset of Gateway-Main Street	HDR[c]	46.70	478	637	-
VHDR Subset of Gateway-Main Street	VHDR[e]	74.58	781	1,041	-
MDR Subset of Gateway-Main Street	MDR[f]	62.70	242	322	483,391
Non-Residential Subset of Gateway-Main Street	MFG[g]	300.30	-	-	954,012
	Subtotal	484.28	1,500	2,000	1,437,403
Milpitas Metro Specific Plan					
VHDR Subset of Metro Plan Area	VHDR	99.00	2,000	4,000	-
HDR Subset of Metro Plan Area	HDR	113.52	3,000	3,000	-
NC Subset of Metro Plan Area[h]	NC	85.35	-	-	2,087,075
	Subtotal	297.87	5,000	7,000	2,087,075
	Total	**2,176**	**8,450**	**11,650**	**17,676,397**

(a) Source: City of Milpitas - Buildout Land Use Condition Assumptions, HydroScience Engineers, August 3, 2020.

(b) Land Use Designations based on Preferred Land Use Map (PLUM), Figure 2-3.

(c) Originally Multifamily High Density (MFH), which has been renamed High Density Residential (HDR) in the PLUM.

(d) Originally Boulevard Very High Density Mixed Use (BVMU), which has been renamed Very High Density Mixed Use (VHDMU) in the PLUM.

(e) Originally Multi-Family Very High Density (VHD), which has been renamed Very High Density Residential (VHDR) in the PLUM.

(f) Originally Mixed Use (MXD), which has been retired in the PLUM. This subset has been recategorized as Medium Density Residential (MDR) based on housing density. MDR is the updated name for Multi-Family Medium Density (MFM).

(g) Originally multiple land uses, Manufacturing (MFG) selected because it is the most conservative (i.e., highest water use).

(h) Includes the "Central Manufacturing Area - South" Opportunity Area, which has been combined with MMSP.

EXISTING WATER SYSTEM FACILITIES

The City's existing potable water system includes the following major facilities: five turnouts, one emergency groundwater well, three emergency interties, five storage reservoirs, five pump stations, 17 pressure reducing valves (PRVs), and approximately 183 miles of pipelines.

There are six main pressure zones within the City's water service area, four served by the San Francisco Public Utilities Commission (SFPUC) (Zones SF1 through SF4), and two served by Valley Water (VW) (Zones VW1 and VW2), which was previously known as the Santa Clara Valley Water District. Under normal conditions, the City operates its potable water system such that the SFPUC and VW supplies remain separate. Isolation valves prevent mixing and create two distinct water service areas.

EXISTING AND PROJECTED FUTURE WATER SUPPLIES

The City's existing water supplies include imported water, groundwater, recycled water, and interties with neighboring agencies. Under normal conditions, imported water comprises the City's entire water supply. The City currently receives water supplies from the following sources:

- Treated surface water from the SFPUC
- Treated surface water from VW
- Tertiary treated recycled water from South Bay Water Recycling (SBWR)
- During emergencies, groundwater pumped from one well (Pinewood Well) within the City
- Emergency interties with San Jose Water (SJW) and the Alameda County Water District (ACWD)

In 2009, the SFPUC and Bay Area Water Supply and Conservation Agency (BAWSCA) members (including the City) entered into a Water Supply Agreement (WSA), a 25-year contract that allocates 184 million gallons per day (mgd) among BAWSCA members. The City's share of SFPUC supply is 9.23 mgd. Per the City's contract with VW, the City submits a request every three years detailing its desired annual supplies from VW. In each of the three years after submitting the request, the City is obligated to purchase at least 95 percent of the maximum annual amount listed on the schedule.

Based on the City's 2015 Urban Water Management Plan (2015 UWMP), the City expects to meet future water demands with the existing imported surface water supplies described above. As a result, there are no plans to develop new supply sources. However, the City hopes to increase future supply reliability by expanding its groundwater capabilities. Two new wells, the Curtis Well and the McCandless Well, are expected to come online during the City's buildout horizon (i.e., by 2040). To further improve supply reliability, this Water Master Plan also recommends that the City construct an additional VW turnout.

EXISTING AND PROJECTED FUTURE WATER DEMANDS

In 2019, the City served approximately 78,000 residents and used approximately 8.33 mgd of water. This translates to approximately 107 gallons per capita per day (gpcd), continuing a trend of lower per capita water use following the recent drought and subsequent mandatory water reduction measures. The City is on track to comply with its 2020 per capita water use target of 146 gpcd.

Buildout water demands equal the sum of existing demands and projected future demands as a result of new development. Demand projections are typically calculated based on land use, with expected land area multiplied by a water use factor (WUF). The WUFs are developed from recent historical consumption data and vary by land use type. In other words, the WUFs recognize that a 10-acre industrial processing plant would use more water than a similarly sized office park

West Yost developed preliminary WUFs for each General Plan land use designation based on existing demands (from billing data) and parcel acreages. These preliminary WUFs were refined by examining water use on a per capita basis and for representative developments (e.g., a typical office park or apartment complex), as identified by the City. Water demand projections were developed by applying finalized WUFs to future land use acreages summarized in Table ES-1.

Table ES-2 summarizes the buildout water demand projection. The City's projected water production required at buildout is approximately 13.9 mgd, or 15,600 acre feet per year (af/yr). This is an increase of approximately 5.6 mgd, or 67 percent, over existing (2019) production (8.3 mgd).

The land use-based water demand projection presented above is significantly lower than projections from the 2009 WMPU and the City's 2015 UWMP. At buildout (2040), the land use-based water demand projection is approximately 3.5 mgd and 7.0 mgd lower than projections from the 2009 WMPU and 2015 UWMP, respectively. In contrast, demand projections in this Water Master Plan are generally consistent with demand projections developed by Maddaus Water Management, Inc. (Maddaus) to help BAWSCA member agencies prepare for their 2020 UWMPs.

Table ES-2. Buildout Potable Water Demand Projection

Development	Land Use Designation[a]	Total Acres[a]	WUF[b], gpd/ac	Demand, mgd
Opportunity Areas - Residential				
Sunny Hills Neighborhood Node/Commercial Center	NCMU	19.92	2,100	0.04
California Circle	NCMU	54.10	2,100	0.11
California Circle	HDR	18.26	4,500	0.08
Landess Neighborhood Node/Commercial Center	NCMU	38.03	2,100	0.08
Calaveras & North Park Neighborhood Node/Commercial Center	NCMU	28.28	2,100	0.06
Milpitas Town Center	HDR	38.07	4,500	0.17
			Subtotal	0.55
Opportunity Areas - Non-Residential				
McCarthy Ranch Industrial Area	INP	192.29	400	0.08
Southwestern Employment Area	BPRD	488.26	400	0.20
Central Manufacturing Area - North	MFG	492.14	2,000	0.98
Jacklin & 680 Neighborhood Node/Commercial Center - East	NC	7.95	1,400	0.01
Jacklin & 680 Neighborhood Node/Commercial Center - West	NC	6.42	1,400	0.01
Jacklin Neighborhood Node/Commercial Center	NC	9.79	1,400	0.01
			Subtotal	1.29
Milpitas Gateway-Main Street Specific Plan				
HDR Subset of Gateway-Main Street	HDR	46.70	4,500	0.21
VHDR Subset of Gateway-Main Street	VHDR	74.58	9,000	0.67
MDR Subset of Gateway-Main Street	MDR	62.70	2,300	0.14
Non-Residential Subset of Gateway-Main Street	MFG	300.30	2,000	0.60
			Subtotal	1.63
Milpitas Metro Specific Plan (MMSP)				
VHDR Subset of Metro Plan Area	VHDR	99.00	9,000	0.89
HDR Subset of Metro Plan Area	HDR	113.52	4,500	0.51
NC Subset of Metro Plan Area	NC	85.35	1,400	0.12
			Subtotal	1.52
			Total New Demand	4.99
			NRW (11%)	0.62
			New Water Production Required	5.60
			Existing (2019) Water Production	8.33
			Buildout Water Production Required	**13.9**

(a) Refer to Table ES-1.

(b) Refer to Table 5-8.

EVALUATION OF EXISTING WATER SYSTEM

The City's existing water system was evaluated based on supply, storage, and pumping capacities, as well as its ability to meet recommended performance and operational criteria under various demand and emergency scenarios. Below is a summary of findings and recommendations from the existing system evaluation. Figure ES-2 shows the recommended improvements from the existing system analysis.

- Supply Capacity
  - Existing firm supplies (i.e., largest turnout offline in each service area) exceed maximum day demand. While the VW service area has a firm supply deficit, it can be met by the surplus in the SFPUC service area. While supplies from SFPUC and VW are normally segregated, the City can intermix supply sources if necessary. No additional supply facilities are recommended based on existing demands and normal operating conditions.
- Storage Capacity
  - There is sufficient storage in the SFPUC service area and a deficit of 0.45 million gallons (MG) in the VW service area. This deficit is not considered critical, as the Zone SF1 storage surplus can cover the shortfall in Zones VW1 and VW2. No additional storage is recommended based on existing demands and normal operating conditions.
- Pumping Capacity
  - Each pressure zone has a pumping capacity surplus. No additional pumping facilities are recommended based on existing demands and normal operating conditions.
- Distribution System
  - The existing distribution system meets all minimum pressure criteria under average day, peak hour, and maximum day demand conditions.
  - Based on fire flow analysis, West Yost identified potential projects to improve overall distribution system flows. These mainly consist of upsizing existing 6-inch and 8-inch diameter pipelines, though some PRV and isolation valve improvements are also recommended.
  - To comply with the City's design guidelines and improve fire flow capacity, the City should consider upsizing any 4-inch diameter pipelines that serve hydrants to 8-inch diameter pipelines.
  - Should SFPUC turnouts go offline, most of Zone SF2 has reduced fire flow capacity. As a result, West Yost recommends installing a pump at the Ayer Pump Station with a capacity of 4,000 gallons per minute (gpm).
  - The existing system is well equipped to handle a power outage or a VW supply outage. No additional significant impacts arise in either emergency scenario.
  - To evaluate system performance during a PRV outage, PRVs normally allowing flow from Zone 2 to Zone 1 were simulated to be disabled one at a time. The Sunnyhills and Parc Metro PRVs are the most critical, as outages at either of these PRVs results in new locations not meeting recommended fire flows. Recommended improvements include a new emergency PRV (EPRV), new pipelines, and pipeline upsizing.

Diel EPRV

Hammond EPRV

Backup Generators

Ayer Fire Pump

DIXON LANDING RD
PARK VICTORIA DR
N MILPITAS BL
JACKLIN RD
ESHELEY PL
ABEL ST
N CALAVERAS BL
237
880
680
E CALAVERAS BL
CALAVERAS RD
PIEDMONT RD
ROSEMILL DR
S PARK VICTORIA DR
S MILPITAS BL
GREAT MALL DR
MONTAGUE EX
TASMAN DR
W MONTAGUE EX
PS
W

Notes:
1. Pipeline improvements include new pipes and existing pipes upsized to address existing deficiencies.

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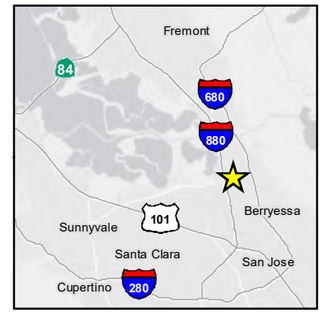


N

0 1,500 3,000

Scale in Feet

Recommended Improvements

- Emergency PRV
- Improved Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure ES-2

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

EVALUATION OF FUTURE WATER SYSTEM

The City's buildout water system was evaluated based on supply, storage, and pumping capacities, as well as its ability to meet recommended performance and operational criteria under various demand and emergency scenarios. At buildout, it is assumed that Curtis Well and McCandless Well would be available in emergencies. While the City does not currently anticipate any other major water system changes, buildout analyses assume that the infrastructure recommendations from the existing system evaluations have been implemented.

Below is a summary of findings and recommendations from the buildout system evaluation. Appendix G shows the locations of and provides details for each recommended improvement.

- Supply Capacity
  - Buildout firm supplies fall short of maximum day demands. The firm supply surplus in the SFPUC service area cannot make up for the deficit in the VW service area. Thus, West Yost recommends constructing a new VW turnout near the intersection of Piper Drive and Garden Street with the same capacity as the existing Gibraltar turnout.
- Storage Capacity
  - Buildout storage capacity is insufficient. The storage capacity surplus in the SFPUC service area cannot make up for the deficit in the VW service area. West Yost recommends constructing a new 2 MG storage reservoir in the VW service area.
  - To deliver water from this new storage reservoir, West Yost recommends constructing a new pump station with a firm capacity of 4,000 gpm.
- Pumping Capacity
  - Each pressure zone has a pumping capacity surplus. No additional pumping facilities are recommended to meet buildout demands.
- Distribution System
  - The buildout distribution system meets the minimum pressure criterion under a peak hour demand condition.
  - To address locations not meeting recommended fire flows, West Yost recommends installing a new EPRV near the intersection of Cedar Way and South Main Street. The Cedar EPRV would allow flows from Zone SF1 to Zone VW1 should pressures in Zone VW1 drop significantly.

ASSET RENEWAL AND REPLACEMENT

For assets in the City's water distribution system, West Yost performed a condition assessment that focused on risk, a combination of an asset's likelihood of failure and consequence of failure. Assets were then grouped according to three risk levels: A (Watch), B (Investigate), and C (Act). Level A is the initial action level, representing the point at which an asset or facility depicts aging or performance that requires increased attention, health checks, or predictive maintenance efforts. Assets in Level B should undergo detailed condition assessments, while assets in Level C are targets for renewal activities (e.g., inclusion in a mid-range capital improvement plan or more immediate design efforts).

Recommendations were identified based on asset classification and consist of both capital and non-capital projects. Capital projects include pipeline condition assessment, detailed facility condition assessment, and developing a water meter test program. Non-capital projects (i.e., operational improvement measures) include collecting asset performance data, developing a valve and hydrant exercising program, and reviewing the existing maintenance program to identify additional asset monitoring opportunities.

RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

The recommended CIP for the City's existing and future water system includes recommendations from the existing system evaluation, the future system evaluation, the asset renewal and replacement study, and the AWIA risk and resilience assessment. Table ES-3 summarizes the proposed CIP phasing and cost in 2020 dollars. Improvements are grouped according to their "source" (e.g., Renewal and Replacement Study), and their costs are assigned to a five-year CIP period. The total CIP cost through 2051 is approximately $78.7 million (2020 dollars).

Table ES-3. Recommended Capital Improvement Program

Improvement	Capital Cost, $M[a,b]						
	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2051[c]	Total
Improvements from Renewal and Replacement Study (Chapter 10)							
Pipeline Condition Assessment	$0.5	-	-	-	-	-	$0.5
Detailed Facility Condition Assessment	$2.2	-	-	-	-	-	$2.2
Water Meter Test Program	$0.1	-	-	-	-	-	$0.1
Asset Renewal and Replacement	$17.1	$1.4	$1.6	$3.3	$17.0	$10.1	$50.5
Subtotal	$20.0	$1.4	$1.6	$3.3	$17.0	$10.1	$53.4
Improvements from Existing System Analysis (Chapter 8)							
Hammond EPRV and Corning Isolation Valve	$0.5	-	-	-	-	-	$0.5
Pipeline Improvements - Fire Flow	$2.6	-	-	-	-	-	$2.6
Fire Pump at Ayer Pump Station	-	$2.1	-	-	-	-	$2.1
Diel EPRV	-	$0.5	-	-	-	-	$0.5
Pipeline Improvements and New Pipelines - Fire Flow (Outage)	-	$0.1	-	-	-	-	$0.1
Backup Generators at Country Club and Tularcitos Pump Stations	-	$0.7	-	-	-	-	$0.7
Hydrant Service Pipeline Improvements	-	$0.2	-	-	-	-	$0.2
Subtotal	$3.1	$3.5	$0.0	$0.0	$0.0	$0.0	$6.6
Improvements from Future System Analysis (Chapter 9)							
Piper Turnout	-	-	-	$0.5	-	-	$0.5
VW Storage Reservoir	-	-	$5.5	-	-	-	$5.5
Pump Station for VW Storage Reservoir	-	-	$4.1	-	-	-	$4.1
Curtis Well	-	-	$6.0	-	-	-	$6.0
Cedar EPRV	-	-	$0.5	-	-	-	$0.5
Subtotal	$0.0	$0.0	$16.1	$0.5	$0.0	$0.0	$16.6
Improvements from Risk and Resilience Assessment[d]							
Perimeter Fencing	$0.030	-	-	-	-	-	$0.030
Site Security Protocols	$0.020	-	-	-	-	-	$0.020
Replace Isolation Valves	$2.0	-	-	-	-	-	$2.0
ShakeAlert Participation	$0.085	-	-	-	-	-	$0.085
Subtotal	$2.1	$0.0	$0.0	$0.0	$0.0	$0.0	$2.1
Total	**$25.2**	**$4.9**	**$17.7**	**$3.8**	**$17.0**	**$10.1**	**$78.7**

(a) Costs shown are in 2020 dollars.

(b) Costs include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

(c) Includes forecasted renewal and replacement costs for the year 2051.

(d) Costs were only developed for four projects recommended in the Risk and Resilience Assessment.

CHAPTER 1
Introduction

1.1 WATER MASTER PLAN PURPOSE

The purpose of this Water Master Plan for the City of Milpitas (City) is to evaluate the existing system infrastructure and incorporate impacts of short-term and long-term planned growth to develop a comprehensive road map for the City's Water System Capital Improvement Program. The City's last Water Master Plan was completed in 2002 and was then updated in 2009 to incorporate an analysis of the impacts of the City's Milpitas Metro Specific Plan (then known as the Transit Area Specific Plan). The City is continuing to experience significant growth and is currently in the process of updating its General Plan and two key specific plans, Milpitas Gateway-Main Street Specific Plan (formerly known as the Midtown Specific Plan) and Milpitas Metro Specific Plan.

Since the completion of the 2009 Water Master Plan Update, the State endured five years of drought starting in 2012, including the driest four consecutive years in California history (2012-2015). These unprecedented conditions led to statewide mandated water conservation, significant surface water supply reductions and curtailments, and legislation establishing new statewide water efficiency standards and contributing to new water use patterns and trends.

These factors make it critical to both reassess the City's water needs, priorities, and strategies and reevaluate water system infrastructure improvements, with a goal of ensuring a safe and reliable water supply for the City's residents and businesses.

1.2 WATER MASTER PLAN OBJECTIVES

The primary objectives of this Water Master Plan are to:

- Evaluate historical and existing water demands to understand current water use patterns, trends, and unit water use factors and develop future water demand projections based on current updates being made to the General Plan
- Review and refine performance and planning criteria used to evaluate the water system and formulate recommendations for future facilities
- Perform a condition assessment of the City's water assets, including evaluating criticality and likelihood of failure, consequence of failure, and business risk exposure for horizontal assets (e.g., pipes, valves) and vertical assets (e.g., reservoirs, pump stations)
- Prepare a water utility asset renewal and replacement study to provide priorities for asset renewal and replacement
- Develop and calibrate the City's water system hydraulic model using InfoWater modeling software to provide an accurate tool for evaluating various water system scenarios
- Evaluate the need for new backbone water facilities (including pipelines, storage facilities and pumping facilities) to serve buildout of the City's General Plan (estimated by the year 2040)

- Evaluate existing and projected source capacity to ensure that adequate storage is provided throughout the City's water system to meet existing and future needs and requirements[1]
- Develop a capital improvement program for recommended potable water system facilities

1.3 PREVIOUS AND ON-GOING STUDIES

1.3.1 Previous Water Master Plans

The City's last Water Master Plan, the 2009 Water Master Plan Update (2009 Update, 2009 WMPU), was an update of the City's 2002 Water Master Plan (2002 Master Plan). The 2002 Master Plan defined the water system improvements necessary to meet the City's 2002 water demand and future demand associated with future development plans for 2008, 2018 and build-out year of 2021. The 2009 Update provided a re-evaluation of the City's water system capacity based on updated land use information from several near-term and long-term development projects, including the Transit Area Specific Plan, that were in the planning process at that time. The 2009 Update provided information required for the City's planning and financial efforts and defined the necessary water supply system improvements to accommodate the City's buildout land use.

The 2009 Update used baseline information, flow factors, and other information from the 2002 Master Plan and did not include any re-evaluation of flow factors or model calibration steps. Revised water demands were developed based on updated land use information and flow factors from the 2002 Master Plan. **In the 2009 Update, each water supply area (i.e., San Francisco Public Utilities Commission and Valley Water) was evaluated independently**. The demand conditions analyzed were peak hour demand and maximum day demand plus fire flow.

As noted above, this Water Master Plan provides a comprehensive review and evaluation of the City's existing and future water system needs through an independent evaluation in lieu of building on the 2002 Master Plan or the 2009 Update. The evaluation incorporates updates to unit water demand factors based on recent and projected water use trends and patterns to develop future demand projections, includes an update of the City's water system hydraulic model to evaluate system capacity, and reflects updates to future development plans to provide an updated and comprehensive review and evaluation of future water system needs. **Rather than evaluating each water supply area independently, this Water Master Plan better matches actual water system operations by evaluating them together as a single, citywide water system.**

1.3.2 Sewer and Storm Drain Master Plans

In parallel with this Water Master Plan, the City is also preparing a Sewer Master Plan (last updated in 2009) and a Storm Drain Master Plan (last updated in 2013). Unit water use factors, wastewater generation factors, and land use planning assumptions used in the new master plans have been coordinated for consistency as appropriate.

[1] Analyses from this Water Master Plan are referenced in the City's Source Capacity Planning Study (per Section 64558, Title 22, of the California Code of Regulations), which is being prepared as a separate deliverable.

1.3.3 City of Milpitas General Plan and Specific Plans

The City's current General Plan was adopted in December 1994 and last amended in April 2015. In May 2016, the City initiated a General Plan Update, which is a comprehensive effort to incorporate City growth and changes since 1994, as well as new laws passed, emerging social and environmental issues, and recently developed planning strategies and practices. The General Plan Update and associated Environmental Impact Report are anticipated to be completed in early 2021.

The City has two major development planning areas, the Milpitas Gateway-Main Street Specific Plan area (or Gateway-Main Street Area, formerly known as the Midtown Specific Plan area) and the Milpitas Metro Specific Plan area (or Metro Plan Area, formerly known as the Transit Area Specific Plan area). These areas have been in development over recent years, and development plans continue to be refined. Specific plans for both planning areas were last revised in 2010 (Gateway-Main Street Area, then known as Midtown) and 2011 (Metro Plan Area, then known as Transit Area) and are currently being updated to reflect current development opportunities and constraints.

Proposed future land use associated with the General Plan Update and updated Milpitas Gateway-Main Street and Milpitas Metro Specific Plans has been incorporated into this Water Master Plan and is discussed further in Chapter 2.

1.3.4 Emergency Response Plan

Also, in conjunction with this Water Master Plan, the City's Emergency Response Plan, last updated in 2010, is being updated to reflect current conditions and comply with requirements of America's Water Infrastructure Act of 2018 (AWIA). AWIA requires the City's completion of a water system Risk and Resilience Assessment (RRA) by December 31, 2020 and an updated Emergency Response Plan (ERP) by June 30, 2021. The City's RRA and ERP are prepared as separate deliverables.

1.4 REPORT ORGANIZATION

This Water Master Plan is organized into the following chapters:

Chapter 1: Introduction	Describes the purpose and objectives for the Water Master Plan, its relationship to other on-going studies, report organization and acknowledgments
Chapter 2: Water Service Area and Land Use	Describes the City's existing water service area and land uses as well as projected future land uses based on information provided by the City Planning Department on planned future development
Chapter 3: Existing Water System Facilities	Provides background information on the City's existing water system (including pressure zones, supply turnouts, groundwater wells and emergency interties) and distribution system facilities (including storage reservoirs, pump stations, pipelines, pressure reducing valves and isolation valves)

Chapter 4: Water Supply Sources	Provides an overview of the City's available water supplies, including supplies from the San Francisco Public Utilities Commission, Valley Water, City groundwater wells, and recycled water provided by South Bay Water Recycling
Chapter 5: Water Demand	Presents historical, current and projected future water demands based on the planned future development described in Chapter 2
Chapter 6: Hydraulic Model Update and Calibration	Describes the update and calibration of the City's water distribution system hydraulic model used to analyze the City distribution system performance
Chapter 7: System Planning and Performance Criteria	Defines the recommended planning and performance criteria for the City water system, including supply, storage and pumping capacity, fire flow requirements, minimum and maximum system pressures, and maximum pipeline velocity and head loss
Chapter 8: Evaluation of Existing Water System	Describes the evaluation of the City's existing water system in comparison to the criteria developed in Chapter 7 and provides recommendations for existing system improvements
Chapter 9: Evaluation of Future Water System	Describes the evaluation of the City's water system and its ability to meet projected future water demands in comparison to the criteria developed in Chapter 7 and provides recommendations for future system improvements
Chapter 10: Asset Renewal and Replacement	Presents a summary of the findings of Water Utility Condition Assessment included in Appendix D and provides a discussion of risk management guidelines and asset profiling and recommends projects and activities to manage infrastructure risk
Chapter 11: Recommended Capital Improvement Program	Based on the evaluations described in Chapters 8, 9 and 10, provides a detailed summary of recommended capital improvements for the City's water system to meet existing and projected future demands, along with estimated construction costs
Chapter 12: References	Lists reference documents used in the preparation of this Water Master Plan

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

Appendix A: Water System Schematic Profile	Provides a schematic profile of the City's existing water system as referenced in Chapter 3
Appendix B: System Operations Narratives	Includes system narratives referenced in Chapter 3 describing normal and emergency operations protocols as prepared by Glen Campi, Public Works Maintenance Manager for Utilities
Appendix C: Hydrant Testing and HPR Placement Plan	Outlines the hydrant testing that was performed in March 2020 and the associated collection of water distribution system pressure data using hydrant pressure recorders needed to calibrate the City's water system hydraulic model as described in Chapter 6
Appendix D: Water Utility Condition Assessment	Provides the Water Utility Condition Assessment performed for the City's water system and referenced in Chapter 10; includes assessment methodologies, asset valuations, likelihood and consequence of failure factors and risk scores
Appendix E: Seismic Risk Assessment	Provides the Seismic Risk Assessment performed as part of the City's RRA and referenced in Chapter 10; includes an estimate of the consequences associated with an earthquake event affecting the City water system
Appendix F: Cost Estimating Assumptions	Describes cost estimating assumptions used to estimate construction costs for recommended water system improvements as described in Chapter 11
Appendix G: Capital Improvement Program Mapbook and Project Summary Sheets	Provides figures showing the location of recommended water system improvements and, for some larger projects (e.g., EPRVs and new Ayer pump), single-page project summaries as referenced in Chapter 11

As noted above, the City's RRA and ERP are prepared as separate deliverables.

1.5 ACKNOWLEDGMENTS

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

Tony Ndah, Public Works Director

Harris Siddiqui, Principal Engineer (Project Manager for the Water Master Plan)

Glen Campi, Public Works Maintenance Manager for Utilities

Sophia Wendt, Assistant Engineer

Ned Thomas, Planning Director

Jessica Garner, Planning Manager

Kevin Riley, Milpitas Metro Specific Plan Manager

CHAPTER 2
Water Service Area and Land Use

This chapter describes the City's existing water service area and existing and future land uses. Future land use designations are based on discussions with the City Planning Department and City-provided data, reports, and maps.

2.1 WATER SERVICE AREA

2.1.1 Location and Description

Located in Santa Clara County, the City is bordered by the City of Fremont to the north and the City of San Jose to the south. Major transportation corridors connecting to the City include Highway 237, Interstate 880 (I-880), I-680, and Montague Expressway. The City is currently served by Valley Transit Authority (VTA) light rail and, as of June 2020, Bay Area Rapid Transit (BART).

As shown on Figure 2-1, the City's water service area is supplied by the San Francisco Public Utilities Commission (SFPUC) and Valley Water (VW, formerly known as the Santa Clara Valley Water District)[2]. The overall water service area is approximately 12 square miles and is generally coincident with City limits, except for some areas in the Calaveras Hills along the City's eastern edge. The City can be divided into two distinct topographical areas: the relatively flat "valley floor" on the western side and the steeper "hillside" area within the Calaveras Hills. Service elevations within the City range from near sea level in the west to almost 900 feet above mean sea level (msl) in the east.

Within its limits, the City has authority over land use and is responsible for providing public services. Figure 2-1 also shows the City's Urban Growth Boundary, the result of a voter-approved initiative that restricts development and the extension of public services and infrastructure in the eastern hill areas. In November 2016, the City voted to extend this development moratorium to December 31, 2038.

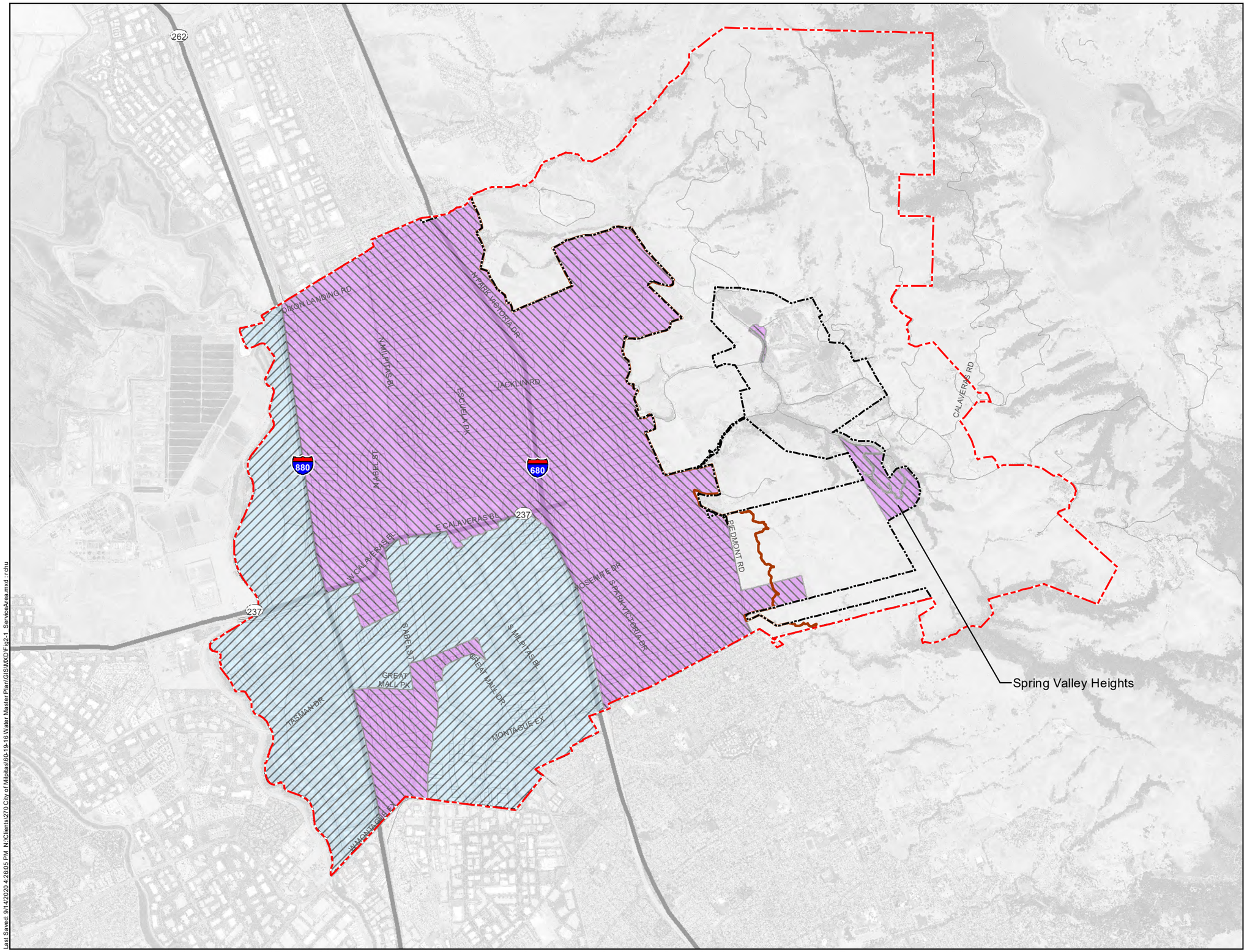
One exception to the moratorium is the Spring Valley Heights community, which is located outside the Urban Growth Boundary but served by City infrastructure. In 2005, after its groundwater supply became inadequate, the Spring Valley Heights community entered into an agreement with the City to receive potable water from its SFPUC service area. The Spring Valley Heights Association's private water system (CA Water System No. CA4300856) connects to the City's municipal supply through a master meter and is operated by the Spring Valley Heights Mutual Water Company.

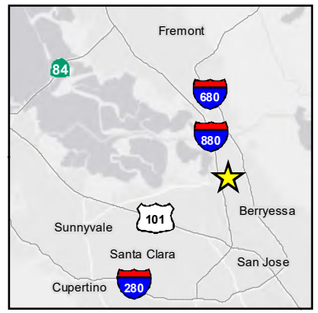
2.1.2 Population Served and Service Connections

The City was incorporated in 1954, then spanning approximately 3 square miles with a population of 825. Manufacturing, assembly, and high-tech industries have since spurred steady expansion and population growth. The California Department of Finance estimates the City's January 1, 2020 population at 77,961, which this report will use as the "existing" population for 2019. Historical population is detailed in Chapter 5 of this report.

The City has nine customer billing codes, which West Yost has organized into three categories (residential, commercial, and public) and up to three connection types (water, fire, and irrigation). Table 2-1 presents a summary of historical potable water service connections by customer and connection type. Service connection counts are based on bimonthly billing data from 2013 through 2019 provided by the City in January 2020. In calendar year (CY) 2019, the City had 16,394 metered water service connections. Almost 89 percent of connections were residential, which includes multi-family connections. Note, one multi-family connection can serve as little as two or as many as hundreds of units.

[2] In 2019, the Santa Clara Valley Water District (SCVWD) changed its name to Valley Water (VW).





N

0 1,750 3,500

Scale in Feet

Water Service Area

- SFPUC
- VW
- City Limits
- Urban Growth Boundary
- Sphere of Influence

Figure 2-1

Existing Water Service Area

City of Milpitas
2020 Water Master Plan

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Table 2-1. Historical Water Service Connections[a, b]

Customer Type	Billing Code	CY 2013		CY 2014		CY 2015		CY 2016		CY 2017		CY 2018		CY 2019	
		Number of Connections	Percent of Total	Number of Connections	Percent of Total	Number of Connections	Percent of Total	Number of Connections	Percent of Total	Number of Connections	Percent of Total	Number of Connections	Percent of Total	Number of Connections	Percent of Total
Residential															
Water	WRES	14,197	86.6%	14,244	86.8%	14,257	86.9%	14,259	87.0%	14,264	87.1%	14,280	87.2%	14,287	87.1%
Fire	FRES	108	0.7%	109	0.7%	109	0.7%	110	0.7%	110	0.7%	110	0.7%	110	0.7%
Irrigation	IRP	119	0.7%	120	0.7%	120	0.7%	120	0.7%	119	0.7%	121	0.7%	124	0.8%
Subtotal Residential		14,424	88.0%	14,473	88.2%	14,486	88.3%	14,489	88.4%	14,493	88.5%	14,511	88.6%	14,521	88.6%
Commercial															
Water	WCOMM	974	5.9%	963	5.9%	958	5.8%	954	5.8%	940	5.7%	938	5.7%	943	5.8%
Fire	FAO	462	2.8%	455	2.8%	446	2.7%	444	2.7%	438	2.7%	436	2.7%	449	2.7%
Irrigation	IP	351	2.1%	346	2.1%	341	2.1%	331	2.0%	326	2.0%	320	2.0%	312	1.9%
Subtotal Commercial		1,787	10.9%	1,764	10.7%	1,745	10.6%	1,729	10.5%	1,704	10.4%	1,694	10.3%	1,704	10.4%
Public															
Water - City	WCITY	44	0.3%	44	0.3%	44	0.3%	44	0.3%	45	0.3%	45	0.3%	46	0.3%
Water - County	WSCC	1	0.0%	1	0.0%	1	0.0%	1	0.0%	1	0.0%	1	0.0%	1	0.0%
Irrigation - City	ICP	130	0.8%	128	0.8%	129	0.8%	129	0.8%	129	0.8%	123	0.8%	122	0.7%
Subtotal Public		175	1.1%	173	1.1%	174	1.1%	174	1.1%	175	1.1%	169	1.0%	169	1.0%
Total		**16,386**	**100.0%**	**16,410**	**100.0%**	**16,405**	**100.0%**	**16,392**	**100.0%**	**16,372**	**100.0%**	**16,374**	**100.0%**	**16,394**	100.0%

(a) Source: Billing data provided by City in January 2020.
(b) Includes potable water service connections only. Recycled water connections are excluded.

2.2 EXISTING LAND USE

Most of the City's existing land use is single family residential, which is located primarily in the north and east. Industrial and commercial land uses comprise much of the City's southern and western regions. Figure 2-2 shows the City's existing land use, while Table 2-2 summarizes key land use statistics.

Table 2-2. Existing Land Use[a]

Population[b]	Dwelling Units	Non-Residential Square Footage	Jobs[c]	Jobs per Housing Unit[d]
77,961	22,215	28,007,888	53,000	2.39

(a) Unless otherwise noted, data is from the Draft Environmental Impact Report - Milpitas General Plan, Table 2.0-3, received January 2020.
(b) Source: CA Department of Finance, E-1 Population Estimates (May 1, 2020).
(c) Source: Estimate provided by the City in February 2021.
(d) Calculated based on dwelling units and jobs estimate.

The City classifies customers (excluding hotels and schools) using at least 30,000 gallons per day (gpd) as Large Water Users. To update the list of Large Water Users, West Yost reviewed City-provided billing data[3] from 2013 through 2019. Users were identified according to the "LOCATION_NO" field provided in billing records. In general, each "LOCATION_NO" corresponds to a single water meter. In CY 2019, there were 19 Large Water Users; they are ranked in Table 2-3.

Table 2-3. Large Water Users[a]

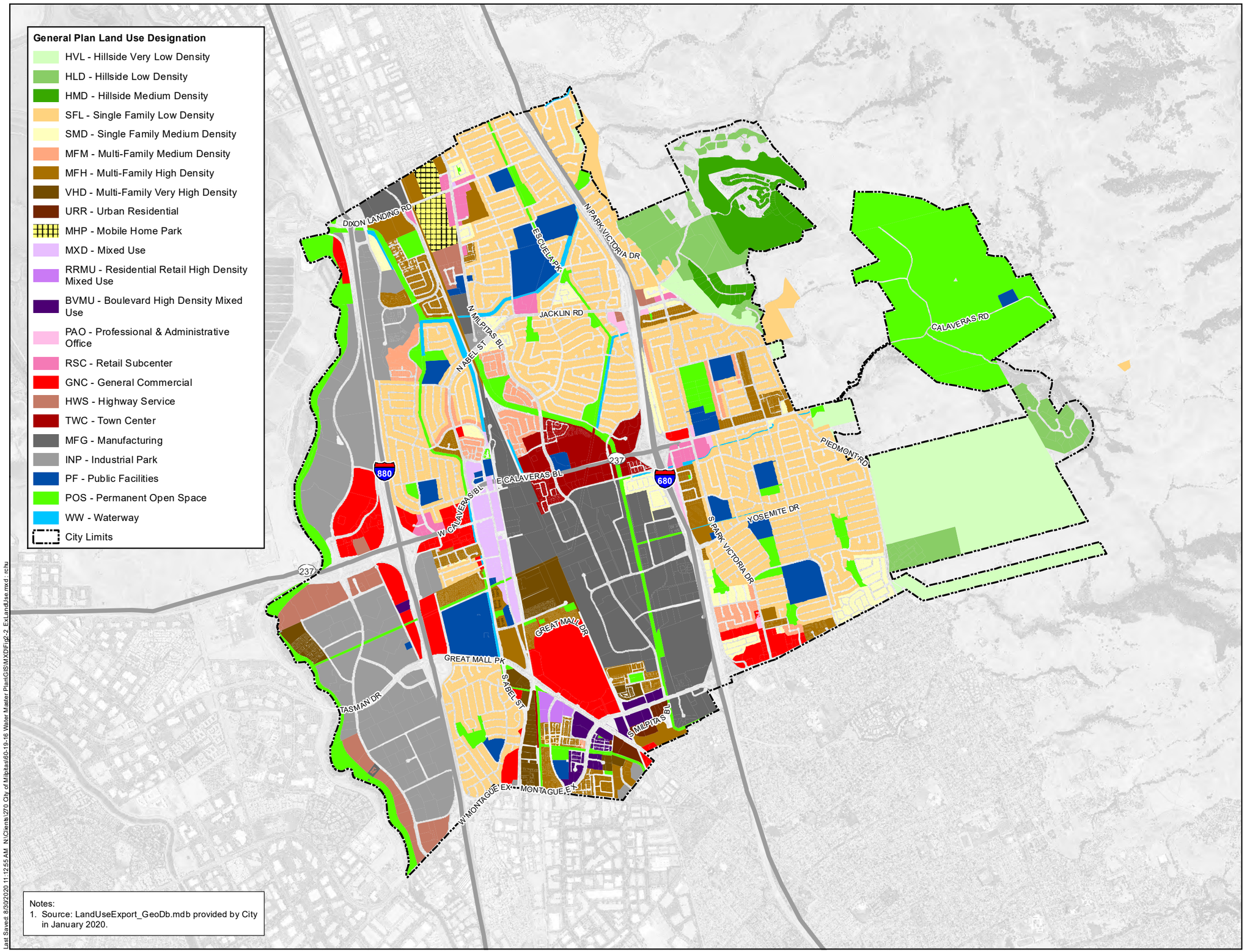
Rank	Location ID[b]	Customer	CY 2019 Consumption, gpd
1	3015659	Linear Technology	179,606
2	3015510	Evoqua Water Technologies LLC	177,956
3	3014575	SCC GSA Fiscal Bldg3	110,257
4	3015655	Headway Technologies Inc	92,605
5	3016862	Essex Management Corporation	92,074
6	3014546	Milpitas Mills LP	77,853
7	3015553	T Marzetti Company-West	73,949
8	3014577	SCC GSA Fiscal Bldg3	49,960
9	3014598	Milpitas Housing Assoc	47,336
10	3013322	City of Milpitas	39,712
11	3015908	Jefferson Smurfit Corp #200585	39,378
12	3015754	Fairfield Murphy Road LLC	38,397
13	3016857	Cisco Systems	35,091
14	3001280	Evoqua Water Technologies LLC	34,175
15	3015508	555 Apartments LLC	33,945
16	3010133	Spinnaker Pointe LLC	32,972
17	3003005	Spring Valley Apartments	31,851
18	3017196	Corwil Technology	31,291
19	3001229	KLA-Tencor	29,969
		Total	**1,248,376**

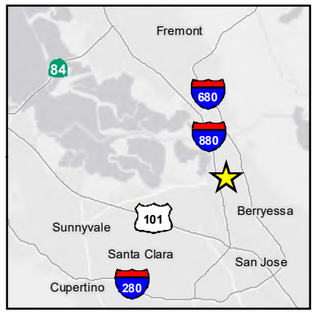
(a) Customer meters using at least 30,000 gpd based on City-provided billing data in January 2020. Large water users were identified based on the "LOCATION_NO" field in City billing records. Each "LOCATION_NO" generally corresponds to a single water meter.
(b) "LOCATION_NO" from City billing data.

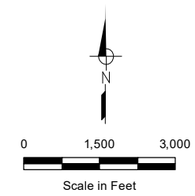
[3] Billing data was bimonthly. Usage was grouped into calendar years based on the ending date of the billing period. As a result, annual consumption may not match other sources.

General Plan Land Use Designation

- HVL - Hillside Very Low Density
- HLD - Hillside Low Density
- HMD - Hillside Medium Density
- SFL - Single Family Low Density
- SMD - Single Family Medium Density
- MFM - Multi-Family Medium Density
- MFH - Multi-Family High Density
- VHD - Multi-Family Very High Density
- URR - Urban Residential
- MHP - Mobile Home Park
- MXD - Mixed Use
- RRMU - Residential Retail High Density Mixed Use
- BVMU - Boulevard High Density Mixed Use
- PAO - Professional & Administrative Office
- RSC - Retail Subcenter
- GNC - General Commercial
- HWS - Highway Service
- TWC - Town Center
- MFG - Manufacturing
- INP - Industrial Park
- PF - Public Facilities
- POS - Permanent Open Space
- WW - Waterway
- City Limits







Notes:
1. Source: LandUseExport_GeoDb.mdb provided by City in January 2020.

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Figure 2-2

Existing Land Use

City of Milpitas
2020 Water Master Plan

2.3 FUTURE LAND USE

The City anticipates future growth in the form of smaller development projects located throughout the City and larger, more significant new development in two planning areas (Gateway-Main Street and Metro Plan). Growth strategies and goals are outlined in the City's General Plan and detailed for the Gateway-Main Street and the Metro Plan areas in their respective specific plans. These documents, which are currently being updated, are discussed further in the following sections.

2.3.1 City of Milpitas General Plan

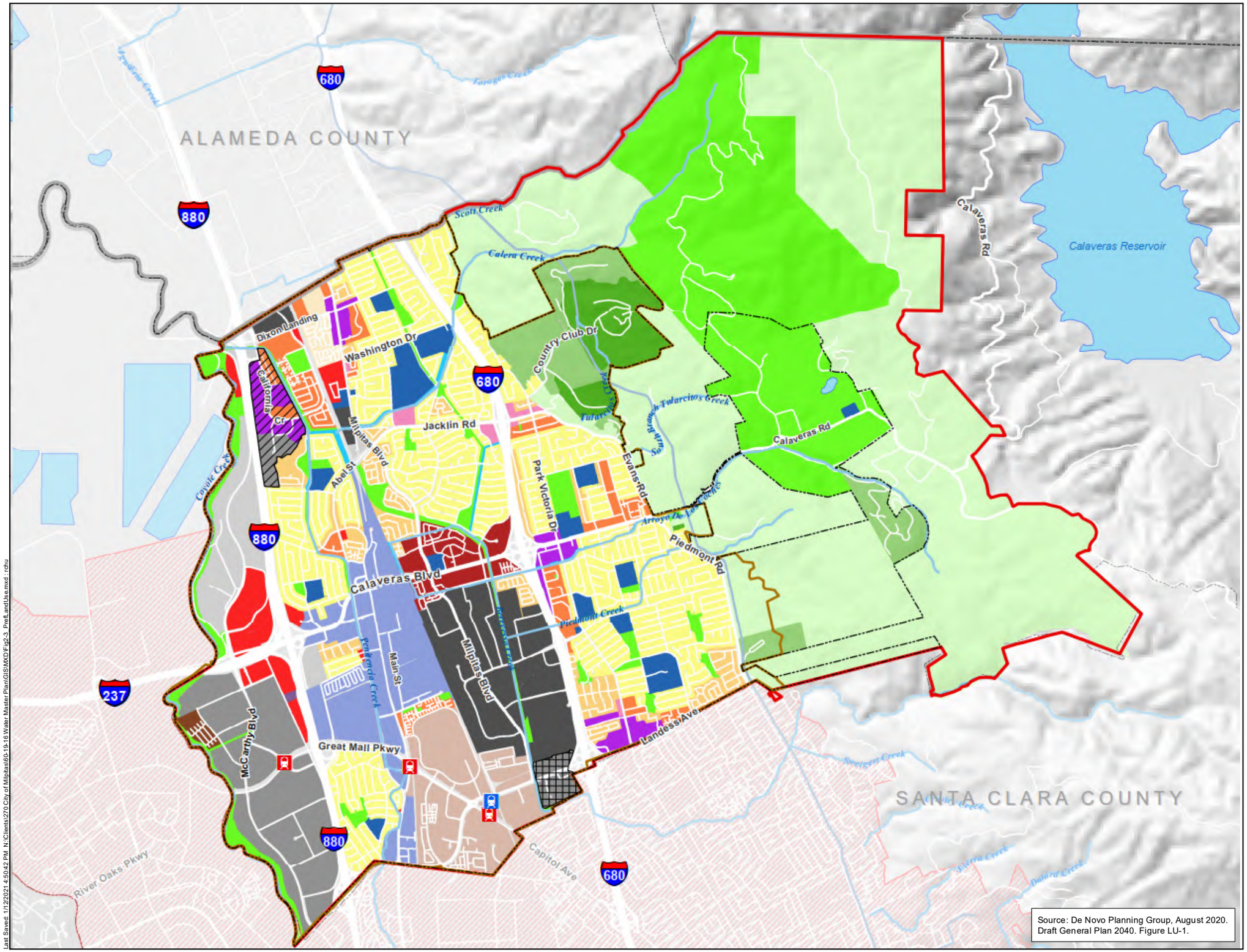
The City's General Plan details the land use plan and policies within the City's incorporated limits and Sphere of Influence (SOI), which includes incorporated and unincorporated territory that is assumed to represent the City's final boundaries and service area. The SOI is bordered by the Santa Clara-Alameda county line to the north, and the City of San Jose to the west and south.

The most recent General Plan was adopted in December 1994 and last amended in April 2015. In May 2016, the City initiated a General Plan Update, a comprehensive effort to incorporate City growth and changes since 1994, as well as new laws passed, emerging social and environmental issues, and recently developed planning strategies and practices. The General Plan Update and associated Environmental Impact Report (EIR) are currently in progress. Figure 2-3 shows the City's preferred land uses based on the Draft General Plan.

As part of the General Plan Update, De Novo Planning Group authored a Land Use Alternatives Report (LUA Report), which evaluates locations throughout the City that can "accommodate future growth, support economic development, maintain fiscal sustainability, and ensure adequate protection of natural resources and open space" (LUA Report). These "Opportunity Areas" are shown on Figure 2-4 of this report, which is adapted from Figure 2-2 of the LUA Report.

West Yost coordinated with the City's Planning Department and HydroScience Engineers, Inc. (HydroScience), who is developing the City's Sewer Master Plan, to develop land use planning assumptions for future residential dwelling units and non-residential square footage for use in the Water and Sewer Master Plans. Table 2-4 summarizes the buildout land use assumptions used in this report. In addition to assigning a preferred land use designation to each Opportunity Area, Table 2-4 breaks down the proposed Milpitas Gateway-Main Street Specific Plan (Gateway Specific Plan) and Milpitas Metro Specific Plan areas into specific land use components. For the purposes of developing and analyzing future system facility and capacity needs, the proposed residential developments have been assigned a range of potential new dwelling units based on coordination with the City's Planning Department.

To remain conservative, this Master Plan assumes the high end of the dwelling unit range will be constructed. In addition, this Master Plan assumes areas listed in Table 2-4 represent new development and not replacing existing developed areas. As detailed in Section 5.3.3 of this report, this means that water demands from growth areas will be in addition to (and not replacing) any existing water demands in those areas. Lastly, land use assumptions in Table 2-4 are preliminary and will be refined as the City updates the General Plan, Gateway Specific Plan, and Milpitas Metro Specific Plan.



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Legend

- HVL - Hillside Very Low Density
- HLD - Hillside Low Density
- HMD - Hillside Medium Density
- LDR - Low Density Residential
- MDR - Medium Density Residential
- HDR - High Density Residential
- VHDR - Very High Density Residential
- MHP - Mobile Home Park
- VHDMU - Very High Density Mixed Use
- NCMU - Neighborhood Commercial Mixed Use
- GNC - General Commercial
- NC - Neighborhood Commercial
- TWC - Town Center
- INP - Industrial Park
- BPRD - Business Park/Research & Development
- MFG - Manufacturing
- PF - Public Facilities
- POS - Permanent Open Space
- MMSP - Milpitas Metro Specific Plan
- MGSP-Milpitas Gateway-Main Street Specific Plan
- WW - Waterway
- Future Specific Plan Overlay
- Innovation District Overlay

Planning Areas

- City of Milpitas
- Milpitas Sphere of Influence
- Milpitas Urban Service Area
- San Jose Planning Limits of Urban Growth
- County Boundary

Transit Stations

- BART Station
- VTA Station

Figure 2-3

Preferred Land Use

City of Milpitas
2020 Water Master Plan

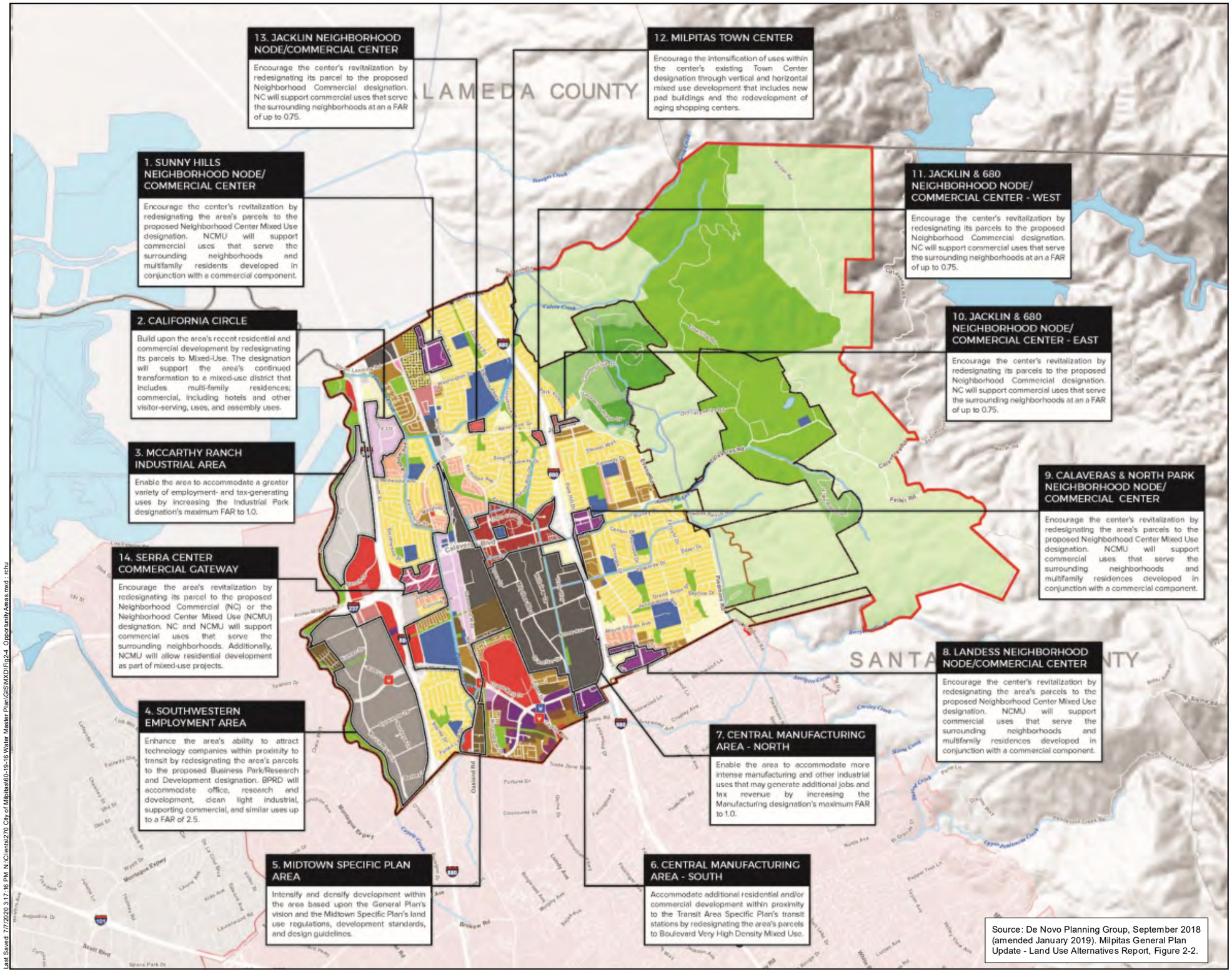


Figure 2-4

Opportunity Areas

City of Milpitas
2020 Water Master Plan

Table 2-4. Potential New Growth at Buildout[a]

Development	Land Use Designation[b]	Total Acres	Range of Potential New Dwelling Units		New Non-Residential Building Square Footage
			Low	High	
Opportunity Areas - Residential					
Sunny Hills Neighborhood Node/Commercial Center	NCMU	19.92	275	350	569,573
California Circle	NCMU	54.10	248	360	551,816
California Circle	HDR	18.26	252	365	551,816
Landess Neighborhood Node/Commercial Center	NCMU	38.03	450	625	521,274
Calaveras & North Park Neighborhood Node/Commercial Center	NCMU	28.28	325	425	416,836
Milpitas Town Center	HDR[c]	38.07	400	525	434,872
	Subtotal	196.66	1,950	2,650	3,046,187
Opportunity Areas - Non-Residential					
McCarthy Ranch Industrial Area	INP	192.29	-	-	3,049,301
Southwestern Employment Area	BPRD	488.26	-	-	5,126,097
Central Manufacturing Area - North	MFG	492.14	-	-	2,602,882
Jacklin & 680 Neighborhood Node/Commercial Center - East	NC	7.95	-	-	152,321
Jacklin & 680 Neighborhood Node/Commercial Center - West	NC	6.42	-	-	75,502
Jacklin Neighborhood Node/Commercial Center	NC	9.79	-	-	99,629
	Subtotal	1,196.85	-	-	11,105,732
Milpitas Gateway-Main Street Specific Plan					
HDR Subset of Gateway-Main Street	HDR[c]	46.70	478	637	-
VHDR Subset of Gateway-Main Street	VHDR[e]	74.58	781	1,041	-
MDR Subset of Gateway-Main Street	MDR[f]	62.70	242	322	483,391
Non-Residential Subset of Gateway-Main Street	MFG[g]	300.30	-	-	954,012
	Subtotal	484.28	1,500	2,000	1,437,403
Milpitas Metro Specific Plan					
VHDR Subset of Metro Plan Area	VHDR	99.00	2,000	4,000	-
HDR Subset of Metro Plan Area	HDR	113.52	3,000	3,000	-
NC Subset of Metro Plan Area[h]	NC	85.35	-	-	2,087,075
	Subtotal	297.87	5,000	7,000	2,087,075
	Total	**2,176**	**8,450**	**11,650**	**17,676,397**

(a) Source: City of Milpitas - Buildout Land Use Condition Assumptions, HydroScience Engineers, August 3, 2020.

(b) Land Use Designations based on Preferred Land Use Map (PLUM), Figure 2-3.

(c) Originally Multifamily High Density (MFH), which has been renamed High Density Residential (HDR) in the PLUM.

(d) Originally Boulevard Very High Density Mixed Use (BVMU), which has been renamed Very High Density Mixed Use (VHDMU) in the PLUM.

(e) Originally Multi-Family Very High Density (VHD), which has been renamed Very High Density Residential (VHDR) in the PLUM.

(f) Originally Mixed Use (MXD), which has been retired in the PLUM. This subset has been recategorized as Medium Density Residential (MDR) based on housing density. MDR is the updated name for Multi-Family Medium Density (MFM).

(g) Originally multiple land uses, Manufacturing (MFG) selected because it is the most conservative (i.e., highest water use).

(h) Includes the "Central Manufacturing Area - South" Opportunity Area, which has been combined with MMSP.

2.3.2 Specific Plans

Specific Plan areas, including the Milpitas Metro Specific Plan (formerly the Transit Area Specific Plan or TASP) and the Milpitas Gateway-Main Street Specific Plan (formerly the Midtown Specific Plan or MSP), are designated by the General Plan Land Use Map (see Figure 2-3). These areas have been designated as Special Planning Areas and each has an adopted or soon to be updated Specific Plan to facilitate comprehensive planning of the large strategic areas. The City is planning significant redevelopment in these Specific Plan areas, each of which had previously completed Specific Plans that are currently being updated.

The following subsections detail land use objectives for each area, based on discussions with the City Planning staff.

2.3.2.1 Milpitas Gateway-Main Street Specific Plan (Gateway Specific Plan)

Originally known as the Midtown Area, the Gateway-Main Street Area has an existing Specific Plan (Midtown Specific Plan, adopted by the City in March 2002) that was last updated in 2010. The Gateway-Main Street Area spans 589 acres and is set between I-880, I-680, Calaveras Boulevard, and the Montague Expressway in the western portion of the City. Per the 2010 plan, the overall strategy for the area is to create a mixed-use community with high-density, transit-oriented housing, a central gathering place, and necessary industrial, service, and commercial uses. Significant development has already occurred within the Gateway-Main Street Area, including new housing units and reinvestment in the Great Mall (which is outside the Gateway-Main Street Area but encompasses its vision) to expand entertainment activities.

While the City is currently updating the Milpitas Gateway-Main Street Specific Plan (henceforth known as the Gateway Specific Plan), the overall strategy is expected to remain generally the same.

As shown in Table 2-4, preliminary projections estimate an additional 1,500 to 2,000 residential dwelling units and approximately 1.4 million square feet of non-residential development at buildout within the Gateway-Main Street Area. These projections are subject to change as the Gateway Specific Plan is updated.

2.3.2.2 Milpitas Metro Specific Plan

The City adopted the current Milpitas Metro Specific Plan (then known as Transit Area Specific Plan) in June 2008, amending it in December 2011. The Metro Plan Area spans approximately 370 acres in southern Milpitas and includes two light rail stations, the new BART station, and the Great Mall. While the Metro Plan Area is within the area covered by the Gateway Specific Plan (except for a 40-acre area between Piper Drive and Milpitas Boulevard and the Great Mall, which was already outside the Gateway-Main Street Area), the Gateway Specific Plan called for the creation of a separate, detailed plan for the area near the BART station.

The Milpitas Metro Specific Plan fulfills that requirement and is independent of the Gateway Specific Plan. Currently an older industrial area in the City, the Metro Plan Area is re-envisioned in the Milpitas Metro Specific Plan as a high-density, mixed -se neighborhood that encourages walking, biking, and use of public transit. The Milpitas Metro Specific Plan is currently being updated and is expected to maintain this Metro Plan Area vision.

As shown in Table 2-4, preliminary projections estimate an additional 5,000 to 7,000 residential dwelling units, approximately 2.1 million square feet of commercial development within the Milpitas Metro Specific Plan area. These projections are subject to change as the Milpitas Metro Specific Plan is updated.

CHAPTER 3
Existing Water System Facilities

This chapter provides a summary of the City's existing key water facilities, which are shown on Figure 3-1. To provide context and understanding of the City's water system, a summary of the current water system configuration and pressure zones is provided before detailing the City's water supply and distribution facilities.

3.1 EXISTING WATER SYSTEM CONFIGURATION, OPERATIONS, AND PRESSURE ZONES

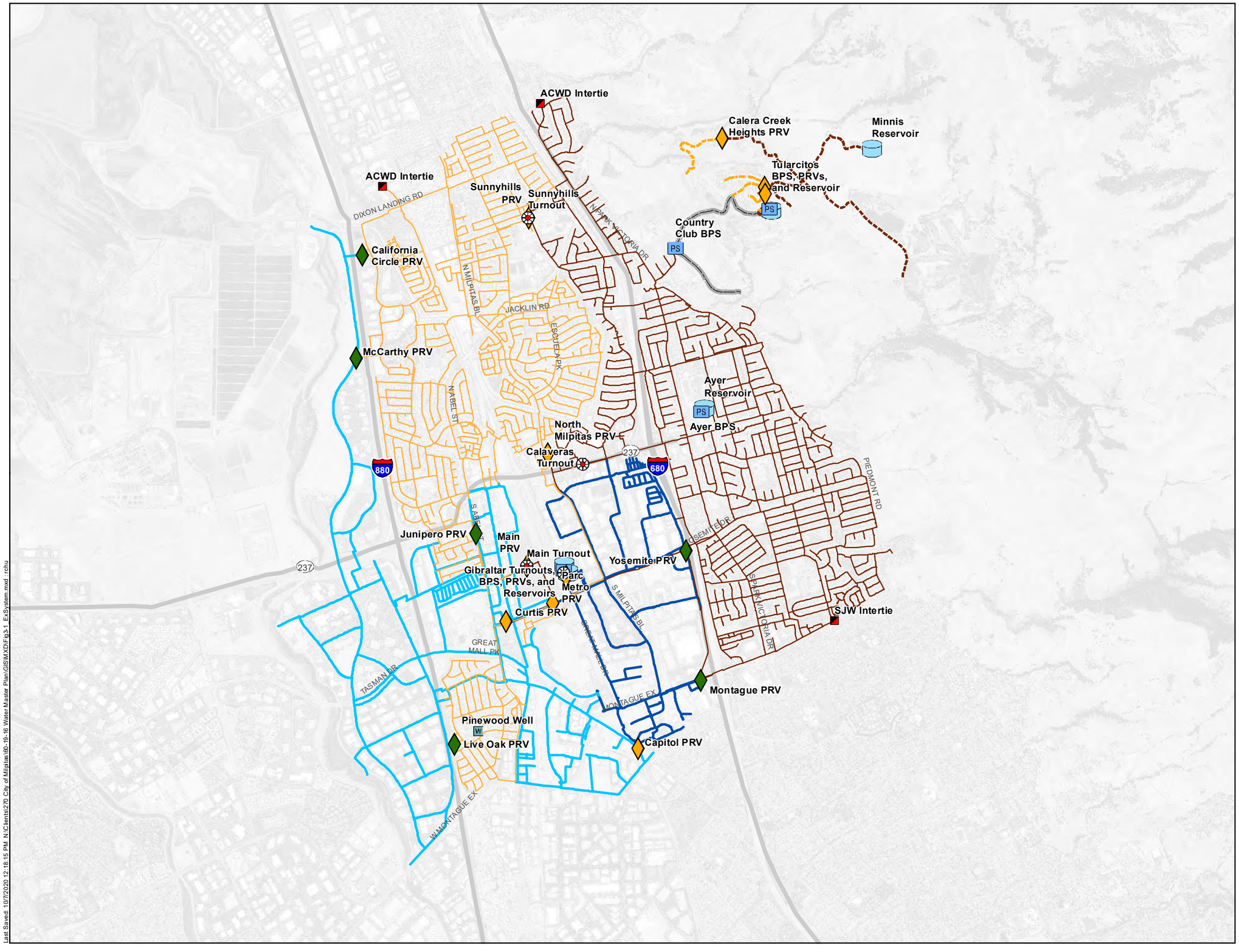
As described further in Chapter 4, the City receives water supplies from SFPUC and VW. Under normal conditions, the City operates its potable water system such that the SFPUC and VW supplies remain separate. Isolation valves prevent mixing and create two distinct water service areas. The SFPUC service area includes the City's valley floor and hillside areas, while the VW service area only encompasses the City's valley floor area. Under emergency conditions (e.g., a loss of supply from either SFPUC or VW), the City can open isolation valves that normally separate the SFPUC and VW service areas to move water between the service areas (see further discussion in Section 3.3.4).

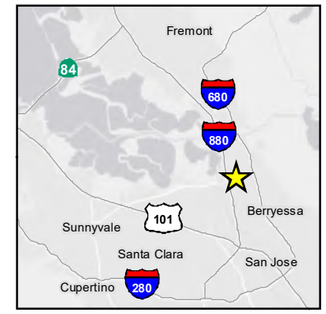
The City's valley floor area is generally served directly from SFPUC or VW turnouts, with pressure reducing valves (PRVs) reducing pressures for lower elevation customers. Storage reservoirs and their associated pump stations in the valley floor area help supply peak demands and meet emergency conditions. Additional pump stations deliver water from the valley floor area to the hillside areas and are operated based on hillside storage reservoir levels. A water system schematic profile is provided in Appendix A, along with a detailed operations narrative in Appendix B.

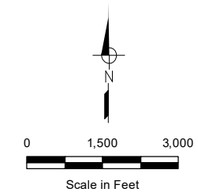
There are six main pressure zones within the City's water service area, four served by the SFPUC (Zones SF1 through SF4), and two served by VW (Zones VW1 and VW2)[4]. Water purchased from SFPUC enters the distribution system through Zone SF2 (directly) or Zone SF1 (via PRV). Zones SF3 and SF4, in the hillside areas, are supplied water from Zone SF2 through a pump station. Significant elevation differences in Zone SF4 require reducing pressures for the lower portions of the zone. As a result, Zone SF4 is split into two subzones: Zone SF4-2 (unregulated) and Zone SF4-1 (regulated via three PRVs).

VW water is regulated through a PRV before entering Zone VW2 and through additional PRVs into Zone VW1. The key characteristics of each pressure zone are summarized in Table 3-1.

[4] Note that the pressure zone designations have been renamed based on the Santa Clara Valley Water District agency name change to Valley Water. Zones VW1 and VW2 were previously known as SC1 and SC2, respectively. The rest of this Water Master Plan will use these updated pressure zone designations.







- Turnout
- Well
- Emergency Intertie
- Pressure Reducing Valve
- Emergency Pressure Reducing Valve
- Pump Station
- Storage Reservoir

Pipeline Pressure Zone

- VW1
- VW2
- SF1
- SF2
- SF3
- SF4-1
- SF4-2

Figure 3-1

Existing Water Distribution System

City of Milpitas
2020 Water Master Plan

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Table 3-1. Existing Pressure Zones

Pressure Zone	Range of Service Elevations[a], feet msl	Nominal HGL[b], feet msl	Static Service Pressure[c], psi	Water Supply Source(s)
SF1	10 – 112	200	38 - 82	Intertie Turnout via the Gibraltar Pump Station (PS) and Zone SF2 via PRVs (Main, North Milpitas, and Sunnyhills)
SF2	17 – 212	340	55 - 140	SFPUC BDPL No. 3 & 4 Turnouts (Sunnyhills, Calaveras, and Main Street)
SF3	233 – 456	545	38 - 135	Zone SF2 via Country Club PS and Tularcitos Tank
SF4-1[d]	477 – 638	740	44 - 114	Tularcitos Tank, PS, and PRVs; Minnis Tank via Zone SF4-2 and Calera Creek Heights PRV
SF4-2[d]	493 – 715	885	74 - 170	Minnis Tank (filled by Tularcitos PS)
VW1	11 – 54	200	63 - 82	Zone VW2 via Capitol, Curtis (East and West), and Parc Metro PRVs
VW2	22 – 75	325	108 - 131	VW Milpitas Pipeline Gibraltar Turnout and Gibraltar PRV

(a) Source: Valley Water LiDAR contours covering the City water service area.
(b) Source: City of Milpitas Water Distribution System Plan Schematic Profile (HydroScience Engineers) unless otherwise noted.
(c) Calculated by subtracting the highest or lowest customer service elevations within the zone from the HGL, and converting from pressure head in feet, to pressure in psi.
(d) Elevation differences in Zone SF4 require breaking pressure and splitting the zone into Zones SF4-1 and SF4-2. Zone SF4-2 is unregulated, while Zone SF4-1 is regulated by the Tularcitos North, Tularcitos South, and Calera Creek Heights PRVs.

3.2 EXISTING SUPPLY FACILITIES

The City's existing supply facilities include the following:

- Five turnouts
- One emergency groundwater well
- Three emergency interties

Normally, the City obtains all of its potable water from SFPUC and VW turnouts. However, in emergencies, it can also pump groundwater and receive water from San Jose Water (SJW) and the Alameda County Water District (ACWD) through emergency interties shown on Figure 3-1.

3.2.1 Turnouts

The City receives wholesale potable water through five turnouts, four from SFPUC Bay Division Pipelines Nos. 3 and 4, and one from VW's Milpitas Pipeline[5]. Under normal operations, water from these turnouts comprises the City's entire potable water supply. Total SFPUC turnout capacity is approximately 37 million gallons per day (mgd), while VW turnout capacity is 14.4 mgd. The SFPUC supply enters the City's system at a hydraulic grade line (HGL) of 340 feet, while VW supply enters the City's system at an HGL of 425 feet. The source, location, pressure zone(s) served, and capacity for each turnout is summarized in Table 3-2.

Table 3-2. Existing Turnouts

Name	Location	Meter Type	Meter ID(s)	Pressure Zone(s) Served	Capacity, mgd[(a)]
SFPUC Service Area					
Sunnyhills	405 Washington Drive	2-8" Neptune High Performance Turbo	4572810858 4572810888	SF1, SF2	10.1
Calaveras	584 East Calaveras Blvd.	2-8" Neptune High Performance Turbo	5000000628 5000000975	SF1, SF2	13.0
Main	534 Hammond Way	1-8" and 1-6" Neptune High Performance Turbo	9338710434 9338710803	SF1, SF2	7.9
Intertie	641 Gibraltar Court	1-10" Neptune High Performance Turbo	3117952820	SF1[(b)]	5.8
				SFPUC Total	**36.8**
VW Service Area					
Gibraltar	641 Gibraltar Court	1-20" WaterMaster Electromagnetic	3K220000195183	VW2[(c)]	14.4
				VW Total	**14.4**
				City Total	**51.2**

(a) Source: 2009 WMPU, Table 4-1.
(b) Turnout can be reconfigured to deliver SFPUC water directly to Zone VW2.
(c) Zone VW2 serves Zone VW1 via four PRVs. Refer to Table 3-1.

3.2.2 Emergency Groundwater Wells

The City currently maintains one groundwater well, the Pinewood Well, for use in emergencies. It is connected to Zone SF1 but is not used as an active potable water supply source. The Pinewood Well is permitted as an emergency well, so it cannot be operated more than 15 calendar days per year, and not more than five consecutive days each year. The Pinewood Well can produce approximately 1.7 mgd (per the 2009 WMPU) and is equipped with a chlorination facility and a plug-in adapter and transfer switch to receive power from a portable generator.

[5] Also known as the East Pipeline.

The City anticipates adding two additional wells, Curtis Well and McCandless Well, to its supply portfolio in the future. These future wells are discussed in Chapter 4 of this report.

3.2.3 Emergency Interties

The City has three interties with two partner agencies, SJW and ACWD, for a total capacity of approximately 7.1 mgd. These emergency interties are all manually activated with mutual agreement between the City and the partner agency with at least two hours' notice. The 8-inch intertie with SJW is located at Landess Avenue and Corktree Lane and can serve Zones SF2, SF3, and SF4. Per City operations staff, the SJW intertie has no flushing points and needs to be upgraded to allow routine operation and flushing. There are two 8-inch interties with ACWD, with one serving Zone SF1 and the other serving Zone SF2. However, the City and ACWD water systems normally operate under significantly different pressures. Key information for all three emergency interties is summarized in Table 3-3. The SJW intertie has not been used, while the Milmont and Green Valley Road interties were last used in May 2010 and January 2016, respectively.

Table 3-3. Existing Emergency Interties

Partner Agency	Location	Pressure Zone(s) Served	Intertie Type	Intertie Diameter, in	Pressure Difference[(a)], psi	Capacity, mgd[(b)]
SJW[(c)]	Landess Avenue and Corktree Lane	SF2, SF3, SF4	Hard piped, closed valve	8	20	2.60
ACWD[(c)]	Milmont Drive	SF1	Hard piped, closed valve	8	10	2.25
	Park Victoria Drive/ Green Valley Road	SF2	Hard piped, closed valve	8	20	2.25
					City Total	**7.1**

(a) Modeled City pressure minus partner agency pressure. Typical partner agency pressures provided by City in February and March 2021.
(b) Source: 2009 WMPU, Table 4-3. It is assumed that each ACWD intertie has equal capacity.
(c) Intertie can be opened with mutual agreement and at least two hours' notice.

3.3 EXISTING DISTRIBUTION FACILITIES

The City's distribution facilities include:

- Five storage reservoirs
- Five pump stations
- 17 PRVs (including six emergency PRVs)
- 49 isolation valves
- 964,000 linear feet (LF) (approximately 183 miles) of pipelines

Under normal operations, the City separates its water system by source water zone (SFPUC vs. VW), meaning that Zones SF1 through SF4 are isolated from Zones VW1 and VW2. During emergencies, the City can open isolation valves to allow supply mixing. Emergency PRVs are also set to automatically operate and allow SFPUC water to flow to VW zones if pressures in the VW zones drop significantly. This emergency supply is unidirectional; it can only flow from SFPUC zones to VW zones.

The City's Gibraltar facility has storage, pumping, and pressure regulating facilities for both SFPUC and VW supplies. To distinguish between the pumps and storage reservoirs, references in the following sections will append parenthetical notes specifying the facility's service area/source (e.g., SF or VW). The PRVs at the station are uniquely named, so no disambiguation is necessary.

3.3.1 Storage Reservoirs

The City has five storage reservoirs, totaling approximately 16 million gallons (MG) of capacity. Four storage reservoirs serve the SFPUC service area, with Tularcitos and Minnis serving customers in the hillside areas (Zones SF3 and SF4) and Gibraltar (SF) and Ayer serving customers in the valley area (Zones SF1 and SF2). The remaining storage reservoir, Gibraltar (VW), serves Zone VW2 directly and Zone VW1 indirectly (via the Capitol, Curtis, and Parc Metro PRVs). The supply source, location, and key operational information for each storage reservoir is listed in Table 3-4.

Additional disinfection and deliberate reservoir operation help ensure stored water quality remains high. At each storage reservoir, chlorine liquid/tablets and liquid ammonia are added to create a chloramine residual.

Table 3-4. Existing Storage Reservoirs

Storage Reservoir	Location	Pressure Zone(s) Served	Year Built	Tank Material	Tank Diameter, ft	Tank Floor Elevation, ft msl	Normal Operating Level Range[(a)], ft	Capacity, MG[(b)]
SFPUC Service Area								
Gibraltar (SF)	641 Gibraltar Court	SF1	1993	Concrete	181	22	15 - 24.5	5.0
Ayer	1429 East Calaveras Boulevard	SF2	1995	Concrete	158	47	31.2 - 36	5.6
Tularcitos	1328 Tularcitos Drive	SF3	1982	Steel	48	544.2	15 - 21.5	0.30
Minnis	901B Downing Road	SF4	1982	Steel	51	885.5	15 - 21.5	0.34
							SFPUC Total	**11.2**
VW Service Area								
Gibraltar (VW)	641 Gibraltar Court	VW2	1993	Concrete	181	22	15 - 24.5	5.0
							VW Total	**5.0**
							City Total	**16.2**

(a) Source: City SCADA data (Gibraltar reservoirs) and City-provided circle charts (Ayer, Tularcitos, and Minnis).
(b) Source: As-builts provided by City in November 2019.

3.3.2 Pump Stations

Of the City's five pump stations, four serve the SFPUC service area, with the remaining pump station serving Zone VW2. Besides drawing from the Gibraltar (VW) reservoir to serve Zone VW2, the Gibraltar (VW) PS also has emergency pumps to increase delivery pressures from the Gibraltar turnout if pressures are not sufficient. While these pumps have been used sparingly, they provide valuable redundancy during peak summer periods or emergencies.

In the SFPUC service area, the Gibraltar (SF) PS delivers stored water from the Gibraltar (SF) reservoir to Zone SF1. Similarly, both the Ayer PS and the Tularcitos PS draw water from their respective storage reservoirs (Ayer and Tularcitos). The Ayer PS serves Zone SF2, while the Tularcitos PS serves Zone SF4. The Country Club PS draws from Zone SF2 to serve Zone SF3 and also fills the Tularcitos reservoir. Pump station service area, pump types and capacity, and backup power features are summarized in Table 3-5.

Table 3-5. Existing Pump Stations

Pump Station	Pressure Zone Served	Number of Pumps and Capacity[a], gpm	Pump Type[b]	Pump Drive Type[c]	Backup Generator?
Gibraltar (SF)	SF1	2 @ 5,500	SCHC	1 Electric, 1 Diesel	Yes
Ayer	SF2	3 @ 1,800	MVT	Electric	Yes
Country Club	SF3	2 @ 250	Submersible MVT	Electric	No
Tularcitos	SF4	2 @ 250	Submersible MVT	Electric	No
Gibraltar (VW)	VW2	2 @ 5,500[d]	SCHC	1 Electric, 1 Diesel	Yes
	VW2[e]	1 @ 5,000 1 @ 4,000 1 @ 2,000 1 @ 2,000	MVT MVT MVT SCHC	Diesel Electric Electric Electric	Yes (all)

(a) Source: City-provided asset spreadsheet (Master List 4.0) and pump curves.
(b) SCHC = split case horizontal centrifugal; MVT = multistage vertical turbine.
(c) All pumps are variable speed except for those at the Country Club and Tularcitos pump stations.
(d) One pump can be valved for either Zone SF1 or VW2.
(e) Emergency backup pumps located at VW turnout, activated when delivery pressures fall below 120 psi.

3.3.3 Pressure Reducing Valves

Eleven PRVs ensure that the City's water system pressures remain within acceptable operating range. Since SFPUC and VW supplies have an HGL of 340 feet and 425 feet, respectively, the City must reduce pressures when serving customers at lower elevations. Any inter-zone pipeline connections (e.g., between Zones VW2 and VW1) must also include PRVs or closed valves. Four PRVs serve Zone SF1, and three PRVs serve Zone SF4-1, a small sub-zone within Zone SF4. There are four PRVs in the VW service area, one serving Zone VW2 and three serving Zone VW1. The location, set points, HGL, and associated pressure zones for each PRV are shown in Table 3-6.

The City also has six emergency PRVs set to automatically operate if pressures in the VW service area fall below an HGL of 125 feet in Zone VW1 or 175 feet in Zone VW2. As a result, SFPUC supply can supplement VW supply when needed. Four emergency PRVs serve Zone VW1, and two serve Zone VW2. Emergency PRV locations and key operational information are summarized in Table 3-7.

Table 3-6. Existing Pressure Reducing Valves

PRV	Location	Set Point[a], psi	Hydraulic Grade Line[b], ft	From Zone	To Zone
Calera Creek Heights	Near 163 Calera Creek Heights Drive	70	787	SF4-2	SF4-1
Capitol	North Capitol Avenue b/w Montague Expressway and City Limits	68	201	VW2	VW1
Curtis East & West	West Curtis Avenue b/w Main Street and Abel Street	80	202	VW2	VW1
Gibraltar 21 & 21A	641 Gibraltar Court	136	325	VW[c]	VW2
Gibraltar 24	641 Gibraltar Court	76	194[d]	SFPUC[c]	SF1
Main	Hammond Way	80	207	SF2	SF1
North Milpitas	North Milpitas/Calaveras	79	207	SF2	SF1
Parc Metro	East Curtis Avenue/East Lane	82	218[d]	VW2	VW1
Sunnyhills	Washington/Escuela	67	199	SF2	SF1
Tularcitos North Vault	Near 1475 Pinehurst Court	67	707	SF4-2	SF4-1
Tularcitos South Vault	Near 1486 Tularcitos Drive	68	762	SF4-2	SF4-1

(a) Source: City-provided data in June 2020.
(b) Source: City of Milpitas Water Distribution System Plan Schematic Profile (HydroScience Engineers).
(c) PRV located immediately downstream of turnout.
(d) Estimated from set point (converted to pressure head in feet) and approximate elevation from as-builts.

Table 3-7. Existing Emergency Pressure Reducing Valves

Emergency PRV	Location	Upstream Setting[a], psi	Downstream Setting[a], psi	Hydraulic Grade Line[b], ft	From Zone	To Zone
Junipero	Junipero & South Abel Street	--[c]	--[c]	169	SF1	VW1
Live Oak	Live Oak Court and I-880	75	70	125	SF1	VW1
McCarthy	South of Cadillac Court	82	72	73	SF1	VW1
California Circle	California Circle and I-880	82	72	71	SF1	VW1
Montague	Montague Expressway and I-680	118	110	216	SF2	VW2
Yosemite	Sinclair Frontage Road and Yosemite Drive	118	110	211	SF2	VW2

(a) Source: City-provided data in February 2021.
(b) Source: City of Milpitas Water Distribution System Plan Schematic Profile (HydroScience Engineers).
(c) PRV is offline.

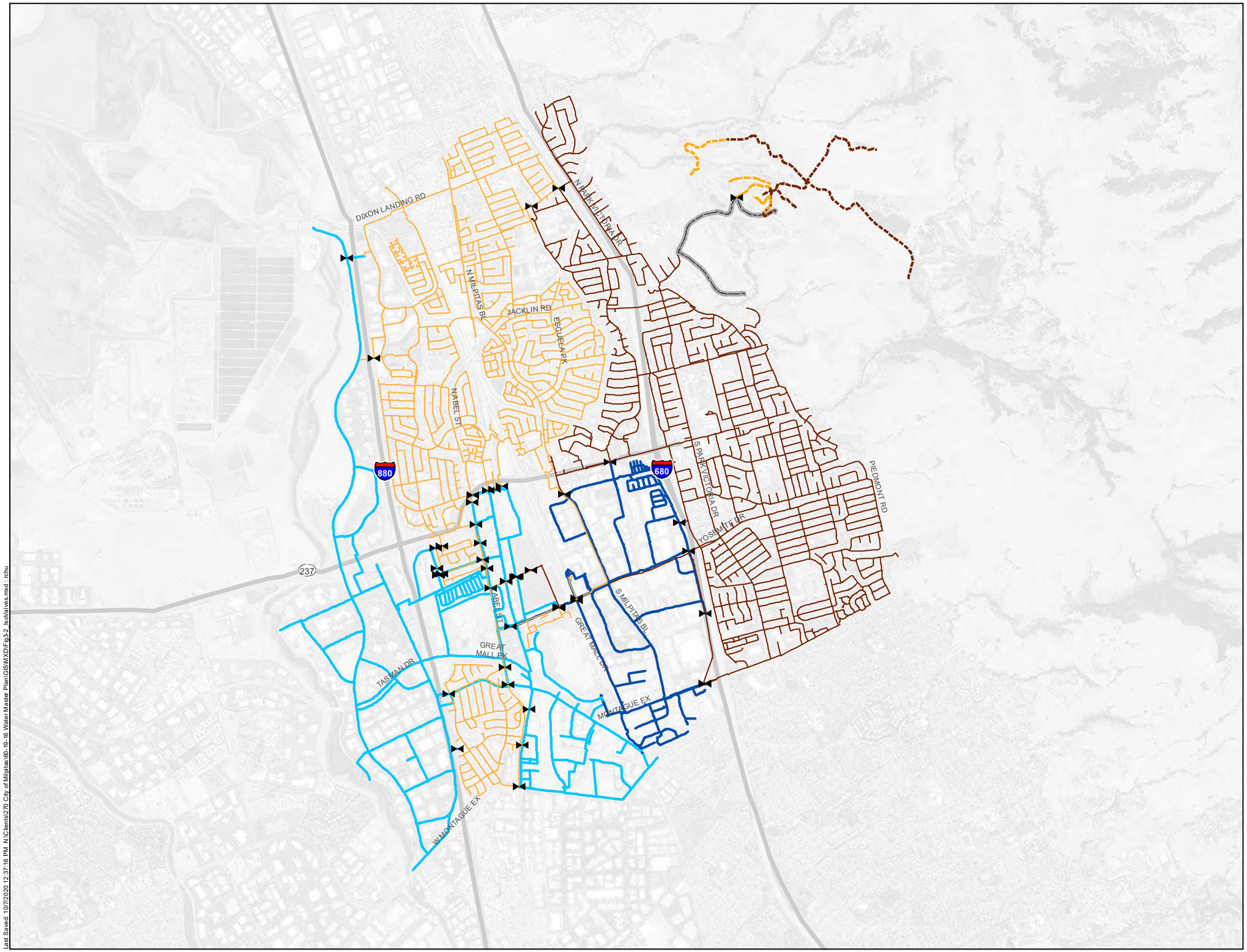
3.3.4 Isolation Valves

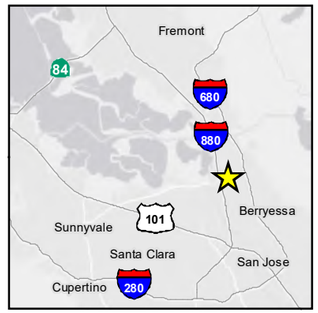
To prevent blending of the two water sources (SFPUC and VW) and better control water quality, the City has installed 49 isolation valves throughout the distribution system. Thirty-one are in Zone 1 (i.e., separating zones SF1 and VW1), and nine are in Zone 2. The remaining nine isolation valves separate pressure zones within the same service area (e.g., Zones SF1 and SF2) but do not have facilities to regulate flow (i.e., PRVs or booster pumps). Therefore, these nine valves should always remain closed.

Isolation valves increase supply reliability, as they can be opened during long-term water shortages from either SFPUC or VW. Existing isolation valves are shown on Figure 3-2 and listed in Table 3-8. Previous modeling performed for the 2009 WMPU demonstrated that the City does not have to open every valve to supply the entire system using one supply source. Per the 2009 WMPU, opening only four "key" valves allowed a single supply source to serve the City service area (refer to Chapters 8 and 9 of this Water Master Plan for updated recommendations). Current City emergency operations procedures are detailed in Appendix B.

3.3.5 Pipelines

The existing water distribution system consists of approximately 183 miles of pipeline with diameters ranging from 2 inches to 30 inches. By length, approximately 85 percent of the City's water pipelines are between 6 inches and 12 inches in diameter, and just over 73 percent are asbestos cement (AC). The diameter and material distributions of the City's water system pipelines are summarized in Table 3-9 and Table 3-10, respectively.





N

0 1,500 3,000

Scale in Feet

Isolation Valve

Pipeline Pressure Zone

- VW1
- VW2
- SF1
- SF2
- SF3
- SF4-1
- SF4-2

Figure 3-2

Existing Water System Isolation Valves

City of Milpitas
2020 Water Master Plan

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Table 3-8. Existing Isolation Valves

Valve Number	Valve Size, in	Location	Classification[(a)]
Pressure Zone 1 (between SF1 and VW1)			
1	14	End of Live Oak Court	None
2	12	Starlite Dr/Capitol Avenue	None
2A	10	150 feet east of Evening Star Court	None
3	8	S. Main Street/S. Abel Street	None
4	12	S. Abel Street/Capitol Avenue	None
5	12	S. Abel Street/Capitol Avenue	None
5A	6	S. Main Street/Cedar Way	None
6	8	S. Main Street/Montague Expwy.	None
7	10	S. Main Street/Montague Expwy.	None
12X	14	South end of Rio Verde Place	None
13	12	S. Abbott Avenue near Economy Inn	None
13A	8	North end of Rio Verde Place	None
14	8	S. Abel Street/Corning Avenue	None
14A	6	Corning Ave/Palmer Avenue	None
15	8	S. Abel Street/Junipero Drive	None
18	12	S. Abel Street/Serra Way	None
18A	12	S. Abel Street south of Calaveras Boulevard	None
20	8	S. Main Street/Carlo Street	None
20A	6	Carlo Street/Calaveras Boulevard	None
20B	12	Carlo Street/Calaveras Boulevard	None
24	6	End of E. Carlo Street	None
25	8	South end of Railroad Avenue	None
26	6	S. Abel Street/Sylvia Avenue	None
27	8	Hammond Way near SFPUC Pipeline	None
28	8	Hammond Way near SFPUC Pipeline	None
30	12	S. Main Street near SFPUC Pipeline	None
31	24	S. Abel Street near SFPUC Pipeline	None
35	8	End of Corning Avenue	None
32045	14	End of Cadillac Court	None
32523	14	N. McCarthy Boulevard	None
35100	8	End of Corning Avenue	None
Pressure Zone 2 (between SF2 and VW2)			
8	8	Montague Expwy/Southbound 680 offramp	None
8A	10	Montague Expwy/Southbound 680 offramp	None
9	24	Sinclair Frontage Road/Yosemite Drive	Key
10	12	Sinclair Frontage Road south of Wrigley Way	None
23C	16	S. Milpitas Boulevard north of Los Coches Street	Key
32	24	S. Hillview Drive/Calaveras Boulevard	Key
137	16	650 feet west of Gibraltar Drive/Yosemite Drive	Key
174	12	650 feet west of Gibraltar Drive/Yosemite Drive	None
31219	12	Sinclair Frontage Road/Montague Court	None
Between Pressure Zones in the Same Service Area			
79	12	Near Main PRV (between SF1 and SF2)	Always Closed
99A	18	Curtis Avenue near Curtis PRV (between VW1 and VW2)	Always Closed
31660	8	Country Club Drive/Tularcitos Drive (between SF3 and SF4-1)	Always Closed
32818	8	Coelho Street/Diel Drive (between SF1 and SF2)	Always Closed
33788	8	Coelho Street/Roger Street (between SF1 and SF2)	Always Closed
34357	8	E. Curtis Avenue near Parc Metro PRV (between SF1 and SF2)	Always Closed
34358	8	E. Curtis Avenue near Parc Metro PRV (between SF1 and SF2)	Always Closed
34359	8	E. Curtis Avenue near Parc Metro PRV (between SF1 and SF2)	Always Closed
35727	12	S. Main Street near Tom Evatt Park (between SF1 and SF2)	Always Closed

(a) Isolation valves are normally closed to separate SFPUC and VW supplies. Per the 2009 WMPU, opening only the four key valves allows a single source (SFPUC or VW) to supply the entire system. Valves located between pressure zones shall remain closed at all times.

Table 3-9. Summary of Existing Pipelines by Diameter[a]

Pipe Diameter, inches	Total Pipeline Length, feet	Total Pipeline Length, miles	Percent of Water System
2	107	0.0	0.0%
4	11,542	2.2	1.2%
6	243,314	46.1	25.2%
8	246,992	46.8	25.6%
10	81,940	15.5	8.5%
12	242,814	46.0	25.2%
14	59,695	11.3	6.2%
16	32,961	6.2	3.4%
18	38,419	7.3	4.0%
20	320	0.1	0.0%
24	5,696	1.1	0.6%
30	216	0.0	0.0%
Total	**964,015**	**183**	**100%**

(a) Source: City GIS pipeline shapefile and as-builts provided February and March 2020.

Table 3-10. Summary of Existing Pipelines by Material[a]

Pipe Material	Abbreviation	Total Pipeline Length, feet	Total Pipeline Length, miles	Percent of Water System
Asbestos Cement	AC / ACP	704,997	133.5	73.1%
Concrete Cylinder	CCP	887	0.2	0.1%
Cast Iron	CIP	5,002	0.9	0.5%
Ductile Iron	DIP	80,772	15.3	8.4%
Polyvinyl Chloride	PVC	144,474	27.4	15.0%
Steel	STL	27,883	5.3	2.9%
	Total	**964,015**	**183**	**100%**

(a) Source: City GIS pipeline shapefile and as-builts provided February and March 2020.

CHAPTER 4
Water Supply Sources

This chapter summarizes the City's existing and future water supply sources. A reliable water supply is critical for ensuring the City can meet water demands through buildout and during emergency outages. The evaluation of water supply availability and reliability begins with understanding the City's supply sources and agreements, as well as the water quality associated with those supply sources. The City's historical and projected future use of its available water supplies is further described in Chapter 5 of this report.

4.1 EXISTING WATER SUPPLIES

The City's existing water supplies include imported water, groundwater, recycled water, and interties with neighboring agencies.

Under normal conditions, imported water comprises the City's entire water supply. The City purchases treated surface water from two agencies: the SFPUC and VW, which was previously known as the Santa Clara Valley Water District. In 2019, water supplies from SFPUC totaled 6,146 acre-feet (af) and represented about 59 percent of the City's total water supplies, while water supplies from VW totaled 3,182 af and represented about 31 percent of the City's total water supplies.

Recycled water is produced at the San José-Santa Clara Regional Wastewater Facility and delivered to the City by South Bay Water Recycling (SBWR). In 2019, the City used approximately 1,049 af of recycled water, mainly for landscape irrigation. This represented about 10 percent of the City's total 2019 water use.

In emergencies, the City can activate interties with SJW and the ACWD and/or pump groundwater. The City overlies the Santa Clara Valley Groundwater Sub-basin and currently has one groundwater well (Pinewood Well).

Each of the City's existing water supplies is described further below.

4.1.1 San Francisco Public Utilities Commission (SFPUC)

The SFPUC is a department of the City and County of San Francisco, which owns and operates the Hetch Hetchy Regional Water System (RWS). The RWS spans from Hetch Hetchy Valley in Yosemite National Park to the City of San Francisco and consists of over 280 miles of pipeline, eleven reservoirs, five pump stations, and two water treatment plants.

The Hetch Hetchy watershed, an area located in Yosemite National Park, is the major source of water for all of San Francisco's retail and wholesale water needs. Spring snowmelt runs down the Tuolumne River and fills Hetch Hetchy Reservoir, the largest reservoir in the Hetch Hetchy water system. This surface water in the Hetch Hetchy Reservoir is treated, but not filtered because it is of such high quality.

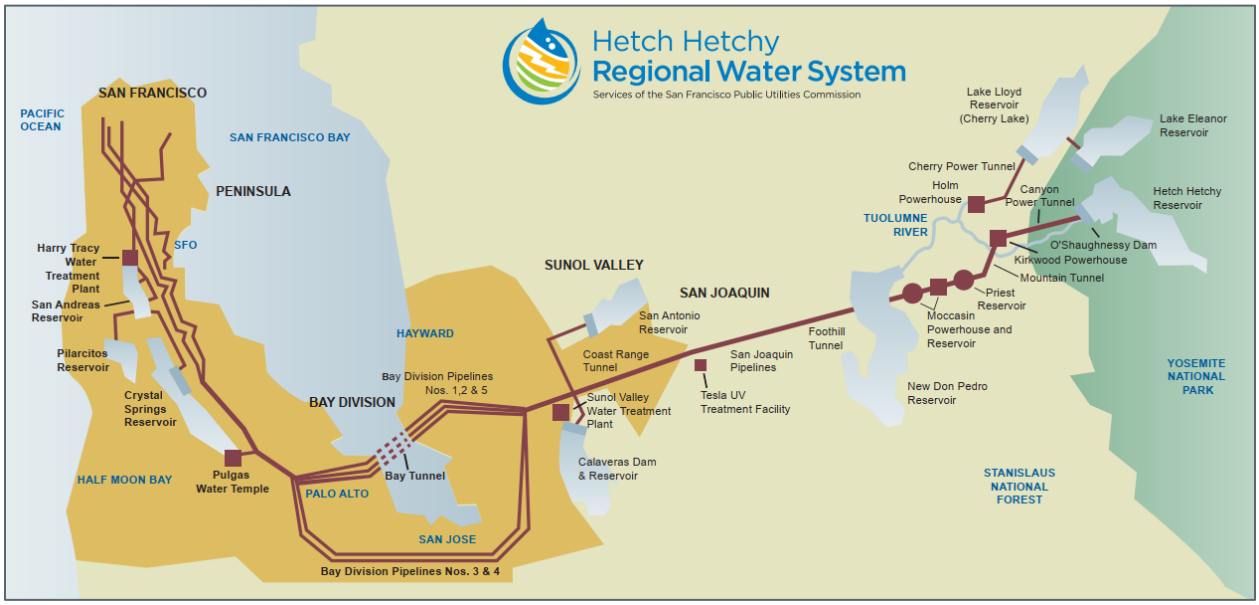
The Alameda and Peninsula watersheds produce the rest of the total water supply. The Alameda watersheds (the San Antonio Creek, Upper Alameda Creek, and Arroyo Hondo watersheds) located in Alameda and Santa Clara Counties, contribute surface water supplies captured and stored in two reservoirs: Calaveras and San Antonio. The Sunol Filter Galleries located near the Town of Sunol, are a groundwater source supplying less than one percent of San Francisco's water. The Peninsula watersheds (the San Mateo Creek and Pilarcitos Creek watersheds) in San Mateo County contribute surface water supplies captured and stored in lower and upper Crystal Springs and San Andreas Reservoirs and in two smaller reservoirs, Pilarcitos and Stone Dam. The six reservoirs in the Alameda and Peninsula watersheds

capture rain and local runoff. Some also store Hetch Hetchy water for use by San Francisco. These local water sources and groundwater from the Sunol filter galleries are treated and filtered before delivery.

Although most of the SFPUC water deliveries originate from the Tuolumne River, typically comprising approximately 85 percent of SFPUC water deliveries, the SFPUC prioritizes local surface water supplies. However, in dry years, when local surface water supply is often decreased, Tuolumne River diversions can exceed 90 percent of SFPUC supplies.

The RWS serves the City of San Francisco as well as 25 wholesale customers located throughout Alameda, Santa Clara, and San Mateo Counties, including the City of Milpitas. Overall, the RWS serves approximately 2.7 million residential, commercial, and industrial customers throughout the San Francisco Bay Area.

A schematic of the RWS is provided on Figure 4-1.



Source: [SFPUC website]

Figure 4-1. SFPUC Regional Water System

4.1.1.1 City Supplies from SFPUC

The Bay Area Water Supply and Conservation Agency (BAWSCA) represents the interests of the 25 wholesale customers (who together manage 27 water systems), including the City of Milpitas. In 2009, the SFPUC and BAWSCA members entered into a Water Supply Agreement, a 25-year contract outlining the relationship between the two entities. A key component of the Water Supply Agreement is that it continued the "Supply Assurance," a maximum supply of 184 mgd to be allocated among BAWSCA members, established by the Water Supply Agreement's predecessor (the 1984 Settlement Agreement and Master Water Sales Contract). Though the Supply Assurance can be reduced due to drought, maintenance, or emergencies, the Water Supply Agreement established the 184 mgd delivery ceiling in perpetuity.

The Supply Assurance is allocated between 22 wholesale customers in the form of Individual Supply Guarantees (ISGs)[6]. ISGs are specified in the Water Supply Agreement and subject to change following the Water Supply Agreement's expiration in 2034. The City's ISG is 9.23 mgd, which is delivered through Bay Division Pipelines Nos. 3 and 4.

4.1.1.2 SFPUC Water Quality

The RWS delivers high quality water that meets all Federal and State requirements. Most of the water originates in the Tuolumne River, which is fed by spring snowmelt in a well-protected watershed in Yosemite National Park. Diverted water is stored in the Hetch Hetchy Reservoir and transported to the Bay Area in pipes and tunnels. According to the SFPUC's 2019 Water Quality Report, Hetch Hetchy water meets Federal and State drinking water quality standards by providing the following treatment: pH adjustment (to control corrosion), disinfection (including ultraviolet light and chlorination), fluoridation (for dental health protection), and chloramination (for maintaining disinfectant residual and minimizing disinfection byproducts). Filtration is not required due to the high water quality.

Local surface water supplies, which typically comprise about 15 percent of SFPUC supplies, require more typical treatment, including coagulation, flocculation, sedimentation, filtration, and disinfection. Most wholesale customers, including the City, receive a blend of Hetch Hetchy and local surface water supplies. The SFPUC does not anticipate any future degradation of water quality.

4.1.2 Valley Water (VW)

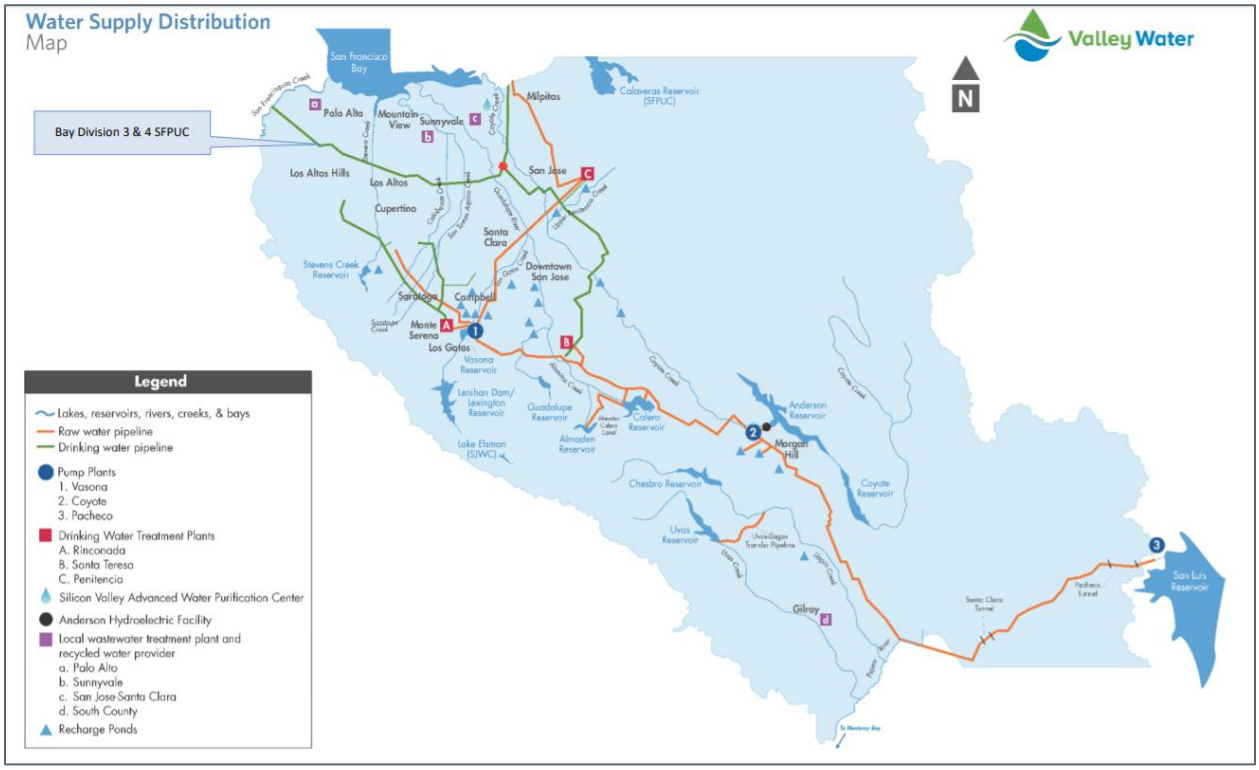
Valley Water, previously known as the Santa Clara Valley Water District, is an independent special district that provides wholesale water supply, groundwater management, flood protection and stream stewardship. Its service area includes all of Santa Clara County, which is located at the southern end of San Francisco Bay. Valley Water was formed as the Santa Clara Valley Water Conservation District in 1929 in response to groundwater overdraft and significant land subsidence. In 1954, it annexed the Central Santa Clara Valley Water District. In 1968, it merged with the countywide flood control district to form one agency to manage the water supply and flood programs for most of the county. The Gavilan Water District in southern Santa Clara County was annexed in 1987 and now Valley Water provides services for the entire county. Valley Water is governed by an elected seven-member Board of Directors following the District Act and its own Board Governance Policies.

Valley Water has been a leader in conjunctive use in California for decades, utilizing imported and local surface water to supplement groundwater and to maintain reliability in dry years. Conjunctive use helps protect local subbasins from overdraft, land subsidence, and saltwater intrusion and provides critical groundwater storage reserves for use during droughts or outages. After it was formed to address declining groundwater levels and land subsidence, Valley Water constructed reservoirs to capture more local water. However, local supplies were insufficient to meet the county's growing population. Valley Water began importing water from the State Water Project in 1965 and from the Central Valley Project's San Felipe Division in 1987. These investments, along with water recycling and conservation, have resulted in sustainable groundwater subbasins and reliable water supplies for the county.

[6] Three wholesale customers do not have ISGs: the cities of San Jose, Santa Clara, and Hayward. The cities of San Jose and Santa Clara are supplied on a temporary and interruptible basis and thus do not have an allocated share of the Supply Assurance. The City of Hayward has an unspecified allocation, equal to the difference between 184 mgd and the sum of the ISGs.

About half of the county's water supply currently comes from local sources and about half comes from imported water sources. Local sources include natural groundwater recharge and surface water supplies, including surface water rights held by Valley Water, San Jose Water, and Stanford University. Imported water includes Valley Water's State Water Project and Central Valley Project contract supplies (100,000 acre-feet per year [af/yr] from the SWP and 152,500 af/yr from the Central Valley Project [CVP]), as well as supplies delivered by the SFPUC to cities in northern Santa Clara County.

A schematic of the VW water supply system is provided on Figure 4-2.



Source: Valley Water, Water Supply Master Plan 2040, November 2019.

Figure 4-2. Valley Water Water Supply System

4.1.2.1 City Supplies from VW

VW delivers treated surface water to the City via the Milpitas Pipeline. Per the City's contract with VW, potable water deliveries consist of SWP and CVP water only, with amounts based on an annual request the City submits every three years. In each of the three years after submitting the request, the City is obligated to purchase at least 95 percent of the maximum amount listed on the schedule. Every month, VW guarantees the City can receive at least 15 percent of the annual delivery schedule.

4.1.2.2 VW Water Quality

The SWP and CVP convey water through the Sacramento-San Joaquin Delta (Delta). Delta supplies are threatened by sea level rise and climate change, with elevated nutrient concentrations (causing algal blooms and reducing dissolved oxygen) and disinfection byproducts presenting a more immediate challenge. The Central Valley Regional Water Quality Control Board is also focused on controlling pesticide and herbicide discharges into the Delta.

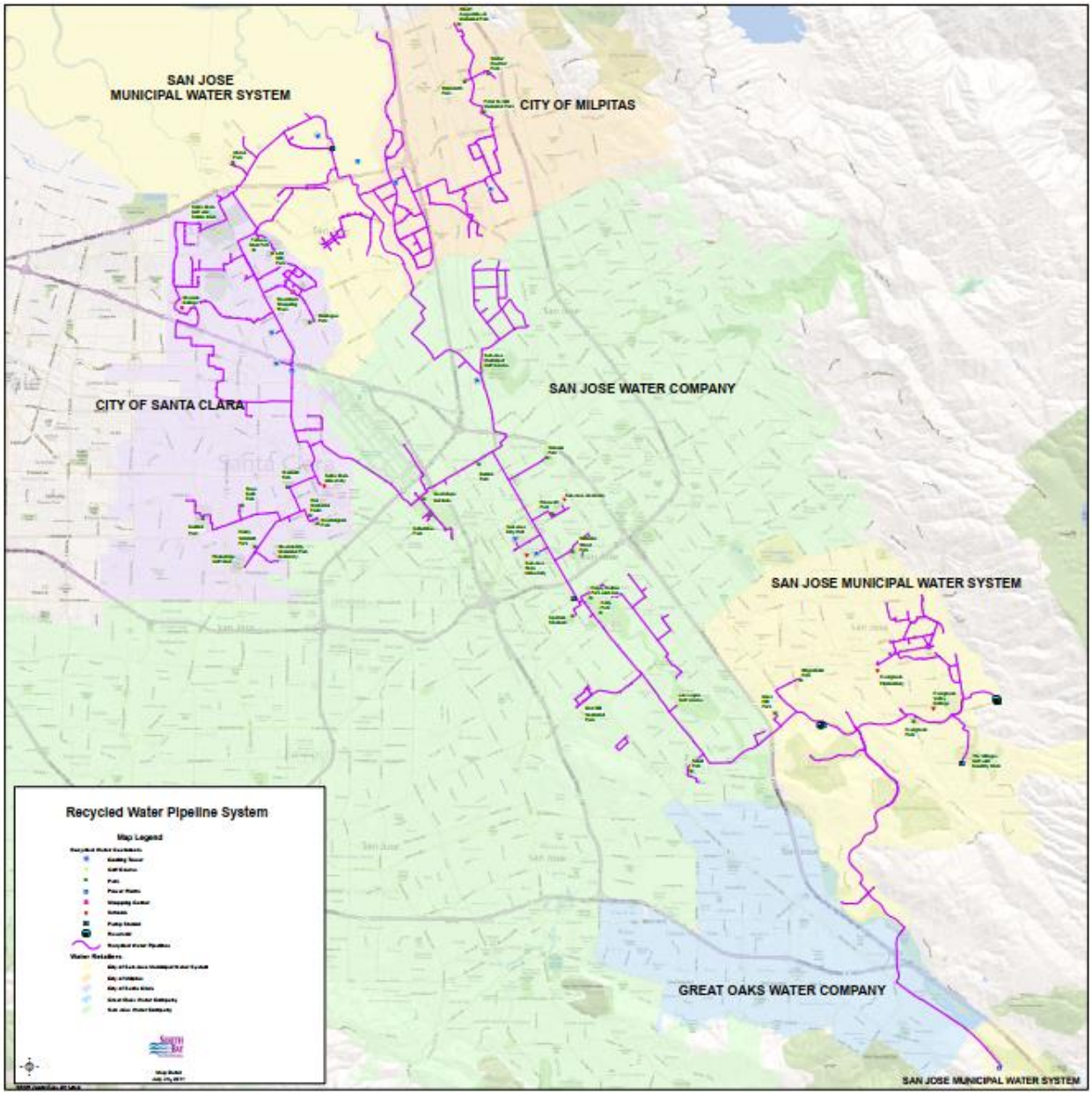
Surface water is treated at either the Penitencia or Santa Teresa Water Treatment Plants (WTPs) before delivery to the City. It should be noted that VW also operates a third WTP, the Rinconada WTP, but it primarily serves the west side of Santa Clara County, which does not include the City. The Penitencia and Santa Teresa WTPs began operations in 1974 and 1989, respectively. In 2006, disinfection facilities at each WTP were upgraded to use ozone instead of chlorine. Not only is ozone a strong disinfectant, but it can also improve taste and odor while also reducing the formation of disinfection byproducts. At both WTPs, raw water is treated via coagulation/flocculation (to remove silt and particles), ozone disinfection, and granular activated carbon filtration (to remove dissolved chemicals). Filtered water is then treated with chloramine to maintain a disinfection residual through the distribution system.

4.1.3 Recycled Water

South Bay Water Recycling (SBWR), a division within the City of San Jose's Environmental Services Department, is the regional permit holder for recycled water in San José, Santa Clara and Milpitas, ensuring compliance with State regulations for recycled water quality and use. SBWR is a recycled water wholesaler to four retailers: San Jose Water, San José Municipal Water, City of Santa Clara, and City of Milpitas. Customers buy recycled water from the retailer in their location.

Tertiary treated recycled water is produced at the San José-Santa Clara Regional Wastewater Facility, one of the largest such treatment facilities in California. SBWR's recycled water system consists of over 150 miles of pipeline, five pump stations, and 10 million gallons of storage in reservoirs. SBWR delivers more than four billion gallons of recycled water per year to more than 900 commercial customers, an average of 11 mgd.

A schematic of the SBWR system is provided on Figure 4-3.



Source: SBWR website

Figure 4-3. South Bay Water Recycling System

The use of recycled water is a priority for the City, which has adopted an ordinance that prohibits using potable water for irrigation if recycled water is available. While SBWR owns the distribution system, the City is responsible for operation and maintenance of any facilities within City boundaries.

In 2019, the City used approximately 1,049 af of recycled water, mainly for landscape irrigation. This represented about 10 percent of the City's total 2019 water use. According to the City's 2015 Urban Water Management Plan (UWMP), continued growth in landscape irrigation and industrial use, along with expansion to golf course irrigation, should increase recycled water use to approximately 2,690 af by 2040. In addition, the City is seeking to improve recycled water reliability via interties with SJW, also a SBWR retailer.

4.1.4 Emergency Groundwater Wells

The City overlies the Santa Clara Groundwater Subbasin, which is managed by VW. In its 2019 Basin Prioritization project, DWR identified the Santa Clara Groundwater Subbasin as a high priority basin for sustainable management. Overdraft and land subsidence have been challenges in the past, and VW actively manages surface recharge to alleviate subsidence.

Groundwater is not part of the City's normal water supply portfolio. Should SFPUC and/or VW supplies be interrupted, the City can activate the Pinewood Well, which draws water from an aquitard-protected area in the southwestern part of the City. While the Pinewood Well is currently permitted for emergency use only, the City may consider permitting it as an active, fully operational well in the future. The State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) defines emergency or standby water sources as not operating more than 15 calendar days nor more than five consecutive days in a year.

Per the 2009 WMPU, the Pinewood Well has a capacity of 1.7 mgd. Pump production testing would be required to confirm this capacity, but that is outside the scope of this master plan. Therefore, this master plan assumes the Pinewood Well capacity remains at 1.7 mgd. Pumped water meets primary drinking water standards; however, there are taste and odor concerns. In 2016, Water Solutions, Inc. conducted a Groundwater Well Evaluation that examined the Pinewood Well and potential sites for a new well. This Groundwater Well Evaluation recommended using ozone and surface water blending to control taste and odor. As discussed previously in Section 3.2.2, the Pinewood Well is equipped with a plug-in adapter and transfer switch to receive power from a portable generator. The City anticipates completing treatment and operational improvements at the Pinewood Well soon.

The City also has two other planned wells, the Curtis Well and the McCandless Well, which are described in Section 4.2 below.

4.1.5 Emergency Interties

The City has one intertie with SJW and two interties with ACWD. With a 2-hour notice and mutual consent, the City can receive water from either source. The ACWD intertie is a two-way intertie, allowing the City to either receive or provide water supplies, while the City can only receive water from SJW.

4.2 FUTURE WATER SUPPLIES

Based on the City's 2015 UWMP, the City expects to meet future water demands with the existing imported surface water supplies described above. As a result, there are no plans to develop new supply sources.

However, the City hopes to increase future supply reliability by expanding its groundwater capabilities. Two new wells, the Curtis Well and the McCandless Well, are expected to come online during the City's buildout horizon (i.e., by 2040). The Curtis Well was drilled in 2003, but the well was not equipped with above-grade infrastructure required for a functioning well, and the facility was never completed. As a result, bringing the Curtis Well online requires significant effort, including installing a submersible pump, piping, and treatment components, as well as conducting testing and permitting. Design for the Curtis Well improvements began in 2020. Construction of the McCandless Well began in 2020 and is anticipated to be completed by 2022.

CHAPTER 5
Water Demand

This chapter reviews the City's existing potable water demands and develops future water demand projections based on refined Water Use Factors (WUFs) described in this chapter and planned future development (described in Chapter 2). Having accurate and thorough water demands allows for:

- Developing and calibrating the potable water system hydraulic model
- Identifying existing and potential future water system deficiencies and recommending improvements

5.1 HISTORICAL WATER PRODUCTION AND CONSUMPTION

As described in Chapter 4, the City imports surface water from SFPUC and VW. During normal operation, water production consists exclusively of water imports. Water consumption is defined as metered water use and is based on actual billing data provided by the City. The difference between water production and water consumption is non-revenue water (NRW).

The following subsections detail the City's historical production and consumption to help determine appropriate NRW, per capita water use, and peaking factors. This information, along with future land use plans, will serve as the foundation for future water demand projections.

5.1.1 Water Production

Table 5-1 summarizes annual water production from 2009 through 2019 and breaks down deliveries by source (SFPUC and VW). Total production decreased between 2014 and 2017 due to the drought and associated water conservation efforts. Production increased in 2018 and held steady in 2019 but remains below pre-drought levels. In recent years SFPUC imports have comprised approximately 60 to 66 percent of the City's total production, though recent production volume has dropped due to increased use of recycled water. VW imports have comprised about 34 to 40 percent of the City's total production in recent years.

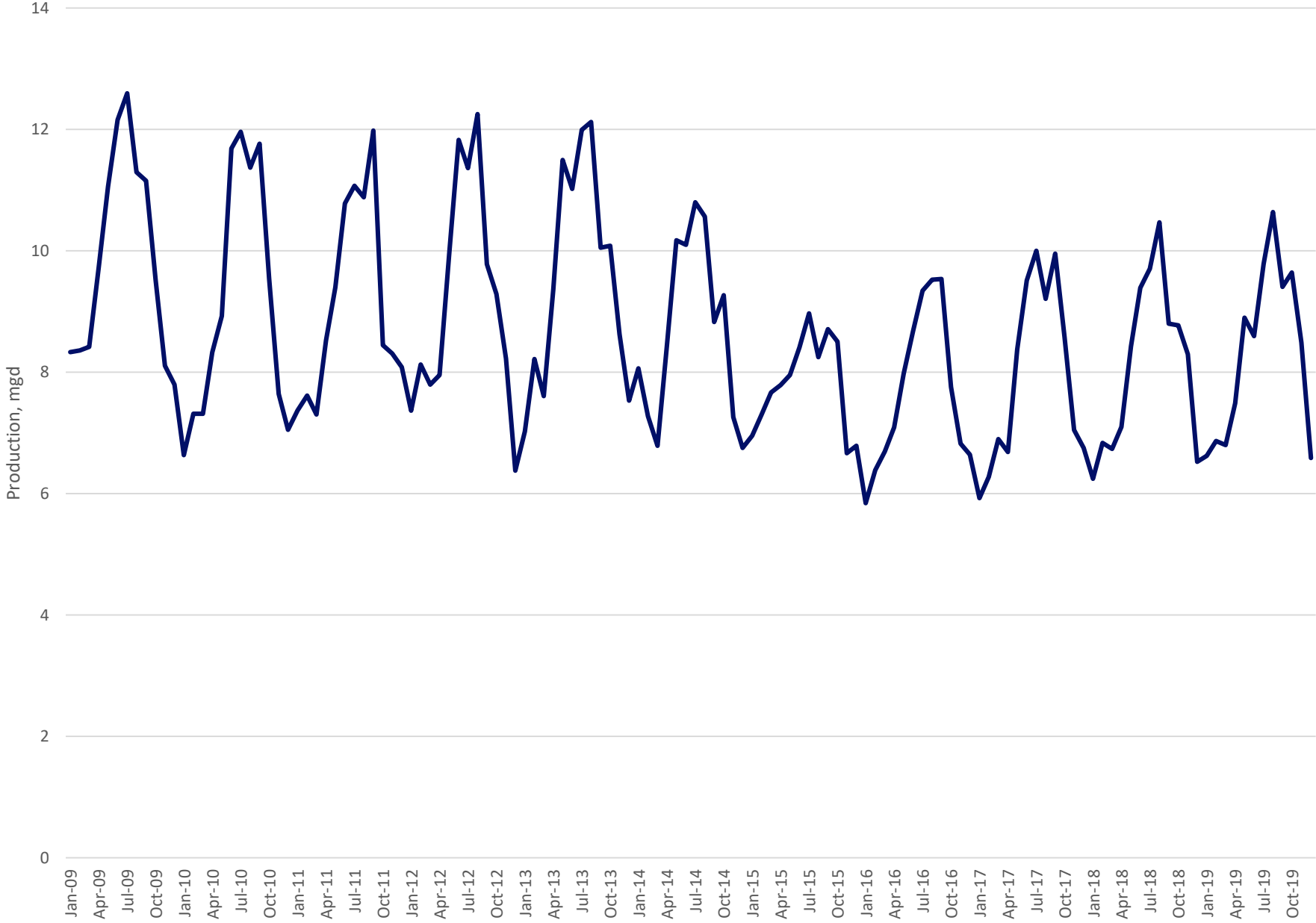
Figure 5-1 shows the City's monthly water production from January 2009 through December 2019. As expected, the City's highest water production has occurred in the summer months (June through September), when temperatures are high and rainfall is minimal. Over this 10-year period, the lowest water production has most frequently occurred in December and March.

Table 5-1. Historical Water Production[a]

Calendar Year	SFPUC		VW		Total Production, af	Average Day Production, mgd
	Volume, af	Percent of Total Production	Volume, af	Percent of Total Production		
2009	7,563	68	3,509	32	11,072	9.9
2010	6,748	66	3,483	34	10,231	9.1
2011	6,855	67	3,395	33	10,250	9.2
2012	6,984	68	3,342	32	10,326	9.2
2013	7,506	70	3,251	30	10,758	9.6
2014	6,418	66	3,330	34	9,748	8.7
2015	5,288	60	3,487	40	8,774	7.8
2016	5,270	61	3,372	39	8,642	7.7
2017	5,707	64	3,191	36	8,898	7.9
2018	5,776	64	3,315	36	9,091	8.1
2019	6,146	66	3,182	34	9,328	8.3
Average	**6,387**	**66**	**3,351**	**34**	**9,738**	**8.7**

(a) Historical production data provided by City in January 2020.

Figure 5-1. Monthly Water Production



5.1.2 Water Consumption

Table 5-2 summarizes historical water consumption (2013 through 2019) by customer type and was developed from City-provided billing data[7]. Over this 7-year period, residential customers averaged about 55 percent of the total City consumption. Commercial users averaged about 40 percent of total consumption, with Public (City and County) users making up the remainder (just over 4 percent). The overall consumption trend follows the City's production and is consistent across residential and commercial customers.

Table 5-2. Historical Metered Water Consumption[(a)]

Customer Type	CY 2013, mgd	CY 2014, mgd	CY 2015, mgd	CY 2016, mgd	CY 2017, mgd	CY 2018, mgd	CY 2019, mgd
Residential							
Water	4.39	4.08	3.82	3.74	3.97	4.31	3.92
Fire	0.00	0.00	0.00	0.00	0.04	0.00	0.00
Irrigation	0.36	0.32	0.21	0.24	0.29	0.31	0.34
Subtotal Residential	4.75	4.40	4.03	3.98	4.31	4.62	4.26
Commercial							
Water	2.95	2.68	2.73	2.57	2.65	2.71	2.43
Fire	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Irrigation	0.64	0.53	0.38	0.37	0.44	0.47	0.51
Subtotal Commercial	3.59	3.21	3.11	2.94	3.10	3.19	2.94
Public							
Water - City	0.04	0.03	0.02	0.03	0.03	0.03	0.04
Water - County	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Irrigation - City	0.38	0.23	0.58	0.17	0.28	0.23	0.18
Subtotal Public	0.42	0.26	0.61	0.20	0.32	0.27	0.22
Total	**8.76**	**7.87**	**7.75**	**7.12**	**7.72**	**8.09**	**7.43**

(a) Based on billing data provided by City in January 2020.

[7] Billing data was bi-monthly. Usage was grouped into calendar years based on the ending date of the billing period. As a result, annual consumption may not match other sources depending on how year-end water use is accounted for.

5.1.2.1 Large Water Users

Refer to Chapter 2 (Table 2-3) for the list of the Large Water Users in CY 2019 (those using more than 30,000 gpd).

5.1.3 Non-Revenue Water

NRW is the difference between the volume of water produced and the volume of water consumed or metered. Though there are many reasons why production may exceed consumption, the most common include system losses including, but not limited to, leakage, measurement errors, and unauthorized use. While water utilities try to minimize NRW, it is difficult to eliminate entirely.

Table 5-3 summarizes the City's historical NRW between 2013 and 2019. NRW is calculated from production and consumption data (Table 5-1 and Table 5-2, respectively) except where available from validated American Water Works Association (AWWA) water audits. NRW falls generally between 9 and 11 percent, though it peaked at 15.4 percent in 2016. The average NRW from 2013 to 2019 is approximately 10.9 percent.

West Yost recommends using a NRW of 11 percent to calculate the City's total future water production requirement.

Table 5-3. Historical Non-Revenue Water[a]

Calendar Year	Total Production, mgd	Total Consumption, mgd	Water Loss, mgd	Non-Revenue Water, %
2013	9.60	8.76	0.84	8.8
2014	8.70	7.87	0.84	9.6
2015	7.83	7.75	0.08	10.5[b]
2016	7.69	7.12	0.57	15.4[b]
2017	7.94	7.72	0.22	9.6[b]
2018	8.12	8.09	0.03	11.2[b]
2019	8.33	7.43	0.90	10.8
Average	**8.32**	**7.82**	**0.50**	**10.9**

(a) Refer to Table 5-1 and Table 5-2. Non-revenue water (NRW) equals Water Loss divided by Total Production, unless otherwise noted.
(b) NRW equals "Non-revenue water as percent by volume of Water Supplied" from City's water audits, received August 2020.

5.1.4 Per Capita Water Use

The City's historical per capita water use is presented in Table 5-4. While population continued to grow through the drought, per capita water use fell dramatically in 2015 and remained low in 2016 due to water conservation and mandatory water reduction measures implemented during the drought. Per capita water use rebounded slightly in 2017 and is holding steady but remains well below 2013 levels.

Table 5-4. Historical Per Capita Water Use[a]

Calendar Year	Population[b]	Total Production, mgd	Per Capita Water Use, gpcd
2013	68,622	9.60	140
2014	70,701	8.70	123
2015	73,632	7.83	106
2016	74,766	7.69	103
2017	74,922	7.94	106
2018	75,083	8.12	108
2019	77,961	8.33	107
		Average	**113**
		Average (excluding 2015 and 2016)[c]	**117**

(a) Refer to Table 5-1.
(b) Population for 2013 through 2018 is from CA Department of Finance, E-4 Population Estimates (May 1, 2020). Population for 2019 is based on January 1, 2020 population from CA Department of Finance, E-1 Population Estimates (May 1, 2020).
(c) Data from 2015 and 2016 were excluded due to mandatory water restrictions implemented by the State Water Resources Control Board during these two years.
gpcd = gallons per capita per day

As described in Section 5.2.1 below, the City's per capita water use in 2015 was well below (in compliance with) the City's 2015 per capita water use goal (164 gpcd) as required by the Water Conservation Act of 2009 and is on track to be in compliance with the City's 2020 per capita water use goal (146 gpcd).

5.1.5 Peaking Factors

Peak demands are used to evaluate and size water system pipelines and storage facilities and define water supply and capacity requirements. Projecting peak demands typically involves applying a multiplier, or peaking factor, to average day demand (ADD), which is calculated by dividing a year's total water production by the number of days in that year (refer to Table 5-1).

Recent water use data help refine peaking factors for key demand conditions. To account for NRW, production totals are used. This subsection describes the methodologies utilized to update the City's maximum day demand (MDD) and peak hour demand (PHD) peaking factors and presents their revised values.

5.1.5.1 Maximum Day Demand Peaking Factor

The MDD peaking factor is calculated by dividing the calendar year's largest single day demand by the ADD of the same year. Under normal conditions, the City's water demands are served by supplies from either turnouts or pumped storage. As a result, determining daily demands requires data for both turnout flows and storage reservoir levels. Detailed historical reservoir information was unavailable, so West Yost reviewed daily flows from SFPUC and VW turnouts as a proxy for daily demands. Turnout flows are a valid substitute for demands if, as is assumed in this master plan, storage reservoir inflows are similar to pumped outflows over a 24-hour period.

Due to the different customer types in each service area, separate MDD peaking factors have been developed for the SFPUC and VW systems. The 2002 WMP (and the 2009 WMPU, which used the same peaking factors as in 2002) also acknowledged the impact of customer type on water use, going so far as to develop separate peaking factors for residential (1.9) and industrial/commercial (1.5) users. Data limitations preclude calculating land use-based peaking factors for this master plan. However, the portion of the City served by the SFPUC system has more residential customers, while the portion of the City served by the VW system has more industrial/commercial customers.

Based on daily turnout flows from 2016 through 2019, the recommended MDD peaking factor for the SFPUC system is 1.6. Table 5-5 summarizes the historical MDD peaking factors by calendar year, including the date and magnitude of maximum daily production. In 2019, the maximum day production was significantly higher than in previous years. On this date (June 20, 2019), VW turnout flows were less than 2,000 gallons, so it is assumed SFPUC turnouts were supplying the entire City (i.e., both SFPUC and VW service areas). Thus, the 2019 MDD peaking factor is excluded when determining the recommended MDD peaking factor for this master plan.

The City has observed especially high daily water use in Zones SF3 and SF4, so the MDD peaking factor will be doubled for those customers. As a result, the MDD peaking factor will be 1.6 for customers in Zones SF1 and SF2 and 3.2 for customers in Zones SF3 and SF4.

The recommended MDD peaking factor for the VW system is 1.9. This is based on daily turnout flows from 2017 through 2019, as 2016 data had some extreme outliers and thus was deemed less reliable. Maximum daily production was relatively consistent from 2017 to 2018 before jumping up significantly in 2019.

Table 5-5. SFPUC Historical Maximum Day Demand Peaking Factors

Calendar Year	Maximum Day Demand Date[a]	Average Day Production[b], mgd	Maximum Day Production[c], mgd	Maximum Day Demand Peaking Factor
2016	August 12	4.71	7.10	1.51
2017	October 15	5.10	8.25	1.62
2018	November 15	5.16	8.09	1.57
2019	June 20	5.48	9.59	1.75
	Average	**5.11**	**8.26**	**1.61**
	Average (excluding 2019)[d,e]	**4.99**	**7.81**	**1.56**

(a) SFPUC turnout flows used as a proxy for customer demands in Zones SF1 through SF4.
(b) Refer to Table 5-1.
(c) SFPUC daily production data provided by City in January 2020.
(d) Data from 2019 excluded due to minimal VW flows on date of maximum SFPUC production (June 20, 2019).
(e) Due to high peak water use in Zones SF3 and SF4, the maximum day demand peaking factor will be doubled for those pressure zones.

Table 5-6. VW Historical Maximum Day Demand Peaking Factors				
Calendar Year	Maximum Day Demand Date[a]	Average Day Production[b], mgd	Maximum Day Production[c], mgd	Maximum Day Demand Peaking Factor
2016[d]	--	3.00	--	--
2017	June 30	2.84	4.90	1.73
2018	April 25	2.96	5.26	1.78
2019	October 10	2.84	6.64	2.34
	Average	**2.91**	**5.60**	**1.95**

(a) VW turnout flows used as a proxy for customer demands in Zones VW1 and VW2.
(b) Refer to Table 5-1.
(c) VW daily production data provided by City in May 2020.
(d) 2016 data incomplete.

5.1.5.2 Peak Hour Demand Peaking Factor

The PHD peaking factor is calculated by dividing the calendar year's largest single hour demand by the ADD of the same year. In the absence of hourly customer water use data for an entire year, the PHD peaking factor is typically estimated by applying diurnal curves during a maximum day demand. A diurnal curve reflects variations in water use over a 24-hour period and often has two demand peaks, one in the morning before residents leave home and another in the evening when they return home.

The City does not have the monitoring and reporting infrastructure in place to provide hourly water use data that would be required to develop a diurnal curve, so the recommended PHD peaking factor is based on West Yost's recent experience and typical PHD peaking factors determined for similar water systems. West Yost recommends a PHD peaking factor of 1.8 times MDD, which is slightly lower than the 2.0 peaking factor utilized in the 2009 WMPU. The recommended PHD peaking factor translates to 2.9 times ADD (1.6 x 1.8) for Zones SF1 and SF2, 5.8 times ADD (3.2 x 1.8) for Zones SF3 and SF4, and 3.4 times ADD (1.9 x 1.8) for the VW service area.

5.1.5.3 Summary of Recommended Peaking Factors

Table 5-7 summarizes the recommended peaking factors for each service area. As shown, the peaking factors represent multipliers applied to average day demands.

Table 5-7. Recommended Peaking Factors			
Service Area	Pressure Zones	Maximum Day Demand Peaking Factor[a]	Peak Hour Demand Peaking Factor[a,b]
SFPUC	SF1, SF2	1.6	2.9
SFPUC	SF3, SF4[c]	3.2	5.8
VW	VW1, VW2	1.9	3.4

(a) Peaking factors shown are applied to average day demand.
(b) The Peak Hour Demand (PHD) peaking factor is calculated by multiplying the Maximum Day Demand (MDD) peaking factor by 1.8 as described in Section 5.1.5.2.
(c) Due to high peak water use in Zones SF3 and SF4, peaking factors are doubled for those pressure zones.

5.2 WATER CONSERVATION

Water conservation is a key component of water demands. Discussions regarding existing and potential future water conservation in the City are presented below. Additional detail regarding the City's conservation efforts are documented in the City's 2020 Urban Water Management Plan, which is currently being prepared.

5.2.1 Water Conservation Act of 2009

In February 2008, the Governor called for a statewide 20 percent reduction in urban per capita water use by 2020 and asked state and local agencies to develop a more aggressive water conservation plan to achieve that goal. A team of state and federal agencies (the 20x2020 Agency Team) was formed to develop a statewide implementation plan.

Subsequently, the Water Conservation Act of 2009 (Senate Bill [SB] X7-7) was enacted in November 2009 as part of a comprehensive set of new Delta and water policy legislation requiring all water suppliers to increase their efficiency. Overall, the objective of SB X7-7 was to reduce statewide urban water use by 20 percent by the year 2020. SB X7-7 required water retailers to establish and adopt per capita water use targets (an interim target for 2015 and a final target for 2020) using defined methodologies. Adopted per capita water use targets were required to be included in the 2010 UWMPs and could be updated as part of the 2015 UWMPs. The City's adopted per capita water use targets are as follows:

- 2015 Interim Per Capita Water Use Target: 164 gpcd
- 2020 Final Per Capita Water Use Target: 146 gpcd

Compliance with the 2015 per capita water use target was required to be reported in the City's 2015 UWMP. In 2015, the City's actual per capita water use was 106 gpcd (refer to Table 5-4), well below (and in compliance with) the City's interim target for 2015. This was due in large part to the on-going drought conditions and associated mandatory water use restrictions in place in 2015. Based on recent water use trends, the City is expected to be in compliance with its 2020 (final) SB X7-7 per capita water use target.

5.2.2 "Making Water Conservation a California Way of Life"

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

In May 2018, the California State Legislature (Legislature) enacted two policy bills (SB 606 and Assembly Bill (AB) 1668) targeting long-term improvements in water conservation and drought planning that could withstand longer and more intense droughts resulting from climate change. These two bills expanded authorities and requirements to enable permanent changes and improve the state's water future. SB 606 and AB 1668 are direct outcomes of Governor Brown's Executive Order B-37-16.

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

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

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

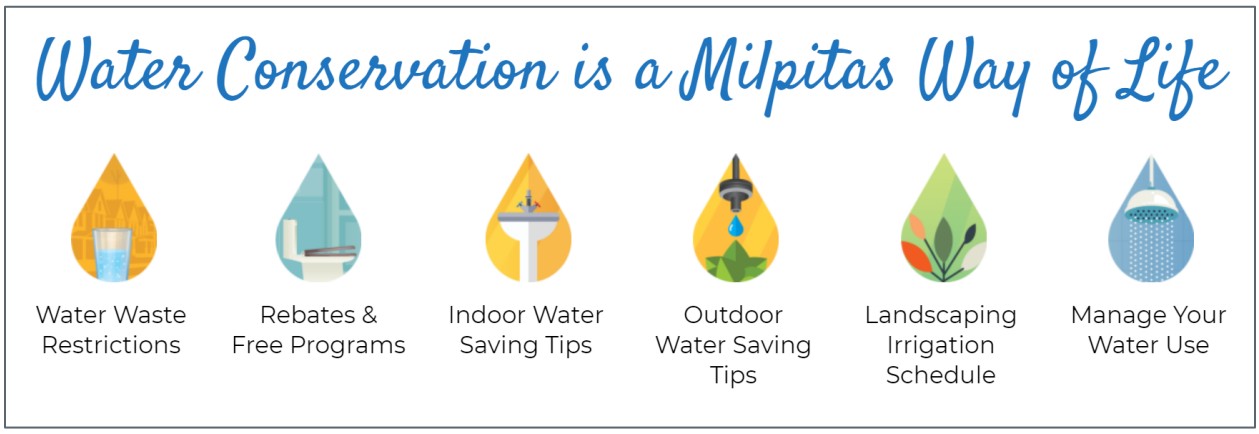
5.2.3 Current Water Conservation Programs

The City's 2015 UWMP describes the water conservation measures that have been implemented by the City. A Water Waste Ordinance (Ordinance 240.4) was in effect during the recent drought, along with a Water Conservation Program to facilitate reporting of water waste. The City also implemented the following measures:

- Conservation pricing
- Public education and outreach in conjunction with Valley Water and the BAWSCA
- Residential water surveys
- Free low-flow plumbing fixtures
- Irrigation submeter rebates
- Landscape water surveys and conversion rebates
- High-efficiency clothes washer rebates

- Rebates for process, technology, and equipment retrofits that save water
- High-efficiency toilet and urinal valve replacement rebates

These water conservation measures continue to be implemented in the City.



From savewatermilpitas.org

Current information on the City's water use restrictions and water conservation and rebate programs is posted on the City's water conservation webpage (savewatermilpitas.org). In addition, the City's water customers have access to MyWater Milpitas which is an on-line tool that allows customers to track and manage their water consumption.



From MyWater Milpitas

5.3 FUTURE WATER DEMAND PROJECTION

Future City water demands were projected based on land use data, the preferred method for water system master planning and hydraulic modeling. Population-based methods are appropriate for estimating overall water demands, but they fail to account for spatial variations in water use. In contrast, land-use based demand projections geographically allocate water use based on existing consumption and future development.

This section details the demand projection methodology and presents the associated results.

5.3.1 Demand Projection Methodology

Buildout water demands equal the sum of existing demands and projected future demands as a result of new development. Demand projections are typically calculated based on land use, with expected land area multiplied by a WUF. WUFs are developed from recent historical consumption data and vary by land use type. In other words, WUFs recognize that a 10-acre industrial processing plant would use more water than a similarly sized office park.

Establishing appropriate WUFs is a critical step in forming reliable water demand projections. The adopted factors will be used to calculate future demands for growth areas in the City, as defined by the City's General Plan and other on-going planning efforts. Future demands will then be adjusted for NRW to determine the required future water production.

5.3.2 Water Use Factors

A WUF is defined as the estimated water use per unit area of a given land use type. The following data was used to update WUFs:

- 2019 consumption data with service addresses (per billing records)
- Service address-Assessor's Parcel Number (APN) database
- General Plan land use parcel map with APNs (GIS file)

Water consumption was linked with spatially located land use based on customer service address and APN. Using a City-provided spreadsheet of customer service addresses and APNs, the 2019 water meter billing records were first linked to APNs using customer service addresses. Water usage could then be linked to land use via APN. Successfully assigning land use to a water billing record required a match for both service address and APN. Approximately 64 percent of 2019 demand could be linked.

West Yost developed preliminary WUFs for each existing General Plan land use designation by dividing the total linked water use by the total corresponding acreage. Due to the lower demand linkage rate, preliminary WUFs were refined by examining specific developments and estimated per capita water use based on estimated dwelling units per acre and people per dwelling unit. The City provided West Yost with a list of representative developments of various land uses (e.g., office park, apartment complex, commercial) to verify whether a development's actual consumption was in line with its WUF-based demand estimate. In addition, West Yost used General Plan density standards to compare per capita water use across residential and mixed use land use types and to the 2009 WMPU. Any WUFs that resulted in unusually high or low per capita consumption were adjusted accordingly. Most of the preliminary WUFs calculated from actual usage were only adjusted slightly to their recommended values. A handful of

preliminary WUFs (e.g., Urban Residential) were unusually low, likely due to limited linked water use for that land use, and increased to their recommended values.

Recommended WUFs are summarized in Table 5-8, along with a comparison to 2009 WMPU values (where available). WUFs are generally lower than in the 2009 WMPU, which is consistent with conservation efforts and efficiency improvements implemented over the last decade. For some land uses, limited data prevented updating WUFs, so the 2009 WMPU values were used. This is a conservative approach, as actual WUFs have likely decreased.

5.3.3 Water Demand Projection

West Yost developed water demand projections by applying the recommended WUFs to the future land use acreages detailed in Chapter 2. Total buildout demand is the sum of existing demands and new demands from future planned growth in Opportunity Areas and the Gateway and Milpitas Metro Specific Plan areas. Based on available data and to be conservative, growth was assumed to be new development, not redevelopment of existing developed areas, so future demands were added to existing demands. The land use-based demand projections are based on preliminary land use estimates that are subject to change as the City refines its planning documents.

Table 5-9 summarizes the buildout water demand projection. After adjusting for NRW, the City's projected water production required at buildout is approximately 13.9 mgd, or 15,600 af/yr. This is an increase of approximately 5.6 mgd, or 67 percent, over existing (2019) production (8.3 mgd).

The buildout water demand projection accounts for existing recycled water use but not additional recycled water use in either existing or future development areas. As discussed in Section 5.3.2, WUFs were based on actual potable water consumption, which reflects any existing recycled water use that would offset potable water use. However, the buildout water demand projection does not include any expanded recycled water use for irrigation or other non-potable uses. Increased recycled water use would mean that actual buildout water demands should be lower than the current projection. Since information on future development remains conceptual, the location and magnitude of future recycled water use are difficult to estimate. As a result, West Yost recommends proceeding with this conservative demand projection.

On a per capita basis, the projected future water use equates to 119 gpcd, slightly higher than the City's 2019 per capita water use (107 gpcd). Using U.S. Census data from 2014 to 2018, the City's household population density averages approximately 3.33 people per dwelling unit (DU). Assuming future housing densities will be similar to existing densities, adding 11,650 new DUs translates to approximately 38,794 new residents, for a total buildout population of approximately 116,755. Dividing the projected buildout demand (13.9 mgd) by the projected future population yields an overall per capita water use of approximately 119 gpcd, similar to the City's recent per capita water use average for the last several years (117 gpcd, see Table 5-4).

In the absence of specific timing for future development, required water production for intermediate planning years was linearly interpolated. Table 5-10 summarizes the land use-based water production projections in five-year increments through buildout (2040).

Table 5-8. Recommended Water Use Factors

Category	Existing General Plan Land Use[a]	Abbreviation[a]	Recommended WUF, gpd/ac	2009 WMPU WUF, gpd/ac	Percent Difference from 2009 WMPU
Residential	Hillside Very Low Density	HVL	300	800	-63
	Hillside Low Density	HLD	300	800	-63
	Hillside Medium Density	HMD	600	800	-25
	Single Family Low Density	SFL/LDR	1,300	2,240	-42
	Single Family Medium Density	SMD	2,400	NA[b]	--
	Multi-Family Medium Density	MFM/MDR	2,300	NA[b]	--
	Multi-Family High Density	MFH/HDR	4,500	5,310	-15
	Multi-Family Very High Density	VHD/VHDR	9,000	9,720	-7
	Urban Residential	URR	4,500	NA[b]	--
	Mobile Home Park	MHP	825	NA[b]	--
Mixed Use	Mixed Use	MXD	10,890	10,890	0[c]
	Residential Retail High Density Mixed Use	RRMU	10,890	NA[b]	--
	Boulevard Very High Density Mixed Use	BVMU/ VHDMU	10,890	NA[b]	--
	Neighborhood Commercial Mixed Use	NCMU	2,100	NA[b]	--
Commercial	Professional & Administrative Office	PAO	3,200	3,200	0[c]
	Retail Subcenter	RSC	2,800	4,290	-35
	General Commercial	GNC	1,400	2,400	-42
	Highway Service	HWS	2,000	NA[b]	--
	Town Center	TWC	2,100	NA[b]	--
	Neighborhood Commercial	NC	1,400	NA[b]	--
Industrial	Manufacturing	MFG	2,000	2,000	0[c]
	Industrial Park	INP	400	1,250	-68
	Business Park/Research & Development	BPRD	400	NA[b]	--
Public	Public Facilities	PF	600	1,000	-40
	Permanent Open Space	POS	1,300	1,300	0[c]
	Waterway	WW	1,300	NA[b]	--

(a) Categories and abbreviations based on land use information provided by the City in January 2020. Multiple abbreviations reflect existing and future iterations of the same land use category. The future abbreviation is listed second.
(b) NA = not applicable. WUF for this land use was not specified in the 2009 WMPU.
(c) WUF was not updated due to limited data.

Table 5-9. Buildout Potable Water Demand Projection

Development	Land Use Designation[(a)]	Total Acres[(a)]	WUF[(b)], gpd/ac	Demand, mgd
Opportunity Areas - Residential				
Sunny Hills Neighborhood Node/Commercial Center	NCMU	19.92	2,100	0.04
California Circle	NCMU	54.10	2,100	0.11
California Circle	HDR	18.26	4,500	0.08
Landess Neighborhood Node/Commercial Center	NCMU	38.03	2,100	0.08
Calaveras & North Park Neighborhood Node/Commercial Center	NCMU	28.28	2,100	0.06
Milpitas Town Center	HDR	38.07	4,500	0.17
			Subtotal	0.55
Opportunity Areas - Non-Residential				
McCarthy Ranch Industrial Area	INP	192.29	400	0.08
Southwestern Employment Area	BPRD	488.26	400	0.20
Central Manufacturing Area - North	MFG	492.14	2,000	0.98
Jacklin & 680 Neighborhood Node/Commercial Center - East	NC	7.95	1,400	0.01
Jacklin & 680 Neighborhood Node/Commercial Center - West	NC	6.42	1,400	0.01
Jacklin Neighborhood Node/Commercial Center	NC	9.79	1,400	0.01
			Subtotal	1.29
Milpitas Gateway-Main Street Specific Plan				
HDR Subset of Gateway-Main Street	HDR	46.70	4,500	0.21
VHDR Subset of Gateway-Main Street	VHDR	74.58	9,000	0.67
MDR Subset of Gateway-Main Street	MDR	62.70	2,300	0.14
Non-Residential Subset of Gateway-Main Street	MFG	300.30	2,000	0.60
			Subtotal	1.63
Milpitas Metro Specific Plan (MMSP)				
VHDR Subset of Metro Plan Area	VHDR	99.00	9,000	0.89
HDR Subset of Metro Plan Area	HDR	113.52	4,500	0.51
NC Subset of Metro Plan Area	NC	85.35	1,400	0.12
			Subtotal	1.52
			Total New Demand	4.99
			NRW (11%)	0.62
			New Water Production Required	5.60
			Existing (2019) Water Production	8.33
			Buildout Water Production Required	**13.9**

(a) Refer to Table 2-4.

(b) Refer to Table 5-8.

Table 5-10. Land Use-Based Water Demand Projection for Intermediate Planning Years

Year	Required Water Production	
	mgd	af/yr
2020	8.33	9,334
2025	9.73	10,904
2030	11.1	12,474
2035	12.5	14,044
2040[a]	13.9	15,614

(a) Refer to Table 5-9.

5.3.4 Comparison with Other Demand Projections

5.3.4.1 2009 WMPU and 2015 UWMP

Table 5-11 compares current projections with the 2009 WMPU and the 2015 UWMP. At buildout (2040), the land use-based water demand projection presented above is approximately 3.5 mgd lower than projections from the 2009 WMPU. This represents a decrease of approximately 20 percent. The 2009 WMPU did not specify a growth timeline or buildout year, so intermediate planning year demands are blank in the table. Further, it was assumed the 2009 WMPU "future" coincides with the year 2040.

Demand projections in the 2015 UWMP follow the same timeline as this master plan. Throughout the planning horizon, the demand projections from this master plan are significantly lower than demand projections from the 2015 UWMP. At buildout (2040), demand projections are 4.6 mgd (about 25 percent) lower than the 2015 UWMP. Based on the available information, it is not clear why the demand projections in the 2015 UWMP were so high.

Table 5-11. Land Use-Based Water Demand Projection Comparison with Previous City Reports

Source	Projected Demand, mgd				
	2020	2025	2030	2035	2040
2020 Water Master Plan[a]	8.33	9.73	11.1	12.5	13.9
2009 WMPU[b]	--[c]	--[c]	--[c]	--[c]	17.4
Difference vs. 2009 WMPU	NA[d]	NA[d]	NA[d]	NA[d]	-3.5
2015 UWMP[e]	10.0	12.1	14.3	16.4	18.5
Difference vs. 2015 UWMP	-1.7	-2.4	-3.2	-3.9	-4.6

(a) Refer to Table 5-10.
(b) Source: 2009 WMPU, Table 3-6 (Scenario 3). It is assumed future demand in the 2009 WMPU equals demand in year 2040.
(c) 2009 WMPU did not specify a timeline for demands.
(d) NA = not applicable.
(e) Source: 2015 UWMP, Table 4-2.

5.3.4.2 BAWSCA Regional Water Demand and Conservation Projections Demand Forecast for 2020 UWMP

Maddaus Water Management, Inc. (Maddaus) prepared a Regional Water Demand and Conservation Projections Project for the BAWSCA to support each member agency's preparation of their 2020 UWMPs. In February 2020, Maddaus prepared a technical memorandum (Technical Memorandum #2) to present the following: (1) the demand projection analysis methodology; (2) the demand analysis results including each BAWSCA member agency demand projections through 2045; and (3) the projections verification process to be completed and signed by each member agency to accept the demand projections.

The demand projection update for each BAWSCA member agency uses a combination of two different analytic models – the Econometric Model and the Least Cost Planning Decision Support System (DSS Model). The purpose of using two tools is to leverage the strengths of each tool to obtain a suite of demand recovery scenarios through the year 2045.

- The Econometric Model estimates the impact of various conditions on service area water demand. The model uses historical patterns to project the future rebound in demand associated with post-drought recovery, while taking into account other factors such as economy, rate increases, conservation activity, and weather. Since the Econometric Model is calibrated using historical data, its reliability depends on the historical relationship between water demand and its influencing factors remaining unchanged from the calibration period to the forecasting period.
- The DSS Model can accommodate historical and projected information reflecting how future service area and water use characteristics may differ from the past in each of the BAWSCA member service areas. Further into the future, changes in demographics, living patterns, housing stock, and industrial structure can alter the historical relationship with water demand. To accommodate all of these considerations, a number of scenarios were generated to model the post-drought demand recovery, including one scenario per member agency generated by each agency's respective Econometric Model. The DSS Model also has a conservation component that quantifies savings from plumbing codes and active conservation programs.

The Econometric Model for each BAWSCA member agency was used to generate water demand forecasts to the year 2023. The Econometric Model assumes temporary behavioral changes encouraged during the drought return to pre-drought norms. However, the water savings emanating from historical water rate increases and active conservation programs (e.g., non-behavior-based programs such as rebates) achieved through 2018 are assumed to be permanent and therefore do not rebound. The model assumes that the predicted demand recovery will occur gradually over an additional five years (2019-2023), based on BAWSCA's historical experience of the 1987-1992 drought.

The DSS Model was used to generate long-term demand forecasts for each BAWSCA member agency for 2019 to 2045. The DSS Model also includes a conservation component that quantifies savings from passive conservation (e.g., plumbing codes) and active conservation programs. The DSS Model's conservation component covers the entire forecast period of 2019-2045.

The City provided historical water use data and confirmed population and employment projections to be used by Maddaus for the demand projections. The resulting demand projections for the City, which include both potable and non-potable (i.e., recycled water) uses, are presented in Table 5-12.

Table 5-12. City of Milpitas Demand Projections as Calculated by Maddaus[a]

Demand Forecast Scenario[b]	Demand Projections, mgd					
	2023	2025	2030	2035	2040	2045
Pre-Recession and Pre-Drought Demand Level Recovery	11.4	12.0	12.3	12.8	13.1	13.5
Pre-Drought Demand Level Recovery	10.7	11.1	11.4	11.9	12.3	12.6
Partial Rebound – Normal Economy, Weather Normalized	11.3	11.9	12.4	13.0	13.5	14.0
Current Water Demand Profile – Normal Economy, Weather Normalized	9.4	9.5	9.5	10.3	10.7	11

Source: Technical Memorandum #2 BAWSCA Regional Water Demand and Conservation Projection Demand Forecast, prepared for Bay Area Water Supply & Conservation Agency, prepared by Maddus Water Management, Inc., February 21, 2020

(a) These demand projections include non-potable (i.e., recycled water) use (approximately 2 mgd by 2045). Savings from active conservation programs are not included in these projections.

(b) See text below for description of demand forecast scenarios.

The demand forecast scenarios are described as follows:

- Pre-Recession and Pre-Drought Demand Level Recovery: Demand projections are based on the City's 2000-2007 water use profile, starting with 2018 demand levels and recovering from the drought in five years.
- Pre-Drought Demand Level Recovery: Demand projections are based on the City's 2004-2013 water use profile, starting with 2018 demand levels and recovering from the drought.
- Partial Rebound–Normal Economy, Weather Normalized: Demand projections are based on the Econometric Model with the following assumptions: (1) normal weather, (2) normal economy, (3) price escalation projections that vary by agency, (4) historical active conservation efforts, and (5) passive conservation plumbing codes.
- Current Water Demand Profile: Demand projections are based on the following assumptions: (1) normal economy, and (2) weather normalized. This is water demand calculated from historical 2018 water production data submitted by each BAWSCA member agency. The 2018 data were weather normalized and assume a normal economy. This scenario does not include any additional post-drought demand recovery.

Savings from plumbing codes (also known as passive conservation) is based on federal and state legislated efficiency standards pertaining to plumbing fixtures and appliances. The impact of codes quantified here include the Energy Policy Act of 1992, CALGreen Building Code, AB 715, and SB 407 (governs the types of fixtures available on the market for toilets, showers, washers, etc.). The plumbing code savings have been added into all four scenarios shown above.

Though the BAWSCA projections include recycled water use and extend to 2045, five years beyond the scope of this Water Master Plan, the buildout demand projections are comparable. As discussed in Section 5.3.3, the Water Master Plan land use-based water demand projection counts any potential new (i.e., above existing) recycled water use as potable water use. Therefore, the projection of 13.9 mgd generally compares well with the Maddaus demand projections, particularly the Partial Rebound – Normal Economy, Weather Normalized scenario demand projection of 14.0 mgd.

CHAPTER 6
Hydraulic Model Update and Calibration

This chapter describes the process of updating and calibrating the City's water system hydraulic model to confirm it accurately represents the City's existing water system. The hydraulic model was then used to evaluate the adequacy of the City's water system under existing (Chapter 8) and future (Chapter 9) water demand scenarios.

The following sections detail the hydraulic model update and calibration process:

- Hydraulic Model Background
- Hydraulic Model Element Naming Scheme
- Hydraulic Model Update Methodology
- Hydraulic Model Review and Update
- Steady-State Hydraulic Model Calibration
- Summary of Findings and Conclusions

6.1 HYDRAULIC MODEL BACKGROUND

As part of the 2002 WMP, Raines, Melton & Carella (RMC) developed an operational water system hydraulic model for the City using H_2ONet. In the 2009 WMPU, RMC converted the hydraulic model to H_2OMAP and re-evaluated the City's water system using updated land use information. This H_2OMAP-based hydraulic model has not been regularly updated since the 2009 WMPU.

In 2017, Innovyze retired the H_2OMAP modeling platform in favor of InfoWater. As a result, West Yost rebuilt the City's hydraulic model in InfoWater using the latest information for major facilities (e.g., pumps, storage reservoirs, and valves) provided by the City.

6.2 HYDRAULIC MODEL ELEMENT NAMING SCHEME

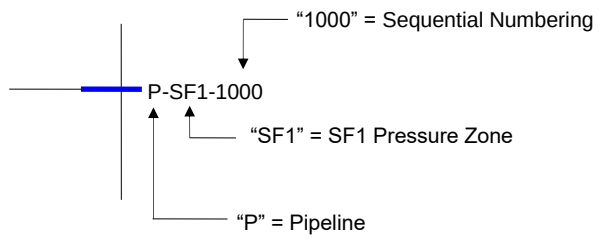
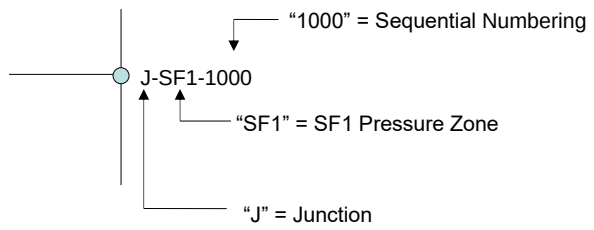
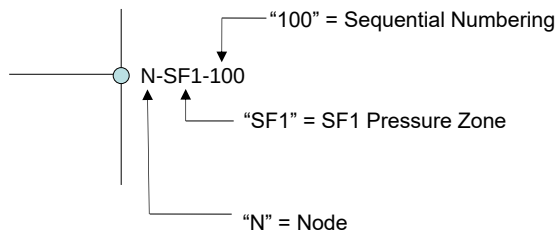
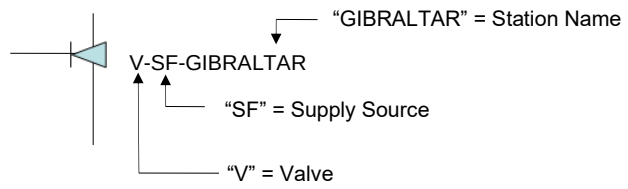
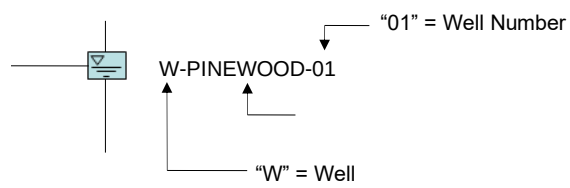
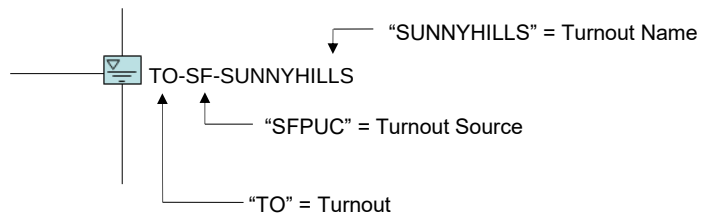
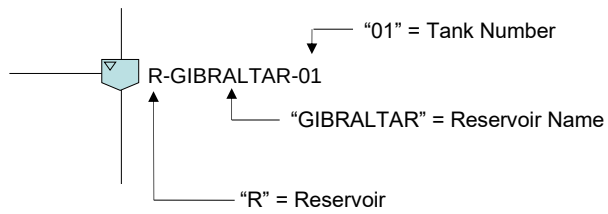
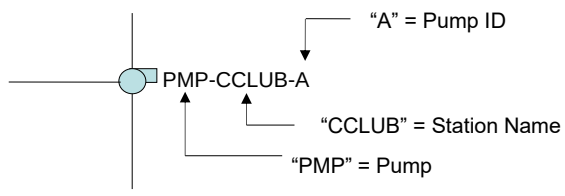
A specific and consistent naming convention allows modelers to easily locate and identify modeling elements like pipes, junctions, pumps, and storage reservoirs. As each facility is created in the model, it is named logically and sequentially based on industry standards and West Yost's extensive modeling experience. Table 6-1 summarizes the hydraulic element functions, along with prefixes used in naming.

Table 6-1. Hydraulic Network Elements

Type	Description	Prefix
Pipelines	Conveys water from one node to another. Pipelines are assigned hydraulic characteristics (e.g., diameter, roughness) and general information (e.g., pressure zone, year of installation).	P
Junctions	Removes (demand) or adds (inflow) water from/to the system. Junctions represent connections to customer service laterals, hydrants, turnouts, etc.	J
Nodes	Represents either a transition in pipeline characteristic (e.g., change in diameter) or a point where pressure and/or water quality are monitored. Nodes are similar to junctions but do not add or remove water to the system.	N
Valves	Controls flow or pressure in the system based on specified criteria. Valves typically represent pressure reducing valves (PRV) or pump variable frequency drives, using pressure settings provided by the City.	V
Wells	A water source with fixed head, representing the hydraulic grade of the groundwater.	W
Turnouts	A water source with fixed head, representing the incoming hydraulic grade from the supplier.	TO
Storage Reservoirs	Represents storage capacity. Storage reservoir characteristics (e.g., dimensions, capacity, elevation, operating levels) are based on information from the City.	R
Pumps	Raises the hydraulic grade to overcome elevation differences and friction losses. Pump operation is based on pump curves or design points provided by the City.	PMP

Table 6-2 details the model's naming scheme, which is primarily based on the hydraulic element prefix.

Table 6-2. Naming Scheme for Hydraulic Model Network Elements

Model Element	Naming Scheme
Pipelines	
Junctions	
Nodes	
Valves	
Wells	
Turnouts	
Storage Reservoirs	
Pumps	

6.3 HYDRAULIC MODEL UPDATE METHODOLOGY

To rebuild and update the City's water system hydraulic model, West Yost performed the following key tasks:

- Imported existing pipelines from City's geographical information system (GIS) database
- Added new pipelines near the new Milpitas BART station, which were not in the GIS database when it was initially received and imported into the model
- Updated existing and added new water system facilities (e.g., storage reservoirs, booster pump stations, pressure regulating valves, and wells)
- Allocated existing water demands using the City's spatially located meter and billing information
- Performed field hydrant testing within the distribution system on March 11, 2020
- Deployed Hydrant Pressure Recorders (HPRs) throughout the distribution system to record system pressures from March 10 through April 1, 2020
- Calibrated the hydraulic model with the results from data collected during the hydrant testing
- Verified that the hydraulic model system configuration is generally representative of the City's current water system based on system pressures, flows, and tank elevations recorded in the field and from the City's charts and Supervisory Control and Data Acquisition (SCADA) system

As part of these efforts, West Yost coordinated closely with the City to obtain and review:

- Information on existing water supply turnouts, storage reservoirs, booster pump stations, pressure regulating valves, wells, and other water system facilities
- As-built drawings associated with water system improvements implemented since 2002, especially adjacent to the new BART station
- City's GIS database of water system facilities (e.g., pipelines, wells, booster pump stations, etc.), received January 2020
- Metered water consumption information
- Historical SFPUC and VW turnout data
- Historical circular chart and SCADA system data

6.4 HYDRAULIC MODEL REVIEW AND UPDATE

The following sections detail specific steps taken to rebuild the hydraulic model in InfoWater and accurately represent the City's existing water system.

6.4.1 Pipeline Import and Update

The City engaged HydroScience to update its GIS-based pipeline records by reviewing recent as-builts, reconciling any discrepancies, and adding any missing alignments. After completing this task, HydroScience transmitted the pipeline shapefiles (one for each pressure zone) to West Yost. The shapefiles, which contained only distribution mains, were then imported to InfoWater via the "Import Manager" tool.

West Yost also checked the pipeline network for connectivity issues using InfoWater's built-in network review tools. This multi-step process identified and helped resolve parallel pipes (i.e., inadvertent duplicates), pipes that should be connected, and pipes that cross but do not intersect.

6.4.2 Pipeline Roughness Factors

Pipeline roughness is represented by a coefficient, known as a C-factor, with higher values corresponding to smoother surfaces. Ideally, C-factors are assigned to pipelines based on material, diameter, and age. In the 2009 WMPU, all pipelines were assigned a roughness coefficient of 120. West Yost assigned preliminary C-factors to pipelines in the hydraulic model based on material and diameter, using an in-house database of C-factors developed from previous hydrant testing performed for numerous water systems. These preliminary C-factors, which were refined as part of the hydraulic model calibration process (Section 6.5), are presented in Table 6-3.

Table 6-3. Preliminary Pipeline C-factors Assigned in the Hydraulic Model

Pipeline Material	Abbreviation	C-Factor	
		Diameter ≤ 8 inches	Diameter > 8 inches
Asbestos Cement	AC / ACP	120	130
Concrete Cylinder	CCP	-[(a)]	130
Cast Iron	CIP	100	110
Ductile Iron	DIP	130	140
Polyvinyl Chloride	PVC	140	150
Steel	STL	120	130

(a) Material in this diameter range does not exist in City system.

6.4.3 System Elevations

Junction elevations in the hydraulic model are based on 1-foot contours[8] developed by VW using LiDAR. ESRI tools were used to interpolate between contours and create a detailed grid map (i.e., raster) of elevations in the City service area. Finally, InfoWater's "Elevation Extractor" tool used the raster map to assign elevations to each junction.

For facility sites (e.g., pump stations and storage tanks), junction elevations were further refined per available as-built drawings. Where elevation or depth information was missing from as-built drawings, junction elevations were unchanged from their original, raster-based values.

6.4.4 Existing System Facilities

West Yost reviewed City-provided as-built drawings for existing system facilities and added them to the hydraulic model. These include water supply turnouts, storage reservoirs, pump stations, PRVs, and the Pinewood Well. Operational parameters, including pump curves, PRV settings, and storage reservoir levels, were also confirmed with City staff.

In some cases, "equivalent" facilities were used in the model to simplify functionality without compromising simulation accuracy. For example, turnouts are represented by fixed head reservoirs using the hydraulic grade line of the source supply (SFPUC or VW). Additionally, pressure reducing valves are used to represent the discharge pressure setting for variable speed pumps.

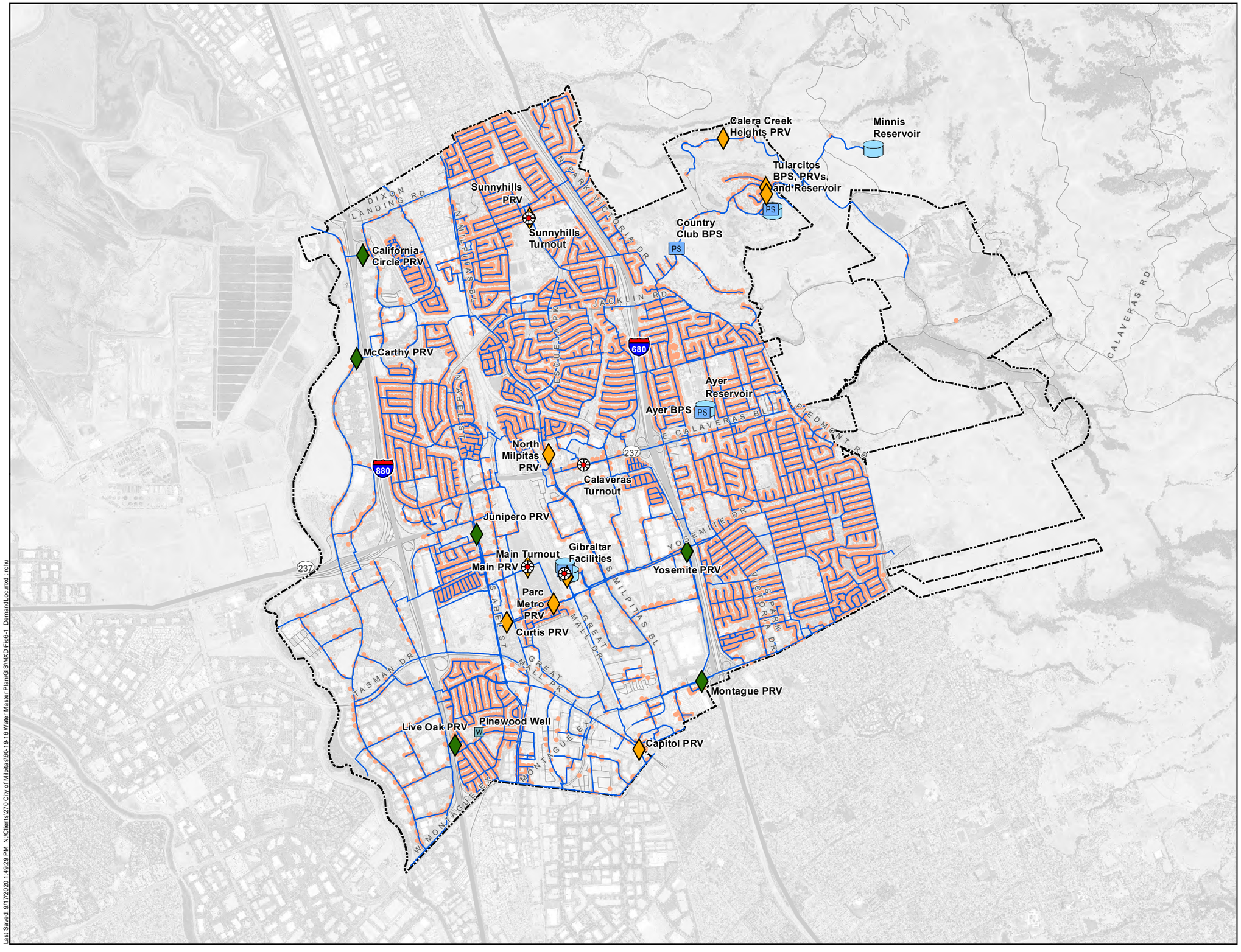
6.4.5 Spatially Located Meter Accounts

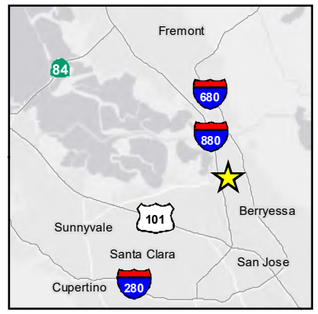
The first step in spatially locating water consumption involved linking billed water consumption to spatially located meters using a unique identifier. The City provided West Yost bimonthly water billing data listing the consumption, service address, unique billing code (i.e., Location_ID), meter type, and billing period for each customer account from 2013 through 2019. Many (but not all) meters in a City-provided water meter GIS file contained this same Location_ID. Using this unique identifier, approximately 77 percent of 2019 demand was spatially located. Ideally, at least 95 percent of demand is spatially located, so additional effort was required.

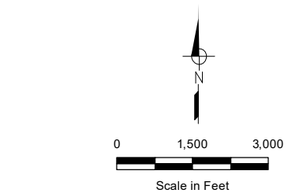
To spatially locate the consumption that could not be linked using Location_IDs, West Yost utilized ESRI's "Geocode Addresses" tool. In short, this tool spatially locates addresses based on a user-provided street database containing details like street name, suffix, direction, and address numbers on each side of the street. Another 21 percent of demand was geocoded, resulting in a total of over 98 percent of demand being spatially located. Figure 6-1 shows the spatial distribution of metered consumption in the hydraulic model.

The goal is to spatially locate production, equal to consumption plus NRW. To this end, spatially located demands were globally scaled up to match the total 2019 consumption. Then, 2019 NRW was added to each location as a fixed proportion of consumption. The final demand included in the hydraulic model equals the City's average daily water production in 2019 (8.3 mgd).

[8] Valley Water Contours downloaded on 2/25/2020 from http://gis.valleywater.org/Download/LIDAR/







- Spatially Located Demand
- Turnout
- Well
- Pressure Reducing Valve
- Emergency Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline
- City Limits

Figure 6-1

Spatially Located Water Demands

City of Milpitas
2020 Water Master Plan

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6.4.6 Water Demand Allocation

InfoWater's "Demand Allocator" tool assigns spatially located demands to the closest junction. Some junctions were excluded from the tool, including those on transmission mains (which typically do not have service connections) or facility sites (e.g., at a pump station). West Yost staff then reviewed the junctions with demands to confirm correct allocation with respect to service area and pressure zone.

The following demand sets were created in the model:

- **EX_ADD**: 2019 average day demand (8.3 mgd)
- **HT_BASE**: Average day demand for hydrant test day (3/11/2020; 8.4 mgd)

The "EX_ADD" demand set was used as the basis to create the "HT_BASE" demand set, which was scaled to equal the average demand on March 11, 2020 and used for steady-state calibration.

6.5 STEADY-STATE HYDRAULIC MODEL CALIBRATION

Hydrant test data was used to calibrate the hydraulic model by verifying whether the model can accurately simulate field-observed fire flow conditions. Part of the calibration process entails adjusting pipeline C-factors (within a typical range) to improve model accuracy. For additional detail on the hydrant test process, refer to West Yost's March 9, 2020 memorandum, which is provided as Appendix C. The following sections summarize the hydrant tests and hydraulic model calibration results.

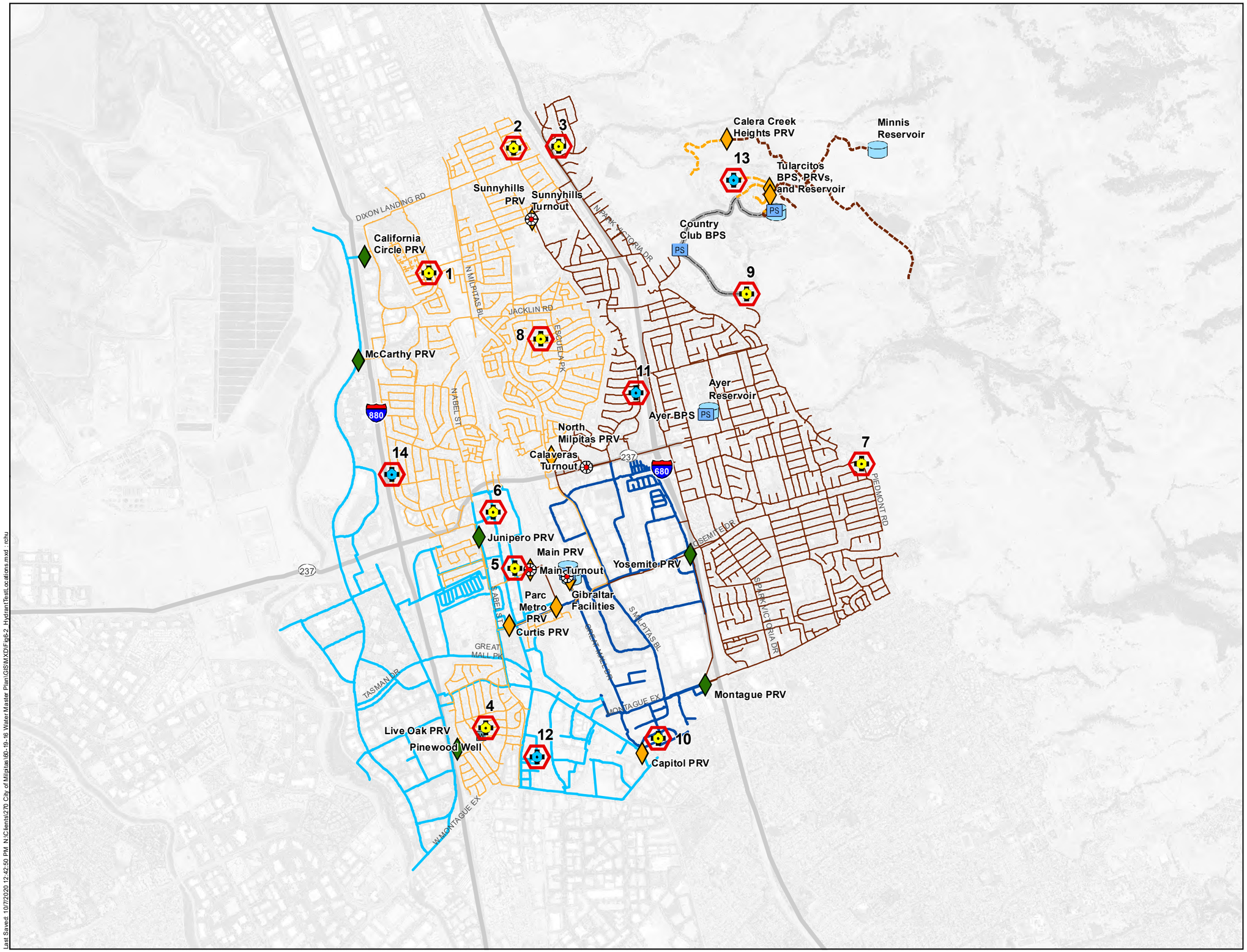
6.5.1 Hydrant Tests

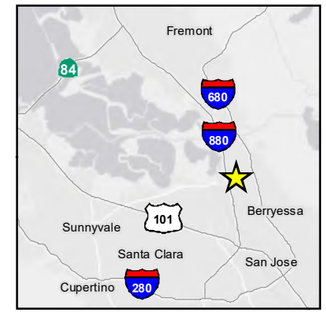
There were 14 hydrant test locations (10 primary and 4 alternate) initially identified based on pipeline diameter, material, and age. Pipeline connectivity was also considered, with priority given to locations requiring fewer valve closures to achieve unidirectional flow. Table 6-4 lists the field status of each test, while Figure 6-2 illustrates the test locations.

Table 6-4. Hydrant Test Field Status

Test No.	Pipeline Material Type	Pipeline Diameter, inches	Location	Field Status
1	PVC	8	Along Elkwood Drive	Completed
2	AC	6	Along Gosser Street	Completed
3	AC	6	Along Stirling Drive and Stratford Drive	Completed
4	AC	6	Along Greentree Way	Completed
5	PVC	8	Along Hammond Way	Completed
6	AC	8	Along Main Street	Completed
7	AC	8	Along Lacey Drive	Completed
8	AC	6	Along Clauser Drive	Not Performed[a]
9	AC	8	Along Calaveras Ridge Drive	Completed
10	DI	8	Within Crossing at Montague Apartments	Completed
11	AC	6	Along Las Lomas Drive and Pacheco Drive	Not Performed[b]
12	PVC	8	Along Costa Street and Mihalakis Street	Not Performed[b]
13	AC	8	Along Pebble Beach Court	Not Performed[b]
14	AC	8	Along Heath Street	Not Performed[b]

(a) Due to operational concerns, City advised against performing Test 8.
(b) Alternate tests were not performed due to time constraints.





N

0 1,500 3,000

Scale in Feet

- Test Location
- Alternate Test Location
- Turnout
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pump Station
- Storage Reservoir

Pipeline Pressure Zone

- VW1
- VW2
- SF1
- SF2
- SF3
- SF4-1
- SF4-2

Figure 6-2

Hydrant Test Locations

City of Milpitas
2020 Water Master Plan

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Each hydrant test included one flowing hydrant and three to four observation hydrants, which are identified by test number and an alphabetical designation based on proximity to the flowing hydrant. For example, Hydrant 1A is the observation hydrant closest to (flowing) Hydrant 1, while Hydrant 1D is the furthest.

To recreate operational and demand conditions for the hydrant test day (March 11, 2020), City staff provided water system data for turnouts and storage reservoirs. The City turned off booster pump stations during the test period; therefore turnouts were serving all demands in the valley floor. Data was limited for hillside demands during the test period, and since hillside demands are relatively low, demands during the hydrant test period were assumed to be equal to the combined flow from all turnouts. SFPUC turnout flows were provided in hourly increments and averaged from 8:00 am to 6:00 pm, while VW turnout flows were provided in minute increments and averaged from 8:30 am to 5:30 pm. The "test day demand" is the sum of the SFPUC and VW average flows. Spatially allocated average day demands were then scaled up such that the total system demand equals the test day demand.

Each completed hydrant test was simulated using the hydraulic model, and results were compared to field observations. Model performance was evaluated using differential pressure, which is defined as the difference between static and residual pressure for a given location. The model was considered calibrated if differential pressures were within 5 pounds per square inch (psi) of the field data. This psi tolerance is based on standard engineering practice for model calibration in water system planning.

6.5.2 Hydraulic Model Calibration Results

The hydraulic model was able to simulate hydrant tests accurately, with only minor adjustments to the preliminary C-factors presented in Table 6-3. Of the nine hydrant tests conducted, eight could be simulated such that differential pressures fell within 5 psi of field observations. The remaining hydrant test (No. 10) was abandoned due to likely incorrect valving during the test. Table 6-5 summarizes the calibration results, while the following sections detail the C-factor adjustments and issues that occurred with Hydrant Test No. 10.

6.5.2.1 Pipeline Roughness Factor Adjustments

Field data from hydrant tests indicated that preliminary C-factors for AC and polyvinyl chloride (PVC) pipes were slightly high. Consequently, the C-factors for AC and PVC pipes 8 inches in diameter and smaller were adjusted down to 110 and 130, respectively. Although no hydrant tests were conducted for AC and PVC pipes larger than 8 inches in diameter, West Yost assumed those preliminary C-factors were also high and decreased them accordingly.

Roughness factors for other pipe materials remain equal to their preliminary values. Table 6-6 summarizes the calibrated C-factors used in the City's hydraulic model.

Table 6-5. Hydrant Test Calibration Results

Hydrant	Field Data					Modeled Data			
	Static Pressure, psi	High Residual Pressure, psi	Low Residual Pressure, psi	Average Residual Pressure, psi	Differential Pressure, psi (Static - Residual)	Static Pressure, psi	Residual Pressure, psi	Differential Pressure, psi (Static - Residual)	Comparison of Differential Pressures between Field and Modeled Data
Hydrant Test No. 1 (8" PVC, 1990s, Zone SF1)									
Flowing 1	86					84			
1A	87	44	40	42	45	83	41	43	2
1B	88	52	50	51	37	83	50	33	4
1C	82	76	50	52	30	84	57	27	3
1D	86	64	62	64	22	84	66	18	4
Hydrant Test No. 2 (6" AC, 1960s, Zone SF1)									
Flowing 2	54					52			
2A	48	18	16	17	31	46	15	31	0
2B	51	31	29	30	21	48	30	19	2
2C	53	48	44	46	7	54	49	5	2
Hydrant Test No. 3 (6" AC, 1980s, Zone SF2)									
Flowing 3	98					94			
3A	96	28	24	26	70	91	24	67	3
3B	94	36	32	35	59	87	32	55	4
3C	84	42	38	40	44	81	41	41	3
3D	82	84	58	58	24	79	54	24	0
Hydrant Test No. 4 (6" AC, 1960s, Zone SF1)									
Flowing 4	78					76			
4A	80	41	29	30	50	76	25	51	-1
4B	82		45	46	36	75	38	37	-1
4C	78	60	53	58	20	74	54	20	0
Hydrant Test No. 5 (8" PVC, 1980s, Zone VW1)									
Flowing 5	80					80			
5A	84	40	40	41	43	80	40	41	3
5B	84	47	45	46	38	81	46	34	4
5C	80	60	50	54	26	81	52	28	-2
Hydrant Test No. 6 (8" AC, UNK, Zone VW1)									
Flowing 6	84					82			
6A	85	50	48	49	36	82	44	38	-2
6B	88	54	52	53	35	82	47	34	1
6C	81	56	52	54	27	81	53	28	-1
Hydrant Test No. 7 (8" AC, 1970s, Zone SF2)									
Flowing 7	60					59			
7A	70	52	50	51	19	67	52	15	4
7B	74	64	60	62	12	74	64	10	2
7C	84	81	78	80	4	84	81	3	1
Hydrant Test No. 9 (8" AC, 1980s, Zone SF3)									
Flowing 9	143					139			
9A	138	54	50	50	88	134	45	89	-1
9B	148	70	68	69	79	146	69	77	2
9C	141	84	78	78	63	140	76	64	-1
9D	136	136	80	85	51	132	83	49	2
Hydrant Test No. 10 (8" DI, 2000s, Zone VW2)									
Flowing 10	118					Test abandoned due to incorrect valving			
10A	120	94	90	92	28				
10B	122	95	92	94	28				
10C	116	92	82	90	26				
10D	119	92	89	90	29				

Table 6-6. Calibrated Pipeline C-factors Assigned in the Hydraulic Model

Pipeline Material	Abbreviation	C-Factor	
		Diameter ≤ 8 inches	Diameter > 8 inches
Asbestos Cement	AC / ACP	110	120
Concrete Cylinder	CCP	-[(a)]	130
Cast Iron	CIP	100	110
Ductile Iron	DIP	130	140
Polyvinyl Chloride	PVC	130	140
Steel	STL	120	130

(a) Material in this diameter range does not exist in City system.

6.5.2.2 Hydrant Test No. 10

Field observations suggest that Hydrant Test No. 10 did not achieve unidirectional flow through the 8-inch ductile iron pipe (DIP) loop within the Crossing at Montague Apartments. While setting up for the test, City staff could not confirm the valve configuration at the intersection between Hydrant 10 and Hydrant 10D. City staff closed a valve at this intersection, but since field-observed differential pressures are relatively consistent across all four observation hydrants, it seems that the isolation valve closed did not direct flow as intended. As a result, the C-factor for 8-inch diameter, DIP could not be confirmed, and Hydrant Test No. 10 should be disregarded.

Abandoning Hydrant Test No. 10 is not a fatal flaw. Only approximately 8 percent of the City's water system consists of DIP, and the preliminary DIP C-factors are based on an extensive list of roughness factors calibrated for other water systems. West Yost remains confident the hydraulic model can accurately simulate the City's water system under various conditions.

6.6 SUMMARY OF FINDINGS AND CONCLUSIONS

Hydrant test simulation results indicate that the hydraulic model can accurately replicate a fire flow or other large demand condition using the pipeline C-factors listed in Table 6-6. As a result, West Yost concludes that the hydraulic model is a reliable representation of the City's existing potable water distribution system and can be used as a planning tool. To ensure long-term accuracy and usefulness, it is recommended that the City regularly update and maintain the hydraulic model as facilities are constructed or replaced. In addition, as data availability increases, the City can augment the hydraulic model to run extended period simulations, which simulate the system operation over time, mimicking the operational controls and settings used for system operations.

CHAPTER 7
System Planning and Performance Criteria

This chapter presents the criteria used to size and evaluate the performance of the City's potable water system. Key criteria from the City's 2009 WMPU have been incorporated into this chapter; however, some of the previous criteria have been updated to reflect more recent or suitable standards based on West Yost's experience working with similar municipal water systems.

Table 7-1 summarizes the recommended criteria for this 2020 WMP. The following sections describe each criterion in more detail.

7.1 GENERAL WATER SYSTEM GUIDELINES

Before discussing specific planning and performance criteria, it is helpful to provide some general guidelines that a water system should meet. This section identifies the requirements for a reliable water system that delivers high-quality water.

7.1.1 Water System Reliability

Based on industry standards, a reliable water system is one that has sufficient storage, redundant pumping and distribution facilities, and emergency alternatives for both water and power supply. Thoughtful water distribution system design also enhances reliability through improved hydraulics and flexibility. For example, replacing pipeline dead-ends with looped configurations improves reliability and reduces the risk of stagnant water, which has poor taste and lower disinfectant residuals. Appropriate pipeline sizing and pressure regulation allows the system to serve peak demands at appropriate pressures while minimizing friction losses. Lastly, proper valve placement streamlines maintenance and repairs, while also increasing operational flexibility.

7.1.2 Water Quality Standards

The United States Environmental Protection Agency (USEPA) and the SWRCB DDW establish water quality standards to protect public health and help manage aesthetics. Primary drinking water standards are legally enforceable limits on contaminants that present a risk to human health. In contrast, secondary standards target contaminants that are not health threatening, but may cause taste, odor, or color issues. As a water retailer, the City is responsible for ensuring that all applicable water quality standards and regulations are always met. The City is currently updating a report on its water quality monitoring program.

Table 7-1. Summary of Recommended Potable Water System Planning and Performance Criteria

Component	Criteria	Remarks/Issues
Water System Performance		
Fire Flow Requirements [(a)]		
Single Family Residential	1,500 gpm @ 2 hrs	Improvements for existing developments will be evaluated on a case-by-case basis because of varying historical standards.
Multi-family Residential	2,500 gpm @ 2 hrs	
Commercial	3,000 gpm @ 3 hrs	
Mixed[(b)]	3,000 gpm @ 3 hrs	
Industrial	4,000 gpm @ 4 hrs	
Peak Supply Capacity		
Normal Demand Conditions	Provide firm supply capacity equal to maximum day demand; meet peak hour demand from a combination of supply capacity and storage	Firm supply capacity defined as the total water supply with the largest turnout out of service.
Fire Flow Demand Conditions	Meet maximum day demand plus fire flow from a combination of supply capacity and storage	
System Pressures		
Minimum Pressure - Normal Conditions	Average and Maximum Day Demand: 40 psi at customer service connection Peak Hour Demand: 30 psi at customer service connection	Services with pressure less than 30 psi during an average day demand condition require an individual booster pump.
Minimum Pressure - Fire Flow Conditions	20 psi	
Maximum Pressure	Zone 1: 80 psi at customer service connection Zone 2 and Hillside Zones: 150 psi at customer service connection	New services with pressure greater than 80 psi require an individual pressure regulator.
Pipeline Sizing		
Transmission Main		
Diameter	16 inches or larger	
Maximum Velocity - Normal Conditions	6 ft/s	Criteria based on requirements for new development, existing transmission mains will be evaluated on a case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Maximum Head Loss - Normal Conditions	5 ft/kft	
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling.
Distribution Main		
Minimum Pipeline Diameter	8 inches	New pipelines only.
Maximum Velocity - Normal Conditions	8 ft/s	Criteria based on requirements for new development, existing distribution mains will be evaluated on a case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Maximum Velocity - Fire Flow Conditions	12 ft/s	
Maximum Head Loss - Normal Conditions	10 ft/kft	
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling.
Storage Facility Sizing		
Operational Storage	25 percent of maximum day demand	
Fire Storage	Fire flow demand for the most severe fire recommended in the pressure zone multiplied by the recommended duration	Refer to Table 7-2. Assumes only one fire flow event would occur in any pressure zone at a time.
Emergency Storage	50 percent of maximum day demand	
Groundwater Storage Credit	Volume of water pumped over a 24-hour period	The maximum credit cannot exceed the recommended emergency storage volume.
Total Storage Capacity	Operational + Fire + Emergency - Groundwater Credit	
Pumping Facility Sizing		
Pumping Capacity	Firm pumping capacity equal to maximum day demand (within the designated operational hours)	Firm pumping capacity defined as the total capacity of all operational pumps minus the capacity of the largest pumping unit. Pumps located in lower pressure zones must deliver the maximum day demand of all pressure zone(s) located above them.
Backup Power	All critical pumping facilities[(c)] should be equipped with an on-site, backup power generator	
Pressure Reducing Station Sizing		
Valve Capacity	In pressure zones with storage, valve capacity must supply the maximum day demand, and in pressure zones without storage, valve capacity must supply maximum day plus fire flow or peak hour demand, whichever is larger	

(a) Based on fire flow requirements adopted in the 2009 WMPU, updated to reflect current fire code.

(b) Includes High Density Multi-family Residential land uses in the MMSP area.

(c) A pump station is defined as critical if it serves a pressure zone(s) and/or service area(s) without sufficient fire or emergency storage and meets one of the following criteria:
- The largest facility that provides water to a particular pressure zone and/or service area;
- It is the sole source of water to single or multiple pressure zones and/or service areas;
- It provides water from a supply turnout; or
- It provides water from key groundwater supply wells.

7.2 WATER SYSTEM PERFORMANCE CRITERIA

This section describes the recommended system performance criteria for fire flows, supply capacity, and distribution system pressures.

7.2.1 Fire Flow Requirements

Municipal water systems providing supply during a fire flow condition must meet minimum standards for fire flow rate and duration and residual pressure. Based on the City's potable water design guidelines and recommendations from state agencies, the City's water system must concurrently meet maximum day demands and maintain at least 20 pounds per square inch (psi) residual pressure when delivering fire flow.

Minimum fire flow requirements are adopted from the 2009 WMPU (updated in coordination with the City's fire department to reflect current fire code) and summarized by land use type in Table 7-2. These requirements specify minimum distribution system capacities during fires and apply to new developments only (not existing system conditions). Existing buildings are assumed to meet fire flow standards that were in place at the time of construction, which are generally lower than current standards. Therefore, the evaluation of the City's water system under existing demand conditions presents systemwide available fire flow only and does not recommend pipeline improvements to increase existing fire flow capacity. However, the City can use these results as a guide for sizing pipeline improvements and to prioritize replacing existing smaller diameter pipelines to improve overall flows throughout the distribution system.

Table 7-2. Recommended Fire Flow Requirements for Future Development and Pipeline Replacement Planning[(a)]

Land Use Designation	Fire Flow, gpm	Duration, hours	Recommended Storage, MG
Single Family Residential	1,500	2	0.18
Multi-family Residential	2,500	2	0.30
Commercial	3,000	3	0.54
Mixed[(b)]	3,000	3	0.54
Industrial	4,000	4	0.96

(a) Based on fire flow requirements adopted in the 2009 WMPU, updated to reflect current fire code.
(b) Includes High Density Multi-family Residential land uses in the Milpitas Metro Specific Plan area.

7.2.2 Peak Supply Capacity

Under normal (i.e., non-emergency) demand conditions, the City must meet peak hour demands through a combination of available supplies and storage. In addition, the City must have a firm supply capacity capable of meeting a maximum day demand condition. Firm supply capacity is defined as the total potable water supply capacity with the largest turnout out of service.

Under fire flow demand conditions, the City must meet fire flows and maximum day demand from both available supply capacity and storage.

7.2.3 Distribution System Pressures

Water systems are typically evaluated based on pressure, pipeline velocity, and pipeline head loss. Pressures are the most critical criterion because they are used to evaluate satisfactory system performance under different demand conditions. Consequently, the City's existing water system will be evaluated using pressure as the primary criterion; secondary criteria, such as pipeline velocity, head loss, age, and material type, will be used as indicators to locate where water system improvements may be needed. Recommended improvements from existing and buildout system pressure evaluations are presented in Sections 8.5 and 9.6, respectively.

Minimum distribution system pressure criteria are based on industry standards and vary by demand condition. Under average day and maximum day demands, system pressures should remain above 40 psi. Under peak hour demand conditions, system pressures should remain above 30 psi. During fire flow conditions, residual pressures of 20 psi are allowed. Customer service connections with a pressure below 30 psi during an average day demand condition should have an individual booster pump installed.

Maximum distribution system pressure criteria are based on industry standards and vary by pressure zone. In the valley (Zone 1), pressures should remain below 80 psi. In Zone 2 and Hillside Zones (SF3 and SF4), the maximum pressure shall not exceed 150 psi. These pressure limits are consistent with the 2009 WMPU and the high end of typical operating pressures for municipal water systems. The Uniform Plumbing Code (UPC) requires new customer service connections with a pressure above 80 psi to have an individual pressure regulator installed. Since typical pressures in Zone 2 and the Hillside Zones exceed 80 psi, an alternative would be to install main-line PRVs and create pressure sub-zones within these existing pressure zones; however, this would make it more difficult to move water between these zones and could potentially reduce fire flow availability.

This distribution system pressure criteria will be applied to all areas that fall within the normal customer service elevation ranges for each pressure zone. Customers located above or below the normal service elevation ranges may require an individual booster pump or pressure regulator.

7.3 WATER FACILITY SIZING

This section describes the recommended sizing criteria for pipelines, storage facilities, booster pumping facilities, backup power, and pressure reducing stations within the City's service area

7.3.1 Pipeline Sizing

Pipeline sizing is based on velocity and head loss, which are directly related; higher velocities translate to higher head loss (increases operating costs). Velocity and head loss criteria are defined below for new pipelines and vary with pipeline diameter. Consistent with the 2009 WMPU, transmission mains are defined as pipelines with a diameter of 16 inches or larger, and distribution mains have a diameter less than 16 inches. However, all new pipelines should be required to have a minimum diameter of 8 inches. Compared to 6-inch diameter pipelines, 8-inch diameter pipelines can significantly reduce friction losses at a competitive cost. Phasing out 6-inch diameter (and smaller) pipelines will also help the City streamline its piping and appurtenance inventory.

The following criteria reflect industry standards and West Yost's experience with municipal water systems:

- For transmission mains, the maximum velocity should be limited to 6 feet per second (ft/s), and the maximum head loss should be 5 feet per 1,000 feet (ft/kft) of pipeline.
- For distribution mains, the maximum velocity should be limited to 8 ft/s under normal demand conditions. During fire flow demand conditions, the maximum velocity should be 12 ft/s. Maximum head loss for distribution mains should be 10 ft/kft.

7.3.2 Storage Facility Sizing

Storage facilities include reservoirs (i.e., tanks), clearwells, and, in certain cases, groundwater wells. The total recommended treated water storage capacity is the sum of the following three components:

- Operational Storage
- Fire Storage
- Emergency Storage

Each component is detailed below, along with a discussion of groundwater storage credit. West Yost will evaluate storage capacity requirements by pressure zone.

7.3.2.1 Operational Storage

Operational storage is defined as the amount of stored water needed to meet peak demands in excess of normal supply delivery. Since water supplies are generally designed to meet maximum day demands, operational storage is typically used to supply peak demands (e.g., the difference between peak hour and maximum day demand). Supplies replenish operational storage during periods of lower demand.

In accordance with American Water Works Association (AWWA) guidelines[9], West Yost recommends the operational storage volume be 25 percent of the maximum day demand. This is consistent with the operational storage criterion used in the 2009 WMPU.

7.3.2.2 Fire Storage

Fire storage is the volume of water reserved for fire suppression. For a given pressure zone, fire storage is determined by multiplying the maximum required fire flow rate by the required duration. Refer to Table 7-2 for fire storage recommendations by land use designation. Per industry standards, it is assumed that no more than one fire event would occur in a pressure zone at a time.

7.3.2.3 Emergency Storage

Emergency storage helps meet demands during an unplanned event that reduces the quality and/or quantity of potable water supplies. Determining the appropriate emergency storage volume is challenging, as it depends on the diversity of supplies, the reliability of production and distribution facilities, and the duration of the emergency event. The City's overall risk tolerance is also a factor. The

[9] The *AWWA Water Distribution Systems Handbook* (AWWA, 2000) (Section 3.2.2.2 Storage) states that the volume of operational storage required is commonly estimated at 25 percent of the total maximum day demand.

AWWA suggests that individual utilities should determine its specific emergency storage requirements based on perceived system vulnerabilities.

West Yost recommends an emergency storage volume equal to 50 percent of the maximum day demand, consistent with the 2009 WMPU. Emergency storage is not required at every reservoir; one reservoir can hold emergency storage for multiple pressure zones if the zones are hydraulically connected and the stored water remains accessible in emergencies.

7.3.2.4 Groundwater Storage Credit

Based on the City's available emergency groundwater wells, groundwater storage could offset some of the recommended emergency storage. However, the following must be true to use the groundwater supply to offset the need to provide surface storage:

- Groundwater supply is of potable water quality and can be reliably accessed (i.e., wells are equipped with on-site backup power or a plug-in adapter and transfer switch)
- Groundwater supply is not already being relied upon to meet the City's average day demand requirements
- Sufficient water distribution facilities are available to distribute this water to demand areas

The groundwater storage credit equals the volume of water pumped over a 24-hour period. The maximum credit cannot exceed the recommended emergency storage volume (i.e., 50 percent of maximum day demand).

7.3.2.5 Recommended Total Storage Capacity

In summary, the City's recommended total water storage capacity is the sum of the following components:

- **Operational Storage**: Volume of water to meet diurnal peaks, assumed to be 25 percent of the maximum day demand; plus
- **Fire Flow Storage**: Volume of water to suppress a fire (varies by land use designation); plus
- **Emergency Storage**: Volume of water as emergency supply during unplanned events, assumed to be 50 percent of maximum day demand; minus
- **Groundwater Storage Credit**: Groundwater supply that can be reliably accessed in an emergency.

7.3.3 Pumping Facility Sizing and Backup Power

Based on industry standards, pumping capacity should be sufficient to meet a maximum day demand within the designated operational hours with pumps assumed to operate at firm pumping capacity. Firm pumping capacity is defined as the total pump station capacity with the largest pump out of service. Pumps located in lower pressure zones must deliver the maximum day demand of all pressure zone(s) located above them.

Critical pumping facilities are defined as those facilities that provide service to pressure zone(s) and/or service area(s) which do not have sufficient fire and/or emergency storage available and meet the following criteria:

- The largest pumping facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas;
- A pumping facility that provides water from a supply turnout; or
- A pumping facility that provides water from key groundwater supply wells (depends on capacity, quality and location).

All critical pumping facilities should be equipped with an on-site, backup power generator.

7.3.4 Pressure Reducing Station Sizing

For pressure zones without available storage capacity and where pressure reducing station(s) are the sole supply source, the total capacity from the active pressure reducing station(s) should be equal to a maximum day demand plus fire flow condition or a peak hour demand condition, whichever is larger. For pressure zones with available storage capacity and where pressure reducing station(s) are the sole supply source, the total capacity from the active pressure reducing station(s) should be equal to a maximum day demand.

CHAPTER 8
Evaluation of Existing Water System

This chapter evaluates the City's existing water system and its ability to meet recommended planning and performance criteria described in Chapter 7 and summarized in Table 7-1 of this report. The evaluation encompasses both system capacity and hydraulic performance using existing water demands developed in Section 5.1 of this report. System capacity is evaluated based on potable water supply, storage, and pumping, while the hydraulic performance evaluation examines distribution system pressures under various demand and outage conditions. The following evaluations frequently refer to "normal" conditions, which are defined as non-emergencies (i.e., no fires or unplanned outages).

For reference, Appendix A contains a water system schematic profile that summarizes the supply and distribution facilities described in Sections 3.2 and 3.3 of this report, respectively.

This chapter also includes recommendations for addressing any deficiencies identified from the evaluation. These are incorporated in a recommended capital improvement program (CIP) described in Chapter 11 of this report. To simplify cross-referencing with Chapter 11, each proposed project is assigned a unique capital improvement program ID (CIP ID).

The following sections present the evaluation methodology and results:

- Existing Potable Water Demands
- Existing Potable Water Supply Capacity Evaluation
- Existing Potable Water Storage Capacity Evaluation
- Existing Pumping Capacity Evaluation
- Existing Water Distribution System Evaluation
- Summary of Findings and Recommended Improvements

8.1 EXISTING POTABLE WATER DEMANDS

Existing potable water demands are based on 2019 billing meter data, which was spatially allocated in the hydraulic model and scaled up to match the City's 2019 average daily water production (8.3 mgd). Maximum day and peak hour demands were calculated based on the adopted peaking factors of 1.6 and 2.9 times the average day demand, respectively, for Zones SF1 and SF2, and 3.2 and 5.8 times the average day demand, respectively, for Zones SF3 and SF4. In the VW service area, the maximum day and peak hour demand peaking factors are 1.9 and 3.4 times the average day demand, respectively. Table 8-1 summarizes existing potable water demands by pressure zone and service area.

Table 8-1. Summary of Existing Water Demands by Pressure Zone

Pressure Zone	Average Day Demand[(a)]		Maximum Day Demand[(b)]		Peak Hour Demand[(c)]	
	gpm	mgd	gpm	mgd	gpm	mgd
SF1	1,748	2.52	2,797	4.03	5,069	7.30
SF2	1,798	2.59	2,877	4.14	5,214	7.51
SF3	14	0.02	44	0.06	81	0.12
SF4-1	19	0.03	61	0.09	110	0.16
SF4-2	17	0.02	54	0.08	98	0.14
SF Subtotal	3,596	5.18	5,833	8.40	10,571	15.2
VW1	1,238	1.78	2,351	3.39	4,208	6.06
VW2	951	1.37	1,806	2.60	3,232	4.65
VW Subtotal	2,188	3.15	4,158	5.99	7,440	10.7
Total	**5,784**	**8.33**	**9,990**	**14.4**	**18,011**	**25.9**

(a) Based on spatially allocated 2019 water meter data, scaled to match 2019 water production.
(b) Maximum day demand is 1.6 times the average day demand for Zones SF1 and SF2, 3.2 times the average day demand for Zones SF3 and SF4, and 1.9 times the average day demand for the VW service area.
(c) Peak hour demand is 2.9 times the average day demand for Zones SF1 and SF2, 5.8 times the average day demand for Zones SF3 and SF4, and 3.4 times the average day demand for the VW service area.

8.2 EXISTING POTABLE WATER SUPPLY CAPACITY EVALUATION

As described in Section 4.1 of this report, the City's potable water is supplied via turnouts from SFPUC and VW transmission pipelines. The recommended water system performance criteria specify that under normal demand conditions, the following must be satisfied:

- Provide firm supply capacity equal to maximum day demand
- Meet peak hour demand from a combination of supply capacity and storage

Firm supply capacity is defined as the normal water supply with the largest turnout out of service. In the SFPUC service area, the largest turnout is Calaveras (see Figure 3-1), which has a capacity of 13.0 mgd. The VW service area has only one turnout (Gibraltar), so firm supply is zero, as there is no redundant supply source from the VW system. However, as described in Section 3.3 of this report, if the VW turnout is not available, water can be moved from the City's SFPUC service area to the VW service area.

Table 8-2 summarizes the available and required firm supply capacity for each service area. Pinewood Well is not listed in Table 8-2 because it is not part of the City's existing normal water supply (it is only used for emergencies). The SFPUC service area has approximately 15.4 mgd of firm supply surplus, while the VW service area has a firm supply deficit equal to its maximum day demand (5.99 mgd), due to the lack of a redundant supply source from the VW system. Since SFPUC can supply the VW service area and the SFPUC surplus (15.4 mgd) exceeds the VW deficit (5.99 mgd), West Yost concludes that the City overall has sufficient firm supply capacity.

For the second supply capacity criterion listed above, the City can meet peak hour demands for each service area from supplies alone (i.e., before counting storage). Given this significant surplus in supplying peak hour demands, the criterion is not discussed further.

Table 8-2. Comparison of Available and Required Firm Supply Capacity

Supply Source	Turnout	Design Capacity	
		gpm	mgd
SFPUC	Sunnyhills	7,014	10.1
	Calaveras	9,028	13.0
	Main Street	5,486	7.90
	Intertie	4,000	5.76
	Total Supply Capacity[a]	**25,528**	**36.8**
	Firm Supply Capacity[b]	16,500	23.8
	Required Supply Capacity[c]	5,833	8.40
	Existing Firm Supply Capacity Surplus (Deficit)	10,667	15.4
VW	Gibraltar	10,000	14.4
	Total Supply Capacity[a]	**10,000**	**14.4**
	Firm Supply Capacity[b]	0	0
	Required Supply Capacity[c]	4,158	5.99
	Existing Firm Supply Capacity Surplus (Deficit)	(4,158)[d]	(5.99)[d]

(a) Total supply capacity assumes all turnouts are available for use.
(b) Firm supply capacity assumes largest turnout in each service area (Calaveras (SFPUC) and Gibraltar (VW)) is offline.
(c) Required supply capacity is equal to the maximum day demand (see Table 8-1).
(d) VW supply deficit can be met by SFPUC supply surplus.

8.3 EXISTING POTABLE WATER STORAGE CAPACITY EVALUATION

Potable water storage is critical for providing operational flexibility and emergency supply during outages or fires. The City's storage reservoir capacity must meet the following requirements (described in Section 7.3.2 of this report):

- Operational storage equal to 25 percent of maximum day demand
- Emergency storage equal to 50 percent of maximum day demand
- Fire storage equal to the largest fire flow demand in a pressure zone multiplied by the recommended duration

The total storage required is the sum of the operational, emergency, and fire storage requirements, less any groundwater credit, which can offset some of the emergency storage requirement. The groundwater credit includes both emergency wells and normally operating wells and equals the volume of water pumped over a 24-hour period. To offset surface storage needs, groundwater must be of potable water quality, and wells must have on-site backup power capabilities. In addition, the City must be able to meet average day demands without relying on groundwater. This is not an issue, since the City does not rely on groundwater as part of its normal (i.e., non-emergency) supply.

The City currently has one operational groundwater well (Pinewood Well), which meets water quality and backup power requirements. As a result, the Pinewood Well provides an emergency groundwater storage credit equal to its daily pumping capacity (1.7 MG).

For each pressure zone, Table 8-3 compares the City's existing potable water storage capacity with storage requirements. Since Zones 1 and 2 in each service area are interconnected through multiple pressure reducing valves (PRVs) that operate under normal conditions, they are combined in each service area (i.e., SF1/SF2 and VW1/VW2). As shown in Table 8-3, there is sufficient storage in the SFPUC service area and a deficit of 0.45 MG in the VW service area. This deficit is not considered critical, due to the flexibility of the Gibraltar facility. Simple valve operations allow the Gibraltar (SF) tank to supply Zone VW2, so the storage surplus for Zones SF1 and SF2 can cover the shortfall in Zones VW1 and VW2.

Table 8-3. Comparison of Available and Required Water Storage Capacity

[A]	[B]	[C]	[D]	[E] = [C] + [D]	[F]	[G]	[H]	[I] = [F] + [G] + [H]	[J] = [E] - [I]
		Available Storage Capacity, MG			Required Storage Capacity, MG				
Station	Status	Reservoir Capacity	Emergency Groundwater Storage Credit[a]	Total Available Storage	Operational[b]	Emergency[c]	Fire Flow[d]	Total Required Storage	Storage Surplus (Deficit), MG
Zones SF1 and SF2									
Gibraltar (SF)	Active	5.00	--	**12.30**	2.04	4.08	0.96	**7.09**	**5.21**
Ayer	Active	5.60	--						
Pinewood Well	Standby	--	1.70						
Zone SF3									
Tularcitos	Active	0.30	--	**0.30**	0.02	0.03	0.18	**0.23**	**0.07**
Zones SF4-1 and SF4-2									
Minnis	Active	0.34	--	**0.34**	0.04	0.08	0.18	**0.30**	**0.04**
Zones VW1 and VW2									
Gibraltar (VW)	Active	5.00	--	**5.00**	1.50	2.99	0.96	**5.45**	**(0.45)**

(a) Credit based on 24 hours of pumping capacity. The credit cannot exceed the required emergency storage capacity.

(b) Based on 25 percent of a maximum day demand (see Table 8-1).

(c) Based on 50 percent of a maximum day demand (see Table 8-1).

(d) Based on storage required for largest potential fire flow within the pressure zone. Zones SF1/SF2 and VW1/VW2 = Industrial; Zones SF3 and SF4 = Single Family Residential.

(e) VW storage deficit can be met by SFPUC storage surplus.

8.4 EXISTING PUMPING CAPACITY EVALUATION

As described in Section 7.3.3 of this report, industry standard is to have firm pumping capacity equal to maximum day demand. For a given pump station, firm capacity is defined as the total capacity of all operational pumps minus the capacity of the largest pumping unit. In addition, pumping capacity in lower pressure zones should also be able to deliver the maximum day demand of any zones above them. For example, the Zone SF3 pumps should be able to deliver the maximum day demand for Zones SF3 and SF4 (i.e., SF4-1 and SF4-2).

Critical pumping facilities should be equipped with an on-site, backup power generator. A pump station is considered critical if it serves a pressure zone with insufficient storage and meets one of the following criteria:

- It is the largest facility that provides water to a pressure zone and/or service area;
- It is the sole water source to a pressure zone and/or service area;
- It provides water from a supply turnout; or
- It provides water from a key groundwater well.

As discussed in Section 8.3, the pressure zones with insufficient storage are VW1 and VW2. Therefore, the Gibraltar (VW) pump station is deemed critical and should have backup power provisions (which it does). While Zones SF3 and SF4 have sufficient storage, each is served by a single pump station. The City should consider installing backup power generators at the Country Club and Tularcitos pump stations for additional redundancy. These backup power projects are included in Table 11-2 as CIP IDs ECIP-BG-CC and ECIP-BG-TL.

Table 8-4 compares the available and required firm pumping capacities for each pressure zone. Similar to the storage capacity evaluation, Zones 1 and 2 in each service area are combined. In Zones SF1 and SF2, firm pumping capacity consists of one 5,500-gpm pump at Gibraltar (SF) and two 1,800-gpm pumps at Ayer. At 9,100 gpm combined, the firm pumping capacity in Zones SF1 and SF2 exceeds the required firm pumping capacity, which equals the existing MDD of Zones SF1, SF2, and all higher zones (i.e., the entire SFPUC service area). The pumping capacity surplus in Zones SF1 and SF2 is approximately 3,270 gpm.

Similarly, the firm pumping capacities in Zones SF3 and SF4 also exceed requirements. In Zone SF3, the firm pumping capacity consists of one 250-gpm pump at Country Club, while the combined existing MDD of Zones SF3 and higher (i.e., Zones SF3 and SF4) is 159 gpm. The pumping capacity surplus in Zone SF3 is approximately 91 gpm. In Zone SF4, the firm pumping capacity consists of one 250-gpm pump at Tularcitos. The existing MDD of Zone SF4 is only 115 gpm, resulting in a pumping capacity surplus of approximately 135 gpm.

Both sets of pumps at the Gibraltar (VW) PS are included in the pumping capacity evaluation for the VW service area. One set draws from the Gibraltar (VW) storage reservoir, while the other set boosts pressures from the Gibraltar turnout (if necessary). By adjusting valve operations, the “turnout” pumps can also draw from the Gibraltar (VW) storage reservoir. The combined firm capacity for both sets of pumps is 13,500 gpm, which exceeds the VW service area MDD (4,158 gpm) by approximately 9,340 gpm.

Table 8-4. Comparison of Available and Required Firm Pumping Capacity

Pump Station	Critical Facility[a]	Existing On-site Backup Power	Status	Firm Capacity[b], gpm	Total Firm Pumping Capacity, gpm	Existing Maximum Day Demand[c], gpm	Pumping Capacity Surplus (Deficit), gpm
Zones SF1 and SF2							
Gibraltar (SF)		✓	Active	5,500	9,100	5,833	3,267
Ayer		✓	Active	3,600			
Zone SF3							
Country Club			Active	250	250	159	91
Zones SF4-1 and SF4-2							
Tularcitos			Active	250	250	115	135
Zones VW1 and VW2							
Gibraltar (VW) - from tank	✓	✓	Active	5,500	13,500	4,158	9,342
Gibraltar (VW) - from turnout[d]	✓	✓	Active	8,000			

(a) Pump stations are considered critical if they serve a pressure zone with insufficient storage and meet other criteria. Refer to Table 7-1.

(b) Firm pumping capacity was defined as the total pump station capacity with the largest pump out of service.

(c) Includes maximum day demands for higher pressure zones, per Table 7-1.

(d) These pumps are intended to boost pressures from the VW turnout but can be valved to draw from the Gibraltar (VW) tank.

8.5 EXISTING WATER DISTRIBUTION SYSTEM EVALUATION

West Yost used the updated hydraulic model to conduct steady-state hydraulic analyses of the existing water distribution system. The goal of this evaluation is to identify necessary improvements to support the City's existing water demands while meeting the recommended system performance criteria presented in Sections 7.2.1 and 7.2.3 of this report.

In evaluating the existing system, pressure criteria are prioritized over velocity criteria. This prioritization is typical, because older water systems tend to have many undersized pipes, and strictly adhering to velocity standards would identify those pipes as candidates for replacement, even though pressures meet recommended criteria. West Yost does not recommend replacing existing pipes solely for failing to meet velocity criteria, so while velocity results will be summarized for non-emergency scenarios, the following analyses focus on pressures and fire flow availability.

The following evaluations examine distribution system performance under existing water demand conditions:

- Average Day Demand Scenario: evaluates the potential for high customer service pressures in the system during an average day demand condition
- Peak Hour Demand Scenario: evaluates the potential for low customer service pressures in the system during a peak hour demand condition
- Maximum Day Demand Scenario: evaluates the potential for low customer service pressures in the system during a maximum day demand condition
- Maximum Day plus Fire Flow Scenario: evaluates fire flow availability in the system under a maximum day demand condition
- Emergency Operations (each scenario is evaluated under (a) maximum day demand conditions and (b) maximum day demand plus fire flow):
  - Outage Scenario 1: SFPUC turnouts are offline
  - Outage Scenario 2: VW turnout is offline
  - Outage Scenario 3: SFPUC and VW turnouts are offline
  - Outage Scenario 4: Power outage; all facilities without backup generators are offline
  - Outage Scenario 5: PRVs normally allowing flow between Zones 1 and 2 are offline.

To capture the entire range of normal water system operations, each non-emergency scenario above was evaluated using two operational alternatives. These alternatives are described in the following section.

8.5.1 Evaluation Alternatives

Throughout a normal day, the City varies water distribution system operations to achieve different goals. During morning (approximately 6:00 am to 10:30 am) and evening (approximately 5:00 pm to 11:00 pm) peak demand periods in the SFPUC service area, pumps at Gibraltar (SF) and Ayer draw from their respective tanks and deliver flows to the system. This supplements turnout flows and turns over water stored in reservoirs. During midday (approximately 11:00 am to 4:00 pm) and overnight (approximately 12:00 am to 5:00 am) low demand periods, the pumps are off. Turnouts alone supply the system, including refilling the Gibraltar (SF) and Ayer tanks.

In the hillside zones (i.e., Zones SF3 and SF4), operations also vary by pump status. Both the Country Club and Tularcitos pump stations operate on a two-pump lead lag system, with operation determined by the water level of the "destination" reservoir (i.e., Tularcitos reservoir for the Country Club pumps and Minnis reservoir for the Tularcitos pumps). The maximum water level in both reservoirs is 23 feet, and setpoints are the same for both pump stations. The lead pump turns on when the destination reservoir level is 15 feet and stops at 21.5 feet, while the lag pump starts at 14 feet and stops at 21 feet. When the Country Club and Tularcitos pumps are off, the Tularcitos and Minnis storage reservoirs serve zones SF3 and SF4, respectively, via gravity. When the Country Club and Tularcitos pumps are operating, they simultaneously serve the hillside zones and refill the elevated storage tanks.

The Gibraltar (VW) pumps also operate on a daily schedule, depending on the season. In the winter and spring, pumps operate during the day (approximately 6:30 am to 5:00 pm), and the Gibraltar (VW) reservoir fills overnight (approximately 7:00 pm to 4:00 am). The schedule reverses in the summer and fall, with the reservoir filling during the day (approximately 7:00 am to 5:00 pm) and pumps running overnight (approximately 9:00 pm to 5:00 am). Seasonal operations change around May 15th and November 15th, based on peak rate schedules set by Pacific Gas and Electric (PG&E).

West Yost identified two operational alternatives to represent the primary modes in which the water system normally functions. These operational alternatives are summarized in Table 8-5. In Base operations, all pumps are off, whereas Alternative 1 allows pump operation as needed. For both alternatives, all turnouts are open, and gravity tank levels are at their minimum. Since the Zone 1 and Zone 2 storage reservoirs (both Gibraltar tanks and the Ayer tank) feed booster pumps, their tank levels do not impact system pressures. Therefore, they are not listed in Table 8-5.

Table 8-5. Summary of Operational Alternatives

Facility	Base	Alternative 1 – Pumps On
SFPUC Service Area		
Turnouts[(a)]	Open	
Gibraltar (SF) Pump Station	**Closed**	Open
Ayer Pump Station	**Closed**	Open
Country Club Pump Station	**Closed**	Open
Tularcitos Tank Level	Minimum	
Tularcitos Pump Station	**Closed**	Open
Minnis Tank Level	Minimum	
VW Service Area		
Gibraltar Turnout	Open	
Gibraltar (VW) Pump Station	**Closed**	Open

(a) SFPUC turnouts include Sunnyhills, Calaveras, Main Street, and the Intertie turnout.

8.5.2 Average Day Demand Analysis

The hydraulic model was used to conduct a steady-state hydraulic analysis of the system during an existing average day demand (ADD) condition for each of the alternatives listed in Table 8-5. As shown in Table 8-1, the ADD for the existing water service area is approximately 5,784 gpm (8.33 mgd). Per recommended water system performance criteria detailed in Section 7.2.3 of this report, under ADD conditions pressures should be at least 40 psi at customer service connections. In addition, customer service pressures should not exceed 80 psi in Zone 1 (SF1 and VW1) or 150 psi in other zones.

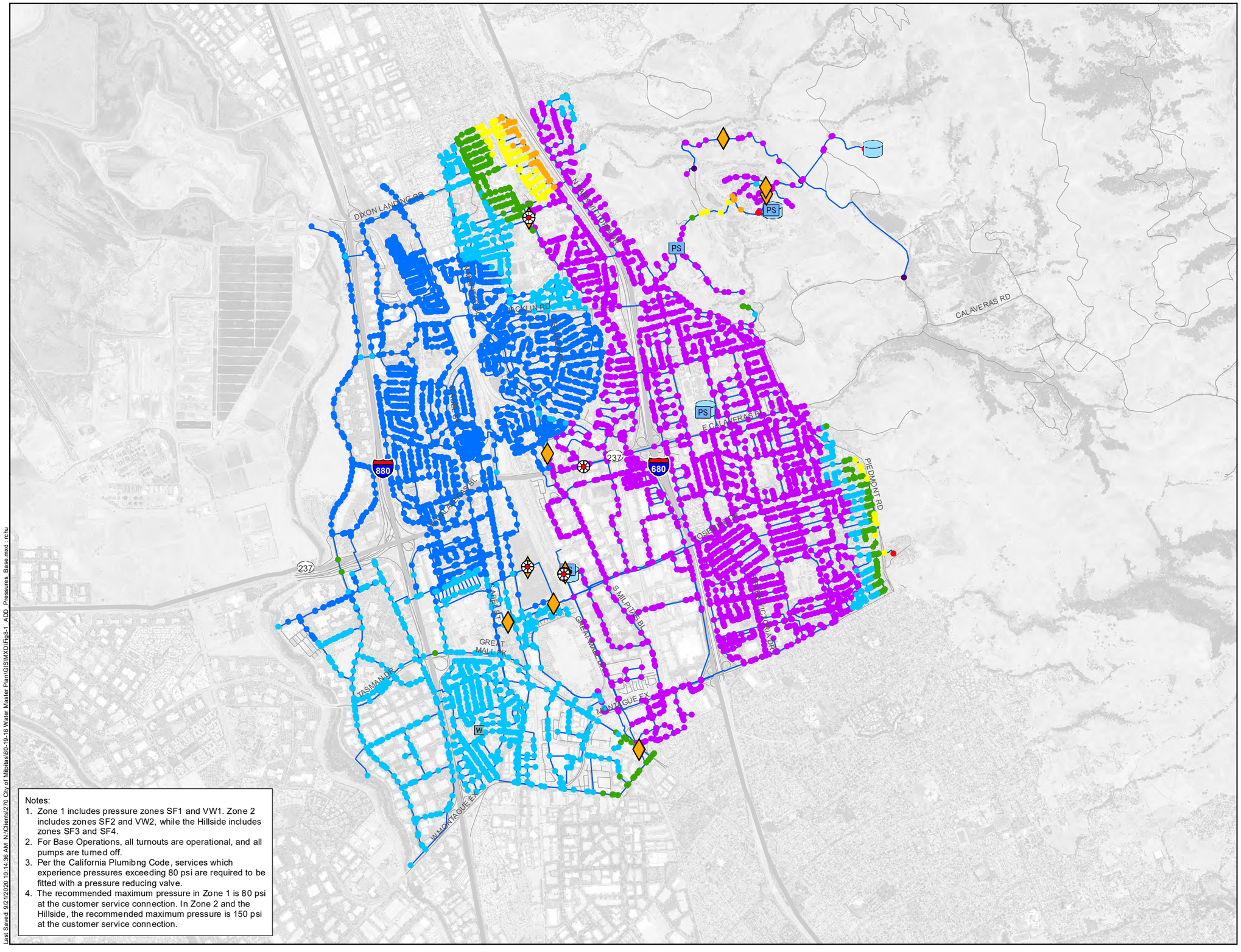
Results from the ADD simulations for Base and Alternative 1 operations are shown on Figure 8-1 and Figure 8-2, respectively. In each figure, color-coded circles represent distribution system pressures during an ADD condition. In both Base and Alternative 1 cases, there are no customer service locations with pressures below 40 psi. The lowest customer service pressure in the distribution system is approximately 42 psi (Base alternative), located at the eastern end of Manferd Street near I-680 in Zone SF1. The same location has the lowest pressure with pumps on (Alternative 1), but the pressure is slightly higher (44 psi).

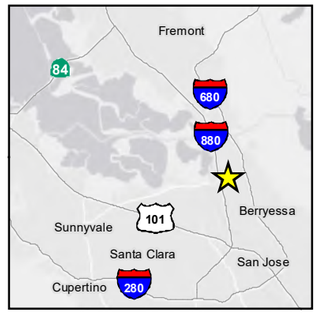
Many customer service locations experience pressures above the recommended limit. Pressures are generally higher when pumps are on, so Alternative 1 (Figure 8-2) is a more conservative representation of high pressures within the system. Per Table 7-1, recommended maximum pressures vary by zone, so Figure 8-1 and Figure 8-2 classify high pressures (i.e., exceeding the maximum) accordingly.

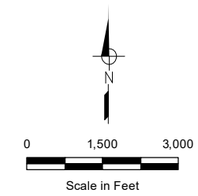
In Zone 1 (SF1 and VW1), high pressures are defined as exceeding 80 psi, and corresponding locations are dark blue. Much of Zone SF1 and the northern portion of Zone VW1 experience high pressures during an ADD condition. In Zone 2 (SF2 and VW2) and above (SF3 and SF4), high pressures are defined as exceeding 150 psi, and corresponding locations are dark purple. As shown on Figure 8-2, the area north of Highway 237 and adjacent to I-680 in Zone SF2 experiences high pressures during an ADD condition.

California Plumbing Code requires new services with pressures greater than 80 psi be fitted with a PRV. West Yost recommends that the City verify that individual PRVs are installed on existing customer service laterals in high pressure areas (i.e., dark blue, light purple, and dark purple locations on Figure 8-2). Alternatively, the City could install PRVs on potable water mains and create pressure sub-zones within the existing pressure zones; however, creation of pressure sub-zones would restrict the ability to move water between the existing zones and would reduce the fire flow availability.

Per Table 7-1, under normal conditions the maximum recommended velocities for transmission and distribution mains is 6 and 8 ft/s, respectively. Transmission mains are pipelines 16 inches or larger in diameter, while distribution mains are pipelines smaller than 16 inches in diameter. Under an existing ADD condition, almost all pipelines meet recommended velocity criteria. The only high-velocity pipeline segments are on either side of the Sunnyhills PRV. This 6-inch diameter stretch of pipe experiences velocities of 16.5 ft/s in the Base alternative and 9.0 ft/s in Alternative 1. The remaining pipes meet recommended velocity criteria, with velocities ranging from 0.01 ft/s to approximately 6.1 ft/s.







Average Day Pressure

- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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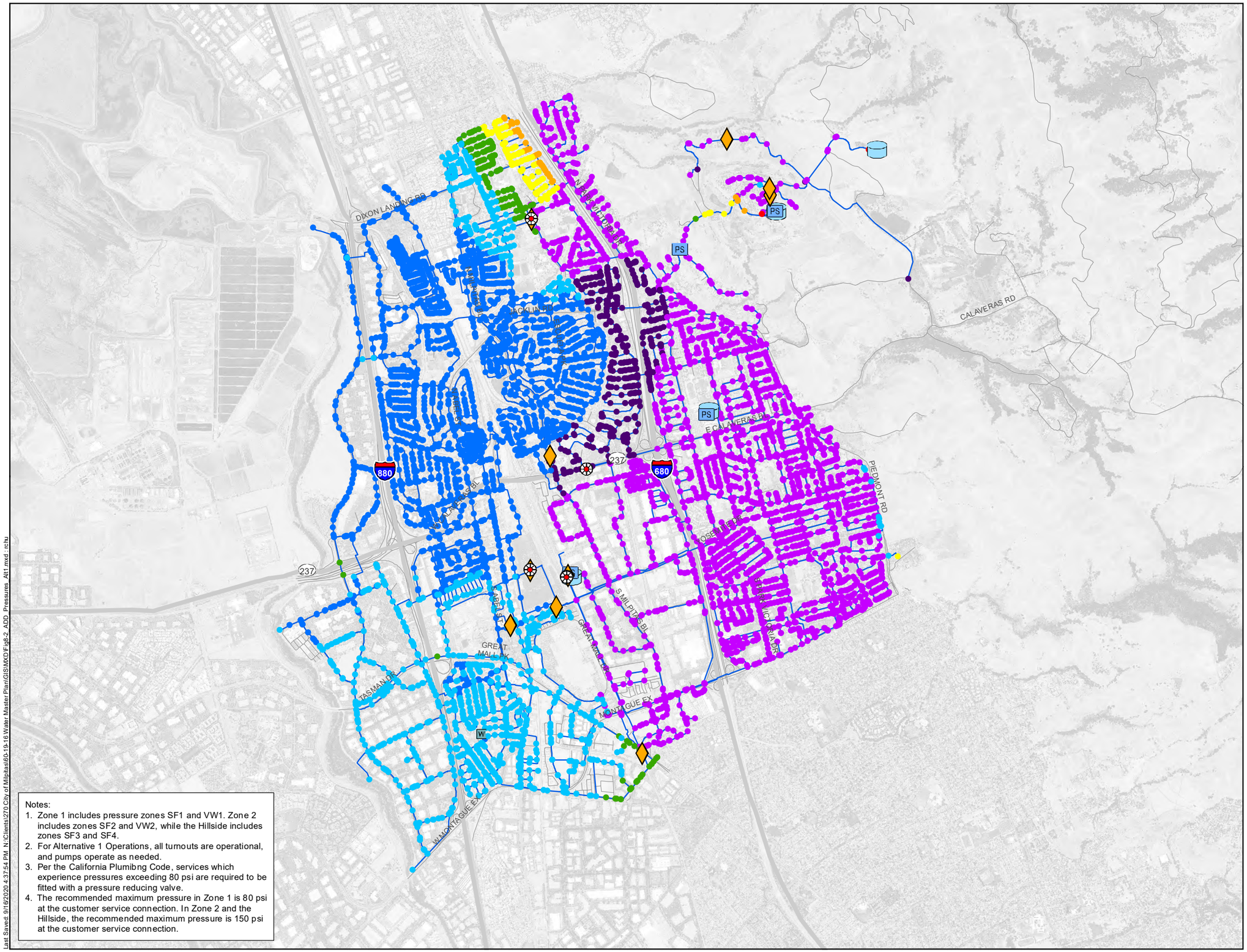
Figure 8-1

Existing System Pressures
Average Day Demand
Base Operations

City of Milpitas
2020 Water Master Plan



Average Day Pressure

- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Alternative 1 Operations, all turnouts are operational, and pumps operate as needed.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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Figure 8-2

Existing System Pressures
Average Day Demand
Alternative 1 Operations

City of Milpitas
2020 Water Master Plan

8.5.3 Peak Hour Demand Analysis

The hydraulic model was used to conduct a steady-state hydraulic analysis of the system during an existing PHD condition for each of the alternatives listed in Table 8-5. As shown in Table 8-1, the PHD for the existing water service area is approximately 18,011 gpm (25.9 mgd). Under PHD conditions, the recommended minimum pressure is 30 psi. Any services experiencing pressures less than 30 psi during a PHD condition would require an individual booster pump.

Results from the PHD simulations for Base and Alternative 1 operations are shown on Figure 8-3 and Figure 8-4, respectively. Figure 8-3 and Figure 8-4 are similar to Figure 8-1 and Figure 8-2, with distribution system locations color coded by pressure. Pressures are slightly higher for Alternative 1 (pumps on), but there are no significant differences in system performance based on operations. In both cases, there are no customer service locations with pressures below 30 psi.

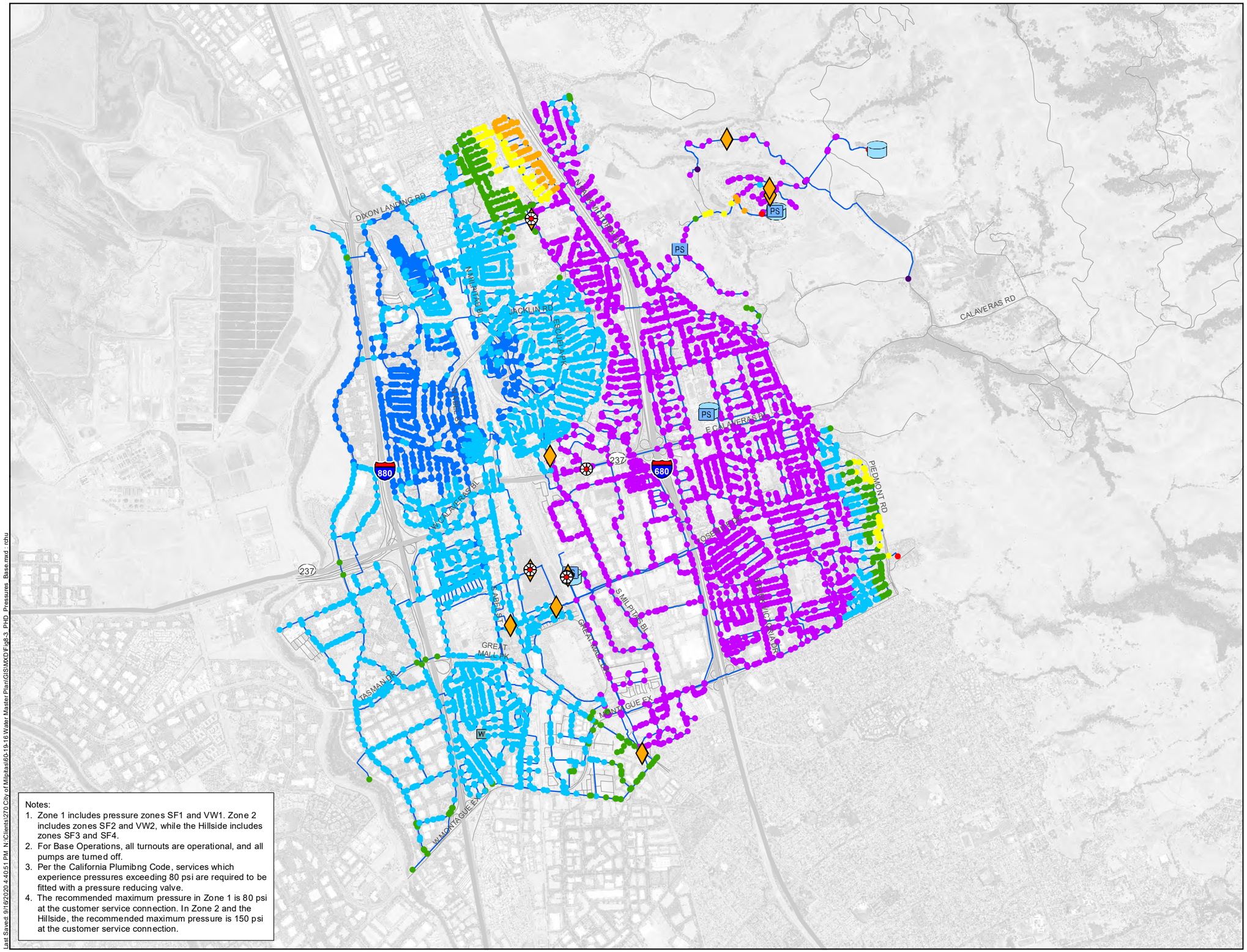
Almost all distribution system pipelines meet velocity criteria under PHD conditions. The 6-inch diameter pipes on either end of the Sunnyhills PRV continue to experience high velocities: 25.5 ft/s in the Base alternative and 19.9 ft/s in Alternative 1. Pipelines at the Gibraltar facility and at the Sunnyhills and Main turnouts also see high velocities (8-12 ft/s). For the rest of the system, velocities range from 0.01 ft/s to approximately 7.8 ft/s.

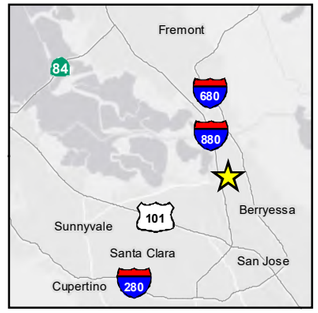
8.5.4 Maximum Day Demand Analysis

The hydraulic model was used to conduct a steady-state hydraulic analysis of the system during an existing MDD condition for each of the alternatives listed in Table 8-5. As shown in Table 8-1, the MDD for the existing water service area is approximately 9,990 gpm (14.4 mgd). Under MDD conditions, the recommended minimum pressure is 40 psi. The same maximum pressure criteria apply as described in the ADD analysis, but since pressures would be higher under ADD conditions, system performance relative to maximum pressures is not discussed here.

Results from the MDD simulations for Base and Alternative 1 operations are shown on Figure 8-5 and Figure 8-6, respectively. As with figures for ADD and PHD demand conditions, distribution system locations are color coded by pressure. Pressures are slightly higher for Alternative 1 (pumps on), but there are no significant differences in system performance based on operations. In both cases, there are no customer service locations with pressures below 40 psi.

Almost all distribution system pipelines meet velocity criteria under MDD demand conditions. The 6-inch diameter pipes on either end of the Sunnyhills PRV experience high velocities: approximately 19.1 ft/s and 12.1 ft/s under Base and Alternative 1 operations, respectively. Also, on either side of the Gibraltar PRV, the 16-inch diameter pipes see velocities of 6.6 ft/s under Base operations. For the rest of the system, velocities range from 0.01 ft/s to approximately 7.7 ft/s.





N

0 1,500 3,000

Scale in Feet

Peak Hour Pressure

- Less than 30 psi
- 30 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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Figure 8-3

Existing System Pressures
Peak Hour Demand
Base Operations

City of Milpitas
2020 Water Master Plan

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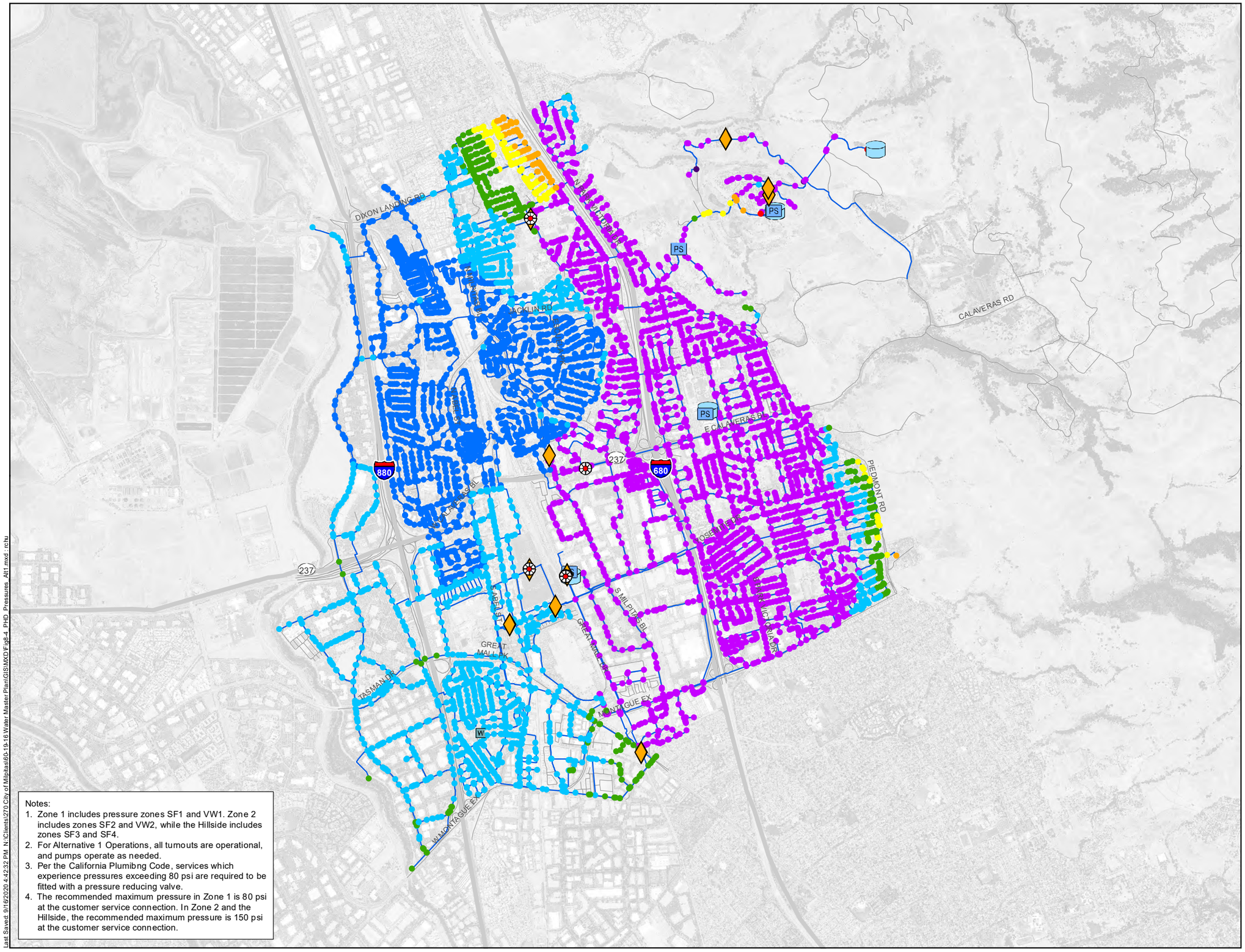

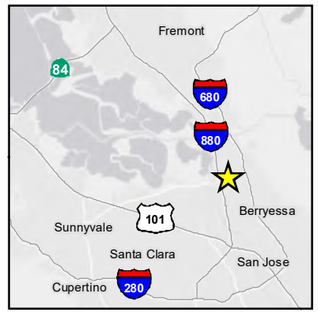

N

0 1,500 3,000

Scale in Feet

Peak Hour Pressure

- Less than 30 psi
- 30 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Alternative 1 Operations, all turnouts are operational, and pumps operate as needed.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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CITY OF MILPITAS CALIFORNIA

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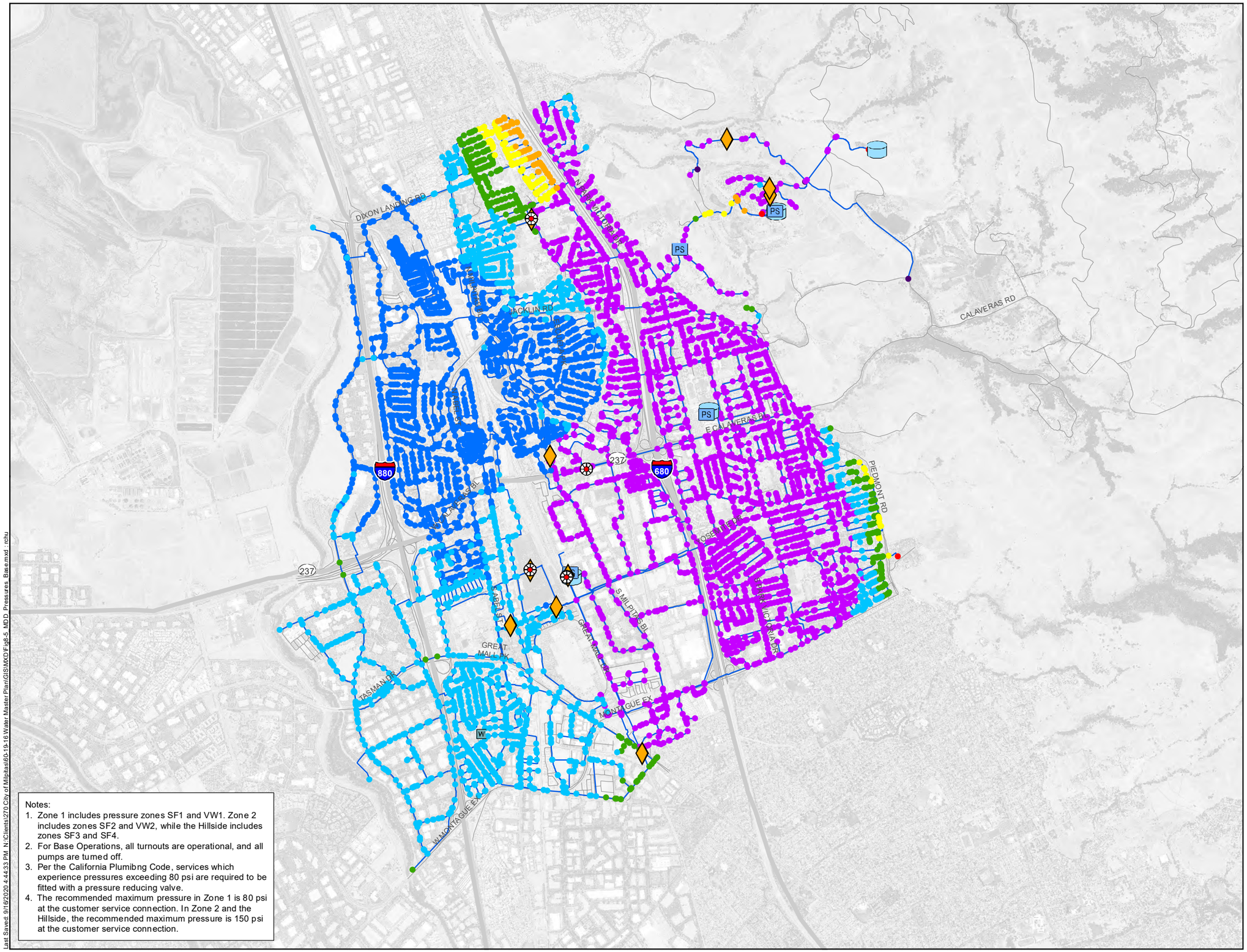
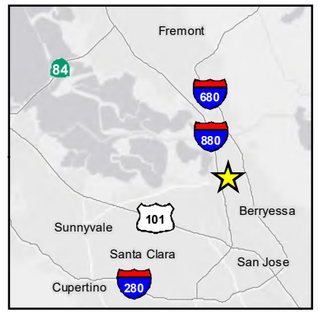
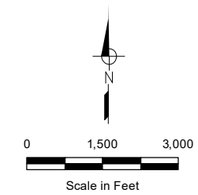
Figure 8-4

Existing System Pressures
Peak Hour Demand
Alternative 1 Operations

City of Milpitas
2020 Water Master Plan







Maximum Day Pressure

- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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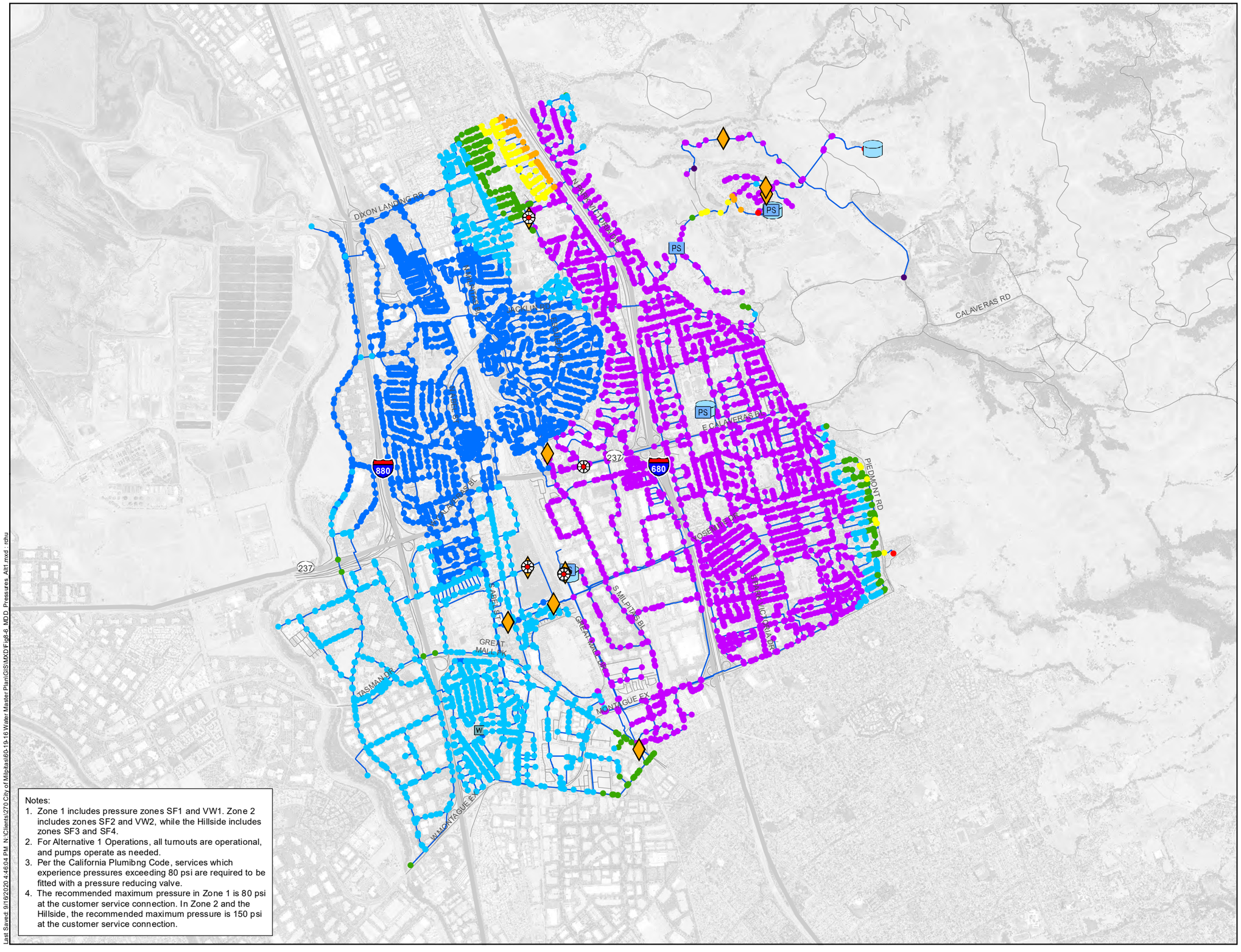
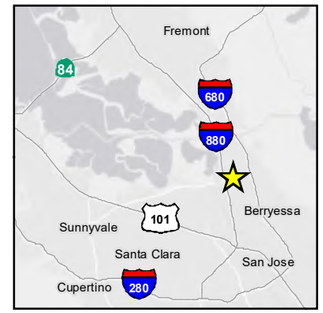
Figure 8-5

Existing System Pressures
Maximum Day Demand
Base Operations

City of Milpitas
2020 Water Master Plan





N

0 1,500 3,000

Scale in Feet

Maximum Day Pressure

- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

CITY OF MILPITAS CALIFORNIA

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Figure 8-6

Existing System Pressures Maximum Day Demand Alternative 1 Operations

City of Milpitas
2020 Water Master Plan

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8.5.5 Maximum Day Demand Plus Concurrent Fire Flow Analysis

Based on existing land use of adjacent parcels and recommended fire flows in Table 7-1, fire flows were assigned to hydrant locations throughout the distribution system. Where a hydrant may serve multiple land uses (e.g., commercial and industrial), the higher fire flow was assigned. In total, fire flows were assigned to approximately 2,150 locations throughout the distribution system.

Fire flows were then simulated during an MDD condition using the hydraulic model. The hydraulic model conducts fire flow analyses by simulating a fire flow demand at one hydrant location and verifying whether the system can serve all other normal customer demands while maintaining desired residual pressures. This is repeated for all hydrant locations within the distribution system. Hydrant locations meet recommended fire flows if they can deliver the recommended fire flow while maintaining a 20-psi residual system pressure. Note, this fire flow analysis reflects distribution system capacity, as individual hydrants and their associated losses are not modeled.

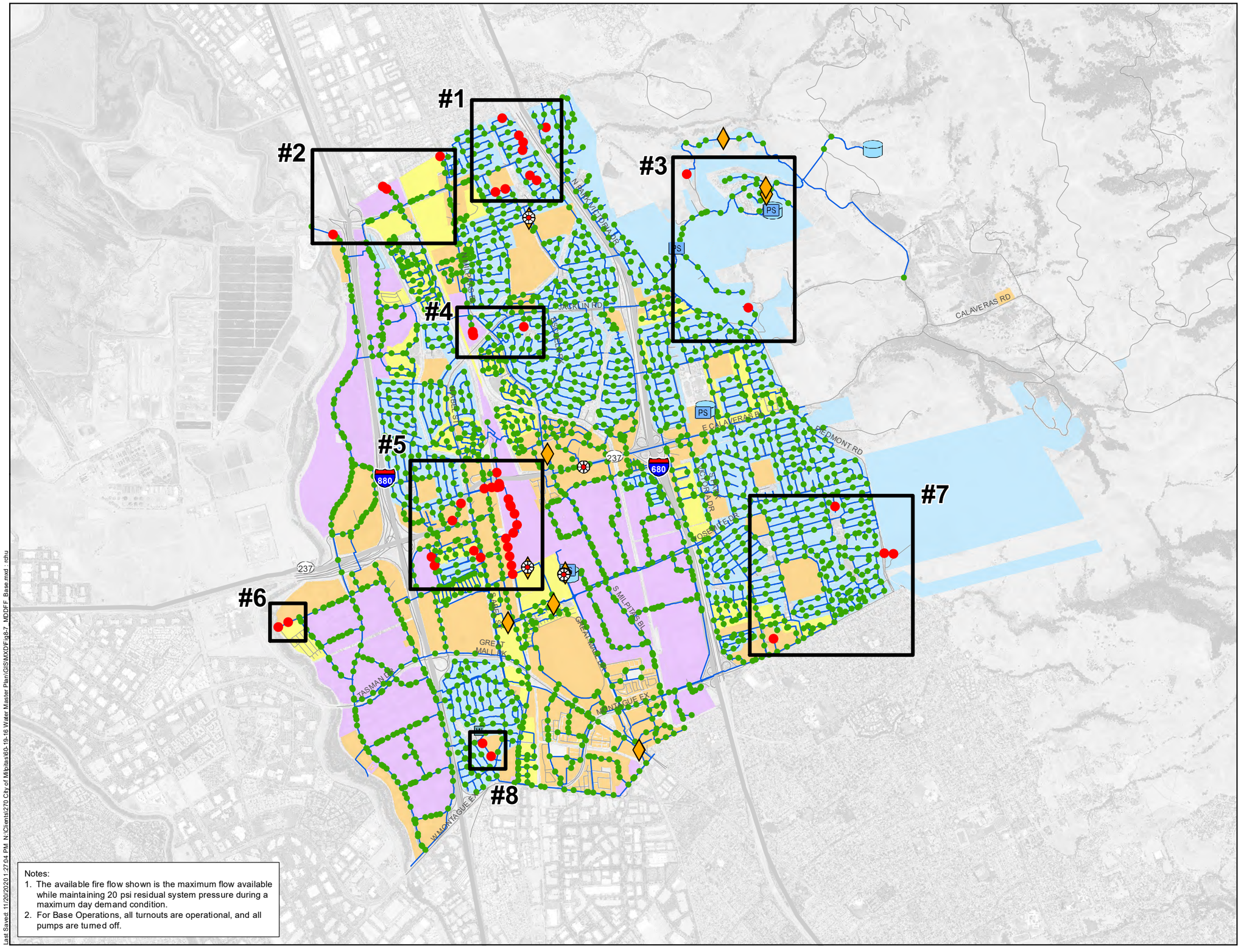
As discussed in Section 7.2.1, recommended fire flow criteria presented in Table 7-2 apply to future development and not existing system conditions. Much of the City's distribution system is older and was designed to earlier fire flow standards in place at the time the pipelines were installed. Therefore, the existing system fire flow evaluation presents systemwide available fire flow and does not recommend pipeline improvements to increase existing fire flow capacity. However, the City can use these results to prioritize replacing smaller diameter pipelines to improve overall flows throughout the distribution system, which is why potential improvement projects are discussed below.

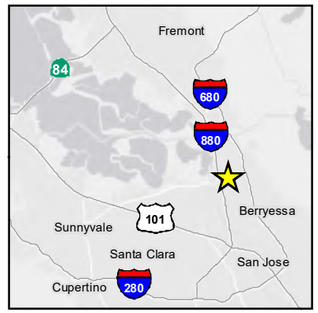
Fire flow analyses were performed independently for each pressure zone, with Zones 1 and 2 combined for each service area. It was assumed that only one fire event would occur at a time, which is standard industry practice. Results from MDD plus concurrent fire flow simulations for Base and Alternative 1 operations are shown on Figure 8-7 and Figure 8-8, respectively. Hydrant locations are represented by circles and color coded by fire flow availability, while parcels are shaded according to recommended fire flow. For example, a green circle adjacent to a purple parcel means that the distribution system can meet a 4,000 gpm fire flow at that location while maintaining 20 psi in the rest of the system.

System performance is similar for the two operational alternatives. With pumps off (Base alternative), 51 locations do not meet recommended fire flows, while 45 locations are below the fire flow criterion under Alternative 1. All "below criterion" locations in Alternative 1 are also flagged in the Base alternative, so pump operation improves fire flow availability for six locations. Since pumps could be off during a fire event, recommended improvements address all 51 below criterion locations identified in the Base alternative.

Before evaluating system improvements, West Yost examined each below criterion location to verify whether the recommended fire flow could be adequately served by multiple hydrants. Distributing the recommended fire flow among multiple hydrants reduces friction losses, because only a portion of the flow reaches the hydrant closest to the simulated fire. The remainder of the fire flow is delivered by an adjacent hydrant served by a shorter (or entirely different) pipeline path. These reduced friction losses can be significant, in some cases allowing otherwise below criterion locations to meet recommended fire flows.

It was assumed that any location with another hydrant within the City's hydrant spacing guidelines (500 feet for single family areas and 300 feet for all other areas) would qualify for delivering fire flows through multiple hydrants. If the qualifying hydrants could combine to deliver the recommended fire flow while maintaining a 20-psi residual system pressure, then the location was no longer considered below criterion" Of the 51 below criterion locations identified in the Base alternative, 13 met recommended fire flows after looking at multiple hydrants.





N

0 1,500 3,000

Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.

Figure 8-7

Existing System Available Fire Flow Base Operations

City of Milpitas
2020 Water Master Plan

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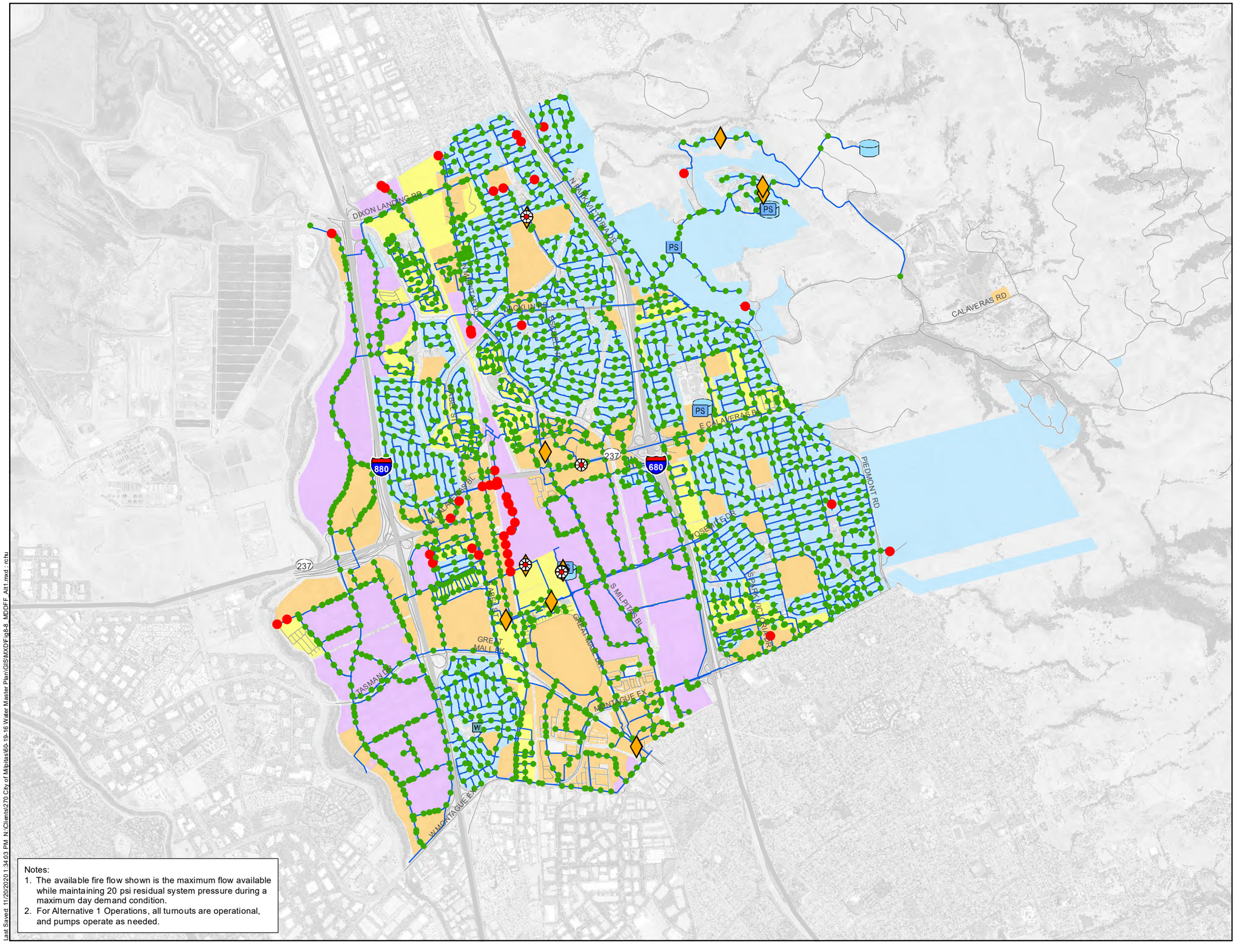

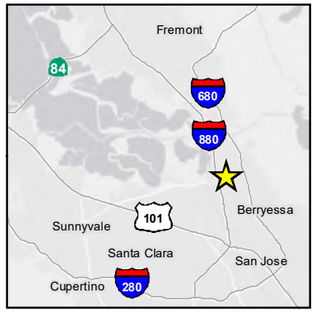

N

0 1,500 3,000

Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

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Figure 8-8

Existing System Available Fire Flow Alternative 1 Operations

City of Milpitas
2020 Water Master Plan

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To organize discussion of the remaining below criterion locations, Figure 8-7 groups them into eight geographic areas. The recommended improvements for each area are discussed below. As mentioned earlier, each proposed project is assigned a CIP ID to simplify cross-referencing with Chapter 11. In general, to comply with the City's design guidelines, the City should also consider upsizing any pipelines smaller than 6 inches in diameter that serve hydrants. These are also listed below.

- Area No. 1
  - Along Sussex Place, replace approximately 190 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-23)
- Area No. 2
  - Along Milmont Drive between Dixon Landing Road and the ACWD intertie, replace approximately 910 LF of 8-inch and 10-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-06)
- Area No. 3
  - Along Calera Creek Heights Drive between approximately hydrants 4A-001 and 4A-005, replace approximately 1,480 LF of 6-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-26)
- Area No. 4
  - Along Hanson Court, replace approximately 610 LF of 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-05)
  - Along Merz Court, replace approximately 430 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-21)
- Area No. 5
  - Along Sinnott Lane, Bothelo Avenue, and East Carlo Street, replace approximately 1,730 LF of 6-inch and 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-01)
  - On Hammond Way near Tom Evatt Park, replace the (normally closed) isolation valve separating Zones VW1 and SF1 with an emergency pressure reducing valve (EPRV) to allow flows from Zone SF1 during a fire event along Hammond Way (ECIP-V-01). Alternatively, the City can replace approximately 1,300 LF of 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-02).
  - Along Railroad Avenue between approximately hydrant 1A-355 and the southern end of Railroad Avenue, replace approximately 880 LF of 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-07)
  - For the below criterion locations near the western end of Corning Avenue, install a new isolation valve at the end of the existing Zone SF1 pipeline, immediately upstream of the tee connecting Zones VW1 and SF1. Should a fire occur at the adjacent industrial site, the City can open existing (normally closed) isolation valves (numbers 35 and 35100) to supplement flows to the area. The hydraulic model shows these locations meet recommended fire flows with this adjustment. The new isolation valve can be closed to maintain separation between Zones VW1 and SF1 (ECIP-V-02). Alternatively, the City can replace approximately 870 LF of 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-03).

  - Along South Abel Street between Sylvia Avenue and Corning Avenue, replace approximately 240 LF of 6-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-11)

- Area No. 6
  - Along Technology Drive between Murphy Ranch Road and the western end of Technology Drive, replace approximately 740 LF of 4-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-04)
- Area No. 7
  - Along Carlsbad Street between Carlsbad Court and Ben Rodgers Park, replace approximately 160 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-25)
  - Along Pinard Street from Ridgemont Drive up to the Lee's Orchard community, replace approximately 680 LF of 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-16)
  - Within the shopping center east of the intersection of South Park Victoria Drive and Landess Avenue, replace approximately 450 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-08)
- Area No. 8
  - Along Greenwood Way between Pinewood Way and Fallen Leaf Drive, replace approximately 860 LF of 6-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-10)
- Pipelines less than 6 inches in diameter that serve hydrants
  - Along Santa Rita Drive near the intersection of Santa Rita Drive and Via Baja Drive, replace approximately 20 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-32)
  - Along Calle del Prado, replace approximately 90 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-33)
  - Along Kennedy Drive between Topham Court and Prada Drive, replace approximately 330 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-34)
  - Along Ramos Court, replace approximately 60 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-36)
  - Along Stemel Court, replace approximately 50 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-37)
  - Along Sepulveda Court, replace approximately 20 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-38)
  - Along Berg Court, replace approximately 110 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-39)

8.5.6 Emergency Outage Scenarios

The following emergency outage evaluations identify how well the distribution system functions without one or more key facilities. For reference, the outage scenarios consist of:

- SFPUC turnouts are offline
- VW turnout is offline
- SFPUC and VW turnouts are offline
- Power outage; all facilities without backup generators are offline
- PRVs normally allowing flow between Zones 1 and 2 are offline

Emergency outage scenarios are not intended to evaluate the adequacy of emergency water supplies, which is outside the scope of this master plan. Instead, these evaluations examine system pressures and fire flow availability during an MDD condition. To be conservative, storage reservoir levels are assumed to be at the minimum of normal operating range (see Table 3-4).

Since emergency scenarios assume certain facilities are offline, the corresponding evaluations do not examine system performance under Base and Alternative 1 operations. Besides the assumed outage, there are no additional operational restrictions. All facilities not assumed offline as part of the scenario are assumed to be operational.

Results for each emergency outage scenario are summarized below. Where presented, figures showing system performance during emergency outages are similar to non-emergency figures discussed above. Distribution system locations are color coded by either pressure (for MDD evaluations) or fire flow availability (for fire flow evaluations).

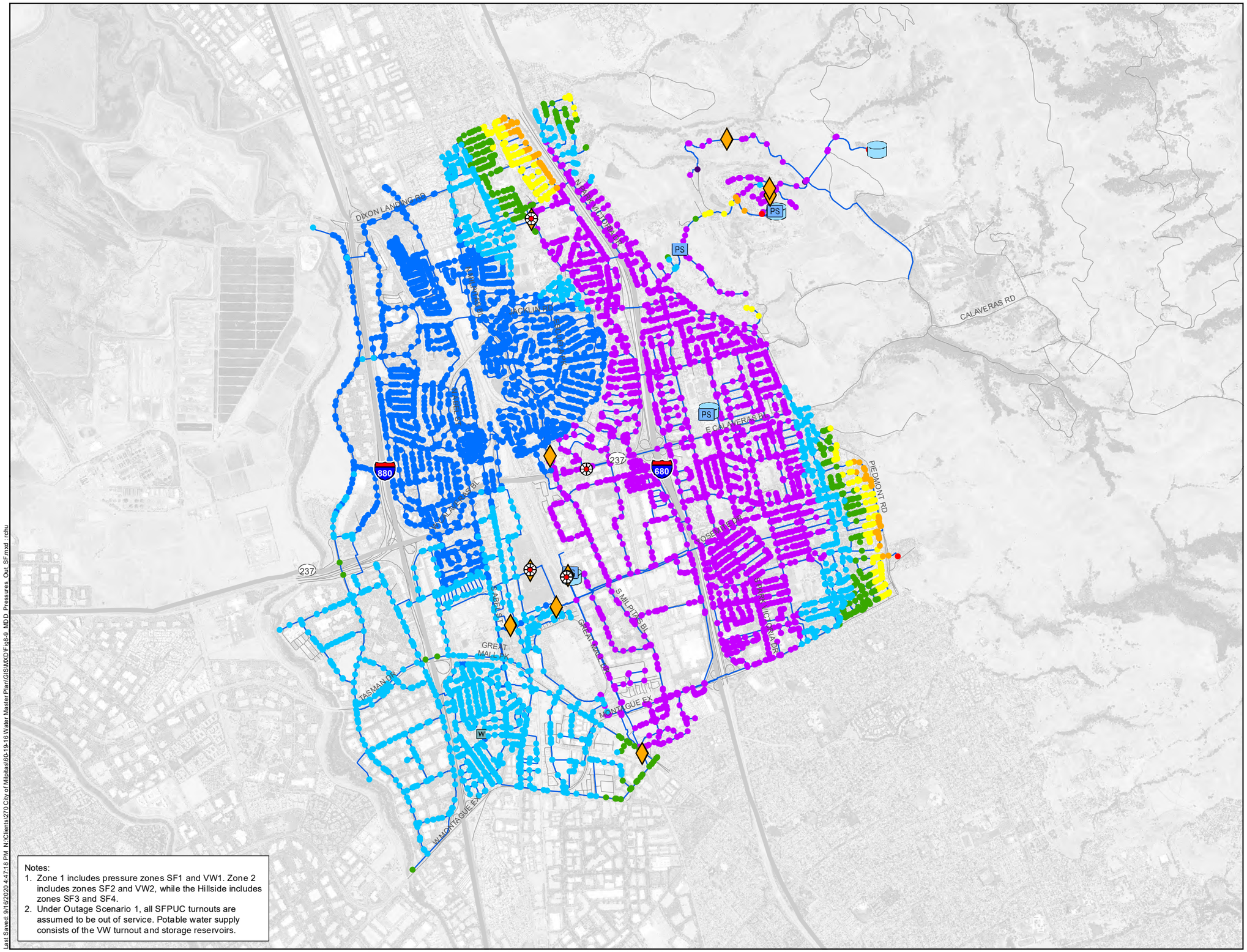
8.5.6.1 Outage Scenario 1 – SFPUC Offline

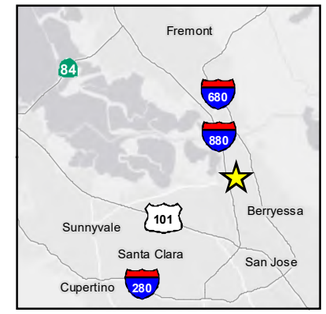
This outage scenario assumes supply from SFPUC is unavailable, so the Sunnyhills, Calaveras, Main Street, and Intertie turnouts are offline. As a result, the City's normally available potable water supply consists of VW (i.e., the Gibraltar turnout) and storage.

Figure 8-9 shows system pressures under MDD conditions in this outage scenario. Even without SFPUC turnout flows, the system is able to maintain adequate pressures. There are no customer service locations with pressures below 40 psi.

Fire flow availability is significantly hindered with SFPUC turnouts offline. As shown on Figure 8-10, in this outage scenario more than 260 locations do not meet recommended fire flows under this outage scenario. Compared to normal operations, this is over 200 additional below criterion locations, most of which are in Zone SF2. This is due to the relatively small pumps at the Ayer pump station. While the Gibraltar (SF) pumps can serve Zone SF1 fire flows, the pumps at the Ayer pump station cannot deliver Zone SF2 fire flows.

As a result, West Yost recommends installing a pump to meet fire flow at the Ayer pump station (ECIP-PS-AY) with a design capacity of 4,000 gpm at 285 ft of total dynamic head (TDH). Hydraulic model results show that with the pump installed, the distribution system actually slightly outperforms the existing system under normal conditions. While 45 locations were below criterion under Alternative 1 operations, 43 are below criterion with SFPUC turnouts offline and the new Ayer pump active.





N

0 1,500 3,000

Scale in Feet

Maximum Day Pressure

- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:
1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. Under Outage Scenario 1, all SFPUC turnouts are assumed to be out of service. Potable water supply consists of the VW turnout and storage reservoirs.

Figure 8-9

Existing System Pressures Maximum Day Demand Outage Scenario 1

City of Milpitas
2020 Water Master Plan

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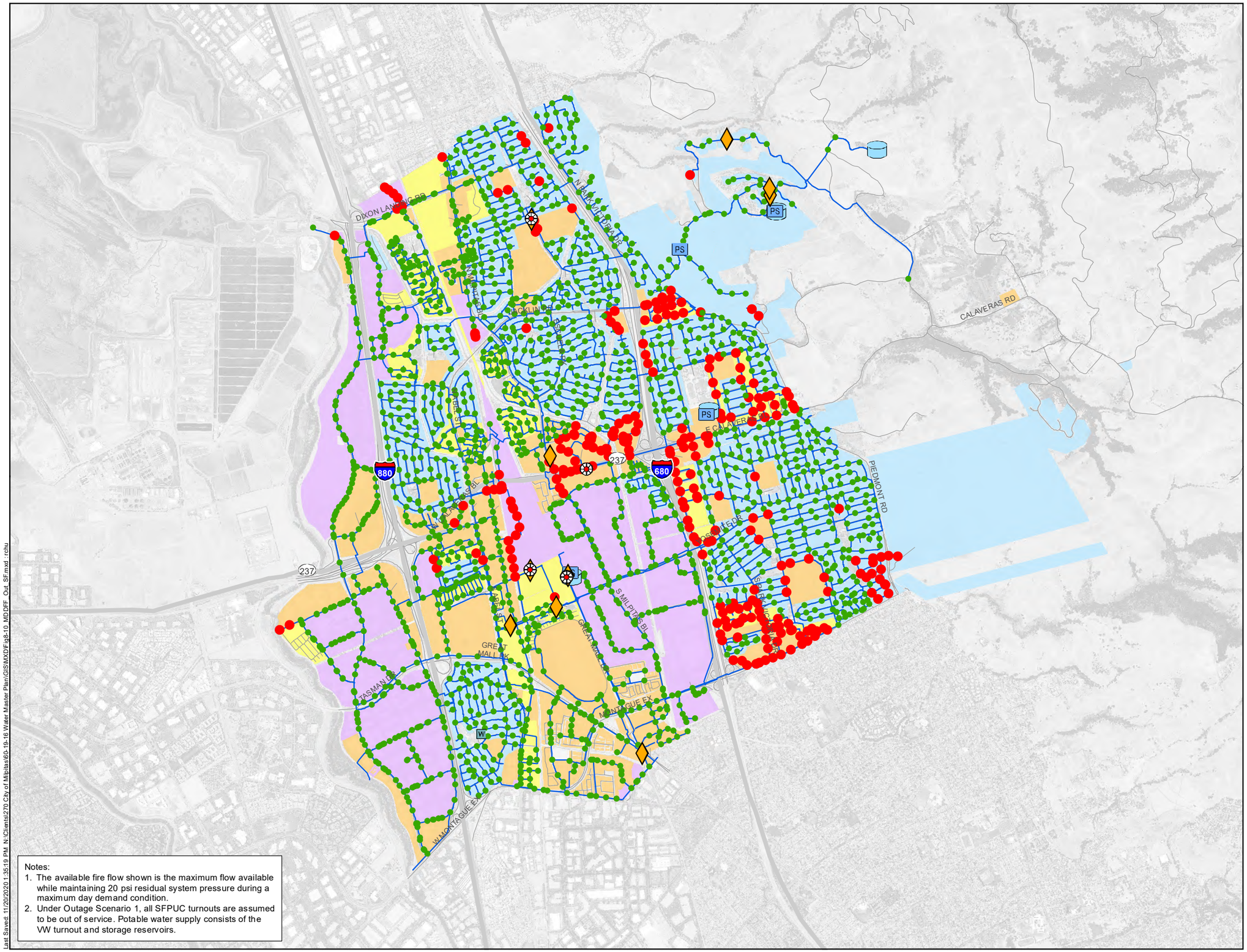

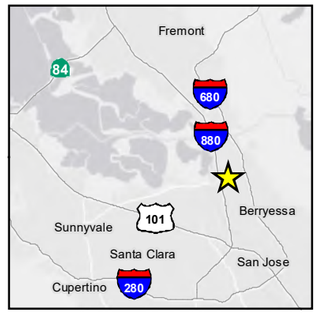

N

0 1,500 3,000

Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:

1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. Under Outage Scenario 1, all SFPUC turnouts are assumed to be out of service. Potable water supply consists of the VW turnout and storage reservoirs.

Figure 8-10

Existing System Available Fire Flow Outage Scenario 1

City of Milpitas
2020 Water Master Plan

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Out_SF.mxd

8.5.6.2 Outage Scenario 2 – VW Offline

This outage scenario assumes supply from VW is unavailable, so the Gibraltar turnout is offline. As a result, the City's normally available potable water supply consists of SFPUC turnouts and storage.

Figure 8-11 and Figure 8-12 show system pressures and fire flow availability, respectively, under MDD conditions in this outage scenario. System performance is similar to the Alternative 1 MDD scenarios (Figure 8-6 and Figure 8-8). The Gibraltar (VW) pumps adequately substitute for the Gibraltar turnout, so there remain no customer service locations with pressures below 40 psi. Regarding fire flow availability, there are no additional below criterion locations resulting from the turnout outage. Thus, West Yost does not recommend any improvements based on Outage Scenario 2.

8.5.6.3 Outage Scenario 3 – SFPUC and VW Offline

This outage scenario assumes supplies from both SFPUC and VW are unavailable, so all turnouts are offline. As a result, the City's normally available potable water supply consists of storage only.

Figure 8-13 and Figure 8-14 show system pressures and fire flow availability, respectively, under MDD conditions in this outage scenario. Since the VW outage does not significantly impact the distribution system, this scenario is similar to Outage Scenario 1 (SFPUC offline). In other words, customer service pressures remain at or above 40 psi, but fire flow availability is significantly reduced.

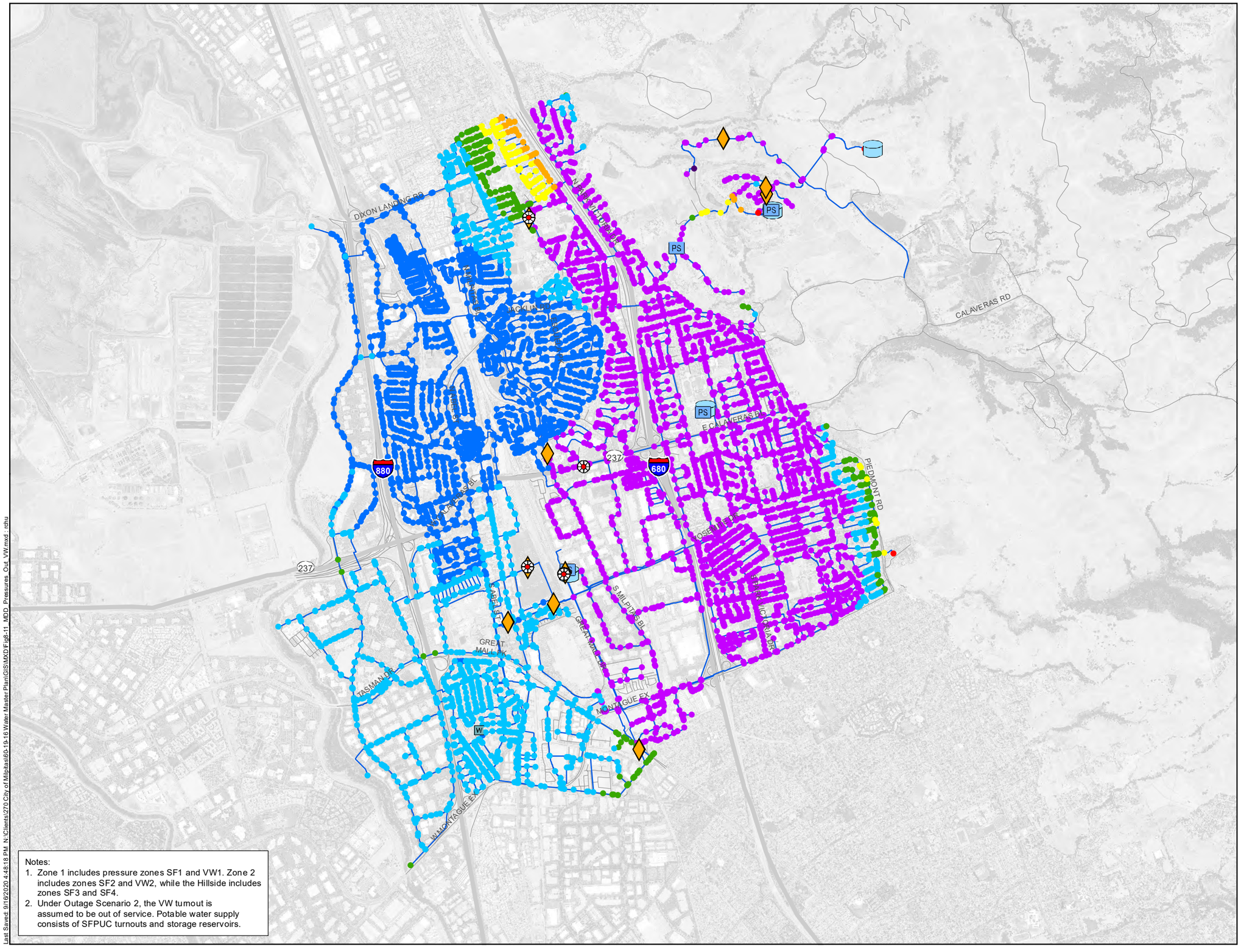
The additional pumping capacity at the Ayer pump station recommended in Outage Scenario 1 eliminates the fire flow impacts resulting from the turnout outage. No other improvements are needed to address issues created by this outage scenario.

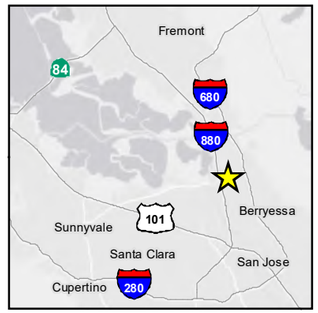
8.5.6.4 Outage Scenario 4 – Power Outage

This outage scenario assumes electrical power is unavailable, so any facilities without backup generators are offline. While this does not impact the City's normally available potable water supply, distribution system operations are hindered. The Country Club and Tularcitos pump stations have backup power plug-in adapters and transfer switches, but the City does not yet have portable generators. To be conservative, it is assumed the Country Club and Tularcitos pump stations are unavailable in a power outage. However, the Tularcitos and Minnis storage reservoirs can still serve Zones SF3 and SF4, respectively, during a power outage.

Figure 8-15 and Figure 8-16 show system pressures and fire flow availability, respectively, under MDD conditions in this outage scenario. The power outage does not significantly impact customer service pressures or fire flow availability, as the hillside storage reservoirs can adequately serve their respective pressure zones via gravity.

While there are no critical improvements associated with this outage scenario, having backup power capabilities at the Country Club and Tularcitos pump stations would provide redundancy. This could entail a backup generator or, as the City has discussed, purchasing a portable genset capable of powering either pump station.





N

0 1,500 3,000

Scale in Feet

Maximum Day Pressure

- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Figure 8-11

Existing System Pressures
Maximum Day Demand
Outage Scenario 2

City of Milpitas
2020 Water Master Plan

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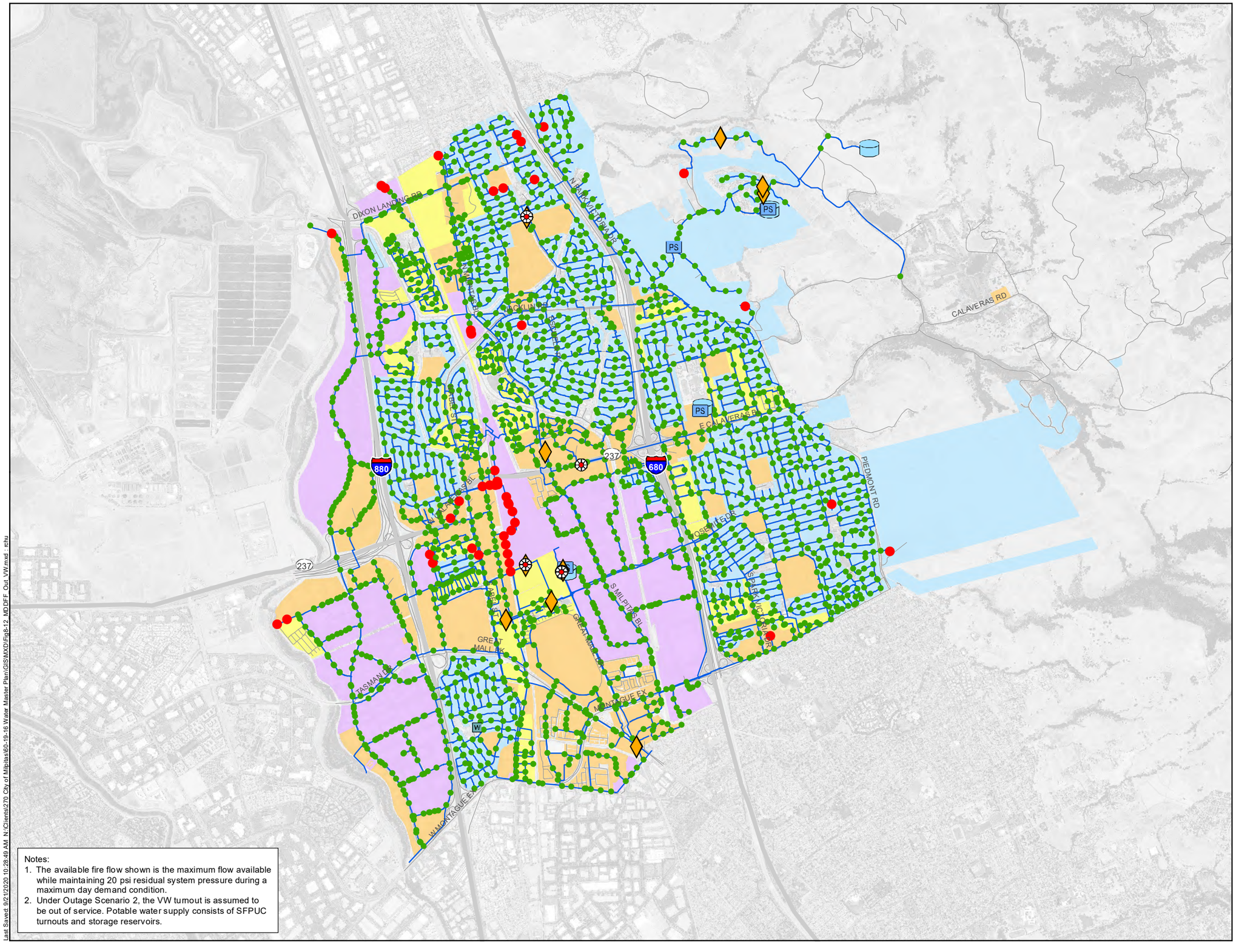

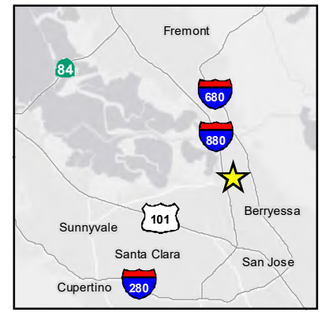

N

0 1,500 3,000

Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. Under Outage Scenario 2, the VW turnout is assumed to be out of service. Potable water supply consists of SFPUC turnouts and storage reservoirs.

Figure 8-12

Existing System Available Fire Flow Outage Scenario 2

City of Milpitas
2020 Water Master Plan

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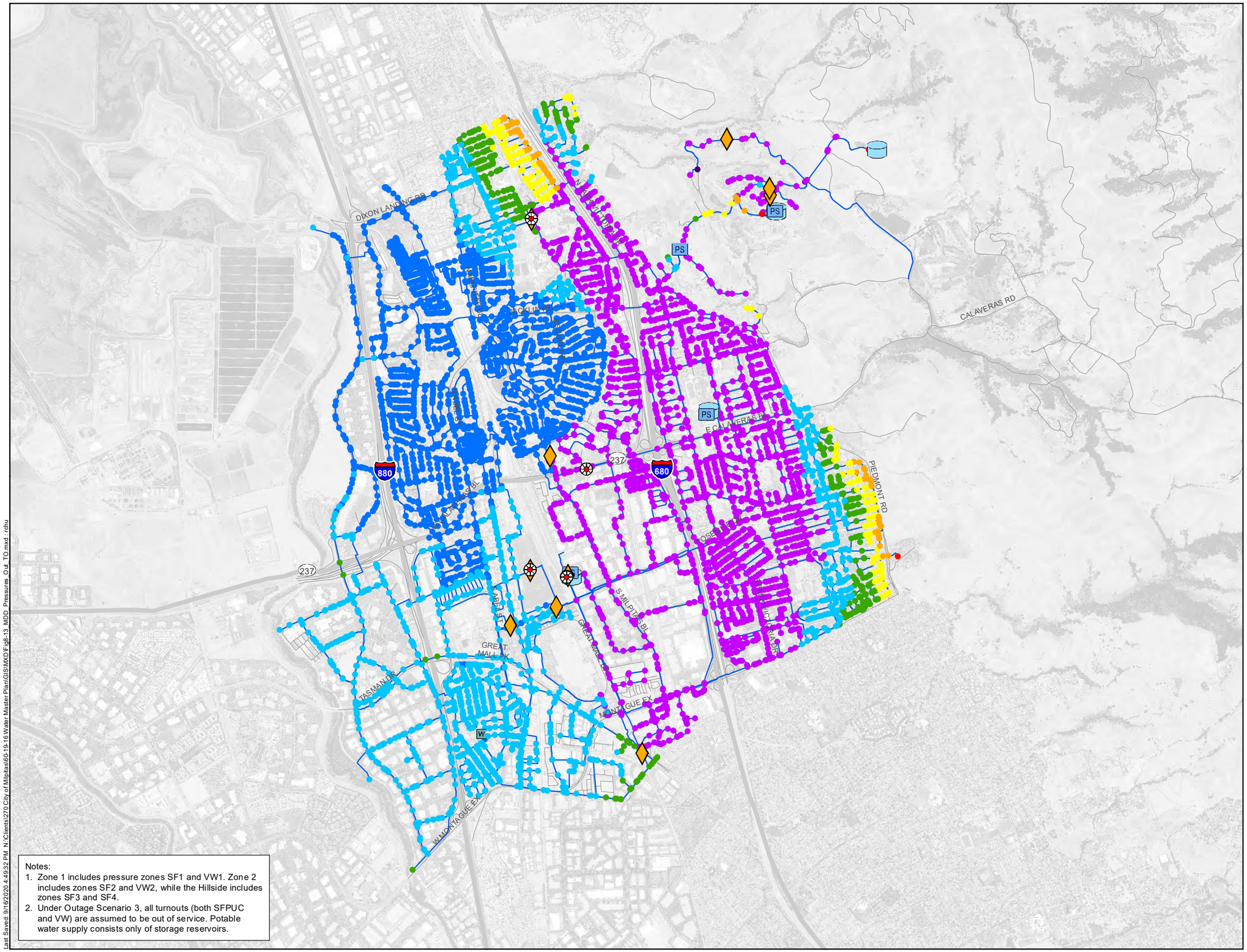

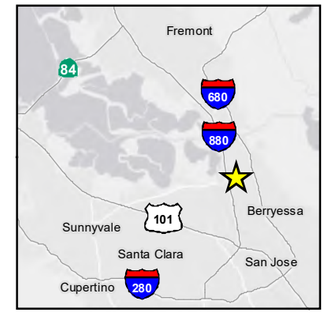

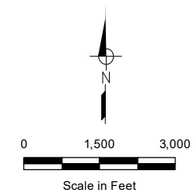

Maximum Day Pressure

- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:
1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. Under Outage Scenario 3, all turnouts (both SFPUC and VW) are assumed to be out of service. Potable water supply consists only of storage reservoirs.

Figure 8-13

Existing System Pressures
Maximum Day Demand
Outage Scenario 3

City of Milpitas
2020 Water Master Plan

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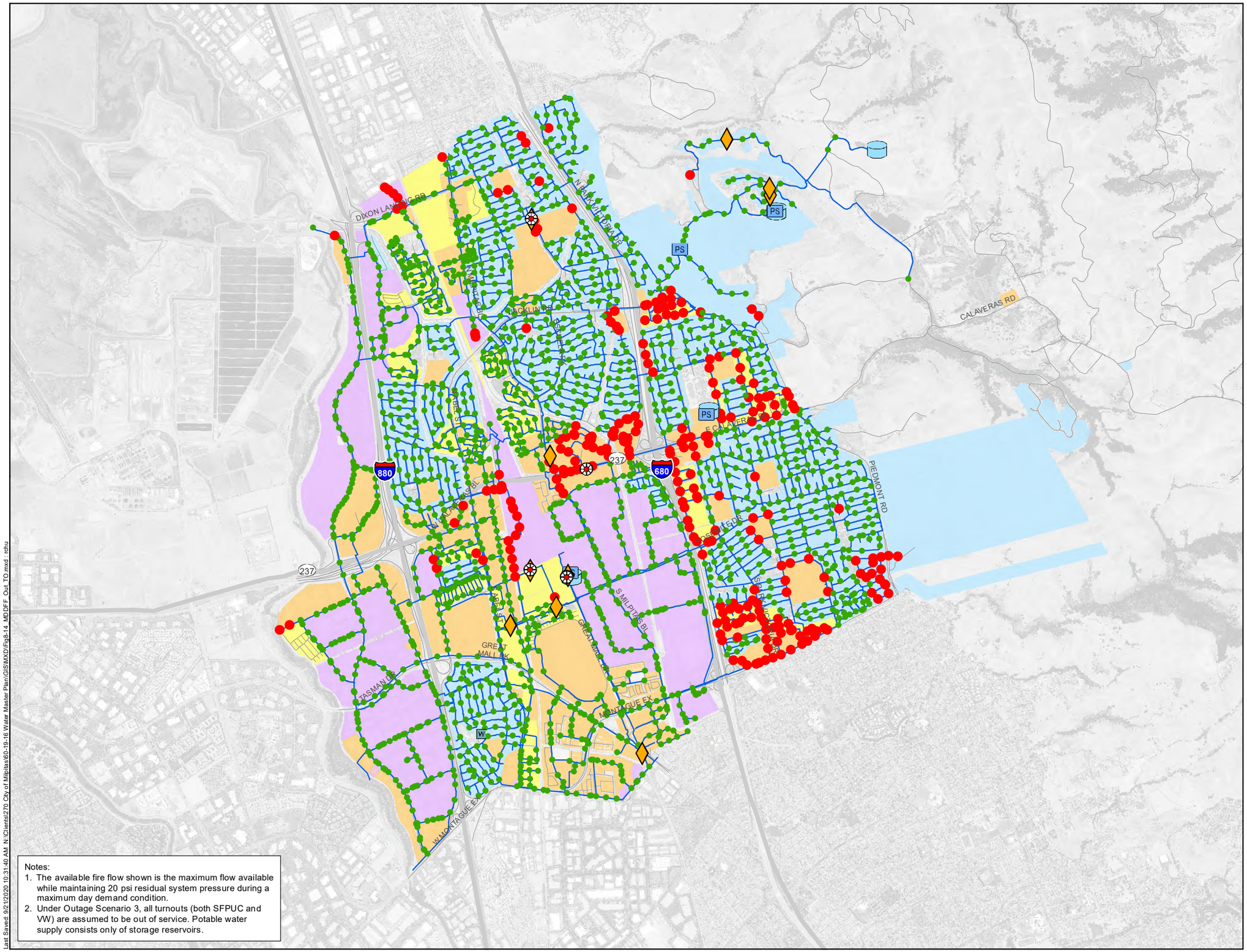

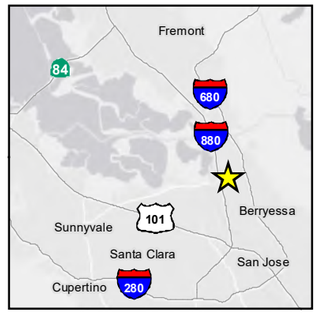

N

0 1,500 3,000

Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:

1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. Under Outage Scenario 3, all turnouts (both SFPUC and VW) are assumed to be out of service. Potable water supply consists only of storage reservoirs.

Figure 8-14

Existing System Available Fire Flow Outage Scenario 3

City of Milpitas
2020 Water Master Plan

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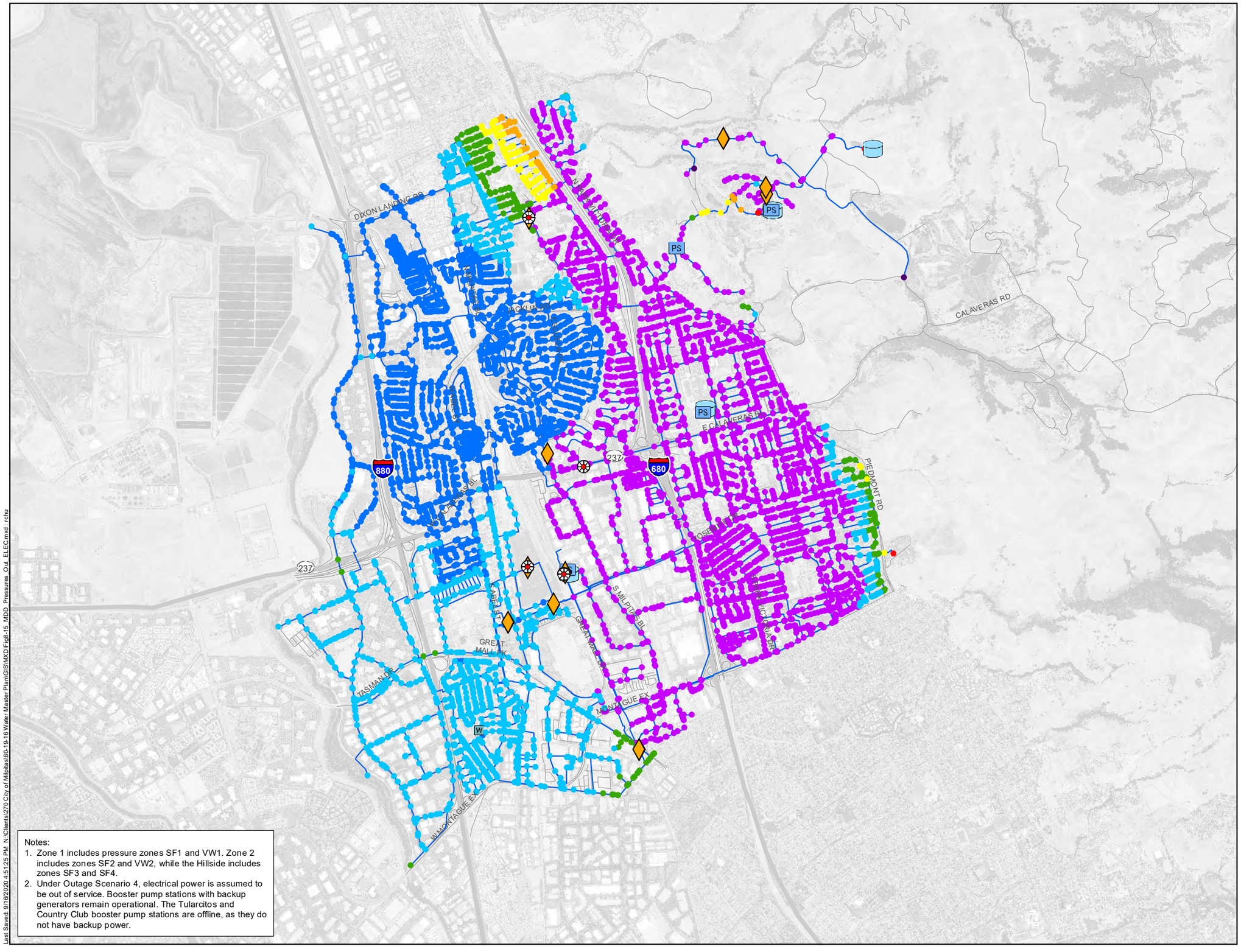

Maximum Day Pressure

- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. Under Outage Scenario 4, electrical power is assumed to be out of service. Booster pump stations with backup generators remain operational. The Tularcitos and Country Club booster pump stations are offline, as they do not have backup power.

Figure 8-15

Existing System Pressures Maximum Day Demand Outage Scenario 4

City of Milpitas
2020 Water Master Plan

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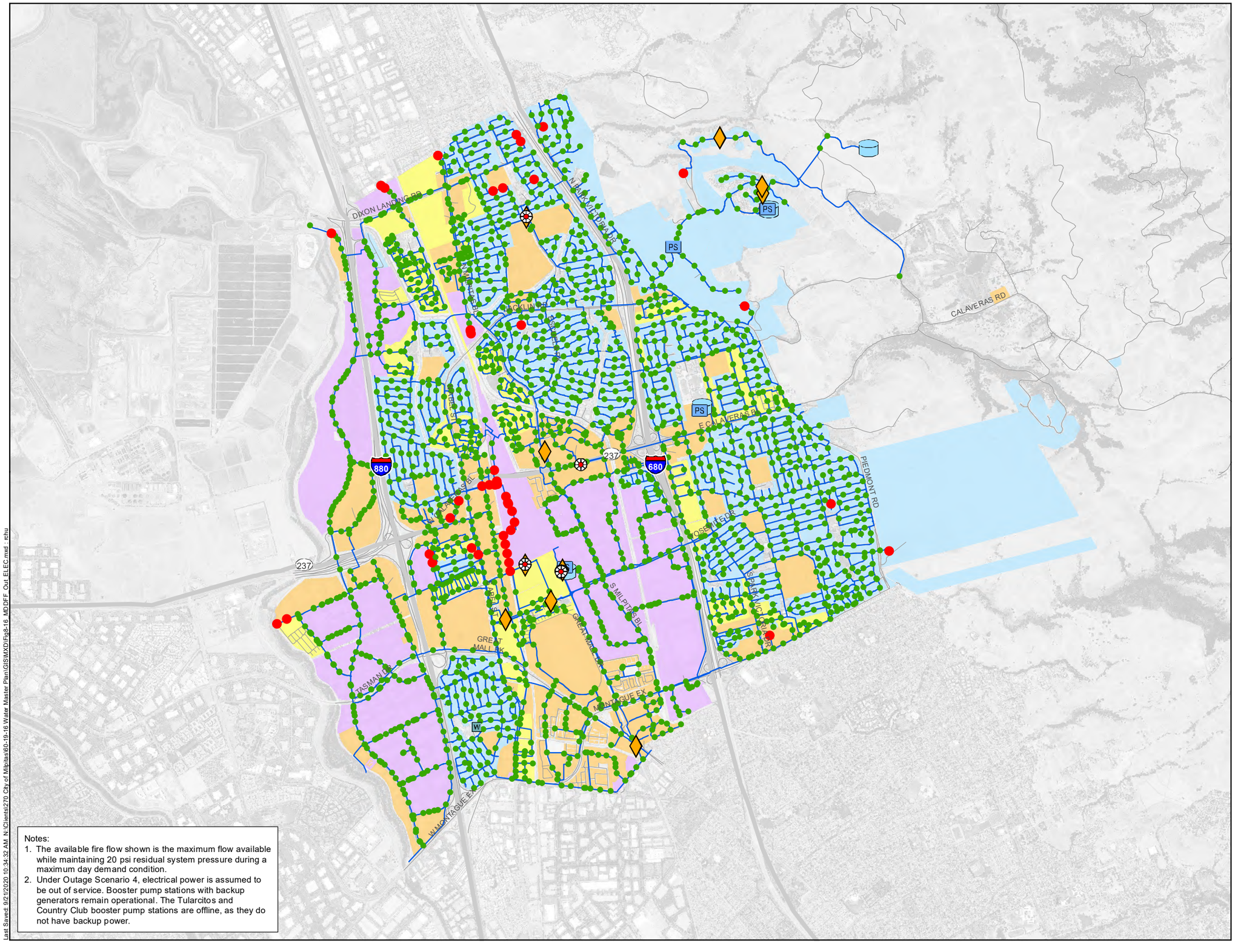

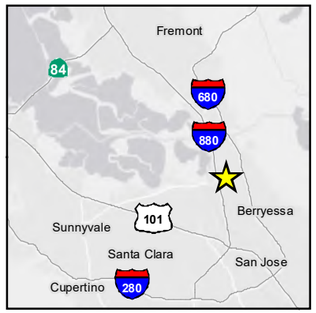

N

0 1,500 3,000

Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:

1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. Under Outage Scenario 4, electrical power is assumed to be out of service. Booster pump stations with backup generators remain operational. The Tularcitos and Country Club booster pump stations are offline, as they do not have backup power.

Figure 8-16

Existing System Available Fire Flow Outage Scenario 4

City of Milpitas
2020 Water Master Plan

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8.5.6.5 Outage Scenario 5 – Zone 1/2 PRVs Offline

Outage Scenario 5 assumes a PRV normally allowing flow between Zones 1 and 2 is offline. These "Zone 1/2" PRVs include Main, North Milpitas, and Sunnyhills in the SFPUC service area and Capitol, Curtis East, Curtis West, and Parc Metro in the VW service area. System performance is evaluated with one PRV closed at a time. It is assumed EPRVs are available as needed.

Under MDD conditions, customer service pressures are not significantly impacted by any single Zone 1/2 PRV outage. Should any of these PRVs fail, the remaining PRVs allow the distribution system to operate such that customer service pressures are at least 40 psi.

In contrast, fire flow availability can be significantly reduced depending on the PRV outage. For Main, North Milpitas, and Curtis (East and West), operational status did not significantly impact fire flow availability. However, when Sunnyhills, Capitol, or Parc Metro were offline, fire flow availability decreased. The fire flow impacts of these outages are shown on Figure 8-17 and discussed below, followed by a review of the recommended improvements.

8.5.6.5.1 Sunnyhills PRV Outage

Should the Sunnyhills PRV go offline, eight additional locations do not meet recommended fire flows. These locations are all in Zone SF1. West Yost recommends the following improvements to address these new below criterion locations:

- Near the intersection of Coelho Street and Diel Drive, replace the (normally closed) isolation valve separating Zones SF1 and SF2 with an EPRV to allow flows from SF2 during a fire event in the northern area of Zone SF1 (ECIP-V-03).
- Along Callan Street near the intersection of Callan Street and Arizona Avenue, replace approximately 140 LF of 6-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-28).
- Along Gross Street, near the intersection of Gross Street and Conway Street, replace approximately 170 LF of 6-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-31).

8.5.6.5.2 Capitol PRV Outage

Should the Capitol PRV go offline, 11 additional locations do not meet recommended fire flows. However, during a fire at any of these 11 locations (all in Zone VW1), the Live Oak and McCarthy EPRVs will allow sufficient flow from Zone SF1 to meet recommended fire flows. Thus, a Capitol PRV outage can be adequately handled by existing facilities, and no improvements are necessary.

8.5.6.5.3 Parc Metro PRV Outage

Should the Parc Metro PRV go offline, five additional locations do not meet recommended fire flows. At one of these locations, EPRV operation improves fire flows to meet the recommended criterion. West Yost recommends the following improvements to address the remaining below criterion locations:

- Along Curtis Avenue, connect the existing 10-inch diameter pipeline on the northern side of the street to the existing 18-inch diameter pipeline on the southern side of the street. This new connection should be a 12-inch diameter pipeline (approximately 30 LF) and installed downstream of the Curtis PRVs (i.e., in Zone VW1) (ECIP-PN-01).

- Along Hammond Way, east of Tom Evatt Park, connect the existing 8-inch diameter pipelines in Zone VW1. These pipelines are currently dead ends, created by normally closed isolation valves separating the SFPUC and VW service areas. This new connection should be an 8-inch diameter pipeline and is estimated to be approximately 60 LF (ECIP PN-02).

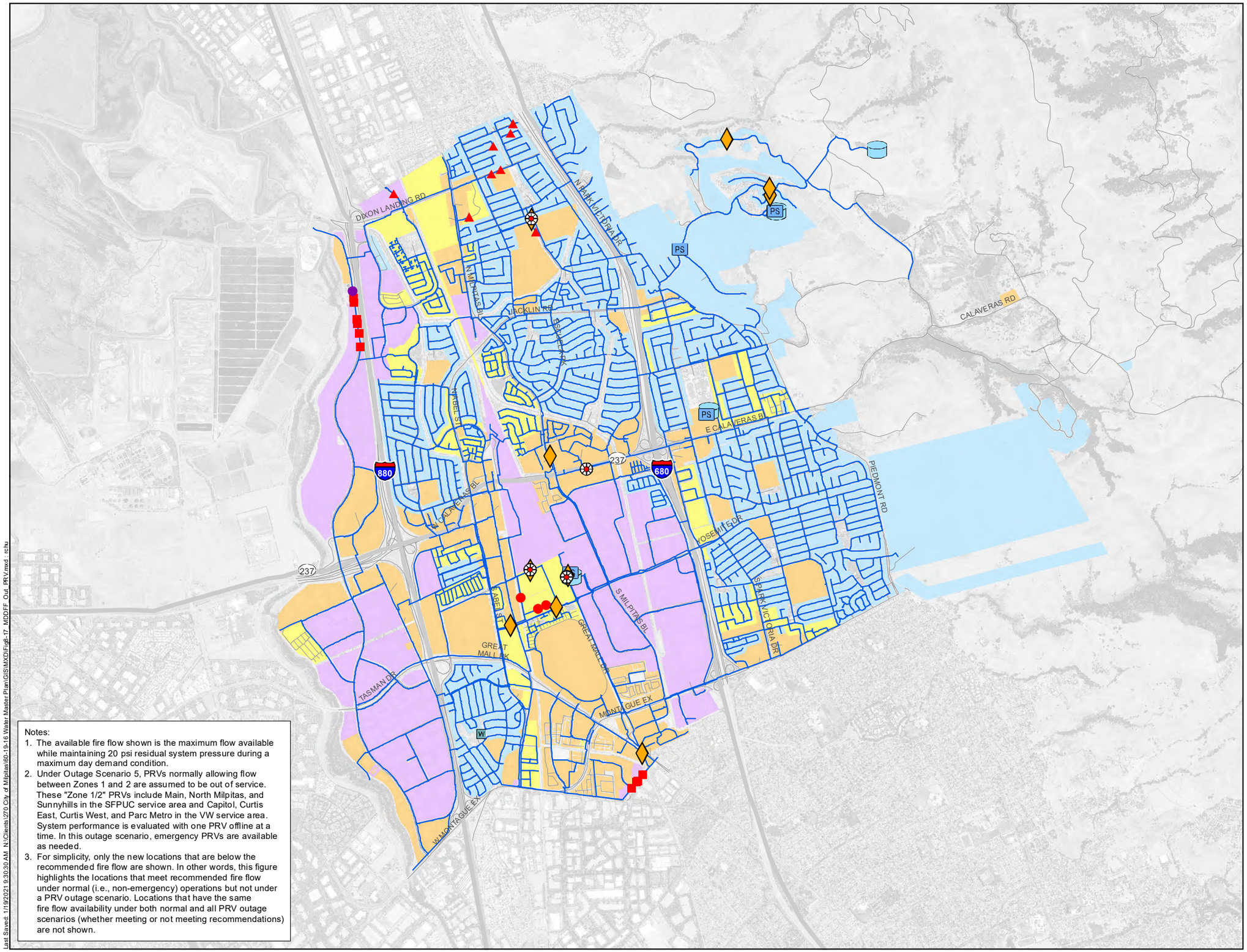
8.5.6.5.4 PRV Outage Priority

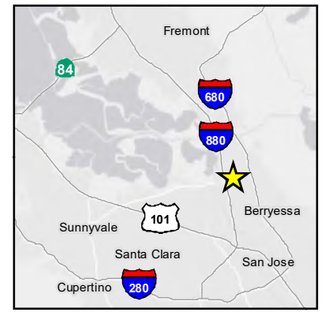
Table 8-6 summarizes distribution system performance for each PRV outage. As shown in Table 8-6, each PRV is assigned a priority based on the impact of its outage. Parc Metro and Sunnyhills are the highest priority PRVs, while Main, North Milpitas, and Curtis East/West are the lowest priority PRVs.

Table 8-6. PRV Outage Priority[a]

PRV	Priority (Low, Med, High)	No. of Additional "Below Criterion" Locations[b]	Notes
SFPUC Service Area			
Sunnyhills	High	8	Pipeline improvements recommended
Main	Low	0	No new below criterion locations from PRV outage
North Milpitas	Low	0	No new below criterion locations from PRV outage
VW Service Area			
Parc Metro	High	5	New pipelines recommended
Capitol	Med	11	New below criterion locations fixed via existing EPRVs
Curtis East	Low	0	No new below criterion locations from PRV outage
Curtis West	Low	0	No new below criterion locations from PRV outage

(a) Only PRVs normally allowing flow from Zone 2 to Zone 1 are assigned a priority.
(b) Below criterion locations cannot serve recommended fire flows while maintaining a 20-psi residual system pressure during maximum day demands. This represents the number of "below criterion" locations above normal operations (i.e., Base scenario).





N

0 1,500 3,000

Scale in Feet

Locations Not Meeting Recommended Fire Flow Due to the Following PRV Outage(s)

- Sunnyhills
- Parc Metro
- Capitol or Parc Metro
- Capitol
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:

1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. Under Outage Scenario 5, PRVs normally allowing flow between Zones 1 and 2 are assumed to be out of service. These "Zone 1/2" PRVs include Main, North Milpitas, and Sunnyhills in the SFPUC service area and Capitol, Curtis East, Curtis West, and Parc Metro in the VW service area. System performance is evaluated with one PRV offline at a time. In this outage scenario, emergency PRVs are available as needed.
3. For simplicity, only the new locations that are below the recommended fire flow are shown. In other words, this figure highlights the locations that meet recommended fire flow under normal (i.e., non-emergency) operations but not under a PRV outage scenario. Locations that have the same fire flow availability under both normal and all PRV outage scenarios (whether meeting or not meeting recommendations) are not shown.

Figure 8-17

Existing System Available Fire Flow Outage Scenario 5

City of Milpitas
2020 Water Master Plan

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8.6 SUMMARY OF FINDINGS AND RECOMMENDED IMPROVEMENTS

Below is a summary of findings and recommendations from the evaluations detailed in this chapter. Key recommendations for the existing system were used to develop a CIP, which is the focus of Chapter 11.

- Supply Capacity
  - Existing firm supplies exceed maximum day demand. While the VW service area has a firm supply deficit, it can be met by the surplus in the SFPUC service area. No additional supply facilities are recommended based on existing demands and normal operating conditions.
- Storage Capacity
  - There is sufficient storage in the SFPUC service area and a deficit of 0.45 MG in the VW service area. This deficit is not considered critical, as the Zone SF1 storage surplus can cover the shortfall in Zones VW1 and VW2. No additional storage is recommended based on existing demands and normal operating conditions.
- Pumping Capacity
  - Each pressure zone has a pumping capacity surplus. No additional pumping facilities are recommended based on existing demands and normal operating conditions.
- Distribution System
  - The existing distribution system meets all minimum pressure criteria under ADD, PHD, and MDD conditions.
  - West Yost identified potential improvements to address the locations not meeting recommended fire flows in the existing system. These mainly consist of upsizing existing 6-inch and 8-inch diameter pipelines, though some PRV and isolation valve improvements are also recommended. It is assumed these improvements will be implemented for the future water system evaluation in Chapter 9.
  - To comply with the City's design guidelines and improve fire flow capacity, the City should consider upsizing any 4-inch diameter pipelines that serve hydrants to 8-inch diameter pipelines.
  - Should SFPUC turnouts go offline, most of Zone SF2 has reduced fire flow capacity. As a result, West Yost recommends installing a pump at the Ayer pump station with a capacity of 4,000 gpm.
  - The existing system is well equipped to handle a power outage or a VW supply outage. No additional significant impacts arise in either emergency scenario.
  - To evaluate system performance during a PRV outage, PRVs normally allowing flow from Zone 2 to Zone 1 were simulated to be disabled one at a time. The Sunnyhills and Parc Metro PRVs are the most critical, as outages at either of these PRVs results in new locations not meeting recommended fire flows. Recommended improvements include a new EPRV, new pipelines, and pipeline upsizing.

CHAPTER 9
Evaluation of Future Water System

This chapter evaluates the City's future (i.e., buildout) water system and its ability to meet recommended planning and performance criteria described in Chapter 7 and summarized in Table 7-1 of this report. It is assumed complete buildout will occur in the year 2040. The evaluation encompasses both system capacity and hydraulic performance using buildout water demands developed in Section 5.1 of this report. System capacity is evaluated based on potable water supply, storage, and pumping, while the hydraulic performance evaluation examines buildout distribution facilities under various demand and outage conditions. The following evaluations frequently refer to "normal" conditions, which are defined as non-emergencies (i.e., no fires or unplanned outages).

This chapter also includes recommendations for addressing any deficiencies identified from the evaluation. These are incorporated in a recommended CIP described in Chapter 11 of this report. To simplify cross-referencing with Chapter 11, each proposed project is assigned a unique CIP ID.

The following sections present the evaluation methodology and results:

- Buildout Potable Water Demands
- Potable Water Facilities for Buildout Analysis
- Buildout Potable Water Supply Capacity Evaluation
- Buildout Potable Water Storage Capacity Evaluation
- Buildout Pumping Capacity Evaluation
- Buildout Water Distribution System Evaluation
- Summary of Findings and Recommended Improvements

9.1 BUILDOUT POTABLE WATER DEMANDS

Buildout potable water demands are summarized in Table 9-1 and represent a combination of existing demands (presented in Table 8-1) and new demands from planned future growth and development in Opportunity Areas and the Gateway Specific Plan/Milpitas Metro Specific Plan areas. While existing demands were adjusted for NRW based on actual production data, future demands were assumed to have an NRW of 11 percent (as discussed in Section 5.1.3). Maximum day and peak hour peaking factors remain as listed in Table 5-7.

New water demand is concentrated in the VW service area, as most of the planned, future growth and development (including Gateway Specific Plan and Milpitas Metro Specific Plan) is anticipated in Zones VW1 and VW2. Existing demands in the SF service area are estimated to increase approximately 18 percent at buildout, while demands in the VW service area are expected to increase by almost 150 percent over the same period. Citywide, the buildout average day demand is estimated at approximately 13.9 mgd, a 67 percent increase from the existing (2019) average day demand of 8.3 mgd.

Table 9-1. Buildout (2040) Potable Water Demands by Pressure Zone

Pressure Zone	Average Day Demand[a]		Maximum Day Demand[b]		Peak Hour Demand[c]	
	gpm	mgd	gpm	mgd	gpm	mgd
SF1	2,213	3.19	3,541	5.10	6,417	9.24
SF2	1,973	2.84	3,157	4.55	5,722	8.24
SF3	14	0.02	44	0.06	81	0.12
SF4-1	19	0.03	61	0.09	110	0.16
SF4-2	17	0.02	54	0.08	98	0.14
SF Subtotal	4,236	6.10	6,857	9.87	12,429	17.90
VW1	3,464	4.99	6,582	9.48	11,779	16.96
VW2	1,974	2.84	3,752	5.40	6,713	9.67
VW Subtotal	5,439	7.83	10,334	14.88	18,492	26.63
Total	**9,675**	**13.93**	**17,191**	**24.75**	**30,920**	**44.53**

(a) Based on existing (2019) demands, plus new demands from Opportunity Areas, Gateway Specific Plan, and Milpitas Metro Specific Plan (see Table 5-9 of this report).

(b) Maximum day demand is 1.6 times the average day demand for Zones SF1 and SF2, 3.2 times the average day demand for Zones SF3 and SF4, and 1.9 times the average day demand for the VW service area.

(c) Peak hour demand is 2.9 times the average day demand for Zones SF1 and SF2, 5.8 times the average day demand for Zones SF3 and SF4, and 3.4 times the average day demand for the VW service area.

9.2 POTABLE WATER FACILITIES FOR BUILDOUT ANALYSIS

At buildout, the City expects three groundwater wells to be available for emergency use only (i.e., at the time of this report, the wells are not planned or intended to operate normally): Pinewood Well, Curtis Well, and McCandless Well. Table 9-2 summarizes the location and capacity for each of these wells. The capacity for Pinewood Well is from the 2009 WMPU (Table 4-3), while the capacity for McCandless Well (currently under construction) is based on discussions with the design team and production testing, which was performed at the end of 2020. It was conservatively assumed that Curtis Well would have the same capacity as McCandless Well, however the Curtis Well capacity is subject to change. While Curtis Well is located within Zone SF1, it is adjacent to transmission mains for Zones SF1, SF2, and VW2. Given the projected large increase in demands in the VW service area (approximately 3,250 gpm in additional average day demand), it is assumed that Curtis Well would serve Zone VW2.

While the City does not currently anticipate any other major water system changes, **the following buildout analyses assume that the existing system infrastructure recommendations detailed in Sections 8.5.5 and 8.5.6 of this report have been implemented**. This includes pipeline improvements, two new EPRVs (Diel and Hammond), and the additional 4,000 gpm pump at Ayer. West Yost recommends that the City complete these existing system CIP projects to optimize system performance and operations as the City approaches buildout. Figure 9-1 shows the existing potable water system with these improvements, Curtis Well, and McCandless Well. On Figure 9-1, the new facilities are highlighted in red.

Diel EPRV
Ayer Fire Pump
Hammond EPRV
Curtis Well
McCandless Well
DIXON LANDING RD
PARK VICTORIA DR
CALAVERAS RD
JACKLIN RD
EDSEL DR
N MILPITAS BL
NABEL ST
E CALAVERAS BL
S MILPITAS BL
ABEL ST
GREAT MALL PKWY
GREAT MALL DR
MONTAGUE EX
TASMAN DR
YOSEMITE DR
S PARK VICTORIA DR
PIEDMONT RD
PS
880
680
237

Notes:
1. Buildout pipelines include new pipes and existing pipes upsized to address existing deficiencies.

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Fremont
84
680
880
Berryessa
Sunnyvale
101
Santa Clara
San Jose
Cupertino
280

N

0 1,500 3,000
Scale in Feet

Buildout Facilities
- Buildout Groundwater Well
- Buildout Emergency PRV
- Buildout Pipeline

Existing Facilities
- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

CITY OF MILPITAS CALIFORNIA

WEST YOST

Figure 9-1

Potable Water Facilities for Buildout Analysis

City of Milpitas
2020 Water Master Plan

Table 9-2. Emergency Groundwater Wells at Buildout

Well Facility	Location	Pressure Zone Served	Capacity	
			gpm	mgd
Pinewood Well[a,d]	227 Lonetree Court	SF1	1,181	1.70
Curtis Well[b,d]	330 East Curtis Avenue	VW2[e]	400	0.58
McCandless Well[c,d]	Near 1680 McCandless Drive	VW1	400	0.58

(a) Pinewood Well capacity per 2009 WMPU, Table 4-3.
(b) Curtis Well capacity is assumed to be equal to McCandless Well but is subject to change pending additional testing.
(c) McCandless Well capacity per discussions with design team in September 2020.
(d) Pinewood Well has a plug-in adapter and transfer switch to receive power from a portable generator. It is assumed Curtis Well and McCandless Well will also have these backup power features.
(e) While Curtis Well is located within Zone SF1, it is adjacent to transmission mains for Zones SF1, SF2, and VW2. Given the projected large increase in demands in the VW service area, it is assumed Curtis Well would serve Zone VW2.

9.3 BUILDOUT POTABLE WATER SUPPLY CAPACITY EVALUATION

As described in Section 7.2.2 of this report, the recommended water system performance criteria specify that under normal demand conditions, the following must be satisfied:

- Provide firm supply capacity equal to maximum day demand
- Meet peak hour demand from a combination of supply capacity and storage

Firm supply capacity is defined as the normal water supply with the largest turnout out of service, therefore, groundwater wells (which provide emergency supply) are excluded. In the SFPUC service area, the largest turnout is Calaveras, which has a capacity of 13.0 mgd. The VW service area has only the Gibraltar turnout, therefore, firm supply capacity is zero.

Table 9-3 summarizes the firm supply capacity evaluation for each service area at buildout. The SFPUC service area has a firm supply capacity surplus of approximately 13.9 mgd, while the VW service area has a firm supply capacity deficit of approximately 14.9 mgd. Since water can be moved from the City's SFPUC service area to the VW service area, the surplus in the SFPUC service area can offset most of the deficit in the VW service area. The resulting net deficit is approximately 1.0 mgd.

To address the firm supply capacity deficit and provide supply redundancy in the VW service area at buildout, West Yost recommends constructing a second VW turnout with a capacity of 10,000 gpm (or 14.4 mgd, equal to the Gibraltar turnout) (CIP ID BCIP-TO-01). This would increase the VW service area firm supply capacity to 14.4 mgd and change the City-wide firm supply deficit to a surplus of approximately 13.4 mgd. Without this new turnout, the City would fail to meet the firm supply capacity criterion described in Section 7.2.2 of this report.

Ideally, the second VW turnout would be adjacent to both VW's Milpitas Pipeline and existing City transmission mains. Locating the turnout is outside the scope of this report, though the City has identified one potential site: within a public service utility easement near the intersection of Piper Drive and Garden Street. The distribution system evaluation described in Section 9.6 below assumes this new "Piper" turnout is active, but other locations for a second VW turnout are possible.

By incrementally increasing existing demands, a firm supply capacity "trigger demand" can be identified. This is the demand at which existing supply facilities become insufficient, and any additional demand would require new supplies (i.e., turnouts or groundwater wells). Due to different peaking factors in each service area, the firm supply capacity trigger demand varies slightly depending on the location and timing of growth. Assuming the SFPUC service area would be fully built out prior to the VW service area, the firm supply capacity trigger demand is approximately 13.4 mgd. In the opposite scenario (i.e., VW service area built out before the SFPUC service area), the trigger demand decreases slightly to 13.3 mgd. Based on the linear demand growth projection summarized in Table 5-10 of this report, City demands will approach these levels around the year 2038. This trigger timing is similar for the Maddaus demand projections (Partial Rebound – Normal Economy, Weather Normalized) discussed in Section 5.3.4.2 of this report.

Table 9-3. Comparison of Available and Required Firm Supply Capacity at Buildout

Supply Source	Facility	Design Capacity	
		gpm	mgd
SFPUC	Sunnyhills Turnout	7,014	10.1
	Calaveras Turnout	9,028	13.0
	Main Street Turnout	5,486	7.90
	Intertie Turnout	4,000	5.76
	Total Supply Capacity[a]	**25,528**	**36.8**
	Firm Supply Capacity[b]	16,500	23.8
	Required Supply Capacity[c]	6,857	9.9
	Buildout Firm Supply Capacity Surplus (Deficit)	**9,643**	**13.9**
VW	Gibraltar Turnout	10,000	14.4
	Total Supply Capacity[a]	**10,000**	**14.4**
	Firm Supply Capacity[b]	0	0
	Required Supply Capacity[c]	10,334	14.9
	Buildout Firm Supply Capacity Surplus (Deficit)[d]	**(10,334)**	**(14.9)**

(a) Total supply capacity assumes all turnouts and wells are available for use.
(b) Firm supply capacity assumes largest turnout in each service area (Calaveras and Gibraltar) is offline.
(c) Required supply capacity is equal to the maximum day demand (see Table 9-1).
(d) Most of the VW service area supply capacity deficit can be met by SFPUC service area supply surplus. A deficit of 1.0 mgd remains if the SFPUC supply capacity surplus is considered.

For the second criterion listed above, Table 9-4 compares total supply plus storage to peak hour demands. Total supply equals the combined capacity from all turnouts, while storage consists of the firm pumping capacity from storage reservoirs. This includes the Ayer, Gibraltar (SF), and Gibraltar (VW) pump stations. To be conservative, firm pumping capacity is assumed (i.e., the largest pump is out of service at each pump station). Also, it is assumed the 4,000 gpm pump recommended in Section 8.5.6.1 of this report has been installed at Ayer.

As shown in Table 9-4, the SFPUC service area has a peak hour supply surplus of approximately 24,000 gpm and can even meet peak hour demands with supplies alone. In the VW service area, peak hour supplies exceed demands by approximately 9,000 gpm. Achieving this surplus in the VW service area requires utilizing the Gibraltar turnout and both sets of pumps at the Gibraltar (VW) pump station. In

other words, the City would need to operate valves within the Gibraltar (VW) pump station so the pumps that normally boost Gibraltar turnout pressures would instead draw from the Gibraltar (VW) reservoir.

Table 9-4. Comparison of Available and Required Peak Hour Supply at Buildout

Supply Source	Total Supply Capacity[(a)], gpm	Firm Pumping Capacity from Storage[(b)], gpm	Total Peak Hour Supply Capacity[(c)], gpm	Peak Hour Demand[(d)], gpm	Peak Hour Supply Surplus (Deficit), gpm
SFPUC	25,528	10,900	36,428	12,429	23,999
VW	10,000	13,500	23,500	18,492	5,008

(a) Equals the total capacity from turnouts. Refer to Table 9-3.
(b) Firm pumping capacity assumes the largest pump is offline at each pump station. Pump stations drawing from storage include Ayer, Gibraltar (SF), and Gibraltar (VW). It is assumed the 4,000 gpm pump recommended in Section 8.5.6.1 of this report has been installed at the Ayer pump station.
(c) Equals the sum of total supply capacity and firm pumping capacity from storage.
(d) Refer to Table 9-1.

9.4 BUILDOUT POTABLE WATER STORAGE CAPACITY EVALUATION

As described in Section 7.3.2 of this report, the required storage reservoir capacity in each pressure zone is the sum of the following components:

- Operational storage equal to 25 percent of maximum day demand
- Emergency storage equal to 50 percent of maximum day demand
- Fire storage equal to the largest fire flow demand in a pressure zone multiplied by the recommended duration

The total storage required is the sum of the operational, emergency, and fire storage requirements, less any groundwater credit, which can offset some of the emergency storage requirement.

The groundwater storage credit is calculated for each pressure zone and equals the volume of water pumped over a 24-hour period. The credit cannot exceed the recommended emergency storage volume (i.e., 50 percent of maximum day demand). To offset surface storage needs, groundwater must be of potable water quality, and wells must have backup power capabilities. In addition, the City must be able to meet average day demands without relying on groundwater (which it can).

For each pressure zone, Table 9-5 compares the City's buildout potable water storage capacity with storage requirements. Since Zones 1 and 2 are interconnected through multiple PRVs that operate under normal conditions (see Figure 3-1), they are combined in each service area (i.e., SF1/SF2 and VW1/VW2). As shown in Table 9-5, all three wells qualify for the emergency groundwater storage credit and contribute a storage capacity equivalent to their 24-hour pumping capacities. As a result, there is a 4.11 MG storage surplus in Zones SF1/SF2 and a deficit of 5.97 MG in Zones VW1/VW2. Since stored SFPUC water at Gibraltar can be delivered to VW customers, the surplus in Zones SF1/SF2 can reduce the VW service area shortfall, up to a maximum of 5 MG (the capacity of the Gibraltar (SF) storage reservoir). However, even after accounting for this offset (4.11 MG), there remains a net storage deficit in the VW service area of approximately 1.86 MG.

Table 9-5. Comparison of Available and Required Water Storage Capacity at Buildout

[A]	[B]	[C]	[D]	[E] = [C] + [D]	[F]	[G]	[H]	[I] = [F] + [G] + [H]	[J] = [E] - [I]
		Available Storage Capacity, MG			Required Storage Capacity, MG				
Facility	Status	Available Reservoir Capacity	Emergency Groundwater Storage Credit[a]	Total Available Storage	Required Operational[b]	Emergency[c]	Fire Flow[d]	Total Required Storage	Storage Surplus (Deficit), MG
Zones SF1 and SF2									
Gibraltar (SF)	Active	5.00	--	**12.30**	2.41	4.82	0.96	**8.19**	**4.11**
Ayer	Active	5.60	--						
Pinewood Well	Standby	--	1.70						
Zone SF3									
Tularcitos	Active	0.30	--	**0.30**	0.02	0.03	0.18	**0.23**	**0.07**
Zones SF4-1 and SF4-2									
Minnis	Active	0.34	--	**0.34**	0.04	0.08	0.18	**0.30**	**0.04**
Zones VW1 and VW2									
Gibraltar (VW)	Active	5.00	--	**6.15**	3.72	7.44	0.96	**12.12**	**(5.97)**
Curtis Well	Standby	--	0.58						
McCandless Well	Standby	--	0.58						

(a) Credit based on 24 hours of pumping capacity. The credit cannot exceed the required emergency storage capacity.

(b) Based on 25 percent of a maximum day demand (see Table 9-1).

(c) Based on 50 percent of a maximum day demand (see Table 9-1).

(d) Based on storage required for largest potential fire flow within the pressure zone. Zones SF1 and VW1/VW2 = Industrial; Zone SF2 = Commercial; Zones SF3 and SF4 = Single Family Residential.

As a result, West Yost recommends the City construct a new, 2 MG storage reservoir in the VW service area (CIP ID BCIP-S-01). While additional groundwater wells would also reduce the storage capacity deficit, lower than expected productivity at the McCandless Well suggests new storage reservoir(s) may be a more reliable investment. The City is currently evaluating potential locations for this new storage reservoir.

To deliver water stored in this new reservoir to the distribution system, West Yost recommends constructing a new pump station (CIP ID BCIP-PS-01) with a firm capacity of 4,000 gpm (approximately 5.8 mgd). This ensures that pumps can meet the largest (i.e., industrial) fire flows in the service area. Also, at this capacity pumps can empty the reservoir in approximately eight hours.

By incrementally increasing existing demands, a storage capacity "trigger demand" can be identified. This is the demand at which existing storage facilities (Gibraltar and Ayer Reservoirs plus Pinewood Well) become insufficient, and any additional demand would require new storage (i.e., reservoirs or groundwater wells). Due to different peaking factors in each service area, the storage capacity trigger demand varies slightly depending on the location and timing of growth. Assuming the SFPUC service area would be fully built out prior to the VW service area, the storage capacity trigger demand is approximately 11.8 mgd. In the opposite scenario (i.e., VW service area built out before the SFPUC service area), the trigger demand decreases slightly to 11.7 mgd. Based on the linear demand growth projection summarized in Table 5-10 of this report, City demands will approach these levels around the year 2032.

This trigger timing is significantly sooner based on the Maddaus demand projections (Partial Rebound – Normal Economy, Weather Normalized) discussed in Section 5.3.4.2 of this report. Because Maddaus projects more demand to be added by 2025 (and more gradual growth from 2025 through 2045), City demands will reach storage trigger levels by around 2024, about eight years sooner than the linear growth projection.

Note, storage and timing requirements may change as actual potable water demands adjust to conservation efforts, efficiency standards, and expanded recycled water use. In addition, if Curtis Well production exceeds expectations, the increased groundwater storage credit would also reduce the overall storage capacity deficit. The City should monitor demands and groundwater well feasibility as it continues to grow and approaches buildout.

9.5 BUILDOUT PUMPING CAPACITY EVALUATION

As described in Section 7.3.3 of this report, the City should have firm pumping capacity equal to MDD. For a given pump station, firm capacity is defined as the total capacity of all operational pumps minus the capacity of the largest pumping unit. In addition, pumping capacity in lower pressure zones should also be able to deliver the maximum day demand of any zones above them. For example, the Zone SF3 pumps should be able to deliver the maximum day demand for Zones SF3 and SF4 (i.e., SF4-1 and SF4-2).

For each pressure zone, Table 9-6 compares the available and required pumping capacities at buildout. In Zones SF1 and SF2, firm pumping capacity consists of one 5,500 gpm pump at Gibraltar (SF) and three 1,800 gpm pumps at Ayer. It is assumed the 4,000-gpm pump recommended in Section 8.5.6.1 of this report has been installed at Ayer, so firm capacity assumes that pump is offline. As a result, the combined firm pumping capacity in Zones SF1 and SF2 is 10,900 gpm, which exceeds the required firm pumping capacity (i.e., the buildout MDD of the entire SFPUC service area). The pumping capacity surplus in Zones SF1 and SF2 is approximately 4,040 gpm.

Table 9-6. Comparison of Available and Required Firm Pumping Capacity at Buildout

Pump Station	Critical Facility[a]	On-site Backup Power	Status	Firm Capacity[b], gpm	Total Firm Pumping Capacity, gpm	Buildout Maximum Day Demand[c], gpm	Pumping Capacity Surplus (Deficit), gpm
Zones SF1 and SF2							
Gibraltar (SF)		✓	Active	5,500	10,900	6,857	4,043
Ayer[d]		✓	Active	5,400			
Zone SF3							
Country Club			Active	250	250	159	91
Zones SF4-1 and SF4-2							
Tularcitos			Active	250	250	115	135
Zones VW1 and VW2							
Gibraltar (VW) - from tank	✓	✓	Active	5,500	13,500	10,334	3,166
Gibraltar (VW) - from turnout[e]	✓	✓	Active	8,000			

(a) Pump stations are considered critical if they serve a pressure zone with insufficient storage and meet other criteria. Refer to Table 7-1.

(b) Firm pumping capacity was defined as the total pump station capacity with the largest pump out of service.

(c) Includes maximum day demands for higher pressure zones, per Table 7-1.

(d) It is assumed the 4,000 gpm fire pump recommended in Section 8.5.6.1 has been installed at the Ayer pump staiton.

(e) These pumps are intended to boost pressures from the VW turnout but can be valved to draw from the Gibraltar (VW) tank.

No changes are anticipated at either the Country Club or Tularcitos pump stations, therefore, firm pumping capacities in Zones SF3 and SF4 remain at 250 gpm each. This comfortably exceeds buildout pumping requirements. Firm pumping capacity surpluses in Zones SF3 and SF4 are 91 and 135 gpm, respectively.

Both sets of pumps at the Gibraltar (VW) PS are included in the pumping capacity evaluation for the VW service area. One set draws from the Gibraltar (VW) storage reservoir, while the other set boosts pressures from the Gibraltar turnout (if necessary). By adjusting valve operations, the "turnout" pumps can also draw from the Gibraltar (VW) storage reservoir. The combined firm capacity for both sets of pumps is 13,500 gpm, which exceeds the VW service area buildout MDD (10,334 gpm) by approximately 3,170 gpm.

9.6 BUILDOUT WATER DISTRIBUTION SYSTEM EVALUATION

West Yost used the updated hydraulic model to conduct steady-state hydraulic analyses of the buildout water distribution system. The goal of this evaluation was to identify necessary improvements to support the City's buildout water demands while meeting the recommended system performance criteria presented in Sections 7.2.1 and 7.2.3 of this report.

This evaluation assumes infrastructure recommendations detailed in Sections 8.5.5 and 8.5.6 of this report have been implemented and that the new VW Piper turnout introduced in Section 9.3 is active. The new VW Piper turnout is assumed to be a 20-inch diameter connection and include a PRV that will evenly distribute VW flows between the Piper and Gibraltar turnouts.

In evaluating the buildout system, pressure criteria are prioritized over velocity criteria. This prioritization is typical, because older water systems tend to have many undersized pipes, and strictly adhering to velocity standards would identify those pipes as candidates for replacement, even though pressures meet recommended criteria. West Yost does not recommend replacing existing pipes solely for failing to meet velocity criteria. While velocity results will be summarized for non-emergency scenarios, the following analyses focus on pressures and fire flow availability.

The following evaluations are intended to identify distribution facility sizing and capacity requirements at buildout. As a result, they examine system performance under high demand scenarios only (i.e., Peak Hour Demand and Maximum Day Demand plus Fire Flow).

- **Peak Hour Demand Scenario**: evaluates the potential for low customer service pressures in the system during a peak hour demand condition
- **Maximum Day Demand plus Fire Flow Scenario**: evaluates fire flow availability in the system under a maximum day demand condition
- **Emergency Operations** (each scenario is evaluated under maximum day demand plus fire flow):
  - Outage Scenario 1: SFPUC turnouts are offline
  - Outage Scenario 2: VW turnouts are offline
  - Outage Scenario 3: SFPUC and VW turnouts are offline
  - Outage Scenario 4: Power outage; all facilities without backup generators are offline
  - Outage Scenario 5: PRVs normally allowing flow between Zones 1 and 2 are offline

To capture the entire range of normal water system operations, each non-emergency scenario above was evaluated using the two operational alternatives summarized in Table 8-5 of this report. In the Base alternative, all pumps are off, whereas Alternative 1 allows pump operation as needed. For both alternatives, all turnouts are open, and gravity tank levels are at their minimum of normal operating range.

9.6.1 Peak Hour Demand Analysis

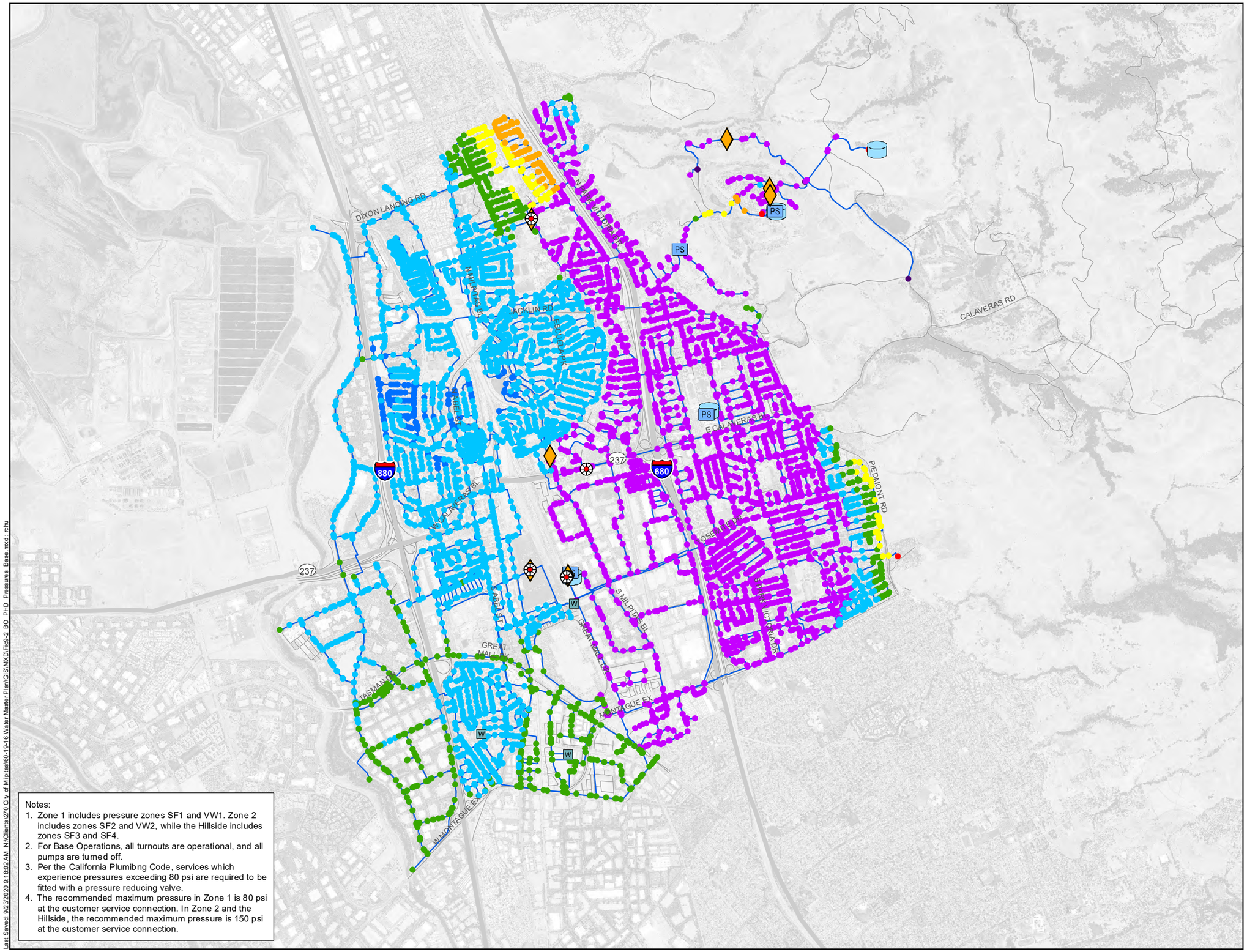
The hydraulic model was used to conduct a steady-state hydraulic analysis of the system during a buildout PHD condition. As shown in Table 9-1, the PHD for the buildout water service area is approximately 30,776 gpm (44.3 mgd). Under PHD conditions, the recommended minimum pressure is 30 psi. Any services experiencing pressures less than 30 psi during a PHD condition would require an individual booster pump.

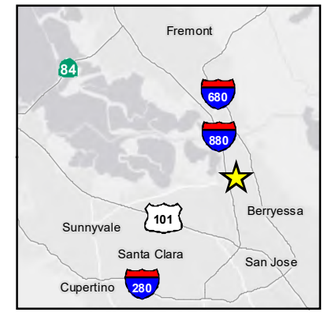
Results from the PHD simulations for Base and Alternative 1 operations are shown in Figure 9-2 and Figure 9-3, respectively. In each figure, color-coded circles represent distribution system pressures during a PHD condition. Pressures are slightly higher for Alternative 1 (pumps on), but there are no significant differences in system performance based on operations. In both cases, there are no customer service locations with pressures below 30 psi.

Per Table 7-1 of this report, under normal conditions the maximum recommended velocities for transmission and distribution mains is 6 and 8 ft/s, respectively. Transmission mains are pipelines 16 inches or larger in diameter, while distribution mains are pipelines smaller than 16 inches in diameter. Under PHD conditions, pipeline velocities exceed recommended limits near supply sources (i.e., turnouts and pump stations) and PRVs.

In the SFPUC service area, high velocity pipelines include those adjacent to the Sunnyhills PRV (over 24 ft/s in both Base and Alternative 1 operations) and downstream of the Sunnyhills, Main, and Calaveras turnouts (between approximately 9 and 11 ft/s under Base operations). When pumps are on (Alternative 1), turnout flows are lower. As a result, during Alternative 1 operations, pipeline velocities near the Sunnyhills, Main, and Calaveras turnouts are below the recommended limit.

In the VW service area, high velocity pipelines are located at and adjacent to the Gibraltar facility and PRVs. This includes the transmission main along Curtis Avenue and Yosemite Drive (between South Abel Street and South Milpitas Boulevard). Transmission mains in this area and downstream of the Gibraltar facility have velocities between 7 and 17 ft/s during Base operations (pumps off) and between 7 and 12 ft/s during Alternative 1 operations (pumps on). Pipeline velocities near PRVs are the same for Base and Alternative 1 operations. The pipelines adjacent to the Curtis East and Parc Metro PRVs have velocities of 7.1 and 8.4 ft/s, respectively, during a PHD condition. Velocities in the pipelines near the Capitol PRV are approximately 10.7 ft/s.





N

0 1,500 3,000

Scale in Feet

Peak Hour Pressure

- Less than 30 psi
- 30 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

Figure 9-2

Buildout System Pressures
Peak Hour Demand
Base Operations

City of Milpitas
2020 Water Master Plan

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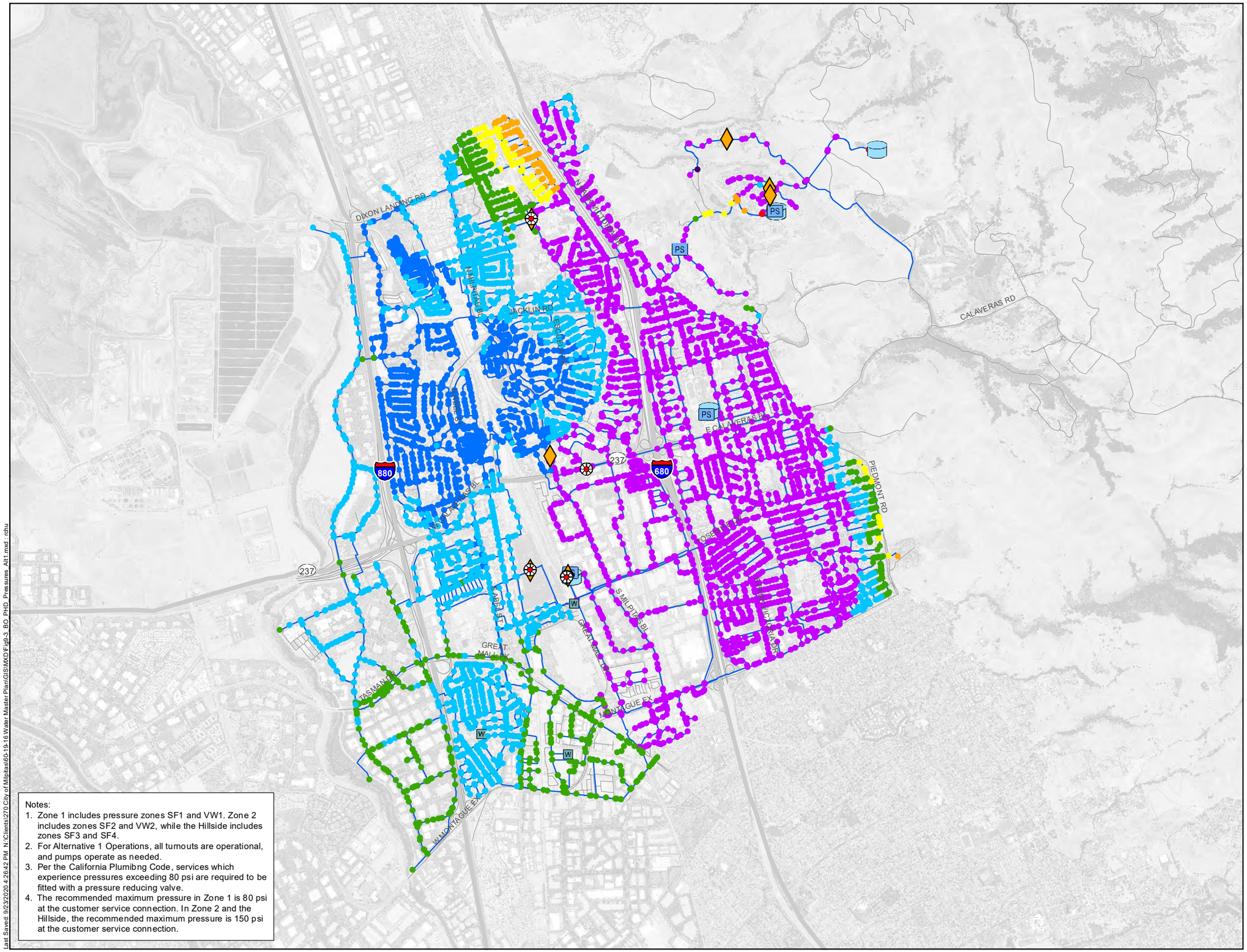

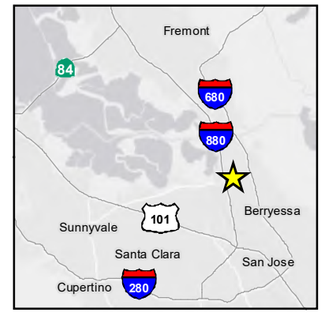

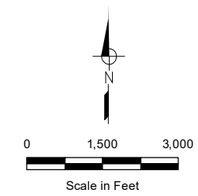

Peak Hour Pressure

- Less than 30 psi
- 30 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Alternative 1 Operations, all turnouts are operational, and pumps operate as needed.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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Figure 9-3

Buildout System Pressures
Peak Hour Demand
Alternative 1 Operations

City of Milpitas
2020 Water Master Plan

9.6.2 Maximum Day Demand Plus Concurrent Fire Flow Analysis

Fire flows in the model were updated based on buildout land uses in growth areas and the Gateway Specific Plan and Milpitas Metro Specific Plan areas. Outside of these areas, fire flows remain as originally assigned in Section 8.5.5 of this report. Fire flows were then simulated during a buildout MDD condition using the hydraulic model. The hydraulic model conducts fire flow analyses by simulating a fire flow demand at one hydrant location and verifying whether the system can serve all other normal customer demands while maintaining desired residual pressures. This is repeated for all hydrant locations within the distribution system. Hydrant locations meet recommended fire flows if they can deliver the recommended fire flow while maintaining a 20-psi residual system pressure. Note, this fire flow analysis reflects distribution system capacity, as individual hydrants, and their associated losses are not modeled.

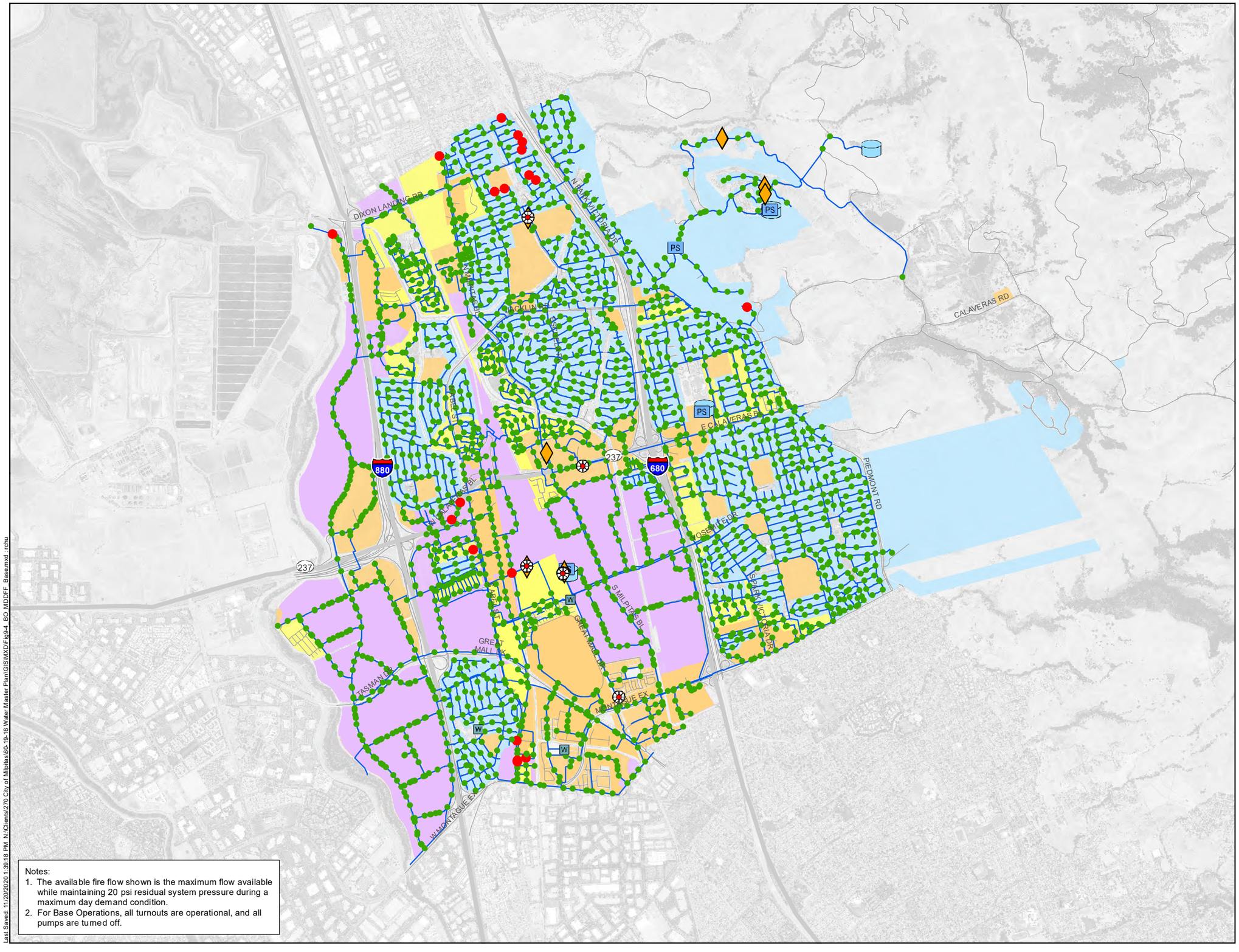
Fire flow analyses were performed independently for each pressure zone, with Zones 1 and 2 combined for each service area (i.e., VW1/VW2 and SF1/SF2). It was assumed that only one fire event would occur at a time, which is standard industry practice. Results from MDD plus concurrent fire flow simulations for Base and Alternative 1 operations are shown on Figure 9-4 and Figure 9-5, respectively. Hydrant locations are represented by circles and color coded by fire flow availability, while parcels are shaded according to the recommended fire flow. For example, a green circle adjacent to a purple parcel means that the distribution system can meet a 4,000 gpm fire flow at that location while maintaining 20 psi in the rest of the system.

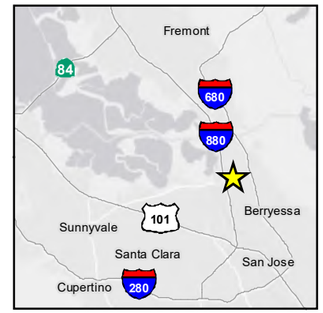
System performance is similar for the two operational alternatives. With pumps off (Base alternative), 19 locations do not meet recommended fire flows, while 15 locations are below the fire flow criterion under Alternative 1. All “below criterion” locations in Alternative 1 are also flagged in the Base alternative, therefore, pump operation improves fire flow availability for four locations. Since pumps could be off during a fire event, recommended improvements address all 19 below criterion locations identified in the Base alternative.

As discussed in Section 8.5.5 of this report, some below criterion fire flows can be eliminated by delivering the recommended flow through multiple hydrants. It was assumed that any location with another hydrant within the City’s hydrant spacing guidelines (500 feet for single family areas and 300 feet for all other areas) would qualify for delivering fire flows through multiple hydrants. If the qualifying hydrants could combine to deliver the recommended fire flow while maintaining a 20 psi residual system pressure, then the location was no longer considered below criterion. Of the 19 below criterion locations identified in the Base alternative, 16 met recommended fire flows after looking at multiple hydrants.

The three remaining below criterion locations are all at the southern end of Zone VW1, near South Main Street. To address these locations, West Yost recommends installing a new EPRV between Zones SF1 and VW1 near the intersection of Cedar Way and South Main Street (CIP ID BCIP-V-01). This emergency 8-inch connection would replace a normally closed isolation valve and allow flow from Zone SF1 if pressures in Zone VW1 fall 5 psi below PHD pressures. In addition to improving fire flows under normal operations, this “Cedar” EPRV also provides redundancy for a Capitol PRV outage (detailed below in Section 9.6.3.5).

The proposed Cedar EPRV location is based on the MDD plus concurrent fire flow hydraulic analysis described in this section and the existing connection between Zones SF1 and VW1 at the intersection of Cedar Way and South Main Street. Additional study is required to determine whether this location is feasible or if other locations would also solve the below criterion locations in this area.





N

0 1,500 3,000

Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.

Figure 9-4

Buildout System Available Fire Flow Base Operations

City of Milpitas
2020 Water Master Plan

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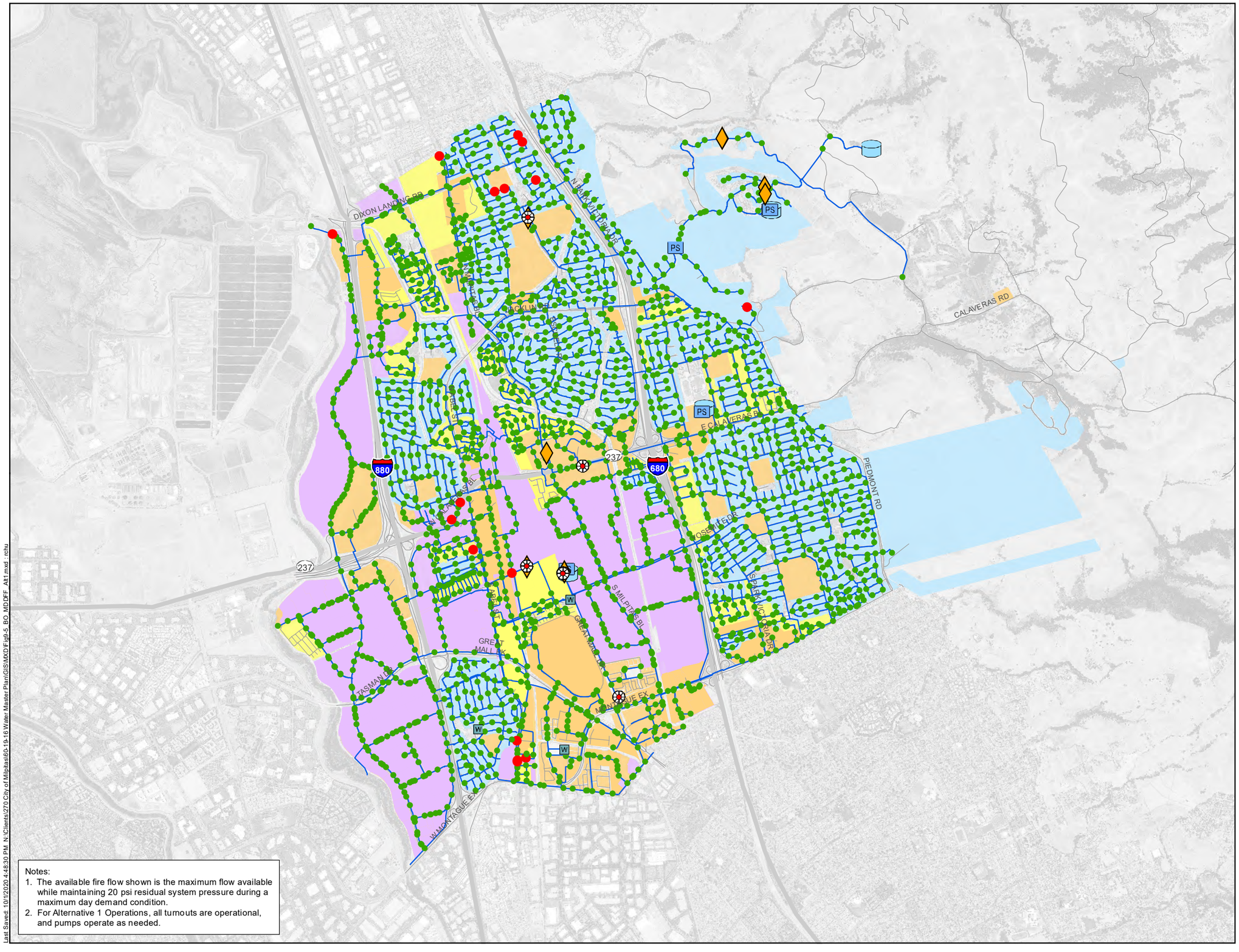

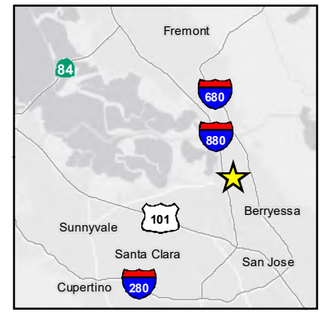

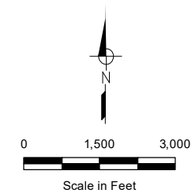

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. For Alternative 1 Operations, all turnouts are operational, and pumps operate as needed.

Figure 9-5

Buildout System Available Fire Flow Alternative 1 Operations

City of Milpitas
2020 Water Master Plan

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9.6.3 Emergency Outage Scenarios

The following emergency outage evaluations identify how well the distribution system functions without one or more key facilities. For reference, the outage scenarios consist of:

- SFPUC turnouts are offline
- VW turnouts are offline
- SFPUC and VW turnouts are offline
- Power outage; all facilities without backup generators are offline
- PRVs normally allowing flow between Zones 1 and 2 are offline

Emergency outage scenarios are not intended to evaluate the adequacy of emergency water supplies, which is outside the scope of this master plan. Instead, these evaluations examine system pressures and fire flow availability during an MDD condition. To be conservative, storage reservoir levels are assumed to be at the minimum of normal operating range (see Table 3-4).

Since emergency scenarios assume certain facilities are offline, the corresponding evaluations do not examine system performance under Base and Alternative 1 operations. Besides the assumed outage, there are no additional operational restrictions. All facilities not assumed offline as part of the scenario are assumed to be operational.

Results for each emergency outage scenario are summarized below. Where presented, figures showing system performance during emergency outages are similar to non-emergency figures discussed above. Distribution system locations are color coded by fire flow availability (for fire flow evaluations).

9.6.3.1 Outage Scenario 1 – SFPUC Offline

This outage scenario assumes supply from SFPUC is unavailable, therefore, the Sunnyhills, Calaveras, Main Street, and Intertie turnouts are offline. As a result, the City's normally available potable water supply consists of VW (i.e., the Gibraltar and Piper turnouts) and storage.

After implementing the distribution system improvements summarized in Section 8.6 of this report, fire flow availability is not significantly impacted with SFPUC turnouts offline. There are no new below criterion locations in this outage scenario. In other words, the pumps at Gibraltar and Ayer alone can adequately serve fire flows in the SFPUC service area during an MDD condition. Thus, West Yost does not recommend any improvements based on Outage Scenario 1.

9.6.3.2 Outage Scenario 2 – VW Offline

This outage scenario assumes supply from VW is unavailable, therefore, the Gibraltar and Piper turnouts are offline. As a result, the City's normally available potable water supply consists of SFPUC turnouts and storage.

Fire flow availability is not significantly impacted with VW turnouts offline. There are no additional below criterion locations in this outage scenario, though adequately serving fire flows during an MDD condition required adjusting pump operation. In addition to the two pumps that normally draw from the Gibraltar (VW) storage reservoir, one 5,000-gpm pump that normally boosts turnout pressures was also drawing

from the same reservoir. Since this operational flexibility already exists at the Gibraltar facility, West Yost does not recommend any improvements based on Outage Scenario 2.

9.6.3.3 Outage Scenario 3 – SFPUC and VW Offline

This outage scenario assumes supplies from both SFPUC and VW are unavailable, therefore, all turnouts are offline. As a result, the City's normally available potable water supply consists of storage only (i.e., Gibraltar (SF), Gibraltar (VW), Ayer, Tularcitos, and Minnis reservoirs).

Since neither the SFPUC nor the VW outages significantly impacted fire flow availability, the same is true for the simultaneous outage of both supplies. During an MDD condition, the Gibraltar (SF) and Ayer pumps can adequately serve fire flows in Zones SF1/SF2. In the VW service area, the same three pumps as Outage Scenario 2 are necessary to serve fire flows: two pumps that normally draw from the Gibraltar (VW) storage reservoir and one 5,000-gpm pump that normally boosts turnout pressures. There are no new below criterion locations in Outage Scenario 3. Thus, West Yost does not recommend any improvements based on Outage Scenario 3.

9.6.3.4 Outage Scenario 4 – Power Outage

This outage scenario assumes electrical power is unavailable, therefore, any facilities without backup generators are offline. While this does not impact the City's normally available potable water supply, distribution system operations are hindered. Because the Country Club and Tularcitos pump stations only have plug-in adaptors and transfer switches to allow for use of portable generators, and do not have on-site emergency generators, they are assumed to be unavailable in a power outage. However, the Tularcitos and Minnis storage reservoirs can still serve Zones SF3 and SF4, respectively, during a power outage.

A power outage does not significantly impact fire flow availability. There are no new below criterion locations associated with this outage scenario, which makes sense, as the impact of a power outage is similar to Base operations (pumps off). As a result, no improvements are necessary from Outage Scenario 4.

9.6.3.5 Outage Scenario 5 – Zone 1/2 PRVs Offline

Outage Scenario 5 assumes a PRV normally allowing flow between Zones 1 and 2 is offline. These "Zone 1/2" PRVs include Main, North Milpitas, and Sunnyhills in the SFPUC service area and Capitol, Curtis East, Curtis West, and Parc Metro in the VW service area. System performance is evaluated with one PRV closed at a time. It is assumed EPRVs are available as needed.

Impacts to fire flow availability vary depending on which PRV is offline. At buildout, the Capitol PRV is most critical. Should the Capitol PRV go offline, 17 additional locations do not meet recommended fire flows. Activating EPRVs and the McCandless Well allows 14 locations to meet recommended fire flows. The remaining three are solved via the proposed Cedar EPRV. While Sunnyhills, Curtis East, and Parc Metro PRV outages also create new below criterion locations, all can be solved by EPRVs (Diel, McCarthy, and Hammond). Outages of the Main, North Milpitas, and Curtis West PRVs did not result in any new below criterion locations.

9.7 SUMMARY OF FINDINGS AND RECOMMENDED IMPROVEMENTS

Below is a summary of findings and recommendations from the evaluations detailed in this chapter. Key recommendations for the buildout system were used to develop a CIP, which is the focus of Chapter 11 of this report.

- Supply Capacity
  - Buildout firm supplies fall short of maximum day demands. The firm supply surplus in the SFPUC service area cannot make up for the deficit in the VW service area. Thus, West Yost recommends constructing a new VW turnout near the intersection of Piper Drive and Garden Street with the same capacity as the Gibraltar turnout.
- Storage Capacity
  - Buildout storage capacity is insufficient. The storage capacity surplus in the SFPUC service area cannot make up for the deficit in the VW service area. West Yost recommends constructing a new, 2 MG storage reservoir in the VW service area.
  - To deliver water from this new storage reservoir, West Yost recommends constructing a new pump station with a firm capacity of 4,000 gpm.
- Pumping Capacity
  - Each pressure zone has a pumping capacity surplus. No additional pumping facilities are recommended based on buildout demands.
- Distribution System
  - The buildout distribution system meets the minimum pressure criterion under a PHD condition.
  - To address locations not meeting recommended fire flows in Base operation and PRV outage scenarios, West Yost recommends installing a new EPRV near the intersection of Cedar Way and South Main Street. The Cedar EPRV would allow flows from Zone SF1 to Zone VW1 should pressures in Zone VW1 drop significantly.

CHAPTER 10
Asset Renewal and Replacement

This chapter presents a summary of the Water Utility Condition Assessment Technical Memorandum prepared in conjunction with this Water Master Plan, provides a discussion of risk management guidelines and asset profiling, and recommends projects and activities to manage infrastructure risk. Recommended projects are incorporated in a recommended CIP described in Chapter 11 of this report.

A summary of the Seismic Risk Assessment of the City's water system facilities, conducted in parallel to this Water Master Plan as part of the compliance with the America's Water Infrastructure Act of 2018, is also provided in this chapter.

10.1 SUMMARY OF WATER UTILITY CONDITION ASSESSMENT FINDINGS

The Water Utility Condition Assessment Technical Memorandum, included in Appendix D, summarizes the condition assessment that was performed for the City's water utility assets under Task 3 – Water Utility Asset Condition Assessment of this Water Master Plan. That technical memorandum presents assessment methodologies, asset valuations, likelihood and consequence of failure factors, and business risk scores for assets in the City's water distribution system.

The analysis focused on asset and facility risk. Risk is a combination of an asset's likelihood to fail and an asset's consequence if it should fail as shown below.

- Likelihood of Failure (LOF), which estimates the probability that a failure will occur in an asset by meeting the end of its physical, design, service, or economic useful life
- Consequence of Failure (COF), which estimates the impacts of asset failure expressed either qualitatively or quantitatively, being a loss, injury, or disadvantage from a social, economic, environmental, or regulatory standpoint
- Risk is estimated using the conventional risk equation: *Risk = LOF x COF*

Risk was defined on a scale from Low to High based on COF ratings of Negligible to Severe and LOF ratings of Unlikely to Very Likely. Table 10-1 presents the adopted risk matrix.

Table 10-1. Risk Methodology

			LOF Rating			
			1 Unlikely	2 Possible	3 Likely	4 Very Likely
COF Rating and Definition	1 Negligible	No fiscal/operational impact	Low	Low	Low	Low
	2 Minimal	Slight pressure loss, minor public response, possible slight injury, minor detours	Low	Low	Medium	Med-High
	3 Moderate	Water service interrupted over local area, increased media coverage, increased injury potential, public transit impacted, restoration up to one-month impact	Medium	Medium	Med-High	High
	4 Severe	Water service interrupted over wide area including fire capacity, potential local media coverage, potential consent order, transit impacts to BART or other outside agencies, long-term economic impact, greater than one-month restoration	Medium	Med-High	High	High

Assets were classified by type and evaluated for LOF and COF to determine a risk rating. Water Meter, Line Valve and Fire Hydrant assets were evaluated as individual assets. Other individual asset assessments were aggregated into PRVs, Wells, Turnouts, Interties, Reservoirs, Pipelines and Pump Stations. Table 10-2 presents a summary of risk by these asset groupings. Some asset groups are represented in more than one risk level since individual assets or facilities are currently at different risk levels.

Table 10-2. Water System Risk Level

		LOF			
		1 Unlikely	2 Possible	3 Likely	4 Very Likely
COF	1 Negligible	Hydrants Valves Pipelines	Hydrants Valves Meters Pipelines	Hydrants Meters Pipelines	Meters Pipelines
	2 Minimal	Hydrants Valves Pipelines	Hydrants Valves PRVs Intertie Meters Pipelines	Hydrants Valves Well Reservoir PRVs Intertie Meters Pipelines	Meters Pipelines
	3 Moderate	Hydrants Valves Pipelines	Hydrants Valves PRVs Intertie Reservoirs Pipelines	Hydrants Valves PRVs Turnouts Reservoirs Pump Stations Pipelines	Pump Stations Pipelines
	4 Severe	Pipelines	Pipelines	Pipelines	Pipelines

10.2 RISK MANAGEMENT GUIDELINES AND ASSET PROFILING

Risk management applied to utility planning and management leverages the assessment of LOF and COF into asset life-cycle decision-making. The combination of LOF and COF together provides a risk rating for assets and facilities. Risk Triggers are defined in this section.

10.2.1 Risk Threshold Triggers

Leveraging risk management involves more than just applying a decision point based on a current condition or risk rating to prioritize a project. Risk management affords the utility manager knowledge of the system to optimize maintenance, plan condition assessment activities, anticipate fiscal expenditures and prioritize refurbishment and replacement. Establishing risk threshold triggers is a valuable tool to anticipate when to modify current practices.

10.2.1.1 Risk Threshold Triggers

Risk threshold triggers can be set at many levels and for many responses; however, it is best to keep them simple and few to avoid complicating maintenance and asset management practices. To keep the analysis simple as the City begins developing its risk management efforts, triggers have been set as follows:

- Level A - Watch
- Level B - Investigate
- Level C - Act

10.2.1.1.1 Level A - Watch

This initial action level represents the point an asset or facility depicts aging or performance that requires increased attention, health checks or predictive maintenance efforts. Vertical assets such as mechanical and electrical equipment and structures warrant this attention and effort based on visual observations, age and runtime. Due to limited access associated with distribution systems, pipeline assets may pass through this level without action.

A typical action associated with this trigger includes maintenance modifications which may be indicated when the likelihood of failure reaches a level where predictive maintenance may be implemented or additional maintenance efforts may benefit the asset. Predictive maintenance is typically a data collection effort that informs the maintenance manager of potential faults or failures that may be remedied prior to an asset component failure.

10.2.1.1.2 Level B - Investigate

This secondary action level is consistent with condition assessment activities. Once an asset or facility reaches this level, a focused condition assessment may be planned to evaluate where the asset is on its useful life curve and identify potential operational or maintenance activities that may support extending its life. Condition assessment also provides the utility manager with valuable forecasting data for fiscal planning. Water distribution pipelines typically fit this profile based on age, combined with failure history and local conditions, such as aggressive soils and pipe type. Vertical assets fit this profile based on age, performance and predictive maintenance data collection.

A typical action associated with this trigger includes condition assessment activities which may be indicated when the risk rating of an asset or a facility reaches a level that advanced planning should be performed to identify its point on the useful life curve. Identifying this point supports advanced planning for rehabilitation and replacement as well as modifications to asset condition monitoring. Preventative maintenance efforts can support condition assessment.

10.2.1.1.3 Level C - Act

The third action level is the beginning of renewal activities. This may be as long-term as placement on a mid-range capital improvement plan or as immediate as design development and construction.

Rehabilitation and replacement (R&R) are indicated when the asset or facility risk does not support its intended level of service and, as such, requires some form of renewal. Rehabilitation and replacement must be planned sufficiently ahead of time to complete the activity prior to failure.

10.2.1.1.4 Risk Threshold Trigger Setpoints

Triggers were applied to the risk threshold matrix to identify trigger levels that will support long-term risk management of the water utility infrastructure. These triggers were also used to develop and prioritize recommendations to improve the water system. Table 10-3 presents the risk threshold triggers (Level A, Level B and Level C) as defined above.

Table 10-3. Risk Threshold Triggers

			LOF Rating			
			1 Unlikely	2 Possible	3 Likely	4 Very Likely
COF Rating and Definition	1 Negligible	No fiscal/operational impact	No Action	No Action	No Action	Level C
	2 Minimal	Slight pressure loss, minor public response, possible slight injury, minor detours	No Action	Level A	Level B	Level C
	3 Moderate	Water service interrupted over local area, increased media coverage, increased injury potential, public transit impacted, restoration up to one-month impact	No Action	Level B	Level C	Level C
	4 Severe	Water service interrupted over wide area including fire capacity, potential local media coverage, potential consent order, transit impacts to BART or other outside agencies, long-term economic impact, greater than one-month restoration	Level A	Level C	Level C	Level C

10.2.2 High Risk Assets Profiling

Risk Threshold Triggers were applied to asset risk ratings developed in the Water Utility Condition Assessment Technical Memorandum (see Appendix D).

10.2.2.1 Facilities

A summary of facilities and their risk threshold triggers are presented in Table 10-4 and Table 10-5. As noted earlier, some asset groups are represented in more than one risk level since individual assets or facilities are currently at different risk levels.

Table 10-4. Risk Threshold Triggers of Facilities by LOF and COF

		LOF Rating			
		1 Unlikely	2 Possible	3 Likely	4 Very Likely
COF	1 Negligible	Hydrants Valves Pipelines	Hydrants Valves Meters Pipelines	Hydrants Meters Pipelines	Meters Pipelines
	2 Minimal	Hydrants Valves Pipelines	Hydrants Valves PRVs Intertie Meters Pipelines	Hydrants Valves Well Reservoir PRVs Intertie Meters Pipelines	Meters Pipelines
	3 Moderate	Hydrants Valves Pipelines	Hydrants Valves PRVs Intertie Reservoirs Pipelines	Hydrants Valves PRVs Turnouts Reservoirs Pump Stations Pipelines	Pump Stations Pipelines
	4 Severe	Pipelines	Pipelines	Pipelines	Pipelines

Table 10-5. Facilities by Risk Threshold Trigger

Facility	Risk Threshold Trigger
Calera Creek Heights PRV	Level A - Watch
Main PRV	
Sunnyhills PRV	
SJW Intertie	
Curtis Well	Level B - Investigate
Live Oak PRV	
Tularcitos North Vault PRV	
Tularcitos South Vault PRV	
North Milpitas PRV	
Capitol PRV	
Junipero PRV	
Gibraltar PRV	
McCarthy PRV	
Yosemite PRV	
Minnis Reservoir	
Gibraltar (VW) Reservoir	
Gibraltar (SF) Reservoir	
ACWD Intertie	
SCVWD Intertie	
Curtis PRV	Level C - Act
Montague PRV	
Main Turnout	
Calaveras Turnout	
Sunnyhills Turnout	
Gibraltar Turnout	
Tularcitos Reservoir	
Ayer Reservoir	
Pinewood Well	
Country Club Pump Station	
Tularcitos Pump Station	
Gibraltar Pump Station	
Ayer Pump Station	

10.2.2.2 Horizontal Assets

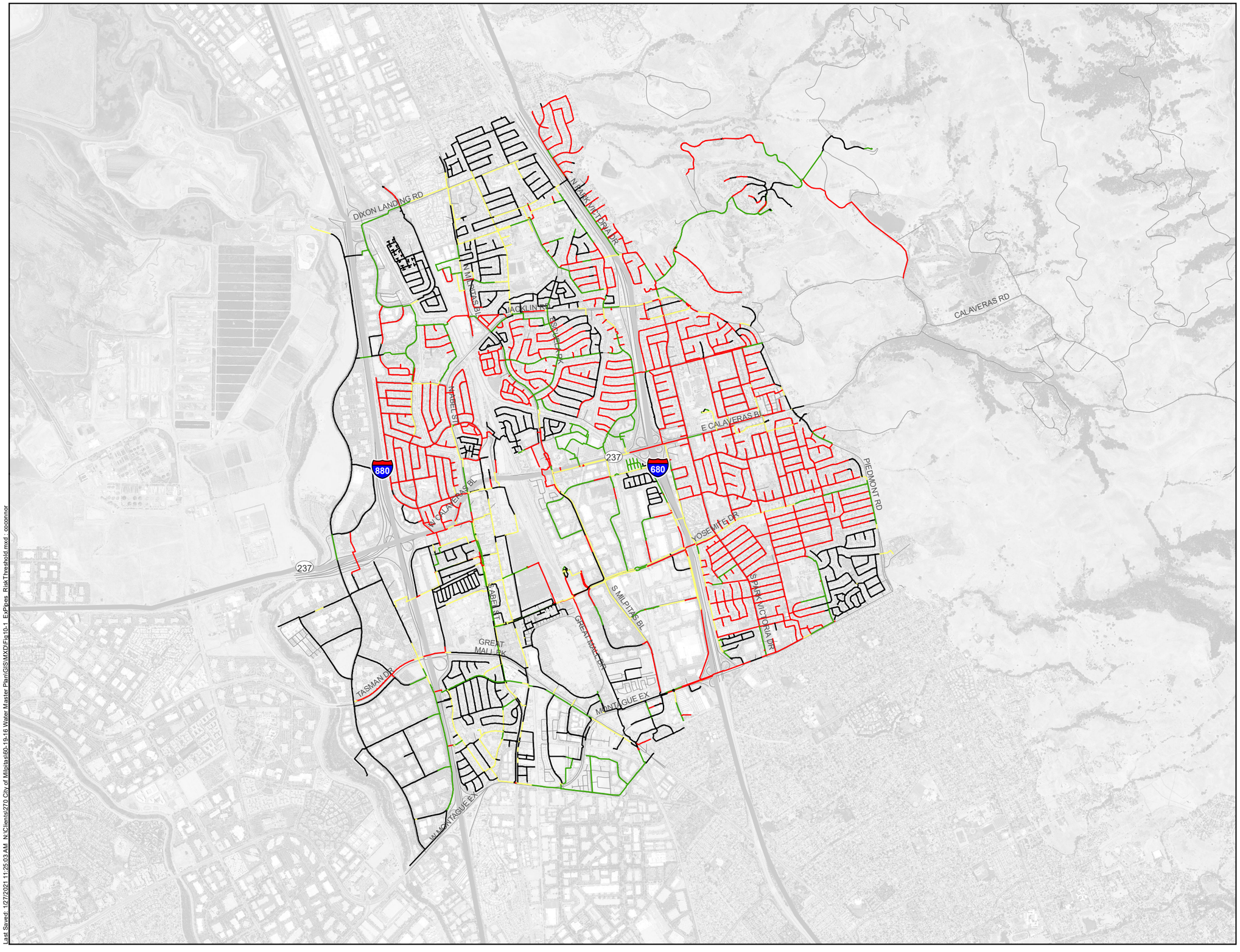
There are numerous other assets, not associated with facilities, that are associated with pipeline or horizontal assets. These include pipelines, fire hydrants, valves and water meters. Table 10-6 presents a summary of pipeline assets in each classification with their corresponding risk threshold level. Table 10-7 presents a summary count of non-pipeline assets by classification. Pipelines represented in Table 10-6 and Table 10-7 are shown on Figure 10-1. A full listing of each asset is included in the Water Utility Condition Assessment Technical Memorandum (see Appendix D).

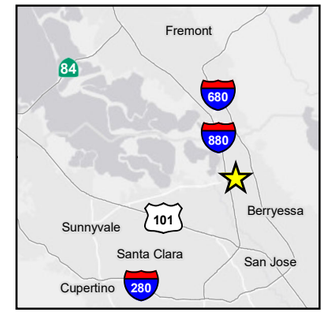
Table 10-6. Asset Count (Miles) of Risk Threshold Trigger by Asset Classification (April 2020 GIS)

Pipe Diameter	Risk Threshold Trigger		
	Level A	Level B	Level C
Pipeline, Miles			
4-inch	0.0	0.0	0.2
6-inch	0.5	0.9	3.2
8-inch	0.5	3.2	7.4
10-inch	0.4	2.9	11.8
12-inch	18.5	7.7	32.2
14-inch	2.7	1.8	7.0
16-inch	0.8	2.7	5.2
18-inch	0.7	1.2	3.9
20-inch	0.0	0.0	0.1
24-inch	0.0	0.2	1.1
30-inch	0.0	0.0	0.0
Total	**24.1**	**20.6**	**72.1**

Table 10-7. Asset Count of Risk Threshold Trigger by Asset Classification

Asset Classification	Risk Threshold Trigger		
	Level A	Level B	Level C
Water Meter	2	4	1815
Fire Hydrants	231	1265	3025
Line Valves	877	1970	4848





N

0 1,500 3,000

Scale in Feet

Pipeline Risk Threshold Trigger

- No Action
- Level A
- Level B
- Level C

Figure 10-1

Existing Pipelines Risk Threshold Level

City of Milpitas
2020 Water Master Plan

Last Saved: 1/27/2021 11:26:03 AM N:\Clients\270 City of Milpitas\60-1 19-16 Water Master Plan\GIS\MXD\Fig10-1 ExPipes_RiskThreshold.mxd - coconnor

10.3 RECOMMENDED PROJECTS

Recommended projects were identified based on the asset classification and the risk prioritization developed above. They include general maintenance modifications, detailed condition assessment, refurbishment and replacement.

10.3.1 Water Meters

Most of the City's 16,351 Water Meters are beyond their typical useful life of roughly 15 years. Roughly 75 percent have exceeded this age in service. The City currently does not have a water meter replacement program other than replacement upon failure. For a water meter, failure is typically hidden resulting in an undetected meter accuracy reduction. The City is currently implementing an Advanced Metering Infrastructure (AMI) program that will ultimately replace existing water meters to conform to the new AMI system.

With the AMI replacement of the water meter inventory the City should investigate the creation of a water meter test program. The American Water Works Association recommends testing of water meters at a minimum of once every 20 years. This minimum test interval is beyond the nominal useful life of a meter and simply serves to confirm that replacement is, in fact, warranted. A meter test program can be established with a goal to test an appropriate sample of water meters and to profile meter performance specifically in the City's water system to confirm performance and useful life. A test program may begin at 10 years meter age with a goal to test 2 to 5 percent of the meter population per year.

As the AMI program evolves, the system will be selected, and it will be known if existing meters and meter components will be compatible with the new AMI system or if existing assets will require replacement. A new meter test program can then be configured based on the asset replacement rate associated with the AMI program and staffing resources.

10.3.2 Facilities

Each of the 32 facilities evaluated are at a risk trigger level of at least Level A which indicates each should be considered at a minimum for maintenance review.

Facilities at Level A consist of PRVs and Interties and, while they require little maintenance, the preventative maintenance (PM) program should be modified to include visual assessments at least annually to begin to collect condition data to support future decision-making.

Facilities at Level B and Level C include PRVs, wells, interties, reservoirs, pumping stations and turnouts. The PM program should be modified as noted for Level A, as well as a detailed condition assessment program. Since these ratings are based on only a desktop assessment, assets at Level C are not immediately identified for replacement but should be given priority in condition assessment.

10.3.3 Pipelines, Fire Hydrants and Line Valves

Pipeline assets are at risk trigger levels as high as Level C based on the desktop condition and risk assessment performed. Given the level of data available to support the desktop analysis, it is recommended that the maintenance program be reviewed to capture measurable performance data associated with pipeline failures and that a comprehensive condition assessment be conducted of representative portions of the distribution system.

Line valve and fire hydrant assets are at risk trigger levels as high as Level C based on the desktop condition and risk assessment performed. Slightly over half of the City's 9,330 fire hydrants and line valves exceed a typical useful life of 30 years. The City recently acquired equipment to support a valve and hydrant exercise program to provide mainline flushing and valve maintenance. The program is just now beginning. The exercise program should be developed with the objective to locate each valve in the field and confirm in GIS; confirm valves are operable, accessible and free of tuberculation; assure they are able to achieve a tight isolation; and, record depth, number of turns and turn direction. A valve exercise program should target the older system valves and hydrants rapidly in the first few years of the program and then settle into a pace of exercising all valves once every 5 years.

10.3.4 Summary of Asset Renewal and Replacement Recommendations

Capital and non-capital recommendations are presented in this section.

10.3.4.1 Capital and Non-Capital Recommendations

A list of capital and non-capital recommendations was developed based on the risk assessment and the risk thresholds presented in this chapter and the Water Utility Condition Assessment Technical Memorandum (included in Appendix D). Table 10-8 presents these recommendations which include projects (capital) and improvement measures (non-capital) that respond to the current state of the City's distribution system.

10.3.4.2 R&R Forecast and Methodology

R&R planning is a forecast of planned effort and expenditures for the renewal or improvement of an asset and ultimately the replacement of the asset. While not yet specifically indicated, pending actual condition assessment, a forecast of asset replacement was developed and included to establish a baseline order of magnitude estimate of asset R&R for fiscal planning. This forecast may be used for current fiscal planning but should be verified based on the findings of the recommended condition assessment studies. Assumptions are presented below:

- Forecast year of action based on remaining asset useful life
- Actual asset replacement assumed to be 20 percent of assets reaching project useful life

A forecast of R&R expenditures is presented on Figure 10-2 and in Table 10-9.

Figure 10-2. 30-Year R&R Forecast

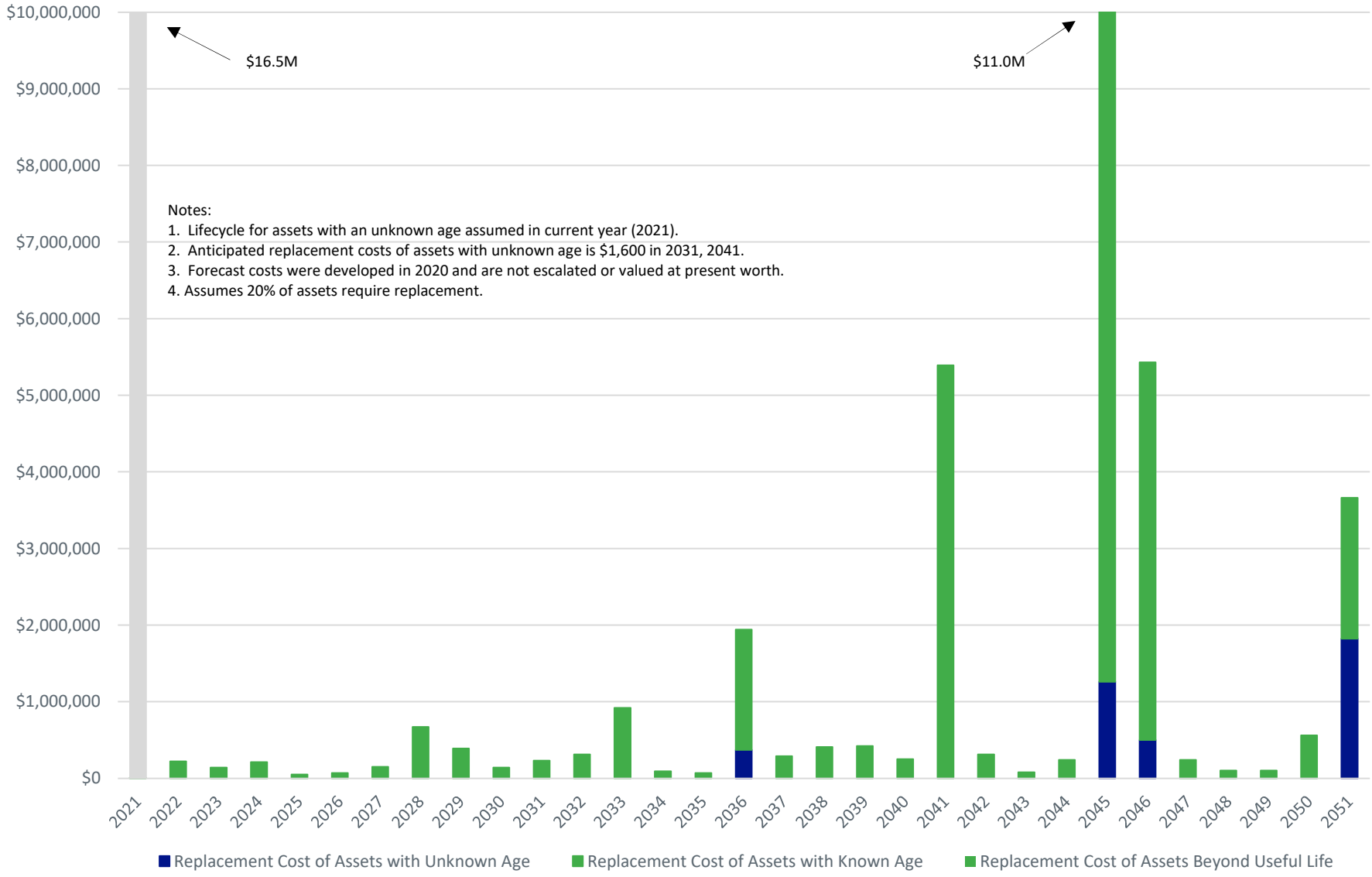


Table 10-8. Asset Renewal and Replacement Recommendations

Title	Description	Capital Cost Estimate, $
Capital Projects		
Pipeline Condition Assessment	Conduct a comprehensive assessment of the pipeline distribution system using both destructive and non-destructive assessment techniques. Technologies may include cathodic protection resistivity surveys, coupon sampling and testing, acoustic surveys and electromagnetic surveys and leak detection monitoring. The condition assessment should include appurtenances to pipelines such as air valves, blow off assemblies, fire hydrants and valves. The assessment should focus on metallic and asbestos cement pipeline material segments to document a correlation between pipe material, diameter, age and soil conditions to better estimate remaining useful life.	$500,000
Detailed Facility Condition Assessment	Detailed facility condition assessment studies should be performed at all Level B and C facilities. Level C facilities should be prioritized for immediate assessment. Condition assessment efforts were valued at 2.5% of asset or facility replacement cost.	
	Level B Recommendations	
	PRV/Intertie/Turnout • Live Oak PRV • North Vault PRV • South Vault PRV • Milpitas PRV • Capitol PRV • Abel PRV • Gibraltar PRV • McCarthy PRV • Sinclair PRV • ACWD Intertie • SCVWD Intertie	 5,000 15,000 15,000 5,000 15,000 5,000 15,000 15,000 5,000 15,000 5,000
	Subtotal PRV/Intertie/Turnout	**$115,000**
	Well/Res/PS • Curtis Well • Minnis Reservoir • Gibraltar Res (VW) • Gibraltar Res (SF)	 75,000 80,000 325,000 325,000
	Subtotal Well/Res/PS	**$805,000**
	Level B Total Cost	**$920,000**
	Level C Recommendations	
	PRV/Intertie/Turnout • Curtis PRV • Montague PRV • Main Street Turnout • Calaveras Turnout • Sunnyhills Turnout • Gibraltar Turnout	 15,000 5,000 20,000 15,000 15,000 25,000
	Subtotal PRV/Intertie/Turnout	**$95,000**
	Well/Res/PS • Tularcitos Reservoir • Country Club Pump Station • Tularcitos Pump Station • Ayer Reservoirs • Pinewood Well • Gibraltar Pump Station • Ayer Pump Station	 75,000 60,000 70,000 355,000 105,000 435,000 125,000
	Subtotal Well/Res/PS	**$1,225,000**
	Level C Total Cost	**$1,320,000**
Water Meters	Develop a water meter test program	$100,000
Non-Capital Projects		
Data Gathering	Develop business processes and modify the CMMS to collect asset performance data. **Failure Hierarchy** – A failure hierarchy should be developed that supports the capture of problems, causes and remedies (PCR) employed for each asset. A sampling of PCR codes is included Appendix D for PUMP assets. Maintenance staff should then note the appropriate code in the work order when responding to asset problems. **Condition Assessment Data** – Visual and predictive data elements should be developed, and the CMMS modified to provide data fields to capture this data during PM activities. At a minimum visual data should be collected to capture corrosion observations, concrete spalling, burning or arcing, and evidence of leakage. A simple domain should be developed to index readings including a photo-based guide for standardization between staff. Predictive data should be consistent with the City's predictive maintenance program and may include oil analysis, vibration monitoring and thermal imaging. **CMMS Automation** - Business Processes and CMMS workflows should be developed or otherwise modified to require the completion of specific fields such as Failure Codes as part of work order completion. The completion of these fields will be controlled by automated workflow that does not allow the work order to advance from the work performer to the quality assurance reviewer unless all required fields are completed.	NA
Line Valves and Fire Hydrants	Develop a valve and hydrant exercise program.	NA
Review Maintenance Program	The existing maintenance program should be reviewed to identify additional monitoring of assets at Level A and B facilities.	NA

Table 10-9. 30-Year R&R Forecast

Year	Replacement Cost of Assets Beyond Useful Life, $	Replacement Cost of Assets with Known Age, $	Replacement Cost of Assets with Unknown Age, $	Total Replacement Costs, $
2021	16,500,000	10,000	-	16,510,000
2022	-	220,000	-	220,000
2023	-	140,000	-	140,000
2024	-	210,000	-	210,000
2025	-	50,000	-	50,000
2026	-	70,000	-	70,000
2027	-	150,000	-	150,000
2028	-	670,000	-	670,000
2029	-	390,000	-	390,000
2030	-	140,000	-	140,000
2031	-	230,000	-	230,000
2032	-	310,000	-	310,000
2033	-	920,000	-	920,000
2034	-	90,000	-	90,000
2035	-	70,000	-	70,000
2036	-	1,570,000	370,000	1,940,000
2037	-	290,000	-	290,000
2038	-	410,000	-	410,000
2039	-	420,000	-	420,000
2040	-	250,000	-	250,000
2041	-	5,390,000	-	5,390,000
2042	-	310,000	-	310,000
2043	-	80,000	-	80,000
2044	-	240,000	-	240,000
2045	-	9,690,000	1,260,000	10,950,000
2046	-	4,930,000	500,000	5,430,000
2047	-	240,000	-	240,000
2048	-	100,000	-	100,000
2049	-	100,000	-	100,000
2050	-	560,000	-	560,000
2051	-	1,840,000	1,820,000	3,660,000
Total	**-**	**$30,090,000**	**$3,950,000**	**$50,540,000**

10.4 OVERVIEW OF SEISMIC RISK ASSESSMENT OF CITY'S WATER SYSTEM FACILITIES

As part of the parallel preparation of the City's Risk and Resilience Assessment (RRA), in compliance with America's Water Infrastructure Act of 2018 (AWIA), a seismic risk assessment of the City's water system facilities was conducted. A technical memorandum was prepared to document the methodologies used and estimated consequences associated with an earthquake event affecting the City water system. The technical memorandum is included as Appendix E of this Water Master Plan.

The earthquake scenario selected for the City is the Hayward-Rodgers Creek event described in the United States Geological Survey (USGS) Northern California Legacy Catalog (also referred to as ShakeMaps). At magnitude 6.8, this event represents the largest magnitude event described by ShakeMap in relatively close proximity to key City utilities. According to USGS, this event has an estimated annual probability of approximately 0.74 percent (i.e., a 0.74 percent chance of occurring in any given year), and an approximately 31 percent chance of occurrence within the next 50 years.

The Hayward-Rodgers Creek 6.8 magnitude earthquake is estimated to cause significant damage to the City's non-linear and linear assets. The Hazus Method (for non-linear assets) estimates moderate damage to the buildings and moderate/severe damage to the pump stations and reservoirs. The ALA Method (for linear assets) estimates 8 breaks and 32 leaks from the transmission mains and 192 breaks and 58 leaks from the distribution pipelines. Repair and replacement costs are estimated using crew size, labor rate, shift duration, and order of magnitude material costs for the City. Specific recommendations resulting from the seismic risk analysis are included within the City's RRA and include retrofit of reservoirs to meet sloshing wave standards, implementation of seismically resilient design standards for pipelines, and installation of overland piping connections for critical pipelines that may be damaged during an earthquake, among others. Recommended projects are incorporated in the recommended CIP described in Chapter 11 of this report.

CHAPTER 11
Recommended Capital Improvement Plan

This chapter presents the recommended CIP for the City's existing and future water system based on the evaluations described in Chapters 8, 9, and 10 of this report, as well as the Risk and Resilience Assessment (RRA) conducted in parallel with this WMP. In addition to summarizing the recommended capital improvement projects, this chapter provides estimates of probable construction costs for each project. The recommended CIP identifies improvements at a Master Plan level and does not necessarily include all required on-site infrastructure or constitute design of improvements. Subsequent detailed design is required to determine the exact sizes and locations of these proposed improvements.

Construction costs are presented in 2020 dollars based on an Engineering News Record (ENR) Construction Cost Index (CCI) of 12920.6 for San Francisco and were developed based on bids from other municipal water facility design projects and standard cost estimating guides. Using cost estimate classifications from the Association for the Advancement of Cost Engineering (AACE), the following costs are Class 5 estimates, which are associated with projects that are only zero to two percent defined. The expected accuracy range for Class 5 cost estimates spans from -50 percent to +100 percent (i.e., the actual cost is typically between half and double the estimate).

Total CIP costs include mark-ups totaling 70 percent of the estimated base construction costs to allow for:

- Design and Construction Contingency: 35 percent
- Engineering: 10 percent
- Construction Management: 15 percent
- Program Implementation: 10 percent

CIP costs do not include costs for land acquisition, right-of-way acquisition, or annual operation and maintenance. Appendix F details the assumptions and development of construction cost estimates for each type of water facility (e.g., storage reservoirs, pump stations, and pipelines).

This chapter organizes the components of the recommended CIP according to the evaluation that identified the improvements. The final section of this chapter summarizes the recommendations and groups them into five-year CIP phases through the year 2051. Sections of this chapter include:

- Improvements from Renewal and Replacement Study
- Improvements from Existing System Analysis
- Improvements from Future System Analysis
- Improvements from Risk and Resilience Assessment
- Summary and Phasing of Recommended Improvements

11.1 IMPROVEMENTS FROM RENEWAL AND REPLACEMENT STUDY

Chapter 10 summarized the condition assessment of the City's water utility assets and recommended projects and activities to manage infrastructure risk. Each water utility asset was evaluated for risk in terms of likelihood and consequence of failure, with recommended projects prioritizing higher risk assets. Recommendations include general maintenance modifications, detailed condition assessment, and renewal and replacement.

Table 11-1 presents the costs for the recommended projects from Chapter 10. Facility condition assessment costs were estimated at 2.5 percent of asset or facility replacement cost. Note, the forecast of renewal and replacement costs is preliminary and based on asset age only. Renewal and replacement costs will change as the City performs detailed condition assessments.

Table 11-1. Probable Costs for Recommendations from Asset Renewal and Replacement Study[a]

Component	Description	CIP Cost, dollars
Pipeline Condition Assessment	Conduct a comprehensive assessment of the pipeline distribution system using both destructive and non-destructive assessment techniques.	500,000
Detailed Facility Condition Assessment[b]	Detailed facility condition assessment studies should be performed at all Level B and Level C facilities. Level C facilities should be prioritized for immediate assessment.	2,240,000
Water Meter Test Program	Develop a water meter test program.	100,000
Asset Renewal and Replacement[c]	30-year forecast of asset renewal and replacement.	50,540,000
	Total	**$ 53,380,000**

(a) Costs shown are in 2020 dollars.
(b) Facility condition assessment efforts were valued at 2.5 percent of asset or facility replacement cost.
(c) Forecast is preliminary and based on asset age only. Renewal and replacement costs will change pending condition assessment.

11.2 IMPROVEMENTS FROM EXISTING SYSTEM ANALYSIS

Chapter 8 summarized the evaluation of the City's existing potable water system and its ability to meet recommended operational and design criteria listed in Table 7-1 of this report. West Yost recommended projects to improve existing system operations. As discussed in Section 7.2.1, the existing system fire flow evaluation presents systemwide available fire flow and does not recommend pipeline improvements to specifically increase existing fire flow capacity. However, because results from the existing system fire flow analysis can help prioritize replacing smaller diameter pipelines to improve overall distribution system flows, recommended improvements from that analysis are included in the CIP.

Table 11-2 presents preliminary capital cost estimates for the recommended existing system improvements, which are organized by priority (high to low) and improvement type. West Yost assigned priorities based on the reason for the improvement, and these will help determine CIP phasing. High priority improvements address meeting recommended fire flows in normal conditions (i.e., no outages), while medium priority improvements address meeting recommended fire flows in emergency outage

scenarios (e.g., SFPUC turnouts offline). Finally, low priority improvements consist of projects that generally improve system performance and/or reliability but do not address any specific issues (e.g., upsizing any 4-inch diameter pipelines that serve hydrants to comply with City design guidelines). Where recommendations consisted of either a pipeline or valve improvement for a particular location (e.g., ECIP-V-01 or ECIP-PI-02), valves were selected for the CIP due to comparable cost and less potential disruption during construction (e.g., traffic impacts). Appendix G contains figures showing the location of these recommended improvements and, for some larger projects (e.g., EPRVs and new Ayer pump), single-page project summaries.

The total CIP cost (including mark-ups) for improvements to the existing system is approximately $6.6 million. This includes a 50 percent discount for the new pump at the Ayer pump station, since the cost basis assumes an entirely new pump station, while the recommendation is to provide an additional pump at an existing pump station. In other words, a cost was developed for a new pump station with a firm capacity of 5.76 mgd (4,000 gpm), and half that cost was used to estimate installing a new 4,000 gpm pump at Ayer.

Table 11-2. Probable Construction Costs for Recommended Improvements to Existing System[a]

Improvement Type	Improvement Description	CIP ID	Reason for Improvement	Priority	Quantity	Estimated Construction Cost[b], dollars	CIP Cost (includes mark-ups)[c,d], dollars
Interconnection	On Hammond Way near Tom Evatt Park, replace the existing (normally closed) isolation valve separating Zones VW1 and SF1 with a new emergency PRV (Hammond EPRV).	ECIP-V-01	Fire Flow	High	1 LS	$ 282,000	$ 479,000
Interconnection	Near the western end of Corning Avenue, install a new isolation valve at the end of the existing Zone SF1 pipeline, immediately upstream of the tee connecting Zones VW1 and SF1.	ECIP-V-02	Fire Flow	High	1 LS	$ 8,000	$ 14,000
Pipeline Improvement	Along Sinnott Lane, Bothelo Avenue, and East Carlo Street, replace existing 6-inch and 8-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-01	Fire Flow	High	1,731 lf	$ 320,301	$ 545,000
Pipeline Improvement	Along Technology Drive between Murphy Ranch Road and the western end of Technology Drive, replace existing 4-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-04	Fire Flow	High	742 lf	$ 137,198	$ 233,000
Pipeline Improvement	Along Hanson Court, replace existing 8-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-05	Fire Flow	High	611 lf	$ 113,070	$ 192,000
Pipeline Improvement	Along Milmont Drive between Dixon Landing Road and the ACWD intertie, replace existing 8-inch and 10-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-06	Fire Flow	High	907 lf	$ 167,841	$ 285,000
Pipeline Improvement	Along Railroad Avenue between approximately hydrant 1A-355 and the southern end of Railroad Avenue, replace existing 8-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-07	Fire Flow	High	880 lf	$ 162,788	$ 277,000
Pipeline Improvement	Within the shopping center east of the intersection of South Park Victoria Drive and Landess Avenue, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-08	Fire Flow	High	450 lf	$ 60,727	$ 103,000
Pipeline Improvement	Along Greenwood Way between Pinewood Way and Fallen Leaf Drive, replace existing 6-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-10	Fire Flow	High	861 lf	$ 116,222	$ 198,000
Pipeline Improvement	Along South Abel Street between Sylvia Avenue and Corning Avenue, replace existing 6-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-11	Fire Flow	High	240 lf	$ 32,397	$ 55,000
Pipeline Improvement	Along Pinard Street from Ridgemont Drive up to the Lee's Orchard community, replace existing 8-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-16	Fire Flow	High	680 lf	$ 125,767	$ 214,000
Pipeline Improvement	Along Merz Court, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-21	Fire Flow	High	425 lf	$ 57,396	$ 98,000
Pipeline Improvement	Along Sussex Place, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-23	Fire Flow	High	192 lf	$ 25,906	$ 44,000
Pipeline Improvement	Along Carlsbad Street between Carlsbad Court and Ben Rodgers Park, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-25	Fire Flow	High	160 lf	$ 21,583	$ 37,000
Pipeline Improvement	Along Calera Creek Heights Drive between approximately hydrants 4A-001 and 4A-005, replace existing 6-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-26	Fire Flow	High	1,476 lf	$ 199,262	$ 339,000
Pump Station[e]	Install a 4,000 gpm (5.76 mgd) fire pump at Ayer Pump Station.	ECIP-PS-AY	Fire Flow (Outage)	Med	1 LS	$ 1,216,733	$ 2,068,000
Interconnection	Near the intersection of Coelho Street and Diel Drive, replace the existing (normally closed) isolation valve separating Zones SF1 and SF2 with a new emergency PRV (Diel EPRV).	ECIP-V-03	Fire Flow (Outage)	Med	1 LS	$ 282,000	$ 479,000
Pipeline Improvement	Along Callan Street near the intersection of Callan Street and Arizona Avenue, replace existing 6-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-28	Fire Flow (Outage)	Med	145 lf	$ 19,562	$ 33,000
Pipeline Improvement	Along Gross Street, near the intersection of Gross Street and Conway Street, replace existing 6-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-31	Fire Flow (Outage)	Med	171 lf	$ 23,072	$ 39,000
New Pipeline (Developed Area)	Along Curtis Avenue, connect the existing 10-inch diameter pipeline on the northern side of the street to the existing 18-inch diameter pipeline on the southern side of the street with a new, 12-inch diameter pipeline.	ECIP-PN-01	Fire Flow (Outage)	Med	30 lf	$ 5,550	$ 9,000
New Pipeline (Developed Area)	Along Hammond Way, east of Tom Evatt Park, connect the existing 8-inch diameter pipelines in Zone VW1 with a new, 8-inch diameter pipeline.	ECIP-PN-02	Fire Flow (Outage)	Med	57 lf	$ 7,628	$ 13,000
Backup Generator	Install a backup generator at the Country Club Pump Station.	ECIP-BG-CC	General Reliability	Low	1 LS	$ 200,000	$ 340,000
Backup Generator	Install a backup generator at the Tularcitos Pump Station.	ECIP-BG-TL	General Reliability	Low	1 LS	$ 200,000	$ 340,000
Pipeline Improvement	Along Santa Rita Drive near the intersection of Santa Rita Drive and Via Baja Drive, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-32	Hydrant Service[f]	Low	21 lf	$ 2,895	$ 5,000
Pipeline Improvement	Along Calle del Prado, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-33	Hydrant Service[f]	Low	89 lf	$ 12,029	$ 20,000
Pipeline Improvement	Along Kennedy Drive between Topham Court and Prada Drive, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-34	Hydrant Service[f]	Low	331 lf	$ 44,646	$ 76,000
Pipeline Improvement	Along Ramos Court, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-36	Hydrant Service[f]	Low	62 lf	$ 8,424	$ 14,000
Pipeline Improvement	Along Stemel Court, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-37	Hydrant Service[f]	Low	45 lf	$ 6,109	$ 10,000
Pipeline Improvement	Along Sepulveda Court, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-38	Hydrant Service[f]	Low	21 lf	$ 2,874	$ 5,000
Pipeline Improvement	Along Berg Court, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-39	Hydrant Service[f]	Low	107 lf	$ 14,483	$ 25,000
						Total	**$ 6,589,000**

(a) Costs shown are in 2020 dollars.

(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate.

(c) Costs include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

(d) Total rounded to the nearest $1,000.

(e) Since this an upgrade to an existing pump station (and not a new pump station), the estimated cost is discounted 50 percent.

(f) To comply with the City's design guidelines, West Yost also recommends upsizing pipelines less than 6 inches in diameter that serve hydrants.

11.3 IMPROVEMENTS FROM FUTURE SYSTEM ANALYSIS

Chapter 9 summarized the evaluation of the City's future (i.e., buildout) potable water system and its ability to meet recommended operational and design criteria listed in Table 7-1 of this report. Evaluation of the buildout system assumed that improvements recommended from the existing system analysis were implemented. Any buildout system deficiencies were then addressed via additional improvements.

Table 11-3 presents preliminary capital cost estimates for the recommended buildout system improvements. With demands in the VW service area increasing over 65 percent from existing levels, supply and storage capacity improvements are recommended. In addition to a new storage reservoir, the Curtis Well helps address the storage capacity deficiency at buildout by providing an emergency groundwater storage credit. The Cedar EPRV will help serve fire flows in Zone VW1 and improve system reliability. Since these projects address capacity deficiencies or improve fire flow, all are considered high priority. Appendix G contains project summary sheets for each of these recommended improvements.

The total CIP cost (including mark-ups) for improvements to the buildout system is approximately $16.6 million. This total does not include land acquisition costs, which may be necessary for the new storage reservoir. A public service utility easement is available for the Piper turnout, but space is limited. As a result, it is assumed a pump station will not be constructed at the Piper turnout. While the Gibraltar facility has a pump station to boost low pressures from the Gibraltar turnout, to date the City has not used it. Therefore, constructing the Piper turnout without a booster pump station is acceptable.

Table 11-3. Probable Construction Costs for Recommended Improvements to Future System[a]

Improvement Type	Improvement Description	CIP ID	Reason for Improvement	Priority	Quantity	Estimated Construction Cost[b], dollars	CIP Cost (includes mark-ups)[c,d], dollars
Turnout	New VW turnout near the intersection of Piper Drive and Garden Street with a capacity of 10,000 gpm (14.4 mgd).	BCIP-TO-01	Firm Supply Capacity	High	1 LS	$ 313,000	$ 532,000
Storage Reservoir[e]	2.0 MG reservoir in VW service area.	BCIP-S-01	Storage Capacity	High	1 LS	$ 3,254,000	$ 5,532,000
Pump Station	Firm capacity of 4,000 gpm (5.76 mgd) for new storage reservoir.	BCIP-PS-01	Storage Capacity	High	1 LS	$ 2,433,466	$ 4,137,000
Groundwater Well[f]	Construct Curtis Well.	BCIP-W-01	Storage Capacity	High	1 LS	$ 3,500,000	$ 5,950,000
Interconnection	Near the intersection of Cedar Way and South Main Street, replace the existing (normally closed) isolation valve separating Zones SF1 and VW1 with a new emergency PRV (Cedar EPRV).	BCIP-V-01	Fire Flow	High	1 LS	$ 282,000	$ 479,000
						Total	**$ 16,630,000**

(a) Costs shown are in 2020 dollars.

(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate.

(c) Costs include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

(d) Total rounded to the nearest $1,000.

(e) Recommended active volume. Cost assumes the storage reservoir will be an aboveground steel tank. Land acquisition costs are not included.

(f) Estimated construction cost assumes Curtis Well capacity is between 500 and 1,000 gpm. A higher capacity may result in higher costs.

11.4 IMPROVEMENTS FROM RISK AND RESILIENCE ASSESSMENT

West Yost conducted an RRA in compliance with the requirements of the 2018 America's Water Infrastructure Act. This effort includes assessments of both cyber and physical risks and resilience and development of a risk and resilience strategy. Recommendations from the RRA, referred to as risk and resilience management strategies (RRMS), include physical upgrades, planning efforts, and cyber security projects.

Table 11-4 presents the recommended RRMS, organized by project type, along with a project description and priority as assigned in the RRA. High-level cost estimates were developed for four of the 23 RRMS. These four projects and their costs, which total approximately $2.1 million (2020 dollars), are included in the CIP summary and phasing detailed in Section 11.5.

Table 11-4. Risk and Resilience Assessment Management Strategies[a]

Project Type	Project No.	Project Name[b]	Project Description[b]	Priority	CIP Cost[c], dollars
Physical Upgrade	1	Physical Security Updates - Perimeter Fencing	Enhance security of site perimeters by establishing and implementing a minimum fencing standard (e.g., 8-feet high, anti-climb fabric, barbed wire).	High	$ 30,000
	2	Physical Security Updates - Turnout	Enhance security of turnout site perimeter by installing minimum 8-ft fencing. Property owned by SFPUC. Work with SFPUC to make improvements.	High	
	3	Warning Signage	Install signage at all facilities to inform that trespassing, tampering, and vandalism are criminal acts under relevant federal statutes.	High	
	4	Site Security Protocols	Implement policy of keeping all gates and doors locked at reservoir and pump station sites, and require key or access card to open.	High	$ 20,000
	5	Harden Critical Transmission Mains against Earthquakes - Emergency Connections	Install overland piping connections for critical pipelines that may be used to provide temporary distribution capacity.	High	
	6	Harden Critical Transmission Mains against Earthquakes - Emergency Connections Exercises	Conduct periodic exercises for existing overland piping connections across faults.	High	
	7	Harden Critical Transmission Mains against Earthquakes - Replace Isolation Valves	Following implementation of a program to locate and assess isolation valves on critical transmission mains (see Harden Critical Transmission Mains against Earthquakes - Identify Isolation Valves). Replace isolation valves according to priority.	High	$ 2,000,000
	8	Harden Critical Reservoirs against Earthquakes - Isolation Valves	Assess and replace (as needed) isolation valves and buried connections at reservoirs.	Medium	
	9	ShakeAlert Participation	Enroll in program to receive early warning indications from USGS (or other agencies). Development of protocols for responding to ShakeAlert signals included in other RRMS projects	Medium	$ 85,000
	10	Valve Integration with ShakeAlert	Install new or modify existing automatic valves to be integrated with or informed by ShakeAlert. Develop remote valve closure protocol to prevent leakage of safe drinking water from reservoirs during and following an earthquake. Coordinate valve closure protocol with Distribution.	High	
	11	Equipment Integration with ShakeAlert	Integrate ShakeAlert with process controls to prevent or reduce earthquake damage. Develop protocols for equipment shutdowns based on risk.	High	
	12	Retrofit Steel Reservoirs to Meet Sloshing Wave Standard	Evaluation of the City's reservoir roof and overflow heights and reservoir operating levels revealed that maximum potential sloshing wave height triggered by an earthquake would exceed the reservoir roof heights for all of the City's reservoirs. This could result in structural damage to the reservoirs. Steel reservoirs may be physically retrofitted to increase the roof height to meet the sloshing wave standard. It is recommended that the reservoirs be retrofitted to meet the standard.	Low	
	13	Implement Seismic Design Standards for Pipeline Upgrades and Replacements	Seismic design standards for pipelines were previously identified in the 2006 City of Milpitas Water System Seismic Improvements Strategic Plan (prepared by DWSA). This project would be a continuation of implementation of the recommended upgrades to pipelines within the system.	Medium	
	14	Security Cameras for Critical and Remote Facilities	Where feasible, install PTZ security cameras at the most critical and remote assets. Evaluate feasibility of storing footage from new cameras. This effort is currently in progress.	High	
	15	Fire Pump at Ayer Pump Station	Install fire pump at the Ayer Pump Station to increase fire flow capacity when the SFPUC turnouts are offline. Note that this project is also included in the recommendations for the 2020 Water Master Plan.	High	
Planning and Studies	16	Harden Critical Transmission Mains against Earthquakes - Identify and Assess Isolation Valves	Locate distribution system PRVs and isolation valves, determine if the valves are functional, evaluate the condition of the valves, and record and summarize the data collected during the field investigation. Following evaluation of the distribution valves prioritize valves for maintenance/replacement.	Medium	
	17	Evaluate Concrete Reservoirs Ability to Withstand Sloshing Wave Forces	Evaluation of the City's reservoir roof and overflow heights and reservoir operating levels revealed that maximum potential sloshing wave height triggered by an earthquake would exceed the reservoir roof heights for all of the City's reservoirs. This could result in structural damage to the reservoirs. Concrete roofs may be capable of withstanding forces produced by the sloshing wave if the roof height does not meet the standard, however, further evaluation by a structural engineer is recommended to confirm this.	Complete	
Cyber Security	18	Develop and Implement a SCADA Master Plan	Prepare a SCADA Master Plan to provide a road map for utility-wide SCADA system policies, procedures and improvements; provide increased security and uniformity across utility. This project would include or provide definition to the projects listed here. This effort is currently in progress.	High	
	19	Conduct Day Without SCADA Exercises & Document Capabilities	Following implementation of the City's new SCADA system, conduct emergency preparedness exercises to test operation of distribution system without automation (SCADA). Since the City currently operates the system without the use of SCADA, the purpose of this excercise is to maintain staff knowledge and capabilities.	High	
	20	Engage DHS for Cybersecurity Services	Engage Cybersecurity Infrastructure Security Agency (CISA) for cybersecurity services including assessments, tools, and recommendations. CISA offers a wide range of assessments. At a minimum, this project will engage DHS for a Phishing Campaign Assessment and a Remote Penetration Test. To be implemented following implementation of SCADA.	Medium	
Shorter Term Activities or Projects	21	Business Continuity Plan	Develop a Business Continuity Plan to outline the policies and procedures the City must follow to resume business operations following a major disruption (fire, flood, earthquake, cyberattack, etc.).	High	
	22	Day without Phone Exercises	Exercise radio skills on bi-annual basis with monthly radio call ins. Planning for this exercise is currently in progress.	High	
	23	Functional Training on ERP	Conduct functional training exercises on the City's ERP to prepare staff for emergency events.	Medium	
				Total	**$ 2,135,000**

(a) Costs shown are in 2020 dollars.

(b) Project names and descriptions have been generalized to not identify specific system vulnerabilities.

(c) Costs were only developed for four projects recommended in the Risk and Resilience Assessment.

11.5 SUMMARY AND PHASING OF RECOMMENDED IMPROVEMENTS

This section combines the above recommendations and organizes them into five-year CIP periods according to project priority. CIP phasing generally consists of five-year periods spanning from 2021 through 2051. This period is 31 years, so the final CIP period spans six years (2046-2051). It was assumed that improvements from the existing system analysis would be implemented in the next ten years (i.e., by 2030), while improvements from the future system analysis would be implemented when existing facilities can no longer meet operational criteria summarized in Table 7-1 of this report.

It was assumed that condition assessments, water meter test development, and physical upgrades would occur by 2025. Asset renewal and replacement follows the schedule presented in Table 10-9 of this report. Note, the asset renewal and replacement schedule was developed based on asset age and is subject to change pending findings from the recommended detailed condition assessments.

For the existing system analysis, high priority improvements are assigned to the 2021-2025 CIP period, while medium and low priority improvements are assigned to the 2026-2030 CIP period. As noted in Section 9.4 of this report, storage capacity is expected to become insufficient around 2032. Therefore, the new storage reservoir and Curtis Well (which reduces the storage requirement via an emergency groundwater storage credit) are assigned to the 2031-2035 CIP period. In contrast, firm supplies (i.e., largest turnout in each service area offline) can meet demands until around 2038, so the Piper turnout can be pushed to the 2036-2040 CIP period.

Table 11-5 summarizes the proposed CIP phasing and cost in 2020 dollars. Improvements are grouped according to their “source” (e.g., Renewal and Replacement Study), and their costs are assigned to a five-year CIP period. The total CIP cost through 2051 is approximately $78.7 million (2020 dollars).

Table 11-5. Capital Improvement Program Phasing

Improvement	Capital Cost, $M[a]						
	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2051[b]	Total
Improvements from Renewal and Replacement Study (Chapter 10)							
Pipeline Condition Assessment	$0.5	-	-	-	-	-	$0.5
Detailed Facility Condition Assessment	$2.2	-	-	-	-	-	$2.2
Water Meter Test Program	$0.1	-	-	-	-	-	$0.1
Asset Renewal and Replacement	$17.1	$1.4	$1.6	$3.3	$17.0	$10.1	$50.5
Subtotal	$20.0	$1.4	$1.6	$3.3	$17.0	$10.1	$53.4
Improvements from Existing System Analysis (Chapter 8)							
Hammond EPRV and Corning Isolation Valve	$0.5	-	-	-	-	-	$0.5
Pipeline Improvements - Fire Flow	$2.6	-	-	-	-	-	$2.6
Fire Pump at Ayer Pump Station	-	$2.1	-	-	-	-	$2.1
Diel EPRV	-	$0.5	-	-	-	-	$0.5
Pipeline Improvements and New Pipelines - Fire Flow (Outage)	-	$0.1	-	-	-	-	$0.1
Backup Generators at Country Club and Tularcitos Pump Stations	-	$0.7	-	-	-	-	$0.7
Hydrant Service Pipeline Improvements	-	$0.2	-	-	-	-	$0.2
Subtotal	$3.1	$3.5	$0.0	$0.0	$0.0	$0.0	$6.6
Improvements from Future System Analysis (Chapter 9)							
Piper Turnout	-	-	-	$0.5	-	-	$0.5
VW Storage Reservoir	-	-	$5.5	-	-	-	$5.5
Pump Station for VW Storage Reservoir	-	-	$4.1	-	-	-	$4.1
Curtis Well	-	-	$6.0	-	-	-	$6.0
Cedar EPRV	-	-	$0.5	-	-	-	$0.5
Subtotal	$0.0	$0.0	$16.1	$0.5	$0.0	$0.0	$16.6
Improvements from Risk and Resilience Assessment[c]							
Perimeter Fencing	$0.030	-	-	-	-	-	$0.030
Site Security Protocols	$0.020	-	-	-	-	-	$0.020
Replace Isolation Valves	$2.0	-	-	-	-	-	$2.0
ShakeAlert Participation	$0.085	-	-	-	-	-	$0.085
Subtotal	$2.1	$0.0	$0.0	$0.0	$0.0	$0.0	$2.1
Total	**$25.2**	**$4.9**	**$17.7**	**$3.8**	**$17.0**	**$10.1**	**$78.7**

(a) Costs shown are in 2020 dollars.

(b) Includes forecasted renewal and replacement costs for the year 2051.

(c) Costs were only developed for four projects recommended in the Risk and Resilience Assessment.

CHAPTER 12
References

Below is a list of references used for the preparation of this Water Master Plan, sorted alphabetically by author.

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Appendix A

Water System Schematic Profile

Elev (FT)

1000
900
800
700
600
500
400
300
200
100
0

LEGEND

- WHOLESALER SUPPLY LINE
- CITY DISTRIBUTION LINE
- EMERGENCY/NORMALLY CLOSED LINE
- SERVICE ZONE
- VALVE (NORMALLY CLOSED)
- WELL
- PRESSURE REDUCING VALVE (PRV)
- EMERGENCY PRV
- CITY RESERVOIR
- PUMP STATION (PS)
- TURNOUT
- INTERTIE

NOTE:
Tank Elevations shown are Top of Tank Elevation

SFPUC
San Francisco Public Utilities Commission

SCVWD
Santa Clara Valley Water District

MINNIS TANK
0.35 MG ELEV: 908'

ZONE 4SF-2 HGL = 885'

CALERA CREEK HEIGHTS PRV

TULARCITOS S. VAULT PRV

ZONE 4SF-1 HGL = 740'

TULARCITOS N. VAULT PRV

TULARCITOS PS

TULARCITOS TANK
0.31 MG
ELEV: 567'

ZONE 3SF HGL = 545'

COUNTRY CLUB PS

SUNNYHILLS TURNOUT

SAN JOSE WATER INTERTIE HGL: 345'

ALAMEDA COUNTY WATER DISTRICT INTERTIE HGL: 345'

SFPUC BAY DIVISION PIPELINES NO. 3 & 4
HGL: 340'

MAIN ST TURNOUT

GIBRALTAR TURNOUT

CALAVERAS BLVD TURNOUT

ZONE 2SF HGL = 340'

MAIN ST PRV

GIBRALTAR PRV

N MILPITAS PRV

ZONE 1SF HGL = 200'

ALAMEDA COUNTY WATER DISTRICT INTERTIE
HGL: 190'

AYER PRV

AYER PS

SUNNY HILLS PRV

YOSEMITE EPRV

JUNIPERO EPRV

MONTAGUE EPRV

LIVE OAK EPRV

GIBRALTAR PS

GIBRALTAR TANK
5 MG ELEV: 48'

AYER TANK
5.6 MG ELEV: 85'

CALIFORNIA CIRCLE EPRV

MCCARTHY EPRV

CURTIS WELL

PINEWOOD WELL

Based on the Gibraltar PRV setting, the Zone 2SC HGL should be 325 feet.

GIBRALTAR SCVWD TURNOUT

SCVWD MILPITAS PIPELINE HGL: 425'

GIBRALTAR PRV

GIBRALTAR EMERGENCY BOOSTER

ZONE 2SC HGL = 258'

ZONE 1SC HGL = 200'

CAPITOL PRV

CURTIS PRV

PARC METRO PRV

GIBRALTAR PS

GIBRALTAR PRV

GIBRALTAR TANK
5 MGD ELEV: 48'

MCCANDLESS WELL
(FUTURE)

	PRESSURE REDUCING VALVES	
	PRV NAME	HGL
SFPUC	MAIN ST	207'
	GIBRALTAR	UK
	N MILPITAS	207'
	AYER	UK
	SUNNY HILLS	199'
	TULARCITOS SOUTH VAULT	762'
	TULARCITOS NORTH VAULT	707'
	CALERA CREEK HEIGHTS	787'
SCVWD	CAPITOL	201'
	GIBRALTAR	325'
	CURTIS	202'
	GIBRALTAR	UK
	PARC METRO	UK
EMERGENCY	MCCARTHY	73'
	CALIFORNIA CIRCLE	71'
	LIVE OAK	125'
	JUNIPERO	169'
	MONTAGUE	216'
	YOSEMITE	211'

NOTE:
UK denotes unknown

HydroScience

City of Milpitas
Water Distribution System Plan
Schematic Profile

Appendix B

System Operations Narratives

City of Milpitas Distribution System Operation

General Description

WATER SUPPLY

The City of Milpitas receives water from two wholesale agencies, San Francisco Public Utilities Commission (SFPUC) and Valley Water (VW). Water from SFPUC is brought through the City by two transmission lines, Bay Division Pipelines 3 & 4, supplies Milpitas through 3 turnouts – Sunnyhills, Calaveras, and Main Street. Valley Water is brought to the City via the East Pipeline, and has one turnout at the City's Gibraltar Pump Station. There is an Intertie connection between Valley Water and SFPUC which runs from the end of the East Pipeline at Gibraltar Pump station and proceeds approximately 1,000 feet north the the SFPUC/VW Intertie Pump Station. Milpitas has a connection to this pipeline which can serve as an additional turnout to SFPUC, which we call the Intertie Turnout. When the SFPUC/VW Intertie is not in operation to transport water from SFPUC to VW or vice versa, the Intertie turnout is used by Milpitas to receive water from SFPUC, thus keeping the Intertie pipeline with fresh water in it.

The City also currently has one operational well, Pinewood Well, can be used to supply water to a portion of the City's zone 1SF distribution system. This well is currently premitted as a Standby Well, and thus can only be used for emergency operations only. An additional well, Curtis Well, has been drilled and developed, but there is no pump station and no connection to distribution system infrastructure. Curtis Well contains manganese and will require treatment. Possible infrastructure connections are to zones 1SC, 2SC and 2SF. In addition, a connection to Gibraltar Pump Station for blending purposes is also in consideration. A third well is in the planning stages now, McCandless Park Well. A test hole had been drilled and the above and below ground portions of the main well are in design with an anticipated completed date of sometime in 2022. This well will also require manganese removal treatment, and will serve zone 1SC.

Pressure Zones

Milpitas does not blend water from the two wholesalers that serve the City. As a result, Milpitas distinct areas that are served water from one or the other wholesaler, and they are designated by the letter codes SF and SC. Each wholesaler served area has two main pressure zones in the area of the City that resides on the valley floor. Zones are identified as low pressure or high pressure. Low pressure zones have a number designation of 1, and are regulated by pressure reducing valves to have a maximum pressure of about 80 psi in the zone. High pressure zones have a number designation of 2. The high pressure zone served

by SF is not regulated and is set by the pressure supplied by SFPUC at the turnouts, which is typically between 130 and 140 psi. For the high pressure zone served by VW, it is set by a pressure reducing valve at Gibraltar Pump Station to between 135 and 140 psi. Valley Water is typically supplied from the East Pipeline at a pressure of 170 – 180 psi.

There are two additional pressure zones that cover the developed area of the hills in Milpitas which includes the Summit Pointe Golf and Country Club. This water system was originally called La Questa and is now commonly referred to as "The Hillside". Water is transported to these zones, designated 3 and 4a and 4b. These system will be described in more detail later in this document.

DISTRIBUTION SYSTEM OPERATION

VW System

The area of Milpitas which is served by Valley Water (formerly known as Santa Clara Valley Water District, or SCVWD) was carved out in the late 1980s to be served separately from the rest of the City's distribution system, which was formerly completely serviced by SFPUC. The area selected was primarily commercial/industrial. See the zone map for visual reference. Gibraltar Pump Station was constructed as part of this effort and has two 5 MG storage tanks, one designated for VW water and one for SFPUC water. The station is really 3 stations in one, and was intended to serve multiple purposes. For the distribution of VW water, the turnout connection to the East Pipeline was located on the station grounds. Water from the turnout goes through a revenue meter and vault, maintained by VW, and then goes through a Pressure Reducing Valve (PRV) to enter the City's zone 2SC distribution system. Water is also sent to the VW reservoir for storage directly from the turnout. Water from the reservoir can be pumped out of the reservoir and into zone 2SC by one of two pumping systems. When pumping from storage, flow from the turnout is generally halted. Once water enters zone 2SC, it is maintained at about 135 psi. There are three PRV stations that then take water from zone 2SC and reduce the pressure to send it to zone 1SC. Pressure in zone 1SC is maintained to have a maximum of about 80 psi as the highest pressure within the zone. The three PRVs that send water to zone 1SC are Curtis, Parc Metro and Capitol. The Curtis PRV is actually two PRVs in parallel, designated East and West.

In addition to the main PRVs that control pressure in zones 1SC and 2SC, there are also Emergency PRV stations. These are standby PRV stations that will only open and supply water if the pressure in zone they are supplying falls below a certain setpoint. For zone 2SC, there are two stations, Yosemite and Montague, that will allow water to pass from zone 2SF to zone 2SC if the pressure in zone 2SC falls below about 120 psi. For zone 1SC, there are 4 emergency PRV stations, Live Oak, McCarthy, California Circle, and Junipero. These stations will supply water from zone 1SF to zone 1SC if the pressure in zone 1SC falls below about 60 psi at the point of highest pressure. It is important to note that the emergency PRVs for both zones

only flow in *one* direction, from the SF zones to the SC zones, and *not* in the opposite direction. The SC zones were intentionally set up to have higher pressures than the corresponding SF zones so that this system could work this way.

SFPUC System

The portion of the City supplied by water from SFPUC is primarily residential, with some commercial. Water is supplied to these zones from the 3 primary turnouts, Sunnyhills (called Washington by SFPUC), Calaveras, and Main Street (called Hammond by SFPUC). Each turnout has connections to the two Bay Division Pipelines, 3 and 4. There are two parallel revenue meters that supply a manifold to which the city connects for our supply. At the Sunnyhills and Main St. turnouts, there are two types of connections. Connections that go directly to zone 2SF are unregulated, fed directly at the pressure supplied by SFPUC. Connections that go to zone 1SF are fed through two parallel PRVs located within the turnout vault structure. At the Calaveras turnout, the connections are all to zone 2SF, and therefore unregulated. There is an associated PRV station a short distance away next to Milpitas City hall, called the Milpitas PRV station, that takes water from the Calaveras turnout and sends it to zone 1SF. This station has two PRVs in parallel, but one larger than the other. All turnout PRV stations with parallel PRVs operate in a lead/lag fashion, with one set to a slightly higher pressure setpoint than the other.

Water from zone 2SF supplies zone 3SF by acting as the supply to the first of two booster pumping stations, Country Club. Country Club booster pump station recieves water from zone 2SF as the suction supply that is then pumped into Zone 3SF. There is a 12" supply line that travels from the output of Country Club pump station up to the next station, Tularcitos, where it both supplies water to zone 3SF and fills the 310,000 gallon reservoir there. Both the pumps and the reservoir supply water to zone 3SF. The pumps at Country Club are activated by the level of the Tularcitos Reservoir. Then the level gets down to 15 feet the lead pump is turned on. Usually this is enough to start filling the reservoir, but if demand is high enough for the reservoir level to continue to fall to 14 feet, the lag pump will also turn on. Once the reservoir reaches 21.5 feet the pumps are shut off.

In the same manner, pumps at Tularcitos pull water from the reservoir and pump it into zone 4SFa and up to the Minnis Reservoir. Tularcitos pumps are controlled by the level of the Minnis Reservoir. Zone 4SF is broken into two subzones, a and b. Water from zone 4SFa feeds three PRVs called North Vault, South Vault, and Calera Creek Heights. Due to the elevation differences in zone 4, the PRVs are necessary to break the pressure midway in the zone. Zone 4SFa is unregulated, and the lower part of the zone, zone 4SFb is the portion regulated by the three PRV stations.

Each reservoir, Minnis and Tularcitos, has a nozzle type mixing system which uses a pump to circulate water from the tank through the pump and back in through the side of the tank and

out a nozzle mounted inside which faces up at an angle to circulate the water both vertically and horizontally to avoid thermal and chemical stratification. Each also has a sampling pump and equipment for conducting water quality testing onsite.

Ayer Pump Station is located within zone 2SF and has 3 vertical turbine pumps and a 5.6 MG reservoir. The station has a single inlet/outlet which can be used to either fill the reservoir with water from zone 2SF or pump water into zone 2SF, but it cannot do both at the same time. Operation of this station is set up on a fill and pump basis, twice per day, pumping into the zone during morning and evening peak times, and filling from the zone during afternoon and overnight low demand periods.

Gibraltar Pump Station is located within zone 2SC, but also receives water from zone 1SF as well as the Intertie turnout. Gibraltar has a 5 MG reservoir and is also set up on a daily pump and fill cycle, pumping during morning and evening peak times to zone 1SF and filling during afternoon and overnight low demand periods from the Intertie turnout when not in use by SFPUC/VW, or from zone 1SF when the Intertie turnout is not available.

Pinewood Well is located in the southwest portion of the City in the neighborhood called The Pines and is in Pinewood Park. This well can produce about 1200 gallons per minute at an output pressure of about 70 psi. It is currently permitted as a Standby well and is need of further renovation, but it is eventually planned to be permitted as an active well and used to supplement the zone 1SF supply.

Curtis Well is located in Curtis Park, and has no pump station or connection to infrastructure yet. It was originally designed to provide emergency water supply to zone 2SF, but it's location facilitates a connection to both zones 1 & 2SC, as well as zone 2SF. In addition, a sleeve was put in crossing under the railroad tracks to allow a future line to connect the well to Gibraltar Pump Station for possible mixing or treatment to take place at Gibraltar. This would allow Curtis Well to run and blend water for pumping to zone 2SC or zone 1SF from Gibraltar.

INTERTIES

There are three inter-city interties. Two are with Alameda County Water District. The first one is located on Milmont drive at the border of Fremont and Milpitas. The second is on North Park Victoria, also at the border of Milpitas and Fremont. Both are manual interties, with significant pressure differences in the normal operating pressures of each system. Both interties have been used successfully to supply water from Milpitas to ACWD.

The third intertie is with San Jose, and is located on Landess Avenue. It is also manual. This intertie has no planned flushing points, and needs to be upgraded to allow routine operation and flushing.

City of Milpitas Water System Emergency Operations Scenarios

This document is a simplified overview of some of the possible emergency conditions that may arise and what changes to system operations are possible to mitigate the impacts of those conditions on the delivery of water to the City's water system customers. This is not a comprehensive how-to manual, as each emergency condition is unique, and the exact circumstances will dictate the actual actions to be taken. This document is intended as a guide to what is possible, and to help guide the responder to considering all possible actions in response to any specific emergency condition. The scenarios below are listed individually, but may occur in any combination, and each will have to be taken into consideration and weighed against the existing system conditions at the time.

SCENARIOS

1. Loss of Supply
    a. Loss of SFPUC Supply
    b. Loss of SCVWD (VW) Supply
    c. Loss of both SFPUC & VW Supply
    d. Loss of Well Supplies
2. Pump Station Issues
    a. Loss of PG&E power
        i. Ayer
        ii. Gibraltar
        iii. Hillside
        iv. Wells
    b. Loss of water supply
        i. Gibraltar
        ii. Ayer
        iii. Hillside

3. Distribution System Issues
    a. PRV Station loss/malfunction
    b. Zone interconnection
    c. Agency interconnection
    d. Contamination
    e. Fire suppression aid
    f. Main Line break
    g. Fire hydrant hit
    h. Construction shutdowns/tie-ins

1. Loss of Supply
    a. Loss of SFPUC supply

The loss of SFPUC supply may can occur in three ways: Loss of a single turnout, a reduction in quantity from SFPUC, or the total loss of supply from SFPUC.

i. Loss of a Turnout

SFPUC water is supplied to the City by four turnouts: Sunny Hills, Calaveras, Main Street and the SFPUC/SCVWD Intertie (when available). The loss of a single turnout can be compensated by the other turnouts. Changes in flow patterns within the distribution system will occur which can result in lower pressures in the extremities of the system and dirty water in areas where the flow has reversed or increased. These changes are most significant in zone SF2. The use of Ayer pump station to support peak use times is recommended.

ii. Reduction of Supply from SFPUC

In the event SFPUC cannot meet demands there may be a reduction in supply. Here are the possible ways to add supply to zones SF1 and SF2:

1. Pump from storage at Gibraltar and Ayer;
2. Activate Pinewood Well to pump to zone SF1;
3. (FUTURE) Activate Curtis Well to pump to either Gibraltar or zone SF2;
4. Use water from SCVWD at Gibraltar to supply zone SF1 through the use of the Intertie turnout;
5. Use water from SCVWD at Gibraltar to fill SFPUC reservoir and pump to zone SF1;
6. Use water from SCVWD by opening isolation valves in zones SC1 and/or SC2;

7. Contact ACWD and/or SJ Muni to activate intercity interties for zones SF1 & 2 – significant pressure differences exist, and this is a last resort.

iii. Total loss of supply from SFPUC

In the unlikely event we lose all supply from SFPUC or are required to isolate from SFPUC, the options are similar to the partial loss scenario above but may require a combination of options. Pumping from storage is the most immediate remedy while the other options are set up. Storage will not last long and is dependent on the amount of water in storage at that moment and the time of year the outage occurs. If the outage will last more than a few days, use of Pinewood and (future) Curtis Wells may be significant, as SCVWD will likely be tasked to help provide water to SFPUC and their supply may also be limited.

b. Loss of SCVWD Supply

SCVWD water is only supplied to the City through a single turnout located at Gibraltar Pump Station. Loss of supply may occur as a reduction in available water or as a total loss.

i. Supply Reduction and Total Loss Options
   1. Pump from storage at Gibraltar and use the VW turnout only to provide water to the SCVWD reservoir;
   2. Use SF water from the SFPUC/VW Intertie directly from the Intertie turnout using the Intertie PRV into zone SC2 – pressure will be reduced to about 130 to 135 psi, max;
   3. Use water from zone SF1 to provide water to the SCVWD reservoir either directly (pumping to zone

SF1 will not be possible in this configuration) or by floating the two reservoirs, while pumping to zone SC2.

c. Total Loss of both VW and SFPUC Supplies
    i. In the event both wholesale suppliers lose the ability to provide water to the City, the remaining supplies are limited to
        1. Storage at Ayer and Gibraltar;
        2. Pinewood, McCandless and Curtis Wells;
        3. Intercity Interties with ACWD and SJWC.
    ii. Pumping from storage would be the first recourse until the other two options are brought online. Ayer can supply water from the center of zone SF2. Gibraltar can provide water to zones SF1 and SC2.
    iii. Pinewood Well can pump to zone SF1 directly. Future options may allow it to pump to zone SC1.
    iv. McCandless Well, when completed, will be able to pump directly to zone SC1.
    v. Curtis Well, if completed, will be able to pump to any of the following:
        1. Gibraltar Pump Station, either or both reservoirs;
        2. Zone SF2;
        3. Zone SC2; or
        4. Zone SC1
    vi. Intercity Interties with ACWD can provide water to zones SF1 and SF 2 if ACWD has water to provide, along the City's north border.
    vii. An Intercity Intertie with SJWC can provide water to zone SF2 along the southeast border of the City if SJWC has water to provide and the zone pressure in our zone SF2 is low enough to accept water from SJWC.

d. Loss of Well Supplies
    i. Currently, the only well capable of supplying water to the City is Pinewood Well. It is currently permitted as

an Emergency Standby Well. Loss of this well would remove it from the options to provide water in the scenarios listed previously.

ii. Once all three of the City's wells are completed and brought into service as everyday supplies, the loss of supply from these wells would increase the amount of water the City would pull from its wholesale providers, which could have contract implications. In the event of an emergency, the loss of these wells as backup water supplies would eliminate the ability of the City to have an independent water supply under its control and eliminate this option as a means to provide water under any of the other emergency scenarios listed previously.

2. Pump Station Issues
    a. Loss of PG&E Power
        i. Ayer
            1. Ayer Pump Station is equipped with a 1,000 KW Caterpillar Genset which is capable of automatically starting and completely powering the station and all three pumps in the event of the loss of outside power.
            2. The station has a 1,000 gallon (900 gallon useable) above ground fuel storage tank that is capable of running the station for 24 hours before requiring refueling.
        ii. Gibraltar
            1. Gibraltar Pump Station is equipped with a 2.5 MW Genset which is capable of automatically starting and completely powering the pump station and all pumps in the event of the loss of outside power.
            2. The station has a 10,000 gallon (9,000 gallons useable) above ground fuel tank that is capable

of running the genset for 72 hours before refueling would be required.

3. The station also has 3 diesel powered pumps which can run independently with local controllers even if the station has no power. Pump 2 can be used to pump to zone SC2, pump 3 can be used to pump to zone SF1, and Pump 7 can be used as a booster to pump water directly from the SCVWD turnout into zone SC2.

iii. Hillside

1. All three Hillside stations are reliant on PG&E power for operation. All three do have a UPS battery emergency supply that will maintain power to the control panel and communications only.
2. Country Club and Tularcitos pump stations have a quick connect transfer switch mounted on the outside of the control building enclosures to be used with a portable trailer genset in the event of a power outage.
3. Country Club and Tularcitos also have pumper connections that can be used with either a trailer mounted portable pump or with a fire truck to act as emergency pumps and bypass the station to pump water to the next station. The City has a portable Paco trailer mounted pump with a capacity of approximately 1,000 gpm that can be used at either station.

iv. Wells

1. Pinewood well is not currently set up to easily take power from a portable generator set, nor does it have any installed backup power generator set. Loss of PG&E Utility power will render the well essentially inoperable and unable to serve water into the distribution system.

2. McCandless Well is being designed with a quick connect backup power transfer connection switch similar to the Hillside pump stations and should be operable to at least serve water on an emergency basis.
3. Curtis Well will likely be designed to the same standard as McCandless and able to use a portable generator as backup power to serve water on an emergency basis.

b. Loss of Water Supply
    i. Gibraltar
        1. Gibraltar Pump Station has three water supply sources:
            a. 42” pipeline from VW, known as the Milpitas Pipeline or the East Pipeline;
            b. 24” distribution line from Zone 1SF which can draw water from Main Street Turnout PRVs and Milpitas PRV (the Zone 1SF connection to the Calaveras Turnout);
            c. 10” connection to the VW/SFPUC Intertie which we call the Intertie Turnout, and normally draws SF water and is closed when VW is using the Intertie to send water to SFPUC.
        2. Virtually any of these supplies can be used to support the loss of any other supply through the use of valving at the pump station and/or the use of the two reservoirs onsite. The pump station was designed with versatility in mind, both in the manner and number of pump installations and in the use of valves and bypass pipelines. There are too many combinations possible to list them out individually. Here we will list the general possibilities – the Operator is encouraged to

carefully examine the potential water pathways for each situation to arrive at the best possible solution and to ensure no harm will be done.

3. Loss of the 42” VW supply:
    a. Intertie supply can be used through the Intertie PRV by setting to its highest pressure setpoint and closing the normally open connection to Zone 1SF and then opening the normally closed connection to Zone 2SC - PRV will support about 130 – 135 psi, so zone will run at a slightly lower pressure - the SF reservoir cannot be filled while in this mode;
    b. Booster or Peak Shaving pumps can be used to supply water from storage by using a Flow Through setup to supply the reservoir from Zone 1SF – Pumps can be run in conjunction with the Intertie PRV by setting the pumps to the same pressure as the PRV or the pumps can run in lead at a higher pressure with the Intertie PRV acting as a backup supply. Pumps 3 and 4 cannot be used to pump water from the SF reservoir while supplying water to the SC reservoir from zone 1SF.
    c. The 30” suction lines from the two 5 MG reservoirs can be linked together by opening valve BFV 101 between pumps 2 and 3. The level between the two reservoirs should be as close to the same as possible – the larger the difference between them, the higher the water velocity will be as valve BFV 101 is opened and the levels begin to equalize. This

method allows filling to occur through the SF reservoir from either zone 1SF or the Intertie PRV.

4. Loss of 24” zone 1SF line supply:
    a. Use the Intertie supply to fill reservoir and supply zone 1SF directly. Do not run pump 4 or 3 at the same time as filling the reservoir from zone 1SF, water will only recirculate and not supply the zone.
    b. Use the SC reservoir by opening valve BFV 101 to equalize the SC and SF reservoirs. See 2.b.i.3.c. above for caveats about opening valve BFV 101.
    c. Use the zone 2SC supply by closing valve BFV 020 and then opening valve BFV 021A to fill the SF reservoir from zone 2SC and use pump 4 and/or 3 to supply zone 1SF. This CANNOT be used to directly supply zone 1SF from zone 2SC due to the higher pressure.
5. Loss of 10” VW/SFPUC Intertie supply
    a. This supply is normally only used when the Intertie is not being used to send water from VW to SFPUC or vice versa. Normal configuration sends SFPUC water through this connection to our zone 1SF. Loss of this supply is made up from the 18” connection to zone 1SF which draws water through the distribution system from the low pressure supply PRV at Main St turnout and/or the Milpitas PRV, which is a nearly direct connection to the Calaveras Turnout.
    b. If it is not possible to fill the SF reservoir through the distribution system connection

to zone 1SF, there is a normally closed connection to zone 2SC which can be used to fill the SF reservoir. Since this is a high pressure zone, it cannot be used to directly supply zone 1SF – this must be done through use of pumps 3 and/or 4.

c. An additional method to use VW water to supply zone 1SF is to open the 30" isolation valve between the two reservoirs so they are both filled from the VW supply and use pumps 3 and/or 4 to send water to zone 1SF.

ii. Ayer

1. Ayer is supplied solely from zone 2SF. The station currently has a single inlet/outlet design, so water can only flow one way into or out of the station at any given time, meaning the station can pump out water or fill the reservoir, but cannot do both at the same time.
2. Calaveras Turnout is the main source of supply to Ayer pump station via large mains that come directly east on Calaveras Blvd from the Calaveras Blvd turnout and valve lot.
3. Loss of supply to Ayer would only occur if there were a loss of the pipeline that supplies the station from Calaveras Blvd, or if that segment of line was not in operation. There is no alternative supply for Ayer in either of those events, and Ayer would not be able to pump water out to the system, regardless of the quantity of water in storage.
4. A CIP project to provide a secondary pipeline connection from zone 2SF to the station has been proposed, but is not currently in design or under construction.

iii. Hillside

1. The Hillside, or La Questa, water system has only a single supply source – zone 2SF. Water is supplied from system pressure in zone 2SF to Country Club Pump Station. CCPS then pumps water into zone 3SF through a 12 inch transmission and distribution line via 2 250 gpm submersible vertical turbine pumps. This line both supplies the zone and delivers water to a 350,000 gallon reservoir (Tularcitos) at the top of the zone. This reservoir provides gravity pressure to the zone when the pumps are not in use.
2. There is no alternative source of supply if water cannot be delivered from zone 2SF to CCPS. If CCPS experiences failure that results in neither of the 2 pumps being able to pump water, then a backup potable water trailer pump must be brought in to act as the pump station. This pump would hook up to a fire hydrant at the pump station that would provide water from zone 2SF to the suction side of the trailer pump, and then the discharge line from the trailer pump would be connected to a special pumper connection designed for this purpose to provide water to zone 3SF. If the trailer pump is not available for some reason, a fire engine pumper can also be used.
3. Tularcitos reservoir and pump station is the next step in the Hillside water system. Tularcitos Pump station is nearly identical to CCPS in that it has 2 250 gpm submersible vertical turbine pumps that send water from zone 3SF and/or the Tularcitos Reservoir and deliver it into a 12 inch combination distribution/transmission line that

serves zone 4SFa and Minnis Reservoir. Minnis Reservoir provides gravity head and flow for zones 4SFa and 4SFb.

4. Loss of the pumps at Tularcitos would result in the loss of water supply to Minnis and zones 4SFa&b. Use of a trailer pump would be needed to replace the function of those pumps, similar to CCPS. Supply would come from a connection on the Tularcitos Reservoir, and discharge would be connected to a special pumper connection, similar to CCPS, to supply water to zone 4SFa and Minnis Reservoir.
5. Loss of the Tularcitos Reservoir would result in the loss of gravity supplied water to zone 3SF. There are two ways to compensate for this reservoir being out of service.
    a. At CCPS there is a pressure relief valve located in a vault with a manhole cover between the fenced pump station and Country Club Drive. This pressure relief valve is specifically there to enable the CCPS pumps to be run constantly to supply water to zone 3SF at a constant pressure. The pumps at CCPS are single speed pumps and cannot be ramped up and down to respond to demand changes in the zone to maintain a constant pressure. Instead, the relief valve will open at a set pressure to relieve the excess discharge from the pumps back into zone 2SF. This is not a perfect solution because the water discharged back into zone 2SF simply returns to the suction side of the CCPS pumps, thus running in a circle, and will result in the water being heated

and boiled by the pumps if not relieved. The solution to this is to use hoses to run a constant flow from hose bib connections on the discharge of each pump to the storm drain so that a minimal flow of new water is always coming into the pumps to keep them cool.

b. The other method to replace the supply from Tularcitos Reservoir is to use a combination pressure relief valve/pressure reducing valve located at Tularcitos Pump Station. There is a double leaf hatch covered vault with this valve located within. This valve has dual pilot valve systems installed on it, and normally uses the pilot valve system that is configured to run the valve as a pressure relief valve. This pilot system must be shut down, and the pilot valve system on the other side opened to configure the valve as a pressure reducing valve. This valve is connected to zone 4SFa and zone 3SF. As a relief valve it opens to relieve excess pressure from zone 4SFa to zone 3SF. As a pressure reducing valve, it opens to maintain use water from zone 4SFa/Minnis Reservoir to maintain a set pressure in zone 3SF, thus doing what Tularcitos reservoir was doing. This is the preferred method to use when Tularcitos Reservoir is not in service to maintain pressure in zone 3SF.

c. Getting water from zone 3SF to zone 4SFa/Minnis when Tularcitos Reservoir is not in service is different depending on

which method you are using to maintain pressure in zone 3SF. If telemetry is still working between Minnis and Tularcitos, the pumps at Tularcitos will cycle according to the level in Minnis reservoir and can be left to run on their own if using the CC pump method in a. above. The pumps at CC will supply water to the pumps at Tularcitos. Only one pump at Tularcitos should be used in auto to fill Minnis so that the capacity of the CC pumps are not exceeded. If using the pressure reducing valve method in b. above to maintain zone 3SF pressure, the pumps at CC and at Tularcitos will need to be run manually and at the same time. The level at Minnis will need to be monitored, and the pumps both shut down at the same time.

6. Loss of the Minnis Reservoir will result in the loss of gravity pressure and flow for zones 4SFa&b. This is compensated by using the combination relief and pressure reducing valve at Tularcitos in a manner similar to using the relief valve at CC when Tularcitos Reservoir is offline. With the combo valve operating on the pressure relief pilot system the pumps can be used to maintain the pressure in the system. Similar to the CC method, hoses need to be connected to the hose bibs on the discharge side of the pumps in order to keep a minimum flow through the pump and prevent the water from recirculating through the pump and overheating/boiling. See 5.a above.

3. Distribution System Issues
    a. PRV Station Loss/Malfunction
        i. Pressure Reducing Stations take water from a higher zone and feed it into a subsequent zone at a lower pressure. They are both a source of supply and pressure regulator. When I PRV fails, it will usually show signs before having a catastrophic failure. The regulated pressure will begin to increase and become more difficult to control to the desired set point. A gradually rising pressure on the regulated downstream side of the PRV can be a sign that the valves main diaphragm has a pinhole in it and needs to be replaced. It can also be a sign that the pilot valve is failing. If a PRV has failed or needs to be taken out of service the valve can usually be isolated by closing the up and down stream line valves and allowing the lag PRV to take over the load, assuming there is a lag PRV – most stations are configured with lead/lag parallel valves, but not all of them (Capital Ave and Parc Metro, for instance). If a valve does not have a parallel lead/lag to take over, the system balance may need to be adjusted by checking the other PRV stations and making minor pressure setpoint changes. Since possible flow direction changes may occur in the distribution system, this may result in dirty water calls and the need for flushing/NO-DES use to respond to the water flow changes.
    b. EPRV Station Loss Malfunction
        i. The EPRV stations are single PRVs set to allow water to move from SF zones into corresponding SC zones in the event that pressure falls in the SC zone below the minimum setpoint of the EPRV. When this happens, the EPRV will open and allow water to flow from the SF zone to the SC zone and will try to regulate the SC zone toe the EPRV setpoint pressure. Malfunction of an

EPRV will not result in overpressure of any zone, since the served zone is normally higher than the supplying zone, and water cannot flow in reverse through a PRV, even if it has failed. Loss of the function of this station only results in the loss of protection for the served zone in the event that zone incurs a pressure reduction. Zone isolation valves can be opened to directly supply water from the SF zone to the SC zone if needed as an alternative to the EPRV.

c. Zone Interconnection
    i. There are 44 zone isolation valves throughout the City. These are valves that were closed when the City went from being solely supplied by SFPUC to being supplied by both SFPUC and SCVWD (VW). There valves were marked by using large G12 valve boxes and painting them red. The are only to be opened in the event a zone has a supply failure that results in the loss of supply and pressure and all other means of supplying the zone are not available. Opening of these valves will need to be accompanied by flushing of the lines up and downstream and there will likely be dirty/stagnant water.
d. Agency Interconnection
    i. Milpitas has 3 intercity interties, two with ACWD and one with SJWC. Similar to the zone isolation valves, use of these valves is a last resort emergency response measure. Pressures are not the same between the separate agencies, and use must be coordinated between both agencies before opening the valves.
    ii. Connections with ACWD are located with one in zone 1SF on Milmont and one in 2SF on Churchill. The connection with SJWC is located in zone 2SF at the south end of the zone on Landess Ave.

Appendix C

Hydrant Testing and HPR Placement Plan

WEST YOST ASSOCIATES

MEMORANDUM

DATE: March 9, 2020 Project No.: 270-60-19-16
SENT VIA: EMAIL

TO: Harris Siddiqui, PE, City of Milpitas
Glen Campi, City of Milpitas

FROM: Roger Chu, PE, RCE #87591

REVIEWED BY: Amy Kwong, PE, RCE #73213

SUBJECT: City of Milpitas – 2020 Water Master Plan Update – Hydrant Testing and HPR Placement Plan

This memorandum summarizes the proposed hydrant testing and pressure data collection procedures required to calibrate the City of Milpitas's (City) potable water system hydraulic model. West Yost Associates' (West Yost) recommended plan for hydrant testing and hydrant pressure recorder (HPR) placement is provided for your review and comment, as summarized in the following sections:

- Hydrant Testing
- Hydrant Pressure Recorder Placement
- Summary of Hydrant Testing and HPR Placement Plan

It is recommended the City shares this plan with the appropriate parties (e.g., water operations and/or Fire Department staff), so they are aware of the equipment being used or installed at the proposed testing/pressure monitoring locations. Field pressure monitoring is scheduled to occur beginning March 10 through March 18 (monitoring period), and hydrant testing is scheduled for March 11, 2020.

HYDRANT TESTING

The purpose of hydrant testing is to confirm the assignment of roughness factors (C-factors) to pipelines in the City's hydraulic model. West Yost will use data collected though hydrant testing to ensure the assigned pipeline C-factors are appropriate and representative of actual field conditions. Hydrant tests were selected based on the combination of pipeline material type, diameter, and age that represents the majority of the City's water distribution system.

Details related to hydrant testing are presented in the following sections:

- Personnel and System Data Requirements
- Hydrant Testing Schedule
- Testing Requirements and Procedure
- City's Responsibilities

Personnel and System Data Requirements

West Yost would like to request the following City personnel and system data to accomplish the recommended hydrant testing under West Yost's direction:

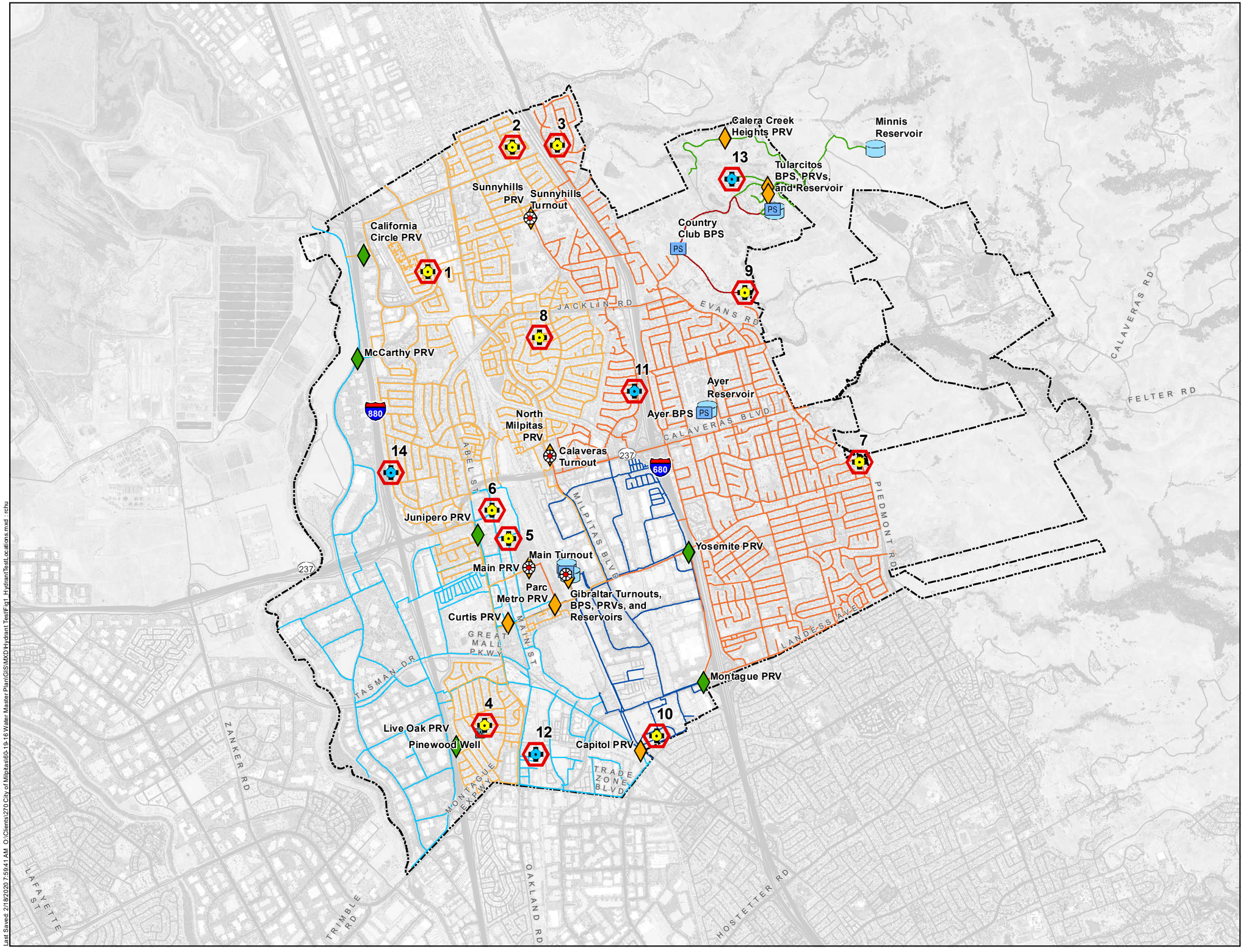
- Three (3) to five (5) City staff members (with vehicles) that will be available during regular working hours to assist with, but not limited to the following:
  - Closing and re-opening valves, as needed, before and after hydrant testing
  - Reading and recording hydrant pressure data
  - Flowing the test hydrant and de-chlorination
  - Directing and controlling traffic and hydrant flows (i.e., to the nearest drainage inlet) to ensure safety
  - Public outreach and interface, as needed
- System information during the monitoring period that includes the following:
  - Available SCADA and telemetry data from all water distribution system facilities:
    - Turnout flows and pressures
    - Reservoir levels [feet]
    - Booster Pump Station information (pump operational status, speed settings, discharge pressures [psi], and flow rate [gpm])
    - Pressure Reducing Valve information (upstream pressure [psi], downstream pressure [psi], and flow rate [gpm], if available)

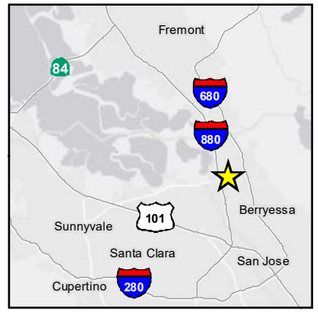
Hydrant Testing Schedule

West Yost requests that hydrant testing be scheduled from **7:30 AM to 4:30 PM on March 11, 2020**. West Yost will meet with the City staff before hydrant testing at the City's Public Works Department, located at 1265 North Milpitas Boulevard, to conduct a brief field coordination meeting to review hydrant testing procedure and protocol (i.e., where to go and what to do). West Yost will also use this coordination meeting to distribute pressure gauges necessary to complete hydrant testing (hydrant wrenches to be provided by City staff). In addition, West Yost will also discuss with City staff what order they prefer to conduct tests (i.e., avoid school traffic or commuter traffic, etc.) and to review hydrant tests that may present challenges.

Testing Requirements and Procedure

West Yost plans to conduct up to ten (10) hydrant tests within the City's water system. Figure 1 shows the proposed hydrant test locations. In addition, four (4) alternative hydrant tests have been identified. If any of the primary test locations are unable to be completed, an alternative location may be used. Table A-1 in Attachment A lists the proposed test locations. Details regarding each of the proposed tests (e.g., flowing hydrant, observation hydrants, closed valves, etc.) is also provided in Attachment A (Figures A-1 through A-14).





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Scale in Feet

- Test Location
- Alternate Test Location
- Turnout
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pump Station
- Storage Reservoir

Pipeline Pressure Zone

- SCZ1
- SCZ2
- SFZ1
- SFZ2
- SFZ3
- SFZ4
- City Limits

Figure 1

Hydrant Test Location Map

City of Milpitas
2020 Water Master Plan Update

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Each hydrant test will involve maintaining flow from a single hydrant while monitoring the residual pressure at two (2) to four (4) observation hydrants located near the flowing hydrant. The field-observed static and residual pressure readings will then be used to confirm pipeline C-factors to calibrate the hydraulic model to observed conditions. Hydrant test locations have been selected to isolate pipelines of a particular material type, diameter, and age. Some tests will require City staff members to close one (1) or more isolation valves prior to the test and then re-open these isolation valves following the test.

The general testing procedure at each of the hydrant test locations is outlined below and illustrated on Figure 2:

Step 1. Before attaching the pressure gauge, flush the test (flowing) hydrant and each observation hydrant to remove sediments, which might damage the gauge or cause faulty readings.

Step 2. Attach the pressure gauge to the hydrant with the gauge's test cock valve open. Slowly open the hydrant and bleed off the gauge with the gauge's test cock until the hydrant is fully pressurized.

Step 3. Close the gauge test cock valve, and then measure the static pressures at the designated test hydrant and each observation hydrant.

Step 4. Flow the designated test hydrant and measure the discharge flow and pressure.

Step 5. Measure the residual pressures at the designated test hydrant and at each observation hydrant while the test hydrant is flowing.

Step 6. Continue monitoring pressure until the "all clear" is given by a West Yost employee. Record the static pressure and then detach the pressure gauge. ***IMPORTANT:*** *Before closing the hydrant, be sure the gauge's test cock valve is open and bleeding while the hydrant is being closed.*

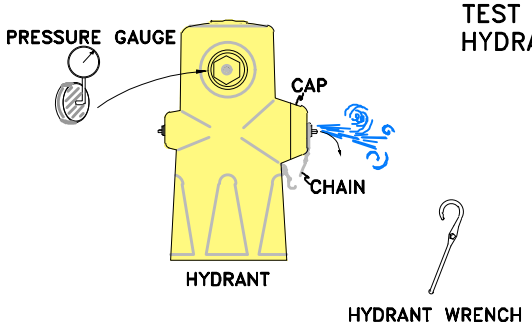
At least one (1) City staff member will be required at the flowing test hydrant and up to two (2) additional City personnel will be required in the field to assist with the opening and closing of valves (refer to Attachment A). West Yost will provide three (3) staff members to direct, oversee, and assist in the field data collection work effort.

It is anticipated that each hydrant test will take no more than 30 minutes and that each hydrant will be flowing for no more than 10 minutes during a test.

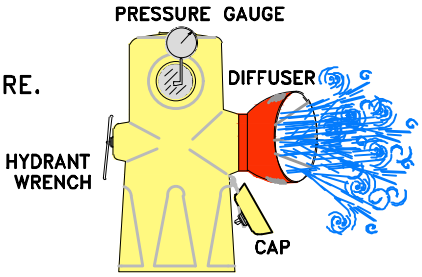
Testing Equipment

West Yost will provide a 4.5-inch diameter Swivel Piezo Diffuser and pressure gauges during the hydrant testing program. It is our recommendation that the 4.5-inch diameter Swivel Piezo Diffuser be used for all proposed hydrant tests. For any hydrant test where is it not possible to use this type of diffuser due to drainage or traffic control issues, an alternative method will need to be further evaluated and confirmed before the day of field testing.

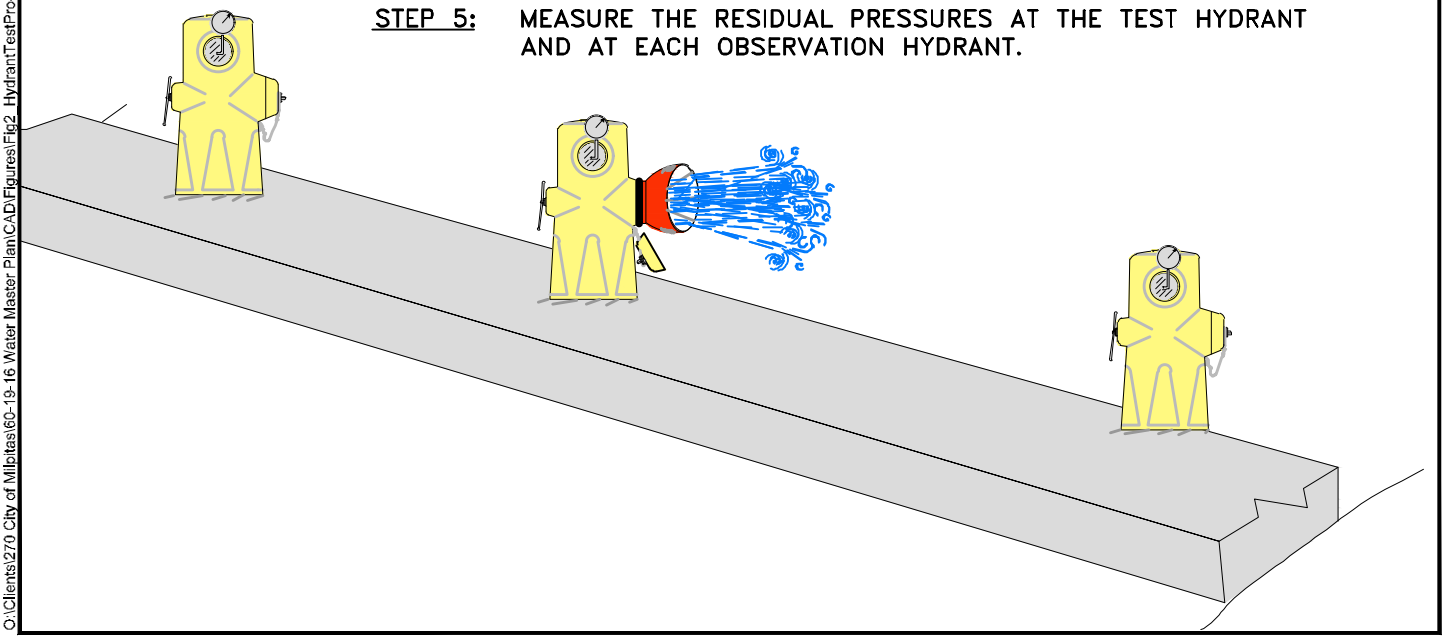
STEPS 1, 2 & 3: REMOVE HYDRANT CAP, FLUSH OUT HYDRANT AND MEASURE THE STATIC PRESSURES AT THE TEST HYDRANT AND AT EACH OBSERVATION HYDRANT.



STEP 4: FLOW THE DESIGNATED TEST HYDRANT AND MEASURE THE DISCHARGE FLOW AND PRESSURE.



STEP 5: MEASURE THE RESIDUAL PRESSURES AT THE TEST HYDRANT AND AT EACH OBSERVATION HYDRANT.



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Note:
1. Figure is not to scale.

WEST YOST ASSOCIATES

Figure 2

Hydrant Test Procedure

City of Milpitas
2020 Water Master Plan Update

City's Responsibilities

The City will be responsible for providing the following hydrant testing equipment:

1. Vehicles
2. Hydrant wrenches
3. Equipment for closing valves and controlling traffic
4. De-chlorination equipment[1]
5. Two-way portable communication for each testing personnel

The City is also responsible for notifying residents, and other City staff and departments (i.e., Fire Department) about the scheduled hydrant testing, obtaining approvals that may be required, and providing proper drainage of the hydrant flow.

West Yost requests that the City staff review and inspect each of the proposed test locations before the testing date to identify any potential problems or hazards with the selected locations. Of concern is the potential for flooding landscaping or building basements or creating hazardous traffic conditions. West Yost recommends that all drainage inlets/manholes be inspected near the testing site to confirm proper drainage. Additionally, the City should check the location and status of hydrants and valves that will be operated during hydrant testing. Detailed figures, which illustrate the flowing hydrant, observation hydrants, and valves to be closed, are provided in Attachment A.

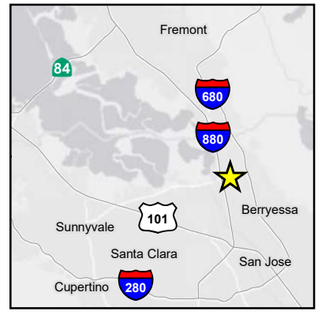
HYDRANT PRESSURE RECORDER PLACEMENT

Placement of HPRs at key hydrants within the City's water system allows West Yost to verify pressures simulated in the City's hydraulic model. West Yost has identified twenty (20) hydrants to monitor water system pressures with HPRs. The selected HPR locations are typically downstream of water supply facilities (e.g., turnouts, booster pump stations, and pressure reducing valves).

West Yost is proposing to install the twenty (20) HPRs on March 10, 2020 to collect pressure information for a total of one (1) week. West Yost plans to attach the HPRs to the 2.5-inch port on specified hydrants and lock them in place with a padlock. After the seven-day monitoring period is complete, West Yost will remove the HPRs from their locations (March 18, 2020) and download and review the collected data. Figure 3 shows the general location of each HPR. Table B-1 (in Attachment B), describes the approximate location of each HPR and the water supply facility being monitored. Attachment B also includes detailed figures showing the specific location of each hydrant selected for HPR placement (Figures B-1 through B-20). West Yost requests that City staff review and inspect each of the proposed HPR placement locations before the placement date to identify any potential problems with the selected locations.

[1] Handling of water released from each hydrant test will need to comply with City Operations procedures and be consistent with the City's NPDES permit for planned releases from hydrant tests.

Calera Creek Heights PRV
18
20
Minnis Reservoir
16
19
Sunnyhills PRV
9
4
California Circle PRV
14
15
17
Tularcitos BPS, PRVs, and Reservoir
Country Club BPS
JACKLIN RD
EVANS RD
McCarthy PRV
680
Ayer Reservoir
Ayer BPS
PS
5
3
North Milpitas PRV
CALAVERAS BLVD
237
8
880
Junipero PRV
ABEL ST
MILPITAS BLVD
Main Turnout
Gibraltar Turnouts, BPS, PRVs, and Reservoirs
Yosemite PRV
2
Main PRV
7
12
Curtis PRV
6
Parc Metro PRV
1
MAIN ST
GREAT MALL PKWY
11
13
Montague PRV
TASMAN DR
CAPITOL AVE
Pinewood Well
W
Live Oak PRV
Capitol PRV
10
TRADE ZONE BLVD
MONTAGUE EXPWY
OAKLAND RD
ZANKER RD
TRIMBLE RD
HOSTETTER RD
LANDESS AVE
PIEDMONT RD
CALAVERAS RD
FELTER RD



N

0 1,500 3,000

Scale in Feet

- Proposed HPR Location
- Turnout
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pump Station
- Storage Reservoir

Pipeline Pressure Zone

- SCZ1
- SCZ2
- SFZ1
- SFZ2
- SFZ3
- SFZ4
- City Limits

Figure 3

Hydrant Pressure Recorder Location Map

City of Milpitas
2020 Water Master Plan Update

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It is important for City staff to coordinate with the Fire Department and any other appropriate parties regarding the HPR locations and duration of monitoring. This will help reduce the chance of inadvertently shutting off a hydrant with an HPR installed and may also reduce the risk of an HPR being removed or tampered with. *Each HPR is equipped with a padlock and a set of keys will be provided to the City staff. However, in case of an emergency, the Fire Department can break the lock to remove the HPR.* If an HPR is required to be removed during a non-emergency, or if the associated hydrant needs to be shut off, West Yost requests that the Fire Department inform City staff and that City staff will then coordinate with West Yost.

SUMMARY OF HYDRANT TESTING AND HPR PLACEMENT PLAN

Hydrant testing will be performed as described above beginning at 7:30 AM on Wednesday, March 11, 2020. West Yost proposes to install HPRs on Tuesday, March 10, 2020 and remove them on Wednesday, March 18, 2020. The locations and associated detailed location maps of the designated hydrants for testing and HPR placement are presented in Attachments A and B, respectively.

West Yost requests a conference call with City staff on Wednesday, March 4, approximately one week before the scheduled testing day, to review and finalize preparations for the hydrant testing and HPR placement. An Outlook meeting request will be sent to City staff to finalize a suitable meeting date and time.

Please feel free to contact Roger Chu at (925) 425-5631 or Amy Kwong at (925) 461-6788 if you have any questions or comments.

ATTACHMENT A

Table A-1. Hydrant Test Locations[a]

Test No.	Pipeline Material	Installation Decade	Pipeline Diameter, Inches	Location	Pressure Zone	No. of Closed Valves	Comments
1	PVC	1990s	8	Along Elkwood Drive	SF1	1	-
2	AC	1960s	6	Along Gosser Street	SF1	1	-
3	AC	1980s	6	Along Stirling Drive and Stratford Drive	SF2	2	-
4	AC	1960s	6	Along Greentree Way	SF1	3	-
5	PVC	1980s	8	Along Hammond Way	SC1	1	-
6	AC	UNK[b]	8	Along Main Street	SC1	2	-
7	AC	1970s	8	Along Lacey Drive	SF2	1	-
8	AC	1970s	6	Along Clauser Drive	SF1	3	-
9	AC	1980s	8	Along Calaveras Ridge Drive	SF3	0	-
10	DI	2000s	8	Within Crossing at Montague Apartments	SC2	1	-
11	AC	1980s	6	Along Las Lomas Drive and Pacheco Drive	SF2	1	Alternate
12	PVC	2000s	8	Along Costa Street and Mihalakis Street	SC1	2	Alternate
13	AC	1980s	8	Along Pebble Beach Court	SF4-1	0	Alternate
14	AC	1960s	8	Along Heath Street	SF1	2	Alternate

(a) 10 test locations and 4 alternate test locations, if time permits.
(b) UNK = unknown

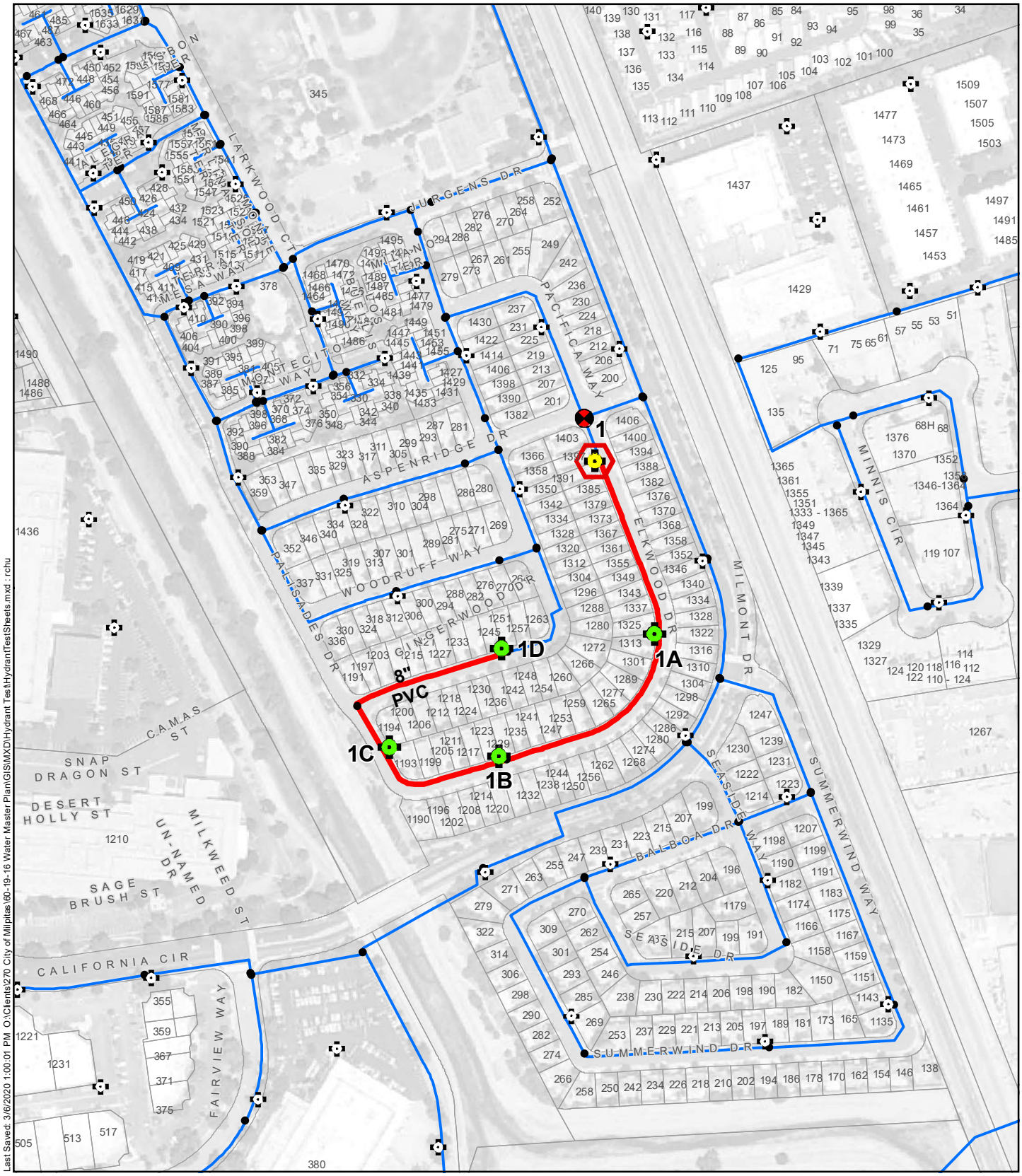

Figure A-1

Test 1 - Zone SF1
(8-inch PVC - 1990s)

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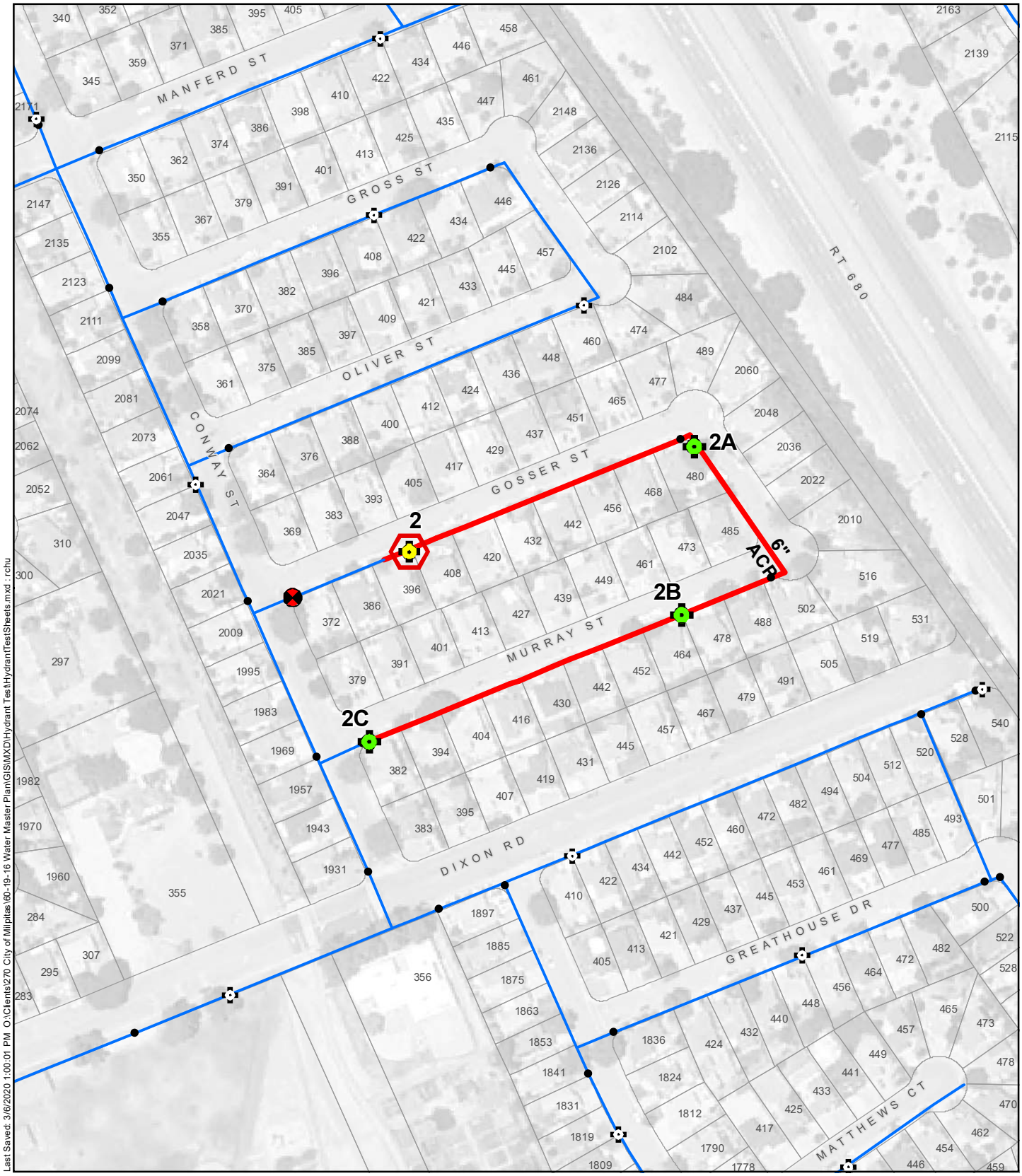

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Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (1 total)
Valve

Test Pipeline
Pipeline

N

0 100 200
Scale in Feet

Figure A-2

Test 2 - Zone SF1
(6-inch AC - 1960s)

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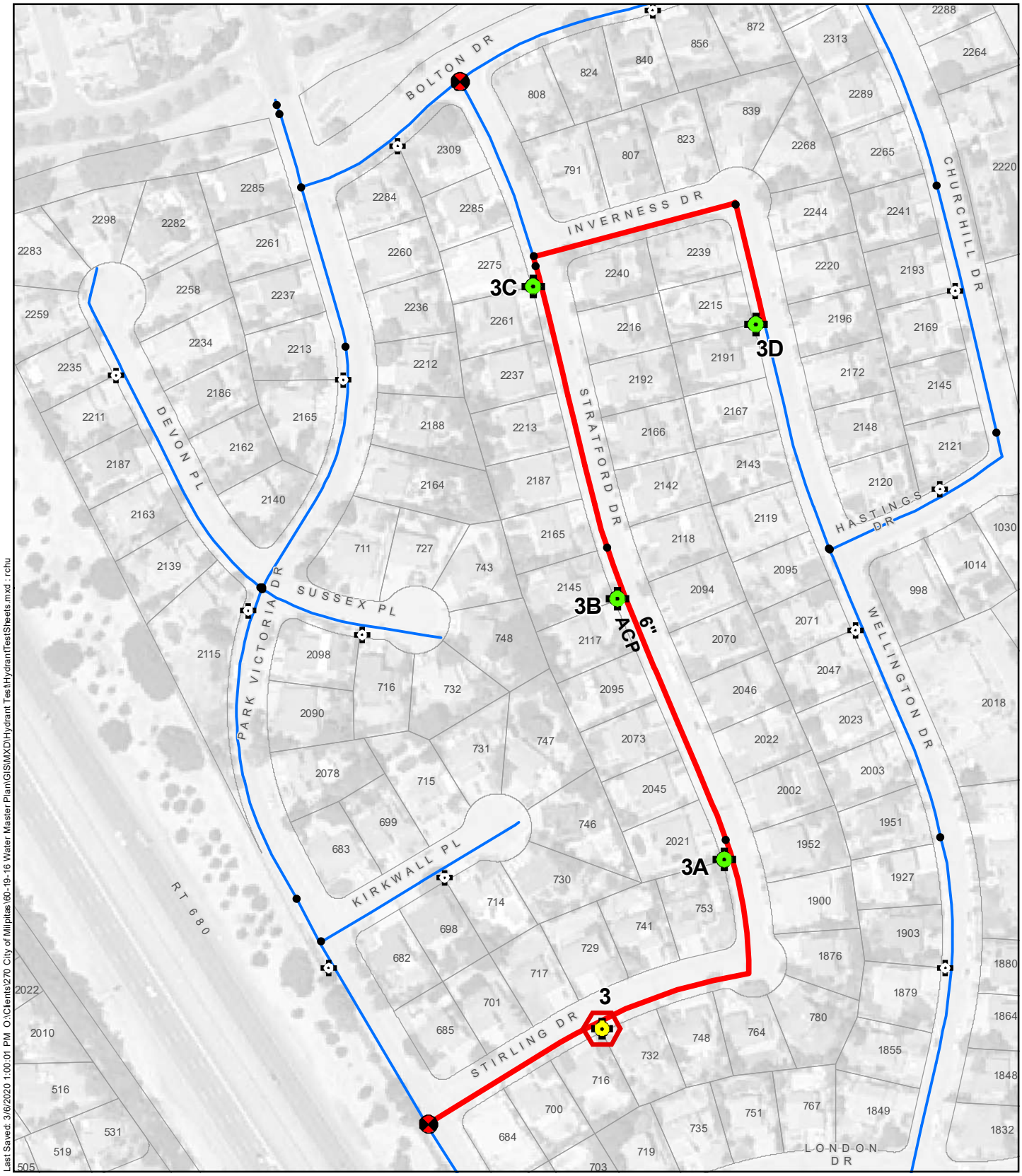

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Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (2 total)
Valve

Test Pipeline
Pipeline

N

0 100 200
Scale in Feet

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Figure A-3

Test 3 - Zone SF2 (6-inch AC - 1980s)

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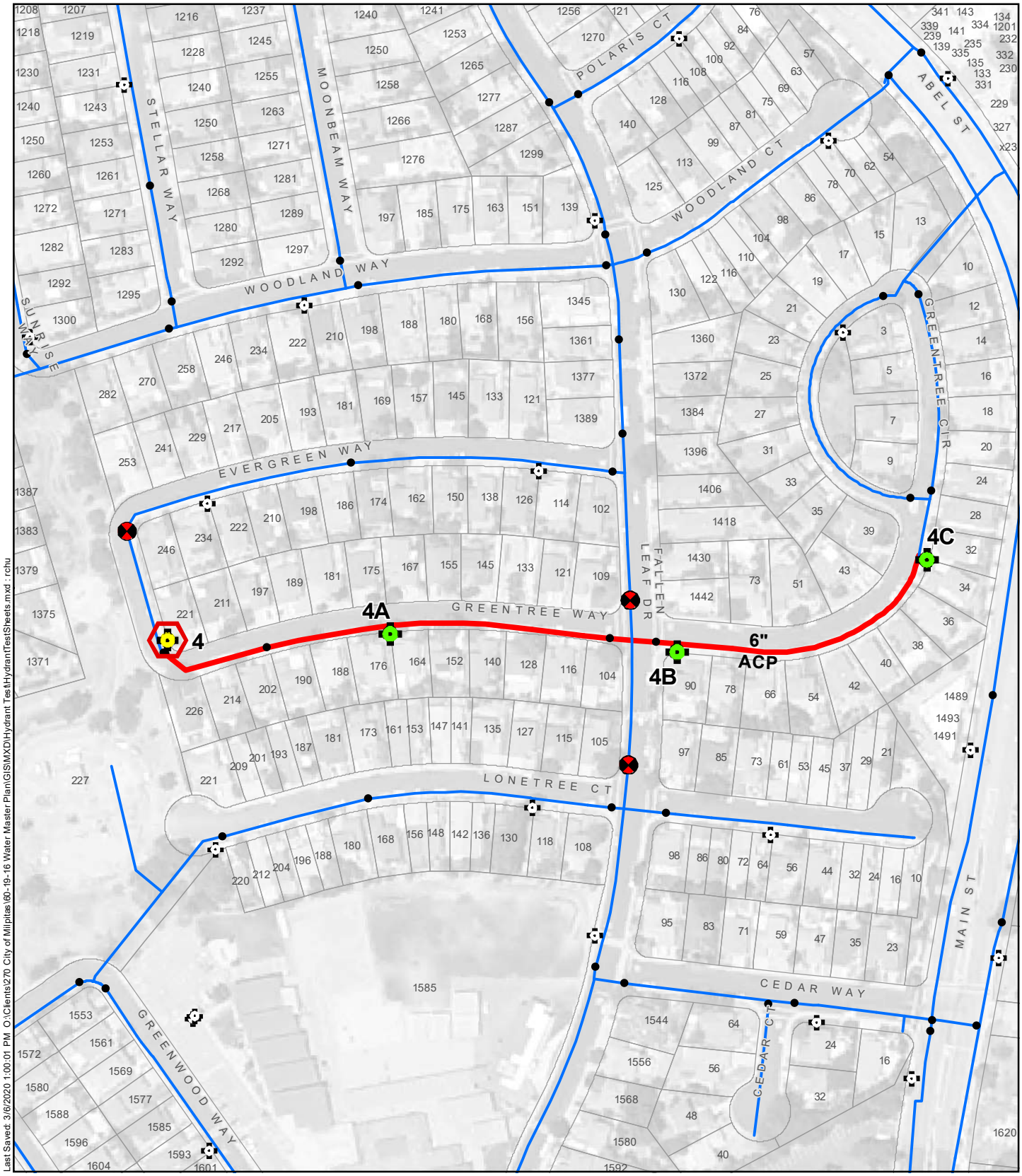

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Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (3 total)
Valve

Test Pipeline
Pipeline

N

0 100 200
Scale in Feet

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Figure A-4

Test 4 - Zone SF1 (6-inch AC - 1960s)

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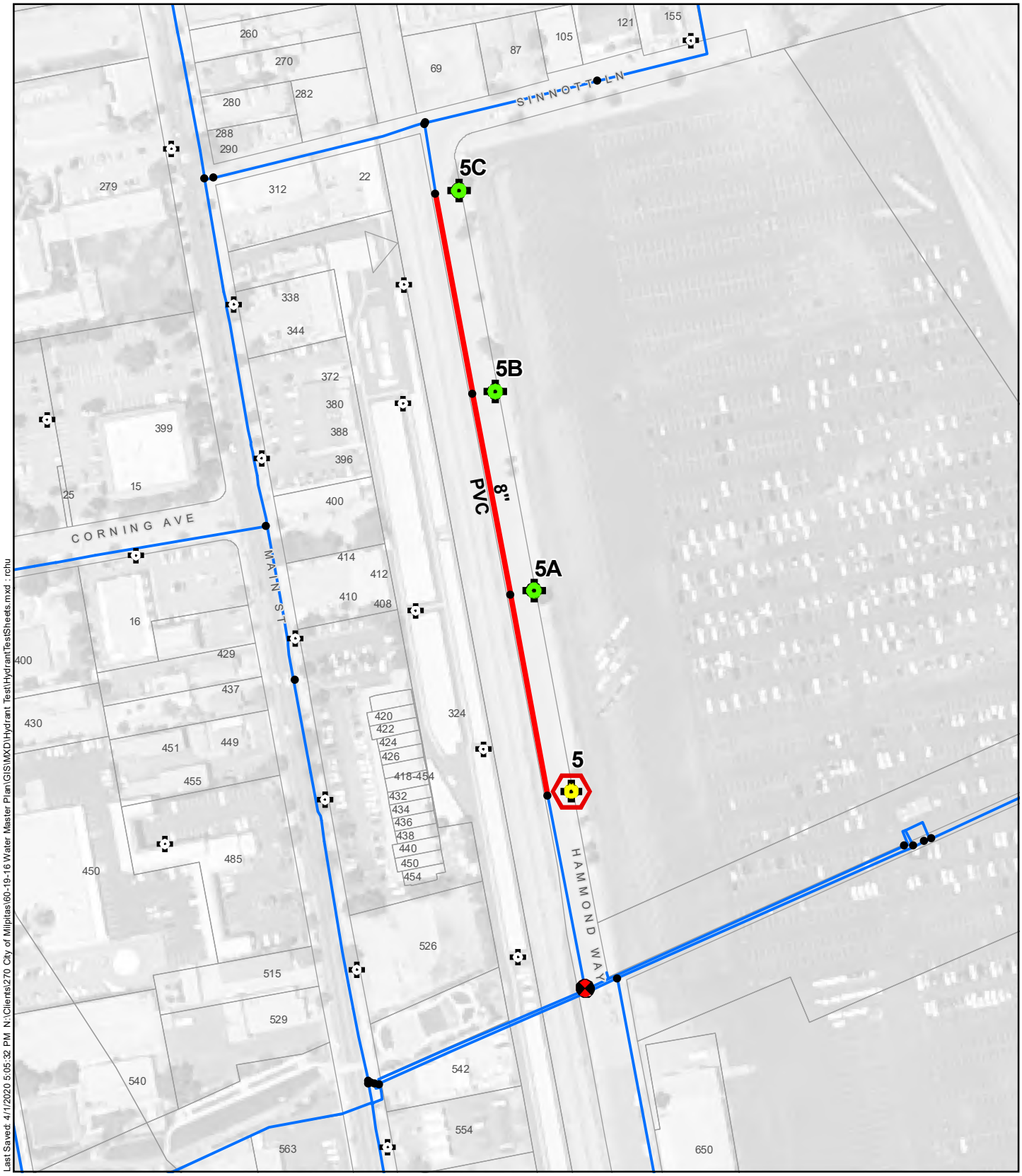

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Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (1 total)
Valve

Test Pipeline
Pipeline

N

0 100 200
Scale in Feet

CITY OF MILPITAS CALIFORNIA

WEST YOST ASSOCIATES

Figure A-5

Test 5 - Zone SC1
(8-inch PVC - 1980s)

City of Milpitas
2020 Water Master Plan Update



Figure A-6

Test 6 - Zone SC1
(8-inch AC - UNK)

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2020 Water Master Plan Update



Figure A-7

Test 7 - Zone SF2
(8-inch AC - 1970s)

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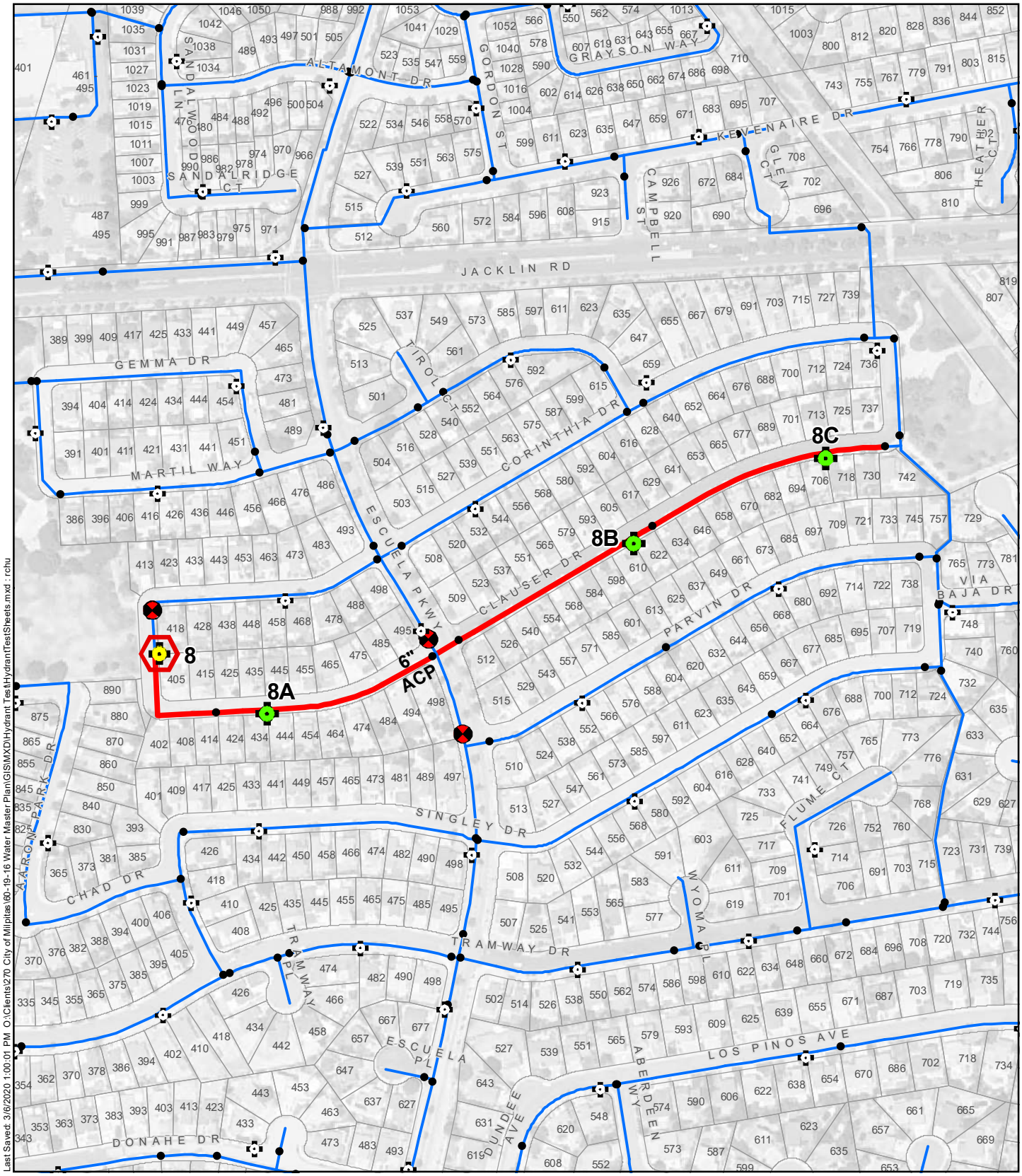

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Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (3 total)
Valve

Test Pipeline
Pipeline

N

0 150 300
Scale in Feet

WEST YOST ASSOCIATES

Figure A-8

Test 8 - Zone SF1
(6-inch AC - 1970s)

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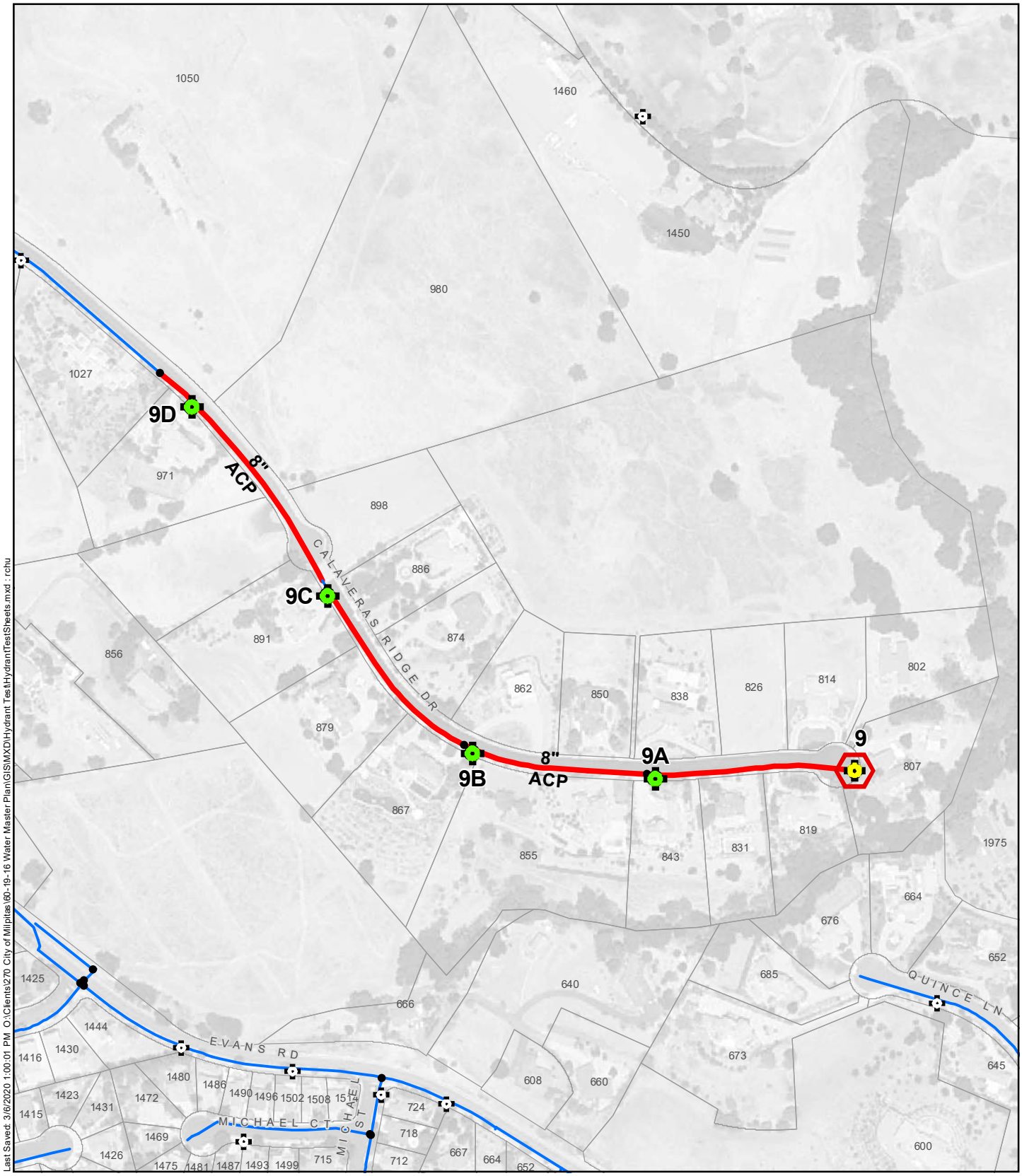

Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (0 total)
Valve

Test Pipeline
Pipeline

N

0 150 300
Scale in Feet

Figure A-9

Test 9 - Zone SF3
(8-inch AC - 1980s)

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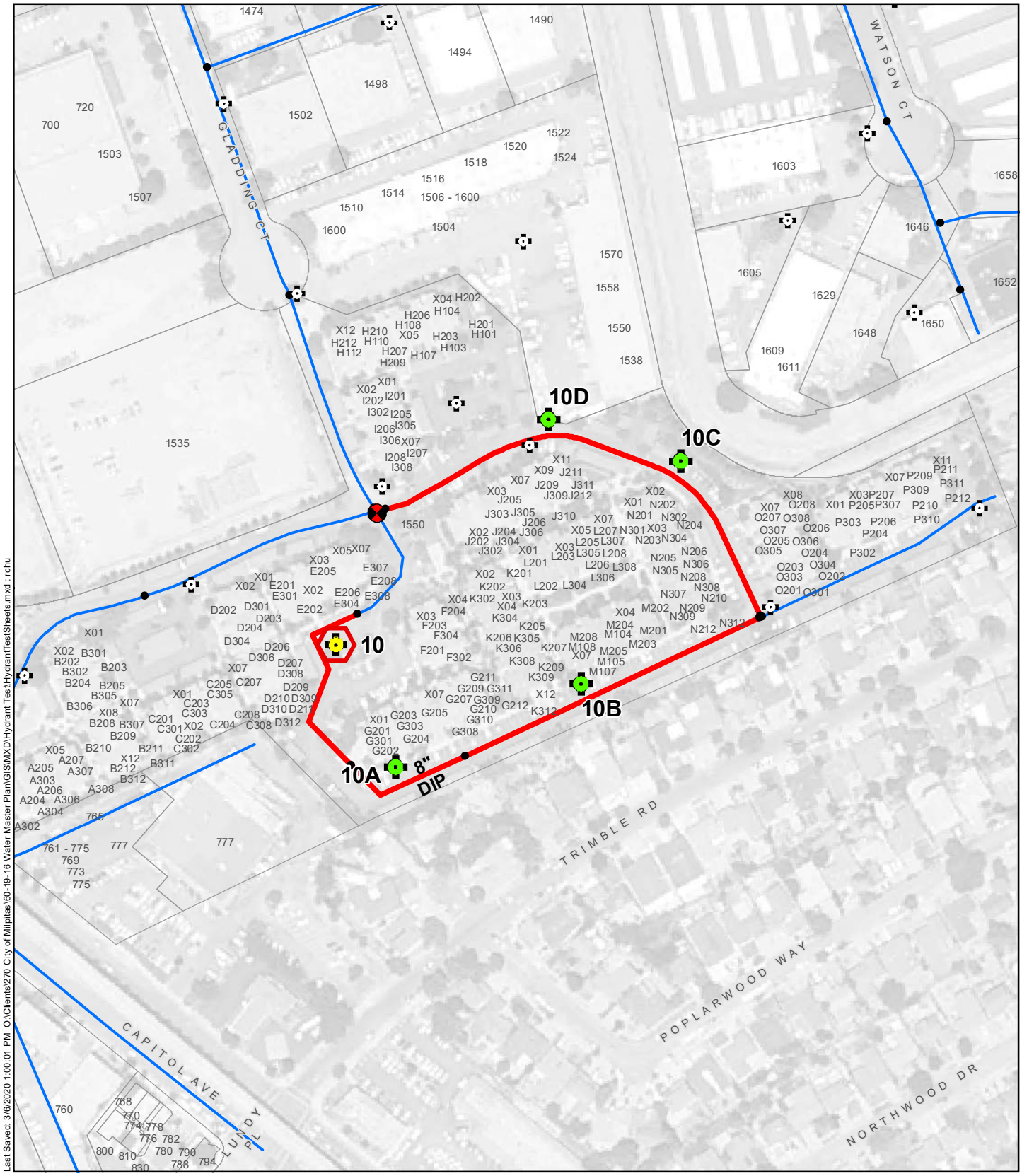

Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (1 total)
Valve
Test Pipeline
Pipeline

N

0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure A-10

Test 10 - Zone SC2 (8-inch DI - 2000s)

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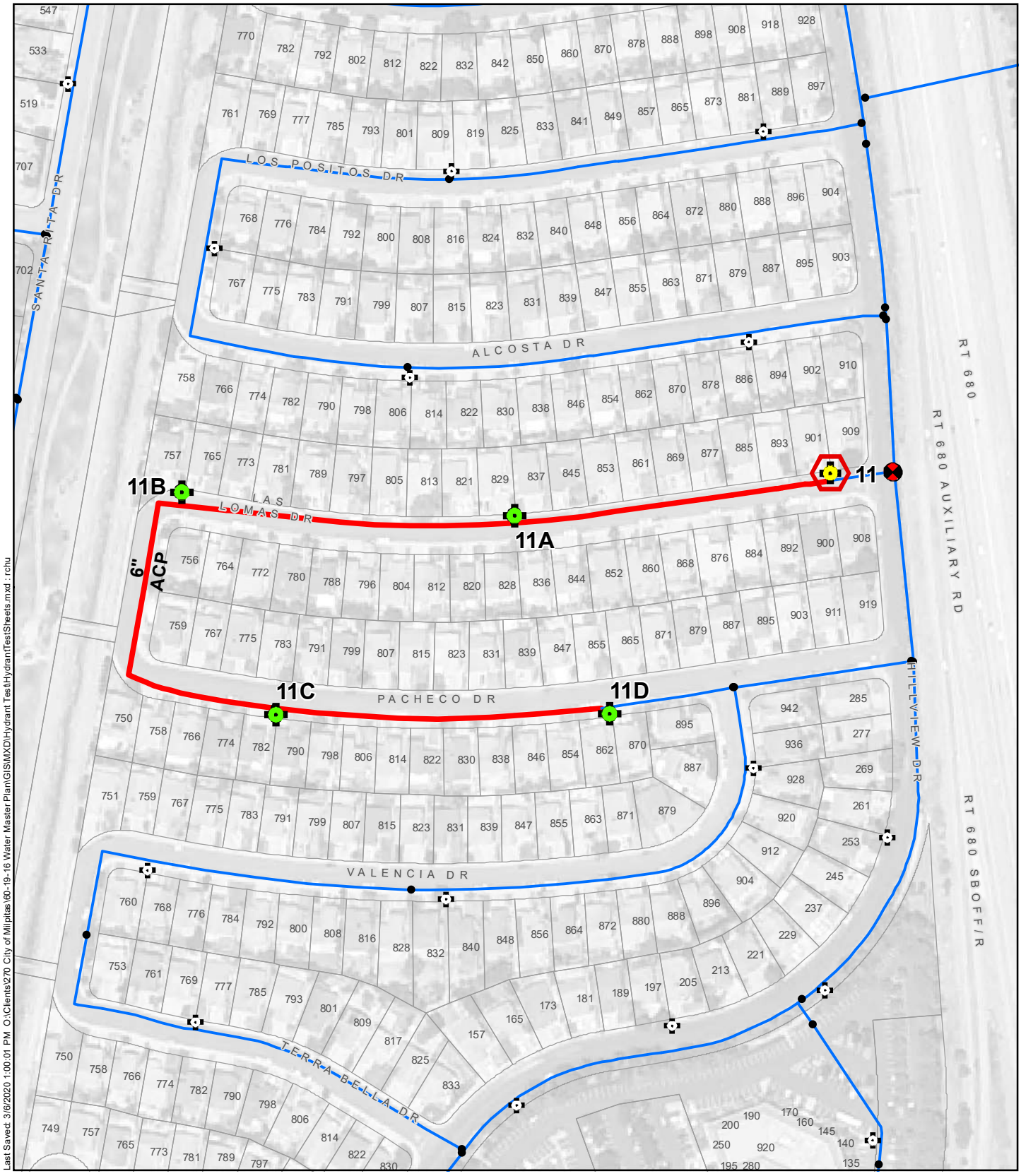

Figure A-11

Alternate Test 11
Zone SF2
(6-inch AC - 1980s)

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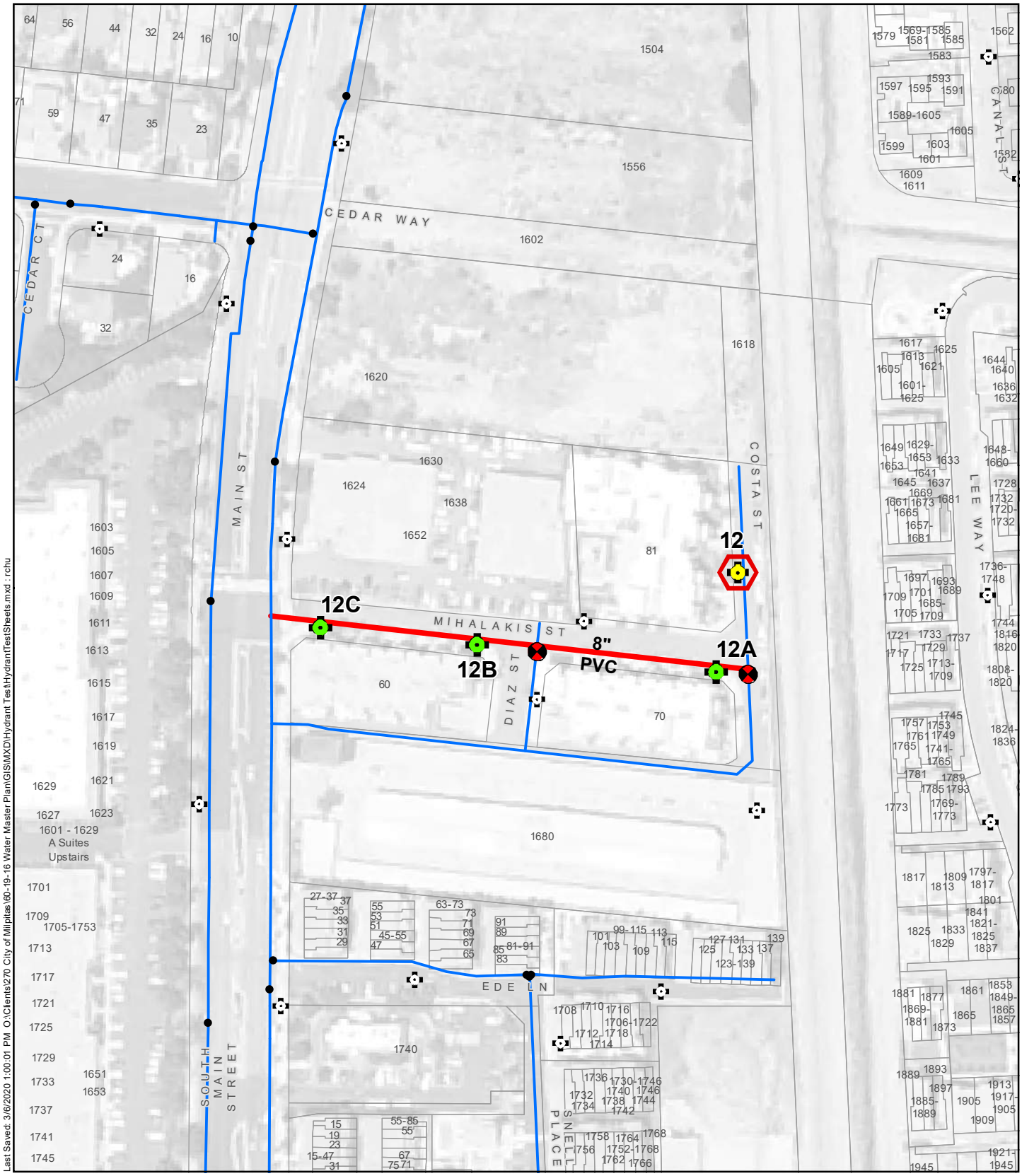

Flowing Hydrant

Observed Hydrant

Hydrant

Closed Valve (2 total)

Valve

Test Pipeline

Pipeline

N

0 75 150

Scale in Feet

Figure A-12

Alternate Test 12
Zone SC1
(8-inch PVC - 2000s)

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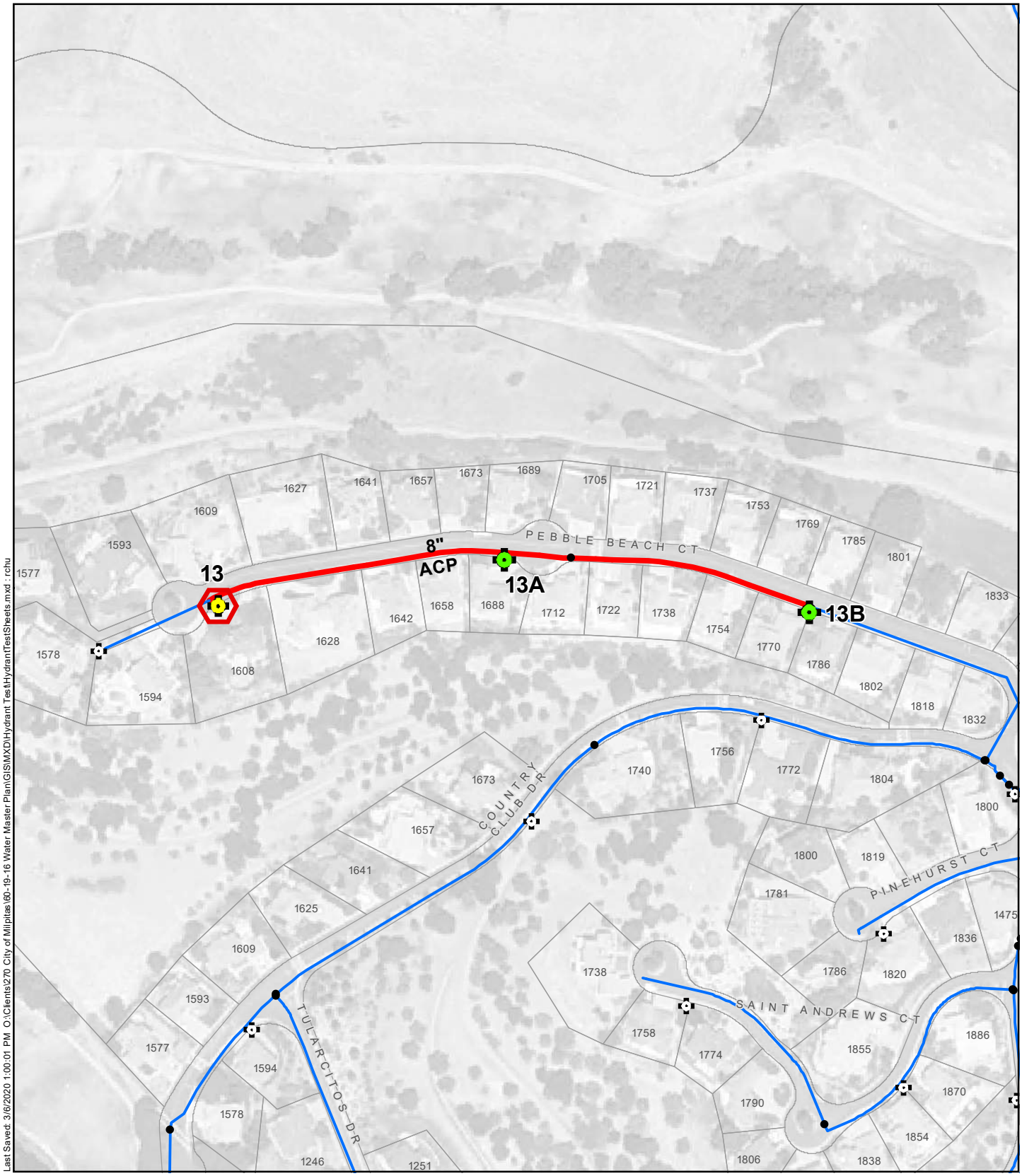
2020 Water Master Plan Update



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Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (0 total)
Valve

Test Pipeline
Pipeline

N

0 100 200
Scale in Feet

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Figure A-13

Alternate Test 13
Zone SF4-1
(8-inch AC - 1980s)

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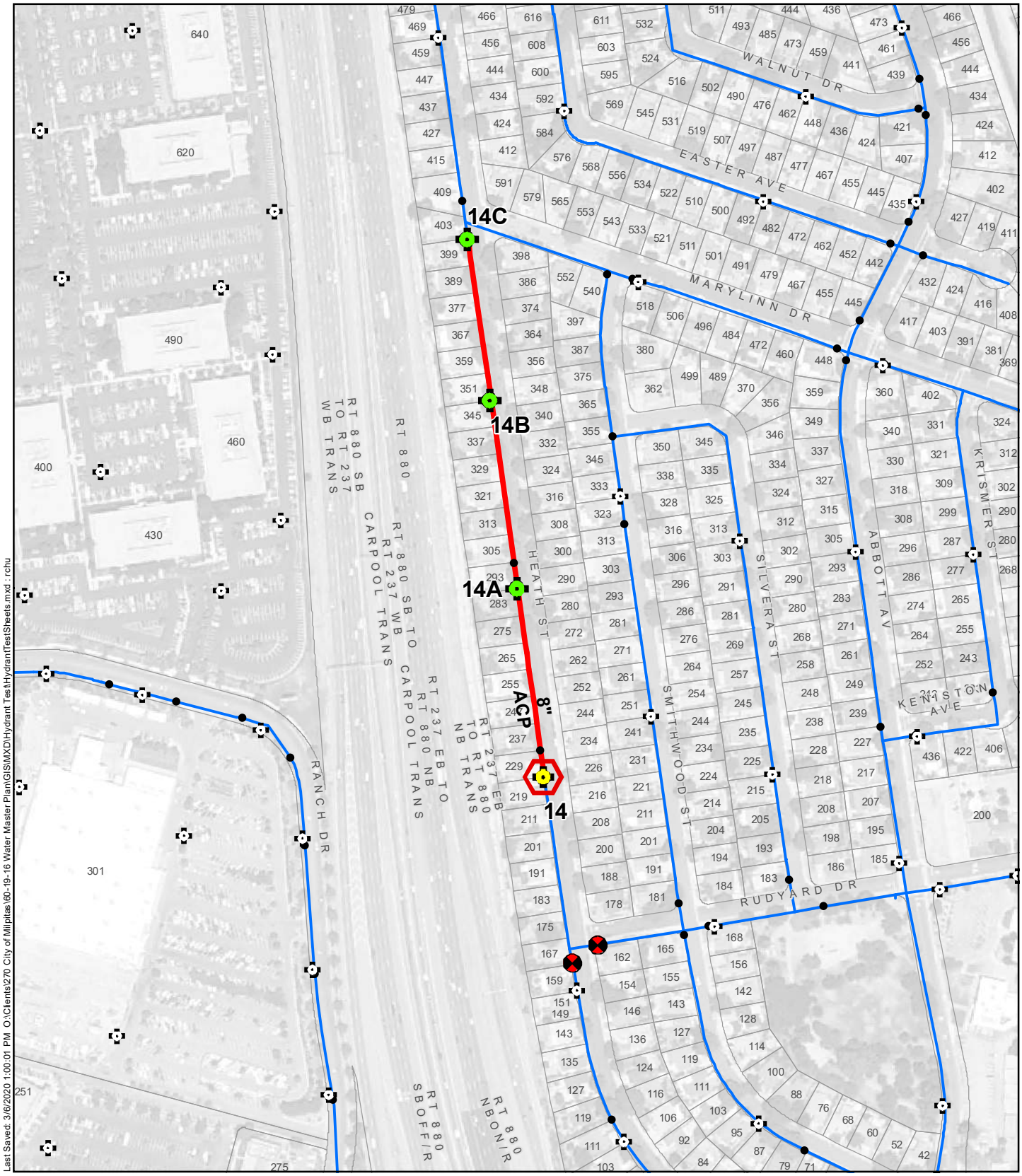

Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (2 total)
Valve
Test Pipeline
Pipeline

N

0 150 300
Scale in Feet

Figure A-14

Alternate Test 14
Zone SF1
(8-inch AC - 1960s)

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ATTACHMENT B

Table B-1. Hydrant Pressure Recorder Locations			
HPR No.	Pressure Zone	Facility Monitored	Location
1	SF1	Gibraltar BPS	Near 819 E Curtis Ave
2	SF1	Main St PRV	SW corner of Corning Avenue and Abel Street
3	SF1	N Milpitas PRV	Near 70 N Milpitas Boulevard
4	SF1	Sunnyhills PRV	Near 361 Washington Drive
5	SF2	Ayer BPS	Near 1439 E Calaveras Boulevard
6	SC1	Parc Metro PRV	Near 232 Parc Place Drive
7	SF2	Main St Turnout	Near 271 Parc Place Drive
8	SF2	Calaveras Turnout	NE corner of N Milpitas Boulevard and E Calaveras Boulevard
9	SF2	Sunnyhills Turnout	Near 1589 Washington Drive
10	SC1	Capitol PRV	Lundy Pl near 880 E Capitol Avenue
11	SC1	Curtis PRV	Near 1189 Barber Lane
12	SC2	Gibraltar PRV	Intersection of Gibraltar Court and Gibraltar/Yosemite Drive
13	SC2	Gibraltar BPS	Piper Dr between Garden Street and Meridian Place
14	SF3	Country Club BPS	Country Club Drive, north of BPS
15	SF3	Tularcitos Tank	Near 1251 Tularcitos Drive
16	SF4-1	Tularcitos N PRV	Near 1772 Country Club Drive
17	SF4-1	Tularcitos S PRV	Near 1870 Saint Andrews Court
18	SF4-1	Calera Creek Heights PRV	Near 1631 Calera Creek Heights Drive
19	SF4-2	Tularcitos BPS	Near 1490 Tularcitos Drive
20	SF4-2	Minnis Tank	Near intersection of Monument Peak Road and Downing Road (Launch Site Road?)



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- Proposed HPR Location
- Hydrant
- Turnout
- Pump Station
- Storage Reservoir
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

N

0 100 200

Scale in Feet

Figure B-1

Hydrant Pressure Recorder Locations

City of Milpitas
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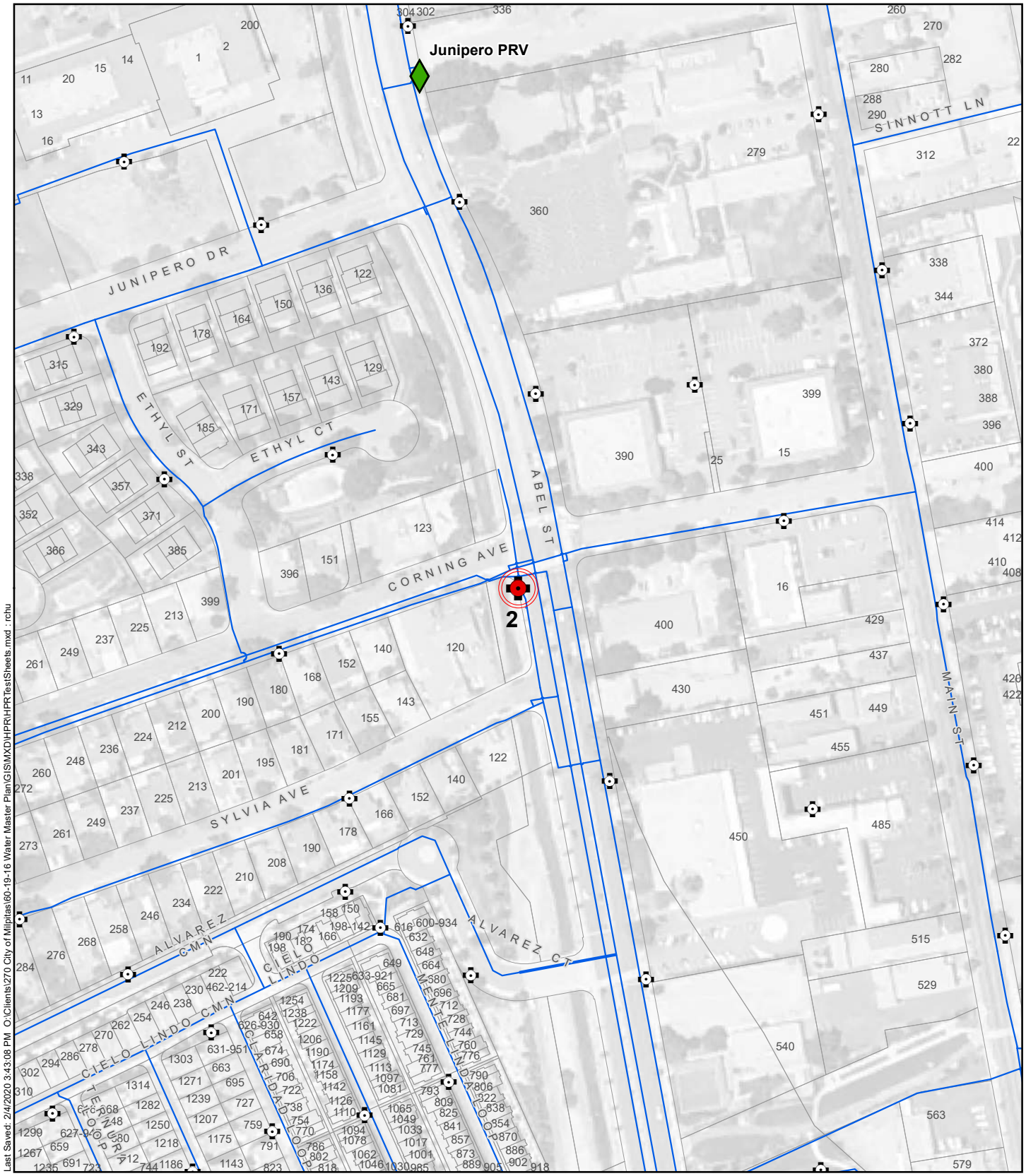

Proposed HPR Location
Hydrant
Turnout
Pump Station
Storage Reservoir
Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200

Scale in Feet

Figure B-2

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



Proposed HPR Location
Hydrant
Turnout
Pump Station
Storage Reservoir
Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200
Scale in Feet

CITY OF MILPITAS CALIFORNIA

WEST YOST ASSOCIATES

Figure B-3

Hydrant Pressure Recorder Locations

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- Proposed HPR Location
- Hydrant
- Turnout
- Pump Station
- Storage Reservoir
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

N

0 100 200

Scale in Feet

WEST YOST ASSOCIATES

Figure B-4

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



Proposed HPR Location
Hydrant
Turnout
PS Pump Station
Storage Reservoir
W Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-5

Hydrant Pressure Recorder Locations

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- Proposed HPR Location
- Hydrant
- Turnout
- Pump Station
- Storage Reservoir
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

N

0 100 200

Scale in Feet

WEST YOST ASSOCIATES

Figure B-6

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



- Proposed HPR Location
- Hydrant
- Turnout
- Pump Station
- Storage Reservoir
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

N

0 100 200

Scale in Feet

Figure B-7

Hydrant Pressure Recorder Locations

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2020 Water Master Plan Update

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Proposed HPR Location
Hydrant
Turnout
Pump Station
Storage Reservoir
Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-8

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



Proposed HPR Location
Hydrant
Turnout
PS Pump Station
Storage Reservoir
W Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

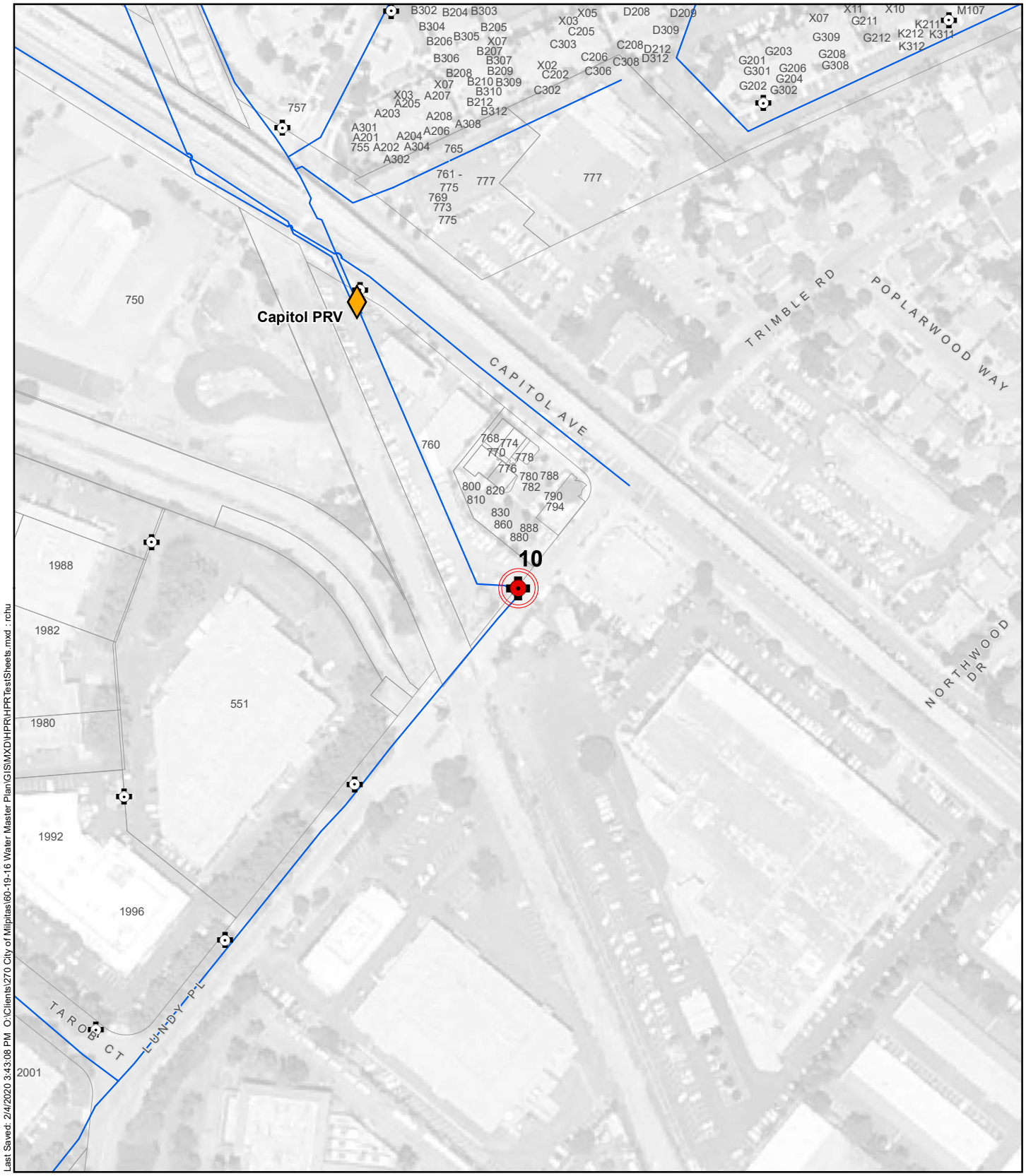
0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-9

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



Proposed HPR Location
Hydrant
Turnout
Pump Station
Storage Reservoir
Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200

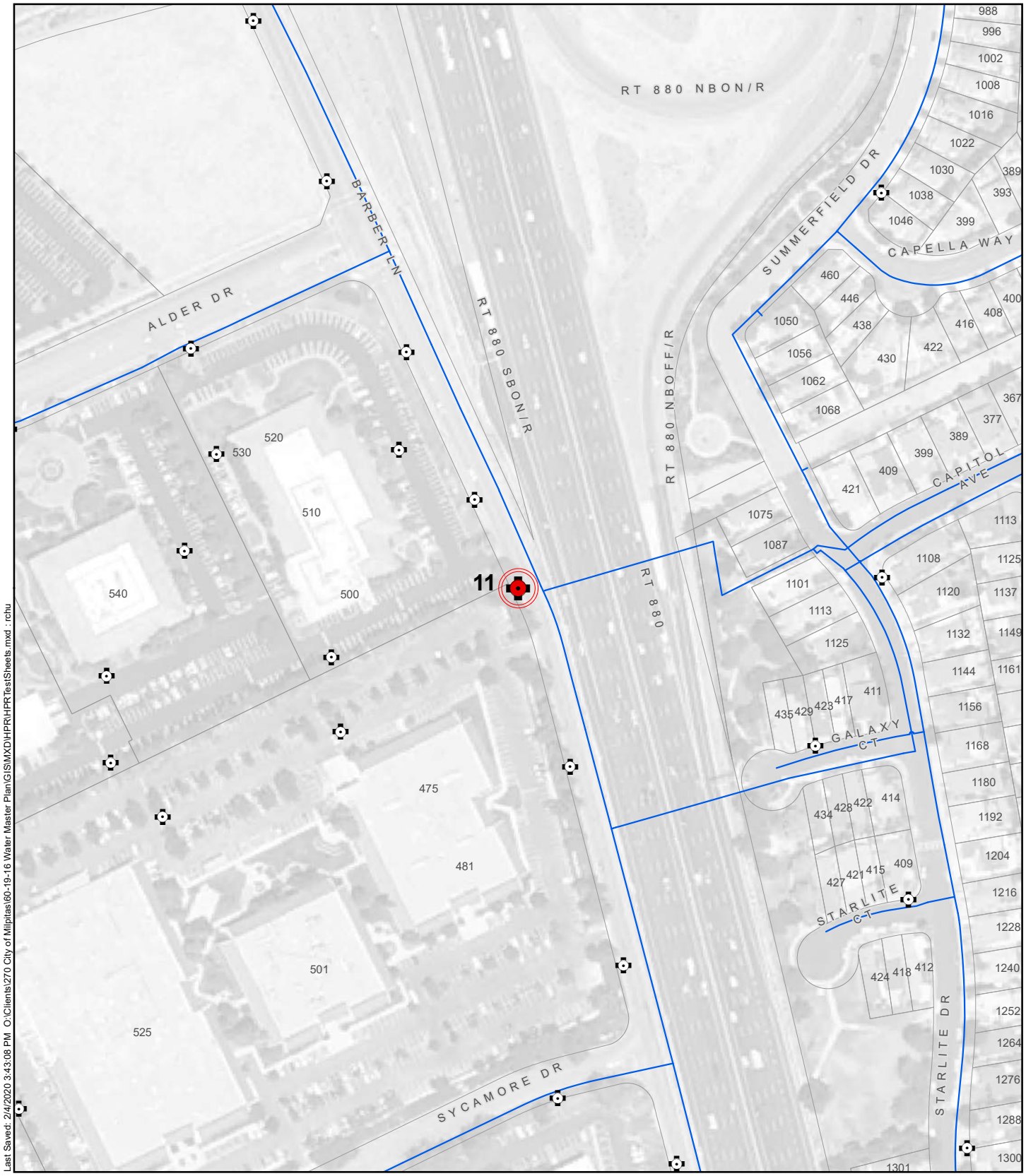
Scale in Feet

WEST YOST ASSOCIATES

Figure B-10

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



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- Proposed HPR Location
- Hydrant
- Turnout
- Pump Station
- Storage Reservoir
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

N

0 100 200

Scale in Feet

Figure B-11

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

WEST YOST ASSOCIATES



Figure B-12

Hydrant Pressure Recorder Locations

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2020 Water Master Plan Update

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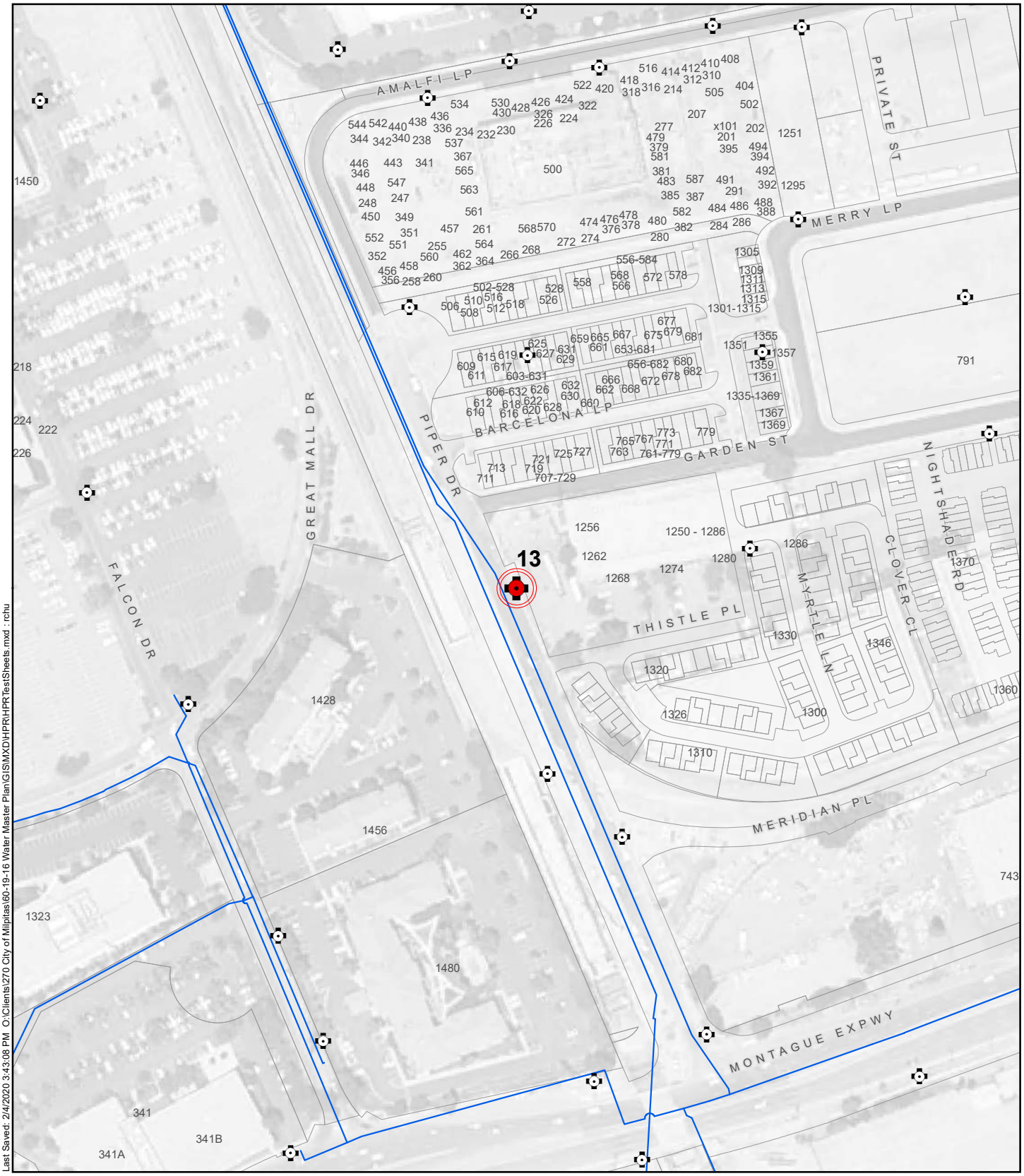

Proposed HPR Location

Hydrant

Turnout

Pump Station

Storage Reservoir

Well

Pressure Reducing Valve

Emergency PRV

Pipeline

N

0 100 200

Scale in Feet

Figure B-13

Hydrant Pressure Recorder Locations

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WEST YOST ASSOCIATES



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Proposed HPR Location
Hydrant
Turnout
PS Pump Station
Storage Reservoir
W Well
Pressure Reducing Valve
Emergency PRV
Pipeline

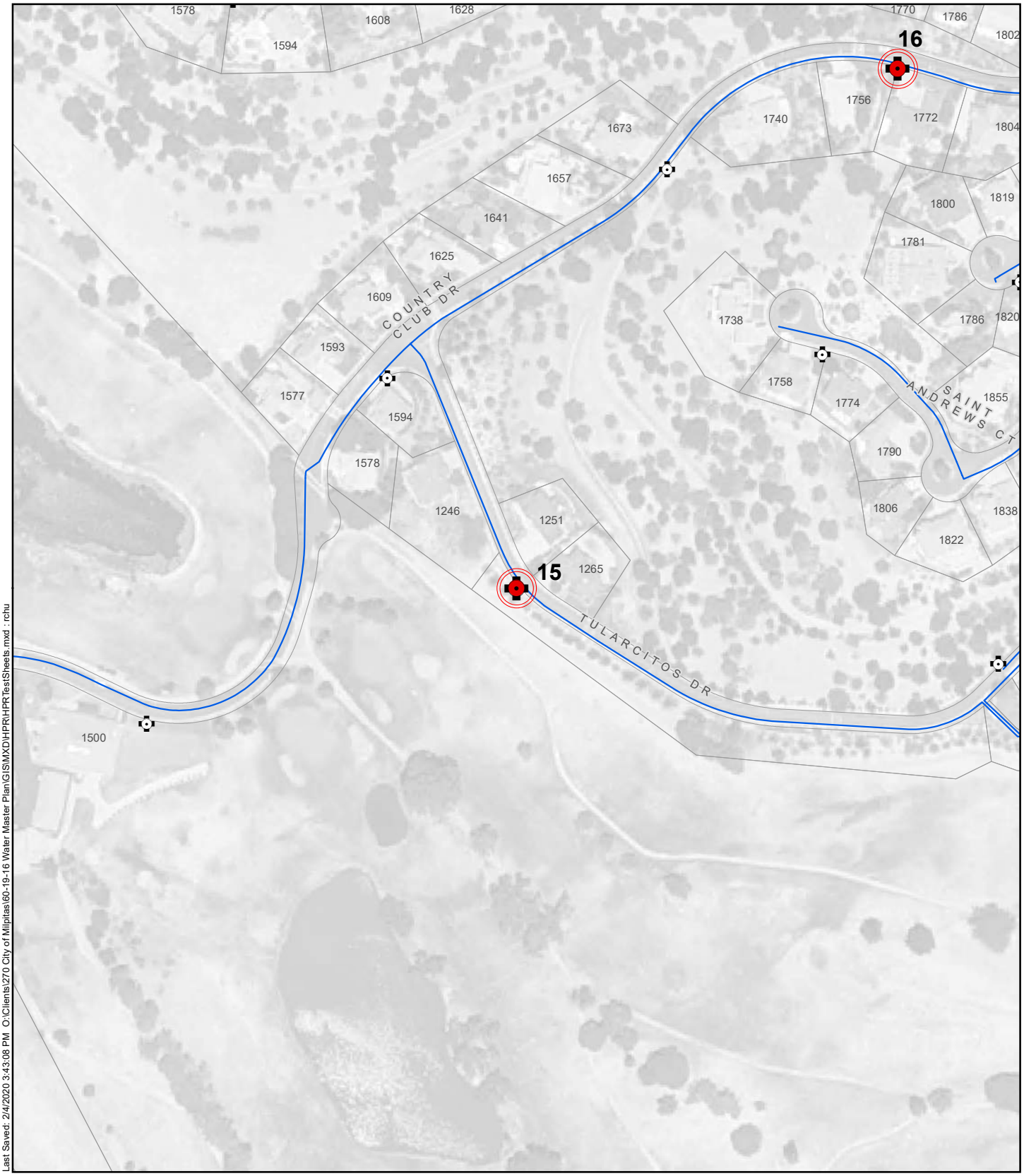
N
0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-14

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



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- Proposed HPR Location
- Hydrant
- Turnout
- Pump Station
- Storage Reservoir
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

N

0 100 200

Scale in Feet

WEST YOST ASSOCIATES

Figure B-15

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



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- Proposed HPR Location
- Hydrant
- Turnout
- Pump Station
- Storage Reservoir
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

N

0 100 200

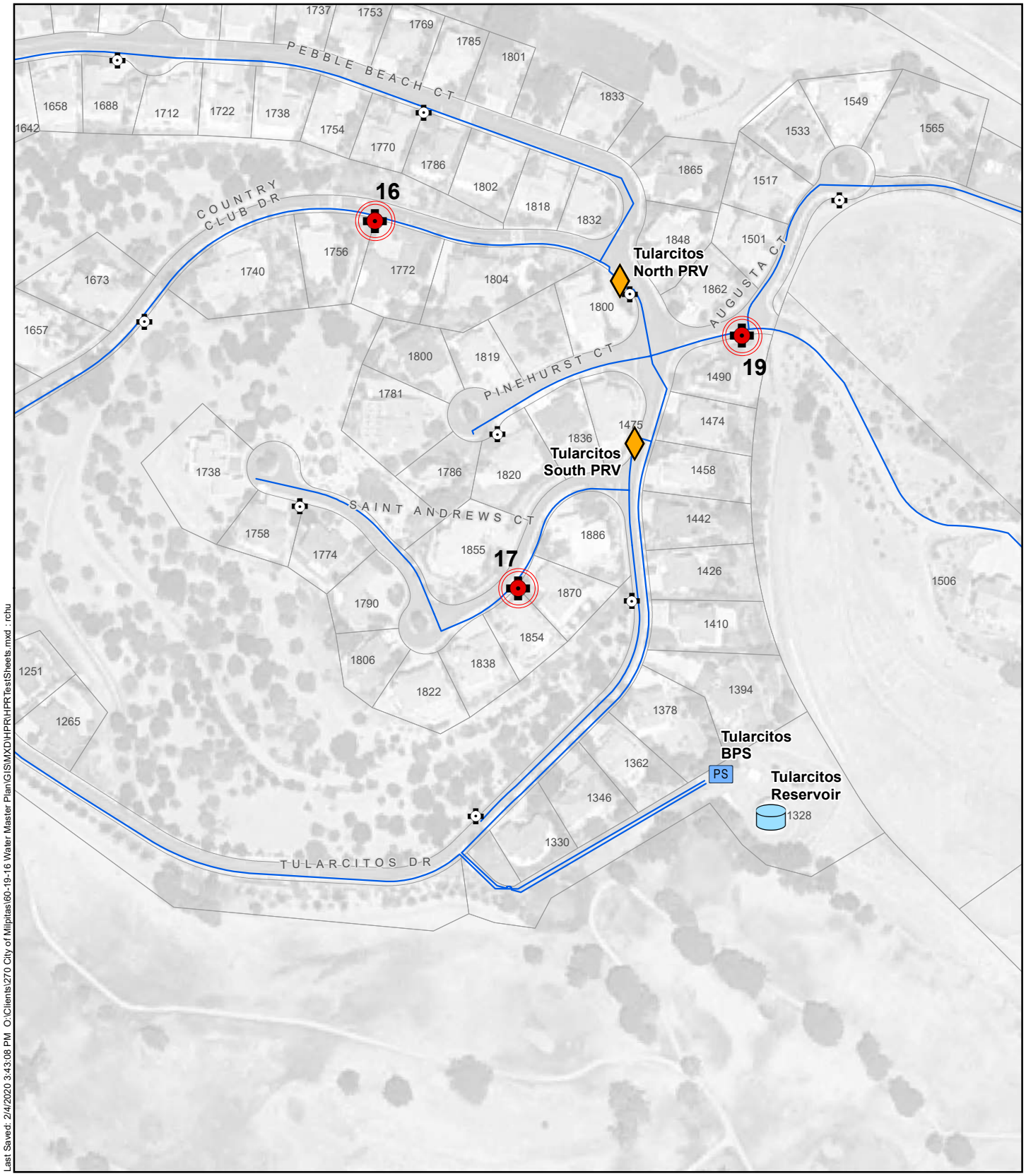
Scale in Feet

WEST YOST ASSOCIATES

Figure B-16

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



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- Proposed HPR Location
- Hydrant
- Turnout
- Pump Station
- Storage Reservoir
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

N

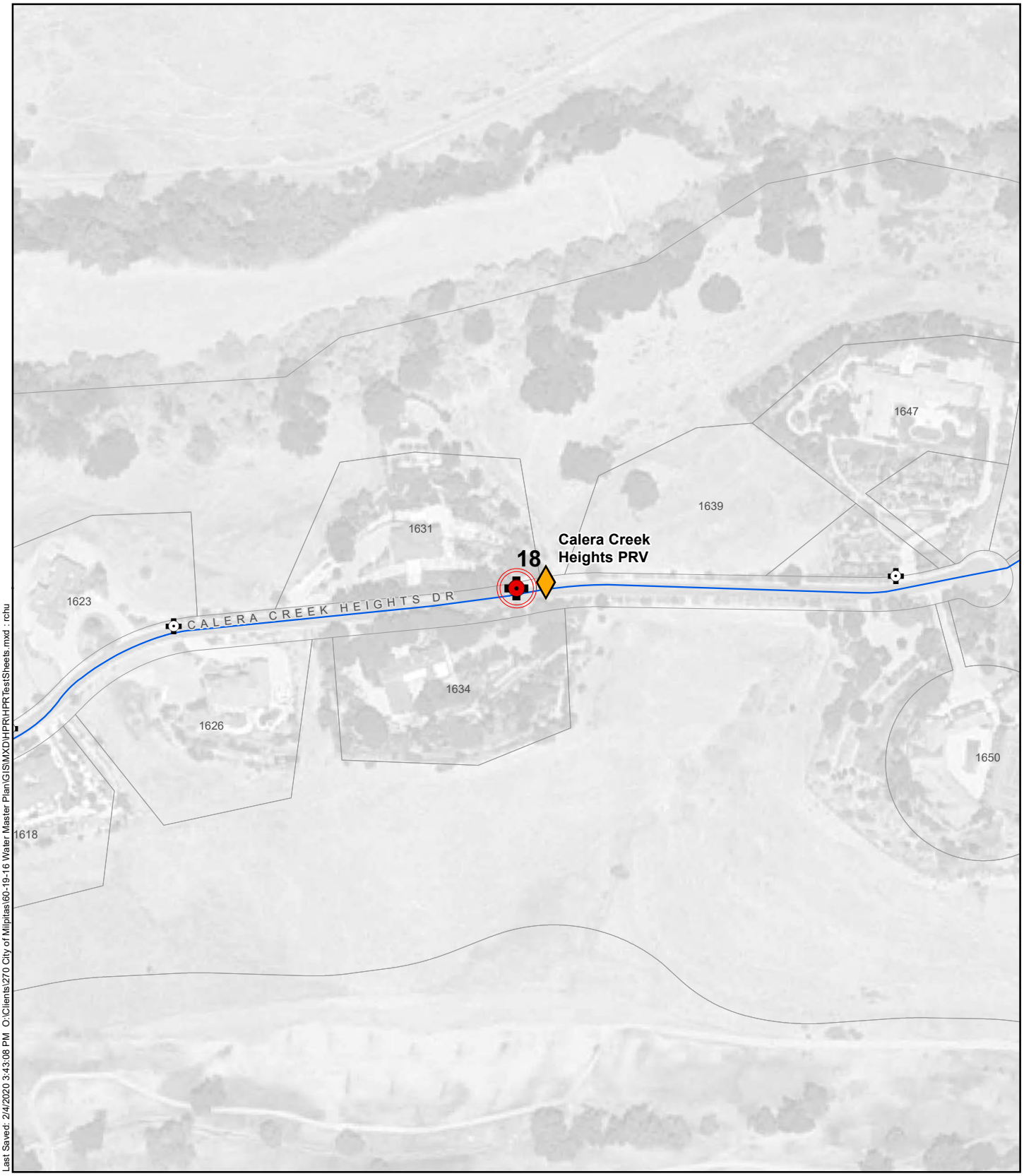
0 100 200

Scale in Feet

Figure B-17

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



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Proposed HPR Location
Hydrant
Turnout
Pump Station
Storage Reservoir
Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200

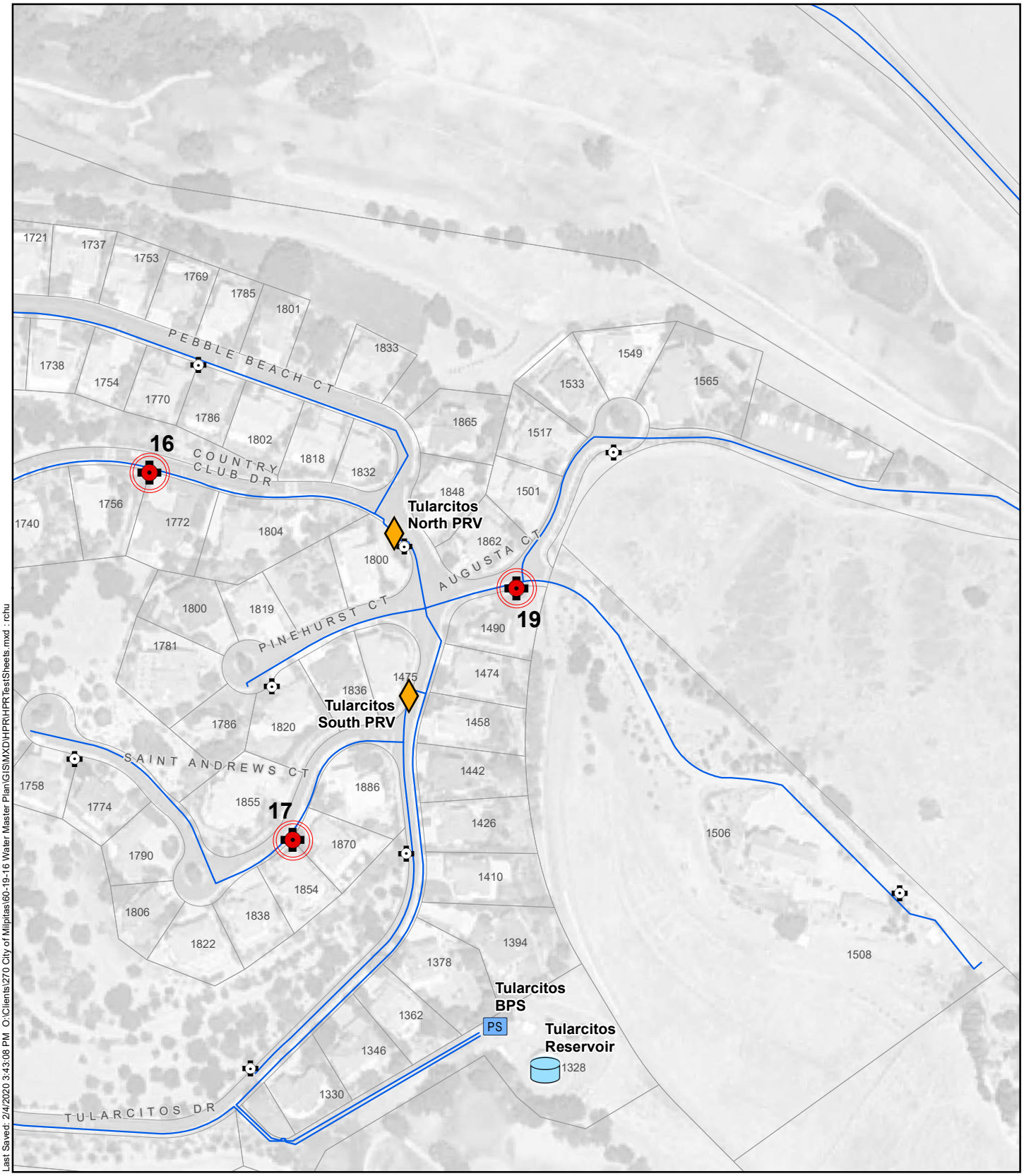
Scale in Feet

WEST YOST ASSOCIATES

Figure B-18

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



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- Proposed HPR Location
- Hydrant
- Turnout
- PS Pump Station
- Storage Reservoir
- W Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

N

0 100 200

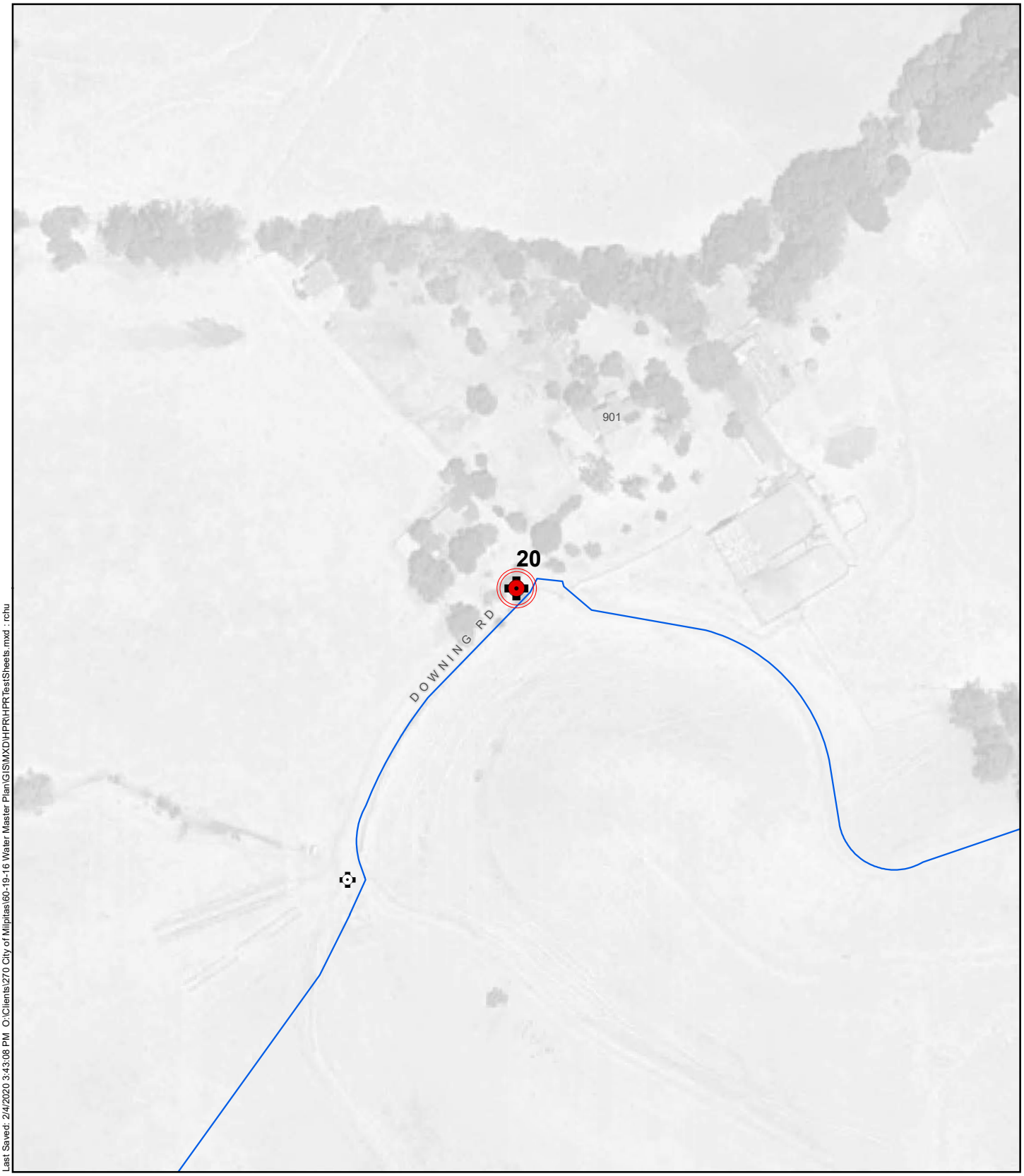
Scale in Feet

Figure B-19

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

WEST YOST ASSOCIATES



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Proposed HPR Location
Hydrant
Turnout
Pump Station
Storage Reservoir
Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200

Scale in Feet

WEST YOST ASSOCIATES

Figure B-20

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

Appendix D

Water Utility Condition Assessment

TECHNICAL MEMORANDUM | OCTOBER 2020

2020 Water Master Plan
Water Utility Condition Assessment

PREPARED FOR

City of Milpitas

PREPARED BY

WEST YOST
Water. Engineered.

2020 Water Master Plan
Water Utility Condition Assessment

Prepared for

City of Milpitas

Project No. 270-60-19-16



Michael Zacharia, PE — 10-30-20 Date



Anne Girtz, PE — 10-30-20 Date

QA/QC Review: Elizabeth Drayer PE — 10-30-20 Date

WEST YOST
Water. Engineered.

TECHNICAL MEMORANDUM | OCTOBER

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2020 Water Master Plan
Water Utility Condition Assessment

This Technical Memorandum (TM) summarizes the condition assessment that was performed of the City of Milpitas's (City) water utility assets under Task 3 – Water Utility Asset Condition Assessment of the 2020 Water Master Plan Update (Master Plan). This TM presents assessment methodologies, asset valuations, likelihood and consequence of failure factors, and risk scores as summarized in the following sections:

1.0 Scope of Work

2.0 Review of Existing Information

3.0 Asset Replacement Cost and Current Valuation

4.0 Risk Assessment Framework

5.0 Likelihood of Failure Methodology

6.0 Consequence of Failure Methodology

7.0 Risk Assessment

8.0 Conclusions

1.0 SCOPE OF WORK

The scope of this assessment includes:

- Preparing an estimate of remaining useful life and replacement cost of assets;
- Developing a risk policy consisting of likelihood of failure (LOF) factors, consequence of failure (COF) factors, and interpretation of both LOF and COF to define risk; and
- Performing a desktop risk analysis of utility assets.

Each asset was evaluated according to the risk policy, resulting in risk scores for each water system asset. Risk scores and corresponding risk action thresholds can be used for decision making including selection and prioritization of asset renewal or replacement efforts. The analysis results will be used to inform the Task 7 Rehabilitation and Replacement Study of the Master Plan.

The standardized evaluation process established in the risk policy can be used in future assessments of condition, risk, and valuation of water system assets. The policy framework was developed so that risk factor definitions are commensurate across assets from other City utilities and can be applied to other departments. Should new data become available to support additional or refined risk factors (e.g. pipe break data with failure cause, condition assessment data, etc.), these can be developed within the risk framework proposed herein.

2.0 REVIEW OF EXISTING INFORMATION

This section describes the existing information upon which the assessments were based, and any data processing required prior to undertaking the assessments.

2.1 Asset Data and Asset Registry

The City provided two data sources containing water system asset information: a master inventory spreadsheet and a GIS database.

The master inventory spreadsheet contained information on water facilities including wells, pump stations, reservoirs, PRVs, turnouts, interties, and isolation valves. In addition to facility data, the spreadsheet contained information on select individual assets at each facility (e.g., for a pump station, the pump size(s), manufacturer, model, and other attributes were provided).

The City's existing GIS database was outdated and was updated by HydroScience as part of their work on the City's Sewer Master Plan (being completed concurrently). The updated database contained geospatial and attribute information for horizontal water assets including pipelines, valves, backflow preventers, blow off assemblies, hydrants, and meters.

The master spreadsheet and GIS database were compiled to create an asset registry of all City water system assets. Upon comparison of the two data sources provided by the City, it was observed that several assets were present in both databases. Duplicate entries included: isolation valves (40), PRVs (18), and reservoirs (5). To reconcile the duplicates, a coordinate comparison was performed in GIS to identify duplicate isolation valves; and visual inspection in GIS was performed to identify duplicate PRVs and reservoirs. Duplicates were removed from the respective database prior to compiling the asset registry. The asset registry facilitated the condition and risk assessment discussed herein and provides a database for the City to track and manage their assets moving forward. This database is provided as a separate deliverable which consists of an Excel spreadsheet titled *Asset Registry and Risk Results.xlsx* and may be used to refresh the City's CMMS database.

The final asset registry contained 35,260 entries, consisting of 35,173 horizonal assets and 87 vertical assets. The breakdown of assets by type is presented in Table 1.

Table 1. Asset Registry – Count of Asset Types	
Asset Type	Count
Horizontal Assets	
Pipelines	9,575 pipe segments (183 miles)
Hydrants	2,906
Valves	6,341
Meters	16,351
Total Horizontal Assets	**35,173**
Vertical Assets	
Fuel Tank	3
Engine	4
Generator	3
Motor	10
PLC	2
PRV	23
Pump	19
Reservoir	5
Turnouts and Interties	7
VFD	9
Well	2
Total Vertical Assets	**87**

2.2 2002 Utility Depreciation Study

A Utility Depreciation Study (Schaaf and Wheeler) was performed in 2002. The study included the following:

- An inventory of all City water system assets;
- Replacement costs for those elements; and
- A timetable for replacement of water system elements based on anticipated remaining useful life estimates.

This replacement cost analysis assumed unit costs based on a March 2003 ENR Construction Cost Index. Table 2 presents the resulting replacement costs from the 2002 study for the City's water system assets in 2002 dollars.

Table 2. Water System Replacement Costs, 2002 Utility Depreciation Study (2002 Dollars)	
Asset Type	Replacement Cost Million dollars
Pipelines	131
Valves and Couplings	8.9
ACP Disposal	80.6
Storage Tanks	13.4
Pump Stations	10.6
Wells	1.1
Total	**$245.6**

2.3 2018 Soil Corrosivity Study

In 2018, the City commissioned a soil corrosivity study (JDH Corrosion Consultants, Inc.) to develop a comprehensive database related to corrosion potential of the soils throughout the City. The assessment was focused on water pipelines made of asbestos cement (AC), ductile iron, cast iron, dielectric coated steel, and mortar coated steel materials. Based on in-situ soil resistance measurements and a review of previous soil evaluations, strategies were developed for long-term corrosion control of AC and metallic pipelines.

3.0 ASSET REPLACEMENT COST AND CURRENT VALUATION

Asset replacement cost and current valuation estimates are asset management best practices that can afford utility agencies improved decision making. This information provides agencies more accurate and integrated information about their assets, and allows more productive relationships with governing authorities, ratepayers, and other stakeholders because they can provide better information in a more transparent way.

Asset Replacement Cost estimates can be used to guide rehabilitation and replacement budgeting. Typically, investment in replacement should cover at a minimum, the deprecation of the assets.

Asset Current Valuation estimates are required to support transactions (public-private partnerships, outright sale, etc.), insurance coverage or claims, and rates cases.

3.1 Water System Asset Replacement Cost

A water system asset replacement cost estimate was developed which represents the cost to replace the entire system in-kind, at current construction and design standards. Costs were developed based on a combination of data supplied by manufacturers, published industry standard cost data and curves, construction costs for similar facilities built by other public agencies, and construction costs previously estimated by West Yost for similar facilities with similar construction cost indexes. Details on cost estimating assumptions are provided in a separate appendix of the Water Master Plan.

A summary of the water system replacement costs is presented in Table 3a. Detailed replacement costs are provided in the *Asset Registry and Risk Results* Excel workbook.

Table 3a. Water System Replacement Costs (2020 Dollars)

Facility Type	Replacement Cost Million dollars
Pipelines	148.4
Valves	4.7
Hydrants	36.2
Meters	6.9
Storage Tanks	46.6
Pump Stations	27.6
Wells	7.2
PRVs	5.9
Turnouts and Interties	4.4
Total	**$287.9**

3.2 Water System Current Valuation

Using the 2020 replacement cost estimate presented in Table 3a, a current water system valuation was prepared using asset useful life estimates (discussed in detail in the Asset Useful Life section) and assuming a straight-line value reduction or depreciation. A straight-line depreciation assumes that the value of an existing asset is reduced gradually over its useful life in a linear relationship. For example, a pipe with 50 percent remaining useful life is valued at 50 percent of its total new replacement cost value. The water system asset valuation estimates the value of individual assets only, not the inherent value of the water system as a whole.

The 2020 water system asset valuation assuming straight-line depreciation is presented in Table 3b. Detailed asset valuation costs are provided in the *Asset Registry and Risk Results* Excel workbook.

Table 3b. Water System Asset Valuation (2020 Dollars)

Facility Type	Asset Valuation, Million dollars
Pipelines	43.5
Valves	1.2
Hydrants	9.1
Meters	0.7
Storage Tanks	16.1
Pump Stations	2.8
Wells	2.0
PRVs	1.5
Turnouts and Interties	1.1
Total	**$78.0**

4.0 RISK ASSESSMENT FRAMEWORK

Understanding the *risk* of each water system asset can help water utilities to prioritize highest-risk assets for renewal or replacement, allowing limited resources to be allocated most effectively. The two components of risk include:

- **Likelihood of Failure (LOF)**, which estimates the probability that a failure will occur in an asset by meeting the end of its physical, design, service, or economic useful life; and
- **Consequence of Failure (COF)**, which estimates the impacts of asset failure expressed either qualitatively or quantitatively, being a loss, injury, or disadvantage from a social, economic, environmental, or regulatory standpoint.

Risk is then estimated using the conventional risk equation:

$$Risk = LOF \times COF$$

The following sections present the LOF and COF methodology that was developed for the City's water system assets, and then calculates asset risk using the risk equation.

5.0 LIKELIHOOD OF FAILURE METHODOLOGY

A desktop assessment was performed on existing water utility assets to estimate the LOF of each asset. For this assessment, asset failure is defined by the asset's inability to perform as intended or needed in its application. The primary failure mode utilized for this assessment was physical mortality, which is defined as physical deterioration due to age, usage, or acts of nature. Operational efficiency failure was also evaluated to consider the reduction in pipeline asset performance due to pipe roughness. Supplemental asset data such as failure history and asset condition assessment can also be used to evaluate LOF. This data was not available at the time this analysis was performed.

For each asset type, one or more LOF factors were developed for each failure mode, as presented in Table 4a.

Table 4a. Asset Failure Modes and LOF Factors

Failure Mode	Failure Description	LOF Factor
Physical Mortality	The percent of useful life remaining considers that older assets are more likely to fail than newer ones due to the age of materials and wear from repeated use.	Remaining Useful Life (for pipelines, considering pipe material, pipe diameter, and soil conditions)
	Pipelines that operate at higher working pressures can undergo stress cycles and cause higher failure rates in older pipelines.	Operating Pressure[(a)]
Operational Efficiency Failure	The accumulation of corrosion byproducts and suspended particles on the inside wall of aged pipes can increase pipe roughness and reduce pipe diameter, thereby increasing operational costs to overcome to greater hydraulic losses.	Pipe Roughness[(a)] (change in Hazen-Williams C-Factor)

(a) LOF Factor only applicable to pipelines

LOF ratings were assigned for each factor using standard definitions presented in Table 4b. Ratings and definitions range from 1 – indicating that an asset is in good condition and asset failure is "unlikely", to 4 – indicating that asset is in poor condition and asset failure is "very likely". Finally, each asset was evaluated under each applicable LOF factor to develop an overall LOF rating.

Table 4b. LOF Definition and Ratings

	LOF Rating			
	1	2	3	4
LOF Definition	Unlikely	Possible	Likely	Very Likely

The following sections describe the development of each LOF factor utilized in the assessment.

5.1 Asset Useful Life Defined

Asset useful life is generally considered to be the time that an asset provides valued service, after which it does not meet its intended service level. End of life is not necessarily indicative of catastrophic failure, and in most cases an asset can still hold functionality when it has reached the end of its useful life. Absent quantifiable condition or performance data, the assumption is that the older the asset, the greater likelihood it will fail.

Municipal water system assets vary by type, manufacture, design, construction, and quality. They have different characteristics in how they operate and, consequently, will have different profiles of how they perform and ultimately fail. Asset useful life expectancies are documented by the American Water Works Association and Water Environment Research Foundation (WERF) in addition to other notable industry associations. Useful life values presented here are nominal and consistent with the water utility industry and are not specific to any geographic region.

5.1.1 Non-Pipeline Useful Life

Table 5a presents a summary of useful life by asset type which were used for the assessment of the City's vertical and non-pipeline horizontal water utility assets. Pipeline assets are discussed separately in the following section.

Table 5a. Useful Life by Asset Type

Asset Type	Useful Life, years
Vertical Assets	
Fuel Tank	15
Engine	15
Generator	15
Motor	25
PLC	15
PRV	25
Pump	25
Reservoir	50
Turnouts and Interties	30
VFD	10
Well	50
Non-Pipeline Horizontal Assets	
Hydrants	50
Meters	15
Valves	50

5.1.2 Pipeline Useful Life

Pipeline useful life can vary significantly based on pipe size, material, and environmental conditions. The City's 2018 soil corrosivity study indicated that the City's AC pipe was more susceptible to failure in clay soils due to the pipe stresses associated with contraction and expansion of the soil. Smaller diameter AC pipes were especially susceptible to failure due to their relatively low resistance to soil movement. The report recommended a range of AC pipe useful lives based on pipe diameter. The investigation also mapped soil corrosivity and found that soils throughout the City were "severely" to "moderately" corrosive to metallic pipes (cast iron, ductile iron, steel).

Table 5b presents the useful lives for pipelines based on industry standards and the JDH report. It includes a base useful life (not considering soil conditions) and an effective useful life for AC pipe in clayey soils and metallic pipes in corrosive soils. Reinforced concrete pipe was considered vulnerable to corrosive soils due to the potential for exposed reinforcement steel.

Table 5b. Useful Life – Pipelines

Pipe Material	Diameter, Inches	Base Useful Life, years	Effective Useful Life, years			
			Clay Soils	Moderately Corrosive Soils	Corrosive Soils	Severely Corrosive Soils
Asbestos Cement	4-10	30	24	-	-	-
	12+	90	72	-	-	-
Polyvinyl Chloride	all	70	-	-	-	-
Concrete Cylinder	all	75	-	68	64	60
Cast Iron	all	100	-	90	85	80
Ductile Iron	all	100	-	90	85	80
Steel	all	95	-	86	81	76

5.1.3 Asset Remaining Useful Life Defined

The asset useful life estimates discussed above were used to calculate the remaining useful life (RUL) of each asset with the following formulas:

RUL = Asset Useful Life – Asset Age

RUL (%) = (Asset Useful Life – Asset Age) / Asset Useful Life

5.1.4 Estimation of LOF based on Remaining Useful Life

Decay curves can be used to illustrate the progression of asset degradation (decay) over an asset's useful life. The curves in Figure 1 were developed by WERF[1] and represent empirical failure patterns at several

[1] WERF SIMPLE (Sustainable Infrastructure Management Program Learning)

polynomial rates that may be experienced in the water industry. For this assessment, Late Decay 2 curve was selected as the indicator of likelihood of failure based on the following assumptions:

- Once municipal assets are beyond the point of early mortality, only a gradual decline in asset condition is expected to occur for much of the asset life. Early mortality is characterized by asset failure very soon after the asset is commissioned and in service. The occurrence of early mortality is often associated with manufacturing and installation issues.
- Late Decay Curve 2 provides only a 30 percent reduction in asset condition for the first two-thirds of the asset life. This is considered a nominal reduction in condition for a major milestone in the asset lifecycle and represents a suitable objective for asset performance.
- Late Decay Curve 2 provides a progression that is not significantly steep in terms of asset degradation over the final, remaining, one-third lifecycle.

Figure 1 also shows how Late Decay Curve 2 is used to correlate asset remaining useful life with the LOF rating (e.g. for an asset with a % RUL of 30 percent, the LOF rating is 2).

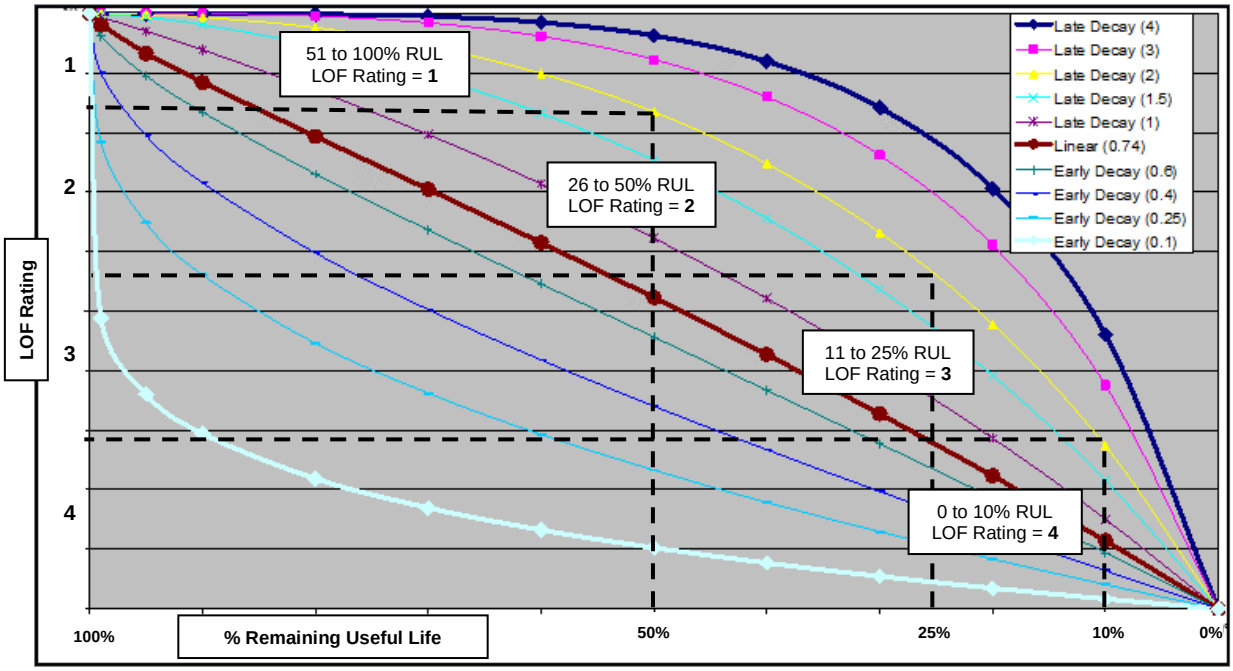


Figure 1. Percent Remaining Useful Life and LOF Rating

Several assets in the City databases were missing age or installation dates. These assets were assigned an LOF rating based on the following assumptions:

- AC pipe was assigned a rating of 4 under the assumption that AC pipe was not installed after the mid-1980s (and therefore the % RUL would be zero). 19 miles (894 pipe segments) of AC pipe had an unknown age/installation date.
- Remaining assets of unknown age were assigned a rating of 3 to account for the generally higher risk associated with unknown asset age and condition.

5.2 Pipeline Hydraulic Conditions

Pipeline conditions from the hydraulic model were considered to evaluate LOF factors of pipe roughness (operational efficiency failure mode) and operational pressure (physical mortality failure mode).

5.2.1 Pipe Roughness

Hydrant testing was performed over a portion of the distribution system to determine calibrated pipeline roughness, or C-Factors (see Task 4 of the Master Plan, presented in Chapter 6). Calibrated C-Factors from the hydraulic model were used to determine the reduction in C-Factor when compared to the C-Factor of a brand-new pipe of the same material. The result of the C-Factor comparison is presented in Table 6.

Table 6. Pipe Roughness: C-Factor Comparison

Pipe Material	Pipe Sizes	New Pipe C-Factor	Calibrated C-Factor	Percent of New C-Factor
Asbestos Cement	Diameter ≤ 8 inches	140	110	79%
	Diameter > 8 inches		120	86%
Polyvinyl Chloride	Diameter ≤ 8 inches	150	130	87%
	Diameter > 8 inches		140	93%
Concrete Cylinder	Diameter > 8 inches	140	130	93%
Cast Iron	Diameter ≤ 8 inches	130	100	77%
	Diameter > 8 inches		110	85%
Ductile Iron	Diameter ≤ 8 inches	140	130	93%
	Diameter > 8 inches		140	100%
Steel	Diameter ≤ 8 inches	140	120	86%
	Diameter > 8 inches		130	93%

5.2.2 Operating Pressure

Operating pressure was obtained from the calibrated hydraulic model under an average day scenario, with system pumps operating. Pipeline assets were evaluated for high operating pressure as an influence to increased LOF. Through discussions with the City, pipeline assets operating continually in excess of 135 psi regardless of design class were considered to be at higher risk of failure or increased LOF.

5.3 Supplemental Condition Data

Supplemental condition data typically consists of focused condition assessment studies of assets and facilities to determine condition based on an established set of metrics and criteria. Such assessments should be performed at intervals generally less than the asset's useful life to confirm condition and status on the useful life curve. Maintenance records may also capture details from asset failure and problems. This information can be used to document type and frequency of failures that serve as an indication of asset condition and be used in the future to develop additional LOF factors.

5.4 Likelihood of Failure Evaluation

Assets were evaluated under each applicable LOF factor to develop an overall LOF rating. Pipeline assets were assessed based on the criteria outlined above consisting of RUL and operating pressure. Non-pipeline assets considered only RUL alone. Since these criteria are baseline and easy to assess they serve as the *fixed* LOF criteria.

Given the availability of supplemental data, the other criteria were incorporated as *modifiers* to the LOF assessment. LOF scores were subjected to the other criteria as potential modifiers that could increase the LOF rating if additional data were available. These modifiers include pipeline roughness, failure history from maintenance or other failure data, and focused condition assessment activities.

Both fixed and modifier LOF factors were assigned a weight based on the relative importance of each factor. For the fixed LOF factors, RUL is weighted to represent 80 percent of the total rating, while operating pressure represents 20 percent of the total rating. The maximum possible weighted rating for the fixed LOF factors is 4. LOF modifiers are only evaluated if the fixed LOF rating is less than 4. LOF modifiers can increase the overall rating up to 1 additional score, resulting in a total possible LOF rating of 4. Table 7 presents the LOF criteria and rating definitions.

Table 7. LOF Factor and Ratings – Water System Assets

Factor	LOF Rating and Definition				Weight	Max Possible Rating
	1 Unlikely	2 Possible	3 Likely	4 Very Likely		
Fixed LOF Factors						
Remaining Useful Life (RUL)	51 to 100% RUL	26 to 50% RUL	11 to 25% RUL; Non-AC pipe asset with unknown age	0 to 10% RUL; AC pipe asset with unknown age	80%	3.2 (Pipelines) 4.0 (All other assets)
Operating Pressure[(a)]	<84 psi	85 psi to 99 psi	100 psi to 1 34 psi	>135 psi	20%	0.8
					Maximum Rating	**4.0**
LOF Modifiers						
Pipe Roughness[(a)]	85% to 100% of new C-Factor Rating	75% to 84% of new C-Factor Rating	65% to 74% of new C-Factor Rating	<64% of new C-Factor Rating	2.5%	0.10
Failure History	<2	3 to 5	6 to 9	>10	10%	0.40
Condition Assessment	New	Used	Worn	Pending Failure	12.5%	0.50
					Maximum Modifier	**1.0**
					Total Possible LOF Rating	**4.0**

(a) Factor only applicable to pipelines

5.5 Asset LOF Results

Table 8 presents the LOF rating results as a percent of total assets by type (i.e. for hydrants, 8 percent of all hydrants were evaluated to have a LOF rating of 1 and 17 percent of all hydrants have a LOF rating of 2, etc.). Individual asset LOF results are provided in the *Asset Registry and Risk Results* Excel workbook.

Table 8. Asset LOF Results, Percent of Total Assets by Type

	LOF Rating, total assets by type, percent			
	1	2	3	4
Horizontal Assets				
Pipelines[(a)]	25	18	20	37
Hydrants	8	17	75	0
Meters	0	3	22	75
Valves	16	23	61	0
Vertical Assets				
Fuel Tank	0	0	33	67
Engine	0	0	0	100
Generator	0	0	67	33
Motor	0	0	30	70
PLC	0	0	50	50
PRV	0	4	87	9
Pump	0	0	16	84
Reservoir	0	60	40	0
Turnouts and Interties	0	0	100	0
VFD	0	0	22	78
Well	50	0	50	0

(a) Pipeline results are shown as percent of total pipeline length, not pipe segments.

5.6 Facility LOF Results

The previous section describes the method for assigning an LOF rating for each asset. For vertical assets, multiple assets can constitute a larger facility; for example, the Ayer Pump Station facility includes a pump, motor, generator, fuel tank, PLC, and VFD. LOF can also be estimated at the facility level by considering the LOF of individual components within that facility. LOF was estimated for Milpitas water system facilities by averaging the associated component LOFs, weighted based on the individual component value. The applied weighting considers the fact that assets of a lower value should have a lesser impact on the overall facility LOF, whereas assets with a higher value should have a greater impact on the overall facility LOF.

$$\text{Facility LOF} = \frac{\sum_{i=1}^{n} Component\ LOF \times Compnent\ Value\ (\$)}{Total\ Facility\ Value\ (\$)}$$

Table 9 presents the LOF rating results for each facility on the same 1 to 4 scale, rounded to the nearest tenth.

Table 9. Facility LOF Results

Facility	LOF Rating
Curtis Well	1.7
Gibraltar Reservoir (SC)	2.0
Gibraltar Reservoir (SF)	2.0
Minnis Reservoir	2.0
ACWD Intertie	2.4
SJWC Intertie	2.4
Calera Creek Heights PRV	2.4
Capitol PRV	2.4
Main PRV	2.4
Milpitas PRV	2.4
Sunnyhills PRV	2.4
Curtis PRV	2.5
SCVWD Intertie	3.0
Gibraltar Turnout	3.0
Calaveras Turnout	3.0
Sunnyhills Turnout	3.0
Main Street Turnout	3.0
Abel PRV	3.0
Gibraltar PRV	3.0
Live Oak PRV	3.0
McCarthy PRV	3.0
Montague PRV	3.0
North Vault PRV	3.0
Sinclair PRV	3.0
South Vault PRV	3.0
Ayer Reservoir	3.0
Tularcitos Reservoir	3.0
Country Club Pump Station	3.2
Tularcitos Pump Station	3.2
Pinewood Well	3.4
Ayer Pump Station	3.6
Gibraltar Pump Station	3.7

6.0 CONSEQUENCE OF FAILURE METHODOLOGY

Consequence of failure (COF) rates the severity of consequences should an asset fail. Consequences typically include system performance impacts; economic or social impacts to the City, residents, or the community; safety impacts; and local or regional environmental impacts.

COF factors were developed in collaboration with City staff to reflect both City Council Core Goals and Priority Areas.

6.1 Consequence of Failure Framework

The Milpitas City Council has adopted a series of goals and priority areas that identify critical elements important to the City in the services it provides. These Goals and Priority Areas are outlined in the City's 2020 fiscal budget as shown below.

Core Goals	Priority Areas
• Superior Customer Service • Integrity and Accountability • Recognition and Celebration • Open Communication • Trust and Respect	• Public Safety • Transportation and Transit • Neighborhoods and Housing • Governance and Administration • Environment • Economic Development and Job Growth • Community Wellness and Open Space

Council objectives such as these can typically align with the critical objectives of a utility's performance and can therefore be related to asset performance and the consequence of an asset failing. A COF framework was developed based on the Council Goals and Priority Areas. Each goal and priority area were evaluated for applicability to asset COF and, for those that could be developed, were categorized, measured, and rating definitions developed. Every objective except for: Recognition and Celebration; Open Communication; Neighborhoods and Housing; and Community Wellness and Open Space were developed into factors within the COF framework. Table 10 presents the COF framework and eight proposed COF factors.

Table 10. COF Framework

Council Goals and Priority Areas	Category	COF Factor	Rating and Metric			
			1 Negligible	2 Minimal	3 Moderate	4 Severe
Superior Customer Service	Reliable, High Quality Customer Service in General	(1) Water Service Interruptions	Negligible Impact to Water Service	Water pressure below 30 psi	Interruption of Water Service Over Localized Area	Interruption of Water Service Over Large Area
Integrity and Accountability	Public Perception/Response	(2) Magnitude and Method of Public Response	No Public Response	May result in telephone calls	May Result in Social Media Coverage	May Result in Local or Greater Media Coverage or Public Comment
Trust and Respect						
Public Safety	Health and Safety of Public and City Employees	(3) Severity of Injury or Illness	No Health or Safety Impact	Minor Injury, First Aid	Injury, Medical Attention	Severe Injury or Loss of Life
Environment	Compliance with Environmental Regulations or other Water Quality Concern	(4) State and Federal Regulatory Violations or Public Response	No Impact	Reportable violation, no enforcement action	May Result in Strong Warning or Fine	Non-compliance resulting in administrative or consent order
Transportation and Transit	Public Transit Service	(5) Public Transit Service Interruptions	No Impact	Minor Detours	Bus Service is impacted >15% to sensitive groups/locations	Community Access to BART is Interrupted Requires Coordination with Outside Agencies i.e., County, CalTrans, VTA, etc.
Economic Development and Job Growth	Economic Impacts	(6) Local Business Impact	No Impact	Localized Short-term Business Impact, no Adverse Impact on Economic Vitality		Long-term or Area-wide Economic Impact, Adverse Impact to Economic Vitality
Governance and Administration	Utility Operations	(7) Response Time to Restore an Asset	Recovery measured in days	Recovery could require up to Two (2) weeks	Recovery Could Require up to One (1) Month	Recovery Requires Greater Than One (1) Month
		(8) Restoration Costs or Impact on Utility Rates	Can be absorbed within fiscal budget without adjustment	Could impact multiple budget objects	May Require Council Action	May Impact Reserves

6.2 Consequence of Failure Rating Defined

The COF framework presented in Table 10 was further developed into a model to assess COF for both horizontal and vertical assets by defining rating interpretations for all factors. Interpretations were developed into metrics such that COF ratings could easily be assigned with asset characteristics or geospatial data, avoiding manual evaluation of individual assets. For horizontal assets, this included assessment based on pipe size, street classification, land use, and hydraulic modeling. For vertical assets this included similar assessment criteria along with asset type.

COF ratings were assigned for each factor using standard definitions presented in Table 11. Ratings range from 1 – indicating the consequence of asset failure would be "negligible", to 4 – indicating the consequence of asset failure would be "severe". Tables 11 and 12 present the COF factors, metrics, and ratings for horizontal and vertical assets, respectively.

Table 11. COF Definition and Ratings

	LOF Rating			
	1	2	3	4
COF Definition	Negligible	Minimal	Moderate	Severe

Table 12. COF Factors and Ratings – Horizontal Assets (Pipes, Valves, Hydrants, Meters)

Factor	Description	Data Source	Rating and Metric			
			1 Negligible	2 Minimal	3 Moderate	4 Severe
(1) Water Service Interruption	Asset failure may cause interruptions to water service	GIS Pipe Diameter[c]; GIS Meter Size	Pipes ≤8-inch	Pipes 10 to 12-inch; All Other Meters	Pipes 14 to 18-inch; Meters 6 to 8-inch	Pipes >18-inch
(2) Magnitude and Method of Public Response	Asset failure may cause a loss in public confidence	GIS Pipe Diameter[c]; Critical Facilities[a]	-	Pipes ≤8-inch; All Other Meters	Pipes 10 to 12-inch; Meters 6 to 8-inch	Pipes >14-inch within 500 feet of a Critical Facility
(3) Severity of Injury or Illness	Asset failure may cause injury or illness to public or utility operations staff	GIS Pipe Diameter[c]	Pipes ≤8-inch; All Other Meters	Pipes 10 to 12-inch; Meters 6 to 8-inch	Pipes 14 to 18-inch	Pipes >18-inch
(4) State and Federal Regulatory Violations or Public Response	Asset failure may result in violation of state or federal environmental regulations	Asset Type	All Valves; All Meters	All Pipes; All Hydrants	-	-
(5) Public Transit Service Interruptions	Asset failure may cause an impedance to public and private transportation function	GIS Road Speed; GIS Land Use; BART stations; and Sensitive Groups/Locations[b]	Streets with speeds up to 25 mph	Streets with speeds from 30-50 mph in Residential LU	Streets with speeds from 30-50 mph in Non-Residential LU; or Adjacent to a Sensitive Group/ Location	Highways, Highway crossings, or Within 100-feet of BART station
(6) Local Business Impact	Asset failure may have a negative impact to the City economy	GIS Land Use (LU)	All Other LU Types	-	LU types including PF, RRMU, M	LU types including TWC, VHDMU, GNC, RSC, INP, MFG, PAO
(7) Response Time to Restore an Asset	The City's ability to respond depends on the location of the asset	GIS Road Speed	Streets with speeds up to 25 mph	Streets with speeds from 30-50 mph in Residential LU	Streets with Speeds from 30-50 mph in Non-Residential LU	Highways or Highway Crossings
(8) Restoration Costs or Impact to Utility Rates	The asset failure may have an impact to utility fiscal performance	GIS Pipe Diameter[c]	Pipes ≤12-inch; All Meters	Pipes 14 to 16-inch	Pipes 18 to 24-inch	Pipes >24-iinch or Highway Crossings

(a) Critical Facilities include Schools, Fire Stations, and Hazardous Pipelines.
(b) Sensitive Groups/Locations include Fire Stations and Schools.
(c) Hydrants were assigned the rating of adjacent/service pipeline; Valves were assigned the rating of connecting pipeline.

Table 13. COF Factors and Ratings – Vertical Assets

Factor	Description	Data Source	Rating and Metric			
			1 Negligible	2 Minimal	3 Moderate	4 Severe
(1) Water Service Interruption	Asset failure may cause interruptions to water service	Asset Type	-	-	PRVs	Interties, Turnouts, Reservoirs, Pumping Stations, Wells, Emergency PRVs
(2) Magnitude and Method of Public Response	Asset failure may cause a loss in public confidence	Asset Type	-	-	-	Interties, Turnouts, Reservoirs, Pumping Stations, Wells, PRVs
(3) Severity of Injury or Illness	Asset failure may cause injury or illness to public or utility operations staff	Asset Type	-	-	PRVs	Interties, Turnouts, Reservoirs, Pumping Stations, Wells, Emergency PRVs
(4) State and Federal Regulatory Violations or Public Response	Asset failure may result in violation of state or federal environmental regulations	Asset Type and location	All Others	-	Wells	Wells within 50-feet to a surface water source and Surface Water Interties
(5) Public Transit Service Interruptions	Asset failure may cause an impedance to public and private transportation function	GIS Road Speed; GIS Land Use; BART stations; and Sensitive Groups/Locations[(b)]	Streets with speeds up to 25 mph	Streets with speeds from 30-50 mph in Residential LU	Streets with speeds from 30-50 mph in Non-Residential LU; or Adjacent to a Sensitive Group/ Location	Highways, Highway crossings, or Within 100-feet of BART station
(6) Local Business Impact	Asset failure may have a negative impact to the City economy	GIS Land Use	All Other LU Types	-	LU types including PF, RRMU, M	LU types including TWC, VHDMU, GNC, RSC, INP, MFG, PAO
(7) Response Time to Restore an Asset	The City's ability to respond depends on the location of the asset	Asset Type	-	PRVs, Interties	Turnouts	Reservoirs, Pumping Stations, Wells
(8) Restoration Costs or Impact to Utility Rates	The asset failure may have an impact to utility fiscal performance	Asset Type	PRVs, Interties	Turnouts	-	Reservoirs, Pumping Stations, Wells

(a) Sensitive Groups/Locations include Fire Stations and Schools

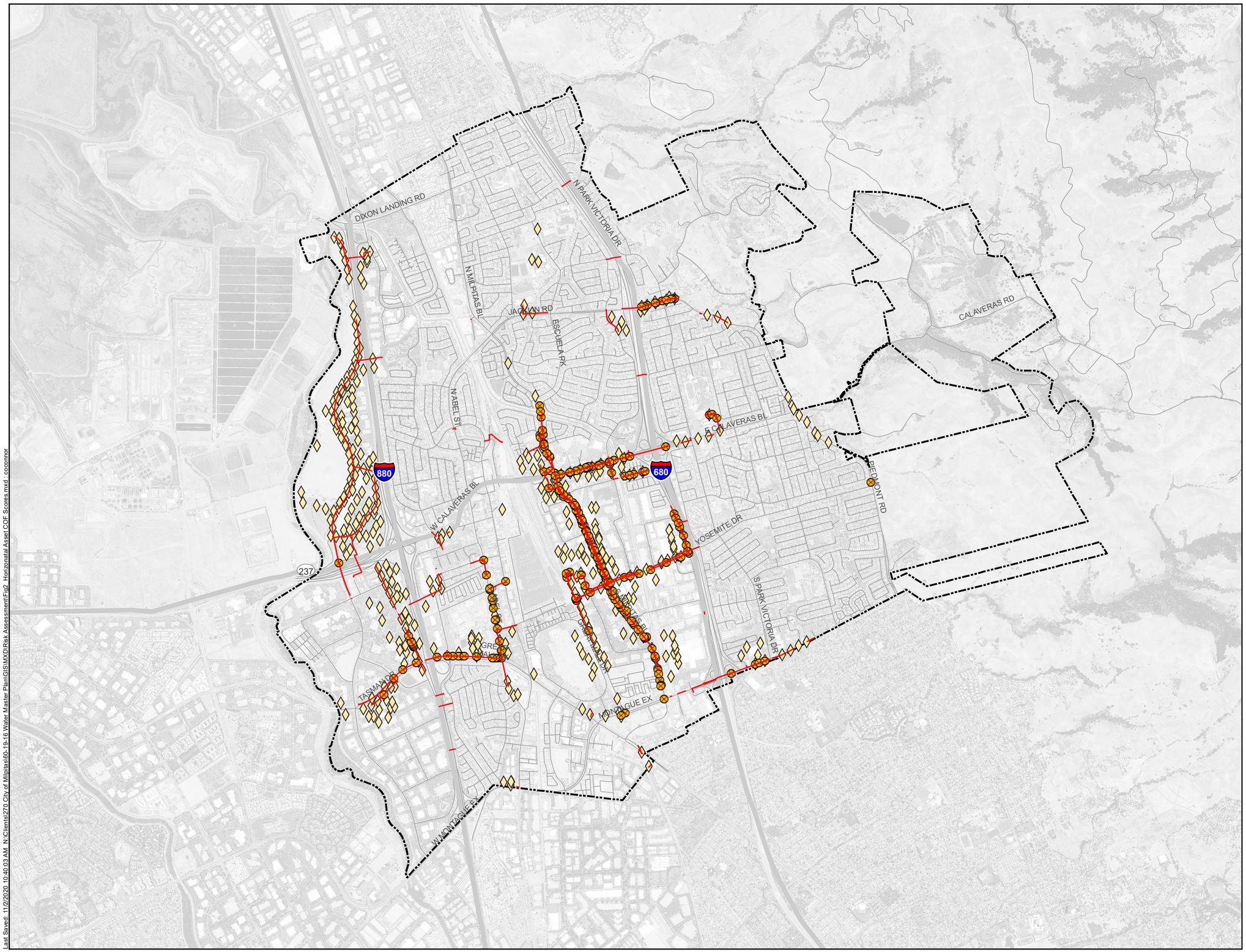
6.3 Horizontal Asset COF Results

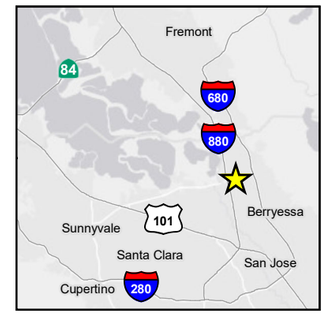
The eight asset COF ratings were averaged to obtain an overall COF rating on the 1 to 4 scale. Table 14 presents the COF rating results for horizontal assets, summarized by percent of total asset type (i.e. for hydrants, 32 percent of all hydrants were evaluated to have a COF rating of 1). Horizontal assets with a moderate (3) COF rating are shown spatially in Figure 2. Individual asset COF results are provided in the *Asset Registry and Risk Results* Excel workbook.

Table 14. Horizontal Asset COF Results, Percent of Total Asset by Type

Horizontal Assets	COF Rating, percent			
	1	2	3	4
Pipelines[(a)]	45	46	9	0
Hydrants	32	53	15	0
Meters	100	0	0	0
Valves	43	52	5	0

(a) Pipeline results are shown as percent of total pipeline length.





N

0 1,500 3,000

Scale in Feet

- Valves
- Hydrants
- Pipelines
- City Limits

Figure 2

Existing Horizontal Assets with COF Score ≥ 3

City of Milpitas
2020 Water Master Plan Update

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6.4 Facility COF Results

For vertical assets, COF ratings were assigned at the facility level (i.e. pump station, reservoir, well, etc.), with all facility components inheriting the COF rating of its parent facility. Table 15 presents the overall COF rating results for each facility on the same 1 to 4 scale, rounded to the nearest decimal.

Table 15. Facility COF Results

Facility	COF Rating
Live Oak PRV	2.0
Main PRV	2.0
North Vault PRV	2.0
South Vault PRV	2.0
Calera Creek Heights PRV	2.0
SCVWD Intertie	2.3
SJWC Intertie	2.3
Abel PRV	2.3
Gibraltar PRV	2.4
McCarthy PRV	2.4
Sinclair PRV	2.4
Sunnyhills PRV	2.4
Milpitas PRV	2.5
Main Street Turnout	2.5
ACWD Intertie	2.6
Capitol PRV	2.6
Curtis PRV	2.6
Montague PRV	2.6
Calaveras Turnout	2.8
Sunnyhills Turnout	2.8
Country Club Pump Station	2.9
Tularcitos Pump Station	2.9
Minnis Reservoir	2.9
Tularcitos Reservoir	2.9
Gibraltar Turnout	2.9
Ayer Reservoir	3.1
Gibraltar Pump Station	3.3
Gibraltar Reservoir (SC)	3.3
Gibraltar Reservoir (SF)	3.3
Curtis Well	3.3
Pinewood Well	3.3
Ayer Pump Station	3.4

7.0 RISK ASSESSMENT

Risk combines both LOF and COF to determine the resulting level of risk exposure that an agency is likely to confront through a potential failure of an asset. Assets with the highest risk have both a high likelihood of failure (i.e., poor condition or increased potential to underperform) and a high consequence of failure (i.e., significant consequences should failure occur).

The conventional risk equation, which was employed in this assessment, is the product of LOF and COF:

Risk = COF x LOF

7.1 Risk Interpretation

Individual COF and LOF factor definitions were combined to define the overall risk of each asset, interpreted as a Low, Medium, Medium-High, or High risk level. Table 16 presents the risk level matrix and risk definitions.

Table 16. Risk Level Matrix

		LOF Rating and Definition			
		1 Unlikely	2 Possible	3 Likely	4 Very Likely
COF Rating and Definition	1 Negligible	Low	Low	Low	Low
	2 Minimal	Low	Low	Medium	Med-High
	3 Moderate	Medium	Medium	Med-High	High
	4 Severe	Medium	Med-High	High	High

7.2 Risk Results

The risk results are summarized in the tables below, including notation of the median risk rating for each asset type.

7.2.1 Pipelines

Table 17 presents the risk results for pipelines by percent of total pipeline length in each risk level. Table 18 presents the detailed LOF and COF ratings by pipeline length. The median risk level for pipelines is Low, with an associated LOF of 3 and COF of 1. Pipeline risk is also presented spatially in Figure 3.

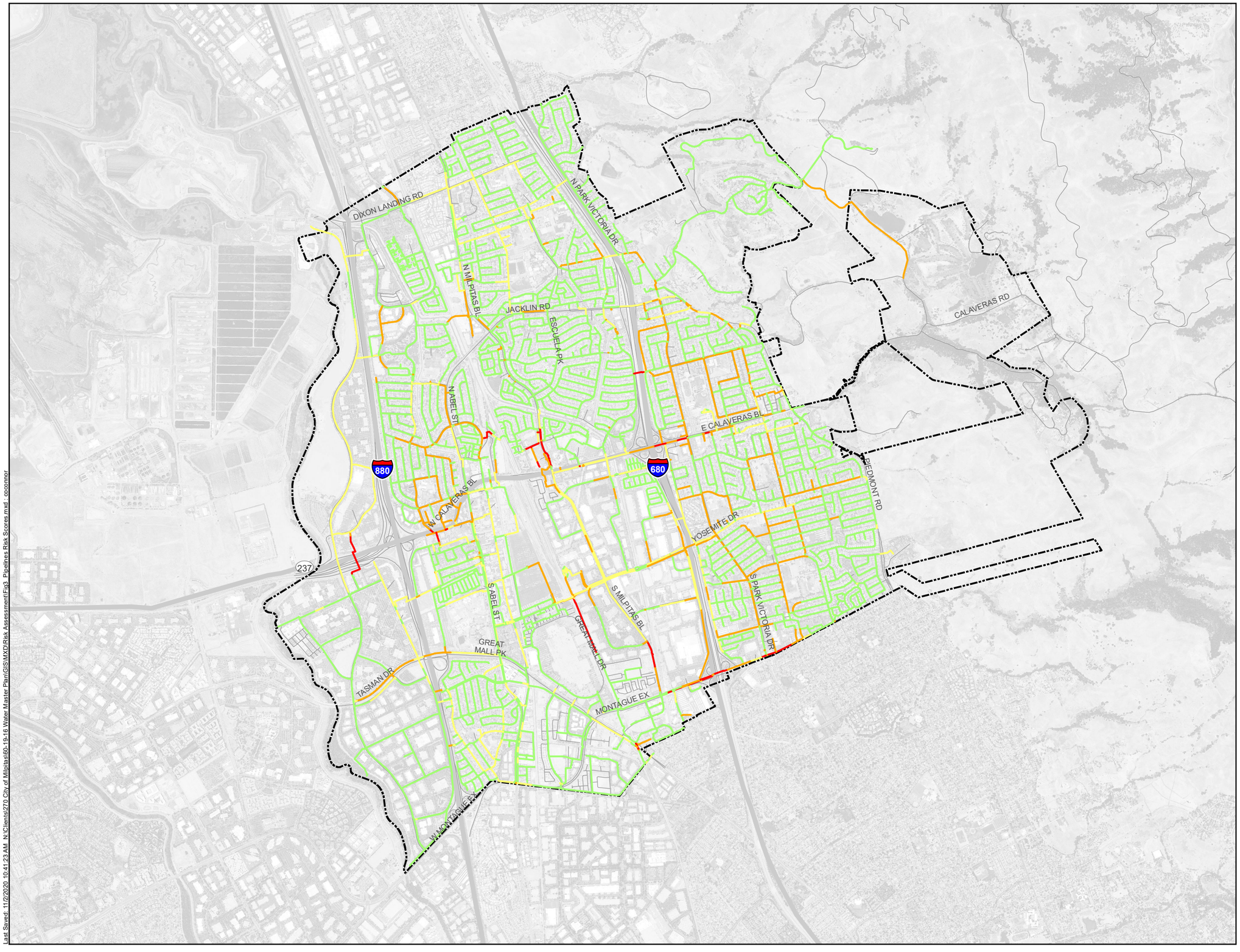
Table 17. Pipeline Risk, Percent of Total Pipeline Length by Risk Level

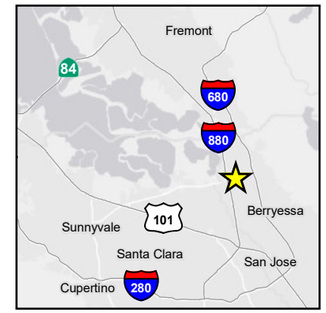
Risk Level	Percent
Low	71
Medium	15
Medium-High	13
High	1

Table 18. Pipeline Risk by LOF and COF, Miles of Pipeline

		LOF				Total Length
		1	2	3	4	
COF	1	15.1	3.0	17.2[(a)]	46.4	81.8
	2	23.6	24.7	15.7	19.8	83.8
	3	5.7	5.6	2.9	1.9	16.2
	4	0.3	0.2	0.4	0.1	0.9
Total		**44.7**	**33.5**	**36.2**	**68.2**	**183**

(a) Denotes the median risk score for all pipelines





N

0 1,500 3,000

Scale in Feet

City Limits
Low
Medium
Med-High
High

Figure 3

Existing Pipelines Risk Classifications

City of Milpitas
2020 Water Master Plan Update

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7.2.2 Hydrants

Table 19 presents the risk results for hydrants by percent of total hydrants in each risk level. Table 20 presents the detailed LOF and COF ratings for all hydrants. The median risk level for hydrants is Low, with an associated LOF of 2 and COF of 2.

Table 19. Hydrant Risk, Percent of Total Hydrants by Risk Level

Risk Level	Percent
Low	78
Medium	22
Medium-High	<0.5
High	0

Table 20. Hydrant Risk by LOF and COF, Count of Hydrants

		LOF				Total Hydrants
		1	2	3	4	
COF	1	71	523	329	0	923
	2	114	1,219[(a)]	216	0	1,549
	3	54	376	4	0	434
	4	0	0	0	0	0
Total		**239**	**2,118**	**549**	**0**	**2,906**

(a) Denotes the median risk score for all pipelines

7.2.3 Valves

Table 21 presents the risk results for valves by percent of total valves in each risk level. Table 22 presents the detailed LOF and COF ratings for all valves. The median risk level for valves is Low, with an associated LOF of 2 and COF of 2.

Table 21. Valve Risk, Percent of Total Valves by Risk Level

Risk Level	Percent
Low	87
Medium	13
Medium-High	<0.5
High	0

Table 22. Valve Risk by LOF and COF, Count of Valves

		LOF				Total Valves
		1	2	3	4	
COF	1	412	1,370	967	0	2,749
	2	509	2,248[(a)]	549	0	3,296
	3	83	187	26	0	296
	4	0	0	0	0	0
Total		**1,004**	**3,794**	**1,542**	**0**	**6,341**

(a) Denotes the median risk score for all pipelines

7.2.4 Meters

Table 23 presents the risk results for meters by percent of total meters in each risk level. Table 24 presents the detailed LOF and COF ratings for all meters. The median risk level for meters is Low, with an associated LOF of 4 and COF of 1.

Table 23. Meter Risk, Percent of Total Meters by Risk Level

Risk Level	Percent
Low	>99.9
Medium	<0.1
Medium-High	<0.1
High	0

Table 24. Meter Risk by LOF and COF, Count of Meters

		LOF				Total Meters
		1	2	3	4	
COF	1	0	476	3,555	12,312[(a)]	16,343
	2	0	2	4	2	8
	3	0	0	0	0	0
	4	0	0	0	0	0
Total		**0**	**478**	**3,559**	**12,314**	**16,351**

(a) Denotes the median risk score for all pipelines

7.2.5 Vertical Assets

Table 25 presents the risk results for all vertical assets by percent of total assets in each risk level. Table 26 presents the detailed LOF and COF ratings for all vertical assets. The median risk level for all vertical assets is Medium-High, with an associated LOF of 3 and COF of 3.

Table 25. Vertical Asset Risk, Percent of Vertical Assets by Risk Level

Risk Level	Percent
Low	1
Medium	25
Medium-High	25
High	48

Table 26. Vertical Asset Risk by LOF and COF, Count of Vertical Assets

		LOF				Total Vertical Assets
		1	2	3	4	
COF	1	0	0	0	0	0
	2	0	0	13	0	13
	3	1	4	29[a]	40	74
	4	0	0	0	0	0
Total		**1**	**4**	**38**	**40**	**87**

(a) Denotes the median risk score for all pipelines

7.2.6 Facility Risk Results

The risk for each facility was evaluated based on the resulting facility LOF and COF ratings discussed previously and the risk equation. Table 27 presents the detailed LOF and COF ratings for each facility. Note the four-by-four risk matrix has been expanded to one decimal to provide greater granularity. The overall facility risk scores (LOF x COF) and risk levels are shown in Table 28 from lowest to highest risk.

Table 27. Risk of Facilities by LOF and COF

COF \ LOF	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
0.5	--	--	--	--	--	--	--	--
1.0	--	--	--	--	--	--	--	--
1.5	--	--	--	--	--	--	--	--
2.0	--	--	--	--	Calera Creek Heights PRV, Main PRV	Curtis Well, Live Oak PRV, North Vault PRV, South Vault PRV	--	--
2.5	--	--	--	--	SJWC Intertie, Sunnyhills PRV, Milpitas PRV, ACWD Intertie, Capitol PRV, Curtis PRV	Abel PRV, SCVWD Intertie, Gibraltar PRV, McCarthy PRV, Sinclair PRV, Main Street Turnout, Montague PRV	--	--
3.0	--	--	--	Minnis Reservoir	--	Calaveras Turnout, Sunnyhills Turnout, Tularcitos Reservoir, Gibraltar Turnout, Country Club Pump Station, Tularcitos Pump Station, Ayer Reservoirs	--	--
3.5	--	--	--	Gibraltar Reservoir (SC), Gibraltar Reservoir (SF)	--	--	Pinewood Well, Gibraltar Pump Station, Ayer Pump Station	--
4.0	--	--	--	--	--	--	--	--

Table 28. Facilities by Risk Score and Risk Level

Facility	Risk Score (LOF x COF)	Risk Level
Calera Heights PRV, Main PRV	4.8	Medium
SJWC Intertie	5.4	Medium
Curtis Well	5.5	Medium
Minnis Reservoir	5.8	Medium
Live Oak PRV, North Vault PRV, South Vault PRV,	6.0	Medium
ACWD Intertie, Capitol PRV	6.3	Medium-High
Gibraltar Reservoir (SC), Gibraltar Reservoir (SF)	6.5	Medium-High
Curtis PRV	6.6	Medium-High
Abel PRV, SCVWD Intertie	6.8	Medium-High
Gibraltar PRV, McCarthy PRV, Sinclair PRV	7.1	Medium-High
Sunnyhills PRV	5.7	Medium-High
Milpitas PRV	6.0	Medium-High
Main Street Turnout	7.5	Medium-High
Montague PRV	7.9	Medium-High
Calaveras Turnout, Sunnyhills Turnout	8.3	Medium-High
Tularcitos Reservoir, Gibraltar Turnout	8.6	Medium-High
Country Club Pump Station, Tularcitos Pump Station	9.2	Medium-High
Ayer Reservoir	9.4	Medium-High
Pinewood Well	11.1	High
Gibraltar Pump Station	12.0	High
Ayer Pump Station	12.2	High

8.0 CONCLUSIONS

8.1 Horizontal Assets

The desktop analysis indicates the horizontal infrastructure of the water system is well into its useful life curve with most assets rated 3 ("likely" asset failure) or higher for LOF.

The consequence of failure analysis indicates that horizontal assets expose mostly a negligible to minimal impact should they fail, with a small percentage of assets potentially yielding a moderate impact.

Overall, the majority (71%) of pipeline assets have a risk rating of Low, with a high LOF and low COF. There is a significant risk exposure to pipeline failure due to this high LOF, which is primarily due to asset age. Hydrants, valves, and meters are also at a Low risk level with generally advanced age contributing to a higher LOF but a relatively low COF.

8.2 Vertical Assets – Facilities

Facilities were generally rated 2 or higher for LOF. The City has developed most of its newer infrastructure in well and reservoir facilities (Curtis Well, Gibraltar Reservoirs, Minnis Reservoir), which are rated with an LOF of less than 3. Remaining facility LOF was consistently rated between 2.4 and 3, except for the Country Club Pump Station, Tularcitos Pump Station, Pinewood Well, Ayer Pump Station and Gibraltar Pump Station which were rated from 3.2 to 3.7. These higher LOF values are indicative of higher asset values with advanced age, suggesting a greater and more immediate investment need in asset renewal.

Facility COF ratings ranged from 2 to 3.4, with the highest ratings assigned to pump stations, reservoirs, and wells. PRVs, interties, and turnouts were all rated below 2.9.

8.3 System Level Risk Summary

The overall risk of the water system is low for horizontal infrastructure and medium-high for facilities. Table 29 illustrates the risk at the distribution system level, allocated by each asset type. Note that some facility types are noted in multiple risk levels.

Table 29. Risk at Water System Level

		LOF			
		1	2	3	4
COF	1	--	--	Pipelines	Meters
	2	--	Hydrants Valves	Well PRVs	--
	3	--	Reservoir	PRVs Turnouts Reservoirs Pump Stations	Well Pump Stations
	4	--	Reservoirs	--	--

Appendix E

Seismic Risk Assessment

WEST YOST
Water. Engineered.

8950 Cal Center Drive
Bldg. 1, Suite 363
Sacramento CA 95826

916.306.2250 phone
530.756.5991 fax
westyost.com

TECHNICAL MEMORANDUM

DATE: October 28, 2020

Project No.: 270-60-19-16
SENT VIA: EMAIL

TO: Harris Siddiqui

FROM: Whitney Sandelin, PE, RCE #86703
Amara Cairns

REVIEWED BY: Mel Damewood III, PE

SUBJECT: City of Milpitas - Summary of Methodologies and Results from Hazus® Earthquake Model and American Lifelines Alliance® Analysis

PURPOSE AND INTRODUCTION

The purpose of this technical memorandum (TM) is to document the methodologies used to estimate consequences and risks associated with an earthquake event affecting the City of Milpitas (City) water system. The results of this analysis conclude in the estimation of the direct consequence of a representative earthquake scenario for the City. The consequence estimates presented herein do not include consideration of community economic losses (e.g. indirect or induced) that may occur due to extended periods without water service.

This TM is organized as follows:

- Introduction to Hazus and American Lifelines Alliance (ALA) Methodologies
- Earthquake Scenario Selection
- Estimated Damage States and Restoration Times
- Estimated Service Denial
- Conclusion and Disclaimer
- References

INTRODUCTION TO HAZUS AND ALA METHODOLOGIES

The Federal Emergency Management Agency (FEMA) has developed a standardized methodology for estimating losses from certain natural hazards, including earthquakes. The methodology, known as Hazus, addresses flooding, hurricanes, coast surge, tsunamis and earthquakes. Specifically, the Hazus Earthquake Model is designed to "produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery".

The American Water Works Association (AWWA) J100 Standard, *Risk and Resilience Management of Water and Wastewater System* (J100 Standard), recommends the Hazus methodology to estimate the damage states and restoration times for individual facilities, such as pump stations and storage tanks. However, West Yost understands that the draft version of the forthcoming update to the J100 Standard recommends the use of the ALA methodology for estimating damages to pipelines and distribution systems under a selected earthquake event. The authors of Hazus acknowledge its limitation for pipelines. As described in the "Message to Users" section of the Hazus Manual, while the Hazus methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology.

Although the revised J100 Standard has not yet been released by AWWA, West Yost considers it to reflect best management practices for conducting earthquake consequence analyses for public water systems. Therefore, West Yost is using two methods in this analysis:

- Hazus for non-linear assets (i.e., storage tanks, pump stations, and treatment facilities). The methodologies presented herein are based on the *Hazus Multi-Hazard Technical Manual, Version 2.1* (Hazus Manual).
- *ALA Seismic Fragility Formulations for Water Systems, Part 1, April 2001 (ALA Manual)* for linear assets.

Hazus deals with all aspects of the built environment, including water system infrastructure. Chapter 8 focuses on direct damage to Utility Systems, including a loss estimation methodology for water system supply, storage, transmission, and distribution components. The ALA Manual provides recommended pipe vulnerability functions and fragility curves in Chapter 4.

The following sections document the specific steps taken to estimate consequences associated with an earthquake event, using the Hazus and ALA methodologies to assess select assets within the City's water system.

EARTHQUAKE SCENARIO SELECTION

In order to apply the Hazus and ALA methodologies, a user must first identify specific parameters associated with a potential ground shaking event, including peak ground acceleration (PGA), peak ground velocity (PGV), and peak ground deformation (PGD). The United States Geological Survey (USGS) Earthquake Scenario Catalogs (also referred to as ShakeMaps) were examined to identify a relevant earthquake scenario for the utility's service area.

The earthquake scenario selected for the City of Milpitas is the Hayward-Rodgers Creek event described in the USGS Northern California Legacy Catalog. At magnitude 6.8, this event represents the largest magnitude event described by ShakeMap in relatively close proximity to key City utilities. The scenario map from the USGS site is shown on Figure 1; the scenario selected for the utility is highlighted in blue. According to USGS, this event has an estimated annual probability of approximately 0.74 percent (i.e., a 0.74 percent chance of occurring in any given year), and an approximately 31.02 percent chance of occurrence within the next 50 years. This event is a scenario (i.e., it is not a historical event) and is intended for planning purposes only.

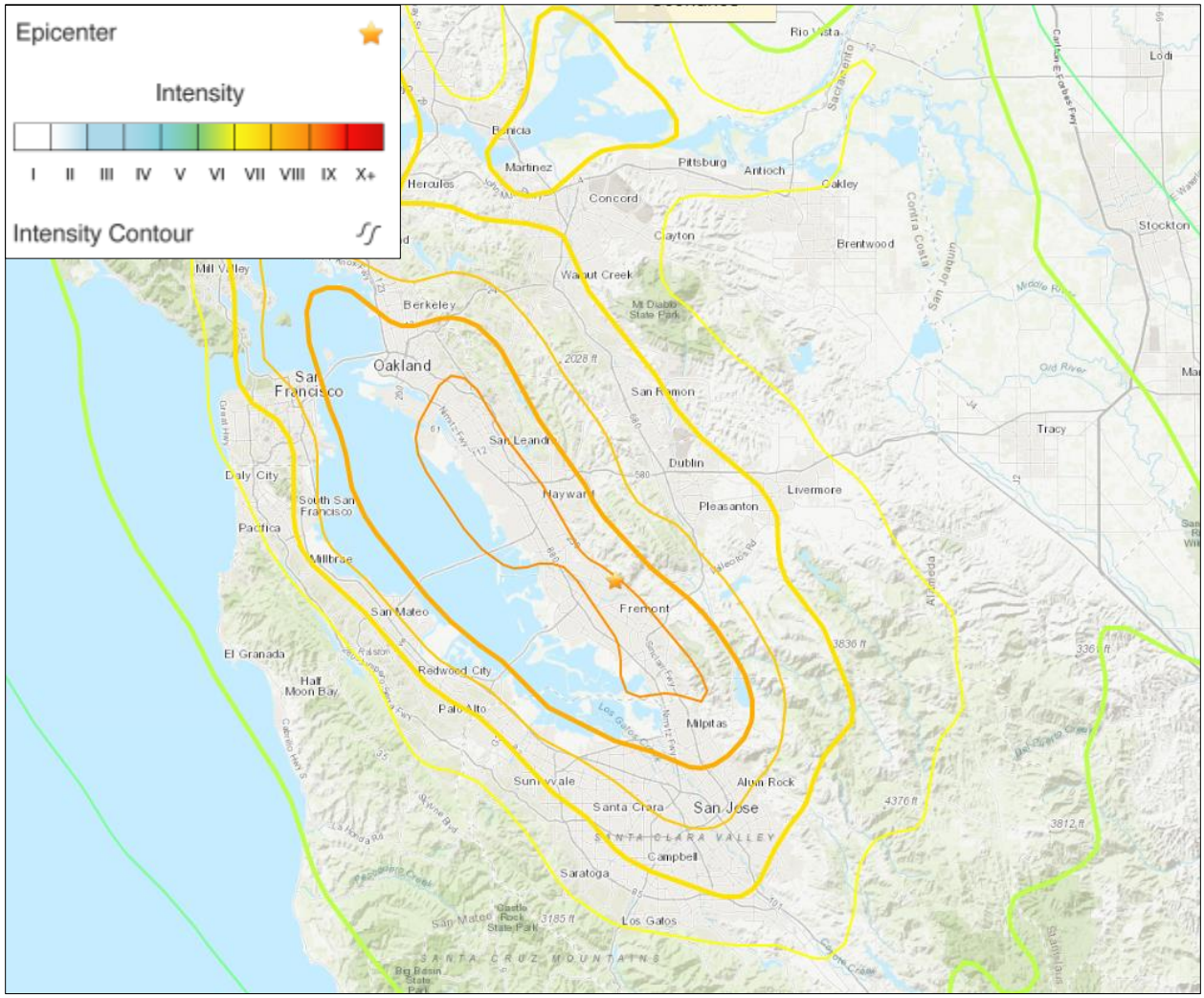

Figure 1. USGS ShakeMap—6.8 Magnitude Earthquake Event for the City of Milpitas

Utilizing the interactive geospatial data interface provided by USGS, ground motion contours were examined based on the scenario epicenter and fault location(s). Values for PGA and PGV were visually interpolated for the location of each asset. For the selected scenario, PGD values were not specified on the USGS ShakeMaps. Table A-1 of Attachment A shows the PGA values assigned to each of the City's selected non-linear assets.

ESTIMATED DAMAGE STATES AND RESTORATION TIMES

The Hazus and ALA methodologies are intended to provide a high-level estimate of damage states for select assets. The purpose of this evaluation is to identify and prioritize more detailed evaluation and mitigation measures in the future.

Based on the PGA and asset type, the Hazus methodology yields an estimate of the damage state for each non-linear asset, along with an associated restoration time as part of the Hazus program. Damage states estimated in this analysis include moderate and extensive for both pump stations and storage tanks. Descriptions of these damage states are included below.

Pump Stations

- **Extensive damage** for pump stations is defined as extensive damage to facility buildings or damage to pumps beyond repair.
- **Moderate damage** for pump stations is defined by the loss of electric power for approximately one-week, considerable damage to mechanical and electrical equipment, or moderate damage to buildings.

Storage Tanks

- **Extensive damage** for storage tanks is defined as damage to the tank extensive enough to require removal of the tank from service, including, for example, elephant foot buckling for steel tanks with loss of content or shearing of concrete tank walls.
- **Moderate damage** for storage tanks is defined by the tank being considerably damaged but with only minor loss of content. Examples of moderate damage include elephant foot buckling for steel tanks without loss of content, or moderate cracking of concrete tanks with minor loss of content.

Similarly, the ALA methodology yields estimated numbers of breaks and leaks among linear assets, based on PGV, PGD, and specific asset attributes (e.g., pipeline material, joint type, etc.). The following sections describe these methodologies and the results of their application to the City's assets in greater detail.

Restoration Times

Restoration time is defined as the time to restore the facility to a functioning level. This analysis considered the time to restore select assets owned and operated by the City. Assets which are required for the delivery of both San Francisco Public Utilities Commission (SFPUC) and Valley Water (VW) source water from the wholesaler to the City were not included in this analysis; it should be noted that, on a regional level, an earthquake event could disrupt supply infrastructure from SFPUC and VW to the City's distribution system, limiting the City's capacity to any wells that are repaired or remain functional.

In this analysis, total restoration time consists of the time to repair the damage (construction and repair activities) plus the preconstruction activities, such as the time involved with the immediate post event, pre-restoration assessment, planning, and mobilization activities. The total restoration time is estimated by using construction/repair duration provided in the Hazus method and adding to this an estimate of the time required for preconstruction activities. Engineering judgement and input from the City were utilized

to fine tune the total restoration times. For linear assets (Pipelines) engineering judgement and input from the City were utilized to estimate restoration times.

Hazus conducted statistical analyses method to provide estimate of the amount of time needed to conduct construction and repair activities for a variety of non-linear assets and a range of damage states. They provide the "mean restoration time" and the standard deviation. This analysis is using the "mean restoration time" provided by Hazus.

Methodology Summary

The overall methodology to this analysis is to estimate the damage to non-linear and linear utility assets from an earthquake, estimate the restoration time for each damaged asset, and then calculate cost to restore the system based on the restoration time needed for each asset. Repair and replacement costs are calculated using the crew size available to the City, the labor rate, the shift duration and order of magnitude material costs for the City. The next section describes how damage is estimated for non-linear and linear assets.

Non-Linear Assets: Reservoirs, Pump Stations, and Key City Properties

Non-linear assets include reservoirs, pump stations, and key city properties. Each facility was assigned a Hazus "facility classification." Classifications are generally based on the type of facility and whether the facility features anchored components/equipment. Hazus defines anchored as "equipment designed with special seismic tiedowns or tiebacks," while unanchored equipment refers to equipment designed with no special considerations other than the manufacturer's normal requirements. Based on review of previously prepared seismic facility assessments and observations made during site visits, all of the utility's assets were assigned to the anchored component facility classification.

The resulting Hazus facility classifications for the City's assets are presented in Table A-1. Hazus Tables 8.3, 8.6, 8.7 and 8.9 (reproduced in Figures A-1 through A-4 in Attachment A) were used to assign damage states based on PGA or PGV values obtained for the selected earthquake event. In the utility's case, there are several non-linear facility classifications deemed susceptible to PGD, including reservoirs and pump stations.

Hazus Table 8.1.a (reproduced as Figure A-5 of Attachment A) was used to estimate the damage state and associated mean restoration time for each facility. Hazus-recommended restoration time estimates are based on Hazus restoration function curves and represent an average time for the facility classification. In addition to the restoration time suggested by Hazus, three days were added to account for the immediate post-event, pre-restoration assessment, planning, and mobilization activities. Table A-1 shows the resulting estimated restoration time for each asset.

Non-Linear Asset Damage State

Using the Hazus Method for non-linear assets, the Hayward-Rogers Creek 6.8 magnitude earthquake scenario is estimated to cause moderate damage to the City's pump stations, storage tanks, and buildings. This is primarily due to the high Peak Ground Acceleration and Velocity (PGA, PGV) that the earthquake will produce in the City's service area. Liquefaction susceptibility ranges from very low to moderate for non-linear assets in the City's service area as well. Probabilities are assigned to each liquefaction susceptibility, as described in Table 3.

The Country Club, Tularcitos, and Ayer pump stations are expected to have extensive damage and require approximately seventeen days for restoration. Extensive damage for pump stations is defined as extensive damage to facility buildings or damage to pumps beyond repair. The Gibraltar pump station (SFPUC and VW) is expected to have moderate damage and take approximately six days for restoration. Moderate damage for pump stations is defined by the loss of electric power for approximately one-week, considerable damage to mechanical and electrical equipment, or moderate damage to buildings. By deploying portable generators in the event of an outage, the City can reduce service losses and associated costs lower than estimated using the Hazus Method.

The Tularcitos, Minnis, and Ayer reservoirs are expected to have extensive damage and require approximately 96 days each for restoration. Extensive damage for storage tanks is defined as damage to the tank extensive enough to require removal of the tank from service, including, for example, elephant foot buckling for steel tanks with loss of content or shearing of concrete tank walls.

Moderate damage was estimated for the Gibraltar Reservoirs (SFPUC and VW) and each are estimated to require six days for restoration. Moderate damage for storage tanks is defined by the tank being considerably damaged but with only minor loss of content. Examples of moderate damage include elephant foot buckling for steel tanks without loss of content, or moderate cracking of concrete tanks with minor loss of content.

The City Hall and Corporation Yard buildings are expected to have moderate damage and take approximately six days for restoration. Moderate damage could include rotation of steel members at connections, cracks through welds, or broken bolts for steel frame buildings; hairline cracks on beams and columns; and larger flexural cracks and concrete spalling. Buildings with red or yellow tags cannot be occupied until an onsite assessment is made by an engineer and will require additional time as needed for restoration.

Reservoir Sloshing Wave Assessment

To supplement the Hazus assessment, a review of the maximum operating levels of each of the City's water storage reservoirs was performed to determine if operating levels are appropriately set to mitigate against the impact of seismically induced sloshing waves. When operating levels within reservoirs are too high, the sloshing wave within the reservoir that is produced by the seismic forces can cause damage to the significant reservoir structure, including potential roof collapse.

The site-specific seismic design parameters for each reservoir site are summarized in Table 1; these parameters were used to calculate the height of the sloshing wave.

Table 1. Site-Specific Seismic Design Parameters

Reservoir	Seismic Risk Category	Site Soil Class[a]	TL[b]	SD1[c]	SDs[d]
Ayer	IV	D – Stiff Soil	12	0.82	1.341
Gibraltar	IV	D – Stiff Soil	12	0.682	1.147
Minnis	IV	C – Very Dense Soil and Soft Rock	8	0.886	1.638
Tularcitos	IV	C – Very Dense Soil and Soft Rock	8	0.828	1.535

(a) Site soil class from *City of Milpitas Seismic Isolation Study*, ABR Engineers, January 2002. Additional study of the site-specific soil conditions could change the soil classification, which would in turn impact the seismic design parameters.
(b) Long-period transition period
(c) Design spectral response acceleration parameter at a period of 1-s
(d) Design spectral response acceleration parameter at short periods

Typically, a reservoir is constructed so that the distance between the overflow and the reservoir roof is great enough to accommodate the full height of the produced sloshing wave. In concrete reservoirs, the concrete roof may be designed to withstand some of the force of the sloshing wave, allowing for less distance to be provided between the overflow and reservoir roof (potentially up to half of the sloshing wave height). West Yost reviewed the maximum operating water levels and reservoir roof heights for each of the reservoirs and compared this distance to the sloshing wave height. A sloshing wave height that is greater than the distance between the maximum water level and the roof indicates that that the standard is not met, and the sloshing wave could collide with the roof structure, potentially causing structural damage. The results of the sloshing wave analysis are presented in Table 2. The analysis shows that none of the City's reservoirs currently meet the standard for sloshing waves.

Table 2. Sloshing Wave Analysis

Reservoir	Inside Diameter, ft	Normal Operating Range (el.)	Overflow Height (el.)	Roof Height (el.)	Sloshing Wave Height, ft	Sloshing Wave Assessment
Ayer	181	78.2 – 83	85.0	89.96	14.2	Does not meet standard [a]
Gibraltar	158	37 – 46.5	48.0	49.7	10.4	Does not meet standard [b]
Minnis	51	900.5 – 907	908.5	909.5	10.0	Does not meet standard [c]
Tularcitos	48	559.2 – 565.7	567.2	568.2	9.2	Does not meet standard [d]

(a) A distance of 4.96 ft is provided between the reservoir roof and the overflow, and a distance of 6.96 ft is provided between the reservoir roof and the high operational level; the calculated sloshing wave height of 14.2 ft exceeds both distances. The concrete tank roof may be capable of withstanding the force of the sloshing wave, but additional structural analysis is needed to confirm this.
(b) A distance of 1.7 ft is provided between the reservoir roof and the overflow, and a distance of 3.2 ft is provided between the reservoir roof and the high operational level; the calculated sloshing wave height of 10.4 ft exceeds both distances. The concrete tank roof may be capable of withstanding the force of the sloshing wave, however, as a rule of thumb, the roof is typically assumed to be capable of withstanding a maximum of only half of the sloshing wave height.
(c) A distance of 1.5 ft is provided between the reservoir roof and the overflow, and a distance of 2.5 ft is provided between the reservoir roof and the high operational level; the calculated sloshing wave height of 10.0 ft exceeds both distances.
(d) A distance of 1.0 ft is provided between the reservoir roof and the overflow, and a distance of 2.5 ft is provided between the reservoir roof and the high operational level; the calculated sloshing wave height of 9.2 ft exceeds both distances.

For steel tanks (e.g., the Minnis and Tularcitos Reservoirs), the tank may be retrofitted to meet the sloshing wave standard by adding a steel ring to the top of the tank, thereby increasing the total tank height so that the height of the sloshing wave may be accommodated. Steel tanks typically have a distance between the tank overflow and the tank roof of the sloshing wave height plus one additional foot. When preparing detailed tank retrofit plans, other damage mechanisms should be considered to better reinforce the structure against potential risks, not limited to shearing off inlet/outlet pipes, anchorage system failure causing uplift, and tank shell failure.

Non-Linear Asset Restoration Time

Hazus Table 8.1.a (reproduced as Figure A-3 of Attachment A) was used to estimate the associated mean restoration time for each facility, using the damage state from Hazus Tables 8.6 and 8.9. Hazus-recommended restoration time estimates are based on Hazus restoration function curves and available crews for restoration and represent an average time for the facility classification. In addition to the restoration time suggested by Hazus, three days were added to account for the immediate post-event, pre-restoration assessment, planning, and mobilization activities. Table A-1 shows the resulting estimated restoration time for each asset.

Two, four- person crews working 12-hour days were assumed to be available to repair and restore facilities following the selected earthquake event. This assumption forms the basis of the overall restoration time for repair and replacement work. This assumption does not include utilizing mutual aid via the Water/Wastewater Agency Response Network (WARN). Utilizing WARN can significantly reduce the time of restoration, which is scalable in the results. The number of days vary based on the size and damage state severity of the facility. Table A-1 shows the resulting estimated restoration time for each asset.

Non-Linear Consequences Cost Estimates

Utility lost water production and utility economic loss were calculated using the total restoration time and service level for each facility, along with the City of Milpitas' cost of water ($7,981/million gallons). Replacement costs for reservoirs and pump stations were calculated using the replacement costs documented in the 2020 WY Asset Management TM scaled to reflect the severity of damage (50% for extensive and 25% for moderate damage). This value was selected to represent the repair/replacement cost for all reservoirs and pump stations.

As shown in Table A-1, the analysis found that Ayer Reservoir, Gibraltar Pump Stations (SFPUC and VW) and Gibraltar Reservoirs (SFPUC and VW) had the largest repair and replacement costs and water lost costs of all non-linear assets for the selected earthquake event. Repair and replacement costs are calculated using crew size, labor rate, shift duration and order of magnitude material costs.

The total cost consequence of the non-linear assets is $5,967,160. This cost includes the total cost of repair and the total cost of water loss.

Linear Assets: Pipelines

The City owns and maintains 183 miles of pipelines, with pipe sizes ranging in diameter from 6 inches to 24 inches. Based on available pipeline material information contained in the utility's pipeline geographic information system (GIS), the majority of the system is made up of asbestos cement (approximately 133.5 miles by length) and polyvinyl chloride (PVC) (approximately 27.4 miles by length) pipe. The system also contains concrete cylinder, cast iron, ductile iron, and steel pipelines. Using the ALA methodology,

West Yost assed the distribution system as a whole to estimate the number of anticipated leaks and breaks. The results of this assessment are presented in Table B-2.

The City had previously identified a select subset of pipelines within the City's service area and designated it as the "backbone". The "backbone" pipelines are pipelines which transmit water from the sources to all parts of the service area. West Yost broke the "backbone" pipeline network into 28 individual pipeline reaches and assessed the individual reach to estimate the number of anticipate leaks and breaks that would occur on the individual pipeline reaches as a result of a seismic event. Pipeline reaches are identified in Figure B-1. The results of this assessment are presented in Table B-1.

Linear Asset Damage State

The ALA methodology considers two damage states for buried pipelines: leaks and breaks. The methodology assumes that damage due to seismic waves (represented by PGV) will consist of 80 percent leaks and 20 percent breaks, while damage due to ground failure (represented by PGD) will consist of 20 percent leaks and 80 percent breaks. Two damage algorithms are used to estimate the number of leaks and breaks:

1. **For Ground Shaking**: $Repair\ Rate/_{1000\ ft} = K_1 \times 0.00187 \times PGV$

   Where K_1 is a fragility constant related to the expected performance of a given pipe material[1]. Units for PGV are inches per second. Assigned K_1 values can be found on table B-1 and B-2 in Attachment B.

2. **For Peak Ground Deformation**: $Repair\ Rate/_{1000\ ft} = K_2 \times 1.06 \times PGD^{0.319} \times L_S$

   Where K_2 is a fragility constant related to the expected performance of a given pipe material[2], and L_S is the estimated probability that PGD will occur during ground shaking. Units for PGD are inches. Assigned K_2 values can be found on table B-1 and B-2 in Attachment B.

ShakeMap information was used to obtain an average PGV value for all pipelines. Spatial liquefaction susceptibility data published by USGS were used to identify areas within the distribution system with "very low", "low", "moderate", "high" and "very high" susceptibility to liquefaction (and therefore, PGD). The estimated probabilities of liquefaction occurring in each liquefaction susceptibility category are listed in Table 3 below. For very low, low, moderate, and high liquefaction susceptibility areas, a PGD of six inches was assumed in accordance with J100 Standard recommendations; for very high liquefaction susceptibility areas, a PGD of 12 inches was assumed. The PGV and PGD calculations were considered additive, and resulted in conservative estimates for breaks and leaks, as summarized on Tables B-1 and B-2 in Attachment B.

[1] See Figure B-1 in Attachment B for a reproduction of K_1 values recommended by the ALA methodology.
[2] See Figure B-2 in Attachment B for a reproduction of K_2 values recommended by the ALA methodology.

Table 3. Liquefaction Susceptibility and Probability

Liquefaction Susceptibility	Probability of Liquefaction
Very High	0.50
High	0.25
Moderate	0.10
Low	0.05[(a)]
Very Low	0.02[(a)]

(a) Hazus recommends using 0.05 for low and 0.02 for very low liquefaction susceptibility.

Two, four-person crews working 12-hour days were assumed to be available to repair breaks and leaks following the selected earthquake event. This assumption forms the basis of the overall restoration time for leaks and breaks. An additional 3 days were added to the resulting total to account for the immediate post-disaster assessment, planning, and mobilization time. Total restoration time and total pipeline repair labor and material cost is summarized on Table B-3 in Attachment B.

Using the ALA methodology for linear assets, the Hayward-Rodgers Creek - 6.8 magnitude earthquake scenario is estimated to cause 192 breaks and 58 leaks to the collective transmission pipeline and distribution pipeline. Break and leak estimates and total restoration time for transmission pipelines and distribution pipelines is summarized on Table B-2 in Attachment B. It is estimated to take approximately 113 days to reach total restoration. This includes 3 days for the immediate post-disaster assessment but does not assume the utilization of mutual aid for pipeline restoration, which would shorten the time of restoration significantly if pipe repair crews were to be brought in from other entities in an isolated event. However, the regional impacts of the anticipated earthquake scenario pose a threat to the availability of mutual aid resources, which consequently may need to be sourced from a significant distance away. The City's emergency response preparation should consider the regional impacts of this earthquake scenario.

Estimated Service Denial

Using the Hazus Method for non-linear assets, the Hayward-Rodgers Creek 6.8 magnitude earthquake scenario is estimated to cause extensive damage to the City's facilities due to an estimated maximum peak ground acceleration of 0.65 g, with g being earth's gravitational acceleration. Hazus predicts significant damage to City facilities would equate to loss of electrical power and backup power and extensive damage to pumping stations and storage tanks. It is also assumed that a loss of water quality would be imminent. Due to the damage anticipated it is expected that there would be a loss of service equivalent to approximately 165 million gallons.

Linear Consequences Cost Estimates

The analysis found the City's trunk lines could have 8 breaks and 32 leaks, as shown in Table B-1. The overall distribution system was estimated to experience 192 breaks and 58 leaks, as shown in Table B-2. Repair and replacement costs are calculated using crew size, labor rate, shift duration and order of magnitude material costs.

The direct linear consequence costs by type of pipeline are presented in Table B-3. The total cost consequence of the linear assets is $334,173 for the trunk lines and $2,515,349 for the overall distribution system. This total includes the cost of the estimated water loss and the cost of repair labor and material.

Consequence Costs Summary

The Hayward-Rodgers Creek - 6.8 magnitude earthquake is estimated to cause significant damage to the City's non-linear and linear assets, with a total consequence cost of approximately $10,322, 527. The consequence cost of all linear assets is approximately $4,355,366, and the consequence cost of all non-linear assets is approximately $5,967,160. The Hazus Method estimates moderate damage to the buildings and moderate/severe damage to the pump stations and reservoirs. The ALA Method estimates 8 breaks and 32 leaks from the trunk lines and 192 breaks and 58 leaks from the distribution pipelines. Table 4 below shows the consequence costs of each asset from the Hayward-Rodgers Creek earthquake. For the purposes of this TM, the costs indicated below reflect the repair and replacement costs and loss of service. See Table A-1 for a breakdown of these individual cost components.

Table 4. Earthquake Threat Asset Pair Consequence Costs

Threat	Asset	Consequence Cost, dollars
Earthquake / Landslide	Tularcitos Reservoir	1,550,471
Earthquake / Landslide	Minnis Reservoir	1,690,507
Earthquake / Landslide	Country Club Pump Station	1,235,196
Earthquake / Landslide	Tularcitos Pump Station	1,390,946
Earthquake / Liquefaction	City Hall	50,020
Earthquake / Liquefaction	Corporation Yard	50,020
Earthquake / Liquefaction	Reach 1 / McCarthy PRV	106,632
Earthquake / Liquefaction	Reach 2 / California Circle PRV	26,291
Earthquake / Liquefaction	Reach 3	12,984
Earthquake / Liquefaction	Reach 4 / Junipero PRV	34,911
Earthquake / Liquefaction	Reach 5 / Live Oak PRV	4,631
Earthquake / Liquefaction	Reach 6	11,516
Earthquake / Liquefaction	Reach 7 / Main PRV	14,069
Earthquake / Liquefaction	Reach 8 / Parc Metro PRV	8,335
Earthquake / Liquefaction	Reach 9 / Curtis PRV	13,982
Earthquake / Liquefaction	Reach 10	17,501
Earthquake / Liquefaction	Reach 11	31,285
Earthquake / Liquefaction	Reach 12 / Gibraltar PRV / Gibraltar Turnout	23,650
Earthquake / Liquefaction	Reach 13 / Capitol PRV	20,874
Earthquake / Liquefaction	Reach 14	8,672
Earthquake / Liquefaction	Reach 15 / Sunnyhills PRV	17,575
Earthquake / Liquefaction	Reach 16	2,569
Earthquake / Liquefaction	Reach 17	6,297
Earthquake / Liquefaction	Reach 18	4,424
Earthquake / Landslide	Reach 19 / Calera Creek Heights & Tularcitos PRVs	9,028
Earthquake / Liquefaction	Reach 20 / North Milpitas PRV	21,612
Earthquake / Liquefaction	Reach 21 / Montague PRV	4,882

Table 4. Earthquake Threat Asset Pair Consequence Costs		
Threat	Asset	Consequence Cost, dollars
Earthquake / Liquefaction	Reach 22	11,495
Earthquake / Liquefaction	Reach 23 / Yosemite PRV	14,714
Earthquake / Liquefaction	Reach 24	3,830
Earthquake / Liquefaction	Reach 25	12,547
Earthquake / Liquefaction	Reach 26	6,210
Earthquake / Liquefaction	Reach 27	2,952
Earthquake / Liquefaction	Reach 28	7,433
Earthquake / Liquefaction	Distribution System	3,894,466
	Total	**10,322,527**

CONCLUSION AND DISCLAIMER

The methodology and results presented in this TM were based on the Hazus Earthquake Model Methodology and Manual and the ALA Methodology. The Hazus and ALA methodologies have been utilized as best management practice, as recommended in the J100 Standard. Data and assumptions used in the analysis were based on best available information. The methodologies have been interpreted to best suit specific City assets and site conditions. Also note that the ALA pipeline damage results are subject to a range of minus 50 percent to plus 100 percent in accuracy.

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Attachment A

Hazus Methodology Results for Non-Linear Assets

Table A-1. HAZUS Methodology Results for Non-Linear Assets

Facility/Asset	Year Built	Service Level, MGD	ShakeMap PGA, g	ShakeMap PGV, cm/s	Liquefaction Susceptibility, %	Assumed PGD, In	HAZUS Damage State, PWT1	HAZUS Mean Restoration Time, d	Days to assess and plan (pre-restoration time), d	Total Time to Restoration, d	Lost Water Production, MG	Utility Economic Loss – Water, $	Repair / Replacement Crew Cost, $/d	Repair / Replacement Cost, $
Reservoirs														
Tularcitos Reservoir	1980	0.06	0.42	41	2%, Very Low	-	extensive	93	3	96	5.76	45,971	8,200	1,504,500[(a)]
Minnis Reservoir	1980	0.17	0.42	41	5% Low	-	extensive	93	3	96	16.32	130,250	8,200	1,560,258[(a)]
Ayer Reservoir	1993	4.14	0.4	40	10%, Moderate	6	extensive	93	3	96	397.44	3,171,969	8,200	7,145,000[(a)]
Gibraltar Reservoir (SFPUC)	1991	4.03	0.35	37	10%, Moderate	6	moderate	3.1	3	6.1	24.58	196,197	8,200	3,272,500[(a)]
Gibraltar Reservoir (VW)	1991	5.99	0.35	37	10%, Moderate	6	moderate	3.1	3	6.1	36.54	291,618	8,200	3,272,500[(a)]
Pump Stations														
Country Club Pump Station	1981	0.06	0.42	49	2%, Very Low	-	extensive	13.5	3	16.5	0.99	7,901	8,200	1,227,295[(a)]
Tularcitos Pump Station	1981	0.17	0.42	41	2%, Very Low	-	extensive	13.5	3	16.5	2.81	22,387	8,200	1,368,560[(a)]
Ayer Pump Station	1995	4.14	0.4	40	10%, Moderate	6	extensive	13.5	3	16.5	68.31	545,182	8,200	2,489,563[(a)]
Gibraltar Pump Station (SFPUC)	1993	4.03	0.35	37	10%, Moderate	6	moderate	3.1	3	6.1	24.58	196,197	8,200	4,366,522[(a)]
Gibraltar Pump Station (VW)	1993	5.99	0.35	37	10%, Moderate	6	moderate	3.1	3	6.1	36.54	291,618	8,200	4,366,522[(a)]
Other														
City Hall	2000	-	0.365	39	10%, Moderate	6	moderate	3.1	3	6.1	-	-	8,200	50,020[(b)]
Corporation Yard	-	-	0.38	40	10%, Moderate	6	moderate	3.1	3	6.1	-	-	8,200	50,020[(b)]
Total	-	-	-	-	-	-	-	-	-	-	**613.87**	**$4,899,288**		**30,673,259**

(a) Cost based on percentage of replacement cost as documented in the 2020 WY Asset Management TM (50% for extensive damage and 25% for moderate damage).
(b) Costs based on (Total Time to Restoration) X (Repair/Replacement Crew Cost)

Table 8.3: Damage Algorithms for Small Water Treatment Plants

Peak Ground Acceleration			
Classification	**Damage State**	**Median (g)**	**β**
Plants with anchored subcomponents (PWT1)	slight/minor	0.25	0.50
	moderate	0.38	0.50
	extensive	0.53	0.60
	complete	0.83	0.60
Plants with unanchored subcomponents (PWT2)	slight/minor	0.16	0.40
	moderate	0.27	0.40
	extensive	0.53	0.60
	complete	0.83	0.60

Figure A-1. Hazus Table 8.3

Table 8.6: Damage Algorithms for Small Pumping Plants

Peak Ground Acceleration			
Classification	**Damage State**	**Median (g)**	**β**
Plants with anchored subcomponents (PPP1)	slight/minor	0.15	0.70
	moderate	0.36	0.65
	extensive	0.66	0.65
	complete	1.50	0.80
Plants with unanchored subcomponents (PPP2)	slight/minor	0.13	0.60
	moderate	0.28	0.50
	extensive	0.66	0.65
	complete	1.50	0.80

Figure A-2. Hazus Table 8.6

Table 8.7: Damage Algorithms for Medium/Large Pumping Plants

Peak Ground Acceleration			
Classification	**Damage State**	**Median (g)**	**β**
Plants with anchored subcomponents (PPP3)	slight/minor	0.15	0.75
	moderate	0.36	0.65
	extensive	0.77	0.65
	complete	1.50	0.80
Plants with unanchored subcomponents (PPP4)	slight/minor	0.13	0.60
	moderate	0.28	0.50
	extensive	0.77	0.65
	complete	1.50	0.80

Figure A-3. Hazus Table 8.7

Table 8.9: Damage Algorithms for Water Storage Tanks

Peak Ground Acceleration			
Classification	**Damage State**	**Median (g)**	**β**
On-Ground Anchored Concrete Tank (PST1)	slight/minor	0.25	0.55
	moderate	0.52	0.70
	extensive	0.95	0.60
	complete	1.64	0.70
On-Ground Unanchored Concrete Tank (PST2)	slight/minor	0.18	0.60
	moderate	0.42	0.70
	extensive	0.70	0.55
	complete	1.04	0.60
On-Ground Anchored Steel Tank (PST3)	slight/minor	0.30	0.60
	moderate	0.70	0.60
	extensive	1.25	0.65
	complete	1.60	0.60
On-Ground Unanchored Steel Tank (PST4)	slight/minor	0.15	0.70
	moderate	0.35	0.75
	extensive	0.68	0.75
	complete	0.95	0.70
Above-Ground Steel Tank (PST5)	slight/minor	0.18	0.50
	moderate	0.55	0.50
	extensive	1.15	0.60
	complete	1.50	0.60
On-Ground Wood Tank (PST6)	slight/minor	0.15	0.60
	moderate	0.40	0.60
	extensive	0.70	0.70
	complete	0.90	0.70
Permanent Ground Deformation			
Classification	**Damage State**	**Median (in)**	**β**
Buried Concrete Tank (PST7)	slight/minor	2	0.50
	moderate	4	0.50
	extensive	8	0.50
	complete	12	0.50

Figure A-4. Hazus Table 8.9

Table 8.1.a: Continuous Restoration Functions for Potable Water Systems (After ATC-13, 1985)

Restoration Functions (All Normal Distributions)			
Classification	**Damage State**	**Mean (Days)**	**σ (days)**
Water Treatment Plants	slight/minor	0.9	0.3
	moderate	1.9	1.2
	extensive	32.0	31.0
	complete	95.0	65.0
Pumping Plants	slight/minor	0.9	0.3
	moderate	3.1	2.7
	extensive	13.5	10.0
	complete	35.0	18.0
Wells	slight/minor	0.8	0.2
	moderate	1.5	1.2
	extensive	10.5	7.5
	complete	26.0	14.0
Water Storage Tanks	slight/minor	1.2	0.4
	moderate	3.1	2.7
	extensive	93.0	85.0
	complete	155.0	120.0

Figure A-5. Hazus Table 8.1.a

Attachment B

ALA Methodology Results for Linear Assets

Table B-1. Trunk Pipeline Lengths and Fragility

Pipe Reach	Total Pipe Length, miles	Average Pipe Diameter, inches	Most Common Pipe Type	K1	K2	Average PGV, cm/s	No. Leaks			No. Breaks		
							Ground Shaking	Ground Deformation	Total	Ground Shaking	Ground Deformation	Total
1	3.9	13	DIP	0.5	0.6	35.5	0.6	11.4	11.9	0.1	2.8	3.0
2	1.6	12	ACP	0.5	0.8	40.8	0.3	2.5	2.7	0.1	0.6	0.7
3	0.5	11	ACP	0.5	0.7	39.8	0.1	1.3	1.4	0.0	0.3	0.3
4	3.3	12	ACP	0.5	0.8	36.5	0.5	2.9	3.4	0.1	0.7	0.8
5	0.4	11	ACP	0.5	0.7	33.8	0.1	0.2	0.3	0.0	0.1	0.1
6	1.0	12	DIP	0.5	0.6	34.3	0.1	0.5	0.6	0.0	0.1	0.2
7	0.5	18	ACP	0.5	0.7	36.5	0.1	0.6	0.7	0.0	0.2	0.2
8	0.7	19	DIP	0.5	0.5	36.3	0.1	0.3	0.4	0.0	0.1	0.1
9	1.1	18	DIP	0.5	0.5	36.3	0.1	0.6	0.7	0.0	0.1	0.2
10	0.9	14	ACP	0.5	0.6	36.5	0.1	0.7	0.9	0.0	0.2	0.2
11	0.2	24	STL	0.3	0.3	36.3	0.0	0.1	0.1	0.0	0.0	0.0
12	0.1	12	ACP	0.5	0.8	36.3	0.0	0.1	0.1	0.0	0.0	0.0
13	1.2	17	ACP	0.5	0.7	34.5	0.2	0.6	0.8	0.0	0.2	0.2
14	1.4	14	ACP	0.5	0.6	35.8	0.2	0.2	0.4	0.1	0.1	0.1
15	3.5	11	ACP	0.5	0.8	38.5	0.5	0.6	1.2	0.1	0.2	0.3
16	0.0	10	ACP	0.5	0.8	41.4	0.0	0.0	0.0	0.0	0.0	0.0
17	1.1	10	ACP	0.5	0.8	41.4	0.2	0.1	0.3	0.0	0.0	0.1
18	0.3	12	ACP	0.5	0.8	41.0	0.0	0.0	0.1	0.0	0.0	0.0
19	2.0	11	ACP	0.5	0.8	41.0	0.3	0.3	0.6	0.1	0.1	0.1
20	2.9	15	ACP	0.5	0.7	37.3	0.4	1.2	1.7	0.1	0.3	0.4
21	0.4	10	ACP	0.5	0.8	35.3	0.0	0.2	0.3	0.0	0.1	0.1
22	0.8	18	DIP	0.5	0.5	37.0	0.1	0.3	0.4	0.0	0.1	0.1
23	1.8	14	ACP	0.5	0.6	37.3	0.3	0.8	1.1	0.1	0.2	0.3
24	0.3	16	DIP	0.5	0.6	39.3	0.1	0.0	0.1	0.0	0.0	0.0
25	1.3	12	ACP	0.5	0.8	38.8	0.2	0.5	0.7	0.1	0.1	0.2
26	0.3	22	STL	0.2	0.2	38.3	0.0	0.0	0.1	0.0	0.0	0.0
27	0.1	18	DIP	0.5	0.5	39.0	0.0	0.0	0.1	0.0	0.0	0.0
28	0.8	11	ACP	0.5	0.8	39.5	0.1	0.4	0.5	0.0	0.1	0.1
Total	**32.6**	-	-	-	-	-	**4.8**	**26.7**	**31.5**	**1.2**	**6.7**	**7.9**

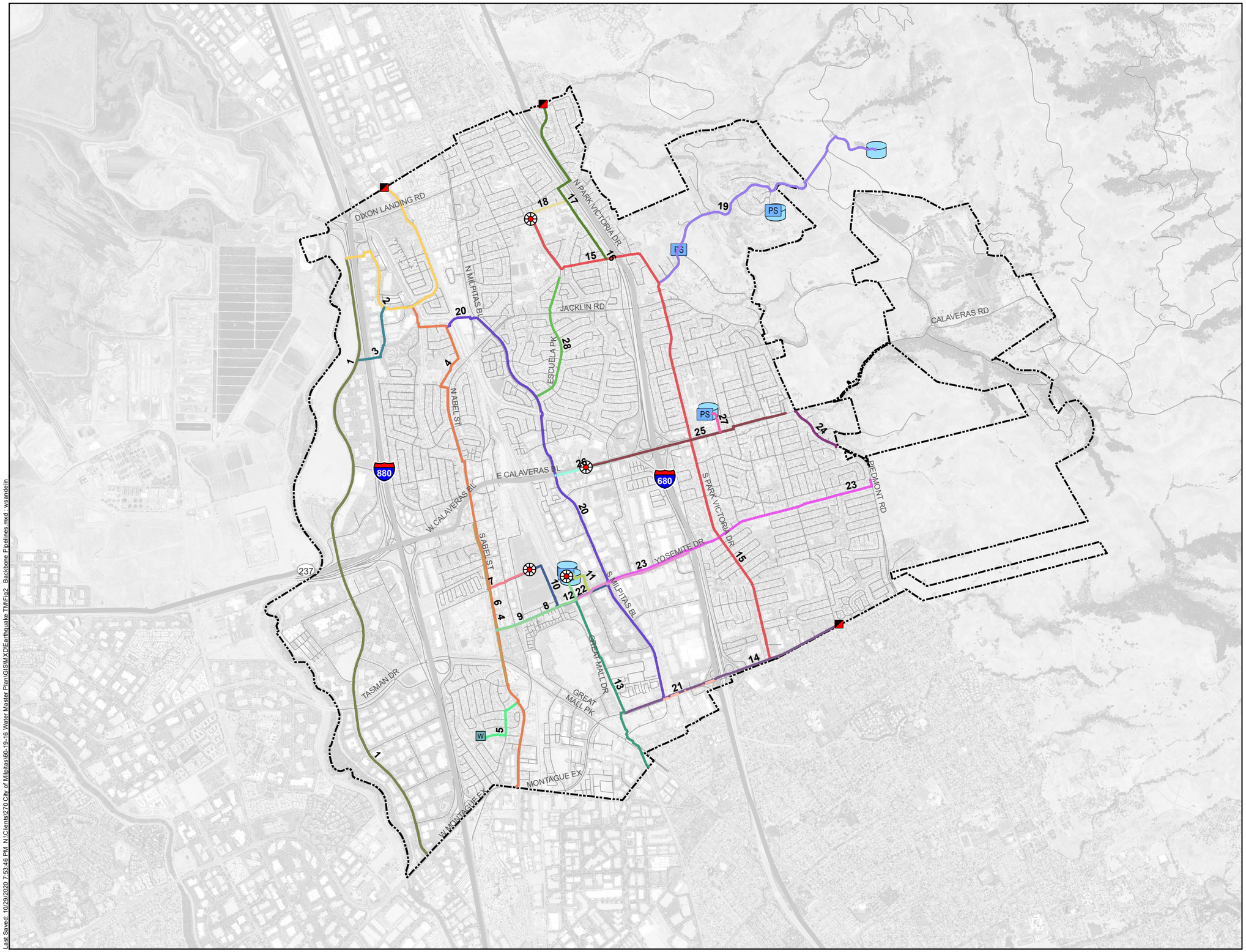
Table B-2. Overall Pipeline Distribution Lengths and Fragility

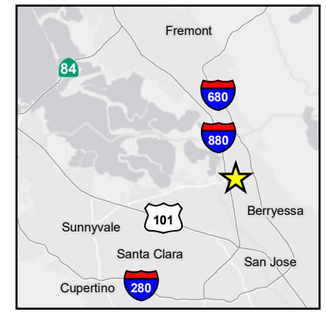
Pipe Material	Total Pipe Length, miles	Average Pipe Diameter	K1	K2	Average PGV, cm/s	No. Leaks			No. Breaks		
						Ground Shaking	Ground Deformation	Total	Ground Shaking	Ground Deformation	Total
AC/ACP	133.5	Small	0.5	0.8	36.1	7.4	36.2	43.7	1.9	144.9	146.8
CCP	0.2	Small	0.8	1.0	36.1	0.0	0.1	0.1	0.0	0.2	0.2
CIP	0.9	Small	0.8	0.8	36.1	0.1	0.3	0.3	0.0	1.0	1.1
DIP	15.3	Large	0.5	0.5	36.1	0.3	0.9	1.2	0.1	3.5	3.5
PVC	27.4	Small	0.5	1.0	36.1	0.0	0.1	0.1	0.0	0.5	0.5
STL	5.3	Large	0.15	0.15	36.1	0.0	0.1	0.1	0.0	0.4	0.4
Total	**182.6**	-	-	-	**36.1**	**10.3**	**47.2**	**57.5**	**2.6**	**188.9**	**191.4**

Table B-3. Pipeline Repair Cost Estimates

Evaluation	Total Repair Time, crew days	Total Pipeline Repair Labor and Material Cost, dollars
Trunk Lines	14.8	$334,173
Overall Distribution	113.0	$2,515,349

(a) Total Pipeline Repair Labor and Material Cost based on crew size 4 workers, 2 crews, $150/hr labor cost, $2500/crew day material cost, and a $50,000 administrative adder.





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0 1,500 3,000

Scale in Feet

- Turnout
- Well
- Emergency Intertie
- Pump Station
- Storage Reservoir
- City Limits

Figure B-1

Backbone Pipeline Reaches

City of Milpitas

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Pipe Material	Joint Type	Soils	Diam.	K_1	Reference Sections
Cast iron	Cement	All	Small	1.0	4.4.2
Cast iron	Cement	Corrosive	Small	1.4	4.4.2
Cast iron	Cement	Non-corrosive	Small	0.7	4.4.2
Cast iron	Rubber gasket	All	Small	0.8	4.4.2
Welded steel	Lap - Arc welded	All	Small	0.6	4.4.4
Welded steel	Lap - Arc welded	Corrosive	Small	0.9	4.4.4
Welded steel	Lap - Arc welded	Non-corrosive	Small	0.3	4.4.4
Welded steel	Lap - Arc welded	All	Large	0.15	4.4.4
Welded steel	Rubber gasket	All	Small	0.7	4.4.6
Welded steel	Screwed	All	Small	1.3	4.4.6 A.3.11
Welded steel	Riveted	All	Small	1.3	4.4.6
Asbestos cement	Rubber gasket	All	Small	0.5	4.4.3 4.4.5
Asbestos cement	Cement	All	Small	1.0	4.4.3
Concrete w/Stl Cyl.	Lap - Arc Welded	All	Large	0.7	4.4.6
Concrete w/Stl Cyl.	Cement	All	Large	1.0	4.4.6
Concrete w/Stl Cyl.	Rubber Gasket	All	Large	0.8	4.4.6
PVC	Rubber gasket	All	Small	0.5	4.4.6
Ductile iron	Rubber gasket	All	Small	0.5	4.4.5 4.4.6

Table 4-5. Ground Shaking - Constants for Fragility Curve

Figure B-2. ALA-Recommended K_1 Fragility Constants for Pipelines

Pipe Material	Joint Type	K_2	Reference Sections
Cast iron	Cement	1.0	4.4.2
Cast iron	Rubber gasket	0.8	4.4.2
Cast iron	Mechanical restrained	0.7	4.4.2
Welded steel	Arc welded, lap welds (large diameter, non corrosive)	0.15	4.4.4
Welded steel	Rubber gasket	0.7	4.4.3
Asbestos cement	Rubber gasket	0.8	4.4.3
Asbestos cement	Cement	1.0	4.4.6
Concrete w/Stl Cyl.	Welded	0.6	4.4.6
Concrete w/Stl Cyl.	Cement	1.0	4.4.6
Concrete w/Stl Cyl.	Rubber Gasket	0.7	4.4.6
PVC	Rubber gasket	0.8	4.4.6
Ductile iron	Rubber gasket	0.5	4.4.6

Table 4-6. Permanent Ground Deformations - Constants for Fragility Curve

Figure B-3. ALA-Recommended K_2 Fragility Constants for Pipelines

Appendix F

Cost Estimating Assumptions

Appendix F
Cost Estimating Assumptions

This appendix details West Yost's assumptions for estimating probable construction costs for the recommended water system facilities. Construction costs were developed based on a combination of data supplied by manufacturers, published industry standard cost data and curves, construction costs for similar facilities built by other public agencies, and construction costs previously estimated by West Yost for similar facilities with similar construction cost indexes.

The costs presented in this appendix are for construction only and do not include estimating or construction uncertainties (e.g., variations in final quantities) or cost estimates for engineering, legal services, environmental review, inspections, and/or contract administration. Some of these items are referred to as contingency costs and are addressed in the last section of this appendix. Construction costs presented in this appendix represent capital infrastructure costs and do not include costs for purchase of additional surface water supplies, supply reliability, or operation and maintenance.

All estimated construction costs have been adjusted to reflect August 2020 dollars for San Francisco, California. These costs should be used for conceptual cost estimates only and should be updated regularly. Construction costs presented in this appendix are not intended to represent the lowest prices in the industry for each type of construction; rather they are representative of average or typical construction costs. These planning-level construction cost estimates have been prepared for guidance in evaluating various facility improvement options and are intended only for budgetary purposes within the context of this master planning effort.

The following sections of this appendix describe the assumptions used to estimate the probable construction costs for the planning and design of recommended water system facilities for the City's water system:

- Water System Construction Costs
- Design and Construction Contingencies and Other Project Costs

WATER SYSTEM CONSTRUCTION COSTS

The following sections present the construction cost estimates used to project probable construction costs for recommended water system facilities in the City's water system and are categorized by type of improvement, including the following:

- Treated Water Storage Reservoirs
- Municipal Groundwater Production Wells
- Treated Water Pump Stations
- Potable Water Pipelines
- Turnouts
- Pressure Reducing Valves and Isolation Valves
- Backup Power Generators

Treated Water Storage Reservoirs

Table 1 summarizes the estimated construction costs for above-ground concrete and steel treated water storage reservoirs between 1.0 and 6.0 million gallons (MG). These costs generally include the installation of the storage tank, site piping, earthwork, paving, instrumentation, and related sitework. These costs are representative of construction under normal excavation and foundation conditions and would be significantly higher for special or difficult foundation requirements.

Table 1. Construction Costs for Treated Water Storage Reservoirs[a]

Capacity, MG	Estimated Construction Cost, million dollars(b)	
	Above-ground Concrete	Above-ground Steel
1.0	3.4	2.4
2.0	4.5	3.3
3.0	5.6	4.2
4.0	6.7	5.1
5.0	7.8	6.0
6.0	8.9	6.9

(a) Based on August 2020 CCI for San Francisco (12,920.6).

(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate and do not include design and construction contingencies or other project costs. See Table 5 for recommended application of contingency and other project costs.

Municipal Groundwater Production Wells

Well construction consists of pilot hole drilling, water quality/soil sampling, pilot hole reaming, well construction, well development and providing the necessary housing, pump, motor, automatic control equipment, discharge piping, supervisory control and data acquisition (SCADA), and disinfection equipment. Costs also assume a backup power generator will be installed.

Construction costs for new groundwater wells are estimated to be approximately $3,500,000 per well (assuming a well capacity between 500 – 1,000 gallons per minute [gpm]). These estimates are based on recent bids for similarly sized wells and representative of construction under normal drilling conditions. Costs would be significantly higher for special or difficult locations, or if specialized wellhead treatment is required.

Treated Water Pump Stations

Pump stations will be required at ground-level and below-grade reservoirs to lift water to the hydraulic grade of the City distribution system. Estimated construction costs for distribution pumping stations, as shown in Table 2, are based on enclosed stations with architectural and landscaping treatment suitable for residential areas. Pump station costs can vary considerably, depending on architectural design, pumping head, and pumping capacity. Therefore, these costs presented below are representative of construction under common or normal conditions and would be significantly higher for special or difficult conditions.

Pump station cost estimates include the installation of the pumps, site piping, earthwork, paving, a chemical feed system (hypochlorite), on-site backup/standby power generator, SCADA, and related sitework.

Table 2. Construction Costs for Treated Water Pump Stations[a]

Firm Capacity[b], mgd	Estimated Construction Cost, million dollars[c]
0.5	1.5
1	1.5
2	1.7
3	1.9
5	2.3
10	3.2
15	4.2

(a) Based on August 2020 CCI for San Francisco (12,920.6).

(b) Equal to the total pumping capacity with the largest pump out of service or on standby.

(c) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate and do not include design and construction contingencies or other project costs. See Table 5 for recommended application of contingency and other project costs.

Potable Water Pipelines

Unit construction costs for potable water pipelines 8 through 36 inches in diameter are provided in Table 3Table 3. These unit costs are categorized by typical pipeline construction either in developed (e.g., in urban or suburban roads) or undeveloped (e.g., across open fields or in rural roads) areas and are representative of pipeline construction under common or normal conditions. Special or difficult conditions would increase costs significantly.

The unit construction costs presented below generally include pipeline materials, trenching, placing and jointing pipe, valves, fittings, hydrants, service connections, placing imported pipe bedding, native backfill material, and partial asphalt pavement replacement, if required. However, the costs presented in Table 3 do not include jacking and boring pipe or constructing boring and receiving pits. Jack and bore costs are shown in Table 4 and should be added where required.

Table 3. Unit Construction Costs for Pipelines[a]

Pipeline Diameter, inches	Unit Construction Cost, dollars/linear foot[b]	
	Developed Areas	Undeveloped Areas
8	135	90
10	165	110
12	185	130
14	200	145
16	220	165
18	240	185
20	265	190
24	290	225
30	365	315
36	470	420

(a) Based on August 2020 CCI for San Francisco (12,920.6).

(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate and do not include design and construction contingencies or other project costs. See Table 5 for recommended application of contingency and other project costs.

Table 4. Unit Construction Costs for Jack and Bore[a]

Pipeline Size	Unit Construction Cost, dollars/linear foot[b]
12-inch pipe (24-inch casing)	935
16-inch pipe (30-inch casing)	1,170
18-inch pipe (32-inch casing)	1,250
24-inch pipe (36-inch casing)	1,405

(a) Based on August 2020 CCI for San Francisco (12,920.6).

(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate and do not include design and construction contingencies or other project costs. See Table 5 for recommended application of contingency and other project costs.

Turnouts

Additional turnouts are recommended to increase supply reliability. The construction cost for a new turnout is estimated to be approximately $313,000. This cost is representative of construction under normal conditions and would be significantly higher for special or difficult conditions.

The construction cost estimate for a turnout includes the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

Pressure Reducing Valves and Isolation Valves

Pressure reducing valves are required to supply water between pressure zones during peak demands and/or emergency conditions. The construction cost for a pressure reducing valve is estimated to be approximately $282,000. This cost is representative of construction under normal conditions and would

be significantly higher for special or difficult conditions. The construction cost for a new isolation valve is estimated to be approximately $8,000.

The construction cost estimate for a pressure reducing valve includes the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

Backup Power Generators

On-site backup power generators are recommended so pumps can continue delivering water to the distribution system in the event of a power outage. These generators should be sized to meet the power demands of the pumps. The construction cost for a new, on-site backup power generator is estimated to be approximately $200,000. This cost is representative of construction under normal conditions and would be significantly higher for special or difficult conditions.

DESIGN AND CONSTRUCTION CONTINGENCIES AND OTHER PROJECT COSTS

Contingency and other project costs must be reviewed on a case-by-case basis, because they will vary considerably with each project. However, to assist City staff with budgeting for the recommended water system facility improvements, standard contingencies (as percentages of the base construction cost) are recommended and are divided into two categories: Design and Construction Contingency Costs and Other Project Costs.

- **Design and Construction Contingency Costs**: 35 percent
  The construction costs presented above are representative of the construction of water system facilities under normal construction conditions and schedules; consequently, it is appropriate to allow for estimating, design, and construction uncertainties unavoidably associated with the conceptual planning of projects at the master planning level. Factors such as unexpected construction conditions, the need for unforeseen mechanical items, and variations in final quantities are only a few of the items that can increase project costs. An allowance of 35 percent of the base construction cost will be included to cover such project related design and construction contingencies.
- **Other Project Costs:** 35 percent
  Other project fees have been divided into three (3) subcategories, totaling 35 percent: 10 percent engineering, 15 percent construction management, and 10 percent program implementation.
  - Engineering costs associated with new facilities include preliminary investigations and reports, right-of-way acquisition, foundation explorations, preparation of drawings and specifications during construction, surveying and staking, sampling of testing material, and start-up services. For this study, engineering costs are assumed to be 10 percent of the base construction cost estimate.
  - Construction management covers such items as contract management and inspection during construction. The cost of these items can also vary, but for the purpose of this study, it is assumed that construction management charges will equal approximately 15 percent of the base construction cost estimate.
  - Program implementation costs cover items such as legal fees, environmental/CEQA compliance requirements, financing expenses, administrative costs, and interest during construction. The cost of these items can also vary, but for the purpose of this study, it is assumed that program implementation costs will equal approximately 10 percent of the base construction cost estimate.

An example application of these standard mark-ups to a project with an assumed base construction cost of $1.0 million is shown in Table 5. As shown, the total cost of all project construction contingencies (construction contingency, engineering, construction management, and program implementation costs) is 70 percent of the base construction cost for each construction project.

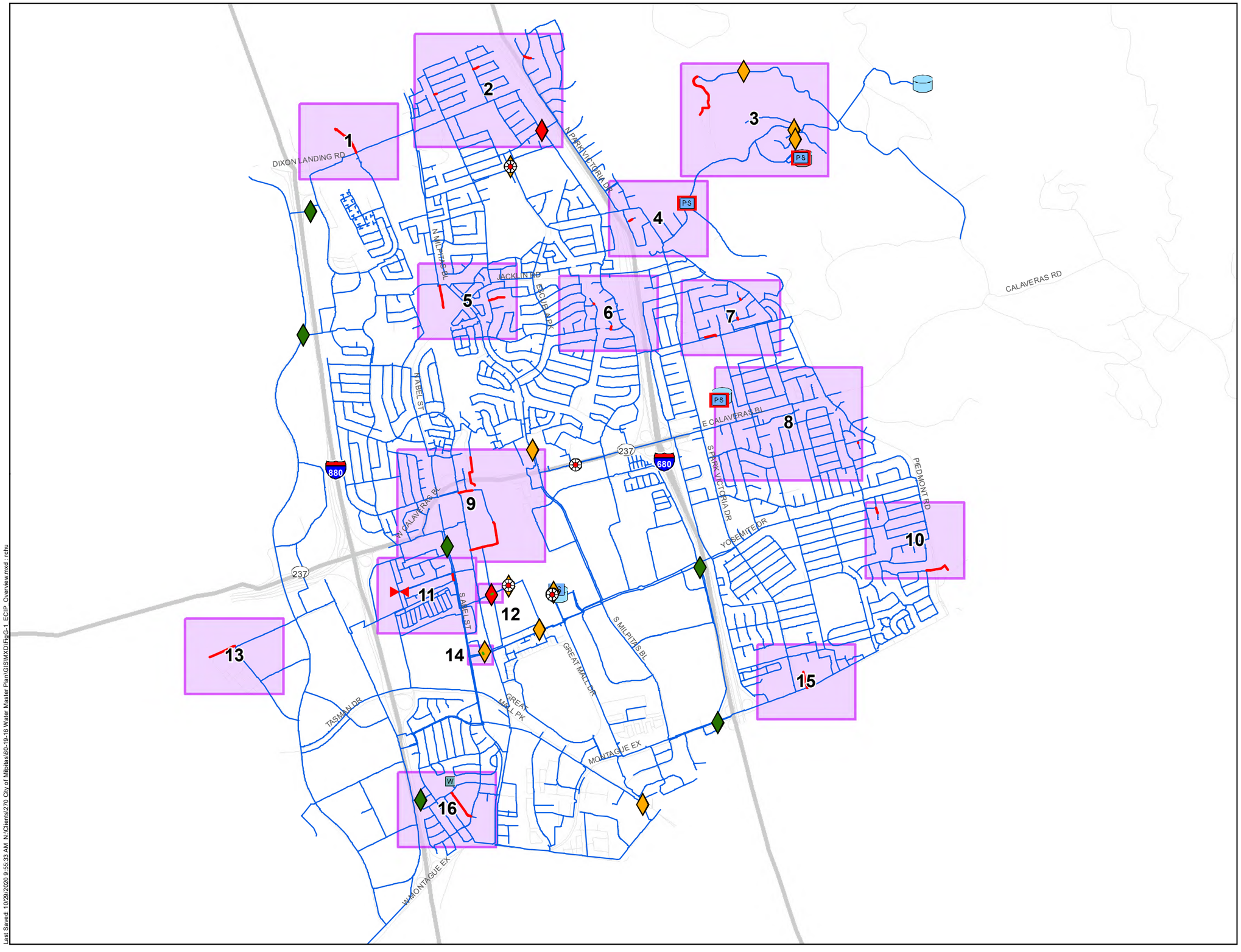
Table 5. Example Application of Contingency and Other Project Costs

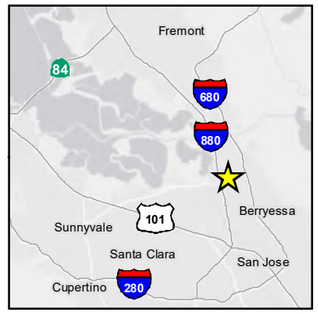
Cost Component	Percent	Cost, dollars
Estimated Base Construction Cost before Mark-ups[(a)]		1,000,000
Design and Construction Contingencies	35	350,000
Other Project Costs		
Engineering	10	100,000
Construction Management	15	150,000
Program Implementation	10	100,000
Estimated Total Project Cost		**$1,700,000**

(a) Assumed cost of an example project.

Appendix G

Capital Improvement Program
Mapbook and Project Summary Sheets







Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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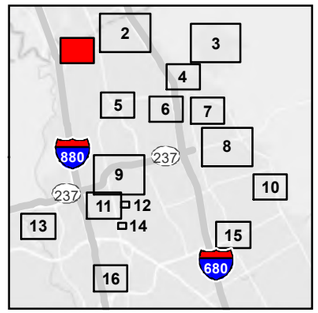

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0 100 200

Scale in Feet

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

CITY OF MILPITAS CALIFORNIA

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Figure G-1.1

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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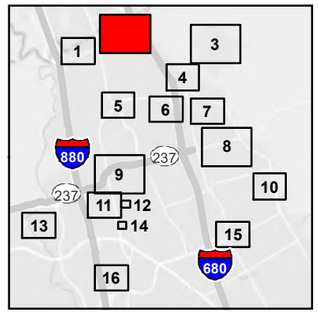

N

0 150 300

Scale in Feet

Recommended Facilities

- Emergency PRV
- PS Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.2

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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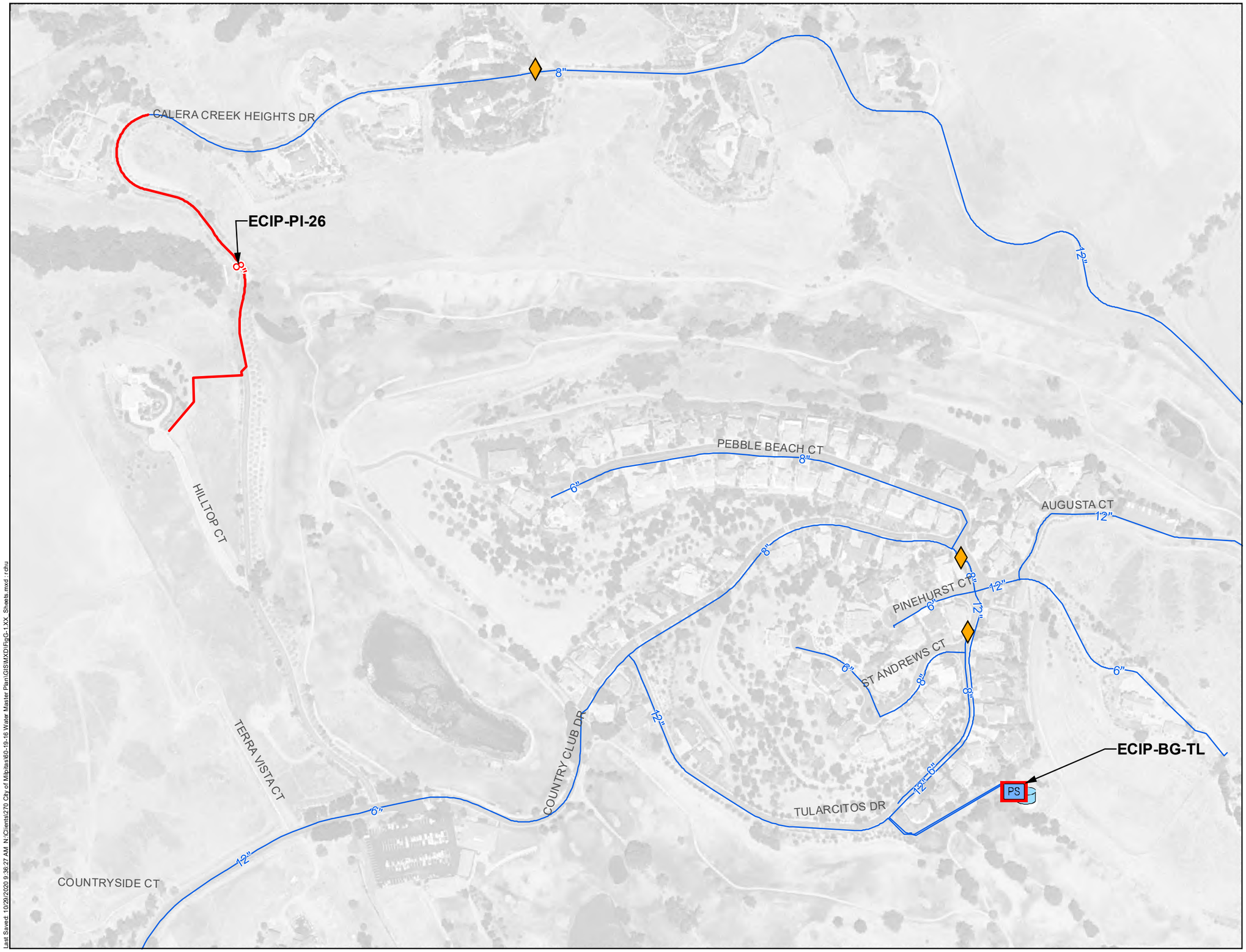

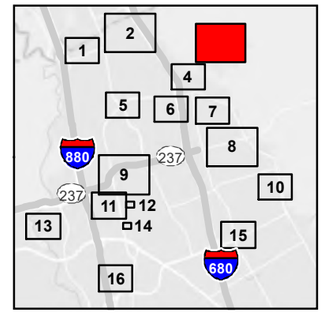

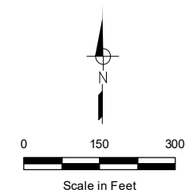

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.3

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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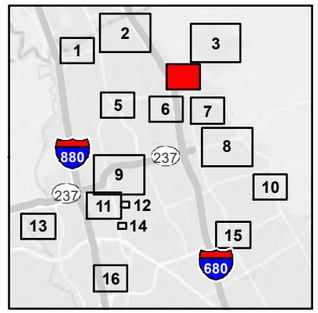

N

0 100 200

Scale in Feet

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.4

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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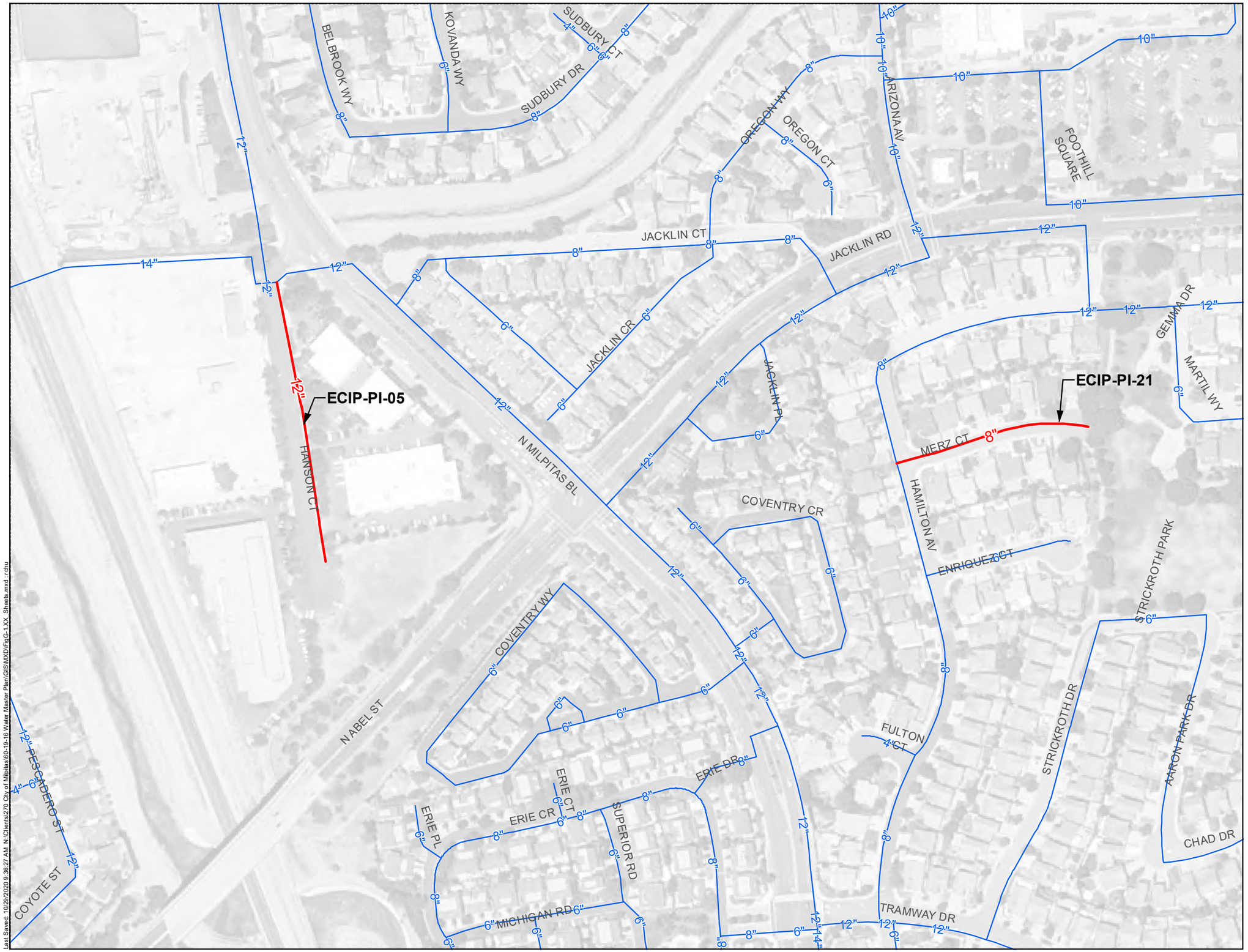

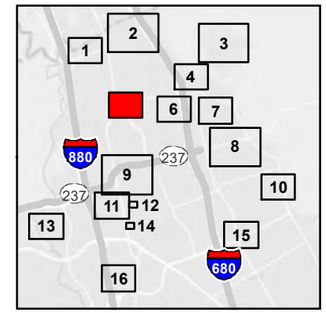

N

0 100 200

Scale in Feet

Recommended Facilities

- Emergency PRV
- PS Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

CITY OF MILPITAS CALIFORNIA

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Figure G-1.5

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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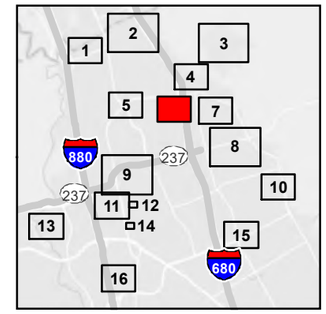

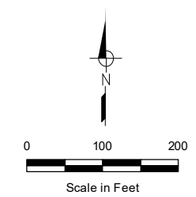

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.6

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

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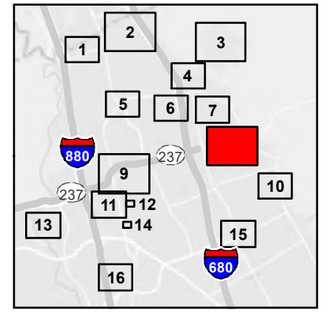
Figure G-1.7

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan





N

0 150 300

Scale in Feet

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.8

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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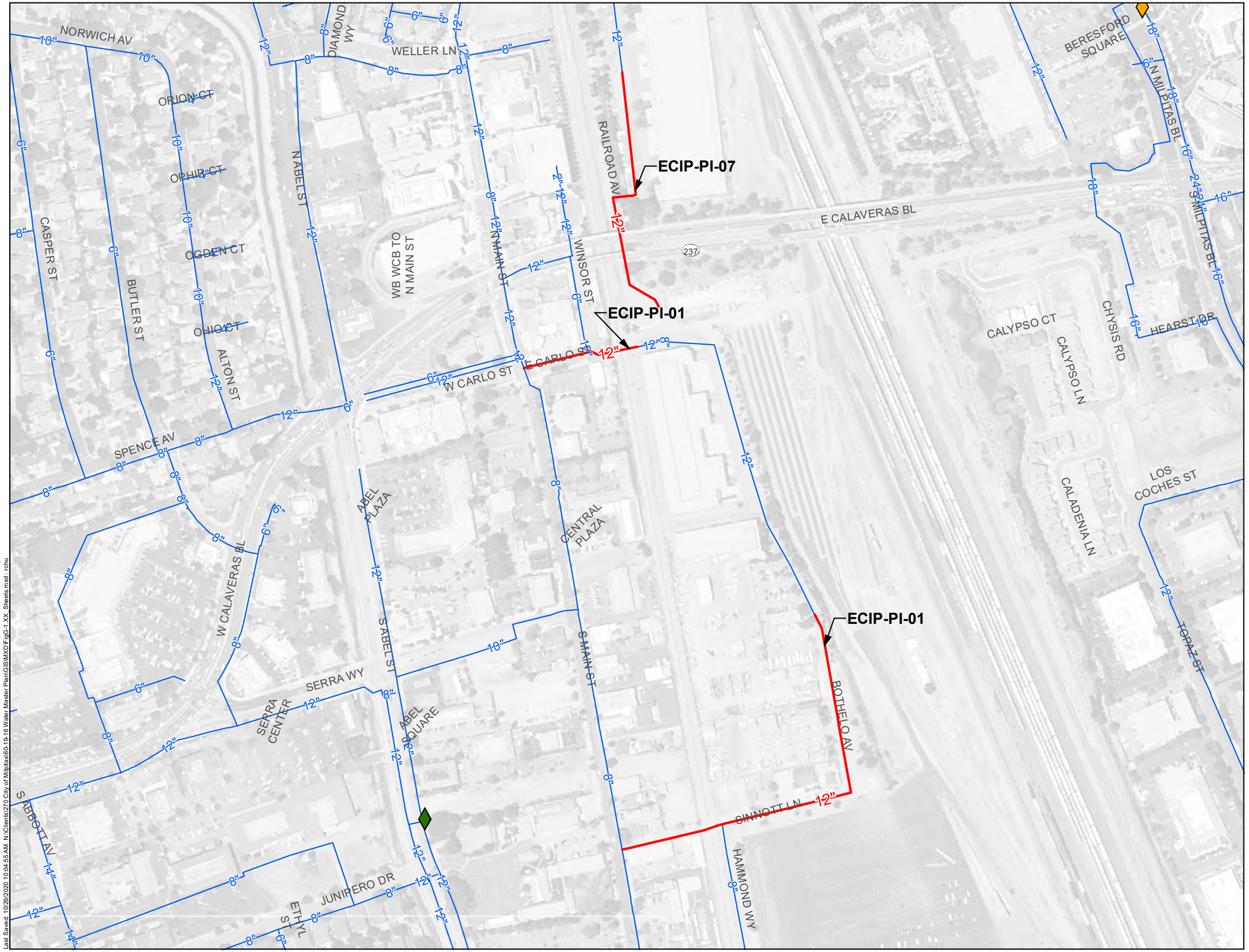
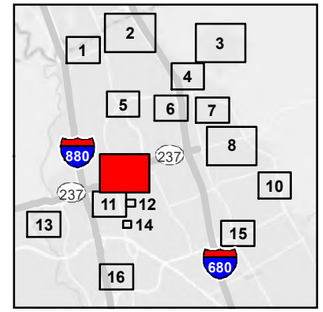




0 150 300

Scale in Feet

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

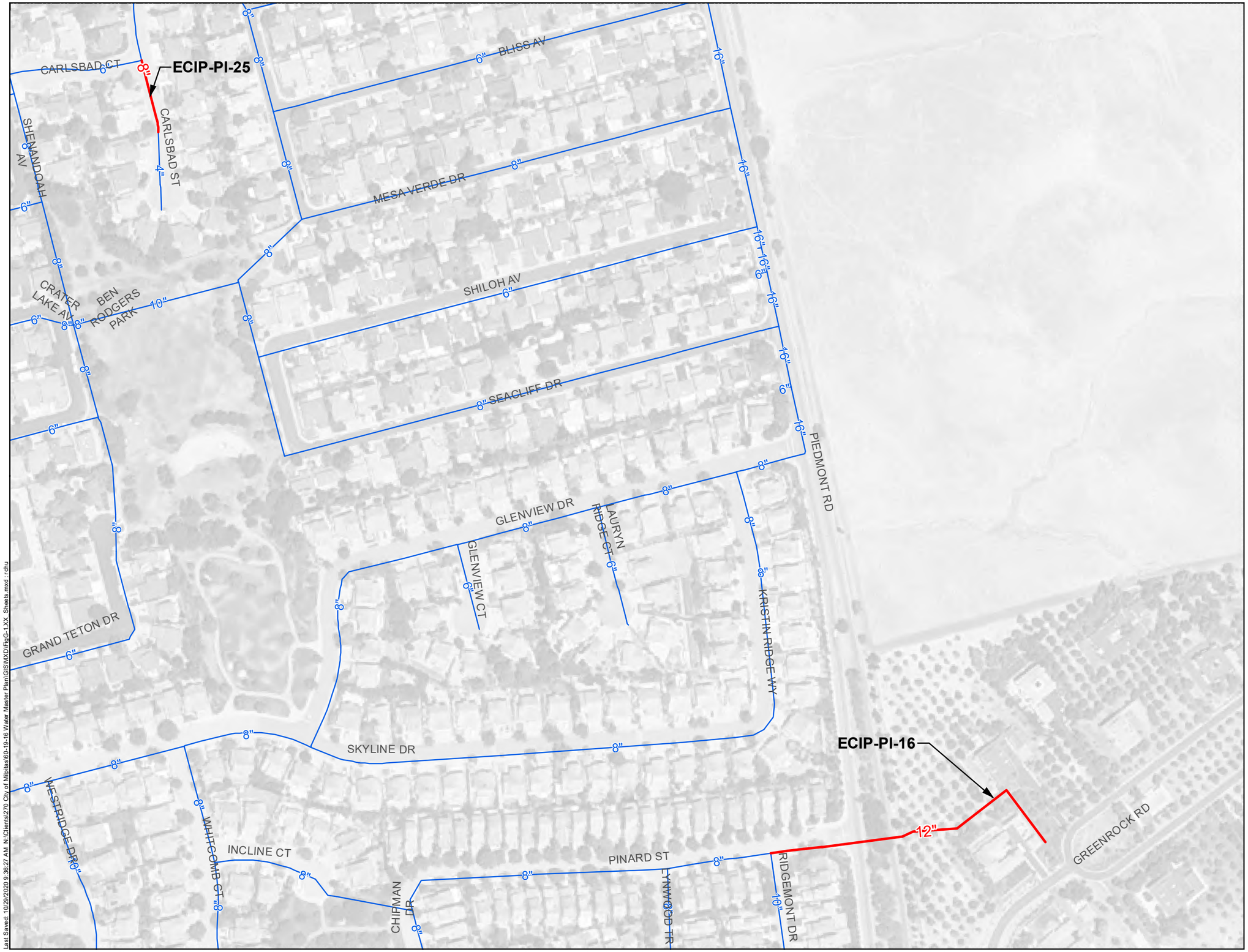
Existing Facilities

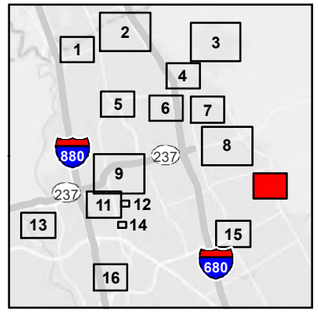
- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

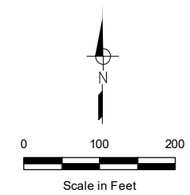
Figure G-1.9

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan







Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.10

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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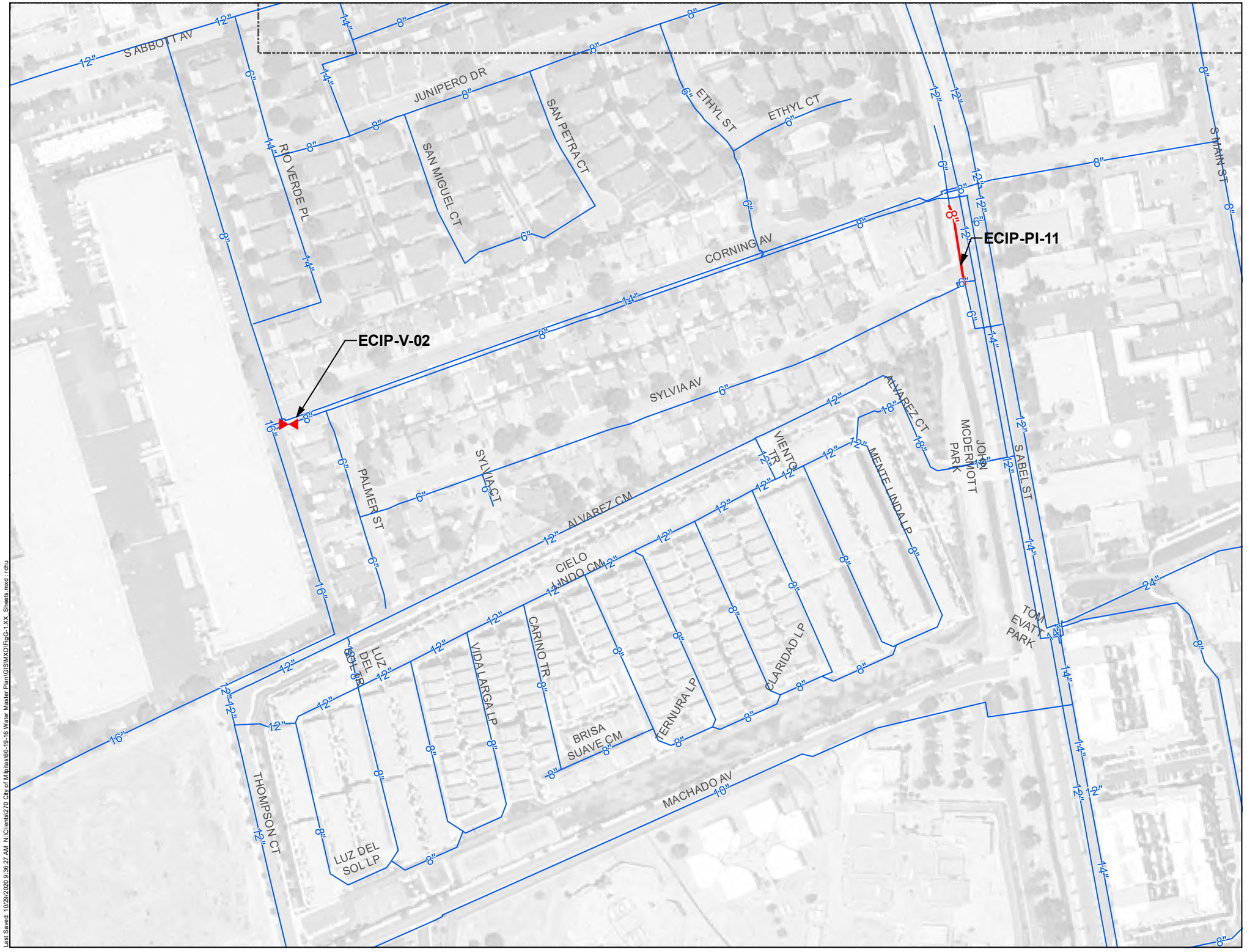

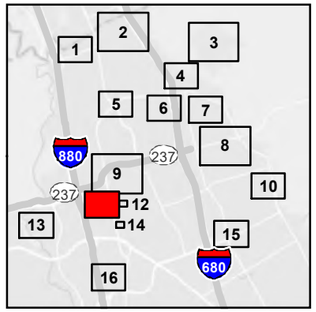

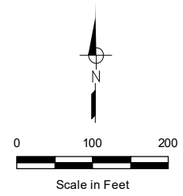

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.11

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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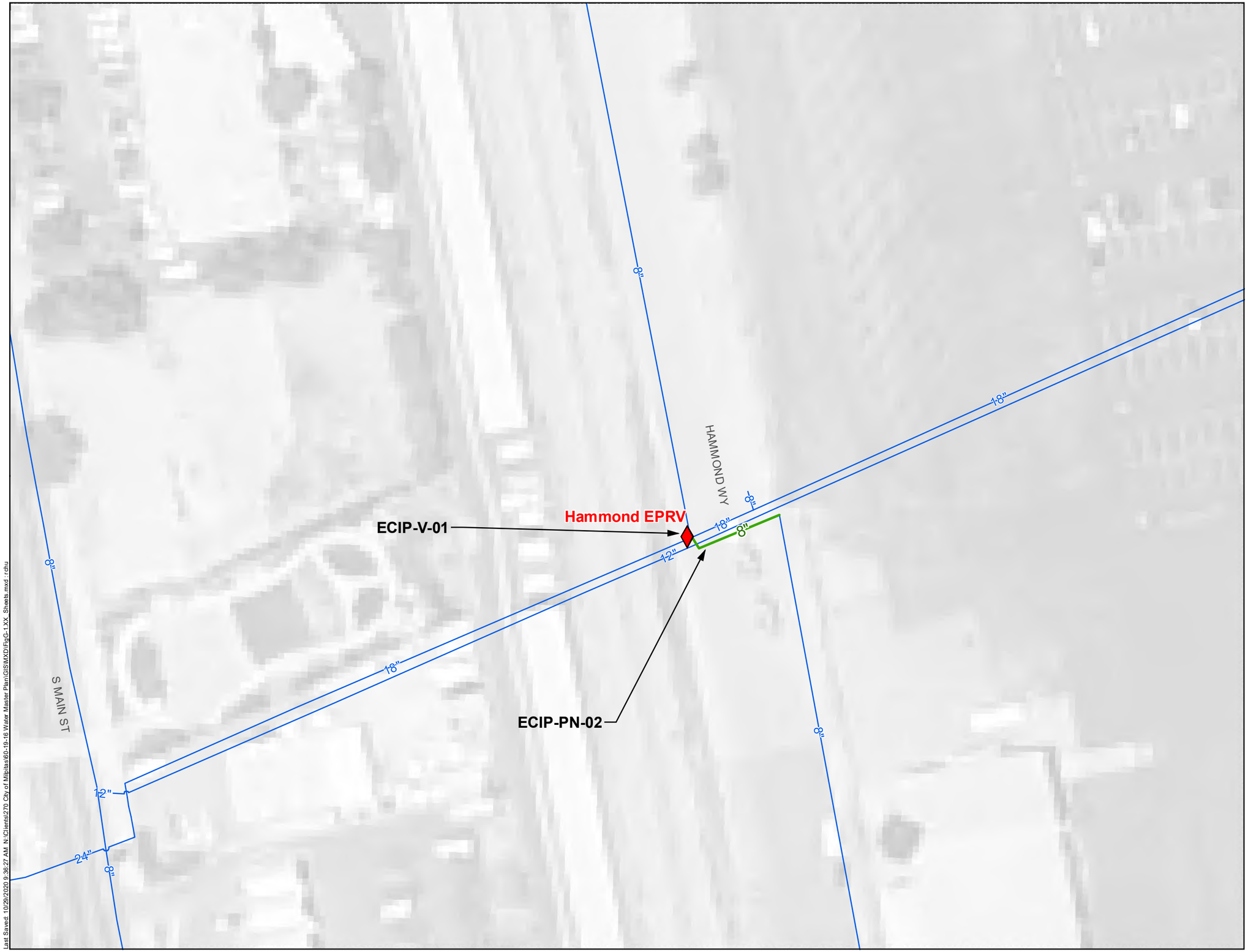

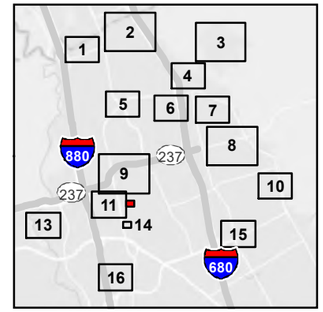

N

0 25 50

Scale in Feet

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.12

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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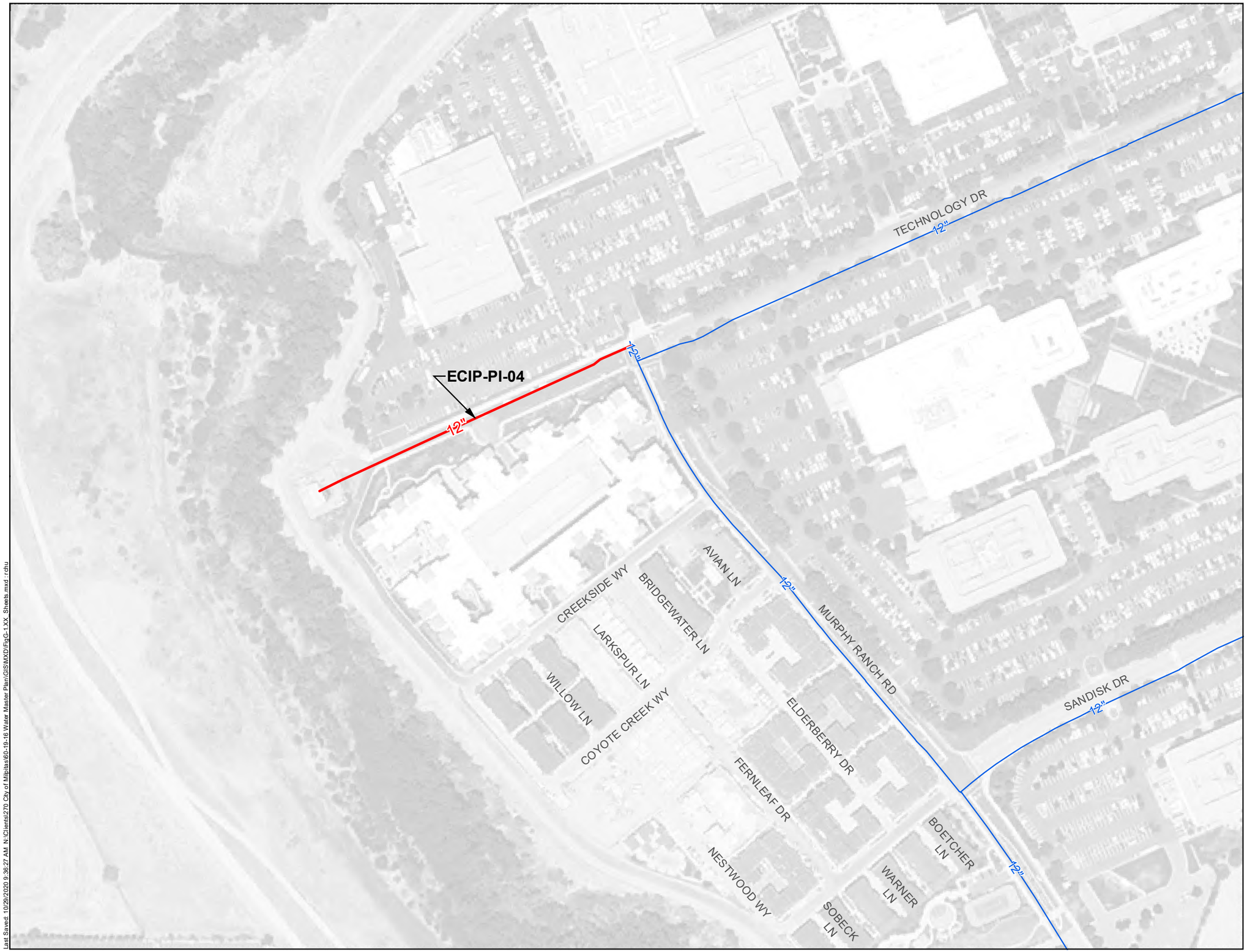

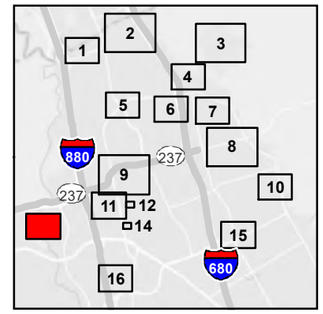

N

0 100 200

Scale in Feet

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.13

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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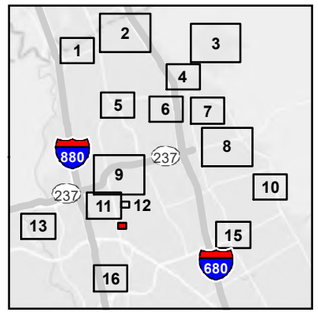

N

0 25 50

Scale in Feet

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

CITY OF MILPITAS CALIFORNIA

WEST YOST

Figure G-1.14

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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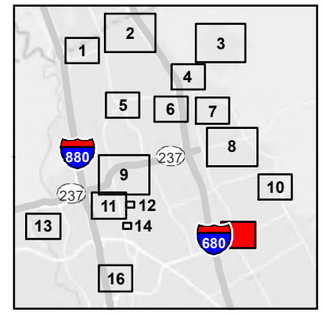

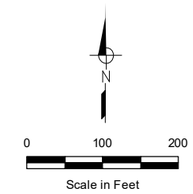

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.15

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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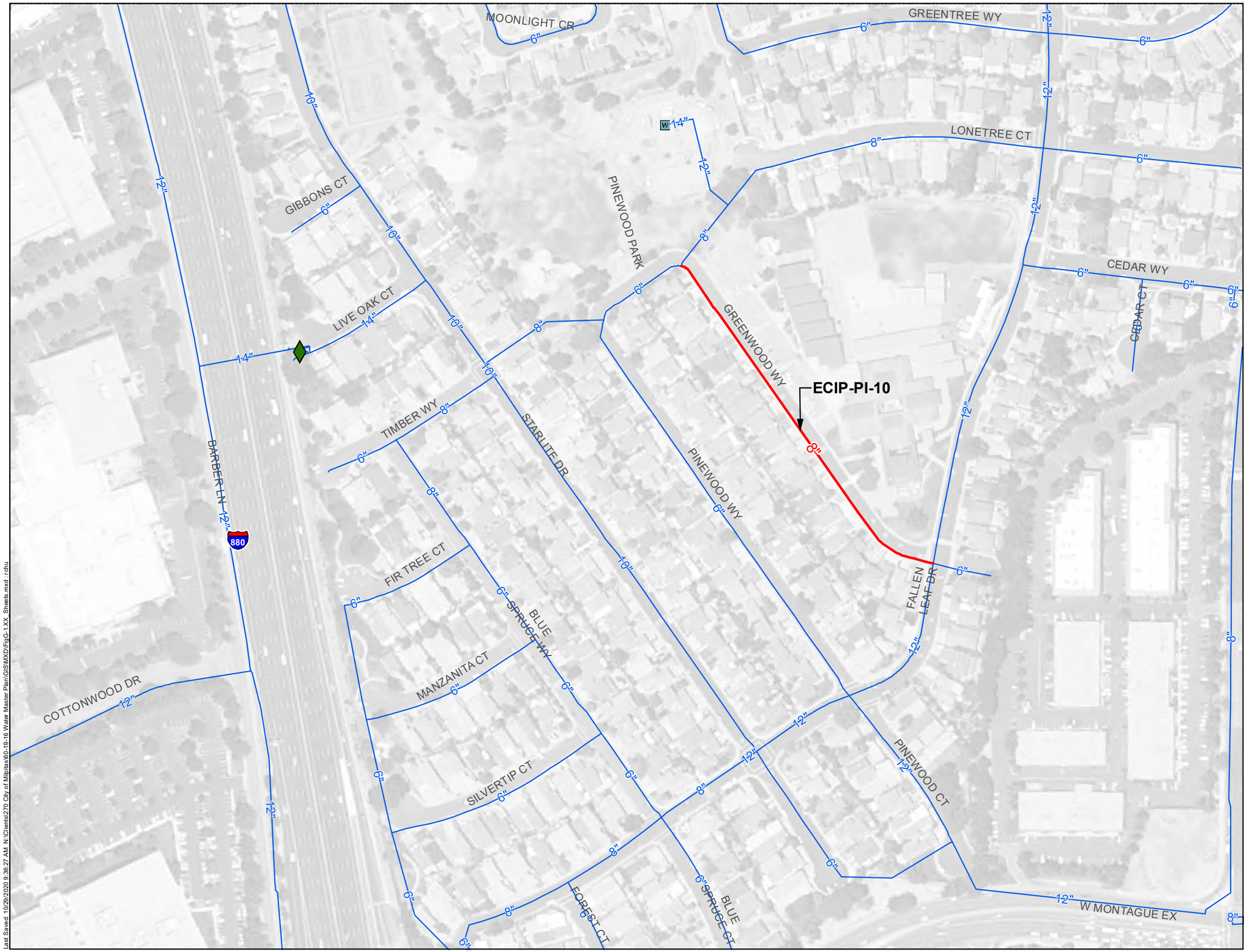

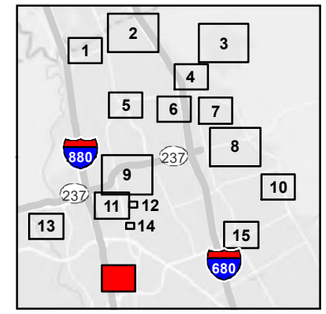

N

0 100 200

Scale in Feet

Recommended Facilities

- Emergency PRV
- PS — Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- W — Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- PS — Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

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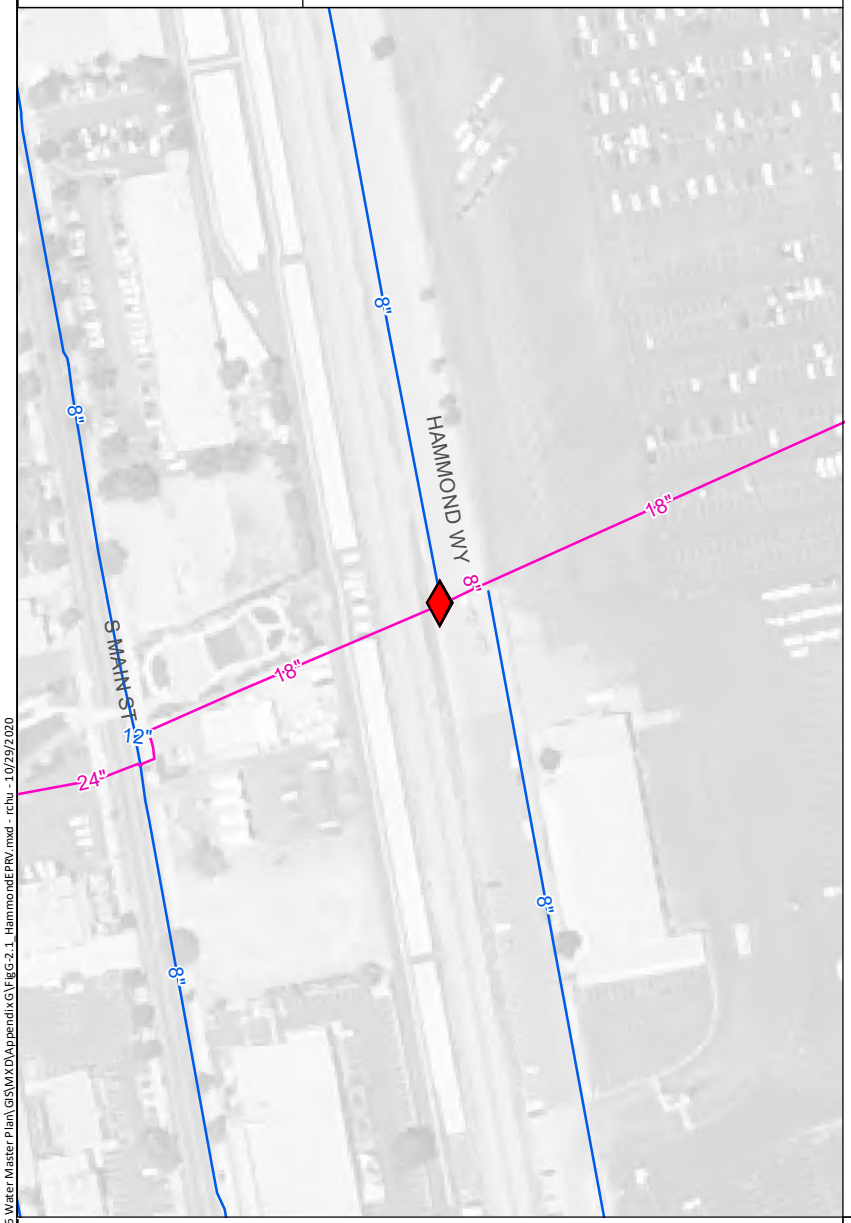
Figure G-1.16

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

ECIP-V-01
Hammond Emergency PRV

CONSTRUCTION COST	$ 282,000
CAPITAL COST	$ 479,000
PRIORITY	High
PURPOSE	Fire Flow
LOCATION	Hammond Way near Tom Evatt Park
PRESSURE ZONE	SF1/VW1



Legend

- Emergency PRV
- Existing SF1 Pipeline
- Existing VW1 Pipeline

N

1 inch = 200 feet

RECOMMENDED IMPROVEMENT SIZE

8-inch diameter PRV and piping.

REASON FOR IMPROVEMENT

Provide fire flows from Zone SF1 to Zone VW1.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

PRV costs include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

Figure G-2.1
City of Milpitas
Project Summary Sheet (ECIP-V-01)

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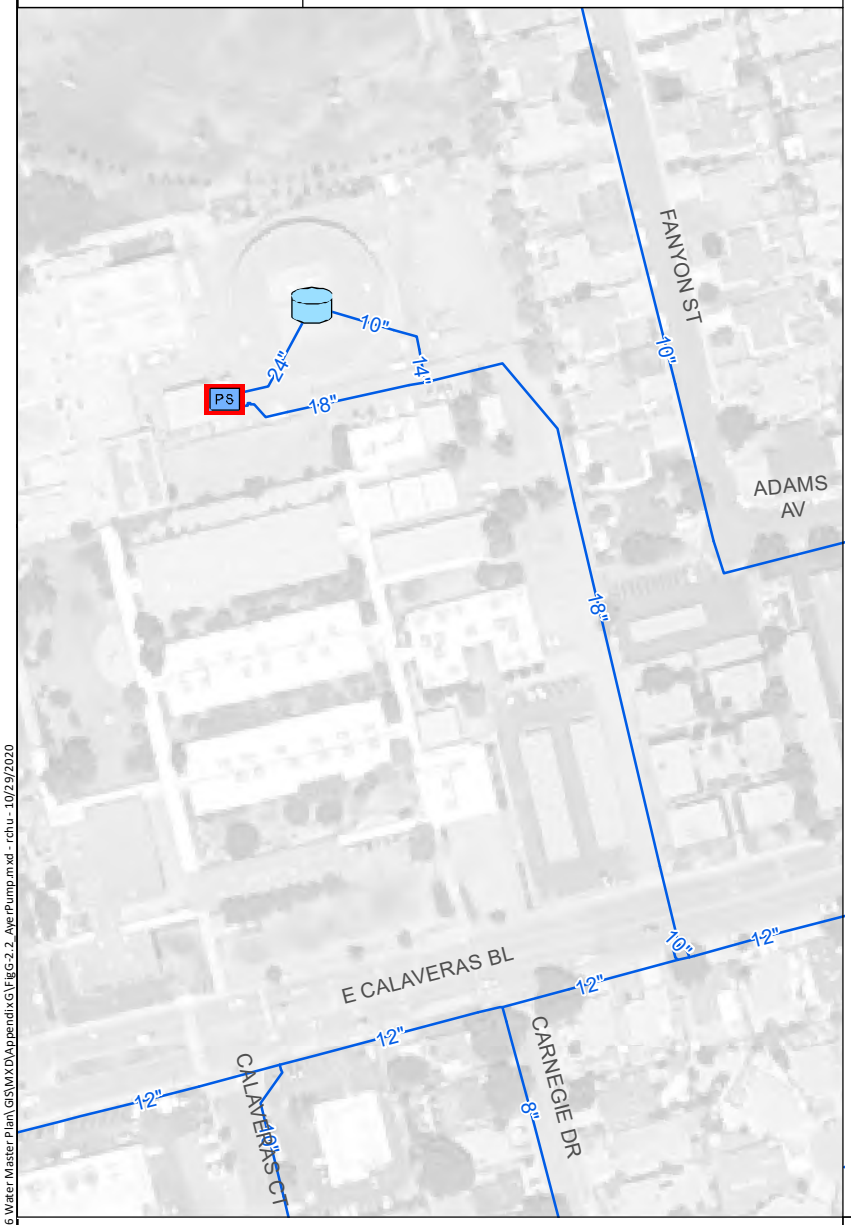
ECIP-PS-AY
New Fire Pump at Ayer Pump Station

CONSTRUCTION COST	$ 1,216,733
CAPITAL COST	$ 2,068,000
PRIORITY	Medium
PURPOSE	Fire Flow Backup
LOCATION	Ayer Pump Station
PRESSURE ZONE	SF2



Legend

- PS — Improvement at Pump Station
- Existing Storage Reservoir
- Existing Pipeline

N

1 inch = 200 feet

RECOMMENDED IMPROVEMENT SIZE

Install one new fire pump at the existing Ayer Pump Station. Capacity shall be 4,00 gallons per minute (gpm) (5.76 million gallons per day (mgd)).

REASON FOR IMPROVEMENT

Provide fire flows to Zone SF2 in the event of an SFPUC supply outage.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

Pump station costs are based on enclosed stations with architectural and landscaping treatment suitable for residential areas. Since this improvement entails adding a pump to an existing pump station, costs for a new pump station (5.76 mgd firm capacity) have been discounted by 50 percent.

Figure G-2.2
City of Milpitas
Project Summary Sheet (ECIP-PS-AY)

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ECIP-V-03
Diel Emergency PRV

CONSTRUCTION COST	$ 282,000
CAPITAL COST	$ 479,000
PRIORITY	Medium
PURPOSE	Fire Flow Backup
LOCATION	Intersection of Coelho Street and Diel Drive
PRESSURE ZONE	SF2/SF1



Legend

- Emergency PRV
- Existing SF1 Pipeline
- Existing SF2 Pipeline

N

1 inch = 200 feet

RECOMMENDED IMPROVEMENT SIZE

8-inch diameter PRV and piping.

REASON FOR IMPROVEMENT

Supplement existing Sunnyhills PRV in providing fire flows from Zone SF2 to Zone SF1.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

PRV costs include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

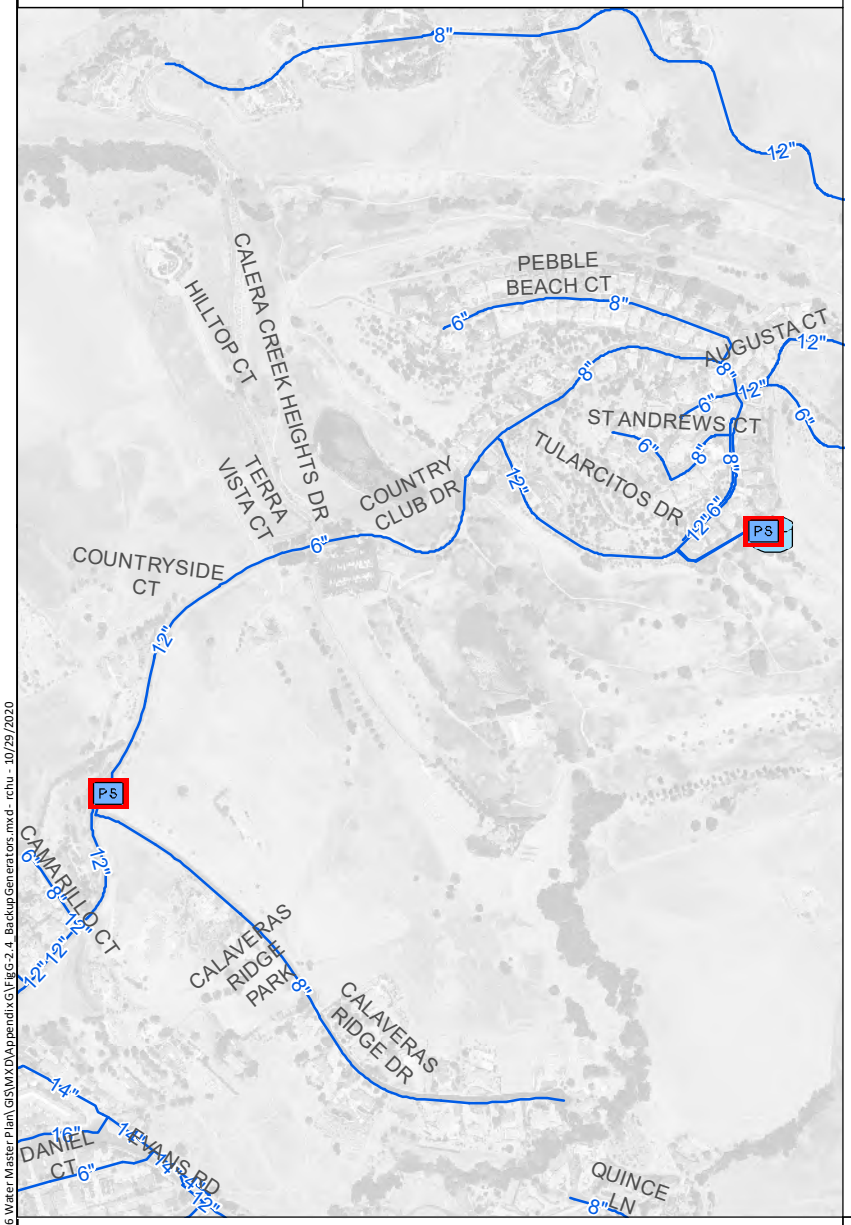
Figure G-2.3
City of Milpitas
Project Summary Sheet (ECIP-V-03)

WEST YOST

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\Appendix G\Fig G-2.3_DielEPRV.mxd - rchu - 10/29/2020

ECIP-BG-CC and ECIP-BG-TL
Backup Generators at Country Club and Tularcitos Pump Stations

CONSTRUCTION COST	$ 200,000 per generator ($400,000 total)
CAPITAL COST	$ 340,000 per generator ($680,000 total)
PRIORITY	Low
PURPOSE	General Reliability
LOCATION	Country Club and Tularcitos Pump Stations
PRESSURE ZONE	SF3 and SF4



Legend

- PS — Improvement at Pump Station
- Existing Storage Reservoir
- Existing Pipeline

N

1 inch = 900 feet

RECOMMENDED IMPROVEMENT SIZE

Generators shall be sized to meet the power demands of each pump station.

REASON FOR IMPROVEMENT

Ensure continued pump operation in the event of a power outage.

PLANNING ASSUMPTIONS

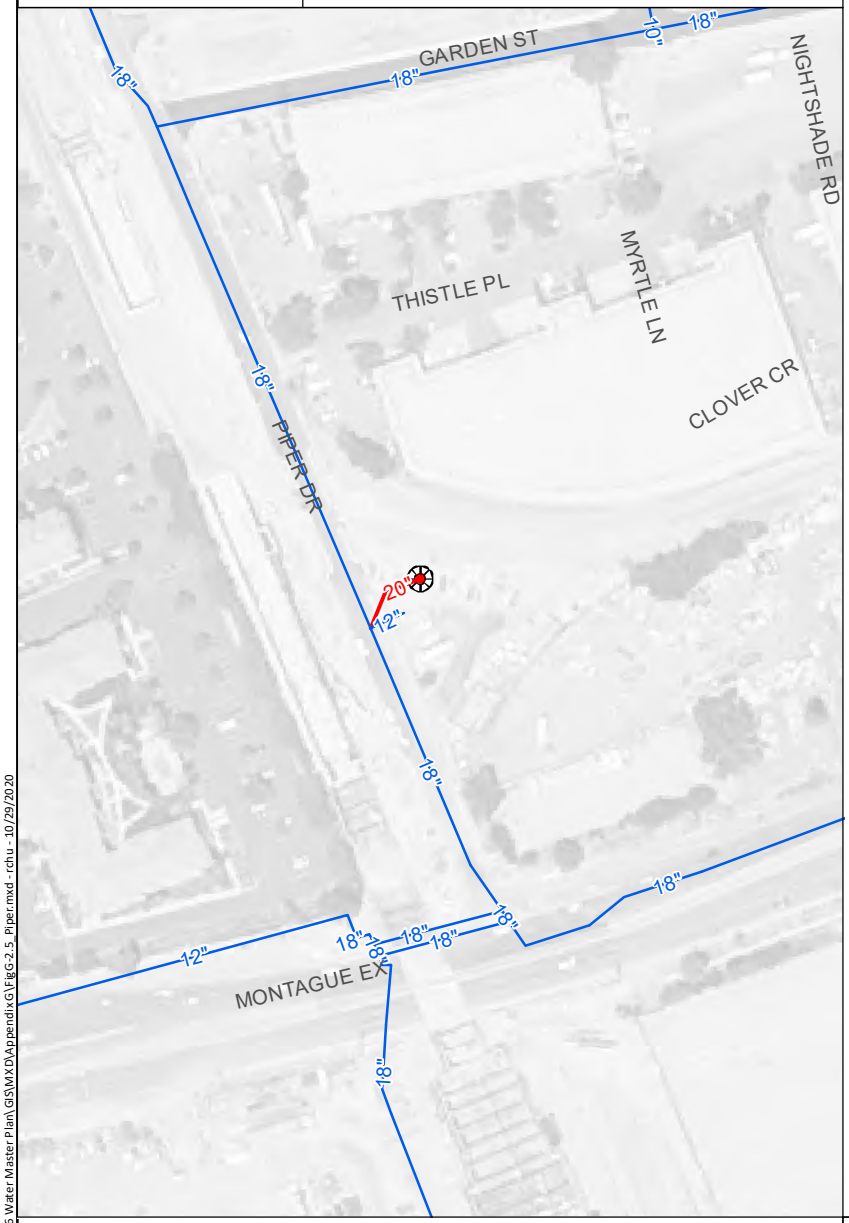
Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

Figure G-2.4
City of Milpitas - Project Summary Sheet (ECIP-BG-CC and ECIP-BG-TL)

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\Appendix G\FigG-2.4_BackupGenerators.mxd - rchu - 10/29/2020

BCIP-TO-01
Piper Turnout

CONSTRUCTION COST	$ 313,000
CAPITAL COST	$ 532,000
PRIORITY	High
PURPOSE	Firm Supply Capacity
LOCATION	Piper Drive south of Garden Street
PRESSURE ZONE	VW2



Legend
- Turnout
- Turnout Pipeline
- Existing Pipeline

N

1 inch = 200 feet

RECOMMENDED IMPROVEMENT SIZE

Same capacity as the existing Gibraltar turnout: 10,000 gallons per minute (gpm) (14.4 million gallons per day (mgd)).

Connection from the turnout to the existing 18-inch diameter transmission main on Piper Drive shall be a 20-inch diameter pipeline.

REASON FOR IMPROVEMENT

Insufficient firm supply capacity in the Valley Water service area at buildout.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

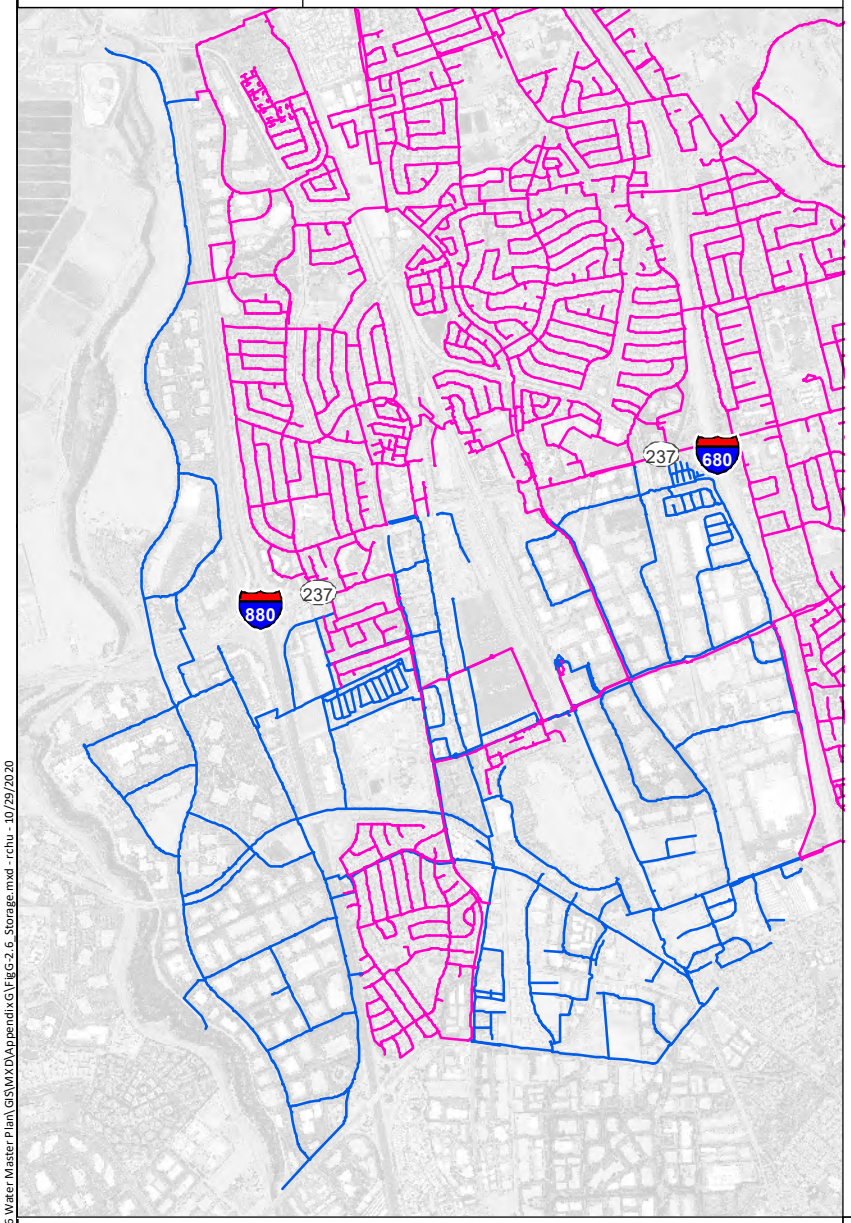
Turnout costs include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

Figure G-2.5
City of Milpitas
Project Summary Sheet (BCIP-TO-01)

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\AppendixG\FigG-2.5_Piper.mxd - rchu - 10/29/2020

BCIP-S-01
Storage Reservoir in Valley Water Service Area

CONSTRUCTION COST	$ 3,254,000
CAPITAL COST	$ 5,532,000
PRIORITY	High
PURPOSE	Storage Capacity
LOCATION	Valley Water Service Area (Specific Location TBD)
PRESSURE ZONE	VW1 or VW2



Legend

Existing SFPUC Pipeline

Existing VW Pipeline

N

1 inch = 3,500 feet

RECOMMENDED IMPROVEMENT SIZE

2.0 million gallons (MG).

REASON FOR IMPROVEMENT

Insufficient storage capacity in the Valley Water service area at buildout.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

Storage reservoir will be aboveground steel tank. Costs include installation of the storage tank, site piping, earthwork, paving, instrumentation, and related sitework.

Figure G-2.6
City of Milpitas
Project Summary Sheet (BCIP-S-01)

WEST YOST

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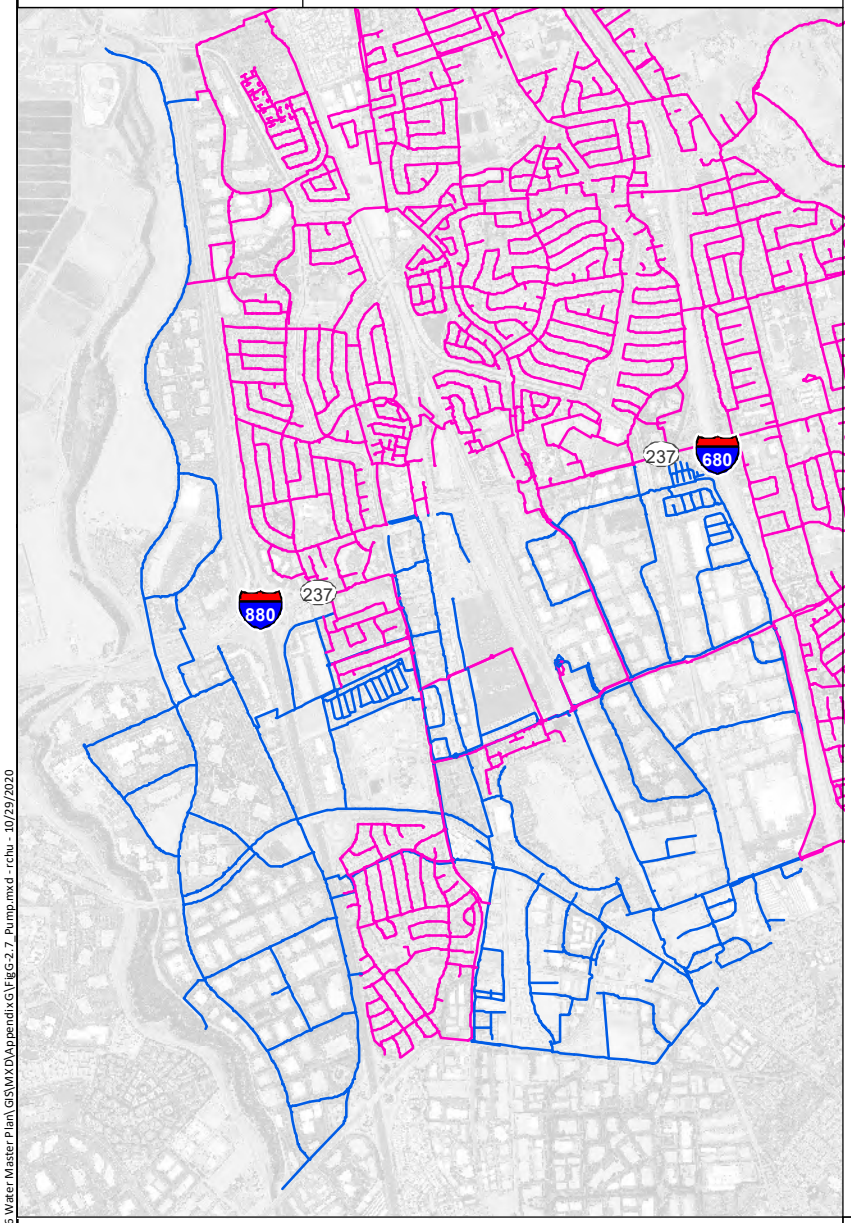
BCIP-PS-01
Pump Station for Reservoir in Valley Water Service Area

CONSTRUCTION COST	$ 2,433,466
CAPITAL COST	$ 4,137,000
PRIORITY	High
PURPOSE	Deliver Stored Water from New Reservoir
LOCATION	Valley Water Service Area (Specific Location TBD)
PRESSURE ZONE	VW1 or VW2



Legend

Existing SFPUC Pipeline

Existing VW Pipeline

N

1 inch = 3,500 feet

RECOMMENDED IMPROVEMENT SIZE

4,000 gallons per minute (gpm) firm capacity.

REASON FOR IMPROVEMENT

Pump station for recommended storage reservoir (BCIP-S-01).

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

Costs assume an enclosed pump station with architectural and landscaping treatment suitable for residential areas.

Figure G-2.7
City of Milpitas
Project Summary Sheet (BCIP-PS-01)

WEST YOST

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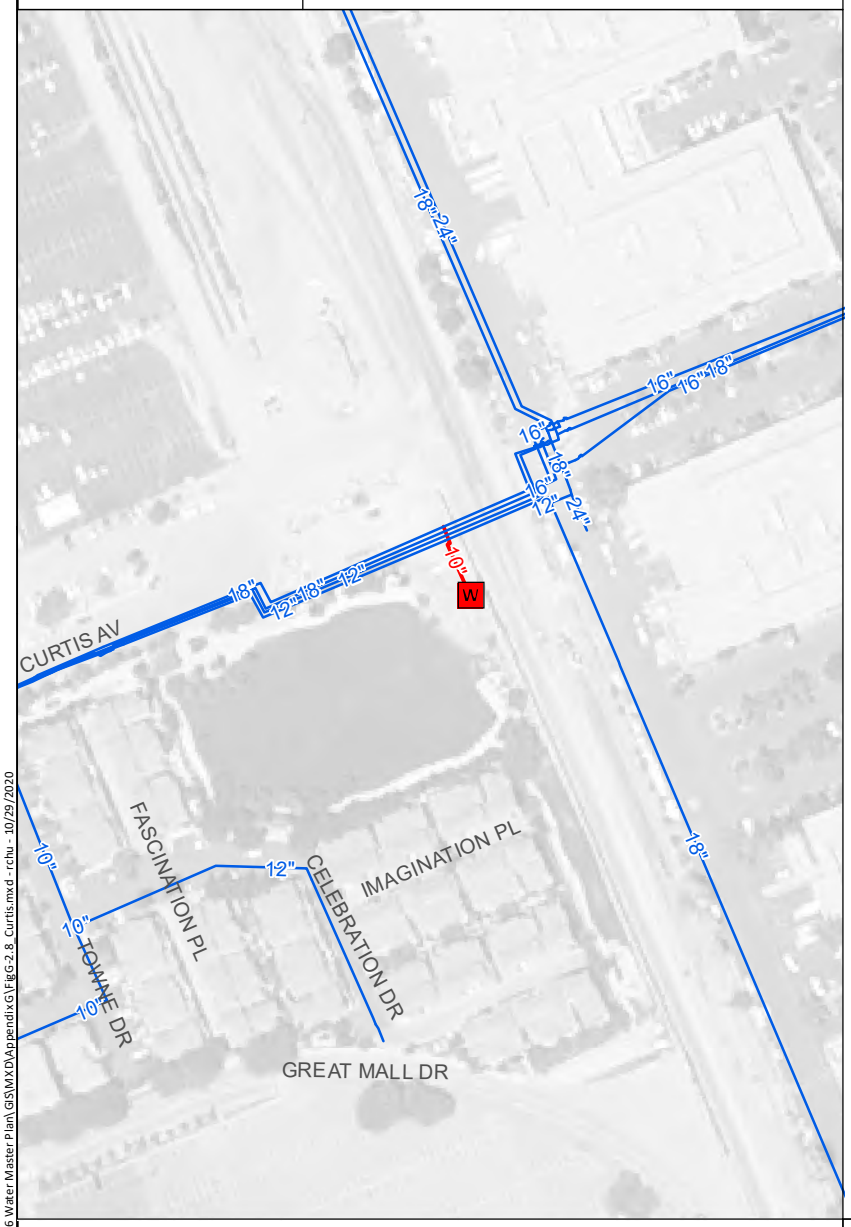
BCIP-W-01
Curtis Well

CONSTRUCTION COST	$ 3,500,000
CAPITAL COST	$ 5,950,000
PRIORITY	High
PURPOSE	Storage Capacity (Groundwater Credit)
LOCATION	Curtis Avenue near Parc Metro East
PRESSURE ZONE	VW2



Legend

- W — Groundwater Well
- Well Pipeline
- Existing Pipeline

N

1 inch = 200 feet

RECOMMENDED IMPROVEMENT SIZE

Well capacity will be based on subsequent groundwater analysis that is not part of this report.

REASON FOR IMPROVEMENT

Increase supply reliability and reduce storage requirement via emergency groundwater storage credit.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

Well construction consists of pilot hole drilling, water quality/soil sampling, pilot hole reaming, well construction, well development and providing the necessary housing, pump, motor, automatic control equipment, discharge piping, supervisory control and data acquisition (SCADA), disinfection equipment, and a backup power generator. Costs assume a well capacity between 500 and 1,000 gpm. A higher capacity may increase costs.

Figure G-2.8
City of Milpitas
Project Summary Sheet (BCIP-W-01)

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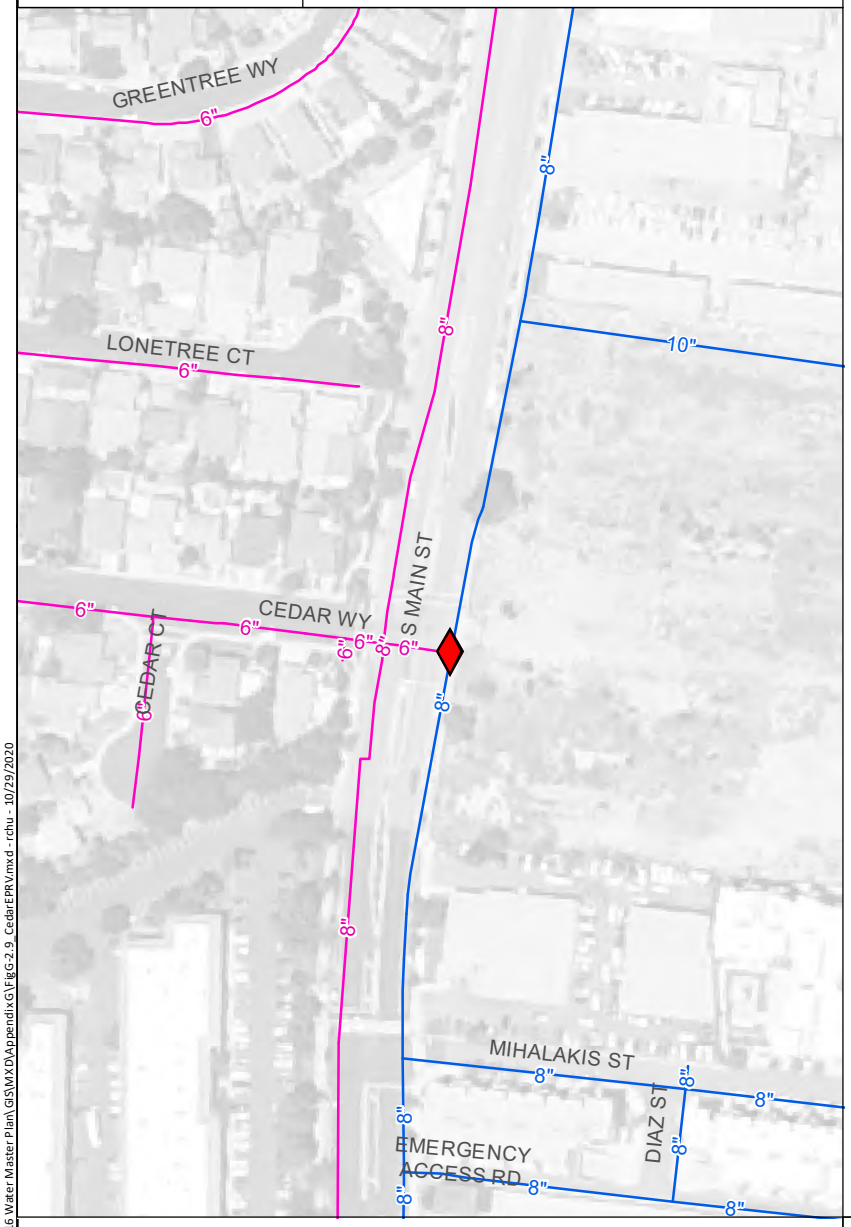
BCIP-V-01
Cedar Emergency PRV

CONSTRUCTION COST	$ 282,000
CAPITAL COST	$ 479,000
PRIORITY	High
PURPOSE	Fire Flow
LOCATION	Intersection of Cedar Way and South Main Street
PRESSURE ZONE	SF1/VW1



RECOMMENDED IMPROVEMENT SIZE

8-inch diameter PRV and piping.

REASON FOR IMPROVEMENT

Provide fire flows from Zone SF1 to Zone VW1.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

PRV costs include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

Figure G-2.9
City of Milpitas
Project Summary Sheet (BCIP-V-01)

WEST YOST

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\Appendix G\FigG-2.9_CedarEPRV.mxd - rchu - 10/29/2020

WE SUPPORT OUR COMMUNITIES

WE ARE WATER FOCUSED

WE TAKE PRIDE IN WHAT WE DO

WE STRIVE TO BECOME OUR BEST

WE DO WHAT'S RIGHT

WE BELIEVE IN QUALITY

WE LISTEN

WE SOLVE CHALLENGING PROBLEMS

WE SEE THE BIGGER PICTURE

WE TAKE OWNERSHIP

WE COLLABORATE

WE HAVE FUN

WE ARE WEST YOST

WEST YOST

Water. Engineered.

City of Milpitas Sewer Master Plan













City of Milpitas Sewer Master Plan

January 2021 | DRAFT

HydroScience

City of Milpitas

Sewer Master Plan

Prepared by HydroScience Engineers, Inc.





January 2021

HydroScience

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ABBREVIATIONS

A	Amperes
ABS	Acrylonitrile-Butadiene-Styrene
AIC	Ampere Interrupting Capacity
BRE	Business Risk Exposure
BSF	Base sanitary flow
CCTV	Closed caption television
CEQA	California Environmental Quality Act
CIP	Capital Improvement Plan/Capital Improvement Program, Cast Iron Pipe
CIPP	Cured-in-Place Pipe
City	City of Milpitas
CoF	Consequence of failure
d	Wastewater depth
D	Pipe diameter
DEM	Digital elevation model
DIP	Ductile Iron Pipe
DU	Dwelling unit
DWF	Dry weather flow
ESDC	Engineering services during construction
FM	Flow meter
ft, ‘	Foot, feet, linear feet
ft/s	Feet per second
FY	Fiscal year
GIS	Geographic Information Systems/ArcGIS geodatabase
GP	General Plan
gpd	Gallons per day
GWI	Groundwater infiltration
HDPE	High-Density Polyethylene
HGL	Hydraulic grade line
Hp	Horsepower
IAP	InfoAsset Planner by Innovyze®
in, “	Inch, inches
InfoWorks	InfoWorks ICM by Innovyze®
kV	Kilovolt
kVA	Kilovolt-ampere
LAFCO	Local Agency Formation Commission
LoF	Likelihood of failure
Main LS	Milpitas Main Lift Station
MGD	Millions of gallons per day
MH	Manhole
NASSCO	National Association of Sewer Service Companies

NAVD 88	North American Vertical Datum of 1988
NEMA	National Electrical Manufacturers Association
NGVD 29	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic and Atmospheric Administration
O&M	Operations & Maintenance
P	Pole
PACP	Pipeline Assessment Certification Program
ph	phase
PVC	Polyvinyl Chloride
QC	Quality control
RCP	Reinforced Concrete Pipe
RDI/I	Rainfall dependent inflow and infiltration
RG	Rain gauge
ROW	Right-of-way
RWF	San Jose-Santa Clara Regional Wastewater Facility
RWQCB	Regional Water Quality Control Board
SBWR	South Bay Water Recycling
SFPUC	San Francisco Public Utility Commission
SMP	Sewer Master Plan
SOI	Sphere of Influence
SSMP	Sanitary Sewer Management Plan
SSO	Sanitary sewer overflow
TASP	Transit Area Specific Plan
UF	Unit flow
UGB	Urban Growth Boundary
USA	Urban Service Area
USGS	United States Geological Survey
V	Volts
VCP	Vitrified Clay Pipe
Venus Way LS	Venus Way Lift Station
VFD	Variable frequency drive
W	Watts
WDR	RWQCB General Waste Discharge Requirements
WWF	Wet weather flow

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EXECUTIVE SUMMARY

HydroScience Engineers, Inc. (HydroScience) was retained by the City of Milpitas (City), to prepare the City Sewer Master Plan (SMP) and develop a Capital Improvement Plan (CIP) based on the current (2020) and future (2040) planning horizons. This executive summary provides a concise discussion of the project elements including background information, analyses conducted, and recommendations.

Services and Service Area

The City is in Santa Clara County and is bounded by the cities of Fremont to the north, San Jose to the south and west, and unincorporated Santa Clara County to the east. The City encompasses 14 square miles and is approximately 45 miles southeast of San Francisco (see **Figure ES-1**). The City provides wastewater collection services to a population of 77,961 according to the Department of Finance.

The wastewater collection system consists of approximately 160 miles of gravity sewers, with pipe diameters ranging from 4- to 66-inches. The collection system generally flows from east to west and south to north towards the San Francisco Bay. Most of the collection system flows by gravity to the Milpitas Main Lift Station (Main LS) then is pumped to the San Jose-Santa Clara Regional Wastewater Facility (RWF) through dual force mains. The Venus Way Lift Station (Venus Way LS) pumps sewage from a small portion of the City that is at a lower elevation up to a higher elevation where it then flows by gravity to the Main LS. **Figure ES-2** provides an overview of the wastewater collection system.

The City's wastewater collection system includes pipelines and structures of varying age, size, and material. According to the City's ArcGIS geodatabase (GIS), most the City's wastewater collection system pipelines are vitrified clay pipe (VCP) and 4- to 12-inches in diameter, and approximately 70% of all pipelines were built before 1990. The collection system also includes almost 3,000 manholes, of which approximately 60% were built before 1990. Of these manholes, 177 were identified as flow splits – manholes that allow outflow via two or more pipes.

Condition Assessment

As part of the City's Master Plan project, a *Sewer Utility Asset Renewal and Replacement Study* (R&R Study) was conducted. The study documents the City's Business Risk Exposure (BRE) based on the physical condition and desktop assessment of the City's collection system applying a set of factors developed to determine the relative risk of failure for each pipeline segment.

The first element of the study involved performing a field investigation using closed-circuit television (CCTV) to assess the condition of key pipeline segments in the collection system. National Plant Services Inc. (NPS) successfully inspected 105,211 ft (approximately 20 miles) of pipeline. For each pipeline segment inspected, structural and operations and maintenance (O&M) related defects were identified and graded on a scale of one (least severe) to five (most severe) based on the type and severity of the defect in accordance with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP).

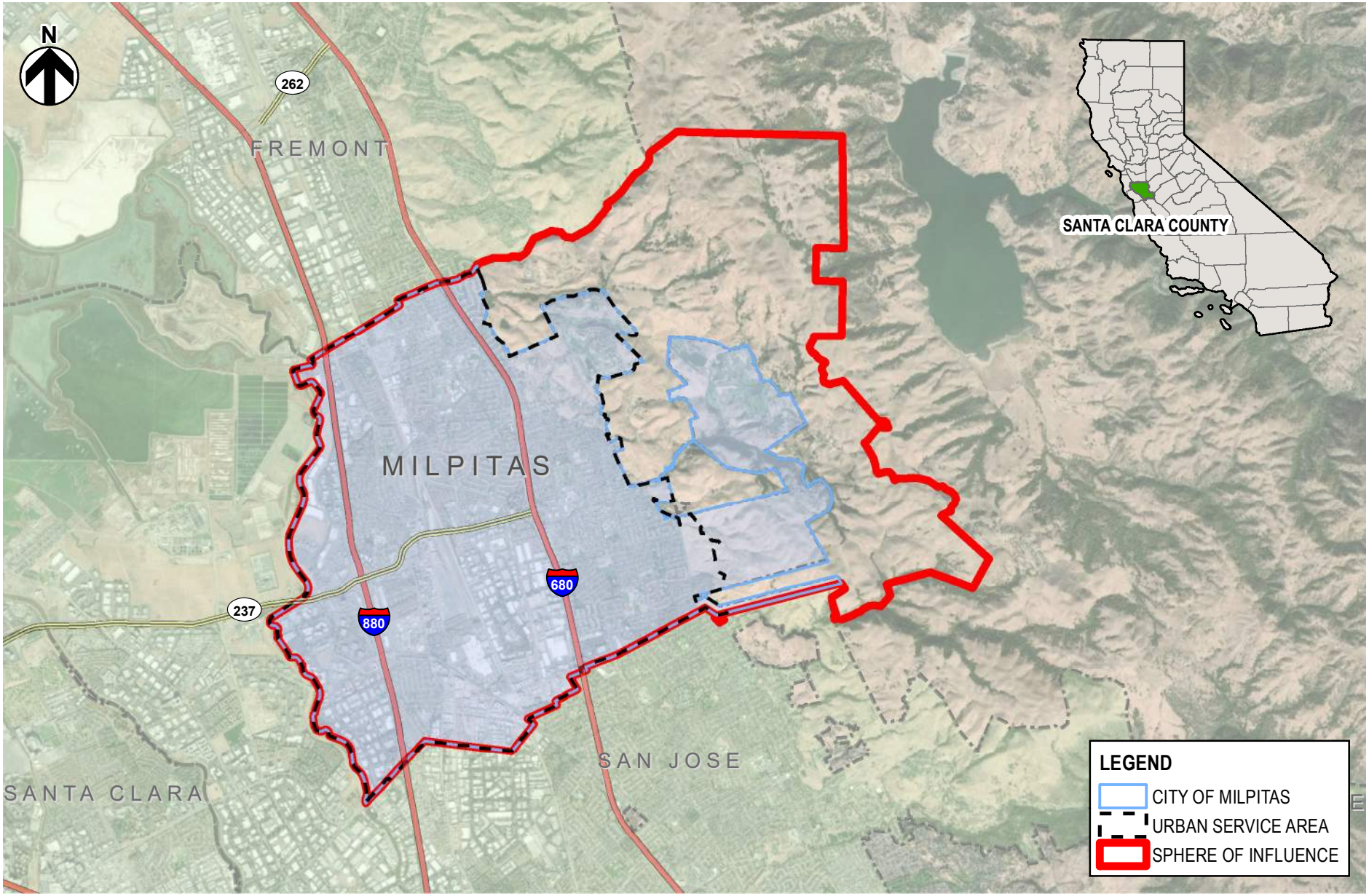

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FIGURE ES-1
CITY OF MILPITAS
SEWER MASTER PLAN
PROJECT LOCATION MAP

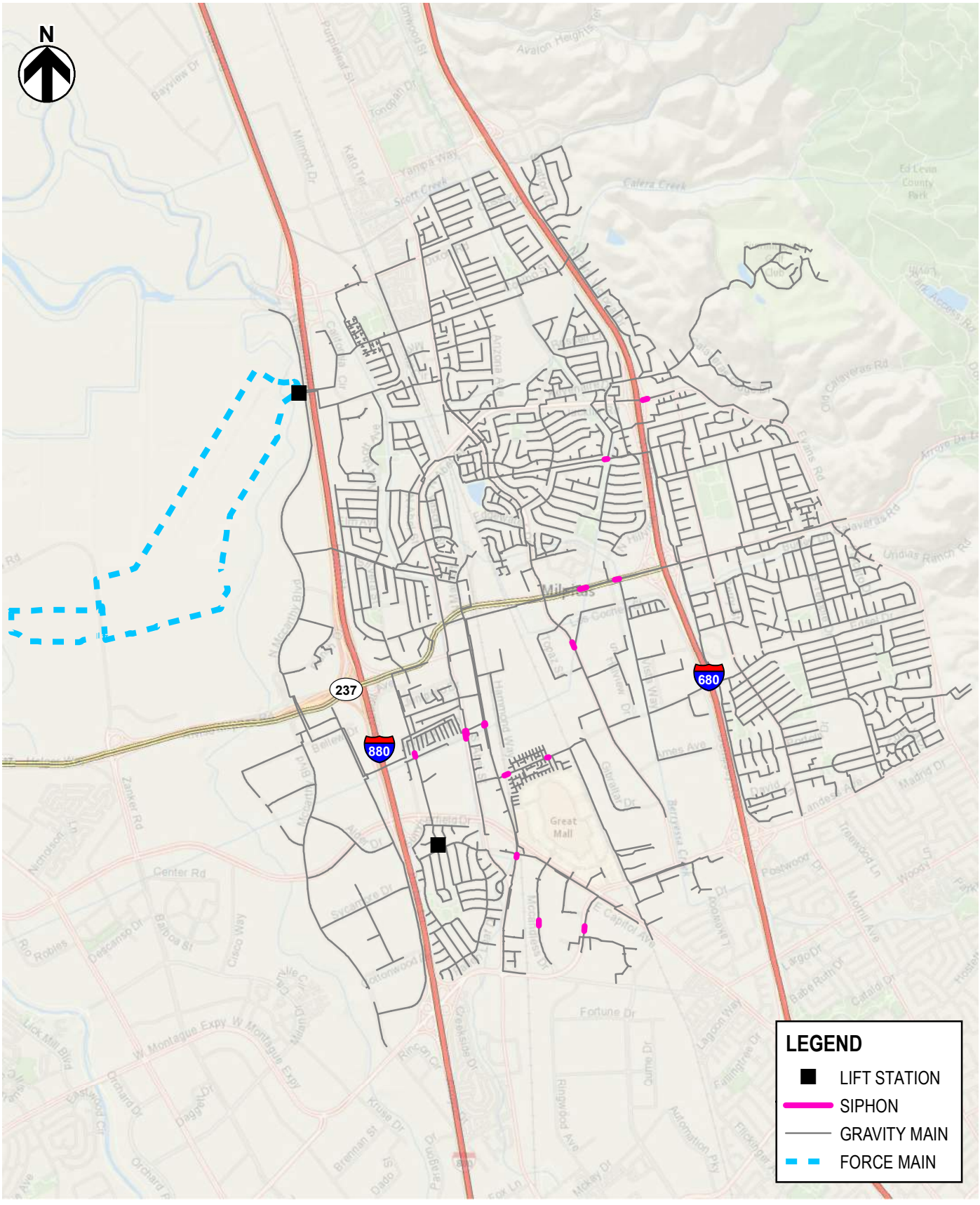

FIGURE ES-2
CITY OF MILPITAS
SEWER MASTER PLAN
WASTEWATER COLLECTION SYSTEM OVERVIEW

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The second element of the study involved a desktop assessment of the entire collection system based on relative risk of failure of each pipeline segment. A pipeline's risk of failure is determined by a combination of the *likelihood* and the *consequence* of the failure of the segment.

Likelihood of failure (LoF) and consequence of failure (CoF) scores were assigned to each pipeline segment by considering various factor ratings with assigned factor weightings. Factor ratings were given on a scale of one (least likely to fail/least consequential) to five (most likely to fail/most consequential). The weighting of each factor was assigned based on the relative criticality of that factor, with higher weighting factors assigned to the most critical factors. The following factors, typical for sewer renewal/replacement, were selected for this Study:

LoF Factors:

- Pipe age
- Pipe material
- Structural condition
- Presence of pipe obstructions
- Required pipe cleaning
- Proximity to landslide zones
- Proximity to earthquake faults

Local geology (liquefaction)

CoF Factors:

- Sewer size (pipe diameter)
- Proximity to critical facilities
- Road type (impact to transit/traffic)
- Railroad proximity
- Easement (access restriction)
- Pipeline depth
- Proximity to waterway or waterbody

The following equations were used to calculate a risk score for each pipeline segment:

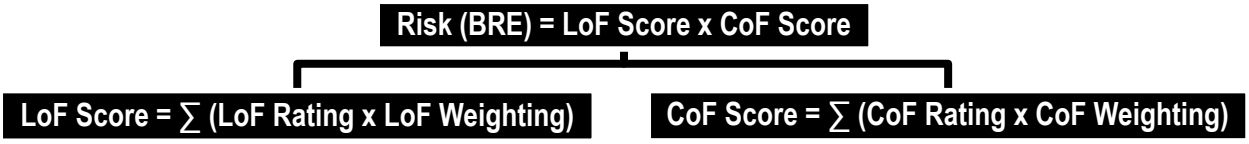

Figure ES-3 presents the resulting BRE scores for all pipelines in the entire city.

Hydraulic Model Land Use and Network Development

To develop base sanitary flows (BSF) – the flow directly contributed by the customer – wastewater flows were assigned to every contributing parcel in the City. For planning level analysis, parcels of similar land use types are estimated to have similar wastewater flow rates either on a per parcel basis (gpd/parcel) or per acre basis (gpd/acre) and similar diurnal patterns. City General Plan (GP) land use designations were reviewed for each parcel in the City. For modeling purposes, some modifications to the land uses were warranted to ensure relevance to the sewer analysis. Land use types expected to generate similar wastewater flows were consolidated into model-based land use designations to facilitate unit flow (UF) analysis (listed in **Table 5-1**). Land uses that have little to no contribution to the sewer system were excluded from further analysis. **Figure ES-4** presents the City according to the model-based land designations.

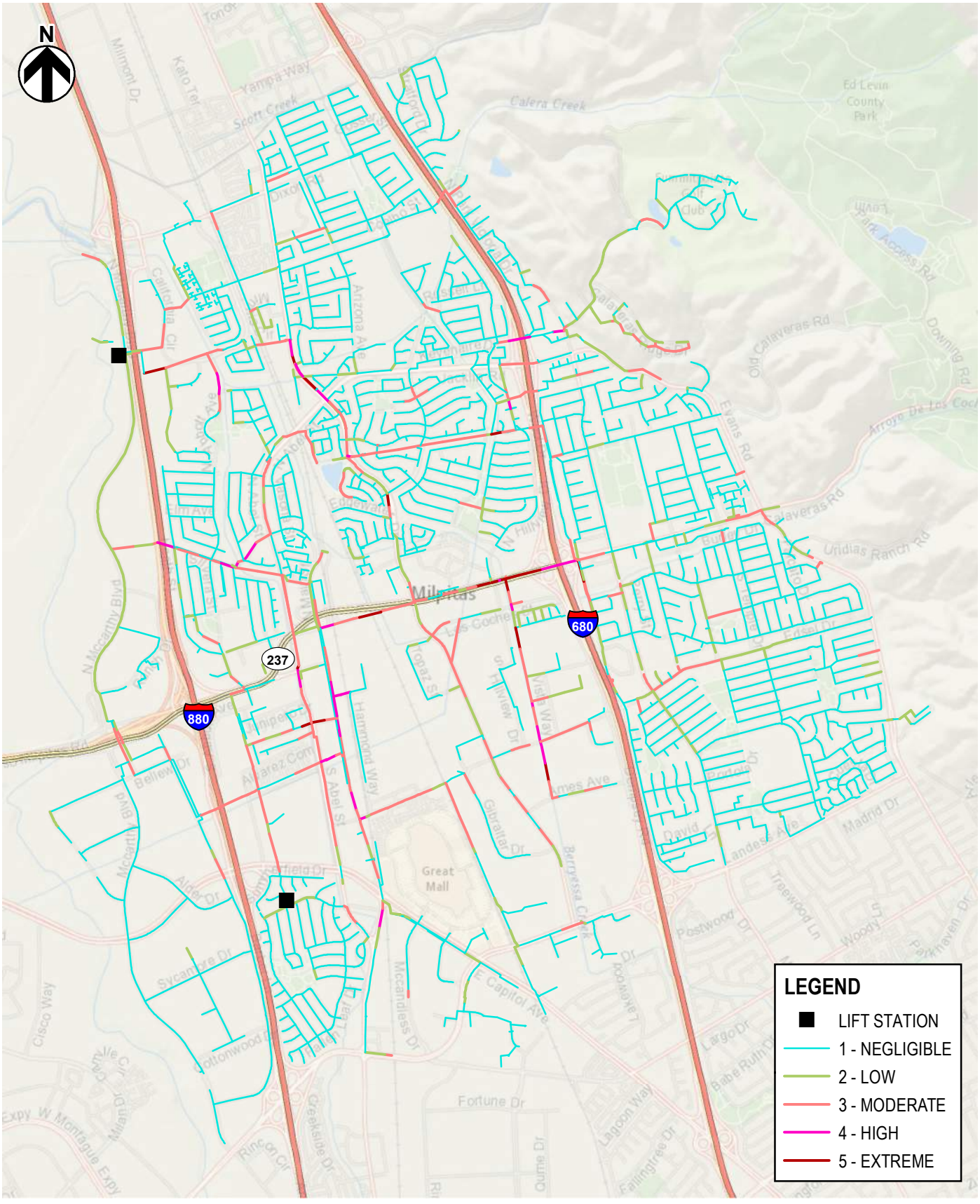

FIGURE ES-3
CITY OF MILPITAS
SEWER MASTER PLAN
BUSINESS RISK EXPOSURE SCORE MAP

HydroScience

The City has identified "Opportunity Areas" which refers to parcels identified within the City that may be considered for future redevelopment. The future land uses identified in the "Opportunity Areas" were reviewed and assigned the model-based land use designations listed in **Table ES-1** according to the anticipated use, density, and wastewater flow rates.

Table ES-1: Model-Based Land Use Designations for Existing Conditions

GP Land Use	Code	Model-Based Land Use	Code
Hillside Very Low Density	HVL	Hillside Single-Family Low Density	HSFL
Hillside Low Density	HLD		
Hillside Medium Density	HMD	Hillside Single Family Medium Density	HSFM
Valley Floor Single-Family Low Density	SFL	Valley Floor Single-Family Low Density	SFL
Valley Floor Single-Family Medium Density	SMD	Valley Floor Single-Family Medium Density	SFM
Multi-Family Medium Density	MFM		
Multi-Family High Density	MFH	Valley Floor Multi-Family High Density	MFH
Multi-Family Very High Density	VHD	Valley Floor Multi-Family Very High Density	MFVH
Mobile Home Park	MHP	Mobile Home Park	MHP
Mixed Use	MXD	Mixed Use	MXD
Boulevard Very High-Density Mixed Use	BVMU	High Density Mixed Use	HDMU
Residential-Retail Mixed Use	RRMU		
Professional & Administrative Offices	PAO	Professional & Administrative Offices	PAO
General Commercial	GNC	Commercial	COM
Retail Sub-Center	RSC		
Industrial Park	INP	Industrial Park	INP
Manufacturing	MFG	Manufacturing	MFG
Public Facilities	PF	Public Facilities[1]	PF
		Elmwood Correctional Facility[2]	COR
TWC, MXD, GNC, INP, HWS, RSC		Hotels[3]	HOTEL
Park Open Space	POS	NF	
Waterways	WATERWAYS	NF	
Highway Services	HWS	Parcels reviewed and model-based land use designation assigned, as appropriate.	
Town Center	TWC		
Urban Residential	URR		
Parcels with no land use designation	-		

Notes:
1. Includes schools, churches, health facilities, libraries, and fire stations.
2. The correctional facility is categorized as PF in the GP. For modeling purposes, it was given a distinct code.
3. Hotels are categorized under various land uses in the GP. They were identified and assigned a distinct code.

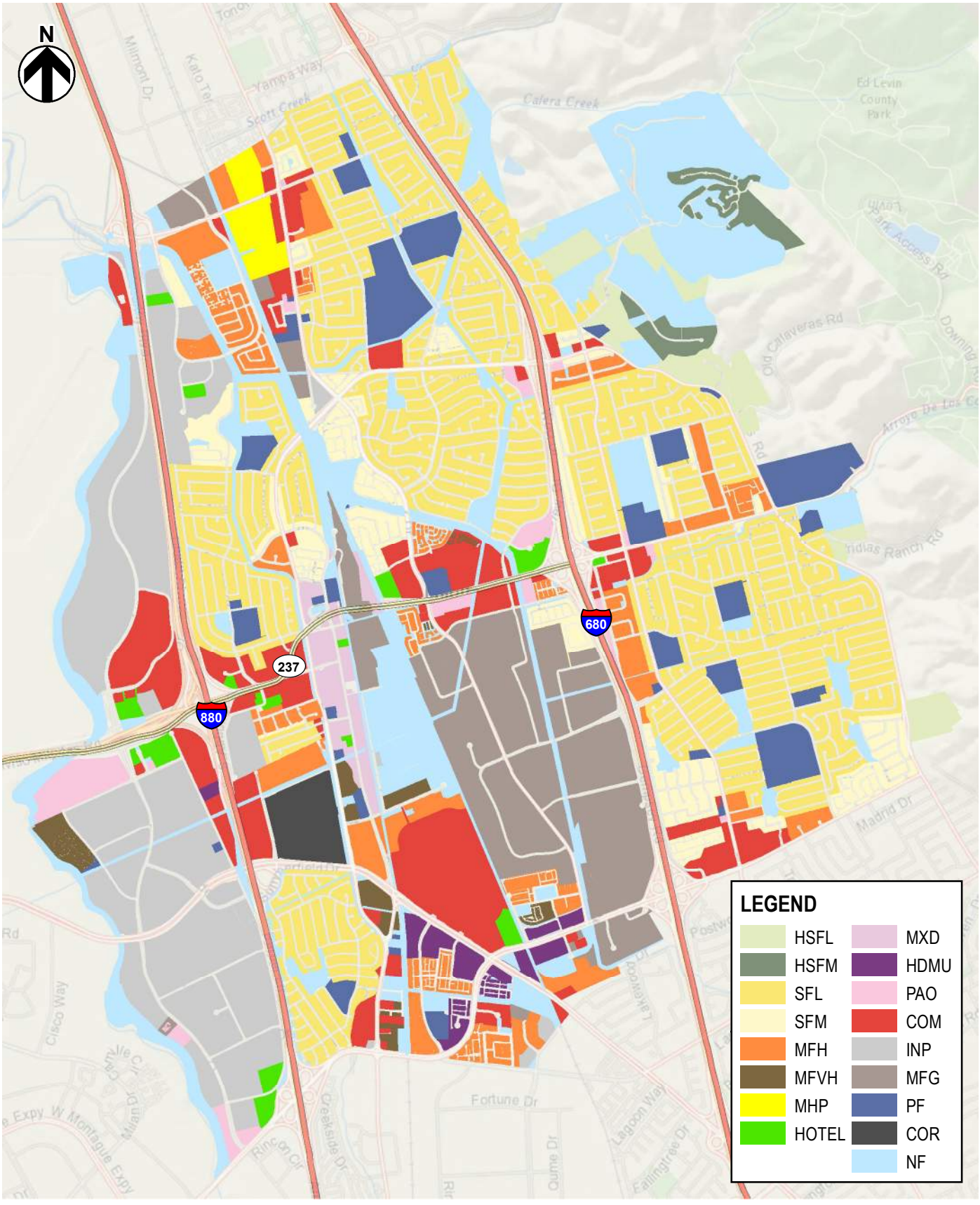

FIGURE ES-4
CITY OF MILPITAS
SEWER MASTER PLAN
MODEL-BASED LAND USE DESIGNATIONS - EXISTING

HydroScience

Wastewater Flow Analysis

The City contracted with ADS Environmental Services (ADS) to perform dry and wet weather flow monitoring within the City collection system. ADS installed 23 FlowShark Triton flow meters throughout the City and monitored flow between November 16, 2019 and March 9, 2020. The collection system was divided into 21 sub-basins based on the location of the flow meters, and the data from the flow monitoring program was used to calibrate the hydraulic model. Dry weather flow data from the flow monitoring program was used to develop dry weather groundwater infiltration (GWI) for each sub-basin and BSF. For modeling purposes, this document defines GWI as any, and all sources of constant flow. GWI is comprised both of groundwater infiltration and any other constant flow that is generally detected during low flow periods. BSF is represented by a combination of UF factors and diurnal patterns for a given land use. The dry weather calibration involved comparing modeled flows to observed flows and iteratively adjusting GWI values, UF factors, and diurnal patterns until modeled flows were reflective of observed flows. **Table ES-2** summarizes the UF factors developed for each land use type and the total modeled dry weather flows for both existing and future conditions.

Table ES-2: UF Factor Summary by Land Use

Land Use Designation	UF Factor (gpd)	Existing Quantity	Future Quantity	Quantity Units	Existing Model BSF (MGD)	Future Model BSF (MGD)
HSFL	400	56	56	Parcel	0.022	0.022
HSFM	465	107	107	Parcel	0.050	0.050
SFL	200	9619	9677	Parcel	1.924	1.935
SFM	1200	266	264	Acre	0.319	0.316
MFH	1500	292	449	Acre	0.438	0.674
MFVH	2000	56	187	Acre	0.113	0.373
MHP[1]	-	-	-	Acre	-	-
HOTEL	4000	60	24	Acre	0.244	0.095
MXD	1000	67	71	Acre	0.067	0.071
HDMU	2200	64	175	Acre	0.141	0.385
PAO	500	65	520	Acre	0.031	0.260
COM	900	467	367	Acre	0.420	0.330
INP	450	727	236	Acre	0.327	0.106
MFG	1500	550	499	Acre	0.825	0.748
PF	190	310	305	Acre	0.059	0.058
COR[1]	-	-	-	-	-	-
Large Dischargers[2]		38	32	Discharger	1.176	1.006
Total	**-**	**-**	**-**	**-**	**6.157[3]**	**6.249[3]**

Notes:
1. Mobile home parks (3) and the correctional facility were considered large dischargers and assigned flows based on water use data.
2. Large dischargers are defined as those customers that discharge a disproportionately large volume of wastewater for the parcel size and use type. They were assigned a diurnal pattern based on the original parcel land use codes.
3. Represents the total BSF. The total BSF plus the total GWI is the total DWF.

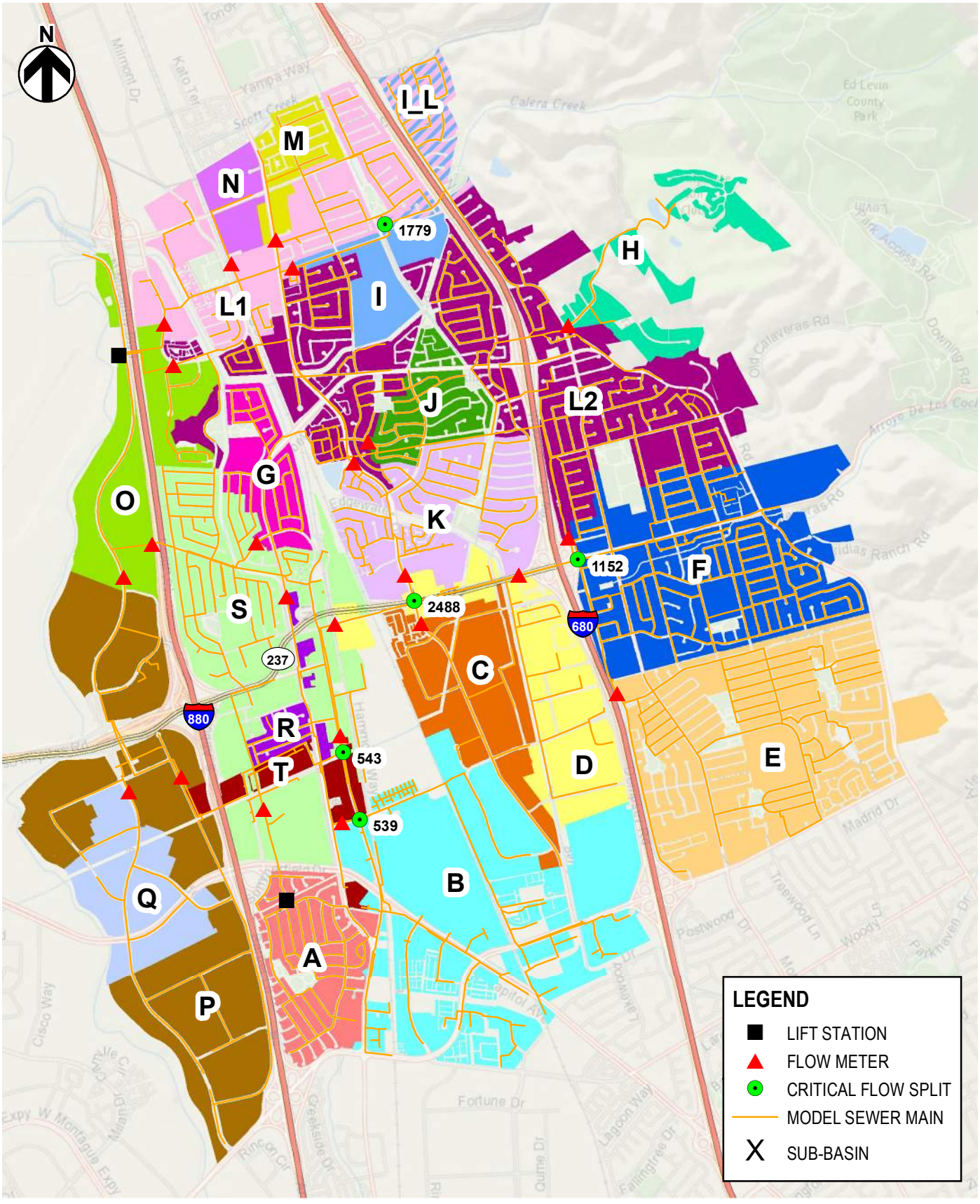

FIGURE ES-5
CITY OF MILPITAS
SEWER MASTER PLAN
SUB-BASIN DELINEATION

HydroScience

The largest storm identified during the flow monitoring period occurred on December 7, 2019 (Storm event 1); this was used to estimate the extent of rainfall-dependent inflow and infiltration (RDI/I) in each sub-basin. RDI/I is characterized by an R-factor, which represents the percentage of rainfall volume that enters the sewer system. GWI also tends to fluctuate throughout the wet season as the groundwater table rises and falls. Modeled flows were compared to observed flows for Storm event 1, and wet weather GWI values and R-factors were iteratively adjusted until modeled flows were reflective of observed flows. **Table ES-3** summarizes the calibrated R-Factors for each of the 21 sub-basins.

Table ES-3: R-Factor Summary by Sub-Basin

Sub-Basin	Total R-Factor
A	1.48%
B	1.59%
C	0.30%
D	1.90%
E	0.60%
F	0.86%
G	3.40%
H	0.24%
I	0.42%
J	2.17%
K	0.81%
L1	0.40%
L2	0.31%
M	1.39%
N	2.06%
O[1]	1.50%
P	1.26%
Q	0.60%
R	3.71%
S	1.64%
T	0.64%

Notes:
1. There is no flow meter at the outfall for sub-basin O. Values were estimated based on surrounding sub-basins.

Capacity Analysis

To estimate wet weather wastewater flows, a design storm is applied to the model and wet weather flows are represented based on the calibrated R-factors for each sub-basin. Under this condition, the existing and future performance of the wastewater collection system can be evaluated. For this Study, the collection system performance was evaluated using the typical 10-year 24-hour storm with a peak hour coinciding with the peak of the typical diurnal curve.

The initial deficiency criteria used to evaluate the capacity of the modeled pipes under design flow conditions was the ratio of wastewater flow depth (d) to pipe diameter (D), or d/D. In InfoWorks, if d/D is greater than one, this means the pipe is flowing full under pressure and the hydraulic grade line (HGL) is higher than the crown of the pipe. InfoWorks reports a "surcharge state" for each pipe, which is defined in **Table ES-4**.

Table ES-4: InfoWorks Surcharge States

Surcharge State	Definition	Deficiency if:
< 1 [1]	When depth of flow is less than the diameter of the pipe	Not considered hydraulically deficient
= 1	Pipe is surcharged due to backwater from a downstream deficiency.	Not considered hydraulically deficient
= 2	Pipe is hydraulically under capacity and needs to be upsized.	Freeboard < 5 feet

Notes:
1. Surcharge State = d/D

In the hydraulic model, the HGL reaching the ground surface indicates a potential SSO. Even for a pipe flowing under capacity or surcharged, if the freeboard – the distance between the ground surface and the HGL – is five feet or greater, the risk of SSO is minimal. Where pipes were shown as surcharged due to inadequate hydraulic capacity (surcharge state of "2"), a pipe was identified as deficient if the freeboard in these locations is also less than five feet.

There is a 6% increase from existing to future conditions, from 7.5 MGD to 7.9 MGD, in average dry weather flow at the outfall. **Table ES-5** presents the total system flows for all modeled conditions.

Table ES-5: Model Flow Summary

Scenario	Average Dry Weather Flow (MGD)	Peak Dry Weather Flow (MGD)	Peak Wet Weather Flow (MGD)
Existing	7.5	10.4	14.9
Future	7.9	11.0	18.5

There were no major capacity deficiencies identified as part of this analysis. There were six pipeline segments with a recorded surcharge state of "2" indicating that they are under capacity. Of these six segments, five of them have freeboard values greater than five feet, so they do not fulfill the criteria for a deficiency, and thus are not considered hydraulically deficient. There were no additional capacity deficiencies identified under future conditions that were not seen under existing conditions.

There is a single pipeline segment that has a freeboard of 4.7 ft., slightly less than the freeboard criteria; however, for a single pipe reach that is considered marginally deficient, replacement is not recommended without further cause. It is recommended that the City monitor this location for potential surcharging. This location (MH GID 1392) is a good candidate for installing a SmartCover to monitor the wastewater level to prevent SSOs.

Capital Improvement Plan

The City's capital improvement program (CIP) is intended to serve as a comprehensive planning tool for budgeting and carrying out capital projects. Capital projects are designed to adhere to the City Council goals and priorities; among them is to maintain a superior level of service to the community. To that end, a compilation of improvement projects was identified as part of the detailed risk and condition assessment. The PACP peak scores from the CCTV inspection and the risk scores calculated from the LoF/CoF desktop condition assessment drive the pipeline rehabilitation selection process. Using the defect coding assigned by NPS and the desktop assessment software, the pipe segments with defects were assigned a defect-level rehabilitation method.

With the rehabilitation method established for each defect code, a decision tree was established to determine the final overall rehabilitation method for the pipeline. This decision tree was prepared based on the following factors:

- CCTV structural peak score and overall peak score;
- Number of point repairs and lining recommendations by the defect-level rehabilitation methods module;
- Number of defects;
- Length of major (score of 4 or 5) and/or minor (score of 3) defects; and
- Presence of specific defects such as infiltration drippers (ID) or Reinforcement Corroded Chemical (SRCC).

Of the approximately 105,000 ft (449 segments) of sewer pipeline inspected, approximately 50,000 ft (178 segments) requires improvement. Recommended improvements include:

- Pipe Replacement
- Full Cured-In-Place Pipe (CIPP)
- Point Repair(s) by Excavation
- Sectional Liner(s)

It is noted that some pipeline segments include more than one recommended rehabilitation method.

For segments without CCTV inspection data, risk scores and diameter were used to develop a prioritized set of segments that are recommended for CCTV inspection and further analysis.

Projects are prioritized based on risk of failure along with consideration for type of proposed rehabilitation and project location. The general strategy is to address the highest risk/highest priority projects in the near-term (Years 1-5) with lower risk projects deferred to the medium- (Years 6-10) and long-term (Years 11-20).

Costs were developed to represent capital construction costs along with soft costs. Soft costs consisting of engineering design and consulting; permitting and obtaining right-of-way; and ESDC, construction management and inspection services are included in the capital project costs.

Provided below in **Table ES-6** is a proposed budget and schedule for the CIP and recommended projects over 20-years in 5-year increments. The most critical projects are scheduled for earlier implementation. It is noted that the timing of projects can be adjusted based on results of CCTV and future operating conditions. **Figure ES-6** presents the proposed improvement projects in 5-year increments.

Table ES-6: Proposed CIP Schedule and Budget

Projects	5-Year (2022-2026)	10-Year (2027-2031)	15-Year (2032-2036)	20-Year (2037-2041)
Existing Projects				
6124 Pump Station Rehabilitation Program	$200,000[1]	--	--	--
6126 Minor Sewer Projects	$200,000[2]	--	--	--
6130 Main Lift Station Odor Emissions Control	$200,000	--	--	--
6131 Sanitary Sewer Cathodic Protection Improvements	$500,000	--	--	--
6134 On-Call Sewer Maintenance & Repair Services	$98,000	--	--	--
Total Existing Projects	**$1,198,000**	**--**	**--**	**--**
Proposed Projects				
CCTV large diameter and high-risk assets	$400,000	--	--	--
Highest Priority Improvements	$1,562,000	--	--	--
Medium- to High- Priority Improvements	$5,266,000	$6,424,000	--	--
Low Priority Improvements	--	--	$6,888,000	$1,240000
Allocation for improvements identified from ongoing CCTV	$1,250,000	$1,250,000	$1,250,000	$1,250,000
Total Proposed Projects	**$8,478,000**	**$7,674,000**	**$8,138,000**	**$2,490,000**
Existing and Proposed Projects	**$9,676,000**	**$7,674,000**	**$8,138,000**	**$2,490,000**

Notes:
1. Original allocation is $200,000 through 2023 with $148,000 in prior year funding from Sewer Infrastructure Fund to be allocated for other projects in FY2020-21.
2. Original allocation is $200,000 with $37,000 in prior year funding from Sewer Infrastructure Fund to be allocated for other projects in FY2020-21.

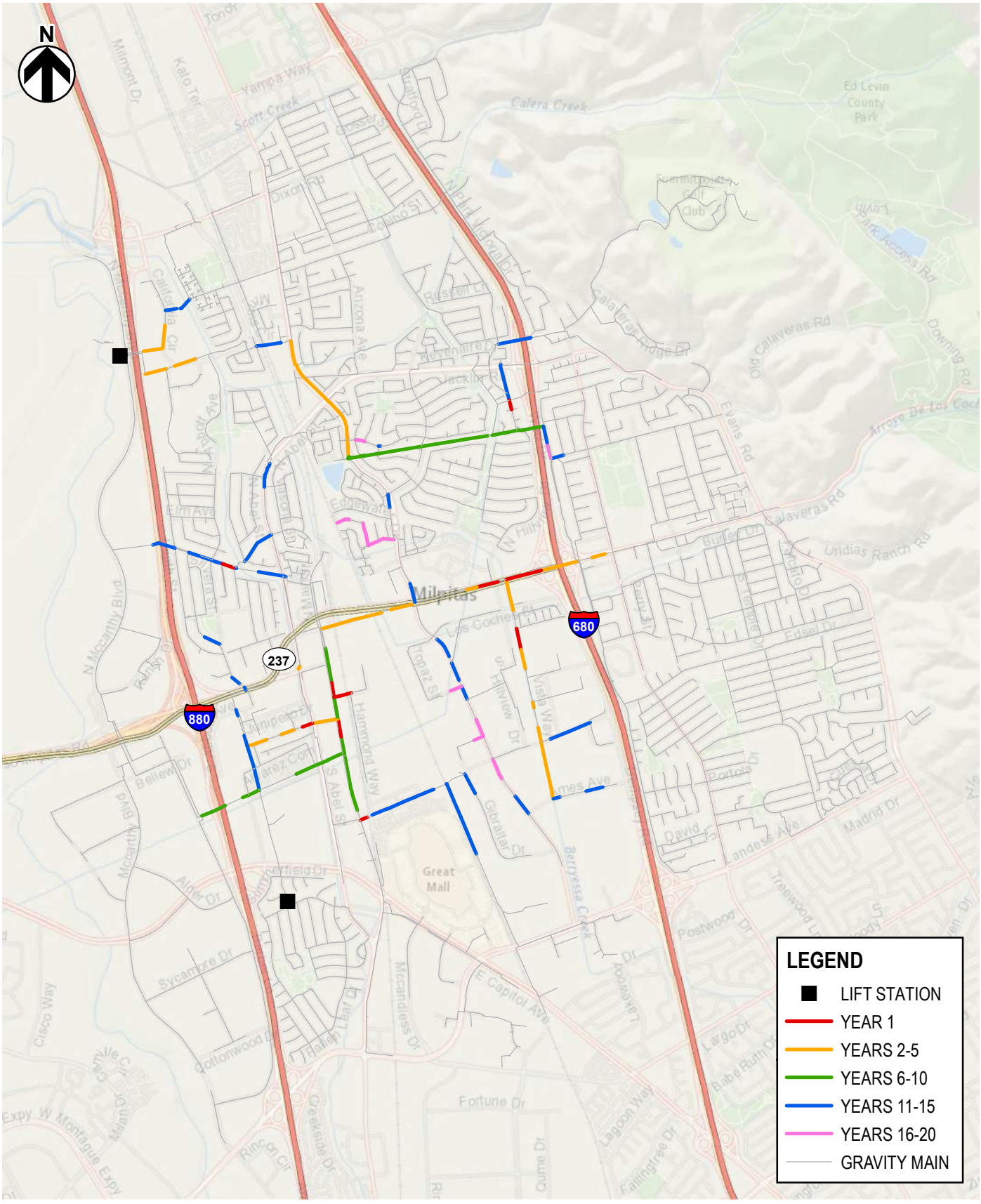

FIGURE ES-6
CITY OF MILPITAS
SEWER MASTER PLAN
CAPITAL IMPROVEMENT PROJECTS

HydroScience

SECTION 1 – INTRODUCTION AND PURPOSE

HydroScience Engineers (HydroScience) was retained by the City of Milpitas (City), to prepare the City Sewer Master Plan (SMP), which includes development of a Capital Improvement Plan (CIP) based on the current (2020) and future (2040) planning horizons. This section outlines the background and SMP objectives.

1.1 Background

The City's wastewater system infrastructure was constructed in the 1950s when the City was established, and it was expanded with the growth of the City. Today, the City is essentially built out. The most recent SMP was completed in 2002 with a revision completed in 2004 and an update completed in 2009.

1.1.1 Previous Studies/Existing Documents

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

- **City of Milpitas Capital Improvement Program 2020-2025 Final Report, July 2020:** Every year the City prepares a five-year Capital Improvement Program (CIP) that provides the City Council, staff, and the public with a comprehensive planning tool for budgeting and carrying out a range of capital projects. Also known as a Capital Budget, this document enables the City to identify estimated costs, priorities and schedules, funding sources and financing methods necessary for delivering critical services to meet community demands. The CIP is a necessary first step for planning the implementation and construction of new capital assets including public facilities such as water, sewer, and storm, and for repairs and replacements of aging infrastructure. The CIP reflects Council's priorities and policies to ensure that the needs of the community are met. The CIP documents the existing planned sewer related projects and the allocated funding for each project.
- **City of Milpitas Sewer Master Plan Revision, RMC, August 2004:** This study assessed the capacity of the wastewater collection system as well as investigated the conditions of the system. The SMP Revision updated the 2002 SMP, also completed by RMC. It provided information required for the City planning and financial efforts and defined the sanitary sewer system improvements necessary to accommodate the City's future land use development plans to the year 2018. During this study, the hydraulic model built using Hydra for the 2002 SMP was updated based on a wet weather flow monitoring program.
- **City of Milpitas Sewer Master Plan Update, RMC, December 2009:** This study was an update to the 2004 SMP Revision to reevaluate the City's sewer system capacity needs as a result of several development projects that were not considered for the 2004 SMP Revision. The Hydra hydraulic model was updated using updated large discharger information as well as updated future land use conditions. A CIP was developed to address any projected capacity deficiencies based on this updated modeling analysis.
- **Sewer System Management Plan 2016 Update, City of Milpitas, December 2016:** In accordance with the requirements of the Regional Water Quality Control Board (RWQCB), public wastewater collection system agencies are required to develop a sanitary sewer management plan (SSMP) that designates sewer system management practice to minimize

sanitary sewer overflows (SSOs) and provide reliable sewer service to the public. The 2016 SSMP describes the City's specific maintenance protocols to meet and exceed all requirements and documentation of the requirements set forth by the RWQCB General Waste Discharge Requirements (WDR).

- **Milpitas General Plan Update – Land Use Alternatives Report, De Novo Planning Group, September 2018:** State law requires that every city and county in California prepare and maintain a general planning document. As part of the General Plan (GP) update process, the City must update its GP Land Use Map. This Land Use Alternatives Report was developed as a tool to identify and evaluate a range of geographic locations ("Opportunity Areas") within the City where some changes to existing land uses may be appropriate.

The following studies were completed in conjunction with the Master Plan Study and are incorporated as appendices to the Master Plan. Where appropriate, details and summaries of findings have been included in the body of the Master Plan Study. For additional detail, the reader is directed to the appendices.

- **Sewer Utility Asset Renewal and Replacement Study, Brown and Caldwell, August 2020 (R&R Study):** This study was conducted as part of this Master Plan Study to assess the current condition of the City's wastewater collection system. This includes CCTV inspection results, an assessment of the relative risk of failure of all pipe segments in the City, as well as lift station inspection results. The purpose of this study is to provide the City with a set of priorities for asset renewal and replacement. This study is included as **Appendix A**.
- **Main and Venus Way Lift Station Inspections Report, Brown and Caldwell, May 2020 (LS Report):** This study was conducted as part of the Master Plan Study to assess the current operations and condition of the Main Lift Station (Main LS) and Venus Way Lift Station (Venus Way LS). This study presents the results of the on-site inspection performed for these two facilities. It is included as part of **Appendix A** (R&R Study App. K [App. K]).
- **Milpitas Sewer Flow Monitoring Report 2019-2020, ADS Environmental Services, April 2020:** This program was completed for the months of November 2019 – March 2020 for the purposes of measuring wastewater flows in the City's collection system. Both wet weather and dry weather flows were captured, and the resulting data was used for the calibration of the hydraulic model for this Study. This report is included as **Appendix B**.

1.2 Objectives

The objectives of this Master Plan project are:

- To perform a condition assessment on the current state of the collection system;
- To evaluate the hydraulic performance of the system under current conditions and under projected future conditions;
- To identify any hydraulic capacity deficiencies or pipes in poor condition, and
- To develop a CIP to address physical and hydraulic deficiencies.

These objectives were developed in collaboration with City Staff through technical review of available asset data and development of a hydraulic model. Through these analyses, projects were identified to help maintain the City's collection system level of service standards..

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 SMP. The sections are as follows:

- **SECTION 1 – Introduction and Purpose**: This section presents the background leading to the development of this SMP, a description of previous work, and objectives and organization of the SMP.
- **SECTION 2 – Service Area and Wastewater Services**: This section describes the City as well as the related wastewater services.
- **SECTION 3 – Existing Wastewater Collection System**: This section describes the existing wastewater collection system and the overall system operation within the service area.
- **SECTION 4 – Condition Assessment**: This section presents the results of the condition assessment performed as part of the SMP, including the results of the closed-circuit television (CCTV) inspections.
- **SECTION 5 – Analysis of Land Uses for Hydraulic Modeling**: This section outlines the land use categories identified by the GP and details the methodology for using these land use categories for the development and calibration of the hydraulic model.
- **SECTION 6 – Hydraulic Model Development**: This section presents the process and assumptions associated with building the hydraulic model infrastructure and filling in any existing data gaps.
- **SECTION 7 – Wastewater Flow Analysis**: This section presents the results of the flow monitoring program and analysis of that data. This section also presents the development of the wastewater flows used to develop and calibrate the hydraulic model and the results of the model calibration.
- **SECTION 8 – Capacity Analysis**: This section presents identified hydraulic capacity-related deficiencies under existing and future modeled conditions.
- **SECTION 9 – Project Development**: This section presents the recommended improvements resulting from the condition assessment and the basis for cost development.
- **SECTION 10 – Capital Improvement Plan**: This section presents the recommended capital improvement projects, costs, and timeline for implementation.

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SECTION 2 – SERVICE AREA AND WASTEWATER SERVICES

The City provides wastewater collection services to all customers within the City boundary. This section describes the service area and related wastewater services.

2.1 Service Area

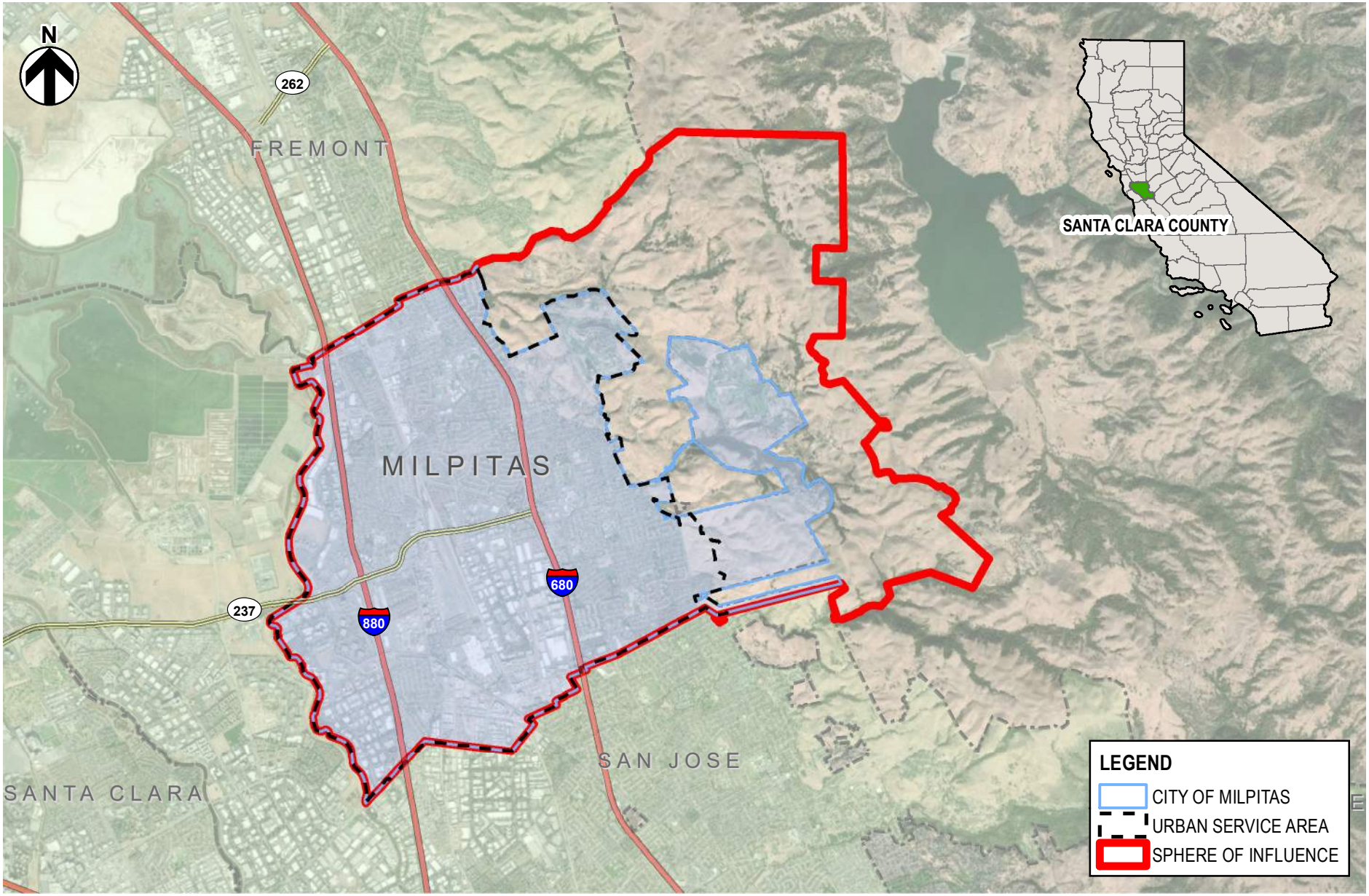
The City is located along the northern boundary of Santa Clara County at the southern tip of the San Francisco Bay, approximately 45 miles southeast of San Francisco. It is bounded by the Cities of Fremont to the north, San Jose to the south and west, and unincorporated Santa Clara County to the east (see **Figure 2-1**).

Incorporated in 1954, the City encompassed 2.9 square miles and housed a population of 825. The Ford Motor Company assembly plant was built in 1955 and this brought the start of the City's rapid growth period; this growth was maintained by the high technology industry in the 1970s. By 1992, the City encompassed 13.6 square miles, which is approximately its current area. Today, the City is almost completely built out, so any future increases in wastewater flows would come from increases in density or changes in land use through redevelopment.

Today, the City encompasses 14 square miles and provides wastewater collection services to a population of 77,961 according to the Department of Finance. There are two distinct areas of the City referred to as the "valley floor," which is relatively flat, and the "hillside" on the eastern edge of the City limits. Elevations gently slope from west to east along the valley floor from approximately 10 ft to 120 ft and up to approximately 700 ft in the hillside area. The valley floor includes a mixture of industrial, manufacturing, commercial, and residential land uses, while the hillside is reserved solely for residential use. Parks and open spaces are scattered throughout the residential areas.

The following boundaries are identified on **Figure 2-1**:

- **City Limits:** The City Limits includes the area within the City's corporate boundary, over which the City exercises land use authority and provides public services.
- **Urban Service Area (USA):** In 1998, voters in the City established an Urban Growth Boundary (UGB) limiting development in its eastern hill areas. The initiative was set to expire in 2018 but was extended through the recent passage of Measure I by Milpitas voters in November 2016. Contiguous with the UGB the USA restricts the extension of public service and infrastructure to new development in eastern areas of the City Limits.
- **Sphere of Influence (SOI):** An SOI is the probable physical boundary and service area of a local agency, as adopted by a Local Agency Formation Commission (LAFCO). An SOI includes both incorporated and unincorporated areas within which a city or special district will have primary responsibility for the provision of public facilities and services. The SOI also coincides with the Planning Area – the area included in the analysis and planning for the 20-year horizon of the City's proposed GP.



HydroScience

FIGURE 2-1
CITY OF MILPITAS
SEWER MASTER PLAN
PROJECT LOCATION MAP

2.1.1 Land Use

The City's current land uses, according to the GP, are listed in **Table 2-1** and displayed in **Figure 2-2**. These land uses served as the basis for the model-based land use designations and analysis, which are described in **SECTION 5**.

Table 2-1: General Plan Land Use Categories

GP Land Use Categories	Land Use Code
Hillside Very Low Density	HVL
Hillside Low Density	HLD
Hillside Medium Density	HMD
Single-Family Low Density	SFL
Single-Family Medium Density	SMD
Multi-Family Medium Density	MFM
Multi-Family High Density	MFH
Multi-Family Very High Density	VHD
Mobile Home Park	MHP
Urban Residential	URR
Mixed Use	MXD
Boulevard Very High-Density Mixed Use	BVMU
Residential-Retail Mixed Use	RRMU
General Commercial	GNC
Retail Sub-Center	RSC
Highway Services	HWS
Town Center	TWC
Industrial Park	INP
Manufacturing	MFG
Professional & Administrative Offices	PAO
Public Facilities	PF
Park Open Space	POS
Waterways	WATERWAYS

Source: Milpitas General Plan Update – Land Use Alternatives Report, September 2018

There are several "Opportunity Areas" identified throughout the City as areas of potential growth and/or redevelopment; these "Opportunity Areas" are identified on **Figure 2-2**. The Midtown Specific Plan and Metro Specific Plan are detailed below:

- **Midtown Specific Plan**: This plan, updated in 2010, provides a new vision for approximately 589 acres of land which is currently undergoing changes related to its growing role as a housing and employment center in Silicon Valley. This plan presents an opportunity to reinvigorate the "historic" commercial and industrial core of Milpitas and bring it into the life of the City. The overall strategy of the Midtown Specific Plan is to create a mixed-use community

that includes high-density, transit-oriented housing and a central community "gathering place," while maintaining needed industrial, service, and commercial uses. This plan provides for up to 2,328 new dwelling units and supporting retail development, new office developments at key locations; bicycle and pedestrian trails linking the areas together and new parks to serve residential development.

- **Metro Specific Plan**: Of the 443 acres of the Metro Specific Plan, approximately 403 acres were previously included as part of the Midtown Specific Plan but have since been broken off into a new standalone specific plan. The goal of the Metro Specific Plan is to bring about an attractive and livable neighborhood that takes advantage of public investment in light rail and BART, and to transform an older light industrial district to meet high demand for housing, offices, and shopping in the Bay Area. The plan creates a structure for a walkable, transit-oriented area with a mix of land uses, which encourages walking, biking, and transit trips and minimizes vehicle trips. This type of development can accommodate substantial growth, minimize impacts on local roadways, and reduce urban sprawl at the periphery of the region.

2.2 Wastewater Treatment and Disposal

Wastewater from the City's collection system is conveyed to and treated by the San Jose-Santa Clara Regional Wastewater Facility (RWF). Eight tributary agencies contribute flow to the RWF including the City of Santa Clara, Cupertino Sanitary District, West Valley Sanitation District, the City of San Jose, County Sanitation District 2-3, Burbank Sanitary District, and the City of Milpitas.

The City of Milpitas pays a share of the capital cost of the RWF, based on the City's capacity rights in proportion to the 167 MGD total capacity of the RWF. The City also pays a share of the operating cost, based on the volume of wastewater discharged to RWF. The City has rights to discharge 14.25 MGD to the RWF under its current allotment.

To calculate dry weather flows from each agency, the RWF identifies the peak week – five-day period during June through October with the highest flows based on the plant's influent data – and each tributary agency is asked to provide an estimate of their average flow for the peak week.

2.3 Recycled Water

The City purchases recycled water from the South Bay Water Recycling (SBWR) Program. The SBWR Program is an on-going, multi-year effort to use high quality recycled water produced at the RWF and distribute for irrigation, industrial, and other purposes. The SBWR Program is administered through the City of San José's Environmental Services Division.

The City uses recycled water for irrigating public and private areas such as parks, medians, and industrial uses to supplement potable water use. The City's existing recycled water pipeline system connects to the SBWR system near Technology Drive and Coyote Creek, southeast of the State Route 237/Interstate-880 interchange. Recycled water provided by the SBWR Program is delivered through an existing transmission line. It is then distributed through a series of mains that provide landscape irrigation to business/retail areas surrounding McCarthy Ranch and Oak Creek Industrial Park, and to central Milpitas. The City maintains and operates approximately 22.4 miles of SBWR-owned recycled water lines that serve approximately 224 service connections. The City has an agreement with SBWR to be reimbursed for its costs to operate and maintain the SBWR-owned system within the City.

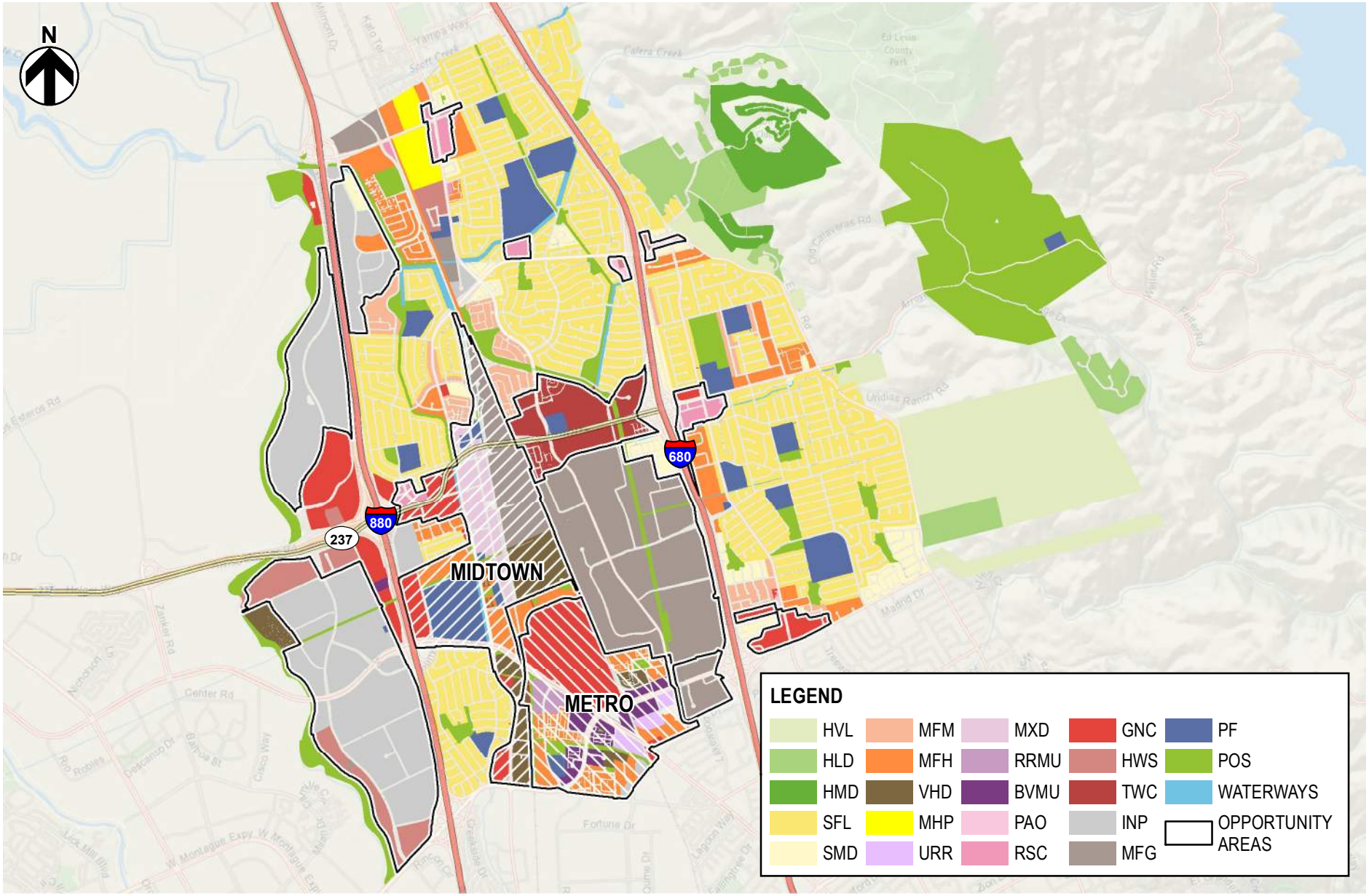


FIGURE 2-2
CITY OF MILPITAS
SEWER MASTER PLAN
CITY GENERAL PLAN LAND USE

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SECTION 3 – EXISTING WASTEWATER COLLECTION SYSTEM

This section describes the City's existing wastewater collection and conveyance system. Information from previous studies, regulatory documentation, field investigation, and discussions with the City Planning Department Staff were compiled herein. A wholesale review and update of the City's ArcGIS geodatabase (GIS) was conducted using an extensive database of record drawings. A summary of the updates made to the GIS is included in **Appendix C**.

3.1 Wastewater Collection System

According to the updated GIS, the wastewater collection system consists of 844,114 feet (ft) (approximately 160 miles) of gravity sewers ranging from pipe diameters of 4- to 66-inches. The eastern side of the City has predominantly residential customers, with the western side of the City on the valley floor dominated by industrial and manufacturing. Commercial and mixed use are scattered throughout the valley floor as well. The topography is generally flat on the valley floor, with gradual elevation drops from the southeast to the northwest. The entire system flows to the Milpitas Main Lift Station (Main LS) in the northwestern corner of the City where it is pumped to the RWF through two force mains. An additional lift station, located on Venus Way, connects a small portion of low-elevation flow to the higher-elevation gravity system. **Figure 3-1** contains an overview of the City's wastewater collection system.

3.1.1 Pipelines and Manholes

The City's wastewater collection system includes pipelines and structures of varying age, size, and material. According to the City's GIS, the majority of the City's wastewater collection system pipelines are vitrified clay pipe (VCP) and 4- to 12-inches in diameter. Approximately 70% of the system was built before 1990. **Table 3-1**, **Table 3-2**, and **Table 3-3** provide breakdowns of the distribution of existing pipe material, size, and age according to the City's GIS, and are reflected in **Figure 3-2**, **Figure 3-3**, and **Figure 3-4**.

As part of the preventative maintenance program, City Staff schedule weekly cleaning for high problem areas of the system. Areas with a moderate frequency of problems receive cleaning on a monthly or biannual basis, and low problem areas including the remainder of the system are cleaned on a recurring 18-month basis.

Based on review of record drawings and existing GIS, 15 siphons were identified throughout the collection system that divert flow under the San Francisco Public Utility Commission (SFPUC) water supply pipeline, creeks, and highways. The siphons are shown in **Figure 3-1**. As part of the preventative maintenance schedule, one problem siphon is cleaned weekly, and the others are cleaned quarterly.

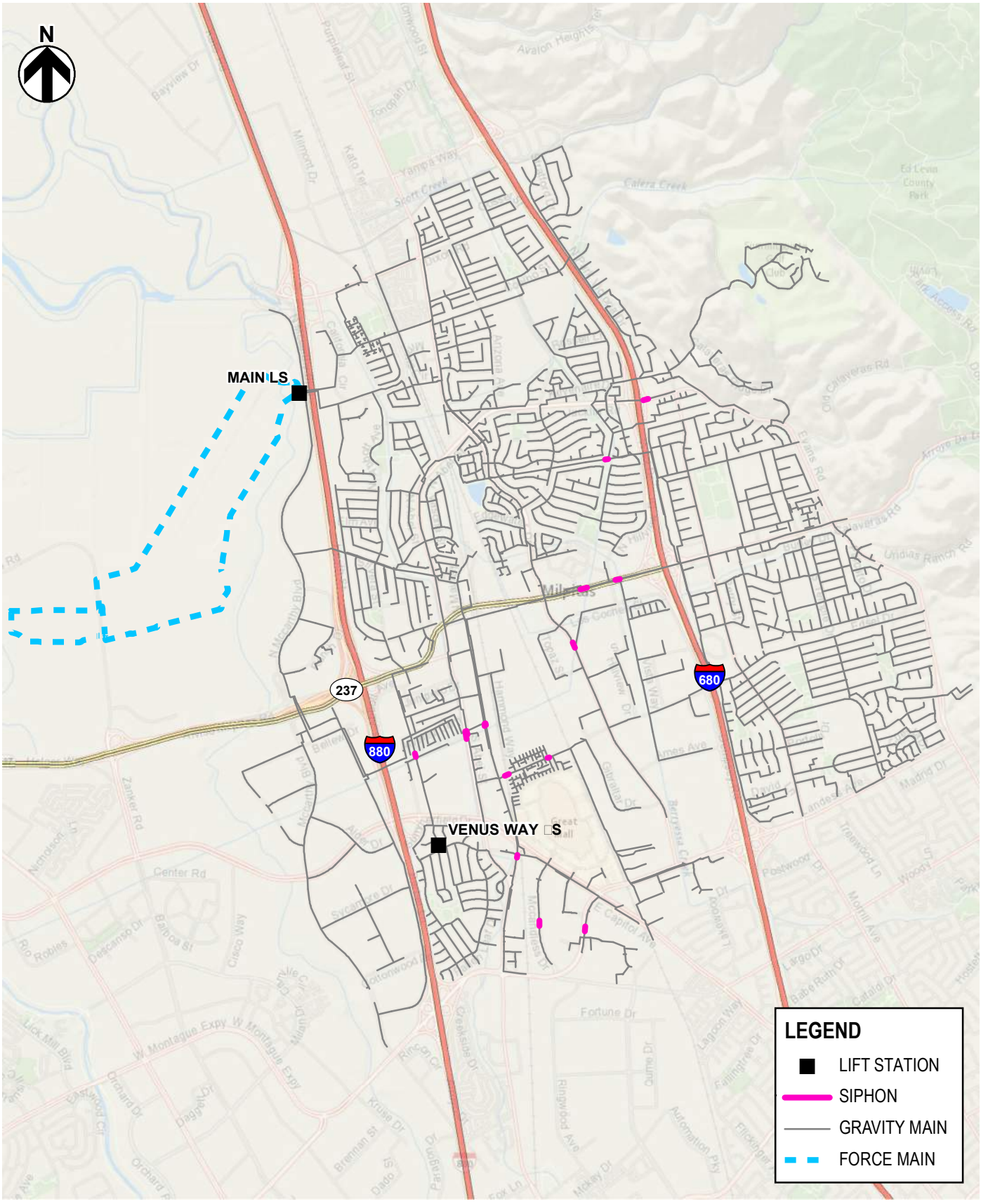

FIGURE 3-1
CITY OF MILPITAS
SEWER MASTER PLAN
WASTEWATER COLLECTION SYSTEM OVERVIEW

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Table 3-1: Collection System Pipeline Material

Pipe Material	Total Length (ft)	Length as Percentage
Acrylonitrile-Butadiene-Styrene (ABS)	13,812	1.64%
Cast Iron Pipe (CIP)	2,027	0.24%
Ductile Iron Pipe (DIP)	2,017	0.24%
High-Density Polyethylene (HDPE)	15,898	1.88%
Polyvinyl Chloride (PVC)	59,188	7.01%
Reinforced Concrete Pipe (RCP)	36,414	4.32%
Vitrified Clay Pipe (VCP)	650,411	77.05%
VCP/ABS	14,337	1.70%
Unspecified	50,011	5.92%
Total	**844,114**	**100.00%**

Table 3-2: Collection System Pipeline Diameter

Pipe Diameter (in)	Total Length (ft)	Length as Percentage
< 8	392,365	46.48%
8-12	300,557	35.61%
15-18	49,886	5.91%
21-24	20,400	2.42%
27-30	24,421	2.89%
33-37	36,479	4.32%
39-42	5,756	0.68%
48-66	5,970	0.71%
Unspecified	8,280	0.98%
Total	**844,114**	**100.00%**

Table 3-3: Collection System Pipeline Age

Installation Date	Total Length (ft)	Length as Percentage
1951-1959	82,527	9.78%
1960-1969	173,537	20.56%
1970-1979	146,186	17.32%
1980-1989	196,192	23.24%
1990-1999	63,195	7.49%
2000-2009	58,136	6.89%
2010-2019	23,611	2.80%
Unspecified	100,729	11.93%
Total	**844,114**	**100.00%**

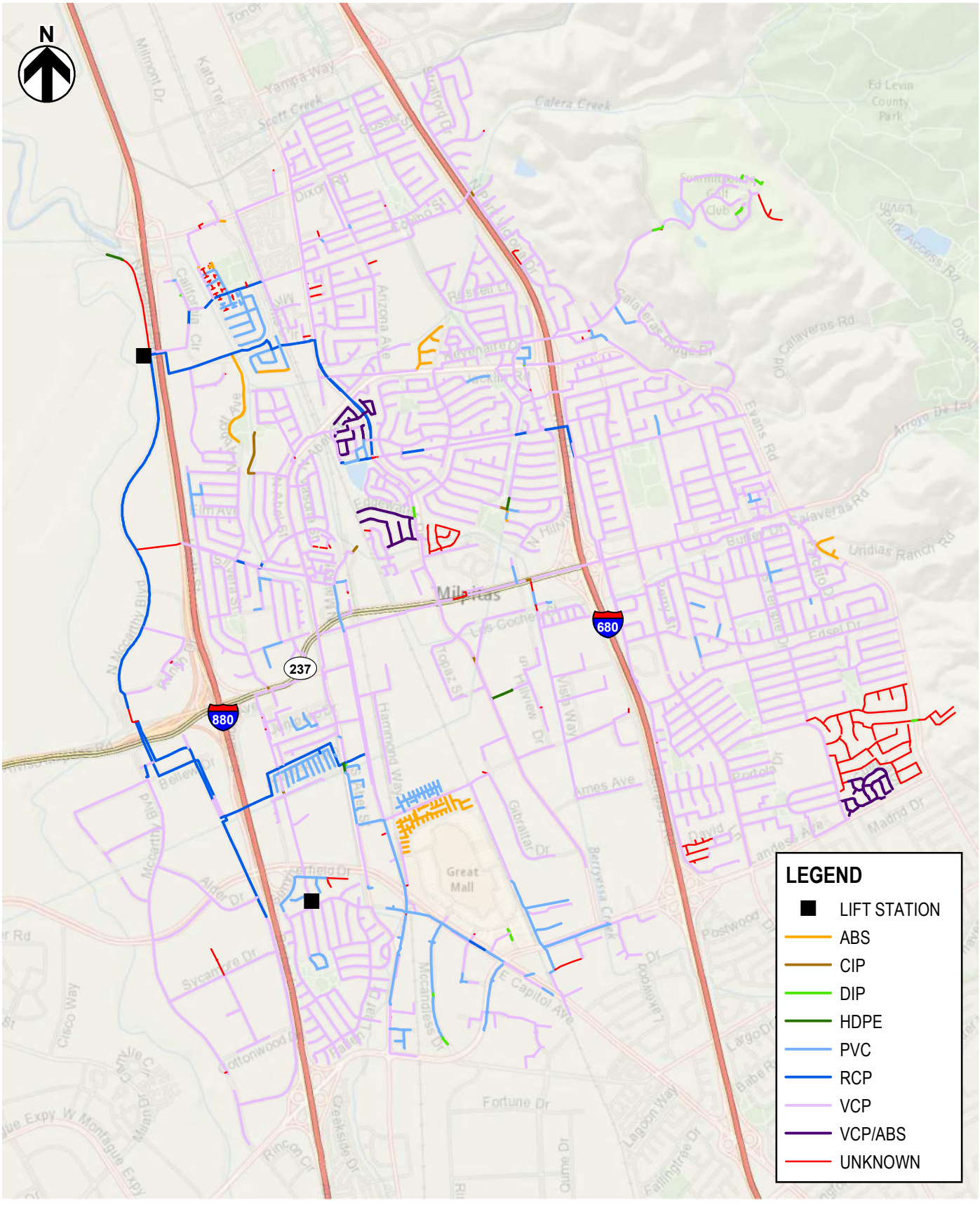

FIGURE 3-2
CITY OF MILPITAS
SEWER MASTER PLAN
COLLECTION SYSTEM PIPELINE MATERIAL

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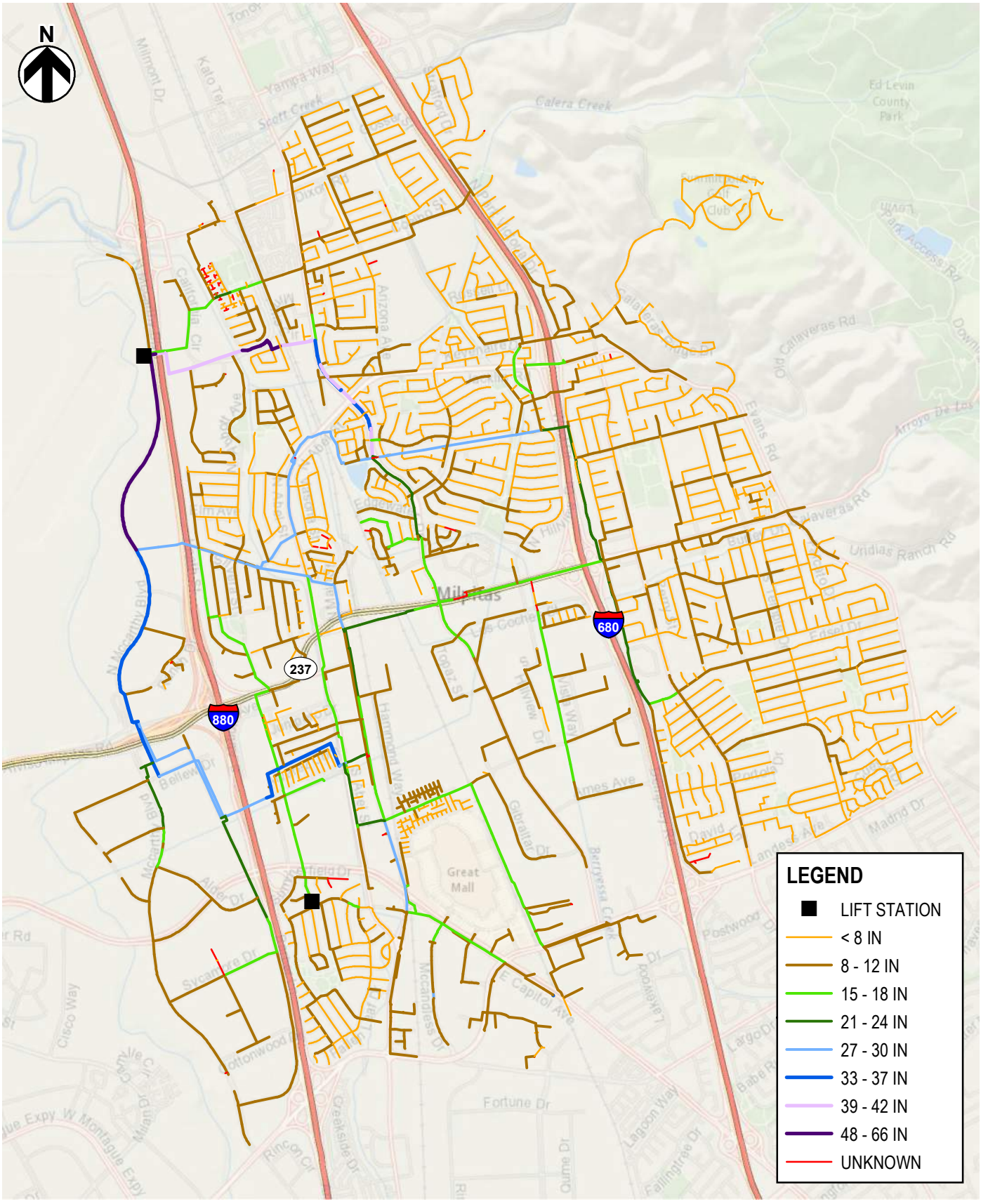

FIGURE 3-3
CITY OF MILPITAS
SEWER MASTER PLAN
COLLECTION SYSTEM PIPELINE DIAMETER

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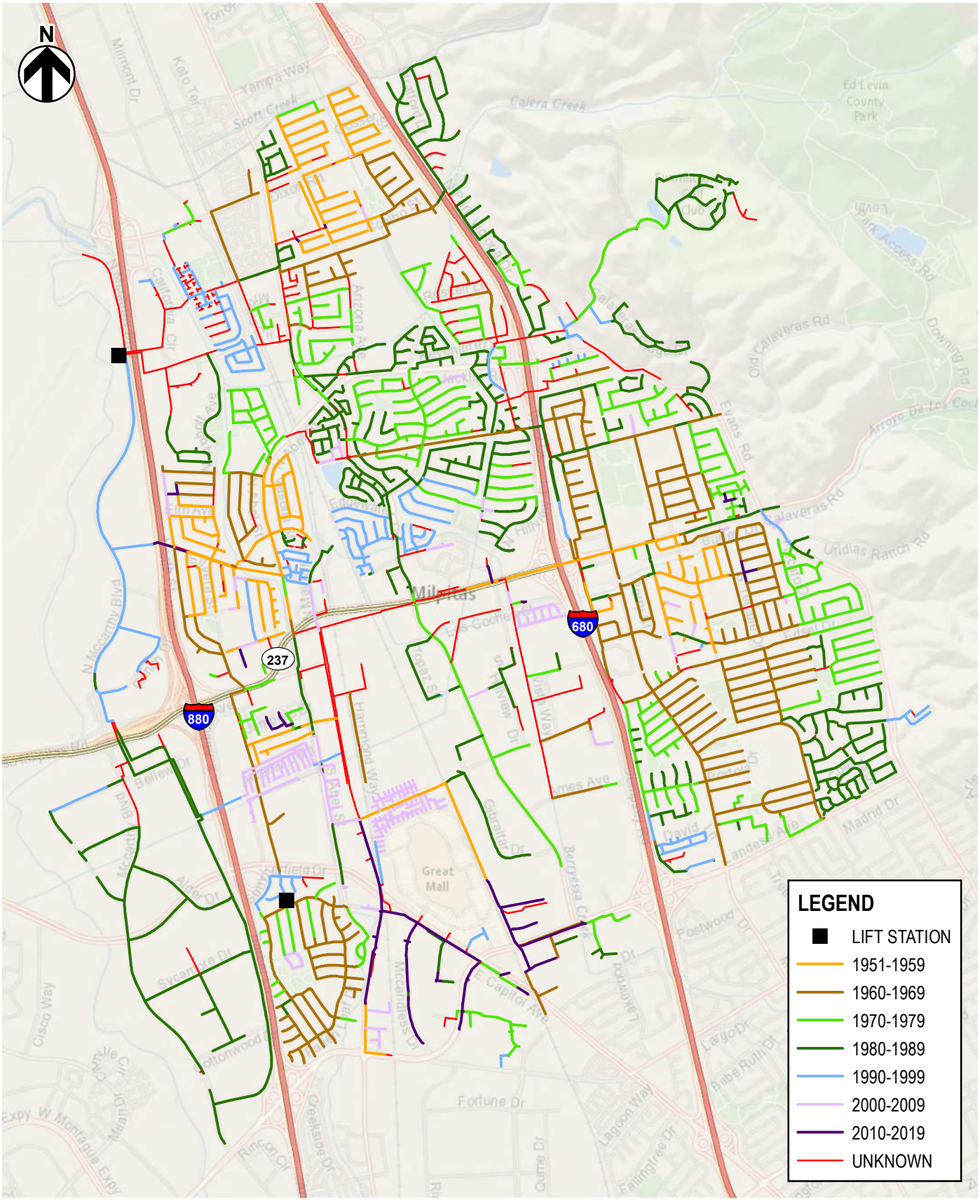

FIGURE 3-4
CITY OF MILPITAS
SEWER MASTER PLAN
COLLECTION SYSTEM PIPELINE AGE

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Based on the City's GIS, the collection system includes almost 3,000 manholes. Of these manholes, approximately 60% were built before 1990. **Table 3-4** provides a breakdown of the age distribution of the existing manholes based on the City's GIS.

Table 3-4: Collection System Manhole Age

Installation Date	Total Count	Count as Percentage (%)
1951-1959	229	7.69%
1960-1969	440	14.77%
1970-1979	415	13.93%
1980-1989	631	21.18%
1990-1999	286	9.60%
2000-2009	204	6.85%
2010-2019	125	4.20%
Unspecified	649	21.78%
Total	**2,979**	**100.00%**

To facilitate operations and maintenance and prevent SSOs, the City has implemented SmartCover technology to monitor the wastewater collection system. They have installed 33 SmartLevel™ Monitoring Systems in sewer manholes throughout the City to provide real-time remote level monitoring to operations staff. SmartCovers can be installed under any manhole lid and can be moved to monitor areas of concern, as needed.

Flow Splits

There are 177 identified flow splits throughout the City's collection system. Flow splits are manholes that allow outflow via two or more pipes. There are three types of flow splits within the City's collection system, including:

- **High point flow splits** – high points from which sewage flows in opposing directions (see **Figure 3-5**);
- **Even flow splits** – manholes where incoming flow is split proportionally in two (or more) directions where downstream pipes have matching inverts (see **Figure 3-6**); and
- **Overflow flow splits** – manhole flow splits with overflow. At an overflow split during normal flow conditions, the flow takes one path and during high flow conditions, if the manhole begins to surcharge and flow reaches a certain depth, there is an "overflow" pipeline that is activated and will carry flow (see **Figure 3-7**).

As part of the network review and hydraulic model calibration processes, three flow diversion structures (MH 1053, MH 2578, and MH 1152) were identified for inclusion in the hydraulic model. These were identified by reviewing record drawings and available CCTV information. They are described as follows:

- **Flow diversion structure** – alters an existing even flow split to mimic an overflow flow split. A typical flow diversion structure is depicted in **Figure 3-8**. As can be seen in the figure, during normal dry weather operating conditions, all inflow is directed to one outflow pipe by the diversion structure. During higher flow conditions as the manhole begins to surcharge, the diversion structure is overtopped, and some flow is diverted to an overflow pipe. To represent these structures in the model, the height of the overflow pipe invert was adjusted to match the height of the diversion structure.

All identified flow splits and flow diversion structures are displayed on **Figure 3-9**.

Figure 3-5: Example High Point Flow Split

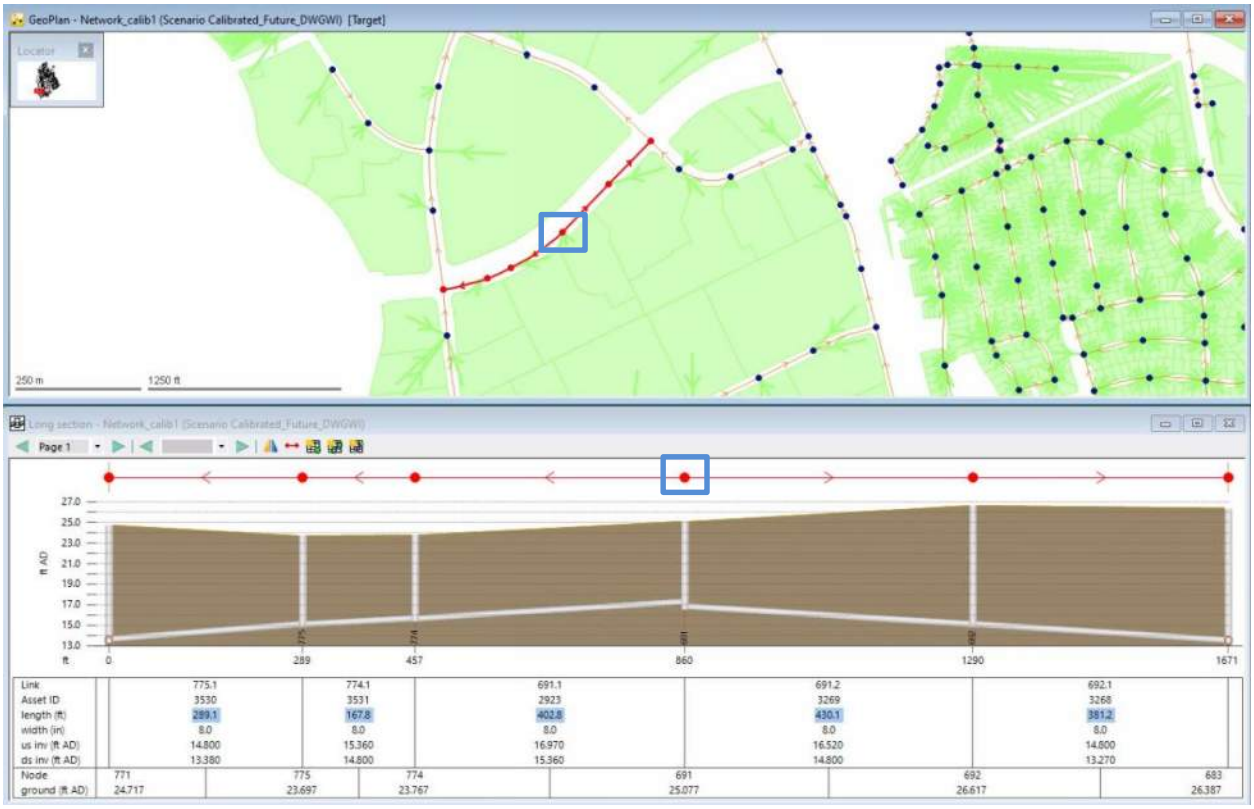


Figure 3-6: Example Even Flow Split

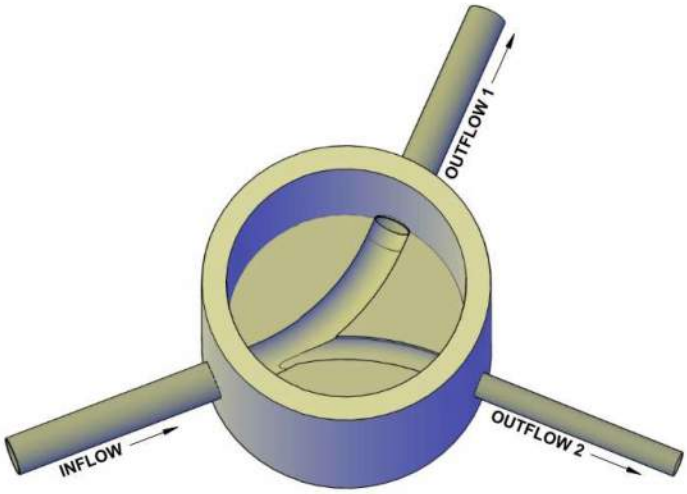


Figure 3-7: Example Overflow Flow Split

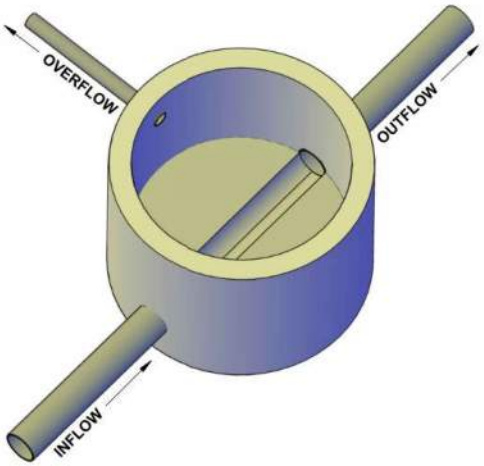
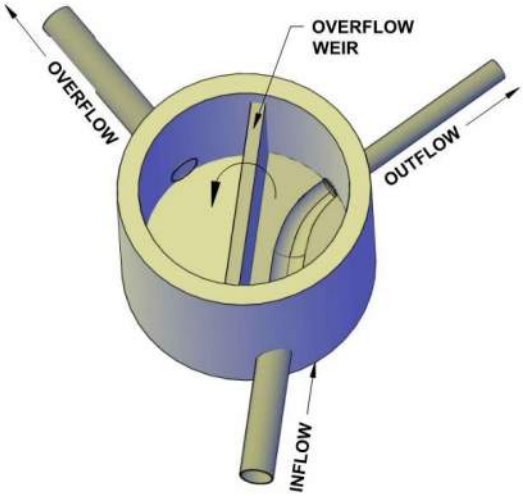


Figure 3-8: Example Flow Diversion Structure



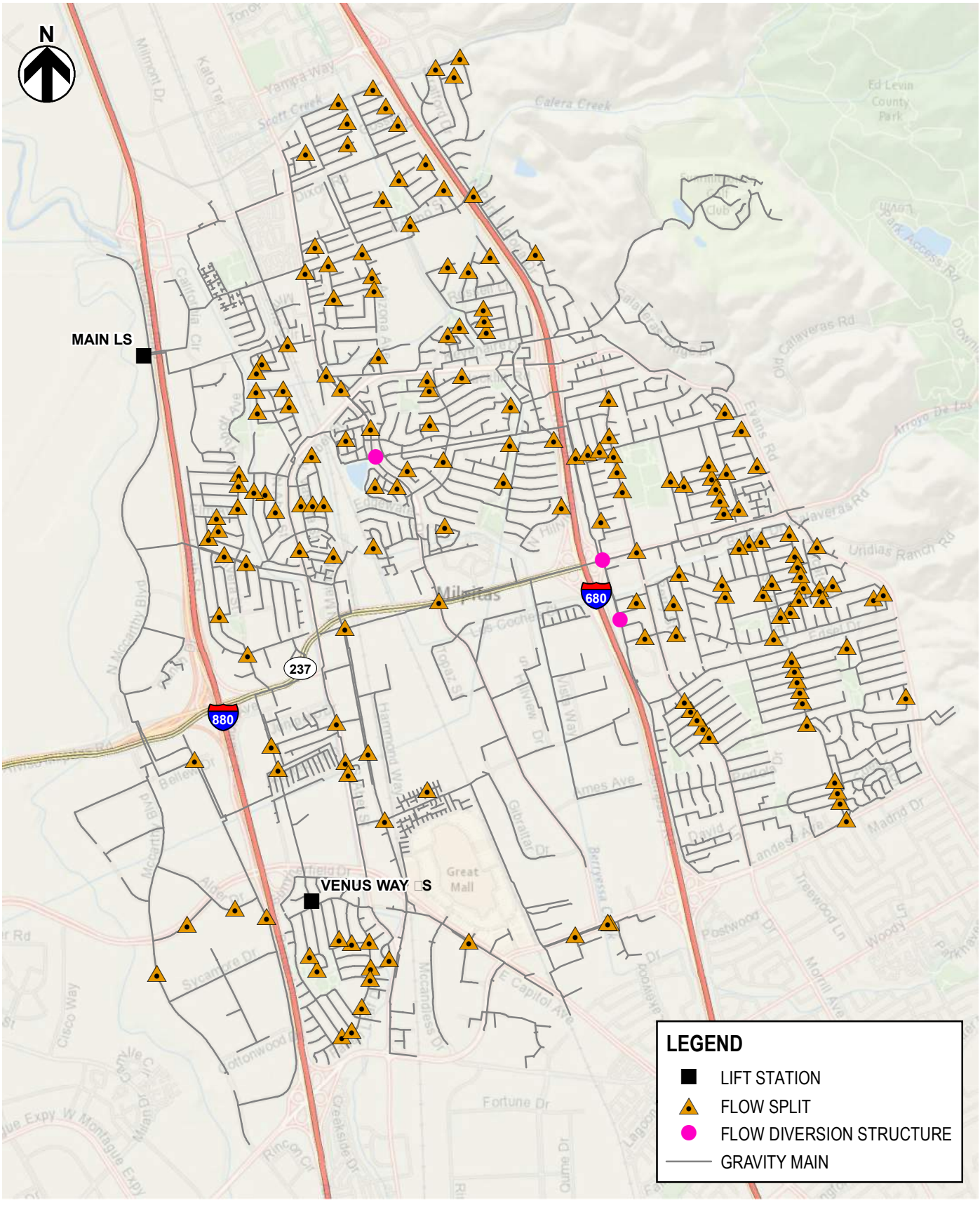


FIGURE 3-9
CITY OF MILPITAS
SEWER MASTER PLAN
FLOW SPLITS AND DIVERSION STRUCTURES

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3.1.2 Lift Stations

In February and March 2020, a condition assessment of the two lift stations was conducted as part of the Master Plan effort. An inspection report detailing the assessment and a full asset inventory list of the lift stations are included as part of **Appendix A** (R&R Study App. K, LS Report).

The Venus Way Lift Station (Venus Way LS) serves approximately 1,200 single-family homes surrounding Pinewood Park in the southwestern corner of the City. It is designed to lift wastewater collected from the lower elevations and transmit it the collector main parallel to, and to the east of, Interstate 880. It is a single pump (with stand-by pump) lift station, equipped with two 5 hp 3-phase 540 gpm non-clog sewage pumps in a packaged dry-well plus wet-well configuration. The wet well is a 72-inch diameter RCP wet well equipped with an aluminum hatch and safety grate. The City rehabilitated this lift station during 2008. As part of the preventative maintenance program, the Venus Way LS is inspected annually. **Table 3-5** provides a summary of the asset inventory list for the Venus Way LS; a detailed asset inventory is provided in **Appendix A** (R&R Study App. K, LS Report Sections 2.2 and 4.1).

Table 3-5: Venus Way LS Asset Inventory List

Asset Name	Asset Description	Asset Type	Year Installed
Mechanical			
Pumps (2) #1 & #2	FLYGT CP3102-441, 5 hp 3-PH 230 V Submersible Pump	Pump	2008
Pump Guide Rails	Reinstalled in 2008		2008
8” Gate Valves (3), Pumps 1 & 2	8” Gate Valve, Pump 1 & 2	Valve	2008
8” Check Valves (2), Pump 1 & 2	8” Check Valve, Pump 1 & 2	Valve	2008
4” Flap Gate	4’ Flap Gate in Wet Well	Valve	2008
2” Combo Air/Vacuum Valve	2” Combo Air/Vacuum Valve	Valve	2008
Electrical			
Utility Transformer	240/120 V, 3-Ph, 3 W	Transformer	2000
Service Pedestal	Service Disconnect and Metering		2008
Pump Control Panel	Starter Panel for Pumps 1 & 2 (each 5 hp)	Panel	2008
Instrumentation			
Level Instrument	Wet Well Level Sensor	Level Switch	2008
Structural			
Wet Well	72” Diameter RCP	Tank	1964
Valve Vault		Vault	1964
Aluminum Hatch-Vault	Aluminum Hatch, slide-in	Vault	2008
Aluminum Hatch-Wet Well	Aluminum Hatch w/ safety grate	Vault	2008

All wastewater is collected at the Main LS, the terminal point in the gravity collection system, where it is pumped to the RWF. The Main LS is located to the west of Interstate 880 between North McCarthy Blvd and Coyote Creek Trail. Flow enters the lift station site through a single 54-inch diameter RCP pipe.

The site consists of three buildings that house the lift station components. The Main LS consists of four grinders and four large submersible 170 hp 3 phase 705 rpm pumps with variable frequency drives (VFDs). Pumps #1 and #6 are slated for future installation though the base assembly, piping, and rail system were installed under Project 6103/2-1066. Grinders #5-8 are also slated for future installation. According to the City's 2016 SSMP, the Main LS has a wet weather capacity of 45 MGD. **Table 3-6** provides a summary of the asset inventory list for the Main LS; a detailed asset inventory is provided in **Appendix A** (R&R Study App. K, LS Report Sections 2.2 and 3.1).

Table 3-6: Main LS Asset Inventory Summary

Asset Name	Asset Description	Asset Type	Year Installed
Mechanical			
Pig Launchers (2) A & B	36" Pig Launcher	Pig Launcher	2002
Pinch Valves (3) 1-3	36" Pinch Valve	Valve	2002
Mag Meter (Flow Meter A)	24" Magnetic Meter	Flow Meter	2002
Venturi Meter – Removed in 2008	36" Venturi Meter (taken out)	Flow Meter	1975
Butterfly Valve	36" Butterfly Valve, FM interconnect	Valve	1970
Manifold Piping Butterfly Valve	36" diameter BFV, middle of manifold	Valve	2008
Manifold Piping Plug Valve #1	36" diameter PV, pumps 1, 2, 3	Valve	2008
Manifold PV #1 & #2 Actuators (2)	plug valve electric actuator	Actuator	2008
Manifold Piping Plug Valve #2	36" diameter PV, pumps 4, 5, 6	Valve	2008
Pumps (3) #2-4	FLYGT CP3531-775, 170 hp Submersible Pump	Pump	2008
Pumps (4) #2-5 Piping	20" Ductile Iron Vertical Discharge Pipe, 20" Ductile Iron 90 Elbow, 20" Flanged Coupling Adapter	Piping	2008
Pumps (4) #2-5 Check Valves	20" Diameter Spring Loaded Check Valve	Valve	2008
Pumps (4) #2-5 Plug Valves	20" Diameter Plug Valve	Valve	2008
Pump #5 (not installed yet)	FLYGT CP3531-775, 170 hp Submersible Pump	Pump	
Main Head Gate	54" sluice gate with manual actuator	Gate	2008
Head Gate (4) #1-4	48" sluice gate with electric actuator	Gate	2008
Grinder (2) #1 & #4	5-hp electric driven	Grinder	2008
Grinder (2) #2 & #3	10-hp electric driven	Grinder	2008
2" combo air/vac valve			
Force Main A B Flow Recorder			
Flow Meter B	This is for force main B		
Main Transformer	1000 kVA, 12 kV-480 V, 3-ph (PG&E)	Transformer	2000
Outdoor Utility Disconnect and Metering Panel	Outdoor NEMA 3R Enclosure	Panel	2000
Main Switchgear	Located in Existing Generator Building	Switchgear	2000

Asset Name	Asset Description	Asset Type	Year Installed
Variable Frequency Drives (4) P2-P5	VFD for Pump (170 hp)	VFD	2008
Local Disconnect for Engine Jacket Water Heater	30A/3P	Switch	2000
Motor Control Center (2) 2 & 2A	600 A, 480 V, 3-ph, 3W, 65000 AIC	MCC	2000
Dry Type Transformers (2)	30 kVA, 480-208/120 V, Dry Type	Transformer	2000 & 2008
Lighting panel (LP-1)		Panel	2008
Lighting panel (LA)	100 A, 1-ph, 3 Wire	Panel	2000
Motor Control Center (2) A &B	400 A, 480 V, 3-ph, 3W, 65000 AIC	MCC	2008
Dry Type Transformer	10 kVA, 480-240/120 V, Dry Type	Transformer	2008
Distribution panels (2) (DP-1 & DP-2)	125 A, NEMA Type 1	Panel	2008
Dry Type Transformer	75 kVA, 480-208/120 V, Dry Type	Transformer	2008
Local Control Panels (4) for Grinders #1-4	LCP grinder 1	Panel	2008
Local Disconnects (4) for CU-1 (for FC-1), EF-1 (for Control Room), HP-1 (for FC-2) & FC-1 (for Control Room)	30A/3P	Switch	2008
Local Disconnects (2) for EF-5 & SF-1 (for Wet Well)	60A/3P	Switch	2008
Generator	1000 kVA, 480 V Diesel Driven Engine Generator	Generator	2000
Automatic Transfer Switch	ATS, 1600 A	Switch	2000
Instrumentation			
Level Switch	Level High High	Level Switch	2008
Level Switches (2)	Ultrasonic level	Level Switch	2008
Structural			
Pinch Valve Vaults (3) 1-3	Pinch Valve Vault	Vault	2002
Mag Meter Vault	24" Magnetic Meter Vault	Vault	2002
Venturi Meter Vault	36" Venturi Meter Vault	Vault	1975
Butterfly Valve Vault	36" Butterfly Valve Vault	Vault	1997
Fuel Tank (bulk)	2,000-gal UL-2085 above ground vault tank	Tank	2008
Fuel Tank (day)		Tank	2000
Grit Chamber/Inflow Structure		Tank	2008
Wet Well		Tank	2008

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SECTION 4 – CONDITION ASSESSMENT

As mentioned in **Section 1.1.1**, as part of the City's Master Plan project, a *Sewer Utility Asset Renewal and Replacement Study* (R&R Study) was conducted. Included in this study is a condition assessment of the City's current collection system based on a set of factors developed to determine the relative risk of failure for each pipeline segment. This section describes the development of the factors established for the Business Risk Exposure (BRE) analysis and the results of the collection system condition assessment. The R&R Study is attached as **Appendix A**.

4.1 CCTV Condition Assessment

Part of evaluating the condition of the City's collection system is understanding the pipe condition based on the level of structural and/or operations and maintenance (O&M) related defects. For this part of the condition assessment, key segments of the system were selected for closed-circuit television (CCTV) investigation based on the following criteria:

- Diameter greater than 8-inches;
- Older pipe (pre-1990) and pipe materials susceptible to corrosion/failure (RCP, VCP);
- Located within high traffic areas; and
- Located within commercial/industrial areas.

Figure 4-1 presents the segments selected for CCTV inspection based on these criteria. The pipelines indicated as "Contract" were the priority for inspection while the "Misc" were completed as time and budget permitted.

National Plant Services Inc. (NPS) was contracted to complete the CCTV assessment (168,180 ft, 31 miles, approximately 20% of the entire system) and performed this inspection between March and May 2020. Additional details regarding the planned scope of the assessment can be found in the **Appendix A** (R&R Study Section 2.1). It is expected that additional CCTV assessment will be performed by City forces in the future as part of a City-wide CCTV program.

4.1.1 CCTV Inspection Results

As part of the assessment work performed by NPS, NPS inspected 105,221 ft. (approximately 20 miles) of pipeline. This constitutes approximately 12% of the entire system. **Figure 4-1** shows the pipelines fully inspected by NPS in green.

There were some pipe segments where NPS attempted inspection but was unable to conduct or complete inspection. NPS reported various reasons for not completing inspection of pipe segments including the presence of siphons; manholes that were paved over or did not exist; and obstructions such as root balls, grease, and rocks. These pipe segments are shown in **Figure 4-2** in red; this includes segments for which inspection was only partially completed. Where there were obstructions observed, the survey was attempted from the next manhole in the opposite direction.

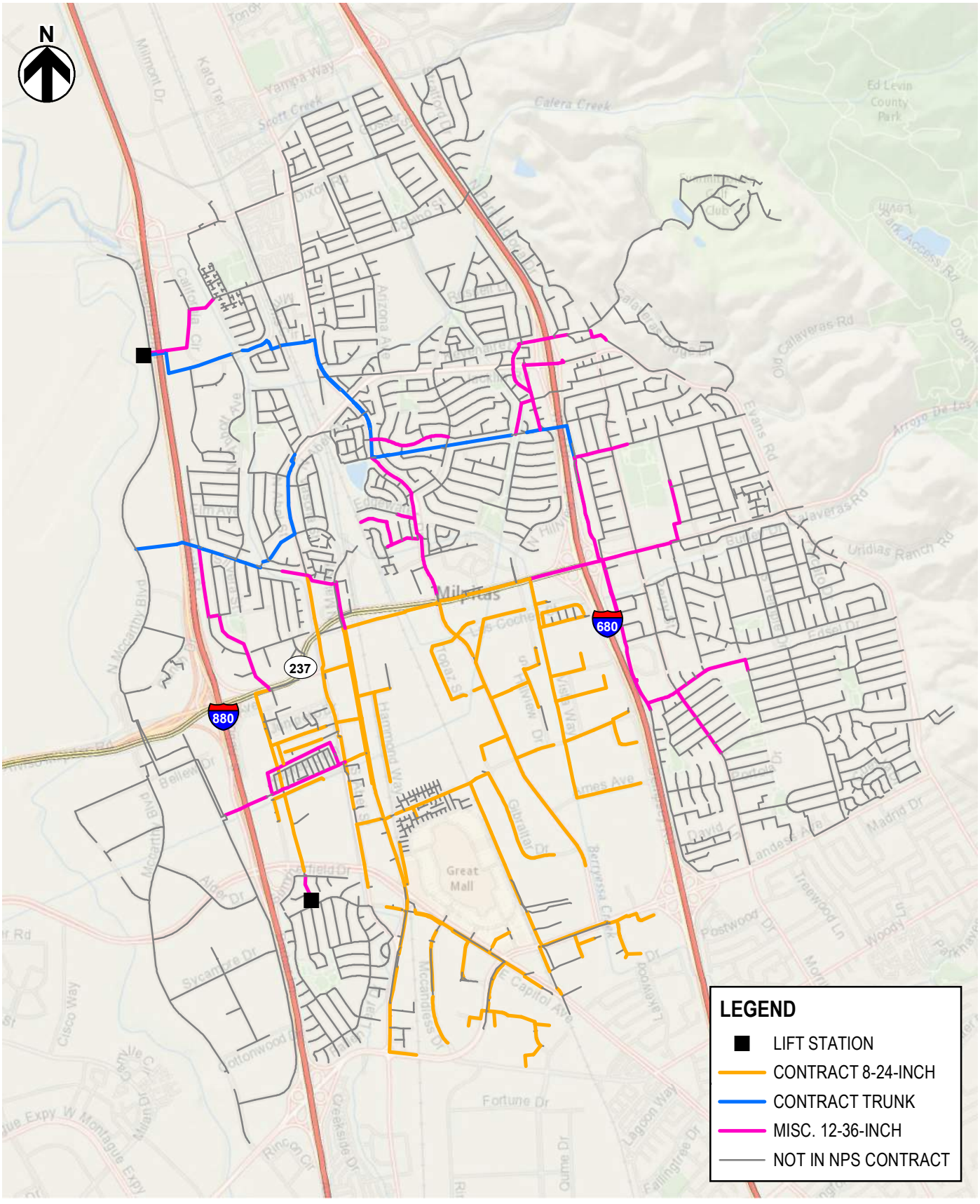

FIGURE 4-1
CITY OF MILPITAS
SEWER MASTER PLAN
NPS CCTV INSPECTION PLAN

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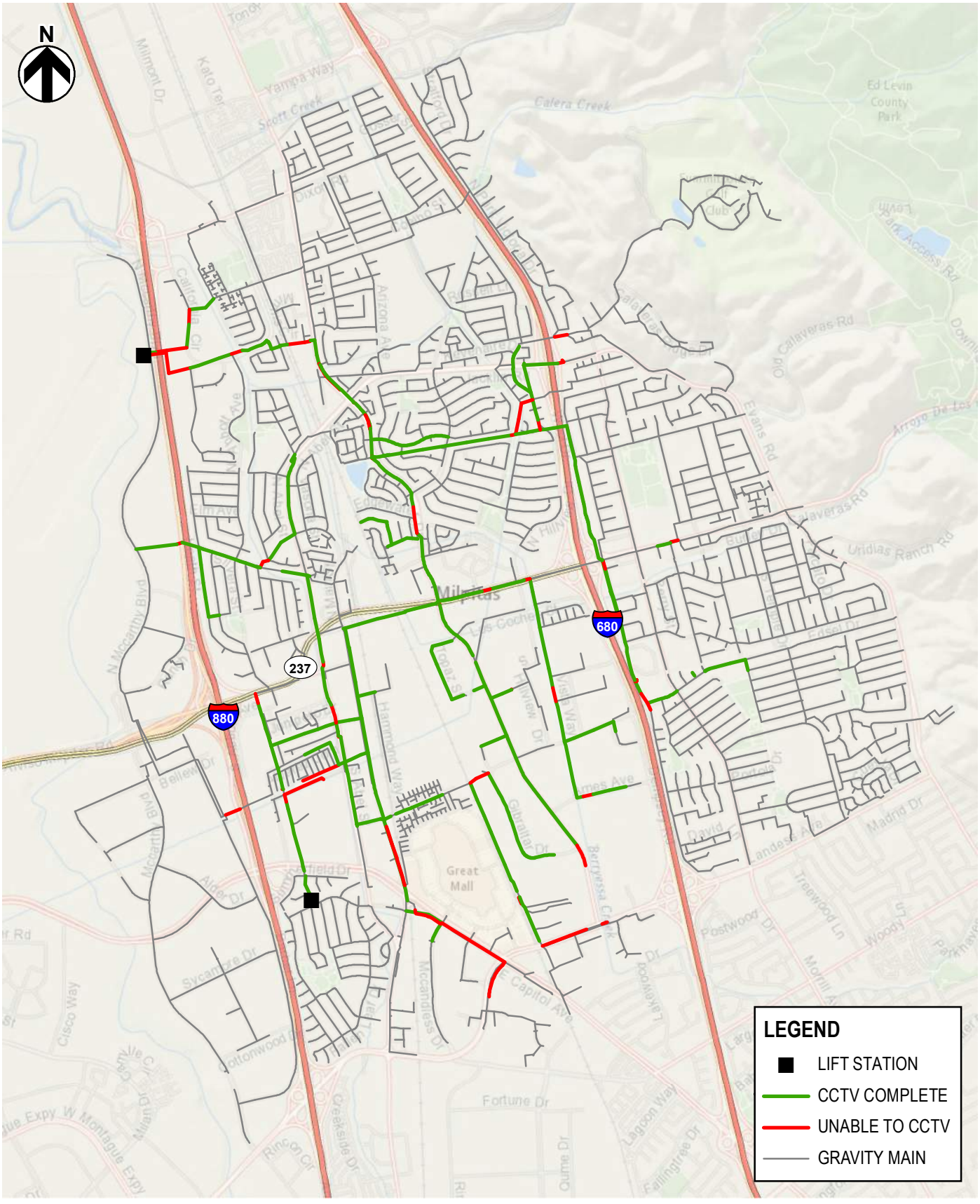

FIGURE 4-2
CITY OF MILPITAS
SEWER MASTER PLAN
COMPLETED CCTV INSPECTION

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A breakdown of the completed segments by pipe diameter is presented in **Table 4-1**.

Table 4-1: Completed CCTV Inspection by Pipe Diameter

Pipe Diameter (in)	Length Inspected (ft)
8	8,221
10	3,540
12	19,003
15	25,552
16	195
18	15,292
21	10,268
24	1,995
27	5,337
30	7,393
33	574
39	2,487
42	2,547
66	1,037
Unspecified	1,788
Total	**105,221**

Defect Coding

Defects were identified and sewer pipeline conditions were assessed according to the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP). PACP-certified NPS staff coded all inspected pipelines. As part of the quality control (QC) process, approximately 20% (89 out of 449 pipe segments) of inspection CCTV and PACP reports were additionally reviewed by PACP-certified staff. A detailed description of the QC process can be found in **Appendix A** (R&R Study Section 2.3).

For the condition assessment, the following steps were taken for each pipeline segment, which is defined from manhole to manhole:

1. Defects identified through review of CCTV footage.
2. Individual grade assigned based on the type and severity of defect(s).
3. Overall condition grade developed by assessing the type and number of defects along the segment.
4. Final condition rating assigned based on the condition grades and the potential for further deterioration and/or failure.

Per NASSCO PACP, each defect is categorized as either structural or O&M-related. Structural defects directly impair the structural condition of the pipe and are typically addressed through repairs, rehabilitation, or replacement. O&M-related conditions are those that directly affect the performance of the sewer or are indicative of potential future structural defects and are typically

addressed through maintenance, though some (such as infiltration) may require additional rehabilitation.

Both structural and O&M-related condition grades range from one to five. **Table 4-2** provides a description of each rating as well as some examples of structural and O&M-related defects at each rating.

Table 4-2: Condition Grade Definitions

Condition Grade	Condition Rating	Structural Examples	O&M Examples
1	Minor defect grade	Circumferential crack; roughness increased due to surface damage; spalling of coating	Fine roots at lateral, connection, or joint; infiltration stains on barrel, lateral, connection, or joint; vermin cockroach
2	Minor to moderate defect grade	Spiral or longitudinal crack; circumferential fracture; aggregate visible due to surface damage	Factory tap intruding <10%; infiltration weeper on barrel, lateral, connection, or joint; vermin rat
3	Moderate defect grade	spiral or longitudinal fracture, lining feature blistered; medium joint offset	Deposits (grease, rags, gravel, etc.) attached 10-20%; medium roots at lateral, connection, or joint
4	Significant defect grade	Broken pipe; surface damage with aggregate missing; large joint offset	Deposits attached 20-30%; medium roots at barrel; infiltration runner at barrel, lateral, connection, or joint
5	Most significant defect grade	Broken pipe with visible void; flexible pipe deformed >10%; collapsed pipe	Deposits attached >30%; root ball at barrel; infiltration gusher at barrel, lateral, connection, or joint

Each defect identified along a pipeline segment is categorized and rated according to **Table 4-2**. The condition of each pipeline segment is ultimately given the following three scores:

- **Structural Peak Score** – The most severe condition grade for structural defects present in a pipeline segment.
- **O&M Peak Score** – The most severe condition grade for O&M-related defects present in a pipeline segment.
- **Overall Peak Score** – The greater of the two peak scores, either the structural or O&M peak score.

The structural and O&M peak scores are used in the BRE analysis. The structural and overall peak scores developed from this CCTV condition assessment are used to develop project recommendations for the City's CIP (see **Section 9.1.1**).

Figure 4-3 presents the overall peak scores resulting from this PACP condition assessment. Additional detail including breakdown by pipe diameter of the structural and O&M peak scores and maps of the structural and O&M peak scores can be found in **Appendix A** (R&R Study Section 2.2.1 and Appendices D and E).

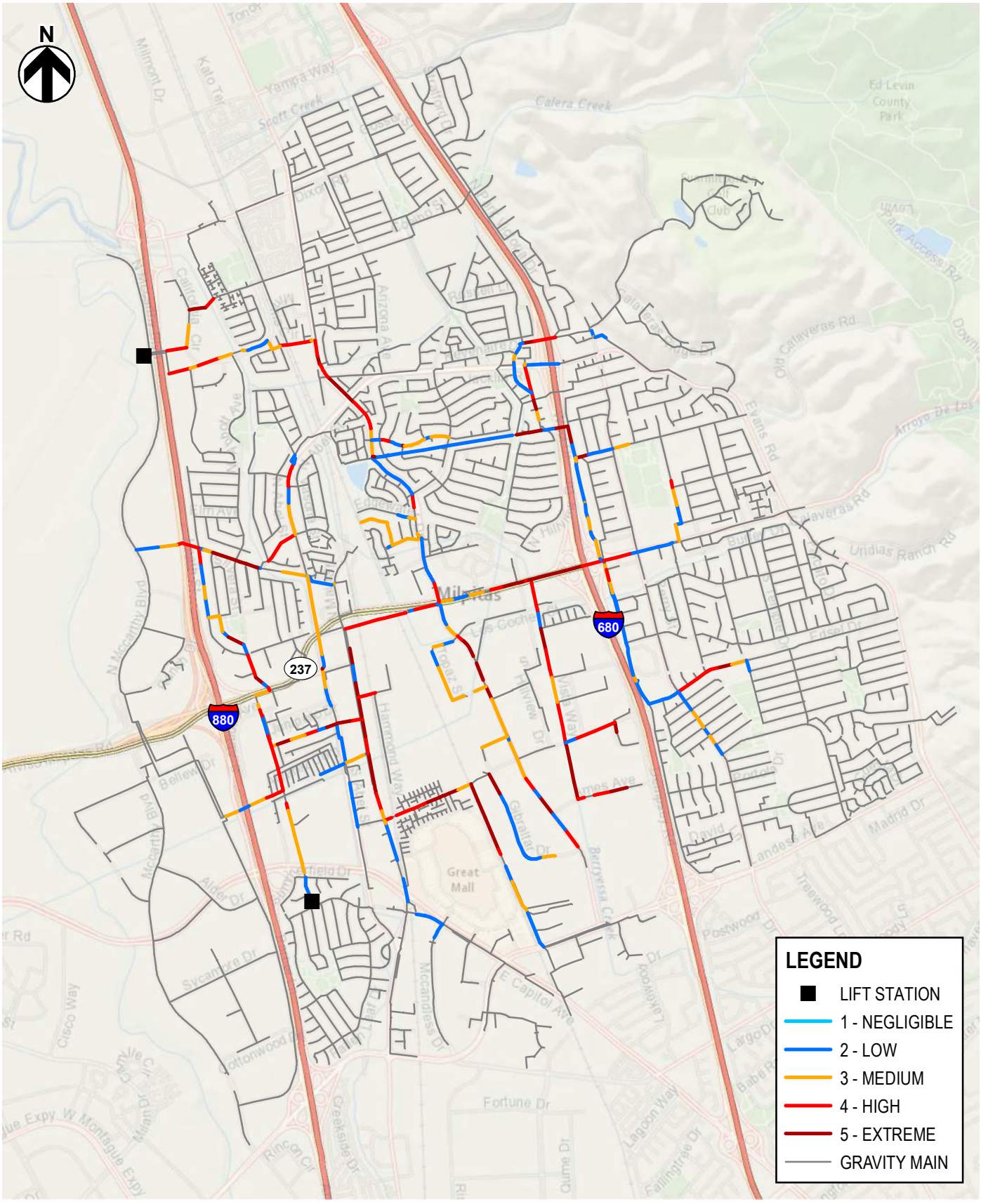


FIGURE 4-3
CITY OF MILPITAS
SEWER MASTER PLAN
PACP OVERALL PEAK SCORES

HydroScience

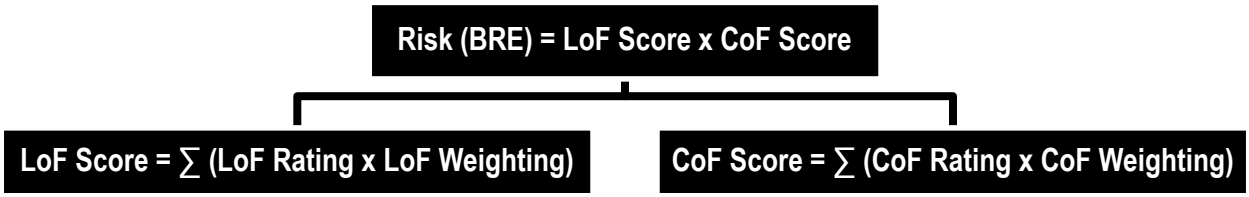
4.2 Desktop Condition Assessment

In addition to the PACP condition assessment performed using the CCTV footage, a desktop condition assessment was performed to determine the relative risk of failure of each pipeline segment. A pipeline's risk of failure is determined by a combination of the *likelihood* and the *consequence* of the failure of the pipe segment. The results of this assessment represent the City's BRE.

Likelihood of failure (LoF) and consequence of failure (CoF) scores were assigned to each pipeline segment by considering various factor ratings with assigned factor weightings. LoF and CoF ratings were given on a scale of one (least likely to fail/least consequential) to five (most likely to fail/most consequential). The weighting of each factor was assigned based on the relative criticality of that factor, with higher weighting factors assigned to the most critical LoF/CoF factors.

Both the factors and the weightings were established by industry standard along with input from the City Staff through a workshop between BC, HydroScience, and City Staff in April 2020. A summary of the discussion at this workshop can be found in **Appendix A** (R&R Study Section 3.4).

The following equations were used to calculate a risk score for each pipeline segment:



4.2.1 Likelihood of Failure (LoF)

The first factor in determining the relative risk of failure of a pipeline was the *likelihood* that the segment is unable to provide the function for which it was installed. This was determined by assigning LoF criteria and ratings based on characteristics, condition, and location of each pipeline. In cases where pipeline characteristics (age and material) were missing or unavailable, medium risk was assigned as this is the equivalent to "neutral." The following criteria were selected for this analysis and are typical for sewer renewal/replacement projects:

- **Pipe age** – In general, as a pipe ages, it has a higher likelihood to fail.
- **Pipe material** – Different pipe materials have different life expectancies and failure modes.
- **Structural condition** – Known structural defects based on 2020 CCTV inspection by NPS.
- **Presence of pipe obstructions** – Known O&M-related defects based on 2020 CCTV inspection by NPS.
- **Required pipe cleaning** – Pipe requiring more frequent cleaning are typically subject to chronic O&M issues (i.e., oil, grease, and roots) when not maintained. However, the act of cleaning with high pressure water jets can contribute to premature failure of older or compromised pipe and inadvertently remove the top layer of corroded concrete or metal pipe.

- **Proximity to landslide zones** – Landslides can pose a threat to pipe segments that are buried at a depth of three feet or less. This factor also accounts for the impact of smaller seismic events on pipe structural integrity.
- **Proximity to earthquake faults** – Pipes located in the Hayward Fault Zone are given a higher LoF rating. This factor also accounts for the impact of smaller seismic events on pipe structural integrity.
- **Local geology (liquefaction)** – A liquefaction layer from County GIS provides soil resiliency ratings to seismic events. This factor also accounts for the impact of smaller seismic events on pipe structural integrity.

Sources include the City's GIS; the City's collection system maintenance schedule; and landslide, fault, and liquefaction zoning provided by the County of Santa Clara Department of Planning and Development. The basis of scoring and weighting of each criteria is detailed in **Table 4-3**.

Table 4-3: LoF Criteria and Ratings

Broad Category	Criteria	LoF Rating (← Least likely to fail 1	2	3	4	Most likely to fail → 5)	Criteria Weighting
Asset Characteristics	**Installation Year**	After 2000	1985 -1999	1970 – 1984[1]	1955 – 1969	Before 1954	2
	Pipe Material	Force Main, HDPE, PVC	VCP[1]	RCP, STL, DIP, ABS, PPR	-	ACP, CIP	2
Asset Condition	**Structural PACP Grade/ Defect Type**	Grade 2 defect(s) or lower	Grade 3 defect(s) (except hinge defects)	One Grade 4 defect (except hinge defects) OR Grade 3 hinge defect	One Grade 5 defect (except soil/void/collapse deformation >10%) OR multiple Grade 4 defects OR Grade 4 hinge defect	Multiple Grade 5 defects OR one Grade 5 defect (soil/void/ collapse deformation >10%)	5
	O&M PACP Grade	Grade 2 defect(s) or lower	Grade 3 defect(s)	One Grade 4 defect	One Grade 5 defect or multiple Grade 4 defects	Multiple Grade 5 defects	5
	Required Pipe Cleaning	-	Require annual cleaning	Requires quarterly cleaning	Requires monthly cleaning	Requires weekly cleaning	5
Asset Location	**Proximity to Landslide Zone**	Not within landslide zone	-	-	-	Within landslide zone	3
	Proximity to Earthquake Faults	Not within fault area	-	-	-	Crossing or within fault area	3
	Likelihood of Liquefaction	-	-	Prone to liquefaction	High likelihood of liquefaction	Very high likelihood of liquefaction	3

Notes:
1. Unknown or unspecified characteristics were classified at this rating.

4.2.2 Consequence of Failure (CoF)

The second factor in calculating the relative risk of failure of a pipeline is the CoF, or the predicted impacts resulting from the failure of the segment. Similar to the LoF analysis, CoF criteria and ratings were assigned based on the following groups: service interruption potential, repair/overflow potential, impact to transportation/transit, response time to potential failure, cost of potential failure, and environmental impacts. The criteria were selected to align with City Council core values and priorities and are typical for sewer renewal/replacement projects.

The CoF criteria and the relationship to City Council core values and priorities are summarized in **Table 4-4**.

Table 4-4: Council Core Values/Priorities and Related CoF Criteria

Council Core Value/Priority Area	Organization Category	Measure of Failure	CoF Criteria
Superior Customer Service	Community	Sewer service interruptions to large areas	Pipe diameter
Integrity and Accountability		Sewer service interruptions to critical and educational facilities	Critical facilities (proximity)
Trust and Respect		Magnitude and method of public response (sewer size)	Pipe diameter
Transportation and Transit		Public transit service and traffic interruptions	Road type
		Railroad interruptions	Railroad proximity
Governance and Administration	Finance	Response time to restore an asset	Easement (access restriction), road type
		Restoration costs or impact on utility rates	Pipe diameter and depth
Environment	Environment	State and Federal regulatory violations or public response (discharge to surface water)	Waterway/waterbody (proximity)

Below is a more detailed description of the selected CoF criteria outlined in **Table 4-4**:

- **Sewer size (pipe diameter)** – Larger diameter pipes are more expensive to replace and provide service to a larger service area than smaller diameter pipes.
- **Proximity to critical facilities** – Pipe proximity to an educational, police, fire, or health facility was calculated and rated for CoF. Pipelines servicing critical facilities were approximated by using a buffer of 500 feet. For context, the facility addresses were plotted as a point, so the buffer of 500 feet accounts for building size and nearby critical pipes.
- **Road type** – Different road types such as arterial or highway will impact more people than a neighborhood street. Therefore, locations where pipe intersects with major traffic conveyance routes such as freeways, state routes, arterial streets, or major roads were identified.
- **Railroad proximity** – Impacts to railroad operations and repairs on railroad property have significant cost and permitting impacts.
- **Easement (access restriction)** – Access restrictions were determined by overlaying the City GIS over an aerial basemap and manually assigning pipes which appeared to be within easements through private property or restricted areas. For example, the parking lot of a shopping mall would be assigned private but not restricted. However, if a pipe is near a swale between a park and a neighborhood, or between two properties, it was assigned "restricted access." In a further analysis, parcels with easement information could provide a more refined outcome.
- **Pipeline depth** – Pipes that are buried deeper require more time and effort to excavate and as a result can be more costly to repair or replace.
- **Proximity to waterway or waterbody** – There are significant permitting impacts for repair or cleanup of failed pipes that discharge into a waterway or waterbody.

Data sources include the City's GIS, Google Maps, major road locations provided by the County of Santa Clara Department of Planning and Development, and railroad and waterbody locations provided by the United States Geological Survey (USGS).

For a more detailed explanation of the City Council core values and how each criterion was rated, see Appendix A (R&R Study Section 3.2). The basis of scoring and weighting of each criteria is summarized in **Table 4-5**.

Table 4-5: CoF Criteria and Ratings

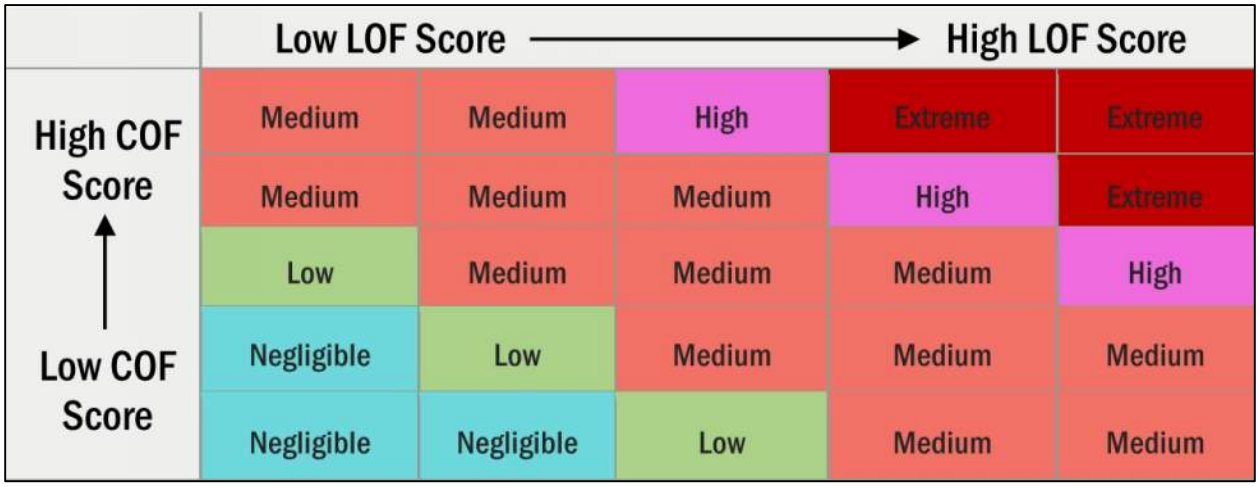
Organization Category	Group	Criteria	CoF Rating (← Negligible consequence 1	2	3	4	Critical consequence → 5)	Criteria Weighting
Community	Service Interruptions and Overflow Potential	**Pipeline Diameter[1,2]**	< 6 in	8 – 12 in[4]	14 – 18 in	18 – 24 in	> 24 in	1
		Critical Facilities	-	-	School	Fire/Police	Hospital	1
	Transportation/ Transit	**Road Type[1,3]**	Neighborhood streets	Collector streets	Arterial streets	Expressway and state routes	Freeways	1
		Railroad Proximity	Not crossing or within 50' of railroad	-	-	-	Crossing or within 50' of railroad	1
Financial	Response Time	**Access Restriction**	Public right-of-way	-	Private property	-	Limited access	2
		Road Type[1,3]	Neighborhood streets	Collector streets	Arterial streets	Expressway and state routes	Freeways	2
	Pipeline Cost	**Pipeline Diameter[1,2]**	< 6 in	8 – 12 in[4]	14 – 18 in	18 – 24 in	> 24 in	1
		Pipeline Depth	All others	-	-	-	Greater than 10' (or special configuration requiring substantial excavation)	1
Environment	Environment	**Waterway or Waterbody**	-	Within 250' of waterway or waterbody	Within 100' of waterway or waterbody	Within 50' of waterway or waterbody	Crossing waterway or waterbody	3

Notes:
1. Pipe diameter and road type affect the CoF in both the broad community and financial categories.
2. Pipe Diameter weighting = 1+1 = 2; 1 (Service Interruptions and Overflow Potential) + 1 (Pipeline Cost) = 2 (overall Pipe Diameter weighting).
3. Road Type weighting = 1+2 = 3; 1 (Transportation/Transit) + 2 (Response Time) = 3 (overall Road Type weighting).
4. Unknown or unspecified characteristics were classified at this rating.

4.2.3 Business Risk Exposure (BRE, Risk of Failure)

The LoF and CoF scores, as described above, were automatically calculated based on the criteria and weightings laid out in **Table 4-3** and **Table 4-5** using the InfoAsset Planner (IAP) software by Innovyze, a GIS extension risk assessment tool. As described at the beginning of **Section 4.2**, the relative risk was given by the product of the LoF and CoF scores calculated by IAP. **Figure 4-4** illustrates the risk assignment for each LoF and CoF pairing.

Figure 4-4: Risk of Failure Assessment Matrix



Total risk scores were normalized within the dataset from one (negligible risk) to five (extreme risk). **Table 4-6** provides a breakdown of the distribution of risk scores as a portion of the total length of pipe; for a more detailed breakdown of the risk scores, see **Appendix A** (R&R Study Section 3.6). **Figure 4-5** presents a map of the resulting risk scores for the entire city, and these were used to provide CCTV recommendations (see **Section 9.1.2**).

Table 4-6: Business Risk Exposure Score Distribution by Length

Risk Score	Length of Pipe (ft)	% of Total
1 – Negligible	610,497	77
2 – Low	77,844	10
3 – Medium	80,247	10
4 – High	9,674	1
5 – Extreme	5,922	1
Blank (no facility ID)	4,935	< 1
Total	**789,119**	**100**

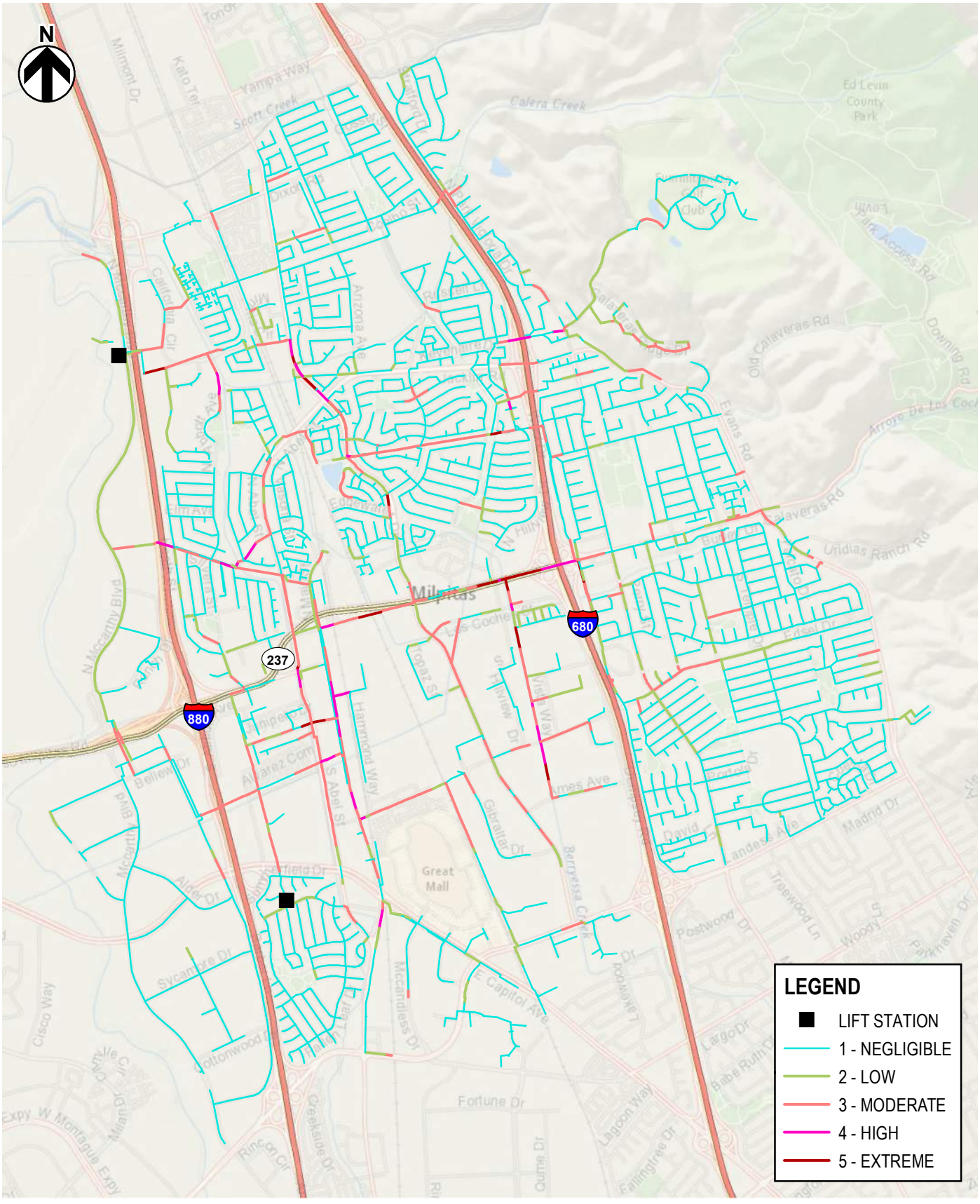


FIGURE 4-5
CITY OF MILPITAS
SEWER MASTER PLAN
BUSINESS RISK EXPOSURE SCORE MAP

HydroScience

4.3 Lift Station Condition Assessment

As part of the R&R Study, BC also performed an on-site inspection of the collection system's two lift stations – the Main LS and Venus Way LS – described in **Section 3.1**. The results of this inspection are presented in the *Main and Venus Way Lift Station Inspections Report* (LS Report) which is included in **Appendix A** (R&R Study App. K). Assets in the following categories were evaluated during the inspection of these lift stations:

- Mechanical;
- Electrical;
- Instrumentation;
- Civil; and
- Structural.

Further breakdown of these categories and the specific assets evaluated are detailed in the LS Report.

Field inspections were completed on February 11 and March 11, 2020. Each asset inspected was reported with a condition score and a performance score from one to five; the breakdown of each score is summarized in **Table 4-7**.

Table 4-7: Condition and Performance Score Definitions

Score	Description	Condition Score Meaning	Performance Score Meaning
1	Excellent/Good	No defects observed.	Functioning as intended.
2	Fair	Only minor defects observed.	In service, but higher than expected O&M.
3	Neutral		
4	Poor	Major defects observed. Asset integrity may be compromised.	In service, but function is highly impaired.
5	Failing or Failed	Asset integrity is compromised. Asset may be out of service.	Not functioning as intended or out of service.

4.3.1 Main LS Inspection

Table 4-8 presents the major deficiencies identified at the Main LS that require timely attention. A summary asset inventory list is provided in **Table 3-6**. A comprehensive list of the inspection notes and scoring for all Main LS components are included in **Appendix A** (R&R Study App. K, LS Report Section 3).

Table 4-8: Main LS Deficiencies

Asset Name	Field Assessment/Comments	Condition Score	Performance Score
Mag Meter (Flow Meter A)[1]	Not in operation	4	4
Manifold PV #2 Actuator	Does not work	5	5
Pump #3	Has exceeded useful life[2]	4	4
Grinder #1	Excessive vibration and inadequate supports	5	5
2" Combination Air/Vacuum Valve	None	4	4
Flow Meter B[1]	Operable, but not accurate	4	4
Air Vacuum 1 to 15	Cavitation, coating failure, and inadequate supports	5	5
Variable Frequency Drive P2	No corrosion identified, arc flash labels missing	4	2
Variable Frequency Drive P3	No corrosion identified, confirmed by City that IGBT was replaced in 2019, arc flash labels missing	4	2
Variable Frequency Drive P4	No corrosion identified, arc flash labels missing	4	2
Variable Frequency Drive P5	No corrosion identified, confirmed by City that cooling fans were replaced in 2019, arc flash labels missing	4	2

Notes:
1. The City is replacing these meters as part of CIP Project 6131: Sanitary Sewer Cathodic Protection Improvements.
2. This pump has logged over 50,000 hours.

4.3.2 Venus Way LS Inspection

Condition and performance scores for all assets inspected were rated as 1 – no defects and functioning as intended. A summary asset inventory list is provided in **Table 3-5**. A comprehensive list of the inspection notes and scoring for the Venus Way LS can be found in **Appendix A** (R&R Study App. K, LS Report Section 4).

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SECTION 5 – ANALYSIS OF LAND USES FOR HYDRAULIC MODELING

To develop base sanitary flows (BSF) – the flow directly contributed by the customer – wastewater flows were assigned to every contributing parcel in the City. For planning level analysis, parcels of similar land use types are estimated to have similar wastewater flow rates either on a per parcel basis (gpd/parcel) or per acre basis (gpd/acre) and similar diurnal patterns. Thus, common land use types were consolidated, where appropriate. This section discusses the land use data used for planning level wastewater modeling.

5.1 Land Use Designations for Model Analysis – Existing Condition

City land use designations were available as a parcel GIS shapefile containing GP land use information for each parcel in the City. For modeling purposes, some modifications to the land uses are warranted to ensure relevance to the sewer analysis. Land use types expected to generate similar wastewater flows were consolidated into general categories to facilitate unit flow (UF) analysis. Land uses that have little to no contribution to the sewer system were excluded from further analysis.

It is noted that the consolidations made for the purpose of this Study might not correspond directly to the land use categories used for the Water Master Plan Study because these categories were established based on expected similar wastewater flow generation, which do not always directly correspond to water use.

Data cleaning was necessary to assure an accurate representation of wastewater flow from individual parcels/customers. Below is a description of the GP land use categories that required further review in order to assign the appropriate model-based land use designation (see **Table 2-1**):

- The following GP Land Use categories and parcel types were assigned as “NF” (no flow) and excluded from this analysis;
    - POS, WATERWAYS, parcels consisting of train tracks, streets, parking lots, or other open space; and parcels located in the City of San Jose or unincorporated areas not serviced by the City’s sewer system.
- All parcels with location specific land use codes (HWS, TWC, and URR) were reviewed using Google Earth Satellite and Street Views and assigned a model-based land use according to facilities present on each parcel as listed in **Table 5-1**.
- Some parcels with GP land use of BVMU were assigned to COM if commercial facilities appeared to be present;
- All hotels in the City were identified and parcels assigned to a new model-based land use code: HOTEL;
- Elmwood Correctional Facility was assigned to its own model-based land use code: COR; and
- All residential GP land use categories with parcels greater than one acre were reviewed to ensure the model-based land use designations were representative according to expected wastewater generation rates. Updated model-based land use designations were assigned, as appropriate.

Table 5-1 summarizes the GP land uses and associated codes included in the data set, and the model-based land uses developed for use in the model for this Study. **Figure 5-1** presents the City according to the model-based land use designations.

Table 5-1: Model-Based Land Use Designations for Existing Conditions

GP Land Use	Code	Model-Based Land Use	Code
Hillside Very Low Density	HVL	Hillside Single-Family Low Density	HSFL
Hillside Low Density	HLD		
Hillside Medium Density	HMD	Hillside Single Family Medium Density	HSFM
Valley Floor Single-Family Low Density	SFL	Valley Floor Single-Family Low Density	SFL
Valley Floor Single-Family Medium Density	SMD	Valley Floor Single-Family Medium Density	SFM
Multi-Family Medium Density	MFM		
Multi-Family High Density	MFH	Valley Floor Multi-Family High Density	MFH
Multi-Family Very High Density	VHD	Valley Floor Multi-Family Very High Density	MFVH
Mobile Home Park	MHP	Mobile Home Park	MHP
Mixed Use	MXD	Mixed Use	MXD
Boulevard Very High-Density Mixed Use	BVMU	High Density Mixed Use	HDMU
Residential-Retail Mixed Use	RRMU		
Professional & Administrative Offices	PAO	Professional & Administrative Offices	PAO
General Commercial	GNC	Commercial	COM
Retail Sub-Center	RSC		
Industrial Park	INP	Industrial Park	INP
Manufacturing	MFG	Manufacturing	MFG
Public Facilities	PF	Public Facilities[1]	PF
		Elmwood Correctional Facility[2]	COR
TWC, MXD, GNC, INP, HWS, RSC		Hotels[3]	HOTEL
Park Open Space	POS	NF	
Waterways	WATERWAYS	NF	
Highway Services	HWS	Parcels reviewed and model-based land use designation assigned, as appropriate.	
Town Center	TWC		
Urban Residential	URR		
Parcels with no land use designation	-		

Notes:
1. Includes schools, churches, health facilities, libraries, and fire stations.
2. The correctional facility is categorized as PF in the GP. For modeling purposes, it was given a distinct code.
3. Hotels are categorized under various land uses in the GP. They were identified and assigned a distinct code.

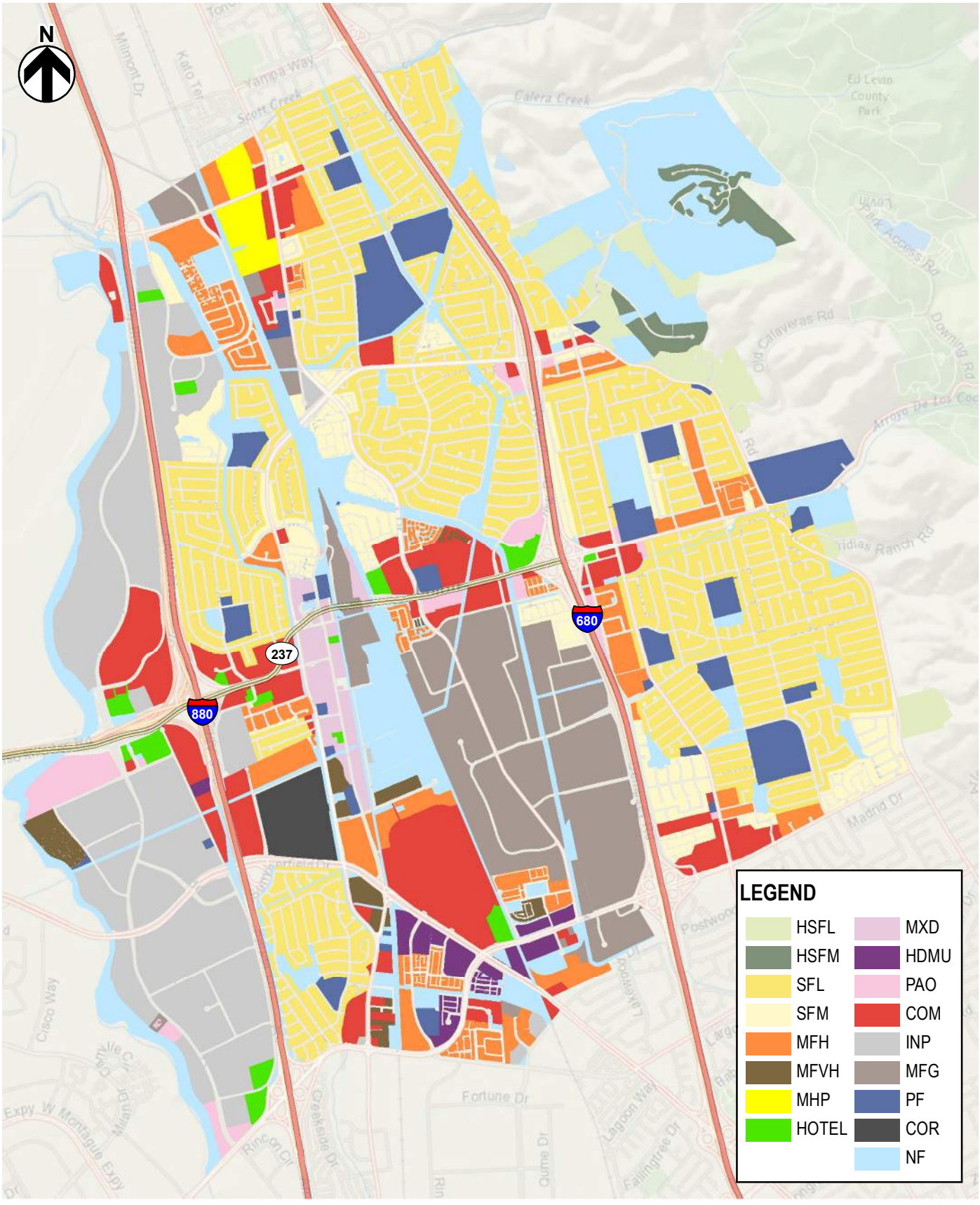

FIGURE 5-1
CITY OF MILPITAS
SEWER MASTER PLAN
MODEL-BASED LAND USE DESIGNATIONS - EXISTING

HydroScience

5.2 Land Use Designations for Model Analysis – Future Condition

The City has identified "Opportunity Areas" (see **Section 2.1.1**) which refers to parcels identified within the City that may be considered for future redevelopment (see **Figure 2-2**). For modeling and planning purposes, it is important to understand the potential impact redevelopment can have on the wastewater collection system. Not all "Opportunity Areas" had proposed changes in land use.

Similar to the existing condition described in **Section 5.1**, the objective is to assign the model-based land use designation to the parcel according to the type of redeveloped land uses planned/anticipated within the "Opportunity Areas". The future land uses identified in the "Opportunity Areas" were reviewed and assigned the model-based land use designations listed in **Table 5-1** according to the anticipated use, density, and wastewater flow rates.

Table 5-2 summarizes the changes in land uses from the existing condition within "Opportunity Areas" that are proposed for redevelopment. The table identifies the redeveloped future land use, the assigned model-based land use designation, and the corresponding area. Areas listed represent the acreage within each opportunity area that is changing and does not include areas within "Opportunity Areas" where land use remains the same. **Figure 5-2** displays the identified "Opportunity Areas" where land use has changed, and the corresponding model-based land use designation within those areas.

Table 5-2: Summary of Future Land Use Updates

"Opportunity Areas"	Proposed Future LU	Model-Based LU	Area (acres)
Sunny Hills Neighborhood/Commercial Center	NCMU	HDMU	19.9
California Circle	NCMU	HDMU	54.1
	HDR	MFH	18.3
Landess Neighborhood/Commercial Center	NCMU	HDMU	38.0
Calaveras & North Park Neighborhood/Commercial Center	NCMU	HDMU	28.3
Milpitas Town Center	HDR	MFH	38.1
Southwestern Employment Area	BPR&D	PAO	488.3
Jacklin & 680 Neighborhood/Commercial Center East	NC	COM	8.0
Jacklin & 680 Neighborhood/Commercial Center West	NC	COM	6.4
Jacklin Neighborhood/Commercial Center	NC	COM	9.8
Midtown Specific Plan	Various	Various	484.3
Metro Specific Plan (aka TASP)	HDR	MFH	212.5
	NC	COM	85.4

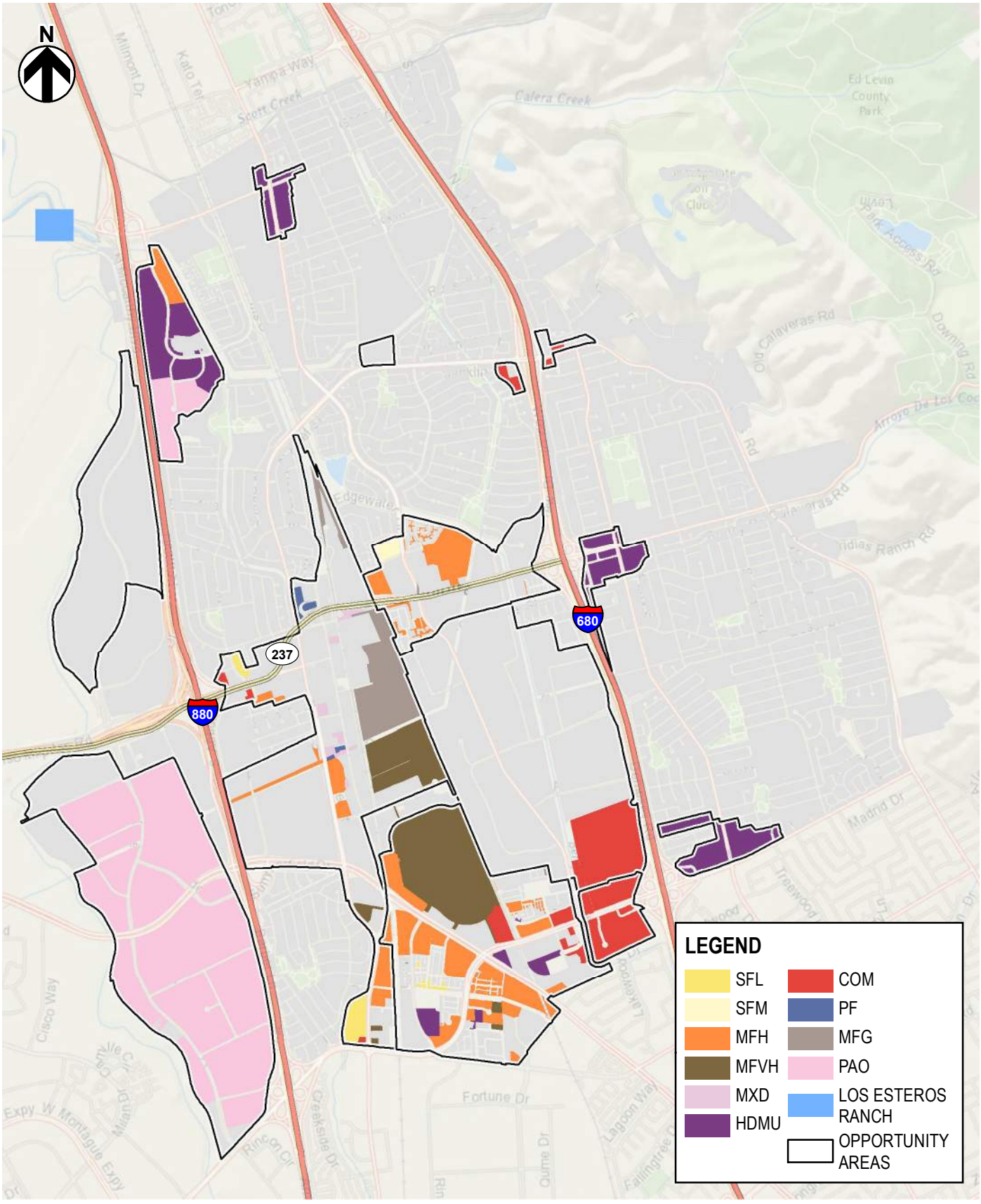

FIGURE 5-2
CITY OF MILPITAS
SEWER MASTER PLAN
MODEL-BASED LAND USE DESIGNATIONS - FUTURE

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SECTION 6 – HYDRAULIC MODEL DEVELOPMENT

This section summarizes the history of the City's hydraulic model and describes the process of developing and building the most up-to-date version of the hydraulic model.

6.1 Model System Development

The City's original hydraulic model was built using SANSYS as part of the 1994 master planning effort. As part of the 2002 master planning effort, the hydraulic model was converted to Hydra® software version 6.0 by Pizer, Inc. The Hydra® model was subsequently reviewed, updated, and calibrated as part of the 2004 and 2009 Master Plan Updates.

For this Master Plan, HydroScience recommended InfoWorks ICM by Innovyze® (InfoWorks) to model the City's collection system because it is a fully dynamic software that uses the full set of St. Venant equations to model and evaluate complicated hydraulic systems. This recommendation was based on the knowledge that the City's collection system includes 177 flow splits, which significantly increases the complexity of the system and model.

As part of the model build, a review and update of the City's GIS was conducted using an extensive database of record drawings. A summary of the updates made to the GIS is included in **Appendix C**.

The updated GIS sewer system consists of 160 miles of gravity sewer main comprised of approximately 3,500 pipe segments and 3,000 manholes. For model development, the network was pared down to approximately 2,600 pipe segments and 2,400 manholes. All pipes 8-inches and larger were included, as well as all smaller pipes that included flow splits as they can affect the direction and quantity of flow downstream. The purpose of trimming the system is to reduce complexity of the system while maintaining all critical infrastructure. Smaller diameter pipes are generally less critical to the system operation. Including all pipe segments increases the complexity of the model but does not necessarily increase the value of the model and its analysis.

6.1.1 Model Network Development

The first step in developing the model network was to identify all pipelines for inclusion in the model. Using GIS, the pipe database was queried to select all pipes 8-inches and larger. To ensure the accuracy of flow representation, smaller pipelines downstream of flow splits were hand-selected where those flow splits would affect the direction and volume of downstream flow. Where there were unselected pipe segments between selected pipes, presenting potential gaps, those pipes were also hand selected for inclusion in the model to ensure network continuity. Pipes that had a listed diameter of "0" inch or an unknown diameter were the most common reason for unselected pipe segments.

The second step in developing the model network was to identify all manholes for inclusion in the model. Using GIS, all manholes that coincided with the selected pipelines were also selected. There were some instances where there was no manhole at the end of a terminal pipe segment

or at the junction between two pipe segments. These instances were most commonly one of the following two conditions:

1. Where a terminal pipe segment has a cleanout or flushing invert at its upstream end that was not represented in GIS; or
2. Where two pipe segments were built at different times and were directly connected without a manhole at the junction.

To remedy this, manhole placeholders were inserted at these locations for inclusion in the model network to prevent errors during the import into InfoWorks. These placeholders were given unique identification numbers to differentiate them from existing manholes.

The Venus Way LS was also included in the model network and the Main LS was modeled as the outfall. **Figure 6-1** shows the final model network that was imported into InfoWorks.

Approximately 63% of the manholes did not have rim elevations documented in the GIS. To reconcile this data gap, regional digital elevation model (DEM) data was downloaded from the USGS web database to obtain surface elevations at each manhole. Two separate DEM files were needed for coverage of the entire modeled collection system. The DEM resolution for most of the collection system (over 99% of manholes) was 1/9 arc-second (approximately 10 feet). For the remaining (~25) manholes, rim elevations were supplemented by a 1/3 arc-second (approximately 30 feet) resolution DEM. **Figure 6-2** shows the coverage for the 1/9 arc-second DEM data set.

DEM surface elevations were given in reference to the North American Vertical Datum of 1988 (NAVD 88). Most of the data in the City's existing GIS is based on the National Geodetic Vertical Datum of 1929 (NGVD 29) due to the age of the system. For consistency, NGVD 29 was established as the reference datum in the hydraulic model. To adjust from NAVD 88 to NGVD 29, the following conversion, referenced from City record drawing #2-1228, was applied:

$$\text{NGVD 29} = \text{NAVD 88} - 2.743 \text{ ft}$$

This equation is a simplified representation of conversion between the two datums but is generally representative within the bounds of the City. Small differences are not expected to affect the hydraulic model results as the relative elevation differences that affect inverts and slopes would be unchanged.

Generally, rim elevations contained in the GIS were used and supplemented by DEM where no rim elevation was documented. Existing rim elevations were compared to DEM elevations for confirmation. The average discrepancy between those listed in GIS and those calculated using the DEM data was approximately 0.8 ft. The cases that had the largest discrepancies were reviewed against record drawings and adjusted, as necessary.

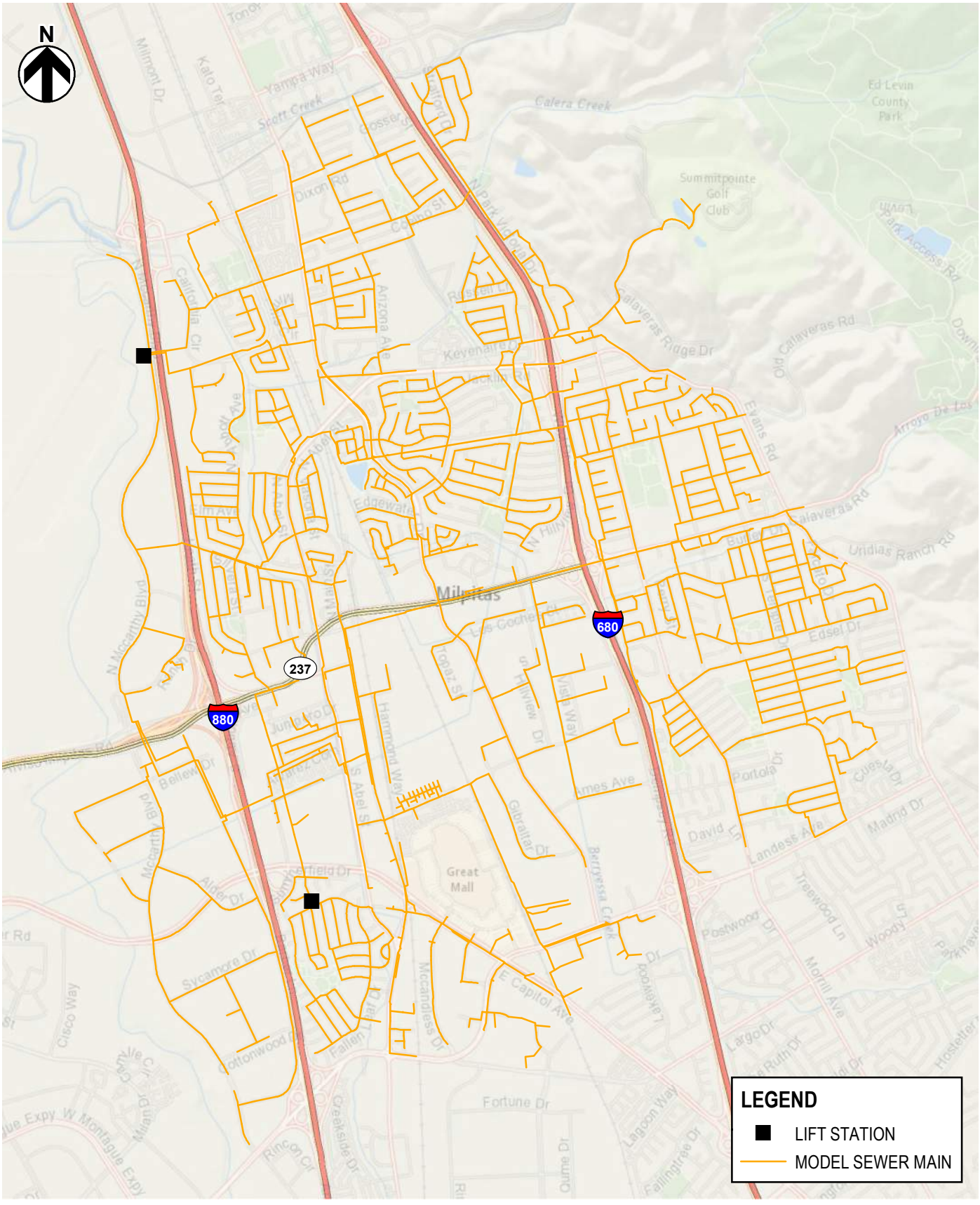

FIGURE 6-1
CITY OF MILPITAS
SEWER MASTER PLAN
MODEL NETWORK

HydroScience

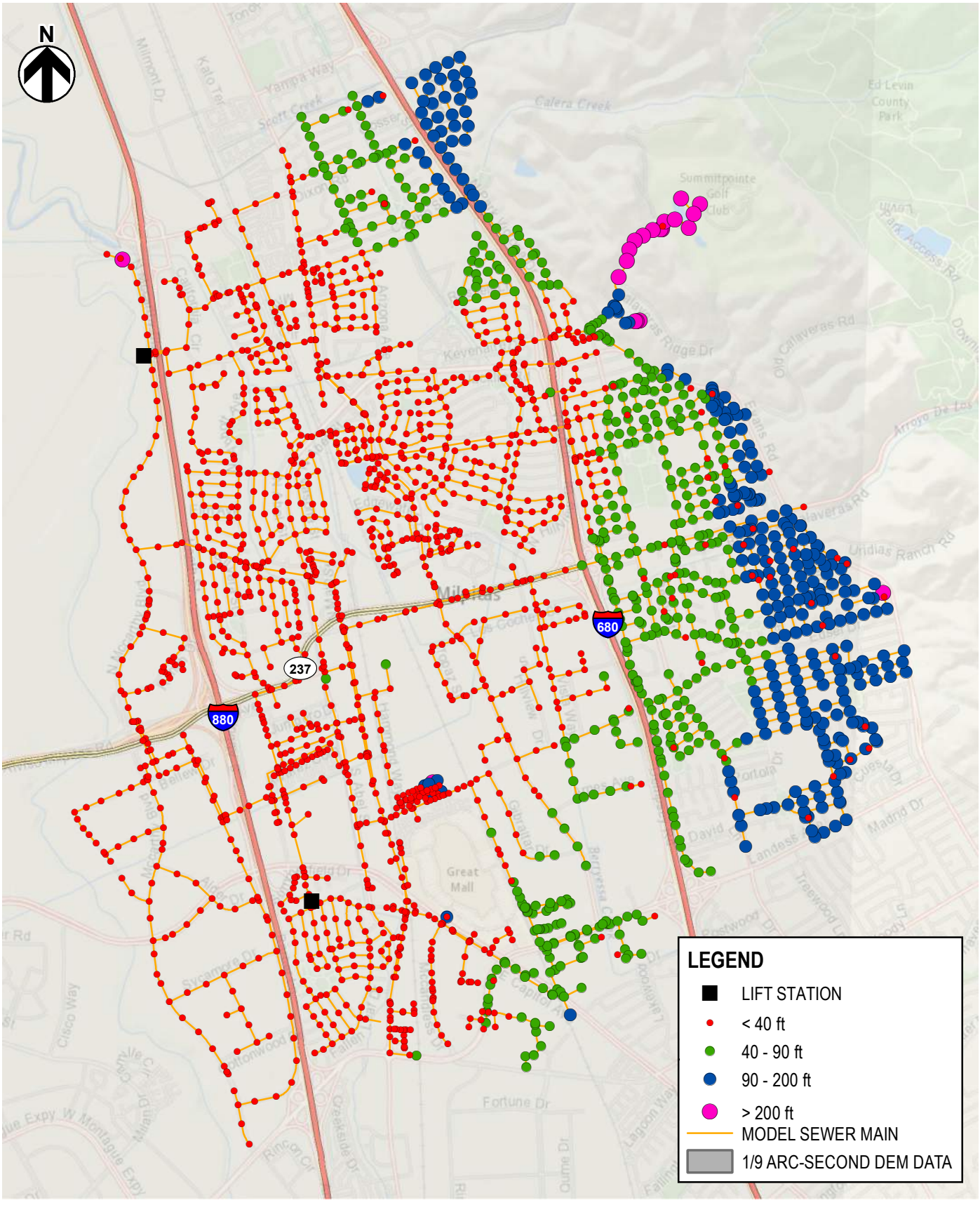

FIGURE 6-2
CITY OF MILPITAS
SEWER MASTER PLAN
MANHOLE RIM ELEVATIONS

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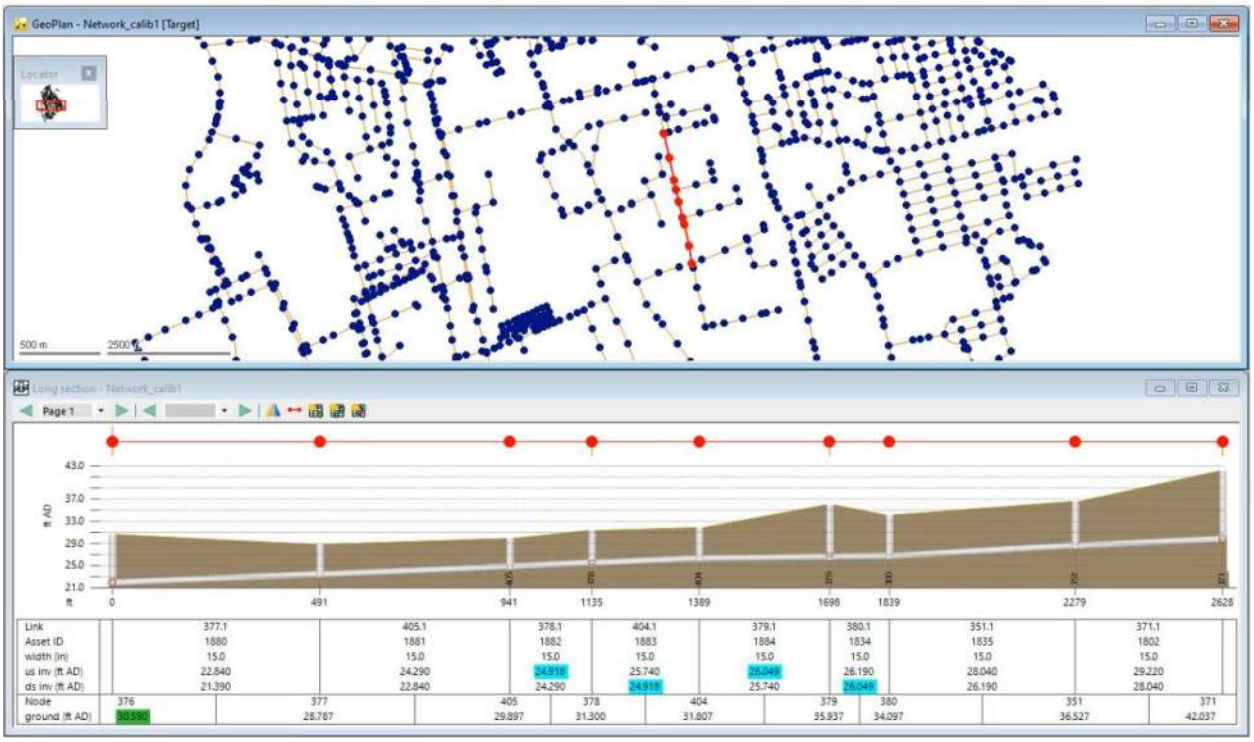
Figure 6-3: InfoWorks Profile View



Network Review

Selected elements were imported into InfoWorks to build the hydraulic model. It is noted that the element selection and import process was iterative as errors in network continuity were identified and resolved. Upon import, InfoWorks will detect any errors when validating the network. Most validation errors encountered were related to network discontinuity and elements with missing data. Where possible, missing data, such as invert elevations or pipe diameters, were interpolated using surrounding data and the *Inference Tool* in InfoWorks.

Once all validation errors were reconciled, the system was analyzed using the pipeline *Profile View* (see **Figure 6-3**). If additional analysis was required, record drawings or CCTV were reviewed, where available. Significant adjustments were made based on differing datums referenced in the record drawings. Each update to the model data was marked with a data flag and different flags were created to represent the varying reasons for the updates. **Figure 6-4** shows the various data flags that were developed and used during the model network review process.

6.1.2 Load Allocation

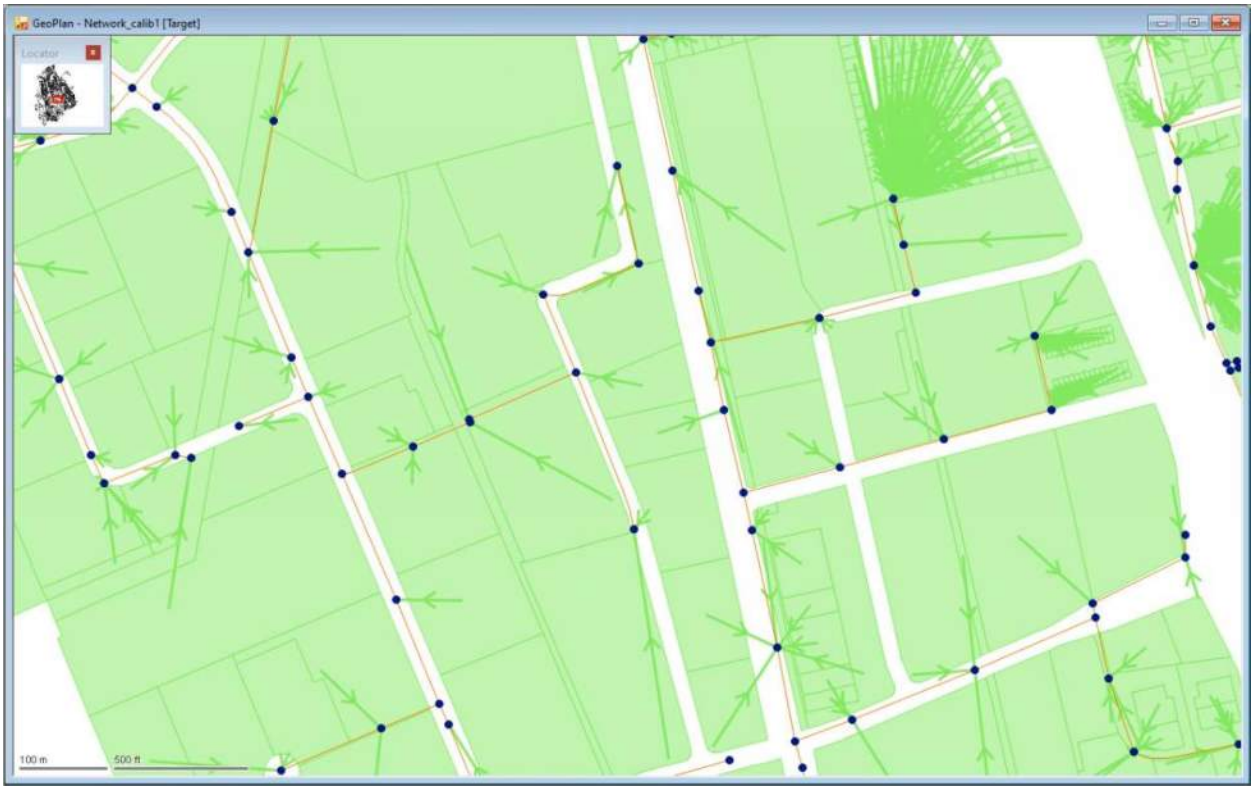
Parcel loads were initially assigned to the nearest manhole. Quality control was performed alongside the map of the sub-basins to verify that the load allocations matched the actual flow path; adjustments were made as necessary. **Figure 6-5** is a sample showing the load allocation from the parcel centroid to the corresponding receiving manhole.

Figure 6-4: InfoWorks Data Flags

Name	Display Colour	Obsolete	Description
#A		☐	Asset Data
#D		☐	System Default
#G		☐	Data From GeoPlan
#I		☐	Model Import
#S		☐	System Calculated
#V		☐	CSV Import
CCTV		☐	Estimated from CCTV footage
DEM		☐	DEM elevation source
DTM		☐	Datum adjustment
DWG		☐	Drawing elevation source
INT		☐	Interpolated elevation
NRBY		☐	Rim based on near-by rims
RLV		☐	Relative adjustment based on drawing
SIPH		☐	Siphon
SLP		☐	Calculated from slope
UPD		☐	Updated during calibration

Notes:
1. Descriptions that are highlighted gray are system defaults.

Figure 6-5: Sample Load Allocation



6.2 Scenario Development

InfoWorks can create many different scenarios within the same model. The following scenarios were developed and analyzed:

1. **Existing Dry Weather:** Used to calibrate the hydraulic model to dry weather conditions and to evaluate hydraulic deficiencies under existing dry weather conditions. Two alternatives were evaluated under this scenario:
    - With obstructions: includes adjustments made to account for flow obstructions as described in **Section 7.3.4**. This scenario was used for dry weather calibration.
    - Design conditions: inverts at flow splits with obstructions returned to the elevations they are designed to operate at. This scenario assumes the flow obstructions have been removed/cleaned and the flow splits are operating as intended. This scenario was used to evaluate hydraulic deficiencies under existing dry weather conditions.
2. **Existing Wet Weather:** Used for calibration of wet weather conditions. This scenario accounts for an elevated water table and R-factors to model wet weather conditions and to evaluate hydraulic deficiencies under existing wet weather conditions. Two alternatives were evaluated under this scenario:
    - With obstructions: includes adjustments made to account for flow obstructions as described in **Section 7.3.4**. This scenario was used for wet weather calibration.
    - Design conditions: inverts at flow splits with obstructions returned to the elevations they are designed to operate at. This scenario assumes the flow obstructions have been removed/cleaned and the flow splits are operating as intended. This scenario was used to evaluate hydraulic deficiencies under existing wet weather conditions.
3. **Future Dry Weather:** Land use categories updated based on future planned land use changes in “Opportunity Areas” (see **Sections 2.1.1** and **5.2**) and dry weather GWI included. This scenario was used to evaluate hydraulic deficiencies under future dry weather conditions assuming flow obstructions are addressed and no longer present.
4. **Future Wet Weather:** Land use categories updated based on future planned land use changes in “Opportunity Areas” and GWI adjusted to match wet weather calibration. This scenario was used to evaluate hydraulic deficiencies under future design storm/wet weather conditions assuming flow obstructions are addressed and no longer present.

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SECTION 7 – WASTEWATER FLOW ANALYSIS

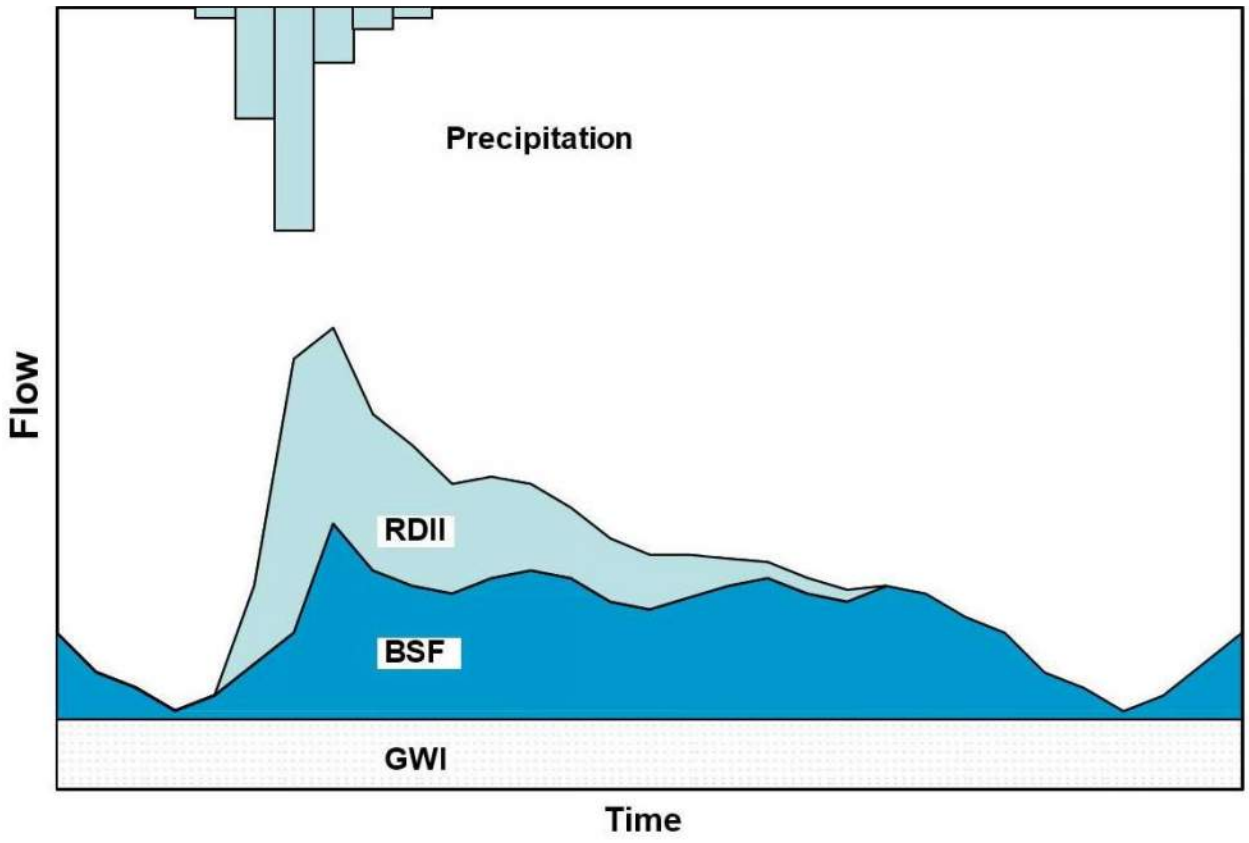
For this study, the flow monitoring data collected by the City was used for model calibration. This section summarizes typical wastewater flow components, summarizes the City's flow monitoring program, describes the basis for developing design wastewater flows used to model the City's collection system, and presents the results of the model calibration.

7.1 Typical Wastewater Flow Components

Wastewater flows consist of three primary flow components: groundwater infiltration (GWI), base sanitary flow (BSF), and rainfall dependent inflow and infiltration (RDI/I) as illustrated in **Figure 7-1**.

- **GWI** – For modeling purposes, this document defines GWI as any, and all sources of constant flow. GWI is comprised both of groundwater infiltration and any other constant flow that is generally detected during low flow periods. Constant flows can be associated with leaking faucets, running toilets, and/or manufacturing or industrial processes, etc. This can also capture any meter reading variance at extremely low flows. GWI is seasonal where dry

Figure 7-1: Typical Wastewater Flow Components



Source: Rainfall Dependent Inflow and Infiltration from the EPA SWMM 5 Hydrology Manual

weather GWI (summer) is typically less than wet weather GWI (winter) due to the elevated water table that occurs during the rainy season.

- **BSF** – This represents the direct diurnal flow contributions from customers. This is represented by a combination of unit flows and diurnal patterns, which is further detailed in **Section 7.3** below.
- **RDI/I** – This is the volume of rainfall that enters the wastewater collection system through various avenues (holes in manhole covers, elevated water table, etc.).

To understand hydraulic capacity of a wastewater collection system, both dry weather flow (DWF) and wet weather flow (WWF) conditions are evaluated. DWF includes both dry weather GWI and BSF while WWF includes wet weather GWI, BSF, and RDI/I.

The flow monitoring and rainfall data collected by the City was evaluated for each of the components, and this process is described in the following sections.

7.2 Flow Monitoring Program

The City contracted with ADS Environmental Services (ADS) to perform dry and wet weather flow monitoring within the City collection system. ADS installed 23 ADS FlowShark Triton flow meters throughout the City and monitored flow between November 16, 2019 and March 9, 2020. This type of meter is a velocity flow meter installed in collection system manholes to measure both depth and velocity at either a 5- or 15-minute intervals for the duration of the flow monitoring period. Depth, velocity, and flow (calculated using the Continuity Equation) were presented in the *Milpitas Sewer Flow Monitoring Report 2019-2020* (ADS Report) in the form of daily averages, and additional data was provided separately in the form of hourly averages. The ADS Report is included as **Appendix B**.

Rain gauges were also installed in two distinct locations for the duration of the monitoring period – one was placed on the valley floor at the Gibraltar Reservoir (RG01) and the other was placed on the hillside near the Summitpointe Golf Club (RG02). Depth of precipitation was presented in the ADS Report in the form of hourly averages to the nearest hundredth of an inch. The raw data was recorded in 5-minute increments to the nearest hundredth of an inch.

The locations of all flow meters and rain gauges are shown in **Figure 7-2**. Flow meters are identified according to the GID of the manhole in which they were installed.

Table 7-1 summarizes the recorded depths, velocities, and flows for each flow meter.

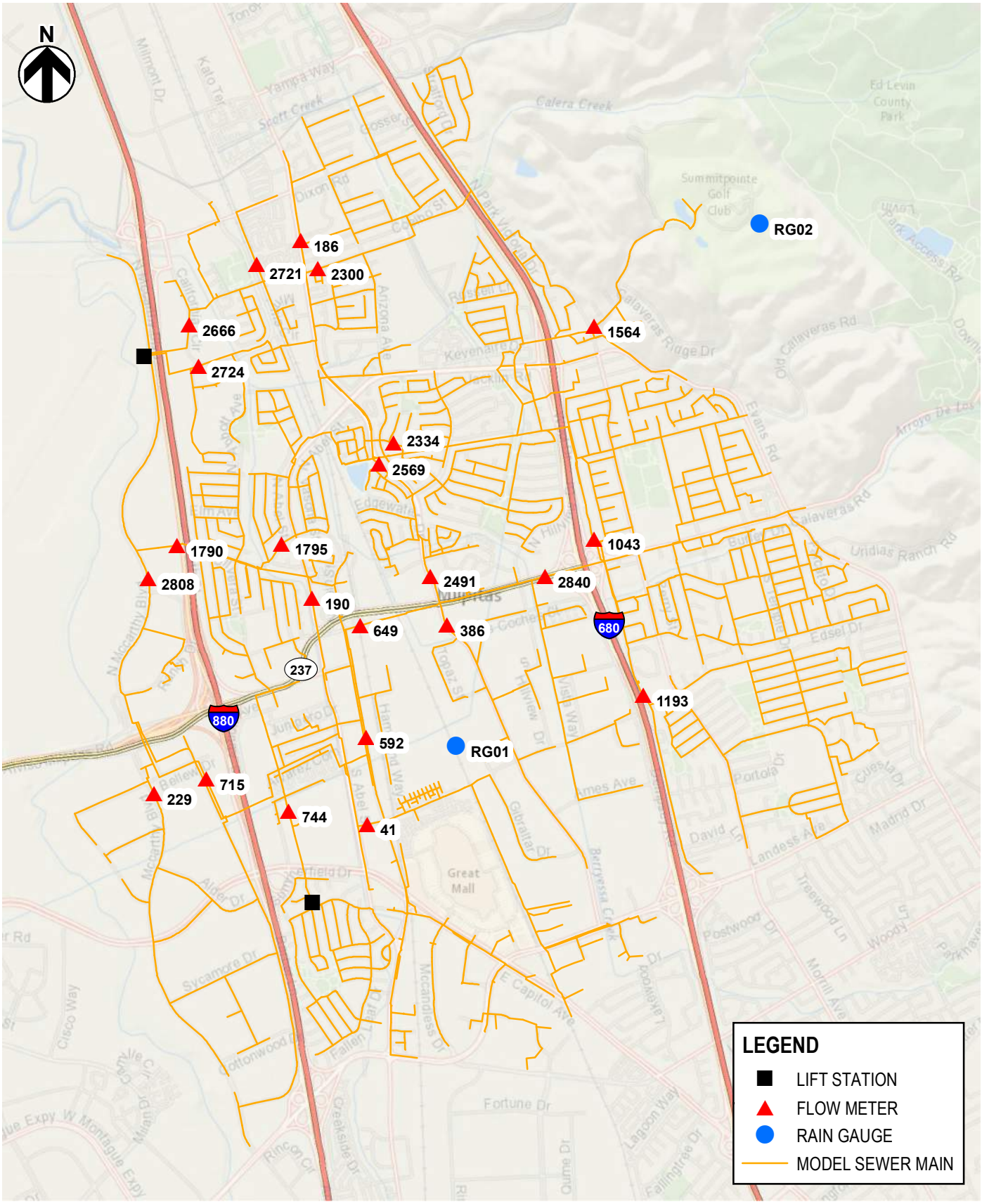


FIGURE 7-2
CITY OF MILPITAS
SEWER MASTER PLAN
FLOW MONITORS AND RAIN GAUGES

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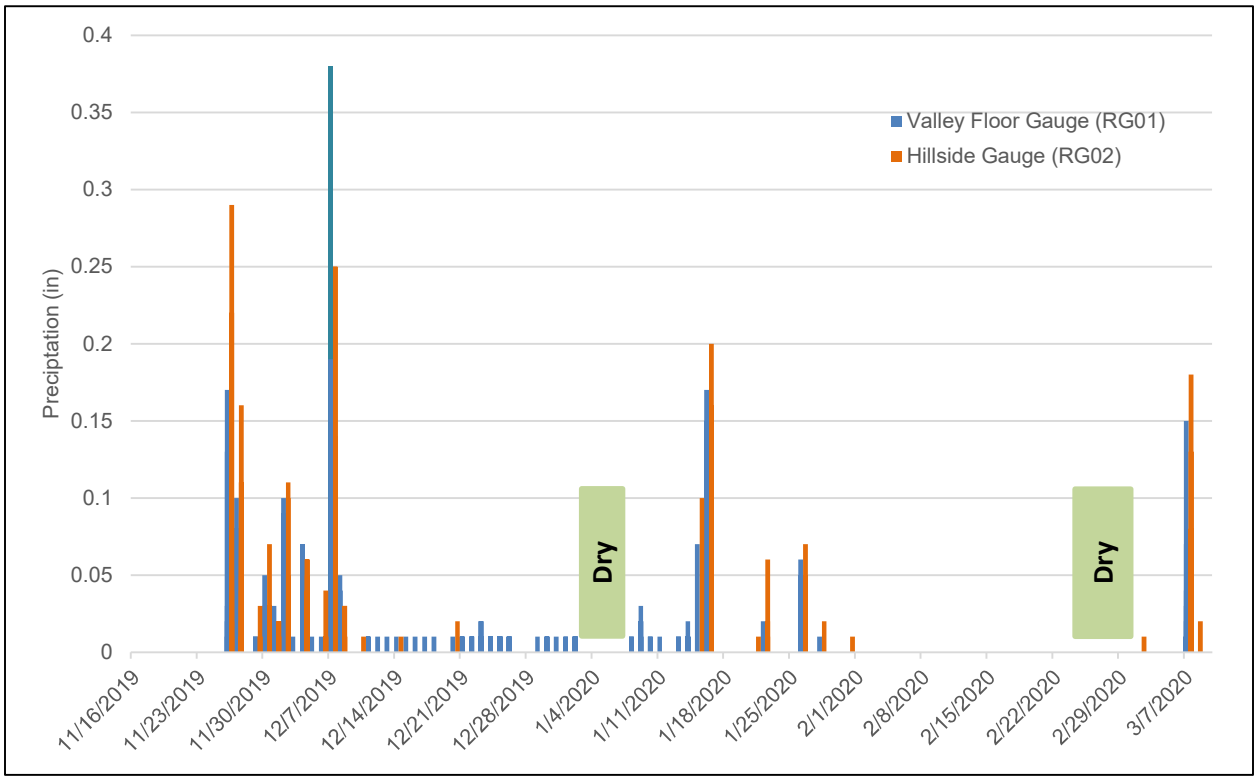
Table 7-1: Flow Monitoring Data Summary

Flow Meter	Nominal Pipe Dia. (in)[1]	Depth (in)[2]			Velocity (ft/s)[2]			Flow (MGD)[2]		
		Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum
41	24	6.515	4.000	9.340	1.543	0.780	2.060	0.708	0.189	1.310
186	8	1.540	0.780	2.060	1.540	0.780	2.060	1.540	0.780	2.060
190	18	2.465	1.820	3.200	0.959	0.500	1.320	0.093	0.031	0.160
226	21	3.466	1.810	5.100	0.591	0.240	0.840	0.103	0.021	0.232
386	16	6.427	5.190	9.000	1.375	1.060	1.880	0.511	0.291	1.071
592[3]	18	3.682	1.280	5.620	1.534	0.430	2.130	0.276	0.016	0.644
649	21	8.655	6.660	11.190	1.236	0.860	1.600	0.776	0.406	1.361
715	30	0.959	0.500	1.320	0.959	0.500	1.320	0.959	0.500	1.320
744	15	0.094	0.032	0.160	0.094	0.032	0.160	0.094	0.032	0.160
1043	21	5.252	3.420	7.270	3.999	2.220	4.800	1.263	0.378	2.277
1193	21	0.590	0.240	0.840	0.590	0.240	0.840	0.590	0.240	0.840
1564	8	0.590	0.240	0.840	0.590	0.240	0.840	0.590	0.240	0.840
1790	30	0.590	0.240	0.840	0.590	0.240	0.840	0.590	0.240	0.840
1795	27	9.483	6.360	12.140	0.399	0.220	0.510	0.300	0.091	0.460
2300	10	1.647	1.020	2.350	1.402	0.450	2.690	0.056	0.009	0.154
2334	12	2.123	1.620	2.580	2.770	1.460	3.460	0.175	0.063	0.263
2491	15	2.345	1.110	3.850	2.356	0.510	3.700	0.216	0.014	0.592
2569	21	6.434	4.390	8.470	1.051	0.540	1.600	0.441	0.148	0.828
2666	18	8.746	5.850	20.960	1.741	0.880	2.160	0.949	0.385	1.371
2721	8	6.229	3.950	7.900	1.053	0.590	1.420	0.198	0.091	0.312
2724	42	18.342	13.520	22.120	0.779	0.510	1.000	2.041	0.876	3.205
2808	36	8.737	5.860	11.120	2.257	1.320	2.920	2.007	0.643	3.438
2840[4]	15	1.995	1.810	2.250	1.384	1.080	1.660	0.087	0.060	0.120

Notes:
1. Pipe diameter listed in GIS. ADS measured internal pipe diameters in the field which are recorded in the ADS Report. Nominal pipe diameters listed in GIS were used in the hydraulic model.
2. These values are calculated using hourly averages. These may differ slightly from the ADS Report since those values are based on all field data collected.
3. Initially identified as FM 602 in the ADS Report, was placed further downstream in manhole GID 592.
4. FM 2840 was directly downstream of a flow diversion structure which diverts wastewater flows away from the flow meter, resulting in extremely low recorded flows at this site.

Figure 7-3: Rainfall during Monitoring Period



Rainfall measured by both rain gauges for the duration of the monitoring period is shown in **Figure 7-3**. The flow monitoring program was designed to capture both WWF and DWF, thus, the flow meters and rain gauges provided the data necessary to estimate both dry weather and wet weather GWI and RDI/I.

The following dry weather and wet weather periods, as shown on **Figure 7-3**, were identified and used for the model calibration and analysis. Dry weather period 1 and Storm event 1 were used primarily, unless there was insufficient data for the flow meter, then Dry weather period 2 or Storm event 2 was used:

- Dry weather period 1: February 24 – March 3, 2020
- Dry weather period 2: January 4 – 8, 2020
- Storm event 1: December 7, 2019
- Storm event 2: November 26, 2019

The maximum rainfall from either of these days are listed in **Table 7-2**, along with the National Oceanic and Atmospheric Administration (NOAA) precipitation frequency estimates for Milpitas, CA. The largest storms were between a 1- and 2-year storm or smaller than a 1-year storm frequency.

Table 7-2: NOAA Rainfall Frequency vs. Rain Gauge Data

NOAA Frequency Estimates[1]					Rain Gauge Data[2]	
Duration	1-year	2-year	5-year	10-year	RG01	RG02
1-hr:	0.34	0.43	0.56	0.66	0.38	0.29
2-hr:	0.50	0.63	0.80	0.95	0.57	0.51
6-hr:	0.85	1.06	1.36	1.62	0.64	0.76
12-hr:	1.10	1.40	1.82	2.18	0.66	0.92
24-hr:	1.37	1.79	2.36	2.83	0.95	1.30

Notes:
1. NOAA Atlas 14 Volume 6 Version 2 precipitation frequency estimates for Milpitas, CA
2. Maximum Rain by Rain Gauge (Total Inches by Duration)

7.2.1 Flow Meter Sewer Sub-Basins

The flow meters served as the basis for the delineation of tributary sewer sub-basins in the City for calibration purposes. Generally, for sub-basins located at the most upstream ends of the collection system, all flow from the sub-basin is captured by a single flow meter which in turn flows to downstream sub-basins. Where there are flow splits, flow can be directed to more than one downstream sub-basin so it is important to understand the flow behavior at each flow split in order to properly delineate sub-basin boundaries.

The identification of all flow splits (see **Section 3.1.1**) was imperative to track the flow through the system. They were each reviewed and identified as either a “non-critical” or “critical” flow split, as follows:

- **Non-Critical Flow Split:** In these cases, the flow is split then returns to the same sub-basin or flow path before it reaches the downstream flow meter. These flows splits and flow are fully contained within a single subbasin.
- **Critical Flow Split:** These are flow splits that divert flow to two different downstream sub-basins (or flow meters). All critical flow splits were evaluated using the City’s most current GIS geodatabase and the City’s extensive library of as-built record drawings.

There are 177 identified flow splits, of which five are considered critical, as shown in **Figure 7-4**. For critical flow splits, the ratio of flow was estimated based on the slopes and diameters of the outgoing pipes.

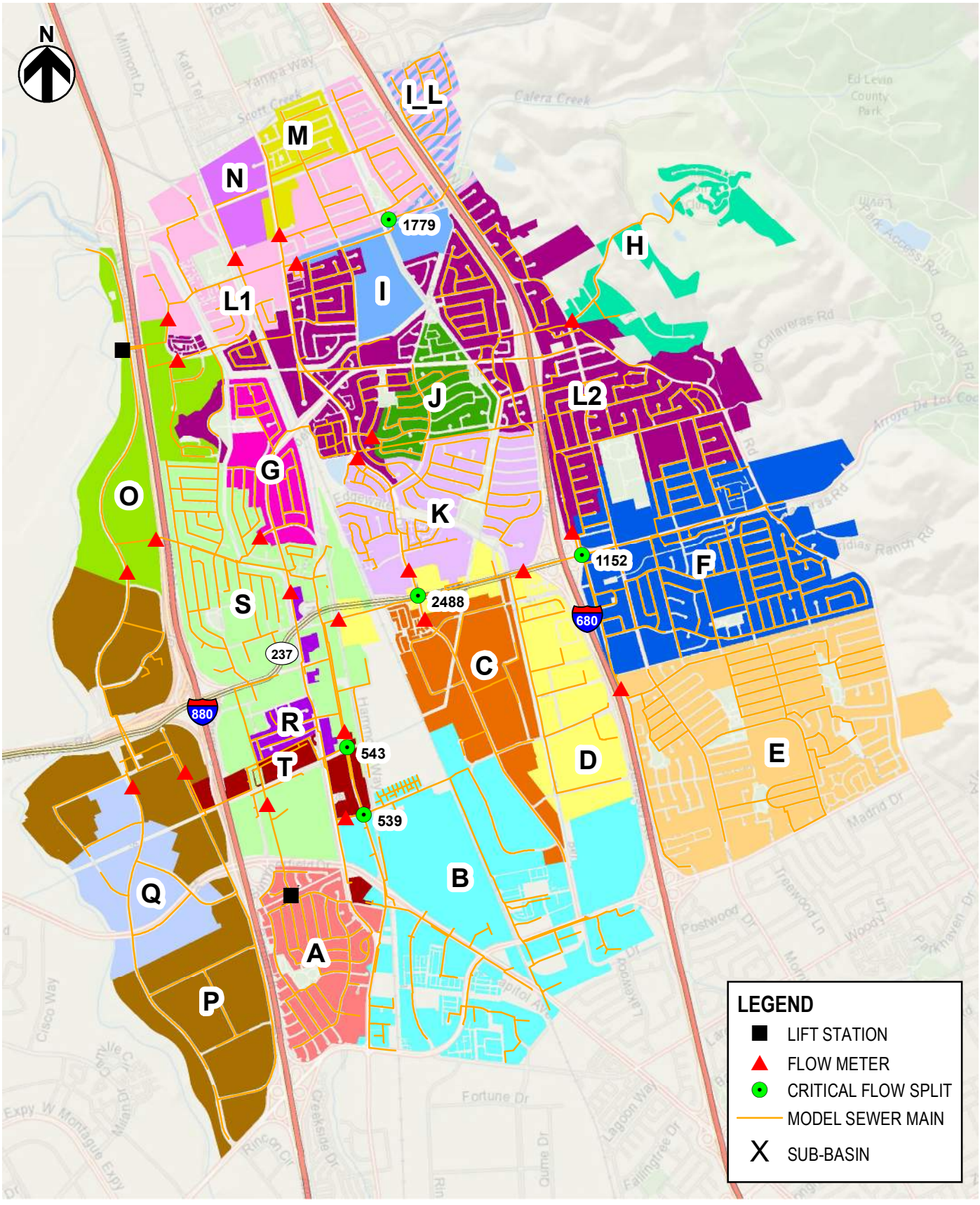


FIGURE 7-4
CITY OF MILPITAS
SEWER MASTER PLAN
SUB-BASIN DELINEATION

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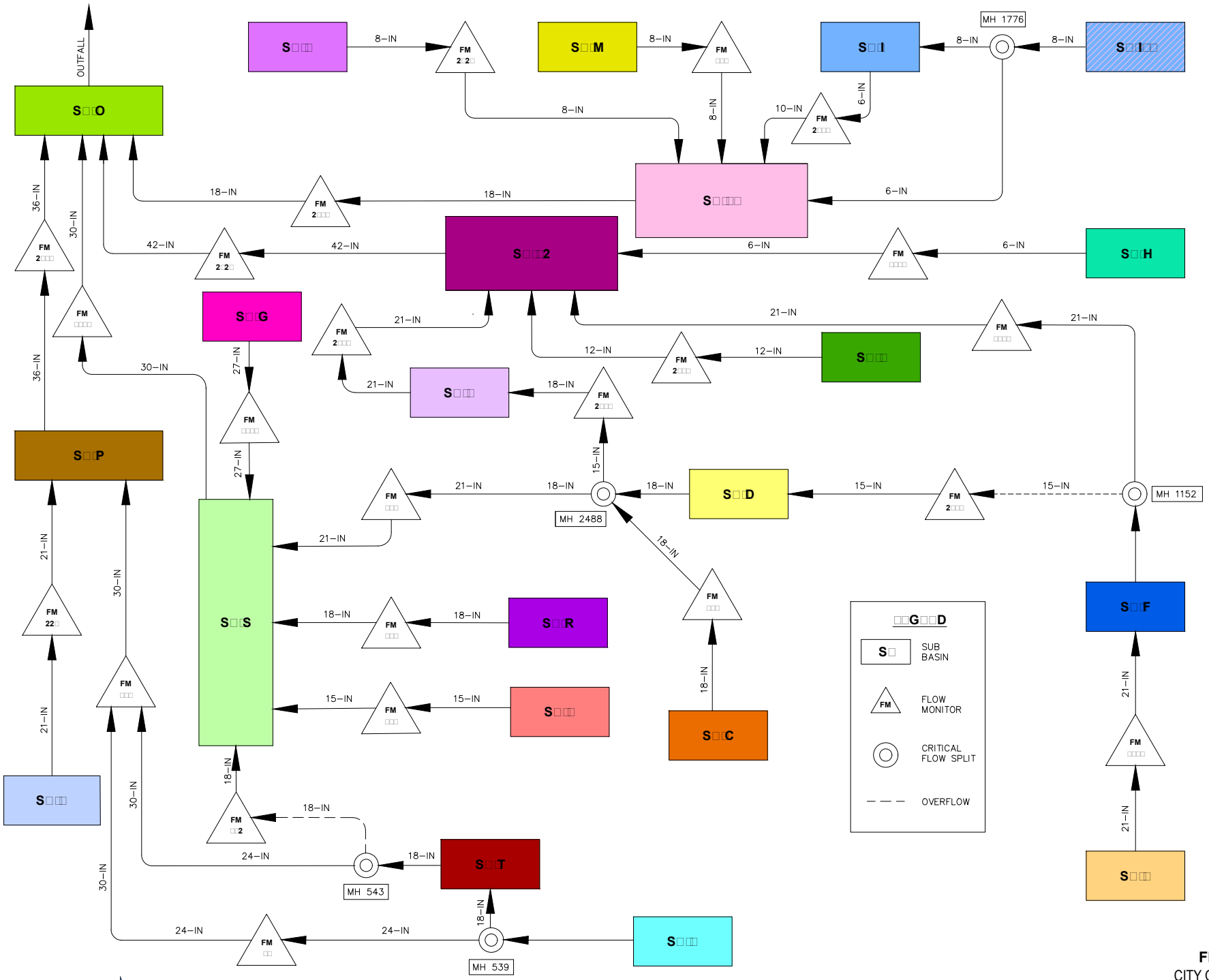
The results of the sub-basin delineation are displayed on **Figure 7-4**. The flow meters immediately upstream of each sub-basin and those that are capturing the flow of each sub-basin are listed in **Table 7-3**. **Figure 7-5** is a diagram summarizing flow through the sub-basins and the flow meters in the entire system, including all critical flow splits.

Table 7-3: Sub-Basins and Corresponding Flow Meters

Sub-Basin	Upstream Flow Meters	Capturing Flow Meters
A	N/A	744
B[1]	N/A	41
C	N/A	386
D	386 & 2840	649 & 2491
E	N/A	1193
F	1193	1043 & 2840
G	N/A	1795
H	N/A	1564
I[2]	N/A	2300
J	N/A	2334
K	2491	2569
L1[2]	186, 2721	2666
L2	1043, 1564, 2300, 2334, & 2569	2724
M	N/A	186
N	N/A	2721
O	1790, 2666, 2724, & 2808	OUTFALL
P	229 & 715	2808
Q	N/A	229
R	N/A	190
S	190, 592, 649, 744, & 1795	1790
T	41	592 & 715

Notes:
1. Flow from sub-basin B splits at MH 539. FM 41 captures a portion of the flow from sub-basin B and the remainder continues downstream to sub-basin T.
2. Flow from parcels upstream of MH 1776 splits and flows to sub-basins I and L1 downstream.

A summary of the various contributing land uses within each sub-basin is shown in **Table 7-4**. The area of each parcel was calculated using the geometry calculator tool in GIS.



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FIG□R□ □□□
CITY OF MILPITAS
SEWER MASTER PLAN
SCHEMATIC FLOW DIAGRAM

Table 7-4: Total Acreage of Each Land Use by Sub-Basin

LU Code	A	B[1]	C	D	E	F	G	H	I[2]	J	K	L1[2]	L2	M	N	O	P	Q	R	S	T[1]	Total
HSFL (DU)[3]	-	-	-	-	22 (17)	9 (4)	-	39 (8)	3 (3)	-	-	2 (2)	71 (22)	-	-	-	-	-	-	-	-	146 (56)
HSFM (DU)[3]	-	-	-	-	-	-	-	67 (107)	-	-	-	-	-	-	-	-	-	-	-	-	-	67 (107)
SFL (DU)[3]	115 (982)	-	-	-	227 (1,586)	228 (1,500)	50 (331)	4 (9)	42 (208)	72 (490)	86 (571)	108 (716)	320 (2,028)	32 (229)	-	-	-	-	12 (101)	131 (868)	-	1,427 (9,619)
SFM	-	-	-	17	87	8	13	-	-	7	32	11	67	6	-	7	-	-	1	10	-	266
MFH	-	93	8	3	25	52	1	-	-	-	6	57	46	-	12	-	-	-	7	15	48	373
MFVH	3	20	1	-	-	-	-	-	-	-	2	-	-	-	-	-	19	2	-	-	27	72
MHP	-	-	-	-	-	-	-	-	-	-	-	13	-	-	39	-	-	-	-	-	-	52
HOTEL	-	5	-	-	-	1	-	-	-	-	14	3	-	-	-	3	28	-	-	7	2	62
MXD	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	-	-	-	-	12	45	10	67
HDMU	-	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	64
PAO	-	-	-	10	1	6	-	-	-	-	9	2	6	-	-	-	54	-	-	-	-	87
COM	13	108	12	17	39	21	2	-	-	-	38	15	18	16	4	9	86	-	1	59	45	502
INP	-	5	-	-	-	-	-	-	-	-	-	21	5	-	-	188	347	148	-	22	2	738
MFG	-	150	171	154	-	-	-	-	-	-	-	24	12	-	-	-	2	-	-	25	50	588
PF	7	6	-	7	54	89	12	-	36	-	<1	10	62	3	-	-	1	1	1	17	5	311
COR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	-	62
Total	**138**	**432**	**192**	**210**	**454**	**414**	**78**	**110**	**81**	**79**	**187**	**266**	**606**	**57**	**55**	**207**	**537**	**151**	**34**	**393**	**207**	**4,889**

Notes:
1. Flow from sub-basin B splits at MH 539. Areas are based on the estimate that 75% of flow from sub-basin B parcels flow to meter 41, and 25% flow from these parcels downstream to sub-basin T.
2. Areas are based on the estimate that 60% of parcels upstream of flow split at MH 1776 flows to sub-basin I, and 40% flows to sub-basin L1.
3. HSFL, HSFM, and SFL are analyzed based on number of dwelling units in UF factor analysis with the assumption that there is one dwelling unit per parcel.
4. The City encompasses 8,680 acres. The area contributing sanitary flows is 4,884 acres. Non-contributing areas include park, streets, railroads, waterways, and other open spaces. Only parcels contributing sanitary flows are included in this table.

7.3 Dry Weather Flow (DWF)

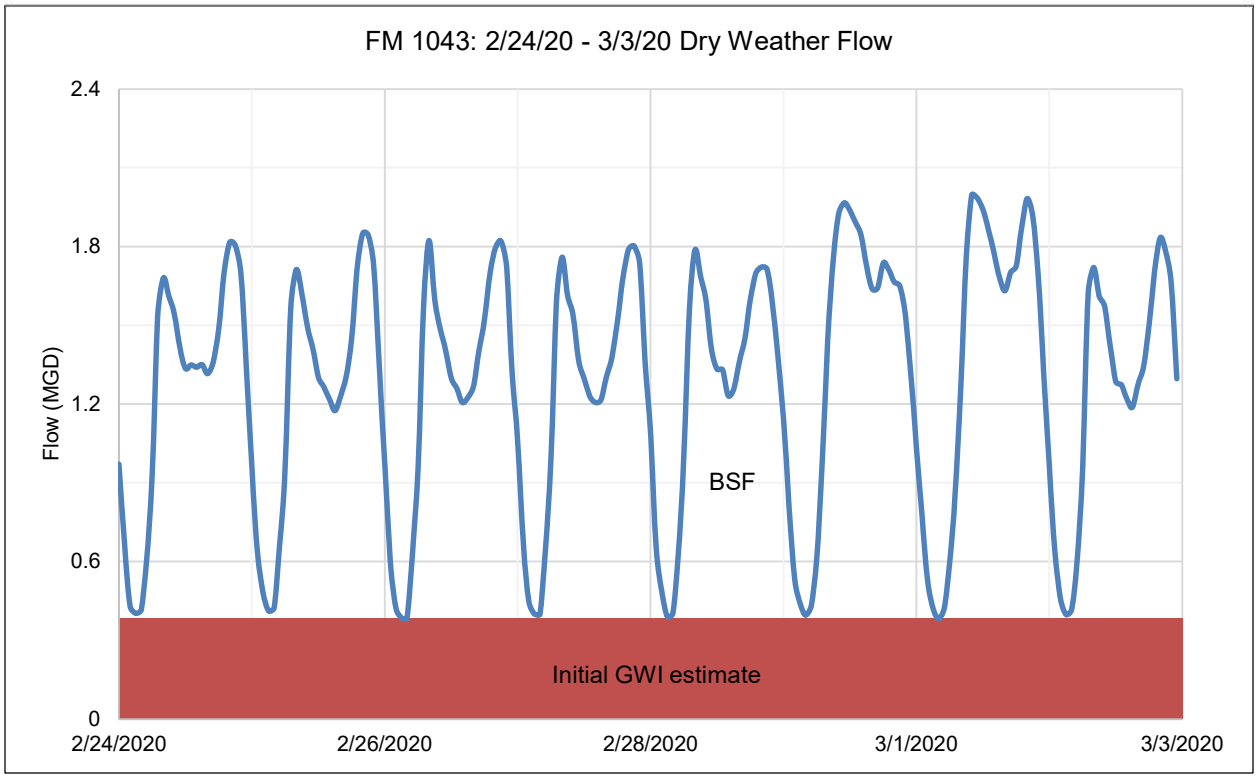
The dry weather periods were analyzed to establish dry weather GWI and BSF inclusive of the diurnal patterns for groups of land uses. The process for developing each of the components and the results are discussed below.

7.3.1 Dry Weather GWI

To isolate BSF, an estimate of GWI was developed. The daily minimum flow was calculated to serve as the initial basis for the GWI estimate. **Figure 7-6** presents an example of the DWF and corresponding estimated GWI for FM 1043. Once GWI estimates were developed for each flow meter, upstream contributing flow meters, outlined in **Table 7-3**, were subtracted to develop an estimate of dry weather GWI by sub-basin. Because GWI is not affected by human activity, and therefore should be the same for weekdays and weekend, there is only one value for GWI.

Using these initial values, a unique unit GWI (gpd/acre) was calculated for each sub-basin by dividing the total estimated GWI by the total contributing sub-basin acreage. This unit GWI was then applied to each parcel by multiplying the parcel area by the unit GWI for the respective sub-basin. These initial GWI estimates served as a starting point for model calibration and were further refined during the calibration using an iterative process, as described in **Section 7.3.4** below.

Figure 7-6: Dry Weather Flow



7.3.2 Base Sanitary Flow (BSF)

The GWI estimates developed for each sub-basin and estimated wastewater flows of identified large dischargers were subtracted from the total weekday DWF for the corresponding sub-basin. The remaining BSF was then used to estimate the UF factors for each land use category. These UF factors represent the average daily contribution to BSF by each parcel according to land use. The analysis was initiated in the most terminal/upstream sub-basins with the fewest land use types, and UF factors were iteratively adjusted until the calculated BSF matched the observed BSF at the corresponding flow meter. UF factors were calibrated to weekday flows; diurnal patterns were then adjusted to account for differences between weekday and weekend discharge patterns.

Large Dischargers

For this analysis, large dischargers are defined as those customers that discharge a disproportionately large volume of wastewater for the parcel size and use type. Large dischargers are typically treated as point sources for hydraulic modeling purposes. The City provided wintertime water use data for January thru March 2019 for non-single family residential, commercial, and industrial customers to estimate wastewater flows. It is preferable to use water data from the winter period to estimate wastewater flows as it is a closer representation of indoor water use, since less water is consumed for irrigation.

Wastewater flows were estimated at approximately 85% of winter water use. Estimated flows greater than 10,000 gpd were linked to a respective parcel, and a unit flow (gpd/acre) was calculated by dividing the total estimated wastewater flow by the total area of the contributing parcel(s). The gpd/acre for each flagged large discharger was compared to the respective land use based UF factor. Each flagged discharger was ultimately classified as a large discharger if the gpd/acre was at least twice the UF factor or more for its respective land use.

Table 7-5 lists the identified large dischargers and **Figure 7-7** shows the location of the associated parcels.

Table 7-5: Large Dischargers

Rank	Location[1]	Estimated Wastewater Flows (gpd) [1]	Model-Based Land Use	Sub-Basin
1	Abel St.	157,678	COR	S
2	Hillview Dr	148,562	MFG	C
3	Ames Ave	74,079	MFG	D
4	Hillview Dr	63,137	MFG	C
5	Abel St	49,821	MFVH	T
6	Main St	39,341	MFH	B
7	Milmont Dr	38,377	MFH	L
8	Dixon Landing Rd	35,426	MFH	L
9[2]	McCandless Dr	32,594	MFH	B
10[2]	Poppylane Townhouses	31,158	MFH	F
11	Murphy Ranch Rd	30,694	MFVH	P

Rank	Location[1]	Estimated Wastewater Flows (gpd) [1]	Model-Based Land Use	Sub-Basin
12	Dixon Landing Rd	30,134	MHP	N
13	Main St	28,747	COM	B
14	Technology Dr	27,964	PAO	P
15	McCarthy Blvd	26,312	INP	P
16	Landess Ave	24,423	COM	E
17	Wilson Way	23,433	MHP	N
18	Milpitas Blvd	23,142	MFG	L
19	Milpitas Blvd	20,737	MFG	C
20	McCarthy Blvd	20,566	INP	P
21	Park Victoria Dr	19,454	MFH	E
22	Main St	16,927	MFVH	A
23	McCarthy Blvd	16,610	INP	P
24	Technology Dr	16,467	PAO	P
25	N Milpitas Blvd	16,315	MFH	N
26	Calaveras Blvd	16,229	COM	F
27	Barber Ln	15,806	COM	T
28	Amalfi Loop	15,335	MFH	B
29[2]	Trento Loop	15,036	MFH	B
30	Turquoise St	13,357	MFG	C
31	Yosemite Rd	11,858	MFG	C
32	Trade Zone Blvd	11,696	MFH	B
33	Ames Ave	11,181	MFG	D
34	Milpitas Blvd	11,044	MHP	L
35	Cypress Dr	10,928	HOTEL	P
36	Park Victoria Dr	10,795	COM	F
37	Calaveras Blvd	10,616	COM	D
38	Milmont Dr	9,664	COM	L
Total	**-**	**1,175,643**	**-**	**-**

Notes:
1. Source: January-March 2019 water meter customer billing data provided by the City multiplied by 85% - assumed portion of water use that contributes to wastewater flows.
2. One meter (or multiple meters) provides water to multiple parcels.

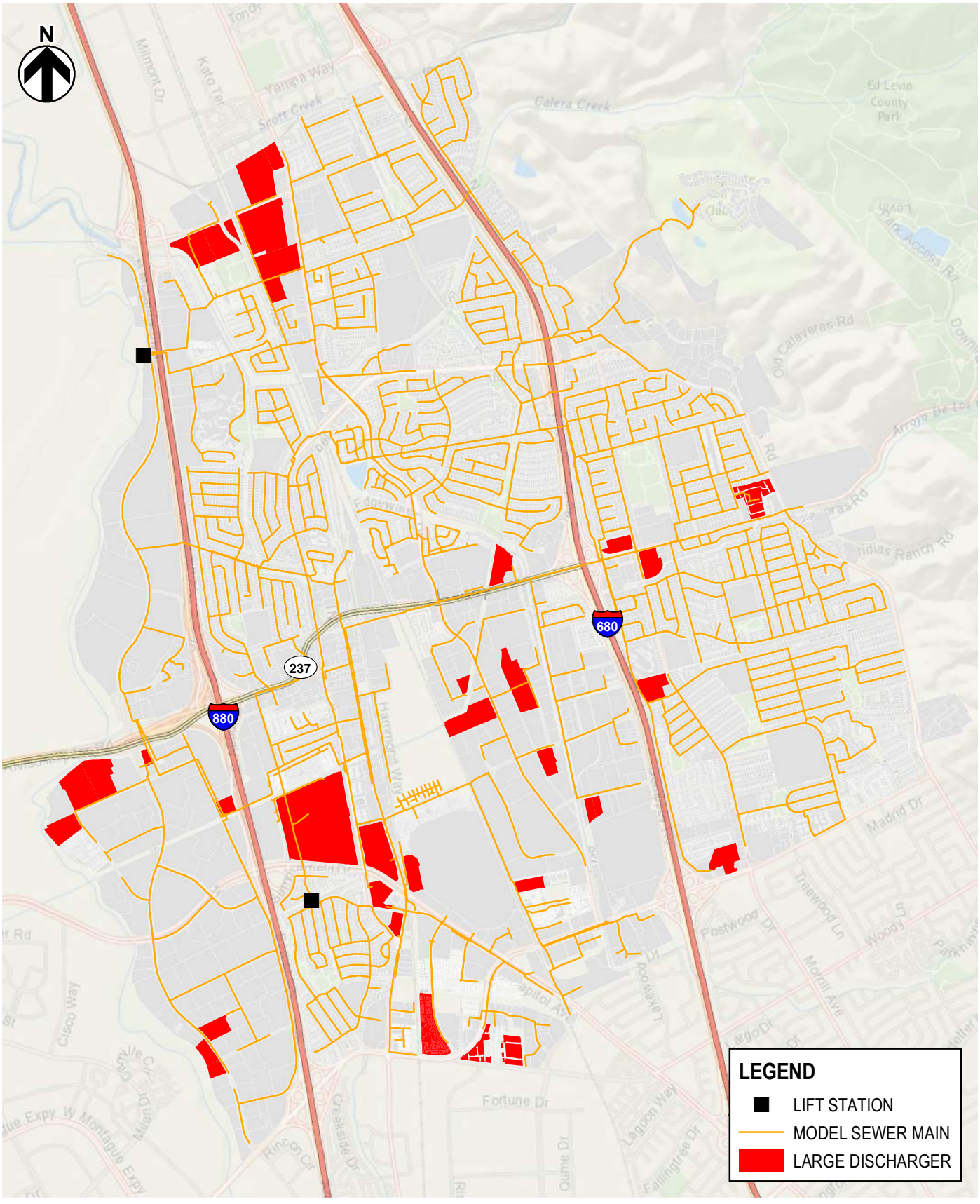


FIGURE 7-7
CITY OF MILPITAS
SEWER MASTER PLAN
LARGE DISCHARGERS

HydroScience

7.3.3 Diurnal Patterns

To account for hourly flow fluctuations, a set of diurnal flow patterns were established for different land use categories for both weekday and weekend conditions. To estimate these patterns, sub-basins with predominately residential, industrial, manufacturing, and commercial land uses were identified.

- **Residential:** Sub-basins H (valley floor) and J (hillside) are comprised of only residential land uses, so the average of these two sub-basins was used to develop the weekday residential diurnal pattern. Two separate weekend diurnal patterns were developed for valley floor and hillside residential land uses. No significant variation was observed during the weekday.
- **Industrial:** Flow in sub-basin Q is 95% industrial. This sub-basin was used to develop industrial diurnal patterns.
- **Manufacturing:** Sub-basin C is comprised of 95% manufacturing land use and was used to develop manufacturing diurnal patterns.
- **Commercial:** Sub-basin B has the highest portion of flow from commercial land uses, which is comprised of 32% commercial flow. It is noted that sub-basin B flow is comprised of approximately 1/3 commercial, 1/3 residential, and 1/3 manufacturing. Residential and manufacturing land use diurnal patterns were established using other sub-basins providing the basis for 2/3 of the flow contribution to the sub-basin. The remaining flow and pattern was used to develop the third diurnal pattern (commercial), accordingly.
- **Correctional Facility:** A diurnal pattern was developed for the correctional facility. The pattern is similar to the residential diurnal pattern but is slightly flattened and roughly based on FM 1790, which is downstream of the correctional facility. There is no variation in weekday and weekend patterns for the correctional facility.

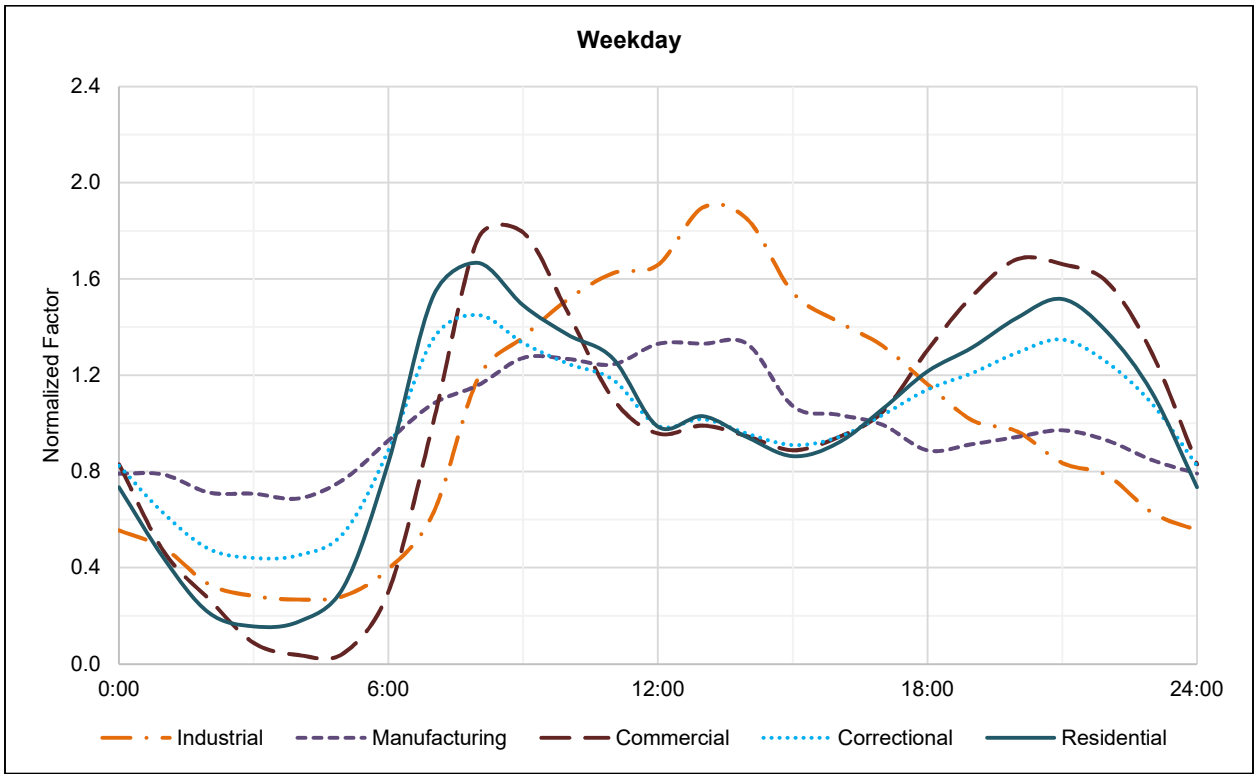
Diurnal patterns were adjusted iteratively for weekday and weekend to match measured flows during the calibration process discussed below.

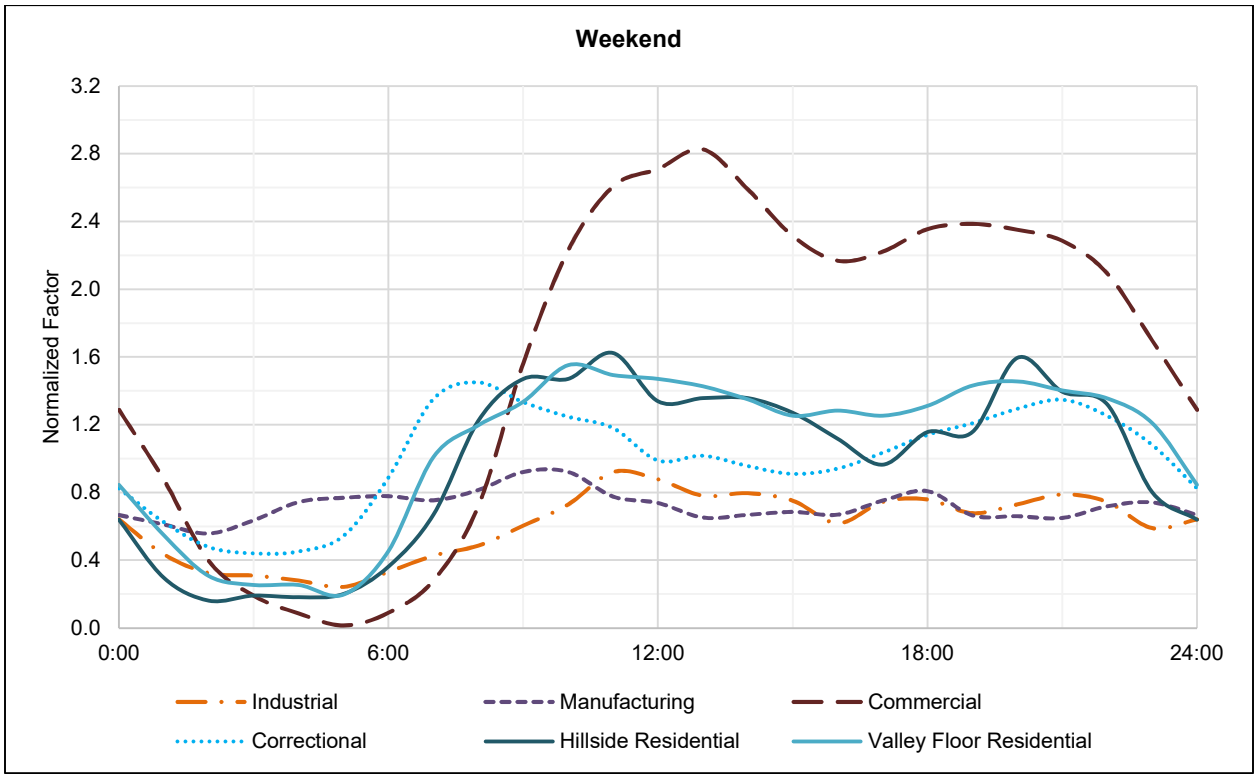
Figure 7-8 displays the calibrated set of weekday and weekend diurnal patterns developed.

7.3.4 Dry Weather Calibration

Initial GWI and base flow estimates, along with diurnal patterns, were added to the model. Large dischargers were assigned the diurnal pattern that corresponds to the original land use listed in **Table 7-5**. After each model run, iterative adjustments were made while comparing the modeled versus the observed flow at each flow meter (see **Figure 7-10**). Adjustments were made to GWI for each sub-basin, UF factors, and diurnal patterns. The process is iteration intensive as one change to a sub-basin affects everything downstream. Thus, the focus was to start with the terminal sub-basins that are in the most upstream areas with the fewest land use types and unknowns, followed by downstream sub-basins.

Figure 7-8: Diurnal Patterns





Flow Obstructions

Where there were consistent discrepancies between modeled and observed flows, CCTV was reviewed to analyze upstream critical flow splits. It was discovered that four of the five critical flow splits were not operating as intended. The key findings and changes that were made in the model to represent these findings are described below and identified on **Figure 7-9**. These adjustments for obstructions were removed for the capacity analysis as detailed in **Section 8.3**.

1. MH 539 is a critical flow split at the intersection of Curtis Avenue and Main Street. There are two pipes flowing into the manhole from the south and the east. During dry weather conditions, all flow should exit the manhole to the west to FM 41 as part of sub-basin B. The outlet to the north is slightly elevated and serves as an overflow flow split flowing to sub-basin T. During CCTV review, a large grease buildup was identified at the manhole. The grease buildup diverts a large portion of the flow entering the manhole from the east to the north to sub-basin T instead of west to FM 41 as part of sub-basin B. To account for this in the model, the upstream pipe invert flowing to the north was adjusted until, as visually estimated using CCTV, approximately two-thirds of the peak flow entering the manhole from the east was flowing north.
2. MH 543 is a critical flow split located where Tom Evatt Park intersects Main Street just downstream of the critical flow split at MH 539. During review of the CCTV for MH 543, it was discovered that there is also a large obstruction here. Based on what was observed in the CCTV, under normal conditions, the flow entering this manhole from the south should flow exclusively to the west during dry weather and the pipe exiting to the north would function as an overflow flow split. Due to a large obstruction at this manhole, some of the flow is being diverted to the north, activating the flow split. To account for this obstruction in the model, the upstream pipe invert of the segment flowing to the north was adjusted to simulate the flow diversion by the obstruction. This invert was adjusted until the modeled flows at FM 592 and FM 715, which are capturing the flow of sub-basin T, approximately matched the observed flows.
3. MH 2488 is a critical flow split located in sub-basin D. After reviewing CCTV, a large obstruction was also observed at this manhole. Under normal conditions, based on the pipe inverts observed in the CCTV, all flow entering this manhole from the south and the east should flow to the north. However, due to the large buildup, a large proportion of the flow is diverted to the west. To account for this obstruction, the upstream pipe invert of the segment exiting this manhole to the north was adjusted until the modeled flows matched the observed flows at FM 649 and FM 2491, which are located just downstream of this flow split to the west and north, respectively.
4. MHs 1053, 1152, and 2578, as discussed in **Section 3.1.1**, are flow diversion structures, and MH 1152 is a critical flow split. As part of the calibration process, the inverts of the overflow segments exiting each of these manholes was adjusted to reflect the operation of the flow diversion structures in the field.

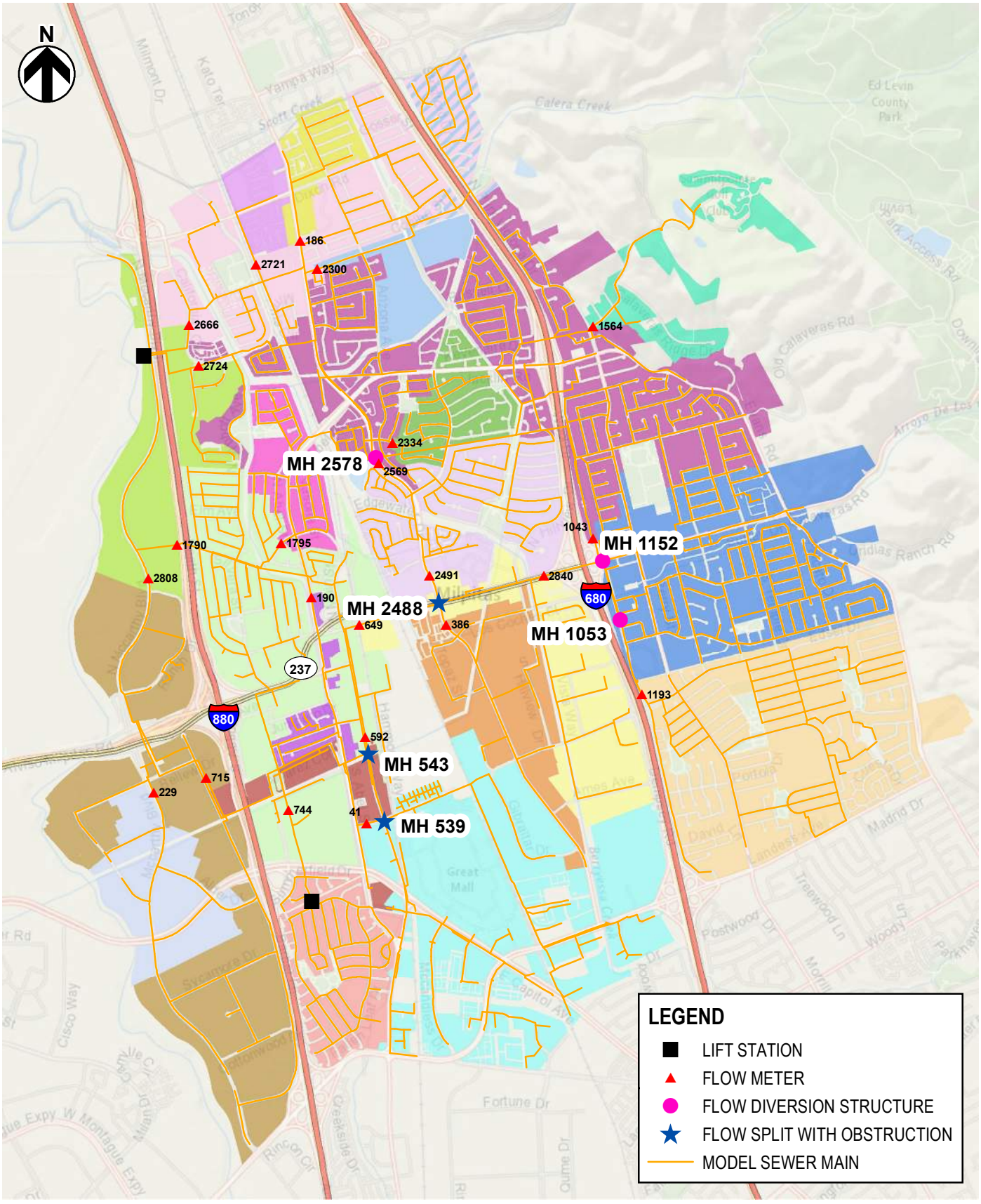


FIGURE 7-9
CITY OF MILPITAS
SEWER MASTER PLAN
FLOW DIVERSION AND OBSTRUCTION

HydroScience

After completing all UF factor and GWI adjustments, and adjusting inverts at flow splits/diversion structures, the modeled flows were determined to align as close to the observed flows as reasonably possible. **Table 7-6** presents the final calibrated UF factors.

The final modeled average DWF at the outfall is 7.55 MGD. The total modeled GWI, which represents both GWI and other continuous flow contributions, is 1.40 MGD. There is no reliable flow data for the outfall at the Main LS; thus, GWI values in sub-basin O were estimated based on the GWI of the nearby sub-basins.

Figure 7-10 presents a sample of the final modeled versus observed flows for dry weather. This chart includes Sunday and Monday, so both weekend and weekday dry weather calibration are represented. Calibration charts for all flow meters are included as **Appendix D**.

Table 7-6: Calibrated UF Factors

Land Use Designation	UF Factor	Units	Quantity	Flow (MGD)	Diurnal Pattern
HSFL	400	gpd/parcel	56	0.022	Hillside Residential
HSFM	465	gpd/parcel	107	0.050	Hillside Residential
SFL	200	gpd/parcel	9619	1.924	Valley Floor Residential
SFM	1200	gpd/acre	266	0.319	Valley Floor Residential
MFH	1500	gpd/acre	292	0.438	Valley Floor Residential
MFVH	2000	gpd/acre	56	0.113	Valley Floor Residential
MHP[1]	-	-	-	-	Valley Floor Residential
HOTEL	4000	gpd/acre	60	0.244	Valley Floor Residential
MXD	1000	gpd/acre	67	0.067	Commercial
HDMU	2200	gpd/acre	64	0.141	Commercial
PAO	500	gpd/acre	65	0.031	Industrial
COM	900	gpd/acre	467	0.420	Commercial
INP	450	gpd/acre	727	0.327	Industrial
MFG	1500	gpd/acre	550	0.825	Manufacturing
PF	190	gpd/acre	310	0.059	Commercial
COR[1]	-	-	-	-	Correctional
Large Dischargers[2]	Various	-	-	1.176	Various
Total	**-**	**-**	**-**	**6.157** [3]	**-**

Notes:
1. All three mobile home parks and the correctional facility were identified as large dischargers and assigned flows based on water use data as described in **Section 7.3.2**.
2. Large dischargers were assigned a diurnal pattern based on their original land use codes, which are listed in **Table 7-5**.
3. Represents the total BSF. The total BSF plus the total GWI is the total DWF.

Figure 7-10: Example of Dry Weather Model Calibration Charts

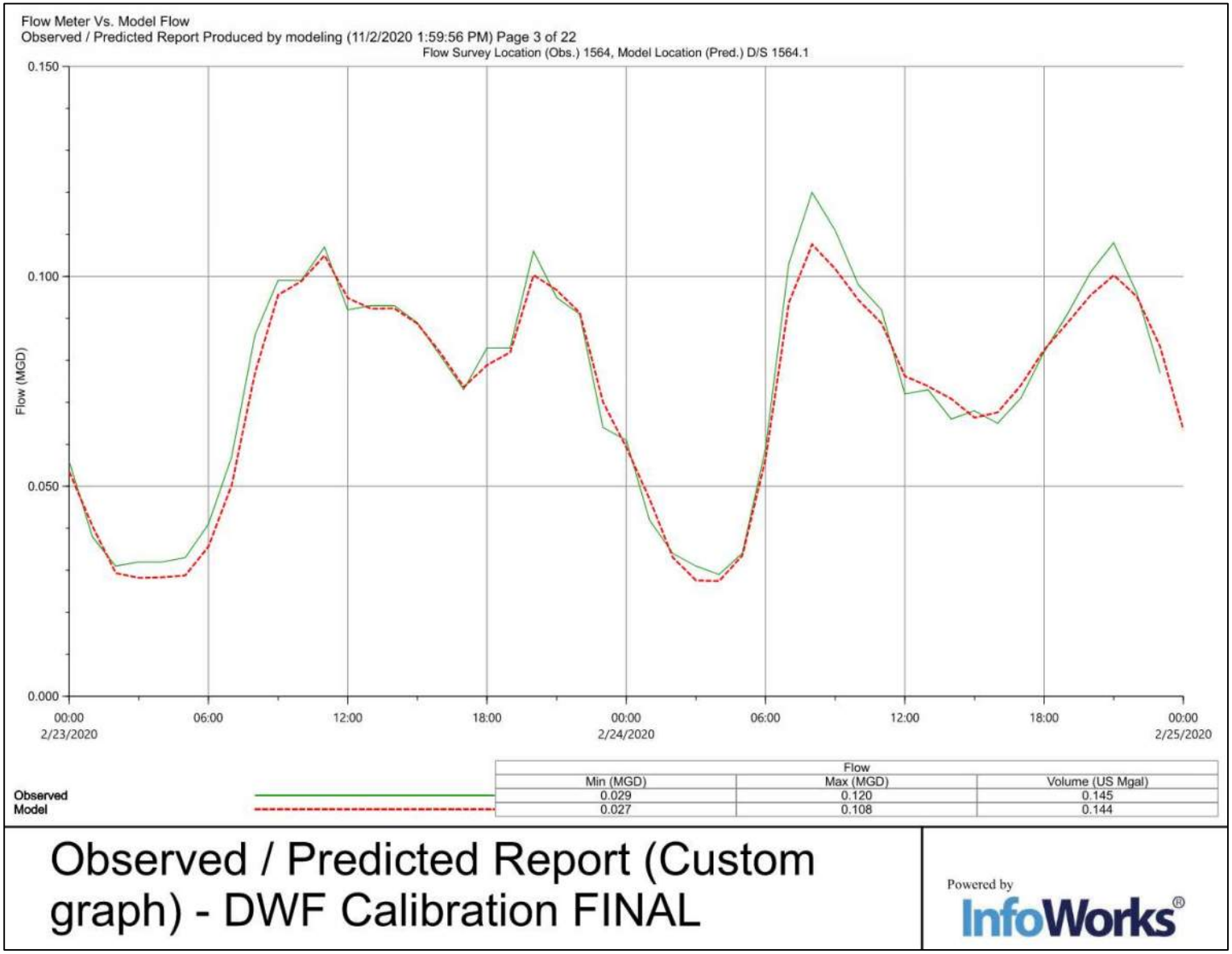


Figure 7-10 presents a comparison between modeled and observed dry weather weekday flows. For the overall system, modeled flows are 3.4% higher than the observed flows on an average dry weekday and are within 10% (higher) of the measured flows on the average dry weekend. A calibration within 5% is considered a good representation of actual conditions and having modeled flows higher than measured flows assures that the model is conservative in its representation of the collection system.

Table 7-7: Calibrated Model vs. Observed Weekday Dry Weather Flow Comparison

Flow Meter	Sub-Basin	Model Avg Flow (MGD)	Observed Avg Flow (MGD)	% Difference
744	A	0.273	0.270	1.2%
41[1]	B	0.540	0.565	-4.4%
386	C	0.566	0.576	-1.8%
649[2]	*D*	*0.892*	*0.862*	*3.5%*
2491[2]	*D*	*0.103*	*0.133*	*-22.9%*
	D Total	**0.995**	**0.995**	**-0.1%**
1193	E	0.588	0.580	1.3%
1043	F	1.219	1.248	-2.4%
1795	G	0.258	0.271	-4.6%
1564	H	0.073	0.074	-2.3%
2300	I	0.059	0.056	5.3%
2334	J	0.163	0.167	-2.2%
2569	K	0.383	0.357	7.5%
2666	L1	0.867	0.889	-2.5%
2724	L2	2.442	2.036	19.9%
186	M	0.113	0.123	-7.5%
2721	N	0.198	0.199	-0.7%
2808	P	1.755	1.837	-4.5%
229	Q	0.091	0.086	6.2%
190	R	0.081	0.087	-7.1%
1790	S	2.267	1.934	17.2%
592[1,3]	*T*	*0.194*	*0.191*	*1.5%*
715[1,3]	*T*	*0.990*	*1.027*	*-3.6%*
	T Total	**1.184**	**1.219**	**-2.8%**
OUTFALL[4]	O	7.492	-	-

Notes:
1. Flows are affected by the obstruction in MH 539 - a critical flow split.
2. Flows are affected by the obstruction in MH 2488 - a critical flow split.
3. Flows are affected by the obstruction in MH 543 - a critical flow split.
4. The flows of sub-basin O capture the entire system. There are not any measured flows at this location, so there is nothing to compare the modeled flows to.

7.4 Wet Weather Flow (WWF)

The remaining components of wastewater flow are additional wet weather GWI related to an elevated groundwater table and the RDI/I as illustrated in **Figure 7-1**. GWI levels typically fluctuate as the water table rises during the wet season and falls during the dry season; GWI values were adjusted to account for the seasonal variation. RDI/I is the flow that enters the system through manhole covers and through temporarily increased groundwater infiltration driven by rainfall.

7.4.1 RDI/I Volume

The volume of RDI/I is calculated by subtracting the volume of DWF in the system from the volume of total wet weather flow, as shown in **Figure 7-11**. For this study, the volume of RDI/I and corresponding R-factor was calculated for the 24-hour period following the start of Storm event 1. Because GWI tends to fluctuate over the course of the wet season as the water table rises and falls, dry weather data from just prior to the storm was used for RDI/I calculations. DWF prior to the storm was subtracted from the storm flow for RDI/I calculations.

Figure 7-11 is an example of the flows at FM 2724 during the storm period.

Figure 7-11: Wet Weather Flow

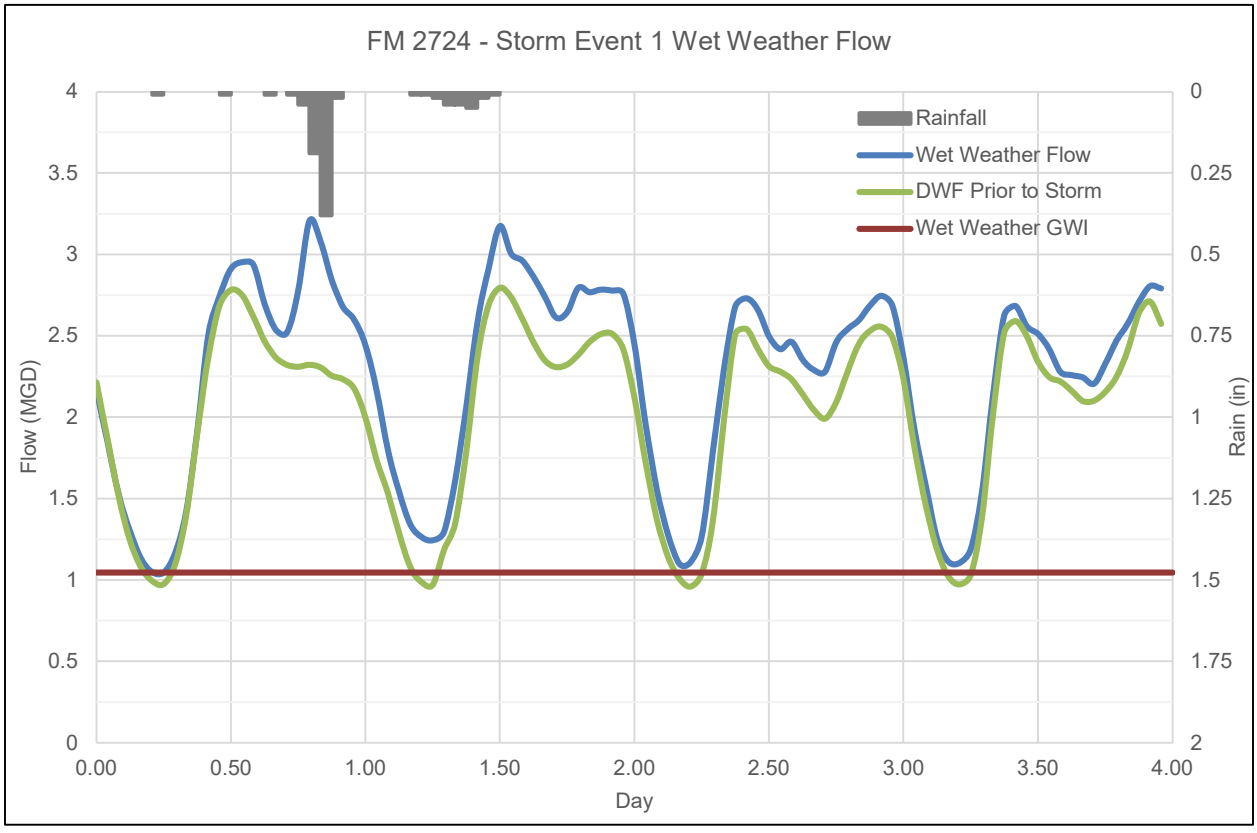
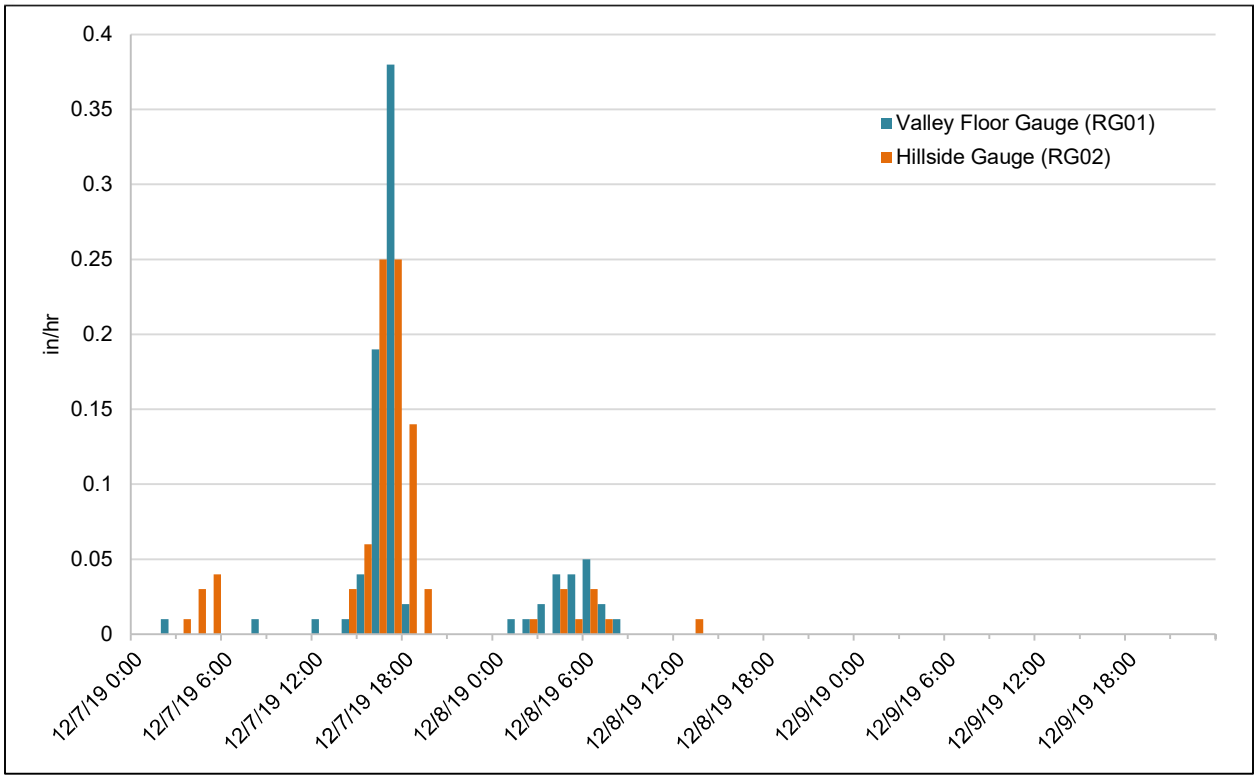


Figure 7-12: Storm Rainfall



7.4.2 Total Rainfall

The volume of rain that fell on each sub-basin is calculated by multiplying the depth of rain by the total area contributing sanitary flows in each respective sub-basin. The areas of each sub-basin are listed in **Table 7-4**. This acreage excludes parcels with no wastewater flows (NF designation – see **Figure 5-1**) such as streets and areas of open space. To calculate the rainfall volume for this initial analysis, each sub-basin was matched to a corresponding rain gauge (RG01 or RG02) based on proximity and elevation. Sub-basin H is the only sub-basin located on the hillside, so this was matched to RG02. The remainder of the sub-basins were matched with RG01 on the valley floor. **Figure 7-12** presents the rainfall for Storm event 1 for both rain gauges.

7.4.3 R-Factor Development

The R-factor represents the percentage of rainfall that enters the City's sewer system by volume: the ratio of RDI/I to total volume of rain. An initial R-factor was calculated for each sub-basin based on the flow data and was iteratively adjusted for the wet weather model calibration process.

There is no separate estimation of antecedent moisture conditions in the soil. It is best to use at least a 2-year storm to estimate R-factors, as it will more likely represent conditions similar to a large representative design storm. For this analysis, the storm selected for the R-factor calculation and calibration was Storm event 1, which was the largest storm available during the flow monitoring period. Storm event 1 was less than a 1-year 24-hour storm, but between a 1- and 2-year 2-hour storm.

Once the RDI/I and total volume of rainfall are calculated, the R-factor is a simple calculation of RDI/I volume divided by rainfall volume, resulting in the estimated portion of rainfall that enters the wastewater collection system. These values were also iteratively adjusted during the model calibration process.

7.4.4 Wet Weather Calibration

To initiate the wet weather calibration process, the observed rainfall collected at both rain gauges for Storm event 1 was added to the model (see **Figure 7-12**). During the calibration process, it was noted that the peak flows for all valley floor sub-basin meters occurred approximately three hours prior to the peak rainfall, which was clearly elevated related to rainfall as compared to dry weather flow. It appears that there may have been an error in the timestamps of RG01, so the rainfall was shifted three hours earlier.

Wet Weather GWI

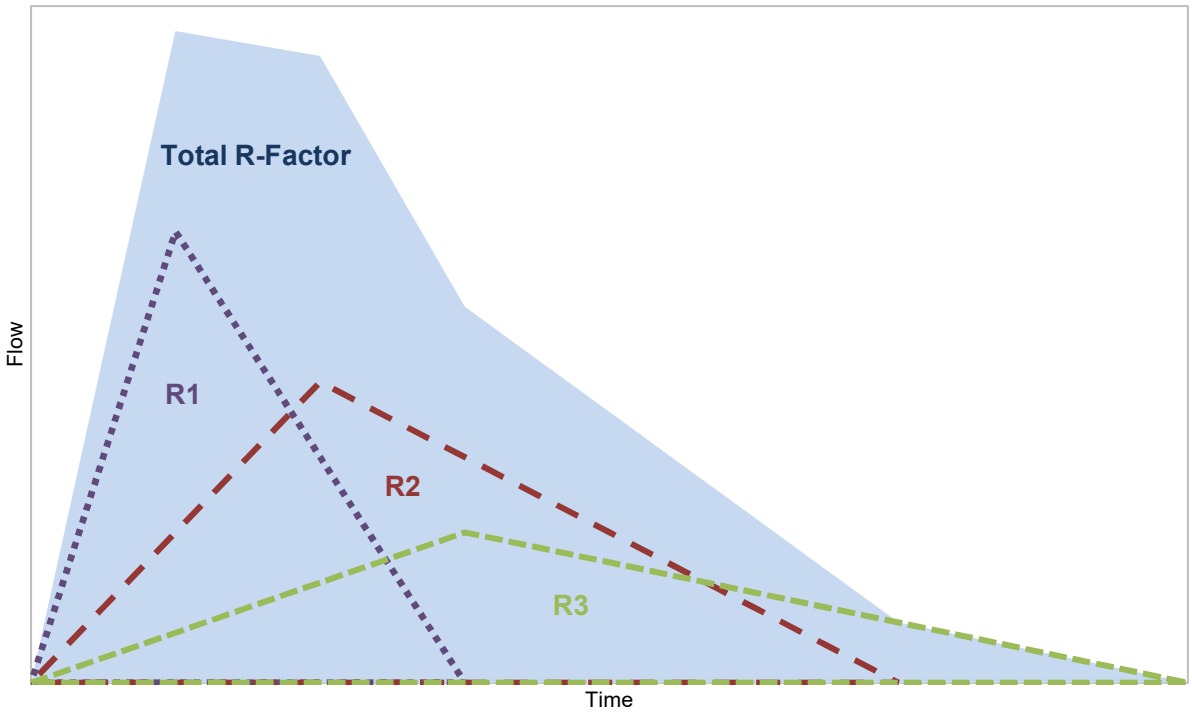
GWI fluctuates over the course of the year, increasing during the wet season as the water table rises. The extent that the water table rises and falls is site specific and can be affected by geology, surface water features, and tides. By extension, wet weather GWI changes are also site specific and can also depend on the condition of the pipelines. In the wet weather calibration scenarios of the model, GWI values established during the dry weather calibration process were iteratively increased to reflect the elevated water table more accurately during the wet season as displayed by an increase in the minimum flows.

RDI/I R-Factor

The RDI/I is estimated using the R-factor, or the percentage of rainfall that enters a sewer system as described in **Section 7.4.1**, and the Tri-Triangular Method. The Tri-Triangular Method, which is the industry standard for representing wet weather flows, involves summing three separate hydrographs to derive a single unit hydrograph. The total R-factor is divided into three separate values, represented as triangles (see **Figure 7-13**), based on the speed at which rainfall enters the sewer system, as described below:

- **Rapid (R1)** – Stormwater inflow that enters the sewer system most rapidly, typically through entry points such as holes in manhole covers. The peak of this triangle occurs one to three hours after the start of the rainfall.
- **Intermediate (R2)** – A combination of rapid stormwater inflow and slow rainfall-dependent infiltration.
- **Slow (R3)** – Long term delayed rainfall-dependent infiltration. The peak of this triangle occurs the longest time after the start of the rainfall, and the effects of this infiltration can continue long after the end of the rainfall.

Figure 7-13: Tri-Triangular R-Factor Method



The initial estimated R-factors (R1, R2, and R3) for each sub-basin were input into the model, which generated the total R-factors. Total R-factors are simply the sum of the individual R-factors (R1 + R2 + R3). The entered R-factors were iteratively adjusted for each sub-basin by comparing modeled flows to observed flows at each flow meter during the day of, and the two days following, the storm. During this part of the calibration process, it is critical to capture the peak flows as accurately as possible to avoid underestimating capacity deficiencies.

The final calibrated R-factors for each sub-basin are presented in **Table 7-8**.

For wet weather calibration of the system, average modeled flows representing Storm event 1 and one day following the storm are 3.3% higher than measured flows. Modeled peak WWF for Storm event 1 are 2.3% higher than measured peak flows. A calibration within 5% is considered a good representation of actual conditions and having modeled flows higher than measured flows assures that the model is conservative in its representation of the collection system.

A sample wet weather calibration chart is displayed in **Figure 7-14**. Wet weather calibration charts for all flow meters are attached as **Appendix E**.

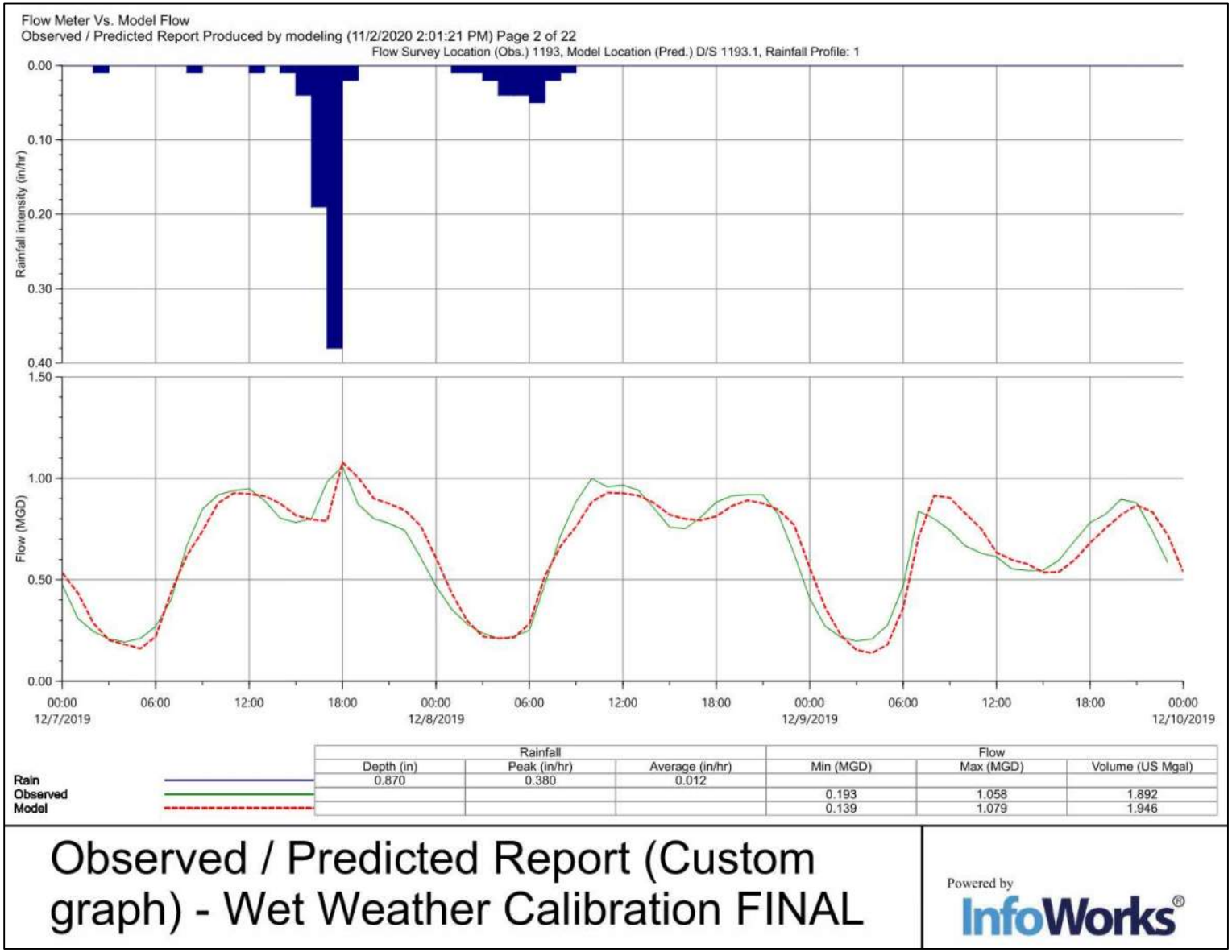
Table 7-8: Final Calibrated R-Factors

Sub-Basin	Acreage	R1	R2	R3	Total R-Factor
A	138	0.40%	0.85%	0.23%	1.48%
B	433	0.80%	0.66%	0.13%	1.59%
C	192	0.27%	0.00%	0.02%	0.30%
D	208	0.26%	1.64%	0.00%	1.90%
E	455	0.53%	0.00%	0.07%	0.60%
F	414	0.67%	0.00%	0.19%	0.86%
G	78	1.27%	2.14%	0.00%	3.40%
H	110	0.24%	0.00%	0.00%	0.24%
I	81	0.08%	0.35%	0.00%	0.42%
J	79	0.00%	0.67%	1.50%	2.17%
K	187	0.10%	0.56%	0.15%	0.81%
L1	266	0.09%	0.17%	0.14%	0.40%
L2	607	0.09%	0.17%	0.05%	0.31%
M	57	1.07%	0.26%	0.07%	1.39%
N	55	0.55%	1.17%	0.34%	2.06%
O[1]	207	0.70%	0.40%	0.40%	1.50%
P	537	0.59%	0.30%	0.37%	1.26%
Q	151	0.45%	0.00%	0.15%	0.60%
R	34	1.30%	2.41%	0.00%	3.71%
S	393	0.00%	1.30%	0.34%	1.64%
T	207	0.25%	0.12%	0.26%	0.64%
Average[2]	**4,889**	**0.40%**	**0.45%**	**0.19%**	**1.04%**

Notes:
1. There is no flow meter at the outfall for sub-basin O. Values were estimated based on surrounding sub-basins.
2. The average represents the weighted average by sub-basin area.

In summary, total R-factors for each subbasin ranges from 0.24% up to 3.71%, which represents the percentage of rainfall entering the collection system. A low R-factor would be less than 3% and 10% is considered high. The weighted average for the entire system is 1.04%; this is considered a relatively watertight system with limited rainfall entering the collection system.

Figure 7-14: Example of Wet Weather Model Calibration Charts



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SECTION 8 – CAPACITY ANALYSIS

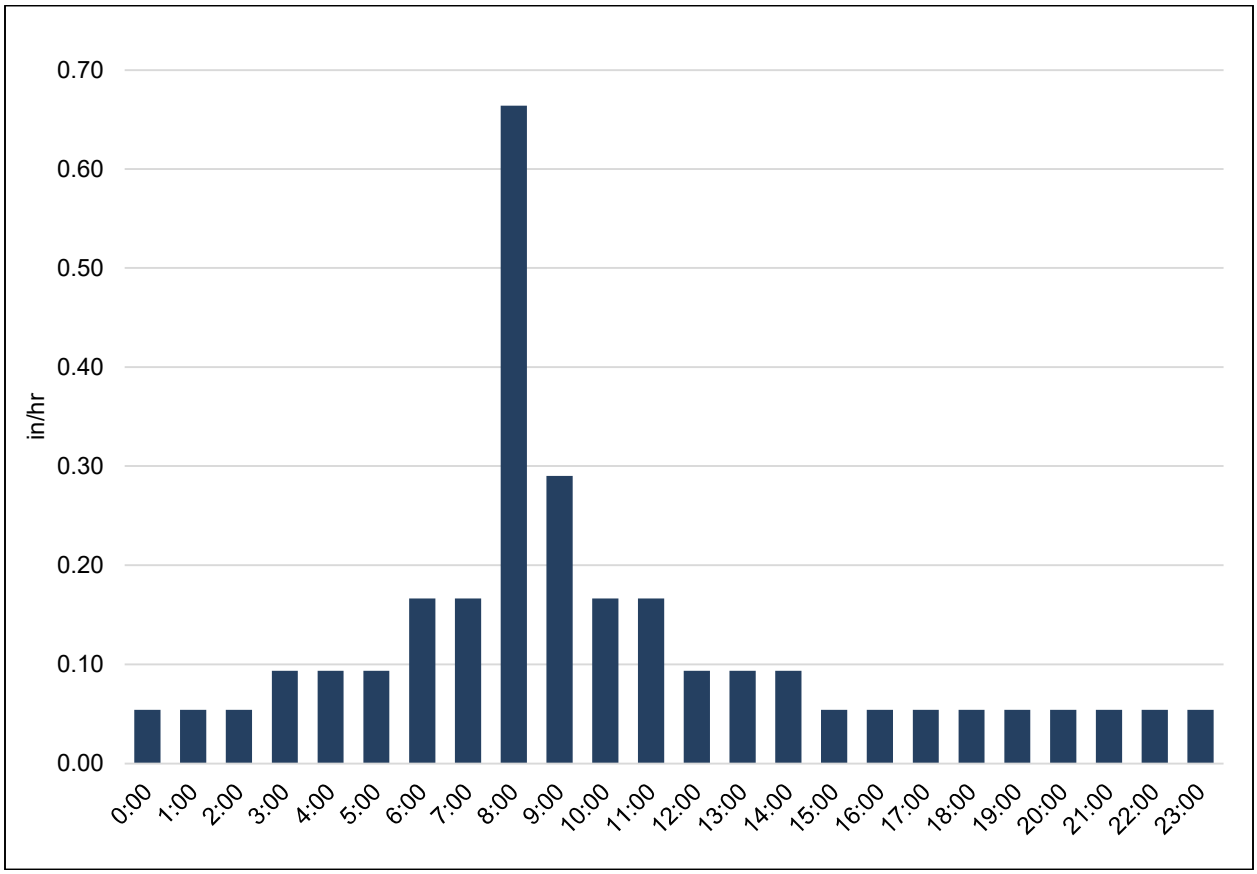
The hydraulic analysis for the collection system was evaluated under design storm for existing and future land use conditions. This section describes the analysis and the resulting deficiencies.

8.1 Design Storm

To estimate WWF, a design storm is applied to the model and wet weather flows are represented based on the calibrated R-factors for each sub-basin. A range of storms was considered for the design condition of this study. Both the 2002 and 2009 Master Plans used a 10-year, 4-hour constant distribution storm. Often, a 10-year 24-hour storm is used with a peak hour coinciding with the peak of the typical diurnal curve. A 5-year 24-hour storm was also available in the event that a 10-year 24-hour storm caused exceedingly large flows due to high rates of RDI/I.

For this study, the typical 10-year 24-hour storm with a peak hour coinciding with the peak of the typical diurnal curve was deemed appropriate.

Figure 8-1: 10-Year 24-Hour Design Storm



Source: NOAA Atlas 14 Volume 6 Version 2 precipitation frequency estimates in inches for Milpitas, California (https://hdsc.nws.noaa.gov/hdsc/pfds).

8.2 Deficiency Criteria

The initial deficiency criteria used to evaluate the capacity of the modeled pipes under design flow conditions was the ratio of wastewater flow depth (d) to pipe diameter (D), or d/D. In InfoWorks, if d/D is greater than one, this means the pipe is flowing full under pressure and the hydraulic grade line (HGL) is higher than the crown of the pipe. InfoWorks also reports a "surcharge state" for each pipe, and **Table 8-1** summarizes the definition of each surcharge state.

In the hydraulic model, the HGL reaching the ground surface indicates a potential SSO. Even for a pipe flowing under capacity or surcharged, if the freeboard – the distance between the ground surface and the HGL – is five feet or greater, the risk of SSO is minimal. Where pipes were shown as surcharged due to inadequate hydraulic capacity (surcharge state of "2"), a pipe was identified as deficient if the freeboard in these locations is also less than five feet.

Table 8-1: InfoWorks Surcharge States

Surcharge State	Definition	Deficiency if:
< 1 [1]	When depth of flow is less than the diameter of the pipe	Not considered hydraulically deficient
= 1	Pipe is surcharged due to backwater from a downstream deficiency.	Not considered hydraulically deficient
= 2	Pipe is hydraulically under capacity and needs to be upsized.	Freeboard < 5 feet

Notes:
1. Surcharge State = d/D

8.3 Assumed Condition

As detailed in **Section 7.3.4**, there were three critical flow splits identified in the system as having major flow obstructions that drastically changed the flow path of wastewater – likely from grease buildup at MH 539, MH 543, and MH 2488. During the dry weather calibration process, these flow splits were modified in the model to match the wastewater flows observed in the system. For the hydraulic analysis, system performance was evaluated based on the assumption that these obstructions have been cleared and the system is operating as intended.

8.4 Future Condition

Section 5.2 presents the process used to update the land use for potential future redevelopment areas in the City to estimate future wastewater flows. For the hydraulic analysis of the system under future conditions, calibrated GWI, UF factors, and R-factors developed above were applied to the updated land uses for projected future buildout conditions. The same design storm was used for both existing and future conditions.

8.4.1 Large Dischargers

If parcels were identified as large dischargers under existing conditions and located within "Opportunity Areas" (see **Figure 2-2** and **Figure 5-2**), the existing land use was compared to the future land use; where the land uses differed, the future land use UF factor was applied. If there

was no change to the land use, then the large discharger wastewater flow (see **Table 7-5**) under existing conditions was maintained for the future scenario.

Table 8-2 lists the large dischargers that were removed from the future condition and replaced with the future land use UF factors.

Table 8-2: Summary of Large Discharger Sites Planned for Redevelopment

Rank	Location[1]	Existing Land Use	Future Land Use
13	Main St	COM	MFH
15	McCarthy Blvd	INP	PAO
16	Landess Ave	COM	HDMU
20	McCarthy Blvd	INP	PAO
23	McCarthy Blvd	INP	PAO
26	Calaveras Blvd	COM	HDMU
36	Park Victoria Dr	COM	HDMU

Notes:
1. Source: January-March 2019 water meter customer billing data provided by the City multiplied by 85% - assumed portion of water use that contributes to wastewater flows.

Los Esteros Ranch, which is located at the intersection of McCarthy Blvd and Dixon Landing Road, is connected to the City collection system. This land use was added to the modeled system in accordance with the City's agreement with Los Esteros Ranch. The agreement between the City and Los Esteros Ranch, attached as **Appendix F**, states that they have a maximum allowable water usage of 50,000 gpd among the three parcels included in the agreement. Applying the same method identified for other large dischargers (see **Section 7.3.2**), it was assumed that wastewater flows constitute approximately 85% of water usage. Los Esteros Ranch was assigned a wastewater flow of 42,500 gpd and was added as a large discharger for the future condition. The area of the three contributing parcels was measured using the Measure tool in Bluebeam Revu 2016 and calibrated using the scale bar displayed on Exhibit "A" of the Los Esteros Ranch Agreement.

8.5 Hydraulic Capacity Deficiencies

Under dry weather conditions, **Table 8-3** shows a 6% increase to 7.9 MGD in average flow for future conditions at the outfall.

Table 8-3: Model Flow Summary

Scenario	Average DWF (MGD)	Peak DWF (MGD)	Peak WWF (MGD)
Existing	7.5	10.4	14.9
Future	7.9	11.0	18.5

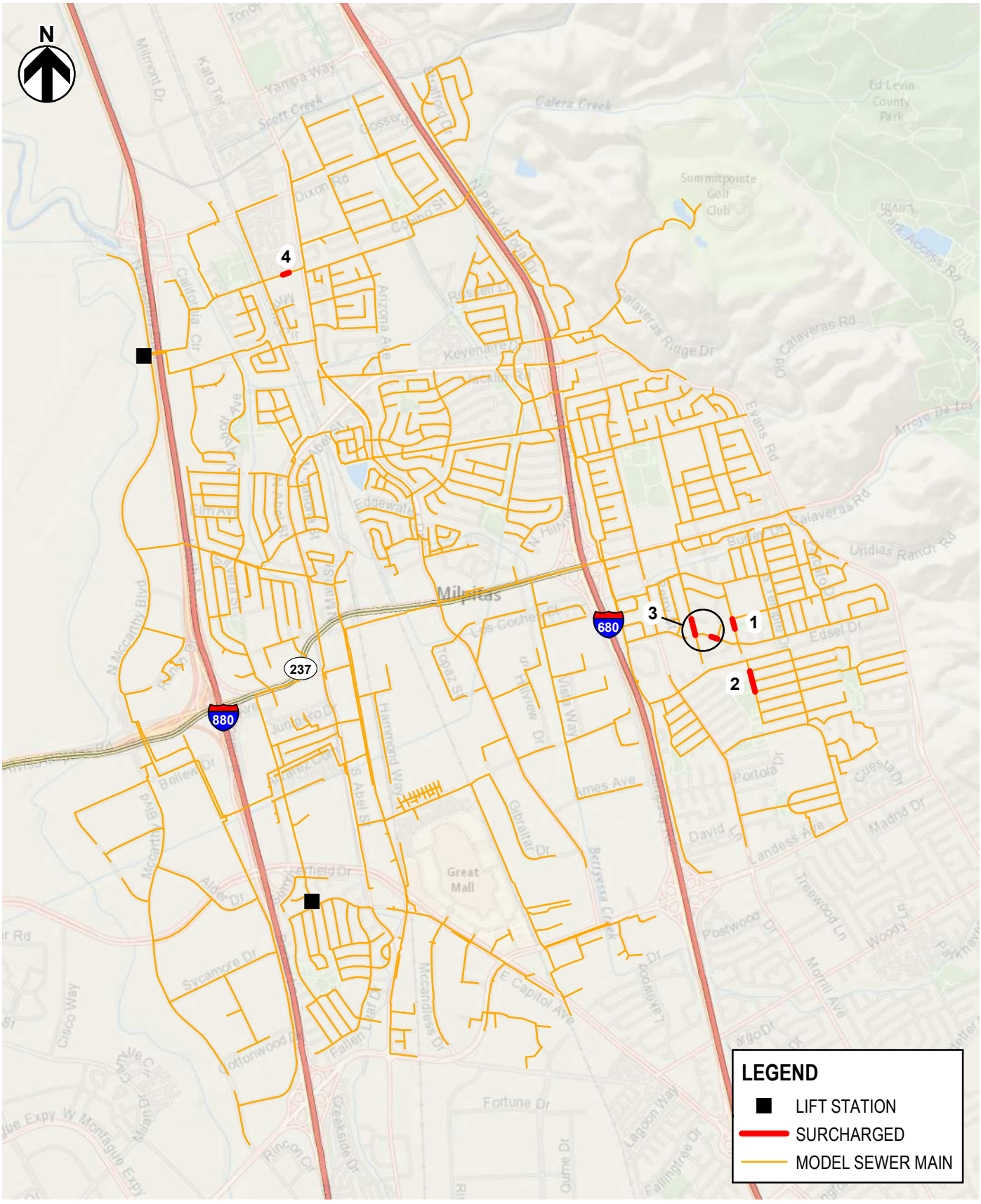


FIGURE 8-2
CITY OF MILPITAS
SEWER MASTER PLAN
SURCHARGED PIPELINE SEGMENTS

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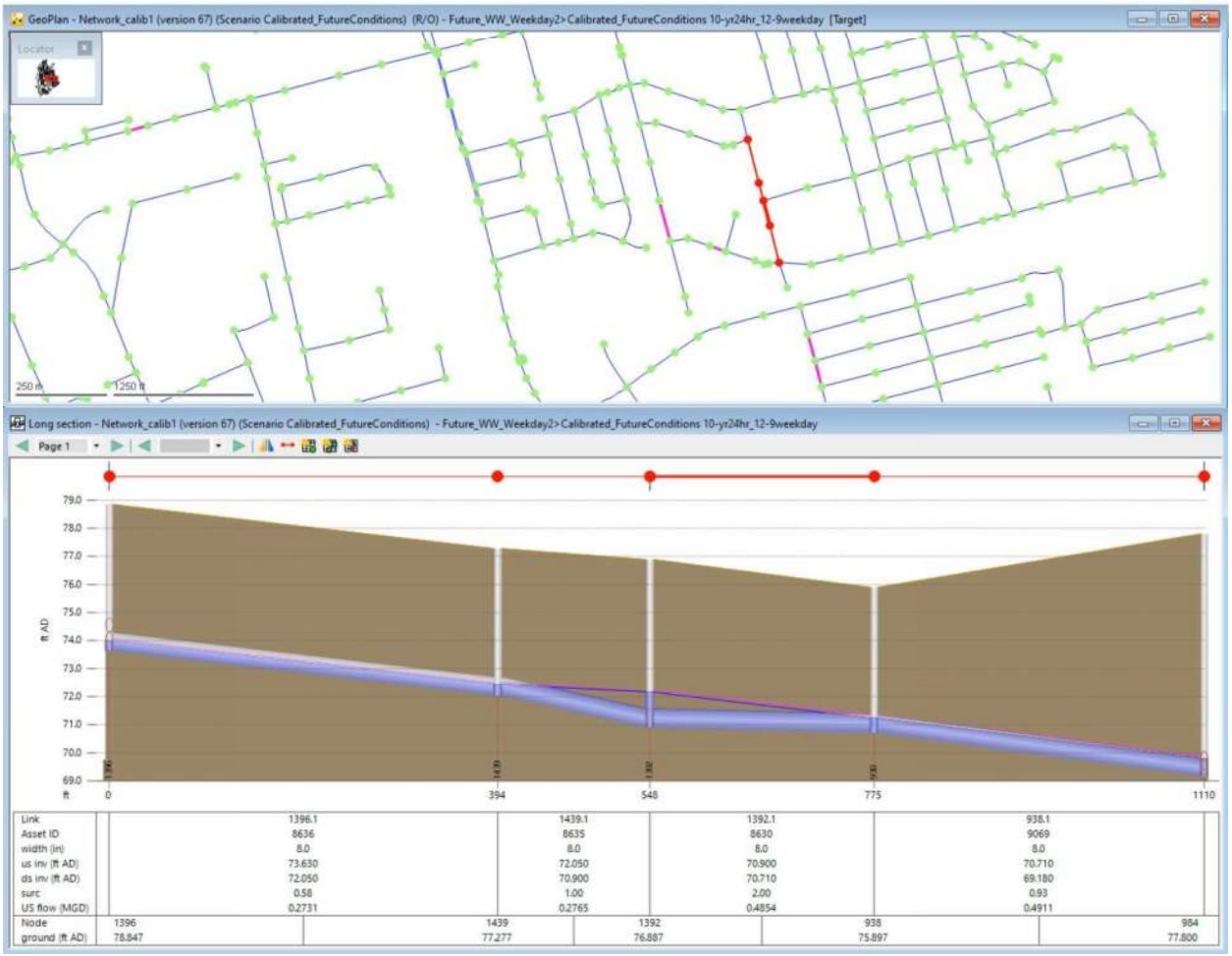
Under all scenarios, there were no additional surcharged segments identified under future conditions that were not seen under existing conditions. It is expected that this is because the City is largely built out and system improvements implemented with development have addressed potential deficiencies.

There were six pipe segments with a recorded surcharge state of "2" (see **Section 8.2**) under both existing and future conditions indicating that they are under capacity. These segments are displayed on **Figure 8-2**. Provided below is a description of each of these pipelines:

- **Surcharged Location 1:** This pipe segment drops below the minimum freeboard deficiency criteria (see **Table 8-1**) with a freeboard of 4.7 ft, shown in **Figure 8-3**. For a single pipe reach, replacement is not recommended without further cause. It is recommended that the City monitor this location for surcharging. This location (MH GID 1392) is a good candidate for installing a SmartCover to monitor the wastewater level and prevent SSOs.
- **Surcharged Location 2:** These two surcharged segments are 6-inch mains. Freeboard at these locations is greater than five feet, so they do not exceed the criteria for a capacity deficiency and therefore are not considered deficient. In general, it is recommended that all future sewer mains in the collection system are constructed with minimum diameters of 8-inches.

Figure 8-3: Surcharged Location 1 with 4.7 feet of Freeboard



- **Surcharged Location 3:** These two surcharged segments are 10-inch pipes. Freeboard at these locations is greater than five feet, so they do not exceed the criteria for a capacity deficiency and therefore are not considered deficient.
- **Surcharged Location 4:** This pipe, identified as under capacity (GID 17506), is located to the west of the intersection between N. Milpitas Blvd. and Washington Dr. In GIS, this segment was identified as an 8-inch pipe; however, both upstream and downstream pipes were identified as 12-inch pipes. During the review of record drawings, it was unclear if this pipe has been upsized to match the neighboring pipes. In the model, this segment experiences surcharging during wet weather as an 8-inch pipe, however, when this segment is upsized to 12-inches to match the neighboring pipe diameters, there is no longer surcharging. An improvement project is not recommended at this location as the freeboard is over ten feet and does not meet the threshold for deficiency identified in **Table 8-1**.

SECTION 9 – PROJECT DEVELOPMENT

Based on the condition assessment described in **SECTION 4**, projects were recommended to address prioritized defects identified in the collection system. This section describes the prioritization process and a summary of the project cost development. Results of this project development and selection translate into a prioritized CIP for the wastewater collection system.

9.1 Rehabilitation Selection Methodology

The PACP peak scores from the CCTV inspection and the risk scores calculated from the LoF/CoF desktop condition assessment drive the pipeline rehabilitation selection process. Below is a summary of the methodology implemented for both inspected and non-inspected pipe.

9.1.1 CCTV Inspected Segments

For segments with CCTV inspection data, a two-step process was used to determine the final rehabilitation recommendation. Using the defect coding assigned by NPS and the IAP software, the pipe segments with defects were assigned one of the following defect-level rehabilitation methods:

- Replace;
- Cured-in-place pipeline (CIPP);
- Point repair by excavation; or
- Sectional liner.

When the user assigns a rehabilitation method for each defect code, IAP assigns the respective rehabilitation method to each segment based on the associated defect coding.

Table 9-1 presents a sample of the assigned rehabilitation methods for all structural defects with a score of 5. A full list of all defect codes and associated rehabilitation methods can be found in **Appendix A** (R&R Study App. H).

With the rehabilitation method established for each defect code, a decision tree was established to determine the final overall rehabilitation method for the pipeline. This decision tree was prepared based on the following factors:

- CCTV structural peak score and overall peak score;
- Number of point repairs and lining recommendations by the defect-level rehabilitation methods module;
- Number of defects;
- Length of major (score of 4 or 5) and/or minor (score of 3) defects; and
- Presence of specific defects such as infiltration drippers (ID) or Reinforcement Corroded Chemical (SRCC).

Figure 9-1 presents a schematic of the established decision tree. Pipeline segments with CCTV inspection data are filtered by their PACP peak scores. Then, they are analyzed based on the number of point repairs and lining recommendations established by the defect-level rehabilitation methods module as well as the number of defects, length of defects, and presence of specified minor, but not negligible, defects. When multiple rehabilitation options were recommended, a cost analysis was performed to determine the best action. For example, if a segment was recommended to receive ten sectional liners, a full liner would be more cost-effective.

Table 9-1: Sample of Defect Codes with Associated Rehabilitation Methods

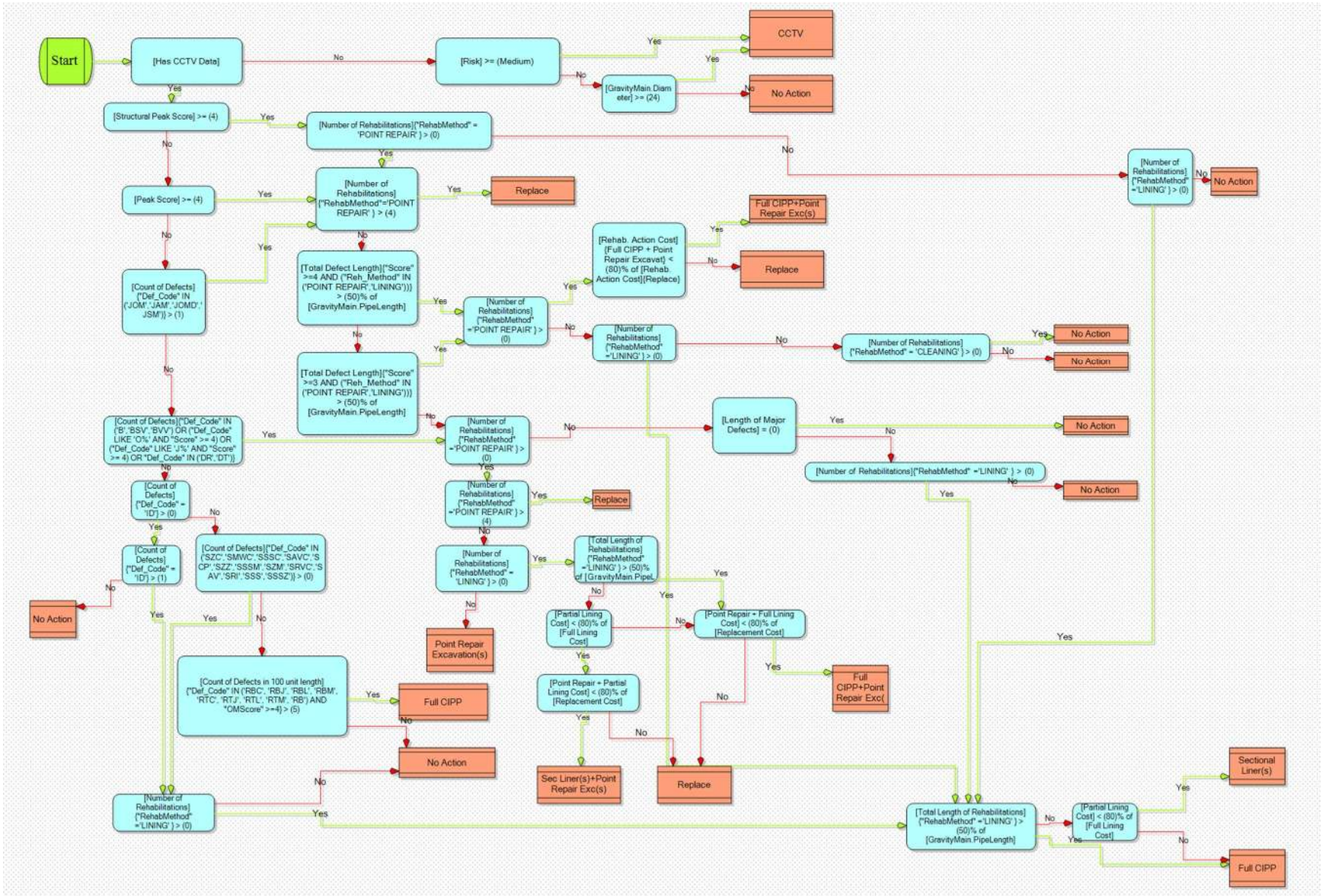
Defect Code	Score	Defect Type	Description	Rehabilitation Method
BSV	5	Structural	Broken Soil Visible	Point repair
BVV	5	Structural	Broken Void Visible	Point repair
DI	5	Structural	Dropped Invert	Point repair
DV	5	Structural	Deformed Vertical Brick	Point repair
HSV	5	Structural	Hole Soil Visible	Point repair
HVV	5	Structural	Hole Void Visible	Point repair
SMW	5	Structural	Missing Wall	Point repair
SMWC	5	Structural	Missing Wall Chemical	Point repair
SMWM	5	Structural	Missing Wall Chemical	Point repair
SMWZ	5	Structural	Missing Wall Unknown	Point repair
SRC	5	Structural	Reinforcement Corroded	Point repair
SRCC	5	Structural	Reinforcement Corroded Chemical	Point repair
SRCM	5	Structural	Reinforcement Corroded Mechanical	Point repair
SRCZ	5	Structural	Reinforcement Corroded Unknown	Point repair
SRP	5	Structural	Reinforcement Projecting	Lining
SRVM	5	Structural	Reinforcement Visible Mechanical	Lining
SRVZ	5	Structural	Reinforcement Visible Unknown	Lining
XB	5	Structural	Collapse Brick Sewer	Point repair
XP	5	Structural	Collapse Pipe Sewer	Point repair

Figure 9-2 displays the final rehabilitation methods recommended for each segment based on the decision tree. For a table of the recommended rehabilitation method for each segment, see **Appendix A** (R&R Study App. A).

9.1.2 Segments without CCTV Inspection

For segments without CCTV inspection data, risk scores and diameter were used to develop a prioritized set of segments that are recommended for CCTV inspection and further analysis. Pipeline segments with a risk score of medium or higher (greater than or equal to three) – see **Section 4.2.3** – were included as part of this CCTV recommendation. Additionally, all pipelines with a diameter of 24-inches or greater are recommended for prioritized CCTV regardless of the associated risk rating. **Figure 9-3** presents the segments recommended to prioritize for CCTV.

Figure 9-1: Rehabilitation Decision Tree



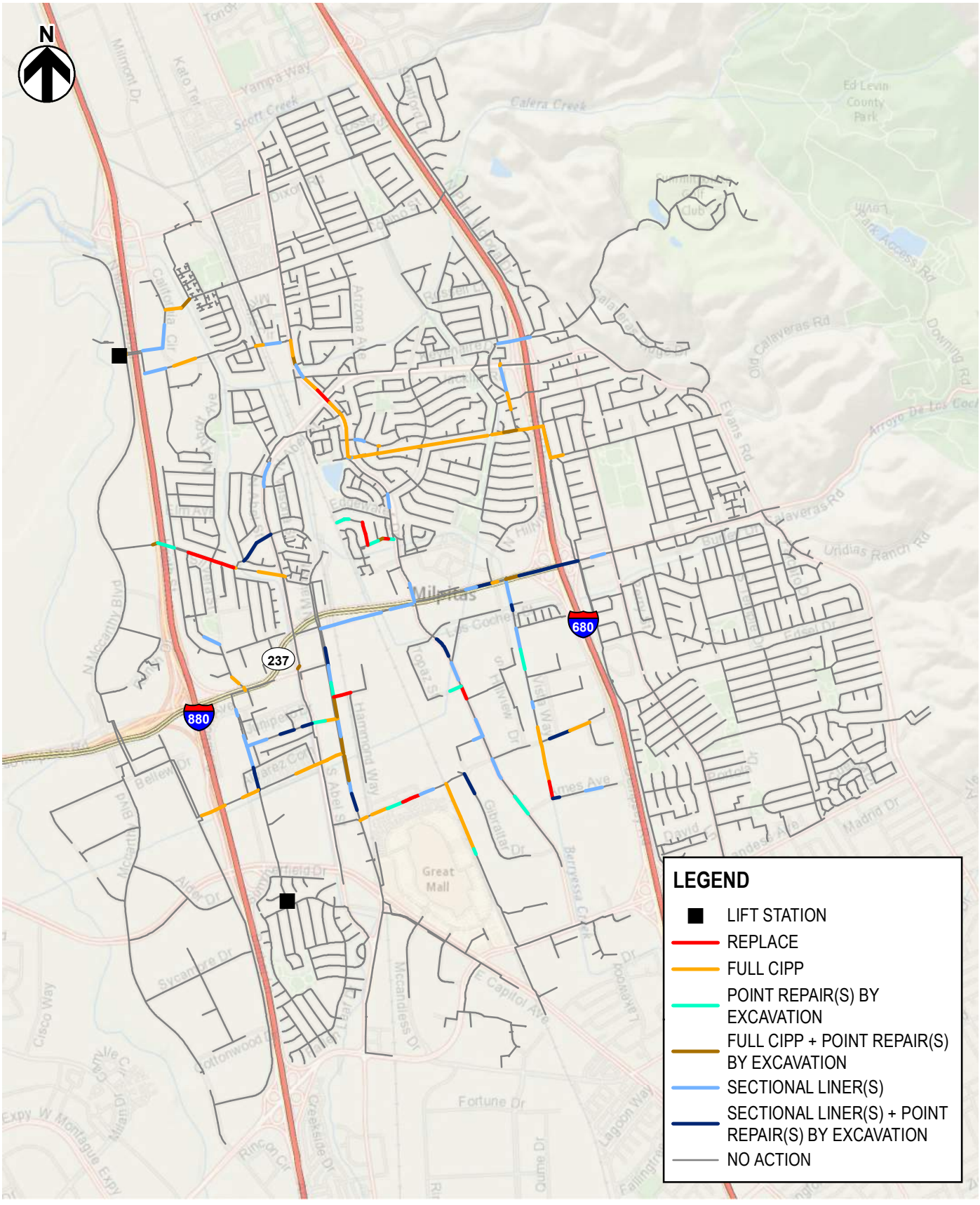


FIGURE 9-2
CITY OF MILPITAS
SEWER MASTER PLAN
RECOMMENDED REHABILITATION METHOD

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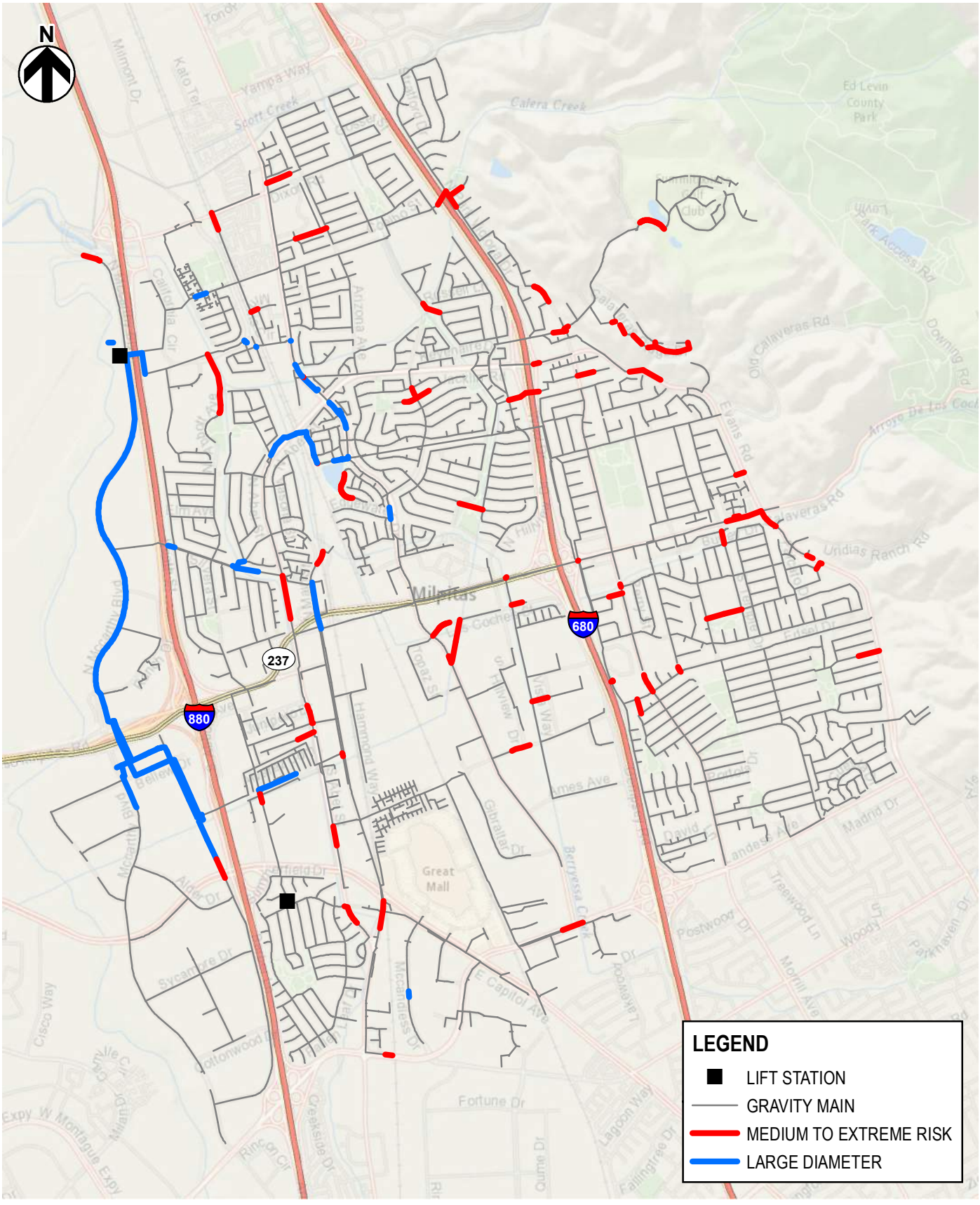

FIGURE 9-3
CITY OF MILPITAS
SEWER MASTER PLAN
RECOMMENDED CCTV PRIORITY

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9.2 Basis of Cost Assumptions

A cost estimate was developed for each type of rehabilitation method. Provided is a description of the basis for unit cost development and associated project-specific costs for pipelines, resurfacing, manholes, pumping systems, structural rehabilitation, protective coatings, bypass and redundancy, and electrical equipment. The purpose of approximating construction costs is to appropriate a conservative level of funding for each identified rehabilitation project included within the proposed scope of the City's upcoming CIP. **Appendix A** (R&R Study App. J) contains details of the preliminary cost estimates for all projects analyzed as part of this SMP.

9.2.1 CCTV Costs

CCTV costs were estimated based on diameter and length. Unit costs are conservative to account for the added cost for specialized techniques, such as laser profiling for large diameter pipe, and general quality control review. Unit costs are provided in **Table 9-2**.

Table 9-2: CCTV Unit Costs

Pipe Diameter (in)	Unit Cost ($/ft)
Up to 18	$4
19 to 24	$5
25 to 36	$6
37 to 66	$8

9.2.2 Pipeline Unit Costs

Unit costs for pipelines were estimated based on recent project bid tabulation for similar Capital Improvement Projects in the Bay Area as well as experience estimating the cost of similar local rehabilitation projects.

Pipeline Replacement and Rehabilitation

For the purposes of this SMP, in general, pipeline replacement projects are estimated using a loaded construction cost estimate of approximately $35/inch-diameter per foot of pipeline replaced. The loaded pipeline unit cost was developed using relevant pipeline replacement project cost of construction bid averages divided by the total foot-inches (the length of pipe multiplied by the diameter in inches) of pipeline included within the scope of each specific project. Budgetary values for sewer bypassing and traffic control are also approximated using assumed construction quantities and according to the unit cost estimation summary provided in **Table 9-3**. The construction contingency provides an allotment of funds designated for unexpected issues that can change the scope of the project. For conceptual planning and cost comparisons of pipeline projects, the following parameters and associated unit costs were globally applied to recommended pipeline projects. Detailed unit costs for each improvement type according to size and depth are detailed in **Appendix A** (R&R Study App. J).

Table 9-3: Pipeline Improvement Unit Cost Summary

Cost Parameter	Unit Cost	Unit Criteria
Pipeline Replacement[1]	$35	Per inch-diameter per pipeline foot-length
Full Pipe Length CIPP	$16	Per inch-diameter per pipeline foot-length
Point Repair by Excavation	$600 - $10,500	Per inch-diameter per pipeline foot-length, depending on depth
Sectional Liner	$3,000 – $15,000	Per repair, depends upon pipeline diameter
Mobilization/Demobilization	5%	Cost of construction
Sewer Bypassing[2]	10%	Cost of construction
Traffic Control During Construction	$10k - $15k	Per roadway traffic rating
Construction Cost and Market Contingency	30%	Construction Subtotal

Notes:
1. Loaded cost including costs associated with earthwork, demolition, sheeting, shoring & bracing, paving, and testing and commissioning. Pavement repair assumes minimum four-foot-wide trench per running foot.
2. Sewer bypassing costs typically requires expected flow capacity to determine hydraulic sizing of temporary equipment and materials.

9.2.3 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 the following:

- Engineering design and consulting is expected to also address California Environmental Quality Act (CEQA) requirements to identify significant environmental impacts, if any.
- Permitting, land acquisition and obtaining right-of-way (ROW) are dependent on the project. For existing City facilities, the cost is expected to be less than if an easement is needed to be obtained through a property. The cost is also expected to be a function of the total cost. A range of percentages were applied to each project.
- Engineering services during construction (ESDC) and construction management costs are those costs associated with the administration of the contract and management of the project, ensuring the project is constructed as designed.
- The annual inflation of cost that would occur over time for a future project.

Table 9-4 provides a summary of the parameters used for estimating the soft costs. Soft costs were applied to all projects.

Table 9-4: Soft Cost Estimating Parameters

Cost Parameter	Cost	Applied to:
Engineering Design and Consulting Services	15%	Construction Subtotal
Permitting, land acquisition, and obtaining ROW	7%	Construction Subtotal
ESDC, Construction Management, & Inspection Services	12%	Construction Subtotal
Annual Inflation	3%	Project Total

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SECTION 10 – CAPITAL IMPROVEMENT PLAN

This section presents a summary of the prioritized set of CIP projects developed as a culmination of the condition assessment (CCTV inspection, desktop inspection, and lift station inspection) presented in **SECTION 4** and the project development summarized in **SECTION 9**. Recommendations include budget estimates and targeted timelines for project implementation based on the prioritization laid out in **SECTION 9**.

10.1 Existing CIP Projects

Every year, the City prepares a five-year CIP that provides the City Council, staff, and public with a comprehensive planning tool for budgeting and carrying out a range of capital projects. To ensure that the recommendations provided as part of this Master Plan Study align with recent, ongoing, and planned projects, a review of the City's 2020-2025 CIP was conducted. **Table 10-1** presents recent and ongoing wastewater collection system and lift station improvement projects per the 2020-2025 CIP.

Table 10-1: Recent Sewer Improvement Projects

Project ID	Project	Description	Status
6119	Sanitary Sewer Condition Assessment Program	Citywide sanitary sewer condition assessment program to determine the condition of the City's sanitary sewer system.	This phase to be completed during FY 2020/21.
6124	Pump Station Rehabilitation Program	Rehabilitation or replacement of wastewater pumps at Main LS and Venus LS to safely discharge sewage.	Replacement of pump no. 3 and purchase of portable backup generator at the Main LS planned for FY 2020-21.
6126	Minor Sewer Projects	Ongoing analysis, engineering, and implementation of various minor modifications and improvements to existing sewer systems.	Transfer switch at Venus and pavement restoration at the Main LS are planned for FY 2020-21.
6130	Main LS Odor Emissions Control	Installation of odor emission controls at the Main LS to address concerns regarding elevated levels of hydrogen sulfide and other odorous compounds at the facility.	Design started in FY2018-19 and construction started during spring 2020.
6131	Sanitary Sewer Cathodic Protection Improvements	Assessment, design, and installation of cathodic protection system along City's steel sewer force main from the Main LS to the RWF. Includes replacement of two existing magnetic flow meters at the Main LS with proper isolation to prevent reading interference.	Assessment and design started in FY 2019-20.
6134	On-Call Sewer Maintenance & Repair Services	On-call repair and maintenance services at all City sewer infrastructure, assets, and appurtenances.	Ongoing
Plan	Sewer Line Replacement at E. Curtis	Design and construction of sanitary sewer main replacement/upgrade on E. Curtis Avenue from S. Main Street to the E. Curtis cul-de-sac. This project will be financed through TASP Impact Fees.	2023-2024

Table 10-2 provides a summary of the 2020-2025 allocation for each of the projects and the sources of funding for each per the City's Capital Improvement Program 2020-2025 Final Report.

Table 10-2: Existing CIP Financing for 2020-2025

Projects	Sewer Infrastructure Fund	Sewer Fund	Sewer Treatment Fund	Total
6119 Sanitary Sewer Condition Assessment Prgm[1]	($50,000)	($74,000)	$0	$ 0
6124 Pump Station Rehabilitation Program[2]	$52,000	$0	$0	$52,000
6126 Minor Sewer Projects[3]	$163,000	$0	$0	$163,000
6130 Main Lift Station Odor Emissions Control	$0	$0	$200,000	$200,000
6131 Sanitary Sewer Cathodic Protection Improvements	$500,000	$0	$0	$500,000
6134 On-Call Sewer Maintenance & Repair Services	$24,000	$74,000	$0	$98,000
Total Existing Projects	$689,000	$0	$200,000	$889,000

Notes:
1. The total $124,000 in prior year funding from Sewer Fund and Sewer Infrastructure Fund to be allocated for other projects in FY2020-21. There is no further allocation for this program according to the Capital Improvement Program 2020-2025 Final Report
2. This is the net allocation. Original allocation is $200,000 with $148,000 in prior year funding from Sewer Infrastructure Fund to be allocated for other projects in FY2020-21.
3. This is the net allocation. Original allocation is $200,000 with $37,000 in prior year funding from Sewer Infrastructure Fund to be allocated for other projects in FY2020-21.

Sewer CIP are largely funded by the Sewer Infrastructure Fund. Other funding sources include the Sewer Fund (user rate structure) and the Sewer Treatment Fund (sewer connection fees). The funds are described in the CIP 2020-2025 Final Report as follows:

- **Sewer Infrastructure Fund:** Monies set aside to replace aging infrastructure for sewer related projects.
- **Sewer Fund:** Enterprise fund which receives revenue from sewer rates for sewer related improvements.
- **Sewer Treatment Fund:** Funded from fees collected from developers connecting to the Sewer System. Funds restricted for sewer related projects.

10.2 Proposed CIP Projects

Three alternatives to project phasing were evaluated in developing the proposed CIP phases. The first alternative addresses CIP projects based on BRE grades without consideration of project location, prioritizing the highest risk projects. The second alternative approach groups projects geographically within the sewer basin. The third alternative, which was selected for implementation, was a hybrid approach where pipelines with significant defects were prioritized in the first year and each subsequent year considered risk, type of rehabilitation, and geographic location. The general strategy is to address the highest risk/highest priority projects in the near-term (Years 1-5) with lower risk projects deferred to the medium- (Years 6-10) and long-term (Years 11-20). The objective was to budget for approximately $1.5M-$2M annually. Depending on funding availability, projects can slide up or down CIP phases while maintaining project priority.

The detailed risk assessment, basis for selecting rehabilitation methods, prioritization of improvements, and the related construction costs (construction and contingency) are provided in **Appendix A** (R&R Study).

Soft costs, as described in **Section 9.2.3**, consisting of engineering design and consulting; permitting and ROW; and ESDC, construction management and inspection services are included in the capital project costs provided. The following sections present the recommended projects for implementation and the proposed timeframe.

10.2.1 CCTV Inspection

Approximately 105,000 ft (449 segments) of sewer main was inspected as part of the condition assessment. The remaining 685,000 ft was analyzed using the desktop assessment. Medium- to extreme-risk pipes and large diameter pipes are recommended for CCTV inspection. Large diameter pipe is defined as 24-inch diameter or greater. **Figure 9-3** presents the recommended CCTV inspection map of these highest priority areas. These inspections total 55,000 ft, with an estimated cost totaling approximately $400,000 based on the unit costs provided in **Section 9.2.1**.

It is noted that the CCTV inspection work may generate additional improvement projects that may augment the proposed CIP. There is an existing CIP project (6126) that is intended to address minor sewer projects that currently allocates $50,000 annually. It is recommended that the City increase the annual allowance to $250,000 ($1.25M every five years) to budget for improvements needed to address defects as they are discovered during new CCTV inspections.

10.2.2 Pipeline Improvements

Of the approximately 105,000 ft (449 segments) of sewer pipeline inspected, approximately 50,000 ft (178 segments, see **Figure 9-2**) requires improvement. Recommended improvements include:

- Pipe Replacement
- Full Cured-In-Place Pipe (CIPP)
- Point Repair(s) by Excavation
- Sectional Liner(s)

It is noted that some pipeline segments include more than one recommended rehabilitation method.

The highest priority improvements are those segments identified to have significant defects during the condition assessment and thus rated as highest risk of failure. These projects are proposed for immediate improvement (Year 1) to reduce the likelihood of a catastrophic failure and are summarized in **Table 10-3**. The proposed method of rehabilitation is provided along with the capital cost for the collective improvements.

Table 10-3: Highest Priority Pipe with Significant Defects (Year 1: 2022)

Average Risk Grade	Street Name	Diameter (in)	Length (ft)	Material	Recommended Rehabilitation Method	Construction Cost
5.0	Coming Ave	8	234	VCP	Sectional Liner(s), Point Repair(s)	$30,000
5.0	E Calaveras Blvd	15	1305	VCP	Sectional Liner(s), Point Repair(s), Full CIPP	$273,000
5.0	Just East of S Hillview Dr	15	491	VCP	Sectional Liner(s), Full CIPP	$50,000
4.0	Curtis Ave	18	172	VCP	Sectional Liner(s)	$39,000
4.0	Marylinn Dr	27	292	VCP, RCP	Pipe Replacement, Full CIPP, Point Repair(s)	$322,000
4.0	N Hillview Dr	12	218	VCP	Sectional Liner(s)	$32,000
4.0	S Main St	18, 21	733	VCP	Sectional Liner(s), Point Repair(s)	$67,000
4.0	Sinnot Ln	12	398	VCP	Full CIPP, Point Repair(s)	$139,000
Construction Subtotal						**$952,000**
Construction Contingency					30%	$286,000
Engineering Design and Consulting Services					15%	$143,000
Permitting and Right of Way (ROW)					7%	$67,000
ESDC, Construction Management, & Inspection Services					12%	$114,000
Total Year 1 Project Costs						**$1,562,000**

Additional high- and some medium-priority improvements are recommended for implementation in the first five years after addressing the highest risk improvements shown in **Table 10-3**. These improvements are listed in **Table 10-4** and include the next priority projects, which also combine pipes with rehabilitation needs (of any risk grading) along the same street for efficiency.

Table 10-4: Medium- to High-Priority Improvements (Years 2-5: 2023-2026)

Average Risk Grade	Street Name	Diameter (in)	Length (ft)	Material	Recommended Rehabilitation Method	Construction Cost
5.0	S Abel St	18	66	VCP	Point Repair(s), Sectional Liner(s)	$32,000
3.9	Just East of S Hillview Dr[1]	12, 15	2,947	VCP	Full CIPP, Point Repair(s), Sectional Liner(s)	$503,000
3.7	N Milpitas Blvd	33, 39	3,062	RCP	Full CIPP, Sectional Liner(s)	$1,776,000
3.5	Nimitz Fwy and California Cir	18, 42	1,974	VCP, RCP	Full CIPP, Sectional Liner(s)	$474,000
3.3	E Calaveras Blvd[1]	12, 15, 18, 21	3,336	VCP	Full CIPP, Point Repair(s), Sectional Liner(s)	$286,000
3.2	Coming Ave[1]	8	1,374	VCP	Full CIPP	$140,000
Construction Subtotal						**$3,211,000**
Contingency					30%	$963,000
Engineering Design and Consulting Services					15%	$482,000
Permitting and Right of Way (ROW)					7%	$225,000
ESDC, Construction Management, & Inspection Services					12%	$385,000
Total Year 2-5 Project Costs						**$5,266,000**

Notes:
1. This street had some rehabilitation addressed in Year 1.

After addressing all high-priority, and some medium-priority, improvements in the first five years, the remaining medium-priority improvements are proposed for the next five-year period (Years 6-10). These improvements are listed in **Table 10-5**.

Table 10-5: Medium-Priority Improvements (Years 6-10: 2027-2031)

Average Risk Grade	Street Name	Diameter (in)	Length (ft)	Material	Recommended Rehabilitation Method	Construction Cost
3.3	S Main St[1]	18, 21	2,882	VCP	Point Repair(s) and Sectional Liner(s)	$427,000
2.9	Machado Ave	24, 30	2,939	RCP, VCP	Full CIPP, Sectional Liner(s)	$1,006,000
2.8	B/w Tramway Dr & Los Pinos Ave	24, 30	4,473	VCP, RCP	Full CIPP, Sectional Liner(s)	$2,484,000
Construction Subtotal						**$3,917,000**
Contingency					30%	$1,175,000
Engineering Design and Consulting Services					15%	$588,000
Permitting and Right of Way (ROW)					7%	$274,000
ESDC, Construction Management, & Inspection Services					12%	$470,000
Total Year 6-10 Project Costs						**$6,424,000**

Notes:
1. This street had some rehabilitation addressed in Year 1.

Low- and very low-priority improvements are proposed in the longer-term CIP (Years 11-20). The next two five-year increments are proposed in **Table 10-6** and **Table 10-7**. While these pipelines pose a small risk of failure, it is expected that they can continue to operate without significant likelihood of immediate failure.

Table 10-6: Low-Priority Improvements (Years 11-15: 2032-2036)

Average Risk Grade	Street Name	Diameter (in)	Length (ft)	Material	Recommended Rehabilitation Method	Construction Cost
3.1	Marylinn Dr	27, 30	2,841	RCP, VCP, SS	Full CIPP, Pipe Replacement, Point Repair(s), Sectional Liner(s)	$1,472,000
3.0	Ames Ave	12	533	VCP	Point Repair(s), Sectional Liner(s)	$50,000
3.0	Connection b/w N Milpitas Blvd & Summerwind Way	42	563	RCP	Full CIPP, Sectional Liner(s)	$176,000
3.0	Curtis Ave	15, 18	1,457	VCP	Full CIPP, Pipe Replacement, Point Repair(s), Sectional Liner(s)	$572,000
3.0	Gibraltar Dr	12	502	VCP	Point Repair(s), Sectional Liner(s)	$46,000
3.0	Kennedy Dr	12	276	VCP	Full CIPP	$82,000
3.0	N Abel St	27	543	VCP	Sectional Liner(s)	$103,000
3.0	N McCarthy Blvd	18	44	VCP	Sectional Liner(s)	$31,000
3.0	N Milpitas Blvd	15	423	VCP	Sectional Liner(s)	$122,000
3.0	River Rock Rd	18	561	VCP, RCP	Full CIPP	$238,000
3.0	S Abbott Ave	15, 16	285	VCP, CIP	Sectional Liner(s), Full CIPP	$103,000
3.0	S Milpitas Blvd	8, 12, 18	1,695	VCP	Point Repair(s), Sectional Liner(s)	$135,000
3.0	Fwy Crossing near Fox Hollow Ct	12	748	VCP	Sectional Liner(s)	$49,000
3.0	Smithwood St	15	388	VCP	Sectional Liner(s)	$19,000
3.0	Tramway Dr	12	38	VCP	Full CIPP	$19,000
3.0	Venus Way	8	46	VCP	Point Repair(s)	$12,000
3.0	Wool Dr	24	368	VCP	Full CIPP	$168,000
3.0	Yosemite Dr	8	970	VCP	Full CIPP, Pt Repair(s), Sectional Liner(s)	$88,000
2.8	Great Mall Dr	15	1,724	VCP	Full CIPP, Pt Repair(s), Sectional Liner(s)	$448,000
2.7	Connection to SW Community Starting from W Calaveras Blvd	15	1,419	VCP	Full CIPP, Pt Repair(s), Sectional Liner(s)	$168,000
2.3	N Hillview Dr	12	833	VCP, DIP	Full CIPP, Sectional Liner(s)	$99,000
Construction Subtotal						**$4,200,000**
Contingency					30%	$1,260,000
Engineering Design and Consulting Services					15%	$630,000
Permitting and Right of Way (ROW)					7%	$294,000
ESDC, Construction Management, & Inspection Services					12%	$504,000
Total Year 11-15 Project Costs						**$6,888,000**

Table 10-7: Very Low-Priority Improvements (Years 16-20: 2037-2041)

Average Risk Grade	Street Name	Diameter (in)	Length (ft)	Material	Recommended Rehabilitation Method	Construction Cost
2.0	S Milpitas Blvd	8, 12	893	VCP	Sectional Liner(s)	$75,000
2.0	Turquoise St	10	275	VCP	Point Repair(s)	$25,000
2.0	Tramway Dr	12	220	VCP	Sectional Liner(s)	$18,000
1.0	Connection b/w S Milpitas Blvd and Gibraltar Ct	12	231	VCP	Sectional Liner(s)	$29,000
1.0	Meadowland Dr	15	816	Unknown	Pipe Replacement and Point Repair(s)	$354,000
1.0	Silverlake Dr	15	621	Unknown	Full CIPP and Point Repair(s)	$86,000
1.0	Wool Dr	24	368	RCP	Full CIPP	$169,000
Construction Subtotal						**$756,000**
Contingency					30%	$227,000
Engineering Design and Consulting Services					15%	$113,000
Permitting and Right of Way (ROW)					7%	$53,000
ESDC, Construction Management, & Inspection Services					12%	$91,000
Total Year 16-20 Project Costs						**$1,240,000**

10.2.3 Lift Station

The Main LS and Venus Way LS were inspected, and major deficiencies were catalogued in the LS Report, as summarized in **Section 4.3** and detailed in **Appendix A** (R&R Study App. K). There are no immediate needs for the Venus Way LS. For the Main LS, the highest scoring deficiencies are identified **Table 10-8** and presented in order of priority according to both the condition and performance scores for the specific asset. Per City's 2019-24 CIP, project 6124, an allowance of $100,000 annual investment from FY 2019-20 through FY 2022-23 is planned to address these rehabilitation needs.

Table 10-8: Main LS Deficiencies

Asset Name	Field Assessment/Comments	Condition Score	Performance Score
Manifold PV #2 Actuator	Does not work	5	5
Grinder #1	Excessive vibration and inadequate supports	5	5
Air Vacuum 1 to 15	Cavitation, coating failure, and inadequate supports	5	5
Mag Meter (Flow Meter A)[1]	Not in operation	4	4
Pump #3	Has exceeded useful life[2]	4	4
2" Combination Air/Vacuum Valve	None	4	4
Flow Meter B[1]	Operable, but not accurate	4	4
Variable Frequency Drive P2	No corrosion identified, arc flash labels missing	4	2
Variable Frequency Drive P3	No corrosion identified, confirmed by City that IGBT was replaced in 2019, arc flash labels missing	4	2
Variable Frequency Drive P4	No corrosion identified, arc flash labels missing	4	2
Variable Frequency Drive P5	No corrosion identified, confirmed by City that cooling fans were replaced in 2019, arc flash labels missing	4	2

Notes:
1. The City is replacing these meters as part of CIP Project 6131: Sanitary Sewer Cathodic Protection Improvements.
2. This pump has logged over 50,000 hours.

10.3 CIP Budget and Schedule

The sewer CIP is funded by the sewer enterprise fund which includes the user rate structure and sewer connection fees. Provided below in **Table 10-9** is a proposed budget and schedule for the CIP and recommended projects over 20-years in 5-year increments. The most critical projects are scheduled for earlier implementation. It is noted that the timing of projects can be adjusted based on results of CCTV and future operating conditions. **Figure 10-1** presents the proposed improvement projects in 5-year increments.

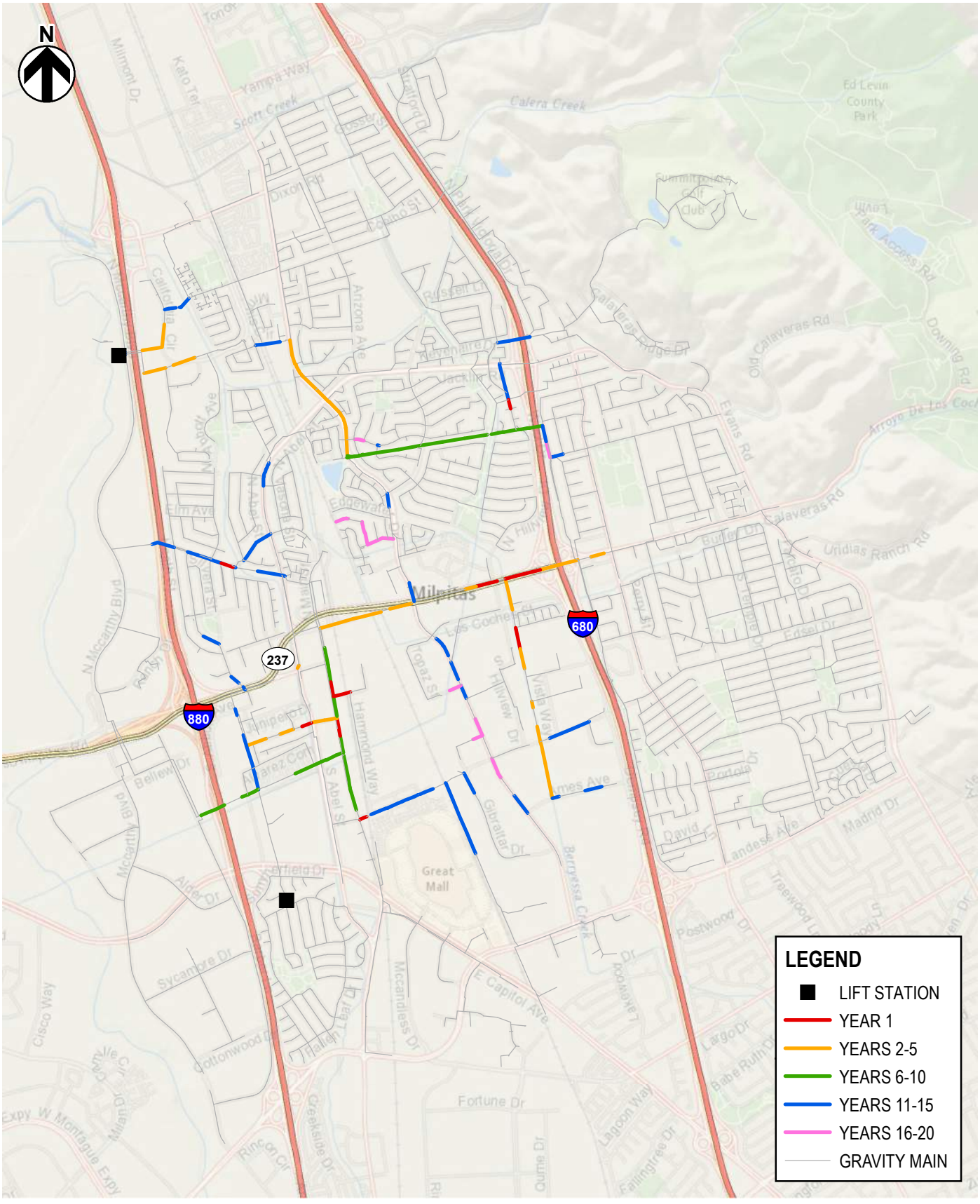

FIGURE 10-1
CITY OF MILPITAS
SEWER MASTER PLAN
CAPITAL IMPROVEMENT PROJECTS

HydroScience

Table 10-9: Proposed CIP Schedule and Budget

Projects	5-Year (2022-2026)	10-Year (2027-2031)	15-Year (2032-2036)	20-Year (2037-2041)
Existing Projects				
6124 Pump Station Rehabilitation Program	$200,000[1]	--	--	--
6126 Minor Sewer Projects	$200,000[2]	--	--	--
6130 Main Lift Station Odor Emissions Control	$200,000	--	--	--
6131 Sanitary Sewer Cathodic Protection Improvements	$500,000	--	--	--
6134 On-Call Sewer Maintenance & Repair Services	$98,000	--	--	--
Total Existing Projects	**$1,198,000**	**--**	**--**	**--**
Proposed Projects				
CCTV large diameter and high-risk assets	$400,000	--	--	--
Highest Priority Improvements	$1,562,000	--	--	--
Medium- to High- Priority Improvements	$5,266,000	$6,424,000	--	--
Low Priority Improvements	--	--	$6,888,000	$1,240000
Allocation for improvements identified from ongoing CCTV	$1,250,000	$1,250,000	$1,250,000	$1,250,000
Total Proposed Projects	**$8,478,000**	**$7,674,000**	**$8,138,000**	**$2,490,000**
Existing and Proposed Projects	**$9,676,000**	**$7,674,000**	**$8,138,000**	**$2,490,000**

Notes:
1. Original allocation is $200,000 through 2023 with $148,000 in prior year funding from Sewer Infrastructure Fund to be allocated for other projects in FY2020-21.
2. Original allocation is $200,000 with $37,000 in prior year funding from Sewer Infrastructure Fund to be allocated for other projects in FY2020-21.

10.4 Other Recommendations

During the CCTV inspection performed by NPS, there were instances of large grease buildup in various locations throughout the wastewater collection system. As explained previously, the presence of grease buildup and other blockages, particularly at, or near, critical flow splits, can significantly impact collection system operations, particularly at flow splits, which are generally intended to mitigate high flows and provide redundancy. This redundancy aids the system's ability to handle higher flows during wet weather events and as the water table rises during the wet season. When flow splits are not operating properly, this can drastically impact the system operation, particularly during wet weather events.

It is recommended that the City cleans the locations identified as having grease buildup. Locations should also be vacuumed to remove blockages from moving further downstream. In addition, stricter FOG Control Program guidelines and increased inspections may be necessary to prevent FOG discharges to the wastewater collection system.

It is expected that there will be additional O&M costs related to the following:

- In-house CCTV inspection;
- Additional cleaning related to the act of inspection and as a result of discovering blockages; and
- Implementing a stricter FOG Control Program/increased inspections of grease traps.

In addition to the projects summarized herein, the City is evaluating the need to rehabilitate or replace Force Main A (FM-A), which conveys wastewater from the Main LS to the RWF (see **Figure 3-1**). Built in 1974, FM-A was identified as requiring inspection because the soils surrounding the pipeline are very corrosive. The City contracted with a third party to perform cleaning and CCTV inspection of FM-A to determine the internal condition. The inspection was not fully completed due to unforeseen obstacles.

It is recommended that the City perform a complete condition assessment of FM-A to verify the internal condition of the pipeline and determine the best options for rehabilitation or replacement. The City's report generated by the engineering department is included as **Appendix G**.

Initial City estimates to rehabilitate or replace FM-A are approximately $1M to complete the force main assessment and maintenance of the appurtenances and an additional $25M to replace the force main. Both of these costs were included as capital projects requiring consideration for an upcoming CIP, in addition to the amounts specified in **Section 10.3**.

APPENDIX A

City of Milpitas
Sewer Master Plan Study
Sewer Utility Asset Renewal and Replacement Study

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Due to the size of the file, this Appendix is provided as a separate document.

APPENDIX B

City of Milpitas
Sewer Master Plan Study
Milpitas Sewer Flow Monitoring Report 2019-2020

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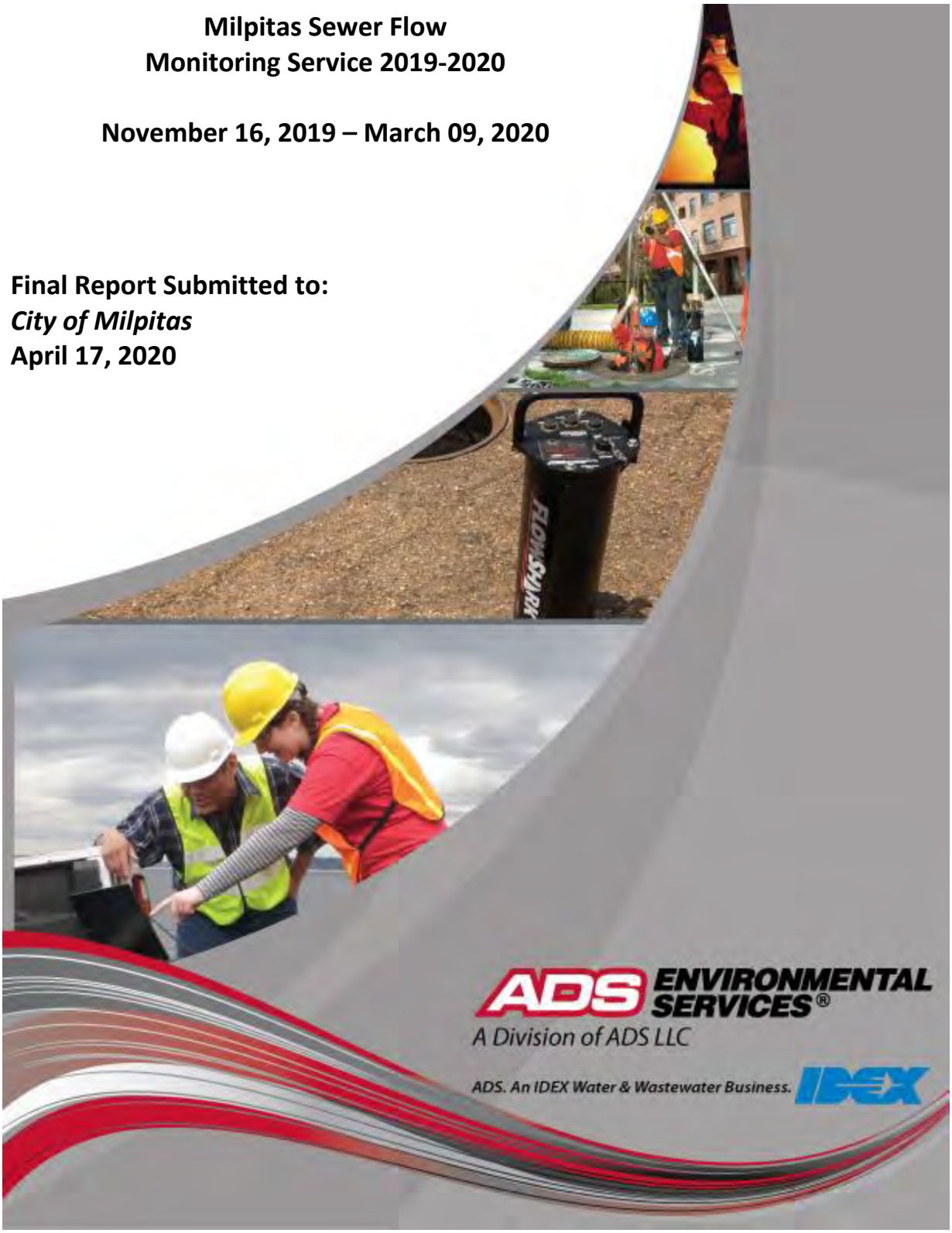
Milpitas Sewer Flow Monitoring Service 2019-2020

November 16, 2019 – March 09, 2020

Final Report Submitted to:
City of Milpitas
April 17, 2020



Milpitas Sewer Flow Monitoring Service
2019 - 2020

Prepared for:

Theodore Alicante
City of Milpitas
455 E. Calaveras Boulevard
Milpitas, CA 95035

Prepared by:

ADS, LLC
15201 Springdale Street
Huntington Beach, CA 92649

Letter of Transmittal

ADS LLC

April 17, 2020

Theodore Alicante
City of Milpitas
455 E. Calaveras Boulevard
Milpitas, CA 95035

SUBJECT: Milpitas Sewer Flow Monitoring Service 2019 - 2020

Dear Theodore,

ADS is pleased to submit the report for the Milpitas Sewer Flow Monitoring Service 2019 - 2020 conducted on behalf of the City of Milpitas. The metering was contracted for ninety (90) days at twenty-three (23) flow monitor and two (2) rain rauge locations. The study period is November 16, 2019 - March 09, 2020. All available data has been provided.

The report contains hourly averaged depth, velocity, and quantity hydrographs as well as daily long tables for the metering period in pdf format. Depth, quantity, and velocity entities for each monitoring location have been provided on Prism.

In addition, we would be happy to further explain any details about the report that may seem unclear. Should you have any questions or comments, you may contact the Project Manager, Paul Mitchell at (714) 379-9778 ext 223.

It has been our pleasure to serve you in the performance of this project. Thank you for choosing ADS products and services to meet your flow monitoring needs.

Sincerely,
ADS ENVIRONMENTAL SERVICES

Mackenzie Michaud
Data Analyst

Scope and Methodology

Introduction

City of Milpitas entered into an agreement with ADS Environmental Services to conduct flow monitoring at twenty-three (23) metering points in the City of Milpitas Collection System. The study was conducted over a ninety (90) day period. The study period is November 16, 2019 - March 09, 2020. The primary objective of the monitoring was to determine current flows for wet weather planning purposes.

Project Scope

The scope of this study involved using flow monitors to quantify wastewater flows at the designated locations. Specifically, the study included the following key components.

- Investigate the proposed flow-monitoring sites for adequate hydraulic conditions.
- Flow monitor installations.
- Flow monitor confirmations and data collections.
- Flow data analysis.

Equipment installation was completed on November 15, 2019. The study period began on November 16, 2019 and was completed on March 09, 2020 .

Flow Monitoring Equipment





The ***ADS FlowShark Triton*** monitor was selected for this project. This flow monitor is an area velocity flow monitor that uses both the Continuity and Manning's equations to measure flow.

The ADS FlowShark Triton monitor consists of data acquisition sensors and a battery-powered microcomputer. The microcomputer includes a processor unit, data storage, and an on-board clock to control and synchronize the sensor recordings. The monitor was programmed to acquire and store depth of flow and velocity readings at 5-minute intervals.

The FS Triton monitor features cross-checking using multiple technologies in each sensor for continuous running of comparisons and tolerances. The FS Triton monitor can support two (2) sets of sensors. The sensor option used for this project was:

The Peak Combo Sensor installed at the bottom of the pipe includes three types of data acquisition technologies.

The ***up looking ultrasonic depth*** uses sound waves from two independent transceivers to measure the distance from the sensor upward toward the flow surface; applying the speed of sound in the water and the temperature measured by sensor to calculate depth.

The ***pressure depth*** is calculated by using a piezo-resistive crystal to determine the difference between hydrostatic and atmospheric pressure. The pressure sensor is temperature compensated and vented to the atmosphere through a

desiccant filled breather tube.

To obtain ***peak velocity*****,** the sensor sends an ultrasonic signal at an angle upward through the widest cross-section of the oncoming flow. The signal is reflected by suspended particles, air bubbles, or organic matter with a frequency shift proportional to the velocity of the reflecting objects. The reflected signal is received by the sensor and processed using digital spectrum analysis to determine the peak flow velocity.

Installation

Installation of flow monitoring equipment typically proceeds in four steps. First, the site is investigated for safety and to determine physical and hydraulic suitability for the flow monitoring equipment. Second, the equipment is physically installed at the selected location. Third, the monitor is tested to assure proper operation of the velocity and depth of flow sensors and verify that the monitor clock is operational and synchronized to the master computer clock. Fourth, the depth and velocity sensors are confirmed and line confirmations are performed.

In pipes up to 42 inches in diameter, the sensors were mounted on expandable stainless steel rings, inserted at least a foot upstream into influent pipes and tightened against the inside walls of the pipes. Influent pipe installations reduce the influences of turbulence and backwater often caused by changes in channel geometry in manholes.





Data Collection, Confirmation, and Quality Assurance

Data collects were done remotely via wireless connect on a weekly basis via ADS Field Representatives. During the monitoring period, field crews visit each monitoring location to verify proper monitor operation and document field conditions. The following quality assurance steps are taken to assure the integrity of the collected data:

Measure power supplies: monitors were powered by dry cell battery packs. Voltages were recorded and battery packs replaced, as necessary. Separate batteries provided back-up power to memory allowing primary batteries to be replaced without loss of data.

Clock synchronization: Field crews synchronized monitor clocks to master clocks.

Confirm depth and velocity readings: Field crews descended into meter manholes to manually measure depths and velocities and compare them meter readings to confirm that they agreed. They also measured silt levels, if any, in the inverts of the pipes. Silt areas were subtracted from flow areas to compute true areas of flow.

Confirm average velocities through cross-sectional velocity profiles: Since ADS velocity sensors measure peak velocity, field crews collected cross-sectional velocity profiles in order to develop a relationship between peak and average velocity in lines that meet the hydraulic criteria.

Upload and Review Data: Data collected from the monitors were uploaded and reviewed by a Data Analyst for completeness, outliers and deviations in the flow patterns, which indicate system anomalies or equipment failure.

Flow Quantification Methods

There are two main equations used to measure open channel flow: the ***Continuity Equation*** and the ***Manning Equation.*** The Continuity Equation, which is considered the most accurate, can be used if both depth of flow and velocity are available. In cases where velocity measurements are not available or not practical to obtain, the Manning Equation can be used to estimate velocity from the depth data based on certain physical characteristics of the pipe (i.e. the slope and roughness of the pipe being measured). However, the Manning equation assumes uniform, steady flow hydraulic conditions with non-varying roughness, which are typically invalid assumptions in most sanitary sewers. The Continuity Equation was used exclusively for this study.

Continuity Equation

The Continuity Equation states that the flow quantity (Q) is equal to the wetted area (A) multiplied by the average velocity (V) of the flow.

$$Q = A * V$$

This equation is applicable in a variety of conditions including backwater, surcharge, and reverse flow.

Data Analysis and Presentation

Data Analysis

A flow monitor is typically programmed to collect data at either 15-minute or 5-minute intervals throughout the monitoring period. The monitor stores raw data consisting of (1) the ultrasonic depth, (2) the peak velocity and (3) the pressure depth. The data is imported into ADS's proprietary software and is examined by a data analyst to verify its integrity. The data analyst also reviews the daily field reports and site visit records to identify conditions that would affect the collected data.

Velocity profiles and the line confirmation data developed by the field personnel are reviewed by the data analyst to

identify inconsistencies and verify data integrity. Velocity profiles are reviewed and an average to peak velocity ratio is calculated for the site. This ratio is used in converting the peak velocity measured by the sensor to the average velocity used in the Continuity equation. The data analyst selects which depth sensor entity will be used to calculate the final depth information. Silt levels present at each site visit are reviewed and representative silt levels established.

Occasionally the velocity sensor's performance may be compromised resulting in invalid readings sporadically during the monitoring period. This is generally caused by excessive debris (silt) blocking the sensor's crystals, shallow flows (~< 1") that may drop below the top of the sensor or very clear flows lacking the particles needed to measure rate. In order to use the Continuity equation to quantify the flow during these periods, a Data Analyst and/or Engineer will use the site's historical pipe curve (depth vs. velocity) data along with valid field confirmations to reconstitute and replace the false velocity recordings with expected velocity readings for a given historical depth along the curve.

Selections for the above parameters can be constant or can change during the monitoring period. While the data analysis process is described in a linear manner, it often requires an iterative approach to accurately complete.

Data Presentation

This type of flow monitoring project generates a large volume of data. To facilitate review of the data, results have been provided in graphical and tabular formats. The flow data is presented graphically in the form of scattergraphs and hydrographs. Hydrographs are based on 5-minute averaging. Tables are provided in daily average format. These tables show the flow rate for each day, along with the daily minimum and maximums, the times they were observed, the total daily flow, and total flow for the month (or monitoring period). The following explanation of terms may aid in interpretation of the tables and hydrographs.

DEPTH - Final calculated depth measurement (in inches)

QUANTITY - Final calculated flow rate (in MGD)

VELOCITY - Final calculated flow velocity (in feet per second)

REPORT TOTAL - Total volume of flow recorded for the indicated time period (in MG)

Site Commentary

Site Information

MIL_0041	
Pipe Dimensions	23
Silt Level	0.00"

Overview

Site MIL_0041 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that both free flow and mild backwater flows were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	6.51	1.54	0.709
Minimum	3.96	0.73	0.178
Maximum	9.42	2.30	1.647
Time of Minimum	2/1/2020 5:05 AM	3/2/2020 3:25 AM	1/7/2020 5:20 AM
Time of Maximum	2/26/2020 8:40 AM	2/1/2020 12:40 PM	2/1/2020 12:40 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_0041

Site Address /Location:	S Abel St and Curtis Ave, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	DRIVE.	Latitude:	37.418531°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.904896°	23.00"x23.50"	Circular



Manhole #	System Characteristics
#0041	Residential/Commercial
Access	Traffic
Drive	Medium







Installation Information

Installation Date:	Installation Type:
Thursday, November 14, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
5:37:00 AM	23.00"x23.50"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
5.50"	
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.40'	0''
Silt (in)	Silt Type
0.0"	

Hydraulic Comments:

Smooth flow with medium depth and moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
7'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Drilled Pavement / Concrete

Additional Site Info. / Comments:

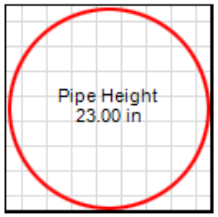
ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

SCATTERGRAPH REPORT

MIL_0041

Flow Monitor

MIL_0041

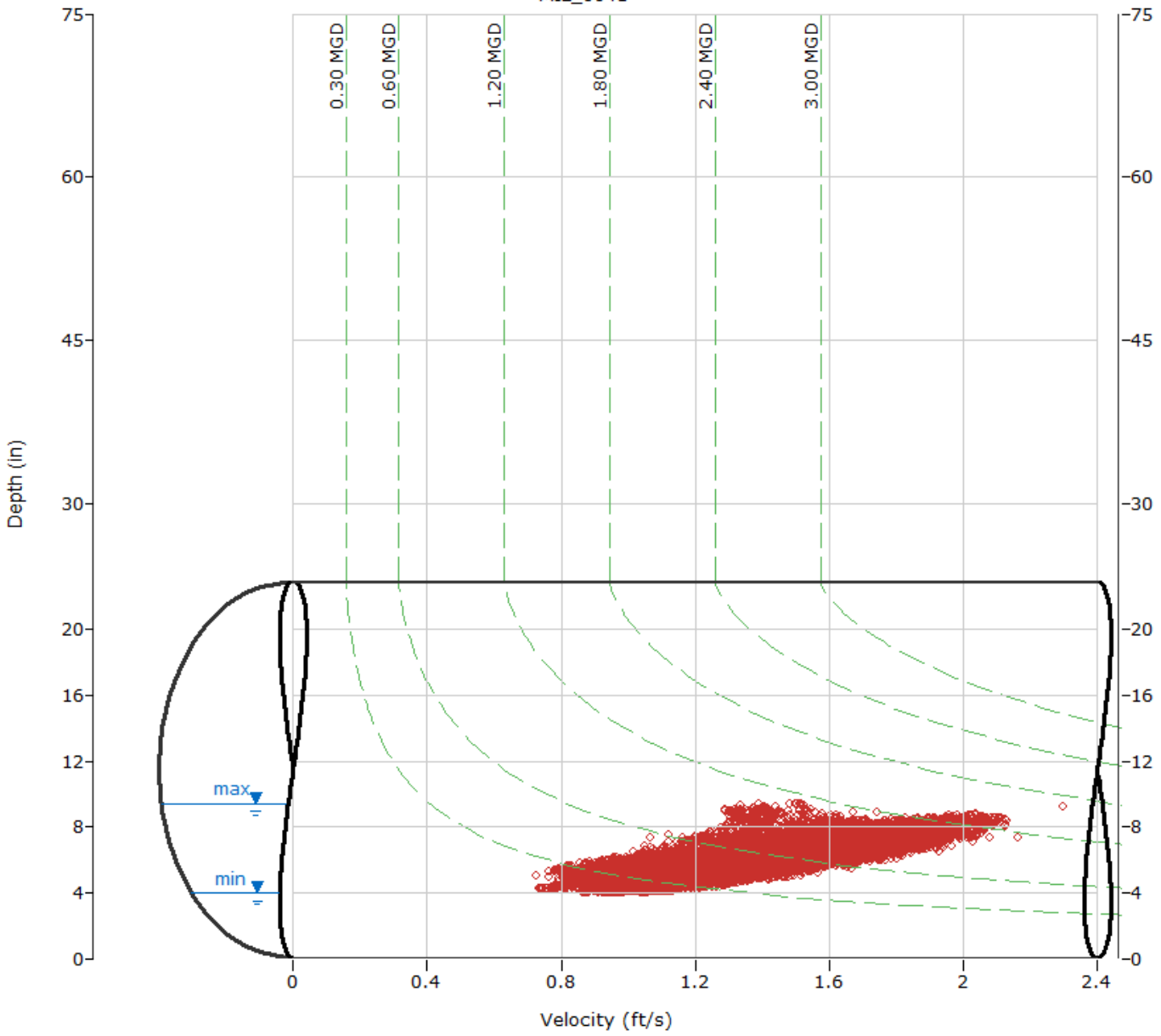


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



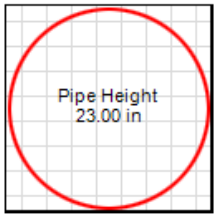
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_0041

Flow Monitor

MIL_0041

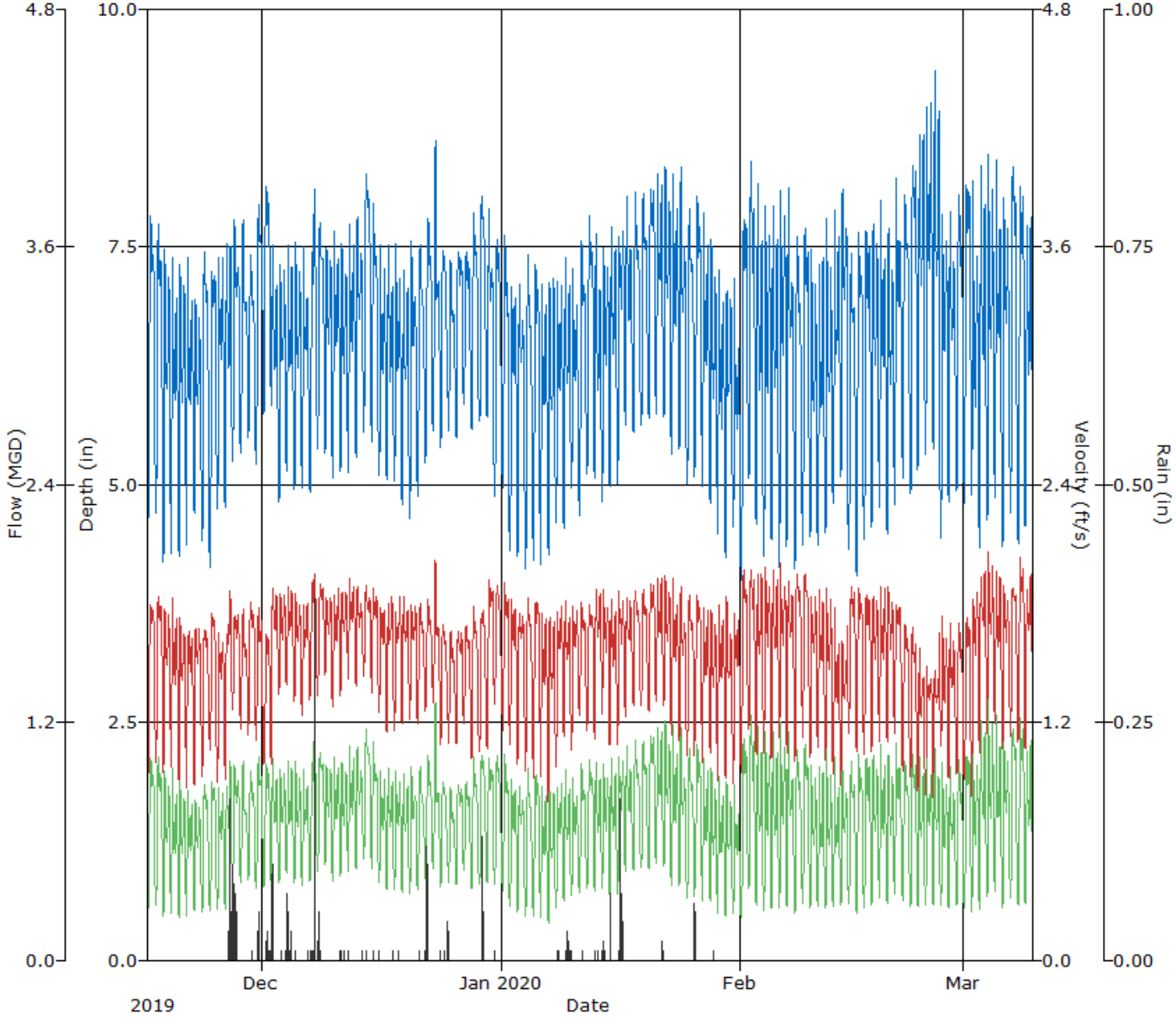


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_0041, Pipe Height: 23.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	05:15	4.62	12:05	7.88	6.62	05:25	0.88	11:25	1.93	1.52	05:25	0.241	11:25	1.094	0.726	0.726	
11/17/2019	05:20	4.67	11:25	8.34	6.52	05:20	0.97	11:25	1.95	1.56	05:20	0.270	11:25	1.217	0.723	0.723	
11/18/2019	04:15	4.15	08:30	7.55	6.01	03:05	0.85	08:15	1.83	1.47	04:05	0.210	08:15	0.985	0.608	0.608	
11/19/2019	04:55	4.19	08:20	7.48	5.96	04:55	0.88	08:15	1.91	1.46	04:55	0.208	08:15	1.027	0.596	0.596	
11/20/2019	04:15	4.19	08:35	7.39	5.98	05:40	0.79	08:30	1.81	1.40	04:35	0.196	08:30	0.954	0.575	0.575	
11/21/2019	04:25	4.31	08:30	7.43	6.00	05:10	0.80	11:05	1.80	1.40	05:10	0.205	08:30	0.900	0.575	0.575	
11/22/2019	05:15	4.66	08:55	7.07	5.95	03:35	0.81	08:40	1.78	1.43	03:35	0.226	08:40	0.879	0.576	0.576	
11/23/2019	05:00	4.37	11:55	7.48	6.29	04:45	0.88	10:40	1.81	1.43	04:45	0.225	12:10	0.942	0.630	0.630	
11/24/2019	04:45	4.02	12:40	7.30	6.19	06:05	1.01	17:25	1.81	1.48	04:45	0.232	12:30	0.935	0.644	0.644	
11/25/2019	05:15	4.66	09:10	7.50	6.34	05:15	0.79	20:50	1.71	1.39	05:15	0.219	09:15	0.919	0.616	0.616	
11/26/2019	04:20	4.70	12:15	8.19	6.41	04:20	0.81	20:35	1.95	1.52	04:20	0.227	12:20	1.088	0.682	0.682	0.36
11/27/2019	05:15	5.22	09:50	7.91	6.72	02:25	1.16	10:15	1.83	1.58	05:15	0.388	10:10	1.047	0.746	0.746	0.63
11/28/2019	06:40	5.31	12:10	7.83	6.58	05:05	1.05	10:45	1.87	1.52	05:05	0.353	12:05	1.052	0.699	0.699	
11/29/2019	05:00	5.46	12:00	7.46	6.63	04:45	1.08	11:35	1.88	1.57	04:45	0.375	11:35	0.998	0.729	0.729	0.02
11/30/2019	05:40	5.20	13:30	7.97	6.83	05:10	0.99	12:35	1.83	1.51	05:10	0.320	12:35	1.066	0.737	0.737	0.10
12/01/2019	05:40	5.70	11:20	8.27	7.25	05:30	0.95	13:35	1.81	1.37	05:40	0.349	13:35	1.088	0.725	0.725	0.06
12/02/2019	04:40	5.80	09:10	7.62	6.59	05:10	0.94	08:45	2.00	1.57	05:10	0.357	08:45	1.080	0.719	0.719	0.30
12/03/2019	04:55	4.79	08:35	7.45	6.30	04:15	1.31	22:25	1.94	1.66	04:15	0.380	08:45	1.018	0.719	0.719	0.01
12/04/2019	03:10	5.10	08:40	7.65	6.44	03:15	1.34	08:45	1.96	1.69	03:15	0.420	08:45	1.089	0.749	0.749	0.39
12/05/2019	04:55	4.93	08:35	7.69	6.41	02:40	1.25	08:15	1.91	1.63	04:50	0.384	09:10	1.046	0.723	0.723	0.01
12/06/2019	04:20	4.94	09:00	7.58	6.37	05:10	1.17	20:00	1.87	1.61	05:10	0.351	08:45	1.014	0.705	0.705	0.01
12/07/2019	05:10	4.91	18:40	8.25	6.63	04:30	1.25	12:05	2.08	1.70	04:30	0.376	18:40	1.266	0.795	0.795	0.67
12/08/2019	06:00	5.35	12:25	7.84	6.84	05:25	1.28	13:35	1.97	1.70	05:25	0.433	13:35	1.083	0.822	0.822	0.20
12/09/2019	04:55	5.30	08:50	7.64	6.59	02:20	1.35	23:05	1.92	1.68	04:45	0.468	23:05	1.041	0.767	0.767	
12/10/2019	04:10	5.03	09:05	7.79	6.55	04:05	1.22	23:30	2.03	1.64	04:10	0.377	08:40	1.086	0.747	0.747	
12/11/2019	04:45	5.11	08:45	7.68	6.43	04:20	1.32	12:20	1.93	1.67	04:45	0.418	08:50	1.060	0.740	0.740	0.03
12/12/2019	04:20	5.10	08:45	7.84	6.55	04:10	1.39	20:55	2.03	1.72	04:20	0.438	08:55	1.152	0.782	0.782	0.01
12/13/2019	05:05	5.27	08:45	7.93	6.72	04:45	1.32	09:40	2.01	1.68	04:45	0.437	09:40	1.150	0.791	0.791	0.01
12/14/2019	05:00	5.51	13:30	8.30	7.22	05:00	1.42	10:45	2.05	1.70	05:00	0.498	10:45	1.202	0.890	0.890	0.01
12/15/2019	05:20	5.43	11:10	8.56	6.91	04:35	1.32	11:15	2.01	1.69	05:20	0.455	11:15	1.269	0.830	0.830	0.01
12/16/2019	04:40	5.08	08:35	7.61	6.38	05:10	1.19	10:10	1.85	1.61	05:10	0.372	08:30	0.990	0.705	0.705	0.01
12/17/2019	04:25	5.04	08:50	7.62	6.40	03:35	1.11	21:45	1.90	1.58	03:55	0.345	09:05	0.993	0.698	0.698	0.01
12/18/2019	04:45	5.02	09:00	7.65	6.39	05:00	1.11	22:00	1.89	1.57	05:00	0.343	08:55	1.001	0.694	0.694	0.01
12/19/2019	04:30	4.75	09:05	7.28	6.19	04:20	1.11	08:55	1.93	1.60	04:20	0.318	08:55	0.997	0.677	0.677	
12/20/2019	04:55	4.61	09:35	7.61	6.29	03:30	1.15	09:30	1.83	1.59	04:50	0.323	09:30	1.004	0.690	0.690	
12/21/2019	05:25	4.85	12:10	7.56	6.46	04:20	1.17	11:15	1.91	1.57	05:20	0.346	11:15	1.012	0.708	0.708	0.01
12/22/2019	04:25	5.21	13:25	7.83	6.75	04:20	1.23	13:10	1.87	1.58	04:20	0.400	13:10	1.067	0.754	0.754	0.41
12/23/2019	06:15	5.50	13:10	8.75	6.92	06:30	1.23	14:40	2.11	1.64	06:15	0.433	13:10	1.357	0.814	0.814	
12/24/2019	04:55	5.36	11:55	7.50	6.69	04:50	1.06	13:55	1.77	1.47	04:55	0.358	13:05	0.945	0.691	0.691	0.02
12/25/2019	04:45	5.54	11:35	7.38	6.52	05:10	1.06	11:35	1.74	1.42	05:10	0.375	11:35	0.916	0.642	0.642	0.08
12/26/2019	04:45	5.46	12:50	7.47	6.76	04:10	1.06	12:05	1.81	1.46	05:25	0.373	12:05	0.966	0.698	0.698	
12/27/2019	04:05	5.79	12:25	7.49	6.84	04:05	1.17	12:10	1.79	1.50	04:05	0.442	12:10	0.954	0.722	0.722	
12/28/2019	05:00	5.54	12:20	7.94	6.87	04:25	0.97	12:25	1.85	1.47	04:25	0.348	12:25	1.076	0.723	0.723	
12/29/2019	06:10	5.64	12:40	8.04	7.02	05:10	1.00	12:10	1.83	1.49	05:10	0.364	12:10	1.083	0.759	0.759	0.22
12/30/2019	05:15	5.67	10:50	7.96	6.85	05:05	1.00	12:00	2.04	1.61	05:05	0.365	12:00	1.086	0.785	0.785	
12/31/2019	04:25	4.83	11:15	7.71	6.53	03:55	1.16	11:10	1.97	1.67	04:20	0.345	11:10	1.102	0.763	0.763	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	06:25	4.93 13:00	7.65	6.43	06:00	1.10 13:00	1.96	1.60	06:20	0.332 13:00	1.088	0.719	0.719	
01/02/2020	05:05	4.24 09:50	7.29	5.99	05:05	1.03 09:35	1.93	1.56	05:05	0.250 09:40	0.995	0.637	0.637	
01/03/2020	04:10	4.22 09:55	7.20	5.95	05:00	0.92 09:50	1.86	1.52	05:00	0.220 09:50	0.943	0.618	0.618	
01/04/2020	05:30	4.08 13:20	7.48	5.97	05:45	0.93 13:35	1.90	1.49	05:30	0.213 13:35	1.021	0.617	0.617	
01/05/2020	05:25	4.14 11:15	7.37	6.08	05:30	0.83 20:35	1.94	1.51	05:30	0.196 12:55	0.981	0.645	0.645	
01/06/2020	05:15	4.07 08:45	7.21	5.83	04:25	0.90 08:50	1.85	1.43	05:15	0.204 08:50	0.938	0.566	0.566	
01/07/2020	04:30	4.21 08:50	7.25	5.93	05:20	0.73 09:20	1.82	1.38	05:20	0.178 09:00	0.918	0.564	0.564	
01/08/2020	03:55	4.51 08:45	7.34	6.12	03:55	0.95 08:30	1.91	1.51	03:55	0.249 08:35	0.988	0.635	0.635	0.02
01/09/2020	04:50	4.53 08:50	7.52	6.14	03:55	1.07 08:25	1.90	1.54	03:55	0.286 08:50	1.022	0.647	0.647	0.18
01/10/2020	05:05	4.95 08:40	7.35	6.21	04:05	1.01 08:40	1.85	1.54	05:05	0.305 08:40	0.969	0.655	0.655	0.02
01/11/2020	05:30	4.65 12:40	7.60	6.39	05:15	1.13 11:45	1.92	1.58	05:15	0.314 11:45	1.033	0.706	0.706	0.01
01/12/2020	05:10	5.10 13:25	7.90	6.73	05:40	1.07 12:45	1.91	1.57	05:40	0.336 12:45	1.082	0.753	0.753	
01/13/2020	04:10	5.05 08:15	7.91	6.33	05:00	1.05 09:10	1.99	1.62	05:00	0.328 09:10	1.077	0.703	0.703	0.02
01/14/2020	05:10	4.78 08:55	7.56	6.29	04:50	1.17 08:00	1.94	1.60	04:50	0.338 08:55	1.044	0.690	0.690	0.11
01/15/2020	04:20	4.96 08:50	7.82	6.52	04:00	1.01 08:10	1.90	1.52	04:00	0.308 08:40	1.061	0.696	0.696	0.07
01/16/2020	05:15	4.98 21:30	7.71	6.70	03:10	1.04 08:20	2.00	1.57	04:05	0.320 08:20	1.102	0.747	0.747	0.66
01/17/2020	05:10	5.60 08:45	8.05	6.90	04:25	1.19 09:15	1.87	1.60	04:25	0.431 09:15	1.109	0.785	0.785	
01/18/2020	05:10	5.54 11:35	8.13	6.95	05:00	1.19 10:30	1.93	1.64	05:00	0.423 11:35	1.137	0.815	0.815	
01/19/2020	05:20	5.61 12:45	8.09	7.03	05:00	1.20 12:25	1.97	1.64	05:00	0.435 12:25	1.175	0.827	0.827	
01/20/2020	05:15	5.67 16:15	8.32	7.24	05:10	1.21 20:05	2.02	1.67	05:10	0.443 20:05	1.214	0.878	0.878	
01/21/2020	04:25	5.72 08:50	8.43	7.21	02:55	1.24 10:25	2.05	1.68	04:20	0.470 09:00	1.224	0.877	0.877	
01/22/2020	05:10	5.69 08:55	8.40	7.11	04:00	1.19 08:55	2.00	1.65	04:00	0.441 08:55	1.261	0.843	0.843	0.03
01/23/2020	04:15	5.29 08:45	8.43	6.88	03:55	1.08 08:40	2.00	1.57	03:55	0.358 08:40	1.264	0.771	0.771	
01/24/2020	04:50	5.32 09:45	8.45	6.87	03:50	1.08 09:35	1.98	1.54	05:00	0.364 09:35	1.247	0.755	0.755	
01/25/2020	05:50	4.98 11:50	7.98	6.71	05:45	0.97 11:45	1.98	1.53	05:45	0.297 11:45	1.162	0.736	0.736	
01/26/2020	04:55	4.98 12:10	8.07	6.83	04:50	1.00 12:40	1.91	1.55	04:50	0.303 12:40	1.125	0.765	0.765	0.16
01/27/2020	04:20	4.95 08:40	7.98	6.44	05:20	0.95 09:10	1.90	1.46	05:20	0.288 09:10	1.098	0.659	0.659	
01/28/2020	04:00	4.76 08:50	7.68	6.20	04:10	0.95 08:45	1.86	1.45	04:05	0.273 08:45	1.037	0.618	0.618	0.01
01/29/2020	04:20	4.40 08:40	7.37	5.94	04:25	0.81 08:35	1.87	1.44	04:25	0.205 08:35	0.985	0.584	0.584	
01/30/2020	05:05	4.11 09:00	7.30	5.92	05:05	0.87 08:25	1.93	1.41	05:05	0.201 09:15	0.966	0.572	0.572	
01/31/2020	05:15	4.48 08:30	7.35	5.81	05:10	0.86 08:35	1.88	1.45	05:10	0.224 08:35	0.985	0.566	0.566	
02/01/2020	05:05	3.96 12:40	9.25	6.29	04:40	0.87 12:40	2.30	1.56	04:55	0.191 12:40	1.647	0.714	0.714	
02/02/2020	06:00	5.04 12:40	8.45	6.90	04:50	1.11 20:10	2.04	1.65	04:50	0.343 12:00	1.266	0.828	0.828	
02/03/2020	04:10	4.56 08:40	8.31	6.47	05:00	0.96 08:50	2.02	1.58	05:00	0.264 08:50	1.250	0.728	0.728	
02/04/2020	04:05	4.23 09:00	8.06	6.25	04:50	0.97 09:20	2.06	1.61	04:50	0.236 08:40	1.214	0.707	0.707	
02/05/2020	03:45	4.37 08:55	8.14	6.26	05:00	0.96 08:45	2.13	1.58	05:00	0.243 08:50	1.279	0.694	0.694	
02/06/2020	03:45	4.08 08:40	8.23	6.35	04:35	1.08 08:15	2.08	1.61	03:45	0.248 08:25	1.262	0.725	0.725	
02/07/2020	03:50	4.23 08:55	8.30	6.39	04:00	0.98 08:30	1.96	1.60	04:00	0.250 08:55	1.202	0.722	0.722	
02/08/2020	05:15	4.07 13:00	7.64	6.20	05:35	0.97 12:45	2.06	1.62	05:35	0.224 12:50	1.128	0.709	0.709	
02/09/2020	04:45	4.30 12:15	7.75	6.34	07:10	1.02 12:25	2.01	1.65	04:45	0.263 12:25	1.137	0.741	0.741	
02/10/2020	04:05	4.43 08:35	7.57	6.02	05:00	0.98 08:25	2.01	1.55	05:00	0.252 08:25	1.095	0.638	0.638	
02/11/2020	04:35	4.33 10:30	7.60	6.03	04:10	1.02 10:30	2.02	1.54	04:10	0.260 10:30	1.108	0.639	0.639	
02/12/2020	04:50	4.48 08:35	8.01	6.15	04:15	0.96 08:05	1.91	1.50	04:15	0.252 08:40	1.117	0.642	0.642	
02/13/2020	04:30	4.78 09:00	7.96	6.47	04:10	0.84 08:10	1.90	1.37	04:10	0.242 08:10	1.090	0.627	0.627	
02/14/2020	05:10	5.02 08:45	8.19	6.87	04:15	0.83 09:00	1.68	1.31	04:15	0.258 09:00	1.020	0.645	0.645	
02/15/2020	04:35	4.27 12:35	7.50	6.23	06:00	1.02 12:15	2.02	1.64	06:00	0.257 12:15	1.063	0.712	0.712	
02/16/2020	05:10	3.99 12:10	7.74	6.22	06:05	1.02 12:00	2.00	1.59	05:10	0.231 12:00	1.121	0.699	0.699	
02/17/2020	05:10	4.39 11:35	7.68	6.46	04:40	1.00 10:05	1.96	1.58	04:40	0.257 10:05	1.088	0.728	0.728	
02/18/2020	05:00	4.52 09:15	7.87	6.33	04:55	1.02 09:15	1.96	1.54	04:55	0.269 09:15	1.128	0.681	0.681	
02/19/2020	04:10	4.73 08:55	8.11	6.40	05:10	1.04 08:45	1.93	1.55	05:10	0.297 08:50	1.151	0.695	0.695	
02/20/2020	05:00	4.46 09:05	7.88	6.20	04:00	1.05 08:30	2.01	1.58	04:00	0.276 09:00	1.142	0.680	0.680	
02/21/2020	04:15	4.77 09:25	8.37	6.69	03:45	1.05 09:30	1.85	1.60	03:45	0.304 09:30	1.155	0.761	0.761	
02/22/2020	05:40	5.03 11:25	8.11	6.88	04:40	0.88 11:20	1.80	1.41	04:40	0.273 11:20	1.077	0.702	0.702	
02/23/2020	05:40	4.84 12:55	8.41	7.11	04:25	0.86 12:45	1.77	1.37	04:25	0.260 12:45	1.114	0.720	0.720	
02/24/2020	03:40	5.07 09:00	8.91	7.24	04:15	0.80 09:05	1.74	1.24	04:15	0.253 09:05	1.182	0.663	0.663	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	04:15	5.23	08:45	9.10	7.45	05:00	0.76	08:45	1.54	1.25	05:00	0.250	08:45	1.083	0.695	0.695	
02/26/2020	04:25	5.32	08:40	9.42	7.39	04:30	0.78	22:50	1.78	1.28	04:30	0.261	08:15	1.106	0.696	0.696	
02/27/2020	04:40	4.39	08:40	7.99	6.36	03:10	0.93	08:10	1.87	1.41	03:10	0.249	08:35	1.082	0.624	0.624	
02/28/2020	04:35	4.79	08:50	8.04	6.54	03:40	0.86	08:20	1.78	1.37	03:40	0.252	08:45	1.045	0.633	0.633	
02/29/2020	05:15	4.88	11:55	8.11	6.79	06:10	0.86	11:55	1.77	1.39	06:10	0.255	11:55	1.061	0.682	0.682	
03/01/2020	05:35	4.76	11:05	8.19	6.93	04:55	0.79	11:00	1.80	1.40	04:55	0.232	11:00	1.089	0.715	0.715	
03/02/2020	04:50	4.86	08:40	8.48	6.34	03:25	0.73	09:00	1.95	1.47	03:25	0.222	09:00	1.101	0.650	0.650	
03/03/2020	04:30	4.29	09:00	8.65	6.46	04:50	0.96	21:30	2.03	1.64	04:50	0.243	09:05	1.319	0.759	0.759	
03/04/2020	04:45	4.59	08:20	8.56	6.65	03:50	1.10	08:10	2.13	1.68	03:50	0.302	08:25	1.362	0.802	0.802	
03/05/2020	04:30	4.80	08:45	8.55	6.71	04:25	1.14	08:45	2.07	1.66	04:25	0.328	08:45	1.333	0.791	0.791	
03/06/2020	04:55	4.29	08:50	8.10	6.52	04:45	1.01	08:45	1.96	1.59	04:50	0.248	08:45	1.174	0.740	0.740	
03/07/2020	05:10	4.64	12:15	8.39	6.91	05:10	1.10	12:50	1.95	1.64	05:10	0.304	12:50	1.214	0.829	0.829	
03/08/2020	05:15	4.36	11:20	8.18	6.66	04:40	1.00	11:20	2.12	1.67	04:40	0.252	11:20	1.286	0.812	0.812	
03/09/2020	04:00	4.54	20:30	7.88	6.40	04:05	1.00	20:40	1.98	1.61	04:05	0.266	20:30	1.140	0.728	0.727	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			81.489	4.90
Avg	6.51	1.54	0.709	

Site Commentary

Site Information

MIL_0186	
Pipe Dimensions	8
Silt Level	1.63"

Overview

Site MIL_0186 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019 and December 7, 2019 - December 8, 2019. Surcharge conditions were experienced at this location. Review of the scattergraph shows free flow conditions during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. Data confidence is less than typical due to sediment. A data gap also occurs beginning February 02, 2020 through February 14, 2020 and another data gap on March 02, 2020 through March 05, 2020 resulting from a meter malfunction.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	4.25	1.45	0.133
Minimum	2.64	0.71	0.030
Maximum	8.80	2.50	0.482
Time of Minimum	2/23/2020 3:35 AM	11/18/2019 3:25 AM	11/18/2019 3:25 AM
Time of Maximum	3/6/2020 2:15 PM	12/4/2019 5:30 AM	12/4/2019 5:30 AM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period. 90 days of data provided.

Percent Uptime	
Depth (in)	88
Velocity (ft/s)	88
Quantity (MGD)	88

Milpitas Temp Study 2019-20

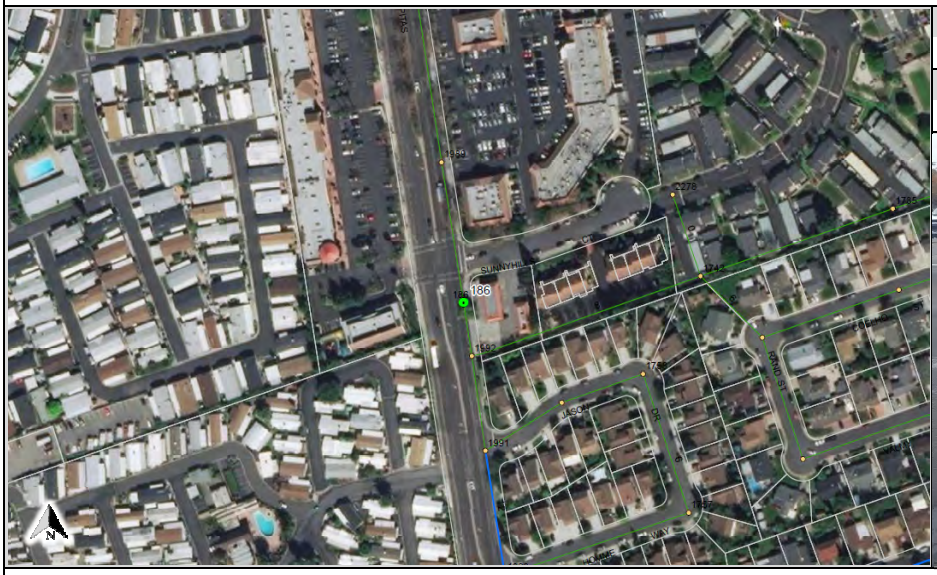
Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

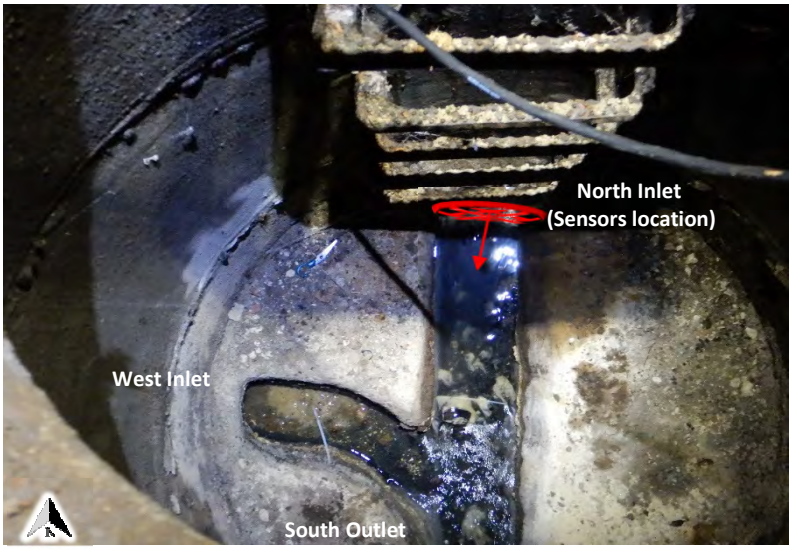
MIL_0186

Site Address /Location:	N Milpitas Blvd and Sunnyhills Ct			Monitor Series: TRITON+	Location Type: Temporary
Site Access Details:	Drive	Latitude:	37.454452°	Pipe Size (H x W): 8.0" x 8.0"	Pipe Shape: Circular
		Longitude:	-121.910707°		



Manhole #	System Characteristics
186	Residential
Access	**Traffic**
Drive	Medium







Installation Information

Installation Date:	Installation Type:
Tuesday, November 12, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	**Monitor Location:**
Upstream 0-5 FT	Manhole
Sensors / Devices:	**Pressure Sensor Range (psi)**
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
3:47:18 AM	8.0" x 8.0"
Depth of Flow (Wet DOF) (in)	**Range (Air DOF) (in)**
3.75	0.00"
Downlooker Physical Offset (in)	**Measurement Confidence (in)**
NA	0.25"
Peak Velocity (fps)	**Velocity Sensor Offset (in)**
0.91	0''
Silt (in)	**Silt Type**
1.63	

Hydraulic Comments:

Medium depth with moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
7'	Single
Manhole Material:	**Manhole Condition:**
Concrete	Good
Manhole Opening Diameter (in)	**Manhole Diameter (Approx.):**
26''	54''
Manhole Cover	**Manhole Frame**
Unbolted	Normal
Active Drop Connections	**Air Quality:**
No	Normal
Pipe Material	**Pipe Condition:**
PVC	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431.11.325

SCATTERGRAPH REPORT

MIL_0186

Flow Monitor

MIL_0186

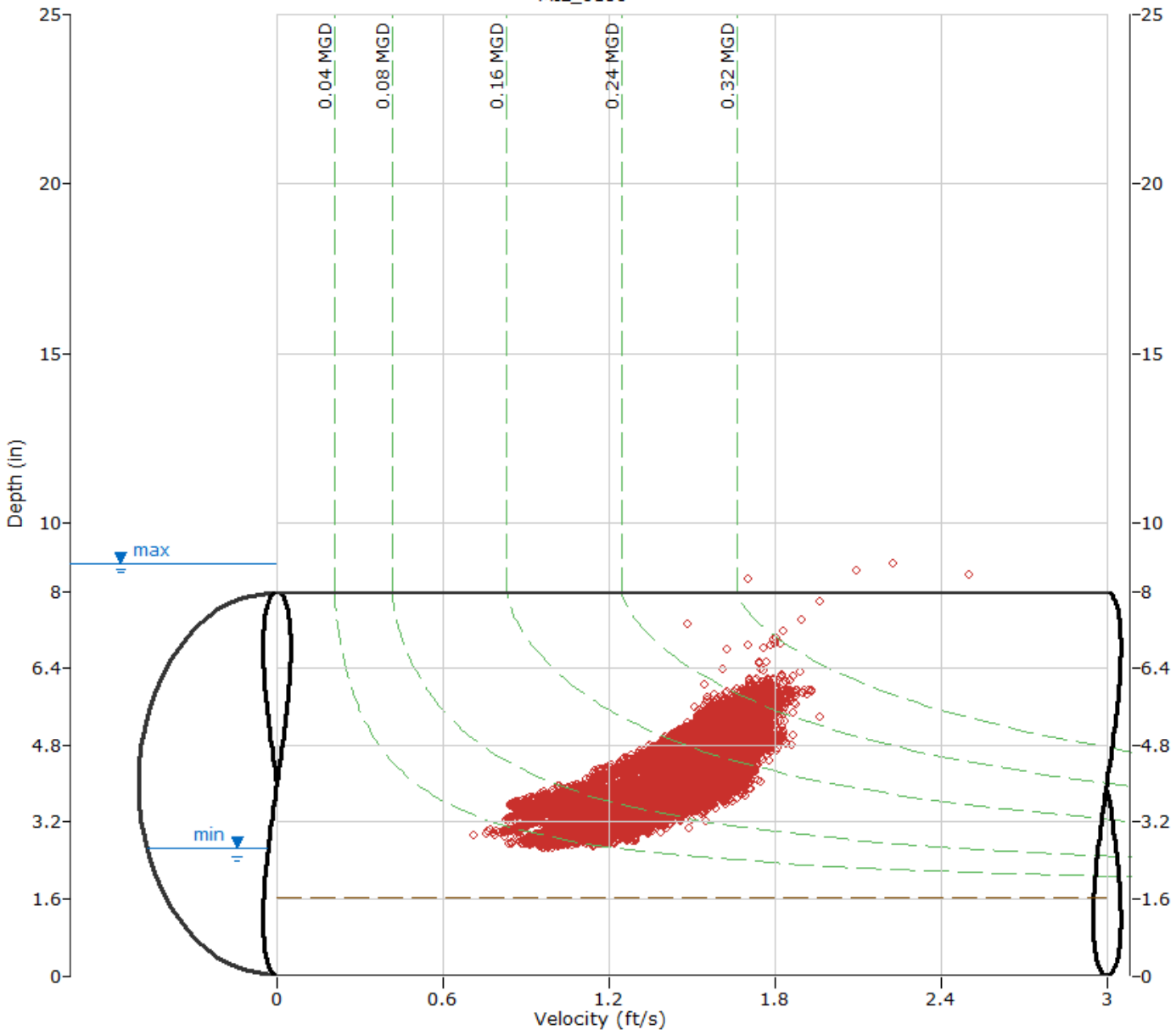
Pipe Height
8.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_0186

Flow Monitor

MIL_0186

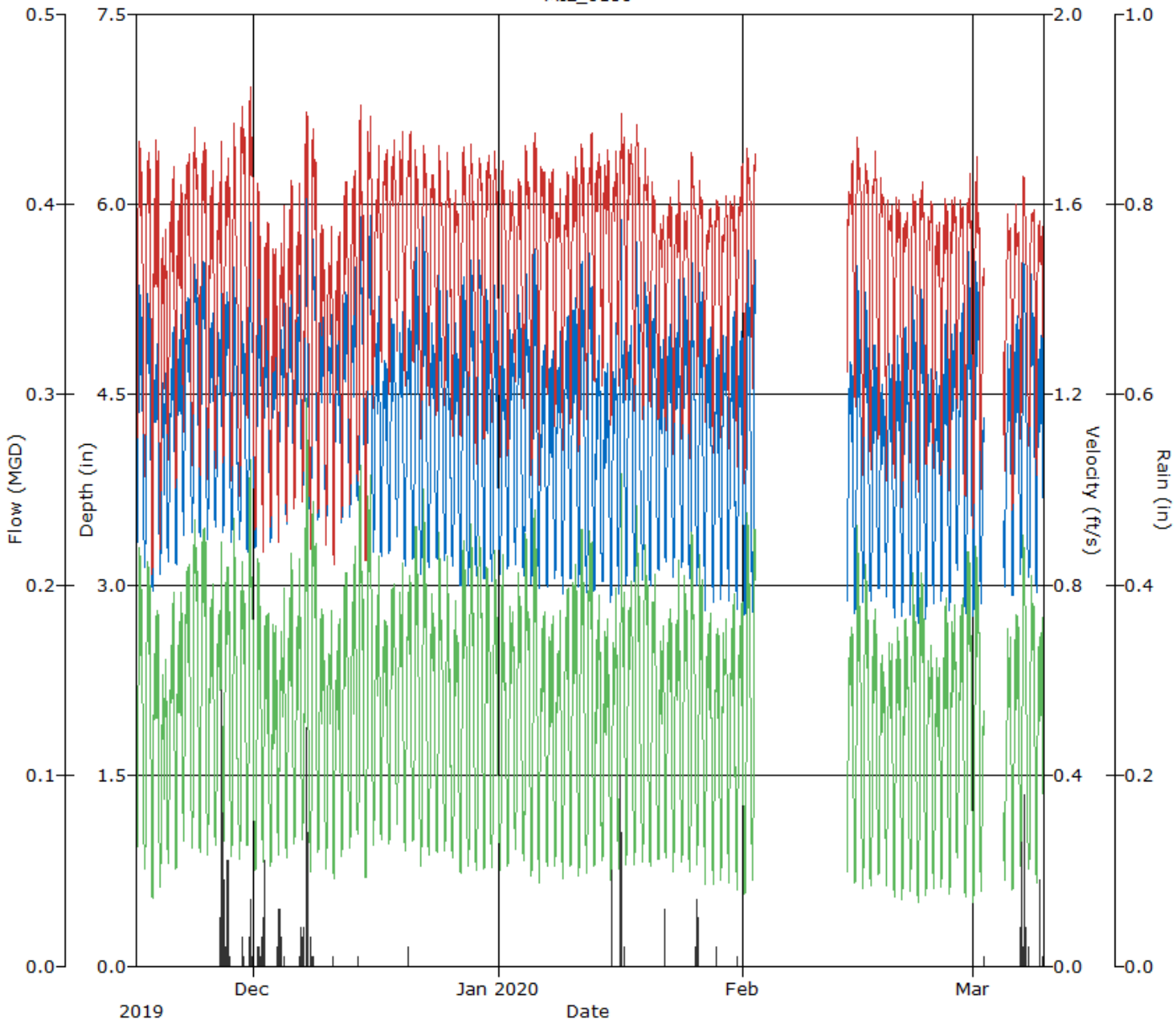
Pipe Height
8.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_0186, Pipe Height: 8.00 in, Silt: 1.63 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	05:15	3.20	12:20	5.64	4.37	05:55	1.05	10:50	1.77	1.48	05:15	0.057	12:20	0.237	0.143	0.143	
11/17/2019	03:40	3.11	11:25	5.54	4.33	04:25	0.98	10:45	1.76	1.44	04:25	0.048	11:30	0.230	0.139	0.139	
11/18/2019	03:05	2.88	18:05	5.00	4.10	03:25	0.71	18:20	1.84	1.40	03:25	0.030	17:35	0.203	0.123	0.123	
11/19/2019	04:00	3.00	19:00	4.98	3.98	04:00	0.83	17:40	1.69	1.32	04:00	0.037	19:00	0.187	0.108	0.108	
11/20/2019	03:45	3.15	20:10	5.37	4.22	03:25	1.00	19:40	1.74	1.44	03:25	0.051	20:10	0.223	0.130	0.130	
11/21/2019	03:05	3.12	18:15	5.37	4.27	03:55	0.95	19:15	1.70	1.41	03:55	0.047	19:15	0.216	0.130	0.130	
11/22/2019	01:50	3.18	14:25	6.22	4.64	01:50	0.96	14:25	1.87	1.51	01:50	0.049	14:25	0.289	0.159	0.159	
11/23/2019	04:40	3.36	17:35	5.69	4.62	04:40	1.02	14:05	1.87	1.48	04:40	0.058	14:05	0.246	0.156	0.156	
11/24/2019	04:05	3.32	14:10	6.25	4.65	04:05	0.93	14:10	1.83	1.47	04:05	0.052	14:10	0.285	0.157	0.157	
11/25/2019	03:40	3.31	18:30	5.37	4.41	04:00	1.00	18:30	1.71	1.42	03:40	0.055	18:30	0.219	0.138	0.138	
11/26/2019	02:20	3.39	20:15	5.60	4.41	02:20	0.99	19:20	1.77	1.43	02:20	0.057	20:15	0.238	0.139	0.139	0.63
11/27/2019	03:15	3.37	20:10	5.55	4.51	03:25	0.97	20:10	1.73	1.45	03:25	0.057	20:10	0.232	0.147	0.147	0.77
11/28/2019	04:25	3.27	11:00	5.69	4.34	05:15	0.99	11:00	1.85	1.43	04:25	0.054	11:00	0.256	0.137	0.137	
11/29/2019	03:55	3.29	17:40	5.39	4.24	03:50	0.91	17:40	1.97	1.48	03:50	0.050	17:40	0.253	0.136	0.136	0.05
11/30/2019	04:10	3.20	11:50	6.33	4.48	03:00	1.06	13:00	1.90	1.52	03:00	0.057	11:50	0.300	0.154	0.154	0.14
12/01/2019	05:10	3.23	13:35	5.79	4.46	02:25	0.87	13:35	1.68	1.32	05:05	0.046	13:35	0.239	0.133	0.133	0.06
12/02/2019	04:35	3.51	12:00	5.39	4.47	04:10	0.85	18:40	1.66	1.30	04:10	0.053	12:00	0.210	0.130	0.130	0.36
12/03/2019	03:55	3.30	11:25	5.34	4.34	03:55	0.87	11:15	1.65	1.25	03:55	0.048	11:25	0.195	0.119	0.119	
12/04/2019	02:35	3.53	05:30	8.48	4.49	02:35	0.84	05:30	2.50	1.32	02:35	0.053	05:30	0.482	0.132	0.132	0.44
12/05/2019	02:15	3.42	18:15	6.88	4.50	02:15	0.91	18:45	1.83	1.34	02:15	0.053	18:15	0.295	0.136	0.136	
12/06/2019	05:05	3.53	17:50	6.03	4.54	03:25	0.87	17:50	1.79	1.34	03:25	0.057	17:50	0.268	0.137	0.137	0.06
12/07/2019	04:25	3.57	06:55	8.34	4.79	02:55	0.87	18:40	1.91	1.42	02:55	0.057	17:25	0.330	0.160	0.160	0.84
12/08/2019	03:40	3.32	10:55	5.95	4.65	03:40	0.86	11:20	1.86	1.39	03:40	0.048	10:55	0.269	0.151	0.151	0.10
12/09/2019	02:55	3.49	12:55	5.47	4.43	02:55	0.94	12:55	1.65	1.31	02:55	0.057	12:55	0.217	0.128	0.128	
12/10/2019	03:10	3.34	19:00	5.46	4.38	03:10	0.87	19:00	1.65	1.29	03:10	0.049	19:00	0.217	0.124	0.124	0.01
12/11/2019	03:40	3.25	20:05	5.32	4.32	03:40	0.83	20:05	1.61	1.26	03:40	0.044	20:05	0.204	0.120	0.120	0.00
12/12/2019	03:45	3.45	12:40	5.53	4.52	03:45	0.92	19:15	1.75	1.37	03:45	0.055	19:15	0.233	0.140	0.140	
12/13/2019	04:10	3.49	18:25	7.77	4.54	04:10	0.94	18:25	1.96	1.38	04:10	0.058	18:25	0.374	0.142	0.142	
12/14/2019	03:10	3.61	11:45	6.10	4.71	03:10	0.99	10:50	1.93	1.40	03:10	0.065	10:50	0.282	0.154	0.154	0.01
12/15/2019	05:15	3.26	18:30	6.35	4.70	05:15	0.83	19:50	1.82	1.40	05:15	0.045	18:30	0.280	0.158	0.158	
12/16/2019	03:15	3.25	19:00	5.69	4.33	02:40	1.14	18:50	1.76	1.50	03:05	0.061	19:00	0.242	0.141	0.141	
12/17/2019	03:35	3.17	11:35	5.00	4.15	04:55	1.21	19:10	1.76	1.55	04:55	0.063	11:30	0.201	0.135	0.135	
12/18/2019	03:35	3.19	13:25	5.40	4.28	02:05	1.10	14:15	1.80	1.54	03:35	0.059	13:25	0.223	0.142	0.142	
12/19/2019	04:20	3.32	20:25	5.64	4.29	04:20	1.26	20:25	1.80	1.55	04:20	0.070	20:25	0.247	0.143	0.143	
12/20/2019	03:25	3.07	18:50	5.49	4.24	03:25	1.14	20:50	1.79	1.55	03:25	0.053	18:50	0.234	0.141	0.141	0.02
12/21/2019	03:40	3.16	10:30	6.15	4.39	05:15	1.14	13:25	1.77	1.51	05:15	0.061	11:10	0.267	0.146	0.146	
12/22/2019	04:00	3.03	13:10	6.16	4.35	05:20	1.03	13:10	1.80	1.48	05:20	0.047	13:10	0.276	0.143	0.143	
12/23/2019	03:55	3.10	15:05	5.78	4.20	03:55	1.16	11:40	1.79	1.50	03:55	0.055	15:05	0.244	0.135	0.135	
12/24/2019	03:20	3.16	12:15	5.83	4.29	04:35	1.07	12:25	1.80	1.48	03:20	0.054	12:30	0.247	0.138	0.138	
12/25/2019	05:30	3.14	11:35	5.87	4.13	03:25	1.12	11:35	1.81	1.49	05:35	0.057	11:35	0.261	0.129	0.129	
12/26/2019	05:35	3.10	11:45	5.49	4.14	03:30	1.07	11:45	1.69	1.44	05:25	0.053	11:45	0.223	0.126	0.126	
12/27/2019	04:30	2.92	13:50	5.86	4.20	04:30	1.07	13:20	1.75	1.49	04:30	0.044	13:50	0.250	0.135	0.135	
12/28/2019	04:10	2.96	10:50	6.81	4.29	03:15	1.09	10:45	1.79	1.48	03:10	0.049	10:50	0.302	0.139	0.139	
12/29/2019	04:05	2.99	12:00	5.94	4.37	05:10	0.99	18:35	1.78	1.47	05:05	0.046	12:00	0.250	0.144	0.144	
12/30/2019	04:00	3.00	11:20	5.74	4.19	04:05	1.00	17:30	1.74	1.50	04:05	0.044	11:20	0.229	0.135	0.135	
12/31/2019	04:20	2.98	12:55	5.49	4.20	02:00	1.08	11:10	1.74	1.50	04:20	0.048	12:55	0.230	0.135	0.135	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/01/2020	05:30	3.00	12:40	5.79	4.11	05:20	0.99	12:55	1.73	1.45	05:20	0.045	12:40	0.243	0.126	0.126	
01/02/2020	02:55	3.05	05:20	8.60	4.21	02:55	1.03	05:20	2.10	1.45	02:55	0.047	05:20	0.404	0.131	0.131	
01/03/2020	03:40	3.15	11:25	5.54	4.28	04:05	1.13	11:25	1.69	1.48	03:40	0.061	11:25	0.226	0.136	0.136	
01/04/2020	04:25	2.98	11:45	5.85	4.27	04:30	1.02	10:25	1.79	1.49	04:30	0.046	11:45	0.252	0.139	0.139	
01/05/2020	04:30	2.96	13:05	6.15	4.33	03:30	0.97	13:05	1.78	1.46	04:30	0.042	13:05	0.272	0.142	0.142	
01/06/2020	03:10	2.93	19:00	5.10	4.06	03:10	0.94	10:05	1.73	1.51	03:10	0.039	19:00	0.203	0.128	0.128	
01/07/2020	02:00	2.91	18:45	5.29	3.99	03:25	1.06	19:15	1.76	1.51	02:00	0.047	18:45	0.214	0.123	0.123	
01/08/2020	04:25	3.01	18:15	5.36	4.12	04:20	1.09	20:40	1.69	1.47	04:20	0.049	18:15	0.209	0.127	0.127	
01/09/2020	03:20	2.91	19:10	5.53	4.21	03:35	1.03	18:55	1.75	1.47	03:35	0.042	19:15	0.226	0.133	0.133	
01/10/2020	03:40	2.97	12:00	5.53	4.22	04:35	1.12	13:50	1.74	1.49	03:40	0.048	19:25	0.227	0.135	0.135	
01/11/2020	03:30	2.94	10:45	6.03	4.34	03:35	1.01	10:50	1.79	1.49	03:35	0.043	10:45	0.267	0.144	0.144	
01/12/2020	04:15	2.91	18:55	5.99	4.35	04:55	1.08	18:50	1.82	1.53	04:10	0.045	18:55	0.268	0.147	0.147	
01/13/2020	02:50	2.91	18:30	5.22	3.96	02:50	1.09	20:00	1.74	1.54	02:50	0.045	18:30	0.213	0.124	0.124	
01/14/2020	04:55	2.96	21:00	4.97	4.01	05:10	1.12	20:50	1.74	1.54	05:10	0.048	21:00	0.198	0.127	0.106	
01/15/2020	05:10	2.84	21:15	5.56	4.02	06:00	1.09	21:05	1.79	1.52	05:35	0.044	21:20	0.227	0.126	0.126	0.10
01/16/2020	05:40	2.91	13:55	6.07	4.18	06:00	1.15	12:45	1.83	1.57	05:30	0.048	13:45	0.269	0.140	0.140	0.66
01/17/2020	04:10	2.98	21:15	5.31	4.18	04:10	1.13	12:30	1.80	1.55	04:10	0.049	19:25	0.224	0.138	0.138	
01/18/2020	05:20	2.98	14:10	6.16	4.32	05:20	1.13	14:30	1.81	1.53	05:20	0.049	14:10	0.272	0.145	0.145	
01/19/2020	06:55	3.01	13:40	5.86	4.31	08:00	1.08	13:05	1.79	1.49	06:55	0.050	13:40	0.253	0.141	0.141	
01/20/2020	05:35	2.93	18:50	5.77	4.29	04:50	1.13	17:50	1.77	1.47	05:35	0.048	18:50	0.236	0.136	0.136	
01/21/2020	06:15	3.05	13:10	5.09	4.12	07:00	1.08	20:30	1.66	1.43	06:15	0.052	20:30	0.189	0.124	0.124	0.01
01/22/2020	05:15	3.12	13:45	5.34	4.22	05:20	1.04	21:00	1.69	1.45	05:20	0.051	20:35	0.208	0.130	0.130	0.09
01/23/2020	02:55	3.04	19:40	5.66	4.29	02:40	1.04	19:20	1.70	1.44	03:30	0.048	20:25	0.231	0.134	0.123	
01/24/2020	05:30	3.10	13:25	6.38	4.33	05:00	1.08	12:15	1.71	1.42	05:30	0.052	13:25	0.258	0.135	0.135	
01/25/2020	05:40	3.02	12:20	5.91	4.20	05:30	1.03	11:00	1.84	1.47	05:40	0.047	12:20	0.257	0.133	0.133	
01/26/2020	03:30	2.97	11:15	5.69	4.25	03:05	1.14	11:05	1.68	1.49	03:25	0.050	11:15	0.227	0.136	0.136	0.16
01/27/2020	04:50	2.78	11:25	5.34	4.09	05:10	1.07	08:05	1.67	1.44	03:50	0.041	20:15	0.206	0.124	0.113	
01/28/2020	04:45	2.79	22:10	5.13	4.03	04:00	1.04	19:25	1.66	1.47	04:45	0.039	20:15	0.193	0.123	0.123	0.02
01/29/2020	03:55	2.83	20:40	5.37	4.11	03:35	1.05	21:40	1.66	1.46	03:35	0.042	20:40	0.211	0.125	0.125	
01/30/2020	03:40	2.84	19:55	5.43	4.09	03:20	1.03	16:15	1.70	1.47	03:40	0.042	19:50	0.214	0.126	0.126	
01/31/2020	05:10	2.77	19:25	5.28	4.05	04:05	0.95	20:05	1.77	1.50	04:05	0.036	21:50	0.213	0.127	0.127	0.01
02/01/2020	04:45	2.73	14:55	6.17	4.26	02:50	0.94	12:20	1.76	1.46	04:55	0.035	11:35	0.266	0.138	0.138	
02/02/2020	04:45	2.75	10:30	6.14	4.00	04:20	1.15	12:20	1.75	1.49	04:45	0.041	10:30	0.261	0.125	0.076	
02/03/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/04/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/05/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/06/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/07/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/08/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/09/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/10/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/11/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/12/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/13/2020	00:00		00:00			00:00		00:00			00:00		00:00				
02/14/2020	05:00	2.84	19:35	5.05	4.19	05:00	1.10	20:30	1.78	1.60	05:00	0.043	19:35	0.199	0.140	0.112	
02/15/2020	05:15	2.69	11:50	5.78	4.08	05:50	1.13	11:50	1.77	1.54	05:15	0.039	11:50	0.251	0.133	0.133	
02/16/2020	04:55	2.81	11:05	5.62	4.11	03:10	0.97	16:55	1.78	1.47	05:05	0.037	11:05	0.232	0.129	0.129	
02/17/2020	04:05	2.85	19:40	5.43	3.94	04:20	0.98	17:20	1.76	1.46	04:15	0.039	19:40	0.218	0.119	0.119	
02/18/2020	04:15	2.90	13:20	4.65	3.87	02:40	1.03	14:10	1.75	1.48	04:15	0.043	13:40	0.167	0.115	0.115	
02/19/2020	02:50	2.87	12:50	5.24	3.98	02:35	0.97	08:50	1.76	1.44	02:35	0.039	12:50	0.200	0.118	0.118	
02/20/2020	03:15	2.71	11:45	5.28	3.99	03:15	0.95	18:45	1.66	1.44	03:15	0.033	11:45	0.201	0.119	0.119	
02/21/2020	02:55	2.68	18:20	5.48	4.01	03:00	0.92	18:45	1.68	1.41	02:55	0.032	18:20	0.211	0.118	0.118	
02/22/2020	04:25	2.70	13:40	5.70	4.10	04:20	0.96	13:40	1.67	1.42	04:25	0.033	13:40	0.232	0.124	0.124	
02/23/2020	03:35	2.64	12:40	5.61	4.16	03:30	0.96	17:35	1.73	1.42	03:30	0.031	13:35	0.232	0.129	0.129	
02/24/2020	03:50	2.70	11:45	6.05	3.94	03:45	0.99	21:25	1.69	1.43	03:50	0.034	11:45	0.232	0.115	0.115	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	03:40	2.82	21:00	5.11	3.95	04:50	1.01	21:00	1.62	1.40	03:40	0.039	21:00	0.192	0.113	0.113	
02/26/2020	02:45	2.74	19:15	5.58	4.13	02:35	0.95	19:05	1.64	1.43	02:45	0.034	19:15	0.219	0.125	0.125	
02/27/2020	02:45	2.70	11:45	5.42	4.14	03:10	0.91	16:35	1.62	1.44	03:10	0.032	11:40	0.206	0.127	0.127	
02/28/2020	04:20	3.05	18:30	5.46	4.24	04:20	1.14	19:50	1.64	1.46	04:20	0.052	19:50	0.212	0.133	0.133	
02/29/2020	04:15	2.72	10:40	5.87	4.28	04:35	0.90	18:10	1.70	1.41	04:35	0.032	10:40	0.235	0.134	0.134	
03/01/2020	05:15	2.73	11:45	5.96	4.27	04:20	0.84	13:25	1.72	1.40	04:20	0.030	11:45	0.245	0.133	0.133	
03/02/2020	03:30	2.82	07:45	4.60	3.48	02:50	0.95	07:30	1.52	1.24	03:25	0.037	07:45	0.148	0.079	0.034	0.01
03/03/2020																	
03/04/2020																	
03/05/2020	03:40	2.93	12:45	5.21	4.10	02:30	0.94	12:45	1.60	1.41	02:30	0.039	12:45	0.196	0.121	0.121	
03/06/2020	04:20	2.85	14:15	8.80	4.14	04:05	0.92	14:15	2.23	1.40	04:05	0.036	14:15	0.429	0.123	0.123	
03/07/2020	05:05	3.01	14:15	5.90	4.41	05:05	1.07	15:10	1.77	1.44	05:05	0.048	15:10	0.257	0.141	0.141	0.58
03/08/2020	04:30	2.96	12:35	5.73	4.30	04:30	1.04	14:05	1.63	1.42	04:30	0.045	12:35	0.227	0.133	0.133	0.02
03/09/2020	04:05	2.91	20:05	5.34	4.08	04:05	1.01	12:40	1.60	1.39	04:05	0.041	20:00	0.202	0.119	0.119	0.11

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			13.410	5.26
Avg	4.25	1.45	0.133	

Site Commentary

Site Information

MIL_0190	
Pipe Dimensions	18
Silt Level	0.00"

Overview

Site MIL_0190 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

This location was installed upstream of site MIL_1790. (See MIL_1790 Site Commentary for More Details)

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	2.47	0.96	0.093
Minimum	1.80	0.41	0.024
Maximum	3.29	1.47	0.198
Time of Minimum	11/22/2019 4:00 AM	11/22/2019 3:50 AM	11/22/2019 3:50 AM
Time of Maximum	12/12/2019 1:55 PM	3/6/2020 9:10 AM	3/6/2020 9:10 AM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

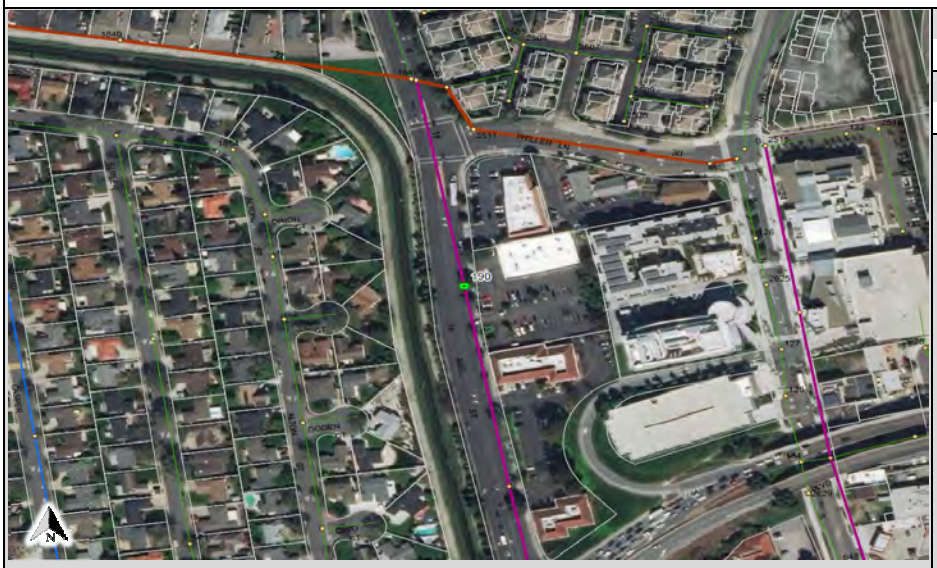
Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

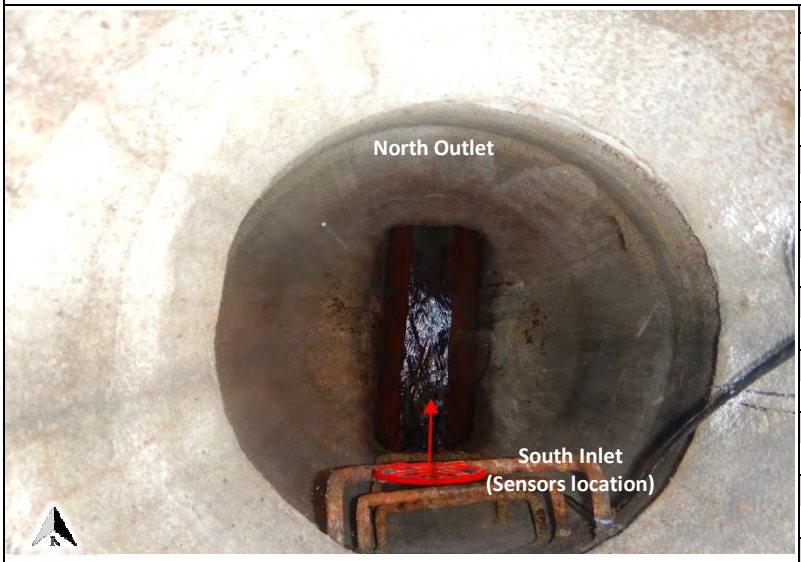
MIL_0190

Site Address /Location:	N Abel St and Weller Ln			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	middle of N bound lanes	Latitude:	37.432482°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.909452°	18.0" x 18.0"	Circular



Manhole #	System Characteristics
190	Residential
Access	Traffic
Drive	Heavy







Installation Information

Installation Date:	Installation Type:
Wednesday, November 13, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
10:04:15 AM	18.0" x 18.0"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
3.00	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
0.97	0''
Silt (in)	Silt Type
0''	

Hydraulic Comments:

Smooth shallow flow with moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
8'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Vitrified Clay Pipe	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

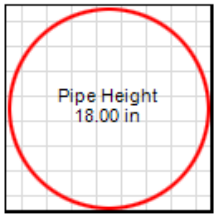
ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_0190

Flow Monitor

MIL_0190

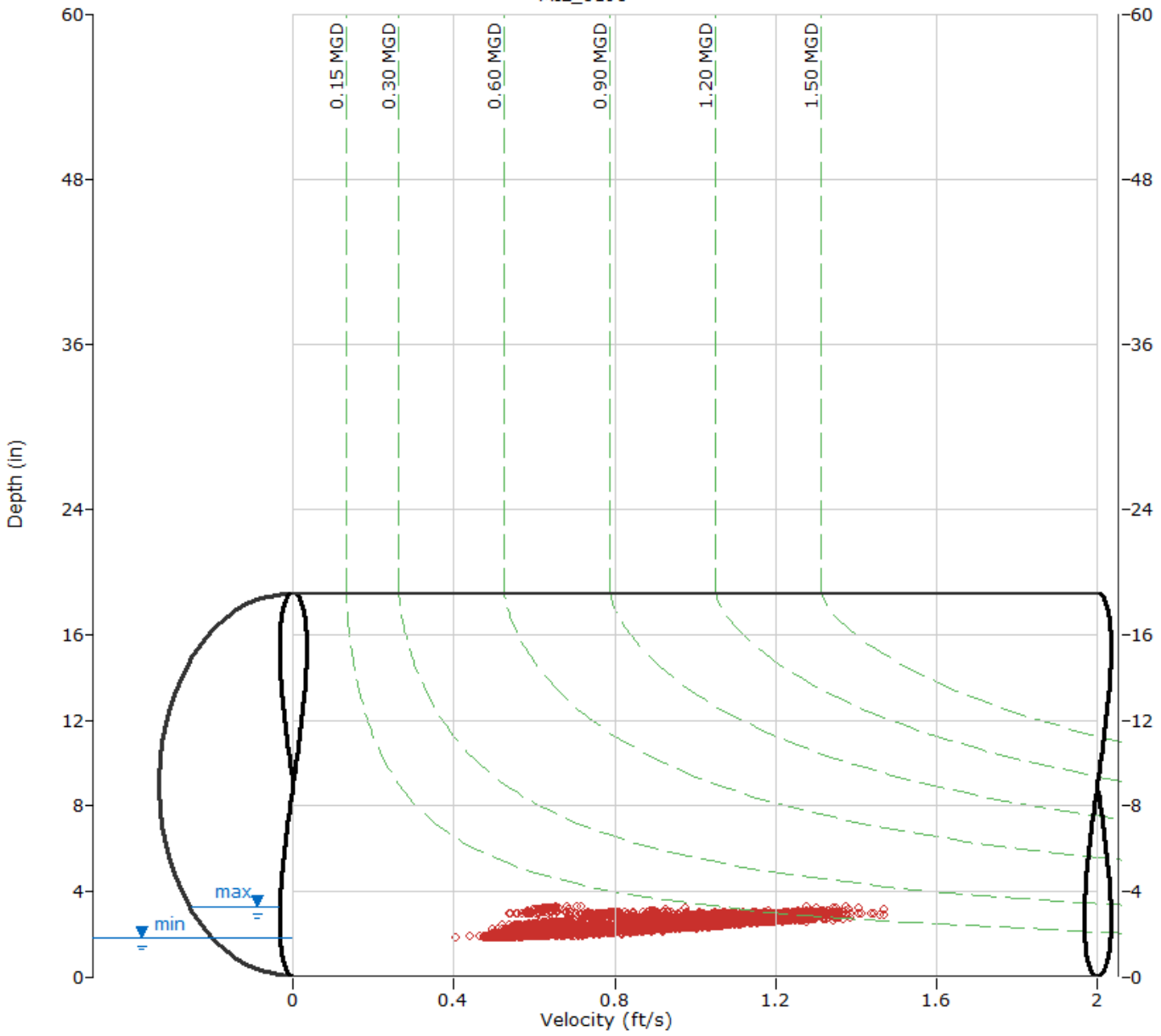


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



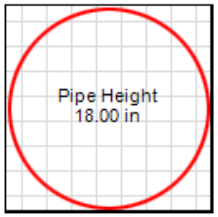
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_0190

Flow Monitor

MIL_0190

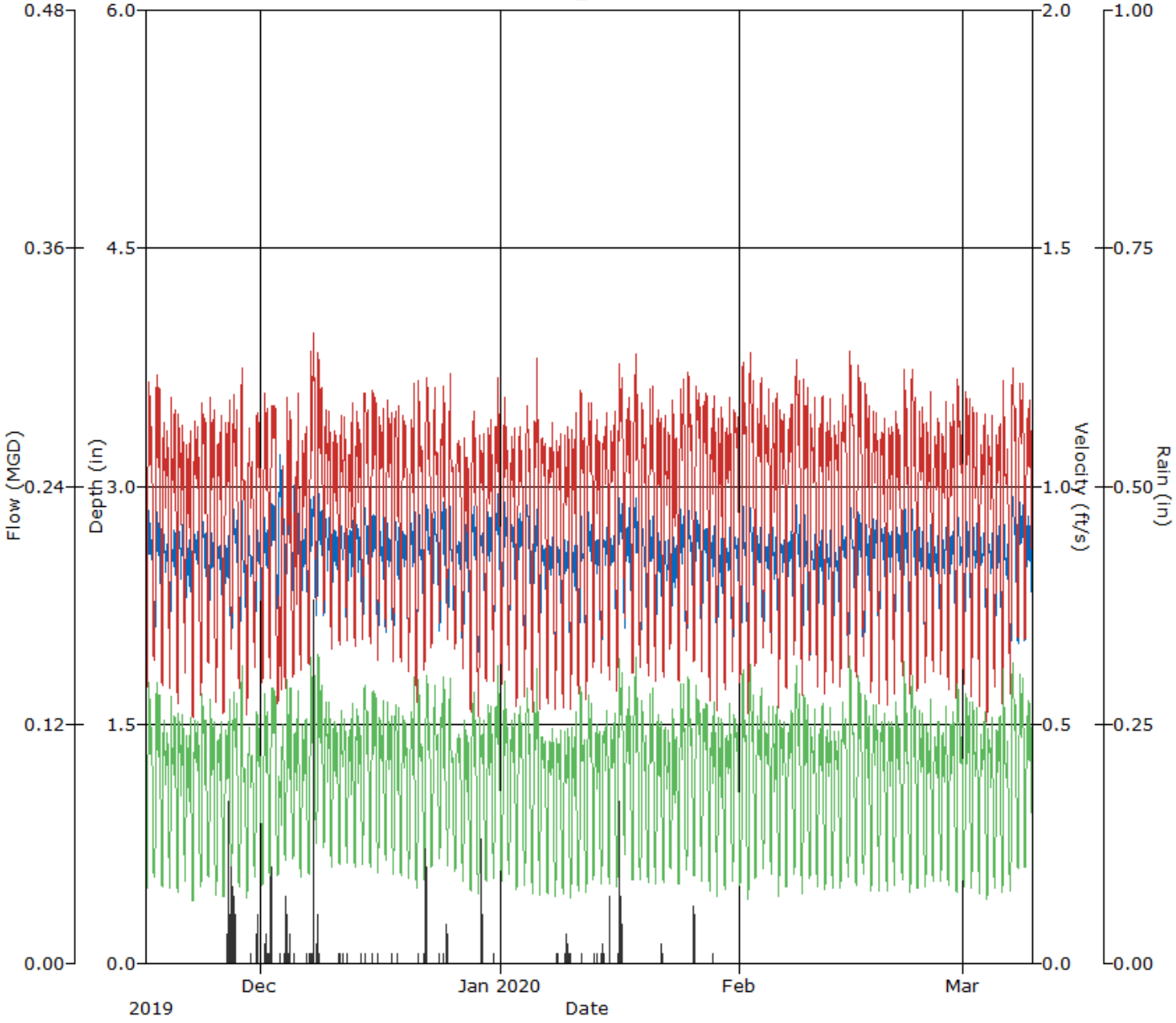


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_0190, Pipe Height: 18.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	05:40	1.91	11:20	2.88	2.45	05:30	0.55	12:55	1.35	0.96	05:30	0.036	13:00	0.155	0.093	0.093	
11/17/2019	05:05	1.95	11:00	3.02	2.48	04:10	0.58	10:55	1.36	0.98	04:10	0.040	10:55	0.172	0.097	0.097	
11/18/2019	03:55	1.91	11:05	2.74	2.42	03:45	0.53	20:00	1.23	0.94	03:45	0.034	11:10	0.130	0.089	0.089	
11/19/2019	05:35	1.89	09:05	2.81	2.44	05:35	0.54	18:45	1.38	0.95	05:35	0.034	18:45	0.150	0.091	0.091	
11/20/2019	04:35	1.91	19:10	2.80	2.46	04:25	0.49	08:35	1.25	0.94	04:25	0.032	19:05	0.137	0.091	0.091	
11/21/2019	04:40	1.95	21:10	2.88	2.41	04:40	0.55	18:35	1.19	0.92	04:40	0.037	21:15	0.138	0.086	0.086	
11/22/2019	04:00	1.80	10:45	2.76	2.41	03:50	0.41	10:25	1.23	0.93	03:50	0.024	10:35	0.134	0.088	0.088	
11/23/2019	03:20	1.96	10:15	2.91	2.46	05:00	0.54	11:15	1.30	0.94	05:00	0.037	10:15	0.150	0.092	0.092	
11/24/2019	03:40	1.98	12:35	2.81	2.44	03:35	0.57	21:55	1.25	0.96	03:35	0.039	22:00	0.141	0.092	0.092	
11/25/2019	05:35	1.83	21:30	2.69	2.38	04:20	0.53	20:30	1.20	0.93	05:35	0.032	18:50	0.126	0.087	0.087	
11/26/2019	05:40	1.84	21:15	2.87	2.39	03:50	0.44	12:50	1.28	0.93	03:50	0.027	21:15	0.147	0.088	0.088	0.36
11/27/2019	05:25	2.00	12:45	2.95	2.52	05:10	0.61	12:40	1.29	0.98	05:10	0.043	12:40	0.157	0.099	0.099	0.63
11/28/2019	05:25	1.92	12:45	3.00	2.41	06:25	0.52	12:50	1.30	0.93	06:25	0.034	12:50	0.160	0.088	0.088	
11/29/2019	05:40	1.85	10:35	2.74	2.35	04:40	0.50	12:25	1.24	0.90	05:50	0.031	10:35	0.135	0.082	0.082	0.02
11/30/2019	05:35	1.99	11:05	2.78	2.42	05:15	0.58	14:20	1.22	0.94	05:15	0.040	11:05	0.135	0.089	0.089	0.10
12/01/2019	06:25	1.92	11:30	2.84	2.43	06:25	0.55	11:30	1.29	0.94	06:25	0.036	11:30	0.150	0.091	0.091	0.06
12/02/2019	05:15	1.92	09:00	2.95	2.56	04:10	0.55	09:00	1.20	1.00	04:10	0.037	09:00	0.147	0.104	0.104	0.30
12/03/2019	06:05	2.19	13:25	3.24	2.75	03:50	0.50	18:45	1.12	0.74	03:50	0.041	20:10	0.130	0.082	0.082	0.01
12/04/2019	02:15	2.36	11:10	2.98	2.72	05:15	0.52	09:10	1.26	0.91	04:00	0.048	09:10	0.153	0.101	0.101	0.39
12/05/2019	04:45	2.33	15:10	3.18	2.67	04:55	0.57	21:45	1.25	0.87	04:55	0.050	15:15	0.152	0.094	0.094	0.01
12/06/2019	03:50	2.01	19:25	2.89	2.49	05:20	0.58	19:25	1.28	0.95	03:20	0.041	19:25	0.152	0.094	0.094	0.01
12/07/2019	05:25	2.01	21:05	2.98	2.58	05:15	0.59	12:50	1.44	1.03	05:15	0.042	12:50	0.174	0.108	0.108	0.67
12/08/2019	04:25	2.18	10:50	2.99	2.63	05:15	0.72	10:55	1.37	1.07	05:15	0.056	10:55	0.170	0.113	0.113	0.20
12/09/2019	03:50	2.16	21:25	2.84	2.55	04:05	0.65	22:00	1.28	1.00	04:05	0.050	11:30	0.144	0.101	0.101	
12/10/2019	04:35	2.05	19:00	2.77	2.50	03:40	0.61	11:00	1.23	0.96	03:40	0.044	11:00	0.134	0.094	0.094	
12/11/2019	03:45	2.07	09:10	2.79	2.50	05:00	0.64	20:55	1.25	0.97	05:00	0.047	20:00	0.137	0.095	0.095	0.03
12/12/2019	03:45	2.08	13:55	3.29	2.50	03:55	0.63	13:50	1.38	0.97	03:55	0.047	13:55	0.196	0.095	0.095	0.01
12/13/2019	05:00	2.02	14:00	2.87	2.49	05:10	0.62	13:50	1.25	0.97	05:10	0.044	10:40	0.144	0.095	0.095	0.01
12/14/2019	05:35	2.05	11:05	2.90	2.53	04:55	0.66	12:05	1.30	1.01	05:35	0.048	11:00	0.150	0.102	0.102	0.01
12/15/2019	04:20	2.04	20:50	2.85	2.53	05:20	0.64	13:45	1.29	1.00	05:20	0.046	13:45	0.149	0.101	0.101	0.01
12/16/2019	04:10	2.01	21:15	2.89	2.48	03:50	0.59	11:25	1.27	0.98	03:50	0.042	21:15	0.145	0.096	0.096	0.01
12/17/2019	04:45	2.05	10:10	2.80	2.49	05:20	0.62	20:55	1.33	1.00	05:20	0.045	20:55	0.142	0.098	0.098	0.01
12/18/2019	04:45	1.99	14:30	2.81	2.48	05:30	0.58	22:00	1.36	0.98	05:30	0.040	22:00	0.148	0.096	0.096	0.01
12/19/2019	03:50	1.98	13:05	2.77	2.47	04:50	0.57	09:30	1.24	0.97	04:50	0.040	09:10	0.138	0.094	0.094	
12/20/2019	04:20	1.98	20:55	2.92	2.49	04:00	0.54	20:55	1.29	0.95	04:00	0.038	20:55	0.155	0.093	0.093	
12/21/2019	05:40	1.97	11:05	2.92	2.46	05:30	0.49	11:05	1.35	0.94	05:30	0.034	11:05	0.162	0.092	0.092	0.01
12/22/2019	06:25	1.94	11:10	2.91	2.50	05:15	0.52	11:00	1.38	0.99	05:15	0.035	11:00	0.163	0.099	0.099	0.41
12/23/2019	05:10	2.04	13:40	2.91	2.52	03:40	0.63	10:45	1.32	0.97	03:40	0.045	13:40	0.154	0.097	0.097	
12/24/2019	05:25	2.07	18:25	2.95	2.54	04:55	0.64	20:25	1.25	0.98	04:55	0.047	18:30	0.150	0.099	0.099	0.02
12/25/2019	06:00	2.02	12:30	2.94	2.47	05:30	0.65	14:30	1.47	0.96	05:55	0.047	14:30	0.174	0.093	0.093	0.08
12/26/2019	04:55	2.00	10:40	2.70	2.42	05:10	0.63	19:45	1.20	0.94	04:55	0.044	19:45	0.128	0.088	0.088	
12/27/2019	04:50	1.94	13:05	2.82	2.44	04:45	0.53	19:35	1.17	0.91	04:45	0.035	13:05	0.134	0.087	0.087	
12/28/2019	06:30	1.95	14:20	2.93	2.48	06:20	0.49	14:30	1.22	0.91	06:20	0.033	14:30	0.145	0.090	0.090	
12/29/2019	06:05	1.94	10:30	2.84	2.45	05:40	0.50	21:30	1.19	0.89	05:50	0.033	20:05	0.133	0.087	0.087	0.22
12/30/2019	04:45	1.99	12:55	2.91	2.50	05:45	0.56	12:55	1.21	0.92	05:45	0.039	12:55	0.145	0.092	0.092	
12/31/2019	05:15	2.01	19:25	3.00	2.56	04:20	0.54	19:00	1.26	0.95	05:05	0.039	19:25	0.157	0.098	0.098	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	06:05	2.01 17:10	3.07	2.51	06:15	0.56 17:10	1.31	0.93	06:15	0.039 17:10	0.170	0.093	0.093	
01/02/2020	05:30	2.04 21:25	2.85	2.50	04:45	0.59 15:10	1.19	0.92	04:45	0.042 21:20	0.134	0.091	0.091	
01/03/2020	05:20	1.96 13:10	2.87	2.48	04:25	0.50 12:40	1.19	0.90	04:25	0.035 13:05	0.138	0.089	0.089	
01/04/2020	05:50	2.01 13:20	2.91	2.50	05:15	0.54 12:40	1.21	0.92	05:15	0.038 12:40	0.144	0.092	0.092	
01/05/2020	05:55	1.93 21:00	3.01	2.47	05:40	0.50 21:00	1.34	0.93	05:40	0.033 21:00	0.168	0.093	0.093	
01/06/2020	05:00	1.86 20:55	2.72	2.40	04:45	0.46 11:20	1.22	0.93	04:45	0.029 12:05	0.128	0.087	0.087	
01/07/2020	04:55	1.85 21:00	2.80	2.38	04:55	0.50 20:55	1.30	0.92	04:55	0.031 20:55	0.148	0.086	0.086	
01/08/2020	05:30	1.84 21:25	2.77	2.39	05:20	0.50 21:15	1.20	0.92	05:30	0.031 21:15	0.131	0.086	0.086	0.02
01/09/2020	05:00	1.88 08:55	2.71	2.41	04:45	0.51 21:15	1.19	0.92	04:55	0.033 21:15	0.127	0.087	0.087	0.18
01/10/2020	05:10	1.82 20:40	2.78	2.38	04:55	0.50 09:35	1.26	0.93	05:10	0.030 09:35	0.135	0.086	0.086	0.02
01/11/2020	05:25	1.87 11:10	2.93	2.43	05:05	0.52 12:40	1.32	0.94	05:05	0.033 12:40	0.154	0.091	0.091	0.01
01/12/2020	05:10	1.88 11:15	2.92	2.46	05:35	0.54 19:05	1.29	0.96	05:35	0.034 11:15	0.147	0.094	0.094	
01/13/2020	03:45	1.94 20:45	2.81	2.43	04:25	0.58 20:45	1.18	0.95	04:25	0.040 20:45	0.134	0.091	0.091	0.02
01/14/2020	03:35	1.90 19:45	2.82	2.44	02:25	0.57 19:40	1.31	0.96	03:25	0.038 19:40	0.149	0.092	0.092	0.11
01/15/2020	04:55	1.91 21:10	2.77	2.44	04:45	0.56 19:35	1.23	0.95	04:45	0.037 21:10	0.137	0.091	0.091	0.07
01/16/2020	04:30	1.93 12:40	3.22	2.52	03:20	0.54 12:50	1.38	1.00	03:50	0.036 12:40	0.186	0.102	0.102	0.66
01/17/2020	04:40	2.08 19:05	2.90	2.54	04:45	0.71 10:55	1.29	1.03	04:45	0.052 19:00	0.149	0.103	0.103	
01/18/2020	05:40	1.98 14:40	3.02	2.51	03:40	0.55 14:40	1.35	0.99	03:40	0.040 14:40	0.170	0.099	0.099	
01/19/2020	04:35	1.95 10:40	2.84	2.43	04:10	0.58 14:00	1.32	0.95	04:10	0.039 14:00	0.146	0.090	0.090	
01/20/2020	05:20	1.95 20:05	2.85	2.44	06:10	0.55 11:00	1.35	0.97	06:10	0.038 11:00	0.149	0.093	0.093	
01/21/2020	04:55	1.94 21:00	2.85	2.45	05:10	0.57 21:05	1.27	0.97	05:10	0.038 21:05	0.147	0.094	0.094	
01/22/2020	05:25	1.92 09:10	2.74	2.41	05:30	0.55 08:55	1.25	0.96	05:25	0.036 09:00	0.135	0.090	0.090	0.03
01/23/2020	05:20	2.01 09:20	2.76	2.42	02:45	0.59 09:00	1.29	0.96	02:45	0.042 11:55	0.138	0.090	0.090	
01/24/2020	05:05	1.92 19:45	3.01	2.49	05:10	0.54 19:45	1.32	1.00	05:10	0.035 19:45	0.165	0.099	0.099	
01/25/2020	06:20	2.00 10:45	2.93	2.49	06:05	0.55 10:25	1.32	1.00	06:05	0.039 10:25	0.157	0.099	0.099	
01/26/2020	04:15	1.97 11:55	2.87	2.49	03:45	0.58 11:55	1.30	1.00	03:45	0.040 11:55	0.152	0.099	0.099	0.16
01/27/2020	04:40	1.97 19:45	2.78	2.48	04:20	0.55 08:35	1.30	1.00	04:20	0.037 21:05	0.139	0.098	0.098	
01/28/2020	04:50	1.91 20:30	2.83	2.44	04:40	0.51 20:25	1.27	0.97	04:50	0.033 20:25	0.145	0.092	0.092	0.01
01/29/2020	05:25	1.83 09:15	2.79	2.39	05:10	0.48 19:20	1.28	0.94	05:10	0.029 09:10	0.136	0.088	0.088	
01/30/2020	05:15	1.90 19:40	2.79	2.40	04:50	0.54 19:35	1.27	0.96	04:50	0.035 19:40	0.143	0.090	0.090	
01/31/2020	04:00	1.95 09:05	2.74	2.46	04:40	0.57 13:50	1.25	1.00	04:40	0.039 13:50	0.135	0.096	0.096	
02/01/2020	04:10	1.90 14:10	2.91	2.45	03:50	0.54 20:10	1.37	0.99	03:50	0.035 14:10	0.157	0.097	0.097	
02/02/2020	05:35	1.83 12:15	2.88	2.45	05:30	0.50 12:35	1.46	0.99	05:30	0.031 12:35	0.171	0.097	0.097	
02/03/2020	03:55	1.95 21:05	2.87	2.45	04:05	0.56 21:00	1.33	0.99	04:05	0.037 21:00	0.157	0.096	0.096	
02/04/2020	04:00	2.02 20:05	2.74	2.45	03:10	0.63 22:10	1.28	1.00	04:00	0.046 20:20	0.139	0.096	0.096	
02/05/2020	05:30	1.98 10:20	2.82	2.45	06:00	0.60 20:55	1.37	0.99	06:00	0.041 20:55	0.145	0.094	0.094	
02/06/2020	04:20	1.84 10:55	2.70	2.41	03:20	0.51 21:25	1.23	0.96	03:00	0.033 21:25	0.130	0.091	0.091	
02/07/2020	05:15	1.88 20:35	2.75	2.42	05:05	0.50 20:35	1.28	0.97	05:05	0.033 20:35	0.141	0.092	0.092	
02/08/2020	05:20	1.98 09:45	3.01	2.47	04:05	0.61 09:40	1.41	1.02	05:05	0.042 09:40	0.173	0.099	0.099	
02/09/2020	06:10	1.83 13:15	2.90	2.40	06:10	0.52 10:50	1.30	0.96	06:10	0.032 10:50	0.149	0.091	0.091	
02/10/2020	05:20	1.91 21:15	2.76	2.41	03:50	0.60 07:55	1.34	0.98	03:50	0.039 07:55	0.136	0.092	0.092	
02/11/2020	04:35	1.91 21:25	2.82	2.42	04:25	0.53 21:20	1.27	0.97	04:25	0.035 21:20	0.144	0.092	0.092	
02/12/2020	04:05	1.87 21:25	2.76	2.42	03:45	0.51 20:00	1.21	0.98	03:45	0.033 21:25	0.133	0.093	0.093	
02/13/2020	04:50	1.88 08:50	2.75	2.40	04:20	0.55 22:45	1.22	0.97	05:00	0.035 09:00	0.129	0.090	0.090	
02/14/2020	05:05	1.88 11:05	2.77	2.44	03:20	0.53 20:40	1.32	0.99	03:20	0.034 20:40	0.141	0.095	0.095	
02/15/2020	03:25	1.99 09:30	2.99	2.48	04:20	0.60 09:20	1.44	1.01	04:20	0.042 09:20	0.176	0.100	0.100	
02/16/2020	05:15	1.90 13:40	2.88	2.45	05:25	0.57 14:10	1.28	0.99	05:25	0.037 13:45	0.151	0.097	0.097	
02/17/2020	05:05	1.94 10:50	2.86	2.43	04:50	0.55 12:35	1.29	0.98	04:50	0.037 10:45	0.148	0.094	0.094	
02/18/2020	03:35	1.87 18:10	2.84	2.45	03:45	0.54 18:10	1.20	0.95	03:30	0.034 18:10	0.139	0.092	0.092	
02/19/2020	04:10	1.95 12:05	2.82	2.47	04:15	0.53 20:45	1.21	0.94	04:10	0.035 20:45	0.137	0.092	0.092	
02/20/2020	04:55	1.91 12:45	2.77	2.45	05:05	0.51 18:45	1.22	0.93	05:05	0.033 20:30	0.131	0.090	0.090	
02/21/2020	05:15	1.97 09:30	2.86	2.48	04:35	0.53 18:45	1.27	0.95	04:35	0.036 09:30	0.140	0.093	0.093	
02/22/2020	06:10	1.97 11:10	3.00	2.48	05:55	0.56 11:50	1.27	0.96	05:55	0.038 11:10	0.158	0.095	0.095	
02/23/2020	05:15	1.87 11:25	2.87	2.45	06:00	0.54 10:10	1.35	0.98	06:00	0.034 10:10	0.152	0.096	0.096	
02/24/2020	03:55	1.89 19:50	2.81	2.43	04:05	0.48 19:40	1.25	0.97	04:05	0.031 19:40	0.142	0.093	0.093	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	04:55	1.88	21:15	2.81	2.42	04:40	0.52	19:55	1.26	0.95	04:40	0.034	21:10	0.139	0.090	0.090	
02/26/2020	05:05	1.92	21:15	2.74	2.42	04:50	0.55	20:30	1.27	0.96	04:55	0.036	20:30	0.135	0.091	0.091	
02/27/2020	04:55	1.94	20:55	2.78	2.44	05:00	0.57	08:50	1.26	0.96	05:00	0.038	20:30	0.138	0.091	0.091	
02/28/2020	05:10	1.91	20:35	2.75	2.44	05:05	0.51	20:45	1.21	0.95	05:05	0.033	21:20	0.132	0.091	0.091	
02/29/2020	06:15	1.89	09:35	2.93	2.43	06:10	0.52	09:30	1.29	0.95	06:15	0.033	09:35	0.156	0.091	0.091	
03/01/2020	05:00	1.90	21:10	2.84	2.44	06:10	0.55	12:30	1.33	0.96	06:10	0.036	12:30	0.148	0.093	0.093	
03/02/2020	04:30	1.93	09:15	2.85	2.46	04:20	0.54	09:10	1.30	0.95	04:20	0.036	09:10	0.149	0.092	0.092	
03/03/2020	05:40	1.90	21:40	2.79	2.44	05:20	0.52	19:10	1.22	0.93	05:20	0.034	19:10	0.136	0.089	0.089	
03/04/2020	04:55	1.86	21:10	2.77	2.41	05:05	0.48	21:05	1.21	0.92	05:05	0.030	21:05	0.135	0.088	0.088	
03/05/2020	04:10	1.91	20:55	2.78	2.44	03:30	0.55	18:55	1.16	0.94	03:35	0.036	21:10	0.129	0.091	0.091	
03/06/2020	04:50	1.89	09:25	3.19	2.42	04:45	0.51	09:10	1.47	0.93	04:45	0.033	09:10	0.198	0.088	0.088	
03/07/2020	05:30	1.88	13:55	3.03	2.52	05:10	0.54	16:10	1.31	1.00	05:25	0.034	13:55	0.166	0.102	0.102	
03/08/2020	05:30	1.98	17:50	3.10	2.56	05:30	0.66	13:35	1.33	1.03	05:30	0.045	17:50	0.173	0.105	0.105	
03/09/2020	03:50	2.01	11:50	2.91	2.49	03:45	0.63	11:40	1.24	0.99	03:45	0.044	11:50	0.145	0.098	0.098	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			10.748	4.90
Avg	2.47	0.96	0.093	

Site Commentary

Site Information

MIL_0229	
Pipe Dimensions	21
Silt Level	0.00"

Overview

Site MIL_0229 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

This location was installed upstream of site MIL_2808. (See MIL_2808 Site Commentary for More Details)

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	3.46	0.59	0.103
Minimum	1.78	0.19	0.021
Maximum	5.18	0.94	0.253
Time of Minimum	11/29/2019 7:00 AM	2/26/2020 4:00 AM	11/29/2019 7:05 AM
Time of Maximum	12/6/2019 3:20 PM	11/21/2019 9:05 AM	1/21/2020 1:55 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

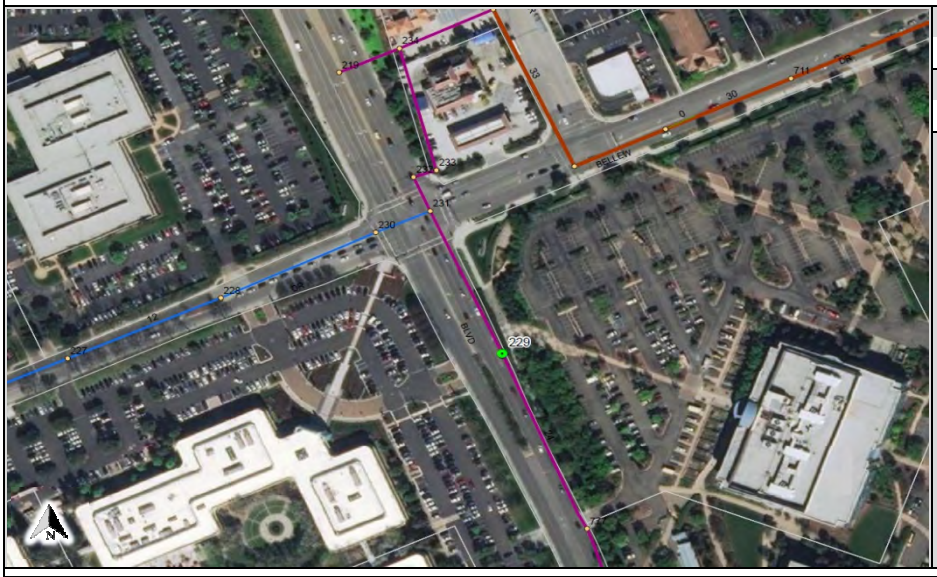
Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_0229

Site Address /Location:	Bellew Dr and McCarthy Blvd			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	In right lane of road	Latitude:	37.420574°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.921605°	21.0" x 21.0"	Circular



Manhole #	System Characteristics
229	Residential/Commercial
Access	Traffic
Drive	Medium







Installation Information

Installation Date:	Installation Type:
Tuesday, November 12, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
4:21:29 AM	21.0" x 21.0"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
2.25	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
0.25	0''
Silt (in)	Silt Type
0.25''	Soft / Loose

Hydraulic Comments:

Shallow depth with slow velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
15'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_0229

Flow Monitor

MIL_0229

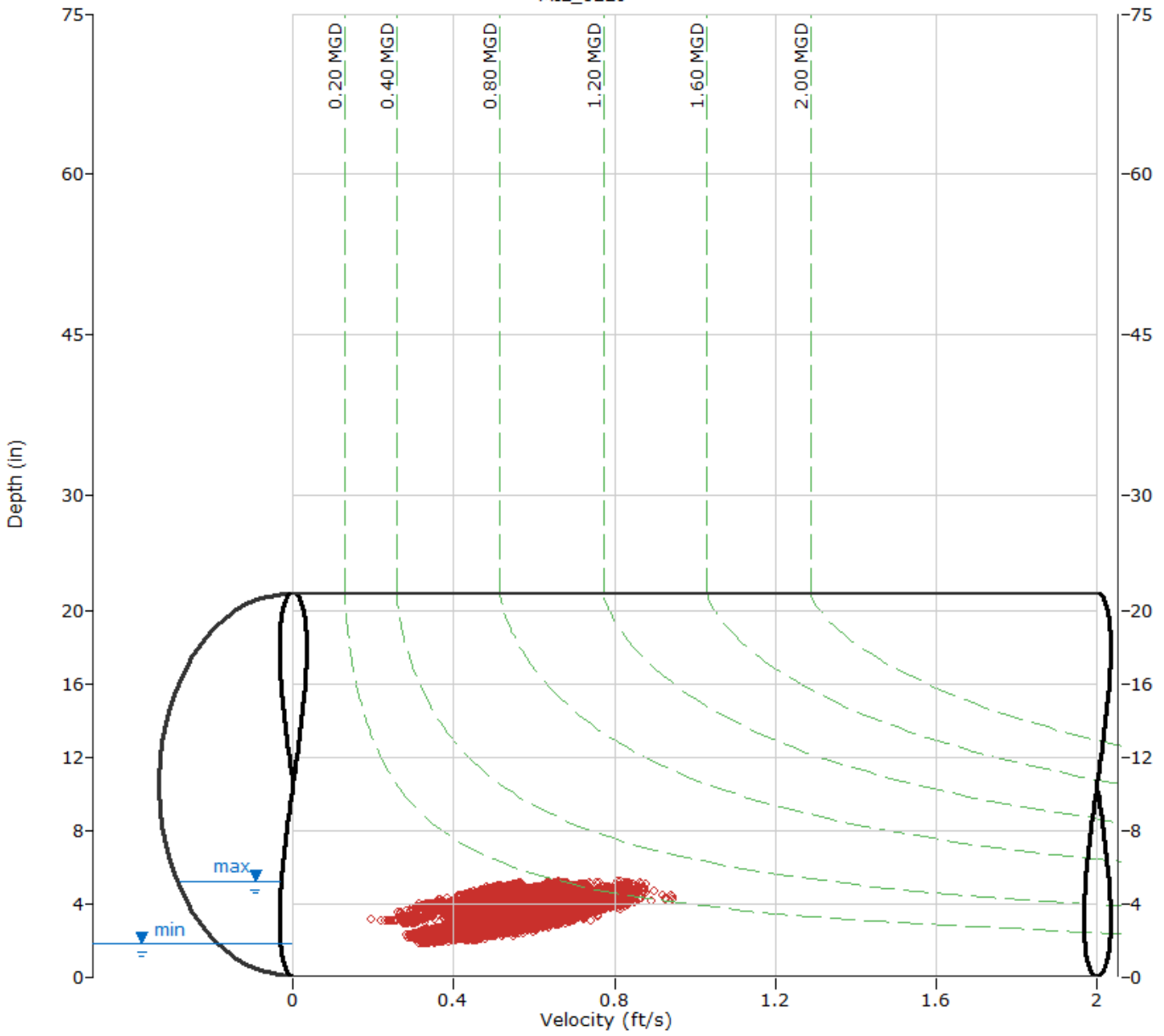
Pipe Height
21.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



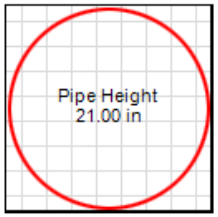
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_0229

Flow Monitor

MIL_0229

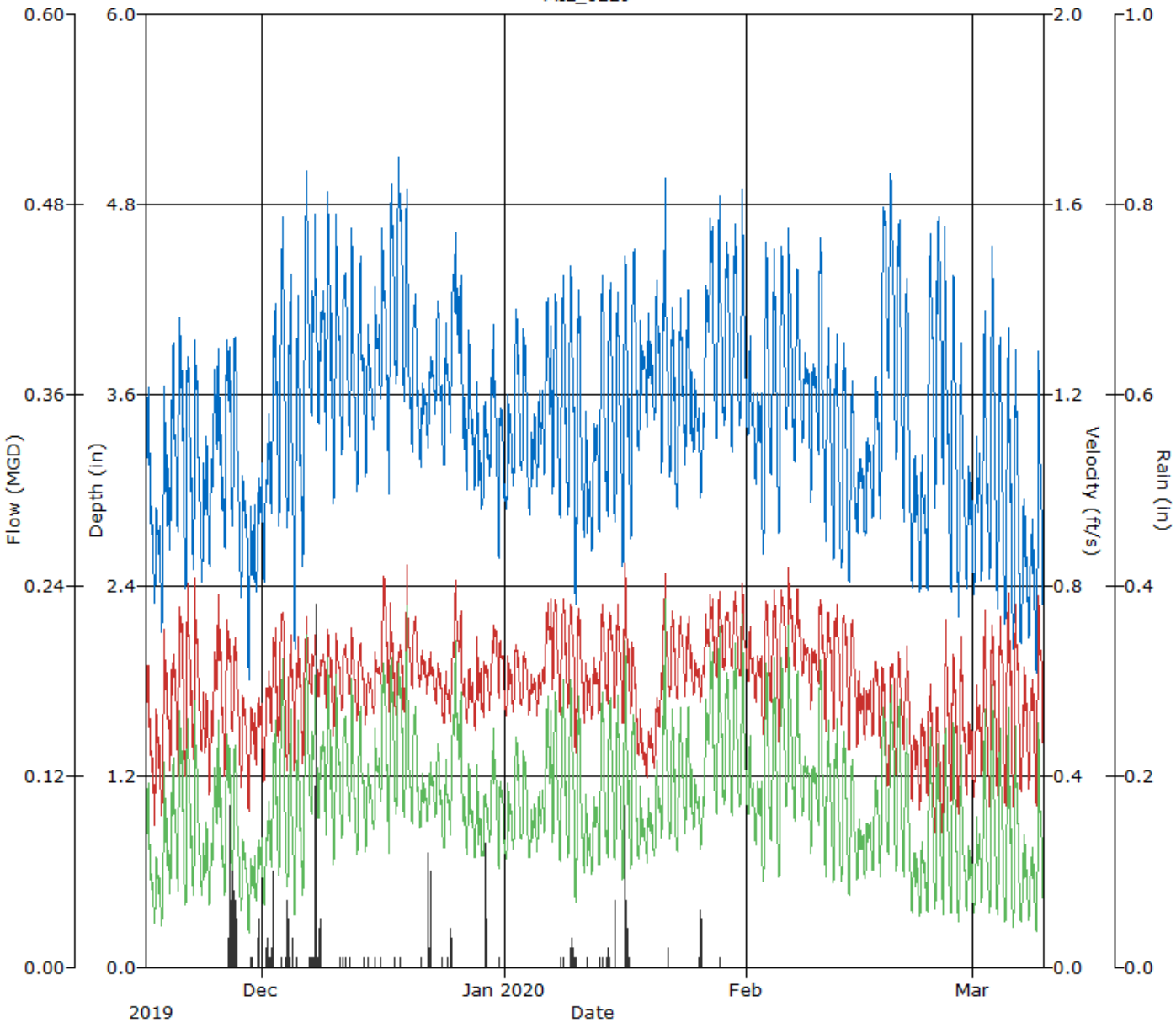


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_0229, Pipe Height: 21.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	21:15	2.61	10:30	4.06	3.16	23:25	0.39	10:30	0.75	0.52	20:50	0.044	10:30	0.157	0.079	0.079	
11/17/2019	07:10	2.27	10:00	3.04	2.63	05:30	0.28	09:55	0.62	0.43	05:30	0.026	09:55	0.085	0.050	0.050	
11/18/2019	03:25	2.07	10:15	3.89	2.91	02:45	0.29	10:10	0.78	0.52	03:15	0.023	10:15	0.153	0.072	0.072	
11/19/2019	05:55	2.56	15:45	4.10	3.30	05:45	0.35	15:55	0.74	0.57	05:55	0.038	15:55	0.155	0.091	0.091	
11/20/2019	03:35	2.72	09:40	4.27	3.35	03:40	0.37	09:40	0.82	0.59	03:40	0.044	09:40	0.185	0.099	0.099	
11/21/2019	03:55	2.34	09:10	4.19	3.17	03:30	0.39	09:05	0.94	0.58	03:30	0.037	09:05	0.208	0.091	0.091	
11/22/2019	04:40	2.46	09:15	4.42	3.20	04:00	0.40	09:20	0.94	0.60	04:00	0.041	09:15	0.225	0.093	0.093	
11/23/2019	07:30	2.40	21:55	3.38	2.90	15:45	0.42	08:25	0.61	0.50	07:35	0.043	22:00	0.095	0.066	0.066	
11/24/2019	07:05	2.49	21:15	3.92	3.07	06:50	0.34	20:55	0.68	0.50	07:05	0.036	21:15	0.134	0.073	0.073	
11/25/2019	20:45	2.82	08:30	3.95	3.32	23:50	0.48	08:40	0.83	0.62	23:55	0.063	08:25	0.168	0.098	0.098	
11/26/2019	06:05	2.61	21:05	4.22	3.37	04:05	0.38	21:05	0.79	0.59	04:05	0.044	21:05	0.176	0.099	0.099	0.36
11/27/2019	05:55	2.73	10:00	4.09	3.37	02:35	0.46	12:50	0.78	0.60	06:00	0.057	10:00	0.154	0.099	0.099	0.63
11/28/2019	05:35	2.21	12:00	3.37	2.75	05:40	0.34	12:00	0.63	0.49	05:40	0.030	12:00	0.101	0.060	0.060	
11/29/2019	07:00	1.78	14:15	3.10	2.51	06:00	0.31	17:20	0.64	0.46	07:05	0.021	14:15	0.084	0.050	0.050	0.02
11/30/2019	06:05	2.34	22:05	3.32	2.79	04:10	0.41	12:45	0.63	0.51	04:10	0.040	12:45	0.096	0.063	0.063	0.10
12/01/2019	05:55	2.39	20:25	3.57	2.95	07:50	0.37	21:50	0.63	0.51	07:50	0.037	20:25	0.110	0.070	0.070	0.06
12/02/2019	04:25	2.82	18:10	4.36	3.59	23:55	0.47	10:05	0.76	0.61	04:25	0.060	18:10	0.169	0.110	0.110	0.30
12/03/2019	04:05	2.73	14:55	4.79	3.72	04:05	0.43	14:00	0.80	0.62	04:05	0.051	14:00	0.212	0.120	0.120	0.01
12/04/2019	23:55	2.51	16:25	4.47	3.40	03:00	0.39	16:40	0.74	0.56	05:00	0.048	16:40	0.174	0.095	0.095	0.39
12/05/2019	05:30	1.98	13:15	4.45	3.16	03:55	0.39	13:15	0.76	0.57	03:55	0.030	13:15	0.182	0.088	0.088	0.01
12/06/2019	03:25	2.50	15:20	5.18	3.79	04:55	0.41	15:20	0.82	0.59	04:15	0.043	15:20	0.243	0.121	0.121	0.01
12/07/2019	06:10	3.39	18:20	4.95	3.99	06:10	0.56	18:20	0.71	0.63	06:10	0.092	18:20	0.199	0.130	0.130	0.67
12/08/2019	05:50	3.37	21:05	4.61	3.89	05:50	0.56	21:05	0.69	0.62	05:50	0.091	21:05	0.173	0.124	0.124	0.20
12/09/2019	03:15	3.25	09:30	5.02	4.05	03:15	0.54	09:30	0.72	0.63	03:15	0.083	09:30	0.205	0.134	0.134	
12/10/2019	03:25	2.87	13:45	5.11	3.81	02:15	0.47	13:45	0.75	0.60	02:45	0.063	13:45	0.221	0.119	0.119	
12/11/2019	04:20	3.21	14:25	4.50	3.86	04:20	0.54	17:30	0.71	0.62	04:20	0.081	14:25	0.166	0.123	0.123	0.03
12/12/2019	04:15	3.32	13:55	4.71	3.81	01:45	0.54	14:00	0.74	0.62	23:30	0.088	14:00	0.191	0.122	0.122	0.01
12/13/2019	03:50	2.97	14:50	4.64	3.73	04:25	0.48	15:10	0.72	0.61	04:25	0.065	14:50	0.177	0.116	0.116	0.01
12/14/2019	06:50	3.07	14:40	4.17	3.59	05:55	0.50	12:25	0.67	0.57	06:20	0.070	12:25	0.138	0.102	0.102	0.01
12/15/2019	06:05	3.37	11:10	4.31	3.78	07:05	0.52	11:10	0.66	0.60	07:05	0.085	11:10	0.153	0.115	0.115	0.01
12/16/2019	03:35	3.55	10:00	4.86	4.00	03:35	0.52	10:05	0.86	0.70	03:35	0.090	10:05	0.216	0.146	0.146	0.01
12/17/2019	04:05	2.95	13:35	5.04	4.10	05:40	0.51	09:35	0.83	0.64	04:05	0.069	13:40	0.217	0.140	0.140	0.01
12/18/2019	03:35	3.66	11:45	5.16	4.41	03:35	0.53	14:10	0.69	0.61	03:35	0.096	10:15	0.199	0.148	0.148	0.01
12/19/2019	22:35	3.46	11:05	4.99	4.03	03:45	0.52	12:15	0.87	0.66	04:20	0.092	12:15	0.235	0.141	0.141	
12/20/2019	05:40	3.22	15:45	4.28	3.76	04:25	0.55	14:55	0.79	0.66	04:25	0.085	14:55	0.177	0.126	0.126	
12/21/2019	07:00	3.12	11:35	3.79	3.44	04:35	0.58	11:30	0.71	0.62	04:35	0.086	11:30	0.135	0.104	0.104	0.01
12/22/2019	06:25	3.24	14:30	3.92	3.60	02:15	0.55	14:30	0.72	0.62	02:15	0.088	14:30	0.143	0.110	0.110	0.41
12/23/2019	03:30	3.46	11:30	4.27	3.78	06:05	0.52	04:20	0.71	0.59	06:20	0.090	14:05	0.148	0.113	0.113	
12/24/2019	06:35	3.14	12:15	4.13	3.58	04:45	0.49	12:30	0.65	0.56	07:15	0.072	12:30	0.139	0.099	0.099	0.02
12/25/2019	05:00	3.34	18:30	4.66	4.10	03:10	0.50	18:25	0.84	0.66	04:45	0.080	18:25	0.215	0.145	0.145	0.08
12/26/2019	19:55	3.21	01:00	4.41	3.84	23:00	0.51	12:05	0.76	0.65	18:55	0.085	12:25	0.178	0.128	0.128	
12/27/2019	05:45	2.99	11:20	4.07	3.50	04:00	0.47	12:10	0.64	0.57	04:00	0.066	11:25	0.132	0.098	0.098	
12/28/2019	05:00	2.98	12:50	4.09	3.21	06:45	0.48	13:00	0.74	0.57	06:45	0.066	12:50	0.151	0.086	0.086	
12/29/2019	02:10	2.86	12:15	3.60	3.21	07:20	0.50	17:45	0.76	0.59	07:20	0.066	12:15	0.123	0.090	0.090	0.22
12/30/2019	02:20	3.07	11:20	4.08	3.53	02:55	0.52	18:35	0.76	0.65	02:55	0.074	14:50	0.155	0.113	0.113	
12/31/2019	06:45	2.53	11:50	3.64	3.15	04:55	0.54	00:55	0.71	0.64	06:40	0.058	11:50	0.122	0.094	0.094	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/01/2020	05:40	2.87	12:50	3.74	3.21	03:45	0.49	16:50	0.70	0.59	05:40	0.064	12:50	0.126	0.089	0.089	
01/02/2020	03:20	2.99	13:10	4.21	3.60	04:30	0.51	09:45	0.72	0.62	04:30	0.070	13:10	0.157	0.111	0.111	
01/03/2020	07:15	3.10	10:40	4.07	3.56	02:45	0.52	12:35	0.68	0.61	02:45	0.075	10:15	0.143	0.107	0.107	
01/04/2020	07:10	2.81	11:55	3.54	3.16	06:05	0.52	22:35	0.64	0.58	07:40	0.066	19:35	0.109	0.085	0.085	
01/05/2020	04:40	3.01	21:40	3.76	3.35	04:40	0.51	10:30	0.68	0.58	04:40	0.070	21:35	0.120	0.094	0.094	
01/06/2020	04:15	3.08	13:40	4.30	3.70	04:15	0.59	22:15	0.81	0.68	04:15	0.084	13:35	0.181	0.128	0.128	
01/07/2020	05:35	2.96	12:10	4.45	3.63	05:35	0.54	12:10	0.84	0.69	05:35	0.072	12:10	0.202	0.126	0.126	
01/08/2020	03:05	2.81	13:30	4.50	3.56	03:10	0.51	13:30	0.82	0.66	03:10	0.063	13:30	0.199	0.119	0.119	0.02
01/09/2020	04:00	2.82	13:40	4.58	3.63	04:25	0.53	11:40	0.79	0.66	04:25	0.066	11:40	0.197	0.122	0.122	0.18
01/10/2020	04:45	2.27	12:25	4.52	3.35	04:45	0.44	14:40	0.79	0.62	04:45	0.040	12:25	0.193	0.105	0.105	0.02
01/11/2020	06:05	2.68	12:20	3.62	2.96	05:55	0.49	10:40	0.68	0.58	05:55	0.057	12:20	0.118	0.078	0.078	0.01
01/12/2020	05:25	2.59	11:35	3.55	3.08	02:45	0.51	18:50	0.67	0.59	03:15	0.057	11:30	0.115	0.084	0.084	
01/13/2020	04:15	2.71	13:30	4.56	3.56	03:50	0.50	14:10	0.79	0.65	03:50	0.060	13:30	0.190	0.117	0.117	0.02
01/14/2020	05:50	2.81	14:20	4.47	3.55	05:45	0.54	13:30	0.82	0.66	05:45	0.067	13:30	0.191	0.117	0.117	0.11
01/15/2020	04:35	2.78	13:35	4.31	3.52	05:30	0.52	13:55	0.78	0.65	05:30	0.063	13:30	0.175	0.115	0.115	0.07
01/16/2020	03:10	2.52	12:35	4.66	3.47	04:30	0.49	12:35	0.90	0.65	04:30	0.053	12:35	0.231	0.114	0.114	0.66
01/17/2020	05:45	2.65	13:50	4.59	3.69	23:15	0.47	10:25	0.75	0.59	05:45	0.059	13:35	0.173	0.111	0.111	
01/18/2020	05:55	3.23	10:25	4.08	3.64	19:50	0.41	00:50	0.61	0.47	05:40	0.064	10:00	0.120	0.085	0.085	
01/19/2020	05:45	3.37	10:50	4.21	3.74	05:50	0.38	04:35	0.59	0.45	05:50	0.061	19:50	0.112	0.085	0.085	
01/20/2020	05:40	3.43	13:15	4.39	3.86	04:10	0.41	18:20	0.69	0.49	04:40	0.068	13:20	0.139	0.098	0.098	
01/21/2020	03:25	3.10	13:55	5.06	3.86	03:25	0.57	13:55	0.88	0.67	03:25	0.081	13:55	0.253	0.135	0.135	
01/22/2020	23:55	3.01	13:50	4.24	3.57	04:10	0.55	13:40	0.77	0.65	04:10	0.077	13:40	0.172	0.116	0.116	0.03
01/23/2020	04:35	2.88	14:10	4.30	3.56	02:45	0.54	14:15	0.76	0.66	04:40	0.070	14:15	0.175	0.117	0.117	
01/24/2020	03:30	3.15	14:25	4.33	3.69	03:20	0.54	16:10	0.76	0.66	03:20	0.080	14:30	0.174	0.122	0.122	
01/25/2020	06:55	3.23	01:30	4.08	3.46	06:45	0.56	01:30	0.71	0.61	06:55	0.085	01:30	0.150	0.103	0.103	
01/26/2020	04:55	2.91	22:05	4.36	3.51	04:10	0.54	19:10	0.76	0.63	04:10	0.072	20:45	0.173	0.110	0.110	0.16
01/27/2020	23:55	3.53	09:20	4.87	4.19	23:45	0.63	09:15	0.82	0.71	23:55	0.108	09:15	0.224	0.157	0.157	
01/28/2020	03:35	3.31	13:25	4.91	3.99	04:45	0.59	13:30	0.81	0.69	04:45	0.094	13:30	0.223	0.145	0.145	0.01
01/29/2020	02:50	3.38	10:05	4.68	3.96	01:55	0.59	17:05	0.79	0.70	23:55	0.098	10:05	0.197	0.143	0.143	
01/30/2020	03:25	3.22	13:50	4.74	3.94	05:45	0.60	13:10	0.83	0.70	05:45	0.092	13:10	0.215	0.143	0.143	
01/31/2020	04:05	3.39	11:00	5.13	3.96	03:05	0.58	10:50	0.87	0.69	03:05	0.097	10:55	0.252	0.142	0.142	
02/01/2020	07:20	3.33	13:00	3.99	3.55	07:25	0.59	11:00	0.77	0.64	07:25	0.093	11:00	0.151	0.113	0.113	
02/02/2020	23:30	2.95	21:20	3.84	3.32	23:30	0.51	21:20	0.70	0.61	23:30	0.068	21:20	0.135	0.096	0.096	
02/03/2020	04:15	2.57	13:55	4.66	3.59	04:15	0.48	13:30	0.78	0.65	04:15	0.053	13:45	0.197	0.120	0.120	
02/04/2020	03:25	3.07	13:20	4.65	3.72	23:30	0.54	13:15	0.84	0.67	23:30	0.077	13:15	0.215	0.129	0.129	
02/05/2020	04:05	2.71	13:35	4.61	3.69	03:55	0.45	16:10	0.81	0.67	04:00	0.054	13:35	0.200	0.129	0.129	
02/06/2020	23:50	3.35	09:30	4.84	3.89	02:45	0.60	09:20	0.87	0.72	02:45	0.097	09:20	0.234	0.145	0.145	
02/07/2020	04:05	3.17	09:45	4.60	3.77	06:20	0.60	12:40	0.87	0.70	05:30	0.091	09:40	0.207	0.135	0.135	
02/08/2020	04:15	3.30	13:25	3.92	3.61	04:05	0.59	08:40	0.72	0.65	04:05	0.093	13:25	0.139	0.117	0.117	
02/09/2020	06:10	2.89	14:05	3.93	3.50	06:05	0.52	11:40	0.70	0.63	06:05	0.067	14:05	0.138	0.107	0.107	
02/10/2020	05:00	3.09	13:25	4.69	3.75	05:15	0.56	14:20	0.81	0.68	05:15	0.083	13:25	0.207	0.130	0.130	
02/11/2020	05:30	2.66	13:35	4.19	3.33	05:35	0.48	07:35	0.83	0.64	05:35	0.055	07:35	0.176	0.104	0.104	
02/12/2020	04:55	2.56	14:15	4.22	3.24	05:00	0.47	14:15	0.79	0.64	05:00	0.051	14:15	0.177	0.101	0.101	
02/13/2020	03:10	2.49	13:35	4.09	3.16	04:35	0.50	15:40	0.79	0.65	04:35	0.053	13:35	0.167	0.098	0.098	
02/14/2020	04:10	2.41	13:35	3.78	3.07	04:30	0.45	12:20	0.75	0.62	04:35	0.045	13:35	0.139	0.090	0.090	
02/15/2020	05:55	2.73	14:00	3.40	2.99	04:55	0.45	00:55	0.65	0.54	04:55	0.054	14:00	0.100	0.074	0.074	
02/16/2020	04:50	2.69	11:55	3.61	3.05	04:45	0.46	19:55	0.67	0.55	04:45	0.054	11:55	0.117	0.077	0.077	
02/17/2020	03:15	2.81	12:15	3.90	3.31	04:10	0.46	13:30	0.70	0.57	03:40	0.058	12:00	0.132	0.092	0.092	
02/18/2020	03:45	2.79	13:45	4.86	3.99	23:45	0.41	13:55	0.70	0.54	03:45	0.055	13:55	0.188	0.113	0.113	
02/19/2020	05:35	3.69	11:30	5.10	4.33	02:45	0.37	11:55	0.68	0.53	05:35	0.069	13:55	0.185	0.125	0.125	
02/20/2020	06:00	3.18	14:20	4.75	3.93	04:00	0.37	10:25	0.79	0.54	04:00	0.056	10:25	0.203	0.113	0.113	
02/21/2020	03:55	2.76	13:25	4.48	3.53	03:50	0.43	14:10	0.70	0.55	03:50	0.052	13:30	0.169	0.099	0.099	
02/22/2020	03:05	2.35	20:25	3.40	2.84	03:00	0.31	09:55	0.55	0.44	03:00	0.029	09:55	0.087	0.056	0.056	
02/23/2020	06:35	2.34	14:10	3.39	2.80	05:10	0.32	20:05	0.55	0.44	06:30	0.030	14:10	0.088	0.055	0.055	
02/24/2020	04:10	2.34	14:15	4.75	3.60	02:05	0.31	13:15	0.64	0.47	02:05	0.031	13:25	0.164	0.088	0.088	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	04:30	2.86	16:30	4.82	3.96	04:40	0.27	10:00	0.60	0.42	04:40	0.035	13:30	0.153	0.089	0.089	
02/26/2020	22:40	2.73	11:10	4.73	3.60	04:00	0.19	12:05	0.80	0.48	04:00	0.028	14:30	0.180	0.089	0.089	
02/27/2020	04:45	2.33	13:30	4.55	3.32	03:45	0.33	13:30	0.70	0.51	03:45	0.031	13:30	0.173	0.086	0.086	
02/28/2020	05:50	2.14	11:45	4.13	3.06	05:55	0.29	14:40	0.77	0.50	05:55	0.024	14:40	0.156	0.075	0.075	
02/29/2020	05:40	2.37	18:55	3.32	2.80	05:20	0.34	15:20	0.57	0.45	05:20	0.033	15:20	0.086	0.057	0.057	
03/01/2020	05:20	2.33	11:40	3.68	2.83	05:35	0.34	11:35	0.71	0.48	05:35	0.032	11:35	0.127	0.062	0.062	
03/02/2020	03:20	2.42	13:20	4.39	3.20	03:30	0.39	13:50	0.80	0.55	03:30	0.039	13:20	0.181	0.087	0.087	
03/03/2020	03:40	2.43	13:25	4.60	3.34	02:45	0.32	10:10	0.75	0.54	03:35	0.032	13:15	0.188	0.093	0.093	
03/04/2020	04:00	2.24	10:50	4.19	3.06	03:50	0.34	13:50	0.85	0.55	03:50	0.030	13:50	0.180	0.082	0.082	
03/05/2020	03:45	2.14	13:05	4.09	2.97	05:00	0.31	13:50	0.80	0.56	05:00	0.027	14:00	0.168	0.081	0.081	
03/06/2020	03:20	1.98	13:30	4.29	2.83	03:20	0.32	13:25	0.86	0.55	03:20	0.024	13:25	0.189	0.075	0.075	
03/07/2020	03:55	2.01	16:15	3.02	2.48	03:50	0.34	16:35	0.66	0.49	03:50	0.026	16:35	0.089	0.052	0.052	
03/08/2020	05:25	2.03	14:05	3.00	2.40	04:35	0.35	14:05	0.67	0.49	04:35	0.028	14:05	0.091	0.050	0.050	
03/09/2020	03:00	1.84	10:50	3.95	2.82	05:15	0.32	10:30	0.82	0.58	03:25	0.022	10:30	0.161	0.079	0.079	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			11.840	4.90
Avg	3.46	0.59	0.103	

Site Commentary

Site Information

MIL_0386	
Pipe Dimensions	18
Silt Level	0.00"

Overview

Site MIL_0386 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows free flow conditions during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

This location was installed upstream of sites MIL_0649 and MIL_2491. (See MIL_0649 and MIL_2491 Site Commentary for More Details)

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	6.43	1.38	0.512
Minimum	5.11	0.93	0.262
Maximum	9.17	2.04	1.187
Time of Minimum	2/9/2020 4:10 AM	12/26/2019 2:40 AM	12/26/2019 2:40 AM
Time of Maximum	2/6/2020 1:35 PM	1/16/2020 10:45 AM	2/6/2020 1:35 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

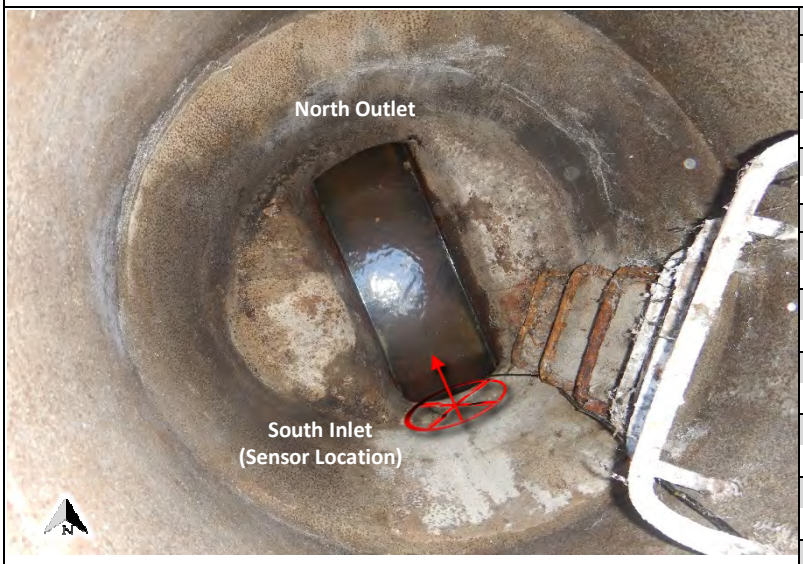
MIL_0386

Site Address /Location:	Milpitas Blvd and Los Coches St, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	DRIVE.	Latitude:	37.430913°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.898992°	18.00"x18.00"	Circular



Manhole #	System Characteristics
#0386	Residential/Commercial
Access	Traffic
Drive	Medium







Installation Information

Installation Date:	Installation Type:
Friday, November 15, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
8:54:00 AM	18.00"x18.00"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
7.25"	
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.76'	0''
Silt (in)	Silt Type
0.0"	

Hydraulic Comments:

Smooth flow with medium depth and moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
14'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Drilled Pavement / Concrete

Additional Site Info. / Comments:

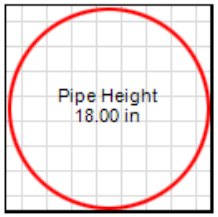
ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

SCATTERGRAPH REPORT

MIL_0386

Flow Monitor

MIL_0386

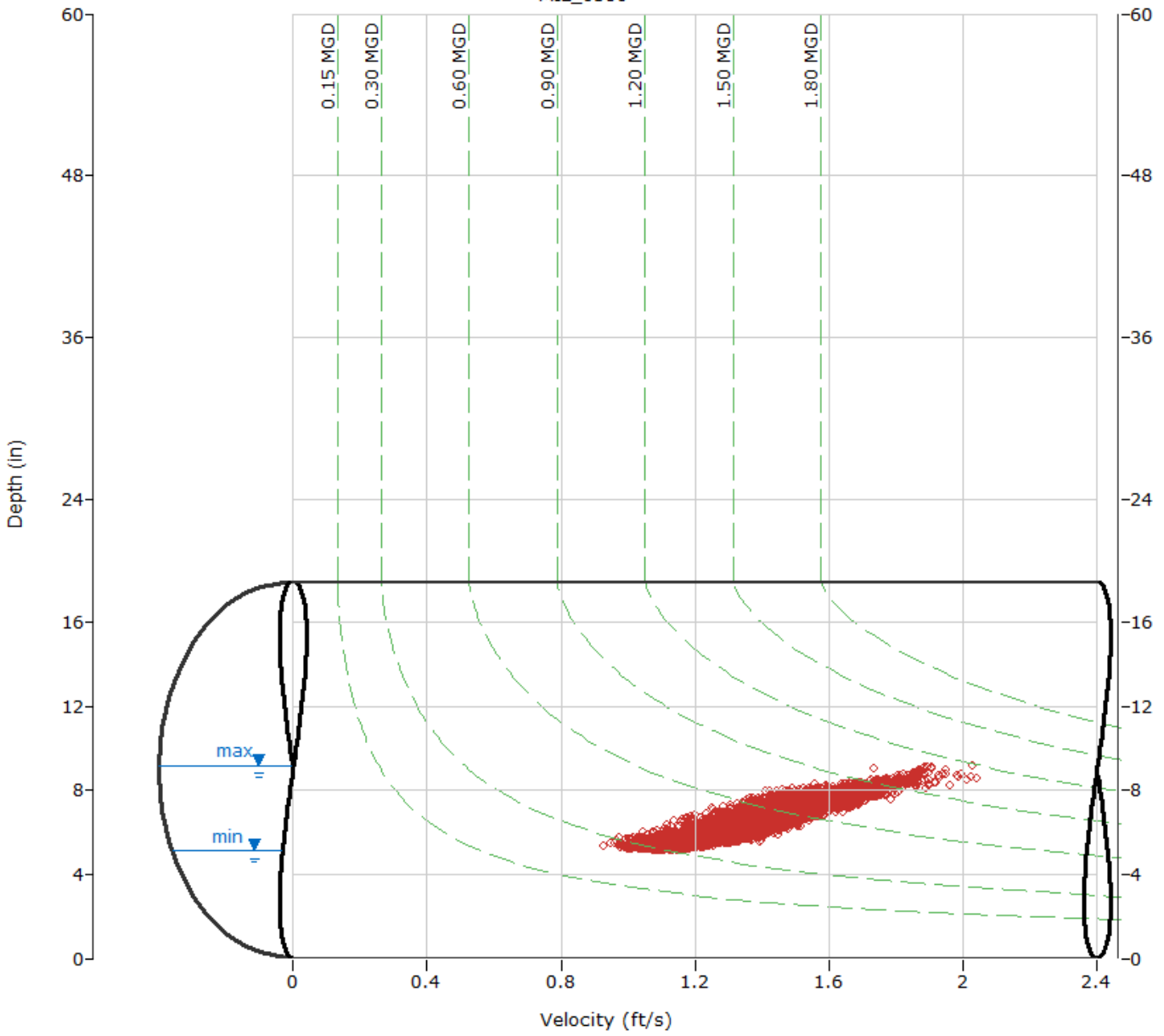


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_0386

Flow Monitor

MIL_0386

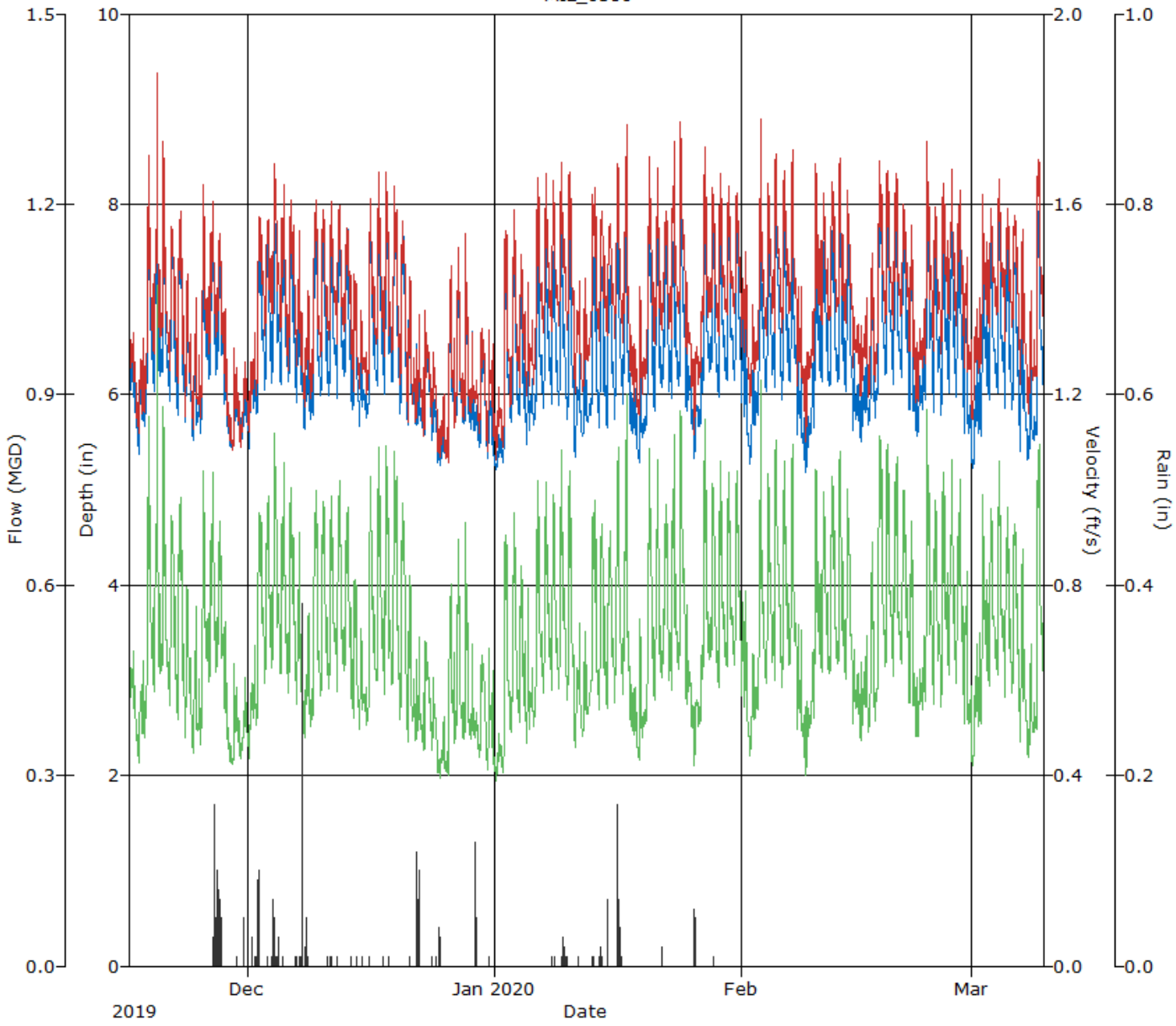
Pipe Height
18.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_0386, Pipe Height: 18.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	22:30	5.72	14:55	6.75	6.11	16:20	1.11	14:55	1.42	1.27	16:20	0.360	14:55	0.557	0.434	0.434	
11/17/2019	06:15	5.34	19:25	6.81	5.80	16:55	0.97	19:15	1.42	1.20	16:55	0.295	19:20	0.560	0.382	0.382	
11/18/2019	00:35	5.50	13:15	8.86	6.79	02:55	1.09	13:10	1.87	1.40	00:35	0.334	13:15	1.046	0.564	0.564	
11/19/2019	04:35	5.95	15:20	9.13	6.85	02:55	1.23	15:00	1.95	1.44	04:30	0.415	15:00	1.109	0.581	0.581	
11/20/2019	23:25	5.95	09:30	8.58	6.73	15:40	1.19	10:15	1.83	1.41	03:15	0.417	10:15	0.976	0.557	0.557	
11/21/2019	04:40	5.86	09:45	7.84	6.69	04:40	1.22	09:45	1.65	1.40	04:40	0.392	09:45	0.790	0.545	0.545	
11/22/2019	04:10	5.75	14:35	7.98	6.74	11:50	1.18	10:00	1.68	1.39	04:25	0.384	08:05	0.813	0.550	0.550	
11/23/2019	04:40	5.58	06:50	7.14	6.26	04:40	1.11	08:40	1.50	1.29	04:40	0.336	08:40	0.630	0.458	0.458	
11/24/2019	03:10	5.42	11:05	7.13	5.97	00:45	1.00	11:05	1.50	1.23	00:45	0.310	11:05	0.632	0.409	0.409	
11/25/2019	00:00	5.54	08:40	8.17	6.61	01:45	1.12	08:40	1.77	1.38	00:15	0.338	08:40	0.890	0.532	0.532	
11/26/2019	04:00	6.11	16:30	8.15	6.84	03:30	1.12	16:30	1.70	1.43	03:30	0.402	16:30	0.854	0.572	0.572	0.36
11/27/2019	00:10	6.10	09:50	7.64	6.78	20:50	1.16	08:35	1.62	1.41	20:50	0.430	09:45	0.745	0.557	0.557	0.63
11/28/2019	20:00	5.34	02:55	6.98	5.85	10:45	0.98	02:50	1.41	1.20	20:00	0.299	02:50	0.578	0.388	0.388	
11/29/2019	04:00	5.43	07:10	6.91	5.81	03:10	0.96	07:05	1.47	1.17	03:10	0.282	07:05	0.593	0.375	0.375	0.02
11/30/2019	06:15	5.40	17:30	6.70	5.75	01:20	0.95	10:45	1.38	1.17	01:20	0.277	17:30	0.516	0.370	0.370	0.10
12/01/2019	03:10	5.38	21:20	7.14	5.92	13:30	1.05	21:25	1.46	1.21	04:30	0.311	21:20	0.613	0.398	0.398	0.06
12/02/2019	03:55	5.70	11:10	7.83	6.72	00:30	1.12	11:05	1.67	1.42	00:30	0.348	11:10	0.792	0.559	0.559	0.30
12/03/2019	03:55	5.96	09:55	7.99	6.80	04:00	1.28	13:05	1.64	1.45	04:00	0.422	10:00	0.792	0.578	0.578	0.01
12/04/2019	00:15	6.04	09:35	8.27	6.96	16:00	1.29	09:25	1.75	1.50	00:10	0.455	09:25	0.893	0.614	0.614	0.39
12/05/2019	03:40	6.08	13:35	8.08	6.90	23:55	1.26	14:50	1.67	1.45	02:15	0.446	13:40	0.828	0.590	0.590	0.01
12/06/2019	00:35	6.08	09:20	8.26	6.83	01:05	1.24	09:15	1.72	1.44	00:30	0.422	09:15	0.875	0.576	0.576	0.01
12/07/2019	23:55	5.61	12:25	7.69	6.39	13:30	1.12	12:05	1.61	1.34	23:55	0.357	12:25	0.745	0.491	0.491	0.67
12/08/2019	03:35	5.56	15:40	7.18	5.97	21:05	1.09	14:10	1.52	1.26	03:35	0.338	15:40	0.605	0.418	0.418	0.20
12/09/2019	04:45	5.68	13:15	7.99	6.74	01:10	1.14	13:15	1.71	1.43	01:10	0.368	13:15	0.835	0.564	0.564	
12/10/2019	04:45	5.93	15:10	7.90	6.78	04:25	1.25	16:30	1.70	1.44	04:25	0.416	15:10	0.813	0.571	0.571	
12/11/2019	04:50	5.88	11:05	7.72	6.69	05:00	1.27	12:50	1.78	1.43	04:45	0.411	12:50	0.811	0.559	0.559	0.03
12/12/2019	05:00	5.92	12:10	7.98	6.82	03:50	1.28	10:30	1.69	1.44	03:55	0.423	12:20	0.824	0.577	0.577	0.01
12/13/2019	04:40	5.97	14:10	7.87	6.79	01:25	1.29	14:00	1.61	1.44	04:35	0.432	14:00	0.765	0.570	0.570	0.01
12/14/2019	06:10	5.72	12:55	7.28	6.39	06:10	1.18	12:55	1.60	1.32	06:10	0.368	12:55	0.693	0.483	0.483	0.01
12/15/2019	06:05	5.55	06:35	7.19	6.04	11:40	1.08	06:40	1.53	1.27	06:05	0.338	06:40	0.644	0.428	0.428	0.01
12/16/2019	03:25	5.72	11:10	8.53	6.73	00:50	1.17	11:10	1.75	1.41	03:25	0.372	11:10	0.931	0.557	0.557	0.01
12/17/2019	05:00	6.01	10:35	8.28	6.93	00:10	1.25	10:35	1.76	1.45	05:15	0.432	10:35	0.900	0.593	0.593	0.01
12/18/2019	03:15	5.93	09:20	8.48	6.89	03:10	1.26	09:20	1.80	1.43	03:10	0.414	09:20	0.952	0.583	0.583	0.01
12/19/2019	05:55	6.04	10:30	8.31	6.93	05:55	1.25	10:25	1.71	1.42	05:55	0.419	10:30	0.880	0.584	0.584	
12/20/2019	04:05	5.76	12:50	8.05	6.74	21:10	1.13	17:00	1.68	1.39	04:05	0.381	17:05	0.822	0.550	0.550	
12/21/2019	04:15	5.60	09:25	7.29	6.25	03:00	1.02	11:10	1.52	1.27	03:00	0.319	09:30	0.657	0.452	0.452	0.01
12/22/2019	03:20	5.43	14:25	7.01	5.93	23:25	1.04	14:20	1.49	1.22	03:25	0.313	14:25	0.607	0.402	0.402	0.41
12/23/2019	05:50	5.50	09:50	6.95	6.12	04:50	1.00	07:30	1.53	1.25	04:50	0.308	07:30	0.604	0.429	0.429	
12/24/2019	20:20	5.23	07:10	6.67	5.68	22:25	0.98	07:05	1.38	1.18	22:25	0.275	07:05	0.531	0.367	0.367	0.02
12/25/2019	03:55	5.20	15:55	6.31	5.42	21:25	1.01	15:55	1.31	1.11	05:40	0.279	15:55	0.469	0.323	0.323	0.08
12/26/2019	04:40	5.26	13:20	7.15	6.15	02:40	0.93	11:10	1.51	1.25	02:40	0.262	11:10	0.636	0.437	0.437	
12/27/2019	00:40	5.66	11:05	8.06	6.27	03:25	1.07	11:05	1.64	1.27	03:25	0.328	11:05	0.812	0.457	0.457	
12/28/2019	05:55	5.64	10:20	8.01	6.18	23:05	1.00	10:10	1.68	1.26	23:05	0.312	10:20	0.817	0.442	0.442	
12/29/2019	23:55	5.46	05:15	6.77	5.83	09:50	1.03	06:00	1.44	1.21	09:50	0.311	05:10	0.542	0.388	0.388	0.22
12/30/2019	04:40	5.38	10:10	6.95	5.96	02:30	1.05	08:45	1.46	1.23	04:35	0.304	10:10	0.586	0.407	0.407	
12/31/2019	04:55	5.30	08:40	7.04	5.71	22:00	0.98	07:25	1.46	1.20	22:00	0.280	08:35	0.583	0.375	0.375	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	06:25	5.16 13:40	5.66	5.37	05:50	0.99 13:40	1.26	1.14	05:50	0.274 13:40	0.388	0.326	0.326	
01/02/2020	03:20	5.20 07:15	8.56	6.25	03:10	1.01 07:20	1.85	1.31	03:10	0.278 07:15	0.988	0.471	0.471	
01/03/2020	01:45	5.66 12:30	7.75	6.41	00:40	1.13 12:20	1.71	1.35	04:55	0.354 12:20	0.799	0.501	0.501	
01/04/2020	23:55	5.63 10:30	7.39	6.34	03:55	1.18 10:25	1.57	1.35	03:55	0.370 10:25	0.694	0.489	0.489	
01/05/2020	03:25	5.43 07:05	7.24	5.90	22:50	1.07 05:45	1.59	1.28	22:50	0.335 07:05	0.666	0.419	0.419	
01/06/2020	01:05	5.58 13:00	7.78	6.56	01:15	1.22 12:50	1.77	1.45	01:15	0.370 12:50	0.831	0.550	0.550	
01/07/2020	03:45	5.76 14:20	7.85	6.63	00:35	1.31 14:20	1.80	1.47	03:40	0.413 14:20	0.860	0.566	0.566	
01/08/2020	05:45	5.81 15:05	7.66	6.58	05:45	1.31 10:30	1.70	1.46	05:45	0.419 10:35	0.779	0.557	0.557	0.02
01/09/2020	03:30	5.78 10:00	7.94	6.64	15:40	1.30 10:45	1.75	1.49	03:30	0.416 10:45	0.848	0.574	0.574	0.18
01/10/2020	05:30	5.65 10:35	7.90	6.48	20:30	1.30 10:25	1.80	1.46	05:30	0.404 10:30	0.864	0.548	0.548	0.02
01/11/2020	03:45	5.31 18:00	7.01	5.83	23:55	1.16 17:45	1.55	1.31	04:45	0.331 17:55	0.632	0.421	0.421	0.01
01/12/2020	03:35	5.53 09:00	6.88	5.83	10:50	1.07 08:45	1.53	1.29	01:30	0.334 09:00	0.612	0.416	0.416	
01/13/2020	04:30	5.74 17:35	7.65	6.56	00:00	1.27 13:00	1.69	1.47	00:05	0.400 13:00	0.778	0.557	0.557	0.02
01/14/2020	04:55	5.59 13:05	7.67	6.46	16:25	1.16 10:05	1.69	1.45	04:50	0.390 13:05	0.771	0.538	0.538	0.11
01/15/2020	04:55	5.62 12:15	7.56	6.48	04:20	1.31 11:45	1.68	1.45	04:55	0.400 11:45	0.746	0.539	0.539	0.07
01/16/2020	04:00	5.69 14:00	8.78	6.74	04:10	1.31 10:45	2.04	1.49	04:00	0.406 13:50	1.097	0.588	0.588	0.66
01/17/2020	04:30	5.83 15:00	8.83	6.72	04:30	1.29 15:00	1.90	1.46	04:30	0.414 15:00	1.058	0.574	0.574	
01/18/2020	22:45	5.41 16:05	6.86	5.76	22:45	1.15 16:10	1.45	1.25	22:45	0.332 16:10	0.580	0.396	0.396	
01/19/2020	04:40	5.20 08:45	6.94	5.66	04:35	1.12 08:45	1.50	1.24	04:35	0.307 08:45	0.609	0.384	0.384	
01/20/2020	00:05	5.56 12:25	8.11	6.65	04:35	1.21 12:20	1.77	1.45	00:25	0.371 12:25	0.881	0.562	0.562	
01/21/2020	05:20	5.67 12:40	8.18	6.61	05:20	1.26 14:00	1.89	1.44	05:20	0.389 14:00	0.938	0.552	0.552	
01/22/2020	00:45	5.95 17:00	7.99	6.74	00:45	1.30 17:00	1.75	1.46	00:45	0.427 17:00	0.855	0.574	0.574	0.03
01/23/2020	00:30	5.86 14:55	8.36	6.79	05:55	1.31 14:50	1.96	1.49	06:00	0.424 14:50	1.004	0.593	0.593	
01/24/2020	01:40	6.04 11:00	8.67	6.90	03:15	1.31 10:50	2.01	1.52	01:40	0.450 10:55	1.078	0.617	0.617	
01/25/2020	22:30	5.50 07:00	6.85	6.08	22:20	1.04 06:20	1.50	1.31	22:20	0.313 06:20	0.594	0.447	0.447	
01/26/2020	05:05	5.29 00:15	6.25	5.71	02:25	1.09 00:10	1.40	1.25	04:50	0.310 00:10	0.494	0.389	0.389	0.16
01/27/2020	00:40	5.84 10:40	8.42	6.83	00:20	1.27 10:35	1.86	1.46	00:40	0.413 10:35	0.974	0.588	0.588	
01/28/2020	04:50	6.06 13:10	7.91	6.83	04:40	1.32 13:10	1.71	1.47	04:45	0.449 13:10	0.828	0.590	0.590	0.01
01/29/2020	04:40	5.93 08:15	8.02	6.76	03:20	1.24 08:00	1.74	1.46	03:20	0.422 08:20	0.848	0.578	0.578	
01/30/2020	04:55	6.08 11:05	8.09	6.81	11:45	1.33 11:00	1.72	1.47	05:00	0.456 11:00	0.851	0.588	0.588	
01/31/2020	05:05	6.06 12:30	8.18	6.84	05:00	1.33 12:30	1.74	1.48	05:05	0.450 12:30	0.876	0.593	0.593	
02/01/2020	23:55	5.46 14:15	7.17	6.12	23:50	1.20 14:15	1.58	1.36	23:50	0.352 14:15	0.670	0.470	0.470	
02/02/2020	02:25	5.23 15:15	6.83	5.73	03:20	1.11 15:05	1.50	1.27	03:20	0.312 15:10	0.591	0.398	0.398	
02/03/2020	02:20	5.74 13:10	8.54	6.79	22:45	1.20 13:05	1.90	1.46	02:25	0.394 13:05	1.010	0.585	0.585	
02/04/2020	03:55	5.94 11:05	7.86	6.77	22:10	1.27 10:25	1.69	1.46	03:50	0.430 10:25	0.797	0.580	0.580	
02/05/2020	06:40	6.04 09:45	8.07	6.90	17:45	1.30 08:25	1.77	1.49	06:20	0.442 09:40	0.875	0.604	0.604	
02/06/2020	04:40	5.87 13:35	9.17	6.75	04:40	1.29 13:35	2.03	1.48	04:40	0.416 13:35	1.187	0.584	0.584	
02/07/2020	02:05	5.99 11:25	7.98	6.73	15:35	1.31 11:15	1.78	1.48	02:10	0.445 11:15	0.855	0.580	0.580	
02/08/2020	23:50	5.25 14:35	6.79	5.85	23:50	1.13 14:40	1.47	1.29	23:50	0.313 14:35	0.579	0.418	0.418	
02/09/2020	04:10	5.11 01:40	6.27	5.62	03:30	1.00 00:20	1.38	1.24	03:30	0.280 01:40	0.477	0.378	0.378	
02/10/2020	04:55	5.33 09:00	7.84	6.66	04:55	1.20 11:30	1.77	1.45	04:55	0.340 11:30	0.841	0.563	0.563	
02/11/2020	06:05	6.04 11:35	7.73	6.80	04:50	1.31 10:15	1.67	1.47	04:55	0.442 11:35	0.779	0.584	0.584	
02/12/2020	04:00	5.95 09:35	7.82	6.82	04:15	1.31 11:50	1.72	1.49	04:15	0.431 11:50	0.817	0.593	0.593	
02/13/2020	05:20	6.07 10:20	7.93	6.83	01:50	1.34 10:05	1.75	1.48	01:50	0.462 10:15	0.838	0.593	0.593	
02/14/2020	06:05	5.96 13:15	7.72	6.75	16:25	1.25 10:25	1.67	1.46	06:00	0.430 10:25	0.777	0.577	0.577	
02/15/2020	23:05	5.56 17:10	6.63	5.93	22:35	1.15 17:05	1.44	1.30	22:35	0.349 17:05	0.548	0.428	0.428	
02/16/2020	01:55	5.41 18:55	6.93	5.89	00:40	1.10 18:55	1.50	1.28	00:40	0.328 18:55	0.608	0.418	0.418	
02/17/2020	01:35	5.60 13:45	7.68	6.25	03:35	1.09 13:45	1.55	1.31	03:35	0.337 13:45	0.719	0.467	0.467	
02/18/2020	00:00	5.81 12:10	8.37	6.96	00:00	1.21 08:45	1.73	1.47	00:00	0.387 12:15	0.883	0.607	0.607	
02/19/2020	05:40	6.09 09:40	8.43	6.98	02:25	1.33 09:35	1.78	1.49	02:25	0.454 09:35	0.933	0.614	0.614	
02/20/2020	02:30	5.95 16:25	8.21	6.95	02:35	1.31 16:30	1.74	1.49	02:30	0.431 16:30	0.880	0.612	0.612	
02/21/2020	07:10	6.09 13:20	7.89	6.86	00:35	1.33 12:30	1.71	1.47	07:10	0.461 12:30	0.813	0.592	0.592	
02/22/2020	23:10	5.58 12:30	8.05	6.34	23:45	1.01 12:30	1.69	1.35	23:45	0.312 12:30	0.838	0.491	0.491	
02/23/2020	03:50	5.50 23:25	6.61	5.93	06:35	1.11 02:05	1.39	1.27	03:50	0.338 02:25	0.514	0.418	0.418	
02/24/2020	04:45	5.87 10:55	8.81	6.87	02:20	1.24 10:45	1.87	1.45	04:40	0.404 10:50	1.032	0.589	0.589	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	04:35	5.79	09:30	7.84	6.74	04:30	1.27	09:20	1.71	1.45	04:30	0.405	09:25	0.814	0.569	0.569	
02/26/2020	04:35	5.77	14:20	7.91	6.76	04:00	1.25	13:15	1.66	1.47	04:00	0.395	13:30	0.789	0.580	0.580	
02/27/2020	02:05	5.82	12:25	8.09	6.76	17:40	1.25	12:25	1.79	1.48	02:05	0.424	12:25	0.893	0.583	0.583	
02/28/2020	00:35	5.92	14:45	7.85	6.79	00:40	1.32	12:40	1.68	1.48	00:35	0.432	14:45	0.792	0.589	0.589	
02/29/2020	02:50	5.53	10:10	7.26	6.08	22:55	1.12	10:00	1.56	1.33	20:50	0.358	10:10	0.673	0.454	0.454	
03/01/2020	03:20	5.20	18:05	7.05	5.66	03:00	1.00	18:05	1.53	1.25	03:00	0.273	18:05	0.636	0.387	0.387	
03/02/2020	03:25	5.55	09:20	7.66	6.56	02:50	1.22	09:05	1.68	1.43	02:55	0.366	09:15	0.770	0.545	0.545	
03/03/2020	04:45	5.92	11:35	7.83	6.68	04:35	1.32	11:35	1.73	1.46	04:35	0.432	11:35	0.827	0.566	0.566	
03/04/2020	06:10	5.93	12:10	8.10	6.75	03:20	1.32	12:10	1.77	1.48	03:20	0.434	12:10	0.882	0.582	0.582	
03/05/2020	04:20	5.83	12:00	7.83	6.69	04:40	1.27	10:50	1.65	1.47	04:40	0.409	12:05	0.769	0.572	0.572	
03/06/2020	01:55	5.48	08:45	7.65	6.65	01:55	1.28	08:25	1.66	1.47	01:55	0.376	08:25	0.744	0.566	0.566	
03/07/2020	02:00	5.39	08:00	7.36	6.06	01:45	1.17	08:00	1.62	1.35	01:45	0.341	08:00	0.709	0.459	0.459	
03/08/2020	02:00	5.24	13:35	6.52	5.65	18:20	1.10	13:35	1.46	1.26	03:50	0.316	13:35	0.544	0.390	0.390	
03/09/2020	04:00	5.52	12:25	8.08	6.66	01:15	1.20	09:05	1.77	1.46	03:50	0.361	12:20	0.875	0.570	0.569	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			58.839	4.90
Avg	6.43	1.38	0.512	

Site Commentary

Site Information

MIL_0602	
Pipe Dimensions	18
Silt Level	0.00"

Overview

Site MIL_0602 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows free flow conditions during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	3.67	1.53	0.274
Minimum	1.21	0.39	0.014
Maximum	6.31	2.37	0.844
Time of Minimum	3/7/2020 5:50 AM	3/9/2020 4:30 AM	3/9/2020 5:55 AM
Time of Maximum	1/7/2020 8:40 AM	1/7/2020 8:40 AM	1/7/2020 8:40 AM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

Site Name

MIL_0602

Site Address /Location:	Main St and Curtis Ave			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	Parking lane	Latitude:	37.424137°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.905174°	18.0" x 18.0"	Circular



Manhole #	System Characteristics
602	Residential/Commercial
Access	Traffic
Drive	Light







Installation Information

Installation Date:	Installation Type:
Tuesday, November 12, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
9:11:40 AM	18.0" x 18.0"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
6.25	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.52	0''
Silt (in)	Silt Type
0''	

Hydraulic Comments:

Smooth flow with medium depth and moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
7'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

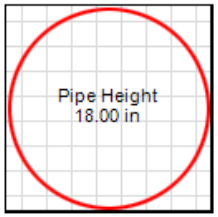
ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_0602

Flow Monitor

MIL_0602

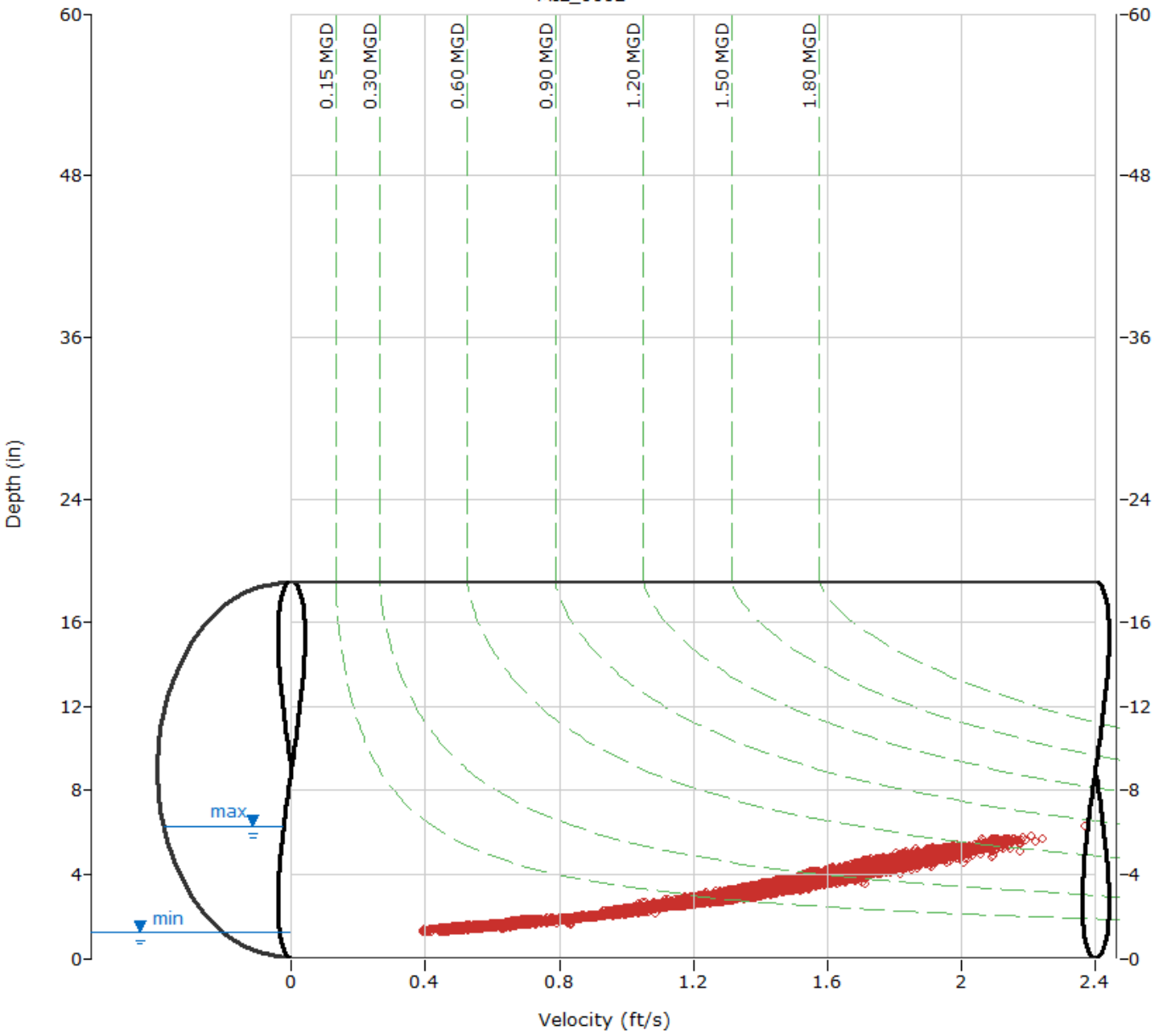


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



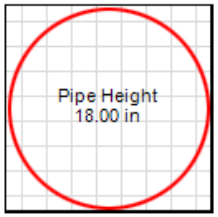
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_0602

Flow Monitor

MIL_0602

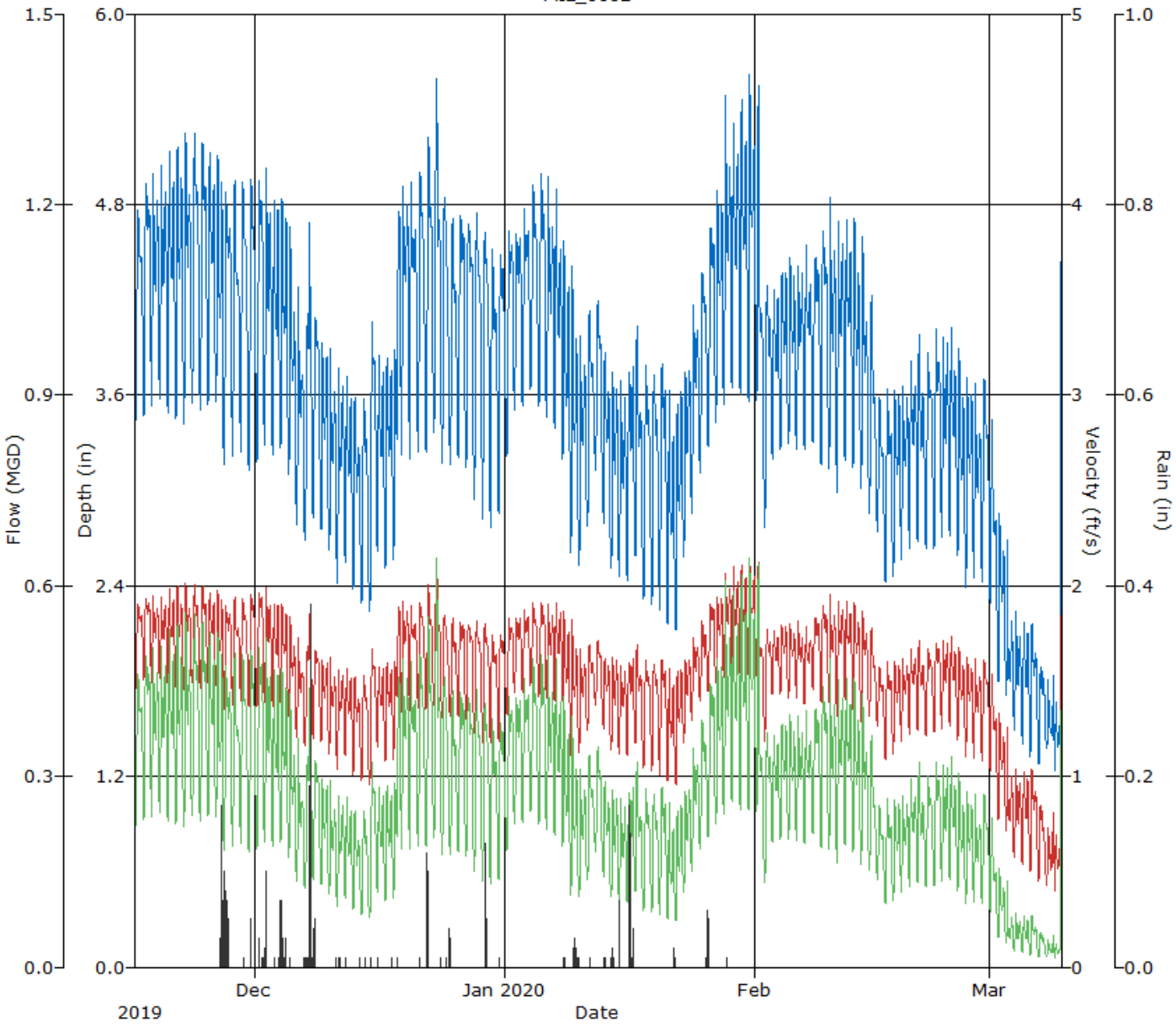


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_0602, Pipe Height: 18.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	03:55	3.43	12:05	4.79	4.22	05:55	1.45	12:35	1.95	1.74	05:55	0.222	11:55	0.473	0.361	0.361	
11/17/2019	06:00	3.44	13:00	4.96	4.37	05:00	1.48	15:05	2.01	1.78	06:05	0.226	11:20	0.502	0.388	0.388	
11/18/2019	04:40	3.52	08:45	5.09	4.35	03:50	1.47	08:30	1.99	1.75	04:40	0.233	08:30	0.527	0.379	0.379	
11/19/2019	04:25	3.57	08:55	5.11	4.40	04:35	1.49	08:45	2.00	1.76	04:35	0.240	08:45	0.531	0.386	0.386	
11/20/2019	04:20	3.46	08:55	5.21	4.41	03:10	1.44	09:15	2.05	1.76	04:20	0.225	09:15	0.557	0.387	0.387	
11/21/2019	04:35	3.44	09:05	5.26	4.42	04:25	1.45	08:55	2.07	1.76	04:25	0.222	08:55	0.571	0.390	0.390	
11/22/2019	03:55	3.41	08:45	5.30	4.43	05:10	1.44	09:00	2.06	1.76	05:10	0.217	09:00	0.578	0.392	0.392	
11/23/2019	05:00	3.54	12:50	5.29	4.53	03:30	1.47	12:20	2.03	1.78	05:05	0.236	12:20	0.565	0.410	0.410	
11/24/2019	05:40	3.48	12:15	5.21	4.51	04:45	1.45	12:05	2.05	1.78	05:40	0.225	12:05	0.560	0.407	0.407	
11/25/2019	04:40	3.53	09:20	5.17	4.44	04:35	1.48	09:25	2.01	1.76	04:40	0.234	09:25	0.545	0.391	0.391	
11/26/2019	05:00	3.53	10:05	5.16	4.34	04:55	1.45	20:50	2.03	1.73	04:55	0.229	20:50	0.540	0.373	0.373	0.36
11/27/2019	05:25	3.13	09:50	5.00	4.24	05:30	1.33	09:25	1.93	1.71	05:30	0.176	10:00	0.495	0.358	0.358	0.63
11/28/2019	06:30	3.20	12:15	4.99	4.12	05:45	1.36	12:45	1.99	1.68	05:45	0.188	12:45	0.508	0.339	0.339	
11/29/2019	05:25	3.23	12:05	4.96	4.26	05:10	1.38	11:30	1.94	1.73	05:10	0.192	12:10	0.495	0.364	0.364	0.02
11/30/2019	05:50	3.11	12:45	4.98	4.20	05:35	1.34	12:25	2.09	1.72	05:40	0.178	12:25	0.523	0.359	0.359	0.10
12/01/2019	05:50	3.16	12:50	4.97	4.26	05:35	1.35	11:35	2.09	1.74	05:35	0.184	11:35	0.512	0.371	0.371	0.06
12/02/2019	04:45	3.27	09:20	5.08	4.22	03:55	1.38	09:25	2.18	1.72	04:50	0.195	09:25	0.574	0.358	0.358	0.30
12/03/2019	05:05	3.20	08:45	4.86	4.12	05:05	1.35	20:10	2.02	1.68	05:05	0.185	20:10	0.484	0.339	0.339	0.01
12/04/2019	03:20	3.25	08:55	4.96	4.11	02:30	1.35	08:40	1.93	1.67	03:15	0.192	08:45	0.491	0.335	0.335	0.39
12/05/2019	05:05	3.07	08:40	4.79	3.83	04:45	1.30	08:35	1.88	1.58	05:05	0.169	08:35	0.458	0.286	0.286	0.01
12/06/2019	04:30	2.77	09:00	4.35	3.49	02:55	1.19	08:55	1.77	1.46	04:35	0.133	08:55	0.375	0.232	0.232	0.01
12/07/2019	05:55	2.67	18:50	4.84	3.62	05:40	1.14	18:45	1.96	1.50	05:40	0.121	18:45	0.483	0.256	0.256	0.67
12/08/2019	06:10	2.80	12:25	4.12	3.61	05:30	1.19	13:10	1.69	1.50	06:25	0.136	13:10	0.329	0.250	0.250	0.20
12/09/2019	05:20	2.74	09:00	4.03	3.40	05:15	1.17	08:55	1.66	1.44	05:15	0.129	08:55	0.315	0.219	0.219	
12/10/2019	05:10	2.61	09:05	3.96	3.26	04:15	1.08	08:10	1.70	1.39	04:15	0.112	08:40	0.304	0.200	0.200	
12/11/2019	05:00	2.40	08:50	3.89	3.18	04:20	1.02	08:45	1.63	1.35	05:05	0.093	08:45	0.296	0.189	0.189	0.03
12/12/2019	05:35	2.53	08:40	3.78	3.16	05:30	1.10	08:40	1.60	1.36	05:30	0.107	08:40	0.279	0.187	0.187	0.01
12/13/2019	04:30	2.37	09:00	3.63	3.04	04:10	1.00	09:45	1.55	1.31	04:25	0.089	08:45	0.252	0.170	0.170	0.01
12/14/2019	05:25	2.28	13:30	3.62	3.03	05:45	0.97	11:45	1.57	1.30	05:45	0.081	11:45	0.253	0.170	0.170	0.01
12/15/2019	06:05	2.23	11:20	4.43	3.25	06:40	0.93	11:20	1.80	1.37	05:55	0.077	11:20	0.393	0.205	0.205	0.01
12/16/2019	05:20	2.60	09:40	3.87	3.28	05:10	1.04	08:45	1.61	1.39	05:10	0.105	09:40	0.288	0.202	0.202	0.01
12/17/2019	05:10	2.51	09:20	3.86	3.28	05:00	1.07	09:25	1.61	1.39	05:00	0.103	09:25	0.288	0.202	0.202	0.01
12/18/2019	04:50	2.55	21:45	4.78	3.68	04:15	1.08	21:40	1.92	1.52	04:55	0.107	21:45	0.467	0.270	0.270	0.01
12/19/2019	04:40	3.19	09:10	4.95	4.25	04:40	1.32	08:55	1.99	1.69	04:40	0.181	09:00	0.506	0.355	0.355	
12/20/2019	05:05	3.16	09:40	4.98	4.25	03:45	1.32	09:40	1.98	1.68	05:10	0.179	09:40	0.511	0.354	0.354	
12/21/2019	05:25	3.23	12:20	5.04	4.32	05:30	1.35	11:35	1.96	1.70	05:30	0.188	11:40	0.508	0.368	0.368	0.01
12/22/2019	06:00	3.22	13:30	5.28	4.35	04:30	1.34	13:35	2.05	1.71	04:35	0.186	13:35	0.573	0.374	0.374	0.41
12/23/2019	05:35	3.32	13:15	5.71	4.47	05:30	1.35	12:15	2.19	1.73	05:30	0.195	12:15	0.666	0.396	0.396	
12/24/2019	05:05	3.16	12:05	4.87	4.19	04:55	1.27	10:40	1.88	1.64	04:55	0.173	12:05	0.467	0.339	0.339	0.02
12/25/2019	04:55	3.15	12:25	4.75	4.00	05:00	1.29	19:25	1.87	1.59	04:55	0.173	12:20	0.444	0.308	0.308	0.08
12/26/2019	05:00	3.18	12:05	4.75	4.18	05:10	1.30	22:50	1.87	1.64	04:55	0.177	10:55	0.440	0.337	0.337	
12/27/2019	04:20	3.10	13:20	4.71	4.11	04:15	1.28	09:45	1.96	1.62	04:15	0.168	09:45	0.443	0.326	0.326	
12/28/2019	04:35	2.91	12:30	4.79	4.00	04:30	1.21	12:20	1.88	1.59	04:30	0.145	12:25	0.455	0.309	0.309	
12/29/2019	06:25	2.81	13:25	4.65	3.93	06:20	1.17	13:55	1.84	1.57	06:20	0.133	13:25	0.422	0.298	0.298	0.22
12/30/2019	05:55	2.75	11:10	4.54	3.81	05:30	1.15	11:20	1.81	1.53	05:30	0.128	11:20	0.408	0.278	0.278	
12/31/2019	04:45	2.84	11:20	4.53	3.89	05:15	1.17	12:40	1.91	1.55	05:15	0.136	12:40	0.419	0.290	0.290	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	05:40	3.20 12:25	4.65	4.06	06:35	1.30 12:05	1.88	1.62	06:35	0.181 19:10	0.436	0.321	0.321	
01/02/2020	04:35	3.49 10:25	4.64	4.23	04:05	1.42 21:00	1.86	1.69	04:05	0.223 10:35	0.431	0.351	0.351	
01/03/2020	04:25	3.50 10:10	4.83	4.30	04:55	1.43 10:05	1.89	1.71	04:20	0.223 10:10	0.465	0.363	0.363	
01/04/2020	04:10	3.61 11:55	4.94	4.36	04:20	1.45 16:40	2.01	1.72	04:20	0.238 12:15	0.500	0.373	0.373	
01/05/2020	04:45	3.52 12:10	5.06	4.38	05:25	1.40 13:50	2.06	1.72	05:25	0.221 13:50	0.525	0.376	0.376	
01/06/2020	04:35	3.46 08:55	5.05	4.25	05:15	1.40 08:50	1.94	1.69	05:05	0.216 08:50	0.508	0.353	0.353	
01/07/2020	04:50	3.38 08:40	6.31	4.14	04:25	1.36 08:40	2.37	1.68	04:25	0.204 08:40	0.844	0.339	0.339	
01/08/2020	04:45	3.16 08:35	4.79	3.81	04:40	1.36 08:35	1.94	1.59	04:40	0.183 08:35	0.471	0.285	0.285	0.02
01/09/2020	05:05	2.58 08:50	4.57	3.44	05:00	1.09 08:35	1.90	1.46	05:00	0.110 08:35	0.425	0.230	0.230	0.18
01/10/2020	04:15	2.51 08:40	4.12	3.33	05:20	1.11 08:40	1.70	1.44	04:55	0.108 08:40	0.334	0.215	0.215	0.02
01/11/2020	05:40	2.76 12:55	4.14	3.54	05:40	1.23 12:55	1.70	1.50	05:40	0.137 12:55	0.337	0.243	0.243	0.01
01/12/2020	06:00	3.09 12:45	4.22	3.73	06:00	1.36 12:45	1.72	1.57	06:00	0.178 12:45	0.350	0.271	0.271	
01/13/2020	05:20	2.74 09:00	3.91	3.36	05:20	1.23 09:00	1.63	1.46	05:20	0.135 09:00	0.298	0.218	0.218	0.02
01/14/2020	05:20	2.49 09:05	3.78	3.17	05:20	1.12 09:00	1.67	1.41	05:20	0.107 09:00	0.292	0.195	0.195	0.11
01/15/2020	04:30	2.45 09:05	3.71	3.12	05:10	1.11 08:55	1.60	1.39	03:55	0.104 09:05	0.271	0.188	0.188	0.07
01/16/2020	05:30	2.42 21:40	3.82	3.26	05:25	1.08 21:40	1.64	1.43	05:25	0.099 21:40	0.289	0.208	0.208	0.66
01/17/2020	05:25	2.58 09:20	4.05	3.27	05:15	1.15 09:30	1.72	1.44	05:15	0.116 09:30	0.329	0.209	0.209	
01/18/2020	05:25	2.31 11:10	3.83	3.14	05:25	1.02 11:25	1.63	1.38	05:25	0.087 11:45	0.287	0.192	0.192	
01/19/2020	05:25	2.28 12:55	3.75	3.11	05:15	0.98 12:30	1.60	1.37	05:15	0.083 12:55	0.274	0.188	0.188	
01/20/2020	05:30	2.23 12:00	3.81	3.16	04:30	1.00 13:05	1.65	1.38	05:30	0.081 13:05	0.289	0.195	0.195	
01/21/2020	04:40	2.14 09:00	3.72	2.87	04:40	0.95 09:05	1.60	1.28	04:40	0.073 08:55	0.272	0.155	0.155	
01/22/2020	04:25	2.11 21:30	3.63	2.93	04:55	0.95 09:10	1.71	1.30	05:20	0.071 09:10	0.278	0.165	0.165	0.03
01/23/2020	04:20	2.57 09:00	3.80	3.28	04:50	1.15 08:55	1.71	1.44	04:50	0.116 08:55	0.301	0.209	0.209	
01/24/2020	05:00	2.84 09:05	4.18	3.62	05:15	1.27 09:05	1.76	1.55	05:15	0.148 09:05	0.355	0.259	0.259	
01/25/2020	05:05	3.09 11:50	4.39	3.89	05:05	1.37 13:55	1.85	1.63	05:05	0.179 11:50	0.394	0.302	0.302	
01/26/2020	05:00	3.27 12:50	4.69	4.12	05:25	1.43 13:00	1.93	1.73	05:25	0.202 12:50	0.457	0.347	0.347	0.16
01/27/2020	05:10	3.40 08:50	4.98	4.26	05:10	1.47 09:20	2.02	1.76	05:10	0.221 09:20	0.509	0.368	0.368	
01/28/2020	04:25	3.53 09:10	5.57	4.53	02:45	1.50 09:10	2.09	1.82	04:25	0.239 09:10	0.630	0.418	0.418	0.01
01/29/2020	04:50	3.63 09:05	5.41	4.54	04:10	1.54 09:05	2.18	1.83	04:55	0.255 09:05	0.628	0.422	0.422	
01/30/2020	04:35	3.58 08:55	5.55	4.62	04:10	1.52 09:20	2.16	1.85	04:35	0.245 09:00	0.640	0.437	0.437	
01/31/2020	05:25	3.53 08:55	5.72	4.67	04:20	1.50 08:55	2.18	1.87	05:30	0.242 08:55	0.682	0.448	0.448	
02/01/2020	12:50	2.55 12:05	5.81	4.22	12:50	1.17 11:15	2.22	1.72	12:50	0.115 12:05	0.706	0.359	0.359	
02/02/2020	05:00	2.76 12:55	4.30	3.71	05:50	1.15 12:30	1.80	1.55	05:50	0.127 12:30	0.377	0.271	0.271	
02/03/2020	04:35	3.18 08:55	4.30	3.82	05:15	1.40 08:45	1.80	1.62	04:35	0.194 08:50	0.375	0.290	0.290	
02/04/2020	04:35	3.25 08:50	4.45	3.93	04:35	1.42 08:40	1.85	1.65	04:35	0.199 08:40	0.404	0.309	0.309	
02/05/2020	04:40	3.27 09:05	4.53	3.96	05:20	1.40 09:00	1.83	1.64	04:40	0.199 09:00	0.412	0.309	0.309	
02/06/2020	04:20	3.24 08:45	4.50	3.96	04:20	1.39 08:40	1.91	1.64	04:20	0.194 08:40	0.426	0.310	0.310	
02/07/2020	03:50	3.25 09:00	4.58	3.97	03:55	1.35 09:05	1.83	1.61	03:55	0.189 09:05	0.418	0.304	0.304	
02/08/2020	06:10	3.25 13:30	4.48	4.03	06:10	1.44 13:20	1.87	1.69	06:10	0.202 13:20	0.412	0.328	0.328	
02/09/2020	06:00	3.13 12:30	4.65	4.07	06:25	1.36 12:35	1.93	1.71	06:25	0.182 12:35	0.452	0.338	0.338	
02/10/2020	05:00	3.07 08:15	5.65	4.03	05:00	1.37 08:15	2.24	1.69	05:00	0.177 08:15	0.688	0.328	0.328	
02/11/2020	04:10	2.98 08:40	4.80	4.01	04:40	1.27 08:55	1.99	1.69	04:40	0.157 08:55	0.482	0.329	0.329	
02/12/2020	04:50	3.17 08:40	4.84	4.07	05:20	1.39 08:50	1.96	1.70	04:55	0.188 08:50	0.483	0.335	0.335	
02/13/2020	04:30	3.12 08:40	4.81	3.95	04:25	1.32 09:00	1.95	1.67	04:35	0.176 09:00	0.472	0.315	0.315	
02/14/2020	04:40	3.00 08:55	4.67	3.80	03:55	1.27 09:25	1.89	1.62	04:40	0.159 08:55	0.442	0.289	0.289	
02/15/2020	05:50	2.83 11:30	4.28	3.54	04:50	1.29 11:20	1.80	1.56	05:40	0.150 11:20	0.373	0.251	0.251	
02/16/2020	04:55	2.73 11:35	3.61	3.19	04:55	1.24 11:00	1.59	1.44	04:55	0.135 12:20	0.259	0.198	0.198	
02/17/2020	04:55	2.42 10:05	3.66	3.10	05:00	1.05 10:00	1.62	1.40	05:00	0.096 10:00	0.268	0.188	0.188	
02/18/2020	04:30	2.45 09:00	3.64	3.11	04:25	1.10 09:50	1.62	1.41	04:25	0.103 08:55	0.267	0.190	0.190	
02/19/2020	04:55	2.54 09:10	3.69	3.18	05:40	1.17 09:35	1.62	1.44	05:05	0.116 09:10	0.273	0.199	0.199	
02/20/2020	05:10	2.62 10:10	3.89	3.31	03:50	1.19 10:10	1.69	1.49	03:50	0.124 10:10	0.308	0.218	0.218	
02/21/2020	04:40	2.67 09:40	4.02	3.32	05:05	1.22 09:35	1.75	1.49	04:55	0.130 09:35	0.332	0.220	0.220	
02/22/2020	05:30	2.62 11:30	3.89	3.37	04:45	1.18 11:30	1.70	1.50	04:45	0.123 11:30	0.308	0.227	0.227	
02/23/2020	05:40	2.60 12:40	4.05	3.45	06:05	1.20 12:35	1.72	1.53	06:05	0.123 12:35	0.330	0.240	0.240	
02/24/2020	05:00	2.68 08:45	4.05	3.40	05:05	1.24 08:35	1.73	1.52	04:55	0.132 08:35	0.331	0.232	0.232	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	04:55	2.69	08:50	4.14	3.41	05:20	1.20	08:50	1.79	1.52	05:20	0.129	08:50	0.356	0.233	0.233	
02/26/2020	04:50	2.56	08:30	3.94	3.22	04:30	1.18	08:40	1.69	1.45	04:50	0.118	08:40	0.312	0.205	0.205	
02/27/2020	04:55	2.38	08:30	3.75	3.15	04:55	1.10	08:40	1.66	1.42	04:55	0.098	08:40	0.287	0.195	0.195	
02/28/2020	04:55	2.43	08:55	3.71	3.09	04:25	1.09	08:55	1.63	1.38	04:55	0.101	08:55	0.277	0.184	0.184	
02/29/2020	05:35	2.41	11:10	3.72	3.17	05:35	1.06	13:15	1.64	1.41	05:35	0.097	11:10	0.278	0.196	0.196	
03/01/2020	05:45	2.27	11:15	3.47	2.79	05:40	1.00	11:10	1.55	1.27	05:40	0.084	11:15	0.238	0.145	0.145	
03/02/2020	05:05	1.78	08:40	2.97	2.36	04:45	0.77	08:40	1.39	1.07	04:50	0.045	08:40	0.171	0.098	0.098	
03/03/2020	04:30	1.69	08:55	2.80	2.00	04:50	0.70	08:55	1.32	0.88	04:30	0.039	08:55	0.149	0.063	0.063	
03/04/2020	05:30	1.46	08:50	2.30	1.87	03:35	0.56	09:10	1.07	0.81	05:30	0.025	08:55	0.091	0.053	0.053	
03/05/2020	05:30	1.38	21:00	2.29	1.83	04:35	0.52	09:10	1.06	0.81	05:15	0.022	21:00	0.087	0.051	0.051	
03/06/2020	04:45	1.31	09:00	2.19	1.82	04:00	0.49	08:10	1.09	0.81	04:45	0.019	08:20	0.084	0.051	0.051	
03/07/2020	05:50	1.21	13:40	1.92	1.67	05:00	0.45	13:45	0.88	0.69	05:50	0.015	13:45	0.058	0.038	0.038	
03/08/2020	06:00	1.37	10:30	1.89	1.51	05:20	0.42	08:50	0.83	0.58	05:20	0.017	10:30	0.050	0.027	0.027	
03/09/2020	06:35	1.23	21:50	5.37	1.75	04:30	0.39	21:50	2.13	0.70	05:55	0.014	21:50	0.608	0.060	0.060	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			31.478	4.90
Avg	3.67	1.53	0.274	

Site Commentary

Site Information

MIL_0649	
Pipe Dimensions	21.5
Silt Level	0.00"

Overview

Site MIL_0649 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

This location was installed upstream of site MIL_1790 and downstream of the combined flows of sites MIL_0386 and MIL_2840. A review of balancing with the combined flows of MIL_0386 and MIL_2840 into MIL_0649 and MIL_2491 shows a net flow between the sites of 0.426 MGD.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	8.66	1.24	0.777
Minimum	6.64	0.82	0.386
Maximum	11.63	1.64	1.448
Time of Minimum	3/1/2020 3:15 AM	2/1/2020 11:40 PM	2/17/2020 1:55 AM
Time of Maximum	2/18/2020 11:55 AM	12/5/2019 2:35 PM	1/9/2020 10:45 AM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

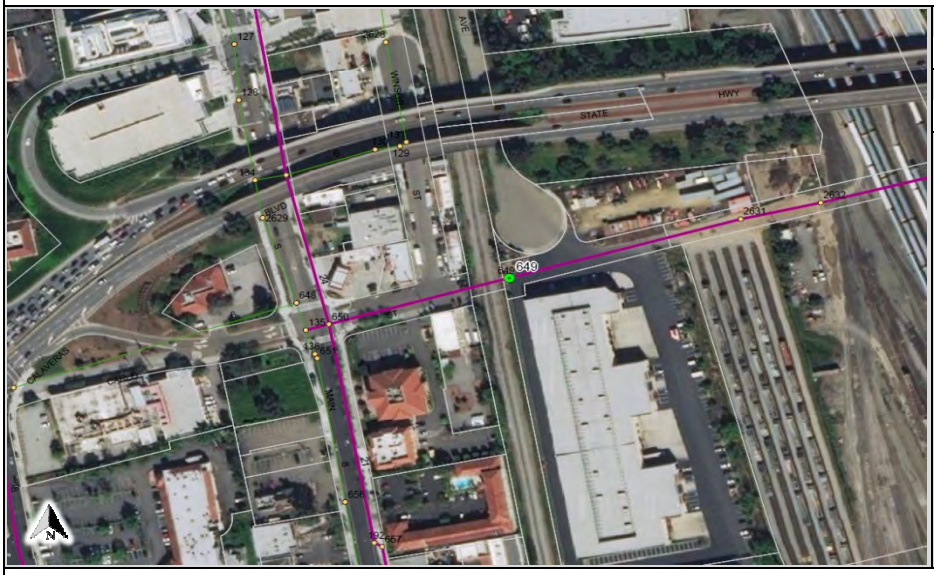
Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

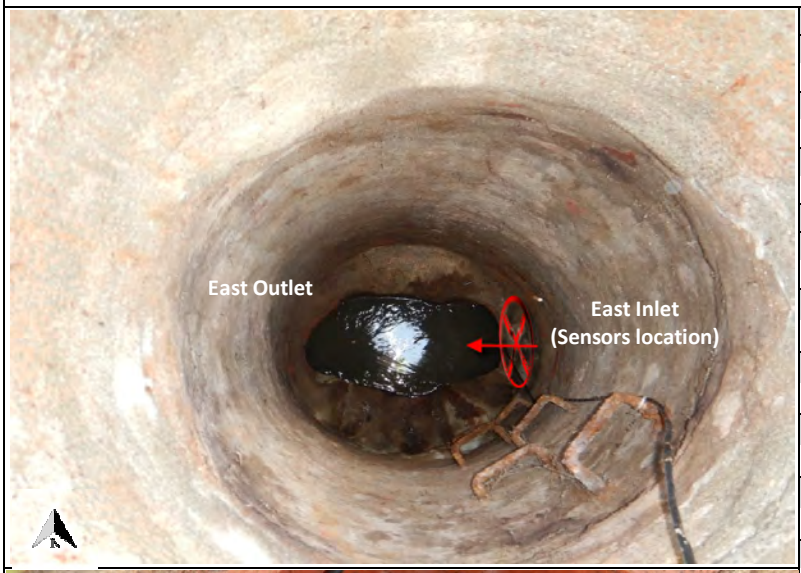
MIL_0649

Site Address /Location:	79 Railroad Avenue			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	Drive	Latitude:	37.430840°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.905657	21.50" x 21.50"	Circular



Manhole #	System Characteristics
649	Residential/Commercial
Access	Traffic
Drive	Light







Installation Information

Installation Date:	Installation Type:
Tuesday, November 12, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
10:22:26 AM	21.50" x 21.50"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
10.50	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.61	0''
Silt (in)	Silt Type
0''	

Hydraulic Comments:

Smooth deep flow with moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
10'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
PVC	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_0649

Flow Monitor

MIL_0649

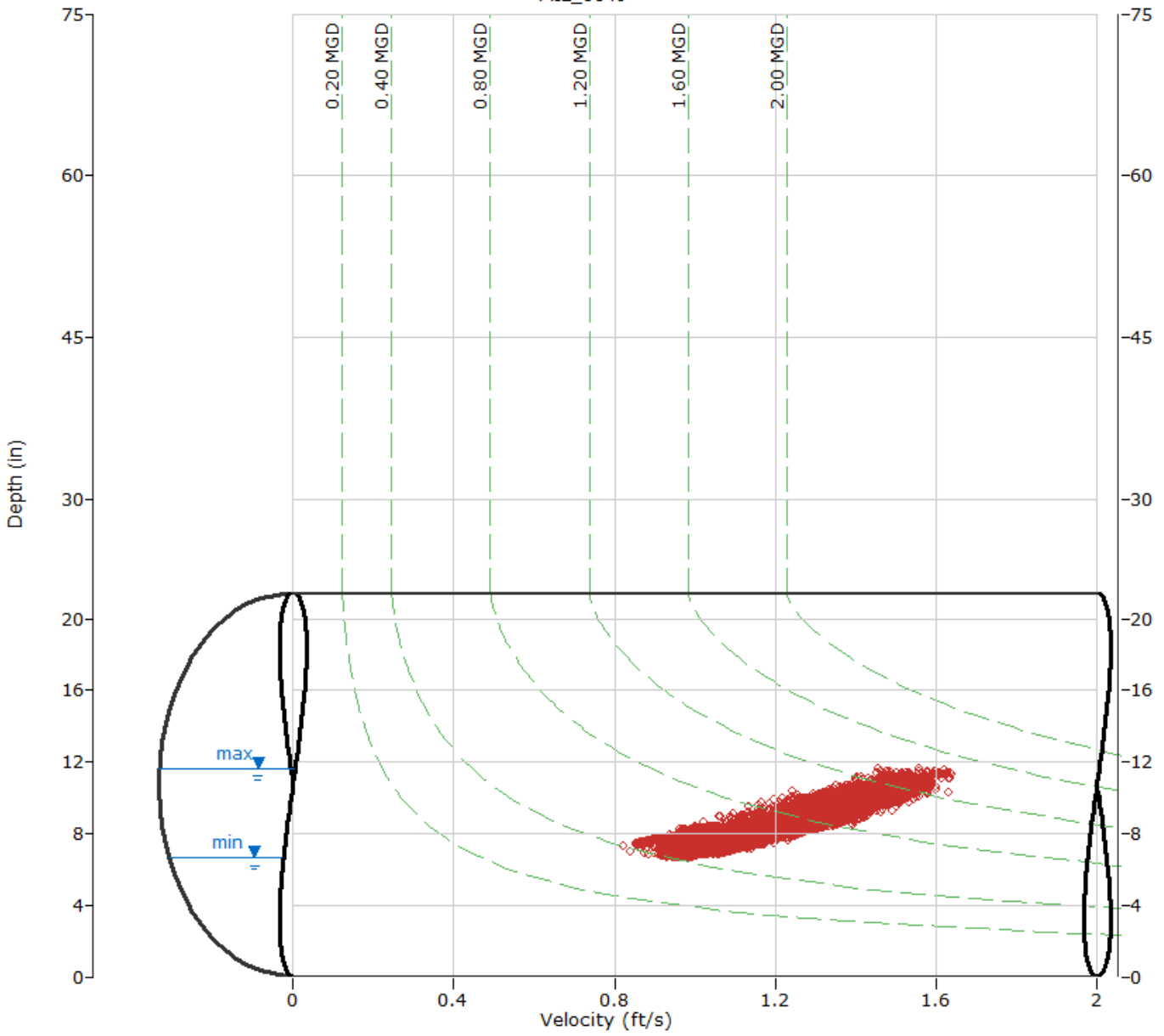
Pipe Height
21.50 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_0649

Flow Monitor

MIL_0649

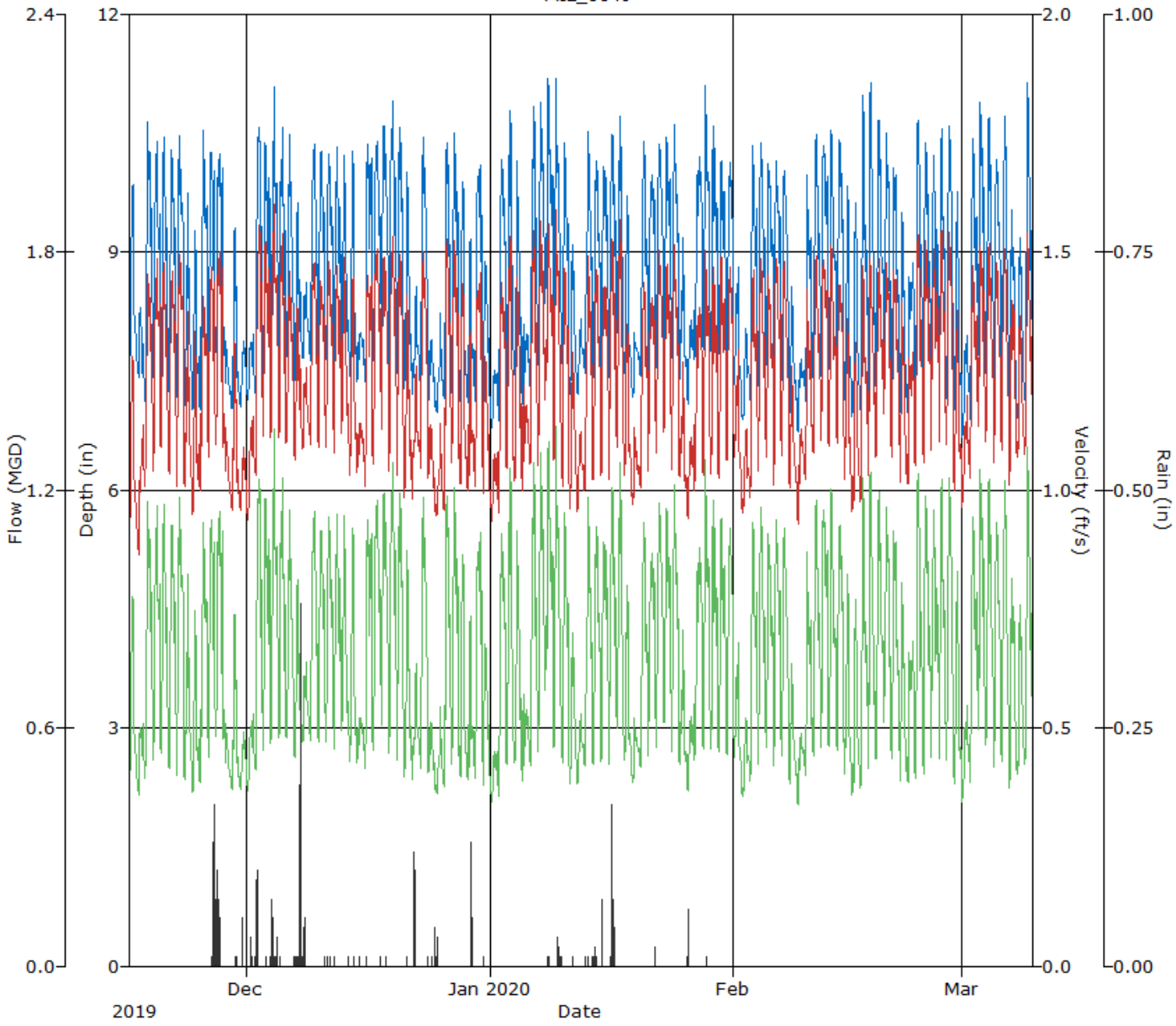
Pipe Height
21.50 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_0649, Pipe Height: 21.50 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	04:20	7.62	12:25	10.26	8.49	04:45	0.93	12:30	1.34	1.07	04:00	0.480	12:30	1.024	0.648	0.648	
11/17/2019	23:55	7.22	15:05	8.57	7.75	06:20	0.85	15:05	1.24	0.99	06:20	0.423	15:05	0.748	0.527	0.527	
11/18/2019	00:55	7.00	10:15	11.13	9.05	03:35	1.00	10:15	1.54	1.27	00:55	0.462	10:15	1.311	0.848	0.848	
11/19/2019	04:50	7.37	15:50	10.61	9.09	05:15	1.01	15:50	1.55	1.30	05:15	0.504	15:50	1.244	0.865	0.865	
11/20/2019	03:30	7.27	12:30	10.87	8.85	03:30	1.06	12:30	1.54	1.28	03:30	0.514	12:30	1.273	0.823	0.823	
11/21/2019	04:20	7.18	11:05	10.80	9.00	04:25	1.03	11:00	1.53	1.30	04:20	0.489	11:00	1.251	0.854	0.854	
11/22/2019	04:40	7.12	11:40	11.16	9.10	04:40	0.99	11:35	1.63	1.32	04:40	0.464	11:35	1.382	0.879	0.879	
11/23/2019	05:05	7.01	12:10	9.90	8.01	04:55	1.00	12:45	1.41	1.13	05:00	0.459	12:10	1.014	0.633	0.633	
11/24/2019	03:25	6.97	13:00	9.71	7.79	03:20	0.93	12:05	1.39	1.09	03:25	0.425	13:00	0.984	0.587	0.587	
11/25/2019	03:50	6.96	12:35	10.77	8.89	02:10	0.97	12:30	1.45	1.24	02:10	0.443	12:30	1.184	0.803	0.803	
11/26/2019	04:20	7.31	09:40	10.62	9.16	04:10	1.05	10:10	1.52	1.32	04:20	0.518	10:10	1.212	0.883	0.883	0.36
11/27/2019	03:20	7.70	10:05	10.48	9.23	03:15	1.09	13:05	1.54	1.34	03:15	0.569	13:10	1.198	0.906	0.906	0.63
11/28/2019	20:20	7.16	00:00	8.75	7.60	23:50	0.90	00:00	1.26	1.07	23:50	0.433	00:00	0.787	0.555	0.555	
11/29/2019	04:20	7.00	14:10	9.99	7.88	22:45	0.92	13:55	1.42	1.10	04:15	0.435	09:15	1.034	0.603	0.603	0.02
11/30/2019	06:30	6.97	17:45	8.05	7.47	06:25	0.93	17:35	1.13	1.02	06:25	0.427	17:45	0.627	0.513	0.513	0.10
12/01/2019	06:05	7.08	21:35	8.27	7.55	06:05	0.91	21:40	1.20	1.05	06:05	0.427	21:40	0.695	0.537	0.537	0.06
12/02/2019	04:15	7.16	13:35	10.70	9.14	04:10	1.02	10:40	1.63	1.34	04:10	0.483	10:40	1.255	0.905	0.905	0.30
12/03/2019	04:20	7.30	10:05	10.72	8.96	04:10	1.10	10:10	1.56	1.34	04:10	0.536	10:10	1.261	0.870	0.870	0.01
12/04/2019	02:45	7.45	12:15	11.41	9.35	02:20	1.11	12:10	1.64	1.39	02:45	0.557	12:10	1.436	0.957	0.957	0.39
12/05/2019	03:30	7.61	14:40	11.30	9.20	03:35	1.10	14:35	1.64	1.35	03:35	0.569	14:35	1.418	0.908	0.908	0.01
12/06/2019	02:15	7.60	12:40	10.59	9.00	01:40	1.02	17:50	1.48	1.29	01:40	0.536	12:55	1.173	0.843	0.843	0.01
12/07/2019	06:00	7.33	11:50	9.77	8.30	06:05	1.05	11:45	1.49	1.21	06:05	0.516	11:50	1.068	0.710	0.710	0.67
12/08/2019	04:15	7.64	07:45	9.62	8.11	05:40	1.08	07:45	1.43	1.17	04:15	0.562	07:45	1.008	0.659	0.659	0.20
12/09/2019	04:40	7.53	16:50	10.46	9.15	04:35	1.08	13:35	1.53	1.32	04:35	0.549	13:35	1.179	0.887	0.887	
12/10/2019	05:10	7.57	12:00	10.57	9.13	04:00	1.08	10:35	1.49	1.31	05:00	0.557	11:55	1.179	0.872	0.872	
12/11/2019	04:20	7.58	13:20	10.40	9.07	04:05	1.08	12:35	1.51	1.31	04:00	0.554	13:20	1.173	0.867	0.867	0.03
12/12/2019	04:30	7.49	12:45	10.46	9.06	04:20	1.07	13:25	1.50	1.31	04:20	0.539	12:40	1.173	0.865	0.865	0.01
12/13/2019	01:50	7.61	12:20	10.35	8.74	01:55	1.09	12:20	1.52	1.27	01:55	0.564	12:20	1.180	0.796	0.796	0.01
12/14/2019	04:10	7.39	13:25	10.37	8.35	03:45	1.01	13:50	1.48	1.19	03:45	0.506	13:25	1.129	0.707	0.707	0.01
12/15/2019	03:10	7.25	06:55	8.09	7.78	09:10	1.00	06:50	1.17	1.10	06:20	0.487	06:50	0.655	0.584	0.584	0.01
12/16/2019	03:45	7.35	08:25	10.48	9.18	03:40	1.00	12:55	1.49	1.29	03:45	0.493	12:50	1.171	0.875	0.875	0.01
12/17/2019	05:15	7.52	16:55	10.65	9.38	03:55	1.04	16:50	1.56	1.34	05:15	0.528	16:50	1.256	0.934	0.934	0.01
12/18/2019	04:20	7.59	12:50	10.77	9.53	04:20	1.07	12:45	1.51	1.36	04:20	0.549	12:45	1.232	0.953	0.953	0.01
12/19/2019	04:35	7.56	13:25	11.00	9.49	04:35	1.02	13:05	1.56	1.34	04:35	0.522	13:05	1.299	0.945	0.945	
12/20/2019	05:05	7.32	14:20	10.74	9.30	05:00	1.00	14:20	1.53	1.32	05:00	0.489	14:20	1.247	0.902	0.902	
12/21/2019	04:25	7.24	11:25	10.10	8.35	05:40	0.97	11:20	1.46	1.16	04:30	0.472	11:20	1.095	0.688	0.688	0.01
12/22/2019	03:25	7.15	14:35	8.70	7.74	03:25	0.97	14:35	1.29	1.10	03:25	0.457	14:35	0.795	0.584	0.584	0.41
12/23/2019	04:40	7.12	11:35	10.73	9.01	04:05	1.04	11:35	1.53	1.31	04:45	0.491	11:35	1.244	0.867	0.867	
12/24/2019	03:10	7.11	00:10	8.79	7.55	18:30	0.96	00:10	1.31	1.07	23:40	0.478	00:10	0.821	0.548	0.548	0.02
12/25/2019	06:00	6.95	16:10	8.45	7.42	01:20	0.93	16:10	1.19	1.02	05:45	0.426	16:10	0.706	0.509	0.509	0.08
12/26/2019	03:10	7.13	13:20	10.47	8.91	01:20	0.90	13:30	1.60	1.28	01:55	0.445	13:30	1.254	0.842	0.842	
12/27/2019	02:50	7.15	11:00	10.96	9.02	02:50	1.04	10:50	1.56	1.32	02:50	0.491	11:00	1.290	0.873	0.873	
12/28/2019	06:15	7.08	13:50	10.07	8.28	06:10	0.99	14:15	1.47	1.20	06:10	0.466	14:15	1.097	0.708	0.708	
12/29/2019	07:30	7.01	09:20	9.47	7.84	01:55	0.94	10:10	1.37	1.12	01:55	0.451	09:20	0.945	0.609	0.609	0.22
12/30/2019	03:35	7.11	18:55	10.29	8.95	02:50	1.00	18:40	1.58	1.28	03:00	0.473	18:40	1.199	0.839	0.839	
12/31/2019	05:10	6.91	08:50	9.14	7.96	05:10	0.97	08:50	1.34	1.14	05:10	0.441	08:50	0.885	0.631	0.631	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/01/2020	06:35	6.75	14:05	7.61	7.22	06:10	0.89	02:20	1.10	1.02	06:10	0.393	13:55	0.564	0.489	0.489	
01/02/2020	03:35	6.84	07:40	10.59	8.94	04:15	0.87	07:35	1.58	1.26	04:15	0.396	07:35	1.263	0.828	0.828	
01/03/2020	03:05	7.23	15:20	10.97	8.90	22:35	0.94	15:15	1.57	1.28	05:05	0.482	15:15	1.297	0.835	0.835	
01/04/2020	03:30	7.42	11:35	10.41	8.44	03:30	1.01	11:10	1.58	1.21	03:30	0.503	11:10	1.209	0.729	0.729	
01/05/2020	03:35	7.06	07:20	8.31	7.67	03:35	0.98	07:15	1.27	1.12	03:35	0.457	07:15	0.736	0.585	0.585	
01/06/2020	04:35	7.15	13:10	11.00	9.07	01:25	1.03	12:20	1.59	1.31	04:35	0.493	15:35	1.322	0.876	0.876	
01/07/2020	04:00	7.48	12:40	11.07	9.28	03:50	1.03	12:35	1.60	1.32	03:55	0.522	12:35	1.349	0.907	0.907	
01/08/2020	04:30	7.94	12:35	11.43	9.75	00:55	1.10	12:35	1.60	1.38	04:30	0.617	12:35	1.405	1.002	1.002	0.02
01/09/2020	03:50	7.55	10:45	11.57	9.35	03:45	1.04	10:50	1.62	1.33	03:45	0.531	10:45	1.448	0.919	0.919	0.18
01/10/2020	05:15	7.50	12:35	10.49	9.02	05:40	1.00	12:30	1.49	1.27	05:40	0.507	12:30	1.177	0.839	0.839	0.02
01/11/2020	06:15	7.15	13:55	9.43	8.01	03:25	0.92	13:55	1.35	1.12	03:25	0.438	13:55	0.925	0.625	0.625	0.01
01/12/2020	04:00	7.19	14:20	8.26	7.67	03:00	0.86	15:30	1.16	1.04	03:00	0.416	15:30	0.668	0.546	0.546	
01/13/2020	04:40	7.37	13:15	10.57	8.93	01:20	0.98	13:15	1.52	1.25	04:35	0.487	13:15	1.212	0.816	0.816	0.02
01/14/2020	04:55	7.37	13:10	10.29	8.99	04:55	1.01	15:05	1.50	1.28	04:55	0.499	15:15	1.148	0.839	0.839	0.11
01/15/2020	04:40	7.36	12:15	10.21	9.12	04:35	1.02	12:10	1.45	1.30	04:35	0.502	12:05	1.107	0.865	0.865	0.07
01/16/2020	04:30	7.39	14:05	10.85	9.26	04:10	1.01	14:05	1.57	1.33	04:10	0.505	14:05	1.293	0.904	0.904	0.66
01/17/2020	04:55	7.83	15:35	10.79	9.11	04:50	1.06	15:05	1.58	1.31	04:50	0.570	15:30	1.292	0.874	0.874	
01/18/2020	06:25	7.42	12:35	9.73	8.13	04:05	0.98	11:50	1.42	1.14	04:05	0.487	11:50	0.989	0.653	0.653	
01/19/2020	05:00	7.11	09:00	8.23	7.62	00:20	0.95	09:00	1.20	1.05	05:10	0.448	09:00	0.690	0.543	0.543	
01/20/2020	05:00	7.38	14:50	10.46	8.94	05:00	0.98	15:20	1.47	1.24	05:00	0.484	15:20	1.148	0.814	0.814	
01/21/2020	04:10	7.42	12:45	10.15	9.18	04:10	1.01	09:40	1.45	1.29	04:10	0.503	12:45	1.099	0.866	0.866	
01/22/2020	04:15	7.49	12:50	10.51	9.24	04:15	1.06	12:45	1.56	1.33	04:15	0.536	12:45	1.232	0.903	0.903	0.03
01/23/2020	04:20	7.68	09:05	10.54	9.36	03:50	1.10	15:30	1.49	1.32	04:20	0.578	09:05	1.179	0.910	0.910	
01/24/2020	04:55	7.63	12:40	10.83	9.25	04:50	1.03	11:00	1.56	1.30	04:50	0.534	11:15	1.267	0.887	0.887	
01/25/2020	03:30	7.34	15:05	9.45	8.02	20:55	0.93	15:00	1.33	1.10	20:55	0.482	15:05	0.912	0.611	0.611	
01/26/2020	05:20	7.02	21:40	8.97	7.69	08:45	0.92	21:35	1.26	1.03	05:20	0.431	21:40	0.807	0.543	0.543	0.16
01/27/2020	00:55	7.55	15:45	10.43	9.27	00:25	0.95	15:35	1.43	1.25	00:25	0.492	15:40	1.120	0.852	0.852	
01/28/2020	05:05	7.64	10:00	11.35	9.43	05:05	1.00	10:35	1.52	1.28	05:05	0.520	10:05	1.324	0.897	0.897	0.01
01/29/2020	04:35	7.60	09:45	10.80	9.18	04:35	1.01	09:40	1.53	1.26	04:35	0.520	09:40	1.250	0.848	0.848	
01/30/2020	02:15	7.68	11:20	10.28	9.06	02:10	1.01	11:15	1.53	1.28	02:10	0.529	11:15	1.176	0.849	0.849	
01/31/2020	05:10	7.40	12:30	10.35	9.01	03:55	1.01	14:20	1.51	1.30	03:55	0.512	12:35	1.150	0.856	0.856	
02/01/2020	03:45	7.26	14:45	9.12	7.86	23:40	0.82	08:45	1.35	1.13	23:40	0.399	14:45	0.878	0.614	0.614	
02/02/2020	02:45	6.88	15:30	8.12	7.40	21:05	0.92	12:25	1.18	1.03	06:15	0.425	12:25	0.663	0.514	0.514	
02/03/2020	02:35	7.10	10:35	10.44	8.94	00:55	0.97	10:30	1.51	1.26	02:40	0.462	10:30	1.182	0.822	0.822	
02/04/2020	04:10	7.26	13:20	10.51	8.97	03:55	1.02	13:00	1.53	1.28	04:20	0.498	13:00	1.203	0.840	0.840	
02/05/2020	04:20	7.46	10:00	10.20	9.12	04:30	1.03	09:35	1.48	1.30	04:30	0.521	09:35	1.121	0.863	0.863	
02/06/2020	04:50	7.38	13:50	10.35	9.07	04:50	0.99	13:45	1.55	1.30	04:50	0.492	13:45	1.202	0.863	0.863	
02/07/2020	02:25	7.30	11:00	10.23	8.93	02:20	1.05	10:55	1.55	1.30	02:20	0.512	10:55	1.181	0.842	0.842	
02/08/2020	04:05	6.92	11:30	8.67	7.59	22:20	0.95	11:35	1.28	1.10	04:05	0.452	11:35	0.789	0.569	0.569	
02/09/2020	04:35	6.70	13:35	7.72	7.29	05:20	0.91	11:55	1.16	1.05	05:05	0.398	11:55	0.606	0.513	0.513	
02/10/2020	04:30	7.08	08:10	10.11	8.52	00:45	0.92	08:10	1.46	1.21	00:50	0.462	08:10	1.095	0.739	0.739	
02/11/2020	04:30	7.26	13:00	10.71	9.08	04:10	1.05	13:05	1.54	1.31	04:30	0.519	13:05	1.248	0.868	0.868	
02/12/2020	04:30	7.23	12:05	10.47	9.29	04:25	1.06	09:55	1.53	1.34	04:25	0.510	12:05	1.199	0.914	0.914	
02/13/2020	02:15	7.42	10:40	10.69	9.06	02:15	1.07	10:30	1.55	1.31	02:15	0.535	10:35	1.254	0.869	0.869	
02/14/2020	04:35	7.35	13:10	10.56	9.17	05:05	1.08	10:35	1.47	1.31	05:05	0.536	13:10	1.165	0.879	0.879	
02/15/2020	03:25	6.97	11:50	10.38	8.15	02:10	0.90	11:45	1.44	1.16	02:10	0.432	11:45	1.117	0.669	0.669	
02/16/2020	02:15	6.86	12:30	10.02	7.96	04:30	0.88	12:35	1.41	1.10	02:55	0.417	12:35	1.046	0.614	0.614	
02/17/2020	04:45	6.98	12:30	11.07	8.66	01:55	0.84	12:25	1.50	1.20	01:55	0.386	12:25	1.265	0.756	0.756	
02/18/2020	04:00	7.08	11:55	11.63	9.17	03:35	0.97	11:55	1.56	1.28	03:35	0.465	11:55	1.399	0.861	0.861	
02/19/2020	04:35	7.26	11:20	10.90	9.04	02:05	1.04	13:45	1.53	1.29	02:05	0.503	11:25	1.236	0.857	0.857	
02/20/2020	04:30	7.37	12:45	10.65	9.14	03:00	1.09	16:20	1.52	1.33	04:25	0.546	12:30	1.208	0.886	0.886	
02/21/2020	03:25	7.27	10:10	10.24	8.74	03:10	1.05	14:50	1.52	1.29	03:10	0.508	10:10	1.156	0.813	0.813	
02/22/2020	04:45	6.91	13:15	9.92	8.12	06:40	0.90	10:55	1.47	1.20	06:40	0.407	13:15	1.064	0.686	0.686	
02/23/2020	06:05	6.85	20:15	9.05	7.96	05:50	0.94	19:55	1.36	1.16	05:50	0.426	19:55	0.872	0.643	0.643	
02/24/2020	04:30	6.86	10:45	11.18	8.92	04:20	0.93	11:05	1.60	1.33	04:20	0.419	11:05	1.364	0.867	0.867	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	04:55	6.92	14:00	10.51	8.85	04:35	1.04	12:30	1.56	1.32	04:55	0.472	13:55	1.234	0.849	0.849	
02/26/2020	04:35	6.97	10:25	10.67	8.86	04:30	1.03	13:30	1.56	1.34	04:30	0.472	10:20	1.228	0.856	0.856	
02/27/2020	04:45	7.05	12:40	10.71	9.02	04:40	1.07	12:45	1.57	1.36	04:40	0.498	12:45	1.274	0.896	0.896	
02/28/2020	02:20	7.09	10:35	10.78	8.92	00:30	1.07	11:40	1.58	1.33	02:20	0.509	10:30	1.286	0.868	0.868	
02/29/2020	03:05	6.92	11:00	10.62	7.97	02:50	0.98	11:00	1.51	1.15	03:00	0.444	11:00	1.208	0.642	0.642	
03/01/2020	03:15	6.64	18:20	8.11	7.30	03:05	0.93	18:25	1.24	1.07	03:05	0.400	18:25	0.696	0.524	0.524	
03/02/2020	03:20	6.85	10:35	10.66	8.91	03:10	1.01	10:40	1.55	1.28	03:15	0.453	10:40	1.249	0.836	0.836	
03/03/2020	05:20	7.40	10:05	11.11	9.27	03:20	1.07	10:10	1.61	1.33	05:15	0.539	10:10	1.364	0.909	0.909	
03/04/2020	03:30	7.22	09:10	11.00	9.17	03:10	1.05	12:20	1.54	1.33	03:10	0.506	09:05	1.285	0.899	0.899	
03/05/2020	04:40	7.10	13:30	10.54	9.04	04:30	1.04	13:25	1.57	1.32	04:35	0.490	13:30	1.242	0.868	0.868	
03/06/2020	02:10	6.88	15:40	10.99	8.95	02:10	1.03	14:15	1.55	1.32	02:10	0.462	15:35	1.273	0.863	0.863	
03/07/2020	02:25	6.80	11:35	10.26	8.12	02:45	0.91	17:45	1.49	1.23	02:45	0.404	11:35	1.111	0.706	0.706	
03/08/2020	02:15	6.84	10:40	9.79	7.88	02:20	1.06	10:40	1.42	1.20	02:15	0.472	10:40	1.029	0.655	0.655	
03/09/2020	03:25	7.04	12:00	11.45	9.16	01:50	1.06	13:30	1.59	1.32	03:25	0.495	13:30	1.388	0.895	0.895	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			89.337	4.90
Avg	8.66	1.24	0.777	

Site Commentary

Site Information

MIL_0715	
Pipe Dimensions	30.5
Silt Level	0.00"

Overview

Site MIL_0715 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. Due to meter malfunction, data confidence is less than typical during January 27, 2020 through February 04, 2020. Also a data gap occured beginning January 05, 2020 through January 09, 2020.

This location was installed upstream of site MIL_2808. (See MIL_2808 Site Commentary for More Details)

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	7.53	1.46	0.969
Minimum	4.42	0.41	0.120
Maximum	10.33	2.18	2.069
Time of Minimum	1/30/2020 5:55 AM	1/30/2020 5:40 AM	1/30/2020 5:40 AM
Time of Maximum	3/8/2020 1:30 PM	3/3/2020 9:20 AM	3/8/2020 1:45 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	96
Velocity (ft/s)	96
Quantity (MGD)	96

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

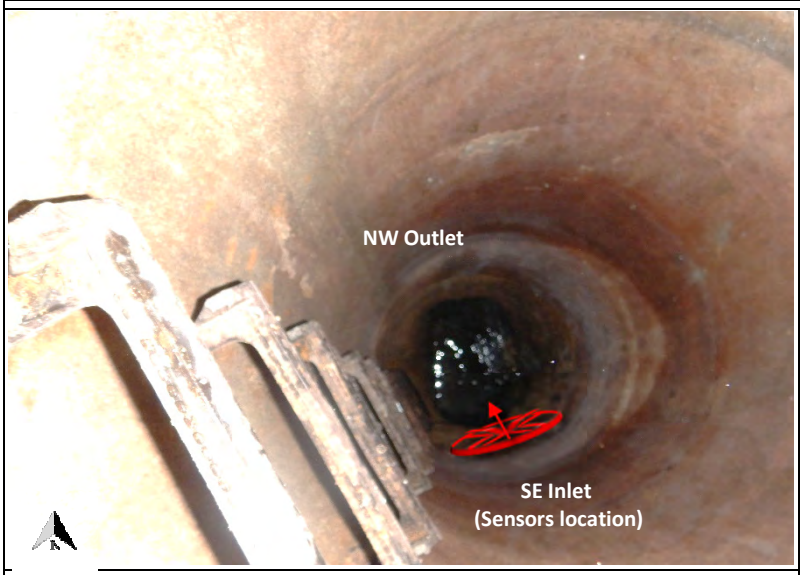
MIL_0715

Site Address /Location:	Barber Ln and Bellew Dr			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	In Parking Lot	Latitude:	37.421203°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.917399	30.5" x 30.0"	Circular



Manhole #	System Characteristics
715	Residential/Commercial
Access	Traffic
Drive	Light







Installation Information

Installation Date:	Installation Type:
Tuesday, November 12, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
5:47:56 AM	30.5" x 30.0"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
5.63	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.03	0''
Silt (in)	Silt Type
0''	

Hydraulic Comments:

Smooth flow with medium depth and moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
5'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_0715

Flow Monitor

MIL_0715

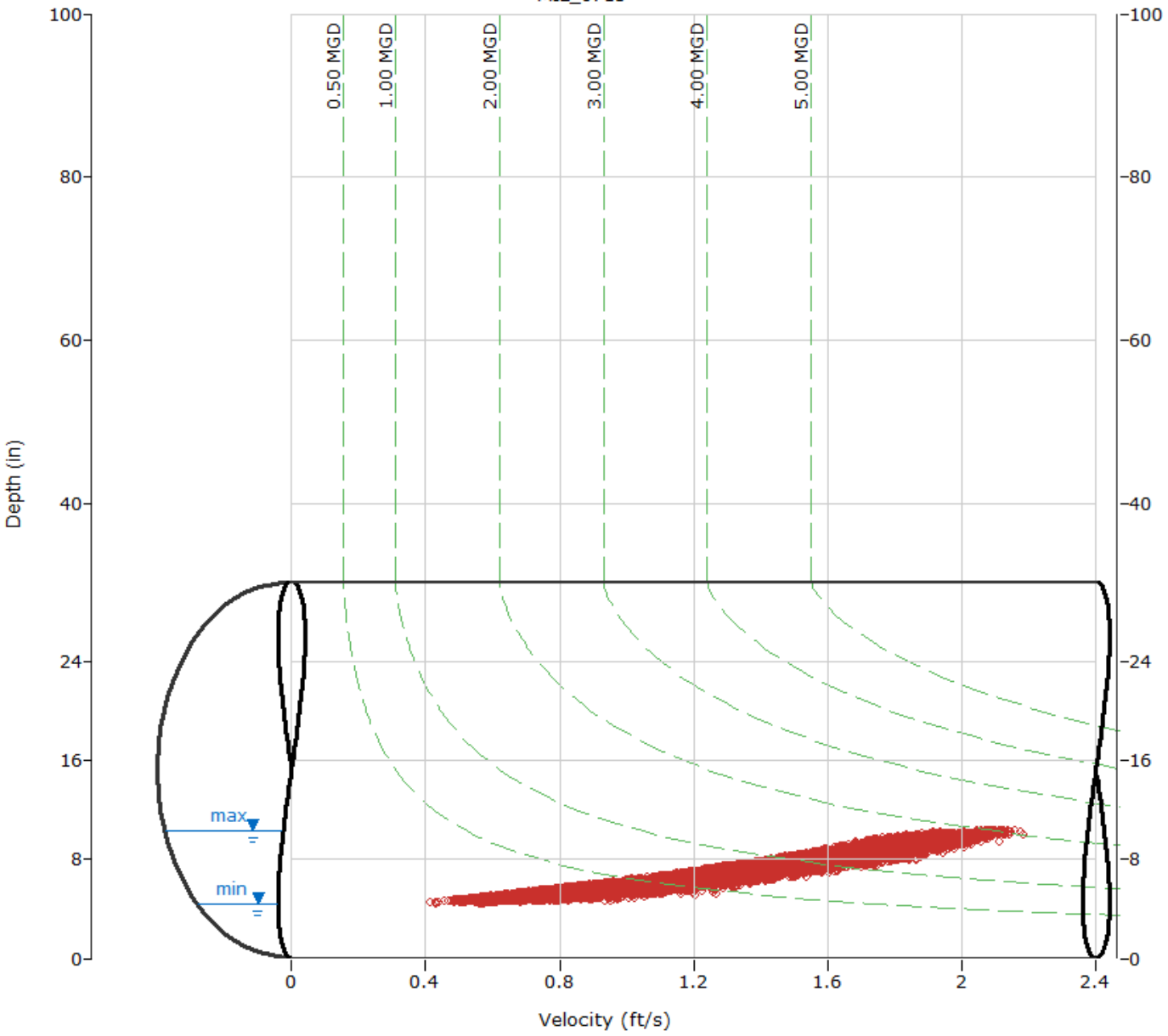
Pipe Height
30.50 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_0715

Flow Monitor

MIL_0715

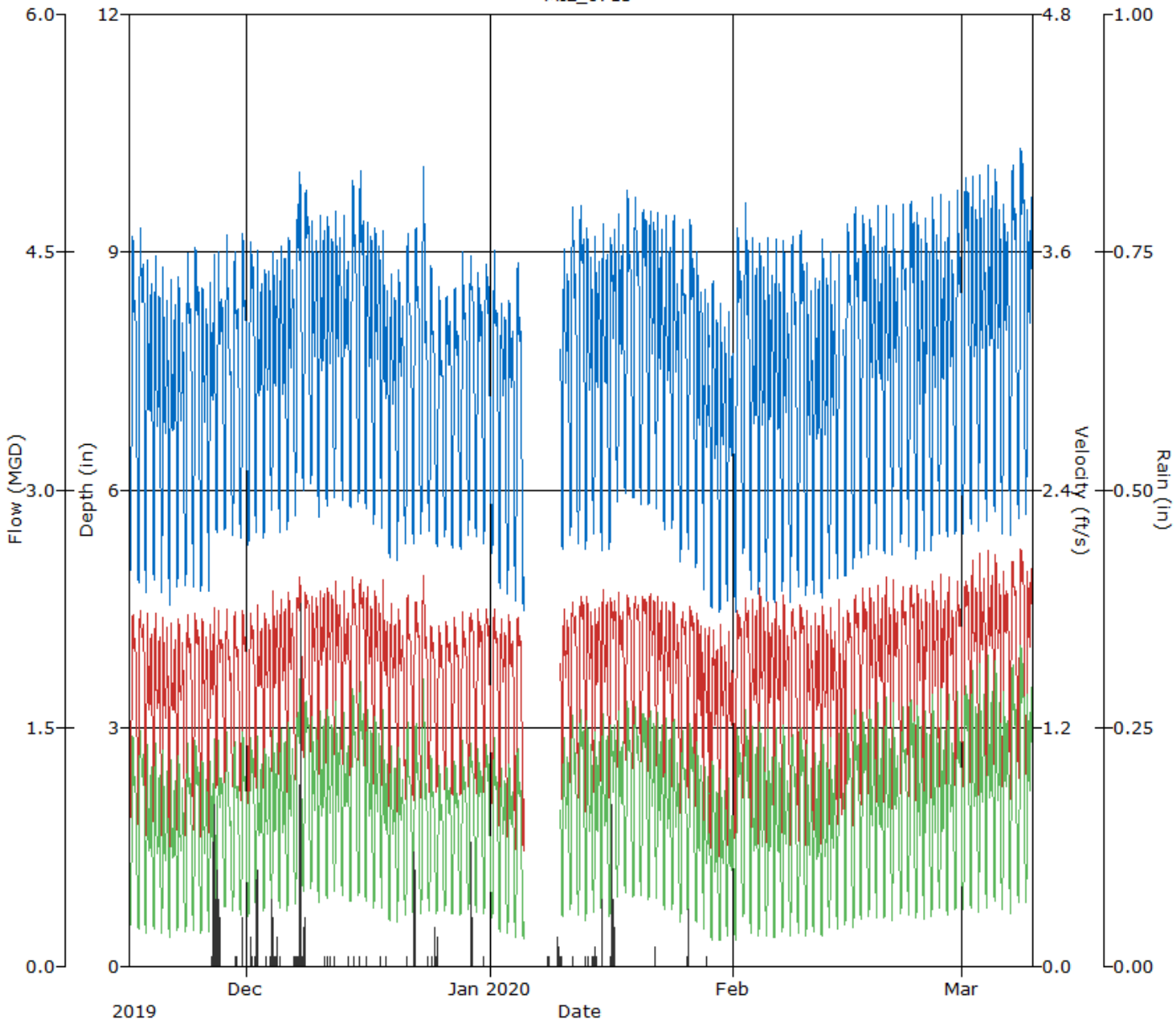
Pipe Height
30.50 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_0715, Pipe Height: 30.50 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	06:25	4.95	11:55	9.20	7.43	05:00	0.66	13:45	1.88	1.39	05:00	0.225	13:45	1.517	0.912	0.912	
11/17/2019	06:10	4.81	12:15	9.36	7.49	04:55	0.58	11:45	1.87	1.40	04:55	0.196	12:40	1.544	0.939	0.939	
11/18/2019	05:25	4.68	09:20	8.94	7.09	03:45	0.61	09:05	1.84	1.31	05:25	0.204	09:10	1.436	0.802	0.802	
11/19/2019	05:55	4.84	09:30	8.99	7.09	05:10	0.56	08:40	1.87	1.32	05:10	0.185	09:35	1.465	0.803	0.803	
11/20/2019	05:15	4.68	09:20	8.90	6.97	04:00	0.65	09:00	1.92	1.31	05:15	0.204	09:00	1.464	0.777	0.777	
11/21/2019	05:25	4.52	09:15	8.71	6.93	03:50	0.56	09:15	1.80	1.29	05:25	0.178	09:15	1.368	0.764	0.764	
11/22/2019	05:20	4.76	09:35	8.75	6.99	06:40	0.61	09:05	1.81	1.32	04:25	0.206	09:05	1.353	0.781	0.781	
11/23/2019	06:05	4.77	13:05	9.03	7.27	06:10	0.51	12:00	1.84	1.37	06:10	0.165	12:05	1.445	0.871	0.871	
11/24/2019	05:50	4.75	13:20	9.10	7.35	05:25	0.57	11:00	1.93	1.39	05:25	0.188	11:55	1.492	0.907	0.907	
11/25/2019	05:15	4.71	09:55	8.66	6.99	04:40	0.54	09:40	1.87	1.31	04:40	0.174	09:40	1.400	0.782	0.782	
11/26/2019	05:25	4.71	21:35	9.03	7.16	04:35	0.58	21:35	1.94	1.36	04:35	0.189	21:35	1.553	0.845	0.845	0.36
11/27/2019	05:35	5.44	10:30	9.06	7.54	06:10	0.76	09:30	1.89	1.45	06:10	0.301	10:35	1.493	0.942	0.942	0.63
11/28/2019	05:35	5.48	13:20	9.29	7.36	06:45	0.76	13:10	1.86	1.40	06:45	0.304	13:10	1.546	0.882	0.882	
11/29/2019	06:20	5.39	12:55	9.04	7.47	06:10	0.80	14:10	1.90	1.43	06:10	0.309	14:10	1.487	0.916	0.916	0.02
11/30/2019	06:40	5.38	13:25	9.28	7.49	06:10	0.72	13:45	1.86	1.41	06:10	0.278	13:45	1.535	0.918	0.918	0.10
12/01/2019	06:05	5.30	13:40	9.13	7.59	06:25	0.69	14:35	1.85	1.42	06:25	0.260	14:35	1.504	0.946	0.946	0.06
12/02/2019	05:50	5.43	09:50	9.15	7.45	04:10	0.81	09:45	1.89	1.43	05:55	0.316	09:50	1.538	0.914	0.914	0.30
12/03/2019	05:40	5.38	09:35	8.83	7.41	05:55	0.72	09:50	1.84	1.44	05:55	0.276	09:50	1.422	0.909	0.909	0.01
12/04/2019	04:05	5.72	09:30	9.05	7.58	04:20	0.84	09:50	1.98	1.50	04:20	0.351	09:50	1.582	0.972	0.972	0.39
12/05/2019	05:15	5.46	09:35	9.13	7.59	05:15	0.81	09:10	1.90	1.48	05:15	0.317	09:40	1.541	0.974	0.974	0.01
12/06/2019	05:20	5.48	09:35	9.24	7.69	04:50	0.76	09:40	1.94	1.50	04:50	0.305	09:40	1.596	0.997	0.997	0.01
12/07/2019	06:20	5.65	19:20	10.08	8.16	06:00	0.81	18:50	2.02	1.57	06:00	0.336	19:15	1.862	1.156	1.156	0.67
12/08/2019	06:20	5.97	13:30	9.78	8.36	07:00	0.94	11:20	1.98	1.61	07:00	0.421	11:20	1.737	1.209	1.209	0.20
12/09/2019	05:40	6.05	09:35	9.47	7.99	05:20	0.95	09:40	1.93	1.58	05:20	0.436	09:40	1.642	1.093	1.093	
12/10/2019	05:05	5.65	09:40	9.52	7.86	05:05	0.81	09:15	2.02	1.57	05:05	0.333	09:15	1.711	1.079	1.079	
12/11/2019	05:30	5.79	09:30	9.50	7.89	04:45	0.88	11:20	1.98	1.59	04:45	0.383	09:20	1.675	1.091	1.091	0.03
12/12/2019	05:15	5.89	09:25	9.54	7.94	04:55	0.89	09:10	2.01	1.59	04:55	0.395	10:00	1.723	1.096	1.096	0.01
12/13/2019	05:10	5.86	09:30	9.52	7.91	05:15	0.86	10:10	1.95	1.54	05:15	0.375	10:10	1.667	1.061	1.061	0.01
12/14/2019	05:55	5.74	13:40	9.92	8.18	05:15	0.85	12:35	2.02	1.59	05:15	0.367	12:35	1.810	1.164	1.164	0.01
12/15/2019	06:15	5.82	12:05	10.12	8.29	05:30	0.93	12:35	2.00	1.62	06:50	0.406	12:15	1.842	1.209	1.209	0.01
12/16/2019	05:25	5.74	09:25	9.43	7.88	06:15	0.87	08:55	2.01	1.56	05:45	0.373	09:20	1.665	1.069	1.069	0.01
12/17/2019	05:10	5.54	09:30	9.36	7.81	05:10	0.78	10:10	1.94	1.54	05:10	0.313	10:10	1.616	1.049	1.049	0.01
12/18/2019	05:25	5.50	09:35	9.34	7.55	05:15	0.77	09:30	2.01	1.51	05:15	0.307	09:30	1.678	0.982	0.982	0.01
12/19/2019	05:30	5.13	10:15	8.79	7.25	05:50	0.64	08:50	1.89	1.44	05:50	0.229	09:25	1.436	0.889	0.889	
12/20/2019	05:55	5.08	10:25	8.81	7.33	05:50	0.66	10:40	1.98	1.44	05:50	0.233	10:40	1.522	0.899	0.899	
12/21/2019	06:00	5.31	12:50	9.30	7.52	06:20	0.71	13:35	1.94	1.46	06:20	0.268	13:35	1.597	0.958	0.958	0.01
12/22/2019	05:40	5.29	14:10	9.35	7.61	06:40	0.71	12:35	1.91	1.47	06:40	0.270	14:05	1.590	0.984	0.984	0.41
12/23/2019	05:20	5.43	13:45	10.14	7.69	05:50	0.75	12:40	2.04	1.50	05:50	0.292	12:40	1.875	1.018	1.018	
12/24/2019	05:50	5.47	12:45	8.86	7.36	06:20	0.76	12:45	1.79	1.42	06:20	0.300	12:45	1.394	0.891	0.891	0.02
12/25/2019	05:55	5.28	13:15	8.66	7.00	05:55	0.76	14:20	1.80	1.38	05:55	0.286	13:20	1.330	0.806	0.806	0.08
12/26/2019	05:45	5.37	12:50	8.46	7.23	06:20	0.75	11:25	1.83	1.43	06:20	0.290	11:25	1.327	0.877	0.877	
12/27/2019	04:50	5.23	11:35	8.59	7.23	06:50	0.73	11:45	1.80	1.42	06:50	0.280	11:45	1.339	0.873	0.873	
12/28/2019	06:00	5.24	13:05	9.09	7.34	07:00	0.71	13:05	1.84	1.42	07:00	0.265	13:05	1.481	0.900	0.900	
12/29/2019	06:05	5.41	13:05	8.96	7.45	05:05	0.74	19:05	1.85	1.44	05:05	0.288	13:55	1.445	0.933	0.933	0.22
12/30/2019	05:55	5.39	12:15	8.77	7.44	06:05	0.74	11:50	1.88	1.48	06:05	0.285	11:55	1.436	0.947	0.947	
12/31/2019	05:45	5.30	13:50	8.87	7.44	06:30	0.73	13:10	1.85	1.47	06:30	0.276	13:10	1.431	0.941	0.941	0.01

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/01/2020	07:15	5.16	13:40	9.05	7.28	05:45	0.70	12:50	1.87	1.43	07:35	0.256	12:50	1.471	0.897	0.897	
01/02/2020	06:05	4.74	11:00	8.50	7.00	04:45	0.55	10:05	1.84	1.37	06:20	0.180	10:35	1.303	0.816	0.816	
01/03/2020	05:25	4.67	11:00	8.44	6.97	05:35	0.49	10:05	1.86	1.36	05:35	0.152	10:05	1.315	0.805	0.805	
01/04/2020	05:25	4.58	13:10	8.88	7.03	05:50	0.46	11:30	1.86	1.36	05:50	0.140	13:15	1.431	0.838	0.838	
01/05/2020	06:30	4.46	00:00	7.34	5.48	05:25	0.49	00:00	1.48	0.92	05:25	0.151	00:00	0.882	0.395	0.136	
01/06/2020																	
01/07/2020																	
01/08/2020	00:00		00:00														0.02
01/09/2020	00:00		00:00														0.18
01/10/2020	05:00	5.24	09:25	9.13	7.53	04:35	0.69	09:25	1.92	1.46	04:35	0.259	09:25	1.555	0.954	0.950	0.02
01/11/2020	06:25	5.41	12:05	9.62	7.81	06:25	0.79	13:55	1.95	1.52	06:25	0.306	13:55	1.677	1.044	1.044	0.01
01/12/2020	05:55	5.29	13:55	9.60	7.87	06:55	0.71	13:35	1.95	1.54	06:55	0.271	13:35	1.696	1.079	1.079	
01/13/2020	05:15	5.24	09:30	9.35	7.51	05:15	0.67	08:55	1.91	1.49	05:15	0.249	09:25	1.598	0.966	0.966	0.02
01/14/2020	05:30	5.42	09:30	9.25	7.54	05:45	0.76	21:20	1.90	1.47	05:45	0.293	09:30	1.517	0.957	0.957	0.11
01/15/2020	05:20	5.23	09:25	9.38	7.55	05:35	0.68	09:15	1.95	1.49	05:35	0.253	09:40	1.645	0.981	0.981	0.07
01/16/2020	05:10	5.23	21:20	9.32	7.82	05:50	0.69	09:40	1.91	1.55	05:50	0.260	22:05	1.571	1.069	1.069	0.66
01/17/2020	04:40	5.84	09:20	9.49	7.97	05:10	0.89	09:45	2.01	1.57	05:10	0.385	09:45	1.716	1.095	1.095	
01/18/2020	05:40	5.93	12:00	9.83	8.11	05:25	0.89	12:10	1.93	1.59	05:25	0.395	12:10	1.726	1.141	1.141	
01/19/2020	05:25	5.87	13:15	9.72	8.09	05:40	0.88	11:05	1.96	1.58	05:40	0.385	11:05	1.684	1.133	1.133	
01/20/2020	05:45	5.79	13:15	9.57	8.16	04:55	0.86	12:00	1.96	1.61	04:55	0.373	12:00	1.687	1.172	1.172	
01/21/2020	04:50	5.78	09:05	9.62	7.96	04:55	0.86	08:55	2.04	1.59	04:55	0.367	08:55	1.767	1.103	1.103	
01/22/2020	04:45	5.74	09:10	9.55	7.85	05:40	0.85	21:10	2.00	1.55	05:40	0.364	21:10	1.668	1.056	1.056	0.03
01/23/2020	04:35	5.47	08:55	9.59	7.70	05:05	0.81	08:55	1.93	1.50	05:05	0.321	08:55	1.673	1.002	1.002	
01/24/2020	05:35	5.49	10:20	9.49	7.61	05:15	0.78	09:40	1.89	1.47	05:15	0.312	10:35	1.616	0.967	0.967	
01/25/2020	05:35	5.07	12:40	9.33	7.53	05:45	0.62	12:05	1.85	1.46	05:45	0.220	12:05	1.520	0.968	0.968	
01/26/2020	05:15	5.13	12:55	9.46	7.67	04:35	0.72	11:50	1.92	1.49	05:00	0.260	11:50	1.591	1.006	1.006	0.16
01/27/2020	05:30	4.99	09:20	9.06	7.08	06:35	0.62	20:30	1.85	1.35	05:25	0.217	09:25	1.467	0.831	0.658	
01/28/2020	05:50	4.73	09:00	8.68	6.92	20:00	0.44	08:55	1.82	1.31	06:10	0.167	08:55	1.371	0.779	0.649	0.01
01/29/2020	04:55	4.47	08:25	8.63	6.70	05:00	0.44	08:15	1.79	1.31	05:00	0.129	08:20	1.341	0.713	0.609	
01/30/2020	05:55	4.42	09:45	8.51	6.66	05:40	0.41	10:10	1.80	1.26	05:40	0.120	09:45	1.298	0.705	0.705	
01/31/2020	05:10	4.58	09:35	8.37	6.64	05:45	0.50	09:40	1.76	1.25	05:45	0.155	09:40	1.268	0.688	0.688	
02/01/2020	05:55	4.44	13:35	9.49	7.23	06:15	0.43	13:20	1.85	1.36	06:15	0.126	13:20	1.566	0.886	0.886	
02/02/2020	05:45	5.17	13:00	9.69	7.67	06:15	0.67	12:45	1.93	1.48	06:15	0.242	12:45	1.687	1.009	1.009	
02/03/2020	05:35	4.71	09:20	9.25	7.18	04:55	0.55	09:35	1.97	1.39	05:25	0.174	09:35	1.621	0.865	0.865	
02/04/2020	05:15	4.68	09:20	9.14	7.17	05:50	0.50	09:50	1.98	1.40	05:50	0.160	09:50	1.592	0.873	0.873	
02/05/2020	05:10	4.59	09:30	9.27	7.09	05:35	0.51	09:40	1.88	1.37	05:35	0.157	09:40	1.554	0.838	0.838	
02/06/2020	05:00	4.57	09:20	9.22	7.04	04:45	0.47	09:25	1.94	1.36	04:45	0.143	09:25	1.592	0.825	0.825	
02/07/2020	04:55	4.73	09:30	9.22	7.12	04:55	0.52	09:20	2.01	1.37	04:55	0.166	09:20	1.643	0.840	0.840	
02/08/2020	06:25	4.56	12:30	9.21	7.29	06:30	0.50	11:00	1.85	1.41	06:30	0.149	13:05	1.487	0.910	0.910	
02/09/2020	06:00	4.75	13:05	9.32	7.46	06:00	0.52	12:40	1.88	1.43	06:00	0.167	12:40	1.545	0.955	0.955	
02/10/2020	05:40	4.65	09:20	8.93	6.98	04:20	0.50	09:35	1.84	1.35	05:20	0.158	09:35	1.440	0.806	0.806	
02/11/2020	05:25	4.67	09:15	8.80	6.99	04:40	0.53	08:45	1.89	1.35	04:40	0.171	09:05	1.425	0.806	0.806	
02/12/2020	05:35	4.61	09:20	9.22	7.04	04:30	0.51	09:05	1.97	1.34	05:35	0.163	09:05	1.602	0.810	0.810	
02/13/2020	05:55	4.87	09:20	9.05	7.15	05:30	0.59	09:35	1.96	1.37	05:30	0.198	09:35	1.570	0.840	0.840	
02/14/2020	05:20	4.87	09:20	9.02	6.65	05:55	0.58	08:50	1.89	1.26	05:55	0.193	09:15	1.489	0.717	0.359	
02/15/2020	05:35	4.89	13:15	9.39	7.63	05:40	0.64	13:25	1.86	1.49	05:40	0.214	13:25	1.572	0.999	0.999	
02/16/2020	05:55	4.99	12:30	9.59	7.70	06:35	0.59	12:05	1.91	1.50	06:35	0.206	12:05	1.643	1.032	1.032	
02/17/2020	05:50	5.13	11:00	9.50	7.80	05:25	0.67	10:40	1.96	1.52	06:05	0.238	11:10	1.674	1.057	1.057	
02/18/2020	05:20	5.16	09:45	9.45	7.58	05:40	0.72	10:10	1.95	1.49	05:40	0.260	09:45	1.654	0.987	0.987	
02/19/2020	05:15	5.24	09:25	9.63	7.60	05:55	0.70	09:55	1.96	1.49	05:55	0.263	09:30	1.698	0.989	0.989	
02/20/2020	05:30	5.18	09:30	9.66	7.59	04:30	0.68	09:15	2.01	1.50	04:30	0.251	09:30	1.737	0.995	0.995	
02/21/2020	05:00	5.15	09:45	9.55	7.57	04:45	0.65	09:40	2.02	1.49	04:45	0.235	09:40	1.746	0.988	0.988	
02/22/2020	07:05	5.33	13:20	9.64	7.80	07:25	0.73	14:05	1.99	1.54	07:25	0.276	14:05	1.713	1.061	1.061	
02/23/2020	07:45	5.27	14:20	9.65	7.91	08:00	0.74	12:45	1.99	1.55	08:00	0.275	14:20	1.711	1.103	1.103	
02/24/2020	06:00	5.11	10:35	9.58	7.50	05:15	0.68	10:25	1.99	1.50	05:15	0.251	10:25	1.713	0.980	0.980	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	06:00	5.21	10:20	9.50	7.40	06:25	0.70	09:30	2.00	1.45	06:25	0.258	10:30	1.690	0.942	0.674	
02/26/2020	05:10	5.21	09:15	9.76	7.63	05:05	0.69	08:50	2.07	1.51	05:05	0.255	08:50	1.790	1.009	1.009	
02/27/2020	05:20	5.43	09:15	9.84	7.73	05:30	0.76	09:00	2.05	1.53	05:30	0.297	09:00	1.821	1.034	1.034	
02/28/2020	05:30	5.39	09:25	9.70	7.73	05:25	0.74	09:35	2.03	1.54	05:25	0.285	09:35	1.784	1.040	1.040	
02/29/2020	05:50	5.41	13:45	9.92	7.93	05:45	0.83	13:35	2.04	1.57	05:45	0.321	13:35	1.836	1.110	1.110	
03/01/2020	06:05	5.44	13:15	9.97	8.20	06:10	0.75	11:50	2.09	1.60	06:10	0.292	11:50	1.882	1.197	1.197	
03/02/2020	05:10	5.56	09:20	10.01	7.97	05:35	0.79	09:45	2.08	1.59	05:35	0.318	09:15	1.905	1.119	1.119	
03/03/2020	05:25	5.45	09:45	10.15	8.02	05:20	0.75	09:20	2.18	1.60	05:20	0.294	09:45	2.004	1.148	1.148	
03/04/2020	05:35	5.59	09:25	10.16	8.10	05:35	0.79	09:20	2.18	1.62	05:35	0.319	09:20	2.041	1.174	1.174	
03/05/2020	05:25	5.71	09:35	10.10	8.11	05:30	0.82	09:05	2.14	1.65	05:30	0.341	09:35	1.971	1.183	1.183	
03/06/2020	05:40	5.43	09:55	9.69	7.97	05:40	0.73	09:45	2.04	1.60	05:40	0.285	09:45	1.789	1.132	1.132	
03/07/2020	06:10	5.39	13:25	10.11	8.26	06:05	0.73	17:05	2.11	1.65	06:05	0.281	13:05	1.947	1.243	1.243	
03/08/2020	07:05	5.62	13:30	10.33	8.44	06:30	0.83	13:45	2.16	1.68	06:30	0.345	13:45	2.069	1.309	1.309	
03/09/2020	05:55	5.69	22:20	9.71	8.15	04:50	0.83	21:40	2.07	1.65	04:50	0.350	21:40	1.825	1.199	1.198	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			105.605	4.90
Avg	7.53	1.46	0.969	

Site Commentary

Site Information

MIL_0744	
Pipe Dimensions	15
Silt Level	0.00"

Overview

Site MIL_0744 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Surcharged conditions were experienced at this location. Review of the scattergraph shows that both free flow and backwater conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	6.17	0.94	0.283
Minimum	2.74	0.16	0.080
Maximum	34.98	1.78	1.416
Time of Minimum	3/1/2020 5:45 AM	2/27/2020 5:30 PM	2/6/2020 3:40 AM
Time of Maximum	3/8/2020 2:15 PM	3/8/2020 2:15 PM	3/8/2020 2:15 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period. Site installed later than other sites on November 22, 2019. Uptime reflects time in service.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

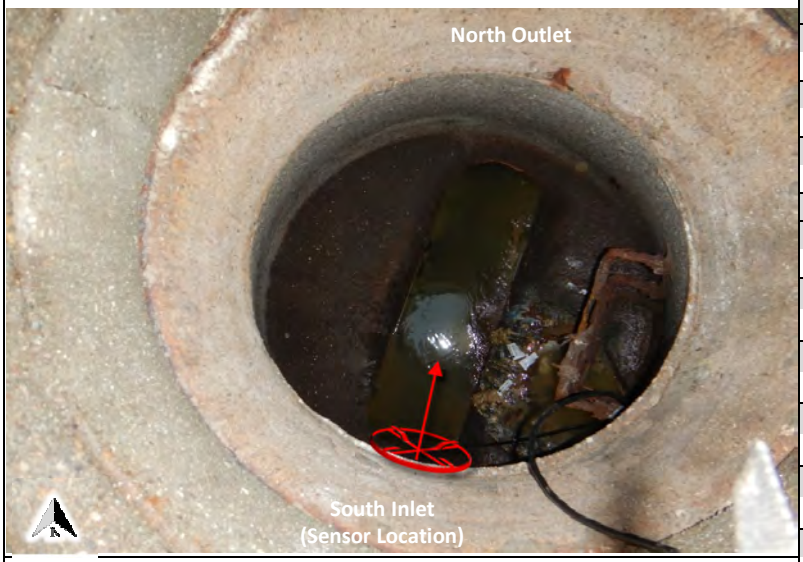
MIL_0744

Site Address /Location:	Thompson Court and Machado Avenue			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	Drive	Latitude:	37.419309°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.911002°	15.0" x 15.0"	Circular



Manhole #	System Characteristics
744	Residential
Access	Traffic
Drive	Light







Installation Information

Installation Date:	Installation Type:
Tuesday, November 12, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
6:52:52 AM	15.0" x 15.0"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
5.50	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.05	0''
Silt	Silt Type
0''	

Hydraulic Comments:

Smooth flow with medium depth and velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
5'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
PVC	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_0744

Flow Monitor

MIL_0744

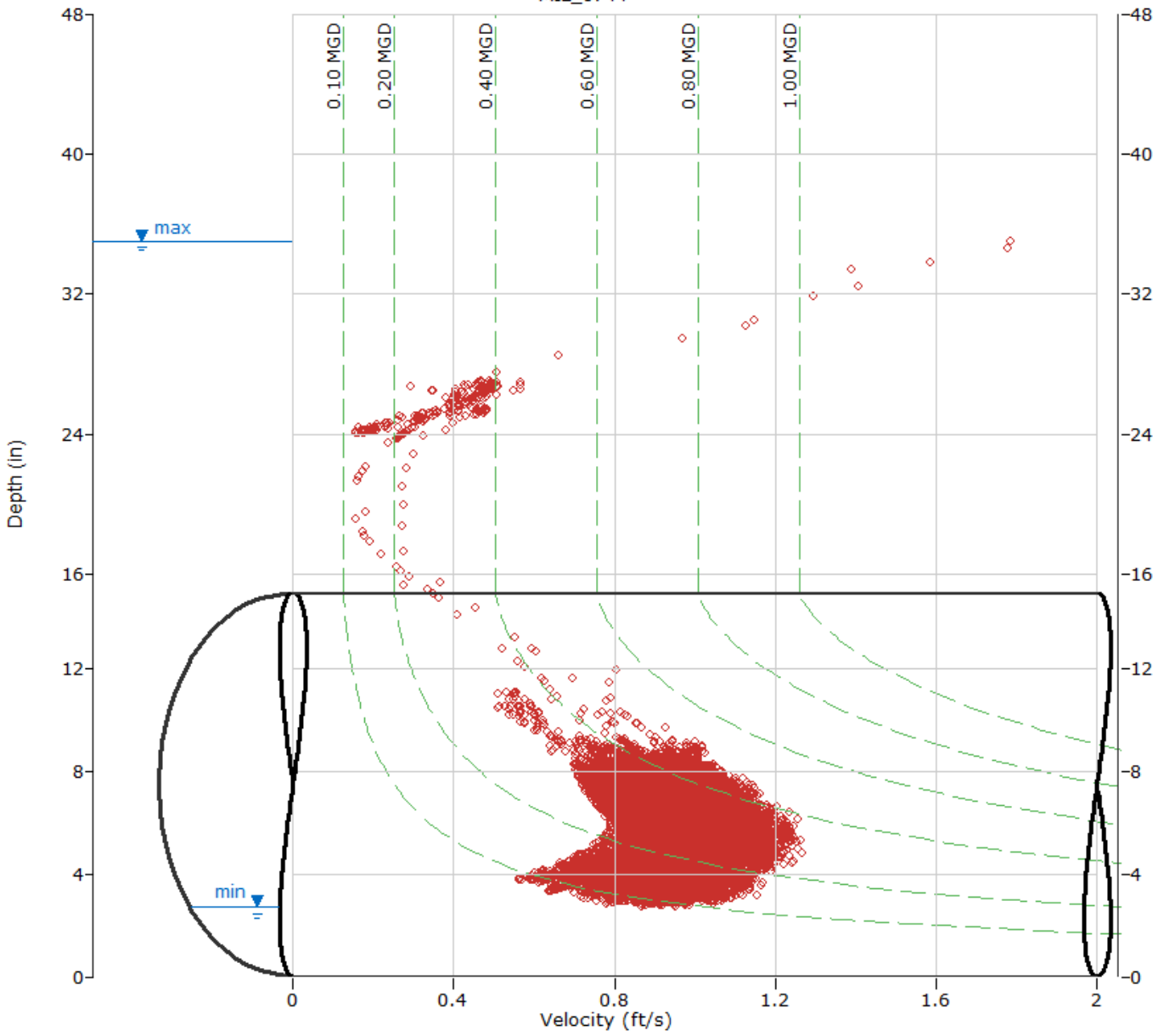
Pipe Height
15.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



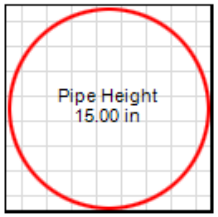
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_0744

Flow Monitor

MIL_0744

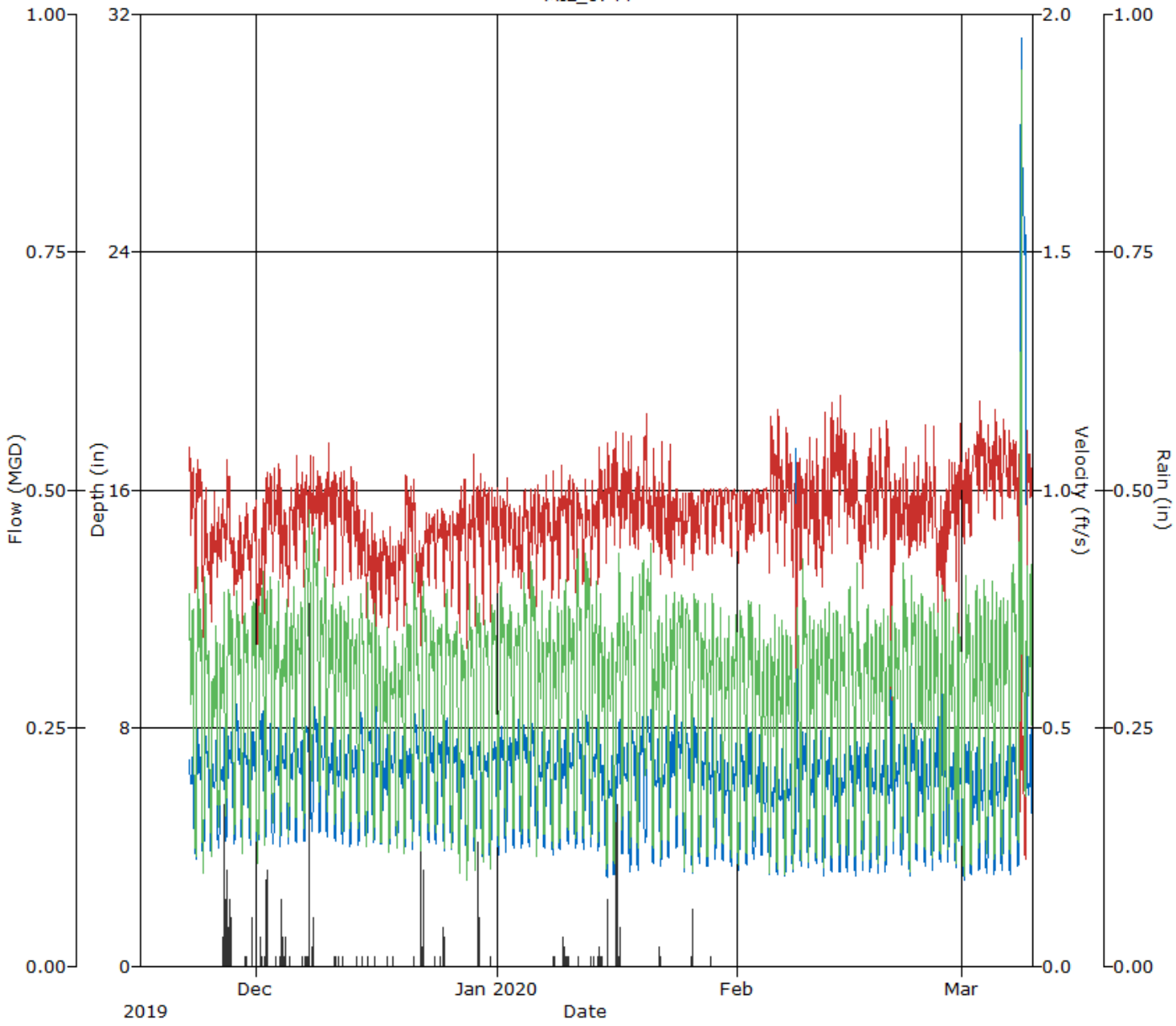


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_0744, Pipe Height: 15.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	00:00		00:00			00:00		00:00			00:00		00:00				
11/17/2019	00:00		00:00			00:00		00:00			00:00		00:00				
11/18/2019	00:00		00:00			00:00		00:00			00:00		00:00				
11/19/2019	00:00		00:00			00:00		00:00			00:00		00:00				
11/20/2019	00:00		00:00			00:00		00:00			00:00		00:00				
11/21/2019	00:00		00:00			00:00		00:00			00:00		00:00				
11/22/2019	23:50	5.35	22:20	7.49	6.47	14:55	0.82	09:25	1.13	1.01	15:05	0.250	22:25	0.403	0.333	0.214	
11/23/2019	05:40	3.43	10:55	8.49	5.95	03:20	0.67	19:05	1.12	0.96	05:25	0.099	10:35	0.451	0.289	0.289	
11/24/2019	05:30	3.43	10:25	8.27	6.10	05:25	0.64	14:15	1.09	0.87	05:25	0.088	10:25	0.454	0.270	0.270	
11/25/2019	05:05	3.63	19:40	7.82	5.81	05:10	0.61	13:25	1.06	0.87	05:10	0.091	21:50	0.428	0.250	0.250	
11/26/2019	03:10	3.81	21:40	8.27	6.02	03:20	0.64	16:55	1.06	0.91	03:20	0.103	21:45	0.435	0.272	0.272	0.36
11/27/2019	03:05	4.05	19:20	8.19	6.46	02:20	0.73	06:40	1.10	0.93	03:10	0.130	09:55	0.412	0.305	0.305	0.63
11/28/2019	05:25	4.07	12:05	9.02	6.58	05:45	0.72	21:55	1.09	0.85	05:40	0.126	14:30	0.469	0.285	0.285	
11/29/2019	05:35	3.84	11:10	8.30	6.25	05:35	0.69	19:50	1.11	0.88	05:35	0.110	10:00	0.437	0.281	0.281	0.02
11/30/2019	06:05	3.92	10:55	8.34	6.32	05:45	0.67	21:35	1.09	0.89	05:45	0.111	14:00	0.456	0.287	0.287	0.10
12/01/2019	06:10	3.73	20:30	8.83	6.59	05:45	0.56	00:00	1.12	0.84	05:55	0.088	20:30	0.451	0.285	0.285	0.06
12/02/2019	03:30	3.89	21:20	8.59	6.30	03:00	0.61	17:55	1.12	0.94	03:00	0.105	21:15	0.458	0.303	0.303	0.30
12/03/2019	04:20	3.93	21:40	8.37	6.16	03:30	0.71	23:40	1.12	0.95	03:30	0.131	20:00	0.416	0.295	0.295	0.01
12/04/2019	03:45	3.94	19:55	8.06	6.37	04:05	0.69	07:10	1.14	0.89	04:05	0.129	21:20	0.425	0.287	0.287	0.39
12/05/2019	03:35	3.90	21:45	8.49	6.25	03:15	0.64	09:45	1.07	0.91	03:40	0.107	09:45	0.433	0.290	0.290	0.01
12/06/2019	05:10	4.03	20:55	7.82	6.20	04:10	0.71	07:30	1.12	0.95	04:10	0.126	19:30	0.422	0.296	0.296	0.01
12/07/2019	05:15	4.06	19:10	9.08	6.79	03:10	0.74	00:00	1.07	0.96	03:30	0.131	19:45	0.501	0.340	0.340	0.67
12/08/2019	05:05	4.47	10:05	9.22	7.10	03:50	0.77	08:05	1.12	0.98	03:50	0.179	09:45	0.508	0.363	0.363	0.20
12/09/2019	05:15	4.35	21:05	8.75	6.50	02:55	0.80	07:05	1.12	0.97	02:55	0.160	21:10	0.458	0.321	0.321	
12/10/2019	02:40	4.22	21:55	8.12	6.28	03:25	0.68	07:05	1.13	0.96	03:25	0.126	21:05	0.417	0.305	0.305	
12/11/2019	03:15	4.08	21:05	7.89	6.10	03:30	0.71	07:10	1.14	0.96	04:05	0.135	08:45	0.408	0.294	0.294	0.03
12/12/2019	03:25	3.80	22:20	8.06	6.16	04:00	0.69	07:55	1.11	0.94	04:00	0.123	21:55	0.434	0.293	0.293	0.01
12/13/2019	05:05	3.88	20:45	7.81	6.09	04:00	0.71	07:25	1.12	0.94	04:00	0.131	09:15	0.386	0.286	0.286	0.01
12/14/2019	05:35	3.92	13:45	8.88	6.45	03:55	0.70	00:20	1.07	0.89	03:10	0.128	11:55	0.433	0.290	0.290	0.01
12/15/2019	05:20	3.90	10:55	8.49	6.59	04:50	0.68	23:55	1.09	0.85	05:40	0.115	10:15	0.444	0.286	0.286	0.01
12/16/2019	03:35	3.88	09:10	10.28	6.53	09:35	0.54	00:00	1.06	0.82	03:35	0.113	08:35	0.440	0.272	0.272	0.01
12/17/2019	05:00	3.92	21:20	7.91	5.99	02:50	0.62	12:35	1.05	0.84	03:25	0.105	21:20	0.376	0.252	0.252	0.01
12/18/2019	03:15	3.76	21:55	8.23	6.22	04:05	0.59	23:40	1.00	0.82	03:15	0.094	21:50	0.372	0.259	0.259	0.01
12/19/2019	03:25	3.79	22:55	7.85	6.15	03:30	0.58	07:05	0.97	0.83	03:25	0.093	21:40	0.369	0.259	0.259	
12/20/2019	03:25	3.78	21:20	7.56	6.10	03:35	0.61	07:30	1.12	0.91	03:35	0.097	08:40	0.399	0.282	0.282	
12/21/2019	03:40	3.74	11:40	8.58	6.50	04:10	0.67	07:30	1.06	0.89	03:45	0.109	11:15	0.458	0.294	0.294	0.01
12/22/2019	05:35	3.73	13:45	9.05	6.67	06:00	0.62	00:10	0.97	0.85	05:45	0.098	13:45	0.417	0.295	0.295	0.41
12/23/2019	05:10	4.00	10:20	8.07	6.28	05:10	0.77	23:55	0.97	0.90	05:10	0.132	10:20	0.383	0.287	0.287	
12/24/2019	05:00	3.90	19:30	7.77	6.23	05:00	0.76	23:25	0.97	0.90	05:00	0.124	19:30	0.369	0.283	0.283	0.02
12/25/2019	05:35	3.79	14:00	8.71	6.43	05:35	0.74	00:05	0.96	0.89	05:35	0.116	14:00	0.409	0.291	0.291	0.08
12/26/2019	05:05	3.79	19:15	8.07	6.15	05:05	0.74	23:50	0.97	0.89	05:05	0.116	19:15	0.383	0.278	0.278	
12/27/2019	05:25	3.33	13:20	7.24	5.73	05:25	0.64	11:35	1.10	0.91	05:25	0.084	11:40	0.385	0.259	0.259	
12/28/2019	05:10	3.31	12:10	8.23	5.96	04:00	0.61	00:00	1.10	0.90	05:10	0.083	12:05	0.417	0.272	0.272	
12/29/2019	05:45	3.36	21:50	8.00	5.98	03:55	0.63	00:30	1.10	0.94	05:45	0.086	17:05	0.416	0.283	0.283	0.22
12/30/2019	03:50	3.56	13:15	7.37	5.84	03:50	0.69	11:45	1.09	0.95	03:50	0.099	13:10	0.395	0.276	0.276	
12/31/2019	05:25	3.44	10:25	7.90	6.03	04:00	0.59	10:05	1.07	0.91	05:25	0.091	17:35	0.404	0.279	0.279	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	05:15	3.66 14:05	8.32	6.32	04:50	0.71 01:00	1.11	0.92	04:50	0.113 13:25	0.443	0.295	0.295	
01/02/2020	04:10	3.69 19:50	7.90	6.20	03:20	0.71 07:50	1.13	0.93	04:05	0.111 22:40	0.405	0.291	0.291	
01/03/2020	05:30	3.78 20:10	8.44	6.42	03:35	0.73 23:55	1.04	0.88	03:35	0.131 20:30	0.405	0.288	0.288	
01/04/2020	05:15	3.92 13:50	8.35	6.36	03:45	0.72 17:55	1.06	0.92	03:45	0.122 14:00	0.434	0.301	0.301	
01/05/2020	06:10	3.85 13:40	8.29	6.53	03:45	0.72 10:15	1.08	0.91	06:00	0.119 10:30	0.457	0.309	0.309	
01/06/2020	03:50	3.65 21:45	8.05	6.02	04:05	0.67 07:25	1.10	0.91	03:25	0.103 19:30	0.433	0.277	0.277	
01/07/2020	04:05	3.75 22:35	8.03	6.21	02:45	0.70 10:20	1.08	0.93	03:55	0.116 10:20	0.394	0.291	0.291	
01/08/2020	05:20	3.62 22:25	8.27	6.07	03:20	0.71 07:20	1.08	0.91	03:25	0.112 19:00	0.409	0.277	0.277	0.02
01/09/2020	05:20	3.74 22:30	8.30	6.15	02:05	0.70 15:35	1.15	0.94	05:15	0.113 22:05	0.448	0.292	0.292	0.18
01/10/2020	05:35	3.96 19:15	8.00	6.23	04:55	0.76 06:50	1.15	0.94	03:15	0.136 09:00	0.422	0.296	0.296	0.02
01/11/2020	04:55	3.86 11:05	8.41	6.35	04:55	0.70 19:05	1.06	0.92	04:55	0.114 11:30	0.458	0.302	0.302	0.01
01/12/2020	05:20	3.86 14:25	8.71	6.51	04:05	0.69 11:40	1.10	0.91	04:05	0.113 11:50	0.457	0.309	0.309	
01/13/2020	03:20	3.85 21:05	8.08	6.17	04:00	0.73 18:15	1.13	0.93	04:00	0.125 20:20	0.425	0.290	0.290	0.02
01/14/2020	03:00	3.81 08:40	7.99	5.78	03:10	0.70 07:30	1.12	0.95	03:10	0.112 08:35	0.410	0.273	0.273	0.11
01/15/2020	05:10	2.74 21:10	7.23	5.28	04:15	0.70 07:40	1.25	0.99	03:30	0.085 20:35	0.374	0.251	0.251	0.07
01/16/2020	03:30	2.82 19:35	8.52	5.88	04:05	0.73 07:05	1.20	0.99	03:20	0.095 19:25	0.458	0.287	0.287	0.66
01/17/2020	03:25	3.55 08:55	8.25	5.93	03:30	0.73 07:00	1.21	1.00	03:30	0.126 20:40	0.395	0.292	0.292	
01/18/2020	05:20	3.05 11:40	8.04	6.00	21:10	0.77 00:10	1.19	0.97	05:25	0.118 11:15	0.441	0.287	0.287	
01/19/2020	05:35	3.12 21:50	8.80	6.19	04:05	0.75 05:45	1.15	0.98	05:15	0.117 21:50	0.451	0.304	0.304	
01/20/2020	05:30	4.11 13:40	9.28	6.70	16:00	0.76 06:35	1.21	1.00	05:30	0.157 13:30	0.459	0.339	0.339	
01/21/2020	05:10	3.31 21:35	7.91	5.69	03:50	0.75 07:45	1.15	0.95	03:45	0.110 21:50	0.399	0.265	0.265	
01/22/2020	03:25	3.21 22:40	8.31	5.88	03:15	0.71 07:40	1.13	0.95	03:25	0.095 22:15	0.419	0.276	0.276	0.03
01/23/2020	03:35	3.43 21:55	8.83	6.29	11:55	0.73 07:15	1.14	0.93	03:40	0.116 13:25	0.400	0.294	0.294	
01/24/2020	05:10	3.85 22:20	8.39	6.52	22:20	0.86 07:45	1.00	0.95	05:10	0.148 22:20	0.393	0.312	0.312	
01/25/2020	05:35	3.13 19:25	8.13	6.06	05:35	0.83 00:25	1.00	0.94	05:35	0.100 19:25	0.388	0.287	0.287	
01/26/2020	05:30	2.96 11:10	8.51	6.24	05:30	0.81 00:30	1.00	0.92	05:30	0.089 11:10	0.394	0.291	0.291	0.16
01/27/2020	03:35	3.19 21:25	8.09	5.82	03:35	0.84 00:00	1.00	0.96	03:35	0.104 21:25	0.387	0.276	0.276	
01/28/2020	05:10	3.08 20:00	8.74	5.85	20:00	0.83 15:25	1.00	0.95	05:10	0.097 20:00	0.396	0.276	0.276	0.01
01/29/2020	03:25	3.18 21:30	8.17	5.84	03:25	0.84 18:05	1.00	0.96	03:25	0.103 21:30	0.389	0.278	0.278	
01/30/2020	03:20	3.43 22:25	7.77	5.66	03:20	0.87 23:50	1.00	0.97	03:20	0.119 22:25	0.379	0.269	0.269	
01/31/2020	05:05	3.20 19:30	7.81	5.71	05:05	0.84 23:35	1.00	0.96	05:05	0.105 19:30	0.380	0.271	0.271	
02/01/2020	03:25	3.10 10:00	7.71	5.75	03:25	0.83 23:40	1.00	0.95	03:25	0.098 10:00	0.377	0.272	0.272	
02/02/2020	03:40	3.31 12:30	8.50	6.00	12:30	0.85 08:30	1.00	0.94	03:40	0.112 12:30	0.394	0.282	0.282	
02/03/2020	03:30	3.48 21:30	7.92	5.75	03:30	0.88 07:30	1.00	0.96	03:30	0.123 21:30	0.383	0.273	0.273	
02/04/2020	03:15	3.53 08:50	7.21	5.32	03:15	0.89 17:00	1.00	0.98	03:15	0.126 08:50	0.360	0.249	0.249	
02/05/2020	02:55	2.93 21:45	6.87	5.14	06:25	0.80 07:40	1.25	1.02	02:55	0.087 11:25	0.400	0.253	0.253	
02/06/2020	03:40	2.80 19:10	7.96	5.29	03:15	0.74 07:40	1.23	1.00	03:40	0.080 19:15	0.385	0.254	0.254	
02/07/2020	03:55	2.91 21:20	7.10	5.29	03:00	0.72 11:55	1.19	1.02	03:00	0.083 08:55	0.379	0.260	0.260	
02/08/2020	05:30	3.06 15:15	25.11	5.77	15:25	0.16 23:40	1.11	0.92	03:30	0.094 16:20	0.407	0.241	0.241	
02/09/2020	05:30	3.30 11:15	8.27	6.03	11:20	0.73 00:00	1.17	0.96	05:55	0.101 11:15	0.470	0.291	0.291	
02/10/2020	03:35	3.12 21:00	7.73	5.70	05:15	0.74 07:30	1.23	0.97	03:40	0.091 19:50	0.418	0.273	0.273	
02/11/2020	04:50	3.17 22:25	8.30	6.09	22:05	0.71 07:25	1.15	0.90	03:05	0.091 09:05	0.394	0.275	0.275	
02/12/2020	03:10	2.94 19:25	7.95	5.79	19:55	0.74 07:20	1.26	0.98	02:50	0.093 19:10	0.408	0.279	0.279	
02/13/2020	03:25	2.94 19:55	7.12	5.34	04:00	0.77 07:35	1.24	1.05	03:35	0.089 21:50	0.415	0.270	0.270	
02/14/2020	03:30	3.03 08:45	7.87	5.43	03:35	0.77 07:25	1.27	1.05	03:35	0.088 20:05	0.424	0.274	0.274	
02/15/2020	05:15	3.12 10:45	8.15	5.71	04:35	0.73 00:05	1.18	1.00	04:35	0.093 10:40	0.436	0.282	0.282	
02/16/2020	05:35	2.89 12:30	7.85	5.72	04:00	0.78 00:50	1.18	0.97	06:00	0.091 11:25	0.460	0.270	0.270	
02/17/2020	05:00	3.07 20:15	7.73	5.73	04:35	0.72 23:40	1.13	0.93	04:40	0.091 20:05	0.425	0.265	0.265	
02/18/2020	03:20	2.98 19:45	7.61	5.52	02:35	0.75 00:00	1.18	1.00	04:50	0.095 18:50	0.389	0.268	0.268	
02/19/2020	03:35	3.04 21:40	8.09	5.55	22:00	0.74 10:30	1.26	1.00	03:25	0.094 19:45	0.404	0.271	0.271	
02/20/2020	03:40	3.06 21:05	11.07	6.09	22:30	0.51 07:25	1.20	0.95	03:05	0.104 23:05	0.444	0.272	0.272	
02/21/2020	03:10	3.58 08:15	9.33	6.13	08:15	0.65 23:30	1.11	0.95	02:45	0.110 18:55	0.393	0.290	0.290	
02/22/2020	06:00	3.24 10:30	8.20	6.00	10:50	0.72 08:10	1.19	0.96	06:05	0.111 10:35	0.443	0.287	0.287	
02/23/2020	05:35	2.93 10:50	8.46	6.10	05:25	0.76 18:10	1.14	0.94	05:25	0.084 12:40	0.437	0.288	0.288	
02/24/2020	04:55	3.37 20:45	7.93	5.75	04:50	0.75 07:30	1.15	0.95	04:10	0.103 19:25	0.414	0.270	0.270	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	03:35	3.02	22:25	7.81	5.65	04:15	0.75	07:20	1.24	0.97	03:15	0.102	21:25	0.403	0.270	0.270	
02/26/2020	03:15	3.11	19:35	9.23	6.17	19:25	0.67	07:30	1.18	0.93	03:30	0.092	20:30	0.419	0.282	0.282	
02/27/2020	04:20	3.28	17:30	19.17	6.12	17:30	0.16	09:35	1.13	0.89	04:30	0.100	09:00	0.545	0.262	0.262	
02/28/2020	05:05	3.30	08:55	7.51	5.69	03:55	0.77	06:55	1.14	0.97	02:55	0.107	08:35	0.414	0.269	0.269	
02/29/2020	05:50	3.23	13:15	23.46	5.72	13:20	0.16	18:15	1.22	0.96	04:30	0.094	14:20	0.502	0.257	0.257	
03/01/2020	05:45	2.74	21:25	7.88	5.70	04:25	0.78	18:25	1.22	1.00	04:25	0.084	11:45	0.433	0.283	0.283	
03/02/2020	05:05	2.90	20:10	7.69	5.28	02:40	0.80	18:20	1.20	1.03	03:30	0.091	19:20	0.422	0.264	0.264	
03/03/2020	05:00	2.90	21:50	7.93	5.37	03:25	0.83	07:25	1.24	1.07	03:25	0.099	21:25	0.429	0.277	0.277	
03/04/2020	05:00	2.99	20:25	7.84	5.43	02:35	0.89	07:45	1.23	1.05	02:35	0.102	21:15	0.418	0.276	0.276	
03/05/2020	03:15	2.84	20:00	7.32	5.44	04:15	0.80	06:55	1.23	1.05	03:25	0.089	19:50	0.415	0.278	0.278	
03/06/2020	03:05	2.95	21:00	7.50	5.53	03:15	0.86	07:25	1.22	1.05	03:15	0.096	21:10	0.399	0.283	0.283	
03/07/2020	03:35	2.92	20:05	7.83	5.79	13:45	0.89	19:00	1.20	1.05	03:45	0.107	12:35	0.454	0.300	0.300	
03/08/2020	04:00	3.28	14:15	34.98	16.56	11:00	0.26	14:15	1.78	0.71	05:10	0.110	14:15	1.416	0.316	0.316	
03/09/2020	23:55	4.57	06:40	25.25	11.60	03:20	0.16	11:30	1.20	0.81	03:20	0.125	07:05	0.472	0.300	0.300	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			30.779	4.90
Avg	6.17	0.94	0.283	

Site Commentary

Site Information

MIL_1043	
Pipe Dimensions	20.75
Silt Level	0.00"

Overview

Site MIL_1043 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited a small response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

This location was installed downstream of MIL_1193. A review of balancing of combined flows MIL_1043 and MIL_2840 shows a net flow of 0.663 MGD.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	5.25	4.00	1.263
Minimum	3.29	1.93	0.306
Maximum	7.55	4.98	2.432
Time of Minimum	2/26/2020 3:35 AM	3/2/2020 4:00 AM	3/2/2020 4:00 AM
Time of Maximum	12/7/2019 6:15 PM	11/28/2019 12:30 PM	12/7/2019 6:15 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

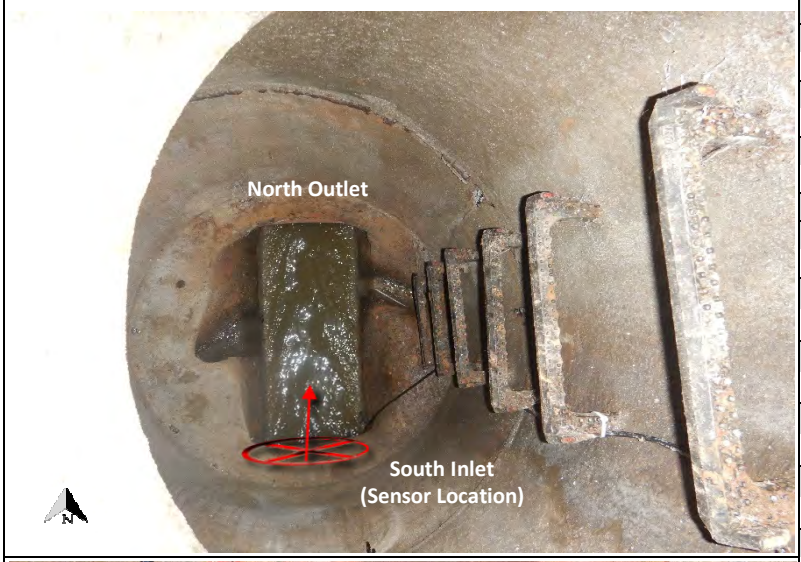
MIL_1043

Site Address /Location:	Ayer St and Park Hill Dr, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	DRIVE.	Latitude:	37.436384°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.887700°	20.75"x20.75"	Circular



Manhole #	System Characteristics
1043	Residential/Commercial
Access	Traffic
Drive	Medium







Installation Information

Installation Date:	Installation Type:
Thursday, November 14, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
6:52:00 AM	20.75"x20.75"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
6.38"	
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
4.50'	0''
Silt (in)	Silt Type
0.0"	

Hydraulic Comments:

Medium depth with fast velocity and small waves

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
10'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Drilled Pavement / Concrete

Additional Site Info. / Comments:

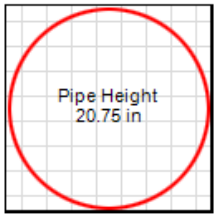
ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

SCATTERGRAPH REPORT

MIL_1043

Flow Monitor

MIL_1043

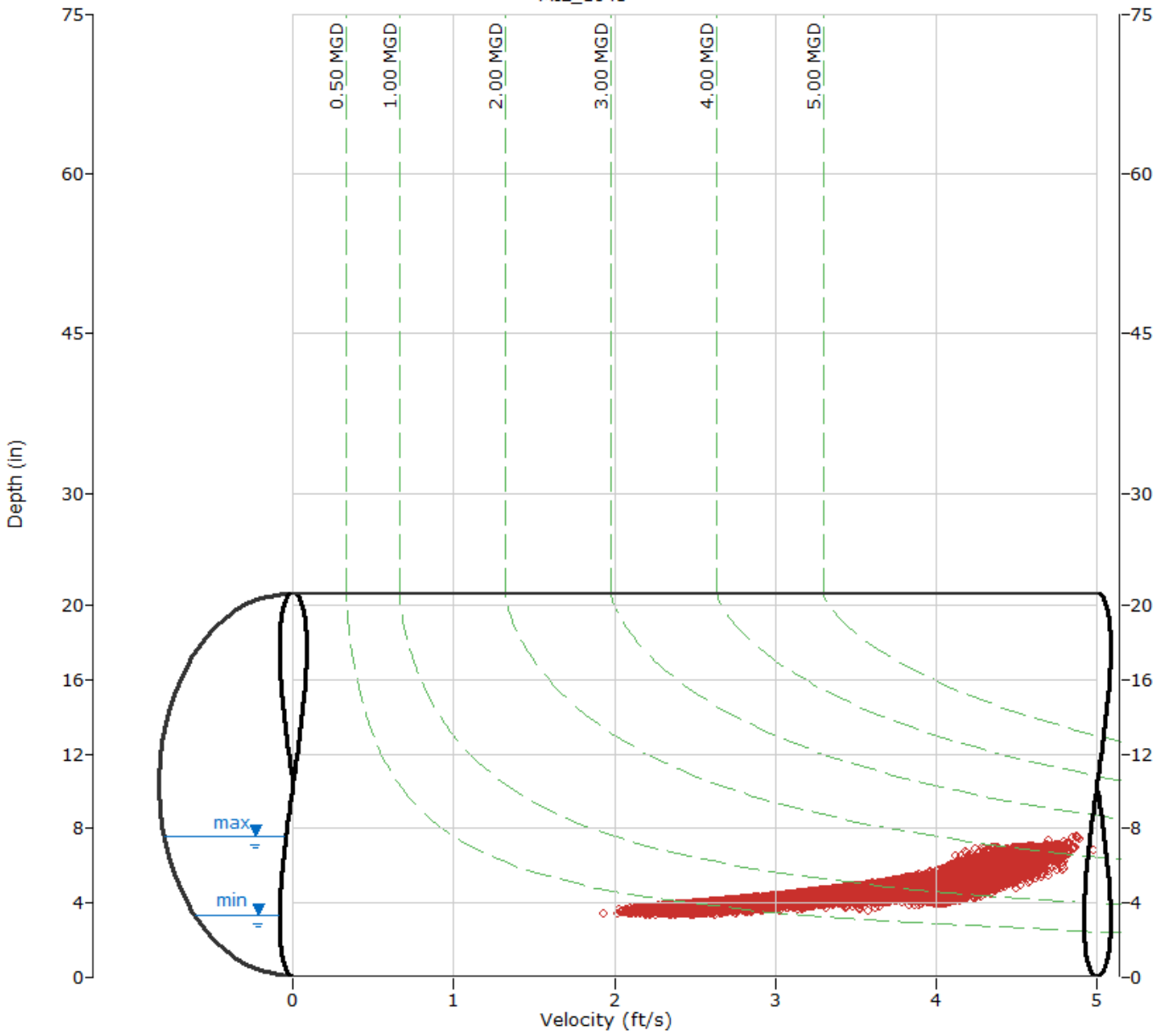


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



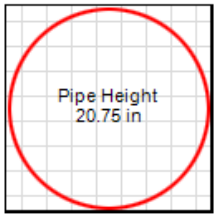
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_1043

Flow Monitor

MIL_1043

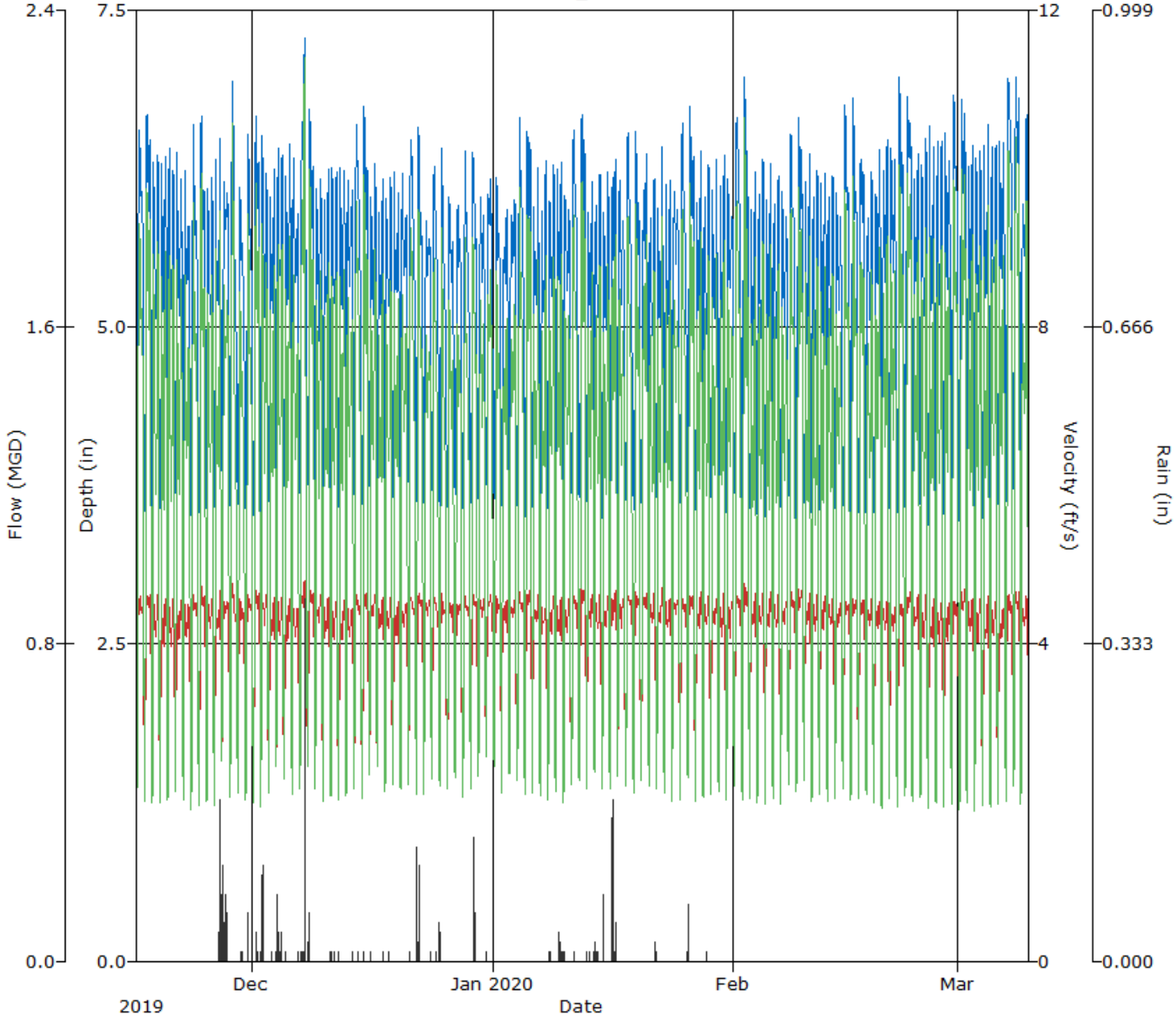


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_1043, Pipe Height: 20.75 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	03:25	3.55	10:30	6.60	5.43	04:55	2.20	13:25	4.68	3.94	04:55	0.387	10:25	1.915	1.316	1.316	
11/17/2019	04:45	3.48	10:40	6.86	5.50	04:30	2.20	21:10	4.74	3.99	04:30	0.373	10:50	2.066	1.366	1.366	
11/18/2019	03:25	3.47	07:55	6.71	5.27	02:20	2.15	20:15	4.73	3.94	04:20	0.372	07:55	2.002	1.251	1.251	
11/19/2019	04:35	3.51	08:05	6.55	5.27	02:55	2.17	07:35	4.63	3.90	04:20	0.381	08:05	1.888	1.238	1.238	
11/20/2019	04:25	3.59	08:10	6.63	5.26	03:30	2.11	07:55	4.70	3.91	03:30	0.377	08:00	1.938	1.235	1.235	
11/21/2019	04:25	3.59	07:55	6.68	5.27	03:35	2.20	18:15	4.70	3.93	03:35	0.400	07:55	1.961	1.242	1.242	
11/22/2019	03:35	3.58	08:05	6.49	5.26	04:25	2.14	08:05	4.62	3.94	04:25	0.382	08:05	1.873	1.240	1.240	
11/23/2019	04:30	3.47	11:00	6.70	5.31	04:00	2.13	11:20	4.71	3.94	04:30	0.361	11:25	1.978	1.276	1.276	
11/24/2019	04:40	3.49	11:10	6.75	5.35	04:45	2.07	11:35	4.82	4.00	04:45	0.350	11:10	2.035	1.314	1.314	
11/25/2019	04:10	3.45	08:05	6.32	5.12	03:20	2.21	21:55	4.65	3.95	04:10	0.371	08:10	1.811	1.203	1.203	
11/26/2019	04:10	3.51	08:00	6.68	5.18	03:45	2.13	07:55	4.82	3.94	03:45	0.373	08:00	2.033	1.223	1.223	0.36
11/27/2019	03:10	3.66	10:10	6.24	5.40	02:35	2.38	21:15	4.64	4.07	03:10	0.439	10:25	1.771	1.324	1.324	0.63
11/28/2019	05:00	3.43	12:10	7.05	5.30	05:00	2.28	12:30	4.98	3.98	05:00	0.375	12:30	2.164	1.288	1.288	
11/29/2019	04:05	3.40	11:15	6.18	5.05	04:20	2.25	11:50	4.70	3.95	04:05	0.390	11:15	1.731	1.177	1.177	0.02
11/30/2019	03:45	3.41	13:15	6.57	5.17	04:10	2.13	11:50	4.69	3.97	05:00	0.357	11:50	1.931	1.237	1.237	0.10
12/01/2019	04:55	3.42	12:45	6.70	5.38	04:15	2.23	18:20	4.74	4.03	04:55	0.366	12:40	2.007	1.334	1.334	0.06
12/02/2019	04:05	3.40	08:15	6.81	5.23	03:05	2.10	08:10	4.75	4.03	03:05	0.348	08:05	2.038	1.267	1.267	0.30
12/03/2019	03:25	3.41	07:55	6.43	5.21	04:25	2.14	20:25	4.64	3.96	04:25	0.375	08:00	1.848	1.232	1.232	0.01
12/04/2019	03:25	3.52	08:05	6.61	5.39	03:25	2.25	08:05	4.77	4.02	03:25	0.383	08:05	1.984	1.303	1.303	0.39
12/05/2019	04:35	3.53	21:35	6.46	5.29	04:10	2.17	07:55	4.66	3.94	04:35	0.392	07:55	1.859	1.251	1.251	0.01
12/06/2019	03:30	3.58	08:15	6.57	5.31	04:45	2.24	17:25	4.62	3.94	03:35	0.402	08:15	1.812	1.253	1.253	0.01
12/07/2019	03:25	3.55	18:15	7.55	5.61	04:25	2.22	18:05	4.90	4.04	04:35	0.392	18:15	2.432	1.417	1.417	0.67
12/08/2019	05:05	3.60	10:55	6.83	5.53	03:35	2.44	20:20	4.75	4.14	05:05	0.436	10:50	2.054	1.404	1.404	0.20
12/09/2019	04:25	3.52	08:05	6.43	5.18	02:40	2.03	20:30	4.71	4.01	02:40	0.364	08:10	1.859	1.233	1.233	
12/10/2019	03:50	3.45	20:50	6.38	5.17	03:45	2.11	20:55	4.68	3.95	03:45	0.356	20:55	1.845	1.212	1.212	
12/11/2019	04:40	3.56	08:10	6.39	5.27	03:30	2.17	20:40	4.62	3.92	04:30	0.387	08:15	1.813	1.240	1.240	0.03
12/12/2019	04:00	3.48	08:00	6.35	5.23	04:05	2.10	08:00	4.60	3.89	04:05	0.356	08:00	1.811	1.220	1.220	0.01
12/13/2019	04:15	3.58	07:55	6.35	5.28	03:15	2.15	07:40	4.63	3.91	03:15	0.386	07:55	1.776	1.237	1.237	0.01
12/14/2019	04:35	3.57	11:05	6.65	5.42	03:25	2.20	14:05	4.68	3.99	03:35	0.397	11:05	1.941	1.322	1.322	0.01
12/15/2019	04:35	3.40	10:50	6.87	5.42	04:15	2.20	10:30	4.71	4.03	04:30	0.380	11:05	2.051	1.347	1.347	0.01
12/16/2019	04:30	3.60	21:20	6.36	5.20	02:40	2.30	21:50	4.66	4.06	03:20	0.422	21:15	1.834	1.256	1.256	0.01
12/17/2019	04:40	3.67	21:55	6.25	5.17	04:25	2.49	21:00	4.67	4.04	04:25	0.460	21:55	1.774	1.229	1.229	0.01
12/18/2019	02:50	3.51	07:50	6.31	5.19	02:55	2.23	22:05	4.68	3.99	02:55	0.390	22:10	1.802	1.232	1.232	0.01
12/19/2019	03:05	3.54	08:25	6.38	5.25	03:20	2.23	07:45	4.71	3.98	03:20	0.399	07:45	1.813	1.246	1.246	
12/20/2019	04:25	3.57	08:05	6.32	5.30	04:40	2.18	18:50	4.68	3.97	04:40	0.399	08:05	1.764	1.259	1.259	
12/21/2019	03:40	3.66	11:55	6.52	5.36	03:30	2.26	14:00	4.67	4.00	04:50	0.418	12:00	1.888	1.302	1.302	0.01
12/22/2019	04:25	3.43	11:00	6.61	5.31	04:15	2.19	19:35	4.75	4.05	04:15	0.379	11:30	1.930	1.304	1.304	0.41
12/23/2019	04:30	3.45	11:00	5.94	5.12	04:25	2.20	12:40	4.62	4.06	04:25	0.373	11:00	1.640	1.224	1.224	
12/24/2019	03:55	3.63	11:50	6.41	5.19	03:30	2.26	12:55	4.78	4.06	03:30	0.414	11:50	1.833	1.252	1.252	0.02
12/25/2019	05:15	3.42	11:15	6.51	5.03	05:25	2.23	11:15	4.72	4.04	05:25	0.387	11:15	1.924	1.190	1.190	0.08
12/26/2019	04:25	3.47	10:10	6.37	5.05	05:00	2.35	10:05	4.67	3.99	04:25	0.406	10:10	1.830	1.188	1.188	
12/27/2019	03:50	3.48	11:45	6.05	5.10	04:30	2.30	22:05	4.61	4.02	04:25	0.393	12:15	1.655	1.207	1.207	
12/28/2019	04:25	3.43	12:05	6.46	5.14	04:45	2.13	12:10	4.64	3.97	04:45	0.373	12:05	1.865	1.220	1.220	
12/29/2019	03:55	3.47	11:55	6.51	5.16	04:35	2.16	10:45	4.73	4.01	04:35	0.381	11:50	1.894	1.242	1.242	0.22
12/30/2019	04:30	3.55	11:30	6.10	5.11	03:30	2.27	12:45	4.79	4.06	03:30	0.396	12:45	1.717	1.226	1.226	
12/31/2019	04:25	3.70	18:20	6.24	5.21	04:20	2.55	19:10	4.68	4.13	04:20	0.469	18:20	1.787	1.275	1.275	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	05:40	3.47 12:10	6.24	5.04	05:20	2.63 12:00	4.67	4.08	05:40	0.463 12:10	1.796	1.205	1.205	
01/02/2020	03:45	3.46 21:10	6.01	5.08	03:35	2.27 21:50	4.59	4.05	03:50	0.392 20:30	1.657	1.208	1.208	
01/03/2020	03:00	3.59 19:45	6.07	5.21	03:10	2.28 20:50	4.58	4.04	04:15	0.419 19:45	1.682	1.248	1.248	
01/04/2020	03:30	3.45 12:45	6.72	5.30	04:55	2.41 12:10	4.72	4.03	04:55	0.408 12:10	1.988	1.299	1.299	
01/05/2020	04:25	3.38 10:25	6.66	5.37	04:20	2.27 20:30	4.76	4.08	04:20	0.382 20:30	1.966	1.341	1.341	
01/06/2020	04:00	3.46 20:35	6.33	5.15	03:40	2.12 19:45	4.73	4.04	04:15	0.376 20:35	1.813	1.235	1.235	
01/07/2020	03:25	3.53 21:00	6.38	5.16	04:50	2.25 21:00	4.66	3.96	03:30	0.400 21:00	1.848	1.216	1.216	
01/08/2020	03:55	3.50 09:50	6.39	5.25	03:45	2.18 20:45	4.63	3.94	03:45	0.375 21:00	1.820	1.242	1.242	0.02
01/09/2020	04:10	3.49 08:00	6.57	5.28	04:10	2.25 21:05	4.62	3.97	04:10	0.379 08:00	1.894	1.262	1.262	0.18
01/10/2020	03:10	3.51 08:05	6.34	5.23	03:50	2.12 08:05	4.61	3.96	03:55	0.364 08:05	1.808	1.238	1.238	0.02
01/11/2020	04:05	3.58 11:35	6.58	5.31	04:35	2.26 10:30	4.77	4.01	04:35	0.416 11:45	1.934	1.292	1.292	0.01
01/12/2020	04:10	3.46 12:20	6.82	5.38	03:55	2.24 10:15	4.76	4.09	03:55	0.385 12:15	2.034	1.349	1.349	
01/13/2020	03:45	3.50 07:55	6.35	5.08	02:25	2.25 08:00	4.68	4.04	03:20	0.396 08:00	1.839	1.212	1.212	0.02
01/14/2020	02:30	3.65 08:00	6.31	5.11	02:10	2.42 21:45	4.74	4.01	02:35	0.451 21:45	1.839	1.209	1.209	0.11
01/15/2020	04:30	3.33 20:40	6.32	5.07	04:35	2.47 21:35	4.66	4.03	04:35	0.391 20:40	1.805	1.202	1.202	0.07
01/16/2020	03:25	3.54 20:35	6.43	5.32	03:20	2.27 13:05	4.79	4.08	03:30	0.393 20:25	1.902	1.311	1.311	0.66
01/17/2020	03:40	3.54 09:00	6.89	5.19	04:30	2.32 08:15	4.66	4.07	04:30	0.409 09:00	2.050	1.251	1.251	
01/18/2020	04:00	3.48 11:15	6.56	5.21	04:05	2.28 12:15	4.72	4.07	04:05	0.385 11:15	1.916	1.274	1.274	
01/19/2020	05:00	3.38 11:00	6.68	5.19	04:40	2.31 10:55	4.73	4.07	04:40	0.376 11:00	1.993	1.271	1.271	
01/20/2020	04:05	3.48 21:10	6.45	5.22	04:05	2.39 14:45	4.80	4.11	04:05	0.402 21:10	1.886	1.284	1.284	
01/21/2020	03:45	3.56 21:55	6.25	5.05	04:35	2.24 20:45	4.78	4.05	04:35	0.401 21:50	1.795	1.197	1.197	
01/22/2020	03:00	3.54 21:35	6.48	5.12	04:05	2.17 19:20	4.75	4.06	04:05	0.382 20:55	1.905	1.228	1.228	0.03
01/23/2020	04:35	3.50 08:05	6.41	5.15	03:30	2.13 07:20	4.67	4.03	03:30	0.369 08:00	1.835	1.228	1.228	
01/24/2020	03:15	3.53 10:35	6.15	5.26	04:20	2.15 19:40	4.60	4.04	03:45	0.374 10:35	1.697	1.275	1.275	
01/25/2020	05:20	3.52 11:35	6.75	5.30	04:20	2.18 11:25	4.69	4.01	04:20	0.382 11:35	1.967	1.286	1.286	
01/26/2020	04:10	3.54 12:15	6.80	5.42	03:40	2.33 19:40	4.68	4.09	04:10	0.415 11:30	2.006	1.352	1.352	0.16
01/27/2020	03:40	3.39 20:55	6.46	5.17	04:15	2.16 20:05	4.70	4.02	03:40	0.370 20:50	1.889	1.240	1.240	
01/28/2020	04:15	3.51 20:30	6.46	5.11	03:55	2.17 20:30	4.71	3.98	03:35	0.378 20:30	1.898	1.208	1.208	0.01
01/29/2020	04:20	3.46 21:05	6.37	5.15	03:50	2.09 22:15	4.66	3.99	03:50	0.369 19:50	1.819	1.220	1.220	
01/30/2020	03:45	3.58 21:55	6.44	5.21	04:30	2.14 20:50	4.78	3.98	02:50	0.392 20:50	1.917	1.237	1.237	
01/31/2020	04:00	3.40 08:05	6.34	5.18	02:55	2.12 18:35	4.69	3.98	04:00	0.361 08:10	1.782	1.228	1.228	
02/01/2020	04:15	3.53 10:45	6.85	5.42	04:15	2.34 10:05	4.76	4.06	04:15	0.401 10:45	2.032	1.344	1.344	
02/02/2020	04:50	3.38 11:35	7.06	5.34	03:50	2.18 12:00	4.87	4.09	03:50	0.370 12:00	2.186	1.340	1.340	
02/03/2020	03:50	3.43 21:10	6.29	5.02	03:40	2.25 19:25	4.72	4.05	03:40	0.380 21:10	1.832	1.194	1.194	
02/04/2020	04:15	3.40 20:45	6.49	5.05	04:10	2.22 20:55	4.72	4.04	04:10	0.363 20:45	1.911	1.203	1.203	
02/05/2020	03:10	3.42 20:45	6.34	5.05	03:00	2.20 21:05	4.71	4.02	03:00	0.369 21:00	1.849	1.197	1.197	
02/06/2020	04:10	3.37 21:25	6.28	5.06	03:40	2.13 20:45	4.68	4.02	04:10	0.358 21:25	1.801	1.198	1.198	
02/07/2020	03:25	3.49 08:05	6.37	5.09	03:30	2.12 07:50	4.64	4.00	03:20	0.367 08:05	1.806	1.200	1.200	
02/08/2020	03:55	3.49 11:45	6.62	5.31	03:55	2.14 12:10	4.70	4.08	03:55	0.360 11:50	1.952	1.310	1.310	
02/09/2020	04:25	3.38 10:45	6.81	5.32	03:40	2.22 10:50	4.80	4.09	03:40	0.370 10:50	2.066	1.331	1.331	
02/10/2020	04:15	3.47 08:00	6.61	5.08	02:50	2.28 20:50	4.77	4.08	04:10	0.386 08:00	1.958	1.223	1.223	
02/11/2020	04:40	3.47 08:05	6.35	5.01	03:15	2.18 20:00	4.67	4.00	03:15	0.365 20:45	1.806	1.176	1.176	
02/12/2020	04:10	3.35 08:05	6.35	5.07	04:15	2.16 08:15	4.67	4.02	04:15	0.345 08:15	1.828	1.204	1.204	
02/13/2020	04:10	3.32 07:55	6.36	5.07	03:30	2.19 07:55	4.70	4.00	04:10	0.349 07:55	1.852	1.198	1.198	
02/14/2020	04:00	3.40 08:05	6.19	5.14	04:55	2.19 18:10	4.60	4.00	04:00	0.360 07:55	1.735	1.215	1.215	
02/15/2020	04:25	3.41 10:45	6.81	5.38	04:40	2.24 11:05	4.66	4.03	04:25	0.388 11:05	1.992	1.323	1.323	
02/16/2020	03:40	3.34 11:15	6.86	5.34	03:30	2.18 10:30	4.67	3.98	03:45	0.367 11:10	2.015	1.308	1.308	
02/17/2020	04:25	3.43 10:45	6.50	5.28	04:05	2.14 10:55	4.62	3.99	03:50	0.380 10:55	1.868	1.277	1.277	
02/18/2020	04:25	3.30 20:20	6.30	5.10	03:20	2.24 20:10	4.62	4.01	04:20	0.368 20:20	1.798	1.208	1.208	
02/19/2020	03:00	3.45 22:00	6.53	5.22	03:25	2.20 18:35	4.58	3.95	03:00	0.372 22:00	1.855	1.238	1.238	
02/20/2020	03:30	3.38 21:10	6.55	5.32	04:45	2.12 20:55	4.80	3.93	04:35	0.357 20:55	1.911	1.265	1.265	
02/21/2020	04:15	3.53 09:10	6.47	5.36	04:55	2.16 09:10	4.57	3.91	03:35	0.381 09:10	1.845	1.273	1.273	
02/22/2020	04:25	3.42 11:25	7.00	5.53	04:25	2.07 09:20	4.67	3.93	04:25	0.340 11:25	2.061	1.355	1.355	
02/23/2020	04:40	3.39 11:05	6.89	5.59	03:45	2.17 12:50	4.70	4.02	04:40	0.370 10:55	2.051	1.410	1.410	
02/24/2020	04:05	3.43 21:45	6.49	5.24	04:30	2.15 20:10	4.71	3.98	04:30	0.365 21:40	1.863	1.255	1.255	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	03:20	3.52	21:50	6.55	5.24	03:50	2.11	20:40	4.66	3.93	03:50	0.374	20:45	1.907	1.239	1.239	
02/26/2020	03:35	3.29	08:05	6.65	5.27	04:15	2.06	21:30	4.65	3.89	04:15	0.337	08:05	1.927	1.241	1.241	
02/27/2020	04:05	3.36	07:55	6.60	5.31	04:30	2.04	20:10	4.56	3.90	03:20	0.341	08:00	1.868	1.250	1.250	
02/28/2020	02:55	3.41	08:35	6.63	5.35	04:05	2.12	20:10	4.55	3.90	04:05	0.355	08:35	1.870	1.264	1.264	
02/29/2020	04:10	3.42	11:30	6.93	5.55	04:20	2.04	18:05	4.64	3.95	04:20	0.340	11:30	2.053	1.364	1.364	
03/01/2020	04:55	3.36	11:05	6.91	5.51	04:20	2.09	10:40	4.83	4.00	04:20	0.342	10:40	2.097	1.380	1.380	
03/02/2020	04:00	3.34	07:50	6.60	5.23	04:00	1.93	07:35	4.69	3.94	04:00	0.306	07:50	1.945	1.239	1.239	
03/03/2020	04:00	3.29	08:00	6.50	5.23	04:10	2.04	19:50	4.63	3.88	04:35	0.336	08:05	1.856	1.226	1.226	
03/04/2020	03:30	3.40	07:55	6.73	5.31	04:05	2.14	07:55	4.83	3.91	04:05	0.353	07:55	2.059	1.256	1.256	
03/05/2020	04:50	3.42	20:15	6.57	5.32	04:25	2.15	20:15	4.63	3.92	04:00	0.362	20:15	1.912	1.264	1.264	
03/06/2020	04:10	3.53	08:00	6.59	5.43	03:55	2.06	07:50	4.56	3.89	03:55	0.354	07:55	1.887	1.286	1.286	
03/07/2020	04:45	3.52	11:35	7.03	5.66	03:35	2.14	12:30	4.70	3.96	04:45	0.376	12:30	2.101	1.410	1.410	
03/08/2020	05:15	3.65	11:40	7.12	5.65	03:50	2.10	09:50	4.77	4.02	03:50	0.378	11:40	2.161	1.427	1.427	
03/09/2020	02:35	3.46	20:35	6.75	5.39	02:35	2.06	20:10	4.72	3.95	02:35	0.343	20:10	1.980	1.296	1.295	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			145.284	4.90
Avg	5.25	4.00	1.263	

Site Commentary

Site Information

MIL_1193	
Pipe Dimensions	21
Silt Level	0.00"

Overview

Site MIL_1193 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited a small response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. Due to a meter malfunction, data confidence is less than typical during December 16, 2019 through December 20, 2019. A data gap occurs during December 20, 2020 at 10:00 pm through December 27, 2020 at 6:00 am.

This location was installed upstream of sites MIL_1043 and MIL_2840. (See MIL_1043 and MIL_2840 Site Commentary for More Details)

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	4.15	2.59	0.600
Minimum	2.34	1.36	0.136
Maximum	6.11	3.72	1.368
Time of Minimum	11/19/2019 4:20 AM	3/4/2020 3:15 AM	2/18/2020 3:50 AM
Time of Maximum	1/8/2020 9:25 AM	2/2/2020 1:10 PM	1/8/2020 9:25 AM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	95
Velocity (ft/s)	95
Quantity (MGD)	95

Milpitas Temp Study 2019-20

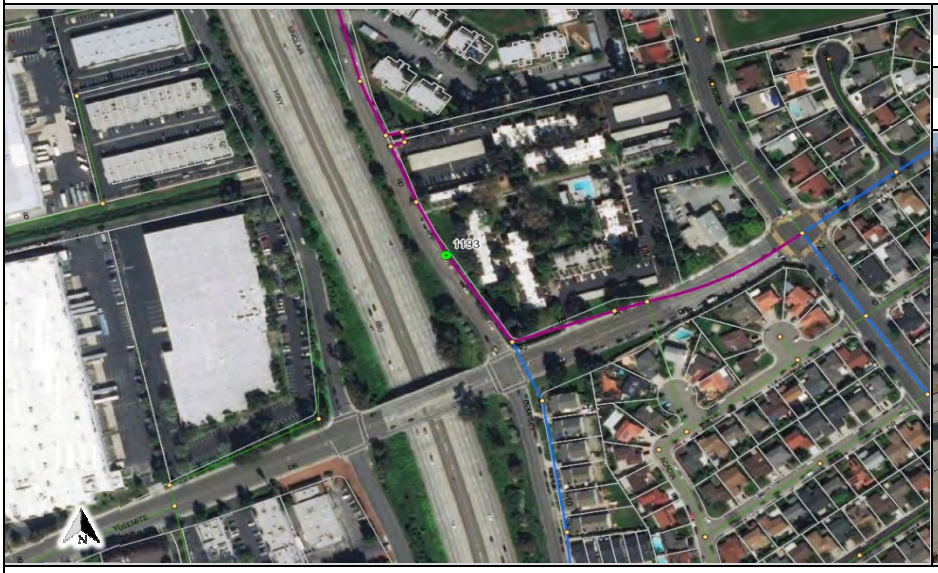
Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_1193

Site Address /Location:	Yosemite Dr and Dempsey Rd, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	DRIVE.	Latitude:	37.426666°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.883676°	21.00"x21.00"	Circular



Manhole #	System Characteristics
1193	Residential/Commercial
Access	Traffic
Drive	Light







Installation Information

Installation Date:	Installation Type:
Thursday, November 14, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
8:09:00 AM	21.00"x21.00"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
5.13"	
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
3.50'	0''
Silt (in)	Silt Type
0.0"	

Hydraulic Comments:

Smooth flow with medium depth and moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
15'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Drilled Pavement / Concrete

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

SCATTERGRAPH REPORT

MIL_1193

Flow Monitor

MIL_1193

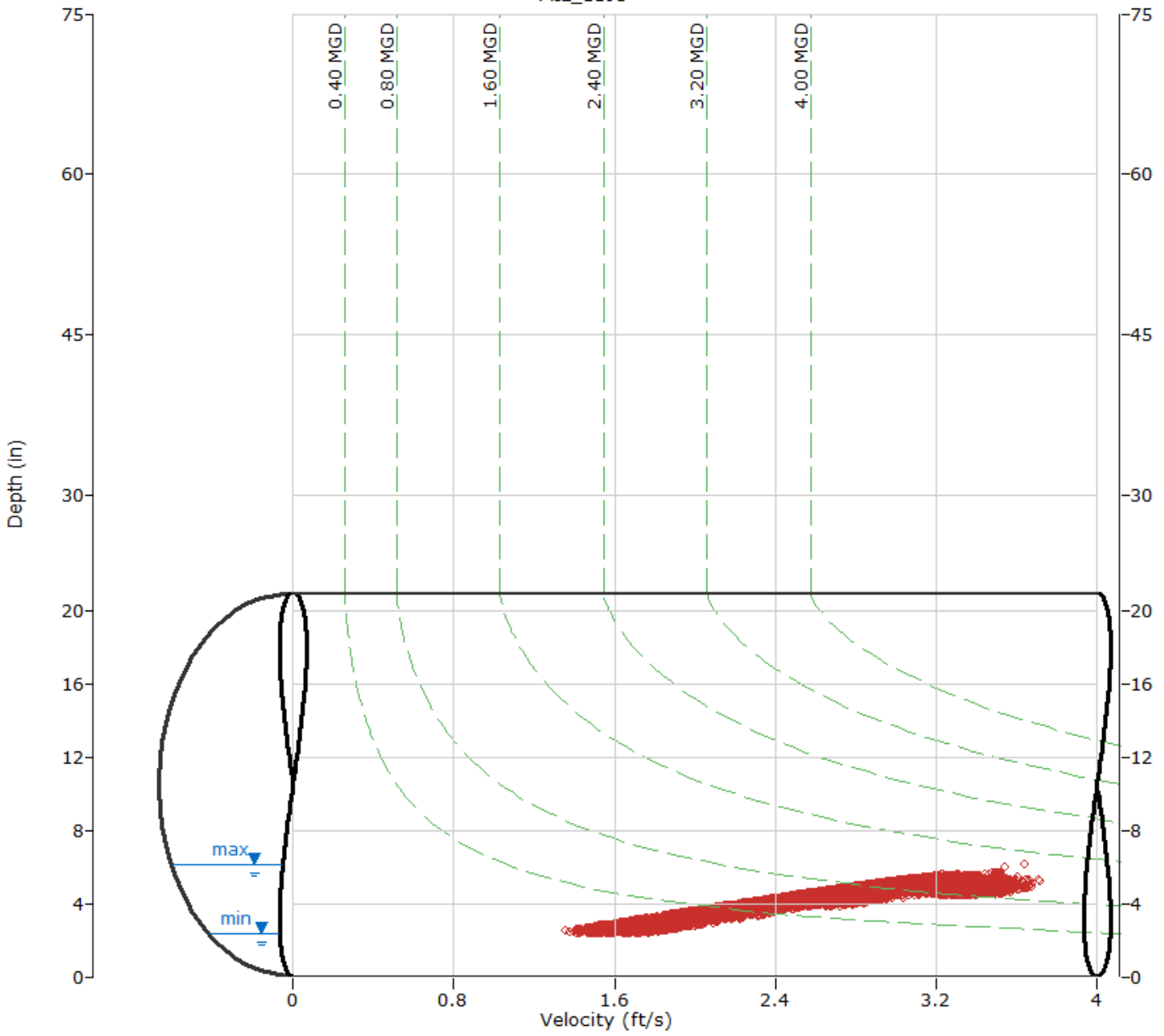
Pipe Height
21.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



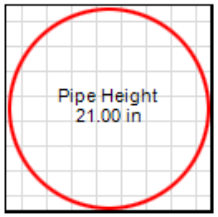
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_1193

Flow Monitor

MIL_1193

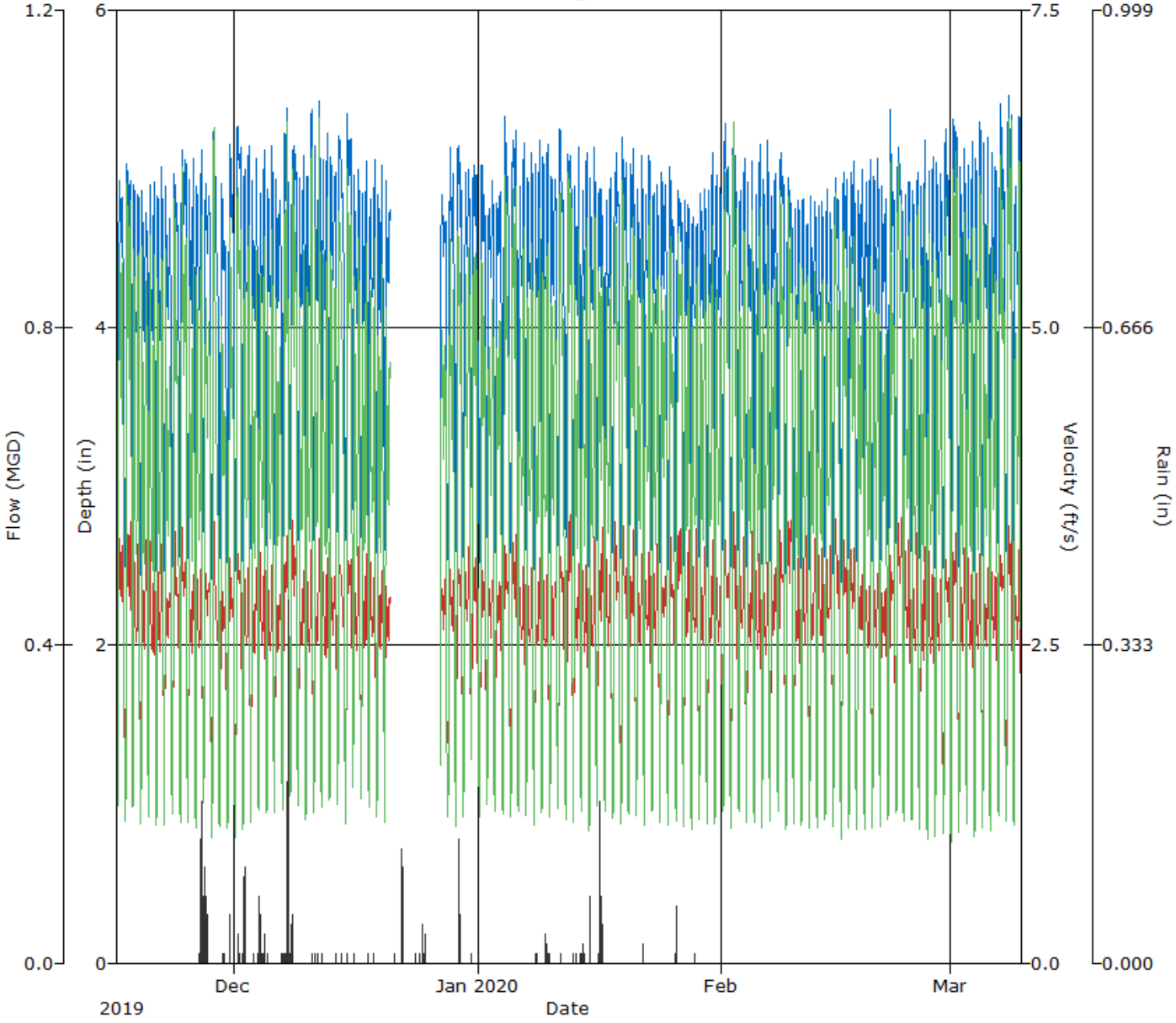


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_1193, Pipe Height: 21.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	04:20	2.45	10:35	4.97	4.10	05:00	1.62	12:00	3.42	2.66	04:20	0.176	10:35	0.938	0.607	0.607	
11/17/2019	05:25	2.41	10:20	5.31	4.16	04:00	1.60	10:20	3.60	2.76	05:25	0.161	10:20	1.111	0.653	0.653	
11/18/2019	03:15	2.54	07:45	5.11	4.01	04:40	1.67	07:50	3.54	2.62	04:40	0.186	07:50	1.027	0.572	0.572	
11/19/2019	04:20	2.34	07:50	5.05	3.92	04:45	1.62	21:40	3.44	2.61	04:15	0.161	07:50	0.981	0.555	0.555	
11/20/2019	04:20	2.37	07:50	5.24	3.99	04:15	1.53	07:45	3.48	2.57	04:15	0.150	07:50	1.053	0.558	0.558	
11/21/2019	03:55	2.39	07:45	5.11	4.01	03:45	1.52	22:00	3.50	2.59	03:55	0.149	07:45	0.993	0.568	0.568	
11/22/2019	03:55	2.37	07:50	5.13	4.02	03:40	1.60	07:45	3.50	2.56	03:40	0.156	07:50	1.024	0.560	0.560	
11/23/2019	05:30	2.36	09:00	5.14	4.12	05:25	1.52	12:00	3.58	2.68	05:25	0.149	10:40	1.038	0.617	0.617	
11/24/2019	04:20	2.41	11:05	5.21	4.23	04:10	1.54	10:50	3.62	2.67	04:10	0.154	10:50	1.080	0.643	0.643	
11/25/2019	04:20	2.44	21:45	5.13	4.08	02:35	1.54	07:45	3.51	2.51	04:00	0.164	07:45	0.991	0.566	0.566	
11/26/2019	04:10	2.42	20:40	5.20	4.09	04:10	1.49	07:40	3.55	2.51	04:10	0.148	07:40	1.050	0.570	0.570	0.36
11/27/2019	03:10	2.64	09:30	5.03	4.20	04:20	1.57	10:45	3.25	2.59	03:10	0.189	10:55	0.908	0.604	0.604	0.63
11/28/2019	04:45	2.37	10:55	5.34	4.12	04:35	1.47	13:10	3.60	2.57	04:35	0.143	11:50	1.082	0.598	0.598	
11/29/2019	03:55	2.43	10:55	5.14	4.02	04:35	1.47	10:50	3.16	2.45	04:35	0.154	10:50	0.933	0.542	0.542	0.02
11/30/2019	04:55	2.46	12:45	5.23	4.20	04:05	1.47	13:35	3.30	2.53	04:45	0.152	13:35	0.968	0.603	0.603	0.10
12/01/2019	04:10	2.43	11:50	5.43	4.32	04:30	1.43	21:05	3.39	2.60	04:30	0.143	11:45	1.051	0.651	0.651	0.06
12/02/2019	03:10	2.51	21:30	5.46	4.18	03:35	1.43	08:00	3.38	2.51	03:35	0.151	21:30	1.067	0.588	0.588	0.30
12/03/2019	04:20	2.52	07:45	5.36	4.09	02:40	1.52	07:45	3.30	2.49	04:20	0.166	07:45	1.032	0.562	0.562	0.01
12/04/2019	03:05	2.53	21:40	5.18	4.13	02:55	1.54	07:45	3.55	2.54	02:55	0.167	07:15	0.999	0.578	0.578	0.39
12/05/2019	04:00	2.48	20:45	5.23	4.13	04:00	1.41	07:35	3.39	2.51	04:00	0.145	21:35	0.967	0.573	0.573	0.01
12/06/2019	04:05	2.59	07:55	5.18	4.14	04:00	1.56	07:55	3.18	2.49	04:00	0.173	07:55	0.949	0.567	0.567	0.01
12/07/2019	04:00	2.60	18:00	5.68	4.33	04:15	1.64	18:20	3.54	2.65	04:15	0.184	18:00	1.195	0.656	0.656	0.67
12/08/2019	04:35	2.68	19:10	5.37	4.34	04:25	1.67	10:50	3.61	2.73	04:25	0.194	13:05	1.058	0.676	0.676	0.20
12/09/2019	04:15	2.60	07:35	5.25	4.16	03:20	1.56	07:55	3.42	2.53	03:20	0.178	07:45	1.007	0.582	0.582	
12/10/2019	03:20	2.50	20:30	5.44	4.17	03:00	1.49	20:30	3.36	2.52	03:00	0.159	20:30	1.073	0.586	0.586	
12/11/2019	04:10	2.56	21:40	5.63	4.24	04:20	1.42	21:40	3.48	2.56	04:20	0.157	21:40	1.167	0.609	0.609	0.03
12/12/2019	03:45	2.61	08:00	5.53	4.22	02:45	1.52	08:00	3.41	2.55	02:45	0.182	08:00	1.116	0.599	0.599	0.01
12/13/2019	03:15	2.66	21:35	5.49	4.27	04:40	1.54	21:35	3.39	2.59	04:40	0.184	21:35	1.096	0.616	0.616	0.01
12/14/2019	04:25	2.68	09:00	5.35	4.33	04:10	1.51	09:00	3.29	2.61	04:10	0.180	09:00	1.027	0.638	0.638	0.01
12/15/2019	05:25	2.56	10:25	5.50	4.42	04:30	1.43	10:35	3.34	2.66	04:30	0.155	10:35	1.069	0.682	0.682	0.01
12/16/2019	04:15	2.75	07:35	5.13	4.18	03:45	1.54	21:25	3.51	2.60	03:45	0.189	07:40	0.985	0.598	0.598	0.01
12/17/2019	04:35	2.63	20:25	5.30	4.10	03:55	1.68	21:20	3.51	2.57	04:30	0.196	20:55	1.018	0.578	0.578	0.01
12/18/2019	03:30	2.63	21:30	5.12	4.10	03:10	1.58	21:35	3.52	2.56	03:10	0.183	21:35	0.959	0.578	0.578	0.01
12/19/2019	04:00	2.53	07:40	5.23	4.03	04:50	1.51	07:45	3.32	2.50	04:50	0.164	19:55	0.941	0.551	0.551	
12/20/2019	04:50	2.56	08:05	5.23	4.14	04:20	1.53	08:10	3.17	2.50	04:20	0.167	08:10	0.941	0.572	0.467	
12/21/2019	00:00		00:00			00:00		00:00			00:00		00:00				0.01
12/22/2019	00:00		00:00			00:00		00:00			00:00		00:00				0.41
12/23/2019	00:00		00:00			00:00		00:00			00:00		00:00				
12/24/2019	00:00		00:00			00:00		00:00			00:00		00:00				0.02
12/25/2019	00:00		00:00			00:00		00:00			00:00		00:00				0.08
12/26/2019	00:00		00:00			00:00		00:00			00:00		00:00				
12/27/2019	05:50	2.90	21:50	5.20	4.47	06:15	1.82	21:35	3.54	2.72	05:50	0.246	21:50	1.001	0.669	0.506	
12/28/2019	04:55	2.49	19:50	5.39	4.16	02:50	1.60	19:50	3.32	2.53	05:35	0.171	19:50	1.048	0.591	0.591	
12/29/2019	05:20	2.49	13:20	5.33	4.25	05:10	1.43	10:30	3.33	2.57	05:10	0.150	13:20	1.019	0.622	0.622	0.22
12/30/2019	04:30	2.52	22:00	5.16	4.18	04:30	1.59	21:05	3.56	2.59	04:30	0.168	21:05	0.977	0.605	0.605	
12/31/2019	03:55	2.95	18:45	5.17	4.26	03:20	1.72	10:55	3.61	2.64	03:20	0.233	10:55	1.013	0.623	0.623	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	05:15	2.39 11:45	5.15	4.10	05:20	1.57 10:50	3.47	2.56	05:15	0.162 12:00	0.966	0.581	0.581	
01/02/2020	03:25	2.60 22:00	5.08	4.14	03:25	1.59 22:00	3.29	2.54	03:25	0.177 22:00	0.956	0.577	0.577	
01/03/2020	03:45	2.44 18:00	4.98	4.16	03:50	1.57 18:00	3.20	2.56	03:50	0.166 18:00	0.903	0.587	0.587	
01/04/2020	03:35	2.46 12:25	5.60	4.24	03:35	1.56 12:25	3.46	2.62	03:35	0.159 12:25	1.152	0.630	0.630	
01/05/2020	04:40	2.54 19:05	5.53	4.30	03:25	1.52 21:30	3.68	2.66	04:30	0.174 19:05	1.117	0.657	0.657	
01/06/2020	03:55	2.54 19:20	5.25	4.22	04:10	1.54 19:20	3.37	2.55	04:10	0.172 19:20	1.025	0.599	0.599	
01/07/2020	04:15	2.51 19:45	5.19	4.19	04:05	1.48 19:40	3.23	2.52	04:05	0.161 19:45	0.962	0.589	0.589	
01/08/2020	03:25	2.37 09:25	6.11	4.17	03:35	1.50 09:25	3.64	2.53	03:35	0.146 09:25	1.368	0.590	0.590	0.02
01/09/2020	03:20	2.58 07:50	5.26	4.19	04:00	1.63 21:25	3.17	2.51	04:00	0.181 07:45	0.958	0.587	0.587	0.18
01/10/2020	04:05	2.45 07:45	5.30	4.18	03:50	1.57 21:50	3.24	2.53	03:50	0.162 07:50	0.975	0.586	0.586	0.02
01/11/2020	04:35	2.59 10:00	5.33	4.27	04:25	1.60 10:10	3.36	2.64	04:25	0.177 10:10	1.002	0.641	0.641	0.01
01/12/2020	04:25	2.60 17:45	5.36	4.31	03:35	1.53 20:55	3.68	2.73	04:25	0.171 10:40	1.056	0.676	0.676	
01/13/2020	03:55	2.51 20:30	5.25	4.14	03:35	1.55 07:45	3.49	2.55	03:50	0.166 07:45	1.015	0.584	0.584	0.02
01/14/2020	04:05	2.57 20:45	5.29	4.15	02:55	1.62 08:00	3.53	2.55	04:20	0.181 21:25	1.010	0.588	0.588	0.11
01/15/2020	03:15	2.44 07:40	5.26	4.10	03:55	1.47 21:35	3.65	2.55	03:55	0.150 07:40	1.037	0.582	0.582	0.07
01/16/2020	04:10	2.57 07:30	5.12	4.15	05:05	1.58 07:45	3.57	2.71	04:15	0.180 09:20	0.994	0.623	0.623	0.66
01/17/2020	04:10	2.52 09:00	5.10	4.13	03:50	1.54 07:50	3.55	2.59	04:25	0.165 07:50	0.955	0.590	0.590	
01/18/2020	03:35	2.53 12:45	5.43	4.18	03:55	1.55 11:00	3.59	2.66	03:35	0.174 12:45	1.028	0.629	0.629	
01/19/2020	04:30	2.48 09:55	5.32	4.23	04:20	1.49 12:00	3.65	2.65	04:20	0.161 10:40	1.063	0.638	0.638	
01/20/2020	03:45	2.54 19:20	5.33	4.24	04:55	1.57 21:05	3.64	2.62	04:20	0.173 19:05	1.016	0.627	0.627	
01/21/2020	04:20	2.48 07:35	5.29	4.12	03:15	1.59 21:30	3.53	2.55	03:15	0.172 21:30	1.001	0.580	0.580	
01/22/2020	03:40	2.43 19:45	5.18	4.15	04:05	1.54 21:35	3.63	2.61	04:05	0.161 21:35	1.044	0.601	0.601	0.03
01/23/2020	04:15	2.48 07:45	5.07	4.07	04:25	1.52 21:35	3.49	2.58	04:25	0.159 07:45	1.001	0.577	0.577	
01/24/2020	04:10	2.41 09:15	5.16	4.16	04:00	1.59 08:30	3.20	2.61	04:00	0.158 21:45	0.906	0.602	0.602	
01/25/2020	03:50	2.45 12:55	5.15	4.09	04:20	1.61 10:55	3.57	2.63	04:20	0.166 10:55	1.024	0.600	0.600	
01/26/2020	04:50	2.40 17:30	5.02	4.10	04:50	1.62 12:05	3.57	2.77	04:50	0.159 11:35	0.980	0.635	0.635	0.16
01/27/2020	04:20	2.39 18:30	5.05	4.01	04:30	1.53 21:20	3.64	2.63	04:20	0.150 21:05	0.975	0.578	0.578	
01/28/2020	03:50	2.36 08:00	5.34	3.95	04:25	1.54 21:40	3.61	2.63	03:50	0.152 08:00	1.085	0.564	0.564	0.01
01/29/2020	03:55	2.49 08:15	5.17	4.05	04:25	1.56 19:25	3.46	2.58	04:25	0.171 21:05	0.963	0.574	0.574	
01/30/2020	03:40	2.46 21:50	5.27	4.10	03:05	1.60 20:30	3.46	2.56	03:50	0.167 21:35	0.988	0.581	0.581	
01/31/2020	04:10	2.48 08:15	5.19	4.10	03:10	1.59 07:50	3.46	2.55	03:55	0.166 07:35	0.969	0.574	0.574	
02/01/2020	04:35	2.56 10:25	5.55	4.29	04:35	1.60 10:35	3.48	2.64	04:35	0.172 10:25	1.134	0.644	0.644	
02/02/2020	04:25	2.41 11:50	5.28	4.23	04:35	1.59 13:10	3.72	2.72	04:25	0.159 11:50	1.137	0.660	0.660	
02/03/2020	04:10	2.43 20:05	5.25	4.09	04:05	1.50 21:05	3.50	2.61	04:05	0.150 20:00	0.981	0.589	0.589	
02/04/2020	04:00	2.43 19:50	5.22	4.07	04:10	1.60 20:30	3.49	2.59	04:00	0.162 07:35	1.013	0.581	0.581	
02/05/2020	03:05	2.47 21:15	5.43	4.08	03:45	1.63 20:20	3.51	2.55	03:05	0.171 21:15	1.066	0.575	0.575	
02/06/2020	04:15	2.46 21:10	5.27	4.13	04:30	1.54 08:00	3.46	2.52	04:15	0.161 08:00	1.009	0.578	0.578	
02/07/2020	03:50	2.46 19:20	5.09	4.15	03:25	1.64 07:35	3.36	2.56	03:50	0.171 19:20	0.964	0.589	0.589	
02/08/2020	03:45	2.52 09:00	5.25	4.25	04:50	1.65 10:10	3.58	2.71	04:50	0.179 12:25	1.010	0.654	0.654	
02/09/2020	04:50	2.40 14:25	5.04	4.08	04:40	1.53 20:15	3.64	2.80	04:40	0.152 10:45	1.024	0.644	0.644	
02/10/2020	04:20	2.46 22:10	5.05	3.97	03:20	1.62 21:40	3.49	2.64	03:50	0.167 07:45	0.992	0.572	0.572	
02/11/2020	04:20	2.42 07:45	5.00	3.95	03:00	1.52 07:40	3.59	2.62	03:00	0.155 07:40	1.005	0.563	0.563	
02/12/2020	04:05	2.39 18:55	5.04	3.99	03:50	1.49 20:05	3.46	2.60	03:50	0.150 07:50	0.946	0.566	0.566	
02/13/2020	03:50	2.37 19:10	5.07	3.98	02:30	1.64 19:50	3.49	2.61	03:50	0.159 19:50	0.983	0.567	0.567	
02/14/2020	04:15	2.40 08:55	4.98	4.00	03:35	1.52 21:50	3.46	2.66	03:35	0.160 07:25	0.907	0.580	0.580	
02/15/2020	04:40	2.38 11:00	5.12	4.08	04:30	1.54 11:00	3.66	2.73	04:30	0.150 11:00	1.075	0.623	0.623	
02/16/2020	04:20	2.35 13:40	5.13	4.11	04:40	1.48 18:55	3.60	2.67	04:40	0.143 18:55	0.994	0.618	0.618	
02/17/2020	04:00	2.49 12:40	5.15	4.17	04:30	1.41 10:15	3.49	2.61	04:30	0.151 11:45	0.969	0.614	0.614	
02/18/2020	04:00	2.36 19:55	5.24	4.10	03:50	1.41 20:00	3.45	2.51	03:50	0.136 20:00	0.966	0.571	0.571	
02/19/2020	03:40	2.47 21:35	5.18	4.09	04:10	1.49 21:25	3.31	2.47	04:10	0.157 21:40	0.979	0.558	0.558	
02/20/2020	03:40	2.48 21:40	5.25	4.12	03:35	1.49 21:15	3.18	2.51	03:35	0.158 21:40	0.960	0.573	0.573	
02/21/2020	04:00	2.47 08:50	5.03	4.10	04:15	1.52 20:45	3.09	2.50	04:15	0.159 08:50	0.878	0.565	0.565	
02/22/2020	03:20	2.58 11:00	5.51	4.23	04:20	1.48 10:35	3.37	2.59	04:25	0.169 10:45	1.081	0.621	0.621	
02/23/2020	05:10	2.60 11:05	5.23	4.25	03:45	1.55 20:55	3.66	2.76	04:15	0.176 12:25	1.035	0.671	0.671	
02/24/2020	04:20	2.44 20:45	5.13	4.08	02:10	1.50 21:25	3.50	2.61	04:20	0.162 19:45	0.975	0.589	0.589	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	04:15	2.51	21:15	5.13	4.05	04:30	1.54	20:25	3.58	2.57	04:00	0.163	20:25	1.004	0.574	0.574	
02/26/2020	04:15	2.39	21:00	5.36	4.11	03:55	1.45	21:05	3.50	2.53	04:15	0.144	21:40	1.058	0.579	0.579	
02/27/2020	04:20	2.42	07:40	5.31	4.14	04:00	1.38	07:35	3.56	2.51	04:00	0.140	07:40	1.097	0.580	0.580	
02/28/2020	03:15	2.43	07:30	5.41	4.16	04:15	1.49	07:45	3.46	2.49	03:20	0.152	07:40	1.029	0.577	0.577	
02/29/2020	03:45	2.39	11:10	5.42	4.27	05:25	1.42	11:10	3.26	2.59	05:25	0.148	11:10	1.037	0.635	0.635	
03/01/2020	05:00	2.40	19:00	5.40	4.33	04:35	1.40	20:05	3.57	2.65	04:35	0.137	22:15	1.089	0.671	0.671	
03/02/2020	04:00	2.39	07:50	5.24	4.11	03:50	1.43	07:20	3.56	2.53	03:55	0.143	07:35	1.031	0.582	0.582	
03/03/2020	04:05	2.43	07:20	5.26	4.13	02:45	1.46	07:45	3.41	2.53	04:05	0.157	21:15	0.997	0.584	0.584	
03/04/2020	04:10	2.40	20:25	5.49	4.13	03:15	1.36	07:30	3.54	2.53	03:15	0.139	20:25	1.099	0.585	0.585	
03/05/2020	04:20	2.38	21:15	5.45	4.19	04:15	1.42	07:35	3.33	2.53	04:15	0.139	07:35	1.053	0.595	0.595	
03/06/2020	04:05	2.45	07:30	5.37	4.18	03:50	1.43	07:35	3.33	2.53	03:50	0.146	07:45	1.036	0.591	0.591	
03/07/2020	04:30	2.55	10:30	5.47	4.32	05:00	1.58	10:10	3.36	2.64	04:15	0.174	10:10	1.079	0.655	0.655	
03/08/2020	04:30	2.57	11:35	5.58	4.40	03:05	1.52	20:35	3.60	2.69	04:30	0.170	12:00	1.135	0.689	0.689	
03/09/2020	03:15	2.47	19:55	5.60	4.21	03:15	1.41	19:40	3.48	2.55	03:15	0.144	19:55	1.100	0.602	0.602	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			65.190	4.90
Avg	4.15	2.59	0.600	

Site Commentary

Site Information

MIL_1564	
Pipe Dimensions	8
Silt Level	0.00"

Overview

Site MIL_1564 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019 and December 7, 2019 - December 8, 2019. Surcharge conditions were experienced at this location. Review of the scattergraph shows that both free flow and backwater flows were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	1.60	2.40	0.078
Minimum	1.17	0.49	0.011
Maximum	21.57	4.82	0.785
Time of Minimum	2/10/2020 4:45 AM	2/16/2020 4:10 AM	2/16/2020 4:10 AM
Time of Maximum	1/29/2020 6:30 PM	1/24/2020 9:45 PM	1/29/2020 6:20 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_1564

Site Address /Location:	Country Club Dr and Park Victoria Dr, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	DRIVE.	Latitude:	37.449480°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.887946°	8.00"x8.00"	Circular



Manhole #	System Characteristics
1564	Residential/Commercial
Access	Traffic
Drive	Medium







Installation Information

Installation Date:	Installation Type:
Thursday, November 14, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
4:25:00 AM	8.00"x8.00"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
0.63"	
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.69	0''
Silt (in)	Silt Type
0.0"	

Hydraulic Comments:

Shallow depth with moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
4'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Drilled Pavement / Concrete

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

SCATTERGRAPH REPORT

MIL_1564

Flow Monitor

MIL_1564

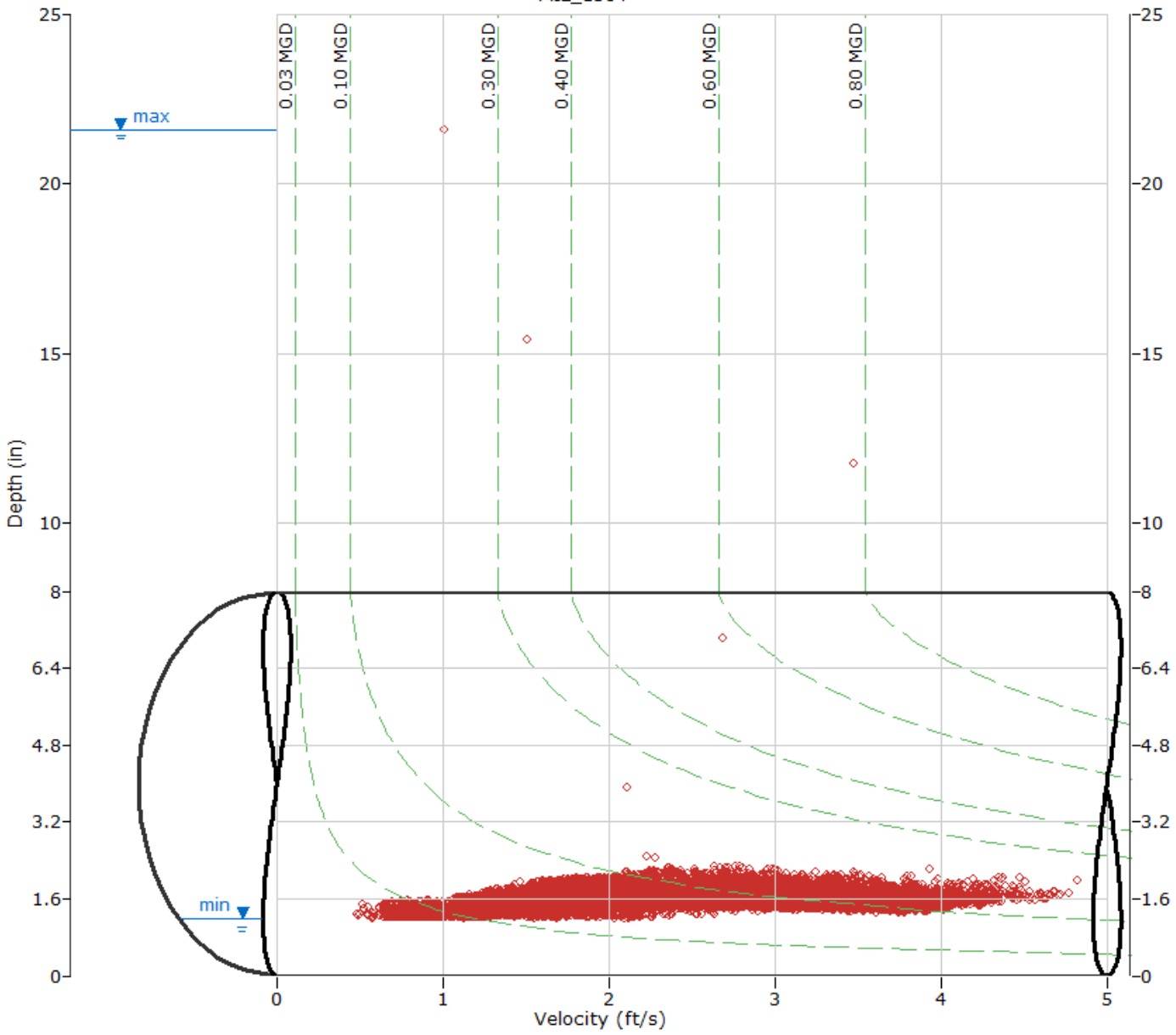
Pipe Height
8.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



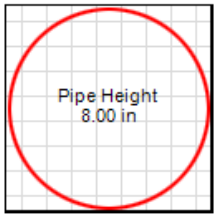
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_1564

Flow Monitor

MIL_1564

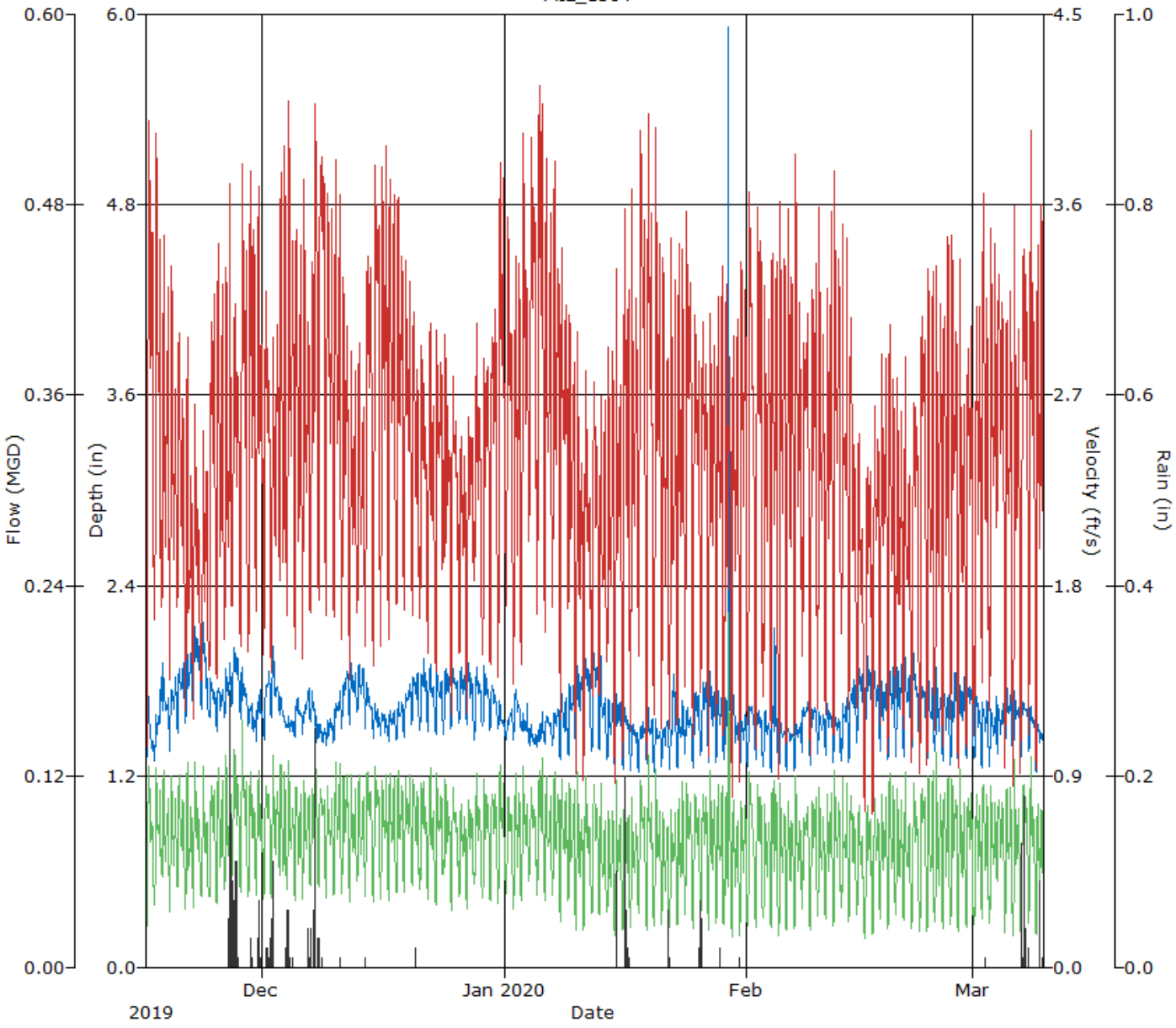


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_1564, Pipe Height: 8.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	05:00	1.30	08:25	1.81	1.47	04:40	0.86	09:30	4.23	2.63	04:40	0.021	09:30	0.149	0.076	0.076	
11/17/2019	03:45	1.28	23:55	1.80	1.49	06:40	1.25	08:50	4.53	2.74	06:40	0.030	08:50	0.143	0.081	0.081	
11/18/2019	16:10	1.46	07:10	2.48	1.70	05:20	1.07	10:15	4.44	2.45	05:20	0.034	10:15	0.174	0.086	0.086	
11/19/2019	03:35	1.34	22:15	1.94	1.64	04:55	0.92	09:30	4.01	2.31	04:55	0.023	09:30	0.146	0.079	0.079	
11/20/2019	04:35	1.46	21:20	2.10	1.74	05:35	1.42	12:40	3.62	2.30	05:35	0.040	21:25	0.152	0.085	0.085	
11/21/2019	03:45	1.52	08:25	2.08	1.81	03:35	1.04	10:25	3.44	1.96	03:35	0.031	10:25	0.152	0.077	0.077	
11/22/2019	04:40	1.58	09:35	2.22	1.91	04:35	1.08	10:25	3.01	1.86	04:35	0.035	08:40	0.152	0.079	0.079	
11/23/2019	04:35	1.61	09:55	2.28	1.88	04:35	1.15	21:10	3.21	1.91	04:35	0.037	09:50	0.147	0.079	0.079	
11/24/2019	07:10	1.54	00:40	1.88	1.69	02:55	1.20	21:50	3.80	2.33	02:55	0.037	10:20	0.133	0.082	0.082	
11/25/2019	04:30	1.46	11:50	1.89	1.65	05:40	1.17	08:25	4.05	2.35	05:40	0.034	08:25	0.164	0.081	0.081	
11/26/2019	04:15	1.56	20:20	2.05	1.75	03:40	1.42	20:20	4.47	2.40	03:40	0.044	20:20	0.204	0.089	0.089	0.63
11/27/2019	01:55	1.61	10:25	2.08	1.85	03:55	1.45	11:25	3.80	2.46	01:55	0.047	08:45	0.166	0.099	0.099	0.77
11/28/2019	04:50	1.55	11:45	2.01	1.73	04:50	1.39	11:50	4.51	2.66	04:50	0.043	11:50	0.191	0.097	0.097	
11/29/2019	22:55	1.42	00:40	1.88	1.59	03:45	1.36	11:15	4.28	2.70	06:20	0.040	11:20	0.159	0.086	0.086	0.05
11/30/2019	05:50	1.39	13:45	1.82	1.60	05:25	1.34	12:15	3.97	2.68	05:25	0.036	12:15	0.147	0.087	0.087	0.14
12/01/2019	05:35	1.40	21:15	1.98	1.68	04:15	1.20	17:55	3.81	2.44	04:15	0.035	12:15	0.149	0.086	0.086	0.06
12/02/2019	03:00	1.51	08:10	2.16	1.76	05:00	0.97	23:10	3.86	2.23	05:00	0.029	08:15	0.177	0.084	0.084	0.36
12/03/2019	22:45	1.46	10:15	1.88	1.61	17:00	1.32	21:15	4.72	2.67	17:00	0.042	10:15	0.171	0.087	0.087	
12/04/2019	11:30	1.40	07:55	1.75	1.53	04:40	1.40	10:40	4.59	2.85	04:40	0.041	10:40	0.157	0.086	0.086	0.44
12/05/2019	04:20	1.43	13:55	1.76	1.59	04:30	1.36	22:05	4.29	2.57	04:30	0.037	22:05	0.134	0.083	0.083	
12/06/2019	04:20	1.44	23:05	1.80	1.62	04:15	1.22	10:10	3.99	2.56	04:15	0.034	10:10	0.147	0.084	0.084	0.06
12/07/2019	21:05	1.36	10:05	1.97	1.60	04:10	1.39	19:05	4.67	2.81	04:10	0.041	10:05	0.186	0.090	0.090	0.84
12/08/2019	13:00	1.35	20:55	1.72	1.48	13:10	1.51	11:50	4.66	3.18	13:10	0.039	11:50	0.159	0.091	0.091	0.10
12/09/2019	04:20	1.37	09:55	1.66	1.49	03:25	1.50	09:35	4.20	2.83	03:25	0.039	09:00	0.138	0.082	0.082	
12/10/2019	03:20	1.40	22:05	1.90	1.59	04:35	1.43	22:05	4.26	2.75	04:35	0.039	22:05	0.175	0.089	0.089	0.01
12/11/2019	04:25	1.47	21:10	1.96	1.73	04:20	1.27	10:20	3.80	2.49	04:20	0.036	21:30	0.146	0.091	0.091	0.00
12/12/2019	04:25	1.50	05:35	2.06	1.75	04:20	1.21	09:00	3.66	2.20	04:20	0.036	05:35	0.154	0.082	0.082	
12/13/2019	04:00	1.55	01:20	2.04	1.77	03:55	1.41	09:25	3.48	2.26	03:55	0.043	09:25	0.154	0.085	0.085	
12/14/2019	04:25	1.49	00:10	1.93	1.68	04:35	1.21	08:25	4.21	2.69	04:35	0.036	08:25	0.160	0.093	0.093	0.01
12/15/2019	18:20	1.37	12:10	1.85	1.56	04:10	1.21	11:55	4.69	2.87	04:10	0.035	12:10	0.173	0.090	0.090	
12/16/2019	04:20	1.39	04:55	1.75	1.54	03:50	1.31	21:10	4.43	2.82	03:50	0.037	07:35	0.151	0.086	0.086	
12/17/2019	03:10	1.40	21:45	1.88	1.53	03:50	1.40	08:05	4.22	2.84	03:55	0.038	21:45	0.171	0.086	0.086	
12/18/2019	03:45	1.41	12:15	1.79	1.57	03:25	1.47	09:15	4.31	2.72	05:50	0.040	09:20	0.159	0.086	0.086	
12/19/2019	03:40	1.42	21:45	1.89	1.66	03:40	1.41	08:10	3.99	2.61	03:40	0.038	08:10	0.150	0.090	0.090	
12/20/2019	02:10	1.48	23:50	1.94	1.72	05:35	1.28	11:00	3.75	2.35	05:35	0.038	08:55	0.148	0.085	0.085	0.02
12/21/2019	04:25	1.46	17:20	2.04	1.74	05:40	1.43	11:50	3.59	2.36	05:40	0.042	11:50	0.150	0.087	0.087	
12/22/2019	06:10	1.45	13:25	2.07	1.71	05:45	1.24	13:25	3.80	2.28	05:45	0.035	13:25	0.175	0.083	0.083	
12/23/2019	05:30	1.45	09:00	2.22	1.69	05:20	1.23	09:00	3.94	2.31	05:20	0.034	09:00	0.201	0.082	0.082	
12/24/2019	04:10	1.44	09:20	1.93	1.72	03:20	1.23	10:55	3.80	2.36	03:20	0.038	10:55	0.158	0.085	0.085	
12/25/2019	03:40	1.48	09:10	1.96	1.73	05:05	1.06	00:35	3.36	2.17	05:10	0.031	10:45	0.138	0.079	0.079	
12/26/2019	04:50	1.52	21:20	1.97	1.74	04:45	1.28	09:30	2.97	2.09	04:45	0.038	09:30	0.125	0.077	0.077	
12/27/2019	04:45	1.52	08:45	1.99	1.74	04:15	1.13	21:00	2.89	2.10	04:15	0.034	08:45	0.124	0.077	0.077	
12/28/2019	04:25	1.41	11:35	2.01	1.68	01:40	1.70	11:30	3.60	2.37	04:30	0.049	10:30	0.146	0.083	0.083	
12/29/2019	02:35	1.50	11:35	2.07	1.69	06:20	1.30	11:25	3.65	2.31	06:20	0.038	11:25	0.166	0.082	0.082	
12/30/2019	04:00	1.48	10:00	1.87	1.66	03:30	1.26	08:55	3.85	2.45	04:30	0.038	08:55	0.140	0.084	0.084	
12/31/2019	19:35	1.46	09:15	1.73	1.57	03:55	1.23	20:10	4.47	2.72	03:55	0.036	20:10	0.153	0.086	0.086	

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	05:35	1.41 23:45	1.67	1.53	06:35	1.59 10:20	4.49	2.71	06:35	0.044 10:20	0.146	0.083	0.083	
01/02/2020	05:10	1.42 10:55	1.82	1.61	05:10	1.20 23:00	4.02	2.36	05:10	0.032 10:55	0.141	0.078	0.078	
01/03/2020	14:15	1.38 09:50	1.90	1.54	03:25	1.25 12:00	4.35	2.78	03:25	0.036 09:50	0.169	0.084	0.084	
01/04/2020	14:05	1.29 13:40	1.82	1.44	14:05	1.25 20:35	4.51	3.06	14:05	0.030 13:40	0.164	0.085	0.085	
01/05/2020	10:40	1.34 12:10	1.68	1.46	05:55	1.43 11:20	4.72	3.14	05:55	0.037 12:10	0.158	0.089	0.089	
01/06/2020	03:40	1.36 08:25	1.70	1.51	05:10	1.42 08:20	4.44	2.72	05:10	0.037 08:25	0.145	0.081	0.081	
01/07/2020	04:00	1.37 09:50	1.88	1.53	03:20	1.56 08:15	4.77	2.73	04:00	0.041 08:15	0.169	0.084	0.084	
01/08/2020	03:30	1.27 09:30	1.83	1.54	05:45	0.81 10:10	3.97	2.47	05:45	0.019 09:30	0.139	0.078	0.078	
01/09/2020	05:30	1.29 07:55	2.00	1.63	05:00	0.65 07:55	3.99	2.43	05:00	0.015 07:55	0.176	0.081	0.081	
01/10/2020	04:55	1.34 09:45	1.99	1.69	05:00	0.71 09:50	3.68	1.98	05:00	0.018 09:55	0.148	0.071	0.071	
01/11/2020	04:30	1.28 08:35	2.11	1.71	04:20	0.63 10:25	3.59	1.91	04:20	0.015 10:20	0.160	0.071	0.071	
01/12/2020	04:50	1.33 10:50	2.12	1.72	04:20	0.67 18:00	3.52	2.07	04:20	0.017 18:00	0.167	0.076	0.076	
01/13/2020	05:00	1.32 08:40	2.13	1.61	04:55	0.73 20:55	3.09	1.96	04:55	0.018 08:40	0.148	0.065	0.065	
01/14/2020	04:55	1.28 21:50	1.89	1.53	06:15	0.76 20:50	3.87	2.13	06:15	0.019 20:50	0.148	0.066	0.066	
01/15/2020	05:15	1.19 08:20	1.93	1.52	05:35	0.58 08:10	4.48	2.08	05:35	0.012 08:10	0.173	0.065	0.065	0.10
01/16/2020	05:35	1.21 10:40	1.89	1.50	05:10	0.77 10:40	4.06	2.36	05:40	0.017 10:40	0.165	0.071	0.071	0.66
01/17/2020	20:05	1.19 07:25	1.59	1.43	04:05	0.75 22:00	4.28	2.40	04:05	0.017 09:50	0.133	0.067	0.067	
01/18/2020	04:40	1.21 14:35	1.69	1.44	06:50	1.05 11:30	4.62	2.92	04:45	0.023 14:35	0.150	0.082	0.082	
01/19/2020	05:40	1.26 11:50	1.85	1.47	05:30	0.78 11:15	4.38	2.62	05:30	0.018 11:50	0.166	0.076	0.076	
01/20/2020	04:40	1.22 10:35	1.80	1.44	04:25	0.96 11:20	4.52	2.64	04:25	0.021 08:45	0.160	0.074	0.074	
01/21/2020	03:00	1.23 22:50	1.63	1.44	05:35	0.95 08:05	3.80	2.36	03:00	0.021 08:05	0.114	0.067	0.067	0.01
01/22/2020	04:25	1.21 17:15	1.97	1.52	02:10	0.92 22:40	3.85	2.27	05:10	0.021 21:25	0.112	0.069	0.069	0.09
01/23/2020	04:15	1.22 23:10	1.79	1.48	02:35	0.89 08:15	3.81	2.32	02:35	0.020 20:20	0.131	0.069	0.069	
01/24/2020	02:55	1.28 21:45	1.97	1.51	04:10	0.92 21:45	4.82	2.62	04:10	0.023 21:45	0.208	0.079	0.079	
01/25/2020	04:50	1.22 22:55	1.91	1.56	04:00	0.85 09:55	3.80	2.44	04:00	0.019 23:00	0.140	0.078	0.078	
01/26/2020	03:15	1.31 18:00	1.92	1.61	03:10	1.14 11:15	3.64	2.32	03:10	0.027 22:25	0.137	0.077	0.077	0.16
01/27/2020	04:05	1.27 08:10	1.94	1.60	03:50	0.83 10:10	3.66	2.24	03:50	0.019 08:20	0.147	0.076	0.076	
01/28/2020	04:05	1.27 07:30	1.81	1.55	04:00	0.87 21:25	4.07	2.26	04:00	0.020 21:20	0.149	0.072	0.072	0.02
01/29/2020	02:15	1.20 18:30	21.57	1.72	01:25	0.68 08:20	3.89	2.16	01:25	0.017 18:20	0.785	0.074	0.074	
01/30/2020	04:00	1.22 07:40	1.81	1.49	03:45	0.58 11:35	3.80	2.16	03:45	0.013 11:35	0.135	0.065	0.065	
01/31/2020	04:10	1.21 20:55	1.66	1.46	04:10	0.70 07:40	4.05	2.45	04:10	0.015 07:40	0.133	0.072	0.072	0.01
02/01/2020	03:45	1.21 05:20	1.84	1.53	02:55	0.79 10:10	4.19	2.52	02:55	0.018 10:10	0.154	0.078	0.078	
02/02/2020	05:25	1.28 07:50	1.78	1.51	04:35	0.76 12:15	3.90	2.50	04:35	0.018 12:15	0.127	0.076	0.076	
02/03/2020	02:50	1.23 08:10	1.68	1.48	05:00	1.02 07:45	3.65	2.32	05:00	0.024 07:50	0.117	0.068	0.068	
02/04/2020	03:30	1.22 14:40	2.24	1.54	03:30	0.85 07:45	4.24	2.39	03:30	0.019 07:45	0.148	0.075	0.075	
02/05/2020	04:40	1.22 08:20	1.69	1.44	05:50	0.58 08:20	4.00	2.40	05:50	0.013 08:20	0.139	0.068	0.068	
02/06/2020	04:05	1.21 07:50	1.56	1.43	03:50	0.84 08:15	4.09	2.39	03:50	0.018 07:50	0.122	0.067	0.067	
02/07/2020	05:25	1.22 08:40	1.77	1.44	03:55	0.93 08:20	4.43	2.44	03:55	0.020 08:40	0.148	0.069	0.069	
02/08/2020	02:50	1.27 04:30	1.97	1.59	02:55	1.15 08:35	4.21	2.47	02:50	0.027 08:35	0.133	0.079	0.079	
02/09/2020	05:20	1.26 12:15	1.79	1.53	05:50	0.84 12:05	3.95	2.36	05:50	0.019 09:10	0.129	0.074	0.074	
02/10/2020	04:45	1.17 08:30	1.89	1.51	04:10	0.99 08:30	4.08	2.40	04:10	0.026 08:30	0.166	0.072	0.072	
02/11/2020	03:30	1.28 09:00	1.88	1.53	01:15	0.95 20:15	3.84	2.40	04:50	0.023 09:00	0.154	0.074	0.074	
02/12/2020	04:00	1.25 08:25	1.82	1.49	04:00	0.76 08:25	4.34	2.48	04:00	0.017 08:25	0.168	0.074	0.074	
02/13/2020	01:35	1.23 09:40	1.86	1.54	02:50	1.23 09:40	4.28	2.45	04:35	0.030 09:40	0.170	0.076	0.076	
02/14/2020	03:25	1.27 18:45	1.95	1.61	05:35	1.04 08:25	3.50	2.16	05:35	0.024 09:25	0.139	0.072	0.072	
02/15/2020	04:25	1.38 20:20	2.12	1.69	05:30	1.06 10:05	2.85	1.80	05:30	0.028 12:00	0.126	0.065	0.065	
02/16/2020	04:25	1.26 12:15	2.19	1.69	04:10	0.49 09:50	3.35	1.70	04:10	0.011 09:50	0.149	0.062	0.062	
02/17/2020	06:10	1.44 11:55	1.96	1.69	03:45	0.52 09:20	3.53	1.92	03:45	0.015 09:20	0.146	0.069	0.069	
02/18/2020	05:05	1.32 08:00	1.89	1.62	04:10	0.89 09:35	3.40	2.13	04:10	0.023 08:00	0.130	0.072	0.072	
02/19/2020	04:05	1.28 08:35	2.09	1.67	03:55	0.88 07:40	3.61	2.12	03:55	0.021 08:40	0.160	0.076	0.076	
02/20/2020	04:00	1.29 22:00	2.09	1.68	04:30	0.70 22:00	3.12	2.04	04:30	0.019 22:00	0.146	0.073	0.073	
02/21/2020	03:35	1.28 19:25	2.10	1.71	03:20	0.76 08:40	3.43	1.94	03:20	0.018 08:40	0.153	0.070	0.070	
02/22/2020	04:05	1.31 11:10	2.06	1.69	03:45	0.83 23:55	3.33	2.05	03:45	0.020 23:55	0.140	0.074	0.074	
02/23/2020	07:05	1.26 12:05	1.93	1.62	07:05	0.49 11:35	3.79	2.25	07:05	0.011 11:35	0.145	0.077	0.077	
02/24/2020	05:35	1.26 21:50	1.88	1.59	05:35	0.84 20:15	3.88	2.16	05:35	0.019 20:15	0.143	0.072	0.072	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	02:40	1.32	08:30	2.00	1.60	05:05	0.88	19:50	4.28	2.21	05:05	0.021	19:50	0.153	0.074	0.074	
02/26/2020	04:50	1.26	20:50	1.85	1.57	04:40	0.87	20:50	4.22	2.29	04:40	0.020	20:50	0.167	0.074	0.074	
02/27/2020	04:50	1.25	17:45	1.91	1.59	04:20	0.88	14:30	4.09	2.42	04:20	0.020	14:30	0.150	0.079	0.079	
02/28/2020	04:10	1.23	22:45	1.90	1.61	04:10	0.72	08:40	3.85	2.08	04:10	0.016	08:40	0.146	0.071	0.071	
02/29/2020	04:30	1.29	20:35	1.93	1.63	04:25	0.88	20:45	3.99	2.21	04:30	0.021	20:40	0.147	0.075	0.075	
03/01/2020	06:15	1.27	15:55	2.03	1.55	06:15	0.73	15:55	4.35	2.23	06:15	0.017	15:55	0.196	0.070	0.070	
03/02/2020	05:30	1.20	07:40	2.04	1.51	04:15	0.93	07:40	4.37	2.50	04:45	0.020	07:40	0.198	0.076	0.076	0.01
03/03/2020	02:00	1.24	22:50	1.71	1.49	05:55	0.92	22:50	4.36	2.48	05:55	0.021	22:50	0.154	0.074	0.074	
03/04/2020	04:15	1.19	01:35	2.27	1.55	01:00	1.67	07:40	4.32	2.72	01:00	0.041	07:40	0.145	0.084	0.084	
03/05/2020	03:40	1.22	09:15	1.94	1.59	02:55	0.82	21:00	3.98	2.26	03:40	0.018	09:15	0.148	0.075	0.075	
03/06/2020	04:00	1.25	08:45	1.93	1.56	03:50	0.71	08:25	4.11	2.24	03:50	0.016	08:25	0.172	0.072	0.072	
03/07/2020	03:40	1.23	01:15	1.79	1.57	04:10	0.68	10:30	3.98	2.55	03:40	0.018	10:35	0.136	0.082	0.082	0.58
03/08/2020	05:55	1.30	11:35	1.88	1.53	04:15	0.92	11:00	4.60	2.51	04:15	0.023	11:35	0.173	0.077	0.077	0.02
03/09/2020	03:40	1.22	20:10	1.69	1.43	03:40	0.81	20:10	4.20	2.45	03:40	0.018	20:10	0.146	0.069	0.069	0.11

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			9.014	5.26
Avg	1.60	2.40	0.078	

Site Commentary

Site Information

MIL_1790	
Pipe Dimensions	28
Silt Level	0.00"

Overview

Site MIL_1790 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

This location was installed downstream of sites MIL_0190, MIL_0649 and MIL_1795. A check of balancing shows a net flow of 0.837 MGD between the sites.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	10.91	1.97	2.006
Minimum	7.93	1.32	0.852
Maximum	13.37	2.51	3.219
Time of Minimum	3/1/2020 5:45 AM	3/1/2020 5:40 AM	3/1/2020 5:40 AM
Time of Maximum	12/23/2019 12:05 PM	11/27/2019 10:55 AM	12/23/2019 12:05 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

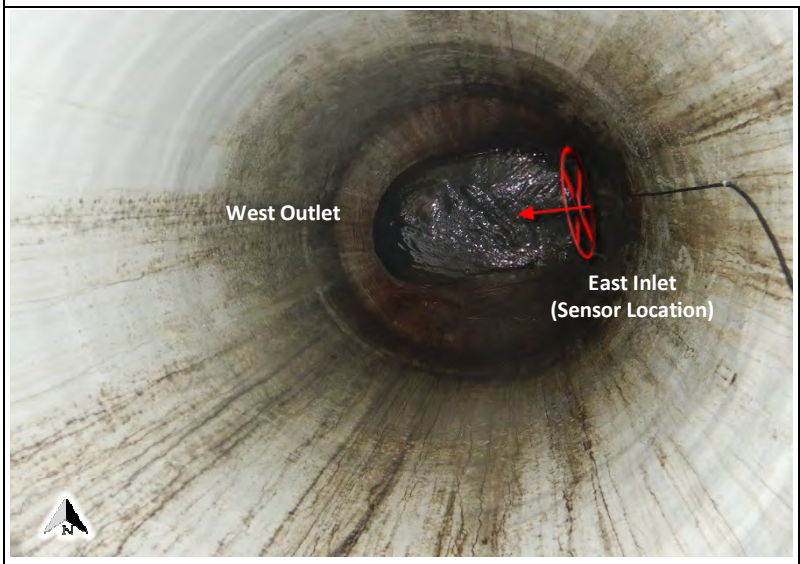
MIL_1790

Site Address /Location:	490 N McCarthy Blvd, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	DRIVE.	Latitude:	37.435578°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.919933°	28.00"x28.00"	Circular



Manhole #	System Characteristics
1790	Residential/Commercial
Access	Traffic
Drive	Light







Installation Information

Installation Date:	Installation Type:
Friday, November 15, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
4:26:00 AM	28.00"x28.00"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
9.00"	
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.82'	0''
Silt (in)	Silt Type
0.0"	

Hydraulic Comments:

Smooth flow with deep depth and moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
12'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Drilled Pavement / Concrete

Additional Site Info. / Comments:

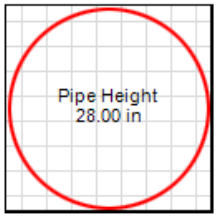
ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

SCATTERGRAPH REPORT

MIL_1790

Flow Monitor

MIL_1790

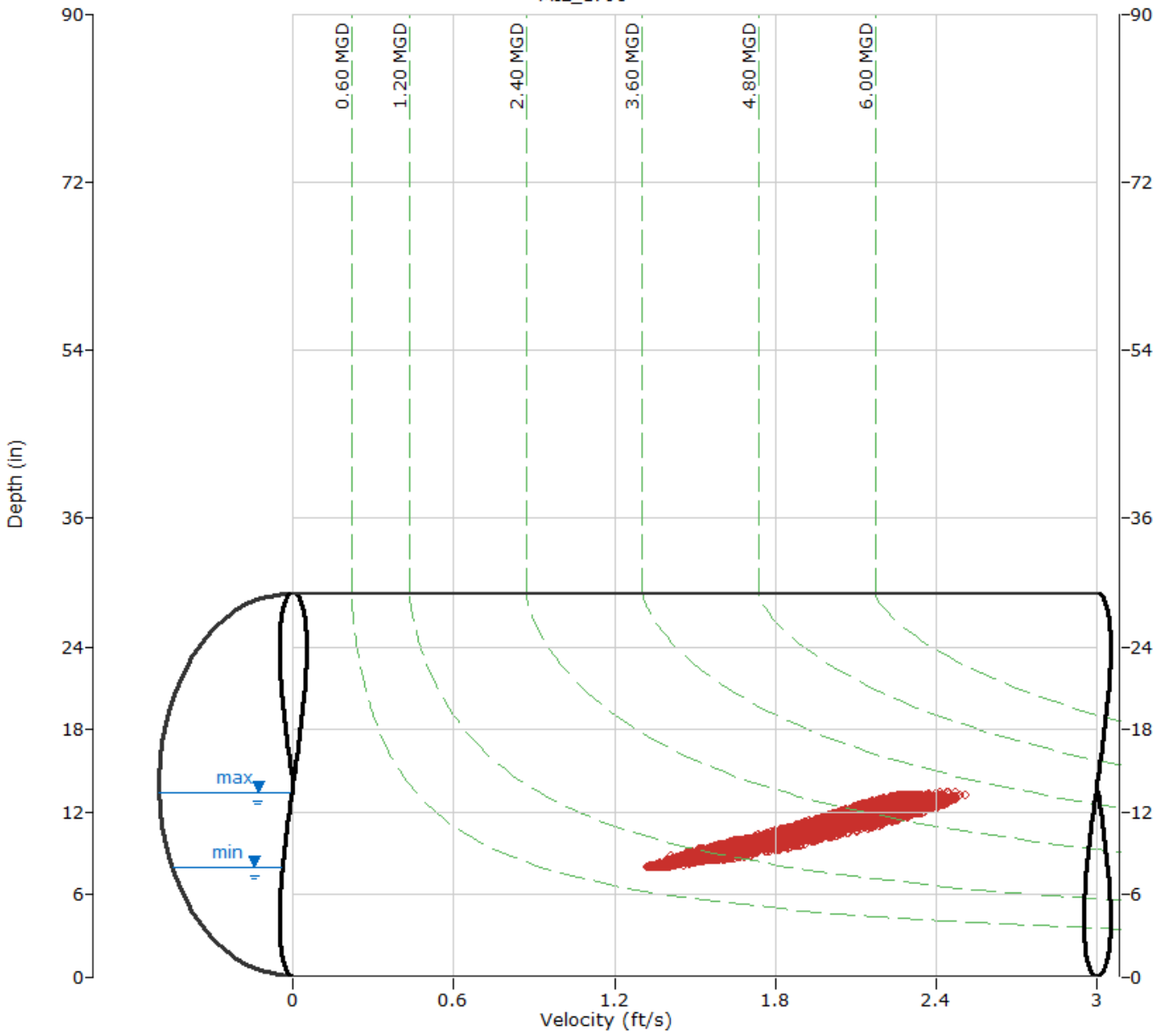


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_1790

Flow Monitor

MIL_1790

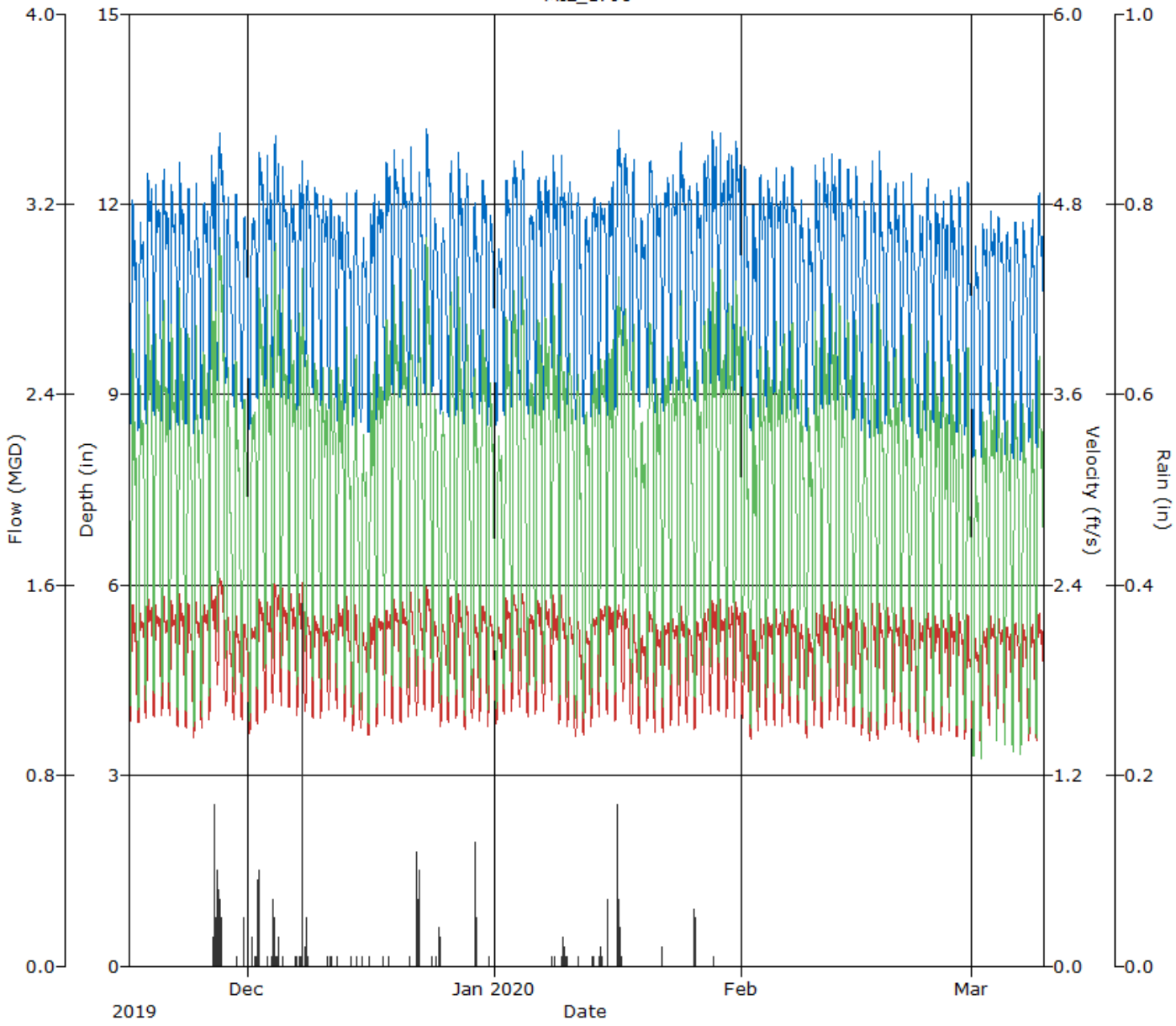
Pipe Height
28.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_1790, Pipe Height: 28.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	04:50	8.41	13:00	12.14	10.48	04:50	1.49	13:05	2.35	1.96	04:50	1.042	13:05	2.693	1.892	1.892	
11/17/2019	05:10	8.36	11:25	11.76	10.38	05:00	1.50	11:30	2.26	1.96	05:00	1.043	11:15	2.492	1.863	1.863	
11/18/2019	03:55	8.47	10:55	12.74	11.03	04:05	1.54	10:40	2.41	2.05	04:05	1.085	10:45	2.934	2.124	2.124	
11/19/2019	04:30	8.64	10:30	12.37	11.03	04:35	1.56	09:20	2.31	2.04	04:30	1.130	10:30	2.717	2.101	2.101	
11/20/2019	04:20	8.59	10:20	12.63	10.92	03:55	1.56	10:40	2.36	2.02	03:55	1.124	10:40	2.840	2.058	2.058	
11/21/2019	04:45	8.43	09:55	12.75	10.93	04:35	1.56	10:00	2.36	2.04	04:35	1.095	09:55	2.893	2.079	2.079	
11/22/2019	04:05	8.48	10:30	12.74	11.03	05:05	1.49	10:40	2.39	2.03	03:55	1.059	10:40	2.911	2.105	2.105	
11/23/2019	05:30	8.52	13:00	12.43	10.62	05:00	1.49	11:25	2.33	1.96	04:55	1.057	11:25	2.735	1.929	1.929	
11/24/2019	04:50	8.32	11:50	12.42	10.50	04:35	1.42	11:00	2.33	1.95	04:50	0.980	11:55	2.752	1.897	1.897	
11/25/2019	04:10	8.35	13:00	12.08	10.80	03:55	1.49	12:15	2.31	2.03	03:55	1.031	12:15	2.618	2.041	2.041	
11/26/2019	03:45	8.54	10:00	12.85	11.16	03:40	1.49	10:00	2.46	2.10	03:40	1.064	10:00	3.038	2.202	2.202	0.36
11/27/2019	03:30	9.16	10:35	13.21	11.60	03:30	1.64	10:55	2.51	2.20	03:30	1.285	10:55	3.198	2.420	2.420	0.63
11/28/2019	05:55	9.13	12:15	12.16	10.64	05:55	1.63	10:45	2.29	1.95	05:55	1.274	12:15	2.542	1.896	1.896	
11/29/2019	05:05	8.72	14:45	12.30	10.67	05:05	1.53	18:15	2.24	1.94	05:05	1.123	14:45	2.601	1.910	1.910	0.02
11/30/2019	06:50	8.72	13:05	11.84	10.52	06:50	1.53	13:05	2.16	1.91	06:50	1.126	13:05	2.400	1.843	1.843	0.10
12/01/2019	06:55	8.39	16:00	11.80	10.50	06:55	1.45	22:05	2.16	1.89	06:55	1.010	22:10	2.376	1.833	1.833	0.06
12/02/2019	04:40	8.91	09:20	12.88	11.47	04:20	1.52	10:50	2.35	2.06	04:25	1.151	09:30	2.909	2.240	2.240	0.30
12/03/2019	04:25	9.10	10:15	12.85	11.19	04:55	1.57	21:30	2.35	2.04	04:55	1.227	10:30	2.880	2.133	2.133	0.01
12/04/2019	04:25	8.62	10:05	13.23	11.53	04:25	1.51	09:45	2.44	2.14	04:25	1.090	10:00	3.092	2.336	2.336	0.39
12/05/2019	04:35	8.92	09:40	12.68	11.22	04:30	1.62	10:55	2.42	2.09	04:30	1.228	09:40	2.931	2.197	2.197	0.01
12/06/2019	04:25	8.85	09:45	12.34	10.95	03:00	1.52	09:45	2.39	2.05	03:00	1.162	09:45	2.800	2.090	2.090	0.01
12/07/2019	04:00	8.72	19:55	12.74	10.99	03:25	1.55	20:15	2.44	2.07	04:50	1.150	19:55	2.988	2.135	2.135	0.67
12/08/2019	06:20	9.41	11:30	12.40	11.14	06:30	1.56	13:40	2.23	1.97	06:30	1.273	10:50	2.621	2.046	2.046	0.20
12/09/2019	04:45	8.99	09:50	12.37	11.20	03:55	1.51	09:30	2.27	1.99	03:55	1.172	09:45	2.644	2.088	2.088	
12/10/2019	04:30	8.80	10:05	12.20	10.96	04:15	1.49	09:20	2.25	1.97	04:15	1.119	09:25	2.587	2.004	2.004	
12/11/2019	03:50	8.74	11:20	12.19	10.87	04:05	1.55	09:05	2.27	2.00	04:05	1.148	11:20	2.570	2.010	2.010	0.03
12/12/2019	04:35	8.56	09:55	11.95	10.77	03:05	1.57	11:35	2.32	2.05	04:20	1.161	11:35	2.574	2.040	2.040	0.01
12/13/2019	03:55	8.75	10:10	12.54	10.61	03:55	1.54	10:15	2.37	1.96	03:55	1.137	10:10	2.832	1.916	1.916	0.01
12/14/2019	04:45	8.48	14:40	12.24	10.45	04:45	1.47	12:00	2.34	1.90	04:45	1.040	12:00	2.658	1.827	1.827	0.01
12/15/2019	03:45	8.49	12:15	11.66	10.25	03:45	1.47	12:15	2.13	1.86	03:45	1.043	12:15	2.322	1.732	1.732	0.01
12/16/2019	03:50	8.27	21:35	12.25	10.76	03:50	1.42	22:10	2.32	1.95	03:50	0.971	22:10	2.668	1.951	1.951	0.01
12/17/2019	04:15	8.56	10:55	12.12	10.94	04:15	1.49	10:55	2.20	1.99	04:15	1.068	10:55	2.523	2.024	2.024	0.01
12/18/2019	04:50	8.81	11:10	12.72	11.41	04:50	1.55	10:15	2.28	2.04	04:50	1.159	11:10	2.775	2.192	2.192	0.01
12/19/2019	04:15	8.96	10:40	12.98	11.54	04:00	1.51	11:05	2.36	2.04	04:20	1.155	10:40	2.908	2.238	2.238	
12/20/2019	05:35	8.91	10:55	12.85	11.40	05:00	1.51	10:45	2.37	2.04	05:00	1.145	10:50	2.925	2.195	2.195	
12/21/2019	04:50	8.76	11:10	12.98	10.98	04:45	1.54	12:00	2.38	2.00	04:45	1.139	11:25	2.970	2.048	2.048	0.01
12/22/2019	04:30	8.77	14:25	12.58	10.86	04:25	1.55	15:00	2.36	1.99	04:25	1.152	15:00	2.816	2.014	2.014	0.41
12/23/2019	04:20	8.98	12:05	13.37	11.47	04:30	1.60	12:05	2.47	2.09	04:30	1.226	12:05	3.219	2.280	2.280	
12/24/2019	04:55	9.01	11:45	11.85	10.67	04:55	1.58	12:55	2.19	1.95	04:55	1.212	11:45	2.436	1.910	1.910	0.02
12/25/2019	07:20	8.64	11:55	11.72	10.39	06:15	1.41	11:55	2.18	1.90	06:15	1.037	11:55	2.385	1.805	1.805	0.08
12/26/2019	04:10	8.56	13:45	12.77	11.05	04:15	1.49	12:50	2.39	2.02	04:10	1.071	13:20	2.889	2.101	2.101	
12/27/2019	04:35	8.59	11:25	12.92	11.09	05:35	1.55	11:20	2.39	2.02	04:30	1.117	11:25	2.969	2.107	2.107	
12/28/2019	06:15	8.43	11:30	12.54	10.69	05:00	1.45	14:55	2.29	1.94	05:00	1.036	11:30	2.729	1.926	1.926	
12/29/2019	03:55	8.63	13:00	12.08	10.52	03:45	1.53	11:50	2.26	1.93	03:55	1.117	11:50	2.567	1.865	1.865	0.22
12/30/2019	05:00	8.63	12:05	12.49	11.06	04:10	1.52	12:10	2.30	2.03	04:50	1.112	12:10	2.745	2.100	2.100	
12/31/2019	04:55	8.48	12:10	11.96	10.57	04:00	1.49	12:00	2.25	1.95	04:55	1.056	12:00	2.512	1.897	1.897	0.01

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/01/2020	06:40	8.45	11:15	11.44	10.24	06:05	1.50	13:00	2.15	1.90	06:50	1.062	13:40	2.250	1.769	1.769	
01/02/2020	04:55	8.64	14:00	12.47	11.10	04:45	1.57	14:05	2.36	2.06	05:00	1.141	14:05	2.803	2.140	2.140	
01/03/2020	04:15	8.73	12:50	12.84	11.17	04:10	1.57	12:40	2.42	2.04	04:10	1.158	12:40	2.975	2.147	2.147	
01/04/2020	04:40	8.87	11:50	13.21	10.98	04:35	1.61	11:50	2.42	2.03	04:50	1.213	11:50	3.104	2.078	2.078	
01/05/2020	04:15	8.67	12:00	11.86	10.68	04:05	1.55	12:15	2.32	1.98	04:15	1.134	12:15	2.581	1.951	1.951	
01/06/2020	05:00	8.63	13:45	12.51	11.13	04:50	1.55	10:45	2.35	2.05	04:50	1.128	10:45	2.804	2.142	2.142	
01/07/2020	04:25	8.73	09:55	12.56	11.21	04:25	1.59	09:30	2.39	2.06	04:25	1.166	09:30	2.848	2.173	2.173	
01/08/2020	05:00	9.14	10:50	12.92	11.34	04:50	1.60	10:40	2.45	2.07	04:50	1.261	10:40	3.044	2.202	2.202	0.02
01/09/2020	04:20	8.55	11:15	13.09	11.17	03:40	1.51	10:45	2.39	2.01	04:20	1.080	11:05	3.005	2.110	2.110	0.18
01/10/2020	04:30	8.79	10:20	12.42	11.06	04:00	1.49	10:05	2.22	1.94	04:20	1.113	10:40	2.629	2.007	2.007	0.02
01/11/2020	04:00	8.51	12:55	12.28	10.62	04:00	1.42	12:50	2.23	1.85	04:00	1.006	12:50	2.596	1.823	1.823	0.01
01/12/2020	04:10	8.51	11:50	11.85	10.50	06:15	1.44	11:50	2.16	1.86	04:10	1.023	11:50	2.406	1.797	1.797	
01/13/2020	04:20	8.58	13:55	12.28	10.93	04:25	1.48	22:35	2.28	1.98	04:25	1.066	13:55	2.606	2.016	2.016	0.02
01/14/2020	04:00	8.64	09:50	12.09	10.94	02:15	1.52	10:35	2.34	2.03	04:00	1.125	10:35	2.645	2.077	2.077	0.11
01/15/2020	04:25	8.64	20:10	12.45	11.09	04:25	1.56	11:10	2.36	2.06	04:25	1.128	11:10	2.687	2.129	2.129	0.07
01/16/2020	04:50	8.69	14:25	13.23	11.54	04:50	1.52	12:45	2.32	2.04	04:50	1.114	14:00	2.970	2.243	2.243	0.66
01/17/2020	04:10	9.72	10:35	12.87	11.64	04:55	1.64	09:40	2.28	2.03	04:05	1.407	09:40	2.809	2.226	2.226	
01/18/2020	04:40	9.03	12:55	12.88	10.93	04:40	1.52	10:50	2.26	1.89	04:40	1.168	12:45	2.801	1.929	1.929	
01/19/2020	06:00	8.73	11:45	11.92	10.57	04:15	1.45	14:35	2.11	1.84	04:15	1.076	11:45	2.359	1.794	1.794	
01/20/2020	03:45	8.99	15:25	12.78	11.27	04:10	1.51	12:55	2.25	1.97	03:45	1.170	15:15	2.750	2.096	2.096	
01/21/2020	04:55	8.63	10:15	12.24	11.02	04:45	1.44	10:15	2.18	1.93	04:45	1.043	10:15	2.529	1.977	1.977	
01/22/2020	04:20	8.72	20:10	12.46	11.16	04:20	1.46	19:55	2.22	1.94	04:20	1.072	20:00	2.633	2.037	2.037	0.03
01/23/2020	04:35	9.06	09:50	12.69	11.30	04:50	1.49	09:25	2.23	1.97	04:50	1.152	09:50	2.687	2.093	2.093	
01/24/2020	04:45	9.02	11:30	13.07	11.46	04:45	1.50	12:00	2.29	1.99	04:45	1.158	11:30	2.891	2.159	2.159	
01/25/2020	04:35	9.03	15:15	12.37	10.91	04:35	1.51	12:15	2.18	1.88	04:35	1.166	11:30	2.537	1.907	1.907	
01/26/2020	05:35	8.87	11:30	12.42	10.90	04:55	1.47	13:40	2.20	1.91	04:55	1.112	11:40	2.599	1.940	1.940	0.16
01/27/2020	04:20	9.13	20:40	12.82	11.47	03:20	1.59	09:40	2.33	2.02	04:35	1.252	09:40	2.855	2.193	2.193	
01/28/2020	04:05	9.12	10:30	13.20	11.57	04:00	1.56	11:00	2.34	2.04	04:00	1.217	10:55	2.986	2.245	2.245	0.01
01/29/2020	04:20	9.14	10:15	13.19	11.53	02:55	1.58	09:40	2.37	2.03	04:20	1.246	09:40	3.013	2.212	2.212	
01/30/2020	04:30	9.07	21:30	12.86	11.45	03:20	1.56	10:55	2.31	2.02	04:30	1.213	10:55	2.855	2.190	2.190	
01/31/2020	04:45	9.04	09:35	13.05	11.54	04:45	1.55	09:55	2.38	2.03	04:45	1.193	09:55	2.995	2.227	2.227	
02/01/2020	04:30	8.93	11:50	12.66	10.87	04:35	1.54	10:35	2.28	1.92	04:35	1.173	10:40	2.756	1.936	1.936	
02/02/2020	05:50	8.37	13:20	12.05	10.42	05:40	1.39	13:50	2.14	1.83	05:40	0.966	12:30	2.413	1.754	1.754	
02/03/2020	04:15	8.60	10:50	12.57	11.06	04:30	1.45	11:10	2.26	1.95	04:00	1.052	11:10	2.703	2.019	2.019	
02/04/2020	03:45	8.73	09:50	12.47	11.14	03:50	1.50	09:20	2.25	1.96	03:50	1.102	09:25	2.660	2.050	2.050	
02/05/2020	04:15	8.88	10:40	12.68	11.19	04:10	1.50	10:35	2.26	1.99	04:15	1.131	10:40	2.740	2.084	2.084	
02/06/2020	04:30	8.67	10:05	12.55	11.15	04:30	1.50	09:50	2.25	1.99	04:30	1.091	10:05	2.693	2.082	2.082	
02/07/2020	04:20	8.71	10:50	12.66	11.16	04:05	1.52	11:25	2.28	1.99	04:25	1.120	11:25	2.761	2.083	2.083	
02/08/2020	04:35	8.67	16:10	12.60	10.62	03:45	1.51	16:10	2.26	1.90	04:35	1.105	16:10	2.726	1.858	1.858	
02/09/2020	05:10	8.41	11:40	11.84	10.41	06:15	1.42	12:05	2.15	1.86	05:10	0.997	12:05	2.372	1.774	1.774	
02/10/2020	04:30	8.66	09:45	12.79	11.02	04:25	1.50	10:10	2.34	1.97	04:25	1.090	10:10	2.866	2.025	2.025	
02/11/2020	05:00	8.73	09:35	12.83	11.31	04:55	1.49	09:45	2.32	1.99	05:00	1.094	09:45	2.850	2.128	2.128	
02/12/2020	05:00	8.79	10:40	12.82	11.40	04:45	1.52	10:00	2.32	2.03	04:55	1.136	10:40	2.859	2.187	2.187	
02/13/2020	04:40	8.81	09:35	12.81	11.16	05:20	1.52	09:20	2.33	2.00	05:15	1.142	09:25	2.868	2.089	2.089	
02/14/2020	04:40	8.71	11:05	12.67	11.19	04:35	1.52	11:05	2.30	2.00	04:35	1.116	11:05	2.791	2.102	2.102	
02/15/2020	04:00	8.50	12:15	12.72	10.65	04:00	1.47	12:20	2.31	1.91	04:00	1.042	12:15	2.818	1.881	1.881	
02/16/2020	04:50	8.31	13:10	12.24	10.40	04:40	1.41	13:05	2.18	1.86	04:45	0.969	13:05	2.531	1.774	1.774	
02/17/2020	05:15	8.29	11:30	12.82	10.70	06:00	1.40	11:35	2.33	1.90	06:00	0.959	11:35	2.864	1.908	1.908	
02/18/2020	04:30	8.31	10:45	12.93	10.89	04:25	1.41	10:15	2.32	1.96	04:25	0.969	10:50	2.855	1.984	1.984	
02/19/2020	04:35	8.51	10:45	12.39	10.85	03:05	1.46	10:35	2.29	1.96	03:40	1.045	10:45	2.701	1.987	1.987	
02/20/2020	05:00	8.69	11:30	12.43	10.95	04:55	1.50	11:30	2.25	1.97	04:55	1.097	11:30	2.667	2.000	2.000	
02/21/2020	04:40	8.56	10:55	12.63	10.77	03:55	1.46	10:50	2.33	1.93	03:55	1.046	10:50	2.795	1.926	1.926	
02/22/2020	06:35	8.46	11:30	12.56	10.54	06:50	1.44	11:15	2.29	1.89	06:20	1.016	11:15	2.737	1.836	1.836	
02/23/2020	06:45	8.26	20:50	11.96	10.49	06:00	1.39	11:40	2.19	1.88	06:40	0.952	11:30	2.444	1.826	1.826	
02/24/2020	03:55	8.42	11:30	12.52	10.87	05:00	1.43	11:30	2.27	1.96	05:00	1.003	11:30	2.718	1.984	1.984	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	05:15	8.41	10:15	12.22	10.84	05:00	1.41	10:20	2.24	1.95	05:05	0.995	10:20	2.584	1.967	1.967	
02/26/2020	05:00	8.35	10:55	12.23	10.78	04:50	1.43	10:55	2.22	1.95	05:00	0.993	10:55	2.581	1.942	1.942	
02/27/2020	05:20	8.44	09:55	12.33	10.84	04:30	1.46	10:10	2.24	1.95	05:20	1.034	09:55	2.618	1.959	1.959	
02/28/2020	04:20	8.37	11:05	12.44	10.75	03:50	1.43	09:55	2.26	1.92	04:35	0.994	11:05	2.664	1.924	1.924	
02/29/2020	04:05	8.25	14:10	12.89	10.38	03:50	1.40	14:00	2.33	1.85	03:50	0.957	14:10	2.893	1.760	1.760	
03/01/2020	05:45	7.93	12:35	11.38	10.01	05:40	1.32	12:10	2.08	1.77	05:40	0.852	12:10	2.189	1.611	1.611	
03/02/2020	04:35	7.99	09:45	12.02	10.50	04:35	1.33	20:50	2.21	1.88	04:35	0.864	20:50	2.488	1.827	1.827	
03/03/2020	05:55	8.52	11:00	12.07	10.65	04:50	1.46	11:00	2.27	1.95	05:50	1.050	11:00	2.588	1.914	1.914	
03/04/2020	03:45	8.00	09:40	12.22	10.51	03:45	1.40	09:35	2.26	1.93	03:45	0.911	09:35	2.607	1.868	1.868	
03/05/2020	04:15	7.99	10:55	11.62	10.43	04:25	1.36	11:00	2.20	1.91	04:25	0.888	11:00	2.379	1.831	1.831	
03/06/2020	04:20	7.96	12:35	11.81	10.44	04:10	1.35	12:30	2.21	1.90	04:10	0.877	12:35	2.447	1.827	1.827	
03/07/2020	04:30	7.94	12:10	11.94	10.24	03:40	1.34	10:20	2.21	1.86	03:40	0.872	12:05	2.474	1.745	1.745	
03/08/2020	05:30	8.22	15:05	12.34	10.08	04:25	1.39	15:00	2.26	1.83	04:25	0.947	15:05	2.655	1.678	1.678	
03/09/2020	03:25	8.15	12:20	12.27	10.71	03:15	1.41	12:10	2.25	1.94	03:25	0.942	12:20	2.618	1.930	1.928	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			230.723	4.90
Avg	10.91	1.97	2.006	

Site Commentary

Site Information

MIL_1795	
Pipe Dimensions	27
Silt Level	1.50"

Overview

Site MIL_1795 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. Sediment and slow flow conditions render data of lower confidence than typical.

This location was installed upstream of site MIL_1790. (See MIL_1790 Site Commentary for More Details)

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	9.47	0.40	0.299
Minimum	6.32	0.17	0.087
Maximum	12.80	0.54	0.503
Time of Minimum	2/7/2020 3:55 AM	11/22/2019 4:40 AM	2/7/2020 3:55 AM
Time of Maximum	1/9/2020 11:40 AM	3/8/2020 1:35 PM	12/30/2019 12:35 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_1795

Site Address /Location:	Marylinn Dr and Penitencia St, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	DRIVE.	Latitude:	37.435797°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.911864°	27.00"x27.00"	Circular



Manhole #	System Characteristics
1795	Residential/Commercial
Access	Traffic
Drive	Medium







Installation Information

Installation Date:	Installation Type:
Friday, November 15, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
6:23:00 AM	27.00"x27.00"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
9.75"	
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
0.34'	0''
Silt (in)	Silt Type
3.0"	Soft / Loose

Hydraulic Comments:

Smooth flow with deep depth and slow velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
8'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Drilled Pavement / Concrete

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

SCATTERGRAPH REPORT

MIL_1795

Flow Monitor

MIL_1795

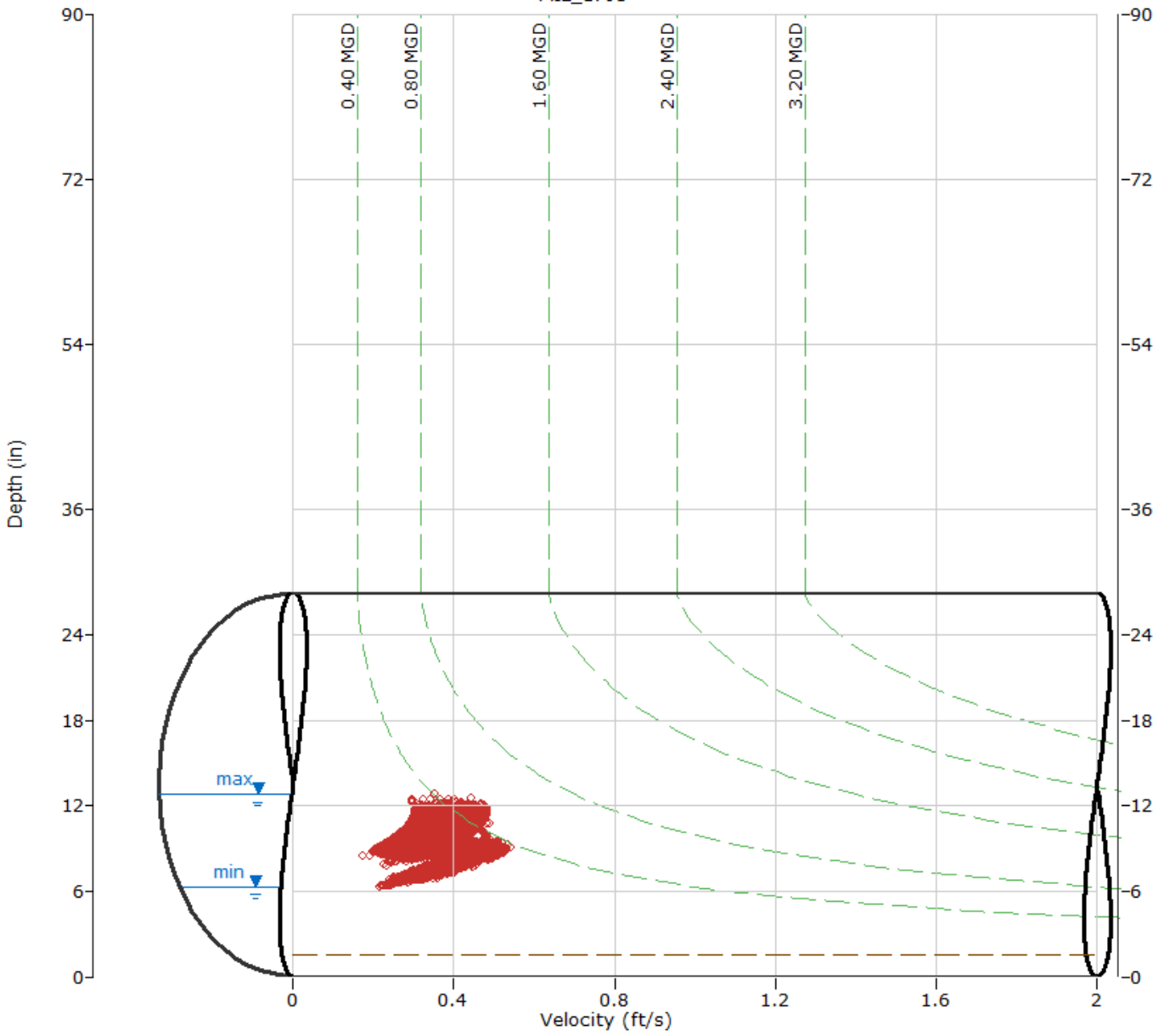
Pipe Height
27.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



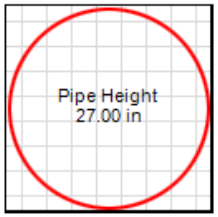
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_1795

Flow Monitor

MIL_1795

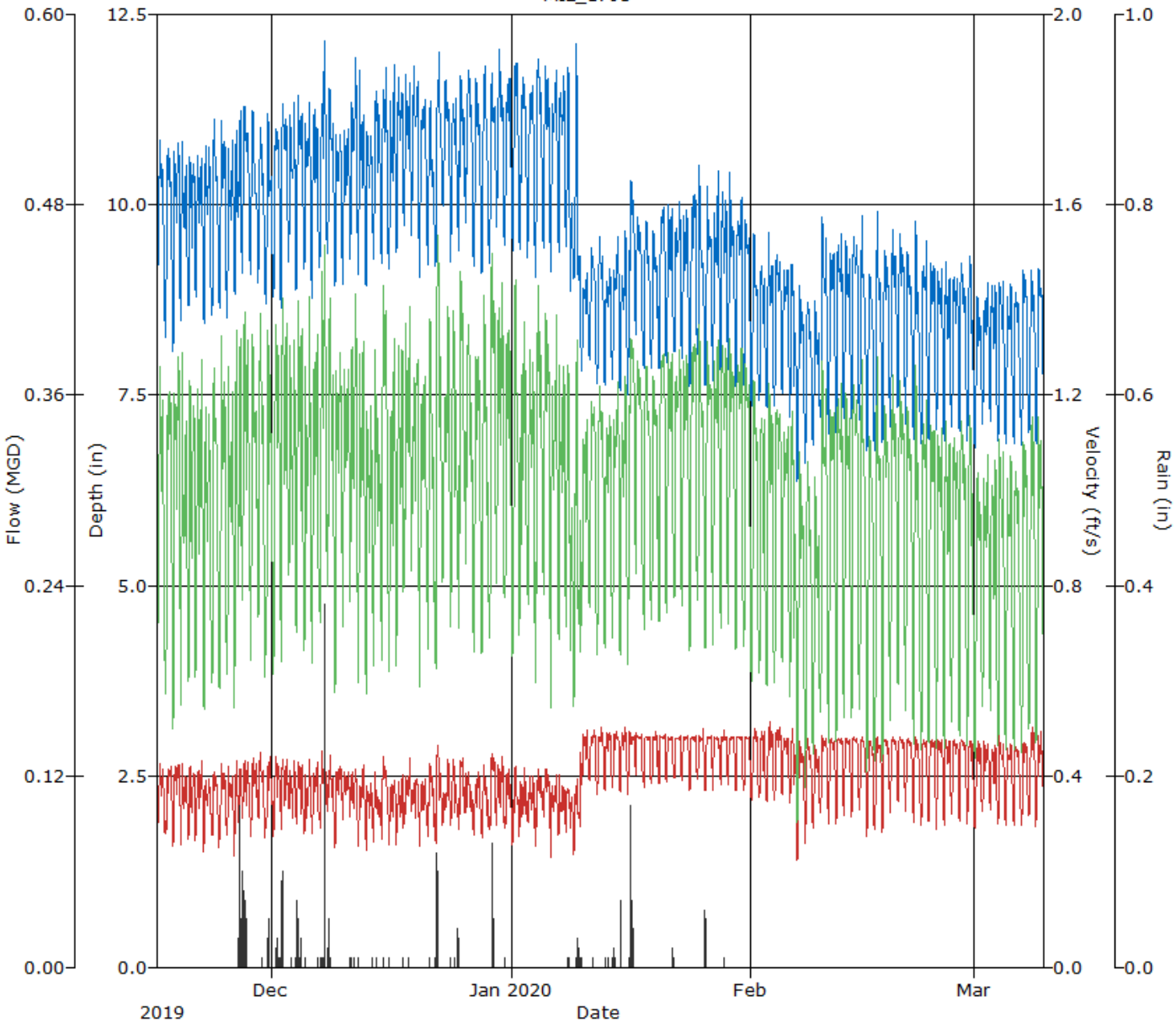


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_1795, Pipe Height: 27.00 in, Silt: 1.50 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	04:40	8.99	11:20	10.88	10.01	04:15	0.22	13:40	0.46	0.36	04:15	0.156	13:40	0.412	0.297	0.297	
11/17/2019	05:20	8.24	13:15	10.80	9.77	05:50	0.24	11:15	0.46	0.36	05:50	0.148	11:15	0.409	0.287	0.287	
11/18/2019	04:20	8.06	08:10	10.91	9.74	04:05	0.24	21:55	0.47	0.37	04:05	0.140	21:55	0.427	0.292	0.292	
11/19/2019	03:30	8.46	07:55	10.99	9.73	04:35	0.22	08:50	0.46	0.35	04:35	0.142	08:45	0.408	0.278	0.278	
11/20/2019	02:40	8.63	17:40	10.85	9.82	04:10	0.21	07:30	0.46	0.36	04:10	0.140	09:05	0.398	0.286	0.286	
11/21/2019	02:40	8.76	20:40	10.77	9.93	02:20	0.24	20:45	0.46	0.36	02:20	0.158	20:45	0.409	0.295	0.295	
11/22/2019	04:15	8.41	17:05	11.12	9.87	04:40	0.17	21:50	0.47	0.34	04:40	0.110	21:50	0.410	0.275	0.275	
11/23/2019	03:55	8.51	13:20	11.32	9.92	05:25	0.23	13:05	0.47	0.35	05:25	0.147	13:05	0.448	0.287	0.287	
11/24/2019	04:45	8.62	12:00	11.14	10.10	02:50	0.21	09:05	0.47	0.36	02:50	0.142	10:45	0.432	0.299	0.299	
11/25/2019	03:30	8.47	20:20	10.88	9.94	04:45	0.20	19:40	0.45	0.36	04:45	0.132	19:40	0.405	0.290	0.290	
11/26/2019	04:15	8.80	21:05	11.28	10.08	04:10	0.20	07:45	0.47	0.35	04:10	0.135	07:45	0.439	0.292	0.292	0.36
11/27/2019	03:20	9.00	09:50	11.41	10.48	05:05	0.29	12:00	0.48	0.39	03:20	0.208	10:35	0.459	0.337	0.337	0.63
11/28/2019	05:25	9.04	11:05	11.32	10.25	05:30	0.22	14:50	0.47	0.37	05:30	0.155	12:30	0.437	0.313	0.313	
11/29/2019	04:05	8.87	10:55	11.05	10.09	04:20	0.23	10:40	0.47	0.38	04:20	0.160	10:40	0.436	0.311	0.311	0.02
11/30/2019	06:00	8.66	11:35	11.32	9.98	03:15	0.21	11:30	0.48	0.36	03:15	0.142	11:30	0.458	0.299	0.299	0.10
12/01/2019	05:50	8.76	15:10	11.11	10.17	06:40	0.21	12:50	0.48	0.37	06:40	0.150	12:50	0.444	0.313	0.313	0.06
12/02/2019	03:35	8.62	08:50	11.52	10.37	04:45	0.24	16:00	0.48	0.38	04:45	0.157	08:20	0.458	0.326	0.326	0.30
12/03/2019	03:10	9.15	19:15	11.56	10.43	04:35	0.27	22:10	0.47	0.38	04:35	0.207	20:10	0.451	0.325	0.325	0.01
12/04/2019	03:10	8.77	08:45	11.59	10.53	03:25	0.26	20:55	0.47	0.38	03:25	0.176	10:35	0.461	0.332	0.332	0.39
12/05/2019	04:00	9.10	21:25	11.42	10.43	05:00	0.23	21:55	0.48	0.36	05:00	0.166	21:55	0.455	0.310	0.310	0.01
12/06/2019	04:10	8.72	07:50	11.41	10.33	03:55	0.21	12:10	0.47	0.37	03:55	0.137	12:10	0.443	0.316	0.316	0.01
12/07/2019	02:50	9.15	18:35	12.16	10.63	05:55	0.26	12:00	0.48	0.38	05:55	0.193	17:45	0.501	0.339	0.339	0.67
12/08/2019	05:50	9.33	10:20	11.56	10.56	23:55	0.28	11:35	0.48	0.38	23:55	0.230	11:35	0.476	0.335	0.335	0.20
12/09/2019	04:10	8.91	06:50	11.26	10.25	04:05	0.21	19:40	0.47	0.37	04:05	0.142	19:40	0.437	0.311	0.311	
12/10/2019	04:20	8.95	08:40	11.04	10.30	04:40	0.27	20:25	0.47	0.38	04:40	0.184	20:25	0.432	0.321	0.321	
12/11/2019	04:10	9.24	20:25	12.06	10.70	04:50	0.25	20:00	0.46	0.37	04:50	0.181	20:00	0.474	0.334	0.334	0.03
12/12/2019	04:55	9.03	08:20	11.94	10.45	04:05	0.23	22:00	0.47	0.35	04:05	0.164	22:00	0.443	0.305	0.305	0.01
12/13/2019	04:05	8.91	07:00	11.11	10.26	04:20	0.21	07:05	0.45	0.34	04:20	0.142	07:05	0.417	0.290	0.290	0.01
12/14/2019	03:35	9.23	19:35	11.88	10.53	04:30	0.24	14:55	0.46	0.33	04:30	0.175	14:55	0.433	0.291	0.291	0.01
12/15/2019	05:30	9.22	19:20	11.90	10.67	06:10	0.24	11:55	0.48	0.38	05:15	0.175	11:55	0.471	0.337	0.337	0.01
12/16/2019	03:25	9.04	19:15	12.04	10.56	04:30	0.23	20:55	0.47	0.35	04:30	0.168	20:55	0.475	0.306	0.306	0.01
12/17/2019	03:00	9.35	11:25	11.82	10.81	03:20	0.23	21:00	0.47	0.34	03:20	0.171	21:00	0.460	0.310	0.310	0.01
12/18/2019	03:20	9.69	09:05	11.84	10.90	03:30	0.25	08:55	0.48	0.37	03:30	0.198	08:55	0.488	0.340	0.340	0.01
12/19/2019	03:10	9.40	21:45	11.97	10.96	05:30	0.27	16:10	0.47	0.36	05:30	0.216	17:55	0.449	0.335	0.335	
12/20/2019	04:00	8.98	19:15	11.49	10.60	04:10	0.23	21:35	0.45	0.34	04:10	0.157	18:55	0.421	0.306	0.306	
12/21/2019	05:05	9.18	14:15	11.67	10.37	05:55	0.23	12:45	0.48	0.36	05:40	0.164	14:30	0.462	0.309	0.309	0.01
12/22/2019	06:00	9.09	15:05	12.18	10.70	05:50	0.22	12:45	0.48	0.37	05:50	0.158	12:40	0.474	0.333	0.333	0.41
12/23/2019	05:10	9.93	10:40	11.67	10.90	02:45	0.28	20:25	0.48	0.36	01:20	0.228	20:45	0.457	0.329	0.329	
12/24/2019	04:50	9.20	19:15	11.56	10.58	04:55	0.28	13:45	0.48	0.36	04:55	0.199	13:45	0.450	0.319	0.319	0.02
12/25/2019	05:10	9.37	11:55	11.70	10.65	04:20	0.25	19:10	0.47	0.37	04:20	0.187	12:00	0.465	0.333	0.333	0.08
12/26/2019	02:45	9.69	12:55	11.93	10.97	02:50	0.27	14:10	0.48	0.37	02:50	0.212	14:10	0.480	0.339	0.339	
12/27/2019	04:55	9.18	11:35	11.70	10.65	04:45	0.24	16:25	0.47	0.35	04:45	0.172	12:25	0.439	0.318	0.318	
12/28/2019	05:05	9.03	14:20	11.92	10.57	05:30	0.24	13:50	0.48	0.34	05:30	0.171	13:50	0.470	0.305	0.305	
12/29/2019	05:05	9.20	13:25	11.80	10.72	06:55	0.27	13:40	0.48	0.37	05:40	0.196	09:45	0.488	0.337	0.337	0.22
12/30/2019	03:55	9.62	12:50	12.09	11.03	03:10	0.26	15:55	0.48	0.38	03:35	0.203	12:35	0.503	0.357	0.357	
12/31/2019	04:10	9.43	19:50	11.96	10.81	06:00	0.26	19:00	0.48	0.36	06:00	0.207	19:00	0.459	0.328	0.328	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/01/2020	06:20	9.37	18:45	12.51	10.90	05:00	0.24	20:00	0.47	0.34	05:00	0.185	18:45	0.491	0.318	0.318	
01/02/2020	03:35	9.39	13:40	11.71	10.83	02:25	0.25	19:10	0.47	0.34	04:30	0.188	19:10	0.467	0.314	0.314	
01/03/2020	03:00	9.16	19:35	11.60	10.72	05:20	0.24	20:50	0.47	0.35	05:20	0.182	20:50	0.459	0.316	0.316	
01/04/2020	04:15	9.03	13:25	11.96	10.76	04:15	0.21	13:05	0.45	0.35	04:15	0.149	13:05	0.464	0.320	0.320	
01/05/2020	04:45	9.38	12:20	11.88	10.84	05:15	0.24	09:20	0.47	0.37	05:15	0.178	09:20	0.456	0.341	0.341	
01/06/2020	04:00	9.02	21:40	11.80	10.72	04:05	0.22	21:20	0.48	0.34	04:00	0.151	21:20	0.490	0.310	0.310	
01/07/2020	04:50	9.35	20:05	11.71	10.90	04:50	0.26	06:15	0.47	0.34	04:50	0.190	06:20	0.435	0.311	0.311	
01/08/2020	15:20	7.76	10:15	11.81	10.31	15:25	0.23	14:35	0.47	0.34	15:25	0.129	14:35	0.434	0.292	0.292	0.02
01/09/2020	23:55	8.58	11:40	12.80	9.84	03:00	0.22	10:40	0.45	0.32	04:25	0.150	11:45	0.465	0.258	0.258	0.18
01/10/2020	03:50	7.77	19:20	9.17	8.61	03:35	0.38	19:00	0.52	0.45	03:35	0.212	19:00	0.364	0.296	0.296	0.02
01/11/2020	05:10	7.93	11:00	9.52	8.81	05:10	0.39	12:30	0.52	0.45	05:10	0.223	12:30	0.380	0.308	0.308	0.01
01/12/2020	05:00	7.61	11:00	9.82	8.72	04:50	0.34	15:55	0.52	0.45	04:50	0.181	11:00	0.380	0.299	0.299	
01/13/2020	04:15	7.61	19:40	9.24	8.59	04:15	0.37	21:15	0.52	0.45	04:15	0.199	21:15	0.367	0.291	0.291	0.02
01/14/2020	02:15	7.68	20:30	9.62	8.74	03:35	0.35	08:15	0.52	0.45	03:35	0.194	20:30	0.370	0.304	0.304	0.11
01/15/2020	04:55	7.52	20:30	9.69	8.65	04:20	0.36	19:00	0.52	0.45	04:20	0.194	21:20	0.380	0.298	0.298	0.07
01/16/2020	04:00	7.44	13:15	10.33	9.21	04:00	0.36	10:05	0.52	0.45	04:00	0.186	13:15	0.395	0.330	0.330	0.66
01/17/2020	04:50	8.28	09:50	9.95	9.22	04:50	0.40	07:20	0.52	0.47	04:50	0.247	09:50	0.386	0.339	0.339	
01/18/2020	05:40	7.83	14:15	9.85	8.91	05:55	0.35	22:25	0.52	0.45	05:55	0.200	14:15	0.382	0.312	0.312	
01/19/2020	04:55	7.85	11:55	9.74	8.86	04:55	0.38	22:50	0.52	0.45	04:55	0.217	11:55	0.376	0.310	0.310	
01/20/2020	04:40	7.84	15:20	10.01	9.16	04:40	0.38	23:35	0.52	0.46	04:40	0.216	15:20	0.388	0.329	0.329	
01/21/2020	03:55	7.87	11:45	10.30	9.14	03:55	0.39	07:25	0.52	0.46	03:55	0.219	11:45	0.395	0.329	0.329	
01/22/2020	05:00	8.01	21:15	10.12	9.17	05:00	0.39	07:35	0.52	0.46	05:00	0.229	21:15	0.391	0.331	0.331	0.03
01/23/2020	04:35	7.98	19:45	10.10	9.12	04:35	0.39	23:30	0.52	0.46	04:35	0.227	19:45	0.391	0.328	0.328	
01/24/2020	04:50	7.59	17:45	10.20	9.19	04:55	0.36	08:35	0.51	0.45	04:55	0.194	17:45	0.393	0.327	0.327	
01/25/2020	05:05	8.00	10:35	10.74	9.09	05:05	0.39	21:20	0.52	0.46	05:05	0.228	10:35	0.438	0.327	0.327	
01/26/2020	05:05	7.59	11:15	10.31	9.05	05:10	0.37	09:00	0.52	0.45	05:05	0.197	11:15	0.395	0.319	0.319	0.16
01/27/2020	05:20	7.67	21:20	10.68	9.17	05:05	0.34	08:10	0.48	0.46	05:05	0.184	21:05	0.396	0.328	0.328	
01/28/2020	04:30	7.76	10:45	10.40	9.18	04:30	0.38	14:35	0.52	0.46	04:30	0.211	10:45	0.396	0.332	0.332	0.01
01/29/2020	04:05	7.76	10:05	10.69	9.20	04:05	0.38	00:00	0.52	0.46	04:05	0.211	10:20	0.396	0.331	0.331	
01/30/2020	04:05	7.59	22:25	10.33	9.14	04:05	0.37	07:35	0.51	0.46	04:05	0.198	22:25	0.395	0.328	0.328	
01/31/2020	04:55	7.62	10:40	9.84	8.99	04:55	0.37	22:50	0.51	0.45	04:55	0.200	10:40	0.381	0.318	0.318	
02/01/2020	04:40	7.32	11:30	9.64	8.60	04:40	0.35	09:50	0.52	0.44	04:40	0.176	11:30	0.371	0.290	0.290	
02/02/2020	04:55	7.41	10:45	9.24	8.40	04:55	0.35	21:30	0.52	0.43	04:55	0.183	21:30	0.366	0.271	0.271	
02/03/2020	04:05	7.32	08:55	10.48	8.57	04:05	0.35	13:30	0.52	0.44	04:05	0.176	09:00	0.396	0.289	0.289	
02/04/2020	04:35	7.34	13:50	9.45	8.62	06:10	0.34	08:20	0.52	0.45	04:35	0.177	08:20	0.364	0.295	0.295	
02/05/2020	05:30	7.48	20:55	9.34	8.56	03:50	0.33	19:15	0.52	0.44	03:50	0.176	09:15	0.368	0.286	0.286	
02/06/2020	15:00	6.59	14:50	9.92	8.19	15:00	0.26	11:40	0.52	0.42	15:00	0.114	14:50	0.385	0.258	0.258	
02/07/2020	03:55	6.32	11:20	8.99	7.91	03:55	0.22	20:10	0.50	0.39	03:55	0.087	11:20	0.328	0.231	0.231	
02/08/2020	04:00	6.57	12:00	8.81	7.88	04:45	0.24	11:00	0.50	0.40	04:00	0.107	12:10	0.337	0.233	0.233	
02/09/2020	03:50	6.83	11:20	8.82	7.82	04:35	0.25	21:55	0.48	0.39	04:35	0.117	11:20	0.316	0.224	0.224	
02/10/2020	03:20	7.20	09:25	9.88	8.65	01:45	0.29	15:55	0.50	0.43	01:45	0.144	09:25	0.383	0.289	0.289	
02/11/2020	03:40	6.95	21:05	9.40	8.58	04:50	0.29	10:05	0.48	0.43	04:50	0.138	09:10	0.353	0.285	0.285	
02/12/2020	04:05	7.00	20:10	9.76	8.68	04:15	0.27	16:25	0.51	0.44	04:15	0.127	20:10	0.377	0.294	0.294	
02/13/2020	04:00	7.13	11:55	9.57	8.65	03:35	0.29	21:00	0.51	0.44	03:35	0.142	21:00	0.376	0.293	0.293	
02/14/2020	04:00	7.12	11:25	9.65	8.74	03:50	0.28	22:55	0.51	0.44	03:50	0.138	19:20	0.372	0.299	0.299	
02/15/2020	05:30	7.13	12:20	9.92	8.50	06:15	0.30	13:55	0.48	0.43	06:15	0.150	12:20	0.385	0.280	0.280	
02/16/2020	04:45	6.74	13:10	9.27	8.18	04:45	0.24	19:55	0.49	0.41	04:45	0.107	13:10	0.344	0.255	0.255	
02/17/2020	04:50	6.75	13:25	9.99	8.37	03:00	0.27	10:45	0.51	0.41	04:50	0.122	13:25	0.387	0.267	0.267	
02/18/2020	03:50	6.85	11:00	9.50	8.45	04:55	0.27	08:30	0.50	0.43	05:25	0.123	11:00	0.358	0.277	0.277	
02/19/2020	04:30	7.06	12:10	9.75	8.61	04:30	0.31	13:25	0.51	0.44	04:30	0.150	13:25	0.383	0.289	0.289	
02/20/2020	03:30	7.30	11:20	9.64	8.72	04:20	0.31	21:45	0.51	0.45	04:20	0.160	11:20	0.371	0.299	0.299	
02/21/2020	04:20	7.10	11:00	9.56	8.48	03:50	0.29	11:00	0.48	0.44	03:50	0.145	11:00	0.367	0.281	0.281	
02/22/2020	05:40	6.88	12:05	9.91	8.34	03:40	0.28	12:35	0.48	0.42	05:45	0.135	12:05	0.384	0.267	0.267	
02/23/2020	05:35	6.85	20:20	9.71	8.32	03:00	0.28	17:55	0.50	0.42	05:15	0.129	20:20	0.375	0.265	0.265	
02/24/2020	04:30	6.91	11:40	9.34	8.37	01:50	0.29	14:50	0.51	0.42	03:50	0.137	14:50	0.360	0.271	0.271	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	05:10	7.00	20:45	9.19	8.44	03:55	0.28	10:55	0.50	0.43	03:55	0.133	10:55	0.351	0.277	0.277	
02/26/2020	04:15	6.90	08:30	9.34	8.33	05:15	0.27	08:50	0.48	0.43	05:15	0.127	08:30	0.348	0.268	0.268	
02/27/2020	04:10	7.06	12:30	9.10	8.41	04:05	0.29	07:50	0.50	0.43	04:05	0.139	07:50	0.336	0.276	0.276	
02/28/2020	04:05	7.00	11:00	9.33	8.41	04:55	0.29	12:25	0.50	0.43	04:55	0.140	11:00	0.350	0.276	0.276	
02/29/2020	03:55	6.85	13:55	9.42	8.13	03:45	0.26	12:10	0.50	0.41	03:45	0.118	12:10	0.363	0.250	0.250	
03/01/2020	05:30	6.79	12:55	8.88	7.97	03:10	0.25	20:40	0.51	0.41	03:15	0.116	14:25	0.328	0.239	0.239	
03/02/2020	04:25	7.12	20:55	9.06	8.22	01:50	0.29	08:55	0.52	0.42	04:00	0.146	08:40	0.336	0.256	0.256	
03/03/2020	04:40	7.14	20:20	9.01	8.18	04:40	0.33	07:55	0.52	0.41	04:40	0.160	07:55	0.353	0.247	0.247	
03/04/2020	03:50	6.87	09:40	9.11	8.21	03:50	0.30	11:45	0.53	0.42	03:50	0.137	11:45	0.361	0.258	0.258	
03/05/2020	03:35	6.84	20:45	9.08	8.16	04:30	0.29	09:40	0.48	0.41	04:30	0.133	20:45	0.331	0.251	0.251	
03/06/2020	05:35	6.83	10:35	8.98	8.16	05:35	0.29	10:35	0.47	0.41	05:35	0.134	10:35	0.323	0.252	0.252	
03/07/2020	05:15	6.78	11:05	9.25	8.19	04:55	0.28	20:40	0.52	0.40	04:55	0.126	20:40	0.348	0.248	0.248	
03/08/2020	04:50	6.98	11:30	9.18	8.17	04:50	0.31	13:35	0.54	0.42	04:50	0.146	13:35	0.379	0.257	0.257	
03/09/2020	03:30	6.86	10:25	9.21	8.25	01:40	0.27	10:20	0.53	0.41	02:40	0.130	10:20	0.383	0.257	0.257	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			34.416	4.90
Avg	9.47	0.40	0.299	

Site Commentary

Site Information

MIL_2300	
Pipe Dimensions	10.25
Silt Level	0.00"

Overview

Site MIL_2300 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited a small response to the wet weather events of November 26, 2019 - November 27, 2019 and December 7, 2019 - December 8, 2019. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	1.65	1.40	0.056
Minimum	0.93	0.33	0.006
Maximum	2.44	2.89	0.177
Time of Minimum	1/13/2020 4:15 AM	2/27/2020 3:50 AM	1/13/2020 3:55 AM
Time of Maximum	11/28/2019 12:45 PM	12/13/2019 11:10 AM	11/28/2019 12:50 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_2300

				Monitor Series	Location Type
Site Address /Location:	Washington Dr and Fontainbleu Avenue, Milpitas, CA			TRITON+	Temporary
Site Access Details:	In between lanes w/buses	Latitude:	37.452734	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.909412	10.25" x 10.25"	Circular



Manhole #	System Characteristics
2300	Residential
Access	Traffic
Drive	Medium







Installation Information

Installation Date:	Installation Type:
Tuesday, November 12, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
3:03:34 AM	10.25" x 10.25"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
1.13"	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.2	0''
Silt (in)	Silt Type
0''	

Hydraulic Comments:

Good flow shallow depth, moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
6'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
PVC	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_2300

Flow Monitor

MIL_2300

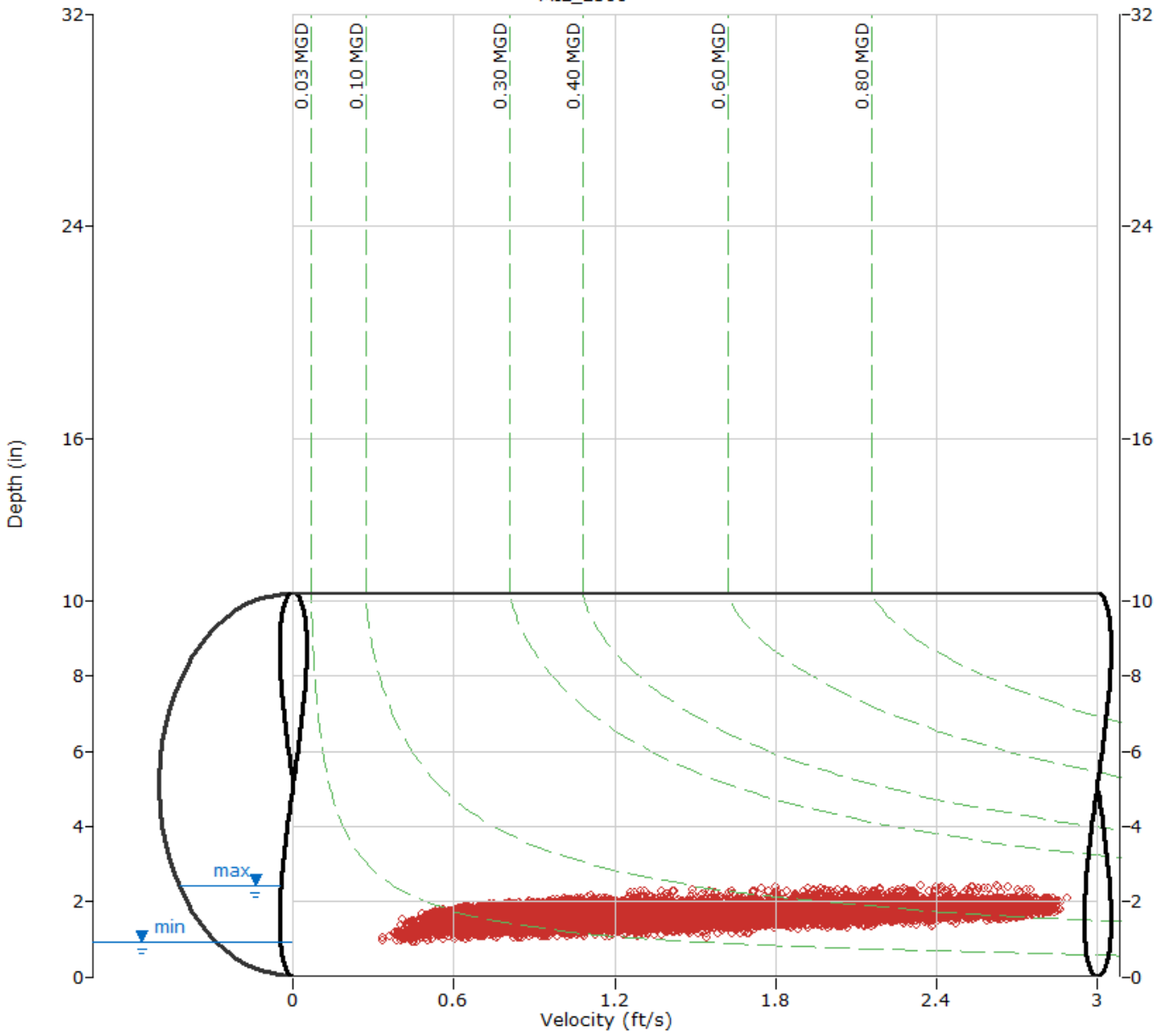
Pipe Height
10.25 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



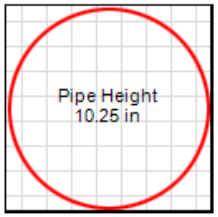
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_2300

Flow Monitor

MIL_2300

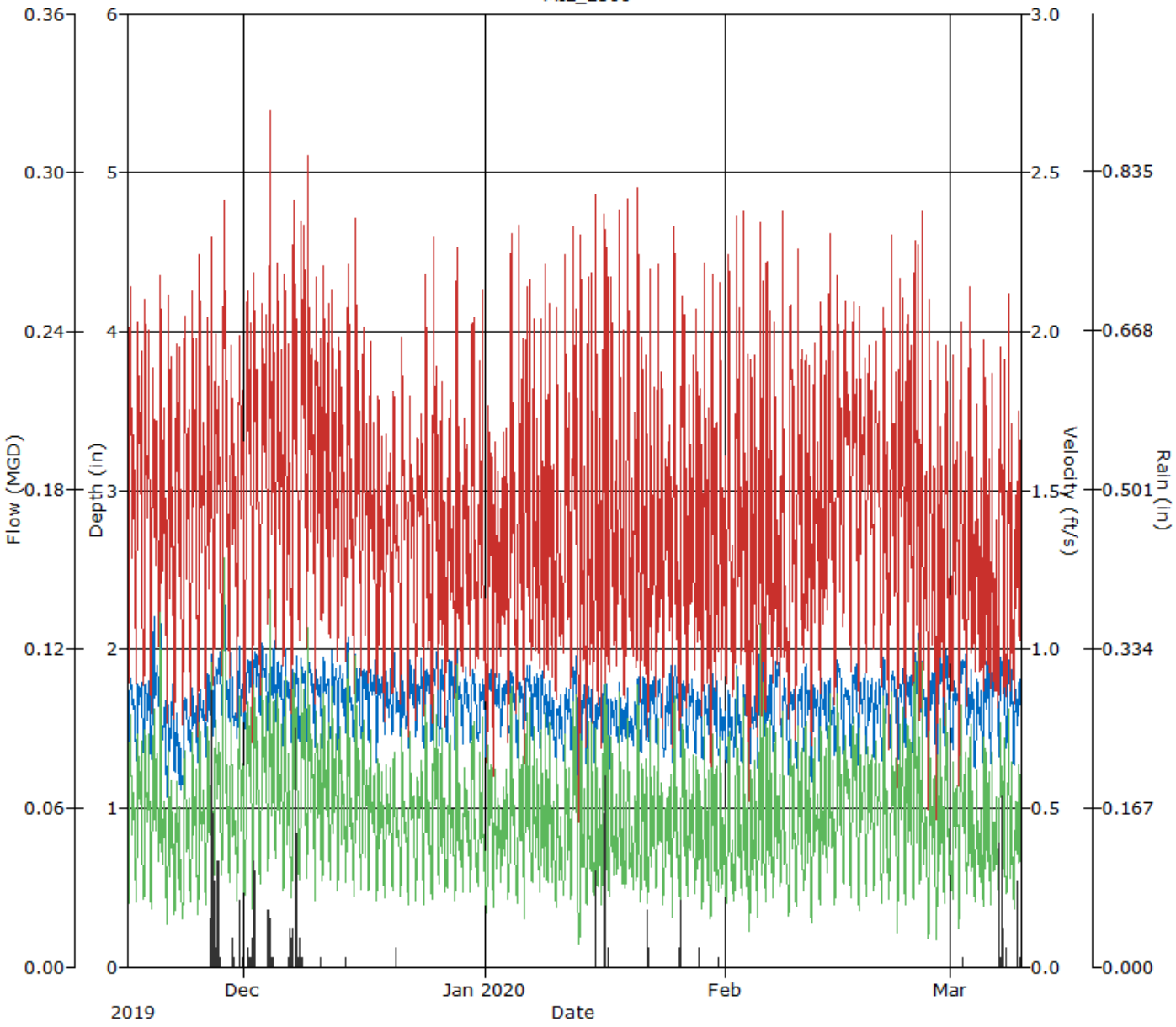


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_2300, Pipe Height: 10.25 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	05:45	1.20	11:55	1.86	1.60	04:05	0.54	11:55	2.71	1.45	04:05	0.014	11:55	0.125	0.055	0.055	
11/17/2019	05:25	1.27	20:00	2.02	1.61	05:25	0.65	20:00	2.83	1.47	05:25	0.017	20:00	0.146	0.057	0.057	
11/18/2019	01:55	1.30	19:25	1.93	1.63	00:35	0.65	18:50	2.58	1.49	04:25	0.020	18:50	0.118	0.058	0.058	
11/19/2019	03:05	1.22	11:15	2.33	1.74	23:50	0.54	07:50	2.59	1.40	02:25	0.015	11:20	0.143	0.061	0.061	
11/20/2019	23:40	1.32	07:35	2.40	1.67	02:40	0.65	07:40	2.63	1.43	23:25	0.021	07:40	0.172	0.058	0.058	
11/21/2019	04:15	0.99	14:00	2.04	1.43	03:40	0.36	14:10	2.66	1.37	03:40	0.008	14:00	0.133	0.045	0.045	
11/22/2019	23:50	1.05	07:55	1.71	1.34	02:30	0.49	10:10	2.67	1.43	02:35	0.013	14:20	0.100	0.042	0.042	
11/23/2019	00:15	1.04	13:40	2.05	1.46	03:20	0.54	12:25	2.82	1.48	03:15	0.012	12:25	0.115	0.050	0.050	
11/24/2019	03:50	1.31	09:50	1.95	1.54	05:15	0.50	09:50	2.82	1.46	05:15	0.014	09:50	0.138	0.052	0.052	
11/25/2019	02:40	1.24	11:15	1.88	1.56	03:15	0.46	11:25	2.76	1.45	03:15	0.012	11:25	0.127	0.053	0.053	
11/26/2019	03:40	1.29	23:55	2.22	1.69	04:00	0.50	21:50	2.74	1.47	04:00	0.014	20:50	0.143	0.061	0.061	0.63
11/27/2019	03:30	1.43	22:05	2.09	1.78	03:55	0.45	22:05	2.67	1.53	03:55	0.015	22:05	0.144	0.067	0.067	0.77
11/28/2019	04:15	1.55	12:45	2.44	1.89	04:10	0.61	11:45	2.75	1.58	04:10	0.021	12:50	0.177	0.078	0.078	
11/29/2019	18:05	1.43	08:55	2.08	1.66	05:20	0.56	10:25	2.44	1.43	05:20	0.019	10:25	0.118	0.057	0.057	0.05
11/30/2019	04:10	1.42	10:25	2.14	1.70	02:40	0.53	19:15	2.73	1.51	02:40	0.017	19:15	0.143	0.063	0.063	0.14
12/01/2019	03:40	1.47	14:30	2.07	1.77	05:05	0.41	12:10	2.70	1.58	05:05	0.014	14:30	0.144	0.070	0.070	0.06
12/02/2019	04:50	1.35	14:50	2.17	1.79	05:05	0.49	14:30	2.76	1.57	04:25	0.017	14:50	0.148	0.071	0.071	0.36
12/03/2019	04:35	1.45	09:55	2.18	1.84	03:20	0.58	08:05	2.73	1.59	03:20	0.020	08:05	0.147	0.074	0.074	
12/04/2019	03:10	1.45	22:00	2.12	1.80	04:05	0.80	09:50	2.84	1.70	04:05	0.027	09:50	0.154	0.077	0.077	0.44
12/05/2019	23:55	1.51	09:40	2.01	1.78	04:30	0.61	07:30	2.80	1.58	04:30	0.027	07:30	0.136	0.069	0.069	
12/06/2019	05:20	1.32	09:00	2.15	1.68	02:00	0.62	11:10	2.75	1.49	02:00	0.019	09:20	0.147	0.061	0.061	0.06
12/07/2019	03:30	1.37	20:15	2.04	1.72	04:20	0.50	17:45	2.84	1.66	04:50	0.015	19:45	0.138	0.070	0.070	0.84
12/08/2019	01:25	1.34	10:25	2.00	1.72	04:45	0.55	19:20	2.82	1.73	04:45	0.018	12:00	0.132	0.073	0.073	0.10
12/09/2019	04:05	1.28	07:40	2.04	1.75	04:10	0.58	07:15	2.84	1.66	04:10	0.016	07:20	0.147	0.072	0.072	
12/10/2019	03:30	1.29	09:15	2.03	1.70	02:55	0.61	10:10	2.74	1.57	03:30	0.018	10:25	0.132	0.065	0.065	0.01
12/11/2019	03:05	1.35	08:30	2.08	1.71	00:55	0.47	21:00	2.78	1.58	00:55	0.015	08:30	0.135	0.066	0.066	0.00
12/12/2019	05:10	1.36	07:35	2.07	1.73	01:45	0.68	15:30	2.75	1.53	01:45	0.022	08:05	0.142	0.065	0.065	
12/13/2019	02:50	1.29	11:20	2.12	1.69	05:05	0.57	11:10	2.89	1.48	03:05	0.017	11:10	0.157	0.061	0.061	
12/14/2019	03:00	1.27	13:30	2.21	1.71	03:55	0.49	08:40	2.79	1.51	03:55	0.016	08:40	0.145	0.063	0.063	0.01
12/15/2019	05:35	1.35	09:20	2.12	1.68	07:25	0.65	18:45	2.73	1.53	03:20	0.020	11:05	0.141	0.063	0.063	
12/16/2019	05:05	1.39	12:15	2.13	1.71	02:40	0.61	08:30	2.74	1.46	02:40	0.020	08:30	0.135	0.061	0.061	
12/17/2019	02:55	1.37	09:15	2.16	1.72	02:50	0.59	07:35	2.72	1.38	02:50	0.018	07:35	0.139	0.058	0.058	
12/18/2019	01:50	1.18	07:00	2.03	1.67	03:45	0.60	09:10	2.41	1.34	03:45	0.018	11:25	0.109	0.054	0.054	
12/19/2019	02:55	1.41	08:50	2.01	1.69	03:05	0.63	11:30	2.39	1.34	03:05	0.020	21:25	0.112	0.054	0.054	
12/20/2019	04:40	1.41	10:35	2.08	1.66	02:40	0.66	08:25	2.45	1.31	02:40	0.023	08:25	0.118	0.052	0.052	0.02
12/21/2019	05:35	1.42	09:35	1.97	1.62	05:05	0.69	09:35	2.51	1.39	05:05	0.022	09:35	0.125	0.053	0.053	
12/22/2019	04:35	1.33	11:30	2.26	1.70	03:50	0.57	10:50	2.40	1.33	03:50	0.017	10:50	0.134	0.055	0.055	
12/23/2019	02:40	1.39	20:30	2.00	1.70	23:35	0.66	22:45	2.70	1.37	02:30	0.022	22:45	0.128	0.056	0.056	
12/24/2019	04:20	1.31	09:55	2.01	1.70	00:25	0.56	13:55	2.71	1.35	03:20	0.019	09:50	0.132	0.055	0.055	
12/25/2019	06:40	1.36	20:40	2.06	1.74	23:55	0.56	11:50	2.75	1.44	05:45	0.019	09:45	0.139	0.062	0.062	
12/26/2019	04:50	1.33	11:05	2.08	1.69	23:25	0.54	11:05	2.77	1.23	04:50	0.018	11:05	0.149	0.050	0.050	
12/27/2019	04:20	1.32	21:15	2.07	1.70	00:15	0.55	11:40	2.59	1.33	00:15	0.019	09:10	0.133	0.055	0.055	
12/28/2019	03:55	1.26	10:35	2.05	1.68	05:00	0.45	10:35	2.77	1.33	05:00	0.014	10:35	0.146	0.055	0.055	
12/29/2019	05:45	1.38	13:45	1.97	1.67	17:35	0.54	10:35	2.65	1.30	05:50	0.017	08:25	0.122	0.052	0.052	
12/30/2019	04:50	1.32	11:35	1.97	1.68	23:15	0.60	11:35	2.65	1.38	03:00	0.021	11:35	0.132	0.056	0.056	
12/31/2019	03:05	1.33	22:00	1.88	1.64	15:40	0.63	16:20	2.80	1.34	03:15	0.019	17:30	0.124	0.052	0.052	

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	05:10	1.24 11:00	2.00	1.68	05:05	0.41 11:00	2.73	1.20	05:05	0.011 11:00	0.138	0.050	0.050	
01/02/2020	05:05	1.47 09:10	1.96	1.71	02:25	0.48 08:35	2.69	1.21	03:20	0.018 09:05	0.130	0.050	0.050	
01/03/2020	01:30	1.40 09:05	1.90	1.67	06:55	0.50 19:10	2.69	1.31	06:55	0.016 19:10	0.126	0.052	0.052	
01/04/2020	04:10	1.40 10:10	1.96	1.67	03:25	0.47 09:50	2.83	1.39	03:25	0.016 11:30	0.135	0.056	0.056	
01/05/2020	04:30	1.27 09:30	1.94	1.64	01:00	0.50 11:20	2.82	1.36	05:15	0.018 11:20	0.129	0.054	0.054	
01/06/2020	03:15	1.29 12:00	2.02	1.71	04:05	0.40 09:50	2.78	1.41	04:05	0.012 09:50	0.134	0.059	0.059	
01/07/2020	03:05	1.33 08:40	1.97	1.69	23:50	0.55 19:25	2.76	1.34	23:50	0.021 07:35	0.131	0.054	0.054	
01/08/2020	02:45	1.32 08:00	1.94	1.65	14:25	0.51 21:30	2.79	1.32	02:30	0.017 11:10	0.131	0.052	0.052	
01/09/2020	10:40	1.32 09:45	1.86	1.59	23:35	0.57 10:10	2.76	1.32	23:35	0.017 07:15	0.124	0.050	0.050	
01/10/2020	04:35	1.12 20:20	1.75	1.53	01:00	0.58 09:30	2.71	1.30	04:30	0.015 08:20	0.107	0.046	0.046	
01/11/2020	03:45	1.21 23:10	1.94	1.57	07:10	0.54 13:50	2.80	1.45	05:25	0.017 11:05	0.116	0.053	0.053	
01/12/2020	23:50	1.14 19:50	2.02	1.64	01:05	0.47 10:40	2.86	1.52	01:05	0.014 19:10	0.144	0.061	0.061	
01/13/2020	04:15	0.93 17:35	2.03	1.47	03:55	0.33 20:50	2.74	1.15	03:55	0.006 12:00	0.127	0.041	0.041	
01/14/2020	04:35	1.26 21:00	1.87	1.59	06:35	0.47 20:25	2.84	1.22	03:20	0.015 21:00	0.129	0.046	0.046	
01/15/2020	04:40	1.20 20:00	1.78	1.55	23:50	0.53 21:30	2.71	1.27	23:50	0.018 21:30	0.116	0.046	0.046	0.10
01/16/2020	23:45	1.34 12:50	1.93	1.62	00:45	0.49 19:50	2.77	1.50	00:45	0.016 07:25	0.131	0.059	0.059	0.66
01/17/2020	01:20	1.22 14:50	1.98	1.55	01:00	0.52 12:20	2.79	1.39	01:00	0.014 07:55	0.121	0.050	0.050	
01/18/2020	22:45	1.33 10:25	1.86	1.55	01:10	0.50 10:15	2.79	1.39	01:10	0.017 10:25	0.124	0.050	0.050	
01/19/2020	05:30	1.38 09:45	1.81	1.55	01:30	0.58 14:50	2.85	1.42	03:50	0.020 14:50	0.120	0.051	0.051	
01/20/2020	23:55	1.35 19:15	1.97	1.57	01:10	0.61 18:10	2.86	1.40	01:10	0.020 18:50	0.135	0.052	0.052	
01/21/2020	04:25	1.24 20:35	2.05	1.59	00:20	0.55 12:30	2.80	1.34	00:20	0.016 20:35	0.137	0.050	0.050	0.01
01/22/2020	00:35	1.34 17:45	1.89	1.65	01:10	0.51 13:25	2.71	1.30	00:55	0.018 17:45	0.125	0.051	0.051	0.09
01/23/2020	23:50	1.33 17:10	1.93	1.62	00:10	0.55 19:45	2.71	1.36	23:50	0.017 07:25	0.124	0.052	0.052	
01/24/2020	12:10	1.19 10:55	2.05	1.57	00:10	0.68 13:05	2.68	1.35	00:10	0.017 22:20	0.114	0.049	0.049	
01/25/2020	03:20	1.19 13:10	1.98	1.64	01:05	0.54 09:30	2.82	1.36	05:00	0.014 13:10	0.137	0.054	0.054	
01/26/2020	18:30	1.13 21:55	1.88	1.62	04:50	0.52 11:10	2.83	1.45	04:50	0.014 11:10	0.130	0.056	0.056	0.16
01/27/2020	01:15	1.18 19:00	1.87	1.61	23:50	0.45 19:50	2.74	1.31	23:50	0.013 19:00	0.123	0.050	0.050	
01/28/2020	18:10	1.18 15:05	1.83	1.55	00:35	0.46 21:25	2.79	1.32	00:35	0.014 15:05	0.121	0.047	0.047	0.02
01/29/2020	00:55	1.05 08:40	1.98	1.56	01:35	0.52 19:20	2.81	1.36	00:55	0.013 19:20	0.134	0.050	0.050	
01/30/2020	00:05	1.23 10:35	2.17	1.60	01:10	0.43 10:00	2.73	1.30	01:10	0.013 19:45	0.133	0.050	0.050	
01/31/2020	17:35	1.20 16:05	1.78	1.49	15:40	0.57 16:10	2.82	1.31	17:35	0.015 16:10	0.121	0.045	0.045	0.01
02/01/2020	03:05	1.15 10:05	1.86	1.49	07:45	0.58 11:05	2.73	1.37	07:45	0.018 13:10	0.114	0.047	0.047	
02/02/2020	01:55	1.20 11:45	2.04	1.57	23:10	0.57 14:10	2.74	1.48	23:10	0.016 11:45	0.127	0.056	0.056	
02/03/2020	05:10	1.12 21:05	1.95	1.59	00:10	0.49 07:10	2.81	1.33	00:10	0.014 21:05	0.122	0.050	0.050	
02/04/2020	00:40	1.15 20:30	1.88	1.53	03:35	0.39 22:25	2.79	1.26	03:35	0.009 22:25	0.118	0.045	0.045	
02/05/2020	03:50	1.21 12:05	2.40	1.75	04:40	0.47 20:25	2.81	1.26	04:40	0.013 12:05	0.168	0.056	0.056	
02/06/2020	03:20	1.34 13:45	1.98	1.65	03:25	0.52 20:20	2.75	1.40	03:25	0.015 20:20	0.130	0.056	0.056	
02/07/2020	05:00	1.28 11:15	2.13	1.73	15:55	0.64 14:15	2.81	1.29	04:25	0.019 14:15	0.147	0.054	0.054	
02/08/2020	06:50	1.39 19:25	1.95	1.63	22:45	0.57 10:00	2.75	1.23	22:45	0.019 14:00	0.121	0.047	0.047	
02/09/2020	04:50	1.10 08:25	1.87	1.53	23:30	0.44 19:45	2.82	1.37	23:30	0.014 08:30	0.121	0.050	0.050	
02/10/2020	04:10	1.16 11:30	2.00	1.60	00:20	0.58 19:55	2.84	1.45	04:40	0.018 13:25	0.128	0.056	0.056	
02/11/2020	02:15	1.34 08:30	1.98	1.65	13:25	0.67 07:30	2.81	1.34	16:25	0.023 07:30	0.137	0.053	0.053	
02/12/2020	02:05	1.08 10:15	2.02	1.59	06:10	0.50 10:05	2.86	1.37	02:00	0.012 10:15	0.146	0.052	0.052	
02/13/2020	02:00	1.25 09:50	1.90	1.61	14:05	0.58 13:20	2.83	1.41	04:35	0.019 07:55	0.127	0.054	0.054	
02/14/2020	04:00	1.40 13:00	2.01	1.62	15:30	0.63 10:05	2.83	1.55	15:30	0.021 13:00	0.140	0.060	0.060	
02/15/2020	02:20	1.27 09:30	2.04	1.70	03:00	0.60 09:05	2.75	1.51	03:00	0.016 09:30	0.141	0.064	0.064	
02/16/2020	05:35	1.26 16:20	1.85	1.61	00:25	0.53 16:30	2.69	1.61	00:25	0.018 16:20	0.112	0.061	0.061	
02/17/2020	04:15	1.26 20:50	1.94	1.67	04:15	0.58 17:40	2.51	1.57	04:15	0.015 14:45	0.121	0.064	0.064	
02/18/2020	04:20	1.20 18:55	1.94	1.62	04:35	0.55 18:55	2.83	1.52	04:35	0.013 18:55	0.138	0.059	0.059	
02/19/2020	04:35	1.30 08:05	1.96	1.62	23:55	0.60 20:25	2.53	1.53	04:20	0.017 08:10	0.122	0.059	0.059	
02/20/2020	04:20	1.24 10:20	1.92	1.60	00:00	0.55 09:25	2.44	1.47	00:00	0.018 09:25	0.109	0.056	0.056	
02/21/2020	03:30	1.25 09:15	2.10	1.63	02:20	0.43 09:15	2.73	1.38	02:20	0.013 09:15	0.149	0.054	0.054	
02/22/2020	03:45	1.30 14:10	1.95	1.68	00:35	0.50 09:35	2.83	1.52	00:35	0.018 09:35	0.130	0.061	0.061	
02/23/2020	04:05	1.10 19:50	2.00	1.63	04:25	0.38 18:05	2.74	1.46	04:10	0.009 18:05	0.131	0.058	0.058	
02/24/2020	03:25	1.33 11:30	2.06	1.67	23:40	0.50 11:30	2.81	1.47	03:05	0.015 11:30	0.149	0.059	0.059	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	04:05	1.27	13:40	2.25	1.79	03:50	0.75	21:35	2.86	1.57	03:55	0.020	20:45	0.151	0.071	0.071	
02/26/2020	23:50	1.44	00:00	2.04	1.71	02:40	0.50	10:00	2.84	1.32	23:05	0.017	10:00	0.143	0.055	0.055	
02/27/2020	04:10	0.99	12:30	1.95	1.62	03:50	0.33	07:35	2.68	1.22	03:50	0.006	18:00	0.120	0.049	0.049	
02/28/2020	03:55	1.03	14:35	2.40	1.64	03:50	0.41	14:35	2.67	1.15	03:50	0.009	14:35	0.176	0.047	0.047	
02/29/2020	05:15	1.33	11:25	2.07	1.71	05:00	0.49	11:40	2.57	1.23	05:00	0.014	11:40	0.132	0.051	0.051	
03/01/2020	05:40	1.29	16:40	1.95	1.62	00:05	0.55	21:05	2.50	1.32	00:05	0.020	21:05	0.120	0.051	0.051	
03/02/2020	01:50	1.20	12:50	2.10	1.75	02:30	0.47	07:30	2.70	1.27	02:30	0.012	07:30	0.138	0.056	0.056	0.01
03/03/2020	04:25	1.35	14:00	1.99	1.63	23:15	0.53	14:05	2.85	1.29	04:25	0.016	14:00	0.144	0.050	0.050	
03/04/2020	04:25	1.18	12:50	1.97	1.56	03:25	0.45	10:25	2.72	1.23	03:25	0.011	12:50	0.123	0.045	0.045	
03/05/2020	04:00	1.21	13:35	2.25	1.66	04:00	0.53	10:10	2.74	1.30	04:00	0.013	13:55	0.144	0.052	0.052	
03/06/2020	03:20	1.17	21:10	1.99	1.69	11:25	0.60	20:45	2.46	1.12	03:20	0.019	20:45	0.116	0.045	0.045	
03/07/2020	04:55	1.24	14:05	2.04	1.72	03:15	0.47	14:00	2.74	1.30	03:15	0.014	14:00	0.142	0.055	0.055	0.58
03/08/2020	04:35	1.34	09:45	2.03	1.68	03:35	0.51	21:50	2.72	1.25	03:35	0.016	09:45	0.125	0.051	0.051	0.02
03/09/2020	04:20	1.22	22:00	1.90	1.59	04:25	0.50	07:10	2.60	1.27	04:25	0.013	19:45	0.108	0.047	0.047	0.11

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			6.402	5.26
Avg	1.65	1.40	0.056	

Site Commentary

Site Information

MIL_2334	
Pipe Dimensions	12.5
Silt Level	0.00"

Overview

Site MIL_2334 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited little to no response to the wet weather events of November 26, 2019 - November 27, 2019 and December 7, 2019 - December 8, 2019. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	2.12	2.77	0.175
Minimum	1.55	1.24	0.052
Maximum	3.31	3.62	0.352
Time of Minimum	11/25/2019 3:50 AM	2/28/2020 3:55 AM	2/28/2020 3:55 AM
Time of Maximum	12/8/2019 2:25 PM	3/6/2020 9:45 AM	12/8/2019 2:25 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

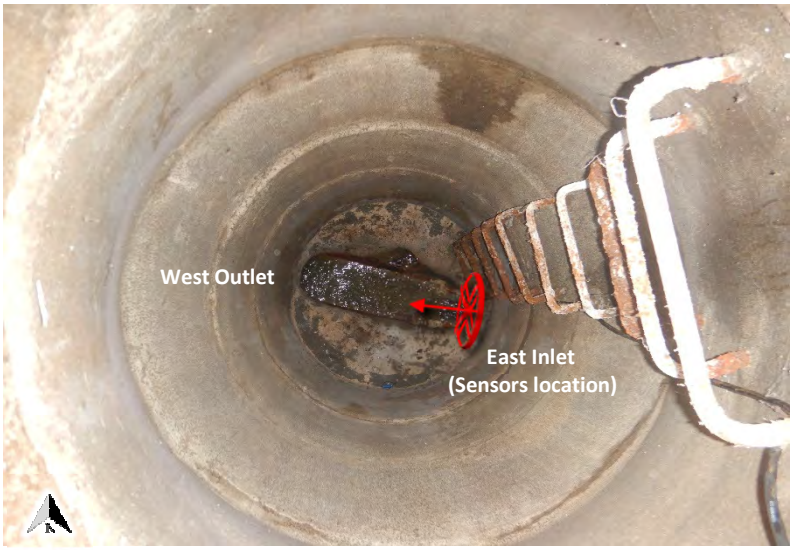
MIL_2334

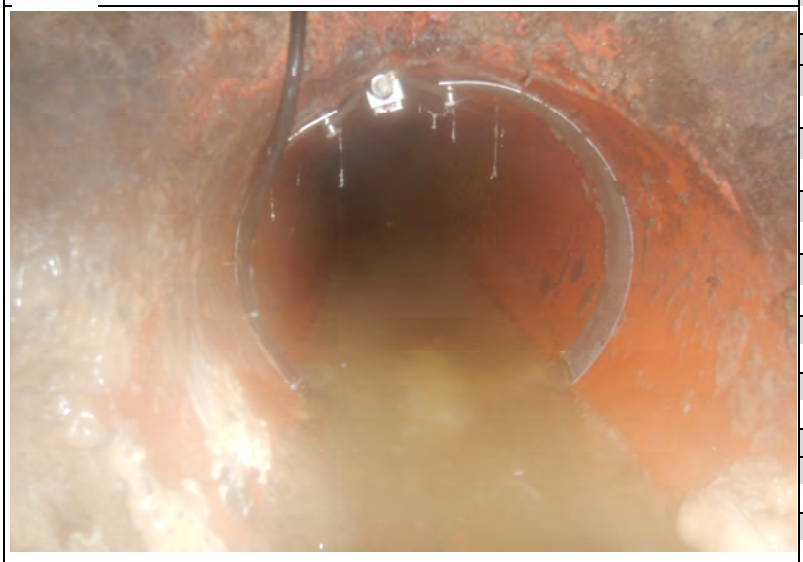
Site Address /Location:	Tramway Dr and Strickroth Dr			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	Drive	Latitude:	37.44209	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.903338	12.5" x 12.5"	Circular



Manhole #	System Characteristics
2334	Residential
Access	Traffic
Drive	Light







Installation Information

Installation Date:	Installation Type:
Friday, November 15, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
7:47:00 AM	12.5" x 12.5"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
2.25"	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
3.52	0''
Silt (in)	Silt Type
0''	

Hydraulic Comments:

good flow, shallow and moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
12'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Vitrified Clay Pipe	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_2334

Flow Monitor

MIL_2334

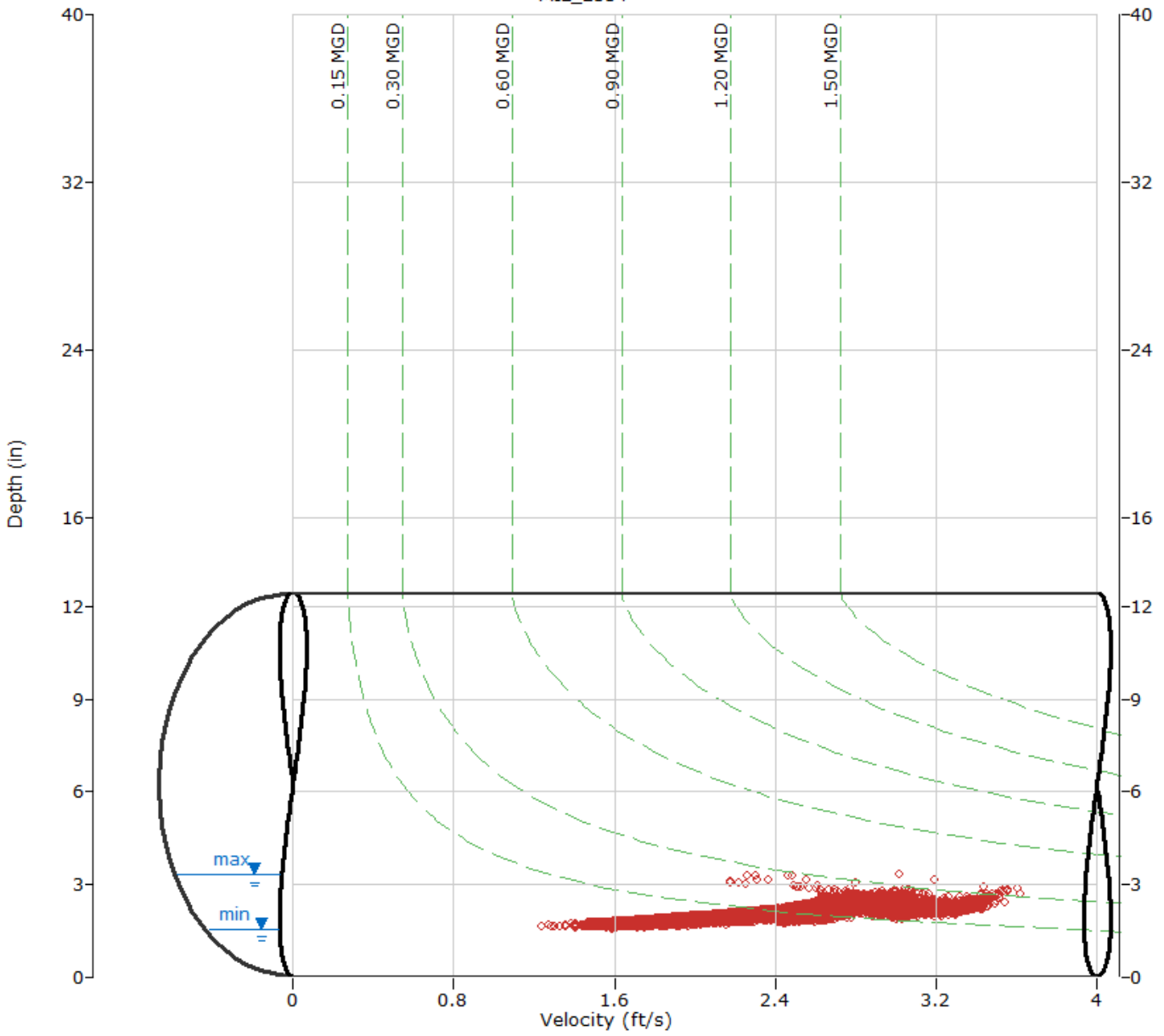
Pipe Height
12.50 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



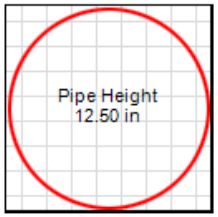
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_2334

Flow Monitor

MIL_2334

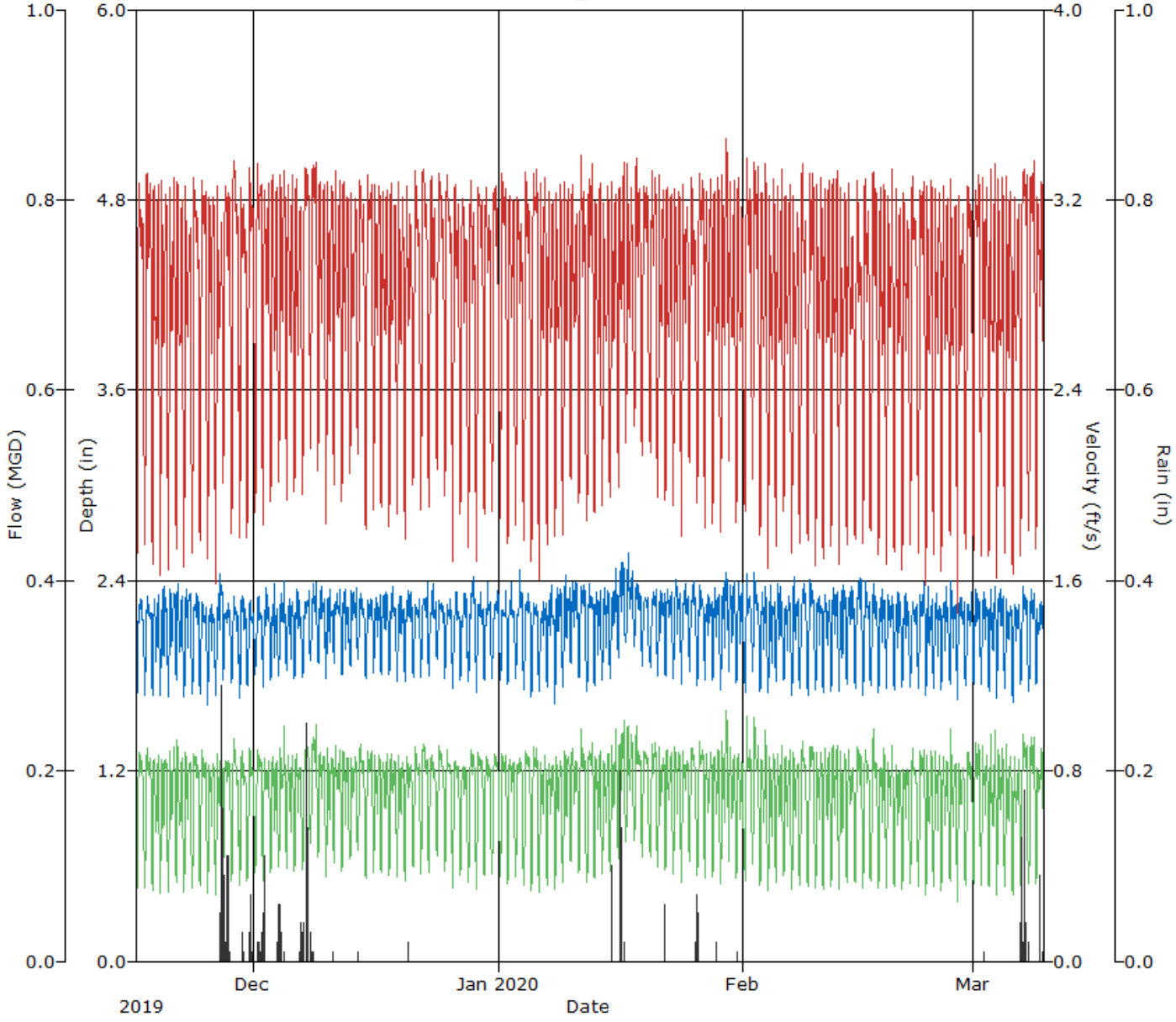


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_2334, Pipe Height: 12.50 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	03:55	1.64	18:45	2.65	2.08	04:10	1.41	12:05	3.37	2.74	04:10	0.062	17:40	0.252	0.170	0.170	
11/17/2019	04:05	1.63	12:25	2.68	2.09	03:45	1.50	11:15	3.41	2.81	03:50	0.067	14:30	0.254	0.175	0.175	
11/18/2019	04:00	1.63	17:25	2.50	2.07	03:55	1.47	08:15	3.35	2.70	03:55	0.062	07:50	0.239	0.165	0.165	
11/19/2019	03:10	1.66	19:15	2.58	2.09	03:10	1.36	20:20	3.38	2.71	03:10	0.059	11:15	0.237	0.168	0.168	
11/20/2019	03:50	1.64	07:10	2.65	2.10	03:50	1.46	20:25	3.38	2.67	03:50	0.062	07:10	0.245	0.168	0.168	
11/21/2019	03:55	1.72	23:00	2.48	2.10	04:00	1.51	07:35	3.41	2.65	04:00	0.070	07:35	0.256	0.166	0.166	
11/22/2019	03:55	1.59	09:15	2.52	2.10	03:40	1.51	07:55	3.38	2.66	03:40	0.063	07:40	0.242	0.167	0.167	
11/23/2019	04:05	1.63	16:55	2.87	2.10	04:15	1.33	10:45	3.35	2.78	04:15	0.057	16:55	0.290	0.174	0.174	
11/24/2019	05:30	1.67	10:55	2.75	2.08	04:35	1.53	10:25	3.39	2.82	04:35	0.071	10:55	0.276	0.173	0.173	
11/25/2019	03:50	1.55	11:40	2.50	2.05	04:10	1.41	21:20	3.34	2.73	04:10	0.057	11:45	0.225	0.165	0.165	
11/26/2019	04:00	1.63	19:05	2.59	2.13	03:55	1.29	08:40	3.34	2.66	03:55	0.054	20:35	0.238	0.170	0.170	0.63
11/27/2019	03:00	1.76	14:45	2.46	2.10	01:40	1.78	11:40	3.38	2.89	01:40	0.089	17:45	0.220	0.179	0.179	0.77
11/28/2019	03:55	1.72	11:50	2.50	2.10	03:40	1.56	11:50	3.47	2.91	03:40	0.073	11:50	0.271	0.180	0.180	
11/29/2019	04:40	1.60	16:35	2.69	2.08	05:30	1.56	09:35	3.33	2.80	05:30	0.067	16:40	0.260	0.171	0.171	0.05
11/30/2019	03:30	1.70	12:00	2.96	2.06	03:35	1.52	11:20	3.37	2.83	03:35	0.068	12:00	0.248	0.172	0.172	0.14
12/01/2019	04:30	1.79	13:55	3.12	2.09	04:05	1.79	10:45	3.39	2.89	04:05	0.088	13:55	0.254	0.178	0.178	0.06
12/02/2019	03:15	1.69	13:05	2.45	2.10	02:35	1.65	07:45	3.36	2.80	03:10	0.077	08:00	0.244	0.174	0.174	0.36
12/03/2019	03:45	1.76	12:15	2.47	2.07	03:40	1.70	08:30	3.35	2.78	03:40	0.081	08:05	0.223	0.169	0.169	
12/04/2019	02:15	1.77	19:15	2.88	2.13	02:10	1.86	19:15	3.61	2.85	03:10	0.089	19:15	0.346	0.180	0.180	0.44
12/05/2019	03:35	1.80	07:30	2.46	2.11	02:25	1.75	20:45	3.34	2.81	02:25	0.086	07:35	0.234	0.174	0.174	
12/06/2019	03:45	1.75	10:20	2.50	2.13	03:35	1.80	08:05	3.35	2.77	03:35	0.086	08:05	0.240	0.174	0.174	0.06
12/07/2019	04:20	1.75	00:00	2.52	2.13	04:10	1.76	20:55	3.39	2.92	04:10	0.084	20:55	0.234	0.185	0.185	0.84
12/08/2019	02:35	1.86	14:25	3.31	2.18	04:40	1.86	19:40	3.56	3.00	04:45	0.098	14:25	0.352	0.195	0.195	0.10
12/09/2019	03:50	1.79	09:50	2.52	2.16	03:05	1.80	08:10	3.38	2.84	03:05	0.091	07:55	0.244	0.183	0.183	
12/10/2019	03:20	1.77	16:20	2.58	2.13	03:30	1.62	07:35	3.39	2.79	03:30	0.077	07:35	0.250	0.176	0.176	0.01
12/11/2019	01:20	1.83	23:45	2.47	2.18	03:45	1.93	07:55	3.41	2.83	03:25	0.099	07:55	0.252	0.184	0.184	0.00
12/12/2019	03:45	1.78	10:30	2.54	2.12	04:35	1.84	22:15	3.39	2.78	03:50	0.090	07:30	0.251	0.175	0.175	
12/13/2019	05:20	1.78	09:05	2.52	2.16	03:00	1.78	08:05	3.34	2.77	03:00	0.088	09:05	0.233	0.179	0.179	
12/14/2019	05:55	1.86	17:25	2.60	2.16	03:50	1.90	11:10	3.31	2.91	03:50	0.101	17:25	0.243	0.187	0.187	0.01
12/15/2019	04:05	1.75	18:15	3.13	2.11	04:10	1.63	21:05	3.39	2.85	04:10	0.077	18:15	0.249	0.179	0.179	
12/16/2019	03:40	1.79	09:10	2.83	2.14	04:00	1.75	08:05	3.35	2.80	04:00	0.086	07:50	0.248	0.177	0.177	
12/17/2019	03:35	1.80	10:45	2.58	2.13	02:30	1.75	07:35	3.36	2.77	02:30	0.087	11:40	0.231	0.175	0.175	
12/18/2019	03:05	1.79	13:45	2.47	2.14	03:55	1.67	08:10	3.42	2.76	03:55	0.083	08:10	0.241	0.175	0.175	
12/19/2019	03:20	1.73	09:05	2.58	2.10	03:20	1.73	07:45	3.34	2.75	03:20	0.079	07:40	0.242	0.171	0.171	
12/20/2019	03:50	1.74	11:45	2.53	2.14	03:15	1.59	07:35	3.38	2.74	03:15	0.075	07:35	0.232	0.175	0.175	0.02
12/21/2019	06:35	1.75	23:25	2.50	2.11	04:10	1.80	12:25	3.37	2.85	04:10	0.086	23:15	0.236	0.178	0.178	
12/22/2019	04:20	1.76	18:55	2.67	2.13	04:20	1.65	17:10	3.50	2.87	04:20	0.078	17:10	0.267	0.183	0.183	
12/23/2019	04:50	1.77	13:30	2.52	2.13	04:55	1.63	09:50	3.42	2.84	04:55	0.078	13:20	0.236	0.179	0.179	
12/24/2019	03:55	1.84	21:00	2.49	2.14	03:40	1.84	17:20	3.43	2.90	03:40	0.097	17:20	0.234	0.184	0.184	
12/25/2019	05:30	1.77	18:45	2.65	2.12	04:40	1.78	11:00	3.37	2.87	04:40	0.086	18:45	0.250	0.180	0.180	
12/26/2019	05:05	1.67	16:40	2.57	2.09	04:40	1.58	11:50	3.43	2.79	04:40	0.072	15:30	0.237	0.173	0.173	
12/27/2019	03:40	1.72	14:15	2.64	2.13	03:50	1.64	12:45	3.32	2.75	03:50	0.075	14:15	0.236	0.173	0.173	
12/28/2019	03:30	1.73	14:30	2.65	2.15	04:35	1.57	12:40	3.36	2.74	04:35	0.073	21:55	0.257	0.177	0.177	
12/29/2019	05:25	1.66	18:25	2.53	2.09	03:50	1.50	20:50	3.35	2.80	05:10	0.068	10:45	0.244	0.174	0.174	
12/30/2019	04:00	1.74	17:05	2.63	2.12	04:00	1.55	11:15	3.31	2.79	04:00	0.072	14:50	0.243	0.176	0.176	
12/31/2019	04:45	1.76	17:05	2.67	2.13	03:10	1.61	18:15	3.36	2.81	03:10	0.078	17:05	0.254	0.178	0.178	

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	05:20	1.76 22:55	2.55	2.11	05:55	1.78 10:25	3.38	2.84	05:55	0.085 22:55	0.235	0.177	0.177	
01/02/2020	03:55	1.72 14:45	2.46	2.12	03:05	1.59 11:55	3.35	2.77	03:55	0.074 11:55	0.223	0.175	0.175	
01/03/2020	04:40	1.76 21:50	2.59	2.15	04:45	1.66 07:45	3.26	2.74	04:45	0.079 17:50	0.241	0.176	0.176	
01/04/2020	05:40	1.67 20:40	2.64	2.11	03:35	1.57 10:35	3.38	2.78	03:35	0.073 20:40	0.253	0.175	0.175	
01/05/2020	04:20	1.64 11:35	2.33	2.09	04:20	1.48 14:05	3.39	2.83	04:20	0.063 11:40	0.236	0.176	0.176	
01/06/2020	03:35	1.68 09:20	2.55	2.08	03:10	1.38 08:20	3.38	2.73	03:10	0.062 09:20	0.232	0.169	0.169	
01/07/2020	03:40	1.69 06:40	2.51	2.11	03:45	1.56 21:30	3.38	2.73	03:45	0.069 17:50	0.225	0.171	0.171	
01/08/2020	04:00	1.61 09:00	2.60	2.12	03:45	1.67 08:00	3.32	2.71	03:45	0.069 09:00	0.245	0.172	0.172	
01/09/2020	03:20	1.68 23:05	2.55	2.13	04:25	1.59 08:05	3.36	2.71	03:20	0.072 07:50	0.252	0.173	0.173	
01/10/2020	01:10	1.85 08:10	2.60	2.18	03:40	1.81 07:35	3.41	2.77	03:40	0.094 08:10	0.271	0.181	0.181	
01/11/2020	05:15	1.76 17:50	2.64	2.16	05:10	1.77 11:00	3.49	2.80	05:10	0.084 11:00	0.252	0.181	0.181	
01/12/2020	04:10	1.67 10:45	3.06	2.12	02:50	1.61 21:20	3.40	2.82	05:10	0.076 14:50	0.270	0.179	0.179	
01/13/2020	03:50	1.70 09:50	2.56	2.13	02:10	1.74 07:40	3.35	2.74	03:45	0.079 09:50	0.250	0.174	0.174	
01/14/2020	02:40	1.72 06:45	2.62	2.13	02:20	1.71 22:15	3.33	2.72	02:40	0.082 14:25	0.247	0.173	0.173	
01/15/2020	04:15	1.76 22:15	2.81	2.16	02:40	1.75 07:45	3.40	2.71	04:30	0.085 22:15	0.285	0.176	0.176	0.10
01/16/2020	03:40	1.88 17:45	2.76	2.27	03:40	1.83 21:20	3.42	2.81	03:40	0.096 12:35	0.276	0.195	0.195	0.66
01/17/2020	01:25	1.90 21:40	2.80	2.28	03:05	2.03 08:00	3.45	2.83	03:05	0.114 21:40	0.282	0.197	0.197	
01/18/2020	03:40	1.93 00:55	2.69	2.24	05:10	2.00 11:15	3.42	2.92	05:10	0.112 00:55	0.263	0.197	0.197	
01/19/2020	03:15	1.81 18:50	2.75	2.17	02:15	1.83 19:25	3.46	2.90	02:15	0.095 18:50	0.243	0.188	0.188	
01/20/2020	05:40	1.84 13:45	2.69	2.15	05:00	1.99 17:50	3.37	2.88	05:00	0.102 13:50	0.245	0.184	0.184	
01/21/2020	03:50	1.76 17:35	2.50	2.15	02:40	1.78 23:50	3.40	2.77	03:45	0.088 23:50	0.252	0.178	0.178	0.01
01/22/2020	05:05	1.78 10:00	2.54	2.16	04:05	1.71 22:00	3.41	2.73	04:05	0.083 22:05	0.238	0.177	0.177	0.09
01/23/2020	03:50	1.74 09:50	2.56	2.17	03:55	1.72 07:45	3.35	2.75	03:55	0.080 12:15	0.244	0.180	0.180	
01/24/2020	03:55	1.71 22:35	2.61	2.17	03:20	1.58 09:00	3.37	2.79	03:20	0.073 22:35	0.245	0.181	0.181	
01/25/2020	04:10	1.77 19:20	2.59	2.17	04:00	1.84 13:00	3.33	2.81	04:00	0.088 23:45	0.239	0.183	0.183	
01/26/2020	04:10	1.67 11:05	2.97	2.13	04:00	1.64 12:25	3.37	2.85	04:00	0.073 11:05	0.262	0.182	0.182	0.16
01/27/2020	03:40	1.73 06:30	2.64	2.12	03:55	1.62 07:45	3.40	2.76	03:55	0.078 06:30	0.243	0.174	0.174	
01/28/2020	04:05	1.75 17:15	2.55	2.13	03:30	1.63 20:10	3.37	2.75	03:30	0.077 06:45	0.236	0.174	0.174	0.02
01/29/2020	03:40	1.68 12:55	2.59	2.17	03:45	1.74 20:00	3.54	2.79	03:45	0.078 20:15	0.276	0.184	0.184	
01/30/2020	04:15	1.79 18:25	2.56	2.18	04:15	1.92 20:35	3.37	2.82	04:15	0.093 07:50	0.251	0.183	0.183	
01/31/2020	03:40	1.73 22:10	2.55	2.13	02:40	1.60 08:25	3.36	2.70	03:45	0.074 07:50	0.238	0.172	0.172	0.01
02/01/2020	05:10	1.65 10:45	2.68	2.13	03:30	1.69 10:40	3.51	2.84	05:35	0.076 10:40	0.304	0.181	0.181	
02/02/2020	03:35	1.80 12:00	3.28	2.16	05:05	1.86 10:15	3.47	2.86	03:45	0.094 10:15	0.292	0.185	0.185	
02/03/2020	03:50	1.68 01:20	2.55	2.11	04:10	1.61 20:10	3.52	2.72	04:10	0.073 20:10	0.281	0.171	0.171	
02/04/2020	03:40	1.66 08:45	2.53	2.09	03:50	1.46 08:00	3.36	2.69	03:50	0.064 10:00	0.242	0.166	0.166	
02/05/2020	03:50	1.73 09:30	2.57	2.11	03:35	1.57 21:40	3.40	2.69	03:50	0.074 07:55	0.238	0.169	0.169	
02/06/2020	02:25	1.74 09:05	2.70	2.10	02:20	1.64 07:30	3.34	2.72	02:20	0.077 09:05	0.259	0.170	0.170	
02/07/2020	04:00	1.65 18:10	2.57	2.12	03:35	1.61 09:20	3.37	2.66	03:35	0.071 10:20	0.237	0.169	0.169	
02/08/2020	04:50	1.68 21:25	2.62	2.15	03:30	1.52 11:15	3.37	2.73	03:30	0.070 14:40	0.244	0.177	0.177	
02/09/2020	05:10	1.66 11:55	3.29	2.13	04:55	1.61 12:05	3.38	2.78	05:00	0.071 11:55	0.262	0.178	0.178	
02/10/2020	02:40	1.67 09:20	2.52	2.11	03:50	1.52 07:30	3.41	2.67	02:45	0.068 07:35	0.233	0.168	0.168	
02/11/2020	03:40	1.65 10:45	2.56	2.09	03:30	1.49 08:05	3.35	2.69	04:10	0.066 10:45	0.245	0.167	0.167	
02/12/2020	03:55	1.68 23:25	2.58	2.13	02:45	1.63 08:00	3.41	2.70	03:50	0.073 08:00	0.253	0.172	0.172	
02/13/2020	04:15	1.68 20:45	2.91	2.10	04:25	1.49 07:35	3.41	2.65	04:25	0.068 20:45	0.246	0.165	0.165	
02/14/2020	03:50	1.65 09:20	2.65	2.13	03:55	1.54 07:50	3.39	2.67	03:55	0.067 07:50	0.252	0.170	0.170	
02/15/2020	05:10	1.67 17:35	2.60	2.16	04:20	1.50 11:20	3.41	2.70	04:20	0.070 11:35	0.251	0.176	0.176	
02/16/2020	05:25	1.64 14:25	2.69	2.12	04:10	1.50 12:05	3.39	2.76	04:10	0.067 14:25	0.256	0.174	0.174	
02/17/2020	04:00	1.68 10:55	2.93	2.11	04:00	1.55 11:00	3.55	2.77	04:00	0.069 10:55	0.338	0.174	0.174	
02/18/2020	03:30	1.67 10:15	2.73	2.10	03:30	1.51 20:25	3.43	2.68	03:30	0.066 20:20	0.265	0.167	0.167	
02/19/2020	03:10	1.68 22:35	2.58	2.12	03:10	1.49 21:00	3.41	2.72	03:10	0.066 22:35	0.245	0.172	0.172	
02/20/2020	03:50	1.67 18:50	2.59	2.09	03:55	1.50 08:00	3.29	2.64	03:55	0.066 18:50	0.232	0.163	0.163	
02/21/2020	03:40	1.68 17:55	2.58	2.09	02:45	1.53 09:45	3.35	2.67	03:50	0.070 20:45	0.236	0.165	0.165	
02/22/2020	04:20	1.68 13:25	2.55	2.08	03:30	1.54 10:05	3.41	2.75	04:20	0.071 11:35	0.228	0.169	0.169	
02/23/2020	04:40	1.66 10:05	3.26	2.12	04:15	1.56 21:45	3.40	2.81	04:20	0.069 10:05	0.263	0.178	0.178	
02/24/2020	03:30	1.65 06:35	2.55	2.08	03:25	1.27 07:30	3.39	2.66	03:25	0.055 07:55	0.235	0.164	0.164	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	04:00	1.65	13:55	2.53	2.10	02:25	1.50	07:30	3.39	2.68	02:25	0.066	07:50	0.233	0.167	0.167	
02/26/2020	02:55	1.62	18:30	2.58	2.11	03:00	1.40	07:35	3.39	2.66	03:00	0.060	07:50	0.248	0.167	0.167	
02/27/2020	04:30	1.72	07:50	2.87	2.10	03:45	1.46	07:50	3.55	2.68	03:45	0.067	07:50	0.339	0.168	0.168	
02/28/2020	03:50	1.61	23:00	2.56	2.10	03:55	1.24	08:10	3.34	2.65	03:55	0.052	07:50	0.234	0.166	0.166	
02/29/2020	04:05	1.68	23:25	2.54	2.09	05:30	1.48	12:05	3.35	2.79	05:30	0.069	22:45	0.237	0.173	0.173	
03/01/2020	05:30	1.69	10:25	3.29	2.10	05:25	1.52	10:20	3.39	2.80	05:25	0.068	10:25	0.285	0.176	0.176	
03/02/2020	03:40	1.72	13:20	2.49	2.11	02:50	1.48	08:10	3.41	2.72	03:55	0.068	07:50	0.260	0.171	0.171	0.01
03/03/2020	02:50	1.66	06:40	2.58	2.08	03:00	1.46	21:20	3.47	2.66	03:00	0.064	21:20	0.279	0.164	0.164	
03/04/2020	03:35	1.61	09:55	2.50	2.13	03:35	1.42	08:05	3.39	2.68	03:35	0.059	07:55	0.238	0.171	0.171	
03/05/2020	03:30	1.69	17:45	2.73	2.08	03:15	1.50	07:55	3.36	2.70	03:30	0.068	17:45	0.246	0.166	0.166	
03/06/2020	03:35	1.62	09:45	2.70	2.08	04:05	1.49	09:45	3.62	2.70	04:05	0.064	09:45	0.317	0.167	0.167	
03/07/2020	03:05	1.67	12:50	2.74	2.12	05:05	1.46	12:05	3.42	2.86	05:05	0.065	12:50	0.259	0.182	0.182	0.58
03/08/2020	04:05	1.65	10:30	3.13	2.11	04:45	1.68	09:50	3.43	2.86	04:45	0.075	10:30	0.345	0.181	0.181	0.02
03/09/2020	02:50	1.70	12:05	2.58	2.09	02:30	1.56	21:15	3.37	2.78	02:30	0.073	19:45	0.235	0.172	0.172	0.11

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			20.139	5.26
Avg	2.12	2.77	0.175	

Site Commentary

Site Information

MIL_2491	
Pipe Dimensions	15
Silt Level	0.00"

Overview

Site MIL_2491 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. Due to a meter malfunction, data confidence is less than typical from January 28, 2020 through February 22, 2020. A data gap also occurs February 23, 2020 through March 2, 2020.

This location was installed upstream of site MIL_2569 and downstream of the combined flows of sites MIL_0386 and MIL_2840. A review of balancing with the combined flows of MIL_0386 and MIL_2840 into MIL_0649 and MIL_2491 shows a net flow between the sites of 0.426 MGD.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	2.34	2.36	0.216
Minimum	1.07	0.37	0.010
Maximum	4.18	3.84	0.682
Time of Minimum	1/3/2020 9:55 PM	3/8/2020 3:05 AM	3/8/2020 3:05 AM
Time of Maximum	1/17/2020 1:15 PM	11/21/2019 9:30 AM	11/21/2019 9:30 AM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	91
Velocity (ft/s)	91
Quantity (MGD)	91

Milpitas Temp Study 2019-20

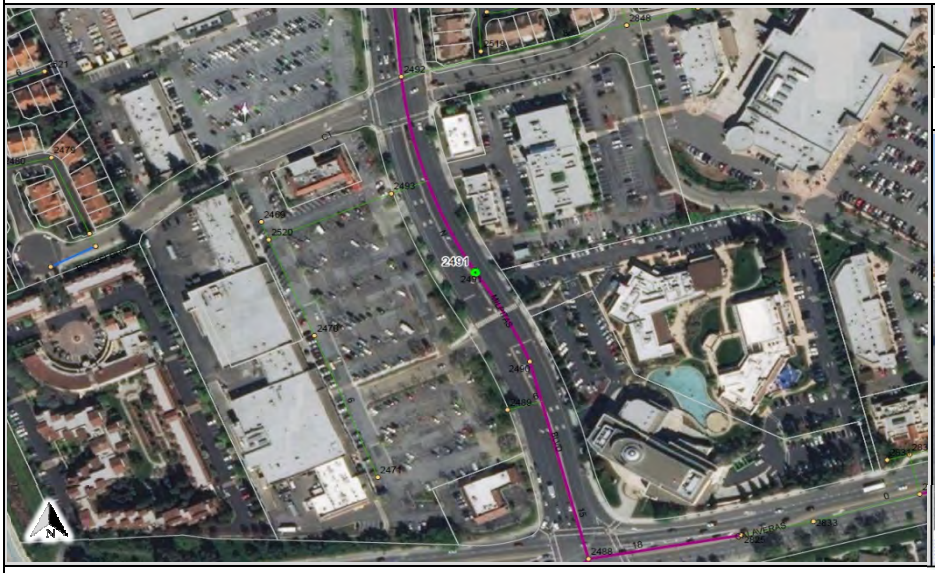
Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_2491

Site Address /Location:	N Milpitas Blvd and E Calaveras Blvd, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	Drive	Latitude:	37.433991	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.900388	15.0" x 15.0"	Circular



Manhole #	System Characteristics
2491	Residential/Commercial
Access	Traffic
Drive	Heavy







Installation Information

Installation Date:	Installation Type:
Wednesday, November 13, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
9:04:37 AM	15.0" x 15.0"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
3.25"	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
3.74	0''
Silt (in)	Silt Type
0''	

Hydraulic Comments:

Good flow, Moderate depth and velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
10'	Single
Manhole Material:	Manhole Condition:
Vitrified Clay Pipe	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
PVC	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

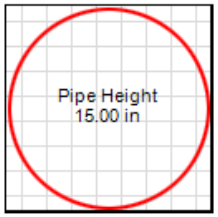
ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_2491

Flow Monitor

MIL_2491

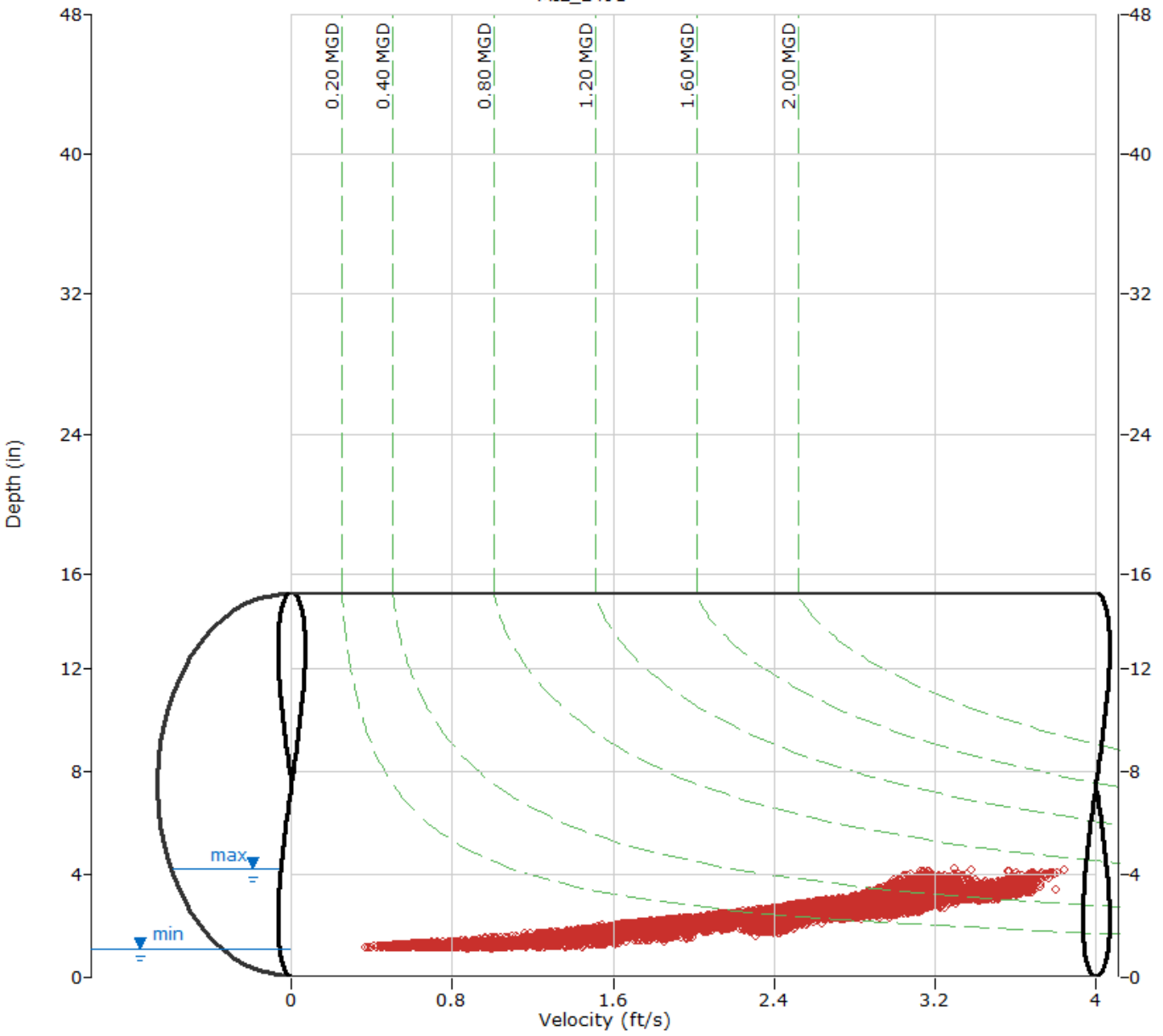


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



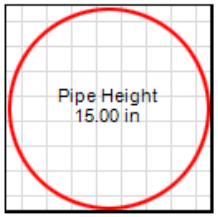
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_2491

Flow Monitor

MIL_2491

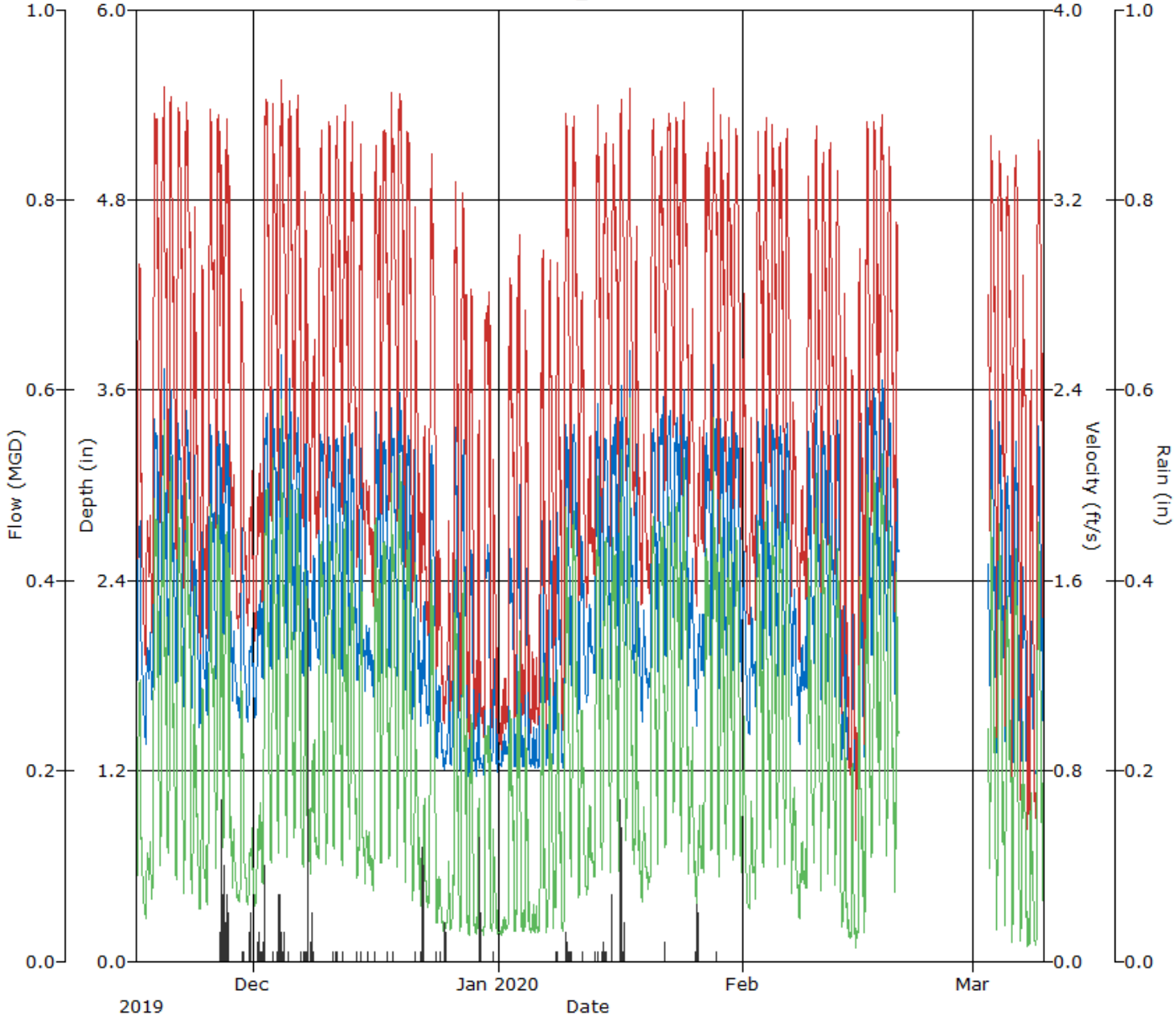


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_2491, Pipe Height: 15.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	23:25	1.71	12:20	3.63	2.11	22:35	1.41	12:20	3.30	2.11	22:35	0.071	12:20	0.488	0.153	0.153	
11/17/2019	06:30	1.33	19:25	2.32	1.75	07:55	1.17	19:30	2.22	1.60	06:20	0.042	19:25	0.171	0.085	0.085	
11/18/2019	00:45	1.57	14:50	3.97	2.72	01:00	1.25	13:25	3.72	2.77	00:45	0.056	13:25	0.582	0.300	0.300	
11/19/2019	04:45	1.76	15:30	3.93	2.76	04:55	1.72	15:45	3.72	2.88	04:55	0.092	15:30	0.615	0.308	0.308	
11/20/2019	03:25	1.82	12:20	3.94	2.66	03:05	1.81	12:20	3.72	2.75	03:25	0.100	12:20	0.618	0.280	0.280	
11/21/2019	04:10	1.68	09:30	4.13	2.70	03:00	1.60	09:30	3.84	2.81	04:15	0.080	09:30	0.682	0.295	0.295	
11/22/2019	04:30	1.58	11:30	3.91	2.79	04:20	1.52	11:30	3.69	2.88	04:20	0.069	11:30	0.607	0.315	0.315	
11/23/2019	05:00	1.55	12:05	3.76	2.14	04:55	1.47	12:00	3.41	2.15	04:55	0.064	12:05	0.504	0.159	0.159	
11/24/2019	03:20	1.44	09:30	3.57	1.98	05:30	1.05	11:15	3.21	1.89	05:30	0.044	09:30	0.452	0.128	0.128	
11/25/2019	02:00	1.51	16:45	3.74	2.58	02:20	1.12	12:40	3.63	2.65	02:05	0.047	12:25	0.519	0.268	0.268	
11/26/2019	04:10	1.75	13:35	3.61	2.75	05:10	1.58	13:10	3.68	2.89	05:10	0.085	13:35	0.493	0.306	0.306	0.36
11/27/2019	03:10	1.92	10:20	3.75	2.79	02:55	1.76	13:55	3.60	2.86	02:00	0.107	21:05	0.502	0.307	0.307	0.63
11/28/2019	20:05	1.59	02:50	2.32	1.86	22:45	1.22	00:00	2.34	1.77	20:00	0.058	09:20	0.177	0.102	0.102	
11/29/2019	04:15	1.50	09:10	3.87	2.01	05:55	1.28	14:05	3.35	1.98	04:25	0.057	09:10	0.524	0.137	0.137	0.02
11/30/2019	06:20	1.46	17:25	2.26	1.79	06:25	1.30	17:35	2.35	1.68	06:25	0.052	17:25	0.172	0.091	0.091	0.10
12/01/2019	06:00	1.49	21:25	2.54	1.94	04:15	1.25	21:40	2.62	1.73	04:15	0.054	21:40	0.223	0.107	0.107	0.06
12/02/2019	04:10	1.74	08:30	3.62	2.77	04:10	1.39	15:20	3.68	2.79	04:10	0.071	13:20	0.513	0.308	0.308	0.30
12/03/2019	04:05	1.79	10:00	4.05	2.75	04:10	1.82	09:55	3.69	2.80	04:05	0.097	10:00	0.636	0.298	0.298	0.01
12/04/2019	01:45	1.87	12:05	4.04	2.92	03:20	1.84	12:05	3.81	2.97	02:00	0.109	12:05	0.656	0.341	0.341	0.39
12/05/2019	03:25	1.88	14:30	4.04	2.82	03:10	1.72	13:25	3.80	2.92	03:10	0.102	14:30	0.643	0.318	0.318	0.01
12/06/2019	05:00	1.87	14:45	3.76	2.73	01:15	1.90	12:30	3.69	2.84	05:00	0.111	14:45	0.524	0.295	0.295	0.01
12/07/2019	06:00	1.76	11:35	3.72	2.35	05:45	1.74	12:15	3.51	2.39	05:45	0.091	11:35	0.508	0.200	0.200	0.67
12/08/2019	03:50	1.82	07:40	3.31	2.11	05:30	1.48	07:35	3.16	2.05	05:30	0.082	07:40	0.410	0.143	0.143	0.20
12/09/2019	04:20	1.82	17:05	3.83	2.69	01:10	1.53	13:30	3.58	2.79	04:15	0.086	17:05	0.507	0.288	0.288	
12/10/2019	04:55	1.78	09:20	3.94	2.70	05:10	1.80	14:40	3.63	2.81	05:10	0.096	09:20	0.540	0.291	0.291	
12/11/2019	04:15	1.87	09:40	3.85	2.74	02:40	1.88	13:10	3.63	2.85	03:55	0.109	14:20	0.532	0.298	0.298	0.03
12/12/2019	04:20	1.77	17:05	3.81	2.72	04:10	1.84	12:30	3.65	2.85	04:20	0.097	17:05	0.518	0.295	0.295	0.01
12/13/2019	01:40	1.92	12:55	3.75	2.57	23:50	1.89	12:25	3.57	2.66	01:40	0.119	12:55	0.515	0.254	0.254	0.01
12/14/2019	03:05	1.74	15:20	3.69	2.30	02:05	1.49	14:05	3.51	2.31	02:05	0.079	15:20	0.510	0.194	0.194	0.01
12/15/2019	06:15	1.61	11:30	2.25	1.93	23:45	1.46	06:35	2.29	1.85	03:10	0.071	11:35	0.160	0.111	0.111	0.01
12/16/2019	03:40	1.64	14:00	4.10	2.75	04:05	1.32	10:05	3.58	2.69	04:05	0.065	14:00	0.556	0.294	0.294	0.01
12/17/2019	05:10	1.75	09:40	3.65	2.74	05:10	1.78	15:35	3.59	2.86	05:10	0.092	16:45	0.470	0.303	0.303	0.01
12/18/2019	04:05	1.68	09:05	3.72	2.82	03:40	1.66	11:15	3.71	2.96	04:05	0.084	11:15	0.551	0.323	0.323	0.01
12/19/2019	03:35	1.77	18:35	3.79	2.84	04:25	1.78	10:15	3.70	2.96	04:25	0.094	13:10	0.561	0.328	0.328	
12/20/2019	04:55	1.63	15:50	3.84	2.69	04:30	1.60	10:20	3.58	2.80	05:00	0.076	15:50	0.538	0.287	0.287	
12/21/2019	04:20	1.50	11:15	3.82	2.15	04:25	1.44	11:20	3.32	2.16	04:25	0.060	11:15	0.514	0.166	0.166	0.01
12/22/2019	03:15	1.44	14:30	2.50	1.77	03:05	1.35	14:30	2.49	1.72	03:30	0.053	14:30	0.217	0.093	0.093	0.41
12/23/2019	01:05	1.40	16:20	3.71	2.47	01:20	1.23	09:50	3.52	2.50	01:20	0.046	16:20	0.493	0.238	0.238	
12/24/2019	22:40	1.25	00:00	2.57	1.49	20:20	1.03	00:00	2.53	1.43	23:50	0.033	00:00	0.229	0.061	0.061	0.02
12/25/2019	01:30	1.18	16:00	1.98	1.36	01:25	0.90	15:45	1.99	1.23	01:30	0.027	16:00	0.123	0.046	0.046	0.08
12/26/2019	02:05	1.17	15:20	3.72	2.27	03:40	1.01	13:15	3.39	2.24	02:15	0.031	14:40	0.486	0.199	0.199	
12/27/2019	02:50	1.16	09:50	3.66	2.23	02:50	1.03	10:55	3.53	2.29	02:50	0.029	13:50	0.494	0.197	0.197	
12/28/2019	03:55	1.10	12:05	2.92	1.73	06:35	0.82	13:00	3.05	1.73	06:35	0.022	13:00	0.318	0.109	0.109	
12/29/2019	03:20	1.10	11:40	2.73	1.41	01:45	0.78	09:15	2.79	1.29	01:45	0.022	11:40	0.252	0.056	0.056	0.22
12/30/2019	01:00	1.08	08:30	2.93	2.03	00:55	0.80	17:40	3.05	2.06	00:55	0.021	17:40	0.328	0.152	0.152	
12/31/2019	21:30	1.11	08:40	2.26	1.48	18:05	0.82	08:45	2.32	1.35	18:05	0.023	08:45	0.170	0.059	0.059	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	14:05	1.14 16:35	1.68	1.30	07:05	0.86 16:35	1.55	1.03	14:05	0.026 16:35	0.076	0.035	0.035	
01/02/2020	23:30	1.23 07:30	3.51	2.01	23:35	0.95 07:30	3.29	2.01	23:35	0.030 07:30	0.465	0.146	0.146	
01/03/2020	21:55	1.07 15:10	3.39	1.92	00:30	0.89 15:10	3.16	1.90	21:55	0.025 15:10	0.425	0.139	0.139	
01/04/2020	19:50	1.14 12:35	2.84	1.64	05:55	0.83 11:00	2.94	1.55	05:55	0.025 12:35	0.282	0.087	0.087	
01/05/2020	11:50	1.11 17:35	2.14	1.29	11:55	0.75 17:35	2.21	1.07	11:50	0.020 17:35	0.153	0.037	0.037	
01/06/2020	00:05	1.22 13:05	3.31	1.93	00:00	0.89 13:05	3.14	1.90	00:00	0.027 13:05	0.408	0.134	0.134	
01/07/2020	23:45	1.13 14:30	2.99	1.92	01:05	0.87 12:30	3.02	1.92	01:05	0.027 12:35	0.323	0.133	0.133	
01/08/2020	04:25	1.12 08:35	3.04	2.01	04:30	0.98 08:35	3.16	2.04	04:30	0.026 08:35	0.364	0.143	0.143	0.02
01/09/2020	02:05	1.09 10:45	4.03	2.41	05:05	0.86 10:45	3.69	2.42	02:05	0.023 10:45	0.633	0.245	0.245	0.18
01/10/2020	05:05	1.72 16:00	3.89	2.68	02:30	1.66 14:05	3.62	2.76	05:05	0.085 16:00	0.538	0.287	0.287	0.02
01/11/2020	06:05	1.53 13:50	3.23	2.09	06:05	1.43 17:45	2.96	2.12	06:05	0.061 13:50	0.371	0.151	0.151	0.01
01/12/2020	03:40	1.62 14:05	2.39	1.94	03:30	1.16 14:15	2.38	1.80	03:30	0.055 14:05	0.193	0.110	0.110	
01/13/2020	04:30	1.72 14:50	3.86	2.68	03:10	1.50 12:55	3.66	2.71	04:25	0.079 13:05	0.535	0.282	0.282	0.02
01/14/2020	04:50	1.74 08:25	3.94	2.70	04:50	1.68 12:50	3.55	2.75	04:50	0.086 08:25	0.555	0.287	0.287	0.11
01/15/2020	04:15	1.73 10:30	4.01	2.80	03:45	1.67 12:10	3.54	2.84	04:20	0.087 10:30	0.542	0.306	0.306	0.07
01/16/2020	04:20	1.75 14:00	4.00	2.84	04:05	1.78 14:00	3.75	2.93	04:20	0.093 14:00	0.637	0.323	0.323	0.66
01/17/2020	04:40	1.89 13:15	4.18	2.77	05:00	1.92 15:00	3.74	2.84	04:45	0.113 15:00	0.629	0.301	0.301	
01/18/2020	07:25	1.68 12:40	3.38	2.18	22:15	1.53 12:40	3.17	2.23	22:15	0.083 12:40	0.425	0.169	0.169	
01/19/2020	04:50	1.46 08:55	2.39	1.81	19:55	1.43 08:55	2.42	1.78	04:50	0.057 08:55	0.197	0.099	0.099	
01/20/2020	00:40	1.63 11:00	3.70	2.64	03:15	1.37 14:55	3.58	2.68	00:55	0.068 12:30	0.495	0.279	0.279	
01/21/2020	04:00	1.75 17:20	3.99	2.91	04:00	1.78 12:40	3.60	2.89	04:00	0.092 17:20	0.562	0.327	0.327	
01/22/2020	04:15	1.84 09:25	3.87	2.87	04:05	1.92 12:50	3.62	2.93	04:15	0.108 09:25	0.516	0.327	0.327	0.03
01/23/2020	04:10	1.94 13:15	3.75	2.92	04:10	1.92 08:55	3.61	2.96	04:10	0.116 15:05	0.503	0.333	0.333	
01/24/2020	04:50	1.88 19:00	4.11	2.81	02:45	1.90 11:05	3.72	2.87	04:45	0.112 11:05	0.594	0.313	0.313	
01/25/2020	23:15	1.66 14:00	2.76	2.07	23:15	1.50 11:10	2.95	2.12	23:15	0.072 11:10	0.287	0.145	0.145	
01/26/2020	03:20	1.42 19:10	2.70	1.88	02:30	1.32 08:15	2.91	1.84	03:20	0.054 08:15	0.270	0.108	0.108	0.16
01/27/2020	22:35	1.84 08:50	3.78	2.76	01:25	1.81 14:40	3.55	2.89	01:15	0.105 08:50	0.495	0.305	0.305	
01/28/2020	22:55	1.70 05:15	3.83	2.81	23:35	1.69 05:10	3.76	2.85	22:55	0.086 05:10	0.599	0.315	0.315	0.01
01/29/2020	21:05	1.84 10:25	3.82	2.69	21:10	1.88 03:25	3.61	2.80	21:05	0.105 03:25	0.505	0.285	0.285	
01/30/2020	18:25	1.78 05:50	3.87	2.76	18:00	1.82 03:20	3.69	2.84	18:25	0.097 05:50	0.529	0.299	0.299	
01/31/2020	17:50	1.67 02:45	3.90	2.67	17:40	1.68 03:05	3.59	2.72	17:50	0.082 02:45	0.528	0.280	0.280	
02/01/2020	14:55	1.39 03:30	2.78	1.84	15:00	1.35 03:30	2.96	1.85	15:00	0.050 03:30	0.300	0.111	0.111	
02/02/2020	13:00	1.58 19:45	3.71	2.24	12:55	1.21 23:15	3.53	2.20	12:55	0.055 19:45	0.490	0.189	0.189	
02/03/2020	13:05	1.73 20:15	3.73	2.77	12:55	1.73 21:15	3.62	2.82	13:00	0.089 21:45	0.524	0.302	0.302	
02/04/2020	11:10	1.85 21:40	3.65	2.80	11:05	1.88 16:10	3.58	2.88	11:10	0.106 21:40	0.490	0.307	0.307	
02/05/2020	09:25	1.75 17:00	3.82	2.75	09:25	1.73 17:35	3.68	2.83	09:25	0.089 17:35	0.584	0.297	0.297	
02/06/2020	04:50	1.73 14:50	3.81	2.76	04:25	1.73 13:10	3.57	2.79	04:50	0.088 14:50	0.505	0.295	0.295	
02/07/2020	03:25	1.55 11:00	2.68	1.94	22:55	1.23 10:40	2.47	1.88	22:55	0.053 10:55	0.234	0.117	0.117	
02/08/2020	01:15	1.34 11:15	2.26	1.75	02:40	1.16 11:15	2.26	1.65	03:55	0.041 11:15	0.170	0.087	0.087	
02/09/2020	01:55	1.65 10:10	3.64	2.50	00:15	1.46 04:30	3.36	2.45	01:55	0.069 10:10	0.456	0.230	0.230	
02/10/2020	20:35	1.62 08:05	4.14	2.71	20:55	1.44 06:30	3.58	2.70	21:00	0.067 08:05	0.603	0.284	0.284	
02/11/2020	16:45	1.70 02:50	4.00	2.80	15:55	1.56 02:00	3.54	2.78	16:45	0.085 02:50	0.537	0.304	0.304	
02/12/2020	16:20	1.57 22:00	4.10	2.62	16:15	1.53 00:10	3.50	2.62	16:25	0.068 22:00	0.553	0.262	0.262	
02/13/2020	12:25	1.15 01:50	3.91	2.17	13:10	0.81 00:00	3.39	2.13	12:45	0.026 01:50	0.522	0.180	0.180	
02/14/2020	16:20	1.13 21:40	2.89	1.67	16:15	0.43 19:25	2.77	1.48	16:15	0.012 21:40	0.280	0.088	0.088	
02/15/2020	06:00	1.12 18:00	4.07	1.79	06:00	0.39 16:35	3.16	1.56	06:00	0.010 18:00	0.544	0.110	0.110	
02/16/2020	04:35	1.20 16:25	4.09	2.40	04:35	0.51 16:35	3.61	2.32	04:35	0.015 16:35	0.625	0.231	0.231	
02/17/2020	08:15	1.83 12:40	3.85	2.79	06:30	1.64 14:00	3.57	2.74	08:05	0.098 14:05	0.546	0.301	0.301	
02/18/2020	06:55	1.93 19:20	4.01	2.96	06:55	1.69 14:35	3.60	2.90	06:55	0.101 14:30	0.563	0.336	0.336	
02/19/2020	02:05	1.89 13:00	3.83	2.69	01:50	1.62 11:00	3.52	2.62	01:50	0.100 16:55	0.514	0.271	0.271	
02/20/2020	06:05	1.60 10:40	3.78	2.43	04:35	1.19 12:40	3.43	2.35	04:35	0.057 12:40	0.498	0.214	0.137	
02/21/2020														
02/22/2020														
02/23/2020														
02/24/2020														

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020																	
02/26/2020																	
02/27/2020																	
02/28/2020																	
02/29/2020																	
03/01/2020																	
03/02/2020																	
03/03/2020	23:50	1.45	10:00	3.65	2.56	05:05	1.01	10:00	3.56	2.80	23:50	0.040	10:00	0.530	0.270	0.238	
03/04/2020	04:35	1.16	09:00	3.60	2.44	04:35	0.50	11:50	3.52	2.56	04:35	0.014	09:00	0.511	0.247	0.247	
03/05/2020	04:35	1.32	08:30	3.42	2.40	04:40	0.72	08:40	3.49	2.63	04:40	0.025	08:30	0.474	0.234	0.234	
03/06/2020	04:15	1.11	15:35	3.39	2.23	03:40	0.50	15:20	3.43	2.43	03:40	0.015	15:35	0.461	0.212	0.212	
03/07/2020	03:35	1.10	11:25	2.98	1.68	03:55	0.48	11:25	3.31	1.81	01:05	0.013	11:25	0.370	0.105	0.105	
03/08/2020	05:15	1.11	11:45	2.77	1.50	03:05	0.37	13:40	3.09	1.40	03:05	0.010	11:45	0.303	0.072	0.072	
03/09/2020	03:50	1.17	12:00	3.55	2.19	02:30	0.45	13:25	3.53	2.30	02:30	0.013	12:00	0.503	0.205	0.205	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			22.365	4.90
Avg	2.34	2.36	0.216	

Site Commentary

Site Information

MIL_2569	
Pipe Dimensions	21
Silt Level	0.00"

Overview

Site MIL_2569 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited a small response to the wet weather events of November 26, 2019 - November 27, 2019 and December 7, 2019 - December 8, 2019. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

This location was installed downstream of site MIL_2491. A check of balancing shows a net flow of 0.225 MGD between the sites.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	6.43	1.05	0.441
Minimum	4.32	0.45	0.121
Maximum	9.03	1.68	0.966
Time of Minimum	11/16/2019 5:00 AM	2/18/2020 3:50 AM	2/18/2020 3:50 AM
Time of Maximum	12/23/2019 3:10 PM	12/4/2019 12:25 PM	12/23/2019 3:10 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

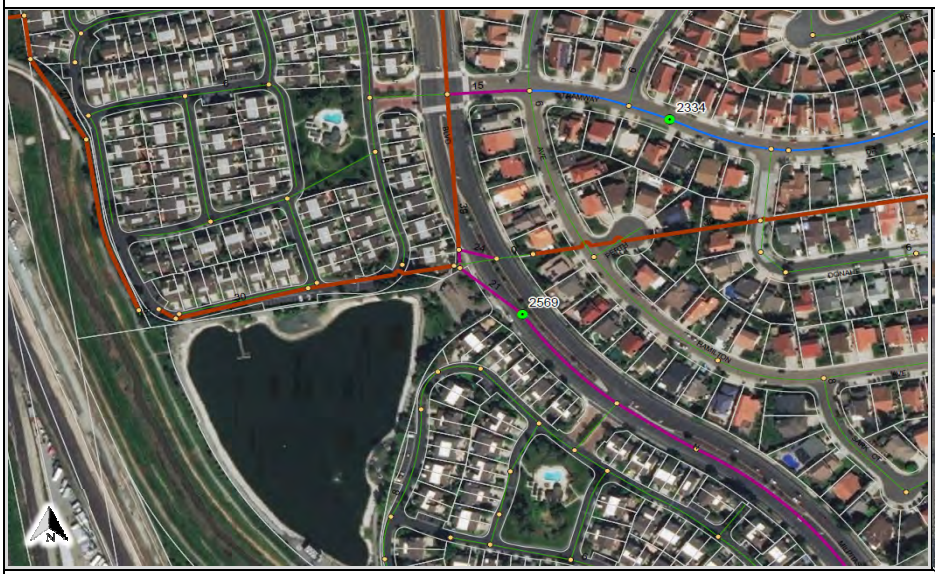
Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

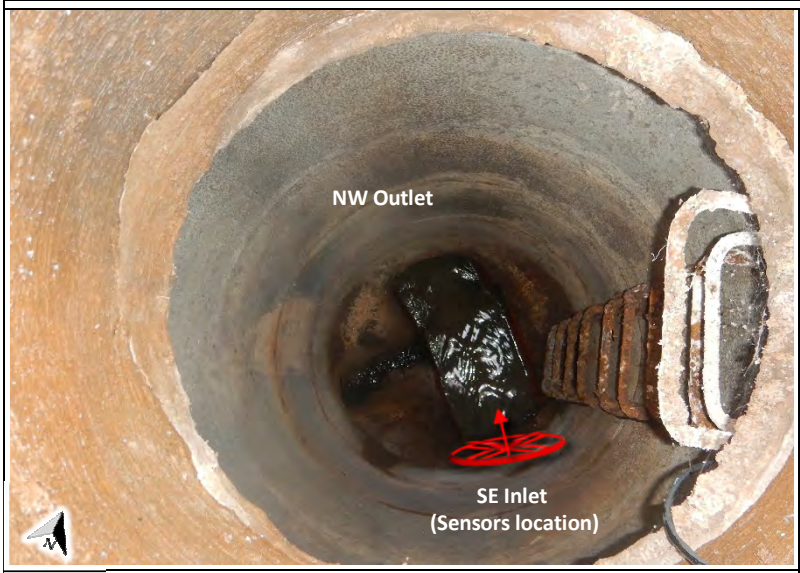
MIL_2569

Site Address /Location:	Milipitas Blvd and Tramway Dr			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	Drive	Latitude:	37.440801	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.9044	21.0" x 21.0"	Circular



Manhole #	System Characteristics
2569	Residential/Commercial
Access	Traffic
Drive	Medium







Installation Information	
Installation Date:	Installation Type:
Wednesday, November 13, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi
Installation Confirmation:	
Confirmation Time:	Pipe Size (HxW)
8:15:00 AM	21.0" x 21.0"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
7.5"	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.26	0''
Silt (in)	Silt Type
0''	
Hydraulic Comments:	
Smooth good flow, Medium depth and velocity	
Manhole / Pipe Information:	
Manhole Depth (Approx. FT):	Manhole Configuration
10'	Single
Manhole Material:	Manhole Condition:
Vitrified Clay Pipe	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
PVC	Good
Communication Information:	
Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole
Additional Site Info. / Comments:	

ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_2569

Flow Monitor

MIL_2569

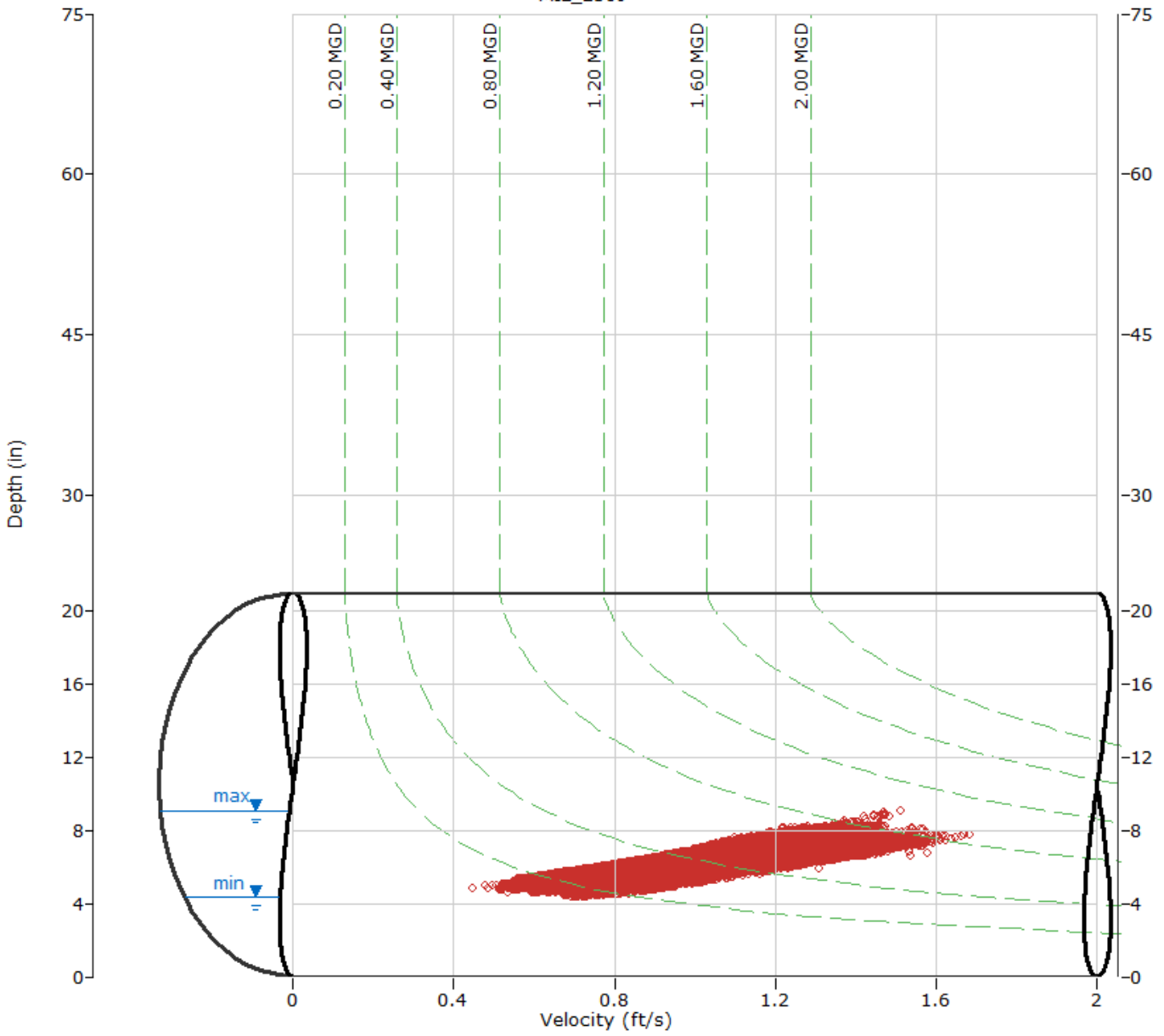
Pipe Height
21.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



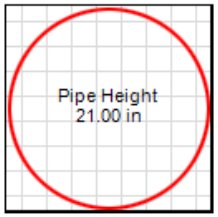
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_2569

Flow Monitor

MIL_2569

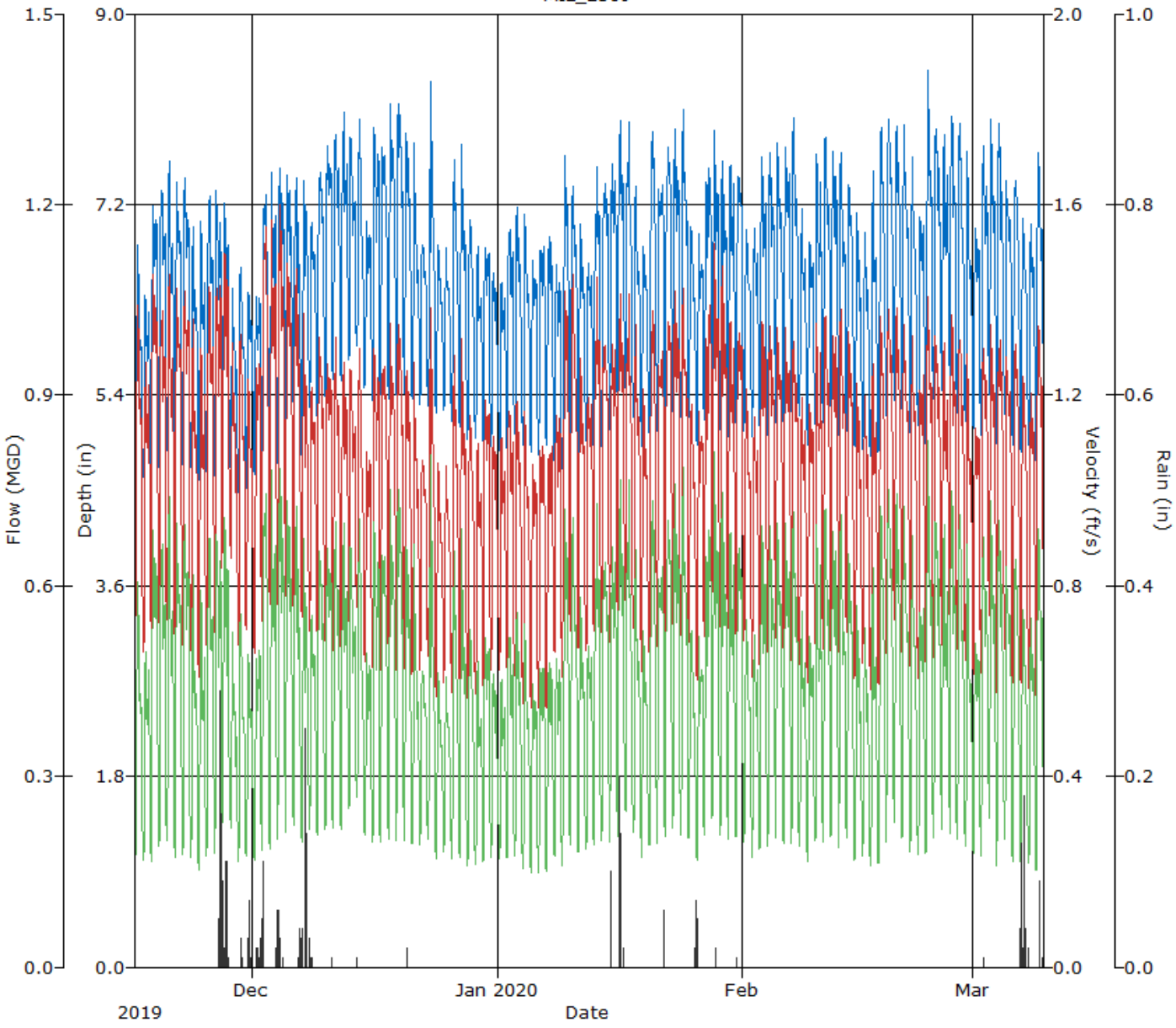


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_2569, Pipe Height: 21.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	05:00	4.32	11:20	6.92	5.69	04:50	0.70	11:10	1.42	1.10	05:00	0.161	11:20	0.631	0.389	0.389	
11/17/2019	03:40	4.61	09:30	6.49	5.63	03:20	0.61	10:50	1.29	1.02	03:20	0.153	10:50	0.507	0.352	0.352	
11/18/2019	03:55	4.38	10:30	7.50	6.21	02:55	0.67	10:35	1.55	1.18	03:15	0.163	10:30	0.773	0.475	0.475	
11/19/2019	05:20	4.71	16:05	7.66	6.46	03:50	0.69	16:00	1.50	1.15	03:50	0.183	16:00	0.771	0.488	0.488	
11/20/2019	04:45	4.82	10:05	7.76	6.34	03:45	0.71	12:35	1.49	1.13	03:45	0.194	10:05	0.780	0.465	0.465	
11/21/2019	04:50	4.70	09:50	7.82	6.35	04:15	0.64	09:50	1.52	1.15	04:15	0.167	09:50	0.801	0.475	0.475	
11/22/2019	05:00	4.71	20:45	7.96	6.47	04:05	0.67	20:50	1.57	1.17	04:00	0.175	20:50	0.845	0.499	0.499	
11/23/2019	05:10	4.67	12:25	7.10	5.94	05:25	0.64	12:50	1.41	1.04	05:25	0.166	12:50	0.654	0.388	0.388	
11/24/2019	05:15	4.57	10:00	7.10	5.89	05:15	0.60	09:55	1.34	1.00	05:15	0.149	09:55	0.619	0.372	0.372	
11/25/2019	04:15	4.66	12:45	7.48	6.21	04:55	0.66	12:45	1.51	1.13	04:55	0.171	12:45	0.749	0.454	0.454	
11/26/2019	05:25	4.60	09:55	7.59	6.31	04:15	0.67	09:40	1.54	1.19	05:30	0.174	09:45	0.772	0.486	0.486	0.63
11/27/2019	03:30	4.60	09:15	7.38	6.17	03:20	0.81	10:10	1.57	1.26	03:20	0.205	10:15	0.759	0.497	0.497	0.77
11/28/2019	05:45	4.53	12:00	6.44	5.53	05:40	0.83	11:40	1.33	1.07	05:40	0.206	12:40	0.535	0.357	0.357	
11/29/2019	04:50	4.40	14:25	6.80	5.65	03:50	0.54	14:25	1.38	1.05	03:50	0.133	14:25	0.602	0.365	0.365	0.05
11/30/2019	04:55	4.48	12:00	6.43	5.60	03:50	0.68	11:40	1.26	1.00	03:50	0.166	11:40	0.506	0.341	0.341	0.14
12/01/2019	05:55	4.61	21:55	6.45	5.70	05:40	0.63	22:05	1.32	1.04	05:45	0.159	22:00	0.533	0.366	0.366	0.06
12/02/2019	04:50	4.50	17:20	7.33	6.29	02:00	0.67	17:00	1.59	1.27	02:00	0.178	17:05	0.763	0.521	0.521	0.36
12/03/2019	04:40	4.46	10:15	7.67	6.20	04:40	0.73	10:05	1.62	1.23	04:40	0.177	10:05	0.833	0.494	0.494	
12/04/2019	03:05	4.74	12:25	7.74	6.49	03:05	0.74	12:25	1.68	1.27	03:05	0.195	12:25	0.875	0.541	0.541	0.44
12/05/2019	04:30	4.83	14:55	7.78	6.51	04:25	0.76	14:50	1.56	1.23	04:25	0.205	14:50	0.814	0.521	0.521	
12/06/2019	05:35	4.97	12:55	7.57	6.44	03:00	0.69	12:55	1.52	1.18	05:35	0.209	12:55	0.765	0.493	0.493	0.06
12/07/2019	05:00	4.77	12:45	7.47	6.32	05:10	0.73	12:15	1.39	1.07	05:05	0.193	12:05	0.689	0.437	0.437	0.84
12/08/2019	05:15	5.27	11:30	7.07	6.33	06:00	0.66	11:10	1.23	1.01	06:00	0.202	11:10	0.562	0.410	0.410	0.10
12/09/2019	05:00	5.12	09:35	7.65	6.72	04:55	0.68	09:30	1.42	1.09	04:55	0.200	09:35	0.715	0.484	0.484	
12/10/2019	05:10	5.36	12:25	7.85	6.92	04:25	0.67	14:50	1.32	1.07	04:30	0.210	12:20	0.696	0.493	0.493	0.01
12/11/2019	03:30	5.52	11:10	7.96	7.00	03:15	0.65	13:35	1.33	1.06	03:15	0.213	13:35	0.715	0.495	0.495	
12/12/2019	04:55	5.50	12:55	8.11	7.06	05:10	0.64	12:55	1.33	1.05	05:10	0.209	12:55	0.735	0.496	0.496	
12/13/2019	05:10	5.63	12:40	7.99	6.96	05:10	0.67	12:40	1.33	1.05	05:10	0.226	12:40	0.720	0.482	0.482	
12/14/2019	05:25	5.84	13:35	8.06	6.87	04:30	0.73	11:05	1.34	1.03	04:30	0.260	13:40	0.728	0.464	0.464	0.01
12/15/2019	03:40	5.41	11:10	7.12	6.43	03:40	0.62	23:00	1.12	0.92	03:40	0.196	11:15	0.520	0.377	0.377	
12/16/2019	03:45	5.31	08:40	8.39	6.92	03:35	0.58	08:35	1.40	1.04	03:35	0.179	08:35	0.813	0.485	0.485	
12/17/2019	04:55	5.37	08:25	7.95	6.97	03:35	0.59	17:05	1.32	1.07	03:35	0.184	08:25	0.713	0.499	0.499	
12/18/2019	04:45	5.30	11:35	8.30	7.09	04:50	0.63	10:20	1.38	1.08	04:50	0.194	11:40	0.782	0.518	0.518	
12/19/2019	05:05	5.36	10:55	8.32	7.13	05:10	0.58	13:35	1.38	1.09	05:10	0.182	10:55	0.790	0.527	0.527	
12/20/2019	05:00	5.32	09:00	8.01	6.98	05:30	0.60	14:45	1.33	1.05	05:05	0.187	14:45	0.712	0.487	0.487	0.02
12/21/2019	03:45	5.31	10:00	7.85	6.51	03:50	0.57	11:35	1.29	0.95	03:50	0.175	10:05	0.685	0.403	0.403	
12/22/2019	04:30	5.28	11:05	6.97	6.26	04:45	0.61	11:05	1.12	0.91	04:45	0.189	11:05	0.503	0.360	0.360	
12/23/2019	05:20	5.29	15:10	9.03	6.68	05:55	0.64	15:10	1.51	1.00	05:55	0.196	15:10	0.966	0.446	0.446	
12/24/2019	05:05	5.20	12:10	6.85	6.18	05:00	0.55	12:50	1.17	0.86	05:00	0.165	12:50	0.514	0.334	0.334	
12/25/2019	05:00	5.23	12:15	6.85	6.09	04:45	0.55	11:25	1.09	0.85	04:45	0.169	11:25	0.475	0.324	0.324	
12/26/2019	03:50	5.12	13:40	7.71	6.51	03:40	0.55	13:35	1.33	0.97	03:40	0.162	13:35	0.685	0.416	0.416	
12/27/2019	04:55	5.06	11:15	7.87	6.45	05:00	0.57	11:15	1.35	0.97	05:00	0.164	11:15	0.720	0.411	0.411	
12/28/2019	05:20	4.97	11:10	7.25	6.18	04:50	0.55	11:35	1.30	0.91	04:50	0.156	11:35	0.584	0.361	0.361	
12/29/2019	05:20	4.96	11:35	6.86	5.94	05:15	0.56	09:50	1.12	0.87	05:15	0.156	11:05	0.490	0.321	0.321	
12/30/2019	03:40	4.93	19:10	6.92	6.13	03:25	0.57	19:05	1.26	0.97	03:25	0.160	19:05	0.561	0.381	0.381	
12/31/2019	05:25	4.91	11:00	6.59	5.90	04:50	0.60	10:55	1.13	0.92	05:15	0.168	11:00	0.473	0.337	0.337	

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	05:25	4.85 12:15	6.51	5.83	05:55	0.60 12:15	1.14	0.91	05:55	0.163 12:15	0.467	0.328	0.328	
01/02/2020	04:45	4.83 10:40	7.01	6.17	03:45	0.60 10:35	1.21	0.96	03:45	0.165 10:35	0.549	0.380	0.380	
01/03/2020	04:45	4.99 12:40	7.24	6.21	02:50	0.58 12:40	1.24	0.94	02:50	0.169 12:40	0.587	0.375	0.375	
01/04/2020	05:05	4.88 11:50	7.28	6.06	05:20	0.52 11:50	1.21	0.88	05:20	0.143 11:50	0.579	0.339	0.339	
01/05/2020	05:25	4.84 11:05	6.79	6.00	05:15	0.52 12:00	1.08	0.86	05:15	0.142 11:05	0.468	0.325	0.325	
01/06/2020	04:50	4.79 12:40	7.01	6.15	04:00	0.49 10:35	1.16	0.91	04:00	0.131 12:45	0.522	0.357	0.357	
01/07/2020	03:20	4.90 12:55	7.03	6.17	05:25	0.51 12:55	1.13	0.90	05:25	0.143 12:55	0.518	0.356	0.356	
01/08/2020	04:45	4.67 10:55	6.68	5.90	04:45	0.63 12:50	1.20	0.98	04:45	0.163 10:55	0.508	0.361	0.361	
01/09/2020	04:40	4.67 11:10	7.79	6.39	03:45	0.59 11:10	1.49	1.10	03:45	0.153 11:10	0.783	0.467	0.467	
01/10/2020	04:40	4.82 13:10	7.44	6.39	03:20	0.68 13:15	1.48	1.15	03:20	0.185 13:15	0.728	0.479	0.479	
01/11/2020	05:20	4.76 11:15	7.15	6.08	03:50	0.64 11:15	1.36	1.02	05:30	0.172 11:15	0.635	0.393	0.393	
01/12/2020	05:30	4.94 11:35	6.70	5.99	05:10	0.65 11:30	1.22	1.00	05:35	0.181 11:35	0.518	0.374	0.374	
01/13/2020	03:30	4.84 13:25	7.66	6.42	03:20	0.68 13:35	1.49	1.13	03:25	0.185 13:35	0.760	0.474	0.474	
01/14/2020	04:40	4.87 13:25	7.50	6.52	02:15	0.68 08:55	1.36	1.10	04:40	0.189 13:20	0.670	0.470	0.470	
01/15/2020	04:40	5.06 12:15	7.69	6.74	04:15	0.67 12:25	1.35	1.10	04:15	0.194 12:25	0.691	0.489	0.489	0.10
01/16/2020	04:45	5.08 14:15	8.22	6.88	04:40	0.68 14:10	1.47	1.14	04:40	0.198 14:10	0.825	0.524	0.524	0.66
01/17/2020	05:10	5.35 15:20	8.19	6.79	05:10	0.74 15:25	1.45	1.12	05:10	0.231 15:20	0.815	0.499	0.499	
01/18/2020	04:35	5.14 13:00	7.56	6.34	03:35	0.69 13:00	1.44	1.04	04:35	0.204 13:00	0.725	0.424	0.424	
01/19/2020	05:20	4.89 10:30	6.86	6.07	05:20	0.60 10:25	1.25	0.95	05:20	0.166 10:25	0.551	0.366	0.366	
01/20/2020	05:20	5.01 12:45	8.10	6.72	03:45	0.60 15:00	1.40	1.09	03:45	0.172 12:45	0.770	0.491	0.491	
01/21/2020	04:15	5.06 21:55	7.60	6.73	04:05	0.66 21:45	1.36	1.11	04:05	0.190 21:55	0.690	0.492	0.492	0.01
01/22/2020	04:40	5.18 12:55	7.81	6.85	04:35	0.67 17:15	1.39	1.14	04:35	0.199 13:05	0.721	0.521	0.521	0.09
01/23/2020	04:40	5.16 09:15	8.02	6.84	04:40	0.70 19:25	1.47	1.15	04:40	0.207 09:15	0.797	0.522	0.522	
01/24/2020	04:45	5.14 11:20	8.24	6.83	05:05	0.68 11:10	1.47	1.13	05:05	0.201 11:20	0.829	0.515	0.515	
01/25/2020	03:40	5.15 11:55	7.03	6.21	03:45	0.66 12:40	1.20	0.97	03:45	0.194 11:50	0.543	0.383	0.383	
01/26/2020	05:35	4.90 11:05	7.06	6.11	05:30	0.59 10:45	1.28	0.95	05:30	0.161 11:05	0.584	0.369	0.369	0.16
01/27/2020	03:00	5.12 18:35	7.84	6.67	02:10	0.66 18:40	1.46	1.13	02:55	0.202 18:35	0.758	0.500	0.500	
01/28/2020	04:05	5.19 10:15	8.02	6.70	03:50	0.77 10:30	1.58	1.20	03:55	0.230 10:15	0.856	0.531	0.531	0.02
01/29/2020	04:55	5.04 10:00	7.69	6.52	04:35	0.71 10:00	1.51	1.16	04:50	0.203 10:00	0.780	0.493	0.493	
01/30/2020	04:45	4.95 11:30	7.66	6.59	02:45	0.66 10:30	1.38	1.12	02:45	0.190 10:30	0.700	0.483	0.483	
01/31/2020	03:30	5.12 12:50	7.71	6.69	03:30	0.68 12:40	1.41	1.13	03:30	0.200 12:45	0.730	0.497	0.497	0.01
02/01/2020	04:10	5.04 11:40	7.11	6.22	03:45	0.66 11:35	1.30	0.99	03:45	0.191 11:35	0.600	0.390	0.390	
02/02/2020	05:20	4.98 12:50	7.10	6.15	05:15	0.59 12:35	1.19	0.93	05:15	0.167 12:50	0.550	0.364	0.364	
02/03/2020	04:45	5.09 10:35	7.73	6.60	03:35	0.62 11:20	1.43	1.09	03:35	0.181 10:40	0.715	0.476	0.476	
02/04/2020	04:50	5.00 13:30	7.77	6.64	03:15	0.62 13:20	1.39	1.09	03:15	0.177 13:25	0.724	0.478	0.478	
02/05/2020	04:45	5.10 09:50	7.91	6.75	04:45	0.67 10:00	1.38	1.11	04:45	0.196 10:00	0.737	0.495	0.495	
02/06/2020	04:40	5.09 11:30	8.02	6.79	05:20	0.65 11:25	1.45	1.09	04:40	0.188 11:30	0.784	0.493	0.493	
02/07/2020	03:30	5.20 11:15	8.10	6.83	03:10	0.62 08:45	1.37	1.08	03:10	0.187 11:10	0.757	0.490	0.490	
02/08/2020	03:45	5.18 11:35	7.37	6.24	04:25	0.58 11:35	1.26	0.97	04:25	0.174 11:35	0.612	0.382	0.382	
02/09/2020	05:40	4.90 11:05	6.87	6.12	05:45	0.58 13:55	1.20	0.97	05:45	0.161 11:25	0.526	0.376	0.376	
02/10/2020	03:55	5.10 08:20	7.98	6.52	03:05	0.63 08:20	1.47	1.06	03:05	0.193 08:20	0.796	0.453	0.453	
02/11/2020	05:00	5.07 13:20	7.97	6.78	04:45	0.64 13:15	1.44	1.11	04:55	0.184 13:15	0.776	0.502	0.502	
02/12/2020	04:40	5.26 09:05	7.86	6.82	03:25	0.56 12:15	1.35	1.12	03:25	0.170 09:05	0.715	0.505	0.505	
02/13/2020	04:40	5.00 11:15	7.82	6.53	03:10	0.63 11:15	1.44	1.09	03:10	0.182 11:15	0.759	0.469	0.469	
02/14/2020	03:55	5.04 10:50	7.50	6.52	03:40	0.68 10:20	1.36	1.09	03:40	0.195 10:45	0.667	0.463	0.463	
02/15/2020	03:50	4.87 12:10	7.48	6.10	03:20	0.55 12:05	1.31	0.95	03:20	0.153 12:05	0.650	0.371	0.371	
02/16/2020	05:10	4.86 11:10	7.04	6.00	05:10	0.63 12:45	1.26	0.95	05:10	0.171 12:45	0.572	0.358	0.358	
02/17/2020	05:10	4.78 12:45	7.56	6.16	05:55	0.48 11:05	1.33	0.96	05:55	0.135 11:05	0.667	0.381	0.381	
02/18/2020	03:45	4.83 12:25	8.16	6.56	03:50	0.45 12:15	1.54	1.05	03:50	0.121 12:20	0.856	0.458	0.458	
02/19/2020	05:00	5.16 12:55	8.14	6.88	03:10	0.56 11:25	1.45	1.11	03:10	0.167 11:25	0.796	0.515	0.515	
02/20/2020	04:55	5.24 11:25	8.09	6.93	04:55	0.70 11:15	1.44	1.13	04:55	0.212 11:15	0.793	0.522	0.522	
02/21/2020	04:40	5.21 10:15	7.98	6.71	03:20	0.59 10:20	1.38	1.07	03:20	0.181 10:20	0.747	0.475	0.475	
02/22/2020	05:10	5.01 11:35	7.71	6.42	05:05	0.61 11:40	1.39	1.03	05:05	0.174 11:40	0.718	0.428	0.428	
02/23/2020	05:55	5.06 10:00	7.14	6.31	06:05	0.56 20:40	1.27	1.00	06:05	0.162 20:40	0.585	0.407	0.407	
02/24/2020	03:45	4.89 11:05	8.78	6.87	03:55	0.60 11:20	1.48	1.11	03:55	0.166 11:05	0.905	0.513	0.513	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	05:00	5.30	12:40	8.03	6.93	05:10	0.62	12:50	1.38	1.07	05:10	0.190	12:50	0.750	0.498	0.498	
02/26/2020	04:55	5.34	10:35	7.98	6.92	05:00	0.63	12:55	1.48	1.07	05:00	0.197	12:55	0.784	0.492	0.492	
02/27/2020	04:55	5.32	12:55	8.12	6.98	04:50	0.61	12:50	1.41	1.10	04:50	0.190	12:50	0.781	0.513	0.513	
02/28/2020	03:35	5.21	10:40	8.05	6.79	02:45	0.64	12:05	1.37	1.07	03:35	0.194	10:55	0.740	0.486	0.486	
02/29/2020	03:30	5.14	11:10	8.12	6.39	03:05	0.62	11:15	1.37	0.98	03:05	0.183	11:15	0.760	0.405	0.405	
03/01/2020	05:50	5.08	12:35	7.05	6.23	05:20	0.55	11:30	1.18	0.94	05:20	0.161	12:35	0.536	0.376	0.376	
03/02/2020	03:35	5.00	10:40	7.86	6.69	03:55	0.60	10:55	1.36	1.06	03:45	0.170	10:55	0.715	0.473	0.473	0.01
03/03/2020	05:40	5.30	10:20	8.14	6.81	05:35	0.70	10:05	1.40	1.08	05:35	0.215	10:15	0.773	0.485	0.485	
03/04/2020	03:45	4.89	09:20	8.20	6.71	03:30	0.55	09:25	1.37	1.06	03:30	0.152	09:25	0.771	0.476	0.476	
03/05/2020	04:55	5.07	08:50	7.82	6.61	04:55	0.59	08:55	1.38	1.07	04:55	0.170	08:50	0.724	0.461	0.461	
03/06/2020	05:10	4.88	15:55	7.57	6.48	03:05	0.49	15:45	1.36	1.04	03:05	0.139	15:45	0.675	0.446	0.446	
03/07/2020	05:05	4.79	11:55	7.44	6.16	05:25	0.56	11:55	1.47	0.99	05:25	0.151	11:55	0.723	0.390	0.390	0.58
03/08/2020	04:55	4.90	11:00	7.14	6.11	05:20	0.50	10:55	1.24	0.95	05:20	0.139	11:00	0.577	0.370	0.370	0.02
03/09/2020	03:20	4.74	12:10	7.84	6.44	03:20	0.52	12:15	1.42	1.05	03:20	0.135	12:10	0.753	0.449	0.449	0.11

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			50.750	5.26
Avg	6.43	1.05	0.441	

Site Commentary

Site Information

MIL_2666	
Pipe Dimensions	17.88
Silt Level	0.00"

Overview

Site MIL_2666 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited a moderate response to the wet weather events of November 26, 2019 - November 27, 2019 and December 7, 2019 - December 8, 2019. Surcharge conditions were experienced at this site. Review of the scattergraph shows that both free flow and backwater conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	8.74	1.74	0.949
Minimum	5.81	0.77	0.363
Maximum	21.77	2.28	1.470
Time of Minimum	2/14/2020 2:55 AM	3/3/2020 7:40 AM	2/25/2020 3:25 AM
Time of Maximum	1/26/2020 11:35 AM	2/25/2020 7:30 AM	1/13/2020 8:00 AM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

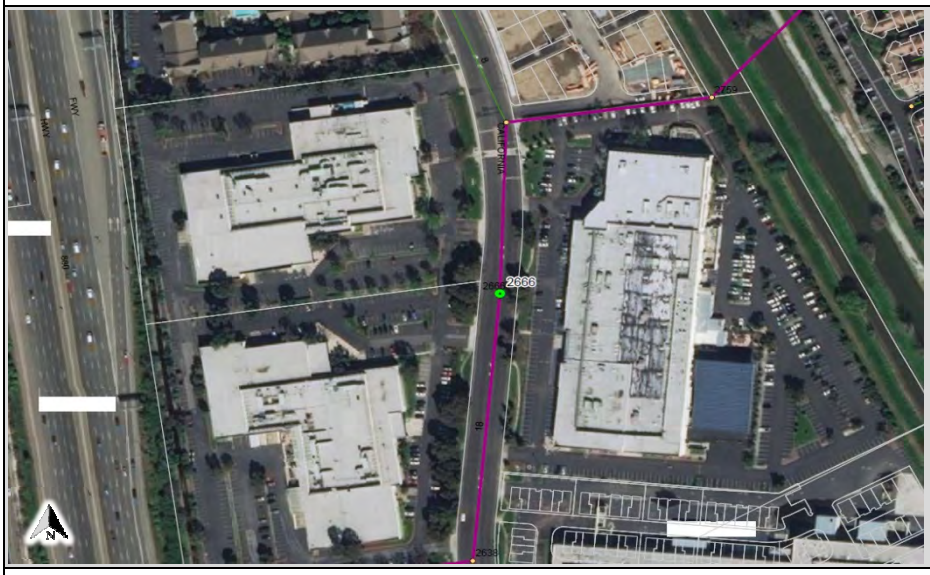
Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

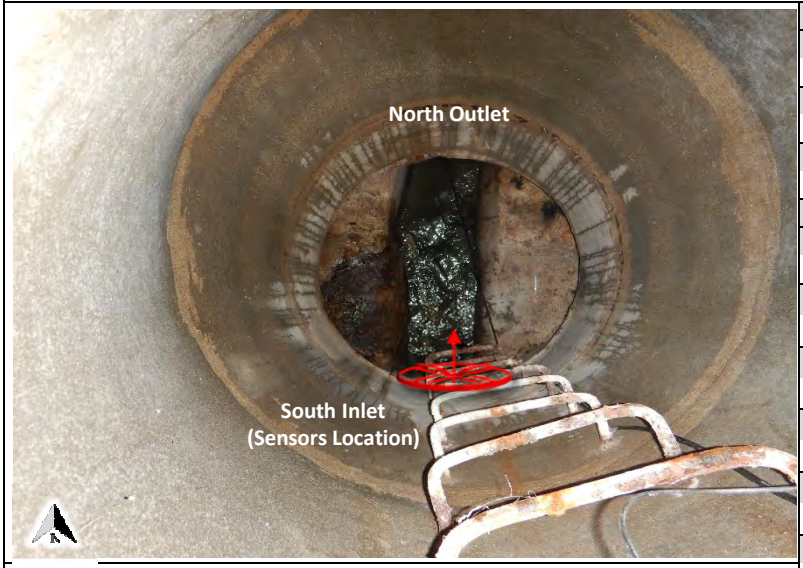
MIL_2666

Site Address /Location:	California Cir and Cadillac Court, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	Drive	Latitude:	37.449182°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.919254°	17.88" x 17.88"	Circular



Manhole #	System Characteristics
2666	Residential/Commercial
Access	Traffic
Drive	Medium







Installation Information

Installation Date:	Installation Type:
Tuesday, November 12, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
4:33:04 AM	17.88" x 17.88"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
6.25"	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.58	0''
Silt (in)	Silt Type
0''	

Hydraulic Comments:

good flow, medium depth and velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
9'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
PVC	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_2666

Flow Monitor

MIL_2666

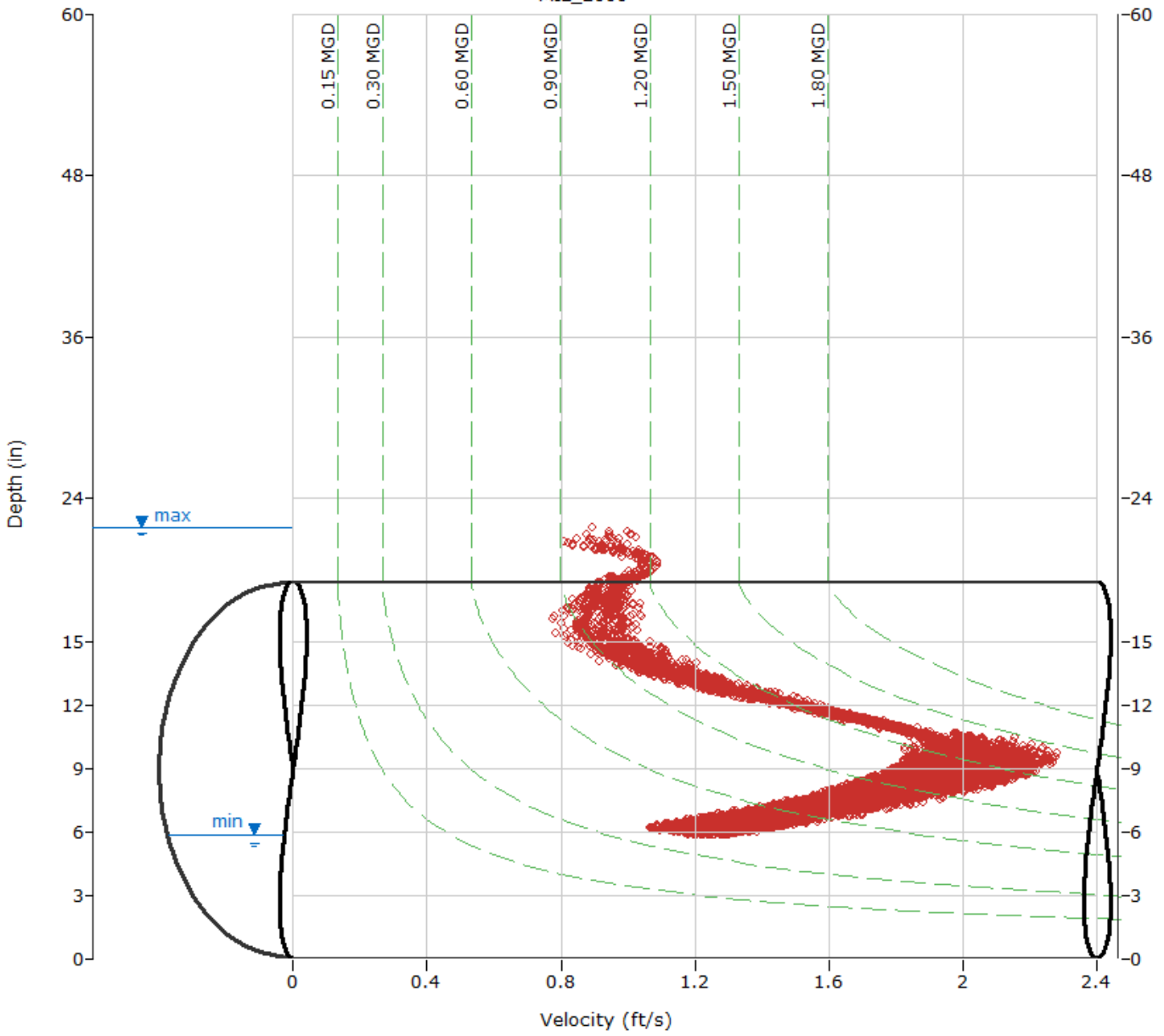
Pipe Height
17.88 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_2666

Flow Monitor

MIL_2666

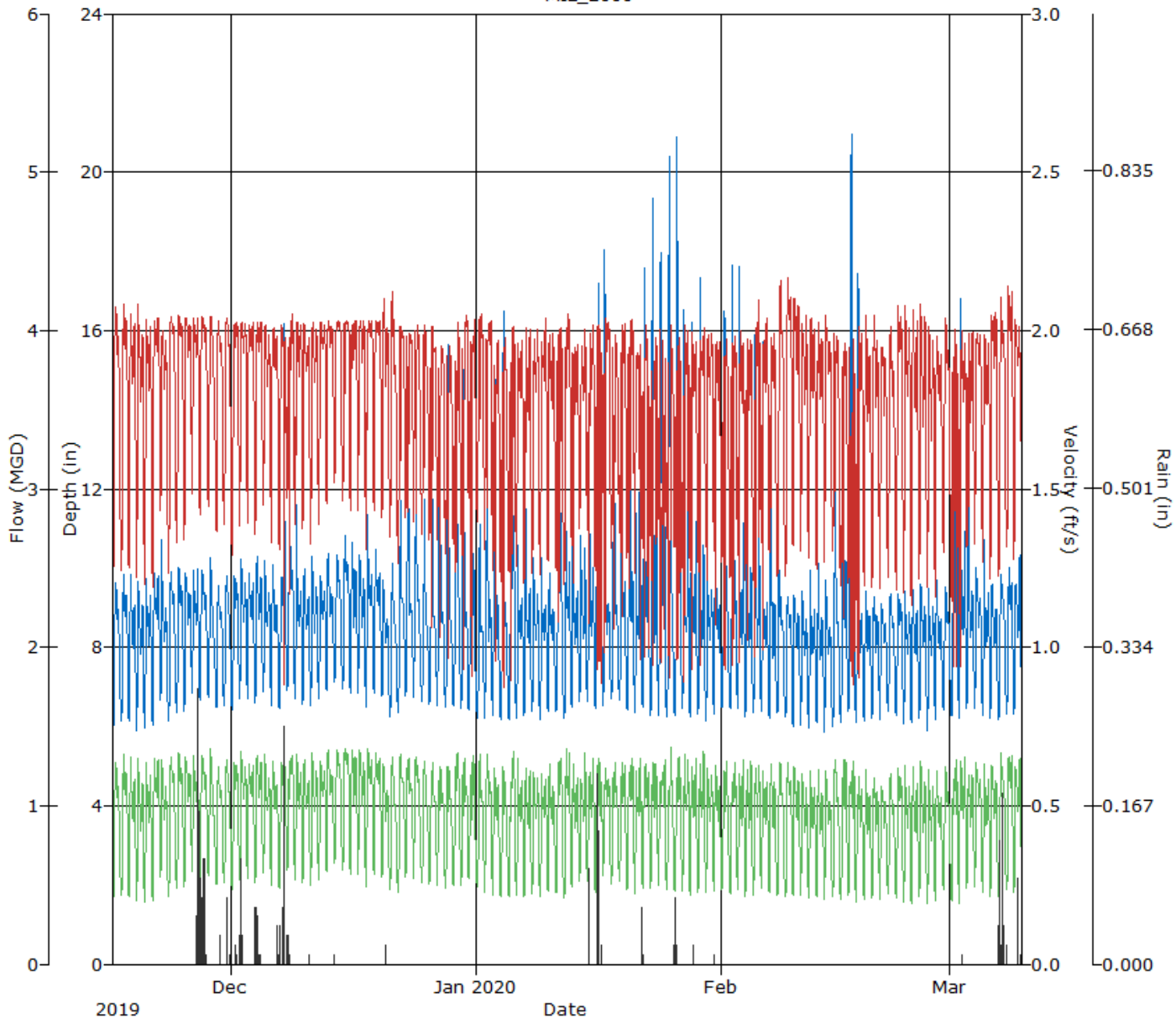
Pipe Height
17.88 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_2666, Pipe Height: 17.88 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	04:30	5.94	11:15	9.75	8.10	04:10	1.19	10:35	2.15	1.78	04:10	0.393	12:50	1.313	0.912	0.912	
11/17/2019	04:10	6.11	10:45	10.15	8.25	03:35	1.20	20:00	2.14	1.78	05:05	0.413	11:15	1.385	0.935	0.935	
11/18/2019	03:25	6.10	07:35	10.12	8.22	02:55	1.19	19:55	2.14	1.79	02:55	0.412	07:40	1.391	0.931	0.931	
11/19/2019	03:40	5.87	07:45	10.35	8.08	02:20	1.14	08:05	2.19	1.78	04:10	0.381	07:35	1.437	0.905	0.905	
11/20/2019	03:45	5.91	07:35	10.48	8.17	03:45	1.18	19:20	2.06	1.78	03:45	0.383	07:35	1.389	0.915	0.915	
11/21/2019	03:45	6.02	08:10	10.54	8.58	03:35	1.13	08:00	2.09	1.84	03:35	0.379	08:10	1.396	1.012	1.012	
11/22/2019	03:45	6.64	07:40	11.30	8.47	03:45	1.42	09:20	2.16	1.84	03:45	0.540	08:10	1.372	0.975	0.975	
11/23/2019	04:10	6.09	11:05	10.26	8.34	03:50	1.18	12:35	2.06	1.79	03:50	0.405	11:05	1.363	0.954	0.954	
11/24/2019	05:05	6.33	12:35	10.23	8.53	05:05	1.32	11:00	2.07	1.83	05:05	0.471	11:45	1.363	0.995	0.995	
11/25/2019	03:55	6.35	07:50	10.47	8.59	03:55	1.32	07:40	2.07	1.86	03:55	0.475	07:45	1.409	1.017	1.017	
11/26/2019	03:45	6.80	07:45	10.52	8.68	03:45	1.47	20:40	2.04	1.88	03:45	0.578	07:45	1.394	1.037	1.037	0.63
11/27/2019	03:30	6.63	08:40	10.23	8.82	03:25	1.37	09:40	2.04	1.90	03:25	0.520	08:40	1.359	1.069	1.069	0.77
11/28/2019	04:40	6.68	11:30	10.47	8.48	04:40	1.43	10:55	2.04	1.84	04:40	0.551	11:30	1.389	0.985	0.985	
11/29/2019	05:05	6.46	10:55	9.77	8.21	05:05	1.36	10:55	2.04	1.80	05:05	0.499	10:55	1.285	0.927	0.927	0.05
11/30/2019	05:25	6.50	12:05	10.15	8.34	05:25	1.38	11:55	2.04	1.82	05:25	0.509	12:05	1.348	0.957	0.957	0.14
12/01/2019	05:15	6.41	11:15	10.05	8.49	05:15	1.29	11:55	2.09	1.80	05:15	0.467	11:15	1.320	0.976	0.976	0.06
12/02/2019	03:35	6.68	07:55	10.76	8.77	03:35	1.38	08:00	2.06	1.86	03:35	0.529	08:00	1.398	1.044	1.044	0.36
12/03/2019	03:50	6.67	07:35	10.41	8.65	03:50	1.38	20:00	2.03	1.86	03:50	0.528	07:40	1.361	1.021	1.021	
12/04/2019	03:15	6.56	08:20	11.02	8.79	03:15	1.34	20:40	2.03	1.87	03:15	0.501	07:35	1.378	1.049	1.049	0.44
12/05/2019	03:40	6.84	08:20	10.59	8.62	03:40	1.43	19:00	2.12	1.84	03:40	0.568	08:20	1.377	1.003	1.003	
12/06/2019	03:40	6.48	07:55	10.81	8.50	03:40	1.31	09:20	2.08	1.83	03:40	0.483	08:15	1.339	0.980	0.980	0.06
12/07/2019	04:55	6.41	18:05	16.58	9.36	19:55	0.87	17:15	2.18	1.67	04:35	0.462	17:15	1.414	0.959	0.959	0.84
12/08/2019	03:55	6.90	11:55	13.35	9.32	12:00	1.12	15:50	2.16	1.77	05:00	0.567	17:55	1.412	1.044	1.044	0.10
12/09/2019	03:15	6.68	07:50	12.68	8.79	07:55	1.29	10:00	2.03	1.83	03:15	0.530	08:45	1.356	1.019	1.019	
12/10/2019	03:25	6.51	08:15	10.66	8.46	02:45	1.31	20:45	2.05	1.83	02:45	0.491	08:20	1.368	0.974	0.974	0.01
12/11/2019	03:25	6.51	08:30	10.68	8.55	03:30	1.29	14:05	2.07	1.82	03:30	0.477	08:15	1.384	0.988	0.988	0.00
12/12/2019	03:45	6.66	07:40	10.43	8.65	03:45	1.37	10:10	2.03	1.86	03:45	0.525	07:40	1.364	1.023	1.023	
12/13/2019	03:00	6.88	08:15	10.59	8.88	03:00	1.44	08:50	2.03	1.90	03:00	0.577	08:15	1.377	1.074	1.074	
12/14/2019	04:20	7.04	10:40	10.60	8.98	04:20	1.49	15:30	2.03	1.89	04:20	0.616	10:40	1.377	1.087	1.087	0.01
12/15/2019	04:40	6.93	11:05	10.95	9.10	04:40	1.46	14:25	2.03	1.87	04:40	0.590	10:50	1.383	1.096	1.096	
12/16/2019	03:45	6.77	08:25	10.78	9.05	03:45	1.41	20:50	2.03	1.89	03:45	0.552	08:40	1.377	1.095	1.095	
12/17/2019	03:35	6.81	07:40	10.73	8.87	03:35	1.42	11:10	2.03	1.89	03:35	0.559	07:35	1.376	1.067	1.067	
12/18/2019	03:45	6.43	08:20	11.98	8.99	04:10	1.26	21:05	2.03	1.86	04:10	0.464	08:50	1.383	1.073	1.073	
12/19/2019	03:35	6.82	08:00	10.95	9.02	03:35	1.42	19:15	2.03	1.89	03:35	0.562	07:40	1.380	1.093	1.093	
12/20/2019	05:05	6.59	08:25	10.05	8.25	05:10	1.38	09:30	2.26	1.86	05:10	0.523	07:40	1.408	0.961	0.961	0.02
12/21/2019	05:00	6.21	11:00	10.40	8.15	04:25	1.32	10:05	2.28	1.80	04:25	0.464	11:00	1.395	0.921	0.921	
12/22/2019	04:45	6.32	12:15	12.19	8.67	04:30	1.24	10:05	2.09	1.75	04:30	0.444	14:25	1.370	0.968	0.968	
12/23/2019	03:25	6.72	12:15	13.17	8.97	12:20	1.18	08:50	2.03	1.79	03:25	0.538	13:40	1.377	1.019	1.019	
12/24/2019	04:05	6.63	11:15	12.60	8.92	04:05	1.36	14:05	2.03	1.78	04:05	0.518	13:40	1.374	1.004	1.004	
12/25/2019	05:20	6.61	13:10	12.38	8.45	05:20	1.35	11:20	2.11	1.76	05:20	0.512	13:55	1.376	0.936	0.936	
12/26/2019	04:10	6.51	11:55	14.17	8.82	11:35	0.97	18:10	2.10	1.72	04:10	0.490	14:00	1.374	0.943	0.943	
12/27/2019	04:15	6.46	11:55	14.12	9.00	11:55	0.98	14:30	2.03	1.67	03:35	0.480	14:05	1.374	0.930	0.930	
12/28/2019	05:00	6.46	12:25	16.08	9.04	11:35	0.86	09:50	2.09	1.62	05:00	0.470	15:10	1.375	0.900	0.900	
12/29/2019	05:05	6.52	11:15	13.33	9.13	11:10	1.15	20:30	2.03	1.66	06:00	0.484	17:25	1.380	0.966	0.966	
12/30/2019	04:05	6.41	11:45	15.44	9.14	12:05	0.83	18:00	2.20	1.68	03:30	0.484	09:15	1.374	0.937	0.937	
12/31/2019	03:25	6.28	11:45	15.22	9.04	11:45	0.87	14:50	2.14	1.72	03:30	0.480	09:55	1.380	0.950	0.950	

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	05:35	6.16 12:20	11.50	8.08	04:10	1.35 16:50	2.19	1.81	05:30	0.474 13:25	1.381	0.913	0.913	
01/02/2020	03:20	6.21 12:10	12.67	8.65	05:05	1.24 18:25	2.13	1.79	03:45	0.437 13:10	1.383	0.973	0.973	
01/03/2020	04:10	6.18 12:05	15.89	9.08	12:15	0.86 08:00	2.04	1.63	04:10	0.417 09:55	1.381	0.909	0.909	
01/04/2020	04:50	6.18 12:55	16.78	9.08	12:25	0.80 15:05	2.02	1.57	04:45	0.377 14:45	1.366	0.862	0.862	
01/05/2020	05:05	6.11 11:00	15.63	9.47	10:55	0.82 22:45	2.07	1.56	05:05	0.395 19:10	1.371	0.924	0.924	
01/06/2020	04:05	6.17 08:15	11.25	8.25	03:15	1.21 10:35	2.07	1.74	03:15	0.420 08:00	1.370	0.905	0.905	
01/07/2020	03:55	6.26 08:10	13.58	8.37	08:10	1.04 07:25	2.11	1.72	03:35	0.417 08:30	1.378	0.906	0.906	
01/08/2020	04:00	6.36 08:05	11.90	8.26	03:40	1.16 07:25	2.09	1.75	03:40	0.419 07:45	1.380	0.908	0.908	
01/09/2020	03:40	6.12 08:10	11.96	8.23	05:00	1.14 21:40	2.11	1.75	03:40	0.403 07:40	1.383	0.910	0.910	
01/10/2020	03:40	6.35 08:35	10.00	8.26	03:10	1.21 18:55	2.13	1.76	03:10	0.436 08:30	1.312	0.912	0.912	
01/11/2020	04:40	6.29 12:35	14.83	9.30	12:45	0.91 09:40	2.10	1.62	04:25	0.425 20:35	1.382	0.957	0.957	
01/12/2020	05:35	6.18 11:05	12.10	8.41	05:10	1.15 19:35	2.17	1.74	05:10	0.397 11:25	1.383	0.939	0.939	
01/13/2020	03:40	6.47 08:35	14.71	8.47	08:40	0.95 08:00	2.15	1.73	03:40	0.483 08:00	1.470	0.915	0.915	
01/14/2020	03:10	6.62 08:00	14.30	8.54	08:00	0.95 09:50	2.03	1.77	04:50	0.492 20:45	1.381	0.954	0.954	
01/15/2020	03:45	6.60 08:00	15.26	8.81	08:00	0.87 10:10	2.02	1.73	03:45	0.514 10:00	1.382	0.949	0.949	0.10
01/16/2020	04:15	6.44 13:20	17.95	10.81	08:00	0.80 15:35	2.02	1.45	03:35	0.445 11:05	1.381	0.954	0.954	0.66
01/17/2020	03:55	6.42 08:50	20.36	9.07	09:30	0.87 11:35	2.19	1.79	04:15	0.523 09:55	1.373	0.979	0.979	
01/18/2020	05:00	6.68 11:05	14.00	9.04	11:05	1.00 15:50	2.10	1.66	04:55	0.492 10:05	1.383	0.935	0.935	
01/19/2020	05:35	6.64 11:45	13.98	8.94	11:50	1.00 18:35	2.12	1.70	05:50	0.484 13:55	1.369	0.945	0.945	
01/20/2020	03:45	6.39 11:40	13.75	8.87	11:50	1.06 18:30	2.16	1.71	04:00	0.439 13:50	1.371	0.953	0.953	
01/21/2020	03:15	6.32 20:45	15.12	9.19	20:55	0.89 14:10	2.08	1.62	03:10	0.425 17:40	1.379	0.918	0.918	0.01
01/22/2020	03:55	6.45 08:20	18.11	9.90	09:05	0.87 07:15	2.11	1.62	04:10	0.472 10:25	1.383	0.978	0.978	0.09
01/23/2020	03:35	6.25 08:50	20.32	10.37	10:45	0.87 06:55	2.12	1.58	03:25	0.466 19:00	1.383	0.967	0.967	
01/24/2020	03:55	6.24 10:10	18.25	11.02	12:40	0.87 07:05	2.07	1.49	03:55	0.483 07:55	1.373	0.985	0.985	
01/25/2020	05:00	6.19 12:00	20.73	10.31	12:05	0.82 22:25	2.05	1.57	05:25	0.395 19:15	1.383	0.935	0.935	
01/26/2020	05:00	6.25 11:35	21.77	10.90	10:15	0.83 16:45	2.02	1.46	04:55	0.450 17:45	1.381	0.943	0.943	0.16
01/27/2020	03:55	6.45 08:15	16.90	9.44	08:00	0.78 07:15	2.14	1.63	03:45	0.448 11:15	1.383	0.949	0.949	
01/28/2020	03:45	6.20 08:10	17.31	9.02	08:40	0.87 07:25	2.06	1.68	03:50	0.428 09:40	1.379	0.944	0.944	0.02
01/29/2020	03:45	6.27 08:20	17.83	9.14	09:10	0.87 11:40	2.06	1.70	04:10	0.440 20:10	1.380	0.954	0.954	
01/30/2020	03:45	6.10 08:20	14.39	8.47	08:20	0.94 19:30	2.12	1.77	03:30	0.437 09:05	1.364	0.935	0.935	
01/31/2020	02:55	6.27 08:15	14.81	8.66	08:15	0.90 07:30	2.19	1.72	03:30	0.448 07:30	1.380	0.927	0.927	0.01
02/01/2020	03:35	6.45 12:10	16.80	9.52	11:05	0.87 08:50	2.05	1.57	03:40	0.433 15:10	1.304	0.915	0.915	
02/02/2020	05:05	6.41 12:10	18.12	9.75	10:55	0.87 16:40	2.07	1.53	04:25	0.437 09:55	1.312	0.902	0.902	
02/03/2020	03:50	6.43 08:15	18.18	9.21	08:55	0.83 07:15	2.18	1.66	03:30	0.440 07:15	1.388	0.940	0.940	
02/04/2020	03:35	6.23 07:55	15.84	8.73	07:45	0.85 07:20	2.08	1.69	03:30	0.407 10:00	1.304	0.918	0.918	
02/05/2020	04:10	6.30 08:15	17.09	9.05	08:10	0.86 18:55	2.19	1.67	04:10	0.420 07:25	1.361	0.935	0.935	
02/06/2020	03:40	6.35 08:10	17.37	8.70	08:25	0.82 11:25	2.17	1.73	03:20	0.467 09:50	1.303	0.925	0.925	
02/07/2020	03:45	6.19 08:05	14.72	8.40	08:00	0.85 18:40	2.08	1.75	02:25	0.441 08:40	1.303	0.917	0.917	
02/08/2020	05:10	6.28 08:30	15.11	8.18	08:30	0.87 13:15	2.27	1.77	05:00	0.414 11:50	1.345	0.909	0.909	
02/09/2020	05:30	6.17 10:40	9.52	8.05	05:30	1.17 12:05	2.26	1.81	05:30	0.404 10:40	1.357	0.920	0.920	
02/10/2020	03:40	5.93 07:55	10.11	7.99	03:40	1.29 07:30	2.23	1.85	03:40	0.422 07:55	1.449	0.923	0.923	
02/11/2020	03:50	5.99 07:55	10.11	7.93	02:30	1.28 07:45	2.25	1.80	02:50	0.428 07:45	1.388	0.888	0.888	
02/12/2020	03:25	5.96 08:10	11.00	7.92	02:25	1.24 07:40	2.21	1.79	03:35	0.409 07:40	1.393	0.883	0.883	
02/13/2020	03:20	6.06 07:55	11.30	7.96	03:05	1.22 09:40	2.18	1.77	03:00	0.412 07:35	1.354	0.879	0.879	
02/14/2020	02:55	5.81 08:30	10.12	7.85	03:45	1.22 07:25	2.17	1.80	03:45	0.391 08:30	1.300	0.878	0.878	
02/15/2020	04:40	5.96 12:20	12.23	8.30	04:40	1.14 18:55	2.14	1.72	04:40	0.374 13:15	1.304	0.900	0.900	
02/16/2020	04:00	6.08 11:30	14.05	8.73	11:30	0.99 17:25	2.12	1.62	05:10	0.389 13:30	1.311	0.895	0.895	
02/17/2020	04:15	6.31 13:10	21.29	11.84	13:30	0.81 08:25	2.03	1.33	04:10	0.414 18:05	1.304	0.913	0.913	
02/18/2020	03:00	6.05 09:15	17.91	9.05	08:20	0.78 12:20	2.15	1.63	03:20	0.368 07:45	1.304	0.881	0.881	
02/19/2020	03:15	6.09 08:10	9.70	8.05	03:20	1.14 08:40	2.21	1.74	03:20	0.386 08:05	1.312	0.878	0.878	
02/20/2020	03:55	6.15 09:00	9.50	8.05	03:50	1.17 10:50	2.16	1.74	03:50	0.401 10:10	1.252	0.874	0.874	
02/21/2020	04:10	6.02 08:20	9.30	8.03	04:00	1.13 14:00	2.06	1.72	04:00	0.377 12:10	1.169	0.865	0.865	
02/22/2020	04:35	6.34 12:15	9.46	8.10	04:40	1.15 11:55	2.09	1.71	04:40	0.411 11:55	1.234	0.869	0.869	
02/23/2020	04:50	6.26 11:10	9.60	8.11	05:35	1.11 11:45	2.25	1.75	05:35	0.391 11:45	1.343	0.899	0.899	
02/24/2020	03:35	6.01 07:25	9.90	8.01	02:55	1.16 07:35	2.25	1.77	03:35	0.389 07:35	1.388	0.887	0.887	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	03:15	6.07	07:40	10.11	8.00	03:25	1.07	07:30	2.28	1.74	03:25	0.363	08:00	1.448	0.872	0.872	
02/26/2020	03:10	6.17	07:25	10.20	8.15	03:15	1.18	07:20	2.16	1.77	03:15	0.408	07:25	1.411	0.903	0.903	
02/27/2020	03:40	5.85	07:35	10.02	7.99	04:00	1.14	08:25	2.21	1.73	04:00	0.373	08:25	1.381	0.866	0.866	
02/28/2020	03:25	6.14	07:50	10.19	8.08	03:25	1.08	07:30	2.01	1.73	03:25	0.371	07:30	1.313	0.876	0.876	
02/29/2020	04:30	6.32	11:20	9.65	8.16	04:30	1.27	11:25	2.16	1.75	04:30	0.451	11:25	1.338	0.899	0.899	
03/01/2020	05:05	6.23	12:00	15.82	9.83	11:40	0.83	15:25	2.02	1.46	05:10	0.391	18:45	1.316	0.890	0.890	
03/02/2020	03:40	6.18	08:00	18.41	9.10	08:40	0.85	11:20	2.02	1.65	03:35	0.368	19:55	1.316	0.930	0.930	0.01
03/03/2020	03:30	6.42	08:05	17.17	8.71	07:40	0.77	20:25	2.06	1.75	03:30	0.477	08:25	1.309	0.949	0.949	
03/04/2020	04:05	6.40	07:50	10.38	8.52	04:05	1.30	09:10	2.16	1.81	04:05	0.471	07:35	1.343	0.978	0.978	
03/05/2020	03:10	6.25	07:40	11.68	8.31	02:30	1.12	07:10	2.22	1.76	02:30	0.400	07:10	1.326	0.919	0.919	
03/06/2020	04:10	6.15	08:15	9.97	8.23	02:55	1.13	20:15	2.21	1.82	02:55	0.399	07:55	1.359	0.941	0.941	
03/07/2020	04:45	6.14	12:20	10.36	8.35	04:35	1.08	12:45	2.21	1.77	04:35	0.369	12:45	1.402	0.943	0.943	0.58
03/08/2020	05:05	6.31	11:20	10.38	8.42	02:45	1.22	20:55	2.25	1.83	04:20	0.439	20:10	1.428	0.981	0.981	0.02
03/09/2020	03:00	6.28	20:10	10.66	8.50	02:20	1.24	07:40	2.16	1.81	02:20	0.440	06:40	1.374	0.978	0.977	0.11

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			109.178	5.26
Avg	8.74	1.74	0.949	

Site Commentary

Site Information

MIL_2721	
Pipe Dimensions	8
Silt Level	0.00"

Overview

Site MIL_2721 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited a moderate response to the wet weather events of November 26, 2019 - November 27, 2019 and December 7, 2019 - December 8, 2019. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. Due to the high flows at the creek, crews could not access the meter and data stops on March 02, 2020 for this location.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	6.23	1.05	0.198
Minimum	3.86	0.53	0.080
Maximum	9.28	1.61	0.363
Time of Minimum	3/2/2020 3:05 AM	2/2/2020 5:45 AM	2/2/2020 5:45 AM
Time of Maximum	1/17/2020 8:05 AM	1/17/2020 8:10 AM	1/17/2020 8:10 AM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 2, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_2721

Site Address /Location:	1545 N Milpitas Blvd			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	Gate access. Need hip waders to cross stream.	Latitude:	37.452946°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.914112°	8.0" x 8.0"	Circular



Manhole #	System Characteristics
2721	Residential
Access	Traffic
Drive	Light







Installation Information

Installation Date:	Installation Type:
Friday, November 15, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
9:56:00 AM	8.0" x 8.0"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
5.50"	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.7	0''
Silt (in)	Silt Type
0''	

Hydraulic Comments:

Good flow medium depth and velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
6'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
PVC	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_2721

Flow Monitor

MIL_2721

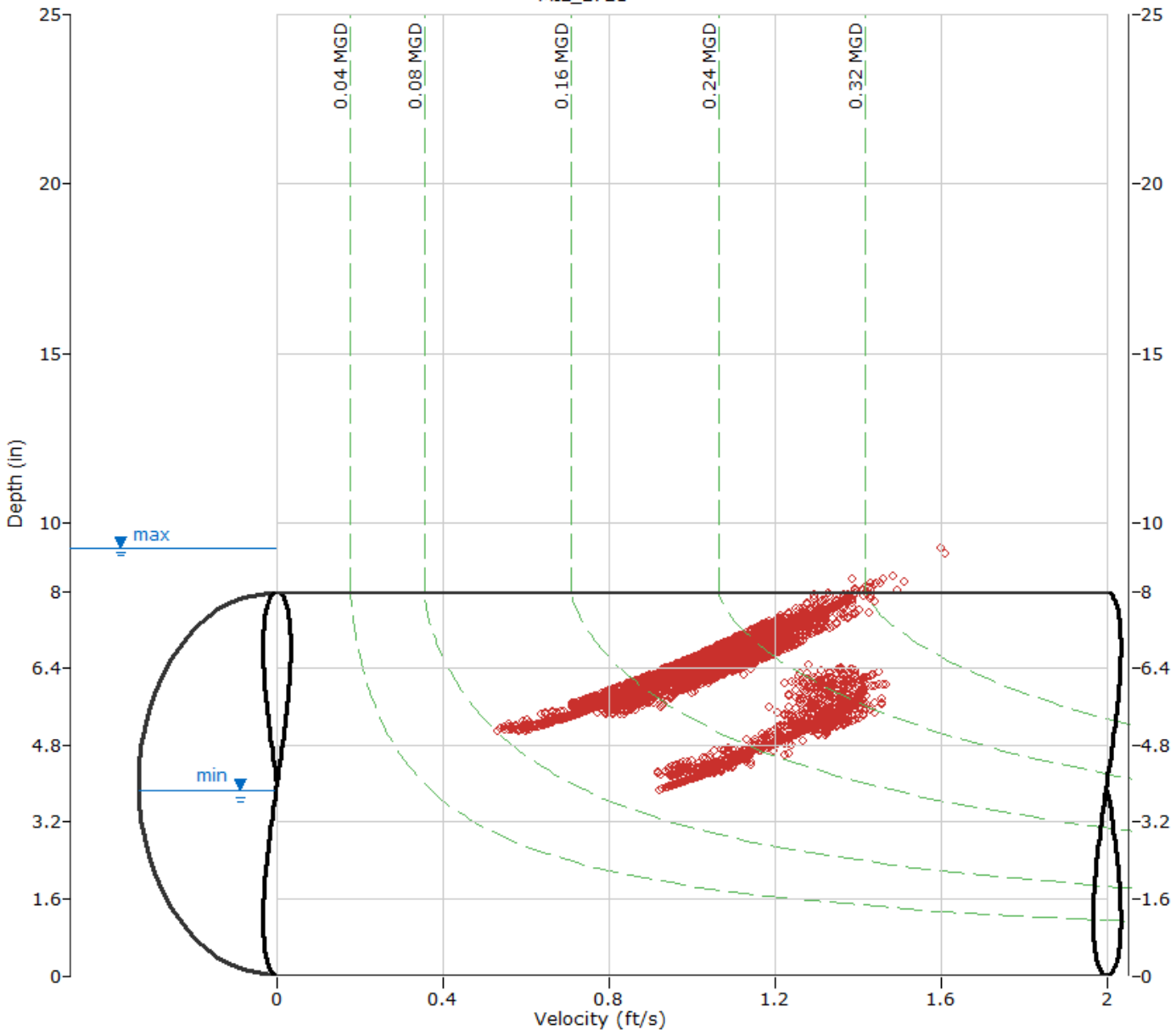
Pipe Height
8.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_2721

Flow Monitor

MIL_2721

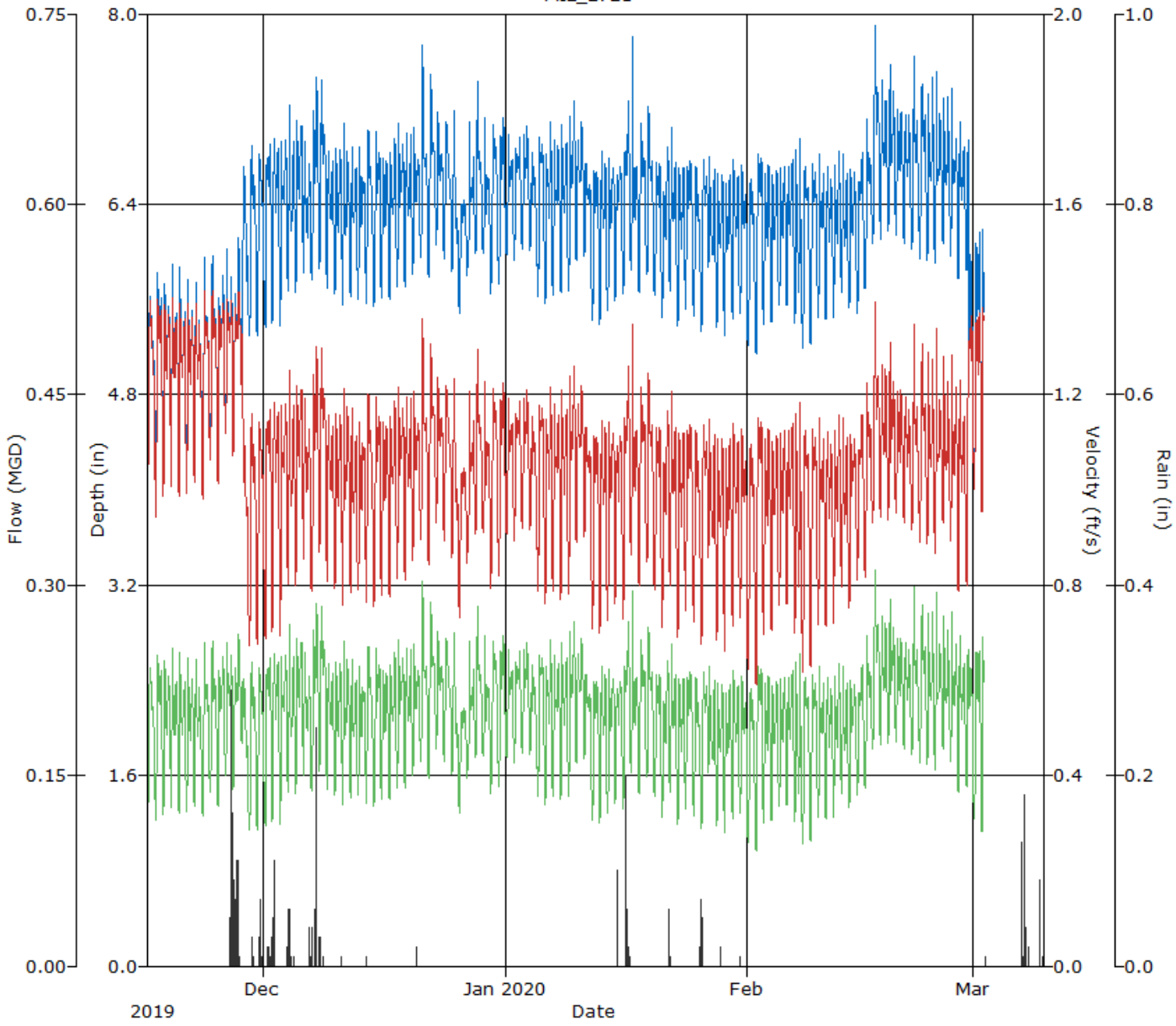
Pipe Height
8.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_2721, Pipe Height: 8.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	03:25	4.20	10:20	5.97	5.03	04:30	1.01	09:55	1.46	1.24	04:30	0.123	10:20	0.255	0.188	0.188	
11/17/2019	03:35	4.18	09:20	6.03	5.11	05:15	0.92	09:25	1.42	1.24	05:20	0.110	09:25	0.257	0.191	0.191	
11/18/2019	02:55	4.16	07:50	5.95	5.08	02:55	0.95	07:50	1.41	1.25	02:55	0.113	07:50	0.254	0.191	0.191	
11/19/2019	03:35	4.28	07:50	6.27	5.07	03:35	1.00	07:20	1.43	1.25	03:35	0.123	07:20	0.261	0.190	0.190	
11/20/2019	03:00	4.19	07:45	6.37	5.04	03:00	0.97	07:55	1.41	1.24	03:00	0.116	07:45	0.261	0.187	0.187	
11/21/2019	03:10	4.20	07:50	6.12	5.03	03:10	0.97	07:55	1.46	1.24	03:10	0.116	07:55	0.267	0.187	0.187	
11/22/2019	02:20	4.28	07:40	6.00	5.03	02:20	1.00	07:40	1.42	1.24	02:20	0.123	07:40	0.257	0.186	0.186	
11/23/2019	04:30	4.15	10:20	6.12	5.09	04:30	0.95	10:15	1.47	1.25	04:30	0.112	10:15	0.269	0.191	0.191	
11/24/2019	04:40	4.41	09:45	6.26	5.19	04:40	1.05	10:35	1.45	1.27	04:40	0.134	09:45	0.272	0.199	0.199	
11/25/2019	03:50	4.22	19:15	6.14	5.19	03:50	0.98	19:10	1.41	1.27	03:50	0.118	19:15	0.256	0.199	0.199	
11/26/2019	01:30	4.57	07:40	6.34	5.29	01:30	1.11	07:25	1.45	1.30	01:30	0.148	07:50	0.271	0.207	0.207	0.63
11/27/2019	04:20	4.42	18:30	6.33	5.34	04:20	1.05	21:25	1.47	1.30	04:20	0.135	18:25	0.277	0.210	0.210	0.77
11/28/2019	04:30	4.82	11:10	6.82	5.85	23:55	0.85	08:20	1.40	1.11	23:55	0.150	08:20	0.247	0.194	0.194	
11/29/2019	04:40	5.27	10:45	7.15	6.21	04:40	0.67	10:45	1.22	0.96	04:40	0.105	10:45	0.260	0.183	0.183	0.05
11/30/2019	04:40	5.23	13:30	7.09	6.19	04:40	0.65	13:30	1.21	0.96	04:40	0.102	13:30	0.256	0.181	0.181	0.14
12/01/2019	05:35	5.34	19:25	7.32	6.31	05:35	0.68	19:25	1.27	1.00	05:35	0.108	19:25	0.275	0.192	0.192	0.06
12/02/2019	02:45	5.31	07:50	7.41	6.35	02:45	0.67	07:50	1.29	1.01	02:45	0.106	07:50	0.282	0.196	0.196	0.36
12/03/2019	03:30	5.32	07:25	7.08	6.34	03:30	0.67	07:25	1.22	1.01	03:30	0.107	07:25	0.257	0.195	0.195	
12/04/2019	02:15	5.65	07:40	7.51	6.39	02:15	0.79	07:40	1.31	1.03	02:15	0.135	07:40	0.289	0.199	0.199	0.44
12/05/2019	02:20	5.63	19:30	7.37	6.52	02:20	0.79	19:30	1.28	1.06	02:20	0.133	19:30	0.279	0.210	0.210	
12/06/2019	03:25	5.77	07:50	7.16	6.37	03:25	0.84	07:55	1.29	1.03	03:25	0.146	07:55	0.274	0.200	0.200	0.06
12/07/2019	04:05	5.72	17:40	7.81	6.66	02:50	0.75	17:40	1.37	1.08	02:50	0.129	17:40	0.308	0.218	0.218	0.84
12/08/2019	04:55	5.79	10:50	7.74	6.68	04:55	0.84	10:50	1.36	1.11	04:55	0.147	10:50	0.304	0.223	0.223	0.10
12/09/2019	04:15	5.62	07:45	7.11	6.38	04:15	0.78	07:45	1.22	1.02	04:15	0.133	07:45	0.259	0.198	0.198	
12/10/2019	02:35	5.59	07:40	7.16	6.33	02:35	0.77	07:40	1.23	1.01	02:35	0.130	07:40	0.263	0.194	0.194	0.01
12/11/2019	02:55	5.51	07:45	7.40	6.30	02:55	0.74	07:45	1.29	1.02	02:55	0.123	07:45	0.281	0.195	0.195	0.00
12/12/2019	04:15	5.55	07:20	7.11	6.30	04:15	0.76	07:55	1.26	0.99	04:15	0.127	07:55	0.261	0.190	0.190	
12/13/2019	03:00	5.57	07:45	7.03	6.31	04:10	0.75	08:00	1.19	0.99	04:10	0.126	08:00	0.249	0.190	0.190	
12/14/2019	03:55	5.51	10:05	7.35	6.40	03:55	0.74	10:05	1.28	1.03	03:55	0.123	10:05	0.277	0.200	0.200	0.01
12/15/2019	03:45	5.49	11:00	7.46	6.39	03:45	0.73	11:00	1.30	1.02	03:45	0.121	11:00	0.285	0.199	0.199	
12/16/2019	02:50	5.57	07:45	7.10	6.33	02:50	0.76	07:45	1.22	1.01	02:50	0.128	07:45	0.258	0.194	0.194	
12/17/2019	01:25	5.57	20:35	7.07	6.39	01:25	0.76	20:35	1.21	1.03	01:25	0.128	20:35	0.256	0.199	0.199	
12/18/2019	03:15	5.65	07:25	7.29	6.46	03:15	0.79	07:25	1.26	1.05	03:15	0.135	07:25	0.273	0.206	0.206	
12/19/2019	03:15	5.63	07:40	7.44	6.42	03:15	0.79	07:40	1.30	1.03	03:15	0.133	07:40	0.284	0.202	0.202	
12/20/2019	03:05	5.71	07:30	7.35	6.50	03:05	0.82	07:30	1.28	1.06	03:05	0.140	07:30	0.277	0.208	0.208	0.02
12/21/2019	04:40	5.89	09:50	7.90	6.65	04:40	0.88	09:50	1.39	1.10	04:40	0.156	09:50	0.313	0.221	0.221	
12/22/2019	04:25	5.75	13:25	7.91	6.70	04:25	0.83	13:25	1.39	1.11	04:25	0.144	13:25	0.313	0.224	0.224	
12/23/2019	04:20	6.01	09:40	7.43	6.61	04:20	0.92	09:40	1.30	1.09	04:20	0.167	09:40	0.283	0.218	0.218	
12/24/2019	04:20	5.92	09:40	7.32	6.59	04:20	0.89	09:40	1.27	1.08	04:20	0.159	09:40	0.275	0.216	0.216	
12/25/2019	23:25	5.75	11:35	8.01	6.31	23:25	0.83	11:35	1.41	1.00	23:25	0.144	11:35	0.318	0.192	0.192	
12/26/2019	04:20	5.42	08:25	6.60	6.14	04:20	0.71	08:25	1.09	0.95	04:20	0.115	08:25	0.218	0.178	0.178	
12/27/2019	03:45	5.76	09:35	7.60	6.33	03:45	0.83	09:25	1.43	1.01	03:45	0.145	09:25	0.315	0.194	0.194	
12/28/2019	06:20	5.92	12:45	7.79	6.60	06:20	0.89	12:45	1.37	1.09	06:20	0.159	12:45	0.307	0.217	0.217	
12/29/2019	02:55	5.95	10:35	7.52	6.44	02:55	0.84	10:35	1.31	1.04	02:55	0.151	10:35	0.289	0.204	0.204	
12/30/2019	02:50	5.60	17:35	7.32	6.47	02:50	0.78	17:35	1.27	1.05	02:50	0.131	17:35	0.275	0.205	0.205	
12/31/2019	04:15	5.67	19:05	7.45	6.52	04:15	0.80	19:05	1.30	1.06	04:15	0.137	19:05	0.284	0.210	0.210	

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	03:55	5.94 10:10	7.26	6.52	03:55	0.89 10:10	1.26	1.07	03:55	0.161 10:10	0.271	0.211	0.211	
01/02/2020	04:25	5.87 09:15	7.18	6.52	04:25	0.87 09:15	1.24	1.07	04:25	0.154 09:15	0.264	0.210	0.210	
01/03/2020	04:15	5.93 17:35	7.45	6.61	04:15	0.89 17:35	1.30	1.09	04:15	0.160 17:35	0.284	0.218	0.218	
01/04/2020	04:00	5.91 11:25	6.98	6.45	04:00	0.88 11:25	1.19	1.05	04:00	0.158 11:25	0.249	0.205	0.205	
01/05/2020	05:40	5.60 20:55	7.20	6.44	05:40	0.78 20:55	1.24	1.04	05:40	0.131 20:55	0.266	0.203	0.203	
01/06/2020	02:25	5.53 18:55	7.42	6.38	04:20	0.71 18:55	1.29	1.02	04:20	0.120 18:55	0.282	0.199	0.199	
01/07/2020	02:25	5.59 20:15	7.17	6.40	02:25	0.77 20:15	1.24	1.03	02:25	0.130 20:15	0.264	0.200	0.200	
01/08/2020	03:20	5.64 07:45	7.45	6.44	02:15	0.75 07:50	1.32	1.03	02:25	0.127 07:50	0.288	0.201	0.201	
01/09/2020	02:50	5.59 19:55	7.54	6.56	03:55	0.71 07:45	1.35	1.06	03:55	0.121 07:45	0.292	0.211	0.211	
01/10/2020	01:30	5.83 07:00	7.22	6.62	01:30	0.86 07:00	1.25	1.09	01:30	0.151 07:00	0.267	0.219	0.219	
01/11/2020	04:15	5.74 09:00	7.10	6.42	04:15	0.83 09:00	1.22	1.04	04:15	0.143 09:00	0.258	0.202	0.202	
01/12/2020	03:30	5.39 17:15	6.87	6.21	03:30	0.70 17:15	1.16	0.97	03:30	0.113 17:15	0.240	0.184	0.184	
01/13/2020	03:40	5.30 08:00	7.49	6.20	03:40	0.66 08:10	1.31	0.97	03:40	0.105 08:00	0.285	0.183	0.183	
01/14/2020	01:45	5.44 07:35	6.97	6.26	01:55	0.64 07:35	1.19	0.98	01:55	0.105 07:35	0.248	0.187	0.187	
01/15/2020	02:35	5.55 09:05	6.95	6.32	01:10	0.71 09:15	1.22	0.99	02:55	0.120 09:15	0.250	0.191	0.191	0.10
01/16/2020	02:40	5.58 18:50	7.48	6.57	02:40	0.71 18:50	1.31	1.06	02:40	0.119 18:50	0.287	0.211	0.211	0.66
01/17/2020	03:35	5.82 08:05	9.28	6.45	03:35	0.85 08:10	1.61	1.04	03:35	0.150 08:10	0.363	0.203	0.203	
01/18/2020	03:10	5.61 09:40	7.41	6.46	03:10	0.78 09:40	1.29	1.04	03:10	0.132 09:40	0.282	0.205	0.205	
01/19/2020	05:10	5.77 09:45	7.80	6.48	05:10	0.84 09:45	1.37	1.05	05:10	0.146 09:45	0.308	0.207	0.207	
01/20/2020	03:30	5.61 20:05	6.90	6.31	03:30	0.78 20:05	1.17	1.00	03:30	0.132 20:05	0.242	0.192	0.192	
01/21/2020	03:00	5.38 21:35	7.07	6.18	04:40	0.65 21:35	1.21	0.96	04:40	0.107 21:35	0.256	0.181	0.181	0.01
01/22/2020	02:35	5.62 08:00	7.17	6.34	02:35	0.78 08:00	1.24	1.01	02:35	0.133 08:00	0.264	0.195	0.195	0.09
01/23/2020	03:15	5.30 19:40	6.92	6.19	03:15	0.66 19:40	1.18	0.97	03:15	0.105 19:40	0.244	0.182	0.182	
01/24/2020	03:05	5.45 09:40	7.00	6.32	03:05	0.72 09:40	1.20	1.01	03:05	0.118 09:40	0.250	0.193	0.193	
01/25/2020	03:10	5.43 12:10	6.92	6.17	03:10	0.71 12:10	1.18	0.96	03:10	0.116 12:10	0.244	0.181	0.181	
01/26/2020	04:40	5.26 11:15	6.98	6.20	04:40	0.65 11:15	1.19	0.96	04:40	0.101 11:15	0.249	0.183	0.183	0.16
01/27/2020	05:55	5.59 05:25	7.24	6.23	00:05	0.78 05:25	1.25	0.98	06:00	0.135 05:25	0.269	0.185	0.185	
01/28/2020	02:35	5.33 07:40	6.83	6.08	02:35	0.67 07:40	1.15	0.93	02:35	0.107 07:40	0.237	0.173	0.173	0.02
01/29/2020	03:20	5.27 19:10	6.82	6.11	03:20	0.65 19:10	1.15	0.94	03:20	0.102 19:10	0.236	0.176	0.176	
01/30/2020	03:05	5.38 07:55	6.95	6.21	03:05	0.69 07:55	1.18	0.97	03:05	0.112 07:55	0.246	0.184	0.184	
01/31/2020	02:55	5.43 08:15	6.88	6.18	02:55	0.71 08:15	1.17	0.96	02:55	0.116 08:15	0.241	0.181	0.181	0.01
02/01/2020	02:55	5.15 08:00	7.09	6.04	04:30	0.56 08:00	1.19	0.92	04:30	0.087 08:00	0.251	0.169	0.169	
02/02/2020	06:05	5.08 21:20	7.08	6.15	05:45	0.53 21:20	1.22	0.94	05:45	0.080 21:20	0.257	0.178	0.178	
02/03/2020	03:35	5.36 07:45	6.92	6.18	03:35	0.68 07:45	1.18	0.96	03:35	0.110 07:45	0.244	0.181	0.181	
02/04/2020	02:15	5.36 18:45	6.91	6.19	02:15	0.68 18:45	1.17	0.97	02:15	0.110 18:45	0.243	0.182	0.182	
02/05/2020	04:05	5.50 07:25	6.89	6.21	04:05	0.74 07:25	1.17	0.97	04:05	0.122 07:25	0.242	0.184	0.184	
02/06/2020	02:25	5.50 21:05	7.16	6.25	02:25	0.74 21:05	1.23	0.99	02:25	0.122 21:05	0.263	0.187	0.187	
02/07/2020	03:10	5.30 18:10	7.26	6.07	03:10	0.66 18:10	1.26	0.93	03:10	0.105 18:10	0.271	0.172	0.172	
02/08/2020	04:20	5.16 09:35	6.93	6.12	04:20	0.60 09:35	1.18	0.94	04:20	0.093 09:35	0.245	0.176	0.176	
02/09/2020	05:00	5.13 12:35	7.04	6.15	05:00	0.59 12:35	1.21	0.95	05:00	0.090 12:35	0.254	0.179	0.179	
02/10/2020	03:30	5.38 07:45	7.14	6.21	03:30	0.69 07:45	1.23	0.97	03:30	0.112 07:45	0.261	0.184	0.184	
02/11/2020	03:45	5.37 07:50	6.94	6.19	03:45	0.69 07:50	1.18	0.96	03:45	0.111 07:50	0.246	0.182	0.182	
02/12/2020	02:05	5.41 07:45	7.02	6.23	02:05	0.70 07:45	1.20	0.98	02:05	0.114 07:45	0.252	0.186	0.186	
02/13/2020	04:05	5.56 07:30	6.96	6.22	04:05	0.76 07:30	1.19	0.98	04:05	0.127 07:30	0.247	0.185	0.185	
02/14/2020	03:30	5.50 07:45	6.84	6.22	03:30	0.74 18:40	1.17	0.99	03:30	0.122 07:45	0.237	0.187	0.187	
02/15/2020	05:10	5.44 15:55	7.03	6.27	03:05	0.79 15:55	1.24	1.02	03:10	0.130 15:55	0.261	0.194	0.194	
02/16/2020	02:20	5.66 10:15	7.49	6.44	04:15	0.79 10:00	1.31	1.05	04:15	0.135 10:15	0.286	0.205	0.205	
02/17/2020	04:20	5.98 10:00	8.34	6.92	04:20	0.90 10:05	1.51	1.14	04:20	0.163 10:05	0.341	0.235	0.235	
02/18/2020	03:05	6.06 09:30	7.95	6.85	03:05	0.93 09:30	1.39	1.12	03:05	0.170 09:30	0.314	0.230	0.230	
02/19/2020	02:45	6.01 08:35	7.78	6.84	02:45	0.91 08:45	1.37	1.11	02:45	0.166 08:35	0.304	0.229	0.229	
02/20/2020	04:20	6.05 09:00	7.73	6.77	04:20	0.92 09:05	1.34	1.10	04:20	0.169 09:05	0.300	0.223	0.223	
02/21/2020	03:40	6.01 18:45	7.58	6.69	03:40	0.91 18:45	1.32	1.07	03:40	0.166 18:45	0.292	0.217	0.217	
02/22/2020	05:00	5.89 10:20	8.07	6.77	05:00	0.87 10:20	1.39	1.10	05:00	0.156 10:20	0.315	0.224	0.224	
02/23/2020	05:15	5.89 11:05	7.88	6.74	05:15	0.87 11:00	1.39	1.10	05:15	0.156 11:05	0.310	0.223	0.223	
02/24/2020	03:15	5.87 19:50	8.34	6.69	03:15	0.87 19:50	1.46	1.08	03:15	0.154 19:50	0.330	0.217	0.217	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	02:30	5.85	07:40	7.89	6.64	02:30	0.79	07:45	1.43	1.07	02:30	0.140	07:45	0.322	0.215	0.215	
02/26/2020	04:10	6.02	07:40	7.55	6.65	04:10	0.91	07:35	1.38	1.07	04:10	0.167	07:35	0.301	0.214	0.214	
02/27/2020	02:50	5.90	07:10	7.61	6.59	02:50	0.88	07:10	1.40	1.07	02:50	0.156	07:10	0.311	0.213	0.213	
02/28/2020	03:10	5.71	07:35	7.69	6.49	02:55	0.74	07:35	1.35	1.03	03:00	0.128	07:35	0.300	0.203	0.203	
02/29/2020	23:50	4.83	11:05	7.31	5.91	03:30	0.79	14:30	1.43	1.15	03:30	0.139	11:05	0.273	0.204	0.204	
03/01/2020	04:35	4.05	20:55	6.58	5.30	04:35	0.99	12:35	1.42	1.24	04:35	0.113	19:40	0.265	0.199	0.199	
03/02/2020	03:05	3.86	07:35	6.38	4.60	03:05	0.92	07:00	1.41	1.12	03:05	0.100	07:30	0.267	0.153	0.055	0.01
03/03/2020																	
03/04/2020																	
03/05/2020																	
03/06/2020																	
03/07/2020																	0.58
03/08/2020																	0.02
03/09/2020																	0.11

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			21.255	5.26
Avg	6.23	1.05	0.198	

Site Commentary

Site Information

MIL_2724	
Pipe Dimensions	39.88
Silt Level	0.00"

Overview

Site MIL_2724 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019 and December 7, 2019 - December 8, 2019. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	18.34	0.78	2.042
Minimum	13.49	0.43	0.744
Maximum	22.23	1.11	3.446
Time of Minimum	3/4/2020 5:30 AM	3/4/2020 4:40 AM	3/4/2020 4:40 AM
Time of Maximum	12/7/2019 7:45 PM	12/2/2019 10:10 AM	12/4/2019 10:25 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_2724

Site Address /Location:	California Cir and Cadillac Court, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	Drive	Latitude:	37.446644°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.918485°	39.88" x 40.50"	Circular



Manhole #	System Characteristics
2724	Residential/Commercial
Access	Traffic
Drive	Light







Installation Information

Installation Date:	Installation Type:
Tuesday, November 12, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
5:37:34 AM	39.88" x 40.50"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
14.00"	0.00"
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
0.89	0"
Silt (in)	Silt Type
0"	

Hydraulic Comments:

Ok flow, Deep and slow

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
20'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26"	54"
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
PVC	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

Additional Site Info. / Comments:

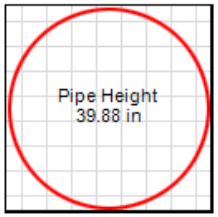
ADS Project Name:	Milpitas.WWTFM.CA19-20
ADS Project Number:	22431

SCATTERGRAPH REPORT

MIL_2724

Flow Monitor

MIL_2724

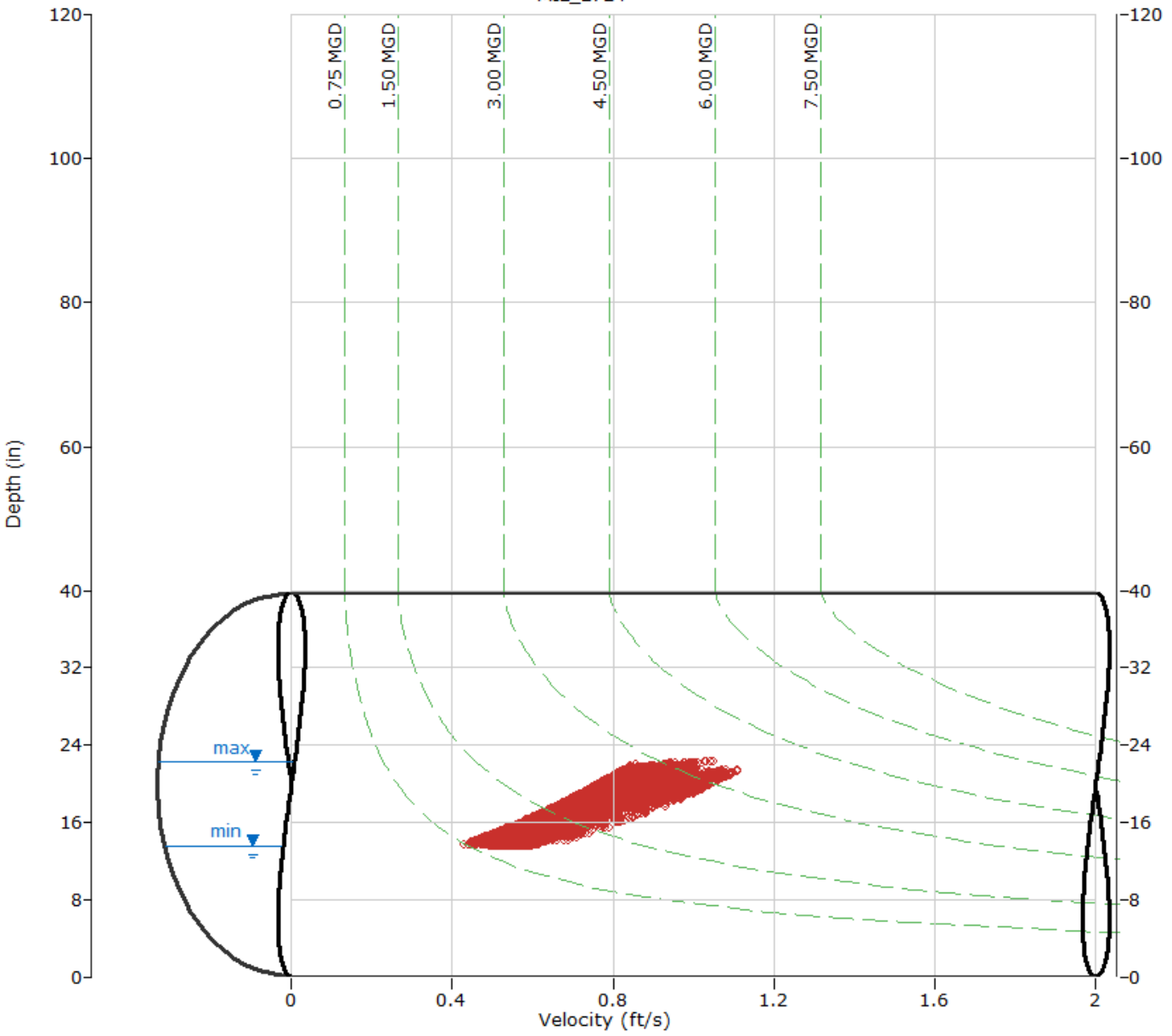


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



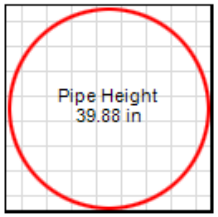
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_2724

Flow Monitor

MIL_2724

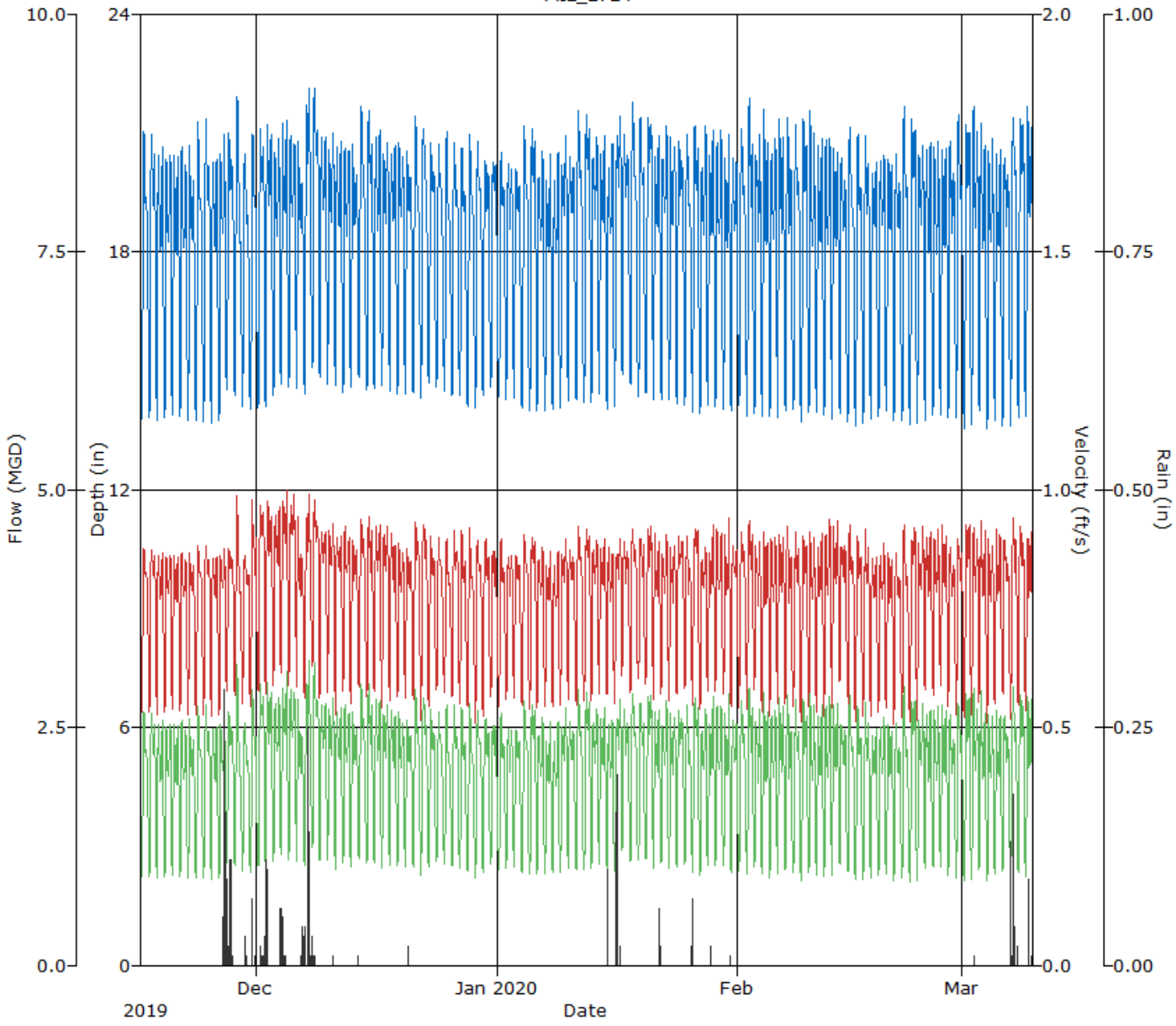


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_2724, Pipe Height: 39.88 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	06:05	13.74	12:15	21.05	18.02	06:05	0.53	12:15	0.88	0.75	06:05	0.917	12:15	2.670	1.935	1.935	
11/17/2019	06:05	13.78	12:45	20.99	18.15	06:05	0.53	12:45	0.87	0.76	06:05	0.925	12:45	2.656	1.968	1.968	
11/18/2019	05:30	13.71	22:10	20.69	18.05	05:30	0.53	22:10	0.87	0.76	05:30	0.910	22:10	2.587	1.942	1.942	
11/19/2019	05:35	13.80	09:50	20.54	18.07	05:35	0.53	09:50	0.86	0.76	05:35	0.931	09:50	2.551	1.949	1.949	
11/20/2019	05:25	13.88	09:50	20.59	18.03	05:25	0.54	09:50	0.86	0.76	05:25	0.946	09:50	2.564	1.938	1.938	
11/21/2019	05:40	13.81	10:10	20.70	18.02	05:40	0.53	10:10	0.87	0.76	05:40	0.932	10:10	2.589	1.937	1.937	
11/22/2019	05:30	13.71	10:05	20.76	18.09	05:30	0.53	10:05	0.87	0.76	05:30	0.912	10:05	2.603	1.953	1.953	
11/23/2019	06:05	13.69	12:45	21.31	18.08	06:05	0.52	12:45	0.88	0.76	06:05	0.906	12:45	2.729	1.951	1.951	
11/24/2019	06:25	13.67	12:30	21.38	18.19	06:25	0.52	12:30	0.88	0.76	06:25	0.902	12:30	2.746	1.977	1.977	
11/25/2019	05:35	13.64	09:55	20.41	17.97	05:35	0.52	09:55	0.86	0.75	05:35	0.897	09:55	2.520	1.925	1.925	
11/26/2019	05:35	13.71	22:15	21.05	18.15	05:35	0.53	22:15	0.88	0.76	05:35	0.911	22:15	2.671	1.968	1.968	0.63
11/27/2019	04:50	14.44	11:30	21.02	18.67	04:50	0.57	11:30	0.88	0.78	04:50	1.065	11:30	2.664	2.093	2.093	0.77
11/28/2019	06:40	14.33	13:45	21.91	18.41	06:40	0.57	13:45	1.00	0.77	06:40	1.043	13:45	3.198	2.040	2.040	
11/29/2019	06:20	14.05	12:50	20.54	17.82	06:20	0.55	12:50	0.86	0.75	06:20	0.981	12:50	2.552	1.884	1.884	0.05
11/30/2019	06:00	13.99	13:50	21.00	17.98	05:40	0.51	11:55	1.06	0.79	05:40	0.914	13:35	3.216	2.021	2.021	0.14
12/01/2019	06:35	14.06	13:45	21.12	18.38	05:15	0.53	12:35	1.09	0.83	06:35	0.950	13:15	3.333	2.196	2.196	0.06
12/02/2019	05:35	14.07	10:05	21.27	18.67	05:45	0.51	10:10	1.11	0.84	05:45	0.916	10:10	3.427	2.251	2.251	0.36
12/03/2019	05:35	14.37	22:15	20.89	18.45	05:25	0.57	21:35	1.08	0.84	05:25	1.051	23:10	3.240	2.193	2.193	
12/04/2019	04:55	14.58	22:25	21.36	18.87	04:50	0.58	22:25	1.11	0.87	04:50	1.091	22:25	3.446	2.348	2.348	0.44
12/05/2019	05:30	14.58	10:05	21.01	18.69	05:45	0.55	10:30	1.07	0.86	05:45	1.039	10:30	3.235	2.303	2.303	
12/06/2019	05:30	14.54	10:15	20.84	18.47	05:00	0.55	09:10	1.06	0.80	05:15	1.034	09:10	3.106	2.087	2.087	0.06
12/07/2019	06:10	14.37	19:45	22.23	18.99	06:40	0.51	19:45	1.05	0.81	06:40	0.953	19:45	3.419	2.231	2.231	0.84
12/08/2019	06:30	15.07	12:25	22.18	19.31	04:35	0.58	12:25	1.00	0.84	06:00	1.140	12:25	3.264	2.341	2.341	0.10
12/09/2019	05:35	14.80	09:50	21.02	18.87	05:05	0.51	21:20	0.97	0.82	05:05	0.991	22:45	2.940	2.204	2.204	
12/10/2019	05:35	14.64	22:50	21.07	18.60	06:00	0.52	22:30	0.98	0.81	06:00	0.993	22:30	2.988	2.153	2.153	0.01
12/11/2019	05:25	14.61	22:55	20.85	18.60	05:05	0.50	10:25	0.96	0.80	05:20	0.935	23:15	2.887	2.115	2.115	0.00
12/12/2019	05:35	14.43	10:00	20.73	18.44	04:45	0.50	09:20	0.96	0.80	04:45	0.932	10:20	2.871	2.097	2.097	
12/13/2019	05:45	14.57	09:50	20.80	18.46	04:50	0.50	10:50	0.94	0.79	05:45	0.932	10:50	2.815	2.078	2.078	
12/14/2019	06:20	14.81	12:30	21.71	18.85	06:35	0.52	13:20	1.01	0.80	06:35	1.006	13:20	3.176	2.176	2.176	0.01
12/15/2019	06:35	14.51	12:30	21.60	18.72	05:20	0.51	12:00	1.00	0.79	06:25	0.978	12:40	3.116	2.141	2.141	
12/16/2019	05:35	14.52	22:40	21.09	18.64	05:35	0.58	10:15	0.98	0.81	05:35	1.078	23:05	2.982	2.152	2.152	
12/17/2019	05:40	14.60	22:55	20.78	18.58	05:35	0.50	09:40	0.96	0.80	05:35	0.935	23:20	2.876	2.127	2.127	
12/18/2019	05:25	14.46	22:30	20.69	18.58	04:55	0.50	10:25	0.96	0.79	04:55	0.947	10:25	2.836	2.100	2.100	
12/19/2019	05:35	14.39	10:00	20.84	18.55	05:55	0.50	09:40	0.94	0.78	05:55	0.935	09:40	2.804	2.051	2.051	
12/20/2019	05:40	14.38	10:10	20.54	18.50	05:50	0.49	10:30	0.93	0.78	05:50	0.899	10:30	2.739	2.039	2.039	0.02
12/21/2019	06:15	14.41	12:50	21.47	18.43	06:40	0.49	11:30	0.99	0.79	06:40	0.906	13:20	3.084	2.093	2.093	
12/22/2019	06:25	14.30	13:20	21.12	18.49	06:05	0.48	13:40	0.99	0.79	06:15	0.876	13:40	3.029	2.093	2.093	
12/23/2019	06:00	14.63	12:50	20.84	18.53	05:35	0.50	11:25	0.96	0.78	05:40	0.939	12:35	2.866	2.071	2.071	
12/24/2019	06:00	14.53	13:20	20.76	18.30	07:00	0.50	12:25	0.95	0.77	07:00	0.941	14:05	2.826	2.004	2.004	
12/25/2019	07:05	14.40	13:15	21.12	18.00	07:05	0.57	13:10	0.95	0.76	07:05	1.051	13:10	2.921	1.927	1.927	
12/26/2019	05:55	14.29	13:00	20.76	18.16	05:55	0.56	12:25	0.97	0.77	05:55	1.029	13:05	2.912	1.998	1.998	
12/27/2019	05:55	14.31	12:15	20.62	18.16	04:50	0.49	12:15	0.96	0.77	05:55	0.893	12:15	2.860	1.998	1.998	
12/28/2019	06:35	14.09	13:35	20.99	18.06	07:10	0.49	12:20	0.96	0.75	07:10	0.880	12:35	2.881	1.928	1.928	
12/29/2019	06:30	14.06	13:20	20.82	18.02	06:25	0.46	13:40	0.96	0.75	06:25	0.823	13:40	2.890	1.933	1.933	
12/30/2019	05:55	14.35	12:55	20.33	18.20	05:15	0.50	12:10	0.95	0.77	05:55	0.913	12:10	2.767	1.991	1.991	
12/31/2019	06:05	14.53	13:00	20.30	18.28	04:55	0.50	19:40	0.94	0.76	06:40	0.951	19:40	2.733	1.974	1.974	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/01/2020	07:20	14.33	13:45	20.53	17.98	06:05	0.50	12:50	0.96	0.75	06:25	0.922	13:55	2.842	1.912	1.912	
01/02/2020	05:50	14.22	11:50	20.44	18.11	05:40	0.50	11:45	0.94	0.76	05:40	0.919	11:50	2.750	1.948	1.948	
01/03/2020	05:50	14.26	12:35	20.09	18.12	05:50	0.56	12:35	0.86	0.76	05:50	1.023	12:35	2.472	1.960	1.960	
01/04/2020	06:30	14.06	13:30	21.19	18.21	06:30	0.55	13:30	0.91	0.77	06:30	0.980	13:30	2.786	1.993	1.993	
01/05/2020	06:45	13.97	13:15	21.14	18.39	06:20	0.46	12:45	0.91	0.77	06:20	0.819	12:45	2.775	2.038	2.038	
01/06/2020	05:35	13.96	22:20	20.57	18.05	05:35	0.54	22:20	0.88	0.76	05:35	0.960	22:20	2.607	1.945	1.945	
01/07/2020	05:35	13.98	22:10	20.49	17.96	05:35	0.54	22:10	0.88	0.75	05:35	0.965	22:10	2.585	1.914	1.914	
01/08/2020	05:50	13.98	22:20	20.50	17.98	05:50	0.54	21:55	0.92	0.75	05:50	0.965	21:55	2.703	1.908	1.908	
01/09/2020	05:35	14.03	22:00	20.97	18.39	05:35	0.54	21:10	0.94	0.77	05:35	0.974	21:20	2.859	2.032	2.032	
01/10/2020	05:40	14.23	10:00	20.40	18.44	05:40	0.56	23:05	0.88	0.78	05:40	1.016	10:00	2.560	2.042	2.042	
01/11/2020	06:20	14.26	13:30	21.59	18.52	06:30	0.49	13:30	0.92	0.78	06:30	0.890	13:30	2.902	2.069	2.069	
01/12/2020	06:20	14.18	12:55	21.48	18.67	06:20	0.55	13:10	0.92	0.78	06:20	1.006	13:10	2.869	2.111	2.111	
01/13/2020	05:25	14.19	22:50	20.89	18.48	05:25	0.56	22:50	0.89	0.78	05:25	1.008	22:50	2.698	2.057	2.057	
01/14/2020	05:45	14.42	22:20	20.92	18.42	05:45	0.57	22:20	0.89	0.78	05:45	1.057	22:20	2.707	2.042	2.042	
01/15/2020	05:30	13.93	22:00	20.77	18.28	05:30	0.54	19:55	0.95	0.77	05:30	0.956	19:55	2.723	1.998	1.998	0.10
01/16/2020	05:30	14.07	22:10	21.46	18.85	03:40	0.51	20:30	0.98	0.79	05:35	0.934	20:30	2.975	2.130	2.130	0.66
01/17/2020	05:30	14.90	10:00	21.03	18.91	03:40	0.55	10:05	0.95	0.79	04:50	1.115	10:05	2.890	2.145	2.145	
01/18/2020	06:15	14.62	13:40	21.78	18.71	06:35	0.51	11:10	0.98	0.79	06:35	0.963	11:20	2.982	2.116	2.116	
01/19/2020	06:30	14.32	13:00	21.43	18.49	05:25	0.49	14:20	0.98	0.78	05:25	0.918	14:20	2.980	2.074	2.074	
01/20/2020	06:00	14.37	13:45	21.42	18.85	04:05	0.52	22:00	0.99	0.80	04:10	1.017	22:00	3.042	2.167	2.167	
01/21/2020	05:35	14.26	22:45	20.98	18.47	05:30	0.47	09:35	0.96	0.78	05:30	0.863	21:50	2.846	2.050	2.050	0.01
01/22/2020	05:45	14.24	22:30	21.20	18.58	04:55	0.49	21:20	0.97	0.78	06:00	0.905	21:20	2.956	2.071	2.071	0.09
01/23/2020	05:40	14.23	10:00	21.02	18.50	05:45	0.48	22:45	0.97	0.78	05:45	0.879	22:45	2.893	2.049	2.049	
01/24/2020	05:50	14.12	12:00	20.91	18.63	05:10	0.49	10:45	0.96	0.80	05:10	0.884	10:45	2.847	2.122	2.122	
01/25/2020	06:15	14.09	13:15	21.03	18.17	07:20	0.52	12:55	0.97	0.78	07:20	0.970	12:55	2.935	2.003	2.003	
01/26/2020	06:15	13.91	13:30	21.20	18.32	05:15	0.47	13:45	0.99	0.79	05:15	0.846	13:45	3.036	2.075	2.075	0.16
01/27/2020	05:40	13.88	21:55	21.17	18.27	05:40	0.54	22:45	0.97	0.77	05:40	0.946	22:45	2.982	1.996	1.996	
01/28/2020	05:20	14.11	21:50	21.09	18.40	04:15	0.52	22:15	0.98	0.79	05:20	0.952	22:15	2.987	2.061	2.061	0.02
01/29/2020	05:30	14.06	22:20	21.11	18.38	05:15	0.57	21:35	0.98	0.79	05:15	1.015	21:35	2.975	2.074	2.074	
01/30/2020	05:35	14.00	22:15	21.00	18.27	05:20	0.54	23:00	0.98	0.79	05:20	0.968	23:00	2.946	2.050	2.050	
01/31/2020	05:35	13.96	10:05	20.42	18.29	04:35	0.49	09:40	0.95	0.78	05:30	0.885	09:40	2.757	2.035	2.035	0.01
02/01/2020	06:15	14.11	12:05	21.13	18.31	05:40	0.50	14:35	0.98	0.78	05:40	0.903	12:30	2.973	2.051	2.051	
02/02/2020	06:30	13.83	13:30	21.92	18.34	05:50	0.48	15:05	0.99	0.78	05:50	0.845	14:10	3.084	2.068	2.068	
02/03/2020	05:30	13.88	22:25	20.98	18.34	04:45	0.48	09:50	0.95	0.78	04:45	0.852	22:35	2.819	2.031	2.031	
02/04/2020	05:45	13.83	10:10	21.72	18.50	04:10	0.47	10:35	0.99	0.78	05:40	0.839	10:05	3.098	2.061	2.061	
02/05/2020	05:30	13.84	22:15	20.86	18.19	05:50	0.45	09:45	0.96	0.77	05:50	0.797	09:45	2.820	1.988	1.988	
02/06/2020	05:35	13.79	10:25	21.37	18.51	06:05	0.50	10:00	0.96	0.78	06:05	0.880	10:00	2.988	2.075	2.075	
02/07/2020	05:35	13.97	12:10	21.45	18.56	04:25	0.48	11:25	0.98	0.79	04:25	0.873	11:25	3.000	2.101	2.101	
02/08/2020	06:05	13.98	12:50	21.28	18.29	05:20	0.48	12:20	0.97	0.77	05:20	0.862	12:50	3.008	2.003	2.003	
02/09/2020	06:30	13.68	12:50	21.39	18.35	05:30	0.48	12:55	0.97	0.77	05:30	0.849	12:55	3.015	2.027	2.027	
02/10/2020	05:45	13.91	10:35	21.64	18.34	04:50	0.47	09:30	0.98	0.77	04:50	0.846	10:55	3.022	2.024	2.024	
02/11/2020	05:40	13.93	22:20	20.89	18.30	05:45	0.46	22:45	0.96	0.78	05:45	0.815	22:45	2.874	2.030	2.030	
02/12/2020	05:20	13.87	22:25	20.89	18.28	04:10	0.48	22:45	0.98	0.78	04:10	0.875	22:45	2.948	2.044	2.044	
02/13/2020	05:45	13.77	10:00	20.68	18.17	05:10	0.44	10:15	0.97	0.79	05:10	0.777	10:15	2.874	2.048	2.048	
02/14/2020	05:40	13.90	10:15	20.40	18.17	04:55	0.56	09:55	0.95	0.80	04:55	0.994	09:55	2.789	2.052	2.052	
02/15/2020	06:20	13.69	12:55	21.28	17.98	05:20	0.48	12:20	0.98	0.77	05:20	0.842	13:05	3.009	1.979	1.979	
02/16/2020	06:50	13.59	13:00	21.00	17.91	05:55	0.46	12:10	0.96	0.76	05:55	0.799	13:10	2.910	1.933	1.933	
02/17/2020	05:50	13.62	13:05	20.97	17.99	06:10	0.47	13:30	0.95	0.75	06:10	0.812	13:30	2.883	1.931	1.931	
02/18/2020	05:35	13.73	22:05	20.32	18.02	05:30	0.46	11:05	0.92	0.75	05:30	0.803	11:05	2.610	1.915	1.915	
02/19/2020	05:45	13.82	23:05	20.49	18.19	06:10	0.47	22:50	0.94	0.75	06:10	0.842	22:50	2.761	1.954	1.954	
02/20/2020	05:35	13.96	11:40	20.35	18.22	04:55	0.46	09:55	0.93	0.76	04:55	0.831	21:00	2.643	1.960	1.960	
02/21/2020	05:25	13.73	11:25	20.49	18.03	04:50	0.45	19:35	0.90	0.74	05:45	0.790	12:15	2.604	1.900	1.900	
02/22/2020	06:25	13.70	12:30	21.74	18.19	05:35	0.46	12:10	1.00	0.75	05:35	0.807	12:10	3.175	1.960	1.960	
02/23/2020	06:45	13.60	12:35	21.39	18.40	07:10	0.44	22:35	0.97	0.77	07:10	0.761	22:35	2.966	2.056	2.056	
02/24/2020	05:40	13.65	22:10	20.68	18.25	05:15	0.45	22:20	0.97	0.77	05:15	0.772	22:20	2.887	2.006	2.006	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	05:25	13.72	22:30	20.76	18.16	06:10	0.53	22:20	0.98	0.78	06:10	0.935	22:20	2.919	2.022	2.022	
02/26/2020	05:45	13.85	09:50	20.90	18.24	05:55	0.54	23:15	0.97	0.79	05:55	0.944	23:15	2.918	2.059	2.059	
02/27/2020	06:05	13.77	09:45	20.68	18.24	06:35	0.55	09:50	0.97	0.80	06:35	0.986	09:50	2.898	2.065	2.065	
02/28/2020	05:25	13.79	10:05	20.86	18.29	04:10	0.48	20:20	0.93	0.76	04:10	0.857	09:25	2.706	1.985	1.985	
02/29/2020	06:40	13.81	12:30	21.47	18.32	06:45	0.45	11:55	0.99	0.76	06:45	0.781	11:55	3.083	2.008	2.008	
03/01/2020	06:35	13.50	13:05	21.27	18.34	05:40	0.46	13:05	0.99	0.78	05:40	0.787	13:05	3.052	2.064	2.064	
03/02/2020	05:35	13.63	11:30	21.72	18.55	05:05	0.45	23:10	0.98	0.78	05:05	0.772	11:05	3.028	2.081	2.081	0.01
03/03/2020	05:40	13.94	10:10	21.48	18.22	05:05	0.51	09:45	1.00	0.78	05:05	0.906	10:05	3.126	2.016	2.016	
03/04/2020	05:30	13.49	22:20	20.92	18.10	04:40	0.43	10:05	0.97	0.77	04:40	0.744	10:05	2.906	1.981	1.981	
03/05/2020	05:50	13.72	09:45	20.67	18.04	06:10	0.46	09:50	0.97	0.78	06:10	0.799	09:50	2.897	2.003	2.003	
03/06/2020	05:40	13.56	14:05	20.51	18.19	06:30	0.53	14:15	0.96	0.78	06:30	0.939	14:15	2.840	2.017	2.017	
03/07/2020	05:45	13.50	13:10	21.42	18.27	03:50	0.48	13:20	1.00	0.77	05:45	0.868	13:20	3.120	2.037	2.037	0.58
03/08/2020	06:05	13.77	13:20	21.37	18.58	07:00	0.51	14:45	0.98	0.79	07:00	0.913	13:40	3.000	2.113	2.113	0.02
03/09/2020	04:10	13.82	10:55	21.69	18.65	04:10	0.53	20:45	0.98	0.78	04:10	0.934	20:45	2.985	2.091	2.090	0.11

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			234.802	5.26
Avg	18.34	0.78	2.042	

Site Commentary

Site Information

MIL_2808	
Pipe Dimensions	36
Silt Level	0.00"

Overview

Site MIL_2808 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that free flow conditions were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

This location was installed downstream of sites MIL_0229 and MIL_0715. A review of balancing shows a net flow of 0.938 MGD between the sites.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	8.74	2.26	2.009
Minimum	5.84	1.16	0.567
Maximum	11.20	3.09	3.591
Time of Minimum	1/5/2020 6:30 AM	1/4/2020 6:30 AM	1/4/2020 6:30 AM
Time of Maximum	12/23/2019 2:10 PM	1/23/2020 9:45 AM	3/4/2020 9:55 AM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

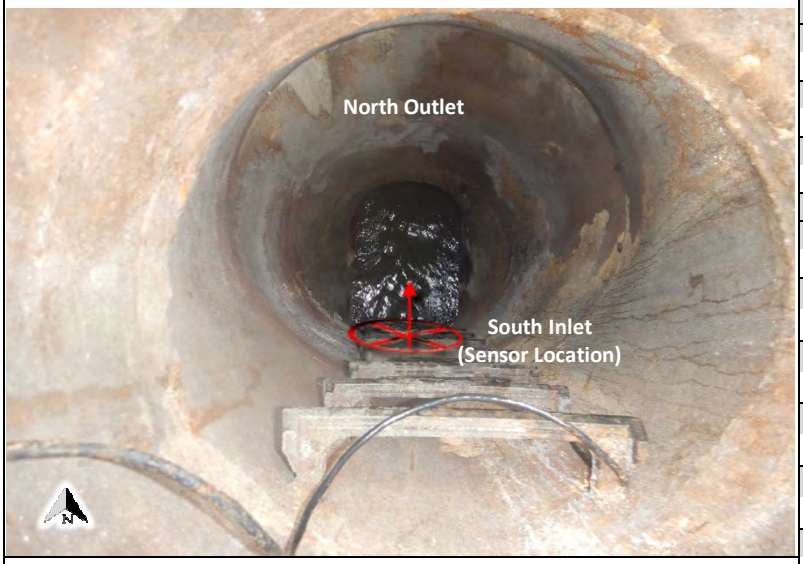
MIL_2808

Site Address /Location:	N McCarthy Blvd and Ranch Dr, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	DRIVE.	Latitude:	37.433534°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.922138°	36.00"x36.00"	Circular



Manhole #	System Characteristics
2808	Residential/Commercial
Access	Traffic
Drive	Heavy







Installation Information

Installation Date:	Installation Type:
Wednesday, November 13, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
12:08:00 AM	36.00"x36.00"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
11.25"	
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
2.45'	0''
Silt (in)	Silt Type
0.0"	

Hydraulic Comments:

Smooth flow with deep depth and moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
12'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Drilled Pavement / Concrete

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

SCATTERGRAPH REPORT

MIL_2808

Flow Monitor

MIL_2808

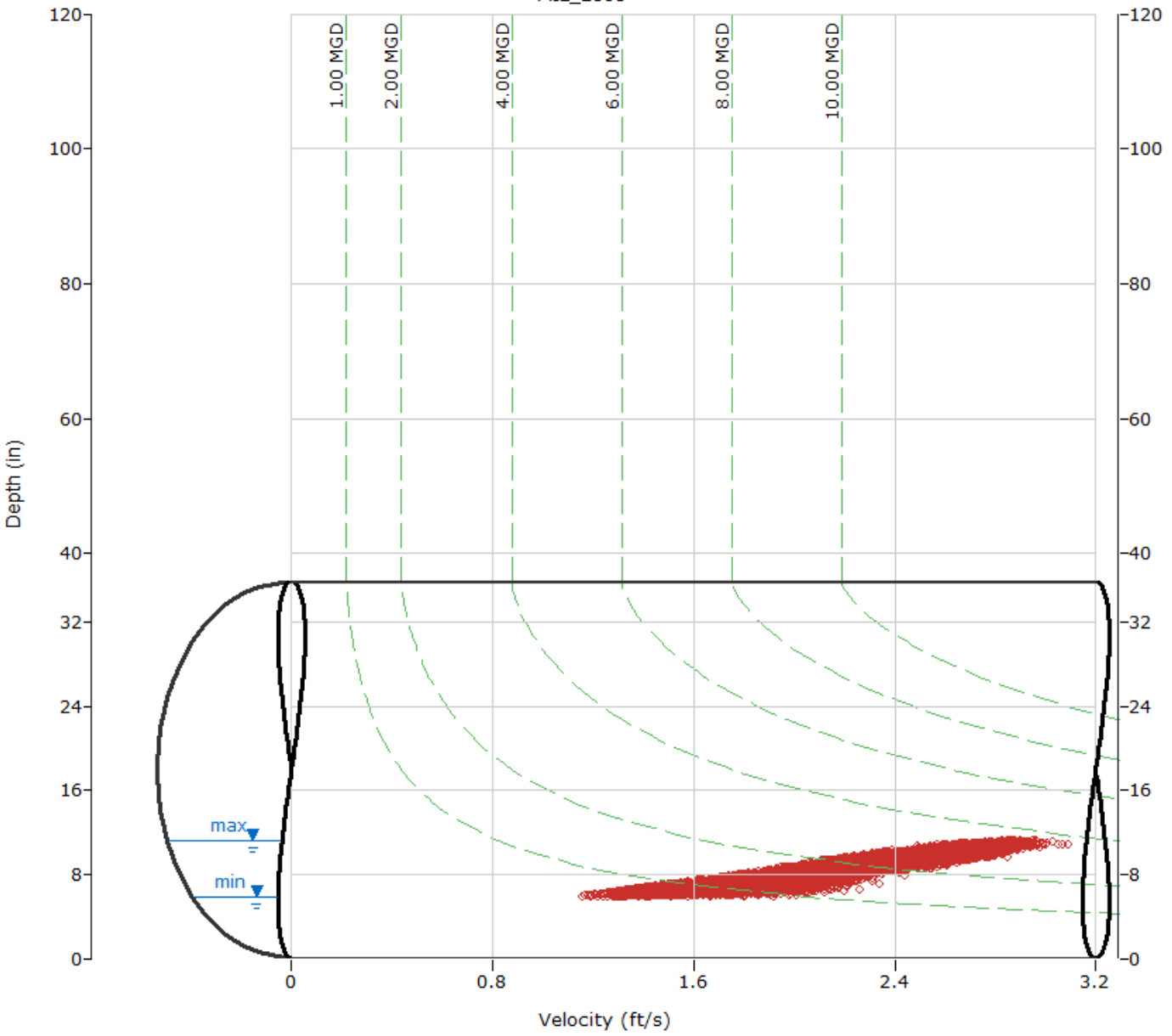
Pipe Height
36.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



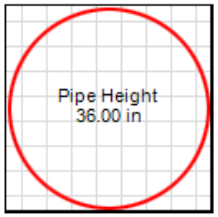
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_2808

Flow Monitor

MIL_2808

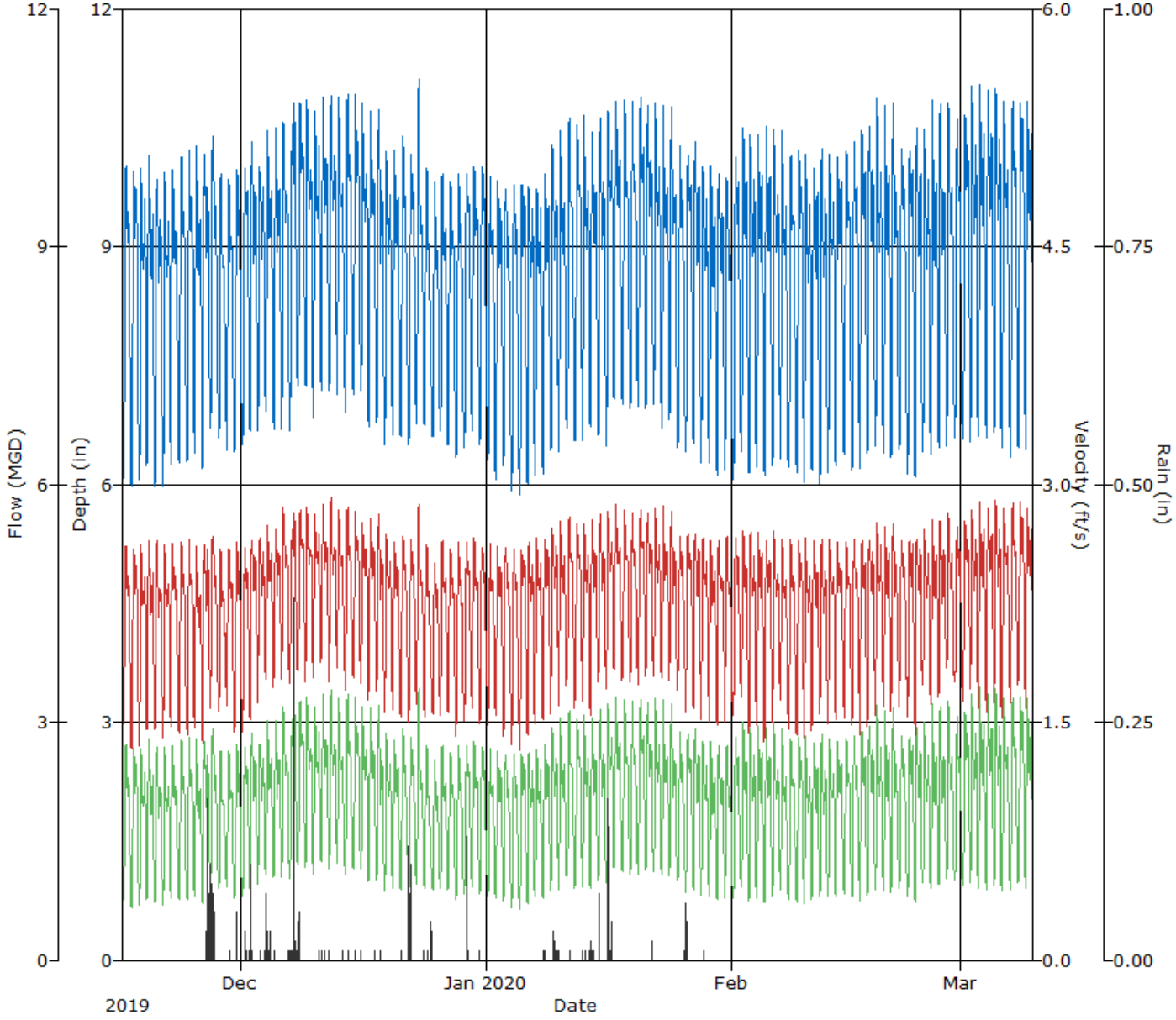


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_2808, Pipe Height: 36.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	06:00	6.05	13:00	10.14	8.37	05:20	1.25	13:30	2.73	2.15	06:00	0.638	13:30	2.852	1.816	1.816	
11/17/2019	06:25	5.94	12:50	10.15	8.39	06:10	1.19	20:00	2.70	2.12	06:10	0.593	12:55	2.766	1.812	1.812	
11/18/2019	05:25	6.04	10:05	10.08	8.43	04:45	1.23	09:20	2.74	2.14	04:45	0.632	09:55	2.810	1.819	1.819	
11/19/2019	04:40	6.18	09:55	10.21	8.48	04:35	1.31	10:55	2.84	2.17	04:35	0.686	10:55	2.954	1.848	1.848	
11/20/2019	06:00	5.93	10:10	9.95	8.35	06:10	1.27	11:00	2.75	2.15	06:10	0.625	11:00	2.777	1.794	1.794	
11/21/2019	06:05	5.93	10:25	10.00	8.40	05:50	1.17	09:25	2.67	2.15	05:55	0.580	10:25	2.715	1.814	1.814	
11/22/2019	05:35	6.19	12:05	10.05	8.47	05:30	1.26	10:10	2.76	2.17	05:30	0.660	10:10	2.863	1.845	1.845	
11/23/2019	06:05	6.26	13:10	10.24	8.52	07:20	1.31	12:35	2.75	2.14	07:20	0.705	12:35	2.910	1.846	1.846	
11/24/2019	07:00	6.23	13:10	10.38	8.54	07:05	1.31	11:45	2.78	2.12	07:05	0.694	13:00	2.939	1.843	1.843	
11/25/2019	06:40	6.37	10:45	10.35	8.57	05:35	1.33	10:45	2.69	2.10	05:35	0.738	10:45	2.921	1.818	1.818	
11/26/2019	05:50	6.17	11:05	10.22	8.58	06:25	1.26	21:50	2.71	2.14	06:25	0.664	10:55	2.869	1.870	1.870	0.36
11/27/2019	05:40	6.69	11:15	10.47	8.78	05:00	1.45	12:10	2.76	2.25	05:10	0.855	11:15	2.981	2.001	2.001	0.63
11/28/2019	07:25	6.55	13:50	9.99	8.33	07:00	1.43	12:55	2.66	2.12	07:00	0.818	13:00	2.723	1.745	1.745	
11/29/2019	07:00	6.39	12:30	9.90	8.35	05:45	1.35	12:35	2.72	2.17	05:45	0.763	12:35	2.746	1.795	1.795	0.02
11/30/2019	06:35	6.39	13:55	10.16	8.43	07:30	1.34	14:30	2.74	2.14	07:30	0.747	13:50	2.859	1.811	1.811	0.10
12/01/2019	07:50	6.47	13:55	10.08	8.53	07:25	1.34	15:25	2.75	2.14	07:25	0.754	15:25	2.854	1.843	1.843	0.06
12/02/2019	06:25	6.62	10:35	10.40	8.73	06:10	1.40	11:25	2.72	2.23	06:10	0.814	10:35	2.955	1.973	1.973	0.30
12/03/2019	05:30	6.66	10:50	10.05	8.77	05:15	1.42	22:20	2.80	2.29	05:15	0.827	11:55	2.782	2.031	2.031	0.01
12/04/2019	05:00	6.81	10:25	10.54	8.95	05:00	1.54	09:55	2.83	2.35	05:00	0.926	10:25	3.108	2.137	2.137	0.39
12/05/2019	05:20	6.68	10:35	10.54	8.92	04:45	1.53	09:40	2.89	2.35	04:45	0.901	09:40	3.117	2.130	2.130	0.01
12/06/2019	05:30	6.65	10:40	10.64	8.98	05:25	1.45	10:20	2.98	2.39	05:25	0.844	10:20	3.330	2.188	2.188	0.01
12/07/2019	05:55	6.66	20:00	10.89	9.09	06:10	1.48	19:15	2.94	2.38	06:10	0.863	20:10	3.399	2.241	2.241	0.67
12/08/2019	06:45	7.19	12:10	10.89	9.28	06:55	1.61	14:25	3.00	2.39	06:55	1.049	14:25	3.449	2.299	2.299	0.20
12/09/2019	06:20	7.20	10:20	10.91	9.23	04:40	1.58	10:15	2.95	2.40	04:50	1.040	10:15	3.444	2.274	2.274	
12/10/2019	05:25	6.83	11:00	10.76	9.18	04:35	1.47	10:40	2.92	2.43	04:35	0.907	10:40	3.336	2.287	2.287	
12/11/2019	06:10	7.14	09:55	10.95	9.28	04:35	1.68	10:30	2.99	2.44	05:10	1.106	10:30	3.491	2.323	2.323	0.03
12/12/2019	04:55	7.14	09:50	10.96	9.32	04:00	1.63	09:25	3.07	2.44	04:55	1.093	09:25	3.534	2.341	2.341	0.01
12/13/2019	05:50	7.09	10:20	10.97	9.25	05:05	1.65	10:10	2.93	2.42	05:05	1.073	10:10	3.421	2.297	2.297	0.01
12/14/2019	06:40	6.86	13:35	10.99	9.18	05:55	1.49	13:20	2.98	2.36	05:55	0.923	13:20	3.493	2.240	2.240	0.01
12/15/2019	07:05	7.08	13:05	11.02	9.25	07:20	1.55	13:25	2.96	2.37	07:20	0.990	13:25	3.491	2.269	2.269	0.01
12/16/2019	06:00	7.11	10:50	10.97	9.20	05:55	1.57	10:10	2.90	2.36	05:55	1.005	10:10	3.321	2.228	2.228	0.01
12/17/2019	04:55	6.71	10:45	10.78	9.08	04:50	1.49	10:15	2.93	2.35	04:50	0.880	10:15	3.330	2.192	2.192	0.01
12/18/2019	05:30	6.76	10:30	10.78	9.00	04:50	1.44	10:45	2.91	2.33	04:50	0.870	09:55	3.303	2.141	2.141	0.01
12/19/2019	05:00	6.48	10:20	10.41	8.76	05:45	1.35	10:10	2.80	2.27	05:45	0.762	10:25	3.041	2.015	2.015	
12/20/2019	06:25	6.60	11:00	10.32	8.75	06:50	1.39	10:05	2.79	2.23	06:50	0.802	10:05	2.873	1.980	1.980	
12/21/2019	07:05	6.57	13:30	10.48	8.66	05:30	1.42	13:25	2.72	2.23	05:30	0.815	13:30	3.007	1.954	1.954	0.01
12/22/2019	06:30	6.47	14:50	10.27	8.67	07:15	1.39	14:45	2.78	2.22	07:15	0.803	14:45	2.968	1.955	1.955	0.41
12/23/2019	06:25	6.74	14:10	11.20	8.83	06:00	1.43	12:55	2.97	2.25	06:15	0.850	14:15	3.580	2.042	2.042	
12/24/2019	06:45	6.73	12:50	10.04	8.48	06:00	1.45	13:40	2.70	2.16	06:00	0.858	14:00	2.787	1.825	1.825	0.02
12/25/2019	06:35	6.58	13:35	9.84	8.22	05:25	1.39	13:15	2.65	2.07	06:25	0.798	13:20	2.665	1.674	1.674	0.08
12/26/2019	06:10	6.67	13:40	9.99	8.46	05:50	1.47	13:00	2.71	2.17	05:50	0.866	13:50	2.773	1.834	1.834	
12/27/2019	05:40	6.46	13:30	9.86	8.40	04:50	1.38	12:45	2.79	2.16	06:20	0.772	12:45	2.809	1.814	1.814	
12/28/2019	06:45	6.31	13:00	9.98	8.35	06:20	1.30	14:10	2.73	2.13	06:20	0.706	14:10	2.800	1.786	1.786	
12/29/2019	06:15	6.44	13:55	10.02	8.48	06:05	1.33	13:05	2.72	2.16	06:05	0.744	12:50	2.775	1.849	1.849	0.22
12/30/2019	06:20	6.66	12:55	10.11	8.63	06:20	1.41	13:15	2.77	2.21	06:20	0.820	13:15	2.897	1.916	1.916	
12/31/2019	06:25	6.46	13:30	10.04	8.59	06:35	1.35	14:20	2.76	2.18	06:35	0.753	14:20	2.838	1.892	1.892	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/01/2020	07:55	6.27	14:00	9.92	8.26	07:10	1.33	14:50	2.71	2.12	07:10	0.722	14:50	2.744	1.741	1.741	
01/02/2020	05:30	6.04	11:50	9.90	8.35	05:35	1.35	11:55	2.77	2.17	05:35	0.686	11:55	2.825	1.812	1.812	
01/03/2020	06:20	6.20	11:50	9.83	8.36	07:10	1.31	11:10	2.69	2.16	06:25	0.700	13:20	2.681	1.806	1.806	
01/04/2020	06:30	5.90	13:35	9.84	8.18	06:30	1.16	13:50	2.71	2.10	06:30	0.567	13:50	2.720	1.722	1.722	
01/05/2020	06:30	5.84	14:30	9.84	8.22	07:30	1.19	13:30	2.70	2.12	07:30	0.578	13:30	2.699	1.753	1.753	
01/06/2020	06:05	5.92	11:00	9.83	8.32	06:05	1.18	11:00	2.73	2.17	06:05	0.579	11:00	2.760	1.810	1.810	
01/07/2020	06:05	6.01	09:45	9.79	8.40	05:15	1.29	10:25	2.73	2.22	06:20	0.673	10:25	2.713	1.863	1.863	
01/08/2020	06:00	6.04	10:20	9.98	8.48	06:05	1.24	10:20	2.78	2.25	06:05	0.628	10:20	2.871	1.923	1.923	0.02
01/09/2020	06:10	6.39	09:50	10.41	8.71	04:10	1.40	09:50	2.87	2.30	04:10	0.795	09:50	3.143	2.028	2.028	0.18
01/10/2020	05:25	6.39	10:45	10.55	8.74	04:25	1.37	10:20	2.84	2.32	04:25	0.785	11:15	3.111	2.049	2.049	0.02
01/11/2020	05:55	6.70	13:45	10.74	8.83	04:35	1.55	13:05	2.86	2.34	05:05	0.911	13:25	3.222	2.096	2.096	0.01
01/12/2020	06:05	6.47	14:15	10.64	8.83	05:05	1.38	12:10	2.86	2.29	05:05	0.794	12:10	3.162	2.077	2.077	
01/13/2020	06:00	6.48	10:25	10.69	8.85	05:00	1.46	14:25	2.85	2.29	06:00	0.820	10:35	3.182	2.065	2.065	0.02
01/14/2020	04:55	6.71	10:45	10.56	8.87	05:05	1.41	10:30	2.87	2.31	05:05	0.831	10:45	3.173	2.086	2.086	0.11
01/15/2020	06:00	6.55	10:05	10.68	8.91	03:20	1.57	10:20	2.85	2.35	06:25	0.919	10:20	3.222	2.129	2.129	0.07
01/16/2020	05:25	6.46	13:55	10.84	9.17	05:00	1.47	10:15	2.94	2.40	05:00	0.823	10:15	3.346	2.279	2.279	0.66
01/17/2020	04:50	7.02	10:50	10.91	9.27	04:00	1.55	10:15	2.93	2.42	04:00	1.004	10:15	3.391	2.314	2.314	
01/18/2020	07:10	6.95	12:55	10.94	9.08	07:15	1.62	12:30	2.95	2.35	07:15	1.002	12:30	3.418	2.189	2.189	
01/19/2020	06:00	6.94	12:55	10.92	9.09	06:30	1.48	12:05	2.91	2.35	06:30	0.913	12:05	3.380	2.194	2.194	
01/20/2020	05:55	6.97	14:25	10.97	9.18	05:30	1.55	13:45	2.94	2.37	05:30	0.972	14:30	3.450	2.254	2.254	
01/21/2020	05:55	6.94	10:30	10.83	9.19	04:30	1.61	10:55	2.90	2.39	04:30	1.008	10:55	3.309	2.261	2.261	
01/22/2020	05:20	6.98	10:20	10.89	9.16	04:45	1.58	10:35	2.92	2.38	04:45	1.012	10:30	3.389	2.236	2.236	0.03
01/23/2020	05:15	6.70	09:55	10.95	9.03	04:45	1.58	09:45	3.09	2.38	05:00	0.931	09:45	3.580	2.200	2.200	
01/24/2020	05:30	6.80	10:15	10.80	9.00	05:35	1.62	10:35	2.90	2.36	05:35	0.971	11:10	3.323	2.161	2.161	
01/25/2020	06:15	6.45	13:15	10.43	8.62	08:20	1.39	13:05	2.74	2.26	08:20	0.810	13:05	2.977	1.964	1.964	
01/26/2020	06:25	6.39	13:50	10.24	8.66	05:30	1.34	13:10	2.77	2.27	05:30	0.751	13:40	2.918	1.994	1.994	0.16
01/27/2020	05:55	6.44	10:25	10.42	8.69	04:20	1.39	10:10	2.80	2.25	04:20	0.796	10:10	3.026	1.982	1.982	
01/28/2020	05:35	6.24	10:15	10.11	8.57	05:45	1.27	09:45	2.80	2.25	05:45	0.676	09:45	2.847	1.934	1.934	0.01
01/29/2020	05:45	6.22	10:35	10.17	8.44	05:10	1.39	09:30	2.70	2.21	05:50	0.737	10:35	2.863	1.864	1.864	
01/30/2020	05:25	6.09	10:20	9.98	8.41	05:50	1.28	10:35	2.79	2.22	05:50	0.662	10:35	2.861	1.861	1.861	
01/31/2020	05:00	6.13	10:55	9.91	8.35	05:25	1.31	11:15	2.77	2.20	05:25	0.684	11:15	2.810	1.826	1.826	
02/01/2020	06:55	6.04	14:10	10.26	8.43	04:35	1.31	15:15	2.74	2.20	07:20	0.673	14:20	2.869	1.875	1.875	
02/02/2020	06:30	6.39	13:20	10.57	8.62	06:00	1.36	13:15	2.80	2.23	06:00	0.756	13:15	3.126	1.946	1.946	
02/03/2020	06:20	6.09	10:25	10.47	8.62	05:35	1.25	11:30	2.85	2.21	05:35	0.645	10:35	3.072	1.938	1.938	
02/04/2020	05:55	6.19	10:10	10.51	8.66	05:05	1.28	10:05	2.81	2.24	05:05	0.678	10:05	3.114	1.967	1.967	
02/05/2020	05:30	6.09	10:00	10.69	8.67	05:50	1.23	09:45	2.80	2.22	05:50	0.632	09:45	3.131	1.961	1.961	
02/06/2020	05:20	6.20	09:55	10.69	8.68	05:20	1.29	10:00	2.75	2.23	05:20	0.677	10:00	3.113	1.958	1.958	
02/07/2020	06:00	6.30	10:05	10.53	8.65	04:10	1.42	09:45	2.81	2.22	05:50	0.769	09:45	3.103	1.941	1.941	
02/08/2020	06:10	6.18	12:55	10.32	8.48	06:05	1.26	12:00	2.72	2.17	06:05	0.659	13:30	2.864	1.862	1.862	
02/09/2020	06:40	6.11	13:45	10.28	8.56	06:15	1.26	13:00	2.85	2.17	06:15	0.656	13:00	3.012	1.893	1.893	
02/10/2020	05:40	5.97	10:35	10.20	8.44	05:40	1.17	10:30	2.76	2.15	05:40	0.582	10:30	2.935	1.828	1.828	
02/11/2020	06:30	6.14	11:50	10.05	8.50	04:05	1.23	12:15	2.80	2.19	04:05	0.639	12:15	2.900	1.872	1.872	
02/12/2020	05:40	5.97	10:00	10.47	8.49	04:15	1.34	10:10	2.71	2.21	06:05	0.682	10:05	2.943	1.882	1.882	
02/13/2020	05:40	6.13	10:00	10.25	8.61	04:10	1.30	11:25	2.74	2.22	04:55	0.707	11:25	2.852	1.931	1.931	
02/14/2020	05:05	6.21	11:15	10.22	8.66	06:10	1.33	09:45	2.73	2.22	06:10	0.704	09:45	2.844	1.946	1.946	
02/15/2020	06:50	6.32	13:30	10.28	8.63	07:35	1.36	12:10	2.72	2.20	07:35	0.740	13:30	2.897	1.924	1.924	
02/16/2020	06:50	6.15	13:25	10.36	8.63	06:25	1.26	11:50	2.71	2.18	06:25	0.661	13:25	2.950	1.921	1.921	
02/17/2020	06:15	6.17	12:05	10.60	8.78	06:50	1.35	11:30	2.77	2.20	06:50	0.713	11:30	3.075	1.987	1.987	
02/18/2020	05:40	6.35	10:50	10.68	8.82	05:00	1.35	10:55	2.74	2.22	05:00	0.753	10:55	3.093	2.006	2.006	
02/19/2020	05:25	6.47	10:20	10.94	8.89	04:15	1.43	10:15	2.89	2.28	04:45	0.822	10:15	3.388	2.074	2.074	
02/20/2020	05:20	6.33	10:25	10.89	8.88	06:20	1.36	10:15	2.85	2.28	06:20	0.760	10:15	3.269	2.072	2.072	
02/21/2020	05:45	6.30	11:00	10.91	8.81	05:45	1.41	10:30	2.85	2.26	05:45	0.759	10:30	3.320	2.031	2.031	
02/22/2020	06:15	6.39	13:00	10.32	8.68	04:55	1.38	12:15	2.73	2.23	04:55	0.800	12:55	2.945	1.966	1.966	
02/23/2020	06:20	6.10	12:55	10.29	8.63	06:20	1.36	22:00	2.75	2.21	06:20	0.695	13:00	2.876	1.949	1.949	
02/24/2020	04:40	6.06	10:45	10.59	8.66	04:40	1.23	10:10	2.73	2.23	04:40	0.624	10:45	3.004	1.972	1.972	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	06:10	6.34	10:05	10.55	8.70	04:35	1.36	10:05	2.84	2.29	04:35	0.772	10:05	3.169	2.015	2.015	
02/26/2020	05:45	6.34	10:15	10.98	8.81	04:30	1.44	10:05	2.89	2.28	06:05	0.800	10:05	3.371	2.048	2.048	
02/27/2020	05:30	6.44	09:55	10.95	8.88	03:45	1.43	10:00	2.88	2.31	04:50	0.818	10:00	3.378	2.096	2.096	
02/28/2020	05:45	6.42	10:50	10.96	8.90	06:25	1.34	10:30	2.91	2.33	06:25	0.755	10:50	3.376	2.111	2.111	
02/29/2020	06:25	6.53	14:30	10.69	8.81	05:10	1.52	13:50	2.88	2.29	05:10	0.888	13:05	3.203	2.055	2.055	
03/01/2020	05:45	6.54	14:10	10.78	8.92	05:25	1.44	14:25	2.88	2.30	06:15	0.837	14:25	3.261	2.118	2.118	
03/02/2020	06:00	6.42	10:40	11.12	9.05	04:45	1.39	10:30	2.92	2.35	04:45	0.804	10:30	3.472	2.194	2.194	
03/03/2020	06:05	6.53	10:35	11.07	9.14	06:25	1.45	10:55	2.97	2.36	06:05	0.836	10:55	3.540	2.240	2.240	
03/04/2020	06:15	6.54	10:00	11.02	9.20	06:10	1.38	09:55	3.03	2.38	06:10	0.784	09:55	3.591	2.275	2.275	
03/05/2020	06:00	6.61	10:05	11.06	9.23	05:00	1.40	10:45	3.01	2.38	05:00	0.823	10:45	3.549	2.277	2.277	
03/06/2020	06:05	6.45	10:05	10.89	9.05	06:05	1.37	10:20	2.99	2.36	06:05	0.760	10:20	3.482	2.209	2.209	
03/07/2020	06:55	6.28	13:30	10.89	9.02	06:50	1.41	12:45	2.98	2.37	06:50	0.759	14:45	3.390	2.223	2.223	
03/08/2020	05:55	6.43	13:55	10.86	9.12	05:30	1.38	12:45	3.05	2.41	05:35	0.771	12:45	3.522	2.287	2.287	
03/09/2020	05:00	6.42	10:35	10.91	9.08	04:45	1.38	10:30	2.93	2.38	04:45	0.766	10:30	3.412	2.239	2.238	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			231.008	4.90
Avg	8.74	2.26	2.009	

Site Commentary

Site Information

MIL_2840	
Pipe Dimensions	15
Silt Level	0.00"

Overview

Site MIL_2840 functioned under normal conditions during the period Saturday, November 16, 2019 to Monday, March 9, 2020 . This site exhibited an observable response to the wet weather events of November 26, 2019 - November 27, 2019, December 7, 2019 - December 8, 2019, and January 16, 2020 - January 17, 2020. Review of the scattergraph shows that both free flow and backwater flows were recorded during the study period.

Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

This location was installed upstream of sites MIL_0649 and MIL_2491, and downstream of MIL_1193. A review of balancing of combined flows MIL_1043 and MIL_2840 shows a net flow of 0.663 MGD.

Observations

Average flow depth, velocity, and quantity data observed during Saturday, November 16, 2019 to Monday, March 9, 2020 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	1.99	1.38	0.087
Minimum	1.80	0.99	0.055
Maximum	2.26	1.82	0.131
Time of Minimum	11/21/2019 3:35 PM	11/24/2019 7:15 AM	11/24/2019 7:15 AM
Time of Maximum	12/8/2019 6:00 PM	12/10/2019 5:35 PM	12/9/2019 5:25 PM

Data Quality

Data uptime observed during the Saturday, November 16, 2019 to the Monday, March 9, 2020 monitoring period is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_2840

Site Address /Location:	S Abel St and Curtis Ave, Milpitas, CA			Monitor Series	Location Type
				TRITON+	Temporary
Site Access Details:	DRIVE.	Latitude:	37.433982°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.891547°	15.00"x15.00"	Circular



Manhole #	System Characteristics
2840	Residential/Commercial
Access	Traffic
Drive	Heavy







Installation Information

Installation Date:	Installation Type:
Wednesday, November 13, 2019	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4)	0 - 5 psi

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
11:04:00 AM	15.00"x15.00"
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
2.00"	
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.28'	0''
Silt (in)	Silt Type
0.0"	

Hydraulic Comments:

Smooth flow with shallow depth and moderate velocity

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
10'	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Unbolted	Normal
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:

Communication Type	Antenna Location
Wireless	Drilled Pavement / Concrete

Additional Site Info. / Comments:

ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

SCATTERGRAPH REPORT

MIL_2840

Flow Monitor

MIL_2840

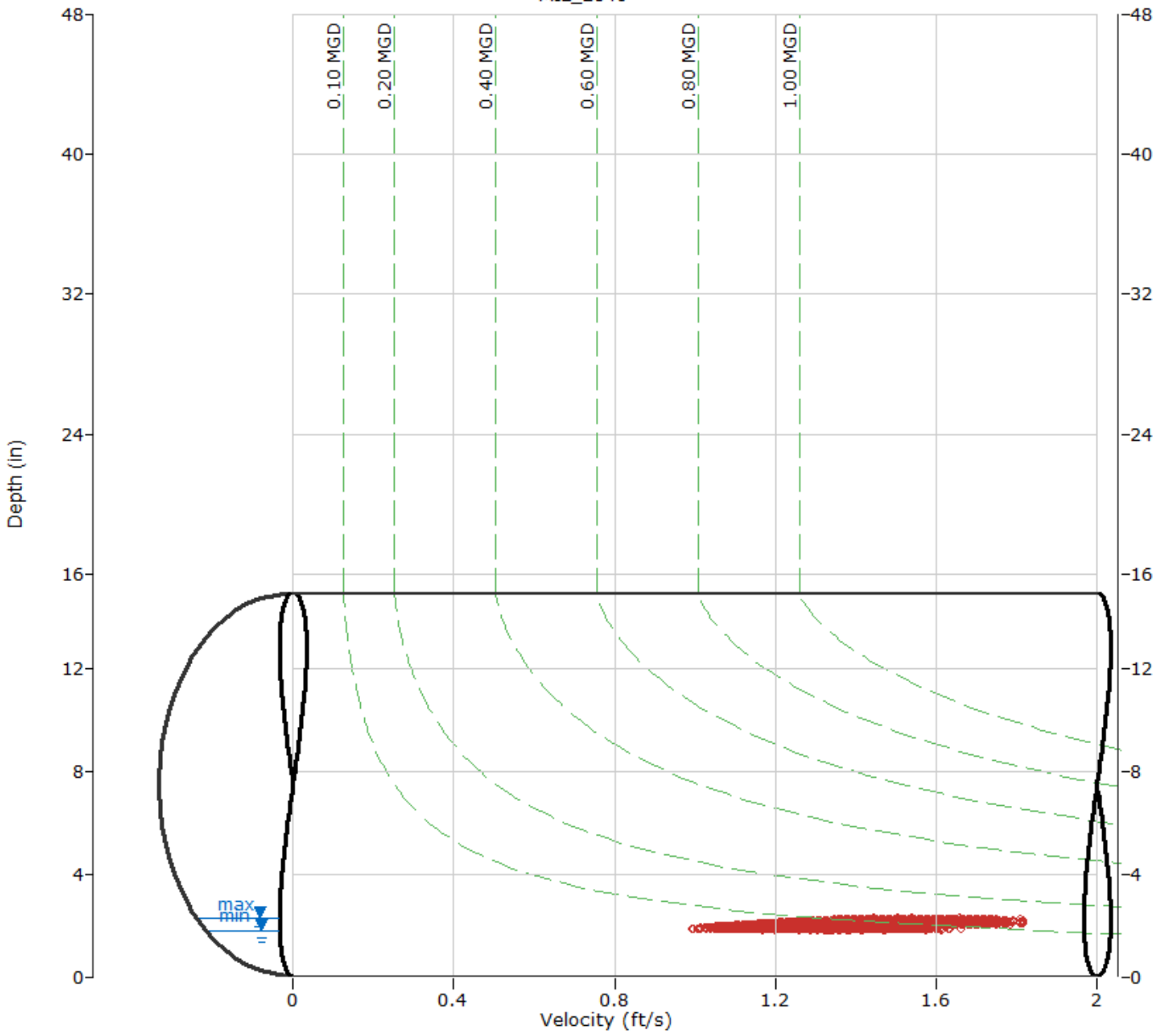
Pipe Height
15.00 in

Report Period

11/16/2019
To
3/9/2020

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



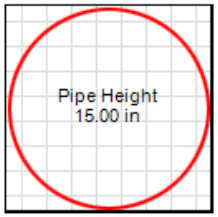
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

MIL_2840

Flow Monitor

MIL_2840

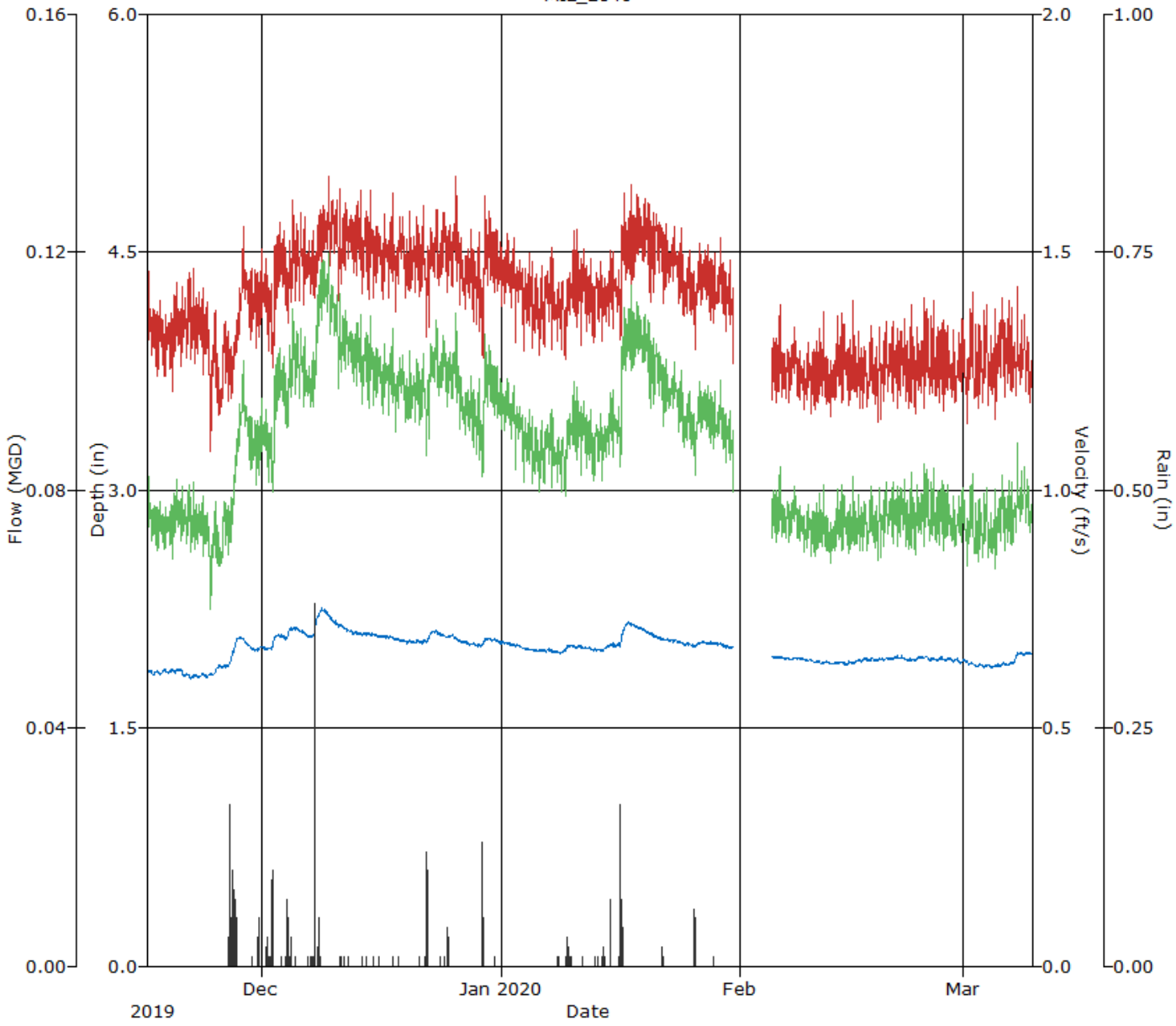


Report Period

11/16/2019
To
3/9/2020

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 11/16/2019 00:00 - 03/09/2020 23:59

MIL_2840, Pipe Height: 15.00 in, Silt: 0.00 in

Daily Tabular Report

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019	21:25	1.83	13:55	1.86	1.85	23:15	1.11	02:50	1.63	1.35	23:15	0.062	02:50	0.091	0.076	0.076	
11/17/2019	16:55	1.83	07:55	1.86	1.85	16:35	1.05	15:05	1.56	1.32	16:35	0.059	15:05	0.087	0.074	0.074	
11/18/2019	19:25	1.84	09:30	1.87	1.85	12:05	1.06	19:50	1.66	1.31	00:30	0.060	19:50	0.093	0.074	0.074	
11/19/2019	16:25	1.84	22:40	1.88	1.86	08:20	1.07	21:30	1.57	1.33	08:20	0.060	22:25	0.090	0.075	0.075	
11/20/2019	23:05	1.83	10:10	1.88	1.85	17:45	1.04	08:45	1.61	1.34	17:45	0.058	08:45	0.092	0.076	0.076	
11/21/2019	15:35	1.80	06:00	1.85	1.83	06:35	1.10	11:30	1.62	1.35	06:35	0.061	11:30	0.090	0.074	0.074	
11/22/2019	00:05	1.81	06:35	1.84	1.83	19:10	1.13	10:35	1.58	1.35	19:10	0.062	10:35	0.087	0.074	0.074	
11/23/2019	21:05	1.81	08:20	1.85	1.83	14:30	1.10	01:10	1.58	1.34	14:30	0.061	01:10	0.087	0.074	0.074	
11/24/2019	00:05	1.82	23:50	1.87	1.84	07:15	0.99	01:00	1.55	1.25	07:15	0.055	23:50	0.086	0.070	0.070	
11/25/2019	00:45	1.85	14:00	1.90	1.88	18:05	1.02	00:55	1.54	1.23	18:05	0.058	00:55	0.087	0.071	0.071	
11/26/2019	05:00	1.87	23:50	1.94	1.90	16:50	1.04	15:50	1.58	1.28	16:50	0.061	15:50	0.091	0.075	0.075	0.36
11/27/2019	00:30	1.94	22:45	2.07	2.02	06:00	1.09	22:00	1.52	1.30	06:00	0.067	22:00	0.100	0.083	0.083	0.63
11/28/2019	22:20	2.03	01:15	2.08	2.06	15:00	1.19	09:40	1.69	1.43	15:00	0.078	09:40	0.111	0.094	0.094	
11/29/2019	18:55	1.99	00:50	2.04	2.01	10:50	1.14	00:40	1.72	1.40	10:50	0.072	00:40	0.111	0.089	0.089	0.02
11/30/2019	08:10	1.98	22:15	2.02	2.00	05:15	1.12	04:15	1.63	1.40	05:15	0.070	04:15	0.102	0.088	0.088	0.10
12/01/2019	11:05	1.98	06:50	2.02	2.00	22:35	1.13	00:05	1.62	1.41	22:35	0.071	00:05	0.103	0.089	0.089	0.06
12/02/2019	05:20	1.99	20:10	2.10	2.04	08:45	1.14	22:35	1.70	1.39	08:45	0.072	22:35	0.113	0.090	0.090	0.30
12/03/2019	22:30	2.06	03:40	2.10	2.08	05:15	1.20	09:50	1.76	1.49	05:15	0.080	09:50	0.116	0.099	0.099	0.01
12/04/2019	02:35	2.05	18:15	2.14	2.10	09:00	1.22	23:35	1.73	1.44	04:15	0.081	23:35	0.119	0.097	0.097	0.39
12/05/2019	22:45	2.10	03:30	2.14	2.12	19:50	1.23	03:00	1.71	1.49	19:50	0.083	03:00	0.118	0.102	0.102	0.01
12/06/2019	22:15	2.06	05:40	2.12	2.09	08:05	1.24	01:00	1.72	1.49	19:55	0.083	01:00	0.116	0.100	0.100	0.01
12/07/2019	03:45	2.06	22:45	2.17	2.09	16:10	1.20	08:55	1.70	1.46	16:10	0.080	08:55	0.113	0.098	0.098	0.67
12/08/2019	00:00	2.17	18:00	2.26	2.22	00:50	1.31	03:05	1.73	1.52	00:50	0.094	17:45	0.126	0.112	0.112	0.20
12/09/2019	23:30	2.17	00:15	2.25	2.22	19:10	1.35	17:25	1.81	1.55	18:35	0.097	17:25	0.131	0.113	0.113	
12/10/2019	23:00	2.13	00:10	2.20	2.16	21:00	1.29	17:35	1.82	1.55	23:15	0.089	02:05	0.128	0.109	0.109	
12/11/2019	16:20	2.11	04:55	2.16	2.14	18:15	1.27	01:50	1.77	1.53	18:15	0.088	01:50	0.123	0.106	0.106	0.03
12/12/2019	16:15	2.08	00:00	2.12	2.11	16:50	1.24	08:10	1.79	1.53	16:50	0.085	08:10	0.122	0.104	0.104	0.01
12/13/2019	22:00	2.07	03:15	2.12	2.10	21:15	1.24	18:25	1.75	1.53	21:15	0.083	20:20	0.118	0.103	0.103	0.01
12/14/2019	00:00	2.08	07:35	2.11	2.09	00:30	1.21	10:55	1.73	1.51	00:30	0.081	10:55	0.116	0.101	0.101	0.01
12/15/2019	03:30	2.07	00:00	2.10	2.09	12:30	1.26	02:10	1.74	1.51	12:30	0.084	02:10	0.117	0.101	0.101	0.01
12/16/2019	00:10	2.06	01:00	2.10	2.08	12:05	1.24	01:00	1.81	1.50	12:00	0.083	01:00	0.122	0.100	0.100	0.01
12/17/2019	00:05	2.06	06:15	2.09	2.07	08:35	1.26	23:55	1.82	1.50	08:35	0.083	23:55	0.120	0.099	0.099	0.01
12/18/2019	17:05	2.04	00:05	2.07	2.06	08:20	1.21	00:05	1.81	1.49	08:20	0.079	00:05	0.120	0.098	0.098	0.01
12/19/2019	20:10	2.02	03:50	2.06	2.05	23:20	1.16	07:55	1.72	1.49	23:20	0.075	03:50	0.113	0.097	0.097	
12/20/2019	02:05	2.03	03:10	2.06	2.04	20:20	1.22	23:35	1.72	1.48	20:20	0.079	23:35	0.111	0.096	0.096	
12/21/2019	17:25	2.02	06:15	2.07	2.04	14:05	1.18	21:55	1.75	1.49	14:05	0.077	21:55	0.113	0.097	0.097	0.01
12/22/2019	06:20	2.03	22:45	2.11	2.06	07:35	1.17	23:00	1.70	1.46	07:35	0.075	23:00	0.115	0.096	0.096	0.41
12/23/2019	19:00	2.08	13:00	2.13	2.10	08:40	1.29	13:50	1.82	1.51	08:40	0.087	13:50	0.124	0.102	0.102	
12/24/2019	14:50	2.07	00:55	2.10	2.08	02:35	1.28	18:10	1.74	1.51	02:35	0.086	15:30	0.115	0.101	0.101	0.02
12/25/2019	03:25	2.06	07:50	2.09	2.08	15:50	1.21	14:20	1.72	1.49	15:50	0.081	14:20	0.115	0.099	0.099	0.08
12/26/2019	19:20	2.03	01:35	2.08	2.05	17:45	1.24	04:25	1.74	1.50	17:45	0.081	04:25	0.115	0.098	0.098	
12/27/2019	20:55	2.01	01:45	2.05	2.03	08:00	1.19	14:25	1.67	1.44	08:00	0.077	14:25	0.108	0.093	0.093	
12/28/2019	23:30	2.00	01:55	2.04	2.02	20:45	1.19	03:00	1.68	1.43	20:45	0.076	03:50	0.108	0.092	0.092	
12/29/2019	01:10	2.01	23:40	2.07	2.03	06:10	1.17	20:25	1.72	1.41	06:10	0.074	20:25	0.111	0.091	0.091	0.22
12/30/2019	03:45	2.04	00:15	2.07	2.06	21:55	1.22	02:30	1.74	1.51	21:55	0.079	02:30	0.114	0.099	0.099	
12/31/2019	14:35	2.03	01:30	2.07	2.05	06:55	1.17	03:45	1.71	1.49	06:55	0.077	03:45	0.111	0.097	0.097	0.01

Date	Depth (in)				Velocity (ft/s)				Quantity (MGD - Total MG)					Rain (in)
	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Time	Min Time	Max	Avg	Total	Total
01/01/2020	11:50	2.02 00:05	2.06	2.04	03:15	1.19 13:25	1.77	1.45	03:15	0.077 13:25	0.114	0.094	0.094	
01/02/2020	03:15	2.01 00:45	2.04	2.03	22:15	1.16 18:20	1.68	1.44	22:15	0.074 18:20	0.107	0.092	0.092	
01/03/2020	21:15	1.99 00:20	2.03	2.01	22:50	1.19 21:50	1.78	1.43	22:50	0.075 21:50	0.113	0.091	0.091	
01/04/2020	10:10	1.98 00:00	2.01	2.00	00:15	1.20 02:30	1.75	1.41	17:05	0.075 02:30	0.109	0.088	0.088	
01/05/2020	10:00	1.97 01:05	2.00	1.99	15:55	1.13 00:25	1.67	1.37	15:55	0.071 00:25	0.104	0.085	0.085	
01/06/2020	19:40	1.97 01:20	2.00	1.99	00:30	1.13 07:45	1.60	1.38	00:30	0.071 07:45	0.100	0.086	0.086	
01/07/2020	16:30	1.97 04:15	2.01	1.99	18:45	1.18 16:15	1.70	1.41	18:45	0.073 16:15	0.106	0.088	0.088	
01/08/2020	07:20	1.96 00:30	1.99	1.98	07:55	1.10 00:15	1.60	1.37	07:55	0.067 00:15	0.099	0.085	0.085	0.02
01/09/2020	00:00	1.97 13:45	2.02	2.00	09:40	1.12 23:10	1.70	1.38	09:40	0.070 23:10	0.107	0.087	0.087	0.18
01/10/2020	21:00	1.99 09:25	2.03	2.01	18:25	1.14 11:30	1.71	1.43	18:25	0.073 11:30	0.109	0.091	0.091	0.02
01/11/2020	17:30	1.99 04:35	2.03	2.01	10:45	1.13 01:45	1.64	1.42	10:45	0.072 01:45	0.104	0.090	0.090	0.01
01/12/2020	21:35	1.98 01:10	2.02	2.00	20:25	1.16 18:15	1.70	1.40	20:25	0.072 18:15	0.106	0.088	0.088	
01/13/2020	00:45	1.98 05:25	2.01	1.99	02:45	1.12 23:30	1.64	1.40	02:45	0.070 23:30	0.101	0.088	0.088	0.02
01/14/2020	02:50	1.97 13:25	2.02	2.00	02:40	1.16 11:05	1.64	1.40	02:40	0.072 11:05	0.103	0.088	0.088	0.11
01/15/2020	01:10	2.01 12:05	2.04	2.02	15:45	1.18 06:45	1.69	1.43	15:45	0.075 06:45	0.107	0.091	0.091	0.07
01/16/2020	10:15	2.00 23:40	2.13	2.05	11:40	1.15 23:10	1.77	1.43	11:40	0.073 23:40	0.120	0.093	0.093	0.66
01/17/2020	00:00	2.12 11:55	2.17	2.15	03:15	1.30 17:05	1.77	1.52	03:15	0.090 17:05	0.124	0.106	0.106	
01/18/2020	20:00	2.11 00:30	2.16	2.14	02:50	1.28 21:40	1.78	1.54	04:30	0.089 01:20	0.123	0.107	0.107	
01/19/2020	11:20	2.10 03:20	2.14	2.12	07:20	1.30 17:55	1.78	1.54	07:20	0.088 18:25	0.121	0.105	0.105	
01/20/2020	17:55	2.07 00:00	2.11	2.09	13:45	1.21 10:40	1.77	1.50	13:45	0.081 10:40	0.118	0.101	0.101	
01/21/2020	16:20	2.04 00:00	2.09	2.07	18:25	1.24 03:40	1.76	1.52	18:25	0.082 03:40	0.116	0.100	0.100	
01/22/2020	01:50	2.04 03:55	2.07	2.05	01:10	1.21 13:00	1.71	1.48	01:10	0.079 13:00	0.113	0.097	0.097	0.03
01/23/2020	22:35	2.03 02:40	2.06	2.05	00:00	1.25 12:15	1.70	1.48	00:00	0.081 12:15	0.111	0.097	0.097	
01/24/2020	04:00	2.02 06:55	2.06	2.03	18:15	1.14 09:35	1.67	1.45	18:15	0.073 09:35	0.108	0.093	0.093	
01/25/2020	02:05	2.01 02:45	2.05	2.03	19:25	1.15 21:55	1.69	1.43	19:25	0.073 21:55	0.108	0.092	0.092	
01/26/2020	03:50	2.00 14:40	2.05	2.03	02:10	1.17 13:40	1.70	1.42	02:10	0.074 13:40	0.110	0.091	0.091	0.16
01/27/2020	10:35	2.02 03:55	2.05	2.04	09:00	1.22 20:25	1.68	1.45	09:00	0.078 20:25	0.109	0.094	0.094	
01/28/2020	03:15	2.02 00:45	2.05	2.03	04:05	1.16 06:15	1.69	1.43	04:05	0.075 06:15	0.108	0.092	0.092	0.01
01/29/2020	21:55	2.00 00:10	2.04	2.02	10:55	1.17 01:15	1.64	1.43	10:55	0.075 01:15	0.106	0.092	0.092	
01/30/2020	06:15	1.99 03:30	2.03	2.01	16:05	1.15 00:50	1.66	1.42	16:05	0.072 00:50	0.105	0.090	0.090	
01/31/2020	01:00	1.99 00:35	2.02	2.01	00:05	1.21 00:20	1.58	1.38	00:05	0.076 00:20	0.100	0.087	0.015	
02/01/2020														
02/02/2020														
02/03/2020														
02/04/2020														
02/05/2020	15:55	1.93 17:25	1.96	1.94	05:30	1.08 17:40	1.57	1.26	14:45	0.065 17:40	0.095	0.076	0.063	
02/06/2020	22:45	1.93 04:30	1.96	1.94	15:00	1.07 06:10	1.52	1.26	15:00	0.064 06:10	0.092	0.076	0.076	
02/07/2020	18:30	1.92 03:10	1.95	1.94	19:45	1.06 17:45	1.48	1.25	19:45	0.063 17:45	0.088	0.075	0.075	
02/08/2020	23:05	1.93 06:35	1.95	1.94	20:05	1.06 04:55	1.52	1.26	20:05	0.063 04:55	0.092	0.076	0.076	
02/09/2020	23:25	1.91 04:05	1.95	1.93	16:50	1.06 19:40	1.51	1.24	20:30	0.062 19:40	0.090	0.074	0.074	
02/10/2020	14:00	1.91 06:25	1.94	1.92	22:40	1.06 00:10	1.50	1.24	22:40	0.062 00:10	0.089	0.074	0.074	
02/11/2020	14:25	1.90 05:05	1.93	1.91	01:20	1.05 11:05	1.63	1.26	15:30	0.062 11:05	0.096	0.074	0.074	
02/12/2020	21:00	1.90 07:35	1.93	1.91	21:50	1.04 08:40	1.61	1.23	21:50	0.061 08:40	0.095	0.072	0.072	
02/13/2020	00:10	1.89 13:30	1.92	1.91	06:15	1.04 02:00	1.49	1.25	06:15	0.061 02:00	0.087	0.073	0.073	
02/14/2020	17:50	1.89 01:40	1.92	1.91	12:05	1.04 05:10	1.50	1.27	12:05	0.061 05:10	0.089	0.074	0.074	
02/15/2020	01:30	1.89 05:15	1.93	1.91	06:35	1.05 19:50	1.54	1.26	11:00	0.062 19:55	0.091	0.074	0.074	
02/16/2020	00:45	1.90 04:25	1.93	1.92	00:50	1.05 00:40	1.51	1.24	00:50	0.061 11:25	0.089	0.074	0.074	
02/17/2020	21:50	1.92 06:05	1.95	1.93	19:25	1.06 11:00	1.54	1.24	19:25	0.063 11:00	0.092	0.074	0.074	
02/18/2020	23:45	1.92 04:35	1.95	1.93	23:50	1.05 20:40	1.49	1.24	23:50	0.062 20:40	0.089	0.074	0.074	
02/19/2020	00:00	1.92 06:50	1.94	1.93	19:30	1.05 05:00	1.55	1.24	19:30	0.063 05:00	0.093	0.074	0.074	
02/20/2020	17:45	1.92 04:35	1.95	1.94	19:05	1.06 01:05	1.52	1.26	19:05	0.064 01:05	0.091	0.076	0.076	
02/21/2020	00:00	1.93 14:25	1.96	1.94	16:15	1.07 04:40	1.58	1.25	21:05	0.064 04:40	0.096	0.076	0.076	
02/22/2020	21:35	1.91 03:45	1.96	1.93	17:50	1.05 10:00	1.52	1.26	17:50	0.062 10:00	0.091	0.076	0.076	
02/23/2020	00:10	1.92 03:25	1.94	1.93	15:55	1.05 13:10	1.54	1.24	15:55	0.062 13:10	0.092	0.074	0.074	
02/24/2020	01:05	1.93 12:10	1.95	1.94	21:45	1.06 09:25	1.54	1.25	21:45	0.064 09:25	0.093	0.075	0.075	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020	22:10	1.92	05:15	1.96	1.94	20:20	1.06	01:50	1.52	1.29	20:05	0.063	03:05	0.092	0.077	0.077	
02/26/2020	14:25	1.92	00:55	1.95	1.93	10:00	1.06	15:15	1.53	1.26	10:00	0.064	15:15	0.091	0.075	0.075	
02/27/2020	18:45	1.92	05:50	1.96	1.93	19:40	1.06	17:20	1.48	1.27	19:40	0.063	08:50	0.089	0.076	0.076	
02/28/2020	20:55	1.91	02:40	1.95	1.93	17:55	1.06	03:20	1.49	1.25	16:55	0.063	03:20	0.090	0.074	0.074	
02/29/2020	22:10	1.90	07:20	1.94	1.92	01:05	1.06	23:40	1.51	1.26	22:05	0.063	23:45	0.089	0.075	0.075	
03/01/2020	20:20	1.89	04:15	1.93	1.92	15:10	1.05	02:55	1.51	1.25	15:10	0.062	02:55	0.090	0.074	0.074	
03/02/2020	18:30	1.88	05:00	1.92	1.90	12:45	1.04	08:25	1.58	1.29	12:45	0.061	08:25	0.093	0.075	0.075	
03/03/2020	20:15	1.87	04:45	1.91	1.89	14:35	1.08	18:20	1.50	1.28	14:35	0.062	01:10	0.087	0.074	0.074	
03/04/2020	22:00	1.87	06:15	1.90	1.89	18:45	1.03	01:50	1.52	1.26	18:45	0.059	01:50	0.088	0.073	0.073	
03/05/2020	11:00	1.88	14:50	1.90	1.89	07:05	1.05	02:35	1.55	1.28	07:05	0.061	02:35	0.090	0.074	0.074	
03/06/2020	18:05	1.88	05:20	1.91	1.90	05:10	1.06	05:05	1.59	1.31	05:10	0.062	05:05	0.093	0.076	0.076	
03/07/2020	00:35	1.88	23:25	1.96	1.92	11:00	1.05	08:05	1.53	1.29	11:00	0.062	08:05	0.090	0.076	0.076	
03/08/2020	01:15	1.95	15:25	1.98	1.97	01:10	1.08	16:40	1.54	1.28	01:10	0.065	16:40	0.094	0.079	0.079	
03/09/2020	21:35	1.95	08:20	1.98	1.97	09:45	1.09	12:40	1.60	1.26	09:45	0.067	12:40	0.099	0.077	0.077	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			9.571	4.90
Avg	1.99	1.38	0.087	

Rainfall data

MIL_RG01	
Rain Collector Dimensions	8"

The rainfall measured at MIL_RG01 from November 16, 2019 to March 09, 2020 is 4.90 inches.

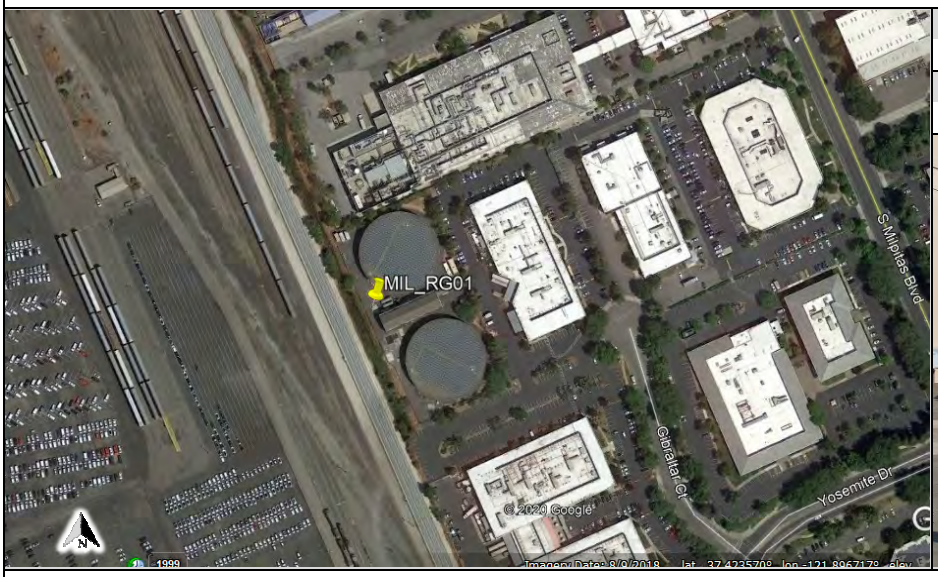
Milpitas Temp Study 2019-20

Flow Monitoring Site Report

Site Name

MIL_RG01

Site Address /Location:	641 Gibraltar Court, Milpitas, CA			Monitor Series: Rain Alert III	Location Type: Temporary
Site Access Details:	DRIVE.	Latitude:	37.423469°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.898106°		



Manhole #	System Characteristics
	Commercial
Access	**Traffic**
Drive	Light







Installation Information

Installation Date:	Installation Type:
Friday, November 15, 2019	Rain Gauge
Monitoring Location (Sensors):	Monitor Location:
Field	Building
Sensors / Devices:	Pressure Sensor Range (psi)
Rain Gauge Tipping Bucket	

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	
Peak Velocity (fps)	Velocity Sensor Offset (in)
	0''
Silt (in)	Silt Type
0.0"	

Hydraulic Comments:

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Active Drop Connections	Air Quality:
	Normal
Pipe Material	Pipe Condition:
Concrete	

Communication Information:

Communication Type	Antenna Location
Wireless	

Additional Site Info. / Comments:

Need key to access.

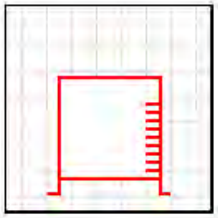
ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

HYDROGRAPH REPORT

MIL_RG01

Rain Gauge

MIL_RG01

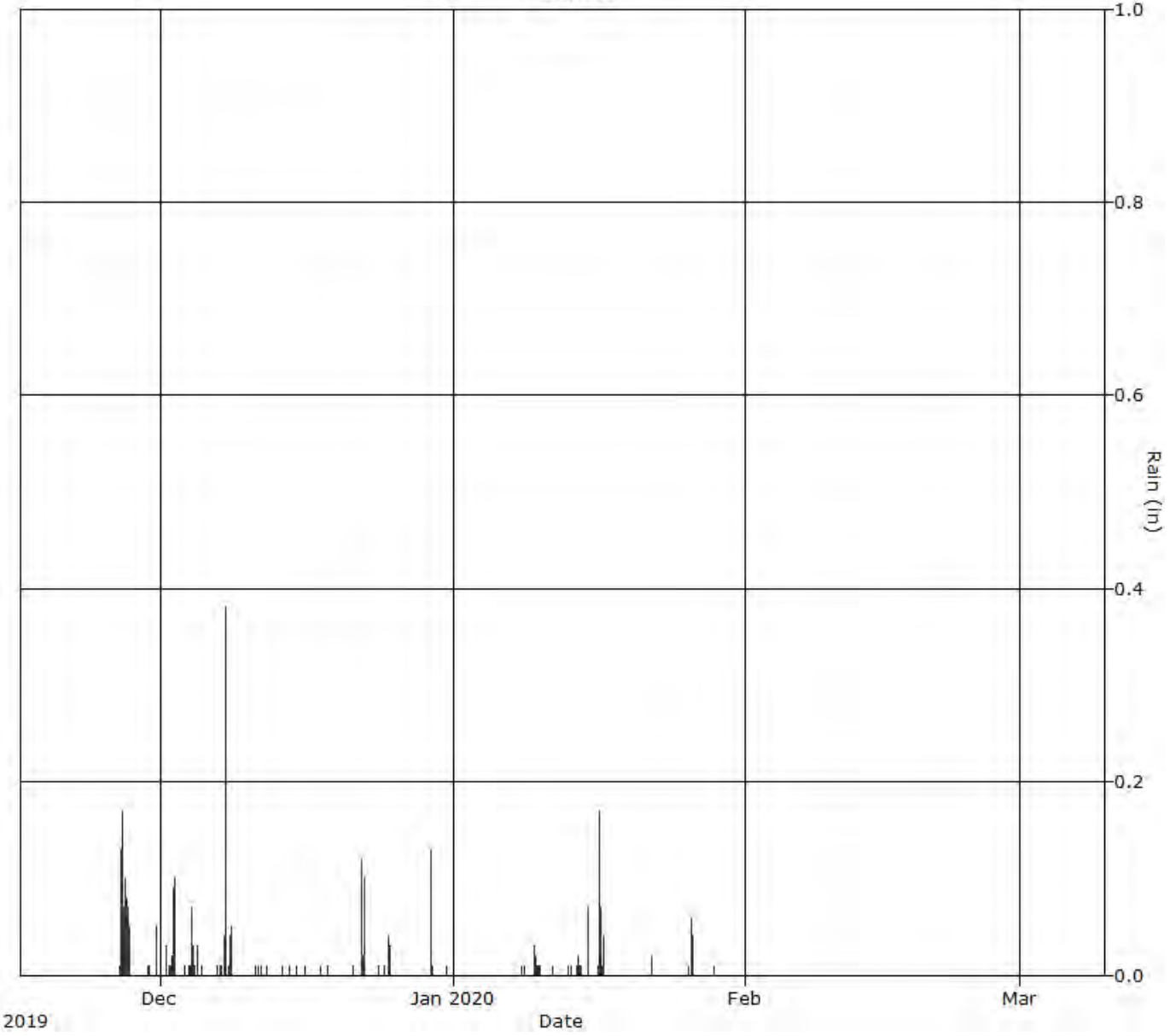


Report Period

11/16/2019
To
3/9/2020

Legend

Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019																	
11/17/2019																	
11/18/2019																	
11/19/2019																	
11/20/2019																	
11/21/2019																	
11/22/2019																	
11/23/2019																	
11/24/2019																	
11/25/2019																	
11/26/2019																	0.36
11/27/2019																	0.63
11/28/2019																	
11/29/2019																	0.02
11/30/2019																	0.10
12/01/2019																	0.06
12/02/2019																	0.30
12/03/2019																	0.01
12/04/2019																	0.39
12/05/2019																	0.01
12/06/2019																	0.01
12/07/2019																	0.67
12/08/2019																	0.20
12/09/2019																	
12/10/2019																	
12/11/2019																	0.03
12/12/2019																	0.01
12/13/2019																	0.01
12/14/2019																	0.01
12/15/2019																	0.01
12/16/2019																	0.01
12/17/2019																	0.01
12/18/2019																	0.01
12/19/2019																	
12/20/2019																	
12/21/2019																	0.01
12/22/2019																	0.41
12/23/2019																	
12/24/2019																	0.02
12/25/2019																	0.08
12/26/2019																	
12/27/2019																	
12/28/2019																	
12/29/2019																	0.22
12/30/2019																	
12/31/2019																	0.01

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/01/2020																	
01/02/2020																	
01/03/2020																	
01/04/2020																	
01/05/2020																	
01/06/2020																	
01/07/2020																	
01/08/2020																	0.02
01/09/2020																	0.18
01/10/2020																	0.02
01/11/2020																	0.01
01/12/2020																	
01/13/2020																	0.02
01/14/2020																	0.11
01/15/2020																	0.07
01/16/2020																	0.66
01/17/2020																	
01/18/2020																	
01/19/2020																	
01/20/2020																	
01/21/2020																	
01/22/2020																	0.03
01/23/2020																	
01/24/2020																	
01/25/2020																	
01/26/2020																	0.16
01/27/2020																	
01/28/2020																	0.01
01/29/2020																	
01/30/2020																	
01/31/2020																	
02/01/2020																	
02/02/2020																	
02/03/2020																	
02/04/2020																	
02/05/2020																	
02/06/2020																	
02/07/2020																	
02/08/2020																	
02/09/2020																	
02/10/2020																	
02/11/2020																	
02/12/2020																	
02/13/2020																	
02/14/2020																	
02/15/2020																	
02/16/2020																	
02/17/2020																	
02/18/2020																	
02/19/2020																	
02/20/2020																	
02/21/2020																	
02/22/2020																	
02/23/2020																	
02/24/2020																	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020																	
02/26/2020																	
02/27/2020																	
02/28/2020																	
02/29/2020																	
03/01/2020																	
03/02/2020																	
03/03/2020																	
03/04/2020																	
03/05/2020																	
03/06/2020																	
03/07/2020																	
03/08/2020																	
03/09/2020																	

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Rain (in)
Total	4.90
Avg	

Rainfall data

MIL_RG02	
Rain Collector Dimensions	8"

The rainfall measured at MIL_RG02 from November 16, 2019 to March 09, 2020 is 5.26 inches.

Milpitas Temp Study 2019-20

Flow Monitoring Site Report

ADS ENVIRONMENTAL SERVICES®

Site Name

MIL_RG02

Site Address /Location:	1328 Tularcitos Drive, Milpitas, CA			Monitor Series	Location Type
				Rain Alert III	Temporary
Site Access Details:	DRIVE.	Latitude:	37.455939°	Pipe Size (H x W)	Pipe Shape
		Longitude:	-121.875253°		



Manhole #	System Characteristics
	Commercial
Access	Traffic
Drive	Light







Installation Information

Installation Date:	Installation Type:
Friday, November 15, 2019	Rain Gauge
Monitoring Location (Sensors):	Monitor Location:
Field	Building
Sensors / Devices:	Pressure Sensor Range (psi)
Rain Gauge Tipping Bucket	

Installation Confirmation:

Confirmation Time:	Pipe Size (HxW)
1:30:00 AM	
Depth of Flow (Wet DOF) (in)	Range (Air DOF) (in)
Downlooker Physical Offset (in)	Measurement Confidence (in)
NA	
Peak Velocity (fps)	Velocity Sensor Offset (in)
	0''
Silt (in)	Silt Type
0.0"	

Hydraulic Comments:

Manhole / Pipe Information:

Manhole Depth (Approx. FT):	Manhole Configuration
	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
26''	54''
Manhole Cover	Manhole Frame
Active Drop Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	

Communication Information:

Communication Type	Antenna Location
Wireless	

Additional Site Info. / Comments:

Tularcitos Pump Station. Needs passcode and key.

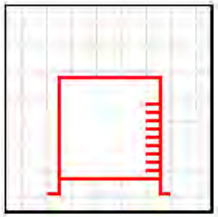
ADS Project Name:	Milpitas.WWTFM.CA2019-2020
ADS Project Number:	22431.11.325

HYDROGRAPH REPORT

MIL_RG02

Rain Gauge

MIL_RG02

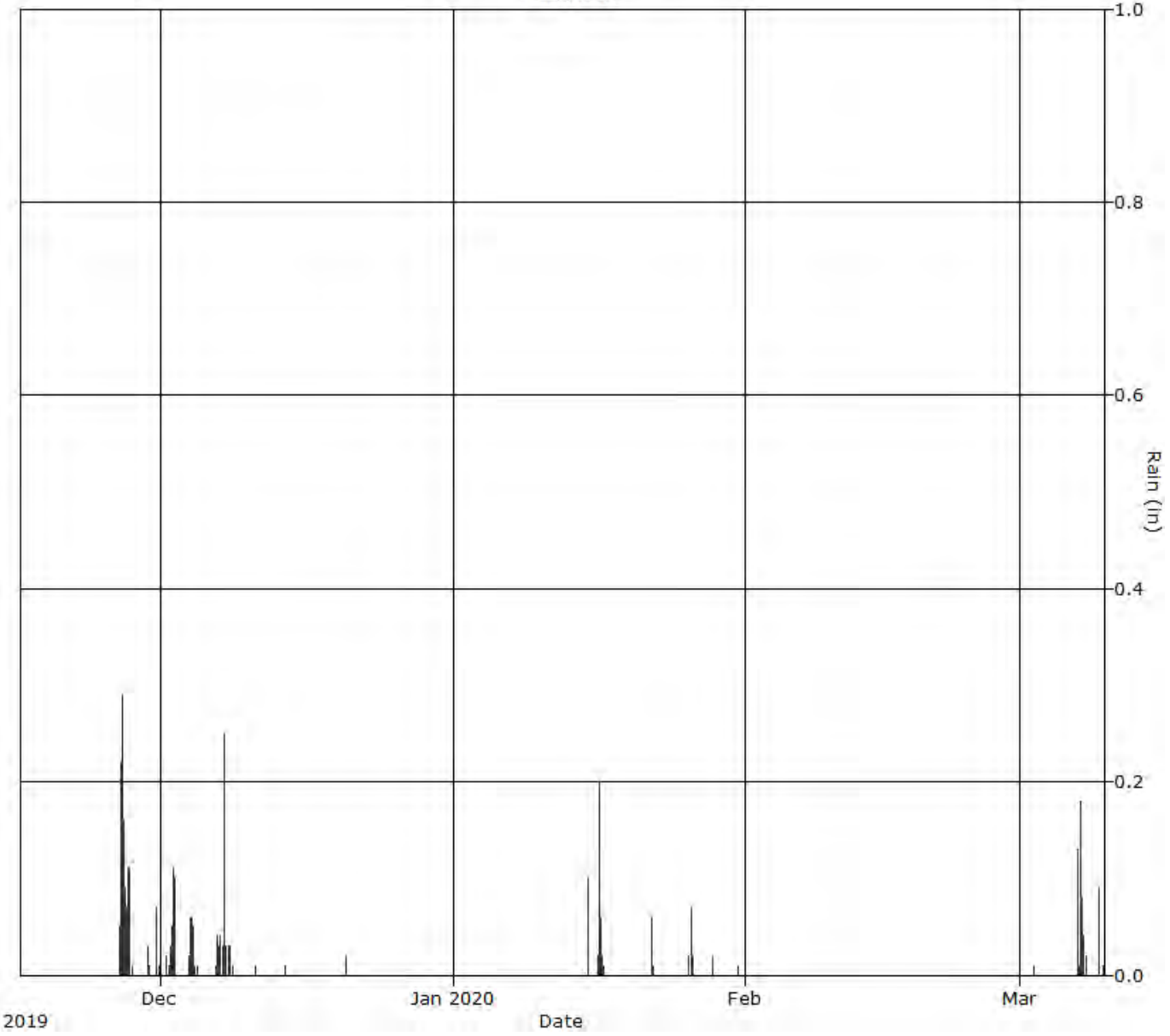


Report Period

11/16/2019
To
3/9/2020

Legend

Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
11/16/2019																	
11/17/2019																	
11/18/2019																	
11/19/2019																	
11/20/2019																	
11/21/2019																	
11/22/2019																	
11/23/2019																	
11/24/2019																	
11/25/2019																	
11/26/2019																	0.63
11/27/2019																	0.77
11/28/2019																	
11/29/2019																	0.05
11/30/2019																	0.14
12/01/2019																	0.06
12/02/2019																	0.36
12/03/2019																	
12/04/2019																	0.44
12/05/2019																	
12/06/2019																	0.06
12/07/2019																	0.84
12/08/2019																	0.10
12/09/2019																	
12/10/2019																	0.01
12/11/2019																	0.00
12/12/2019																	
12/13/2019																	
12/14/2019																	0.01
12/15/2019																	
12/16/2019																	
12/17/2019																	
12/18/2019																	
12/19/2019																	
12/20/2019																	0.02
12/21/2019																	
12/22/2019																	
12/23/2019																	
12/24/2019																	
12/25/2019																	
12/26/2019																	
12/27/2019																	
12/28/2019																	
12/29/2019																	
12/30/2019																	
12/31/2019																	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/01/2020																	
01/02/2020																	
01/03/2020																	
01/04/2020																	
01/05/2020																	
01/06/2020																	
01/07/2020																	
01/08/2020																	
01/09/2020																	
01/10/2020																	
01/11/2020																	
01/12/2020																	
01/13/2020																	
01/14/2020																	
01/15/2020																	0.10
01/16/2020																	0.66
01/17/2020																	
01/18/2020																	
01/19/2020																	
01/20/2020																	
01/21/2020																	0.01
01/22/2020																	0.09
01/23/2020																	
01/24/2020																	
01/25/2020																	
01/26/2020																	0.16
01/27/2020																	
01/28/2020																	0.02
01/29/2020																	
01/30/2020																	
01/31/2020																	0.01
02/01/2020																	
02/02/2020																	
02/03/2020																	
02/04/2020																	
02/05/2020																	
02/06/2020																	
02/07/2020																	
02/08/2020																	
02/09/2020																	
02/10/2020																	
02/11/2020																	
02/12/2020																	
02/13/2020																	
02/14/2020																	
02/15/2020																	
02/16/2020																	
02/17/2020																	
02/18/2020																	
02/19/2020																	
02/20/2020																	
02/21/2020																	
02/22/2020																	
02/23/2020																	
02/24/2020																	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
02/25/2020																	
02/26/2020																	
02/27/2020																	
02/28/2020																	
02/29/2020																	
03/01/2020																	
03/02/2020																	0.01
03/03/2020																	
03/04/2020																	
03/05/2020																	
03/06/2020																	
03/07/2020																	0.58
03/08/2020																	0.02
03/09/2020																	0.11

Report Summary For The Period 11/16/2019 00:00 - 03/09/2020 23:59

	Rain (in)
Total	5.26
Avg	

APPENDIX C

City of Milpitas
Sewer Master Plan Study
Summary of GIS Updates

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GIS Updates

The City provided their most up-to-date records of the wastewater collection system as an ArcGIS geodatabase (GIS) as well as a hard-drive containing most of the record drawings on file. The GIS had not been updated with any recent CIP projects implemented since the last model update in 2009. The City also provided a spreadsheet listing all of the record drawings and designating them as one of the following seven categories:

1. Category 1: Pre-2002, DWG # is not referenced on GIS, plat sheet # has been identified;
2. Category 2: Pre-2002, DWG # is referenced on GIS, plat sheet # has not been identified;
3. Category 3: Pre-2002, DWG # is not referenced on GIS, plat sheet # has not been identified;
4. Category 4: Post-2002, DWG # is referenced on GIS, plat sheet # has not been identified;
5. Category 5: Post-2002, DWG # is referenced on GIS, plat sheet # has been identified;
6. Category 6: Post-2002, DWG # is not referenced on GIS, plat sheet # has been identified, alignment not drawn in GIS; and
7. Category 7: Post-2002, No utility improvements but existing utilities shown on plan for reference.

Based on these categories, the following drawing reviews were completed to update the GIS:

1. All category 1, 4, and 5 record drawings, along with many category 2 record drawings, were reviewed and updates were made where there was missing information;
2. All available category 3 record drawings were reviewed, but none of the available drawings had any sanitary sewer pipe information;
3. All category 6 record drawings were reviewed and new alignments were added;
4. Benchmark and/or datum information found on each reviewed drawing was recorded or it was noted if there was no information.

Based on the review of the abovementioned record drawings, the following information was added to or updated in the GIS:

1. Pipe GIS updates:
    - Material, diameter, upstream and downstream invert elevations, measured length, slope, year built, and drawing number were updated where information was found in the set of available record drawings;
    - The actual length was also calculated using one dimensional horizontal distance calculator in ArcGIS once all updates were complete;
    - Where siphons are located throughout the system, “siphon” was listed in the “slope” field;
    - All existing pipe segments with the material “High Density Polyurethane” were changed to “HDPE” for consistency with the rest of the system;
    - In cases where the pipe material was not specified on the drawing, but it was listed in the notes that all sanitary sewer pipes on this drawing should be, for example, “VCP or ABS or other approved material,” the material was listed as “VCP/ABS”;
    - Where the material was listed as “SS” or “SSP” and no material was listed in the record drawings, these were left as “SS” or “SSP.” When referring to pipe material, these

acronyms often represent stainless steel pipe; however, for a gravity collection system, it is assumed that these are simply to indicate that the pipelines are “sanitary sewer” and are not a representation of the pipe material;

- An attribute column titled “HSE_NOTES” was added for tracking notes and edits made to the pipeline GIS file. Notes were standardized to the extent possible for streamlined sorting. Notes indicated in that column include the following:
  - If a drawing indicated that a liner was added to an existing pipe or the pipe was rehabilitated, the year built was updated to indicate the year the liner was added or the rehab was completed, and “UPDT_YR(NEWLINER)” or “UPDT_YR(REHAB)” was added;
  - Abandoned pipes were labeled “ABANDONED”;
  - New pipes were labeled “ADDED_SEGMENT”;
  - Pipes that were already in GIS but were indicated as private on record drawings were labeled “PRIVATE”;

2. Manhole GIS updates:
   - Rim elevation, year of installation, and drawing number were updated where available;
   - Manhole invert elevations were not typically available on record drawings and were not prioritized;
   - An attribute column titled “HSE_NOTES” was also added for tracking notes and edits made to the manhole GIS file. Notes indicated in that column include the following:
     - Abandoned and floating manholes were labeled “ABANDONED” or “DISCONNECTED,” respectively;
     - New manholes were labeled “ADDED_MH”;
3. Two of the fields included in the attributes table for both the pipeline and manhole GIS files are DRAWINGNO (drawing number) and UPDTSRC (update source). The DRAWINGNO was reserved for the original utility construction drawing. The UPDTSRC field indicated the drawing number for updates made during our review and generally referred to record drawings of new facilities that might show the facility as “existing.”

During the GIS update process, the update of model information for areas containing either flow splits or where critical information, such as pipe diameter, material, invert elevations, and year built, was missing was prioritized.

APPENDIX D

City of Milpitas
Sewer Master Plan Study
Dry Weather Calibration Charts

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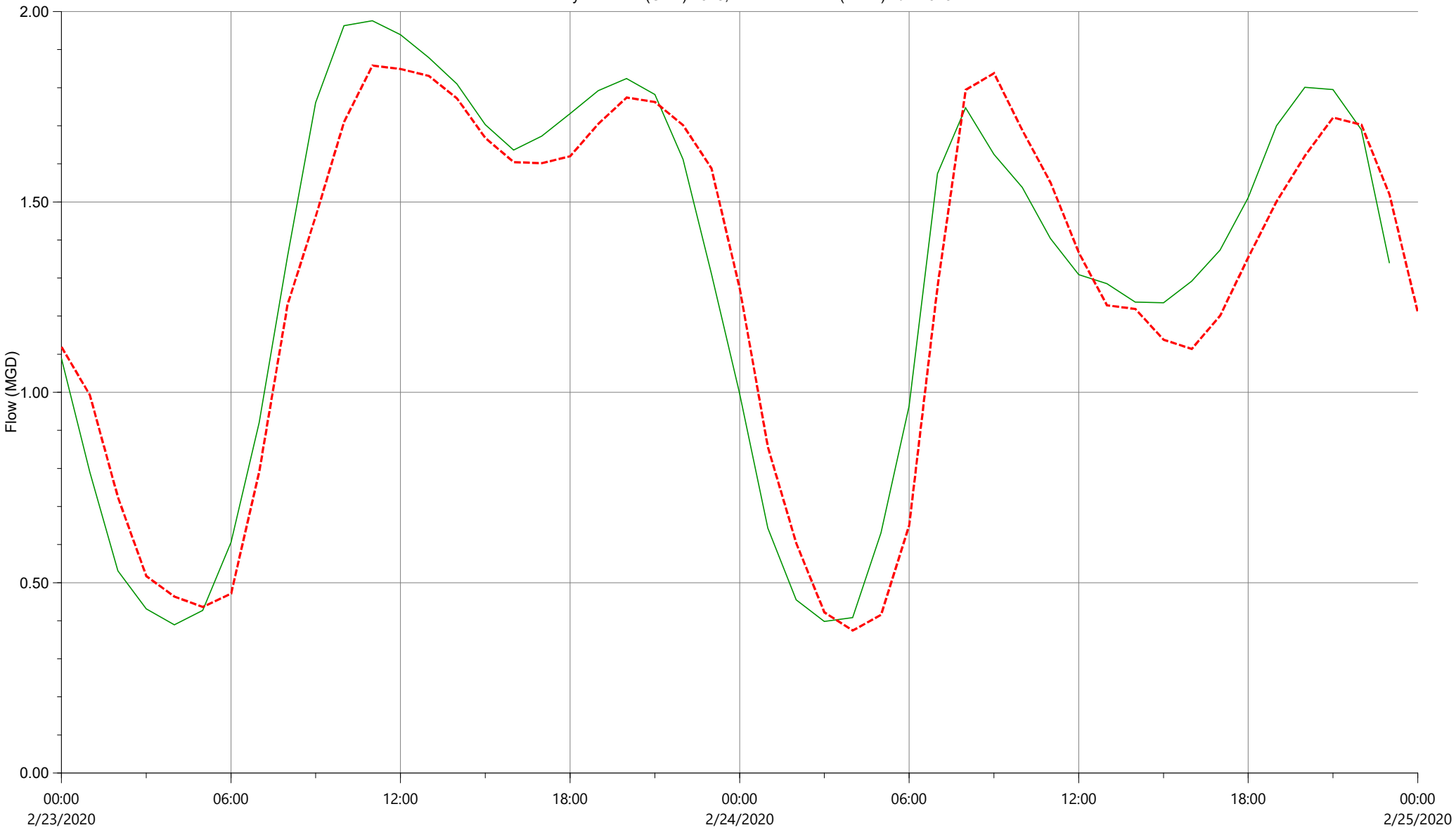
Flow Survey Location (Obs.) 1043, Model Location (Pred.) D/S 1043.1

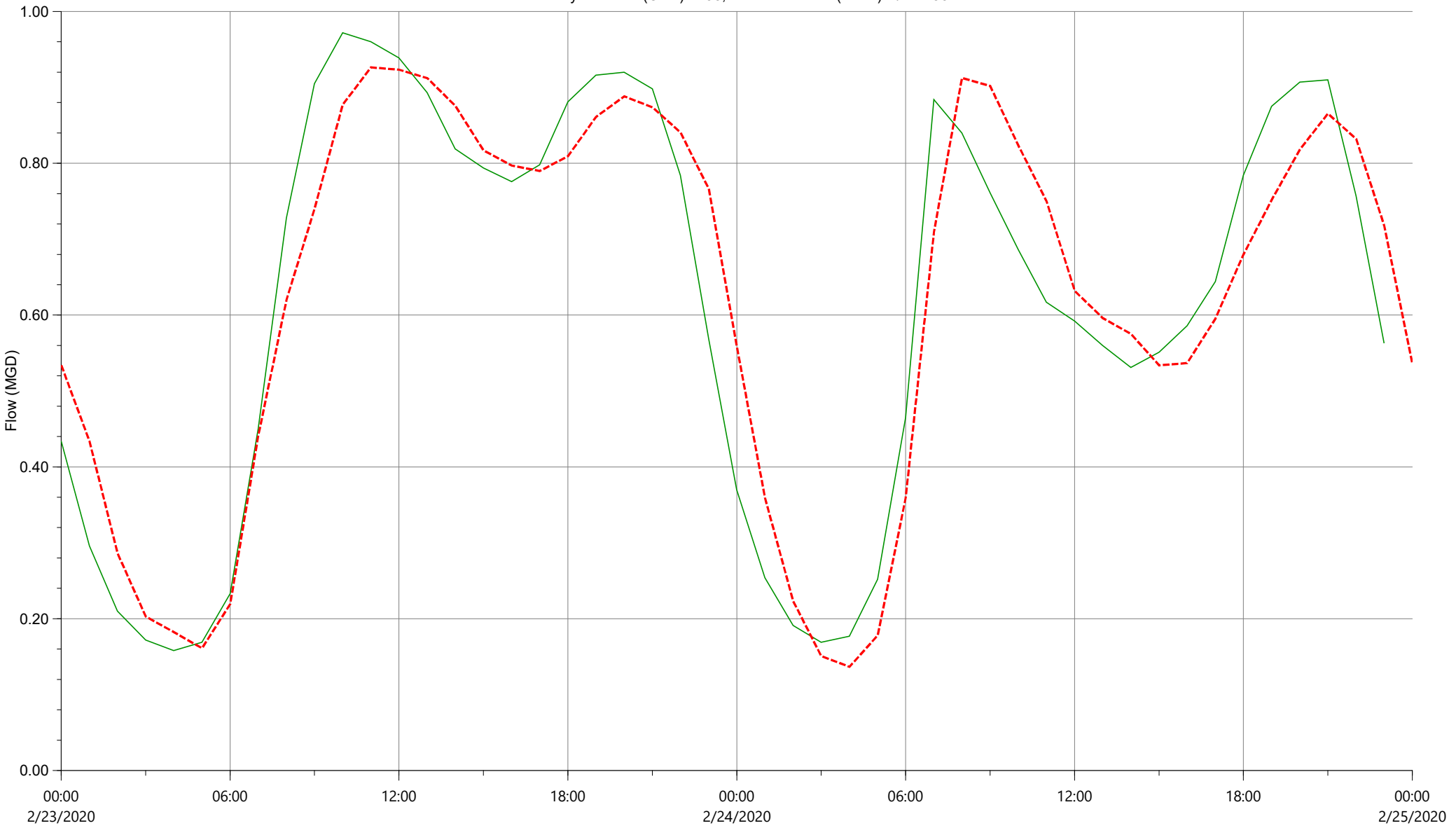


	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.389	1.976	2.570
Model	0.374	1.858	2.572

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 1193, Model Location (Pred.) D/S 1193.1

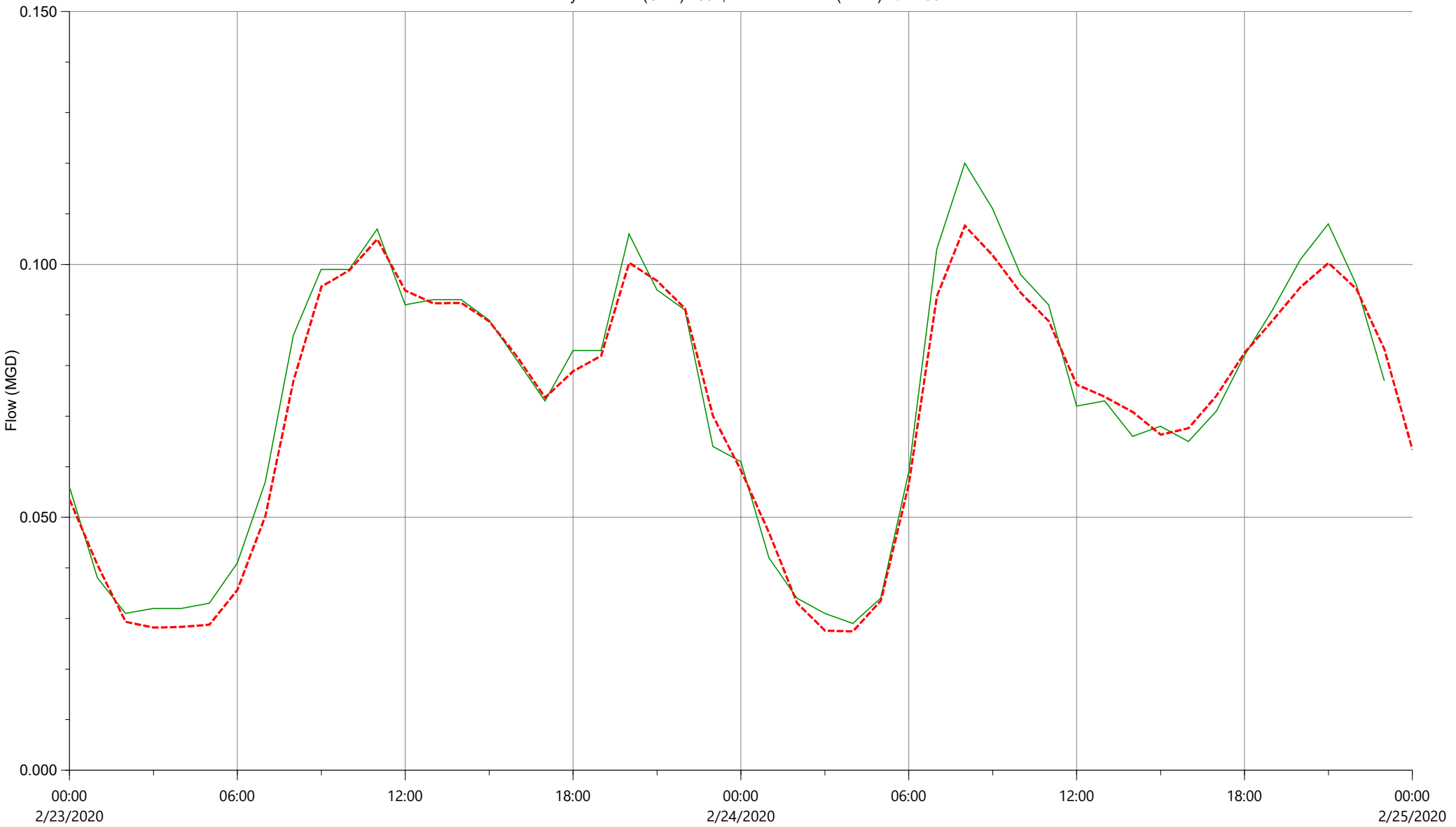


	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.158	0.972	1.213
Model	0.137	0.926	1.249

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 1564, Model Location (Pred.) D/S 1564.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.029	0.120	0.145
Model	0.027	0.108	0.144

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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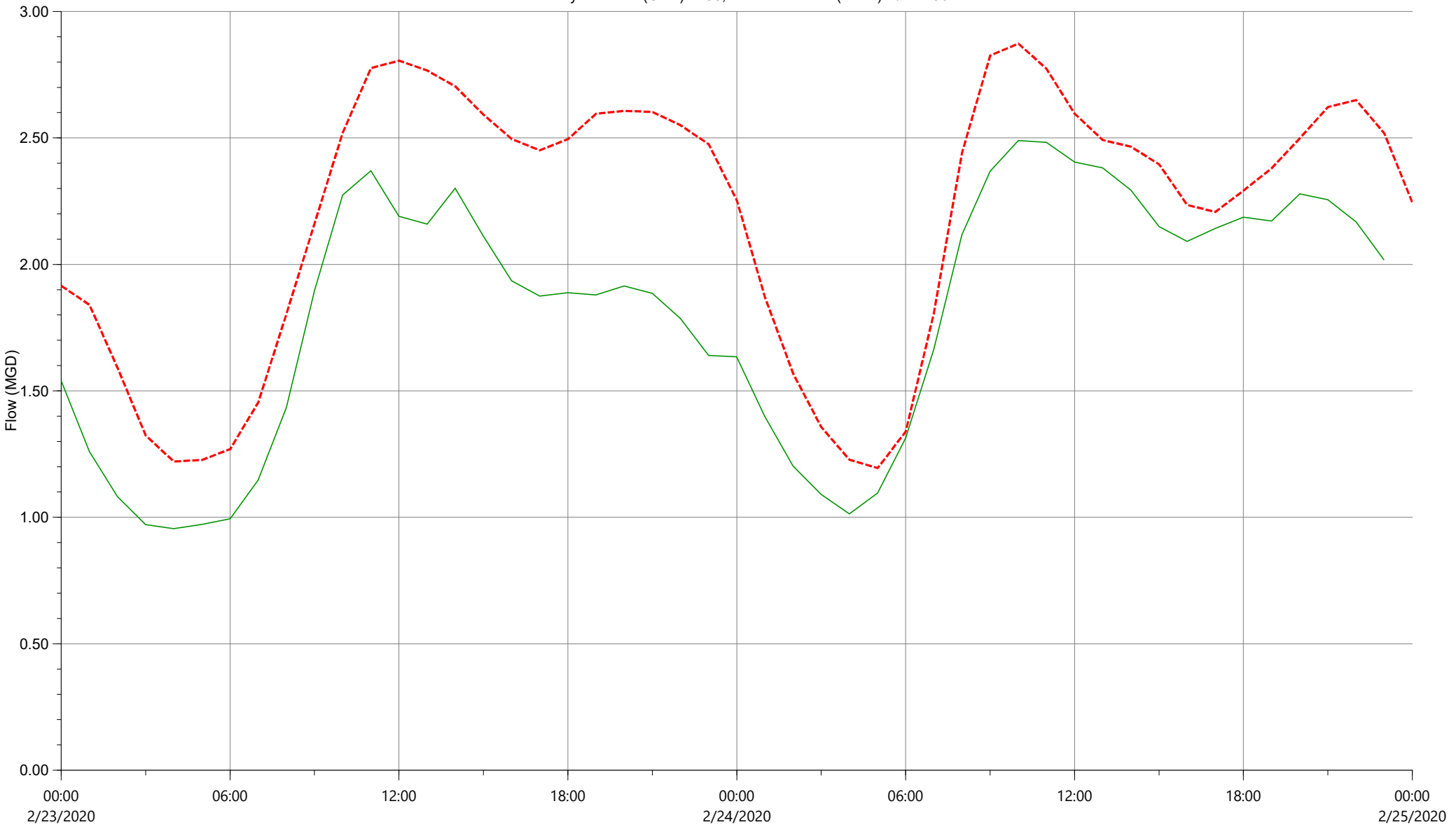
Flow Survey Location (Obs.) 1790, Model Location (Pred.) D/S 1790.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.955	2.490	3.546
Model	1.196	2.874	4.388

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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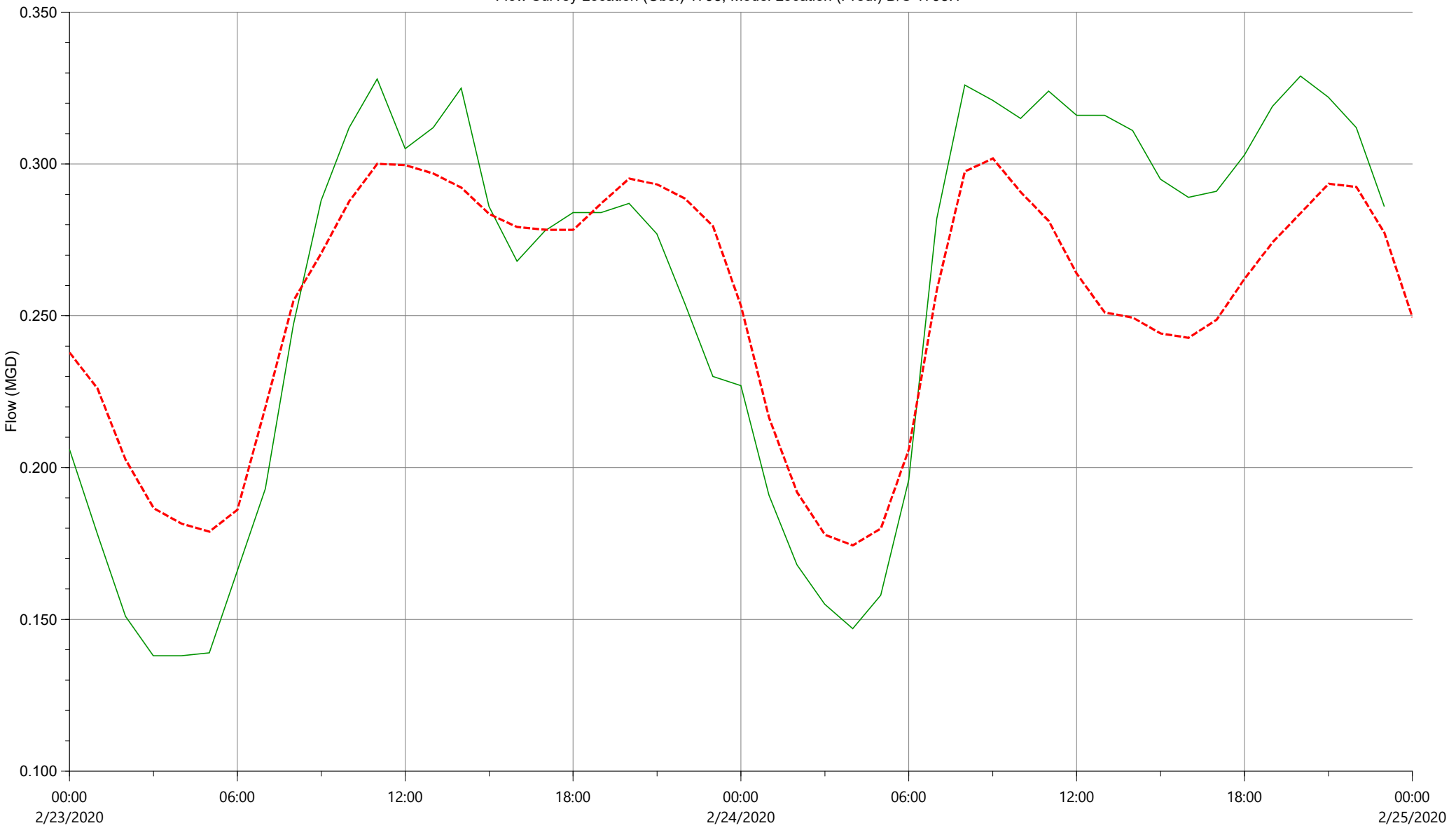
Flow Survey Location (Obs.) 1795, Model Location (Pred.) D/S 1795.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.138	0.329	0.505
Model	0.174	0.302	0.509

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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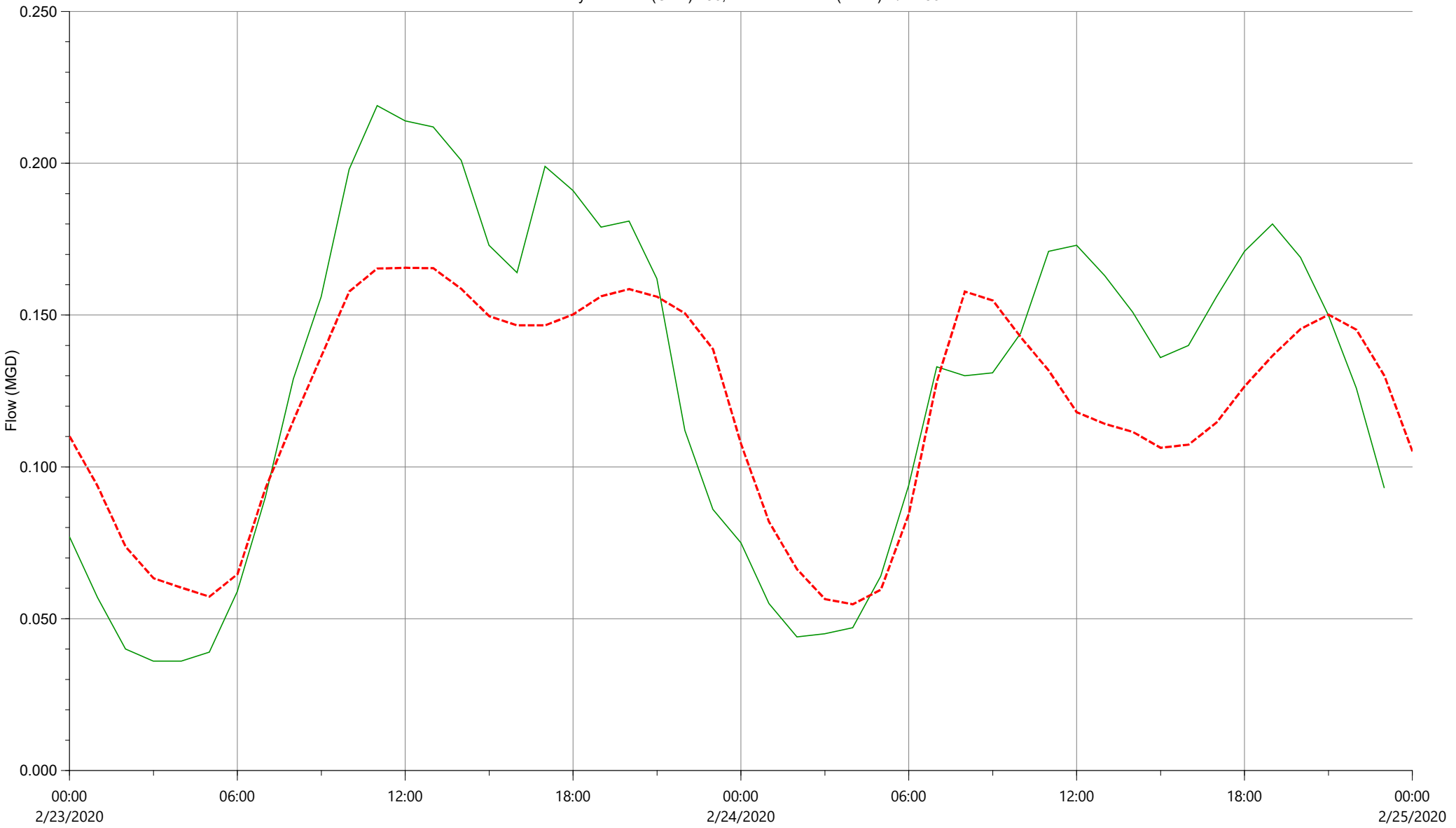
Flow Survey Location (Obs.) 186, Model Location (Pred.) D/S 186.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.036	0.219	0.253
Model	0.055	0.166	0.240

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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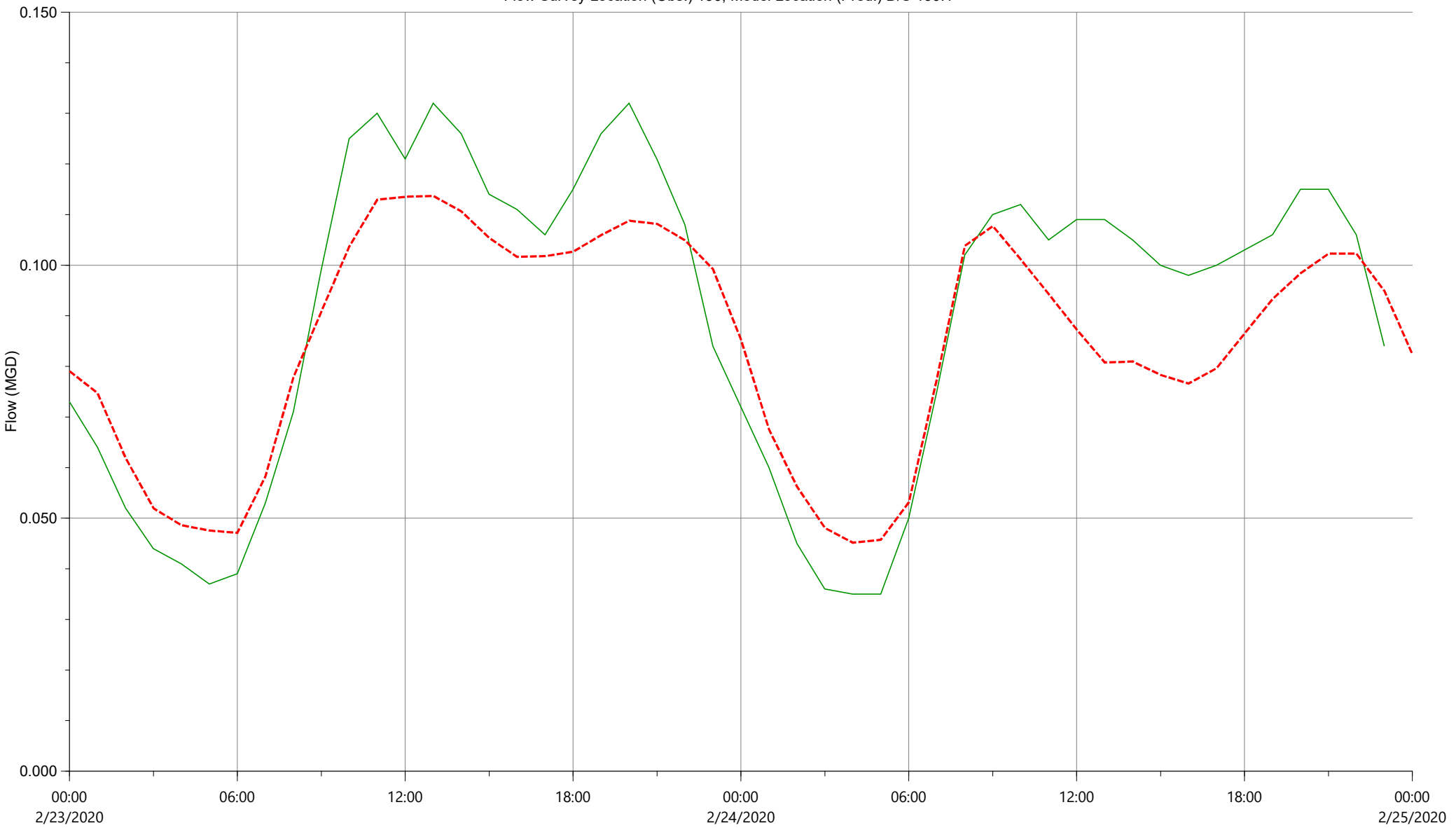
Flow Survey Location (Obs.) 190, Model Location (Pred.) D/S 190.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.035	0.132	0.176
Model	0.045	0.114	0.170

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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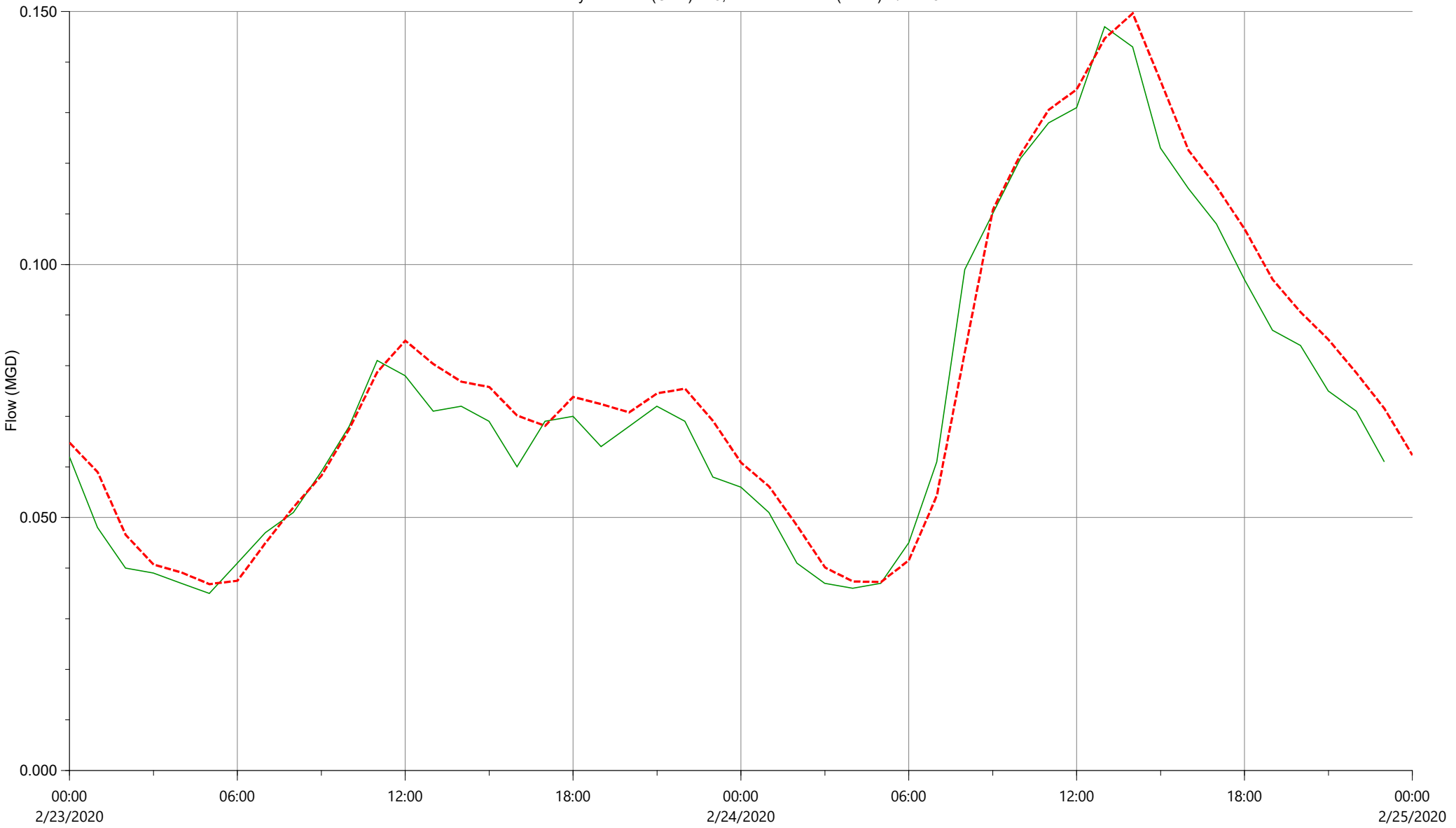
Flow Survey Location (Obs.) 229, Model Location (Pred.) D/S 229.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.035	0.147	0.143
Model	0.037	0.150	0.153

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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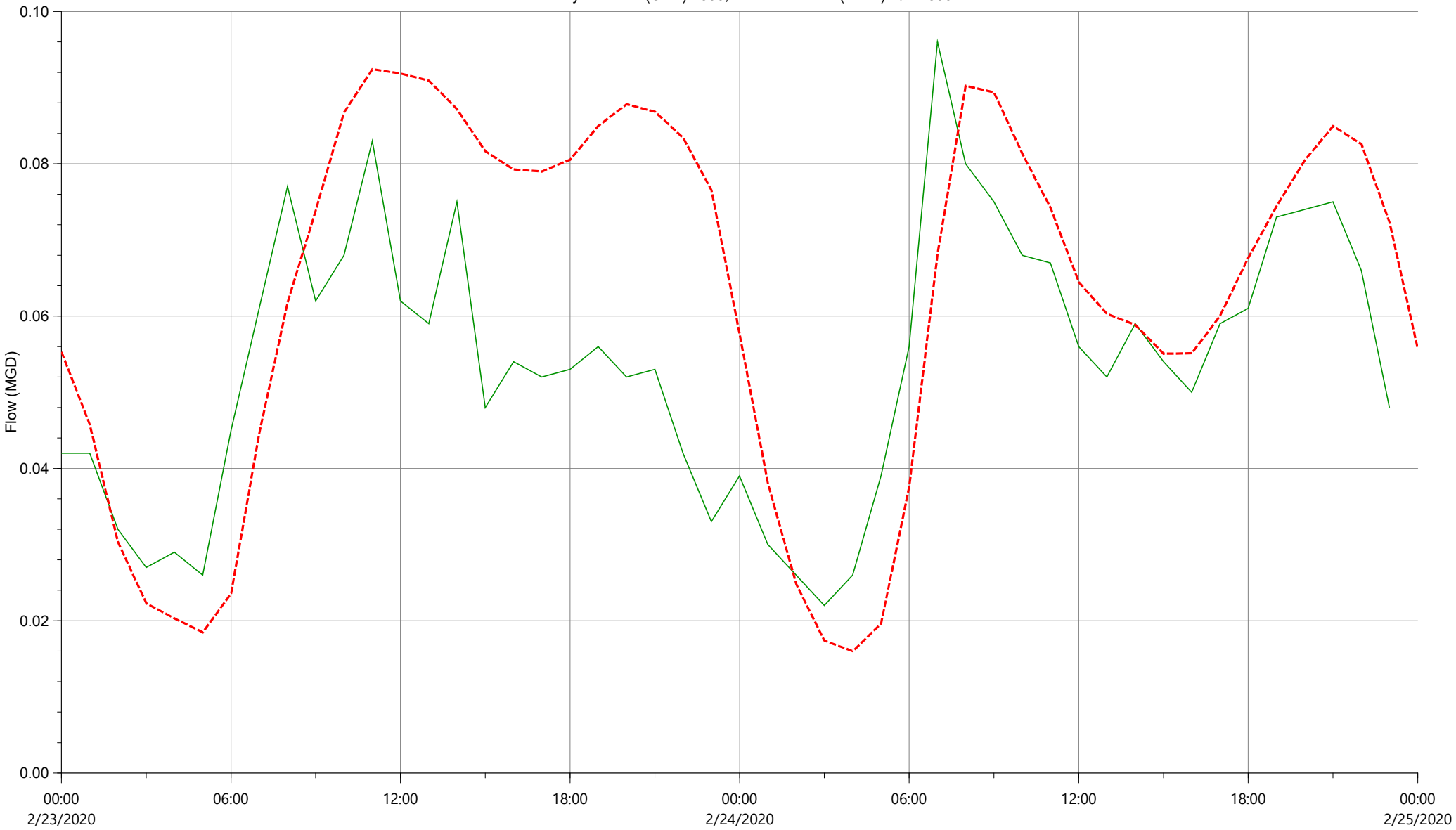
Flow Survey Location (Obs.) 2300, Model Location (Pred.) D/S 2300.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.022	0.096	0.106
Model	0.016	0.092	0.126

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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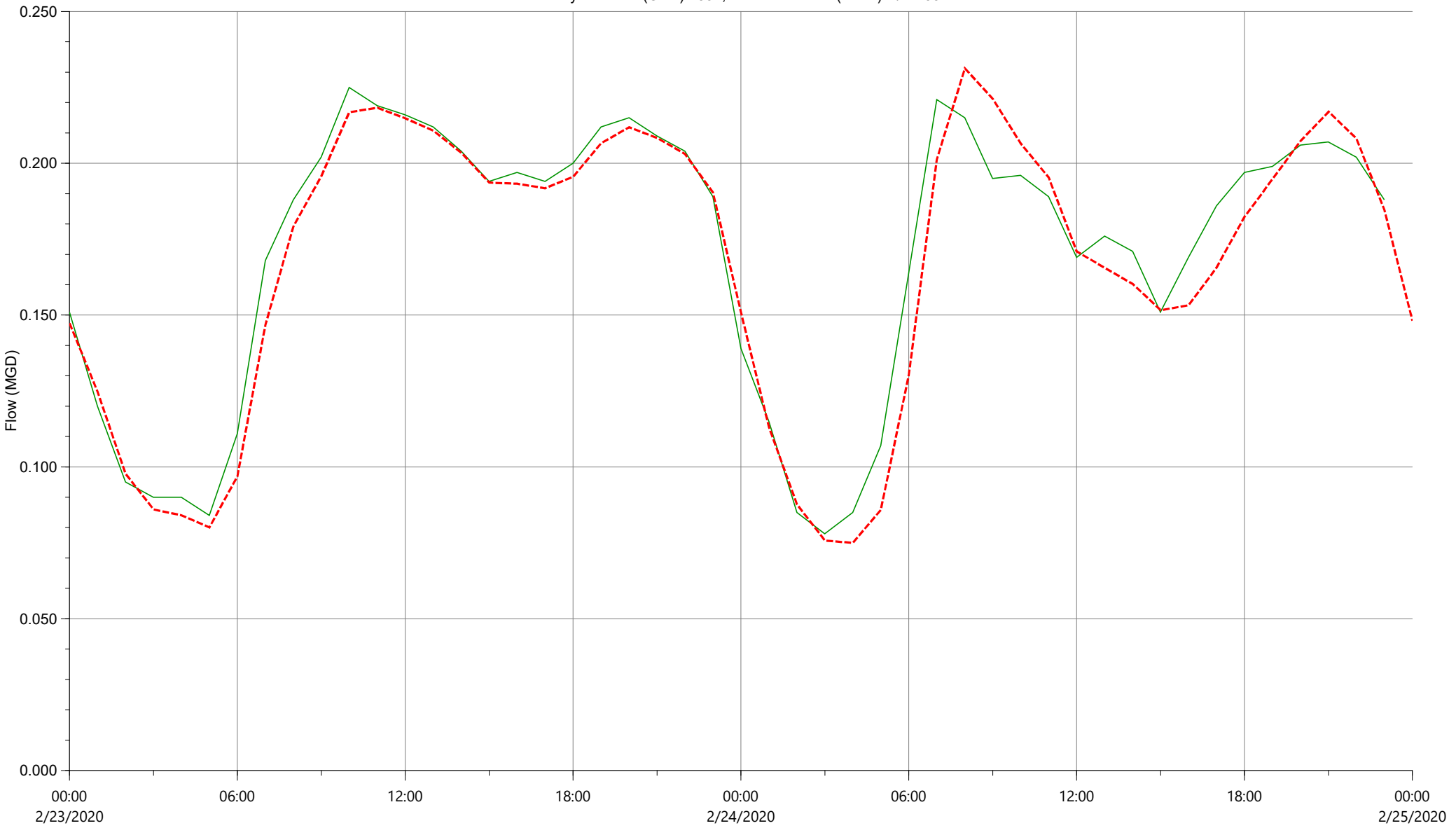
Flow Survey Location (Obs.) 2334, Model Location (Pred.) D/S 2334.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.078	0.225	0.335
Model	0.075	0.231	0.335

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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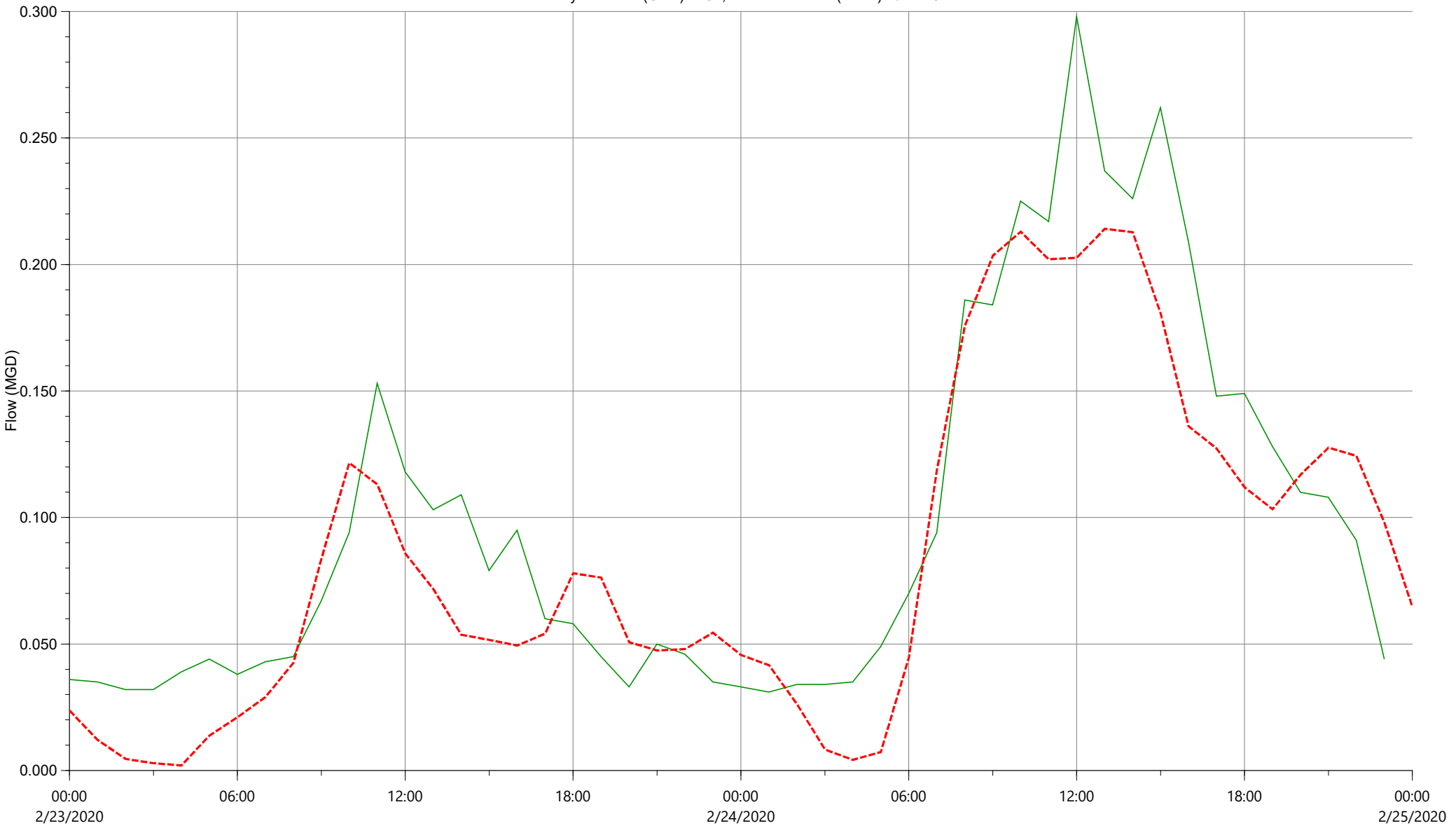
Flow Survey Location (Obs.) 2491, Model Location (Pred.) D/S 2491.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.031	0.298	0.194
Model	0.002	0.214	0.169

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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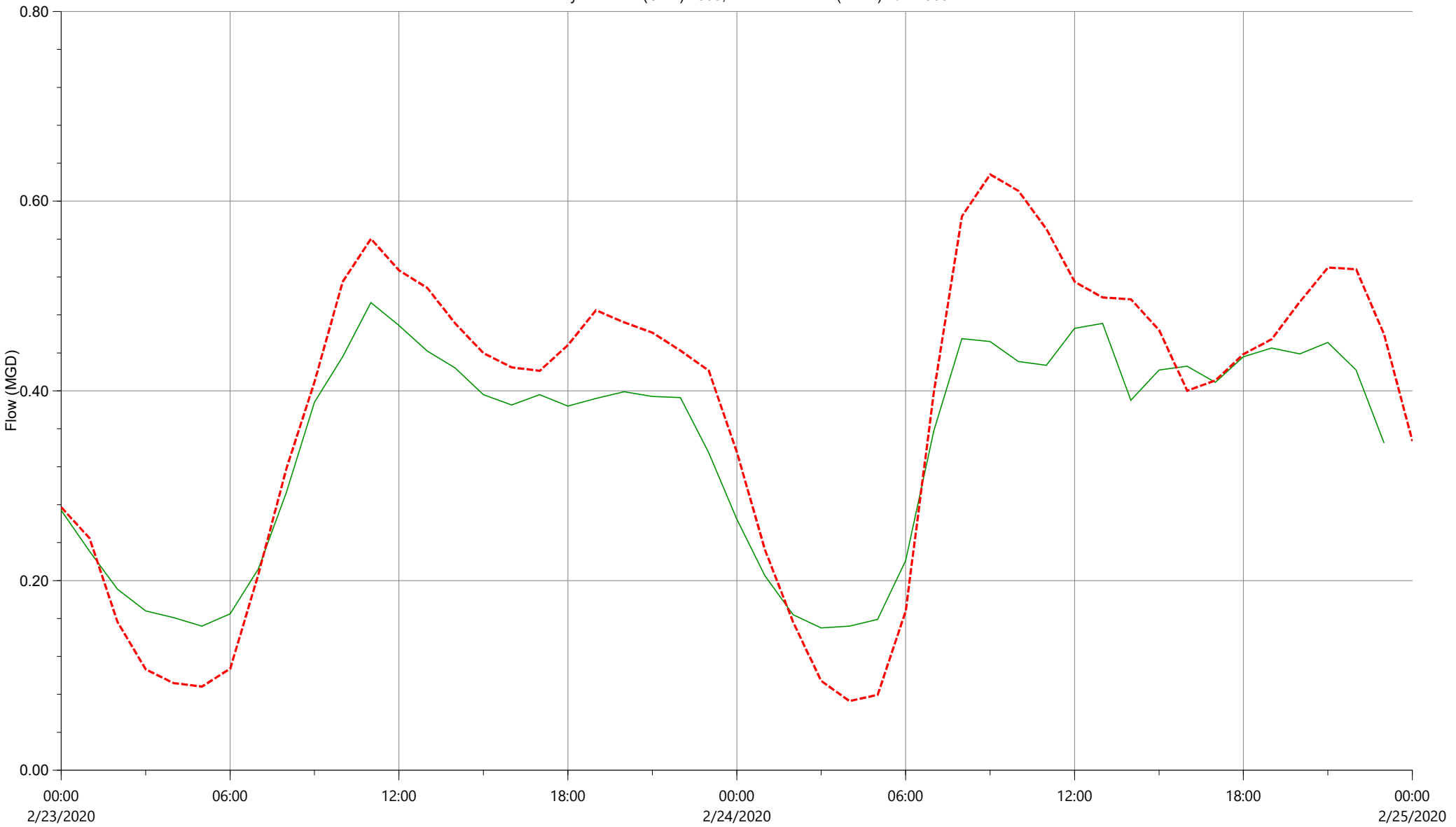
Flow Survey Location (Obs.) 2569, Model Location (Pred.) D/S 2569.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.150	0.493	0.676
Model	0.073	0.628	0.761

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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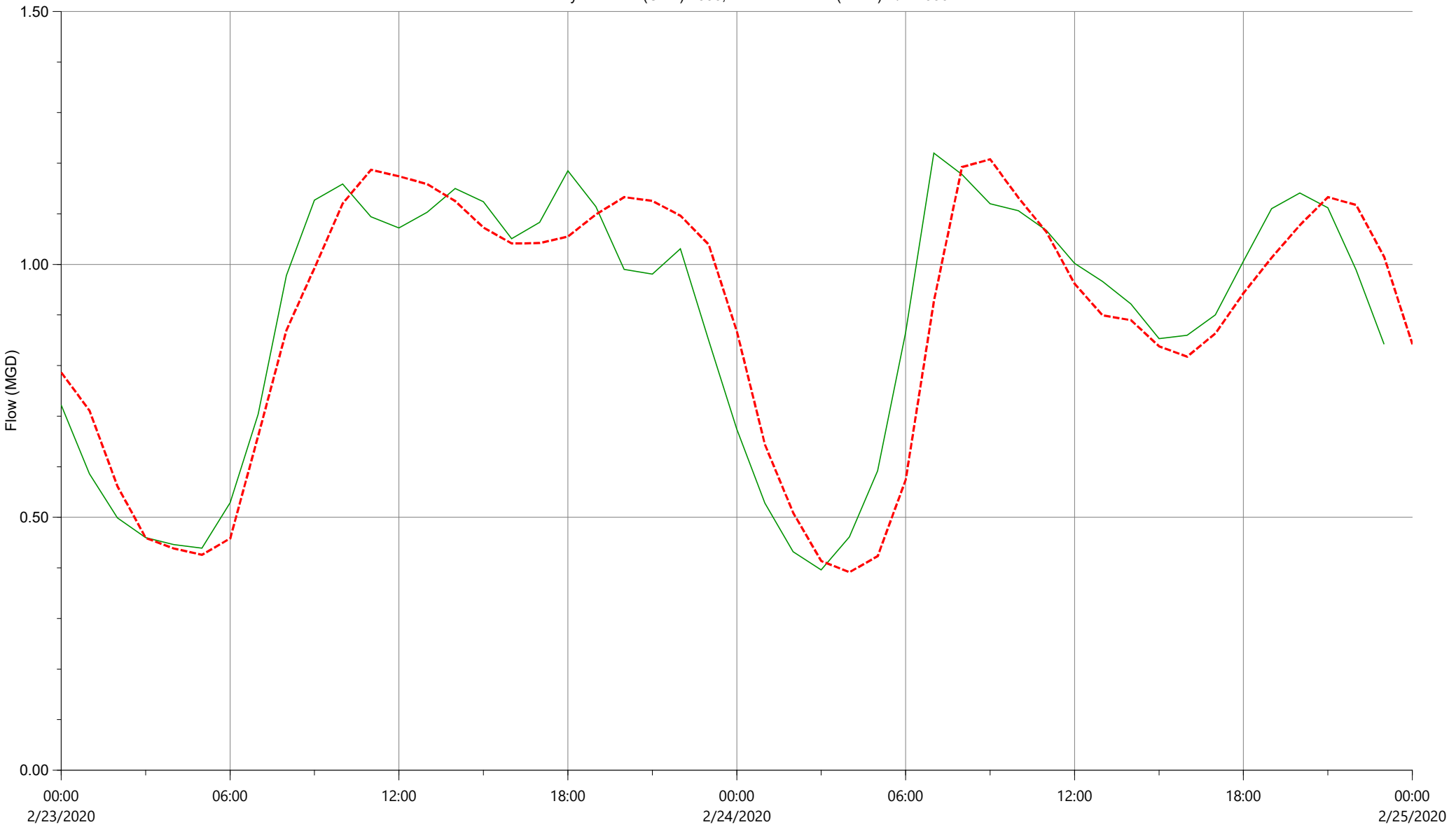
Flow Survey Location (Obs.) 2666, Model Location (Pred.) D/S 2666.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.396	1.220	1.752
Model	0.392	1.208	1.783

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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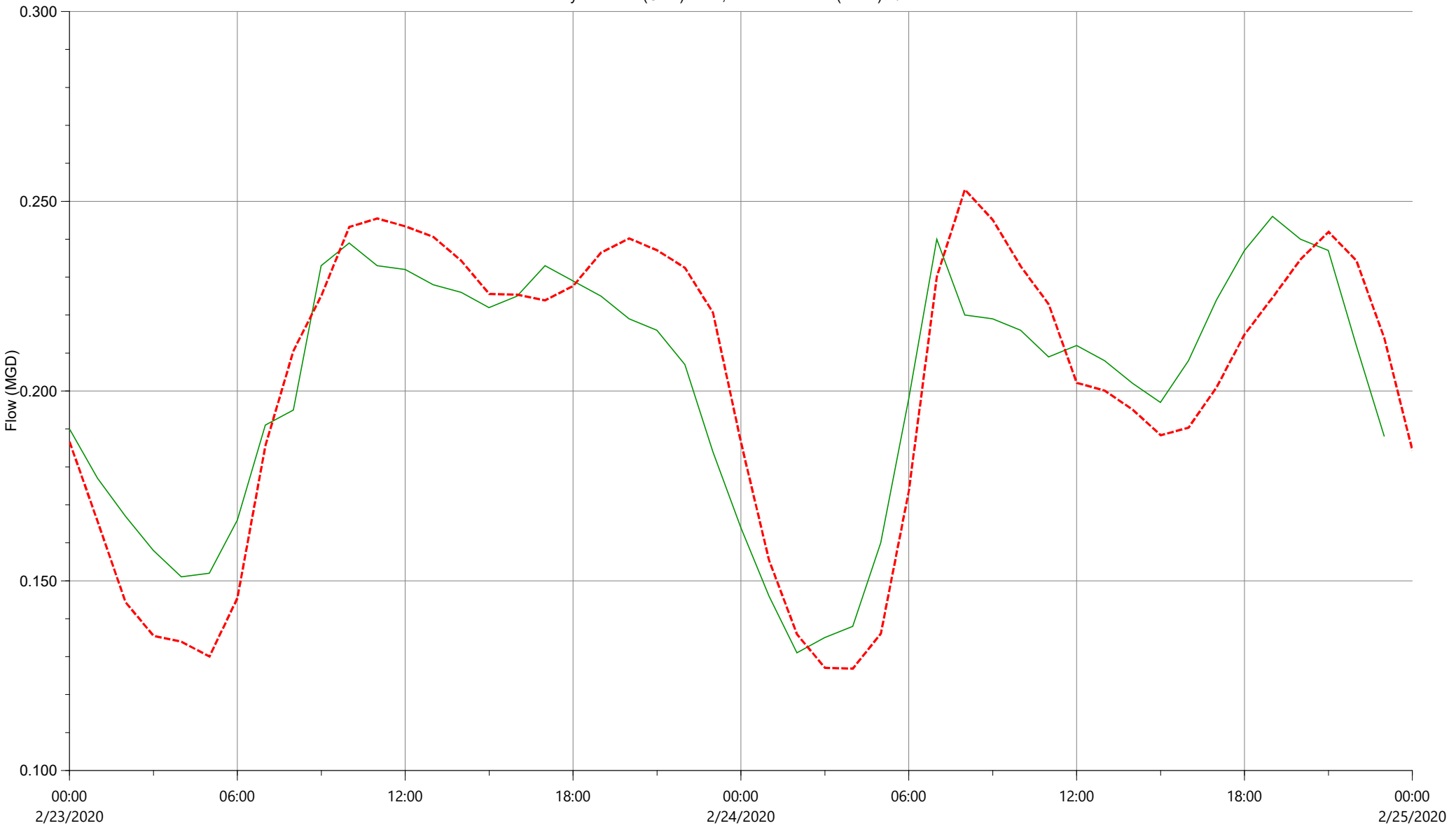
Flow Survey Location (Obs.) 2721, Model Location (Pred.) D/S 2721.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.131	0.246	0.396
Model	0.127	0.253	0.404

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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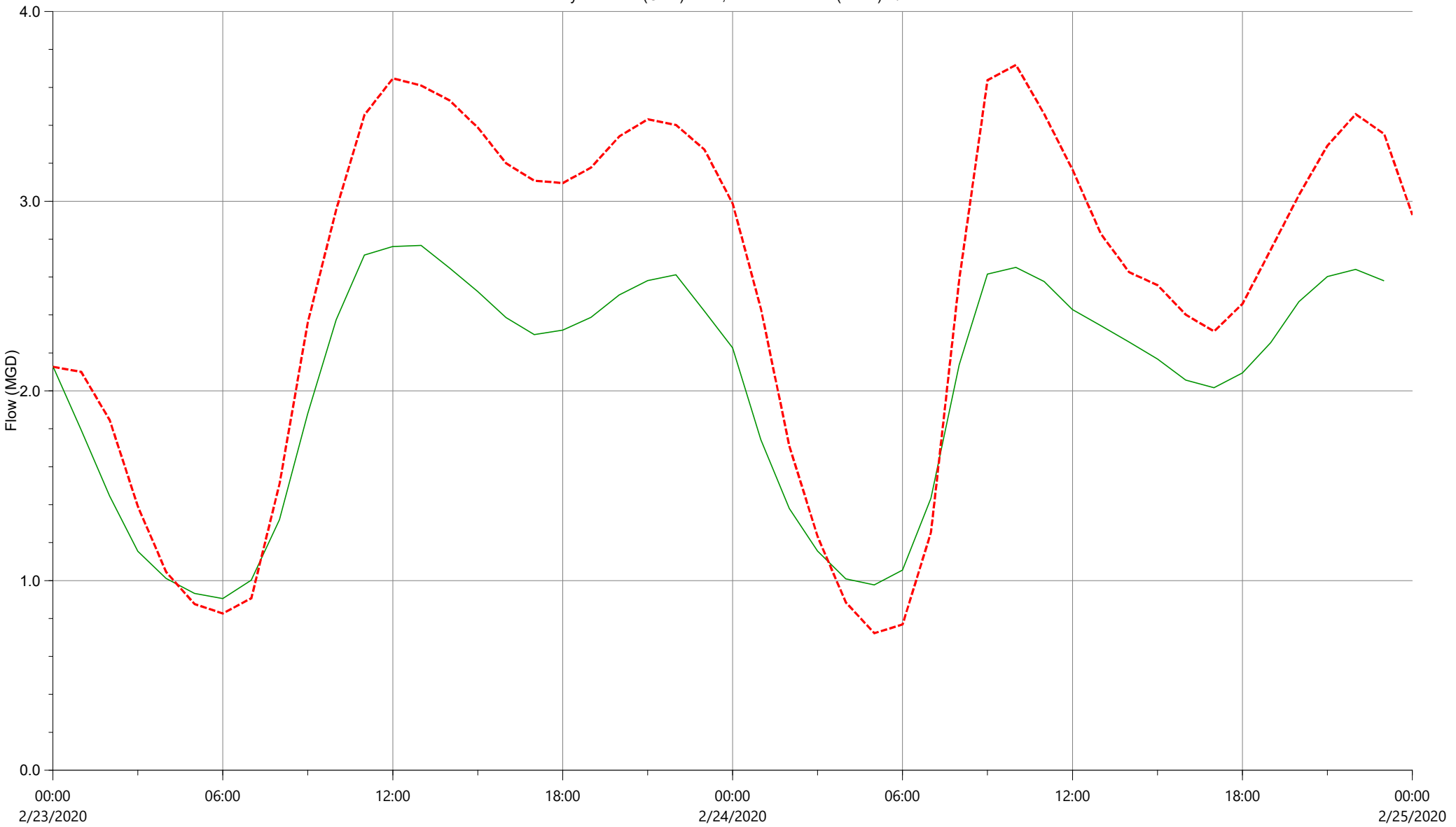
Flow Survey Location (Obs.) 2724, Model Location (Pred.) D/S 2724.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.905	2.767	3.975
Model	0.723	3.719	5.069

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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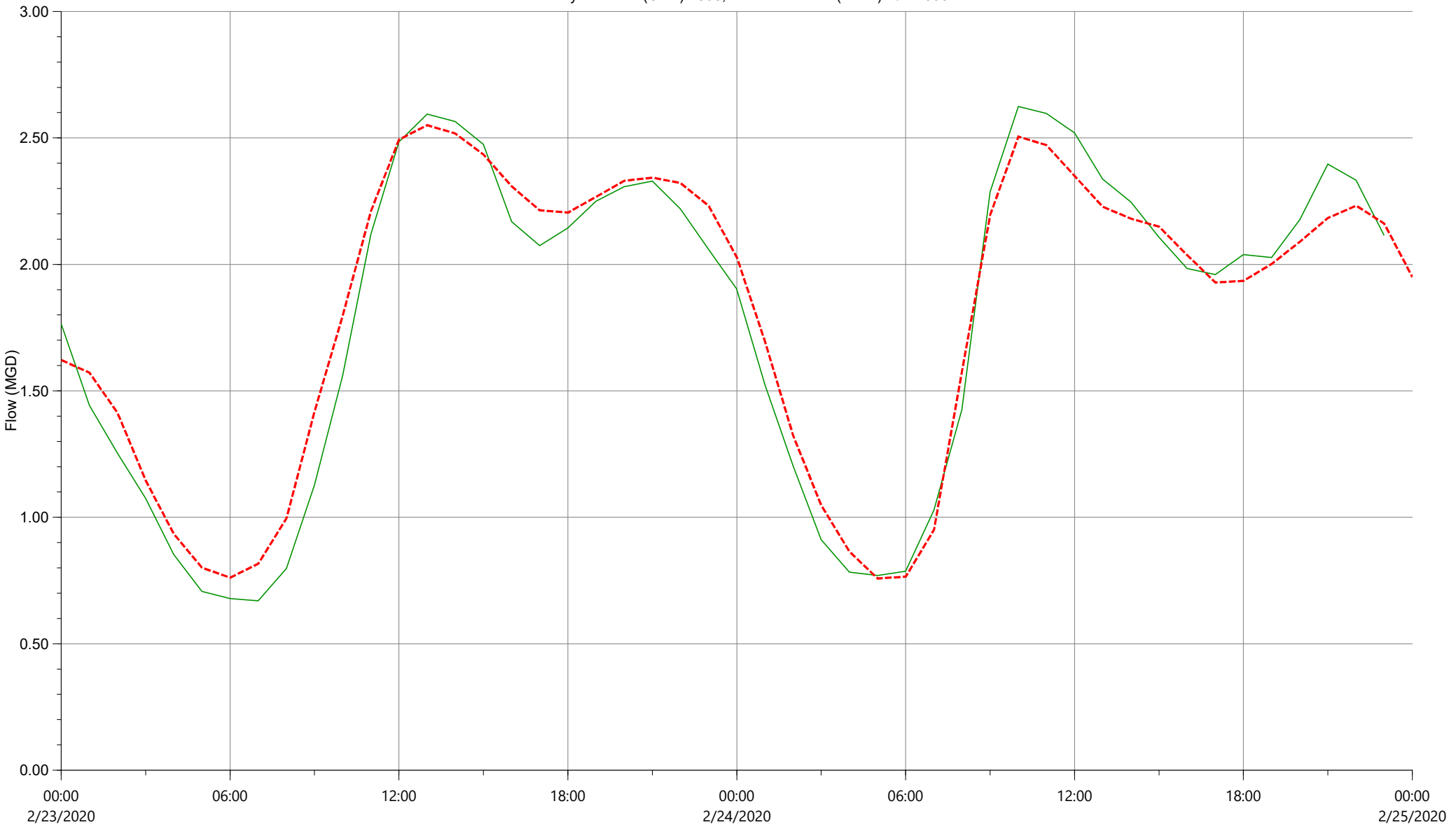
Flow Survey Location (Obs.) 2808, Model Location (Pred.) D/S 2808.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.670	2.624	3.494
Model	0.758	2.551	3.648

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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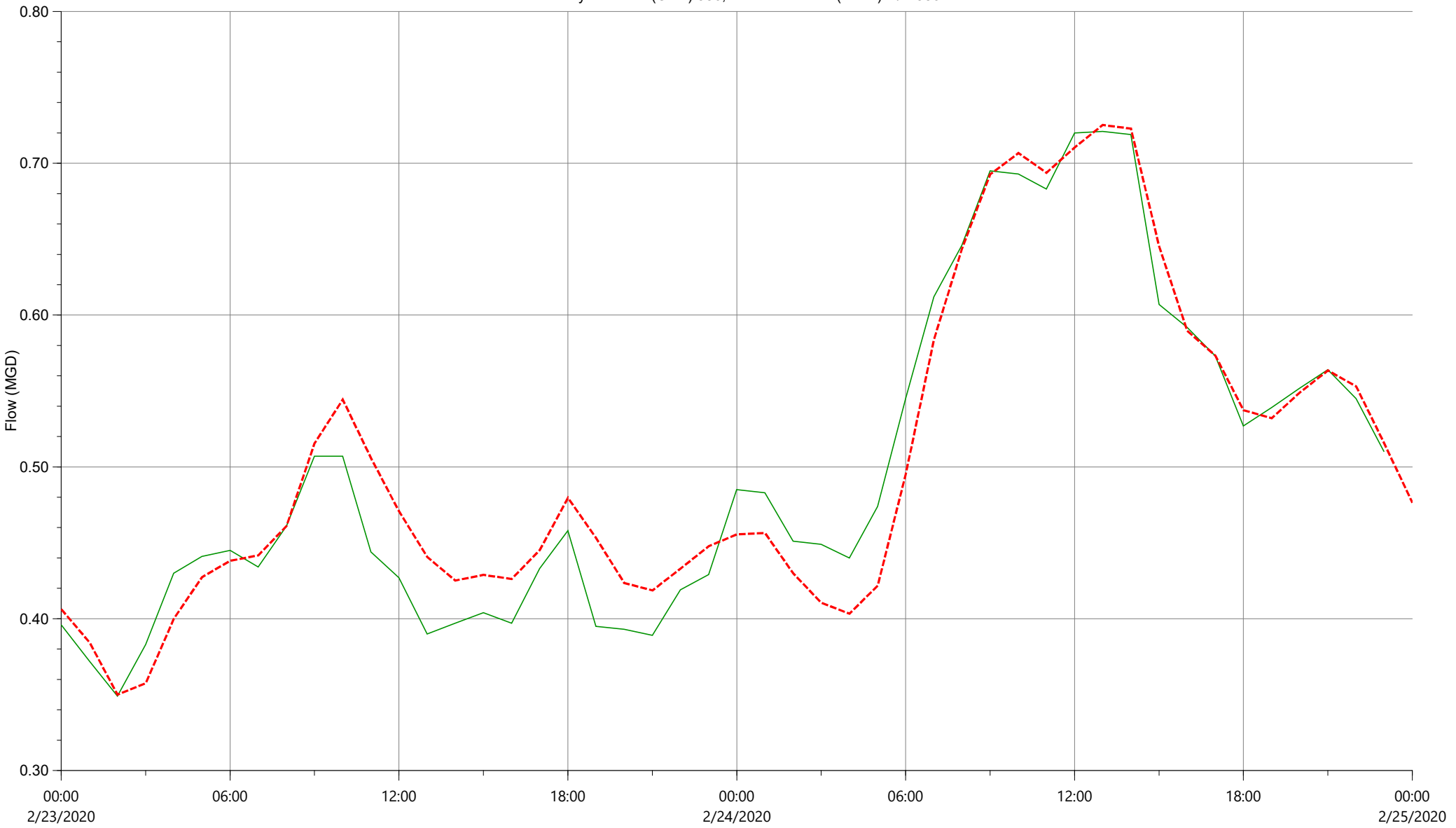
Flow Survey Location (Obs.) 386, Model Location (Pred.) D/S 386.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.349	0.721	0.978
Model	0.350	0.725	1.007

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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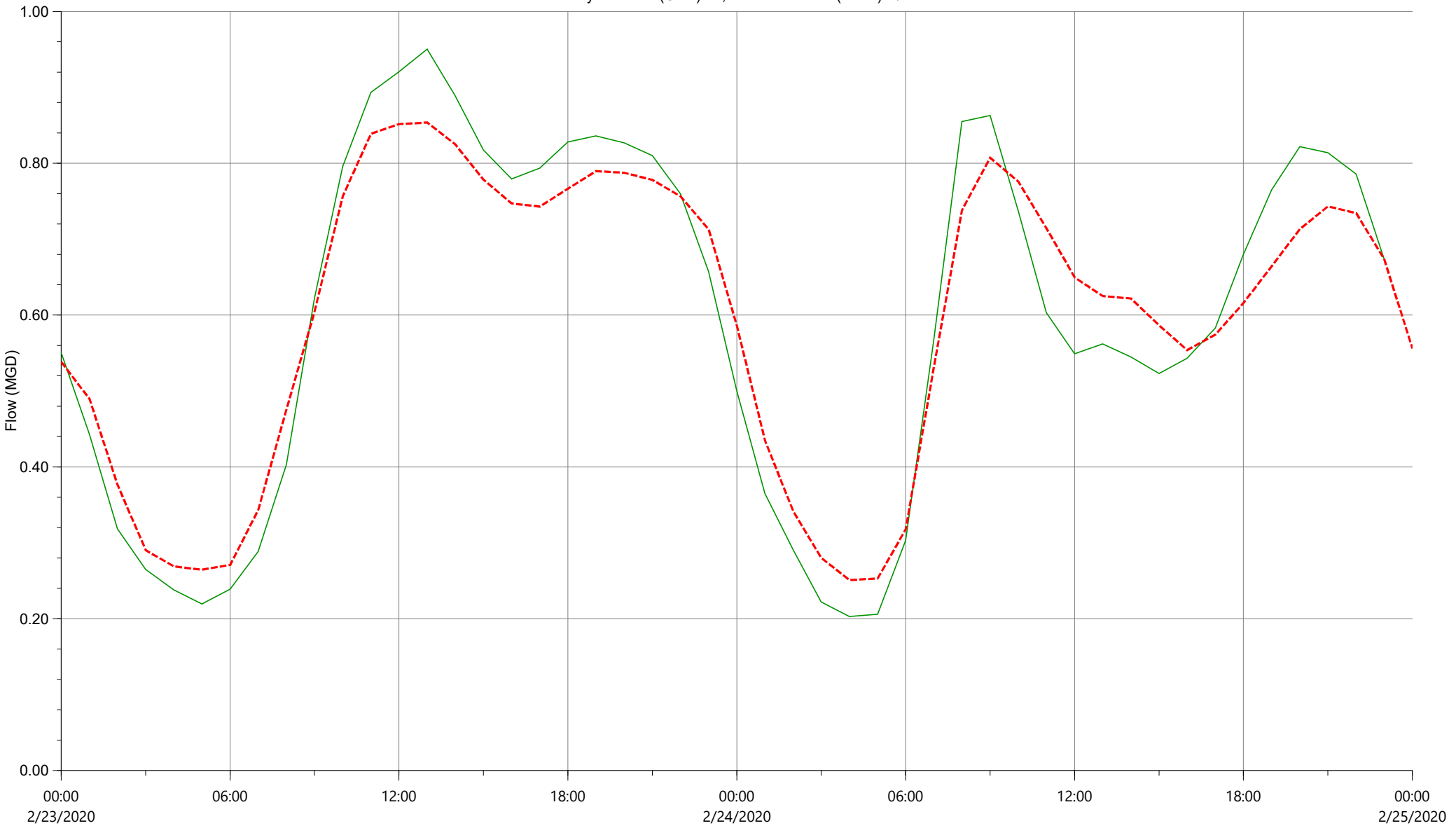
Flow Survey Location (Obs.) 41, Model Location (Pred.) D/S 41.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.203	0.951	1.171
Model	0.251	0.854	1.196

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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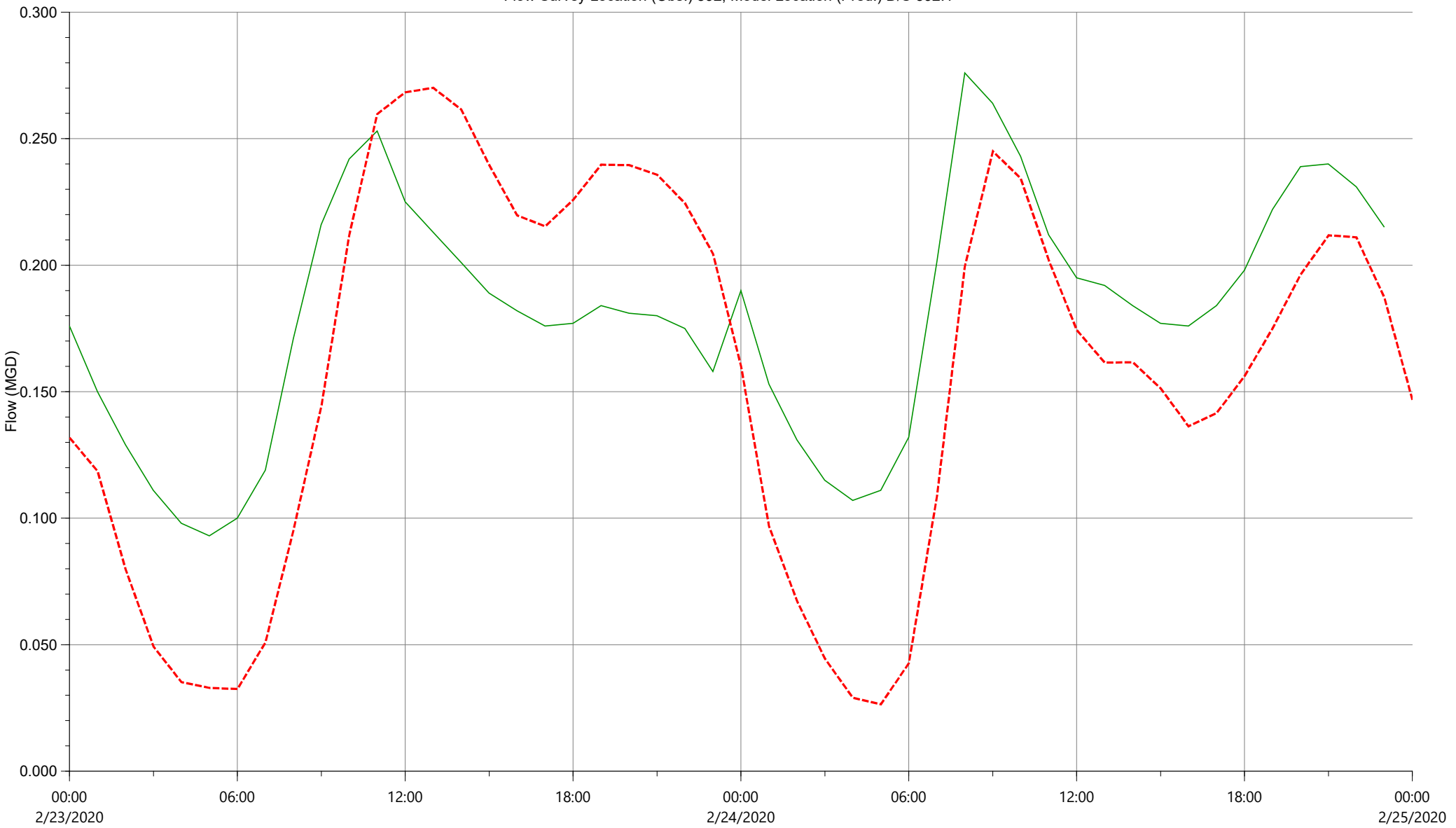
Flow Survey Location (Obs.) 592, Model Location (Pred.) D/S 592.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.093	0.276	0.354
Model	0.027	0.270	0.317

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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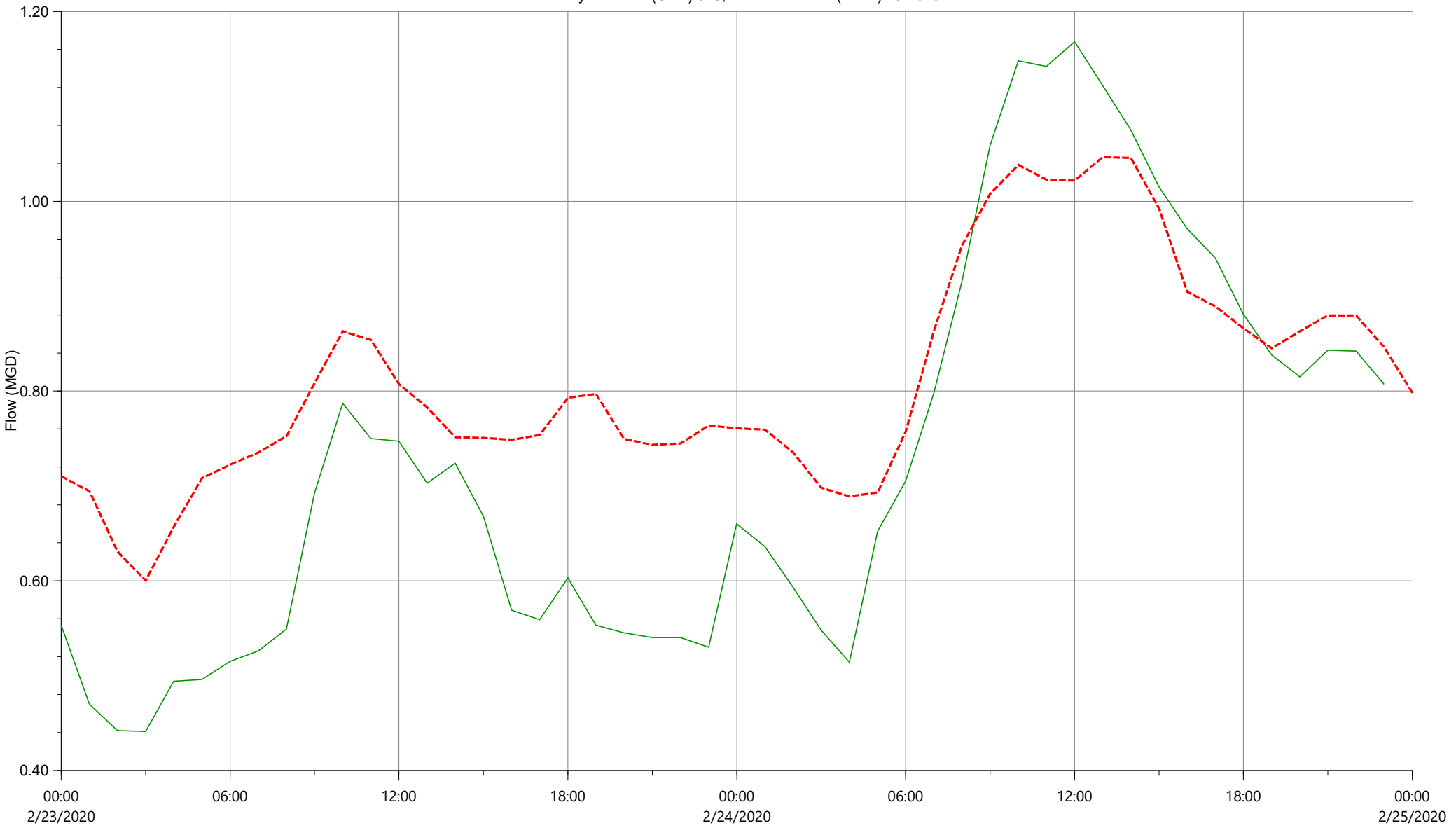
Flow Survey Location (Obs.) 649, Model Location (Pred.) D/S 649.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.441	1.168	1.417
Model	0.600	1.047	1.626

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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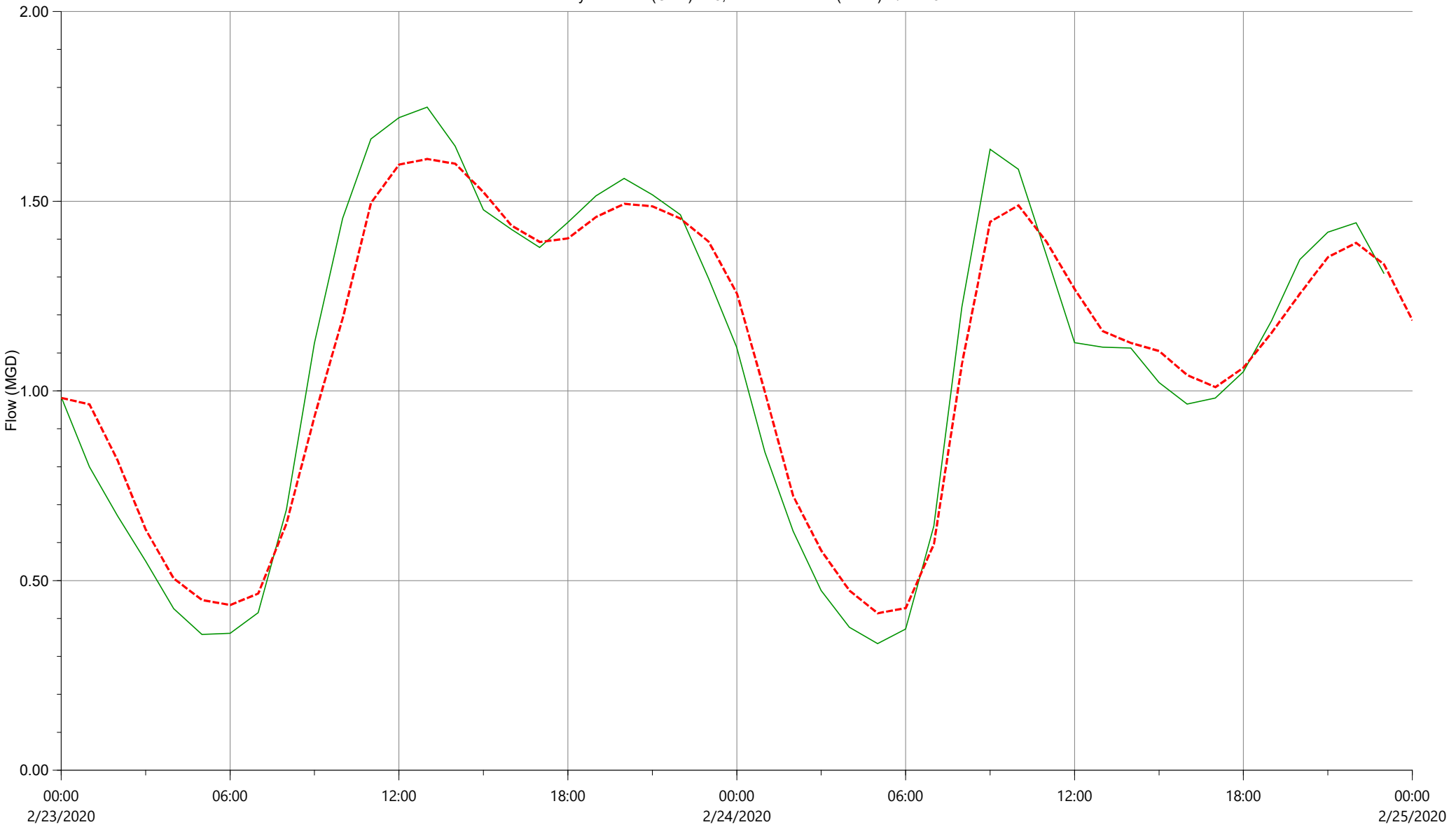
Flow Survey Location (Obs.) 715, Model Location (Pred.) D/S 715.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.334	1.748	2.133
Model	0.414	1.611	2.192

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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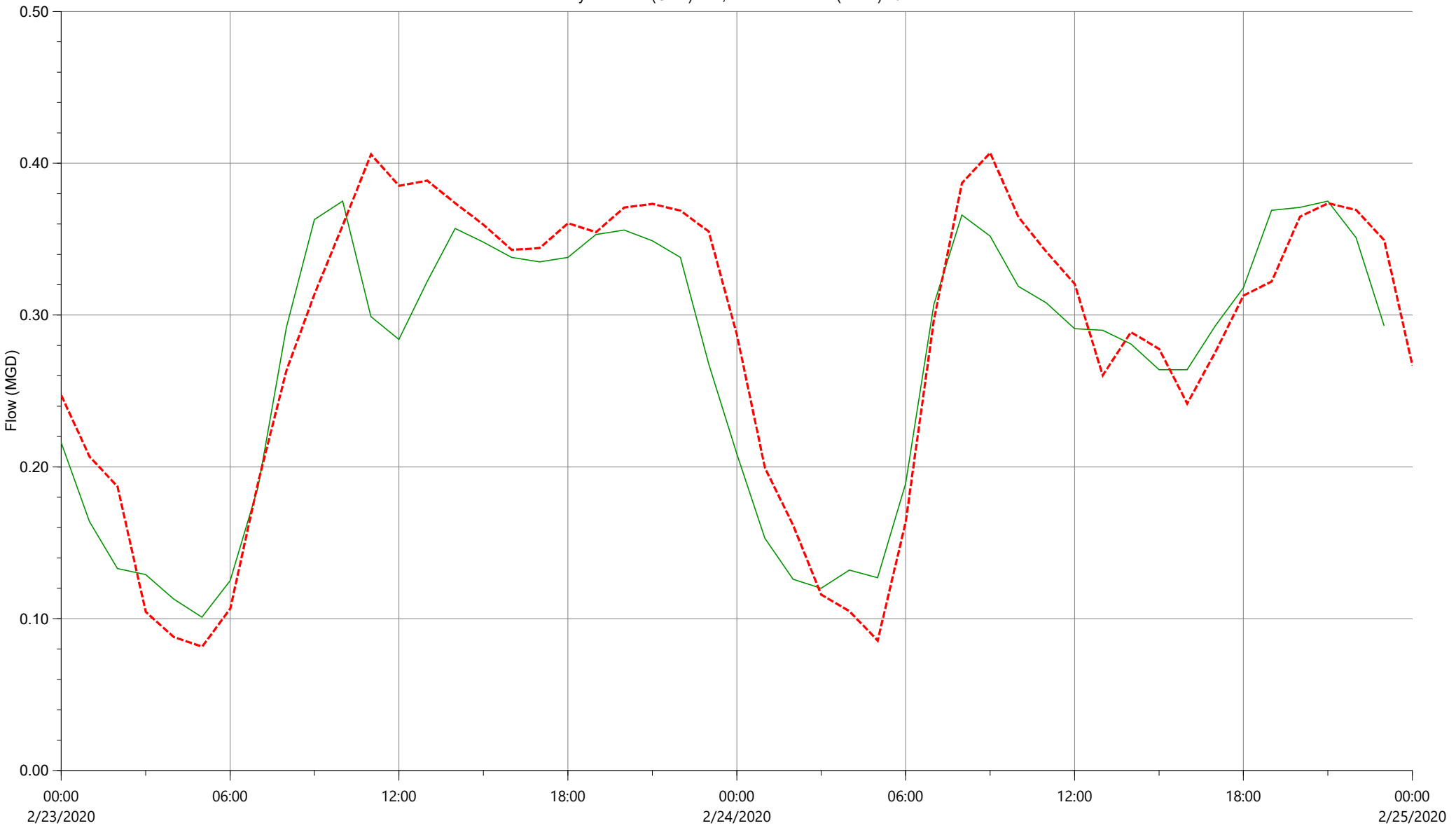
Flow Survey Location (Obs.) 744, Model Location (Pred.) D/S 744.1



	Flow		
	Min (MGD)	Max (MGD)	Volume (US Mgal)
Observed	0.101	0.375	0.529
Model	0.082	0.407	0.567

Observed / Predicted Report (Custom graph) - DWF Calibration FINAL

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APPENDIX E

City of Milpitas
Sewer Master Plan Study
Wet Weather Calibration Charts

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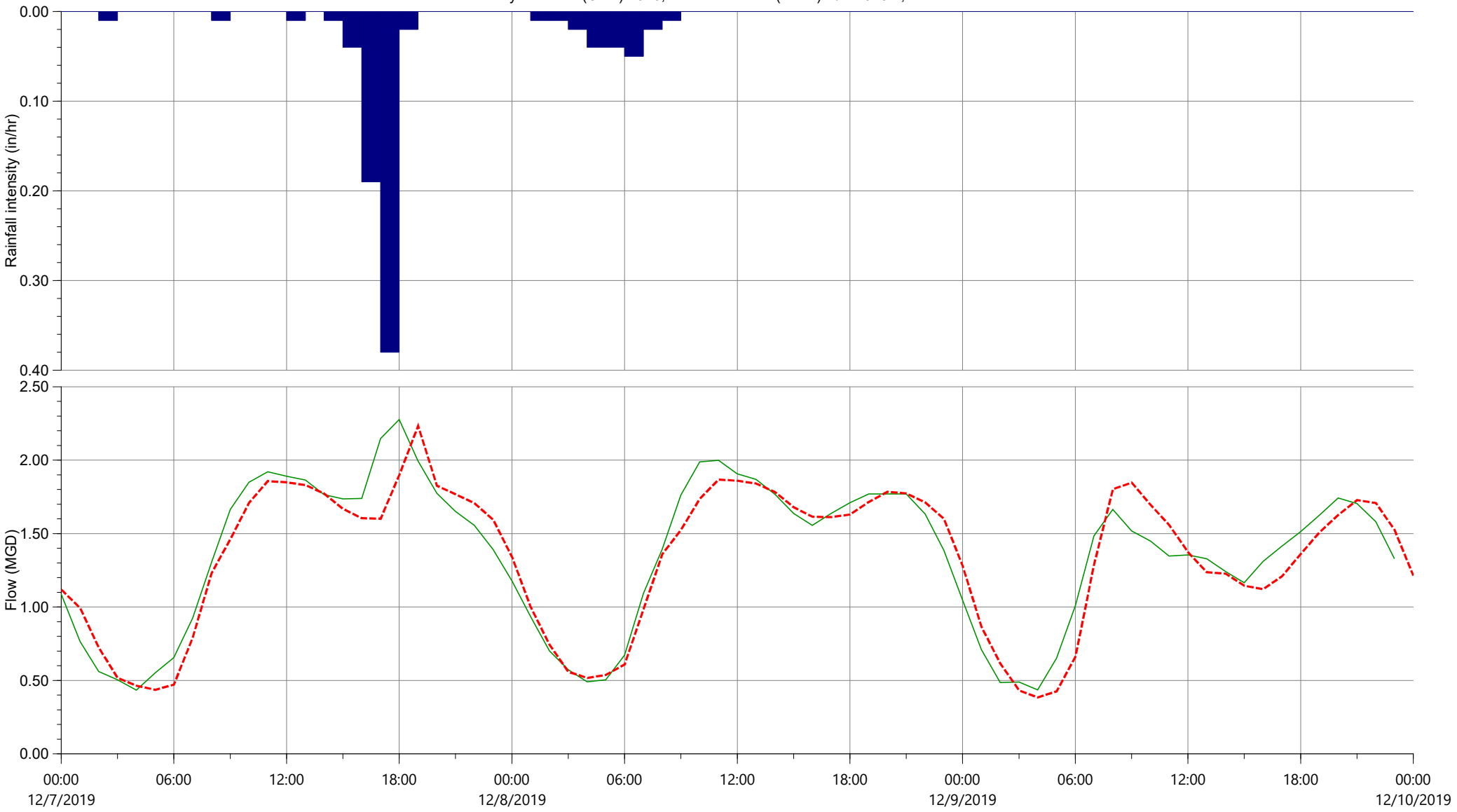
Flow Survey Location (Obs.) 1043, Model Location (Pred.) D/S 1043.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.433	2.277	4.004
Model				0.384	2.235	4.010

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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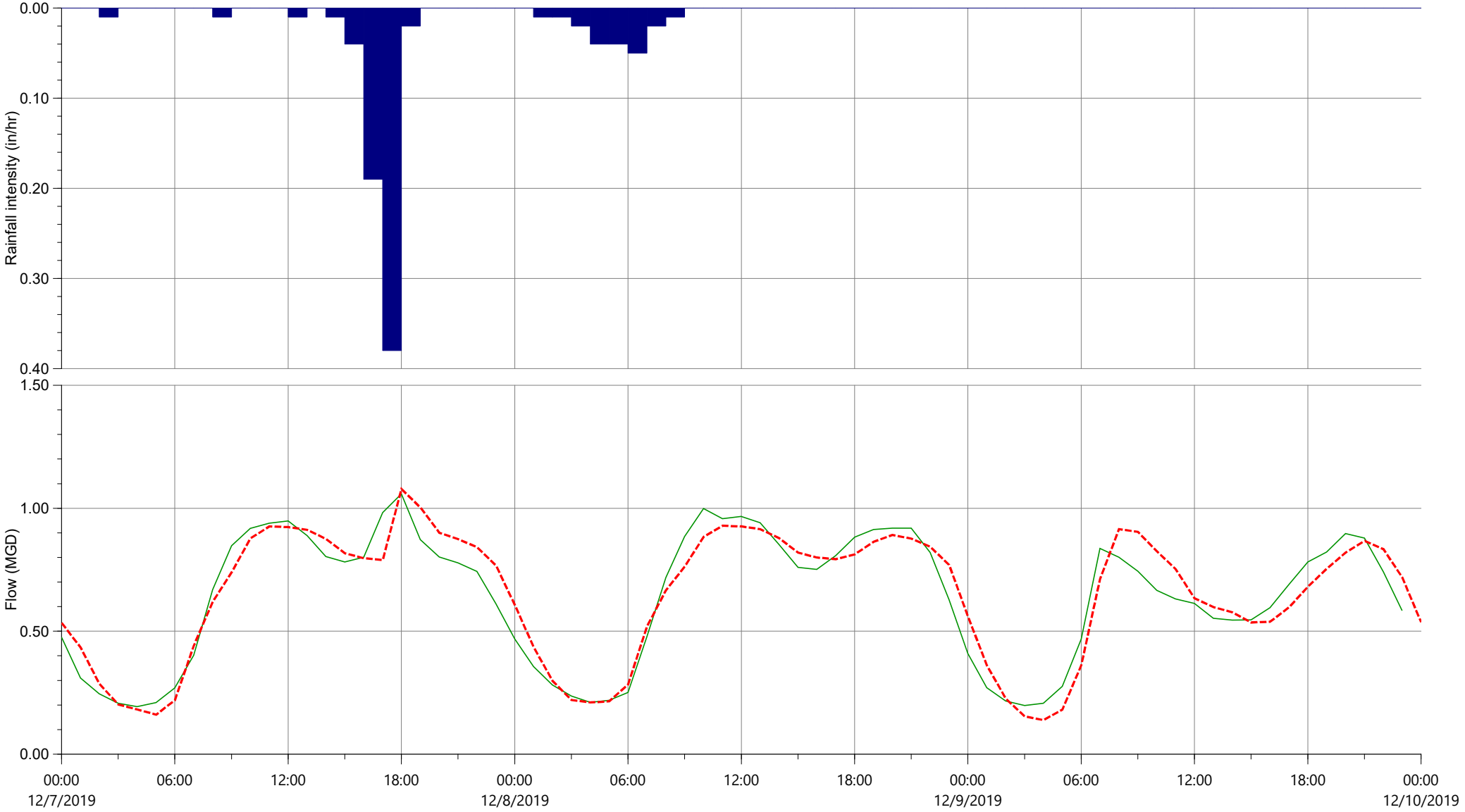
Flow Survey Location (Obs.) 1193, Model Location (Pred.) D/S 1193.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.193	1.058	1.892
Model				0.139	1.079	1.946

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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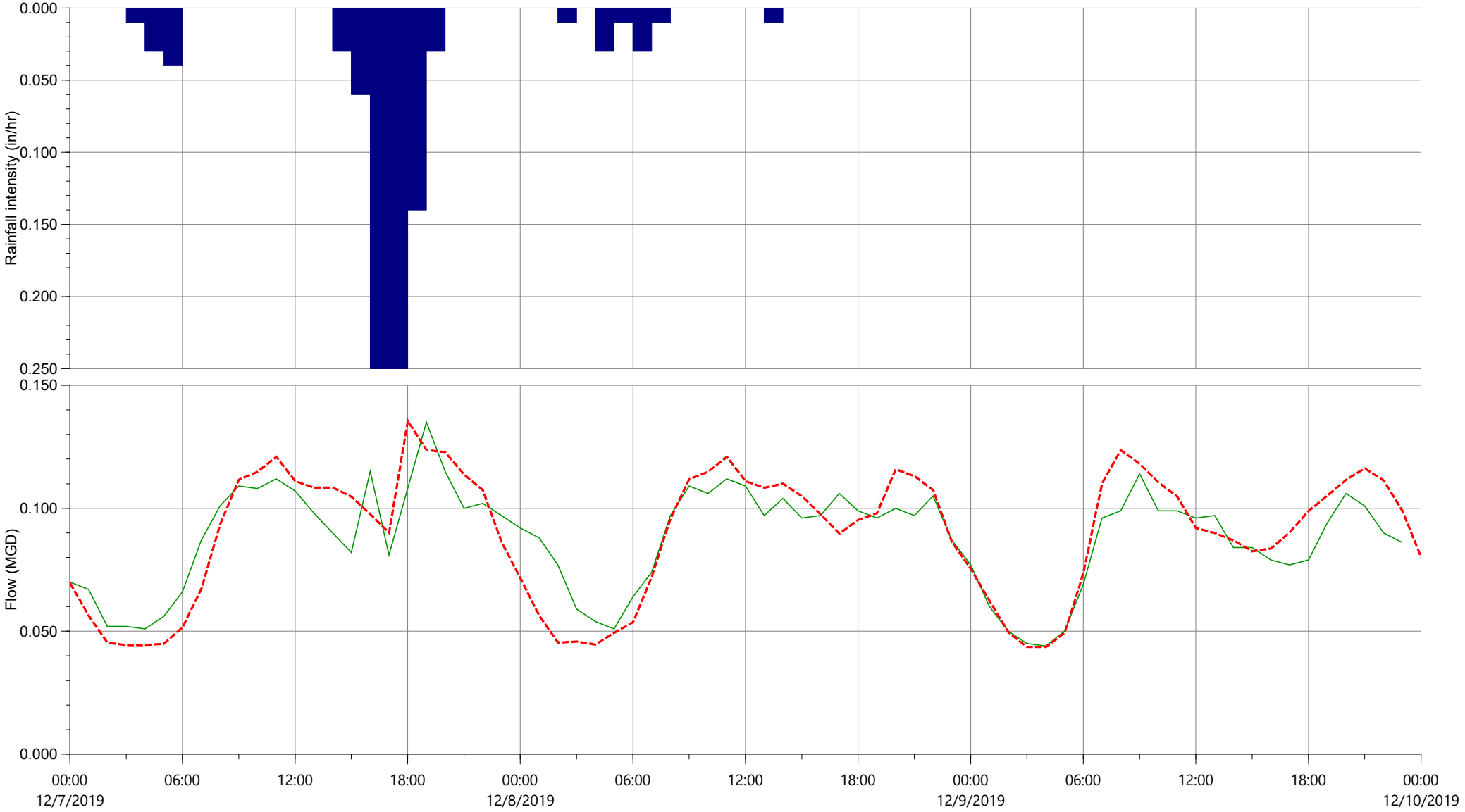
Flow Survey Location (Obs.) 1564, Model Location (Pred.) D/S 1564.1, Rainfall Profile: 2



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.940	0.250	0.013			
Observed				0.044	0.135	0.260
Model				0.044	0.135	0.268

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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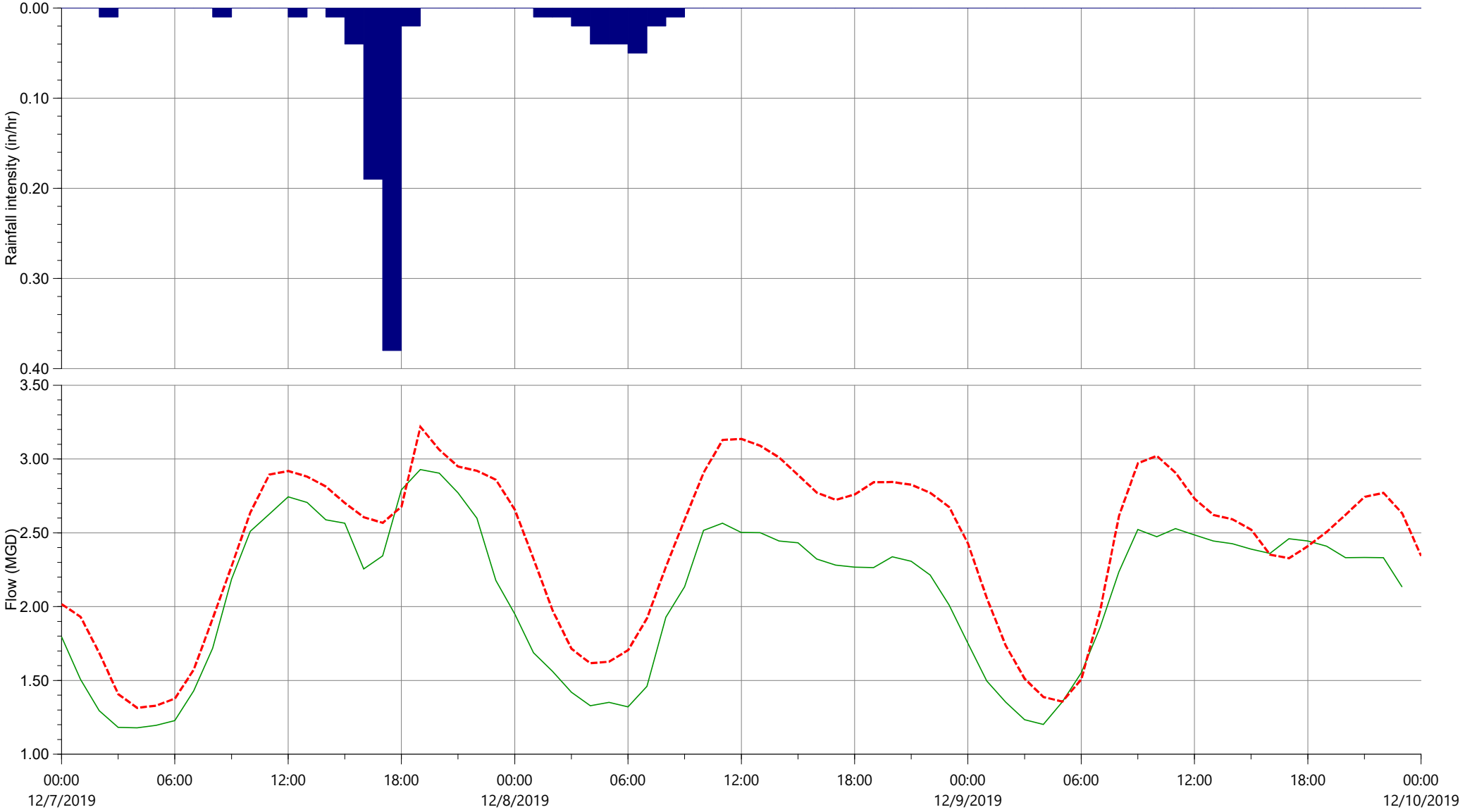
Flow Survey Location (Obs.) 1790, Model Location (Pred.) D/S 1790.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				1.179	2.929	6.187
Model				1.314	3.219	7.243

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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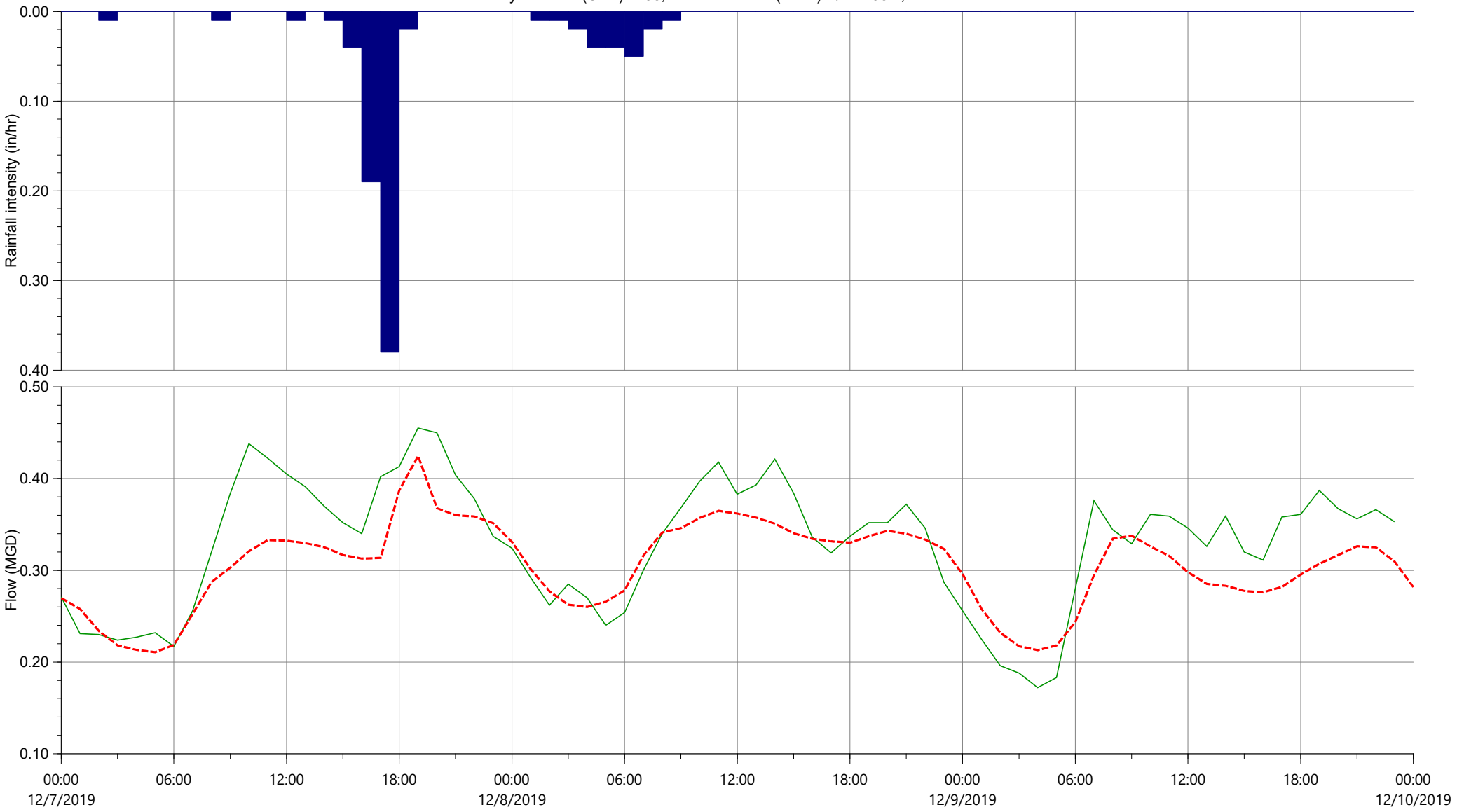
Flow Survey Location (Obs.) 1795, Model Location (Pred.) D/S 1795.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.172	0.455	0.973
Model				0.211	0.425	0.915

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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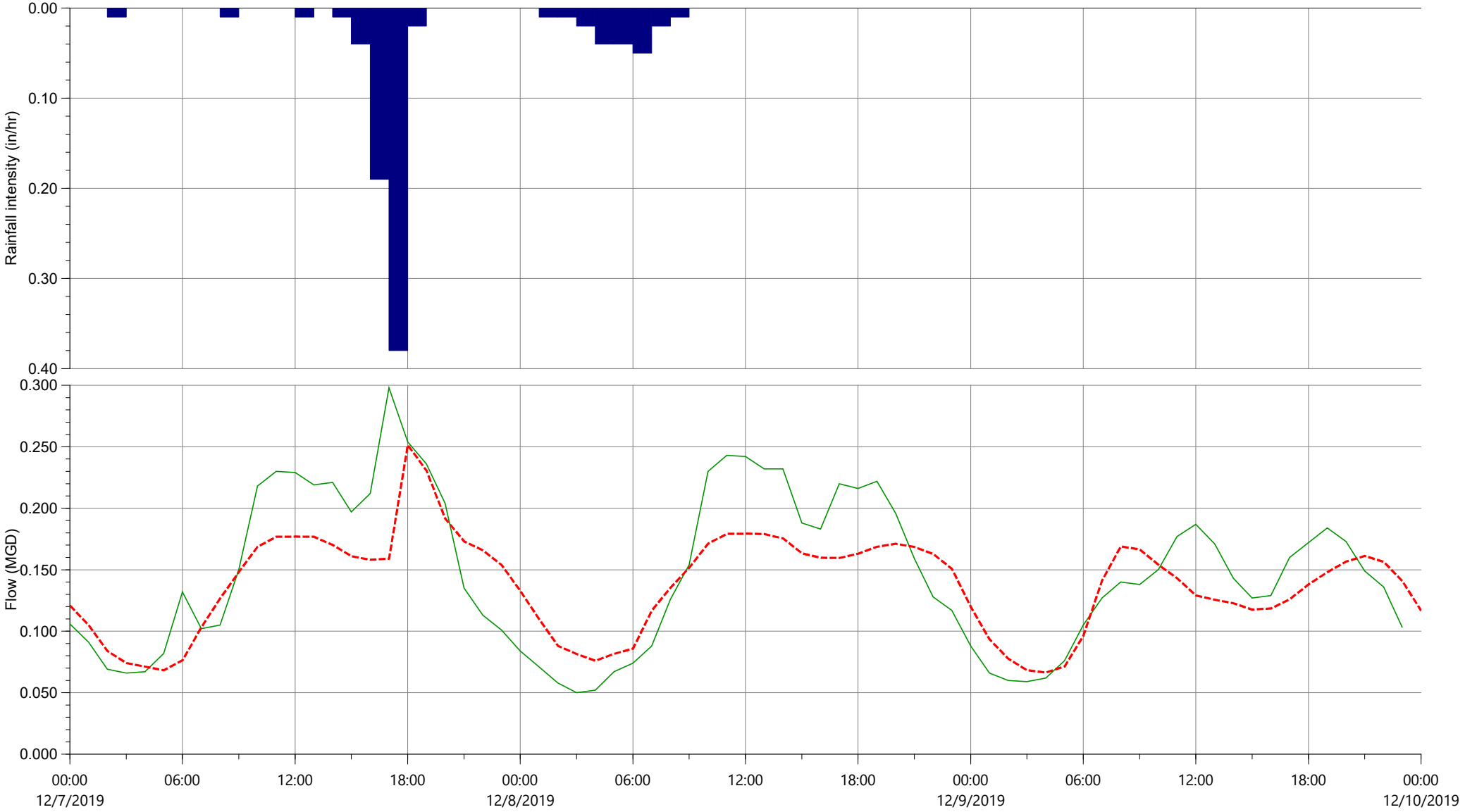
Flow Survey Location (Obs.) 186, Model Location (Pred.) D/S 186.1, Rainfall Profile: 1

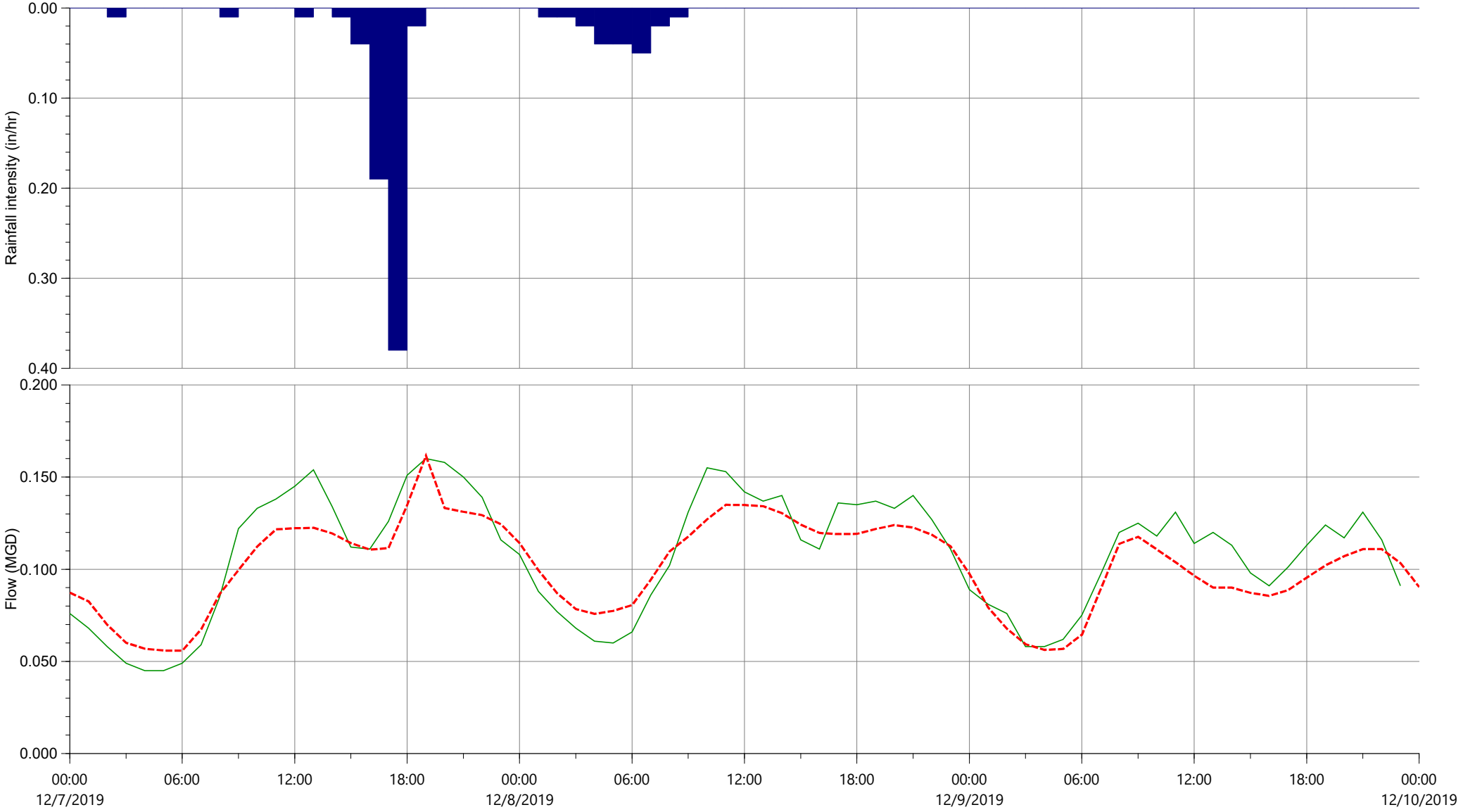


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.050	0.298	0.435
Model				0.067	0.251	0.413

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 190, Model Location (Pred.) D/S 190.1, Rainfall Profile: 1

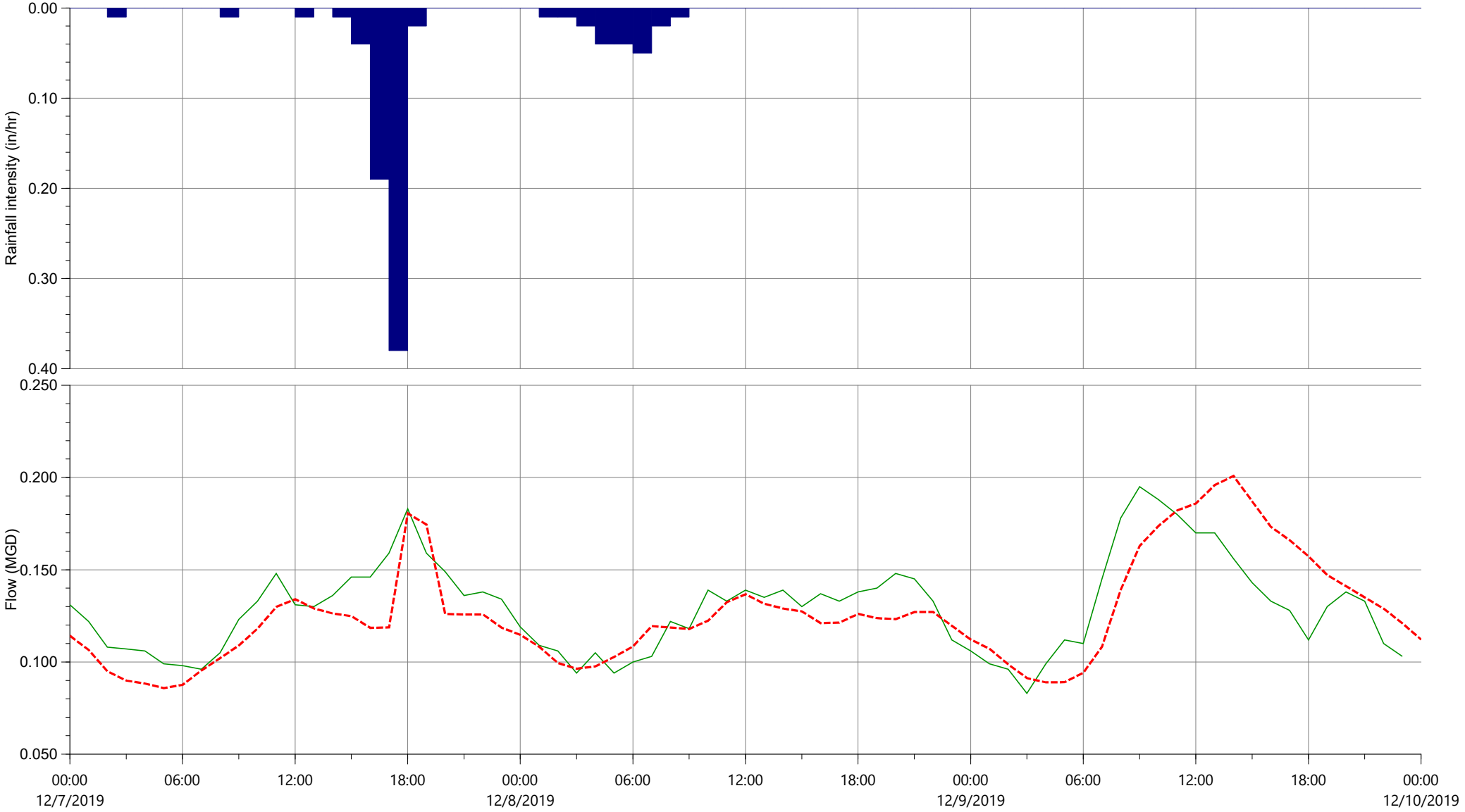


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.045	0.160	0.318
Model				0.056	0.162	0.306

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 229, Model Location (Pred.) D/S 229.1, Rainfall Profile: 1

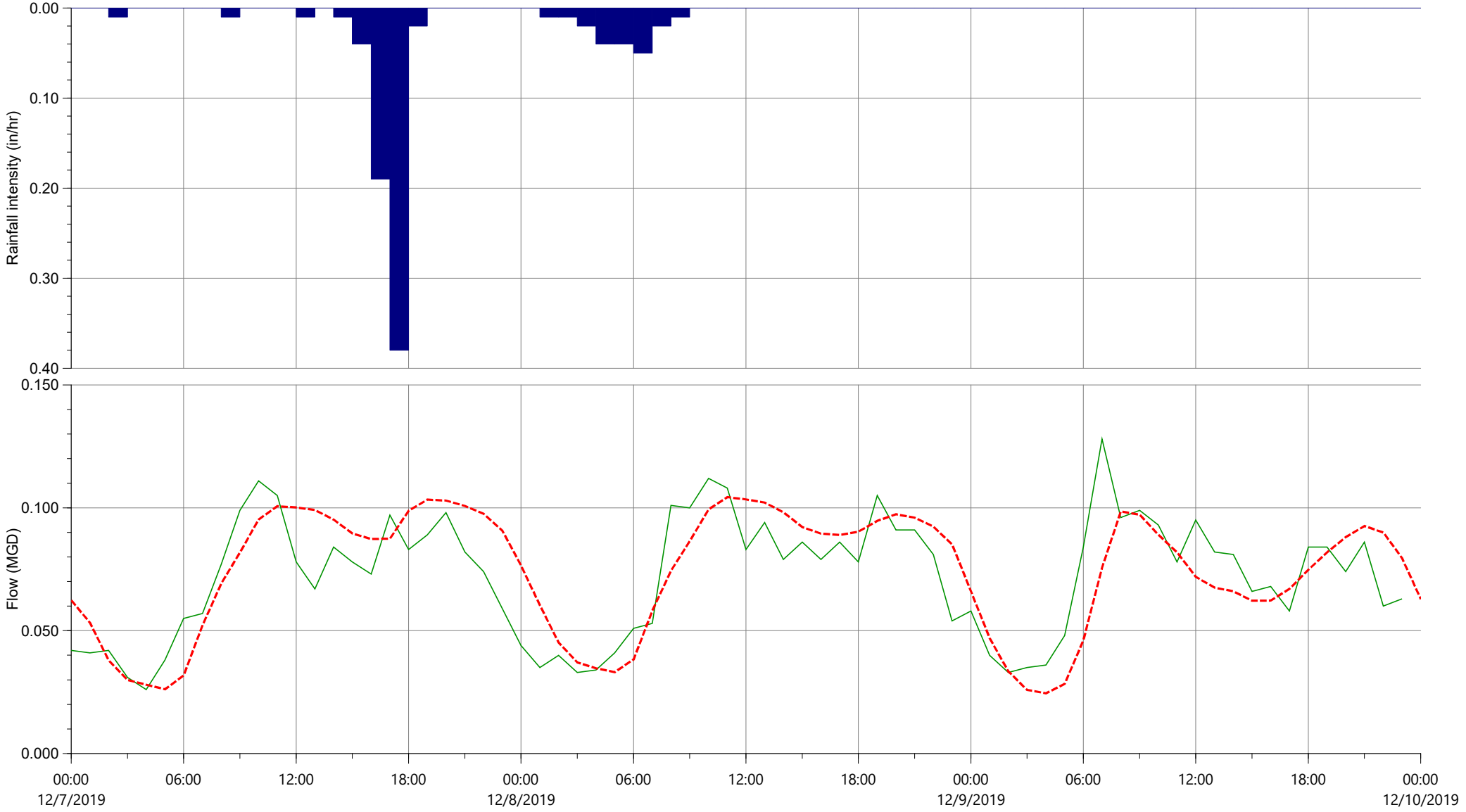


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.083	0.195	0.383
Model				0.086	0.201	0.378

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 2300, Model Location (Pred.) D/S 2300.1, Rainfall Profile: 1

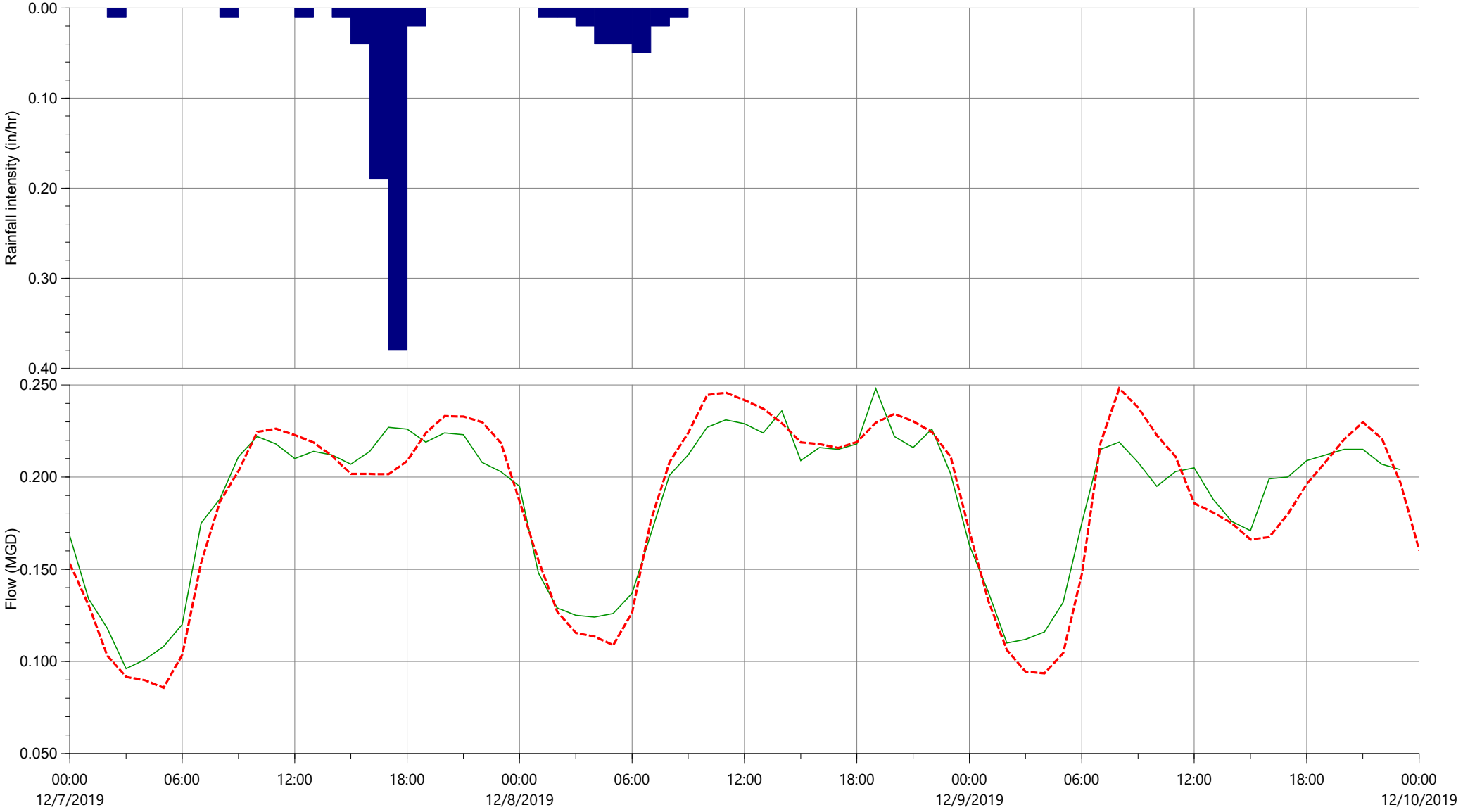


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.026	0.128	0.213
Model				0.025	0.104	0.222

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 2334, Model Location (Pred.) D/S 2334.1, Rainfall Profile: 1

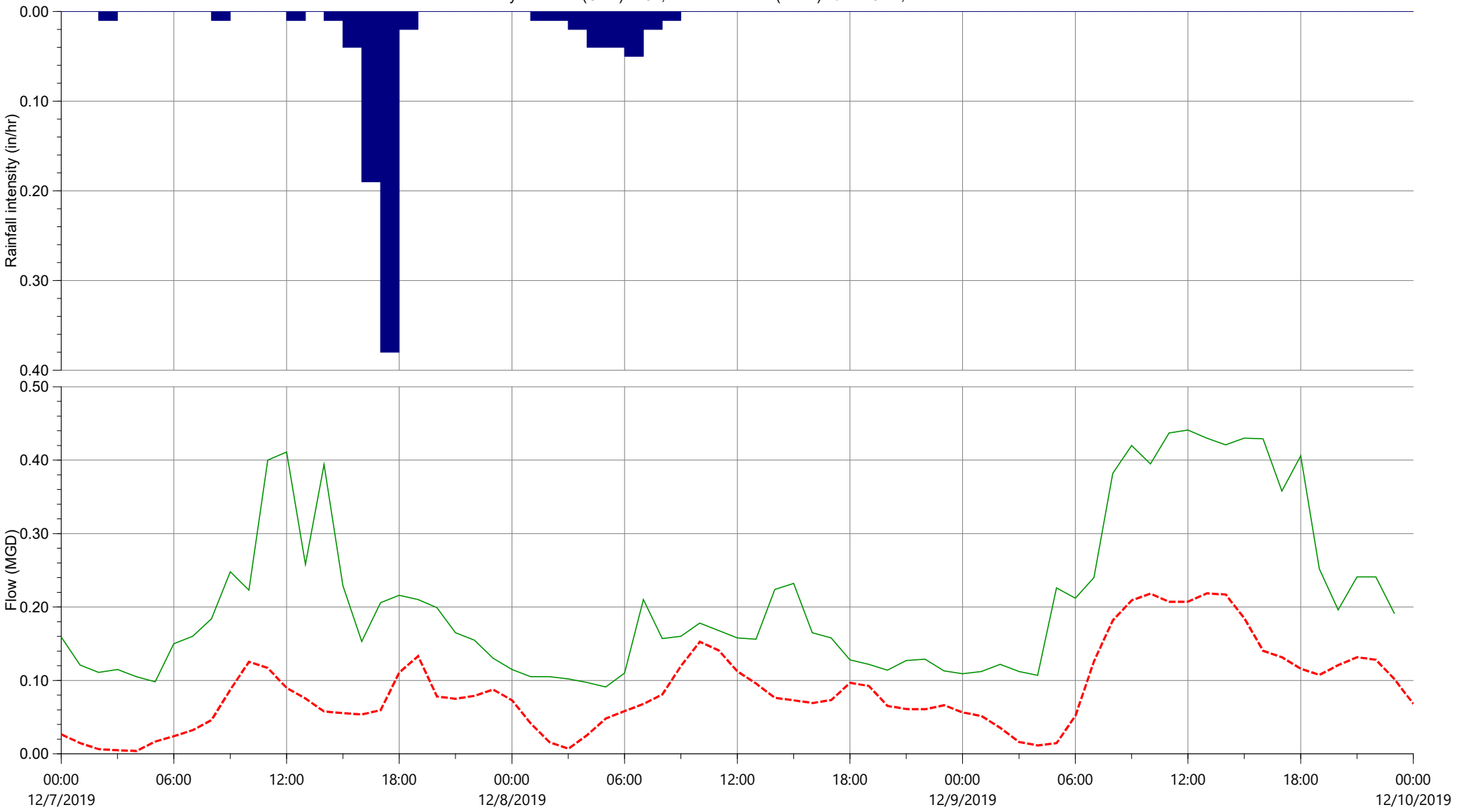


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.096	0.248	0.555
Model				0.086	0.248	0.559

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 2491, Model Location (Pred.) D/S 2491.1, Rainfall Profile: 1

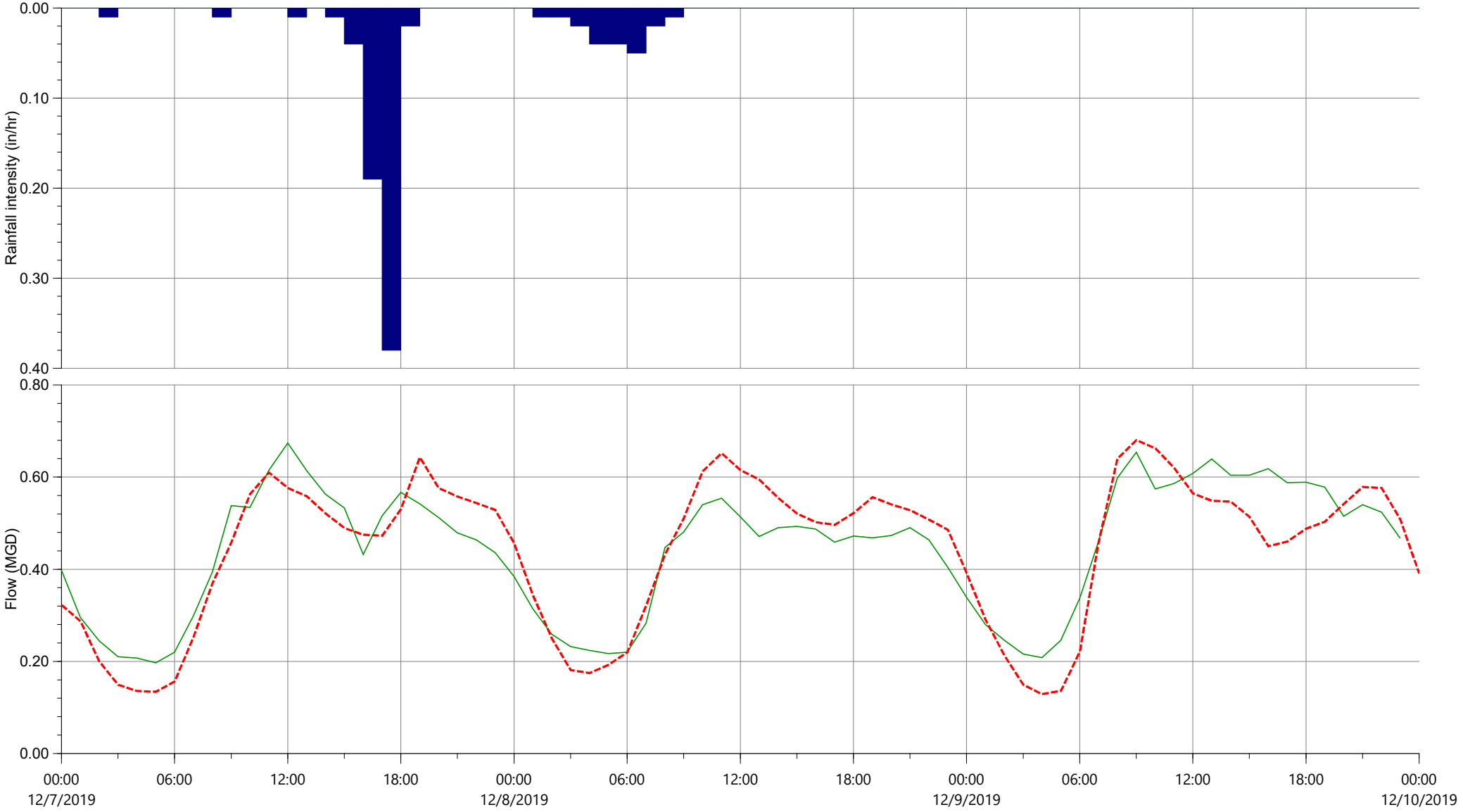


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.091	0.441	0.623
Model				0.004	0.219	0.260

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 2569, Model Location (Pred.) D/S 2569.1, Rainfall Profile: 1

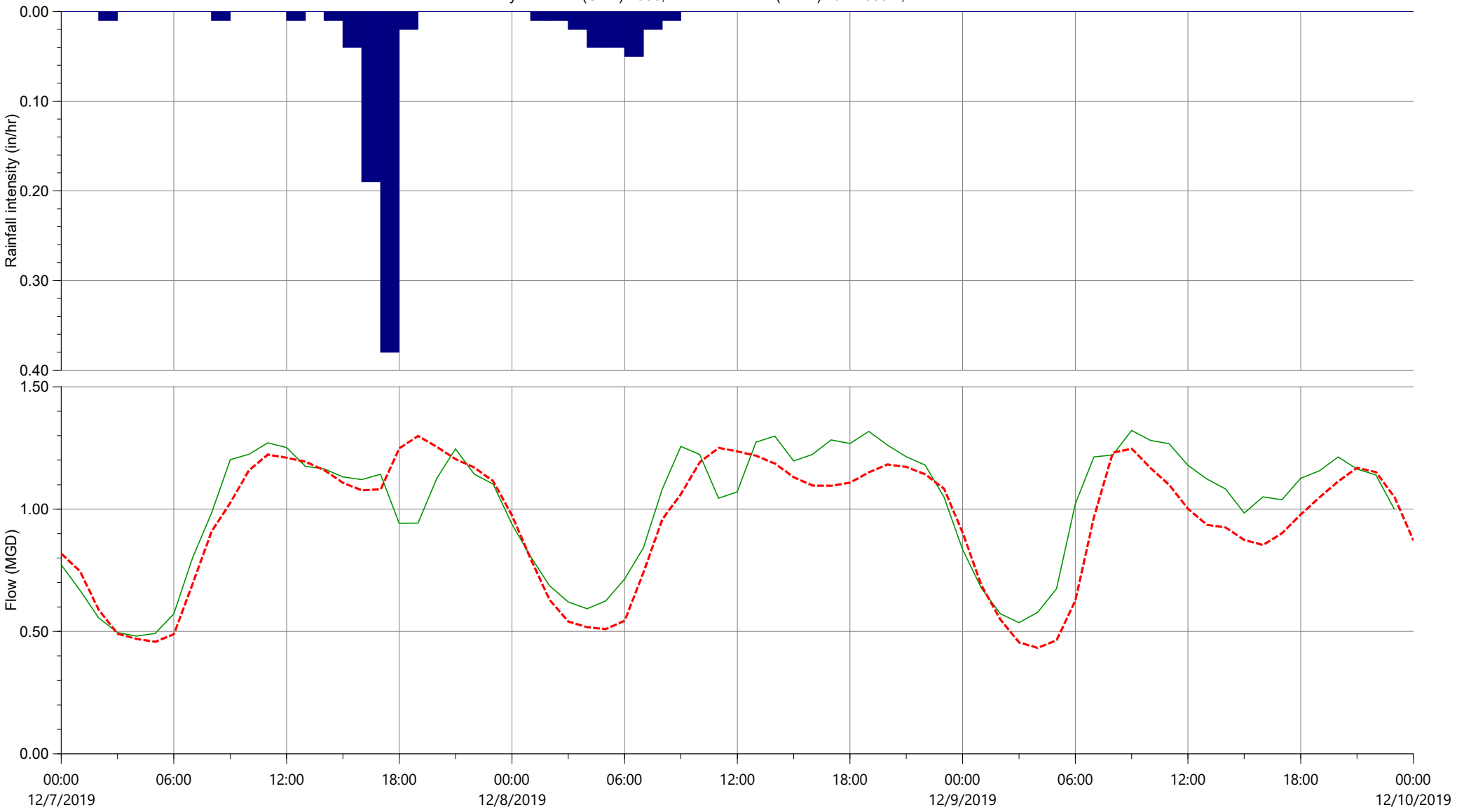


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.197	0.674	1.313
Model				0.129	0.680	1.325

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 2666, Model Location (Pred.) D/S 2666.1, Rainfall Profile: 1

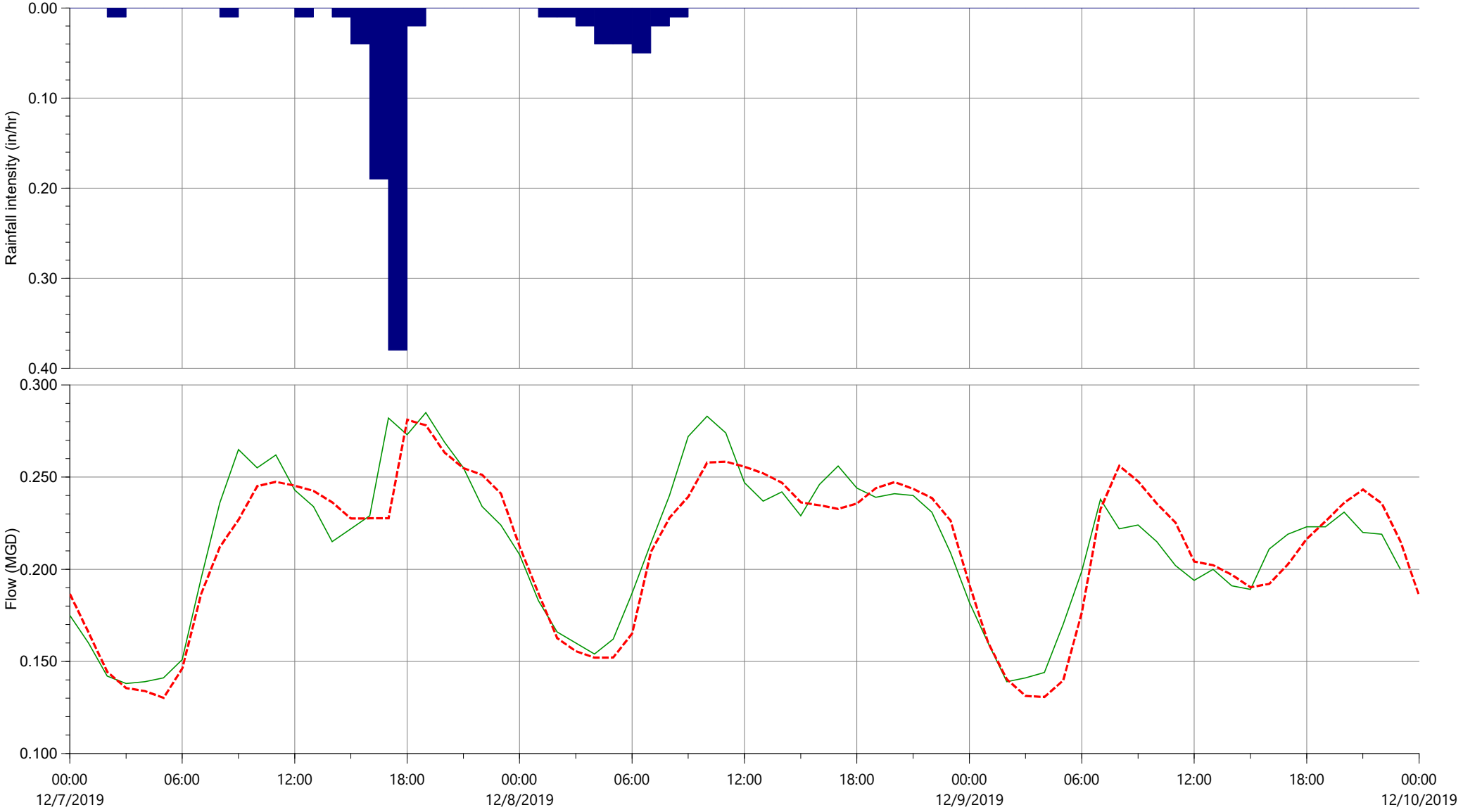


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.481	1.321	2.985
Model				0.433	1.299	2.858

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 2721, Model Location (Pred.) D/S 2721.1, Rainfall Profile: 1

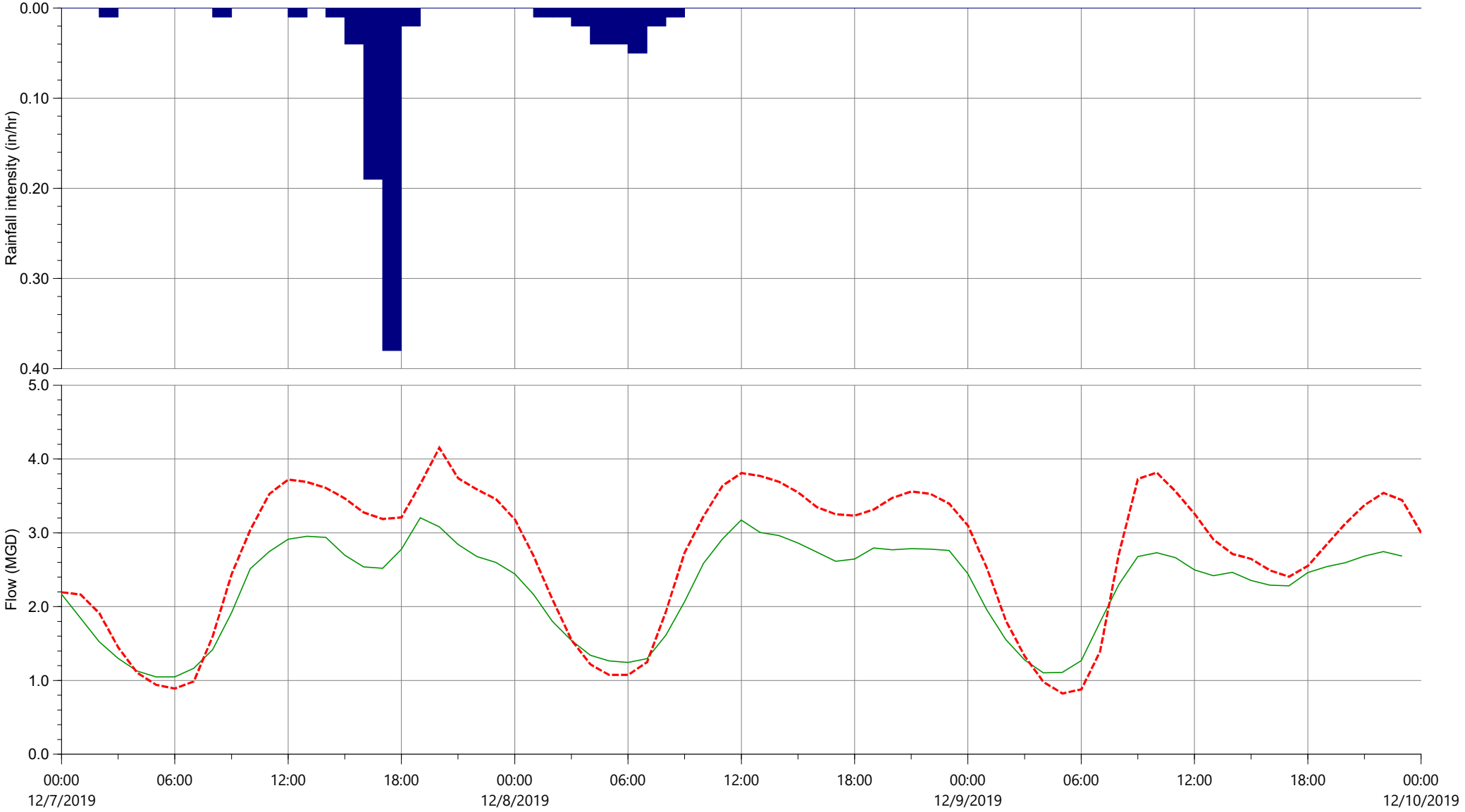


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.138	0.285	0.632
Model				0.130	0.281	0.635

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

Powered by InfoWorks®

Flow Survey Location (Obs.) 2724, Model Location (Pred.) D/S 2724.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				1.047	3.205	6.675
Model				0.824	4.153	8.127

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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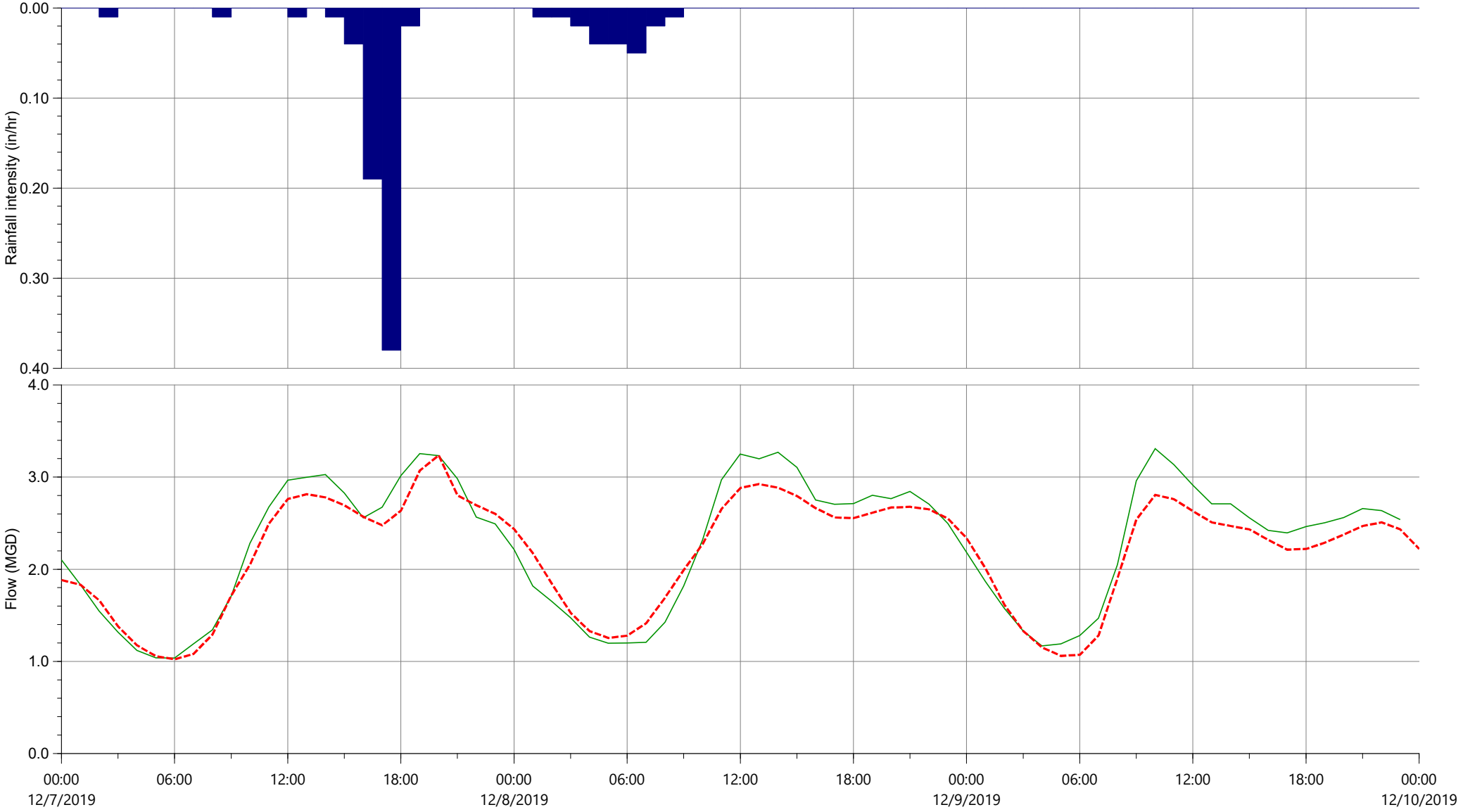
Flow Survey Location (Obs.) 2808, Model Location (Pred.) D/S 2808.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				1.036	3.308	6.717
Model				1.023	3.238	6.544

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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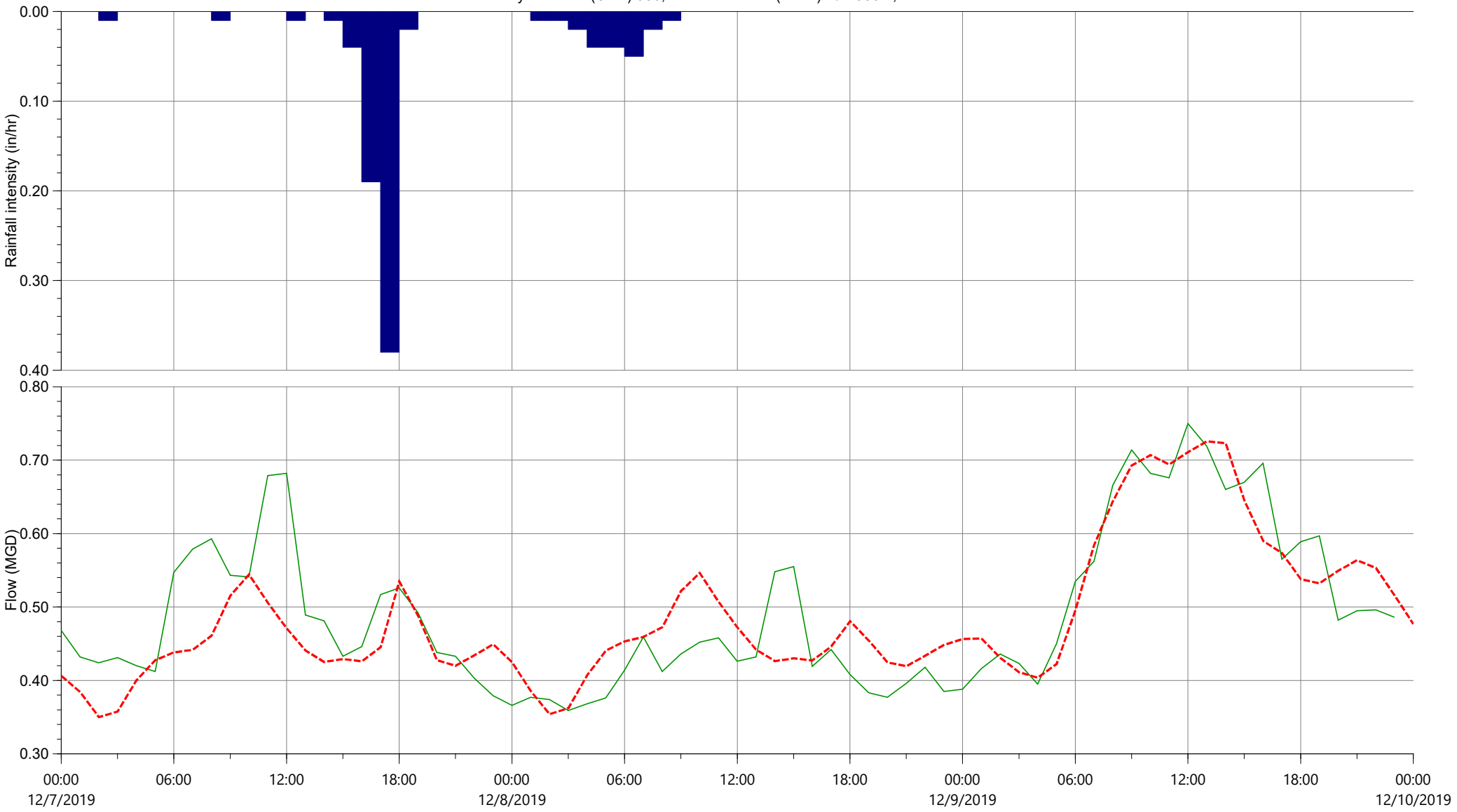
Flow Survey Location (Obs.) 386, Model Location (Pred.) D/S 386.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.359	0.750	1.454
Model				0.350	0.726	1.455

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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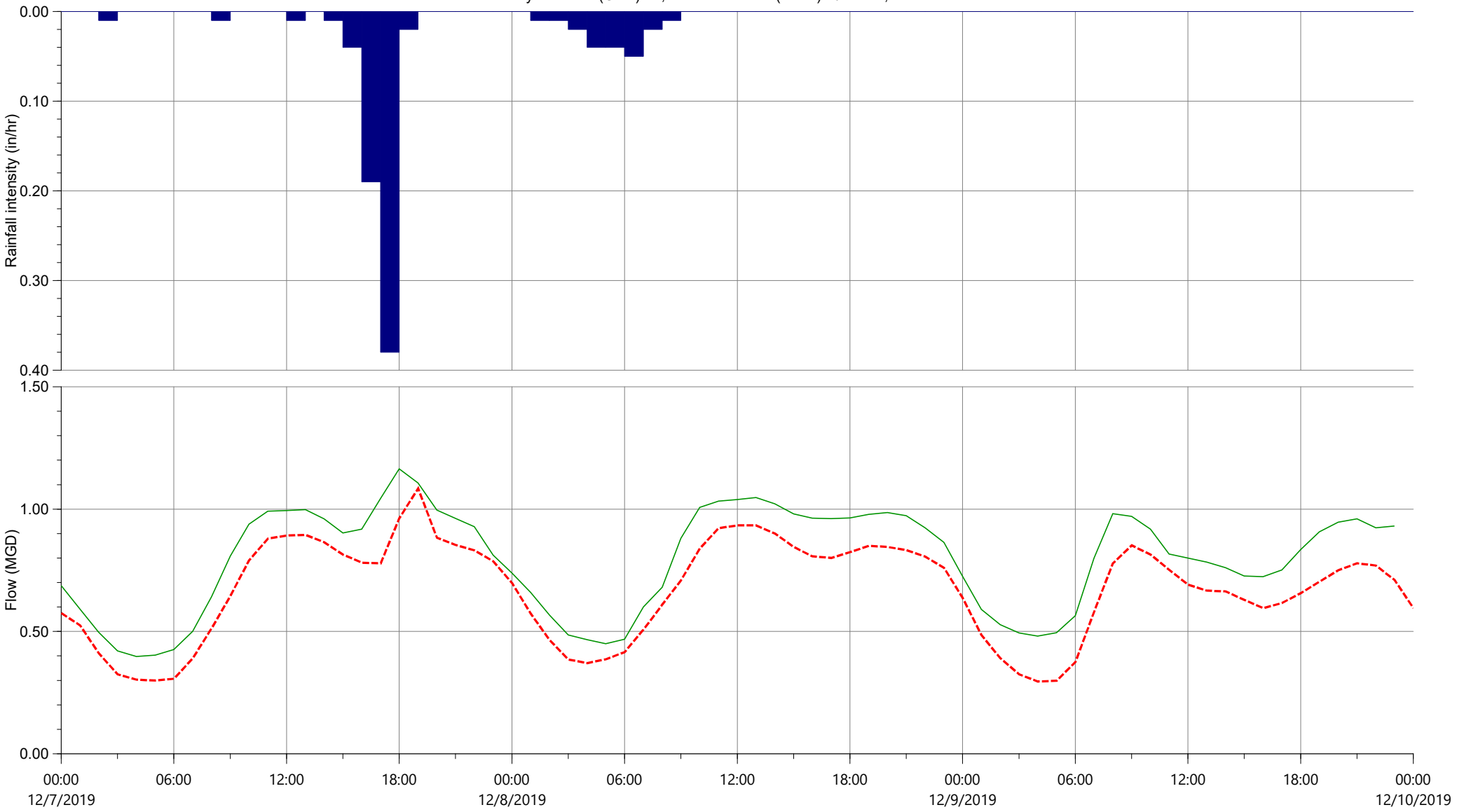
Flow Survey Location (Obs.) 41, Model Location (Pred.) D/S 41.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.398	1.165	2.351
Model				0.296	1.085	2.011

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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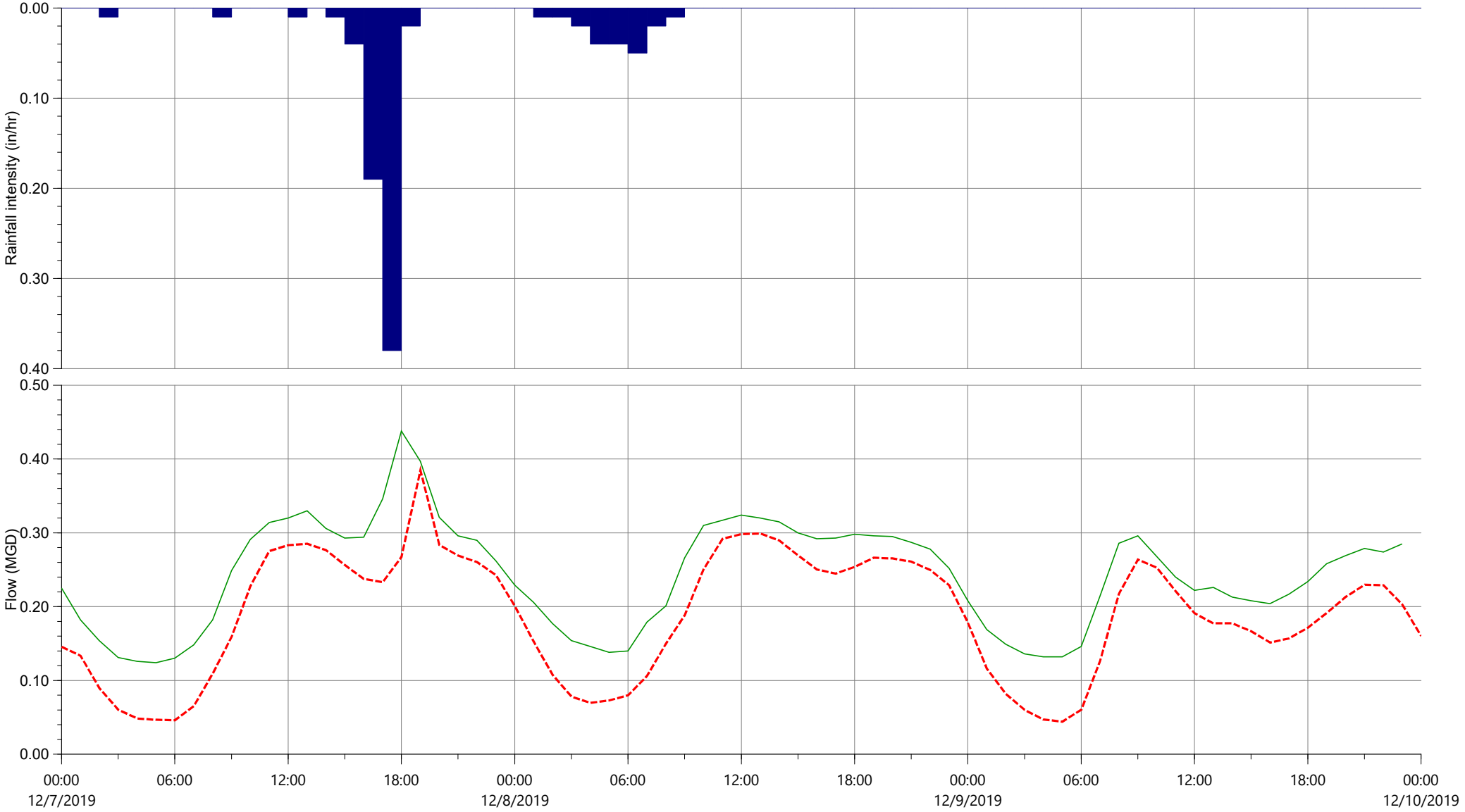
Flow Survey Location (Obs.) 592, Model Location (Pred.) D/S 592.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.124	0.438	0.715
Model				0.044	0.385	0.565

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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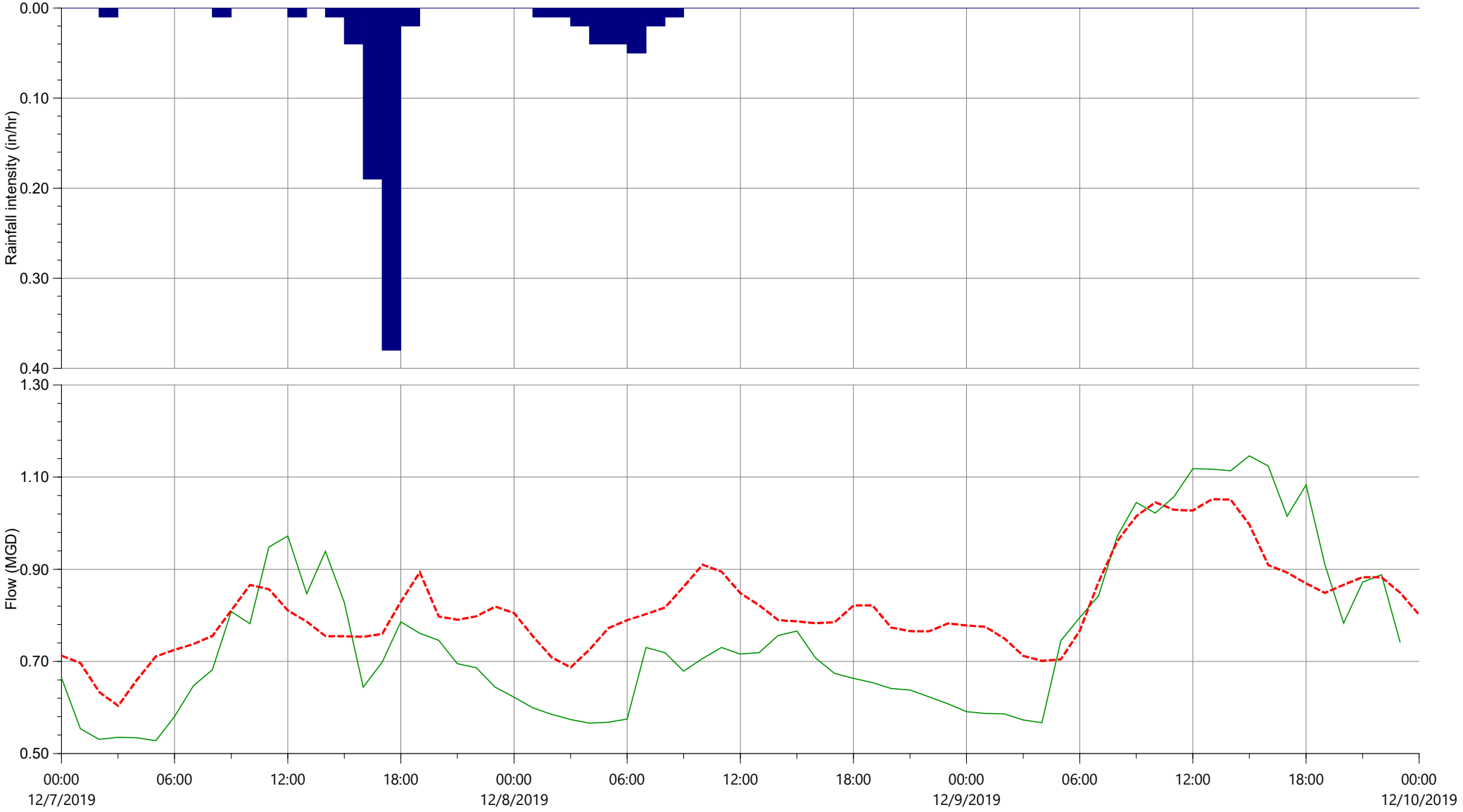
Flow Survey Location (Obs.) 649, Model Location (Pred.) D/S 649.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.528	1.146	2.227
Model				0.603	1.052	2.445

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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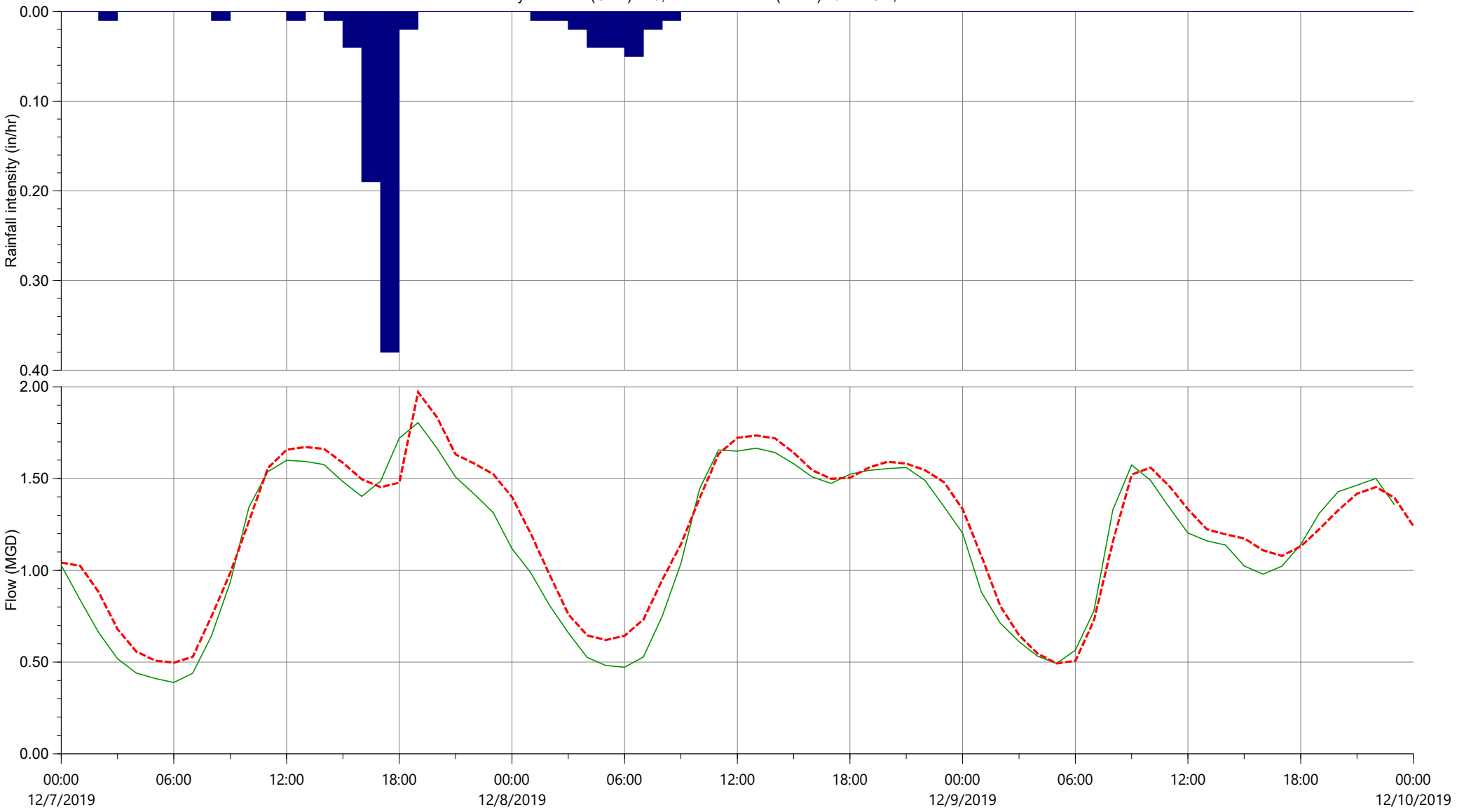
Flow Survey Location (Obs.) 715, Model Location (Pred.) D/S 715.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.388	1.804	3.408
Model				0.494	1.971	3.670

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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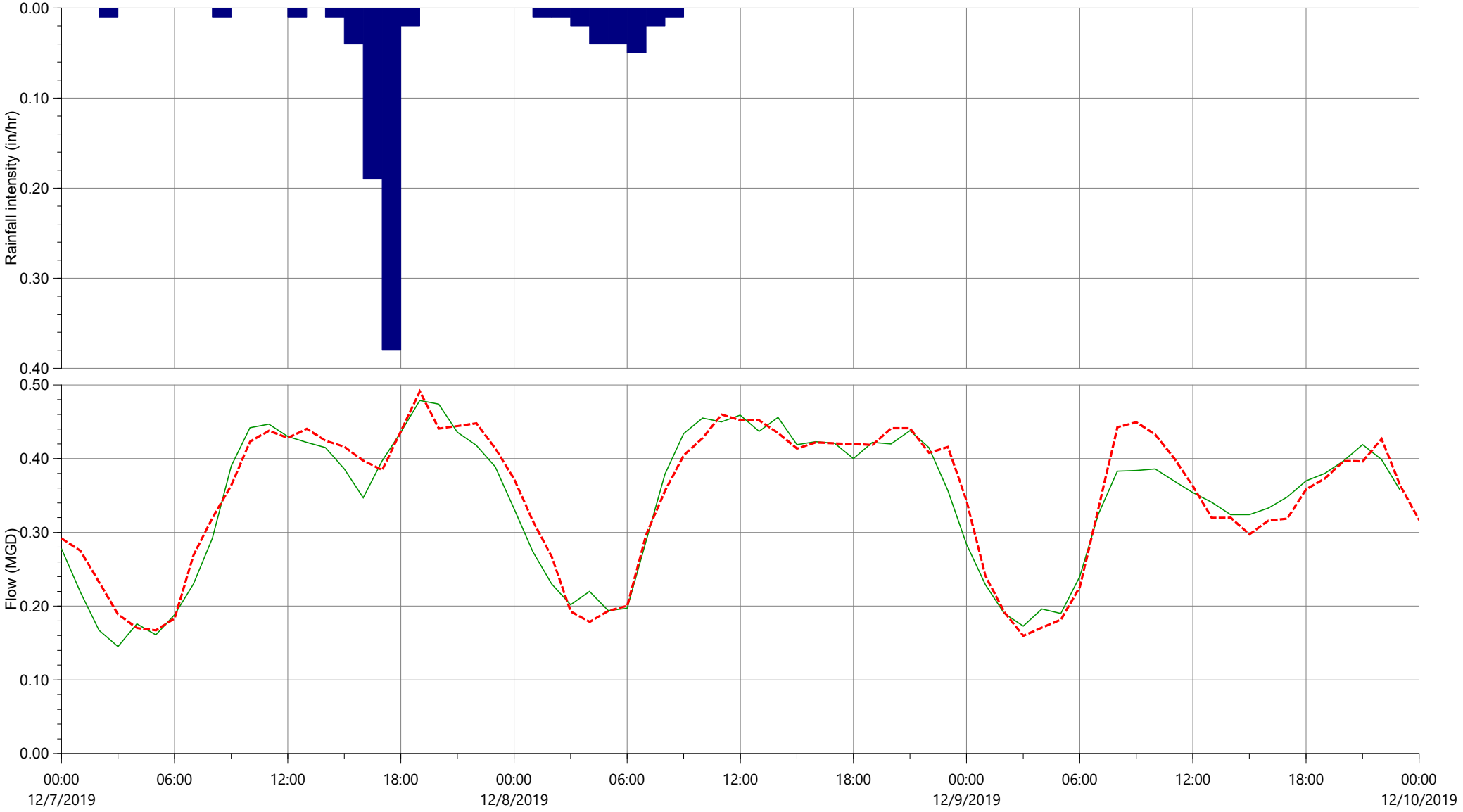
Flow Survey Location (Obs.) 744, Model Location (Pred.) D/S 744.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.870	0.380	0.012			
Observed				0.145	0.479	1.011
Model				0.160	0.492	1.047

Observed / Predicted Report (Custom graph) - Wet Weather Calibration FINAL

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APPENDIX F

City of Milpitas
Sewer Master Plan Study
Los Esteros Ranch Agreement

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DOCUMENT: 490116

Pages: 41

Fees.... * No Fees
Taxes...
Copies..
AMT PAID

BRENDA DAVIS
SANTA CLARA COUNTY RECORDER
Recorded at the request of
City

RDE # 003
11/25/2003
9:18 AM

Control No. 2003-008

Recording requested by:
City of Milpitas
When recorded mail to:
City of Milpitas
City Engineer's Office
455 E. Calaveras Blvd.
Milpitas, Ca 95035

Record without fee under Section 6103-Government Code, State of California

AGREEMENT BETWEEN THE CITY OF MILPITAS AND LOS ESTEROS RANCH PARTNERSHIP FOR USE OF CERTAIN CITY OF MILPITAS SANITARY SEWER AND WATER FACILITIES BY THE CITY OF SAN JOSE

This agreement ("Agreement"), is made and entered into this 6th day of August, 2003 ("Effective Date"), by and between the City of Milpitas, California, a general law city of the State of California ("Milpitas") and Los Esteros Ranch Partnership ("Property Owner"). Milpitas and Property Owner may be referred to herein individually as a "Party" or collectively as the "Parties" or the "Parties to this Agreement".

RECITALS

The purpose for which this Agreement is made, and all pertinent recitals, is described below:

A. Property Owner owns or leases certain real property located in the city of San Jose as shown on Exhibit A. The properties subject to this Agreement are Parcel 1, hereinafter referred to as the "East of McCarthy Boulevard Parcel", Parcel 2, hereinafter referred to as the "West of McCarthy Boulevard Parcel" and Parcel 3, hereinafter referred to as the "BFI Recyclery Parcel" ("Subject Properties"). Parcel 1 and Parcel 2 are jointly subject to the terms and conditions of San Jose PDC No. 99-09-078

and PD 01-084. Parcel 3 is subject to the terms and conditions of San Jose Planned Development Zoning PDC93-044, Planned Development Permit PD95-068, and Planned Development Permit Adjustments AD01-637 and AD02-679.

B. Property Owner wishes to be allowed to discharge sewage into the Milpitas-Owned Sewer System as shown on Exhibit B; and receive potable water from the Milpitas-Owned Water System.

C The City of Jose and Milpitas are preparing to enter into sewer and water agreements to enable the Subject Properties to receive sewage discharge and receive water services from the City of Milpitas without cost or expense to Milpitas ("City Agreements") attached hereto and incorporated herein as Exhibit C.

D. Property Owner, in consideration for Milpitas entering into the City Agreements, provides the commitments herein.

Therefore, in consideration of their mutual covenants, promises and undertakings, Property Owner and Milpitas agree as follows:

1. EFFECTIVE DATE

This Agreement will become effective immediately upon the execution of both the City Agreements by San Jose and Milpitas and this Agreement.

2. DEFINITIONS

For the purpose of this Agreement, the following words or terms shall have the following meanings, unless otherwise stated in this Agreement:

A. Milpitas-Owned Sewer System - "Milpitas-Owned Sewer Lines" means those sewer lines and related facilities including pump stations within the legal boundaries of Milpitas, or outside Milpitas where rights are defined by ownership of property, easements, public right of way or other agreements.

B. Milpitas-Owned Water System – "Milpitas-Owned Water Lines" means those water lines and related facilities within the legal boundaries of Milpitas, or outside Milpitas where rights are defined by ownership of property, easements, public right of way or other agreements.

3. LAND USE CONSENT

A. Property Owner acknowledges that the subject Property is located adjacent to the McCarthy Business Park and is in an area that serves as a gateway entrance to Milpitas. Milpitas, therefore, has a significant interest in ensuring that any new development or redevelopment on the subject Property is consistent and/or compatible with the McCarthy Business Park and with the City's goals for this gateway area. Property Owner hereby agrees that there shall be no new change in use, or other development, redevelopment, or change in design of the subject Property, or improvement thereon, without the prior consent of the Milpitas Planning Manager or employee with equivalent responsibilities.

B. Milpitas has reviewed and approved the terms and conditions of San Jose PDC99-09-078 and the plans for the development of the West of McCarthy Boulevard Parcel. Milpitas consents to this development receiving sewer and water service. All connections to Milpitas facilities will be performed at no cost to Milpitas.

C. No development has been initiated for the East of McCarthy Boulevard Parcel. Prior to any future development on this parcel receiving water and sewer service pursuant to the City Agreements, the Property Owner shall comply with Section 3.A of this Agreement.

D. The BFI Recyclery Parcel contains an existing use and improvements. This Agreement shall serve as Milpitas' consent to this parcel receiving sewer and water service from San Jose to serve this existing use.

4. INDEMNIFICATION

A. The City of San Jose has agreed to defend, hold harmless, and indemnify Milpitas, its elective and appointive boards and commissions; and its officers, agents, and employees for loss or damage to any person or entity, and to defend, indemnify, hold harmless and release Milpitas, its agents and employees, from and against any and all actions, regulatory proceedings, claims, damages, liabilities, fines, penalties, or expenses that may be asserted by any person or entity, including San Jose arising out of or in connection with the performance of the Agreement hereunder, whether or not there is concurrent negligence on the part of the Milpitas, but excluding liability due to the sole active negligence or sole willful misconduct of the Milpitas.

B. Property Owner has agreed to provide an indemnification to the City of San Jose which indemnifies that city to the full extent of its indemnification of Milpitas.

5. WAIVERS

Waiver by any party to this Agreement of any breach, default, or violation of any term or condition of this Agreement shall not be deemed to be a waiver of any other term or condition of this Agreement, or a waiver of any subsequent breach or violation of the same, or any other term or condition.

6. NOTICES

All notices and other communications required or permitted to be given under this Agreement shall be in writing and shall be personally served or mailed, postage prepaid and return-receipt requested, addressed to the respective Parties, or by facsimile, as follows:

To Property Owner: Los Esteros Ranch
c/o Mr. Will Oswald
1125 North Amphlett Blvd.
San Mateo, CA 94401

Copy To: Realty Law, LLP
c/o Joan Gallo
125 S. Market St. Suite 500
San Jose, CA 95112

To Milpitas: City Engineer
City of Milpitas
455 E. Calavaras Blvd.
Milpitas, CA 95035
Or by facsimile at (408) 586-3305

Notice shall be deemed effective on the date personally delivered or, if mailed, three (3) days after deposit in the mail.

7. NO TITLE OR PROPERTY RIGHTS CONFERRED

This Agreement is not intended to and shall not confer title or any other property right to Property Owner in any part of Milpitas Owned Sewer or Water Lines.

8. RECORDATION

This Agreement is intended to and shall run with the land. Property Owner shall cause this Agreement to be recorded within thirty (30) days after the effective date and shall provide a copy of the recorded document to Milpitas.

9. TERMINATION AND NONRENEWAL

The City Agreements give rights of termination to both cities. Milpitas shall immediately give notice to Property Owner of any violation under the City Agreements Termination clause. In addition, the City Agreements are subject to a limited term of twenty years with a provision that allows for an extension of not more than ten (10) years. Milpitas shall endeavor to provide property owners with one year advance notice should it determine for any reason that it will not extend either of the City Agreements. This Agreement shall terminate if such termination or refusal to extend by either City shall ever become effective. If in the future, for any reason, services to a property subject to this Agreement are provided by the City of San Jose, this Agreement shall terminate with respect to that property. In addition, each Property Owner may terminate this Agreement on ninety (90) days advance written notice to the City, at which time this Agreement will be of no further force or effect.

10. GOVERNING LAW

The law governing this Agreement shall be that of the State of California.

11. COMPLIANCE WITH LAWS

Parties agree to comply with all applicable laws, ordinances, codes and regulations of the federal, state and local governments.

12. VENUE

In the event that suit shall be brought by either Party to this Agreement, the Parties agree that venue shall be exclusively vested in the State Courts of the County of Santa Clara, or where otherwise appropriate, exclusively in the United States District Court, Northern District of California, San Jose, California.

13. PRIOR AGREEMENTS AND AMENDMENTS

This Agreement, including all Exhibits attached hereto, represents the entire understanding of the Parties as to those matters contained herein. No prior or written understanding shall be of any force or effect with respect to those matters covered hereunder.

14. INTERPRETATION OF AGREEMENT

The Parties to this Agreement acknowledge that each Party and their respective counsel have participated in the drafting and revision of this Agreement. Accordingly, the Parties agree that any rule of construction to the effect that ambiguities are to be resolved against the drafting party shall not apply in the interpretation of this Agreement or any Exhibit hereto.

15. THIRD PARTY BENEFICIARY

This Agreement shall be binding on and inure to the benefit of the Parties any owner, tenant or other person with an interest in the subject Properties.

16. AMENDMENT

This Agreement may be modified only by a written amendment duly executed by the Parties to this Agreement.

The Parties acknowledge and accept the terms and conditions of this Agreement as evidenced by the following signatures of their duly authorized representatives. It is the intent of the Parties that this Agreement shall become operative on the Effective Date.

PROPERTY OWNER

Will Oswald, Partner
Los Esteros Ranch Partnership

MILPITAS

Approved as to Form:

for Steven T. Mattas, City Attorney

By: Thomas J. Wilson
THOMAS WILSON
City Manager

ATTEST:

Gail Blalock, City Clerk

Attach Notary Certificate

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of CALIFORNIA

County of SAN MATEO

On AUGUST 6, 2003 (Date) before me, LORI L. HORN, NOTARY PUBLIC (Name and Title of Officer (e.g., "Jane Doe, Notary Public"))

personally appeared WILL OSWALD (Name(s) of Signer(s))

☐ personally known to me – OR – ☒ proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

LORI L. HORN
COMM. # 1284833
NOTARY PUBLIC • CALIFORNIA
SAN MATEO COUNTY
Comm. Exp. DEC. 17, 2004

WITNESS my hand and official seal.

Signature of Notary Public

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or Type of Document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____

☐ Individual
☐ Corporate Officer
Title(s): _____
☐ Partner — ☐ Limited ☐ General
☐ Attorney-in-Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: _____

Signer Is Representing:

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer's Name: _____

☐ Individual
☐ Corporate Officer
Title(s): _____
☐ Partner — ☐ Limited ☐ General
☐ Attorney-in-Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: _____

Signer Is Representing:

RIGHT THUMBPRINT OF SIGNER
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CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of California

County of Santa Clara } ss.

On 11-20-2003 (Date), before me, Gail A. Blalock Notary Public (Name and Title of Officer (e.g., "Jane Doe, Notary Public")),

personally appeared Thomas J. Wilson (Name(s) of Signer(s)),

☒ personally known to me
☐ proved to me on the basis of satisfactory evidence

to be the person(s) whose name(s) is/~~are~~ subscribed to the within instrument and acknowledged to me ~~that~~ he/~~she/they~~ executed the same in his/~~her/their~~ authorized capacity(~~ies~~), and that by his/~~her/their~~ signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

Gail A. Blalock
Signature of Notary Public

GAIL A. BLALOCK
Commission # 1283395
Notary Public - California
Santa Clara County
My Comm. Expires Dec 6, 2004

Place Notary Seal Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or Type of Document: Agreement for Sanitary Sewer & Water

Document Date: August 6, 2003 Number of Pages: 6 + exhibits

Signer(s) Other Than Named Above: Will Oswald

Capacity(ies) Claimed by Signer

Signer's Name: Thomas J. Wilson

☐ Individual
☒ Corporate Officer — Title(s): City Manager
☐ Partner — ☐ Limited ☐ General
☐ Attorney in Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: _____

Signer Is Representing: City of Milpitas

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

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William J. Wagner
Thomas A. Armstrong
Michael L. Morsilli
David M. Wilson
James E. Thompson

July 9, 2003
HMH 2734-01-099

EXHIBIT "A"

All that certain real property situate in the City of San Jose, County of Santa Clara, State of California, described as follows:

PARCEL A

A portion of that certain parcel of land described in the deed from J. E. Fifer and Ellie E. Fifer, His Wife, to A. M. Standish dated September 23, 1946 and recorded in Book 1534 Official Records at page 499, Santa Clara County Records, said portion being bounded and described as follows:

COMMENCING at a 3/4 inch iron pipe found in the Northerly line of said parcel conveyed from J. E. Fifer, et ux, to A. M. Standish at the Westerly line of a 60 foot strip of land conveyed by William Boots, et al., to the County of Santa Clara, by deed dated April 26, 1876 and recorded July 11, 1876 in Book 41 of Deeds, page 469, Santa Clara County Records, said 3/4 inch iron pipe being N. 34° 39' 00" E., 3209.7 feet from a one (1) inch bar found at the section corner common to Sections 1 and 2, Township 6 South, Range 1 West, M.D.B. & M. and Sections 35 and 36, Township 5 South, Range 1 West, M.D.B. & M. as surveyed by Mission Engineers, Inc., in April 1963.

THENCE, along said Westerly line of a 60 foot strip of land conveyed by William Boots, et al, to the County of Santa Clara, the following courses and distances:

S. 69° 34' 00" E., 473.39 feet; S. 9° 09' 00" E., 111.36 feet; S. 48° 59' 00" W., 99.64 feet; S. 77° 15' 00" W., 478.87 feet; N. 85° 56' 00" W., 250.14 feet;

Thence S. 53° 33' 00" W. a distance of 11.67 feet, more or less, to the point of intersection with the Easterly prolongation of the common boundary lines of Parcels 1 and 2 above described (the course of said common boundary being N. 89° 58' 00" W.); thence N. 89° 58' 00" W. along said Easterly prolongation of said common boundary line a distance of 122.09 feet, more or less, to the Southeasterly corner of said Parcel 1 above described; thence along the Easterly boundary line of said Parcel 1 N. 43° 02' 00" E. a distance of 595.61 feet to a one (1) inch iron pipe in the said Northerly line of the said parcel conveyed to A. M. Standish; thence along said Northerly line S. 89° 58' 00" E., a distance of 55.46 feet to the point of commencement.

Being a portion of the Swamp and Overflow Survey No. 59 in Section 36, Township 5 South, Range 1 West, M.D.B. & M.

1570 Oakland Road, Suite 200 • P.O. Box 611510 • San Jose, CA 95161-1510 • Tel: (408) 487-2200 • Fax: (408) 487-2222
4456 Black Avenue, Suite 100 • Pleasanton, CA 94566-6147 • Tel: (925) 600-7335 • Fax: (925) 600-8895
7951 Wren Avenue, Suite D • Gilroy, CA 95020-4903 • Tel: (408) 846-0707 • Fax: (408) 846-0676

PARCEL B

BEGINNING at a point on the general Southerly line of that certain parcel of land described in the Deed from J. E. Fifer et ux to A. M. Standish, recorded December 1, 1947 in Book 1534, Official Records, at page 499, Santa Clara County Records distant thereof North 77° 15' 00" East 175.16 feet from the Southwesterly terminus of that certain course designated as North 77° 15' 00" East, 478.87 feet; thence leaving said point of beginning along said general Southerly line North 77°15' 00" East 279.04 feet to a point hereinafter referred to as Point "A"; thence leaving said general Southerly line from a tangent bearing of South 42° 14' 45" West along a curve to the right with a radius of 190.00 feet through a central angle of 48° 03' 04" for an arc length of 159.34 feet and North 89° 42' 11" West, 130.53 feet to the point of beginning.

PARCEL THREE

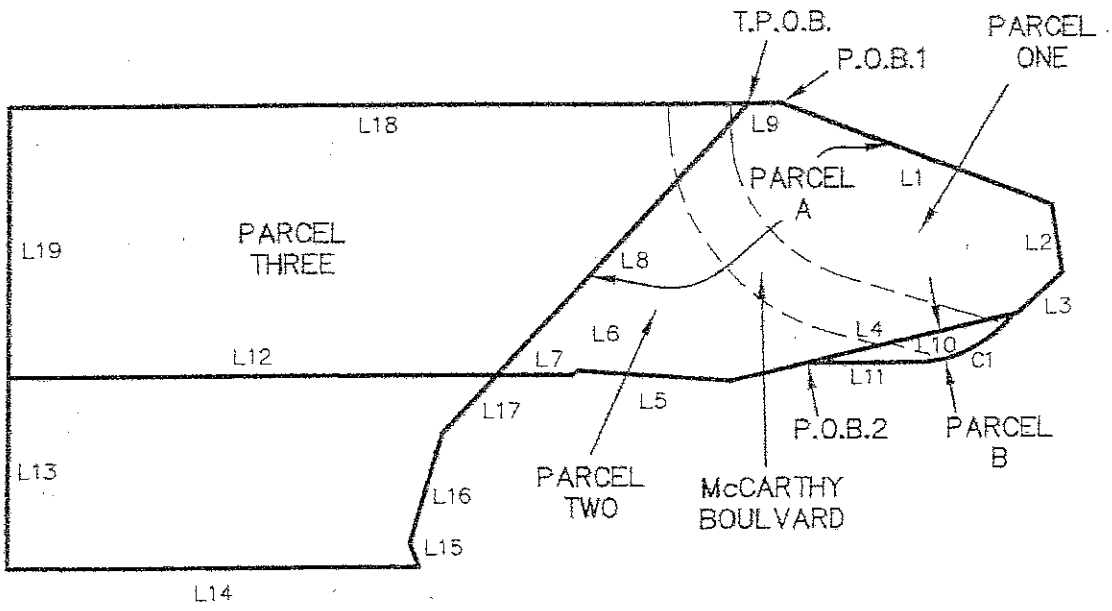
A portion of that certain parcel of land described in the deed from J. E. Filer and Ellie E. Filer, his wife, to A. M. Standish dated September 23, 1946 and recorded in Book 1534 Official Records at page 499, Santa Clara County Records, said portion being bounded and described as follows:

COMENCING at a 3/4 inch iron pipe found in the northerly line of said parcel conveyed from J. E. Filer, et ux to A. M. Standish at the westerly line of a 60 foot strip of land conveyed by William Boots, et al., to the County of Santa Clara, by deed dated April 26 1876 and recorded July 11, 1876 in Book 41 of Deeds, page 469, Santa Clara County Records, said 3/4 inch iron pipe being N. 34° 39' 00" E.,3209.7 feet from a one (1) inch bar found at the section corner common to Sections 1 and 2, Township 6 South, Range 1 West, M.D.B.& M. and Sections 35 and 36; Township 5 South, Range 1 West, M.D.B.& M. as surveyed by Mission Engineers, Inc. in April, 1963.

THENCE, on and along the said northerly line of said parcel conveyed to A. M. Standish N. 89° 58' 00" W., 55.46 feet to a one (1) inch iron pipe and the TRUE POINT OF COMMENCMENT.

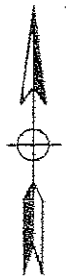
THENCE, along said northerly line N. 89° 58' 00" W., 1203.10 feet to a one (1) inch iron pipe; thence, S. 0° 02' 00" W., 435.60 feet to a one (1) inch iron pine; thence, S. 89° 58' 00" E., 796.90 feet to a one (1) inch iron pipe; thence, N. 43° 02' 00" E., 595.61 feet to the true point of commencement.

And being a portion of the Swamp and Overflow Survey No. 59 in Section 36, Township 5 South, Range 1 West, M.D.B.& M.



LINE	BEARING	DISTANCE
L1	S69°34'00"E	473.39'
L2	S09°09'00"E	111.36'
L3	S48°59'00"W	99.64'
L4	S77°15'00"W	478.87'
L5	N85°56'00"W	250.14'
L6	S53°33'00"W	11.67'
L7	N89°58'00"W	122.09'
L8	N43°02'00"E	595.61'
L9	S89°58'00"E	55.46'
L10	N77°15'00"E	279.04'
L11	N89°42'11"W	130.53'
L12	S89°58'00"E	796.90'
L13	S00°02'00"W	310.52'
L14	S89°58'00"E	671.84'
L15	N22°54'00"W	41.59'
L16	S16°40'00"W	185.40'
L17	N43°02'00"E	129.32'
L18	N89°58'00"W	1203.10'
L19	S00°02'00"W	435.60'

CURVE	RADIUS	DELTA	LENGTH
C1	190.00'	48°03'04"	159.34'





GRAPHIC SCALE
1 INCH = 300 FT.

SHEET 1 OF 1

Date:	7-09-03
Scale:	1"=300'
Designed:	–
Drawn:	dt
Checked:	DT
Proj. Engr.:	–
Dwg Name:	2734PL11

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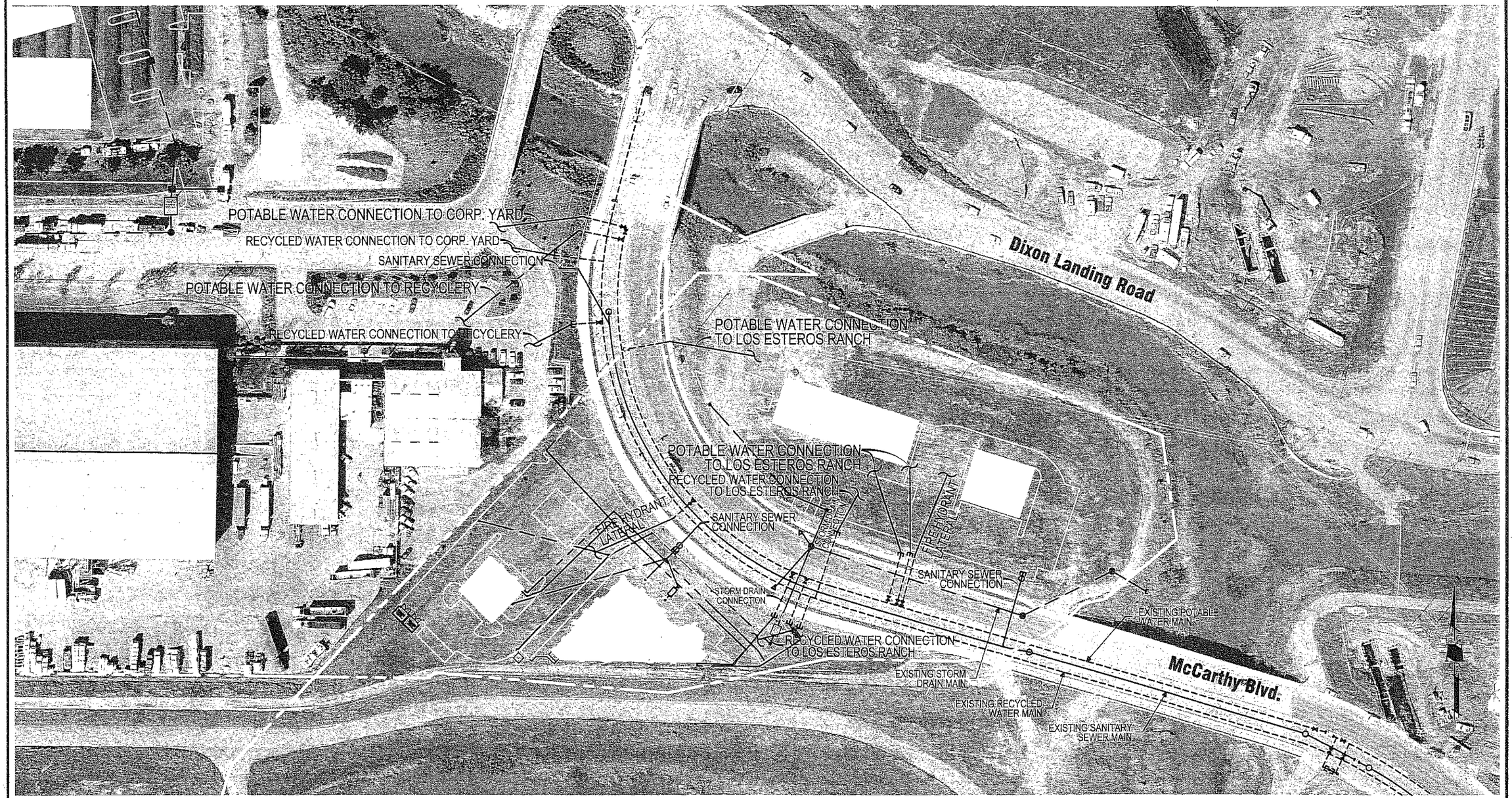
PLAT TO ACCOMPANY
EXHIBIT "A"
LOS ESTEROS RANCH PROPERTIES"
SAN JOSE CALIFORNIA

20030709.1113

EXHIBIT B

LEGEND

POTABLE WATER LINE	EXISTING	PROPOSED	SANITARY SEWER	EXISTING	PROPOSED
RECYCLED WATER LINE	EXISTING	PROPOSED	STORM DRAIN	EXISTING	PROPOSED



BY	DATE	REVISIONS

The Los Esteros Ranch
1125 N. Amphlett
San Mateo, CA 94401

Date:	7.29.03
Scale:	1"=100'
Designed:	DRR
Drawn:	JAM
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Proj. Engr:	DRR
File:	273401EX04

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The Los Esteros Ranch - Site One & Two
BFI Proposed Corporation Yard
Utility Connections

Sheet 1 of 1 Sheets
JOB NUMBER 2734-01

LEGEND

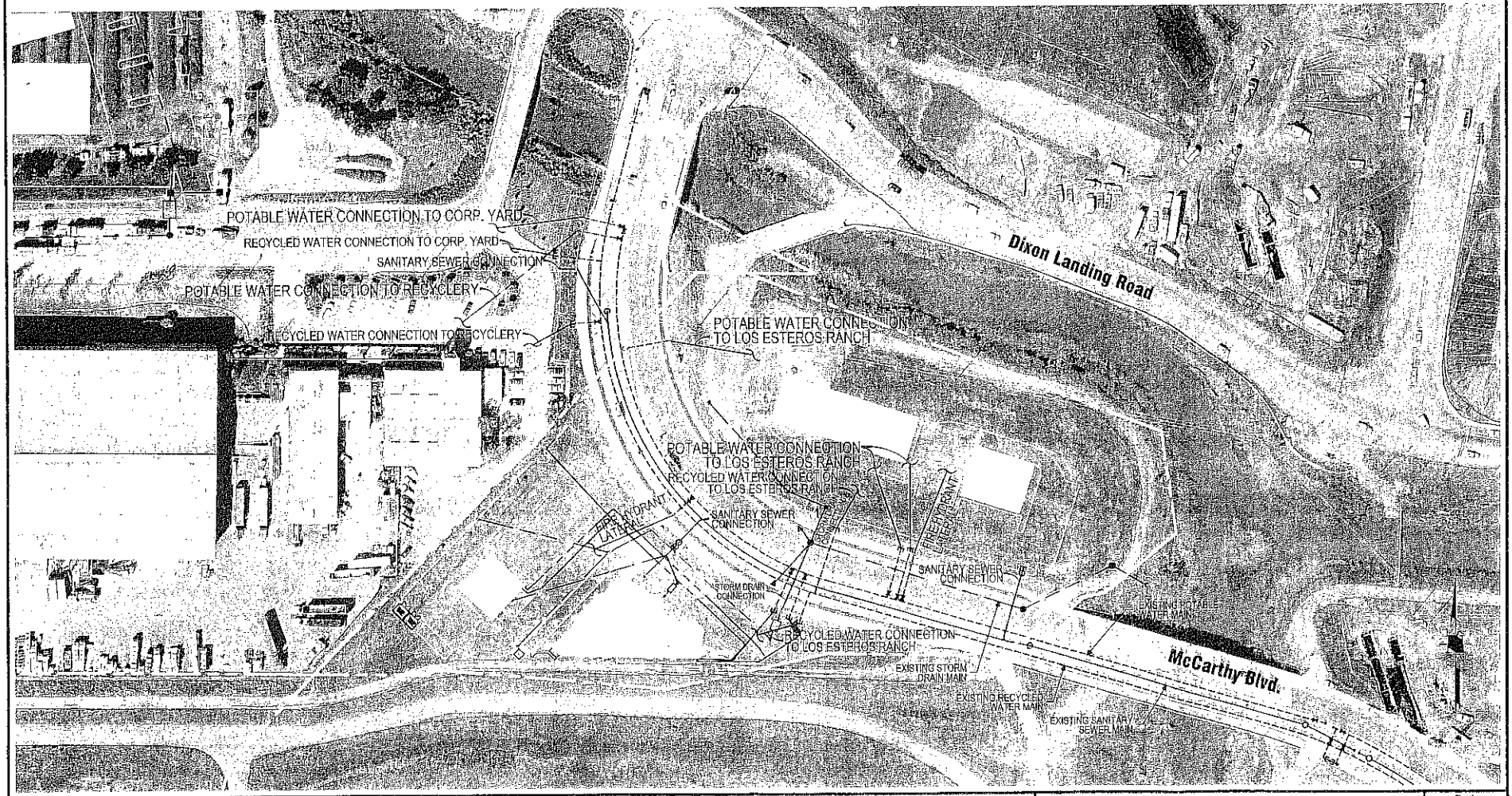
EXISTING ---------- POTABLE WATER LINE ———— PROPOSED

EXISTING ---------- RECYCLED WATER LINE ———— PROPOSED

EXISTING ———— SANITARY SEWER ———— PROPOSED

EXISTING ———— STORM DRAIN ———— PROPOSED

EXHIBIT B



BY	DATE	REVISIONS

The Los Esteros Ranch
1125 N. Amphlett
San Mateo, CA 94401

Date:	7.28.03
Scale:	1"=100'
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Drawn:	JAM
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Proj. Engr:	DRR
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The Los Esteros Ranch - Site One & Two
BFI Proposed Corporation Yard
Utility Connections

Sheet 1 of 1 Sheets
JOB NUMBER 2734-01

EXHIBIT C

City Agreements

APPENDIX G

City of Milpitas
Sewer Master Plan Study
Sanitary Sewer Force Main Cleaning and CCTV Inspection
Project Report

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PROJECT REPORT

SANITARY SEWER FORCE MAIN CLEANING AND CCTV INSPECTION

CITY OF MILPITAS
ENGINEERING DEPARTMENT
PREPARED BY: LYHAK EAM, P.E.
REVIEWED BY: MICHAEL SILVEIRA, P.E.
DATE: FEBRUARY 22, 2021



EXECUTIVE SUMMARY

The City of Milpitas sanitary sewer system consists of two force mains that carries the City's wastewater from the City of Milpitas Main Lift Sewer Pump Station at North McCarthy Boulevard to the San Jose-Santa Clara Regional Wastewater Treatment Plants. Force Main A and B were constructed in 1974 and 2000, respectively. The objective of this project was to perform an internal assessment of Force Main A ("FM-A"), but it was not possible to complete within budget due to unforeseen conditions and challenges. Engineering Department reported the findings to Public Works and recommends FM-A be either rehabilitated or replaced due to the its condition and age.

PROJECT BACKGROUND

Cathodic Protection Improvement Project No. 6131 ("Project") is in the approved Capital Improvement Program 2020-2025. The Project provides for the replacement of two existing mag meters at the Milpitas Main Lift Station, installation of cathodic protection system along the FM-A, removal or abandonment of the existing diverter valve vault near the Coyote Creek, evaluation and renovation of existing pinch valve vaults, and an assessment of FM-A. Per the "Water Pollution Control Facilities Project" record drawing dated April 1972 (**Attachment A),** FM-A is approximate 12,000 feet including 12 access manholes spaced approximately 1,000 feet apart. The force main extends from the Main Lift Pump Station, crossing under the Coyote Creek as a siphon, going underneath San Jose Residual Sludge Management (RSM) drying beds (Lagoons) and Zander Road, and connecting to the San Jose-Santa Clara Regional Wastewater Treatment Plants. (***Figure 01)***.

JDH Corrosion Consultant, Inc. was retained to perform an indirect pipe assessment by using a Close Interval Survey (CIS) to measure the soil corrosivity surrounding the FM-A. The survey concluded the soils are inherently very corrosive and can potentially corrode and damage the steel force main (**Attachment B**). Based on the survey and the age of the system, Pipe and Plant Solutions Inc (PPSI) was retained to perform the cleaning and CCTV inspection to assess the internal condition of the force main. The work included site investigation of all sewer manholes, replacement of any corroded bolts and gaskets as needed, clearing and grubbing surrounding areas for safe and secure access, removal and disposal of any debris from the sanitary sewer force main, and performing CCTV inspection.



***Figure 1**- Ariel Map of City Force Mains*

SITE INVESTIGATION FINDINGS/CHALLANGES

The following is a summary of findings/challenges that Engineering staff encountered during the site investigation.

1. RIGHT-OF-WAY/PERMITTING PROCESS

The entire FM-A (**Figure 02**) is located within the Santa Clara-San Jose Wastewater Treatment Plant property, and the City of Milpitas has an easement to maintain and operate the facility at any time (**Attachment B**). Without any additional provisions or requirements mentioned in the easement, the City of San Jose requires the City of Milpitas to enter into Right of Entry agreement (**Attachment C**) to access the City right-of-way for any work. The City attorney reviewed the languages in the easement and re-affirmed that the City of Milpitas has the right to access and perform work necessary without any further restriction by San Jose. Due to the schedule and need to investigate the FM-A, Engineering applied for a Right of Entry permit and tabled the discussion of the City of Milpitas rights to their Right of way. The permit process took approximately 3 months.



***Figure 2**- Force Main A Alignment*

In addition, the City is required to obtain an encroachment permit from Santa Clara Valley Water District (Valley Water) to access manhole #1 because of its close proximity to Coyote Creek that falls under their jurisdiction (**Figure 3**). At the time, Valley Water issued a permit for pedestrian access for site investigation search of the manhole with no excavation allowed. To obtain a vehicle access permit, the Valley Water will require an environmental assessment of invasive plants in the area. The assessment shall include the impacts of the work and any mitigation measures to preserve the surrounding area.

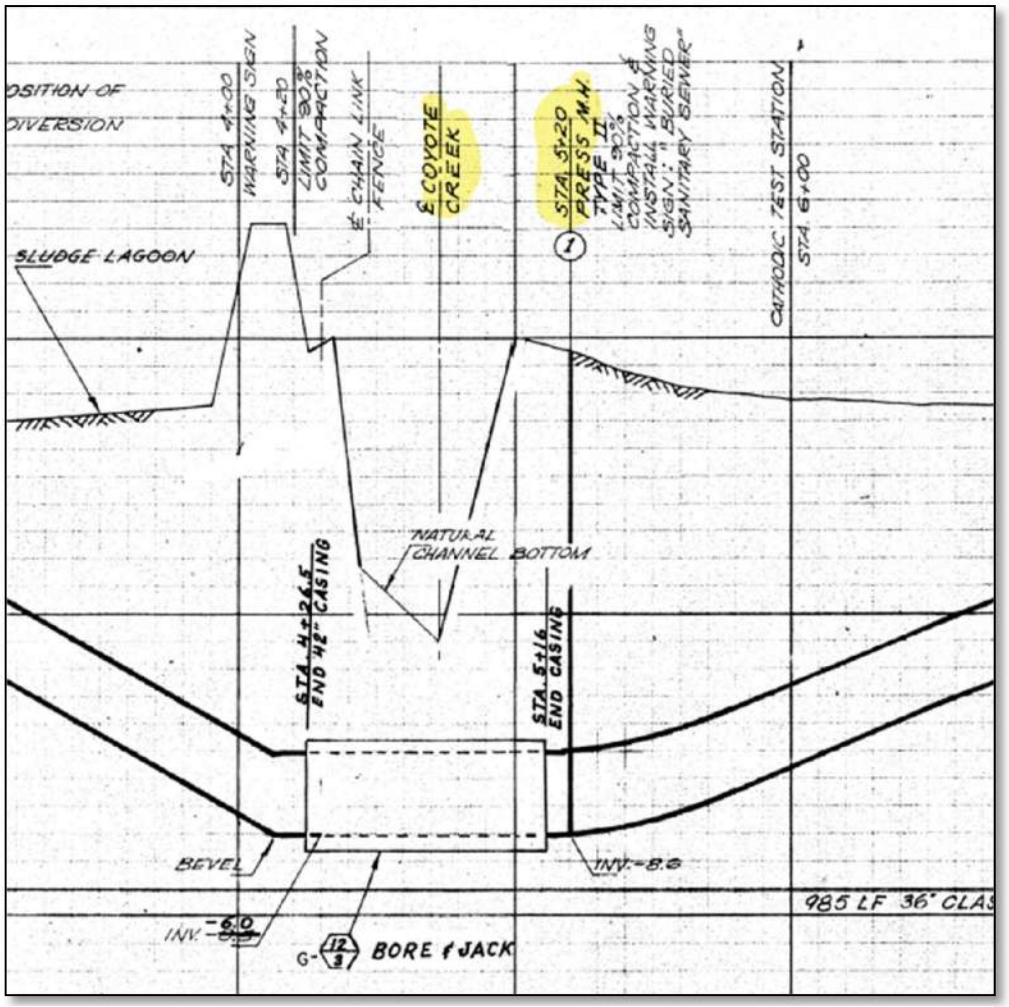

***Figure 3**- Manhole #1 Location Per As built*

2. MISSING MANHOLES

After securing necessary permits, the contractor began to locate and assess all the manholes to access FM-A for cleaning and CCTV inspection. The contractor was able to locate manhole #2-6, 9-12, but unable to locate manhole #1, 7, and 8.

Manhole #1: Per Record Drawings, the manhole is located adjacent to Coyote Creek (**Figure 04**) under District jurisdiction. The manhole was not found because the permit issued by Valley Water is limited to pedestrian access and no excavation or removal of vegetation allowed. In order to locate the manhole, heavy equipment will have to be used to excavate and remove the vegetation around the area.



***Figure 4**: Force Main Manhole #1 Location*

Manhole #7: Per Record Drawings, the manhole is approximate 972 feet from manhole #6 (**Figure 05**). Contractor was unable to locate the manhole and speculated it is buried under the existing access road.



Figure 5: *Force Main Manhole #7 Location*

According to the force main profile shown in **Figure 06**, manhole #7 is a critical access point to remove debris from pipe segment between manhole 6-7, 7-8 & 8-9 because it is the low point in the system.



Figure 6: *Force Main Profile*

Manhole #8: Contractor searched for the manhole without success but found a 30' high vertical pipe where the manhole should be located as shown in **Figure 07**. It is assumed the manhole was modified for this vertical pipe. Public Works staff does not have knowledges or the functionality of this pipe. The City does not have existing records of this modification.



***Figure 7**: Force Main Manhole #8 Location*

3. CORRODED MANHOLES' COMPONENTS

The Contractor investigated available manholes and the internal components including air release valves, bolts, gaskets and blind flanges. The components in manholes #9-12 appeared to be in good conditions. However, components in manholes #2 – 6, located in the lagoon area, are significantly corroded and not functional, see **Figure 8 &9.**

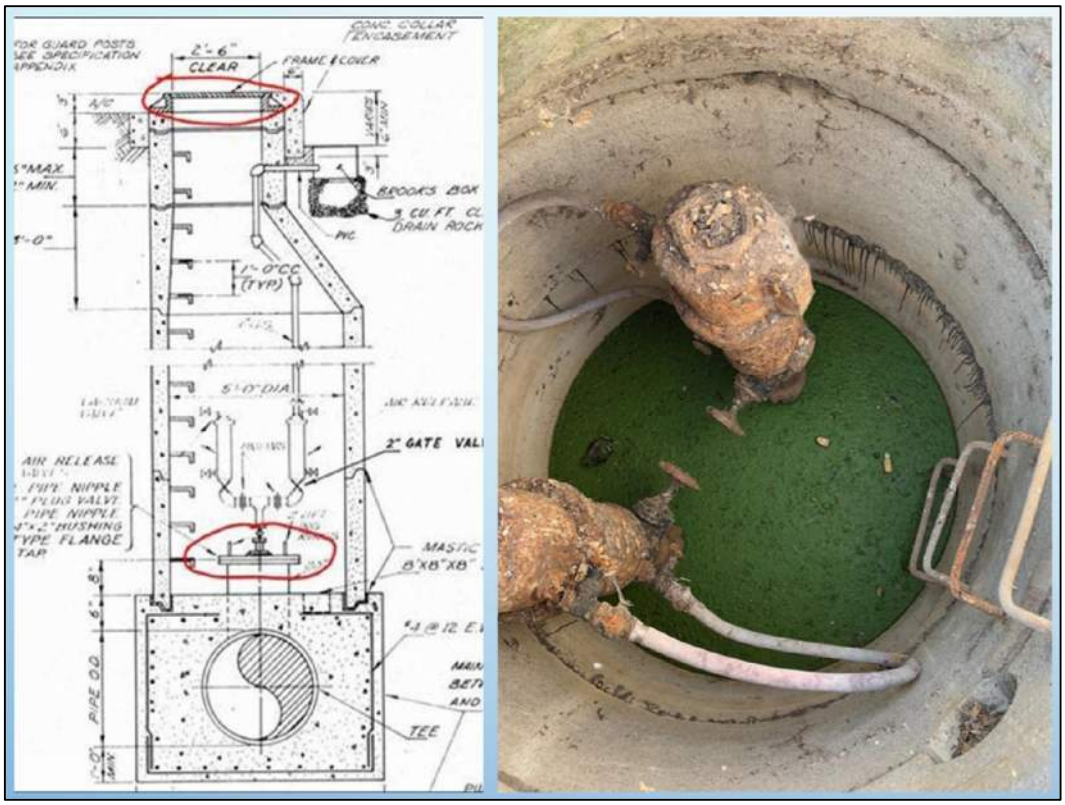

***Figure 8**: Force Main Manhole*



***Figure 9**: Corroded Air Release Valve and Blind Flange*

In order to access the force main at manholes, both air release valves and blind flanges must be removed. Since components at manhole #2-6 are significantly corroded, they must be replaced to ensure the force main is properly sealed. The cost of replacing these components with stainless steel is approximately $25,000, which is not included in the project scope and budget. Therefore, the cleaning and CCTV inspection of the segments between manhole #2-6 were postponed until the aforementioned issues are resolved.

4. HIGH LEL AND H2S GAS LEVELS

During first attempt of the removal of the blind flange at MH#12, the Contractor encountered H2S and LEL gases levels that were beyond the maximum value of 100%, which was considered very hazardous. The Contractor had to immediately seal the blind flange and evacuate the area. It was assumed that the existence of high gas levels was due to the stagnant wastewater in the force main for approximate 4 weeks and could not be completely flush out of the system due to challenges accessing the system. Not knowing the exact source of the gases, staff recommended to resume the operation of the FM-A for 48-hours in the hope the gas would dissipate. The strategy was successful, and the Contractor was able to access the manhole safely. The source of the gases were not determined and may appear again in future work if the wastewater is stagnant for a period of time.

5. SEWER OVERFLOW INCIDENT AND UNFUNCTIONAL SLIDE GATE

After resolving the gas issue, Public Works switched the wastewater operation from Force Main A to Force Main B (FM-B) to allow the Contractor to access manhole #12. As the contractor began to remove the blind flange, effluent started to overflow out of the manhole as shown in **Figure 10**. The overflow was a result from the wastewater from FM-B backflowing into FM-A at the Milpitas structure (**Figure 11**). Both FM-A and FM-B are connected directly to the Milpitas structure (**Figure 12)** that serves as a detention basin to receive and store all effluent before sending down to the Plant for treatment via an overflow weir wall.

In order to prevent the backflow from FM-B to FM-A, the FM-A sliding gate in the structure needs to be closed which is currently non-operational. Public Works shut down both force mains to stop the

overflow and allow the contractor to re-install the blind flange. The non-functional sliding gate caused effluent to backflow into the entire system because the elevation of force main A is lower than the Milpitas Structure. Such condition will create the potential overflow situation at other manholes similar to that encountered at manhole #12. To conduct any inspections of FM-A by CCTV, the sliding gate needs to be repaired to isolate the force main from one another.

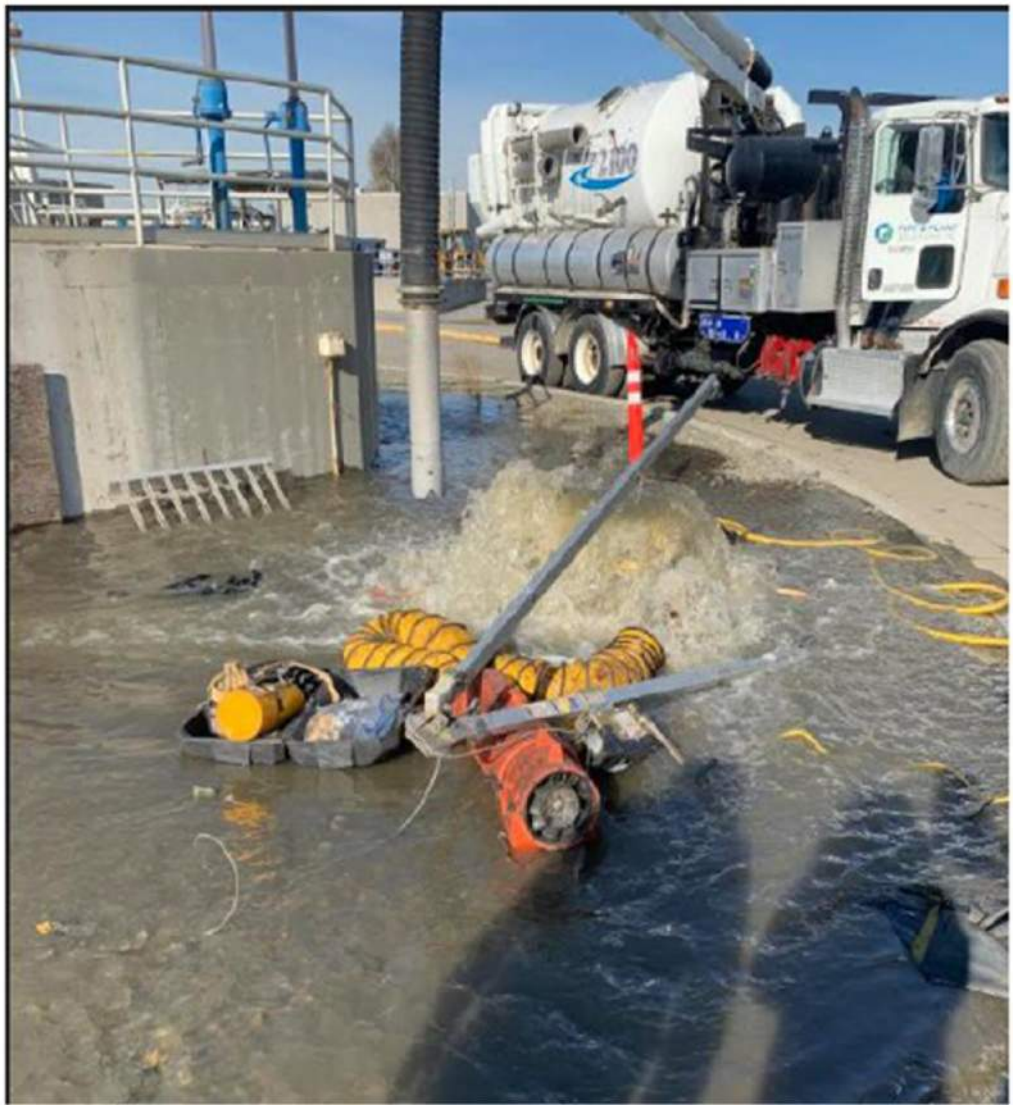

Figure 10: *Sewer Overflow at MH #12*

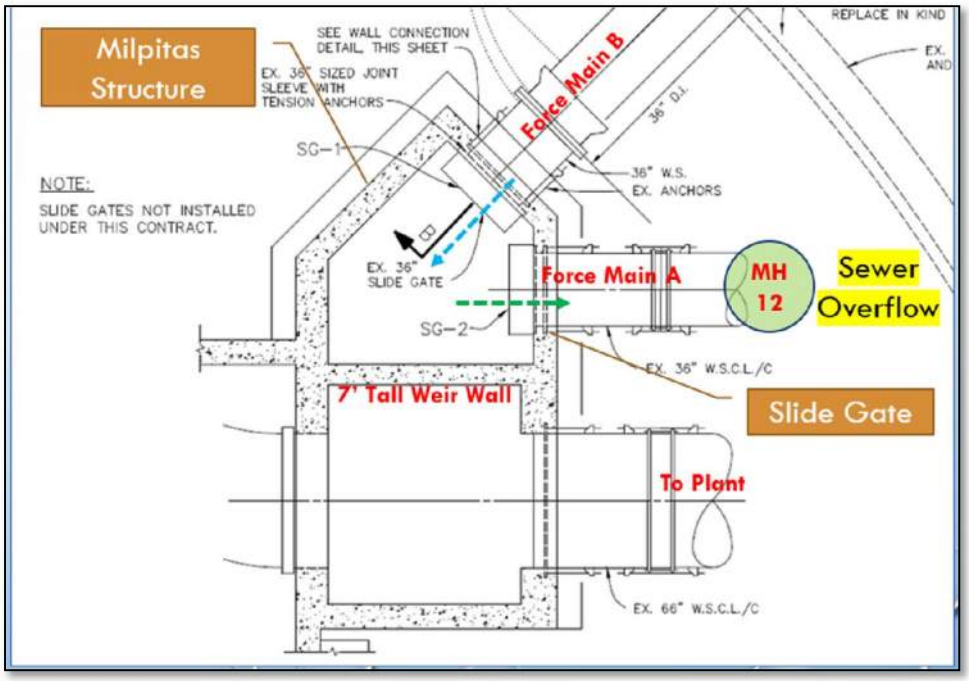

Figure 11: *Milpitas Structure Drawing*



Figure 12*: Milpitas Structure*

CONCLUSION

Due to numerous issues as described, the following tasks shall be completed prior to performing the cleaning and CCTV inspection of the force main.

1. Locate all missing manholes along the force main including manholes #1, 7, and 8.
2. Replace all corroded air release valves and blind flanges for manhole #2 to #6.
3. Repair slide gate at Milpitas Structure so that the FM-A can be isolated from the structure itself.

Based upon this preliminary evaluation, the cost to complete the cleaning and CCTV inspection and all associated work is approximate $ 850,000. The following is the summary of the cost breakdown.

Description	Cost
Cleaning and CCTV inspection	$350,000
Replacement of (6) manholes' parts (bolts, blind flange, gasket, ARV)	$150,000
Repair slide gate and bypass pumping	$150,000
Permitting process	$30,000
Bidding process and construction administration	$30,000
Construction contingency (20%)	$140,000
TOTAL	$850,000

It is assumed the condition of the force main is deteriorating and doesn't meet industrial standards due to the age of the system, level of soil corrosivity surrounding the steel pipe, and the minimal routine maintenance since it was installed in 1974. The City should consider to either rehabilitate or replace the system in the near future. Rehabilitation of existing force main with a liner may extend its service life; however, the City should hire a professional license engineer to evaluate the existing system and provide improvement options and estimated cost. The installation of new force main is another option that the City should consider to ensure the well-being of this critical infrastructure for next 50 years. The estimated project cost for the construction of a new force main is as follows, and detailed cost breakdown is provided in **Attachment D**.

Improvement Cost	$14,197,000
Design (20%)	$ 2,839,400
Administration (15%)	$ 2,129,550
Testing and Inspection (5%)	$ 709,850
Environmental Review & Permitting (5%)	$ 709,850
TOTAL	**$20,585,650**

Note the Engineering cost estimate provided are based on the construction cost of the Force Main B in 2000 and cost escalations over the past decades. No details planning or study has been conducted as part of this process. The basis for this estimate includes the following assumptions:

- 12,000 linear feet of 36" HDPE line
- The new force main is parallel to the existing force main B (HDPE)
- 12 manholes access with air release valves
- Bore and Jack under Zanker Road & Milpitas Structure
- Micro-tunneling- Coyote Creek crossing

ATTACHMENTS

Attachment A : Water Pollution Control Facilities As built
Attachment B : Close Internal Survey Report
Attachment C : Right of Entry Agreement
Attachment C : Detailed Cost Estimate to Construct New Fore Main



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City of Milpitas Strom Drain Master Plan



City of Milpitas
Storm Drain Master Plan
2021







PREPARED FOR:
City of Milpitas
455 E Calaveras Blvd
Milpitas, CA 95035

PREPARED BY:
Schaaf & Wheeler
1171 Homestead Rd, Ste 255
Santa Clara, CA 95050

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

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List of Abbreviations

Ac	Acres
BMP	Best Management Practices
CIP	Capital Improvement Program
CFS	Cubic Feet per Second
CMP	Corrugated Metal Pipe
CTP	Cooperating Technical Partnership
D/S	Downstream
EPA	Environmental Protection Agency
GIS	Geographic Information System
GPM	Gallons Per Minute
HDPE	High-Density Polyethylene
IDF	Intensity-Duration-Frequency
KW	Kinematic Wave
LiDAR	Light Detection and Ranging
MAP	Mean Annual Precipitation
MSL	Mean Sea Level
NAVD	National Adjusted Vertical Datum of 1988
NGVD	National Geodetic Vertical Datum of 1929
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resource Conservation Service
RWQCB	San Francisco Regional Water Quality Control Board
SDMP	Storm Drain Master Plan
TASP	Transit Area Specific Plan
UH	Unit Hydrograph
U/S	Upstream

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Executive Summary

Milpitas completed its first comprehensive storm drainage master plan in 2001, which was updated in 2013. This effort represents a significant re-envisioning of that updated document and has been undertaken to help guide the city of Milpitas (city) to implement a prioritized capital improvement program. This document represents a new and complete Storm Drain Master Plan (SDMP).

The city has been incorporated for more than sixty years. It is beginning to experience the effects of aging storm drainage infrastructure, the need to maintain and replace expensive equipment and facilities, significant planned and completed redevelopment, and changing regulatory requirements. This SDMP identifies the capital improvements needed to maintain recommended levels of protection against local flooding from stormwater runoff, the need for a revenue stream that will allow the necessary capital improvements made, and the need to keep the storm drain system in working order into the future.

Storm Drainage and Flooding in Milpitas

Flooding within Milpitas is caused by two basic interrelated factors: 1) major creeks and channels that overflow due to limited capacity with flood flow, and 2) inadequate local drainage facilities. Since the operation and maintenance of major creeks and channels are, for the most part, outside the city's control, the focus of this document, therefore, is on local storm drainage collection and pumping facilities owned and operated by the city of Milpitas. Of the major creeks and channels, only Wrigley and Ford Creeks are owned and operated by the city and considered in detail herein.

Urbanization tends to increase the rate of runoff generated from local precipitation. Once primarily agricultural with an economy dominated by fruit and vegetable growers, Milpitas has evolved into a more fully urban community. (Urbanization is generally confined between Coyote Creek to the west and the Calaveras Foothills to the east.) Storm runoff in Milpitas is collected in a system of underground pipes and a network of street gutters. Local runoff flows into creeks and channels that run through the city, ultimately discharging to the San Francisco Bay. Drainage in Milpitas generally is from the southeast to the northwest. Storm drain systems close to the bay also tend to rely heavily upon pumping facilities to move water. Milpitas owns and operates 13 stormwater pumping stations.

Regional Storm Water Coordination

The Santa Clara Valley Water District (Valley Water) is Milpitas' primary partner in managing local stormwater issues. Valley Water's stated mission is to "provide Silicon Valley safe, clean water for a healthy life, environment, and economy." More specifically, Valley Water manages most of Milpitas's major drainage-ways, including Arroyo de los Coches, Berryessa Creek, Calera Creek, Coyote Creek, Lower Penitencia Creek, East Penitencia Creek, Piedmont Creek, and Tularcitos Creek.

Coordination with Valley Water is integral to the Storm Drain Master Plan's success since all the city's storm drainage systems eventually discharge into a Valley Water-managed facility. Valley Water is keenly interested in any city storm drain project that might impact one of their receiving creeks. In turn, the city has a vested interest in how Valley Water manages its legislated flood protection responsibility. This master plan focuses on storm drainage and flood management, which are only two factors in the overall management of stormwater within Milpitas. The city's storm drain system must address its infrastructure needs considering these factors: new capital assets (Capital Improvement Program); finances (utility

asset management); operations and maintenance; and regulatory compliance (San Francisco Regional Water Quality Control Board's [RWQCB] Municipal Regional Storm Water Permit, National Pollutant Discharge Elimination System [NPDES] permit).

Basis of System Evaluation

Criteria used to design storm drain systems and evaluate their performance must be defensible yet simple to understand and apply. Ideally, the same criteria used to analyze system performance will also continue for future infrastructure design. Storm drain design criteria set forth by the city of Milpitas, in its July 15, 2010 standards and the Santa Clara County Drainage Manual (2007), is used in this master plan, with some additional provisions as discussed throughout the document.

The ICM model used to evaluate Milpitas' storm drainage system herein was first created as part of FEMA's Cooperating Technical Partnership (CTP) program to study flood hazards within Upper Penitencia Creek, Lower Penitencia Creek, and Berryessa Creek watersheds in San Jose and Milpitas. The basis for analyses described herein is consistent with broader floodplain studies in the area that have already been vetted with Valley Water and FEMA.

Schaaf & Wheeler used data provided by the City and Valley Water and data gathered in the field to construct an integrated hydrologic and hydraulic InfoWorks ICM (Integrated Catchment Modeling) model representing storm drain systems, creeks, and ground surface throughout Milpitas. This model uses a design storm event and land-use-based runoff coefficients to generate runoff from the surface areas tributary to each collection system. The hydraulic capacity of each drainage system component is calculated and resulting overflows to the two-dimensional surface are reviewed to confirm if city drainage system performance criteria are being met. If the existing storm drainage system does not meet specific criteria, the model is then used to establish the capital improvement(s) needed so that those criteria are being met upon the completion of a prioritized capital improvement program.

Estimated Capital Costs and Annual Revenue Requirements

A prioritized capital improvement program (CIP) is established based on the analytical evaluation of Milpitas' existing storm drainage system using the integrated ICM hydrologic and hydraulic model, a. Figure ES–1 shows the locations of city-wide high-priority capital improvement projects. Table ES-1 includes an estimate of the present worth of capital expenditures required to complete those projects shown in Figure ES–1 and provides capital costs for other low priority capital improvements needed to meet established storm drain performance criteria. Table ES-2 provides the estimated annual revenue stream needed to complete the CIP over 20 years. Except for low priority projects that are optional or potential ancillaries to other site development or public projects, long-term equipment replacement, and annual operations and maintenance.

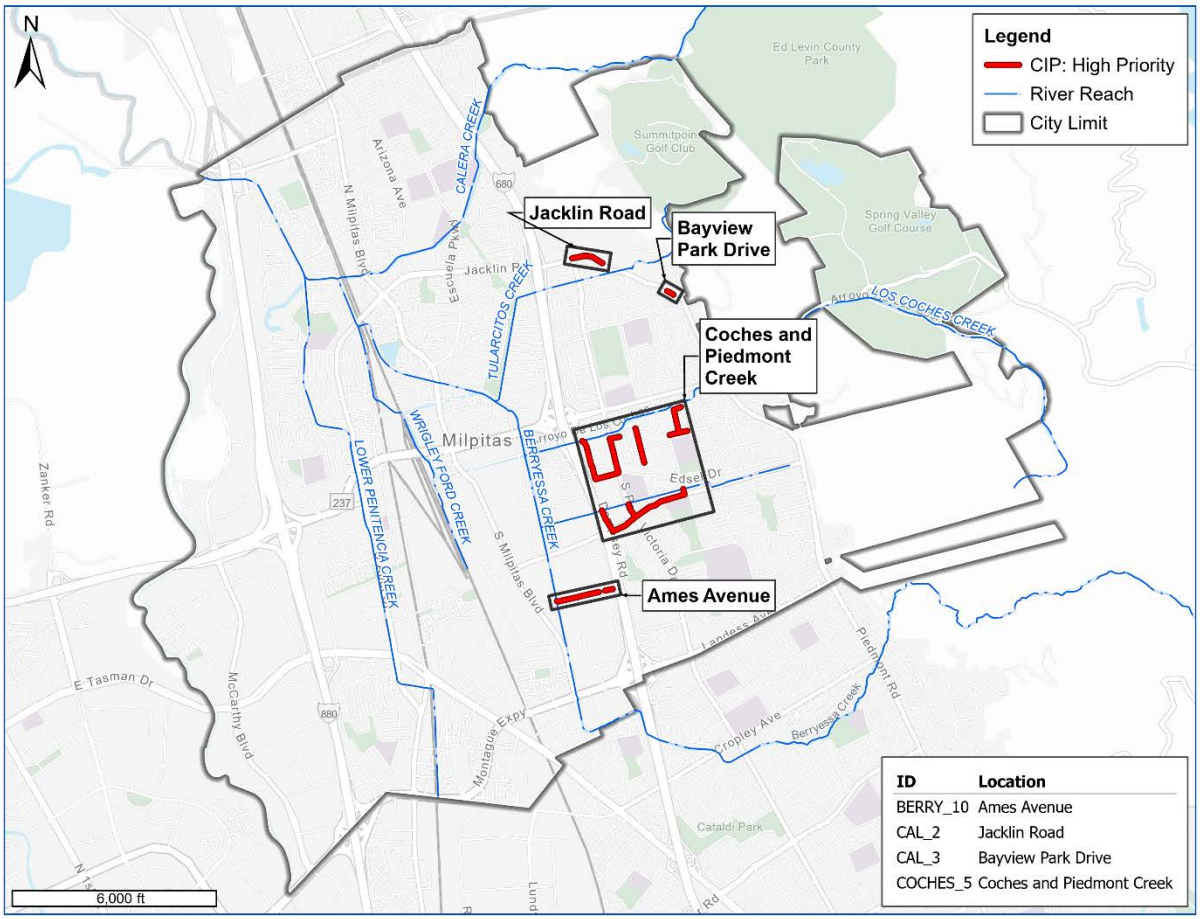


Figure ES-1: High Priority CIP

Table ES-1: Capital Improvement Program Costs

Category	Cost
High Priority CIP	$14,000,000
Low Priority CIP	$24,000,000
Extension CIP	$1,000,000
Total Budget	$39,000,000

Table ES-2: Summary of Storm Drainage Budget Requirements

Category	Present Worth	Annualized Cost
High Priority Capital Improvements	$14,000,000	$800,000
Long-Term Equipment Replacement	$48,000,000	$2,700,000
Annual Operations and Maintenance		$1,800,000
Total Budget	$62,000,000	$5,000,000

Work Products

The updated master plan intends to function at several levels. City planners and engineers responsible for capital improvements should find that this document contains sufficient background information and data to serve as a basis for CIP implementation and/or modification. For those city staff and other parties interested in a more in-depth examination of storm drain facilities within Milpitas, the companion InfoWorks ICM model is available.

Comparison to Previous Master Plan

This updated master plan and corresponding CIP differs from previous master plans due to the ICM model, which integrates updated rainfall and a different hydrologic methodology as described herein. Additionally, the model accounts for surface storage within streets and other open spaces and the precise timing of coincident creek discharges, which was not directly accounted for in previous master plans. These updates generally result in less flooding at the desired level of service and fewer CIP projects to meet the city's storm drainage criteria. Figure ES-2 depicts the CIP from the 2013 master plan for reference.

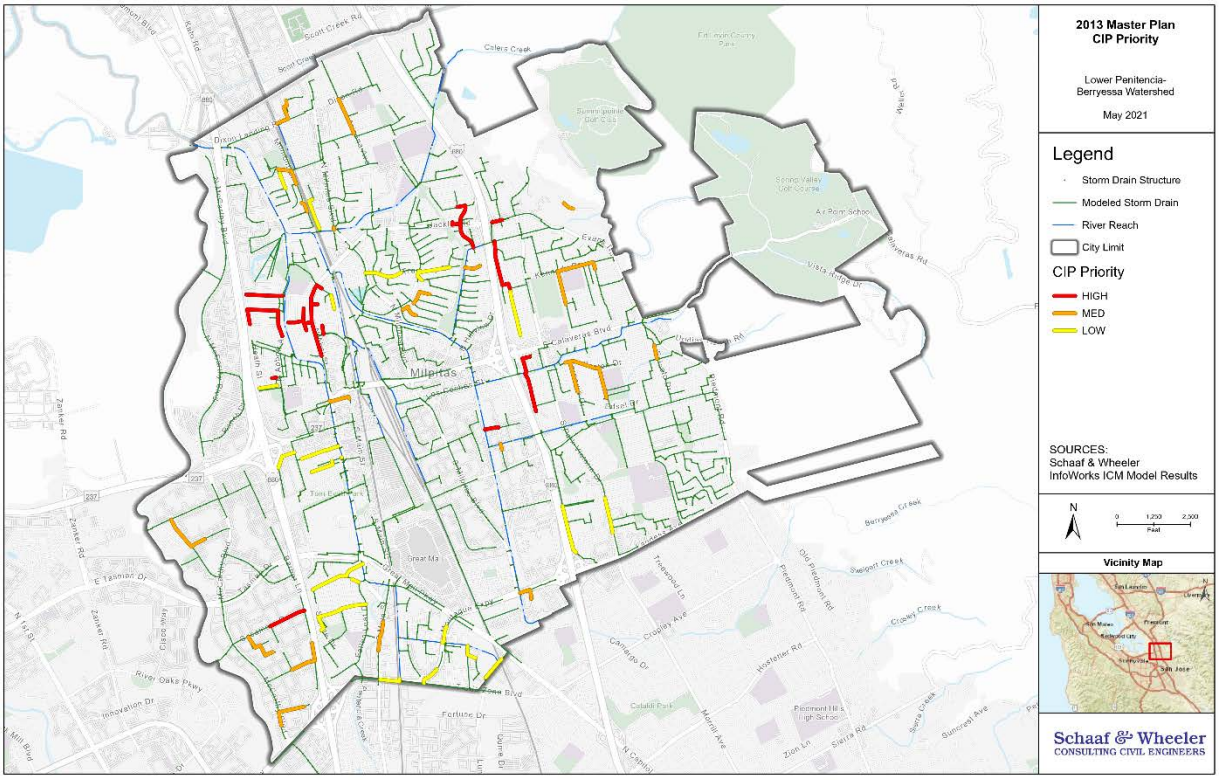


Figure ES-2: 2013 Master Plan CIP Priority

Chapter 1: Introduction

Milpitas completed a comprehensive storm drain master plan in 2001, which was last updated in 2013. This effort represents a substantially new evaluation of Milpitas' storm drain systems and floodplains using tools developed in conjunction with Santa Clara Valley Water District (Valley Water) as part of the Cooperating Technical Partner (CTP) program sponsored by the Federal Emergency Management Agency (FEMA). Under that program, the interaction of storm drains and floodplains within the combined Berryessa Creek and Lower Penitencia Creek watersheds was studied to complete updated flood hazard mapping.

This storm drain master plan update takes advantage of the work completed with Valley Water but adds further detail to comprehensively evaluate storm drain system performance in addition to flood hazard mapping. This master plan focuses on storm drainage infrastructure, while acknowledging that storm drain performance is fully intertwined with floodplain behavior during extreme stormwater runoff events.

This document is a guide for the City of Milpitas (City) to implement a prioritized capital improvement program (CIP) and secure sufficient funds for annual operation and maintenance, and long-term system replacement. This document represents an updated and complete storm drain master plan. Key objectives of this SDMP update include:

- Updating the geographical information systems (GIS) to include pipelines 12 inches and greater in diameter throughout the entire city to reflect all storm drain projects and operational improvements completed by the end of 2020, as well as any changed land uses.
- Utilizing the ICM program to create an integrated hydrologic and hydraulic model that accounts for surface storage and routing and the coincident timing of water surface elevations within the major streams and drainage ways.
- Preparing an updated Capital Improvement Program that remediates identified system deficiencies and provides for underserved areas within the Specific Plan Areas of Milpitas Metro and Main Street Gateway (previously TASP and Midtown).
- Updating projected capital improvement, operations, maintenance, and replacement schedules and costs.

Authorization

Schaaf & Wheeler Consulting Civil Engineers, Inc. prepared this updated Stormwater Master Plan for the city of Milpitas in accordance with the provisions of an agreement executed by the city in November 2019.

Study Area

Milpitas is located near San Francisco Bay in what is colloquially referred to as Silicon Valley. Downtown San José is eight miles to the south; San Francisco is about 45 miles to the northwest. The boundary that separates Santa Clara County from Alameda County also forms the northern border between Milpitas and neighboring Fremont. Incorporated Milpitas encompasses 13.5 square miles, all within the 315 square mile Coyote Creek watershed. Placing Milpitas within its regional context (Figure 1-1) demonstrates that events occurring well outside of the city proper can potentially impact flood risks within Milpitas. However, as stated previously, this master plan focuses on the impacts of events occurring within the city itself.

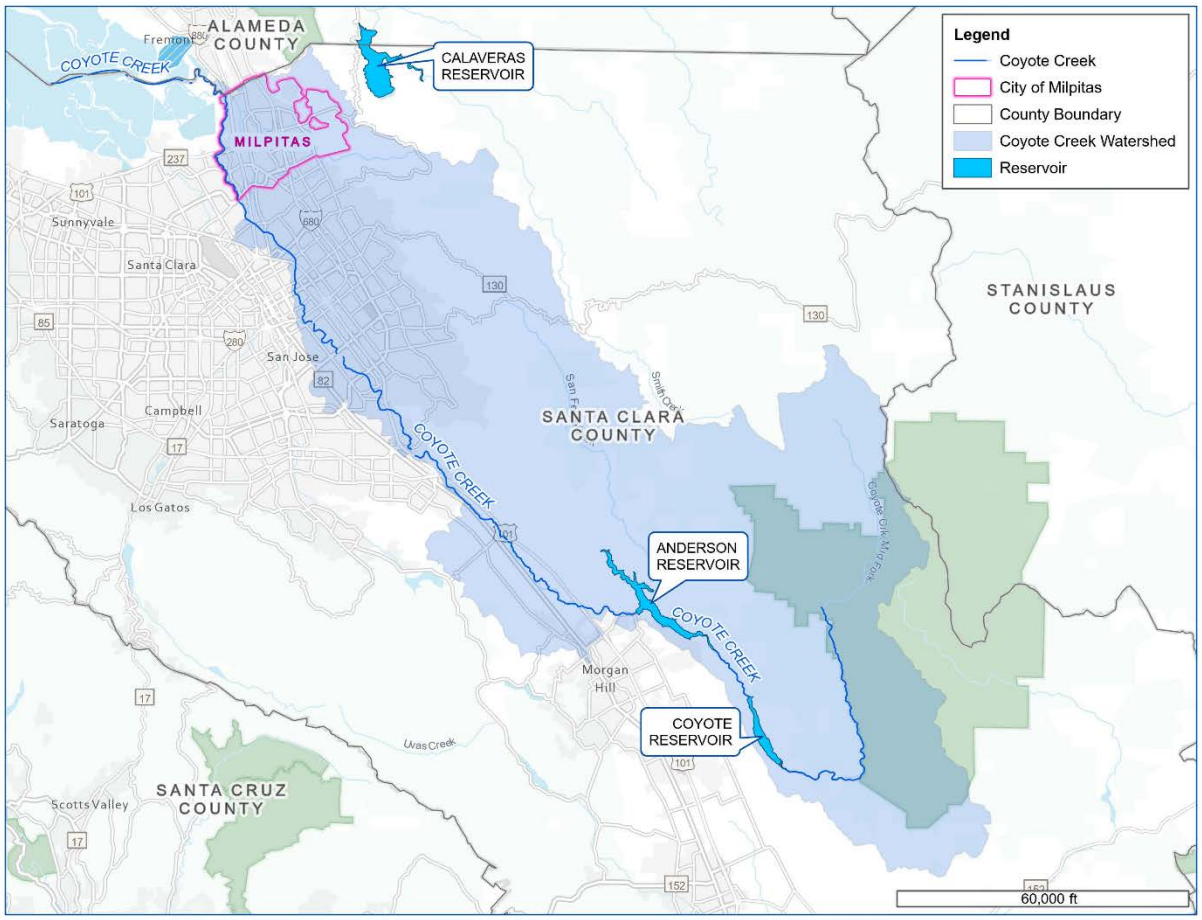


Figure 1-1: City of Milpitas within the Coyote Creek Watershed

Climate

Milpitas has a mild Mediterranean climate with average temperatures ranging from 46°F in the winter to 71°F in the summer. From May to October, there is virtually no chance of precipitation within the area, but winters can be cool and moist. Rainfall is the only significant cause of stormwater runoff (significant snowfall is extremely rare), averaging 14 inches per year near the bay, up to 18 inches annually near the eastern ridgeline.

Most precipitation events in the Milpitas area are either orographic when moist air is lifted over the hills, then cools and condenses, or cyclonic, where rain is with air masses' movement from higher barometric pressure regions to lower pressure. Cyclonic events can also be caused by frontal activity. Warm fronts are generally associated with broad bands of relatively low-intensity rainfall, while higher rainfall intensifies typify cold fronts. Convective precipitation (e.g., thunderstorms) caused by air heating at the ground often leads to too intense localized storms, but it is not common in this area.

Physiography

The city lies at the Diablo Range base, extending from its foothills on an alluvial plain of the Santa Clara Valley toward San Francisco Bay. Almost half of the city is east of Interstate 680, where elevations vary from about 40 feet mean sea level (MSL) at Evans Road to nearly 800 feet at Monument Peak just west of Calaveras Reservoir. Once on the valley floor, the land falls away from the hill's base toward the west and approaches sea level along the bay.

Soil deposits on the valley floor are characteristic of alluvial fan development. Calera, Tularcitos, Los Coches, and Berryessa Creeks deposited older fans of coarse sand and gravel at the foothill's base. Throughout the city center, younger clays deposited between the creeks are interspersed with smaller amounts of old San Francisco Bay mud. At the western limits of Milpitas, Coyote Creek deposits are found along the edge of alluvial fan deposits from Lower Penitencia Creek. A majority of the soil within Milpitas is either clay or clayey loam with very low infiltration rates when wetted and has a high runoff potential. At the western city limits near Coyote Creek, some soil is loamier with better infiltration characteristics and a moderate to high runoff potential.

Land Development and Drainage Characteristics

Urbanization tends to increase the rate of runoff generated from local precipitation. Once primarily agricultural with an economy dominated by fruit and vegetable growers, Milpitas has evolved into a more fully urban community. Urbanization is generally confined between Coyote Creek to the west and the Calaveras Foothills to the east. Although some selected hillside development is allowed in the city's General Plan, the hillside area (which comprises almost one-half of the city) is generally zoned for permanent open space, including the Ed Levin Regional Park. The western one half of the city has developed as a mix of residential, commercial, and industrial development, with parks, schools, and greenbelts woven into the urban fabric. Future growth in Milpitas, particularly non-hillside residential will tend to be infill development which will become denser as property values escalate. Recent land-use changes and growth are concentrated within the Main Street Gateway and Milpitas Metro areas. Therefore, storm drain systems serving these tributary areas are the most potentially impacted by new development.

A system of underground pipes and a network of street gutters collect storm runoff in Milpitas. Local runoff flows into creeks and channels that run through the city, ultimately discharging to San Francisco Bay. Drainage in Milpitas generally is from the southeast to the northwest. Storm drain systems closer to the Bay also tend to rely heavily upon pumping facilities to move water.

Concurrent City Planning

The city of Milpitas has concurrent planning efforts focused within the Main Street Gateway and Milpitas Metro Specific Plan areas. These specific plans focus on the new BART station and downtown areas where infill development has occurred or is planned. Generally, impervious surface does not increase with infill development, so the impacts of the specific plan areas would be based on realigned roads or identifying currently underserved areas where parcels drain by gravity to the street frontage. Improvements associated with these underserved areas are described herein. At the time of this study, plans for new or re-routed city roadways had not been developed.

The city has developed a green stormwater infrastructure (GSI) plan as required under the NPDES Municipal Regional Permit Section C.3.j. The plan relies on information produced in the Santa Clara Basin Stormwater Resource Plan. Opportunities to combine green infrastructure with capacity projects are considered in the stormwater improvements identified in this study.

Work Products

As discussed in subsequent sections, the following information is available via GIS:

1. ***Inventory of Drainage Facilities.*** Information pertaining to each system component may be accessed graphically through GIS or numerically using the ICM model.
2. ***Tributary Drainage Areas.*** Land areas used to generate local runoff are available in GIS and tabular format with tributary areas, runoff coefficients, and concentration times.
3. ***Ground Surface.*** Ground surface information based on Countywide 2006 LiDAR, updated with available modified ground surface data from developments constructed between 2006 to 2018, is available in raster format.

Chapter 2: Methodologies

Criteria used to design storm drain systems and evaluate their performance must be defensible yet simple to understand and apply. Ideally, future infrastructure design will use the same criteria used to analyze system performance. As discussed in this chapter and the next, storm drain design criteria set forth by Milpitas in its July 15, 2010 standards and the Santa Clara County Drainage Manual (2007) are used in this master plan; some additional provisions as discussed herein.

An integrated hydrologic and hydraulic InfoWorks ICM model representing storm drain systems, creeks, and ground surface throughout Milpitas was constructed using data from the city and Valley Water and gathered in the field. This model uses a design storm event and land-use-based runoff coefficients to generate runoff from the surface areas tributary to each collection system. The hydraulic capacity of each drainage system component is calculated and resulting overflows to the two-dimensional surface are reviewed to confirm whether city drainage system performance criteria are met. If the existing storm drainage system does not meet specific criteria, the model is then used to establish the capital improvement(s) needed so that those criteria are completed based on the capital improvement priority system described in Chapter 3.

Data Sources

The comprehensive master plan model was built upon an integrated hydrologic and hydraulic ICM storm drain system model previously created by Schaaf & Wheeler and Wood Rodgers under a Cooperating Technical Partnership (CTP) between Valley Water and FEMA. The CTP model built is based on as-built plans, field surveys, LiDAR and aerial surveys, photos, improvement plans, other data documents, and field investigations. The model has been calibrated to the design storm and validated with stream gauge data of historical events.

For the comprehensive master plan, Schaaf & Wheeler updated the CTP model with data provided by the city of Milpitas in the form of GIS shapefiles of the storm drain network received 04/02/2020. The purpose was to incorporate changes in the storm drain network and include pipes 12 inches in diameter or greater. The CTP model only had pipes 18 inches in diameter or greater. To fill in any new, missing, or conflicting information, Schaaf & Wheeler consulted record drawings for street improvements or tracts as needed. All elevations have been converted to the National Adjusted Vertical Datum of 1988 (NAVD) to match the most currently available LiDAR-based citywide topography.

The most common data transformation involves the conversion of the National Geodetic Vertical Datum of 1929 (NGVD):

NGVD +2.78 feet = NAVD (88).

Sub catchment parameters of the model are based on the current land use data provided by the city in form of GIS shapefile called “ZonedParcels2012”. This is most current land use information available to characterize existing land surfaces. Aerial maps have been used to assign land use for areas not defined by the city parcel data and for recent development since 2012. Future zoning information could be used to analyze land use changes, but future land uses almost uniformly have lower percentages of impervious surface. This master plan does not rely on potential reductions in runoff that may not come to fruition.

Information regarding pump station operation has been obtained from record drawings and information from the 2013 master plan update, corroborated by conversations with City operations and maintenance staff in 2020.

Modeling Software

INFOWORKS ICM

InfoWorks ICM by Innovyze is a GIS-based, integrated modeling platform that incorporates both urban and river catchments. The integration of 1D and 2D hydrodynamic simulation techniques allows the modeling of both the above- and below-ground elements of catchments to represent all flow paths accurately.

Hydrology

Design Storm

Flood frequency analyses are used to design facilities that control storm runoff since it is impossible to anticipate every conceivable storm's effect. A common practice that both the Milpitas and Santa Clara County standards follow is constructing a design storm. A rainfall pattern is used in hydrologic models to estimate surface runoff – and compare the surface runoff to the capacity of drainage systems designed to convey this runoff to major facilities outside of the city's jurisdiction.

Precipitation-runoff frequency analyses are based on concepts of probability and statistics. Engineers generally assume that a rainfall event's frequency (probability) coincides with direct stormwater runoff frequency. However, the runoff generation depends on several factors (particularly antecedent moisture conditions in the drainage basin) not necessarily dependent upon the precipitation event.

The 10-year storm recurrence interval is used as the design storm to evaluate the flood control systems for this master plan. It is worth noting that over the typical 30-year life of a home mortgage, the chance of experiencing at least one 10-year event is about 96 percent.

The 100-year storm recurrence interval is used as the design storm to evaluate if pump stations have sufficient capacity. A 100-year design storm is assumed to evaluate pump stations as critical facilities where gravity conveyance is not possible and flooding is likely to remain for extended periods.

Design Storm Duration

A 24-hour storm duration determines the governing design storm event and the conservative operational conditions of the city's drainage facilities. This storm duration is for the following reasons:

1. The 24-hour duration is a standard for many local, state, and federal agencies.
2. The 24-hour duration is short enough to be consistent with the watershed size and long enough to create volume-induced flood problems in the watershed. The 24-hour storm duration generally results in the most extensive floodplain relative to other storm durations within the local historical record.

Design Storm Rainfall Depths

Design rainfall depths are calculated using the TDS Regional Equation provided by Valley Water:[1]

$$P_{f,d} = A_{f,d} + B_{f,d}(MAP) \quad \text{Equation 1}$$

Where:

$P_{f,d}$ Precipitation depth for a given storm frequency, f and duration, d, in inches

$A_{f,d}$ & $B_{f,d}$ Regression constants and coefficients

MAP Mean annual precipitation, in inches

Af,d and Bf,d values used are displayed below in **Error! Not a valid bookmark self-reference.**-1 and Table 2-2, which are provided by Valley Water as well.

Table 2-1: $A_{f,d}$ and $B_{f,d}$ Values for Design Rainfall Depth Equation

Frequency	Recurrence Interval (Yr)	$A_{f,d}$	$B_{f,d}$
		24 Hr	24 Hr
10%	10	0.0028	0.1653

The resultant design rainfall depths from Equation 1 are displayed in Table 2-2.

Table 2-2: 24-hour Duration Design Storm Depth per MAP

MAP (in)	24-hour Design Rainfall Depth (in)
	10-Year
12	1.99
13	2.15
14	2.32
15	2.48
16	2.65
17	2.81
18	2.98
19	3.14
20	3.31
21	3.47

The resultant design rainfall depths from Equation 1 are displayed in Table 2-3.

[1] SCVWD 2013: Precipitation Gage Data and Depth-Duration-Frequency Analysis. Revised from Saah et al. 2004

Table 2-3: 24-hour Duration Design Storm Depth per MAP

MAP (in)	24-hour Design Rainfall Depth (in)							
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	200-Year	500-Year
12	1.26	1.72	1.99	2.30	2.51	2.71	2.91	3.15
13	1.37	1.86	2.15	2.49	2.72	2.93	3.14	3.40
14	1.48	2.01	2.32	2.67	2.92	3.15	3.37	3.65
15	1.59	2.15	2.48	2.86	3.12	3.37	3.60	3.89
16	1.70	2.30	2.65	3.05	3.32	3.58	3.83	4.14
17	1.81	2.44	2.81	3.24	3.53	3.80	4.06	4.39
18	1.92	2.59	2.98	3.42	3.73	4.02	4.29	4.63
19	2.03	2.74	3.14	3.61	3.93	4.23	4.52	4.88
20	2.14	2.88	3.31	3.80	4.14	4.45	4.75	5.13
21	2.25	3.03	3.47	3.99	4.34	4.67	4.98	5.38

Design Storm Temporal Distribution

The 24-hour design storm temporal distribution obtained from Valley Water is displayed as Figure 2-2 below. The temporal rainfall distribution is for a 24-hour design storm with 15-minute intervals.

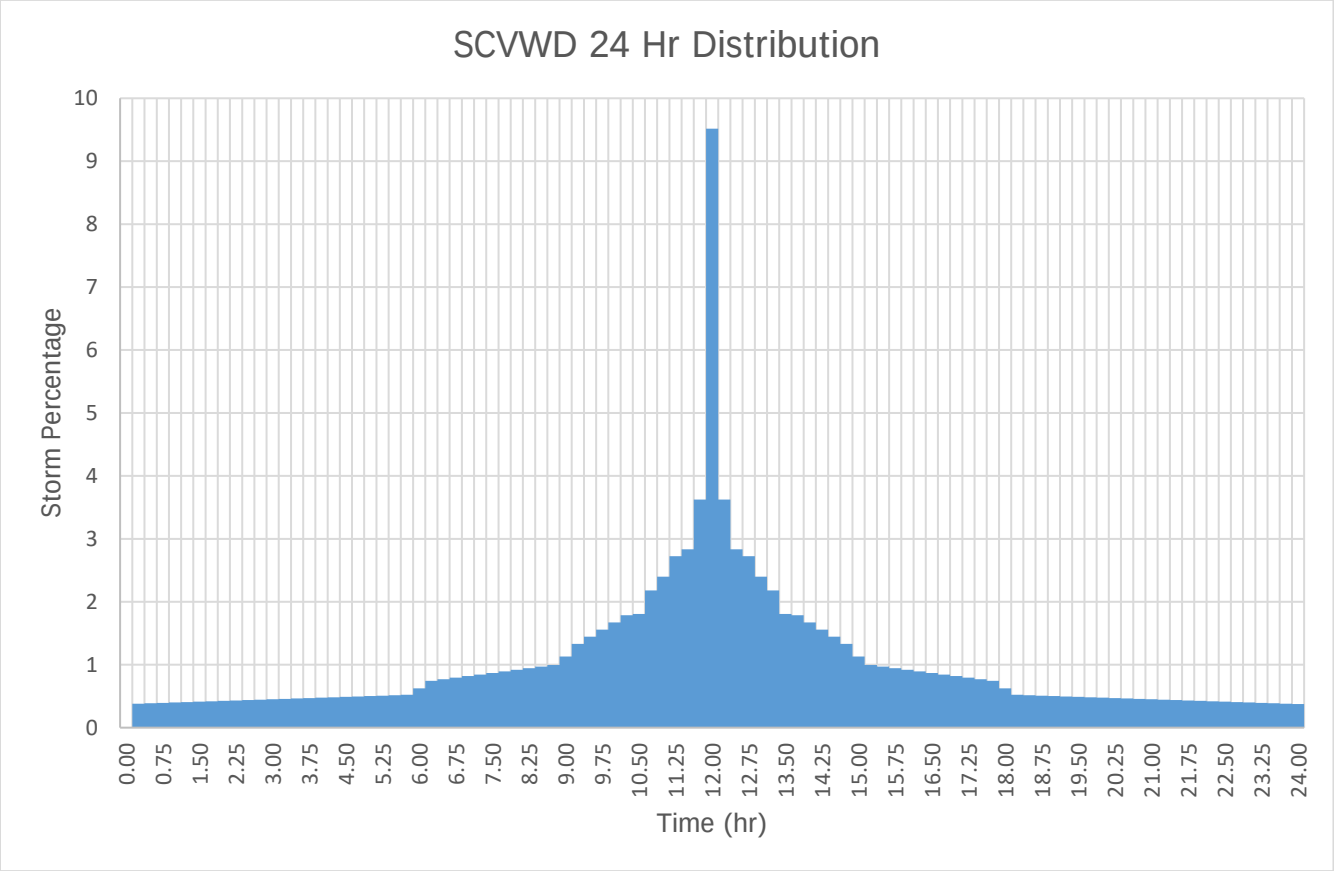


Figure 2-1: Valley Water 24hr Storm Distribution

Historical Storm

Schaaf & Wheeler used the December 11, 2014, a historical event, to validate the Lower Penitencia-Berryessa and Upper Penitencia watershed Model as part of the CTP program. This storm produced 1.2 inches of rain in 3.0 hours, 2.0 inches of rain fell in 12.0 hours, and 3.7 inches of rain fell in 24 hours period in San Jose. The estimated storm recurrence interval based on these depths varies from a 10-year 3-hour, a 5-year 12-hour, and a 100-year 24-hour interval, respectively, for a MAP of 18 inches. This 18-inch MAP is the average for Lower Penitencia-Berryessa and Upper Penitencia watersheds. The December 2014 storm event was one of the most intense urban rainfall events in recent memory, surpassing the wet year of 2016-2017.

It should be noted that based on the response time of the Lower Penitencia-Berryessa and Upper Penitencia watershed (approximately 1 hour), the durations between 3 hours and 12 hours are the most relevant for this study.

In addition, the February 16-20, 2017 event is used to validate the model. Approximately 1.2 inches of rain fell over 3 hours, and 2.7 inches of rain fell in 24 hours. The estimated storm recurrence interval based on these depths varies from a 2-year, 3-hour storm to a 2-year, 24-hour storm.

Rainfall/Runoff Transformation Method

Described below is the methodology for the transformation of the precipitation into the stormwater runoff. The general steps to transform rainfall into runoff are:

1. Apply a loss method to convert rainfall distributions into excess rainfall. The method is done by accounting for the portion of rainfall from the sky lost to surface depressions, evaporation, and soil infiltration. The amount of precipitation that is lost will not result in direct runoff. Losses also vary over time during a storm. For example, as wetted soil becomes more saturated, losses decrease, and more rainfall becomes surface runoff. Losses are a function of land use and soil conditions.

2. Transform the excess rainfall into surface runoff using the hydrograph methods subsequently described.

3. Route surface runoff hydrographs through the storm drain and creek systems. Where stormwater flows exceed a storm drain or creek's hydraulic capacity, some portion of the runoff hydrograph will be carried over the ground surface. The timing and depth of this overland flow produce flood hazard mapping.

Hydrograph Method

The transformation of rainfall into runoff can be calculated in a model using various methods. In the detailed regional calibration efforts for smaller urban watersheds that were conducted with Valley Water, Alameda County Public Works Agency (ACPWA), and the city of San Jose, Valley Water it concluded that hydrographs using the Kinematic Wave (KW) method best match recorded flows for the smaller urban watershed (less than 100 acres). For larger, rural, and hilly watersheds, hydrographs using the Snyder Unit Hydrograph (Snyder UH) match recorded flows well. Still, hydrographs using KW methods diverged from those developed using the Snyder UH and the recorded gauge data.

Therefore, the KW method is used for smaller urban watersheds less than 50 acres in size only, and the Snyder UH method is used for all other catchments within the study area.

The combination of the small urban and large rural or open space watersheds in the Lower Penitencia-Berryessa and Upper Penitencia Watershed drainage systems warrant both KW and Snyder's use of UH methods as described above.

Loss Method

The Horton Loss Rate Method reflects the effects of infiltration in the model because of its initial loss decay and recovery features. The method is also well documented by the Environmental Protection Agency (EPA) and has been used successfully throughout Alameda County, Redwood City, and other Bay Area agencies. Table 2-4 lists the reasonable range of parameters recommended by the EPA.

Infiltration rate ranges from Alameda County (see Table 2-5) are also considered and used in the calibration because of the proximity and geologic similarity to the Lower Penitencia-Berryessa and Upper Penitencia watersheds. These parameters have been calibrated for Alameda County and reflect local soil characteristics in Milpitas.

Horton Loss Equation:[2] $f_p = f_c + (f_0 - f_c)\, e^{-\beta t}$

where:

f_p = Infiltration Capacity
f_c = Constant Rate
f_0 = Maximum Infiltration Rate
β = Decay constant

Table 2-4: Horton Loss Equation Parameters[3]

Hydrologic Soil Group	Max. Infiltration Rate Range	Min. Infiltration Rate Range	Decay Const. Range	Drying Time Range
	(in/hr)	(in/hr)	(1/hr)	(days)
A	5-10	>=0.45	2-7	2-14
B	4-8	0.30-0.15	2-7	2-14
C	3-6	0.15-0.05	2-7	2-14
D	1-2	0.00-0.05	2-7	2-14

Table 2-5: Alameda County Loss Parameters [4]

Hydrologic Soil Group	Min. Infiltration Rate Range
	(in/hr)
A	>=0.45
B	0.35-0.40
C	0.14-0.25
D	0.05-0.09

The Horton Loss Rate Method can be used for both single-event design storms and continuous simulations with multiple intermittent storms because the initial loss capacity can be recovered. Antecedent soil moisture conditions and the soil storage saturation level before a storm were analyzed before determining the continuous storm simulation's appropriate initial loss rate.

[2] Handbook of Hydrology, David R. Maidment, 1993

[3] Storm Water Management Model User's Manual, Version 5.0, EPA, Revised July 2010

[4] Alameda County Hydrology and Hydraulics Manual, ACPWA, 2003

Imperviousness

The percentages of directly connecting impervious surface, non-directly touching impervious surface, and porous surface for each land-use shown in Table 2-6 are determined by sampling five areas of the same land use and identifying the average percentage for each surface type. Directly connected impervious surfaces drain the city storm drain system with limited surface attenuation, such as driveways, street pavements, and sidewalks. Non-directly is connecting impervious areas within a sub-basin experience more peak flow attenuation by flowing across pervious surfaces before entering the storm drain. These are mostly roofs that are collected by gutters and discharge to previous lawns.

Table 2-6: Land Use Percent Impervious

LAND USE TYPE	Impervious (%)		Pervious (%)
	Directly Connecting	Non-Directly Connecting	Area
Hillside Very Low Density (HVL): up to 1 unit/10gross acres	2	2	96
Hillside Low Density (HDL): up to 1 unit/gross acre	5	6	89
Hillside Medium Density (HMD): up to 3 units/gross acre	9	37	54
Single Family Low Density (SFL): 3-5 units/ gross acre	17	59	24
Single Family Medium Density (SMD): 6-15 units/gross acre	20	56	24
Multi-Family Residential Medium Density (MFM): 7-11 units/gross acre	5	58	37
Multi-Family Residential High Density (MFH): 12-20 units/gross acre	33	37	30
Multi-Family Residential, Very High Density (VHD): 31-40 units/gross acre	52	34	14
Urban Residential (URR): 41-75 units/gross acre	32	48	20
Mobile Home Park (MHP)	22	72	6
Residential Retail High Density Mixed Use (RRMU)	24	64	12
Boulevard Very High-Density Mixed Use (BVMU)	40	43	17
General Commercial (GNC)	65	24	11
Town Center (TWC)	56	36	8
Industrial Park (INP)	46	23	31
Public Facilities (PF)	32	30	38
Parks and Open Space (POS)	7	3	90

Hydrograph Method Parameters

Kinematic Wave

Based on calibration efforts conducted by the ACPWA that were reviewed with the city of San Jose, the KW method was selected for this project as the hydrologic transformation method for small urban sub-basins up to 50 acres in size.

The use of the KW method requires developing watershed parameters that result in consistent, reproducible results; because of the need to simplify the models enough to meet the software, hardware, and data management constraints, applying the KW method to watersheds that vary in size from about 3 acres to 50 acres. Therefore, some modification of KW method parameters is necessary, noting parameters have been carefully vetted during the calibration process to confirm their validity.

For example, the KW method requires a representative watershed "plane" width (Figure 2-6), overland flow length, and slope. In small watersheds, these planes would represent a row of residential lots draining to the street. In larger watersheds, the planes would represent a group of lots and streets draining to a central conveyance. In most cases of larger watersheds, the plane width was assumed to be twice the central conveyance's length, thus representing two planes draining to the central conveyance from each side.

Since this approach (two planes draining to each side of the central conveyance) does not explicitly account for the routing of the runoff in the central conveyance, the resistance parameters used have been carefully calibrated to account for this. They are expressed as overland flow roughness factor, N, developed from the *HEC-1 User Manual*, 1990, Table 12.1. (Table 2-7). Watersheds are broken down into small sub-catchments with a single plane as much as possible to reduce the impact of this simplification.

The KW method parameters include shed area, flow length, watercourse slope, and percent imperviousness. In contrast, the Horton Loss Rate parameters include maximum infiltration losses (initial loss rate) and minimum infiltration capacity (uniform loss rates).

Table 2-7: Kinematic Wave Method Resistance

Surface	N value	Source
Asphalt/Concrete	0.05-0.15	Harley (1975)
Bare Packed Soil Free of Stone	0.10	Hathaway (1945)
Fallov - No Residue	0.008-0.012	Engman (1986)
Convential Tillage - No Residue	0.06-0.12	Engman (1986)
Convential Tillage - With Residue	0.16-0.22	Engman (1986)
Chisel Plow - No Residue	0.06-0.12	Engman (1986)
Chisel Plow - With Residue	0.10-0.16	Engman (1986)
Fall Discing - With Residue	0.30-0.50	Engman (1986)
No Till - No Residue	0.04-0.10	Engman (1986)

Surface	N value	Source
No Till (20-40 percent residue cover)	0.07-0.17	Engman (1986)
No Till (60-100 percent residue cover)	0.17-0.47	Engman (1986)
Sparse Rangeland with Debris: 0 Percent Cover	0.09-0.34	Engman (1986)
Sparse Rangeland with Debris - 20 Percent Cover	0.05-0.25	Engman (1986)
Sparse Vegetation	0.053-0.13	Woolhiser (1975)
Short Grass Prairie	0.10-0.20	Woolhiser (1975)
Poor Grass Cover on Moderately Rough Bare Surface	0.30	Hathaway (1945)
Light Turf	0.20	Harley (1975)
Average Grass Cover	0.40	Hathaway (1945)
Dense Grass	0.17-0.30	Palmer (1946)
Bermuda Grass	0.30-0.48	Palmer (1946)
Dense Shrubbery and Forest Litter	0.40	Harley (1975)

Snyder Unit Hydrograph

Based on calibration efforts conducted by the ACPWA that were reviewed with the city of San Jose, the Snyder UH method is selected as the hydrologic transformation method for large sub-basins greater than 50 acres in size. The Snyder UH method is especially appropriate in open space because of the proper application as described previously.

Snyder UH Equation:[5] $Q_p = 640 * C_p * A / t_L$

Where:

Q_p = Peak discharge of the unit hydrograph (cfs)
C_p = storage coefficient / peaking factor
A = Drainage Area (sq mi)
t_L = basin lag time (hr)

The selected Snyder UH method is the ACPWA revised version of the standard Snyder UH documented in HEC-1 and HEC-HMS. ACPWA revised the method based on historical calibration efforts performed in Alameda County, which has similar meteorological characteristics as Santa Clara County.

[5] Handbook of Hydrology, David R. Maidment, 1993

The two major input parameters of the method are Basin Lag Time and Basin Peaking Factor. The Basin Lag Time (see Equation 13) is based on the calculated Basin Roughness (see Equation 12) using the main watercourse Manning's *n* within a sub-basin.

TABLE 6 BASIN ROUGHNESS FACTORS FOR RURAL WATERSHEDS

Basin Type	Basin Roughness Factor (*N*)
1. Rural watersheds with generally clear stream bed and minimal vegetation growth in the drainage reaches.	0.05
2. Rural watersheds with moderate to high levels of vegetation growth, or rock and boulder deposits within the main drainage reaches.	0.07
3. Rural watersheds with dense vegetation or high levels of boulder deposits within the main drainage reaches.	0.08

(District 2003)

EQUATION 12 BASIN ROUGHNESS FACTOR FOR URBAN WATERSHEDS

$$N = 0.3318n^{0.6328} \quad (12)$$

where:

N = *basin roughness factor*
n = *Manning's roughness coefficient (from Table 7)*

(District 2003)

Figure 2-2: Basin Roughness (N) (ACPWA H&H Manual)

TABLE 7 MANNING'S ROUGHNESS COEFFICIENT

Type of Facility	*n*
Reinforced Concrete Pipe	
Conduit > 36" diameter	0.012
Conduit ≤ 36" diameter	0.014
Corrugated Metal Pipe	
Annular	0.021
Helical	0.018
Concrete-Lined Channels	
Smooth-troweled	0.015
District Simulated Stone	0.017
Reinforced Concrete Box	
Cast-in-Place	0.015
Pre-Cast	0.014
Earth Channels	
Smooth Geometric	0.030 – 0.035
Irregular or Natural	0.045 – 0.050

(Chow 1959, District 1989)

EQUATION 13 BASIN LAG TIME

$$t_L = K \cdot N \left(\frac{L \cdot L_c}{\sqrt{S}} \right)^{0.38} \quad (13)$$

where:

t_L = *lag time (hr)*
K = *distance factor*
for $L > 1.7$ *mi,* $K = 24$
for $L \leq 1.7$ *mi,* $K = 15.22 + 2.15L + 8.7/L$
if calculated value of K *is greater than 30, use* $K=30$
N = *basin roughness factor (from* ***Table 6****, rural watershed or* ***Equation 12****, urban watershed)*
L = *length of longest watercourse (mi) (see* ***Figure 4****)*
L_c = *length along longest watercourse measured from the point of concentration to a point opposite the watershed centroid (see* ***Figure 4****)*
S = *average stream slope (ft / mi from* ***Equation 11****)*

(District 1994)

Figure 2-3: Manning's n and Basin Lag Time (ACPWA H&H Manual)

The peaking factor is a function of overland basin storage. Large areas with flat slopes are associated with relatively high amounts of overland basin storage. Conversely, water that falls on steeply sloped areas will run off quickly, with little overland basin storage. The lower the basin storage, the higher the corresponding peaking factor.

EQUATION 14 BASIN PEAKING FACTOR

$$C_p = 0.6e^{0.06(S_o/A)} \quad (14)$$

where:

C_p = *basin peaking factor* $(C_p \leq 0.85)$
S_o = *average watershed slope (percent from* ***Attachment 9****)*
For $S_o \leq 5\%$, $C_p = 0.6$
A = *drainage area (mi²; if* $A < 5mi^2$, *use* $A = 5mi^2$)

(District 1994)

Figure 2-4: Basin Peaking Factor (ACPWA H&H Manual)

Watershed Characteristics

To model the storm drain system and include all pipes 12 inches in diameter and larger, relatively small sub-watersheds have been developed for representation in the models.

The area that contributes runoff to a drainage line within these watersheds is referred to as a "Drainage Area". The smaller sub-watersheds within the Drainage Areas are noted as "Sub-Basins".

Therefore, the hierarchy terminology for watersheds includes:

1. Watersheds – delineating the basin for each major creek system
2. Drainage Areas – delineating the basin for each named drainage line
3. Sub-Basins – delineating the smallest sub-basin for each drainage line

Watershed Size

Sub-Basins are delineated based on the 2006 topographic LIDAR mapping furnished by Valley Water and the County of Santa Clara, City of San Jose and Milpitas collector system locations, and overland release flow paths. The Sub-Basin size ranges from 0.007 acres in densely developed urban areas to approximately 2,200 acres in undeveloped hilly areas.

The Sub-Basin size ranges from 0.007 acres in densely developed urban areas to approximately 2,200 acres in undeveloped hilly areas.

Watershed Delineation

Sub-Basins are also delineated based on stream channels and storm drain networks. In the Sub-Basins where the overland flow path and the storm drain network flow path conflicted, the storm drain flow path usually governs, as it usually conveys the most flow.

ESRI ArcMap Hydrology tools condition the input terrain to include underground pipes and channels. This approach ensures that the hydraulically connected pipe systems not modeled (lateral pipes smaller than 12 inches) can be routed to the modeled pipes hydrologically. The conditioned terrain creates sub-basins automatically. Sub-Basins are then further divided to model pipes 12 inches and greater. This approach provides consistent, reproducible watershed delineation results.

Basin Width

For sub-basins using the KW method, a representative watershed "plane" width needs to be determined. Each sub-basin is classified as either a 2 plane KW or 1 plane KW, shown in Figure 2-6, based on the distance (d), which is the shortest distance between the sub-basin centroid to the longest flow path. If d is relatively small, then the sub-basin is classified as a 2 plane KW, assuming it is the longest flow path runs relatively down the center of the sub-basin; thus, there is 1 KW plane draining from each side of the longest flow path. If d is relatively large, the sub-basin is classified as a 1 plane KW, assuming it is the longest flow path is relatively located along the sub-basin side; thus, there is only 1 KW plane draining into the longest flow path from only one side.

An algorithm can classify the sub-basins automatically. The following calculations are performed using the centroid flow path (L_c), which is the length from sub-basin centroid to the sub-basin drainage node along the longest flow path.

Assume 2 plane KW – width (W_2),

$$W_2 = 4L_c$$

Assume 1 plane KW – width (W_1),

$$W_1 = 2L_c$$

The minimum of |d-0.33W_1| and |d-0.33W_2| controls whether 1 plane or 2 plane KW, and the appropriate width calculated will be used as the representative watershed "plane".

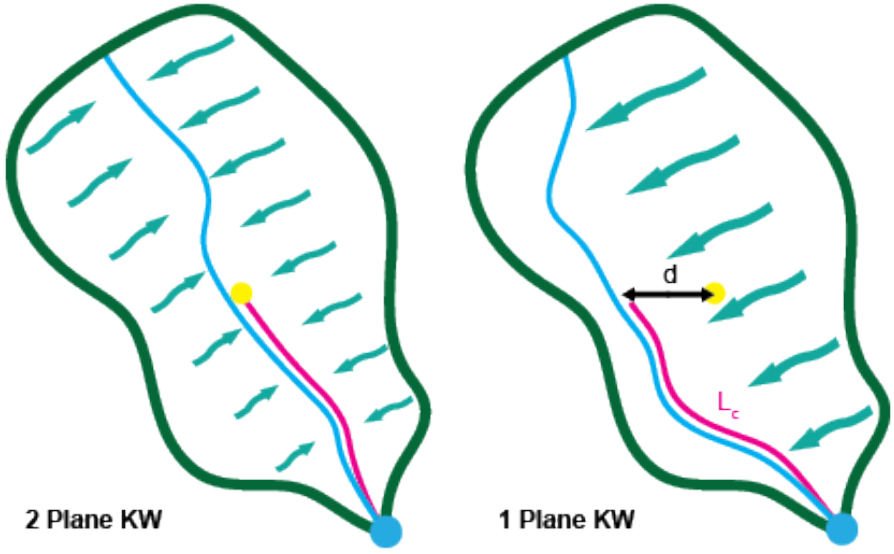


Figure 2-5: KW Planes

Watershed Soils

The National Resource Conservation Service (NRCS) soil survey and map information identifies soils in hydrologic soil groups based upon their infiltration properties.

Hydrologic soil groups "A," "B," "C," "C/D," and "D" are found present within the Berryessa/Penitencia drainage system. Group "A" has a higher infiltration rate than Group "D". "C/D" soils indicate a duality of hydrologic soil conditions. When the groundwater table is seasonably high (less than 24" from the surface), the soil has a "D" type response. When the water table is well-drained (greater than 24" from the surface), the soil has a "C" type response. The open space areas in the eastern portion of the Study area have more Groups "C" and "D". The urban areas along Upper Penitencia, Lower Penitencia, and Berryessa Creeks are mostly undetermined soil groups and are calibrated and validated under Valley Water's previous analysis. Figure 2-7 presents the NRCS Soils Map.

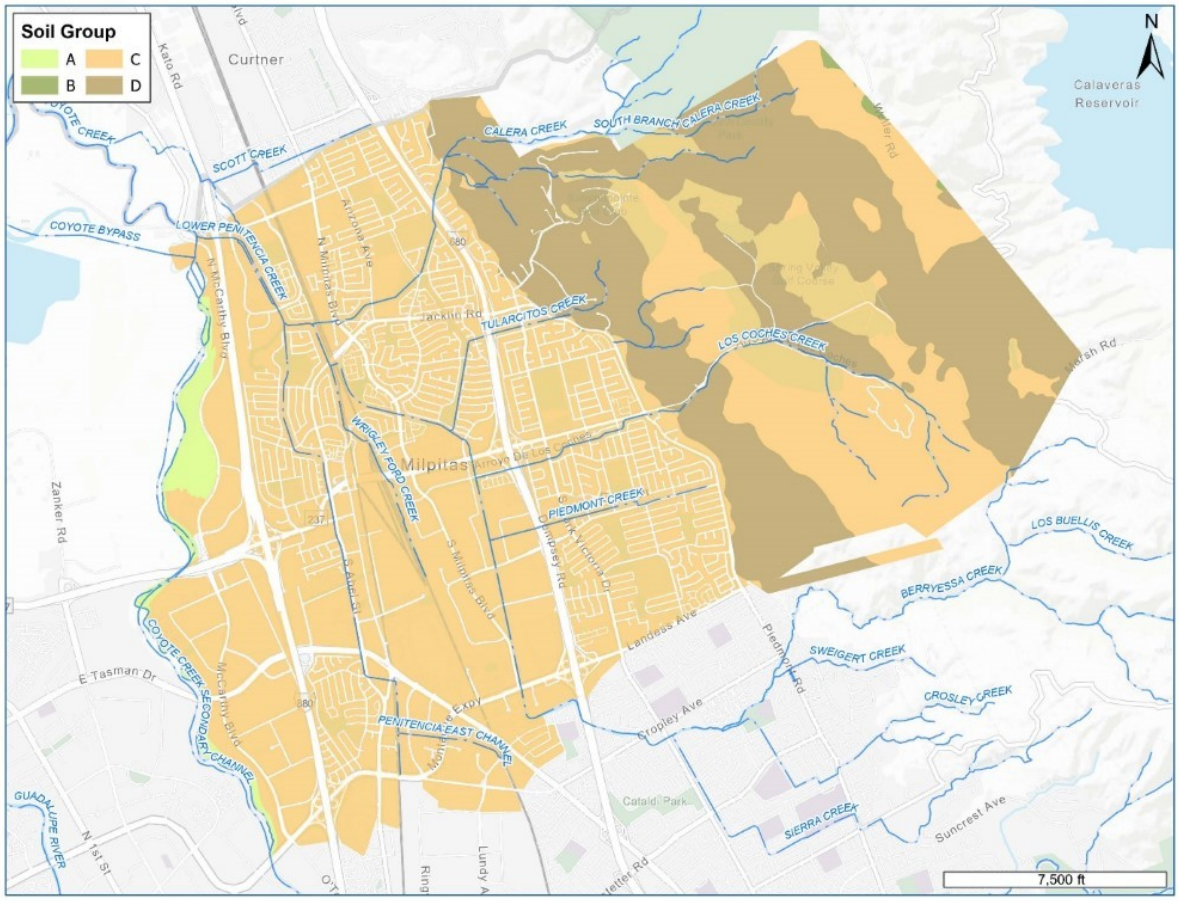


Figure 2-6: NRCS Soil Classification Map for the Berryessa/Penitencia Watershed

Each soil type consists of a combination of seven soil groups, A, A/B, B, B/C, C, C/D, D, and the NRCS assigns the dominant hydrologic soil group in the soil survey publication. In the event of an even split of percentages between two soil groups, the soil group with a lower infiltration rate is assigned.

Loss Rates

The NRCS Soil Group Boundaries are used to calculate each hydrologic soil group's quantity within each watershed. This information is input directly to the model in conjunction with each hydrologic soil group's infiltration properties (defined in Table 2-5).

Watershed Land Use

The City of Milpitas provided a land-use GIS reflecting the level of development within the city boundary. Each land use category was assigned a value of relative imperviousness based upon Table 2-6. To develop sub-basin-specific hydrology parameters for the KW and Snyder UH methods used a combination of percent imperviousness and underlying soil infiltration regime.

Figure 2-8 shows the land use. Areas with no defined land use in the city's GIS are assigned sub-basin-specific hydrology parameters based on the Esri World Imagery Map.

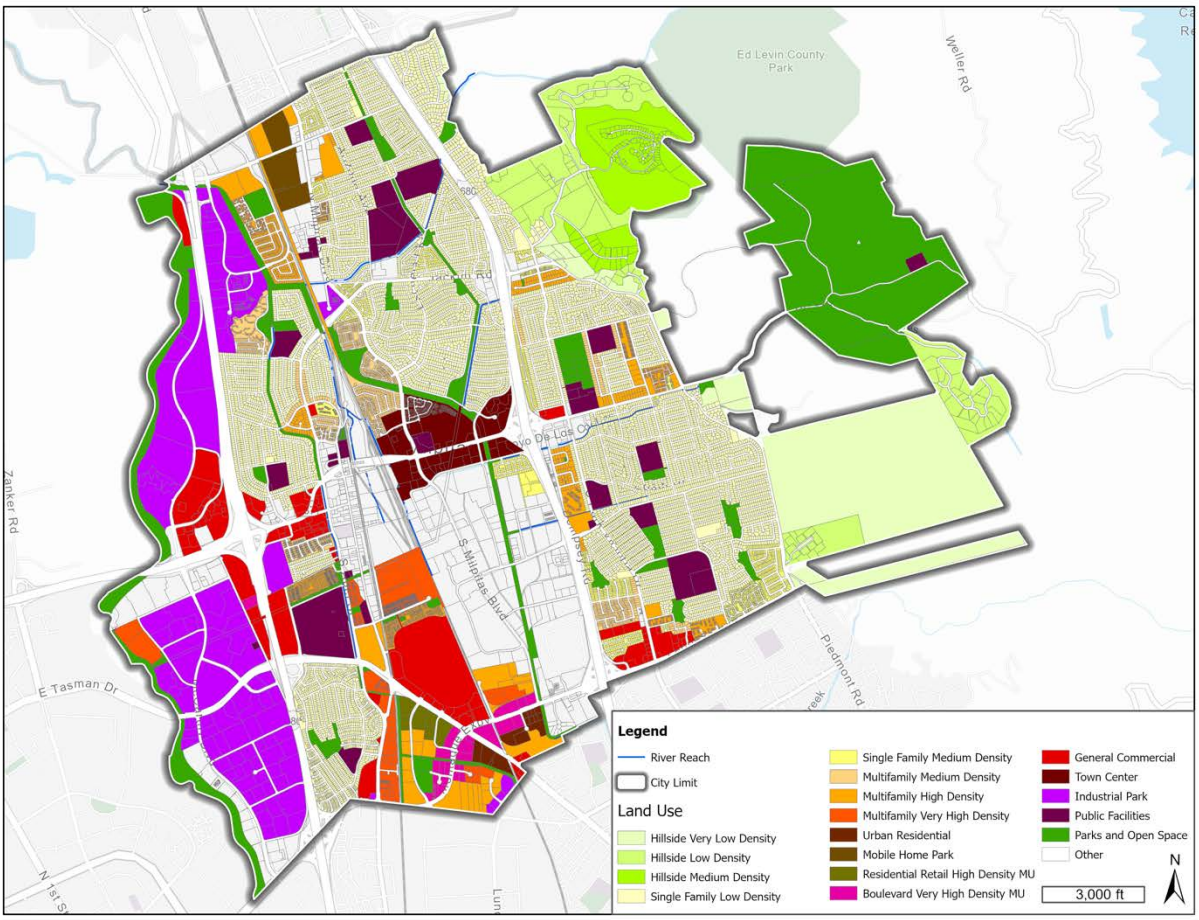


Figure 2-7: Milpitas Land Use

Hydraulics

A detailed representation of both the 'conduit and street' systems and the open channel systems is required in the model to evaluate the city's level of service storm drain system goals. This representation accounts for both conveyance and storage in the streets, conduits, and open channels. The InfoWorks ICM modeling software preforms the hydraulic analysis.

The Valley Water CTP model includes both the Upper Penitencia and Lower Penitencia/Berryessa watersheds, tributary creeks, and storm drain networks in San Jose and Milpitas. That CTP model is truncated at the Milpitas/San Jose boundary to focus on the city of Milpitas storm drain system. Channel, pipe, and 2D surface flow hydrographs are boundary inputs to the Milpitas SDMP model at the border between San Jose and Milpitas.

Conduit and Street Systems

The conduit and street systems were modeled using parameters as discussed in the following sections.

Conduit and Manhole Invert Elevations

The city of Milpitas GIS file of the storm drain network provided inverts of conduits and manholes. If inverts are missing from these two data sources, as-builts have been referenced to fill in any data gaps.

If data is still not found from these two data sources, an appropriate assumption is made by referencing upstream and downstream inverts and storm drain pipe cover.

Conduit Manning's n Roughness

Manning's n-values for conduit and street systems are estimated based on values specified in the reference shown in Table 2-8.

Table 2-8: Manning's n

Conduit Material	Manning's n
Reinforced Concrete Pipe	
Conduit > 36" diameter	0.012, 0.012*
Conduit < 36" diameter	0.012, 0.014*
Corrugated Metal Pipe	
Annular	0.021
Helical	0.018
Concrete-Lined Channels	
Smooth-Troweled	0.015
ACPWA Simulated Stone	0.017
Reinforced Concrete Box	
Cast-In-Place	0.015
Pre-Cast	0.014

**Bottom third of the conduit is assigned the first manning's n listed, while the top two-thirds are assigned the second manning's n listed to account for friction loss.*

All conduits of unknown material were assumed to be reinforced concrete pipe. For conduits with materials not listed in the table above, Manning's n values were referenced from other sources[6]. These materials and their associated Manning's n values are listed in Table 2-9.

Table 2-9: Conduit Manning's n Not Listed in Table 2-8

Material	Manning's n
Asbestos Cement (ACP)	0.011
Polyvinyl Chloride (PVC)	0.009
Cast Iron Pipe (CIP)	0.012
Ductile Iron Pipe (DIP)	0.012

All conduit material descriptions by pipe segment were obtained from the city of Milpitas.

Conduit Manhole Losses

Manhole losses are calculated in InfoWorks ICM using the Normal Headloss Method. The method does not account for bend, drop, contraction, and expansion losses but does account for simple junction losses. However, storm drains are generally built on straight alignments of the same diameter from manhole to manhole; without significant bends, drops, contractions, or expansions. Also, particularly for the larger pipe diameters, manholes simply provide periodic access to the top of continuous pipelines.

[6] Engineering ToolBox, (2004). Manning's Roughness Coefficients. [online] Available at: https://www.engineeringtoolbox.com/mannings-roughness-d_799.html [2020]

Conduit Boundary Conditions

The storm drain network's downstream boundary conditions are dynamically linked to 1D open channels in the InfoWorks ICM model. Creek levees are assumed to hold their elevations if overtopped in a modeling scenario. Levees do not fail in the SDMP analyses as they might for a Federal Emergency Management Association (FEMA) flood hazard analysis.

Conduit Assumptions

All conduits are assumed to have their full conveyance available. That is, all conduits are modeled with no silt or debris.

Pump Stations

The Milpitas storm drain system relies heavily on pump stations to move runoff from pipe networks to creeks that flow to San Francisco Bay. There are 13 pump stations owned and operated by the city of Milpitas within the study area, as shown in Figure 2-9. These pump stations are generally located at the discharge points of the city of Milpitas's storm drain system to Lower Penitencia Creek, Berryessa Creek, or Coyote Creek. Four (4) of the 13 stations discharge directly into Coyote Creek. Wrigley-Ford Creek pump station discharges the tributary Wrigley, Ford, and Wrigley-Ford Creeks (owned and operated by the city of Milpitas) to Berryessa Creek.

The pump stations are input into the InfoWorks ICM model based on a combination of data obtained from record drawings and the previous city of Milpitas SDMP (2013). Conversations with City operations and maintenance staff confirmed there have been no changes to pump station capacities since 2013. As-built documents determine the pump station storage volumes, including the larger storage areas at California Circle and Hidden Lake. Where system drawings are not available, storage curves from previous work on the 2013 SDMP and ancillary studies were used. The City of Milpitas provided set levels for the pump stations on- and off-levels. Pumps are modeled as having a flat rate of discharge based on the peak operating levels. A sensitivity analysis validates this simplification, as discussed below.

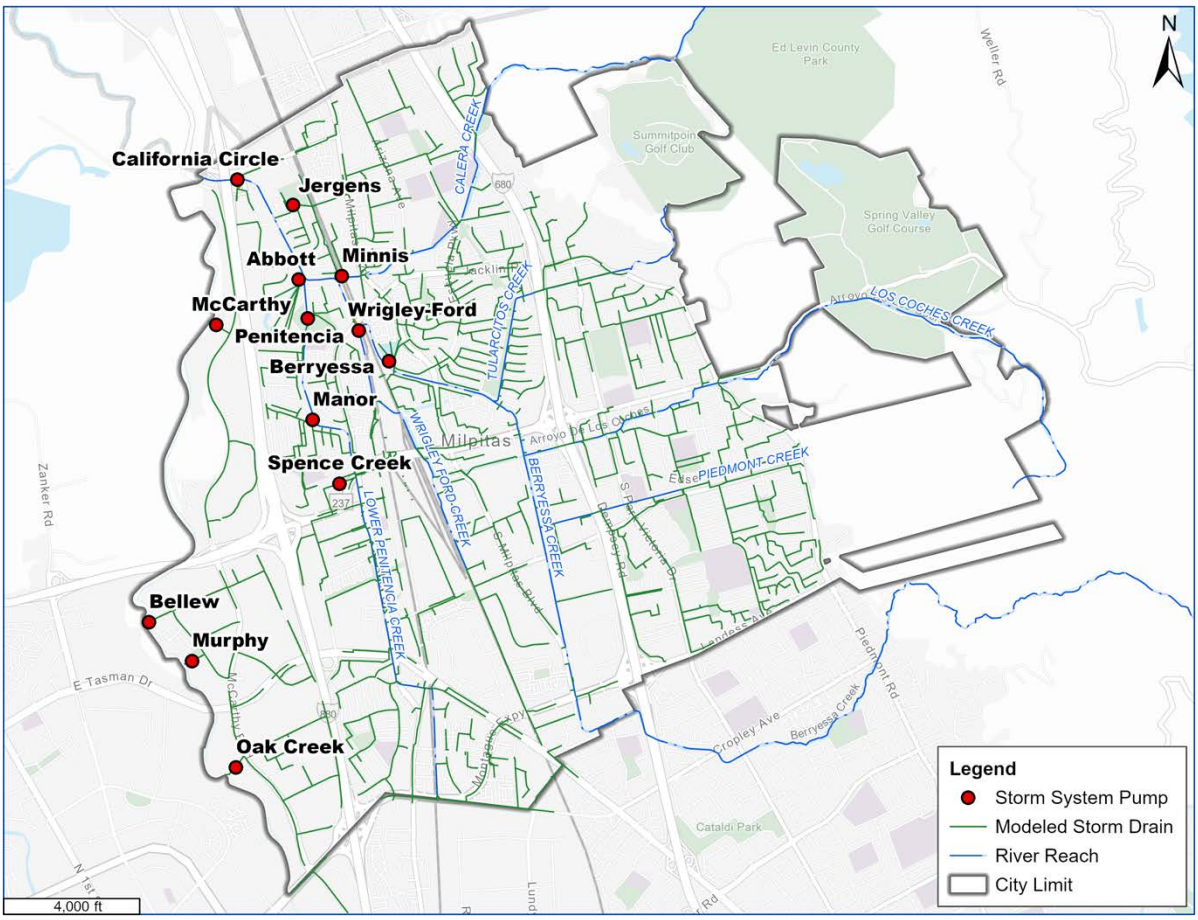


Figure 2-8: Pump Station Locations

Pumping Rate Sensitivity Analysis

To preserve the data associated with pump operation and simplify the ICM model, the pumps are not de-rated for minor losses; nor are pump curves inserted into the model. Pumps are modeled with a constant discharge set the maximum pump flow based on the city's pump curves. A sensitivity analysis has been performed to verify the validity of this assumption. The pipe or creek depth upstream and downstream of the pump station are compared using three pump capacity scenarios to test the pump capacity's sensitivity during the 100-yr storm, which exceeds the 10-year SDMP storm recurrence.

Downstream pipe depths are not sensitive to the pumping capacity, except at the Bellew, McCarthy, and Murphy Pump Stations that discharge to Coyote Creek, as summarized in Table 2-9. Since Coyote Creek is not specifically modeled and the pump discharges are in fact decoupled from the stage in the creek, these pump stations discharge under a free outfall condition, which artificially increases the sensitivity of the downstream water depth to pump capacity.

The sensitivity analysis indicates that the pumping capacity does not change the simulation outcome (maximum depth in the modeled downstream reaches) when the pumping capacity varies between 70% and 110% of its rated capacity. This constant-rate pump capacity methodology is deemed adequate for CIP formulation since there is no change in proposed CIPs based on a variable pumping rate tied to the creek stage at the pump station outfalls.

Table 2-10: Pump Station Sensitivity Analysis

Max Water Depth (ft) during the 100-yr Event							
Pump Station	Base Scenario		70% Pump Rated Capacity		110% Pump Rated Capacity		Receiving Creek
	U/S	D/S	U/S	D/S	U/S	D/S	
California	1.9	10.9	3.5	10.8	1.9	10.9	Lower Penitencia
Jurgens	4.8	13.3	4.8	13.2	4.8	13.3	Lower Penitencia
McCarthy	10.2	4.8	11.0	3.7	11.0	4.5	Coyote Creek
Minnis	6.3	10.3	13.1	10.2	6.6	10.2	Calera Creek
Abbott	7.5	11.4	7.7	11.4	7.5	11.4	Lower Penitencia
Penitencia	2.2	10.7	2.2	10.6	2.2	10.7	Lower Penitencia
Wrigley-Ford	5.4	10.8	6.3	10.7	5.5	10.8	Berryessa Creek
Berryessa	6.0	9.8	6.3	9.8	6.1	9.8	Berryessa Creek
Manor	3.2	9.2	5.2	9.1	3.4	9.1	Lower Penitencia
Spence Creek	7.4	12.9	7.3	12.8	7.4	12.9	Lower Penitencia
Bellew	22.8	1.2	23.2	1.0	22.8	1.2	Coyote Creek
Murphy	11.4	4.0	12.3	3.8	12.0	5.2	Coyote Creek
Oak Creek	6.2	5.0	7.0	4.8	6.9	4.6	Coyote Creek

Open Channel Systems

The open channel systems are modeled as discussed in the following subsections. Most of the open channels in the Lower Penitencia-Berryessa and Upper Penitencia Watershed in the CTP model are shown, including Upper Penitencia Creek, Sierra Creek, Sweigert Creek, Berryessa Creek, Los Coches Creek, Tularcitos Creek, Calera Creek, Wrigley Creek, Ford Creek, Wrigley-Ford Creek, East Penitencia Creek, and Lower Penitencia Creek. Crosley Creek is not modeled explicitly because its banks are not adjacent to any man-made structures. Crosley Creek was accounted for in hydrologic routing. In the truncated SDMP model for this report, Upper Penitencia, Berryessa upstream of Highway 680, and Sierra Creeks are removed from the model and input as hydrographs.

Open channel cross-sectional geometry is from a variety of sources, including surveys, as-builts, permitted design plans, previous HEC-RAS models, and the 2006 LiDAR dataset. Each source is described in the following sections, while Figure 2-9 spatially displays each creek's cross-section source (channels designated as "Survey" displays the year of the survey). This assumes projects funded by Valley Water at the time of this master plan will be completed, but does not include future planned projects.

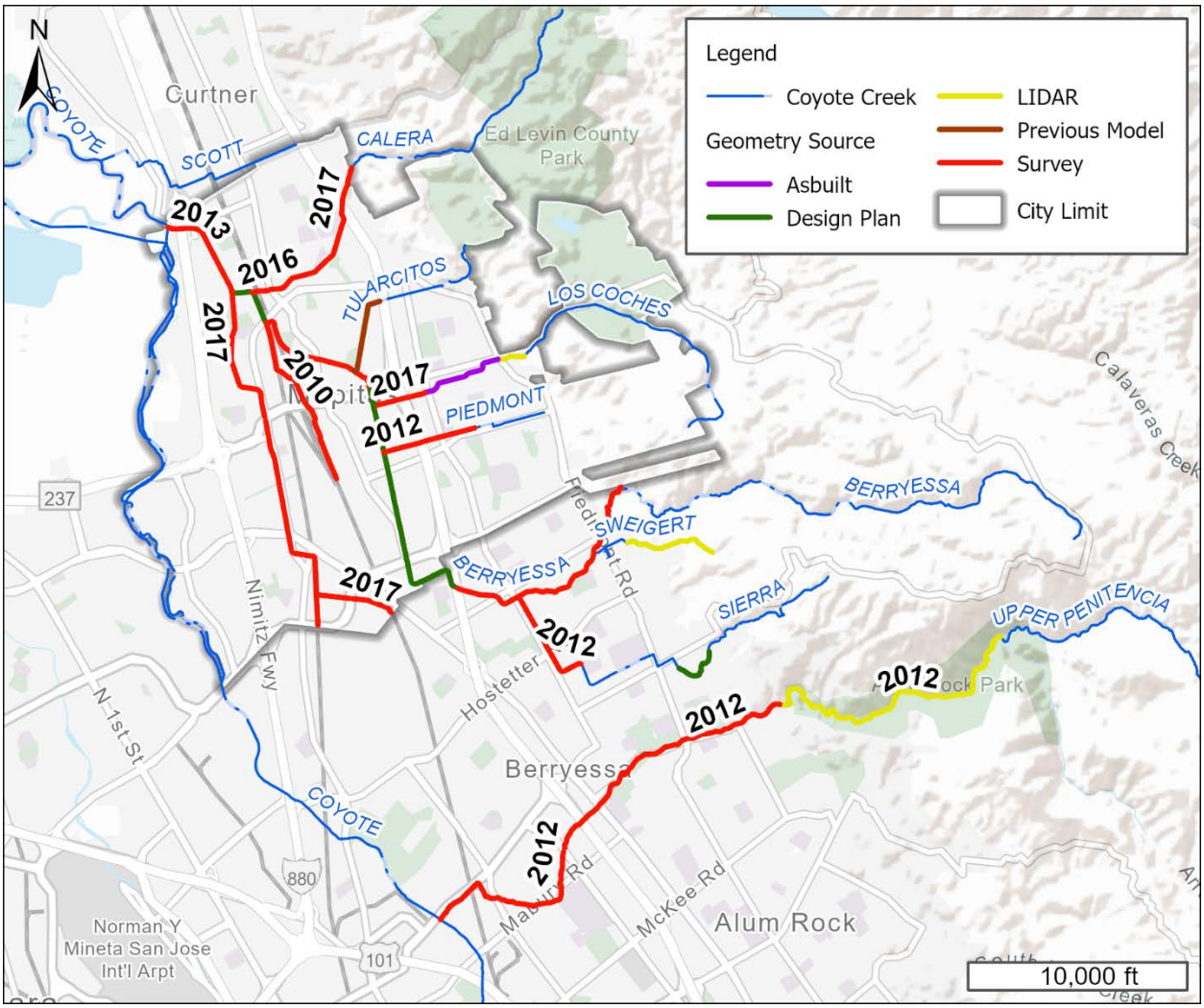


Figure 2-9: Map of Channel Cross Sectional Geometry Source

Levees and Floodwalls

All levees and floodwalls included in the model are assumed to not fail and therefore maintain flow within the channel to the top of bank, levee, or floodwall elevation. This produces the most conservative water surface elevation in the channel for storm drain modeling.

Storage Areas

Some storage areas in the model define pump station storage. California Circle Pump Station, Wrigley-Ford Pump Station, Berryessa Pump Station, Penitencia Pump Station, Jurgens Pump Station, and Abbott Pump Station are the pump stations with six storage areas defined. Storage areas are represented by stage-storage curves, which have been obtained from record drawings or previous studies.[7]Another storage area in the model not associated with pump stations is Dixon Landing Park, which is used to store surcharges upstream of Jurgens Pump Station.

[7] "City of Milpitas Storm Drain Master Plan", Schaaf & Wheeler, July 2013

Table 2-11: Pump Station Storage Areas

Pump Station	Storage Area
California Circle Pump Station	Dixon Landing Lagoon
Berryessa Pump Station	Hidden Lake Lagoon
Penitencia Pump Station	Hall Park Lagoon
Abbott Pump Station	City of Milpitas Drainage Lagoon
Wrigley-Ford Pump Station	Storage area located where Ford Creek joins Wrigley-Ford Creek
Spence Creek Pump Station	Spence Creek Pump Station Storage Area

Channel Bankline

Channel bank lines connect channel overbanks to 2D floodplains hydraulically. Theses lines' ground elevations are sampled from a GIS terrain to ensure smooth transitions from channel overbanks to the 2D floodplains.

Channel bank lines represent floodwalls along Lower Penitencia Creek, Calera Creek, and Berryessa Creek. These elevated tops of wall floodwall elevations have been converted from the as-builts georeferenced to ortho-imagery. These lines, when used as floodwalls, contain runoff within channels until and unless the floodwalls are overtopped.

A map of flood walls and levees is displayed as Figure 2-10.

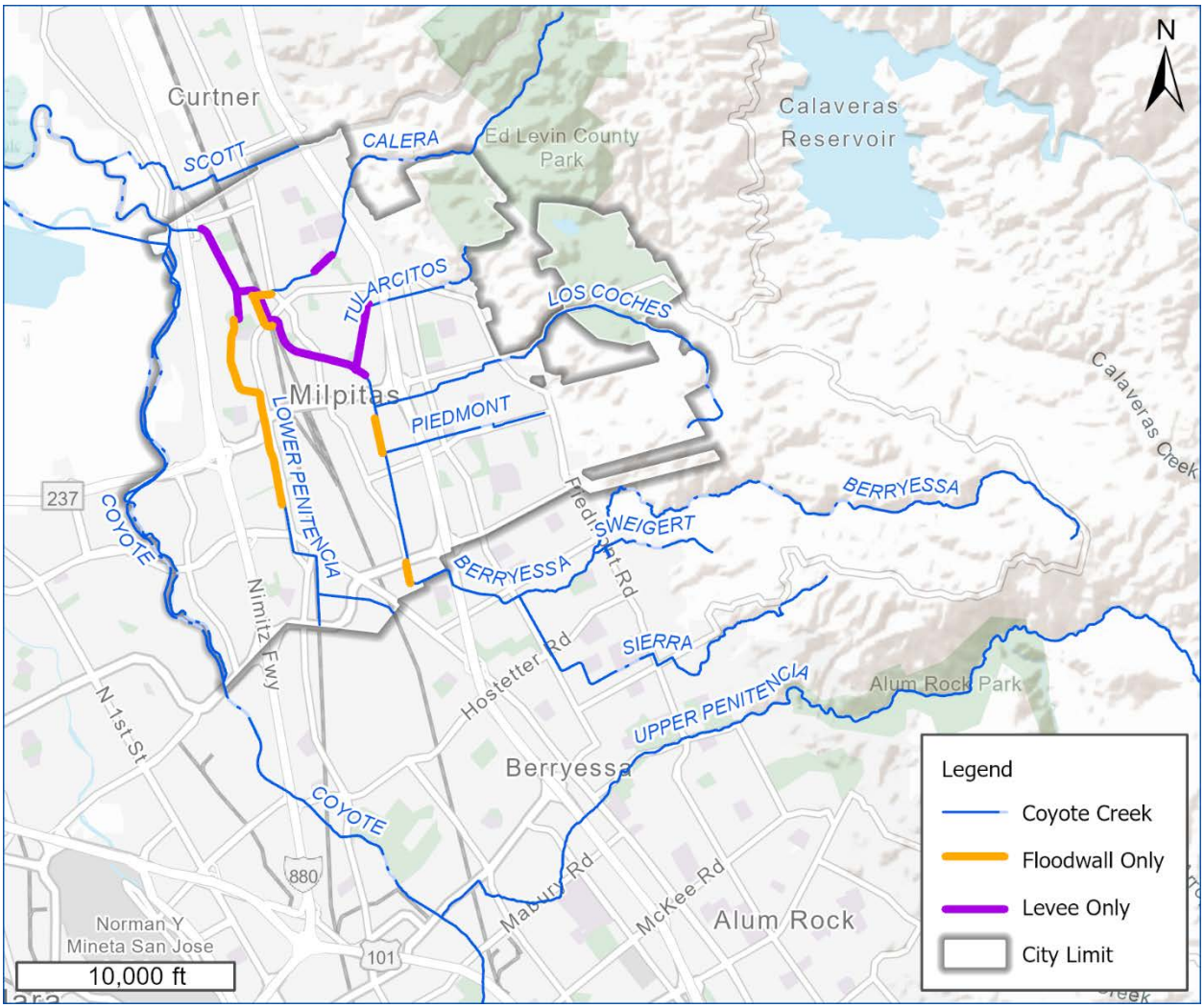
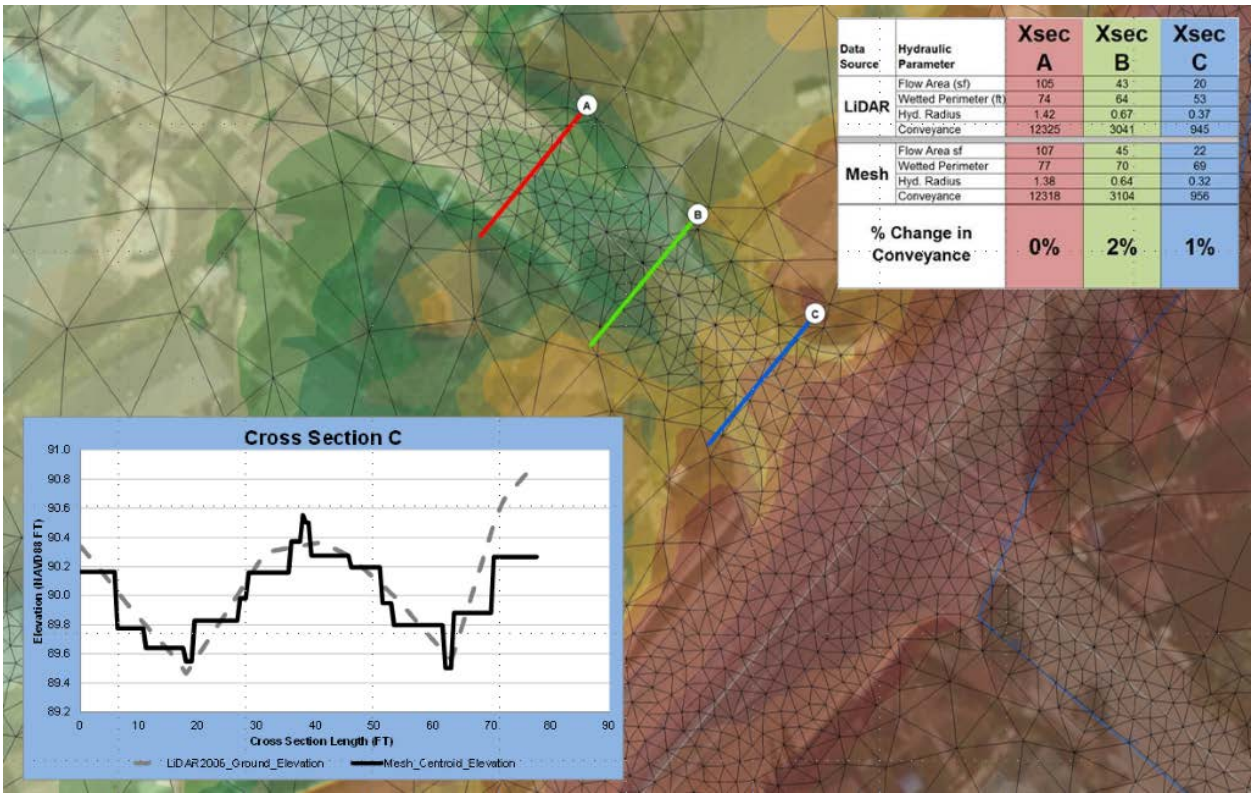


Figure 2-10: Flood Wall and Levee Map of the Berryessa/Penitencia Watershed

Two-Dimensional Surface

A two-dimensional (2D) surface is modeled and linked with pipe nodes to reflect flow exchanges and the hydraulic performance between different drainage facilities when pipe capacities exceed and flow spills to the 2D surface. The features that affect the predicted flooding extents with the spill to the 2D surface resolve the modeled 2D surface and surface roughness.



Data Source	Hydraulic Parameter	Xsec A	Xsec B	Xsec C
LiDAR	Flow Area (sf)	105	43	20
	Wetted Perimeter (ft)	74	64	53
	Hyd. Radius	1.42	0.67	0.37
	Conveyance	12325	3041	945
Mesh	Flow Area sf	107	45	22
	Wetted Perimeter	77	70	69
	Hyd. Radius	1.38	0.64	0.32
	Conveyance	12318	3104	956
% Change in Conveyance		0%	2%	1%

Figure 2-11: Cross Section Comparison between the Modeled vs. Terrain

Two-dimensional surface resolutions are classified into two groups. A high-resolution group built to reflect appropriate street conveyance. The model elements (triangles) representing the terrain resolution have sizes ranging from 25 to 500 square feet. The high-resolution group has sufficient accuracy in representing street conveyance, as indicated in Figure 2-11. The percent of cross-section conveyance difference between the modeled and original terrain is less than 5 percent.

A lower resolution group is built for other areas with no well-defined drainage conveyance geometry, such as open space, residential, and commercial areas. The model elements (triangles) that represent a lower resolution terrain have sizes ranging from 1,000 to 5,000 square feet.

Valley Water provided the LiDAR topographic terrain used for the 2D surface modeling and has a cell size/resolution of a 3-foot by 3-foot grid. In addition, known projects completed between the 2006 LiDAR and 2018 are inserted into the 2D surface as fill based on development design plans.

Two-dimensional Surface Manning's n Roughness

Surface roughness over the 2D grid is estimated with Manning's n values and is typically higher than the channel roughness because of the shallow flow characteristics. Aerial photography and land use classifications made estimates of Manning's n-values for the 2D surface by considering the density of buildings on the overbank and the base "n" values of the open areas of the buildings. Although the density of buildings and the presence of fences and other obstructions vary considerably across a given land use polygon, it is assumed that a general urban roughness value reasonably represents the effects of structures within the floodplain.

Surface land uses are categorized into four different Manning's n values displayed in Table 2-12:

Table 2-12: Floodplain Manning's n Values

Floodplain Description	N value
Street	0.025
Open Space, Institution, Public Facilities	0.03
Commercial	0.12
Residential and Industrial	0.13

Based on the above methodology, the model is sufficient to evaluate storm drain system performance for a 10-year design storm. The resulting flooding onto the two-dimensional surface identifies deficiencies that need correction with a Capital Improvement Program (CIP).

Chapter 3: Capital Improvement Program

This chapter describes deficiencies in major storm drain facilities and outfalls, historical problem areas, pumping and storage facilities, and other known flood hazards. Detailed descriptions of necessary capital improvement projects and their prioritization are provided in this chapter.

Existing Conditions Flooding

The master plan evaluates the existing storm drain system performance for the 10-year design storm. Figure 3-1 shows the flooding that is modeled to occur with the 10-year design storm. In this flood study, the master plan proposes CIP projects that can eliminate or ameliorate the identified inundation.

Existing Conditions 10-Year Floodplain

Lower Penitencia-Berryessa Watershed

August 2021

Legend

- Modeled Storm Drain
- River Reach
- City Limit

CIP Priority

- Low
- High
- Specific Plan Extension

Flood Depth (ft)

- 0 - 1.0
- > 1.0

Land Use - Specific Plan

- Main Street Gateway
- Milpitas Metro

SOURCES:
Schaaf & Wheeler
InfoWorks ICM Model Results

N

0 1,250 2,500
Feet

Vicinity Map

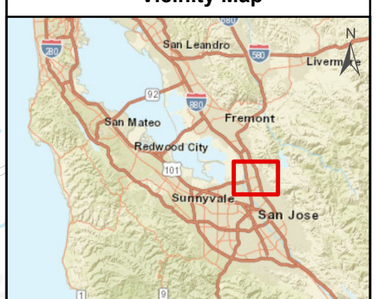


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Figure 3-1

Improvement Projects

Recommended CIP projects are identified graphically, and general project routes are given. The following color code is used throughout this chapter to highlight system performance and general CIP prioritization, as described by Table 3-1:

Green	Satisfactory Performance / No Improvement Necessary
Red	High Priority Project
Orange	Low Priority Project

CIP priorities are assigned based on inundation impact in the existing condition. A high-priority CIP project addresses extensive flooding on residential or commercial properties that spreads across several streets and can widely disrupt traffic, residential and commercial activities. A low-priority CIP project manages flooding only in streets, minor flooding on properties, or flooding that can only be partially alleviated. No numeric threshold was used in categorizing CIP priorities. The tables of statistics associated with each collection system group give a general indication of the capital expenditure level necessary to correct storm drain deficiencies. Sometimes installing additional pipe lengths is required to complete corrective action.

City-owned storm drainpipes 12 inches and larger in diameter have been evaluated. Pipes that act as laterals are not in the mainline analysis but are assumed to be part of the system that delivers flow into the main drainage lines.

Alternative Improvement Projects

To increase storm drain system capacity, two essential types of projects are available: installing a new relief sewer parallel to the system lacking capacity; or replacing the overloaded pipe with a larger diameter pipe in the same alignment. The two alternatives can be made equivalent to one another using the following formula, assuming that pipe material and length are equal:

$$D_R = \left(D_e^{2.63} + D_p^{2.63} \right)^{0.38}$$

where D_R = diameter of replacement pipe;

D_e = diameter of overloaded pipe; and

D_p = diameter of parallel relief drain.

The city's selection of a capacity improvement strategy will vary from project to project and be governed by construction constraints, including available rights-of-way and existing utilities. It is most likely that the storm drain CIP for Milpitas will utilize parallel relief drains unless right-of-way and utility constraints appear to favor the pipe's actual replacement, which is more costly.

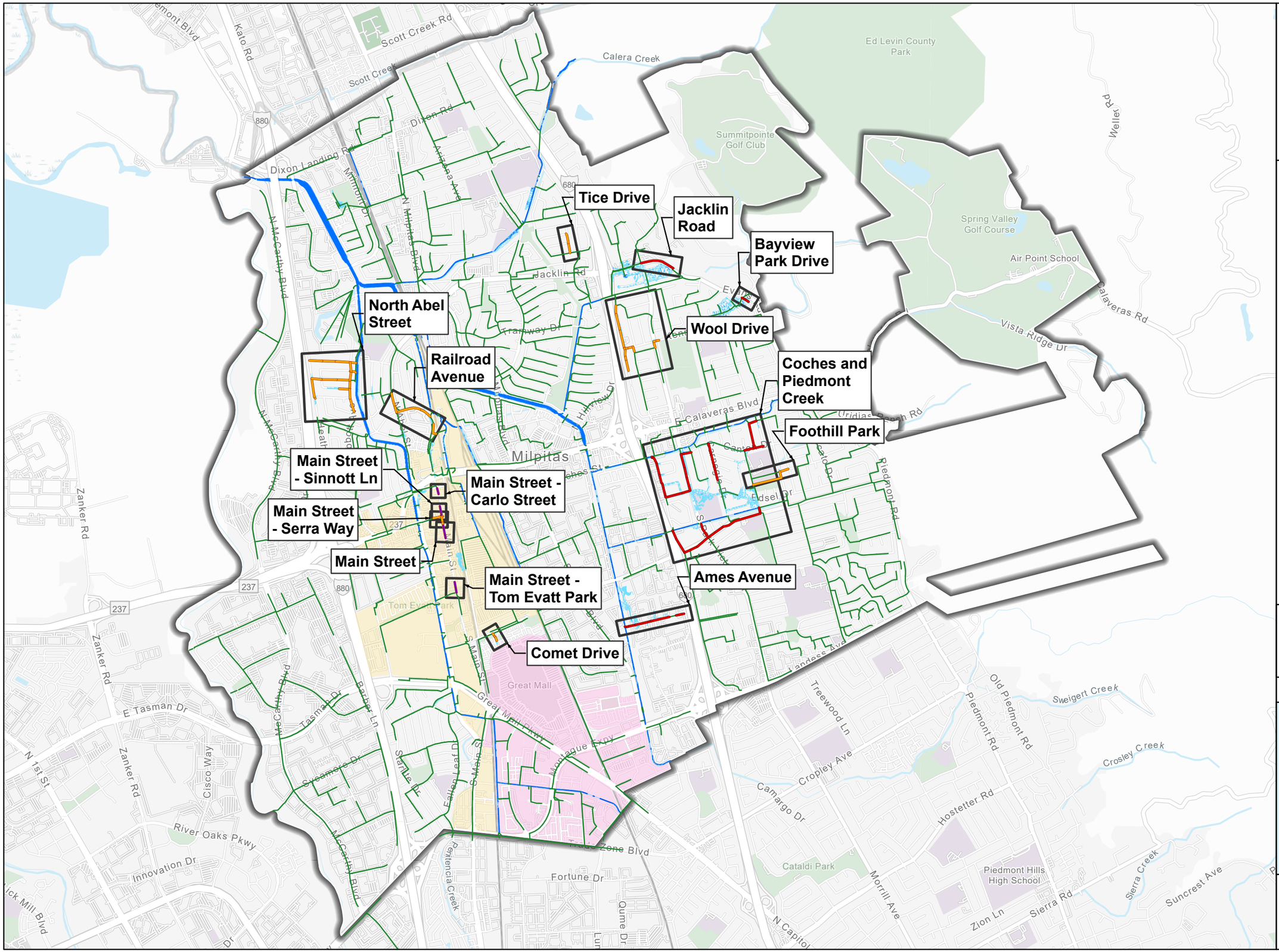
Installing new parallel drains should be more cost-effective than replacing pipes in most cases since the required pipe size is smaller, and the existing pipe does not need removal. Given the 50 percent contingency applied to unit cost estimates, there is no differentiation between the cost of pipe replacement and parallel drain installation in the CIP. (That is, the cost of existing pipe removal is included in the large contingency.)

Therefore, the default project for in-street improvements is a parallel relief drain, while the default project for improvements within existing off-street easements is pipe replacement. The CIP assumes storm drain size is not allowed to decrease in the downstream direction. Thus, an additional downstream pipe may be listed in the CIP, although there is no indication of substandard storm drain performance based on hydraulic grade calculations.

Capital Improvement Program

CIP projects are identified in Figure 3-2 and Table 3-1, which will correct inadequate storm drain capacity caused primarily by undersized pipes during a 10-year design storm. The inundation areas that each of the projects specifically address is shown in Figures 3-4 to 3-10. Detailed figures for each CIP project are included in Appendix A.

However, the fourteen (14) identified CIP projects do not resolve surcharges from high creek levels downstream of the storm drain network, nor do they address inlets or manholes at isolated low points with low ground cover. The inundated areas are areas not resolved by the fourteen CIP projects, shown in Figure 3-3. These areas would only be resolved by major creek projects (outside of the scope of this Master Plan) or by the installation of small, localized pump stations, all found to be cost-prohibitive. The inundations are located mainly on the streets and empty lots. There is minor flooding on residential and commercial properties. Figure 3-3 shows that there is one location that is intentionally flooded. Instead of increasing the storm drain capacity for this area, Dixon Landing Park is used as a designated temporary storage area as a cost-effective solution that will not have any critical impact to the City.



Existing Conditions 10-Year Floodplain

Lower Penitencia-Berryessa Watershed

August 2021

Legend

- Modeled Storm Drain
- River Reach
- City Limit

CIP Priority

- Low
- High
- Specific Plan Extension
- CIP Location

Flood Depth (ft)

- 0 - 1.0
- > 1.0

Land Use - Specifc Plan

- Main Street Gateway
- Milpitas Metro

SOURCES:
Schaaf & Wheeler
InfoWorks ICM Model Results

N

0 1,250 2,500
Feet

Vicinity Map

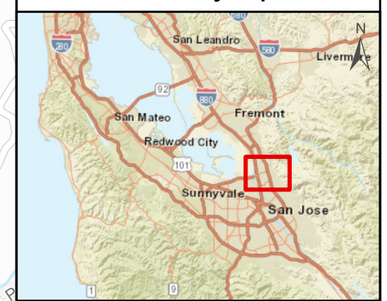


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Figure 3-2

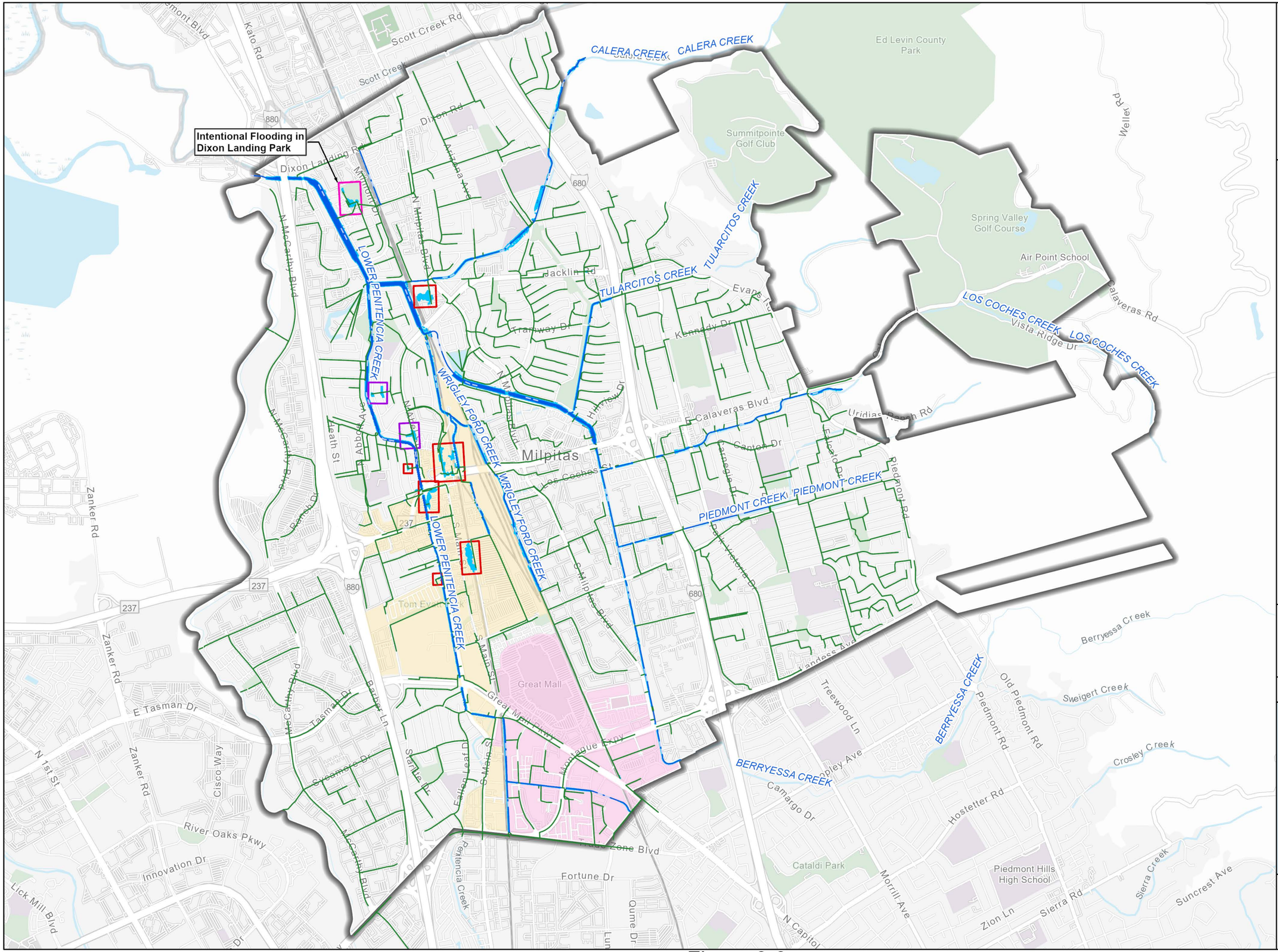


Figure 3-3

Post-CIP 10-Year Floodpain

Lower Penitencia-Berryessa Watershed

April 2021

Legend

- Modeled Storm Drain
- River reach
- City Limit

Land Use

- Midtown Specific Plan
- Metro Area Specific Plan

Remaining Inundation

- High Creek Level
- Intentional Flooding
- Low Point

Flood Depth (ft)

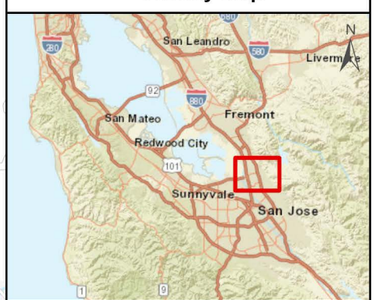
- 0 - 1.0
- > 1.0

SOURCES:
Schaaf & Wheeler
InfoWorks ICM Model Results

N

0 1,250 2,500
Feet

Vicinity Map



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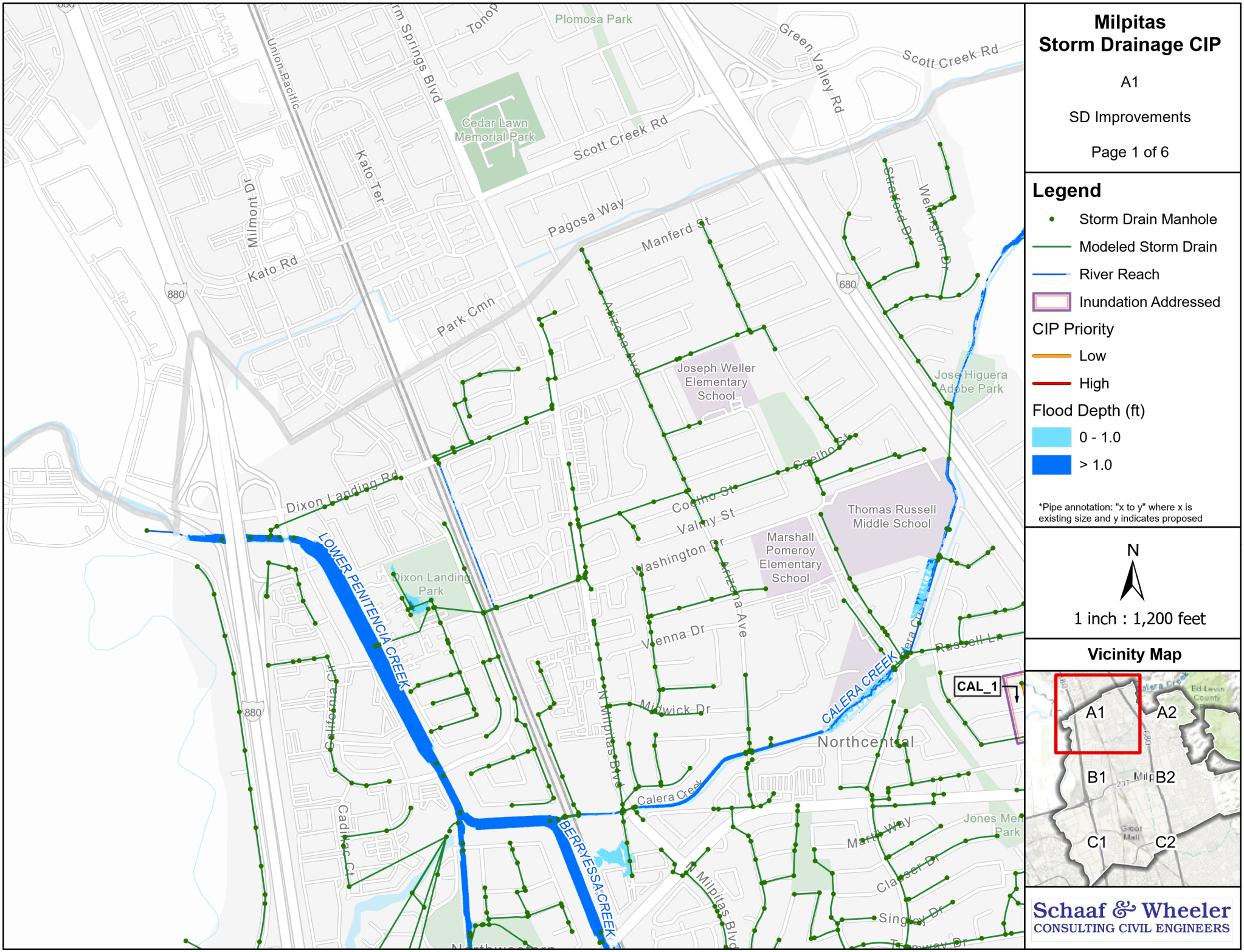
Milpitas
Storm Drainage CIP
A1
SD Improvements
Page 1 of 6
Legend
Storm Drain Manhole
Modeled Storm Drain
River Reach
Inundation Addressed
CIP Priority
Low
High
Flood Depth (ft)
0 - 1.0
> 1.0
*Pipe annotation: "x to y" where x is existing size and y indicates proposed
N
1 inch : 1,200 feet
Vicinity Map
A1
A2
B1
B2
C1
C2
Schaaf & Wheeler
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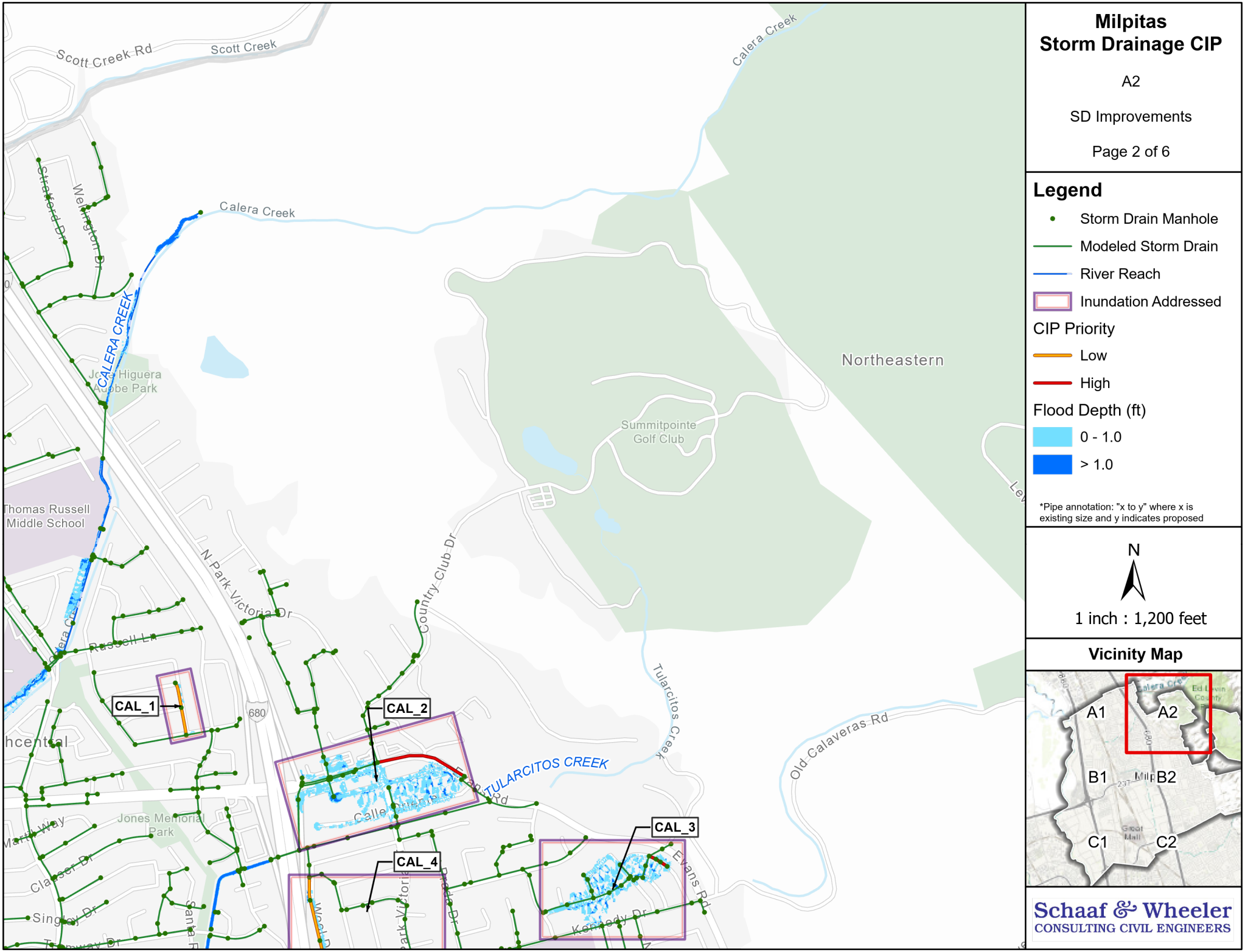
Plomosa Park
Cedar Lawn Memorial Park
Scott Creek Rd
Green Valley Rd
Union Pacific
Milmont Dr
Kato Ter
Kato Rd
Pagosa Way
Park Cmn
Manford St
Arizona Ave
Joseph Weller Elementary School
Stratford Dr
Washington Dr
680
880
Jose Higuera Adobe Park
Dixon Landing Rd
Coelho St
Valmy St
Thomas Russell Middle School
Marshall Pomeroy Elementary School
Dixon Landing Park
LOWER PENITENCIA CREEK
Vienna Dr
Midwick Dr
CALERA CREEK
CAL_1
Russell Ln
N Milpitas Blvd
Northcentral
Calera Creek
BERRYESSA CREEK
Cadillac Ct
Jones Memorial Park
Marti Way
Classen Dr
Singley Dr
E Milpitas Blvd



Milpitas Storm Drainage CIP

A2

SD Improvements

Page 2 of 6

Legend

- Storm Drain Manhole
- Modeled Storm Drain
- River Reach
- Inundation Addressed

CIP Priority

- Low
- High

Flood Depth (ft)

- 0 - 1.0
- > 1.0

*Pipe annotation: "x to y" where x is existing size and y indicates proposed

N

1 inch : 1,200 feet

Vicinity Map

Schaaf & Wheeler
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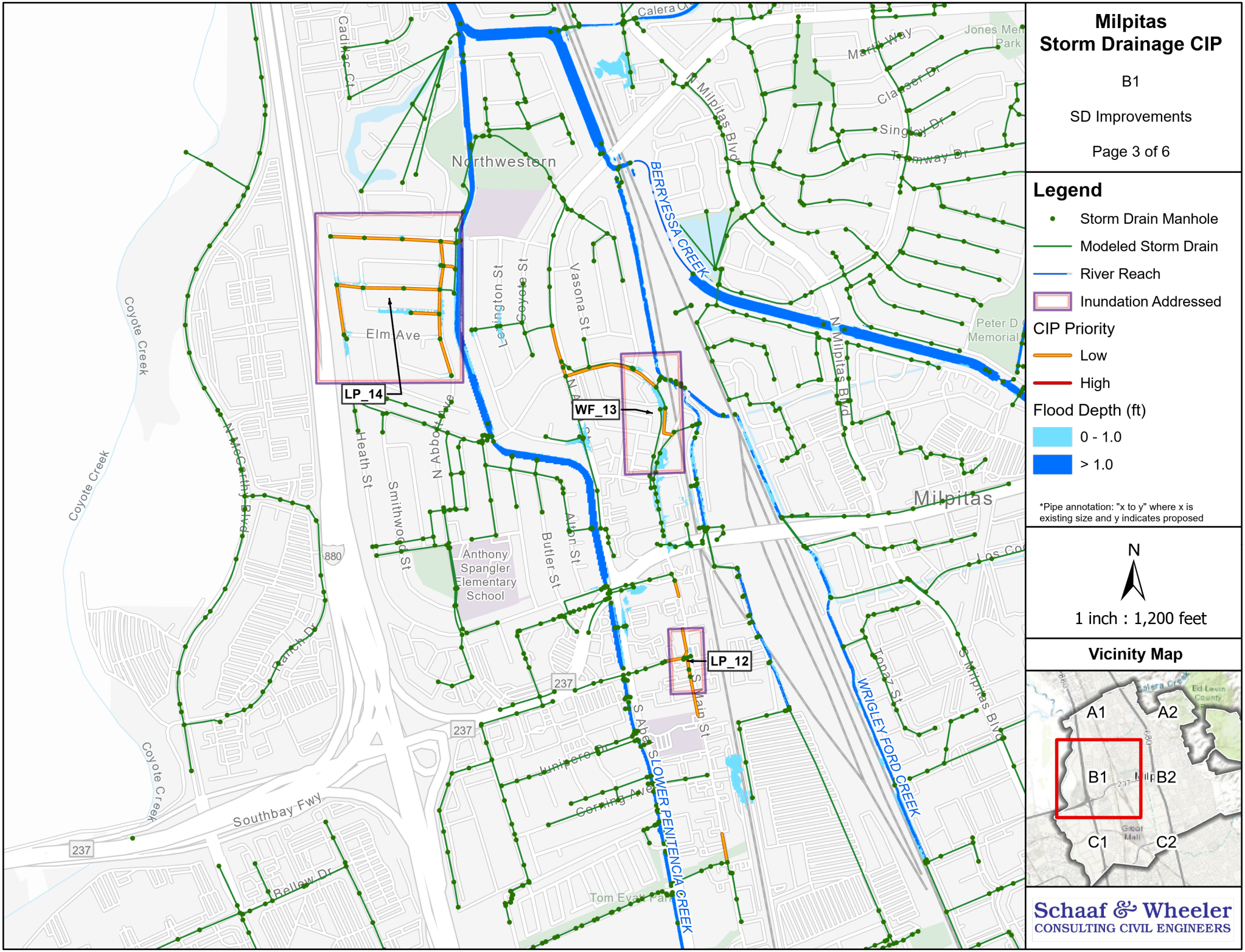


Milpitas Storm Drainage CIP

B1

SD Improvements

Legend

- Storm Drain Manhole
- Modeled Storm Drain
- River Reach
- Inundation Addressed

CIP Priority

- Low
- High

Flood Depth (ft)

- 0 - 1.0
- > 1.0

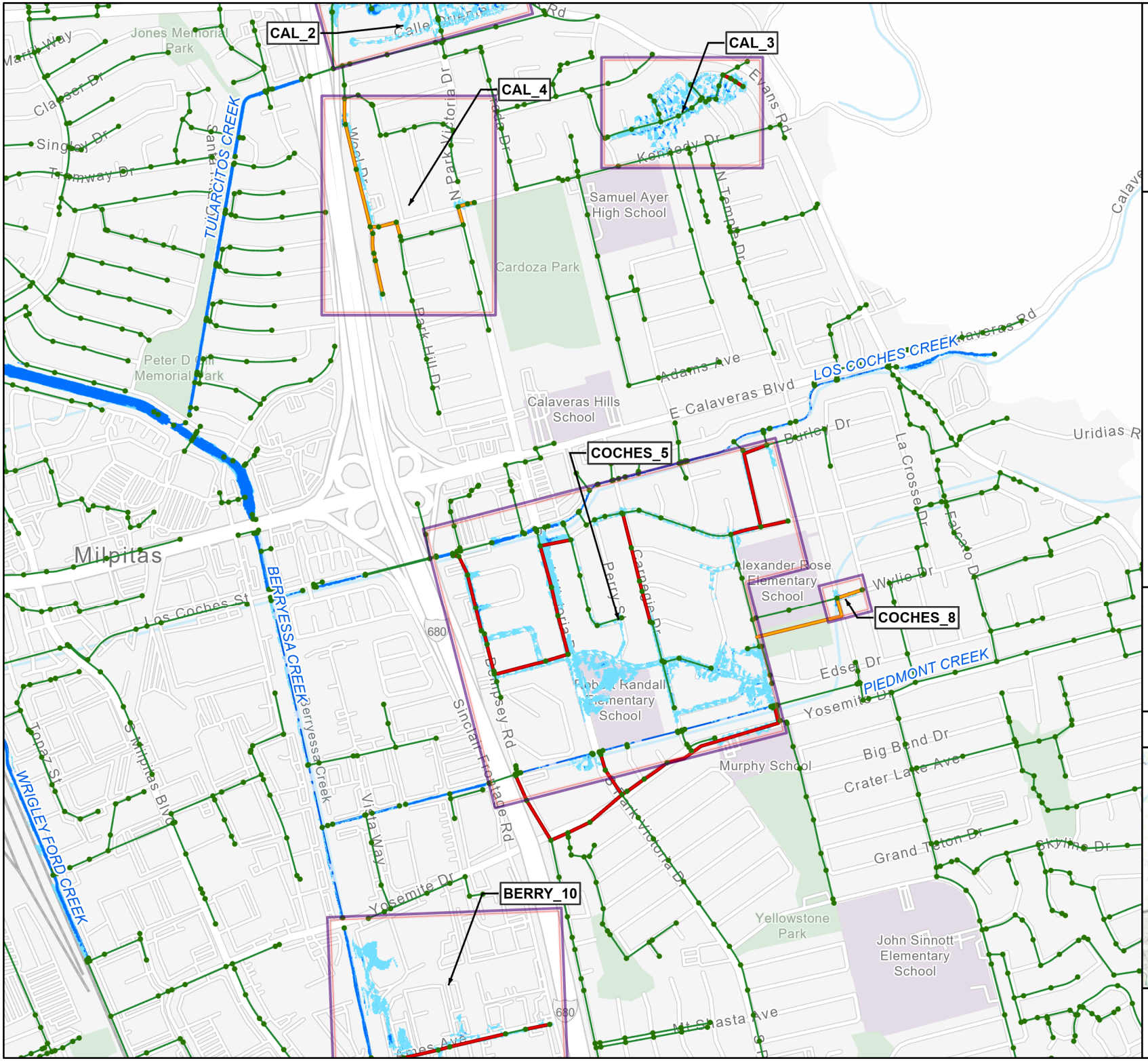
*Pipe annotation: "x to y" where x is existing size and y indicates proposed

N

1 inch : 1,200 feet

Vicinity Map

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS



Milpitas Storm Drainage CIP

B2

SD Improvements

Legend

- Storm Drain Manhole
- Modeled Storm Drain
- River Reach
- Inundation Addressed

CIP Priority

- Low
- High

Flood Depth (ft)

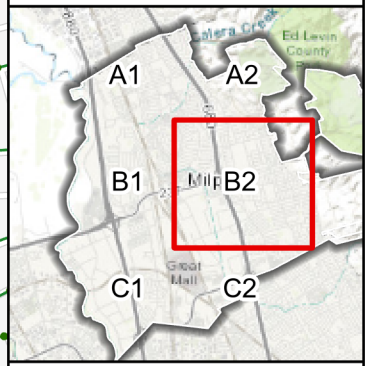
- 0 - 1.0
- > 1.0

*Pipe annotation: "x to y" where x is existing size and y indicates proposed

N

1 inch : 1,200 feet

Vicinity Map



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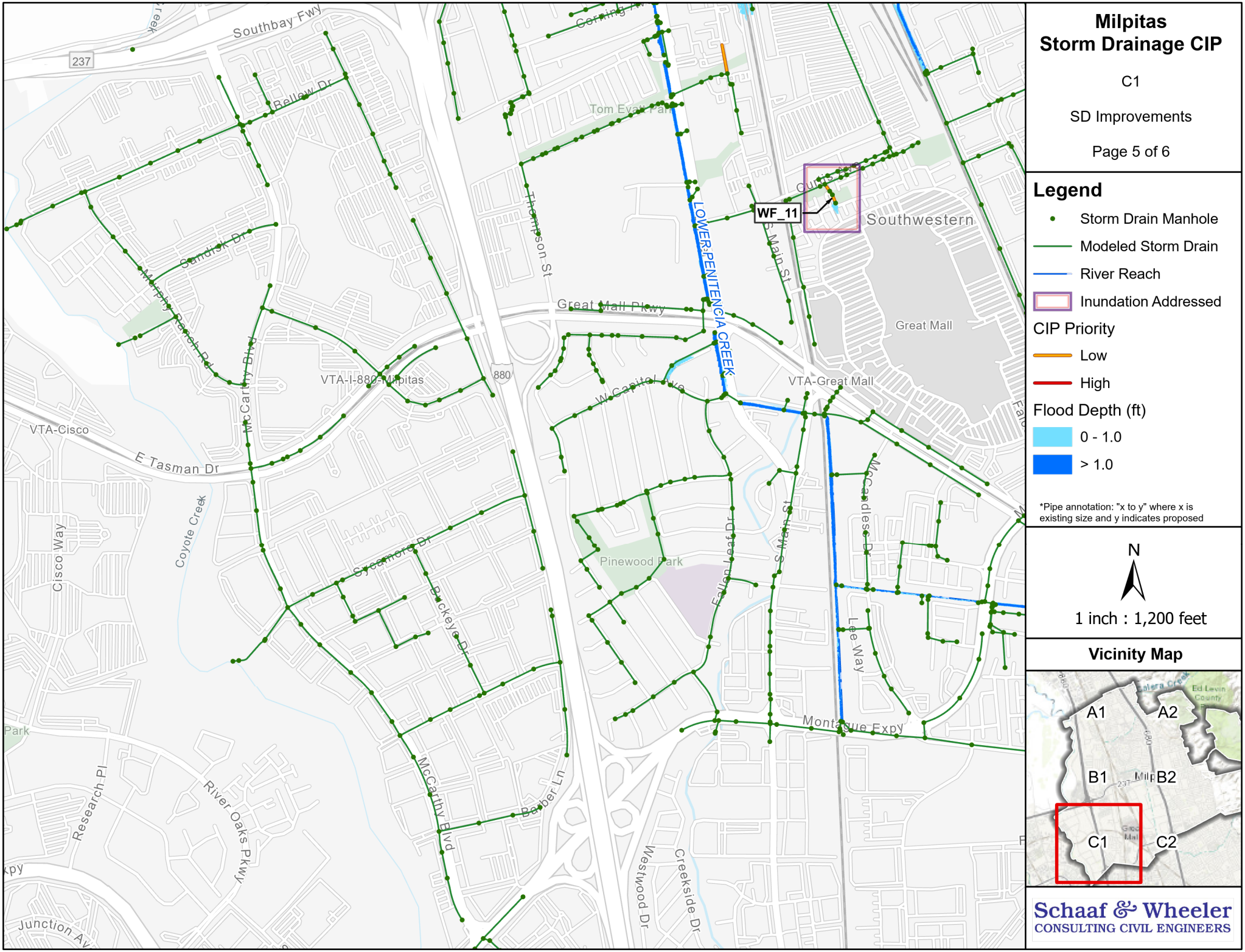

Milpitas Storm Drainage CIP

C1

SD Improvements

Legend

- Storm Drain Manhole
- Modeled Storm Drain
- River Reach
- Inundation Addressed

CIP Priority

- Low
- High

Flood Depth (ft)

- 0 - 1.0
- > 1.0

*Pipe annotation: "x to y" where x is existing size and y indicates proposed

N

1 inch : 1,200 feet

Vicinity Map

Schaaf & Wheeler
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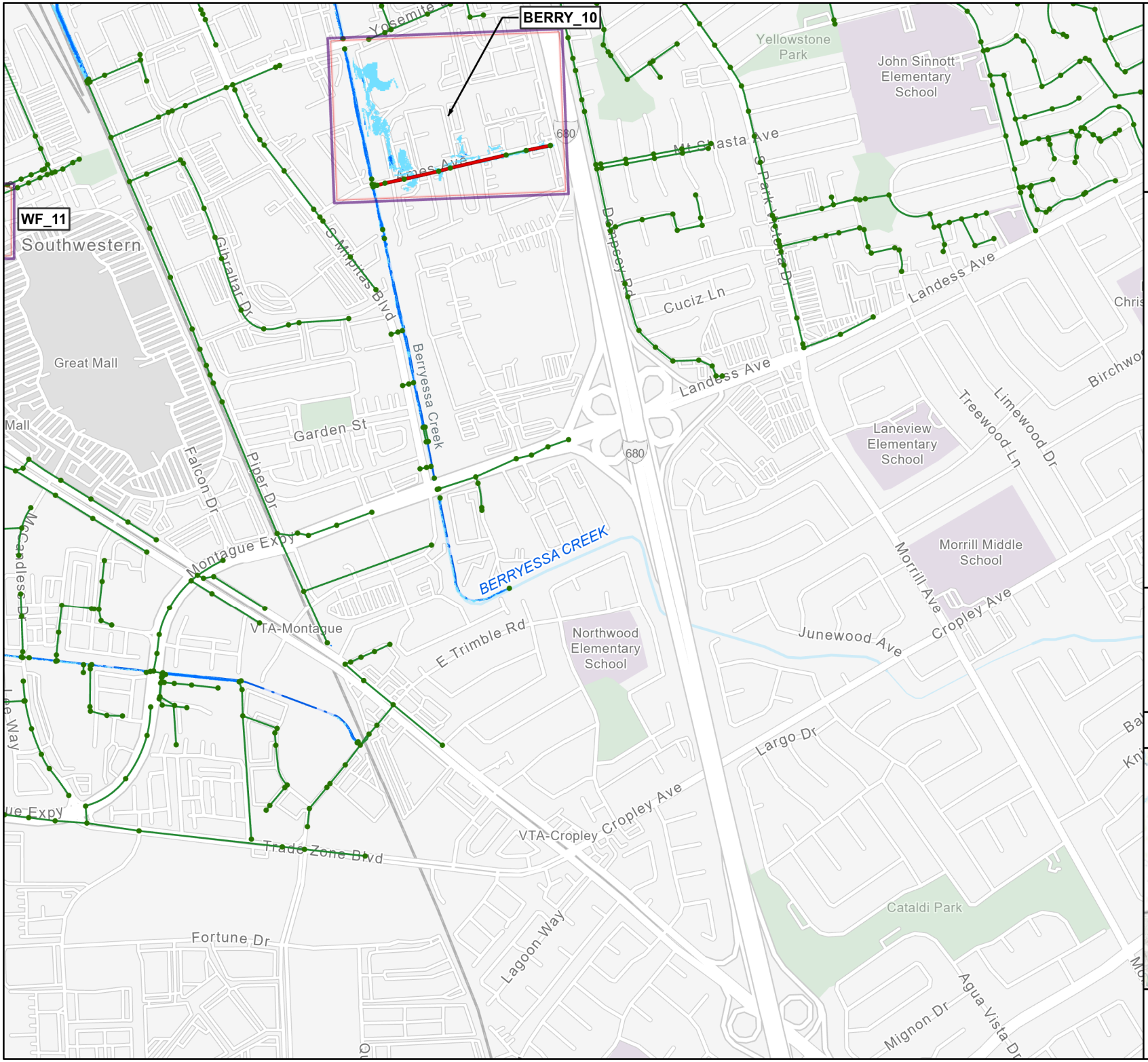

Milpitas Storm Drainage CIP

C2

SD Improvements

Legend

- Storm Drain Manhole
- Modeled Storm Drain
- River Reach
- Inundation Addressed

CIP Priority

- Low
- High

Flood Depth (ft)

- 0 - 1.0
- > 1.0

*Pipe annotation: "x to y" where x is existing size and y indicates proposed

N

1 inch : 1,200 feet

Vicinity Map

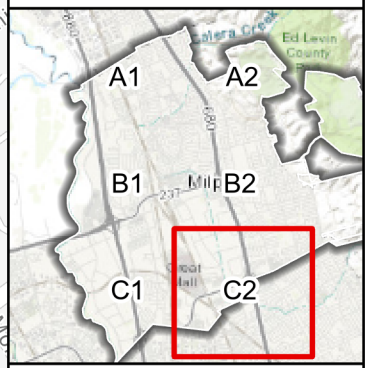

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Table 3-1: Capital Improvement Projects

ID	Project	Priority	Replacement Option	Parallel Option
CAL_2	Jacklin Road	High	Install approximately 950 LF of 30-inch RCP along Jacklin Rd between Calle Oriente and N Park Victoria Dr.	Use replacement option.
CAL_3	Bayview Park Drive	High	Replace approximately 210 LF of existing 12-inch RCP on Bayview Park Dr with 24-inch RCP.	Install approximately 210 LF of 24-inch RCP on N Bayview Dr.
COCHES_5	Coches and Piedmont Creek	High	Replace approximately 490 LF of existing 12-inch RCP on Edsel Dr between Dempsey Rd and Shirley Dr with 36-inch RCP. Replace approximately 640 LF of existing 18-inch RCP and approximately 710 LF of existing 21-inch RCP with 36-inch RCP on Dempsey Road between Edsel Dr to the outfall.	Install approximately 1840 LF of 36-inch RCP on Edsel Dr between Dempsey Rd and Shirley Dr and on Dempsey Road between Edsel Dr to the outfall.
			Install approximately 350 LF of 18-inch RCP from Rodrigues Ave to S Park Victoria Dr. Install approximately 1390 LF of 36-inch RCP from S Park Victoria Dr to Edsel Dr., directing flow away from Los Coches Creek.	Use replacement option of installing approximately 350 LF of 18-inch RCP from Rodrigues Ave to S Park Victoria Dr. Install approximately 1390 LF of 36-inch RCP from S Park Victoria Dr to Edsel Dr., directing flow away from Los Coches Creek.
			Replace approximately 710 LF of existing 27-inch RCP and 490 LF of existing 30-inch RCP with 36-inch RCP on Carnegie Dr between Mercury Ct and Canton Dr.	Replace approximately 710 LF of existing 27-inch RCP and 490 LF of existing 30-inch RCP with 36-inch RCP on Carnegie Dr between Mercury Ct and Canton Dr.
			Connect existing at Burley Drive outfall to new improvements where Lawton Dr and Canton Dr	Use replacement option for connect existing at Burley Drive outfall to

ID	Project	Priority	Replacement Option	Parallel Option
			intersects with approximately 920 LF of new 24-inch RCP to direct flow away from Los Coches Creek.	new improvements where Lawton Dr and Canton Dr intersects with approximately 920 LF of new 24-inch RCP to direct flow away from Los Coches Creek.
			Replace approximately 260 LF of existing 12-inch RCP with 18-inch RCP on Canton Dr between Beacon Dr and Lawton Dr. Replace approximately 280 LF of existing 12-inch RCP with 24-inch RCP on Canton Dr between Lawton Dr and Roswell Dr.	Install 15-inch RCP on Canton Dr between Beacon Dr and Lawton Dr. Install 24-inch RCP on Canton Dr between Lawton Dr and Roswell Dr.
			Install approximately 1260 LF of 54-inch RCP on Yosemite Dr between Roswell Dr and Zion Ct. Replace approximately 250 LF of existing 12-inch RCP with 54-inch RCP on Yosemite Dr between Zion Ct and S Park Victoria Dr. Install approximately 390 LF of 54-inch RCP on Yosemite Dr from S Park Victoria Dr to existing main between S Park Victoria Dr and Dempsey Rd. Replace approximately 220 LF of existing 18-inch RCP and approximately 170 LF of existing 33-inch RCP on Yosemite Dr between S Park Victoria Dr to Dempsey Rd with 60-inch RCP. Replace approximately 690 LF of existing 42-inch RCP on Dempsey Rd between Yosemite Dr and the outfall with 60-inch RCP. Remove or abandon approximately 274 LF of existing 39-inch RCP, approximately 170 LF of existing 42 –inch RCP, and outfall along S Park Victoria Dr. Install approximately 425 LF of 30-inch RCP to direct flow	Use replacement option.

ID	Project	Priority	Replacement Option	Parallel Option
			away from Piedmont Creek from the 3 inlets along S Park Victoria Park Dr. currently draining to Piedmont Creek in approximately 25 LF of 15-inch RCP.	
BERRY_10	Ames Avenue	High	On Ames Ave replace approximately 230 LF of existing 18-inch RCP with 24-inch RCP. Replace approximately 640 LF of existing 24-inch RCP with 30-inch RCP. Replace approximately 510 LF of existing 24-inch RCP with 42-inch RCP. Replace approximately 80 LF of 30-inch RCP and approximately 50 LF of existing 30-inch CMP with 42-inch RCP.	Install approximately 1050 LF of 24-inch RCP and approximately 430 LF of 42-inch RCP on Ames Ave.
LP_14	North Abel Street	Low	Replace approximately 160 LF of existing 12-inch RCP on Maple Ave with 24-inch RCP.	Parallel option: Install approximately 160 LF of 24-inch RCP on Maple Ave.
			Along Redwood Ave, replace approximately 740 LF of existing 15-inch RCP and 400 LF of existing 21-inch RCP with 30-inch RCP, and 160 LF of existing 24-inch RCP with 36-inch RCP.	Install approximately 1,300 LF of 24-inch RCP in Redwood Ave from Heath St to the existing Abbott Ave SD.
			On Abbott Ave, replace approximately 400 LF of existing 15-inch RCP with 24-inch RCP between Walnut Dr and Elm Ave; approximately 255 LF of existing 21-inch RCP from Elm Ave to Willow Ave and approximately 250 LF of existing 24- inch RCP with 42-inch RCP from Willow Ave to Chestnut Ave. Install approximately 520 LF of 42-inch RCP in Abbott Ave from Chestnut to Redwood Ave.	Install approximately 1,425 LF of 36-inch RCP in Abbott Ave from Walnut Dr to Redwood Ave.
			Along Chestnut Ave, replace approximately 270 LF of existing	Install approximately 1,060 LF of 36-inch RCP in

ID	Project	Priority	Replacement Option	Parallel Option
			18- inch RCP, 420 LF of existing 21-inch RCP, and 370 LF of existing 24-inch RCP with 42-inch RCP.	Chestnut Ave from Heath St to Abbott Ave.
			Replace approximately 50 LF of 12-inch RCP and 520 LF of 15-inch RCP with 42-inch RCP in Heath St from Elm Ave to Chestnut Ave.	Install approximately 520 LF of 36-inch RCP in Heath St from Elm Ave to Chestnut Ave.
CAL_4	Wool Drive	Low	Replace approximately 315 LF of existing 15-inch RCP and approximately 350 LF of existing 18-inch RCP on Moretti Ln to Kennedy Dr with 24-inch RCP. Replace approximately 70 LF of existing 18-inch RCP and approximately 540 LF of existing 27-inch RCP with 30-inch RCP on Moretti Ln and Wool Dr adjacent to Kennedy Dr. Replace approximately 660 LF of existing 27-inch RCP on Wool Dr with 36-inch RCP between Kennedy Dr and Traughber St.	Install approximately 570 LF 24-inch RCP on Moretti Ln to Kennedy Dr. Install approximately 1270 LF 30-inch RCP on Wool Dr from Kennedy Dr.
			Replace approximately 150 LF of existing 12-inch RCP on Kennedy Dr and approximately 170 LF of existing 15-inch RCP on N Park Victoria Dr between Kennedy Dr and Park View Dr with 18-inch RCP.	Install approximately 150 LF of 18-inch RCP on Kennedy Dr and approximately 170 LF of 18-inch RCP on N Park Victoria Dr between Kennedy Dr and Park View Dr.
			Replace approximately 920 LF of existing 27-inch RCP extending from Park View Dr to Kennedy Dr to where it intersects with Wool Dr with 30 RCP.	Install approximately 920 LF of 18-inch RCP extending from Park View Dr to Kennedy Dr to where it intersects with Wool Dr.
COCHES_8	Foothill Park	Low	Replace approximately 250 LF of existing 12-inch RCP with 24-inch RCP on Wylie Dr between Bixby Dr	Use replacement option.

ID	Project	Priority	Replacement Option	Parallel Option
			and Temple Dr. Install approximately 150 LF of 30-inch RCP along S Temple Dr. from Wylie Dr. and then approximately 800 LF of 30-inch RCP between S Temple Dr. and Roswell Dr.	
CAL_1	Tice Drive	Low	Replace approximately 260 LF of existing 12-inch RCP and approximately 290 LF of existing 15-inch RCP on Tice Dr. between Rivera St and Horcajo St with 18-inch RCP.	Install approximately 610 LF of 18-inch RCP on Tice Dr between Rivera St and Horcajo St.
WF_11	Comet Drive	Low	Replace approximately 220 LF of existing 12-inch RCP with 24-inch RCP on Comet Dr between Metro Walk Dr and Curtis Ave.	Install approximately 220 LF of 24-inch RCP on Comet Dr between Metro Walk Dr and Curtis Ave.
WF_13	Railroad Avenue	Low	Install approximately 350 LF of 36-inch RCP from Railroad Ave to Marylinn Dr. Install approximately 1020 LF of 42-inch x 28-inch rectangular RCP along Marylinn Dr to N Abel St. Replace the approximately 150 LF of existing 24-inch RCP with 42-inch x 28-inch rectangular RCP.	Use replacement option.
LP_12	Main Street – Serra Way	Low	Replace approximately 190 LF of existing 12-inch RCP on S Main St with 15-inch RCP. Replace approximately 270 LF of existing 12-inch RCP from S Main St to Serra Way with 18-inch RCP.	Install approximately 190 LF of 15-inch RCP on S Main St. Install approximately 270 LF of 18-inch RCP from S Main St to Serra Way.

Underserved Areas

Potential future CIP projects have been identified within areas currently underserved by storm drainage infrastructure to address potential future development needs within those areas and the connection of new storm drainage infrastructure to the City system. Main Street Gateway Specific Plan and Milpitas Metro Specific Plan (formerly Transit Area Specific Plan) are recognized as underserved areas (see Figure 3-3) by the City. The Milpitas Metro Specific Plan area is now almost entirely built out, and there are no longer adequate areas identified that do not have adequate storm water runoff collection.

However, some vacant and underutilized parcels hold potential for development or redevelopment. Four (4) potential CIP projects are proposed to address those that do not have a storm drain line serving them already in the Main Street Gateway Specific Plan. These projects are identified in Table 3-2, and detailed maps are included in Appendix A. The identified projects have no priority. While they are not necessary to correct deficiencies within the existing storm drain system, they will need to be built when the developments they service occur.

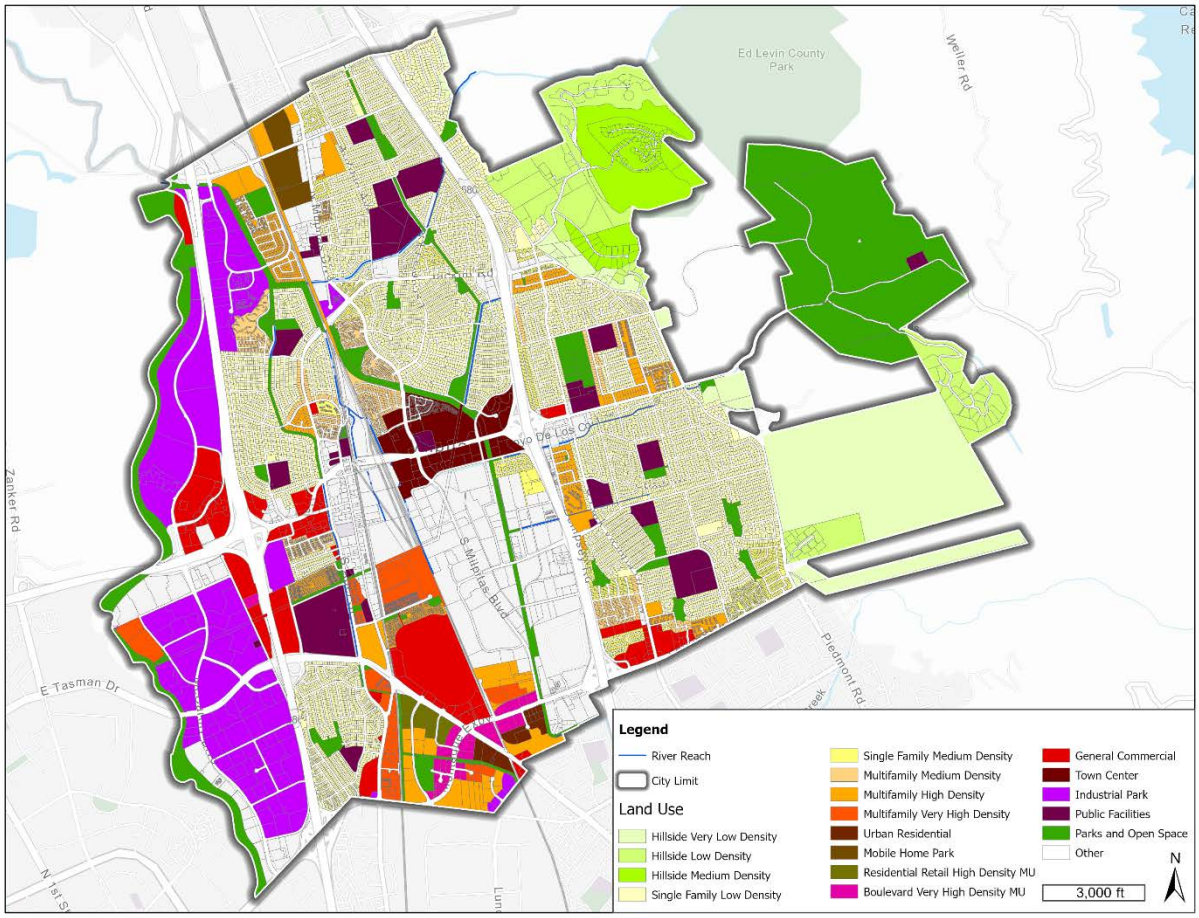


Figure 3-10: Milpitas Future Plan Land Use Map

Table 3-2: Capital Improvement Projects for Underserved Areas

ID	Project	Priority	Replacement Option	Parallel Option
LP_15	Main Street – Tom Evatt Park	---	Install approximately 170 LF of 18-inch RCP on S Main St to the existing 24-inch RCP on Carlo St.	Use replacement method.
LP_16	Main Street	---	Install approximately 450 LF of 18-inch RCP on S Main St to the improvement project of the existing system on Serra Way.	Use replacement method.
LP_17	Main Street – Sinnott Lane	---	Install approximately 70 LF of 18-inch RCP on S Main St from near Sinnott Ln to the improvement project of the existing system.	Use replacement method.
LP_18	Carlo Street	---	Install approximately 300 LF of 18-inch RCP on S Main Street to the existing system.	Use replacement method.

Multi-benefit and Green Street Projects

The City has developed a green stormwater infrastructure (GSI) plan as required under the NPDES Municipal Regional Permit Section C.3.j. The plan relies on information produced in the Santa Clara Basin Stormwater Resource Plan. There are several green streets and public parcel projects identified in the plan that are depicted in Figure 3-4. It may be beneficial to construct these green stormwater infrastructure projects simultaneously as the CIP identified herein. These opportunities are identified where GSI projects and storm drain CIP projects overlap or are directly adjacent to one another. These opportunities are listed in Table 3-3. For those CIP projects which do not overlap with green stormwater infrastructure projects identified, each should be reviewed for GSI potential even if it is not included in the GSI Plan.

Table 3-3: Capital Improvement Projects to Include Green Stormwater Infrastructure

CIP ID	Project	GSI Location	GSI Type
BERRY_10	Ames Avenue	Street	Green Street
COCHES_5	South Park Victoria	Street	Green Street
COCHES_6	Carnegie Drive	Street	Green Street
COCHES_8	Foothill Park	Park/Open Space	Green Street and detention
PIED_9	Yosemite Drive	Street	Green Street and detention
WF_11	Comet Drive	Park/Open Space	Green Street and detention

For Green Street projects, the street greening could be included as part of the design of the storm drain system capacity upgrade when on the same stretch of street. Detention projects would require more detailed concept design to accomplish both flood control and green infrastructure goals. Flooding identified near Foothill Park could potentially be remedied with an integrated project which greens the park and provides detention storage. Similarly, the Yosemite Drive and South Park Victoria projects could potentially be remedied by storage facilities in Merryhill and Robert Randall schools, respectively. Storage facilities are discussed in more detail in subsequent sections.

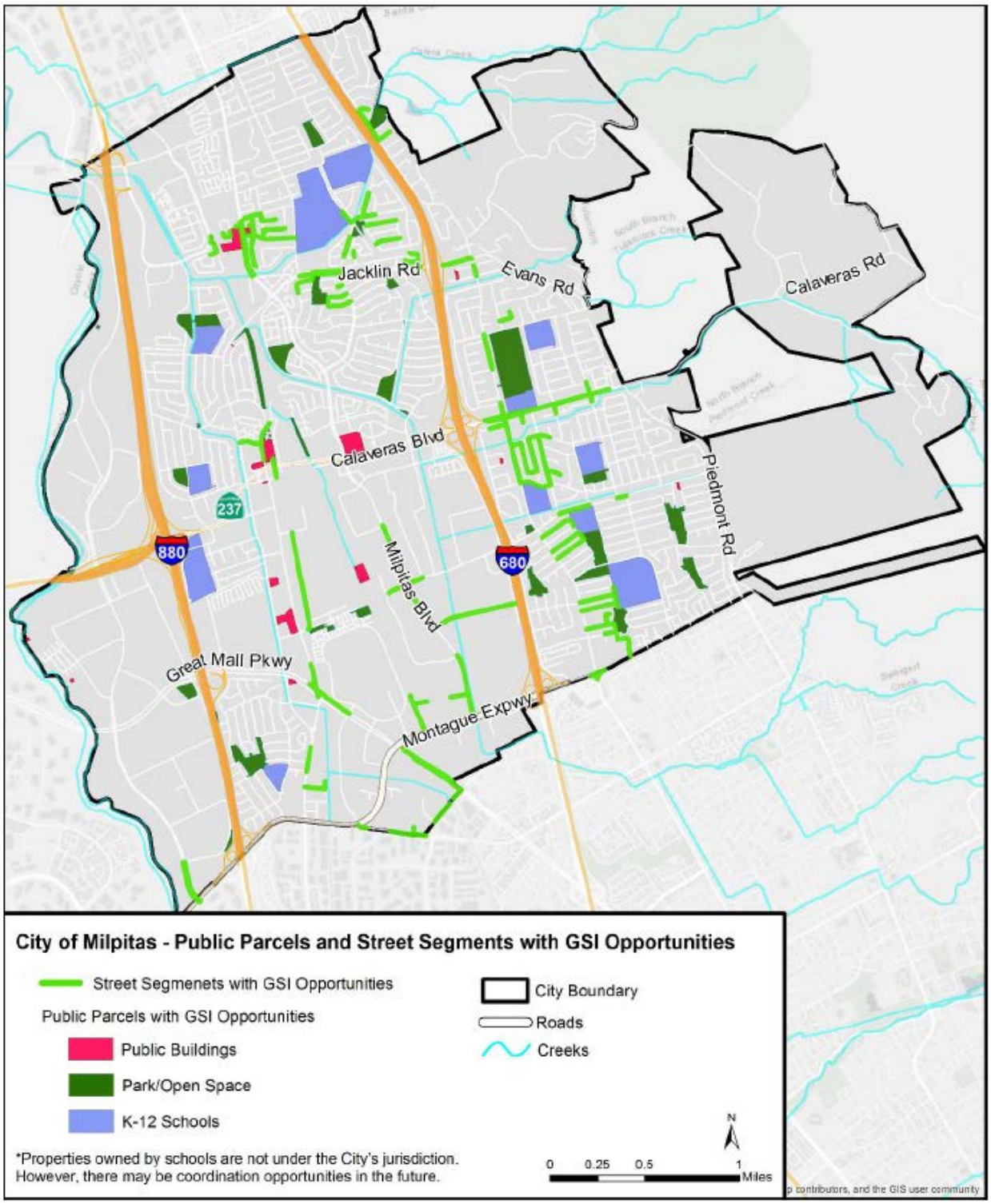


Figure 3-11: Green Stormwater Opportunity Map from Santa Clara Basin Stormwater Resource Plan

Storm Trouble Spots

The city has identified 15 inlet locations that flood during storms. These are shown in Figure 3-5. To address these storm trouble spots, inlet replacements are proposed for these locations except for the

one at Evans at Bayview Park. That storm trouble spot will be addressed by the Bayview Park Drive CIP project.

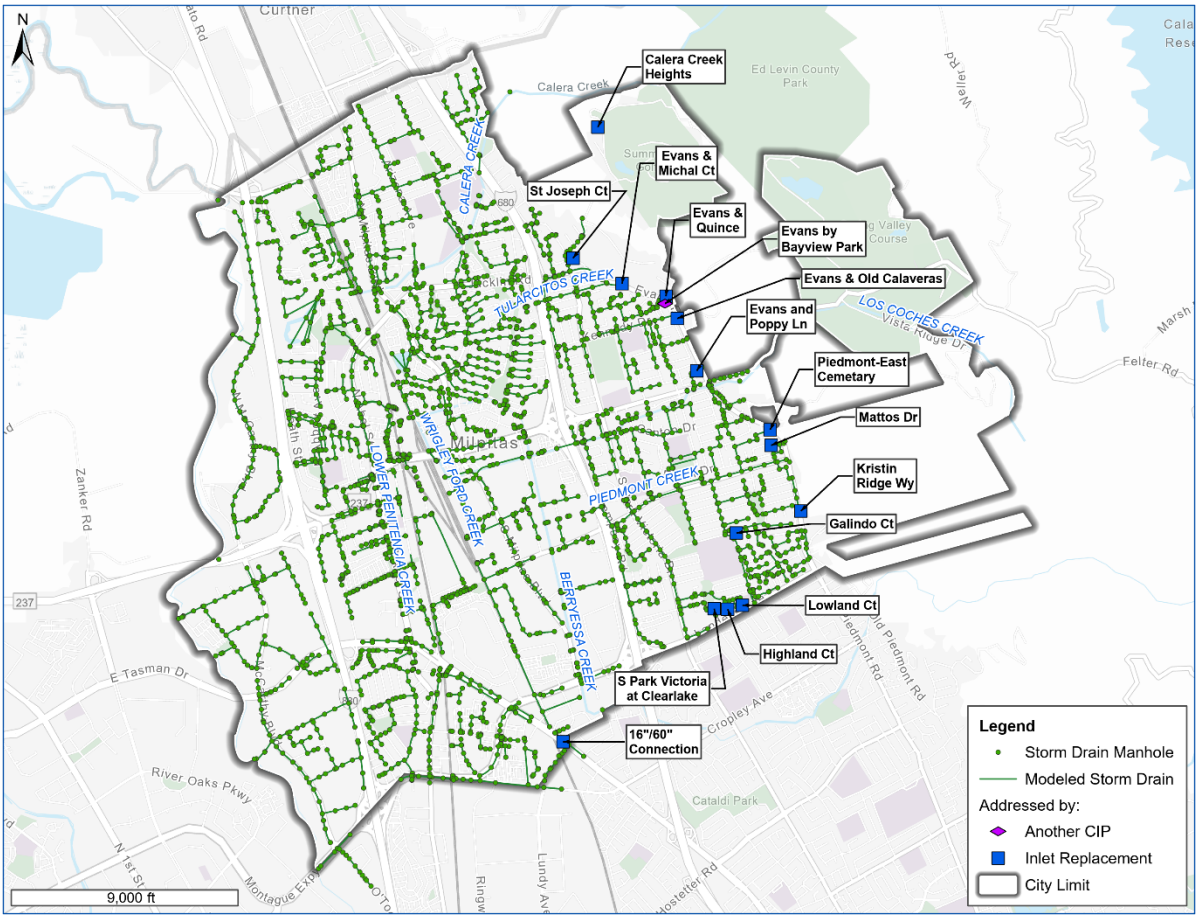


Figure 3-12: Storm Trouble Spots

Storage Facilities

Two basic categories of stormwater storage are commonly used: detention and retention. Some facilities blur the distinction between the two but, in general:

Detention refers to the temporary storage of incoming runoff that exceeds the permissible release. After the storm event, the facility empties and returns to its natural function – such as a parking lot or park.

Retention facilities, on the other hand, hold on to the excess runoff for an indefinite period. Natural ponds and lakes exemplify retention facilities where water levels change only through evaporation, infiltration, and additional storm runoff.

With the tight clay that underlies much of Milpitas, true retention facilities are not advantageous. However, several storage facilities in the city do serve a dual role for both stormwater detention and retention. For instance, pumps are used to move to attenuate flood waves through the facility, but a permanent pool of water remains behind for aesthetic (or perhaps recreational) purposes.

Properly designed, constructed, and maintained stormwater storage facilities could reduce peak flows, thereby better utilizing the capacity of downstream conveyance facilities. Such facilities can also

potentially mitigate the need for system upgrades. The efficacy of any detention facility and ancillary improvements in the quality of storm runoff to receiving waters needs evaluation on a case-by-case basis. However, some general design criteria need to be applied to every basin:

1. Basins should be sized so that their output does not exceed the downstream facilities' design capacity.
2. There must be an overflow section capable of safely discharging the 100-year peak inflow (should outlet works become clogged) without causing property damage.
3. At least one foot of freeboard over the maximum 100-year water surface elevation should be provided for excavated basins. Three feet of freeboard (minimum) must be provided where berms or levees create basins.
4. Infiltration capacity shall not be considered when designing basins, unless percolation rates are determined by on-site soil testing certified by a Civil or Geotechnical Engineer.
5. Debris and sediment loading must be considered in design (see below).
6. Ponds and basins need to be designed with shallow side slopes (5:1 minimum) so that people and animals may extricate themselves from the water should the need arise. A safety shelf may also be considered. Facilities that pose an inordinate risk to the public should be fenced off. Openings larger than six inches in diameter must be screened to protect children and animals.
7. A mechanism for draining the basin should be provided. If the basin also serves as a pumping forebay, the pumping facilities must fully dewater the basin.
8. Facilities designed for the permanent (or semi-permanent) retention of water should be deep enough to avoid eutrophication (accumulation of excess nutrients that stimulates plant growth) and breeding insects. Pond surface areas should be at least one-half acre, with a minimum depth of 10 feet over at least a quarter of the area. The average depth over the rest of the pond needs to be at least five feet. Basin outlets should be positioned opposite the inlet to promote circulation. Stocking permanent ponds with fish also promote good water quality.
9. Underdrain systems to minimize wetness should be considered for detention facilities not intended as permanent water features. This helps prevent the facility from encouraging insect populations and provides for a quicker return to its dry weather function.
10. Basin bottoms and sides should be stabilized with vegetation to withstand periodic flooding and prevent erosion. Basin outlets need to be provided with erosion protection, such as riprap.

Debris Loading

Detention and retention basins will eventually fill up with sediment and other debris, reducing their storage capacity to where they will not operate as designed. Therefore, some considerations of debris loading must be made for each basin. Depending upon the desired frequency of maintenance, some allowance for "dead" storage should be made to handle sediment and debris. Based on work by Schaaf & Wheeler for the Santa Clara Valley Water District, the following empirical relationships (debris load per unit drainage area) are used to evaluate debris loading:

Highly urban areas	0.1 acre-feet/mi^2/year
Hillside open space	0.4 acre-feet/mi^2/year

Chapter 4: Pump Stations

Each of Milpitas' thirteen (13) stormwater pumping stations is evaluated based on the set of criteria described herein. Detailed pump station assessment evaluation criteria are presented in Appendix B. This chapter describes how well each of the city's pumping facilities performs against the established performance criteria, identifies those stations with deficiencies, prioritizes the correction of said deficiencies, and establishes the requisite master plan improvements to remedy those deficiencies.

Pump Station Performance Criteria

Stormwater pump stations owned and operated by Milpitas must meet, at a minimum, the criteria established herein. If a pump station is substantially improved or rehabilitated, the performance and design guidelines provided in the Appendix should be followed.

Capacity

Every pump station should be capable of discharging the 100-year runoff from its tributary area. One way to accomplish this is a combination of pumping capacity and retention storage. Pump stations with lesser capacity (e.g. a 10-year capacity) may only be considered if there is a fail-safe way to overflow excess flows without causing property damage. Nearly all the pumping facilities within the city meet these criteria. Table 4-1 compares current pump station capacities to the potential 100-year inflow.

Number of Pumps

For redundancy, in every pump station, installing at least two identical pumps is necessary. It is unnecessary to include standby pumps because providing excess capacity is expensive and not justified by the relatively small risk of having a major storm event coincide with mechanical failure. (Schedule pump maintenance for the summer months.)

No pumping station in Milpitas is equipped with fewer than two identical pumps. Most stations have three main pumping units, and the Jurgens Pump Station has four. Each of the stations (except California Circle, Abbott, and Minnis) has a smaller electric dewatering pump to drain the wet well when water falls below the minimum allowable pumping level for the large stormwater pumps. Permanent retention ponds are maintained at the California Circle, Berryessa and Abbott stations, eliminating a small dewatering pump's utility. In contrast, the Minnis and Berryessa stations utilize submersible pumps capable of nearly completely dewatering their respective wet wells.

Standby Power

An emergency engine-generator capable of starting the largest motor while simultaneously running all other motors and auxiliary loads should be installed at each stormwater pump station where the primary pump drivers are electric motors. Pump stations without standby power or engine-driven pumps are at risk of becoming inoperable during an electrical power outage.

The lack of adequate automatic standby power is a potentially significant deficiency. When mapping special flood hazards, FEMA will only consider pumping capacity for those pumps with engine drive units or motor drivers that can be started and operated at the station with an automatic standby power generator installed. Portable generators and manual power transfer capabilities are not sufficient.

Pump Station Evaluations

Table 4-1 provides a summary of pump station capacities and emergency readiness throughout Milpitas. Further detailed evaluation for each station follows the identified deficiencies and recommended improvements. Figure 4-1 shows pump station locations within the city. When evaluating pump station capacity, available storage is in consideration. Table 4-2 provides a summary of pump stations with recommended CIP.

Table 4-1: Pumping Station Summary

ID	Facility	Year Built	Approximate Capacity	Primary Drivers	Standby Power	Description
1	California Circle Pump Station	1983	100-year	Engines	n/a	page 53-54
2	Jurgens Pump Station	1989	10-year	Engines	n/a	page 55-56
3	McCarthy Pump Station	1994	100-year	Engines	n/a	page 57
4	Abbott Pump Station	1983	100-year	Motors	NO	page 58-59
5	Minnis Pump Station	1978	100-year	Motors	NO	page 60-61
6	Penitencia Pump Station	1960	100-year	Engines	n/a	page 62-63
7	Wrigley-Ford Pump Station	1993	100-year	Engines	n/a	page 64
8	Berryessa Pump Station	1977	100-year	Engines	n/a	page 65-66
9	Manor Pump Station	1993	100-year	Motors	n/a	page 67
10	Spence Creek Pump Station	1988	100-year	Motors	NO	page 68
11	Bellew Pump Station	1985	100-year	Motors/ Engine	YES	page 69
12	Murphy Pump Station	1983	100-year	Engines	n/a	page 70
13	Oak Creek Pump Station	1979	100-year	Engines	n/a	page 71

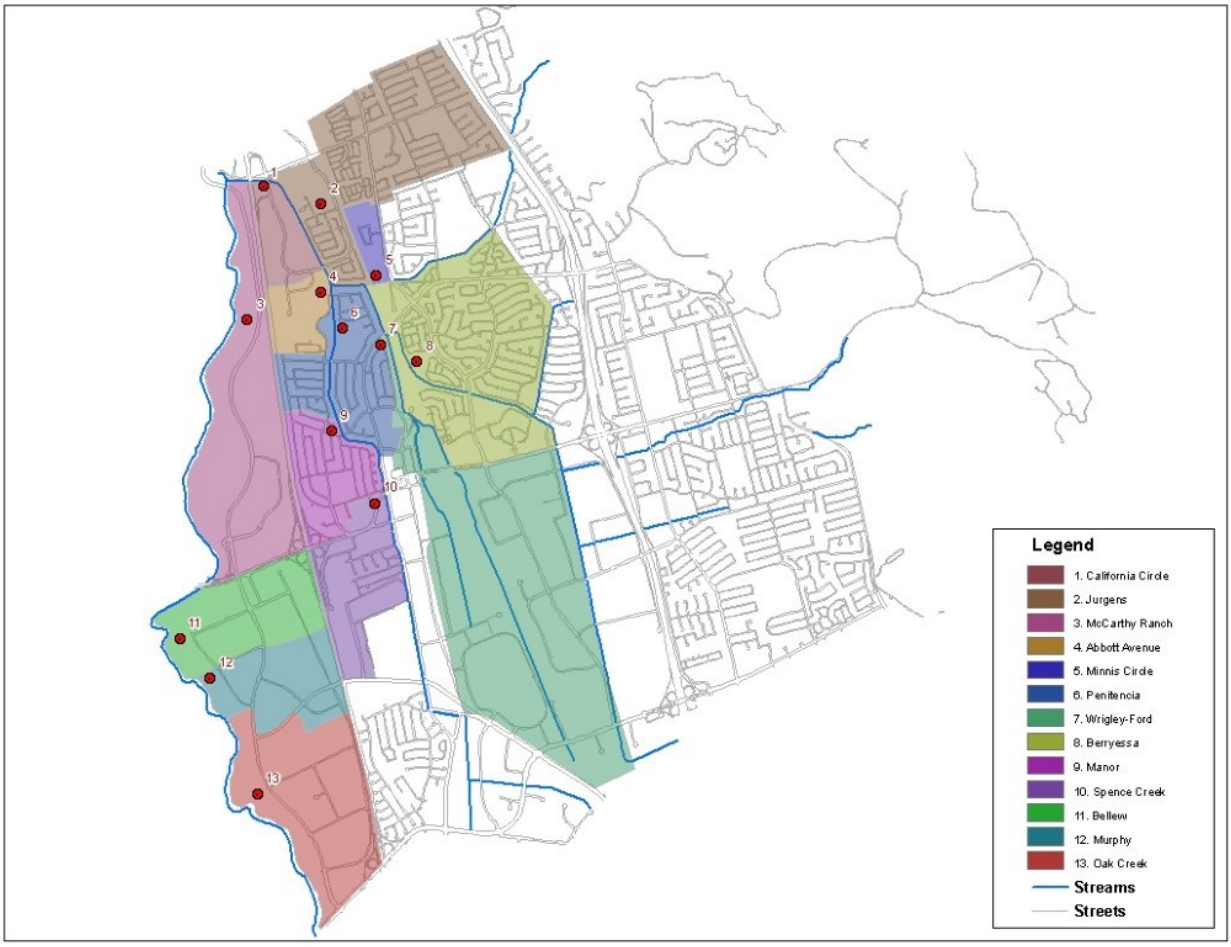


Figure 4-1: Storm Water Pump Stations in Milpitas

Table 4-2: Pump Station CIP Summary

Pump Station	Priority	CIP Details
Murphy	High	Control system rehabilitation
Penitencia	High	Complete pump station replacement.
Abbott	Low	Provide complete station replacement, including raising floor above base flood elevation
Jurgens	Low	Pump station replacement to provide increased level of design protection and eliminate the periodic flooding of Dixon Landing Park.
Spence Creek	Low	Provide permanent standby power.

California Circle Pump Station

Facility ID	**SD-1**
Location	California Circle at Dixon Landing Road
Discharges to	Lower Penitencia Creek at STA 15+00
WSEL at Discharge Location	11.4 feet NAVD
Pipe Discharge Elevation	Invert 13.8 feet NAVD
Storage	2.5-acre wet pond
Design Lagoon Elevation	9.9 feet NAVD
Top of Lagoon Bank	14.0 feet NAVD
Tributary Area	263 acres
Station Capacity	117 cfs

This facility drains a retention pond located at the intersection of Dixon Landing Road and Interstate 880. The lagoon is designed as a wet pond with standing water; the normal minimum water surface elevation is 4.5 NAVD. Stormwater is pumped through three 28-inch diameter (SDR 26) high-density polyethylene (HDPE) pipes to Lower Penitencia Creek, near the top of the levee. This facility was originally designed to drain an industrial area of 150 acres. However, a detailed accounting of tributary area based on Interstate 880 / Highway 237 freeway interchange plans indicates that 263 acres are potentially tributary to the lagoon, as tabulated below.

Table 4-3: Areas Tributary to California Circle Lagoon

Location	Land Use	Tributary Area (acres)
Abbott Avenue	Residential	53
California Circle	Industrial	83
Route 880/237	Freeway	127
Total		263

Of these 263 acres, 210 acres (about 80 percent) are directly tributary to the lagoon and pump station. Runoff from the Abbott Avenue area can be discharged into Hall Park Lagoon and thence to Penitencia Creek through a storm drain outfall. Still, runoff above its capacity flows into the ditch running between Glenmoor Circle and Redwood Avenue and then into the freeway channel. The Abbott Lagoon drains the area between the outfall to Hall Park Lagoon on the south and the California Circle storm drain system on the north. This facility is adequate, so overflows are not anticipated from these potentially tributary areas, and they are not included in Table 4-3.

Since the last master plan update, engine components including starters and radiators have been replaced and the controls have been refurbished.

Equipment Schedule

Pumps	(3) Aurora 24P axial flow rated 17,000 gpm at 14 feet TDH (86hp)
Prime Power	(3) Caterpillar 3208 diesel engines rated at 175hp (2,400 rpm)
Standby Power	Not required
Fuel Storage	2,000 gallons for 96 hours run time at peak load with 3 pumps
Finish Floor Elevation	14.3 feet NAVD
Base Flood Elevation	12.5 feet NAVD

Resolution of Previously Identified Deficiencies

1. The finished floor elevation is six inches below the base flood elevation as shown on the currently effective Flood Insurance Rate Map (FIRM). Flood hazards depicted by the FIRM are based on spills from Lower Penitencia Creek becoming trapped behind the downstream levee adjacent to the pump station. However, unpublished flood hazard mapping based on the FEMA CTP work indicates this is not an issue. For the purpose of the Storm Drain CIP, the CTP work is considered the best available information.
2. The discharge pipe invert at elevation 13.8 feet NAVD is two feet above the 100-year water surface elevation in Lower Penitencia Creek based on effective FEMA data. However, if the creek were to rise above the published elevation, creek water could potentially flow into the pond back through the discharge pipes when the pumps are off. Eventually, the volume of water that flows back into the lagoon will cause the pumps to start again, thereby eliminating the problem. When fewer than three pumps are operating, some water will be re-circulated through the system (which is inefficient). Still, since this situation is beyond the design condition, this deficiency does not require remedial action.

Capital improvements are not proposed for California Circle Pump Station, noting that the control systems were upgraded since the last master plan update in 2013.

California Circle Lagoon Operation

Surcharging storm drains within the California Circle area control the maximum allowable water surface in the lagoon. Due to the grade up to Dixon Landing Road, California Circle does not naturally release to the lagoon, so excess water on the street does not drain. Maximum design water surface elevations in the lagoon for the above-listed pumping levels and the lowest adjacent street grade, located on California Circle opposite Lower Penitencia Creek from Terra Mesa Way, are indicated in Table 4-4.

Table 4-4: California Circle Lagoon Operation

	10-year
Lowest Adjacent Street Grade (feet NAVD)	12.28
Maximum Lagoon Stage (feet NAVD)	6.51

Jurgens Pump Station

Facility ID	**SD-2**
Location	345 Jurgens Drive
Discharges to	Lower Penitencia Creek at STA 26+50
Design WSEL at Discharge Location	12.3 feet NAVD 88
Storage	1 ac-ft in City Park
Tributary Area	433 acres (residential)
Station Capacity	150 cfs
10-year Inflow	144.0 cfs
100-year Inflow	145.5 cfs
Deficit	Not applicable due to storage in Dixon Landing Park However, City desires to eliminate the need to store water in the park.

Located in Dixon Landing Park, this facility drains mixed residential areas between Penitencia Creek and Interstate 680 at Milpitas's northern end. The system was designed to function in tandem with detention storage in the park itself since the pump station is undersized even for a ten-year event. During the February 3, 1998 storm, Jurgens Pump Station was overwhelmed by storm runoff (albeit some from Berryessa Creek overflows) to the point at which engine batteries and other control equipment were inundated, thus shutting down the station. A subsequent investigation of local rainfall during the storm, however, indicated that even if Berryessa Creek had not spilled through a gap in its levee near the railroad, local runoff rates that exceeded pumping capacity would still have overwhelmed the station and caused its failure since control equipment was located less than one foot above the finished floor elevation.

A failed attempt was made to "flood-proof" the pump station by sealing floor openings and raising essential control equipment above the floor so that the equipment does not shut off during a flooding event. Based on the CTP model and assuming the pumps do not shut off during a storm, water will pond to the following elevation with the current pumps in operation.

$$WSEL_{100} = 12.0 \text{ feet NAVD (2 feet above finished floor)}$$

Maximum ten-percent flood limits are shown in Figure 4-2. Based on available topography and aerial photographs, the one-percent flooding does not inundate private property. Periodic inundation is limited to facilities within Dixon Landing Park, including the snack bar and restrooms.

Capital Improvement Program

To eliminate the temporary storage of excess runoff within Dixon Landing Park, a new station with a capacity of at least 243 cfs (110,000 gpm) would be required. It is not feasible to retrofit the existing pumping facility to nearly double its capacity. Such a project would entail demolishing the existing facility, building an upsized replacement pump station, and replacing the existing 72-inch diameter discharge pipe to Lower Penitencia Creek with at least a 96-inch diameter discharge pipe. An order of magnitude estimate of construction cost is $10 to $15 million. This is part of the Capital Improvement Plan as a ***Low Priority*** project with an estimated cost of $15 million in 2021 dollars.

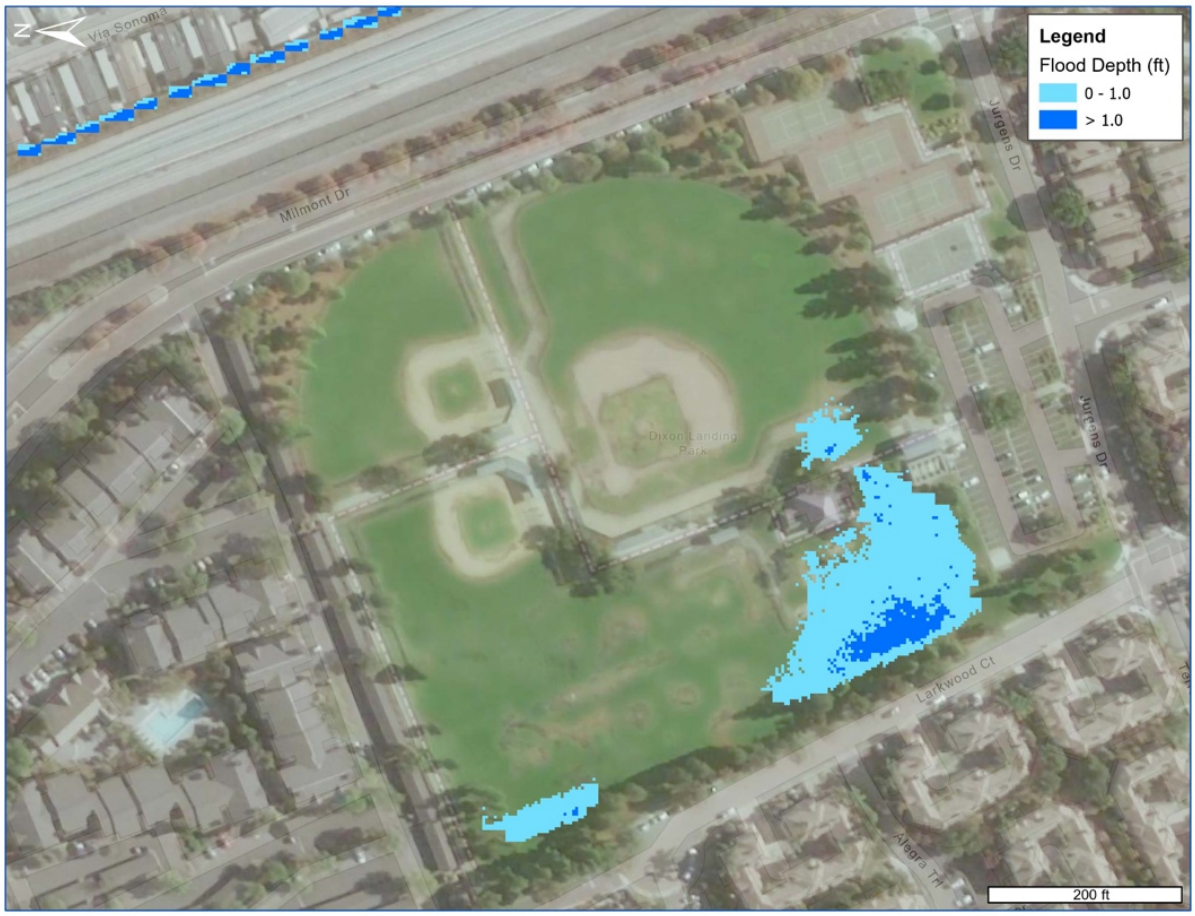


Figure 4-2: 10-year Ponding Adjacent to Jurgens Pump Station

Equipment Schedule

Pumps	(4) Johnston 24PO axial flow rated 16,000 gpm at 10 feet TDH (700rpm, 60hp)
	(1) 3,000 gpm 25 hp electric jockey
Prime Power	(4) Caterpillar 3208 diesel engines rated at 150 hp (2,400 rpm) (4) Randolph right angle gear drives (7:2) rated at 110 hp
Standby Power	Not required
Control Power	120 VAC backed up by 24 VDC batteries with charger
Fuel Storage	2,500 gallons; 125 hours at peak load (4 pumps)
Finish Floor Elevation	10.0 feet NAVD
Effective BFE	12.0 feet NAVD

Station Operation

In response to the February 1998 station shutdown, the City tried flood-proofed the equipment by sealing access openings on the floor and relocating the controls, so the station can continue to operate even with a base flood elevation two feet above the finished floor. Unfortunately, this has not prevented water from the wet well from entering the equipment room when the park floods. It is imperative that the engines do not shut down during a storm, so if the City believes that could happen, the wet well should be sealed. Since the last master plan update, improvements have been made to building ventilation, so the engines no longer overheat.

McCarthy Pump Station

Facility ID	**SD-3**
Location	1005 N McCarthy Boulevard
Discharges to	Coyote Creek at STA 145+00
Design WSEL at Discharge Location	18.6 feet (NAVD '88)
Storage	Wet Well
Tributary Area	185 acres (mixed use)
Station Capacity	400 cfs
10-year Inflow	259.3 cfs

Located in the McCarthy Ranch Development, this facility drains mixed-use areas between Coyote Creek and Interstate 880, north of State Highway 237. This station has excess capacity and the luxury of leaving one pump as standby. The facility is 25 years old, but every indication is that the pumping plant is well-maintained and operating as intended.

Equipment Schedule

Pumps	(3) Cascade 48AM axial flow (500 rpm, 560 hp, 60,000 gpm at 28 feet TDH)
	(1) Cascade 12MF 3,400 gpm 30 hp electric jockey
Prime Power	(3) Caterpillar 3412 diesel engines rated at 750 hp (2,100 rpm)
Standby Power	Not required
Control Power	120 VAC backed up by 24 VDC batteries with charger
Fuel Storage	2,000 gallons; 22 hours at peak load (3 pumps)
Finish Floor Elevation	18.5 feet NAVD
Effective BFE	Shaded Zone X (area of moderate flood hazard)

Pump Station Operation

Capital improvements are not necessary for the McCarthy Pump Station. However, to enhance operational efficiencies and minimize pump cycling, it is recommended to have the pump starts rotate so that each motor will start no more than five times per hour.

Abbott Pump Station

Facility ID	**SD-4**
Location	1225 N Abbott Avenue
Discharges to	Lower Penitencia Creek at STA 46+50
Design WSEL at Discharge Location	10.9 feet NAVD
Outfall Invert Elevation	18.3 feet NAVD
Storage	27 ac-feet in lagoon
Tributary Area	53 acres (park and industrial)
Station Capacity	24 cfs
Required Capacity	17 cfs
Excess Capacity	17 cfs
10-year Lagoon Level	9.5 feet NAVD
100-year Lagoon Level	10.3 feet NAVD

Located on Abbott Avenue, the facility serves as a recreational and aesthetic feature inside an industrial park. If the pump station is functioning properly, there is no problem with flooding in the area. Pump motors have recently been rewound, and the station is in good working order.

However, the prime drivers are electric motors without any provision for standby power. If the pump station's power supply were to fail during a 24-hour storm, the lagoon could exceed the maximum ponding level. Ponding levels above 12.0 feet NAVD will begin to flood the adjacent property, so making standby power provisions will reduce the risk of flooding in extreme events.

Since the last master plan update, the pump motors have been rebuilt.

Equipment Schedule

Pumps	(2) Aurora axial flow pumps rated 5,350 gpm at 16 feet TDH
Prime Power	(2) Westinghouse 30 hp vertical electric motors (480V, 3 phase)
Standby Power	None
Fuel Storage	n/a
Finished Floor Elevation	13.7 feet NAVD
Effective BFE	10.3 feet NAVD

Deficiencies

1. The pump station is not provided with standby power in the form of an emergency engine-generator set; so, if the power were to fail during an intense storm, adjacent properties could be flooded depending upon prior lagoon levels and duration of the power outage.
2. Abbott Pump Station discharges to Penitencia Creek via twin 18-inch diameter high-density polyethylene outfalls through the western levee without flap gates. However, the discharge outfalls are almost 1.5 feet above the design water surface in Penitencia Creek. Should water levels ever exceed the design freeboard, the situation would exceed the design condition because any water that runs back through the pump discharge pipes into the lagoon would eventually cause the pumps to start. Hence, this "deficiency" does not require remedial action.

Capital Improvement Recommendation

Providing emergency standby power is a ***Low Priority*** project associated with the Abbott station. (Note that engine-generator sizing is approximate only and requires a full load analysis.). The engine-generator should be in a building like the pump house to preserve this station's aesthetic feel. Estimated capital costs are summarized in Table 4-5.

Table 4-5: Medium Priority CIP for Abbot Pump Station

Capital Improvement	Estimated Cost
125 kW standby engine-generator	$225,000
Automatic transfer switch	$75,000
Electrical modifications	$100,000
Building for standby power equipment and site improvements	$200,000
Construction Subtotal	$600,000
Engineering, CM, and Administration (20%)	$120,000
Contingencies (50% nominal)	$380,000
	$1,100,000

Supplemental Recommendation

A style of pump with fewer maintenance requirements might be more appropriate at this pump station. In 2005 a pump specialist recommended the replacement of the existing line shaft pumps with axial flow submersible pumps because, in his opinion, they should require less maintenance and experience less corrosion. The pump specialist's recommendation is retained in this Storm Drain Master Plan as information only.

Repair and the replacement of parts for the two existing pumps would cost about $60,000. If the impellers are not available "off the shelf", the disassembled pump(s) would likely take up shop space while awaiting delivery of that part. This would add shop rental costs to the costs already enumerated. The cost to replace the existing Aurora Verti-Line 14P pumps with the same pump type would be about $300,000. Replacement of the existing pumps with axial flow submersible pumps requiring less maintenance is about $250,000.

Minnis Pump Station

Facility ID	**SD-5**
Location	1125 N Milpitas Boulevard
Discharges to	Calera Creek at STA 1+50
Design WSEL at Discharge Location	9.6 feet NAVD 88
Storage	None
Tributary Area	30 acres (commercial and industrial)
Station Capacity	33 cfs
10-year Inflow	8.5 cfs
100-year Inflow	20 .4cfs
Excess Inflow	12.6 cfs

Located off of North Milpitas Boulevard, the Minnis Pump Station drains a low-lying area adjacent to Minnis Circle that cannot drain by gravity into Calera Creek. The station is located within a mapped 100-year special flood hazard area (Zone AH Elevation 16 feet NAVD). A projected capacity deficit exists for the 100-year inflow. However, even if this capacity deficit were to be corrected, the area would still be subject to 100-year flooding from Calera Creek until Valley Water solves Calera Creek's capacity issues. Therefore, improving pump station capacity has been downgraded from medium priority to low priority. However, when the Minnis station gets scheduled for long-term replacement (Chapter 9), pumping capacity should be increased to 100-year as described below.

The station is equipped with recently replaced submersible electric pumps and motors, and a set of plugs and automatic transfer switch for standby power if a portable generator can be made available.

The pump station is a duplex Flygt-style station with submersible pumps and motors mounted on a rail with a 14-inch quick disconnect discharge elbow. The pumps are housed in an 11-foot square underground structure. Personnel do not enter this structure but rather pull the rail systems pumps to the surface for lubrication and repair. Electrical meters and controls are enclosed in weatherproof housings and mounted on a pedestal above the pump access slab.

Since the last master plan update, the pumps and motors have been replaced and a portable standby power with ATS has been added.

Equipment Schedule

Pumps	(2) Flygt CP 3300 submersible electric rated 4,500 gpm at 45 feet
Standby Power	Trailer mounted portable with automatic start and transfer switch
Control Power	120 VAC (no backup)
Fuel Storage	n/a
Finished Slab	16.7 feet NAVD
Effective BFE	15.9 feet NAVD (Zone AH)

Deficiencies

Pump station capacity is not sufficient for the influent 100-year design flow, and without pumping, this water becomes trapped by the Calera Creek floodwall. Given that there is sufficient reaction time to bring portable standby power to the site and the pump station has more than 100-year discharge capacity, no capital improvement project is identified for Minnis Pump Station.

Penitencia Pump Station

Facility ID	**SD-6**
Location	La Honda Drive
Discharges to	Lower Penitencia Creek at STA 57+50
Design WSEL at Discharge Location	10.0 feet NAVD
Storage	Hall Memorial Park Lagoon
Tributary Area	215 acres (residential)
Station Capacity	65 cfs
10-year Inflow	64.4 cfs
100-year Inflow	80.4 cfs
10-year Lagoon Level	8.3 feet NAVD
100-year Lagoon Level	9.0 feet NAVD
Top of Lagoon Bank	14 feet NAVD

This ancient pump station sits across Penitencia Creek from the Hall Park Lagoon. A 60-inch gravity bypass pipe allows storm runoff to drain when creek levels are low. Another 60-inch pipe crosses beneath the creek and ties the lagoon to the pump station wet well. This pipe enters the lagoon in a bubble-up box equipped with a combination flap gate and slide gate. With the slide gate open, water levels in the lagoon and wet well equalize, so the system behaves as a single detention pond. In combination with available lagoon storage, the pumping station has sufficient capacity. A discharge standpipe, located above the creek floodwall elevation, provides backflow protection from Penitencia Creek. While the facility remains operational, it needs to be completely replaced in the near future.

Using the Jarad Global Positioning System and a rod to measure water depths, Schaaf & Wheeler conducted surveys of the lagoon between July 20 and July 25, 2000. The references used were the North American Vertical Datum of 1988 (NAVD88) and the North American Horizontal Datum of l983 (NAD83).

Since the last master plan update, the engines have been rebuilt.

Storage Capacity

Based on the survey, Hall Park Lagoon can store about 25 acre-feet before spilling north onto Abbott Avenue. Its summer water surface elevation is 6.4 feet, and the average depth of bottom sediment is about 1.5 feet. The lake overflows when its water surface elevation reaches about 13.5 feet.

Lagoon Odors

During the fall, when the city draws down the lake in preparation for winter storms, some neighbors have complained of odors. Adding oxygen can minimize odors caused by the activity of microbes in the sediment and water. Aerators were not operating at Hall Park during Schaaf & Wheeler's survey. Operating the aerators could reduce odors if the one-foot reduction in water surface during the winter is a problem because the lagoon becomes very shallow (about a foot deep). A microbiologist could help identify and implement further biological and chemical solutions.

Storm Drain Backup

All of the storm drain outfalls into the lagoon are above the summer water surface elevation of 6.4 feet, so lagoon water is not likely to back up into neighboring storm drains during the summer months. Design lagoon levels are based upon the 2000 survey of Hall Park Lagoon and the pumping equipment data and operating levels contained herein. Figure 4-3 shows the storage-elevation curve for the lagoon.

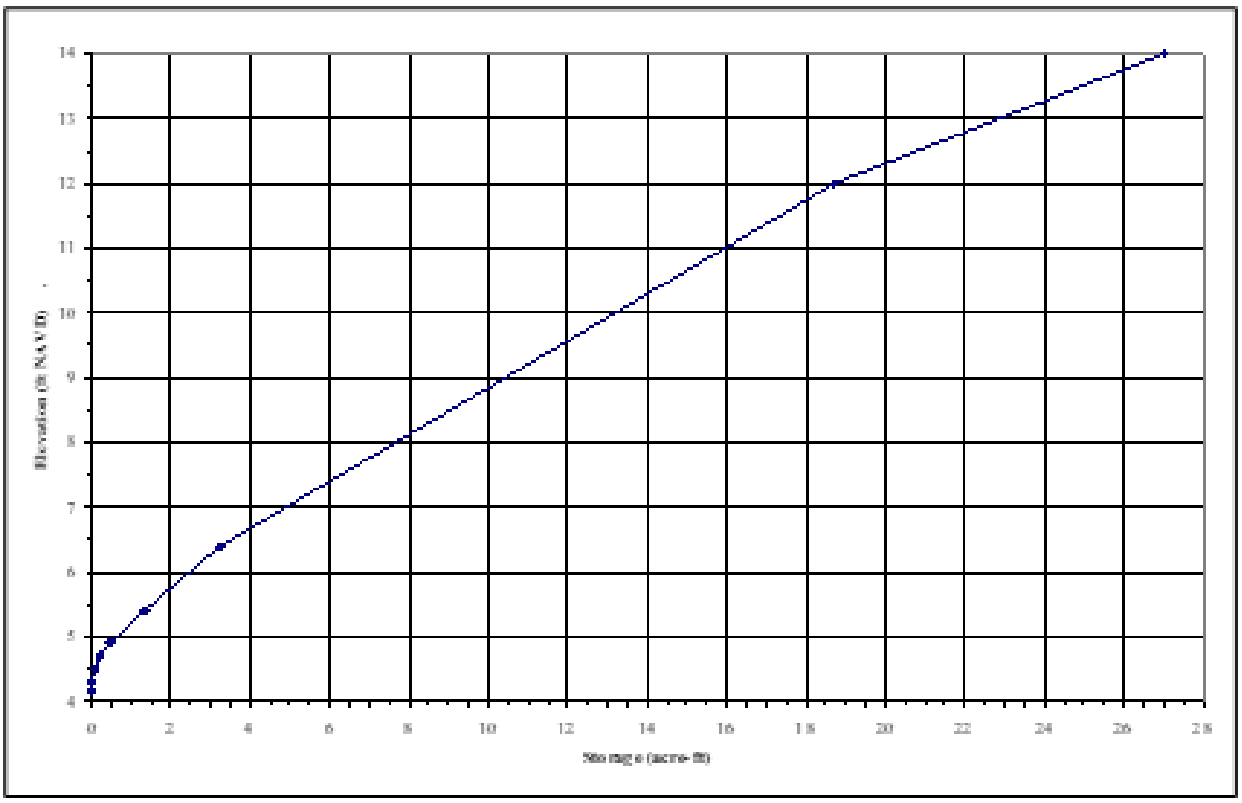


Figure 4-3: Storage Elevation Curve for Hall Memorial Park Lagoon

Pump Station Equipment Schedule

Pumps	(3) Fairbanks Morse 6310 axial flow (700 rpm, 40 hp, 9,750 gpm at 12 feet TDH)
	(1) Fairbanks Morse 6360 (840 gpm 7.5 hp electric jockey)
Prime Power	(3) Fiat 8041I05 diesel engines rated at 60 hp
Standby Power	Not required
Finish Floor Elevation	14.3 feet NAVD
Effective BFE	15.4 feet NAVD

Capital Improvement Recommendation

Given its age and the equipment condition, a complete station replacement for the Penitencia Pump Station is a ***High Priority***, including raising the floor above the base flood elevation. Based on a survey of available storage volume, the resulting 100-year water surface elevation of 10.1 feet is less than the spill elevation. It does not affect storm drain performance or recommended improvements, so the assumed pump station capacity and operation do not necessarily need to be modified. Detailed design will need to account for proper submergence for pump operation and maintain sump dimensions recommended by the Hydraulic Institute and pump manufacturers. The new axial flow pumps will likely be electric motor driven with a standby diesel engine-generator set that may require Tier 4 emissions control equipment. Estimated capital costs are provided in Table 4-6.

Table 4-6: High Priority CIP for Penitencia Pump Station

Capital Improvement	Estimated Cost
Demolish existing structure and equipment	$500,000
Wetwell and sump modifications, trash rack	$1,000,000
Furnish and install (3) axial flow pumps	$700,000
Furnish and install new motors and electrical panels	$1,250,000
New pump station building	$700,000
Automatic standby power generator	$750,000
Site grading and pump discharge outfall construction	$600,000
Construction Subtotal	$5,500,000
Engineering, CM, and Administration (20%)	$1,000,000
Contingencies (50% nominal)	$3,500,000
	$10,000,000

Wrigley-Ford Pump Station

Facility ID	**SD-7**
Location	Levee access from Marylinn Drive
Discharges to	Berryessa Creek at STA 24+00
Design WSEL at Discharge Location	10.1 feet NAVD
Storage	Forebay and channel storage
Tributary Area	760 acres (commercial and industrial)
Station Capacity	432 cfs
10-year Inflow	297.6 cfs
100-year Inflow	408.2 cfs
Excess Capacity	23.8 cfs

The downstream reach of Wrigley-Ford Creek was created when Valley Water realigned the original Berryessa Creek channel in 1974. To prevent Berryessa Creek flows from backing up into the old channel, a flood-gate structure with three 60-inch discharge pipes was built in 1976. At the time, Wrigley-Ford Creek's high flows would combine with high Berryessa stages and flood residential properties adjacent to the old channel. High water surface elevations in Wrigley-Ford Creek also made local drainage to that creek problematic.

In 1991 Valley Water built the Wrigley-Ford Pump Station to pump tributary creek flows into Berryessa Creek, eliminating the local flooding and gravity drainage problems. This pump station is outfitted with a weir and low flow gravity bypass system so that the pumps only operate when hydrologic conditions warrant. Recirculation piping was also constructed, enabling the pump station to be tested before each storm season using a limited amount of water that is generally available year-round. A resistive load bank furnished for the standby diesel engine-generator set so that the EG-set may be exercised and tested against load during the summer months.

Equipment Schedule

Pumps	(3) Couch EC54 axial flow (240 rpm, 130 hp, 65,000 gpm at 5.8 feet TDH)
	(1) Flygt 3102X-441 submersible (500 gpm 5 hp electric jockey)
Prime Power	(3) US Motors Model RE 150hp, 1200 rpm horizontal electric motors
	(3) Amarillo Gear Co. 5:1 right angle propeller pump drive
Standby Power	400 kV Caterpillar 3406TA diesel engine-generator set (600 hp)
Fuel Storage	500 gallons; 24 hours with 3 pumps, 52 hours with 1 pump
Control Power	120 VAC backed up by 24 VDC batteries with charger
Finish Floor Elevation	20.7 feet NAVD
Effective BFE	16.4 feet NAVD

Pump Station Operation

Capital improvements are not necessary for the Wrigley-Ford Pump Station. Originally set pump operating levels may still be used, as they will ensure that the pumps do not start more than twice per hour as recommended by the motor manufacturer. The pumps regularly rotate, allowing all three pumps to alternate for lesser storm events, and using forebay and channel storage prevent cycling.

Berryessa Pump Station

Facility ID	**SD-8**
Location	Folsom Circle
Discharges to	Berryessa Creek at STA 48+75
Design WSEL at Discharge Location	10.3 feet (NAVD 88)
Storage	52 acre-feet based on 2000 survey of Hidden Lake
Tributary Area	550 acres (res. and commercial)
Station Capacity	150 cfs
10-year Inflow	187 cfs
100-year Inflow	329.1 cfs
Normal Lake Level	9.0 feet NAVD
10-year Lake Level	9.0 feet NAVD
100-year Lake Level	13.3 feet NAVD (not including Calera Creek overflows)
Allowable Lake Level	12.0 feet NAVD
Lake Spill Elevation	13.5 feet NAVD

Hidden Lake was originally constructed as a storm drainage detention facility to act as a forebay for the Berryessa Pump Station, serving residential and commercial areas on both sides of Berryessa Creek. A 60-inch diameter storm drain crosses the creek and drains the Beresford Meadows area and the Town Center. The current operating practice is to use this lake as an aesthetic amenity throughout the year. Residents have complained of objectionable odors and sights whenever the city has lowered the normal water level for winter pumping in the past.

Using the Jarad Global Positioning System and a rod to measure water depths, Schaaf & Wheeler conducted surveys of Hidden Lake between July 20 and July 25, 2000. The references used were the North American Vertical Datum of 1988 (NAVD88) and the North American Horizontal Datum of 1983 (NAD83). This lake can store about 52 acre-feet before spilling north onto Erie Circle (Figure 4-4). Its summer water surface elevation is 8.8 feet, and the average depth of bottom sediment is about 0.75 feet. The lake overflows when its water surface reaches about 13.5 feet in elevation. Local street grades are about 14 feet in elevation. Some flooding of adjacent properties can be expected in a 100-year runoff event once the lagoon elevation reaches about 12 feet.

Berryessa Pump Station was rehabilitated in 2006, including installing replacement equipment and the elevations of all controls to the flood-proofed elevation of 16.78 feet NAVD. Electrical equipment has been replaced since 2013. Although the building itself is not flood-proofed, equipment essential to pump function that would fail if submerged is raised above the regulatory flood elevation. The electric motor, air intake stationary louver, main distribution panel, metering panel, jockey pump starter, and backup diesel engine have all been raised above the minimum flood-proofing elevation. In addition, conduits are run from the ceiling. With these essential elements above water, the pumps can operate if the building itself is flooded. Electronic controls have also recently been replaced. Occasional problems with odors during low lake levels have been resolved using aerators.

Since the last master plan update, the electronics have been replaced.

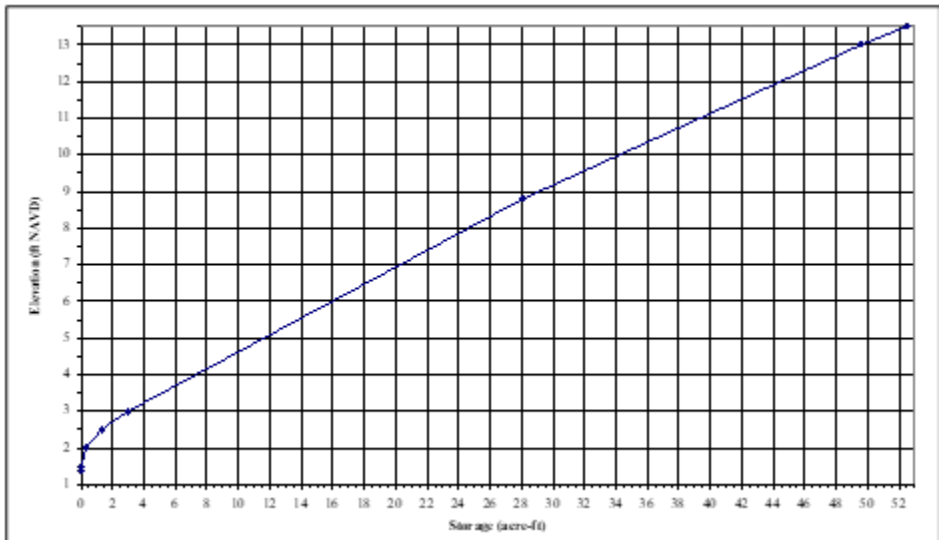


Figure 4-4: Storage Elevation Curve for Hidden Lake

Equipment Schedule

Pumps	(3) Berkeley 30M26 580 rpm 140 hp axial flow rated 22,500 gpm at 14 feet TDH
	(1) Berkeley 10K3M 7.5 hp 650 gpm jockey
Prime Power	(3) Waukesha-Scania\F67D3U 150 hp diesel engines
	(1) GE 240V, 3φ electric motor (jockey)
Standby Power	Not required
Control Power	120 VAC backed up by 24 VDC batteries with charger
Fuel Storage	1,000 gallons; ~48 hours run time at peak load
Flood-proofed Elevation	16.8 feet NAVD
Effective BFE	17.0 feet NAVD

Deficiencies

There are no identified pump station deficiencies and no recommended capital improvements.

Manor Pump Station

Facility ID	**SD-9**
Location	Marylinn Ave. and Barker St.
Discharges to	Lower Penitencia Creek at STA 90+00
Design WSEL at Discharge Location	9.5 feet NAVD
Storage	Wet Well Only
Tributary Area	146 acres (residential and commercial)
Station Capacity	95 cfs
10-year Inflow	95.7 cfs
100-year Inflow	113.3 cfs

Residential and commercial areas drain to the Manor Pump Station, which activates when the adjacent 21-inch diameter bypass can no longer drain local runoff into Penitencia Creek, either because it becomes overloaded or the creek stage is high.

Since the last master plan update, the pumps and motors have been rebuilt.

Equipment Schedule

Pumps	(3) Flygt 7060-885, 880 rpm, 85 hp submersible axial flow (14,000 gpm at 12')
	(1) Flygt CP-3102 submersible centrifugal jockey pump (5 hp) at 600 gpm
Standby Power	600A automatic transfer switch for on-site engine-generator
Control Power	120 VAC backed up by 24 VDC batteries with charger
Fuel Storage	n/a
Electrical Pad Elevation	18.2 feet NAVD
Effective BFE	16.0 feet NAVD

A third axial flow pump has been added to the pump station since the completion of the 2001 master plan, so the station now has adequate capacity for the design 10-year inflow. The pumps and motors were recently rebuilt.

Deficiencies

There are no identified pump station deficiencies and no recommended capital improvements.

Spence Creek Pump Station

Facility ID	**SD-10**
Location	11 Butler Street
Discharges to	Lower Penitencia Creek at STA 110+00
Design WSEL at Discharge Location	9.1 feet NAVD
Storage	Wetwell Only
Tributary Area	109 acres (residential and commercial)
Station Capacity	94 cfs
10-year Inflow	43.5 cfs
100-year Inflow	68.0 cfs
Excess Capacity	8cfs

***Note pump station inoperable at time of study**

Residential and commercial areas drain to Spence Creek until Penitencia Creek backwater forces runoff over a weir into the Spence Creek Pump Station. This facility discharges water to Lower Penitencia Creek through 600 feet of 42" diameter RCP force main. At the time of the master plan update, this station was inoperable due to pump equipment issues, electrical issues, and pump control issues.

This pump station is needed based on the 10-year storm CTP model. Figure 4-5 shows that without the pump, residential areas will become inundated.



Figure 4-5: 10-year Inundation With and Without Spence Creek Pump Station

Equipment Schedule

Pumps	(2) Flygt 7080-885, 880 rpm, 215 hp submersible axial flow (21,000 gpm at 26')
	(1) Flygt CP-30856 submersible centrifugal jockey pump (3 hp) at 300 gpm
Standby Power	800A Kirk-Key Interlock (manual transfer switch) for portable engine-generator
Control Power	120 VAC backed up by 24 VDC batteries with charger
Fuel Storage	n/a
Electrical Pad Elevation	18.2 feet NAVD
Effective BFE	18.0 feet NAVD

Deficiency

The station is inoperable, and while a plug and manual transfer switch are provided for a portable engine generator-set, there is no guarantee that either the EG-set or personnel to plug it in and turn it on will be available when power fails. Without any associated flood storage, adjacent areas will begin to flood just as soon as the power is gone. (This can occur with relatively minor storms if Penitencia Creek levels preclude gravity drainage.) The station needs to be retrofit with a permanent skid-mounted 400kW engine generator-set equipped with an automatic transfer switch to provide emergency power whenever the PG&E power supply fails, and there is a call for one of the pumps. Electrical work is required to make the station operational and the current bubbler level sensor needs replacement. ***[Low Priority]***

Capital Improvement Recommendation

Permanent standby power needs to be furnished at the site. Estimated capital costs are:

Table 4-7: Low Priority CIP for Spence Creek Pump Station

Capital Improvement	Estimated Cost
800A automatic transfer switch	$60,000
Motor Control Center modifications	$80,000
Miscellaneous electrical work	$40,000
400kW EG-Set in acoustic enclosure	$240,000
Engineering and Administration (20%)	$80,000
Contingency (50%)	$250,000
CIP Cost	**$750,000**

Bellew Pump Station

Facility ID	**SD-11**
Location	481 Murphy Ranch Road
Discharges to	Coyote Creek at STA 616+00
Design WSEL at Discharge Location	32.7 feet NAVD
Storage	Wet well only
Tributary Area	270 acres (industrial)
Station Capacity	375 cfs
10-year Inflow	45.6 cfs
100-year Inflow	49.7 cfs
Excess Capacity	325.3 cfs

Located at the end of Bellew Drive within the Milpitas Business Park Development, this facility drains the industrial area located between Coyote Creek and Interstate 680; from State Highway 237 to the Hetch-Hetchy aqueduct. This station has excess capacity to discharge the 100-year inflow.

Since the last master plan update, the underground fuel tank has been replaced with a belly tank under the emergency generator.

Equipment Schedule

Pumps	(3) Cascade 42MF axial flow (460 rpm, 600 hp, 56,000 gpm at 29 feet TDH)
	(1) Cascade 10MF 3,100 gpm 40 hp electric jockey
Prime Power	(2) Baldor 1,800 rpm 600 hp electric motors with variable frequency drive
	(1) Caterpillar 3412 diesel engine rated at 750 hp (2,100 rpm)
Standby Power	Diesel generator to run electric motors
Control Power	120 VAC backed up by 24 VDC batteries with charger
Fuel Storage	2,500 gallons; 72 hours at peak load (3 pumps)
Finish Floor Elevation	25.2 feet NAVD
Effective BFE	Shaded Zone X (area of moderate flood hazard)

Identified Deficiencies

Capital improvements are not necessary to maintain adequate pumping capacity at the Bellew Pump Station. However, during the Coyote Creek flood event of 2017, which produced water surface elevations in the creek that were a few feet from spilling over the levee at the Bellew Pump Station outlet, the outlet itself was submerged and water was flowing back through the pump discharge into the station wet well. City crews tried to improve the backflow prevention but could not; an engineered solution is needed to prevent creek backflow when the outlet is submerged and prevent excessive pump cycling due to high stage at Coyote Creek.

Murphy Pump Station

Facility ID	**SD-12**
Location	801 Murphy Ranch Road
Discharges to	Coyote Creek at STA 636+00
Design WSEL at Discharge Location	34.0 feet NAVD
Storage	Wet well only
Tributary Area	130 acres (industrial)
Station Capacity	200 cfs
10-year Inflow	118.8 cfs
100-year Inflow	197.5 cfs
Excess Capacity	2.5 cfs

Located just south of the Hetch-Hetchy aqueduct in the Milpitas Business Park Development, this facility drains the industrial area located between Coyote Creek and Interstate 680; from Hetch-Hetchy to Tasman Drive. This station has excess capacity to discharge the 100-year inflow. A control system upgrade is planned in the near future.

Equipment Schedule

Pumps	(3) Cascade 30MF axial flow (525 rpm, 250 hp, 30,000 gpm at 27 feet TDH)
	(1) Cascade 8MF 2,900 gpm 25 hp electric jockey
Prime Power	(3) Cumins NT655P diesel engines rated at 335 hp (2,600 rpm)
Standby Power	Not required
Control Power	120 VAC backed up by 24 VDC batteries with charger
Fuel Storage	2,000 gallons; 120 hours at peak load (3 pumps)
Finish Floor Elevation	27.7 feet NAVD
Effective BFE	Shaded Zone X (area of moderate flood hazard)

Identified Deficiencies

Capital improvements are not necessary to maintain adequate pumping capacity at the Murphy Pump Station. However, during the Coyote Creek flood event of 2017, which produced water surface elevations in the creek that were a few feet from spilling over the levee at the Murphy Pump Station outlet, the outlet itself was submerged and water was flowing back through the pump discharge into the station wet well. City crews tried to improve the backflow prevention but could not; an engineered solution is needed to prevent creek backflow when the outlet is submerged and prevent excessive pump cycling due to high stage at Coyote Creek.

Control systems have exceeded their life expectancy and with performance issues becoming increasingly problematic, control system rehabilitation is a ***high priority project*** expected to cost $250,000.

Oak Creek Pump Station

Facility ID	**SD-13**
Location	1521 McCarthy Boulevard
Discharges to	Coyote Creek at STA 678+00
Design WSEL at Discharge Location	38.3 feet NAVD
Storage	Wet Well and Pipe
Tributary Area	280 acres (industrial)
Station Capacity	320 cfs
10-year Inflow	102.5 cfs
100-year Inflow	216.4 cfs
Excess Capacity	103.6 cfs

Oak Creek Pump Station drains an industrial area at the southwestern corner of Milpitas, between Coyote Creek and Interstate 680 Tasman Drive to Montague Expressway. Because the direct-drive engines appear to be slightly overloaded when the Coyote Creek stage is high, they tend to run warm. A control system upgrade is planned soon.

Equipment Schedule

Pump	(3) Aurora 36P axial flow (590 rpm, 600hp, 48,000 gpm at 28.5 feet TDH)
	(1) Aurora 10LM 2,900 gpm 25 hp electric jockey
Prime Power	(3) Caterpillar 3408 diesel engines rated at 480 hp (2,100 rpm)
Standby Power	Not required
Fuel Storage	2,000 gallons; 80 hours at peak load (3 pumps)
Finish Floor Elevation	33.7 feet NAVD
Effective BFE	Shaded Zone X (area of moderate flood hazard)

Identified Deficiencies

Capital improvements are not necessary to maintain adequate pumping capacity at the Oak Creek Pump Station. However, during the Coyote Creek flood event of 2017, which produced water surface elevations in the creek that were a few feet from spilling over the levee at the Oak Creek Pump Station outlet, the outlet itself was submerged and water was flowing back through the pump discharge into the station wet well. City crews tried to improve the backflow prevention but could not; an engineered solution is needed to prevent creek backflow when the outlet is submerged and prevent excessive pump cycling due to high stage at Coyote Creek.

Control systems have exceeded their life expectancy and with performance issues becoming increasingly problematic, control system rehabilitation is a ***high priority project*** expected to cost $250,000.

Chapter 5: Operations, Maintenance, and Replacement

The intent of this Master Plan is not as a treatise on storm drain system operations and maintenance requirements or techniques (city operations and maintenance staff are the foremost authorities on this subject.) Rather, some foresight provided into anticipated ongoing maintenance schedules, including periodic replacement of major storm drain system components.

Milpitas is over 60 years old, and some of its older storm drainage infrastructures, particularly pumping equipment, are reaching the end of its useful life. Over the next several decades, major equipment replacements will be needed, and the city needs to set aside sufficient funds for annual facility maintenance and a systematic long-term replacement program, as outlined in Chapter 6.

General Maintenance Regimen

Table 5-1 presents very general criteria that may be useful in establishing a routine maintenance regimen. Again, city staff will have the best feel for the necessary frequency and extent of ongoing maintenance on a system-by-system basis. Also, maintenance needs will fluctuate depending upon seasonal and annual factors, particularly the amount of precipitation; and to a lesser extent, the general climate.

It is vitally important that all collection, storage, and pumping systems be in working order prior to the start of Milpitas's wet season near the end of October. Realizing the limited number of maintenance staff and the finite number of hours in a year, it is a given that certain items will have higher priorities than others.

Table 5-1: Storm System Maintenance Guidelines

Category	Schedule
Inlet Inspection	annually (summer-fall)
Inlet Cleaning	as required (ongoing)
Storm Drainpipe Cleaning	continuous if possible (ongoing)
Channel Cleaning	annually (fall)
Detention Basin Dredging	every ten years
Wet Well cleaning	annually (fall)
Direct Observation/Inspection	monthly (year-round)
Pump Exercising	monthly (year-round)
Engine Exercising	monthly at full load (year-round)
Equipment Lubrication	per manufacturers' recommendations
Preventative Maintenance per Equipment O&M	annually (spring)
Clean and Polish Diesel Fuel/Remove Water	annually (fall)
Underground Storage Tank Inspection	weekly
Aboveground Storage Tank Inspection	monthly
Motor / Engine Control Testing	annually (fall)

Collection System Maintenance

The storm drain and channel system cannot function if one of its components is plugged. Even though hydraulic analyses say criteria are met, blocked inlets, pipes, or channels will cause flooding, potentially with serious consequences; lagoons and pumping forebays need to be monitored and periodically dredged to preserve design capacities. Even the most rigorous maintenance programs cannot prevent all problems during a storm event; still, problems must not accumulate.

It is also important to maintain the more natural drainage features such as open channels and lagoons as drainage features, so they do not become jurisdictional and require extensive regulatory permits to perform what should be routine maintenance.

Based on system history, the most significant problems occur at the base of the foothills, where sediment- and debris-laden runoff are easily carried within the steeper pipes and streets. This sediment and debris, some of which originates outside of the city limits in unincorporated Santa Clara County, are deposited as the topography flattens out to the west.
Adding debris basins and modifying inlets along Evans Road and Piedmont Road could help with the maintenance effort. Depending on the desired frequency for maintenance, storage in debris basins made to handle sediment and debris as described in Chapter 3. Retrofitting certain storm drain inlets to mimic the existing inlet for Piedmont Creek on Piedmont Road, as shown in Figure 5-1, would also help ease downstream maintenance.



Figure 5-1: Trash and Debris Protection at Piedmont Creek Inlet

Another area of concern is where so-called “self-cleansing” velocities of two feet per second are not maintained even with significant runoff. This circumstance may occur in larger diameter pipelines, particularly in the terminal drainage areas west of Interstate 880. Collection systems in terminal drainage areas have been designed to handle the 100-year discharge where pipes are continuously submerged in water due to backwater from pump stations.

Open Channel Maintenance

Open channels are important to maintain to allow for proper stormwater drainage from the city storm drain system. Debris and overgrown vegetation in open channels owned by the city should be removed to keep creek levels low so that stormwater in the collection system can drain out and not surcharge. There are surcharges causing flooding in the storm drain network in the existing system due to high creek levels in Wrigley-Ford Creek. Figure 5-2 shows that decreasing the Manning's roughness coefficient of Wrigley-Ford Creek to reflect the effects of maintained creek results in reduced surcharges in the collection system. Figure 5-3 and 5-4 show the creek WSEL profile with and without maintenance allowed by the Wrigley-Ford Creek maintenance permit for 10-year and 100-year storm.

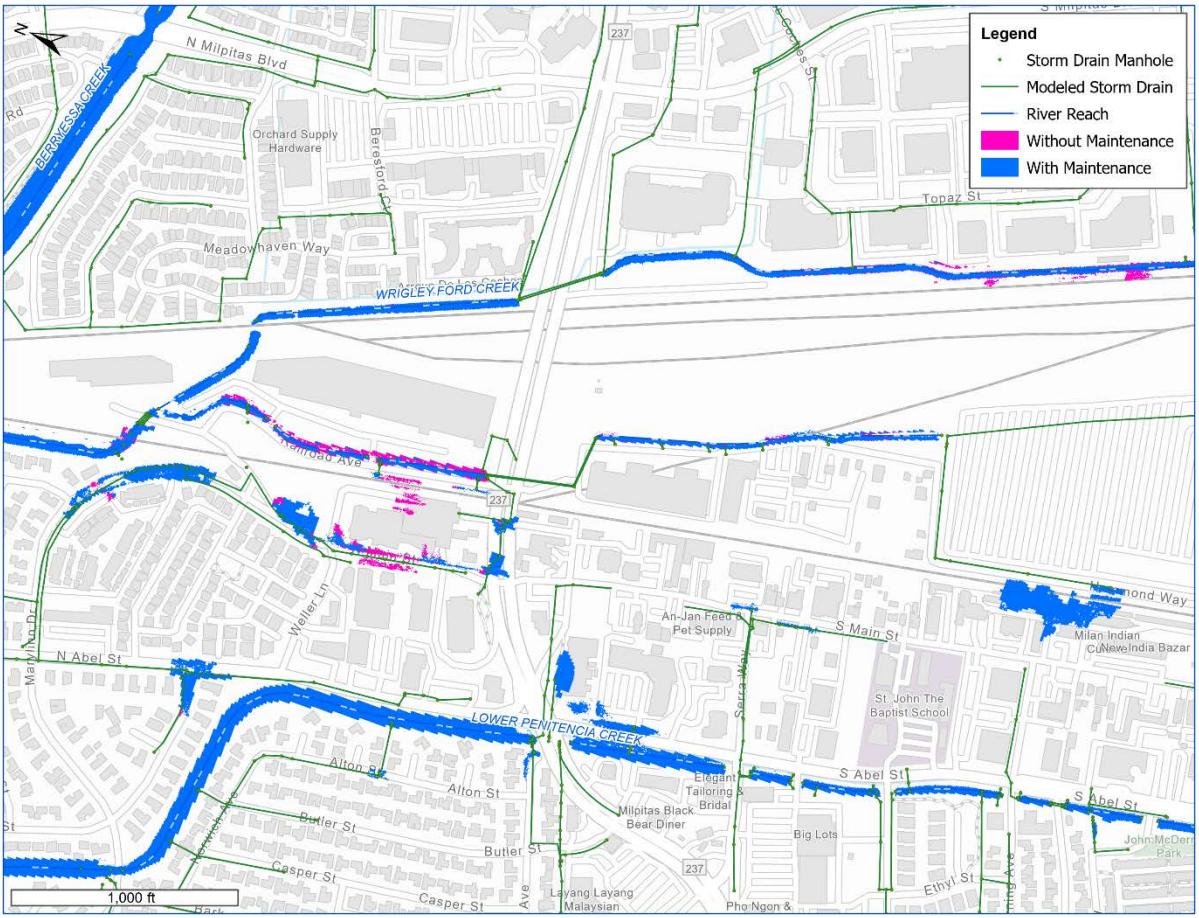


Figure 5-2: Wrigley-Ford Creek Flooding with and Without Maintenance for 10-Year Storm

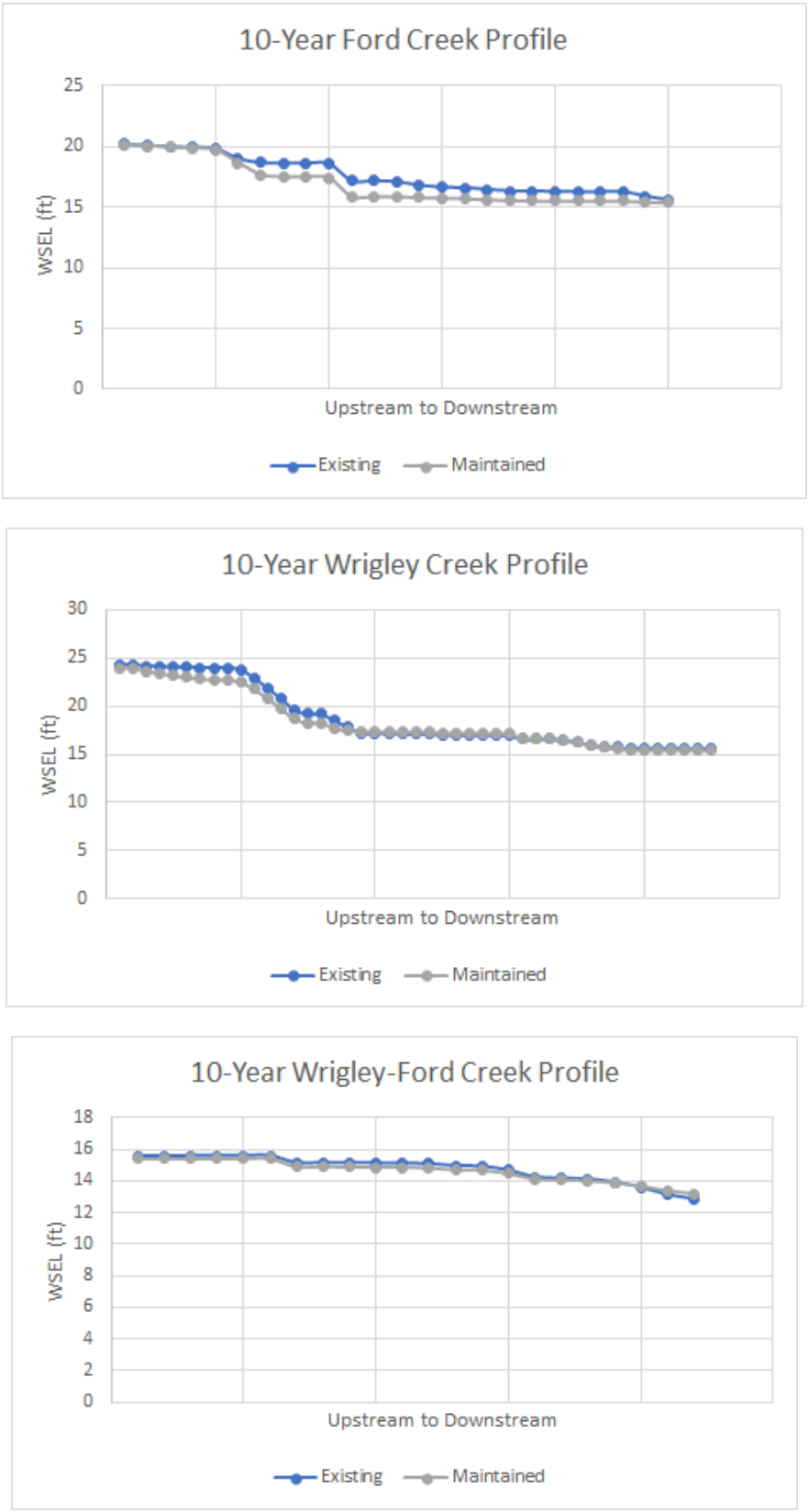


Figure 5-3: 10-Year Storm Profile With and Without Maintenance on Wrigley, Ford, and Wrigley-Ford Creek

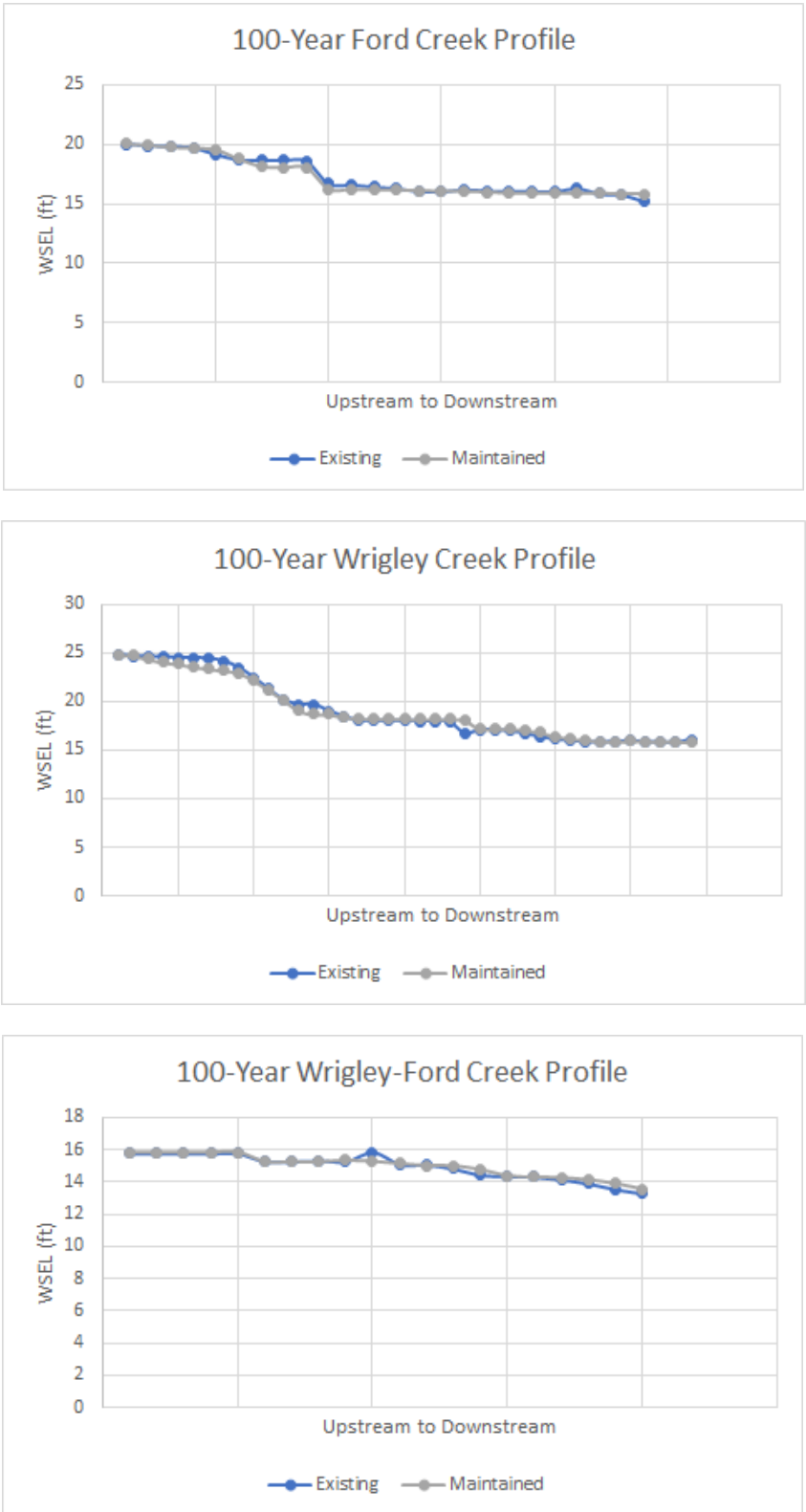


Figure 5-4: 100-Year Storm Profile With and Without Maintenance on Wrigley, Ford, and Wrigley-Ford Creek

Pumping Facility Maintenance

Pumping stations are critical to maintain since mechanical or electrical failure can jeopardize system operation. Each pump station should have a bound copy of its site-specific operations and maintenance manual on-site, and all personnel need to be familiar with the contents of these manuals.

Proper equipment lubrication and maintenance following manufacturers' recommendations (which must be included in the operations and maintenance manual) is essential to efficient operation and longevity, particularly when one considers how infrequently pump operation may occur. For this reason, recommending the city retrofit any pump station control system that does not automatically alternate lead and lag pump status so that each pump within a station operates roughly the same number of hours every year.

Appendix B outlines pump station design, maintenance, and operation features that can help further the maintenance effort. All engine drive units installed run on diesel fuel. Table 5-2 summarizes the recommended frequency.

Table 5-2: Typical Maintenance Frequency for Engines and EG Sets

Maintenance Task	Operating Time	Calendar Time
Inspect fuel, oil level, coolant	8 hr	1 m
Inspect air cleaner, battery	50 hr	1 yr
Clean governor linkage, breather, air cleaner	100 hr	1 yr
Clean fuel filter, replace oil filter, change crankcase oil, check switchgear	200 hr	1 yr
Clean commutator, collector rings, relays, cooling system; inspect brushes, valve clearances, starting and stopping systems, water pump	500 hr	1 yr
Check injectors, grind valves (if required), remove carbon, clean oil passages, replace secondary fuel filter, clean generator, and grease bearings	1000 hr	2 yr

Municipal Regional Stormwater Permit Requirements

Milpitas participates in the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) as a co-permittee under the California Regional Water Quality Control Board San Francisco Bay Region (Water Board) Municipal Regional Stormwater NPDES Permit (Order No. R2-2015-0049). Also referred to as the "MS4 Permit" or "MRP", it became effective November 19, 2015. Requirements outlined in the city's MS4 Permit are subject to change. As such, this storm drain master plan does not intend to document specific NPDES requirements or their implementation; but rather provide a brief background regarding the requirements likely to affect system-wide operation and maintenance. An allowance is made in Chapter 6 for typical annual costs to satisfy system-wide permit requirements. A permit update (MRP3.0) is in the draft form currently and anticipated to be adopted in 2021.

Regulatory Background

The Water Board has found that stormwater runoff from urban and developing areas within the San Francisco Bay region contains significant sources of pollutants that contribute to water quality impairment in the waters of the region. In Milpitas, these could include creeks, streams, and San Francisco Bay. In conformance with the Clean Water Act, the Water Board has established total maximum daily loading

limits (TMDLs) for various pollutants to gradually eliminate the water bodies' impairment and attain water quality standards.

As a co-permittee, Milpitas is required to effectively prohibit the discharge of anything other than stormwater into storm drain systems and watercourses. It is specifically prohibited from discharging rubbish, refuse, sediment, or other solid wastes into surface waters or anywhere such trash will eventually transport to surface waters, including floodplain areas.

Routine Practices

Implement best management practices (BMPs) to control and reduce polluted stormwater and non-stormwater discharges to storm drains and watercourses during operation, inspection, and routine repair and maintenance activities of municipal facilities and infrastructure, including storm drain infrastructure. These practices apply to:

- Road repair and maintenance
- Sidewalk and other hardscape repairs, maintenance, and cleaning
- Structural maintenance (e.g., bridge repair) and graffiti removal
- Stormwater pump station operation and maintenance
- Corporation yard activities
- Construction sites
- Pesticide toxicity control

Milpitas must implement an industrial and commercial site control program at all sites that could reasonably be considered to cause storm water runoff pollution. Routine inspections and enforcement to abate actual or potential pollution sources need to be consistent with an Enforcement Response Plan prepared to confirm the implementation of appropriate and effective pollutant controls by industrial and commercial site operators. In addition, Milpitas is responsible detecting and eliminating illicit discharges by any party within its jurisdiction. An illicit discharge program shall be developed and implemented to include active surveillance, a centralized point of contact for complaints, a tracking system, and reporting. Public outreach and water quality monitoring, which can be collaborative with other co-permittees such as the Santa Clara Valley Water District, also permit requirements.

New Development and Redevelopment

Milpitas administers the implementation of new development and redevelopment projects to comply with the Municipal Regional Stormwater Permit requirements. For regulated projects (which is a function of size, land use, and location), this includes project review and permitting in the areas of site design, onsite stormwater treatment, hydro-modification management, landscaping, trash enclosures, plumbing, swimming pool water disposal, and fire test water disposal. The MS4 Permit does allow the city to consider the construction of regional stormwater treatment facilities in lieu of treatment on individual building sites. Such regional stormwater treatment facilities are not factored into capital planning for the stormwater system described in this master plan document.

Green Infrastructure

The City of Milpitas Green Infrastructure Plan (GI Plan) aims to gradually transform the urban landscape and storm drainage systems from "gray" to "green". It involves shifting from having stormwater runoff flow directly off impervious surfaces into the storm drainage system to having runoff flow into a local, sustainable system such as draining into vegetated areas for infiltration and evaporation, collecting runoff for non-potable uses, using permeable pavements, and treating runoff with biotreatment. This green

infrastructure will help limit the transport of pollutants in stormwater by reducing runoff. Coordinating the proposed CIP projects with street greening can lower the marginal cost of stormwater management.

Trash Capture

The city must capture all trash originating from the city's Municipal Separate Sewer System (MS4) before it enters the waterways by the year 2022 (draft permit may revise the deadline to 2023). The city is accomplishing this through full trash capture systems and devices located at individual storm drain inlets. One example is the screening device at Wrigley-Ford Pump Station. It is outside the scope of the master plan to identify and model these devices; however, the design and operation of these devices may result in impediments to flow and the potential to cause localized flooding. This needs consideration during the locating and design of these devices, and ongoing operations and maintenance.

System Replacement

With predominantly reinforced concrete pipe, collection system materials can be expected to last indefinitely, so a major replacement schedule for the pipe is not presented. System breaks, joint misalignment, and other problems do occur, of course, so periodic collection system rehabilitation has been included with the estimated annual maintenance cost.

On the other hand, pumping facilities rely heavily on mechanical and electrical equipment that will wear out, particularly since the stations are not operated constantly. On average, pumping equipment can be expected to last anywhere from 20 to 30 years with proper maintenance. Structural facilities should last much longer – at least 50 years – although metal, wood, and even concrete surfaces all require regular care.

Table 5-3 lists Milpitas' pumping facilities, their approximate age, and possible dates for mechanical and electrical equipment replacement to be completed within 5-year intervals based on input from city staff. Major rehabilitation might include complete pump station replacement, depending upon the circumstances. City maintenance crews need to monitor the condition of these facilities and prepare for system replacement several years in advance.

More detailed pump station assessments are provided in Chapter 6. Thorough individualized pump station assessments should be made prior to undertaking major equipment replacement or station rehabilitation.

Table 5-3: Pumping Facility Replacement

ID	Station Name	Originally Built	Age (years)	Recent Equipment Replacement	Proposed Schedule for	
					Equipment Replacement	Major Rehabilitation
1	California Circle	1983	38		2030	2070
2	Jurgens	1989	32	Ventilation	Low Priority CIP	Low Priority CIP
3	McCarthy Ranch	1994	27		2045	2075
4	Abbott Avenue	1983	38	Equip rehab/motors	2040	2070
5	Minnis[1]	1978	43	Pumps/ATS	2050	2050
6	Penitencia[1]	1960	61	Engines rebuilt	High Priority CIP	High Priority CIP
7	Wrigley-Ford	1993	28		2035	2070
8	Berryessa[2]	1977	44	electronics	2045	2045
9	Manor	1993	28	Pumps and motors rebuilt	2040	2070
10	Spence Creek	1988	33		2030	2065
11	Bellew[3]	1985	36		2060	2060
12	Murphy	1983	38		2035	2070
13	Oak Creek	1979	42		2025	2055

[1]Scheduled as High-priority CIP
[2]All pumping, electrical, and control equipment replaced and flood-proofed in 2006
[3]Two engines replaced with electric motors, variable frequency drives, and controls in 2012

Chapter 6: Storm Drainage Funding Requirements

This chapter summarizes budget requirements to fund Capital Improvement Program projects described in Chapter 3, and facility maintenance and replacement as outlined in Chapter 4 and 5. Table 6-1 summarizes these projects.

Table 6-1: Comprehensive Master Plan CIP Projects

CIP Project	Priority
CAL_2	High
CAL_3	High
COCHES_5	High
BERRY_10	High
Inlet Replacements	High
Murphy Pump Station	High
Penitencia Pump Station	High
CAL_1	Low
CAL_4	Low
COCHES_8	Low
WF_11	Low
LP_12	Low
WF_13	Low
LP_14	Low
Wrigley-Ford Creek Maintenance	Low
Abbott Pump Station	Low
Jurgens Pump Station	Low
Spence Creek Pump Station	Low
LP_15	Extension
LP_16	Extension
LP_17	Extension
LP_18	Extension

Table 6-2 summarizes estimated annual costs for implementing the proposed priority Capital Improvement Program, near-term equipment replacement, facility maintenance, and future facility replacement. All cost estimates are in 2020 dollars (ENR Index = 10,000). Annual equal payment capital recovery costs assume 20-year financing with a six percent interest rate. The cost of money associated with actual project timing is assumed to be included with CIP contingencies. CIP implementation estimates in Table 6-2 assume that where feasible, the parallel pipe alternative will be selected to save cost. For the purpose of setting aside sufficient funds for future work, the amortized annual costs for low priority projects are not calculated since these optional projects would likely be built only with outside funding in conjunction with other work.

Table 6-2: Storm Drainage Funding Requirements

Category	Present Worth	Annualized Cost
High Priority CIP Implementation	$15,000,000	$1,000,000
Long-Term Equipment Replacement	$45,000,000	$3,500,000
Annual Operations and Maintenance	---	$2,500,000
Total Budget	$60,000,000	$7,000,000

Spread over Milpitas' 6,048 acres of developed or developable land, the average annual cost per acre is $1,160 to fund high priority Master Plan improvements, replace equipment and maintain storm drainage facilities.

Cost Basis of Capital Improvement Program

Chapter 3 discusses evaluation criteria used to prioritize improvements. Based on hydrologic and hydraulic analyses of stormwater collection and pumping facilities, master plan improvements will bring systems into compliance with performance criteria. This is a master plan level effort. Hence, many of the practical constraints that will govern the detailed design and construction of actual infrastructure improvements are unknown at this time, such as:

- Utility interference and relocation;
- Right-of-way and/or easement availability;
- Traffic control requirements;
- Geotechnical and hazardous waste conditions;
- Archaeological discoveries and environmental impacts; and/or
- Regulatory and permitting requirements.

Since these impacts cannot be estimated with any certainty, this master plan's approach is to estimate capital improvement costs based on current construction market conditions and apply 10% for mobilization and demobilization, 5% for traffic control, and 40% on contingency. A 40% contingency has been included to account for 15% design and 25% construction contingency. Table 6-3 and 6-4 provides unit cost information for storm drain collection systems. Costs are based on bids from past storm drain projects adjusted to the current ENR index.

Table 6-3: Storm Drainpipe Collection Costs per Lineal Foot
(All costs in 2020 dollars)

Diameter	18"	24"	30"	36"	42"	48"	54"	60"	72"	84"	94"
Pipe	$283	$350	$447	$516	$614	$692	$789	$898	$1,171	$1,590	$1,920
10% Mob/Demob	$28	$35	$45	$52	$61	$69	$79	$90	$117	$159	$192
5% Traffic Control	$14	$18	$22	$26	$31	$35	$39	$45	$59	$80	$96
40% Contingency	$113	$140	$179	$206	$246	$277	$316	$359	$469	$636	$768
Total Unit Cost	**$439**	**$543**	**$693**	**$800**	**$952**	**$1,073**	**$1,223**	**$1,392**	**$1,816**	**$2,465**	**$2,976**

Table 6-4: Storm Drain Manhole Costs per Unit
(All costs in 2020 dollars)

Diameter	18"	24"	30"	36"	42"	48"	54"	60"	72"	84"	94"
Manhole	$13,369	$13,655	$13,941	$14,228	$14,514	$14,801	$16,080	$16,406	$18,268	$20,915	$23,005
10% Mob/Demob	$1,337	$1,366	$1,394	$1,423	$1,451	$1,480	$1,608	$1,641	$1,827	$2,091	$2,301
5% Traffic Control	$668	$683	$697	$711	$726	$740	$804	$820	$913	$1,046	$1,150
40% Contingency	$5,347	$5,462	$5,577	$5,691	$5,806	$5,920	$6,432	$6,562	$7,307	$8,366	$9,202
Total Unit Cost	**$20,722**	**$21,165**	**$21,609**	**$22,053**	**$22,497**	**$22,941**	**$24,923**	**$25,429**	**$28,315**	**$32,418**	**$35,658**

Table 6-5 details the calculation of estimated CIP cost by Master Plan improvement priority.

Table 6-5: Storm Drain Capital Improvements Costs
(All costs in 2020 dollars)

Category	Cost
High Priority CIP	$14,000,000
Low Priority CIP	$24,000,000
Extension CIP	$1,000,000
Total Budget	$39,000,000

Annual Maintenance Costs

Existing storm drainage infrastructure and new improvements to be constructed from the CIP must be operated and maintained as described in Chapter 5. Based on these regimens and input from city staff, the annual funding levels summarized by Table 6-6 are recommended for facility operation, preventative maintenance, programmed replacement, and mandated non-point source control programs. Some allowance should also be made for increased power and fuel costs for pumping.

Table 6-6: Storm Drain Annual Operation and Maintenance Costs
(All costs in 2020 dollars)

Category	Cost
Annual Operations	$600,000
Preventative Maintenance	$500,000

Category	Cost
Wrigley-Ford Creek Maintenance	$800,000
NPDES Permit Compliance	$300,000
Programmed Replacement	$300,000
Total Annual Costs	**$2,500,000**

Cost of Major Facility Replacement

Replacing major mechanical equipment for pumping stations is outside of the annual allowance made for programmed replacement. Detailed cost estimates to replace equipment at the Abbott Pump Station and Oak Creek Pump Station have been prepared. Estimated costs in 2020 dollars for other pump station replacement projects are based on the unit costs indicated in Table 6-7. Equal payment series capital-recovery fund amounts for equipment replacement and major rehabilitation are given in Table 6-8, based on an interest rate of six percent, and beginning to accumulate the annual fund in 2020.

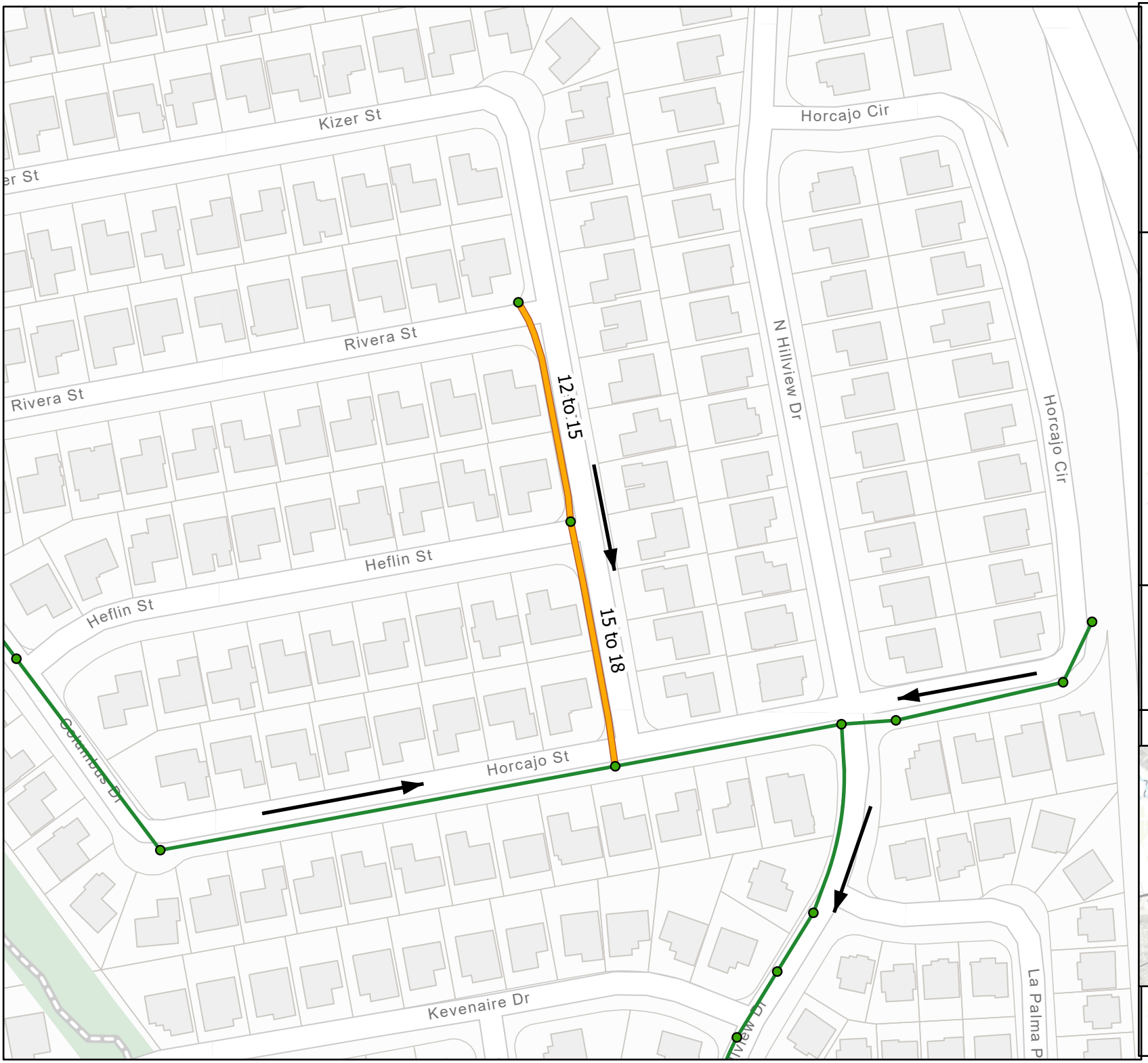
Table 6-7: Storm Pumping and Storage Unit Costs
(All costs in 2020 dollars; ENR = 13,500)

Category	Unit Cost
Axial Flow Pump and Driver	$3,500 per cfs of capacity
Direct Drive Engine	$950 per horsepower
Engine-Generator Set	$700 per kilowatt
Pump Building	$400 per square foot
Storage Excavation	$40 per cubic yard

Table 6-8: Pumping Facility Replacement

ID	Facility	Next Scheduled Replacement			Second Scheduled Replacement		
		Year	Cost	Annual Fund	Year	Cost	Annual Fund
1	California Circle	2030	$1,000,000	$136,000	2070	$2,000,000	$129,000
2	Jurgens	CIP	$0	$0	2075	$3,000,000	$185,000
3	McCarthy	2040	$3,000,000	$262,000	2080	$5,000,000	$313,000
4	Abbott	CIP	$0	$0	2050	$1,000,000	$73,000
5	Minnis	2050	$1,000,000	$73,000	2080	$1,000,000	$63,000
6	Penitencia	CIP	$0	$0	2070	$2,500,000	$161,000
7	Wrigley-Ford	2035	$2,000,000	$206,000	2065	$3,000,000	$226,000
8	Berryessa	2045	$3,000,000	$234,000	2060	$1,000,000	$67,000
9	Manor	2040	$1,000,000	$87,000	2070	$1,000,000	$65,000
10	Spence Creek	CIP	$0	$0	2065	$1,000,000	$65,000
11	Bellew	(2012)	$0	$0	2055	$3,000,000	$208,000
12	Murphy	CIP	$0	$0	2070	$3,000,000	$193,000
13	Oak Creek	2025	$2,000,000	$475,000	2055	$3,000,000	$208,000
	Total		**$13,000,000**	$1,500,000		**$30,000,000**	$2,000,000

Appendix A Storm Drain Inundation Maps



Milpitas Storm Drainage CIP

CAL_1
Tice Drive
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

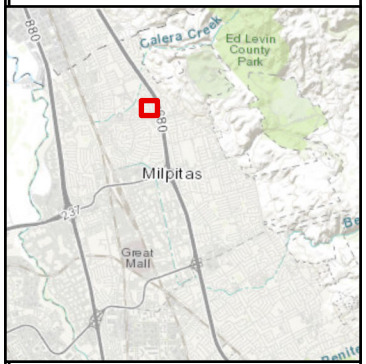
- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 150 feet

Vicinity Map



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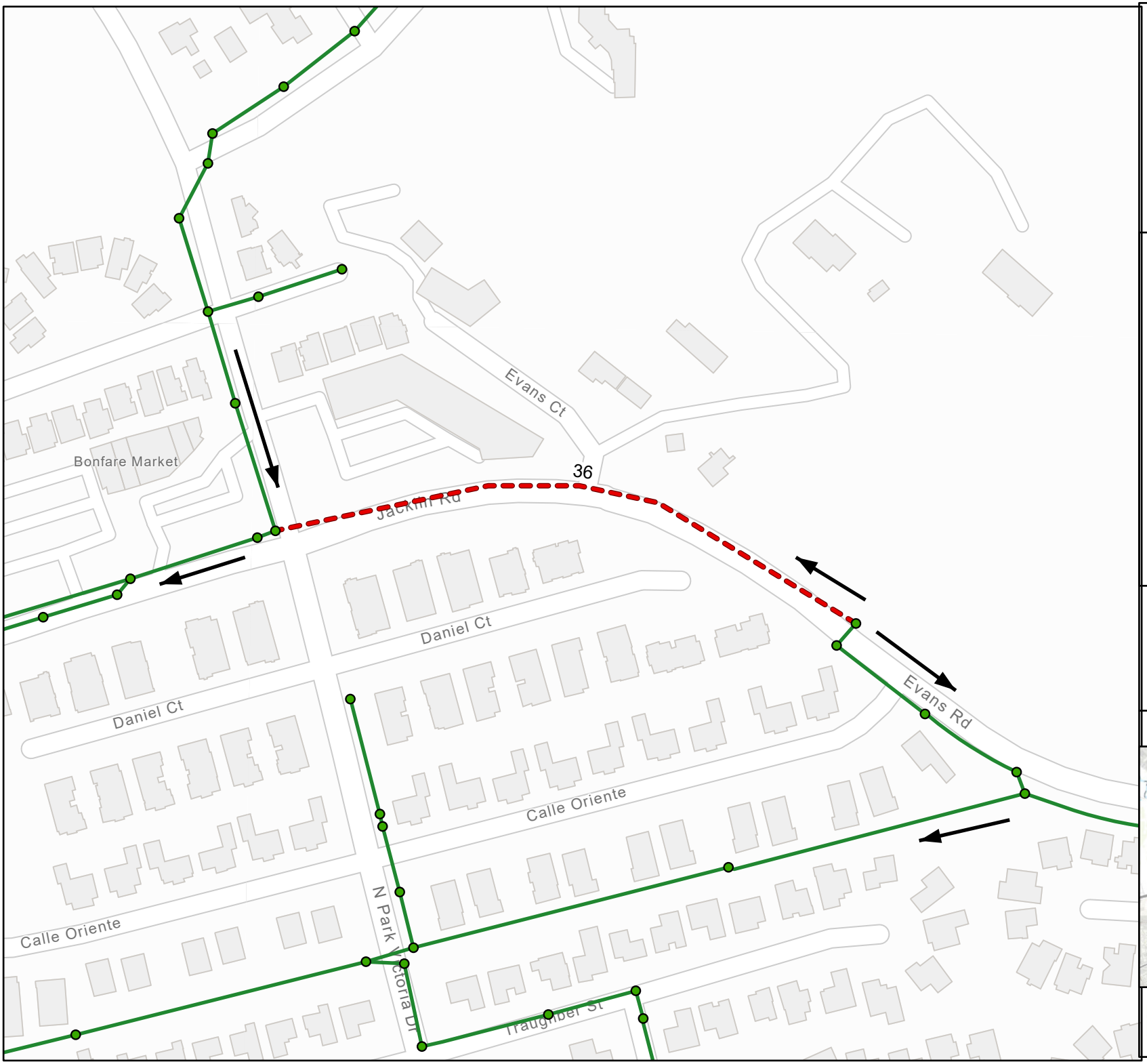


Milpitas Storm Drainage CIP

CAL_2
Jacklin Road
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

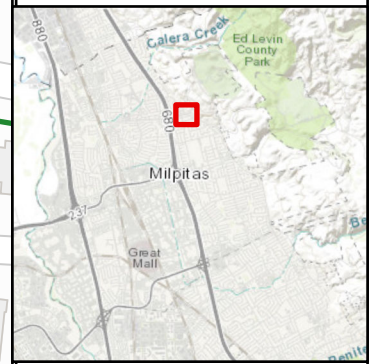
- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 200 feet

Vicinity Map



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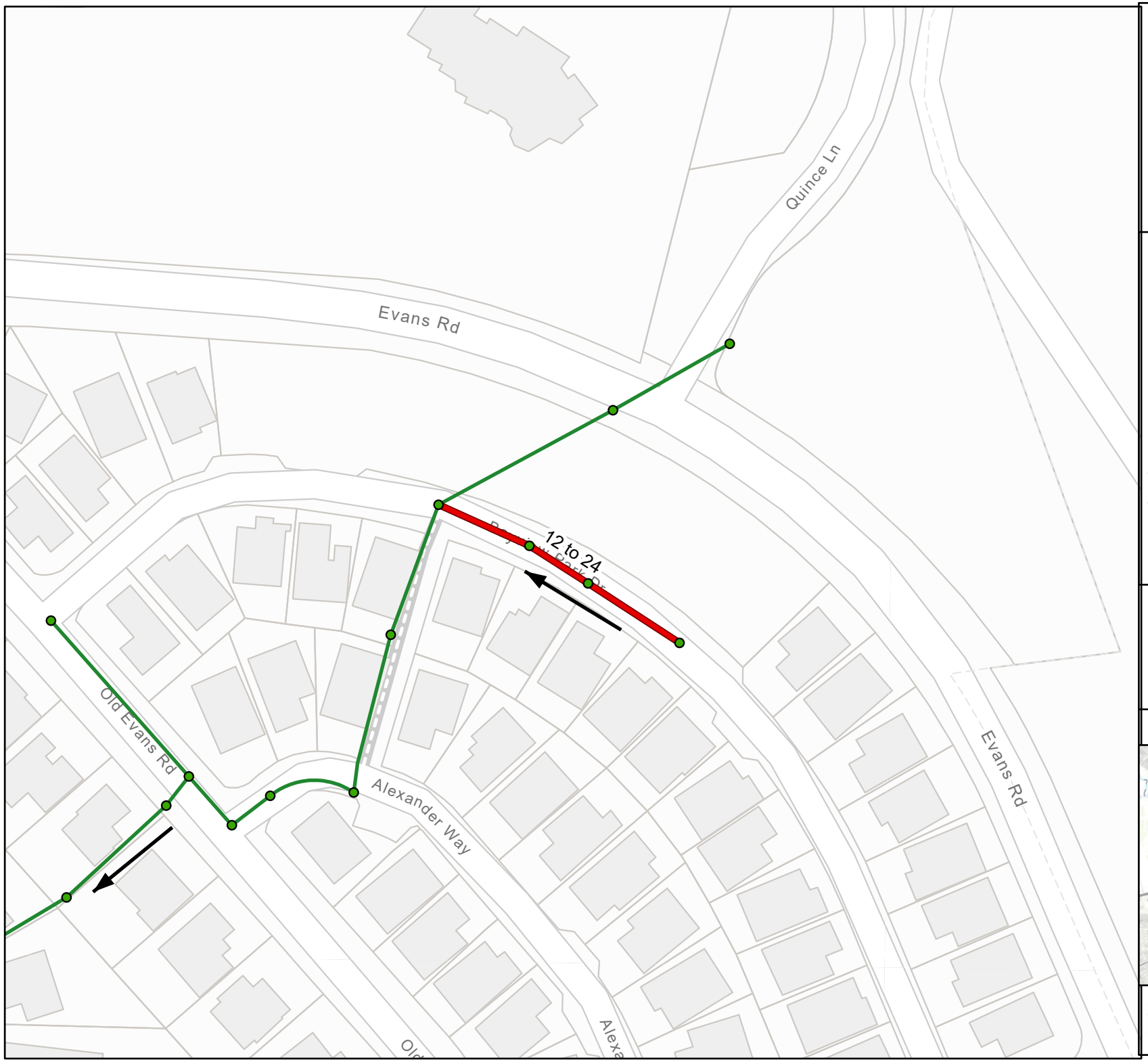
Milpitas
Storm Drainage CIP

CAL_3
Bayview Park Drive
SD Improvements



Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 100 feet

Vicinity Map



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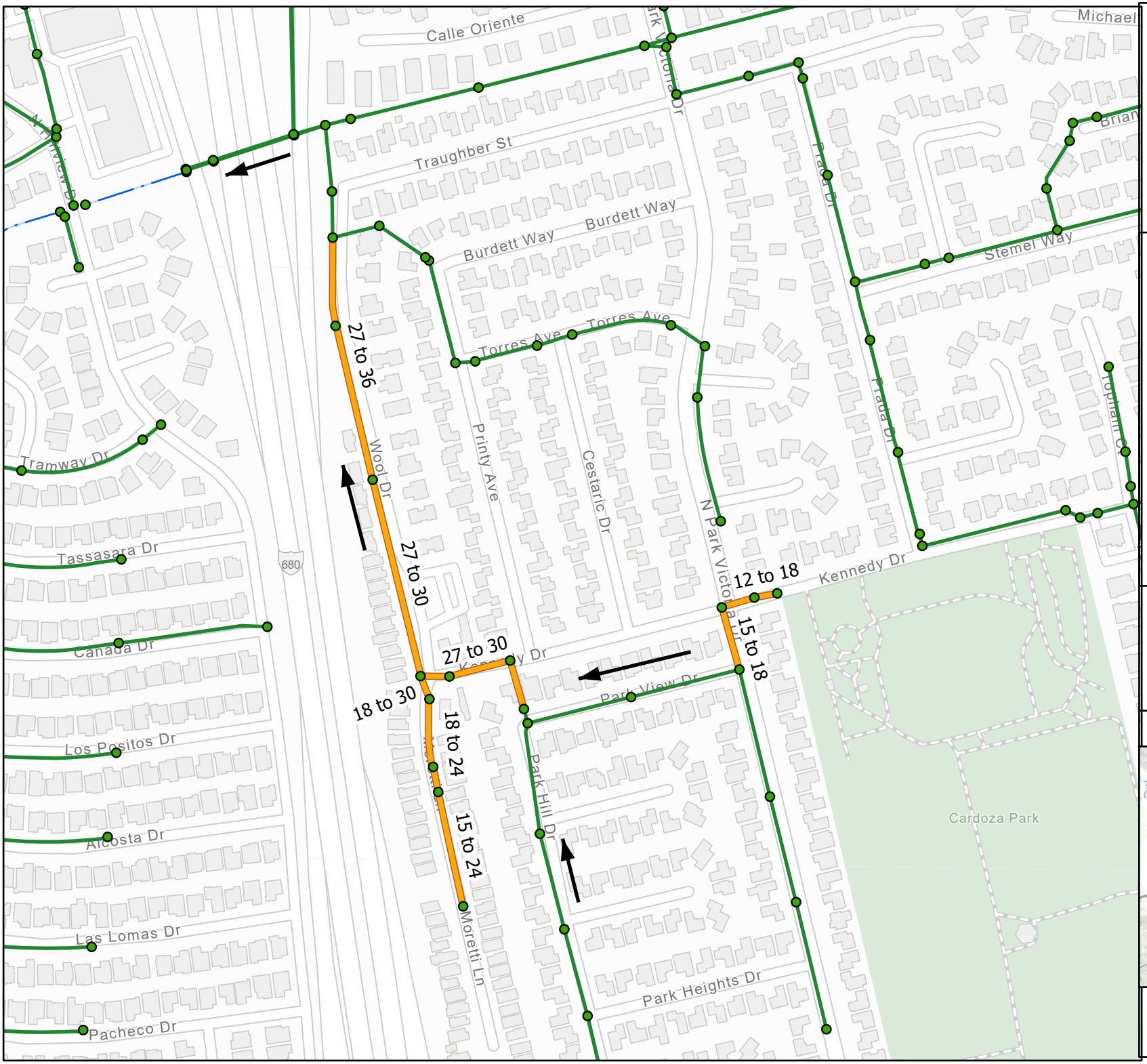


Milpitas Storm Drainage CIP

CAL_4
Wool Drive
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

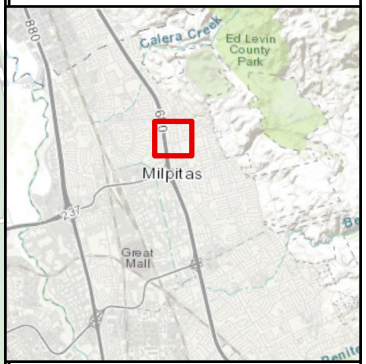
- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 350 feet

Vicinity Map



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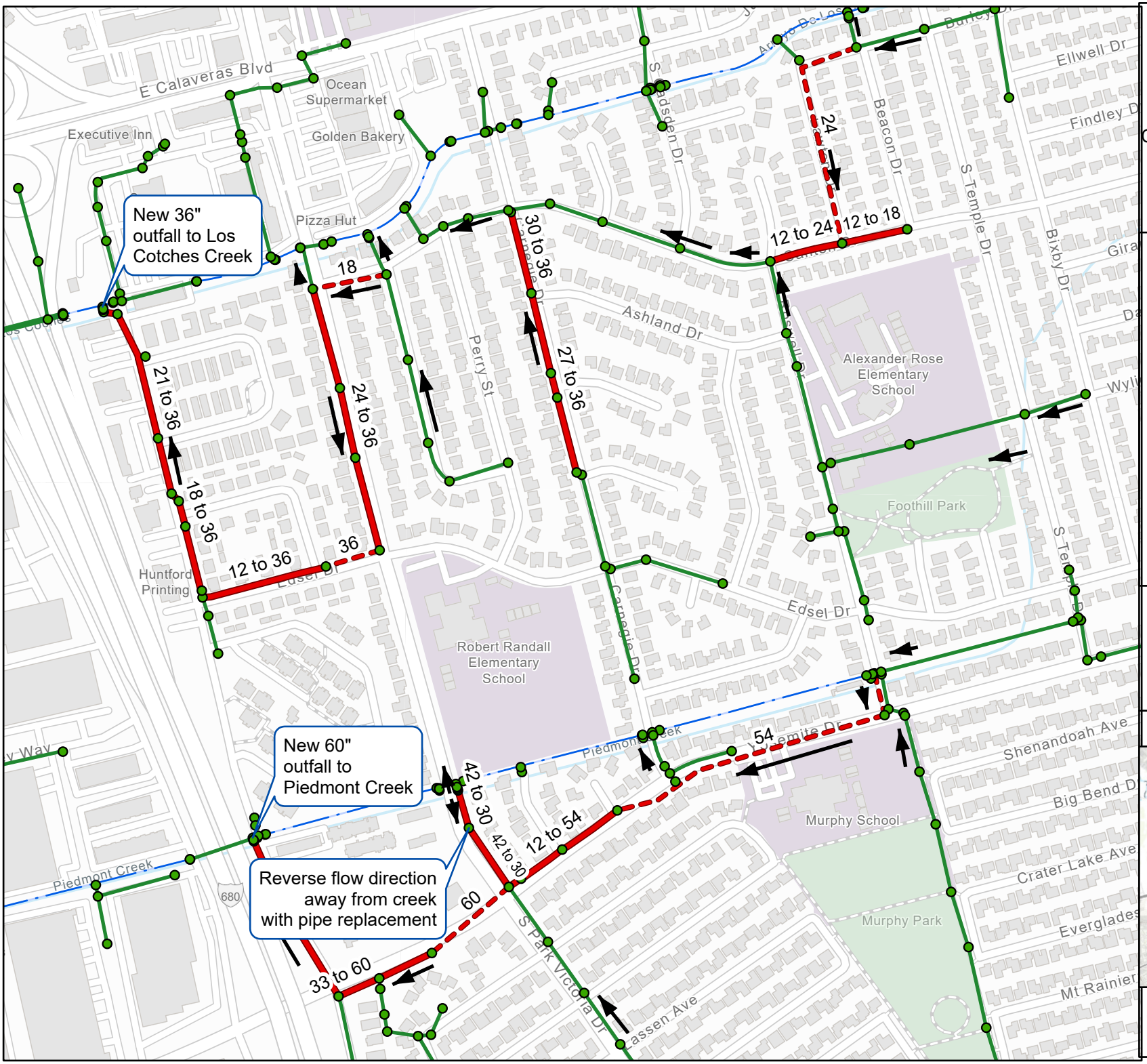


Milpitas Storm Drainage CIP

COCHES_5
Coches and Piedmont Creek SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

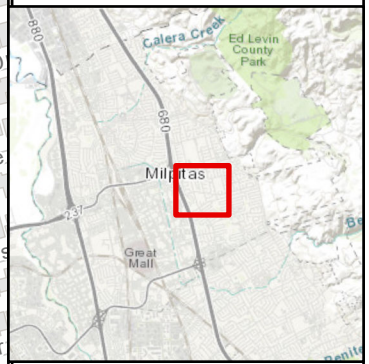
- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 500 feet

Vicinity Map



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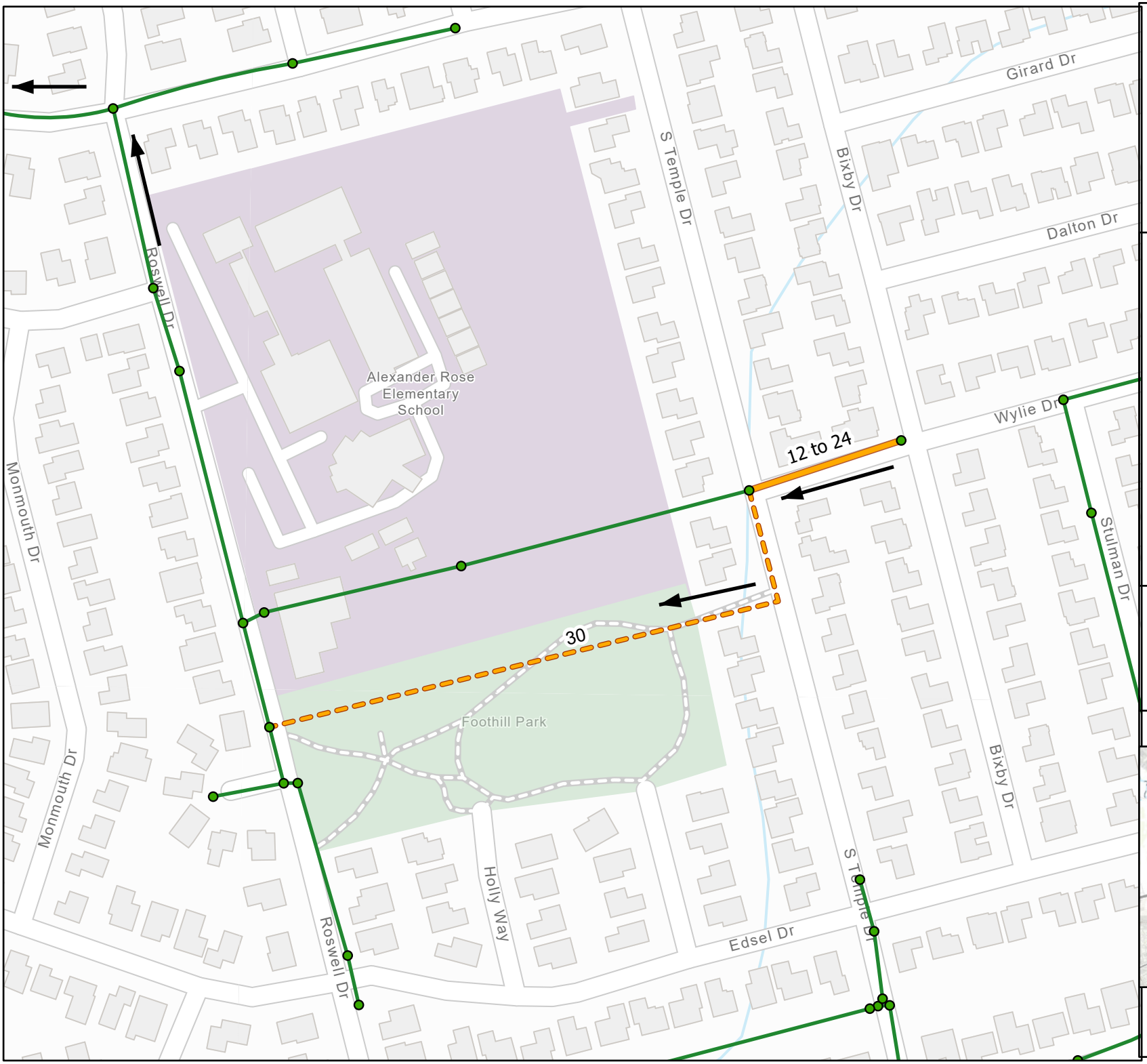


Milpitas Storm Drainage CIP

COCHES_8
Foothill Park
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

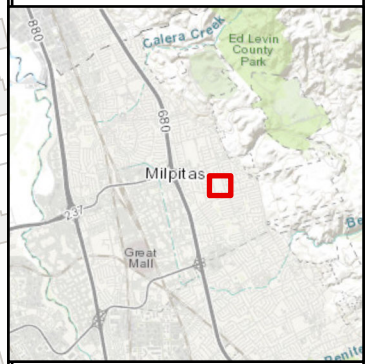
- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 200 feet

Vicinity Map



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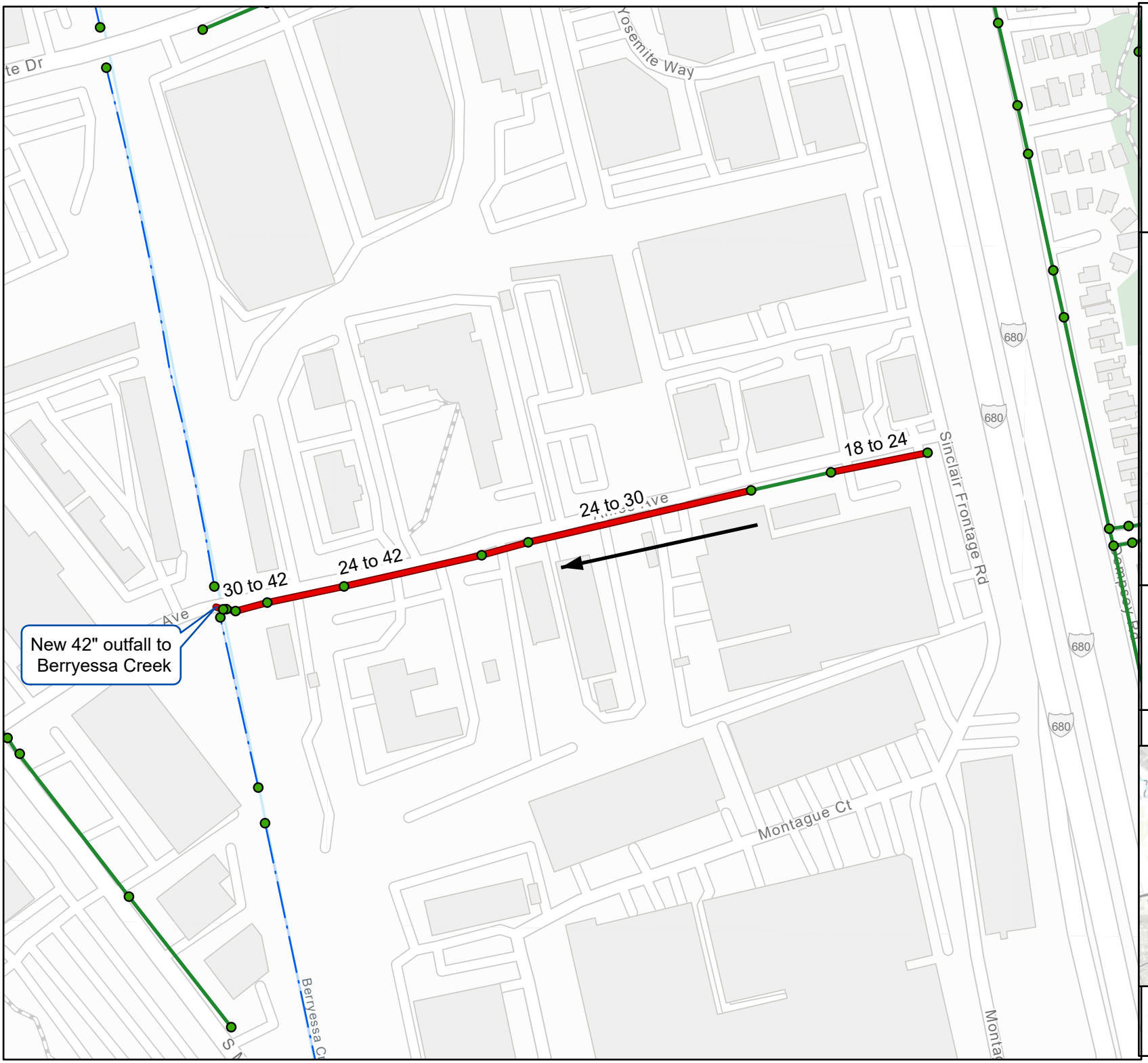

Milpitas
Storm Drainage CIP

BERRY_10
Ames Avenue
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 300 feet

Vicinity Map



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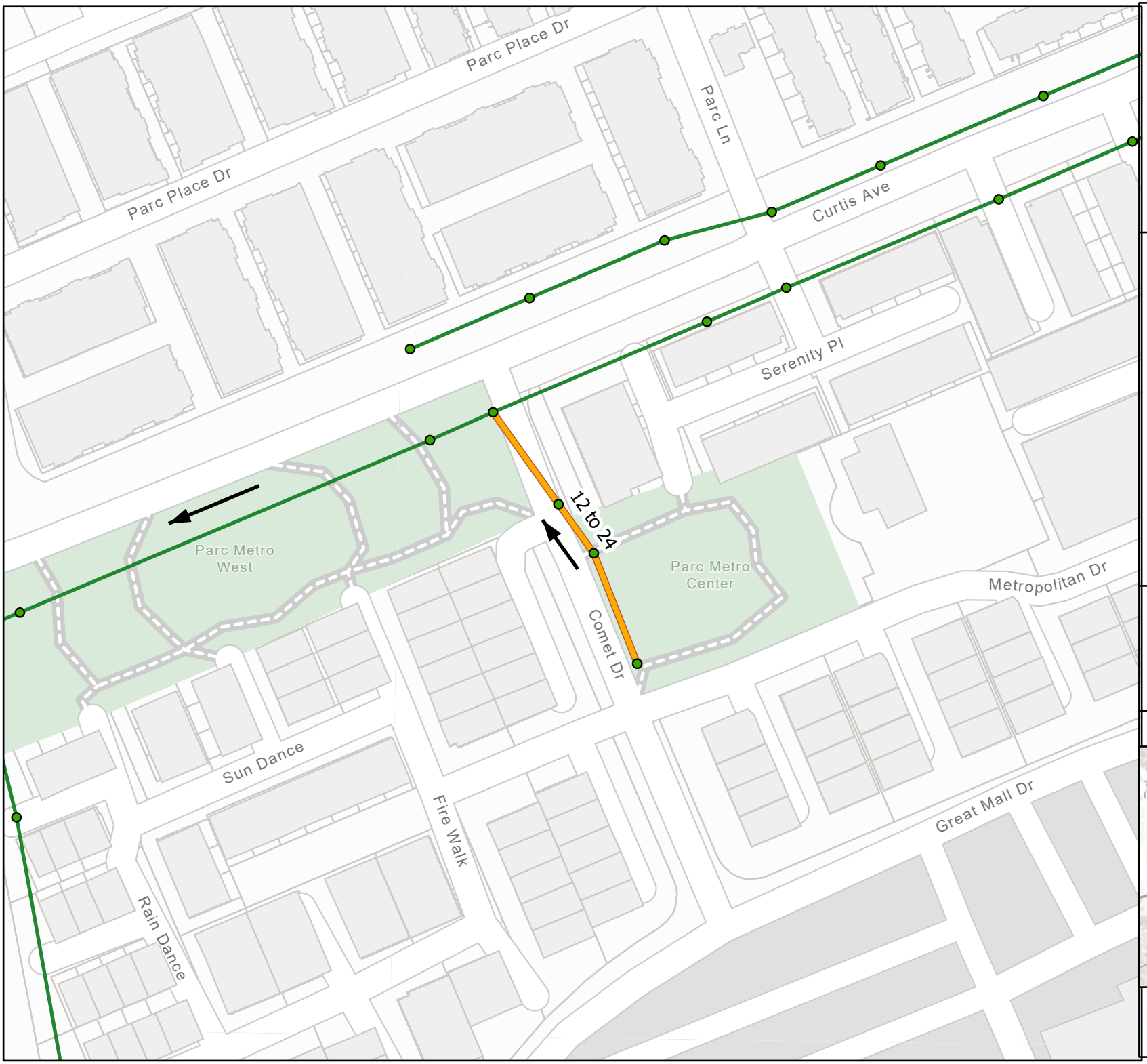

Milpitas Storm Drainage CIP

WF_11
Comet Drive
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 100 feet

Vicinity Map



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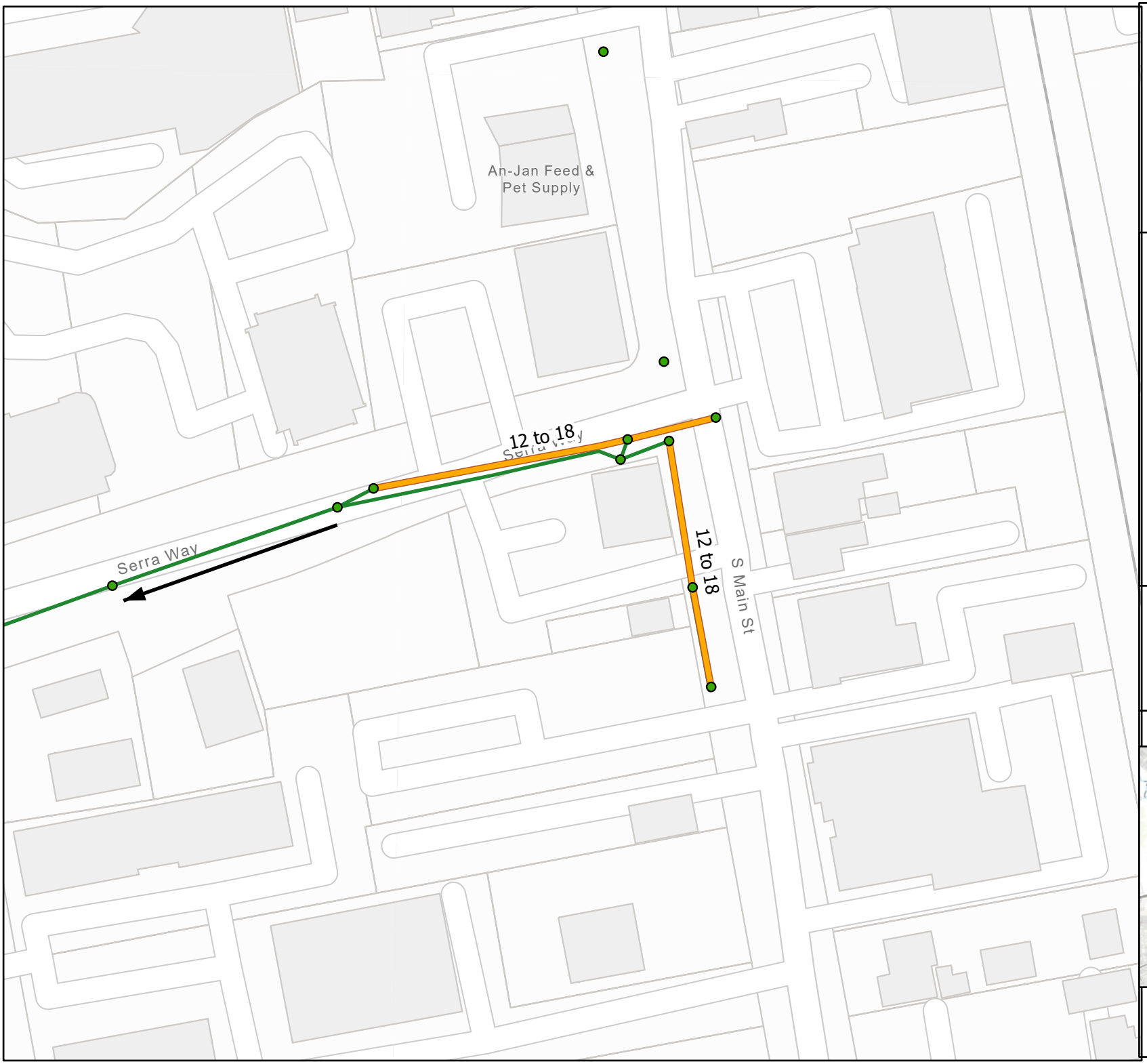

Milpitas
Storm Drainage CIP

LP_12
Main Street - Serra Way
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 100 feet

Vicinity Map



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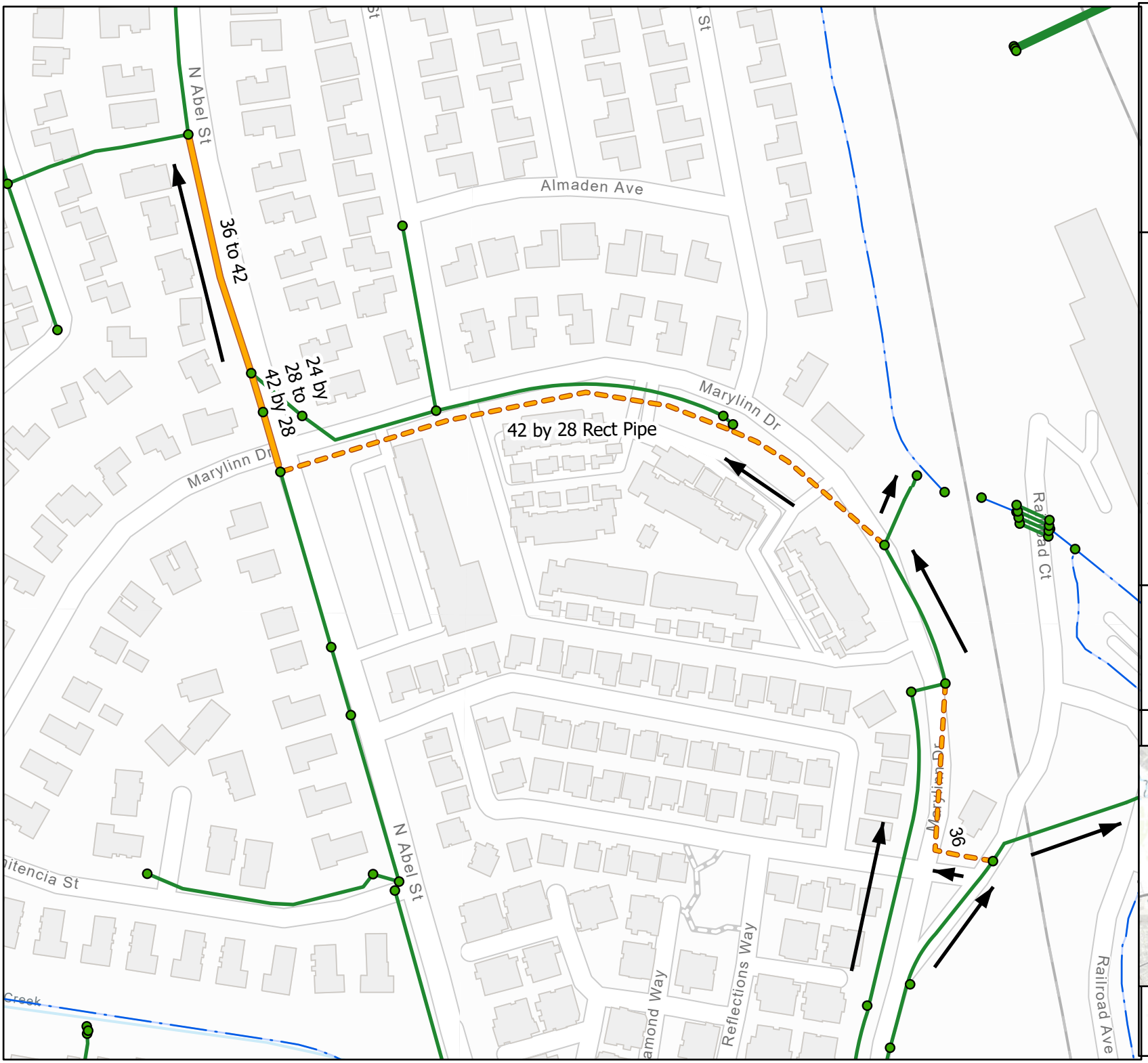


Milpitas Storm Drainage CIP

WF_13
Railroad Avenue
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

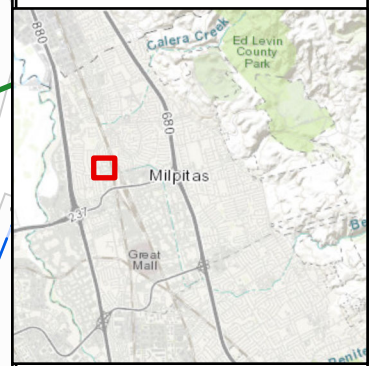
- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 200 feet

Vicinity Map



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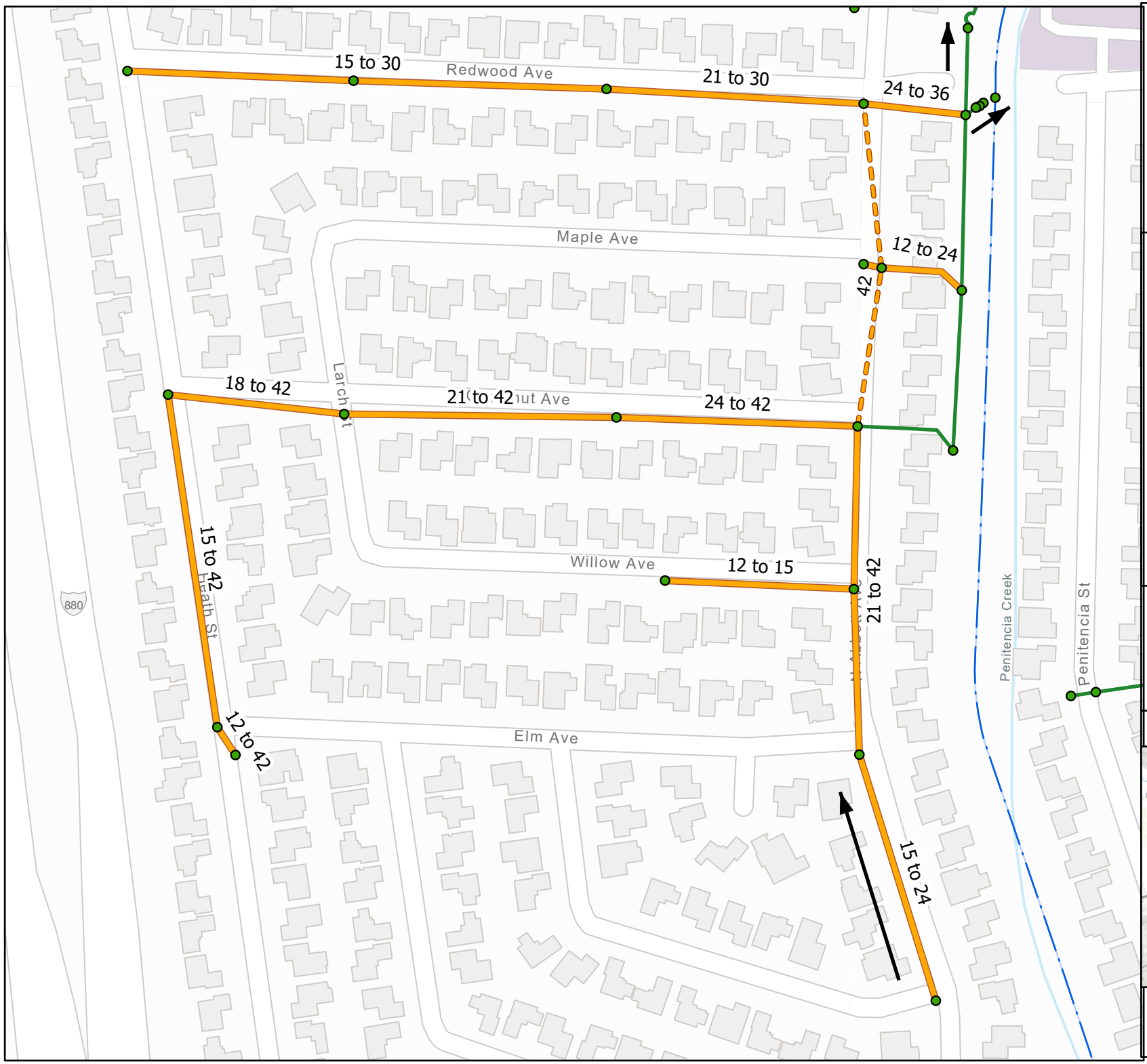


Milpitas Storm Drainage CIP

LP_14
North Abel Street
SD Improvements

Page 11 of 15

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

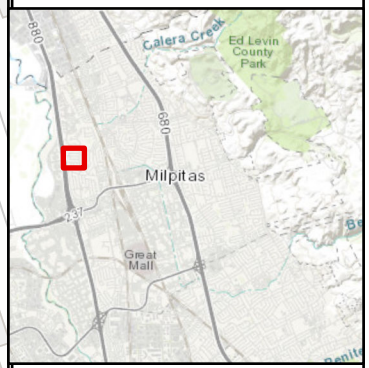
- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 200 feet

Vicinity Map



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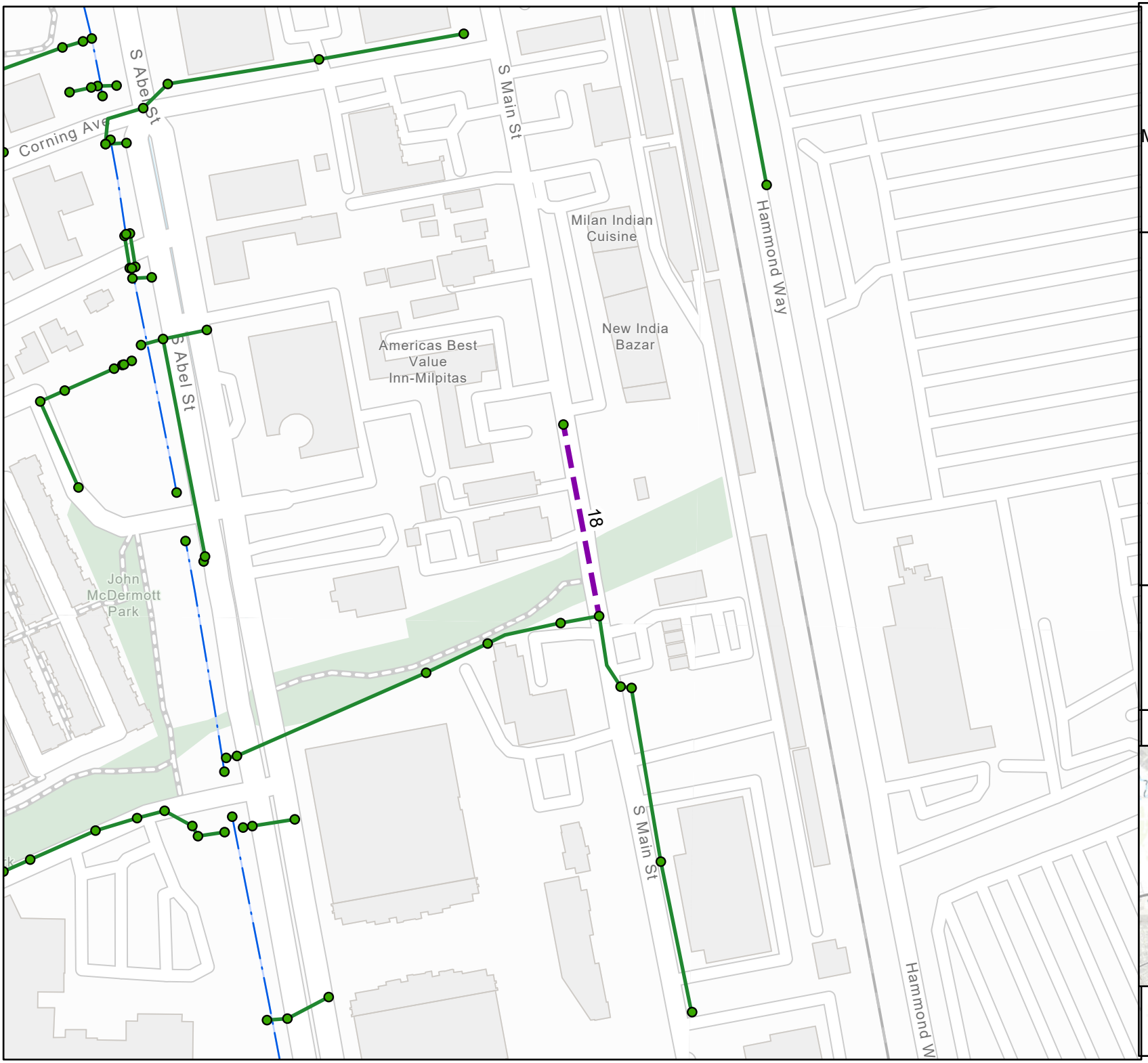

Milpitas
Storm Drainage CIP

Under-served Area
LP_15
Main Street - Tom Evatt Park
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 200 feet

Vicinity Map



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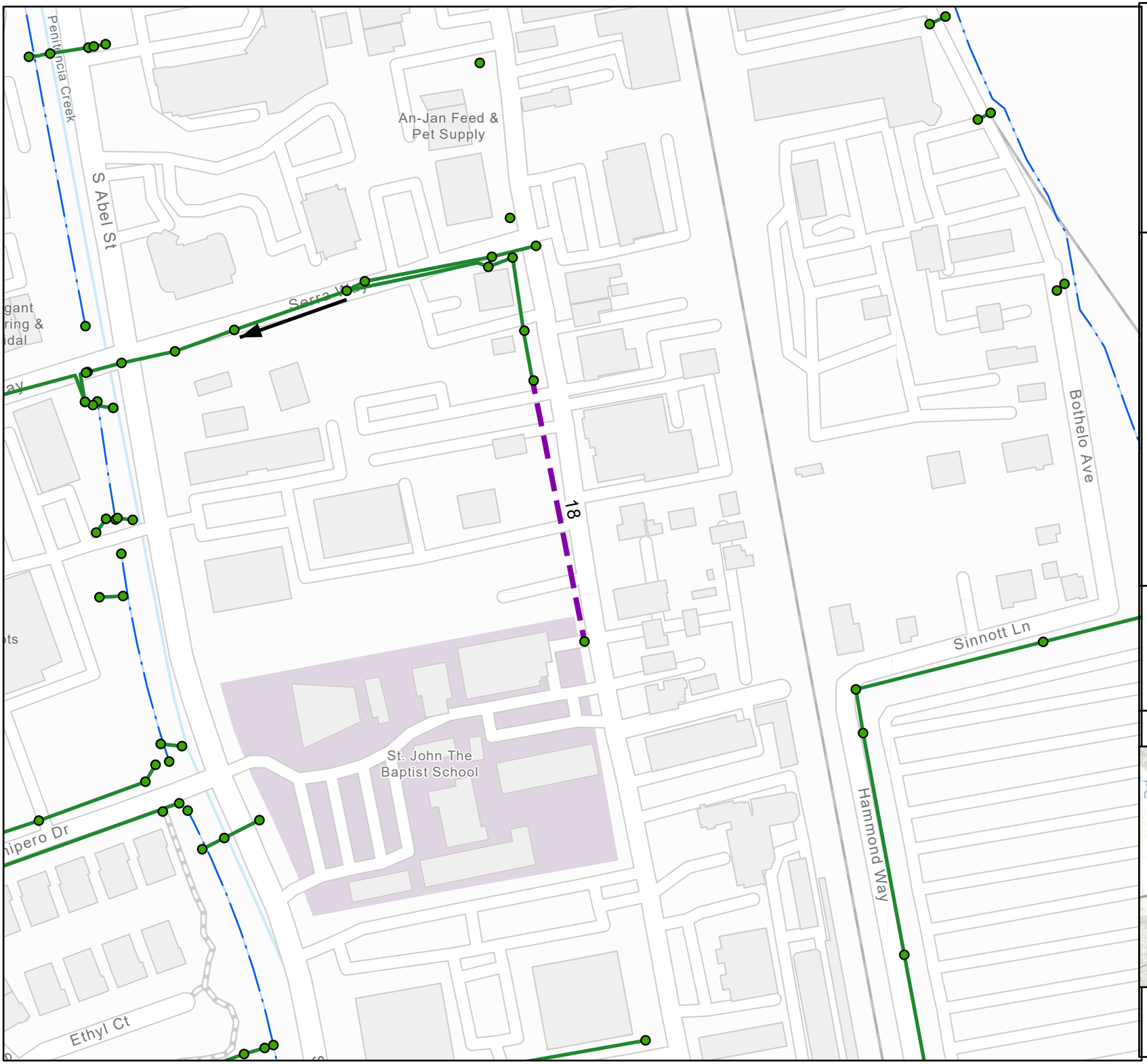

Milpitas
Storm Drainage CIP

Under-served Area
LP_16
Main Street
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 200 feet

Vicinity Map



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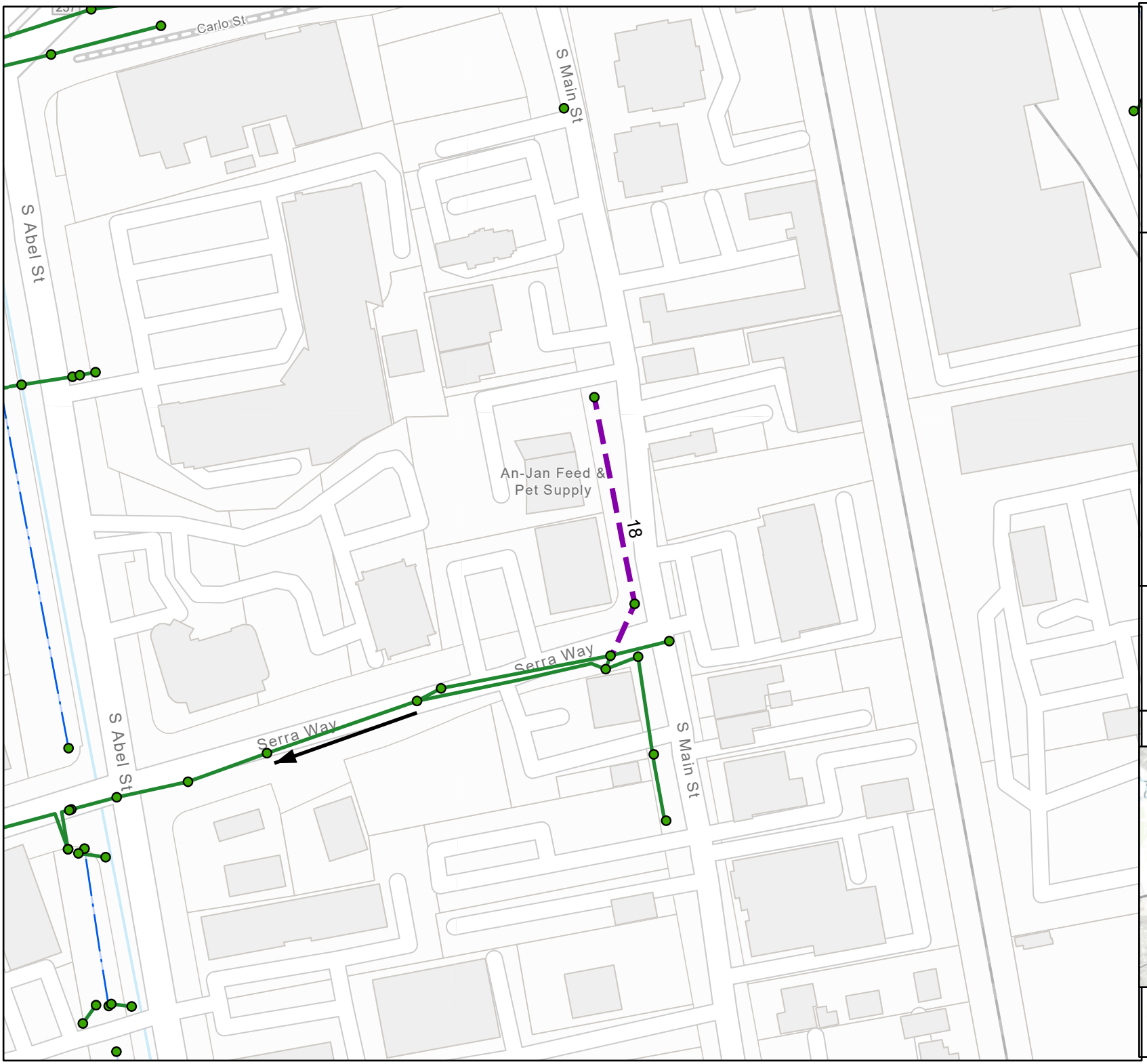

Milpitas
Storm Drainage CIP

Under-served Area
LP_17
Main Street - Sinnott Ln
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 150 feet

Vicinity Map



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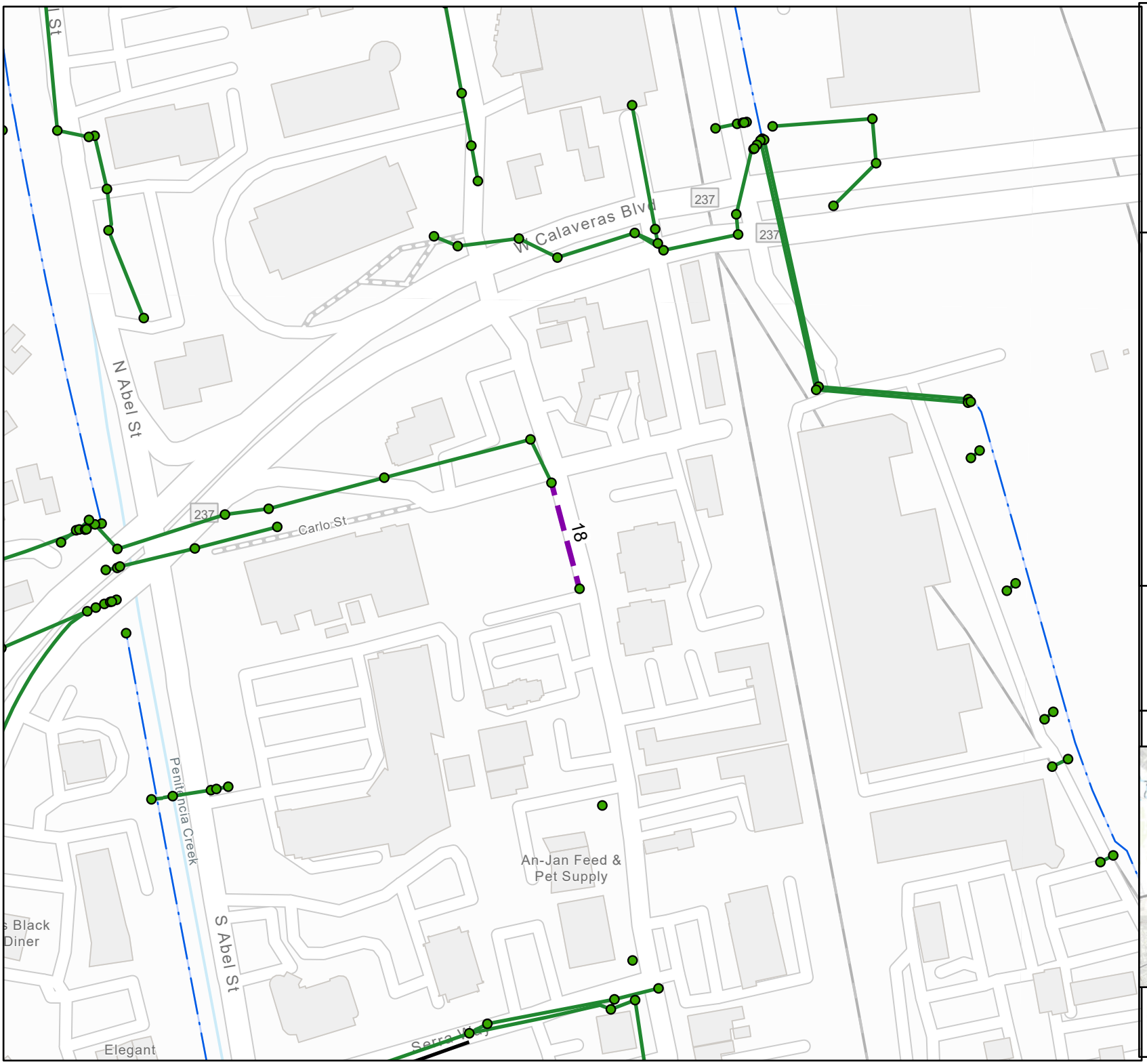

Milpitas
Storm Drainage CIP

Under-served Area
LP_18
Main Street - Carlo Street
SD Improvements

Legend

- Storm Drain Structure
- Modeled Storm Drain
- River reach

CIP Priority

- New High Priority SD
- New Low Priority SD
- Specific Plan SD Extension
- Low Priority SD Replacement
- High Priority SD Replacement

*Pipe annotation: "a to b" where 'a' is existing size and 'b' indicates proposed

N

1 inch : 200 feet

Vicinity Map



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Appendix B Pump Station Recommendations

General recommendations for pump station design and operation, including upgrading and rehabilitating existing stations are contained in this appendix.

Pump Station Design Guidelines

These recommendations apply to the design of new or substantially renovated pumping facilities.

Capacity

Every pump station should be capable of discharging the 100-year runoff from its tributary area. A combination of pumping capacity and retention storage can accomplish this. Pump stations with lesser capacity (e.g., ten-year) should be considered only if there is a fail-safe way to overflow excess flows without causing property damage. Nearly all of the pumping facilities within the city meet these criteria. Table 6-1 indicates whether individual pump stations have sufficient capacity.

Number of Pumps

For redundancy, at least two identical pumps must be installed in every stormwater pump station. It is not unnecessary to include standby pumps because providing excess capacity is expensive and not justified by the relatively small risk of having a major storm event coincide with mechanical failure. (Schedule pump maintenance for the summer months as well.) However, installing a larger number of smaller pumps is generally better than a lesser number of large pumps for the same capacity. When individual pumps comprise a smaller percentage of overall pump station capacity, having one pump out is less detrimental. In terms of redundancy and ease of maintenance, all pumping units within one particular station should be identical.

No pumping station in Milpitas is equipped with fewer than two identical pumps. Most stations have three main pumping units, and the Jurgens Pump Station has four. All stations (except California Circle, Abbott, and Minnis) have a smaller electric dewatering pump to drain the wet well when water falls below the minimum allowable pumping level for the large stormwater pumps. Permanent retention ponds are maintained at the California Circle and Abbott stations, while the Minnis station utilizes submersible pumps capable of dewatering the wet well.

Pump and Driver Types

Pump selection is on a station-by-station basis and needs coordination with city operations staff for consistency with other similar pump stations. Prime power for new pumping stations should be by an electric motor rather than direct-drive engines if at all possible, particularly for frequent operation. Electric motors are quieter, require less space and ventilation, and are not subject to tighter air quality restrictions in the future. Diesel engines drive a majority of the existing stormwater pumps in Milpitas. This pump driver style eliminates the need for standby power at most stations, and the city has generally experienced reliable operation.

While electric motors are recommended for new stations, the costs of adding power distribution and switching equipment, motor starters, and a standby engine-generator set to older stations generally preclude the replacement of engine drive units with electric motors. Hence, when old pumping units are upgraded or replaced, the type of replacement drive units should be consistent with existing equipment.

Pump Operation and Cycling

Lead and lag pumps should be automatically alternated on every start to minimize pump cycling and extend the operating life of the equipment. Sufficient operational wet well storage (Vol_p) must also be available to prevent excessive pump cycling for proposed operating levels:

$$Vol_p = t\left(\frac{Q_i}{Q_p}\right)\left(Q_p - Q_i\right)$$

where Vol_p = active sump volume per pump (cubic feet)

t = pump cycle time to fill and empty volume (minutes)

Q_i = inflow into station (cubic feet per minute)

Q_p = flow rate of pump (cubic feet per minute)

Differentiating the equation shows that the minimum pump cycle time occurs when flow into the pump station is exactly one-half the pumping rate. Required sump volume is determined by setting the maximum number of pumps starts per hour below the maximum criterion established by the pump, motor, or engine manufacturers. In the absence of specific data, the pump starts should be limited to six per hour. This criterion is based on general limits set by large electric motor manufacturers; diesel engine suppliers also recommend that engines should run at least five to ten minutes at full operating temperatures each time they're started.

Pumping equipment must be specified so that motor or engine nameplate ratings are not exceeded at any point on the pump characteristic curve. Pump performance under different hydraulic conditions should be analyzed to ensure that pumps operate within manufacturers' recommended limits. Pumps must discharge their rated flow against the 100-year design tailwater elevation at the station outfall.

This criterion is evaluated on a station-by-station basis. Most of the control systems used by the city have the ability to automatically rotate lead and lag pump sequences.

Forebay, Intake and Wet Well Design

If retention storage is necessary, designing the pump station forebay provides access to that storage over the pumps' operating range. The design of the forebay also plays a role in whether the retention will be wet or dry. Certain three-dimensional hydraulic phenomena often present in large pump intakes must be avoided to minimize the potential for submerged vortices, free-surface vortices, stagnations and flow separations, uneven or unsteady flow distribution, swirl of flow entering the pumps, or air entrainment.

These phenomena can lead to the degradation of pump performance, including decreased pump capacity, reduced pump efficiency, excessive wear, and increased vibration and noise. Although quantifying this complex hydraulic behavior is virtually impossible without scaled physical model studies, pumping intakes and sumps designed in conformance with one of the following standards should perform at their optimal level under varying operating conditions:

British Hydromechanics Research Association (BHRA)

Hydraulic Institute

Pump manufacturer design guidelines

Failure to properly design intake configurations can lead to negative performance, as described above. Since it is difficult to quantitatively analyze the three-dimensional flow phenomena associated with large pump intakes, any unusual intake, wet well, or sump designs that do not conform to an established standard are subject to physical model testing.

Most of Milpitas' pump stations are designed to house several pumps in the same wet well. Under these conditions, the primary objective in inlet design is still to provide an even, air-free flow distribution to each pump intake regardless of pump configuration or which pumps are operating. Given the difficulty of providing uniform flow distribution in multiple pump sumps, current design standards favor using a "unitized" wet well, whereby a number of single-pump sumps (pump cells) are placed side by side.

In Milpitas, only the Wrigley-Ford Pump Station utilizes this unitized sump approach and strictly meets current Hydraulic Institute standards for sump design. During individual pump station evaluations, inlet and sump dimensions are compared to recommended standards. Most station dimensions do not strictly match those standards. Correcting the deficiencies, however, can be extremely difficult and expensive. Since most pump stations operate for only a limited number of hours in any year, and there has been no demonstrated catastrophic loss of efficiency, the master plan does not recommend correcting sump design deficiencies. In order to minimize problems caused by deficient sump inlet design, proper pump submergence must be maintained. This will lower intake velocities and help reduce the risk of vortex formation and air entrainment.

Pumping equipment that demonstrates excessive wear, vibration, noise, and particularly cavitation may be indicative of more serious hydraulic problems associated with the sump and intake. In those instances, physical model studies and sump rehabilitation is warranted.

Submergence

Established operating prevent excessive cycling and provide for adequate pump submergence, defined as the minimum allowable height of the low water level above the pump suction inlet. Inadequate submergence can lead to the inducement of free-surface and submerged vortices, the entrainment of air, a reduction in pumping capacity, and premature pump failure. Limited pump submergence can also potentially lead to pump cavitation, which may cause severe damage. As a rule of thumb, the minimum water depth should be two bell diameters over the wet well floor for submergence of one and a half bell diameters (BHRA guidelines). Recent design guidelines published by the Hydraulic Institute (1998) suggest the following formula for establishing minimum pump submergence:

$$S = D(1 + 2.3\,F_D)$$

where S = submence (feet)

D = pump bell diameter (feet)

F_D = Froude number at pump inlet, given as:

$$F_D = \frac{V}{(g\ D)^{0.5}}$$

V = velocity at the pump suction inlet (fps)

g = gravitational acceleration

Discharge Piping

Pump discharge piping must protect upstream systems and properties from damage caused by backwater from high tides or tailwater. Discharge flap gates or check valves should be provided, or pipe discharge elevations need to be three feet above the design tailwater level and/or one foot above protective levees.

Pump Testing

Station design should provide for the testing of pumps with water under non-storm conditions. A means for recirculating water, or some other method, can be provided to enable a test of reasonable duration (15 minutes). This may also be important since engines need exercise at least once a month and should be done so under load (see Chapter 9).

Most pump stations in the city do not have the means to recirculate water for testing. (Wrigley-Ford Storm Water Pump Station is a notable exception.) Those stations with large forebays – California Circle, Abbott, Penitencia, and Berryessa – can simply discharge water over an extended period of time without necessarily needing an influent runoff. For other stations, unfortunately, providing additional piping for testing is difficult.

Standby Power

An emergency engine-generator, capable of starting the largest motor while running all other motors and auxiliary loads, should be installed at each stormwater pump station that does not utilize engines for prime pump drivers. Diesel is the preferred fuel, but natural gas engines may be considered as an alternative since they are reliable and burn cleanly. Natural gas engines, however, tend to be underpowered compared to diesel engines. There is also a risk that the fuel will not be available when needed.

Gasoline is not an acceptable fuel for stationary engines because it is a fire and explosion hazard, and the allowable storage period is very short. Diesel fuel is much less hazardous and can be stored for up to a year in double-walled tanks meeting requirements set forth by the Fire Department. All fuel piping must be double contained.

Discussions with city operations and maintenance personnel indicate that a majority of the city's pumping stations have been upgraded to meet current fuel storage requirements, with double-walled tanks (about one-half of which are above ground), double-contained fuel piping, and leak detection.

Engine-generators should be housed in a sound-attenuated weatherproof enclosure or inside buildings meeting appropriate codes for such use. Proper ventilation will be provided for engine aspiration and cooling. Some means for exercising the engine-generator set under load must also be furnished, either through pump testing with water as described above, load banks, or a combination of both. Generators

must be present on-site and connected to the power supply with an automatic transfer switch to be considered as available in an emergency. The use of portable generators, or even permanently parked generators with manual transfer switches, is not recommended since crews may not be able to respond to high water alarms, physically reach the pump station with a generator, and manually restore power before property damage has occurred. This is the current condition at the Spence Creek and Manor stations.

Small lift or pumping stations that generally handle “nuisance” flows (if the pump station were to fail to operate significant property damage does not occur) would not necessarily require a standby power source.

Controls and SCADA

The pump starts and stops using a programmable logic controller (PLC) or programmable pump controller. Pump station controls are tied into the city's Supervisory Control and Data Acquisition (SCADA) telemetry system. City operations and maintenance staff shall coordinate pump station controls and level monitoring systems regarding function and standardization. They must also provide control with standby power to ensure that the station can function even during prolonged power outages. The preferred mechanism for providing standby power to control systems is rechargeable batteries.

Equipment Housing

All electrical equipment in or open to the wet well must be explosion-proof and placed a minimum of one foot above the base flood elevation (BFE). Submersible motors should also be explosion-proof. Control panels must not be located so they are subject to possible flooding. All equipment must be housed in NEMA-rated weatherproof enclosures or in buildings. Sufficient lighting (including back-up battery power) should be provided so that crews may work on equipment during the night. Also, access must be provided that will allow for the removal and reinstallation of all equipment.

Consider noise abatement, visual impacts, and odor control when locating a pump station and designing the equipment housing. This is particularly important where the installation of engine units are near residential areas.

Ventilation

Good ventilation is important to maintaining a dry, benign environment for mechanical and electrical equipment within a pump station. Proper ventilation helps reduce the deterioration of equipment due to condensation and provides better working conditions for city crews. Without adequate ventilation, enclosures below grade may be classified as confined spaces, requiring special permits and rescue equipment for anyone entering them. Explosive gases from illegally dumped flammable liquids may also accumulate in wet wells and ancillary spaces. Many deaths and illnesses have been attributed to poor ventilation at pump stations.

Wet wells can intentionally be designed as a confined space, particularly if there is no regular need for personnel to enter them. (The only equipment allowed in such a wet well includes explosion-proof measuring devices and submersible pumps.) However, proper ventilation should be provided for pump station buildings, particularly those housing engines or engine-generators.

All heating, ventilating, and cooling systems should be designed in conformance with city ordinances; uniform building, fire, mechanical, plumbing, and energy codes; the National Electric Code and NFPA; EPA regulations; Occupational Safety and Health Act (OSHA) requirements; and ASHRAE design standards.

Radiator exhaust ducts should be designed based on actual airflow requirements, but in general, they need to discharge at air velocities no greater than 800 to 1500 feet per minute. Intake louvers that bring air into the pump station should be designed with sufficient free area to maintain velocities of 250 to 400 feet per minute. This helps keep the rain out of the pump station when the engines are operating.

Low Flow Bypass

If conditions permit, a gravity outflow pipe that bypasses the pump station should be installed. During low tailwater conditions, a substantial savings in pumping costs can be realized. Pumping stations with bypass capability include Penitencia, Wrigley-Ford, Spence Creek, and Manor.

Pump Station Operation and Maintenance Guidelines

These general recommendations apply to all pumping facilities as appropriate.

Pumps

Large axial flow pumps with right angle gear drives, which are the predominant pump type in the systefm, actually require fairly little maintenance. Shafts and bearings need to be periodically balanced and/or replaced. The frequency of inspection (pumps will need to be pulled out of the building) will vary depending upon the “L-10” bearing life rating of the pump in question. Average bearing life is defined as the operating hours at which half of the group of bearings fails, and the rest continue to operate. AFBMA (the Anti-Friction Bearing Manufacturers Association) defines average life statistically as three to five times the L-10 life. (For example, the Wrigley-Ford pumps have 50,000-hour bearings.) Although grease is the most maintenance-free bearing lubricant, most of the pumps in Milpitas have drip fee oil systems, which ensure the lowest bearing operating temperature. Consequently, the oiling reservoir needs to be checked on a routine basis and topped off as necessary

Engines

Manufacturers’ maintenance instructions should be followed to the letter, particularly when the engine is still under warranty. Maintenance schedules depend somewhat on whether the engine is used as the prime pump driver (as in most stations) or is on standby (such as for power generation).

A typical schedule of maintenance based on references provided by Cummins/Onan (Sanks, 1989) is provided as Table B-1, giving both operating hours and calendar time.

Diesel engines should be operated at full power for at least 15 to 30 minutes after reaching operating temperatures once a month to eliminate carbon deposits. Unfortunately, without significant stormwater inflow to the station, pump engines cannot be run under load for any significant length of time (the water quickly runs out). Wrigley-Ford Pump Station is equipped both with a resistive load bank to provide a working load for automatic exercise and a discharge pipe system to recirculate available water back into the forebay. The pumps can be tested and exercised without large amounts of inflow.

Other stations with permanent water storage (California Circle Lagoon, Abbott Lagoon, Hall Memorial Park lagoon, and Hidden Lake) could be run for 15 minutes every month, although lagoon levels will not necessarily return to normal quickly. Unless provisions for the recirculation of test water at the other pump stations are made, those engines cannot be exercised under load during the summer months. Providing for test water recirculation has not been included in the Capital Improvement Program because retrofitting existing stations to operate in this manner is difficult.

Diesel oil is safer to store than most fuels and is easy to obtain and transport, but diesel deteriorates in storage and must be turned over every six months to one year.

Table B-1: Typical Maintenance Frequency for Engines and EG-Sets

Maintenance Task	Operating Time	Calendar Time
Inspect fuel, oil level, coolant	8 hr	1 m
Inspect air cleaner, battery	50 hr	1 yr
Clean governor linkage, breather, air cleaner	100 hr	1 yr
Clean fuel filter, replace oil filter, change crankcase oil, check switchgear	200 hr	1 yr
Clean commutator, collector rings, relays, cooling system; inspect brushes, valve clearances, starting and stopping systems, water pump	500 hr	1 yr
Check injectors, grind valves (if required), remove carbon, clean oil passages, replace secondary fuel filter, clean generator, grease bearings	1000 hr	----

Assumed Pump Operating Levels

Operating levels are assumed at individual pumping facilities for storm drain master plan modeling. It is noted that the city changes these levels depending upon station operating needs, including repair and maintenance. Actual operating levels and station operation manual guidelines supersede the levels provided herein. All levels are feet NAVD with distance above the wet well floor in parentheses.

California Circle Pump Station (SD-1)

Current pump operating levels are:

#3 ON	9.3 feet NAVD
#2 ON	7.5
#1 ON	5.8
PUMPS OFF	4.5

When the pump settings listed above are analyzed, the maximum one-percent lagoon level is 11.0 feet NAVD. Although this is less than the minimum elevation on California Circle, it is only 0.8 feet lower than the one-percent water surface elevation in Lower Penitencia Creek. To minimize pond fluctuations while beginning pumping in time to accommodate inflow during heavy runoff periods, the pump-on levels for the second and third pumps in the rotation could be lowered during the rainy season. Since a large volume of storage is available, the pump set points can be set closer together without excessive cycling, which is assumed for storm drain master plan modeling.

HI ALARM	11.0	(17.0')
#3 ON	7.5	(15.5')
#2 ON	6.5	(12.5')
#1 ON	5.5	(11.5')
#3 OFF	5.0	(11.0')
#2 OFF	4.7	(10.7')
#1 OFF	4.5	(10.5')
LOW ALARM	1.5	(7.5')

Jurgens Pump Station (SD-2)

To minimize pump cycling the following operating levels are assumed.

HI ALARM	9.5	(19.0')
#4 ON	8.0	(17.5')
#3 ON	7.5	(17.0')
#2 ON	7.0	(16.5')
#1 ON	5.0	(14.5')
#4 OFF	1.5	(11.0')
#3 OFF	1.0	(10.5')
#2 OFF	0.5	(10.0')
#1 OFF	0.0	(9.5')
LOW ALARM	-1.0	(8.5')

McCarthy Pump Station (SD-3)

To enhance operational efficiencies and minimize pump cycling, however, it is recommended that pump starts rotate and the following operating levels are assumed. Pumps will start no more than five times per hour.

HI ALARM	2.0	(19.0')	
#3 ON	1.5	(18.5')	
#2 ON	1.0	(18.0')	
#1 ON	0.5	(17.5')	
#3 OFF	-4.5	(12.5')	
#2 OFF	-5.0	(12.0')	
#1 OFF	-5.5	(11.5')	
LOW ALARM	-6.0	(11.0')	Drainage Pumps
JOCKEY ON	-15.5	(1.5')	
JOCKEY OFF	-17.0	(-0.5')	
LOW ALARM	-17.5	(-1.0')	Jockey Pump

Abbott Pump Station (SD-4)

These operating levels are sufficient to prevent pump cycling, while maintaining the aesthetic function of the lagoon. (Elevations are given as feet NAVD with distance above the wet well floor in parenthesis.

HI ALARM	11.0	(16.0')
#2 ON	9.5	(14.5')
#1 ON	9.0	(14.0')
#2 OFF	8.5	(13.5')
#1 OFF	8.0	(13.0')
LOW ALARM	6.0	(11.0')

Minnis Pump Station (SD-5)

The following operating levels allow for eight starts per hour in alternation, since wet well storage is very limited. Pump settings are provided in feet NAVD with the distance from the wet well floor in parentheses.

HI ALARM	5.0	(12.0')
#2 ON	4.5	(11.5')
#1 ON	4.0	(11.0')
#2 OFF	-3.5	(3.5')
#1 OFF	-4.0	(3.0')
LOW ALARM	-4.5	(2.5')

Penitencia Pump Station (SD-6)

Original pump operating levels are assumed per record plans.

HI ALARM	12.0	(12.2')
#3 ON	9.8	(10.0')
#2 ON	8.3	(8.5')
#1 ON	6.3	(6.5')
ALL OFF	5.3	(5.5')
SUMMER WSEL	6.4	(6.6')

Wrigley-Ford Pump Station (SD-7)

Minimum individual pump cycle times (based on pump rotation) and settings are given below.

HI ALARM	13.7	(17.0')	
#3 ON	13.2	(16.5')	2 starts per hour
#2 ON	12.7	(16.0')	2 starts per hour
#1 ON	12.2	(15.5')	1 start per hour
#3 OFF	12.0	(15.3')	
#2 OFF	11.7	(15.0')	
#1 OFF	11.2	(14.5')	
JOCKEY ON	-5.5	(1.0')	
JOCKEY OFF	-6.5	(-0.5')	

Berryessa Pump Station (SD-8)

City staff has provided current pump settings, which are indicated below as referenced from the pump station sump floor (elevation -6.0 feet□NAVD). The resulting 100-year water surface elevation of 10.7 feet would not cause spill out of the lake or property damage in the absence of Calera Creek overflows, and with overflow from Calera Creek, the resulting flood level of 15 feet remains below the pumping equipment flood-proof elevation. (Levels have been referenced to feet NAVD with distance above the wet well floor given parenthetically.)

HI ALARM	10.0	(16.0')
#3 ON	9.5	(15.5')
#2 ON	9.0	(15.0')
#1 ON / #3 OFF	8.5	(14.5')

#2 OFF	8.0	(14.0')	
#1 OFF	7.0	(13.0')	
SUMMER WSEL	9.0	(15.0')	

Manor Pump Station (SD-9)

The assumed design operating levels are sufficient to prevent pump cycling, while maintaining minimum pump submergence levels.

HI ALARM	7.7	(12.5')	
#3 (NEW) ON	6.7	(11.5')	
#2 ON	6.2	(11.0')	
#1 ON	5.7	(10.5')	
#3 (NEW) OFF	2.7	(7.5')	
#2 OFF	1.7	(6.5')	
#1 OFF	0.7	(5.5')	
LOW ALARM	-0.7	(4.5')	Stops Drainage Pumps
JOCKEY ON	-3.8	(1.0')	
JOCKEY OFF	-6.8	(-2.0')	
LOW ALARM	-7.3	(-2.5')	Stops Jockey Pump

Spence Creek Pump Station (SD-10)

The design operating levels are sufficient to prevent pump cycling, while maintaining minimum pump submergence levels. Spence creek itself also provides storage volume that helps limit pump starts. (All levels are referenced to feet NAVD with distance from wet well bottom indicated parenthetically.)

HI ALARM	14.2	(10.5')	
#3 ON	14.0	(10.3')	
#2 ON	13.7	(10.0')	
#1 ON	11.7	(8.0')	
#3 OFF	11.2	(7.5')	
#2 OFF	10.2	(6.5')	
#1 OFF	9.2	(5.5')	
LOW ALARM	8.2	(4.5')	Stops Drainage Pumps
JOCKEY ON	4.7	(1.0')	
JOCKEY OFF	1.7	(-2.0')	
LOW ALARM	1.2	(-2.5')	Stops Jockey Pump

Bellew Pump Station (SD-11)

HI ALARM	15.0	(19.0')	
#3 ON	14.0	(18.0')	
#2 ON	13.5	(17.5')	
#1 ON	13.0	(17.0')	
#3 OFF	8.0	(12.0')	
#2 OFF	7.5	(11.5')	
#1 OFF	7.0	(11.0')	
LOW ALARM	6.5	(10.5')	Drainage Pumps
JOCKEY ON	-2.5	(1.5')	
JOCKEY OFF	-4.1	(-0.1')	
LOW ALARM	-17.5	(-1.0')	Jockey

Murphy Pump Station (SD-12)

HI ALARM	19.2	(16.2')	
#3 ON	19.0	(16.0')	
#2 ON	18.5	(15.5')	
#1 ON	18.0	(15.0')	
#3 OFF	14.0	(11.0')	
#2 OFF	13.5	(10.5')	
#1 OFF	13.0	(10.0')	
LOW ALARM	11.5	(8.5')	Drainage Pumps
JOCKEY ON	4.0	(1.0')	
JOCKEY OFF	2.8	(-0.2')	
LOW ALARM	2.5	(-0.5')	Jockey Pump

Oak Creek Pump Station (SD-13)

HI ALARM	20.0	(14.0')	
#3 ON	19.5	(13.5')	
#2 ON	19.0	(13.0')	
#1 ON	18.5	(12.5')	
#3 OFF	17.0	(11.0')	
#2 OFF	16.5	(10.5')	
#1 OFF	16.0	(10.0')	
LOW ALARM	15.5	(9.5')	Drainage Pumps
JOCKEY ON	7.0	(1.0')	
JOCKEY OFF	5.8	(-0.2')	
LOW ALARM	5.5	(-0.5')	Jockey Pump