September 2019

Marina Coast Water District
Sewer Master Plan

Final Draft

AKEL
ENGINEERING GROUP, INC.

MARINA COAST WATER DISTRICT

2019

SEWER MASTER PLAN

Final Draft

September 2019

AKEL
ENGINEERING GROUP, INC.

September 9, 2019

Marina Coast Water District
2840 4th Avenue
Marina, CA 93933

Attention: Michael Wegley, P.E.
District Engineer

Subject: 2019 Sewer Master Plan – Final Draft Report

Dear Michael:

We are pleased to submit the final draft report for the Marina Coast Water District Sewer Master Plan. This master plan is a standalone document, though it was prepared as part of the integrated infrastructure master plans for the water, sewer, and recycled water master plans. The master plan documents the following:

- Existing sewer system facilities, acceptable hydraulic performance criteria, and projected sewer flows consistent within the District service area.
- Development and calibration of the District's GIS-based sewer system hydraulic model.
- Capacity evaluation of the existing water system with improvements to mitigate existing deficiencies and to accommodate future growth.
- Capital Improvement Program (CIP) with an opinion of probable construction costs and suggestions for cost allocations to meet AB 1600.

We extend our thanks to you; Keith Van Der Maaten, General Manager; Brian True, Senior Civil Engineer; and other District staff whose courtesy and cooperation were valuable components in completing this study.

Sincerely,

AKEL ENGINEERING GROUP, INC.

Tony Akel, P.E.
Principal

Enclosure: Report

Acknowledgements

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EXECUTIVE SUMMARY

The purpose of this Sewer Master Plan is to determine the future sewer flows for Marina Coast Water District (District) and to identify the sewer facilities needed to collect and convey sewer flows to the existing District discharge locations..

This executive summary presents a brief background of the District's sewer system, the planning area characteristics, the system performance and design criteria, the hydraulic model, and a capital improvement program. A hydraulic model of the District's existing sewer system was created and used to evaluate the capacity adequacy of the existing system and to recommend improvements to mitigate existing deficiencies, as well as servicing future growth.

The highlights of this Sewer Master Plan are listed as follows:

1. The sewer flow projections used for ultimate build-out of the District are based on land uses from General Plans and other planning documents from the following jurisdictions: City of Marina, City of Seaside, City of Del Rey Oaks, CSU Monterey Bay, County of Monterey, Fort Ord Reuse Authority, as well as review and comments from District staff.
2. The projected development within the District will require an investment in new infrastructure. This study analyzes this future development and identifies the facilities needed to serve it.
3. The District will continue to convey its collected sewer flows to the Monterey 1 Water sewer interceptors for treatment at the Monterey 1 Water Wastewater Treatment Plant.
4. This Sewer Master Plan estimated sewer flows and identified potential capital improvements based on two separate development horizons, which are summarized as follows:
   - Near-Term Development: This development horizon includes the buildout of the Central Marina service area and assumes development within the Fort Ord Community consistent with the Fort Ord Reuse Authority CIP development limits. Capital improvements and associated costs were estimated for this development horizon.
   - Buildout Development: This development horizon assumes the buildout of the lands within the Fort Ord Community in addition to the development assumed to occur within the near-term development horizon. Improvements necessary to serve this development horizon were identified for planning purposes but capital improvements were not estimated.

5. This Sewer Master Plan included a condition assessment of a majority of the District's existing lift stations. This condition assessment included a thorough review of the lift station site, facilities, and equipment necessary to operate the station. Ratings were given to the elements of the review and costs were estimated to mitigate the most critical issues identified.

ES.1 STUDY AREA AND SERVICE AREA

The District collects sewer flows from customers generally located in the City of Marina, the former Fort Ord military base, the County of Monterey, and the City of Seaside. The service area, approximately 10 miles north of the City of Monterey, is generally bounded by Pacific Coast Highway 1 to the east, Road 218 to the south, Reservation Road to the east, and Marina Green Drive to the north. The Planning Boundary consists of the City of Marina and the former Fort Ord. The District is responsible for serving the former Fort Ord under a 1998 Facilities Agreement.

The boundaries and planning area characteristics are discussed in detail in Chapter 2 and briefly described as follows:

Central Marina Service Area

The Central Marina service area region is the portion of the City of Marina outside of the Ord Community, generally north of Patton Parkway and west of Salinas Avenue. The future development within this service area region is generally comprised of the development of vacant parcels located throughout the city as well as one large area of potential development generally north of Beach Road.

Ord Community Service Area

The Ord Community service area region includes developed, vacant, and designated open space lands within the former Fort Ord as well as portions of the County of Monterey, City of Seaside, City of Marina, the City of Monterey, and City of Del Rey Oaks. It should be noted that currently vacant lands in proximity to the Laguna Seca development area are within the District's Planning Area Boundary but planned for service by California American Water; therefore these lands are not included within the Future Study Area.

The potential future development within the Ord Community Service Area is generally comprised of the new development on currently vacant lands. For conservative planning purposes the master plan assumes the buildout development of potential developable land. However, the Fort Ord Reuse Authority (FORA) has established limits for growth within the former Fort Ord area. The Fort Ord Base Reuse Plan (BRP) has a 6,160 unit development limit on new residential units until 18,000 new jobs are created on the former Fort Ord per BRP 3.11.5.4 (b) 2) & 3.11.5.4 (c).

ES.2 SYSTEM PERFORMANCE AND DESIGN CRITERIA, SYSTEM OVERVIEW, AND DESIGN FLOWS

This report documents the District's performance and design criteria that were used for evaluating the sewer collection system. Chapter 3 discusses the system performance and design criteria for the domestic water system. The system performance and design criteria are used to establish guidelines for determining future sewer, evaluating existing sewer collection facilities, and for sizing future facilities. These facilities consist of 20 lift stations, more than 140 miles of gravity sewer pipes, and approximately six miles of force main, which are documented in Chapter 4. Collected sewer flows are discharged to the M1W interceptor pipeline and are conveyed towards the M1W treatment plant, located north of the City of Marina.

The existing sewer flows used for this master plan were based on the District's historical discharge to the M1W interceptor. Future flows were based on development expected to occur within the near-term and buildout term development horizons. The existing flows and projected design flows are documented in Chapter 5.

ES.3 HYDRAULIC MODEL AND SYSTEM EVALUATION

Hydraulic network analysis has become an effective and powerful tool in many aspects of water distribution planning, design, operation, management, emergency response planning, system reliability analysis, fire flow analysis, and water quality evaluations. As a part of this master plan a new hydraulic model was developed for the District's water distribution system, combining information on the physical characteristics of the water system (pipelines, groundwater wells, valves, booster stations, and storage reservoirs) and operational characteristics (how they operate). The hydraulic model development process included a thorough verification and calibration process with District staff to ensure the water model was consistent with the existing water distribution system and provided results consistent with real-world conditions. The hydraulic model, and the calibration and data validation process, are discussed in Chapter 6 of this master plan.

The hydraulic model was used to evaluate the District's existing sewer collection system. This hydraulic evaluation included analyzing the system-wide depth-to-diameter rations under existing and future conditions; additionally, a lift station and force main capacity analysis was performed. The District's existing system is generally able to meet the system performance criteria under existing conditions. Improvements will be recommended to mitigate the deficiencies identified as part of the evaluation.

ES.4 CAPITAL IMPROVEMENT PROGRAM

The Capital Improvement Program includes improvements consistent with ongoing projects planned by the District as well as improvements recommended for mitigating existing system deficiencies and servicing future growth. The capital improvement program is allocated for existing and future users, intended to address the Assembly Bill 1600 requirements, as well as a more detailed breakdown for the Ord Community and Central Marina cost centers. A more detailed cost summary including capacity allocations and construction triggers are included in Chapter 8. The overall Capital Improvement Program is summarized on **Table ES.1**.

Table ES.1 Capital Improvement Cost Summary

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Cost Center	Existing Users ($)	Future Users ($)	Total ($)
Central Marina	5,033,148	2,166,654	7,199,802
Ord Community	14,850,151	21,841,121	36,691,272
General System	216,300	0	216,300
Total CIP Cost	**20,099,599**	**24,007,775**	**44,107,374**

AKEL ENGINEERING GROUP, INC.

5/28/2019

CHAPTER 1 - INTRODUCTION

This chapter provides a brief background of the Marina Coast Water District's (District) sewer system, the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

1.1 BACKGROUND

The Marina Coast Water District (District) is located approximately 10 miles north of the City of Monterey, 8 miles east of the City of Salinas, and 6 miles south of the City of Castroville (**Figure 1.1**). The District provides sewer collection service to approximately 36,000 residents, as well as a myriad of commercial, industrial, and institutional establishments. The District owns, operates, and maintains the sewer collection system, which consists of more than 150 miles of gravity trunks and force mains up to 72-inches in diameter, which ultimately convey flows to the Monterey One Water treatment plant.

In 2005, the District developed a Wastewater Collection System Master Plan for the Central Marina system that identified capacity deficiencies in the existing sewer system and recommended improvements to alleviate existing deficiencies and serve future developments within the defined Planning Service Area. The District completed a similar master plan for the Fort Ord Cost Center in 2005.

Recognizing the importance of planning, developing, and financing system facilities to provide reliable sanitary sewer service to existing customers and for servicing anticipated growth within the sphere of influence, the District initiated updating elements of the previous master plans to reflect current land use conditions, and to consolidate the plans into one comprehensive planning document.

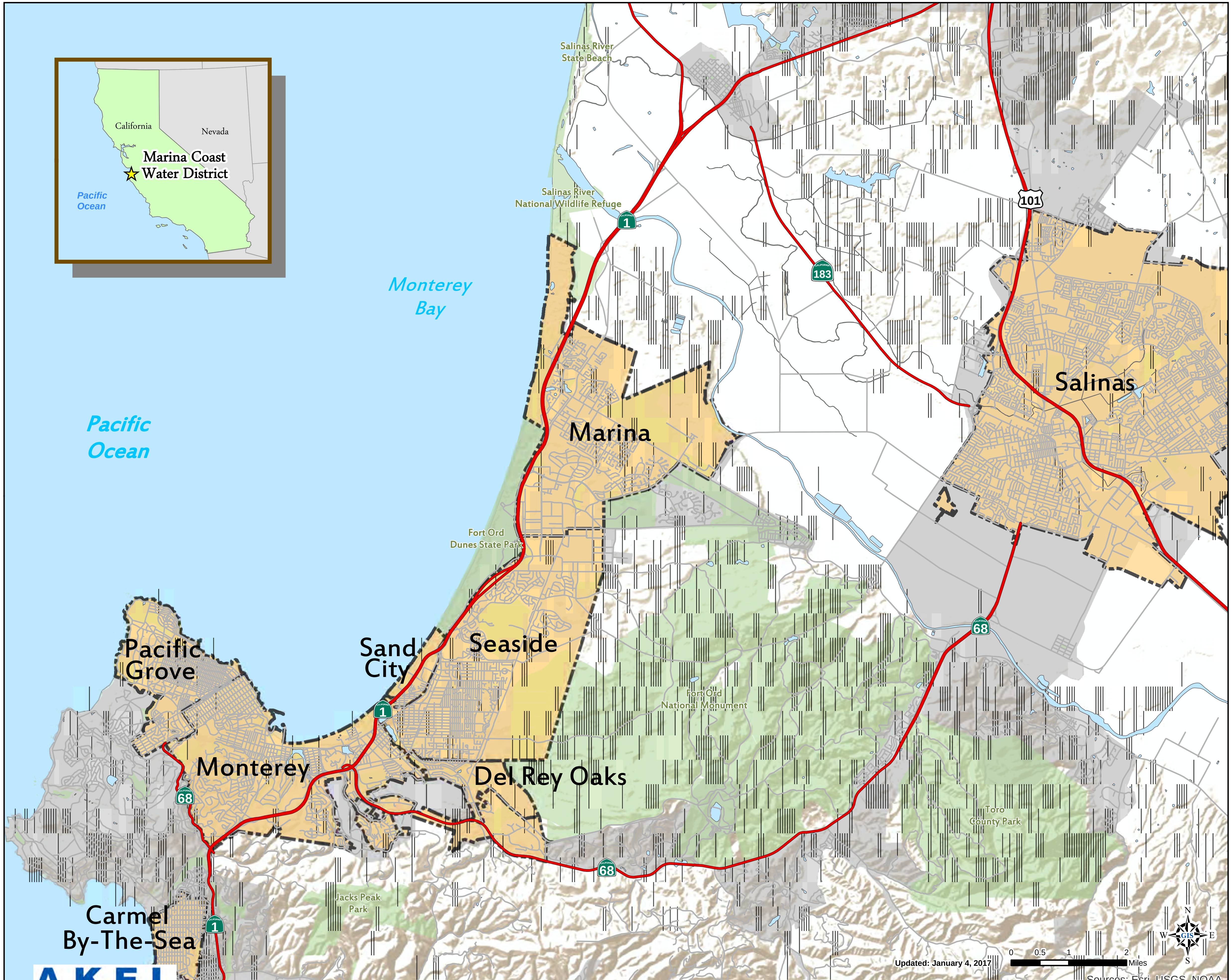
1.2 SCOPE OF WORK

Marina Coast Water District approved Akel Engineering Group Inc. to prepare this master plan in November of 2016. This 2019 Sewer Master Plan (SMP) is intended to serve as a tool for planning and phasing the construction of future sanitary sewer system facilities for the projected buildout of the Marina Coast Water District. The 2019 SMP evaluates the District's sewer system and recommends capacity improvements necessary to service the needs of existing users and for servicing the future growth of the District.

Should planning conditions change, and depending on their magnitude, adjustments to the master plan recommendations might be necessary.

This master plan includes the following tasks:

- Summarize the District's existing sewer system facilities.



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Legend

- Major Highways
- City Limits
- Urbanized Area
- Protected Open Space
- Rivers/Streams
- Waterbodies

PRELIMINARY

Figure 1.1
Regional Location Map

Sewer Master Plan
Marina Coast Water District

- Document growth planning assumptions and known future developments.
- Summarize the sewer system performance criteria and design storm event.
- Project future sewer flows.
- Develop and calibrate the physical characteristics of the hydraulic model (gravity mains, force mains, and lift stations).
- Evaluate the adequacy of capacity for the sewer system facilities to meet existing and projected peak dry weather flows and peak wet weather flows.
- Recommend a capital improvement program (CIP) with an opinion of probable construction costs.
- Perform a capacity allocation analysis for cost sharing purposes between existing users and future growth.
- Develop a 2019 Sewer Master Plan Report.

1.3 INTEGRATED APPROACH TO MASTER PLANNING

This District implemented an integrated master planning approach and contracted the services of Akel Engineering Group to prepare the following documents:

- Water Master Plan
- Sewer Master Plan
- Recycled Water Master Plan

While each of these reports is published as a standalone document, they have been coordinated for consistency with the various planning documents within the District's service area. Additionally, each document has been cross referenced to reflect relevant analysis results with the other documents.

1.4 PREVIOUS MASTER PLANS

The District's most recent sewer master plan was completed in 2005. This master plan included evaluation of servicing growth to the planning area, evaluated existing sewer flows and projected future flows and recommended phased improvements to the sewer system for a horizon year of 2020. Additionally, the 2005 master plan included the development of the hydraulic model which was used for evaluating the sewer system. Improvements were recommended for servicing existing and future growth areas, and a corresponding Capital Improvement Program was developed to quantify the corresponding costs.

1.5 RELEVANT REPORTS

The District has completed several special studies intended to evaluate localized growth. These reports were referenced and used during this capacity analysis. The following lists relevant reports that were used in the completion of this master plan, as well as a brief description of each document:

- **Marina Coast Water District Wastewater Collection System Master Plan, February 2005 (2005 WWSMP).** This report documents the planning and performance criteria, evaluates the sewer system, recommends improvements, and provides an estimate of costs.
- **Ord Community Wastewater System Master Plan, July 2005 (2005 WWSMP)**. This report documents the planning and performance criteria, evaluates the sewer system, recommends improvements, and provides an estimate of costs.
- **Seaside County Sanitation District, 2011 Sewer Master Plan and Rate Study.** This report documents the planning and performance criteria, existing and future flows, collection system analysis, recommends improvements, and provides an estimate of costs for the Seaside County Sanitation District service area, which includes portions of the City of Seaside, the City of Del Rey Oaks, and Sand City.
- **City of Marina General Plan, December 2006, (2006 General Plan).** The City's 2006 General Plan provides future land use planning, and growth assumptions for the planning areas. Additionally, this report establishes the planning horizon for improvements in this master plan.
- **County of Monterey General Plan, October 2010.** The County's 2010 General Plan addresses unincorporated areas of the County and considers the general plans of cities within the County to allow for cooperative planning. The Fort Ord Land Use Plan provided within the County's 2010 General Plan was used to assist in the development of the potential future land use within the District's service area.
- **City of Monterey General Plan, January 2005.** The City's 2005 General Plan provides future land use planning and growth assumptions. These growth assumptions were used to assist in the development of the potential future land use within the District's service area, generally along South Boundary Road.
- **City of Seaside General Plan, August 2004.** The City of Seaside's 2004 General Plan provides future land use planning and growth assumptions. These growth assumptions were used to assist in the development of the potential future land use within the District's service area, generally along General Jim Moore Boulevard south of Inter-Garrison Road.
- **City of Del Rey Oaks General Plan, January 1997.** The City of Del Rey Oaks' 1997 General Plan provides future land use planning and growth assumptions. These growth assumptions were used to assist in the development of the potential future land use within the District's service area, generally along South Boundary Road east of General Jim Moore Boulevard.

- **California State University, Monterey Bay Draft Campus Master Plan, June 2017.** The California State University, Monterey Bay's (CSUMB) Draft Campus Master Plan provides future land use planning and growth assumptions for the exiting campus. These growth assumptions were used to assist in the development of the planned future land use of the CSUMB campus within the District's service area.

- **Fort Ord Reuse Plan, June 1997 (1997 FORP).** The Fort Ord Reuse Plan, prepared by the Fort Ord Reuse Authority, provides future land use planning and development assumptions for lands that are part of the former Fort Ord.

- **Marina Coast Water District 2015 Urban Water Management Plan, (2015 UWMP).** The 2015 Urban Water Management Plan (UWMP) establishes a benchmark per capita water usage and targets in order to achieve higher levels of water conservation for the sustainability of water supply sources. This includes adopting an updated water shortage contingency plan, defining supply sources, addressing supply reliability, and projecting sustainable supply yields and future demands.

1.6 REPORT ORGANIZATION

The Sewer Master Plan report contains the following chapters:

Chapter 1 – Introduction. This chapter provides a brief background of the Marina Coast Water District's (District) sewer system, the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

Chapter 2 – Planning Area Characteristics. This chapter presents a discussion of the planning area characteristics for this master plan and includes a study area description, service area land use, and population for the Marina Coast Water District.

Chapter 3 – System Performance and Design Criteria. This chapter presents the District's performance and design criteria, which were used in this master plan for evaluating the adequacy of capacity for the existing sewer system and for sizing improvements required to mitigate deficiencies and to accommodate future growth. The design criteria includes: capacity requirements for the sewer facilities, flow calculation methodologies for future users, flow peaking factors, and accounting for infiltration and inflows.

Chapter 4 – Existing Sewer Collection Facilities. This chapter provides a description of the District's existing sewer system facilities including gravity trunks, force mains, lift stations, and sewer collection basins. The chapter also includes a brief description of the Monterey One Water (M1W) wastewater treatment plant, which treats and disposes of the wastewater for Central Marina and the Ord Community.

Chapter 5 –Sewer Flows. This chapter summarizes historical sewer flows experienced at the Monterey One Water WWTP and defines flow terminologies relevant to this evaluation. This chapter discusses the wastewater flow distribution within the collection basins and identifies the design flows used in the hydraulic modeling effort and capacity evaluation. The design flows include the flows due to existing conditions and buildout development conditions.

Chapter 6 – Hydraulic Model Development. This chapter describes the development and calibration of the District's sewer system hydraulic model. Hydraulic network analysis has become an effectively powerful tool in all aspects of sewer system planning, design, operation, management, and system reliability analysis. The District's hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

Chapter 7 – Evaluation and Proposed Improvements. This chapter presents a summary of the sewer system capacity evaluation during peak dry weather flows and peak wet weather flows for the existing and buildout development conditions. This chapter summarizes the lift station condition assessment performed by GHD. The recommended sewer system improvements needed to mitigate capacity deficiencies are also discussed in this chapter.

Chapter 8 – Capital Improvement Program. This chapter provides a summary of the recommended Capital Improvement Program (CIP) for the District's sewer system. The program is based on the evaluation of the District's sewer system and on the recommended projects described in the previous chapters. The CIP has been prepared to assist the District in planning and constructing the collection system improvements through the ultimate buildout scenario. This chapter also presents the cost criteria and methodologies for developing the capacity improvement costs.

1.7 ACKNOWLEDGEMENTS

Obtaining the necessary information to successfully complete the analysis presented in this report, and developing the long term strategy for mitigating the existing system deficiencies and for accommodating future growth, was accomplished with the strong commitment and very active input from dedicated team members including:

- Keith Van Der Maaten, General Manager
- Mike Wegley, District Engineer
- Derek Cray, Maintenance and Operations Manager
- Brian True, Senior Civil Engineer
- Jaron Hollida, Assistant Engineer
- Andrew Racz, Associate Engineer
- Andy Sterbenz, Consultant

1.8 UNIT CONVERSIONS AND ABBREVIATIONS

Engineering units were used in reporting flow rates and volumes pertaining to the design and operation of various components of the sewer system. In some cases, different sets of units were used to describe the same parameter where it was necessary to report values in smaller or larger quantities. Values reported in one set of units can be converted to another set of units by applying a multiplication factor. A list of multiplication factors for units used in this report are shown on **Table 1.1**.

Various abbreviations and acronyms were also used in this report to represent relevant sewer system terminologies and engineering units. A list of abbreviations and acronyms is included in **Table 1.2.**

1.9 GEOGRAPHIC INFORMATION SYSTEMS

This master planning effort made extensive use of Geographic Information Systems (GIS) technology, for efficiently completing the following tasks:

- Developing the physical characteristics of the hydraulic model (gravity mains, force mains, and lift stations).
- Allocating existing sewer loads, as calculated using the developed sewer unit factors.
- Calculating and allocating future sewer loads, based on the future developments land use.
- Extracting ground elevations along the gravity and force mains from available contour maps.
- Generating maps and exhibits used in this master plan.

Table 1.1 Unit Conversions

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Volume Unit Calculations

To Convert From:	To:	Multiply by:
acre feet	gallons	325,857
acre feet	cubic feet	43,560
acre feet	million gallons	0.3259
cubic feet	gallons	7.481
cubic feet	acre feet	2.296×10^{-5}
cubic feet	million gallons	7.481×10^{-6}
gallons	cubic feet	0.1337
gallons	acre feet	3.069×10^{-6}
gallons	million gallons	1,000,000
million gallons	gallons	1×10^{-6}
million gallons	cubic feet	133,672
million gallons	acre feet	3.069

Flow Rate Calculations

To Convert From:	To:	Multiply By:
ac-ft/yr	mgd	8.93×10^{-4}
ac-ft/yr	cfs	1.381×10^{-3}
ac-ft/yr	gpm	0.621
ac-ft/yr	gpd	892.7
cfs	mgd	0.646
cfs	gpm	448.8
cfs	ac-ft/yr	724
cfs	gpd	646300
gpd	mgd	1×10^{-6}
gpd	cfs	1.547×10^{-6}
gpd	gpm	6.944×10^{-4}
gpd	ac-ft/yr	1.12×10^{-3}
gpm	mgd	1.44×10^{-3}
gpm	cfs	2.228×10^{-3}
gpm	ac-ft/yr	1.61
gpm	gpd	1,440
mgd	cfs	1.547
mgd	gpm	694.4
mgd	ac-ft/yr	1,120
mgd	gpd	1,000,000

Table 1.2 Abbreviations and Acronyms

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Abbreviation	Expansion	Abbreviation	Expansion
10yr-24hr	10-Year 24-Hour	HGL	Hydraulic Grade Line
AACE	Association for the Advancement of Cost Engineering	in/hr	Inch per Hour
ADWF	Average Dry Weather Flow	I&I	Infiltration and Inflow
AAF	Annual Average Flow	LF	Linear Feet
Akel	Akel Engineering Group, Inc.	LS	Lift Station
AWWF	Average Wet Weather Flow	M1W	Monterey One Water
CCI	Construct Cost Index	MCWRA	Monterey County Water Resources Agency
CCTV	Closed Circuit Television	MDDWF	Maximum Day Dry Weather Flow
CDP	Census Designated Place	MDWWF	Maximum Day Wet Weather Flow
CIP	Capital Improvement Program	MGD	Million Gallons per Day
CIPP	Cured in Place Pipe	MMDWF	Maximum Month Dry Weather Flow
DDF	Depth Duration Frequency	MMWWF	Maximum Month Wet Weather Flow
d/D	depth of flow to pipe diameter	MPWMD	Monterey Peninsula Water Management District
District/ MCWD	Marina Coast Water District	NASSCO	National Association of Sewer Service Compaines
ENR	Engineering News Record	NOAA	National Oceanic and Atmospheric Administration
ft	Feet	PDWF	Peak Dry Weather Flow
fps	Feet per Second	PWWF	Peak Wet Weather Flow
FY	Fiscal Year	PACP	Pipeline Assessment and Certification Program
GIS	Geographic Information Systems	ROW	Right of Way
gpdc	Gallons per day per capita	SWRCB	State Water Resources Control Board
gpd	Gallons per Day	VCP	Vitrified Clay Pipe
gpm	Gallons per Minute	UWMP	Urban Water Management Plan
HE	Household equivalent	WWTP	Wastewater Treatment Plant

CHAPTER 2 - PLANNING AREA CHARACTERISTICS

This chapter presents a discussion of the planning area characteristics for this master plan and includes a study area description, service area land use, and population for the Marina Coast Water District.

2.1 STUDY AREA DESCRIPTION

The Marina Coast Water District is located in Monterey County on the west coast of California, south of the City of San Francisco. The District is located approximately 10 miles north of the City of Monterey, 8 miles east of the City of Salinas, and 6 miles south of the City of Castroville. Pacific Coast Highway 1 runs from south to north near the District's western boundary. The District currently serves more than 36,000 customers and encompasses an area greater than 29,000 acres. **Figure 2.1** displays the District's existing service area and the local municipal boundaries.

The District operates and maintains a sanitary sewer collection system that covers the majority of former Fort Ord area, the City of Marina, and portions of the City of Seaside. Currently, the wastewater flows are conveyed to outfalls that enter regional interceptors that convey flow to the Monterey One Water wastewater treatment plant (M1W).

2.2 SEWER SERVICE AREA

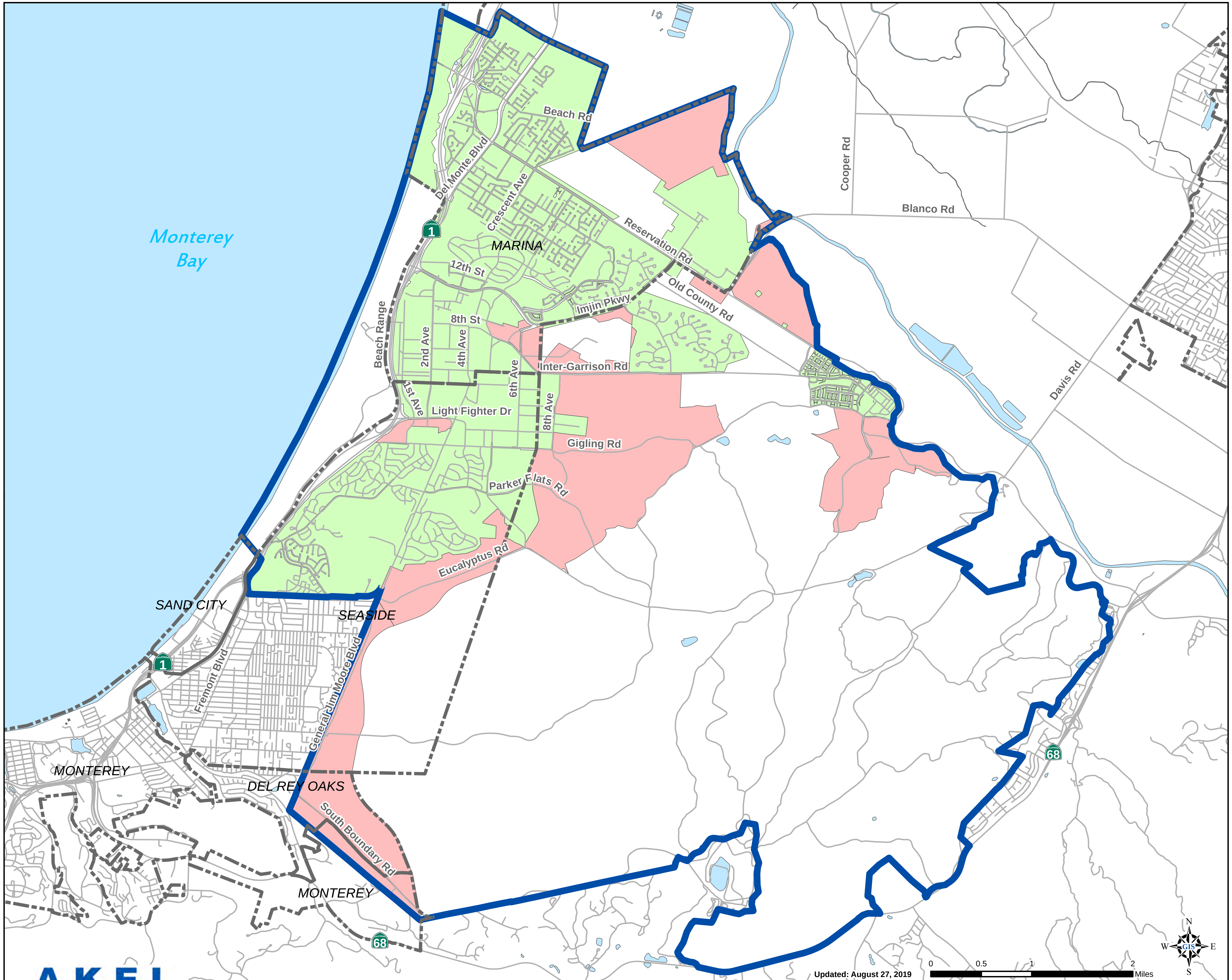
The District's sewer system services residential and non-residential lands within the District limits, as shown on **Figure 2.1**. The figure includes the following:

- **Planning Boundary.** This boundary consists of the City of Marina and the former Fort Ord. The District is responsible for serving the former Fort Ord under a 1998 Facilities Agreement.
- **Future Study Area.** This area consists of future areas planned for service by the District.

The boundaries and planning area characteristics of the Central Marina and Ord Community service areas are briefly described in the following sections:

2.2.1 Central Marina Service Area

The Central Marina service area is within the city limits generally north of Patton Parkway and west of Salinas Avenue. The future development within this service area region is generally comprised of the development of vacant parcels located throughout the city as well as one large area of potential development generally north of Beach Road.



Legend

- Planning Boundary
- Existing Service Area
- Future Study Area
- Municipal Boundaries
- Rivers/Streams
- Waterbodies

PRELIMINARY

Figure 2.1
Planning Area
Sewer Master Plan
Marina Coast Water District

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2.2.2 Ord Community Service Area

The Ord Community service area includes developed, vacant, and designated open space lands within portions of the County of Monterey, City of Marina, City of Seaside, City of Monterey within the former Fort Ord. The City of Del Rey Oaks within the former Fort Ord is part of the Seaside County Sanitation District. The potential future development within this area is generally comprised of the redevelopment of the former Fort Ord and the new development on currently vacant lands.

It should be noted that currently vacant lands in proximity to the Laguna Seca development area are within the District's Planning Area Boundary but planned for service by others; therefore these lands are not included within the Future Study Area shown on **Figure 2.1**.

For conservative planning purposes the master plan assumes the buildout development of potential developable lands, however the Fort Ord Reuse Authority (FORA) has established limits for growth within the former Fort Ord area. The Fort Ord Base Reuse Plan (BRP) has a 6,160 unit development limit on new residential units until 18,000 new jobs are created on the former Fort Ord per BRP 3.11.5.4 (b) 2) & 3.11.5.4 (c). These growth limits are briefly summarized as follows:

2.2.2.1 15-Year Development Areas

In addition to outlining improvements, the FORA capital improvement plan specifies the allowable development within the former Fort Ord area. The portion of this allowable development that has been built to date is summarized on **Table 2.1**, while the remaining entitlements are summarized in **Table 2.2**. The potential acreages associated with these development limits, summarized on **Table 2.3**, were estimated for the purposes of establishing future water demands. These acreages were based on the following general assumptions:

- Residential: Future dwelling units were converted to acreages based on an average dwelling unit density of 8 du/acre
- Office, Industrial, Commercial: Future square feet of development were converted to acreages based on an average floor-area-ratio of 0.6.
- Hotel: Acreages for future hotels were estimated based on various planning documents and County of Monterey parcel database

2.2.2.2 Parker Flats Land Use Swap

The 1997 Fort Ord Installation-Wide Multi-Species Habitat Management Plan (1997 HMP) identified up to 6,300 acres throughout the Fort Ord base that could potentially develop from vegetation and habitat to a municipal-type use. As part of the 1997 HMP, East Garrison development was limited to 200 acres, with the majority of development slated for the Parker Flats area of Fort Ord. In 2002, FORA, the County of Monterey, and Monterey Peninsula College submitted a proposal to modify the 1997 HMP land use, specifically allowing for more development in the East Garrison area, while converting developable lands in Parker Flats to

Table 2.1 Fort Ord 15-Year Development Limits, Built to Date

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Development Areas[1]	Residential (du)	Office (sf)	Industrial (sf)	Commercial (sf)	Hotel (rooms)
City of Marina					
Dunes Phase 1 (Entitled)	390	203,000		418,000	108
Preston Park (Entitled)	352				
Seahaven (Entitled)	121				
Abrams B (Entitled)	192				
MOCO Housing Authority (Entitled)	56				
Shelter Outreach Plus (Entitled)	39				
VTC (Entitled)	13				
Interim Inc (Entitled)	11	14,000		14,000	
Imjin Office Park (Entitled)		28,000			
Seaside East (Planned)		14,900	14,900		
Marina CY (Entitled)			12,300		
Marina Airport (Entitled)			250,000		
Subtotal	1,174	259,900	277,200	432,000	108
City of Seaside					
Seaside Resort (Entitled)	3				
Sunbay (Entitled)	297				
Bayview (Entitled)	225				
Seaside Highlands (Entitled)	380				
Subtotal	905	0	0	0	0
University of California					
UC (Planned)			38,000		
Subtotal	0	0	38,000	0	0
County of Monterey					
East Garrison I (Entitled)	749				
Subtotal	749	0	0	0	0
Development Total					
	2,828	**259,900**	**315,200**	**432,000**	**108**

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8/27/2019

Notes:

1. Development areas and units built to date extracted from FORA "FY 2018-2019 Capital Improvement Program", Table 6 and Table 7, as provided by District staff December 18, 2018.

Table 2.2 Fort Ord Reuse Authority 15-Year Development Limits, Remaining Development

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Development Areas[1]	Residential (du)	Office (sf)	Industrial (sf)	Commercial (sf)	Hotel (rooms)
Campus Town Specific Plan					
26 Acre Parcel (Planned)	150	0	0	0	0
Campus Town / 26 Acre (Planned)	0	10,000	30,000	40,000	300
Campus Town / Surplus II (Planned)	0	10,000	40,000	50,000	0
Surplus II (Planned)	238	0	0	0	0
Subtotal	388	20,000	70,000	90,000	300
Cypress Knolls					
Cypress Knolls (Entitled)	712	0	0	0	0
Del Rey Oaks					
Del Rey Oaks (Planned)	691	0	0	0	0
Del Rey Oaks RV Park (Entitled)	0	400,000	0	0	0
Del Rey Oaks RV Park (Planned)	0	0	0	0	550
Subtotal	691	400,000	0	0	550
Dunes Phase 1, 2, & 3					
Dunes Phase 1 (Entitled)	187	69,000	0	80,000	0
Dunes Phase 2 (Entitled)	225	0	0	0	394
Dunes Phase 3 (Entitled)	435	450,000	450,000	0	0
Subtotal	847	519,000	450,000	80,000	394
East Garrison					
East Garrison I (Entitled)	721	68,000	0	34,000	0
Main Gate					
Main Gate	0	0	0	150,000	350
Main Gates (Planned)	145	0	0	0	0
Subtotal	145	0	0	150,000	350
City of Monterey					
Monterey (Planned)	0	721,524	216,276	0	0
Sea Haven					
Sea Haven A (Entitled)	802	0	0	0	0
Seahaven Replacement (Entitled)	127	0	0	0	0
Subtotal	929	0	0	0	0
Seaside East					
Seaside East (Planned)	310	30,000	30,000	30,000	0
Seaside Resort					
Seaside Resort (Entitled)	122	0	0	10,000	330
Seaside Resort TS (Entitled)	0	0	0	0	68
Subtotal	122	0	0	10,000	398
UC MBEST					
UC (Planned)	0	680,000	100,000	310,000	0
UC Blanco Triangle (Planned)	240	0	0	0	0
Subtotal	240	680,000	100,000	310,000	0
Nurses Barracks					
Nurses Barracks	40				
Development Total					
	5,145	**2,438,524**	**866,276**	**704,000**	**1,992**

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Note:

1. Development Areas extracted from Development Forecasts documented in FORA "FY 2018-2019 Capital Improvement Program", Table 6 and Table 7.

Table 2.3 15-Year Development Summary

Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Development Areas	Development Limits[1]			Estimated Development Area			
	Residential (du)	Office, Industrial, Commercial (sf)	Hotel (rooms)	Residential[2] (acres)	Office, Industrial, Commercial[3] (acres)	Hotel[4] (acres)	Total (acres)
1	2	3	4	5	6	7	8
Campus Town Specific Plan	388	180,000	300	48.5	6.9	2.5	57.9
Cypress Knolls	712	0	0	89.0	0.0	0.0	89.0
Del Rey Oaks	691	400,000	550	86.4	15.3	38.6	140.2
Dunes Phase 1, 2, & 3	847	1,049,000	394	105.9	40.1	12.9	158.9
East Garrison	721	102,000	0	90.1	3.9	0.0	94.0
Main Gate	145	150,000	350	18.1	5.7	7.8	31.6
City of Monterey	0	937,800	0	0.0	35.9	0.0	35.9
Sea Haven	929	0	0	116.1	0.0	0.0	116.1
Seaside East	310	90,000	0	38.8	3.4	0.0	42.2
Seaside Resort	122	10,000	398	15.3	0.4	16.8	32.4
UC MBEST	240	1,090,000	0	30.0	41.7	0.0	71.7
Nurses Barracks	40	0	0	5.0	0.0	0.0	5.0
Total	**5,145**	**4,008,800**	**1,992**	**643.1**	**153.4**	**78.5**	**875.0**

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Notes:

1. Development limits based on development Forecasts documented in FORA "FY 2018-2019 Capital Improvement Program", Table 6 and Table 7 and reflect remaining entitlements.
2. Residential acreage estimated based on average residential density of 8 dwelling units per acre.
3. Office, Industrial, and Commercial acreage estimated bsaed on average floor-area-ratio of 0.6.
4. Acreage for hotel development estimated based on available planning information and County of Monterey parcel database.

habitat reserve areas. This proposal was submitted as an official Land Swap Agreement (LSA) to the United States Army and the United States Fish and Wildlife Service.

The LSA ultimately allowed for an additional 210 acres of land to be developed at East Garrison, while converting approximately 447 acres of land within Parker Flats to habitat reserve. The Memorandum of Understanding (MOU) for the LSA was signed on October 14, 2003.

The tables and figures included in this Master Plan document the respective land use planning agency General Plan maps, with input from District staff. However, and in adherence to the LSA, developable acreages were adjusted to reflect the most recent planning data, and as provided by FORA staff. This included utilizing FORA GIS information to determine on a parcel by parcel basis what lands are included in the LSA.

2.3 EXISTING AND FUTURE LAND USE

The existing and future land use for the District service area is based on a combination of planning documents that includes the following sources: City of Marina, City of Seaside, City of Monterey, City of Del Rey Oaks, CSU Monterey Bay, County of Monterey, FORA, and District staff. For planning purposes, the various residential and commercial land use types across the multiple jurisdictions within the District service area were consolidated into single residential and commercial categories.

The existing and future land use conditions are graphically summarized on **Figure 2.2** and **Figure 2.3.** It should be noted that **Figure 2.3** also includes the aforementioned Parker Flats – East Garrison LSA boundaries. The existing and future land use acreages, summarized on **Table 2.4**, can be broken down into the following categories:

- **Existing Development:** These acreages represent existing developed lands.
- **Existing Lands - Redeveloped:** These acreages represent existing developed lands expected to redevelop into other land use types within the buildout horizon of the master plan.
- **Existing Development - Unchanged:** These acreages represent the total existing acreages expected to remain within the buildout horizon of the master plan.
- **New Lands - Redevelopment:** These acreages represent lands that have redeveloped from a prior use and into a new respective category.
- **New Development:** These acreages represent gains from the development of existing vacant lands.

The total existing and future land use acreages are summarized below and shown on **Table 2.4**:

- 4,776 acres of developed lands inside the service area.
- 5,113 acres of undeveloped lands inside the service area.

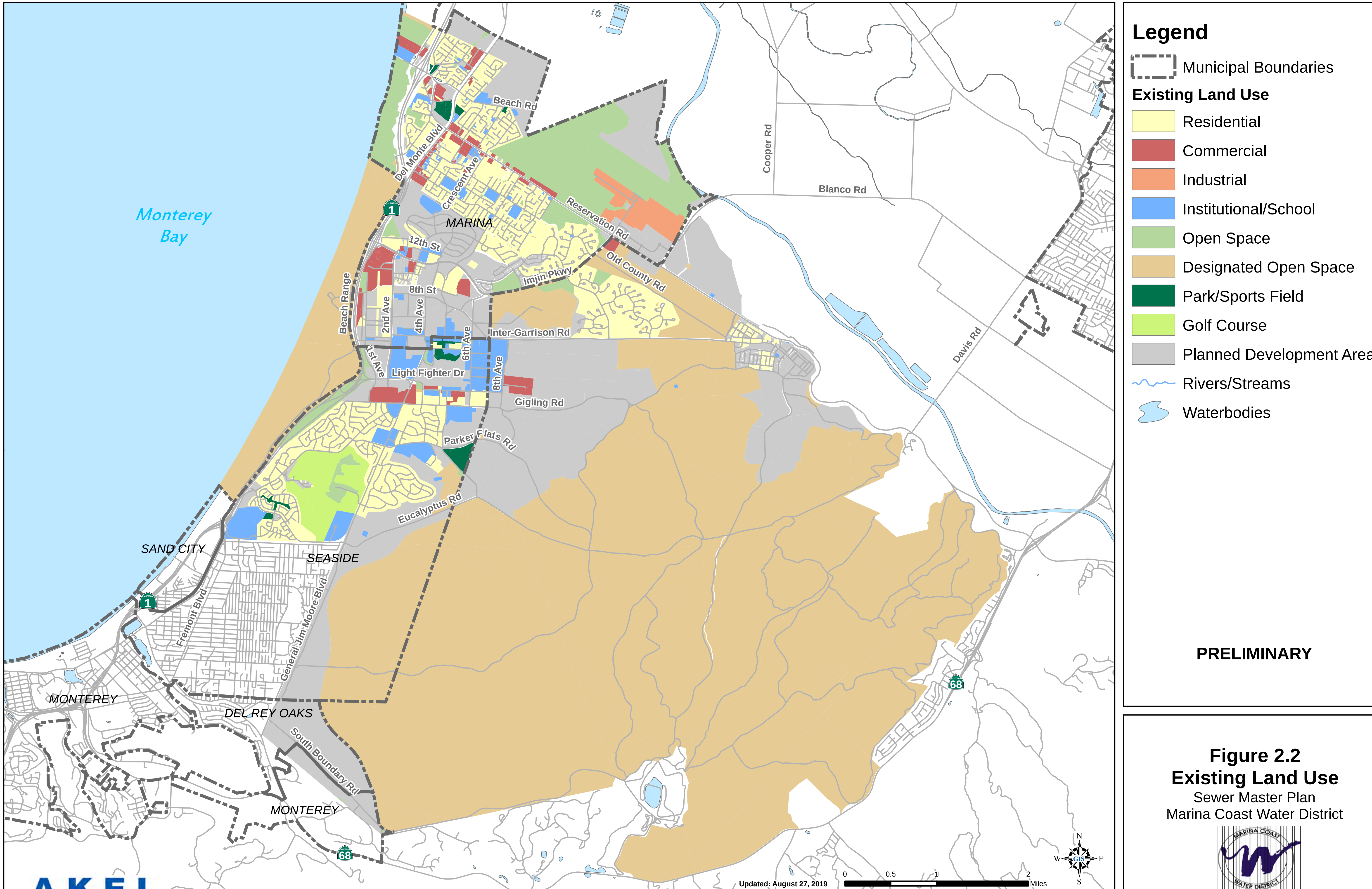

Figure 2.2
Existing Land Use
Sewer Master Plan
Marina Coast Water District

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File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Sewer\MCWD_Fig2-2_ExistingLandUse_082719.mxd

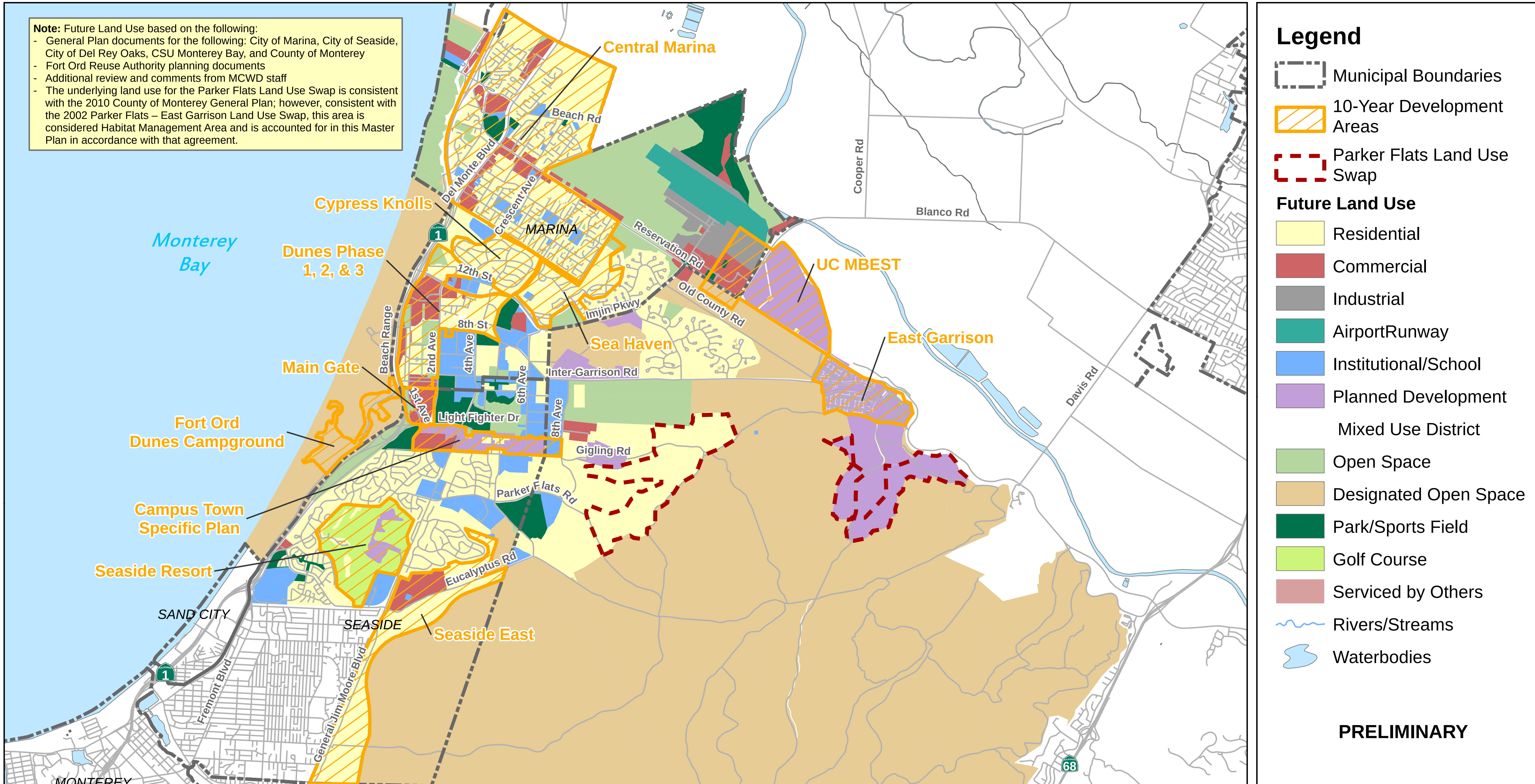

Figure 2.3
Future Land Use
Sewer Master Plan
Marina Coast Water District

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File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Sewer\MCWD_Fig2-3_FutureLandUse_082719.mxd

Table 2.4 Existing and Future Service Areas

Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Land Use Classification	Existing Development: Existing Development (acres)	Existing Development: Existing Lands - Redeveloped (acres)	Subtotal Existing Development - Unchanged (acres)	Future Development: New Lands - Redevelopment (acres)	Future Development: New Development: Inside Existing Service Area (acres)	Future Development: New Development: Outside Existing Service Area (acres)	Subtotal Future Development (acres)	Total Development at Buildout of Study Area (acres)	Development Outside of Future Study Area (acres)	Planning Area Total (acres)
Residential										
Residential	2,574	-196	2,378	85	1,167	1,033	2,285	4,663	0	4,663
Non-Residential										
Commercial	349	-40	309	21	235	139	395	704	1	705
Park	103	-5	98	103	156	222	481	579	0	579
Institutional	689	-148	541	23	191	58	272	813	1	814
Planned Development Mixed Use District	0	0	0	134	475	726	1,336	1,336	0	1,336
Other										
Bayonet Golf Course	322	-15	307	0	0	0	0	307	0	307
Open Space - Other	438	0	438	46	0	0	46	484	0	484
Designated Open Space[5]	45	0	45	0	0	0	0	45	17,754	17,799
ROW	33	-8	25	0	1	0	1	26	0	26
Airport Runway	224	0	224	0	0	0	0	224	0	0
Parker Flats LU Swap	0	0	0	0	0	709	709	709	0	0
Total										
	4,776	-412	4,364	412	2,225	2,888	5,524	9,889	17,756	26,712

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Note:

1. Designated Open Space includes lands not planned for development, based on directions from District staff.

2.4 HISTORICAL AND FUTURE GROWTH

According to the District's 2015 UWMP the 2015 service area population was approximately 32,375. The District's 2015 UWMP utilized varying annual growth rates and projected a 2035 population of 70,161. For the purpose of this master plan, District staff used a set annual population growth rate of 3.0 percent. This resulted in a 2035 population of 58,473. Assuming 3.0 percent growth, the District service area is not expected to reach the UWMP 2035 population until the year 2041.

Based on the land use estimated in this master plan, there is a population capacity of approximately 83,300 people. Based on an annual growth rate of 3.0 percent, the District service area will not reach the buildout population until the year 2047. The District's historical and projected population estimates are summarized on **Table 2.5**.

Table 2.5 Historical and Projected Population

Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Year	Population[1,2]	Annual Growth (%)
Historical Population		
2005	29,477	-
2006	29,154	-1.1%
2007	29,065	-0.3%
2008	29,533	1.6%
2009	29,743	0.7%
2010	30,840	3.7%
2011	31,141	1.0%
2012	31,445	1.0%
2013	31,752	1.0%
2014	32,062	1.0%
2015	32,375	1.0%
2016	33,346	3.0%
2017	34,347	3.0%
2018	35,377	3.0%
Projected Population		
2019	36,438	3.0%
2020	37,531	3.0%
2021	38,657	3.0%
2022	39,817	3.0%
2023	41,012	3.0%
2024	42,242	3.0%
2025	43,509	3.0%
2026	44,815	3.0%
2027	46,159	3.0%
2028	47,544	3.0%
2029	48,970	3.0%
2030	50,439	3.0%
2031	51,952	3.0%
2032	53,511	3.0%
2033	55,116	3.0%
2034	56,770	3.0%
2035	58,473	3.0%
2036	60,227	3.0%
2037	62,034	3.0%
2038	63,895	3.0%
2039	65,812	3.0%
2040	67,786	3.0%
2041	69,820	3.0%
2042	71,914	3.0%
2043	74,072	3.0%
2044	76,294	3.0%
2045	78,583	3.0%
2046	80,940	3.0%
2047	83,368	3.0%

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Note:

1. Population for years 2005 - 2015 extracted from Marina Coast Water District 2015 Urban Water Management Plan
2. Population for years 2016 - 2047 calculated assuming annual growth rate of 3.0% as directed by District staff.

CHAPTER 3 - SYSTEM PERFORMANCE AND DESIGN CRITERIA

This chapter presents the District's performance and design criteria, which were used in this master plan for evaluating the adequacy of capacity for the existing sewer system and for sizing improvements required to mitigate deficiencies and to accommodate future growth. The design criteria includes: capacity requirements for the sewer facilities, flow calculation methodologies for future users, flow peaking factors, and accounting for infiltration and inflows.

3.1 HYDRAULIC CAPACITY CRITERIA

In addition to applying the District design standards for evaluating hydraulic capacities; this master plan included dynamic hydraulic modeling. The dynamic modeling was a critical and essential element in identifying surcharge conditions resulting from downstream bottlenecks in the gravity sewers. Dialed in.

3.1.1 Gravity Sewers

Gravity sewer capacities depend on several factors including: material and roughness of the pipe, the limiting velocity and slope, and the maximum allowable depth of flow. The hydraulic modeling software used for evaluating the capacity adequacy of the Madera sewer system, InfoSWMM by Innovyze Inc., utilizes the fully dynamic St. Venant's equation which has a more accurate engine for simulating backwater and surcharge, in addition to manifolded force mains. The software also incorporates the use of the Manning Equation in other calculations including upstream pipe flow conditions.

Manning's Equation for Pipe Capacity

The Continuity equation and the Manning equation for steady-state flow are used for calculating pipe capacities in open channel flow. Open channel flow can consist of either open conduits or, in the case of gravity sewers, partially full closed conduits. Gravity full flow occurs when the conduit is flowing full but has not reached a pressure condition.

- Continuity Equation: $Q = V A$

  Where:
  Q = peak flow, in cubic feet per second (cfs)
  V = velocity, in feet per second (fps)
  A = cross-sectional area of pipe, in square feet (sq. ft.)

- Manning Equation: $V = (1.486 R^{2/3} S^{1/2})/n$

  Where:
  V = velocity, fps
  n = Manning's roughness coefficient
  R = hydraulic radius (area divided by wetted perimeter), ft
  S = slope of pipe, in feet per foot

St. Venant's Equation for Pipe Capacity

Dynamic modeling facilitates the analysis of unsteady and non-uniform flows (dynamic flows) within a sewer system. Some hydraulic modeling programs have the ability to analyze these types of flows using the St. Venant equation, which take into account unsteady and non-uniform conditions that occur over changes in time and cross-section within system pipes.

The St. Venant equation is a set of two equations, a continuity equation and a dynamic equation, that are used to analyze dynamic flows within a system. The first equation, the continuity equation, relates the continuity of flow mass within the system pipes in terms of: (A) the change in the cross-sectional area of flow at a point over time and (B) The change of flow over the distance of piping in the system. The continuity equation is provided as follows:

- Continuity Equation: $$\underset{(A)}{\frac{\partial A}{\partial t}} + \underset{(B)}{\frac{\partial Q}{\partial x}} = 0$$

Where:
t = time
x = distance along the longitudinal direction of the channel
Q = discharge flow
A = flow cross-sectional area perpendicular to the x directional axis

The second equation, the dynamic equation, relates changes in flow to fluid momentum in the system using: (A) Changes in acceleration at a point over time, (B) Changes in convective flow acceleration, (C) Changes in momentum due to fluid pressure at a given point, (D) Changes in momentum from the friction slope of the pipe and (E) Fluid momentum provided by gravitational forces. The dynamic equation is provided as follows:

- Dynamic Equation: $$\underset{(A)}{\frac{\partial Q}{\partial t}} + \underset{(B)}{\frac{\partial}{\partial t}\left(\beta \frac{Q^2}{A}\right)} + \underset{(C)}{gA\frac{\partial y}{\partial x}} + \underset{(D)}{gAS_f} - \underset{(E)}{gAS_o} = 0$$

Where:
t = time
x = distance along the longitudinal direction of the channel
Q = discharge flow
A = flow cross-sectional area perpendicular to the x directional axis
y = flow depth measured from the channel bottom and normal to the x directional axis
S_f = friction slope
S_o = channel slope
β = momentum
g = gravitational acceleration

Use of this method of analysis provides a more accurate and precise analysis of flow conditions within the system compared to steady state flow analysis methods. It must be noted that two assumptions are made for use of St. Venant equations in the modeling software. First, flow is one dimensional. This means it is only necessary to consider velocities in the downstream direction and not in the transverse or vertical directions. Second, the flow is gradually varied. This means the vertical pressure distribution increases linearly with depth within the pipe.

Manning's Roughness Coefficient (n)

The Manning roughness coefficient 'n' is a friction coefficient that is used in the Manning formula for flow calculation in open channel flow. In sewer systems, the coefficient can vary between 0.009 and 0.017 depending on pipe material, size of pipe, depth of flow, root intrusion, smoothness of joints, and other factors.

For the purpose of this evaluation, and in accordance with District standards, an "n" value of 0.013 was used for both existing and proposed gravity sewer pipes unless directed otherwise by District staff based on pipe structural condition. This "n" value is an acceptable practice in planning studies.

Partial Flow Criteria (d/D)

Partial flow in gravity sewers is expressed as a depth of flow to pipe diameter ratio (d/D). For circular gravity conduits, the highest capacity is generally reached at 92 percent of the full height of the pipe (d/D ratio of 0.92). This is due to the additional wetted perimeter and increased friction of a gravity pipe.

When designing sewer pipelines, it is common practice to use variable flow depth criteria that allow higher safety factors in larger sizes. Thus, design d/D ratios may range between 0.5 and 0.92, with the lower values used for smaller pipes. The smaller pipes may experience flow peaks greater than planned or may experience blockages from debris.

The District's design standards pertaining to the d/D criteria are summarized in **Table 3.1**. During peak dry weather flows (PDWF) and peak wet weather flows (PWWF), the maximum allowable d/D ratio for gravity pipelines are summarized as follows:

- 12-inch diameter and smaller: 0.67
- 15-inch to 24-inch diameter: 0.80
- 27-inch diameter and larger: 0.90

During peak wet weather flows (PWWF), to avoid premature or unnecessary trunk line replacements, the capacity analysis allowed the d/D ratio to exceed the dry weather flow criteria and surcharge. This condition is evaluated using the dynamic hydraulic model and the criteria listed on **Table 3.1**, which stipulates that the hydraulic grade line (HGL), even during a surcharged condition, should be at least three feet below the manhole rim elevation.

Table 3.1 Performance and Design Criteria

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Pipeline Peak Dry Weather Flow Criteria	
Diameter (in)	Maximum Allowable d/D
12" pipe or smaller	**0.67**
15" to 24"	**0.80**
27" pipe or larger	**0.90**
Pipeline Peak Wet Weather Flow Criteria	
No surcharging within 3 feet of rim elevation	
Pipeline Velocities	
Max Velocity (ft/s)	**8.00**
Min Velocity (ft/s)	**2.00**
Lift Station Capacity	
Lift Station capacity shall be sized to meet Peak Wet Weather Flow with largest unit out of service	

Pipe Size (in)	Minimum Grade (ft/100 ft)	Capacity (n = 0.013) (mgd)	Capacity (n = 0.013) (cfs)
6	0.60	0.22	0.34
8	0.40	0.39	0.60
10	0.32	0.63	0.97
12	0.28	0.96	1.49
15	0.15	1.59	2.46
18	0.12	2.30	3.56
21	0.10	3.17	4.90

Minimum Pipe Sizes and Design Velocities

In order to minimize the settlement of sewage solids, it is standard practice in the design of gravity sewers to specify that a minimum velocity of 2 feet per second (fps) be maintained when the pipeline is half-full. At this velocity, the sewer flow will typically result with self-cleaning of the pipe.

Due to the hydraulics of a circular conduit, velocity of half-full flows approaches the velocity of nearly full flows. **Table 3.1** lists the minimum slopes, varying by pipe size, in accordance with the District's design standards.

Changes in Pipe Size

When a smaller gravity sewer pipe joins a larger pipe, the invert of the larger pipe is generally to maintain the same energy gradient. One of the methods used to approximate this condition includes placing the 80 percent depth point (d/D at 0.8) from both sewers at the same elevation. For master planning purposes, and in the absence of known field data, sewer crowns were matched at the manholes.

3.1.2 Force Mains and Lift Stations

The Hazen-Williams formula is commonly used for the design of force mains as follows:

- Hazen Williams Velocity Equation: $V = 1.32\ C\ R^{0.63}\ S^{0.54}$

Where:
V = mean velocity, fps
C = roughness coefficient
R = hydraulic radius, ft
S = slope of the energy grade line, ft/ft

The value of the Hazen-Williams 'C' varies and depends on the pipe material and is also influenced by the type of construction and pipe age. A 'C' value of 110 was used in this analysis.

The minimum recommended velocity in force mains is at 2 feet per second. The economical pumping velocity in force mains ranges between 3 and 5 fps. A maximum desired velocity is typically around 7 fps and a maximum not-to-exceed velocity is at 10 fps. For the purposes of this plan, a minimum velocity of 2 fps and a maximum design velocity of 8 fps were used.

The capacities of pump stations are evaluated and designed to meet the peak wet weather flows with one standby pump having a capacity equal to the largest operating unit. The standby pump provides a safety factor in case the duty pump malfunctions during operations and allows for maintenance.

3.2 DRY WEATHER FLOW CRITERIA

Sewer unit flow factors are coefficients commonly used in planning level analysis to estimate future average daily sewer flows for areas with predetermined land uses. The unit factors are multiplied by the number of dwelling units or gross acreages for residential categories, and by the gross acreages for non-residential categories, to yield the average daily sewer flow projections.

3.2.1 Average Daily Sewer Unit Flow Factors

Sewer flow factors were based on water demands as extracted from the District's 2016 water consumption billing records and system-wide return to sewer ratios. A return to sewer ratio, which reflects the proportion of water consumed that is discharged to the sewer system, was applied to each unadjusted water demand factor for individual land use types.

The return to sewer ratios were identified for both the Central Marina and Ord Community service areas to determine an appropriate system-wide average ratio; a summary of this return-to-sewer analysis is provided on **Table 3.2**. Generally, non-residential land uses within both the Central Marina and Ord Community service areas return between 85% and 95% of the water demand to the sewer system. The residential land use return to sewer ratios were estimated at 70% for the Central Marina and 60% for Ord Community. For planning purposes, a District-wide residential return to sewer ratio of 70% was selected for the unit flow factor analysis.

These return to sewer ratios were incorporated into the sewer unit flow factor analysis summarized on **Table 3.3**, where they were applied to the unadjusted water unit demand factors. Based on this analysis, the sewer unit flow factors range from 190 gpd/acre for Institutional land use types to nearly 1,200 gpd/acre for Commercial land use types. The recommended sewer unit flow factors are summarized on **Table 3.4**. Certain areas of the various general plans used as part of this analysis include mixed-use type developments. In an effort to plan for these areas, a combination of the residential and commercial unit factors were used, assuming development at approximately 70% residential and 30% commercial.

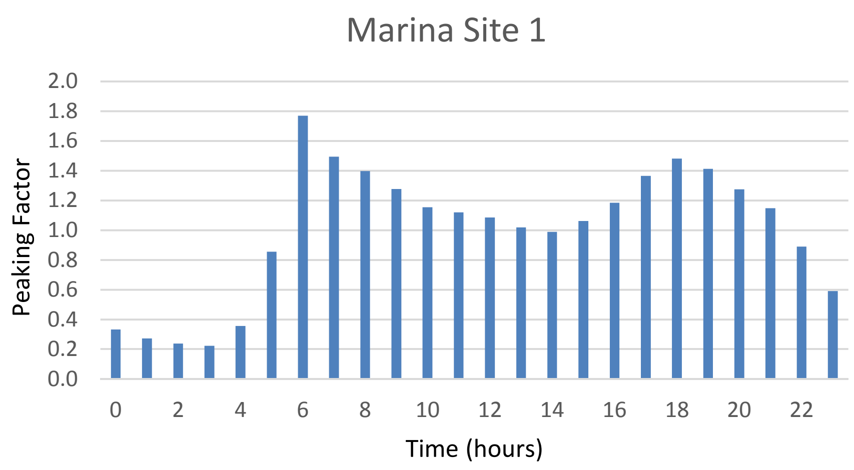
3.2.2 Peaking Factors

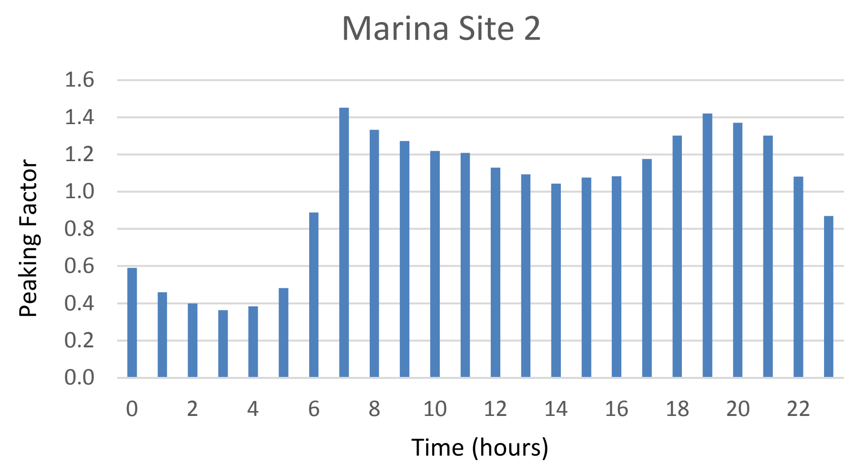
The sanitary sewer system is evaluated based on its ability to convey peak sewer flows. Peaking factors represent the increase in sewer flows experienced above the average dry weather flows (ADWF). The various peaking conditions are numerical values obtained from a review of historical data and, at times, tempered by engineering judgment.

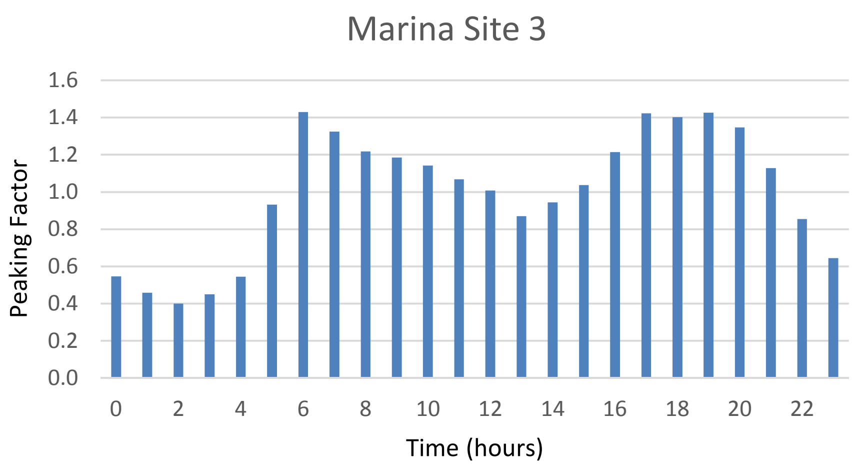
The peaking conditions that are significant to hydraulic analysis of the sewer system include:

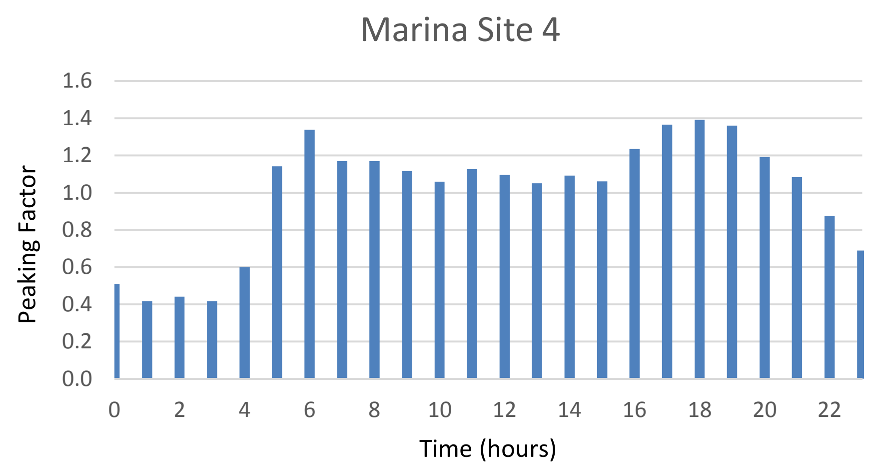
- Peak Dry Weather Flows (PDWF)
- Peak Wet Weather Flows (PWWF)

Typical values for peaking factors of 2.0 or less are generally used to estimate peak flows at treatment facilities where flow fluctuations are smoothed out during the time of travel in the sewer, while peaking factors between 3.0 and 4.0 are used to estimate peak flows in the smaller upstream areas of the system where low flow conditions are prone to greater fluctuations. This study developed 24-hour diurnal patterns and peaking factors for dry and wet weather flows for the tributary area to each flow monitor, as shown on **Figure 3.1**, **Figure 3.2**, and **Figure 3.3**.









LEGEND

Peaking Factor

PRELIMINARY

Note: Detailed flow monitor locations provided in Appendix A

February 15, 2018

Figure 3.1

Hydraulic Model Diurnals

Sewer Master Plan

Marina Coast Water District

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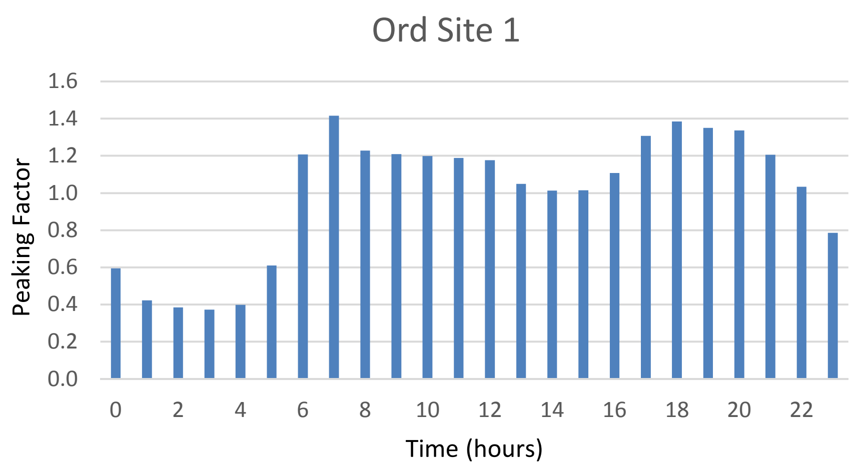
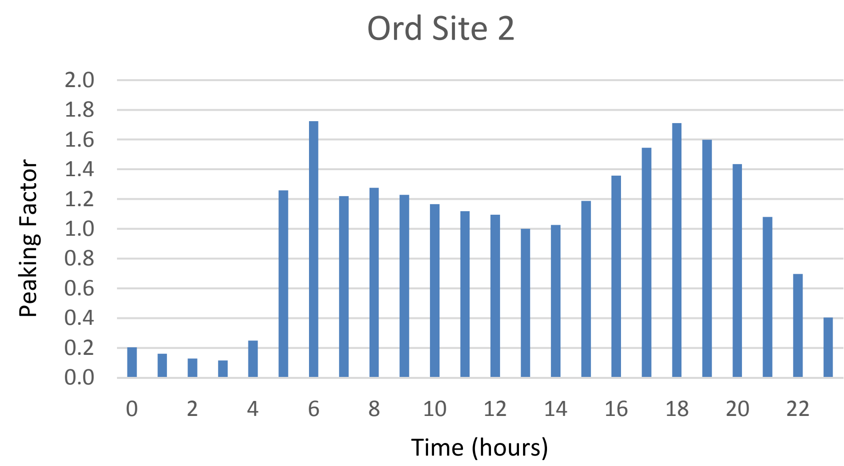
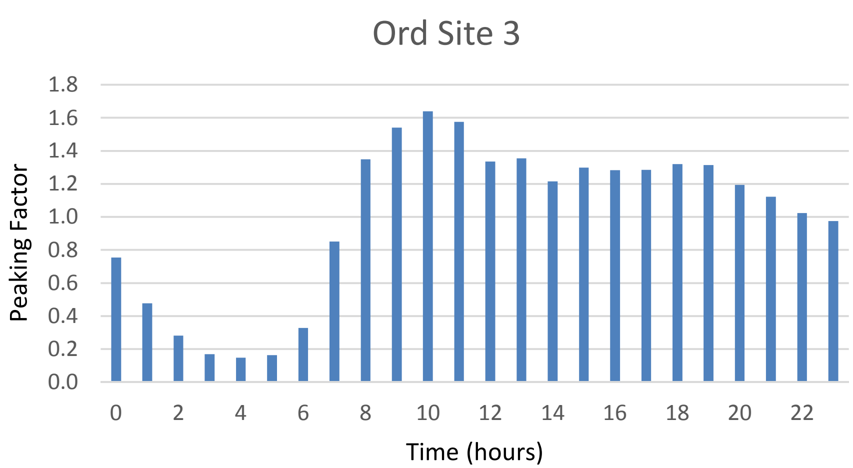
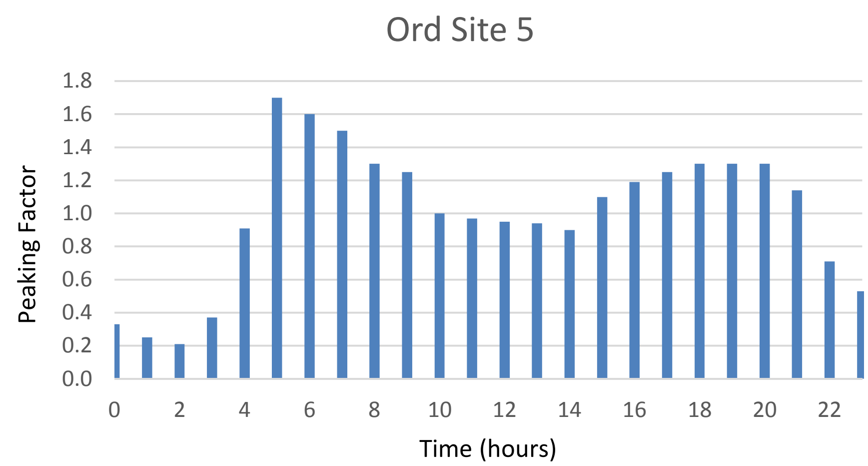








LEGEND

Peaking Factor

PRELIMINARY

Note: Detailed flow monitor locations provided in Appendix A

February 15, 2018

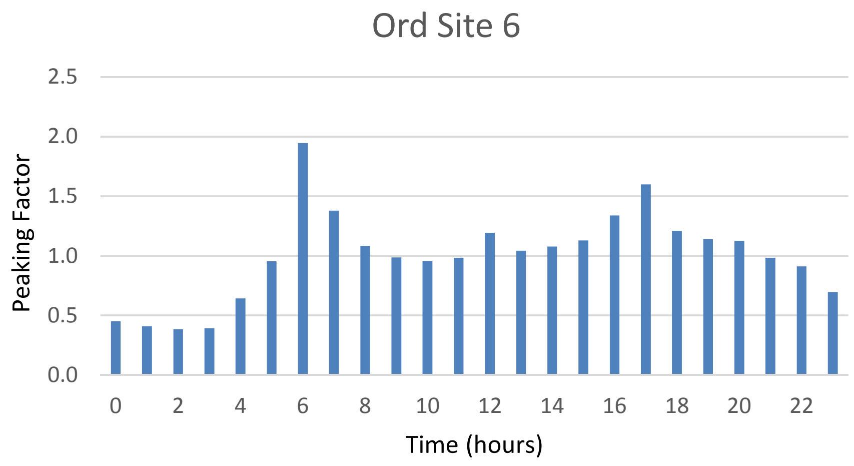
Figure 3.2

Hydraulic Model Diurnals

Sewer Master Plan

Marina Coast Water District

AKEL ENGINEERING GROUP, INC.



LEGEND

PRELIMINARY

Peaking Factor

Note: Detailed flow monitor locations provided in Appendix A

February 15, 2018

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Figure 3.3

Hydraulic Model Diurnals

Sewer Master Plan

Marina Coast Water District

Table 3.2 Return to Sewer Ratios Analysis
Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Land Use Classification	City of Marina			Fort Ord Community			System-Wide	
	Consumption[1,2] (gpd)	Return to Sewer Ratio (%)	Balance to Wastewater Flows (gpd)	Consumption[1,2,3] (gpd)	Return to Sewer Ratio (%)	Balance to Wastewater Flows (gpd)	Return to Sewer Ratio (%)	Balance to Wastewater Flows
Residential								
Residential	1,159,219	0.7	811,453	1,087,160	0.6	652,296	0.7	1,572,465
Subtotal	1,159,219		811,453	1,087,160		652,296		1,572,465
Non-Residential								
Commercial	347,141	0.95	329,784	45,357	0.95	43,090	0.95	372,873
Institutional	5,099	0.85	4,334	134,097	0.85	113,982	0.85	118,316
Irrigation	32,168	0	0	103,348	0	0	0	0
Subtotal	384,407		334,118	282,802		157,072		491,189
Non-Demand Generating								
Open Space	0	0	0	0	0	0	0	0
Designated Open Space	0	0	0	0	0	0	0	0
Other[4]	0	0	0	0	0	0	0	0
Subtotal	0		0	0		0		0
Total Wastewater Flows								
Total ADWF Using Return to Sewer Ratios			**1,145,571**			**809,368**		**2,063,655**
Measured ADWF			**1,140,000**			**800,000**		**1,940,000**

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10/16/2017

Note:
1. Water demand distribution was based on the 2016 Water Billing Records. These demands were verified and do not vary greatly from year to year.
2. Consumption based on 2014 production minus 10% and 10% water loss was in the water distribution system.
3. Consumption Tributary to the Fritzche Lift Station has been removed from the above return to sewer analysis.
4. "Other" land use classification includes non-demand generating land use types, including the Bayonet Golf Course and ROW.

Table 3.3 Sewer Flow Unit Factor Analysis

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Land Use Classification	Existing Development within Service Area (acres)	Average Daily Water Demand: Consumption[1,2] Annual Consumption (gpd)	Unadjusted Unit Factor (gpd/acres)	Balance to Consumption	Existing Average Daily Sewer Unit Factors: Recommended Return to Sewer Ratio	Sewer Flows: Unadjusted Sewer Unit Factor (gpd/acre)	Balance to Existing Conditions (gpd)	Sewer Flows at 100% Occupancy: Vacancy Rate[3,4] (%)	Projected Flows at 100% Occupancy (gpd/acre)	Projected Flows at 100% Occupancy (gpd)	Sewer Unit Factor: Recommended Factor (gpd/acre)	Balance Using Recommended Unit Factor (gpd)
Residential												
Residential	2,560	2,246,565	878	2,246,565	0.67	588	1,505,198	8.0%	635	1,625,614	640	1,638,112
Subtotal	2,560	2,246,565		2,246,565			1,505,198			1,625,614		1,638,112
Non-Residential												
Commercial	345	393,510	1,139	393,510	0.95	1,082	373,834	9.4%	1,184	408,975	1,190	411,079
Institutional	719	139,302	197	139,302	0.85	167	120,154	9.4%	183	131,448	190	136,596
Park	140	136,456	974	136,456	0	0	0	0.0%	0	0	0	0
Subtotal	1,205	669,268		669,268			493,988			540,423		547,675
Non-Demand Generating												
Open Space	0	0	0	0	0	0	0	0.0%	0	0	0	0
Designated Open Space	0	0	0	0	0	0	0	0.0%	0	0	0	0
Other[5]	362	0	0	0	0	0	0	0.0%	0	0	0	0
Subtotal	362	0		0			0			0		0
Totals												
	4,126	**2,915,832**		**2,915,832**			**1,999,186**			**2,166,037**		**2,185,787**

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1/25/2019

Note:

1. Water demand distribution was based on the 2016 Water Billing Records. These demands were verified and their distribution does not vary greatly from year to year.
2. Consumption based on 2014 production minus 10%
3. Residential vacancy rate extracted from California Department of Finance Sheet E-5 published 2016. (Average of City of Marina and City of Seaside : 8.0 % Vacancy Rate).
4. Commercial/Institutional vacancy rate extracted from market study by Cushman and Wakefield, dated first quarter of 2016. Vacancy rates shown are average of rates for the cities of Marina, Del Rey Oaks, Seaside and Sand City.
5. Other Land use classification includes non-demand generating landuse types, including the Bayonet Golf Course and ROW.

Table 3.4 ADWF Sewer Unit Factors

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Land Use Classification	Recommended Factor (gpd/acre)
Residential	**640**
Commercial	**1,190**
Institutional	**190**
Planned Development Mixed Use District[1]	**805**

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11/10/2017

Notes:

1. ADWF Sewer Unit Factor assumes development consists of 70% Residential and 30% Commercial.

3.3 WET WEATHER FLOW CRITERIA

The wet weather flow criteria accounts for the infiltration and inflows (I&I) that seep into the District's sewer system during storm events.

3.3.1 Infiltration and Inflow

Groundwater infiltration and inflow is associated with extraneous water entering the sewer through defects in pipelines and manholes. Infiltration occurs when groundwater rises or the soil is saturated due to seasonal factors such as a storm event which causes an increase in flows in the sewer system. The ground water will enter the sewer system through cracks in the pipes or deteriorating manholes. Inflow occurs when surface water enters the wastewater collection system from storm drain cross connections, manhole covers, or roof/footing drains. **Figure 3.4** was developed by King County, Washington and was included in this chapter to illustrate the typical causes of infiltration and inflow.

There are several accepted methodologies for estimating infiltration and inflows (I&I). These include:

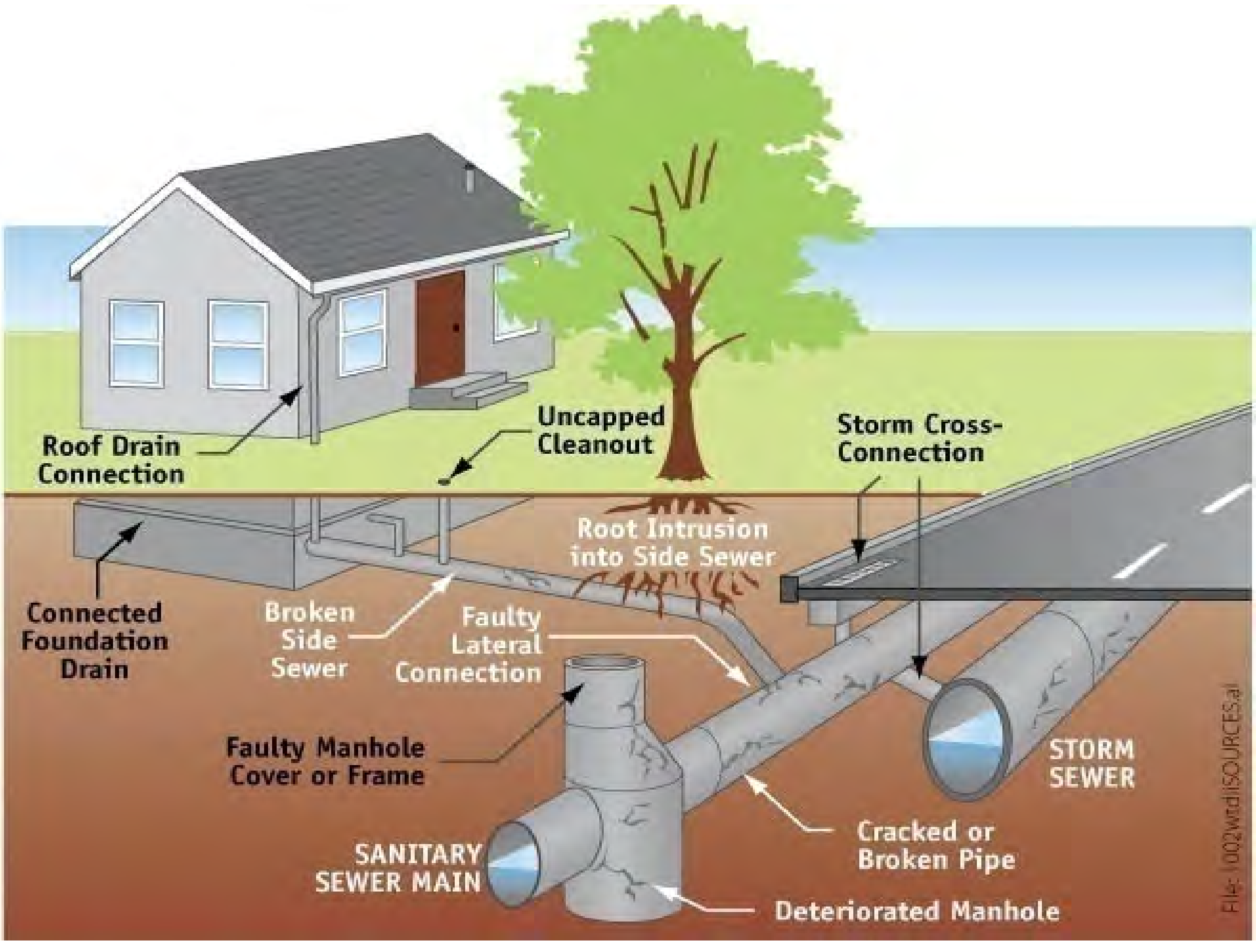
- **Methodology 1.** Based on Acreages. In this methodology, factors that may range between 400 and 1,500 gallons per day (gpd) or more are applied to acreages for estimating the I&I component.
- **Methodology 2.** Based on Linear Feet of Pipe. In this methodology, factors that may range between 12 and 30 or more gallons per day per inch diameter per 100 linear feet (gpd/inch diameter/100LF) are applied to linear feet of gravity sewers.
- **Methodology 3**. Based on a percentage of Average Dry Weather Flows. In this methodology, Infiltration and Inflows (I&I) are calculated based on a percentage of the average dry weather flow.
- **Methodology 4**. Based on flow monitoring data. In this methodology, infiltration and inflows are determined by analyzing flow monitoring data of current and past flow monitoring efforts.

This capacity analysis and master plan based the infiltration and inflow on specific flow monitoring data from the Villalobos and Associates (V&A) 2017 Flow Monitoring Program (**Appendix A**). Thus, the infiltration and inflows are reasonable and reflect the actual behavior of the sewer system.

3.3.2 Sewer System Flow Monitoring

In 2017, V&A's services were used for a temporary flow monitoring program to capture 9 sites during dry and wet weather flows, which are summarized on **Figure 3.5**.

- There were two rain gauges used for the wet weather analysis. The rainfall historical data



Source: King County, WA
http://www.kingcounty.gov/environment/wastewater/II/What.aspx?print=1

LEGEND

Inflow Sources (Black Text)

Infiltration Sources (White Text)

PRELIMINARY

Figure 3.4
Infiltration and Inflow Sources

Sewer Master Plan
Marina Coast Water District

December 13, 2016

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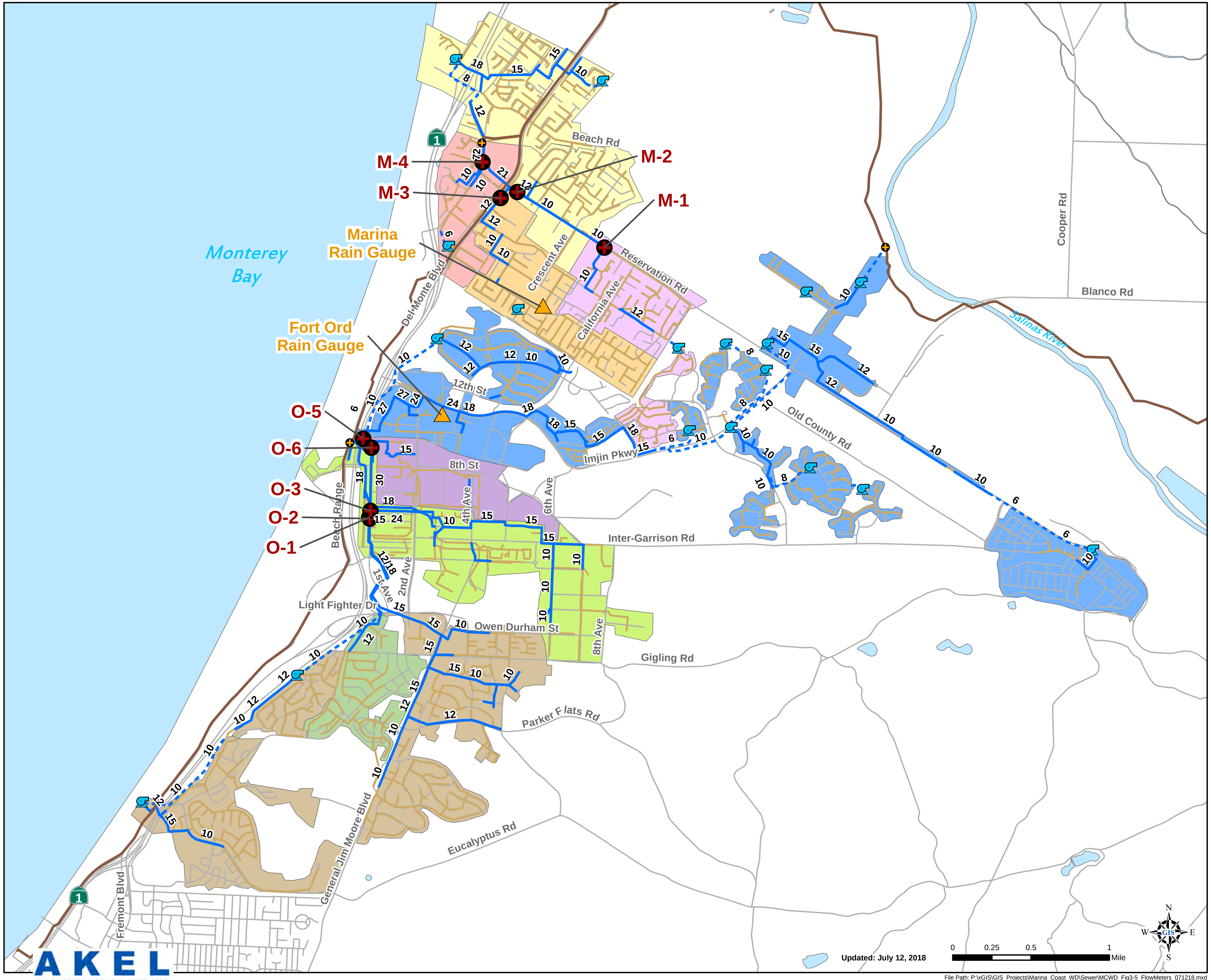

Legend

- Rain Gauge
- Flow Meters

Flow Meter Basins

- M-1
- M-2
- M-3
- M-4
- O-1
- O-2
- O-3
- O-5
- O-6

Existing Modeled System

- Lift Stations
- Outfalls

Gravity Mains by Size

- 8" and Smaller
- 10" and Larger
- Force Mains
- Monterey One Water Interceptor
- Streets
- Waterbodies
- Rivers/Streams

PRELIMINARY

Figure 3.5
Flow Monitoring Program
Sewer Master Plan
Marina Coast Water District

was then determined by weighted average of those two rain gauges. The two rain gauges were located in the City of Marina close to the intersection of Vaughn Avenue and Reindollar Avenue and in the Ord Community near the intersection of Imjin Parkway and Third Avenue. The flow monitoring and rain data were used in this analysis to calibrate the computer hydraulic model to average dry weather flow and wet weather flow conditions.

3.3.3 10-Year 24-Hour Design Storm

A synthetic design storm is typically used to evaluate the sewer collection system's response during wet weather flow conditions. The design storm information was collected from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Volume 6.

- **10-Year Frequency.** Industry standards include design storms that range between 5-year and 20-year events. Based on current regulatory trends, a 10-year storm event was chosen for the District to evaluate the capacity adequacy of the sanitary sewer system.
- **24-Hour Duration.** Peak flows from a storm event are usually cause by brief intense rains, that can happen as part of an individual event or as a portion of a larger storm. The 24-hour storm duration is longer than needed to determine peak flow but aids in identifying infiltration and inflows a sewer system may experience during a storm event.
- **Balanced Rainfall Centered Distribution.** The National Resources Conservation Service, previously known as the Soil Conservation Service, has developed rainfall distributions for wide geographic regions based on traditional Depth-Duration-Frequency (DDF) rainfall data. In this methodology, the highest rainfall intensity is placed at the center of the storm. Incrementally lower intensities are placed on alternating sides of the peak.

Thus, the NOAA Atlas 14 Depth Duration Frequency (DDF), 10-year 24-hour (10yr-24hr) design storm, with a balanced rainfall distribution, was used to evaluate the capacity adequacy of the District's sewer system during wet weather flow conditions.

The selected 10-year 24-hour design storm was further compared to historical storm events used for the calibration process, between January 2017 and February 2017, as shown on **Table 3.5**. The table lists the total rainfall volume, duration, peak hour intensity, and total rainfall depth (if available) for each storm event.

Figure 3.6 is intended to show the diurnal comparison between the design storm and the two storm events experienced during February of 2017. The comparison indicates that, based on the balanced centered hyetograph, the design storm's peak hour value is at 0.60 inches per hour (in/hr), while the February 9th and 19th storms peak values are respectively 0.20 and 0.31 in/hr respectively. This comparison illustrates the more conservative nature of the design storm.

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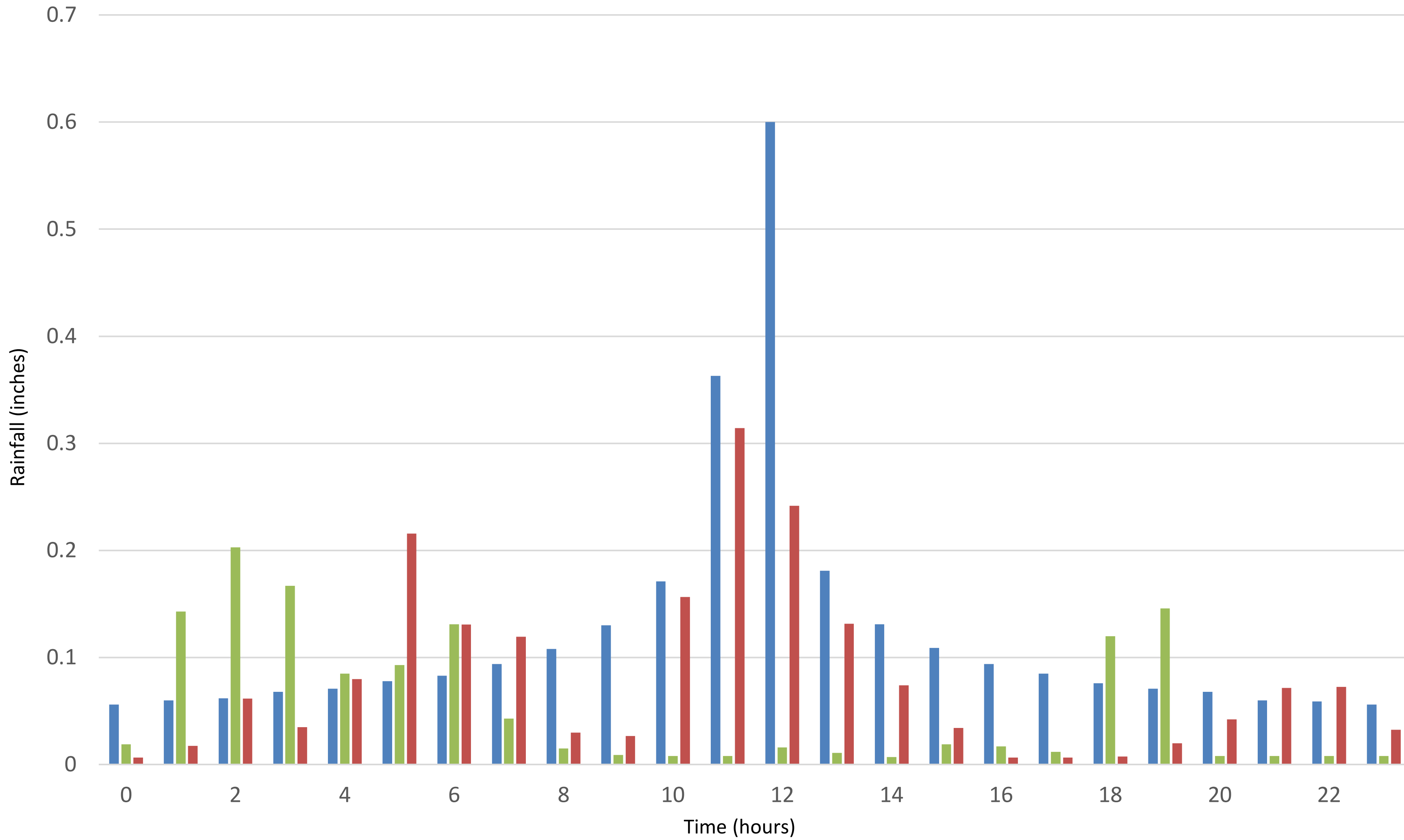

LEGEND

PRELIMINARY

- Design Storm: 10 Year 24 Hour (2.93 in)
- Historical Storm Event 1: February 19-20, 2017 (1.94 in)
- Historical Storm Event 2: February 9-10, 2017 (1.30 in)

Note: Historical storm events based on data recorded at the following locations:

- Fort Ord, Intersection of Imjin Parkway and 3rd Avenue
- Marina, Intersection of Vaughn Avenue and Reindollar Avenue

March 15, 2018

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Figure 3.6

10-Year 24-Hour Storm
(Design vs Historical Storm)

Sewer Master Plan
Marina Coast Water District

Table 3.5 Storm Events Analysis

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Storm Event	Estimated Return Interval	Single Rainfall Event Volume and Intensity[1]	
		Volume (in)	Peak Intensity (in//hr)
Central Marina			
February 9 - February 10, 2017	4-Year 6-Hour	1.30	0.20
February 19 - February 20, 2017	8-Year 12-Hour	1.94	0.31
Ord Community			
February 9 - February 10, 2017	4-Year 6-Hour	1.30	0.21
February 19 - February 20, 2017	10-Year 12-Hour	2.07	0.31
Design Storm	10-Year 24-Hour	**2.93**	0.60

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5/5/2017

Notes:

1. Rainfall volume and peak intensities based on 2017 V&A flow monitoring information.

CHAPTER 4 - EXISTING SEWER COLLECTION FACILITIES

This chapter provides a description of the District's existing sewer system facilities including gravity trunks, force mains, lift stations, and sewer collection basins. The chapter also includes a brief description of the Monterey One Water (M1W) wastewater treatment plant, which treats and disposes of the wastewater for Central Marina and the Ord Community.

4.1 SEWER COLLECTION SYSTEM OVERVIEW

The District provides sewer collection services to approximately 10,000 residential, commercial and institutional accounts. The District's modeled collection system, shown on **Figure 4.1**, consists of approximately 150 miles of gravity sewer pipes that convey flows, via the M1W interceptor pipeline, towards the M1W treatment plant, located north of the City of Marina.

A system-wide pipe inventory, listing the total length by pipe diameter, is shown on **Table 4.1**. This table is based on information extracted from the District's GIS and was updated to reflect the review of construction drawings provided by District Staff. The 8-inch to 15-inch diameter pipes account for more than 80 percent of the total length of sewer pipe.

4.2 SEWER COLLECTION BASINS AND TRUNKS

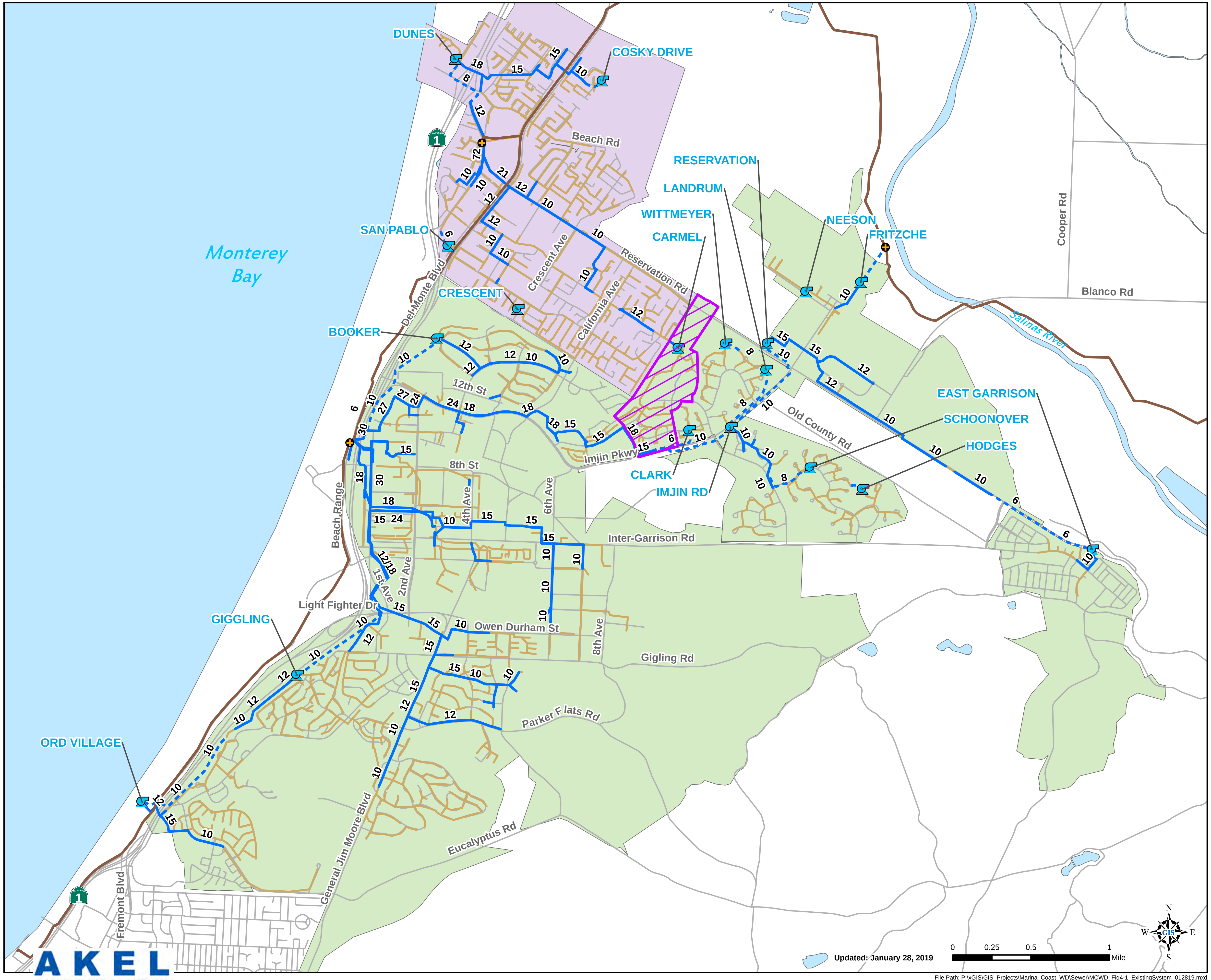
Based on the varying topography and numerous lift stations, the sewer system is divided into multiple collection basins that serve to collect flows from smaller developments and route that flow to larger sewer trunk lines. These basins are based on the areas tributary to the flow monitors installed as part of the 2017 V&A flow monitoring program as discussed in a previous chapter. These collection basins are shown on **Figure 4.2** and summarized in the following section.

4.2.1 M-1 Collection Basin

The M-1 collection basin encompasses approximately 319 acres in the southeast portion of the Central Marina service area, south of Reservation Road and east of Everett Circle. Flows are collected in a 12-inch gravity pipeline along Carmel Avenue before entering the M-2 collection basin. This collection basin also includes flows tributary to the Carmel Lift Station, which are discharged to the 8-inch gravity main on Carmel Avenue at Salinas Avenue.

4.2.2 M-2 Collection Basin

The M-2 collection basin encompasses approximately 700 acres in the north portion of the Central Marina service area, generally north of Reservation Road between Highway 1 and Crescent Avenue. Flows are collected in a 12-inch pipeline along Reservation Road before being conveyed to the M1W interceptor pipeline. This collection basins also includes flows tributary to the Dunes Lift Station and Cosky Lift Station.



File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Sewer\MCWD_Fig4-1_ExistingSystem_012819.mxd

Legend

Existing Modeled System

- Lift Stations
- Outfalls

Gravity Mains by Size

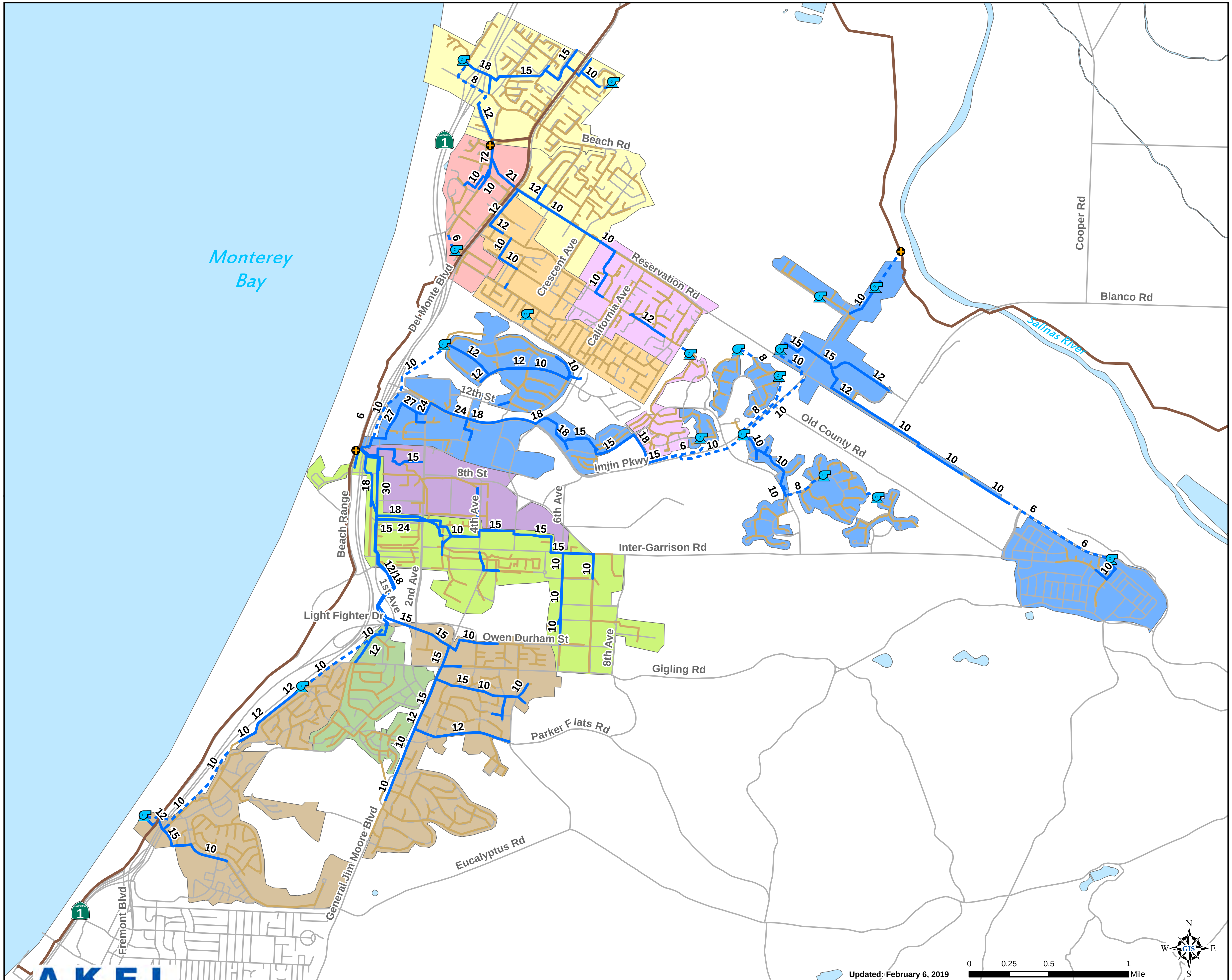
- 8" and Smaller
- 10" and Larger
- Force Mains
- Monterey One Water Interceptor

Cost Centers

- Central Marina
- Ord Community
- Ord Community Service Area Tributary to Central Marina Outfall
- Streets
- Waterbodies
- Rivers/Streams

PRELIMINARY

Figure 4.1
Existing Modeled Sewer System
Sewer Master Plan
Marina Coast Water District



Legend

Existing Modeled System

- Lift Stations
- Outfalls

Gravity Mains by Size

- 8" and Smaller
- 10" and Larger
- Force Mains
- Monterey One Water Interceptor

Collection Basins

- M-1
- M-2
- M-3
- M-4
- O-1
- O-2
- O-3
- O-5
- O-6
- Streets
- Waterbodies
- Rivers/Streams

PRELIMINARY

Figure 4.2
Sewer Collection Basins
Sewer Master Plan
Marina Coast Water District

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ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Sewer\MCWD_Fig4-2_CollectionBasins_020619.mxd

Table 4.1 Existing Pipe Inventory

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Pipe Size (in)	Pipe Length (ft)	(miles)
Gravity Mains		
4	21,503	4.1
6	278,147	52.7
8	321,825	61.0
10	42,988	8.1
12	29,724	5.6
14	669	0.1
15	34,100	6.5
18	13,899	2.6
21	1,415	0.3
24	3,375	0.6
27	4,379	0.8
30	4,326	0.8
54	1,190	0.2
72	486	0.1
Subtotal	**758,026**	**143.6**
Force Mains		
4	4,706	0.9
6	3,914	0.7
8	5,069	1.0
10	19,641	3.7
12	420	0.1
15	349	0.1
18	1,459	0.3
27	40	0.0
42	849	0.2
Subtotal	**33,749**	**6.4**
Total		
	791,775	**150.0**

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7/20/2017

4.2.3 M-3 Collection Basin

The M-3 collection basin encompasses approximately 337 acres in the south portion of Central Marina service area, generally south of Carmel Avenue between Highway 1 and Bayer Drive. Separate 8-inch gravity mains on Reindollar Avenue and Carmel Avenue collect a majority of the collection basin flows before entering a 12-inch gravity main on Del Monte Boulevard, which conveys the flows to the M-2 collection basin. This collection basin also includes flows tributary to the Crescent Lift Station, which are discharged to the 8-inch gravity main on Crescent Avenue south of Reindollar Avenue.

4.2.4 M-4 Collection Basin

The M-4 collection basin encompasses approximately 208 acres in the west portion of the Central Marina service area, generally south of Reservation Road between Highway 1 and Del Monte Boulevard. Flows are collected by an 8-inch and 10-inch gravity mains along Lake Drive before being conveyed to the M1W interceptor pipeline. This collection basin also includes flows tributary to the San Pablo Lift Station, which are discharged to the 8-inch gravity main on Lake Drive at Palm Avenue.

4.2.5 O-1 Collection Basin

The O-1 collection basin encompasses approximately 1,001 acres in the south portion of the Ord Community service area and is generally divided into two sections. The first section collects flows tributary to the existing Fort Ord Village and Gigling lift stations, which are then discharged to an existing 15-inch gravity main on First Avenue at Lightfighter Drive. The second section collects flows east of General Jim Moore Boulevard south of Owen Durham Street, which are ultimately conveyed by a 15-inch gravity main to an existing 15-inch gravity main on First Avenue at Lightfighter Drive. These flows are eventually conveyed to the M1W interceptor pipeline.

4.2.6 O-2 Collection Basin

The O-2 collection basin encompasses approximately 215 acres in the south portion of the Ord Community service area, south of Lighfighter Drive between Luzon Road and General Jim Moore Boulevard. Two separate 8-inch gravity mains along existing right-of-way and California Road collect flows before combining into a 12-inch gravity main in existing right-of-way north of Gigling Road. These flows are eventually conveyed to the M1W interceptor pipeline.

4.2.7 O-3 Collection Basin

The O-3 collection basin encompasses approximately 592 acres in the west portion of the Ord Community service area, generally east of First Avenue and south of 5th Street. Flows are collected by 8-inch, 10-inch, and 15-inch pipelines along Inter-Garrison Road and existing right-of-way before entering an existing 30-inch gravity main on First Avenue. These flows are eventually conveyed to the M1W interceptor pipeline.

4.2.8 O-5 Collection Basin

The O-5 collection basin encompasses approximately 1,217 acres in the northeast portion of the Ord Community service area. This collection basins includes flows from the tributary areas of the following lift stations: East Garrison, Hodges, Schoonover, Wittemeyer, Landrum, Clark, Reservation, Imjin, and Booker. Flows are generally collected by gravity along Imjin Road and existing right-of-way in 15-inch, 18-inch, 24-inch, and 27-inch mains before being conveyed to the M1W interceptor pipeline.

4.2.9 O-6 Collection Basin

The O-6 collection basin encompasses approximately 243 acres in the northwest portion of the Ord Community service area, east of 1st Avenue generally between 9th Street and 5th Street. 8-inch and 15-inch gravity pipelines collect flow along existing right-of-way before being conveyed to the Ord Community outfall.

4.2.10 Monterey One Water Interceptor System

The District's sewer flows are discharged into the M1W interceptor pipeline system, which conveys flows to the M1W treatment plant, located north of the City of Marina.

In addition to flows from Central Marina and the Ord Community the interceptor pipeline system, commonly referred as the Monterey Peninsula Interceptor System collects the flows from the nearby cities of Seaside, Del Rey Oaks, Sand City, Monterey, and Pacific Grove.

4.3 LIFT STATIONS

When routing flows by gravity is not possible due to adverse grades, lift stations are used to pump flows. The District currently maintains fourteen lift stations in the sewer collection system, shown on **Table 4.2** and **Figure 4.3**, which are summarized on the following pages. Additionally, a flow diagram summarizing the connectivity of the existing lift stations is shown on **Figure 4.4**.

- **Ord Village Lift Station.** The lift station, constructed prior to 1960, is located near the end of Beach Range Road and was rehabilitated in 2016. The Ord Village Lift Station was initially installed as a wastewater treatment plant to treat flows generated by the Ord Community. The lift station includes 2 duty pumps and 1 standby pump that are each rated at 960 gpm. The pumps discharge into a 10-inch force main that conveys flows northwest toward Monterey Road.

- **Gigling Lift Station.** The lift station is located at the intersection of Okinawa Road and Noumea Road and was built in 2016. The lift station includes 2 duty pumps and 1 standby pump that are each rated at 874 gpm. The pump discharges into a 10-inch force main that conveys flows northeast along Cabrillo Highway.

- **Hatten Lift Station.** The lift station is located at the southern end of Hatten Road and was built in 1966. The lift station includes 1 duty pump and 1 standby pump that are both rated

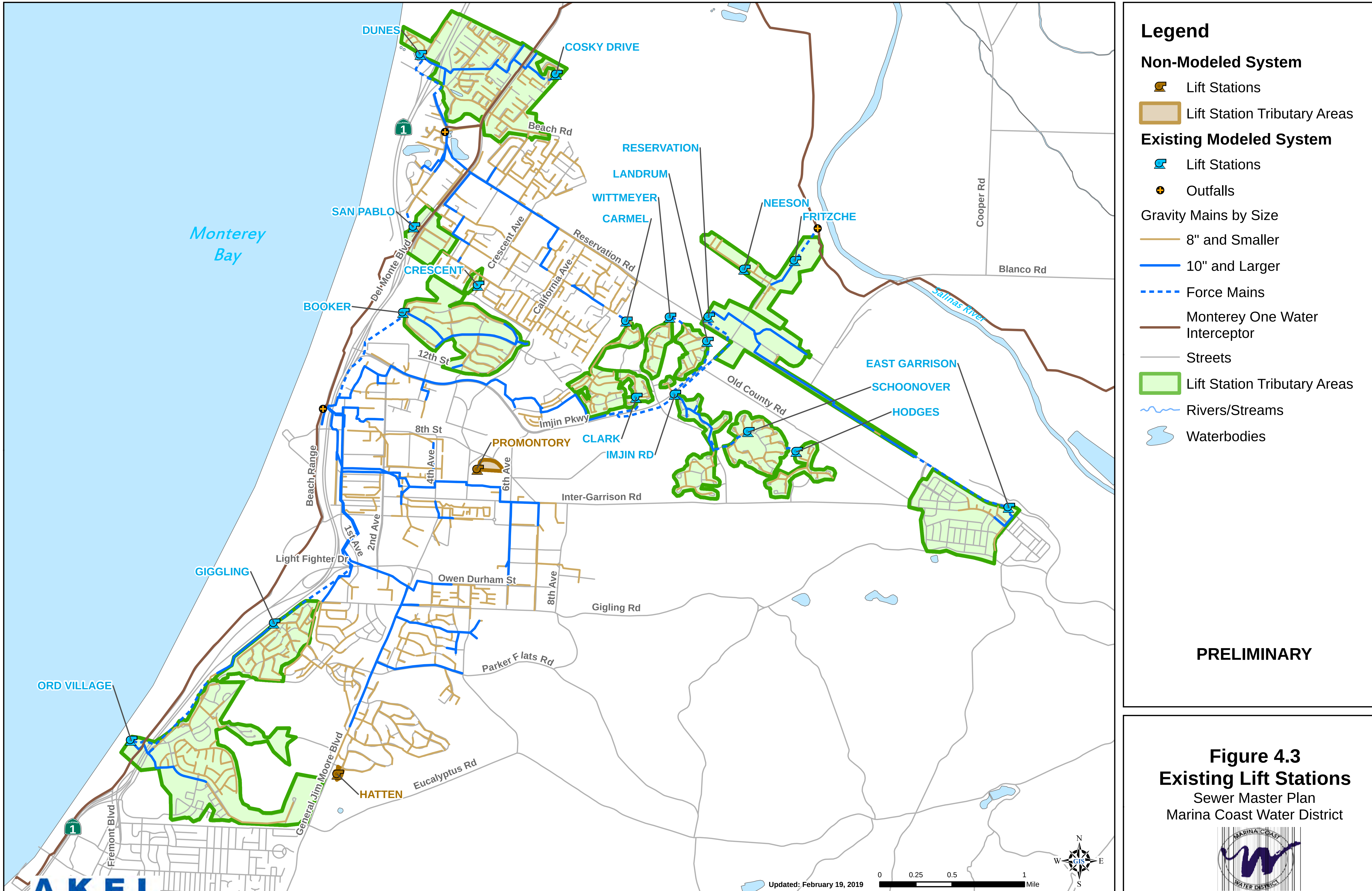
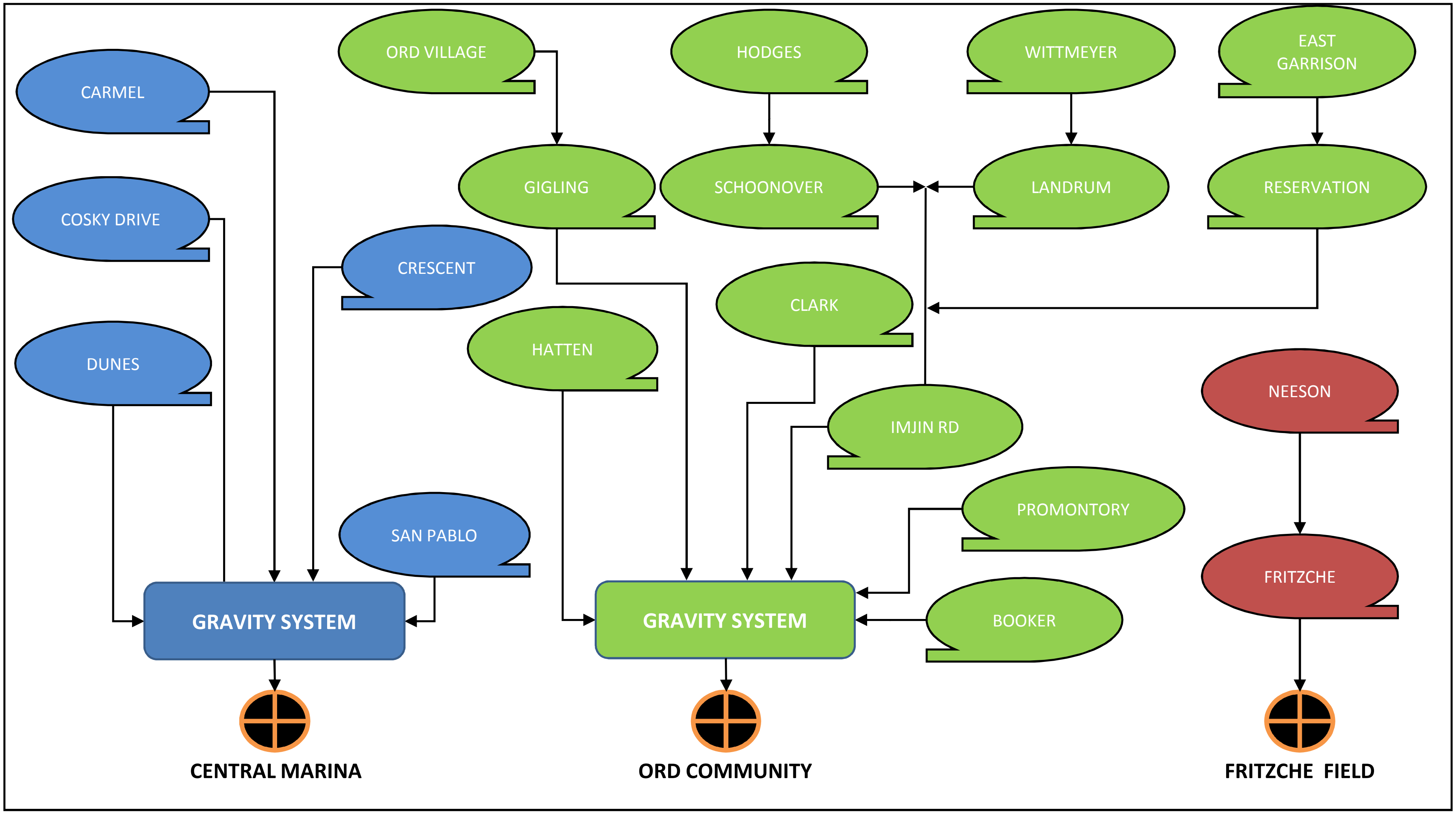


Figure 4.3
Existing Lift Stations
Sewer Master Plan
Marina Coast Water District



LEGEND

PRELIMINARY

Wastewater Outfall

Gravity Main System

Central Marina

Wastewater Lift Station

Ord Community

Wastewater Trunks

Fritzche Field

January 16, 2019

Figure 4.4

Lift Station Connectivity Schematic

Sewer Master Plan

Marina Coast Water District

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Table 4.2 Lift Station Inventory

Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Lift Station Information			Wet Well Dimensions [1]				Pumps [5]				Pump Controls [3]					
No.	Location	Type	Diameter (ft)	Length (ft)	Width (ft)	Depth (ft)	Quantity	Capacity (mgd)	Capacity (gpm)	TDH (ft)	Lead On (ft)	Lead Off (ft)	Lag 1 On (ft)	Lag 1 Off (ft)	Lag 2 On (ft)	Lag 2 Off (ft)
Ord Community																
Fritzche Field	Fritzsche Field North	Submersible		8.0	8.0	11.0	2	2 @ 0.23	2 @ 160	44	4.5	2.5	5.0	2.5		
Promontory	8th Street	Submersible	6			21.0	2	2 @ 0.13	2 @ 93	50.9	4.5	2.5	5.0	2.5		
Carmel	Carmel Avenue	Submersible	6			22.0	2	2 @ 0.37	2 @ 254	23	5.5	2.0	6.0	2.5		
East Garrison	Reservation Rd	Submersible	8			18.0	2	2 @ 0.53	2 @ 370	100	5.0	2.0	5.5	2.0		
Ord Village	End of Beach Range Road	Dry Pit		12.0	6.0	11.0	4	3 @ 1.38 Sump @ 0.07	3 @ 960 Sump @ 50	3 @ 162	5.0	2.2	5.2	2.4	5.4	2.5
Wittemeyer	North of Wittemeyer Court	Submersible	6			16.0	2	2 @ 0.2	2 @ 140	36	4.0	2.0	5.0	2.5		
Booker	End of Booker Street	Dry Pit		13.0 8.0	6.0 8.0	20.0 17.0	3	2 @ 1.09 Sump @ 0.07	2 @ 760 Sump @ 50	2 @ 64	5.0	2.0	5.0	2.0		
Clark	Brostrum Drive at Clark Court	Submersible	6			16.0	2	2 @ 0.37	2 @ 260	86.5	4.0	2.0	4.5	2.0		
Neeson	Neeson Road/ Marina Airport	Submersible		6.6	6.0	16.0	1	0.29	200	13.2	Floats					
Landrum	Landrum Court	Submersible	7			24.0	2	2 @ 0.50	2 @ 350	48	7.0	2.0	7.3	2.0		
Imjin	Imjin at Abrams	Submersible	8			12.0	2	2 @ 1.00	2 @ 700	62.5	4.5	1.7	5.0	2.0		
Schoonover	Schoonover at Warrelman	Submersible	7			22.0	2	2 @ 0.68	2 @ 470	69.5	6.5	2.0	7.0	2.0		
Hatten	Hatten Road	Submersible	3			10.0	2	2 @ 0.06	2 @ 40		Floats					
Gigling	Okinawa and Noumea Road	Dry Pit		22.0	8.0	16.0	4	3 @ 1.26 Sump @ 0.07	3 @ 874 Sump @ 50	3 @ 115	7.5	4.0	7.7	4.0	8.0	4.0
Reservation	Reservation Road 1,125 ft nw/o Imjin	Submersible	8			24.0	2	2 @ 1.02	2 @ 710	68	4.6	2.5	6.0	4.0		
Hodges	Hodges Court	Submersible	6			13.0	2	2 @ 0.14	2 @ 95	41	5.5	3.0	6.0	3.0		
Central Marina																
Dunes	Dunes Drive	Submersible	7			20.0	2	2 @ 1.00	2 @ 700	71	7.5	2.8	8.0	2.8		
San Pablo	San Pablo Ct	Submersible	6			19.9	2	2 @ 0.29	2 @ 200	26	5.5	2.0	5.8	2.0		
Cosky	Cosky Drive	Submersible	6			13.9	2	2 @ 0.31	2 @ 216	42.9	3.5	2.0	4.0	2.0		
Crescent	Crescent Street	Submersible	5.0			11.0	2	2 @ 0.14	2 @ 100	28	4.5	2.0	5.0	2.0		

3/1/2019

Notes:

1. From "Lift Station Inventory Table" received 01/20/2017.
2. Information extrated from "MVWD EOC Charts", Infrastructure inventories, received 12/14/2016.
3. From "Lift Station Inventory Table" received 01/20/2017.
4. Based on information received from District March 2, 2018.
5. Updated inventory information received from MCWD Staff on March 1, 2019.

at 40 gpm. The pump discharges into a 6-inch force main that conveys flows north towards Arloncourt Road. This lift station is not included in the hydraulic model.

- **Promontory Lift Station.** This lift station is located on the Promontory student housing facility, southeast of the intersection of 5th Avenue and 8th Street. This lift station includes 1 duty pump and 1 standby pump that are both rated at 93 gpm. The pump discharges into two parallel 3-inch force mains that convey flows south toward Inter-Garrison Road. This lift station is not included in the hydraulic model.

- **Hodges Lift Station.** The lift station is located at Hodges Court and was built in 1989. The lift station includes 1 duty pump and 1 standby pump that are both rated at 94 gpm. The pump discharges into a 4-inch force main that conveys flows west towards Sherman Court.

- **Fritzche Field Lift Station.** The lift station is located at Fritzche Field North. The lift station includes 1 duty pump and 1 standby pump that are both rated at 160 gpm. The pump discharges into a 6-inch force main that conveys flows north along existing right-of-way..

- **East Garrison Lift Station.** The lift station is located at the intersection of Reservation Road and East Garrison Road and was built in 1999. The lift station includes 1 duty pump and 1 standby pump that are both rated at 370 gpm. The pump discharges into a 6-inch force main that conveys flows east along Reservation Road.

- **Wittemeyer Lift Station.** This lift station is located at the intersection of Reservation Road and East Garrison Road and was built in 1985. The lift station includes 1 duty pump and 1 standby pump that are both rated at 140 gpm. The pump discharges into a 4-inch force main that conveys flows east towards Bandholtz Court.

- **Carmel Lift Station.** This lift station is located on Carmel Avenue and was built in 2007. The lift station includes 1 duty pump and 1 standby pump that are both rated at 254 gpm. The pump discharges into a 6-inch force main that conveys flows along Carmel Avenue.

- **Booker Lift Station.** This lift station is located approximately 100 feet west of the intersection of Booker Street and Hayes Circle and was built in 1966. The lift station includes 1 duty pump and 1 standby pump that are both rated at 760 gpm. The pump discharges into a 10-inch force main that conveys flows south along State Highway 1.

- **Clark Lift Station.** This lift station is located at the intersection of Brostrom Drive and Clark Court and was rehabilitated in 2016. The lift station includes 1 duty pump and 1 standby pump that are both rated at 260 gpm. The pump discharges into a 6-inch force main that conveys flows west along Imjin Road.

- **Neeson Lift Station.** This lift station is located at the intersection of Neeson Road and Foxtrot Street. The lift station includes a duty pump that is rated at 400 gpm. The pump discharges into an 8-inch force main that conveys flows north along Foxtrot Street.

- **Landrum Lift Station.** This lift station is approximately located at the northeast end of Landrum Court and was rehabilitated in 2006. The lift station includes 1 duty pump and 1 standby pump that are both rated at 350 gpm. The pump discharges into an 8-inch force main that conveys flows west along Imjin Road.
- **Imjin Lift Station.** This lift station is located approximately 700 feet east of the intersection of Imjin Parkway and Abrams Drive. The Imjin lift station was built in 1970 and includes 1 duty pump and 1 standby pump that are both rated at 700 gpm.. The pump discharges into a 10-inch force main that conveys flows west along Imjin Road.
- **Schoonover Lift Station.** This lift station is located approximately 100 feet west of the intersection of Schoonover Road and Warrelman Court. The lift station includes 1 duty pump and 1 standby pump that are both rated at 470 gpm. The pump discharges into an 8-inch force main that conveys flows west along Schoonover Road.
- **Reservation Lift Station.** This lift station is located approximately 1,000 feet west of the intersection of Reservation Road and Imjin Parkway and was built in 1998. The lift station includes 1 duty pump and 1 standby pump that are both rated at 710 gpm. The pump discharges into a 10-inch force main that conveys flows east along Reservation Road.
- **Dunes Lift Station (#2).** This lift station, originally constructed in 1969, is located on Dunes Drive and was rehabilitated in 1987. The lift station was reconstructed in 2016, and along with the force main alignment, was moved to the west side of Highway 1. The lift station includes 1 duty pump and 1 standby pump that are both rated at 700 gpm. The pump discharges into an 8-inch force main that conveys flows west along Reservation Road.
- **San Pablo Lift Station (#3).** This lift station, originally constructed in 1959, is located on San Pablo Court and was rehabilitated in 2000. The lift station includes 1 duty pump and 1 standby pump that are both rated at 200 gpm. The pump discharges into a 6-inch force main that conveys flows north along Lake Drive.
- **Cosky Drive Lift Station (#5).** This lift station, originally constructed in 1969, is located approximately 300 feet east of the intersection of Michael Drive and Cosky Drive and was rehabilitated in 2016. The lift station includes 1 duty pump and 1 standby pump that are both rated at 216 gpm. The pump discharges into a 6-inch force main that conveys flows west along Cosky Drive.
- **Crescent Lift Station (#6).** This lift station is located approximately 300 feet north of the intersection of Patton Parkway and Crescent Street and was built in 1977 and rehabilitated in 2012. The lift station includes 1 duty pump and 1 standby pump that are both rated at 100 gpm. The pump discharges into a 6-inch force main that conveys flows north of Crescent Street

Table 4.2 lists each lift station with relevant information obtained from the District's records including: lift station number, location, wet well dimensions, and number of pumps and respective capacities. The lift stations are operated to turn "on" or "off" based on the levels in their wet wells.

4.4 MONTEREY ONE WATER WASTEWATER TREATMENT PLANT

Sewer flows from the Central Marina and Ord Community service areas are conveyed to the Monterey One Water interceptor, commonly referred to as the Peninsula Interceptor System. Flows are conveyed through this interceptor to the Monterey One Water regional treatment plant (formerly MRWPCA). The Ord Community service area discharges to the Monterey One Water interceptor through a parshall flume located at the headworks of the decommissioned Main Garrison Wastewater Treatment Plant. The Central Marina service area discharges to the M1W 72-inch diameter forebay pipe and lift station near the intersection of Reservation Road and Dunes Drive. The lift station pumps the sewage into the M1W interceptor pipeline that flows into the M1W wastewater treatment plant.

M1W wastewater treatment plant treats on average 18.5 mgd of sewer flows, collecting flows from 12 different entities including the cities of Pacific Grove, Monterey, Seaside, Sand City, Del Rey Oaks, and Marina. The construction of the wastewater treatment plant began in the late 1980s. The wastewater treatment plant currently services approximately 250,000 people on the Monterey Peninsula.

CHAPTER 5 –EXISTING AND BUILDOUT SEWER FLOWS

This chapter summarizes historical sewer flows experienced at the Monterey One Water WWTP and defines flow terminologies relevant to this evaluation. This chapter discusses the wastewater flow distribution within the collection basins and identifies the design flows used in the hydraulic modeling effort and capacity evaluation. The design flows include the flows due to existing conditions and buildout development conditions.

5.1 FLOWS AT THE MONTEREY ONE WATER INTERCEPTOR

The wastewater flows collected for the Central Marina and Ord Community service areas are discharged to the M1W interceptor. The parshall flume located at the decommissioned Main Garrison Wastewater Treatment plant records the daily wastewater flows collected throughout the Ord Community service area, while a lift station located near the intersection of Reservation Road and Dunes Drive records the daily wastewater flows collected throughout the Central Marina service area. Figure 5.1 shows the monthly flows for both service areas, including the Central Marina and the Ord Community versus rainfall at the for year 2015. January, February, March and April were also the maximum months during 2015, due to the considerable amount of rain received those months.

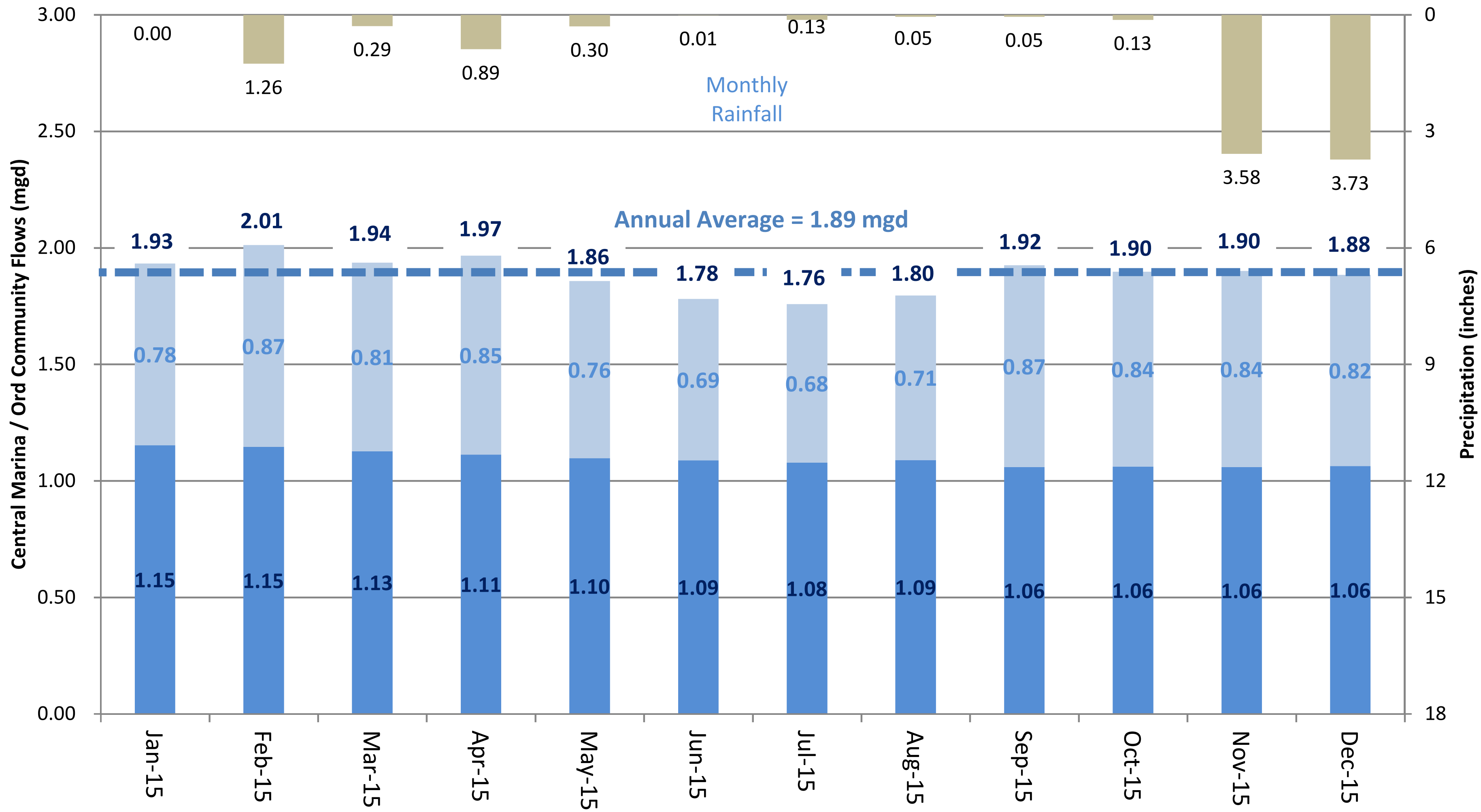
Flow data influent to the M1W interceptor was obtained from District and M1W operation staff. The flow data covered a period from 2009 to 2016. From this data monthly, daily, and peak daily flows, were determined as summarized on Table 5.1 and Table 5.2.

The following definitions are intended to document relevant terminologies shown on Table 5.1:

- **Average Annual Flow (AAF).** The average annual flow is the total annual flow, or average monthly flow, for a given year, expressed in daily or other time units. This flow includes the combined average of the average dry weather flow (ADWF) and average wet weather flow (AWWF).

- **Average Dry Weather Flow (ADWF).** The average dry weather flow occurs on a daily basis during the dry weather season, with no evident reaction to rainfall. The ADWF also includes the Base Wastewater Flow (BWF). The base wastewater flow is the average flow that is generated by residential, commercial, and industrial users. The flow pattern from these users varies depending on land use types.

- **Average Wet Weather Flow (AWWF).** This average wet weather flow occurs on a daily basis during the wet weather season. In addition to the flow components in the ADWF, the AWWF includes infiltration and inflow from storm rainfall events.



LEGEND

Central Marina Monthly Flows

2015 Average Flow

Ord Community Monthly Flows

Rainfall

PRELIMINARY

October 13, 2017

Figure 5.1

2015 Monthly Flows

Sewer Master Plan

Marina Coast Water District

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Table 5.1 Historical Data - Central Marina Outfall

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Year	Average Annual Flow (AAF) (mgd)	Percentage Change	Seasonal Average ADWF[1] (mgd)	Seasonal Average AWWF[2] (mgd)	Maximum Month MMDWF (mgd)	Maximum Month MMWWF (mgd)	Maximum Day MDDWF (mgd)	Maximum Day MDWWF (mgd)
Historical Flows								
2009	1.21		1.21	1.21	1.23	1.23	1.35	1.36
2010	1.22		1.22	1.23	1.26	1.28	1.38	1.42
2011	1.21		1.21	1.20	1.22	1.23	1.30	1.33
2012[3]	1.17		1.17	1.17	1.18	1.19	1.31	1.32
2013[3]	1.17		1.17	1.17	1.18	1.19	1.28	1.39
2014	1.14		1.14	1.14	1.15	1.16	1.23	1.26
2015	1.09		1.08	1.10	1.10	1.15	1.20	1.38
2016	1.09		1.09	1.10	1.10	1.11	1.19	1.27
Historical Peaking Factors (Applied to ADWF)								
2009			1.00	1.00	1.01	1.01	1.12	1.12
2010			1.00	1.00	1.03	1.05	1.13	1.16
2011			1.00	0.99	1.01	1.02	1.07	1.10
2012[3]			1.00	1.00	1.01	1.02	1.11	1.12
2013[3]			1.00	1.00	1.01	1.02	1.09	1.19
2014			1.00	1.00	1.01	1.02	1.08	1.11
2015			1.00	1.02	1.01	1.06	1.11	1.28
2016			1.00	1.01	1.01	1.02	1.09	1.17

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Notes:

1. Dry weather months include months from May to September.
2. Wet weather months include months from October to April.
3. Year 2012 and 2013 statistics shown in grey due to incomplete data. Values shown are 2011 and 2014 average.
4. Definitions are as follows:

AAF - Average Annual Flow (annual flow, expressed in daily or other time units)
ADWF - Average Dry Weather Flow (average flow that occurs on a daily basis during the dry weather season)
AWWF - Average Wet Weather Flow (average flow that occurs on a daily basis during the wet weather season)
MMDWF - Maximum Month Dry Weather Flow (maximum month flow during the dry weather season)
MMWWF - Maximum Month Wet Weather Flow (maximum month flow during the wet weather season)
MDDWF - Maximum Day Dry Weather Flow (highest measured daily flow that occurs during a dry weather season)
MDWWF - Maximum Day Wet Weather Flow (highest measured daily flow that occurs during a wet weather season)

Table 5.2 Historical Data - Ord Community Outfall

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Year	Average Annual Flow (AAF) (mgd)	Percentage Change	Seasonal Average ADWF[1] (mgd)	Seasonal Average AWWF[2] (mgd)	Maximum Month MMDWF (mgd)	Maximum Month MMWWF (mgd)	Maximum Day MDDWF (mgd)	Maximum Day MDWWF (mgd)
Historical Flows								
2009	0.91		0.89	0.92	0.94	0.96	0.97	1.00
2010	0.90		0.87	0.92	0.96	0.98	0.99	0.99
2011	0.90		0.88	0.91	0.94	0.96	0.98	1.03
2012[3]	0.87		0.84	0.90	0.91	0.94	1.05	0.96
2013[3]	0.87		0.84	0.90	0.91	0.94	0.94	1.00
2014	0.85		0.80	0.88	0.88	0.93	0.90	0.98
2015	0.79		0.74	0.83	0.87	0.87	0.88	0.93
2016	0.85		0.83	0.88	0.90	0.91	0.94	0.95
Historical Peaking Factors (Applied to ADWF)								
2009			1.00	1.04	1.06	1.08	1.09	1.13
2010			1.00	1.05	1.09	1.11	1.13	1.13
2011			1.00	1.04	1.07	1.09	1.11	1.17
2012[3]			1.00	1.07	1.08	1.12	1.25	1.14
2013[3]			1.00	1.07	1.08	1.12	1.12	1.18
2014			1.00	1.10	1.10	1.16	1.13	1.22
2015			1.00	1.12	1.17	1.17	1.19	1.25
2016			1.00	1.06	1.08	1.09	1.13	1.15

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Notes :

1. Dry weather months include months from May to September.
2. Wet weather months include months from October to April.
3. Year 2012 and 2013 statistics shown in grey due to incomplete data. Values shown are 2011 and 2014 average.
4. Definitions are as follows:

AAF - Average Annual Flow (annual flow, expressed in daily or other time units)

ADWF - Average Dry Weather Flow (average flow that occurs on a daily basis during the dry weather season)

AWWF - Average Wet Weather Flow (average flow that occurs on a daily basis during the wet weather season)

MMDWF - Maximum Month Dry Weather Flow (maximum month flow during the dry weather season)

MMWWF - Maximum Month Wet Weather Flow (maximum month flow during the wet weather season)

MDDWF - Maximum Day Dry Weather Flow (highest measured daily flow that occurs during a dry weather season)

MDWWF - Maximum Day Wet Weather Flow (highest measured daily flow that occurs during a wet weather season)

- **Maximum Month Dry Weather Flow (MMDWF).** This maximum month flow occurs during the dry weather season.
- **Maximum Month Wet Weather Flow (MMWWF).** This maximum month flow occurs during the wet weather season.
- **Maximum Day Dry Weather Flow (MDDWF).** This is the highest measured daily flow that occurs during a dry weather season.
- **Maximum Day Wet Weather Flow (MDWWF).** This is the highest measured daily flow that occurs during a wet weather season.
- **Peak Dry Weather Flow (PDWF).** This is the highest measured hourly flow that occurs during a dry weather season.
- **Peak Wet Weather Flow (PWWF).** This is the highest measured hourly flow that occurs during a wet weather season.

Table 5.1 shows the historical sewer flows for Central Marina while Table 5.2 shows the historical sewer flows for the Ord Community. The average annual flows for the Central Marina have decreased from 1.21 mgd in 2009 to 1.09 mgd in 2016, which is a decrease of approximately 9.7%. The average annual flows for the Ord Community have decreased from 0.91 mgd in 2009 to 0.85 mgd in 2016, which is a decrease of 6%.

In addition to listing the 2009-2016 flows, and for comparison purposes, the table calculates the peaking factors applied to the corresponding average dry weather flows (ADWF) for each year. During wet weather flows in 2016, the maximum daily volume (MDWWF) contributed by the City of Marina at the outfall was 1.17 times higher than the average dry weather flow for the same year. During wet weather flows in 2016, the maximum daily volume contributed by the Ord Community was 1.15 times higher than the average dry weather flow for the same year.

5.2 EXISTING SEWER FLOWS BY MONITORING BASIN

The existing sewer flows represented in this Master Plan were based on the District's water consumption billing records. The number of acres and corresponding wastewater flows, by sewer collection basin, are summarized on Table 5.3. These basins correspond to flow monitor collection basins discussed in a previous chapter. Below is a description of the existing average annual flows of the nine basins delineated for the development of this Master Plan.

- **Central Marina Basin M-1.** This basin includes 20 percent of the total acres and 11 percent of the existing dry weather flows generated by the City of Marina.
- **Central Marina Basin M-2.** This basin includes 45 percent of the total acres and 49 percent of the existing dry weather flows generated by the City of Marina.

Table 5.3 Existing Average Dry Flows by Basin

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Basin ID	Area [1]		Average Dry Weather Flows	
	Acres	Percent of Total	Flows (mgd)	Percent of Total
Central Marina				
M-1	306	20%	0.11	11%
M-2	689	45%	0.51	49%
M-3	348	23%	0.26	25%
M-4	178	12%	0.17	16%
Subtotal	**1,522**	**100%**	**1.06**	**100%**
Ord Community				
O-1	1,016	31%	0.40	40%
O-2	230	7%	0.07	7%
O-3	636	20%	0.18	18%
O-4	*Removed from the analysis*			
O-5	1,173	36%	0.34	34%
O-6	174	5%	0.02	2%
Subtotal	**3,229**	**100%**	**1.01**	**100%**
Total	**4,751**		**2.06**	

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Note:

1. Area shown represents developed parcels within meter tributary area.
2. Meter O-4 was initially installed on a pipeline that had no flow. District staff elected not to reinstall the meter and received in leiu services.

- **Central Marina Basin M-3.** This basin includes 23 percent of the total acres and 25 percent of the existing dry weather flows generated by the City of Marina,

- **Central Marina Basin M-4.** This basin includes 12 percent of the total acres and 16 percent of the existing dry weather flows.

- **Ord Community Basin O-1.** This basin includes 31 percent of the total acres and 40 percent of the existing dry weather flows.

- **Ord Community Basin O-2.** This basin includes 45 percent of the total acres and 49 percent of the existing dry weather flows.

- **Ord Community Basin O-3.** This basin includes 26 percent of the total acres and 25 percent of the existing dry weather flows.

- **Ord Community Basin O-5.** This basin includes 36 percent of the total acres and 34 percent of the existing dry weather flows.

- **Ord Community Basin O-6.** This basin includes 5 percent of the total acres and 2 percent of the existing dry weather flows.

5.3 FUTURE SEWER FLOWS

Future sewer flows were projected using unit factors for residential and non-residential land uses and included the developments within the Future Service Area, as identified in Chapter 2. These flows were used in sizing future infrastructure facilities, include gravity and force mains as well as lift stations. Flows were also used for allocating and reserving capacities in the existing or proposed facilities. The following sections document the future sewer flows based on the development limits prepared by FORA as well as the buildout development horizon.

5.3.1 Near-Term Sewer Flows

The potential development area associated with the FORA development limits was previously summarized on Table 2.2. Using the sewer factors for residential and non-residential land uses the future average dry weather flows for the near-term developments are summarized on Table 5.4. The total average annual sewer flows due to the near-term developments is estimate to be 0.7 mgd.

5.3.2 Buildout Sewer Flows

Table 5.5 documents the total acreages for residential and non-residential land use, and the undeveloped lands designated for urbanization. The undeveloped lands were multiplied by the corresponding unit flow factor to estimate the future sewer flows. The 2017 flows were increased to 2.2 mgd to account for 100% occupancy, and the ultimate buildout flows were calculated at 5.1 mgd.

Table 5.2 Near-Term Development Flows

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Development Areas	Development Limits[1]			Estimated Development Area				Estimated Average Dry Weather Flow[5]
	Residential	Office, Industrial, Commercial	Hotel	Residential[2]	Office, Industrial, Commercial[3]	Hotel[4]	Total	
	(du)	(sf)	(rooms)	(acres)	(acres)	(acres)	(acres)	(mgd)
1	2	3	4	5	6	7	8	10
Campus Town Specific Plan	388	180,000	300	48.5	6.9	2.5	57.9	0.04
Cypress Knolls	712	0	0	89.0	0.0	0.0	89.0	0.06
Del Rey Oaks	691	400,000	550	86.4	15.3	38.6	140.2	0.12
Dunes Phase 1, 2, & 3	847	1,049,000	394	105.9	40.1	12.9	158.9	0.13
East Garrison	721	102,000	0	90.1	3.9	0.0	94.0	0.06
Main Gate	145	150,000	350	18.1	5.7	7.8	31.6	0.03
City of Monterey	0	937,800	0	0.0	35.9	0.0	35.9	0.04
Sea Haven	929	0	0	116.1	0.0	0.0	116.1	0.07
Seaside East	310	90,000	0	38.8	3.4	0.0	42.2	0.03
Seaside Resort	122	10,000	398	15.3	0.4	16.8	32.4	0.03
UC MBEST	240	1,090,000	0	30.0	41.7	0.0	71.7	0.07
Nurses Barracks	40	0	0	5.0	0.0	0.0	5.0	0.00
Total	**5,105**	**4,008,800**	**1,992**	**643.1**	**153.4**	**78.5**	**875.0**	**0.68**

8/27/2019

Notes:

1. Development limits based on development Forecasts documented in FORA "FY 2018-2019 Capital Improvement Program", Table 6 and Table 7 and reflect remaining entitlements.
2. Residential acreage estimated based on average residential density of 8 dwelling units per acre.
3. Office, Industrial, and Commercial acreage estimated bsaed on average floor-area-ratio of 0.6.
4. Acreage for hotel development estimated based on available planning information and County of Monterey parcel database.
5. Estimated demand based on residential and non-residential unit factors consistent with master plan unit factors.

Table 5.5 Average Daily Sewer Flows
Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Land Use Classifications	Buildout Sewer Flows														
	Existing Development			Future Development within Study Area								Future Development Ouside of Future Study Area			Total	
	Existing Development - Unchanged	Sewer Unit Factor	Average Daily Flow	New Lands - Redevelopment	New Development: Inside Existing Service Area	New Development: Outside Existing Service Area	Subtotal Future Development	Sewer Unit Factor	Average Daily Flow	Total Development at Buildout of Study Area	Total Average Daily Flow	Development Outside of Future Study Area	Sewer Unit Factor	Average Daily Flow	Total Development within Planning Area	Average Daily Flow
	(acre)	(gpd/acre)	(gpd)	(acre)	(acre)	(acre)	(acre)	(gpd/acre)	(gpd)	(gpd/acre)	(gpd)	(acre)	(gpd/acre)	(gpd)	(acre)	(gpd)
Residential																
Residential	2,378	640	1,521,793	85	1,167	1,033	2,285	640	1,462,310	4,663	2,984,102	0	640	30	4,663	2,984,133
Subtotal Residential	2,378		1,521,793	85	1,167	1,033	2,285			4,663	2,984,102	0		30	4,663	2,984,133
Non-Residential																
Commercial	309	1,190	367,460	21	235	139	395	1,190	470,104	704	837,564	1	1,190	1,216	705	838,780
Park	98	0	0	103	156	222	481	0	0	579	0	0	0	0	579	0
Institutional	541	190	102,863	23	191	58	272	190	51,653	813	154,516	1	190	174	814	154,690
Planned Development Mixed Use District	0	805	0	134	475	726	1,336	805	1,075,256	1,336	1,075,256	0	805	0	1,336	1,075,256
Subtotal Non-Residential	948		470,323	280	1,058	1,146	2,484		1,597,013	3,432	2,067,336	2		1,390	3,433	2,068,726
Other																
Bayonet Golf Course	307	0	0	0	0	0	0	0	0	307	0	0	0	0	307	0
Open Space - Other	438	0	0	46	0	0	46	0	0	484	0	90	0	0	574	0
Designated Open Space	45	0	0	0	0	0	0	0	0	45	0	18,238	0	0	18,283	0
ROW	25	0	0	0	1	0	1	0	0	26	0	0	0	0	26	0
Airport Runway	224	0	0	0	0	0	0	0	0	224	0	0	0	0	224	0
Parker Flats LU Swap	0	0	0	0	0	709	709	0	0	709	0	0	0	0	709	0
Subtotal Other	1,039		0	46	1	709	756		0	1,794	0	18,328		0	20,122	0
Totals	4,364		**1,992,116**	412	2,225	2,888	5,524	0	0	9,889	**5,051,439**	18,330	0	1,420	28,218	**5,052,859**

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11/6/2017

Additional sewer flows at the buildout of the District's Planning Area include flows from infill development, which occurs within the existing service area, and future development outside of the District's existing service area. Future sewer flows were allocated to the sewer system based on the following methodologies:

- **Infill Development:** Future sewer flows due to either the redevelopment of existing developed lands or the development of existing lands within the existing service area were allocated to existing manholes in proximity to the future development.

- **Future Development:** Future sewer flows for new development outside of the existing service area were consolidated into general tributary areas based on parcel boundaries and existing topography and assumed to discharge to the existing sewer system at various locations. These future consolidated tributary areas, and preliminary discharge locations, are documented on **Figure 5.2**. It should be noted that, due to the unknown development horizon of future development, these discharge connections are preliminary and future hydraulic analysis is recommended as development occurs.

5.4 SEWER SYSTEM DESIGN FLOWS

The design flows most relevant in this capacity analysis of the sewer system, in addition to the Maximum Day Dry Weather Flows (MDDWF), include the peak dry weather flow (PDWF) and peak wet weather flow (PWWF).

- **Peak Dry Weather Flow (PDWF).** The PDWF is used for evaluating the capacity adequacy of the sanitary sewer system, and to meet the criteria set forth in the previous chapter and in the District standards.

- **Peak Wet Weather Flow (PWWF).** The PWWF is used for designing the capacity of the collection system, while allowing acceptable amounts of surcharging in the system. During PWWF a relaxed criteria was used compared to PDWFs. The hydraulic analysis allowed surcharging to occur during wet weather conditions with the hydraulic grade line (HGL) rising up to three feet below the manhole rim. If the HGL at any time was less than three feet from the manhole rim, the pipe was considered deficient.

The design flows used in evaluating the capacity adequacy of the sewer collection system are summarized on **Table 5.6**. The table lists the maximum day and peak hour flows for dry and wet weather conditions.

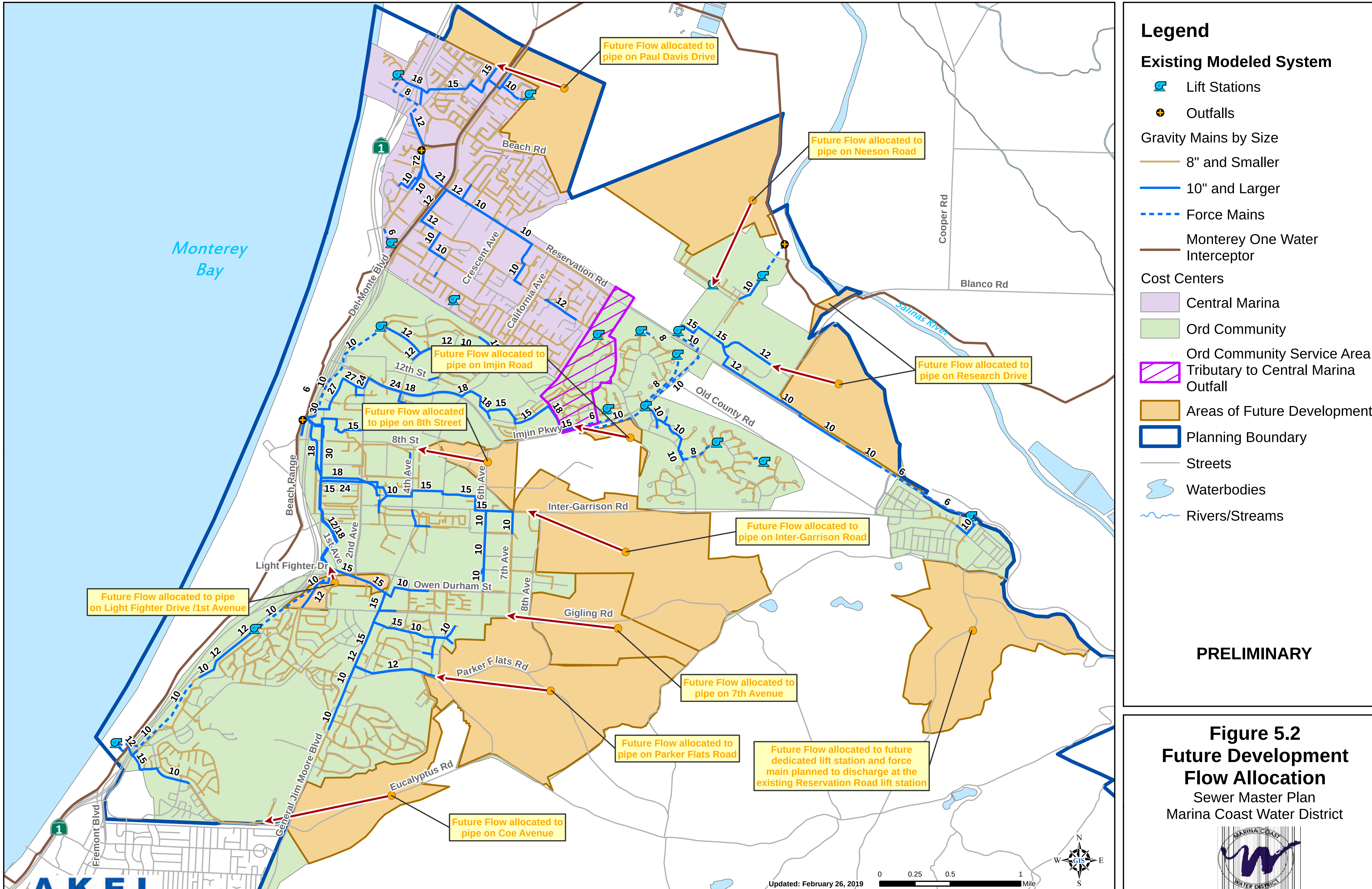

Figure 5.2
Future Development Flow Allocation
Sewer Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Sewer\MCWD_Fig5-2_FutureDevAllocation_022619.mxd

Table 5.6 Design Flows (Near Term)

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Flow Condition	Existing Conditions		Near Term Conditions	
	DWF (mgd)	WWF (mgd)	DWF (mgd)	WWF (mgd)
Central Marina				
Maximum Day	1.3	2.0	1.7	2.6
Peak Hour	2.1	4.9	2.6	6.5
Ord Community				
Maximum Day	1.2	4.9	5.3	7.4
Peak Hour	1.9	7.7	8.2	15.7

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1/31/2019

Notes:

1. Flows shown were extracted from District sewer system hydraulic model and reflect operations of lift stations and flow attenuation.

CHAPTER 6 - HYDRAULIC MODEL DEVELOPMENT

This chapter describes the development and calibration of the District's sewer system hydraulic model. Hydraulic network analysis has become an effectively powerful tool in all aspects of sewer system planning, design, operation, management, and system reliability analysis. The District's hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

6.1 HYDRAULIC MODEL SOFTWARE SELECTION

The District's hydraulic model combines information on the physical characteristics of the sanitary sewer system (pipelines, lift stations) and operational characteristics (how they operate). The hydraulic model then performs calculations and solves series of equations to simulate flows in pipes, including backwater calculations for surcharged conditions.

There are several network analysis software products released by different manufacturers that can equally perform the hydraulic analysis satisfactorily. The selection of a particular software depends on user preferences, the sanitary sewer system's unique requirements, and the costs for purchasing and maintaining the software.

The hydraulic modeling software used for evaluating the capacity adequacy of the District's sewer system, InfoSWMM by Innovyze Inc., utilizes the fully dynamic St. Venant's equation which has a more accurate engine for simulating backwater and surcharge conditions, in addition to having the capability for simulating manifolded force mains. The software also incorporates the use of the Manning Equation in other calculations including upstream pipe flow conditions. The St Venant's and Manning's equations are discussed in the System Performance and Design Criteria chapter.

6.2 HYDRAULIC MODEL DEVELOPMENT

Computer modeling requires the compilation of large numerical databases that enable data input into the model. Detailed physical aspects, such as pipe size, ground elevation, invert elevations, and pipe lengths contribute to the accuracy of the model.

Pipes and manholes represent the physical aspect of the system within the model. A manhole is a computer representation of a place where sewer flows may be allocated into the hydraulic system, while a pipe represents the conveyance aspect of the sewer flows. In addition, selected lift station capacity and design head settings were also included into the hydraulic model.

Developing the hydraulic model included system skeletonization, digitizing and quality control, developing pipe and manhole databases, and sewer loading allocation.

6.2.1 Skeletonization

Skeletonizing the model refers to the process where pipes not essential to the hydraulic analysis of the system are stripped from the model. Skeletonizing the model is useful in creating a system that accurately reflects the hydraulics of the pipes within the system. In addition, skeletonizing the model will reduce complexities of large models, which will also reduce the time of analysis while maintaining accuracy, but will also comply with the limitations imposed by the computer program. **Table 6.1** lists the total length of modeled sewer pipes at 104 miles.

6.2.2 Digitizing and Quality Control

During the development of the new hydraulic model, the project team consisting of District staff and Akel Engineering staff, implemented a thorough quality control program to resolve discrepancies. The quality control program included the following:

- The previous hydraulic model, developed in H2OMap Sewer, and used in the previous master plan
- Supplemental field surveys
- Existing CAD sewer system maps

6.2.3 Load Allocation

Load allocation consists of assigning sewer flow to the appropriate manholes (nodes) in the model. The goal is to distribute the loads throughout the model to best represent actual system response.

Allocating loads to manholes within the hydraulic model required multiple steps, incorporating the efficiency and capabilities of GIS and the hydraulic modeling software. Determining the sewer loads was accomplished by using the wastewater flow factors developed for this master plan as well as parcel data including acreage and land use. The loads calculated were allocated to the nearest manhole that serves the corresponding parcel using the capabilities the hydraulic model has for allocating loads.

6.3 MODEL CALIBRATION

Calibration is intended to instill a level of confidence in the flows that are simulated, and it generally consists of comparing model predictions to the 2017 V&A flow monitoring program, and making necessary adjustments.

6.3.1 Calibration Plan

Calibration can be performed for steady state conditions, which model the peak hour flows, or for dynamic conditions (24 hours or more). Dynamic calibration consists of comparing the model predictions to diurnal operational changes in the wastewater flows. The District’s hydraulic model was calibrated for dynamic conditions.

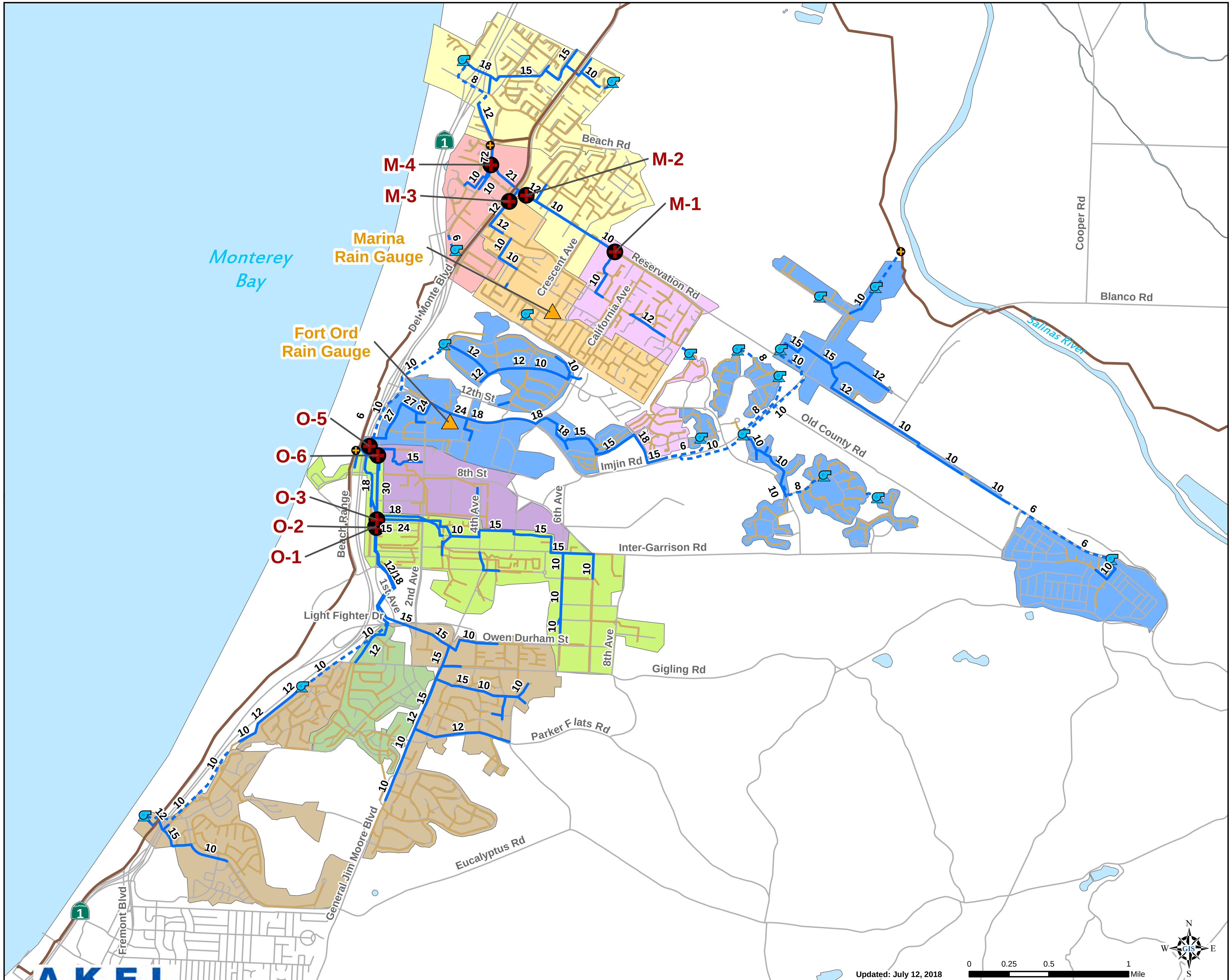

Figure 6.1
Flow Meter Locations
Sewer Master Plan
Marina Coast Water District

Table 6.1 Existing Modeled Pipe Inventory

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Pipe Size (in)	Pipe Length (ft)	(miles)
Gravity Mains		
4	1,127	0.2
6	114,937	21.8
8	263,721	49.9
10	43,449	8.2
12	30,827	5.8
14	0	0.0
15	31,083	5.9
18	13,474	2.6
21	1,376	0.3
24	5,626	1.1
27	2,237	0.4
30	3,563	0.7
72	440	0.1
Subtotal	**511,861**	**96.9**
Force Mains		
4	967	0.2
6	8,166	1.5
8	6,659	1.3
10	18,888	3.6
Subtotal	**34,680**	**6.6**
Total		
	546,541	**103.5**

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2/13/2018

Note:

1. Pipeline length extracted from hydraulic model developed by Akel Engineering Group.

In sewer systems, and when using dynamic hydraulic modeling to evaluate the impact of wet weather flows, it is common practice to calibrate the model to the following three conditions:

- Peak dry weather flows.
- Peak wet weather flows from storm rainfall Event No. 1.(19 February 2017-20 February 2017)
- Peak wet weather flows from storm rainfall Event No. 2.(9 February 2017- 10 February 2017)

After the model is calibrated to these conditions, it is benchmarked and used for evaluating the capacity adequacy of the sanitary sewer system, under dry and wet weather conditions.

6.3.2 2017 V&A Temporary Flow Monitoring Program

A temporary flow monitoring program was included in this project to validate the existing dry and wet weather flows from each sewer basin. The program consisted of installing 9 flow meters, for a period of 5 weeks, from January 2017 to February 2017. Villalobos and Associates (V&A) was retained to install the flow meters, monitor rainfall, and perform an Infiltration and Inflow analysis. The selected flow monitoring sites are listed on **Table 6.2** and shown on **Figure 6.1**.

The 2017 V&A Flow Monitoring Program captured two rainfall events and included a summary report identifying areas of the District that were most affected by rain dependent infiltration and inflows. The two rainfall events experienced during the flow monitoring period varied in duration and intensity (**Table 3.5**), and provided an insight into the sewer system response to storm conditions.

During the V&A flow monitoring program two rain gauges were set up within the District service area to record storm events during the monitoring period and are shown on **Figure 6.1**. Data from the V&A flow monitoring effort, as documented in the 2017 V&A Flow Monitoring Program, was used in this analysis to calibrate the computer hydraulic model to average dry weather flow (ADWF) and peak wet weather flow (PWWF) conditions.

It should be noted that the site for Meter O-4 was initially located on a sewer main that did not have any flow. In the process of locating the other sites, V&A was tasked with additional work to determine and document pipeline connectivity in the Ord Community, as well as notifying District staff of a deteriorated sewer main requiring immediate attention. In lieu of additional out of scope, District staff chose to eliminate O-4 from the flow monitoring program.

6.3.3 Dynamic Model Calibration

The calibration process was iterative as it involved calibrating each of the 6 flow monitored sites and for the three calibration conditions: 1) peak dry weather flow, 2) peak wet weather flows from storm rainfall Event No. 1, and 3) peak wet weather flows from storm rainfall Event No. 2.

Table 6.2 Flow Monitor Sites

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Site ID	Location Description	Pipe Size (in)	Manhole ID
Central Marina			
M-1	1,000 ft e/o intersection of Reservation Rd and Crescent Ave	12" SW (In Pipe)	K606
M-2	Intersection of Reservation Rd and Del Monte Blvd	12" SE (In Pipe)	L368
M-3	Intersection of Reservation Rd and Del Monte Blvd	12" SW (In Pipe)	G421
M-4	Intersection of Robin Dr and Hilo Ave	10" N (Out Pipe)	E331
Ord Community			
O-1	Intersection of 5th St and 1st Ave	18" SW (In Pipe)	G451
O-2	Intersection of 5th St and 1st Ave	12" SE (In Pipe)	D452
O-3	Intersection of 5th St and 1st Ave	15" E (In Pipe)	J306
O-5	NW corner of VA Clinic Parking Lot	15" N (In Pipe)	UVA1
O-6	1st Ave n/o 8th St	15" E (In Pipe)	UVB6

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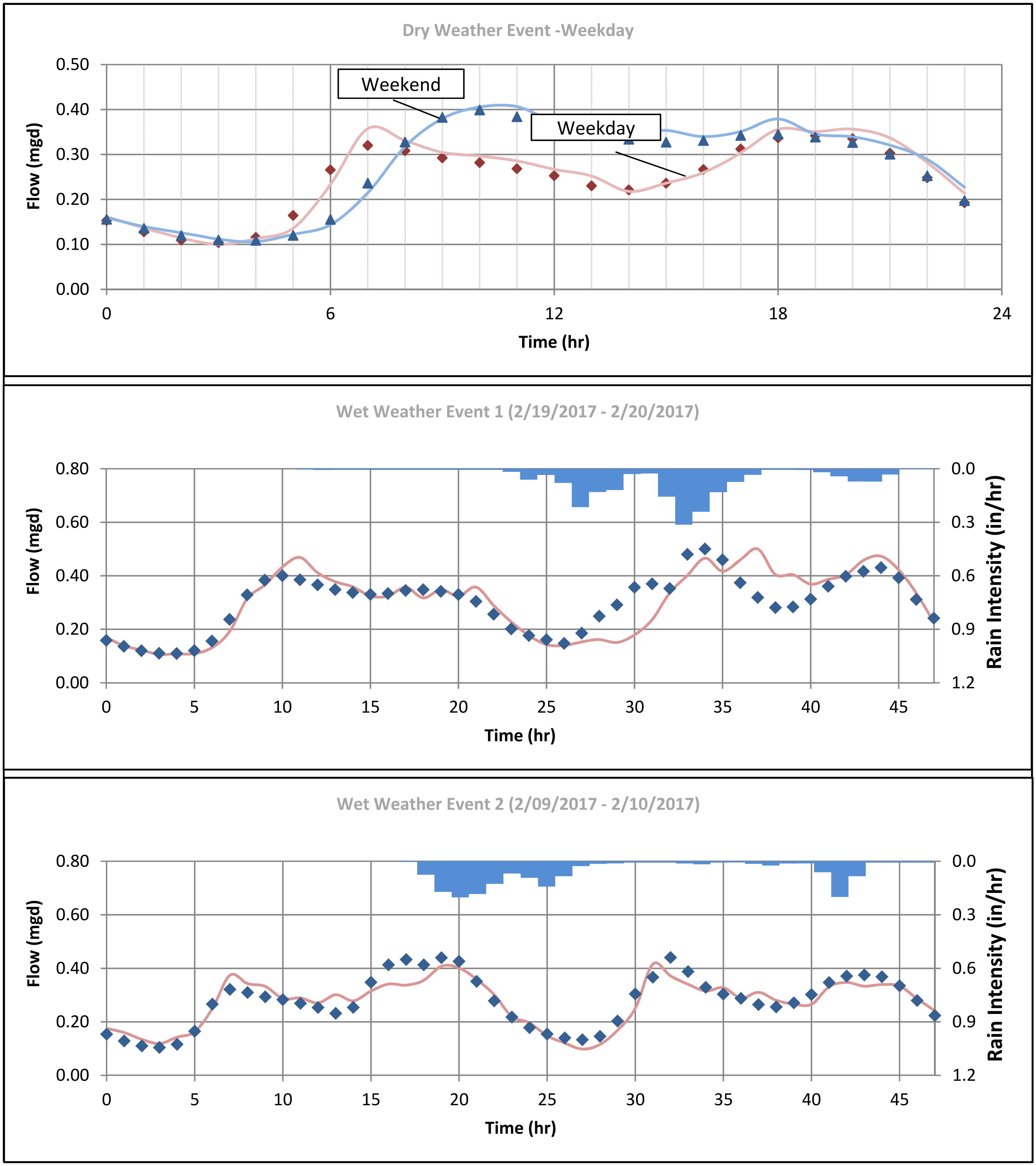
3/15/2018

The rain events of February 19-20, 2017 (Event No. 1) and February 9-10, 2017 (Event No. 2), as listed on **Table 3.5**, were used to calibrate the hydraulic model to the wet weather conditions. The diurnal curves for each of the 9 sites were extracted from the 2017 V&A Flow Monitoring Program and the data was used for comparison purposes with the hydraulic model predictions. The calibration effort is an iterative process and continues until it yields acceptable results for each site and for each of the three calibration conditions.

The calibration results for each flow monitoring site are documented in **Appendix B** and briefly summarized on Table 6.3. These results indicate the calibration effort yielded reasonable comparisons between the flow monitoring data and the hydraulic model predictions at the 9 sites. The calibration results were reviewed and approved by District staff, and representative extracts from **Appendix B** are shown on **Figures 6.2** and **6.3**. After each of the calibration process has been completed, the hydraulic model was benchmarked for further analysis and evaluation.

6.3.4 Use of the Calibrated Model

The calibrated hydraulic model was used as an established benchmark in the capacity evaluation of the existing sanitary sewer system. The model was also used to identify improvements necessary for mitigating existing system deficiencies and for accommodating future growth. The hydraulic model is a valuable investment that will continue to prove its worth to the District as future planning issues or other operational conditions surface. It is recommended that the model be maintained and updated with new construction projects to preserve its integrity.



LEGEND

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

PRELIMINARY

AKEL ENGINEERING GROUP, INC.

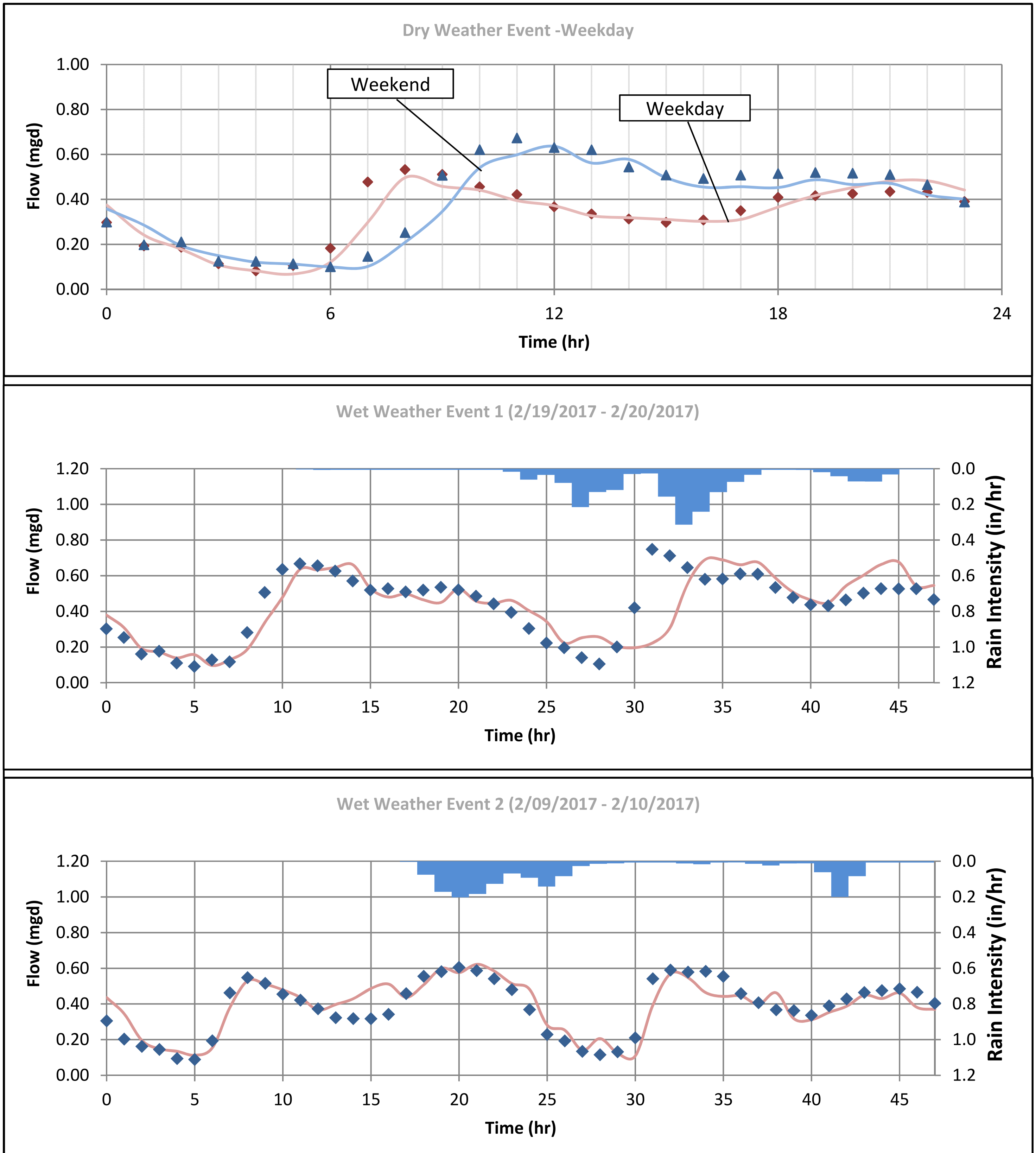
October 18, 2017

Figure 6.2

M-3 Marina

Sewer Master Plan

Marina Coast Water District



LEGEND

PRELIMINARY

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

AKEL ENGINEERING GROUP, INC.

October 18, 2017

Figure 6.3

O-5 Fort Ord

Sewer Master Plan
Marina Coast Water District

Table 6.3 Calibration Results Summary

Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Flow Monitoring ID		Units	Dry Period (Weekday)			Dry Period (Weekend)			Wet Weather (Event 1)			Wet Weather (Event 2)		
			Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M-1	Flow Monitored	(mgd)	0.0237	0.188	0.106	0.017	0.206	0.114	0.022	0.225	0.131	0.026	0.200	0.116
	Model	(mgd)	0.0281	0.164	0.106	0.025	0.198	0.120	0.022	0.214	0.135	0.024	0.201	0.122
	Difference	(mgd)	-0.0044	0.023	0.000	-0.0076	0.008	-0.006	0.0005	0.011	-0.004	0.0017	-0.001	-0.006
		(%)	**16**	**-14**	**0**	**30**	**-4**	**5**	**-3**	**-5**	**3**	**-7**	**0**	**5**
M-2	Flow Monitored	(mgd)	0.1286	0.514	0.354	0.122	0.636	0.389	0.120	1.170	0.514	0.134	0.738	0.401
	Model	(mgd)	0.1209	0.510	0.363	0.120	0.682	0.413	0.115	0.977	0.477	0.116	0.817	0.430
	Difference	(mgd)	0.0077	0.003	-0.009	0.0019	-0.045	-0.023	0.0058	0.194	0.037	0.0174	-0.080	-0.029
		(%)	**-6**	**-1**	**2**	**-2**	**7**	**6**	**-5**	**-20**	**-8**	**-15**	**10**	**7**
M-3	Flow Monitored	(mgd)	0.0999	0.357	0.250	0.106	0.407	0.278	0.106	0.500	0.302	0.098	0.416	0.274
	Model	(mgd)	0.1040	0.342	0.241	0.109	0.399	0.268	0.109	0.500	0.299	0.104	0.440	0.278
	Difference	(mgd)	-0.0040	0.016	0.009	-0.0028	0.008	0.010	-0.0032	0.000	0.003	-0.0059	-0.024	-0.004
		(%)	**4**	**-5**	**-4**	**3**	**-2**	**-4**	**3**	**0**	**-1**	**6**	**6**	**1**
M-4	Flow Monitored	(mgd)	0.0694	0.232	0.167	0.056	0.244	0.170	0.066	0.274	0.181	0.072	0.239	0.172
	Model	(mgd)	0.0676	0.227	0.164	0.060	0.236	0.167	0.060	0.274	0.185	0.072	0.257	0.183
	Difference	(mgd)	0.0018	0.005	0.002	-0.0036	0.008	0.002	0.0060	0.000	-0.004	0.0003	-0.017	-0.011
		(%)	**-3**	**-2**	**-1**	**6**	**-3**	**-1**	**-10**	**0**	**2**	**0**	**7**	**6**
O-1 [1]	Flow Monitored	(mgd)	0.1671	0.636	0.449	0.144	0.637	0.440	0.145	0.705	0.468	0.131	0.956	0.473
	Model	(mgd)	0.0746	0.726	0.446	0.062	0.755	0.452	0.065	0.796	0.480	0.065	0.776	0.470
	Difference	(mgd)	0.0925	-0.090	0.003	0.0821	-0.119	-0.013	0.0800	-0.092	-0.013	0.0653	0.180	0.003
		(%)	**-124**	**12**	**-1**	**-132**	**16**	**3**	**-123**	**12**	**3**	**-100**	**-23**	**-1**
O-2	Flow Monitored	(mgd)	0.0088	0.130	0.076	0.008	0.125	0.072	0.009	0.209	0.083	0.007	0.170	0.070
	Model	(mgd)	0.0100	0.123	0.075	0.010	0.131	0.076	0.010	0.171	0.093	0.010	0.164	0.086
	Difference	(mgd)	-0.0012	0.007	0.001	-0.0022	-0.006	-0.004	-0.0006	0.038	-0.010	-0.0027	0.006	-0.015
		(%)	**12**	**-6**	**-1**	**22**	**5**	**5**	**6**	**-22**	**10**	**28**	**-3**	**18**
O-3	Flow Monitored	(mgd)	0.0250	0.278	0.169	0.014	0.239	0.143	0.031	0.924	0.258	0.030	0.703	0.235
	Model	(mgd)	0.0283	0.273	0.169	0.028	0.235	0.146	0.028	0.977	0.251	0.028	0.550	0.225
	Difference	(mgd)	-0.0033	0.005	0.001	-0.0139	0.004	-0.002	0.0034	-0.053	0.007	0.0020	0.153	0.010
		(%)	**12**	**-2**	**0**	**51**	**-2**	**1**	**-12**	**5**	**-3**	**-7**	**-28**	**-5**
O-5	Flow Monitored	(mgd)	0.0679	0.497	0.327	0.099	0.636	0.375	0.097	0.690	0.432	0.109	0.622	0.389
	Model	(mgd)	0.0819	0.532	0.335	0.100	0.673	0.399	0.091	0.748	0.431	0.088	0.605	0.382
	Difference	(mgd)	-0.0139	-0.036	-0.008	-0.0005	-0.037	-0.024	0.0053	-0.058	0.001	0.0203	0.017	0.007
		(%)	**17**	**7**	**2**	**1**	**5**	**6**	**-6**	**8**	**0**	**-23**	**-3**	**-2**
O-6	Flow Monitored	(mgd)	0.0078	0.040	0.020	0.006	0.029	0.019	0.009	0.183	0.043	0.006	0.072	0.027
	Model	(mgd)	0.0085	0.031	0.021	0.007	0.030	0.020	0.007	0.126	0.038	0.009	0.092	0.032
	Difference	(mgd)	-0.0007	0.009	0.000	-0.0009	-0.001	-0.001	0.0013	0.057	0.005	-0.0028	-0.020	-0.005
		(%)	**9**	**-28**	**0**	**13**	**2**	**6**	**-19**	**-46**	**-14**	**32**	**22**	**17**

12/11/2017

Note:

1. Flow Fluctuations are heavily influenced by the Ord Village Lift Station at flow monitoring site O-1.

CHAPTER 7 - EVALUATION AND PROPOSED IMPROVEMENTS

This chapter presents a summary of the sewer system capacity evaluation during peak dry weather flows and peak wet weather flows for the existing and buildout development conditions. This chapter summarizes the lift station condition assessment performed by GHD. The recommended sewer system improvements needed to mitigate capacity deficiencies are also discussed in this chapter.

7.1 OVERVIEW

The calibrated hydraulic model was used for evaluating the sanitary sewer system for capacity deficiencies during peak dry weather flows (PDWF) and peak wet weather flows (PWWF). Since the hydraulic model was calibrated for dynamic modeling, the analysis duration was established at 24 hours for most analyses.

The criteria used for evaluating the capacity adequacy of the wastewater collection system facilities (gravity mains, force mains, and lift stations) were discussed and summarized in the System Performance and Design Criteria chapter.

7.2 EXISTING SEWER SYSTEM CAPACITY EVALUATION

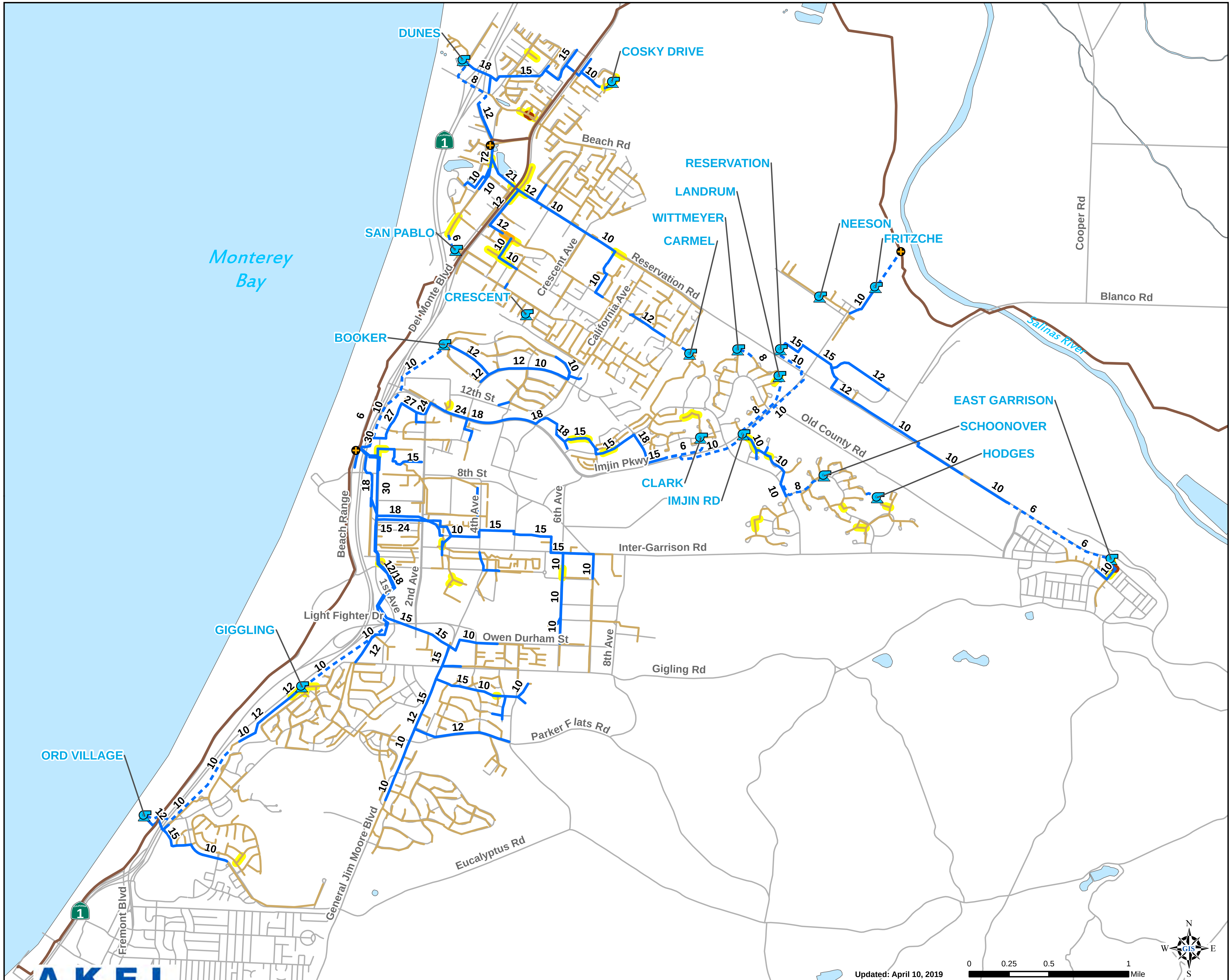
The system performance and design criteria summarized on **Table 3.1** were used as a basis to judge the adequacy of capacity for the existing sewer system. The design flows simulated in the hydraulic model for existing conditions were summarized on **Table 5.6**.

During the peak dry weather simulations, the maximum allowable pipe d/D criteria for gravity pipelines (0.67 for 12-inch or, 0.8 for sewer mains ranging in size from 15-inches to 24 inches, and 0.9 for sewer mains equal or greater to 27 inches) was used. During the peak wet weather simulations, capacity deficiencies included pipe segments with a hydraulic grade line (HGL) that rises within three feet of the manhole rim elevation.

In general, the hydraulic model indicated that the sewer system exhibited acceptable performance to service the existing customers during both peak dry weather flows (**Figure 7.1**) and peak wet weather flows (**Figure 7.2**). The results of the existing system capacity evaluations are discussed in the following sections.

7.2.1 Existing Peak Dry Weather Flows Capacity Evaluation

The existing dry weather flow analysis indicated that the existing sewer system exhibited acceptable performance to service existing customers during peak dry weather flows, as



Legend

Pipe d/D

- d/D > 0.90
- d/D 0.75 - 0.90
- d/D 0.50 - 0.75

Existing Modeled System

- Lift Stations
- Outfalls

Gravity Mains by Size

- 8" and Smaller
- 10" and Larger
- Force Mains
- Monterey One Water Interceptor
- Streets
- Waterbodies
- Rivers/Streams

PRELIMINARY

Figure 7.1
Existing System Analysis for PDWF
Sewer Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

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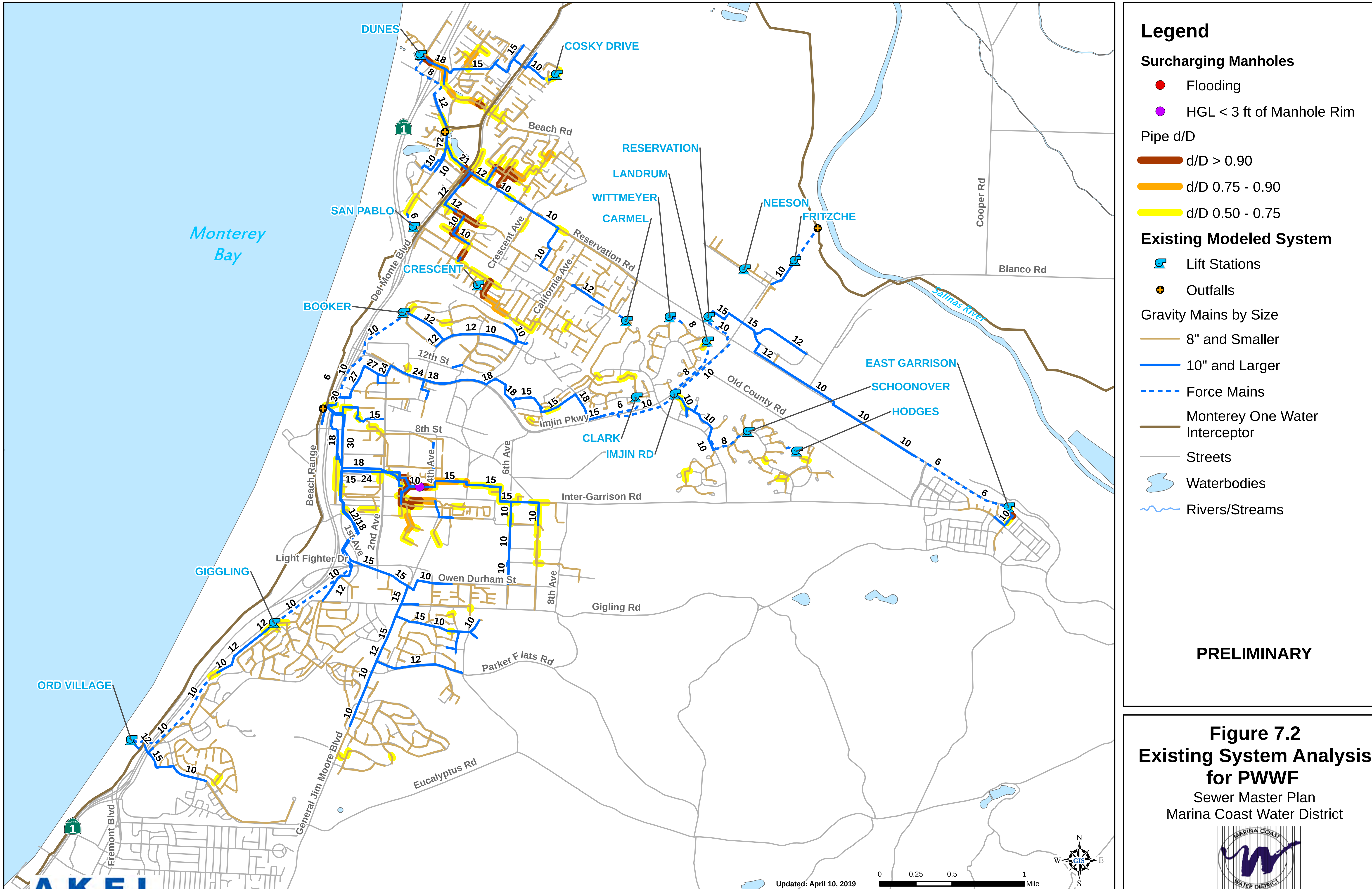


Figure 7.2
Existing System Analysis for PWWF
Sewer Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Sewer\MCWD_Fig7-2_Exist-PWWF_041019.mxd documented on Figure 7.1, with the following exception:

- Beach Road west of Del Monte Boulevard. This existing 8-inch pipeline experiences d/D ratios over 0.9 under peak dry weather flow conditions.

7.2.2 Existing Peak Wet Weather Flows Capacity Evaluation

The design flows for the capacity evaluation under existing and buildout development conditions are summarized on Table 5.5. The existing wet weather flow analysis indicated that the existing sewer system exhibited acceptable performance to service existing customers during peak wet weather flows, with some exceptions noted on Figure 7.2.

It should be noted that District staff have indicated that under existing wet weather flow conditions the manholes shown on Figure 7.2 have not been noted as surcharging in the field. The PWWF analysis represents a conservative evaluation, and while not experiencing consistent surcharging under existing wet weather conditions, it is recommended District staff monitor these manholes during significant storm events.

7.3 LIFT STATION ASSESSMENT

This Sewer Master Plan included a review of the District's exiting sewer lift stations, which included the following analyses:

- **Pumping Capacity Evaluation:** The pumping capacity of each modeled lift station was reviewed to ensure each station is capable of conveying sewer flows under existing and buildout development conditions. This evaluation compared peak lift station inflows under peak wet weather conditions against the existing lift station firm capacities and documented any recommended improvements. The results of the pump station capacity evaluation are documented on Table 7.1.

- **Force Main Evaluation:** The existing lift station force mains were evaluated to determine capacity adequacy for both existing and buildout development conditions. This evaluation analyzed the pipeline velocity for the existing force mains and determined if a larger pipeline is required to convey either existing or buildout sewer flows. The results of the force main evaluation are documented on Table 7.2.

- **Condition Assessment:** GHD conducted a condition assessment of the 12 highest priority lift stations, which included documentation of the existing physical conditions, a condition rating of 1 (Very Good) to 5 (Very Poor) for various onsite components, and an opinion of probable cost for potential improvements. The report completed by GHD for the condition assessment is included in Appendix C, while the following sections include a brief summary of the information prepared for each lift station. It should be noted that the

Table 7.1 Lift Station Capacity Analysis

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Pump Station	Firm Capacity (Excludes Standby) (gpm)	Total Capacity (Includes Standby) (gpm)	Existing Peak Wet Weather Flows (gpm)	Existing Peak Wet Weather Flows (mgd)	Surplus/ Deficiency (gpm)	Future Peak Wet Weather Flows (gpm)	Future Peak Wet Weather Flows (mgd)	Surplus/ Deficiency (gpm)	Recommended Improvements
Central Marina									
Dunes	700	1,400	1,135	1.63	**-435**	882	1.27	**-182**	Replace with 3 x 450 gpm
San Pablo	200	400	84	0.12	116	90	0.13	110	
Cosky	216	432	43	0.06	173	42	0.06	174	
Crescent	100	200	12	0.02	88	12	0.02	88	
Ord Community									
Fritzche Field	160	320	31	0.04	129	279	0.40	**-119**	Replace with 3 x 150 gpm
Carmel	254	508	46	0.07	208	60	0.09	194	
East Garrison	370	740	123	0.18	247	288	0.41	82	
Ord Village	1,920	2,880	308	0.44	1,612	725	1.04	1,195	
Wittemeyer	140	280	34	0.05	106	34	0.05	106	
Booker	760	1,520	61	0.09	699	309	0.44	451	
Clark	260	520	34	0.05	226	34	0.05	226	
Neeson	400	400	10	0.01	390	100	0.14	300	
Landrum	350	700	89	0.13	261	87	0.13	263	
Imjin	700	1,400	431	0.62	269	1,358	1.96	**-658**	Replace with 3 x 700 gpm
Schoonover	470	940	205	0.29	265	197	0.28	273	
Gigling	1,700	2,550	401	0.58	1,299	856	1.23	844	
Reservation	710	1,420	179	0.26	531	1,180	1.70	**-470**	Replace with 3 x 600 gpm
Hodges	94	188	50	0.07	44	49	0.07	45	

Table 7.2 Force Main Evaluation

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Lift Station ID	Force Main Length (ft)	Force Main Diameter (in)	Existing Peak Wet Weather Flows Flow (mgd)	Existing Peak Wet Weather Flows Velocity (ft/s)	Future Peak Wet Weather Flows Flow (mgd)	Future Peak Wet Weather Flows Velocity (ft/s)	Recommended Improvements
Central Marina							
Dunes	2,240	8	1.39	6.8	1.37	6.1	
San Pablo	632	6	0.14	2.0	0.16	1.2	
Cosky	526	6	0.08	0.9	0.09	0.7	
Crescent	42	6	0.07	0.3	0.03	0.3	
Ord Community							
Fritzche Field	872	6	0.01	0.2	0.44	3.5	
Carmel	487	6	0.10	0.9	0.10	0.8	
East Garrison	3,964	6	0.18	2.2	0.41	3.2	
Ord Village	4,038	10	0.58	3.1	1.08	3.1	
Wittemeyer	536	4	0.06	1.3	0.06	1.1	
Booker	4,080	10	0.27	0.5	0.84	2.4	
Clark	1,642	6	0.09	1.0	0.12	0.9	
Neeson	78	8	0.01	0.1	0.15	0.6	
Landrum	2,449	8	0.20	1.0	0.16	0.7	
Imjin	2,910	10	1.03	2.8	1.96	5.5	
Schoonover	1,893	8	0.40	2.2	0.39	1.7	
Gigling	3,697	10	0.65	2.5	1.47	4.2	
Reservation	4,156	10	0.30	1.5	1.74	4.9	
Hodges	432	4	0.09	1.9	0.09	1.6	

discussion in the following sections only includes a summary of the condition assessment results for components that received a score of 4 (Poor) or 5 (Very Poor).

7.3.1 Dunes Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the Dunes Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 1,135 gpm and 882 gpm under buildout PWWF conditions. This lift station experiences a decrease in flows due to the future diversion of flows along Cove Way, Cardoza Ave, and Reservation Road. This lift station is under capacity during existing and buildout development conditions. It should be noted that District staff have indicated operational records show that the existing lift station firm capacity is capable of conveying peak flows. Therefore, it is recommended that District staff continue to monitor the operations of this lift station and replace the existing pumps when necessary.

- **Force Main Evaluation:** As documented on **Table 7.2** the existing 8-inch Dunes force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** In order to improve personnel safety, the installation of a ground fault circuit interrupter (GFCI) on both the 120-volt convenience receptacle and the receptacle unit circuit breaker is recommended.

7.3.2 San Pablo Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the San Pablo Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 84 gpm and 90 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on **Table 7.2** the existing 6-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** The condition assessment indicated that the components of this lift station are in generally acceptable condition, with no components receiving a score of 4 or greater.

7.3.3 Cosky Lift Station

The following sections document the pumping capacity evaluation and force main evaluation for the Cosky Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 43 gpm and 42 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on Table 7.2 the existing 6-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** The condition assessment conducted by GHD did not include the Cosky lift station.

7.3.4 Crescent Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the Crescent Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 12 gpm and 12 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on Table 7.2 the existing 6-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** The existing valve pit interior shows signs of cracking and surface damage, as well as a collection of sand in the bottom; additionally, the piping and valves within the existing valve pit lack proper support. The full replacement of the valve pit is recommended. Additionally, at the time of the condition assessment the float switch cables were coiled on a hook within the wet well and the floats were not within the operating range of the wet well.

7.3.5 Fritzche Field Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the Fritzche Field Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 31 gpm and 279 gpm under buildout PWWF conditions. This lift station is under capacity during buildout development conditions and is recommended for replacement.

- **Force Main Evaluation:** As documented on Table 7.2 the existing 6-inch force main is adequate to convey flows under existing and buildout development conditions

  Condition Assessment: Due to signs or rusting and component overheating, the pump control panel and backup power generator enclosure and exhaust system are recommended for replacement.

7.3.6 Carmel Lift Station

The following sections document the pumping capacity evaluation and force main evaluation for the Carmel Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 46 gpm and 60 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.
- **Force Main Evaluation:** As documented on Table 7.2 the existing 6-inch force main is adequate to convey flows under existing and buildout development conditions
- **Condition Assessment:** The condition assessment conducted by GHD did not include the Carmel lift station.

7.3.7 East Garrison Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the East Garrison Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 123 gpm and 288 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.
- **Force Main Evaluation:** As documented on Table 7.2 the existing 6-inch force main is adequate to convey flows under existing and buildout development conditions
- **Condition Assessment:** Due to signs of significant corrosion, it is recommended that the valve vault pipes and valves, as well as the wet well piping be replaced. Additionally, the valve vault drainage appeared to be blocked due to signs of standing water within the valve vault.

7.3.8 Ord Village Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the Ord Village Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 308 gpm and 725 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.
- **Force Main Evaluation:** As documented on Table 7.2 the existing 10-inch force main is adequate to convey flows under existing and buildout development conditions

  Condition Assessment: Due to a lack of drainage on an on-site concreate pad, damage to the existing main pullbox and meter has occurred, which presents a safety hazard; adding drainage to this concrete pad is recommended. Additionally, the fuel tank leak detection panel is heavily rusted and recommended for full replacement. The existing bulk fuel tank is also in poor condition and is recommended for replacement.

7.3.9 Wittemeyer Lift Station

The following sections document the pumping capacity evaluation and force main evaluation for the Wittemeyer Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 34 gpm and 34 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.
- **Force Main Evaluation:** As documented on **Table 7.2** the existing 4-inch force main is adequate to convey flows under existing and buildout development conditions
- **Condition Assessment:** The condition assessment conducted by GHD did not include the Wittemeyer lift station.

7.3.10 Booker Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the Booker Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 61 gpm and 309 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.
- **Force Main Evaluation:** As documented on **Table 7.2** the existing 10-inch force main is adequate to convey flows under existing and buildout development conditions
- **Condition Assessment:** According to the condition assessment, the lift station's service area is planned to be redeveloped, and it is recommended that the lift station undergo major rehabilitation or replacement.

7.3.11 Clark Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the Clark Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 34 gpm and 34 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.
- **Force Main Evaluation:** As documented on **Table 7.2** the existing 6-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** The condition assessment conducted by GHD did not include the Clark lift station.

7.3.12 Neeson Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the Neeson Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 10 gpm and 100 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on **Table 7.2** the existing 8-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** Due to significant aging and deterioration of multiple components of the lift station, including the pump, piping, valves, piping and valve supports, concrete slab, electrical equipment, and wet well level monitoring unit, a complete lift station replacement is recommended.

7.3.13 Landrum Lift Station

The following sections document the pumping capacity evaluation and force main evaluation for the Landrum Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 89 gpm and 87 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on **Table 7.2** the existing 8-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** The condition assessment conducted by GHD did not include the Landrum lift station.

7.3.14 Imjin Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the Imjin Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 1,236 gpm and 1,358 gpm under buildout PWWF conditions. This lift station is under capacity during buildout development conditions and is recommended for replacement.

- **Force Main Evaluation:** As documented on **Table 7.2** the existing 10-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** Due to a high amount of corrosion the valve vault piping and valves are recommended for replacement.

7.3.15 Schoonover Lift Station

The following sections document the pumping capacity evaluation and force main evaluation.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 205 gpm and 197 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on Table 7.2 the existing 8-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** The condition assessment conducted by GHD did not include the Schoonover lift station.

7.3.16 Gigling Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the Gigling Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 401 gpm and 856 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on Table 7.2 the existing 10-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** Due to rust and excess polyurethane foam within the SCADA equipment enclosure some components of the PLC are recommended for replacement.

7.3.17 Reservation Lift Station

The following sections document the pumping capacity evaluation, force main evaluation, and condition assessment for the Reservation Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 179 gpm and 1,180 gpm under buildout PWWF conditions. This lift station is under capacity during buildout development conditions and is recommended for replacement.

- **Force Main Evaluation:** As documented on Table 7.2 the existing 10-inch force main is adequate to convey existing flows but will require upsizing to a new 12-inch in order to accommodate sewer flows under buildout development conditions.

- **Condition Assessment:** Due to significant corrosion the valve pit pipes and valves are recommended for replacement.

7.3.18 Hodges Lift Station

The following sections document the pumping capacity evaluation and force main evaluation for the Hodges Lift Station.

- **Pumping Capacity Evaluation:** 49 maximum modeled lift station inflow under existing PWWF conditions is 50 gpm and 43 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on **Table 7.2** the existing 4-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** The condition assessment conducted by GHD did not include the Hodges lift station.

7.3.19 Hatten Lift Station

This lift station services a small tributary area and was not included in the hydraulic model. However, it was included in the condition assessment by GHD and the results are described in the following section.

- **Condition Assessment:** The lack of concrete slab at the base of the electrical control panel has contributed to severe corrosion. Additionally, there is no support for the exterior piping and valves. The installation of a concrete slab and appropriate piping and valve supports is recommended.

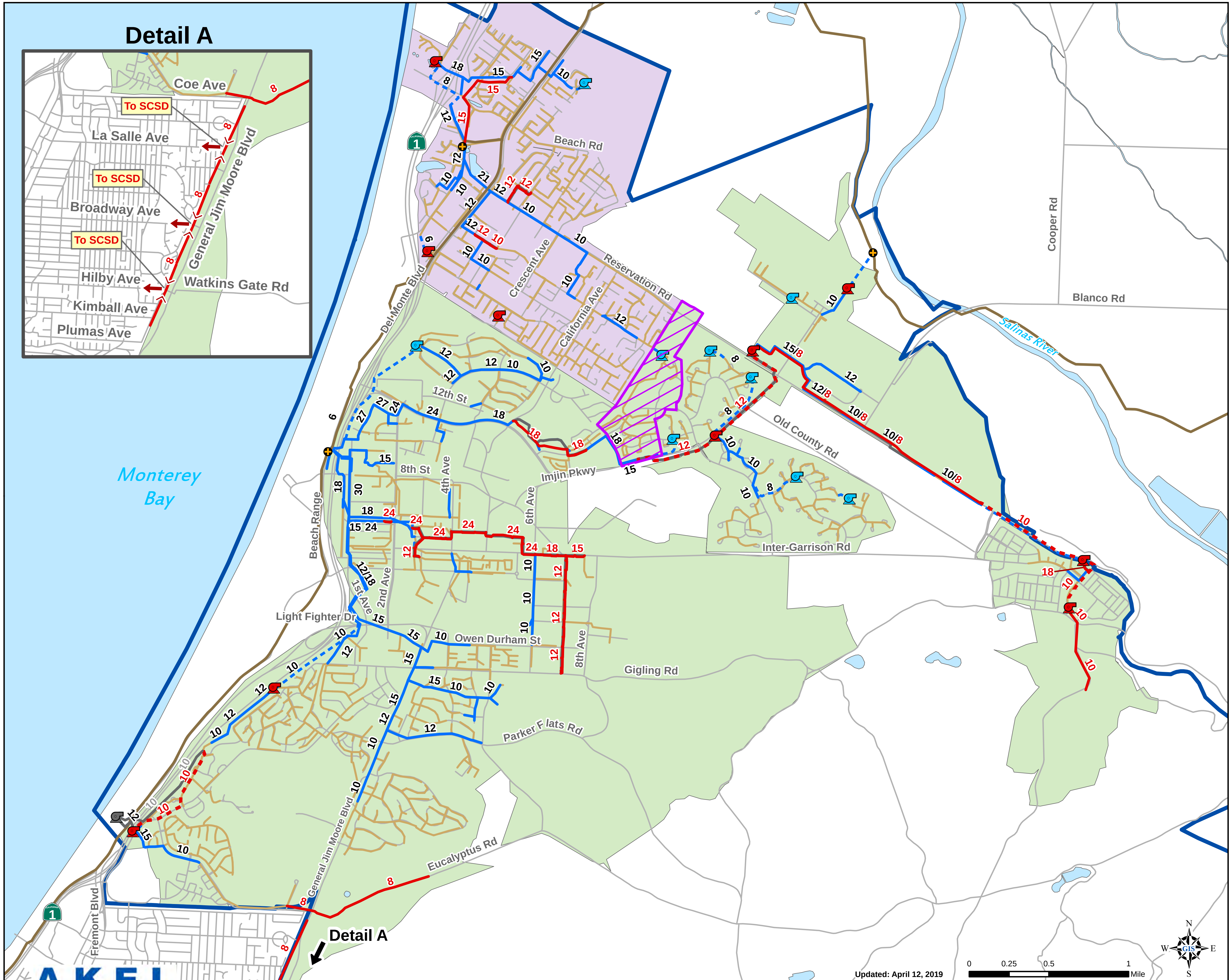
7.4 BUILDOUT CAPACITY IMPROVEMENTS

The system performance and design criteria summarized on **Table 3.1** were used as a basis to recommend improvements to the District's sewer system to mitigate existing system deficiencies and accommodate future growth. The design flows simulated in the hydraulic model for the buildout of the District service area are documented on **Table 5.5**.

The proposed capacity improvements for the sewer system are shown graphically on **Figure 7.3** and summarized on **Table 7.3**, which includes lift station, force main, and gravity main improvements. This table lists the master plan assigned improvement number (e.g., P-1), along with other relevant information including alignment description, capacity or pipe size, and pipe length. These improvements are also summarized on the following pages.

7.4.1 Lift Station Capacity Improvements

This section summarizes the recommended lift station capacity improvements. It should be noted that recommended lift station replacement capacities are quantified in terms of three-pump lift



Legend

Future Improvements

- Lift Stations
- Gravity Mains
- Force Mains
- Abandoned Lift Stations
- Abandoned Pipes

Existing Modeled System

- Lift Stations
- Outfalls

Gravity Mains by Size

- 8" and Smaller
- 10" and Larger
- Force Mains
- Monterey One Water Interceptor
- Planning Boundary

Cost Centers

- Central Marina
- Ord Community
- Ord Community Service Area Tributary to Central Marina Outfall
- Streets
- Waterbodies
- Rivers/Streams

PRELIMINARY

Figure 7.3
Proposed Improvements
Sewer Master Plan
Marina Coast Water District

Table 7.3 Schedule of Improvements

Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Improv. No.	Improv. Type	Alignment	Limits	Improvement Details			
Central Marina Sewer System							
Gravity Main Improvements				**Existing Diameter** (in)	**New/Parallel/ Replace**	**Diameter** (in)	**Length** (ft)
M-P1	Gravity Main	ROW, Cove Way, Cardoza	From Abdy Way to Reservation Rd	-	New	15	1,975
M-P2	Gravity Main	Reservation Rd	From Cardoza Ave to 150' s/o Seaside Cir	-	New	15	1,725
M-P3	Gravity Main	Eucalyptus St, Peninsula Dr, Vista del Camino	From Viking Ln to Reservation Rd	8	Replace	12	1,350
M-P4	Gravity Main	Carmel Ave	From Seacrest Ave to Sunset Ave	8	Replace	10	575
M-P5	Gravity Main	Reservation Rd	From Sunset Ave to Casa de Bolea	8	Replace	12	350
Lift Station Improvements				**Existing Capacity** (gpm)	**Recommended Capacity** (gpm)		
M-LSD	Lift Station Replacement	Dunes Lift Station		2 x 700	Replacement Capacity	3 x 450	
M-LSCR	Lift Station Replacement	Crescent Lift Station		2 x 100	Replacement Capacity		
Miscellaneous Improvements				**Improvement Type**			
MS-M1	WWTP	Located at the Marina WWTP		Demolition			
MS-M2	Gravity Main	Del Monte Boulevard	Reservation Road	Replace			
Ord Community Sewer System							
Gravity Main Improvements				**Existing Diameter** (in)	**New/Parallel/ Replace**	**Diameter** (in)	**Length** (ft)
O-P1	Gravity Main	Barloy Canyon Road	3,000' of future pipeline to convey future flows from development	-	New	10	2,950
O-P2	Gravity Main	ROW	From Ord Avenue to East Garrison Lift Station	15	Replace	18	400
O-P3	Gravity Main	Reservation Rd	From 4,700' w/o East Garrison Lift Station to Reservation Road Lift Station	-	New	8	9,900
O-P4	Gravity Main	Abrams Dr	From w/o Inchon Ct to 80th Artillery Ct	10,15	Replace	18	675
O-P5	Gravity Main	ROW	N/o Abrams Dr following Abrams Dr/ Imjin Pkwy	15	Replace	18	1,325
O-P6	Gravity Main	ROW e/o Imjin Pkwy	From California Ave to 475' n/o Abrams Dr	18	Replace	18	1,100
O-P7	Gravity Main	7th Ave	From n/o Butler St to Inter-Garrison Rd	8,10	Replace	12	4,550
O-P8	Gravity Main	Inter-Garrison Rd	From 625' e/o 7th Ave to 7th Ave	8	Replace	15	700
O-P9	Gravity Main	Inter-Garrison Rd	From 7th Avenue to 6th Ave	10	Replace	18	1,100
O-P10	Gravity Main	Inter-Garrison Rd	Jogging from 6th Ave to General Jim Moore Blvd	10,15	Replace	24	3,975
O-P11	Gravity Main	ROW n/o Inter-Garrison Rd	Jogging from 4th Ave to 1,300' w/o 4th Ave	10	Replace	24	1,675
O-P12	Gravity Main	ROW	Jogging from 3rd Ave to 400' n/o Inter-Garrison Rd	8,10	Replace	12	1,000
O-P13	Gravity Main	5th St	From 2nd Ave to 200' w/o 2nd Ave	15	Replace	24	250
O-P14	Gravity Main	1st Ave	From 1st St to 8th St	12,18,30	Replace	12,18,30	3,100
O-P15	Gravity Main	Eucalyptus Rd	From approximately 4,000' e/o General Jim Moore Blvd to approximatley 800' w/o General Jim Moore Blvd	-	New	8	5,050
Force Main Improvements				**Existing Diameter** (in)	**New/Parallel/ Replace**	**Diameter** (in)	**Length** (ft)
O-FM1	Force Main	Reservation Rd	From Phase 2 of the East Garrison Development to 4,700 ft w/o East Garrison	-	New	10	6,075
O-FM2	Force Main	Monterey Rd, existing ROW	From relocated Ord Village LS to existing gravity main n/o Corregidor Rd	10	Replace	10	3,950

Table 7.3 Schedule of Improvements
Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Improv. No.	Improv. Type	Alignment	Limits	Existing Capacity (gpm)	Recommended Capacity (gpm)	
Lift Station Improvements						
O-LSEG2	New	East Garrison Phase 2	Watkins Gate Rd and Chapel Hill Road	-	New	3 x 175 gpm
O-LSR	Lift Station Replacement	Reservation Road Lift Station		2 x 710	Replacement Capacity	3 x 600
O-LSI	Lift Station Replacement	Imjin Lift Station		2 x 700	Replacement Capacity	3 x 700
O-LSF	Lift Station Replacement	Fritzche Lift Station		2 x 160	Replacement Capacity	3 x 150
O-LSG	Lift Station/ Force Main	Gigling Lift Station				
O-LSO	Lift Station Rehabilitation		Ord Village Sewer Pipeline and Lift Station Improvement Project			
O-LSB	Lift Station Demolition and Replacement		Booker, Hatten, Neeson LS improvements			
Miscellaneous Improvements						
MS-O1	Service		Del Rey Oaks Collection System Planning			
MS-O2	Gravity Main		SCSD Sewer Improvements - Del Rey Oaks			
MS-O3	Service		Monterey One Water Buy-In			
MS-O4	Gravity Main		Inter-Garrison/ 8th Avenue Sewer Connection			
MS-O5	WWTP		Demolish Ord Main Garrison WWTP			
MS-O6	Gravity Main		Seaside East Side Developments Parcels (future growth)			
MS-O7	Lift Station		Miscellaneous Lift Station Improvements			
MS-O8	Lift Station/ Gravity Main		Cypress Knolls Sewer Pipeline and Lift Station Improvement Project			
General Sewer System Improvements						
G-1	Odor Control Project	Various Locations				
G2	Corporation Yard Demolition and Rehab					

stations. However, two-pump replacement capacities are documented for informational purposes and may be implemented at the discretion of District staff

- **Dunes:** As documented on **Table 7.1** the buildout flow requirement for the Dunes lift station is 882 gpm. A new lift station is recommended for construction with three 450 gpm pumps, two duty and one standby, for a total lift station capacity of 1,350 gpm. As an alternative two-pump option, two 900 gpm pumps, one duty and one standby, may be constructed for a total lift station capacity of 1,800 gpm;

- **Fritzche Field:** As documented on **Table 7.1** the buildout flow requirement for the Fritzche Field lift station is 280 gpm. A new lift station is recommended for construction with three 150 gpm pumps, two duty and one standby, for a total lift station capacity of 450 gpm. As an alternative two-pump option, two 300 gpm pumps, one duty and one standby, may be constructed for a total lift station capacity of 600 gpm;

- **Imjin:** As documented on **Table 7.1** the buildout flow requirement for the Imjin lift station is 1,358 gpm. A new lift station is recommended for construction with three 700 gpm pumps, two duty and one standby, for a total lift station capacity of 2,100 gpm. As an alternative two-pump option, two 1,400 gpm pumps, one duty and one standby, may be constructed for a total lift station capacity of 2,800 gpm.

- **Reservation:** As documented on **Table 7.1** the buildout flow requirement for the Reservation lift station is 1,180 gpm. A new lift station is recommended for construction with three 600 gpm pumps, two duty and one standby, for a total lift station capacity of 1,800 gpm. As an alternative two-pump option, two 1,200 gpm pumps, one duty and one standby, may be constructed for a total lift station capacity of 2,400 gpm.

- **East Garrison Phase 2:** In order to convey the future flows from the East Garrison Phase 2 development a new lift station is recommended. This lift station is planned to have three 175 gpm pumps, two duty and one standby, for a total lift station capacity of 425 gpm. As an alternative two-pump option, two 350 gpm pumps, one duty and one standby, may be constructed for a total lift station capacity of 700 gpm.

7.4.2 Force Main Improvements

This section documents the recommended force main capacity improvements.

- **East Garrison Phase 2**: A new 10-inch force main is recommended to convey flows from the future East Garrison Phase 2 development.

- **Ord Village Force Main**: As part of the lift station relocation project the existing 10-inch forcemain is planned for replacement.

7.4.3 Gravity Main Improvements

This section documents the gravity main improvements. This section documents pipeline improvements within the Marina Coast sewer service area.

7.4.3.1 Central Marina

This section documents pipeline improvements within the Central Marina sewer service area.

- **M-P1:** Construct a new 15-inch gravity main in Cove Way and Cardoza Avenue from Abdy Way to Reservation Road.
- **M-P2:** Construct a new 15-inch gravity main in Reservation Road from Cardoza Avenue to 150 feet south of Seaside Circle.
- **M-P3:** Replace the existing 8-inch gravity main with a new 12-inch gravity main along Eucalyptus Street, Peninsula Drive, and Vista del Camino from Viking Lane to Reservation Road.
- **M-P4:** Replace the existing 8-inch gravity main with a new 10-inch gravity main along Carmel Avenue from Seacrest Avenue to Sunset Avenue.
- **M-P5:** Replace the existing 8-inch gravity main with a new 12-inch gravity main along Reservation Road from Sunset Avenue to Casa de Bolea.

7.4.3.2 Ord Community

This section documents pipeline improvements within the Ord Community sewer service area.

- **O-P1:** Construct a new 10-inch gravity sewer in Barloy Canyon Road to serve future development.
- **O-P2:** Replace the existing 15-inch gravity main with a new 18-inch gravity main along existing right-of-way from Ord Avenue to East Garrison Lift Station.
- **O-P3:** Construct a new 8-inch gravity main in Reservation Road from 4,700 feet west of East Garrison Lift Station to Reservation Road Lift Station.
- **O-P4:** Replace the existing 10-inch and 15-inch gravity mains with a new 18-inch gravity main along Abrams Drive from west of Inchon Court to 80th Artillery Court.
- **O-P5:** Replace the existing 15-inch gravity main with a new 18-inch gravity main within the planned Marina Heights development.
- **O-P6:** Replace the existing 18-inch gravity main with a new 18-inch gravity main along the within the planned Marina Heights development

- **O-P7:** Replace the existing 8-inch and 10-inch gravity mains with a new 15-inch gravity main along 7th Avenue from north of Butler Street to Inter-Garrison Road.
- **O-P8:** Replace the existing 8-inch gravity main with a new 15-inch gravity main along Inter-Garrison Road from 625 feet east of 7th Avenue to 7th Avenue
- **O-P9:** Replace the existing 10-inch gravity main with a new 18-inch gravity main along Inter-Garrison Road from 7th Avenue to 6th Avenue.
- **O-P10:** Replace the existing 10-inch and 15-inch gravity mains with a new 24-inch gravity main along Inter-Garrison Road and existing right-of-way, jogging from 6th Avenue to General Jim Moore Boulevard.
- **O-P11:** Replace the existing 10-inch gravity main with a new 24-inch gravity main along existing right-of-way, generally jogging from 4th Avenue to approximately 1,300 feet west of 4th Avenue.
- **O-P12:** Replace the existing 8-inch and 10-inch gravity mains with a new 12-inch gravity main along the right-of-way north of Inter-Garrison Road from 4th Avenue to 405 feet west of 4th Avenue.
- **O-P13:** Replace the existing 15-inch gravity main with a new 24-inch gravity main along 5th Street from 2nd Avenue to 200 feet west of 2nd Avenue.
- **O-P14:** Replace the existing 12, 18, and 30-inch gravity main with a new 30-inch gravity main along 1st Avenue from 1st Street to 8th Street.
- **O-P15:** Construct a new 8-inch gravity main along Eucalyptus Road from approximately 4,000 feet east of General Jim Moore Boulevard to approximately 800 feet west of General Jim Moore Boulevard.

7.4.4 Miscellaneous Improvements

This section documents miscellaneous improvements within the Marina Coast sewer service area.

7.4.4.1 Central Marina

This section documents miscellaneous improvements within the Central Marina sewer service area.

- **MS-M1:** Demolish the Marina Waste Water Treatment Plan located on Reservation Road 500 feet northwest of Dunes Drive.
- **MS-M2:** Replace the existing gravity main with a new gravity main along Del Monte Boulevard from Del Monte Boulevard to Reservation Road.

7.4.4.2 Ord Community

This section documents miscellaneous improvements within the Ord Community sewer service area.

- **MS-O1:** This project will provide resources for the purpose of planning how future district waste water generated from Del Rey Oaks development will be conveyed to Monterey OneWater.

- **MS-O2:** This improvement includes the planning, design, and construction of future sewer system infrastructure to convey flows from the future development within the City of Del Rey Oaks to the existing Seaside County Sanitation District (SCSD) sewer system. This also improvement also accounts for the District's proportional cost for the necessary improvements to the SCSD sewer system.

- **MS-O3:** This is a preliminary value for the cost of purchasing additional capacity for conveying sanitary sewer flows to Monterey OneWater beyond the pre-purchase capacity obtained from the Army.

- **MS-O4:** This project includes the construction of a gravity sewer main to serve potential future development along the proposed Eastside Parkway alignment.

- **MS-O5:** Demolish the Ord Main Garrison Waste Water Treatment Plant located on Beach Range Road between 8th Street and 12th Street.

- **MS-O6:** This project accounts for the District's proportional cost for improvements to the existing SCSD sewer system due to the future development of Seaside East, east of General Jim Moore Boulevard south of Eucalyptus Road. Flows are currently planned to be collected along General Jim Moore Boulevard and conveyed to the existing SCSD sewer system at La Salle Avenue, Broadway Avenue, and Hilby Avenue. Preliminary sizes and alignments for the pipelines intended to serve this area are documented in the capital improvements section, and are shown for completeness. The final alignment and diameter are subject to the review and approval of the District Engineer.

- **MS-O7:** This project includes general maintenance, health, and safety improvements to 8 existing lift stations in the Ord Community area in order to increase lift station life and accommodate increased capacity. The improvements included in this project may supersede the recommendations of the lift station condition assessment discussed in a previous section.

- **MS-O8:** This projects includes the construction of small portions of up-sized gravity main conveying flow to Booker Lift Station to provide capacity for potential future development.

CHAPTER 8 - CAPITAL IMPROVEMENT PROGRAM

This chapter provides a summary of the recommended Capital Improvement Program (CIP) for the District's sewer system. The program is based on the evaluation of the District's sewer system and on the recommended projects described in the previous chapters. The CIP has been prepared to assist the District in planning and constructing the collection system improvements through the ultimate buildout scenario. This chapter also presents the cost criteria and methodologies for developing the capacity improvement costs.

8.1 COST ESTIMATE ACCURACY

Cost estimates presented in the capacity improvement costs were prepared for general master planning purposes and, where relevant, for further project evaluation. Final costs of a project will depend on several factors including the final project scope, costs of labor and material, and market conditions during construction.

The Association for the Advancement of Cost Engineering (AACE International), formerly known as the American Association of Cost Engineers, has defined three classifications. These classifications are presented in order of increasing accuracy: Order of Magnitude, Budget, and Definitive.

- **Order of Magnitude Estimate.** This classification is also known as an "original estimate", "study estimate", or "preliminary estimate", and is generally intended for master plans and studies.

  This estimate is not supported with detailed engineering data about the specific project, and its accuracy is dependent on historical data and cost indices. It is generally expected that this estimate would be accurate within -30 percent to +50 percent.

- **Budget Estimate.** This classification is also known as an "official estimate" and generally intended for pre-design studies. This estimate is prepared to include flow sheets and equipment layouts and details. It is generally expected that this estimate would be accurate within -15 percent to +30 percent.

- **Definitive Estimate.** This classification is also known as a "final estimate" and prepared during the time of contract bidding. The data includes complete plot plans and elevations, and equipment data sheets, and complete specifications. It is generally expected that this estimate would be accurate within -5 percent to +15 percent.

Costs developed in this study should be considered "Order of Magnitude" and have an expected accuracy range of **-30 percent** and **+50 percent**.

8.2 COST ESTIMATE METHODOLOGY

Cost estimates presented in this chapter are opinions of probable construction and other relevant costs developed from several sources including cost curves, Akel experience on other master planning projects, and input from District staff on the development cost sharing. Where appropriate, costs were escalated to reflect the more current Engineering News Records (ENR) Construction Cost Index (CCI).

This section documents the unit costs used in developing the opinion of probable construction costs, the Construction Cost Index, and markups to account for construction contingency and other project related costs.

8.2.1 Unit Costs

The unit cost estimates used in developing the Capital Improvement Program are summarized on **Table 8.1**. The unit costs are intended for developing the Order of Magnitude estimate, and do not account for site specific conditions, labor or material costs during the time of construction, final project scope, implementation schedule, detailed utility and topography surveys, investigation of alternative routings for pipes, and other various factors. These factors are assumed included in the contingencies applied to the final capital improvement cost.

8.2.2 Construction Cost Index

Costs estimated in this study are adjusted utilizing the Engineering News Record (ENR) Construction Cost Index (CCI), which is widely used in the engineering and construction industries.

The costs in this Sewer Master Plan were benchmarked using a 20-City national average ENR CCI of 11,089, reflecting a date of June 2018.

8.2.3 Construction Contingency Allowance

Knowledge about site-specific conditions for each proposed project is limited at the master planning stage; therefore construction contingencies were used. The estimated construction costs in this master plan include a **48.5 percent** contingency allowance to account for unforeseen events and unknown field conditions.

8.2.4 Project Related Costs

The capital improvement costs also account for project-related costs, comprising of engineering design, project administration (developer and District staff), construction management and inspection, and legal costs. The project related costs in this master plan were estimated by applying an additional **25 percent** to the estimated construction costs.

Table 8.1 Unit Costs

Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Pipelines[1,2]	
Pipe Size (in)	**Cost** ($/lineal foot)
8	218
10	243
12	279
15	303
18	327
21	352
24	400
27	450
30	500
36	600

Lift Station[2,3]

Estimated Lift Station Project Cost = $9{,}045 \cdot Q^2 + 293951 \cdot Q + 342{,}261$, where Q is in mgd

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2/7/2019

Notes :

1. Construction costs are based on Bid Tabs Results received from District staff on October 18, 2018.
2. Construction costs estimated using June 2018 ENR CCI of 11,089.
3. Lift Station costs based on Akel Engineering Group experience on similar projects.

8.3 LIFT STATION CONDITION ASSESSMENT COSTS

The lift station condition assessment, completed by GHD, included an opinion of probable costs for improvements to priority components receiving a condition score of 5 (Very Poor), 4 (Poor), or 3 (Moderate/Fair). The recommended improvements and associated costs are documented in **Table 8.2**. The costs for these condition assessment improvements are incorporated into the sewer system Capital Improvement Program, with the following exceptions:

- **Dunes Lift Station:** Under existing conditions, the Dunes lift station is under capacity and recommended for replacement. It is assumed that the existing condition deficiencies will be mitigated as part of this lift station replacement.

- **Crescent Lift Station:** The District plans to replace the Crescent lift station in the near future as a result of age and condition. It is assumed that the existing condition will be mitigated as part of this lift station replacement.

- **Hatten Lift Station:** The District plans to abandon the Hatten lift station in the near future; therefore, the condition assessment costs are not included in the Capital Improvement Program.

- **Neeson Lift Station:** The District plans to abandon the Neeson lift station in the near future; therefore, the condition assessment costs are not included in the Capital Improvement Program.

- **Booker Lift Station:** The District plans to reconfigure the existing wet well and perform site work at the Booker lift station in the near future. It is assumed that this will address the existing condition deficiencies, which primarily consists of wet well configuration and issues with the existing site. However, it is recommended District staff review the condition assessment findings and incorporate any additional improvements not currently planned in the upcoming reconfiguration and site work.

- **Ord Village Lift Station:** The District plans to relocate the existing Ord Village lift station and it is assumed that that this will address the existing condition deficiencies.

8.4 CAPITAL IMPROVEMENT PROGRAM

The schedule of improvements for the projects identified in this master plan for mitigating existing system deficiencies and for serving anticipated buildout future growth throughout the District are summarized on **Table 8.3**. Each improvement was assigned a unique coded identifier associated with the improvement type and is summarized graphically on **Figure 8.1**.

8.4.1 Near-Term Development Infrastructure Requirements

For the purposes of this master plan, and based on District staff input on the potential for buildout development to occur over an extended period of time, the Capital Improvement Program

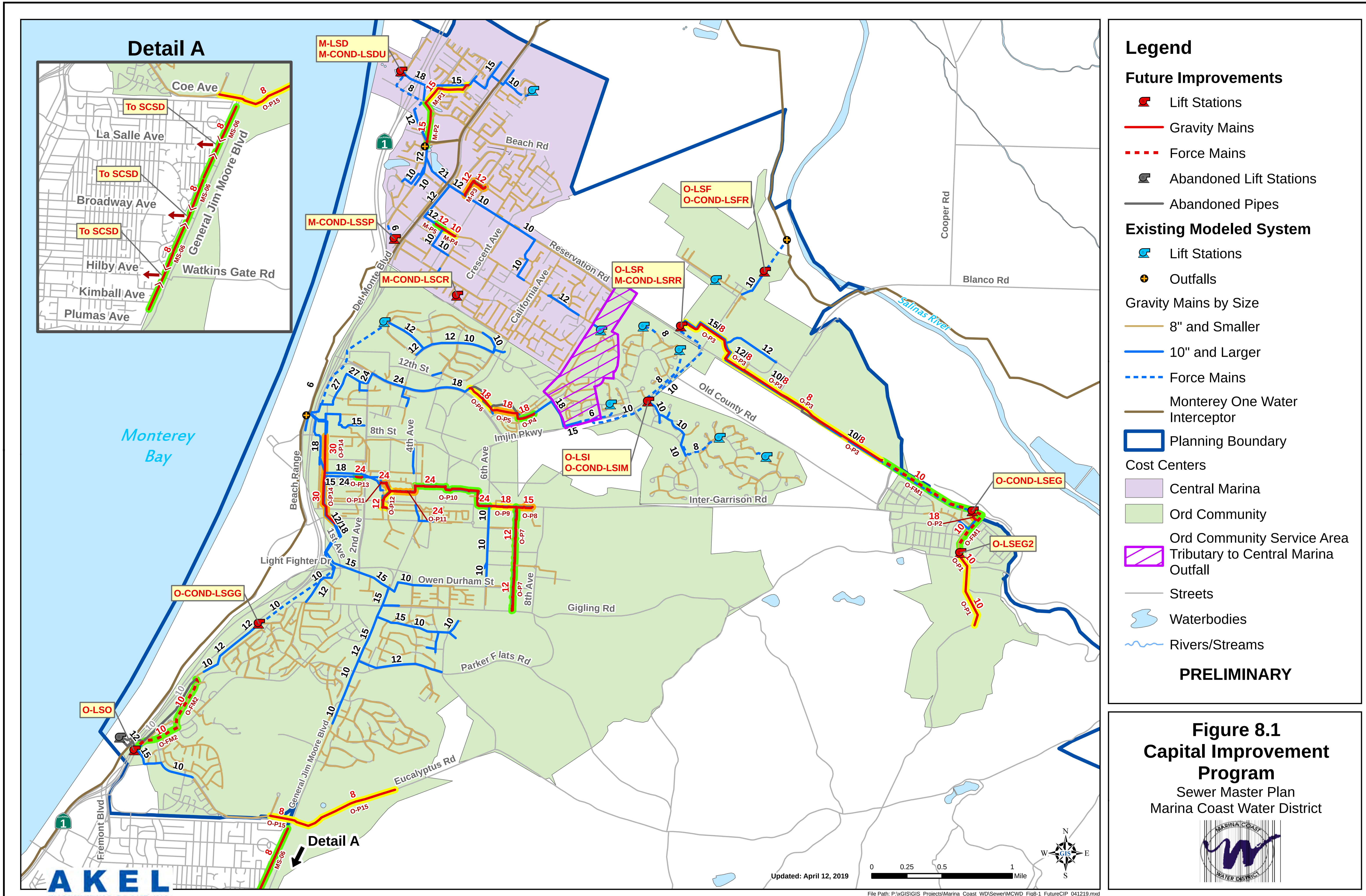

Figure 8.1
Capital Improvement Program
Sewer Master Plan
Marina Coast Water District

Table 8.2 Lift Station Condition Assessment Improvement Costs

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Lift Station	Assessment Factor	Lift Station Component	Construction Cost[1] ($)	Baseline Const. Cost ($)	Estimated Const. Cost[2] ($)	Capital Improv. Cost[3] ($)
City of Marina Sewer System						
Dunes						
DUN-1	Wet Well	Discharge Pipes	3,200	3,200	4,800	6,000
DUN-2	Wet Well	Concrete Wall	19,900	19,900	29,600	37,000
DUN-3	Electrical Equipment	120 volt convenience receptacle	500	500	800	1,000
		Lift Station Subtotal -	**23,600**	**23,600**	**35,200**	**44,000**
San Pablo						
SPB-1	Hatches	Structural Support	4,000	4,000	6,000	7,500
SPB-2	Electrical Equipment	NEMA 3R equipment enclosure	2,200	2,200	3,300	4,200
SPB-3	Electrical Equipment	Conduit	2,000	2,000	3,000	3,800
SPB-4	Backup Power	Generator	16,300	16,300	24,300	30,400
SPB-5	Controls	Float Switches	100	100	200	300
		Lift Station Subtotal -	**24,600**	**24,600**	**36,800**	**46,200**
Crescent						
CRE-1	Piping / Valves	Valve Pit, Valves, Piping, and Valve Pit Structure	5,900	5,900	8,800	11,000
CRE-2	Electrical Equipment	Pump Control Panel Enclosure	500	500	800	1,000
CRE-3	Electrical Equipment	Transfer Switch Enclosure	300	300	500	700
CRE-4	Electrical Equipment	Conduits entering the wet well	100	100	200	300
CRE-5	Controls	Float Switches	17,800	17,800	26,500	33,200
CRE-6	Access / Safety	Expand Fence	25,100	25,100	37,300	46,700
		Lift Station Subtotal -	**49,700**	**49,700**	**74,100**	**92,900**
Fort Ord Sewer System						
Neeson						
NEE-1	Pumping Unit	Pumps	94,600	94,600	140,500	175,700
NEE-2	Piping / Valves	Piping / Valves	2,000	2,000	3,000	3,800
NEE-3	Wet Well	Lid	2,500	2,500	3,800	4,800
NEE-4	Wet Well	Piping / Valves	3,100	3,100	4,700	5,900
NEE-5	Structure	Concrete Slab	2,200	2,200	3,300	4,200
NEE-6	Pipe / Equip Supports	Support for Pipes and Valves	700	700	1,100	1,400
NEE-7	Wet Well	Support for Pipes and Valves	700	700	1,100	1,400
NEE-8	Electrical Equipment	General Electrical Equipment	50,000	50,000	74,300	92,900
NEE-9	Controls	Level Control	2,500	2,500	3,800	4,800
NEE-10	SCADA / Alarms	PLC/ telemetry package	10,000	10,000	14,900	18,700
NEE-11	SCADA / Alarms	Alarm Notification	2,000	2,000	3,000	3,800
NEE-12	General Site	Access	2,000	2,000	3,000	3,800
NEE-13	General Site	Security Lighting	1,000	1,000	1,500	1,900
		Lift Station Subtotal -	**173,300**	**173,300**	**258,000**	**323,100**
Gigling						
GIG-1	HVAC	Metal Ducts	2,100	2,100	3,200	4,000
GIG-2	Piping / Valves	Access to pump removal	20,000	20,000	29,700	37,200
GIG-3	Piping / Valves	Air Lock Issues - Piping / Valves	10,000	10,000	14,900	18,700
GIG-4	Primary Power	Generator	46,400	46,400	69,000	86,300
GIG-5	Primary Power	Bulk Tank	200,000	200,000	297,000	371,300
GIG-6	SCADA / Alarms	PLC - Contents	500	500	800	1,000
GIG-7	Access	Pavement	135,300	135,300	201,000	251,300
GIG-8	Security	Barbed Wire Fence	30,000	30,000	44,600	55,800
		Lift Station Subtotal -	**444,300**	**444,300**	**660,200**	**825,600**

Table 8.2 Lift Station Condition Assessment Improvement Costs

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Lift Station	Assessment Factor	Lift Station Component	Construction Cost[1] ($)	Baseline Const. Cost ($)	Estimated Const. Cost[2] ($)	Capital Improv. Cost[3] ($)
Hatten						
HAT-1	Structure	Base Support	2,300	2,300	3,500	4,400
HAT-2	Structure	Pipe / Equip Support	200	200	300	400
HAT-3	Wet Well	Wet Well Lid	2,500	2,500	3,800	4,800
HAT-4	Backup Power	Generator or Trailer Mount Unit	16,300	16,300	24,300	30,400
HAT-5	SCADA / Alarms	PLC / Telemetry	11,000	11,000	16,400	20,500
HAT-6	Security	Fencing	22,800	22,800	33,900	42,400
		Lift Station Subtotal -	**55,100**	**55,100**	**82,200**	**102,900**
Imjin						
IMJ-1	Piping / Valves	Valve Vault Piping and Valves	10,700	10,700	15,900	19,900
IMJ-2	Wet Well	Fall Protection	2,300	2,300	3,500	4,400
IMJ-3	Electrical Equipment	Auto Transfer Switch	6,000	6,000	9,000	11,300
IMJ-4	Electrical Equipment	Conduit	2,500	2,500	3,800	4,800
IMJ-5	Electrical Equipment	Demo Control Panel / New Pullbox	7,500	7,500	11,200	14,000
		Lift Station Subtotal -	**29,000**	**29,000**	**43,400**	**54,400**
Ord Village						
FOV-1	Headworks	Muffin Monster Communitors	42,700	42,700	63,500	79,400
FOV-2	HVAC	Metal Ducting	2,400	2,400	3,600	4,500
FOV-3	Piping / Valves	Pipe at the end of discharge line	3,200	3,200	4,800	6,000
FOV-4	Piping / Valves	Air lock Issues	10,000	10,000	14,900	18,700
FOV-5	Structure	Drainage of Concrete Pad on West Side of Pump Station	500	500	800	1,000
FOV-6	Structure	Bulk Fuel Tank	20,000	20,000	29,700	37,200
FOV-7	Windows	Window Replacement	500	500	800	1,000
FOV-8	Wet Well	Wet Well Hatch	4,000	4,000	6,000	7,500
FOV-9	Electrical Equipment	Service entrance switchboard	25,000	25,000	37,200	46,500
FOV-10	Electrical Equipment	Fuel tank leak detection panel	2,000	2,000	3,000	3,800
FOV-11	Backup Power	175 kW Caterpillar diesel generator	60,700	60,700	90,200	112,800
FOV-12	Security	Fencing and Site Lighting	2,000	2,000	3,000	3,800
		Lift Station Subtotal -	**173,000**	**173,000**	**257,500**	**322,200**
Booker						
BKR-1	Pumping Unit	Additional Pump	10,000	10,000	14,900	18,700
BKR-2	Headworks	Muffin Monster Communitor	40,700	40,700	60,500	75,700
BKR-3	HVAC	Redesign of HVAC System	4,600	4,600	6,900	8,700
BKR-4	Piping / Valves	Gate Valves	900	900	1,400	1,800
BKR-5	Wet Well / Dry Pit	Dry Pit Dimensions	5,200	5,200	7,800	9,800
BKR-6	Wet Well / Dry Pit	Dry Pit Hatch Upgrade	4,000	4,000	6,000	7,500
BKR-7	Wet Well / Dry Pit	Dry Pit Stairs	1,500	1,500	2,300	2,900
BKR-8	Structure	Concrete Slab	82,100	82,100	122,000	152,500
BKR-9	Primary Power	Pole mount transformer	5,000	5,000	7,500	9,400
BKR-10	Backup Power	Generator	32,100	32,100	47,700	59,700
BKR-11	Backup Power	250 gallon bulk diesel fuel tank	18,000	18,000	26,800	33,500
BKR-12	SCADA /Alarms	PLC - radio link	300	300	500	700
BKR-13	Security	Fencing	22,800	22,800	33,900	42,400
BKR-14	Security	Lighting	5,000	5,000	7,500	9,400
		Lift Station Subtotal -	**232,200**	**232,200**	**345,700**	**432,700**
Fritzche						
FRI-1	Piping / Valves	Valve Vault Piping & Valves	7,000	7,000	10,400	13,000
FRI-2	Wet Well	Pipes	900	900	1,400	1,800

Table 8.2 Lift Station Condition Assessment Improvement Costs

Sewer Master Plan

Marina Coast Water District

PRELIMINARY

Lift Station	Assessment Factor	Lift Station Component	Construction Cost[1] ($)	Baseline Const. Cost ($)	Estimated Const. Cost[2] ($)	Capital Improv. Cost[3] ($)
FRI-3	Hatches	Pneumatics and Fall Protection	4,000	4,000	6,000	7,500
FRI-4	Electrical Equipment	Cabinet - Pump Motor Starters and Militronics Mini-Ranger level controller	35,000	35,000	52,000	65,000
FRI-5	Backup Power	Generator	16,300	16,300	24,300	30,400
		Lift Station Subtotal -	**63,200**	**63,200**	**94,100**	**117,700**
East Garrison						
EAG-1	Piping /Valves	Valve Vault Pipes and Valves	2,800	2,800	4,200	5,300
EAG-2	Wet Well	Piping in Wet Well	2,600	2,600	3,900	4,900
EAG-3	Structure	Concrete Pad	1,700	1,700	2,600	3,300
EAG-4	Pipe / Equip Supports	Concrete block under Y Valve in valve vault	400	400	600	800
EAG-5	Electrical Equipment	PVC conduits between the electrical panels and wet well	5,000	5,000	7,500	9,400
EAG-6	Backup Power	Generator Receptacle	19,200	19,200	28,600	35,800
EAG-7	Backup Power	Automatic Transfer Switch	600	600	900	1,200
		Lift Station Subtotal -	**32,300**	**32,300**	**48,300**	**60,700**
Reservation Road						
RES-1	Headworks	Muffin Monster Grinder	5,700	5,700	8,500	10,700
RES-2	Piping / Valves	Valve Vault Piping and Valves	2,900	2,900	4,400	5,500
RES-3	Wet Well	Wet Well Coating	2,500	2,500	3,800	4,800
RES-4	Electrical Equipment	Automatic Transfer Switch	6,000	6,000	9,000	11,300
RES-5	Security	Fencing	22,800	22,800	33,900	42,400
		Lift Station Subtotal -	**39,900**	**39,900**	**59,600**	**74,700**

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7/13/2018

Notes:

1. Condition assessment improvements and construction costs based on lift station condition assessment report prepared by GHD. Improvements shown may be superseded based on hydraulic capacity improvements or other lift station improvements currently planned by District staff.
2. Estimated Construction costs include 48.5 percent of baseline construction costs to account for unforeseen events and unknown field conditions, and for Contractor's overhead and profit, general conditions, and sales tax, consistent with 2007 Water Master plan.
3. Capital Improvement Costs also include an additional 25 percent of the estimated construction costs to account for administration, construction management, and legal costs.

Table 8.3 Buildout Capital Improvement Program
Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvement Details				Infrastructure Costs		Baseline Construction Costs	Estimated Construction Cost[1]	Capital Improvement Cost[2,3]	Suggested Cost Allocation		Included in 15-Year CIP	Cost Allocation	
								Unit Cost	Infr. Cost				Existing Users	Future Users		Existing Users	Future Users
								($)	($)	($)	($)	($)	(%)	(%)		($)	($)
Central Marina Sewer System																	
Gravity Main Improvements				Existing Diameter (in)	New/Parallel/Replace	Diameter (in)	Length (ft)										
M-P1	Gravity Main	ROW, Cove Way, Cardoza Ave	From Abdy Way to Reservation Rd	-	New	15	1,975	303	598,745	598,800	889,300	1,111,700	1%	99%	Yes	11,117	1,100,583
M-P2	Gravity Main	Reservation Rd	From Cardoza Ave to 150' s/o Seaside Cir	-	New	15	1,725	303	522,955	523,000	776,700	970,900	1%	99%	Yes	9,709	961,191
M-P3	Gravity Main	Eucalyptus St, Peninsula Dr, Vista del Camino	From Viking Ln to Reservation Rd	8	Replace	12	1,350	279	376,527	376,600	559,300	699,200	85%	15%	Yes	594,320	104,880
M-P4	Gravity Main	Carmel Ave	From Seacrest Ave to Sunset Ave	8	Replace	10	575	243	139,455	139,500	207,200	259,000	100%	0%	Yes	259,000	0
M-P5	Gravity Main	Reservation Rd	From Sunset Ave to Casa de Bolea	8	Replace	12	350	279	97,618	97,700	145,100	181,400	100%	0%	Yes	181,400	0
							Subtotal - City of Marina Pipeline Improvements		**1,735,300**	**1,735,600**	**2,577,600**	**3,222,200**				**1,055,546**	**2,166,654**
Lift Station Improvements				Existing Capacity (gpm)	Improvement Type	Recommended Capacity (gpm)											
M-LSD	Lift Station Replacement	Dunes Lift Station		2 x 700	Capacity Upgrade	3 x 450			1,127,627	1,127,700	1,674,700	2,093,400	100%	0%	Yes	2,093,400	0
M-LSCR	Lift Station Replacement	Crescent Lift Station		2 x 100	Capacity Upgrade	2 x 100			-	-	-	401,576	100%	0%	Modified	401,576	0
							Subtotal - City of Marina Lift Station Improvements		**1,127,627**	**1,127,700**	**1,674,700**	**2,494,976**				**2,494,976**	**0**
Condition Assessment Improvements[4]					Improvement Type												
M-COND-LSSP	Condition	San Pablo Lift Station			Condition Improvements				24,600	24,600	36,800	46,200	100%	0%	Yes	46,200	0
							Subtotal - Central Marina Condition Assessment Improvements		**24,600**	**24,600**	**36,800**	**46,200**				**46,200**	**0**
Miscellaneous Improvements					Improvement Type												
MS-M1	WWTP	Located at the Marina WWTP			Demolition							883,265	100%	0%	Yes	883,265	0
MS-M2	Gravity Main	Del Monte Boulevard	Del Monte Blvd/ Reservation Rd		Replace							553,161	100%	0%	Yes	553,161	0
							Subtotal - Central Marina Miscellaeous Improvements					**1,436,426**				**1,436,426**	**0**
Total Central Marina Improvement Costs																	
							Gravity Main Improvements		**1,735,300**	**1,735,600**	**2,577,600**	**3,222,200**				**1,055,546**	**2,166,654**
							Lift Station Improvements		**1,127,627**	**1,127,700**	**1,674,700**	**2,494,976**				**2,494,976**	**0**
							Condition Assessment Improvements		**24,600**	**24,600**	**36,800**	**46,200**				**46,200**	**0**
							Miscellaneous Improvements		**0**	**0**	**0**	**1,436,426**				**1,436,426**	**0**
							Total - Central Marina Improvements		**2,887,527**	**2,887,900**	**4,289,100**	**7,199,802**				**5,033,148**	**2,166,654**
Ord Community Sewer System																	
Gravity Main Improvements				Existing Diameter (in)	New/Parallel/Replace	Diameter (in)	Length (ft)										
O-P1	Gravity Main	Barloy Canyon Road	3,000' of future pipeline to convey future flows from development	-	New	10	2,950	243	715,463	715,500	1,062,600	1,328,300	0%	100%	-	0	1,328,300
O-P2	Gravity Main	ROW	From Ord Avenue to East Garrison Lift Station	15	Replace	18	400	327	130,966	131,000	194,600	243,300	0%	100%	Yes	0	243,300
O-P3	Gravity Main	Reservation Rd	From 4,700' w/o East Garrison Lift Station to Reservation Road Lift Station	-	New	8	9,900	218	2,160,940	2,161,000	3,209,100	4,011,400	0%	100%	-	0	4,011,400
O-P4	Gravity Main	Abrams Dr	From w/o Inchon Ct to 80th Artillery Ct	10,15	Replace	18	675	327	221,005	221,100	328,400	410,500	34%	66%	Yes	138,626	271,874
O-P5	Gravity Main	ROW	N/o Abrams Dr following Abrams Dr/ Imjin Pkwy	15	Replace	18	1,325	327	433,825	433,900	644,400	805,500	27%	73%	Yes	214,677	590,823
O-P6	Gravity Main	ROW e/o Imjin Pkwy	From California Ave to 475' n/o Abrams Dr	18	Replace	18	1,100	327	360,157	360,200	534,900	668,700	24%	76%	Yes	160,100	508,600
O-P7	Gravity Main	7th Ave	From n/o Butler St to Inter-Garrison Rd	8,10	Replace	12	4,550	279	1,269,037	1,269,100	1,884,700	2,355,900	0%	100%	-	0	2,355,900

Table 8.3 Buildout Capital Improvement Program
Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvement Details				Infrastructure Costs: Unit Cost ($)	Infrastructure Costs: Infr. Cost ($)	Baseline Construction Costs ($)	Estimated Construction Cost[1] ($)	Capital Improvement Cost[2,3] ($)	Suggested Cost Allocation: Existing Users (%)	Suggested Cost Allocation: Future Users (%)	Included in 15-Year CIP	Cost Allocation: Existing Users ($)	Cost Allocation: Future Users ($)
O-P8	Gravity Main	Inter-Garrison Rd	From 625' e/o 7th Ave to 7th Ave	8	Replace	15	700	303	212,214	212,300	315,300	394,200	0%	100%	-	0	394,200
O-P9	Gravity Main	Inter-Garrison Rd	From 7th Avenue to 6th Ave	10	Replace	18	1,100	327	360,157	360,200	534,900	668,700	0%	100%	-	1,137	667,563
O-P10	Gravity Main	Inter-Garrison Rd	Jogging from 6th Ave to General Jim Moore Blvd	10,15	Replace	24	3,975	400	1,590,692	1,590,700	2,362,200	2,952,800	11%	89%	-	310,332	2,642,468
O-P11	Gravity Main	ROW n/o Inter-Garrison Rd	Jogging from 4th Ave to 1,300' w/o 4th Ave	10	Replace	24	1,675	400	670,292	670,300	995,400	1,244,300	15%	85%	Modified	191,429	1,052,871
O-P12	Gravity Main	ROW	Jogging from 3rd Ave to 400' n/o Inter-Garrison Rd	8,10	Replace	12	1,000	279	278,909	279,000	414,400	518,000	47%	53%	-	246,027	271,973
O-P13	Gravity Main	5th St	From 2nd Ave to 200' w/o 2nd Ave	15	Replace	24	250	400	100,044	100,100	148,700	185,900	0%	100%	-	0	185,900
O-P14	Gravity Main	1st Ave	From 1st St to 8th St	12,18,30	Replace	30	3,100	-	-	-	-	408,340	100%	0%	Yes	408,340	0
O-P15	Gravity Main	Eucalyptus Rd	From approximately 4,000' e/o General Jim Moore Blvd to approximatley 800' w/o General Jim Moore Blvd	-	New	8	5,050	218	1,102,298	1,102,300	1,637,000	2,046,300	0%	100%	Yes	0	2,046,300
				Subtotal - Ord Community Pipeline Improvements					**9,605,998**	**9,606,700**	**14,266,600**	**18,242,140**				**1,670,669**	**16,571,471**
Force Main Improvements				**Existing Diameter (in)**	**New/Parallel/ Replace**	**Diameter (in)**	**Length (ft)**										
O-FM1	Force Main	Reservation Rd	From Phase 2 of the East Garrison Development to 4,700 ft w/o East Garrison Lift Station	-	New	10	6,075	214	1,300,752	1,300,800	1,931,700	2,414,700	0%	100%	-	0	2,414,700
O-FM2	Force Main	Monterey Rd, existing ROW	From relocated Ord Village LS to existing gravity main n/o Corregidor Rd	10	Replace	10	3,950	214	845,756	845,800	1,256,100	1,570,200	42%	58%	Yes	667,033	903,167
				Subtotal - Ord Community Force Main Improvements					**2,146,508**	**2,146,600**	**3,187,800**	**3,984,900**				**667,033**	**3,317,867**
Lift Station Improvements				**Existing Capacity (gpm)**	**Improvement Type**	**Recommended Capacity (gpm)**											
O-LSEG2	New	East Garrison Phase 2	East Garrison Phase 2	-	New	3 x 175 gpm		-	571,326	571,400	848,600	1,060,800	0%	100%	-	0	1,060,800
O-LSR	Lift Station Replacement	Reservation Road Lift Station	Reservation Road Lift Station	2 x 710	Replacement Capacity	3 x 600		-	1,127,627	1,127,700	1,674,700	2,093,400	15%	85%	-	317,744	1,775,656
O-LSI	Lift Station Replacement	Imjin Lift Station	Imjin Lift Station	2 x 700	Replacement Capacity	3 x 700		-	1,258,521	1,258,600	1,869,100	2,336,400	32%	68%	-	740,930	1,595,470
O-LSF	Lift Station Replacement	Fritzche Lift Station	Fritzche Lift Station	2 x 160	Replacement Capacity	3 x 150		-	538,602	538,700	800,000	1,000,000	11%	89%	-	109,707	890,293
O-LSG	Lift Station/ Force Main	Gigling Lift Station	Gigling LS and FM Improvements			-	-	-	-	-	-	2,021,079	100%	0%	Yes	2,021,079	0
O-LSO	Lift Station Rehabilitation		Ord Village Sewer Pipeline and Lift Station Improvement Project			-	-	-	-	-	-	2,247,000	43%	57%	Yes	956,206	1,290,794
O-LSB	Lift Station Demolition and Replacement		Booker, Hatten, Neeson LS improvements			-	-	-	-	-	-	726,240	100%	0%	Yes	726,240	0
				Subtotal - Ord Community Lift Station Improvements					**3,496,076**	**3,496,400**	**5,192,400**	**11,484,919**				**4,871,906**	**6,613,013**
Condition Assessment Improvements[4]					**Improvement Type**												
O-COND-LSGG	Condition	Gigling Lift Station			Condition Improvements				444,300	444,300	660,200	825,600	100%	0%	Yes	825,600	0
O-COND-LSIM	Condition	Imjin Lift Station			Condition Improvements				29,000	29,000	43,400	54,400	100%	0%	Yes	54,400	0
O-COND-LSFR	Condition	Fritzche Lift Station			Condition Improvements				63,200	63,200	94,100	117,700	100%	0%	Yes	117,700	0
O-COND-LSEG	Condition	East Garrison Lift Station			Condition Improvements				32,300	32,300	48,300	60,700	100%	0%	Yes	60,700	0
O-COND-LSRR	Condition	Reservation Road Lift Station			Condition Improvements				39,900	39,900	59,600	74,700	100%	0%	Yes	74,700	0
				Subtotal - Ord Community Condition Assessment Improvements					**608,700**	**608,700**	**905,600**	**1,133,100**				**1,133,100**	**0**
Miscellaneous Improvements																	
MS-O1	Service		Del Rey Oaks Collection System Planning									61,200	0%	100%	Yes	0	61,200
MS-O2	Gravity Main		SCSD Sewer Improvements - Del Rey Oaks									2,039,964	0%	100%	Yes	0	2,039,964

Table 8.3 Buildout Capital Improvement Program
Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvement Details	Infrastructure Costs: Unit Cost ($)	Infrastructure Costs: Infr. Cost ($)	Baseline Construction Costs ($)	Estimated Construction Cost[1] ($)	Capital Improvement Cost[2,3] ($)	Suggested Cost Allocation: Existing Users (%)	Suggested Cost Allocation: Future Users (%)	Included in 15-Year CIP	Cost Allocation: Existing Users ($)	Cost Allocation: Future Users ($)
MS-O3	Service		Monterey One Water Buy-In						11,040,808	50%	50%	Yes	5,520,404	5,520,404
MS-O4	Gravity Main		Inter-Garrison/ 8th Avenue Sewer Connection						1,035,000	0%	100%	Yes	0	1,035,000
MS-O5	WWTP		Demolish Ord Main Garrison WWTP						1,623,648	100%	0%	Yes	1,623,648	0
MS-O6	Gravity Main		Seaside East Side Developments Parcels (future growth)						6,480,709	0%	100%	Yes	0	6,480,709
MS-O7	Lift Station		Miscellaneous Lift Station Improvements						1,497,360	50%	50%	Yes	748,680	748,680
MS-O8	Lift Station/ Gravity Main		Cypress Knolls Sewer Pipeline and Lift Station Improvement Project						97,424	0%	100%	Yes	0	97,424
				Subtotal - Ord Community Miscellaneous Improvements		**0**	**0**	**0**	**23,876,113**				**7,892,732**	**15,983,381**
Total Ord Community Improvement Costs														
				Gravity Main Improvements		**9,605,998**	**9,606,700**	**14,266,600**	**18,242,140**				**1,670,669**	**16,571,471**
				Force Main Improvements		**2,146,508**	**2,146,600**	**3,187,800**	**3,984,900**				**667,033**	**3,317,867**
				Lift Station Improvements		**3,496,076**	**3,496,400**	**5,192,400**	**11,484,919**				**4,871,906**	**6,613,013**
				Condition Assessment Improvements		**608,700**	**608,700**	**905,600**	**1,133,100**				**1,133,100**	**0**
				Miscellaneous Improvements		**0**	**0**	**0**	**23,876,113**				**7,892,732**	**15,983,381**
				Total Ord Community Community Improvements		**15,857,282**	**15,858,400**	**23,552,400**	**58,721,172**				**16,235,440**	**42,485,732**
General Miscellaneous Sewer System Improvements														
G-1	Odor Control Project	Various Locations	Odor Control Project						100,000	100%	0%		100,000	0
G-2	Other	Corporation Yard Demolition and Rehab							116,300	100%	0%		116,300	0
				Subtotal - General Sewer System Improvements					**216,300**				**216,300**	**0**
Total Sewer System Improvement Costs														
				Gravity Main Improvements		**11,341,298**	**11,342,300**	**16,844,200**	**21,464,340**				**2,726,215**	**18,738,125**
				Force Main Improvements		**2,146,508**	**2,146,600**	**3,187,800**	**3,984,900**				**667,033**	**3,317,867**
				Lift Station Improvements		**4,623,703**	**4,624,100**	**6,867,100**	**13,979,895**				**7,366,882**	**6,613,013**
				Condition Assessment Improvements		**633,300**	**633,300**	**942,400**	**1,179,300**				**1,179,300**	**0**
				Miscellaneous Improvements		**0**	**0**	**0**	**25,528,839**				**9,545,458**	**15,983,381**
				Total Improvement Cost		**18,744,809**	**18,746,300**	**27,841,500**	**66,137,274**				**21,484,888**	**44,652,386**

AKEL ENGINEERING GROUP, INC.

5/24/2019

Notes :
1. Estimated Construction costs include 48.5 percent of baseline cosntruction costs to account for unforeseen events and unknown field conditions, and for Contractor's overhead and profit, general conditions, and sales tax, consistent with 2007 Water Master plan.
2. Capital Improvement Costs also include an additional 25 percent of the estimated construction costs to account for administration, construction management, and legal costs.
3. Costs for improvements shown with only Capital Improvement Cost are based on information provided by District staff.
4. Costs associated with condition assessment improvements are included for planning purposes and are to be implemented at the discretion of District staff or may be superceded by other planned lift station improvements.

parallels the FORA development limit horizon and evaluates the improvements required in the next 15 years. These improvements and their associated costs are included on **Table 8.4** and shown graphically on **Figure 8.2**, reflect the sewer system infrastructure necessary to mitigate existing system deficiencies and serve the 15-year development.

It should be noted that some improvements are required for buildout development only and are not included in this Capital Improvement Program. Additionally, the capacities of recommended gravity mains and lift stations may be reduced based on the limited development within the near-term horizon. District staff may, at their prerogative and based on the approval of the District Engineer, require the construction of the buildout improvement. Thus, capacity sharing for the buildout improvements are documented on **Table 8.3**.

Capital Improvement project sheets are provided in **Appendix D**. These project sheets document the location of the recommended improvements as well as providing a description of the improvement, the capital improvement costs, triggers, and cost sharing.

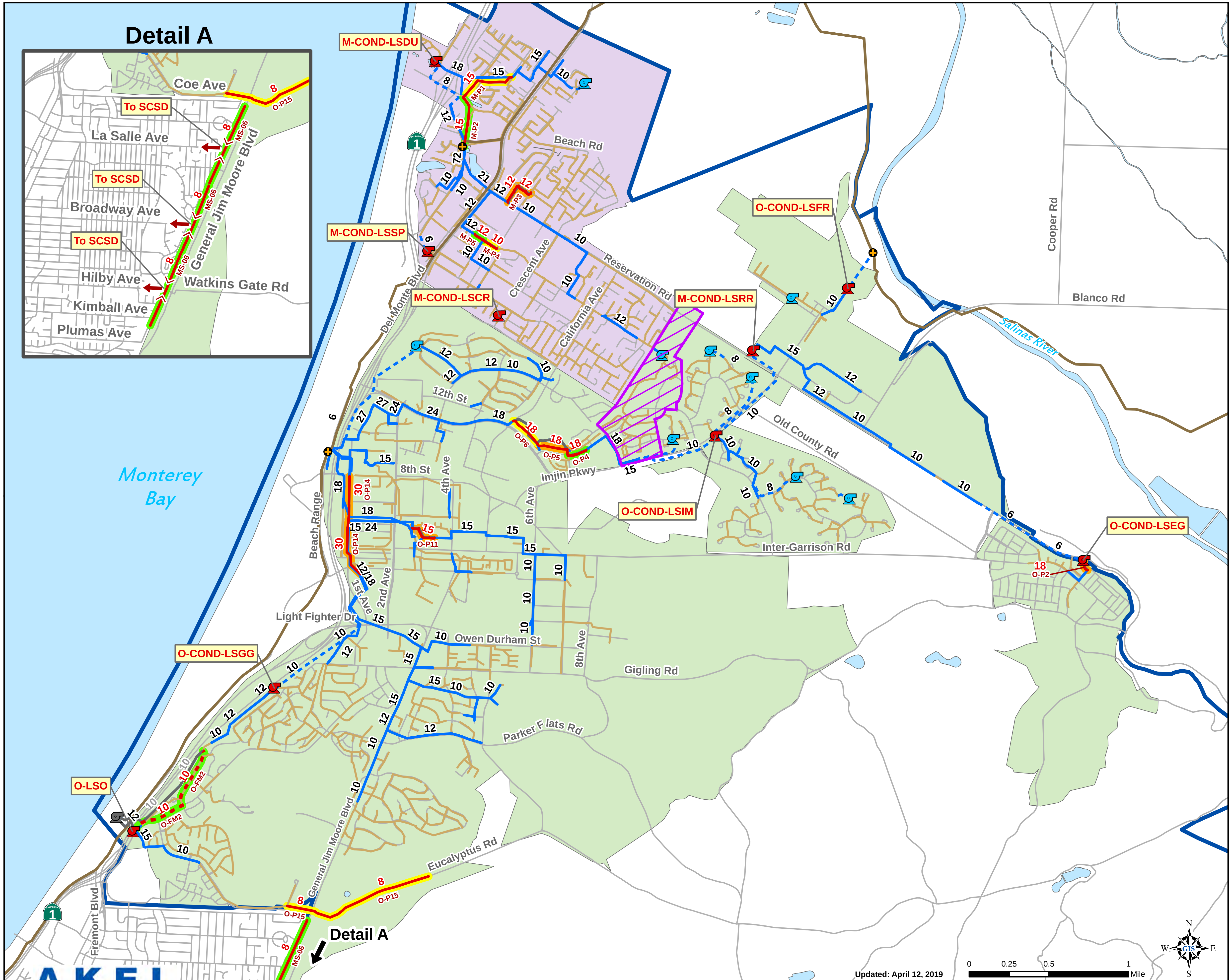
8.4.2 Recommended Cost Allocation Analysis and "In-Tract" Development

Cost allocation analysis is needed to identify improvement funding sources, and to establish a nexus between development impact fees and improvements needed to service growth. In compliance with the provisions of Assembly Bill AB 1600, the analysis differentiates between the project needs of servicing existing users and for those required to service anticipated future developments. The cost responsibility is based on model parameters for existing and future land use, and may change depending on the nature of development. **Table 8.3** and **Table 8.4** lists each improvement, and separates the cost by responsibility between existing and future users. For improvements planned to serve both the Central Marina and Fort Ord Community service areas, **Table 8.5** summarizes the cost responsibility of the existing and future users within each service area.

It should be noted that the District adopted an "In-Tract" policy in January 2004, and as related to development, and redevelopment, within the Ord Community Cost Center. This policy was adopted in an effort to fulfill obligations to the Fort Ord Reuse Authority, as well as avoiding undue cost burden to the existing customers within the Ord community. This policy is a result of inadequate design, age, and aggressive deterioration of the facilities located within the Ord Community Cost Center. The full "In-Tract" policy is included in **Appendix E**. The following is directly from the District's "In-Tract" policy:

For all proposed redevelopment projects in areas served by existing water and wastewater collection infrastructure, the developer will be required to implement one of the following procedures:

1. *Where redevelopment will raze the existing buildings and streets:*
    - *Developer completes a subdivision water and sewer master plan per the District standards.*
    - *Developer replaces all existing water and wastewater collection pipelines and components within the project area to District standards, and replaces all existing*



Legend

Future Improvements

- Lift Stations
- Gravity Mains
- Force Mains
- Abandoned Lift Stations
- Abandoned Pipes

Existing Modeled System

- Lift Stations
- Outfalls

Gravity Mains by Size

- 8" and Smaller
- 10" and Larger
- Force Mains
- Monterey One Water Interceptor
- Planning Boundary

Cost Centers

- Central Marina
- Ord Community
- Ord Community Service Area Tributary to Central Marina Outfall
- Streets
- Waterbodies
- Rivers/Streams

PRELIMINARY

Figure 8.2
Near Term Improvements

Sewer Master Plan
Marina Coast Water District

Table 8.4 Near-Term Capital Improvement Program
Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvement Details				Infrastructure Costs: Unit Cost ($)	Infrastructure Costs: Infr. Cost ($)	Baseline Construction Costs ($)	Estimated Construction Cost[1] ($)	Capital Improvement Cost[2,3] ($)	Construction Trigger	Project No.	Suggested Cost Allocation: Existing Users (%)	Suggested Cost Allocation: Future Users (%)	Cost Allocation: Existing Users ($)	Cost Allocation: Future Users ($)
Central Marina Sewer System																		
Gravity Main Improvements				**Existing Diameter** (in)	**New/Parallel/Replace**	**Diameter** (in)	**Length** (ft)											
M-P1	Gravity Main	ROW, Cove Way, Cardoza Ave	From Abdy Way to Reservation Rd	-	New	15	1,975	303	598,745	598,800	889,300	1,111,700	With Development	Project S1	1%	99%	11,117	1,100,583
M-P2	Gravity Main	Reservation Rd	From Cardoza Ave to 150' s/o Seaside Cir	-	New	15	1,725	303	522,955	523,000	776,700	970,900	With Development	Project S1	1%	99%	9,709	961,191
M-P3	Gravity Main	Eucalyptus St, Peninsula Dr, Vista del Camino	From Viking Ln to Reservation Rd	8	Replace	12	1,350	279	376,527	376,600	559,300	699,200	Existing Deficiency	Project S2	85%	15%	594,320	104,880
M-P4	Gravity Main	Carmel Ave	From Seacrest Ave to Sunset Ave	8	Replace	10	575	243	139,455	139,500	207,200	259,000	Existing Deficiency	Project S3	100%	0%	259,000	0
M-P5	Gravity Main	Reservation Rd	From Sunset Ave to Casa de Bolea	8	Replace	12	350	279	97,618	97,700	145,100	181,400	Existing Deficiency	Project S3	100%	0%	181,400	0
				Subtotal - City of Marina Pipeline Improvements					**1,735,300**	**1,735,600**	**2,577,600**	**3,222,200**					**1,055,546**	**2,166,654**
Lift Station Improvements				**Existing Capacity** (gpm)	**Improvement Type**	**Recommended Capacity** (gpm)												
M-LSD	Lift Station Replacement	Dunes Lift Station		2 x 700	Capacity Upgrade	3 x 450			1,127,627	1,127,700	1,674,700	2,093,400	Existing Deficiency	Project S10	100%	0%	2,093,400	0
M-LSCR	Lift Station Replacement	Crescent Lift Station		2 x 100	Station Replacement	2 x 100			-	-	-	401,576	Existing Condition Improvement	Project S11	100%	0%	401,576	0
				Subtotal - City of Marina Lift Station Improvements					**1,127,627**	**1,127,700**	**1,674,700**	**2,494,976**					**2,494,976**	**0**
Condition Assessment Improvements[4]					**Improvement Type**													
M-COND-LSSP	Condition	San Pablo Lift Station			Condition Improvements				24,600	24,600	36,800	46,200	Future Condition Improvements	Project S12	100%	0%	46,200	0
				Subtotal - Central Marina Condition Assessment Improvements					**24,600**	**24,600**	**36,800**	**46,200**					**46,200**	**0**
Miscellaneous Improvements					**Improvement Type**													
MS-M1	WWTP	Located at the Marina WWTP			Demolition				-	-	-	883,265	Planned System Improvement	-	100%	0%	883,265	0
MS-M2	Gravity Main	Del Monte Boulevard	Del Monte Blvd/ Reservation Rd		Replace				-	-	-	553,161	As Funding is Available	-	100%	0%	553,161	0
				Subtotal - Central Marina Miscellaeous Improvements								**1,436,426**					**1,436,426**	**0**
Total Central Marina Improvement Costs																		
				Gravity Main Improvements					**1,735,300**	**1,735,600**	**2,577,600**	**3,222,200**					**1,055,546**	**2,166,654**
				Lift Station Improvements					**1,127,627**	**1,127,700**	**1,674,700**	**2,494,976**					**2,494,976**	**0**
				Condition Assessment Improvements					**24,600**	**24,600**	**36,800**	**46,200**					**46,200**	**0**
				Miscellaneous Improvements					**0**	**0**	**0**	**1,436,426**					**1,436,426**	**0**
				Total - Central Marina Improvements					**2,887,527**	**2,887,900**	**4,289,100**	**7,199,802**					**5,033,148**	**2,166,654**
Ord Community Sewer System																		
Gravity Main Improvements				**Existing Diameter** (in)	**New/Parallel/Replace**	**Diameter** (in)	**Length** (ft)											
O-P2	Gravity Main	ROW	From Ord Avenue to East Garrison Lift Station	15	Replace	18	400	327	130,966	131,000	194,600	243,300	With East Garrison Phase 2	Project S4	0%	100%	0	243,300
O-P4	Gravity Main	Abrams Dr	From w/o Inchon Ct to 80th Artillery Ct	10,15	Replace	18	675	327	221,005	221,100	328,400	410,500	With Sea Haven Development	Project S5	43%	57%	175,039	235,461
O-P5	Gravity Main	ROW	N/o Abrams Dr following Abrams Dr/ Imjin Pkwy	15	Replace	18	1,325	327	433,825	433,900	644,400	805,500	With Sea Haven Development	Project S5	38%	62%	303,514	501,986
O-P6	Gravity Main	ROW e/o Imjin Pkwy	From California Ave to 475' n/o Abrams Dr	18	Replace	18	1,100	327	360,157	360,200	534,900	668,700	With Sea Haven Development	Project S5	45%	55%	299,507	369,193
O-P11	Gravity Main	ROW n/o Inter-Garrison Rd	Jogging from 4th Ave to 1,300' w/o 4th Ave	10	Replace	15	950	303	288,004	288,100	427,900	534,900	Existing Deficiency	Project S6	50%	50%	267,361	267,539
O-P14	Gravity Main	1st Ave	From 1st St to 8th St	12,18,30	Replace	30	3,100	-	-	-	-	408,340	Existing Condition Improvement	Project S7	100%	0%	408,340	0
O-P15	Gravity Main	Eucalyptus Rd	From approximately 4,000' e/o General Jim Moore Blvd to approximatley 800' w/o General Jim Moore Blvd	-	New	8	5,050	218	1,102,298	1,102,300	1,637,000	2,046,300	With Development	Project S8	0%	100%	0	2,046,300
				Subtotal - Ord Community Pipeline Improvements					**2,536,255**	**2,536,600**	**3,767,200**	**5,117,540**					**1,453,761**	**3,663,779**
Force Main Improvements				**Existing Diameter** (in)	**New/Parallel/Replace**	**Diameter** (in)	**Length** (ft)											
O-FM2	Force Main	Monterey Rd, existing ROW	From relocated Ord Village LS to existing gravity main n/o Corregidor Rd	10	Replace	10	3,950	214	845,756	845,800	1,256,100	1,570,200	With O-LSO	Project S9	42%	58%	667,033	903,167
				Subtotal - Ord Community Force Main Improvements					**845,756**	**845,800**	**1,256,100**	**1,570,200**					**667,033**	**903,167**

Table 8.4 Near-Term Capital Improvement Program
Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvement Details: Existing Capacity (gpm)	Improvement Details: Improvement Type	Improvement Details: Recommended Capacity (gpm)	Infrastructure Costs: Unit Cost ($)	Infrastructure Costs: Infr. Cost ($)	Baseline Construction Costs ($)	Estimated Construction Cost[1] ($)	Capital Improvement Cost[2,3] ($)	Construction Trigger	Project No.	Suggested Cost Allocation: Existing Users (%)	Suggested Cost Allocation: Future Users (%)	Cost Allocation: Existing Users ($)	Cost Allocation: Future Users ($)
Lift Station Improvements																	
O-LSG	Lift Station/ Force Main	Gigling Lift Station	Gigling LS and FM Improvements			- -	-	-	-	-	2,021,079	With O-COND-LSGG	Project S13	100%	0%	2,021,079	0
O-LSO	Lift Station Rehabilitation					- -	-	-	-	-	2,247,000	Planned System Improvement	Project S15	43%	57%	956,206	1,290,794
O-LSB	Lift Station Demolition and Replacement		Booker, Hatten, Neeson LS improvements			- -	-	-	-	-	726,240	Planned System Improvement	Project S16	100%	0%	726,240	0
					Subtotal - Ord Community Lift Station Improvements			**0**	**0**	**0**	**4,994,319**					**3,703,525**	**1,290,794**
Condition Assessment Improvements[4]					**Improvement Type**												
O-COND-LSGG	Condition	Gigling Lift Station			Condition Improvements			444,300	444,300	660,200	825,600	With O-LSG	Project S14	100%	0%	825,600	0
O-COND-LSIM	Condition	Imjin Lift Station			Condition Improvements			29,000	29,000	43,400	54,400	Future Condition Improvements	Project S17	100%	0%	54,400	0
O-COND-LSFR	Condition	Fritzche Lift Station			Condition Improvements			63,200	63,200	94,100	117,700	Future Condition Improvements	Project S18	100%	0%	117,700	0
O-COND-LSEG	Condition	East Garrison Lift Station			Condition Improvements			32,300	32,300	48,300	60,700	Future Condition Improvements	Project S19	100%	0%	60,700	0
O-COND-LSRR	Condition	Reservation Road Lift Station			Condition Improvements			39,900	39,900	59,600	74,700	Future Condition Improvements	Project S20	100%	0%	74,700	0
					Subtotal - Ord Community Condition Assessment Improvements			**608,700**	**608,700**	**905,600**	**1,133,100**					**1,133,100**	**0**
Miscellaneous Improvements																	
MS-O1	Service		Del Rey Oaks Collection System Planning								61,200	With Development	-	0%	100%	0	61,200
MS-O2	Gravity Main		SCSD Sewer Improvements - Del Rey Oaks								2,039,964	With Development	-	0%	100%	0	2,039,964
MS-O3	Service		Monterey One Water Buy-In								11,040,808	-	-	50%	50%	5,520,404	5,520,404
MS-O4	Gravity Main		Inter-Garrison/ 8th Avenue Sewer Connection								1,035,000	With Development	-	0%	100%	0	1,035,000
MS-O5	WWTP		Demolish Ord Main Garrison WWTP								1,623,648	Planned System Improvement	-	100%	0%	1,623,648	0
MS-O6	Gravity Main		Seaside East Side Developments Parcels (future growth)								6,480,709	With Development	-	0%	100%	0	6,480,709
MS-O7	Lift Station		Miscellaneous Lift Station Improvements								1,497,360	Planned System Improvement	-	50%	50%	748,680	748,680
MS-O8	Lift Station/ Gravity Main		Cypress Knolls Sewer Pipeline and Lift Station Improvement Project								97,424	Planned System Improvement	-	0%	100%	0	97,424
					Subtotal - Ord Community Miscellaneous Improvements			**0**	**0**	**0**	**23,876,113**					**7,892,732**	**15,983,381**
Total Ord Community Improvement Costs																	
					Gravity Main Improvements			**2,536,255**	**2,536,600**	**3,767,200**	**5,117,540**					**1,453,761**	**3,663,779**
					Force Main Improvements			**845,756**	**845,800**	**1,256,100**	**1,570,200**					**667,033**	**903,167**
					Lift Station Improvements			**0**	**0**	**0**	**4,994,319**					**3,703,525**	**1,290,794**
					Condition Assessment Improvements			**608,700**	**608,700**	**905,600**	**1,133,100**					**1,133,100**	**0**
					Miscellaneous Improvements			**0**	**0**	**0**	**23,876,113**					**7,892,732**	**15,983,381**
					Total Ord Community Community Improvements			**3,990,711**	**3,991,100**	**5,928,900**	**36,691,272**					**14,850,151**	**21,841,121**
General Miscellaneous Sewer System Improvements																	
G-1	Odor Control Project	Various Locations	Odor Control Project								100,000	Planned System Improvement		100%	0%	100,000	0
G-2	Other	Corporation Yard Demolition and Rehab									116,300	As Funding is Available		100%	0%	116,300	0
					Subtotal - General Sewer System Improvements						**216,300**					**216,300**	**0**
Total Sewer System Improvement Costs																	
					Gravity Main Improvements			**4,271,556**	**4,272,200**	**6,344,800**	**8,339,740**					**2,509,307**	**5,830,433**
					Force Main Improvements			**845,756**	**845,800**	**1,256,100**	**1,570,200**					**667,033**	**903,167**
					Lift Station Improvements			**1,127,627**	**1,127,700**	**1,674,700**	**7,489,295**					**6,198,501**	**1,290,794**
					Condition Assessment Improvements			**633,300**	**633,300**	**942,400**	**1,179,300**					**1,179,300**	**0**
					Miscellaneous Improvements			**0**	**0**	**0**	**25,528,839**					**9,545,458**	**15,983,381**
					Total Improvement Cost			**6,878,238**	**6,879,000**	**10,218,000**	**44,107,374**					**20,099,599**	**24,007,775**

AKEL ENGINEERING GROUP, INC.

3/28/2019

Notes :
1. Estimated Construction costs include 48.5 percent of baseline cosntruction costs to account for unforeseen events and unknown field conditions, and for Contractor's overhead and profit, general conditions, and sales tax, consistent with 2007 Water Master plan.
2. Capital Improvement Costs also include an additional 25 percent of the estimated construction costs to account for administration, construction management, and legal costs.
3. Costs for improvements shown with only Capital Improvement Cost are based on information provided by District staff.
4. Costs associated with condition assessment improvements are included for planning purposes and are to be implemented at the discretion of District staff or may be superceded by other planned lift station improvements.

water and wastewater collection pipelines and components adjacent to the project area to District standards, as project impacts necessitate.
  - *Developer provides meter boxes for all structures and landscaping.*
  - *Developer provides for District's installation of remote read meters.*
2. *Where redevelopment will use existing buildings and infrastructure or will raze or remodel a portion or all of the existing buildings but streets and existing infrastructure will remain:*
  - *Developer completes a subdivision water and sewer master plan per the District standards. This subdivision master plan would include a physical and design standard condition assessment of the systems per District standards. The subdivision master plan must be approved by the District prior to receiving water and sewer service.*
  - *From the subdivision master plan, the Developer replaces components as required by the District.*
  - *Developer relocates the District's backbone water/sewer infrastructure (infrastructure that serves other upstream and downstream users) onto roadway right of way, as necessary.*
  - *When the Developer is planning to construct improvements, including, but not limited to, structures, landscape areas, walkways, parking facilities, etc., over existing water and sewer infrastructure, then the Developer is responsible to relocate existing water/sewer infrastructure away from under proposed improvements.*

  - *The developer will enter into a separate utility agreement with the District to provide for anticipated higher maintenance costs of the remaining older systems that will be left in place.*
  - *The separate utility agreement will include an annual water and wastewater collection inspection report to be completed by the Developer or its successor in accordance with District standards. That agreement will require the developer to provide an annual wastewater collection system, water system inspection report in accordance with District standards and to provide master meters for the project. The water inspection report will include a water audit.*
  - *Developer provides meter boxes for all structures and landscaping.*
  - *Developer provides for District's installation of remote read meters.*

8.4.3 Construction Triggers

As a part of this Master Planning process construction triggers were developed in an effort to plan the expansion of the water system in an orderly manner. The construction triggers for multiple improvements are based on mitigating an existing system deficiency, increasing hydraulic reliability, or continuing improvements currently planned by the District. Other improvements replace existing infrastructure that is not currently deficient but will violate master plan criteria with future development. The construction triggers quantify the amount of additional development that may occur before the improvement becomes necessary.

APPENDICES

APPENDIX A

Sewer Flow Monitoring and Inflow/Infiltration Study, 2017 (V&A)

DRAFT

Marina Coast Water District

2017 Sewer Flow Monitoring and Inflow/Infiltration Study

Prepared for: Akel Engineering Group, Inc.
7433 N. First Street, Suite 103
Fresno, CA 93720

Date: June 2017

Prepared by: V&A consulting engineers

<V&A Project No. 16-0271>

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Tables

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Photo Log

Abbreviations and Acronyms

Abbreviations/Acronyms	Definition
ADWF	Average Dry Weather Flow
AVG.	Average
CCTV	Closed-Circuit Television
CDEC	California Data Exchange Center
CIP	Capital Improvement Plan
CO	Carbon Monoxide
CWOP	Citizen Weather Observing Program
DIA.	Diameter
d/D	Depth/Diameter Ratio
FT.	Feet
FM	Flow Monitor
GPD	Gallons per Day
GPM	Gallons per Minute
GWI	Groundwater Infiltration
H2S	Hydrogen Sulfide
IN.	Inch
I/I	Inflow and Infiltration
IDM	Inch-Diameter Mile
IDW	Inverse Distance Weighting
LEL	Lower Explosive Limit
MAX.	Maximum
MGD	Million Gallons per Day
MIN.	Minimum
NOAA	National Oceanic and Atmospheric Administration
N/A	Not applicable
PF	Peaking Factor
PS	Pump Station
Q	Flow Rate
RDI/I	Rainfall-Dependent Infiltration and Inflow
RG	Rain Gauge
SSO	Sanitary Sewer Overflow
V&A	V&A Consulting Engineers, Inc.
WEF	Water Environment Federation
WRCC	Western Regional Climate Center

Terms and Definitions

Term	Definition
Average dry weather flow (ADWF)	Average flow rate or pattern from days without noticeable inflow or infiltration response. ADWF usage patterns for weekdays and weekends differ and must be computed separately. ADWF is expressed as a numeric average and may include the influence of normal groundwater infiltration (not related to a rain event).
Basin	Sanitary sewer collection system upstream of a given location (often a flow meter), including all pipelines, inlets, and appurtenances. Also refers to the ground surface area near and enclosed by pipelines. A basin may refer to the entire collection system upstream from a flow meter or exclude separately monitored basins upstream.
Depth/diameter (*d*/*D*) ratio	Depth of water in a pipe as a fraction of the pipe's diameter. A measure of fullness of the pipe used in capacity analysis.
Design storm	A theoretical storm event of a given duration and intensity that aligns with historical frequency records of rainfall events. For example, a 10-year, 24-hour design storm is a storm event wherein the volume of rain that falls in a 24-hour period would historically occur once every 10 years. Design storm events are used to predict I/I response and are useful for modeling how a collection system will react to a given set of storm event scenarios.
Infiltration and inflow	Infiltration and inflow (I/I) rates are calculated by subtracting the ADWF flow curve from the instantaneous flow measurements taken during and after a storm event. Flow in excess of the baseline consists of inflow, rainfall-responsive infiltration, and rainfall-dependent infiltration. **Total I/I** is the total sum in gallons of additional flow attributable to a storm event.
Infiltration, *groundwater*	Groundwater infiltration (**GWI**) is groundwater that enters the collection system through pipe defects. GWI depends on the depth of the groundwater table above the pipelines as well as the percentage of the system that is submerged. The variation of groundwater levels and subsequent groundwater infiltration rates is seasonal by nature. On a day-to-day basis, groundwater infiltration rates are relatively steady and will not fluctuate greatly.
Infiltration, *rainfall-dependent*	Rainfall-dependent infiltration (**RDI**) is similar to groundwater infiltration but occurs as a result of storm water. The storm water percolates into the soil, submerges more of the pipe system, and enters through pipe defects. RDI is the slowest component of storm-related infiltration and inflow, beginning gradually and often lasting 24 hours or longer. The response time depends on the soil permeability and saturation levels.
Inflow	**Inflow** is defined as water discharged into the sewer system, including private sewer laterals, from **direct** connections such as downspouts, yard and area drains, holes in manhole covers, cross-connections from storm drains, or catch basins. Inflow creates a peak flow problem in the sewer system and often dictates the required capacity of downstream pipes and transport facilities to carry these peak instantaneous flows. Overflows are often attributable to high inflow rates.
Peaking factor (PF)	PF is the ratio of peak measured flow to average dry weather flow. This ratio expresses the degree of fluctuation in flow rate over the monitoring period and is used in capacity analysis.
Surcharge	When the flow level is higher than the crown of the pipe, then the pipeline is said to be in a **surcharged** condition. The pipeline is surcharged when the *d*/*D* ratio is greater than 1.0.
Synthetic hydrograph	A set of algorithms has been developed to approximate the actual I/I hydrograph. The synthetic hydrograph is developed strictly using rainfall data and response parameters representing response time, recession coefficient and soil saturation.

Executive Summary

Scope and Purpose

V&A Consulting Engineers, Inc. (V&A) has completed sanitary sewer flow monitoring and inflow and infiltration (I/I) analysis within the Marina Coast Water District (District) collection system. Flow monitoring was performed for 4 weeks from January 19, 2017 through February 20, 2017 at nine open-channel flow monitoring sites. There were three general purposes of this study.

1. Establish the baseline sanitary sewer flows at the flow monitoring sites.
2. Estimate available sewer capacity.
3. Isolate I/I response and perform I/I analysis.

Monitoring Sites

The flow monitoring sites were selected and approved by Akel Engineering Group (AEG) and are listed in Table ES-1 and illustrated in Figure ES-1. Site O4 was removed from this study; upon a thorough investigation, this pipeline was determined to be abandoned.

Table ES-1. List of Monitoring Sites

Site / Basin	District Manhole No.	Monitored Pipe	Pipe Dia. (in)	Location	Basin Isolation Equation	Basin Area (acres)
M1	K606	SW Inlet	11.5	358 Reservation Road	$= Q_{M1}$	197
M2	L638	SE Inlet	12	210 Reservation Road	$= Q_{M2} - Q_{M1}$	103
M3	G421	SW Inlet	12	3148 Del Monte Boulevard	$= Q_{M3}$	152
M4	E331	South Inlet	10	Robin Drive at Hilo Avenue	$= Q_{M4}$	163
O1	J306	South Inlet	18	Lot northwest of intersection of 1st Avenue and 5th Street	$= Q_{O1}$	879
O2	D452A	South Inlet	12	Open space southwest of intersection of 1st Avenue and 5th Street	$= Q_{O2}$	215
O3	J306	East Inlet	15	Lot northwest of intersection of 1st Avenue and 5th Street	$= Q_{O3}$	243
O5	UVA1	NE Inlet	29.5	Northwest corner VA Clinic parking lot	$= Q_{O5}$	1,518
O6	UVB1	East Inlet	14.5	VA Clinic parking lot, near motorcycle parking	$= Q_{O6}$	235

Note: NE = Northeast, SE = Southeast, SW = Southwest

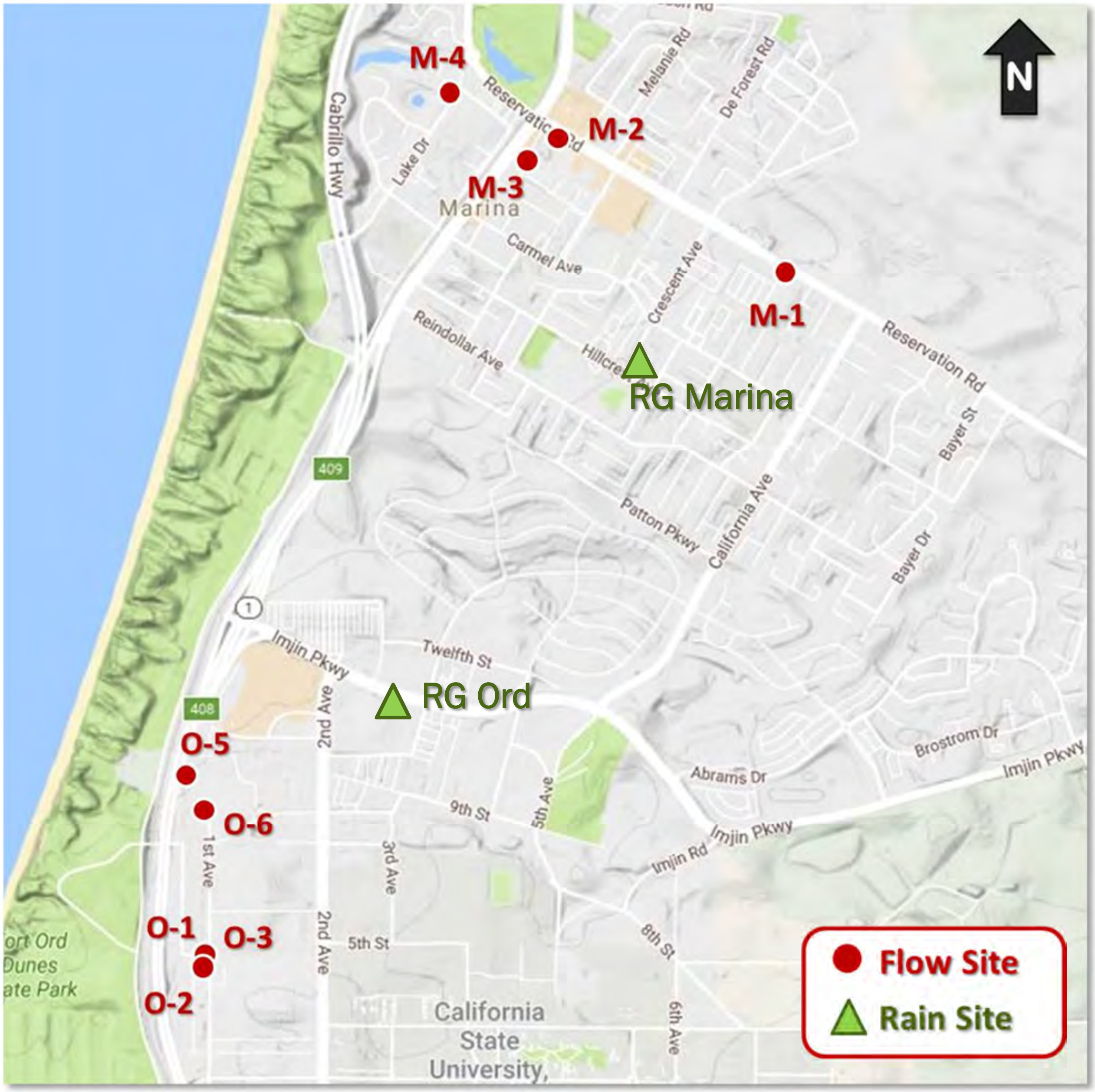

Figure ES-1. Map of Flow Monitoring Sites

Rainfall Monitoring

There were four main rainfall events that occurred over the course of the flow monitoring period and rainfall totals for the District were approximately 86% above historical normal. The following storm event classification items are noted:

- Event 4 (February 20 - 21, 2017) was the largest classified rainfall event over the monitoring period, classified as about a 5-year, 12-hour event and a 3-year, 24-hour event.
- The full flow monitoring period had rainfall classified as about a 2-year, 45-day event.

Flow Monitoring and Capacity Results

Peak measured flows and the consequent hydraulic grade line data are important to understand the capacity limitations of a collection system. The following capacity analysis terms are defined as follows:

- **Peaking Factor**: Peaking factor is defined as the peak measured flow divided by the average dry weather flow (ADWF). Peaking factors are influenced by many factors including size and topography of tributary area, flow attenuation, flow restrictions, characteristics of I/I entering the collection system, and hydraulic features such as pump stations.
- **d/D Ratio**: The d/D ratio is the peak measured depth of flow (d) divided by the pipe diameter (D). The d/D ratio for each site was computed based on the maximum depth of flow for the study. Standards for d/D ratio vary from agency to agency, but typically range between d/D ≤ 0.5 and d/D ≤ 0.75.

Table ES-2 summarizes the peak recorded flows, levels, *d/D* ratios, and peaking factors per site during the flow monitoring period. Results of note have been shaded in RED Capacity analysis data is presented on a site-by-site basis and represents the hydraulic conditions only at the site locations; hydraulic conditions in other areas of the collection system will differ.

Table ES-2. Capacity Analysis Summary

Metering Site	ADWF (MGD)	Peak Measured Flow (MGD)	Peaking Factor	Pipe Diameter, *D* (IN)	Max Depth, *d* (IN)	*Max d/D* Ratio	Surcharge above Pipe Crown (FT)
M1	0.110	0.279	2.5	11.5	6.79	0.59	-
M2	0.371	1.465	4.0	12	9.69	0.81	-
M3	0.260	0.634	2.4	12	3.01	0.25	-
M4	0.169	0.330	2.0	10	5.67	0.57	-
O1	0.446	1.384	3.1	18	3.61	0.20	-
O2	0.075	0.342	4.5	12	2.46	0.21	-
O3	0.168	1.068	6.4	15	4.58	0.31	-
O5	0.344	0.832	2.4	29.5	5.35	0.18	-
O6	0.020	0.199	10.1	14.5	3.54	0.24	-

Figure **ES**-2 illustrates a flow schematic of the peak flow condition at the flow monitoring sites. The following capacity analysis results are noted:

- **Peaking Factor**: Sites O3 and O6 had peaking factors greater than 5 corresponding to rainfall events; Site O6 had the highest peaking factor with a value greater than 10.
- **d/D Ratio**: None of the flow monitoring sites surcharged during this flow study. Site M2 had a maximum *d/D* ratio that just exceeded the typical threshold of 0.75.

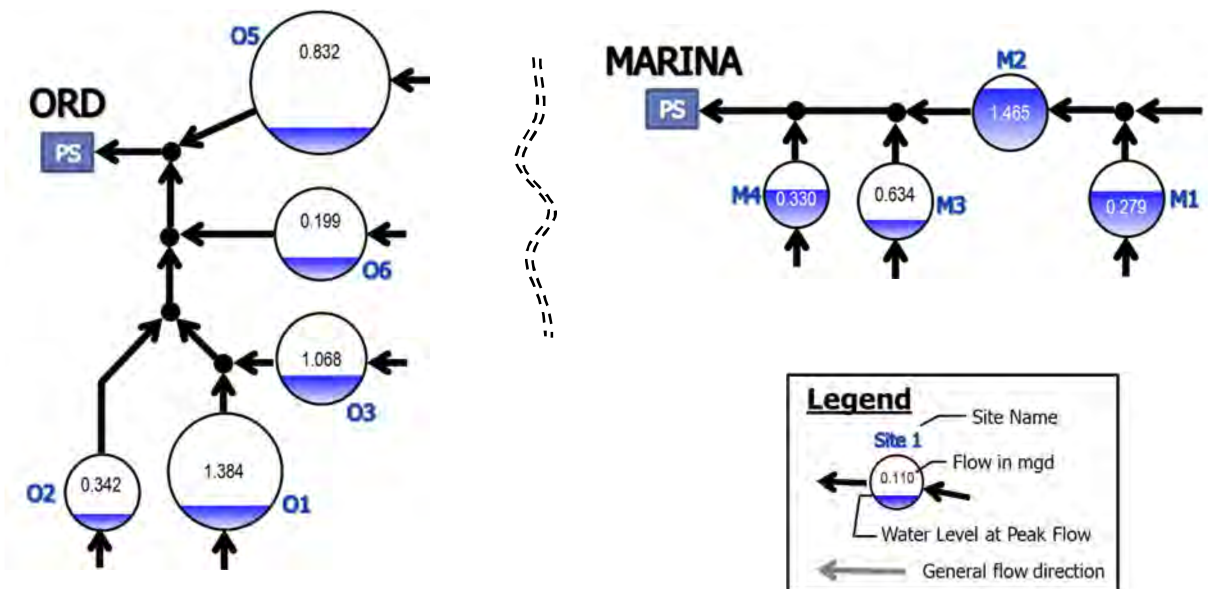

Figure ES-2. Peak Measured Flow (Flow Schematic)

Infiltration and Inflow Analysis

Table ES-3 summarizes I/I results for the flow monitoring sites that were monitored during this study. Please refer to the *I/I Methods* section for more information on inflow and infiltration analysis methods and ranking methods. Event 3 (February 16 – 19, 2017) and Event 4 (February 20 – 21, 2017) elicited the greatest I/I response and were analyzed for this study. Results of note have been shaded in RED.

Table ES-3. I/I Analysis Summary

Monitoring Basin	ADWF (mgd)	Event 3 (Feb 16-19)		Event 4 (Feb 19-20)		Inflow Rank[A]	Total I/I Rank[A]
		Peak I/I Rate (mgd)	Total I/I (gallons)	Peak I/I Rate (mgd)	Total I/I (gallons)		
Basin M1	0.110	0.105	10,000	0.082	14,000	8	6
Basin M2	0.263	0.282	58,000	0.753	128,000	3	3
Basin M3	0.260	0.136	15,000	0.270	53,000	5	5
Basin M4	0.169	0.057	5,000	0.151	15,000	9	9
Basin O1	0.446	0.297	25,000	0.447	49,000	6	8
Basin O2	0.075	0.031	2,000	0.075	13,000	7	7
Basin O3	0.168	0.618	132,000	0.848	219,000	2	2
Basin O5	0.344	0.536	53,000	0.332	75,000	4	4
Basin O6	0.020	0.133	20,000	0.165	38,000	1	1

[A] Ranking of 1 represents most I/I after normalization.

The following inflow analysis results are noted:

- Basins O3 and O6 ranked highest for normalized inflow contribution. For the Marina collection system, Basin M2 ranked highest for normalized inflow contribution.

- Basins O3 and O6 ranked highest for normalized total I/I contribution. For the Marina collection system, Basin M2 ranked highest for normalized total I/I contribution.
- For all sites, the I/I receded to baseline levels within a couple hours of the conclusion of the rainfall event, indicating minimal RDI component. Infiltration does not appear to be an issue for the Marina or Ord collection systems.

Recommendations

V&A advises that future I/I reduction plans consider the following recommendations:

1. **Determine I/I Reduction Program:** The District should examine its I/I reduction needs to determine a future I/I reduction program.
   a. If peak flows, sanitary sewer overflows, and pipeline capacity issues are of greater concern, then priority can be given to investigate and reduce sources of inflow within the basins with the greatest inflow problems. The highest inflow occurs in Basins O3 and O6 in the Ord collection system, and in Basin M2 for the Marina collection system.
   b. If total infiltration and general pipeline deterioration are of greater concern, then the program can be weighted to investigate and reduce sources of infiltration within the basins with the greatest infiltration problems. Infiltration does not appear to be an issue for the Marina or Ord collection systems.
2. **I/I Investigation Methods:** Potential I/I investigation methods include the following:
   c. Smoke testing
   d. Mini-basin flow monitoring
   e. Nighttime reconnaissance work to (1) investigate and determine direct point sources of inflow and (2) determine the areas and pipe reaches responsible for high levels of infiltration contribution.
3. **I/I Reduction Cost-Effectiveness Analysis:** The District should conduct a study to determine which is more cost-effective: (1) locating the sources of inflow and infiltration and systematically rehabilitating or replacing the faulty pipelines or (2) continued treatment of the additional rainfall-dependent I/I flow.

1 Introduction

1.1 Scope and Purpose

V&A Consulting Engineers, Inc. (V&A) has completed sanitary sewer flow monitoring and inflow and infiltration (I/I) analysis within the Marina Coast Water District (District) collection system. Flow monitoring was performed for 4 weeks from January 19, 2017 through February 20, 2017 at nine open-channel flow monitoring sites. There were three general purposes of this study.

1. Establish the baseline sanitary sewer flows at the flow monitoring sites.
2. Estimate available sewer capacity.
3. Isolate I/I response and perform I/I analysis.

1.2 Flow Monitoring Sites, Sewerage Basins and Rain Gauges

The FM sites were selected and approved by Akel Engineering Group. Flow monitoring sites are identified as the manholes where the flow monitors were secured and the pipelines wherein the flow sensors were placed. Sites 01 and 03 were located in the same manhole but measured different inlet pipes. Site 04 was removed from this study; upon a thorough investigation, this pipeline was determined to be abandoned. Capacity analyses and flow rates are presented on a site-by-site basis.

Flow monitoring site data may include the flows of one or many drainage basins. Flow monitoring basins are localized areas of a sanitary sewer collection system upstream of a given location (often a flow meter), including all pipelines, inlets, and appurtenances. The basin refers to the ground surface area near and enclosed by the pipelines[1]. A basin may refer to the entire collection system upstream from a flow meter or may exclude separately monitored basins upstream. I/I analysis in this report will be conducted on a basin-by-basin basis. For this study, subtraction of flows was required to isolate the drainage areas of some flow monitoring basins[2].

Rain data was obtained from the National Oceanic and Atmospheric Administration (NOAA) Citizen Weather Observer Program (CWOP). CWOP members send data from their private weather station (PWS) to the NOAA MADIS server; the data undergoes quality checking and then is distributed. While V&A has no direct control over the rain gauges, V&A performs additional QA/QC on the data to ensure its suitability for use.

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[1] Basin boundaries were estimated using rough sanitary sewer maps provided by AEG. Basin acreages are considered estimates.

[2] There is error inherent in flow monitoring. Addition: When adding flows, the overall error will be approximately the weighted average of the errors of elements of the equation. For example: if Site A has a value of 12 mgd and an error of ±10% (±1.2 mgd) and Site B has a value of 10 and an error of ±10% (±1 mgd), then the resulting flow when adding Sites A + B is 22 ± 2.2 mgd (error is still 10%).

Subtraction: When subtracting flows, the overall error can be considerably higher than the errors of the components. For example: if Site A has a value of 12 mgd and an error of ±10% (±1.2 mgd) and Site B has a value of 10 and an error of ±10% (±1 mgd), then the resulting flow when subtracting Site A - Site B is 2 ± 2.2 mgd (the error is now very high at ±110%).

The FM sites and associated basins (including basin flow equations) are listed in Table 1-1. The FM sites and associated basins and shown in Figure 1-1 and Figure 1-2, respectively. Detailed descriptions of the individual flow monitoring sites, including photographs, are included in Appendix A.

Table 1-1. List of Flow Monitoring Sites

Site / Basin	District Manhole No.	Monitored Pipe	Pipe Dia. (in)	Location	Basin Isolation Equation	Basin Area (acres)
M1	K606	SW Inlet	11.5	358 Reservation Road	$= Q_{M1}$	197
M2	L638	SE Inlet	12	210 Reservation Road	$= Q_{M2} - Q_{M1}$	103
M3	G421	SW Inlet	12	3148 Del Monte Boulevard	$= Q_{M3}$	152
M4	E331	South Inlet	10	Robin Drive at Hilo Avenue	$= Q_{M4}$	163
O1	J306	South Inlet	18	Lot northwest of intersection of 1st Avenue and 5th Street	$= Q_{O1}$	879
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O3	J306	East Inlet	15	Lot northwest of intersection of 1st Avenue and 5th Street	$= Q_{O3}$	243
O5	UVA1	NE Inlet	29.5	Northwest corner VA Clinic parking lot	$= Q_{O5}$	1,518
O6	UVB1	East Inlet	14.5	VA Clinic parking lot, near motorcycle parking	$= Q_{O6}$	235

Note: NE = Northeast, SE = Southeast, SW = Southwest

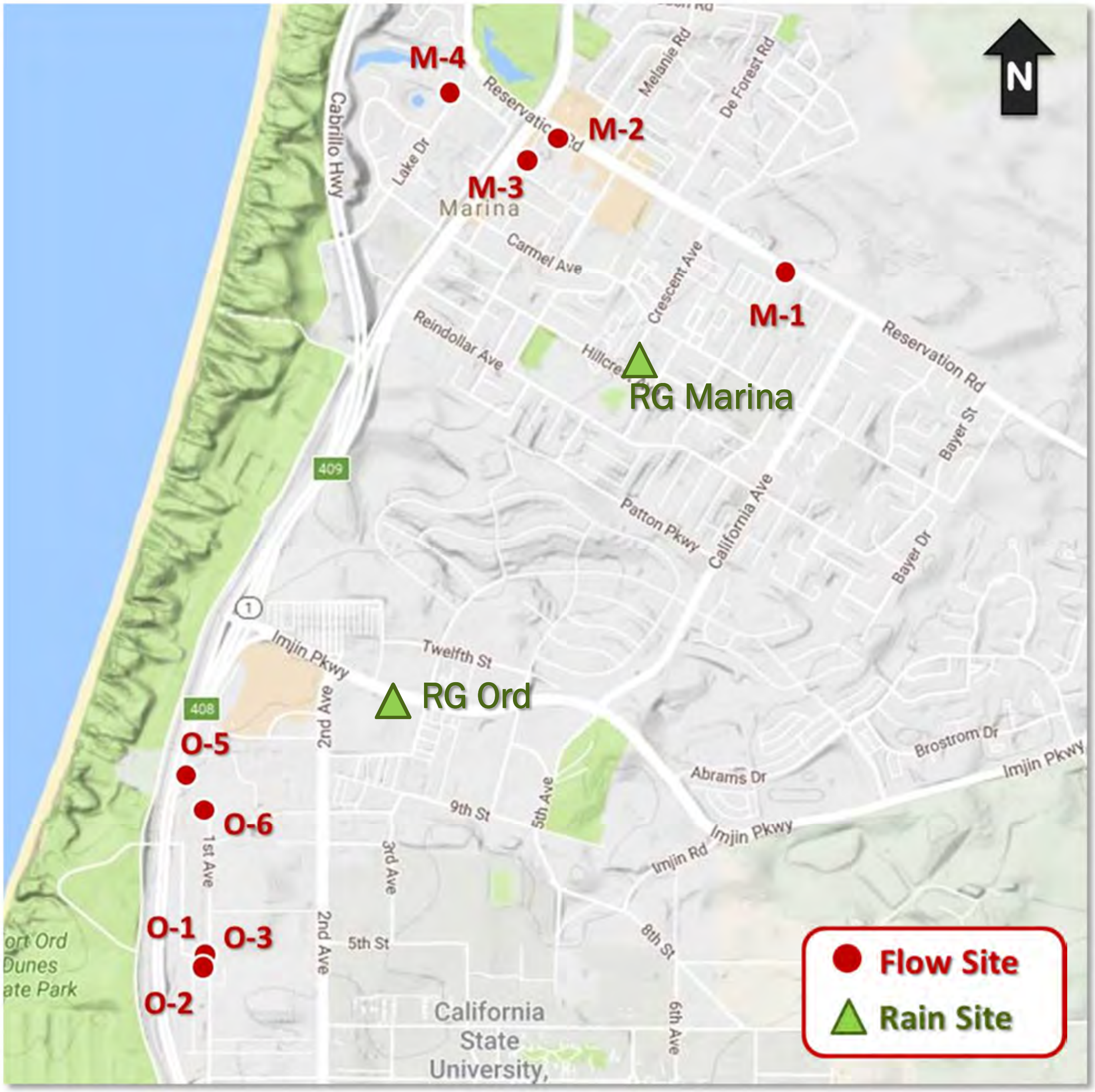

Figure 1-1. Map of Flow Monitoring Sites

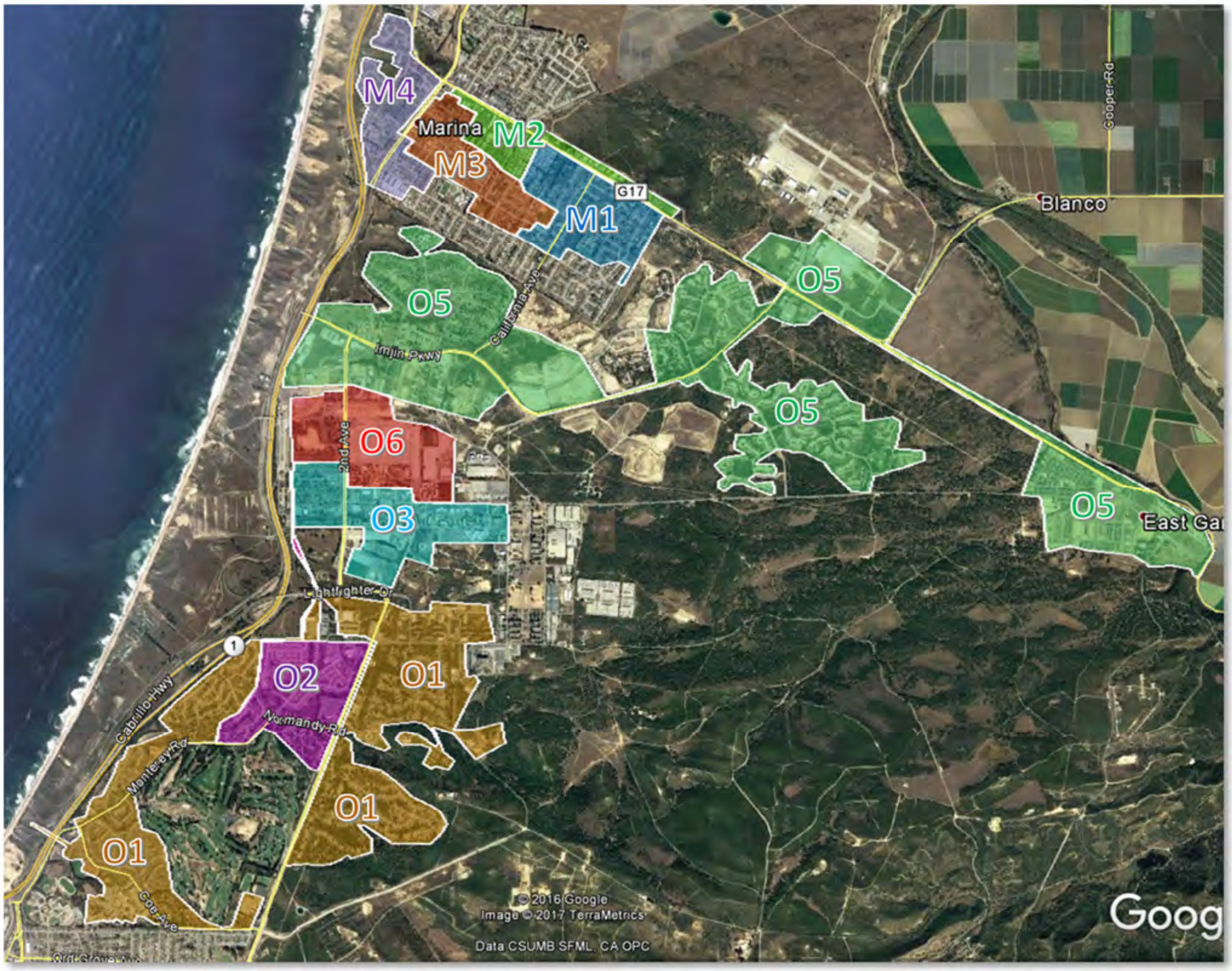

Figure 1-2. Flow Monitoring Basin Map

2 Methods and Procedures

2.1 Confined Space Entry

A confined space (Photo 2-1) is defined as any space that is large enough and so configured that a person can bodily enter and perform assigned work, has limited or restricted means for entry or exit and is not designed for continuous employee occupancy. In general, the atmosphere must be constantly monitored for sufficient levels of oxygen (19.5% to 23.5%), and the presence of hydrogen sulfide (H_2S) gas, carbon monoxide (CO) gas, and lower explosive limit (LEL) levels. A typical confined space entry crew has members with OSHA-defined responsibilities of Entrant, Attendant and Supervisor. The Entrant is the individual performing the work. He or she is equipped with the necessary personal protective equipment needed to perform the job safely, including a personal four-gas monitor (Photo 2-2). If it is not possible to maintain line-of-sight with the Entrant, then more Entrants are required until line-of-sight can be maintained. The Attendant is responsible for maintaining contact with the Entrants to monitor the atmosphere using another four-gas monitor and maintaining records of all Entrants, if there is more than one. The Supervisor is responsible for developing the safe work plan for the job at hand prior to entering.

Photo 2-1. Confined Space Entry

Photo 2-2. Typical Personal Four-Gas Monitor

2.2 Flow Meter Installation

V&A installed Isco 2150 area-velocity flow meters for temporary metering within the collection system. Isco 2150 meters use submerged sensors with a pressure transducer to collect depth readings and an ultrasonic Doppler sensor to determine the average fluid velocity. The ultrasonic sensor emits high-frequency (500 kHz) sound waves, which are reflected by air bubbles and suspended particles in the flow. The sensor receives the reflected signal and determines the Doppler frequency shift, which indicates the estimated average flow velocity. The sensor is typically mounted at a manhole inlet to take advantage of smoother upstream flow conditions. The sensor may be offset to one side to lessen the chances of fouling and sedimentation where these problems are expected to occur. Manual level and velocity measurements were taken during installation of the flow meters and again when they were removed and compared to simultaneous level and velocity readings from the flow meters to ensure proper calibration and accuracy. Figure 2-1 shows a typical installation for a flow meter with a submerged sensor.

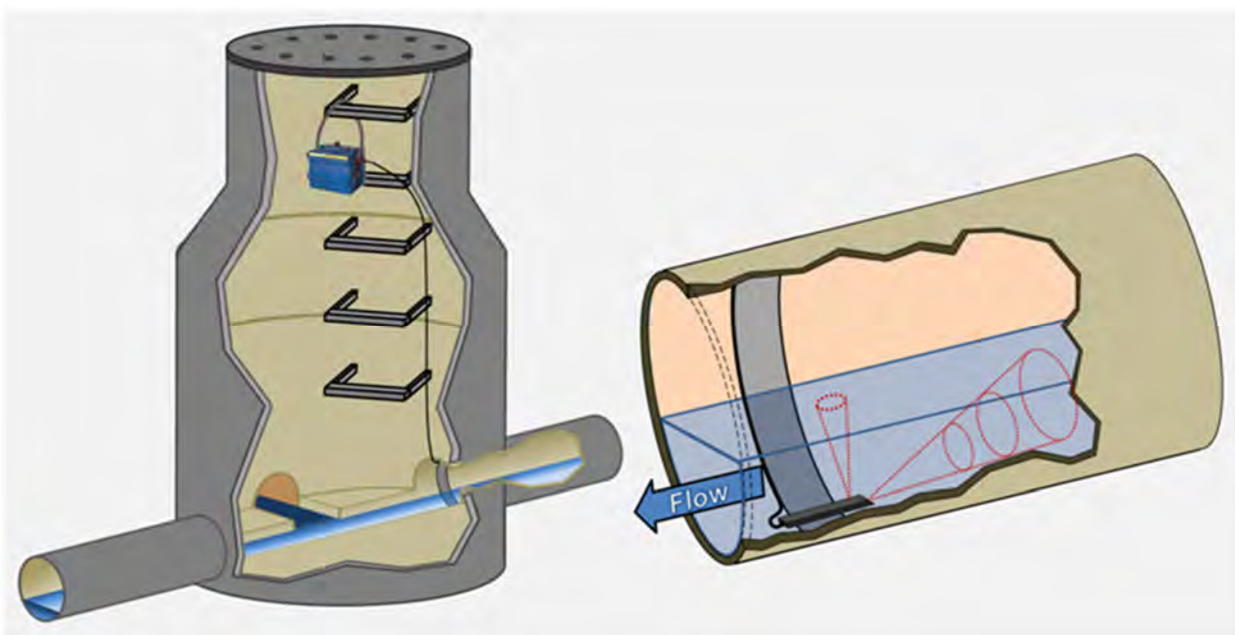

Figure 2-1. Typical Installation for Flow Meter with Submerged Sensor

2.3 Flow Calculation

Data retrieved from the flow meter was placed into a spreadsheet program for analysis. Data analysis includes data comparison to field calibration measurements, as well as necessary geometric adjustments as required for sediment (sediment reduces the pipe's wetted cross-sectional area available to carry flow). Area-velocity flow metering uses the continuity equation,

$$Q = v \cdot A = v \cdot (A_T - A_S)$$

where Q : volume flow rate
v: average velocity as determined by the ultrasonic sensor
A: cross-sectional area available to carry flow
A_T: total cross-sectional area with both wastewater and sediment
A_S: cross-sectional area of sediment.

For circular pipe,

$$A_T = \left[\frac{D^2}{4}\cos^{-1}\left(1-\frac{2d_W}{D}\right)\right] - \left[\left(\frac{D}{2}-d_W\right)\left(\frac{D}{2}\right)\sin\left(\cos^{-1}\left(1-\frac{2d_W}{D}\right)\right)\right]$$

$$A_S = \left[\frac{D^2}{4}\cos^{-1}\left(1-\frac{2d_S}{D}\right)\right] - \left[\left(\frac{D}{2}-d_S\right)\left(\frac{D}{2}\right)\sin\left(\cos^{-1}\left(1-\frac{2d_S}{D}\right)\right)\right]$$

where d_W: distance between wastewater level and pipe invert
d_S: depth of sediment
D: pipe diameter

2.4 Average Dry Weather Flow Determination

For this study, four distinct average dry weather flow curves were established for each site location:

- Mondays – Thursdays
- Fridays
- Saturdays
- Sundays

Flows for many sites differ on Friday evenings compared to Mondays through Thursdays. Starting around 7 pm, the flows are often decreased (compared to Monday through Thursday). Similarly, flow patterns for Saturday and Sunday were also separated due to their unique evening flow pattern. This type of differentiation can be important when determining I/I response, especially if a rain event occurs on a Friday, Saturday or Sunday evening.

Figure 2-2 illustrates a sample of varying flow patterns within a typical week dry week.

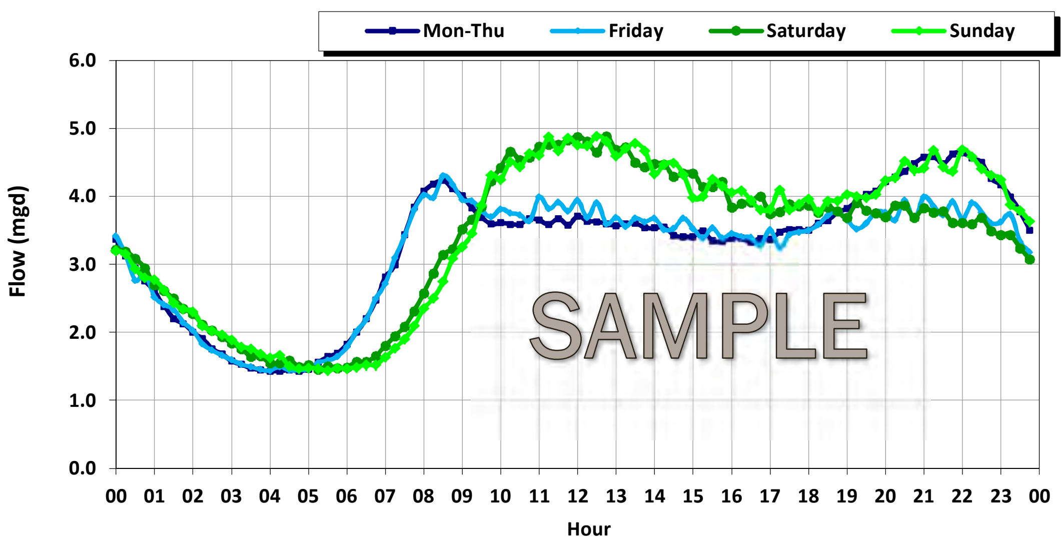

Figure 2-2. Sample ADWF Diurnal Flow Patterns

ADWF curves are taken from “Dry Days”, when RDI had the least impact on the baseline flow. The overall average dry weather flow (ADWF) was calculated per the following equation:

$$ADWF = \left(ADWF_{Mon-Thu} \times \frac{4}{7}\right) + \left(ADWF_{Fri} \times \frac{1}{7}\right) + \left(ADWF_{Sat} \times \frac{1}{7}\right) + \left(ADWF_{Sun} \times \frac{1}{7}\right)$$

2.5 Flow Attenuation

Flow attenuation in a sewer collection system is the natural process of the reduction of the peak flow rate through redistribution of the same volume of flow over a longer period of time. This occurs as a result of friction (resistance), internal storage and diffusion along the sewer pipes. Fluids are constantly working towards equilibrium. For example, a volume of fluid poured into a static vessel with no outside turbulence will eventually stabilize to a static state, with a smooth fluid surface without peaks and valleys. Attenuation within a sanitary sewer collection system is based upon this concept. A flow profile with a strong peak will tend to stabilize towards equilibrium, as shown in Figure 2-3.

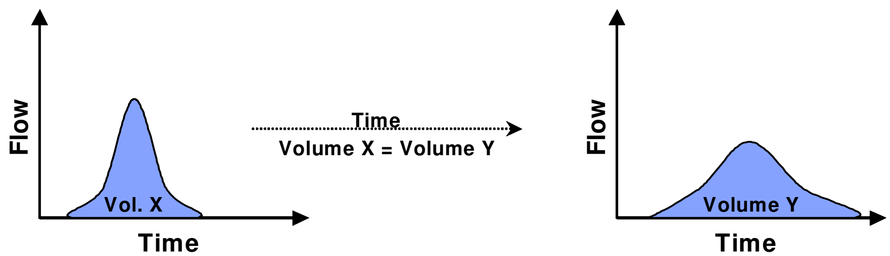

Figure 2-3. Attenuation Illustration

Within a sanitary sewer collection system, each individual basin will have a specific flow profile. As the flows from the basins combine within the trunk sewer lines, the peaks from each basin will (a) not necessarily coincide at the same time, and (b) due to the length and time of travel through the trunk sewers, peak flows will attenuate prior to reaching the treatment facility. The sum of the peak flows of the individual basins within a collection system will usually be greater than the peak flows observed at the treatment facility.

2.6 Inflow / Infiltration Analysis: Definitions and Identification

Inflow and infiltration (I/I) consists of storm water and groundwater that enter the sewer system through pipe defects and improper storm drainage connections and is defined in the following subsections..

2.6.1 Definition and Typical Sources

- **Inflow:** Storm water inflow is defined as water discharged into the sewer system, including private sewer laterals, from direct connections such as downspouts, yard and area drains, holes in manhole covers, cross-connections from storm drains, or catch basins.
- **Infiltration:** Infiltration is defined as water entering the sanitary sewer system through defects in pipes, pipe joints, and manhole walls, which may include cracks, offset joints, root intrusion points, and broken pipes.

Figure 2-4 illustrates the possible sources and components of I/I.

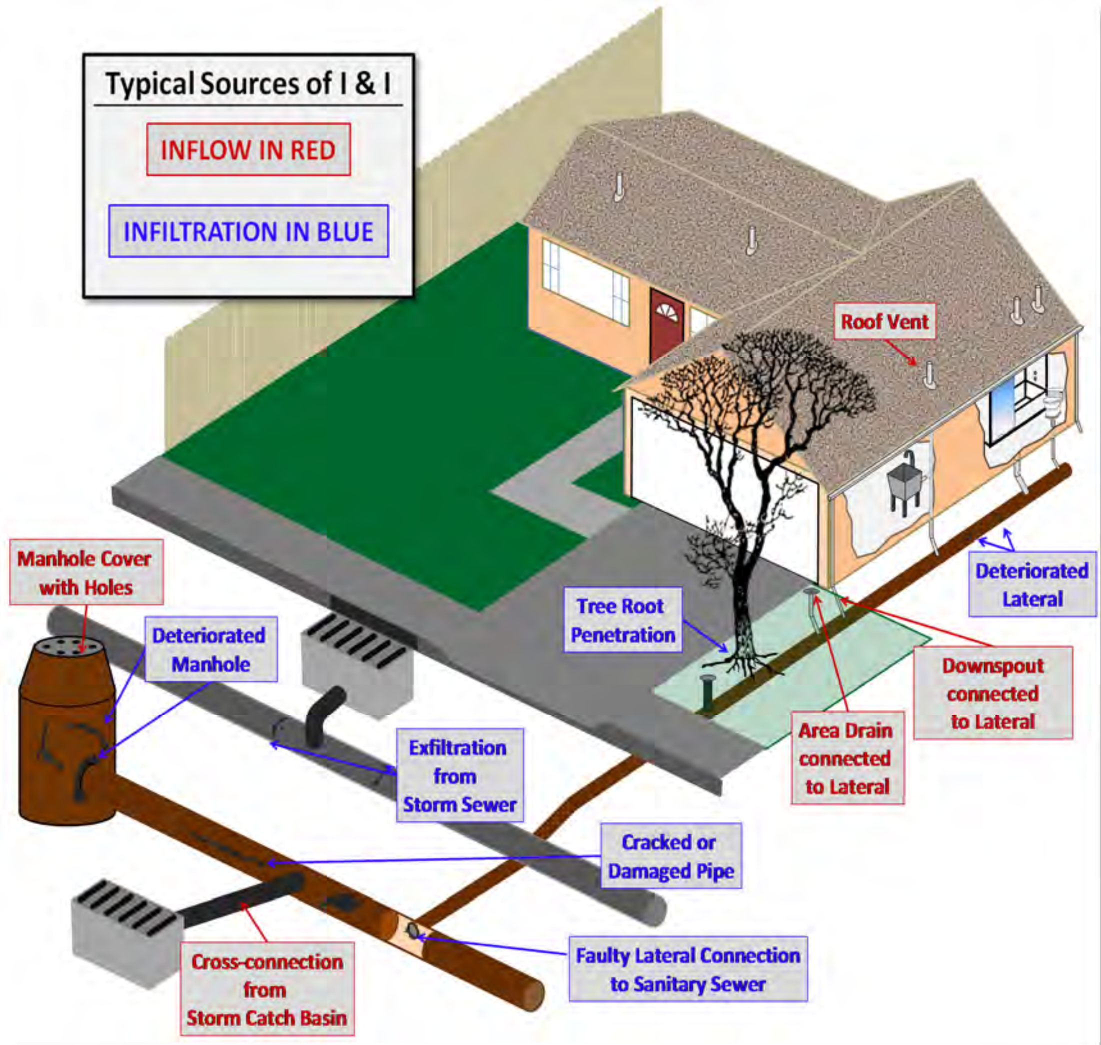

Figure 2-4. Typical Sources of Infiltration and Inflow

2.6.2 Infiltration Components

Infiltration can be further subdivided into components as follows:

- **Groundwater Infiltration:** Groundwater infiltration (GWI) depends on the depth of the groundwater table above the pipelines as well as the percentage of the system submerged. The variation of groundwater levels and subsequent groundwater infiltration rates is seasonal by nature. On a day-to-day basis, groundwater infiltration rates are relatively steady and will not fluctuate greatly.
- **Rainfall-Dependent Infiltration:** Rainfall-Dependent Infiltration (RDI) occurs as a result of storm water and enters the sewer system through pipe defects, as with groundwater infiltration. The storm water first percolates directly into the soil and then migrates to an infiltration point. Typically, the time of concentration for rainfall-related infiltration may be 24 hours or longer, but this depends on the soil permeability and saturation levels.
- **Rainfall-Responsive Infiltration** is storm water which enters the collection system indirectly through pipe defects, but normally in sewers constructed close to the ground surface such as private laterals. Rainfall-responsive infiltration is independent of the groundwater table and reaches defective sewers via the pipe trench in which the sewer is constructed, particularly if the pipe is placed in impermeable soil and bedded and backfilled with a granular material. In this case, the pipe trench serves as a conduit similar to a French drain, conveying storm drainage to defective joints and other openings in the system. This type of infiltration can have a quick response and graphically can look very similar to inflow.

2.6.3 Impact and Cost of Source Detection and Removal

- **Inflow:**
    - Impact: This component of I/I creates a peak flow problem in the sewer system and often dictates the required capacity of downstream pipes and transport facilities to carry these peak instantaneous flows. Because the response and magnitude of inflow is tied closely to the intensity of the storm event, the short-term peak instantaneous flows may result in surcharging and overflows within a collection system. Severe inflow may result in sewage dilution, resulting in upsetting the biological treatment (secondary treatment) at the treatment facility.
    - Cost of Source Identification and Removal: Inflow locations are usually less difficult to find and less expensive to correct. These sources include direct and indirect cross-connections with storm drainage systems, roof downspouts, and various types of surface drains. Generally, the costs to identify and remove sources of inflow are low compared to potential benefits to public health and safety or the costs of building new facilities to convey and treat the resulting peak flows.
- **Infiltration:**
    - Impact: Infiltration typically creates long-term annual volumetric problems. The major impact is the cost of pumping and treating the additional volume of water, and of paying for treatment (for municipalities that are billed strictly on flow volume).
    - Cost of Source Detection and Removal: Infiltration sources are usually harder to find and more expensive to correct than inflow sources. Infiltration sources include defects in deteriorated sewer pipes or manholes that may be widespread throughout a sanitary sewer system.

2.6.4 Graphical Identification of I/I

Inflow is usually recognized graphically by large-magnitude, short-duration spikes immediately following a rain event. Infiltration is often recognized graphically by a gradual increase in flow after a wet-weather event. The increased flow typically sustains for a period after rainfall has stopped and then gradually drops off as soils become less saturated and as groundwater levels recede to normal levels. Real time flows were plotted against ADWF to analyze the I/I response to rainfall events. Figure 2-5 illustrates a sample of how this analysis is conducted and some of the measurements that are used to distinguish infiltration and inflow. Similar graphs were generated for the individual flow monitoring sites and can be found in Appendix A.

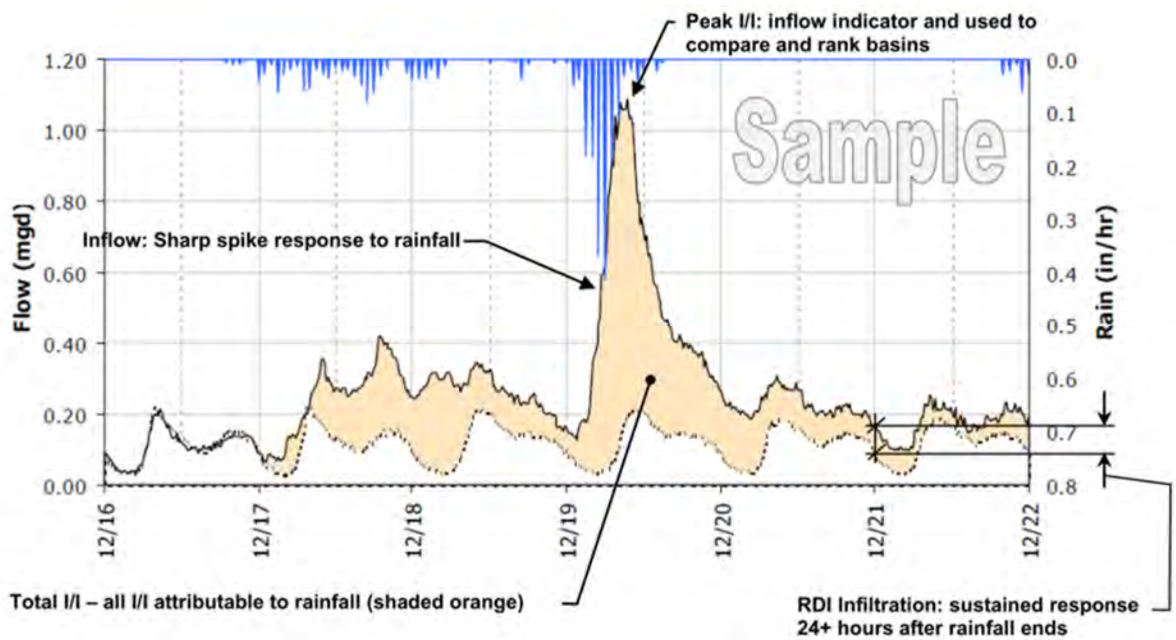

Figure 2-5. Sample Infiltration and Inflow Isolation Graph

2.6.5 Analysis Metrics

After differentiating I/I flows from ADWF flows, various calculations can be made to determine which I/I component (inflow or infiltration) is more prevalent at a particular site and to compare the relative magnitudes of the I/I components between drainage basins and between storm events:

- **Inflow – Peak I/I Flow Rate:** Inflow is characterized by sharp, direct spikes occurring during a rainfall event. Peak I/I rates are used for inflow analysis[4].
- **Groundwater Infiltration:** GWI analysis is conducted by looking at minimum dry weather flow to average dry weather flow ratios and comparing them to established standards to quantify the rate of excess groundwater infiltration.
- **Rainfall-Dependent Infiltration:** RDI Analysis is conducted by looking at the infiltration rates at set periods after the conclusion of a storm event. Depending on the particular collection system

[4] I/I flow rate is the real time flow less the estimated average dry weather flow rate. It is an estimate of flows attributable to rainfall. By using peak measured flow rates (inclusive of ADWF), the I/I flow rate would be skewed higher or lower depending on whether the storm event I/I response occurs during low-flow or high-flow hours.

and the time required for flows to return to ADWF levels, different periods may be examined to determine the basins with the greatest or most sustained rainfall-dependent infiltration rates.

- **Total Infiltration:** The total inflow and infiltration is measured in gallons per site and per storm event. Because it is based on total I/I volume, it is an indicator of combined inflow and infiltration and is used to identify the overall volumetric influence of I/I within the monitoring basin.

2.6.6 Normalization Methods

There are three ways to *normalize* the I/I analysis metrics for an “apples-to-apples” comparison amongst the different drainage basins:

- **per-ADWF:** The metric is divided by the established average dry weather flow rate and typically expressed as a ratio. *Peaking Factors* are examples of using ADWF to normalize data from different sites.
- **per-IDM:** The metric is divided by length of pipe (IDM [inch-diameter mile]) contained within the upstream basin. Final units typically are gallons per day (gpd) per IDM.
- **per-ACRE:** The metric is divided by the acreage of the upstream basin. Final units typically are gallons per day (gpd) per ACRE.

I/I metrics for each basin were normalized by the per-ADWF method in this report.

3 Rainfall Results

3.1 Rainfall Monitoring

There were four main rainfall events that occurred over the flow monitoring period, summarized in Table 3-1. Figure 3-1 shows rainfall activity and intensity over the flow monitoring period (Marina Rain Gauge shown). Figure 3-2 shows the rain accumulation plots for both rain gauges compared to the historical average rainfall[5] in the District during this project duration. Rainfall totals for the District were approximately 86% above historical normal levels during this time period.

Table 3-1. Rainfall Events Used for I/I Analysis

Rainfall Event	Rain Gauge MARINA (in)	Rain Gauge ORD (in)
Event 1: January 18 - 24, 2017	2.19	2.04
Event 2: February 9 - 11, 2017	1.23	1.23
Event 3: February 16 - 18, 2017	1.20	1.20
Event 4: February 20 - 21, 2017	1.87	1.95
Total over Monitoring Period	**7.39**	**7.21**

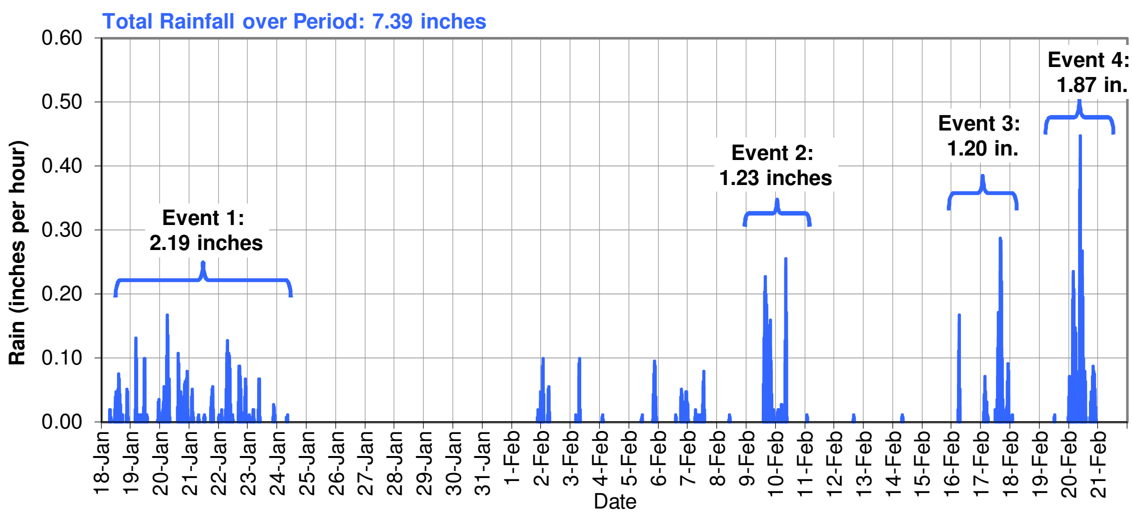

Figure 3-1. Rainfall Activity over Monitoring Period (Marina Rain Gauge)

[5] Historical data taken as weighted average from the WRCC Stations 45795 in Monterey and 47669 in Salinas: http://www.wrcc.dri.edu/summary/climsmnca.html

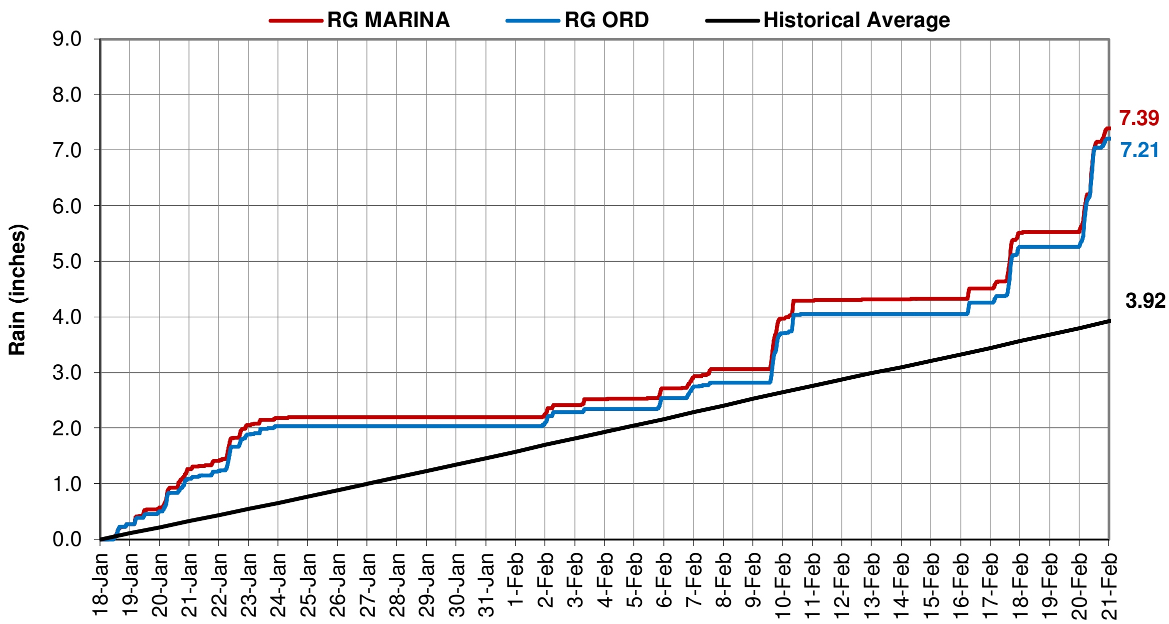

Figure 3-2. Monitored Accumulated Precipitation Compared to Historical Average

3.2 Rainfall: Rain Event Classification

It is important to classify the relative size of the major Rain event that occurs over the course of a flow monitoring period[6]. Rain events are classified by intensity and duration. Based on historical data, frequency contour maps for Rain events of given intensity and duration have been developed by NOAA for all areas within the continental United States. For example, the NOAA Rainfall Frequency Atlas[7] classifies a 10-year, 24-hour Rain event in Marina at the Marina Rain Gauge location as 2.63 inches (Figure 3-3). This means that in any given year, at this specific location, there is a 10% chance that 2.63 inches of rain will fall in any 24-hour period.

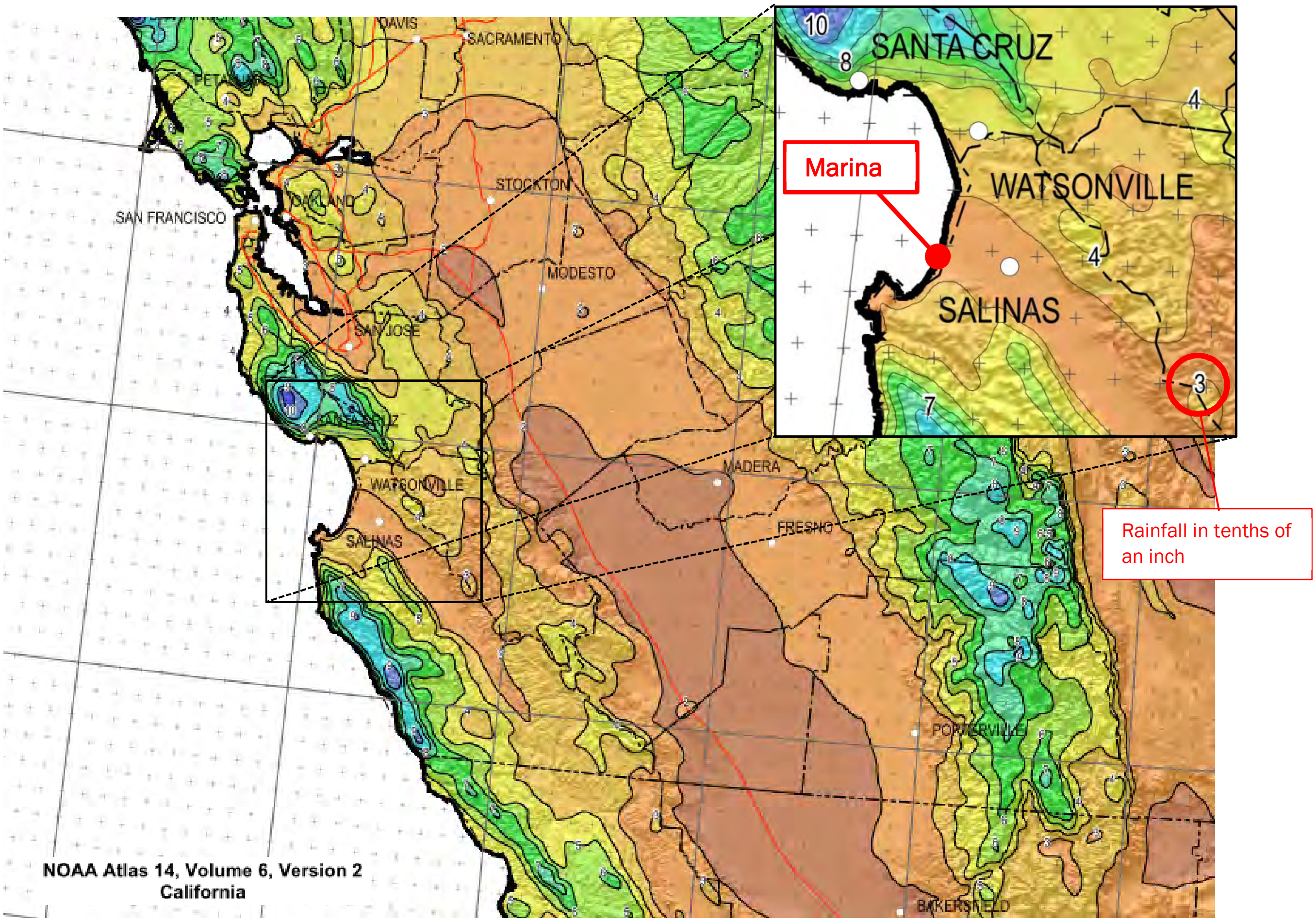

Figure 3-3. NOAA California Map of Isopluvials of 10-year, 24-hour Precipitation

From the NOAA frequency maps, for a specific latitude and longitude, the rainfall densities for period durations ranging from 15 minutes to 60 days are known for rain events ranging from 1-year to 100-year intensities. These are plotted to develop a rain event frequency map specific to each rainfall monitoring site. Superimposing the peak measured densities for all the rainfall events on the rain event frequency plot determines the classification of the rain events, shown in Figure 3-4 and Figure 3-5 for the Marina Rain Gauge. Table 3-2 summarizes the classification of the rainfall events for both rain gauge locations that occurred during the flow monitoring period.

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[6] Sanitary sewers are often designed to withstand I/I contribution to sanitary flows for specific-sized "design" Rain events.

[7] A Atlas 14, Volume 6, Version 2 California ftp://hdsc.nws.noaa.gov/pub/hdsc/data/sw/ca10y24h.pdf

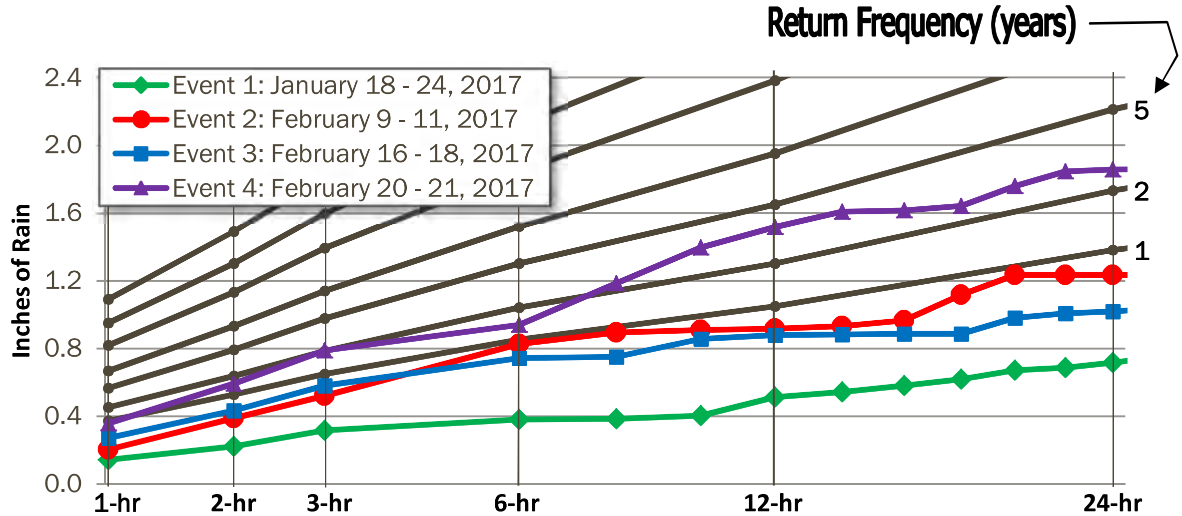


Figure 3-4. Short-Term Rain Event Classification (Marin RG)

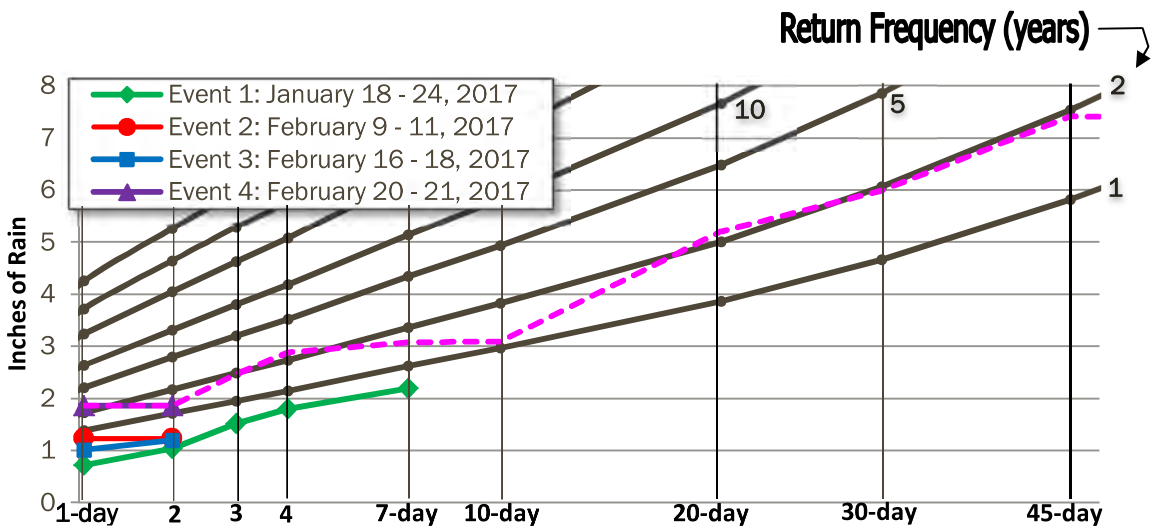


Figure 3-5. Long-Term Rain Event Classification (Marin RG)

Table 3-2. Classification of Rainfall Events

Rainfall Event	Rain Gauge Marina	Rain Gauge Ord
Event 1: January 18 - 24, 2017	< 1-year	< 1-year
Event 2: February 9 - 11, 2017	< 1-year	< 1-year
Event 3: February 16 - 18, 2017	< 1-year	< 1-year
Event 4: February 20 - 21, 2017	4-year, 12-hour 3-year, 24-hour	6-year, 12-hour 3-year, 24-hour
Monitoring Period (January 18 – February 21, 2017)	2-year, 45-day	2-year, 20-day

The following storm event classification items are noted:

- Event 4 (February 20 - 21, 2017) was the largest classified rainfall event over the monitoring period, classified as about a 5-year, 12-hour event and a 3-year, 24-hour event.
- The full flow monitoring period had rainfall classified as about a 2-year, 45-day event.

4 Flow Monitoring Results

4.1 Average Flow Analysis

Table 4-1 summarizes the dry weather flow data measured for this study. ADWF curves for each site can be found in Appendix A. Figure 4-1 shows a schematic diagram of the average dry weather flows and flow levels.

Table 4-1. Average Dry Weather Flow Summary

Site	Sediment (inches)	Mon - Thu ADWF (mgd)	Friday ADWF (mgd)	Saturday ADWF (mgd)	Sunday ADWF (mgd)	Overall ADWF (mgd)
M1	1.0	0.106	0.105	0.114	0.124	0.110
M2	none	0.360	0.348	0.389	0.416	0.371
M3	none	0.256	0.244	0.278	0.272	0.260
M4	none	0.169	0.164	0.170	0.174	0.169
O1	none	0.446	0.452	0.440	0.446	0.446
O2	none	0.075	0.076	0.072	0.079	0.075
O3	none	0.182	0.156	0.143	0.147	0.168
O5	none	0.328	0.326	0.375	0.394	0.344
O6	none	0.019	0.022	0.019	0.021	0.020

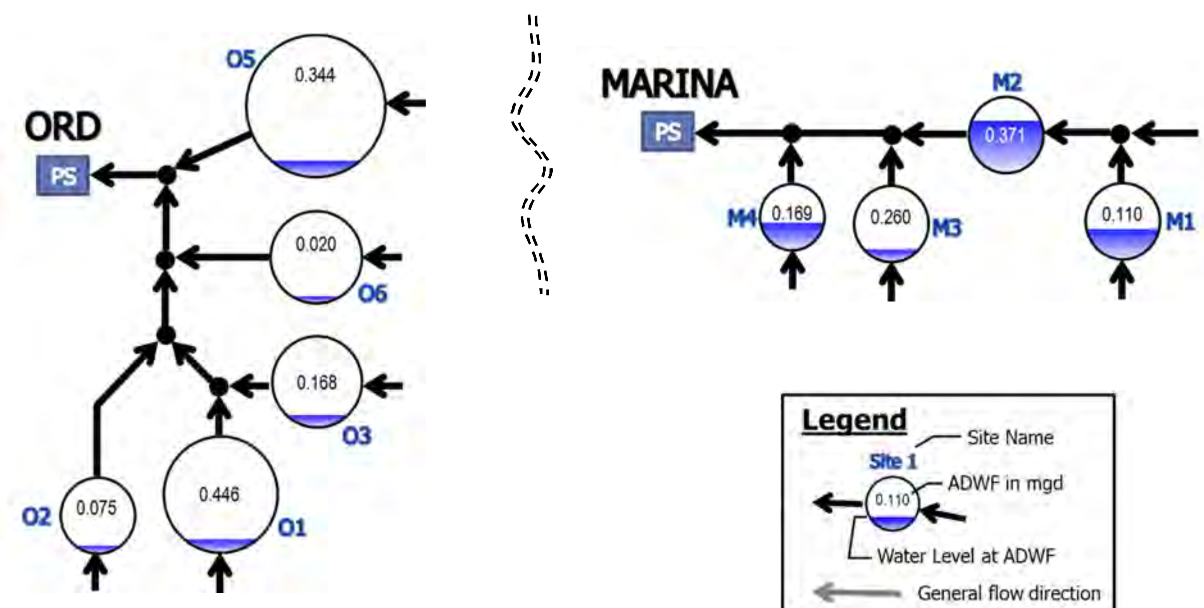


Figure 4-1. Dry Weather Flow Schematic

4.2 Capacity Analysis: Peaking Factor and d/D Ratio

Peak measured flows and the corresponding flow levels (depths) are important to understand the capacity limitations of a collection system. The peak flows and flow levels reported are from the peak measurements as taken across the entirety of the flow monitoring period. Peak flows and levels may not correspond to a rainfall event. The following capacity analysis terms are defined as follows:

- **Peaking Factor:** Peaking factor is defined as the peak measured flow divided by the ADWF. Peaking factors are influenced by many factors including size and topography of tributary area, proximity to pump stations, and the amount and characteristics of I/I entering the collection system. Flow attenuation and flow restrictions will also affect the peaking factor. A peaking factor threshold value of 3.0 is commonly used for sanitary sewer design of new pipe; however, it is noted that this value is variable and subject to attenuation and the size of the upstream collector area. The District should follow its own standards and criteria when examining peaking factors.
- **d/D Ratio:** The d/D ratio is the peak measured depth of flow (d) divided by the pipe diameter (D). Standards for d/D ratio vary from agency to agency, but typically range between 0.5 and 0.75. The d/D ratio for each site was computed based on the maximum depth of flow for the flow monitoring study.

Table 4-2 summarizes the peak recorded flows, levels, *d/D* ratios, and peaking factors per site during the flow monitoring period. Results of note have been shaded in RED. Capacity analysis data are presented on a site-by-site basis and represents the hydraulic conditions only at the site locations; hydraulic conditions in other areas of the collection system will differ. Figure 4-2 and Figure 4-3 show bar graphs of the capacity results. Figure 4-4 shows a schematic diagram of the peak measured flows with peak flow levels.

Table 4-2. Capacity Analysis Summary

Metering Site	ADWF (MGD)	Peak Measured Flow (MGD)	Peaking Factor	Pipe Diameter, *D* (IN)	Max Depth, *d* (IN)	*Max d/D* Ratio	Surcharge above Pipe Crown (FT)
M1	0.110	0.279	2.5	11.5	6.79	0.59	-
M2	0.371	1.465	4.0	12	9.69	0.81	-
M3	0.260	0.634	2.4	12	3.01	0.25	-
M4	0.169	0.330	2.0	10	5.67	0.57	-
O1	0.446	1.384	3.1	18	3.61	0.20	-
O2	0.075	0.342	4.5	12	2.46	0.21	-
O3	0.168	1.068	6.4	15	4.58	0.31	-
O5	0.344	0.832	2.4	29.5	5.35	0.18	-
O6	0.020	0.199	10.1	14.5	3.54	0.24	-

The following capacity analysis results are noted:

- **Peaking Factor**: Sites O3 and O6 had peaking factors greater than 5 corresponding to rainfall events; Site O6 had the highest peaking factor with a value greater than 10.
- **d/D Ratio**: None of the flow monitoring sites surcharged during this flow study. Site M2 had a maximum *d/D* ratio that just exceeded the typical threshold of 0.75.

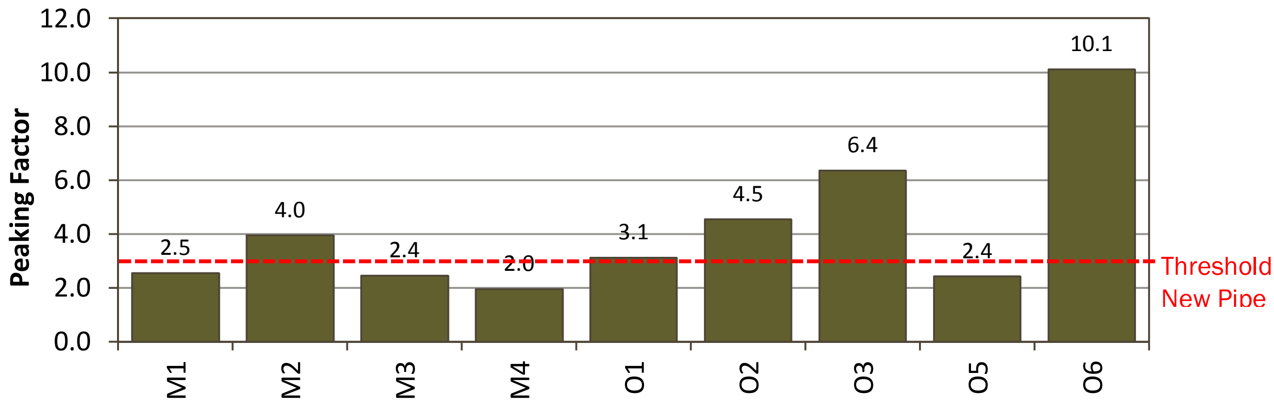


Figure 4-2. Capacity Summary: Peaking Factors

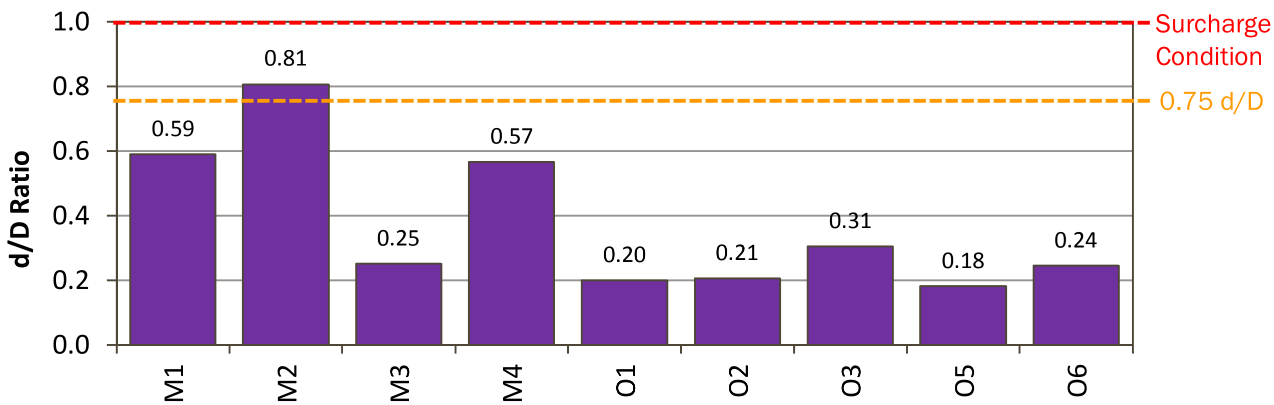


Figure 4-3. Capacity Summary: Max d/D Ratios

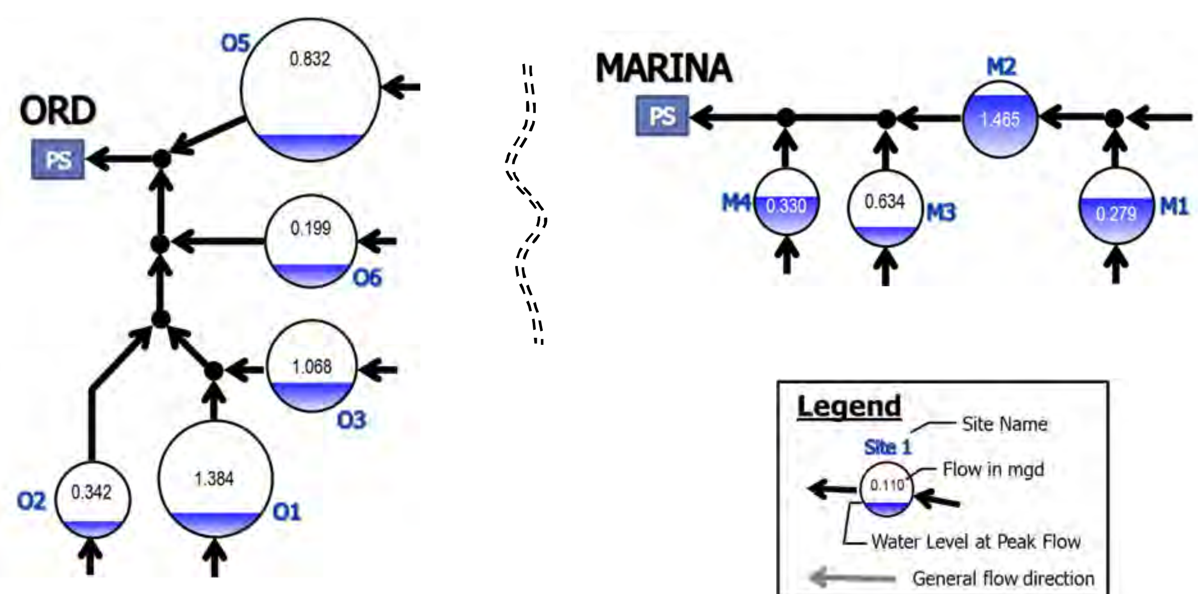


Figure 4-4. Peak Measured Flow (Flow Schematic)

5 Inflow and Infiltration Results

5.1 Preface

Figure 5-1 is shown in reference to the I/I analyses conducted for this study.

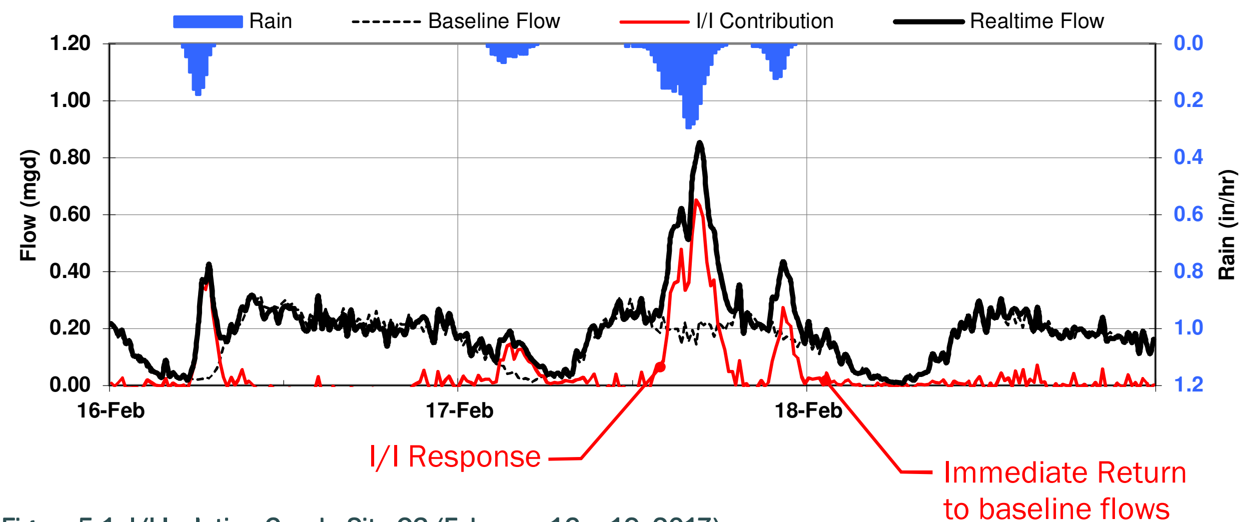


Figure 5-1. I/I Isolation Graph, Site 03 (February 16 – 19, 2017)

The following items are noted for the I/I analyses of this study:

- In all sites, the I/I receded to baseline levels within a couple hours of the conclusion of the rainfall event, indicating minimal RDI component within the total I/I response. A quantitative RDI analysis could not be performed for this study. It is estimated that soils of the region are sandy and porous and do not hold groundwater or rain dependent infiltration water above the elevation levels of the pipes. Similarly, RDI analysis could not be performed for this study.
- Event 3 (February 16 – 19, 2017) and Event 4 (February 20 – 21, 2017) elicited the greatest I/I response and were analyzed for this study.

5.2 Inflow Results Summary

Inflow is rain water discharged into the sewer system through direct connections such as downspouts, area drains, and cross-connections to catch basins. These sources transport rain water directly into the sewer system and the corresponding flow rates are tied closely to the intensity of the rain. This component of I/I often causes a peak flow problem in the sewer system and often dictates the required capacity of downstream pipes and transport facilities to carry these peak instantaneous flows.

Table 5-1 and Figure 5-2 summarize the peak measured I/I flows and normalized inflow results. Results of note in Table 5-1 have been shaded in RED. The following inflow analysis results are noted:

- Basins O3 and O6 ranked highest for normalized inflow contribution. For the Marina collection system, Basin M2 ranked highest for normalized inflow contribution.

Table 5-1. Inflow Analysis Summary

Monitoring Basin	ADWF (mgd)	Event 3 (Feb 16-19)		Event 4 (Feb 19-20)		Overall Rank[A]
		Peak I/I Rate (mgd)	Peak I/I per ADWF (rank)	Peak I/I Rate (mgd)	Peak I/I per ADWF (rank)	
Basin M1	0.110	0.105	1.0 (5)	0.082	0.7 (9)	8
Basin M2	0.263	0.282	1.1 (4)	0.753	2.9 (3)	3
Basin M3	0.260	0.136	0.5 (7)	0.270	1.0 (4)	5
Basin M4	0.169	0.057	0.3 (9)	0.151	0.9 (8)	9
Basin O1	0.446	0.297	0.7 (6)	0.447	1.0 (5)	6
Basin O2	0.075	0.031	0.4 (8)	0.075	1.0 (6)	7
Basin O3	0.168	0.618	3.6 (2)	0.848	5.0 (2)	2
Basin O5	0.344	0.536	1.6 (3)	0.332	1.0 (7)	4
Basin O6	0.020	0.133	6.9 (1)	0.165	8.5 (1)	1

[A] Ranking of 1 represents most inflow after normalization. Event 4 had the higher response and was used to break ties.

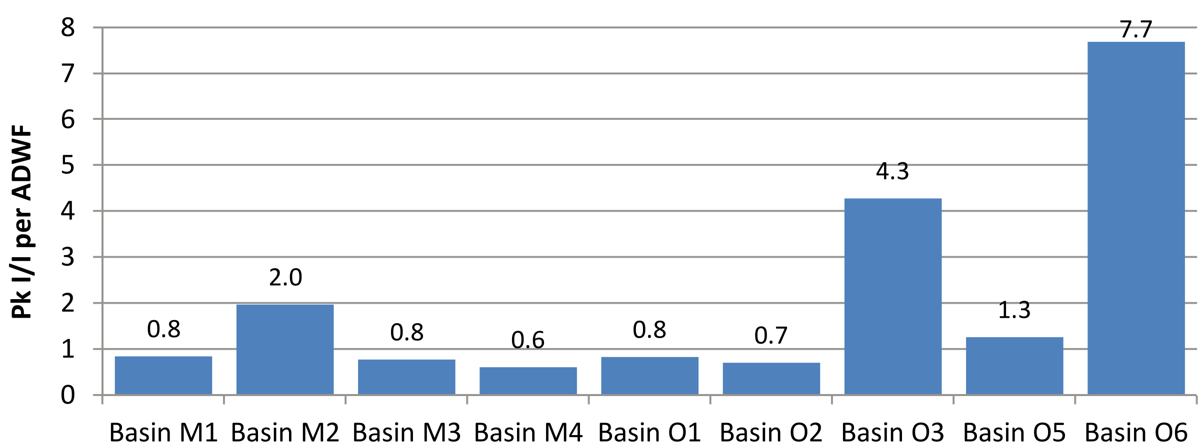


Figure 5-2. Bar Graph: Inflow Analysis Results (Avg Peak I/I to ADWF Ratio, both events)

5.3 Combined I/I Results Summary

Combined I/I analysis considers the totalized volume (in gallons) of both inflow and rainfall-dependent infiltration over the course of a storm event. Table 5-2 and Figure 5-3 summarize the combined I/I flow results. The top ranked basins with the highest normalized combined I/I have been shaded in RED. The following inflow analysis results are noted:

- Basins O3 and O6 ranked highest for normalized total I/I contribution. For the Marina collection system, Basin M2 ranked highest for normalized total I/I contribution. As inflow was determined to be the primary component of I/I for this system, it makes sense that these rankings match the inflow rankings.

Table 5-2. Basins Combined I/I Analysis Summary

Monitoring Basin	ADWF (mgd)	Event 3 (Feb 16-19)		Event 4 (Feb 19-20)		Overall Rank[A]
		Total I/I (gallons)	Total I/I per ADWF (rank)	Total I/I (gallons)	Total I/I per ADWF (rank)	
Basin M1	0.110	10,000	0.08 (5)	14,000	0.07 (7)	6
Basin M2	0.263	58,000	0.18 (3)	128,000	0.26 (3)	3
Basin M3	0.260	15,000	0.05 (6)	53,000	0.11 (5)	5
Basin M4	0.169	5,000	0.02 (8)	15,000	0.05 (9)	9
Basin O1	0.446	25,000	0.05 (7)	49,000	0.06 (8)	8
Basin O2	0.075	2,000	0.02 (9)	13,000	0.09 (6)	7
Basin O3	0.168	132,000	0.64 (2)	219,000	0.66 (2)	2
Basin O5	0.344	53,000	0.13 (4)	75,000	0.11 (4)	4
Basin O6	0.020	20,000	0.86 (1)	38,000	1.01 (1)	1

[A] Ranking of 1 represents most inflow after normalization. Event 4 had the higher response and was used to break ties.

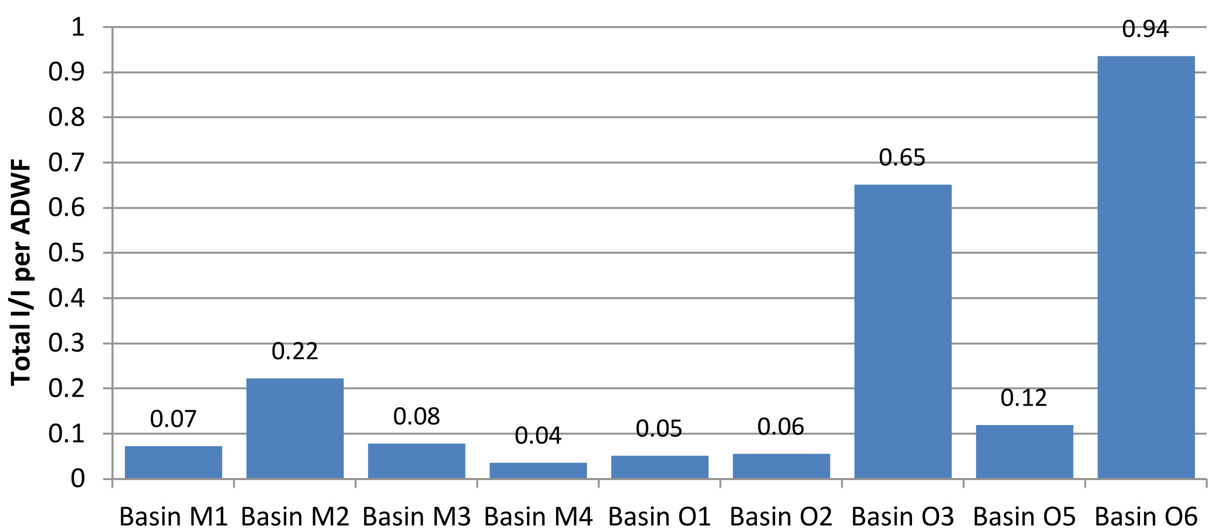


Figure 5-3. Bar Graph: Total I/I Analysis Results (Avg Ratio, both events)

6 Recommendations

V&A advises that future I/I reduction plans consider the following recommendations:

1. **Determine I/I Reduction Program:** The District should examine its I/I reduction needs to determine a future I/I reduction program.
    a. If peak flows, sanitary sewer overflows, and pipeline capacity issues are of greater concern, then priority can be given to investigate and reduce sources of inflow within the basins with the greatest inflow problems. The highest inflow occurs in Basins O3 and O6 in the Ord collection system, and in Basin M2 for the Marina collection system.
    b. If total infiltration and general pipeline deterioration are of greater concern, then the program can be weighted to investigate and reduce sources of infiltration within the basins with the greatest infiltration problems. Infiltration does not appear to be an issue for the Marina or Ord collection systems.
2. **I/I Investigation Methods:** Potential I/I investigation methods include the following:
    a. Smoke testing
    b. Mini-basin flow monitoring
    c. Nighttime reconnaissance work to (1) investigate and determine direct point sources of inflow and (2) determine the areas and pipe reaches responsible for high levels of infiltration contribution.
3. **I/I Reduction Cost-Effectiveness Analysis:** The District should conduct a study to determine which is more cost-effective: (1) locating the sources of inflow and infiltration and systematically rehabilitating or replacing the faulty pipelines or (2) continued treatment of the additional rainfall-dependent I/I flow.

Appendix A
Flow Monitoring Site Reports: Data, Graphs, Information

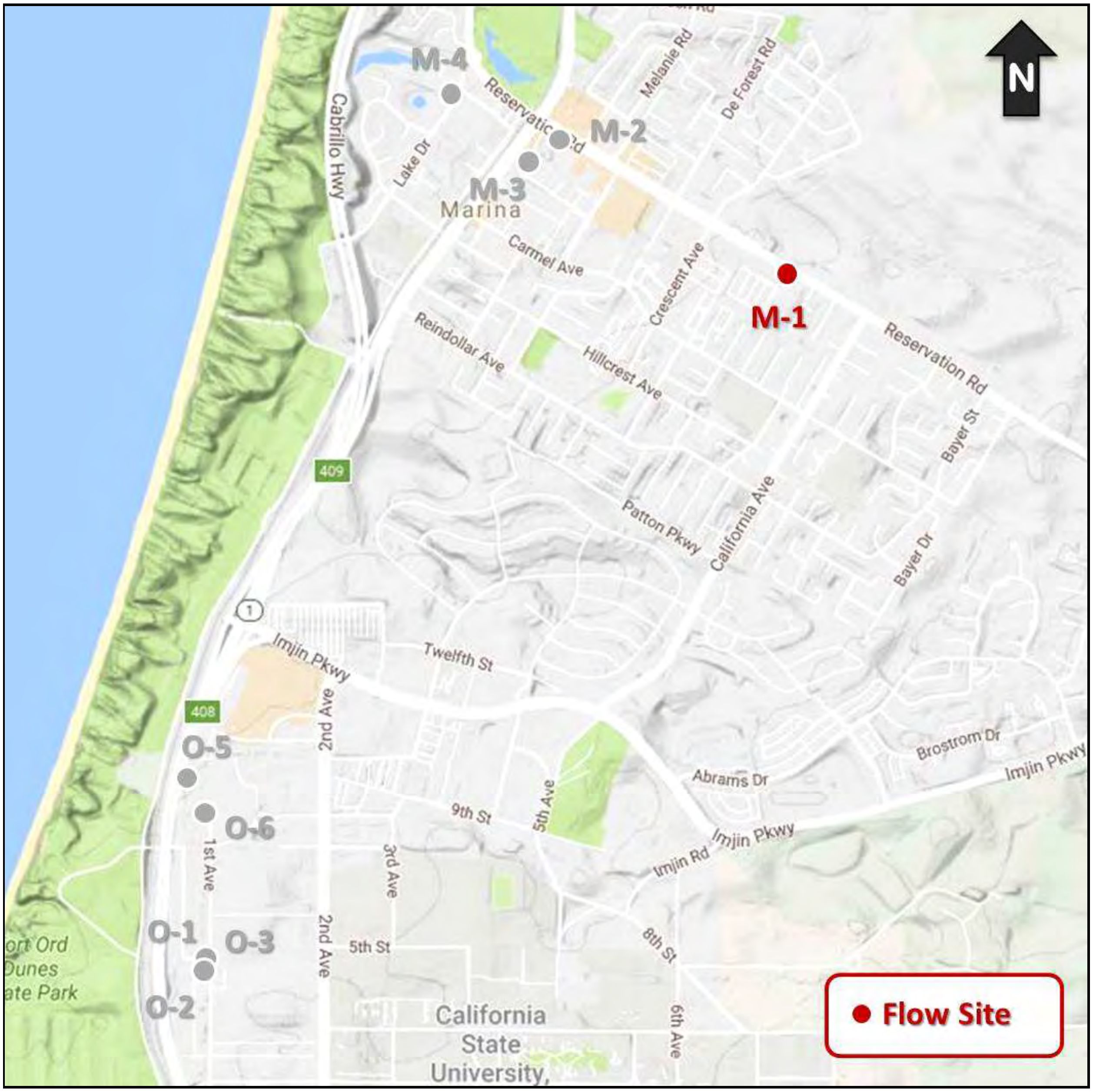
Marina Coast Water District

Sanitary Sewer Flow Monitoring
Temporary Monitoring: January 2017 - March 2017

Monitoring Site: Site M1

Location: 358 Reservation Road

Data Summary Report



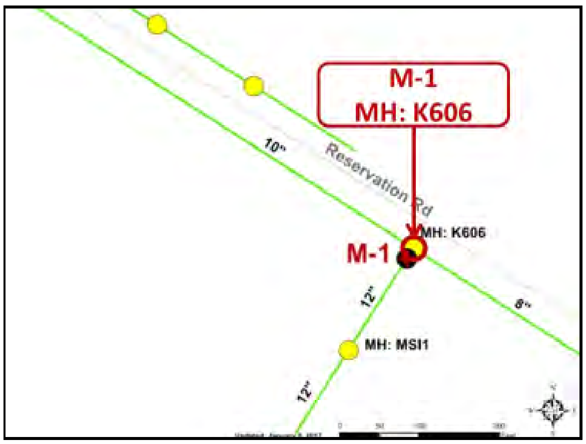
Vicinity Map: Site M1

SITE M1

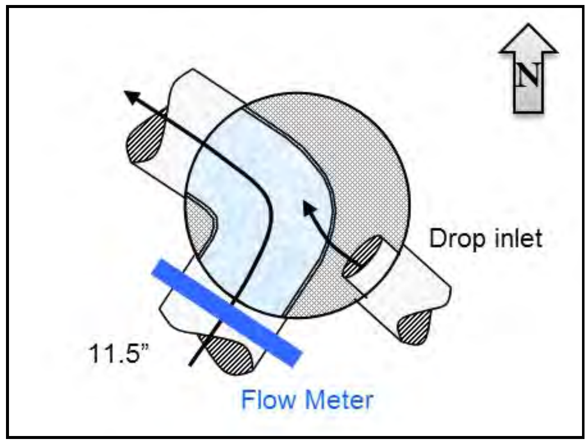
Site Information

Location:	358 Reservation Road
Coordinates:	121.7885° W, 36.6822° N
Pipe Diameter:	11.5 inches
ADWF:	0.110 mgd
Peak Measured Flow:	0.279 mgd

Satellite Map



Sewer Map



Flow Sketch

Street View

Plan View

SITE M1

Additional Site Photos

Effluent Pipe

West Influent Pipe

SITE M1

Additional Site Photos

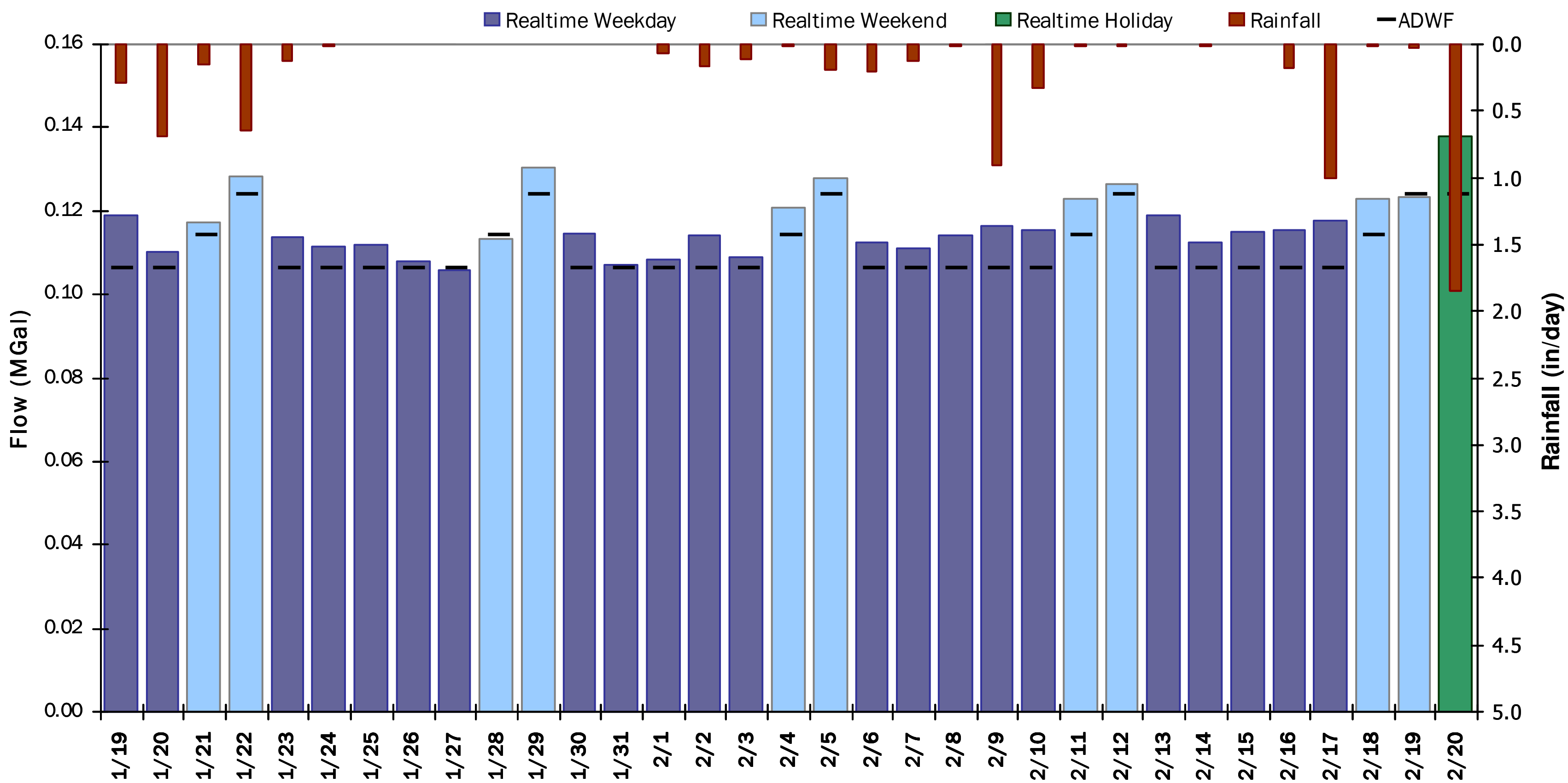
East Influent Pipe (Lower)

SITE M1

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.117 MGal **Peak Daily Flow: 0.138 MGal** **Min Daily Flow: 0.106 MGal**

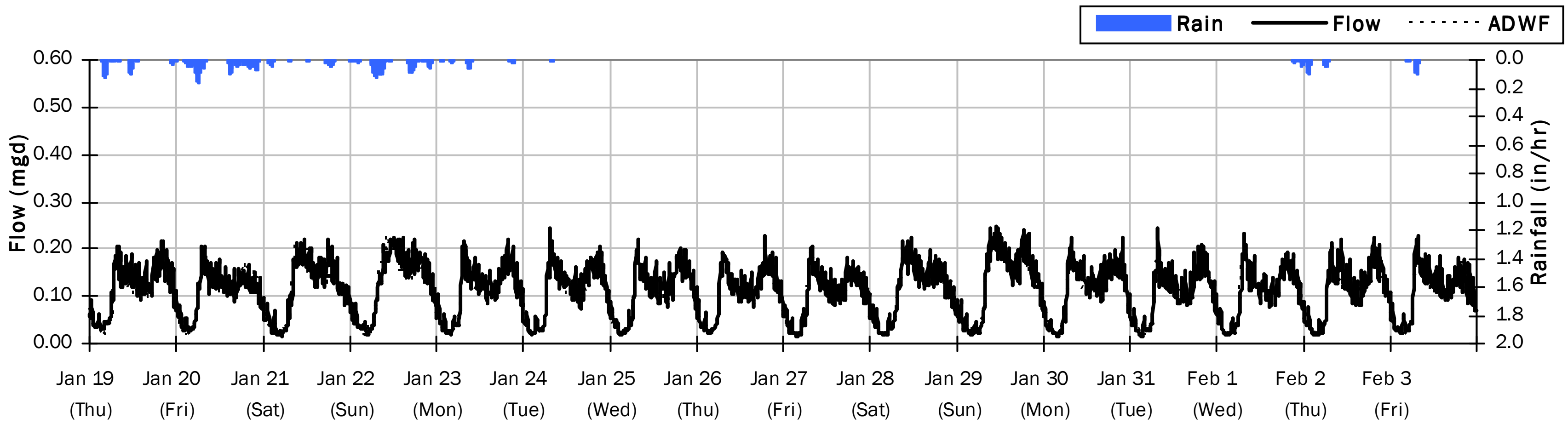
Total Period Rainfall: 7.11 inches

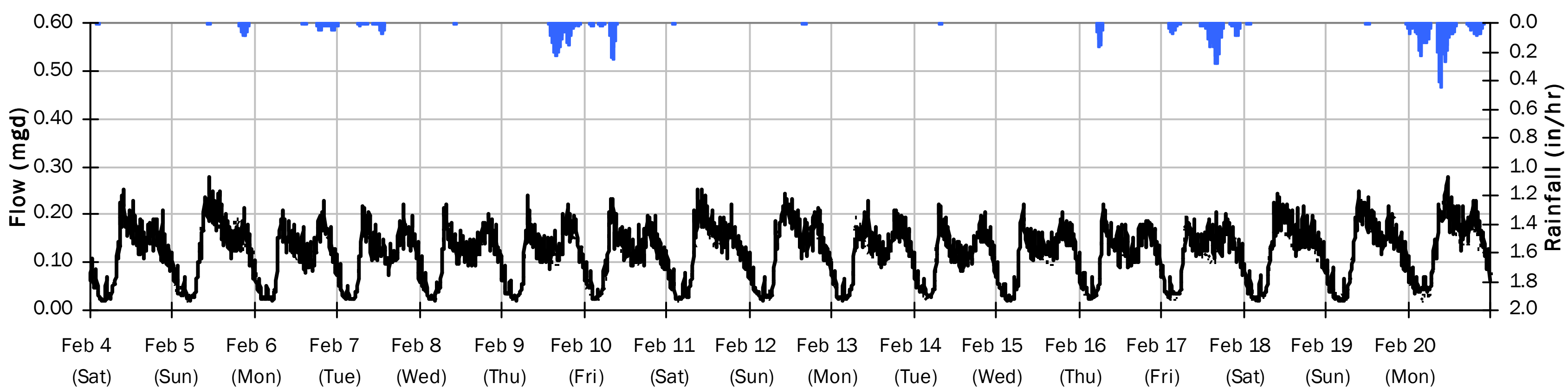


SITE M1

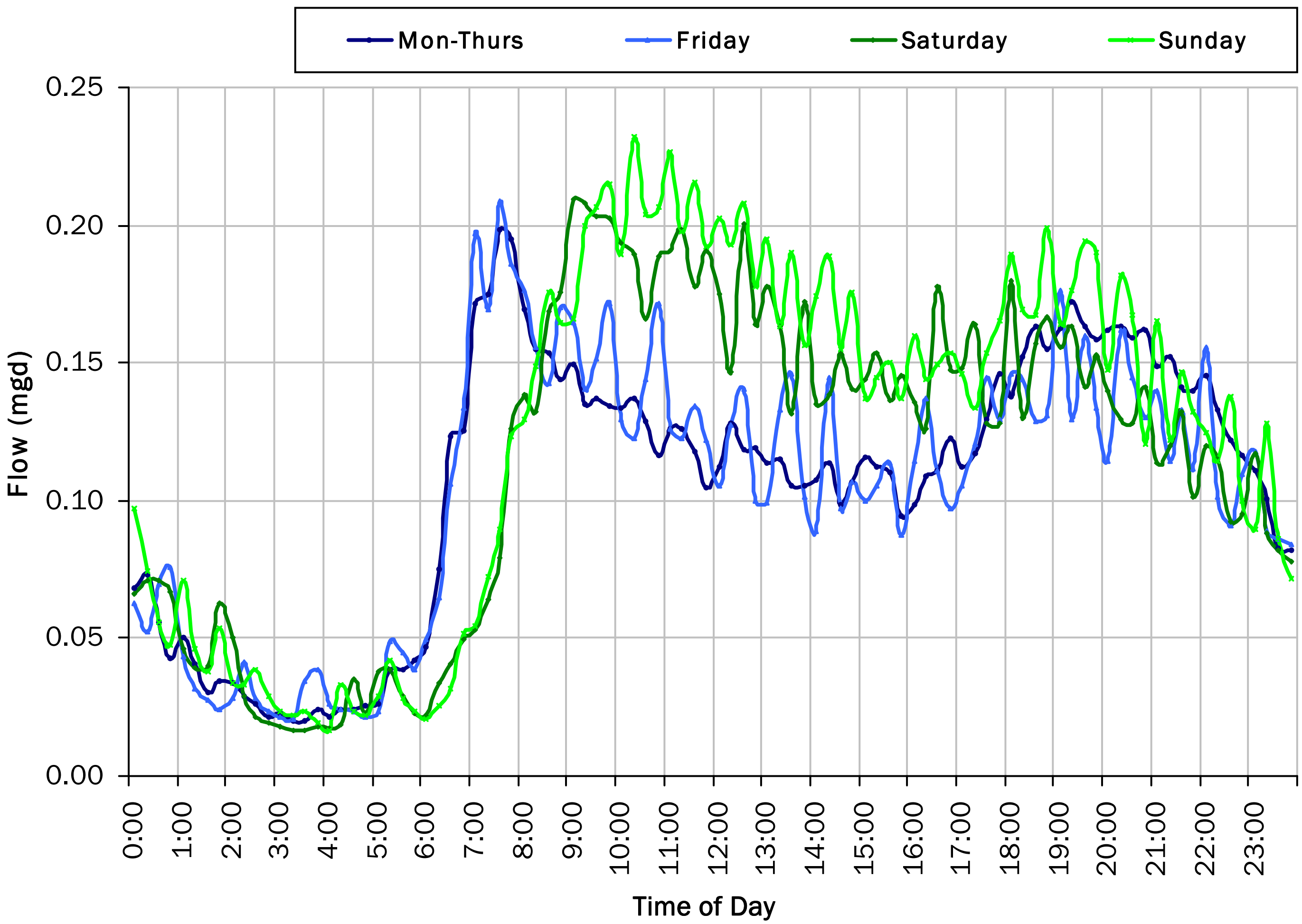
Flow Summary: 1/19/2017 to 2/20/2017

Total Period Rainfall: 7.11 inches   **Avg Flow: 0.117 mgd**   **Peak Flow: 0.279 mgd**   **Min Flow: 0.016 mgd**



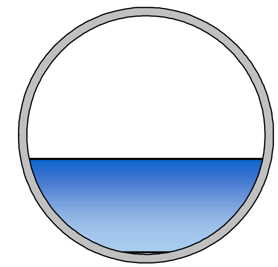


SITE M1
Average Dry Weather Flow Hydrographs



ADWF:

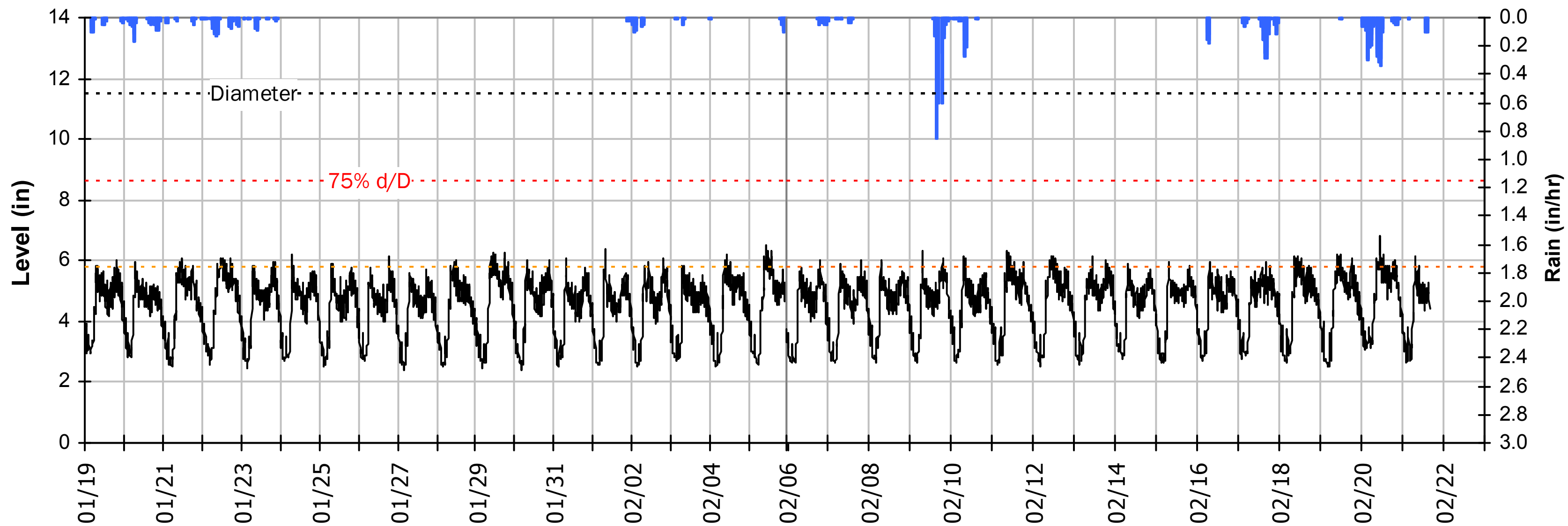
0.110 *mgd*

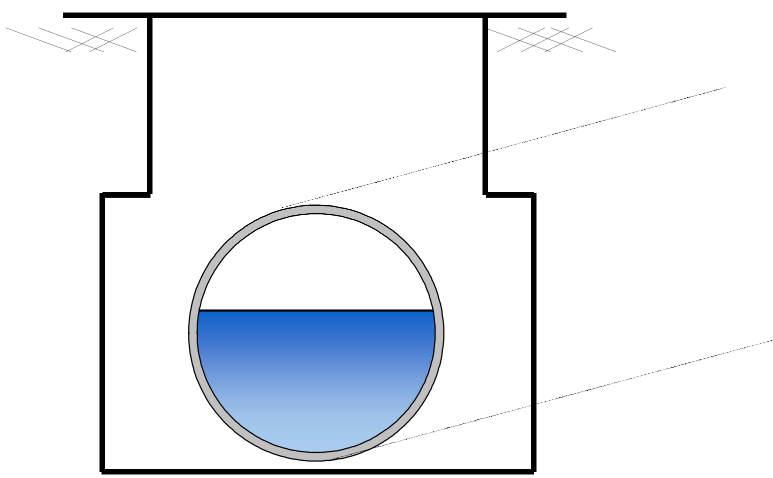


SITE M1

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

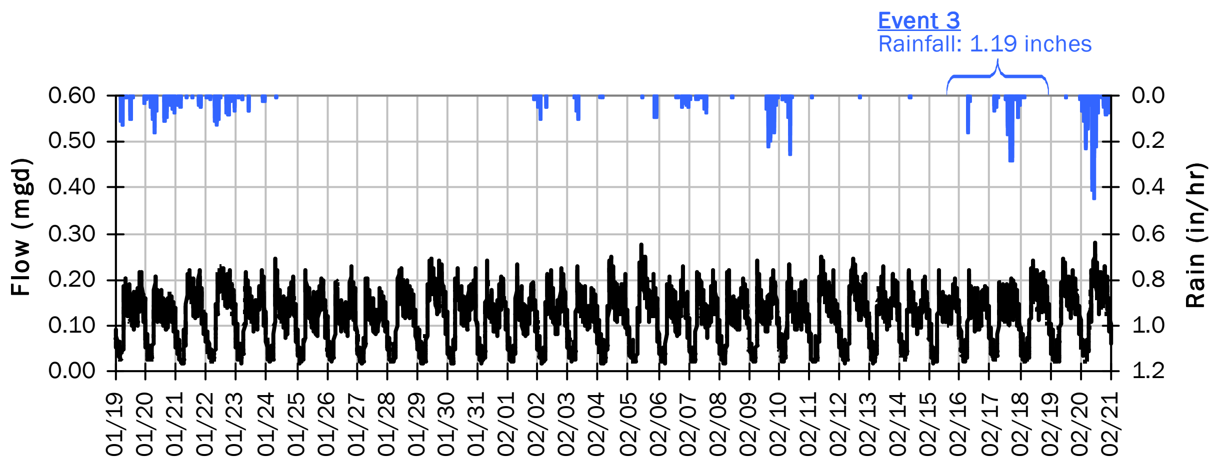




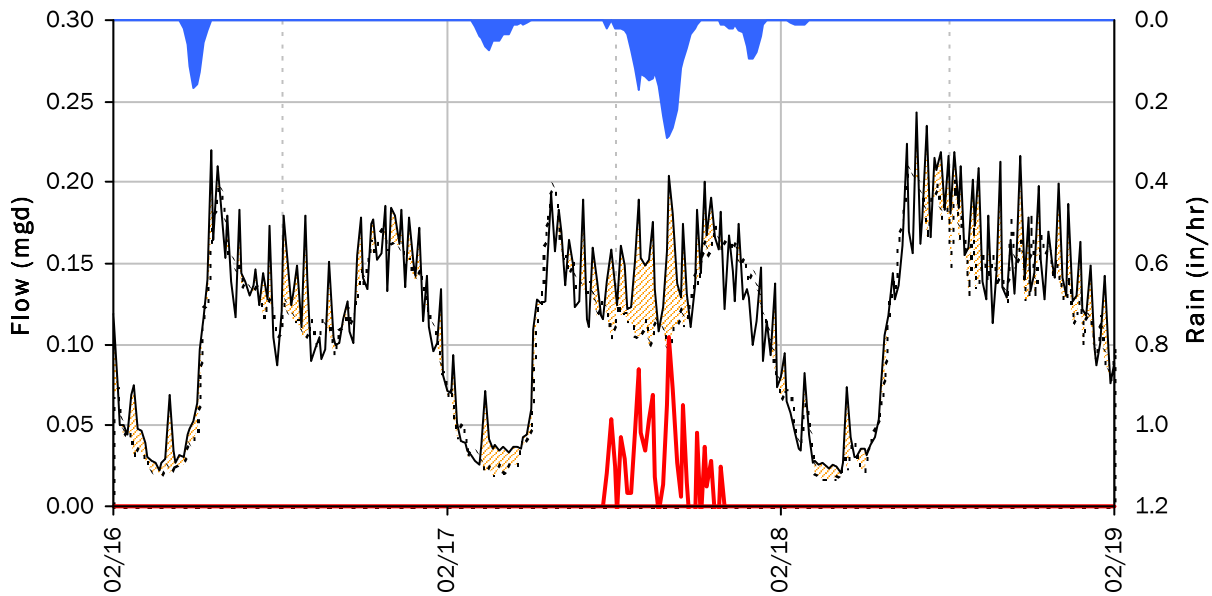
Pipe Diameter:	11.5	*inches*
Peak Measured Level:	6.79	*inches*
Peak d/D Ratio:	0.59	

SITE M1
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



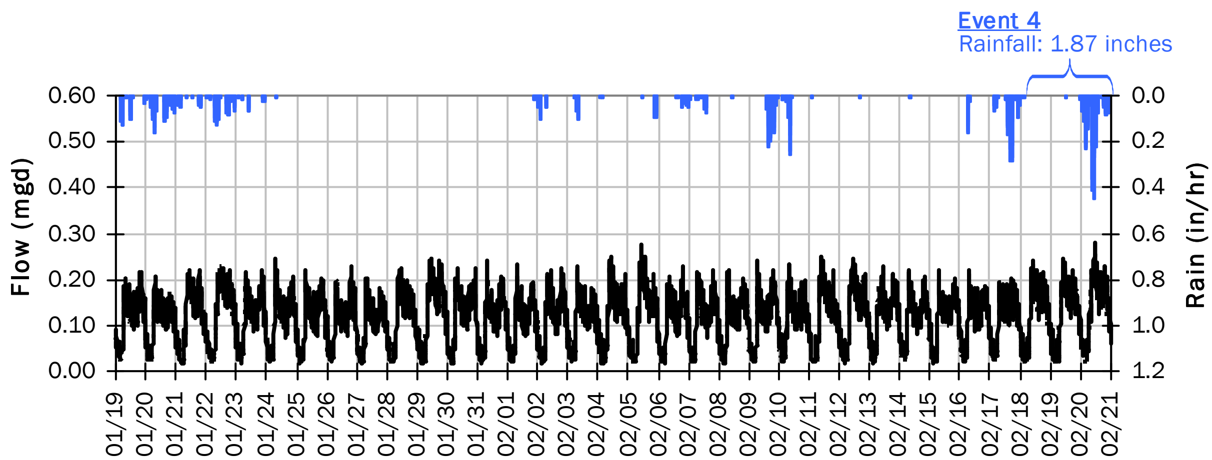
Storm Event I/I Analysis (Rain = 1.20 inches)

Capacity		**Inflow / Infiltration**	
Peak Flow:	0.20 *mgd*	**Peak I/I Rate:**	0.11 *mgd*
PF:	1.85	**Total I/I:**	10,000 *gallons*
Peak Level:	5.93 *in*		
d/D Ratio:	0.52		

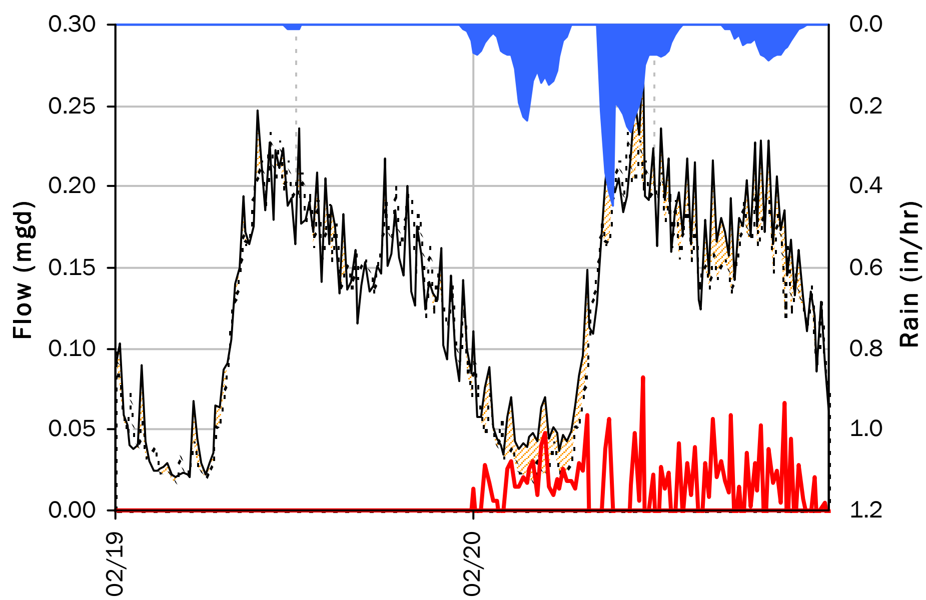
SITE M1

I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



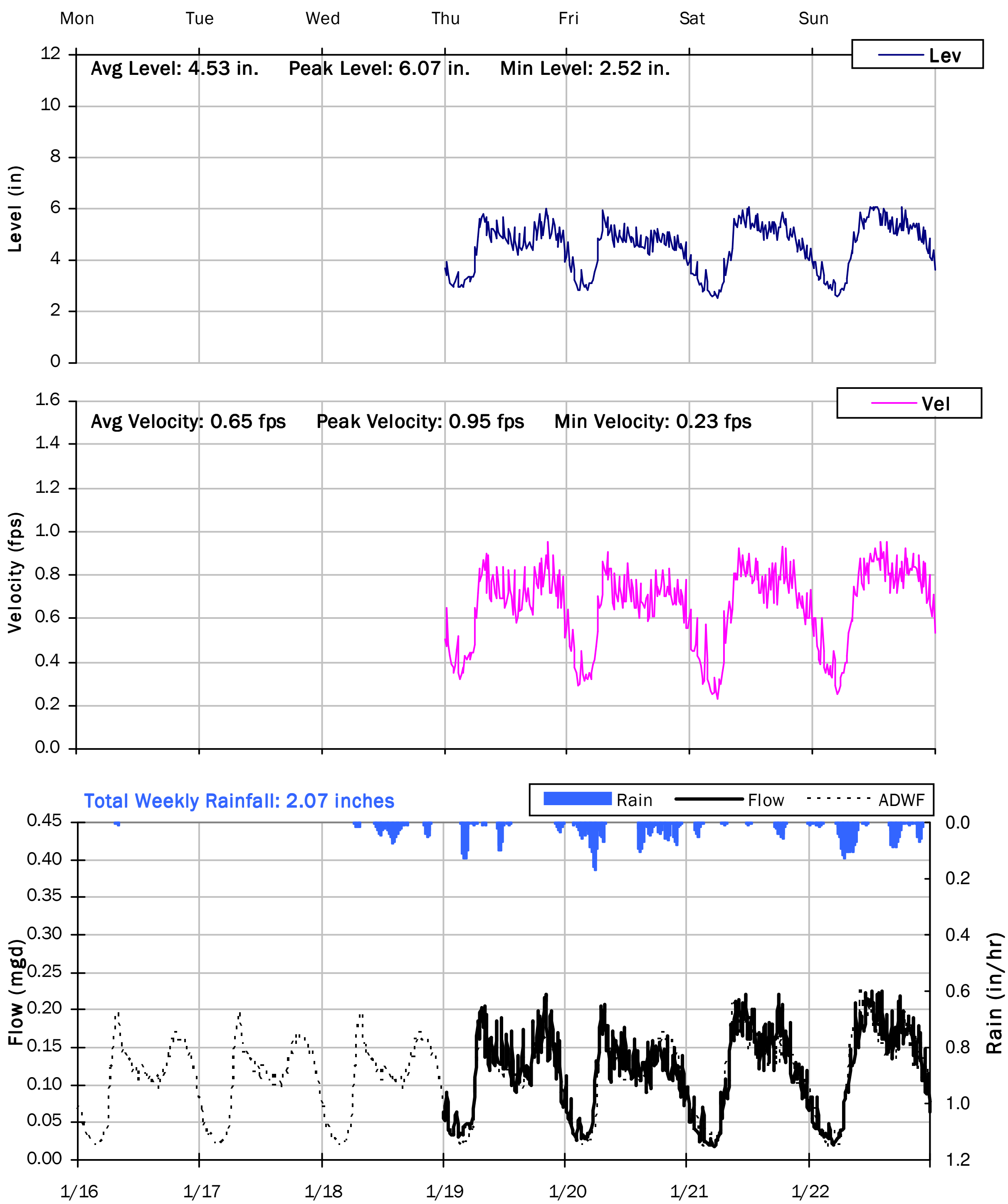
Event 4 Detail Graph



Storm Event I/I Analysis (Rain = 1.87 inches)

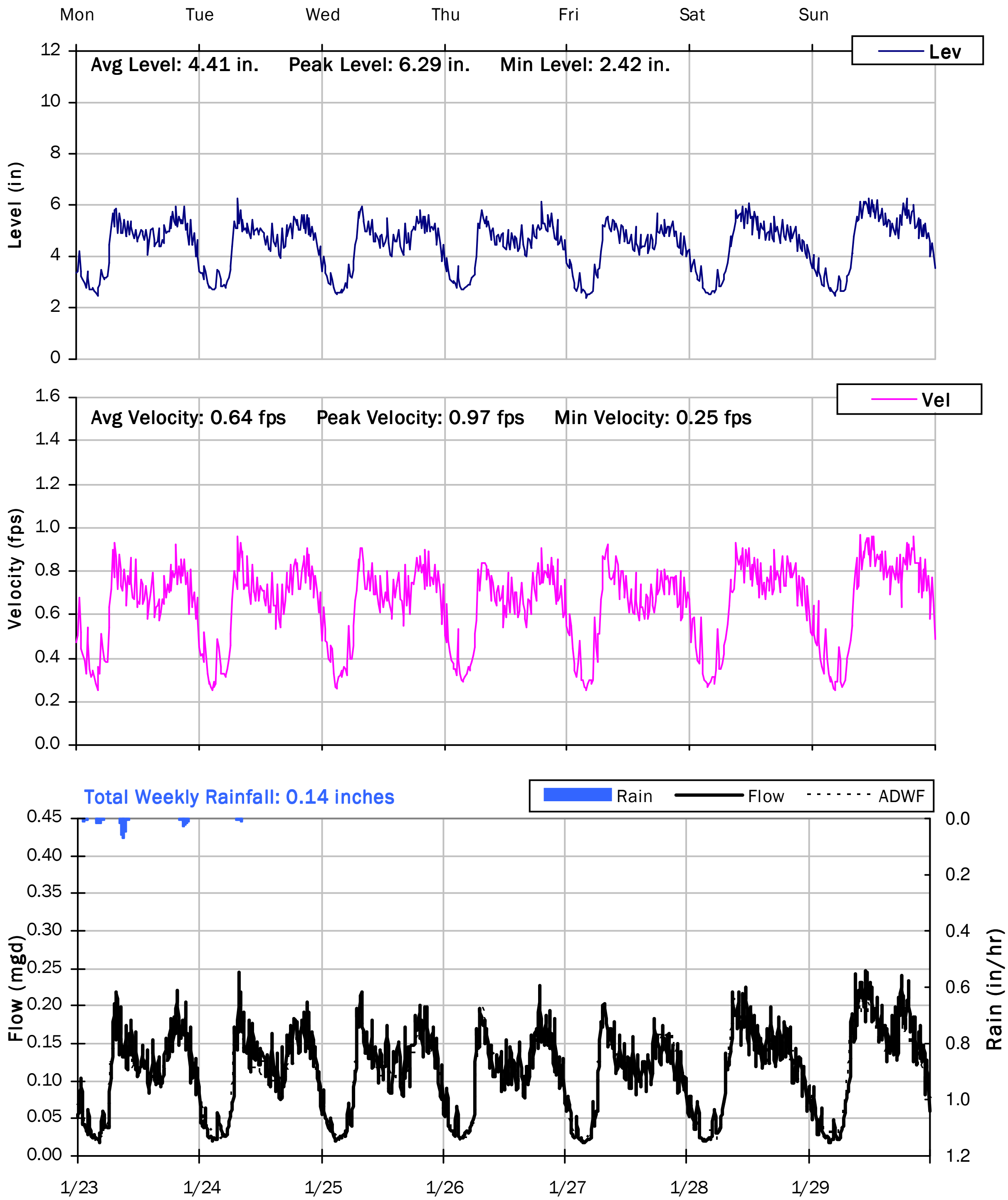
Capacity		Inflow / Infiltration	
Peak Flow:	0.28 *mgd*	**Peak I/I Rate:**	0.08 *mgd*
PF:	2.53	**Total I/I:**	14,000 *gallons*
Peak Level:	6.79 *in*		
d/D Ratio:	0.59		

SITE M1
Weekly Level, Velocity and Flow Hydrographs
1/16/2017 to 1/23/2017



Avg Flow: 0.119 mgd **Peak Flow: 0.226 mgd** **Min Flow: 0.017 mgd**

SITE M1
Weekly Level, Velocity and Flow Hydrographs
1/23/2017 to 1/30/2017

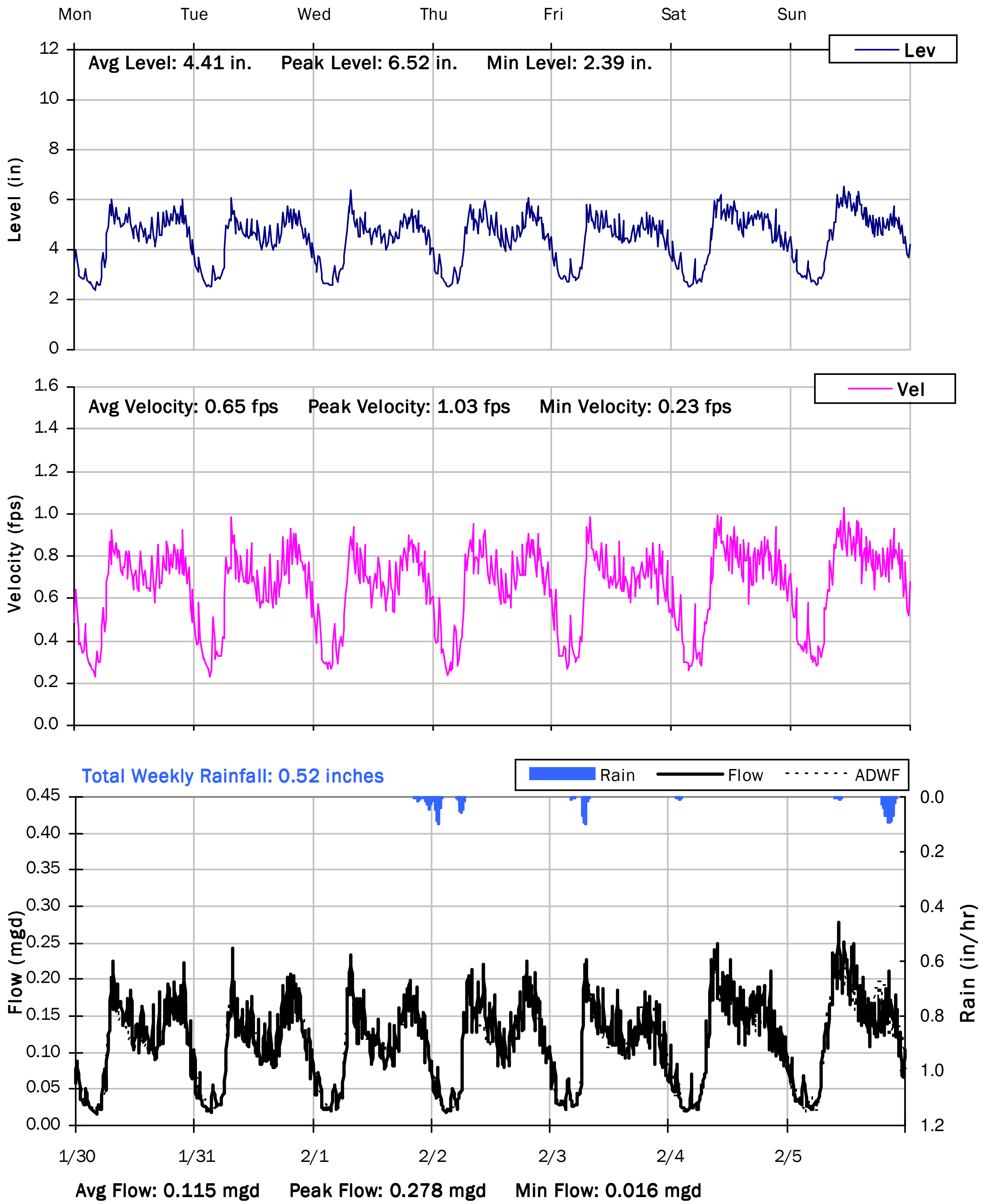


Avg Flow: 0.114 mgd **Peak Flow: 0.246 mgd** **Min Flow: 0.017 mgd**

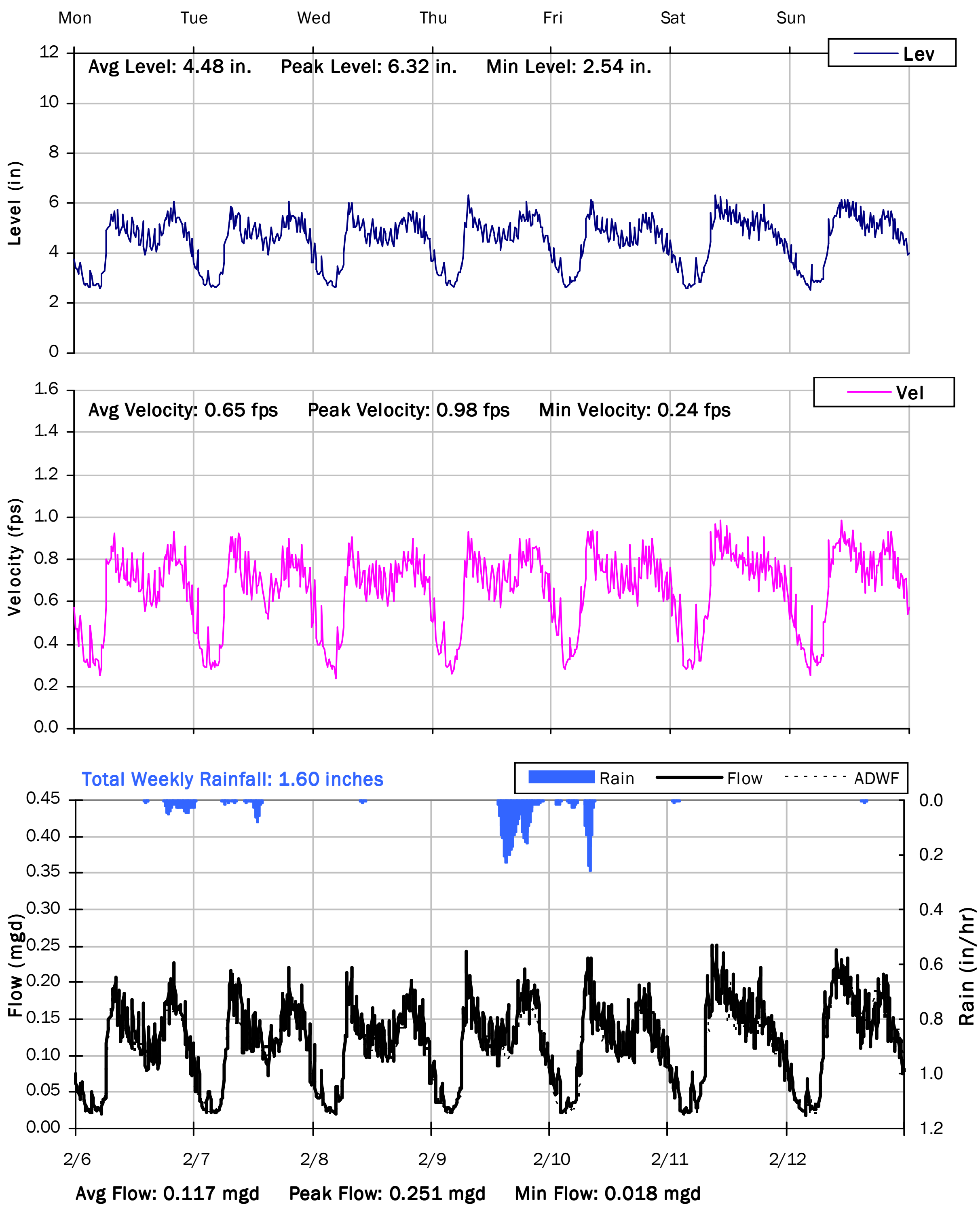
SITE M1

Weekly Level, Velocity and Flow Hydrographs

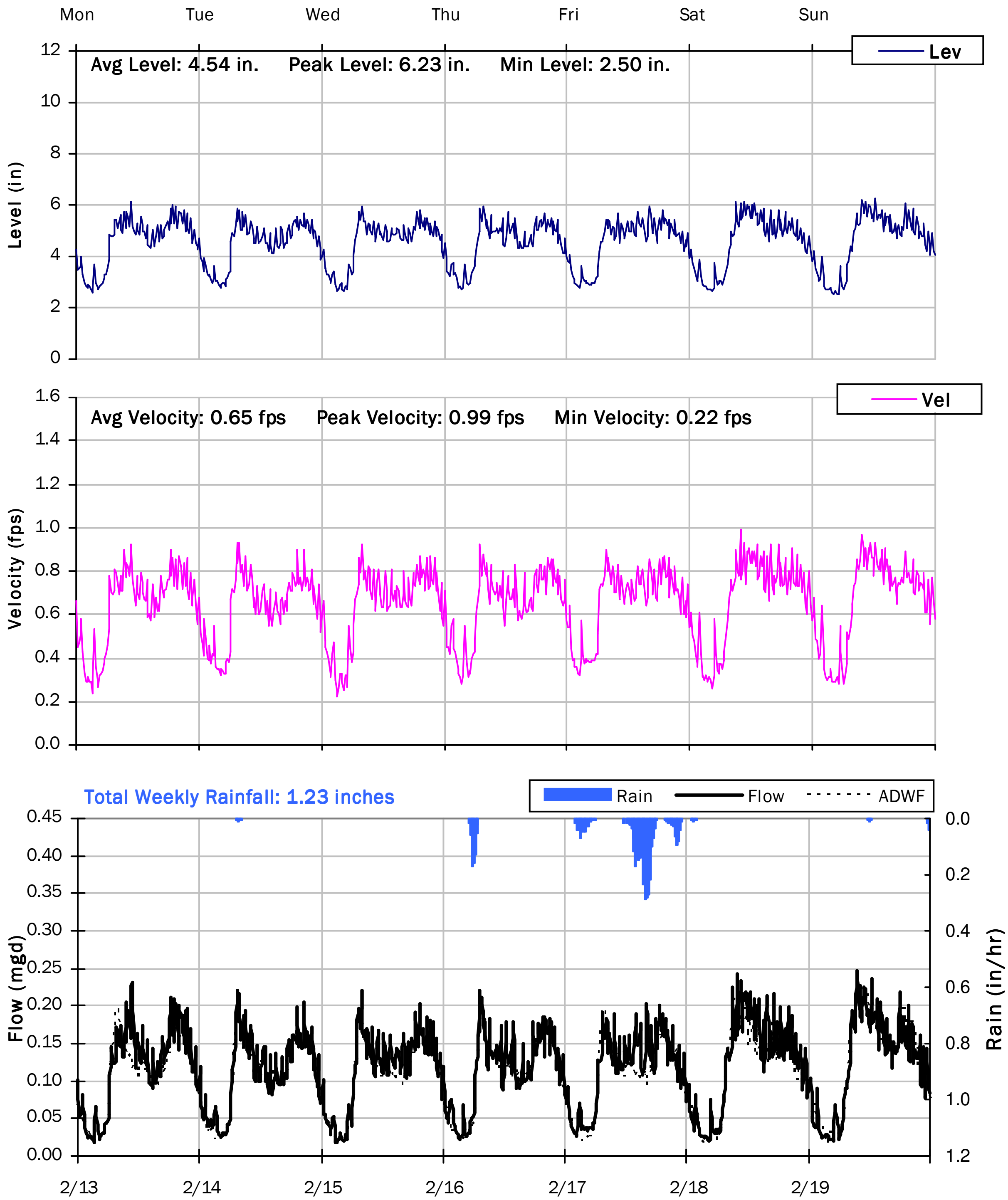
1/30/2017 to 2/6/2017



SITE M1
Weekly Level, Velocity and Flow Hydrographs
2/6/2017 to 2/13/2017

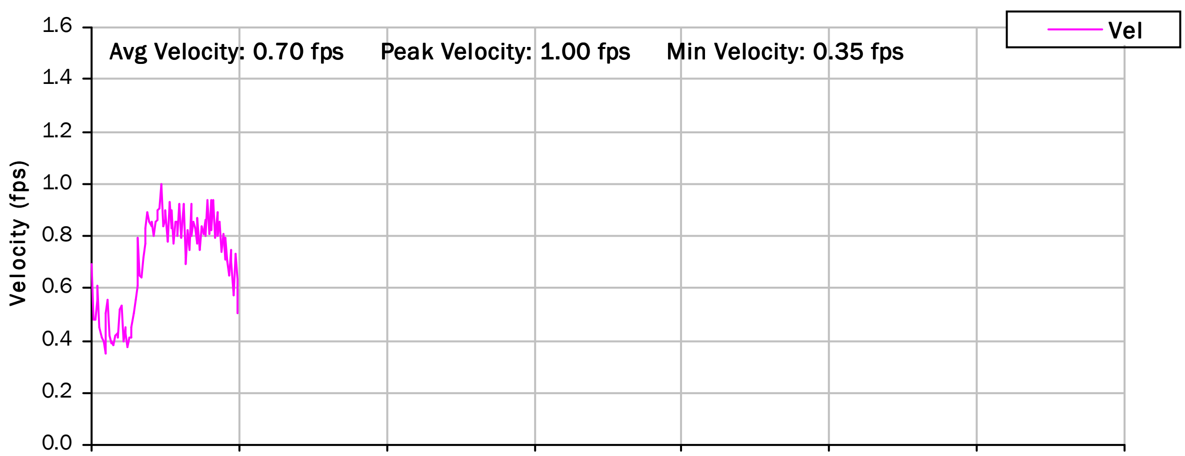


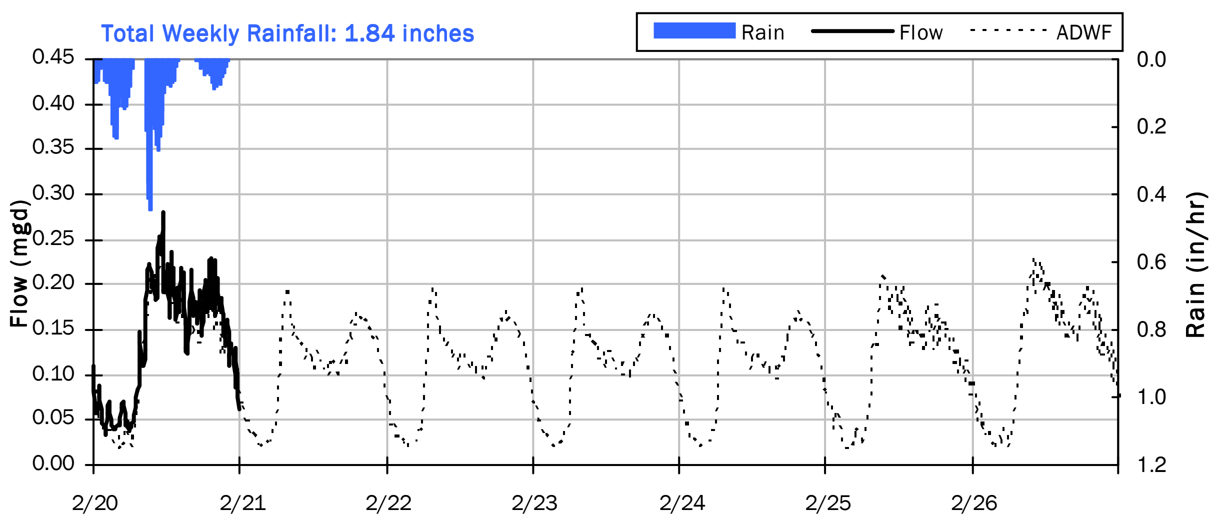
SITE M1
Weekly Level, Velocity and Flow Hydrographs
2/13/2017 to 2/20/2017



Avg Flow: 0.118 mgd **Peak Flow: 0.247 mgd** **Min Flow: 0.018 mgd**

SITE M1
Weekly Level, Velocity and Flow Hydrographs
2/20/2017 to 2/27/2017





Avg Flow: 0.138 mgd **Peak Flow: 0.279 mgd** **Min Flow: 0.034 mgd**

Marina Coast Water District

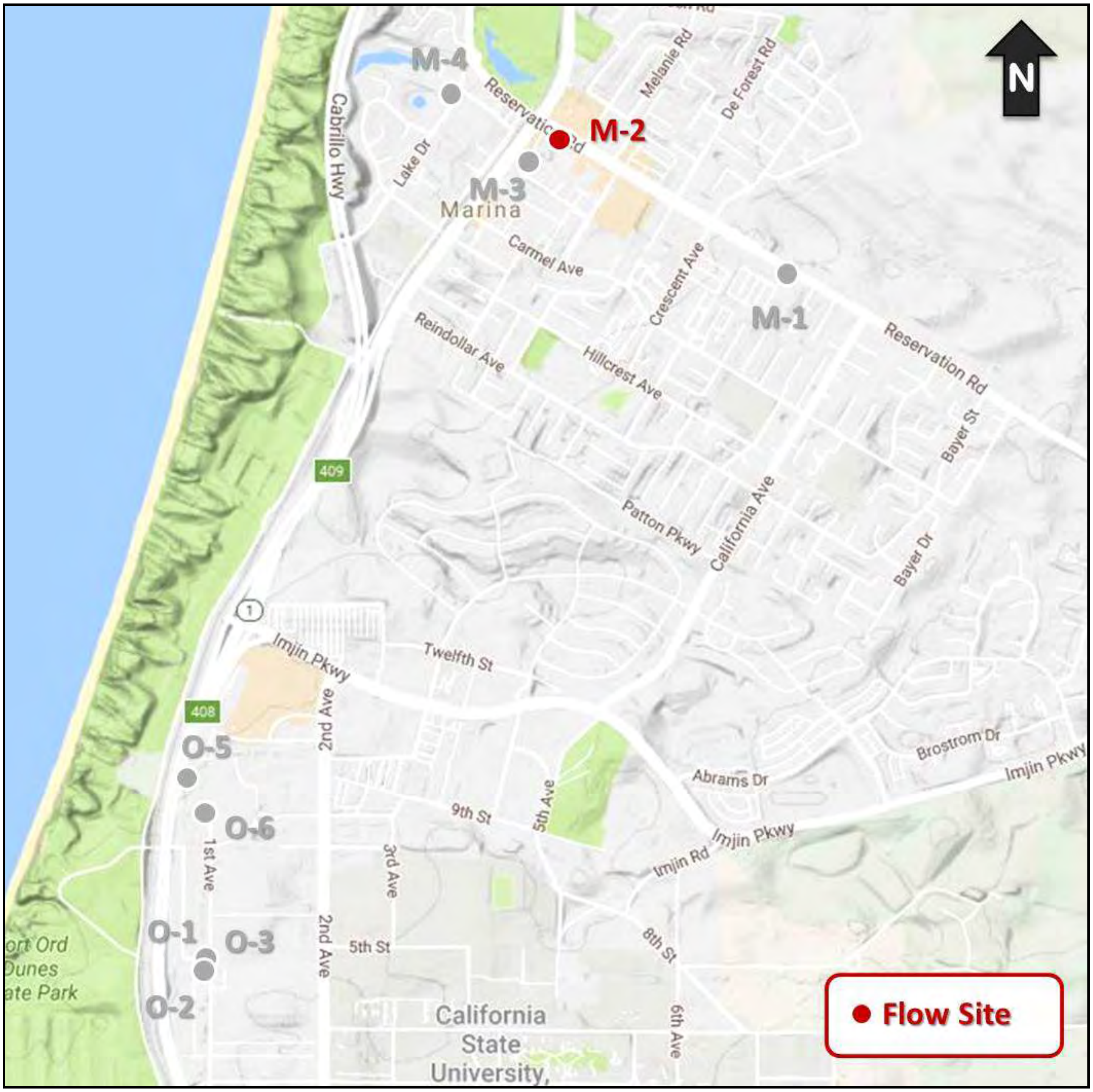
Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - March 2017

Monitoring Site: Site M2

Location: 210 Reservation Road

Data Summary Report



Vicinity Map: Site M2

SITE M2

Site Information

Location: 210 Reservation Road

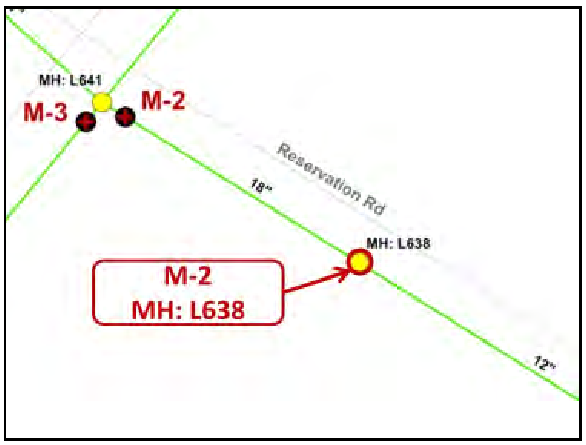
Coordinates: 121.7988° W, 36.6870° N

Pipe Diameter: 12 inches

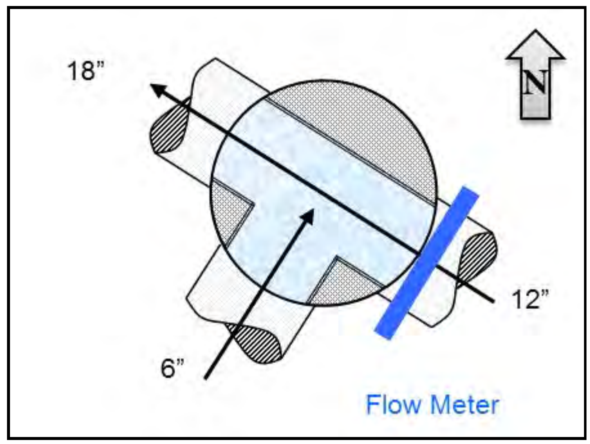
ADWF: 0.372 mgd

Peak Measured Flow: 1.465 mgd

Satellite Map

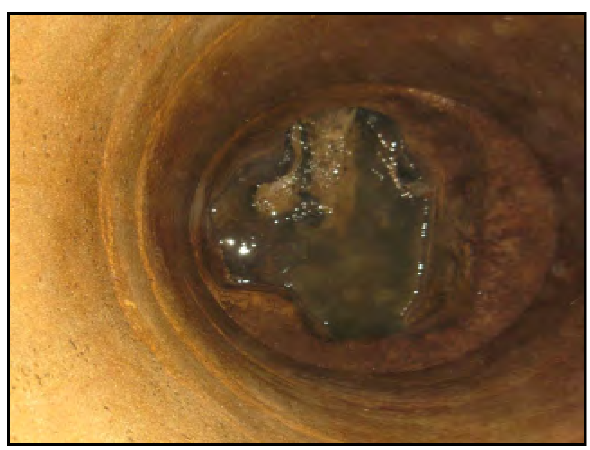


Sewer Map



Flow Sketch

Street View



Plan View

SITE M2

Additional Site Photos

Effluent Pipe

East Influent Pipe

SITE M2

Additional Site Photos

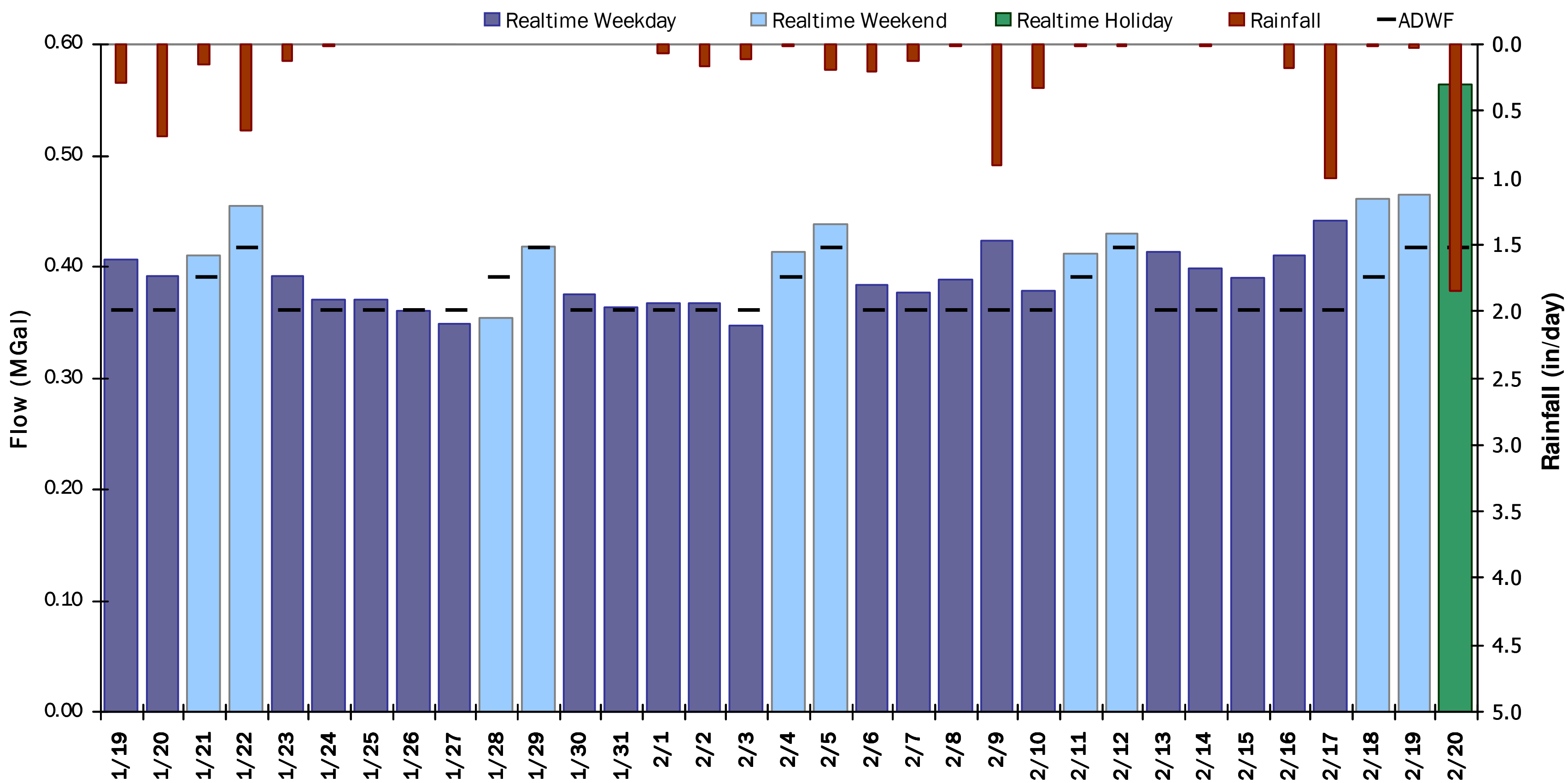
South Influent Pipe

SITE M2

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.403 MGal **Peak Daily Flow: 0.563 MGal** **Min Daily Flow: 0.348 MGal**

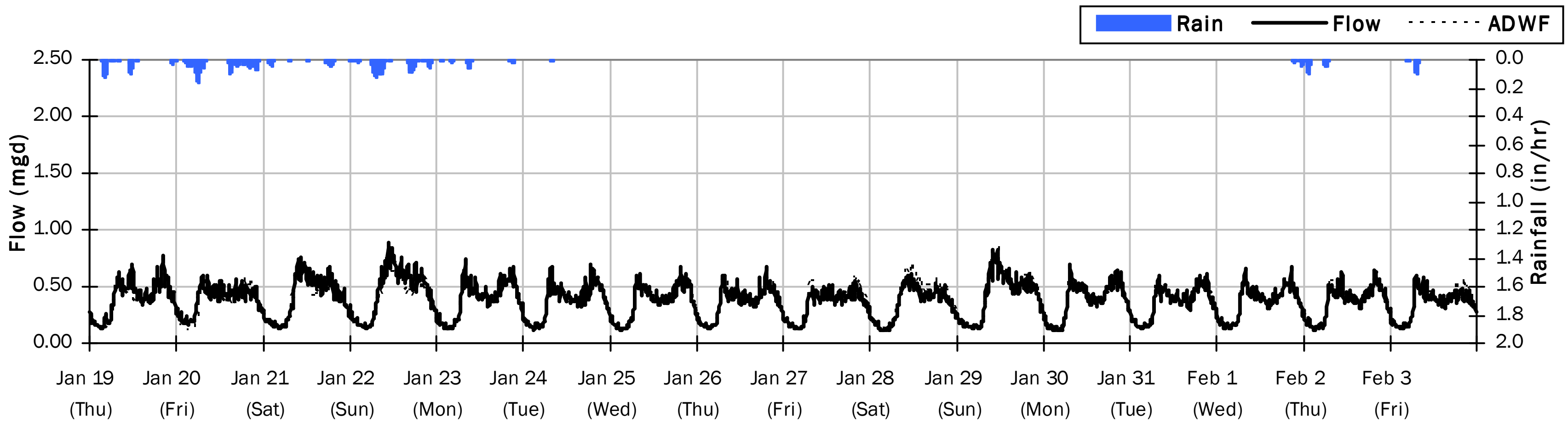
Total Period Rainfall: 7.11 inches

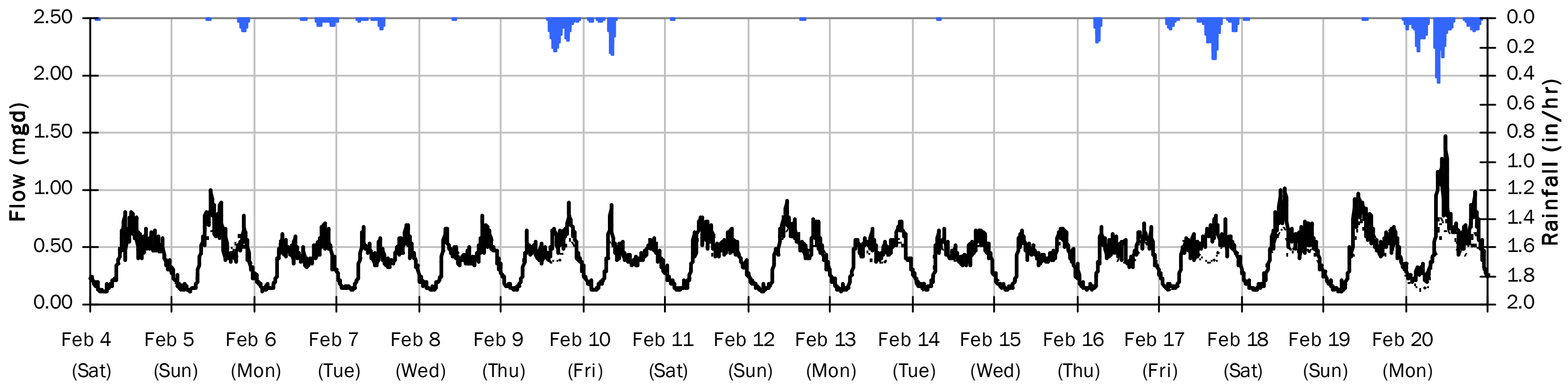


SITE M2

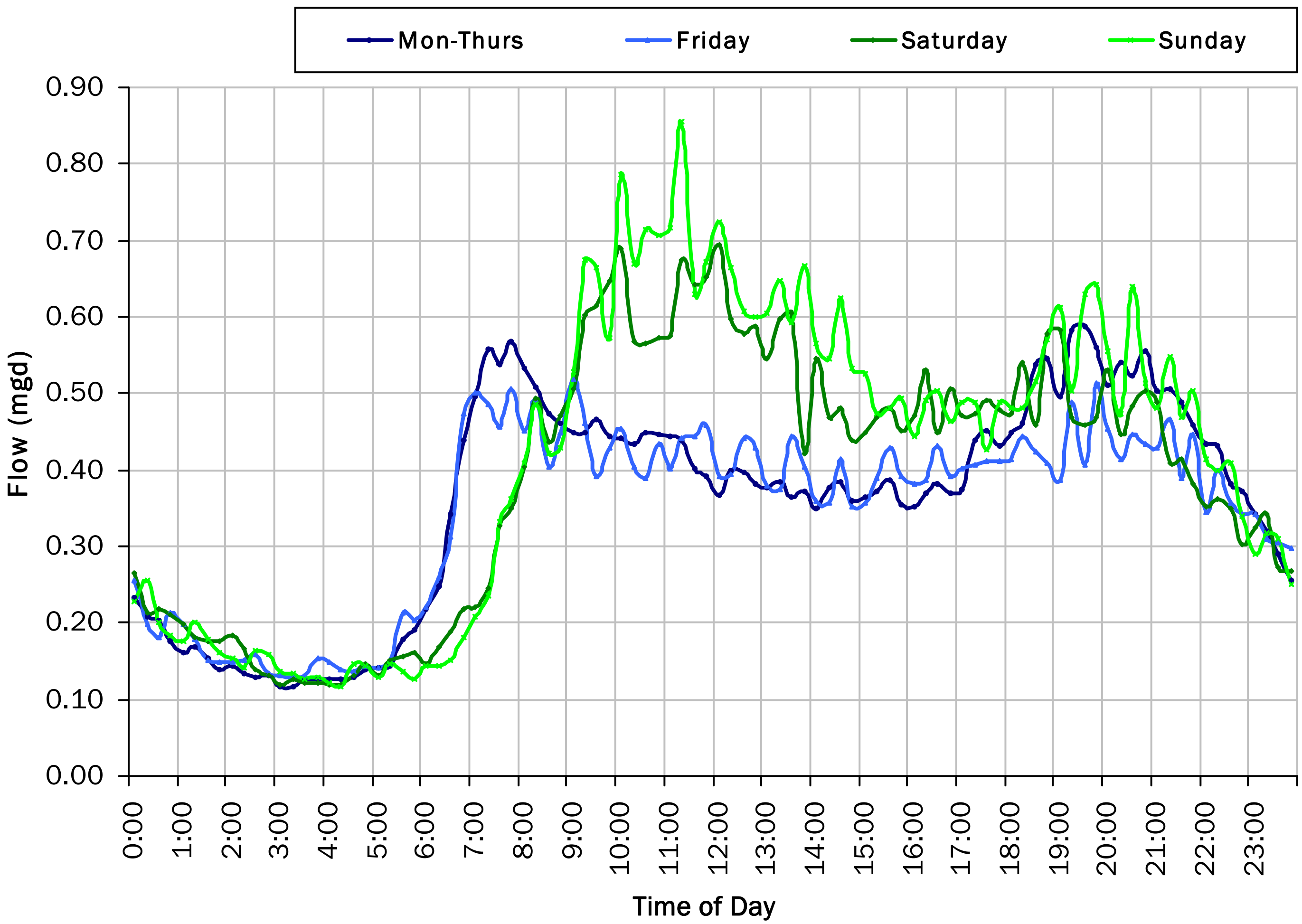
Flow Summary: 1/19/2017 to 2/20/2017

Total Period Rainfall: 7.11 inches   **Avg Flow: 0.403 mgd**   **Peak Flow: 1.465 mgd**   **Min Flow: 0.109 mgd**

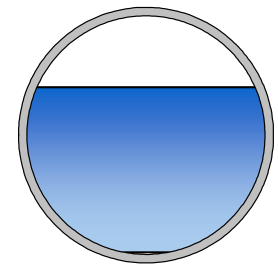




SITE M2
Average Dry Weather Flow Hydrographs

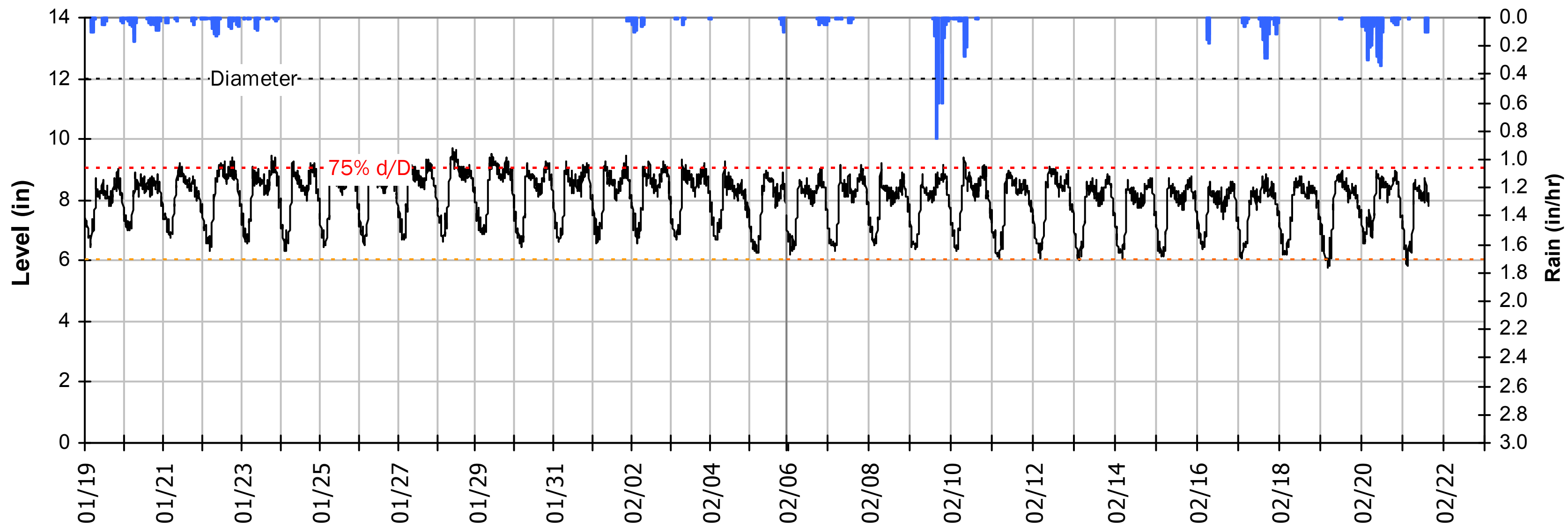


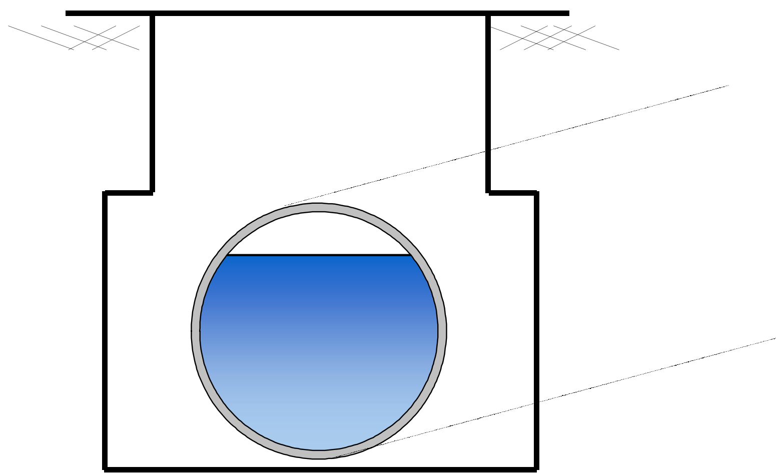
ADWF:
0.372 *mgd*



SITE M2
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

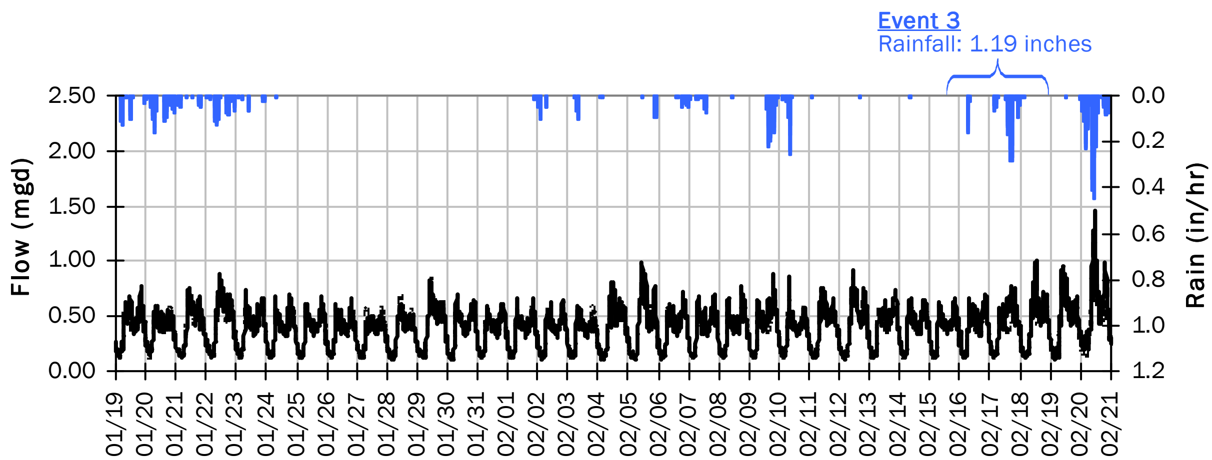




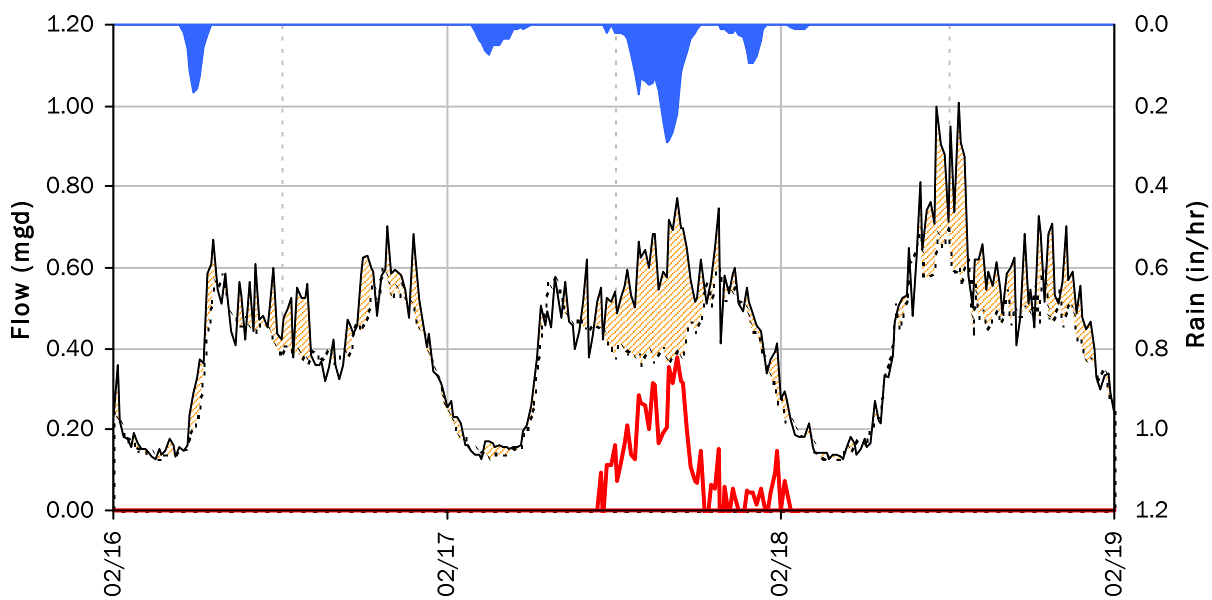
Pipe Diameter:	12	*inches*
Peak Measured Level:	9.69	*inches*
Peak d/D Ratio:	0.81	

SITE M2
I/I Summary: Event 3

<u>Baseline and Realtime Flows with Rainfall Data over Monitoring Period</u>



<u>Event 3 Detail Graph</u>

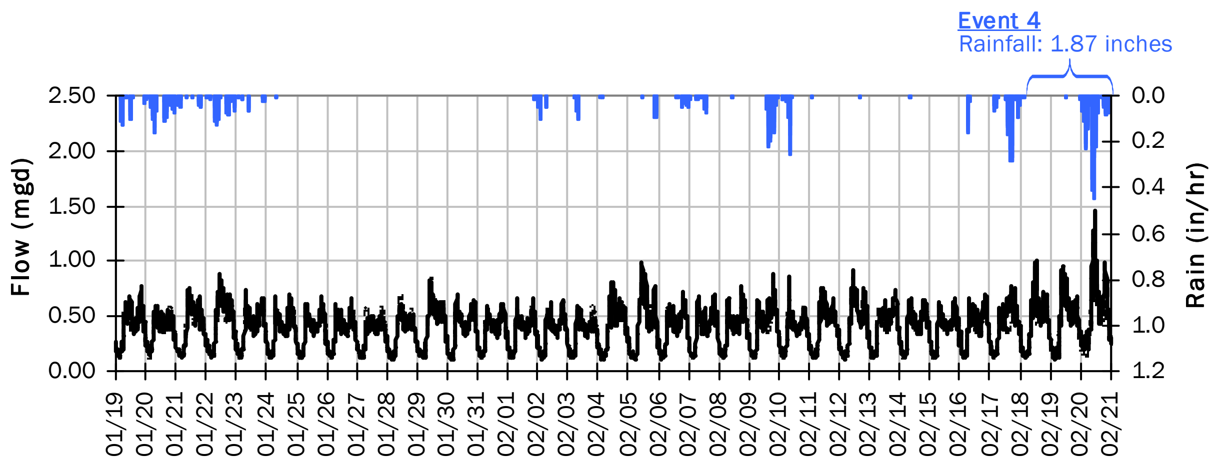


Storm Event I/I Analysis (Rain = 1.20 inches)

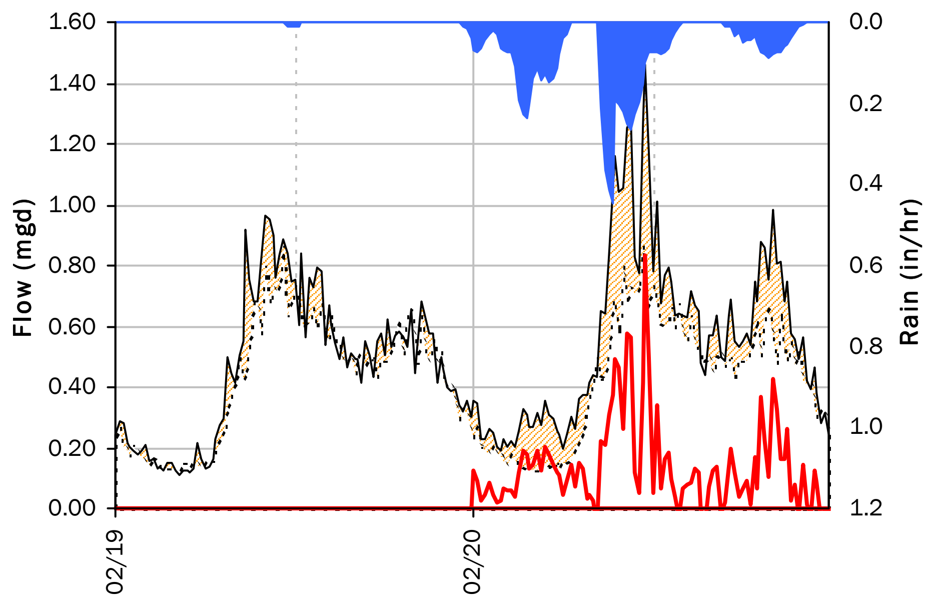
<u>**Capacity**</u>		<u>**Inflow / Infiltration**</u>	
Peak Flow:	0.77 *mgd*	**Peak I/I Rate:**	0.38 *mgd*
PF:	2.07	**Total I/I:**	68,000 *gallons*
Peak Level:	8.82 *in*		
d/D Ratio:	0.74		

SITE M2
I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



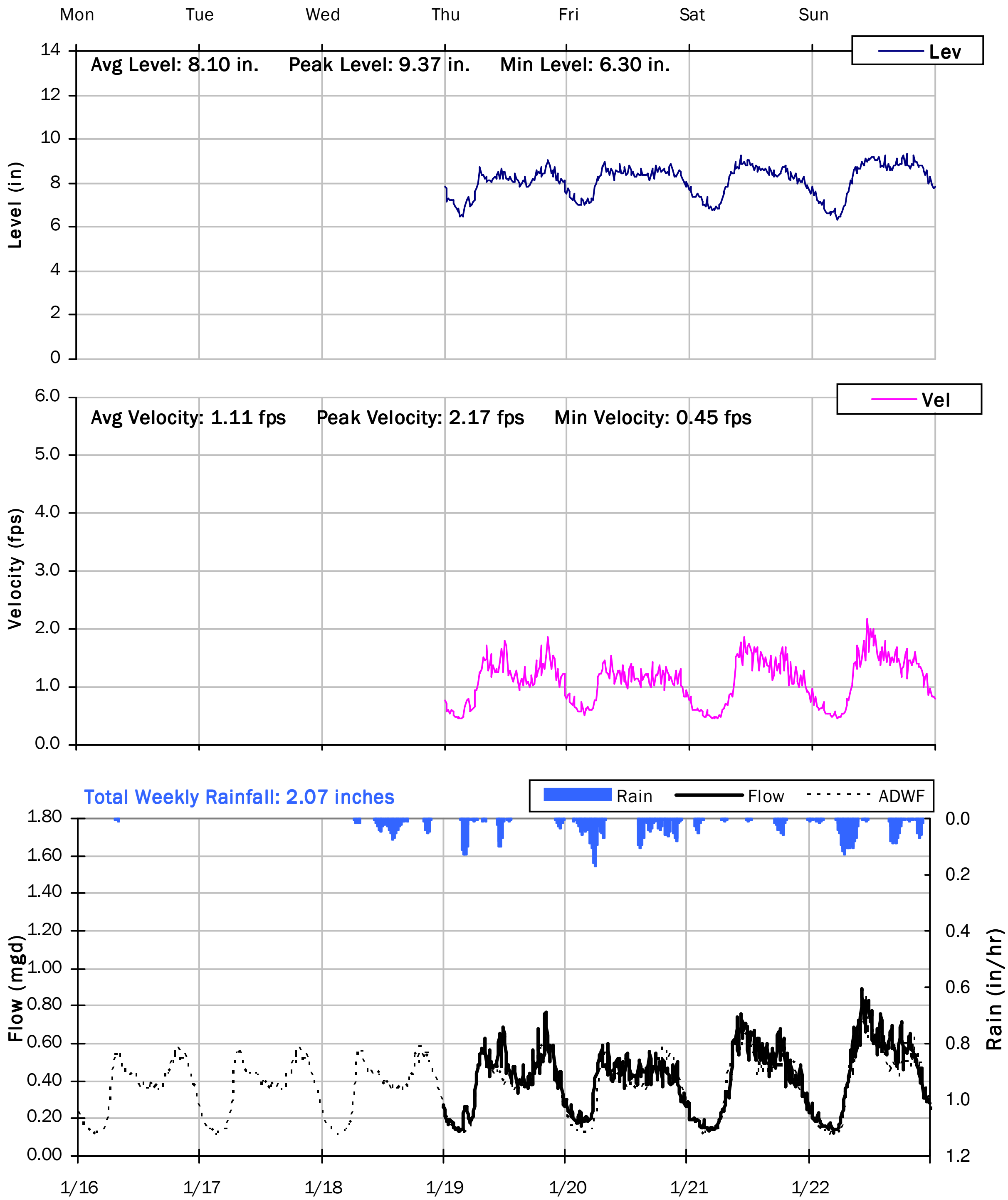
Event 4 Detail Graph



Storm Event I/I Analysis (Rain = 1.87 inches)

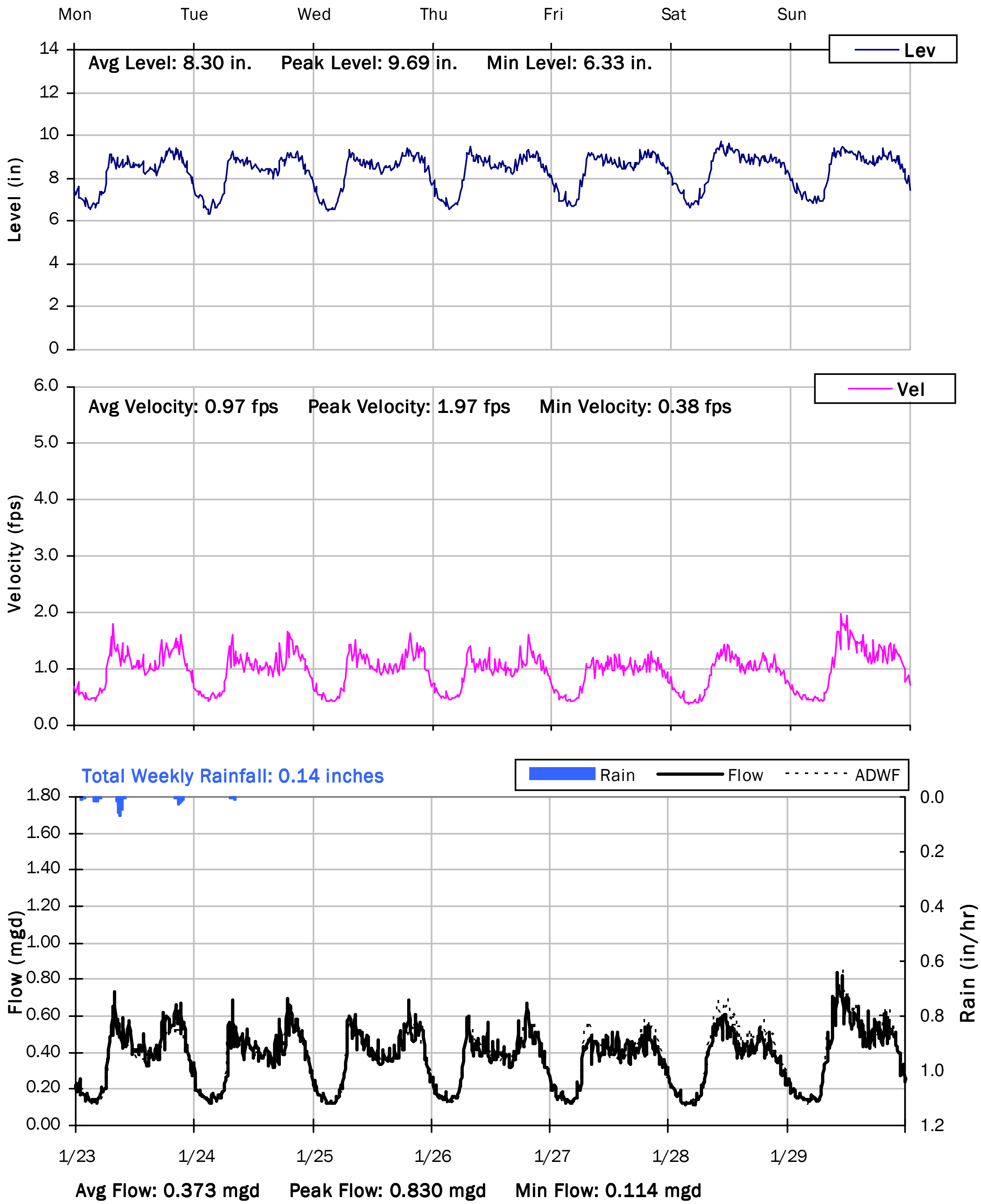
Capacity		Inflow / Infiltration	
Peak Flow:	1.46 *mgd*	**Peak I/I Rate:**	0.83 *mgd*
PF:	3.92	**Total I/I:**	142,000 *gallons*
Peak Level:	8.98 *in*		
d/D Ratio:	0.75		

SITE M2
Weekly Level, Velocity and Flow Hydrographs
1/16/2017 to 1/23/2017



Avg Flow: 0.416 mgd Peak Flow: 0.885 mgd Min Flow: 0.122 mgd

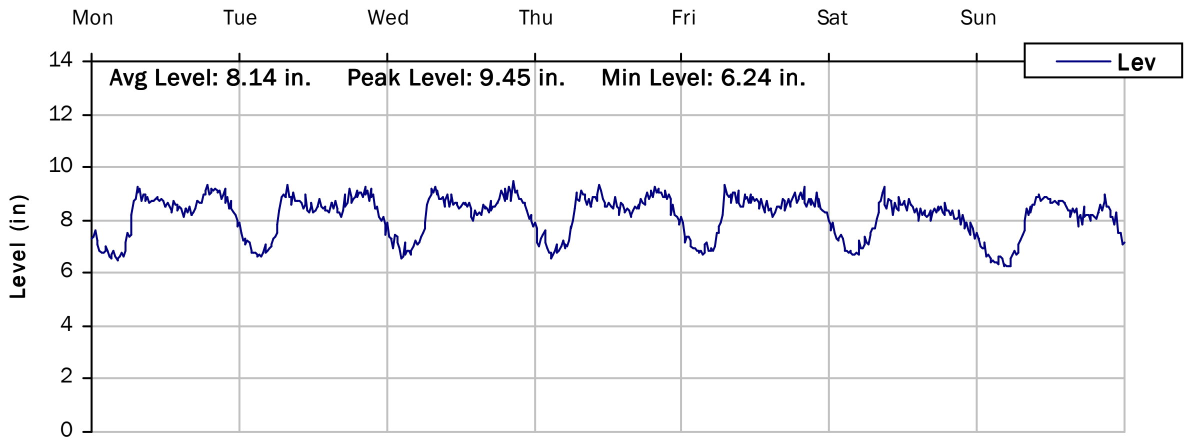
SITE M2
Weekly Level, Velocity and Flow Hydrographs
1/23/2017 to 1/30/2017

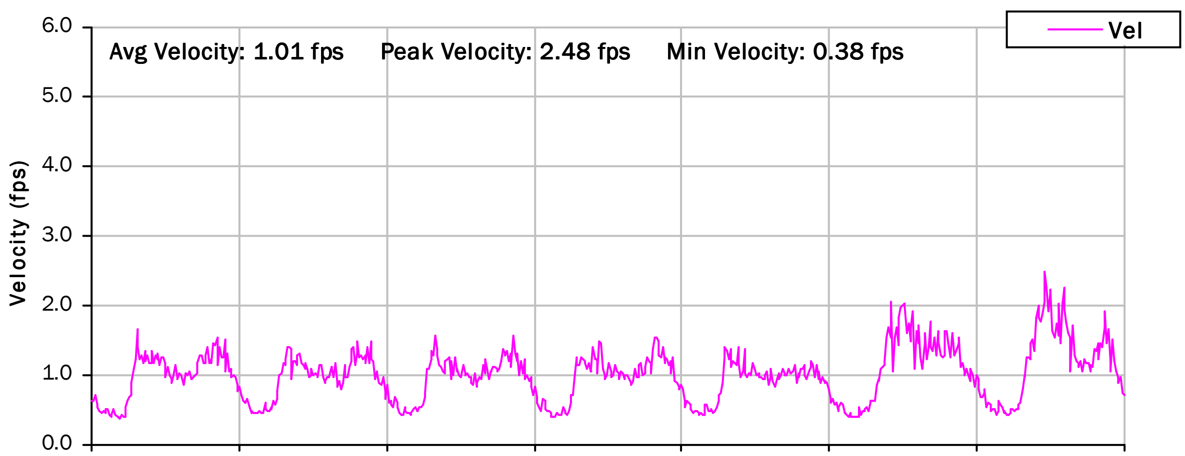


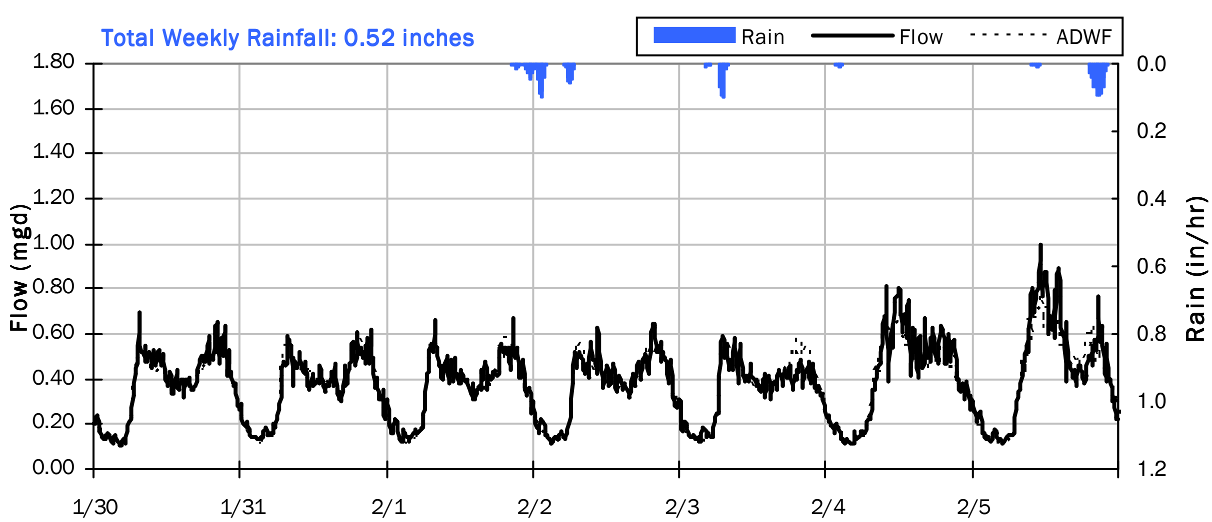
SITE M2

Weekly Level, Velocity and Flow Hydrographs

1/30/2017 to 2/6/2017

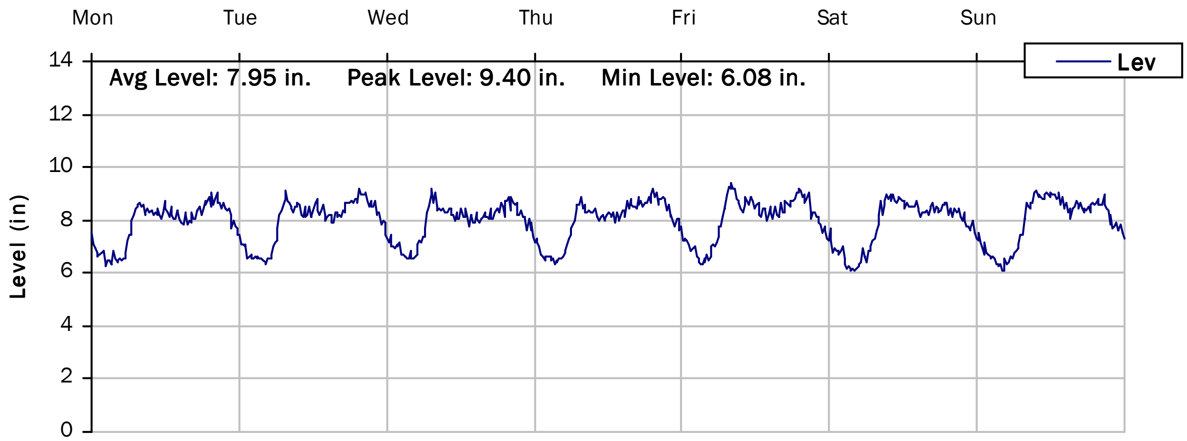


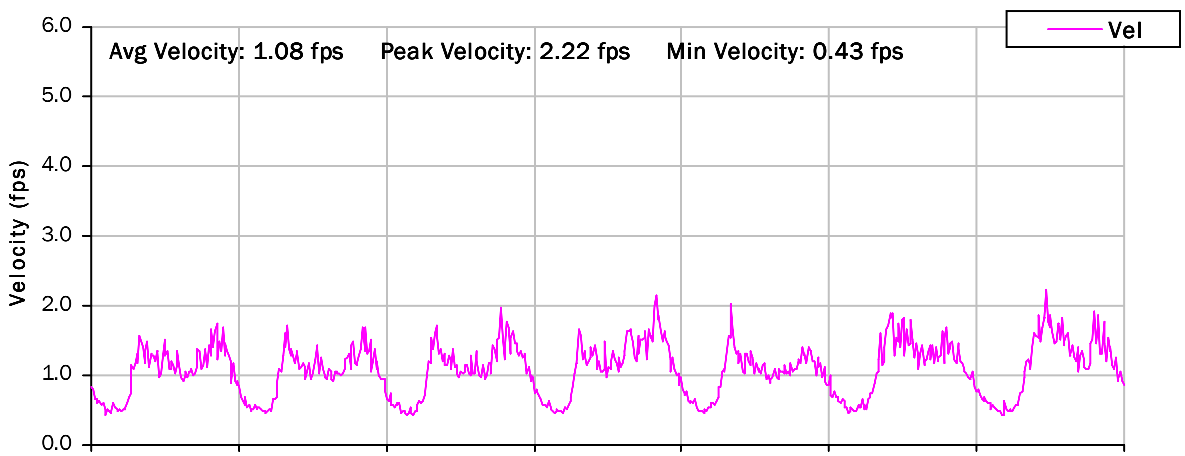


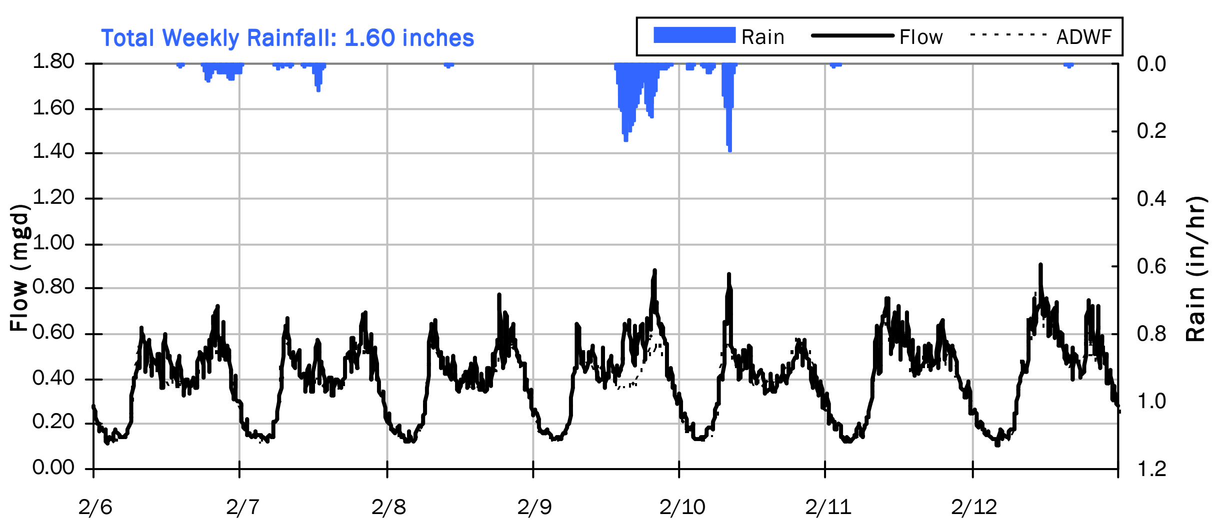


Avg Flow: 0.382 mgd **Peak Flow: 0.998 mgd** **Min Flow: 0.110 mgd**

SITE M2
Weekly Level, Velocity and Flow Hydrographs
2/6/2017 to 2/13/2017





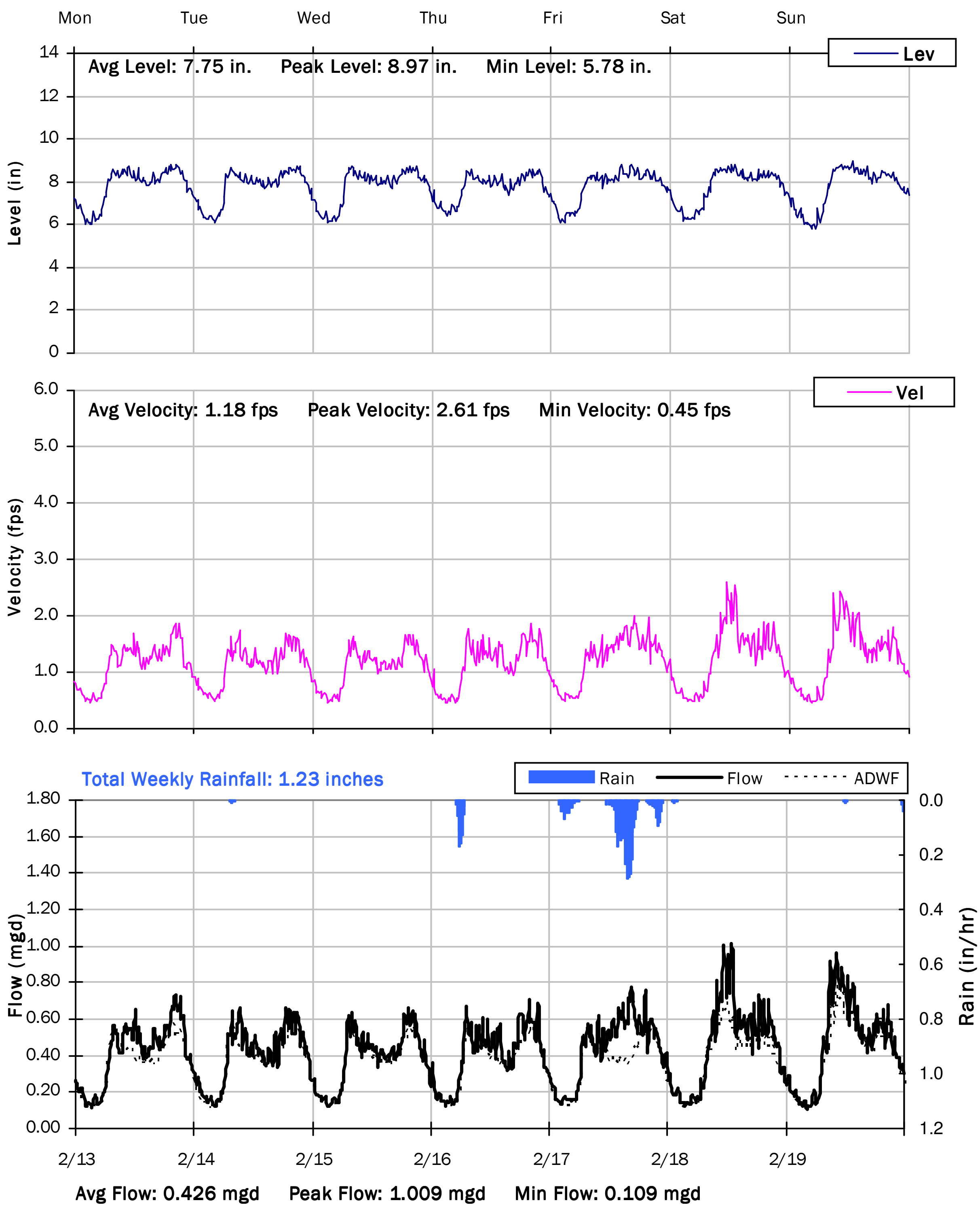


Avg Flow: 0.399 mgd **Peak Flow: 0.910 mgd** **Min Flow: 0.110 mgd**

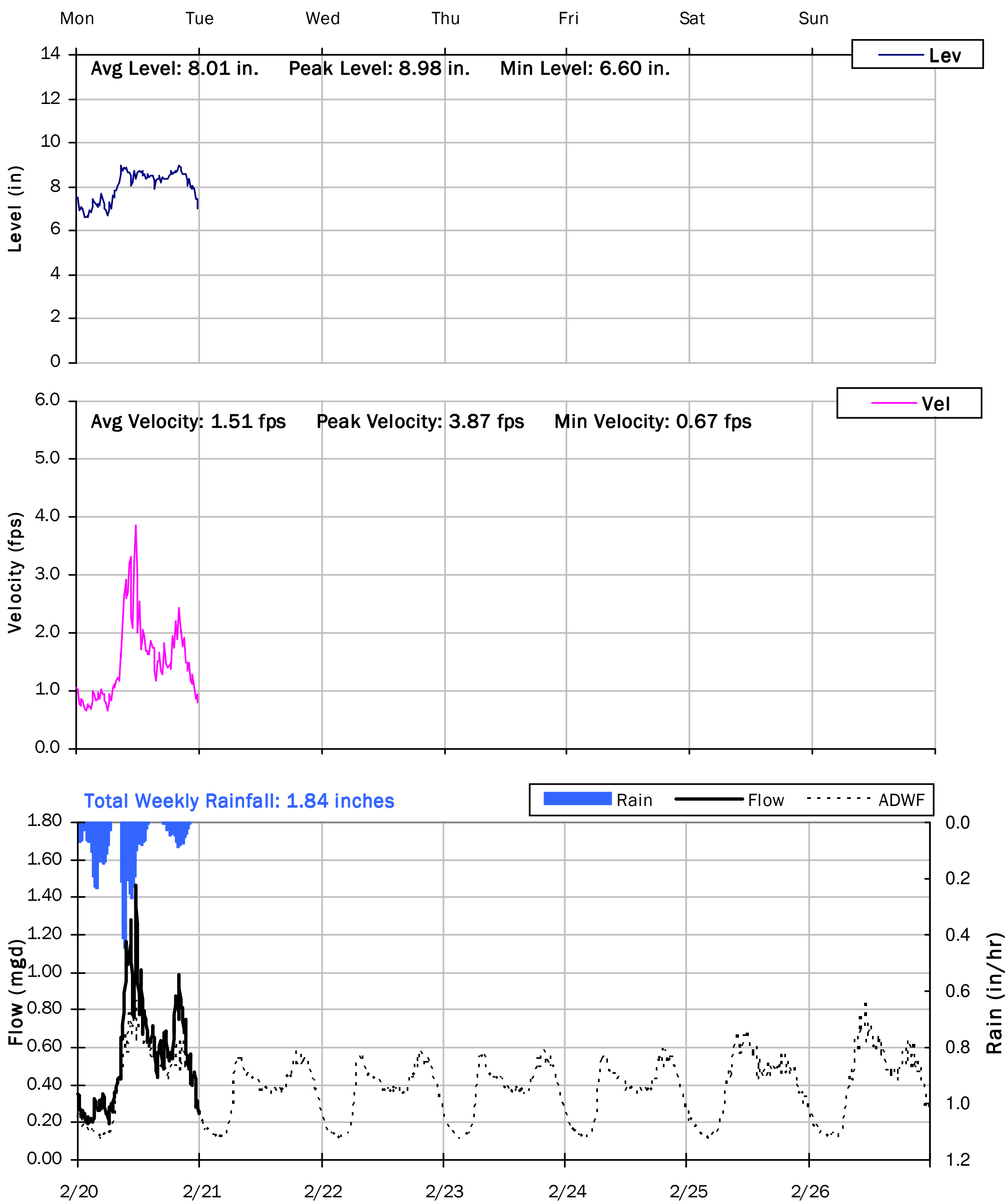
SITE M2

Weekly Level, Velocity and Flow Hydrographs

2/13/2017 to 2/20/2017



SITE M2
Weekly Level, Velocity and Flow Hydrographs
2/20/2017 to 2/27/2017



Avg Flow: 0.563 mgd **Peak Flow: 1.465 mgd** **Min Flow: 0.191 mgd**

Marina Coast Water District

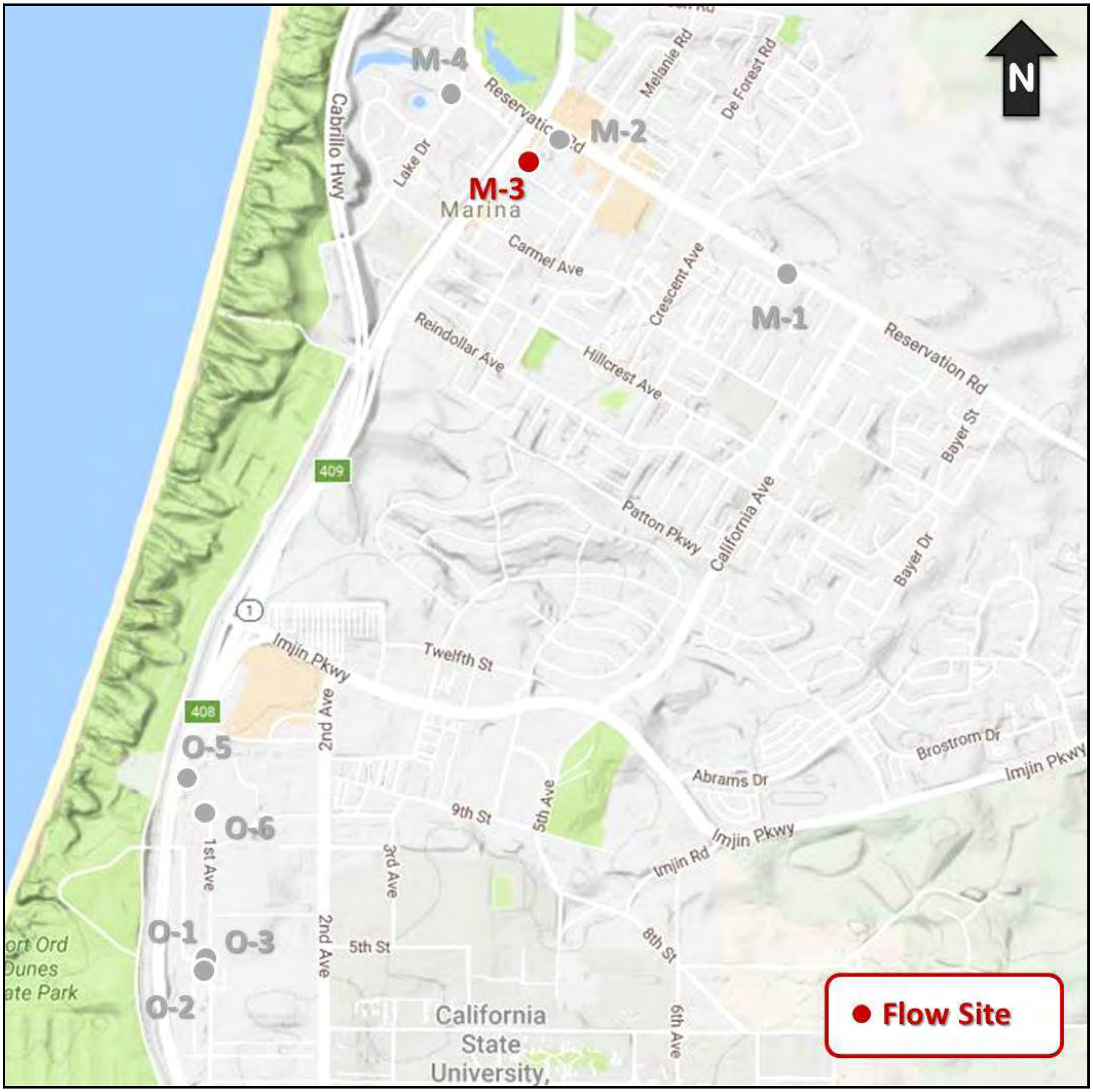
Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - March 2017

Monitoring Site: Site M3

Location: 3148 Del Monte Boulevard

Data Summary Report



Vicinity Map: Site M3

SITE M3

Site Information

Location: 3148 Del Monte Boulevard

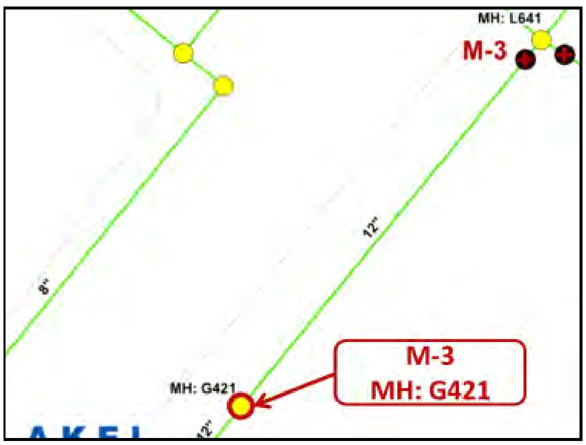
Coordinates: 121.8006° W, 36.6864° N

Pipe Diameter: 12 inches

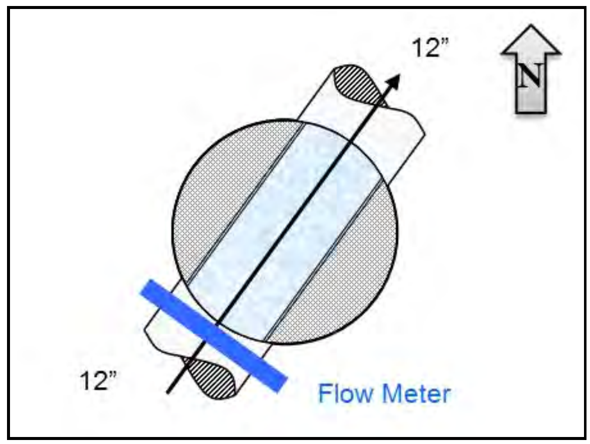
ADWF: 0.261 mgd

Peak Measured Flow: 0.634 mgd

Satellite Map



Sewer Map



Flow Sketch


Street View


Plan View

SITE M3

Additional Site Photos

Effluent Pipe

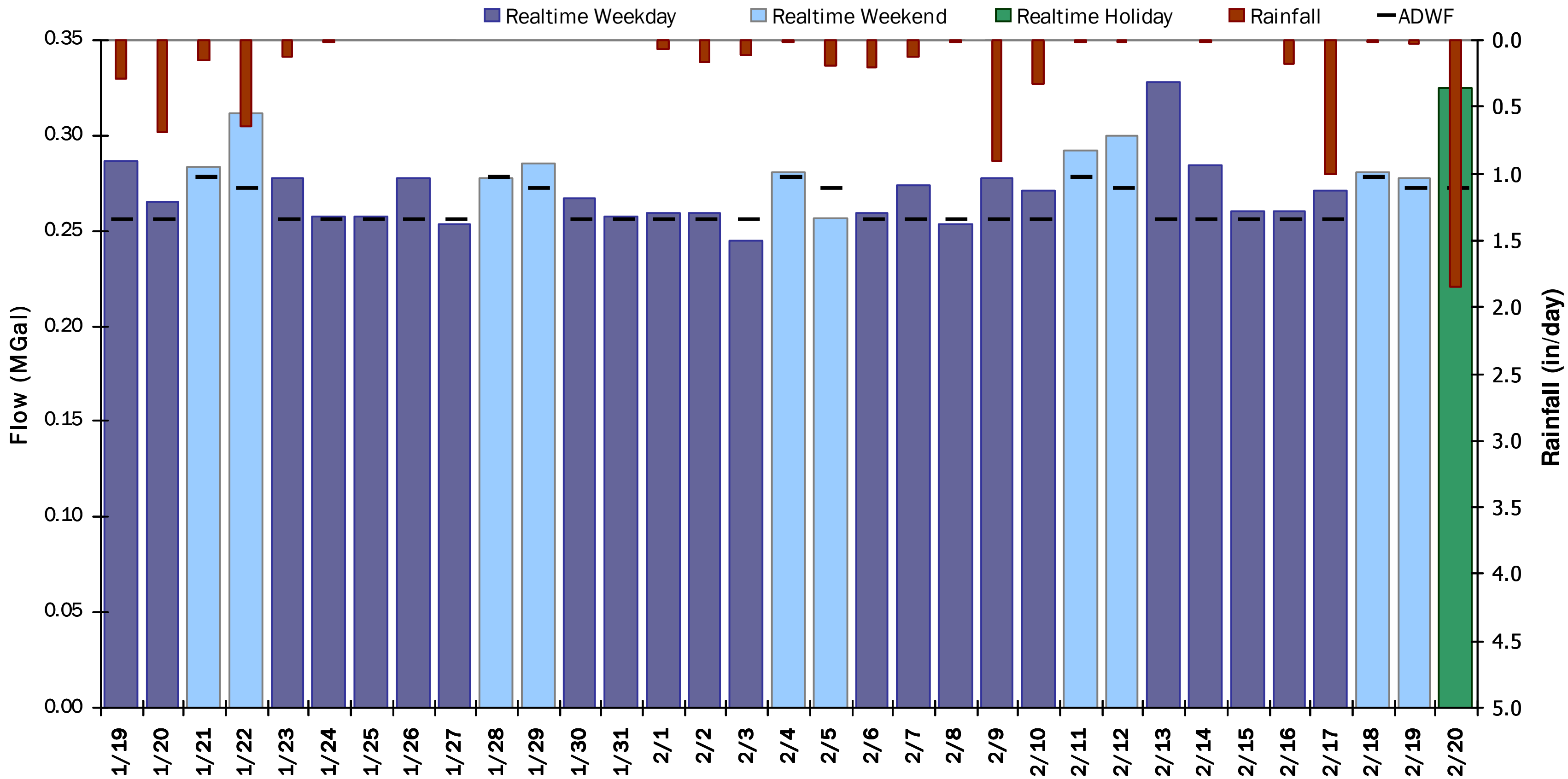
Influent Pipe

SITE M3

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.275 MGal **Peak Daily Flow: 0.328 MGal** **Min Daily Flow: 0.245 MGal**

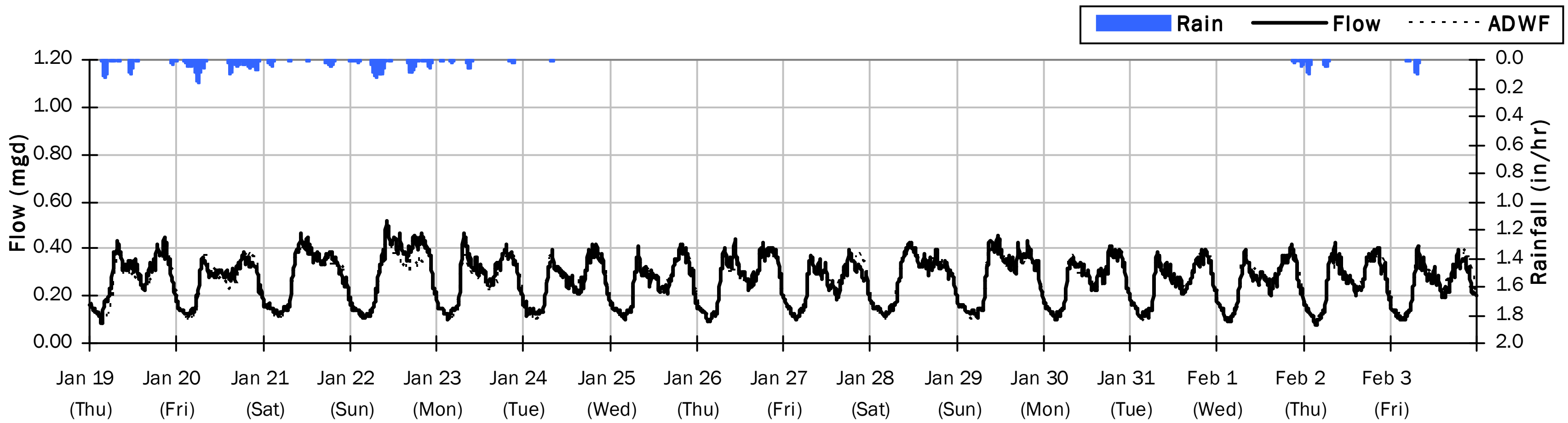
Total Period Rainfall: 7.11 inches

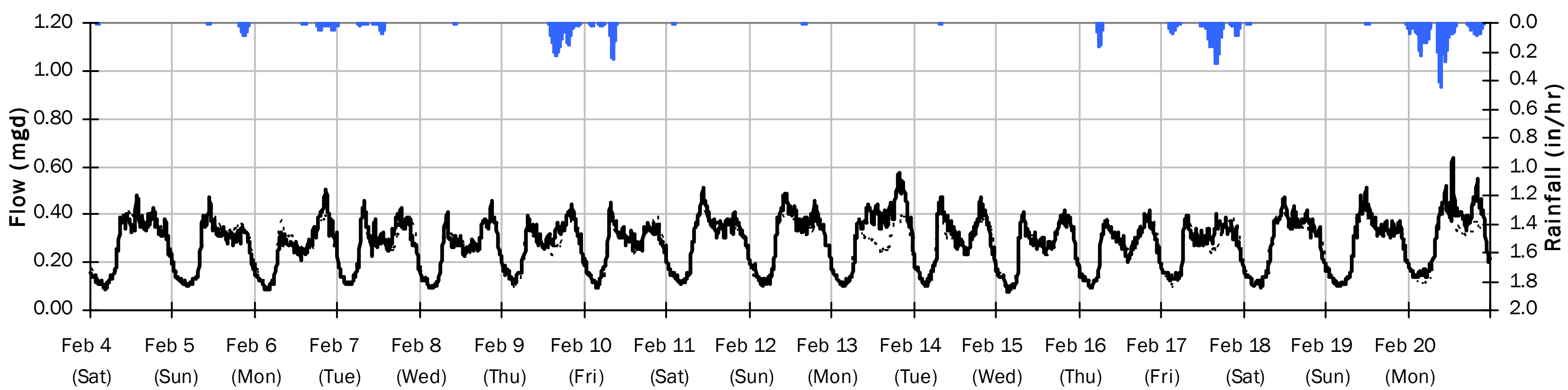


SITE M3

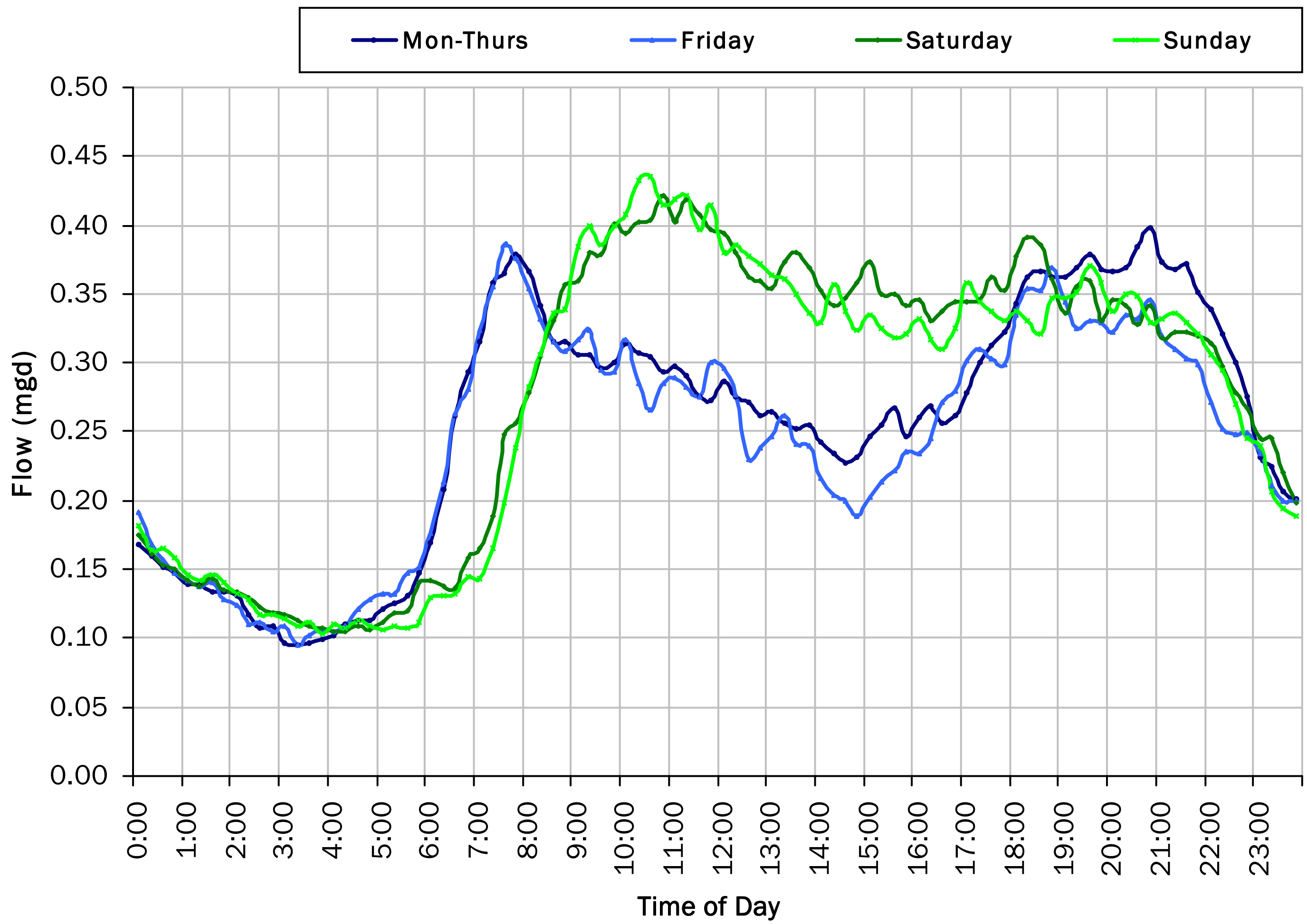
Flow Summary: 1/19/2017 to 2/20/2017

Total Period Rainfall: 7.11 inches   **Avg Flow: 0.275 mgd**   **Peak Flow: 0.634 mgd**   **Min Flow: 0.079 mgd**



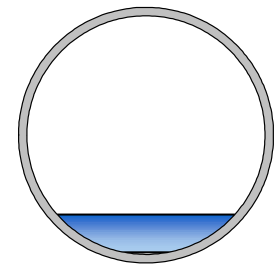


SITE M3
Average Dry Weather Flow Hydrographs



ADWF:

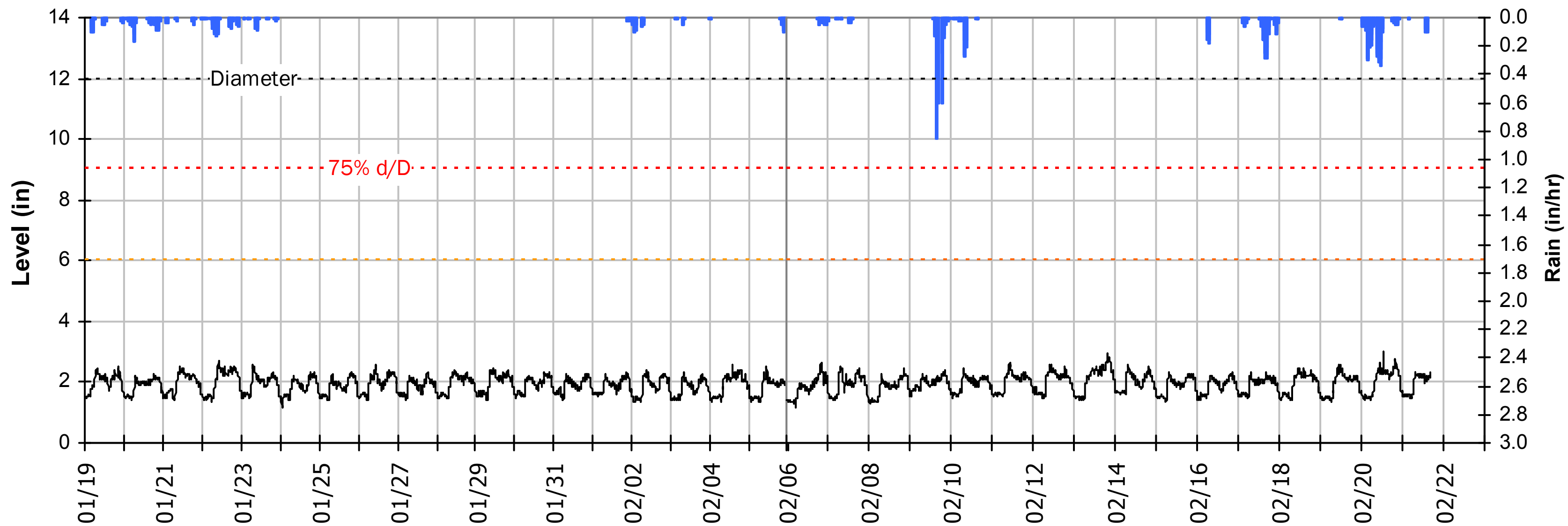
0.261 *mgd*

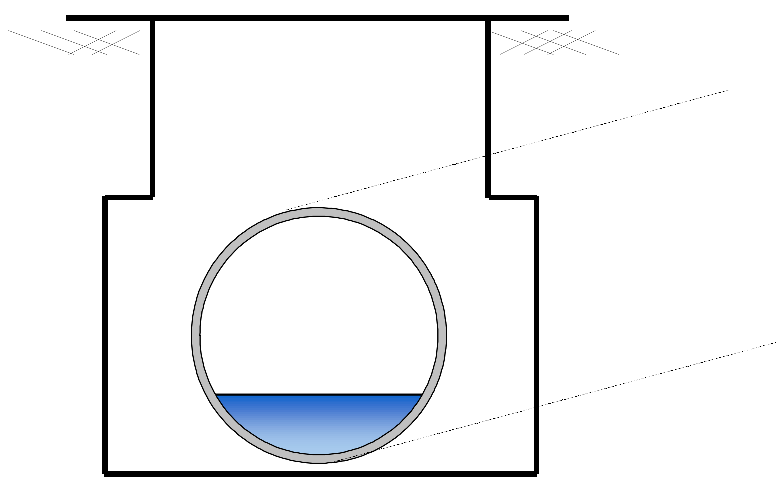


SITE M3

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

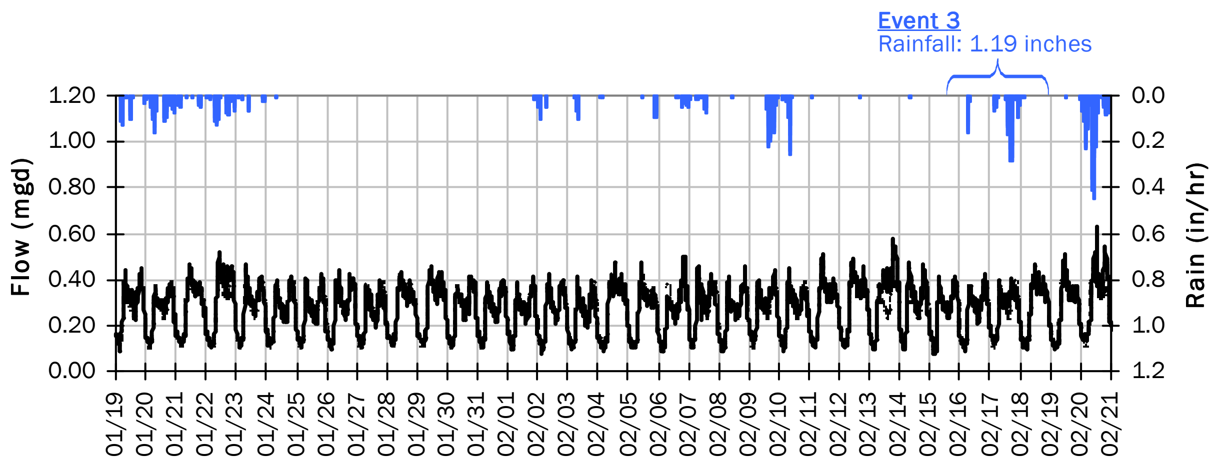




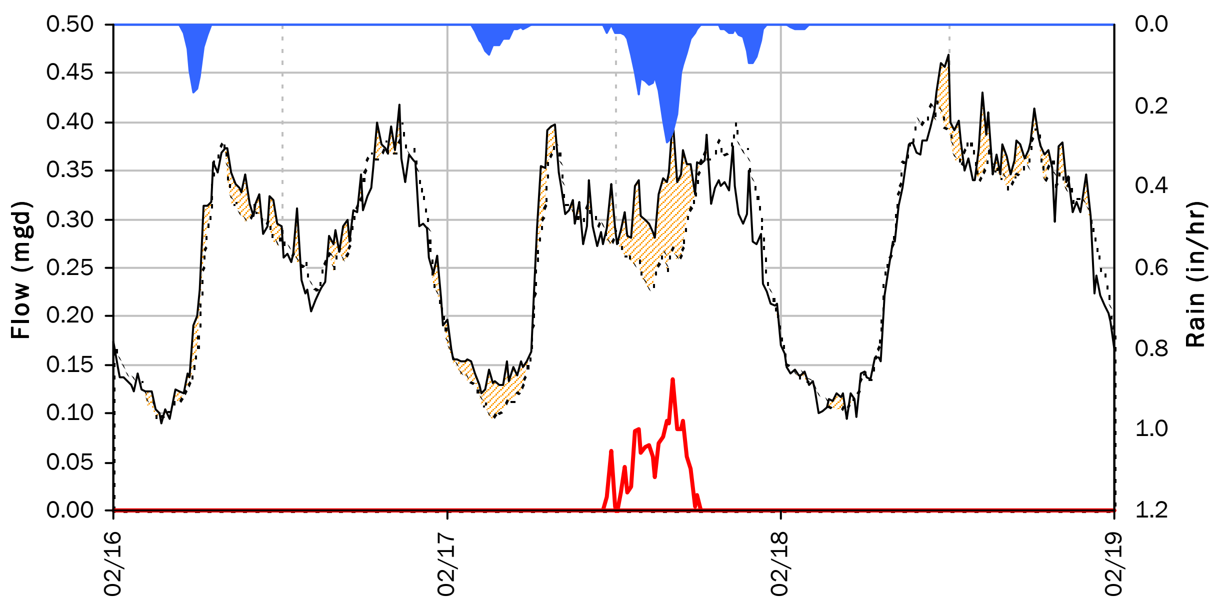
Pipe Diameter:	12	*inches*
Peak Measured Level:	3.01	*inches*
Peak d/D Ratio:	0.25	

SITE M3
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph

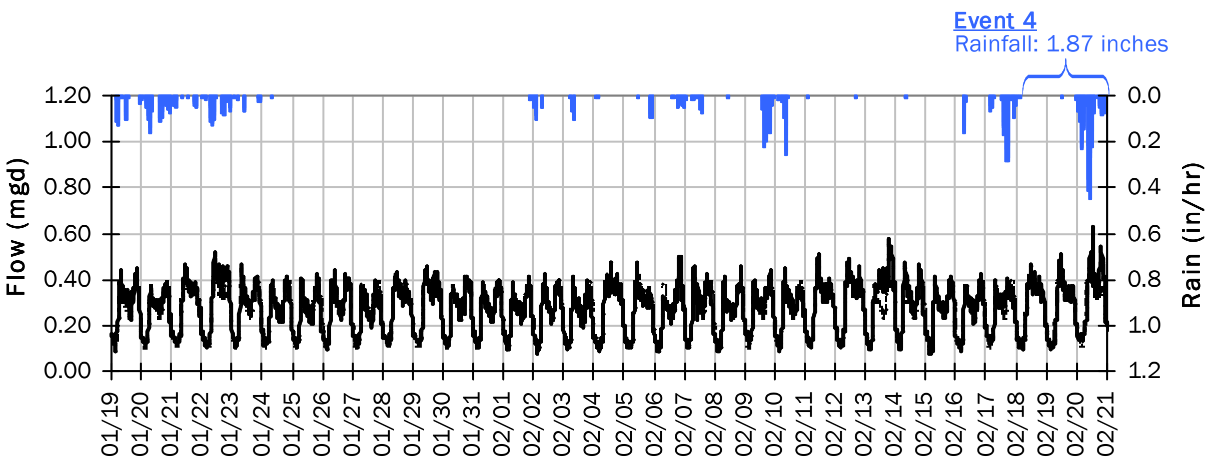


Storm Event I/I Analysis (Rain = 1.20 inches)

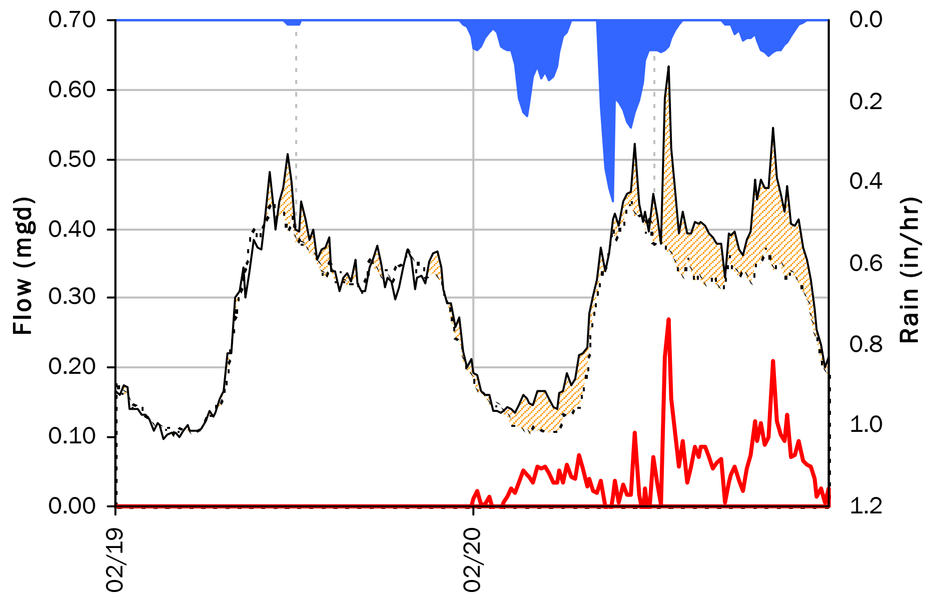
Capacity		Inflow / Infiltration	
Peak Flow:	0.40 *mgd*	**Peak I/I Rate:**	0.14 *mgd*
PF:	1.54	**Total I/I:**	15,000 *gallons*
Peak Level:	2.32 *in*		
d/D Ratio:	0.19		

SITE M3
I/I Summary: Event 4

<u>Baseline and Realtime Flows with Rainfall Data over Monitoring Period</u>



<u>Event 4 Detail Graph</u>



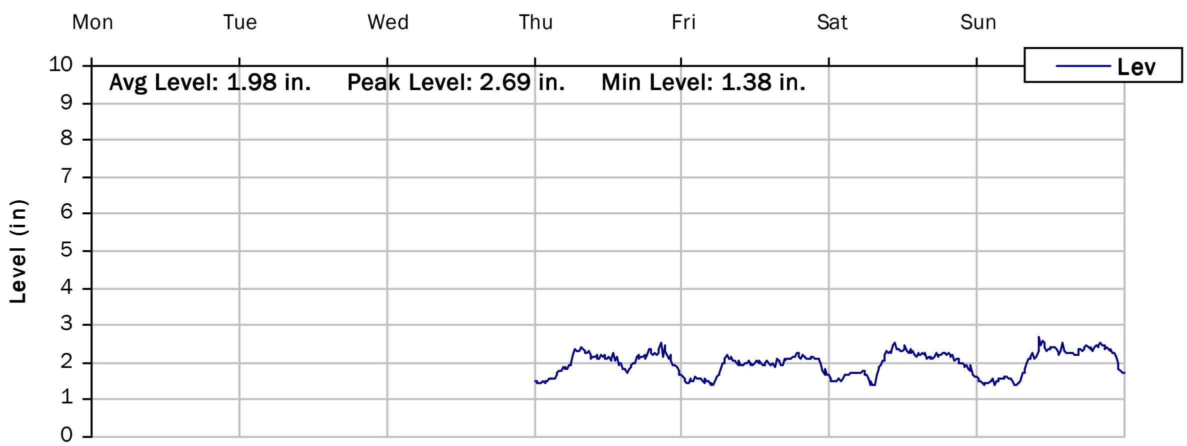
Storm Event I/I Analysis (Rain = 1.87 inches)

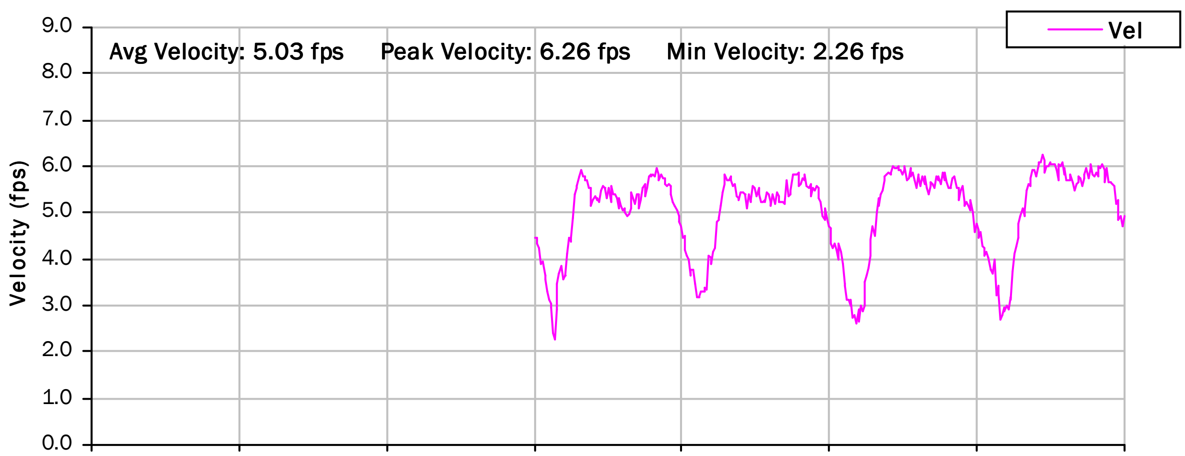
Capacity		**Inflow / Infiltration**	
Peak Flow:	0.63 *mgd*	**Peak I/I Rate:**	0.27 *mgd*
PF:	2.42	**Total I/I:**	53,000 *gallons*
Peak Level:	3.01 *in*		
d/D Ratio:	0.25		

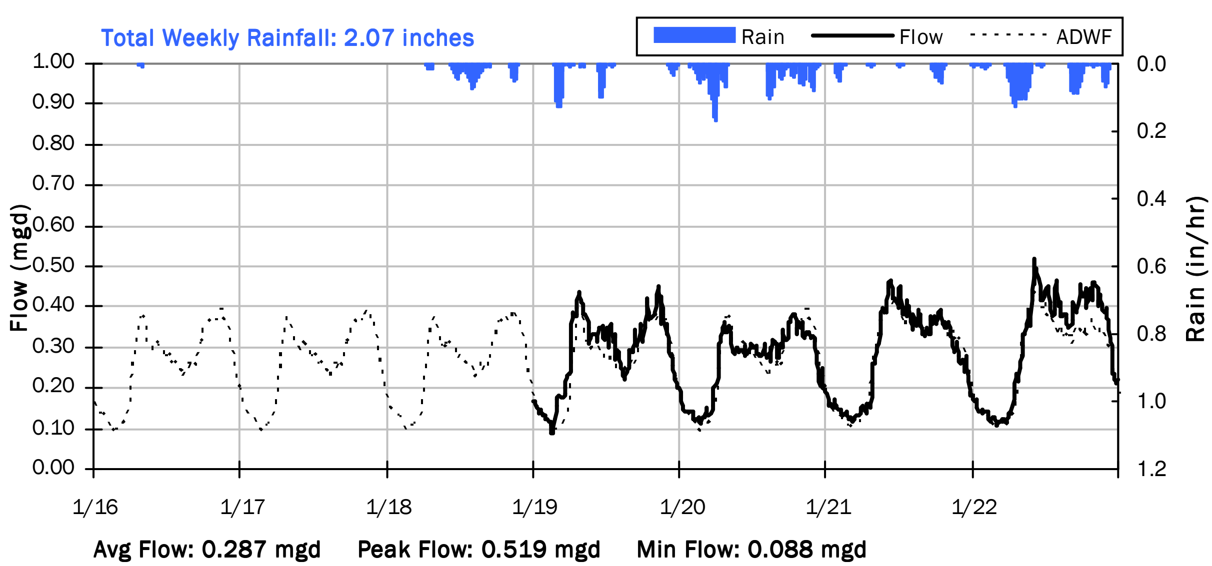
SITE M3

Weekly Level, Velocity and Flow Hydrographs

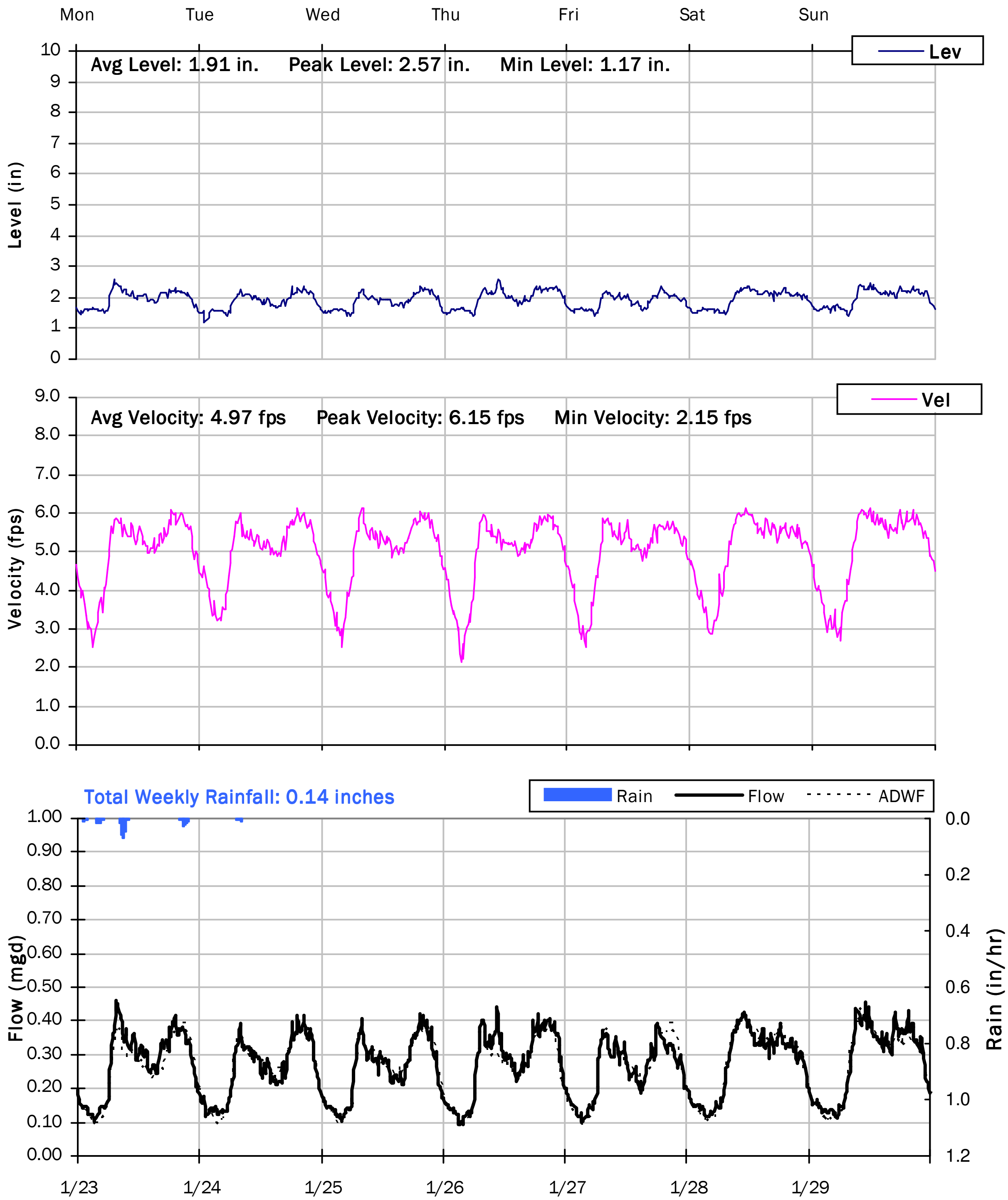
1/16/2017 to 1/23/2017







SITE M3
Weekly Level, Velocity and Flow Hydrographs
1/23/2017 to 1/30/2017

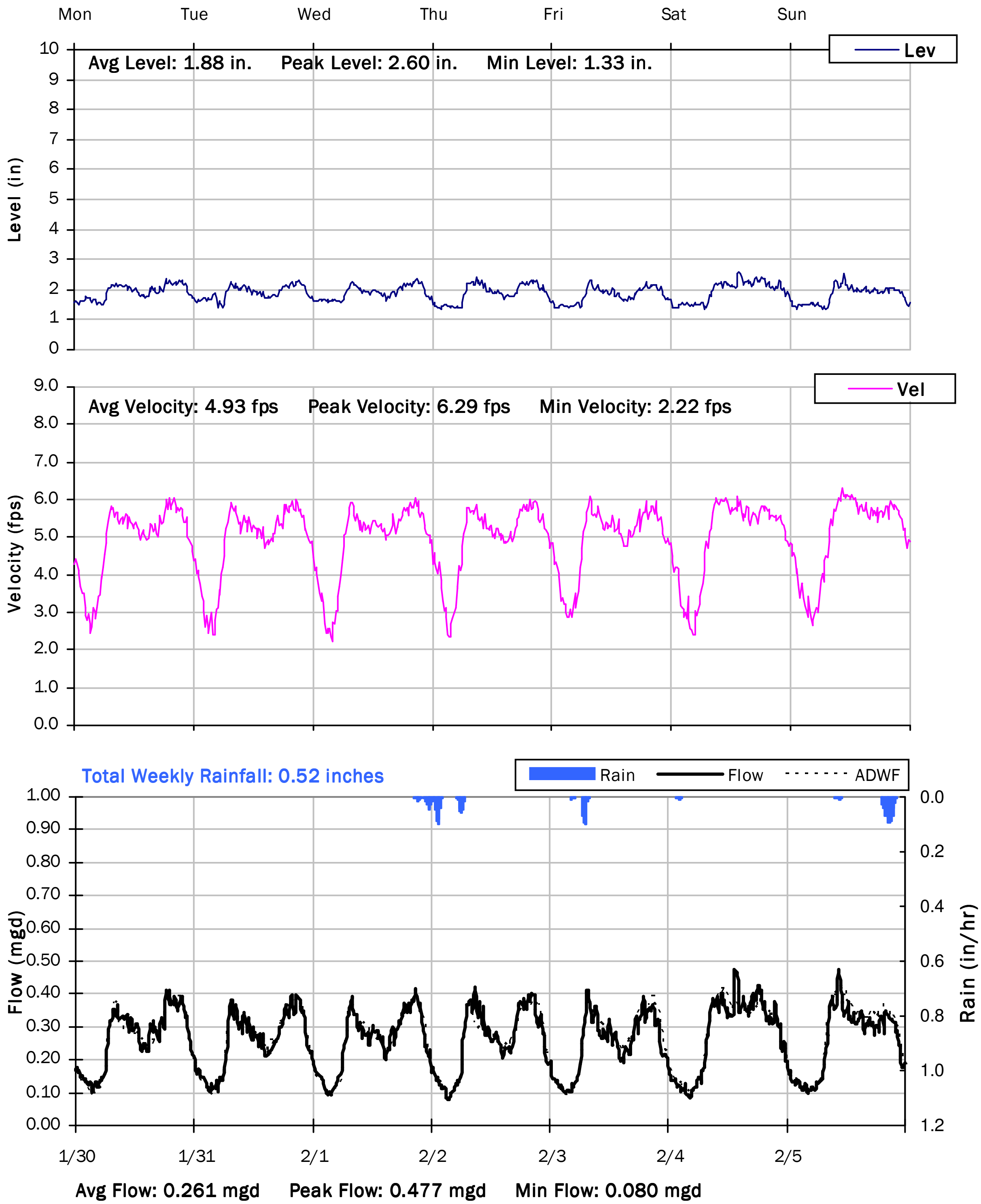


Avg Flow: 0.269 mgd **Peak Flow: 0.463 mgd** **Min Flow: 0.091 mgd**

SITE M3

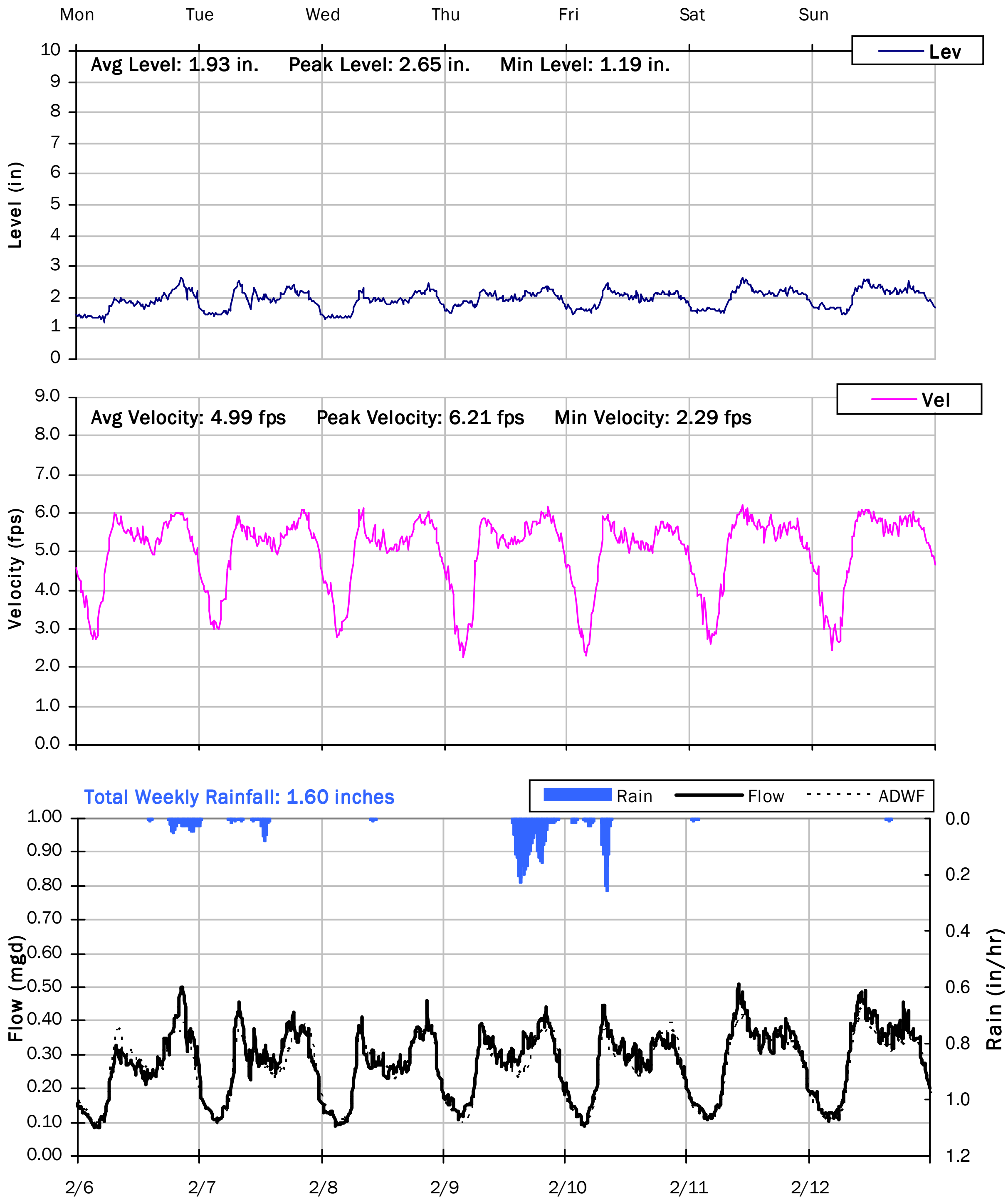
Weekly Level, Velocity and Flow Hydrographs

1/30/2017 to 2/6/2017



SITE M3

Weekly Level, Velocity and Flow Hydrographs
2/6/2017 to 2/13/2017

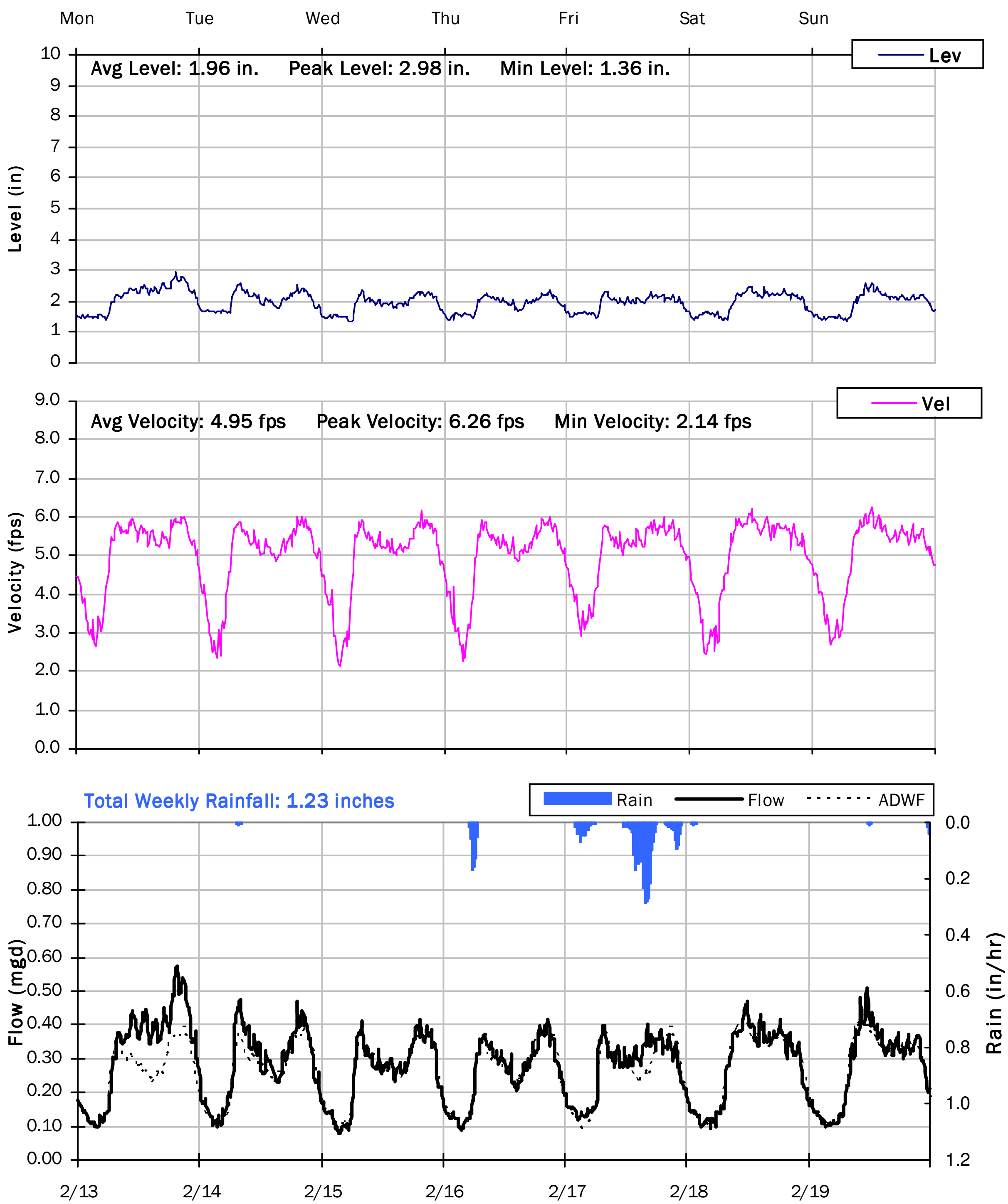


Avg Flow: 0.275 mgd **Peak Flow: 0.509 mgd** **Min Flow: 0.084 mgd**

SITE M3

Weekly Level, Velocity and Flow Hydrographs

2/13/2017 to 2/20/2017

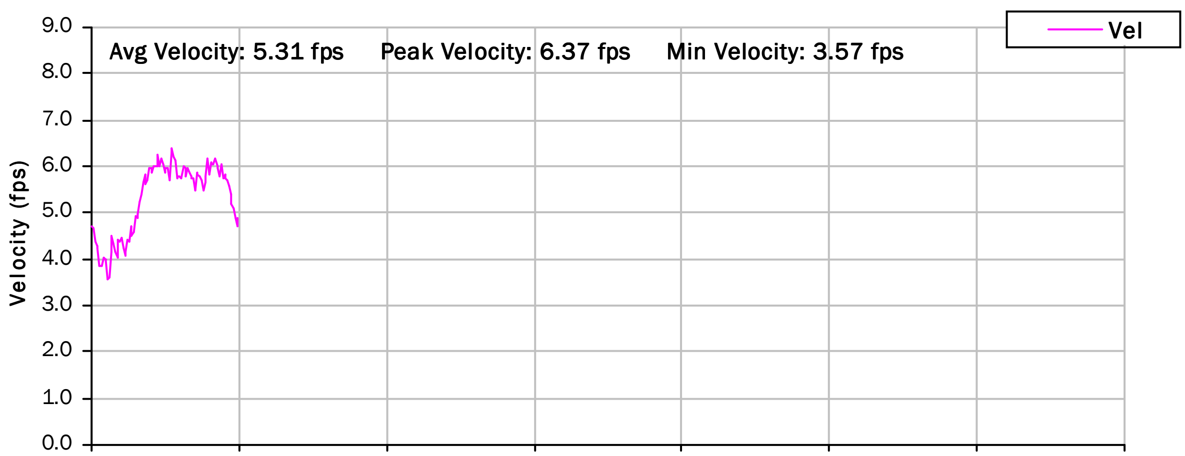


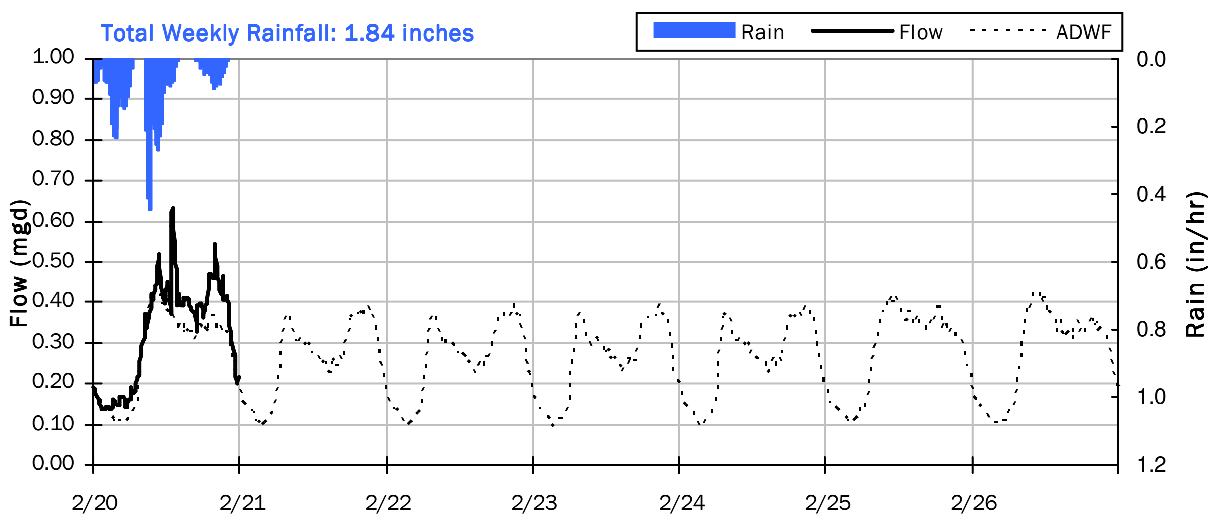
Avg Flow: 0.280 mgd **Peak Flow: 0.576 mgd** **Min Flow: 0.079 mgd**

SITE M3

Weekly Level, Velocity and Flow Hydrographs

2/20/2017 to 2/27/2017





Avg Flow: 0.325 mgd **Peak Flow: 0.634 mgd** **Min Flow: 0.136 mgd**

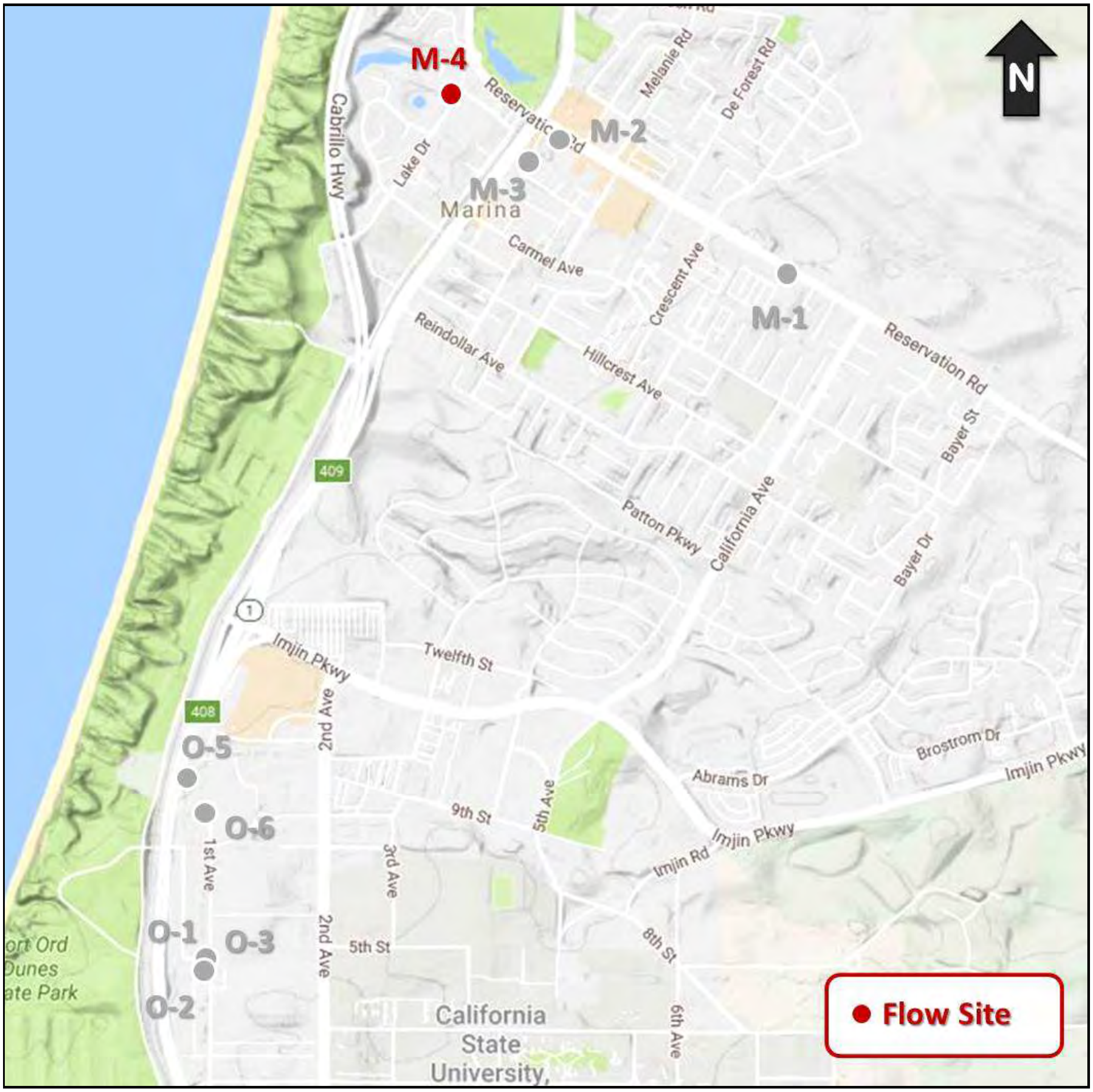
Marina Coast Water District

Sanitary Sewer Flow Monitoring
Temporary Monitoring: January 2017 - March 2017

Monitoring Site: Site M4

Location: Robin Drive at Hilo Avenue

Data Summary Report



Vicinity Map: Site M4

SITE M4

Site Information

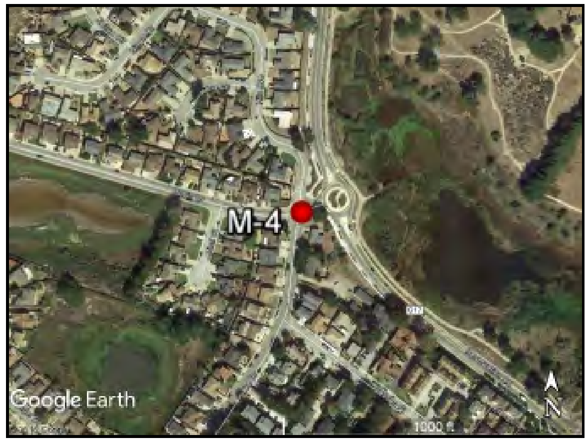
Location: Robin Drive at Hilo Avenue

Coordinates: 121.8029° W, 36.6897° N

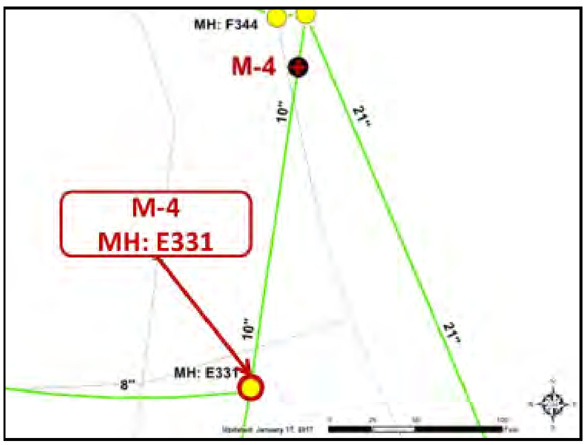
Pipe Diameter: 10 inches

ADWF: 0.170 mgd

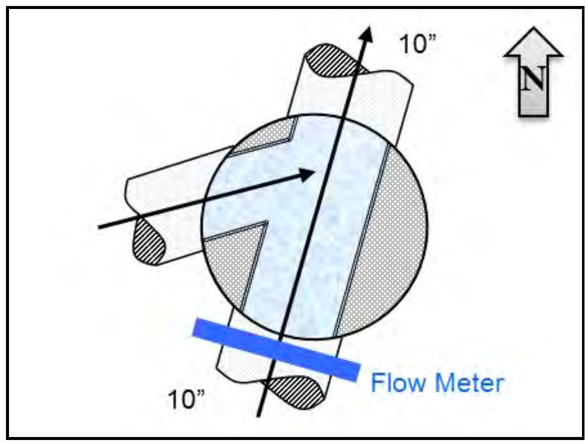
Peak Measured Flow: 0.330 mgd



Satellite Map



Sewer Map



Flow Sketch


Street View


Plan View

SITE M4

Additional Site Photos

Effluent Pipe

South Influent Pipe

SITE M4

Additional Site Photos

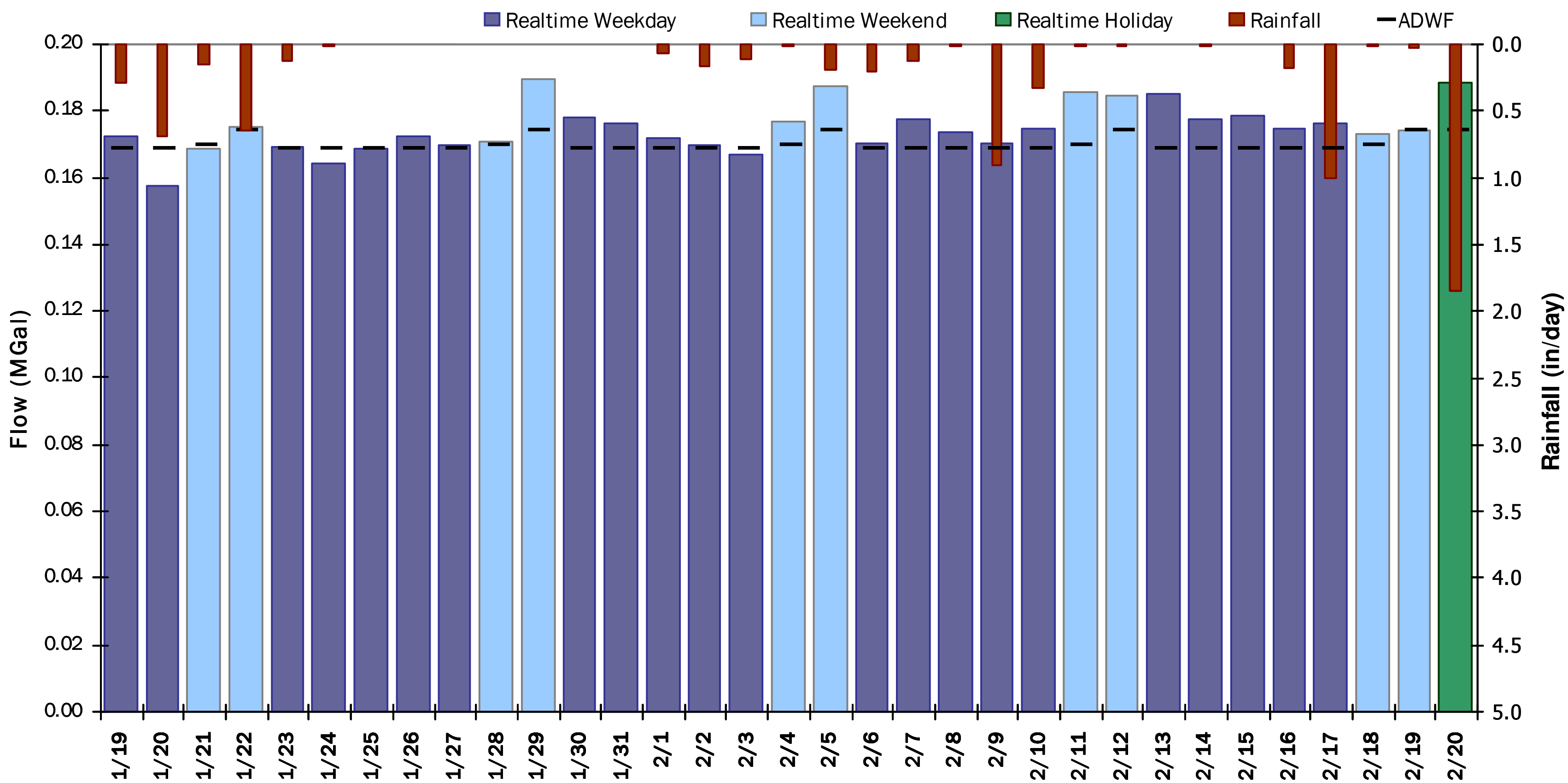
West Influent Pipe

SITE M4

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.175 MGal **Peak Daily Flow: 0.190 MGal** **Min Daily Flow: 0.158 MGal**

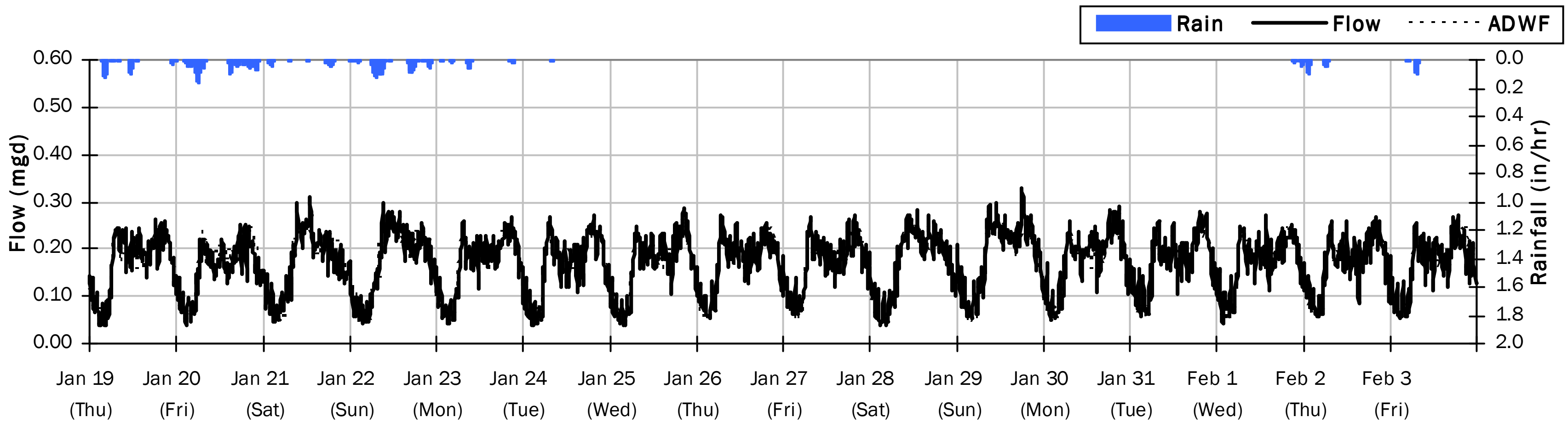
Total Period Rainfall: 7.11 inches

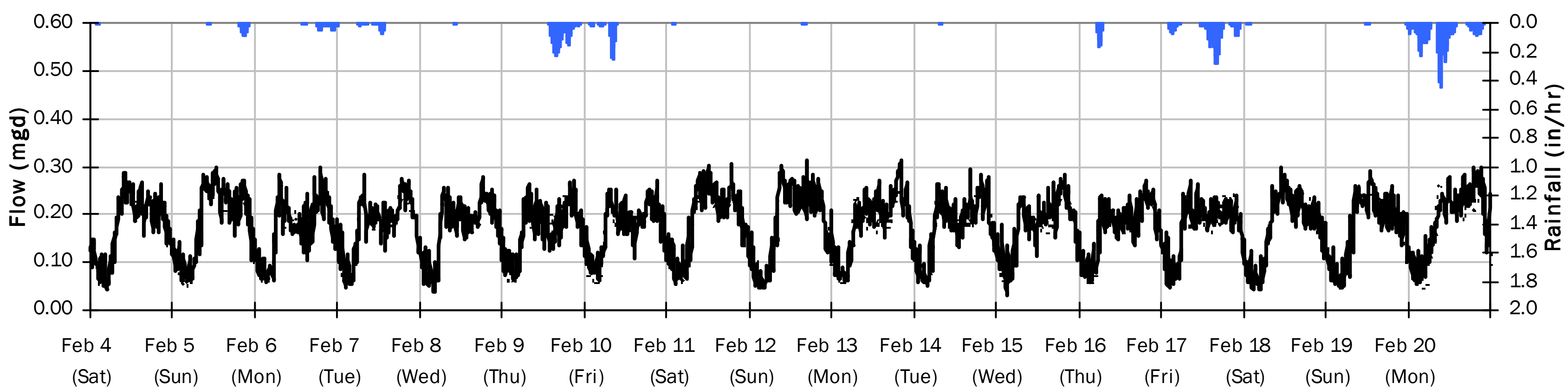


SITE M4

Flow Summary: 1/19/2017 to 2/20/2017

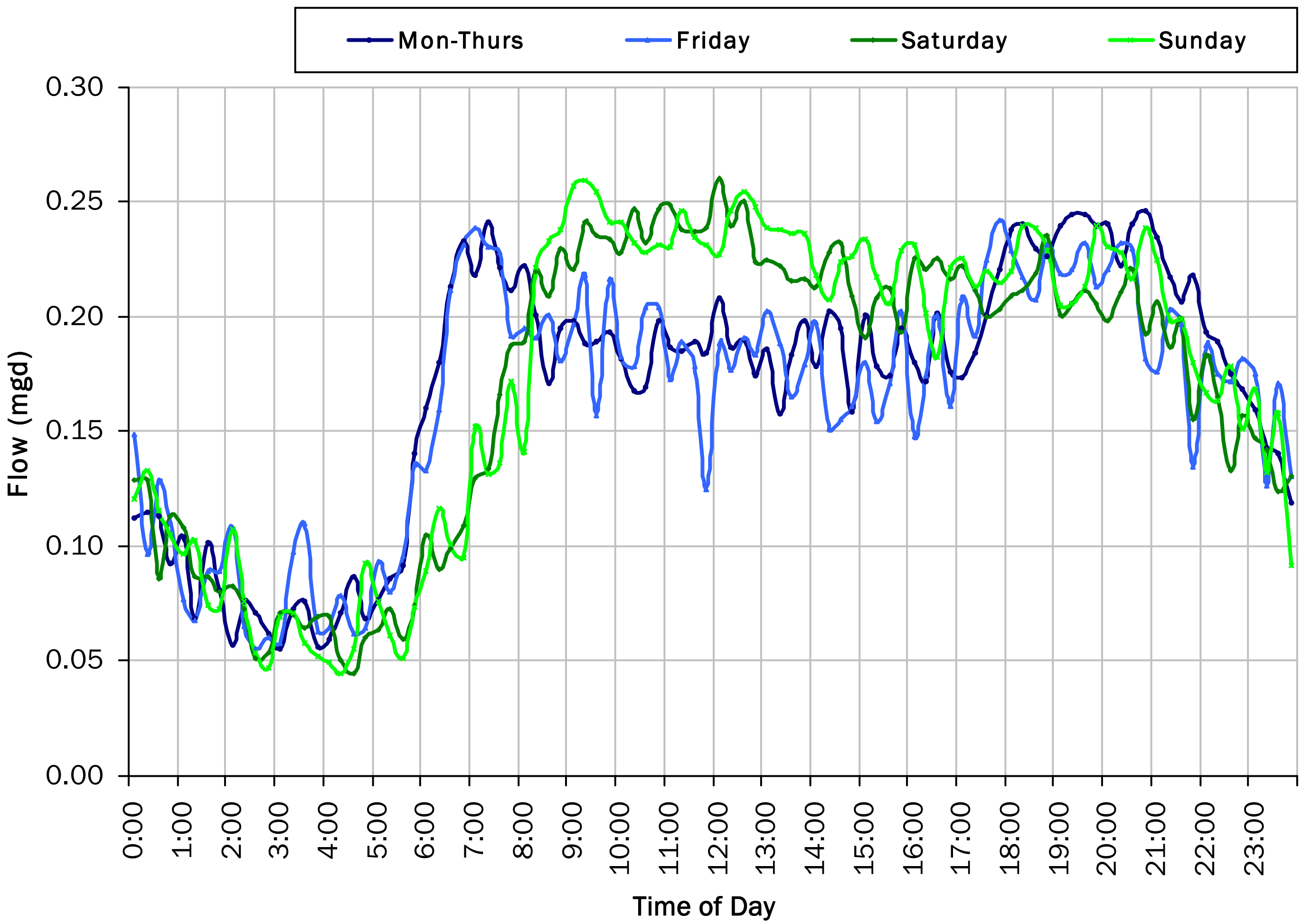
Total Period Rainfall: 7.11 inches   **Avg Flow: 0.175 mgd**   **Peak Flow: 0.330 mgd**   **Min Flow: 0.030 mgd**





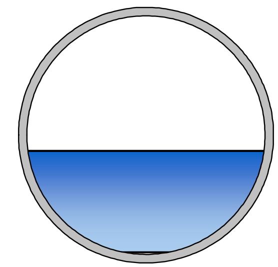
SITE M4

Average Dry Weather Flow Hydrographs



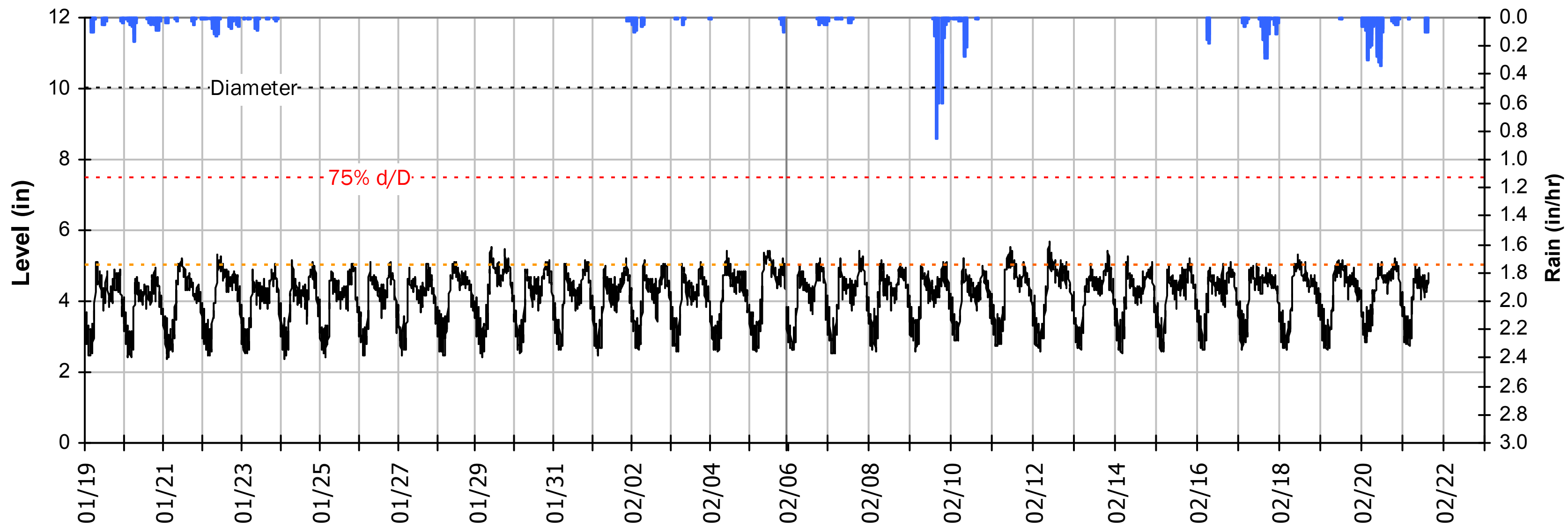
ADWF:

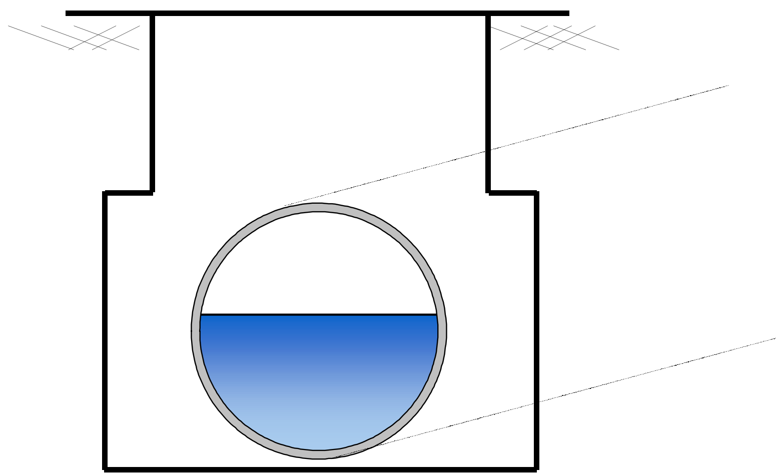
0.170 *mgd*



SITE M4
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

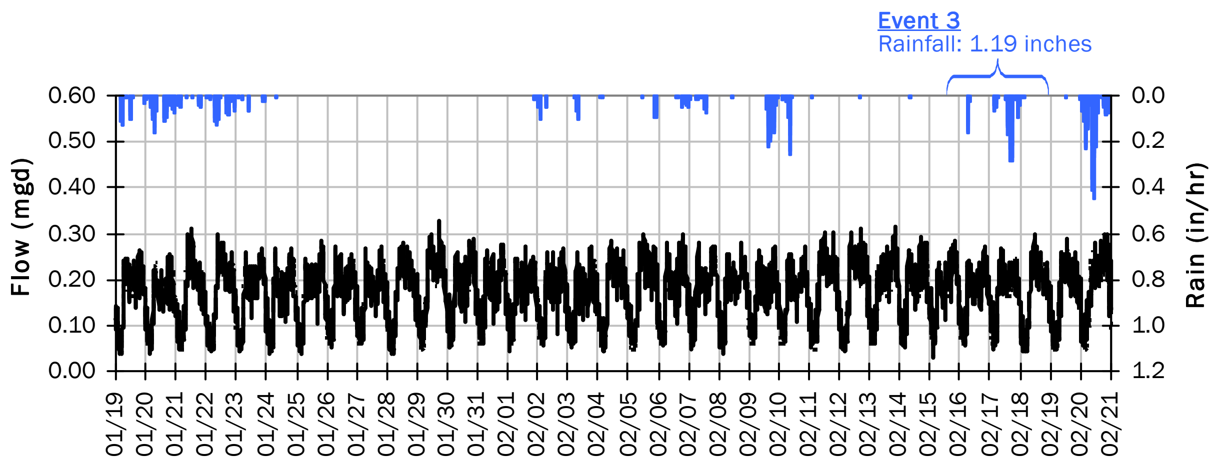




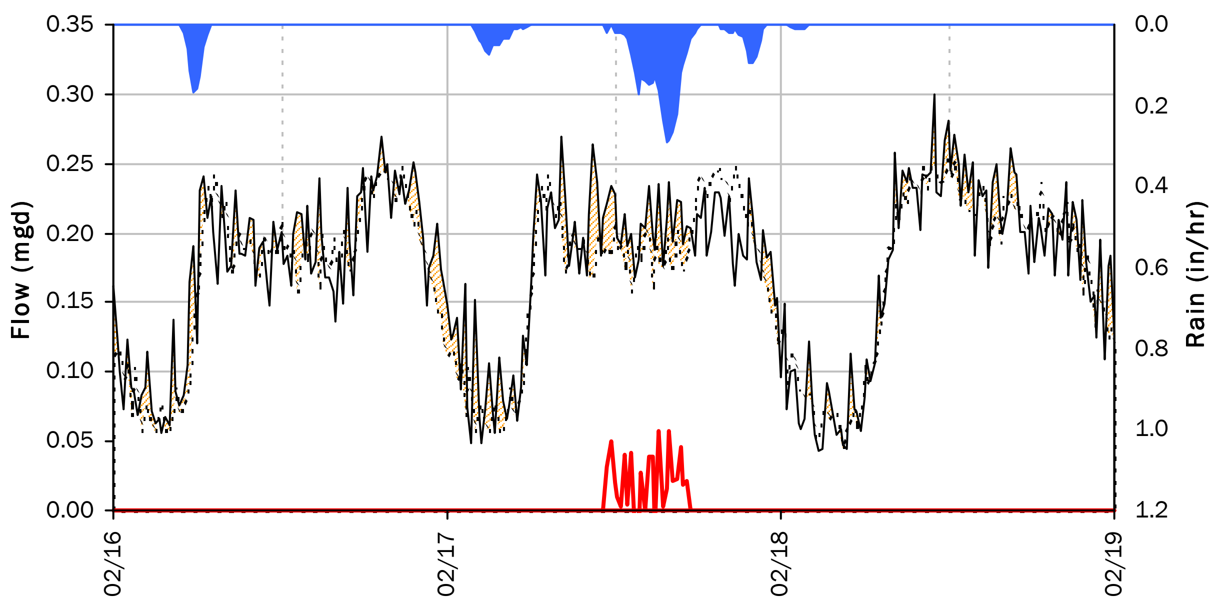
Pipe Diameter:	10	*inches*
Peak Measured Level:	5.67	*inches*
Peak d/D Ratio:	0.57	

SITE M4
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



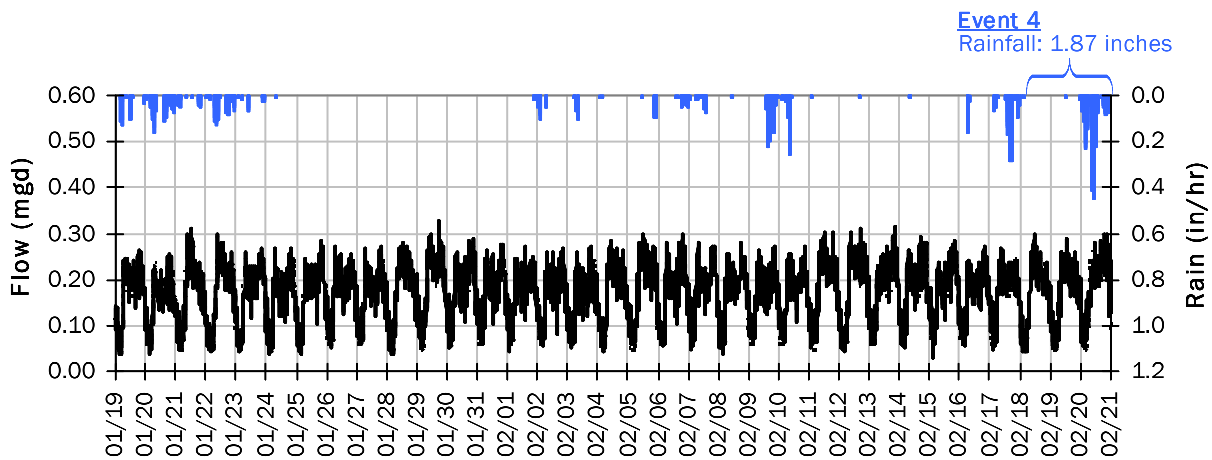
Storm Event I/I Analysis (Rain = 1.20 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.24 *mgd*	**Peak I/I Rate:**	0.06 *mgd*
PF:	1.39	**Total I/I:**	5,000 *gallons*
Peak Level:	4.95 *in*		
d/D Ratio:	0.49		

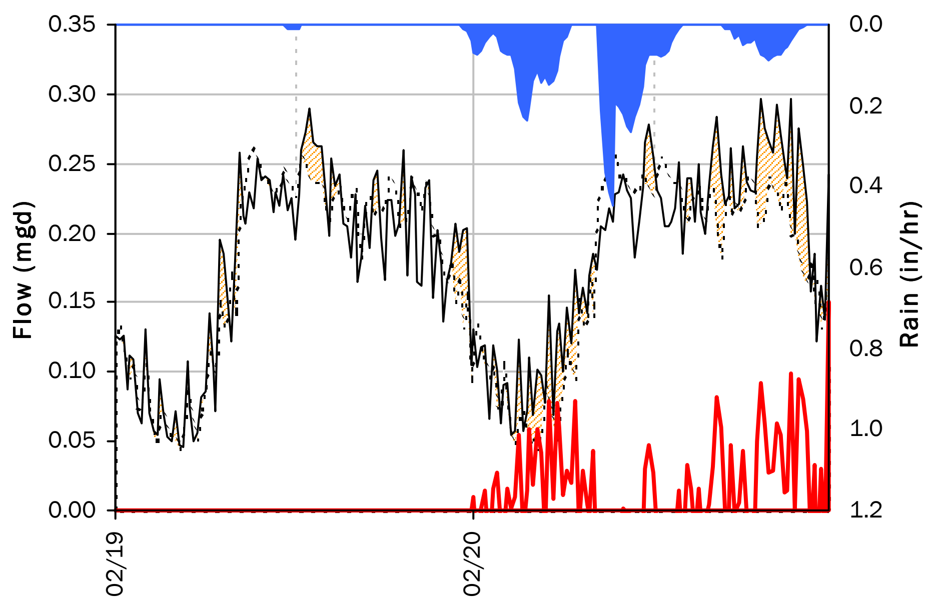
SITE M4

I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 4 Detail Graph



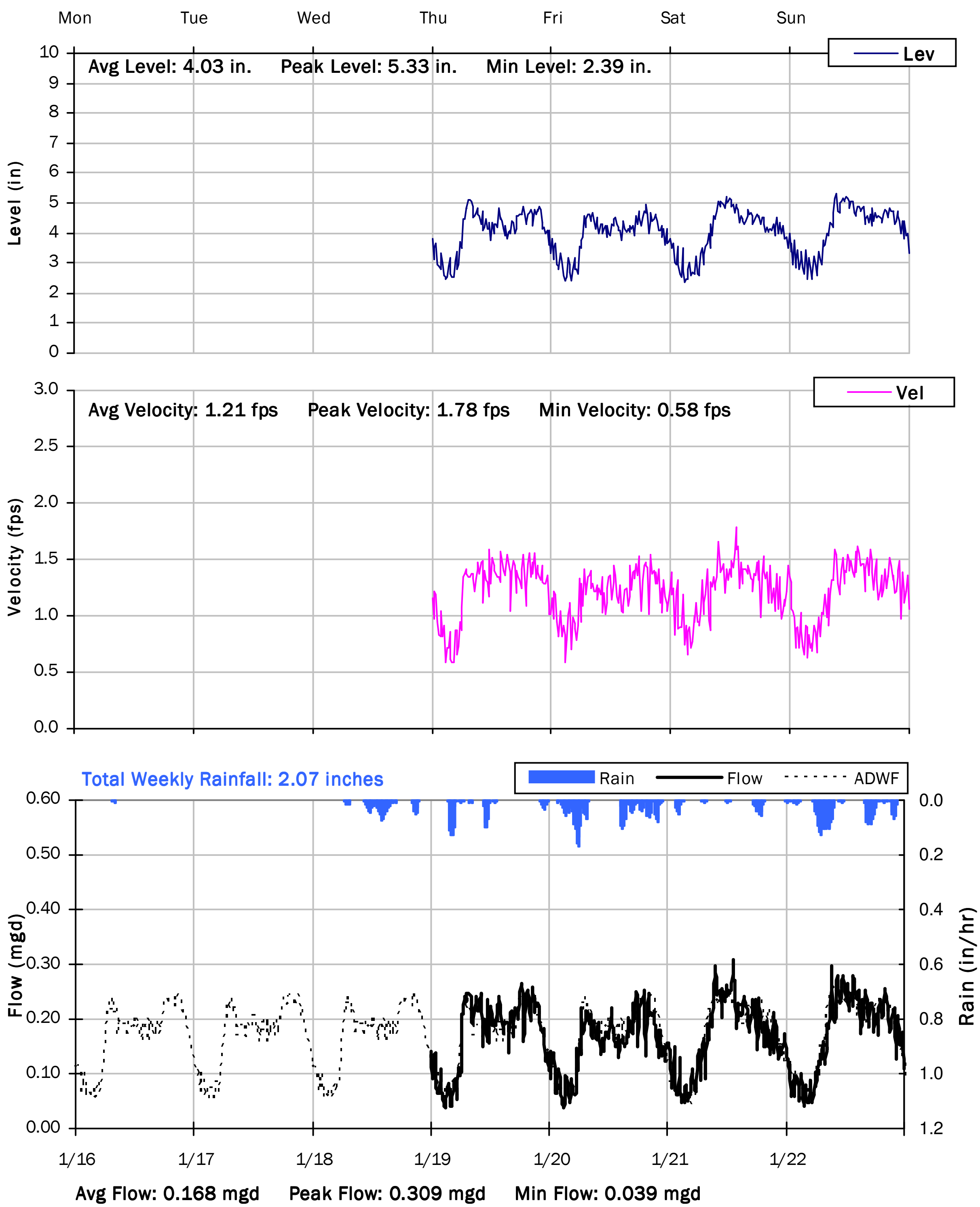
Storm Event I/I Analysis (Rain = 1.87 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.30 *mgd*	**Peak I/I Rate:**	0.15 *mgd*
PF:	1.75	**Total I/I:**	15,000 *gallons*
Peak Level:	5.23 *in*		
d/D Ratio:	0.52		

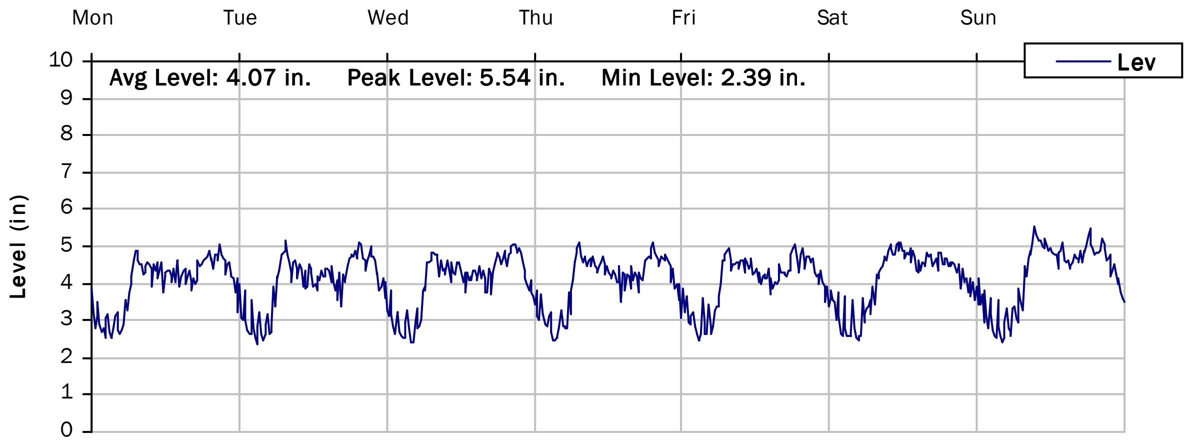
SITE M4

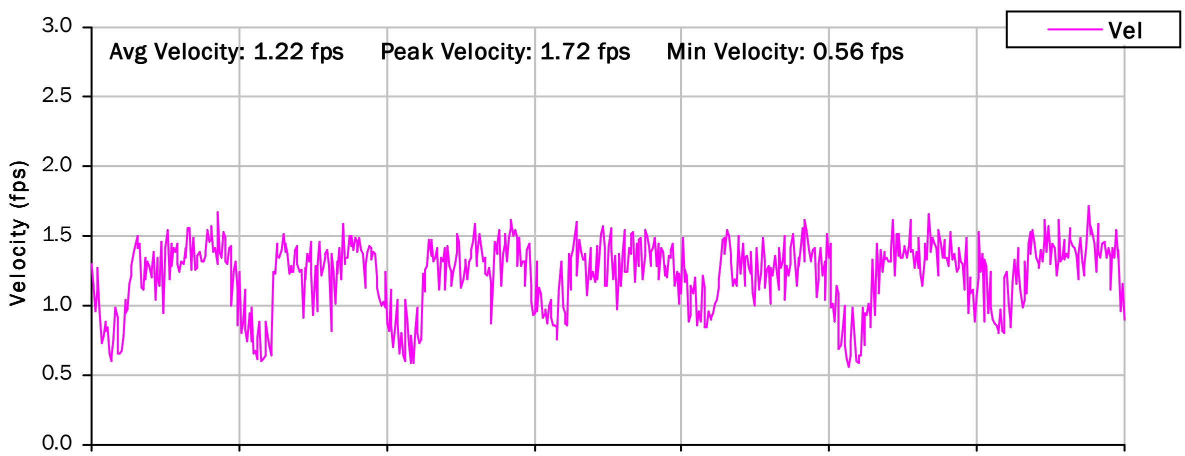
Weekly Level, Velocity and Flow Hydrographs

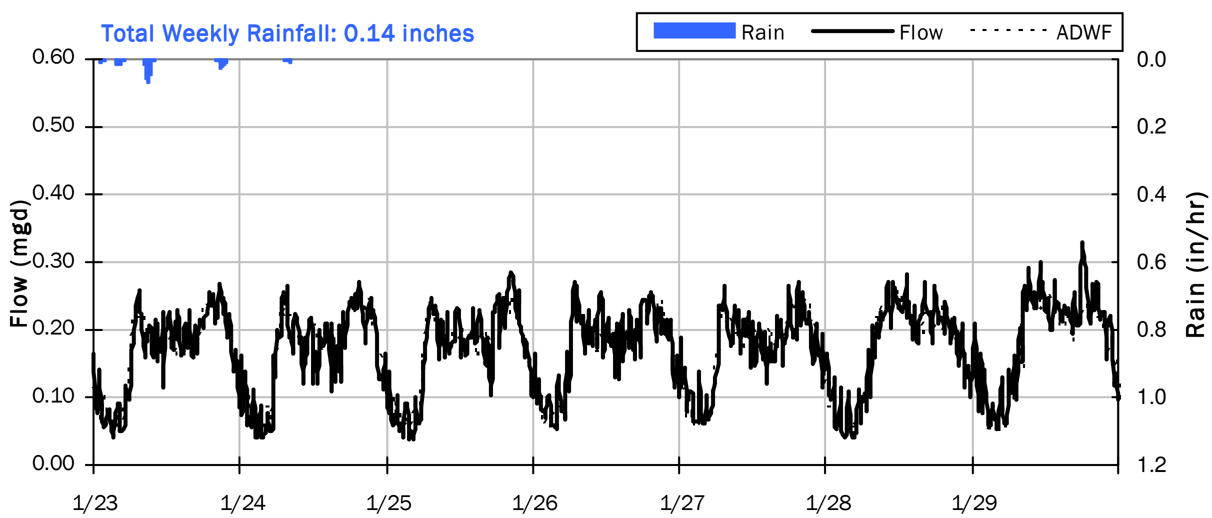
1/16/2017 to 1/23/2017



SITE M4
Weekly Level, Velocity and Flow Hydrographs
1/23/2017 to 1/30/2017





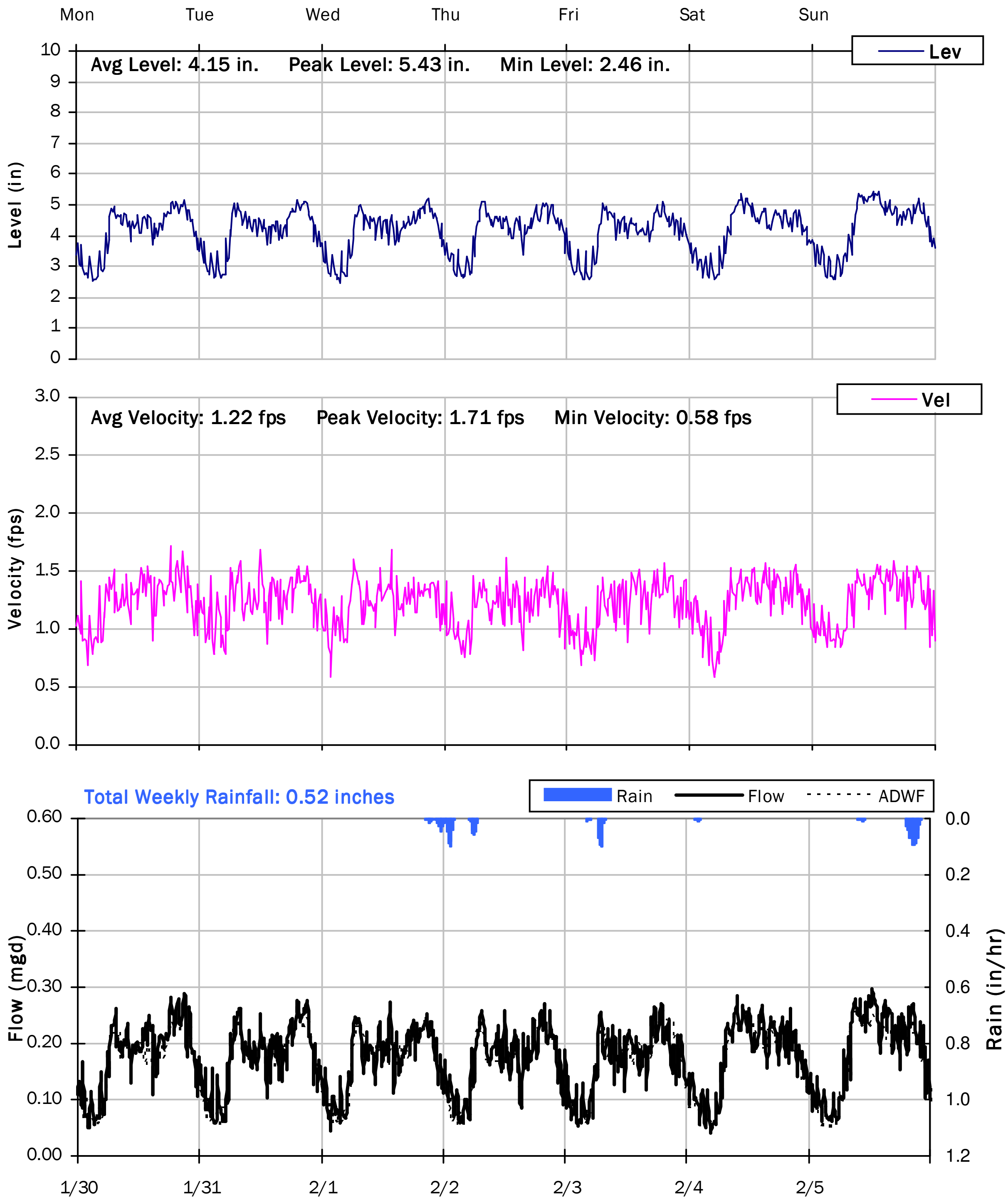


Avg Flow: 0.172 mgd **Peak Flow: 0.330 mgd** **Min Flow: 0.039 mgd**

SITE M4

Weekly Level, Velocity and Flow Hydrographs

1/30/2017 to 2/6/2017

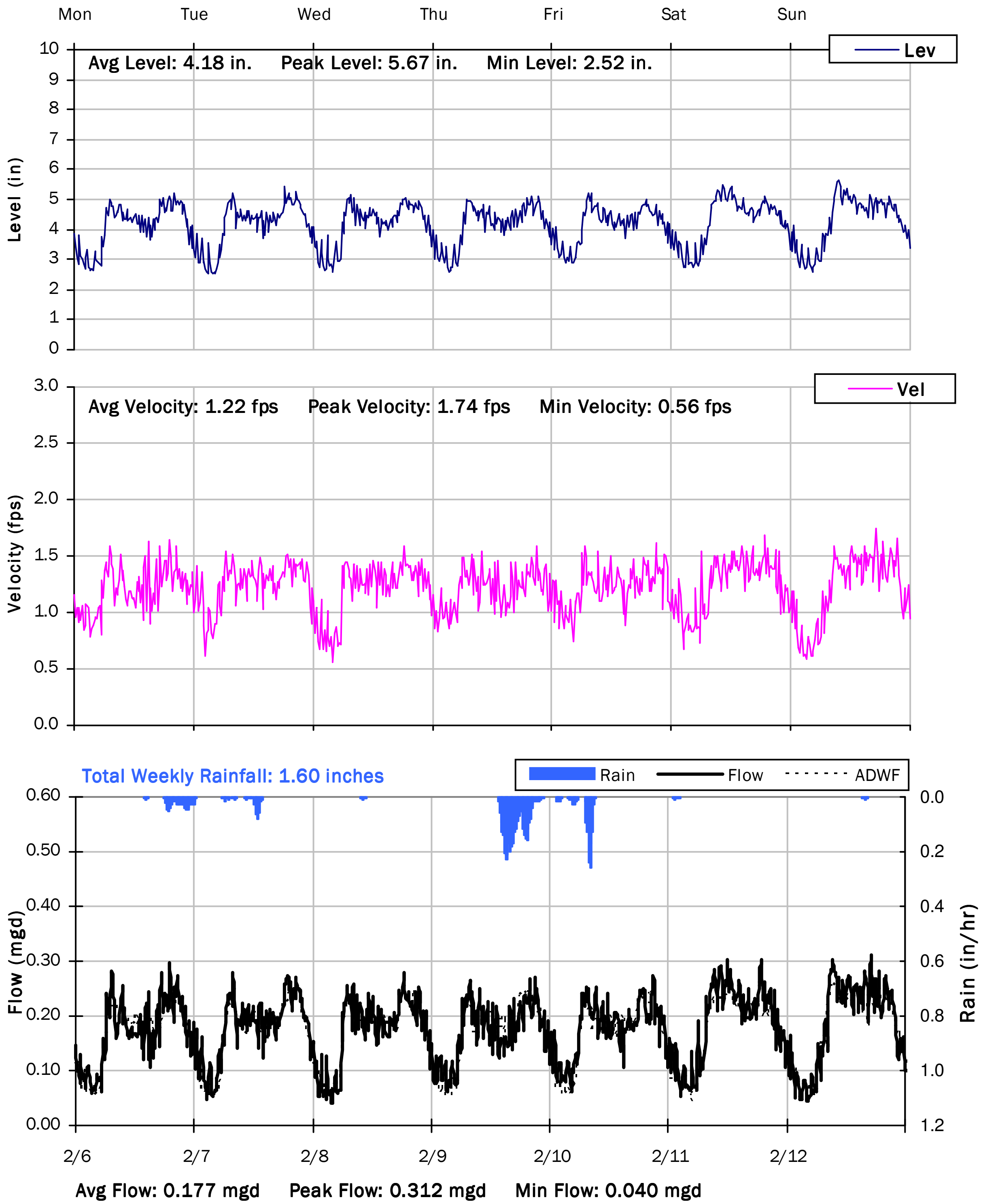


Avg Flow: 0.175 mgd **Peak Flow: 0.298 mgd** **Min Flow: 0.042 mgd**

SITE M4

Weekly Level, Velocity and Flow Hydrographs

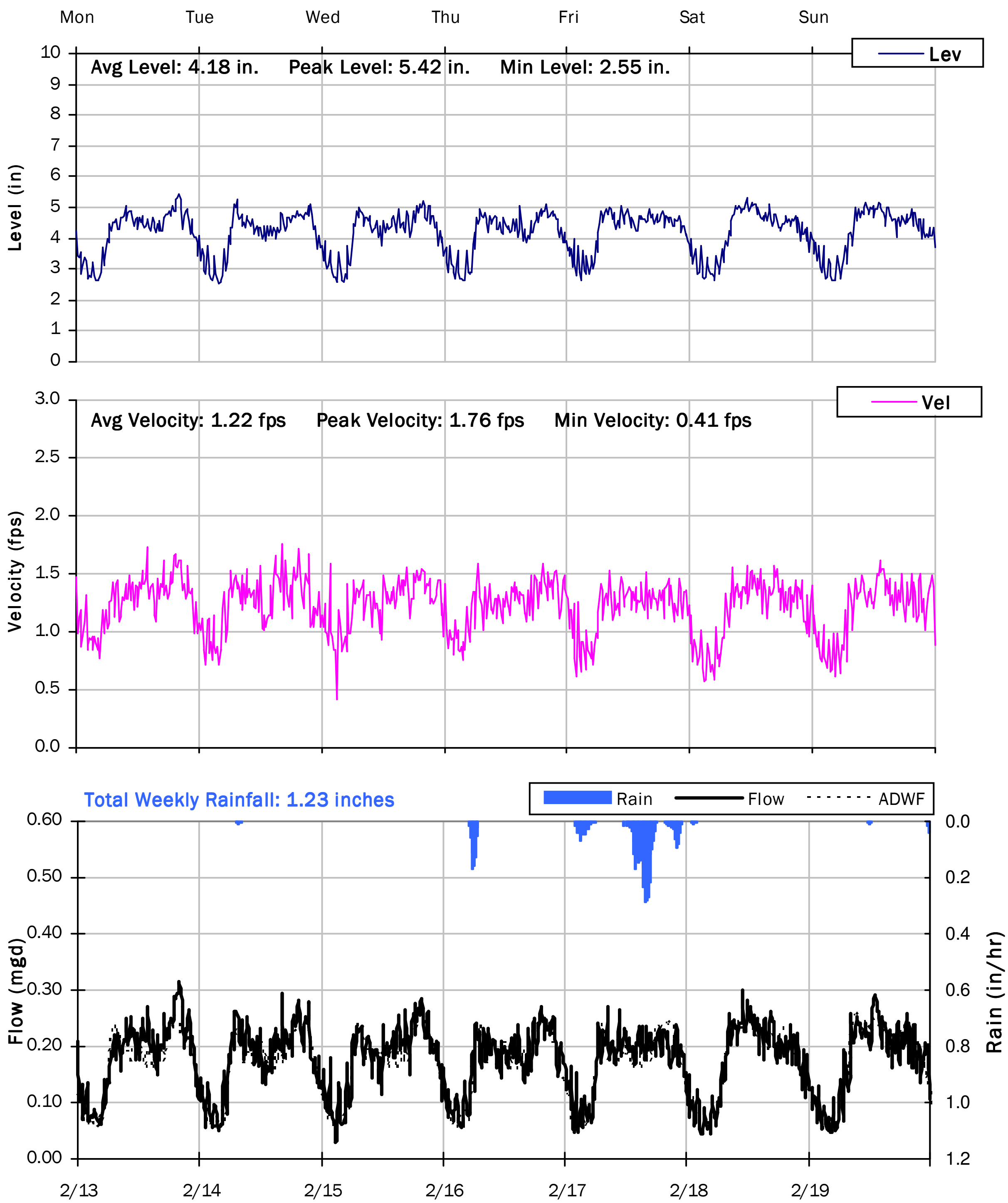
2/6/2017 to 2/13/2017



SITE M4

Weekly Level, Velocity and Flow Hydrographs

2/13/2017 to 2/20/2017

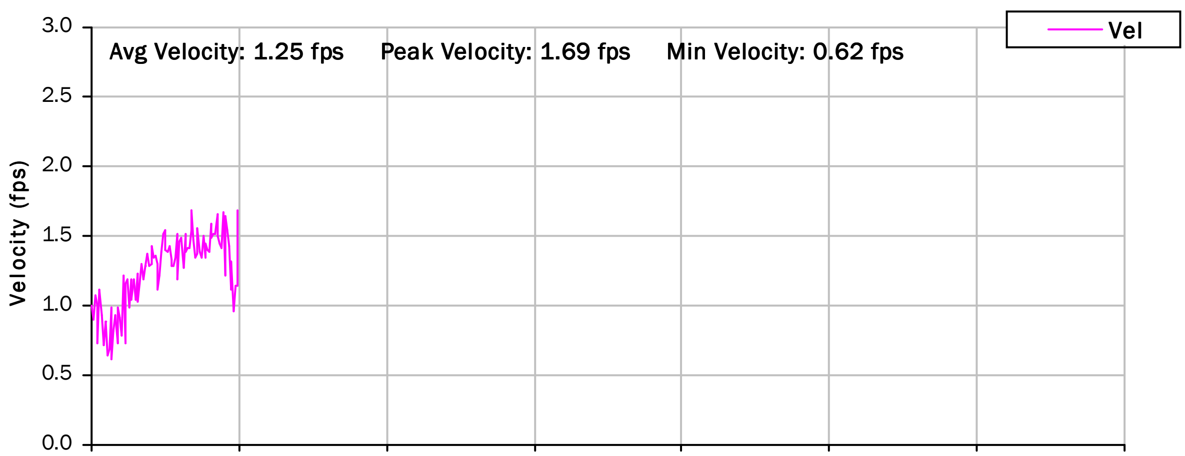


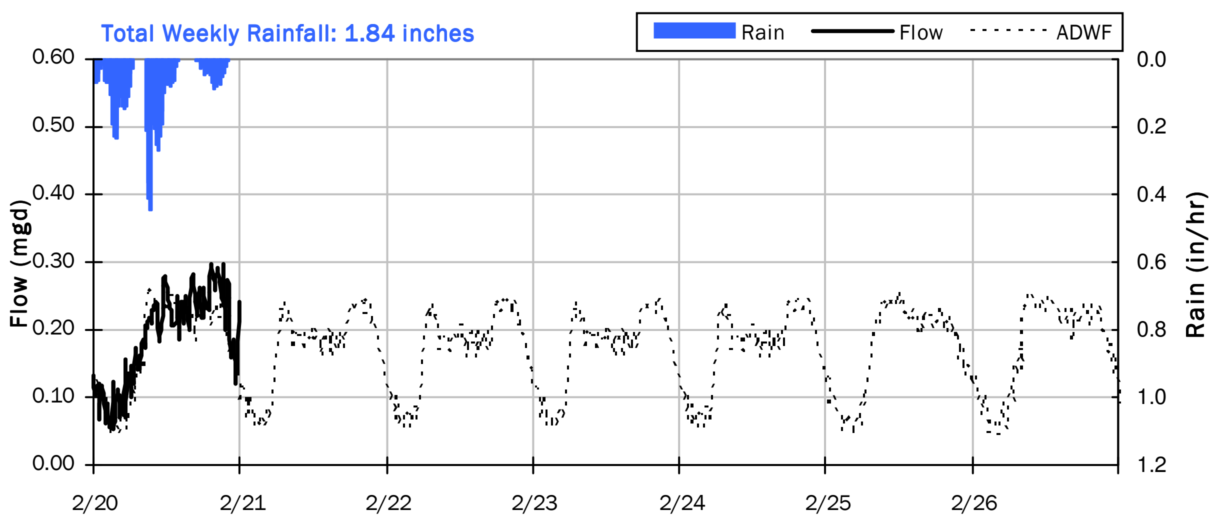
Avg Flow: 0.177 mgd **Peak Flow: 0.315 mgd** **Min Flow: 0.030 mgd**

SITE M4

Weekly Level, Velocity and Flow Hydrographs

2/20/2017 to 2/27/2017





Avg Flow: 0.189 mgd **Peak Flow: 0.297 mgd** **Min Flow: 0.055 mgd**

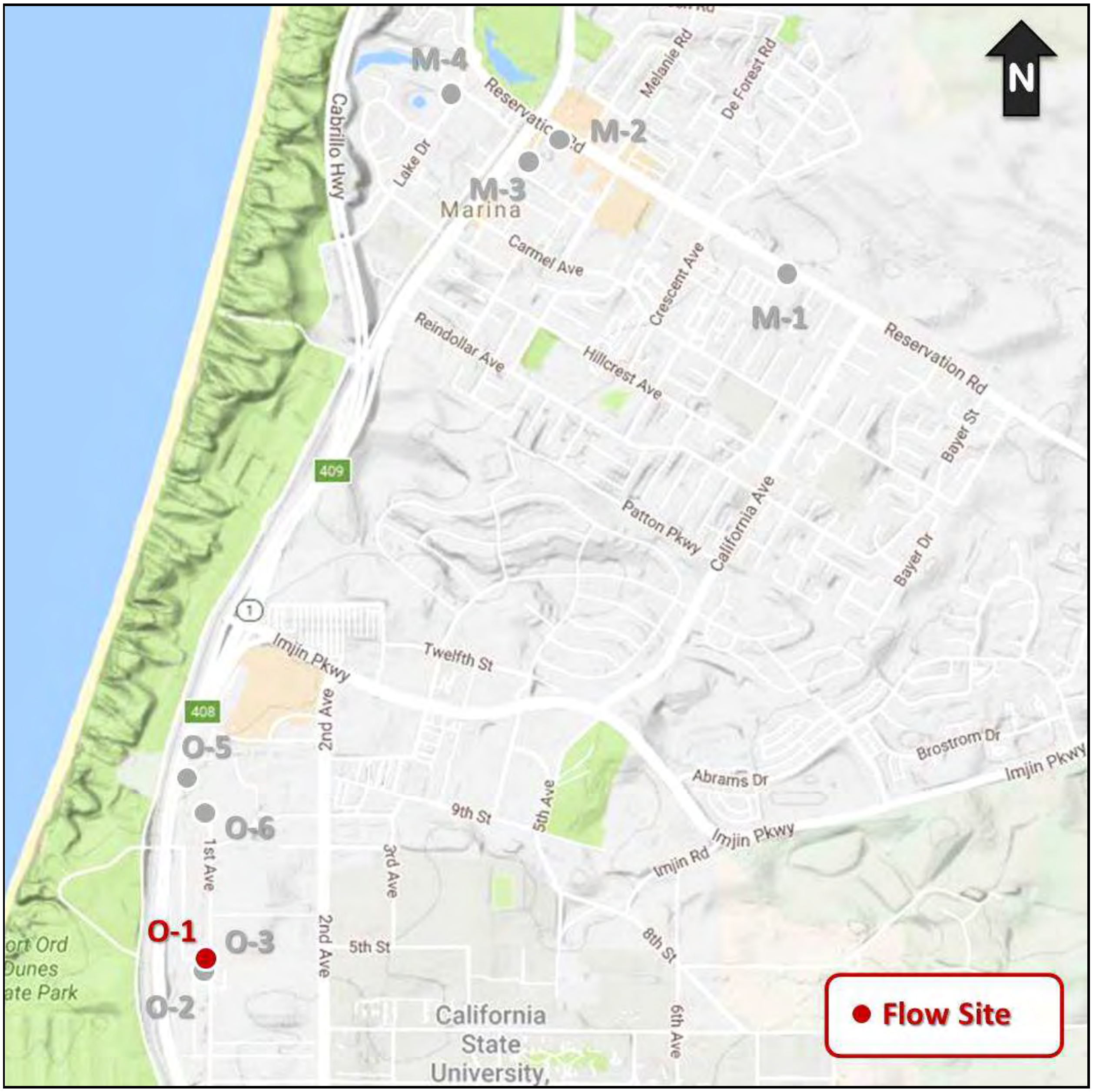
Marina Coast Water District

Sanitary Sewer Flow Monitoring
Temporary Monitoring: January 2017 - March 2017

Monitoring Site: Site 01

Location: Lot northwest of intersection of 1st Avenue and 5th Street

Data Summary Report



Vicinity Map: Site 01

SITE 01

Site Information

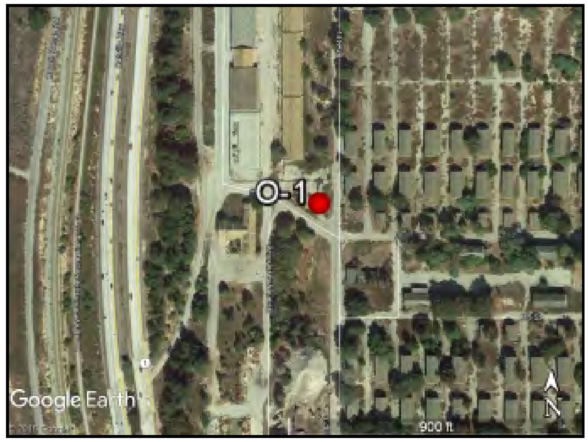
Location: Lot northwest of intersection of 1st Avenue and 5th Street

Coordinates: 121.8145° W, 36.6573° N

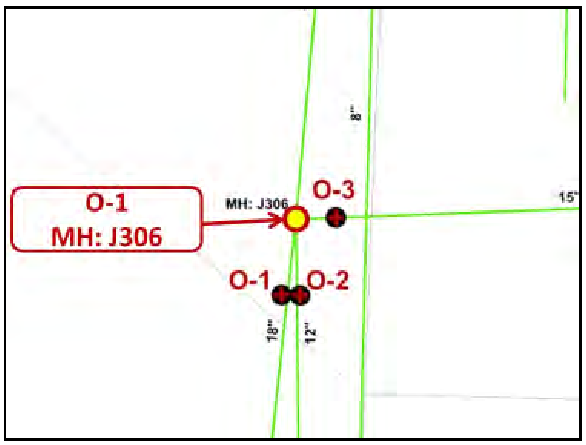
Pipe Diameter: 18 inches

ADWF: 0.445 mgd

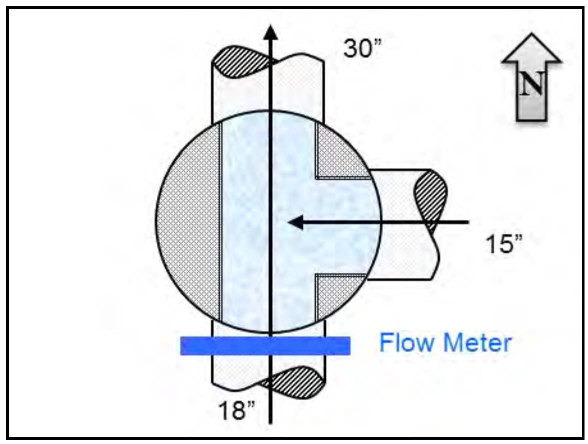
Peak Measured Flow: 1.384 mgd



Satellite Map



Sewer Map



Flow Sketch


Street View


Plan View

SITE 01

Additional Site Photos

Effluent Pipe

South Influent Pipe

SITE 01

Additional Site Photos

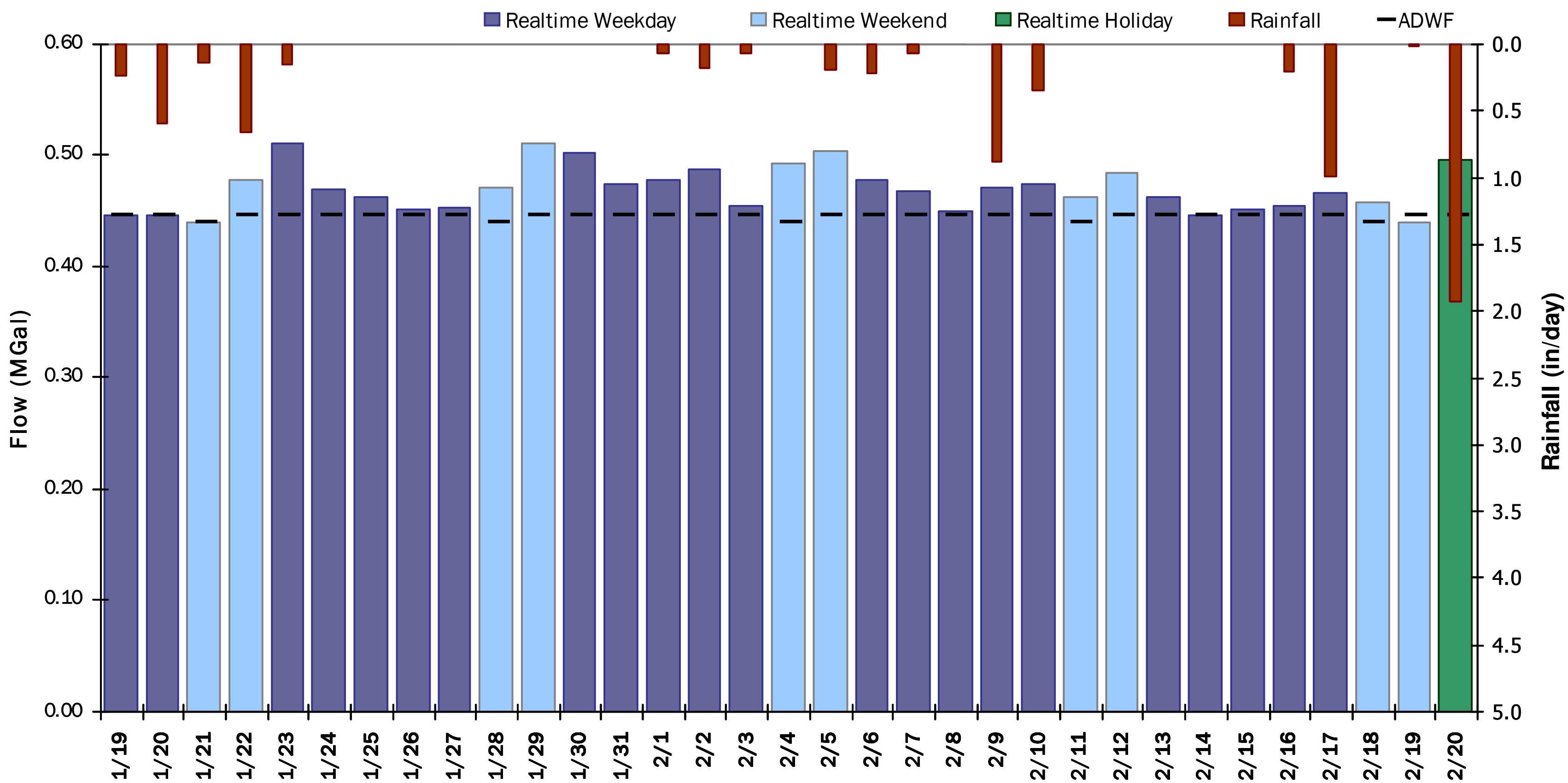
East Influent Pipe

SITE 01

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.469 MGal **Peak Daily Flow: 0.512 MGal** **Min Daily Flow: 0.439 MGal**

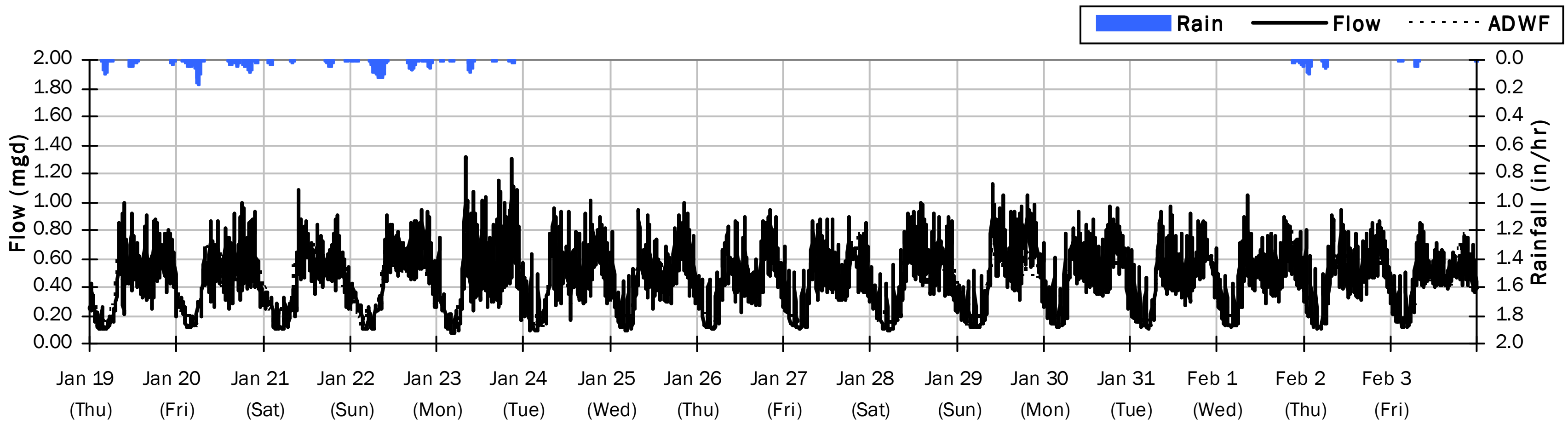
Total Period Rainfall: 6.93 inches

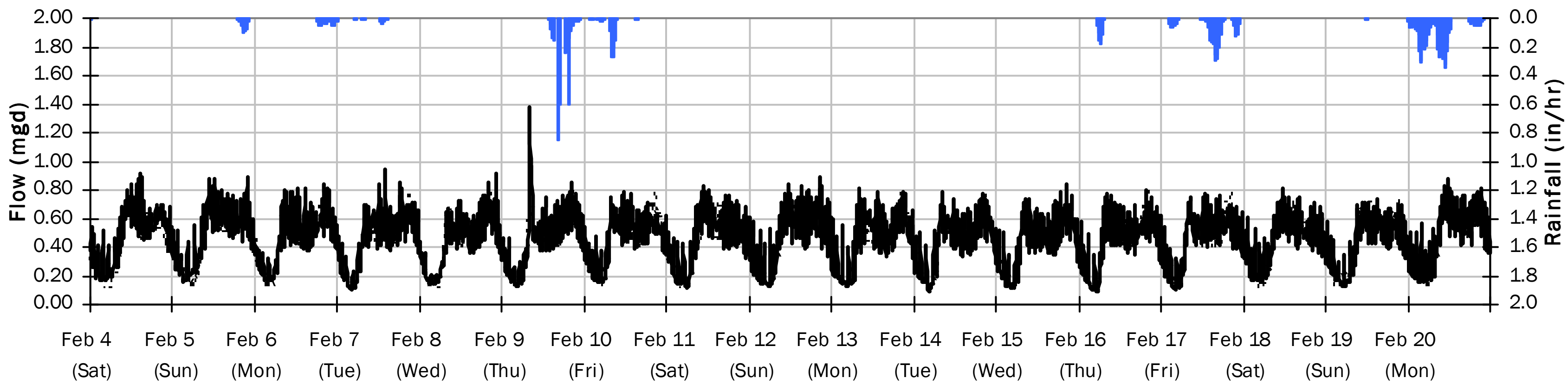


SITE 01

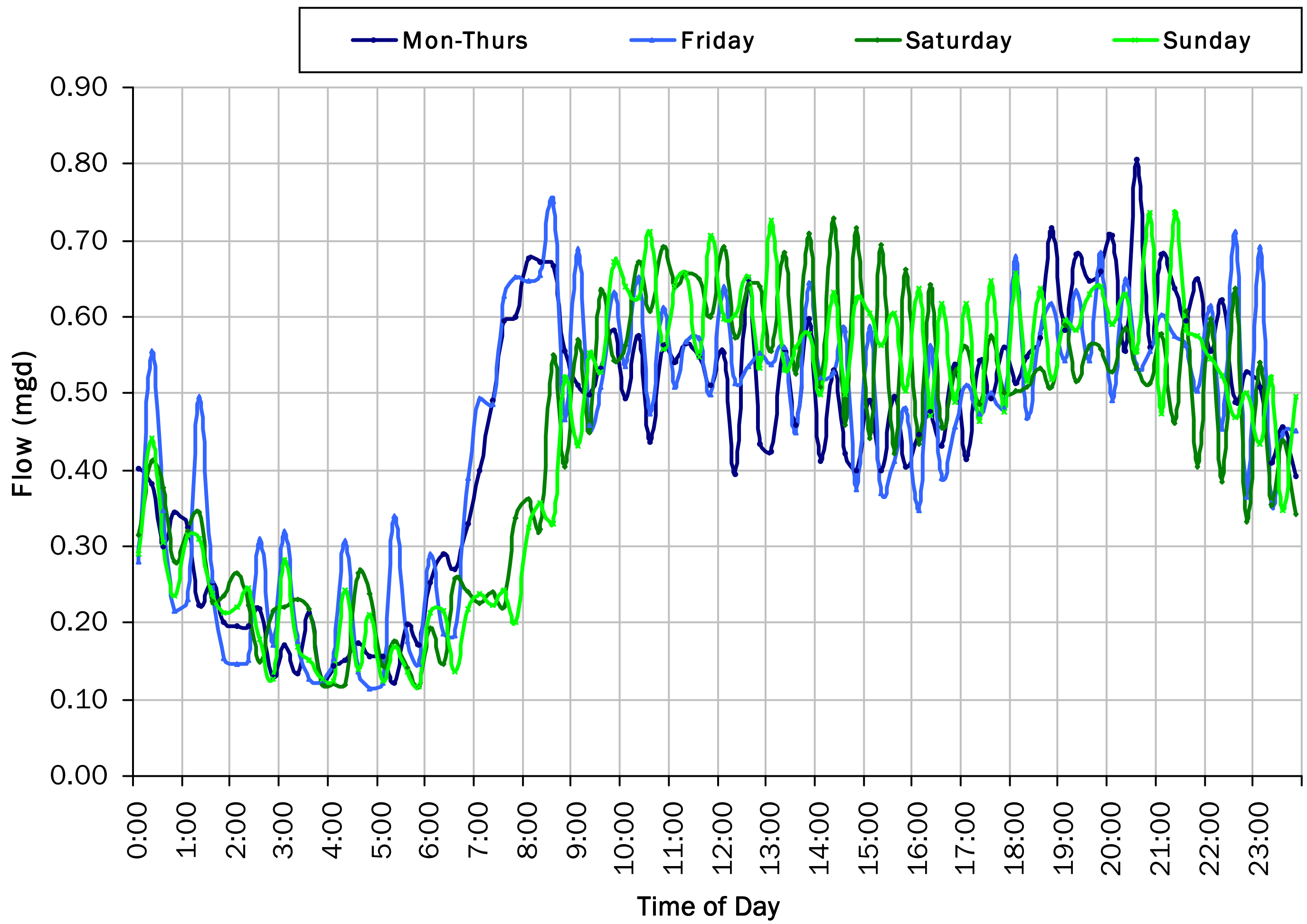
Flow Summary: 1/19/2017 to 2/20/2017

Total Period Rainfall: 6.93 inches   Avg Flow: 0.469 mgd   Peak Flow: 1.384 mgd   Min Flow: 0.081 mgd

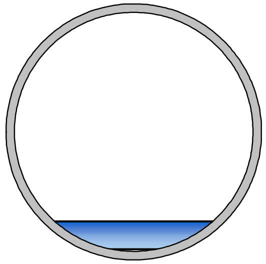




SITE 01
Average Dry Weather Flow Hydrographs

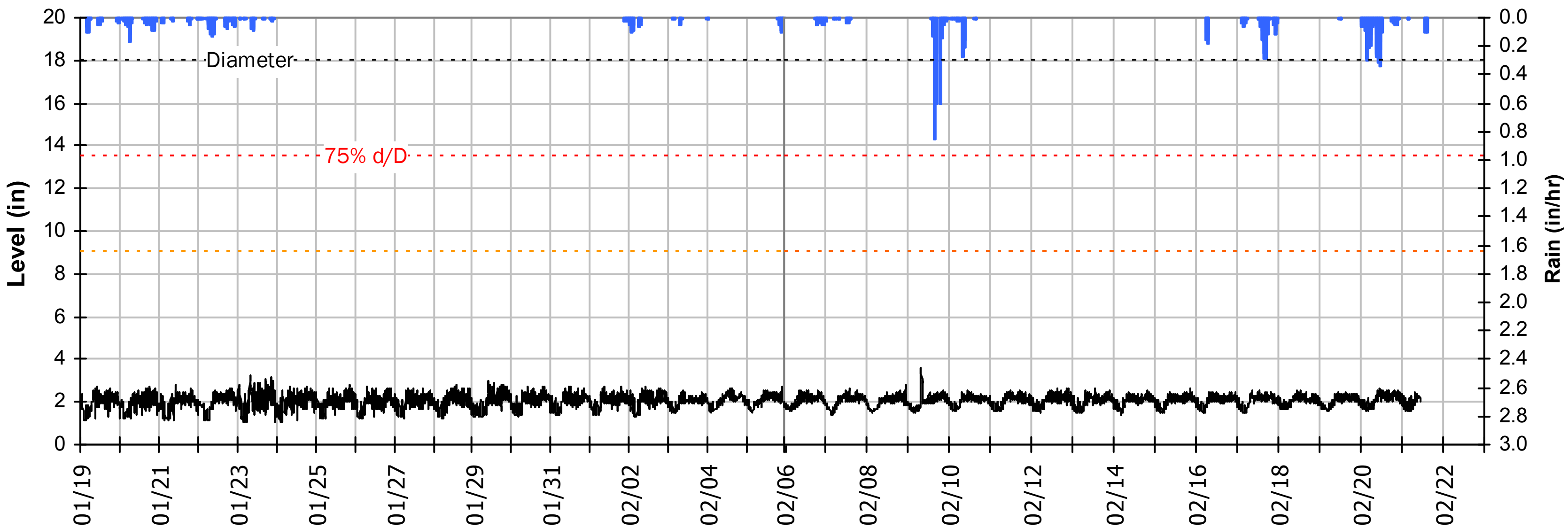


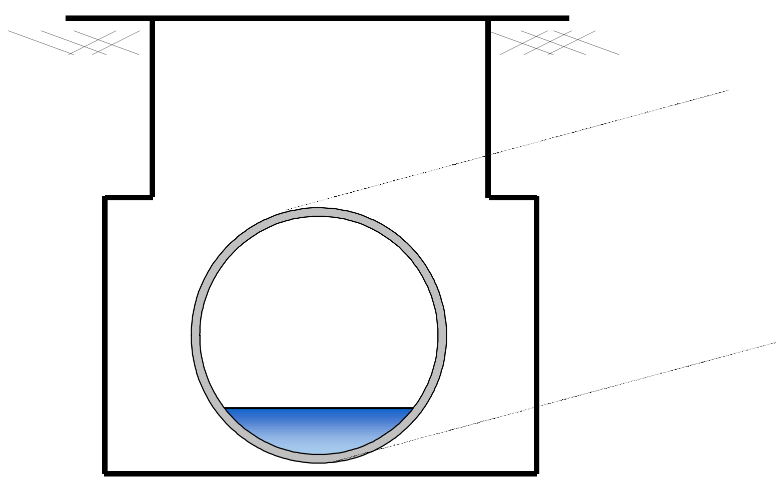
ADWF:
0.445 *mgd*



SITE 01
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

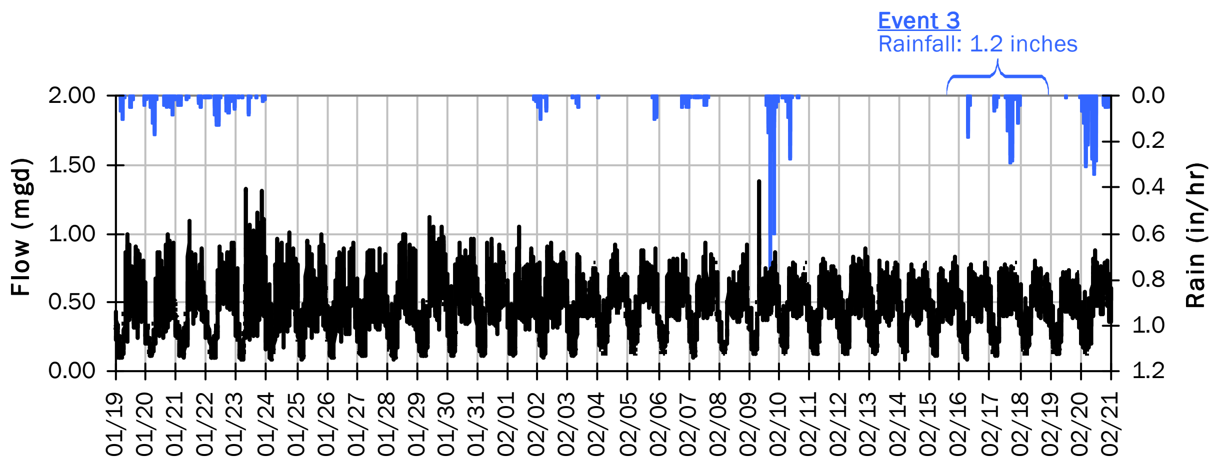




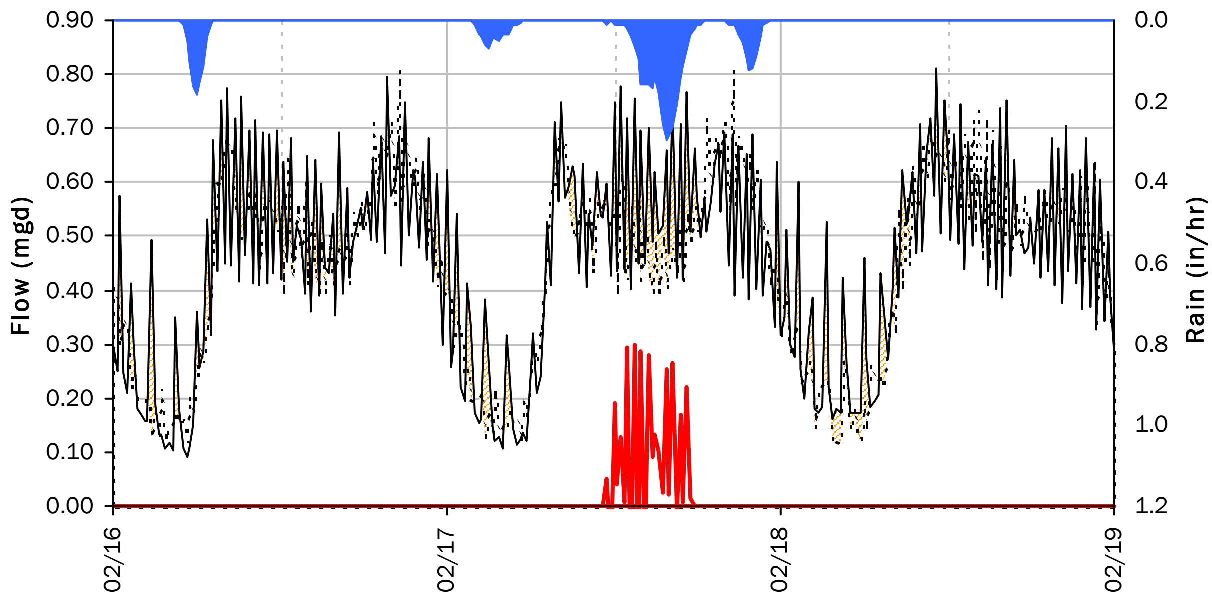
Pipe Diameter:	18	*inches*
Peak Measured Level:	3.61	*inches*
Peak d/D Ratio:	0.20	

SITE 01
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph

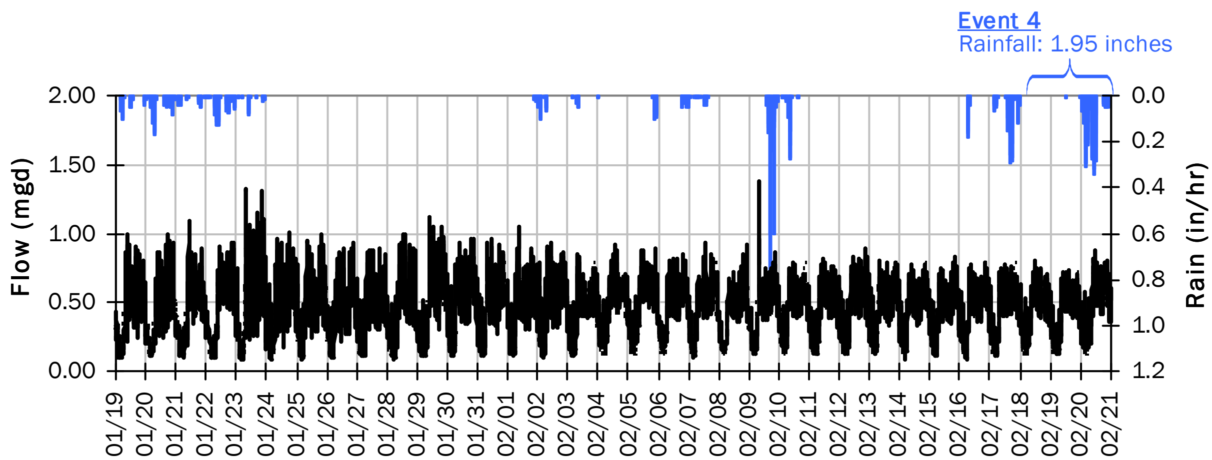


Storm Event I/I Analysis (Rain = 1.20 inches)

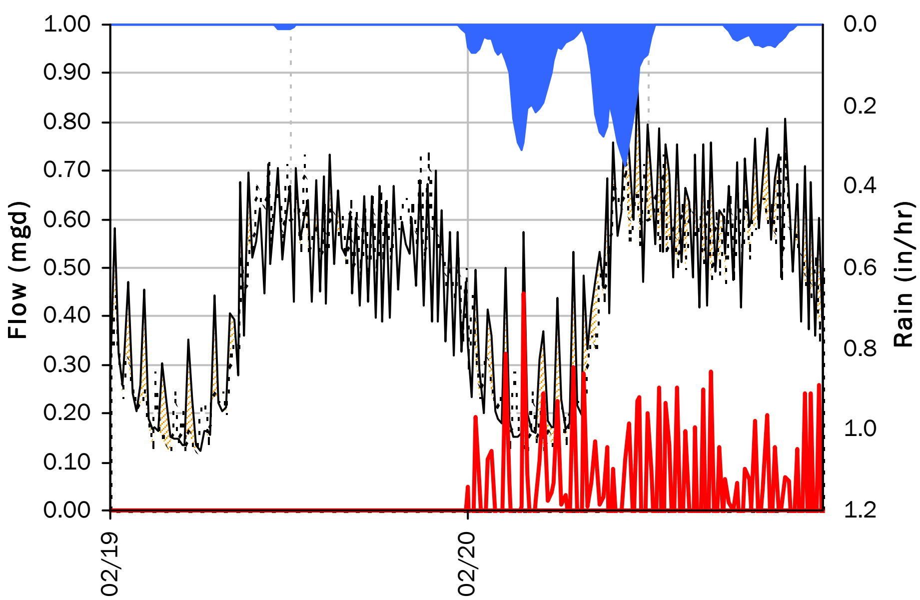
Capacity		Inflow / Infiltration	
Peak Flow:	0.78 *mgd*	**Peak I/I Rate:**	0.30 *mgd*
PF:	1.75	**Total I/I:**	25,000 *gallons*
Peak Level:	2.56 *in*		
d/D Ratio:	0.14		

SITE 01
I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



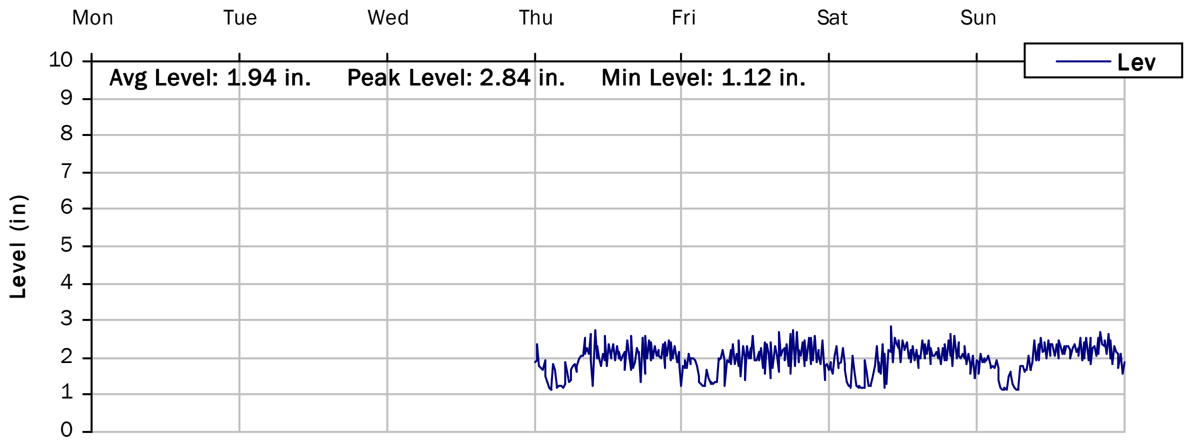
Event 4 Detail Graph

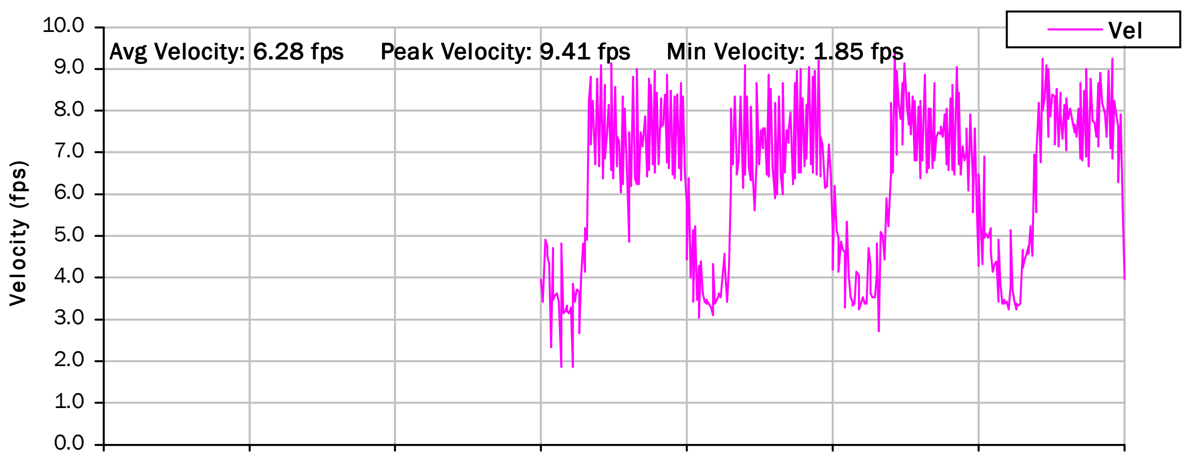


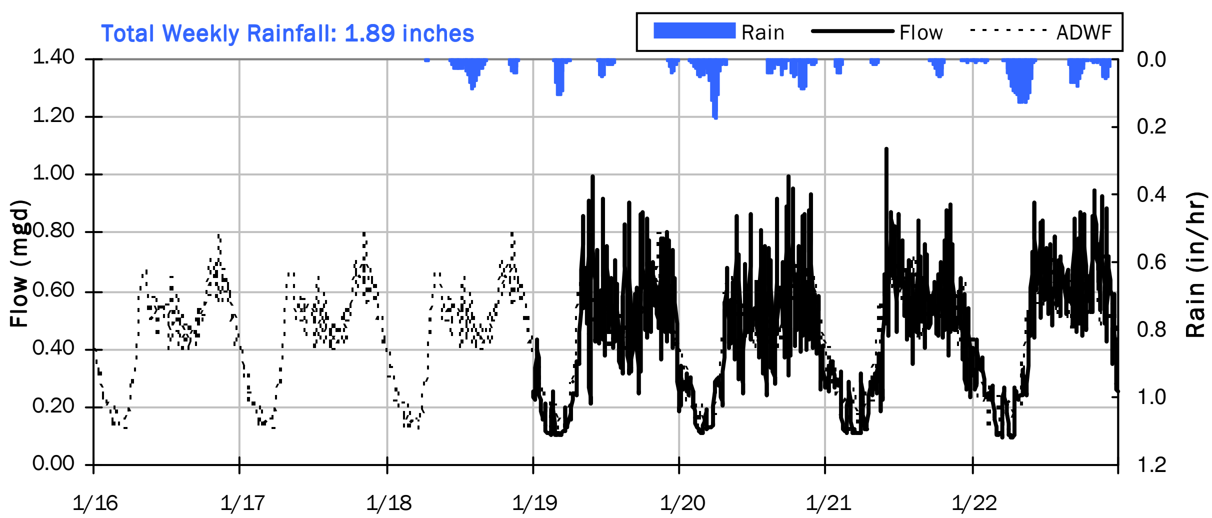
Storm Event I/I Analysis (Rain = 1.95 inches)

Capacity		**Inflow / Infiltration**	
Peak Flow:	0.88 *mgd*	**Peak I/I Rate:**	0.45 *mgd*
PF:	1.98	**Total I/I:**	49,000 *gallons*
Peak Level:	2.65 *in*		
d/D Ratio:	0.15		

SITE 01
Weekly Level, Velocity and Flow Hydrographs
1/16/2017 to 1/23/2017

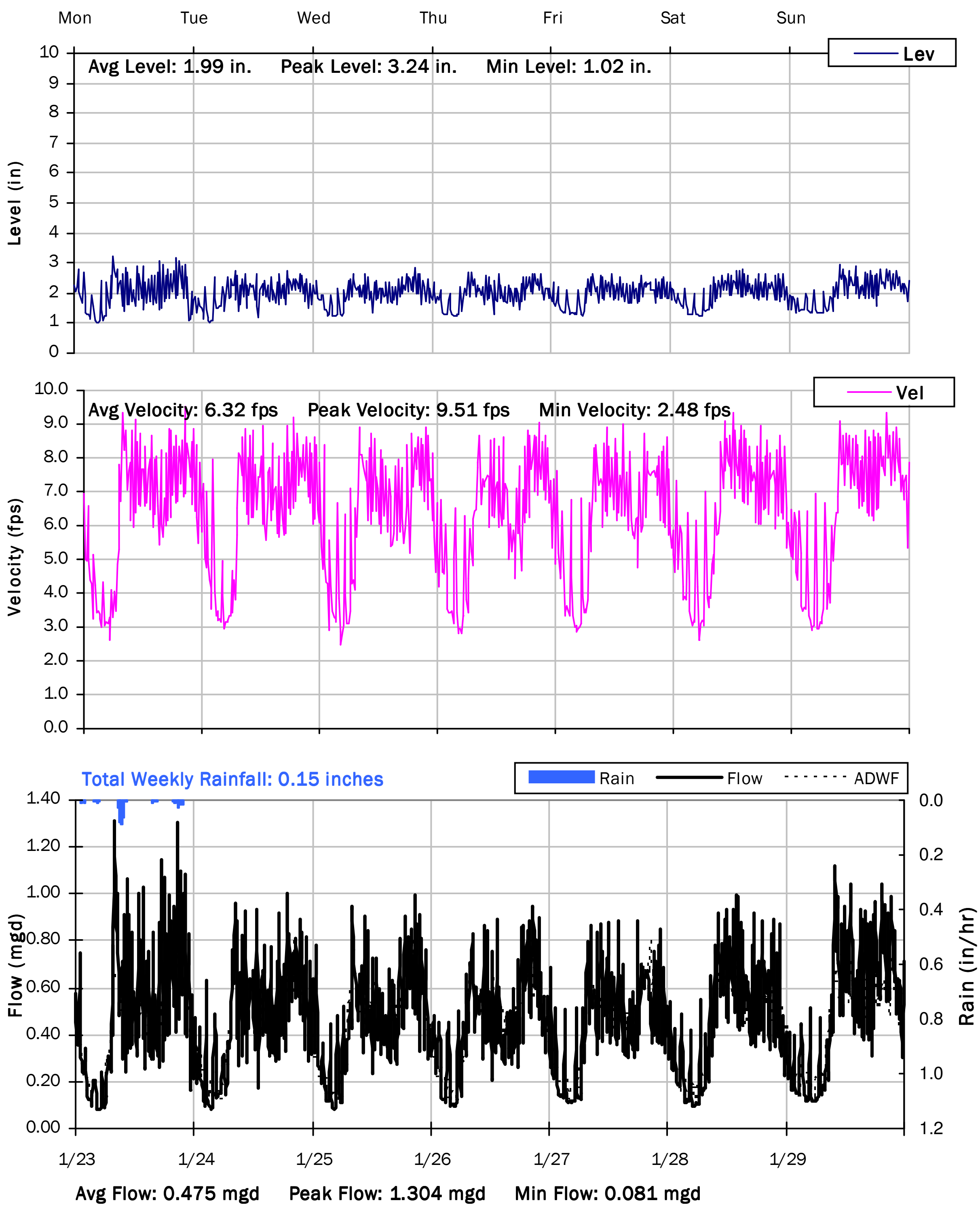






Avg Flow: 0.453 mgd **Peak Flow: 1.088 mgd** **Min Flow: 0.097 mgd**

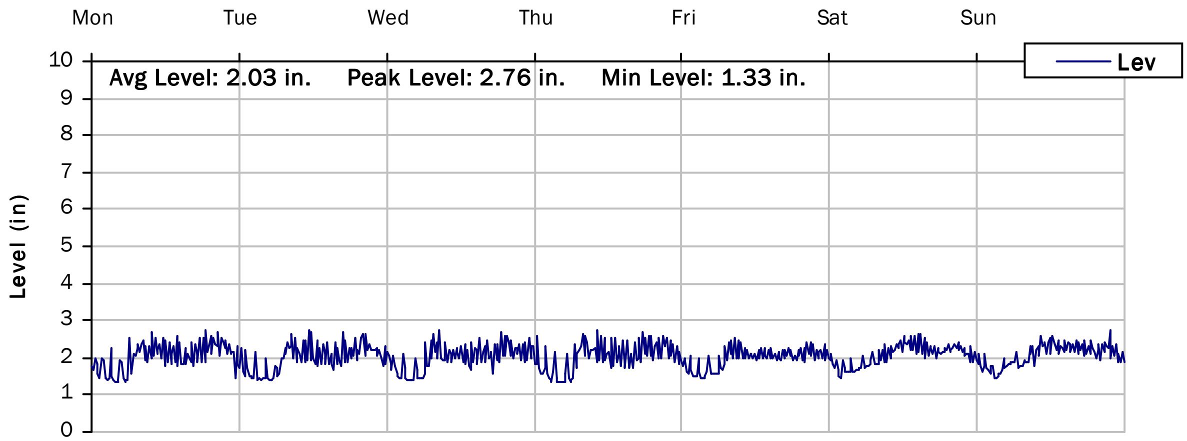
SITE 01
Weekly Level, Velocity and Flow Hydrographs
1/23/2017 to 1/30/2017

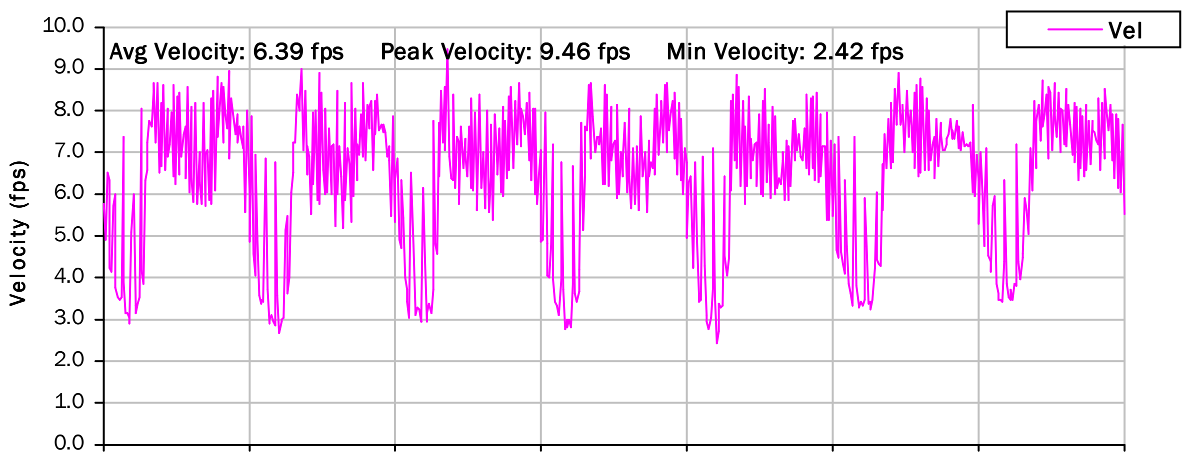


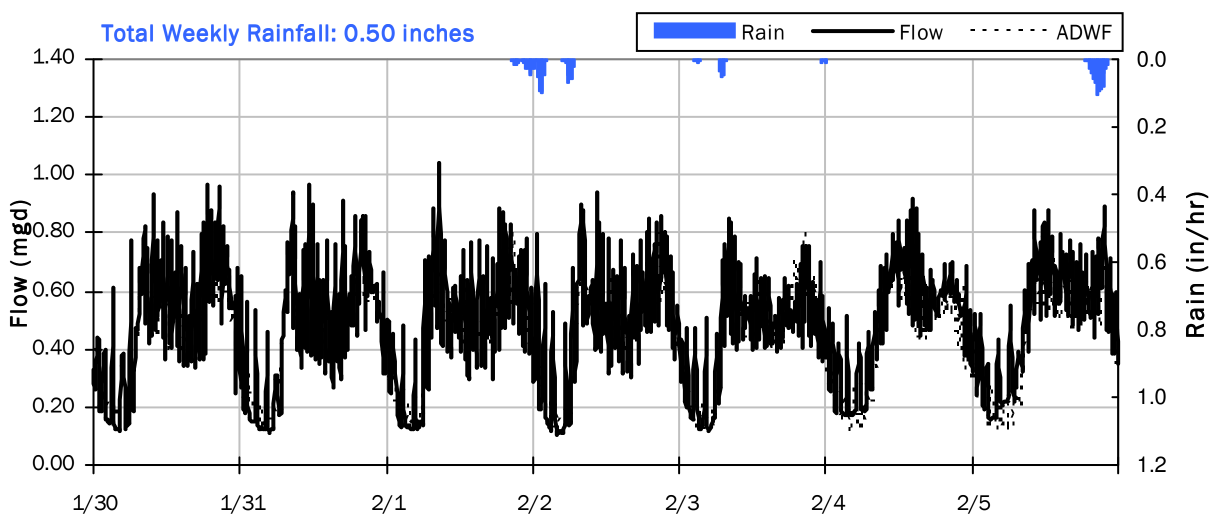
SITE 01

Weekly Level, Velocity and Flow Hydrographs

1/30/2017 to 2/6/2017





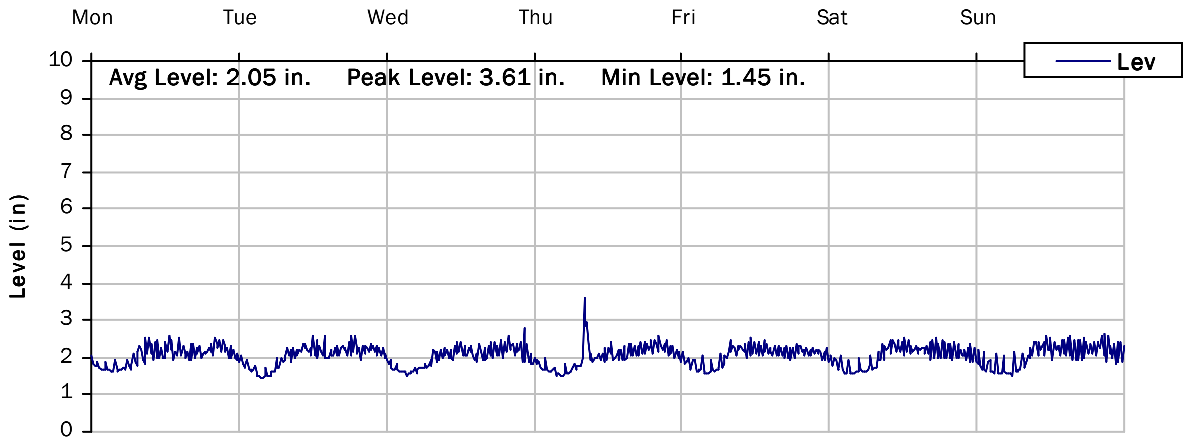


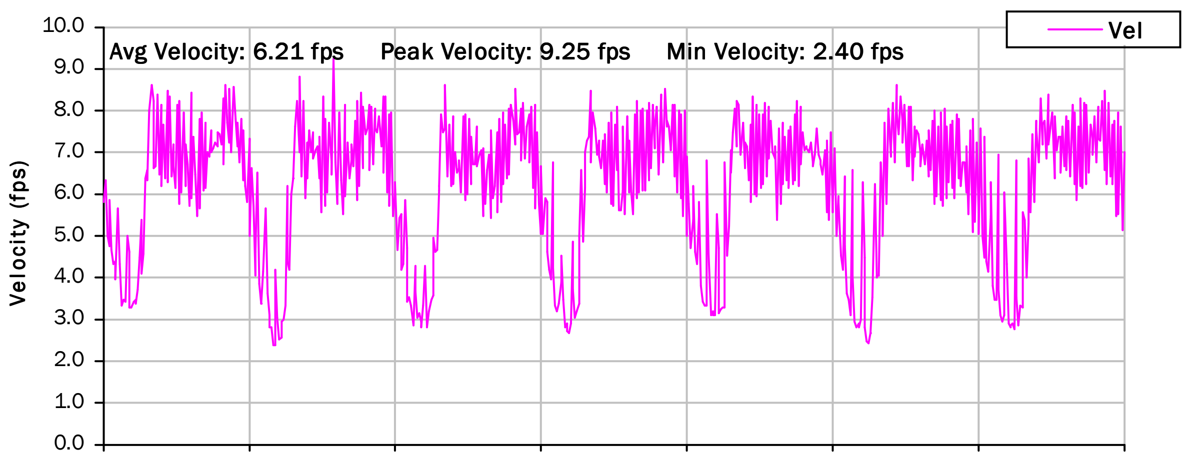
Avg Flow: 0.484 mgd **Peak Flow: 1.046 mgd** **Min Flow: 0.106 mgd**

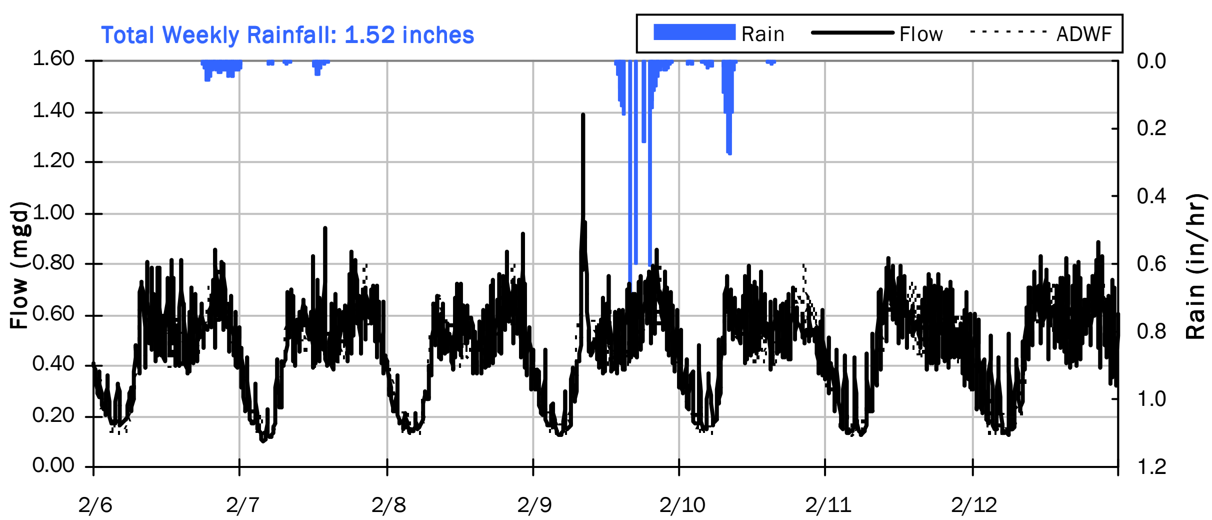
SITE 01

Weekly Level, Velocity and Flow Hydrographs

2/6/2017 to 2/13/2017

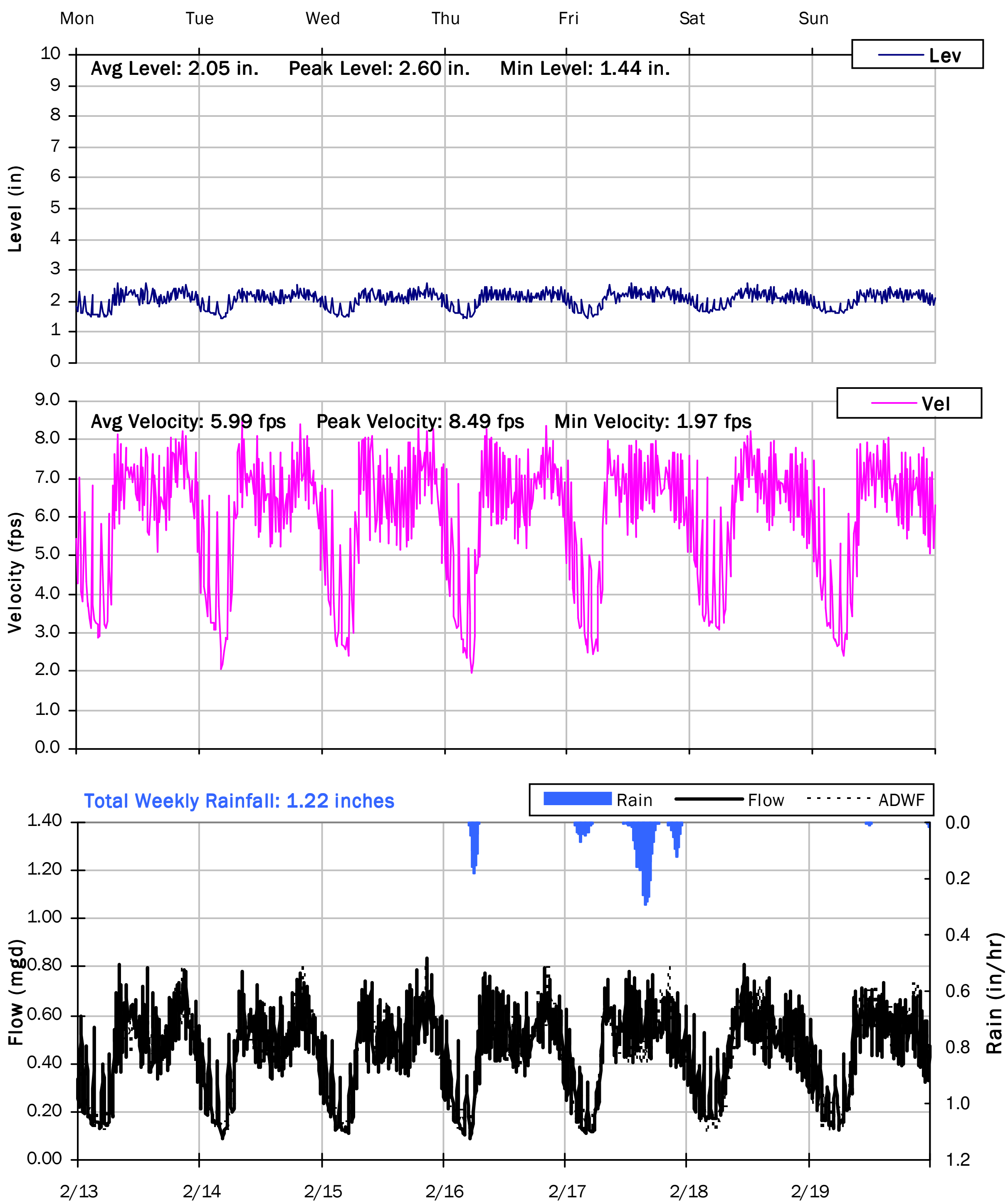






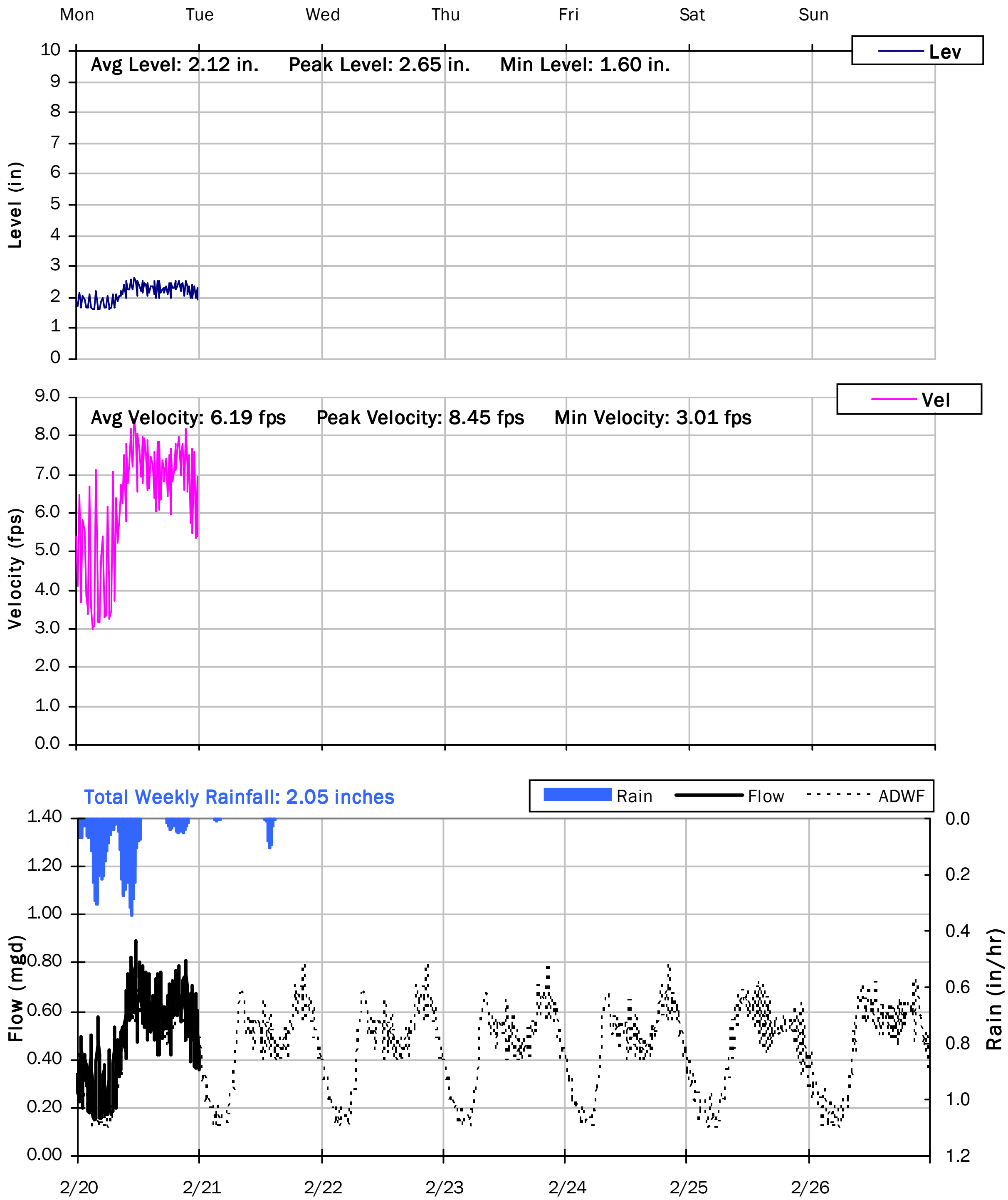
Avg Flow: 0.470 mgd **Peak Flow: 1.384 mgd** **Min Flow: 0.104 mgd**

SITE 01
Weekly Level, Velocity and Flow Hydrographs
2/13/2017 to 2/20/2017



Avg Flow: 0.454 mgd **Peak Flow: 0.834 mgd** **Min Flow: 0.089 mgd**

SITE 01
Weekly Level, Velocity and Flow Hydrographs
2/20/2017 to 2/27/2017



Avg Flow: 0.495 mgd **Peak Flow: 0.883 mgd** **Min Flow: 0.152 mgd**

Marina Coast Water District

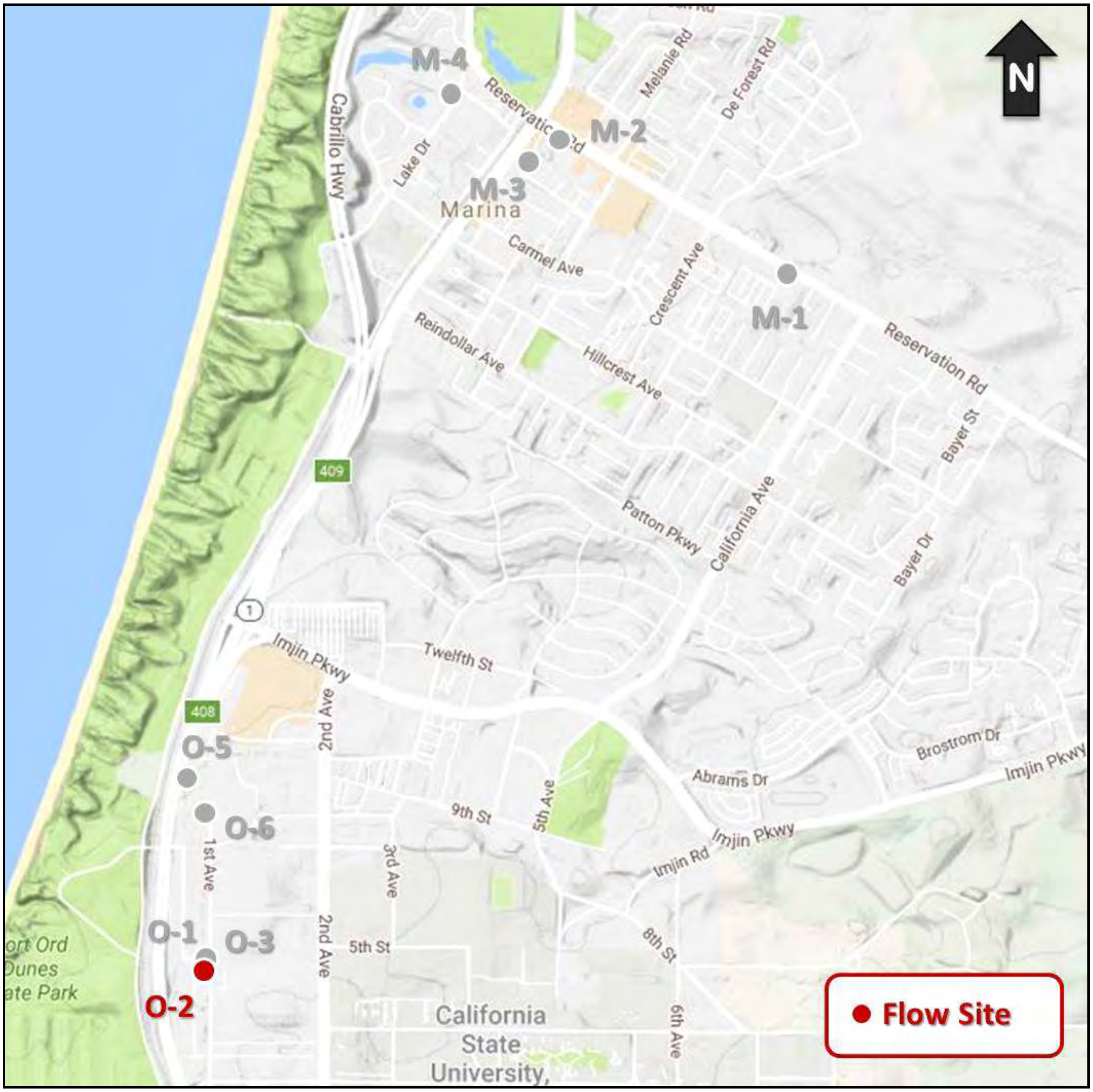
Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - March 2017

Monitoring Site: Site 02

Location: Open space southwest of intersection of 1st Avenue and 5th

Data Summary Report



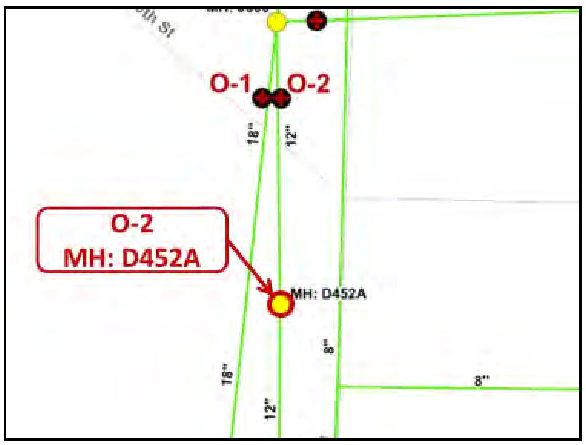
Vicinity Map: Site 02

SITE 02

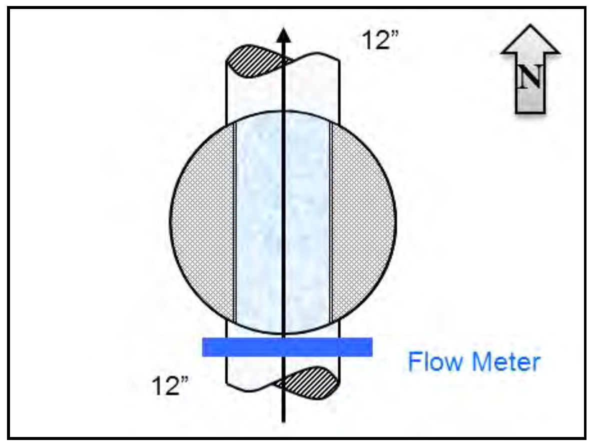
Site Information

Location:	Open space southwest of intersection of 1st Avenue and 5th Street
Coordinates:	121.8145° W, 36.6570° N
Pipe Diameter:	12 inches
ADWF:	0.075 mgd
Peak Measured Flow:	0.342 mgd

Satellite Map



Sewer Map



Flow Sketch


Street View


Plan View

SITE 02

Additional Site Photos

Effluent Pipe

Upper Influent Pipe

SITE 02

Additional Site Photos

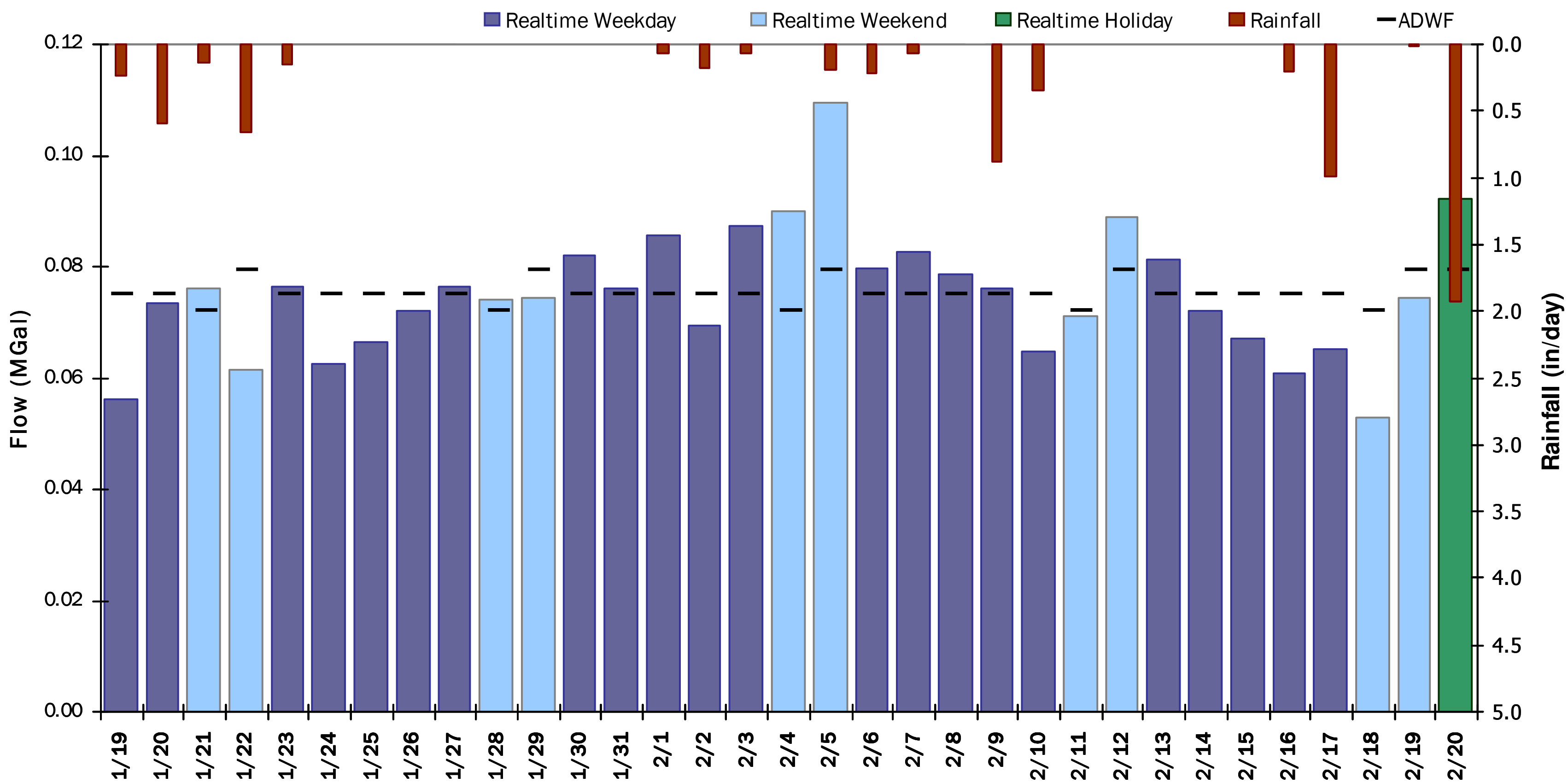
Lower Influent Pipe

SITE 02

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.075 MGal **Peak Daily Flow: 0.109 MGal** **Min Daily Flow: 0.053 MGal**

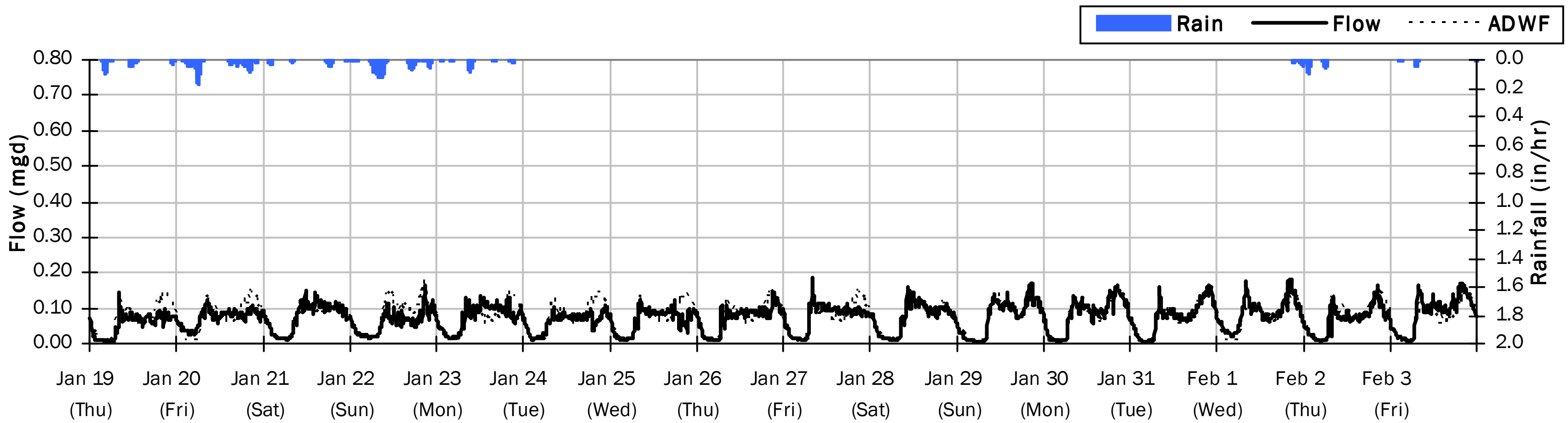
Total Period Rainfall: 6.93 inches

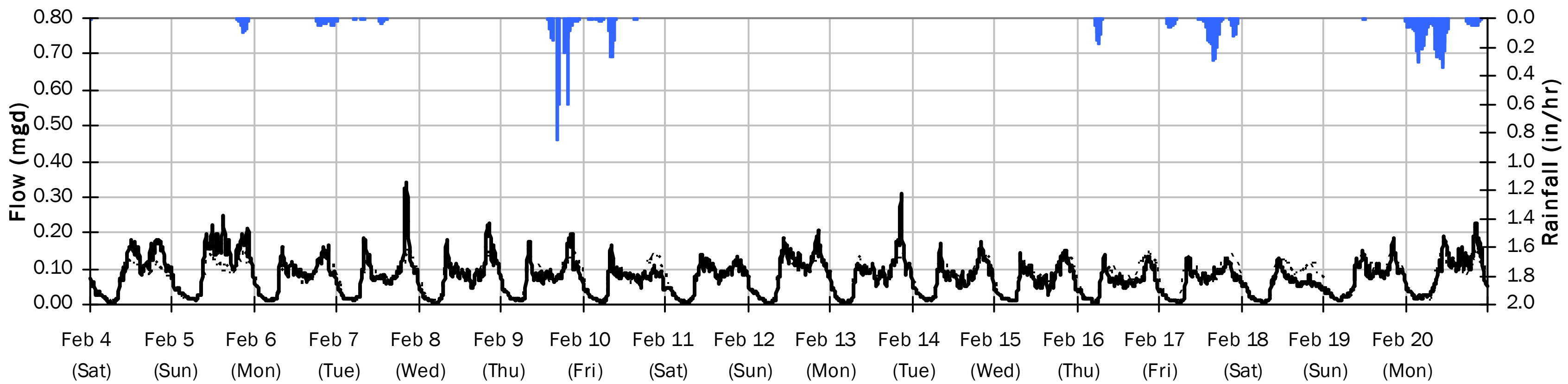


SITE 02

Flow Summary: 1/19/2017 to 2/20/2017

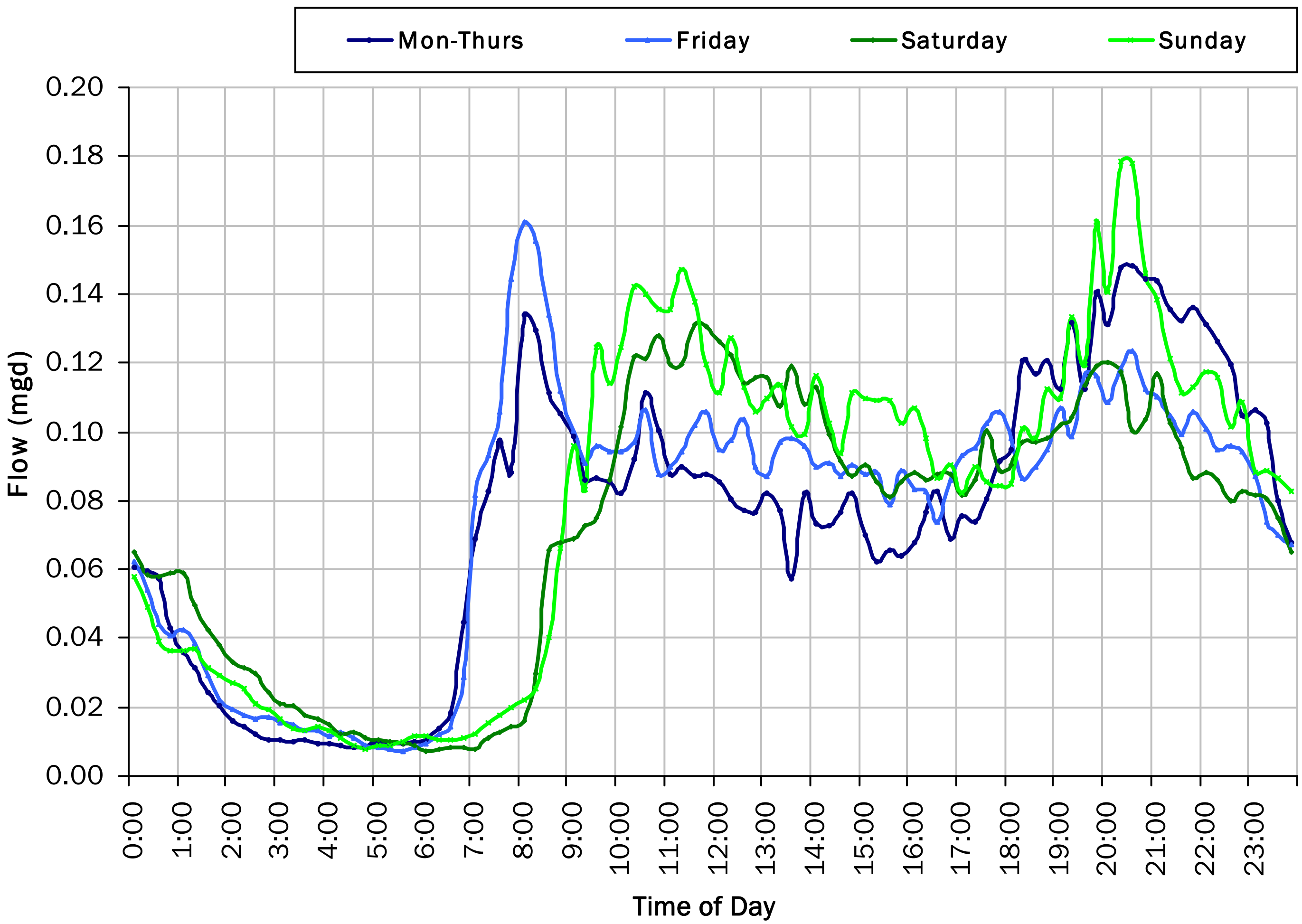
Total Period Rainfall: 6.93 inches   **Avg Flow: 0.075 mgd**   **Peak Flow: 0.342 mgd**   **Min Flow: 0.004 mgd**





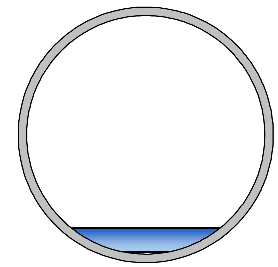
SITE 02

Average Dry Weather Flow Hydrographs



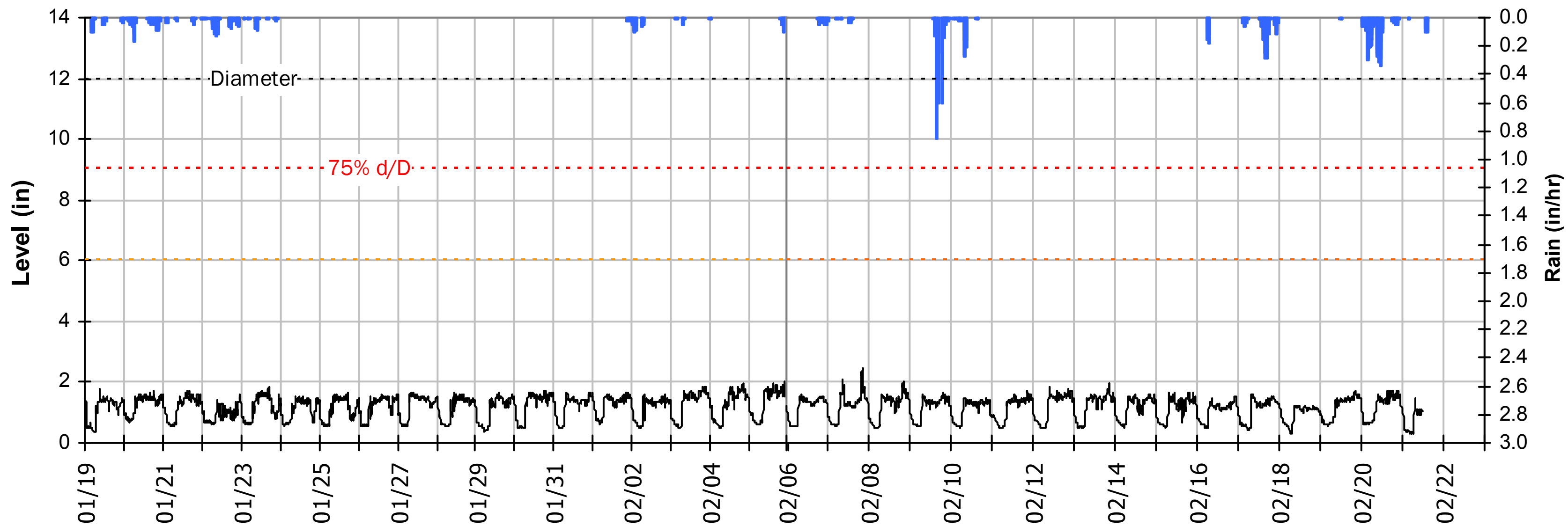
ADWF:

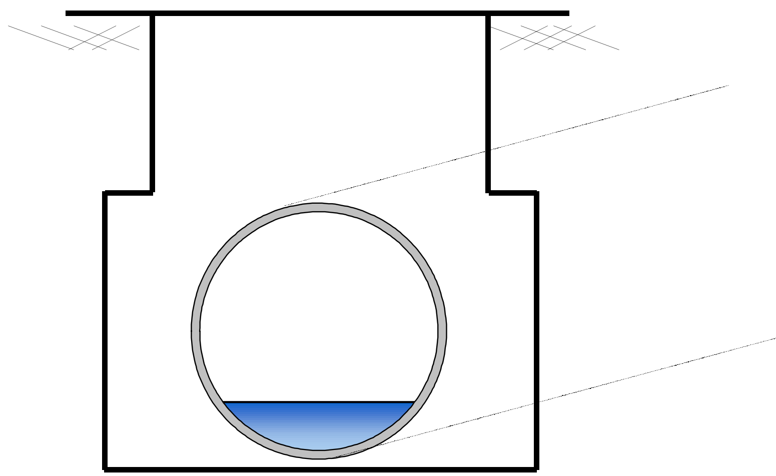
0.075 *mgd*



SITE 02
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



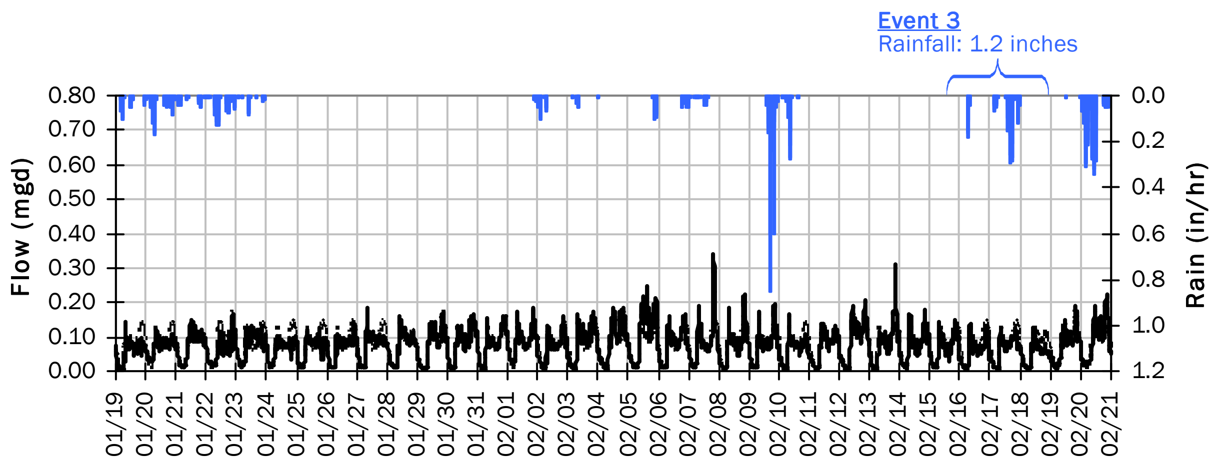


Pipe Diameter:	12	*inches*
Peak Measured Level:	2.46	*inches*
Peak d/D Ratio:	0.21	

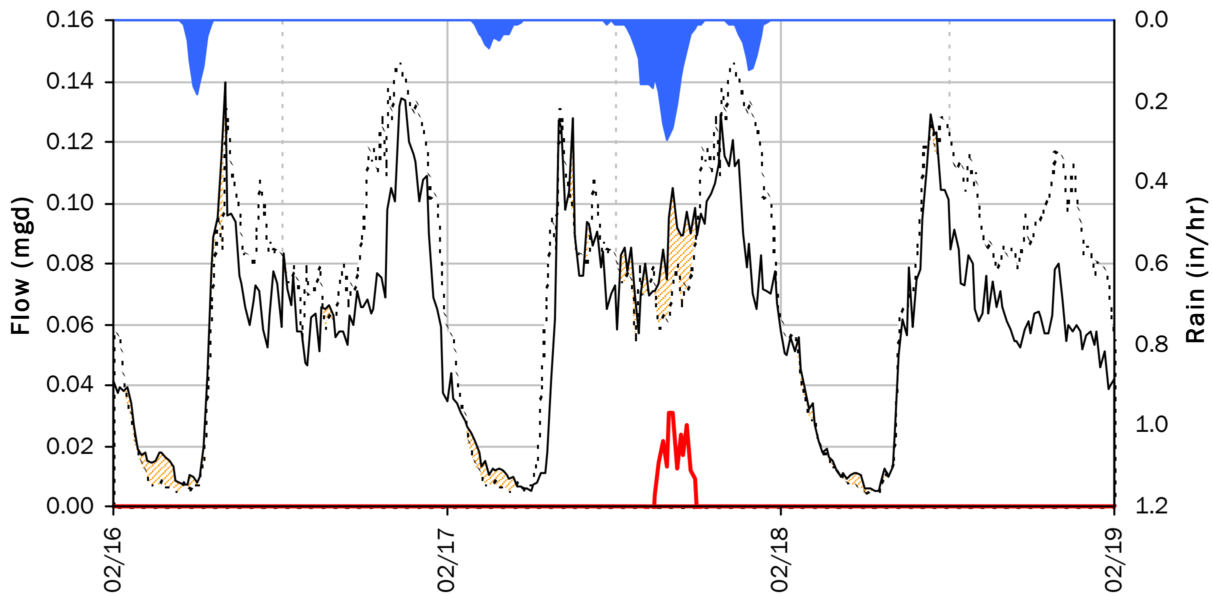
SITE 02

I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



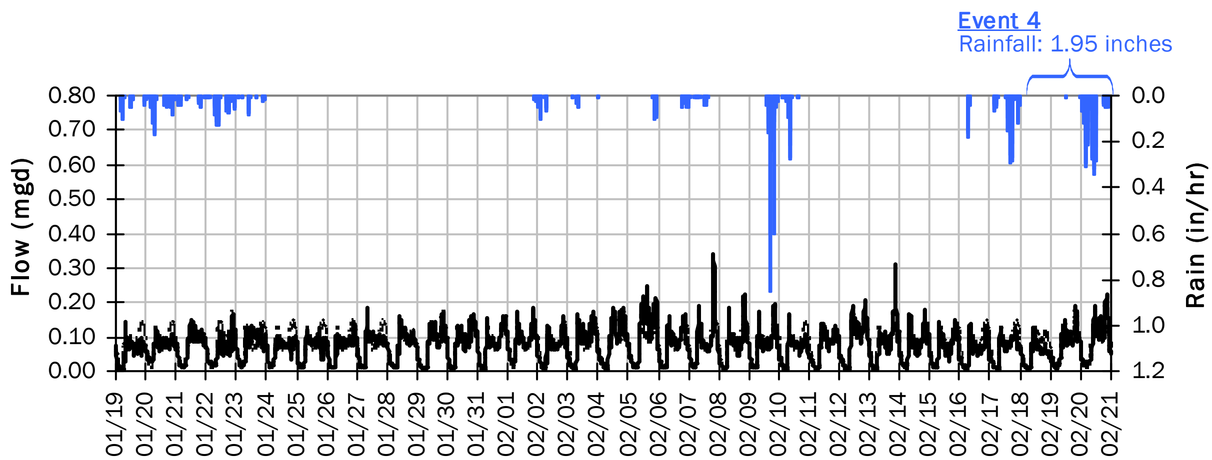
Storm Event I/I Analysis (Rain = 1.20 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.10 *mgd*	**Peak I/I Rate:**	0.03 *mgd*
PF:	1.39	**Total I/I:**	2,000 *gallons*
Peak Level:	1.46 *in*		
d/D Ratio:	0.12		

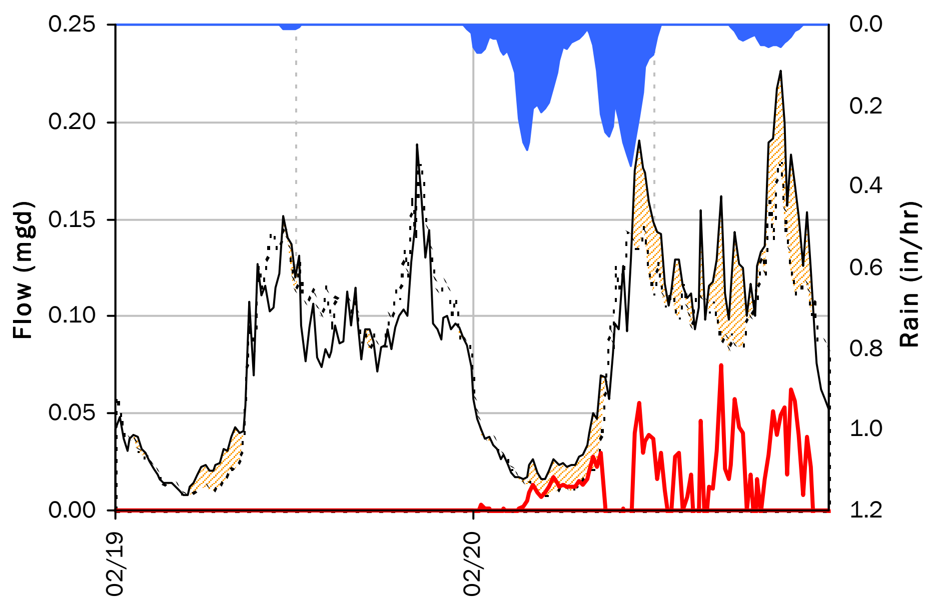
SITE 02

I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



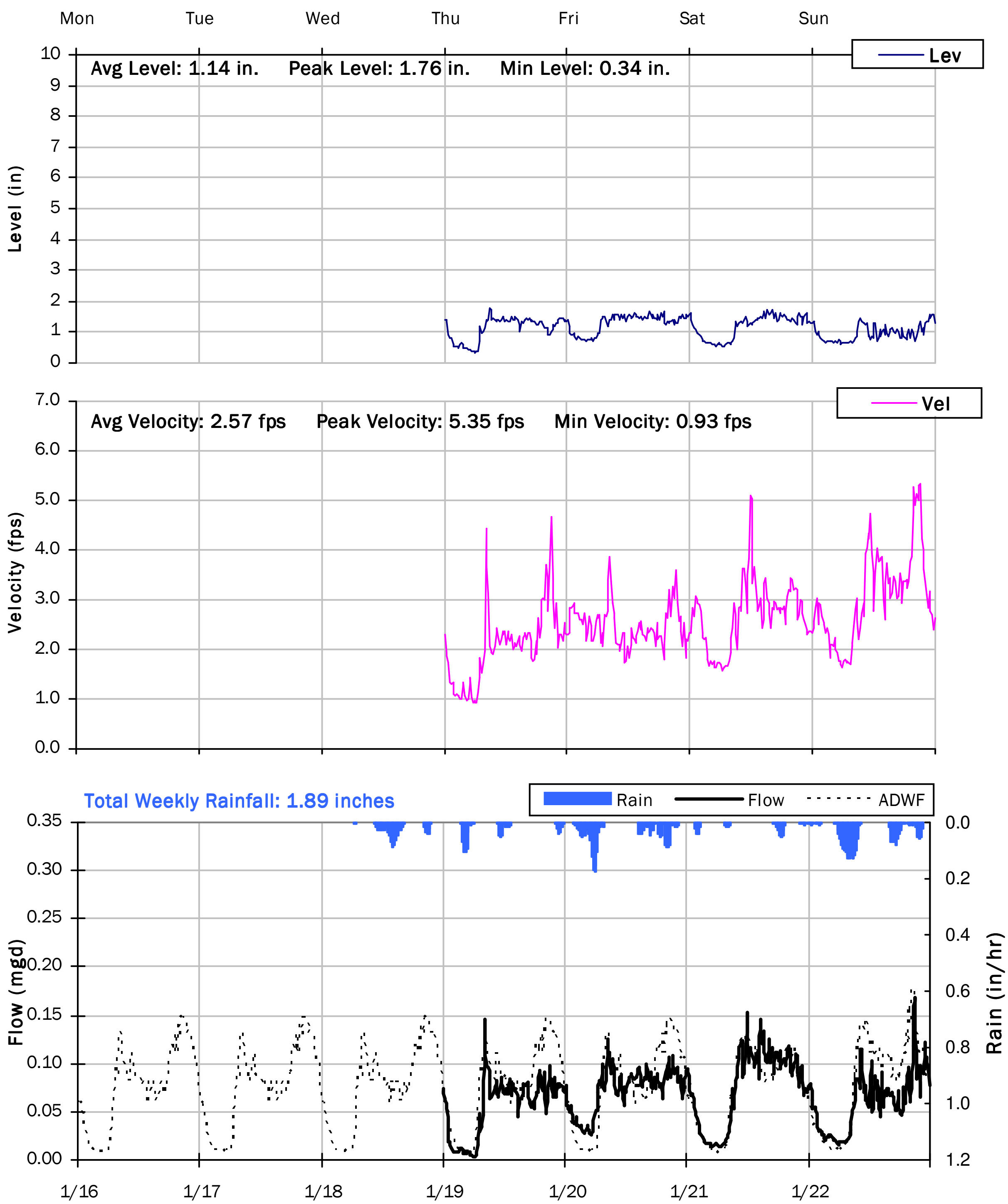
Event 4 Detail Graph



Storm Event I/I Analysis (Rain = 1.95 inches)

Capacity		**Inflow / Infiltration**	
Peak Flow:	0.23 *mgd*	**Peak I/I Rate:**	0.07 *mgd*
PF:	3.01	**Total I/I:**	13,000 *gallons*
Peak Level:	1.73 *in*		
d/D Ratio:	0.14		

SITE 02
Weekly Level, Velocity and Flow Hydrographs
1/16/2017 to 1/23/2017

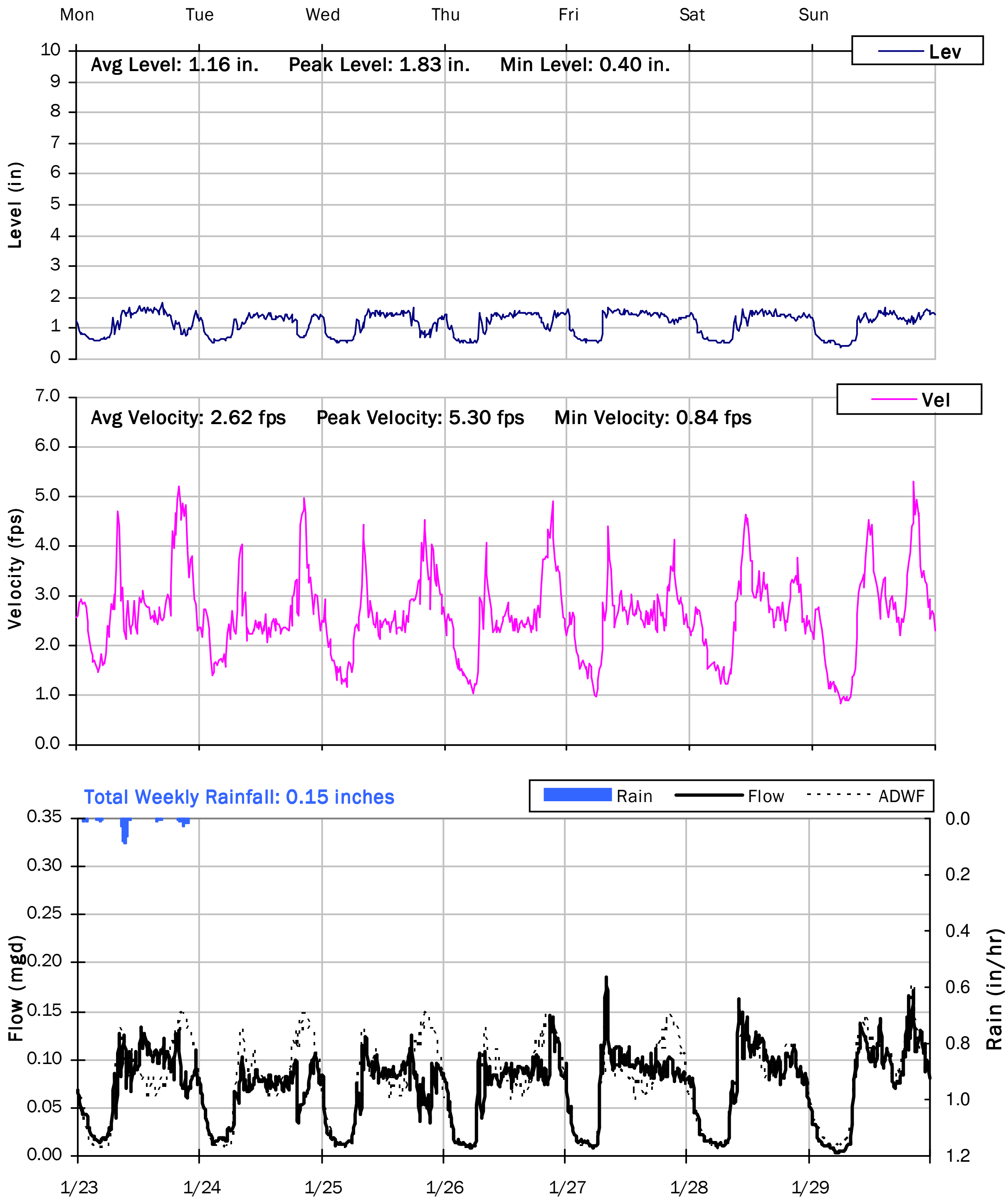


Avg Flow: 0.067 mgd **Peak Flow: 0.166 mgd** **Min Flow: 0.004 mgd**

SITE 02

Weekly Level, Velocity and Flow Hydrographs

1/23/2017 to 1/30/2017

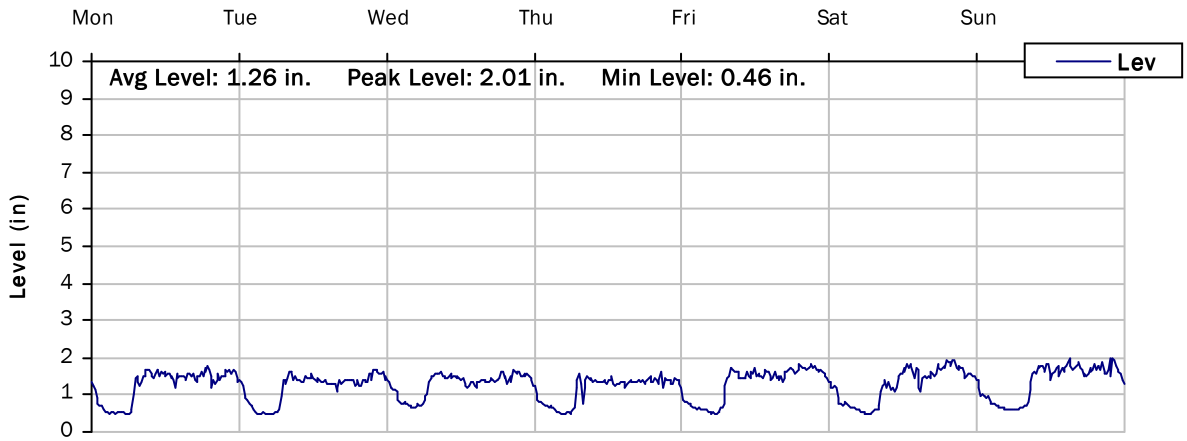


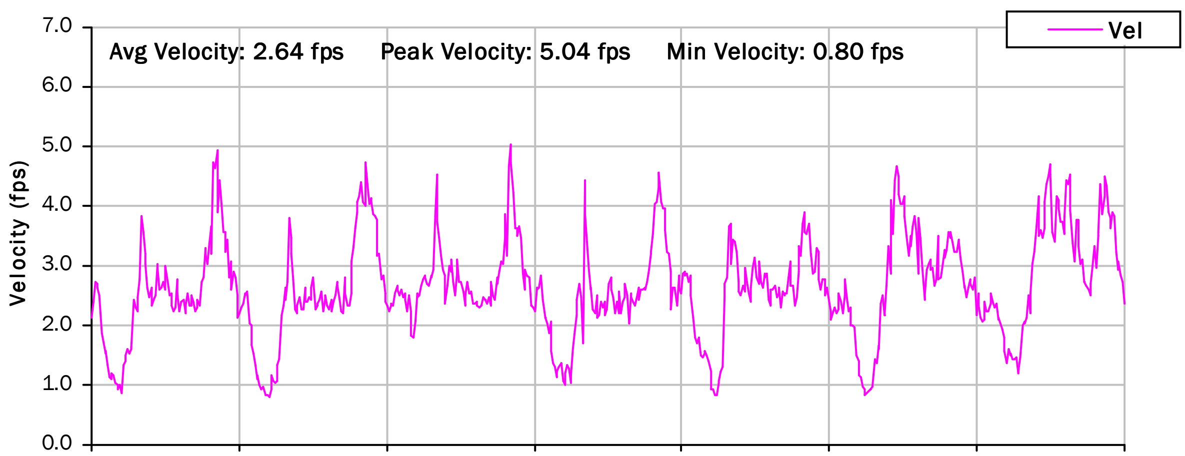
Avg Flow: 0.072 mgd Peak Flow: 0.185 mgd Min Flow: 0.004 mgd

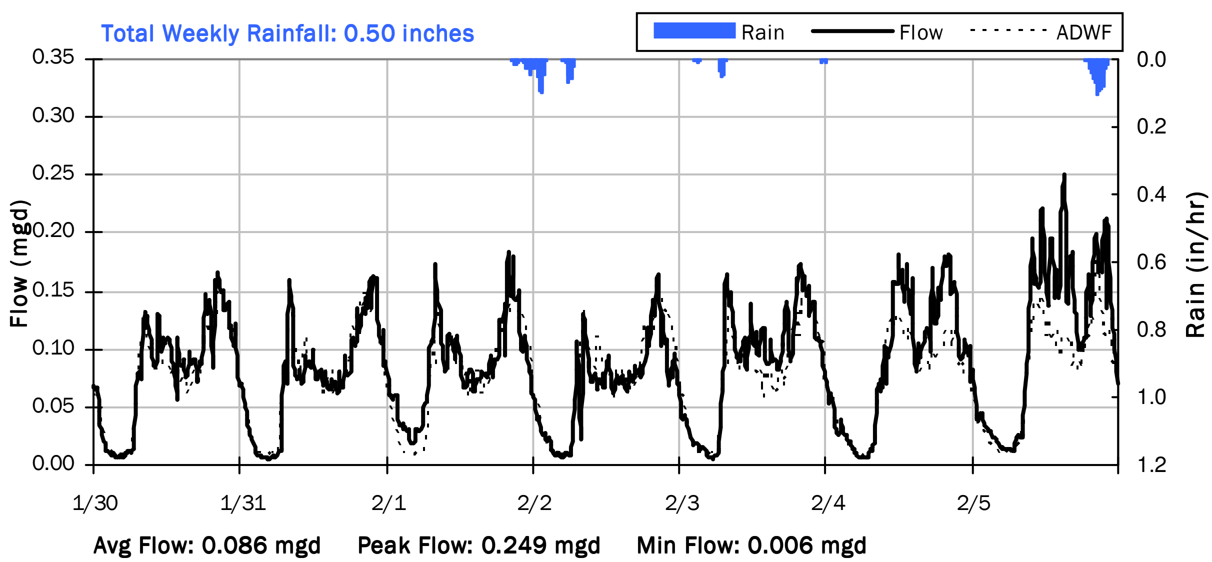
SITE 02

Weekly Level, Velocity and Flow Hydrographs

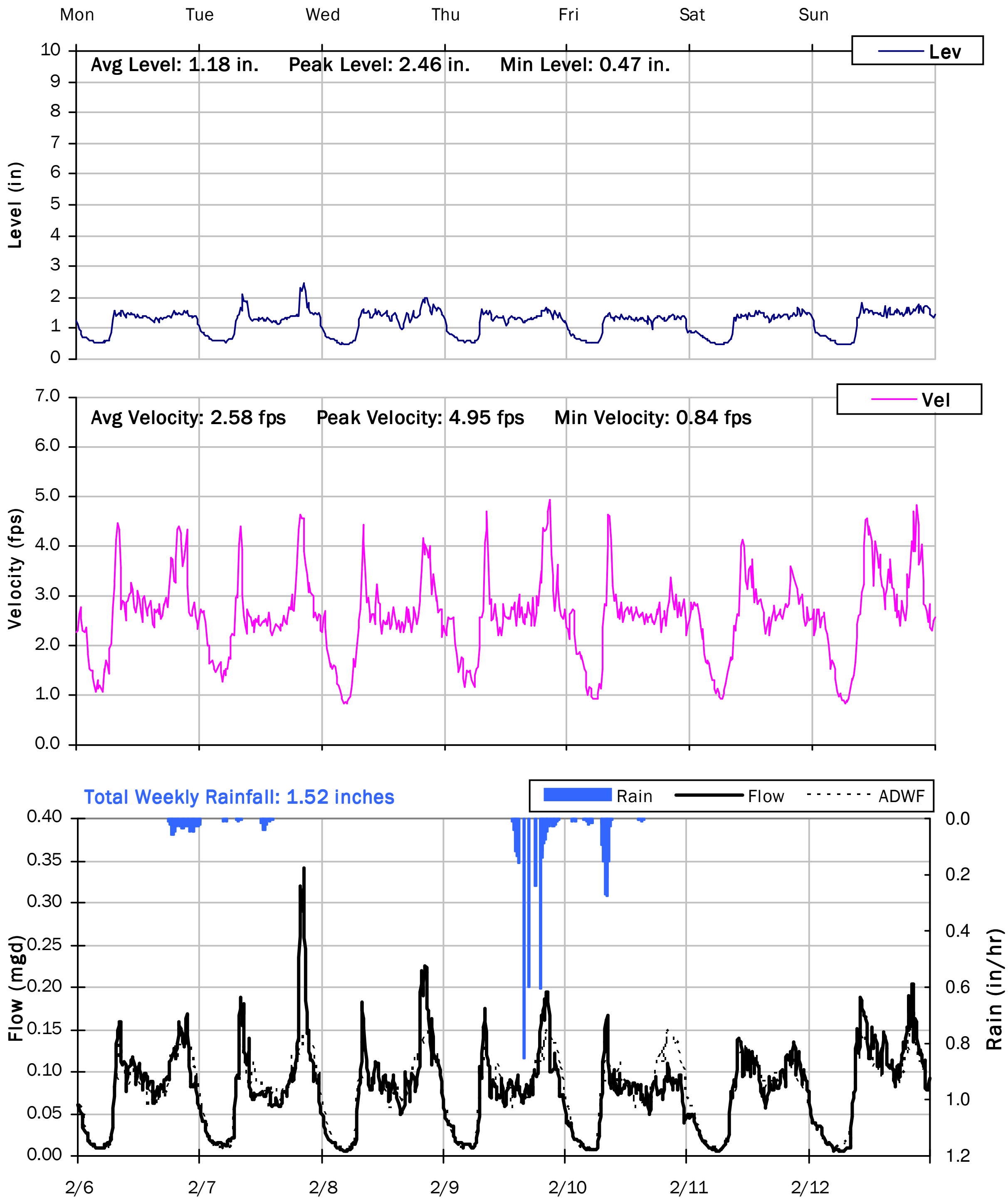
1/30/2017 to 2/6/2017





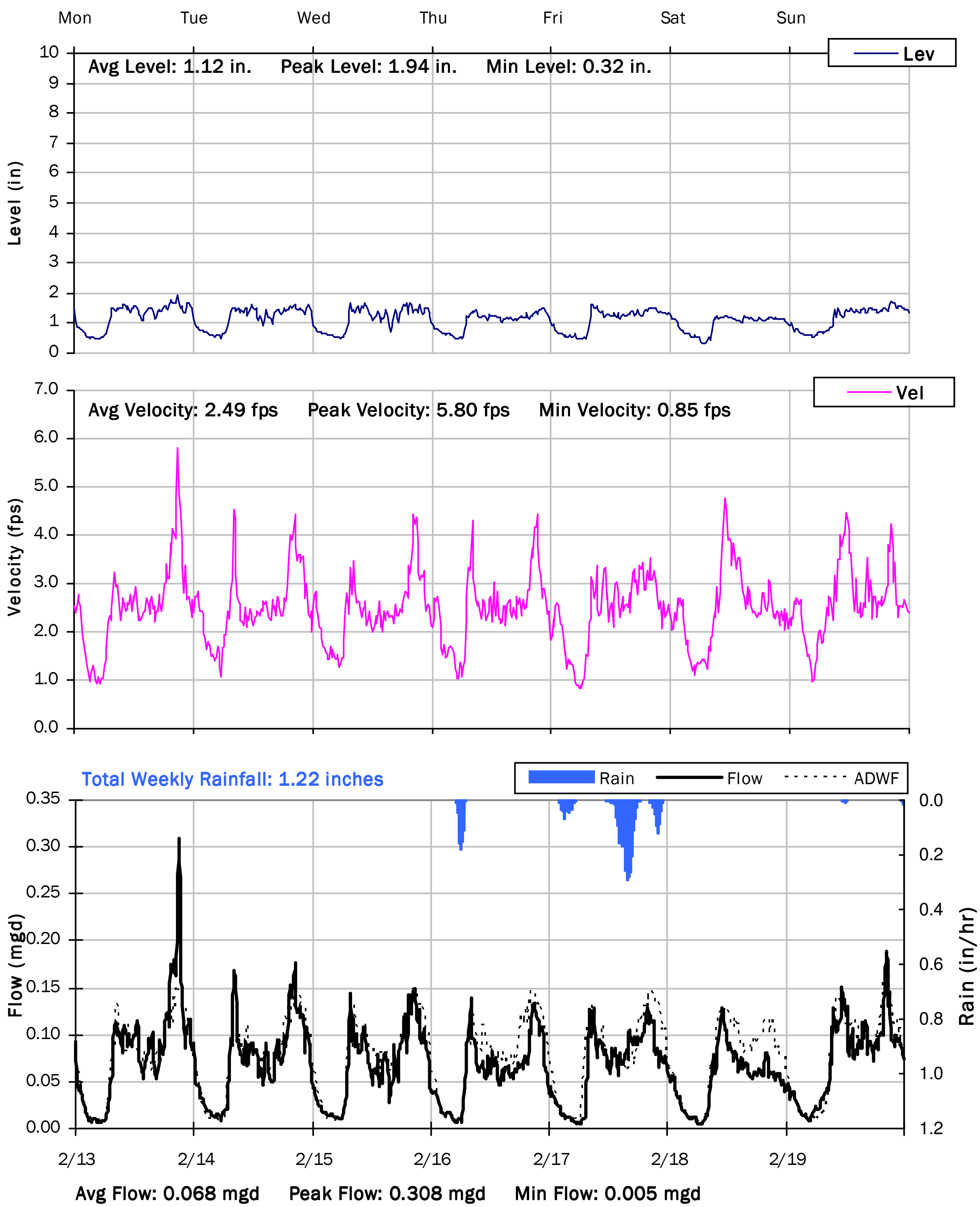


SITE 02
Weekly Level, Velocity and Flow Hydrographs
2/6/2017 to 2/13/2017



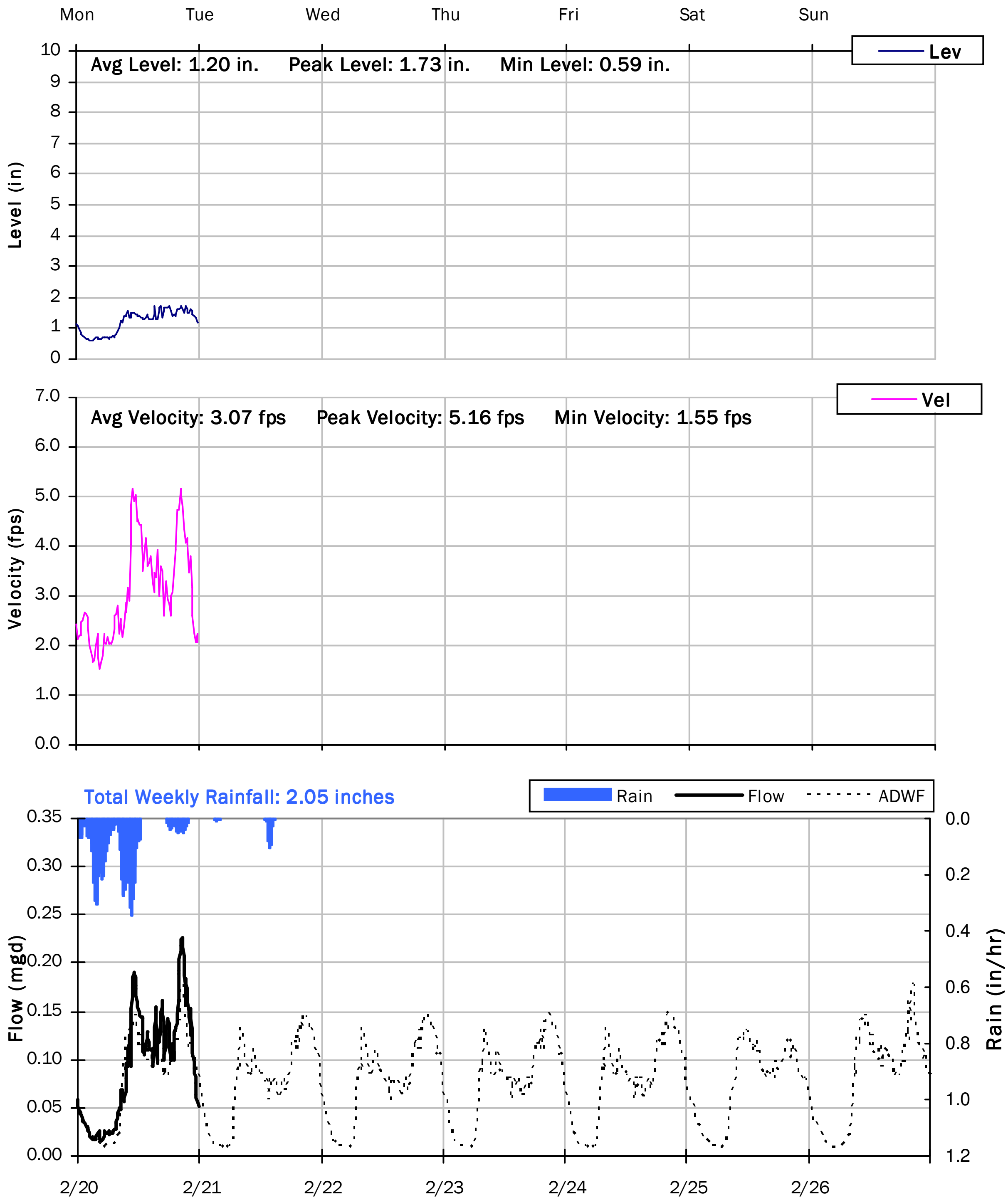
Avg Flow: 0.077 mgd Peak Flow: 0.342 mgd Min Flow: 0.006 mgd

SITE 02
Weekly Level, Velocity and Flow Hydrographs
2/13/2017 to 2/20/2017



SITE 02

Weekly Level, Velocity and Flow Hydrographs
2/20/2017 to 2/27/2017



Avg Flow: 0.092 mgd   Peak Flow: 0.227 mgd   Min Flow: 0.016 mgd

Marina Coast Water District

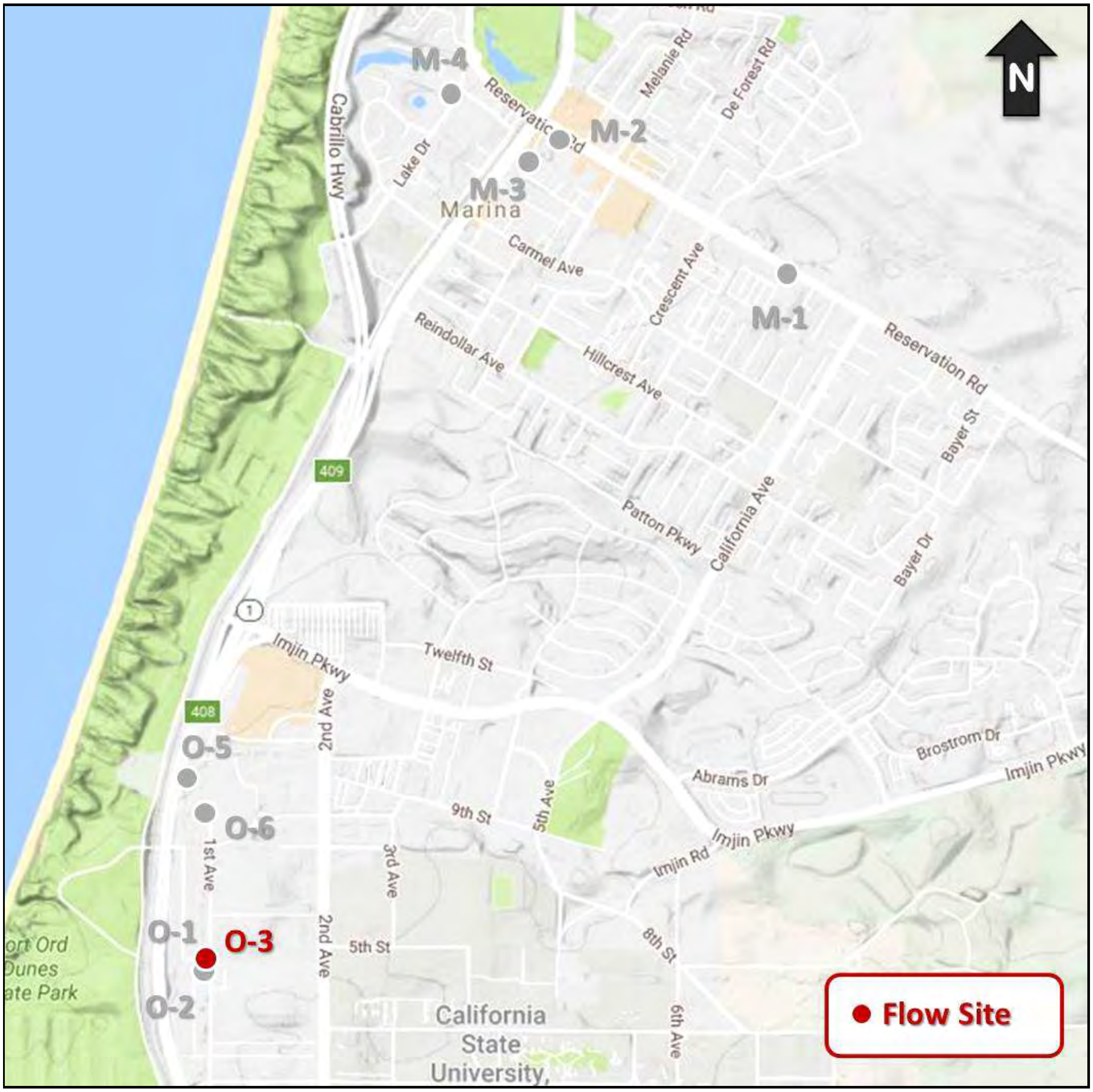
Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - March 2017

Monitoring Site: Site 03

Location: Lot northwest of intersection of 1st Avenue and 5th Street

Data Summary Report



Vicinity Map: Site 03

SITE 03

Site Information

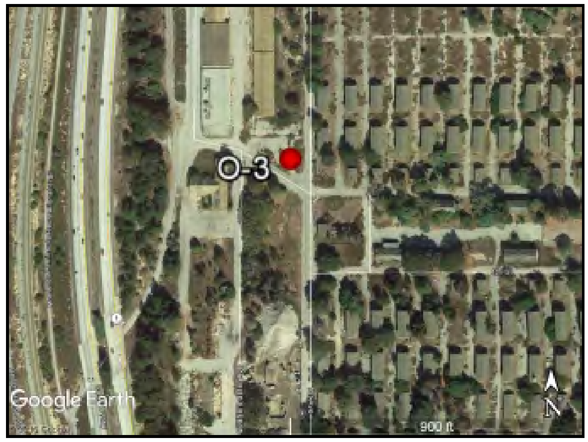
Location: Lot northwest of intersection of 1st Avenue and 5th Street

Coordinates: 121.8145° W, 36.6573° N

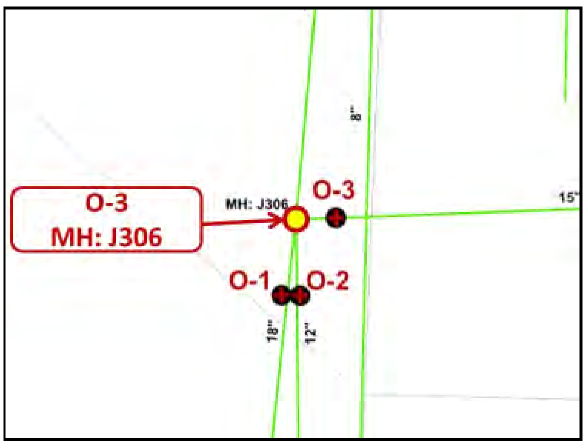
Pipe Diameter: 15 inches

ADWF: 0.172 mgd

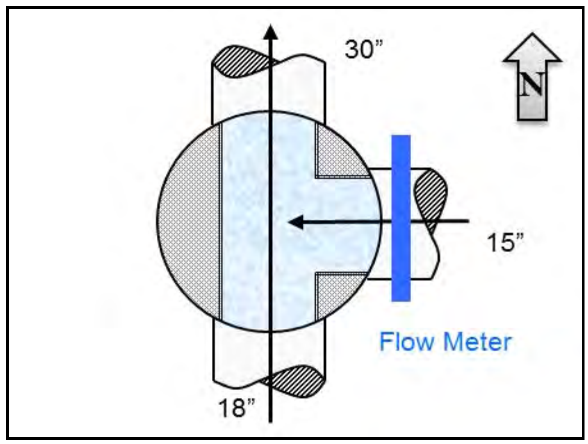
Peak Measured Flow: 1.068 mgd



Satellite Map



Sewer Map



Flow Sketch

Street View

Plan View

SITE 03

Additional Site Photos

Effluent Pipe

South Influent Pipe

SITE 03

Additional Site Photos

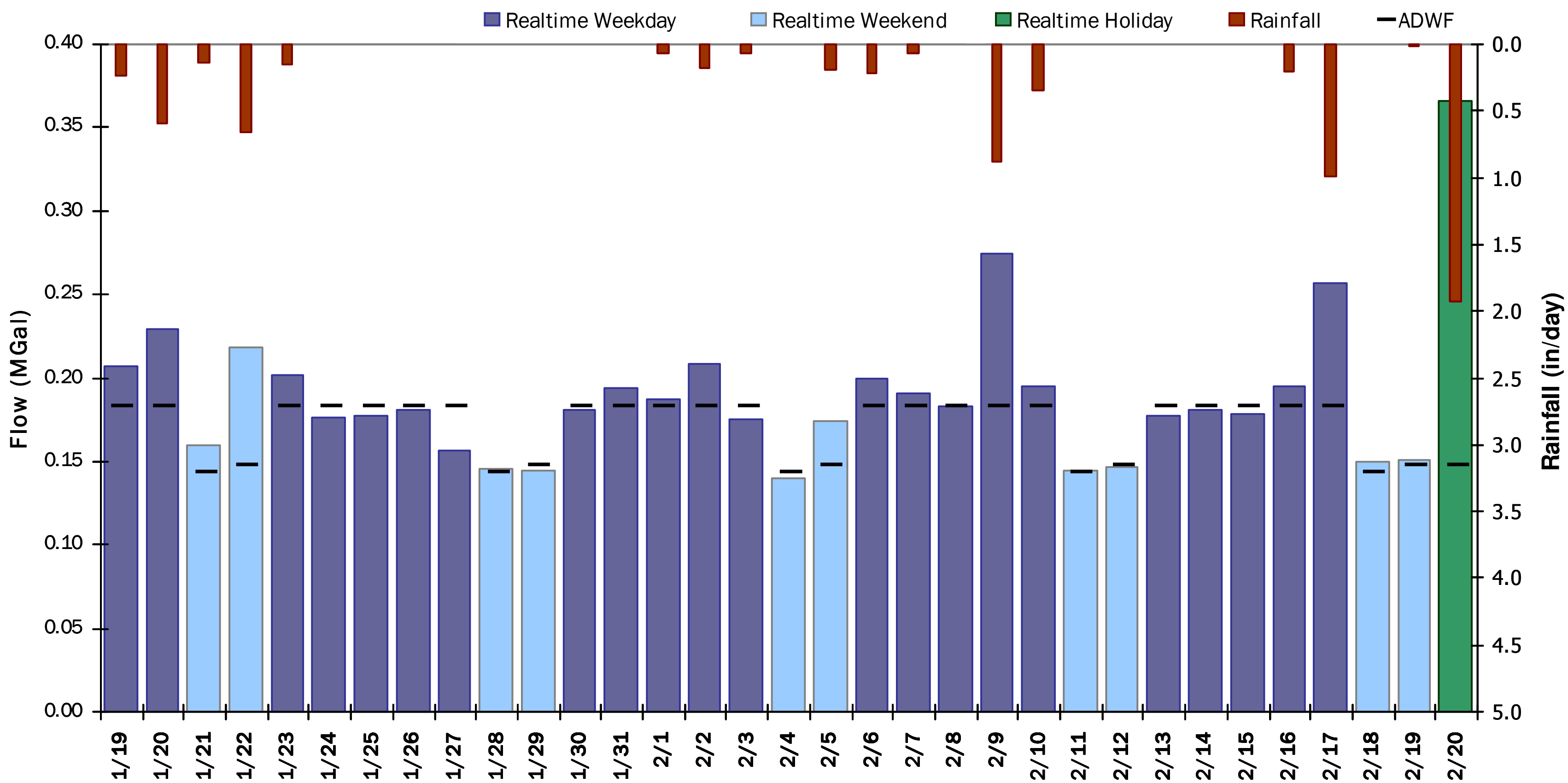
East Influent Pipe

SITE 03

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.189 MGal **Peak Daily Flow: 0.366 MGal** **Min Daily Flow: 0.140 MGal**

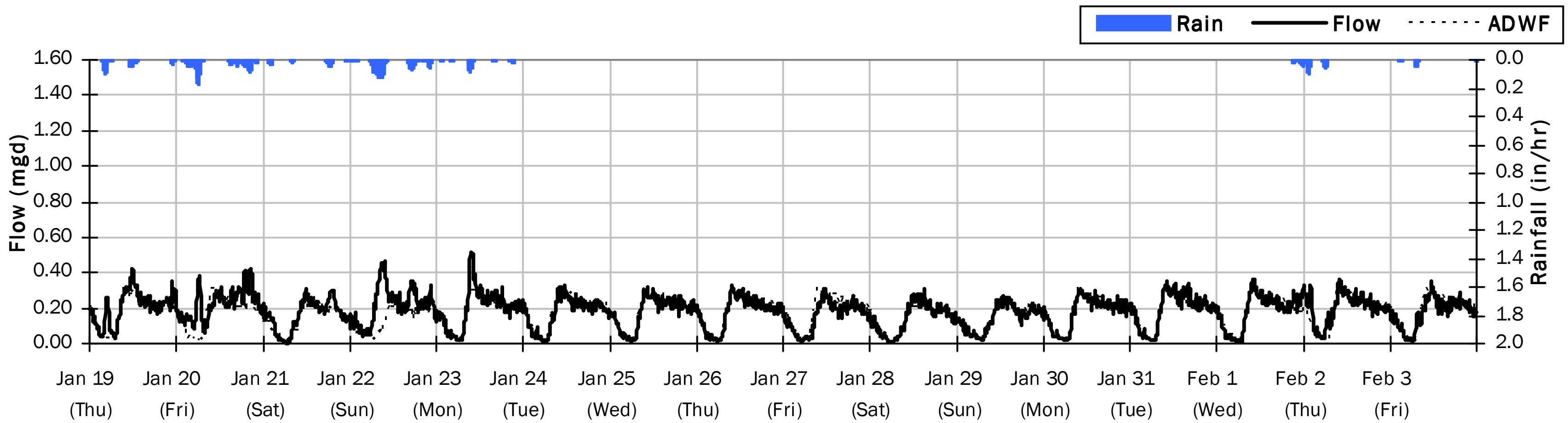
Total Period Rainfall: 6.93 inches

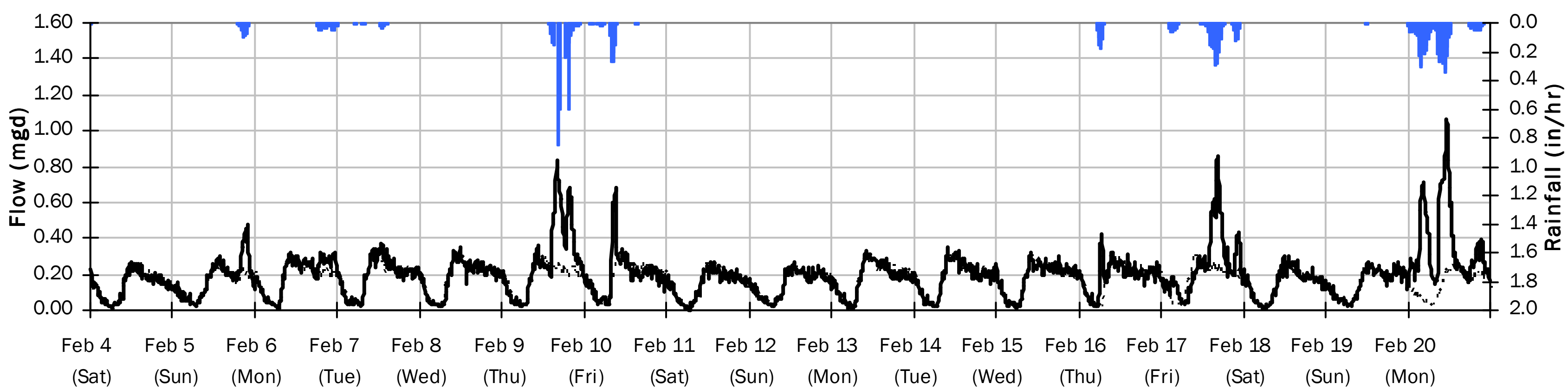


SITE 03

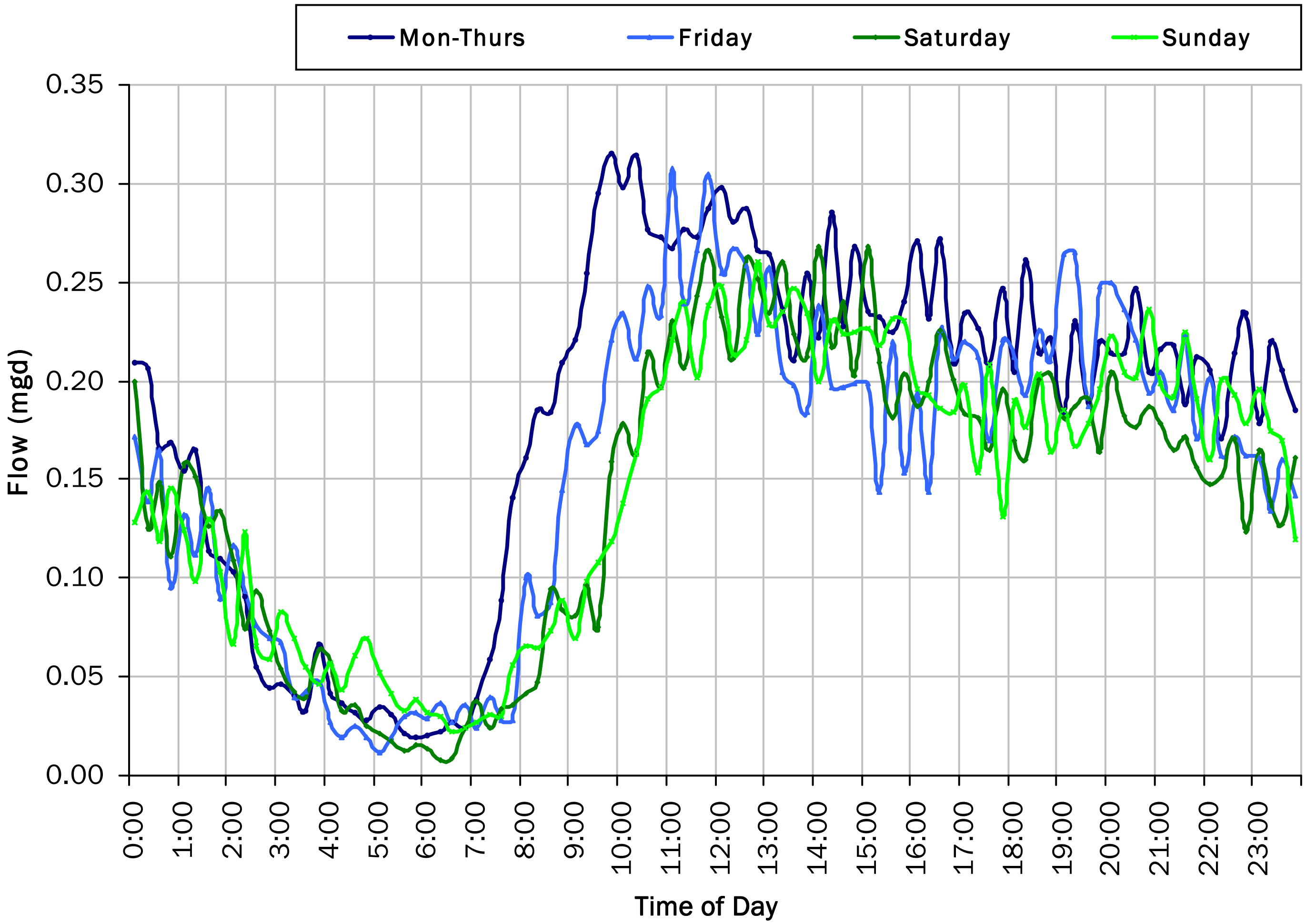
Flow Summary: 1/19/2017 to 2/20/2017

Total Period Rainfall: 6.93 inches Avg Flow: 0.189 mgd Peak Flow: 1.068 mgd Min Flow: 0.003 mgd

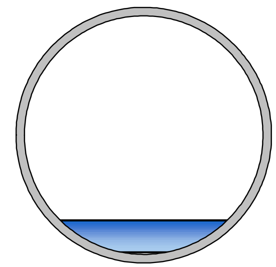




SITE 03
Average Dry Weather Flow Hydrographs



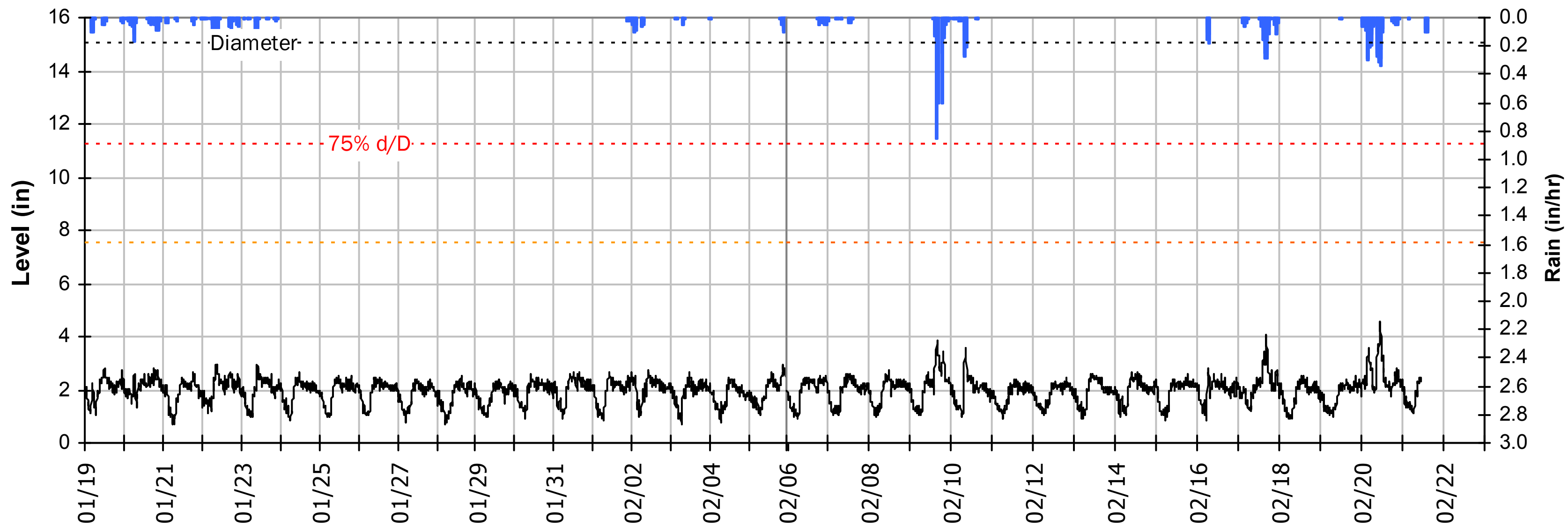
ADWF:
0.172 *mgd*

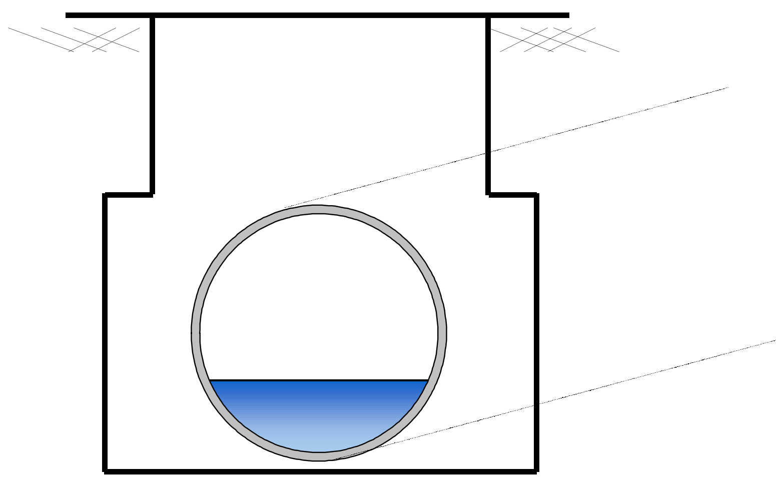


SITE 03

Site Capacity and Surcharge Summary

<u>Realtime Flow Levels with Rainfall Data over Monitoring Period</u>

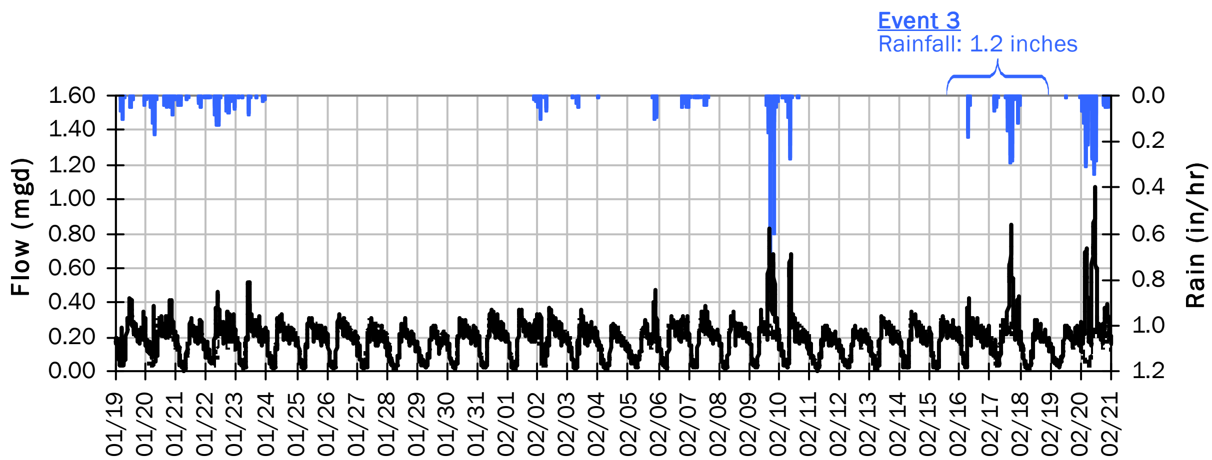




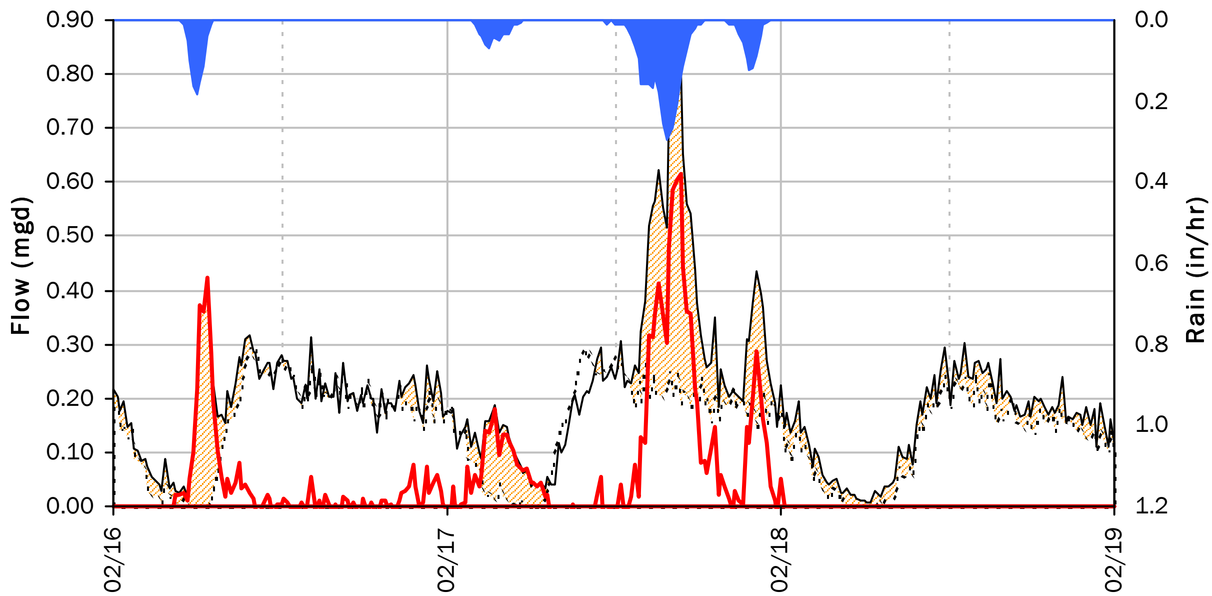
Pipe Diameter:	15	*inches*
Peak Measured Level:	4.58	*inches*
Peak d/D Ratio:	0.31	

SITE 03
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph

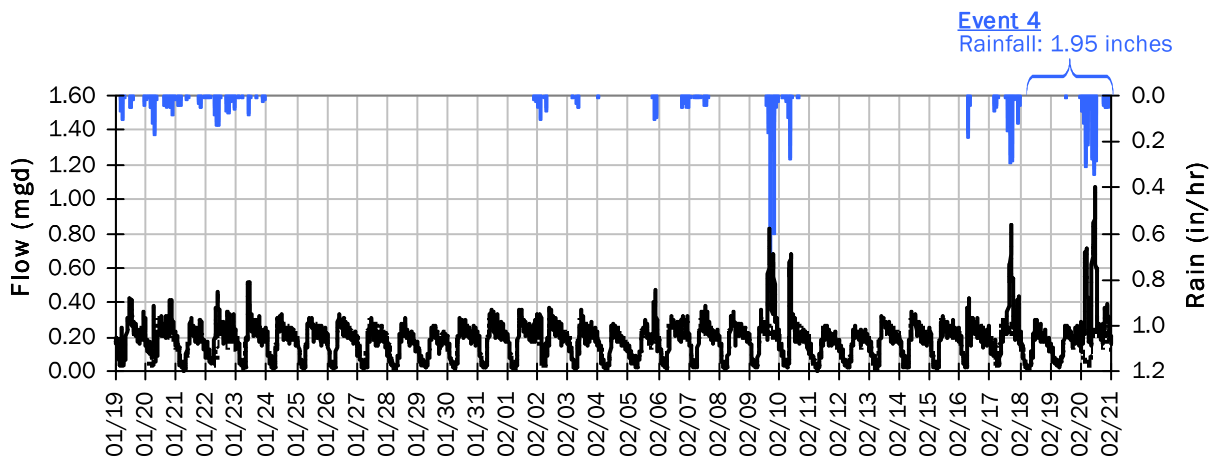


Storm Event I/I Analysis (Rain = 1.20 inches)

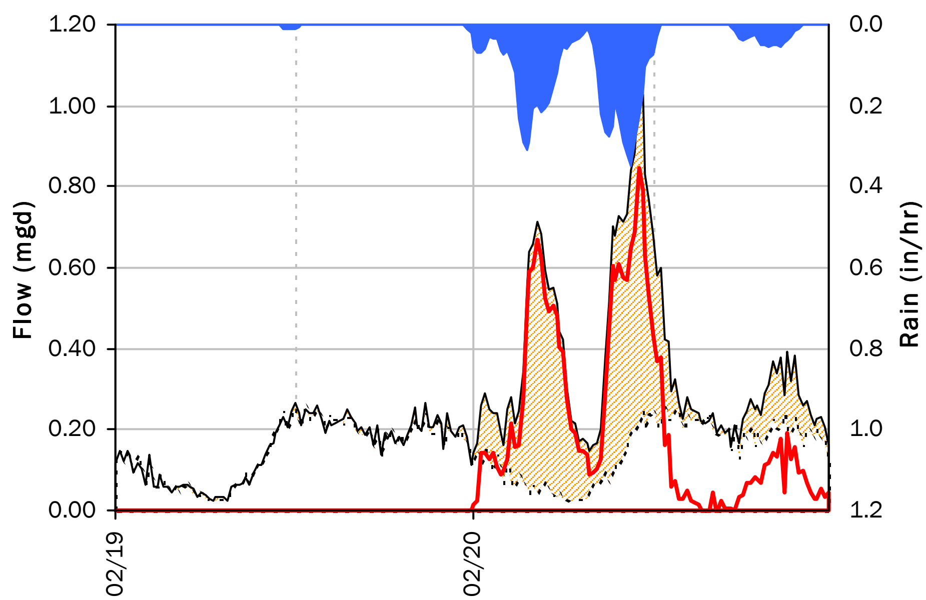
Capacity		Inflow / Infiltration	
Peak Flow:	0.85 *mgd*	**Peak I/I Rate:**	0.62 *mgd*
PF:	4.99	**Total I/I:**	132,000 *gallons*
Peak Level:	4.06 *in*		
d/D Ratio:	0.27		

SITE 03
I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 4 Detail Graph



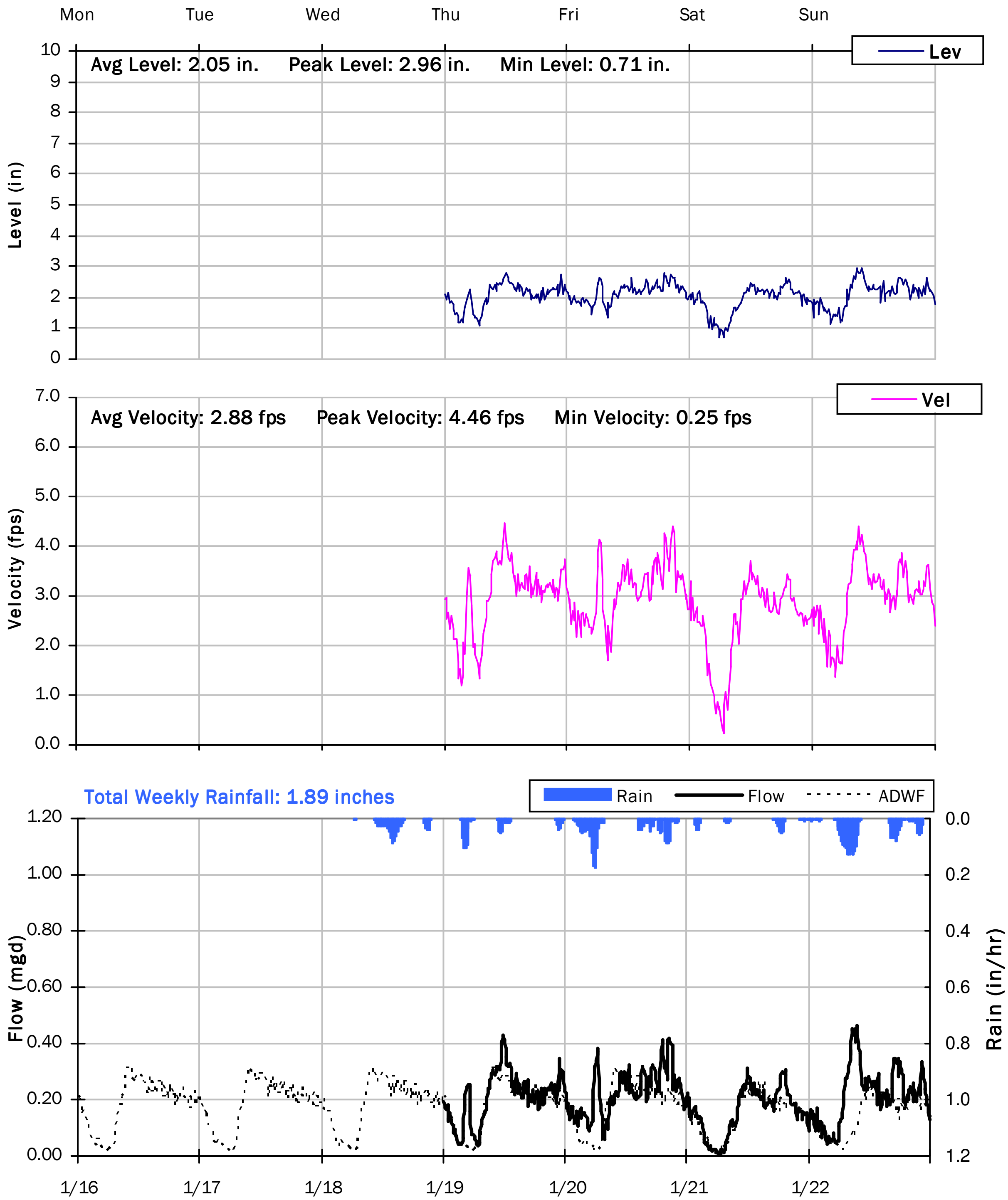
Storm Event I/I Analysis (Rain = 1.95 inches)

Capacity		**Inflow / Infiltration**	
Peak Flow:	1.07 *mgd*	**Peak I/I Rate:**	0.85 *mgd*
PF:	6.25	**Total I/I:**	219,000 *gallons*
Peak Level:	4.58 *in*		
d/D Ratio:	0.31		

SITE 03

Weekly Level, Velocity and Flow Hydrographs

1/16/2017 to 1/23/2017

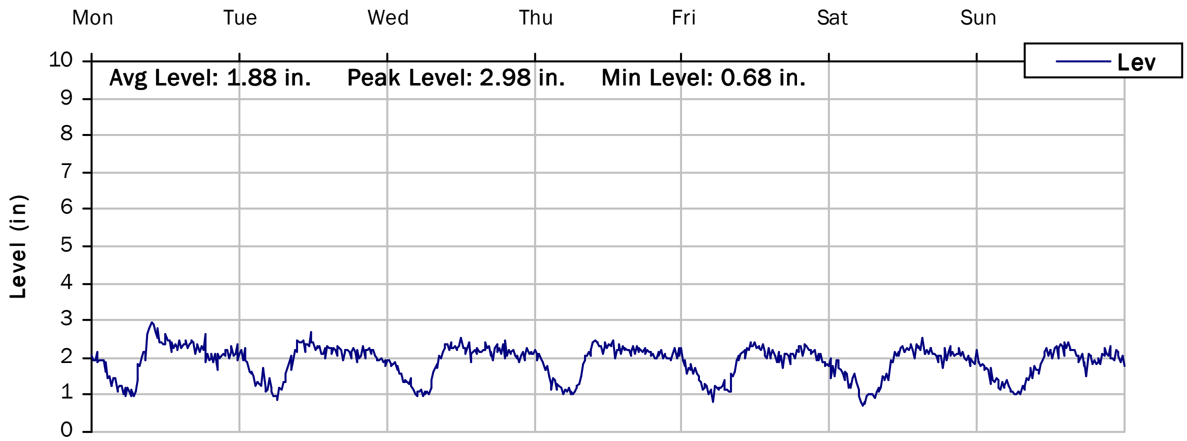


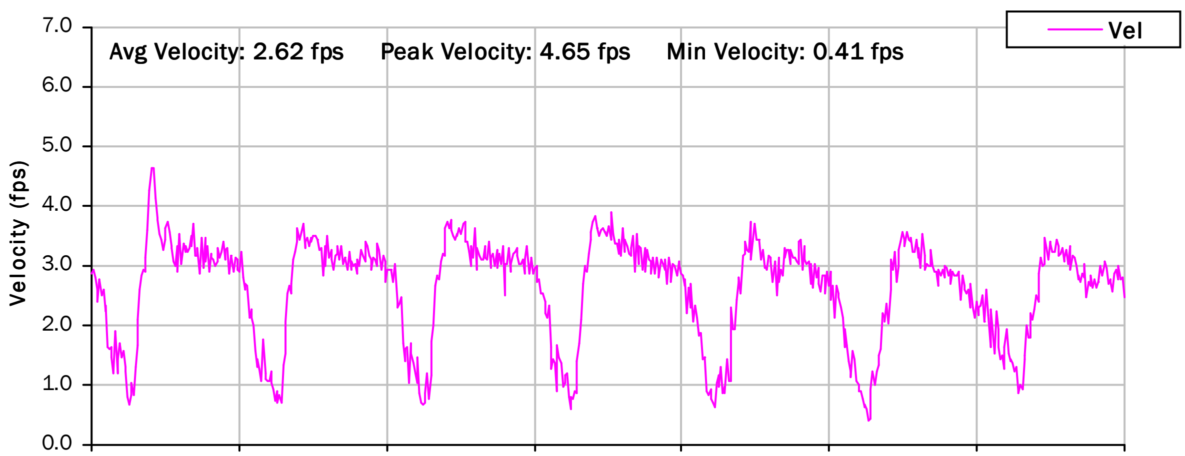
Avg Flow: 0.204 mgd   Peak Flow: 0.465 mgd   Min Flow: 0.003 mgd

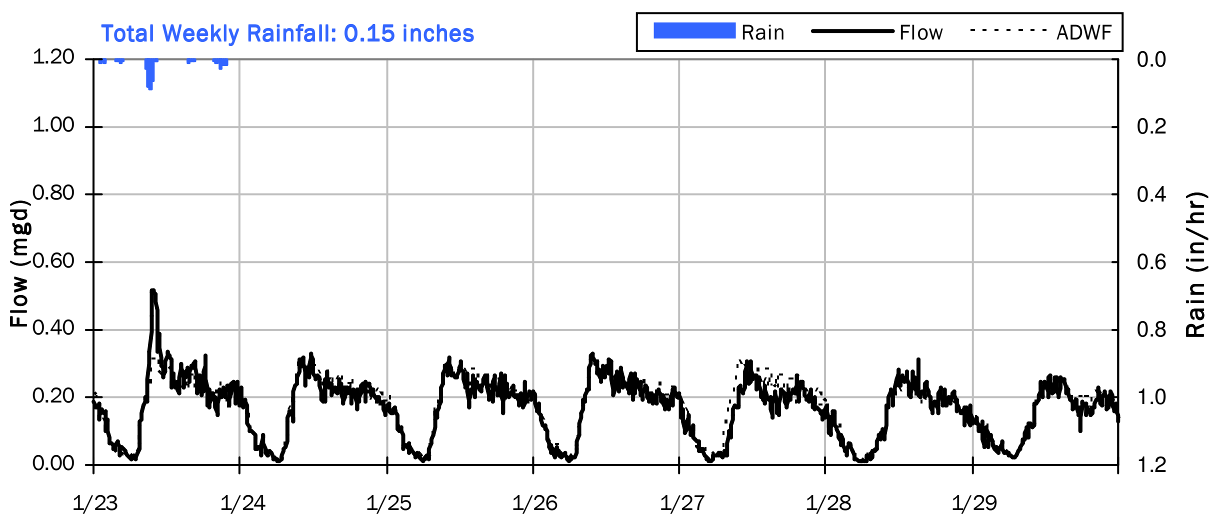
SITE 03

Weekly Level, Velocity and Flow Hydrographs

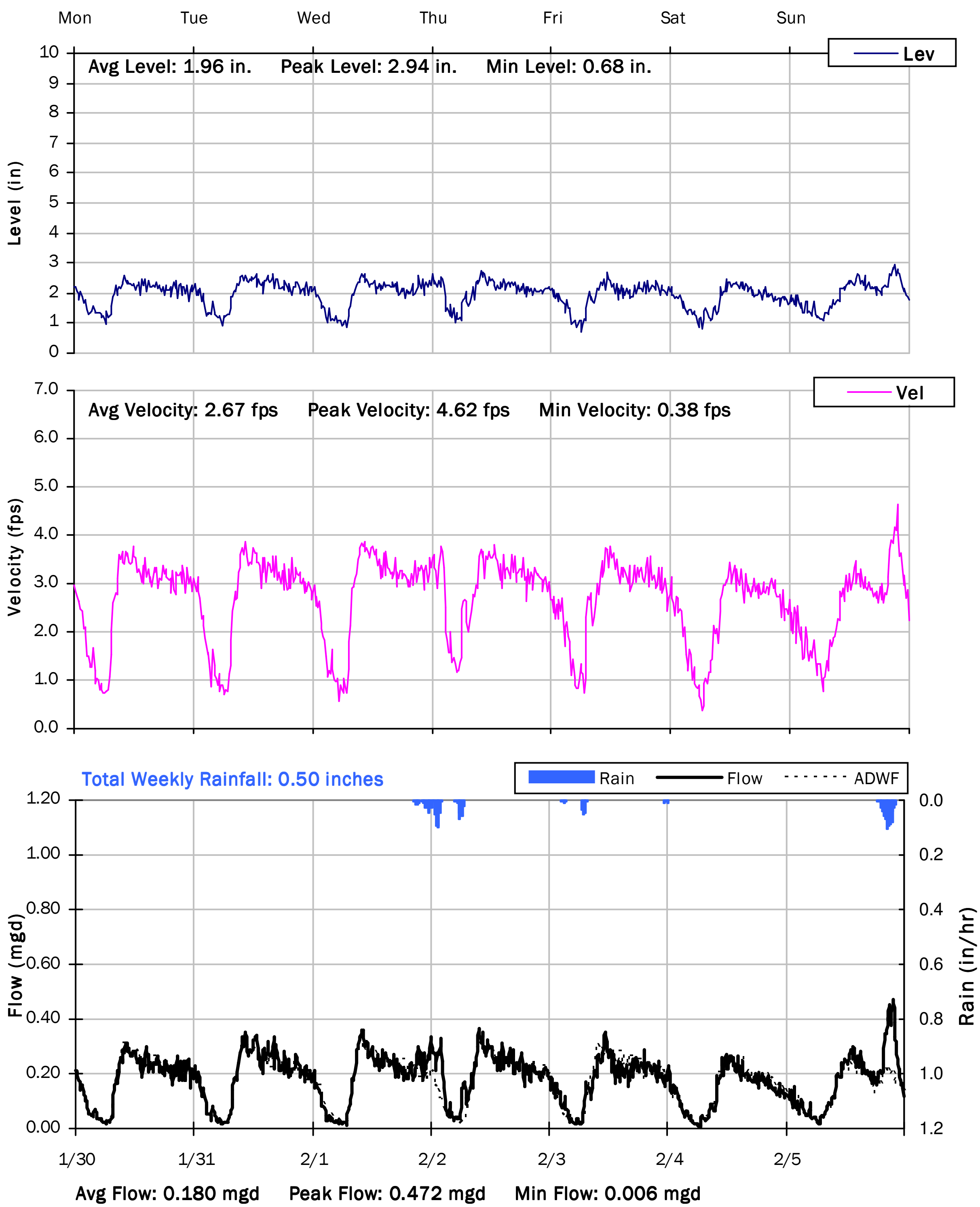
1/23/2017 to 1/30/2017



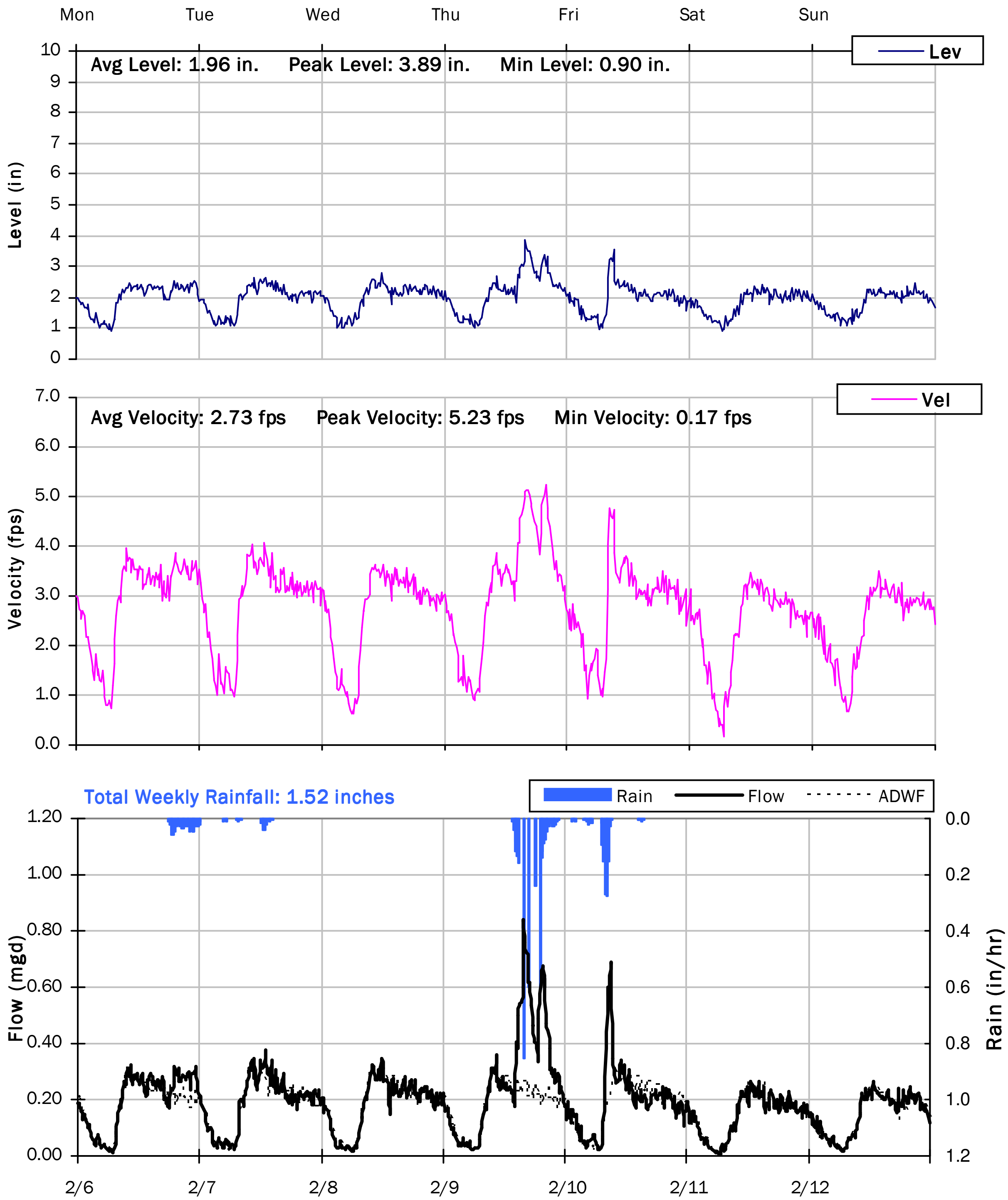




SITE 03
Weekly Level, Velocity and Flow Hydrographs
1/30/2017 to 2/6/2017

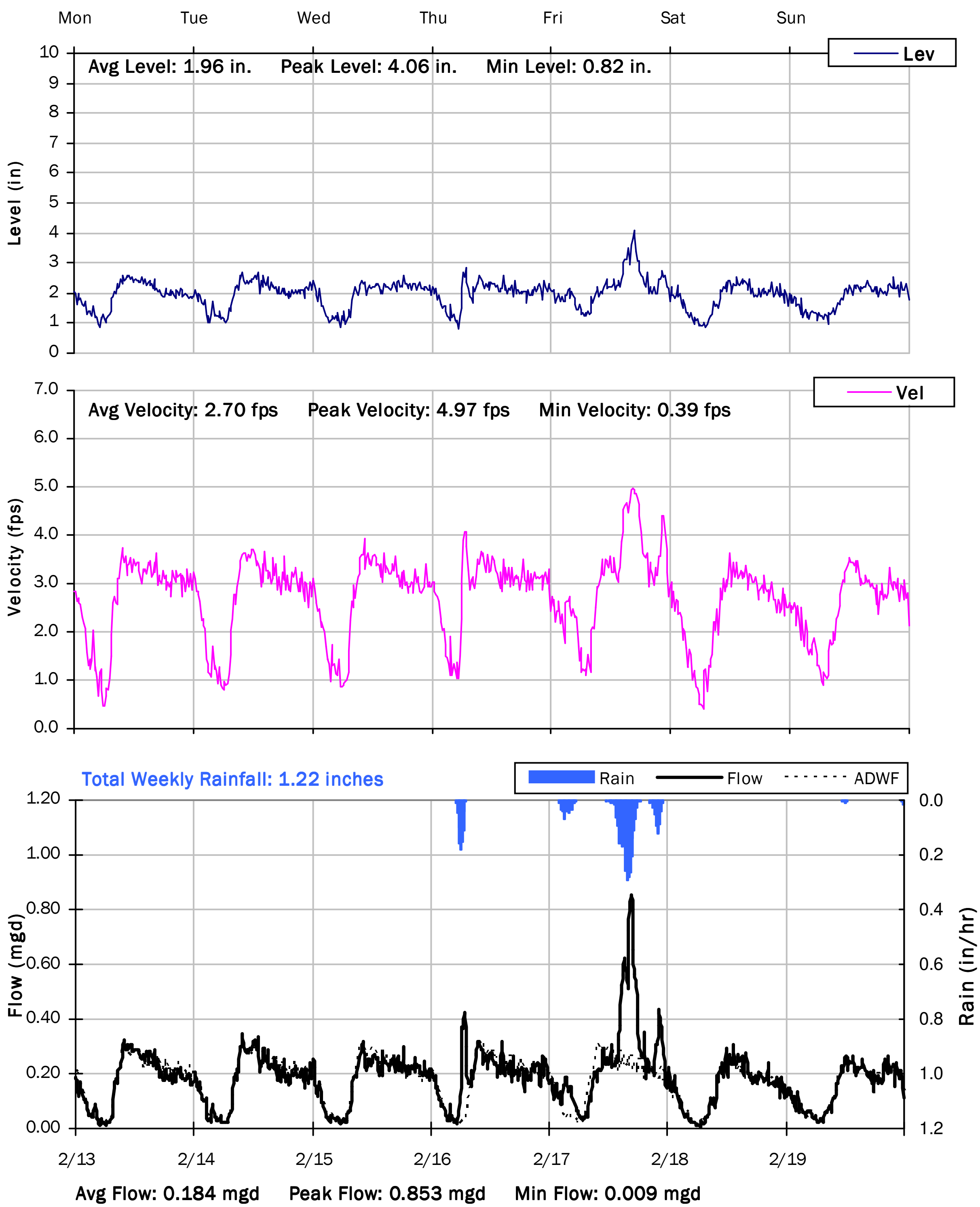


SITE 03
Weekly Level, Velocity and Flow Hydrographs
2/6/2017 to 2/13/2017

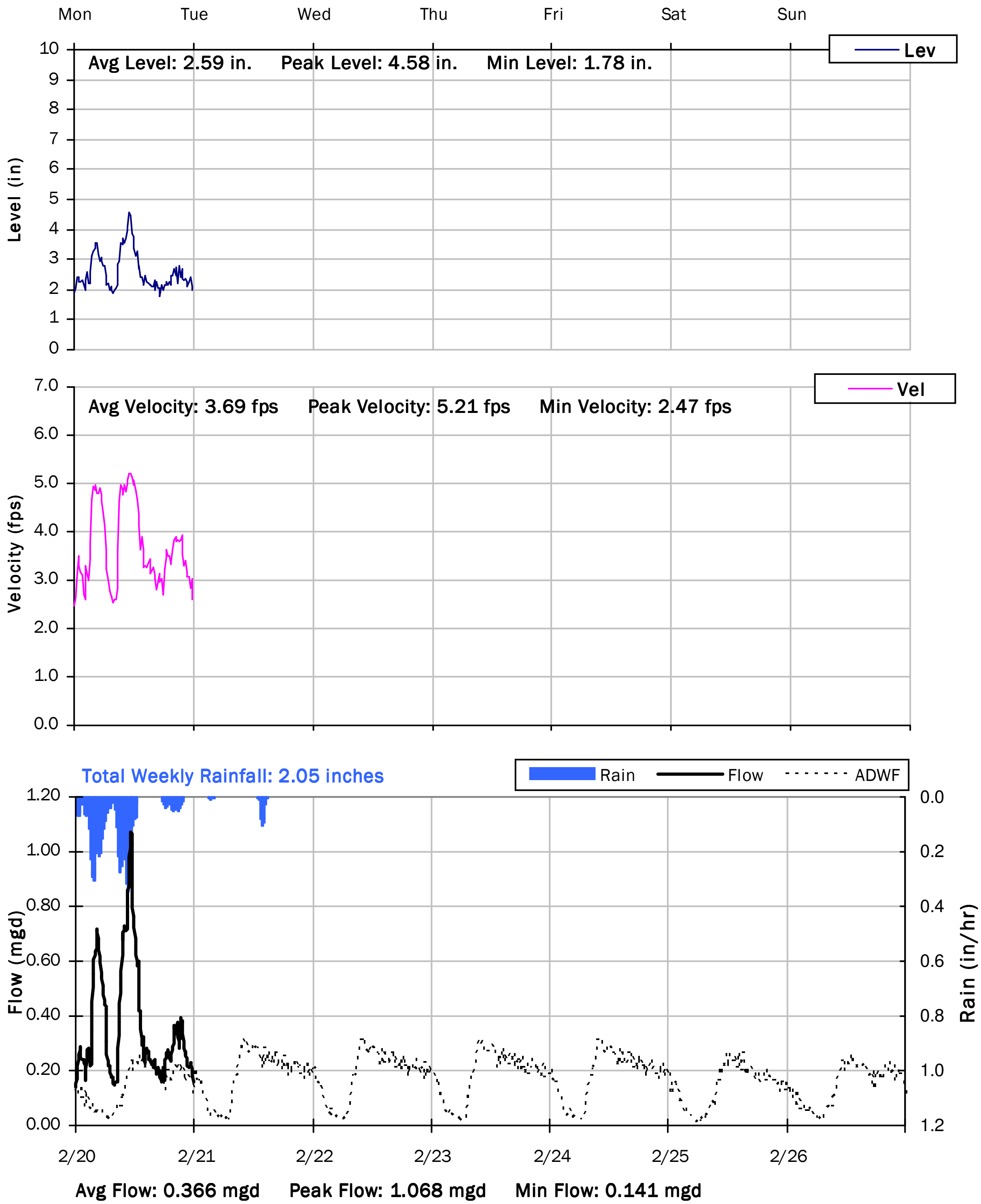


Avg Flow: 0.190 mgd **Peak Flow: 0.833 mgd** **Min Flow: 0.004 mgd**

SITE 03
Weekly Level, Velocity and Flow Hydrographs
2/13/2017 to 2/20/2017



SITE 03
Weekly Level, Velocity and Flow Hydrographs
2/20/2017 to 2/27/2017



Marina Coast Water District

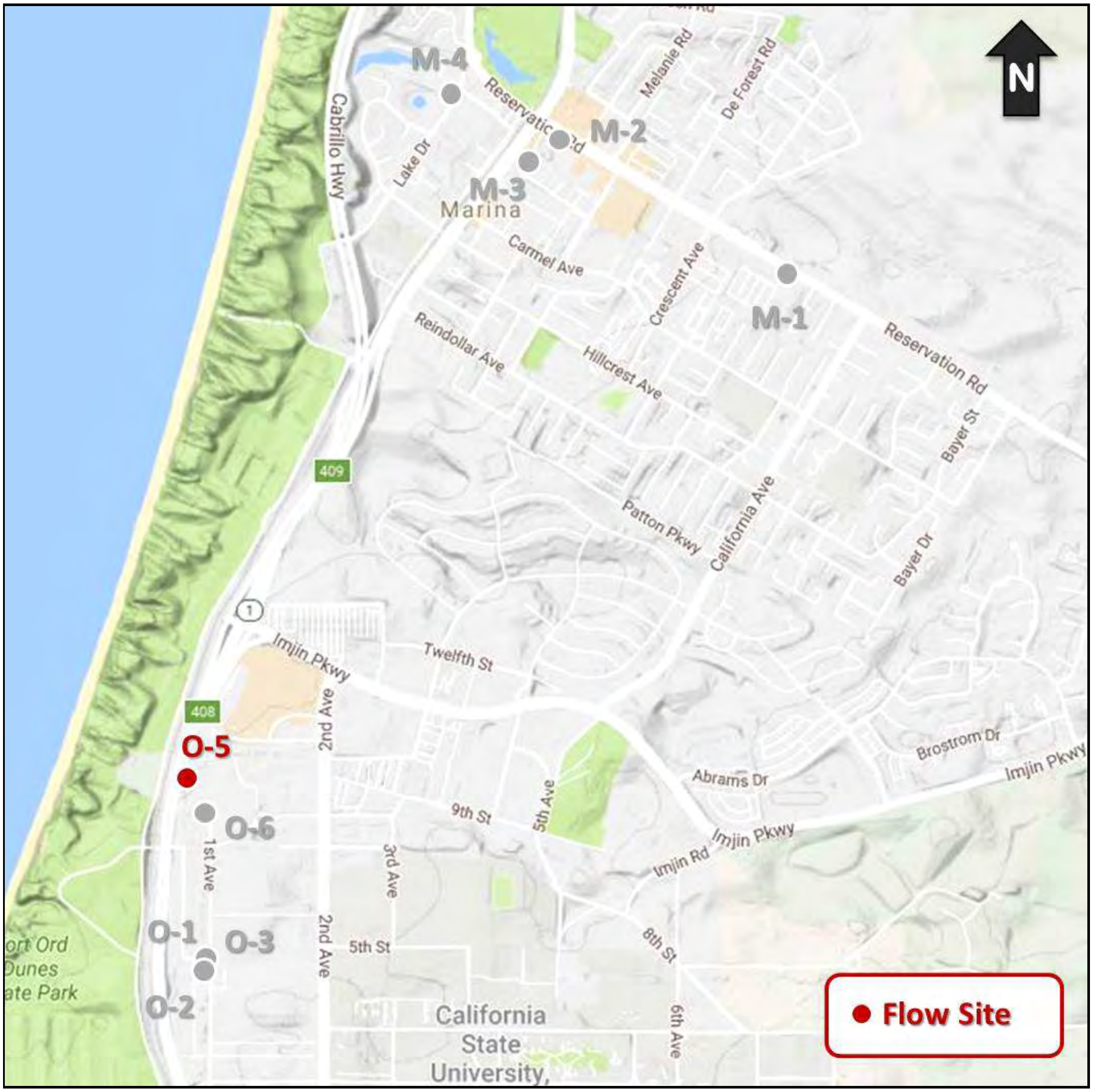
Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - March 2017

Monitoring Site: Site 05

Location: Northwest corner VA Clinic parking lot

Data Summary Report



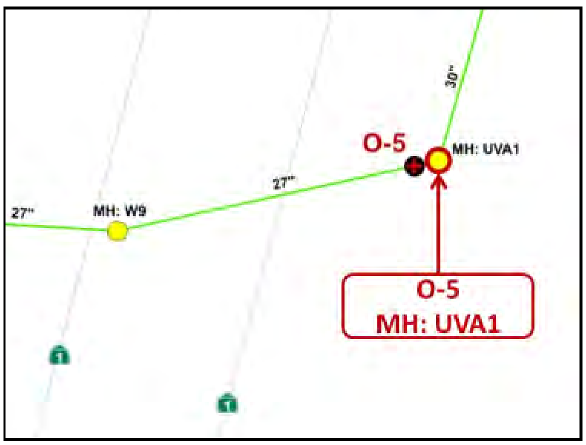
Vicinity Map: Site 05

SITE 05

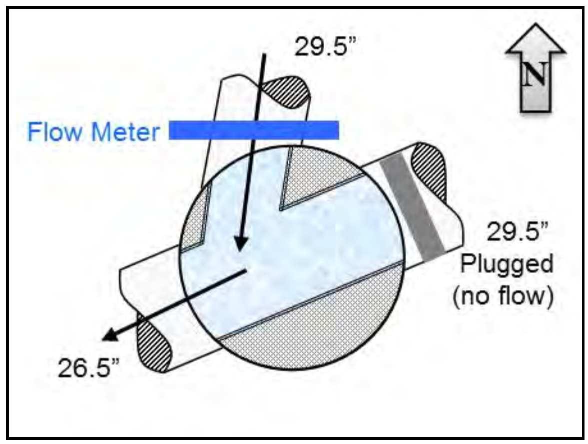
Site Information

Location:	Northwest corner VA Clinic parking lot
Coordinates:	121.8155° W, 36.6639° N
Pipe Diameter:	29.5 inches
ADWF:	0.344 mgd
Peak Measured Flow:	0.832 mgd

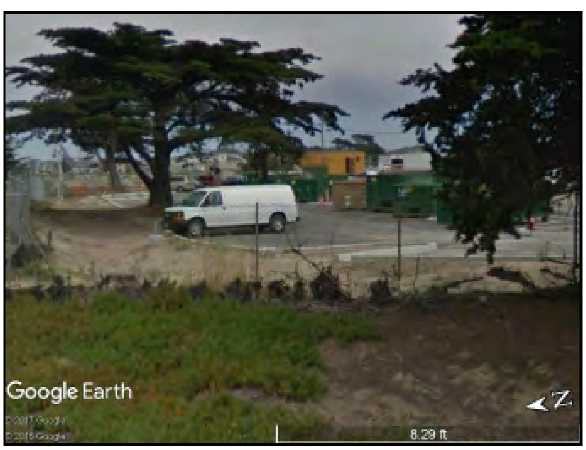
Satellite Map



Sewer Map



Flow Sketch



Street View


Plan View

SITE 05

Additional Site Photos

Effluent Pipe

North Influent Pipe

SITE 05

Additional Site Photos

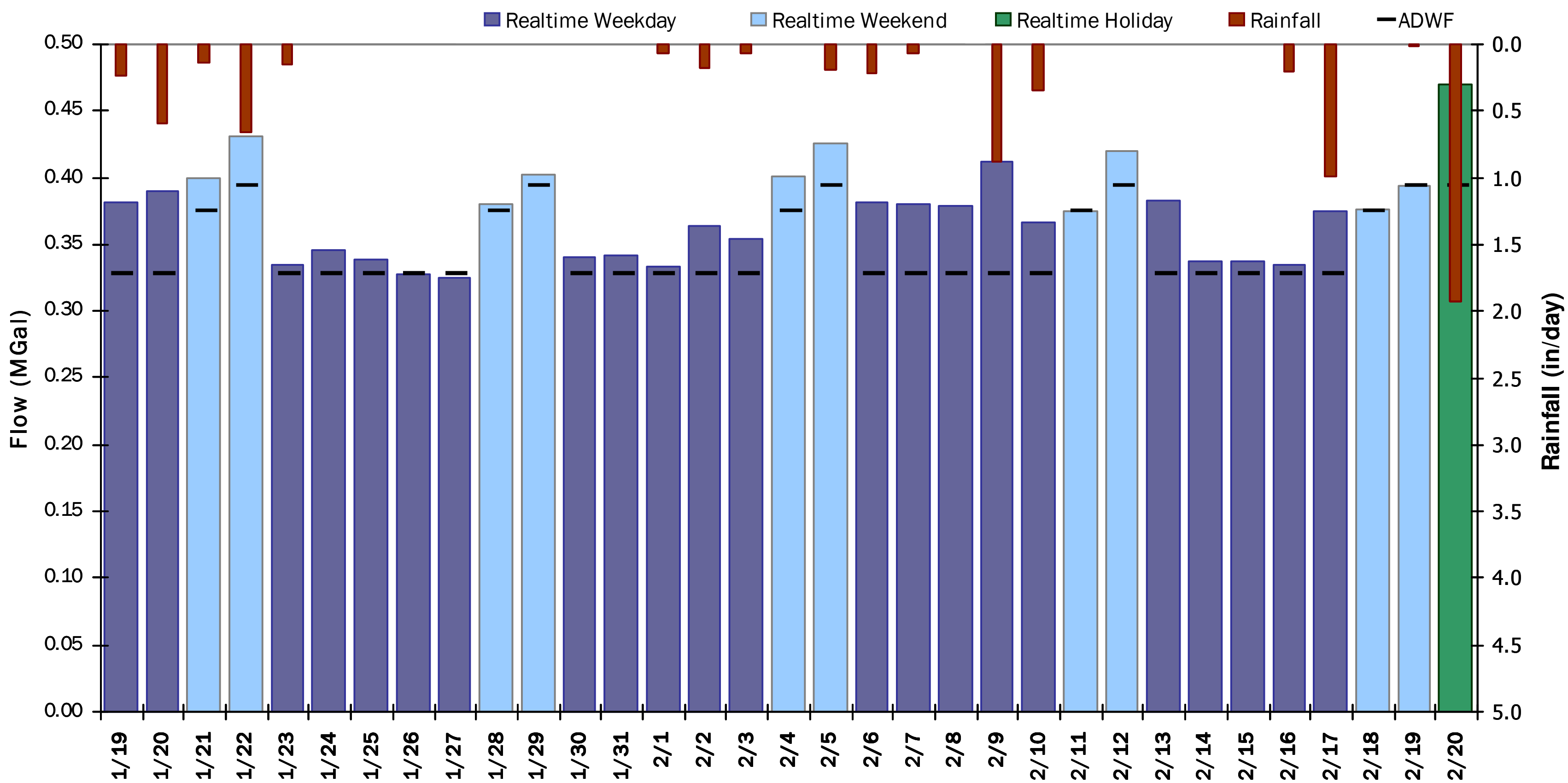
East Plugged Pipe

SITE 05

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.374 MGal **Peak Daily Flow: 0.469 MGal** **Min Daily Flow: 0.326 MGal**

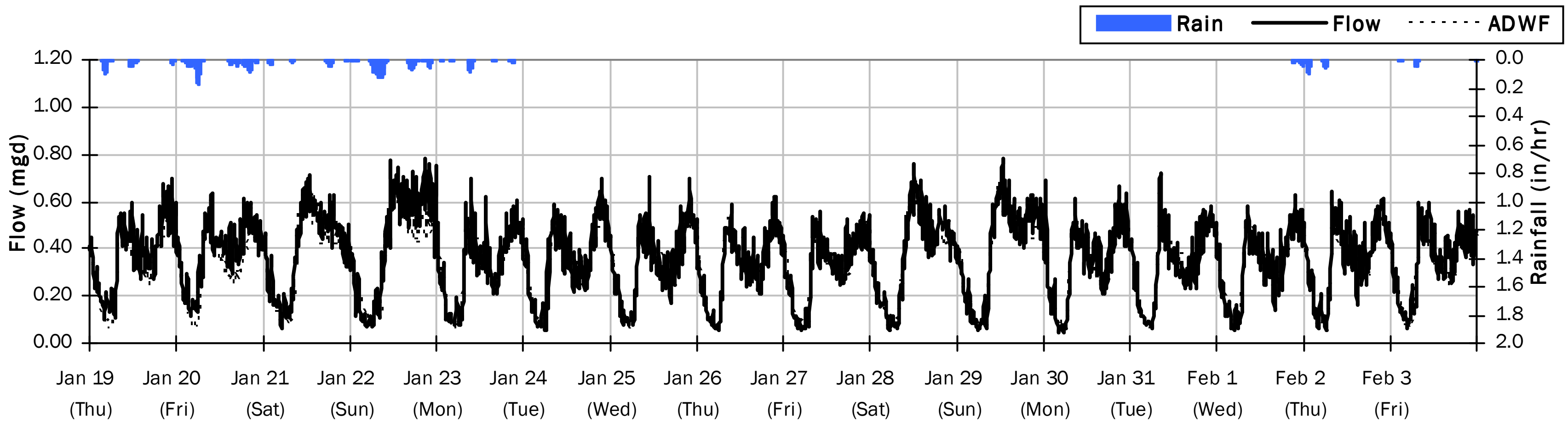
Total Period Rainfall: 6.93 inches

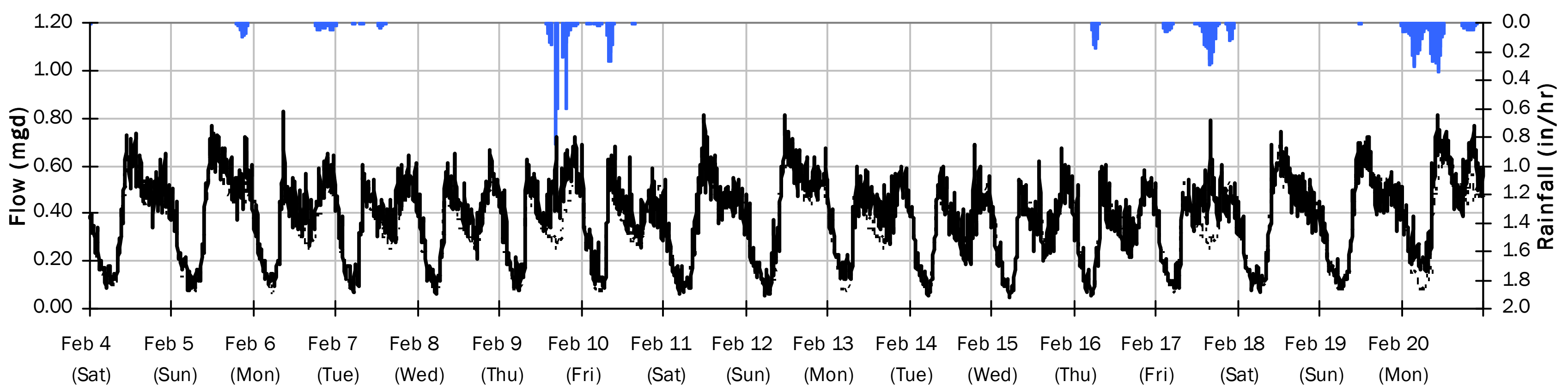


SITE 05

Flow Summary: 1/19/2017 to 2/20/2017

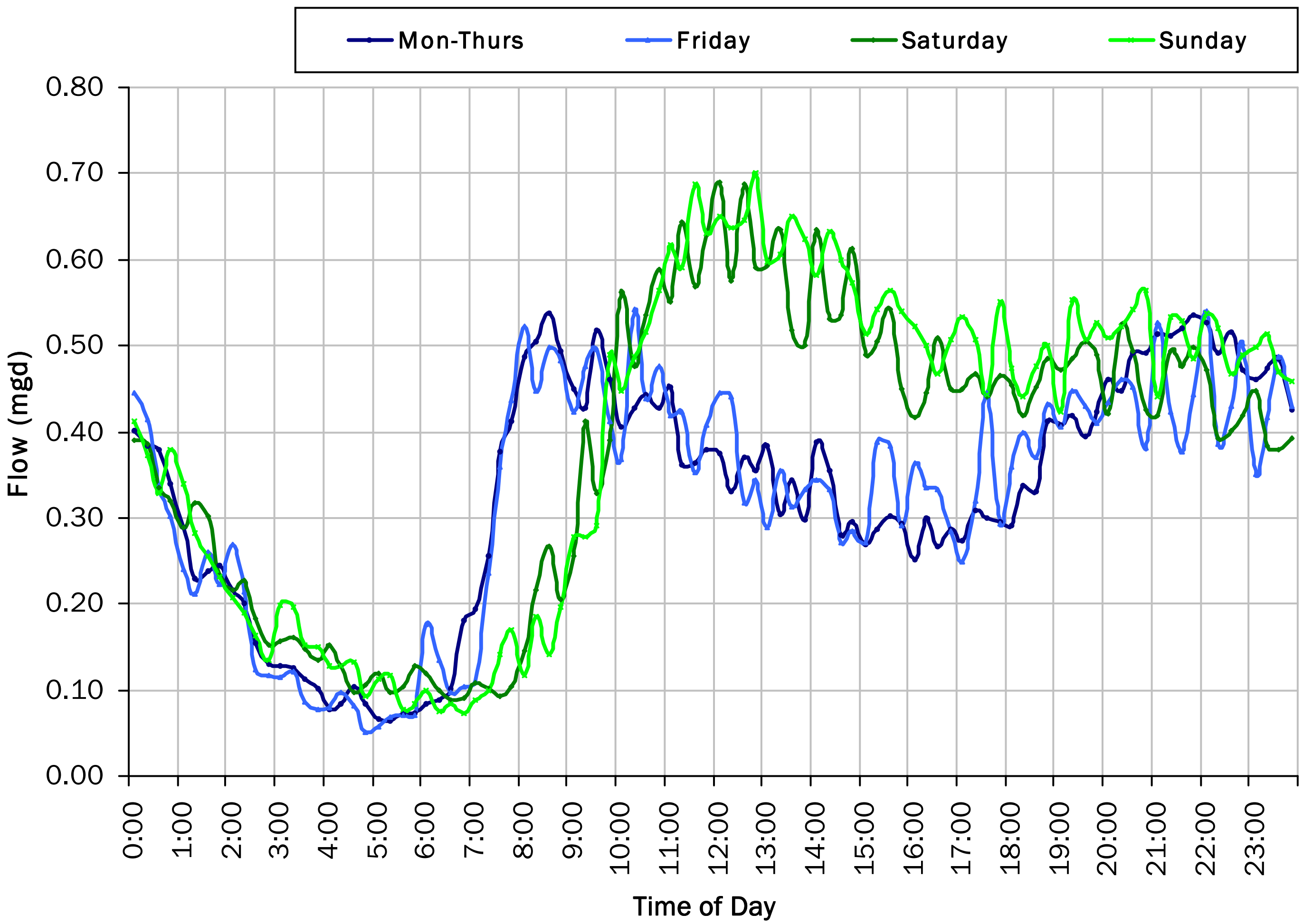
Total Period Rainfall: 6.93 inches **Avg Flow: 0.374 mgd** **Peak Flow: 0.832 mgd** **Min Flow: 0.046 mgd**





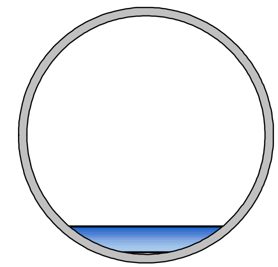
SITE 05

Average Dry Weather Flow Hydrographs



ADWF:

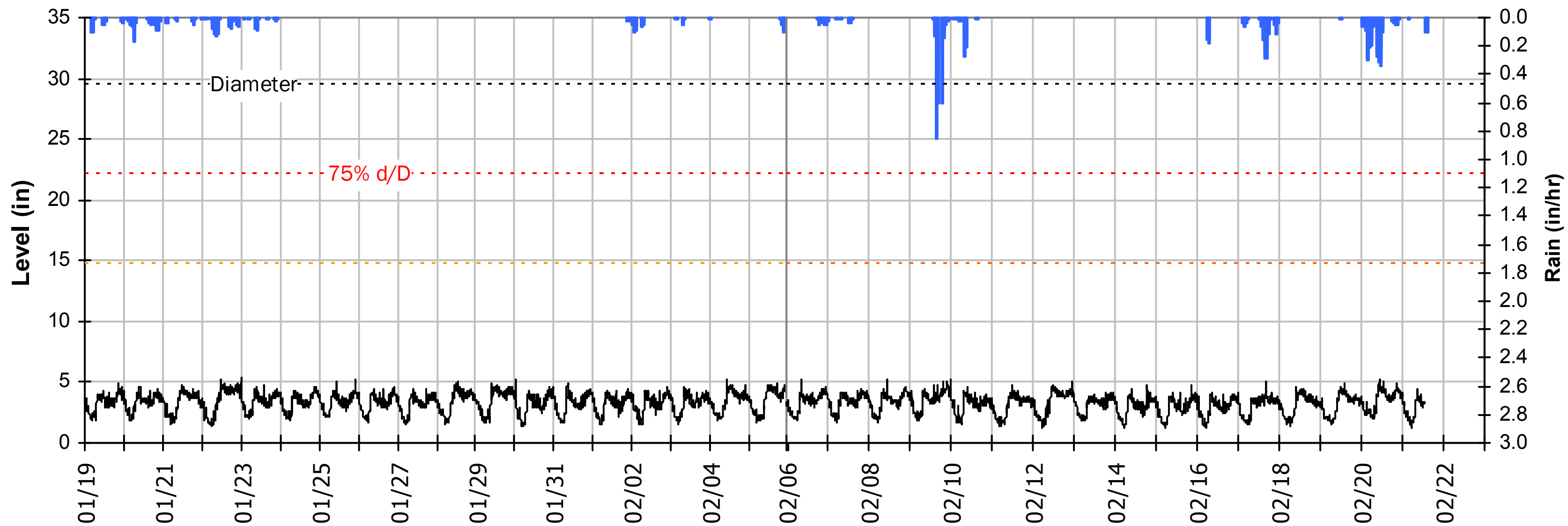
0.344 *mgd*

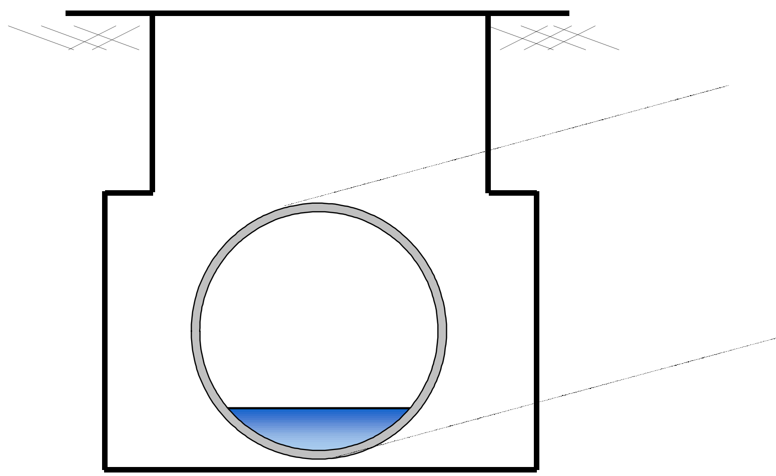


SITE 05

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



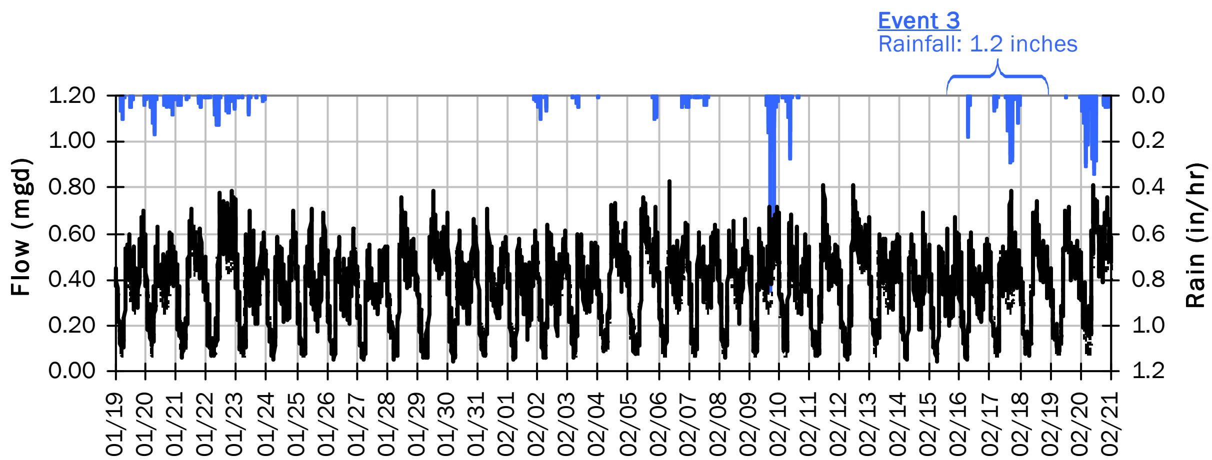


Pipe Diameter:	29.5	*inches*
Peak Measured Level:	5.35	*inches*
Peak d/D Ratio:	0.18	

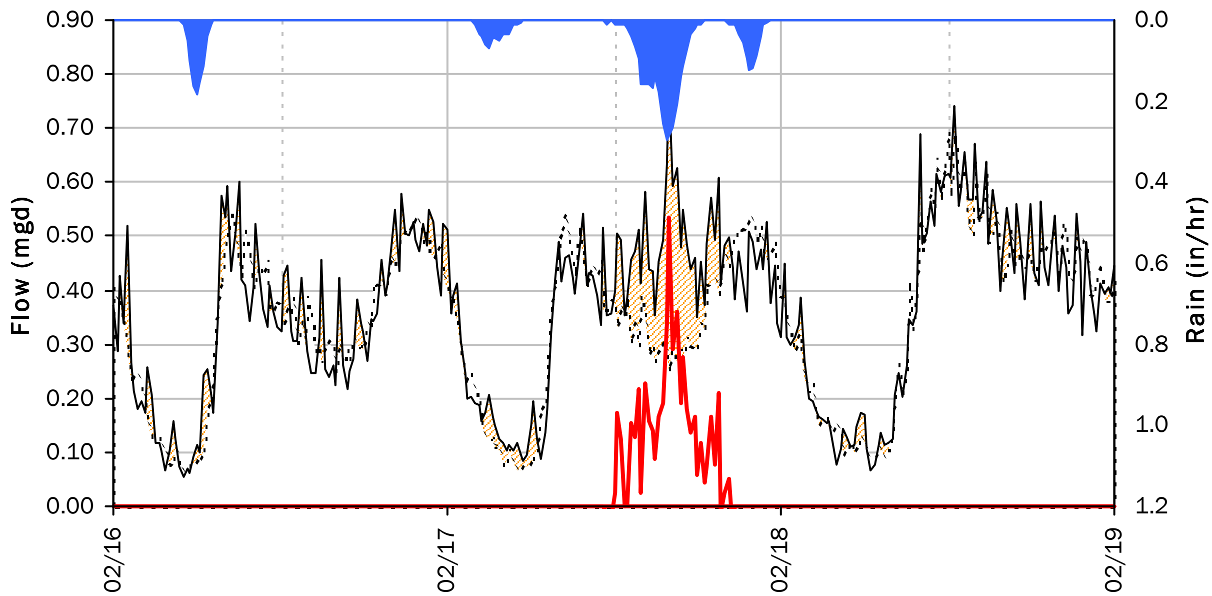
SITE 05

I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph

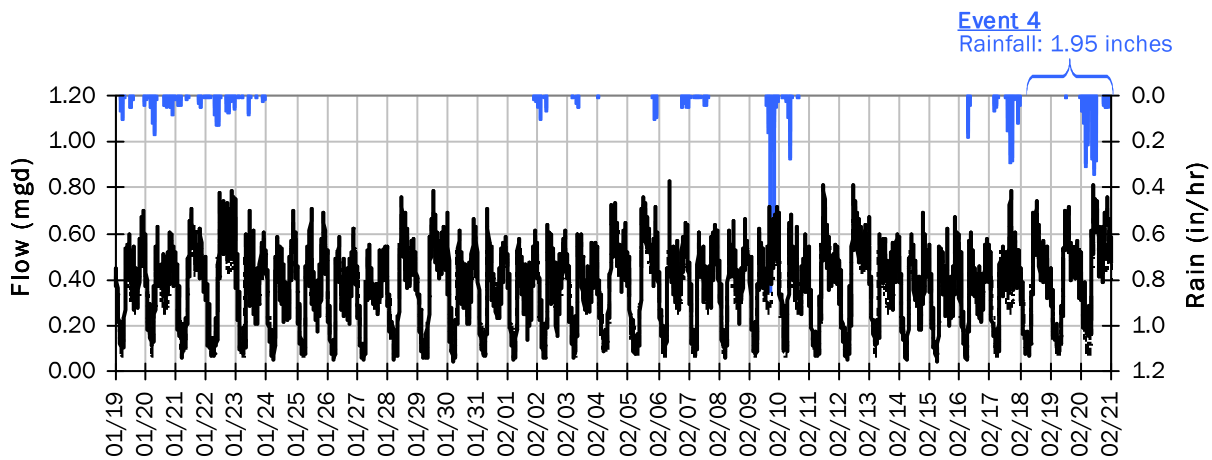


Storm Event I/I Analysis (Rain = 1.20 inches)

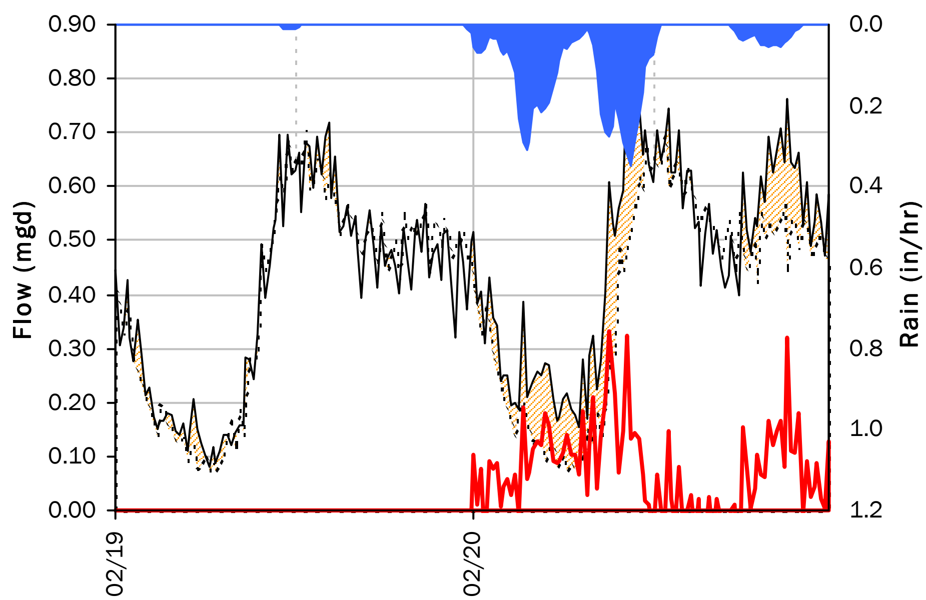
Capacity		Inflow / Infiltration	
Peak Flow:	0.79 *mgd*	**Peak I/I Rate:**	0.54 *mgd*
PF:	2.27	**Total I/I:**	53,000 *gallons*
Peak Level:	5.14 *in*		
d/D Ratio:	0.17		

SITE 05
I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



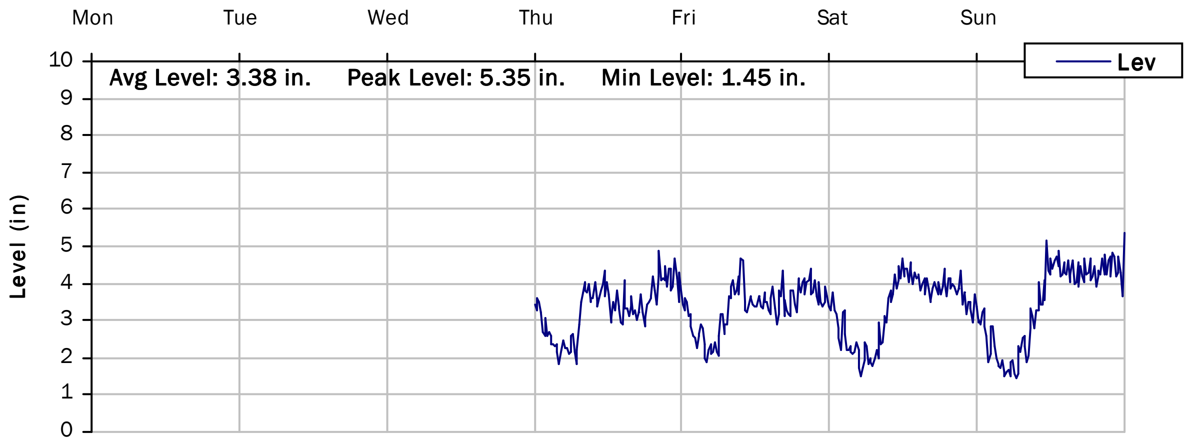
Event 4 Detail Graph

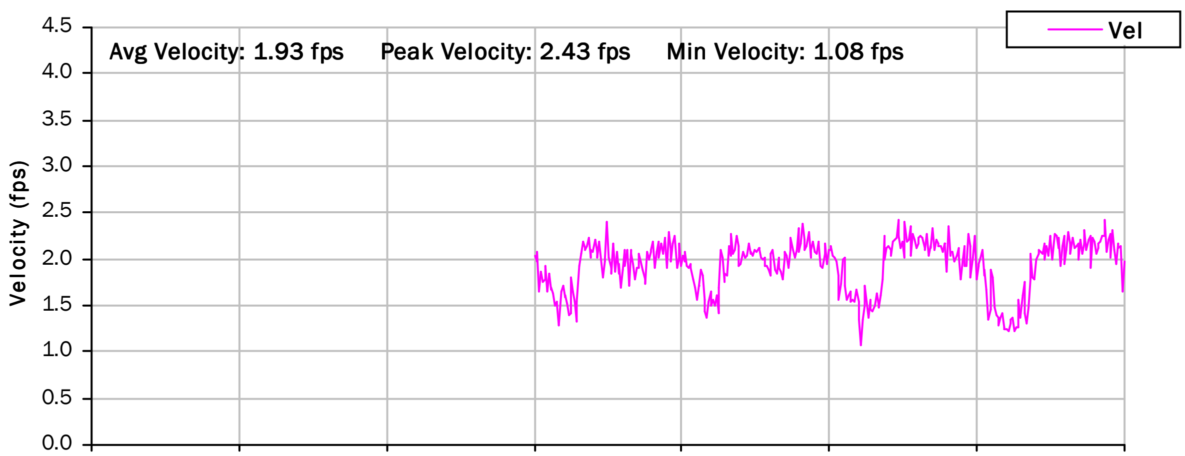


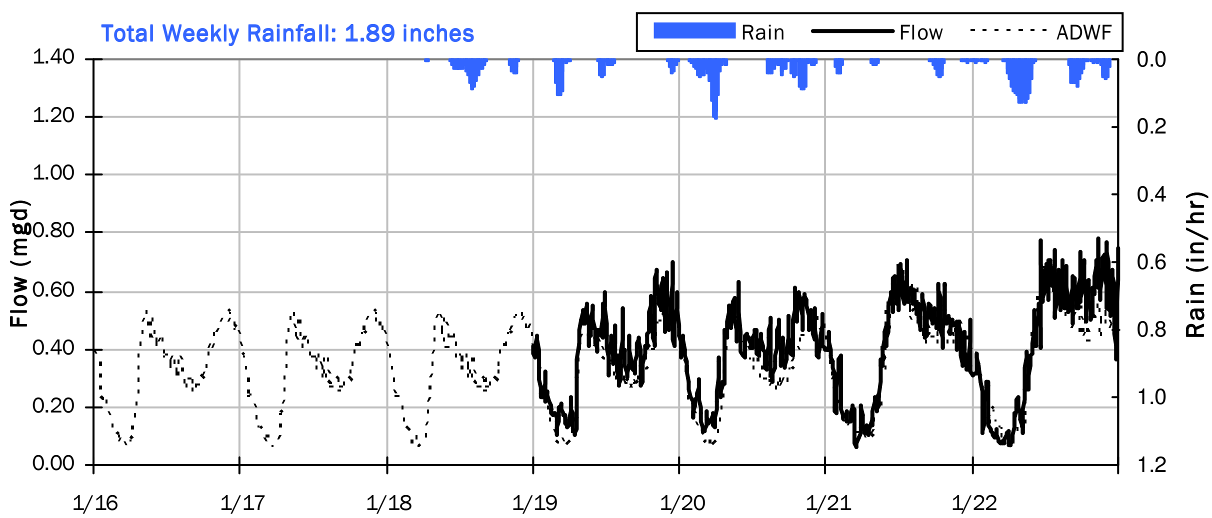
Storm Event I/I Analysis (Rain = 1.95 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.81 *mgd*	**Peak I/I Rate:**	0.33 *mgd*
PF:	2.35	**Total I/I:**	75,000 *gallons*
Peak Level:	5.25 *in*		
d/D Ratio:	0.18		

SITE 05
Weekly Level, Velocity and Flow Hydrographs
1/16/2017 to 1/23/2017





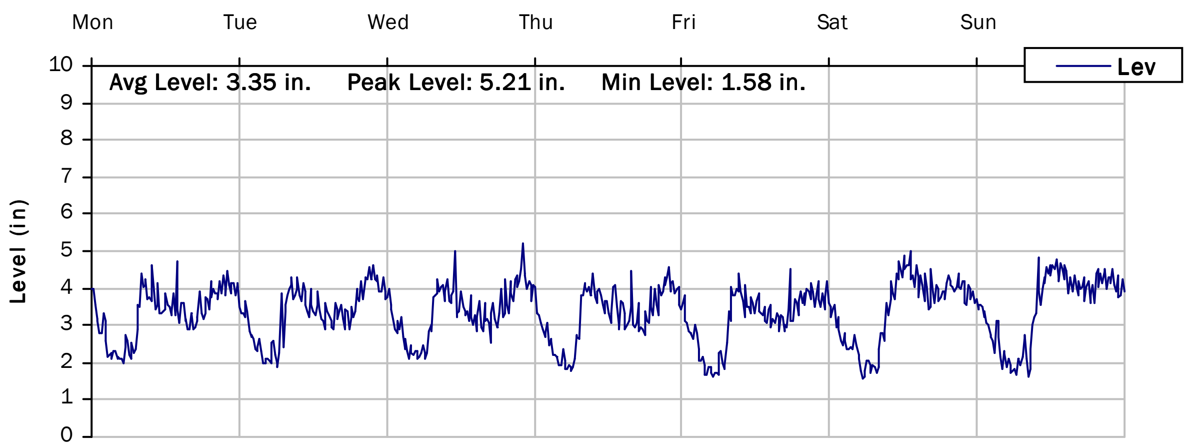


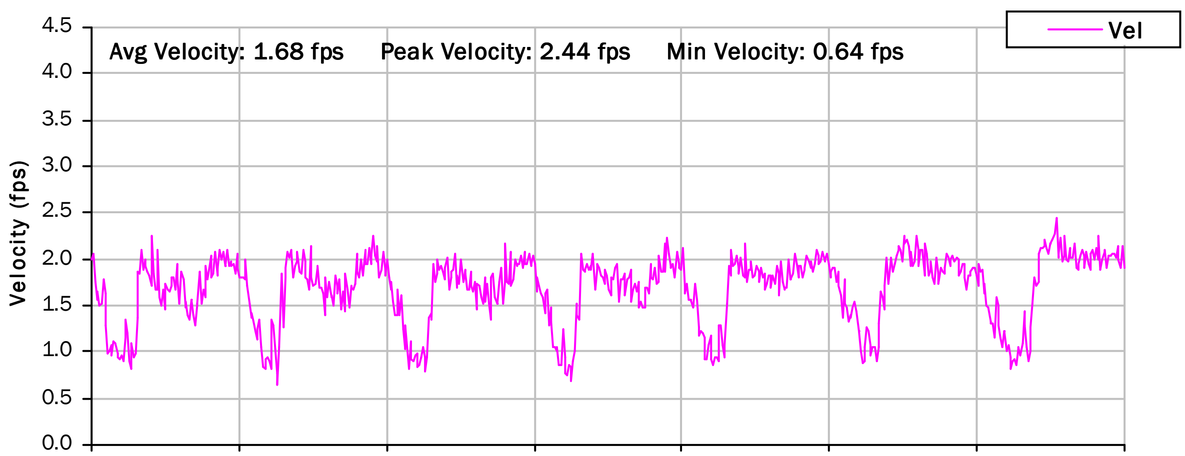
Avg Flow: 0.401 mgd **Peak Flow: 0.783 mgd** **Min Flow: 0.063 mgd**

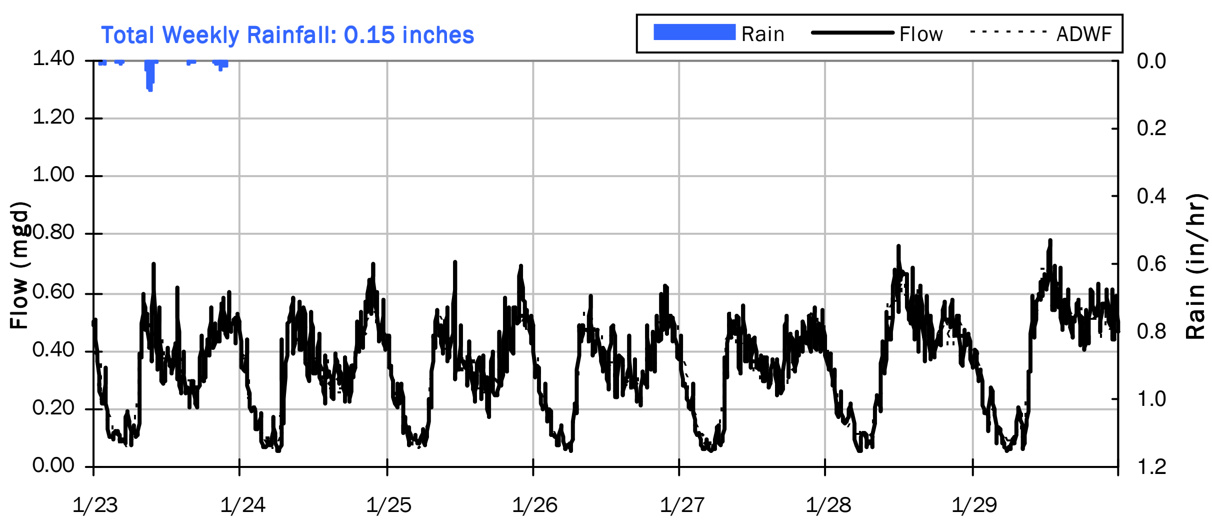
SITE 05

Weekly Level, Velocity and Flow Hydrographs

1/23/2017 to 1/30/2017





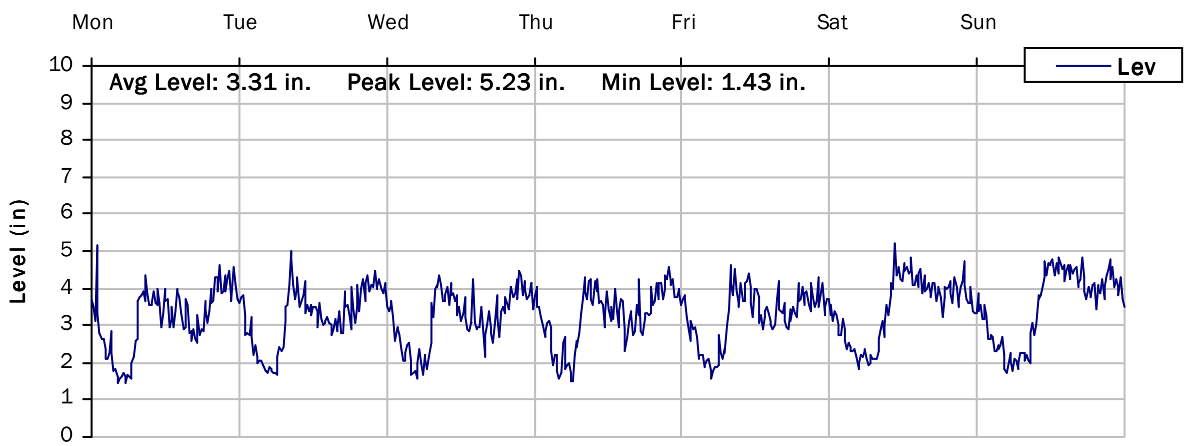


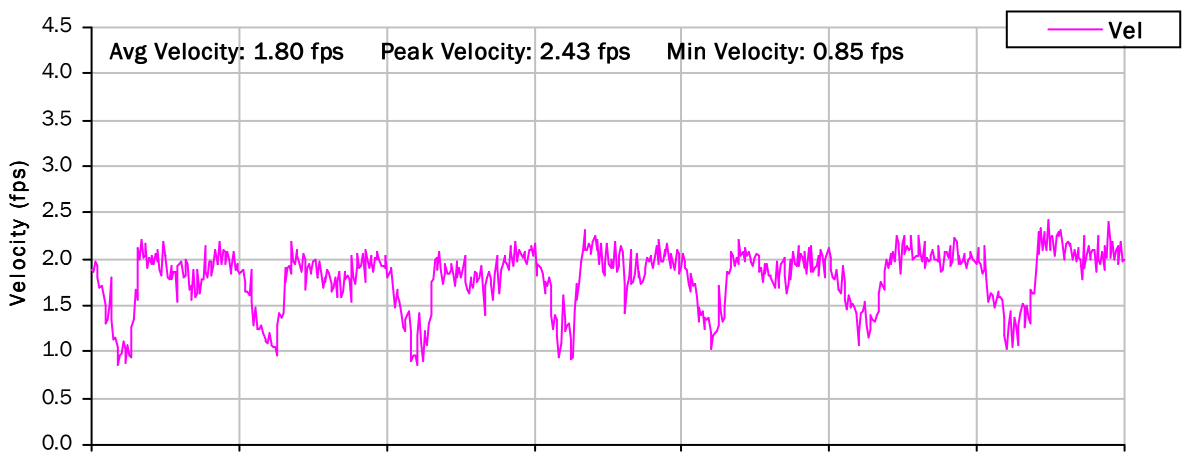
Avg Flow: 0.351 mgd **Peak Flow: 0.785 mgd** **Min Flow: 0.052 mgd**

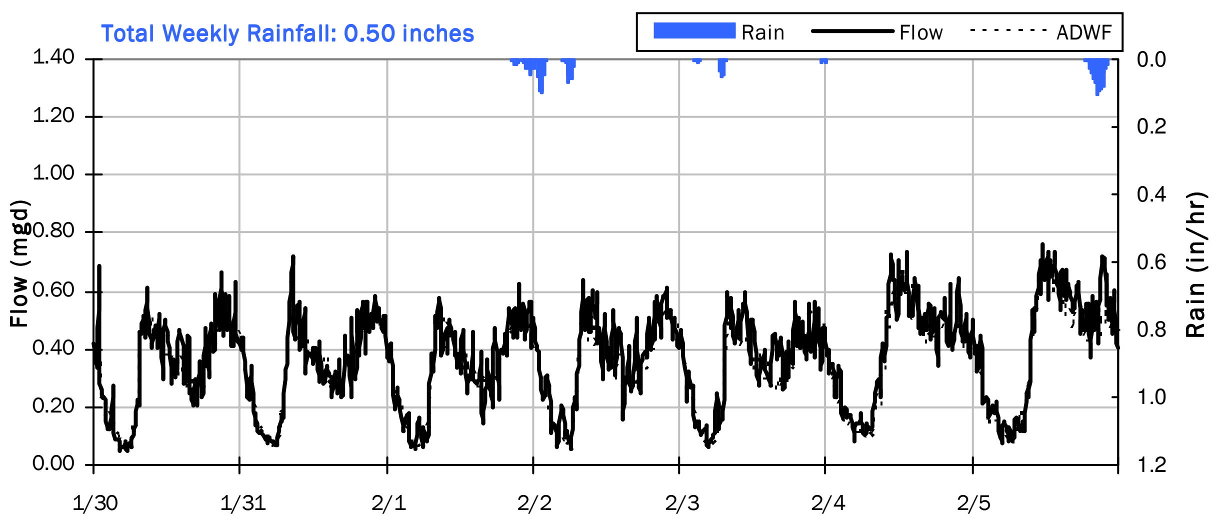
SITE 05

Weekly Level, Velocity and Flow Hydrographs

1/30/2017 to 2/6/2017





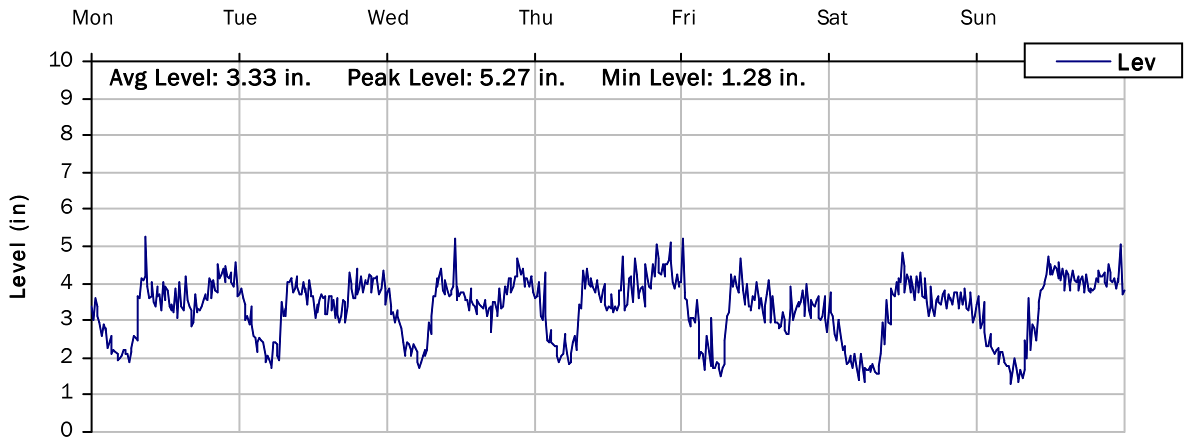


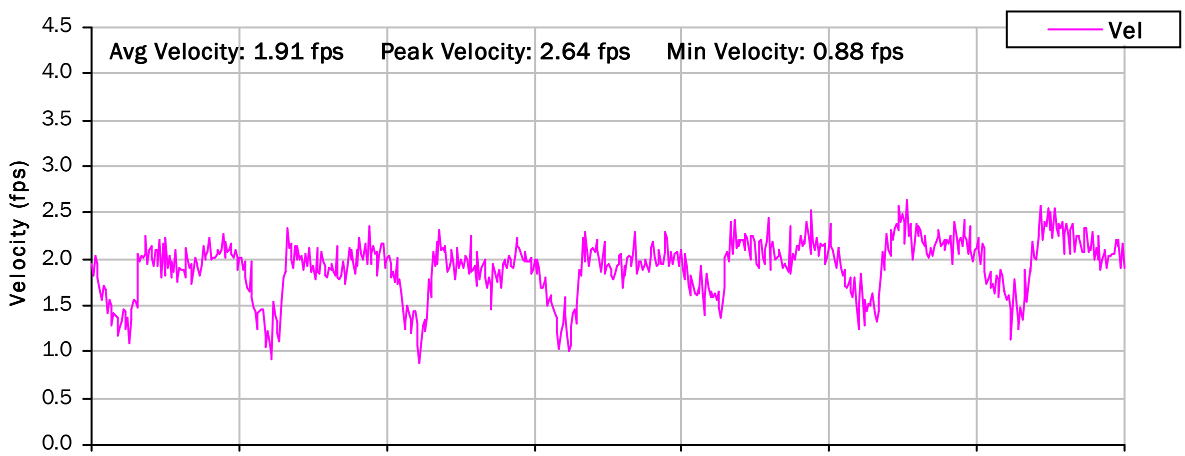
Avg Flow: 0.365 mgd **Peak Flow: 0.763 mgd** **Min Flow: 0.047 mgd**

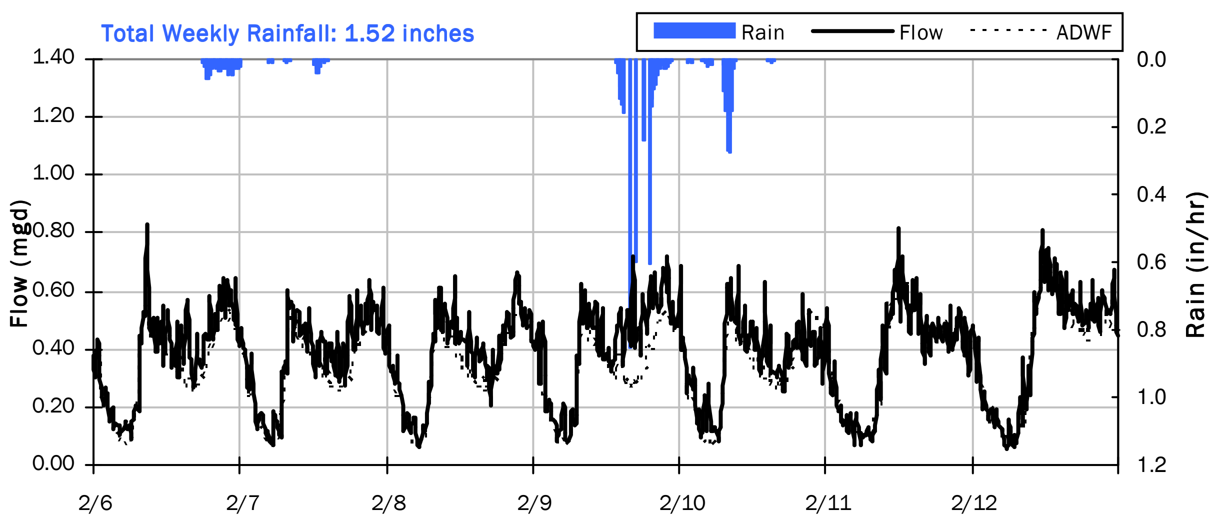
SITE 05

Weekly Level, Velocity and Flow Hydrographs

2/6/2017 to 2/13/2017

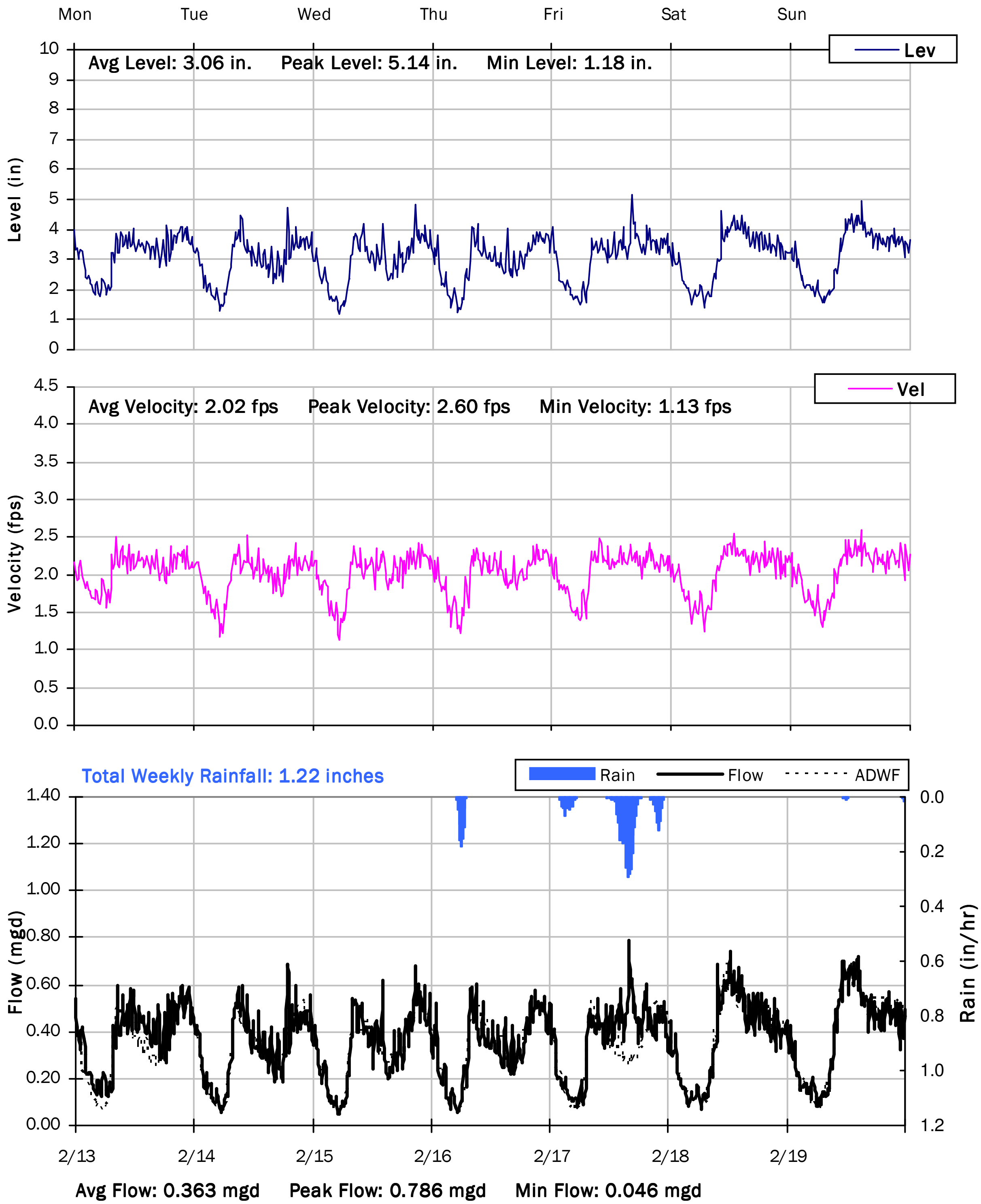






Avg Flow: 0.387 mgd **Peak Flow: 0.832 mgd** **Min Flow: 0.052 mgd**

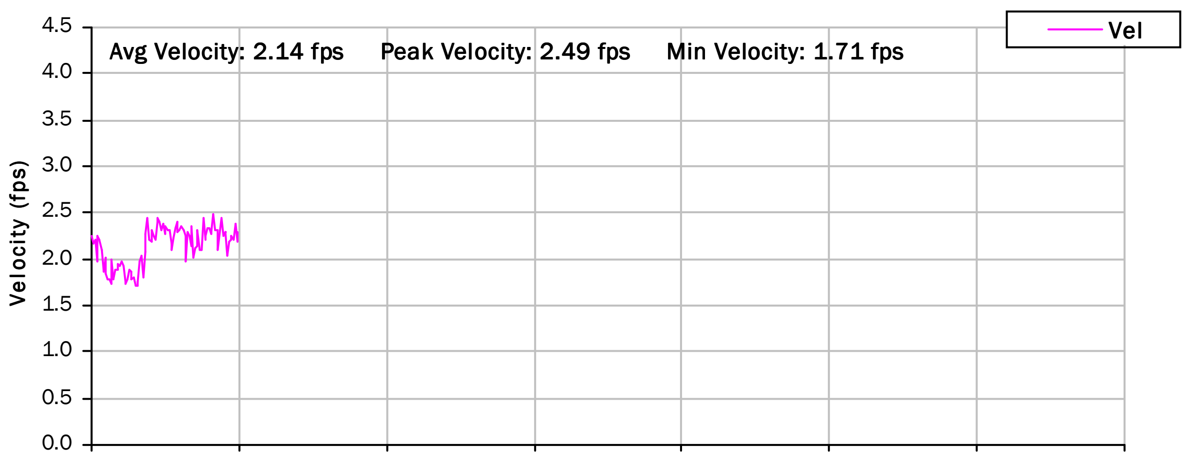
SITE 05
Weekly Level, Velocity and Flow Hydrographs
2/13/2017 to 2/20/2017

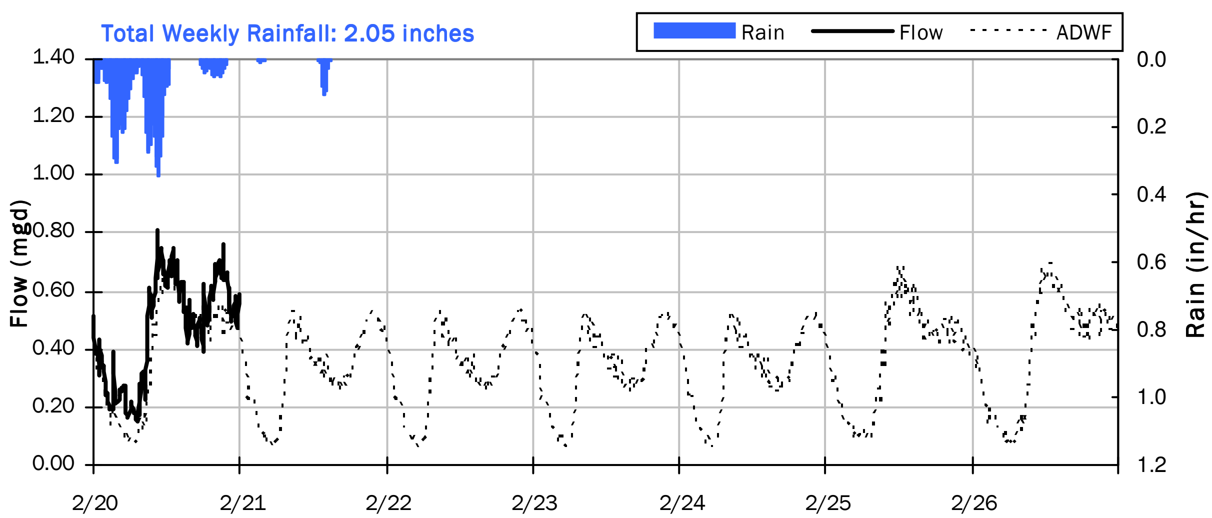


SITE 05

Weekly Level, Velocity and Flow Hydrographs

2/20/2017 to 2/27/2017





Avg Flow: 0.469 mgd Peak Flow: 0.813 mgd Min Flow: 0.153 mgd

Marina Coast Water District

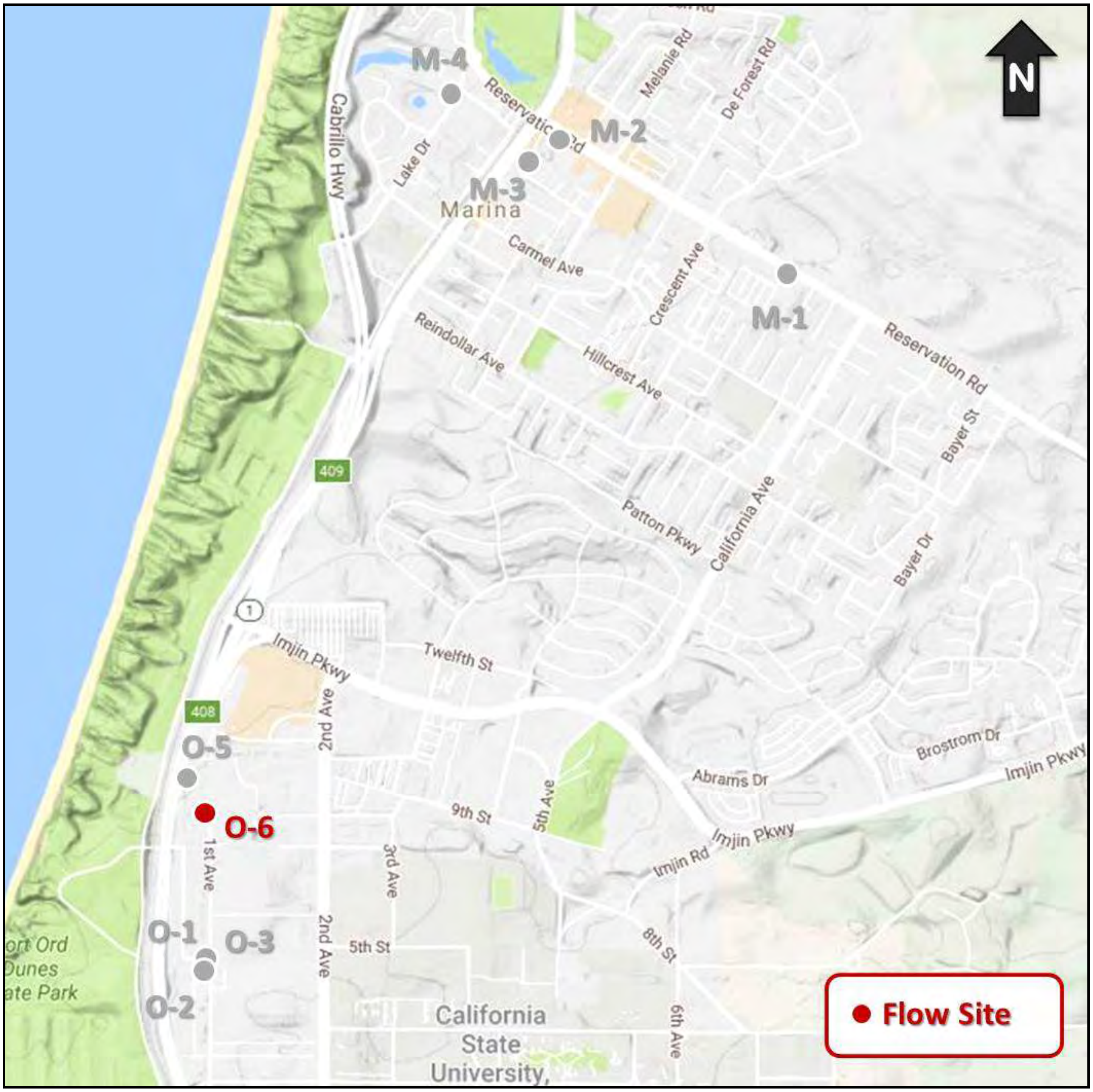
Sanitary Sewer Flow Monitoring

Temporary Monitoring: January 2017 - March 2017

Monitoring Site: Site 06

Location: VA Clinic parking lot, near motorcycle parking

Data Summary Report



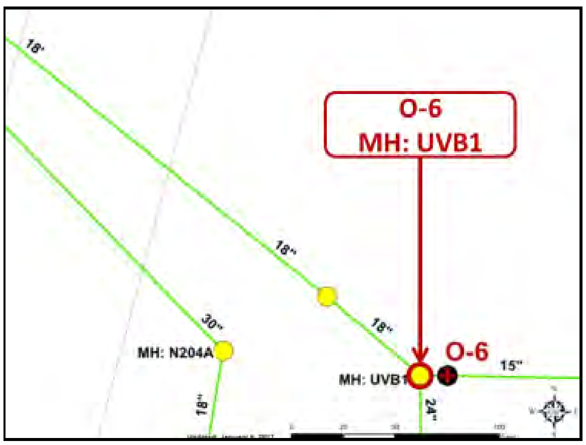
Vicinity Map: Site 06

SITE 06

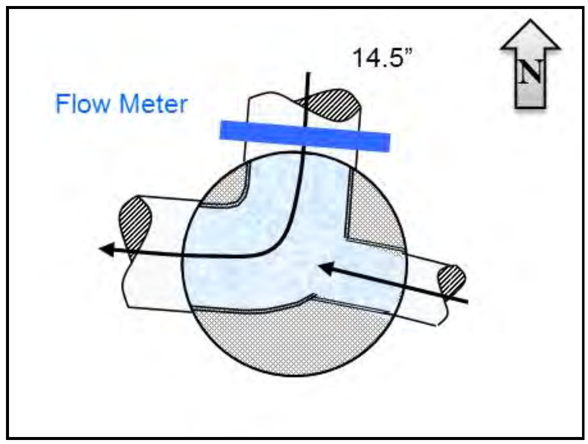
Site Information

Location:	VA Clinic parking lot, near motorcycle parking
Coordinates:	121.8146° W, 36.6630° N
Pipe Diameter:	14.5 inches
ADWF:	0.019 mgd
Peak Measured Flow:	0.199 mgd

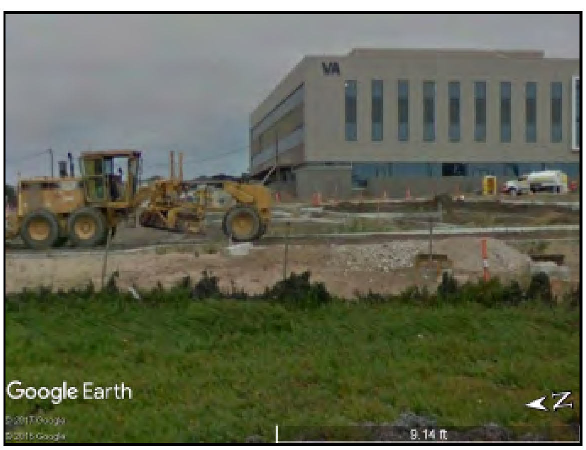
Satellite Map



Sewer Map



Flow Sketch



Street View

Plan View

SITE 06

Additional Site Photos

Effluent Pipe

North Influent Pipe

SITE 06

Additional Site Photos

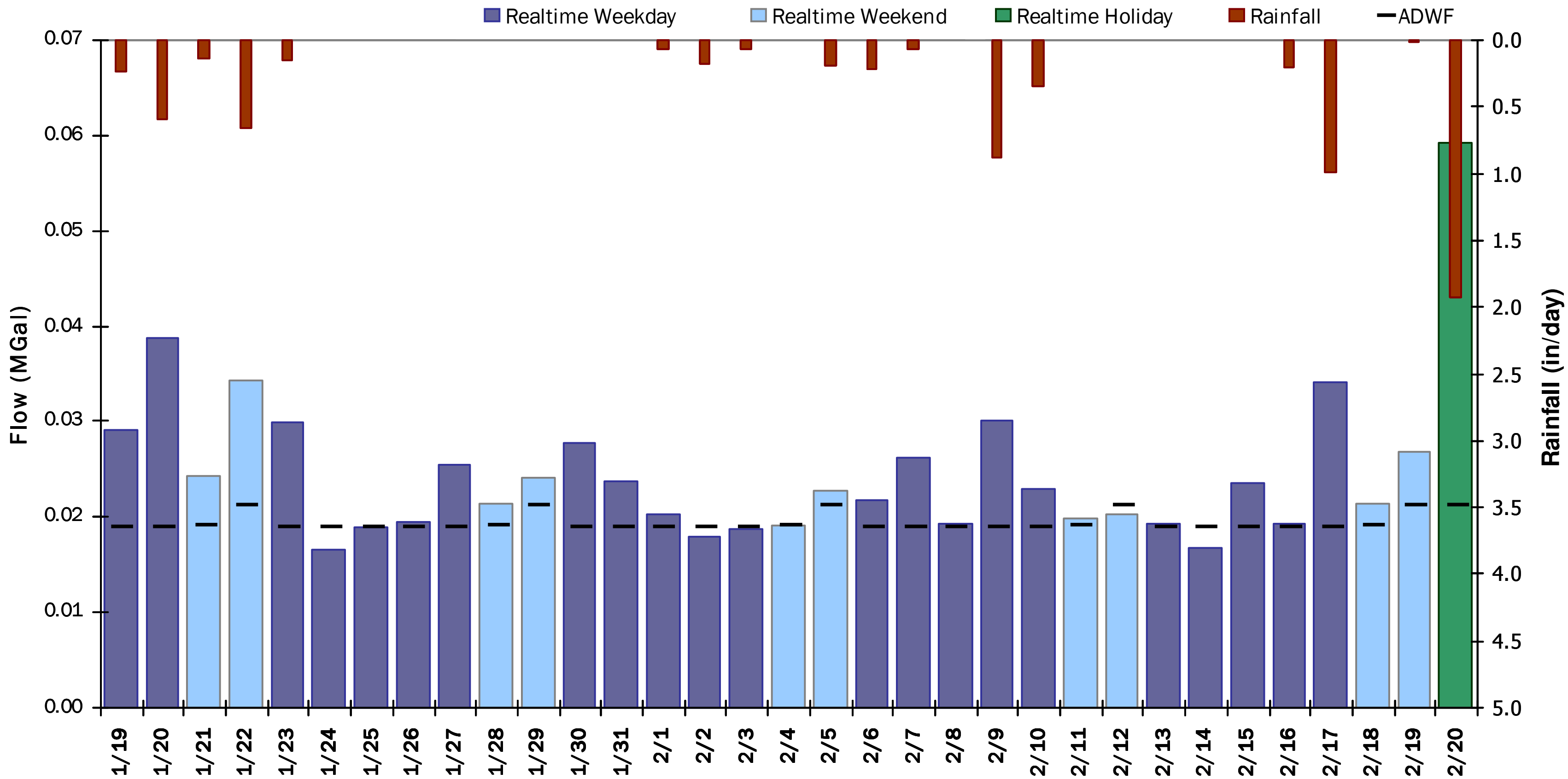
East Influent Pipe

SITE 06

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.025 MGal **Peak Daily Flow: 0.059 MGal** **Min Daily Flow: 0.017 MGal**

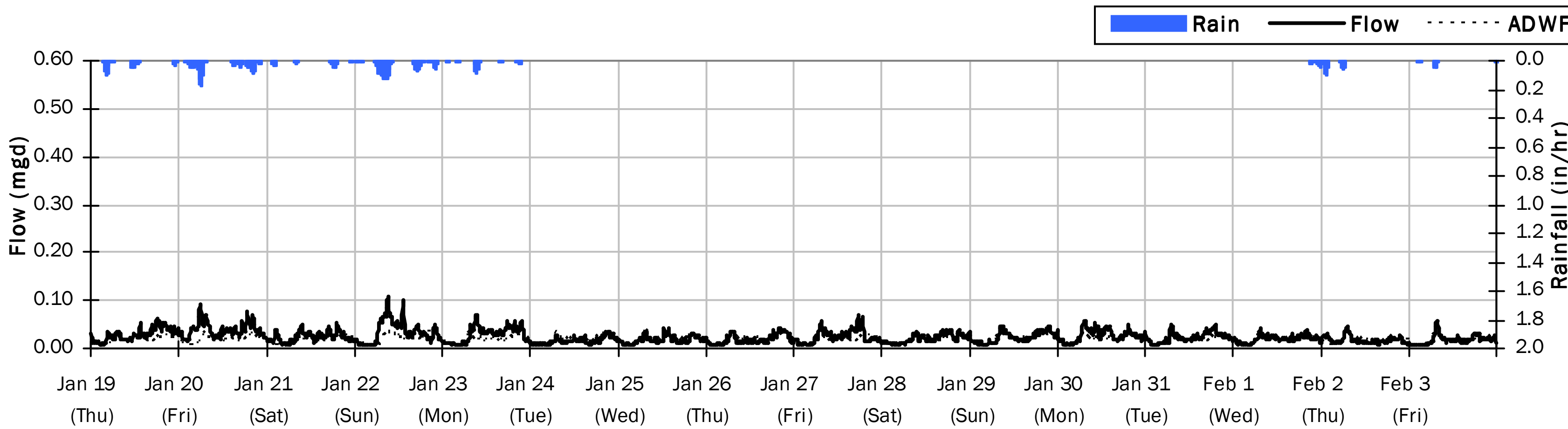
Total Period Rainfall: 6.93 inches

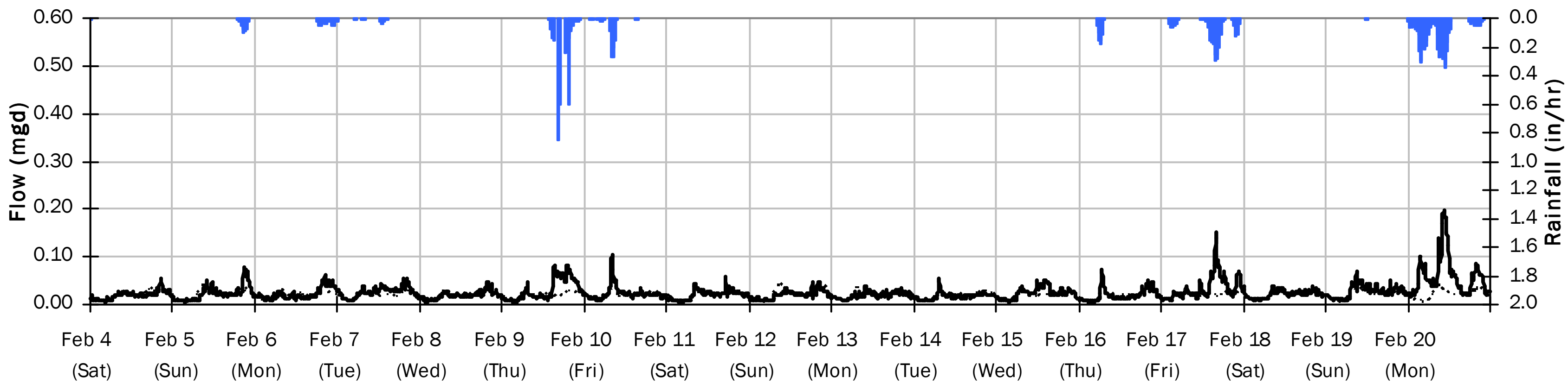


SITE 06

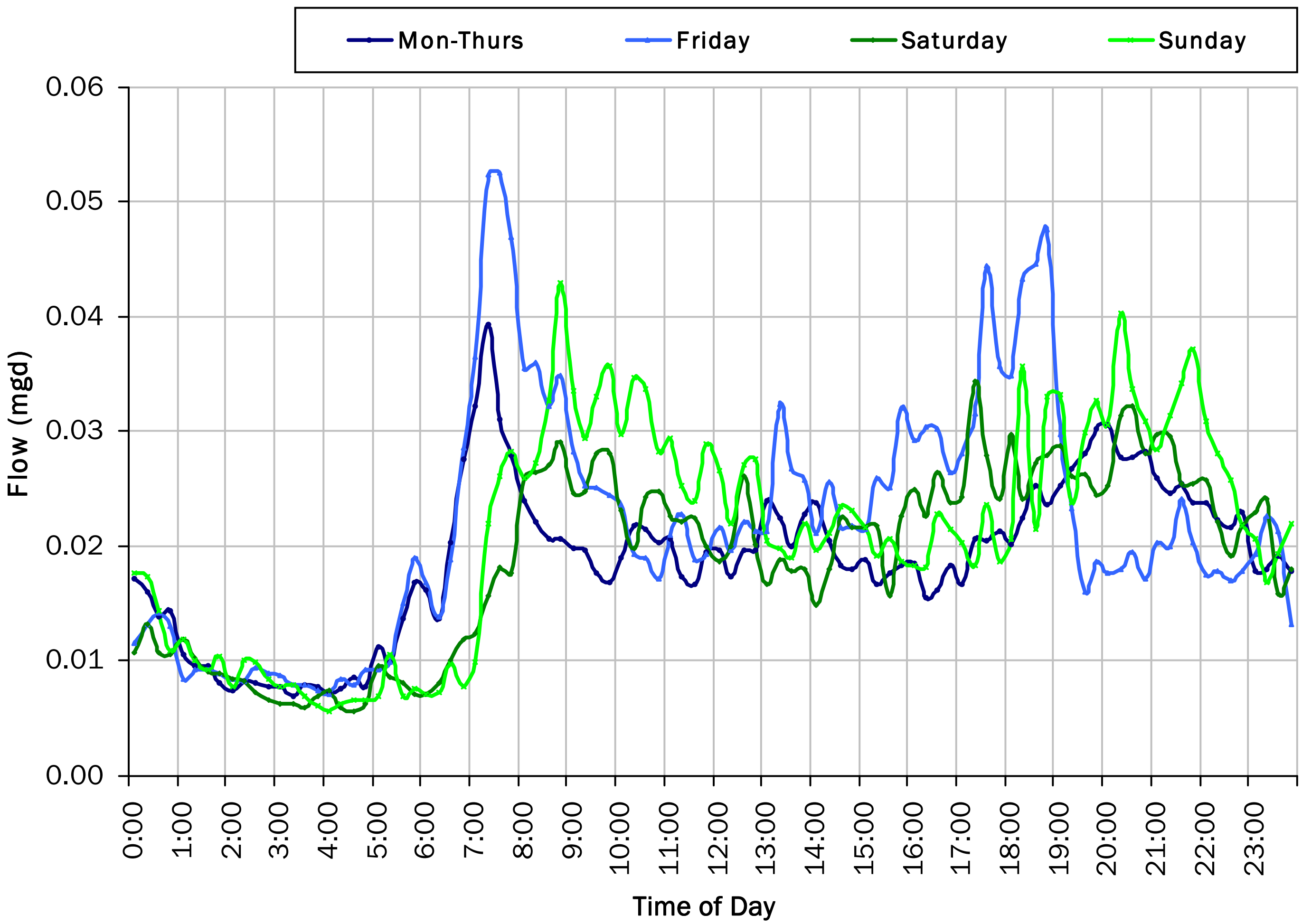
Flow Summary: 1/19/2017 to 2/20/2017

Total Period Rainfall: 6.93 inches   **Avg Flow: 0.025 mgd**   **Peak Flow: 0.199 mgd**   **Min Flow: 0.004 mgd**



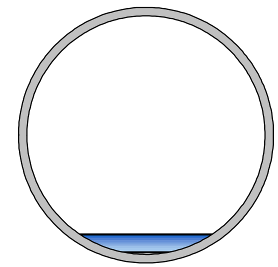


SITE 06
Average Dry Weather Flow Hydrographs



ADWF:

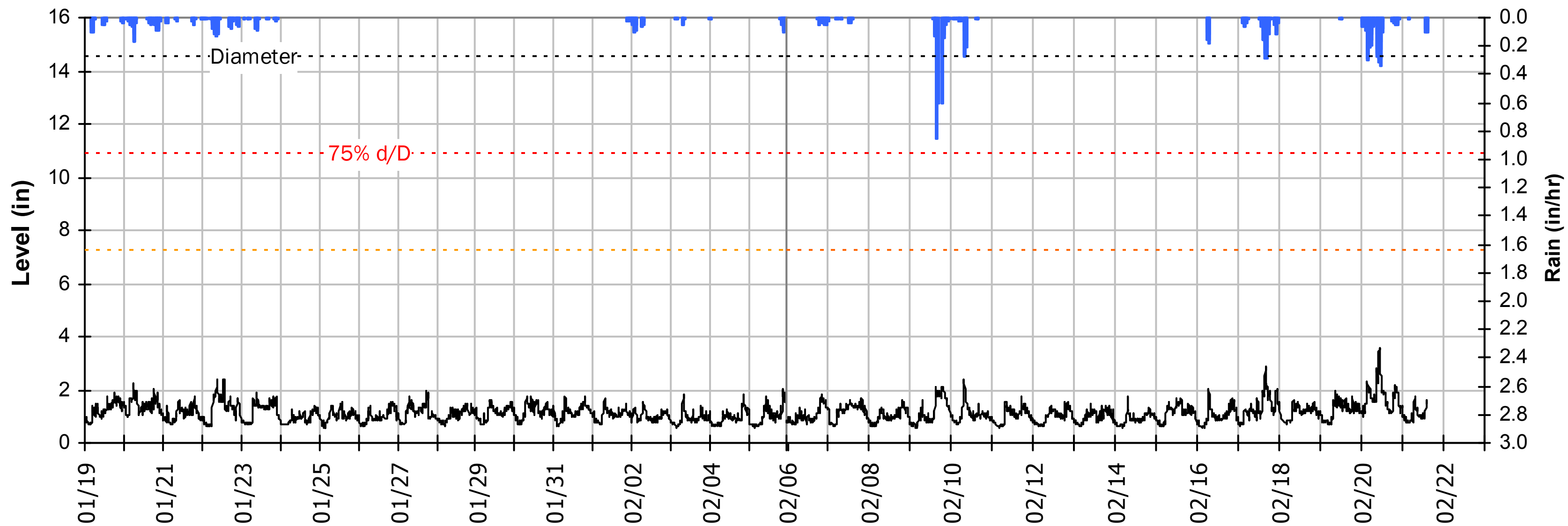
0.019 *mgd*

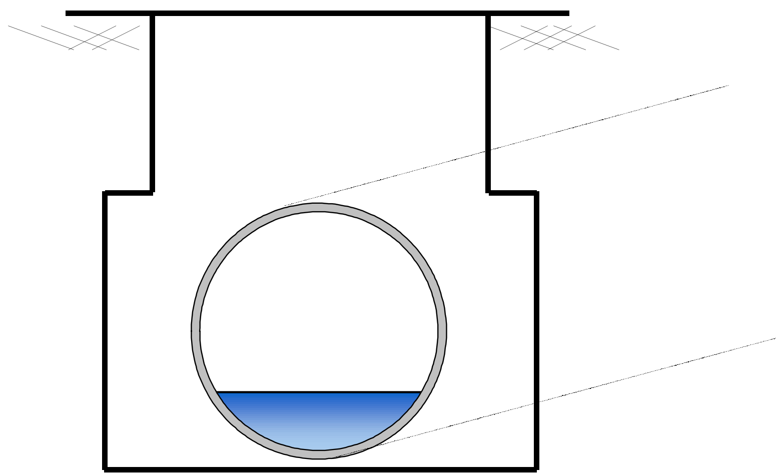


SITE 06

Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





Pipe Diameter: 14.5 *inches*

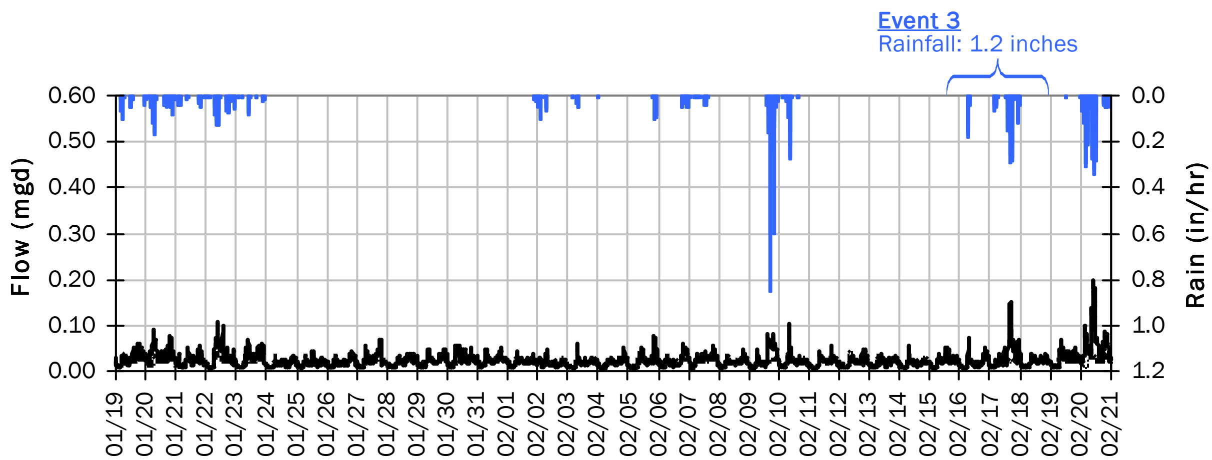
Peak Measured Level: 3.54 *inches*

Peak d/D Ratio: 0.24

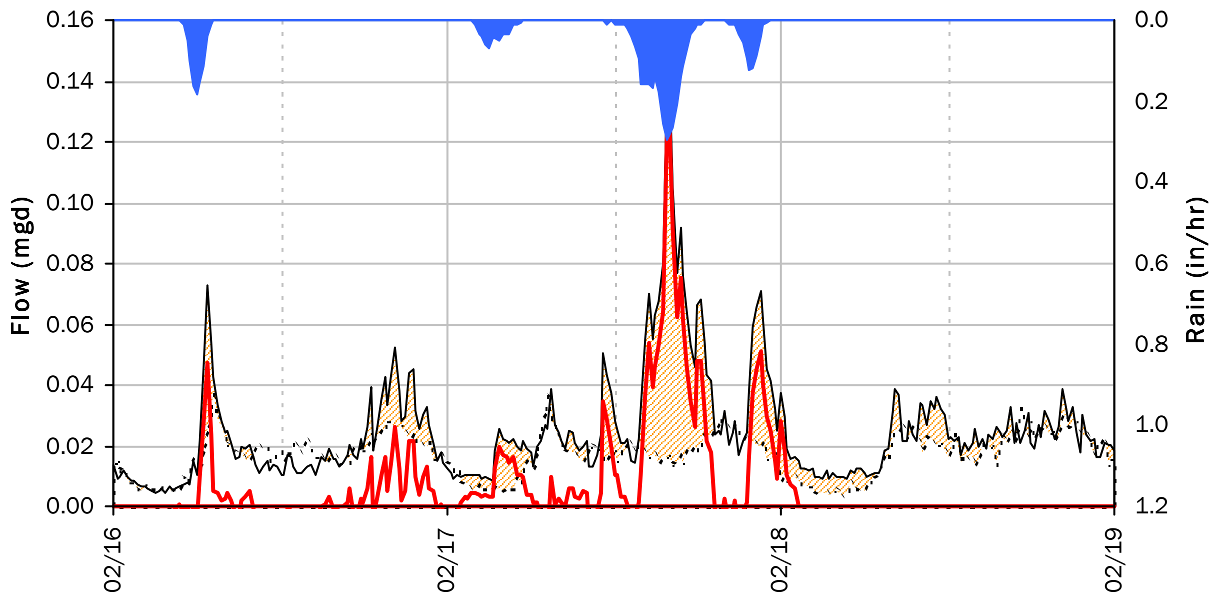
SITE 06

I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



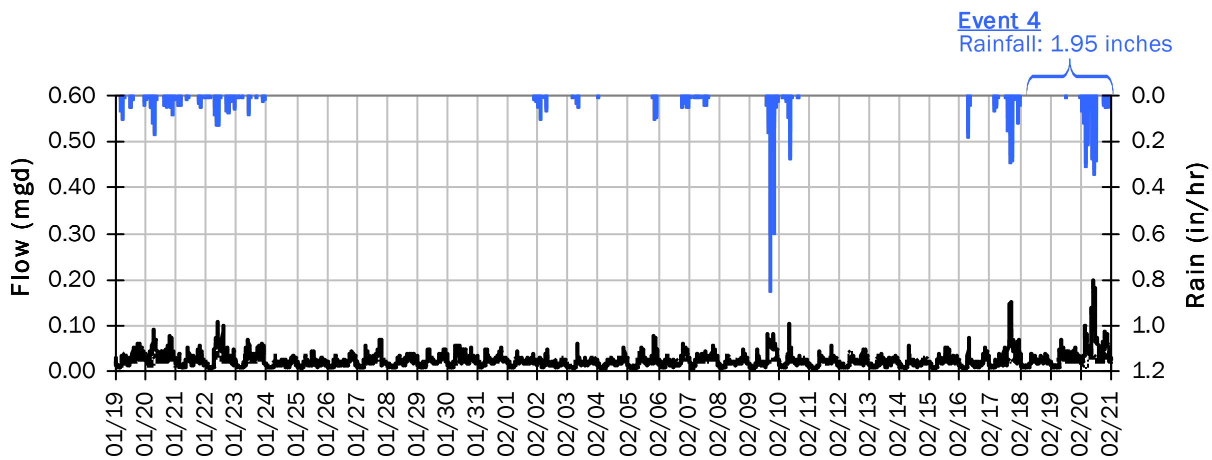
Storm Event I/I Analysis (Rain = 1.20 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.15 *mgd*	**Peak I/I Rate:**	0.13 *mgd*
PF:	7.72	**Total I/I:**	20,000 *gallons*
Peak Level:	2.90 *in*		
d/D Ratio:	0.20		

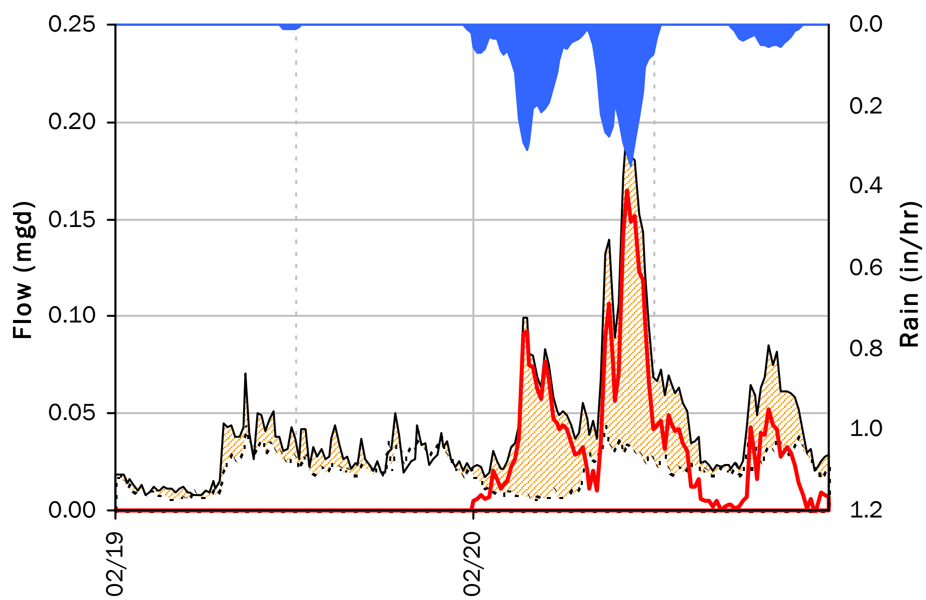
SITE 06

I/I Summary: Event 4

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



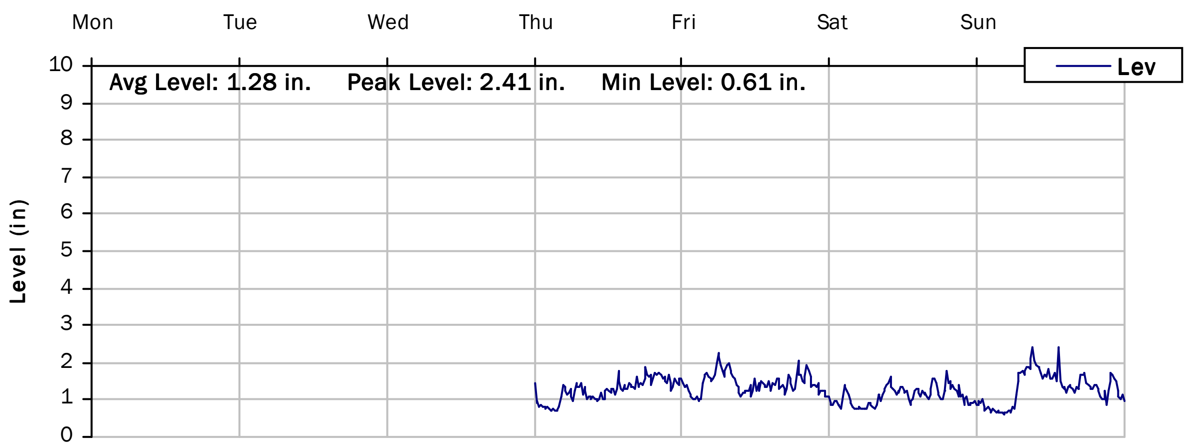
Event 4 Detail Graph

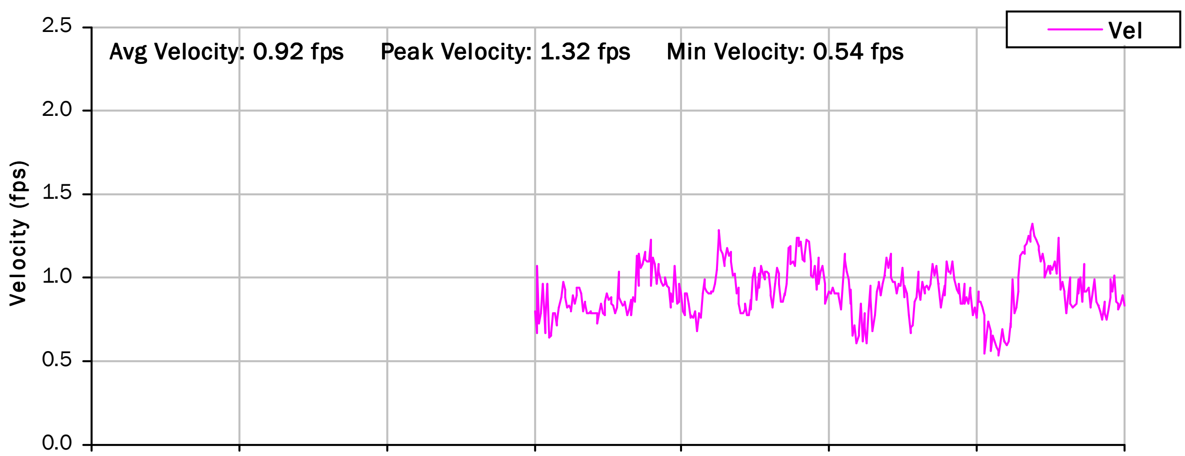


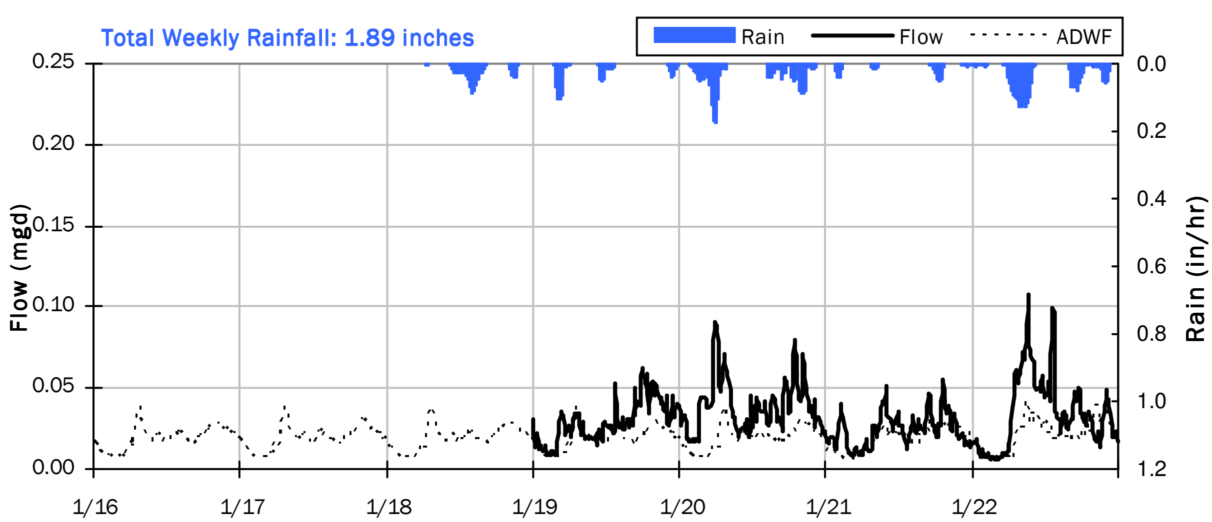
Storm Event I/I Analysis (Rain = 1.95 inches)

Capacity		**Inflow / Infiltration**	
Peak Flow:	0.20 *mgd*	**Peak I/I Rate:**	0.16 *mgd*
PF:	10.31	**Total I/I:**	38,000 *gallons*
Peak Level:	3.54 *in*		
d/D Ratio:	0.24		

SITE 06
Weekly Level, Velocity and Flow Hydrographs
1/16/2017 to 1/23/2017

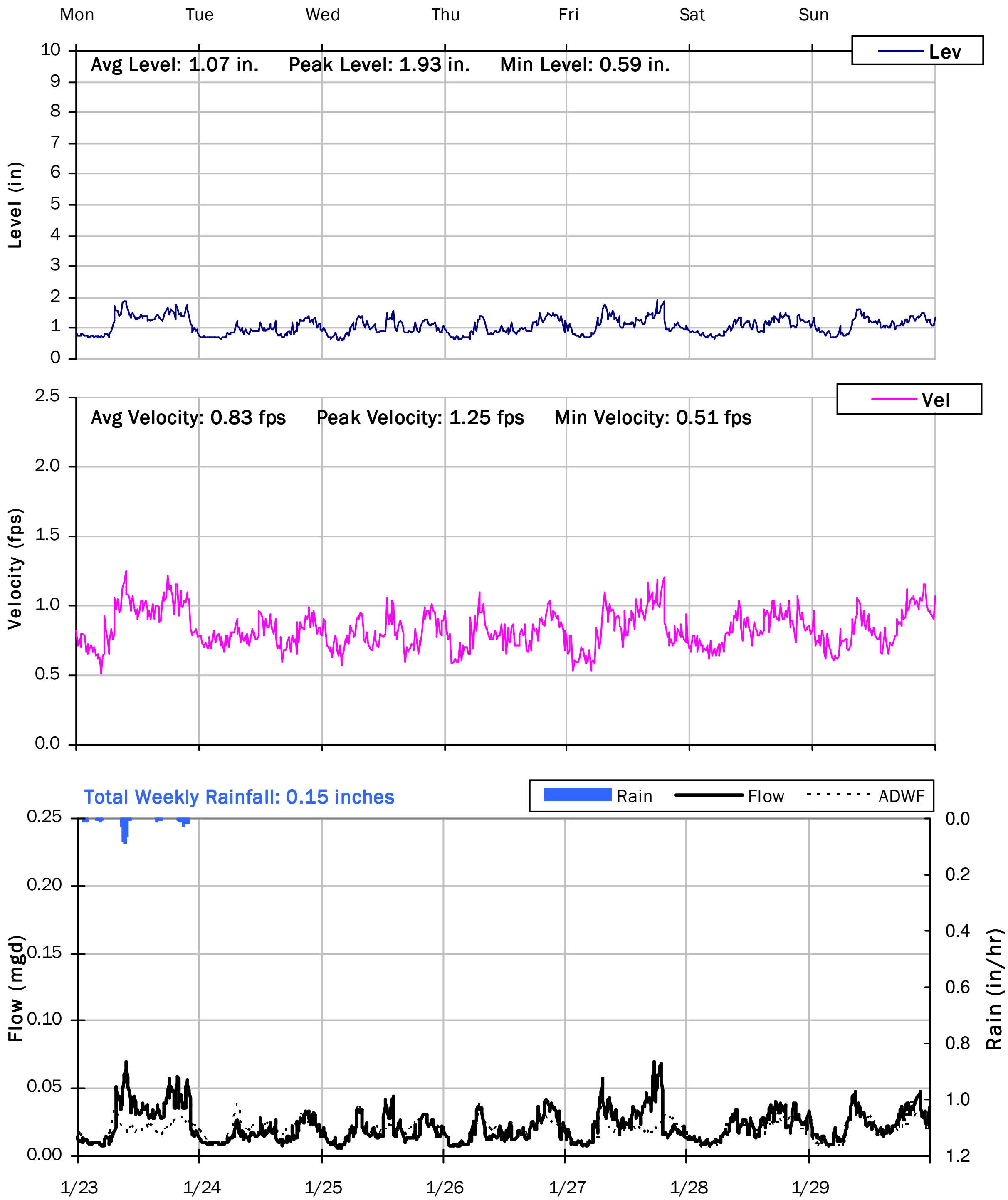






Avg Flow: 0.032 mgd **Peak Flow: 0.107 mgd** **Min Flow: 0.006 mgd**

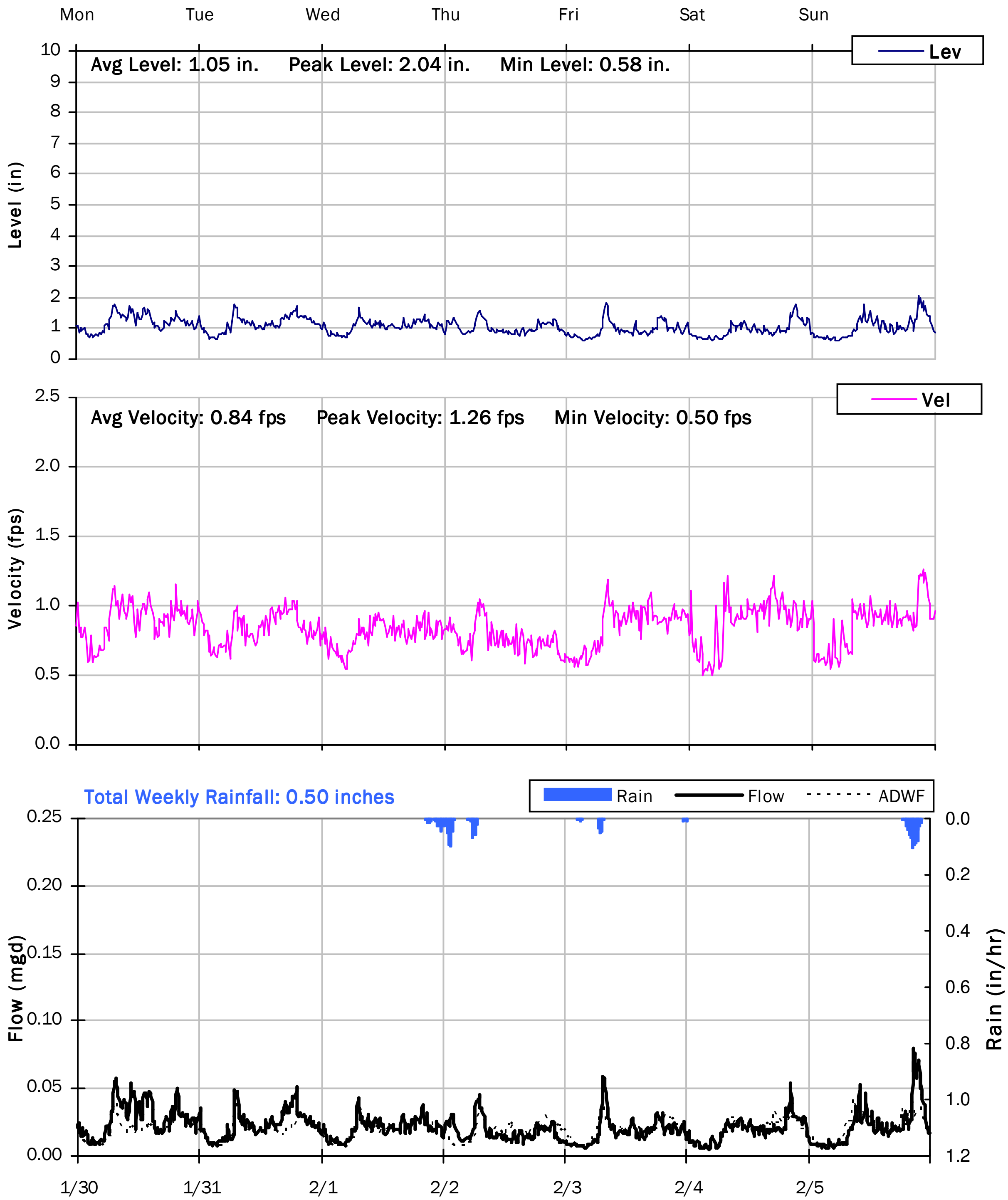
SITE 06
Weekly Level, Velocity and Flow Hydrographs
1/23/2017 to 1/30/2017



Avg Flow: 0.022 mgd **Peak Flow: 0.070 mgd** **Min Flow: 0.006 mgd**

SITE 06

Weekly Level, Velocity and Flow Hydrographs
1/30/2017 to 2/6/2017

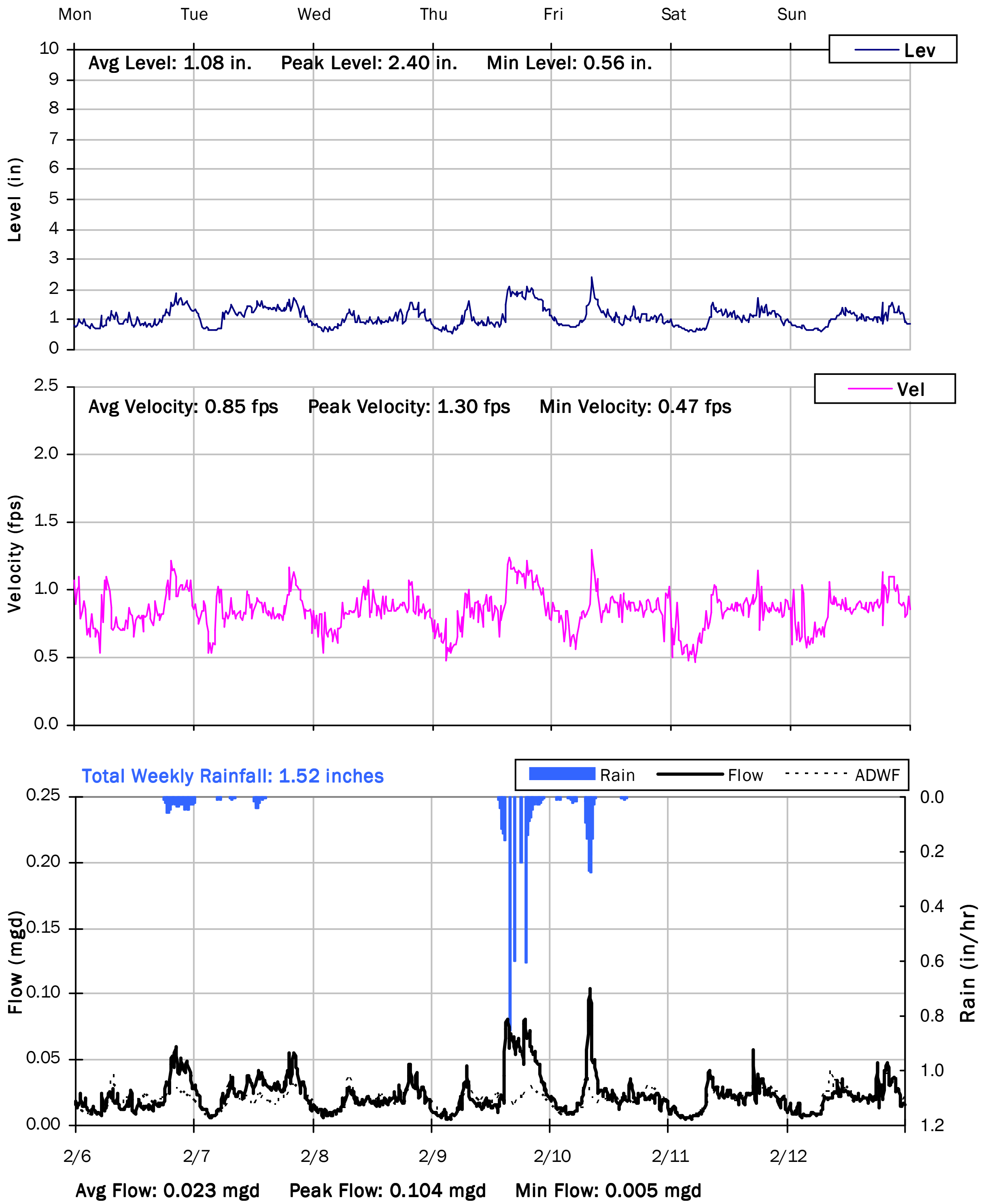


Avg Flow: 0.021 mgd Peak Flow: 0.078 mgd Min Flow: 0.005 mgd

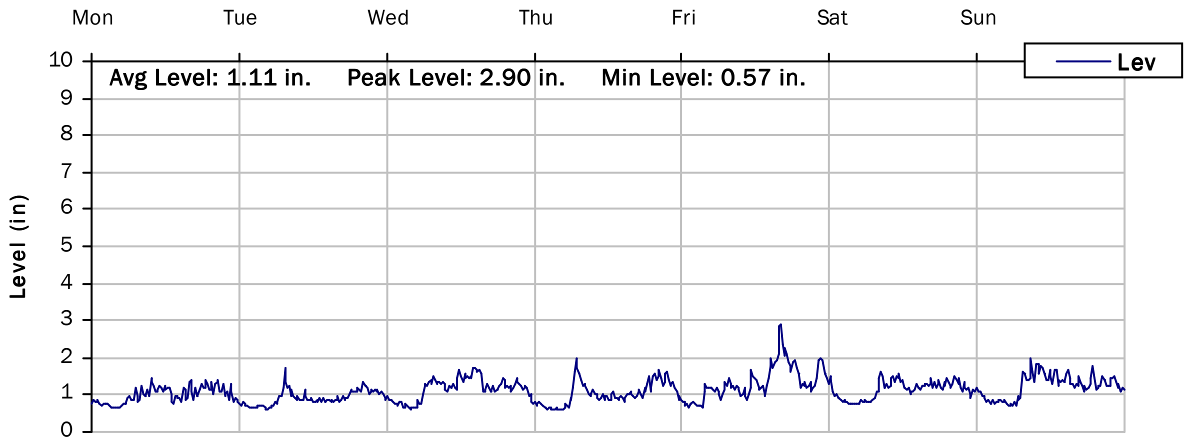
SITE 06

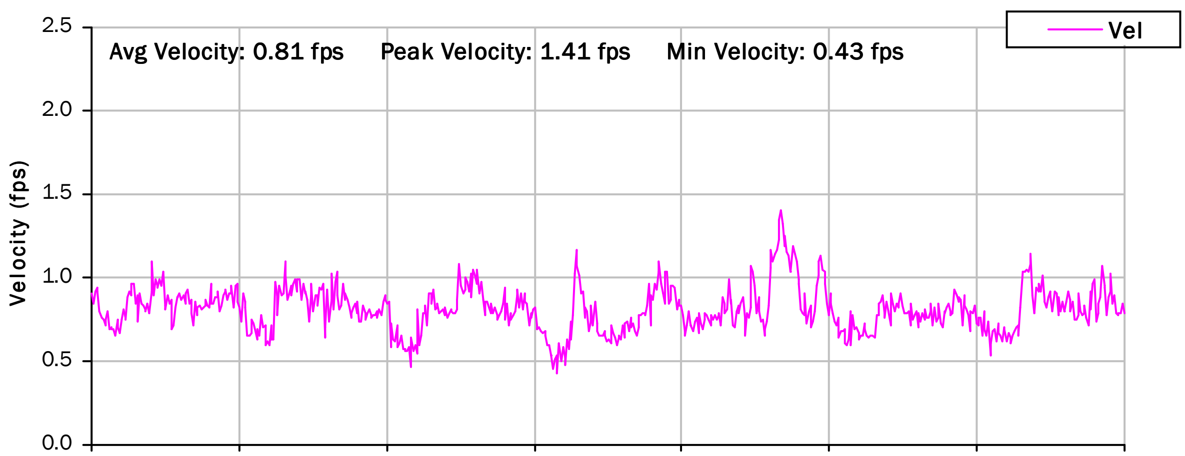
Weekly Level, Velocity and Flow Hydrographs

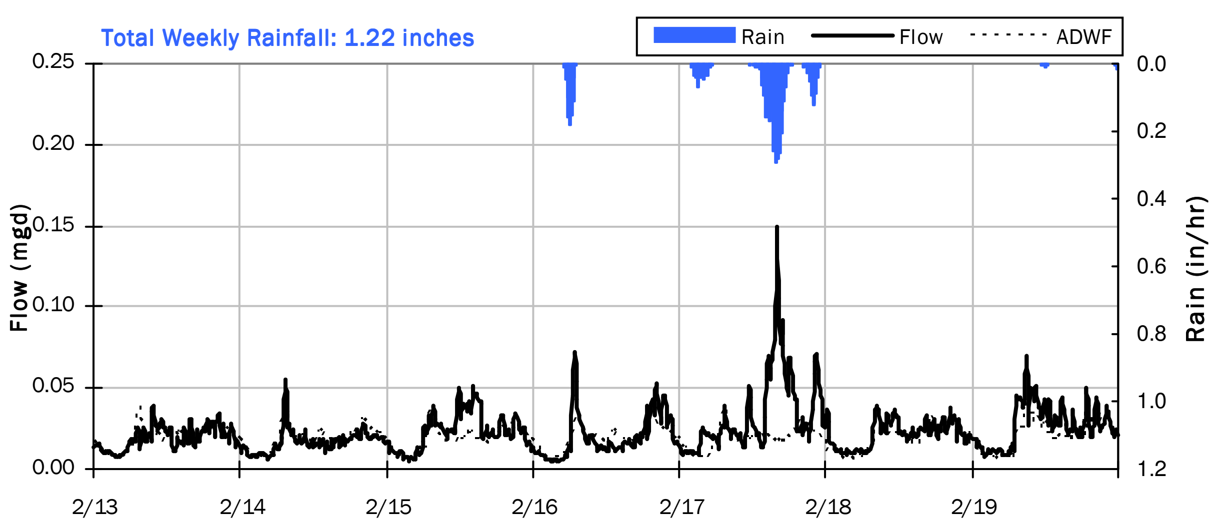
2/6/2017 to 2/13/2017



SITE 06
Weekly Level, Velocity and Flow Hydrographs
2/13/2017 to 2/20/2017



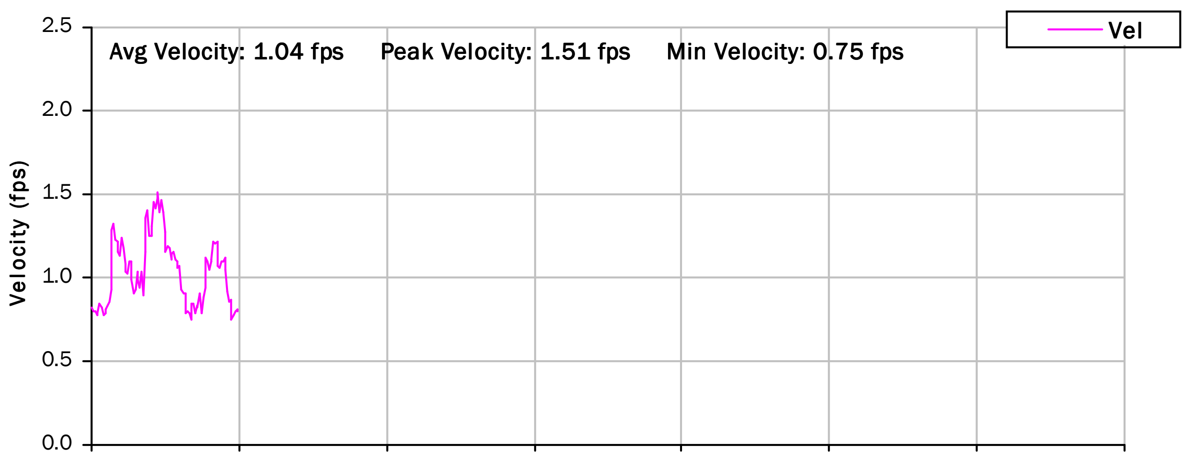


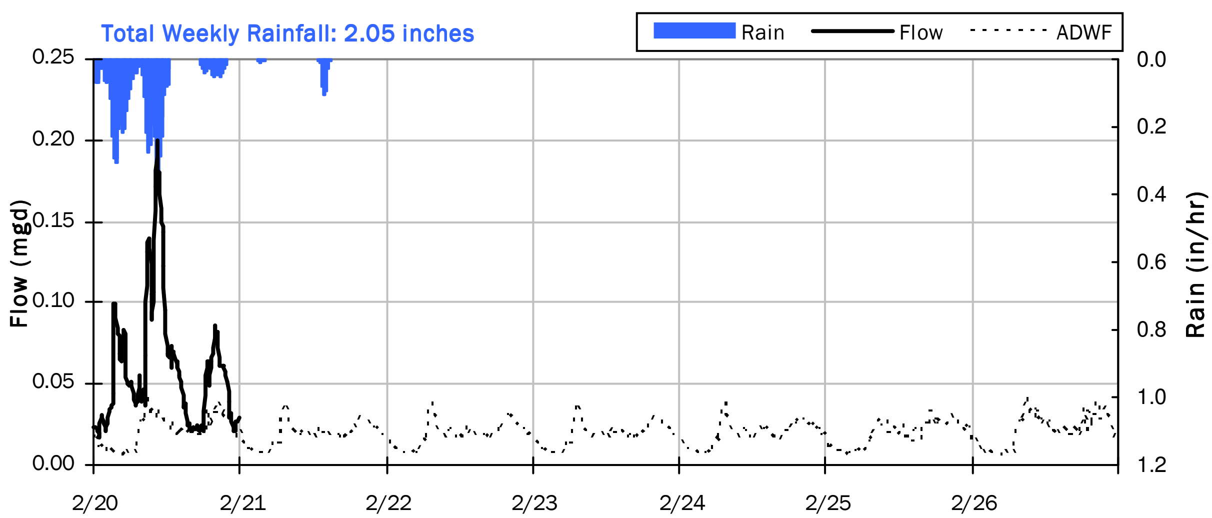


Avg Flow: 0.023 mgd **Peak Flow: 0.149 mgd** **Min Flow: 0.004 mgd**

SITE 06

Weekly Level, Velocity and Flow Hydrographs
2/20/2017 to 2/27/2017





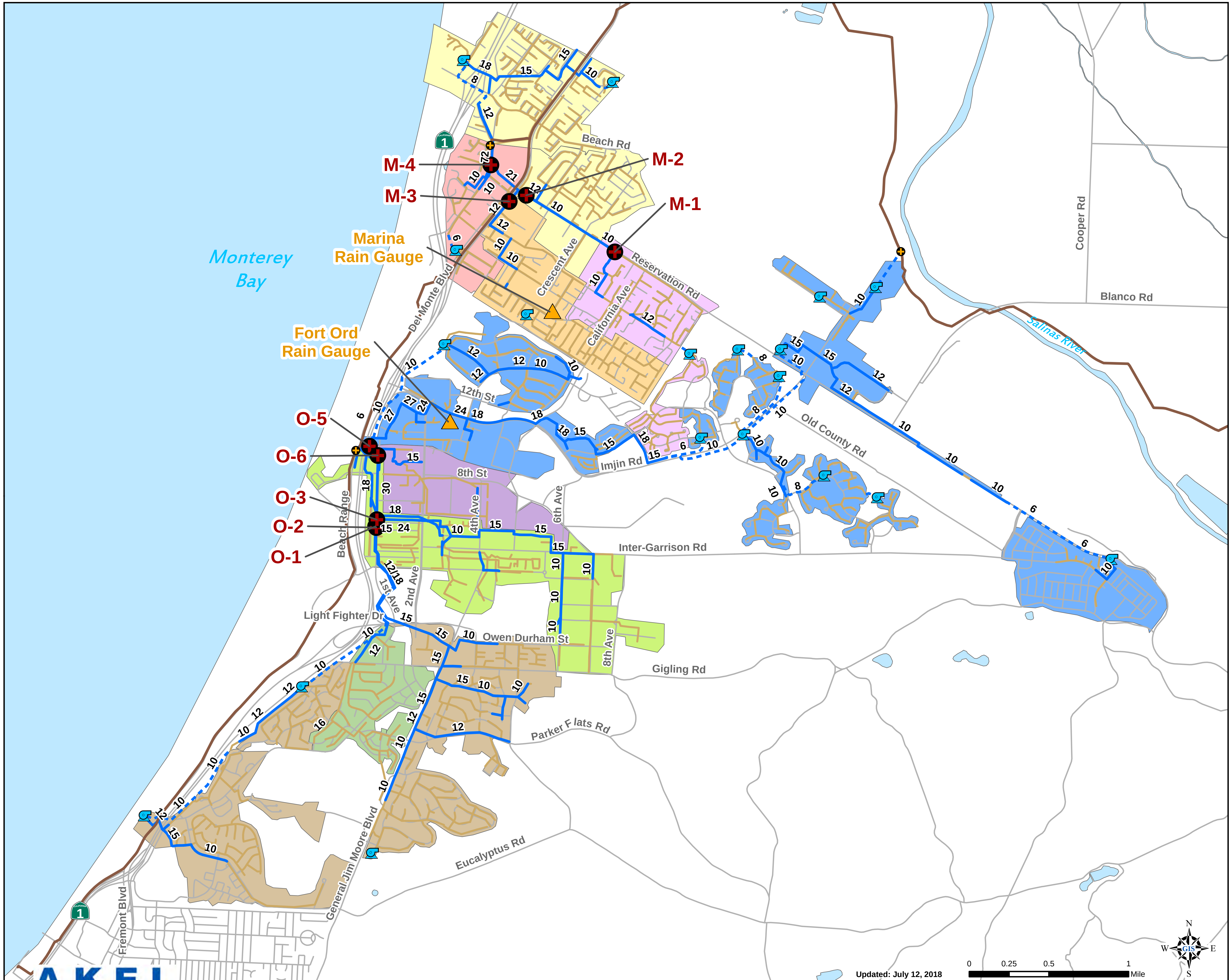
Avg Flow: 0.059 mgd **Peak Flow: 0.199 mgd** **Min Flow: 0.017 mgd**

V&A Project No. 16-0271

V&A
consulting engineers
1000 Broadway, Suite 230
Oakland, CA 94607
510.903.6600
510.903.6601, Fax

APPENDIX B

Hydraulic Model Calibration Exhibits



Legend

- Rain Gauge
- Flow Meters

Flow Meter Basins

- M-1
- M-2
- M-3
- M-4
- O-1
- O-2
- O-3
- O-5
- O-6

Existing Modeled Sytem

- Lift Stations
- Outfalls

Gravity Mains by Size

- 8" and Smaller
- 10" and Larger
- Force Mains
- Monterey One Water Interceptor
- Streets
- Waterbodies
- Rivers/Streams

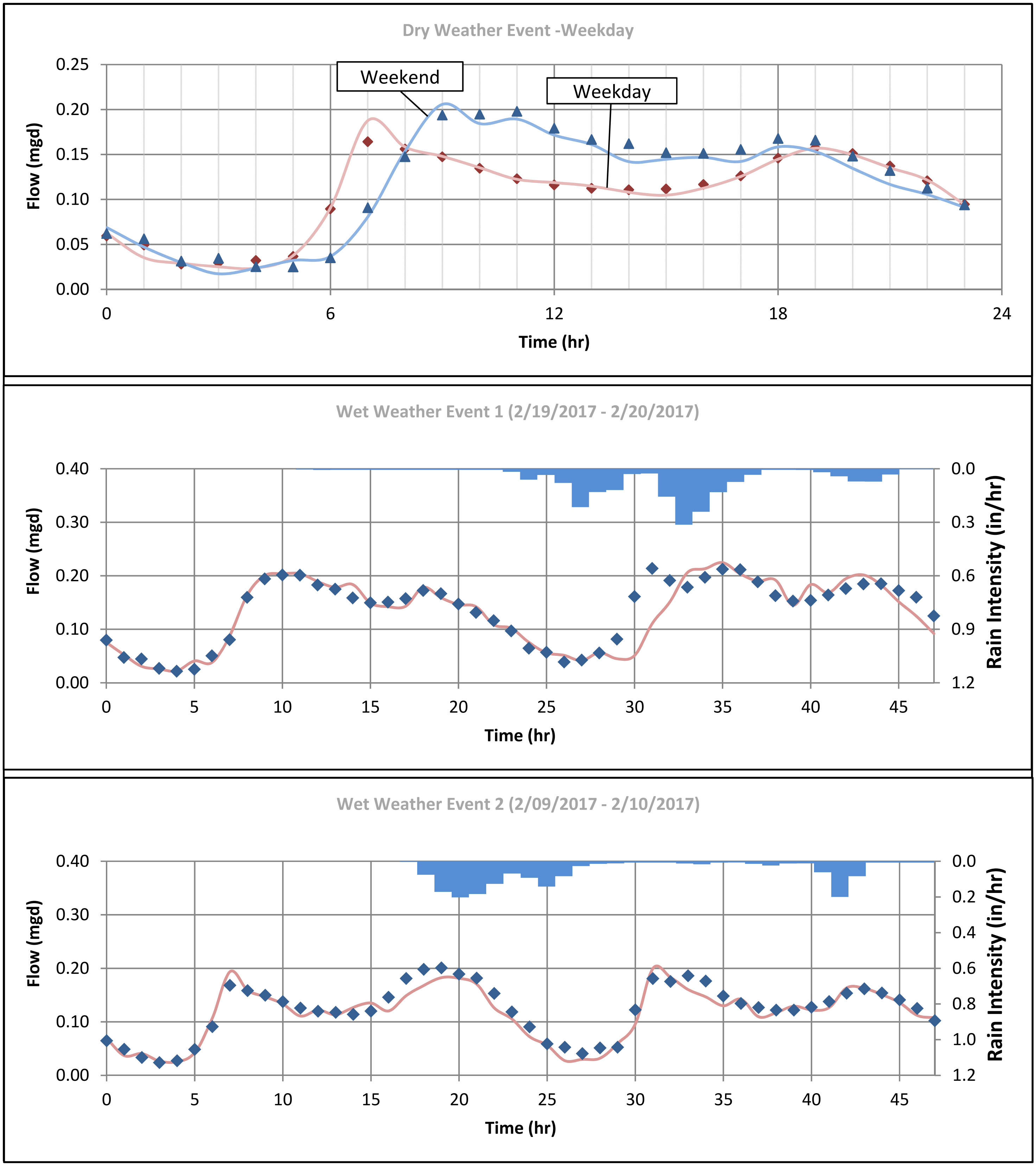
PRELIMINARY

Figure 1
Flow Meter Locations

Sewer Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Sewer\Apdx\MCWD_Fig1_FlowMeters_071218.mxd



LEGEND

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

PRELIMINARY

AKEL ENGINEERING GROUP, INC.

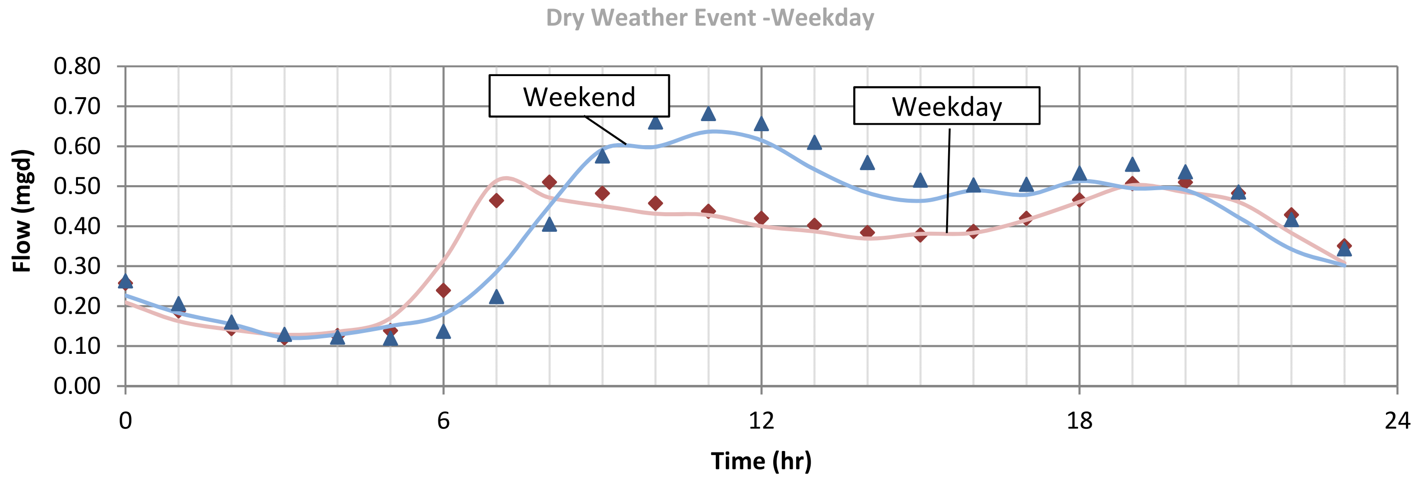
October 18, 2017

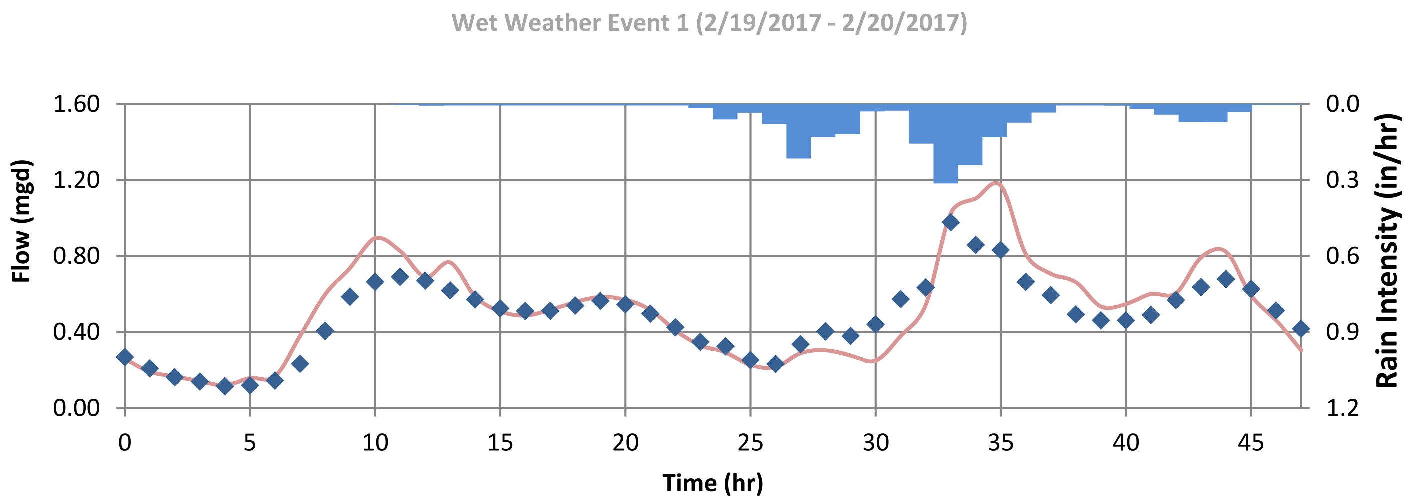
Figure 2

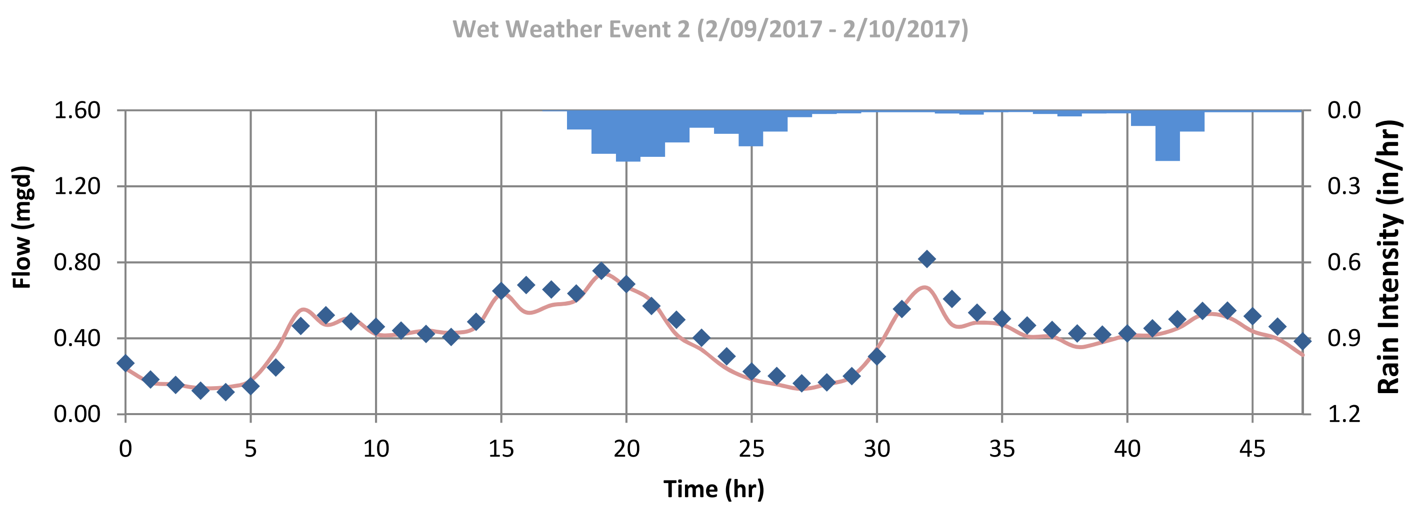
M-1 Marina

Sewer Master Plan

Marina Coast Water District







LEGEND

PRELIMINARY

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

AKEL ENGINEERING GROUP, INC.

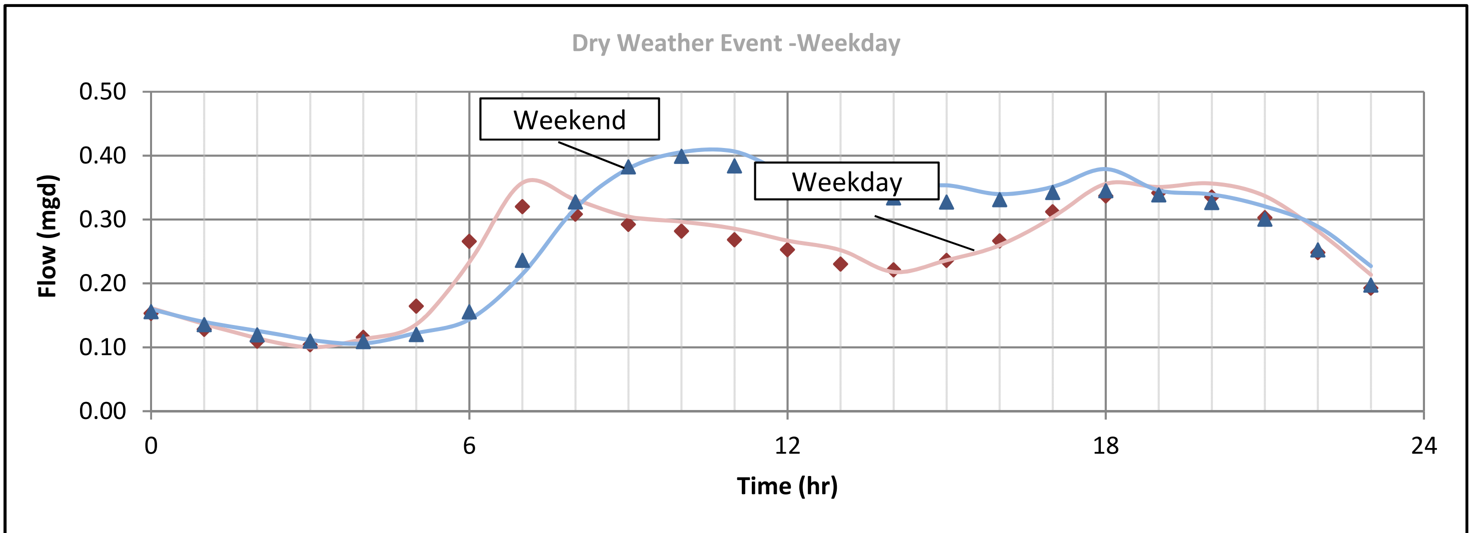
October 18, 2017

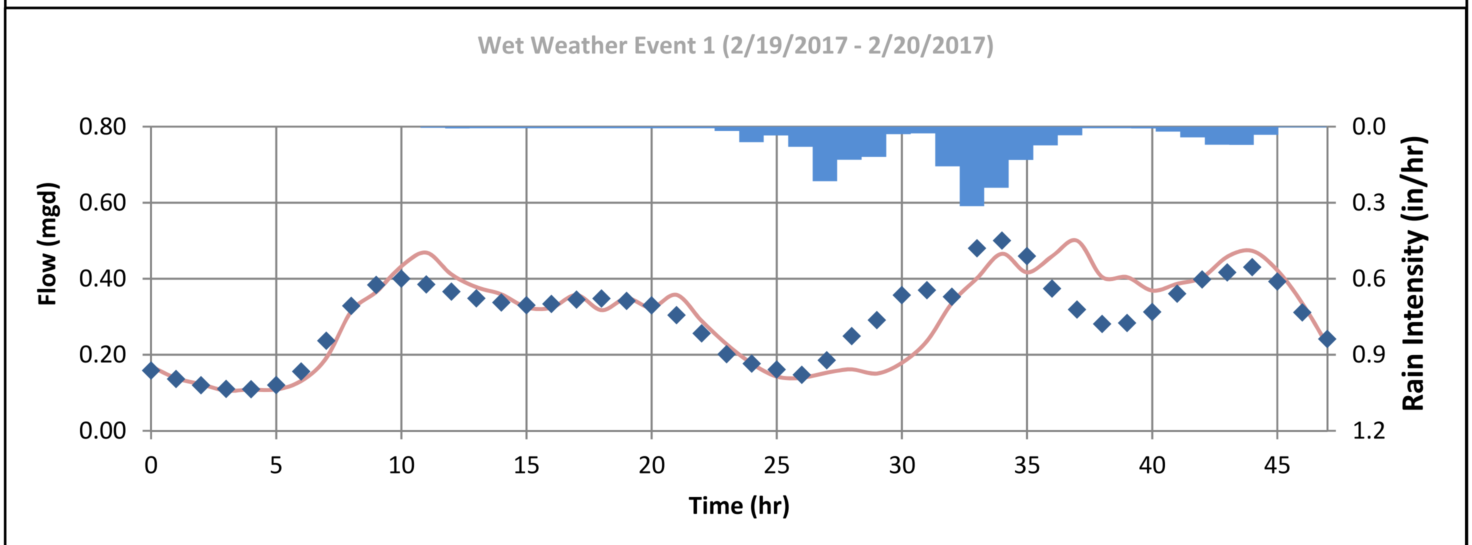
Figure 3

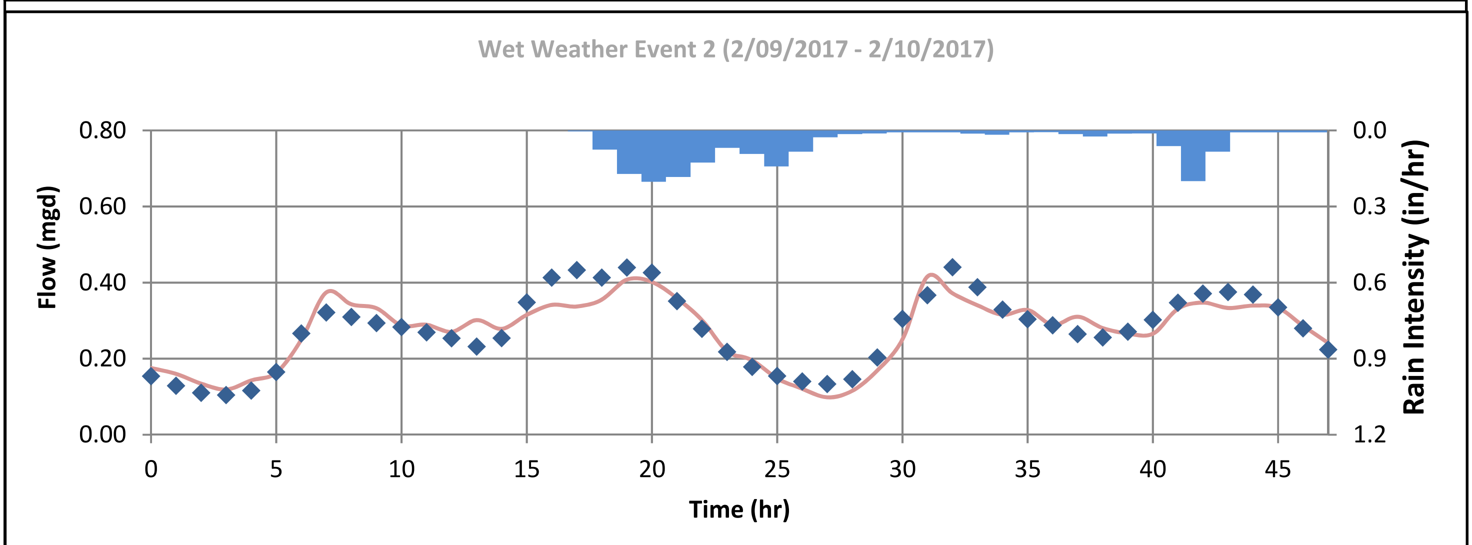
M-2 Marina

Sewer Master Plan

Marina Coast Water District







LEGEND

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

PRELIMINARY

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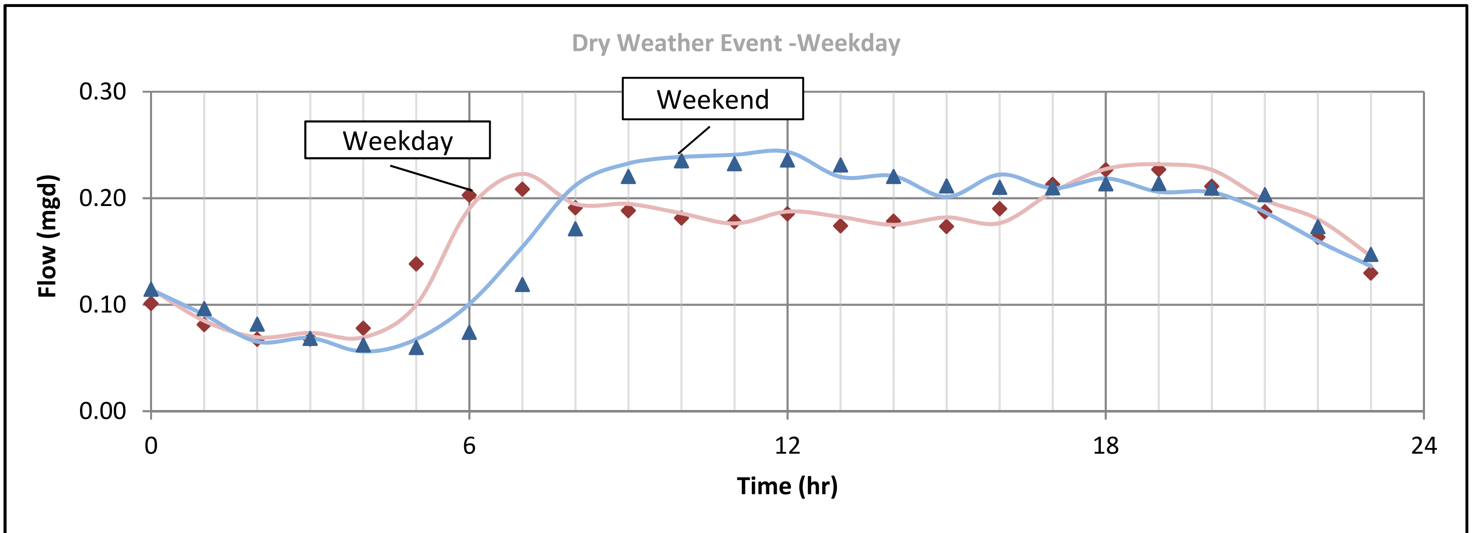
October 18, 2017

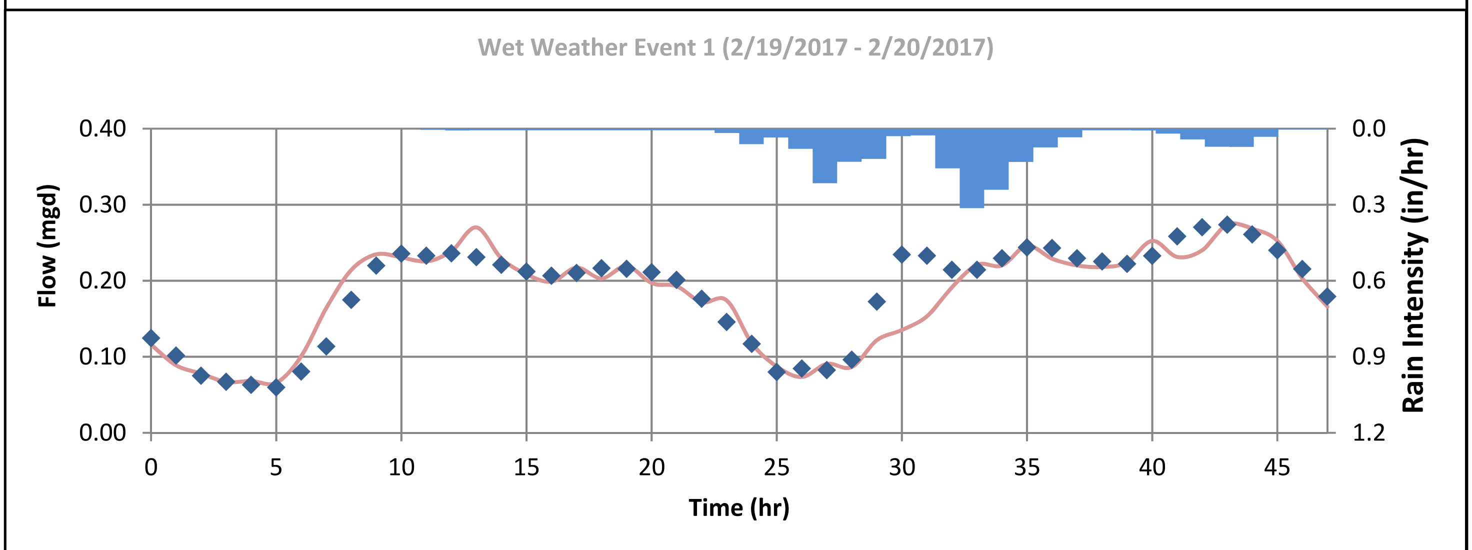
Figure 4

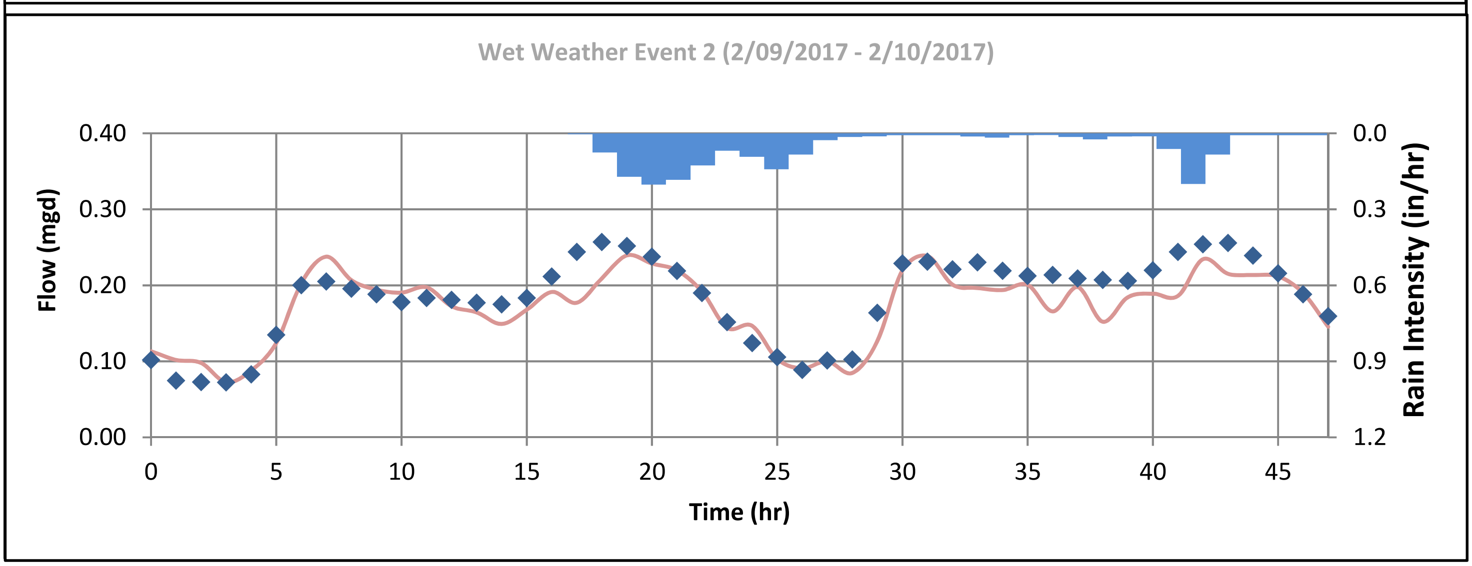
M-3 Marina

Sewer Master Plan

Marina Coast Water District







LEGEND

PRELIMINARY

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

AKEL ENGINEERING GROUP, INC.

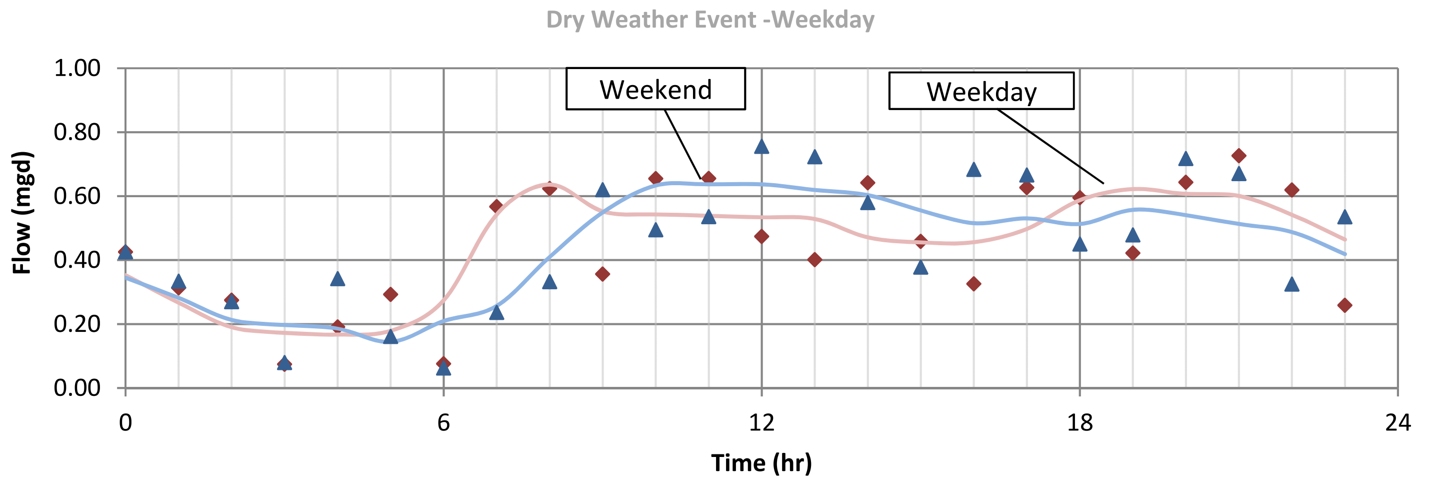
October 18, 2017

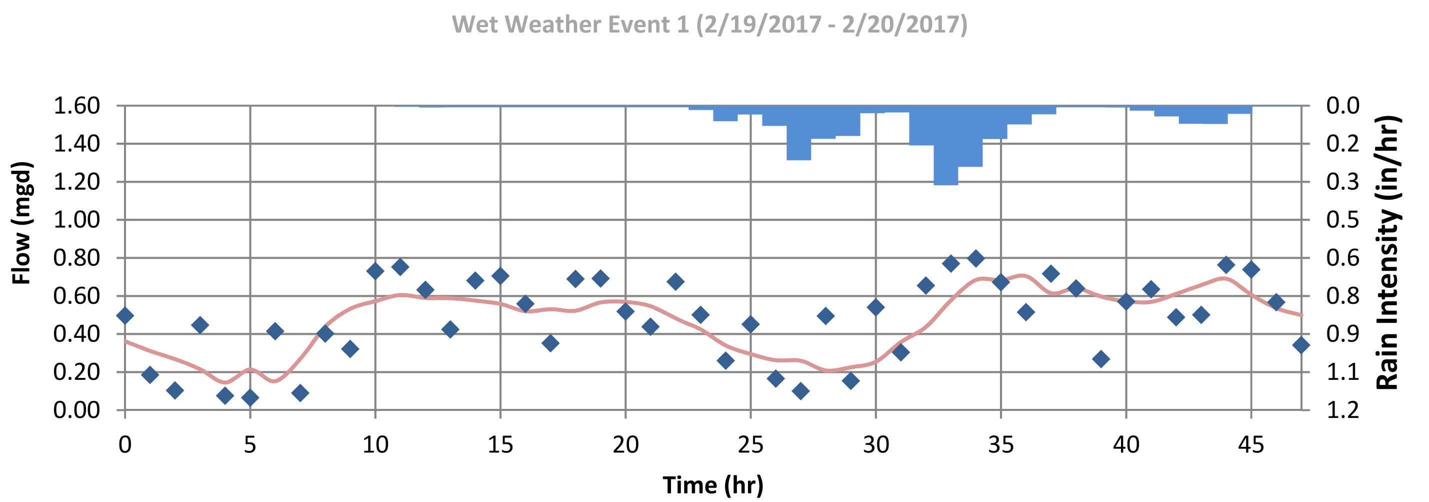
Figure 5

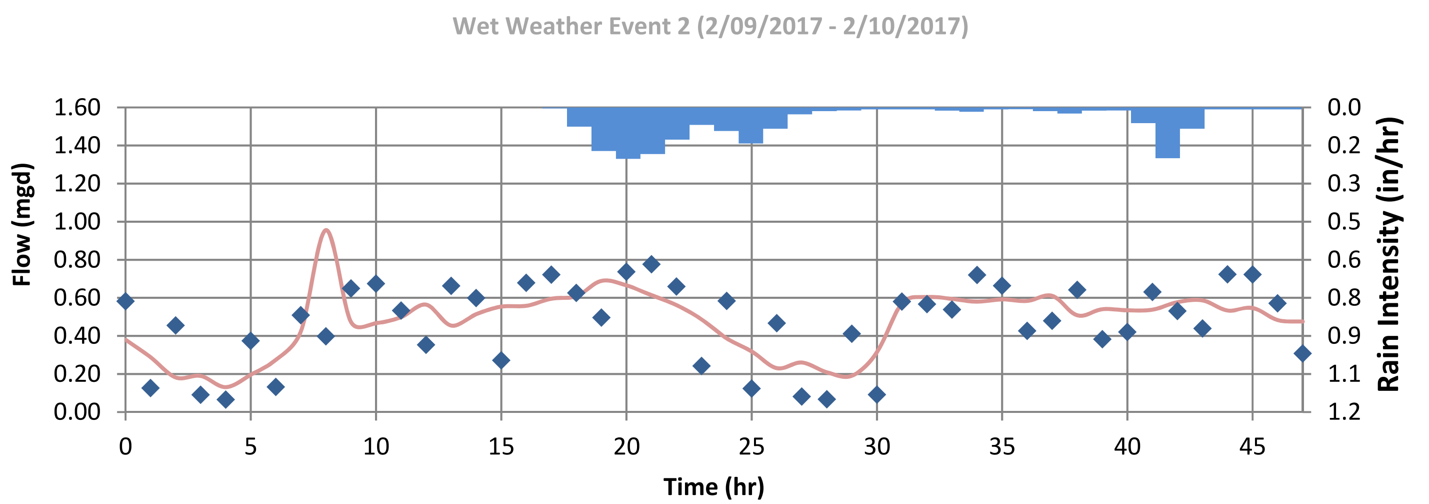
M-4 Marina

Sewer Master Plan

Marina Coast Water District







LEGEND

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

PRELIMINARY

Note :
Flow Fluctuations are heavily influenced by the Ord Village Lift Station.

October 18, 2017

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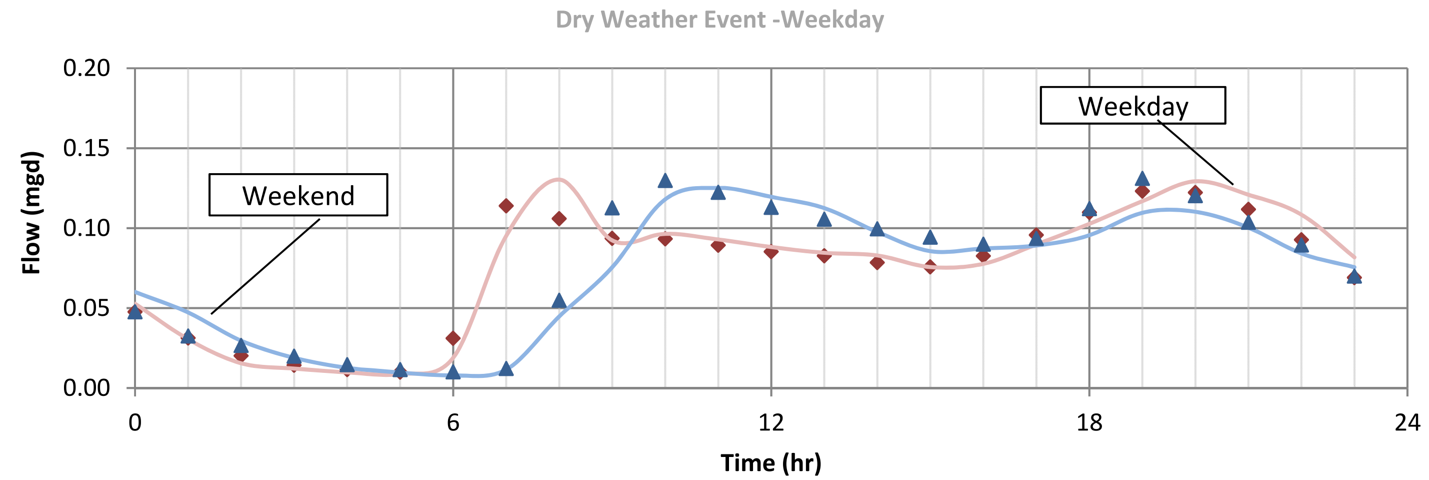
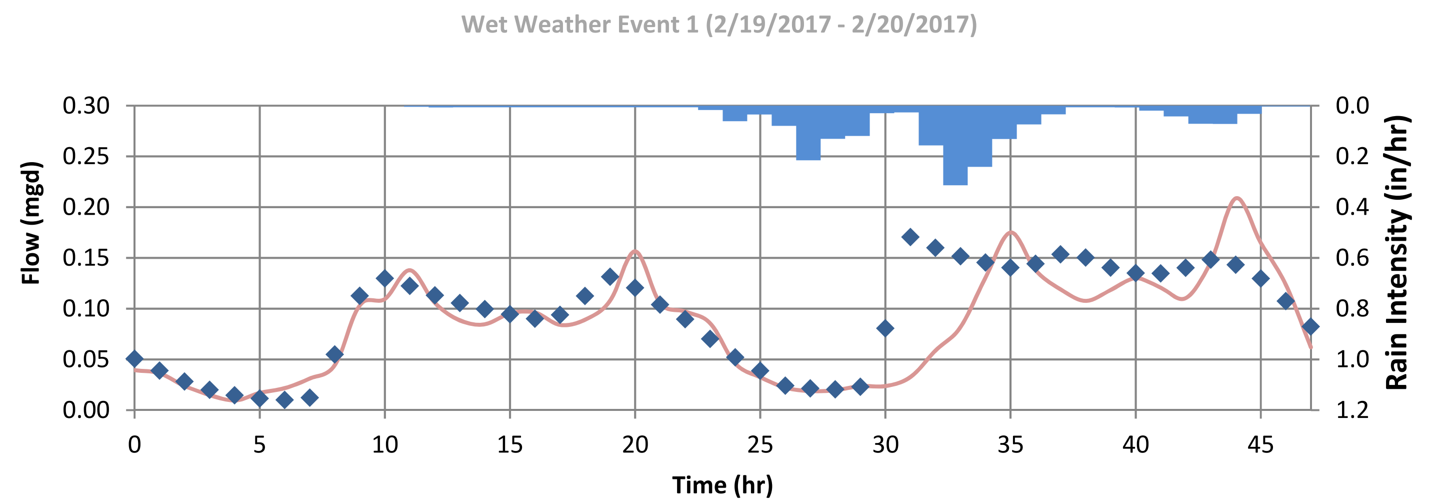
Figure 6

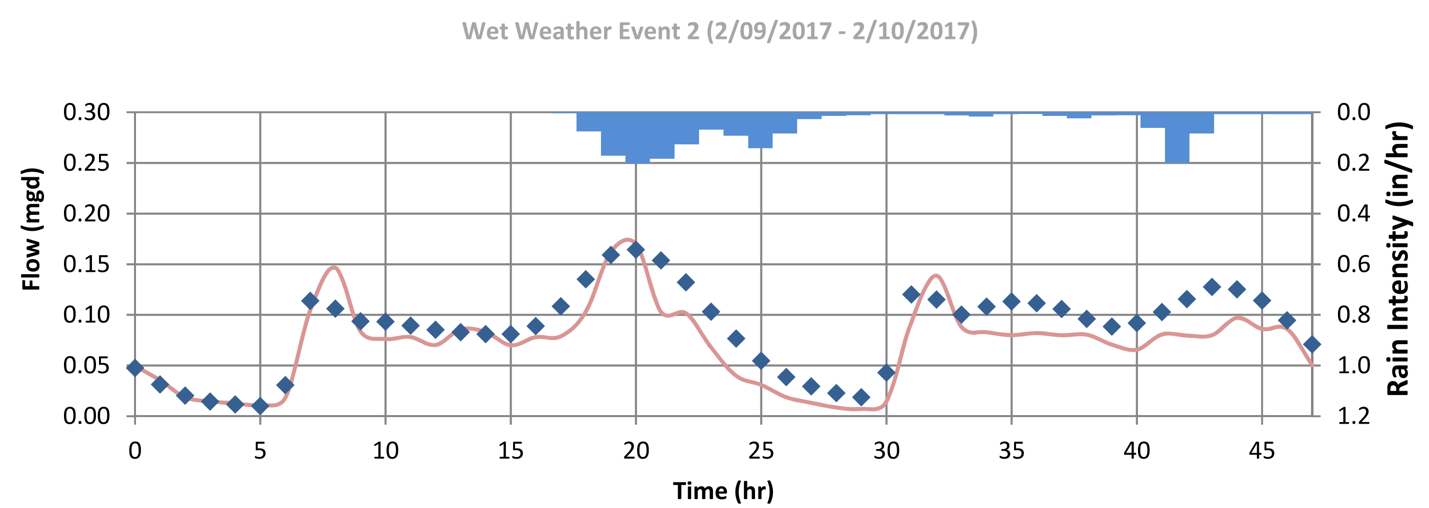
O-1 Fort Ord

Sewer Master Plan

Marina Coast Water District







LEGEND

PRELIMINARY

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

AKEL ENGINEERING GROUP, INC.

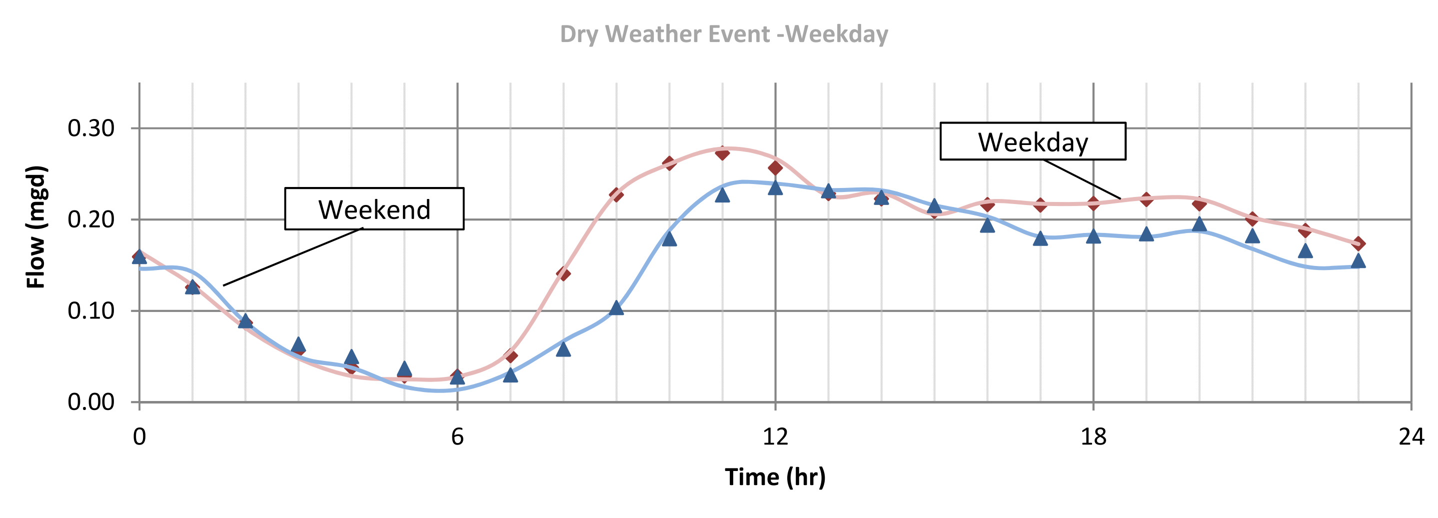
October 18, 2017

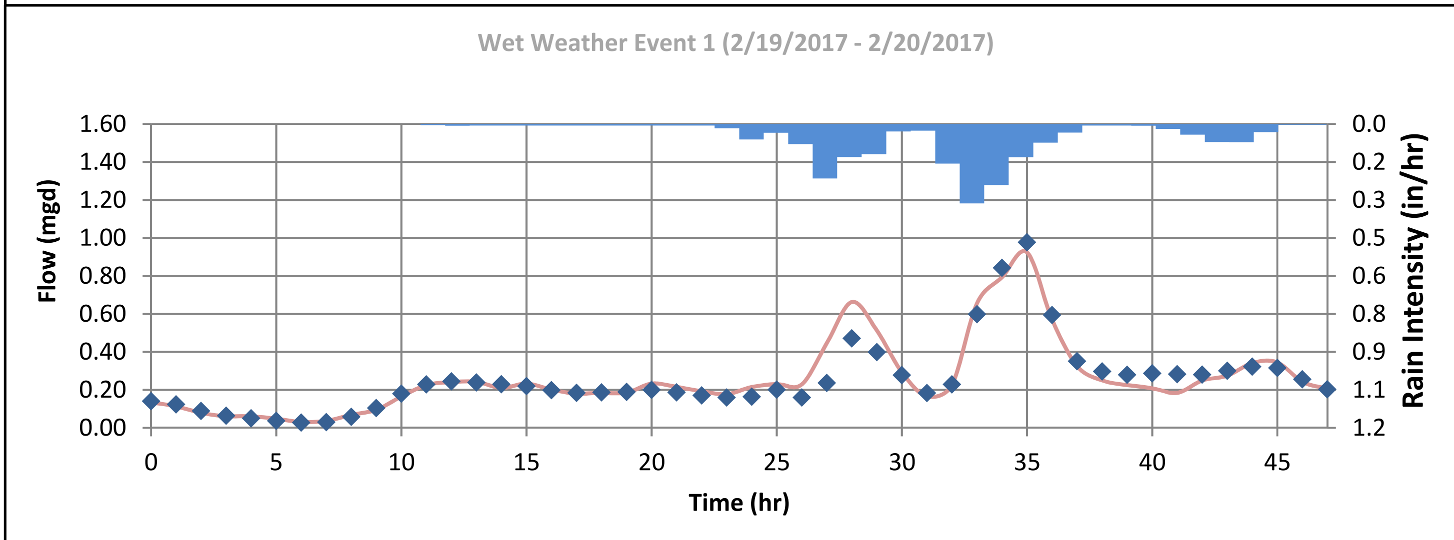
Figure 7

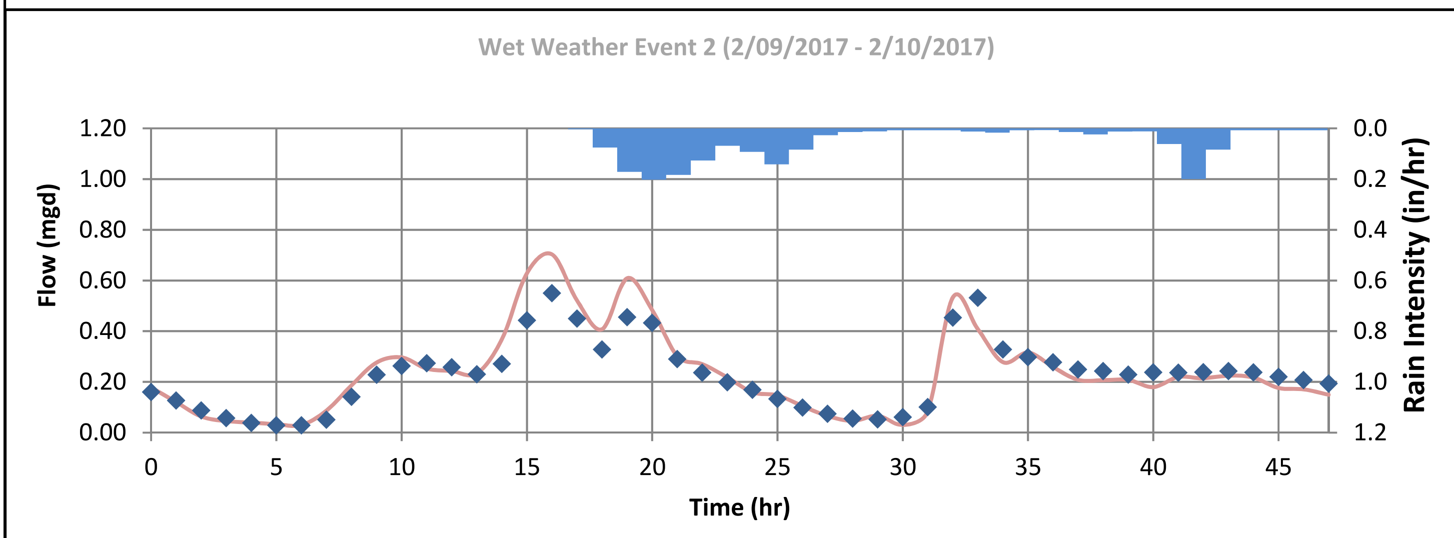
O-2 Fort Ord

Sewer Master Plan

Marina Coast Water District







LEGEND

PRELIMINARY

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

AKEL ENGINEERING GROUP, INC.

October 18, 2017

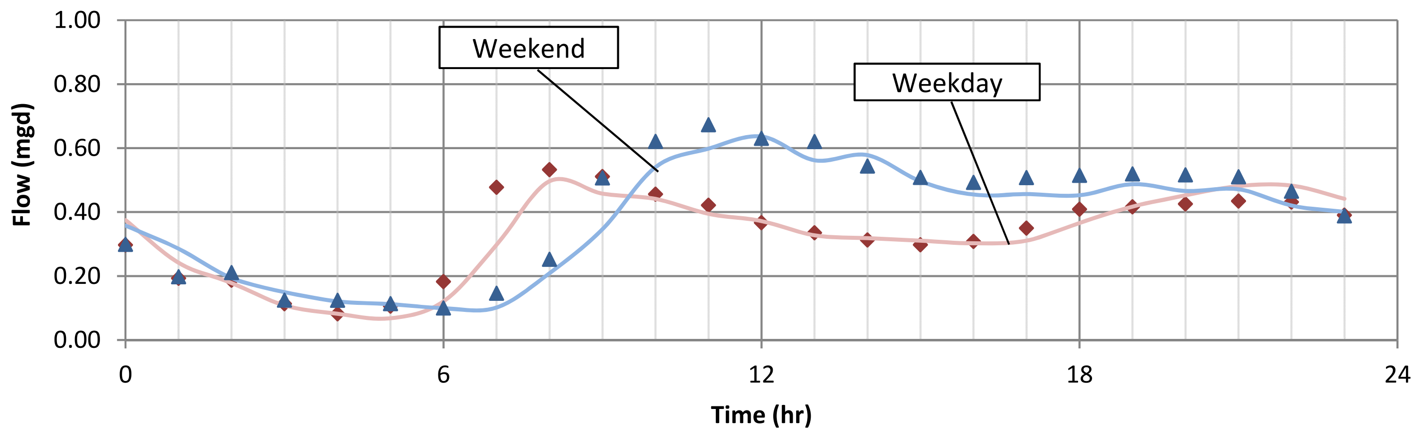
Figure 8

O-3 Fort Ord

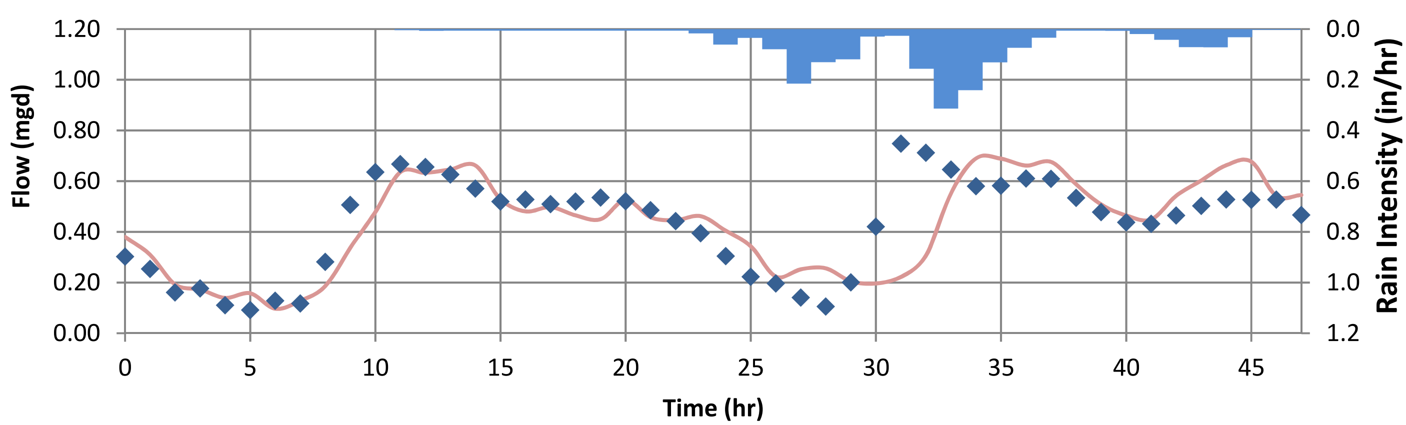
Sewer Master Plan

Marina Coast Water District

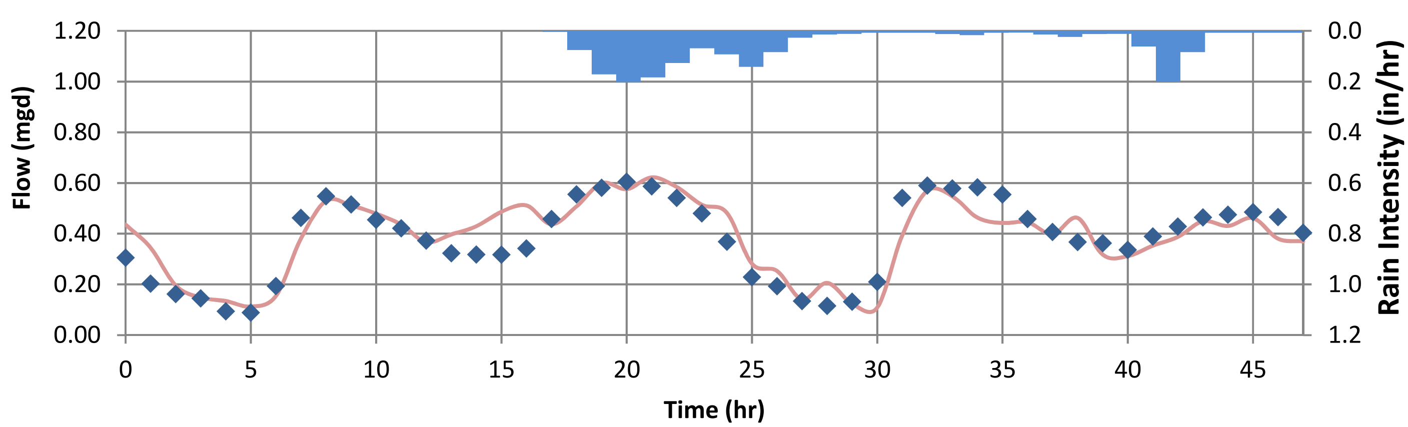
Dry Weather Event -Weekday



Wet Weather Event 1 (2/19/2017 - 2/20/2017)



Wet Weather Event 2 (2/09/2017 - 2/10/2017)



LEGEND

PRELIMINARY

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

AKEL ENGINEERING GROUP, INC.

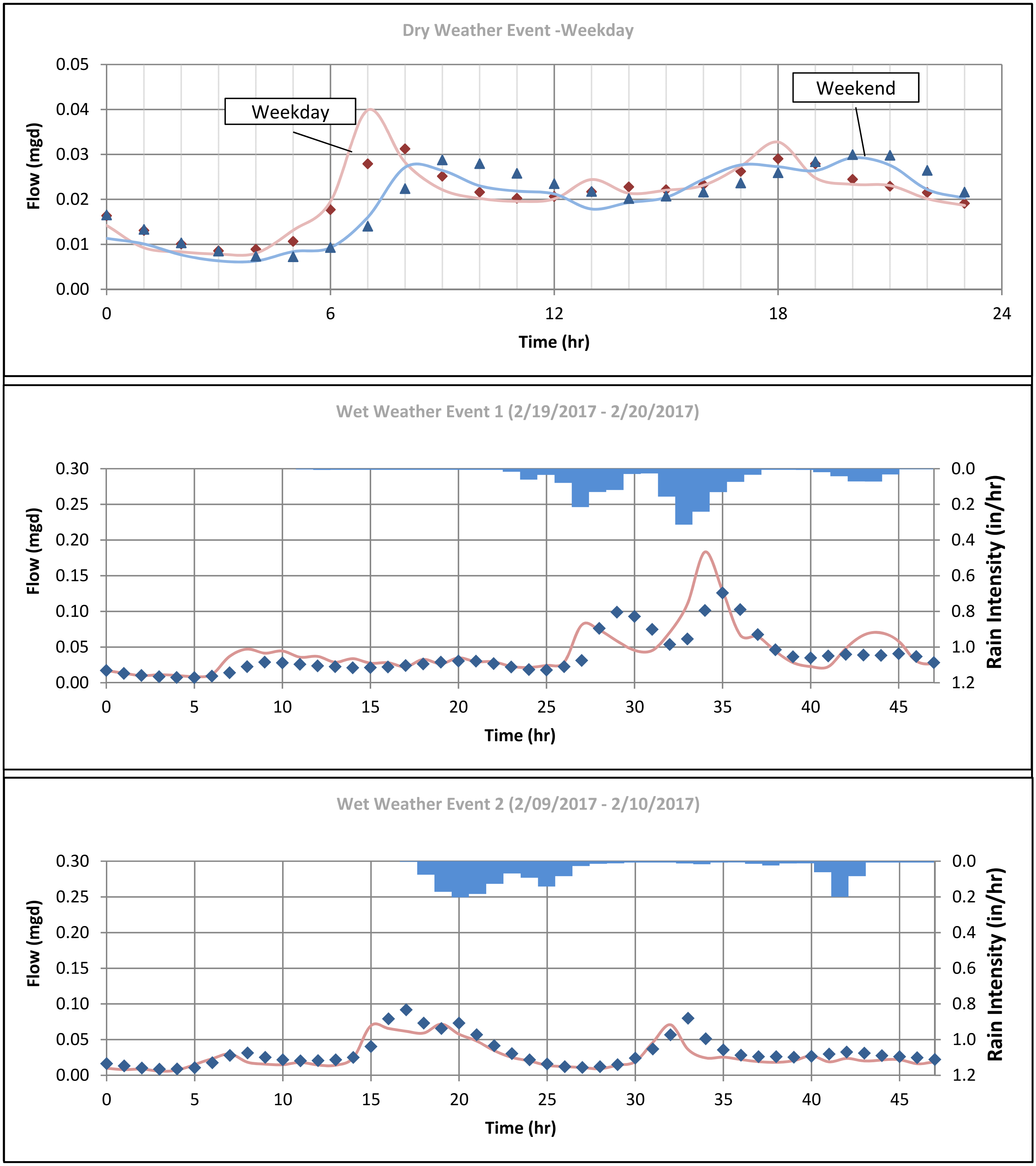
October 18, 2017

Figure 9

O-5 Fort Ord

Sewer Master Plan

Marina Coast Water District



LEGEND

PRELIMINARY

Rain Event

Hydraulic Model

V&A Flow Monitoring

V&A Flow Monitoring

AKEL ENGINEERING GROUP, INC.

October 18, 2017

Figure 10

O-6 Fort Ord

Sewer Master Plan

Marina Coast Water District

Table 1 Flow Monitor Locations
Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Site ID	Location Description	Pipe Size (in)	Manhole ID
City of Marina			
M-1	1,000 ft e/o intersection of Reservation Rd and Crescent Ave	12" SW (In Pipe)	K606
M-2	Intersection of Reservation Rd and Del Monte Blvd	12" SE (In Pipe)	L368
M-3	Intersection of Reservation Rd and Del Monte Blvd	12" SW (In Pipe)	G421
M-4	Intersection of Robin Dr and Hilo Ave	10" N (Out Pipe)	E331
Ord Community			
O-1	Intersection of 5th St and 1st Ave	18" SW (In Pipe)	G451
O-2	Intersection of 5th St and 1st Ave	12" SE (In Pipe)	D452
O-3	Intersection of 5th St and 1st Ave	15" E (In Pipe)	J306
O-5	NW corner of VA Clinic Parking Lot	15" N (In Pipe)	UVA1
O-6	1st Ave n/o 8th St	15" E (In Pipe)	UVB6

AKEL ENGINEERING GROUP, INC.

3/15/2018

Table 2 Calibration Results Summary

Sewer Master Plan
Marina Coast Water District

PRELIMINARY

Flow Monitoring ID		Units	Dry Period (Weekday)			Dry Period (Weekend)			Wet Weather (Event 1)			Wet Weather (Event 2)		
			Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M-1	Flow Monitored	(mgd)	0.0237	0.188	0.106	0.017	0.206	0.114	0.022	0.225	0.131	0.026	0.200	0.116
	Model	(mgd)	0.0281	0.164	0.106	0.025	0.198	0.120	0.022	0.214	0.135	0.024	0.201	0.122
	Difference	(mgd)	-0.0044	0.023	0.000	-0.0076	0.008	-0.006	0.0005	0.011	-0.004	0.0017	-0.001	-0.006
		(%)	**16**	**-14**	**0**	**30**	**-4**	**5**	**-3**	**-5**	**3**	**-7**	**0**	**5**
M-2	Flow Monitored	(mgd)	0.1286	0.514	0.354	0.122	0.636	0.389	0.120	1.170	0.514	0.134	0.738	0.401
	Model	(mgd)	0.1209	0.510	0.363	0.120	0.682	0.413	0.115	0.977	0.477	0.116	0.817	0.430
	Difference	(mgd)	0.0077	0.003	-0.009	0.0019	-0.045	-0.023	0.0058	0.194	0.037	0.0174	-0.080	-0.029
		(%)	**-6**	**-1**	**2**	**-2**	**7**	**6**	**-5**	**-20**	**-8**	**-15**	**10**	**7**
M-3	Flow Monitored	(mgd)	0.0999	0.357	0.250	0.106	0.407	0.278	0.106	0.500	0.302	0.098	0.416	0.274
	Model	(mgd)	0.1040	0.342	0.241	0.109	0.399	0.268	0.109	0.500	0.299	0.104	0.440	0.278
	Difference	(mgd)	-0.0040	0.016	0.009	-0.0028	0.008	0.010	-0.0032	0.000	0.003	-0.0059	-0.024	-0.004
		(%)	**4**	**-5**	**-4**	**3**	**-2**	**-4**	**3**	**0**	**-1**	**6**	**6**	**1**
M-4	Flow Monitored	(mgd)	0.0694	0.232	0.167	0.056	0.244	0.170	0.066	0.274	0.181	0.072	0.239	0.172
	Model	(mgd)	0.0676	0.227	0.164	0.060	0.236	0.167	0.060	0.274	0.185	0.072	0.257	0.183
	Difference	(mgd)	0.0018	0.005	0.002	-0.0036	0.008	0.002	0.0060	0.000	-0.004	0.0003	-0.017	-0.011
		(%)	**-3**	**-2**	**-1**	**6**	**-3**	**-1**	**-10**	**0**	**2**	**0**	**7**	**6**
O-1 [1]	Flow Monitored	(mgd)	0.1671	0.636	0.449	0.144	0.637	0.440	0.145	0.705	0.468	0.131	0.956	0.473
	Model	(mgd)	0.0746	0.726	0.446	0.062	0.755	0.452	0.065	0.796	0.480	0.065	0.776	0.470
	Difference	(mgd)	0.0925	-0.090	0.003	0.0821	-0.119	-0.013	0.0800	-0.092	-0.013	0.0653	0.180	0.003
		(%)	**-124**	**12**	**-1**	**-132**	**16**	**3**	**-123**	**12**	**3**	**-100**	**-23**	**-1**
O-2	Flow Monitored	(mgd)	0.0088	0.130	0.076	0.008	0.125	0.072	0.009	0.209	0.083	0.007	0.170	0.070
	Model	(mgd)	0.0100	0.123	0.075	0.010	0.131	0.076	0.010	0.171	0.093	0.010	0.164	0.086
	Difference	(mgd)	-0.0012	0.007	0.001	-0.0022	-0.006	-0.004	-0.0006	0.038	-0.010	-0.0027	0.006	-0.015
		(%)	**12**	**-6**	**-1**	**22**	**5**	**5**	**6**	**-22**	**10**	**28**	**-3**	**18**
O-3	Flow Monitored	(mgd)	0.0250	0.278	0.169	0.014	0.239	0.143	0.031	0.924	0.258	0.030	0.703	0.235
	Model	(mgd)	0.0283	0.273	0.169	0.028	0.235	0.146	0.028	0.977	0.251	0.028	0.550	0.225
	Difference	(mgd)	-0.0033	0.005	0.001	-0.0139	0.004	-0.002	0.0034	-0.053	0.007	0.0020	0.153	0.010
		(%)	**12**	**-2**	**0**	**51**	**-2**	**1**	**-12**	**5**	**-3**	**-7**	**-28**	**-5**
O-5	Flow Monitored	(mgd)	0.0679	0.497	0.327	0.099	0.636	0.375	0.097	0.690	0.432	0.109	0.622	0.389
	Model	(mgd)	0.0819	0.532	0.335	0.100	0.673	0.399	0.091	0.748	0.431	0.088	0.605	0.382
	Difference	(mgd)	-0.0139	-0.036	-0.008	-0.0005	-0.037	-0.024	0.0053	-0.058	0.001	0.0203	0.017	0.007
		(%)	**17**	**7**	**2**	**1**	**5**	**6**	**-6**	**8**	**0**	**-23**	**-3**	**-2**
O-6	Flow Monitored	(mgd)	0.0078	0.040	0.020	0.006	0.029	0.019	0.009	0.183	0.043	0.006	0.072	0.027
	Model	(mgd)	0.0085	0.031	0.021	0.007	0.030	0.020	0.007	0.126	0.038	0.009	0.092	0.032
	Difference	(mgd)	-0.0007	0.009	0.000	-0.0009	-0.001	-0.001	0.0013	0.057	0.005	-0.0028	-0.020	-0.005
		(%)	**9**	**-28**	**0**	**13**	**2**	**6**	**-19**	**-46**	**-14**	**32**	**22**	**17**

12/11/2017

Note:

1. Flow Fluctuations are heavily influenced by the Ord Village Lift Station at flow monitoring site O-1.

APPENDIX C

Lift Station Condition Assessment

Lift Station Condition Assessment Report

Marina Coast Water District

GHD | 2235 Mercury Way, Suite 150, Santa Rosa, California

11140005 **|** May 30, 2018

Marina Coast Water District

Lift Station Condition Assessment Report

Project No. 11140005

Prepared for:

AKEL ENGINEERING GROUP, INC
7433 N. First Street, #103
Fresno, CA 93720

Prepared by:

Luke Philbert
Project Engineer

Reviewed by:

Matt Winkelman, P.E.
Principal

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Santa Rosa, CA 95407
(707) 523-1010

May 30, 2018

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1. Introduction

GHD civil and electrical engineers performed field inspections of 12 lift stations to determine existing physical conditions. This occurred during a two day field visit on June 20-21, 2017 accompanied by District staff. The following is a technical evaluation of each lift station observed through information provided by the District and physical observations. The evaluation addresses the following components of each lift station.

- **Civil/Mechanical/Structural**

  This includes the evaluation of pumps, discharge piping, pump lifting equipment, valves, valve pits, and lift station wet well and dry well configuration. It also includes a visual assessment for above- and below-grade structures and concrete slabs that support the electrical equipment.

- **Electrical and Instrumentation**

  The electrical and instrumentation evaluation includes: the power supply system, transfer switch, pump starters, power generator, backup generator receptacle, cable and conduits, electrical equipment enclosures, and other related components that are critical to a reliable power supply. The level control and pump control in each lift station were also evaluated.

- **Site**

  This section reviews the accessibility to the lift station and the ease to access equipment at the station for service or replacement. Adequacy of on-site supporting facilities such as lighting, fencing, security, and wash down hose bibbs are also evaluated. Also assessed are aspects of the adjacent area that are relevant to the lift station operation, such as curb site parking, noise, or other neighborhood issues.

The following items were not performed as part of this condition assessment:

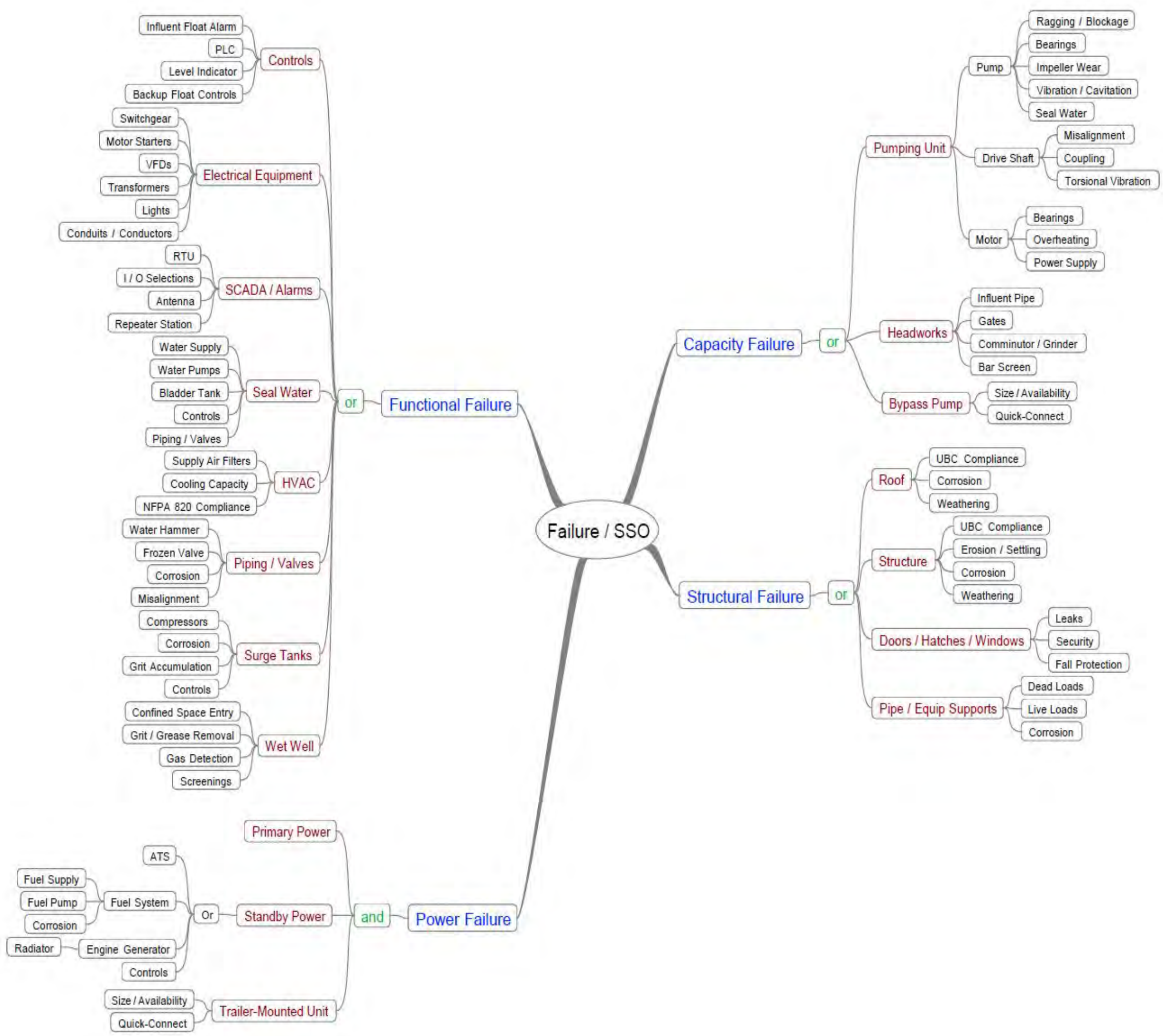
- Confined space entry and associated visual or physical testing for below-grade spaces.
- Review of maintenance records.
- Pump or physical tests performed in the field.
- Safety evaluation.
- Though some code compliance items were noted, this scope did not include a full inventory of code compliance.

The findings and conclusions in this report are intended to be used in conjunction with hydraulic evaluation and other planning for lift stations prepared by Akel Engineering for each of the lift stations. As such, some recommendations may be superseded. For example, a pump found to be in sound condition in this report may require replacement based on hydraulic deficiency.

2. Lift Station Facilities Approach

In order to maintain a thorough condition assessment, it is important to think about the lift station condition and criticality in the context of failure modes. Staff performed field inspections with a Fault Tree Diagram, presented in Figure 1, in order to encompass the variety of factors that could possibly contribute to failure.

Figure 1 – Fault Tree Diagram



Categories of failure include Functional, Power, Capacity, and Structural. The diagram flowchart shows how specific variables of the lift station (black text) contributes to a general variable (red text), which can lead to a type of failure (blue text) that ultimately can lead to a sanitary sewer overflow (SSO). As an example from the top left; failure with the influent float alarms could lead to the controls not turning the pumps on while the wet well water level rises, thus a functional failure is occurring that may lead to an SSO.

To address redundancy, the Fault Tree Diagram organizes the general variable (red text) into its position of contributing to failure in the context of and/or (green text). The “and” factor means there is redundancy. In the case of Power Failure, the primary power from the grid may fail, but a standby generator or trailer mounted unit prevents failure. The expression translates to “A power failure may occur if there is no primary power, and there is no standby power, and there is no trailer-mounted unit.” The “or” category is a signal that redundancy may not occur. In the case of controls, problems from influent float alarms could contribute to failure regardless of other variables. The expression translates to “A functional failure may occur if there are problems occurring with controls, or there are problems with piping / valves, or there are problems with the wet well, etc.”

All items from the Fault Tree Diagram were considered during the condition assessment. For each lift station, each general variable is mentioned within the write-up so long as it was relevant for the assessment. Variables that were not relevant for the write-up (e.g., no pump stations had seal water or surge tanks) were not discussed in Section 4 of this document.

Lift Station facility components were based on a quantitative condition score. Table 1-1 shows the condition rating score of 1 to 5 that is used to assess the condition of the component along with the description of each score.

Certain components are assigned a score even when the component is not necessarily a physical object. These are assigned with the same scoring factor (a component with a condition score of 1 does not need to be addressed in the near term, whereas a component with a condition score of 5 needs to be addressed immediately). The descriptions for each score will vary for these exceptions.

Where there are field observations available for a component, the information is used to assign the condition ratings. If the component has not been inspected, then its condition is estimated based on its age. If available, the age based condition rating is supplemented with information from historical work orders or equivalent history information. Depending on the level of detail and type of available work order information, work orders can serve as means to differentiate components with similar in-service years that for one reason or another have decayed at different rates, possibly due to differences in operating environments, manufacture quality, or design/installation issues. Work orders can provide operational history of a component giving a further indication of performance other than that based on age considerations only.

While a visual condition assessment was performed for each lift station, there were limits to the assessment and there may be unforeseen circumstances in the future. While one component may appear upon inspection to have a condition score of 2, there is no guarantee that the component will remain in acceptable condition for at least 5 years. For this reason it is recommended to assess components continually throughout the future.

Table 1-1 - Condition Rating Description

Condition Score	Definition	Description
1	Very Good	Sound physical condition to meet current standards. Operable and well maintained. Component likely to perform acceptably with routine maintenance for 10 years or more. No work required.
2	Good	Acceptable physical condition but not designed to current standard. Component shows minor wear. Deterioration has minimal impact on component performance. Minimal short-term failure risk but potential for deterioration or reduced performance in medium term (5-10 years). Only minor work required (if any).
3	Moderate / Fair	Functionally sound plant and components, but showing some wear with minor failures and some diminished efficiency. Minor parts or isolated sections of component require replacement or repair but asset still functions safely at acceptable level of service. Work required but still serviceable. For example, bearing and gland wear becoming evident and some corrosion present.
4	Poor	Parts function but require a high level of maintenance to remain operational. Likely to cause a noticeable deterioration in performance in short-term. No immediate risk to health or safety but work required to ensure asset remains safe. Substantial work required in short-term, asset barely serviceable.
5	Very Poor	Failed or failure imminent. Asset effective life exceeded and significant maintenance costs incurred. A high risk of breakdowns with a serious impact on component. No life expectancy. Health and safety hazards exist which preset a possible risk to public safety, or component cannot be serviced/operated without risk to personnel. Major work or replacement.

3. Lift Station Locations

A discussion occurred with the project team at the start of the June 20-21, 2017 field visit that agreed on pump stations to be included in the condition assessment. Appendix A shows a map of all Lift Stations under the Marina Coast Water District jurisdiction, with the lift stations chosen for condition assessment in yellow. Table 3-1 presents a summary of the chosen lift stations, with pump descriptions and capacity for each.

Table 3-1 – Lift Station Locations and Capacity

Lift Station Information			Pumps				Notes from Operator / Condition Assessment
Lift Station	Location	Type	Quantity	Capacity (mgd)	Capacity (gpm)	TDH (ft)	
Dunes	Dunes Drive – next to Marina Dunes Resort	Submersible	2	2 @ 0.79	2 @ 550		Operator - new pumps installed in last 5 years at same size
San Pablo	180 San Pablo Court	Submersible	2	2 @ 0.54	2 @ 375		Operator mentioned Flygt pumps were installed within last decade - may be referring to 2000 installation
Crescent	3009 Crescent Street	Submersible	2	2 @ 0.14	2 @ 100		Operator mentioned new pumps may have been installed since 2005
Neeson	Neeson Road/Marina Airport	Submersible	1	0.58	400		1 pump currently, previously 2
Gigling	Okinawa and Noumea Road	Dry Pit	4	3 @ 1.22 Sump @ 0.07	3 @ 850 Sump @ 50	3 @ 100	3 new pumps at 45 HP each; flow unknown for new pumps
Hatten	Hatten Road	Submersible	2	2 @ 0.06	2 @ 40		No upgrades since 2005
Imjin	Imjin at Abrams	Submersible	2	2 @ 2.15	2 @ 1490	33	Two Flygt pumps installed in 2003
Fort Ord Village	End of Beach Range Road	Dry Pit	4	3 @ 0.40 1 @ 0.07	3 @ 280 Sump @ 50	3 @ 110	
Booker	End of Booker Street	Dry Pit	3	2 @ 1.09 Sump @ 0.07	2 @ 760 Sump @ 50	2 @ 64	
Fritzche	Fritzsche Field North	Submersible	2	2 @ 0.23	2 @ 160		.
East Garrison	Inter-Garrison Road and Ord Ave	Submersible	2				Pump is now active. Pump type unknown from operator.
Reservation Road	Reservation Road 1125 feet NW of Imjin	Submersible	2	2 @ 1.3	2 @ 900	120	Visual showed 2 pumps that were not Flygt.

A write-up of each lift station evaluation is included in the next section.

4. Lift Station Facilities Evaluation

4.1 DUNES

The Dunes Lift Station is a wet well submersible lift station with no building. Valves and pipes are above grade. Electrical cabinets are also above grade. The entire lift station is fenced in.

The Dunes Lift Station is located at Dunes Drive, next to the Marina Dunes Resort, west of Highway 1. The lift station was originally built in 1969, with the pumps upgraded in 1987. Capacity with both pumps running is 0.79 MGD.

The lift station meets firm capacity according to District staff, with adequate capacity to convey peak flows with the largest pumping unit out of service and with available standby power, in this case a trailer mounted generator. This site is a critical facility when power is out. The operators will come to it first and hook up power.

4.1.1 Civil/Mechanical

Pumping Unit

Component	Score	Reason
Pumps	1	Flygt pumps installed in the last 5 years. No issues from operator.

For Photo - See Piping / Valves in Section 4.1.1.

The Dunes Lift Station was originally equipped with two Paco 4-inch AE type NCD submersible centrifugal wastewater pumps. These pumps were replaced in 1987 with two Flygt CP3152-454 pumps. These 20 hp submersible pumps provide 550 gpm of flow capacity at 77 ft of Total Dynamic Head (TDH).

According to the District's operator, the new pumps were installed in the last 5 years. These new pumps were the same size, at 2-20 HP, and most likely the Flygt model. The pumps alternate in a lead / lag mode. During wet weather flows, the operator is able to convey peak flows with only one pump.

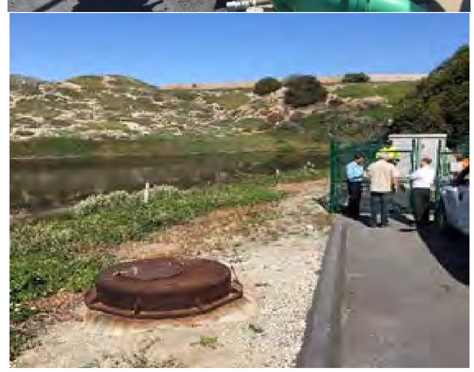
Bypass Pump

Component	Score	Reason
Bypass Port	1	Located on the discharge header, no issues reported from operator.

For Photo – See Pipe / Equip Supports in Section 4.1.2.

Piping / Valves

Component
Discharge piping and valves
Score
2
Reason
Recently upgraded and functions well, though access is difficult to remove the valves with a lifting device.



Piping was replaced from the flange out of the wet well up to the ductile iron force main discharge at the intersection nearby. The original pipe routing went up to the old treatment plant, and came back down the hill to a gravity feed. When two pumps were on and stayed on too long it would end up flooding a cleanout near a residence, through the lateral. The piping was rerouted through check valves to a manhole approximately 40 feet near the wet well, which adds capacity.

The District implements a fats, oils, and grease (FOG) program which has prevented grease problems through the piping system.

Since the valves are located behind the wet well, access is difficult for O&M staff to remove the valves with a lifting device.

Wet Well

Component
Pump Guide Rails
Score
1
Reason
Appears to be in good condition with no signs of corrosion

Inside the wet well, the stainless steel pump lifting guide rails appear to be in good condition.

Component	Score
Discharge Pipes	3
Reason	
Pipes show signs of corrosion, though immediate replacement may not be necessary.	

For Photo - See Pump Guide Rails in Wet Well, Section 4.1.1.

Inside the wet well, while the stainless steel pump lifting guide rails appear to be in good condition, the cast iron discharge pipes show signs of corrosion.

4.1.2 Structural

Pipe / Equip Supports

Component
Pipe and Equipment Support
Score
1
Reason
Appear to be in good condition. No issues noted by the operator.

Pipe and equipment support appears to be new and in good working condition.

Wet Well

Component	Score	Reason
Concrete wall	3	Minor signs of surface deterioration.

For Photo – See Wet Well in Section 4.1.1.

The 7-ft diameter, 11-ft deep concrete wet well is unlined, and shows signs of some surface deterioration. Surface prep and coating is recommended to preserve the concrete and prevent spalling. Visual inspection of the wet well was performed solely from the ground level due to limited means of entry/exit. The wet well hatch cover also appears to show signs of age but the operator has not seen signs of infiltration and inflow (I&I). The wet well water marks noted at the time of inspection and the lack of overflows historically (unrelated to power outages) suggest that there is sufficient storage capacity in the existing wet well.

The top slab of the wet well and the slab for the electrical equipment are in good physical condition.

4.1.3 Electrical

Electrical Equipment

Component	Score	Reason
Meter	1	No issues observed.
Component	Score	Reason
Circuit Breaker	1	No issues observed.
Component	Score	Reason
Manual Transfer Switch	1	No issues observed.
Component	Score	Reason
Surge Protector	1	No issues observed.
Component	Score	Reason
Power Monitor	1	No issues observed.

No photo available.

A meter, circuit breaker (serving as the main service disconnect), manual transfer switch, surge protector, and a power monitor are located in one fiberglass enclosure mounted in the front corner of the pump station site.

Component	Score	Reason
100 Amp Receptacle for Portable Generator	1	No issues observed.
Component	Score	Reason
Pump Motor Starters	1	No issues observed.
Component	Score	Reason
Pump Control Panel	1	No issues observed.
Component	Score	Reason
480-240/120-volt step-down transformer	1	No issues observed.
Component	Score	Reason
240/120-volt lighting panel	1	No issues observed.
Component	Score	Reason
NEMA 3RX fiberglass enclosures	1	No issues observed.

A 100-amp receptacle for connecting a portable generator is mounted to the exterior of this enclosure. Two pump motor starters, a pump control panel, a 480-240/120-volt step-down transformer, and a 240/120-volt lighting panel are located in another fiberglass outer enclosure located on top of the wet well slab. While the

NEMA 3RX fiberglass enclosures are moderately weathered, the individual painted steel components inside show no signs of weathering or corrosion.

Component	Score	Reason
Grounding System	1	No issues observed.

No photo available.

The grounding system consists of two old ground rods, each in grounding wells on opposite sides of the wet well. A third, newer rod and ground well are located adjacent to the telemetry antenna mast at the rear of the site. This ground rod apparently is provided for lightning protection, and is bonded properly to the two older ground rods to form a coherent, code-compliant grounding electrode system for the site electrical system.

Component	Score	Reason
Power Cables	1	Appear to be in good condition

No photo available.

The power cables in the wet well to the pump motors appeared to be in good condition.

Component	Score	Reason
120 volt convenience receptacle	4	Provide GFCI Device for safety
Component	Score	Reason
Circuit Breaker on Receptacle Circuit	4	Provide GFCI Device for safety

No photo available

A single 120-volt convenience receptacle is located in a non-metallic weatherproof box (NEMA 3RX) on top of the concrete wet well slab. While the receptacle, box, and weatherproof cover appear to be in good condition, neither the receptacle nor the circuit breaker on the receptacle circuit have Ground Fault Circuit Interrupter (GFCI) functionality. While the electrical code does not currently call for a GFCI device for receptacles in this specific location, it is recommended to provide one for improved personnel safety.

Primary Power

Component	Score	Reason
Pole mount transformer	1	No issues observed.

No photo available.

The lift station electrical distribution system is fed from a pole-mount Pacific Gas & Electric (PG&E) transformer, located across the street from the lift station. The service is rated at 100-amps, 480/277 volts, three-phase, four-wire.

Backup Power

Component	Score	Reason
Trailer mounted unit	1	No issues observed.

No photo available.

There is no backup generator on site. Currently there are provisions for hookup of a portable emergency generator. A trailer-mounted unit is available.

4.1.4 Instrumentation

Controls

Component	Score	Reason
Ultrasonic level transducer	1	No issues observed.
Component	Score	Reason
Level Controller	1	No issues observed.
Component	Score	Reason
Float Switches	1	No issues observed.

No photo available

Level control is provided by a Zenith Pulsar ultrasonic level transducer, mounted in the wet well. The transducer is connected to Zenith Pulsar level controller, which provides output to the motor starters to control the wet well pumps in automatic mode. High-level and low-level float switches act as a backup in case of failure of the transducer.

SCADA / Alarms

Component	Score	Reason
PLC – 2.4 GHz radio link	1	No issues observed.
Component	Score	Reason
PLC – Yagi antenna	1	No issues observed.
Component	Score	Reason
PLC - Cabinet	1	New condition
Component	Score	Reason
PLC - Contents	1	New condition

No photo available

The PLC provides status and alarms to the central SCADA monitoring station via a 2.4GHz radio link, using a Yagi antenna mounted on a mast. The PLC cabinet, contents, and antenna are in like-new condition.

4.1.5 Site

Security

Component
Fence
Score
1
Reason
Appear to be in good condition. No issues from operator.

Security issues have not been a problem at this site, either with theft or vandalism. The lift station is now screened by a coated chain linked fence and three strands of barbed wire at the top after corrosion issues addressed in the 2005 Wastewater Collection System Master Plan[1].

Access

Component
Road Space
Score
2
Reason
There is not sufficient space for vehicle turnaround, but the short length of the access road makes this a minor issue.

The site is paved and is adjacent to an existing storm water detention pond. There is no space for vehicle turnaround, requiring vehicles to exit in reverse, uphill along the access drive onto the street. There is no parking space other than the access road.

Water Supply

Component	Score	Reason
Water Supply	1	Appears to be in good condition. No issues from operator.

No Photo

Water supply is adequate, used for spray down at the wet well only.

4.1.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-1, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.1. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning. General recommendations and observations are included at the end of this section.

[1] Marina Wastewater Collection System Master Plan. Winzler & Kelly Consulting Engineers. February 2005.

Table 4-1 – Dunes Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.1.1	Wet Well	Discharge Pipes	3	$ 3,200
4.1.2	Wet Well	Concrete Wall	3	$ 19,900
4.1.3	Electrical Equipment	120 volt convenience receptacle	4	$ 500
			Total Cost - Parts	$ 23,600
			Total Cost – Parts with Contingency	$ 30,700

General Recommendations and Observations

The following are in addition to individual components.

- Since the valves are located behind the wet well, access is difficult for O&M staff to remove the valves with a lifting device (See Piping / Valves in Section 4.1.1).

4.2 SAN PABLO

The San Pablo Lift Station is a wet well submersible lift station with no building. Valves and pipes are below grade. Electrical cabinets are above grade. The entire lift station is fenced in.

The lift station is located next to 180 San Pablo Court. A two-story apartment building and some single family homes are located in close proximity to the lift station. The lift station was originally built in 1969 and had a major upgrade in 2000.

The lift station collects wastewater flow from the area bounded by Hillcrest Avenue, Sunset Avenue, and Del Monte Boulevard. In addition, wastewater flow in the vicinity of San Pablo Court is also conveyed to the San Pablo Lift Station. An 8-inch inlet pipe conveys all wastewater from the lift station service area to the wet well. A 6-inch force main conveys wastewater from the lift station to a 6-inch gravity sewer main along Lake Drive.

4.2.1 Civil/Mechanical

Pumping Unit

Component	Score	Reason
Pumps	1	Flygt pumps installed in the last 5 years. No issues from operator.

For Photo - See Wet Well in Section 4.2.1

The lift station was originally equipped with two Smith & Loveless 4B2A submersible, centrifugal pumps. They were replaced in 2000 with two Flygt CP3102-434 submersible pumps. These 5 hp submersible pumps provide 375 gpm of flow capacity at 26 ft TDH. The pumps run in lead / lag mode.

The pumps alternate and are used for redundancy. During wet weather flows, the operator is able to run one pump. The operator reported minor ragging and blockage but mentioned it could be cleaned out that day.

Piping / Valves

Component	Score	Reason
Piping	1	No apparent signs of corrosion.

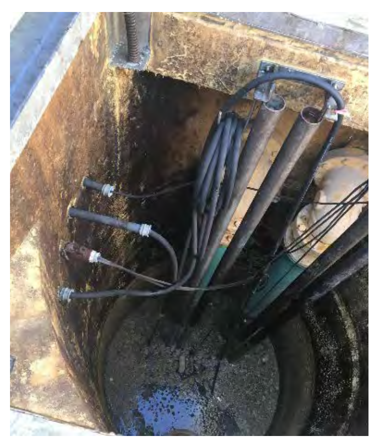
The discharge pipes inside the wet well show no apparent signs of corrosion. The discharge pipes that extend to the valves pit located behind the wet well were not visible on the ground, but the pipes were installed in the 2000 lift station upgrade and are likely still in good condition.

Component
Valve Vault
Score
2
Reason
Valves and piping are in good condition, but valve vault has short clearance to fences.

Within the valve pit, a check valve and gate valve are provided on each discharge pipe. The discharge pipes then combine to form a common 6-inch force main leaving the lift station to the west. The valve pit is located behind the wet well at the rear of the site next to the generator, with very little clearance to the side fences.

Wet Well

Component
Guide Rails
Score
2
Reason
Minor surface deterioration.



Inside the 6-ft diameter, 13-ft deep concrete wet well, there is surface deterioration visible on the pump guide rails. There is no lifting device on site for pump removal.

From observed water marks and the history of lack of overflows, the wet well appears to provide sufficient storage capacity.

There is a gooseneck ventilation outlet on top of the wet well.

4.2.2 Structural

Pipe / Equip Supports

Component	Score	Reason
Support Structures	1	No problems observed.

For Photo - See Piping / Valves in Section 4.2.1

The pipe and equipment supports appear to be adequate.

Hatches

Component	Score	Reason
Structural Support	3	Wet well and valve pit hatches not strong enough to allow for truck access

The wet well hatch is not strong enough to support a service truck stopping on the top of wet well, making access to the valve pit difficult. It is recommended that the existing wet well and valve pit hatches are upgraded to improve truck access.

Wet Well

Component	Score	Reason
Concrete Walls	2	Minor surface deterioration

For Photo - See Wet Well in Section 4.2.1

There is surface deterioration visible on the wet well walls.

4.2.3 Electrical

Electrical Equipment

Component	Score	Reason
Utility revenue meter	1	No issues observed.
Component	Score	Reason
Circuit Breaker	1	No issues observed.
Component	Score	Reason
240/120-volt lighting panel	1	No issues observed.
Component	Score	Reason
Automatic transfer switch	1	No issues observed.
Component	Score	Reason
Level Controls	1	No issues observed.
Component	Score	Reason
Pump Motor Starters	1	No issues observed.
Component	Score	Reason
Telemetry	1	No issues observed.

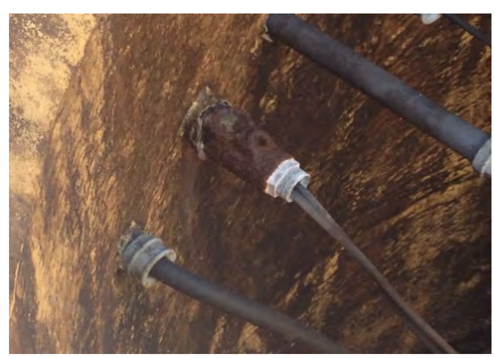
No photo available.

The equipment is housed in a low profile, weather-protective, painted steel switchgear lineup. The equipment consists of a utility revenue meter, circuit breaker (serving as the main service disconnect), a 240/120-volt lighting panel, automatic transfer switch, level controls, pump motor starters, and telemetry.

Component
NEMA 3R equipment enclosure
Score
3
Reason
Weathered, faded, and moderate rust.

The exterior surface of the NEMA 3R equipment enclosure is weathered and faded with a uniform layer of light rust on the top surface. The edges around the top of the enclosure and around the access doors have moderate rust, but the enclosure is otherwise in serviceable condition.

Component
Conduit
Score
3
Reason
Fittings show moderate corrosion, only one conduit has explosion proof fittings.



Only one conduit entering the wet well is terminated with explosion-proof fittings. The fitting shows moderate corrosion.

Primary Power

Component	Score	Reason
Pole mount transformer	1	No issues observed.

No photo available.

The lift station electrical distribution system is fed from a pole-mount Pacific Gas & Electric (PG&E) transformer, located across the street from the lift station. The service is rated at 100-amps, 240/120 volts, three-phase, four-wire.

Backup Power

Component	Score	Reason
Generator	3	Moderate to heavy rust

An Olympian model D20P2 diesel engine-generator set, rated at 20 kilowatts/ 25 kilovolt-amps, is located on an adjacent side of the valve pit at the rear of the site The generator is equipped with a 60-gallon, UL-listed dual-wall subbase tank, and a sound-attenuating enclosure. The generator enclosure and tank have localized areas of moderate-to-heavy rust.

4.2.4 Instrumentation

Controls

Component	Score	Reason
Ultrasonic level transducer	1	No issues observed.
Component	Score	Reason
Level Controller	1	No issues observed.
Component	Score	Reason
Float Switches	3	Low-level set point in the pump controller is set lower than the low level float.

No photo available

Level control is provided by a new Zenith Pulsar ultrasonic level transducer, mounted in the wet well. The transducer is connected to Zenith Pulsar level controller, which provides output to the motor starters to control the wet well pumps in automatic mode. High-level and low-level float switches act as a backup in case of failure of the transducer.

It appeared that the low-level set point in the pump controller is set lower than the low-level float, as it was observed that the low-level float appeared to be the element that stopped the pumps on low wet well level.

SCADA / Alarms

Component	Score	Reason
Allen Bradley MicroLogix 1400 PLC	1	No issues observed.
Component	Score	Reason
PLC – 2.4 GHz radio link	1	No issues observed.
Component	Score	Reason
PLC – Yagi antenna	1	No issues observed.
Component	Score	Reason
PLC - Cabinet	1	New condition
Component	Score	Reason
PLC - Contents	1	New condition

No photo available

An Allen-Bradley MicroLogix 1400 PLC provides status and alarms to the central SCADA monitoring station via a 2.4GHz radio link, using a Yagi antenna mounted on a mast. The PLC cabinet, contents, and antenna are in like-new condition.

4.2.5 Site

Access

Component
Road Space
Score
2
Reason
Access to valve pit and backup generator is difficult

For Additional Photo - See Overview Photo at the beginning of Section 4.2

The site is unpaved and is close to a residential area and San Pablo Court. Since there is adjacent open area to the lift station, there is adequate space for vehicle turnaround. However, access to the valve pit and backup generator is difficult since they are located behind the wet well. The wet well hatch is not strong enough to support a service vehicle (See Hatches in Section 4.2.2), and the gooseneck ventilation outlet on top of the wet well impedes truck access to the back of the site.

There is informal off-street parking adjacent to the pump station and along the street. A hose bibb, with backflow preventer, hose and hose rack, are provided for washdown water.

Security

Component	Score	Reason
Fence	1	Appears to be in good condition. No issues from operator.

For Photo - See Access in Section 4.2.5
For Additional Photo - See Overview Photo at the beginning of Section 4.2

The lift station is screened by 6-ft high chain link fence with redwood slats. A double-leaf gate with 15-ft opening provides access into the lift station site. The fence appears to be in good condition. There is no barbed wire, but given that apartments are nearby and there is adequate lighting, this may not be necessary.

Component	Score	Reason
Lighting	1	Appears to be in good condition. No issues from operator.

For Photo - See Overview Photo at the beginning of Section 4.2

Adequate lighting is provided by a pole-mounted light located in a corner of the fenced area, near the wet well and the access gate. The light is controlled by an integral photocell.

Effect on Residence

Component	Score	Reason
Visibility, Odor and Noise	2	Low visual impact, no apparent odors, noise disruption may occur when on site backup generator is running.

For Photo - See Access in Section 4.2.5

The lift station has medium to low visibility. The fence sits close to the road but the slats provide adequate privacy. The lift station has no apparent odors observed, however, noise disruption to the surrounding neighborhood may occur when the on-site backup generator is running.

4.2.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-2, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.2. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning.

Table 4-2 – San Pablo Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.2.2	Hatches	Structural Support	3	$ 4,000
4.2.3	Electrical Equipment	NEMA 3R equipment enclosure	3	$ 2,200
4.2.3	Electrical Equipment	Conduit	3	$ 2,000
4.2.3	Backup Power	Generator	3	$ 16,300
4.2.4	Controls	Float Switches	3	$ 100
			Total Cost - Parts	$ 24,600
			Total Cost – Parts with contingency	$ 32,000

4.3 CRESCENT

The Crescent Lift Station is a wet well submersible lift station with no building. Valves and pipes are below grade. Electrical cabinets are above grade. While the electrical cabinets are fenced off, the wet well and valve pit are located outside the fence near a residential sidewalk.

The Crescent Lift Station is located at 3009 Crescent Street, next to a storm water detention pond. The lift station was built in 1977 to serve the local residential area along Crescent Street and Vera Lane, where the low ground elevation prevents gravity flow to Reindollar Avenue.

4.3.1 Civil/Mechanical

Pumping Unit

Component	Score	Reason
Pumps	1	No issues from operator.

For Photo – See Wet Well in Section 4.3.1

The pump curve for this lift station is not available. However, previous studies for this lift station indicate that the lift station is equipped with two Flygt CG3065 submersible pumps. These 2 hp submersible pumps provide 100 gpm of flow capacity at 28 ft TDH. The pumps operate in lead / lag mode.

There is no on-site pump lifting device. However, since the wet well is close to the curb, pumps can be removed by a truck-mounted lifting device.

Piping / Valves

Component
Valve Pit
Score
4
Reason
Valve pit and components within need to be replaced.

The interior of the valve pit shows signs of cracking and surface damage. The valve pit hatch and the hatch rim are rusty. The bottom of the valve pit is filled with sand. The valve pit should be replaced.

Wet Well

Component
Discharge Pipe and Guide Rails
Score
2
Reason
Discharge pipes show signs of corrosion.

The discharge pipes inside the wet well show signs of corrosion, while the pump lifting guide rails appear to be in good condition.

Based on the watermarks at the side of the wet well, the storage in the wet well appears to be adequate.

4.3.2 Structural

Pipe / Equip Supports

Component	Score	Reason
Support Structures in Valve Pit	4	Valve Pit filled with sand / no proper support.

For Photo – See Piping / Valves in Section 4.3.1

The piping and valves lack proper support in the valve pit.

Wet Well

Component	Score	Reason
Concrete Wall	2	Minor deterioration on the unlined concrete wet well wall.

For Photo – See Wet Well in Section 4.3.1

There is some minor deterioration apparent on the unlined concrete wet well wall. The top slab of the wet well and the top slab of the valve pit are in good physical condition. The wet well is 5 feet in diameter and 11 feet deep.

4.3.3 Electrical

Electrical Equipment

Component	Score	Reason
Revenue meter	1	No issues observed.
Component	Score	Reason
Circuit breaker	1	No issues observed.
Component	Score	Reason
60 amp manual transfer switch	1	No issues observed.
Component	Score	Reason
100 amp receptacle for connecting a portable generator	1	No issues observed.
Component	Score	Reason
Pump Control Panel Enclosure	3	Steel – moderate rust around the edges, paint is heavily weathered
Component	Score	Reason
Transfer Switch Enclosure	3	Steel – moderate rust around the edges, paint is heavily weathered
Component	Score	Reason
Conduits entering the wet well	3	Conduits entering wet well are not sealed.

No photo available.

A revenue meter and a circuit breaker (serving as the main service disconnect) are located in a pedestal behind a fence, adjacent to the wet well access hatch. A 60-amp manual transfer switch is mounted to the side of the service pedestal, as is a 100-amp receptacle for connecting a portable generator. The steel pump control panel and transfer switch enclosures (NEMA 3R) have moderate rust around the edges, and the paint is heavily weathered. Conduits entering the wet well are not sealed.

Component
Pump Control Panel
Score
3
Reason
Lower corner of front door is rusted through.

The lower corner of the pump control panel front door is rusted through.

Component	Score	Reason
Telemetry cabinet	1	No issues observed.
Component	Score	Reason
Radio antenna	1	No issues observed.

No photo available.

A telemetry cabinet and radio antenna mast are located adjacent to the pedestal, and appear to be in excellent condition.

Primary Power

Component	Score	Reason
Pole mount transformer vault	1	No issues observed.

No photo available.

The lift station electrical distribution system is fed from a Pacific Gas & Electric (PG&E) transformer vault, located adjacent to the lift station. The service is rated at 100-amps, 240/120 volts, single-phase, three-wire.

Backup Power

Component	Score	Reason
Trailer mounted unit	1	No issues observed.

No photo available.

There is no on-site backup power generator, but a receptacle is provided to connect a portable trailer-mounted unit.

4.3.4 Instrumentation

Controls

Component	Score	Reason
Ultrasonic level transducer	2	Protection is provided by a round plastic valve box, which provides only minimal protection
Component	Score	Reason
Level Controller	1	No issues observed.

No photo available.

Level control is provided by a new Zenith Pulsar ultrasonic level transducer, mounted on the top slab of the wet well. A round plastic valve box, of a type typically found in landscaped areas, is fastened upside down over the top of the transducer to provide a minor degree of protection from physical damage. The transducer is connected to Zenith Pulsar level controller, located in the pump control panel, which provides output to the motor starters, also located in the pump control panel, to control the wet well pumps in automatic mode.

Component
Float Switches
Score
4
Reason
Cables are coiled up and hung above the wet well operating range.

High-level and low-level float switches are installed, but the cables are coiled up and hung on a hook well above the wet well operating range.

SCADA / Alarms

Component	Score	Reason
Allen Bradley MicroLogix 1400 PLC	1	No issues observed.
Component	Score	Reason
PLC – 2.4 GHz radio link	1	No issues observed.
Component	Score	Reason
PLC – Yagi antenna	1	No issues observed.
Component	Score	Reason
PLC - Cabinet	1	New condition
Component	Score	Reason
PLC - Contents	1	New condition

No photo available.

An Allen-Bradley MicroLogix 1400 PLC provides status and alarms to the central SCADA monitoring station via a 2.4GHz radio link, using a Yagi antenna mounted on a mast. The PLC cabinet, contents, and antenna are in like-new condition.

4.3.5 Site

Security

Component	Score	Reason
Theft or Vandalism	1	No security issues reported

For Photo - See Overview Photo at the beginning of Section 4.3

Security issues have not been a problem at this site, either with theft or vandalism.

Component	Score	Reason
Lighting	2	Lighting provided from nearby streetlight

No lighting is provided on-site. However, the street light in proximity to the lift station provides some lighting to the site. A hose bibb is provided for wash-down water. This station has low visibility since most of the station is below ground. No odor was detected at the time of inspection.

Access / Safety

Component	Score	Reason
Expanded Fence	5	Safety Concerns

For Photo - See Overview Photo at the beginning of Section 4.3

The site is unpaved and is in the middle of a residential area. Service vehicles can park along Crescent Street, which is a residential street with only minimal local traffic.

The lift station wet well and valve pit are located at the back of sidewalk along Crescent Street, with no fencing protection. The lift station electrical panels and the adjacent storm water detention pond are surrounded by a chain link fence with a double leaf gate and barbed wire. There is not enough space for a service vehicle to drive to the electrical panels. It is recommended to expand the fencing so that the wet well and the valve pit can be guarded by the fence. The operator expressed safety concerns with people walking along the sidewalk while the wet well and valve pit hatches are open. In addition, this would provide additional space for vehicle access to the electrical equipment.

4.3.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-3, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.3. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning. General recommendations and observations are included at the end of this section.

Table 4-3 – Crescent Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.3.1	Piping / Valves	Valve Pit, Valves, Piping, and Valve Pit Structure	4	$ 5,900
4.3.3	Electrical Equipment	Pump Control Panel Enclosure	3	$ 500
4.3.3	Electrical Equipment	Transfer Switch Enclosure	3	$ 300
4.3.3	Electrical Equipment	Conduits entering the wet well	3	$ 100
4.3.4	Controls	Float Switches	4	$ 17,800
4.3.5	Access / Safety	Expanded Fence	5	$ 25,100
			Total Cost - Parts	$ 25,100
			Total Cost – Parts with Contingency	$ 32,700

General Recommendations and Observations

The following are in addition to individual components. Costs associated with these recommendations would be provided in a future study or predesign effort.

- Since this lift station is located next to a storm water detention pond, the lift station failure could lead to sewer overflows to the pond, thus causing storm water contamination problems. Major lift station rehabilitation or replacement is recommended.

4.4 NEESON

The Neeson Lift Station is a wet well submersible lift station with no building. Valves and pipes are above grade. Electrical cabinets are above grade. The entire lift station is fenced in with limited space.

The Neeson Lift Station is a float actuated duplex package sump type lift station that has one pump and a total capacity of 0.58 MGD (400 gpm). It is recommended that a complete lift station replacement be performed.

4.4.1 Civil/Mechanical

Pumping Unit

Component	Score	Reason
Pumps	5	An additional pump is needed for redundancy

For Photo - See Bypass Pump in Section 4.4.1.

There is only one submersible pump at a capacity of 0.58 mgd (400 gpm). An additional submersible pump is recommended for redundancy. With a working system, the pumps operate with float controls.

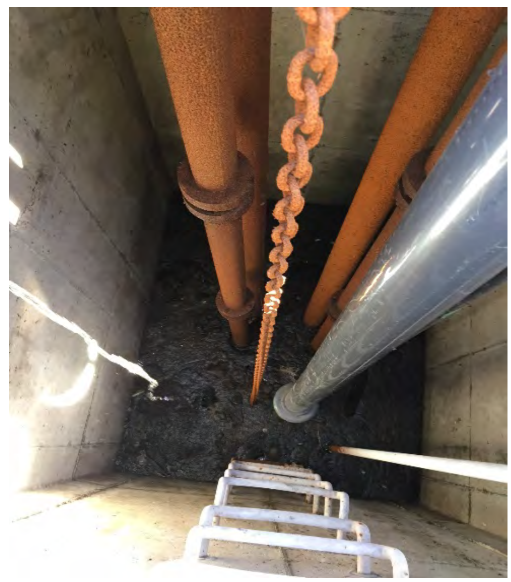
Bypass Pump

Component
Pump Bypass
Score
5
Reason
Bypass is permanent. Not recommended.

The lift station appears to be in permanent bypass, which is not recommended

Piping / Valves

Component
Piping / Valves
Score
4
Reason
Corrosion issues



Piping and valves show signs of corrosion both inside the well and on the discharge side (For Photo - See Bypass Pump in Section 4.4.1.) of the pump station.

The permanent bypass line is showing deterioration from ultraviolet radiation.

Component
Domestic Water Hose Bib
Score
1
Reason
Backflow Prevention Device was installed.

The domestic water hose bibb within the fence did not have a backflow prevention device accepted by the California Code; this was corrected as of the 2005 Wastewater Collection System Master Plan.

Wet Well

Component	Score	Reason
Lid	5	Heavy Corrosion
Component	Score	Reason
Piping / Valves	5	Heavy Corrosion

For Photo - See Bypass Pump in Section 4.4.1 and Piping / Valves in Section 4.4.1.

The coatings have severely deteriorated from corrosion on the lid as well as on all piping and valves.

4.4.2 Structural

Structure

Component	Score	Reason
Concrete Slab	4	Deteriorating slab. Needs to cover more area.

For Photo – See Bypass Pump in Section 4.4.1.

In addition to replacing this deteriorating concrete slab, it is recommended that a concrete slab is provided underneath all the piping and valves. The wet well is 6.6-ft long, 6-ft wide, and 16-ft deep.

Pipe / Equip Supports

Component	Score	Reason
Support for Pipes and Valves	4	Support is poor, pipes and valves appear to be slanted.

For Photo – See Bypass Pump in Section 4.4.1.

Piping and valves on the discharge side of the pump appear to be slanted.

Wet Well

Component	Score	Reason
Support for Pipes and Valves	4	Support is poor, pipes and valves appear to be slanted.

For Photo – See Piping / Valves in Section 4.4.1.

The wet well coating is in fair condition, but is recommended to be replaced along with the rest of the lift station.

4.4.3 Electrical

Electrical Equipment

Component
General Electrical Equipment
Score
5
Reason
In poor condition and not functioning.

Electrical equipment appears to be in poor condition and not functioning.

Primary Power

Component	Score	Reason
Pole mount transformer	1	No issues observed.

No photo available.

The lift station electrical distribution system is fed from a pole-mount Pacific Gas & Electric (PG&E) transformer, located somewhat adjacent to the lift station. The service is rated at 100-amps, 208/120 volts, three-phase, four-wire.

Backup Power

Component	Score	Reason
Backup Power	4	No backup power

No photo available.

There is no backup power.

4.4.4 Instrumentation

Controls

Component
Level Control
Score
4
Reason
Appear to be in poor condition and in need of replacement.

Level control is provided by a float on a vertical rod, which actuates a switch that is mounted above the wet well cover. The level control appears to be in poor condition and in need of replacement.

SCADA / Alarms

Component	Score	Reason
PLC/telemetry package	4	No equipment.
Component	Score	Reason
Alarm notification	4	No equipment

No photo available.

This site is not equipped with the PLC/telemetry package that is present at the other pump stations. There is not any apparent means of providing alarm notification.

4.4.5 Site

General Site

Component	Score	Reason
Access	3	Bare ground needs to be paved.
Component	Score	Reason
Security Lighting	3	No security lighting.

No photo available.

All vegetation from within the fence should be cleared and the site should be paved.

There is no security lighting. It is recommended that security lighting is installed.

4.4.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-4, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.4. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning. While Neeson is recommended for a major replacement, packaged costs would be determined in a separate study or predesigned effort. General recommendations and observations are included at the end of this section.

Table 4-4 – Neeson Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost	
4.4.1	Pumping Unit	Pumps	5	$	94,600
4.4.1	Piping / Valves	Piping / Valves	4	$	2,000
4.4.1	Wet Well	Lid	5	$	2,500
4.4.1	Wet Well	Piping / Valves	5	$	3,100
4.4.2	Structure	Concrete Slab	4	$	2,200
4.4.2	Pipe / Equip Supports	Support for Pipes and Valves	4	$	700
4.4.2	Wet Well	Support for Pipes and Valves	4	$	700
4.4.3	Electrical Equipment	General Electric Equipment	5	$	50,000
4.4.4	Controls	Level Control	4	$	2,500
4.4.4	SCADA / Alarms	PLC/telemetry package	4	$	10,000
4.4.4	SCADA / Alarms	Alarm Notification	4	$	2,000
4.4.5	General Site	Access	3	$	2,000
4.4.5	General Site	Security Lighting	3	$	1,000
			Total Cost - Parts	$	173,300
			Total Cost – Parts with Contingency	$	225,290

General Recommendations and Observations

The following are in addition to individual components. Costs associated with these recommendations would be provided in a future study or predesign effort.

- It is recommended that the lift station be completely replaced to meet current standards for redundancy, communication, and access.

4.5 GIGLING

The Gigling Lift Station is a dry pit/wet well lift station with a building. Valves and pipes are in the dry pit below the building. Electrical cabinets are inside the building. The entire lift station is fenced in.

Maximum Capacity is 1.22 MGD (850 gpm).

4.5.1 Civil/Mechanical

Pumping Unit

Component
Pumps
Score
1
Reason
No issues observed.

The lift station has three pumps that together run at a maximum capacity of 1.22 MGD (850 gpm), and a TDH of 100 ft. The Flygt submersible pumps were converted to dry pit service. A sump pump in the dry pit has a capacity of 0.07 GPD (50 gpm).

HVAC

Component
Metal Ducts
Score
3
Reason
HVAC reported to work properly, but there are signs of corrosion.

Though the HVAC was reported to be working properly, there appears to be signs of corrosion.

Piping / Valves

Component	Score	Reason
Dry Pit – Piping / Valves	1	No issues observed.

For Photo - See Pumping Unit in Section 4.5.1.

Inside the dry pit, there are new check valves. The remaining piping appears to be in good working condition. The dry pit appears to be a non-corrosive atmosphere.

Component	Score	Reason
Access to pump removal	3	Though possible, pump removal is difficult.

For Photo - See Pumping Unit in Section 4.5.1.

Access to pump removal seems difficult. It is recommended that a landing be put in place for easier removal of pumps.

Component	Score	Reason
Air Lock issues - Piping / Valves	3	Force main causing air issues in piping

For Photo - See Pumping Unit in Section 4.5.1.

Due to problems in the force main on the discharge side of the lift station, the operators have a gauge to monitor air pressure. For this station and Fort Ord Village, even with new pumps installed, there are air lock issues. There is a lot of bleeding, and sometimes the District will have to lift up the check valve and backflush before it will prime again. Condition assessment of the force main is recommended to address the air lock issues in the piping at the lift station.

Wet Well

Component	Score	Reason
Wet Well – Piping / Valves	1	No issues observed.

For Photo – See Wet Well in Section 4.5.2.

The operator reported no issues with the suction side of the lift station.

4.5.2 Structural

Roof

Component	Score	Reason
Roof	1	Recently repaired

For Photo - See Overview Photo at the beginning of Section 4.7

Appears to be in good working condition. The roof had been attended to recently, with some of the planks replaced.

Structure

Component	Score	Reason
Concrete Slab	1	No issues observed.

For Photo, See Overview Photo at the beginning of Section 4.5.

The concrete slab under the generator appears to be in good condition.

Doors / Hatches

Component	Score	Reason
Door	1	No issues observed.

For Photo, See Overview Photo at the beginning of Section 4.5.

The door appears to have recent work done due to a change in paint color around the door versus the rest of the wall. It appears to be in good working condition.

Component	Score	Reason
Hatches	1	No issues observed.

No photos available.

Hatches appear to be in good working condition.

Pipe / Equip Supports

Component	Score	Reason
Dry Pit – Pipe / Equipment Support Structures	1	No issues observed.

No photo available.

Pipe and Equipment supports appear to be adequate.

Wet Well

Component
Wet Well Walls
Score
1
Reason
Appear to be in good condition, though covered with an epoxy coating.

The wet well was epoxy coated, and although there is a bumpy coating to the walls, the walls are in good condition, and may have had coating over rough aggregate. The wet well dimensions are 22-ft long, 8-ft wide, and 16-ft deep.

4.5.3 Electrical

Electrical Equipment

Component	Score	Reason
Service Entrance Switchboard	1	No issues observed.
Component	Score	Reason
Automatic Transfer Switch	1	No issues observed.
Component	Score	Reason
Motor Control Center	1	No issues observed.
Component	Score	Reason
480:208/120V stepdown transformer	1	No issues observed.
Component	Score	Reason
Breaker Panel	1	No issues observed.

No photo available.

The electrical equipment consists of a service entrance switchboard, automatic transfer switch, motor control center, 480:208/120V stepdown transformer, and breaker panel. The service entrance switchboard is a single section with PG&E utility compartment and the main breaker. The MCC contains three autotransformer-type reduced-voltage motor starters.

Primary Power

Component	Score	Reason
Pole mount transformer	1	No issues observed.

No photo available.

The lift station electrical distribution system is fed from a pole-mount Pacific Gas & Electric (PG&E) transformer, located adjacent to the lift station. The service is rated at 400-amps, 480/277 volts, three-phase, four-wire.

Backup Power

Component	Score	Reason
Generator	3	Subbase tank is wet with lube oil and fuel..

No photo available.

The site is equipped with a 110 kW Katolight diesel generator and an Olympian automatic transfer switch. The generator has a subbase fuel tank with a transfer pump that draws from an adjacent above-grade 500 gallon bulk tank. The generator is reportedly in good operating condition, but the top of the subbase tank is wet with lube oil and fuel, indicating that the generator engine has leaks.

Component
Bulk Tank
Score
3
Reason
Signs of paint deterioration observed.

Signs of paint deterioration were observed on the top of the bulk fuel tank.

4.5.4 Instrumentation

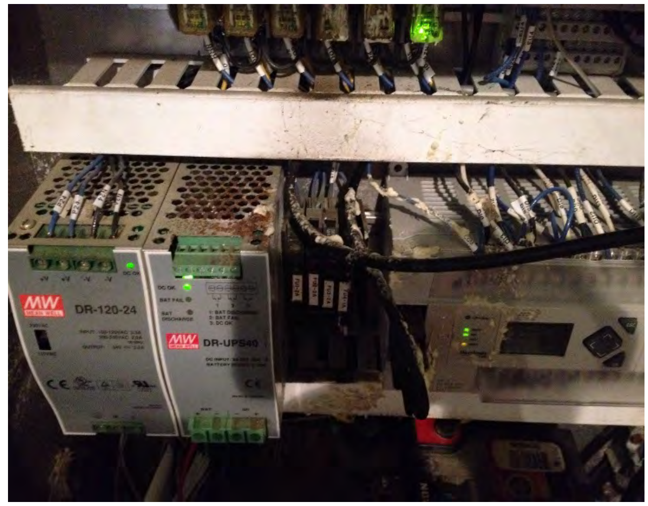
Controls

Component	Score	Reason
Ultrasonic level transducer	1	No issues observed.
Component	Score	Reason
Level Controller	1	No issues observed.
Component	Score	Reason
Float Switches	1	No issues observed.

Level control is provided by a Zenith Pulsar ultrasonic level transducer, mounted in the wet well. The transducer is connected to Zenith Pulsar level controller, which provides output to the motor starters to control the dry well pumps in automatic mode. High-level and low-level float switches act as a backup in case of failure of the transducer.

SCADA / Alarms

Component	Score	Reason
PLC – 2.4 GHz radio link	1	No issues observed.
Component	Score	Reason
PLC – Yagi antenna	1	No issues observed.
Component	Score	Reason
PLC - Cabinet	1	New condition
Component	Score	Reason
PLC - Contents	4	Rust and polyurethane foam on internal components.



The PLC provides status and alarms to the central SCADA monitoring station via a 2.4GHz radio link, using a Yagi antenna mounted on a rooftop mast. Some components in the SCADA enclosure showed minor signs of rust staining from water, due to rainwater dripping down from the antenna mast. The mast conduit has since been sealed with polyurethane foam, which is also splattered on some of the internal components.

4.5.5 Site

Access

Component	Score	Reason
Pavement	3	Access difficult with heavy rains

No photo available.

There is no paved access to the site. Without a paved path, weed growth, potholes, and heavy rains can inhibit access to the site.

Security

Component	Score	Reason
Barbed Wire Fence	3	Theft issues reported with generator.

For Photo - Overview Photo at the beginning of Section 4.7.

The operator mentioned there had been theft issues with the generator. It is recommended to replace barbed wire around the fence.

4.5.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-5, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.5. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning.

Table 4-5 – Gigling Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.5.1	HVAC	Metal Ducts	3	$ 2,100
4.5.1	Piping / Valves	Access to pump removal	3	$ 20,000
4.5.1	Piping / Valves	Air Lock Issues – Piping / Valves	3	$ 10,000
4.5.3	Primary Power	Generator	3	$ 46,400
4.5.3	Primary Power	Bulk Tank	3	$ 200,000
4.5.4	SCADA / Alarms	PLC – Contents	4	$ 500
4.5.5	Access	Pavement	3	$ 135,300
4.5.5	Security	Barbed Wire Fence	3	$ 30,000
			Total Cost - Parts	$ 444,300
			Total Cost – Parts with Contingency	$ 577,600

4.6 HATTEN

The Hatten Lift Station is a packaged duplex submersible lift station with no building. Valves and pipes are above grade. Electrical cabinets are above grade. The entire lift station has no fence, and is located at the end of the front yard of a residential home. The Hatten Lift Station was construction in 1966, and is controlled by a float system with a capacity of 40 gpm.

Complete lift station replacement is recommended.

4.6.1 Civil/Mechanical

Pumping Unit

Component	Score	Reason
Pumps	1	No issues observed.

No photo available.

The packaged unit is a duplex submersible pump lift station with a capacity of 0.06 GPD (40 gpm).

Piping / Valves

Component	Score	Reason
Piping / Valves	2	Minor corrosion

For Photo – See Overview Photo at the beginning of Section 4.6.

The pipes and valves appear to have minor corrosion.

4.6.2 Structural

Structure

Component
Base Support
Score
5
Reason
Panel is corroded at the base, in danger of falling over. No concrete slab

Structural support is inadequate. It is recommended to have a concrete slab for proper pipe support. In addition, the packaged lift station panel appears to be corroded at the base and is in danger of falling over.

Pipe / Equip Supports

Component	Score	Reason
Pipe / Valve Support	4	No pipe support

For photo - See Overview Photo at the beginning of Section 4.6.

There is no structural support for the piping / valves. It is recommended to have a concrete slab for proper pipe support.

Wet Well

Component	Score	Reason
Wet Well Lid	3	Appears to be corroded.

For Photo – See Structure in Section 4.6.2.

Wet well dimensions are 3-ft diameter and 10-ft deep. The metal wet well lid appears to be corroded.

4.6.3 Electrical

Electrical Equipment

Component	Score	Reason
Meter/main panel	1	No issues observed.
Component	Score	Reason
Breaker panel	1	No issues observed.
Component	Score	Reason
Control Panels	1	No issues observed.

The lift station electrical equipment consists of a meter/main panel, a separate breaker panel, and the packaged lift station control panels. It appears that the meter/main panel feeds the adjacent breaker panel, which, in turn, feeds the lift station and several other unidentified facilities. It appears that the breaker panel may have formerly served the adjacent residences, but that is merely conjecture. Other than the structural issues at the base of the control panel, the electrical equipment appears to be in satisfactory condition.

Primary Power

Component	Score	Reason
Pad mount transformer	1	No issues observed.

No photo available.

The Lift Station electrical distribution system is fed from a pad-mount PG&E transformer located adjacent to the meter/main panel. The service is rated at 200-amps, 240/120 volts, single-phase, three-wire.

Backup Power

Component	Score	Reason
Backup power	3	No backup power available

No photo available.

This lift station is not equipped with any means for backup power.

4.6.4 Instrumentation

Controls

Component	Score	Reason
SJE Rhombus Control Package	1	No issues observed.

See SCADA / Alarms in Section 4.6.4.

This lift station is equipped with an SJE-Rhombus control package that uses fixed floats for determining pump start and stop levels. This site does not use the Zenith Pulsar ultrasonic transducer and level controller that is used a nearly all of the other pump stations.

SCADA / Alarms

Component	PLC/Telemetry
Score	3
Reason	No PLC/telemetry package. No audible device for alarm notification.

This site is not equipped with the PLC/telemetry package that is present at the other pump stations. The control panel is equipped with two red lights for alarm notification. The presence of an audible device was not noted.

4.6.5 Site

Security

Component	Score	Reason
Fencing	3	No fencing or security measures.

For Photo – See Overview Photo at the beginning of Section 4.6.

The lift station is not secure. It is recommended that the site has fencing around the lift station.

Water Supply

Component	Score	Reason
Domestic Water Supply	1	New domestic water supply line.

A domestic water supply line was constructed to meet Title 22 requirements.

4.6.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-6, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.6. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning. While Hatten is recommended for a major replacement, packaged costs would be determined in a separate study or predesigned effort. General recommendations and observations are included at the end of this section.

Table 4-6 – Hatten Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.6.2	Structure	Base Support	5	$ 2,300
4.6.2	Structure	Pipe / Equip Support	4	$ 200
4.6.2	Wet Well	Wet Well Lid	3	$ 2,500
4.6.3	Backup Power	Generator or Trailer Mount Unit	3	$ 16,300
4.6.4	SCADA / Alarms	PLC/Telemetry	3	$ 11,000
4.6.5	Security	Fencing	3	$ 22,800
			Total Cost - Parts	$ 55,100
			Total Cost – Parts with Contingency	$ 71,700

General Recommendations and Observations

The following are in addition to individual components. Costs associated with these recommendations would be provided in a future study or predesign effort.

- Complete lift station replacement is recommended to meet current standards for redundancy, security, and communication.

4.7 IMJIN

The Imjin Lift Station is a wet well submersible lift station with no building. Valves and pipes are below grade. Electrical cabinets are above grade. The entire lift station is fenced in.

The Imjin Lift Station is currently the largest lift station in the Ord Community sanitary sewer system, and is projected to more than double in size in the future. This key lift station is a critical facility for proper system operation. The Imjin Lift Station was built in 1970, replaced in 1982, and renovated in 2003 with an upgrade of two new 1,490-gpm pumps and associated pump 7 control equipment [2]. It is located alongside Imjin Road east of Abrams Drive. The arrangement of multiple gravity and force main inlets make isolation of the wet well for cleaning or maintenance very difficult.

4.7.1 Civil/Mechanical

Pumping Unit

Component	Score
Pumps	2
Reason	
No issues from the operator, but Flygt pumps were installed over 15 years ago.	

For Photo – See Wet Well in Section 4.7.1

[2] Ord Community Sewer System Improvement Project, Final Technical Memorandum No. 1. Lift Stations Predesign Study. Winzler and Kelly. May 2004

Two Flygt pumps were installed in 2003 and the pump station has capacity of 1,490 gpm at 33-ft TDH each (Model NP3153-433, 18 hp pumps). The operators reported that the pumps worked fine during peak flows, and they operate in lead / lag mode with one as a duty and one as a standby.

Bypass Pump

Component	Score	Reason
Multiple Inlets	3	A single inlet allows for proper bypass

For Photo - See Wet Well in Section 4.7.1

An issue with the Imjin Lift Station is bypass pumping, due to the multiple inlets that come into the system. If the wet well were to be replaced, a tee could be added to it. If there were modifications to the pipes where they could be routed together and come through, then a single point could come in that allows for proper bypass. For this to happen, the old HOA electrical cabinet would have to be removed.

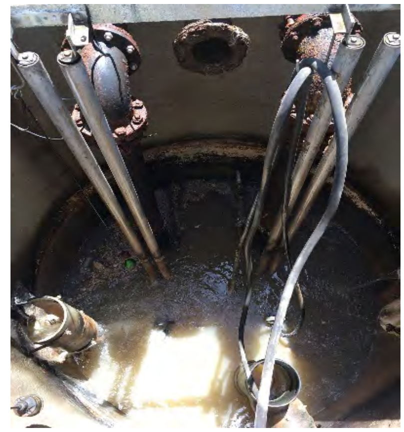
Piping / Valves

Component
Valve Vault Piping and Valves
Score
4
Reason
High amounts of corrosion. Recommended replacement.

Two new Flygt pumps have a 6-inch diameter ductile iron discharge pipe with a gate valve and a check valve. The discharge pipes combine in a valve pit, and a 10-inch diameter force main conveys flow to the Abrams Trunk Sewer. Only one of the discharge pipes are currently used, thus emergency bypass is not possible. The piping and valves in the valve vault show high amounts of corrosion, and it is recommended to replace all parts within the vault.

Wet Well

Component
Discharge Piping
Score
2
Reason
Minor signs of corrosion.



The discharge piping in the wet well shows signs of corrosion.

The operator has said there were no complaints with odor issues.

4.7.2 Structural

Structure - Concrete

Component	Score	Reason
Concrete Support	2	Concrete support for the entire lift station is recommended

For Photo - See Overview Photo at the beginning of Section 4.7

Concrete support for the entire lift station is recommended.

Wet Well

Component	Score	Reason
Concrete Wall	2	Minimal signs of surface deterioration

For Photo – See Wet Well in Section 4.7.1

The concrete wall appears to be in fair condition with minimal signs of corrosion. Wet well dimensions are a diameter of 8 feet and a depth of 12 feet.

Component
Fall Protection
Score
3
Reason
Fall Protection is recommended for safety.

The wet well hatch cover is in fair condition, but fall protection is recommended.

4.7.3 Electrical

Primary Power

Component	Score	Reason
Pad mount transformer	1	No issues observed.

No photo available.

The lift station electrical distribution system is fed from a pad-mount Pacific Gas & Electric (PG&E) transformer, located adjacent to the lift station. The service is rated at 200-amps, 480/277 volts, three-phase, four-wire.

Electrical Equipment

Component	Score	Reason
Meter/main panel	1	No issues observed.
Component	Score	Reason
Automatic Transfer Switch	1	No issues observed.
Component	Score	Reason
Pump Control Panel – prior to 2003 upgrades	3	Consider removing in favor of an underground pullbox or handhole.
Component	Score	Reason
Current Pump Control Panel	3	Conduits have rust where in contact with the soil.
Component	Score	Reason
480:208/120V unit power center	1	No issues observed.

The electrical equipment consists of a meter/main panel, automatic transfer switch, pump control panel, and a 480:208/120V unit power center with stepdown transformer and breaker panel. The pump control panel contains a Zenith Pulsar level controller and combination full-voltage, non-reversing two motor starters. The pump control panel is weathered, but in otherwise good condition. Galvanized conduits extending from underground were not properly wrapped during installation, causing the conduits to rust where in contact with soil.

The pump control panel that existed prior to the 2003 upgrades has been repurposed essentially as a pullbox for the generator and pump motor feeders. It is in fair-to-poor condition, but serves the current purpose. The District should consider removing this panel in favor of an underground pullbox or handhole.

Backup Power

Component	Score	Reason
Cummins generator	1	No issues observed.
Component	Score	Reason
400 gallon subbase fuel tank	1	No issues observed.

No photo available.

The site has a Cummins generator with weather-protective enclosure and 400-gallon subbase fuel tank. The generator was installed after the 2003 upgrades. The generator appears to be in good condition.

Component
Outer enclosure of the automatic transfer switch.
Score
3
Reason
Severe rust to the metal enclosures that protects the ATS control boards.

The outer enclosure of the automatic transfer switch is rusted through in two places at the drip edge above the door. Water is dripping inside, causing severe rust to the metal enclosure that protects the ATS control boards. It is a matter of time before the rusted metal no longer protects the control boards from the dripping water.

4.7.4 Instrumentation

Controls

Component	Score	Reason
Ultrasonic level transducer	1	No issues observed.
Component	Score	Reason
Level Controller	1	No issues observed.
Component	Score	Reason
Float Switches	1	No issues observed.

No photo available

Level control is provided by a Zenith Pulsar ultrasonic level transducer, mounted in the wet well. The transducer is connected to Zenith Pulsar level controller, which provides output to the motor starters to control the dry well pumps in automatic mode. High-level and low-level float switches act as a backup in case of failure of the transducer.

SCADA / Alarms

Component	Score	Reason
Allen Bradly MicroLogix 1400 PLC	1	No issues observed.
Component	Score	Reason
PLC – 2.4 GHz radio link	1	No issues observed.
Component	Score	Reason
PLC – Yagi antenna	1	No issues observed.
Component	Score	Reason
PLC - Cabinet	1	New condition
Component	Score	Reason
PLC - Contents	1	New condition

No photo available

An Allen-Bradley MicroLogix 1400 PLC provides status and alarms to the central SCADA monitoring station via a 2.4GHz radio link, using a Yagi antenna mounted on a mast. The PLC cabinet, contents, and antenna are in like-new condition.

Component
Second Antenna
Score
3
Reason
Unknown purpose from District personnel

A second antenna, appearing similar to a remote cellular antenna, is mounted at the top of the mast. Cabling from this antenna is routed in underground conduit, and could not be traced. The antenna cable was not observed in any of the equipment enclosures. District personnel also were unsure of its purpose.

4.7.5 Site

The Imjin Lift Station is a 0.25-acre site on a larger plot of land owned by the District. The lift station is reached from Imjin Road. Adequate room is available to pull off the roadside and turn large vehicles around. The surrounding soils, however, are very soft and rutted. A hose bibb is provided for wash-down water. Site lighting is adequate.

Paving

Component	Score	Reason
Road Access and LS Paving	2	Improved access and improved parking is a benefit without urgency

For Photo – See Overview Photo at the beginning of Section 4.7

Since Imjin Lift Station is a main District facility, it is recommended that a paved access road and adequate onsite parking be provided to allow vehicular access. It is recommended that the entire lift station site and access road be paved

4.7.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-7, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.7. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning. General recommendations and observations are included at the end of this section.

Table 4-7 – Imjin Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.7.1	Piping / Valves	Valve Vault Piping and Valves	4	$ 10,700
4.7.2	Wet Well	Fall Protection	3	$ 2,300
4.7.3	Electrical Equipment	Auto Transfer Switch	3	$ 6,000
4.7.3	Electrical Equipment	Conduit	3	$ 2,500
4.7.3	Electrical Equipment	Demo Control Panel/ New Pullbox	3	$ 7,500
			Total Cost - Parts	$ 29,000
			Total Cost – Parts with Contingency	$ 37,700

General Recommendations and Observations

The following are in addition to individual components. Costs associated with these recommendations would be provided in a future study or predesign effort.

- Perimeter fencing and site lighting is adequate. Since Imjin Lift Station is a main District facility, it is recommended that a paved access road and adequate onsite parking be provided to allow vehicular access. It is recommended that the entire lift station site and access road be paved.
- The arrangement of multiple gravity and force main inlets make isolation of the wet well for cleaning or maintenance very difficult. Reconfiguration of these pipelines is recommended to improve wet well isolation and bypass pumping capability.

4.8 ORD VILLAGE

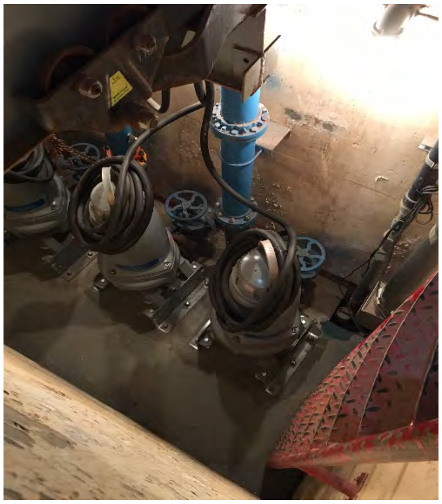
The Ord Village Lift Station is a dry pit/wet well lift station with a building. Valves and pipes on the discharge side are outside the building. Electrical cabinets are both inside and outside of the building. The entire lift station is fenced in.

The Ord Village Lift Station is the only District lift station located on the west side of Highway 1, the Union Pacific Railroad (UPRR), and Beach Range Road. This lift station, which was initially a sewage treatment plant that provided wastewater treatment for Fort Ord and was constructed prior to 1960, is situated near the shoreline of Monterey Bay. Lift station reliability is critical because, if an overflow were to occur, untreated wastewater would quickly reach the sensitive ocean habitat.

4.8.1 Civil/Mechanical

Pumping Unit

Component
Pumps
Score
1
Reason
No issues related to pumps



The Ord Village Lift Station has three Flygt pumps that replaced three ABS submersible pumps (Model AFP1001-4P) with 58-hp motors. Each of these units has a rated capacity of 280 gpm at 110-ft TDH. A bimetallic thermal switch is provided in the upper portion of the stator winding of each pump to protect against damage caused by high temperatures. The pumps are designed to shut off at a temperature of 140° C ± 5° C. In addition, each pump has an electrical probe in the oil reservoir connected to a solid-state device mounted in the control panel. A low voltage, low amperage signal communicated between the solid-state device and the probe warns of water in the oil reservoir and provides an indication of early seal failure, resulting in activation of a warning light in the control panel and/or pump shutdown.

Normal operation of the pumps is a lead / lag mode.

A Meyers 1/2-hp sump pump, with a rated capacity of 50 gpm at 19-ft TDH, is provided in the dry well. The sump pump is used to keep the below ground areas dry.

Headworks

Component
Muffin Monster Comminutors
Score
3
Reason
One comminutor is highly corroded and recommended to be replaced.

Prior to being converted to a lift station, the Ord Village facility was a wastewater treatment plant. Two open influent channels enter the lift station wet well. Each influent channel is fitted with a Muffin Monster comminutor. The comminutors have 3-hp electric motors with 18-inch helical stack cutters to grind solids into smaller portions for easy passage through the pumps. One of these is highly corroded and is recommended to be replaced (see photo above).

HVAC

Component
Metal Ducting
Score
3
Reason
Signs of dampness and corrosion. Recommended replacement.

A heating, ventilation, and air conditioning (HVAC) system is also provided to provide ventilation in the below ground areas and to dehumidify the air within the lift station control building (to reduce corrosion and to increase personnel safety). The HVAC system includes a PACE F-1 supply fan, a Baldor 1/3-hp, 530 cfs motor, and a Penn EF-1 exhaust fan with 1/4-hp Marathon motor. Stainless steel ducting draws air from the dry well and the lift station control room and exhausts the air outside the building. In several locations, especially near the exit wall, the ducting shows signs of dampness and corrosion and is recommended to be replaced.

Piping / Valves

Component
Piping and Valves
Score
1
Reason
New pipes and valves

Piping and valves on the discharge side of the pump station are new.

Component
Pipe at end of discharge line
Score
3
Reason
Corrosion – recommended recoat or replacement.

In general, piping and valves appear to be adequate. There does, however, appear to be corrosion at the end of the discharge line, and it is recommended to recoat or replace this section. The extent of exterior corrosion on the pipe is unknown beyond the limits shown in the photo above.

Component
Air Lock issues - Piping / Valves
Score
3
Reason
Force main causing air issues in piping

For this station and for the Gigling Lift Station, even with new pumps installed, there are air lock issues due to problems with the force main. The District reported breaks in the force main. Due to this, the District has been monitoring pressure. There is a lot of bleeding, and sometimes the District will lift up the check valve and backflush before it will prime again. Problems with water hammer have been partially solved by the air release valve. Condition assessment of the force main will require flow handling or bypass. For cost efficiency, condition assessment should be coordinated with other activities at the lift station that necessitate flow handling or bypass.

Wet Well

Component	Score	Reason
Pipes in the wet well	1	No issues from operator

No photo available.

There were no visuals on pipes in the wet well. The operator mentioned there were no known issues. Condition assessment is recommended if/when other modifications are scheduled within the wet well.

4.8.2 Structural

Roof

Component	Score	Reason
Roof	1	No issues observed.

For Photo – See Doors / Hatches / Windows in Section 4.8.2.

The roof had been attended to recently, with some of the planks replaced.

Structure

Component
Concrete Slabs on grade
Score
1
Reason
Appear to be in good condition

Concrete slabs-on-grade are provided for the generator, fuel storage tank, and outdoor electrical facilities.

Component	Score	Reason
Drainage of Concrete Pad on West Side of Pump Station	5	Safety hazard.

For Photo – See Structure – Concrete Slabs on in Section 4.8.2

It is recommended that drainage be provided for the concrete pad on the west side of the pump building next to the generator basin to prevent standing water at the base of the main pullbox and meter. This condition presents a significant safety hazard and has resulted in damage to the enclosure.

Component	Score	Reason
Bulk Fuel Tank	4	In poor condition

A new bulk fuel tank is needed at this pump station.

Wall Penetrations

Component
Wall Penetration Replacement
Score
3
Reason
Wall appears to have a boarded up louver or duct penetration. Repair of this location is recommended.

One wall appears to have a boarded up louver or duct penetration with a wood plank and may need to be replaced.

Pipe / Equip Supports

Component	Score	Reason
Pipe / Equipment Supports	1	No issues observed.

For Photo – See Piping / Valves in Section 4.8.1.

Pipe and equipment supports appear to be adequate.

Wet Well

Component
Wet Well Hatch
Score
3
Reason
Operator mentioned wet well is difficult to clean. Larger hatch is recommended.

Dimensions of the wet well are 12-ft long, 6-ft wide, and 11-ft deep. The wet well structure appears to be in good condition, but the operator mentioned it is difficult to clean. A larger hatch is recommended.

4.8.3 Electrical

Electrical Equipment

Component	Score	Reason
Automatic Transfer Switch	1	No issues observed.
Component	Score	Reason
Motor Control Center	1	No issues observed.
Component	Score	Reason
480:208/120V stepdown transformer	1	No issues observed.
Component	Score	Reason
Breaker Panel	1	No issues observed.

No photo available.

The electrical equipment consists of a service entrance switchboard, automatic transfer switch, motor control center, 480:208/120V stepdown transformer, and breaker panel. The MCC contains three autotransformer-type reduced-voltage motor starters.

Component
Service entrance switchboard
Score
3
Reason
Heavily rusted

The service entrance switchboard consists of a utility underground pull section, and a PG&E metering compartment and main breaker. The switchboard, mounted on a pad outside the building, is heavily rusted. It is recommended to replace the rusted mild-steel main service entrance enclosure located on the west side of the pump building with a stainless steel enclosure.

Component
Fuel tank leak detection panel
Score
5
Reason
Heavily rusted. Functionality in doubt.

The fuel tank leak detection panel, also mounted outside, is very heavily rusted, and its functionality is in doubt. Exterior conduits and conduit supports are heavily rusted. Equipment that is mounted inside the building shows some minimal surface rust on up to 10% of the overall surface area.

Primary Power

Component	Score	Reason
Pad mount transformer	1	No issues observed.

No photo available.

The lift station electrical distribution system is fed from a pad-mount Pacific Gas & Electric (PG&E) transformer, located adjacent to the lift station. The service is rated at 400-amps, 480/277 volts, three-phase, four-wire.

Backup Power

Component
175 kW Caterpillar diesel generator
Score
3
Reason
Muffler is rusted through

The site is equipped with a 175 kW Caterpillar diesel generator and an Olympian automatic transfer switch. The generator is reportedly in good operating condition, but the muffler is rusted, and the straps that hold the muffler to the enclosure are rusted through.

Component
Alternator Housing
Score
4
Reason
Heavily rusted. Small pieces of rusty metal could short out the tank.

The exterior of the alternator housing is heavily rusted, causing one to hypothesize that the housing interior is also heavily rusted, perhaps to the point that small pieces of rusty metal could flake off and potentially short out the generator windings or cause other modes of failure. The fiberglass outer enclosure is heavily weathered. The spill basin on the diesel bulk tank is rusted through, and the paint on the tank is failing. As mentioned above, the leak detection panel is in poor condition, and likely does not function. These elements should be replaced to ensure reliability of the backup power system.

4.8.4 Instrumentation

Controls

Component	Score	Reason
Ultrasonic level transducer	1	No issues observed.
Component	Score	Reason
Level Controller	1	No issues observed.
Component	Score	Reason
Float Switches	1	No issues observed.

No photo available

Level control is provided by a Zenith Pulsar ultrasonic level transducer, mounted in the wet well. The transducer is connected to Zenith Pulsar level controller, which provides output to the motor starters to control the dry well pumps in automatic mode. High-level and low-level float switches act as a backup in case of failure of the transducer.

SCADA / Alarms

Component	Score	Reason
PLC – 2.4 GHz radio link	1	No issues observed.
Component	Score	Reason
PLC – Yagi antenna	1	No issues observed.
Component	Score	Reason
PLC – Cabinet	1	New condition
Component	Score	Reason
PLC – Contents	1	New condition

No photo available

The PLC provides status and alarms to the central SCADA monitoring station via a 2.4GHz radio link, using a Yagi antenna mounted on a rooftop mast. The PLC cabinet, contents, and antenna are in like-new condition.

4.8.5 Site

Security

Component	Score	Reason
Fencing and Site Lighting	3	Issues with Vandalism

For Photo – See Overview Photo at the beginning of Section 4.8.

Even though the lift station is surrounded by a fence and a locked gate, there have been issues with vandalism. It is recommended to upgrade the fence security and the limited site lighting that is available.

Access

Component	Score	Reason
Access	1	Large enough to allow truck access. No issues with access road.

For Photo – See Overview Photo at the beginning of Section 4.8.

The area is large enough to allow truck access. The access road is packed sand.

Water Supply

Component	Score	Reason
Hose bibb and wash-down water	1	Provided onsite.

No photo available.

A hose bibb and wash-down water is provided onsite.

4.8.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-8, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.8. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning. General recommendations and observations are included at the end of this section.

Table 4-8 – Fort Ord Village Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.8.1	Headworks	Muffin Monster Communitors	3	$ 42,700
4.8.1	HVAC	Metal Ducting	3	$ 2,400
4.8.1	Piping / Valves	Pipe at end of discharge line	3	$ 3,200
4.8.1	Piping / Valves	Air Lock Issues	3	$ 10,000
4.8.2	Structure	Drainage of Concrete Pad on West Side of Pump Station	5	$ 500
4.8.2	Structure	Bulk Fuel Tank	4	$ 20,000
4.8.2	Windows	Window Replacement	3	$ 500
4.8.2	Wet Well	Wet Well Hatch	3	$ 4,000
4.8.3	Electrical Equipment	Service entrance switchboard	3	$ 25,000
4.8.3	Electrical Equipment	Fuel tank leak detection panel	5	$ 2,000
4.8.3	Backup Power	175 kW Caterpillar diesel generator	3	$ 60,700
4.8.5	Security	Fencing and Site Lighting	3	$ 2,000
			Total Cost - Parts	$ 173,000
			Total Cost – Parts with Contingency	$ 224,900

General Recommendations and Observations

The following are in addition to individual components. Costs associated with these recommendations would be provided in a future study or predesign effort.

- The District is considering connecting the Ord Village force main directly to the Monterey One Water interceptor that parallels Beach Range Road. Any force main replacement and inspection should be coordinated with this potential project.

4.9 BOOKER

The Booker Lift Station is a dry pit/wet well lift station with a building. Valves and pipes on the discharge side are below the building. Electrical cabinets are both inside the building. The entire lift station is fenced in.

Booker Lift Station was constructed in approximately 1966 and was upgraded in 1997. The lift station has a total capacity of 760 gpm with two pumps, but only one operable pump was reported from District staff. It is a dry pit/wet well type lift station and is controlled by a sonic level sensor. The service area is planned to be redeveloped, and major rehabilitation or replacement of the lift station is recommended.

4.9.1 Civil/Mechanical

Pumping Unit

Component	Score	Reason
Additional Pump	4	Only one pump – no redundancy.

For Photo - See Wet Well / Dry Pit in Section 4.9.1.

Visuals of the dry pit were difficult due to no light and the inability to safely enter the space. According to District staff, there is only one operable pump, an RBS pump. The pump kicks on once every few hours. A small amount of flow comes from the high school and a few houses in the area.

Headworks

Component	Score	Reason
Muffin Monster Communitor	3	Needs visual.

No photo available.

According to the electrical panel labels, there is a Muffin Monster communitor that was not visualized onsite.

HVAC

Component
Redesign of HVAC system
Score
5
Reason
Exhaust fan discharges into the building. Strong odor inside the building. Potentially hazardous condition.

The wet well and dry well vents are connected via a single duct to an exhaust fan that is mounted inside the pump station building. The exhaust fan discharges into the building, not outside. This creates a strong odor problem inside the building, essentially negates the attempt to ventilate the dry well, and potentially creates a hazardous condition inside the pump station building. The ventilation system needs to be redesigned to effectively achieve the pump station's ventilation goals.

Piping / Valves

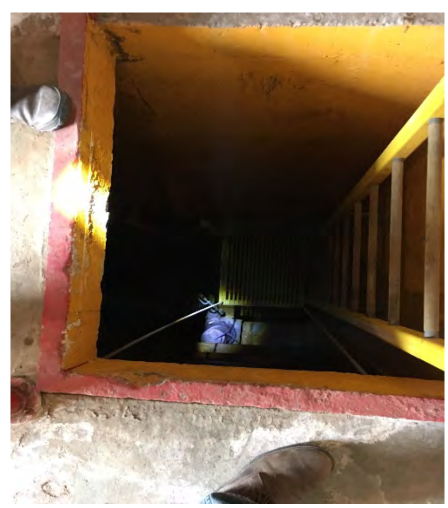
Component	Score	Reason
Gate valves	3	Stems are inconveniently long, making it difficult to turn

No photo available.

There are gate valves on the suction side of the pump. The stems for the gate valves are inconveniently long, making it difficult to turn.

Wet Well / Dry Pit

Component	Score	Reason
Dry Pit Dimensions	3	Too deep for valve stems and good access
Component	Score	Reason
Dry Pit Hatch Upgrade	3	Access Hatch too small
Component	Score	Reason
Dry Pit Stairs	3	Stairs preferred over ladder



For Photo of Wet Well – See Wet Well in Section 4.9.1.

Both the wet well and the dry pit are deep. If the line in the street is not as deep, it is recommended to build a shallower wet well and dry pit during an upgrade. Access is also limited. It is recommended to widen the access hatch during an upgrade, and construct stairs that lead down to the dry pit.

4.9.2 Structural

Roof

Component	Score	Reason
Roof	1	Appears to be in decent condition.

For Photo – See Overview Photo at the beginning of Section 4.9.

Appears to be in decent condition.

Structure

Component	Score	Reason
Concrete Slabs	3	Provide concrete slabs for the entire lift station during the recommended replacement.

For Photo – See Overview Photo at the beginning of Section 4.9.

Concrete slabs appear to be on grade and in decent condition, but it is recommended to provide concrete slabs for the entire lift station during the recommended replacement.

Doors / Hatches / Windows

Component
Door
Score
1
Reason
Appears to be in decent condition.

The door appears to be in decent condition. For information on hatches see Wet Well / Dry Pit in Section 4.9.1. There are no windows.

Pipe / Equip Supports

Component	Score	Reason
Pipe / Equip Support	1	Appears to be in decent condition.

No photo available.

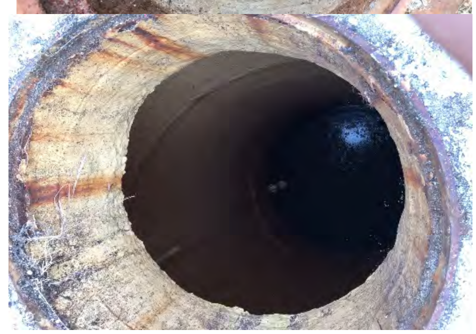
Though limited in observation, looking down the deep dry pit there appeared to be decent pipe and equipment support.

Wet Well / Dry Pit

Component
Wet well coating
Score
2
Reason
Appears to be in decent condition.

The coatings on the wall appear to be in good condition. Wet well dimensions are 13-ft long, 6-ft wide, and 20-ft deep.

Component
Manhole 1
Score
1
Reason
Walls appear to be in good working condition.
Component
Manhole 2
Score
1
Reason
Walls appear to be in good working condition.



On both sides of the wet well there are manholes. The walls appear to be in good working condition.

4.9.3 Electrical

Electrical Equipment

Component	Score	Reason
Meter/main panel	1	No issues observed.
Component	Score	Reason
Olympian automatic transfer switch	1	No issues observed.
Component	Score	Reason
Pump Control Panel	1	No issues observed.
Component	Score	Reason
480-240/120-volt step-down transformer	1	No issues observed.

No photo available.

The electrical equipment consists of a meter/main panel, Olympian automatic transfer switch, pump control panel, and a 480:208/120V unit power center with stepdown transformer and breaker panel. The pump control panel contains a Zenith Pulsar level controller and combination full-voltage, non-reversing two motor starters. The panels show some minor surface rusting, but are otherwise observed to be in serviceable condition.

Primary Power

Component
Pole mount transformer
Score
3
Reason
Electrical service should be upgraded to meet PG&E's current standard for a 480V system.

The lift station electrical distribution system is fed from three single-phase pole-mount PG&E transformers, located within the lift station fence. The service is rated at 200-amps, 480 volts, three-phase, three-wire. A surge protection capacitor is mounted at the service panel, perhaps as an attempt to provide capacitive grounding to the otherwise ungrounded system. The electrical service should be upgraded to meet PG&E's current standard for a 480V system and to create a safer system for District personnel to operate and maintain.

Backup Power

Component
Generator
Score
4
Reason
Reported to have engine valve problems and not in operating condition.
Component
250 gallon bulk diesel fuel tank
Score
4
Reason
Heavily rusted

The generator is reported to have engine valve problems and to not be in operating condition. The 250-gallon bulk diesel fuel tank site is heavily rusted. These elements should be replaced.

4.9.4 Instrumentation

Controls

Component	Score	Reason
Ultrasonic level transducer	1	No issues observed.
Component	Score	Reason
Level Controller	1	No issues observed.
Component	Score	Reason
Float Switches	1	No issues observed.

No photo available

Level control is provided by a Zenith Pulsar ultrasonic level transducer, mounted in the wet well. The transducer is connected to Zenith Pulsar level controller, which provides output to the motor starters to control the dry well pumps in automatic mode. High-level and low-level float switches act as a backup in case of failure of the transducer.

SCADA / Alarms

Component	Score	Reason
PLC –radio link	3	Trio 2.4 GHz radio onsite, presumably to replace the existing radio.
Component	Score	Reason
PLC - Cabinet	1	New condition
Component	Score	Reason
PLC - Contents	1	New condition

No photo available

The PLC provides status and alarms to the central SCADA monitoring station via a radio link, using a Yagi antenna mounted on a rooftop mast. The current radio is a Control Microsystems SCADAWave40, which appears to be incompatible with the upgraded radio system. A new Trio 2.4GHz radio is onsite, presumably to replace the existing radio. The PLC cabinet, contents, and antenna are otherwise in like-new condition.

4.9.5 Site

Security

Component	Score	Reason
Fencing	3	Site may be at risk due to abandoned areas surrounding the site.
Component	Score	Reason
Lighting	3	Site may be at risk due to abandoned areas surrounding the site.

For Photo – See Overview Photo at the beginning of Section 4.9.

There have not been issues with vandalism in the past, though the site is at risk due to the abandoned areas surrounding the site. It is recommended to have improved fencing, barbed wire, and lighting with the upgrade.

4.9.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-9, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.9. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning. General recommendations and observations are included at the end of this section.

Table 4-9 – Booker Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.9.1	Pumping Unit	Additional Pump	4	$ 10,000
4.9.1	Headworks	Muffin Monster Communitor	3	$ 40,700
4.9.1	HVAC	Redesign of HVAC System	5	$ 4,600
4.9.1	Piping / Valves	Gate Valves	3	$ 900
4.9.1	Wet Well / Dry Pit	Dry Pit Dimensions	3	$ 5,200
4.9.1	Wet Well / Dry Pit	Dry Pit Hatch Upgrade	3	$ 4,000
4.9.1	Wet Well / Dry Pit	Dry Pit Stairs	3	$ 1,500
4.9.2	Structure	Concrete Slab	3	$ 82,100
4.9.3	Primary Power	Pole mount transformer	3	$ 5,000
4.9.3	Backup Power	Generator	4	$ 32,100
4.9.3	Backup Power	250 gallon bulk diesel fuel tank	4	$ 18,000
4.9.4	SCADA / Alarms	PLC – radio link	3	$ 300
4.9.5	Security	Fencing	3	$ 22,800
4.9.5	Security	Lighting	3	$ 5,000
			Total Cost - Parts	$ 232,200
			Total Cost – Parts with Contingency	$ 301,900

General Recommendations and Observations

The following are in addition to individual components. Costs associated with these recommendations would be provided in a future study or predesign effort.

- Major rehabilitation or replacement of the lift station is recommended. Improvements should be coordinated with planning for the lift station service area.

4.10 FRITZCHE

The Fritzche Lift Station is a wet well submersible lift station with no building. Valves and pipes on the discharge side are below grade. Electrical cabinets are mounted at grade. The lift station is not fenced in, though it is inside an airfield, which has perimeter fencing and security.

4.10.1 Civil/Mechanical

Pumping Unit

Component	Score	Reason
Pumps	1	No issues observed.

No photo available.

There are two 160-gpm pumps located at this station. The operator did not know the model name or date of installation, but mentioned the pumps come on about twice a day. Pumps operate in lead / lag mode.

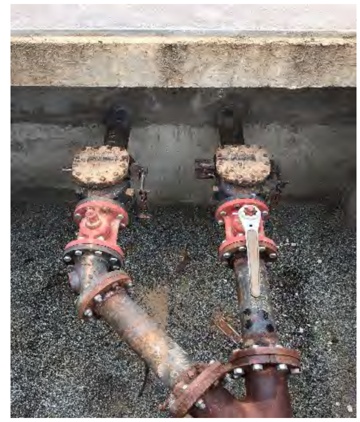
Headworks

Component
Oil Separator
Score
3
Reason
Needs to be cleaned on a regular basis.

There is an oil separator that appears to be clogged. Cleaning of the oil separator on a regular basis is recommended.

Piping / Valves

Component
Valve Vault Piping / Valves
Score
3
Reason
Corroded – recommended for replacement



Piping and valves appear to be corroded in the Valve Vault, and are recommended for replacement.

Wet Well

Component	Score
Pipes	3
Reason	
Corroded – recommended for replacement	

For Photo – See Wet Well in Section 4.10.2.

The pipes inside the wet well are corroded.

4.10.2 Structural

Structure

Component
Concrete Slabs
Score
2
Reason
Appear to be on grade and in decent condition

Concrete slabs appear to be on grade and in decent condition.

Hatches

Component	Score	Reason
Pneumatics and Fall Protection for wet well and valve vault hatches	3	Pneumatics and fall protection are recommended.

For Photo – See Structure in Section 4.10.2.

Wet well and valve vault hatches do not have pneumatics. These are recommended to stay in the upright position for convenience to the operator. Fall protection is also recommended.

Pipe / Equip Supports

Component	Score	Reason
Pipe Support inside Valve Vault	1	Support structures recommended.

For Photo – See Piping / Valves in Section 4.10.1.

Within the valve vault there is no support for the piping and valves. It is recommended to install support structures when replacing the corroded piping and valves.

Wet Well

Component
Wet well walls
Score
1
Reason
Appear to be in good condition.

The wet well walls appear to be in good condition. The wet well dimensions are 8-ft long, 8-ft wide, and 11-ft deep.

4.10.3 Electrical

Electrical Equipment

Component
Cabinet – Asco automatic transfer switch and breaker panel
Score
2
Reason
Moderate rusting
Component
Cabinet – Pump motor starters and a Milltronics Mini-Ranger level controller
Score
4
Reason
Evidence that components have overheated. Recommended replacement.

The electrical equipment consists of one cabinet with an Asco automatic transfer switch and a breaker panel, and another cabinet with pump motor starters and a Milltronics Mini-Ranger level controller. The panels show some moderate rusting. The pump control panel shows evidence that the components at one time had overheated. Existing components have a light layer of rust. These components should be replaced.

Primary Power

Component
Pad mount transformer
Score
1
Reason
Appear to be on grade and in decent condition

Drawings were not available to show the layout of the site electrical distribution system. Conclusions were drawn from what could be observed above ground. The lift station electrical distribution system is apparently fed from a 12kV distribution system that is owned by the airport, and likely feeds other adjacent equipment installations. The pump station appears to be fed by its own 208Y/120V, 3-phase, four-wire pad-mount transformer.

Backup Power

Component
Generator
Score
4
Reason
Enclosure and exposed exhaust system heavily rusted.

The generator enclosure and exposed exhaust system components are heavily rusted. The subbase fuel tank has minor-to-moderate rust. It is recommended for the generator to be replaced.

4.10.4 Instrumentation

Controls

Component	Score	Reason
Ultrasonic level transducer	1	No issues observed.
Component	Score	Reason
Level Controller	1	No issues observed.
Component	Score	Reason
Float Switches	2	Specific float functions are unclear.

No photo available

Level control is provided by an ultrasonic level transducer mounted in the wet well. The transducer is connected to a Milltronics Mini-Ranger level controller, which provides output to the motor starters to control the wet well pumps in automatic mode. Four (4) level float switches apparently act as a backup in case of failure of the transducer. Since a 4-float system is not typical of the level controls used at most of the other pump stations, the specific float functions are unclear.

SCADA / Alarms

Component	Score	Reason
PLC – 2.4 GHz radio link	1	No issues observed.
Component	Score	Reason
PLC – Yagi antenna	1	No issues observed.
Component	Score	Reason
PLC - Cabinet	1	Good condition
Component	Score	Reason
PLC - Contents	1	Good condition

No photo available

The PLC provides status and alarms to the central SCADA monitoring station via a 2.4GHz radio link, using a Yagi antenna mounted on a mast. The PLC cabinet, contents, and antenna are in good condition.

4.10.5 Site

The site location is far away and inconvenient to access. With improvements at upstream lift stations, the Fritzche Field lift station may not be necessary.

4.10.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-10, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.10. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning. General recommendations and observations are included at the end of this section.

Table 4-10 – Fritzche Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.10.1	Piping / Valves	Valve Vault Piping & Valves	3	$ 7,000
4.10.1	Wet Well	Pipes	3	$ 900
4.10.2	Hatches	Pneumatics and Fall Protection	3	$ 4,000
4.10.3	Electrical Equipment	Cabinet – Pump Motor Starters and Milltronics Mini-Ranger level controller	4	$ 35,000
4.10.3	Backup Power	Generator	4	$ 16,300
			Total Cost - Parts	$ 63,200
			Total Cost – Parts with Contingency	$ 82,200

General Recommendations and Observations

The following are in addition to individual components. Costs associated with these recommendations would be provided in a future study or predesign effort.

- Evaluate the possibility of decommissioning the lift station if upstream lift station improvements are made.

4.11 EAST GARRISON

The East Garrison Lift Station is a wet well submersible lift station with no building. Valves and pipes on the discharge side are below grade. Electrical cabinets are above grade. The lift station is fenced in.

4.11.1 Civil/Mechanical

Pumping Unit

Component	Score	Reason
Pumps	1	No issues observed.

No photo available.

There are two pumps with an unknown capacity. No issues were reported from the operator. Pumps operate in lead / lag mode.

Piping / Valves

Component
Valve Vault Drainage
Score
4
Reason
Standing water needs to be removed
Component
Valve Vault Pipes and Valves
Score
4
Reason
Piping and Valves heavily corroded.

On inspection the valve vault was seen to have standing water up to the piping. There appeared to be a drain that ran to the wet well, with a closed valve. It is recommended to open the valve and clean out the drain line in order to remove standing water at the valve vault. The piping and valves within the valve vault also appear to be corroded, and are recommended to be replaced.

Wet Well

Component
Piping in wet well
Score
4
Reason
Corrosion Issues. Recommended replacement.

Piping appears to have corrosion issues within the wet well, and it is recommended to be replaced.

4.11.2 Structural

Structure

Component	Score	Reason
Concrete pad	3	No issues observed.

For Photo – See Electrical Equipment in Section 4.11.3.

The concrete pad for one of the electrical panels appears to be shifting due to subgrade settlement (See Electrical Equipment in Section 4.11.3).

Pipe / Equip Supports

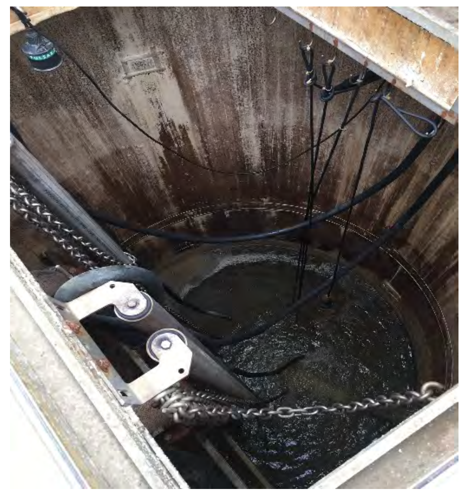
Component	Score	Reason
Concrete block under Y valve in valve vault	3	Install proper support when replacing piping and valves.

For Photo – See Piping / Valves in Section 4.11.1.

Within the valve vault there is a concrete block under the y valve. It is recommended to install proper support structures when replacing the corroded piping and valves.

Wet Well

Component
Wet well liner
Score
1
Reason
No issues observed.



The wet well appears to have a liner rather than coating. No issues observed. Wet well dimensions are 8-ft in diameter and 18-ft deep.

4.11.3 Electrical

Electrical Equipment

Component	Score	Reason
Meter/main panel	1	No issues observed.
Component	**Score**	**Reason**
Pump control panel	2	Shows minor weathering, otherwise appears to be in good condition.
Component	**Score**	**Reason**
PVC conduits between the electrical panels and the wet well	3	Appear to be shifting due to subgrade settlement.

The electrical equipment consists of a meter/main panel, and a pump control panel. The pump control panel contains a Zenith Pulsar level controller and combination full-voltage, non-reversing two motor starters. The panels show some minor weathering, but are otherwise appear to be in good condition. The concrete pad on which the electrical panels are mounted appears to be shifting due to subgrade settlement. The PVC conduits between the electrical panels and the wet well may be stressed or broken due to this settlement. It is recommended that the concrete pad and any broken conduits be replaced, and the electrical panels remounted.

Primary Power

Component	Score	Reason
Pad mount transformer	1	No issues observed.

No photo available.

The lift station electrical distribution system is fed from a pad-mount Pacific Gas & Electric (PG&E) transformer, located within the lift station fence. The service is rated at 200-amps, 480 volts, three-phase, four-wire.

Backup Power

Component	Score	Reason
Generator Receptacle	3	Recommended to install a generator on top of a new concrete pad.
Component	Score	Reason
Automatic Transfer Switch	3	Recommend to provide an automatic transfer switch along with the recommended new generator.

No photo available.

The pump station is equipped with a generator receptacle for connecting a portable generator. It is recommended to install a generator on top of a new concrete pad.

A manual transfer switch is built-in to the pump control panel. It is recommended that an automatic transfer switch be provided along with the recommended new generator.

4.11.4 Instrumentation

Controls

Component	Score	Reason
Ultrasonic level transducer	1	No issues observed.
Component	Score	Reason
Level Controller	1	No issues observed.
Component	Score	Reason
Float Switches	1	No issues observed.

No photo available

Level control is provided by a Zenith Pulsar ultrasonic level transducer, mounted in the wet well. The transducer is connected to Zenith Pulsar level controller, which provides output to the motor starters to control the dry well pumps in automatic mode. Four (4) level float switches apparently act as a backup in case of failure of the transducer. Since a 4-float system is not typical of the level controls used at most of the other pump stations, the specific float functions are unclear.

SCADA / Alarms

Component	Score	Reason
PLC – 2.4 GHz radio link	1	No issues observed.
Component	Score	Reason
PLC – Yagi antenna	1	No issues observed.
Component	Score	Reason
PLC - Cabinet	1	New condition
Component	Score	Reason
PLC - Contents	1	New condition

No photo available

The PLC provides status and alarms to the central SCADA monitoring station via a 2.4GHz radio link, using a Yagi antenna mounted on a rooftop mast. The PLC cabinet, contents, and antenna are in like-new condition.

4.11.5 Site

Component	Score	Reason
Bioxide tank	1	No issues observed.

For Photo – See Overview Photo at the beginning of Section 4.11

The site contains a bioxide tank from Evoqua Technologies in order to eliminate sewer odor, corrosion, and safety problems associated with hydrogen sulfide.

4.11.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-11, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.11. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning.

Table 4-11 – East Garrison Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.11.1	Piping / Valves	Valve Vault Pipes and Valves	4	$ 2,800
4.11.1	Wet Well	Piping in Wet Well	4	$ 2,600
4.11.2	Structure	Concrete Pad	3	$ 1,700
4.11.2	Pipe / Equip Supports	Concrete block under Y valve in valve vault	3	$ 400
4.11.3	Electrical Equipment	PVC conduits between the electrical panels and wet well	3	$ 5,000
4.11.3	Backup Power	Generator Receptacle	3	$ 19,200
4.11.3	Backup Power	Automatic Transfer Switch	3	$ 6,000
			Total Cost - Parts	$ 37,700
			Total Cost – Parts with Contingency	$ 49,100

4.12 RESERVATION

The Reservation Lift Station is a wet well submersible lift station with no building. Valves and pipes on the discharge side are below grade. Electrical cabinets are above grade. The lift station is fenced in.

4.12.1 Civil/Mechanical

Pumping Unit

Component
Pumps
Score
1
Reason
No issues observed.

There are two pumps with a maximum capacity of 900 gpm. The wet well water level was lowered for a visual on the pumps. It was confirmed that the pumps were not Flygt models. The operator mentioned that they may have O&M manuals for these pumps. Pumps operate in lead / lag mode.

Headworks

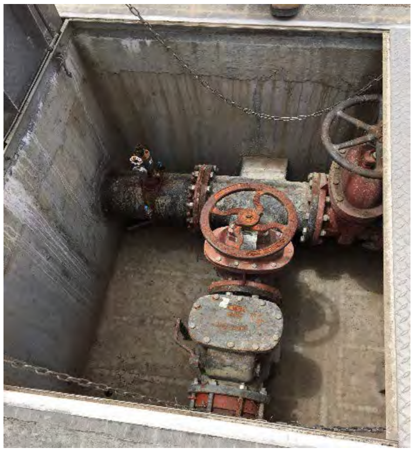
Component	Score	Reason
Muffin Monster Grinder	3	Taken out of service. May need to be reinstalled.

No photo available.

According to the operator, a Muffin Monster grinder was taken out of pumping system (directly in front of the inflow pipe) due to mechanical issues.

Piping / Valves

Component
Valve Vault Piping and Valves
Score
4
Reason
High amount of corrosion



Piping and valves within the valve vault appears corroded and in need of repair. Within the valve vault there is a strap on device to help bleed the air. It is recommended to conduct a condition assessment of the force main in order to resolve air lock issues at the lift station. Condition assessment of the force main will require flow handling or bypass. For cost efficiency, condition assessment should be coordinated with other activities at the lift station that necessitate flow handling or bypass.

Wet Well

Component
Stainless steel lifting guide rails
Score
1
Reason
No issues observed.
Component
Pipes
Score
1
Reason
No issues observed.

Inside the wet well, the stainless steel pump lifting guide rails appear to be in good condition. The pipes within the wet well also appear to be in good condition and are functioning properly.

4.12.2 Structural

Structure

Component	Score	Reason
Concrete slabs	1	No issues observed.

For Photo – See overview photo at the beginning of Section 4.12.

Concrete slabs appear to be on grade and in decent condition.

Hatches

Component	Score	Reason
Hatches	1	No issues observed.

No photo available.

Hatches appear to be structurally sound and function properly.

Pipe / Equip Supports

Component	Score	Reason
Pipe and Equipment Supports	1	No issues observed.

For Photo – See Piping / Valves in Section 4.12.

Pipe and equipment support appears to function properly.

Wet Well

Component
Wet Well Coating
Score
3
Reason
Rust bleed below a drain line

The wet well coating appears to be in good condition, though there is rust bleed below a drain line that is recommended to be recoated. The wet well is 8-ft in diameter and 24-ft deep.

4.12.3 Electrical

Electrical Equipment

Component	Score	Reason
Meter/main panel	1	No issues observed.
Component	Score	Reason
Automatic transfer switch	3	One area on the enclosure top surface that is rusted through.
Component	Score	Reason
Manual Transfer Switch	1	No issues observed.
Component	Score	Reason
Pump control panel	1	No issues observed.
Component	Score	Reason
480:208/120V unit power center	1	No issues observed.

The electrical equipment consists of a meter/main panel, automatic transfer switch, manual transfer switch, pump control panel, and a 480:208/120V unit power center with stepdown transformer and breaker panel. The pump control panel contains a Zenith Pulsar level controller and combination full-voltage, non-reversing two motor starters. The panels are individually mounted on a unistrut support structure. The panels are weathered, with small areas of light rust but in otherwise good condition. The exception is the automatic transfer switch, which has one area on the enclosure top surface that is rusted through.

Primary Power

Component	Score	Reason
Pad mount transformer	1	No issues observed.

No photo available.

The lift station electrical distribution system is fed from a pad-mount Pacific Gas & Electric (PG&E) transformer, located outside the lift station fence. The service is rated at 200-amps, 480Y/277 volts, three-phase, four-wire.

Backup Power

Component
100kW Olympian generator
Score
1
Reason
No issues observed.

The pump station is equipped with a 100kW Olympian generator, which is mounted inside a weather-protective fiberglass enclosure.

Component
Convault bulk tank
Score
1
Reason
No issues observed.

A Convault bulk tank is located next to the generator. Both the generator and tank appear to be in good condition.

4.12.4 Instrumentation

Controls

Component	Score	Reason
Ultrasonic level transducer	1	No issues observed.
Component	Score	Reason
Level Controller	1	No issues observed.
Component	Score	Reason
Float Switches	1	No issues observed.

No photo available

Level control is provided by a new Zenith Pulsar ultrasonic level transducer, mounted in the wet well. The transducer is connected to Zenith Pulsar level controller, which provides output to the motor starters to control the wet well pumps in automatic mode. High-level and low-level float switches act as a backup in case of failure of the transducer.

SCADA / Alarms

Component	Score	Reason
PLC – 2.4 GHz radio link	1	No issues observed.
Component	Score	Reason
PLC – Yagi antenna	1	No issues observed.
Component	Score	Reason
PLC - Cabinet	1	New condition
Component	Score	Reason
PLC - Contents	1	New condition

No photo available

An Allen-Bradley MicroLogix 1400 PLC provides status and alarms to the central SCADA monitoring station via a 2.4GHz radio link, using a Yagi antenna mounted on a mast. The PLC cabinet, contents, and antenna are in like-new condition.

4.12.5 Site

The site appears to have adequate space for truck access.

Security

Component	Score	Reason
Fencing	3	Improved barb wire fencing for increased security.

For Photo – See Overview Photo at the beginning of Section 4.12.

Though vandalism was not reported for this site, improved barbed wire would prevent an event.

4.12.6 Costs and Recommendations

Priority components with associated costs are organized in Table 4-12, based on a condition rating of 5 (Very Poor), 4 (Poor), and 3 (Moderate / Fair) as described in Table 1-1. Recommendations can be found for each component in their respective table in Section 4.12. Costs presented in this section are for construction only, and include a 30% contingency. Other soft costs (engineering, construction management, etc.) should be included for further project planning.

Table 4-12 – Reservation Lift Station - Critical Components and Associated Costs

Section	Factor	Component	Score	Cost
4.12.1	Headworks	Muffin Monster Grinder	3	$ 5,700
4.12.1	Piping / Valves	Valve Vault Piping and Valves	4	$ 2,900
4.12.2	Wet Well	Wet Well Coating	3	$ 2,500
4.12.3	Electrical Equipment	Automatic Transfer Switch	3	$ 6,000
4.12.5	Security	Fencing	3	$ 22,800
			Total Cost - Parts	$ 39,900
			Total Cost – Parts with Contingency	$ 51,900

5. Summary of Lift Station Recommendations

Table 5-1 provides a summary of the total costs, including contingency, for the rehabilitation of existing lift station components. Costs for major rehabilitation or replacement would be determined in a separate study or predesign effort.

Table 5-1 - Summary of Lift Station Recommendations

Lift Station	Section	Location	Total Costs (Contingency Included)	Summary of Lift Station Recommendations
Dunes	4.1	Dunes Drive – next to Marina Dunes Resort	$30,700	Various civil/mechanical, structural, and electrical recommendations.
San Pablo	4.2	180 San Pablo Court	$32,000	Various structural, electrical, and instrumentation recommendations.
Crescent	4.3	3009 Crescent Street	$32,700	Due to high civil/mechanical, structural, electrical, instrumentation, and site issues, major lift station rehabilitation or replacement is recommended.
Neeson	4.4	Neeson Road/Marina Airport	$225,300	Abandon existing pump station and construct new pump station.
Gigling	4.5	Okinawa and Noumea Road	$577,600	Various civil/mechanical, electrical, instrumentation, and site recommendations.
Hatten	4.6	Hatten Road	$71,700	Abandon existing pump station and construct new pump station.
Imjin	4.7	Imjin at Abrams	$37,700	Various civil/mechanical, structural, and electrical recommendations.
Fort Ord Village	4.8	End of Beach Range Road	$224,900	Various civil/mechanical, structural, electrical, and site recommendations.
Booker	4.9	End of Booker Street	$301,900	Due to high civil/mechanical, structural, electrical, instrumentation, and site issues, major lift station rehabilitation or replacement is recommended.
Fritzche	4.10	Fritzsche Field North	$82,200	In addition to various civil/mechanical, structural, and electrical recommendations, evaluate the possibility of decommissioning the lift station if upstream lift station improvements are made.
East Garrison	4.11	Inter-Garrison Road and Ord Ave	$49,100	Various civil/mechanical, structural, and electrical recommendations.
Reservation Road	4.12	Reservation Road 1,125 feet NW of Imjin	$51,900	Various civil/mechanical, structural, electrical, and security recommendations.

Appendix A – Lift Station Locations

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APPENDIX D

Capital Improvement Program Project Sheets

Central Marina Service Area

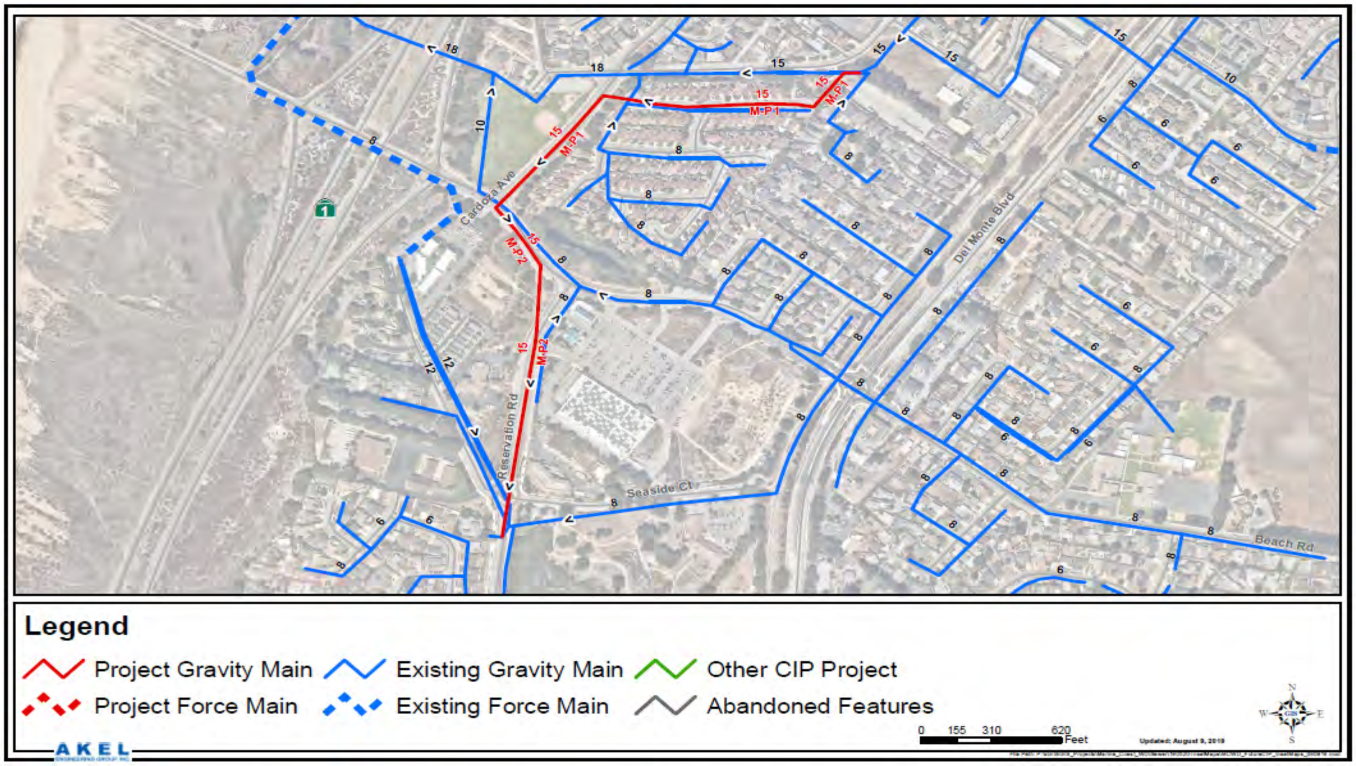
Project S1

Future Gravity System Diversion

Project Background

This project includes the construction of a new 15-inch gravity main along future right-of-way, Cove Way, and Cardoza Avenue between Abdy Way and Reservation Road. This pipeline is intended to divert flows currently routed to the Dunes Lift Station.

Project Description



Sewer System	Project Completion	Project Component(s)
Central Marina		Pipeline

Project Benefit

Existing Customers:	**1%**
New Development:	**99%**

Project Trigger

Trigger:	With Development
Development:	Armstrong Ranch

Project Need

Development

Project Cost Breakdown (2018 Dollars)

Base Construction:	**1,121,800**
Constr. Contingency (48.5%):	544,200
Construction Total	**1,666,000**
Engr., CM, Legal/Admin (25%):	416,600
Total Project Cost:	**2,082,600**

Central Marina Service Area

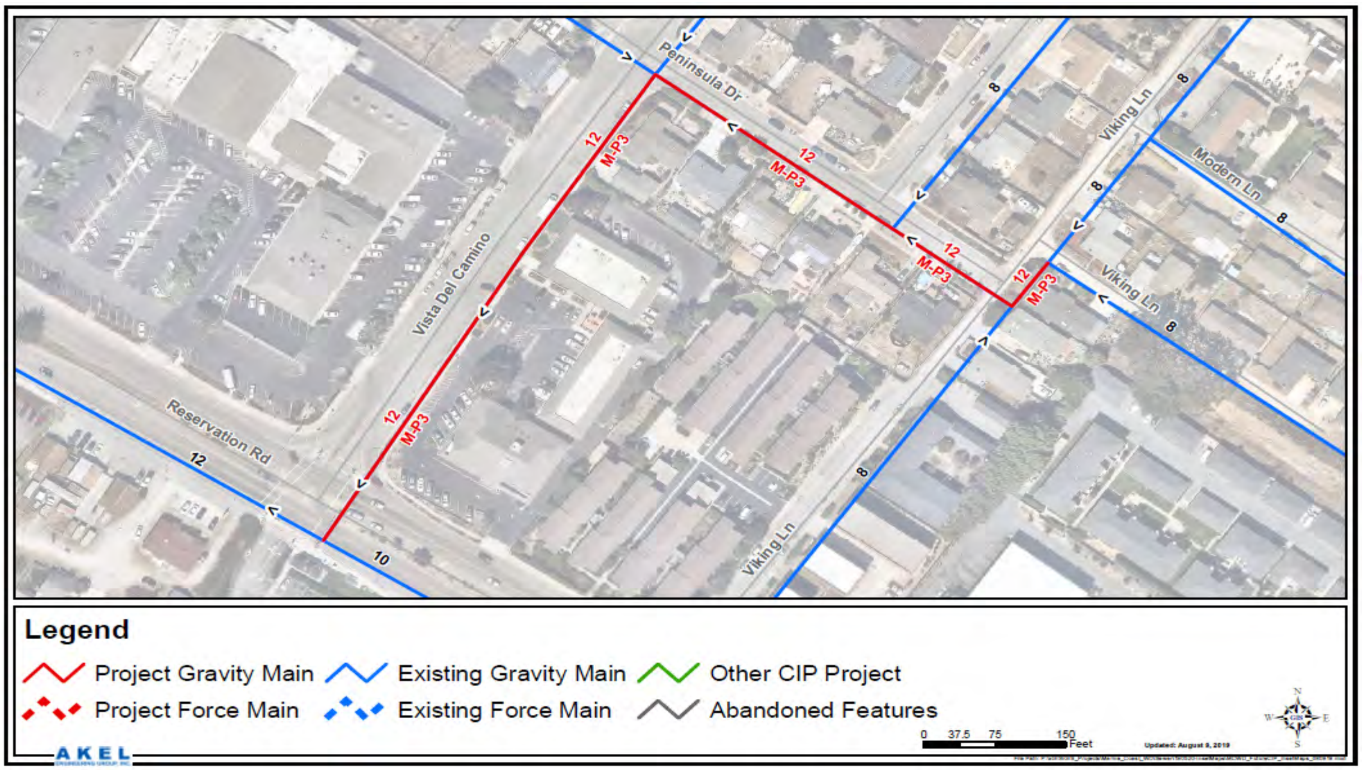
Project S2

Peninsula Drive and Vista Del Camino Gravity Main

Project Background

This project includes the replacement of an existing 8-inch gravity main with a new 12-inch gravity main along Peninsula Drive and Vista del Camino from Viking Lane to Reservation Road. This project is intended to mitigate an existing system deficiency.

Project Description



Sewer System	Project Completion	Project Component(s)
Central Marina		Pipeline

Project Benefit

Existing Customers: **85%**
New Development: **15%**

Project Trigger

Trigger: Existing Deficiency
Development: -

Project Need

Capacity

Project Cost Breakdown (2018 Dollars)

Base Construction:	**376,600**
Constr. Contingency (48.5%):	182,700
Construction Total	**559,300**
Engr., CM, Legal/Admin (25%):	139,900
Total Project Cost:	**699,200**

Central Marina Service Area

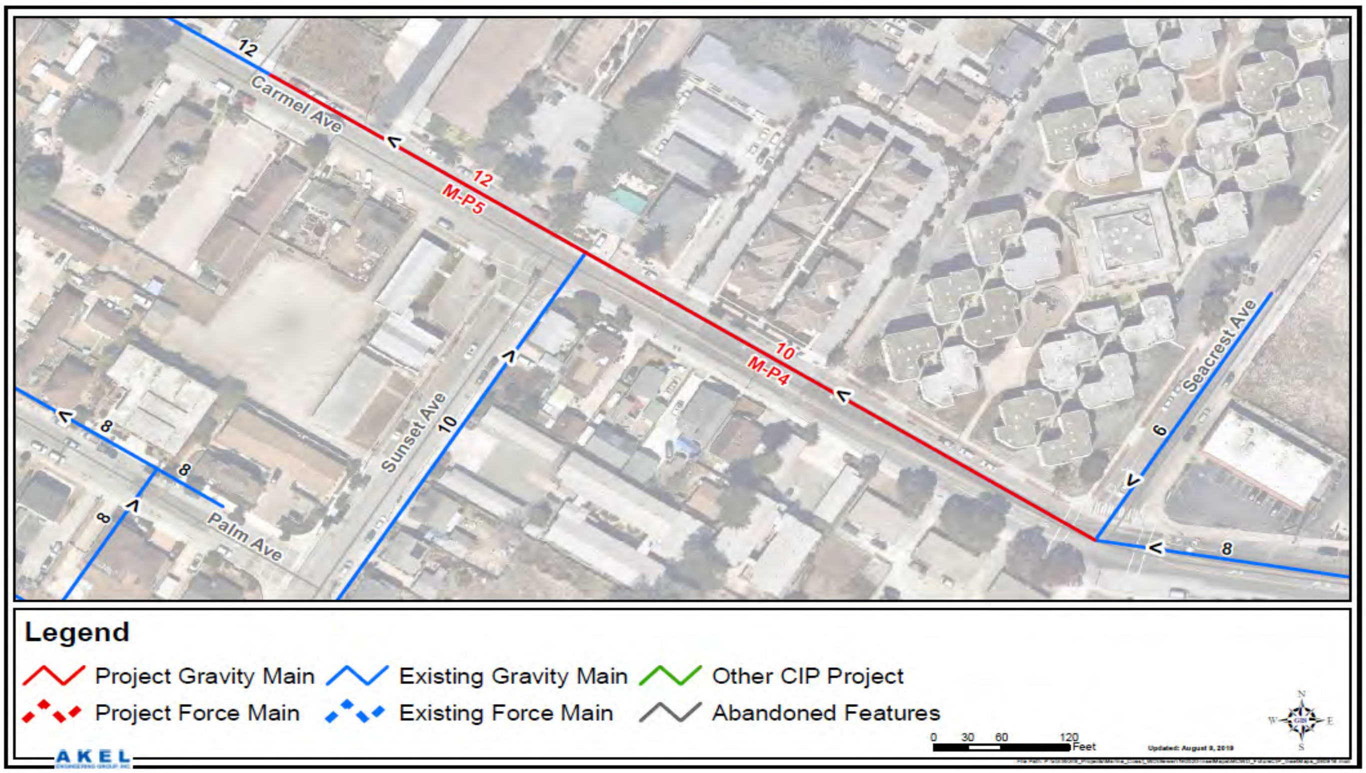
Project S3

Carmel Avenue Gravity Main

Project Background

This project includes the replacement of an existing 8-inch gravity main with new 10-inch and 12-inch gravity mains along Carmel Avenue between Seacrest Avenue and approximately 400 feet west of Sunset Avenue. This project is intended to mitigate an existing system deficiency.

Project Description



Sewer System	Project Completion	Project Component(s)
Central Marina		Pipeline

Project Benefit

Existing Customers: **100%**
New Development: **0%**

Project Trigger

Trigger: Existing Deficiency
Development: -

Project Need

Capacity

Project Cost Breakdown (2018 Dollars)

Base Construction:	**237,200**
Constr. Contingency (48.5%):	116,100
Construction Total	**352,300**
Engr., CM, Legal/Admin (25%):	88,100
Total Project Cost:	**440,400**

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Ord Community Service Area

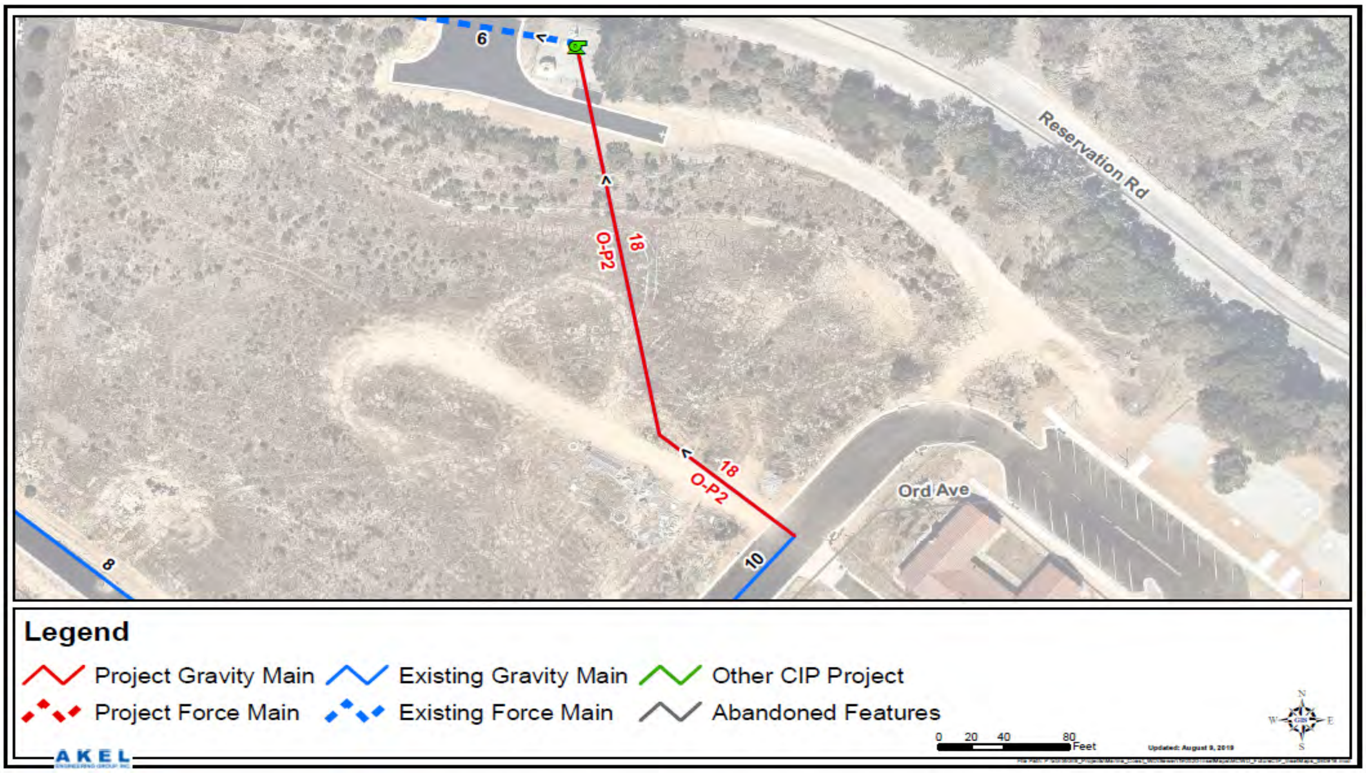
PROJECT S4

East Garrison Gravity Main

Project Background

This project includes the replacement of an existing 15-inch gravity main with a new 18-inch gravity main in right-of-way between Ord Avenue and the East Garrison Lift Station. This project is intended to mitigate a future system deficiency.

Project Description



Sewer System	Project Completion	Project Component(s)
Ord Community		Pipeline

Project Benefit

Existing Customers:	**0%**
New Development:	**100%**

Project Trigger

Trigger:	With East Garrison Phase 2
Development:	East Garrison Phase 2

Project Need

Capacity

Project Cost Breakdown (2018 Dollars)

Base Construction:	**131,000**
Constr. Contingency (48.5%):	63,600
Construction Total	**194,600**
Engr., CM, Legal/Admin (25%):	48,700
Total Project Cost:	**243,300**

Ord Community Service Area

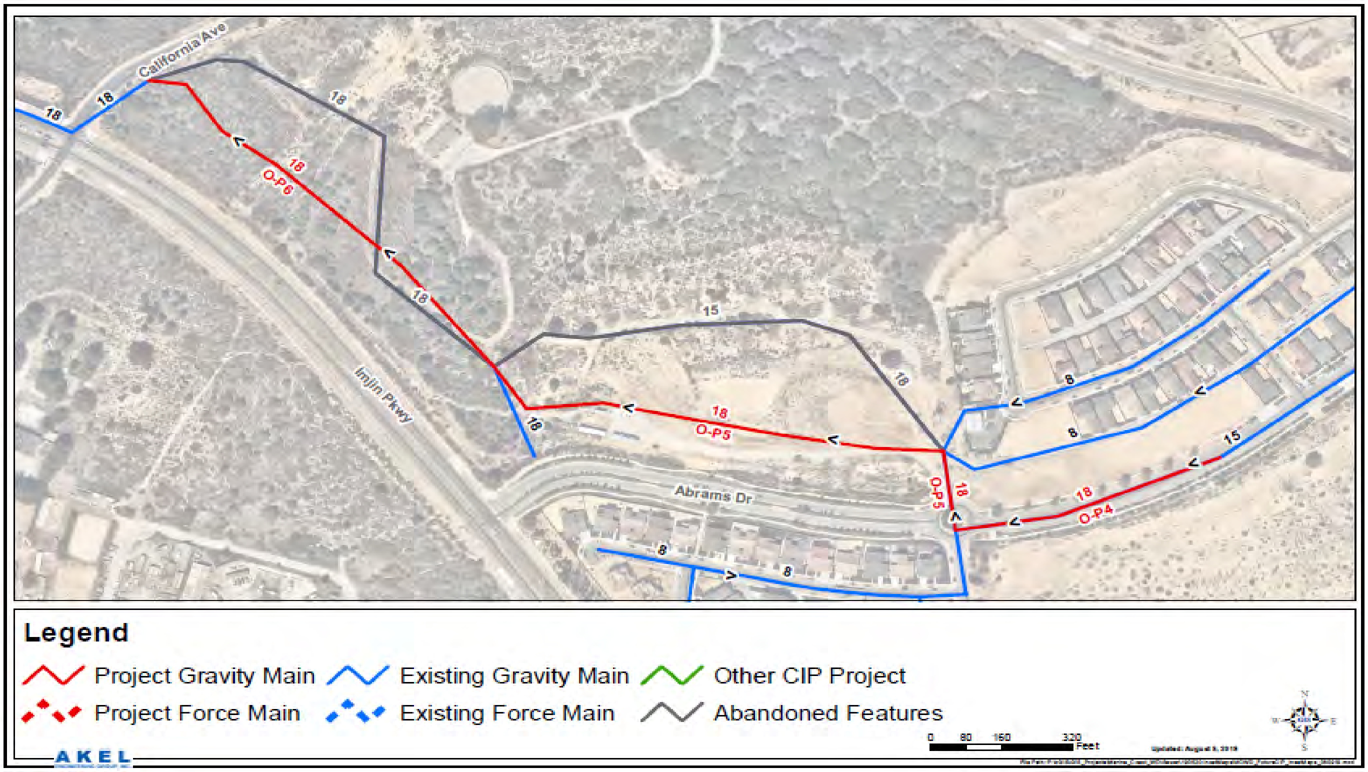
PROJECT S5

Sea Haven Gravity Main

Project Background

This project includes the replacement of existing 10-inch and 15-inch gravity mains with a new 18-inch gravity main along Abrams Drive from west of Inchon Court to 80th Artillery Court. This project is intended to mitigate a future system deficiency.

Project Description



Sewer System	**Project Completion**	**Project Component(s)**
Ord Community		Pipeline

Project Benefit

Existing Customers: Varies
New Development: Varies

Project Trigger

Trigger: With Sea Haven Development
Development: -

Project Need

Capacity

Project Cost Breakdown (2018 Dollars)

Base Construction:	**1,015,200**
Constr. Contingency (48.5%):	492,500
Construction Total	**1,507,700**
Engr., CM, Legal/Admin (25%):	377,000
Total Project Cost:	**1,884,700**

Ord Community Service Area

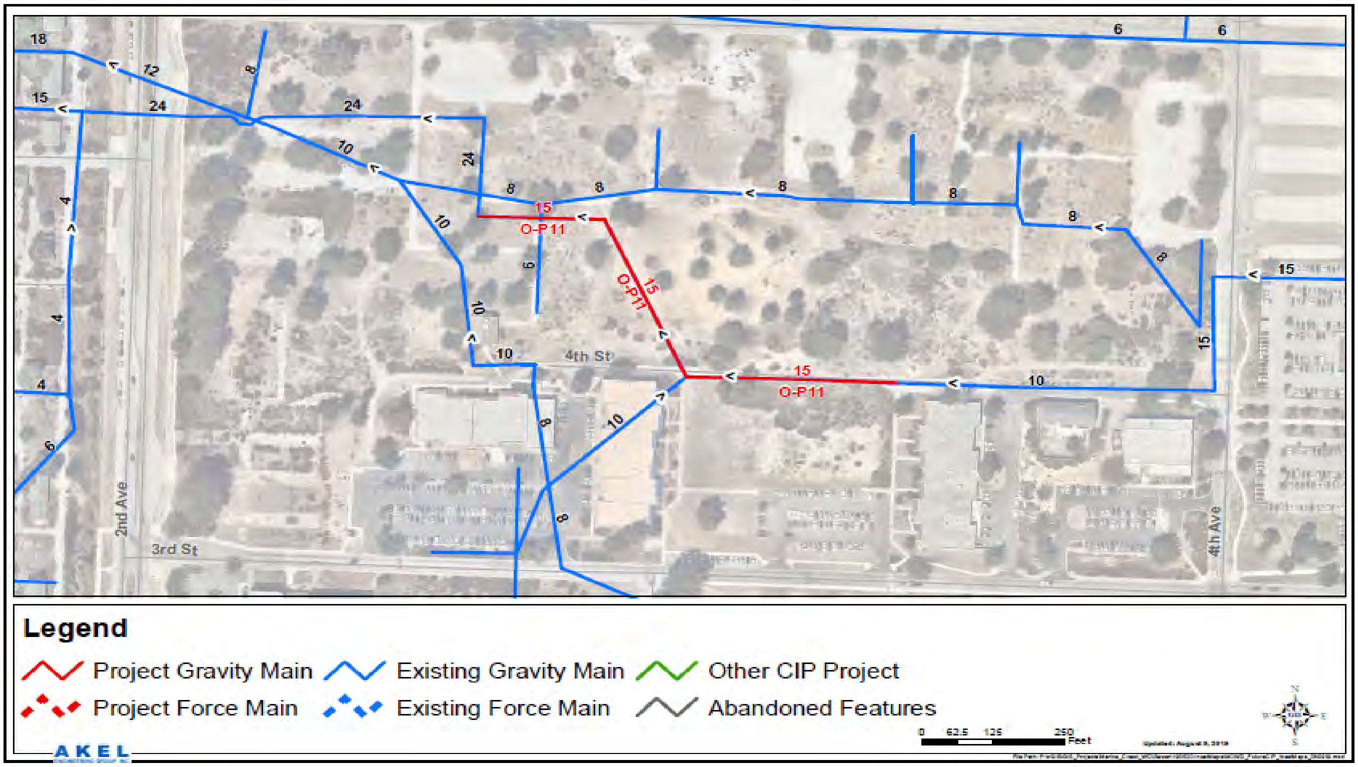
PROJECT S6

Right-of-Way Gravity Main

Project Background

This project includes the replacement of an existing 10-inch gravity main with a new 15-inch gravity main along right-of-way north of Intergarrison Road between 4th Avenue and approximatley 1,300' west of 4th Avenue. This project is intended to mitigate an existing system deficiency.

Project Description



Sewer System	Project Completion	Project Component(s)
Ord Community		Pipeline

Project Benefit

Existing Customers:	**50%**
New Development:	**50%**

Project Trigger

Trigger:	Existing Deficiency
Development:	-

Project Need

Capacity

Project Cost Breakdown (2018 Dollars)

Base Construction:	**288,100**
Constr. Contingency (48.5%):	139,800
Construction Total	**427,900**
Engr., CM, Legal/Admin (25%):	107,000
Total Project Cost:	**534,900**

Ord Community Service Area

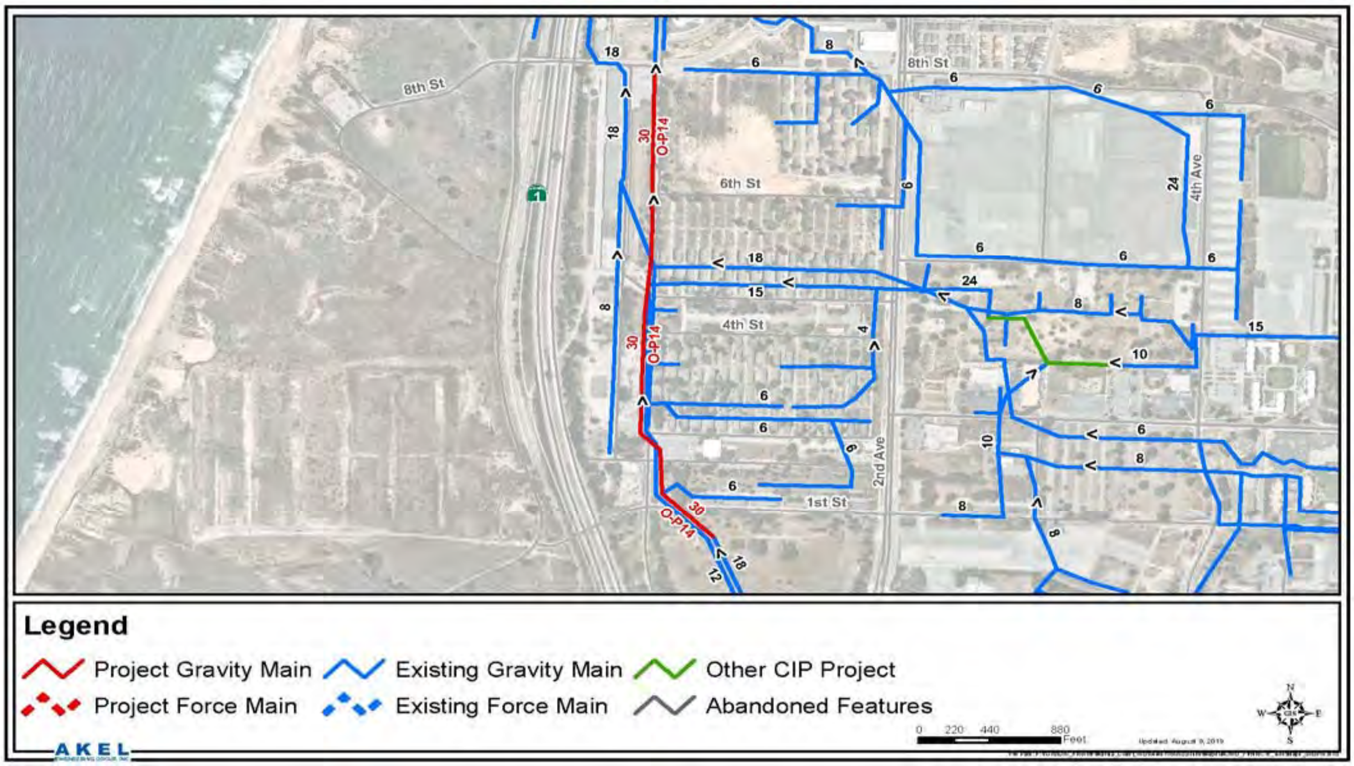
PROJECT S7

1st Avenue Gravity Main

Project Background

This project includes the replacement of existing 12-inch, 18-inch, and 30-inch gravity mains with a new 30-inch gravity main along 1st Avenue from 1st Street to 8th Street. This project is intended to replace sections of pipeline that have known condition issues.

Project Description



Sewer System	Project Completion	Project Component(s)
Ord Community		Pipeline

Project Benefit

Existing Customers:	**100%**
New Development:	**0%**

Project Trigger

Trigger: Existing Condition Improvement
Development: -

Project Need

Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	-
Constr. Contingency (48.5%):	-
Construction Total	-
Engr., CM, Legal/Admin (25%):	-
Total Project Cost:	**408,340**

Ord Community Service Area

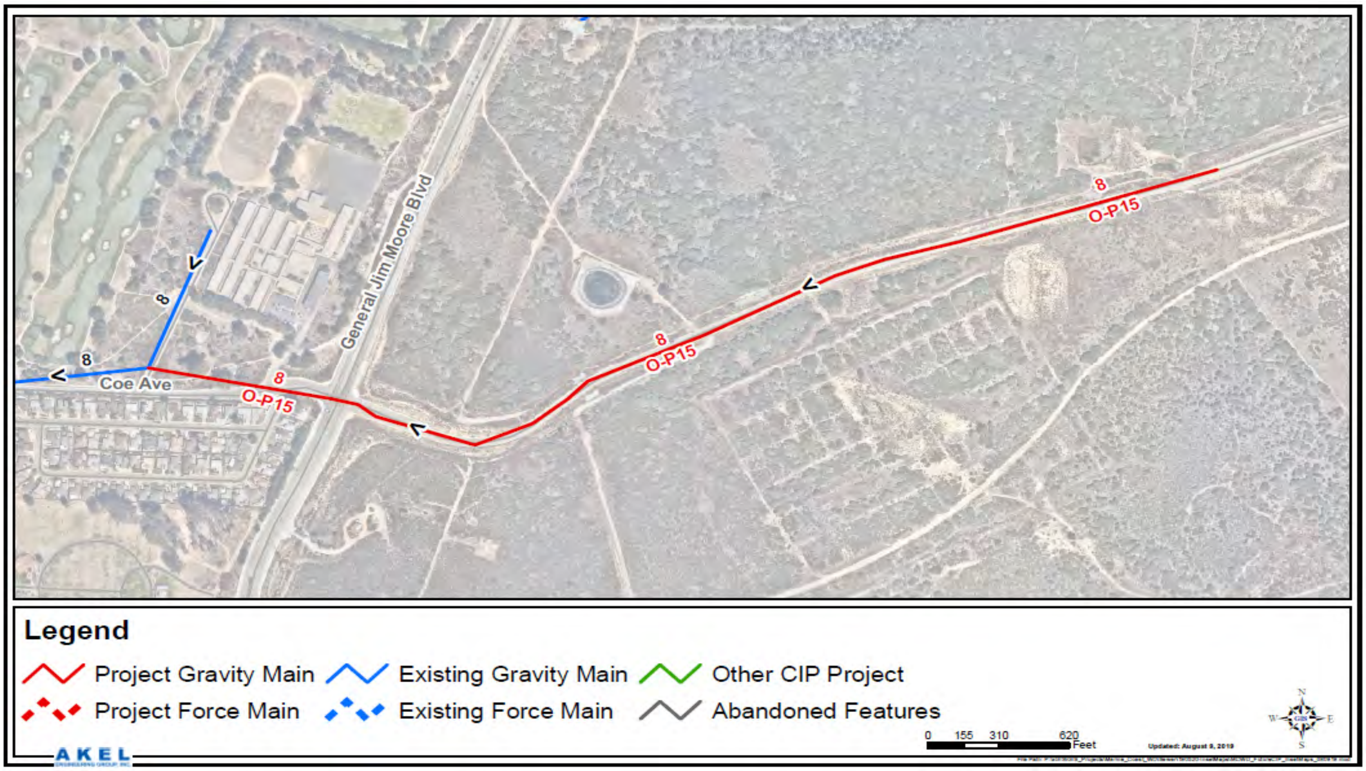
PROJECT S8

Seaside East Gravity Main

Project Background

This project includes the construction of a new 8-inch gravity main along Eucalyptus Road from approximately 4,000' east of General Jim Moore Boulevard to approximately 800' west of General Jim Moore Boulevard. This project is planned to serve potential development along Eucalyptus Road.

Project Description



Sewer System	Project Completion	Project Component(s)
Ord Community		Pipeline

Project Benefit

Existing Customers:	**0%**
New Development:	**100%**

Project Trigger

Trigger:	With Development
Development:	Seaside East

Project Need

Development

Project Cost Breakdown (2018 Dollars)

Base Construction:	**1,102,300**
Constr. Contingency (48.5%):	534,700
Construction Total	**1,637,000**
Engr., CM, Legal/Admin (25%):	409,300
Total Project Cost:	**2,046,300**

Ord Community Service Area

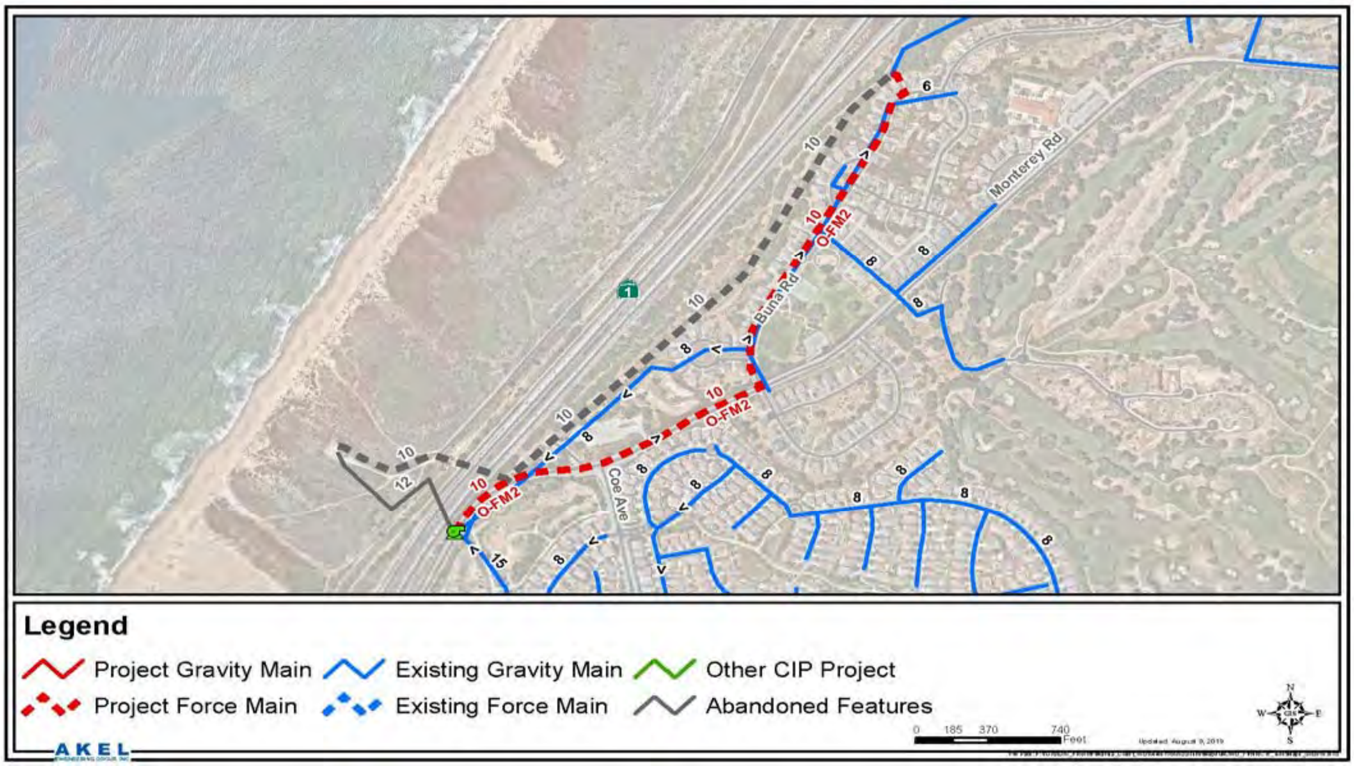
PROJECT S9

Ord Village Force Main Relocation

Project Background

This project consists of relocating the Ord Village lift station force main.

Project Description



Sewer System
Ord Community

Project Completion

Project Component(s)
Pipeline

Project Benefit

Existing Customers:	**42%**
New Development:	**58%**

Project Trigger

Trigger:	With O-LSO
Development:	-

Project Need
Capacity
Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	**845,800**
Constr. Contingency (48.5%):	410,300
Construction Total	**1,256,100**
Engr., CM, Legal/Admin (25%):	314,100
Total Project Cost:	**1,570,200**

AKEL ENGINEERING GROUP, INC.

Central Marina Service Area

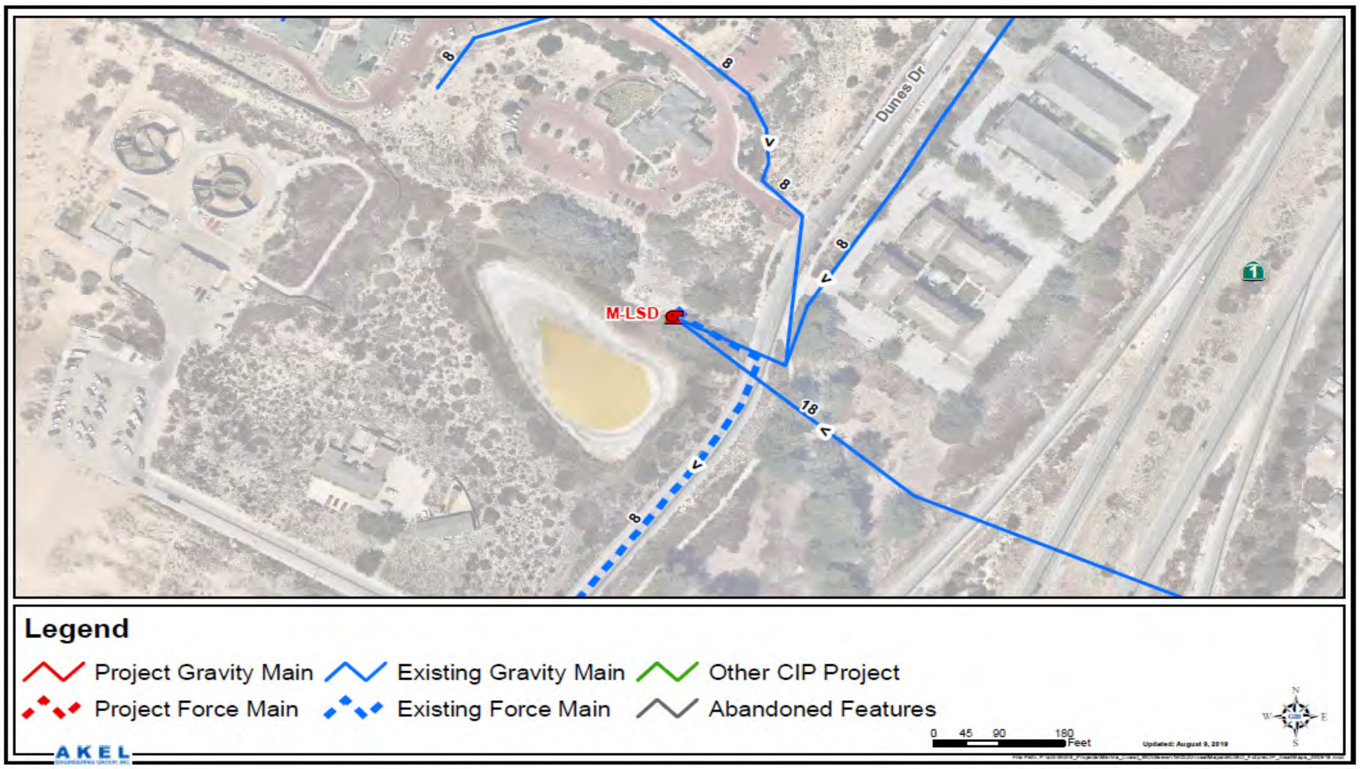
PROJECT S10

Dunes Lift Station Capacity Improvements

Project Background

This project consists of increasing the capacity of the Dunes Lift Station from an existing firm capacity of 350 gpm (total capacity of 700 gpm) to a firm capacity of 900 gpm (total capacity of 1,350 gpm). This project is intended to mitigate an existing system deficiency.

Project Description



Sewer System	Project Completion	Project Component(s)
Central Marina		Lift Station Capacity

Project Benefit

Existing Customers:	**100%**
New Development:	**0%**

Project Trigger

Trigger:	Existing Deficiency
Development:	-

Project Need

Capacity

Project Cost Breakdown (2018 Dollars)

Base Construction:	**1,127,700**
Constr. Contingency (48.5%):	547,000
Construction Total	**1,674,700**
Engr., CM, Legal/Admin (25%):	418,700
Total Project Cost:	**2,093,400**

Central Marina Service Area

PROJECT S11

Crescent Lift Station Replacement

Project Background

This project includes the replacement of the Crescent Lift Station. The firm and total capacity is planned to remain the same as existing conditions.

Project Description

Sewer System	Project Completion	Project Component(s)
Central Marina		Lift Station Condition

Project Benefit

Existing Customers:	**100%**
New Development:	**0%**

Project Trigger

Trigger:	Existing Condition Improvement
Development:	-

Project Need

Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	-
Constr. Contingency (48.5%):	-
Construction Total	-
Engr., CM, Legal/Admin (25%):	-
Total Project Cost:	**401,576**

AKEL ENGINEERING GROUP, INC.

Central Marina Service Area

PROJECT S12

San Pablo Condition Improvements

Project Background

This project includes improvements from the 2017 Lift Station Condition Assessment. The improvements include hatch structural supports, electrical equipment enclosures and conduit, a backup power generator, and float switches.

Project Description

Sewer System	Project Completion	Project Component(s)
Central Marina		Lift Station Condition

Project Benefit

Existing Customers:	**100%**
New Development:	**0%**

Project Trigger

Trigger:	Future Condition Improvements
Development:	-

Project Need

Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	**24,600**
Constr. Contingency (48.5%):	12,200
Construction Total	**36,800**
Engr., CM, Legal/Admin (25%):	9,400
Total Project Cost:	**46,200**

AKEL ENGINEERING GROUP, INC.

Ord Community Service Area

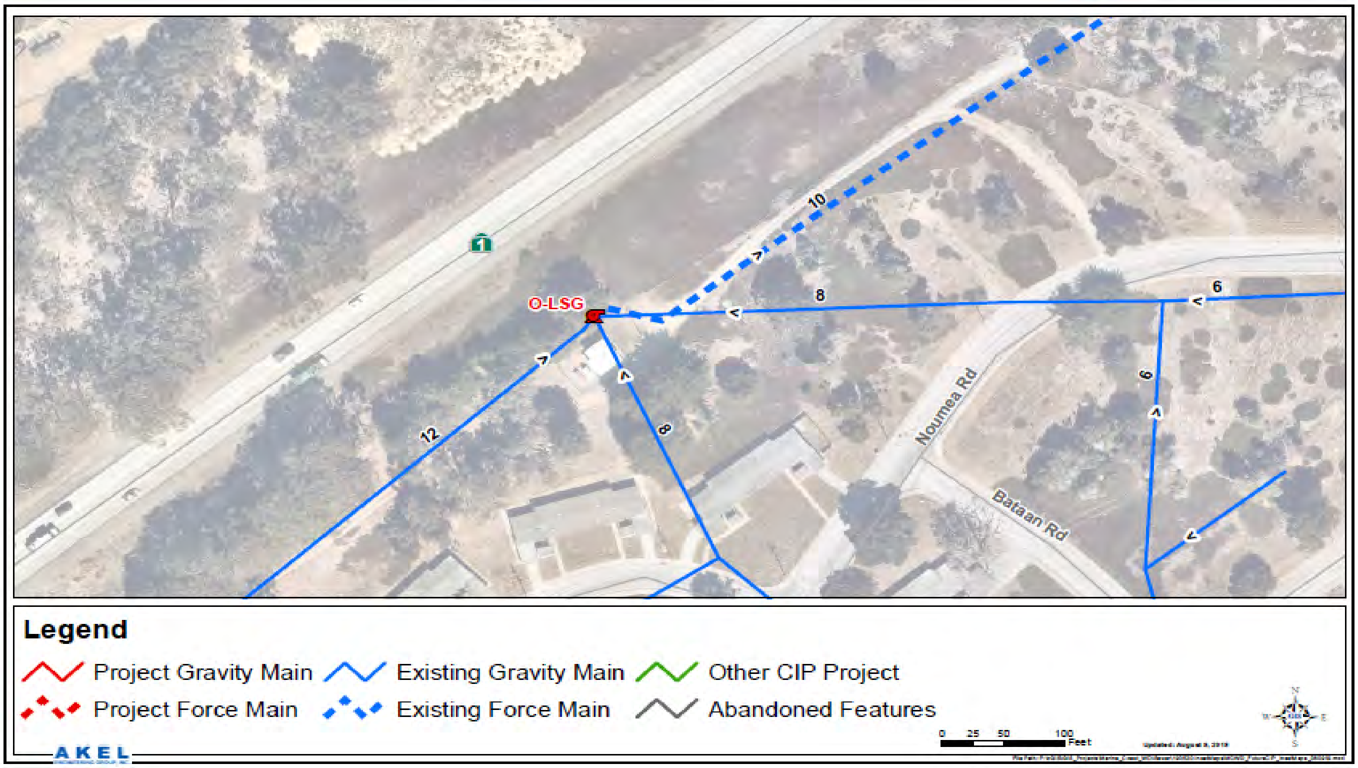
PROJECT S13

Gigling Lift Station and Force Main Condition Improvements

Project Background

This project includes improvements to the Gigling lift station and force main. These improvements are intended to increase the capacity of the existing force main and mitigate condition issues of the existing lift station.

Project Description



Sewer System
Ord Community

Project Completion

Project Component(s)
Lift Station Condition

Project Benefit

Existing Customers: **100%**
New Development: **0%**

Project Trigger

Trigger: With O-COND-LSGG
Development: -

Project Need
Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	-
Constr. Contingency (48.5%):	-
Construction Total	-
Engr., CM, Legal/Admin (25%):	-
Total Project Cost:	**2,021,079**

Ord Community Service Area

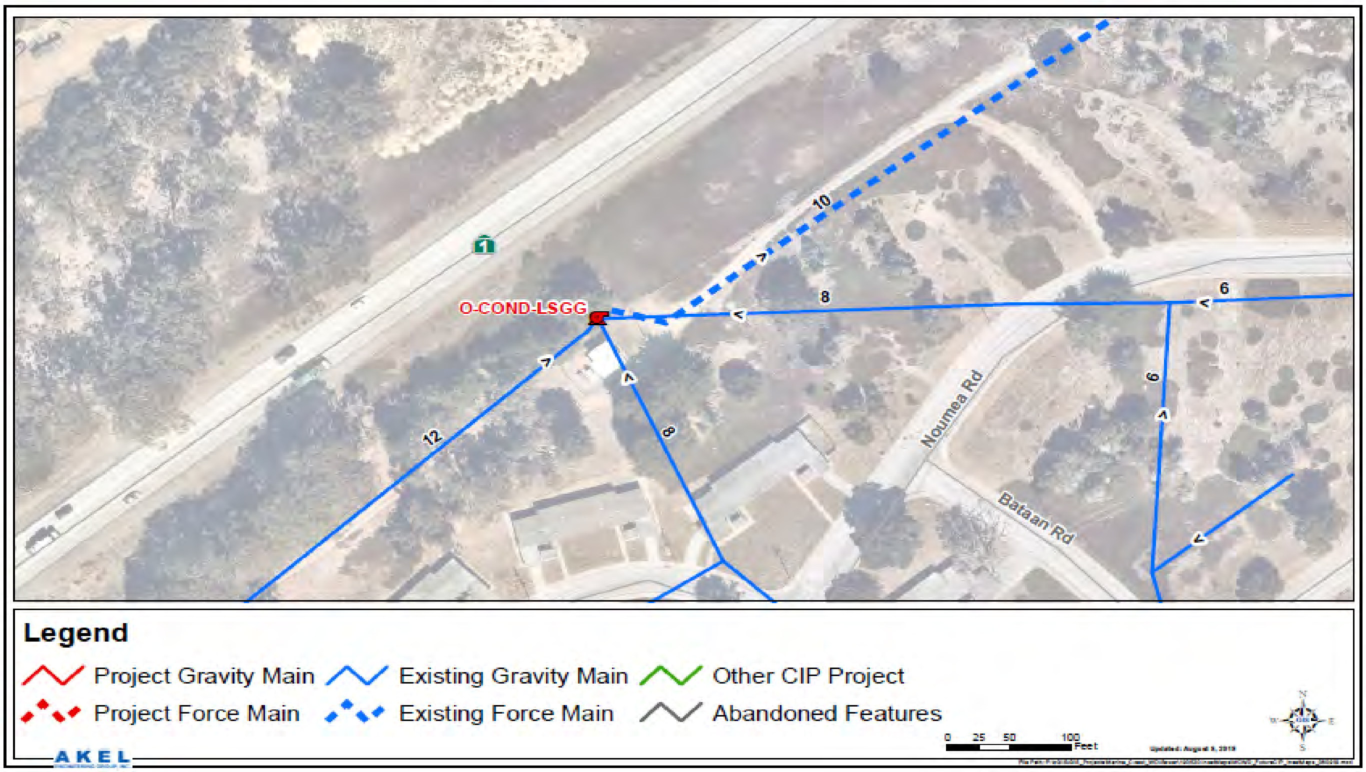
PROJECT S14

Gigling Lift Station Condition Improvements

Project Background

This project includes improvements from the 2017 Lift Station Condition Assessment. The improvements include replacing HVAC metal ducts, improving pump access, new force main air lock piping and valves, a generator and bulk tank, and new onsite pavement and fencing.

Project Description



Sewer System
Ord Community

Project Completion

Project Component(s)
Lift Station Condition

Project Benefit
Existing Customers: **100%**
New Development: **0%**

Project Trigger
Trigger: With O-LSG
Development: -

Project Need
Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	**444,300**
Constr. Contingency (48.5%):	215,900
Construction Total	**660,200**
Engr., CM, Legal/Admin (25%):	165,400
Total Project Cost:	**825,600**

Ord Community Service Area

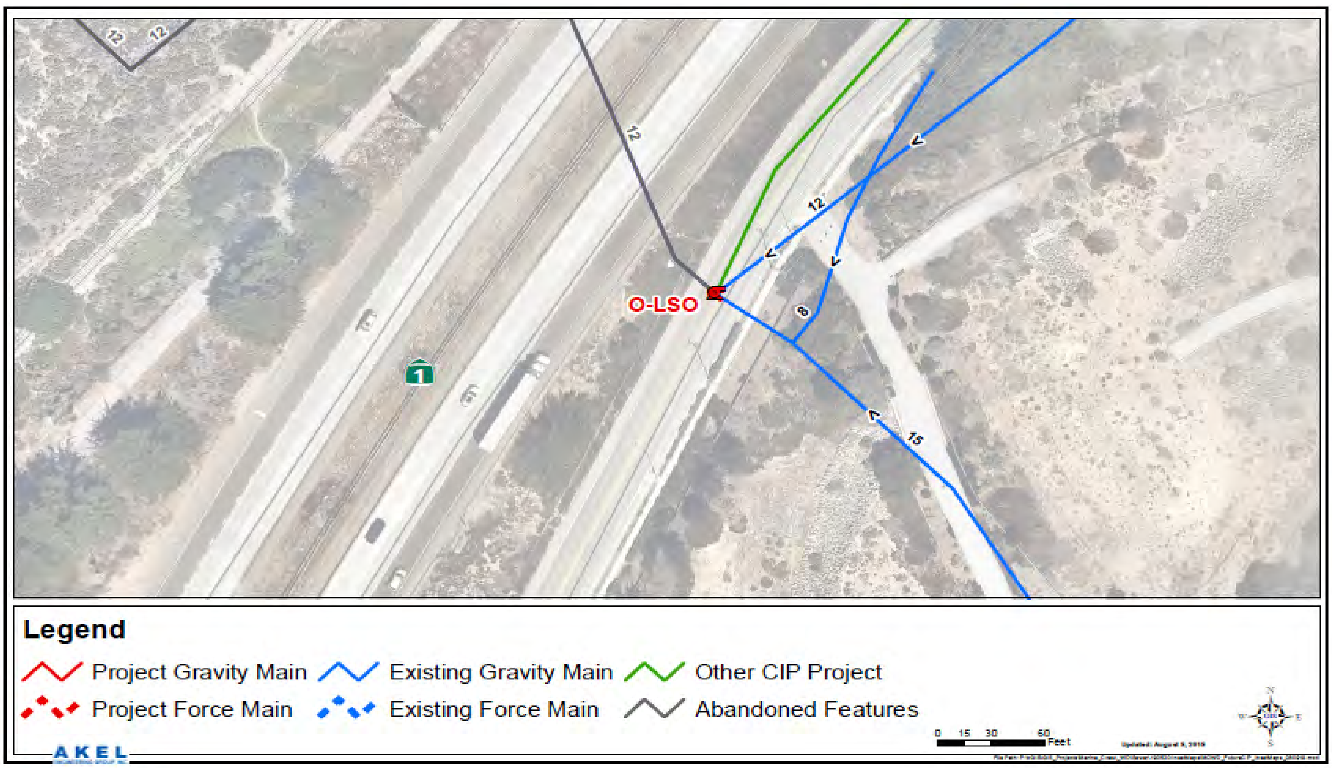
PROJECT S15

Ord Village Lift Station Relocation

Project Background

This project includes the relocation of the existing Ord Village lift station from its current location west of Highway 1 to a new site east of Highway 101. The existing lift station and force main will be abandoned and the existing gravity mains will be rerouted to the new lift station.

Project Description



Sewer System	Project Completion	Project Component(s)
Ord Community		Lift Station Capacity Lift Station Condition

Project Benefit

Existing Customers:	**43%**
New Development:	**57%**

Project Trigger

Trigger:	Planned System Improvement
Development:	-

Project Need

Capacity
Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	-
Constr. Contingency (48.5%):	-
Construction Total	-
Engr., CM, Legal/Admin (25%):	-
Total Project Cost:	**2,247,000**

Ord Community Service Area

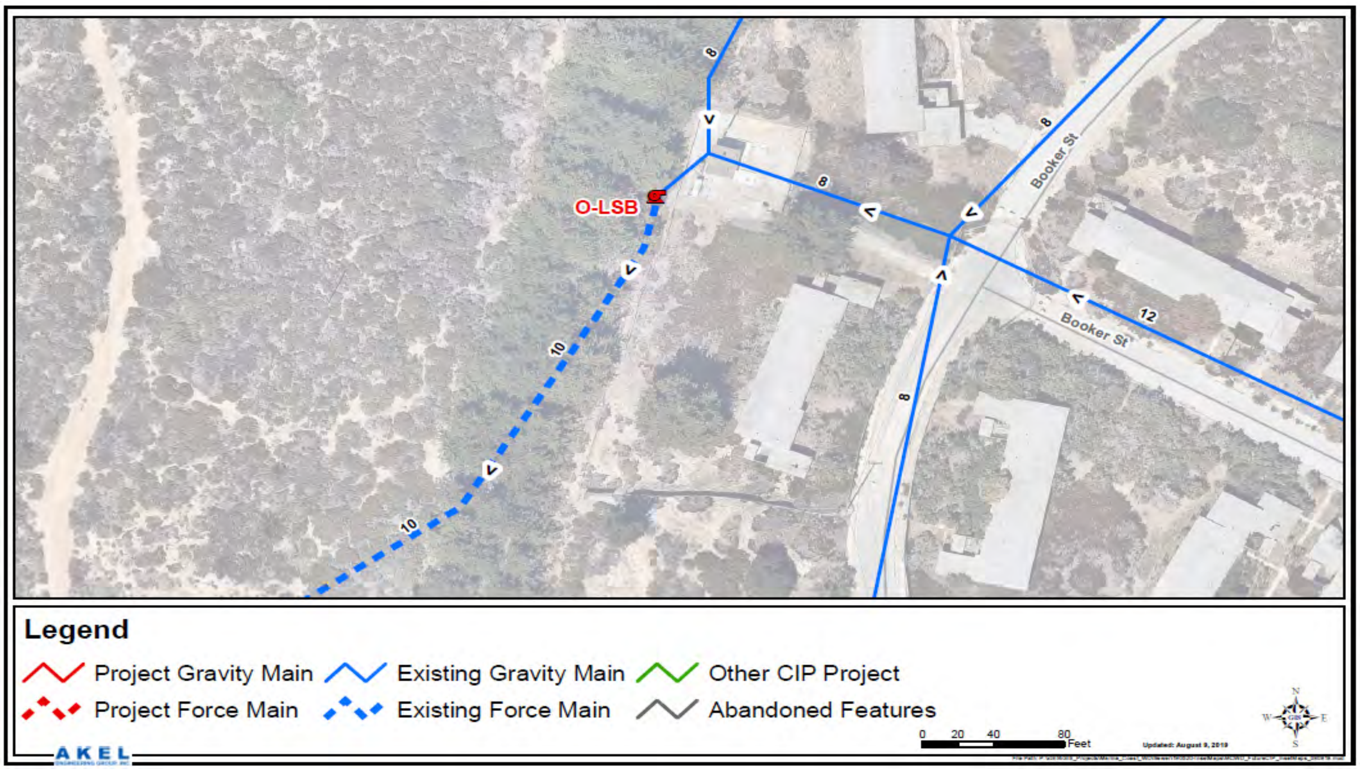
PROJECT S16

Lift Station Reconfiguration

Project Background

This project provides gravity solutions for the Hatten and Neeson lift station as well as site work and a reconfigured wet well at the Booker lift station.

Project Description



Sewer System	Project Completion	Project Component(s)
Ord Community		Lift Station Capacity

Project Benefit

Existing Customers:	**100%**
New Development:	**0%**

Project Trigger

Trigger:	Planned System Improvement
Development:	-

Project Need

Capacity

Project Cost Breakdown (2018 Dollars)

Base Construction:	-
Constr. Contingency (48.5%):	-
Construction Total	-
Engr., CM, Legal/Admin (25%):	-
Total Project Cost:	**726,240**

AKEL ENGINEERING GROUP, INC.

Ord Community Service Area

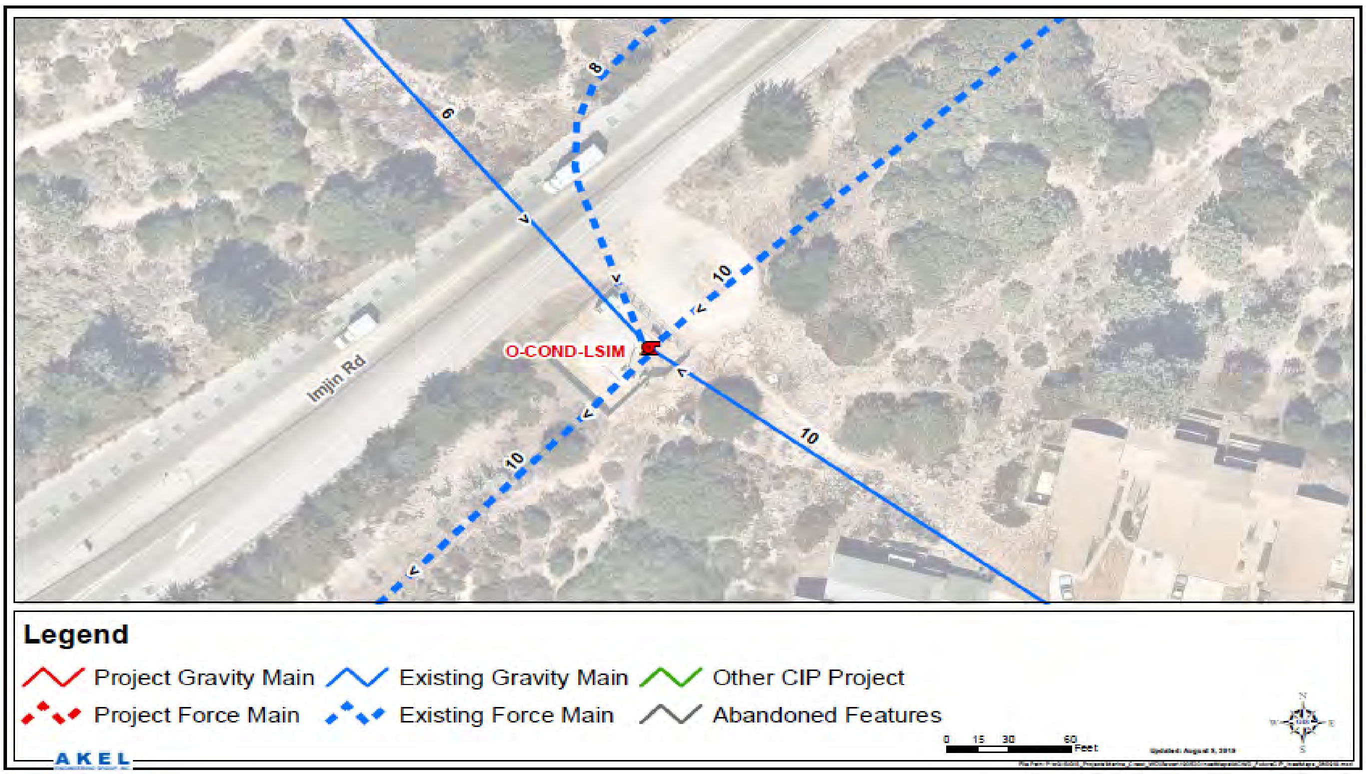
PROJECT S17

Imjin Lift Station Condition Improvements

Project Background

This project includes improvements from the 2017 Lift Station Condition Assessment. The improvements include valve vault piping and valves, wet well fall protection, and electrical switches, panels, and conduit.

Project Description



Sewer System
Ord Community

Project Completion

Project Component(s)
Lift Station Condition

Project Benefit

Existing Customers:	**100%**
New Development:	**0%**

Project Trigger

Trigger:	Future Condition Improvements
Development:	-

Project Need
Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	**29,000**
Constr. Contingency (48.5%):	14,400
Construction Total	**43,400**
Engr., CM, Legal/Admin (25%):	11,000
Total Project Cost:	**54,400**

Ord Community Service Area

PROJECT S18

Fritzche Lift Station Condition Improvements

Project Background

This project includes improvements from the 2017 Lift Station Condition Assessment. The improvements include valve vault piping and valves, wet well piping, concrete work, electrical conduit, and backup generator receptacle and transfer switch.

Project Description

Sewer System
Ord Community

Project Completion

Project Component(s)
Lift Station Condition

Project Benefit

Existing Customers:	**100%**
New Development:	**0%**

Project Trigger

Trigger:	Future Condition Improvements
Development:	-

Project Need
Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	**63,200**
Constr. Contingency (48.5%):	30,900
Construction Total	**94,100**
Engr., CM, Legal/Admin (25%):	23,600
Total Project Cost:	**117,700**

Ord Community Service Area

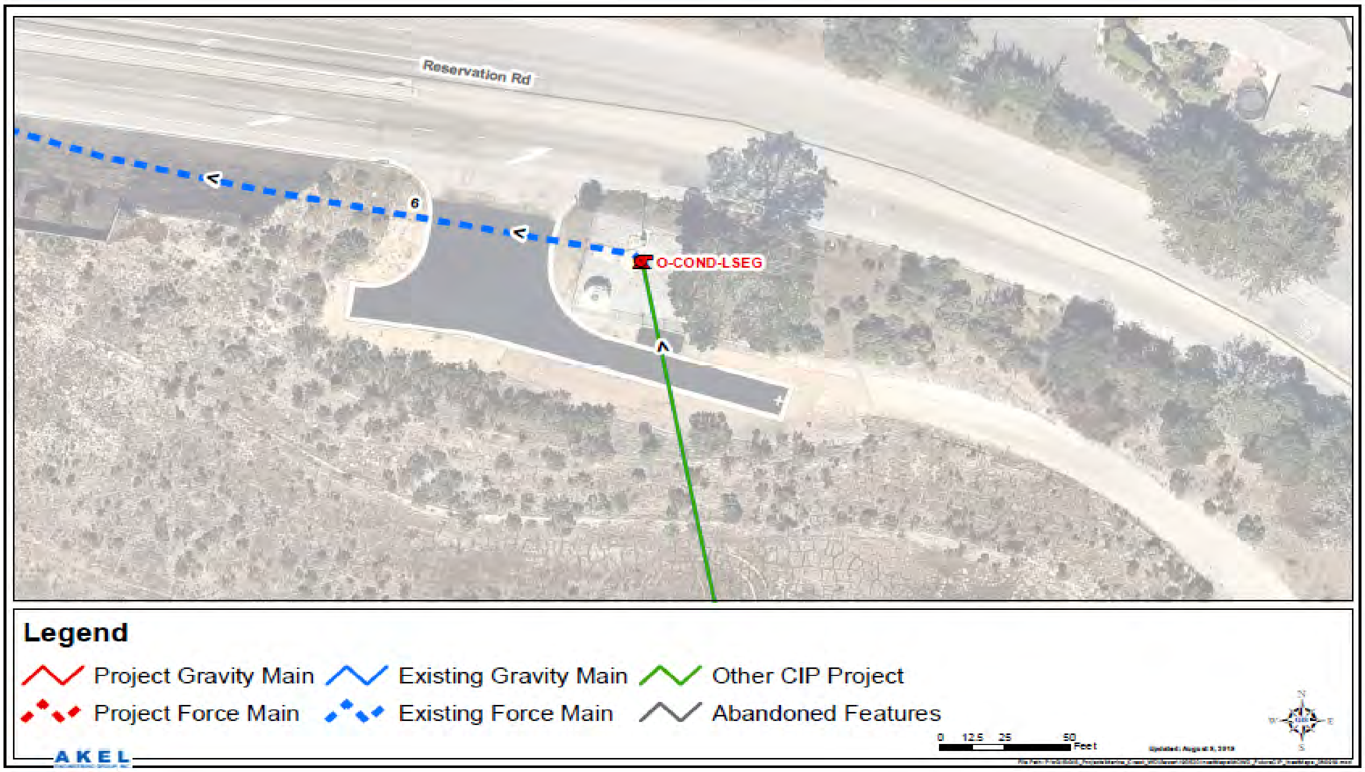
PROJECT S19

East Garrison Lift Station Condition Improvements

Project Background

This project includes improvements from the 2017 Lift Station Condition Assessment. The improvements include valve vault piping and valves, wet well piping, concrete work, electrical conduit, and backup generator receptacle and transfer switch.

Project Description



Sewer System	Project Completion	Project Component(s)
Ord Community		Lift Station Condition

Project Benefit

Existing Customers:	**100%**
New Development:	**0%**

Project Trigger

Trigger:	Future Condition Improvements
Development:	-

Project Need

Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	**32,300**
Constr. Contingency (48.5%):	16,000
Construction Total	**48,300**
Engr., CM, Legal/Admin (25%):	12,400
Total Project Cost:	**60,700**

Ord Community Service Area

PROJECT S20

Reservation Road Lift Station Condition Improvements

Project Background

This project includes improvements from the 2017 Lift Station Condition Assessment. The improvements include valve vault piping and valves, wet well coating, headworks grinder, electrical transfer switch, and security fencing.

Project Description

Sewer System
Ord Community

Project Completion

Project Component(s)
Lift Station Condition

Project Benefit

Existing Customers:	**100%**
New Development:	**0%**

Project Trigger

Trigger:	Future Condition Improvements
Development:	-

Project Need
Condition

Project Cost Breakdown (2018 Dollars)

Base Construction:	**39,900**
Constr. Contingency (48.5%):	19,700
Construction Total	**59,600**
Engr., CM, Legal/Admin (25%):	15,100
Total Project Cost:	**74,700**

APPENDIX E

In-Tract Infrastructure Policy

Marina Coast Water District Water/Wastewater Systems

In-Tract Water and Wastewater Collection System Infrastructure Policy

By
Marina Coast Water District

January 2004

Summary

During the last 10 to 15 years, an increasing number of studies nationwide have confirmed that water and sewer infrastructure replacement costs are soaring. Water pipe replacement costs alone are estimated to be $1.7 billion per year nationwide, and numerous other studies add to the sense of urgency to improve the nation's underground infrastructure. The infrastructure found on the former Fort Ord is no exception. Much of the water and wastewater collection systems infrastructure is estimated to be 50 years old and integrity and performance issues have already been documented.

Under the Water/Wastewater Facilities Agreement between the District and the FORA, the District is responsible for the successful operation and maintenance of the water and wastewater collection systems on the former Fort Ord, as well as improvements to the systems as FORA reasonably determines are necessary. In an effort to assure the successful redevelopment of the former Fort Ord, the District may cause to be planned, designed, and constructed any other facilities as the District reasonably determines may be needed to carry out the goals as established by FORA.

Systems Age

The former Fort Ord water and wastewater collection systems are on average estimated to be 40 to 50 years old and are nearing the end of their useful life. From this point forward, the systems will continue to deteriorate at an unpredictable pace. A majority of all valves are experiencing failure. Many of the service taps (laterals connecting to mains) have been found to be leaking due to poor construction. Pipelines will increasingly become more brittle over time.

The District implemented a preventative maintenance program to enable a systematic approach to pipeline maintenance. However, when operation and maintenance crews continue to repair or replace components of a system that continues to fail unpredictably, the success of a prudent preventative maintenance program cannot be realized.

Water Infrastructure System

FORA and the District depend on the ability to extract and deliver up to 6,600 afy of groundwater from the Salinas River groundwater basin in accordance with a FORA-approved water allocation plan for land use jurisdictions.

The majority of water use in the Ord Community service area is estimated because meters have not yet been installed on residences. Within the overall water allocation for all jurisdictions, 532 afy (or 8 percent of 6,600 afy) is presently estimated and assigned as water loss. (Industry standards for water loss range from 6% to 15% and include water lost due to water line breaks, fire hydrant use, construction water, etc.) The District accepts its responsibility as the steward of the significantly important water resources in support of FORA's redevelopment plan, and will work to minimize water loss. The District has established a water loss goal of 5 percent from water leaks. To achieve this goal, water use will need to be accurately measured and distributed through a watertight system

Wastewater Collection System

The District is responsible for maintaining a system free from sewage overflows. Much of the collection system was not constructed to current design standards and is showing signs of aging. It is difficult to determine the failure rate of an aging system as pipelines loose integrity over time. Sewage spills (overflows) is one of the symptoms of system failure. During 2002, the District experienced 15 sewage spills. Many of the spills occurred within redevelopment areas.

The District completed its Wastewater Master Plan for the Ord Community service area in 2001 which included visually inspecting (via video) many of the collection lines and connections. The Plan describes a system that requires an aggressive and costly collection pipe replacement program.

As the collection system continues to experience problems, the District is subject to increasingly tighter regulatory control that will not tolerate sewage spills. Per recent sewer system maintenance regulations promulgated by the California Regional Water Quality Control Board, the District is required to minimize sewage overflows. Given that the sewage system is not constructed to today's design standards, overflows are expected to continue to occur at an accelerated pace. By replacing components of the aging wastewater collection system, the District will be able to keep its permits in good standing and improve upon overall maintenance costs to customers.

Capital Improvement Program

The District is making every effort to keep rates affordable for our customers. With monthly water and wastewater collection rates already on the high end for this region, additional District-funded (in-tract) capital improvements would cause the rates to escalate further, adding to the burden on potentially low to middle income customers in an area where low-income housing is strongly encouraged. Requiring developers to be responsible for in-tract capital improvements to the water system and wastewater collection system would help contain District rates while ensuring the systems are progressively brought up to standard.

Pipelines Relocated from Planned Lots of Record and Planned Improvements

Upon conveyance, the District agreed to accept the systems "as-is" and "where-is". To address right of way issues to decrease District exposure to liabilities due to systems maintenance and/or repair, we must assure that new pipelines planned in redevelopment areas are not constructed to conflict with planned lots of record or planned improvements. Examples of planned improvements include structures, roads, landscape areas, walkways, parking facilities, etc. The District will work to relocate all systems within public easements, e.g. roadway easements. Better access to systems infrastructure will result in more cost effective repairs and reduced liability to the District.

In conclusion, an in-tract water and wastewater collection system infrastructure policy that clearly establishes requirements for developers to bring systems components to industry standards during redevelopment projects is supportive of District responsibilities to FORA and to our customers.

In-Tract Infrastructure Policy

For all proposed redevelopment projects in areas served by existing water and wastewater collection infrastructure, the developer will be required to implement one of the following procedures:

1. Where redevelopment will raze the existing buildings and streets:

- Developer completes a subdivision water and sewer master plan per the District standards.
- Developer replaces all existing water and wastewater collection pipelines and components within the project area to District standards, and replaces all existing water and wastewater collection pipelines and components adjacent to the project area to District standards, as project impacts necessitate.
- Developer provides meter boxes for all structures and landscaping.
- Developer provides for District's installation of remote read meters.

2. Where redevelopment will use existing buildings and infrastructure or will raze or remodel a portion or all of the existing buildings but streets and existing infrastructure will remain:

- Developer completes a subdivision water and sewer master plan per the District standards. This subdivision master plan would include a physical and design standard condition assessment of the systems per District standards. The subdivision master plan must be approved by the District prior to receiving water and sewer service.
- From the subdivision master plan, the Developer replaces components as required by the District.
- Developer relocates the District's backbone water/sewer infrastructure (infrastructure that serves other upstream and downstream users) onto roadway right of way, as necessary.
- When the Developer is planning to construct improvements, including, but not limited to, structures, landscape areas, walkways, parking facilities, etc., over existing water and sewer infrastructure, then the Developer is responsible to relocate existing water/sewer infrastructure away from under proposed improvements.
- The developer will enter into a separate utility agreement with the District to provide for anticipated higher maintenance costs of the remaining older systems that will be left in place.
- The separate utility agreement will include an annual water and wastewater collection inspection report to be completed by the Developer or its successor in accordance with District standards. That agreement will require the developer to provide an annual wastewater collection system, water system inspection report in accordance

with District standards and to provide master meters for the project. The water inspection report will include a water audit.

- Developer provides meter boxes for all structures and landscaping.
- Developer provides for District's installation of remote read meters.